Proposed Tortugas 2000 Ecological Reserve

FINAL

Socioeconomic Impact Analysis of Alternatives

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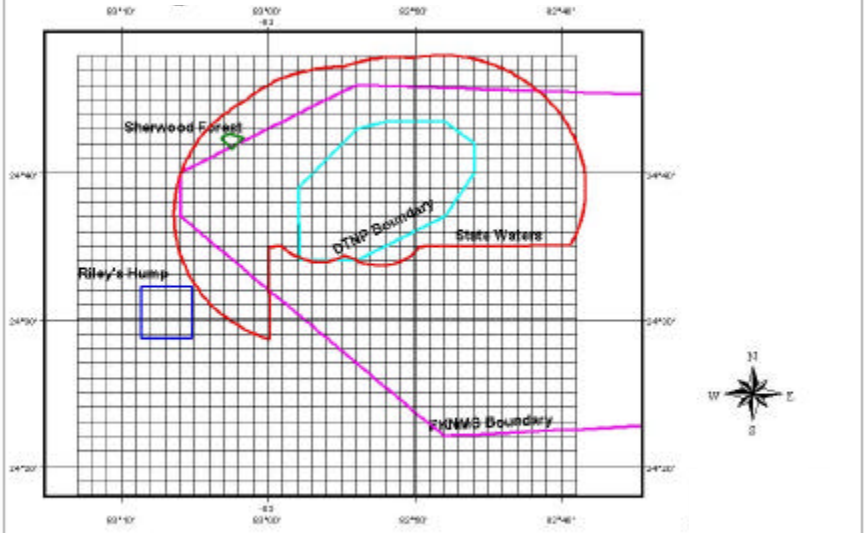
Introduction

This report is a final economic impact analysis of the proposed ecological reserve boundaries in the Tortugas Region of Florida Keys National Marine Sanctuary. The purpose of this report is to provide detailed analyses of all the alternatives considered by NOAA and the State of Florida and serve as detailed documentation of the socioeconomic analyses that are summarized in the Final Environmental Impact Statement/Management Plan (EIS/MP), Regulatory Impact Review (RIR), Final Regulatory Flexibility Analysis (FRFA) and the Manguson Act National Standards 8 and 9 analyses (Community Impacts). This document is also a revision of the previous Draft document (Leeworthy and Wiley, October 1999) and incorporates responses to public comments (see Appendix D). There are five boundary alternatives being considered, the first of which is the status quo alternative with no ecological reserve. An Ecological Reserve is a "no-take" area, meaning that no consumptive activities may take place in an area that has been designated as an Ecological Reserve.

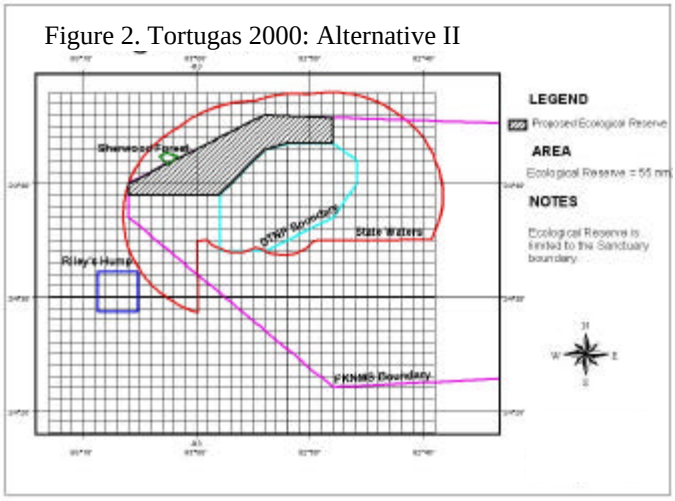
Definition of the Study Areas. For purposes of the analyses presented in this report, there are five basic study areas. The first is a 1,020 square mile area called the **Tortugas Ecological Reserve Study Area (TERSA)** (see Figure 1). This was the area selected by the Florida Keys National Marine Sanctuary for analyzing different alternatives for the proposed Tortugas Ecological Reserve. All socioeconomic information was collected and organized in the TERSA at geographical resolution of one square mile. Detailed descriptions of the data are included in Chapter 1 for the recreation industry and in Chapter 2 for the commercial fisheries.

Figure 1. The Tortugas Ecological Reserve Study Area (TERSA)



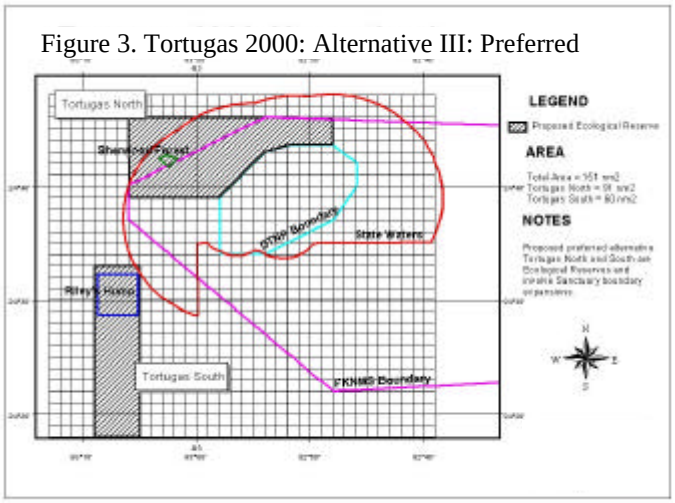
Alternative II. This Alternative is indicated by the hatched area in Figure 2 and consists of 55 nautical square miles (nm^2). Alternative II incorporates the portion of the preferred alternative (see below) that falls within the FKNMS boundary. Included are some of the best coral reef habitats in the TERSA which include high levels of biodiversity, as well as the northern half of the Tortugas Bank.

Figure 2. Tortugas 2000: Alternative II



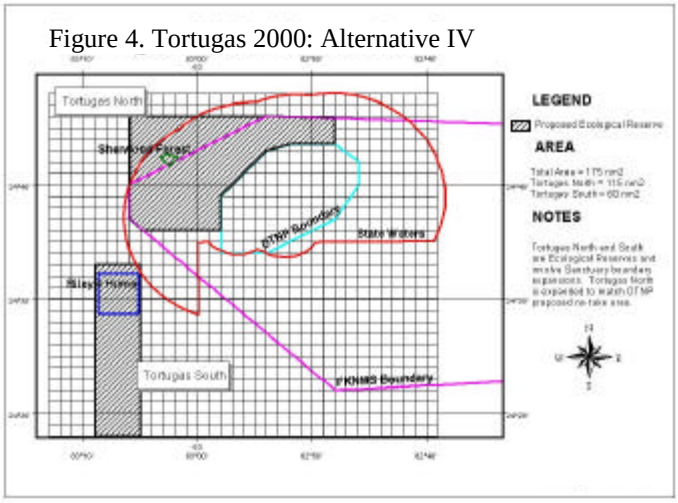
Alternative III: Preferred. The Preferred Alternative is indicated by the hatched area in Figure 3 and consists of two non contiguous areas covering 151 nautical square miles (nm^2). The preferred alternative incorporates a wide range of habitats essential to its effectiveness. Included are some of the best coral reef habitats in the TERSA as well as high levels of biodiversity. The northern portion protects a range of shallow, mid-level, and deep water habitats containing both seagrass beds and highly productive coral reef areas, including Sherwood Forest, a highly diverse area of almost 100% coral cover as well as the northern half of the Tortugas Bank. The southern portion of the preferred alternative covers mainly deep-water habitats and includes Riley's Hump which is a known spawning area for many fish and invertebrate species.

Figure 3. Tortugas 2000: Alternative III: Preferred



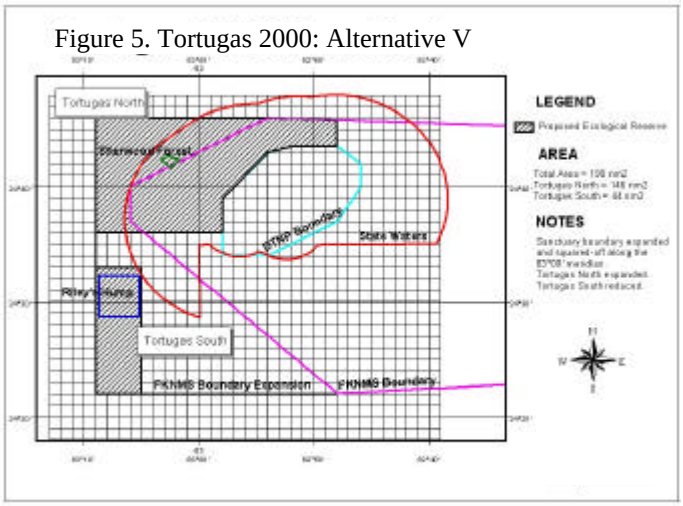
Alternative IV. This alternative includes all of the preferred alternative plus an extension of the northern portion to coincide with the Dry Tortugas National Park's (DRTO) proposed no-take area. It covers 175 nm^2, including 115 nm^2 in the northern portion (Tortugas North) and 60 nm^2 in the southern portion (Tortugas South). The northwestern corner of Tortugas North and all of Tortugas South would involve sanctuary boundary expansions. See figure 4.

Figure 4. Tortugas 2000: Alternative IV



Alternative V. This alternative expands and squares off the sanctuary boundary to the 83°09' meridian. The ecological reserve covers 190 nm^2. The alternative expands Tortugas North to 146 nm^2 and reduces Tortugas South to 44 nm^2.

Figure 5. Tortugas 2000: Alternative V



Organization of this Report. Chapter 1 provides a socioeconomic impact analysis for the recreation industry and Chapter 2 provides the socioeconomic impact analysis for the commercial fisheries. Within each chapter, we provide and overview of the TERSA, then an analysis of each alternative. Chapter 3 provides analyses of other potential benefits of the proposed ecological reserve, including nonuse economic values, scientific values and education values. Appendix A includes tables that provide greater detail than the summary tables found in Chapters 1 and 2. Appendix B documents how we calculated consumer's surplus for the commercial fisheries. Appendix C includes the maps generated from the geographical information system (GIS) showing the distribution of catch by species/species groups for the commercial fisheries and the distribution of recreation activity by activity type. Appendix D includes the responses to all public comments related to socioeconomic issues.

Chapter 1
Recreation Industry

Introduction

This chapter addresses the socioeconomic impact on the recreation industry associated with the four boundary alternatives for which there is an ecological reserve component. A brief description of the data used is provided followed by a Summary/Profile for the TERSA. An analysis of each of the alternatives for the Tortugas Ecological Reserve is then presented.

Description of the Data

The recreation data was collected through 16 person-to-person and telephone interviews taking place in December 1998 through April 1999. Data was collected from both active operators in the study area and other individuals who are knowledgeable about the area and the activities that take place therein. Of the 16 interviews that took place, 50% were in-person and 50% were by telephone; 75% were active operators in the area and 25% were other knowledgeable individuals. The source of the list of potential respondents came from the Dry Tortugas National Park (DRTO), List of Incidental Business Permittees list, and as a result of discussions with current operators and other persons with experience in the area. Fishing Clubs were also considered as a source of data. Only one was found in the region and in an interview with a representative of the club it was determined that private boat usage in the study area was minimal. In the course of interviewing the commercial operators, when asked if they saw other boats when in the Tortugas, they consistently said that they did not. This question did not include the area inside Dry Tortugas National Park. Some members of the clubs said they fished in the park, but not in the 1,020 nautical square mile area outside the National Park called the Tortugas Ecological Reserve Study Area (TERSA). We were not able to identify any private households that did any activity in the TERSA.

In total, contact was attempted with 23 potential respondents – seven of whom we failed to contact with repeated attempts. Because we do not have any knowledge that the remaining potential respondents operate in the study area, it is believed that the current sample is the population of recreation operators in the area (i.e. for practical purposes, a census).

The data collected include the following variables: person-days of activity, revenue, cost and profit by activity[1]. Because many of the respondents only operate in the area sporadically or during certain times of the year, the data was also collected by month. As will be shown later in this report, having seasonal data will also enable more accurate impact estimates to be calculated. The data was collected in four categories of activity: non-consumptive diving, spearfishing, diving for lobsters, and fishing (hook and line) which represent all of the recreational activities that could potentially be impacted..

GIS Database. The study area is a rectangular area that extends 34 nautical miles (nm) east-west by 30 nm north-south, divided into 1020 square nm (nm^2) grid cells. It surrounds Dry Tortugas National Park (DRTO) and includes the far western portion of the Florida Keys National Marine Sanctuary (FKNMS), Sherwood Forest and Riley's Hump (both outside sanctuary waters). The recreation data was collected by grid cell including the portion of trips spent in respective grid cells and proportion of business done in respective grid cells. The data was then put into a GIS database by grid cell so that the economic impact of any boundary alternative can be estimated. No data was collected in DRTO as this area is outside of the sanctuary waters.

[1] The data collected actually included a much broader range of variables (such as trips, days per trip and passengers per trip) from which person-days were derived. A person-day is defined as one person spending one day at the site (so one person spending three days at the site would account for three person-days). The questions referred to the twelve-month period immediately preceding the interview.

Summary/Profile of the Study Area.

In the Tortugas 2000 study area, the variety and extent of participation in recreation activities has been limited. Although the region is a unique ecosystem with unrivaled opportunity for recreation, the investment in time and money to get there and the lack of options for lodging keep it from becoming a highly sought-after destination. Visitation to Dry Tortugas National Park (DRTO) is very large and has been increasing dramatically (over the past 14 years visitation at Dry Tortugas National Park has quadrupled, rising from 18,000 visitors in 1984 to an estimated 72,000 visitors in 1998). However, a small proportion of these visitors takes side trips outside of the National Park to participate in recreation activities. The majority of visitors to the Tortugas 2000 study area are on multi-day trips for which recreation outside of the National Park is their main reason for going and visits to the Dry Tortugas National Park are either side trips or are for the purpose of anchoring for the night.

Operators in the TERSA. To operate in the DRTO, an operator must have an Incidental Business Permit (IBP). Although there is no institutionalized method of tracking the number of people who operate outside of the park boundaries, it is very unlikely that a business will operate in the vicinity without having an IBP. There are several operators who provide services in the DRTO, which are not relevant to the Tortugas 2000 study area. These services include air taxi services, ferry services and walking tours/bird-watching services. The remainder of the IBP holders were contacted in a survey of recreational use.

Conclusions. In general the most significant conclusion is that there are very few people who operate outside of the DRTO boundaries. All of the respondents presented a very consistent story when asked about other boat traffic they see in the areas in which they operate. All respondents said they almost never see a private (non-charter) recreation boat outside of the park boundary - for practical purposes, the number of private household boats operating in the study area is zero. When they do see other boats they are generally able to identify the boats as being one of the other respondents to this survey.

With regard to the activities that take place outside of the park boundary, only one activity (diving) is non-consumptive and it represents 4.98% of the person days of activity. The majority of person days in consumptive activities were in fishing with 77.89% followed by Diving for Lobsters (8.23%) and Spearfishing (8.90%).

Table 1.1. Activity Participation in the TERSA

	Person-Days (number)	Person-Days (percent)
Diving for Lobsters	1,730	8.23%
Diving (non-consumptive)	1,048	4.98%
Fishing	16,377	77.89%
Spearfishing	1,872	8.90%

Table 1.2. Totals for Commercial Charter/Party Operations in the TERSA

Number of Operations		12
Total Person-Days		21,027
Total Revenue	$	1,413,739
Total Cost	$	1,013,719
Total Profit	$	400,020

Boundary Analysis

The interpretation of the estimates provided in this analysis is critical to understanding the "true" impact of the various alternatives proposed for the Tortugas Ecological Reserve. The estimates from our geographic information system (GIS) analysis for the different boundary alternatives are simply the sum of each measurement within the boundaries for a given alternative. The estimates therefore represent the **maximum total potential loss from displacement of the consumptive recreational activities**. This analysis ignores possible mitigating factors and the possibility of net benefits that might be derived if the proposed ecological reserve has replenishment effects. Although we don't have the ability to quantify either the extent of the mitigating factors or the potential benefits from replenishment, we will discuss these as well as other potential benefits of the proposed ecological reserve after we have presented and discussed the maximum potential losses from displacement of the current consumptive recreational uses.

There are two types of potential losses identified and quantified in our analysis; 1) non-market economic values and market economic values. There are two types of ***non-market economic values***. The first is consumer's surplus, which is the amount of economic value a consumer receives by consuming a good or service over and above what he or she pays for the good or service. It is a net benefit to the consumer and in the context of recreation use of natural resources, where the natural resources go unpriced in markets, this value is often referred to as the net user value of the natural resource. The second type of non-market economic value is one received by producers or owners of the businesses providing goods or services to the users of the natural resources. This is commonly referred to as producer's surplus. The concept is similar to consumer's surplus in that the businesses do not pay a price for the use of natural resources when providing goods or services to users of the resources. However, this concept is a little more complicated because, in 'welfare economics', not all producer's surplus is considered a proper indicator in the improvement of welfare. Only that portion of producer's surplus called 'economic rent' is appropriate for inclusion. Economic rent is the amount of profit a business receives over and above a normal return on investment (i.e., the amount of return on investment that could be earned by switching to some alternative activity). Again, because businesses that depend on natural resources in the Tortugas do not have to pay for the use of them, there exists the possibility of earning above normal rates of return on investment or 'economic rent'. This like consumer's surplus would be additional economic value attributable to the natural resources (i.e., another user value).

Economic rents are different from consumer's surplus in that supply and demand conditions are often likely to lead to dissipation of the economic rents. This is generally true for most open access situations. As new firms enter the industry because of the lure of higher than normal returns on investment, the net effect is to eliminate most if not all of the economic rent. However, given the remoteness of the TERSA, it is likely that all economic rents would not be eliminated. We use accounting profits as a proxy for economic rents in our analysis. The absolute levels of accounting profits are not a good proxy for economic rents, however, we use them as an index for assessing the relative impacts across the different boundary alternatives.

The estimates for consumer's surplus were derived by combining estimates of person-days from all the operators in the TERSA with estimates of consumer's surplus per person-day from Leeworthy and Bowker 1997. The estimates were derived separately by season (see Appendix Table A.1).

Market Economic Values. Revenues from the charter boat operations that provided service to the consumptive recreational users provide the basis for this portion of the analysis. Total output/sales, income and employment impacts on the Monroe County economy are then derived from these estimates. These impacts include the ripple or multiplier impacts. Total output/sales is equal to business revenue times the total output multiplier of 1.12 from English et al 1996. Income is then derived by taking the total output/sales impact and dividing by the total output-to-income ratio (2.63) from English et al. And, total employment was derived by dividing the total income impact by the total income-to-employment ratio ($23,160) from English et al.

Alternative I: No Action

The no action alternative simply means that the proposed Tortugas Ecological Reserve and corresponding no take regulations would not take place. The no action alternative has a simple interpretation in that any costs of imposing the no take regulations, for any given alternative with no take regulations, would be the benefits of the no action alternative. That is, by not adopting the no take regulations, the costs are avoided. Similarly, any benefits from imposing the no take regulations, for any given alternative with no take regulations, would be the costs of the no action alternative. That is, by not adopting the no take regulations, the costs are the benefits lost by not adopting the no take regulations. Said another way, the opportunities lost. The impacts of the no action alternative can only be understood by comparing it to one of the proposed alternatives. Thus the impacts of the no action alternative can be obtained by reading the impacts from any of the proposed alternatives in reverse.

Alternative II

Non-Market Economic Values. This alternative would displace over 26% of the total person-days of diving for lobsters, about 26% of the spearfishing, and just over 2% of the fishing. Across all three consumptive recreational activities just under 6% of the person-days would be displaced (Table 1.4). This alternative is entirely within the FKNMS boundary. Because of the way in which Consumer's surpluses are calculated, they generally mirror the patterns in displaced use. Minor differences would be due to the distributions across activities by season. Only in the case of diving for lobsters are the impacts on person-days and profits equal. For spearfishing, the impacts on profits is lower than the impact on person-days (18.7% versus 25.9%), while for fishing the impact is greater on profits than on person-days (6.5% versus 1.2%). The GIS generated maps show why diving for lobsters and spearfishing are relatively more impacted than fishing. The reason is that diving for lobsters and spearfishing is concentrated on Tortugas Bank, while relatively little fishing currently takes place on the Tortugas Bank.

Table 1.3. Boundary Analysis Summary: TERSA - Consumptive Recreation

	Diving for Lobsters	Fishing	Spearfishing	Total	
Within FKNMS Boundary					
Person-Days	1,442	12,215	1,569	15,226	
Revenue	$ 99,282	$ 579,143	$ 291,898	$ 970,323	
Cost	$ 68,372	$ 471,657	$ 149,503	$ 689,532	
Profit	$ 30,909	$ 107,497	$ 142,395	$ 280,801	
Number of Firms	2	10	3	12	1
Consumer Surplus	$ 131,222	$ 996,744	$ 144,034	$ 1,272,000	
Outside FKNMS Boundary					
Person-Days	288	4,163	303	4,754	
Revenue	$ 19,868	$ 267,597	$ 41,795	$ 329,260	
Cost	$ 13,680	$ 217,794	$ 22,926	$ 254,400	
Profit	$ 6,188	$ 49,804	$ 18,869	$ 74,861	
Number of Firms	2	4	2	5	1
Consumer Surplus	$ 26,208	$ 339,619	$ 27,815	$ 393,642	
Total					
Person-Days	1,730	16,378	1,872	19,980	
Revenue	$ 119,150	$ 846,740	$ 333,693	$ 1,299,583	
Cost	$ 82,052	$ 689,451	$ 172,429	$ 943,932	
Profit	$ 37,097	$ 157,301	$ 161,264	$ 355,662	
Number of Firms	2	10	3	12	1
Consumer Surplus	$ 157,430	$ 1,336,363	$ 171,850	$ 1,665,643	

1. Number of firms does not add up to the total because individual firms may engage in more than one activity.

Table 1.4. Boundary Analysis Summary: Alternative 2 - Consumptive Recreation

	Diving for Lobsters[2]		Fishing[2]		Spearfishing[2]		Total[2]		
Within FKNMS Boundary									
Person-Days	461	(31.97%)	200	(1.64%)	485	(30.91%)	1,146	(7.53%)	
Revenue	$ 31,732	(31.96%)	$ 24,691	(4.26%)	$ 66,816	(22.89%)	$ 123,239	(12.70%)	
Cost	$ 21,862	(31.98%)	$ 14,496	(3.07%)	$ 36,656	(24.52%)	$ 73,014	(10.59%)	
Profit	$ 9,870	(31.93%)	$ 10,195	(9.48%)	$ 30,160	(21.18%)	$ 50,225	(17.89%)	
Number of Firms	2	(100.00%)	8	(80.00%)	3	(100.00%)	9	(75.00%)	[1]
Consumer Surplus	$ 41,977	(31.99%)	$ 15,859	(1.59%)	$ 44,548	(30.93%)	$ 102,384	(8.05%)	
Outside FKNMS Boundary									
Person-Days	-	(0.00%)	-	(0.00%)	-	(0.00%)	-	(0.00%)	
Revenue	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	
Cost	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	
Profit	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	
Number of Firms	-	(0.00%)	-	(0.00%)	-	(0.00%)	-	(0.00%)	[1]
Consumer Surplus	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	
Total									
Person-Days	461	(26.65%)	200	(1.22%)	485	(25.91%)	1,146	(5.74%)	
Revenue	$ 31,732	(26.63%)	$ 24,691	(2.92%)	$ 66,816	(20.02%)	$ 123,239	(9.48%)	
Cost	$ 21,862	(26.64%)	$ 14,496	(2.10%)	$ 36,656	(21.26%)	$ 73,014	(7.74%)	
Profit	$ 9,870	(26.61%)	$ 10,195	(6.48%)	$ 30,160	(18.70%)	$ 50,225	(14.12%)	
Number of Firms	2	(100.00%)	8	(80.00%)	3	(100.00%)	9	(75.00%)	[1]
Consumer Surplus	$ 41,977	(26.66%)	$ 15,859	(1.19%)	$ 44,548	(25.92%)	$ 102,384	(6.15%)	

1. Number of firms does not add up to the total because individual firms may engage in more than one activity.

2. Percent of TERSA (See Table 1.3) by activity and total in parentheses.

Market Economic Values. Nine of the twelve charter boat operations operating within the TERSA would be potentially impacted by this alternative. Direct business revenue would include potential losses of 26.6% for diving for lobsters, 20% for spearfishing, and 3% for fishing. Across all three consumptive recreational activities, 9.5% of revenue would be potentially impacted (Table 1.4).

Through the ripple or multiplier effects, 9.5% of output/sales, income and employment associated with all the consumptive recreational activities in the TERSA could potentially be lost (Table 1.8). Although these impacts could have significant impact on the nine firms operating in the TERSA, the impact would not likely be noticed in the Monroe County economy because the impact would amount to only a fraction of a percent of the total economy supported by recreating visitors to the Florida Keys (Table 1.10).

Alternative III: Preferred

Non-Market Economic Values. Because the portion of this alternative that is within the FKNMS boundary is exactly the same as Alternative II and there is no diving for lobsters or spearfishing activity in the outside the FKNMS boundary portion of this alternative, the analysis for these two activities will be exactly the same for the two alternatives. The preferred alternative would displace over 26% of the total person-days of diving for lobsters, about 26% of the spearfishing, and just over 3% of the fishing. Across all three consumptive recreational activities over 7% of the person-days would be displaced (Table 1.5). For fishing, 40% of the displaced activity would be from within the FKNMS boundaries. Consumer's surpluses generally mirror patterns of displaced use. Again, minor differences would be due to the distributions across activities by season. Only in the case of diving for lobsters are the impacts on person-days and profits equal. For spearfishing, the impacts on profits is lower than the impact on person-days (18.7% versus 25.9%), while for fishing the impact is greater on profits than on person-days (10.2% versus 3.0%).

Table 1.5. Boundary Analysis Summary: Alternative 3 - Preferred Alternative - Consumptive Recreation

	Diving for Lobsters[2]		Fishing[2]		Spearfishing[2]		Total[2]		
Within FKNMS Boundary									
Person-Days	461	(31.97%)	200	(1.64%)	485	(30.91%)	1,146	(7.53%)	
Revenue	$ 31,732	(31.96%)	$ 24,691	(4.26%)	$ 66,816	(22.89%)	$ 123,239	(12.70%)	
Cost	$ 21,862	(31.98%)	$ 14,496	(3.07%)	$ 36,656	(24.52%)	$ 73,014	(10.59%)	
Profit	$ 9,870	(31.93%)	$ 10,195	(9.48%)	$ 30,160	(21.18%)	$ 50,225	(17.89%)	
Number of Firms	2	(100.00%)	8	(80.00%)	3	(100.00%)	9	(75.00%)	[1]
Consumer Surplus	$ 41,976	(31.99%)	$ 15,859	(1.59%)	$ 44,548	(30.93%)	$ 102,383	(8.05%)	
Outside FKNMS Boundary									
Person-Days	-	(0.00%)	297	(7.13%)	-	(0.00%)	297	(6.25%)	
Revenue	$ -	(0.00%)	$ 28,815	(10.77%)	$ -	(0.00%)	$ 28,815	(8.75%)	
Cost	$ -	(0.00%)	$ 23,254	(10.68%)	$ -	(0.00%)	$ 23,254	(9.14%)	
Profit	$ -	(0.00%)	$ 5,561	(11.17%)	$ -	(0.00%)	$ 5,561	(7.43%)	
Number of Firms	-	(0.00%)	2	(50.00%)	-	(0.00%)	2	(40.00%)	[1]
Consumer Surplus	$ -	(0.00%)	$ 23,570	(6.94%)	$ -	(0.00%)	$ 23,570	(5.99%)	
Total									
Person-Days	461	(26.65%)	497	(3.03%)	485	(25.91%)	1,443	(7.22%)	
Revenue	$ 31,732	(26.63%)	$ 53,506	(6.32%)	$ 66,816	(20.02%)	$ 152,054	(11.70%)	
Cost	$ 21,862	(26.64%)	$ 37,750	(5.48%)	$ 36,656	(21.26%)	$ 96,268	(10.20%)	
Profit	$ 9,870	(26.61%)	$ 15,756	(10.02%)	$ 30,160	(18.70%)	$ 55,786	(15.69%)	
Number of Firms	2	(100.00%)	8	(80.00%)	3	(100.00%)	9	(75.00%)	[1]
Consumer Surplus	$ 41,976	(26.66%)	$ 39,429	(2.95%)	$ 44,548	(25.92%)	$ 125,953	(7.56%)	

1. Number of firms does not add up to the total because individual firms may engage in more than one activity.

2. Percent of TERSA (See Table 1.3) by activity and total in parentheses.

Market Economic Values. Nine of the twelve charter boat operations operating within the TERSA would be potentially impacted by this alternative. Direct business revenue would include potential losses of 26.6% for diving for lobsters, 20.0% for spearfishing, and 6.3% for fishing. Across all three consumptive recreational activities, 11.7% of revenue would be potentially impacted (Table 1.5).

Through the ripple or multiplier effects, 11.7% of output/sales, income and employment associated with all the consumptive recreational activities in the TERSA could potentially be lost (Table 1.8). Although these impacts could have significant impact on the nine firms operating in the TERSA, the impact would not likely be noticed in the Monroe County economy because the impact would amount to only a fraction of a percent of the total economy supported by recreating visitors to the Florida Keys (Table 1.10).

Alternative IV

Non-Market Economic Values. This alternative would displace over 73% of the total person-days of diving for lobsters, just under 72% of the spearfishing, and over 6% of the fishing. Across all three consumptive recreational activities over 18% of the person-days would be displaced (Table 1.6). All the diving for lobsters and spearfishing activity displaced would be from within the FKNMS boundaries. For fishing, 71% of the displaced activity would be from within the FKNMS boundaries. Similarly to the other alternatives, consumer's surpluses mirror the patterns in displaced use because of the way in which they are calculated. Minor differences would be due to the distributions across activities by season. Again, profits are only equal to the impact on person-days for diving for lobsters. For spearfishing, the impacts on profits is lower than the impact on person-days (56.2% versus 71.7%), while for fishing the impact is greater on profits than on person-days (17.6% versus 6.3%).

Table 1.6. Boundary Analysis Summary: Alternative 4 - Consumptive Recreation

	Diving for Lobsters[2]		Fishing[2]		Spearfishing[2]		Total[2]		
Within FKNMS Boundary									
Person-Days	1,269	(88.00%)	736	(6.03%)	1,343	(85.60%)	3,348	(21.99%)	
Revenue	$ 87,361	(87.99%)	$ 60,261	(10.41%)	$ 196,944	(67.47%)	$ 344,566	(35.51%)	
Cost	$ 60,165	(88.00%)	$ 38,093	(8.08%)	$ 106,360	(71.14%)	$ 204,618	(29.67%)	
Profit	$ 27,196	(87.99%)	$ 22,168	(20.62%)	$ 90,584	(63.61%)	$ 139,948	(49.84%)	
Number of Firms	2	(100.00%)	8	(80.00%)	3	(100.00%)	10	(83.33%)	[1]
Consumer Surplus	$ 115,449	(87.98%)	$ 58,501	(5.87%)	$ 123,271	(85.58%)	$ 297,221	(23.37%)	
Outside FKNMS Boundary									
Person-Days	-	(0.00%)	297	(7.13%)	-	(0.00%)	297	(6.25%)	
Revenue	$ -	(0.00%)	$ 28,815	(10.77%)	$ -	(0.00%)	$ 28,815	(8.75%)	
Cost	$ -	(0.00%)	$ 23,254	(10.68%)	$ -	(0.00%)	$ 23,254	(9.14%)	
Profit	$ -	(0.00%)	$ 5,561	(11.17%)	$ -	(0.00%)	$ 5,561	(7.43%)	
Number of Firms	-	(0.00%)	2	(50.00%)	-	(0.00%)	2	(40.00%)	[1]
Consumer Surplus	$ -	(0.00%)	$ 23,570	(6.94%)	$ -	(0.00%)	$ 23,570	(5.99%)	
Total									
Person-Days	1,269	(73.35%)	1,033	(6.31%)	1,343	(71.74%)	3,645	(18.24%)	
Revenue	$ 87,361	(73.32%)	$ 89,076	(10.52%)	$ 196,944	(59.02%)	$ 373,381	(28.73%)	
Cost	$ 60,165	(73.33%)	$ 61,347	(8.90%)	$ 106,360	(61.68%)	$ 227,872	(24.14%)	
Profit	$ 27,196	(73.31%)	$ 27,729	(17.63%)	$ 90,584	(56.17%)	$ 145,509	(40.91%)	
Number of Firms	2	(100.00%)	8	(80.00%)	3	(100.00%)	10	(83.33%)	[1]
Consumer Surplus	$ 115,449	(73.33%)	$ 82,071	(6.14%)	$ 123,271	(71.73%)	$ 320,791	(19.26%)	

1. Number of firms does not add up to the total because individual firms may engage in more than one activity.

2. Percent of TERSA (See Table 1.3) by activity and total in parentheses.

Market Economic Values. Ten of the twelve charter boat operations operating within the TERSA would be potentially impacted by this alternative. Direct business revenue would include potential losses of 73.4% for diving for lobsters, 59.0% for spearfishing, and 10.5% for fishing. Across all three consumptive recreational activities, 28.7% of revenue would be potentially impacted (Table 1.6).

Through the ripple or multiplier effects, 28.7% of output/sales, income and employment associated with all the consumptive recreational activities in the TERSA could potentially be lost (Table 1.8). Although these impacts could have significant impact on the ten firms operating in the TERSA, the impact would not likely be noticed in the Monroe County economy because the impact would amount to only a fraction of a percent of the total economy supported by recreating visitors to the Florida Keys (Table 1.10).

Alternative V

Non-Market Economic Values. This alternative would displace over 86% of the total person-days of diving for lobsters, over 84% of the spearfishing, and over 7% of the fishing. Across all three consumptive recreational activities over 21% of the person-days would be displaced (Table 1.7). For diving for lobsters 85% of the displaced activity would be from within the FKNMS boundaries, 59% of the fishing, and 85% of the spearfishing. Because of the way in which Consumer's surpluses are calculated, they generally mirror the patterns in displaced use. Minor differences would be due to the distributions across activities by season. Profits are only equal to the impact on person-days for diving for lobsters. For spearfishing, the impacts on profits is lower than the impact on person-days (65.5% versus 84.7%), while for fishing the impact is greater on profits than on person-days (21.9% versus 7.6%).

Table 1.7. Boundary Analysis Summary: Alternative 5 - Consumptive Recreation

	Diving for Lobsters[2]		Fishing[2]		Spearfishing[2]		Total[2]		
Within FKNMS Boundary									
Person-Days	$ 1,269	(88.00%)	736	(6.03%)	1,343	(85.60%)	3,348	(21.99%)	
Revenue	$ 87,361	(87.99%)	$ 60,261	(10.41%)	$ 196,944	(67.47%)	$ 344,566	(35.51%)	
Cost	$ 60,165	(88.00%)	$ 38,093	(8.08%)	$ 106,360	(71.14%)	$ 204,618	(29.67%)	
Profit	$ 27,196	(87.99%)	$ 22,168	(20.62%)	$ 90,584	(63.61%)	$ 139,948	(49.84%)	
Number of Firms	2	(100.00%)	10	(100.00%)	3	(100.00%)	10	(83.33%)	[1]
Consumer Surplus	$ 115,449	(87.98%)	$ 58,501	(5.87%)	$ 123,271	(85.58%)	$ 297,221	(23.37%)	
Outside FKNMS Boundary									
Person-Days	231	(80.21%)	511	(12.27%)	243	(80.20%)	985	(20.72%)	
Revenue	$ 15,894	(80.00%)	$ 48,832	(18.25%)	$ 33,436	(80.00%)	$ 98,162	(29.81%)	
Cost	$ 10,944	(80.00%)	$ 36,495	(16.76%)	$ 18,341	(80.00%)	$ 65,780	(25.86%)	
Profit	$ 4,950	(79.99%)	$ 12,337	(24.77%)	$ 15,095	(80.00%)	$ 32,382	(43.26%)	
Number of Firms	2	(100.00%)	3	(75.00%)	2	(100.00%)	3	(60.00%)	[1]
Consumer Surplus	$ 20,992	(80.10%)	$ 40,617	(11.96%)	$ 22,277	(80.09%)	$ 83,886	(21.31%)	
Total									
Person-Days	1,500	(86.71%)	1,247	(7.61%)	1,586	(84.72%)	4,333	(21.69%)	
Revenue	$ 103,255	(86.66%)	$ 109,093	(12.88%)	$ 230,380	(69.04%)	$ 442,728	(34.07%)	
Cost	$ 71,109	(86.66%)	$ 74,588	(10.82%)	$ 124,701	(72.32%)	$ 270,398	(28.65%)	
Profit	$ 32,146	(86.65%)	$ 34,505	(21.94%)	$ 105,679	(65.53%)	$ 172,330	(48.45%)	
Number of Firms	2	(100.00%)	10	(100.00%)	3	(100.00%)	11	(91.67%)	[1]
Consumer Surplus	$ 136,441	(86.67%)	$ 99,118	(7.42%)	$ 145,548	(84.69%)	$ 381,108	(22.88%)	

1. Number of firms does not add up to the total because individual firms may engage in more than one activity.

2. Percent of TERSA (See Table 1.3) by activity and total in parentheses.

Market Economic Values. Eleven of the twelve charter boat operations operating within the TERSA would be potentially impacted by this alternative. Direct business revenue would include potential losses of 86.7% for diving for lobsters, 69.0% for spearfishing, and 12.9% for fishing. Across all three consumptive recreational activities, 34.1% of revenue would be potentially impacted (Table 1.7).

Through the ripple or multiplier effects, 34.1% of output/sales, income and employment associated with all the consumptive recreational activities in the TERSA could potentially be lost (Table 1.8). Although these impacts could have significant impact on the ten firms operating in the TERSA, the impact would not likely be noticed in the Monroe County economy because the impact would amount to only a fraction of a percent of the total economy supported by recreating visitors to the Florida Keys (Table 1.9).

Table 1.8 Summary of Maximum Total Potential Loss from Displacement: Summary: Consumptive Recreation

	TERSA	Alternative II		III Preferred Alternative[1]		Alternative IV		Alternative V	
Market Impacts									
Output/Sales	$ 1,455,533	$ 138,028	(9.48%)	$ 170,300	(11.70%)	$ 418,187	(28.73%)	$ 495,855	(34.07%)
Income	$ 553,435	$ 52,482	(9.48%)	$ 64,753	(11.70%)	$ 159,006	(28.73%)	$ 188,538	(34.07%)
Employment	24	2	(8.37%)	3	(12.55%)	7	(29.29%)	8	(33.48%)
Non-market Impacts									
Consumer's Surplus	$ 1,665,643	$ 102,965	(6.18%)	$ 127,029	(7.63%)	$ 320,791	(19.26%)	$ 381,108	(22.88%)
Producer's Surplus (profit)	$ 355,662	$ 50,225	(14.12%)	$ 55,786	(15.69%)	$ 145,509	(40.91%)	$ 172,330	(48.45%)

1. Percent of TERSA in parentheses.

Table 1.9 Comparison to the Economic Contribution of Visitors to Florida Keys to Monroe County

	Monroe County	Alternative II	III Preferred Alternative[1]	Alternative IV	Alternative V
Output/Sales	$ 1,548,762,097	0.009%	0.011%	0.027%	0.032%
Income	$ 573,566,049	0.009%	0.011%	0.028%	0.033%
Employment	18,892	0.011%	0.016%	0.037%	0.042%

1. For year June 1997 - May 1998. Represents total impact of spending by recreating visitors (non-residents of Monroe County) on economy of Monroe County. See Leeworthy and Vanasse, 1999.

Mitigating Factors – Are the Potential Losses Likely?

In the above GIS-based analysis, we constantly referred to the impacts as "***potential losses***". The reason is that there are several factors that could mitigate these potential losses and further there is a possibility that there ***might not be any losses at all***. It is quite possible that there ***might be actual benefits*** to even the current displaced users. We discuss these factors only in qualitative terms because it is not possible for us to quantify them. Below we discuss two possible mitigating factors and how likely they might mitigate the potential losses from displacement and further how this might differ for each of the three alternatives.

Substitution. If displaced users are simply able to relocate their activities, they may be able to fully or partially mitigate their losses. This of course depends on the availability of substitute sites and further depends on the substitute site qualities. Several scenarios are possible. Even when total activity remains constant (i.e., person-days remain the same as they simply go to other sites), if the quality of the site is lower there could be some loss in consumer's surplus. If it costs more to get to the substitute sites, there could still be increases in costs and thus lower profits. If there is not a completely adequate supply of substitute sites, then there could be losses in total activity and in all the non-market and market economic measures referenced in our above analysis of displaced use. The possibilities for substitution vary by alternative.

Long-term benefits from Replenishment Effects. Ecological reserves or marine reserves may have beneficial effects beyond the direct ecological protection for the sites themselves. That is, both the size and number of fish, lobster and other invertebrates both inside and outside the reserves may increase. The quote from Davis 1998 summarizes what is currently known about marine reserves:

"…we found 31 studies that tested whether protected areas had an effect on the size, reproductive output, diversity, and recruitment of fish in adjacent areas. Fisheries targeted species were two to 25 times more abundant in no-take areas than in surrounding areas for fish, crustaceans, and mollusks on coral and temperate reefs in Australia, New Zealand, the Philippines, Japan, Kenya, South Africa, the Mediterranean Sea, Venezuela, Chile, and the United States (California, Florida and Rhode Island). Mean sizes of fished species protected in no-take zones were 12 to 200 percent larger than those in surrounding areas for all fishes studied and in 75 to 78 percent of the invertebrates. Eighty-six percent of the studies that tested fishery yields found that catches within three kilometers of the marine protected areas were 46 to 50 percent higher than before no-take zones were created. It is clear that fishers all over the world believe no-take zones increase yields because they fish as close to the boundaries as possible."

The long-term benefits from the reserve could offset any losses from displacement and may also result in long-term benefits and no costs to recreational users that are displaced by the proposed Tortugas Ecological Reserve. Again, this conclusion may still vary by alternative.

Alternative II

Substitution. Complete mitigation by substituting to alternative sites has a high probability for this alternative because over half of the Tortugas Bank will still be available for all consumptive recreation activities. Given the equal distribution of use for diving for lobsters and spearfishing on the Tortugas Bank, it is not likely that increased costs of relocation would occur or that there would be losses from users forced to go to sites of lower quality. Crowding effects, by pushing all the use currently spread over the whole Tortugas Bank onto half the bank, would also be unlikely given the small absolute amounts of activity. For fishing, only 1% of the activity would be displaced, so for this activity we would also expect there would be no crowding effects and recreational fishermen would not likely suffer any losses.

Long-term Benefits from Replenishment Effects. From Schmidt et al, 1999, there are five spawning areas identified in the western portion of the TERSA. On of these spawning areas is in the Alternative II boundary area. As mentioned previously, Alternative II is the portion of the preferred alternative that lies

within the FKNMS sanctuary. Therefore the long-term benefits to stocks derived from the portion of the preferred alternative that lies outside of the FKNMS boundary will not be realized. This alternative is the smallest of the three analyzed here and so the potential long-term benefits to stocks outside the protected area would be smaller than the other alternatives. But by the same token, the displaced activity to be mitigated is also much smaller and thus on net there is a high likelihood that there would be long-term benefits to all the consumptive recreational users in the TERSA.

Alternative III: Preferred

Substitution. As with Alternative II, complete mitigation by substituting to alternative sites has a high probability for this alternative because of the small proportion of the Tortugas Bank included in the alternative. Given the equal distribution of use for diving for lobsters and spearfishing on the Tortugas Bank, it is not likely that increased costs of relocation would occur or that there would be losses from users forced to go to sites of lower quality. Crowding effects, again, would be unlikely given the small absolute amounts of activity. For fishing, only 3% of the activity would be displaced, so recreational fishermen would not likely suffer any losses.

Long-term Benefits from Replenishment Effects. Again, from Schmidt et al, 1999, three of the five spawning sites identified in the western portion of the TERSA are located within the boundaries of this alternative. Because this alternative includes areas outside the FKNMS sanctuary, the potential long-term benefits to stocks outside the protected area would be comparatively larger than it would be for Alternative II. The mitigating effort required on the part of operators in the boundary alternative will be also be comparatively larger, but as mentioned above, because of the small percentage of the active recreational area included in the alternative, the effect is likely to be very small. Therefore, there is a high likelihood that there would be long-term benefits to all the consumptive recreational users in the TERSA.

Alternative IV

Substitution. Under this alternative, about 73% of the diving for lobsters and 72% of the spearfishing would be displaced. The potential for substituting to alternative sites is greatly reduced as compared with alternatives II and III. The reason is that under this alternative all of the Tortugas Bank falls within this boundary alternative. Some substitution is possible, but the probability of crowding effects rises considerably for diving for lobsters and spearfishing.

For fishing, substitution mitigating all the losses is still highly probable since only about 6 percent of the fishing activity would be displaced. This represents a relatively low amount of activity and given the wide distribution of this activity in the study area, crowding effects are still a low probability under this alternative.

Long-term Benefits from Replenishment Effects. Again, from Schmidt et al, 1999, four of the five spawning sites identified in the western portion of the TERSA are located within the boundaries of this alternative. For diving for lobsters and spearfishing, it is not clear whether there would be significant benefits offsite given that most of this activity currently takes place on the Tortugas Bank and none of the bank available for the activity. Not much is currently known about other areas which might benefit from the stock effect and where they could relocate to reap these benefits. Whether the activities displaced could find alternative sites where both the quantity and quality of activity could be maintained or enhanced seems less likely given the extent of displacement.

For fishing, however, the small amount of displacement relative to the entire area plus the wider distribution of fishing activity still makes it highly likely that the long-term benefits of replenishment will more than offset the potential losses from displacement resulting in net benefits to this group.

Alternative V

Substitution. This alternative displaces about 87% of the diving for lobsters and 85% of the spearfishing. Substitution possibilities for these activities are reduced even more, meaning that losses given in Table 1.7 are more likely to actually occur.

For fishing, mitigating all the losses through substitution is still highly probable since only about 8% of the fishing activity would be displaced. This again, represents a relatively low amount of activity and given the wide distribution of this activity in the study area, crowding effects are still a low probability under this alternative.

Long-term Benefits from Stock Effects. Again, from Schmidt et al, 1999, four of the five spawning sites identified in the western portion of the TERSA are located within the boundaries of this alternative. However, because the entire Tortugas Bank would be closed to diving for lobsters and spearfishing and the additionally large area encompassed by the proposed reserve, it is highly unlikely that these two user groups would benefit from the enhanced stocks of lobster and fish. Therefore, under this alternative, the maximum potential losses listed in Table 1.7 are highly likely to occur.

For fishing, however, the stock effects for the reserve could be substantial. Whether the benefits would be large enough to offset the displacement cannot be determined. But given the past experience with reserves, it is still somewhat likely that the long-term benefits would offset the displacement costs yielding net benefits.

Benefits of the Proposed Tortugas Ecological Reserve to Recreational Users

Recreational Users on Entire Florida Keys Reef Tract. Above we discussed the possibility that consumptive recreational users could possibly benefit if there were long-term offsite impacts. But given the work by Ault et al (1998), Bohnsack and Ault (1996), Bohnsack and McClellan (1998), and Lee et al (1994 and 1999), there is also the possibility that a protected area in the Tortugas could yield beneficial stock effects to a wide variety of species all along the entire Florida Keys reef tract and to species such as sailfish that are primarily offshore species. Even small increases in recreational tourist activities along the entire Florida Keys reef tract could more than offset the total displacements from the most extreme alternative analyzed here. Table 1.10 shows the total impacts for each alternative relative to the total Florida Keys recreational visitor economic contribution. They are only fractions of a percent of the total recreational visitor economic contribution. One-tenth of one percent increase in the total recreational visitor contribution along the entire Florida Keys reef tract would more than offset the maximum potential losses from alternative V (Table 1.7).

Non-consumptive Users (Divers) in Tortugas. Currently there are four operators that bring divers to the TERSA for non-consumptive diving. There were 1,048 person-days of non-consumptive diving which account for 4.98% of the total recreational activity in the TERSA (excluding the National Park). Of the total non-consumptive diving, 83.3% is currently done within the FKNMS boundaries. Table 1.11 summarizes the information for non-consumptive divers. We expect that this group would be benefited by the ecological reserve. As the site improves in quality, we would expect that the demand for this site will increase and person-days, consumer's surplus, business revenues and profits will all increase. This would be expected to vary by alternative with the more protective alternatives having greater benefits

Table 1.10. Non-consumptive Diving

	TERSA	Alternative II		Alternative III Preferred Alternative		Alternative IV		Alternative V	
Within FKNMS Boundary									
Person-Days	873	279	(31.96%)	279	(31.96%)	768	(87.97%)	768	(87.97%)
Revenue	$ 95,123	$ 30,439	(32.00%)	$ 30,439	(32.00%)	$ 83,708	(88.00%)	$ 83,708	(88.00%)
Cost	$ 58,157	$ 18,610	(32.00%)	$ 18,610	(32.00%)	$ 51,178	(88.00%)	$ 51,178	(88.00%)
Profit	$ 36,966	$ 11,829	(32.00%)	$ 11,829	(32.00%)	$ 32,530	(88.00%)	$ 32,530	(88.00%)
Number of Firms	1	1	(100.00%)	1	(100.00%)	1	(100.00%)	1	(100.00%)
Consumer Surplus	$ 77,198	$ 24,710	(32.01%)	$ 24,710	(32.01%)	$ 67,954	(88.03%)	$ 67,954	(88.03%)
Outside FKNMS Boundary									
Person-Days	175	-	(0.00%)	-	(0.00%)	-	(0.00%)	140	(80.00%)
Revenue	$ 19,025	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	$ 15,220	(80.00%)
Cost	$ 11,631	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	$ 9,305	(80.00%)
Profit	$ 7,393	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	$ 5,915	(80.01%)
Number of Firms	1	-	(0.00%)	-	(0.00%)	-	(0.00%)	1	(100.00%)
Consumer Surplus	$ 15,475	$ -	(0.00%)	$ -	(0.00%)	$ -	(0.00%)	$ 12,355	(79.84%)
Total									
Person-Days	1,048	279	(26.62%)	279	(26.62%)	768	(73.28%)	908	(86.64%)
Revenue	$ 114,148	$ 30,439	(26.67%)	$ 30,439	(26.67%)	$ 83,708	(73.33%)	$ 98,928	(86.67%)
Cost	$ 69,788	$ 18,610	(26.67%)	$ 18,610	(26.67%)	$ 51,178	(73.33%)	$ 60,483	(86.67%)
Profit	$ 44,359	$ 11,829	(26.67%)	$ 11,829	(26.67%)	$ 32,530	(73.33%)	$ 38,445	(86.67%)
Number of Firms	1	1	(100.00%)	1	(100.00%)	1	(100.00%)	1	(100.00%)
Consumer Surplus	$ 92,673	$ 24,710	(26.66%)	$ 24,710	(26.66%)	$ 67,954	(73.33%)	$ 80,309	(86.66%)

Chapter 2
Commercial Fishery

Background

The commercial fishery in the **Tortugas Ecological Reserve Study Area (TERSA)** is a multi-species fishery. Four species or species groups comprise the commercial fishery of the TERSA: 1) Lobster (primarily spiny but some Spanish), 2) Shrimp (primarily pink but some rock), 3) Reef Fish (includes all finfish other than pelagics[1]), and 4) King Mackerel. Some pelagic species (e.g., sharks, tuna, swordfish) are also caught along the western edge of the TERSA by long-liners, but the research team found this to be minimal.

The Florida Marine Research Institute (FMRI) and the National Marine Fisheries Service (NMFS) are the primary government agencies that compile information on catch and ex vessel value of catch (i.e., the value or revenue received by the fisherman). NMFS compiles statistics on catch and ex vessel value by species and by county where the catch is landed. FMRI has a "trip ticket" system and a saltwater product license (SPL) requirement for the commercial fisheries. The trip ticket system records, for each SPL holder, catch by species, area where caught, and the county where landed.

For purposes of assessing alternative ecological reserve boundaries, information on the spatial distribution of catch is required. The FMRI statistical areas are shown in Figure 2.1. These areas are quite large and the two areas specific to the Tortugas Area (e.g., FMRI areas 2.0 and 2.9) are much larger than the TERSA (within which alternative ecological reserve boundaries are being considered). Tables 2.1-2.3 show the total catch and ex vessel value of the Tortugas Area commercial fishery as defined by FMRI statistical areas 2.0 and 2.9 for year 1997.

In 1997, over nine million pounds with an ex vessel value of over $23 million was commercially caught in FMRI areas 2.0 and 2.9. Shrimp accounted for almost 68 percent of the total ex vessel value. Invertebrates (primarily spiny lobster) accounted for 18.64 percent, reef fish 9.73 percent, and pelagics 3.71 percent of the total ex vessel value (Table 2.1).

For estimating economic impacts in terms of local output/sales, income and employment, it is important to know where the catch is landed. Table 2.2 shows how much of the catch was landed in Monroe County and Table 2.3 shows how much was landed in all other counties. In 1997, catch from FMRI areas 2.0 and 2.9 was landed in 10 counties other than Monroe County. Most of the catch landed in counties other than Monroe included shrimp and pelagics. Appendix Table A.2.1. shows the catch by county for all counties other than Monroe. Most of the impact from landings outside Monroe was concentrated in Lee County because of shrimp landings. In 1997, shrimp caught in FMRI areas 2.0 and 2.9 and landed in Lee County accounted for 85 percent of the ex vessel value of all catch from FMRI areas 2.0 and 2.9 landed outside Monroe County.

Although the information from FMRI areas 2.0 and 2.9 places some bounds on the commercial fishery "potentially impacted" by the proposed ecological reserve, the area is still much too large relative to the TERSA to derive accurate estimates of the potential economic impacts. To address this we designed a data collection effort to estimate catch and ex vessel value specifically for the TERSA. The approach combined catch and trip information from FMRI's trip ticket system with interviews of fishermen that hold an SPL and had commercially fished in FMRI areas 2.0 and 2.9. The objective was to identify the population of SPL holders that commercially fished in the TERSA, estimate their total catch and revenue, and obtain socioeconomic profiles of the commercial fishermen currently operating in the TERSA.

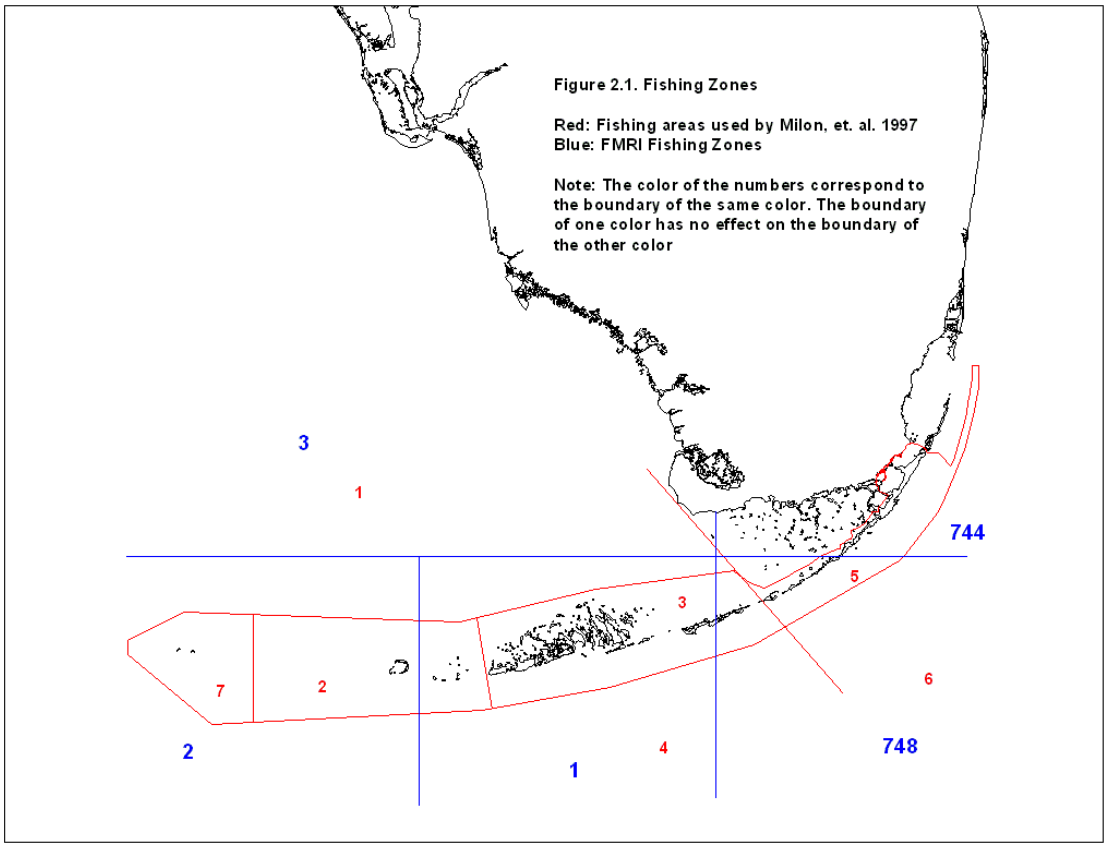


Figure 2.1. Fishing Zones
Red: Fishing areas used by Milon, et. al. 1997
Blue: FMRI Fishing Zones
Note: The color of the numbers correspond to the boundary of the same color. The boundary of one color has no effect on the boundary of the other color
3
1
744
5
3
6
7
2
2
4
748
1

Table 2.1. Tortugas Commercial Fishing Catch 1997 (FMRI Areas 2.0 & 2.9)

Species/Where Landed	Pounds	Value $	% of Value
Total (All Counties)	**9,134,582**	**23,247,633**	**100.00**
Pelagics[1]	**429,157**	**863,398**	**3.71**
Monroe County	240,373	338,717	1.46
All Other Counties	188,784	524,681	2.25
Shrimp	**6,565,387**	**15,789,170**	**67.92**
Monroe County	2,780,144	6,676,145	28.72
All Other Counties	3,785,243	9,113,025	39.20
Reef Fish[2]	**1,116,805**	**2,261,309**	**9.73**
Monroe County	877,512	1,811,231	7.79
All Other Counties	239,293	450,078	1.94
Invertebrates[3]	**1,023,233**	**4,333,756**	**18.64**
Monroe County	1,009,124	4,229,092	18.19
All Other Counties	14,109	104,664	0.45

1. Pelagics include Dolphin, Cero Mackerel, King Mackerel, Spanish Mackerel, Sharks, Swordfish, Tuna and Wahoo.
2. Reef Fish include all finfish other than Pelagics.
3. Invertebrates include crabs, lobster, octopus, squid, and sponges.

Table 2.2. Tortugas Commercial Fishing Catch 1997: Monroe County Landings (FMRI Areas 2.0 & 2.9)

Species	Pounds	Value $	% of Value
Finfish	1,117,885	2,149,948	16.47
Invertebrates[1]	1,009,124	4,229,092	32.39
Shrimp	2,780,144	6,676,145	51.14
Total	**4,907,153**	**13,055,185**	**100.00**
Pelagics	**240,373**	**338,717**	**2.59**
Dolphin	7,034	8,933	0.07
Cero Mackerel	369	351	0.003
King Mackerel	51,976	49,377	0.38
Spanish Mackerel	108,563	55,367	0.42
Sharks	25,209	23,641	0.18
Swordfish	42,289	190,301	1.46
Tuna	3,131	7,179	0.05
Wahoo	1,802	3,568	0.03
Reef Fish[2]	**877,512**	**1,811,231**	**13.87**
Invertebrates			
Spiny Lobster	922,090	3,808,232	29.17
Spanish Lobster	3,270	30,804	0.24
Stone Crabs	69,480	377,915	2.89

1. Invertebrates include crabs, lobster, octopus, squid, and sponges.
2. Reef Fish include all finfish other than Pelagics.

Table 2.3. Tortugas Commercial Fishing Catch 1997: All Other Counties Landings (Not Including Monroe County, FMRI Areas 2.0 & 2.9)

Species	Pounds	Value $	% of Value
Finfish	428,077	974,759	9.56
Invertebrates[1]	14,109	104,664	1.03
Shrimp	3,785,243	9,113,025	89.41
Total	**4,227,429**	**10,192,448**	**100.00**
Pelagics	**188,784**	**524,681**	**5.15**
Dolphin	2,017	2,562	0.025
Cero Mackerel	0	0	0.00
King Mackerel	44,370	42,151	0.41
Spanish Mackerel	4	2	-
Sharks	40,073	43,011	0.42
Swordfish	92,741	417,335	4.09
Tuna	8,980	18,434	0.18
Wahoo	599	1,186	0.01
Reef Fish[2]	**239,293**	**450,078**	**4.41**
Invertebrates (Top 2)			
Spanish Lobster	9,390	88,454	0.87
Spiny Lobster	3,202	13,224	0.13

1. Invertebrates include crabs, lobster, octopus, squid, and sponges.
2. Reef Fish include all finfish other than Pelagics.

Description of the Data

NOAA entered into a contract with Thomas Murray & Associates with a sub-contract to the University of Miami's Rosenstiel School of Marine and Atmospheric Science, Marine Affairs Department (RSMAS) to collect the necessary information. These two entities have extensive experience with the commercial fisheries of Monroe County/Florida Keys, as well as other commercial fisheries around the State of Florida, and commercial fishermen expressed confidence in working with the research team. This was critical since the effort required access to personal financial information and individual trip ticket information.

Two types of databases were delivered to NOAA. The first was the socioeconomic profiles data base. This included a socioeconomic profile of each SPL holder (e.g., age, race/ethnicity, number of family members supported, membership in organizations, years of experience in the Monroe County commercial fishery, years of experience in the Tortugas commercial fishery, percent of income derived from commercial fishing, percent of income derived from the TERSA commercial fishery, and primary hauling port). Other information obtained included the number of vessels, cost of vessels, number and type of different gear, cost by gear type, maintenance and repair costs and trip costs. Trip costs were broken down

into fuel, bait, ice, food & supplies, and other costs. Costs for captain and crew were not included because crew are often paid on a share basis. Number of captain and crew was also obtained. Trips costs, number of trips (normalized to days), and catch were obtained by species or species groups (e.g., Lobster, Shrimp, Reef Fish, King Mackerel, and other). In addition, catch by species or species groups was reported for seven areas or zones throughout the Florida Keys. Zone 7 corresponds to the TERSA (Figure 2.1).

The second data base was designed for analyzing different boundary alternatives for the proposed ecological reserve. The catch, number of trips, and trip costs identified in zone 7 (TERSA) from the first data base was then distributed across 1,020 square nautical mile grid cells that define the TERSA. The RSMAS researcher, Manoj Shivlani, worked with each fisherman and determined how much of their total catch for each species or species group was caught in each of the 1,020 grid cells. Since the Dry Tortugas National Park currently prohibits commercial fishing within the park, the values for grid cells within the park are "true zeroes" (i.e., no commercial fishing impacts for those portions of the proposed ecological reserve within park boundaries).

The data collection strategy was not to simply collect a random sample of fishermen that fished in the TERSA. Instead, the strategy was to identify the entire population from the SPL list that fished in FMRI areas 2.0 and 2.9, then determine how many of these represent the population of commercial fishermen within the smaller TERSA. Once it was determined that an SPL holder fished within the TERSA, the SPL holder was asked to sign an affidavit allowing the RSMAS researcher to access their trip ticket information from FMRI. An interview was then scheduled to obtain all the information outlined above for both the socioeconomic profiles and GIS data bases. SPL holders living in Monroe, Dade, Collier and Lee counties were prioritized for data collection since these four counties accounted for most of the landings (see Tables 2.1-2.3 and Appendix A, Table A.5).

Overall, 105-110 SPL holders were identified as making up the population of commercial fishing operations in the TERSA. Detailed interviews were completed with 90 of the 105-110 SPL holders in the population or a sampling rate of 82-86 percent. In addition, for total catches within the TERSA, we estimate that our sample includes 90-93 percent of the total catch for all species or species groups caught in the TERSA. Thus, in extrapolating from sample to population, none of our extrapolation factors exceeded 1.10 (Table 2.4). Given the small increments to total catch from extrapolation, the distribution of catch by grid cells would not (in our opinion) be significantly affected by our assumption that the extrapolated portions of catch for each species or species group had the same distribution as our sample.[2,3,4]

Table 2.4. TERSA Sample Catch as a Percent of Total TERSA Catch

Species/Species Group	Sample Catch As Percent of Total TERSA Catch	Sample to Population Factor[1]
Lobster	93.14	1.07
Shrimp	90.91	1.10
Reef Fish	90.91	1.10
King Mackerel	92.68	1.08

1. Equal to reciprocal of sample percent of total TERSA catch.

The population of 105-110 commercial fishing operations include an estimated 164 vessels and a total number of crew (including captain) of 270 (Table 2.5). Under federal regulations for conducting Initial Regulatory Flexibility Analyses (IRFA), all the commercial fishing operations that operate in the TERSA qualify as small businesses.

Table 2.5. Number of Commercial Fishing Operations, Vessels and Captain & Crew in TERSA

Species/Species Group	Number Of Operations [1,2]	Number of Vessels	Number of Cpt. & Crew
Lobster	30 (28)	31 (29)	87 (81)
Shrimp	28 (18)	75 (65)	213 (193)
Reef Fish	46 (42)	48 (44)	112 (102)
King Mackerel	17 (16)	17 (16)	34 (32)
Shark [3]	1 (1)	1 (1)	3 (3)
Total [4]	105-110 (90)	164 (155)	270 (241)

1. Number of saltwater product license (SPL) holders.
2. Sample numbers in parentheses next to population estimates.
3. The research team learned that there are 15-18 long-liners that fish the western edge of the TERSA for pelagic species such as sharks, tunas and swordfish, but the catch was minimal.
4. Totals are less than additions across species because of multi-species fishery.

Socioeconomic Profile of the TERSA Commercial Fishery

The 90 commercial fishing operations (SPL holders) included several husband and wife or father and son combinations that each hold separate SPLs. Each operated a different vessel and had separate crews, so each was treated as a separate operation.

Presented here is a profile of the current SPL holders that fished in the TERSA. For many items in the socioeconomic profile, a comparison is made between SPL holders that fished anywhere in the Florida Keys and those that fished in the Lower Keys. The profile information for all Florida Keys fishermen and Lower Keys fishermen comes from a 1994-95 sample as reported in Milon et al 1997.

Age and Experience. TERSA fishermen appear to be younger, but have more experience fishing in Monroe County than either fishermen from the entire Florida Keys or those from the Lower Keys. Almost 63 percent of the TERSA fishermen have over 20 years experience fishing in Monroe County compared to 29.5 percent for fishermen from the entire Florida Keys and 30.7 percent of fishermen from the Lower Keys (Table 2.6). TERSA fishermen also have considerable experience fishing in the TERSA. Over 64 percent of TERSA fishermen have fished in the TERSA of over 10 years and 47.2 percent have fished there for over 20 years.

Race/Ethnicity. TERSA fishermen, as fishermen throughout the Florida Keys, are predominantly Anglo-Americans. About 77 percent of TERSA fishermen are Anglo-American, 21 percent Hispanic, and two percent African American. There are slightly more Hispanic and African American fishermen that fish the TERSA in comparison to fishermen throughout the Florida Keys, but there is no significant differences between TERSA fishermen and Lower Keys fishermen.

Memberships in Organizations. Monroe County Commercial Fishermen, Inc. (MCCF) was the most popular organization among all fishermen, and membership rates did not differ between TERSA fishermen and other fishermen in the Florida Keys. For all other organizations, TERSA fishermen had significantly lower membership rates than other Florida Keys fishermen.

Table 2.6. Profile of TERSA Fishermen Compared to Other Keys Fishermen

	1997-98	1994-95[1]	
	Tortugas (%)	All Keys (%)	Lower Keys (%)
Age			
18-30	13.3	10.5	8.0
31-40	18.9	18.6	16.0
41-50	36.7	30.3	32.5
51-60	20.0	23.4	23.9
Over 60	11.1	17.1	19.6
Years of Fishing in Monroe			
Less than one year	1.1	0.0	0.0
1-5 years	6.7	17.0	19.0
6-10 years	12.4	22.5	16.6
11-20 years	16.9	31.0	33.7
21 or more years	62.9	29.5	30.7
Years of Fishing in TERSA			
1-5 years	10.1	N/A	N/A
6-10 years	25.8	N/A	N/A
11-20 years	16.9	N/A	N/A
21 or more years	47.2	N/A	N/A
Race/Ethnicity			
Anglo-American	76.7	80.1	74.8
Hispanic	21.1	18.2	23.9
African-American	2.2	0.9	1.2
Other	0.0	0.9	0.0
Membership in Organizations			
Conch Coalition	7.0	16.9	12.3
OFF	12.0	19.0	14.1
MCCF	38.0	24.2	26.4
Environmental	2.0	6.9	5.5

Table 2.6. (Continued)

	1997-98	1994-95[1]	
	Tortugas (%)	All Keys (%)	Lower Keys (%)
	Occupation		
Full-time Commercial Fishing	87.8	10.5	8.0
Part-time Commercial Fishing	1.1	18.6	16.0
Charter Boat (sell some catch)	11.1	30.3	32.5
	Income		
Percent Income from Fishing	89.1	61.0	62.3
Percent Income from Fishing in TERSA			

- 84.9% of Tortugas fishermen are full-time commercial fishermen earning 100% of their income from fishing
- 11 % of Tortugas fishermen are Charter fishermen holding a SPL, but DO NOT rely on selling fish as part of their primary income (mates do sell 10% of catch)
- 4.7% of Tortugas fishermen earn 100 percent of their income from fishing in the TERSA
- On average, TERSA fishermen earn 44.69 percent of their income from fishing in the TERSA

	Family Members Supported		
1 (Myself)	19.3	80.1	74.8
2	28.9	18.2	23.9
3	22.9	0.9	1.2
4 or more	28.9	0.9	0.0
	Primary Hauling Port		
Key West/Stock Island	74.4	N/A	N/A
Big Pine Key	4.4	N/A	N/A
Marathon	3.3	N/A	N/A
Tavernier	2.2	N/A	N/A
Naples/Ft. Myers	15.6	N/A	N/A
Fish House Usage (% Yes)	41.1	N/A	N/A

1. From Milon et al 1997.

*Charter boat fishermen were not reported separately in Milon et al 1997. They were included in part-time commercial fishermen.

Occupation and Dependence on Commercial Fishing. Almost 88 percent of TERSA fishermen are full-time commercial fishermen compared to 59 percent of other fishermen in the Florida Keys. About 11 percent of TERSA fishermen are charter boat fishermen holding a SPL, but do not rely on selling fish as part of their income. However, the mates aboard these charter boats sell an estimated 10 percent of the catch to supplement their incomes. About one percent of TERSA fishermen are part time commercial fishermen.

On average, TERSA fishermen earn 89 percent of their income from commercial fishing compared to 61 percent for all Florida Keys fishermen and 62 percent for fishermen in the Lower Keys. About 85 percent of TERSA fishermen get 100 percent of their incomes from commercial fishing. In addition, TERSA fishermen, on average, derive about 45 percent of their income from the TERSA. About five percent derive 100 percent of their income from the TERSA.

Number of Family Members Supported. TERSA fishermen appear to support larger families than either fishermen in the entire Keys or those in the Lower Keys. Over 51 percent of TERSA fishermen support families of three or more compared to 38 percent for the entire Keys and 41.5 percent for the Lower Keys. On average, TERSA fishermen support 2.87 family members, including themselves, or 1.87 additional family members. Given our population estimate of 270 captain and crew operating in the TERSA, and assuming they (on average) support similar family sizes, we estimate that around 775 people are to some extent dependent on the commercial fisheries of the TERSA. This estimate would exclude those that might be more indirectly dependent on the commercial fishery through multiplier impacts from spending associated with the TERSA commercial fishery.

Primary Hauling Port and Fish House Usage. Key West/Stock Island is the primary hauling port or place where TERSA fishermen land their catch (74.4 %). The Naples/Ft. Myers/Ft. Myers Beach areas rank second with 15.5 percent of TERSA fishermen. The Naples/Ft. Myers/Ft. Myers Beach areas are primarily shrimp operations. Other Florida Keys sites (e.g., Big Pine Key, Marathon, and Tavenier) account for the remaining 10 percent.

About 41 percent of TERSA fishermen were associated with 13 different fish houses. The two top fish houses were Stock Island Lobster Company and Sea Lobster each accounting for about 19 percent of the fishermen that are associated with fish houses. These two fish houses are located in Key West/Stock Island.

Catch. TERSA fishermen generally do not rely on one species or species group or on one area/zone for all of their catch. Table 2.1 reported that in 1997 there were 69,480 pounds of stone crabs caught from FMRI areas 2.0 and 2.9. TERSA fishermen account for all this stone crab catch but they report catching none of it in the TERSA. They report that they do not catch stone crabs west of the Marquesas. Table 2.7 shows the different species or species groups caught in the TERSA and the percent of TERSA fishermen that caught each species or species group (the column labeled All Monroe), and the percent of TERSA fishermen that caught each species or species group in the TERSA. In the TERSA, 31 percent caught lobster, 20 percent caught shrimp, 47 percent caught reef fish, about 18 percent caught King Mackerel, and one percent caught shark. The percents across species or species groups add to more than 100 percent indicating the multi-species nature of the TERSA fishery.

As described in the beginning of this section of the report, information was obtained on how much of the catch was caught in each of the seven zones throughout the Florida Keys/Monroe County. Table 2.8 shows the percentage of sample catch for each species or species group caught in each of the seven zones. Over 68 percent of the total lobster catch caught by TERSA fishermen was caught in the TERSA (zone 7). This was followed by 48 percent for reef fish, 18 percent for shrimp, and 17.75 percent for King Mackerel. Zones 1-3 appear to be the main alternative fishing grounds for TERSA fishermen. None reported catching anything in zone 5 and less than one percent of any species or species group caught by TERSA fishermen was caught in either zone 4 or 6.

Table 2.7. Percent of TERSA Fishermen that Caught Each Species

Species/Species Group	Caught in Zones (1-7) (%) of TERSA Fishermen	Caught in TERSA (%) of TERSA Fishermen
Stone Crabs	16.67 (N=15)[2]	0.00 (N=0)
Lobster	38.89 (N=35)	31.11 (N=28)
Shrimp	21.11 (N=19)	20.00 (N=18)
Reef Fish	54.44 (N=49)	46.67 (N=42)
King Mackerel	25.56 (N=23)	17.78 (N=16)
Shark	2.22 (N=2)	1.11 (N=1)
Other [1]	5.55 (N=5)	0.00 (N=0)

1. Includes amberjack, bait fish, dolphin, and Spanish mackerel.
2. Number in sample that caught species in parentheses. Total N=90.

Table 2.8. Distribution of TERSA Fishermen's Catch by Zone

	Zones (Percent of Catch)						
Species/Species Group	1	2	3	4	5	6	**7**
Stone Crab	7.01	77.76	15.23	0.00	0.00	0.00	**0.00**
Lobster	5.13	21.65	4.84	0.00	0.00	0.00	**68.38**
Shrimp	79.97	1.65	0.00	0.00	0.00	0.22	**18.16**
Reef Fish	31.16	14.80	4.79	0.41	0.00	0.61	**48.23**
King Mackerel	73.20	7.47	0.89	0.29	0.00	0.40	**17.75**

Zones (See Figure 2.1)
1 = Middle and Lower Keys Outside FKNMS – Gulf of Mexico
2 = Lower Keys west to the Tortugas Study Area (TERSA)
3 = Middle Keys in FKNMS
4 = Middle and Lower Keys Outside FKNMS – Atlantic Ocean
5 = Upper Keys in FKNMS and Florida Bay
6 = Upper Keys Outside FKNMS – Atlantic Ocean
7 = Tortugas Ecological Reserve Study Area (TERSA)

Earlier we discussed the extrapolation from sample to population. Table 2.9 shows the calculations for extrapolating sample catch to population catch for each species or species group in the TERSA. These catch estimates provide control totals that are used for our boundary analyses using the geographic information system (GIS) data base. The totals of catch potentially lost from displacement can be assessed relative to these totals for the TERSA. Generally, the control totals represent either 1997 catch totals or averages of the 1997 and 1998 totals.[5]

Lobster. In 1997, we estimate that 937,952 pounds of lobster was caught in the TERSA. About 60.60 percent was caught within the FKNMS.

Reef Fish. In 1997, we estimate that 574,642 pounds of reef fish was caught in the TERSA. About 51.05 percent was caught within the FKNMS.

King Mackerel. In 1997, we estimate that 96,346 pounds of king mackerel was caught in the TERSA. About 80.2 percent was caught within the FKNMS.

Shrimp. In 1997, we estimate that 715,500 pounds of shrimp was caught in the TERSA. About 25.61 percent was caught in the FKNMS.

Table 2.9. Derivation of TERSA Catch

	FMRI Areas 2.0 and 2.9 (pounds)			
Species/Species Group	1997	1998	Average 1997-1998	Sample Sum
Lobster	937,952	989,697	963,825	873,620
Reef Fish	1,116,805	1,064,027	1,090,416	522,402
King Mackerel	96,346	199,420	147,883	88,695
Shrimp	6,565,387	8,167,965	7,366,676	665,500

		TERSA Catch [1]
Lobster	1.07 times sample sum =	937,952
Reef Fish	1.10 times sample sum =	574,642
King Mackerel	1.08 times sample sum =	96,346
Shrimp	1.10 times sample sum =	715,500

1. See end notes 2 through 5 at the end of this section of the report and Table 2.4 for the sample to population extrapolation factors.

Economic Impact/Contribution of the Commercial Fishery of the TERSA to Local Economies

Above an overview of the TERSA commercial fishery was presented including a socioeconomic profile of the commercial fishermen and the extent of both their total catch and their catch from within the TERSA. Here the overview is extended to the economic impact or contribution the commercial fishing activity in the TERSA has on the local economies where the catch is landed. The overview will also provide the model of how we estimate the economic impact of different boundary alternatives for the proposed ecological reserve.

For FMRI areas 2.0 and 2.9, we showed that catch was landed in 11 counties (including Monroe). Our sample of TERSA fishermen, however, reveals that catch from the TERSA is landed in just three counties: Monroe, Collier and Lee. Table 2.11 shows the percent of TERSA catch for each species/species group landed in Monroe County. The remaining catch was landed in Collier and Lee counties. So for purposes of estimating economic impact or contribution to local economies, we estimate it for Monroe and the combination of Collier/Lee counties.

Economic impact/contribution to the local economies measures the market economic values associated with commercial fishing activity. Market economic values are measured by output/sales, income, and number of full and part-time jobs, and also includes multiplier impacts.

Economic Impact/Contribution Model. Tables 2.10 to 2.13 are more than just tabular summaries of results. The tables are also representations of a linked set of spreadsheets that contain all the necessary information to estimate economic impact/contribution. Footnotes for each table document the source of information and include formulas used in the various calculations.

Harvest Revenue. The first step in calculating economic impact/contribution is to convert catch to revenue to the commercial fishing operations. Revenue to commercial fishing operations is commonly referred to as "ex vessel value". We used the landings and ex vessel values for Monroe County 1997 to derive a price per pound for each species/species group. Price per pound was then multiplied by TERSA catch to estimate total harvest revenue to the commercial fishing operations from TERSA catch.

In 1997, total TERSA catch was over 2.3 million pounds worth almost $6.9 million in harvest revenue. Lobsters accounted for over 40 percent of catch by weight, but over 56.5 percent of catch by value (Table 2.10). This was followed by shrimp which accounted for almost 31 percent of catch by weight and about 25 percent of catch by value. Reef Fish accounted for about 25 percent of catch by weight and about 17 percent by value. And, king mackerel accounted for a little over 4 percent of catch by weight and a little over one percent of catch by value.

Table 2.10. Total Harvest and Ex Vessel Value of Commercial Catch in TERSA

Species/Species Group	Pounds[1]	Percent	$/lb.[2]	Revenue[3]	Percent
Lobster	937,952	40.35	4.15	3,892,501	56.54
Reef Fish	574,642	24.72	2.06	1,183,763	17.19
King Mackerel	96,346	4.14	0.95	91,529	1.33
Shrimp	715,500	30.78	2.40	1,717,200	24.94
Total	2,324,440	100.00	2.96	6,884,992	100.00

1. From Sample of TERSA Fishermen extrapolated to population estimates (Table 2.9).
2. From National Marine Fisheries Service, Key West Office. Landings and Ex Vessel Value of Monroe County Landings, 1997.
3. Revenue equals pounds times $/lb.

Primary Output. Step two in estimating economic impact/contribution is to determine where the catch is landed, trace the landings through different market levels to their final destination (consumers), and apply appropriate mark-up margins to account for value added at each market level. Using the value added concept avoids double-counting. We do this by using mark-ups at each market level and derive mark-up margins at each market level. Margins at each market level can be added across market levels without double-counting.

Table 2.11 summarizes how much (in percentage terms) of catch is landed in Monroe County, how much is exported out of the county, how much is sold to Keys retail markets and how much is sold to Keys restaurants. Price mark-ups at each market level are also included. Table 2.12 shows the results of combining the information contained in Tables 2.10 and 2.11 in estimating primary output for Monroe County and Table 2.13 shows the results for Collier/Lee counties.

For TERSA catch landed in Monroe County, commercial fishing operations received about $5.8 million. This generated over $2.2 million in added value at the wholesale market level, about $126 thousand of added value at the Keys retail market level, and almost $1.7 million in added value at the Keys restaurant market level for a total primary output of almost $9.9 million. Lobster accounted for 64.37

percent of total primary output in Monroe County followed by 17.27 percent for shrimp, 16.77 percent for reef fish, and 1.59 percent for king mackerel.

Table 2.11. Market Distribution of Catch and Price Mark-ups

	Lobster	Reef Fish	King Mackerel	Shrimp
Percent of Catch Landed in Monroe County[1]	100	77.89	90.53	51.42
Wholesale Distribution (%)[2]				
a. Exported	90	80	80	90
b. Keys Retail	3	6	6	3
c. Keys Restaurant	7	14	14	7
Price Mark-ups (%)[3]				
a. Wholesale	37	27	34	62
b. Keys Retail[4]	30	84.5	84.5	30
c. Keys Restaurant[4]	257.1	257.1	257.1	257.1

1. From sample of TERSA fishermen.
2. From Rockland (1988). Market distributions of catch of finfish used for Reef Fish and King Mackerel and market distribution of shellfish used for Lobsters and Shrimp.
3. From Adams (1992). Wholesale mark-ups per pound converted to percent mark-ups.
4. From Rockland (1988). Retail and Restaurant mark-ups for finfish used for Reef Fish and King Mackerel and percent mark-ups for shellfish used for Lobster and Shrimp.

For TERSA catch landed in Collier/Lee counties, commercial fishing operations received about $1.1 million. This generated almost $591 thousand added value at the wholesale market level, $29.6 thousand at the local retail market level, and $367 thousand at local restaurants for a total primary output of over $2 million. Shrimp accounted for 76.8 percent of the total primary output followed by 22.4 percent for reef fish and less than one percent for king mackerel. No lobster from the TERSA was landed in Collier/Lee counties.

Total Output. It is usual practice, when estimating economic impact/contribution, to first identify direct effects, then using multipliers, estimate indirect and induced effects. Direct effects plus indirect effects plus induced effects equal total effects. Here a different approach is used that does not separately identify the intermediate effects, but instead goes from primary output to total output. This is done using a multiplier for Monroe County of 1.2. This multiplier is slightly higher than the relationship between total tourist spending and total tourist related output for Monroe County (1.12, See English et al, 1996). This multiplier accounts for the fact that primary output includes inputs purchased from outside Monroe county which must be deducted from primary output to derive direct output. The approach used here skips over this step (due to lack of information) and goes directly from primary output to total output. We use a slightly higher multiplier than what was used for the tourist industry because the tourist industry is more directly characterized by part-time help commuting to work from outside Monroe County. This represents an additional input that is purchased from outside Monroe County and this also reduces the induced impacts from these workers spending their incomes outside the county (i.e., in their home counties). We expect this is less true for the commercial fishermen and their crews, so we use a slightly higher multiplier. For Collier/Lee counties, we used a multiplier of 1.51 derived for Lee County (See Adams and Mulkey, 1988).

For TERSA catch landed in Monroe County, total output was about $11.8 million, while for Collier/Lee counties total output was $3.1 million.

Total Income and Number of Jobs. For estimating total income and jobs, we used the ratios of total income by place of work to total output and total income by place of work to number of jobs from English et al, 1996 for Monroe County. These ratios are presented in footnotes 4 and 5 on Table 2.13. For Monroe County, total income from TERSA catch was about $7.3 million which supported an estimated 319 jobs. For Collier/Lee counties, total income generated was about $1.9 million which supported an estimated 85 jobs. Given our estimate of 270 captain and crew that directly fish in the TERSA, and a total number of jobs supported in Monroe and Collier/Lee counties of 404, translates into an estimate of 134 jobs created through the multiplier process.

Summary: **Across all three counties, we estimate that commercial fishing catch from the TERSA generated harvest revenue to commercial fishing operations of about $6.9 million which generated an estimated total output of almost $15 million, a total income of about $9.3 million and an estimated 404 jobs.**

Table 2.12. Economic Impact of Tortugas Study Area Commercial Fishery on Monroe County, 1997

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	3,892,501	922,033	82,861	882,984	5,780,379
Wholesale Margin[1]					
a. Exported	1,296,203	199,159	22,538	492,705	2,010,605
b. Keys Retail	43,207	14,937	1,690	16,424	76,258
c. Keys Restaurant	100,816	34,853	3,944	38,322	177,934
Keys Retail Margin	47,995	59,369	5,629	12,874	125,867
Keys Restaurant Margin	959,731	421,483	39,966	257,435	1,678,615
Total Primary Output[2]	6,340,452	1,651,834	156,629	1,700,744	9,849,658
Total Output[3]	7,608,542	1,982,201	187,955	2,040,892	11,819,590
Total Income[4]	4,717,296	1,228,964	116,532	1,265,353	7,328,146
Number of Jobs[5]	205	54	5	55	319

1. Margins = (harvest revenue times percent of catch landed in Monroe County) times mark-up margins. See Table 2.12 for percent of catch landed in Monroe County and mark-up margins.
2. Total Primary Output is the sum of harvest revenue and the margins from wholesale, retail and Restaurant and exclude double-counting across market levels.
3. Total Output = Total Primary Output times multiplier for Monroe County of 1.2. This multiplier adjust Inputs of production that are purchased outside the county and includes indirect and induced effects of Spending.
4. Total Income = Total Output times the ratio of income to output for Monroe County of 0.62.
5. Number of Jobs = Total Income divided by the Total Income to jobs ratio for Monroe County of $22,697.

To put some of the above estimates into perspective, we can take the economic impact/contribution of TERSA catch landed in Monroe County and relate it to the entire Monroe County commercial fishery and the Monroe County economy. TERSA catch landed in Monroe County accounted for 9.34 percent of the total 1997 harvest revenue received by all commercial fishing operations in Monroe County. Total output generated from TERSA landings in Monroe County accounted for less that one-half of one percent (0.48%) of the entire Monroe County economy. Similarly, total income from TERSA landings accounted for 0.62% of Monroe County's total income, and employment from TERSA landings accounted for 0.63% of Monroe County's total employment. Although elimination of the entire TERSA commercial fishery would have devastating impact on the hundreds of people that directly and indirectly

depend on the TERSA commercial fishery for their livelihoods, it would have relatively little impact on the local economies of Monroe or Collier/Lee counties. Although we only detail the impacts on Monroe and Collier/Lee counties, the quantities of catch from Landings in all counties is included, thus overstating slightly the impacts in Monroe and Collier/Lee Counties. However, the impacted amounts for boundary alternatives are insignificant for other counties (see Appendix D, Comments 1 and 2).

Table 2.13. Economic Impact of the TERSA Commercial Catch on Collier and Lee Counties

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	261,730	8,668	834,216	1,104,614
Wholesale Margin[1]					
a. Exported	-	56,534	2,358	465,492	524,384
b. Retail	-	4,240	177	15,516	19,933
c. Restaurant	-	9,893	413	36,205	46,511
Retail Margin	-	16,853	589	12,163	29,604
Restaurant Margin	-	119,643	4,181	243,217	367,040
Total Primary Output[2]	-	468,893	16,384	1,606,809	2,092,086
Total Output[3]	-	703,339	24,577	2,410,214	3,138,129
Total Income[4]	-	436,070	15,237	1,494,333	1,945,640
Number of Jobs[5]	0	19	1	65	85

1. Margins = (harvest revenue times percent of catch landed in Collier and Lee Counties) times mark-up Margins. Percent of catch landed in Collier and Lee Counties is equal to Total TERSA catch minus that
   Landed in Monroe County. Monroe County market distributions and mark-up margins used for Collier and Lee Counties (See Table 2.12).
2. Total Primary Output is the sum of harvest revenue and the margins from wholesale, retail, and Restaurant and exclude double-counting across market levels.
3. Total Output = Total Primary Output times multiplier for Lee County of 1.5 from Adams (1992). This Multiplier adjusts for inputs of production that are purchased outside the county and includes indirect and induced effects of spending.
4. Total Income = Total Output times the ratio of income to output of 0.62.
5. Number of Jobs = Total Income divided by the Total Income to jobs ratio of $22,697.

Non-Market Economic Values from the TERSA Commercial Fishery

Market economic values or economic impact/contribution (e.g., output/sales, income and employment) describe the relationship of commercial fishing activity to local and regional economies. These are not considered by economists to be the appropriate inputs into benefit-cost analyses because it is assumed that labor and capital are completely mobile and the economy is at full employment (i.e., labor and capital could simply be used in producing other goods and services or could be used in producing the same or similar goods and services elsewhere). This assumption is rarely ever completely true, especially in the short-run. It may take time to modify capital or relocate and train labor for producing other goods and services and these actions are not without costs (adjustment costs). Formal benefit-cost analysis might not take adjustment costs fully into account and even if it did, the calculus is based on economic efficiency

concerns which ignores issues of equity or fairness. The changes in market economic values yields additional information about the possible extent of displacements and possibly about who is affected and may shed light on the issues of equity or fairness. That is the reason why we include such an extensive discussion of the market economic values here.

Non-market economic values are part of gross value of a good or service and represent a net value, which depending on the context of the analysis, represent net benefits or net costs. There are two general types of non-market values associated with products derived from commercial fishing activity: consumer's surplus and producer's surplus or economic rent.

Consumer's surplus is the amount of value consumer's have for a good or service over and above what they actually have to pay, given market supply of the good or service. It is a net value and in the context of the commercial fishery, consumer's surplus can be considered part of the net value for the fishery.

Producer's surplus is an amount a producer receives for a good or service over and above the cost of producing the good or service, including a normal return on investment. Producer's surplus is then a return on investment above what could be earned on alternative investments, and, in the context of the commercial fishery, would be considered an additional net value of the fishery. This return on investment above normal returns is often referred to as economic rent. Economic rents exist because no one owns the fishery and there is no price charged to the commercial fishermen for his catch (i.e., a free input of production).

Producer's surplus or economic rents in the commercial fishery are more complex than consumer's surplus. In general, producer's surplus or economic rents are thought not to exist in open access fisheries. The reason is that new entrants keep entering the fishery until rates of return on investment are driven down to normal rates of return. Many fishery management strategies are aimed at either increasing or maximizing economic rents. The logic here is an efficiency argument e.g., the same amount of fish could be caught with much less effort, thus too much labor and capital is wasted on the fishery. The reef fishery of the Gulf of Mexico has a permit system that currently requires a new entrant to buy out two current permit holders. This will limit the amount of investment in the fishery and potentially increase economic rents to those remaining in the fishery. Other factors may also lead to economic rents in the TERSA commercial fishery. The remoteness of the TERSA combined with the increasing docking costs in Key West reduce entry into the fishery and the lobster trap reduction program is also reducing effort in the TERSA fishery. Thus, there is some potential for the existence of economic rent in the TERSA fishery. However, as will be shown below, currently we estimate that there are no economic rents in the TERSA fishery.

Measurement of Non-market Economic Values of the TERSA Commercial Fishery

Consumer's Surplus. For consumer's surplus to exist in the commercial fisheries of the TERSA requires that restrictions on supply result in changes in prices to consumers. For changes in consumer's surplus to be significant requires significant changes in supply relative to demand. So to measure consumer's surplus or consumer's surplus changes, we must have an estimation of a demand function for each species/species group and an estimate of total market supply. TERSA catch relative to total market supply can serve as a good indicator of whether we could expect significant changes in consumer's surplus from changes in TERSA supply. Knowledge of the market demand function will allow us to estimate changes in consumer's surplus from changes in TERSA supply.

For 1997, the NMFS provides estimates of total domestic landings by species. Spiny lobsters from the TERSA represent almost 13 percent of total U.S. domestic landings. However, NMFS also reports that total supply measured as total U.S. domestic landings plus imports minus exports (e.g., total supply to U.S. consumers). TERSA spiny lobster catch is less than one percent (0.9475%) of total U.S. supply. For shrimp, TERSA catch was 0.3995 percent of U.S. landings and only 0.0775 percent of total

U.S. supply. ***Thus we should expect that changes in TERSA catch will have little to no effect on price and thus little to no change in consumer's surplus.***

For king mackerel and reef fish, the statistics are not as complete on total supply. For king mackerel, TERSA catch was 1.7378 percent of total U.S. landings. Imports are only reported for the total of all mackerels (king mackerel was only 6.62 percent of all U.S. landings of all mackerels). Total commercial landings of all mackerels was 83.78 million pounds and imports were 28.779 million pounds for a total supply of 112.559 million pounds. TERSA king mackerel catch was 0.115 percent of total mackerel landings and 0.086 percent of total mackerel supply. For reef fish, we used the total U.S. landings for all snappers and groupers. TERSA reef fish catch was 2.75 percent of U.S. landings of snapper/groupers and 0.89 percent of the total U.S. supply. ***Again, we should expect there to be little to no impact on prices and consumer's surplus from changes in TERSA king mackerel landings or reef fish landings.***

From the above, we can generally assume that since TERSA catch for all species/species groups is a small proportion of U.S. supply, consumer's surplus changes from changes in supply will be relatively small to nonexistent.

Table 2.14. Estimated Consumer's Surpluses from the Commercial Fisheries of the TERSA, 1997

Species/Species Group	TERSA Catch as % of U.S. Landings	TERSA Catch as % of U.S. Supply	Consumer's Surplus (1997 $)
King Mackerel[1]	1.74	N/A	$2,694 to $20,216
Shrimp[2]	0.40	0.08	$600,000 to $1.946 million
Lobster[3]	12.96	0.95	$4.561 to $4.696 million
Reef Fish[4]	2.75	0.89	$875,591

1. Range of values using demand equations from Vondruska (1999) and Easley et al (1993). See Appendix B for details of calculations.
2. Range of values derived from demand equations found in Gillig, Caps & Griffin (1998) and Keithly, Roberts and Ward (1993). See Appendix B for details of calculations.
3. Demand equation not found in literature for spiny lobster. Used range of Uncompensated flexibility's from Easley, Thurman and Park (1996) and Florida Landings and value data for 1997. See Appendix B for detailed calculations.
4. Derived from separate demand equations for Grouper, Snapper, Jacks, Tilefishes, and Porgies (porgies used for all other reef fish). Demand equations and consumer's surplus formulas from Easley, Thurman and Park (1996). See Appendix B for details of calculations.

We attempted to verify the above statement by researching the literature for estimations of demand functions for each of the species/species groups and assess whether enough information was available to estimate consumer's surplus. We found enough information for king mackerel, shrimp, and reef fish. For king mackerel, we estimate that if all of the TERSA catch was eliminated, the loss in consumer's surplus would be between $2,694 and $20,216 (in 1997 dollars). For shrimp, we estimate that if all TERSA catch were eliminated the loss in consumer's surplus would be between $600,000 and $1.946 million (in 1997 dollars). For Reef Fish, we estimate that if all TERSA catch were eliminated the loss in consumer's surplus

would be over $875 thousand. These results are summarized in Table 2.14. These are extremely small impacts as was expected given the small proportions that TERSA catch is to total supply. We could not find any estimated demand functions for spiny lobsters. To estimate consumer's surplus, we used the range of uncompensated flexibility's used for Reef Fish from Easley, Thurman and Park (1996) and Florida and TERSA landings and ex vessel value. Given spiny lobster's shares of total supply relative to shrimp, we might expect prices would change with elimination of the entire TERSA spiny lobster catch. We estimate that elimination of the total TERSA supply of lobster would result in a loss of consumer's surplus of between $4.561 million and $4.696 million. The demand equations, their sources and the consumer's surplus calculations are included in Appendix B.

Given that any proposed ecological reserve would only be some sub-set of this total, we do not expect there will be significant impacts on consumer's surplus. However, we do include estimation of the potential losses in consumer's surplus for all the species or species groups.

Producer's Surplus/Economic Rent. We did collect information from TERSA fishermen on trip costs and attempted to get other fixed costs and amount of investment, but the latter proved to be inadequate for estimating producer's surplus or economic rent. Instead, we were able to obtain cost and earnings studies for the Gulf of Mexico fisheries for spiny lobsters, shrimp, snapper/grouper, and king mackerel hook and line) from Kearney/Centaur (1988). These cost and earnings studies report the return to labor and capital to captain/owners for each fishery and normalized these estimates as a percent of ex vessel value or harvest revenue. Return to labor and capital is not good measure of producer's surplus or economic rent in an absolute sense. If producer's surplus or economic rents exist, they will be some portion of the return to labor and capital. So, for lack of better information, we will treat the measurement of the return to labor and capital as simply an index number when comparing the impacts of alternative proposed boundaries for the ecological reserve. Table 2.15 shows our estimates of the return to labor and capital for the TERSA commercial fishery.

We have some information that will allow us to assess whether producer's surplus or economic rents potentially exist in the TERSA fishery. From our survey of TERSA fishermen, the average investment in vessels per operation was $327,194. Given the population of 105-110 operations this would yield a range of investment from $34.3 to $36 million. We estimate the total return to labor and capital for TERSA fishermen's entire catch (i.e., catch in TERSA plus catch in zones 1-6) of $4.6 million. This would translate into a range of returns on investment of 12.8% to 13.4%. Alternatively, Milon et al (1997) estimate the replacement value of vessel and equipment for commercial fishermen in the Lower Keys to be $138,549 per operation. This would give us an estimate of investment of between $14.5 million and $15.2 million and a rate of return on investment between 30.3 % and 31.7%.

Table 2.15. Total Return to Labor and Capital from Commercial Catch in TERSA

Species/Species Group	Revenue[1]	Return to Labor and Capital as % of Revenue[2]	Return to Labor and Capital[3]
Lobster	3,892,501	36.20	1,409,085
Reef Fish	1,183,763	11.00	130,214
King Mackerel	91,529	19.30	17,665
Shrimp	1,717,200	21.50	369,198
Total	6,884,992	27.98	1,926,162

1. From Table 2.10.
2. From Kearney/Centaur (1984). Return to captain/owner for labor and

Capital of captain/owners. Does not include crew shares.
3. Revenue times percent of revenue that is return to labor and capital of Owner/captain.

Value Line puts the normal rate of return on investment between 16-20%. Adding a risk premium for commercial fishing of between 7-8% would yield a required normal rate of return on investment of between 23% and 28%. ***Given our estimated range of rates of return from above, plus the fact that rate of return on labor and capital overstate the rate of return (i.e., one should subtract out the return to labor), there does not appear to be any producer's surplus or economic rent in the commercial fishery of the TERSA.***

To add further support to the above conclusion, we reviewed a recent study by Milon, Larkin and Ehrhardt (1999). These researchers developed a bioeconomic model of the spiny lobster fishery. The authors develop the model to estimate the number of lobster traps that would maximize the profits or economic rents to the lobster fishery. An important finding of this study is that the current number of traps in the spiny lobster fishery are close to the open access equilibrium despite the enormous reduction of traps since 1992. At the open access equilibrium there is zero economic rent. The report further concludes that the marginal benefits of reducing the number of traps will not be forthcoming until the number of traps is reduced below 400,000. In fiscal year 1997-98, FMRI reports there were 604,920 lobster trap certificates with 428,411 in Monroe County. So even in the fishery most likely for economic rents to exist in the TERSA, we conclude there are no economic rents.

Boundary Analysis

Boundary Analysis Methodology. In performing the boundary analysis, for the each alternative, the impact estimates are broken out by "within the FKNMS boundary" and "outside the FKNMS boundary." No commercial fishing is currently allowed in the DTRO so these grid cells are 'true' zeroes in the analysis. Before breaking out the impact, the status of each grid cell (i.e. inside or outside of the boundary) had to be determined. Two methods were considered to carry out this task: the "centroid method" and the "intersection method." The centroid method characterizes a grid cell as within a boundary if the centroid (e.g. center point) of the cell is within the boundary. The intersection method characterizes a grid cell as within a boundary if any part of the cell is intersected by the boundary. The centroid method was selected because it was more consistent with how the data was collected (i.e. 1 nm^2 grid cells was the finest resolution).

The interpretation of the estimates provided in this analysis is critical to understanding the "true" impact of the various alternatives proposed for the Tortugas Ecological Reserve. The estimates from our geographic information system (GIS) analysis for the different boundary alternatives are simply the sum of each measurement within the boundaries for a given alternative. The estimates therefore represent the **maximum total potential loss from displacement of the commercial fishing activities**. This analysis ignores possible mitigating factors and the possibility of net benefits that might be derived if the proposed ecological reserve has replenishment effect. Although we don't have the ability to quantify either the extent of the mitigating factors or the potential benefits from replenishment we will discuss these as well as other potential benefits (Chapter 3) of the proposed ecological reserve after we have presented and discussed the maximum potential losses from displacement of the current commercial fisheries.

The boundary analysis is driven by the catch summed across grid cells within each boundary alternative. The set of relationships, measures and methods described in the overview are then used to translate catch into estimates of market and non-market economic values potentially impacted. These estimates are broken-down by area both inside and outside FKNMS boundaries and are done by species. Table 2.16 shows the results for catch for each alternative. Catch for the total TERSA is also presented to allow assessment of the proportion of the TERSA fishery potentially impacted by each alternative.

Table 2.16. TERSA Catch Potentially Lost from Displacement, 1997

Alternative/Area	Species/Species Group (Pounds)/Percent[1]							
	King Mackerel		Lobster		Reef Fish		Shrimp	
TERSA	**96,346**		**937,952**		**574,642**		**715,500**	
Inside FKNMS	77,285	(80.22%)	568,399	(60.60%)	293,374	(51.05%)	183,262	(25.61%)
Outside FKNMS	19,061	(19.78%)	369,553	(39.40%)	281,268	(48.95%)	532,238	(74.39%)
Alternative II	**4,057**		**56,625**		**74,494**		**7,940**	
Inside FKNMS	4,057	(100.00%)	56,625	(100.00%)	74,494	(100.00%)	7,940	(100.00%)
Outside FKNMS	-	(0.00%)	-	(0.00%)	-	(0.00%)	-	(0.00%)
Preferred Alternative	**13,489**		**108,639**		**116,642**		**58,374**	
Inside FKNMS	4,057	(30.08%)	56,802	(52.29%)	74,494	(63.87%)	7,940	(13.60%)
Outside FKNMS	9,432	(69.92%)	51,837	(47.71%)	42,148	(36.13%)	50,434	(86.40%)
Alternative IV	**14,999**		**153,778**		**161,997**		**58,374**	
Inside FKNMS	5,568	(37.12%)	101,940	(66.29%)	119,849	(73.98%)	7,940	(13.60%)
Outside FKNMS	9,431	(62.88%)	51,838	(33.71%)	42,148	(26.02%)	50,434	(86.40%)
Alternative V	**14,999**		**164,908**		**169,907**		**73,427**	
Inside FKNMS	5,568	(37.12%)	101,940	(61.82%)	119,849	(70.54%)	7,940	(10.81%)
Outside FKNMS	9,431	(62.88%)	62,968	(38.18%)	50,058	(29.46%)	65,487	(89.19%)

1. Percents of catch inside and outside FKNMS in parentheses.

The alternatives are ordered according to size and potential impact. Alternative I is the "No Action" alternative. Alternative II is the "Least Protective" alternative. Alternative III is the "Preferred Alternative". Alternatives IV and V are the largest and "Most Protective" alternatives. For catch, generally the higher the alternative number the greater the potential impact on catch, except for king mackerel and shrimp. Potential impact on king mackerel catch is the same for both alternatives IV and V and, the potential impact on shrimp catch is the same for the preferred alternative (III) and alternative IV.

Both the market and non-market economic values potentially lost from displacement for each alternative, except the "no action" alternative (I), are summarized in Table 2.17. Appendix A, includes greater detail by species/species groups, and for the market economic values, separate estimates for Monroe and Collier/Lee counties.

Table 2.17. Maximum Potential Losses to the Commercial Fisheries from Displacement

Area/Measure	Total TERSA	Alternatives: Alternative II	Preferred Alternative	Alternative IV	Alternative V
Total TERSA					
Market[1]					
Harvest Revenue	$ 6,884,992	$ 411,632	$ 843,583	$ 1,126,237	$ 1,224,849
Total Output	$ 14,957,717	$ 865,819	$ 1,817,843	$ 2,400,730	$ 2,621,627
Total Income	$ 9,273,785	$ 536,808	$ 1,127,063	$ 1,488,453	$ 1,625,409
Total Employment	404	23	49	65	71
Non-market					
Consumer's Surplus[2]	$ 7,537,781	$ 473,097	$ 879,973	$ 1,103,808	$ 1,239,587
Producer's Surplus[3]	$ -	$ -	$ -	$ -	$ -
Return to Labor & Capital[4]	$ 1,926,162	$ 106,789	$ 221,968	$ 300,599	$ 326,880
Inside FKNMS					
Market					
Harvest Revenue	$ 3,476,456	$ 411,632	$ 411,632	$ 694,284	$ 694,284
Total Output	$ 7,292,387	$ 865,819	$ 865,819	$ 1,448,700	$ 1,448,700
Total Income	$ 4,521,280	$ 536,808	$ 536,808	$ 898,194	$ 898,194
Total Employment	197	23	23	39	39
Non-market					
Consumer's Surplus	$ 3,890,933	$ 473,097	$ 473,097	$ 696,932	$ 696,932
Producer's Surplus	$ -	$ -	$ -	$ -	$ -
Return to Labor & Capital	$ 1,029,118	$ 106,789	$ 106,789	$ 185,420	$ 185,420
Outside FKNMS					
Market					
Harvest Revenue	$ 3,408,536	$ -	$ 431,951	$ 431,953	$ 530,565
Total Output	$ 7,665,330	$ -	$ 952,024	$ 952,030	$ 1,172,927
Total Income	$ 4,752,505	$ -	$ 590,255	$ 590,259	$ 727,215
Total Employment	207	-	26	26	32
Non-market					
Consumer's Surplus	$ 3,646,848	$ -	$ 406,876	$ 406,876	$ 542,655
Producer's Surplus	$ -	$ -	$ -	$ -	$ -
Return to Labor & Capital	$ 897,044	$ -	$ 115,179	$ 115,179	$ 141,460

1. Market economic measures include impacts on Monroe County and Collier/Lee counties. See Appendix A, Tables A.6 – A.11 for details by species and counties.
2. Maximum values from each species were used when range of estimates was generated from multiple demand equations. See Appendix B for detailed calculations by species and alternatives.
3. Producer's surplus or economic rents were assumed to be zero for two reasons. First, all fisheries, except spiny lobsters, are open access fisheries and therefore economic rents would be zero i.e., firms are earning only normal rates of return on investment. Second, even using total return to labor & capital, which overstates return on investment, does not yield rates of return on investment above normal rates of return.
4. Return to Labor & Capital is not a non-market value but would include rent if it existed.

Alternative I: No Action

The no action alternative simply means that the proposed Tortugas Ecological Reserve and corresponding no take regulations would not take place. The no action alternative has a simple interpretation in that any costs of imposing the no take regulations, for any given alternative with no take regulations, would be the benefits of the no action alternative. That is, by not adopting the no take regulations, the costs are avoided. Similarly, any benefits from imposing the no take regulations, for any given alternative with no take regulations, would be the costs of the no action alternative. That is, by not

adopting the no take regulations, the costs are the benefits lost by not adopting the no take regulations. Said another way, the opportunities lost. The impacts of the no action alternative can only be understood by comparing it to one of the proposed alternatives. Thus the impacts of the no action alternative can be obtained by reading the impacts from any of the proposed alternatives in reverse.

Alternative II

Market Economic Values. This alternative could potentially impact 4.2 % of the catch of King Mackerel, 6 % of the lobster catch, 12.96 % of the Reef Fish catch, and 1 % of the shrimp catch in the TERSA. This would lead to a reduction in about $411 thousand in harvest revenue or 6 % of the TERSA harvest revenue. This reduction in revenue would result in a reduction of 5.8 % of total output, income and employment generated by the TERSA fishery. Since this alternative was restricted to reside within FKNMS current boundaries, the impacts are all inside FKNMS boundaries. Although these impacts might seem significant to those firms that might potentially be impacted, the overall impact on the local economies would be so small they would not be noticed. Harvest revenue potentially impacted was only 0.67 % of all harvest revenue of catch landed in Monroe County. In addition, this lost revenue would translate (accounting for the multiplier affects) into only fractions of a percent of the total Monroe County economy; 0.035 % of total output, 0.046 % of total income and 0.045% of total employment.

Non-market Economic Values. For all species/species groups, we estimate that this alternative could result in a potential loss of over $473 thousand in consumer's surplus. This was 6.28 % of the consumer's surplus generated by the entire TERSA. Although producer's surplus or economic rents are estimated to be zero, about 5.54 % of the return to labor and capital of the TERSA fishery is potentially impacted by this alternative.

Preferred Alternative (III)

Market Economic Values. This alternative could potentially impact 14 % of the catch of King Mackerel, 11.58% of the lobster catch, 20.30 % of the Reef Fish catch, and 8.16 % of the shrimp catch in the TERSA. This would lead to a reduction in about $844 thousand in harvest revenue or 12.26 % of the TERSA harvest revenue. This reduction in revenue would result in a reduction of 12.16 % of total output, income and employment generated by the TERSA fishery. The impacts are split almost evenly between the areas inside and outside FKNMS boundaries. Although these impacts might seem significant to those firms that might potentially be impacted, the overall impact on the local economies would be so small they would not be noticed. Harvest revenue potentially impacted was only 1.16% of all harvest revenue of catch landed in Monroe County. In addition, this lost revenue would translate (accounting for the multiplier affects) into only fractions of a percent of the total Monroe County economy; 0.0596% of total output, 0.0779 % of total income and 0.0785% of total employment.

Non-market Economic Values. For all species/species groups, we estimate that this alternative could result in a potential loss of about $880 thousand in consumer's surplus. This was 11.7 % of the consumer's surplus generated by the entire TERSA. Whereas the market economic values were almost evenly split inside and outside the FKNMS, 53.76 % of the consumer's surplus potentially impacted is from inside the FKNMS boundaries. This is due to the distributions of lobster and reef fish catch where a higher proportion of the potentially impacted catch come from inside FKNMS boundaries, whereas the distributions of shrimp and king mackerel come largely form outside the FKNMS boundaries.

Although producer's surplus or economic rents are estimated to be zero, about 11.5% of the return to labor and capital of the TERSA fishery is potentially impacted by this alternative. The distribution inside versus outside the FKNMS boundaries follows that of the market economic values with 48 % from catch inside the FKNMS.

Alternative IV

Market Economic Values. This alternative could potentially impact 15.57 % of the catch of King Mackerel, 16.4 % of the lobster catch, 28.19 % of the Reef Fish catch, and 8.16 % of the shrimp catch in the TERSA. This would lead to a reduction in about $1.126 million in harvest revenue or 16.45 % of the TERSA harvest revenue. This reduction in revenue would result in a reduction of 16.05 % of total output, income and employment generated by the TERSA fishery. About 61.65 % of the harvest revenue and 60.34 % of the output, income and employment impacts would come from catch displaced from within FKNMS boundaries. Although the impacts might seem significant to those firms that might potentially be impacted, the overall impact on the local economies would be so small they would not be noticed. Harvest revenue potentially impacted was only 1.82% of all harvest revenue of catch landed in Monroe County. In addition, this lost revenue would translate (accounting for the multiplier affects) into only fractions of a percent of the total Monroe County economy; 0.0968% of total output, 0.127 % of total income and 0.1281% of total employment.

Non-market Economic Values. For all species/species groups, we estimate that this alternative could result in a potential loss of about $1.1 million in consumer's surplus. This was 14.64 % of the consumer's surplus generated by the entire TERSA. 63.14 % of the consumer's surplus potentially impacted is from catch from inside the FKNMS boundaries. This is due to the distributions of lobster and reef fish catch where a higher proportion of the potentially impacted catch come from inside FKNMS boundaries, whereas the distributions of shrimp and king mackerel come largely form outside the FKNMS boundaries.

Although producer's surplus or economic rents are estimated to be zero, about 15.6 % of the return to labor and capital of the TERSA fishery is potentially impacted by this alternative. The distribution inside versus outside the FKNMS boundaries follows that of the market economic values with 61.68 % from catch inside the FKNMS.

Alternative V

Market Economic Values. This alternative could potentially impact 15.57 % of the catch of King Mackerel, 17.58 % of the lobster catch, 29.57 % of the Reef Fish catch, and 10.26 % of the shrimp catch in the TERSA. This would lead to a reduction in about $1.224 million in harvest revenue or 17.89 % of the TERSA harvest revenue. This reduction in revenue would result in a reduction of 17.5 % of total output, income and employment generated by the TERSA fishery. About 56.68 % of the harvest revenue and 55.26 % of the output, income and employment impacts would come from catch displaced from within FKNMS boundaries. Although the impacts might seem significant to those firms that might potentially be impacted, the overall impact on the local economies would be so small they would not be noticed. Harvest revenue potentially impacted was only 1.98 % of all harvest revenue of catch landed in Monroe County. In addition, this lost revenue would translate (accounting for the multiplier affects) into only fractions of a percent of the total Monroe County economy; 0.106 % of total output, 0.138 % of total income and 0.1399 % of total employment.

Non-market Economic Values. For all species/species groups, we estimate that this alternative could result in a potential loss of about $1.24 million in consumer's surplus. This was 16.4 % of the consumer's surplus generated by the entire TERSA. 56.2 % of the consumer's surplus potentially impacted is from catch from inside the FKNMS boundaries. This is due to the distributions of lobster and reef fish catch where a higher proportion of the potentially impacted catch come from inside FKNMS boundaries, whereas the distributions of shrimp and king mackerel come largely form outside the FKNMS boundaries.

Although producer's surplus or economic rents are estimated to be zero, about 16.97 % of the return to labor and capital of the TERSA fishery is potentially impacted by this alternative. The distribution inside versus outside the FKNMS boundaries follows that of the market economic values with 56.7 % from catch inside the FKNMS.

Profiles of Fishermen Potentially Impacted

In the overview section, a profile of TERSA fishermen was given with a comparison with other commercial fishermen in Monroe County (Table 2.6). Here we compare the profiles of those potentially impacted by each alternative. The profiles are summarized in Table 2.18. Statistical tests were performed comparing the sample distributions for the groups that fished within each boundary alternative as compared with TERSA fishermen as a whole. Except for the number of fishing operations potentially impacted, the only significant differences for all alternatives were in ***membership in organizations and fish house usage.***

In terms of memberships in organizations, the fishermen potentially impacted by all alternatives had significantly lower participation rates in the Conch Coalition, the Organized Fishermen of Florida (OFF) and in the Monroe County Commercial Fishermen, Inc. (MCCF), but had a significantly higher participation rates in environmental organizations and the Chambers of Commerce. Fish house usage was significantly lower for those fishermen potentially impacted by all alternatives.

Fishermen potentially impacted by alternative II were the only group that was significantly different for any other characteristics listed in Table 2.18. These fishermen had less experience fishing in Monroe County than the general TERSA fishermen, however they were not significantly different with respect to years fishing in the TERSA. Fishermen potentially impacted by alternative II also earned a significantly lower proportion of their income from fishing than the general TERSA fishermen, however they earned a significantly higher proportion of their income from fishing within the TERSA than the general TERSA fishermen.

Fishermen potentially impacted by alternative II were also significantly different from the general TERSA fishermen in the distribution of their primary hauling port. A significantly higher proportion of those potentially impacted by alternative II used Key West/Stock Island and Tavenier than the general TERSA fishermen, and they used Big Pine Key, Marathon and Naples/Ft. Myers significantly less than the general TERSA fishermen.

Fifty-one (51) or 57 percent of the sampled fishing operations could be potentially impacted by alternative II followed by 64 operations or 71 percent for the preferred alternative, and 65 operations or 72 percent for both alternatives IV and V. Twenty-four (24) of the 28 or 86 percent of all the lobster operations could be potentially impacted by alternative II, while 27 of the 28 lobster operations or 96 percent are potentially impacted by alternatives III, IV, and V. Six (6) of the 18 or 33.3 percent of the shrimp operations are potentially impacted by alternative II, while the preferred alternative could potentially impact 15 of 18 or 83 percent of the shrimp operations. Alternatives IV and V could potentially impact 14 of the 18 or 78 percent of the shrimp operations. Fifteen (15) of the 16 king mackerel operations could be potentially impacted by alternative II, while alternatives III, IV and V could potentially impact all 16 of the king mackerel operations. Thirty-seven (37) of the 42 or 88 percent of the reef fish operations could be potentially impacted by alternative II, while 40 or 95 percent of the reef fish fishing operations could be potentially impacted by the preferred alternative. Alternatives IV and V could potentially impact all 42 reef fish operations.

Other Potential Costs and Mitigating Factors – Are the Potential Losses Likely ?

In the above GIS-based analysis, we constantly referred to the impacts as "***potential losses***". We also referred to them as the "***maximum potential losses***". There is the possibility that there could be an additional cost not discussed but which cannot be quantified, that is, crowding and the resulting conflicts among users forced to compete in a smaller area. There are also several factors that could mitigate all the potential losses and further there is a possibility that there ***might not be any losses at all***. It is quite possible that there ***might be actual net benefits*** to even the current displaced users. Below the issue of crowding costs and the mitigating factors and potential for beneficial outcomes are discussed in qualitative terms because it is not possible for us to quantify them. We discuss two mitigating factors and how likely they might mitigate the potential losses from displacement and further how this might differ for each of the alternatives.

Crowding. As we have shown above, each of the alternatives will result in a certain amount of displacement. Displacement of commercial fishing activity is a certainty under all alternatives, except

alternative I, the no action alternative. If this displacement results in the activity being transferred to other sites, there is a potential for crowding effects. Crowding effects could raise the costs of fishing, both private costs to each fishing operation and social costs in resolving conflicts. Crowding conflicts were one

Table 2.18. Profile of TERSA Fishermen Compared to Other Keys Fishermen

	TERSA (%)	Alternative II	Preferred Alternative	Alternative IV	Alternative V
			Age		
18-30	13.3	19.6	15.6	15.4	15.4
31-40	18.9	19.6	18.8	20.0	20.0
41-50	36.7	29.4	34.4	33.8	33.8
51-60	20.0	21.6	21.9	21.5	21.5
Over 60	11.1	9.8	9.4	9.2	9.2
			Years of Fishing in Monroe		
Less than one year	1.1	**2.0**	1.6	1.5	1.5
1-5 years	6.7	**9.8**	7.8	7.7	7.7
6-10 years	12.4	**13.7**	12.5	12.3	12.3
11-20 years	16.9	**19.6**	17.2	18.5	18.5
21 or more years	62.9	**54.9**	60.9	60.0	60.0
			Years of Fishing in TERSA		
1-5 years	10.1	9.8	10.9	10.8	10.8
6-10 years	25.8	25.5	20.3	21.5	21.5
11-20 years	16.9	17.6	17.2	18.5	18.5
21 or more years	47.2	47.1	51.6	49.2	49.2
			Race/Ethnicity		
Anglo-American	76.7	74.5	78.1	78.5	78.5
Hispanic	21.1	25.5	20.3	20.0	20.0
African-American	2.2	0.0	1.6	1.5	1.5
			Membership in Organizations		
Conch Coalition	7.0	**3.9**	**3.1**	**3.1**	**3.1**
OFF	12.0	**9.8**	**7.8**	**7.7**	**7.7**
MCCF	38.0	**23.5**	**21.9**	**21.5**	**21.5**
Environmental	2.0	**3.9**	**4.7**	**4.6**	**4.6**
Chambers of Commerce	303.0	**2.0**	**4.7**	**4.6**	**4.6**

Table 2.18. (Continued)

	TERSA (%)	Alternative II	Preferred Alternative	Alternative IV	Alternative V
			Occupation		
Full-time Commercial Fishing	87.8	84.3	85.9	86.2	86.2
Part-time Commercial Fishing	1.1	2.0	1.6	1.5	1.5
Charter Boat (sell some catch)	11.1	13.7	12.5	12.3	12.3
			Income		
Percent Income from Fishing	89.1	**84.3**	87.3	87.5	87.5
Percent Income from Fishing in TERSA	44.7	**51.2**	46.8	45.9	45.9
			Family Members Supported		
1 (Myself)	19.3	17.0	15.5	16.9	16.9
2	28.9	27.7	29.3	27.1	27.1
3	22.9	29.8	27.6	28.8	28.8
4 or more	28.9	25.5	27.6	27.2	27.2
			Primary Hauling Port		
Key West/Stock Island	74.4	**82.4**	75.0	72.3	72.3
Big Pine Key	4.4	**3.9**	4.7	4.6	4.6
Marathon	3.3	**0.0**	0.0	1.5	1.5
Tavernier	2.2	**3.9**	3.1	3.1	3.1
Naples/Ft. Myers	15.6	**9.8**	17.2	18.5	18.5
Fish House Usage (% Yes)	41.1	**35.3**	**35.9**	**36.9**	**36.9**
Number in Sample	90	51	64	65	65
Lobster Operations	28	24	27	27	27
Shrimp Operations	18	6	15	14	14
King Mackerel Operations	16	15	16	16	16
Reef Fish Operations	42	37	40	42	42

1. Numbers in bold identify statistically significant differences compared to total TERSA.
Kolgromov-Smirnoff two-sample test at 5 percent level of significance.

of the issues mentioned when the State of Florida created the lobster trap certificate program which was designed to reduce the number of lobster traps. If fishing stocks outside the protected area are already fished to their limits (i.e., limits of sustainable harvests), then displacement could also lead to adverse stock effects and a lower level of catch from all commercial fisheries. Crowding effects would represent a potential costs not accounted for in our above GIS-based analysis and the potential for the existence of crowding effects would vary by alternative. Whether crowding effects are experienced will depend on the status of the fisheries outside the proposed protected area, the extent of displacement, the current knowledge and fishing patterns of the displaced fishermen, and other potential regulations. The trap reduction program is an example where crowding effects could be mitigated by making room for the displaced traps.

Relocation. If displaced commercial fishermen are simply able to relocate their fishing effort and they are able to partially or completely replace their lost catch by fishing elsewhere, then there might be less or no impact. However, the possibility exists that displacement, even if it does not result in lower overall catch, may result in higher costs. This would result in lower profits to fishing operations. Whether fishermen are able to relocate to other fishing sites and replace lost catch or avoid cost increases would depend, like with the issue of crowding, on the status of the fisheries outside the proposed protected area, the extent of the displacement, the current knowledge and fishing patterns of the displaced fishermen, and other potential regulations.

Long-term benefits from Replenishment Effects. Ecological reserves or marine reserves may have beneficial effects beyond the direct ecological protection from the sites themselves. That is, both the size and number of fish, lobster, and other invertebrates both inside and outside the reserves may increase i.e., the ***replenishment effect***. The quote from Davis 1998 summarizes what is currently known about marine reserves:

"…we found 31 studies that tested whether protected areas had an effect on the size, reproductive output, diversity, and recruitment of fish in adjacent areas.

Fisheries targeted species were two to 25 times more abundant in no-take areas than in surrounding areas for fish, crustaceans, and mollusks on coral and temperate reefs in Australia, New Zealand, the Philippines, Japan, Kenya, South Africa, the Mediterranean Sea, Venezuela, Chile, and the United States (California, Florida and Rhode Island). Mean sizes of fished species protected in no-take zones were 12 to 200 percent larger than those in surrounding areas for all fishes studied and in 75 to 78 percent of the invertebrates.

Eighty-six percent of the studies that tested fishery yields found that catches within three kilometers of the marine protected areas were 46 to 50 percent higher than before no-take zones were created. It is clear that fishers all over the world believe no-take zones increase yields because they fish as close to the boundaries as possible."

The long-term benefits from the reserve could offset any losses from displacement and may also result in long-term benefits and no costs (net benefits) to commercial fishermen that would be displaced by a proposed reserve. Again, this conclusion may vary by alternative.

Alternative II

Crowding and Relocation. For the lobster fishery, it appears that the lobster trap reduction program could fully mitigate the potential for crowding costs. We estimate that this alternative would displace 2,228 traps. A ten percent reduction in traps in the TERSA would provide space for 3,690 traps. Further, lobster fishermen in the TERSA only catch 68 percent of their lobsters from the TERSA (Table 2.8). Thus, lobster fishermen are knowledgeable about fishing in other areas of the Keys where they might move their displaced traps. Thus, we conclude that under this alternative their would be no crowding costs for lobsters

and we expect they will be able to replace catch from other areas. **Thus, for lobsters, the potential economic losses identified in Table 2.17 are not likely to occur under alternative II.**

Crowding is not an issue for King Mackerel because they are a pelagic species and thus move around and catching them elsewhere is highly likely without interfering with other fishermen. Shrimp fishermen currently only catch ten percent of their total shrimp catch from the TERSA. Displacement of shrimp catch under the alternative II will only be about one percent of their TERSA catch and less than one percent of their total shrimp catch. It would seem highly likely that there will be no crowding costs from displacement and given the small amounts of catch impacted, it is highly likely that shrimp fishermen will be able to replace lost catch from other sites. However, some shrimp fishermen have said that they cannot replace lost catch from other sites. **Thus, for king mackerel, the potential economic losses identified in Table 2.17 are not likely to occur under the alternative II, but for shrimp the economic losses could range from zero to the maximum potential losses in Table 2.17**.

Reef Fish fishermen comprise the largest group of TERSA fishermen. Under alternative II, 37 of the sampled 42 fishermen would be impacted. Reef fishermen are knowledgeable of other fishing locations outside the TERSA. In 1997, they caught 52 percent of their reef fish from areas in the Keys outside the TERSA (Table 2.8). However, stocks of reef fish in the TERSA and throughout the Keys appear to be overfished. Alternative II displaces about 13 percent of the reef fish catch in the TERSA. **Given the status of reef fish stocks, we expect that the losses identified in Table 2.17 are likely to occur in the short-term until the benefits of replenishment could off-set these losses in the longer-term.**

Replenishment. We don't expect that there will be any replenishment benefits to king mackerel or shrimp. For lobsters and reef fish, replenishment benefits are expected. Davis (1998) provided an estimate that invertebrates and reef fish at other marine reserves had shown increases in yields of 46-50 percent within three kilometers of the protected areas. Also, from Schmidt et al, 1999, they identified 5 spawning areas in the western portion of the TERSA. Only one of the five spawning areas are located within alternative II boundaries and will be protected, and to thus support the replenishment effect. **For lobsters, we expect their to be long-term net benefits under alternative II to the commercial fishery of the TERSA. For reef fish, it is not clear whether the full 13 percent lost catch from displacement would be replaced from replenishment, but the costs of displacement would be mitigated and the losses expected to be less than the 13 percent reductions that are the basis for the losses calculated and presented in Table 2.17.**

Alternative III: Preferred Alternative

Crowding and Relocation. For the lobster fishery, there is some potential for crowding costs. We estimate that this alternative would displace 4,346 traps. A ten percent reduction in traps in the TERSA would provide space for 3,690 traps. However, if the remaining 656 traps are relocated to zones 1-3 in the Keys, there would be more than adequate space given the 10 percent reduction in traps that took place in Monroe County between 1997-98 and 1998-99 (475,094 to 428, 411). See FMRI, 1998. Lobster fishermen in the TERSA only catch 68 percent of their lobsters from the TERSA (Table 2.8). Thus, lobster fishermen are knowledgeable about fishing in other areas of the Keys where they might move their displaced traps. Thus, we conclude that under this alternative their would be no crowding costs for lobsters and we expect they will be able to replace catch from other areas. However, some shrimp fishermen have said that they cannot replace lost catch from other sites. **Thus, for king mackerel, the potential economic losses identified in Table 2.17 are not likely to occur under the preferred alternative, but for shrimp the economic losses could range from zero to the maximum potential losses in Table 2.17**.

Crowding is not an issue for King Mackerel because they are a pelagic species and thus move around and catching them elsewhere is highly likely without interfering with other fishermen. Shrimp fishermen currently only catch ten percent of their total shrimp catch from the TERSA. Displacement of shrimp catch under the preferred alternative will only be about eight percent of their TERSA catch and less than one percent of their total shrimp catch. It would seem highly likely that there will be no crowding costs from displacement and given the small amounts of catch impacted, it is highly likely that shrimp fishermen will

be able to replace lost catch from other sites. **Thus, for king mackerel and shrimp, the potential economic losses identified in Table 2.17 are not likely to occur under the preferred alternative**.

Reef Fish fishermen comprise the largest group of TERSA fishermen. Under the preferred alternative, 40 of the sampled 42 fishermen would be impacted. Reef fishermen are knowledgeable of other fishing locations outside the TERSA. In 1997, they caught 52 percent of their reef fish from areas in the Keys outside the TERSA (Table 2.8). However, stocks of reef fish in the TERSA and throughout the Keys appear to be overfished. The preferred alternative displaces 20 percent of the reef fish catch in the TERSA. **Given the status of reef fish stocks, we expect that the losses identified in Table 2.17 are likely to occur in the short-term until the benefits of replenishment could off-set these losses in the longer-term.**

Replenishment. We don't expect that there will be any replenishment benefits to king mackerel or shrimp. For lobsters and reef fish, replenishment benefits are expected. Davis (1998) provided an estimate that invertebrates and reef fish at other marine reserves had shown increases in yields of 46-50 percent within three kilometers of the protected areas. Also, from Schmidt et al, 1999, they identified 5 spawning areas in the western portion of the TERSA. Three of the five spawning areas are located within the preferred alternative boundaries and will be protected, thus bolstering the replenishment effect. **For lobsters, we expect their to be long-term net benefits under the preferred alternative to the commercial fishery of the TERSA. For reef fish, it is not clear whether the full 20 percent lost catch from displacement would be replaced from replenishment, but the costs of displacement would be mitigated and the losses expected to be less than the 20 percent reductions that are the basis for the losses calculated and presented in Table 2.17.**

Alternative IV

Crowding and Relocation. For the lobster fishery, there is some potential for crowding costs. We estimate that this alternative would displace 6,050 traps. A ten percent reduction in traps in the TERSA would provide space for 3,690 traps. However, if the remaining 2,360 traps are relocated to zones 1-3 in the Keys, there would be more than adequate space given the 10 percent reduction in traps that took place in Monroe County between 1997-98 and 1998-99 (475,094 to 428, 411). See FMRI, 1998. Lobster fishermen in the TERSA only catch 68 percent of their lobsters from the TERSA (Table 2.8). Thus, lobster fishermen are knowledgeable about fishing in other areas of the Keys where they might move their displaced traps. Thus, we conclude that under this alternative their would be no crowding costs for lobsters and we expect they will be able to replace catch from other areas. **Thus, for lobsters, the potential economic losses identified in Table 2.17 are not likely to occur under alternative IV.**

Crowding is not an issue for King Mackerel because they are a pelagic species and thus move around and catching them elsewhere is highly likely without interfering with other fishermen. Shrimp fishermen currently only catch ten percent of their total shrimp catch from the TERSA. Displacement of shrimp catch under alternative IV will only be about eight percent of their TERSA catch and less than one percent of their total shrimp catch. It would seem highly likely that there will be no crowding costs from displacement and given the small amounts of catch impacted, it is highly likely that shrimp fishermen will be able to replace lost catch from other sites. However, some shrimp fishermen have said that they cannot replace lost catch from other sites. **Thus, for king mackerel, the potential economic losses identified in Table 2.17 are not likely to occur under the alternative IV, but for shrimp the economic losses could range from zero to the maximum potential losses in Table 2.17**.

Reef Fish fishermen comprise the largest group of TERSA fishermen. Under alternative IV, all 42 of the sampled fishermen would be impacted. Reef fishermen are knowledgeable of other fishing locations outside the TERSA. In 1997, they caught 52 percent of their reef fish from areas in the Keys outside the TERSA (Table 2.8). However, stocks of reef fish in the TERSA and throughout the Keys appear to be overfished. Alternative IV displaces 28 percent of the reef fish catch in the TERSA. **Given the status of reef fish stocks, we expect that the losses identified in Table 2.17 are likely to occur in the short-term until the benefits of replenishment could off-set these losses in the longer-term.**

Replenishment. We don't expect that there will be any replenishment benefits to king mackerel or shrimp. For lobsters and reef fish, replenishment benefits are expected. Davis (1998) provided an estimate that invertebrates and reef fish at other marine reserves had shown increases in yields of 46-50 percent within three kilometers of the protected areas. Also, from Schmidt et al, 1999, they identified 5 spawning areas in the western portion of the TERSA. Four of the five spawning areas are located within the alternative IV boundaries and will be protected, thus bolstering the replenishment effect. **For lobsters, we expect their to be long-term net benefits under alternative IV to the commercial fishery of the TERSA. For reef fish, it is not clear whether the full 28 percent lost catch from displacement would be replaced from replenishment, but the costs of displacement would be mitigated and the losses expected to be less than the 28 percent reductions that are the basis for the losses calculated and presented in Table 2.17.**

Alternative V

Crowding and Relocation. For the lobster fishery, there is some potential for crowding costs. We estimate that this alternative would displace 6,487 traps. A ten percent reduction in traps in the TERSA would provide space for 3,690 traps. However, if the remaining 2,797 traps are relocated to zones 1-3 in the Keys, there would be more than adequate space given the 10 percent reduction in traps that took place in Monroe County between 1997-98 and 1998-99 (475,094 to 428, 411). See FMRI, 1998. Lobster fishermen in the TERSA only catch 68 percent of their lobsters from the TERSA (Table 2.8). Thus, lobster fishermen are knowledgeable about fishing in other areas of the Keys where they might move their displaced traps. Thus, we conclude that under this alternative their would be no crowding costs for lobsters and we expect they will be able to replace catch from other areas. **Thus, for lobsters, the potential economic losses identified in Table 2.17 are not likely to occur under alternative V.**

Crowding is not an issue for King Mackerel because they are a pelagic species and thus move around and catching them elsewhere is highly likely without interfering with other fishermen. Shrimp fishermen currently only catch ten percent of their total shrimp catch from the TERSA. Displacement of shrimp catch under alternative V will only be about ten percent of their TERSA catch and about one percent of their total shrimp catch. It would seem highly likely that there will be no crowding costs from displacement and given the small amounts of catch impacted, it is highly likely that shrimp fishermen will be able to replace lost catch from other sites. However, some shrimp fishermen have said that they cannot replace lost catch from other sites. **Thus, for king mackerel, the potential economic losses identified in Table 2.17 are not likely to occur under the alternative V, but for shrimp the economic losses could range from zero to the maximum potential losses in Table 2.17**.

Reef Fish fishermen comprise the largest group of TERSA fishermen. Under alternative V, all 42 of the sampled fishermen would be impacted. Reef fishermen are knowledgeable of other fishing locations outside the TERSA. In 1997, they caught 52 percent of their reef fish from areas in the Keys outside the TERSA (Table 2.8). However, stocks of reef fish in the TERSA and throughout the Keys appear to be overfished. Alternative V displaces 29 percent of the reef fish catch in the TERSA. **Given the status of reef fish stocks, we expect that the losses identified in Table 2.17 are likely to occur in the short-term until the benefits of replenishment could off-set these losses in the longer-term.**

Replenishment. We don't expect that there will be any replenishment benefits to king mackerel or shrimp. For lobsters and reef fish, replenishment benefits are expected. Davis (1998) provided an estimate that invertebrates and reef fish at other marine reserves had shown increases in yields of 46-50 percent within three kilometers of the protected areas. Also, from Schmidt et al, 1999, they identified 5 spawning areas in the western portion of the TERSA. Four of the five spawning areas are located within the alternative V boundaries and will be protected, thus bolstering the replenishment effect. **For lobsters, we expect their to be long-term net benefits under alternative V to the commercial fishery of the TERSA. For reef fish, it is not clear whether the full 29 percent lost catch from displacement would be replaced from replenishment, but the costs of displacement would be mitigated and the losses expected to be less than the 29 percent reductions that are the basis for the losses calculated and presented in Table 2.17.**

End Notes

1. Pelagics include dolphin, mackerel (Spanish, cero, and King), sharks, swordfish, tuna and wahoo.
2. 93 interviews were actually completed but three of these were determined to not have fished in the TERSA and were therefore eliminated from both the sample and the population of commercial fishermen in the TERSA. Ten of the SPL holders not completing the full interview were small shrimpers (40,000 – 60,000 pounds annually). They were estimated to catch about 10 percent of their total catches from the TERSA. Shrimpers told our researchers that about 10 percent of their catch from FMRI areas 2.0 and 2.9 come from the TERSA. Adding 50,000 pounds of shrimp to our sample's shrimp catch makes our sample's shrimp catch about 9.7 percent of the 1997-98 average of total shrimp catch from FMRI areas 2.0 and 2.9. Our sample then accounts for 90.03 percent of the 10 percent of shrimp catch reported in FMRI areas 2.0 and 2.9.
3. For reef fish, the research team determined that about half the reef fish caught from FMRI areas 2.0 and 2.9 were caught in the TERSA. Our sample of TERSA fishermen accounted for a little over 90 percent of this catch.
4. For King Mackerel and lobster, all the reported catch for FMRI areas 2.0 and 2.9 were assumed to be caught within the TERSA. Our sample of TERSA fishermen accounted for over 93 percent of the lobster and almost 93 percent of the King Mackerel catch in FMRI areas 2.0 and 2.9.
5. It would have been preferable to have had a longer time series of catches from which to estimate a representative year of catch., given the range of natural fluctuations in fish stocks. However, the FMRI catch data by area would not support such an approach. In 1994, about two-thirds of all catch was reported as "unknown" as to the area of catch. This improved to about 37 percent in 1995, to 3.7 percent in 1996 and to 0.1 percent in 1997. If we look at Monroe County landings and value from NMFS (which is not by area where caught), 1997 was a relatively good year for the commercial fisheries. If anything, using 1997 might slightly overstate potential impacts from displacement.

Chapter 3
Other Potential Benefits

In both the recreational industry and the commercial fishery, we discussed the potential benefits to recreational and commercial fisheries from the replenishment effect of an ecological reserve. We also discussed the potential benefits to nonconsumptive recreational users. Here we discuss several of the most important benefits of an ecological reserve: nonuse economic values, scientific values, and education values.

Nonuse Economic Values. Nonuse or passive use economic values encompass what economists refer to as option value, existence value and other nonuse values. See Kopp and Smith (1993) for a detailed discussion. All nonuse economic values are based on the fact that people are willing to pay some dollar amount for a good or service they currently do not use or consume directly. In the case of an ecological reserve, they are not current visitors (users), but derive some benefit from the knowledge that the reserve exists in a certain state and are willing to pay some dollar amount to ensure that actions are taken to keep the reserve in that state.

Option value is a bit different from other nonuse economic values in that option value is a willingness to pay for the possibility of some future use. The concept of option value was first introduced by Weisbrod (1964). As argued by Weisbrod, an individual uncertain as to whether or not he will visit some unique site at some future point in time would be willing to pay a sum in excess of his consumer's surplus to assure that the site would be available in the future should he wish to visit it. Option value then is characterized by uncertainty of both future supply and future demand. Some have questioned whether option value is a legitimate economic value, Freeman (1993). But, the U.S. Environmental Protection Agency (EPA) still lists option value as a legitimate value to be included in intrinsic benefits when conducting benefit-cost analysis of proposed regulations mandated under the terms of Executive Order 12291.

Other nonuse values have traditionally been labeled according to motive e.g., existence value or bequeath value. The key distinctions between option value and other nonuse values is that the other nonuse values do not relate to any future use and uncertainty is not a factor. Existence value is an individual's willingness to pay a dollar amount to simply know that a resource will be protected in a given state. Bequeath value is an individual's willingness to pay a dollar amount to ensure the resource will be protected in a given state so one's heirs may have the opportunity to enjoy them. The motive themselves are unimportant as to the value's legitimacy, since, in economics, people's motives for their willingness to pay for any good or service is not questioned. Motives with respect to nonuse values are used simply to differentiate them from use values. Randall and Stoll (1983) has argued that when estimating nonuse economic values, nonuse economic values cannot be separated from use values for users of the resource. Methods available for estimating nonuse economic values are only capable of revealing "total value" which cannot be broken down into separate components of use and nonuse. Pure nonuse economic values can only be estimated for nonusers.

The terminology of "passive use" economic values has become more accepted when referring to nonuse economic values. This change in terminology grew out of the debate over the whether nonuse economic values could actually be measured. People must have some knowledge of the resource they are being asked to place a dollar value whether it is through a newspaper, magazine, television show, etc. People must first learn about the resource and it's current state and then must make a decision about what they would be willing to pay to ensure that the resource will be protected in that state. It is of key importance that the individuals are making this decision under their budget constraints. That is, willingness to pay is constrained by a person's income and wealth and the person is forced to make a budget allocation between spending for protection of the resource or on something else.[1]

To date there are no known studies that have estimated nonuse or passive use economic values for coral reefs or marine ecological reserves. However, Spurgeon (1992) has offered two sets of identifiable factors which will dictate the magnitude of nonuse or passive use economic values. First, nonuse economic values will be positively related to the quality, condition, and uniqueness of the ecosystem on a national or

global scale. Second, the size of population, standard of education, and environmental perception of people in the country owning or having jurisdiction over the ecosystem will be positively related to nonuse or passive use economic values. Thus, nonuse or passive use economic values are determined by both supply and demand conditions. The existence of many similar sites would reduce the value. Although Spurgeon limits his scope to the people in the country owning or having jurisdiction over the ecosystem, people from all over the world may have nonuse or passive use economic values for ecosystem protection in other countries. Debt for nature protection swaps being conducted by The Nature Conservancy in South America are just one example. Legitimacy of including the values of people from other countries is more a judicial concern than an economic one. In some judicial proceedings people from other countries might not have legal standing over issues of resource protection and their economic values may be eliminated from inclusion in the proceedings.

What we know about nonuse economic values. We searched the literature and found 19 studies in which nonuse economic values were estimated. Desvouges et al (1992) contained summaries of 18 of the 19 studies. The remaining study was by Carson et al (1992) on the Exxon Valdez Oil Spill. Sixteen (16) of the 18 studies found in Desvouges et al (1992) reported values (not adjusted for inflation) of $10 or more per household per year for a broad variety of natural resource protection efforts. Of the two (2) studies that reported values less than $10/household/year, one reported $3.80/household/year for adding one park in Australia and $5.20/household per year for a second park (these estimates were from a National sample of Australians). The other study that estimated nonuse economic values less than $10/household/year was a study of Wisconsin resident's willingness to pay for protecting bald eagles and striped shiners in the State of Wisconsin. For the bald eagle, nonuse economic values had an estimated range of $4.92 to $28.38/household/year, while for striped shiners the values ranged from $1.00 to $5.66/household/year. Total value ranged from $6.50 to $75.31/household/year.

Only two (2) of the 18 studies summarized in Desvouges et al (1992) used National samples of U.S. households, the others were limited to state or region populations. The Exxon Valdez Oil Spill Study (Carson et al, 1992) used a National sample of U.S. households. An important caveat is that the sample included only English speaking households and eliminated Alaskan residents. Alaskan residents were eliminated to limit the sample to primarily nonusers of Prince William Sound (site of the oil spill) and non English speaking households were eliminated because the researchers were not able to convert their questionnaires to other languages. The impact was that the sample represented only 90 percent of U.S. households.

Carson et al (1992) reported a median willingness to pay of $31 per household. The payment was a lump sum payment through income taxes and covered a ten year period. The funds would go into a trust fund to pay for equipment and other costs necessary to prevent a future accident like the Exxon Valdez in Prince William Sound. After 10 years, double hull tankers would be fully implemented and the need for the protection program would expire. Mean willingness to pay was higher and more variable to model specification than the median willingness to pay, so the authors argued that the median value was a conservative estimate. Applying the $31/household to only 90 percent of the U.S. population of households was also considered conservative since non English speaking people probably have positive nonuse economic values as do Alaskans.

Estimation of Nonuse Economic Values. Given what we know about nonuse economic values, we can develop a range of "conservative" (i.e., lower bound) estimates of nonuse or passive use economic values for an ecological reserve in the Tortugas. To do this requires the following assumptions and facts:

Assumptions:

1. One (1) percent of U.S. households would have some positive nonuse or passive economic use values for an ecological reserve in the Tortugas.
2. The one (1) percent of U.S. households would, on average, be willing to pay either $3/household/year, $5/household/year, or $10/houshold/year for an ecological reserve in the Tortugas.

Fact:

1. As of July 1, 1997, there were 113 million households in the U.S.

Using the above assumptions and the number of U.S. households in 1997, we can estimate a probable lower bound set of estimates for the nonuse or passive use economic values for the Tortugas Ecological Reserve.

	$3/household/year	$5/household/year	$10/household/year
1997 Annual Amount	$3.39 million	$5.65 million	$11.3 million
1997 Asset Value of Ecological Reserve @ 3% discount rate	$113 million	$188.3 million	$376.7 million

The 1997 annual willingness to pay for the ecological reserve would range between $3.39 million and $11.3 million, depending on the assumed willingness to pay per household. Since the ecological reserve would exist into the indefinite future (into perpetuity), we can also calculate an estimated range of the asset values of the ecological reserve based simply on nonuse economic value. This later estimation requires that we assume a constant annual willingness to pay (value per household does not change and/or the number of households does not change) and a real discount rate of 3% to convert future dollar amounts to their present value. Since we know population will increase in the future, this is again a conservative estimate. The asset value of an ecological reserve in the Tortugas for just nonuse economic value is estimated to be between $113 million to $376.7 million. The asset value represents what someone would be willing to pay today for the Tortugas Ecological Reserve to ensure the future annual flow of nonuse economic values.

If we simply compare the estimated annual nonuse economic values with the maximum potential losses to the displaced recreational users and commercial fisheries (losses in consumer's surplus and economic rents), the nonuse economic values would exceed the maximum potential losses to all current consumptive users under all the alternatives analyzed (Table 3.1). **Thus, there would be net national benefits to adopting any of the alternatives for the proposed Tortugas Ecological Reserve.**

Table 3.1 A Comparison of Nonuse Economic Values with Consumer's Surplus and Economic Rents from the Recreation Industry and Commercial Fisheries: Assuming Maximum Potential Losses and Without Considering Mitigating Factors

	Alternatives			
Industry/Range of Values	II	III Preferred	IV	V
Recreation Industry	$ 102,965	$ 127,029	$ 320,791	$ 381,108
Commercial Fisheries	$ 473,097	$ 879,973	$1,103,808	$ 1,239,587
Total	$ 576,062	$ 1,007,002	$1,424,599	$ 1,620,695
Nonuse Value				
Lowest	+	+	+	+
Mid-range	+	+	+	+
Highest	+	+	+	+

+ Means Nonuse Value exceeds the sum of recreational industry and commercial fishery maximum potential losses.

We would expect that nonuse economic values would be greater the larger the area protected. But as described earlier, we would also expect willingness to pay to be positively related to both the characteristics of those valuing the reserve and the characteristics of what they are asked to value. Since our estimates of nonuse economic values are based on an assumed range of values (at the lowest end of the distribution of values estimated in other studies), we are not able to compare the values of the different alternatives in dollar terms. However, following the suggestions of Spurgeon, we demonstrate the characteristics of the U.S. population that would support our statement that the above estimates would likely be lower bound estimates.

Factors Supporting Positive Nonuse Economic Value. We reviewed three studies based on National surveys of U.S. households that evaluated adults perceptions and concerns about the environment. Each of the surveys demonstrated that U.S. citizens have a high level of concern about the environment and believe the environment is threatened and requires action. In addition, one of the studies focused specifically on ocean related issues (SeaWeb, 1996) and found strong support for marine protected areas. Also, our assumption that only one (1) percent of U.S. households would be willing to pay for an ecological reserve would appear to be a conservative lower bound estimate since the Roper survey (Roper, 1990) indicated that in 1990 eight (8) percent of U.S. households made financial contributions to environmental organizations. Selected results from the three studies are summarized below.

Environmental Opinion Study, Inc. National sample of 804 households conducted 18-26 May 1991.

Identification with Environmental Label

	%
Strong Environmentalist	31
Weak Environmentalist	29
Lean Towards Environmentalism	30
Neutral	6
Anti-Environmentalist	4

Roper 1989 and 1990 National Surveys

1. Things the Nation Should Make a Major Effort on Now

	1989 (%)	1990 (%)
a. Trying to solve the problem of crime and drugs	78	88
b. Taking steps to contain the cost of health care	70	80
c. **Trying to improve the quality of the environment**	**56**	**78**
d. Trying to improve the quality of public school education	N//A	77
2. Contribute money to environmental groups	7	8

SeaWeb 1996. National Sample of 900 U.S. Households 10-15 May, 1996

1. Condition of the ocean	49% very important	38% somewhat important
2. Destruction of the ocean on Quality of Life		
a. Today	52% very serious	35% somewhat serious
b. 10 years from now	63% very serious	23% somewhat serious
3. Oceans threatened by human activity		82% agree
4. The federal government needs to do more to help protect the oceans		85% agree to strongly agree
5. Destruction of ocean plants/ animals		56% very serious problem
6. Overfishing by commercial fishermen		45% very serious problem

7. Deterioration of coral reefs	43% very serious problem
8. Protect sanctuaries where fishing, boating, etc, prohibited	62% strongly agree
9. Support efforts to set up Marine Sanctuaries	24% say they are almost certain to take this action
10. Marine sanctuaries where no human activity is permitted	19% say they are almost certain to take this action

The U.S. population is certainly a high income and highly educated population and ,as the results above predictably show, the U.S. population has a high environmental concern. However, since the characteristics of the people valuing the reserve would be constant (U.S. Households) across different proposed ecological reserve boundary alternatives, to differentiate among alternatives would require that we compare some measurements that would serve as indicators of the relative quality, condition and uniqueness of the proposed reserve across alternatives. Unfortunately, the information has not been compiled in a manner for us to do this at this time.

Scientific and Education Values. Ecological reserves provide a multitude of benefits. Sobel (1996) provides a long list of these benefits. Most of those benefits have been covered in Chapter 1 and 2 and in our discussion of nonuse economic benefits above. Scientific and education values were categorized by Sobel into those things a reserves provides that increase knowledge and understanding of marine systems. Sobel provides the following lists of benefits:

Scientific

- Provides long-term monitoring sites
- Provides focus for study
- Provides continuity of knowledge in undisturbed site
- Provides opportunity to restore or maintain natural behaviors
- Reduces risks to long-term experiments
- Provides controlled natural areas for assessing anthropogenic impacts, including fishing and other impacts

Education

- Provides sites for enhanced primary and adult education
- Provides sites for high-level graduate education

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Appendix A

Table A.1. Calculation of Consumer Surplus for Recreational Activities: Alternative 2

	Person-Days	User Value Per Person-Day[1]	Consumer Surplus
Total			
Summer (June - November)	728	$ 97	$ 70,600
Winter (December - May)	413	$ 77	$ 31,784
Total			$ 102,384
Diving for Lobsters			
Summer (June - November)	323	$ 97	$ 31,322
Winter (December - May)	138	$ 77	$ 10,656
Total			$ 41,977
Fishing			
Summer (June - November)	46	$ 97	$ 4,452
Winter (December - May)	148	$ 77	$ 11,407
Total			$ 15,859
Spearfishing			
Summer (June - November)	359	$ 97	$ 34,827
Winter (December - May)	126	$ 77	$ 9,721
Total			$ 44,548

1. From Leeworthy and Bowker, 1997.

Table A.2. Calculation of Consumer Surplus for Recreational Activities: Alternative 3 - Preferred Alternative

	Person-Days	User Value Per Person-Day[1]	Consumer Surplus
Total			
Summer (June - November)	796	$ 97	$ 77,217
Winter (December - May)	633	$ 77	$ 48,738
Total			$ 125,955
Diving for Lobsters			
Summer (June - November)	323	$ 97	$ 31,322
Winter (December - May)	138	$ 77	$ 10,656
Total			$ 41,977
Fishing			
Summer (June - November)	114	$ 97	$ 11,068
Winter (December - May)	368	$ 77	$ 28,361
Total			$ 39,429
Spearfishing			
Summer (June - November)	359	$ 97	$ 34,827
Winter (December - May)	126	$ 77	$ 9,721
Total			$ 44,548

1. From Leeworthy and Bowker, 1997.

Table A.3. Calculation of Consumer Surplus for Recreational Activities: Alternative 4

	Person-Days	User Value Per Person-Day[1]	Consumer Surplus
Total			
Summer (June - November)	2,119	$ 97	$ 205,551
Winter (December - May)	1,497	$ 77	$ 115,239
Total			$ 320,791
Diving for Lobsters			
Summer (June - November)	888	$ 97	$ 86,143
Winter (December - May)	381	$ 77	$ 29,306
Total			$ 115,449
Fishing			
Summer (June - November)	238	$ 97	$ 23,038
Winter (December - May)	767	$ 77	$ 59,033
Total			$ 82,071
Spearfishing			
Summer (June - November)	994	$ 97	$ 96,371
Winter (December - May)	349	$ 77	$ 26,900
Total			$ 123,271

1. From Leeworthy and Bowker, 1997.

Table A.4. Calculation of Consumer Surplus for Recreational Activities: Alternative 5

	Person-Days	User Value Per Person-Day[1]	Consumer Surplus
Total			
Summer (June - November)	2,509	$ 97	$ 243,416
Winter (December - May)	1,788	$ 77	$ 137,690
Total			$ 381,106
Diving for Lobsters			
Summer (June - November)	1050	$ 97	$ 101,806
Winter (December - May)	450	$ 77	$ 34,635
Total			$ 136,441
Fishing			
Summer (June - November)	287	$ 97	$ 27,823
Winter (December - May)	926	$ 77	$ 71,295
Total			$ 99,117
Spearfishing			
Summer (June - November)	1173	$ 97	$ 113,787
Winter (December - May)	412	$ 77	$ 31,761
Total			$ 145,548

1. From Leeworthy and Bowker, 1997.

Table A.5. Tortugas Commercial Fishing Landings 1997 By County (excluding Monroe) (FMRI Areas 2.0 & 2.9)

County	Species Group	Pounds	Value ($)	% of Value
Brevard (15)	Finfish	4,006	8,297	0.08
	Pelagics	0	0	0.00
	Reef Fish	4,006	8,297	0.08
	Invertebrates	0	0	0.00
	Shrimp	0	0	0.00
	Total	**4,006**	**8,297**	**0.08**
Broward (16)	Finfish	19,184	61,092	0.60
	Pelagics	9,907	43,439	0.43
	Reef Fish	9,277	17,652	0.17
	Invertebrates	0	0	0.00
	Shrimp	0	0	0.00
	Total	**19,184**	**61,092**	**0.60**
Collier (21)	Finfish	108,712	250,523	2.46
	Pelagics	92,016	236,983	2.33
	Reef Fish	16,696	13,539	0.13
	Invertebrates	441	2,151	0.02
	Shrimp	0	0	0.00
	Total	**109,153**	**252,674**	**2.48**
Dade (23)	Finfish	49	62	0.0006
	Pelagics	49	62	0.0006
	Reef Fish	0	0	0.00
	Invertebrates	2,391	9,875	0.10
	Shrimp	0	0	0.00
	Total	**2,440**	**9,937**	**0.10**
Franklin (29)	Finfish	0	0	0.00
	Pelagics	0	0	0.00
	Reef Fish	0	0	0.00
	Invertebrates	0	0	0.00
	Shrimp	6,739	16,307	0.16
	Total	**6,739**	**16,307**	**0.16**
Hillsborough (39)	Finfish	6	104	0.001
	Pelagics	6	104	0.001
	Reef Fish	0	0	0.00
	Invertebrates	36	149	0.001
	Shrimp	39,853	96,186	0.94
	Total	**39,895**	**96,439**	**0.95**

Table A.5. Tortugas Commercial Fishing Landings 1997 By County (excluding Monroe) (continued)

County	Species Group	Pounds	Value ($)	% of Value
Lee (46)	Finfish	1,184	2,417	0.02
	Pelagics	0	0	0.00
	Reef Fish	1,184	2,417	0.02
	Invertebrates	10,999	91,903	0.90
	Shrimp	3,601,924	8,663,004	84.99
	Total	**3,614,107**	**8,757,324**	**85.92**
Pinellas (62)	Finfish	257,252	526,154	5.16
	Pelagics	60,721	138,900	1.36
	Reef Fish	196,531	387,254	3.80
	Invertebrates	132	132	0.001
	Shrimp	136,727	337,528	3.31
	Total	**394,111**	**863,813**	**8.48**
St. Lucie (66)	Finfish	26,503	105,625	1.04
	Pelagics	26,085	105,191	1.03
	Reef Fish	418	435	0.004
	Invertebrates	0	0	0.00
	Shrimp	0	0	0.00
	Total	**26,503**	**105,625**	**1.04**
Sarasota (68)	Finfish	11,181	20,485	0.20
	Pelagics	0	0	0.00
	Reef Fish	11,181	20,485	0.20
	Invertebrates	110	454	0.005
	Shrimp	0	0	0.00
	Total	**11,291**	**20,939**	**0.21**
All Counties, except Monroe	Finfish	428,077	974,759	9.56
	Pelagics	188,784	524,681	5.15
	Reef Fish	239,293	450,078	4.41
	Invertebrates	14,109	104,664	1.03
	Shrimp	3,785,243	9,113,025	89.41
	Total	**4,227,429**	**10,192,448**	**100.00**

Table A.6. Total Harvest and Ex Vessel Value of Commercial Catch from TERSA

Total - TERSA					
Species	Pounds	%	$/lb.	Revenue	%
Lobster	937,952	40.35	4.15	3,892,501	56.54
Reef Fish	574,642	24.72	2.06	1,183,763	17.19
King Mackerel	96,346	4.14	0.95	91,529	1.33
Shrimp	715,500	30.78	2.40	1,717,200	24.94
Total	2,324,440	100.00	2.96	6,884,992	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	3,892,501	36.20	1,409,085
Reef Fish	1,183,763	11.00	130,214
King Mackerel	91,529	19.30	17,665
Shrimp	1,717,200	21.50	369,198
Total	6,884,992	27.98	1,926,162

Inside the FKNMS Boundary - TERSA					
Species	Pounds	%	$/lb.	Revenue	%
Lobster	568,414	50.65	4.15	2,358,918	67.85
Reef Fish	293,374	26.14	2.06	604,350	17.38
King Mackerel	77,285	6.89	0.95	73,421	2.11
Shrimp	183,262	16.33	2.40	439,829	12.65
Total	1,122,335	100.00	2.96	3,476,518	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	2,358,918	36.20	853,928
Reef Fish	604,350	11.00	66,479
King Mackerel	73,421	19.30	14,170
Shrimp	439,829	21.50	94,563
Total	3,476,518	29.60	1,029,140

Table A.6. (Continued)

Outside the FKNMS Boundary - TERSA					
Species	Pounds	%	$/lb.	Revenue	%
Lobster	366,365	30.56	4.15	1,520,415	44.78
Reef Fish	281,268	23.46	2.06	579,412	17.07
King Mackerel	19,061	1.59	0.95	18,108	0.53
Shrimp	532,238	44.39	2.40	1,277,371	37.62
Total	1,198,932	100.00	2.96	3,395,306	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	1,520,415	36.20	550,390
Reef Fish	579,412	11.00	63,735
King Mackerel	18,108	19.30	3,495
Shrimp	1,277,371	21.50	274,635
Total	3,395,306	26.28	892,255

Table A.7. Economic Impact of TERSA Commercial Fishing on Monroe County

Total - TERSA					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	3,892,501	922,033	82,861	882,984	5,780,379
Wholesale Margin					
a. Exported	1,296,203	199,159	22,538	492,705	2,010,605
b. Keys Retail	43,207	14,937	1,690	16,424	76,258
c. Keys Restaurant	100,816	34,853	3,944	38,322	177,934
Keys Retail Margin	47,995	59,369	5,629	12,874	125,867
Keys Restaurant Margin	959,731	421,483	39,965	257,435	1,678,615
Total Primary Output	6,340,451	1,651,833	156,629	1,700,744	9,849,657
Total Output	7,608,542	1,982,200	187,954	2,040,892	11,819,588
Total Income	4,717,296	1,228,964	116,532	1,265,353	7,328,145
Number of Jobs	205	54	5	55	319

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 3,892,501	$ 922,033	$ 82,861	$ 882,984	$ 5,780,379
Wholesale Revenue					
a. Exported	$ 4,799,453	$ 936,785	$ 88,827	$ 1,287,391	$ 7,112,457
b. Key Retail	$ 159,982	$ 70,259	$ 6,662	$ 42,913	$ 279,816
c. Keys Restaurant	$ 373,291	$ 163,937	$ 15,545	$ 100,130	$ 652,903
Keys Retail Revenue	$ 207,976	$ 129,628	$ 12,291	$ 55,787	$ 405,682
Keys Restaurant Revenue	$ 1,333,022	$ 585,420	$ 55,510	$ 357,566	$ 2,331,518

Inside the FKNMS boundary - TERSA					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	2,358,918	470,729	66,468	226,160	3,122,274
Wholesale Margin					
a. Exported	785,520	101,677	18,079	126,197	1,031,474
b. Keys Retail	26,184	7,626	1,356	4,207	39,372
c. Keys Restaurant	61,096	17,794	3,164	9,815	91,869
Keys Retail Margin	29,085	30,310	4,516	3,297	67,208
Keys Restaurant Margin	581,612	215,181	32,059	65,937	894,789
Total Primary Output	3,842,416	843,316	125,641	435,614	5,246,987
Total Output	4,610,899	1,011,979	150,770	522,737	6,296,384
Total Income	2,858,757	627,427	93,477	324,097	3,903,758
Number of Jobs	124	27	4	14	170

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 2,358,918	$ 470,729	$ 66,468	$ 226,160	$ 3,122,274
Wholesale Revenue					
a. Exported	$ 2,908,546	$ 478,260	$ 71,253	$ 329,741	$ 3,787,801
b. Key Retail	$ 96,952	$ 35,870	$ 5,344	$ 10,991	$ 149,156
c. Keys Restaurant	$ 226,220	$ 83,696	$ 12,469	$ 25,647	$ 348,032
Keys Retail Revenue	$ 126,037	$ 66,179	$ 9,860	$ 14,289	$ 216,365
Keys Restaurant Revenue	$ 807,832	$ 298,877	$ 44,528	$ 91,584	$ 1,242,821

Table A.7. (Continued)

Outside the FKNMS boundary - TERSA					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	1,520,415	451,304	16,393	656,824	2,644,936
Wholesale Margin					
a. Exported	506,298	97,482	4,459	366,508	974,747
b. Keys Retail	16,877	7,311	334	12,217	36,739
c. Keys Restaurant	39,379	17,059	780	28,506	85,725
Keys Retail Margin	18,747	29,059	1,114	9,576	58,496
Keys Restaurant Margin	374,872	206,302	7,907	191,498	780,578
Total Primary Output	2,476,587	808,517	30,987	1,265,130	4,581,221
Total Output	2,971,904	970,220	37,185	1,518,156	5,497,465
Total Income	1,842,581	601,537	23,055	941,257	3,408,428
Number of Jobs	80	26	1	41	148

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 1,520,415	$ 451,304	$ 16,393	$ 656,824	$ 2,644,936
Wholesale Revenue					
a. Exported	$ 1,874,671	$ 458,525	$ 17,573	$ 957,650	$ 3,308,420
b. Key Retail	$ 62,489	$ 34,389	$ 1,318	$ 31,922	$ 130,118
c. Keys Restaurant	$ 145,808	$ 80,242	$ 3,075	$ 74,484	$ 303,609
Keys Retail Revenue	$ 81,236	$ 63,448	$ 2,432	$ 41,498	$ 188,614
Keys Restaurant Revenue	$ 520,680	$ 286,544	$ 10,982	$ 265,982	$ 1,084,187

Table A.8. Economic Impact of TERSA Commercial Catch on Collier and Lee Counties

Total - TERSA					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	261,730	8,668	834,216	1,104,613
Wholesale Margin					
a. Exported	-	56,534	2,358	465,492	524,384
b. Retail	-	4,240	177	15,516	19,933
c. Restaurant	-	9,893	413	36,205	46,511
Retail Margin	-	16,853	589	12,163	29,604
Restaurant Margin	-	119,643	4,181	243,217	367,040
Total Primary Output	-	468,892	16,384	1,606,809	2,092,086
Total Output	-	703,339	24,576	2,410,214	3,138,129
Total Income	-	436,070	15,237	1,494,333	1,945,640
Number of Jobs	-	19	1	65	85

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 261,730	$ 8,668	$ 834,216	$1,104,613
Wholesale Revenue					
a. Exported	$ -	$ 265,918	$ 9,292	$ 1,216,287	$1,491,496
b. Retail	$ -	$ 19,944	$ 697	$ 40,543	$ 61,184
c. Restaurant	$ -	$ 46,536	$ 1,626	$ 94,600	$ 142,762
Retail Revenue	$ -	$ 36,796	$ 1,286	$ 52,706	$ 90,788
Restaurant Revenue	$ -	$ 166,179	$ 5,807	$ 337,817	$ 509,802

Inside the FKNMS boundary - TERSA					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	133,622	6,953	213,669	354,244
Wholesale Margin					
a. Exported	-	28,862	1,891	119,227	149,981
b. Retail	-	2,165	142	3,974	6,281
c. Restaurant	-	5,051	331	9,273	14,655
Retail Margin	-	8,604	472	3,115	12,191
Restaurant Margin	-	61,082	3,354	62,295	126,731
Total Primary Output	-	239,385	13,143	411,554	664,082
Total Output	-	359,078	19,714	617,331	996,124
Total Income	-	222,628	12,223	382,745	617,597
Number of Jobs	-	10	1	17	27

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 133,622	$ 6,953	$ 213,669	$ 354,244
Wholesale Revenue					
a. Exported	$ -	$ 135,760	$ 7,454	$ 311,529	$ 454,743
b. Retail	$ -	$ 10,182	$ 559	$ 10,384	$ 21,125
c. Restaurant	$ -	$ 23,758	$ 1,304	$ 24,230	$ 49,292
Retail Revenue	$ -	$ 18,786	$ 1,031	$ 13,500	$ 33,317
Restaurant Revenue	$ -	$ 84,840	$ 4,658	$ 86,525	$ 176,023

Table A.8. (Continued)

Outside the FKNMS boundary - TERSA

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	128,108	1,715	620,547	750,370
Wholesale Margin					
a. Exported	-	27,671	466	346,265	374,403
b. Retail	-	2,075	35	11,542	13,653
c. Restaurant	-	4,842	82	26,932	31,856
Retail Margin	-	8,249	117	9,048	17,413
Restaurant Margin	-	58,561	827	180,921	240,310
Total Primary Output	-	229,507	3,241	1,195,255	1,428,004
Total Output	-	344,261	4,862	1,792,882	2,142,005
Total Income	-	213,442	3,015	1,111,587	1,328,043
Number of Jobs	-	9	0	48	58

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 128,108	$ 1,715	$ 620,547	$ 750,370
Wholesale Revenue					
a. Exported	$ -	$ 130,158	$ 1,838	$ 904,757	$1,036,753
b. Retail	$ -	$ 9,762	$ 138	$ 30,159	$ 40,058
c. Restaurant	$ -	$ 22,778	$ 322	$ 70,370	$ 93,469
Retail Revenue	$ -	$ 18,011	$ 254	$ 39,206	$ 57,471
Restaurant Revenue	$ -	$ 81,339	$ 1,149	$ 251,291	$ 333,779

Table A.9 Total Harvest and Ex Vessel Value of Commercial Catch from TERSA: Alternative 2

Total

Species	Pounds	%	$/lb.	Revenue	%
Lobster	56,625	39.57	4.15	234,994	57.13
Reef Fish	74,494	52.05	2.06	153,458	37.31
King Mackerel	4,057	2.84	0.95	3,854	0.94
Shrimp	7,940	5.55	2.40	19,055	4.63
Total	143,116	100.00	2.96	411,362	100.00

Total Return to Labor and Capital from Commercial Catch in TSA

Species	Revenue	% Return	Return L/C
Lobster	234,994	36.20	85,068
Reef Fish	153,458	11.00	16,880
King Mackerel	3,854	19.30	744
Shrimp	19,055	21.50	4,097
Total	411,362	25.96	106,789

Inside the FKNMS Boundary

Species	Pounds	%	$/lb.	Revenue	%
Lobster	56,625	39.57	4.15	234,994	57.13
Reef Fish	74,494	52.05	2.06	153,458	37.31
King Mackerel	4,057	2.84	0.95	3,854	0.94
Shrimp	7,940	5.55	2.40	19,055	4.63
Total	143,116	100.00	2.96	411,362	100.00

Total Return to Labor and Capital from Commercial Catch in TSA

Species	Revenue	% Return	Return L/C
Lobster	234,994	36.20	85,068
Reef Fish	153,458	11.00	16,880
King Mackerel	3,854	19.30	744
Shrimp	19,055	21.50	4,097
Total	411,362	25.96	106,789

Table A.9 (Continued)

Outside the FKNMS Boundary

Species	Pounds	%	$/lb.	Revenue	%
Lobster	0	0.00	4.15	0	0.00
Reef Fish	0	0.00	2.06	0	0.00
King Mackerel	0	0.00	0.95	0	0.00
Shrimp	0	0.00	2.40	0	0.00
Total	0	0.00	2.96	0	0.00

Total Return to Labor and Capital from Commercial Catch in TSA

Species	Revenue	% Return	Return L/C
Lobster	0	36.20	0
Reef Fish	0	11.00	0
King Mackerel	0	19.30	0
Shrimp	0	21.50	0
Total	0	0.00	0

Table A.10 Economic Impact of TERSA Commercial Fishing on Monroe County: Alternative 2

Total

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	234,994	119,529	3,489	9,798	367,810
Wholesale Margin					
a. Exported	78,253	25,818	949	5,467	110,488
b. Keys Retail	2,608	1,936	71	182	4,798
c. Keys Restaurant	6,086	4,518	166	425	11,196
Keys Retail Margin	2,897	7,696	237	143	10,974
Keys Restaurant Margin	57,940	54,639	1,683	2,857	117,119
Total Primary Output	382,779	214,137	6,596	18,872	622,384
Total Output	459,334	256,965	7,915	22,647	746,861
Total Income	284,787	159,318	4,907	14,041	463,054
Number of Jobs	12	7	0	1	20

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 234,994	$ 119,529	$ 3,489	$ 9,798	$ 367,810
Wholesale Revenue					
a. Exported	$ 289,747	$ 121,441	$ 3,741	$ 14,285	$ 429,215
b. Key Retail	$ 9,658	$ 9,108	$ 281	$ 476	$ 19,523
c. Keys Restaurant	$ 22,536	$ 21,252	$ 655	$ 1,111	$ 45,554
Keys Retail Revenue	$ 12,556	$ 16,804	$ 518	$ 619	$ 30,497
Keys Restaurant Revenue	$ 70,496	$ 71,444	$ 2,201	$ 3,476	$ 147,616

Inside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	234,994	119,529	3,489	9,798	367,810
Wholesale Margin					
a. Exported	78,253	25,818	949	5,467	110,488
b. Keys Retail	2,608	1,936	71	182	4,798
c. Keys Restaurant	6,086	4,518	166	425	11,196
Keys Retail Margin	2,897	7,696	237	143	10,974
Keys Restaurant Margin	57,940	54,639	1,683	2,857	117,119
Total Primary Output	382,779	214,137	6,596	18,872	622,384
Total Output	459,334	256,965	7,915	22,647	746,861
Total Income	284,787	159,318	4,907	14,041	463,054
Number of Jobs	12	7	0	1	20

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 234,994	$ 119,529	$ 3,489	$ 9,798	$ 367,810
Wholesale Revenue					
a. Exported	$ 289,747	$ 121,441	$ 3,741	$ 14,285	$ 429,215
b. Key Retail	$ 9,658	$ 9,108	$ 281	$ 476	$ 19,523
c. Keys Restaurant	$ 22,536	$ 21,252	$ 655	$ 1,111	$ 45,554
Keys Retail Revenue	$ 12,556	$ 16,804	$ 518	$ 619	$ 30,497
Keys Restaurant Revenue	$ 70,496	$ 71,444	$ 2,201	$ 3,476	$ 147,616

Table A.10 (Continued)

Outside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	-	-	-	-
Wholesale Margin					
a. Exported	-	-	-	-	-
b. Keys Retail	-	-	-	-	-
c. Keys Restaurant	-	-	-	-	-
Keys Retail Margin	-	-	-	-	-
Keys Restaurant Margin	-	-	-	-	-
Total Primary Output	-	-	-	-	-
Total Output	-	-	-	-	-
Total Income	-	-	-	-	-
Number of Jobs	0	0	0	0	-

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ -	$ -	$ -	$ -
Wholesale Revenue					
a. Exported	$ -	$ -	$ -	$ -	$ -
b. Key Retail	$ -	$ -	$ -	$ -	$ -
c. Keys Restaurant	$ -	$ -	$ -	$ -	$ -
Keys Retail Revenue	$ -	$ -	$ -	$ -	$ -
Keys Restaurant Revenue	$ -	$ -	$ -	$ -	$ -

Table A.11 Economic Impact of TERSA Commercial Catch on Collier and Lee Counties: Alternative 2

Total					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	33,930	365	9,257	43,552
Wholesale Margin					
a. Exported	-	7,329	99	5,165	12,593
b. Retail	-	550	7	172	729
c. Restaurant	-	1,283	17	402	1,702
Retail Margin	-	2,185	25	135	2,344
Restaurant Margin	-	15,510	176	2,699	18,385
Total Primary Output	-	60,785	690	17,830	79,305
Total Output	-	91,178	1,035	26,745	118,958
Total Income	-	56,530	642	16,582	73,754
Number of Jobs	-	2	0	1	3

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 33,930	$ 365	$ 9,257	$ 43,552
Wholesale Revenue					
a. Exported	$ -	$ 34,473	$ 391	$ 13,496	$ 48,360
b. Retail	$ -	$ 2,585	$ 29	$ 450	$ 3,065
c. Restaurant	$ -	$ 6,033	$ 68	$ 1,050	$ 7,151
Retail Revenue	$ -	$ 4,770	$ 54	$ 585	$ 5,409
Restaurant Revenue	$ -	$ 20,280	$ 230	$ 3,284	$ 23,794

Inside the FKNMS boundary					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	33,930	365	9,257	43,552
Wholesale Margin					
a. Exported	-	7,329	99	5,165	12,593
b. Retail	-	550	7	172	729
c. Restaurant	-	1,283	17	402	1,702
Retail Margin	-	2,185	25	135	2,344
Restaurant Margin	-	15,510	176	2,699	18,385
Total Primary Output	-	60,785	690	17,830	79,305
Total Output	-	91,178	1,035	26,745	118,958
Total Income	-	56,530	642	16,582	73,754
Number of Jobs	-	2	0	1	3

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 33,930	$ 365	$ 9,257	$ 43,552
Wholesale Revenue					
a. Exported	$ -	$ 34,473	$ 391	$ 13,496	$ 48,360
b. Retail	$ -	$ 2,585	$ 29	$ 450	$ 3,065
c. Restaurant	$ -	$ 6,033	$ 68	$ 1,050	$ 7,151
Retail Revenue	$ -	$ 4,770	$ 54	$ 585	$ 5,409
Restaurant Revenue	$ -	$ 20,280	$ 230	$ 3,284	$ 23,794

Table A.11 (Continued)

Outside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	-	-	-	-
Wholesale Margin					
a. Exported	-	-	-	-	-
b. Retail	-	-	-	-	-
c. Restaurant	-	-	-	-	-
Retail Margin	-	-	-	-	-
Restaurant Margin	-	-	-	-	-
Total Primary Output	-	-	-	-	-
Total Output	-	-	-	-	-
Total Income	-	-	-	-	-
Number of Jobs	-	0	0	0	0

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ -	$ -	$ -	$ -
Wholesale Revenue					
a. Exported	$ -	$ -	$ -	$ -	$ -
b. Retail	$ -	$ -	$ -	$ -	$ -
c. Restaurant	$ -	$ -	$ -	$ -	$ -
Retail Revenue	$ -	$ -	$ -	$ -	$ -
Restaurant Revenue	$ -	$ -	$ -	$ -	$ -

Table A.12 Total Harvest and Ex Vessel Value of Commercial Catch from TERSA: Alternative 3: Preferred

Total					
Species	Pounds	%	$/lb.	Revenue	%
Lobster	108,639	36.56	4.15	450,853	53.42
Reef Fish	116,642	39.25	2.06	240,283	28.47
King Mackerel	13,489	4.54	0.95	12,814	1.52
Shrimp	58,374	19.65	2.40	140,098	16.60
Total	297,144	100.00	2.96	844,047	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	450,853	36.20	163,209
Reef Fish	240,283	11.00	26,431
King Mackerel	12,814	19.30	2,473
Shrimp	140,098	21.50	30,121
Total	844,047	26.33	222,234

Inside the FKNMS Boundary					
Species	Pounds	%	$/lb.	Revenue	%
Lobster	56,802	39.64	4.15	235,726	57.20
Reef Fish	74,494	51.99	2.06	153,458	37.24
King Mackerel	4,057	2.83	0.95	3,854	0.94
Shrimp	7,940	5.54	2.40	19,055	4.62
Total	143,293	100.00	2.96	412,094	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	235,726	36.20	85,333
Reef Fish	153,458	11.00	16,880
King Mackerel	3,854	19.30	744
Shrimp	19,055	21.50	4,097
Total	412,094	25.98	107,054

Table A.12 (Continued)

Outside the FKNMS Boundary

Species	Pounds	%	$/lb.	Revenue	%
Lobster	51,838	33.69	4.15	215,126	49.80
Reef Fish	42,148	27.40	2.06	86,824	20.10
King Mackerel	9,431	6.13	0.95	8,960	2.07
Shrimp	50,435	32.78	2.40	121,043	28.02
Total	153,851	100.00	2.96	431,953	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	215,126	36.20	77,876
Reef Fish	86,824	11.00	9,551
King Mackerel	8,960	19.30	1,729
Shrimp	121,043	21.50	26,024
Total	431,953	26.66	115,180

Table A.13 Economic Impact of TERSA Commercial Fishing on Monroe County: Alternative 3: Preferred

Total					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	450,853	187,156	11,601	72,038	721,648
Wholesale Margin					
a. Exported	150,134	40,426	3,155	40,197	233,912
b. Keys Retail	5,004	3,032	237	1,340	9,613
c. Keys Restaurant	11,677	7,074	552	3,126	22,430
Keys Retail Margin	5,559	12,051	788	1,050	19,448
Keys Restaurant Margin	111,162	85,553	5,595	21,003	223,313
Total Primary Output	734,389	335,292	21,928	138,755	1,230,365
Total Output	881,267	402,351	26,314	166,506	1,476,437
Total Income	546,385	249,458	16,315	103,234	915,391
Number of Jobs	24	11	1	4	40

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 450,853	$ 187,156	$ 11,601	$ 72,038	$ 721,648
Wholesale Revenue					
a. Exported	$ 555,901	$ 190,151	$ 12,436	$ 105,032	$ 863,519
b. Key Retail	$ 18,530	$ 14,261	$ 933	$ 3,501	$ 37,225
c. Keys Restaurant	$ 43,237	$ 33,276	$ 2,176	$ 8,169	$ 86,859
Keys Retail Revenue	$ 24,089	$ 26,312	$ 1,721	$ 4,551	$ 56,673
Keys Restaurant Revenue	$ 135,251	$ 111,866	$ 7,316	$ 25,554	$ 279,987

Inside the FKNMS boundary					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	235,726	119,529	3,489	9,798	368,542
Wholesale Margin					
a. Exported	78,497	25,818	949	5,467	110,731
b. Keys Retail	2,617	1,936	71	182	4,806
c. Keys Restaurant	6,105	4,518	166	425	11,215
Keys Retail Margin	2,907	7,696	237	143	10,983
Keys Restaurant Margin	58,120	54,639	1,683	2,857	117,300
Total Primary Output	383,972	214,137	6,596	18,872	623,577
Total Output	460,766	256,965	7,915	22,647	748,293
Total Income	285,675	159,318	4,907	14,041	463,942
Number of Jobs	12	7	0	1	20

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 235,726	$ 119,529	$ 3,489	$ 9,798	$ 368,542
Wholesale Revenue					
a. Exported	$ 290,650	$ 121,441	$ 3,741	$ 14,285	$ 430,118
b. Key Retail	$ 9,688	$ 9,108	$ 281	$ 476	$ 19,553
c. Keys Restaurant	$ 22,606	$ 21,252	$ 655	$ 1,111	$ 45,624
Keys Retail Revenue	$ 12,595	$ 16,804	$ 518	$ 619	$ 30,536
Keys Restaurant Revenue	$ 70,715	$ 71,444	$ 2,201	$ 3,476	$ 147,835

Table A.13 (Continued)

Outside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	215,126	67,627	8,111	62,240	353,105
Wholesale Margin					
a. Exported	71,637	14,607	2,206	34,730	123,181
b. Keys Retail	2,388	1,096	165	1,158	4,807
c. Keys Restaurant	5,572	2,556	386	2,701	11,215
Keys Retail Margin	2,653	4,354	551	907	8,465
Keys Restaurant Margin	53,041	30,914	3,912	18,146	106,014
Total Primary Output	350,417	121,155	15,332	119,883	606,787
Total Output	420,501	145,386	18,399	143,859	728,145
Total Income	260,710	90,139	11,407	89,193	451,450
Number of Jobs	11	4	0	4	20

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 215,126	$ 67,627	$ 8,111	$ 62,240	$ 353,105
Wholesale Revenue					
a. Exported	$ 265,251	$ 68,709	$ 8,695	$ 90,746	$ 433,402
b. Key Retail	$ 8,842	$ 5,153	$ 652	$ 3,025	$ 17,672
c. Keys Restaurant	$ 20,631	$ 12,024	$ 1,522	$ 7,058	$ 41,234
Keys Retail Revenue	$ 11,494	$ 9,508	$ 1,203	$ 3,932	$ 26,137
Keys Restaurant Revenue	$ 64,536	$ 40,422	$ 5,115	$ 22,079	$ 132,151

Table A.14 Economic Impact of TERSA Commercial Catch on Collier and Lee Counties:
Alternative 3: Preferred

Total

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	53,126	1,213	68,059	122,399
Wholesale Margin					
a. Exported	-	11,475	330	37,977	49,783
b. Retail	-	861	25	1,266	2,151
c. Restaurant	-	2,008	58	2,954	5,020
Retail Margin	-	3,421	82	992	4,496
Restaurant Margin	-	24,285	585	19,843	44,713
Total Primary Output	-	95,177	2,294	131,091	228,562
Total Output	-	142,765	3,441	196,637	342,843
Total Income	-	88,514	2,133	121,915	212,563
Number of Jobs	-	4	0	5	9

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 53,126	$ 1,213	$ 68,059	$ 122,399
Wholesale Revenue					
a. Exported	$ -	$ 53,976	$ 1,301	$ 99,231	$ 154,508
b. Retail	$ -	$ 4,048	$ 98	$ 3,308	$ 7,453
c. Restaurant	$ -	$ 9,446	$ 228	$ 7,718	$ 17,391
Retail Revenue	$ -	$ 7,469	$ 180	$ 4,300	$ 11,949
Restaurant Revenue	$ -	$ 31,754	$ 765	$ 24,143	$ 56,662

Inside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	33,930	365	9,257	43,552
Wholesale Margin					
a. Exported	-	7,329	99	5,165	12,593
b. Retail	-	550	7	172	729
c. Restaurant	-	1,283	17	402	1,702
Retail Margin	-	2,185	25	135	2,344
Restaurant Margin	-	15,510	176	2,699	18,385
Total Primary Output	-	60,785	690	17,830	79,305
Total Output	-	91,178	1,035	26,745	118,958
Total Income	-	56,530	642	16,582	73,754
Number of Jobs	-	2	0	1	3

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 33,930	$ 365	$ 9,257	$ 43,552
Wholesale Revenue					
a. Exported	$ -	$ 34,473	$ 391	$ 13,496	$ 48,360
b. Retail	$ -	$ 2,585	$ 29	$ 450	$ 3,065
c. Restaurant	$ -	$ 6,033	$ 68	$ 1,050	$ 7,151
Retail Revenue	$ -	$ 4,770	$ 54	$ 585	$ 5,409
Restaurant Revenue	$ -	$ 20,280	$ 230	$ 3,284	$ 23,794

Table A.14 (Continued)

Outside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	19,197	848	58,803	78,848
Wholesale Margin					
a. Exported	-	4,147	231	32,812	37,189
b. Retail	-	311	17	1,094	1,422
c. Restaurant	-	726	40	2,552	3,318
Retail Margin	-	1,236	58	857	2,151
Restaurant Margin	-	8,775	409	17,144	26,329
Total Primary Output	-	34,391	1,604	113,262	149,257
Total Output	-	51,587	2,406	169,892	223,885
Total Income	-	31,984	1,492	105,333	138,809
Number of Jobs	-	1	0	5	6

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 19,197	$ 848	$ 58,803	$ 78,848
Wholesale Revenue					
a. Exported	$ -	$ 19,504	$ 910	$ 85,734	$ 106,148
b. Retail	$ -	$ 1,463	$ 68	$ 2,858	$ 4,389
c. Restaurant	$ -	$ 3,413	$ 159	$ 6,668	$ 10,241
Retail Revenue	$ -	$ 2,699	$ 126	$ 3,715	$ 6,540
Restaurant Revenue	$ -	$ 11,474	$ 535	$ 20,859	$ 32,868

Table A.15 Total Harvest and Ex Vessel Value of Commercial Catch from TERSA: Alternative 4

Total					
Species	Pounds	%	$/lb.	Revenue	%
Lobster	153,778	39.52	4.15	638,177	56.66
Reef Fish	161,997	41.63	2.06	333,713	29.63
King Mackerel	14,999	3.85	0.95	14,249	1.27
Shrimp	58,374	15.00	2.40	140,098	12.44
Total	389,147	100.00	2.96	1,126,237	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	638,177	36.20	231,020
Reef Fish	333,713	11.00	36,708
King Mackerel	14,249	19.30	2,750
Shrimp	140,098	21.50	30,121
Total	1,126,237	26.69	300,600

Inside the FKNMS Boundary					
Species	Pounds	%	$/lb.	Revenue	%
Lobster	101,940	43.32	4.15	423,051	60.93
Reef Fish	119,849	50.94	2.06	246,889	35.56
King Mackerel	5,568	2.37	0.95	5,289	0.76
Shrimp	7,940	3.37	2.40	19,055	2.74
Total	235,296	100.00	2.96	694,284	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	423,051	36.20	153,144
Reef Fish	246,889	11.00	27,158
King Mackerel	5,289	19.30	1,021
Shrimp	19,055	21.50	4,097
Total	694,284	26.71	185,420

Table A.15 (Continued)

Outside the FKNMS Boundary

Species	Pounds	%	$/lb.	Revenue	%
Lobster	51,838	33.69	4.15	215,126	49.80
Reef Fish	42,148	27.40	2.06	86,824	20.10
King Mackerel	9,431	6.13	0.95	8,960	2.07
Shrimp	50,435	32.78	2.40	121,043	28.02
Total	153,851	100.00	2.96	431,953	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	215,126	36.20	77,876
Reef Fish	86,824	11.00	9,551
King Mackerel	8,960	19.30	1,729
Shrimp	121,043	21.50	26,024
Total	431,953	26.66	115,180

Table A.16 Economic Impact of TERSA Commercial Fishing on Monroe County: Alternative 4

Total					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	638,177	259,929	12,900	72,038	983,044
Wholesale Margin					
a. Exported	212,513	56,145	3,509	40,197	312,364
b. Keys Retail	7,084	4,211	263	1,340	12,898
c. Keys Restaurant	16,529	9,825	614	3,126	30,095
Keys Retail Margin	7,869	16,737	876	1,050	26,532
Keys Restaurant Margin	157,348	118,820	6,222	21,003	303,393
Total Primary Output	1,039,520	465,666	24,383	138,755	1,668,325
Total Output	1,247,424	558,799	29,260	166,506	2,001,990
Total Income	773,403	346,456	18,141	103,234	1,241,234
Number of Jobs	34	15	1	4	54

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 638,177	$ 259,929	$ 12,900	$ 72,038	$ 983,044
Wholesale Revenue					
a. Exported	$ 786,873	$ 264,088	$ 13,828	$ 105,032	$ 1,169,821
b. Key Retail	$ 26,229	$ 19,807	$ 1,037	$ 3,501	$ 50,574
c. Keys Restaurant	$ 61,201	$ 46,215	$ 2,420	$ 8,169	$ 118,006
Keys Retail Revenue	$ 34,098	$ 36,543	$ 1,913	$ 4,551	$ 77,106
Keys Restaurant Revenue	$ 191,446	$ 155,363	$ 8,135	$ 25,554	$ 380,498

Inside the FKNMS boundary					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	423,051	192,302	4,788	9,798	629,939
Wholesale Margin					
a. Exported	140,876	41,537	1,302	5,467	189,183
b. Keys Retail	4,696	3,115	98	182	8,091
c. Keys Restaurant	10,957	7,269	228	425	18,879
Keys Retail Margin	5,216	12,382	325	143	18,067
Keys Restaurant Margin	104,307	87,906	2,310	2,857	197,379
Total Primary Output	689,103	344,511	9,051	18,872	1,061,538
Total Output	826,924	413,413	10,862	22,647	1,273,845
Total Income	512,693	256,316	6,734	14,041	789,784
Number of Jobs	22	11	0	1	34

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 423,051	$ 192,302	$ 4,788	$ 9,798	$ 629,939
Wholesale Revenue					
a. Exported	$ 521,622	$ 195,379	$ 5,133	$ 14,285	$ 736,419
b. Key Retail	$ 17,387	$ 14,653	$ 385	$ 476	$ 32,902
c. Keys Restaurant	$ 40,571	$ 34,191	$ 898	$ 1,111	$ 76,771
Keys Retail Revenue	$ 22,604	$ 27,036	$ 710	$ 619	$ 50,968
Keys Restaurant Revenue	$ 126,911	$ 114,941	$ 3,020	$ 3,476	$ 248,347

Table A.16 (Continued)

Outside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	215,126	67,627	8,111	62,240	353,105
Wholesale Margin					
a. Exported	71,637	14,607	2,206	34,730	123,181
b. Keys Retail	2,388	1,096	165	1,158	4,807
c. Keys Restaurant	5,572	2,556	386	2,701	11,215
Keys Retail Margin	2,653	4,354	551	907	8,465
Keys Restaurant Margin	53,041	30,914	3,912	18,146	106,014
Total Primary Output	350,417	121,155	15,332	119,883	606,787
Total Output	420,501	145,386	18,399	143,859	728,145
Total Income	260,710	90,139	11,407	89,193	451,450
Number of Jobs	11	4	0	4	20

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 215,126	$ 67,627	$ 8,111	$ 62,240	$ 353,105
Wholesale Revenue					
a. Exported	$ 265,251	$ 68,709	$ 8,695	$ 90,746	$ 433,402
b. Key Retail	$ 8,842	$ 5,153	$ 652	$ 3,025	$ 17,672
c. Keys Restaurant	$ 20,631	$ 12,024	$ 1,522	$ 7,058	$ 41,234
Keys Retail Revenue	$ 11,494	$ 9,508	$ 1,203	$ 3,932	$ 26,137
Keys Restaurant Revenue	$ 64,536	$ 40,422	$ 5,115	$ 22,079	$ 132,151

Table A.17 Economic Impact of TERSA Commercial Catch on Collier and Lee Counties: Alternative 4

Total					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	73,784	1,349	68,059	143,193
Wholesale Margin					
a. Exported	-	15,937	367	37,977	54,282
b. Retail	-	1,195	28	1,266	2,489
c. Restaurant	-	2,789	64	2,954	5,807
Retail Margin	-	4,751	92	992	5,835
Restaurant Margin	-	33,728	651	19,843	54,222
Total Primary Output	-	132,185	2,551	131,091	265,827
Total Output	-	198,277	3,826	196,637	398,740
Total Income	-	122,932	2,372	121,915	247,219
Number of Jobs	-	5	0	5	11

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 73,784	$ 1,349	$ 68,059	$ 143,193
Wholesale Revenue					
a. Exported	$ -	$ 74,964	$ 1,447	$ 99,231	$ 175,642
b. Retail	$ -	$ 5,622	$ 108	$ 3,308	$ 9,039
c. Restaurant	$ -	$ 13,119	$ 253	$ 7,718	$ 21,090
Retail Revenue	$ -	$ 10,373	$ 200	$ 4,300	$ 14,873
Restaurant Revenue	$ -	$ 44,102	$ 851	$ 24,143	$ 69,095

Inside the FKNMS boundary					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	54,587	501	9,257	64,345
Wholesale Margin					
a. Exported	-	11,791	136	5,165	17,092
b. Retail	-	884	10	172	1,067
c. Restaurant	-	2,063	24	402	2,489
Retail Margin	-	3,515	34	135	3,684
Restaurant Margin	-	24,953	242	2,699	27,894
Total Primary Output	-	97,794	947	17,830	116,570
Total Output	-	146,690	1,420	26,745	174,855
Total Income	-	90,948	881	16,582	108,410
Number of Jobs	-	4	0	1	5

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 54,587	$ 501	$ 9,257	$ 64,345
Wholesale Revenue					
a. Exported	$ -	$ 55,461	$ 537	$ 13,496	$ 69,494
b. Retail	$ -	$ 4,160	$ 40	$ 450	$ 4,650
c. Restaurant	$ -	$ 9,706	$ 94	$ 1,050	$ 10,849
Retail Revenue	$ -	$ 7,674	$ 74	$ 585	$ 8,334
Restaurant Revenue	$ -	$ 32,627	$ 316	$ 3,284	$ 36,227

Table A.17 (Continued)

Outside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	19,197	848	58,803	78,848
Wholesale Margin					
a. Exported	-	4,147	231	32,812	37,189
b. Retail	-	311	17	1,094	1,422
c. Restaurant	-	726	40	2,552	3,318
Retail Margin	-	1,236	58	857	2,151
Restaurant Margin	-	8,775	409	17,144	26,329
Total Primary Output	-	34,391	1,604	113,262	149,257
Total Output	-	51,587	2,406	169,892	223,885
Total Income	-	31,984	1,492	105,333	138,809
Number of Jobs	-	1	0	5	6

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 19,197	$ 848	$ 58,803	$ 78,848
Wholesale Revenue					
a. Exported	$ -	$ 19,504	$ 910	$ 85,734	$ 106,148
b. Retail	$ -	$ 1,463	$ 68	$ 2,858	$ 4,389
c. Restaurant	$ -	$ 3,413	$ 159	$ 6,668	$ 10,241
Retail Revenue	$ -	$ 2,699	$ 126	$ 3,715	$ 6,540
Restaurant Revenue	$ -	$ 11,474	$ 535	$ 20,859	$ 32,868

Table A.18 Total Harvest and Ex Vessel Value of Commercial Catch from TERSA: Alternative 5

Total					
Species	Pounds	%	$/lb.	Revenue	%
Lobster	164,908	38.96	4.15	684,366	55.87
Reef Fish	169,907	40.14	2.06	350,009	28.58
King Mackerel	14,999	3.54	0.95	14,249	1.16
Shrimp	73,427	17.35	2.40	176,225	14.39
Total	423,241	100.00	2.96	1,224,849	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	684,366	36.20	247,741
Reef Fish	350,009	11.00	38,501
King Mackerel	14,249	19.30	2,750
Shrimp	176,225	21.50	37,888
Total	1,224,849	26.69	326,880

Inside the FKNMS Boundary					
Species	Pounds	%	$/lb.	Revenue	%
Lobster	101,940	43.32	4.15	423,051	60.93
Reef Fish	119,849	50.94	2.06	246,889	35.56
King Mackerel	5,568	2.37	0.95	5,289	0.76
Shrimp	7,940	3.37	2.40	19,055	2.74
Total	235,296	100.00	2.96	694,284	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	423,051	36.20	153,144
Reef Fish	246,889	11.00	27,158
King Mackerel	5,289	19.30	1,021
Shrimp	19,055	21.50	4,097
Total	694,284	26.71	185,420

Table A.18 (Continued)

Outside the FKNMS Boundary - Preferred

Species	Pounds	%	$/lb.	Revenue	%
Lobster	62,968	33.50	4.15	261,315	49.25
Reef Fish	50,058	26.63	2.06	103,120	19.44
King Mackerel	9,431	5.02	0.95	8,960	1.69
Shrimp	65,487	34.84	2.40	157,170	29.62
Total	187,944	100.00	2.96	530,565	100.00

Total Return to Labor and Capital from Commercial Catch in TERSA

Species	Revenue	% Return	Return L/C
Lobster	261,315	36.20	94,596
Reef Fish	103,120	11.00	11,343
King Mackerel	8,960	19.30	1,729
Shrimp	157,170	21.50	33,791
Total	530,565	26.66	141,460

Table A.19 Economic Impact of TERSA Commercial Fishing on Monroe County: Alternative 5

Total					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	684,366	272,622	12,900	90,615	1,060,502
Wholesale Margin					
a. Exported	227,894	58,886	3,509	50,563	340,852
b. Keys Retail	7,596	4,416	263	1,685	13,962
c. Keys Restaurant	17,725	10,305	614	3,933	32,577
Keys Retail Margin	8,438	17,554	876	1,321	28,190
Keys Restaurant Margin	168,737	124,622	6,222	26,419	325,999
Total Primary Output	1,114,756	488,406	24,383	174,536	1,802,081
Total Output	1,337,708	586,087	29,260	209,443	2,162,498
Total Income	829,379	363,374	18,141	129,855	1,340,749
Number of Jobs	36	16	1	6	58
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 684,366	$ 272,622	$ 12,900	$ 90,615	$ 1,060,502
Wholesale Revenue					
a. Exported	$ 843,823	$ 276,984	$ 13,828	$ 132,116	$ 1,266,752
b. Key Retail	$ 28,127	$ 20,774	$ 1,037	$ 4,404	$ 54,342
c. Keys Restaurant	$ 65,631	$ 48,472	$ 2,420	$ 10,276	$ 126,799
Keys Retail Revenue	$ 36,566	$ 38,328	$ 1,913	$ 5,725	$ 82,532
Keys Restaurant Revenue	$ 205,302	$ 162,950	$ 8,135	$ 32,144	$ 408,531

Inside the FKNMS boundary					
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	423,051	192,302	4,788	9,798	629,939
Wholesale Margin					
a. Exported	140,876	41,537	1,302	5,467	189,183
b. Keys Retail	4,696	3,115	98	182	8,091
c. Keys Restaurant	10,957	7,269	228	425	18,879
Keys Retail Margin	5,216	12,382	325	143	18,067
Keys Restaurant Margin	104,307	87,906	2,310	2,857	197,379
Total Primary Output	689,103	344,511	9,051	18,872	1,061,538
Total Output	826,924	413,413	10,862	22,647	1,273,845
Total Income	512,693	256,316	6,734	14,041	789,784
Number of Jobs	22	11	0	1	34
	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 423,051	$ 192,302	$ 4,788	$ 9,798	$ 629,939
Wholesale Revenue					
a. Exported	$ 521,622	$ 195,379	$ 5,133	$ 14,285	$ 736,419
b. Key Retail	$ 17,387	$ 14,653	$ 385	$ 476	$ 32,902
c. Keys Restaurant	$ 40,571	$ 34,191	$ 898	$ 1,111	$ 76,771
Keys Retail Revenue	$ 22,604	$ 27,036	$ 710	$ 619	$ 50,968
Keys Restaurant Revenue	$ 126,911	$ 114,941	$ 3,020	$ 3,476	$ 248,347

Table A.19 (Continued)

Outside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	261,315	80,320	8,111	80,817	430,563
Wholesale Margin					
a. Exported	87,018	17,349	2,206	45,096	151,669
b. Keys Retail	2,901	1,301	165	1,503	5,870
c. Keys Restaurant	6,768	3,036	386	3,507	13,698
Keys Retail Margin	3,222	5,172	551	1,178	10,123
Keys Restaurant Margin	64,430	36,716	3,912	23,562	128,620
Total Primary Output	425,653	143,895	15,332	155,664	740,544
Total Output	510,784	172,674	18,399	186,796	888,653
Total Income	316,686	107,058	11,407	115,814	550,965
Number of Jobs	14	5	0	5	24

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ 261,315	$ 80,320	$ 8,111	$ 80,817	$ 430,563
Wholesale Revenue					
a. Exported	$ 322,202	$ 81,605	$ 8,695	$ 117,831	$ 530,333
b. Key Retail	$ 10,740	$ 6,120	$ 652	$ 3,928	$ 21,440
c. Keys Restaurant	$ 25,060	$ 14,281	$ 1,522	$ 9,165	$ 50,027
Keys Retail Revenue	$ 13,962	$ 11,292	$ 1,203	$ 5,106	$ 31,563
Keys Restaurant Revenue	$ 78,392	$ 48,008	$ 5,115	$ 28,668	$ 160,184

Table A.20 Economic Impact of TERSA Commercial Catch on Collier and Lee Counties: Alternative 5

Total

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	77,387	1,349	85,610	164,346
Wholesale Margin					
a. Exported	-	16,716	367	47,770	64,853
b. Retail	-	1,254	28	1,592	2,874
c. Restaurant	-	2,925	64	3,715	6,705
Retail Margin	-	4,983	92	1,248	6,323
Restaurant Margin	-	35,375	651	24,960	60,986
Total Primary Output	-	138,640	2,551	164,896	306,086
Total Output	-	207,960	3,826	247,344	459,130
Total Income	-	128,935	2,372	153,353	284,660
Number of Jobs	-	6	0	7	12

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 77,387	$ 1,349	$ 85,610	$ 164,346
Wholesale Revenue					
a. Exported	$ -	$ 78,625	$ 1,447	$ 124,819	$ 204,891
b. Retail	$ -	$ 5,897	$ 108	$ 4,161	$ 10,166
c. Restaurant	$ -	$ 13,759	$ 253	$ 9,708	$ 23,721
Retail Revenue	$ -	$ 10,880	$ 200	$ 5,409	$ 16,489
Restaurant Revenue	$ -	$ 46,255	$ 851	$ 30,369	$ 77,475

Inside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	54,587	501	9,257	64,345
Wholesale Margin					
a. Exported	-	11,791	136	5,165	17,092
b. Retail	-	884	10	172	1,067
c. Restaurant	-	2,063	24	402	2,489
Retail Margin	-	3,515	34	135	3,684
Restaurant Margin	-	24,953	242	2,699	27,894
Total Primary Output	-	97,794	947	17,830	116,570
Total Output	-	146,690	1,420	26,745	174,855
Total Income	-	90,948	881	16,582	108,410
Number of Jobs	-	4	0	1	5

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 54,587	$ 501	$ 9,257	$ 64,345
Wholesale Revenue					
a. Exported	$ -	$ 55,461	$ 537	$ 13,496	$ 69,494
b. Retail	$ -	$ 4,160	$ 40	$ 450	$ 4,650
c. Restaurant	$ -	$ 9,706	$ 94	$ 1,050	$ 10,849
Retail Revenue	$ -	$ 7,674	$ 74	$ 585	$ 8,334
Restaurant Revenue	$ -	$ 32,627	$ 316	$ 3,284	$ 36,227

Table A.20 (Continued)

Outside the FKNMS boundary

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	-	22,800	848	76,353	100,001
Wholesale Margin					
a. Exported	-	4,925	231	42,605	47,761
b. Retail	-	369	17	1,420	1,807
c. Restaurant	-	862	40	3,314	4,216
Retail Margin	-	1,468	58	1,113	2,639
Restaurant Margin	-	10,422	409	22,261	33,092
Total Primary Output	-	40,846	1,604	147,066	189,516
Total Output	-	61,269	2,406	220,599	284,274
Total Income	-	37,987	1,492	136,771	176,250
Number of Jobs	-	2	0	6	8

	Lobster	Reef Fish	King Mackerel	Shrimp	Total
Harvest Revenue	$ -	$ 22,800	$ 848	$ 76,353	$ 100,001
Wholesale Revenue					
a. Exported	$ -	$ 23,165	$ 910	$ 111,323	$ 135,397
b. Retail	$ -	$ 1,737	$ 68	$ 3,711	$ 5,516
c. Restaurant	$ -	$ 4,054	$ 159	$ 8,658	$ 12,871
Retail Revenue	$ -	$ 3,205	$ 126	$ 4,824	$ 8,155
Restaurant Revenue	$ -	$ 13,628	$ 535	$ 27,085	$ 41,248

Appendix B: Estimation of Consumer's Surplus

King Mackerel

Three studies were found in the literature that estimated demand functions for king mackerel and that could be used for estimating consumer's surplus; 1) Leeworthy (1990), 2) Vondruska (1999) and 3) Easley, Adams, Thurman and Kincaid (1993). All three studies used monthly data. Since the Vondruska model specification was the same as Leeworthy (1990), but was updated with more recent data, only the Vondruska (1999) and Easley et al (1993) results are used here.

1. Results using the Vondruska (1999) demand estimation.

Vondruska estimated a linear demand model with price as the dependent variable. Price was specified as ex vessel value per pound in 1990 dollars. Quantity was in thousands of pounds of South Atlantic and Gulf of Mexico landings. The estimated coefficient on quantity (Q) was 0.03608. Inverting the demand model to make quantity a function of price simply requires taking the reciprocal of the estimated coefficient on (Q) to get the estimated coefficient on price or 27.716. The equation for consumer's surplus for a linear equation is as follows:

Consumer's Surplus = Quantity squared divided by two times the price coefficient.

Since price was in 1990 dollars, consumer's surplus must be adjusted to 1997 dollars. The adjustment using the Consumer Price Index is to multiply by 1.144. Also, the above is specified in terms of monthly quantity. So we must calculate consumer's surplus for each month and sum the results across months.

$CS = [(Q)^2 / (2 * 27.716)] * 1.144$ Monthly CS in 1997 dollars.

To estimate consumer's surplus for the entire TERSA means that we eliminate the TERSA catch from the total supply from the South Atlantic and Gulf of Mexico. So step one is to calculate the base CS or the CS with the total South Atlantic and Gulf of Mexico supply. Step two is to subtract the TERSA supply and calculate the new CS with the TERSA supply removed. The difference between the base CS and the new CS is the CS for the TERSA. The same methodology is followed for each boundary alternative.

Before we could implement the above estimation, we had to estimate the monthly catch from the TERSA. We did this by assuming the monthly catch of the TERSA was distributed according to the distribution of the Florida West Coast 1997 monthly distribution for months January, February, March, November, and December. From our survey, we determined that TERSA fishermen catch king mackerel during these five months. The total 1997 catch of king mackerel was 96,346 pounds. For 1997, using the Vondruska demand equation results in an estimate of consumer's surplus for TERSA catch of $2,694. Table B.1 summarizes the calculations for TERSA consumer's surplus. Consumer's surplus estimates for each of the alternatives are in Tables B.2, B.3, B.4 and B.5.

Table B.1. Consumer's Surplus for TERSA King Mackerel, 1997

Month	1997 Landings SA & Gulf 000's Pounds	1997 Base CS	1997 TERSA Landings 000's Pounds	New CS SA & Gulf 1997 $	TERSA CS 1997 $
Jan.	774.312	12,374	59.243	10,553	1,821
Feb.	438.199	3,963	10.165	3,781	182
Mar.	684.112	9,659	1.589	9,614	45
Nov.	701.023	10,143	14.606	9,724	419
Dec.	516.360	5,503	10.743	5,276	227
Total			**96.346**		**2,694**

Table B.2. Consumer's Surplus Loss King Mackerel, 1997: Preferred Alternative

Month	1997 Landings SA & Gulf 000's Pounds	1997 Base CS	Lost Landings 000's Pounds	New CS SA & Gulf 1997 $	Lost CS 1997 $
Jan.	774.312	12,374	8.294	12,267	107
Feb.	438.199	3,963	1.423	3,928	34
Mar.	684.112	9,659	0.223	9,575	84
Nov.	701.023	10,143	2.045	10,054	89
Dec.	516.360	5,503	1.504	5,455	48
Total			**13.489**		**362**

Table B.3. Consumer's Surplus Loss for King Mackerel, 1997: Alternative II

Month	1997 Landings SA & Gulf 000's Pounds	1997 Base CS	Lost Landings 000's Pounds	New CS SA & Gulf 1997 $	Lost CS 1997 $
Jan.	774.312	12,374	1.009	12,341	33
Feb.	438.199	3,963	0.571	3,953	10
Mar.	684.112	9,659	0.891	9,634	25
Nov.	701.023	10,143	0.913	10,116	27
Dec.	516.360	5,503	0.673	5,488	15
Total			**4.057**		**110**

Table B.4. Consumer's Surplus Loss King Mackerel, 1997: Alternative IV

Month	1997 Landings SA & Gulf 000's Pounds	1997 Base CS	Lost Landings 000's Pounds	New CS SA & Gulf 1997 $	Lost CS 1997 $
Jan.	774.312	12,374	3.730	12,255	119
Feb.	438.199	3,963	2.111	3,924	38
Mar.	684.112	9,659	3.295	9,566	93
Nov.	701.023	10,143	3.377	10,045	98
Dec.	516.360	5,503	2.487	5,450	53
Total			**14.999**		**402**

Table B.5. Consumer's Surplus Loss King Mackerel, 1997: Alternative V

Month	1997 Landings SA & Gulf 000's Pounds	1997 Base CS	Lost Landings 000's Pounds	New CS SA & Gulf 1997 $	Lost CS 1997 $
Jan.	774.312	12,374	3.730	12,255	119
Feb.	438.199	3,963	2.111	3,924	38
Mar.	684.112	9,659	3.295	9,566	93
Nov.	701.023	10,143	3.377	10,045	98
Dec.	516.360	5,503	2.487	5,450	53
Total			**14.999**		**402**

2. Estimates using the Easley, Adams, Thurman and Kincaid (1993)

The Easley et al equation also used price per pound as the dependent variable in 1982-84 dollars. Quantity, however, was specified as pounds of South Atlantic and Gulf of Mexico landings per million population of the U.S. The estimated coefficient on quantity was 0.000051699. Inverting the equation to make quantity a function of price results in an estimate of the coefficient on price of 19,342.36 (reciprocal of .000051699). The equation for consumer's surplus is the same as that used above for the Vondruska equation except that the CPI adjustment to 1997 dollars is 1.605 and the monthly CS is per million people so must be multiplied by the 1997 U.S. population of 267.744 million. Results for the TERSA and for each of the alternatives are in tables B.6., B.7, B.8, B.9 and B.10. The estimated consumer's surpluses using the Easley et al equations are about 7.5 times higher than those using the Vondruska equation.

Table B.6. Consumer's Surplus for TERSA King Mackerel, 1997

Month	1997 Landings SA & Gulf lbs per million	1997 Base CS	1997 TERSA Landings lbs per million	New CS SA & Gulf 1997 $	TERSA CS 1997 $
Jan.	2,892	92,908	221.268	79,235	13,673
Feb.	1,637	29,768	37.964	28,403	1,365
Mar.	2,555	72,517	5.937	72,180	337
Nov.	2,618	76,137	54.552	72,997	3,140
Dec.	1,929	41,335	40.123	39,634	1,701
Total			**359.844**		**20,216**

Table B.7. Consumer's Surplus King Mackerel, 1997: Preferred Alternative

Month	1997 Landings SA & Gulf lbs per million	1997 Base CS	Lost Landings lbs per million	New CS SA & Gulf 1997 $	Lost CS 1997 $
Jan.	2,892	92,908	30.979	90,928	1,980
Feb.	1,637	29,768	5.315	29,575	193
Mar.	2,555	72,517	0.831	72,469	48
Nov.	2,618	76,137	7.638	75,693	444
Dec.	1,929	41,335	5.617	41,094	241
Total			**50.380**		**2,906**

Table B.8. Consumer's Surplus King Mackerel, 1997: Alternative II

Month	1997 Landings SA & Gulf lbs per million	1997 Base CS	Lost Landings lbs per million	New CS SA & Gulf 1997 $	Lost CS 1997 $
Jan.	2,892	92,908	9.317	92,310	598
Feb.	1,637	29,768	1.599	29,710	58
Mar.	2,555	72,517	0.250	72,502	15
Nov.	2,618	76,137	2.297	76,003	134
Dec.	1,929	41,335	1.689	41,263	72
Total			**15.153**		**876**

Table B.9. Consumer's Surplus King Mackerel, 1997: Alternative IV

Month	1997 Landings SA & Gulf lbs per million	1997 Base CS	Lost Landings lbs per million	New CS SA & Gulf 1997 $	Lost CS 1997 $
Jan.	2,892	92,908	34.447	90,708	2,200
Feb.	1,637	29,768	5.910	29,554	214
Mar.	2,555	72,517	0.924	72,464	53
Nov.	2,618	76,137	8.493	75,644	493
Dec.	1,929	41,335	6.246	41,068	267
Total			**56.020**		**3,228**

Table B.10. Consumer's Surplus King Mackerel, 1997: Alternative V

Month	1997 Landings SA & Gulf lbs per million	1997 Base CS	Lost Landings lbs per million	New CS SA & Gulf 1997 $	Lost CS 1997 $
Jan.	2,892	92,908	34.447	90,708	2,200
Feb.	1,637	29,768	5.910	29,554	214
Mar.	2,555	72,517	0.924	72,464	53
Nov.	2,618	76,137	8.493	75,644	493
Dec.	1,929	41,335	6.246	41,068	267
Total			**56.020**		**3,228**

Shrimp

We were able to locate two studies on the demand for shrimp; Keithly, Roberts and Ward (1993) and Gillig, Caps and Griffin (1998).

1. Keithly, Roberts and Ward (1993).

The Keithly, Roberts and Ward study modeled annual demand using a simultaneous equation model which modeled both import and export demand. Under U.S. demand, ex vessel price of South Atlantic and Gulf of Mexico landings were a function of U.S. disposable income, import quantity, beginning of the year inventories and South Atlantic and Gulf of Mexico landings. The ex vessel demand function was linear and the estimated coefficient on landings was equal to .0093. Inverting the demand function to make quantity a function of price yields a coefficient on price of 107.52688 (the reciprocal of 0.0093). Prices and income were in 1980 dollars, so the adjustment to 1997 dollars using the Consumer Price Index was 1.948. Consumer's surplus was calculated using the following formula:

$CS = [(Q^2)/(2*107.52688)] * 1.948$ Annual Consumer's Surplus in 1997 dollars.

Quantity (Q) was measured in millions of headless pounds of South Atlantic and Gulf of Mexico landings. A conversion factor of 0.65 was used to convert heads-on weight to headless weight. We used the same

conversion for TERSA landings. In 1997, South Atlantic and Gulf of Mexico landings were 222.136 million pounds. Multiplying this by 0.65 converts this to headless weight (144.388 million pounds).

Total TERSA Consumer's Surplus

TERSA landings in 1997 was 715,500 pounds

Base CS SA & Gulf - CS SA & Gulf Without TERSA Landings = TERSA Consumer's Surplus

Base CS = $[(144.388^2)/(2 * 107.52688)] * 1.948$ = $188.840 million

CS without TERSA landings = $[(144.388 - .7155)^2 / (2 * 107.52688)] * 1.948$ = $186.894 million

TERSA Consumer's Surplus = $188.840 million - $186.894 million = **$1.946 million**

Consumer's Surplus: Preferred Alternative (Lost Landings 58,374)

CS without landings from Preferred Alternative Boundaries = $[(144.388 - .058374)^2 / 215.06] * 1.948$
= $188.686 million

Lost CS = $188.840 million - $188.686 million = **$0.154 million**

Consumer's Surplus: Alternative II (Lost Landings 7,940)

CS without landings from Alternative 1B boundaries = $[(144.388 - .00794)^2 / 215.06] * 1.948$
= $188.818 million

Lost CS = $188.840 million - $188.818 million = **$0.022 million**

Consumer's Surplus: Alternative IV (Lost Landings 58,375)

CS without landings from Alternative 2C boundaries = $[(144.388 - .058375)^2 / 215.06] * 1.948$
= $188.686 million

Lost CS = $188.840 million - $188.686 million = **$0.154 million**

Consumer's Surplus: Alternative V (Lost Landings 73,427)

CS without landings from Alternative 2C boundaries = $[(144.388 - .073427)^2 / 215.06] * 1.948$
= $188.647 million

Lost CS = $188.840 million - $188.647 million = **$0.193 million**

2. Gillig, Caps, and Griffin (1998)

Gillig, Caps and Griffin estimate monthly models for three different size classes of shrimp; small, medium and large. The demand equations were estimated in linear functional form with real price as the dependent variable. Price was in 1987 dollars so converting to 1997 dollars requires multiplying by 1.4129. Quantity was measured in millions of pounds (headless) of Gulf of Mexico landings. Again, we use the .65 conversion factor to derive headless weight. In 1997, gulf shrimp landings were 197,458,466 pounds heads-on and 128,348,003 pounds headless. This yields an average monthly catch of 10.696 million pounds. The distribution by size class was 25.21 % small, 34.92 % medium, and 39.77 % large. We use

the same distribution for TSA shrimp landings and assume average monthly landings are annual landings divided by 12 months (.7155 million / 12 = 0.060 million).

Table B.11. Derivation of Consumer's Surplus for Shrimp from the TERSA, 1997

Class	(1) Monthly Gulf Landings millions Pounds	(2) Monthly Gulf CS millions 1997 $	(3) Annual Gulf CS millions 1997 $	(4) Annual TERSA Landings millions Pounds	(5)=(4)/12 Monthly TERSA Landings millions Pounds	(6)=(1)-(5) New Gulf Landings millions Pounds
Small	2.707	0.187	2.249	0.181	0.015	2.692
Medium	3.735	0.466	5.594	0.250	0.021	3.714
Large	4.254	2.150	25.804	0.284	0.024	4.230
Total	**10.696**			**0.715**	**0.060**	

Class	(7) New Monthly Gulf CS millions 1997 $	(8) New Annual Gulf CS millions 1997 $	(9) = (3) - (8) Annual TERSA CS millions 1997 $
Small	0.185	2.224	0.025
Medium	0.461	5.531	0.284
Large	2.126	25.513	0.291
Total			**0.600**

Monthly CS Small shrimp = [(monthly landings)^2 / (2 * 27.142)] * 1.4129

Monthly CS Medium shrimp = [(monthly landings)^2 / (2 * 21.142)] * 1.4129

Monthly CS Large shrimp = [(monthly landings)^2 / (2 * 5.9453)] * 1.4129

Annual CS = Monthly CS * 12

Table B.12. Derivation of Consumer's Surplus for Shrimp: Preferred Alternative

Class	(1) Monthly Gulf Landings millions Pounds	(2) Monthly Gulf CS millions 1997 $	(3) Annual Gulf CS millions 1997 $	(4) Annual Lost Landings millions Pounds	(5)=(4)/12 Monthly Lost Landings millions Pounds	(6)=(1)-(5) New Gulf Landings millions Pounds
Small	2.707	0.187	2.249	0.01476	0.00123	2.70577
Medium	3.735	0.466	5.594	0.02040	0.00170	3.73333
Large	4.254	2.150	25.804	0.02316	0.00193	4.25207
Total	**10.696**				**0.00486**	

Class	(7) New Monthly Gulf CS millions 1997 $	(8) New Annual Gulf CS millions 1997 $	(9) = (3) - (8) Annual Lost CS millions 1997 $
Small	0.187	2.247	0.002
Medium	0.466	5.589	0.005
Large	2.148	25.780	0.024
Total			**0.031**

Table B.13. Derivation of Consumer's Surplus for Shrimp: Alternative II

Class	(1) Monthly Gulf Landings millions Pounds	(2) Monthly Gulf CS millions 1997 $	(3) Annual Gulf CS millions 1997 $	(4) Annual Lost Landings millions Pounds	(5)=(4)/12 Monthly Lost Landings millions Pounds	(6)=(1)-(5) New Gulf Landings millions Pounds
Small	2.707	0.187	2.249	0.00201	0.00017	2.70683
Medium	3.735	0.466	5.594	0.00277	0.00023	3.73477
Large	4.254	2.150	25.804	0.00316	0.00026	4.25374
Total	**10.696**				**0.00066**	

Class	(7) New Monthly Gulf CS millions 1997 $	(8) New Annual Gulf CS millions 1997 $	(9) = (3) - (8) Annual Lost CS millions 1997 $
Small	0.191	2.288	0.00028
Medium	0.466	5.593	0.00069
Large	2.150	25.801	0.00032
Total			**0.0042**

Table B.14. Derivation of Consumer's Surplus for Shrimp: Alternative IV

Class	(1) Monthly Gulf Landings millions Pounds	(2) Monthly Gulf CS millions 1997 $	(3) Annual Gulf CS millions 1997 $	(4) Annual Lost Landings millions Pounds	(5)=(4)/12 Monthly Lost Landings millions Pounds	(6)=(1)-(5) New Gulf Landings millions Pounds
Small	2.707	0.187	2.249	0.01477	0.00123	2.70577
Medium	3.735	0.466	5.594	0.02038	0.00170	3.73330
Large	4.254	2.150	25.804	0.02322	0.00193	4.25206
Total	**10.696**				**0.00486**	

Class	(7) New Monthly Gulf CS millions 1997 $	(8) New Annual Gulf CS millions 1997 $	(9) = (3) - (8) Annual Lost CS millions 1997 $
Small	0.191	2.287	0.002
Medium	0.466	5.589	0.005
Large	2.148	25.780	0.023
Total			**0.031**

Table B.15. Derivation of Consumer's Surplus for Shrimp: Alternative V

Class	(1) Monthly Gulf Landings millions Pounds	(2) Monthly Gulf CS millions 1997 $	(3) Annual Gulf CS millions 1997 $	(4) Annual Lost Landings millions Pounds	(5)=(4)/12 Monthly Lost Landings millions Pounds	(6)=(1)-(5) New Gulf Landings millions Pounds
Small	2.707	0.187	2.249	0.01858	0.00155	2.70545
Medium	3.735	0.466	5.594	0.02564	0.00213	3.73286
Large	4.254	2.150	25.804	0.02920	0.00243	4.25157
Total	**10.696**				**0.00611**	

Class	(7) New Monthly Gulf CS millions 1997 $	(8) New Annual Gulf CS millions 1997 $	(9) = (3) - (8) Annual Lost CS millions 1997 $
Small	0.190	2.286	0.003
Medium	0.466	5.587	0.006
Large	2.148	25.774	0.029
Total			**0.038**

Reef Fish

Only one study was identified that could be used for estimating consumer's surplus for reef fish. The study was by Easley, Thurman and Park (1996) and was done for the South Atlantic Snapper-Grouper complex. The authors use what they term a synthetic inverse demand system approach and estimated separate demands for grouper, snapper, jacks, porgies, and tilefishes. They aggregated species that their results indicated were perfect substitutes. The report published formulas for consumer's surplus and uncompensated flexibility's which come from the estimated demand system (complete estimated demand functions were not presented in the report). The model was estimated with all prices and income measured in 1982-84 dollars, so using the Consumer Price Index 1982-84=1.00 to derive 1997 dollars we multiply by 1.605. The models were estimated using monthly data. The consumer's surplus formula was as follows:

$CS = \Delta q [V^0 - .5 * (\text{uncompensated flexibility}) * (V^0/q^0)*\Delta q]$

where,

Δq = the change in landings measured in pounds per million of U.S. Population

V^0 = ex vessel value of landings in thousands of $ / per capita disposable income thousands $

q^0 = pounds of landings per million people

The uncompensated flexibilities are as follows:

Grouper = .477
Snapper = .432
Jacks = .127
Titlefishes = .042
Porgies = .085 (We use porgies for all other reef fish)

Below are the tables summarizing the calculations for consumer's surplus. Tables B.13 through B.17 are for grouper, Tables B.18 – B.22 for snapper, B.23 – B.27 for jacks, B.28 – B32 for tilefishes, and B.33-B37 for other reef fish. The first table of each series contains the information for the constants used in the equations. The following column label definitions are used across all tables:

SA&G lbs = South Atlantic and Gulf of Mexico monthly landings in pounds 1997.
SA&G $ = Ex vessel value of South Atlantic and Gulf of Mexico monthly landings in dollars 1997.
DISP = Disposable Personal Income Per Month billions of dollars 1997
DISP PC = Disposable Personal Income Per Capita, thousands of dollars per person per month 1997.
V = Ex Vessel value of landings in thousands of $ divided by per capita disposable income in thousands of dollars.
Q = pounds of landings per million people
CSPC = Consumer's surplus per million people in 1997 dollars
CS = total consumer's surplus in 1997 dollars.

Table B.16. Grouper: Inputs into Consumer's Surplus Calculations

Month	SA&G lbs	SA&G $	$/lb	DISP	DISP PC	V	Q	V/Q
Jan	512,557	1,049,229	2.047048	1,903.73	7.110262	0.551144	1,914.355	0.000288
Feb	503,717	941,703	1.869508	1,903.73	7.110262	0.494662	1,881.338	0.000263
Mar	616,368	1,278,736	2.074631	1,903.73	7.110262	0.6717	2,302.080	0.000292
Apr	536,118	1,155,090	2.154544	1,922.63	7.180852	0.600786	2,002.353	0.000300
May	965,025	1,662,788	1.723052	1,922.63	7.180852	0.864851	3,604.282	0.000240
Jun	966,799	1,567,167	1.620985	1,922.63	7.180852	0.815116	3,610.908	0.000226
Jul	898,717	1,545,944	1.720168	1,940.50	7.247595	0.796673	3,356.628	0.000237
Aug	799,706	1,561,173	1.952184	1,940.50	7.247595	0.804521	2,986.831	0.000269
Sep	656,637	1,275,408	1.942333	1,940.50	7.247595	0.657257	2,452.481	0.000268
Oct	499,075	954,142	1.911821	1,959.80	7.319678	0.486857	1,864.001	0.000261
Nov	552,750	1,169,013	2.114904	1,959.80	7.319678	0.596496	2,064.472	0.000289
Dec	459,823	878,013	1.909459	1,959.80	7.319678	0.448012	1,717.398	0.000261
Total	7,967,292	15,038,406						

Table B.17. Consumer's Surplus Calculations for Grouper in TERSA 1997

Month	%SA&G lbs	TERSA Lbs	TERSA lbs per million people	CSPC	CS
Jan.	0.064332649	9,405	35.1258	19.27	8,283
Feb.	0.063223113	9,243	34.5200	17.00	7,306
Mar.	0.077362296	11,310	42.2400	28.25	12,139
Apr.	0.067289865	9,837	36.7405	21.98	9,444
May	0.121123338	17,707	66.1337	56.95	24,471
Jun.	0.121345998	17,739	66.2553	53.77	23,106
Jul.	0.112800811	16,490	61.5896	48.85	20,993
Aug.	0.100373628	14,674	54.8043	43.90	18,864
Sept.	0.082416585	12,048	44.9997	29.45	12,654
Oct.	0.062640481	9,157	34.2019	16.58	7,124
Nov.	0.069377399	10,142	37.8803	22.50	9,667
Dec.	0.057713838	8,437	31.5119	14.06	6,040
		146,189			**160,093**

Table B. 18. Consumer's Surplus Calculations for Grouper: Preferred Alternative

Month	III lbs	III lbs per million people	III- CSPC	III - CS
Jan.	1,909	7.1300	3.93	1,687
Feb.	1,876	7.0070	3.46	1,488
Mar.	2,296	8.5740	5.75	2,473
Apr.	1,997	7.4577	4.48	1,924
May	3,594	13.4241	11.60	4,985
Jun.	3,601	13.4487	10.95	4,707
Jul.	3,347	12.5017	9.95	4,276
Aug.	2,978	11.1244	8.94	3,843
Sept.	2,446	9.1342	6.00	2,578
Oct.	1,859	6.9424	3.38	1,451
Nov.	2,059	7.6891	4.58	1,969
Dec.	1,713	6.3964	2.86	1,230
	29,674			**32,610**

Table B. 19. Consumer's Surplus Calculations for Grouper: Alternative II

Month	II lbs	II lbs per million people	II - CSPC	II - CS
Jan.	1219.168	4.553484044	2.508201	1,078
Feb.	1198.141	4.474950732	2.212333	951
Mar.	1466.093	5.475726316	3.67596	1,580
Apr.	1275.21	4.762796643	2.8598	1,229
May	2295.408	8.573145893	7.410285	3,184
Jun.	2299.628	8.588905859	6.996985	3,007
Jul.	2137.688	7.98407498	6.357089	2,732
Aug.	1902.181	7.104475231	5.712457	2,455
Sept.	1561.877	5.833470428	3.831917	1,647
Oct.	1187.1	4.433711859	2.157358	927
Nov.	1314.771	4.910552983	2.927464	1,258
Dec.	1093.735	4.085002631	1.82909	786
	18951			**20,833**

Table B. 20. Consumer's Surplus Calculations for Grouper: Alternative IV

Month	IV lbs	IV lbs per million people	IV - CSPC	IV - CS
Jan.	2651.277	9.902284018	5.4508496	2,342
Feb.	2605.551	9.731500689	4.8078655	2,066
Mar.	3188.255	11.90784829	7.9886376	3,433
Apr.	2773.15	10.35746796	6.2149494	2,671
May	4991.735	18.64368574	16.104114	6,920
Jun.	5000.911	18.67795833	15.205925	6,534
Jul.	4648.747	17.36265622	13.815295	5,937
Aug.	4136.598	15.44982498	12.414374	5,335
Sept.	3396.552	12.68582045	8.3275633	3,579
Oct.	2581.539	9.641820122	4.6883948	2,015
Nov.	2859.181	10.6787879	6.3619967	2,734
Dec.	2378.503	8.883495775	3.9749986	1,708
	41212			**45,274**

Table B. 21. Consumer's Surplus Calculations for Grouper: Alternative V

Month	V lbs	V lbs per million people	V - CSPC	V - CS
Jan.	2780.714	10.38572077	5.716619	2,457
Feb.	2732.756	10.20659967	5.042285	2,167
Mar.	3343.908	12.48919816	8.378143	3,600
Apr.	2908.537	10.86312712	6.517975	2,801
May	5235.435	19.55388413	16.88931	7,258
Jun.	5245.059	19.58982992	15.94733	6,853
Jul.	4875.702	18.21031381	14.48889	6,226
Aug.	4338.55	16.20409674	13.01967	5,595
Sept.	3562.374	13.30515148	8.733594	3,753
Oct.	2707.572	10.11254084	4.916989	2,113
Nov.	2998.769	11.20013414	6.672192	2,867
Dec.	2494.623	9.31719454	4.16881	1,791
	43224			**47,482**

Table B.22. Snapper: Inputs to Consumer's Surplus Calculations

Month	SA&G lbs	SA&G $	DISP	DISP PC	V	Q	V/Q
Jan	339,594	739,353	1903.73	7.110262	0.388371	1268.353	0.000306
Feb	2,220,364	3,881,220	1903.73	7.110262	2.038745	8292.862	0.000246
Mar	1,969,250	3,551,959	1903.73	7.110262	1.865789	7354.973	0.000254
Apr	483,476	1,006,288	1922.63	7.180852	0.523391	1805.74	0.00029
May	669,909	1,168,103	1922.63	7.180852	0.607555	2502.05	0.000243
Jun	686,706	1,147,159	1922.63	7.180852	0.596661	2564.786	0.000233
Jul	627,290	1,040,909	1940.5	7.247595	0.536413	2342.872	0.000229
Aug	473,381	883,293	1940.5	7.247595	0.455188	1768.036	0.000257
Sep	1,475,268	2,786,940	1940.5	7.247595	1.436197	5509.995	0.000261
Oct	737,504	1,443,727	1959.8	7.319678	0.736671	2754.512	0.000267
Nov	369,793	784,636	1959.8	7.319678	0.400365	1381.144	0.00029
Dec	298,679	643,952	1959.8	7.319678	0.32858	1115.539	0.000295
Total	10,351,214	19,077,539					

Table B.23. Consumer's Surplus Calculations for Snapper TERSA 1997

Month	%SA&G lbs	TERSA Lbs	TERSA lbs per million people	CSPC	CS
Jan.	0.0328	11,645	43.4934	16.77	7,205
Feb.	0.2145	76,139	284.3725	575.47	247,296
Mar.	0.1902	67,528	252.2112	467.09	200,721
Apr.	0.0467	16,579	61.9211	32.17	13,824
May	0.0647	22,972	85.7984	51.74	22,235
Jun.	0.0663	23,548	87.9497	52.09	22,384
Jul.	0.0606	21,511	80.3400	42.78	18,382
Aug.	0.0457	16,233	60.6281	27.39	11,771
Sept.	0.1425	50,589	188.9446	269.35	115,748
Oct.	0.0712	25,290	94.4556	69.07	29,680
Nov.	0.0357	12,681	47.3611	18.82	8,088
Dec.	0.0289	10,242	38.2532	12.48	5,361
		354,956			**702,696**

Table B.24. Consumer's Surplus Calculations for Snapper: Preferred Alternative

Month	III lbs	III lbs per million people	III - CSPC	III - CS
Jan.	2,364	8.8284	3.42	1,471
Feb.	15,455	57.7228	117.51	50,495
Mar.	13,707	51.1946	95.37	40,985
Apr.	3,365	12.5689	6.57	2,823
May	4,663	17.4156	10.57	4,540
Jun	4,780	17.8523	10.64	4,570
Jul.	4,366	16.3076	8.73	3,753
Aug.	3,295	12.3065	5.59	2,404
Sept.	10,269	38.3525	55.00	23,635
Oct.	5,133	19.1729	14.10	6,060
Nov.	2,574	9.6135	3.84	1,652
Dec.	2,079	7.7648	2.55	1,095
	72,050			**143,483**

Table B.25. Consumer's Surplus Calculations for Snapper: Alternative II

Month	II lbs	II lbs per million people	II - CSPC	II - CS
Jan.	2363.756	8.828419453	3.423545	1,471
Feb.	15454.92	57.72276522	117.5051	50,495
Mar.	13707.04	51.19455882	95.37465	40,985
Apr.	3365.252	12.56891737	6.568573	2,823
May	4662.926	17.4156129	10.56503	4,540
Jun.	4779.842	17.85228423	10.63575	4,570
Jul.	4366.275	16.30764748	8.734479	3,753
Aug.	3294.986	12.30647782	5.593343	2,404
Sept.	10268.66	38.35251715	54.99895	23,635
Oct.	5133.423	19.17287897	14.10286	6,060
Nov.	2573.958	9.613502344	3.843126	1,652
Dec.	2078.966	7.764752893	2.54751	1,095
	46015			**143,483**

Table B.26. Consumer's Surplus Calculations for Snapper: Alternative IV

Month	IV lbs	IV lbs per million people	IV - CSPC	IV - CS
Jan.	2806.227	10.48100645	4.063251	1,746
Feb.	18347.92	68.52785799	139.4615	59,931
Mar.	16272.85	60.77764022	113.1959	48,644
Apr.	3995.192	14.92168612	7.795942	3,350
May	5535.776	20.67563193	12.53916	5,388
Jun.	5674.578	21.19404352	12.6231	5,425
Jul.	5183.595	19.36026707	10.36656	4,455
Aug.	3911.772	14.61012066	6.638486	2,853
Sept.	12190.84	45.53170381	65.27577	28,051
Oct.	6094.346	22.76183967	16.73805	7,193
Nov.	3055.775	11.41304858	4.561233	1,960
Dec.	2468.127	9.21823273	3.023525	1,299
	100065			**170,294**

Table B.27. Consumer's Surplus Calculations for Snapper: Alternative V

Month	V lbs	V lbs per million people	V - CSPC	V - CS
Jan.	3443.145	12.8598397	4.983447	2,142
Feb.	22512.28	84.08135923	171.045	73,503
Mar.	19966.23	74.57210469	138.8311	59,660
Apr.	4901.965	18.30840314	9.561475	4,109
May	6792.21	25.36829965	15.37888	6,609
Jun.	6962.515	26.0043731	15.48182	6,653
Jul.	6360.096	23.75439155	12.71425	5,464
Aug.	4799.612	17.92612288	8.141892	3,499
Sept.	14957.75	55.86585743	80.05865	34,404
Oct.	7477.556	27.92800584	20.52868	8,822
Nov.	3749.333	14.0034238	5.594207	2,404
Dec.	3028.308	11.31045914	3.708257	1,594
	104951			**208,860**

Table B.28. Jacks: Inputs to Consumer's Surplus Calculations

Month	SA&G lbs	SA&G $	DISP	DISP PC	V	Q	V/Q
Jan	170262	170652	1903.73	7.110262	0.089641	635.9134	0.000141
Feb	177416	167454	1903.73	7.110262	0.087961	662.633	0.000133
Mar	354565	347321	1903.73	7.110262	0.182442	1324.269	0.000138
Apr	166390	165830	1922.63	7.180852	0.086252	621.4518	0.000139
May	433818	404306	1922.63	7.180852	0.210288	1620.272	0.00013
Jun	270131	224534	1922.63	7.180852	0.116785	1008.915	0.000116
Jul	224748	207143	1940.5	7.247595	0.106747	839.4138	0.000127
Aug	212867	196451	1940.5	7.247595	0.101237	795.0393	0.000127
Sep	176435	155275	1940.5	7.247595	0.080018	658.969	0.000121
Oct	150202	138759	1959.8	7.319678	0.070803	560.9911	0.000126
Nov	130786	126345	1959.8	7.319678	0.064468	488.4741	0.000132
Dec	122694	119910	1959.8	7.319678	0.061185	458.2512	0.000134
Total	2590314	2423980					

Table B.29. Consumer's Surplus Calculations for Jacks in the TERSA, 1997

Month	%SA&G lbs	TERSA Lbs	TERSA lbs per million people	CSPC	CS
Jan.	0.0657	1,299	4.8530	0.43	187
Feb.	0.0685	1,354	5.0569	0.44	191
Mar.	0.1369	2,706	10.1062	1.84	792
Apr.	0.0642	1,270	4.7426	0.41	176
May	0.1675	3,311	12.3651	2.60	1,117
Jun.	0.1043	2,062	7.6995	0.90	386
Jul.	0.0868	1,715	6.4060	0.68	294
Aug.	0.0822	1,624	6.0673	0.61	264
Sept.	0.0681	1,346	5.0289	0.40	173
Oct.	0.0580	1,146	4.2812	0.30	130
Nov.	0.0505	998	3.7278	0.24	103
Dec.	0.0474	936	3.4971	0.21	92
		19,768			**3,904**

Table B.30. Consumer's Surplus Calculations for Jacks: Preferred Alternative

Month	III lbs	III lbs per million people	III - CSPC	III - CS
Jan.	264	0.9849	0.09	38
Feb.	275	1.0263	0.09	39
Mar.	549	2.0511	0.37	161
Apr.	258	0.9625	0.08	36
May	672	2.5096	0.53	227
Jun.	418	1.5627	0.18	78
Jul.	348	1.3001	0.14	60
Aug.	330	1.2314	0.12	54
Sept.	273	1.0206	0.08	35
Oct.	233	0.8689	0.06	26
Nov.	203	0.7566	0.05	21
Dec.	190	0.7098	0.04	19
	4,012			**793**

Table B.31. Consumer's Surplus Calculations for Jacks: Alternative II

Month	II lbs	II lbs per million people	II - CSPC	II - CS
Jan.	168.4666	0.629207914	0.056399	24
Feb.	175.5452	0.655645719	0.057668	25
Mar.	350.8262	1.310304731	0.23904	103
Apr.	164.6355	0.614898832	0.053033	23
May	429.2435	1.603186377	0.33711	145
Jun.	267.2826	0.998276557	0.116576	50
Jul.	222.3781	0.830562429	0.088655	38
Aug.	210.6224	0.786655866	0.079634	34
Sept.	174.5746	0.652020406	0.05217	22
Oct.	148.6182	0.555075631	0.039298	17
Nov.	129.4069	0.483323268	0.031157	13
Dec.	121.4002	0.453419059	0.027741	12
	2563			**506**

Table B.32. Consumer's Surplus Calculations for Jacks: Alternative IV

Month	IV lbs	IV lbs per million people	IV - CSPC	IV - CS
Jan.	366.3147	1.368152831	0.122626	53
Feb.	381.7064	1.425639325	0.125384	54
Mar.	762.8383	2.849133151	0.519732	223
Apr.	357.9842	1.33703909	0.115306	50
May	933.3493	3.485976465	0.732959	315
Jun.	581.1805	2.170657531	0.253465	109
Jul.	483.5401	1.805979094	0.192757	83
Aug.	457.9784	1.710508444	0.173144	74
Sept.	379.5958	1.417756427	0.113431	49
Oct.	323.1561	1.206959225	0.085444	37
Nov.	281.383	1.050940528	0.067743	29
Dec.	263.9733	0.985916667	0.060315	26
	5573			**1,101**

Table B.33. Consumer's Surplus Calculations for Jacks: Alternative V

Month	V lbs	V lbs per million people	V - CSPC	V - CS
Jan.	384.1933	1.43492792	0.12861	55
Feb.	400.3362	1.495220142	0.131502	57
Mar.	800.07	2.988190072	0.545094	234
Apr.	375.4562	1.402295619	0.120933	52
May	978.903	3.656115636	0.768727	330
Jun.	609.5461	2.276600263	0.265834	114
Jul.	507.1401	1.894123059	0.202163	87
Aug.	480.3308	1.793992797	0.181593	78
Sept.	398.1226	1.486952506	0.118966	51
Oct.	338.9283	1.265866978	0.089614	39
Nov.	295.1164	1.102233516	0.071049	31
Dec.	276.8569	1.034036052	0.063258	27
	5845			**1,155**

Table B.34. Tilefishes: Inputs to the Consumer's Surplus Calculations

Month	SA&G lbs	SA&G $	DISP	DISP PC	V	Q	V/Q
Jan	290,902	482,200	1903.73	7.110262	0.253292	1086.493	0.000233
Feb	359,127	535,465	1903.73	7.110262	0.281272	1341.307	0.00021
Mar	426,964	684,474	1903.73	7.110262	0.359544	1594.673	0.000225
Apr	505,447	541,277	1922.63	7.180852	0.281529	1887.8	0.000149
May	533,204	584,366	1922.63	7.180852	0.303941	1991.469	0.000153
Jun	530,290	596,611	1922.63	7.180852	0.31031	1980.586	0.000157
Jul	397,861	419,546	1940.5	7.247595	0.216205	1485.975	0.000145
Aug	372,625	429,470	1940.5	7.247595	0.221319	1391.721	0.000159
Sep	331,063	431,480	1940.5	7.247595	0.222355	1236.491	0.00018
Oct	445,152	531,249	1959.8	7.319678	0.271073	1662.603	0.000163
Nov	361,336	417,563	1959.8	7.319678	0.213064	1349.558	0.000158
Dec	389,721	464,799	1959.8	7.319678	0.237167	1455.573	0.000163
Total	4,943,692	6,118,500					

Table B.35. Consumer's Surplus Calculations for Tilefishes in TERSA, 1997

Month	%SA&G lbs	TERSA Lbs	TERSA lbs per million people	CSPC	CS
Jan.	0.0588	808	3.0184	0.76	329
Feb.	0.0726	998	3.7263	1.05	450
Mar.	0.0864	1,186	4.4301	1.59	684
Apr.	0.1022	1,404	5.2445	1.48	634
May	0.1079	1,481	5.5325	1.68	723
Jun.	0.1073	1,473	5.5022	1.71	734
Jul.	0.0805	1,105	4.1282	0.89	384
Aug.	0.0754	1,035	3.8663	0.86	368
Sept.	0.0670	920	3.4351	0.76	328
Oct.	0.0900	1,237	4.6189	1.25	538
Nov.	0.0731	1,004	3.7492	0.80	343
Dec.	0.0788	1,083	4.0437	0.96	412
		13,734			**5,927**

Table B.36. Consumer's Surplus Calculations for Tilefishes: Preferred Alternative

Month	III lbs	III lbs per million people	III - CSPC	III - CS
Jan.	164	0.6127	0.16	67
Feb.	203	0.7564	0.21	91
Mar.	241	0.8993	0.32	139
Apr.	285	1.0646	0.30	129
May	301	1.1231	0.34	147
Jun.	299	1.1170	0.35	149
Jul.	224	0.8380	0.18	78
Aug.	210	0.7849	0.17	75
Sept.	187	0.6973	0.16	67
Oct.	251	0.9376	0.25	109
Nov.	204	0.7611	0.16	70
Dec.	220	0.8209	0.19	84
	2,788			**1,203**

Table B.37. Consumer's Surplus Calculations for Tilefishes: Alternative II

Month	II lbs	II lbs per million people	II - CSPC	II - CS
Jan.	104.7407	0.391197	0.099086	43
Feb.	129.3054	0.482944	0.135837	58
Mar.	153.7304	0.574169	0.206437	89
Apr.	181.9886	0.679711	0.191357	82
May	191.9827	0.717038	0.217936	94
Jun.	190.9335	0.713119	0.221286	95
Jul.	143.2518	0.535033	0.115676	50
Aug.	134.1654	0.501096	0.110901	48
Sept.	119.2008	0.445204	0.098993	43
Oct.	160.2791	0.598628	0.162271	70
Nov.	130.1008	0.485915	0.10353	44
Dec.	140.3209	0.524086	0.124295	53
	1780			**768**

Table B.38. Consumer's Surplus Calculations for Tilefishes: Alternative IV

Month	IV lbs	IV lbs per million people	IVI - CSPC	IVI - CS
Jan.	227.8404	0.850963	0.215539	93
Feb.	281.2756	1.050539	0.295482	127
Mar.	334.4069	1.24898	0.449055	193
Apr.	395.8764	1.478563	0.416252	179
May	417.6162	1.559759	0.474067	204
Jun.	415.3339	1.551235	0.481356	207
Jul.	311.6128	1.163846	0.251625	108
Aug.	291.8475	1.090024	0.241239	104
Sept.	259.2953	0.968445	0.215335	93
Oct.	348.6521	1.302185	0.352981	152
Nov.	283.0057	1.057001	0.225205	97
Dec.	305.2374	1.140035	0.270374	116
	3872			**1,671**

Table B.39. Consumer's Surplus Calculations for Tilefishes: Alternative V

Month	V lbs	V lbs per million people	V - CSPC	V - CS
Jan.	238.9617	0.892501	0.22606	97
Feb.	295.0052	1.101818	0.309905	133
Mar.	350.7299	1.309945	0.470974	202
Apr.	415.1999	1.550735	0.43657	188
May	438.0009	1.635894	0.497207	214
Jun.	435.6072	1.626954	0.504851	217
Jul.	326.8233	1.220656	0.263907	113
Aug.	306.0931	1.143231	0.253015	109
Sept.	271.952	1.015716	0.225846	97
Oct.	365.6705	1.365747	0.370211	159
Nov.	296.8198	1.108595	0.236198	102
Dec.	320.1366	1.195682	0.283571	122
	4061			**1,753**

Table B.40. Other Reef Fish: Inputs to Consumer's Surplus Calculations

Month	SA&G lbs	SA&G $	DISP	DISP PC	V	Q	V/Q
Jan	77,672	79,442	1903.73	7.110262	0.04173	290.098	0.000144
Feb	91,632	90,959	1903.73	7.110262	0.047779	342.2374	0.00014
Mar	101,043	90,163	1903.73	7.110262	0.047361	377.3866	0.000125
Apr	75,787	78,986	1922.63	7.180852	0.041082	283.0577	0.000145
May	114,424	112,430	1922.63	7.180852	0.058477	427.3635	0.000137
Jun	123,715	113,155	1922.63	7.180852	0.058854	462.0645	0.000127
Jul	114,684	112,983	1940.5	7.247595	0.058224	428.3345	0.000136
Aug	101,299	96,090	1940.5	7.247595	0.049518	378.3427	0.000131
Sep	85,158	74,924	1940.5	7.247595	0.038611	318.0575	0.000121
Oct	87,672	68,493	1959.8	7.319678	0.034949	327.4471	0.000107
Nov	76,413	57,946	1959.8	7.319678	0.029567	285.3958	0.000104
Dec	62,477	54,591	1959.8	7.319678	0.027855	233.346	0.000119
Total	1,111,976	1,030,162					

Table B.41. Consumer's Surplus for Other Reef Fish in TERSA, 1997

Month	%SA&G lbs	TERSA Lbs	TERSA lbs per million people	CSPC	CS
Jan.	0.0699	2,794	10.43	0.43	187
Feb.	0.0824	3,296	12.31	0.59	252
Mar.	0.0909	3,634	13.57	0.64	276
Apr.	0.0682	2,726	10.18	0.42	179
May	0.1029	4,116	15.37	0.90	386
Jun.	0.1113	4,450	16.62	0.98	420
Jul.	0.1031	4,125	15.41	0.90	385
Aug.	0.0911	3,643	13.61	0.67	289
Sept.	0.0766	3,063	11.44	0.44	190
Oct.	0.0788	3,153	11.78	0.41	177
Nov.	0.0687	2,748	10.26	0.30	130
Dec.	0.0562	2,247	8.39	0.23	100
		39,995			**2,971**

Table B.42. Consumer's Surplus Calculations for Other Reef Fish: Preferred Alternative

Month	I lbs	I lbs per million people	I - CSPC	I - CS
Jan.	567	2.1179	0.09	38
Feb.	669	2.4985	0.12	51
Mar.	738	2.7551	0.13	56
Apr.	553	2.0665	0.08	36
May	835	3.1200	0.18	78
Jun.	903	3.3733	0.20	85
Jul.	837	3.1271	0.18	78
Aug.	740	2.7621	0.14	59
Sept.	622	2.3220	0.09	39
Oct.	640	2.3905	0.08	36
Nov.	558	2.0835	0.06	26
Dec.	456	1.7035	0.05	20
	8,118			**604**

Table B.43. Consumer's Surplus Calculations for Other Reef Fish: Alternative II

Month	II lbs	II lbs per million people	II - CSPC	II - CS
Jan.	362.1745	1.352689	0.056436	24
Feb.	427.2681	1.595808	0.076232	33
Mar.	471.1504	1.759705	0.083325	36
Apr.	353.385	1.319861	0.054212	23
May	533.5443	1.99274	0.116507	50
Jun.	576.867	2.154547	0.126779	54
Jul.	534.7566	1.997268	0.116265	50
Aug.	472.3441	1.764163	0.087341	38
Sept.	397.0807	1.483061	0.057251	25
Oct.	408.8032	1.526843	0.053351	23
Nov.	356.3039	1.330763	0.039339	17
Dec.	291.3222	1.088062	0.030302	13
	5185			**386**

Table B.44. Consumer's Surplus Calculations for Other Reef Fish: Alternative IV

Month	IV lbs	IV lbs per million people	IV - CSPC	IV - CS
Jan.	787.5636	2.94148	0.122694	53
Feb.	929.1125	3.470152	0.16573	71
Mar.	1024.536	3.826552	0.181152	78
Apr.	768.4504	2.870094	0.117859	51
May	1160.214	4.333298	0.25329	109
Jun.	1254.422	4.685153	0.275622	118
Jul.	1162.851	4.343144	0.252765	109
Aug.	1027.132	3.836247	0.189882	82
Sept.	863.4687	3.224979	0.124465	53
Oct.	888.9597	3.320185	0.115987	50
Nov.	774.7978	2.893801	0.085525	37
Dec.	633.4922	2.366037	0.065878	28
	11275			**838**

Table B.45. Consumer's Surplus Calculations for Other Reef Fish: Alternative V

Month	V lbs	V lbs per million people	V - CSPC	V - CS
Jan.	826.0512	3.085228	0.128687	55
Feb.	974.5175	3.639736	0.173826	75
Mar.	1074.605	4.013552	0.190001	82
Apr.	806.004	3.010353	0.123616	53
May	1216.913	4.545062	0.265662	114
Jun.	1315.724	4.914112	0.289086	124
Jul.	1219.678	4.55539	0.265112	114
Aug.	1077.327	4.023721	0.199157	86
Sept.	905.6657	3.382581	0.130545	56
Oct.	932.4024	3.48244	0.121653	52
Nov.	812.6615	3.035219	0.089703	39
Dec.	664.4505	2.481663	0.069096	30
	11826			**879**

Spiny Lobster

For spiny lobster, we were unable to locate any research that estimated a demand equation. We attempted to estimate a few simple models similar to the models used for the other species with annual data. However, none of these attempts produced downward sloping demand curves. Enough monthly data was not available to estimate a monthly model given the time constraints for developing estimates. Therefore, we decided to employ the methods used for Reef Fish above except we used annual instead of monthly numbers and we used the range of uncompensated flexibilities used for reef fish to generate an upper and lower bound set of estimates. The upper bound estimate on uncompensated flexibilities produces the lower bound estimate on consumer's surplus. We use South Atlantic and Gulf of Mexico landings and value for 1997 to estimate base consumer's surplus. The formula for consumer's surplus is the same as was used for Reef Fish. As with other species, all dollars are 1997 dollars. The consumer's surplus calculations are shown below:

1997 Constants

$V^0 = 5.0206$ $q^0 = 26544.01$ $V^0/q^0 = .000189142$ Population = 267.744 million

Consumer's Surplus for the TSA – lower bound estimate (Dq=3503.17)

CS per million people = 3503.17 [5.0206 – .5 *(.477 * .000189142) 3503.17)] = $17,034.41
CS = $17,034.41 * 267.744 = **$4,560,862**

Consumer's Surplus for the Preferred Alternative – lower bound estimate (Dq=405.10)

CS per million people = 405.10 [5.0206 - .5 * (.477 * .000189142) 405.10)] = $2,026.44
CS = $2,026.44 * 267.744 = **$542,567**

Consumer's Surplus for Alternative II – lower bound estimate (Dq=211.49)

CS per million people = 211.49 [5.0206 - .5 * (.477 * .000189142) 211.49)] = $1,059.79
CS = $1,059.79 * 267.744 = **$283,752**

Consumer's Surplus for Alternative IV – lower bound estimate (Dq=574.35)

CS per million people = 574.35 [5.0206 - .5 *(.477 * .000189142) 574.35)] = $2,868.70
CS = $2,868.70 * 267.744 = **$768,077**

Consumer's Surplus for Alternative V – lower bound estimate (Dq=615.92)

CS per million people = 615.92 [5.0206 - .5 * (.477 * .000189142) 615.92)] = $3,075.17
CS = $3,075.17 * 267.744 **= $823,358**

Consumer's Surplus for the TSA – upper bound estimate (Dq=3503.17)

CS per million people = 3503.17 [5.0206 - .5 * (.042 * .000189142) 3503.17)] = $17,539.27
CS = $17,539.27 * 267.744 = **$4,696,034**

Consumer's Surplus for the Preferred Alternative – upper bound estimate (Dq=405.10)

CS per million people = 405.10 [5.0206 - .5 * (.042 * .000189142) 405.10)] = $2,033.19
CS = $2,033.19 * 267.744 = **$544,374**

Consumer's Surplus for Alternative II – upper bound estimate (D**q=211.49)**

CS per million people = 211.49 [5.0206 - .5 *(.042 * .000189142) 211.49)] = $1,061.63
CS = $1,061.63 * 267.744 = **$284,245**

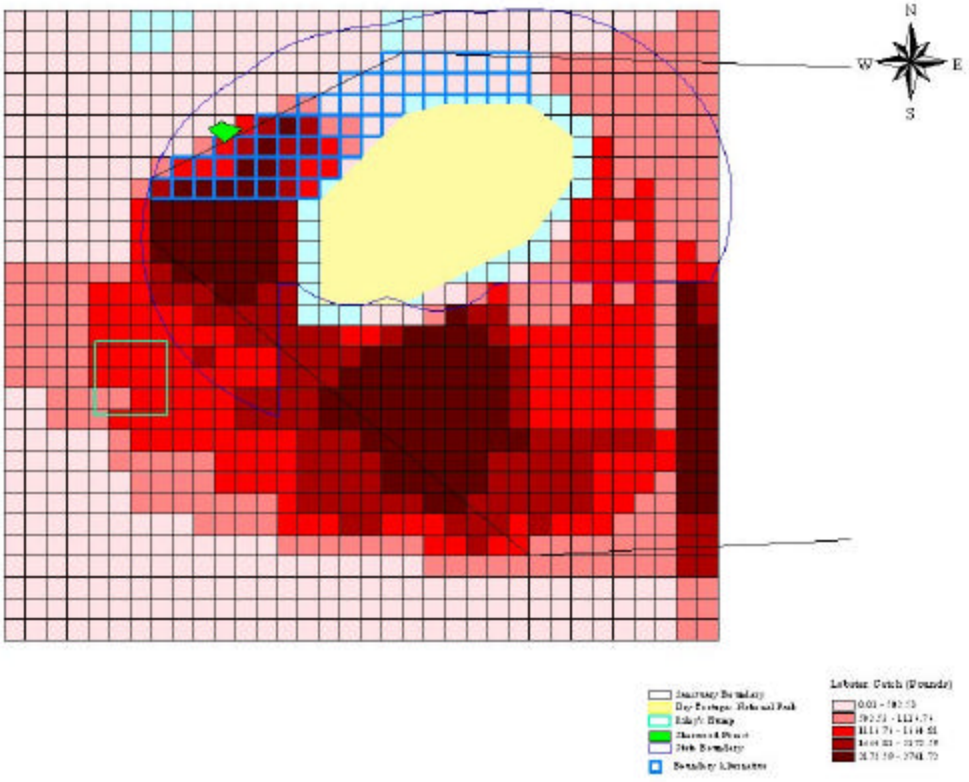
Consumer's Surplus for Alternative IV – upper bound estimate (D**q=574.35)**

CS per million people = 574.35 [5.0206 - .5 * (.042 * .000189142) 574.35)] = $2,882.27
CS = $2,882.27 * 267.744 **= $771,710**

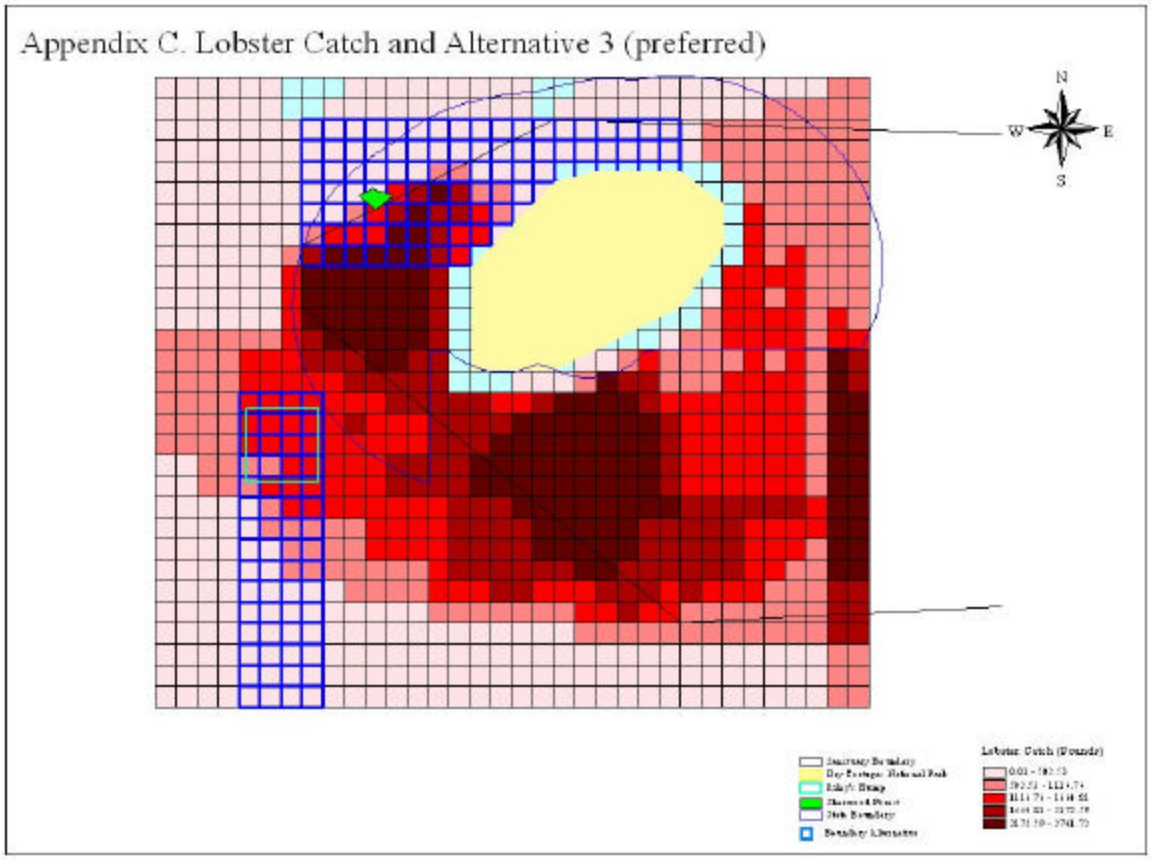
Consumer's Surplus for Alternative V – upper bound estimate (D**q=615.92)**

CS per million people = 615.92 [5.0206 - .5 * (.042 * .000189142) 615.92)] = $3,090.78
CS = $3,090.78 * 267.744 **= $827,538**

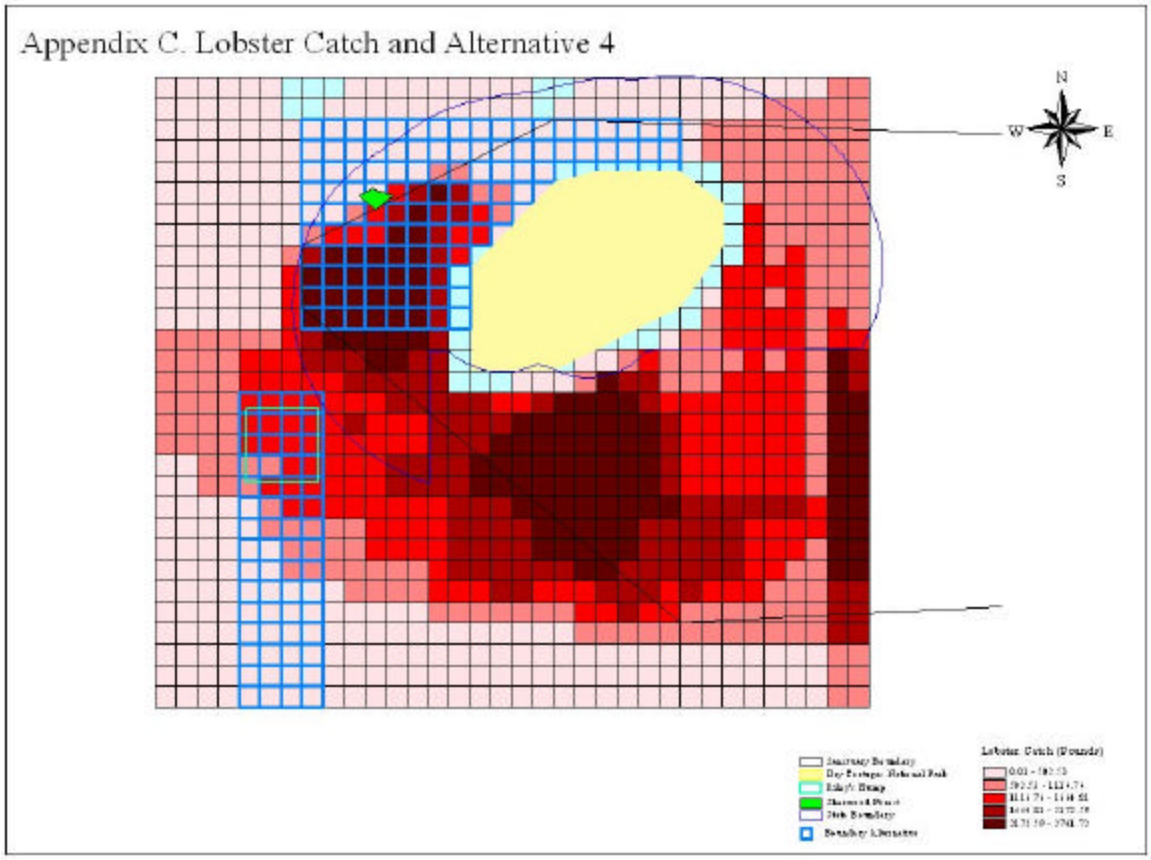
Appendix C. Lobster Catch and Alternative 2



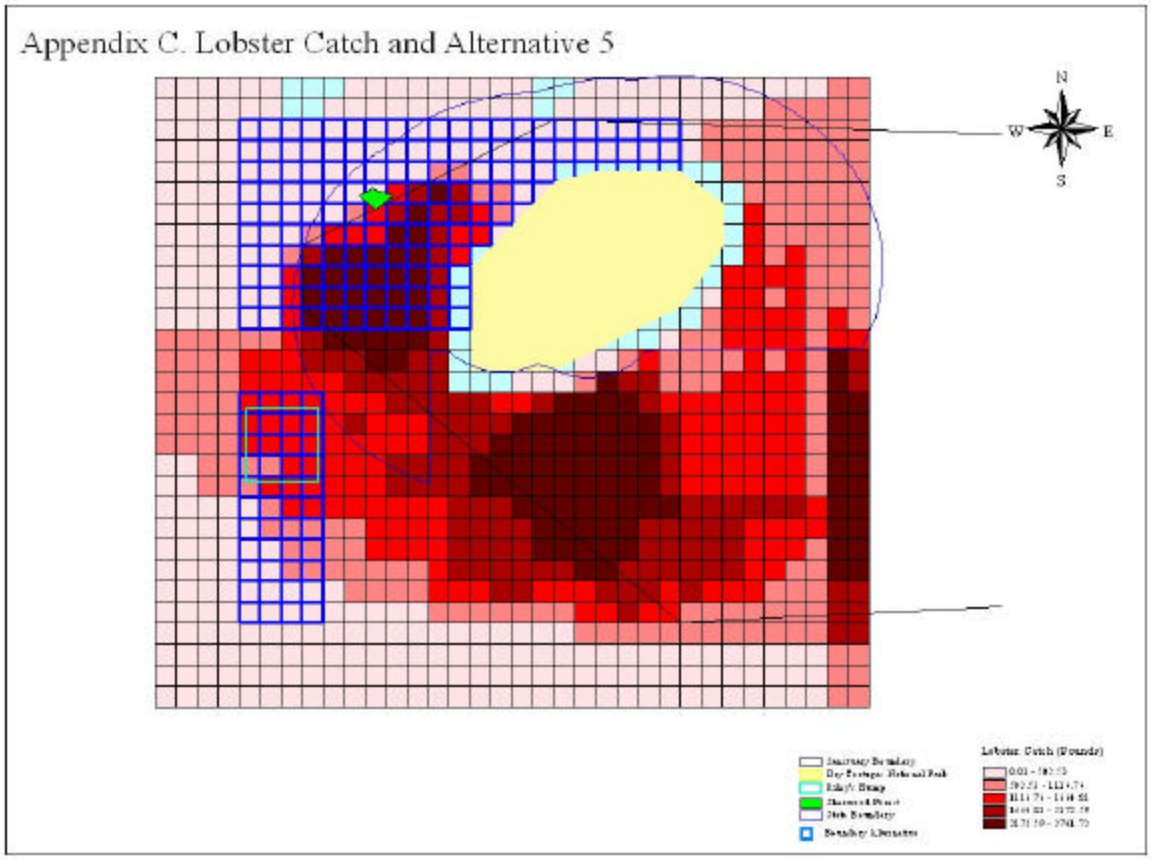
Appendix C. Lobster Catch and Alternative 3 (preferred)



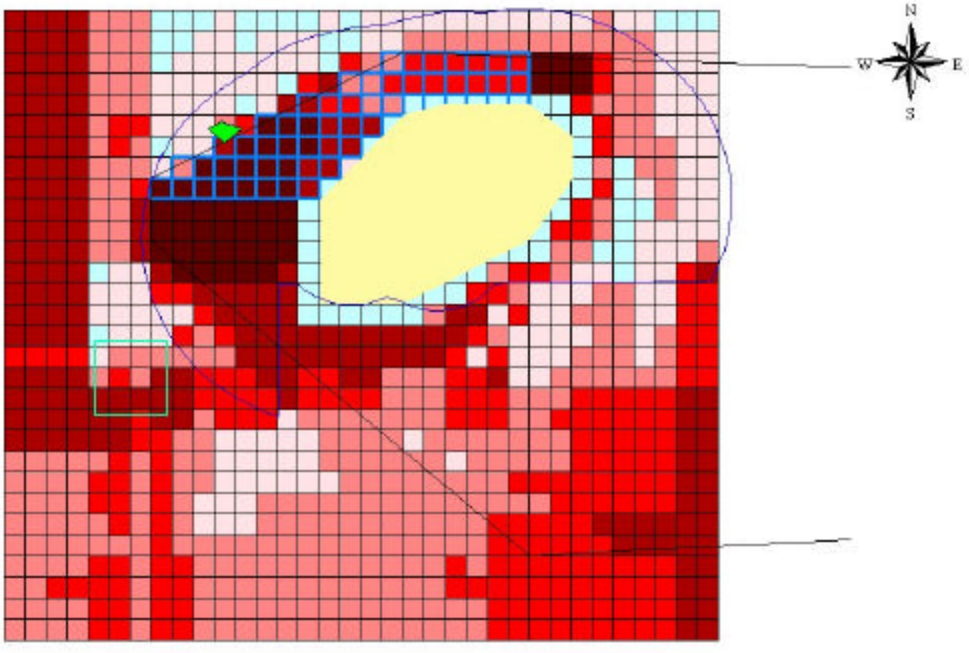
Appendix C. Lobster Catch and Alternative 4



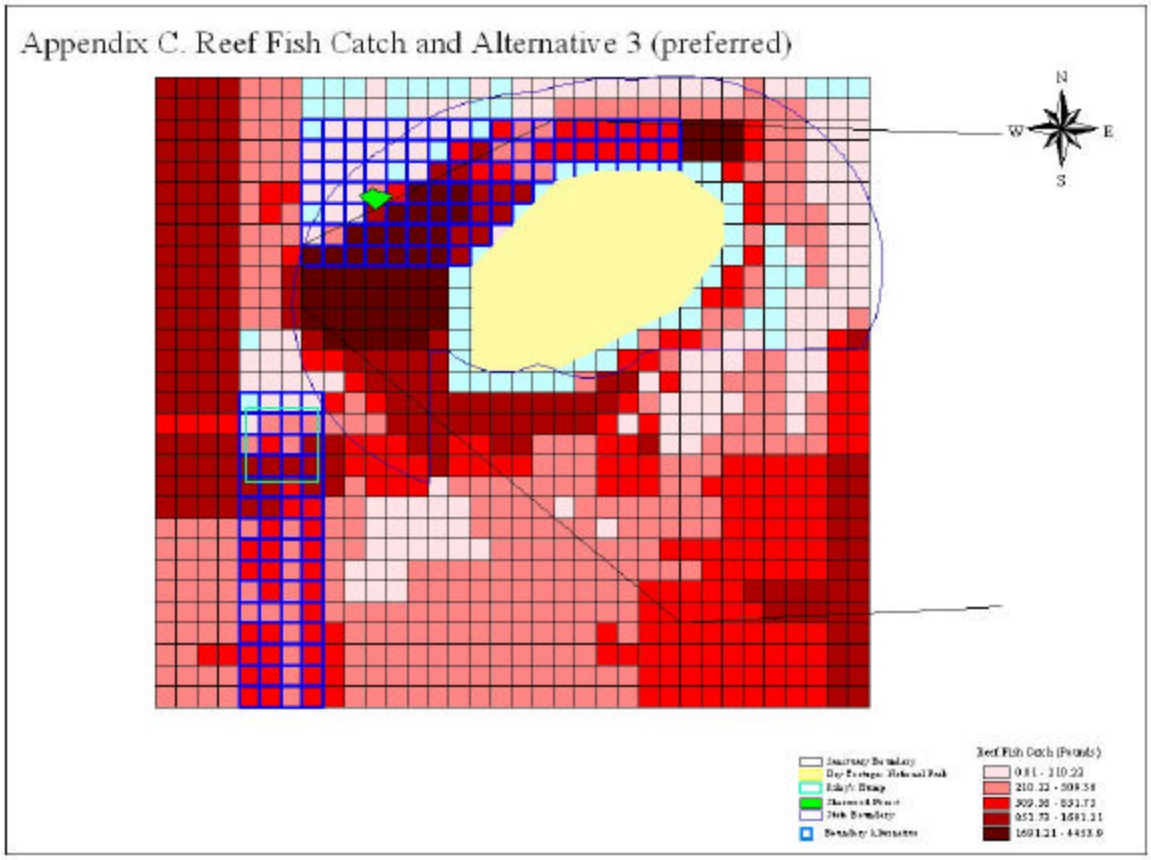
Appendix C. Lobster Catch and Alternative 5



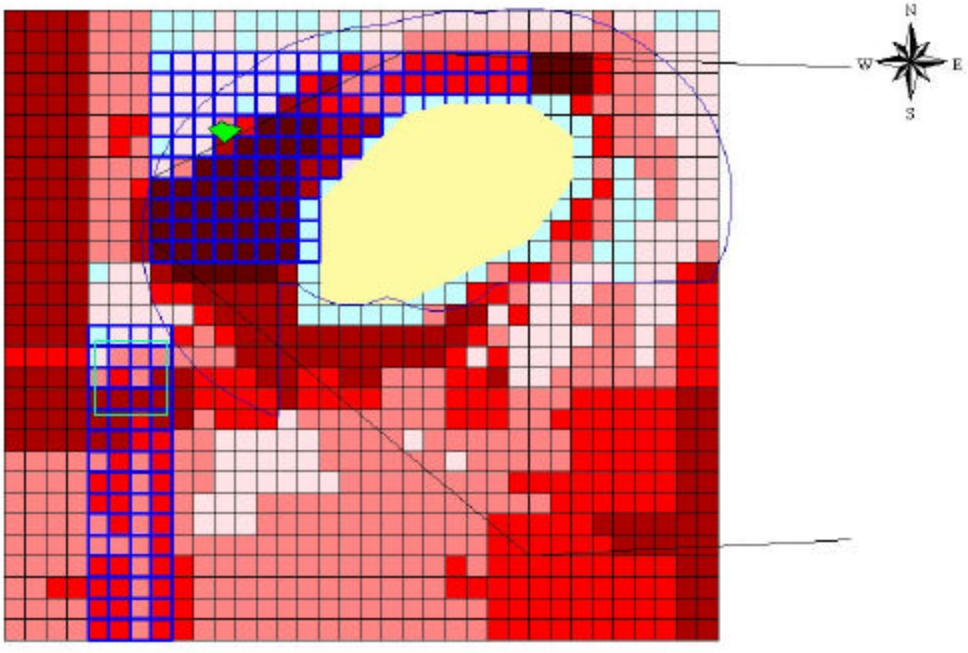
Appendix C. Reef Fish Catch and Alternative 2



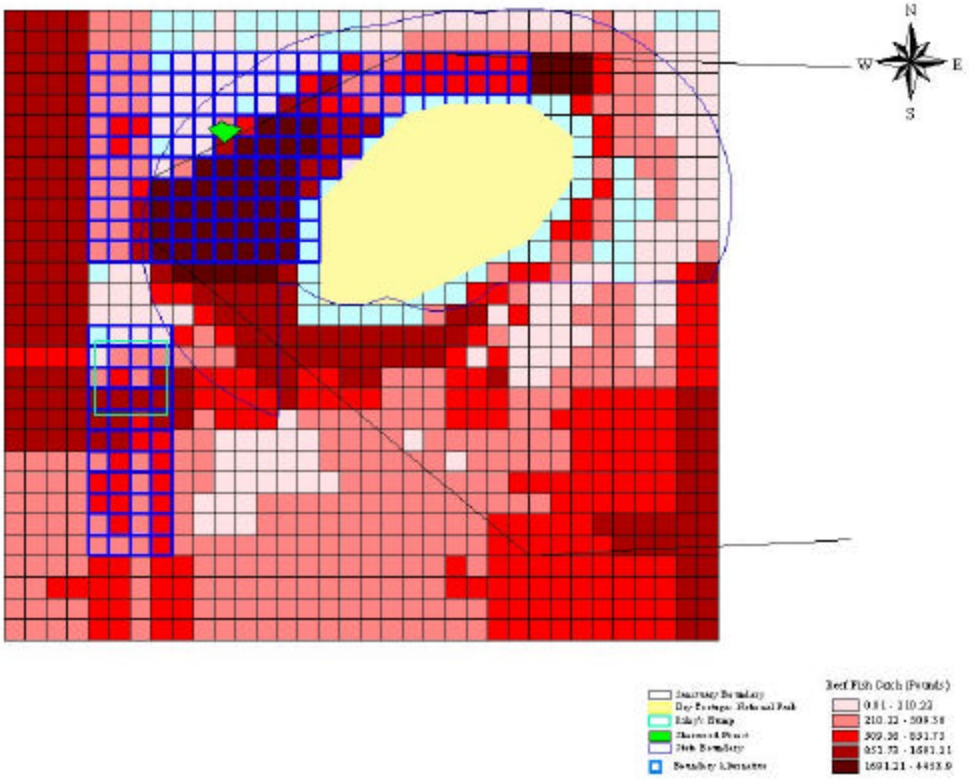
Appendix C. Reef Fish Catch and Alternative 3 (preferred)



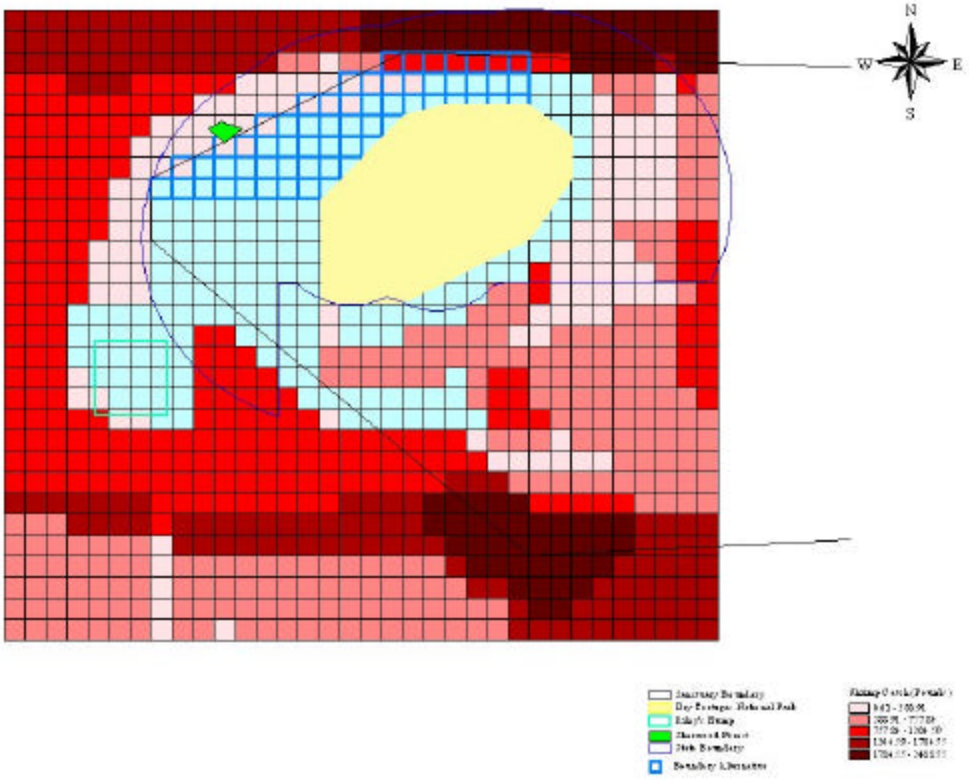
Appendix C. Reef Fish Catch and Alternative 4



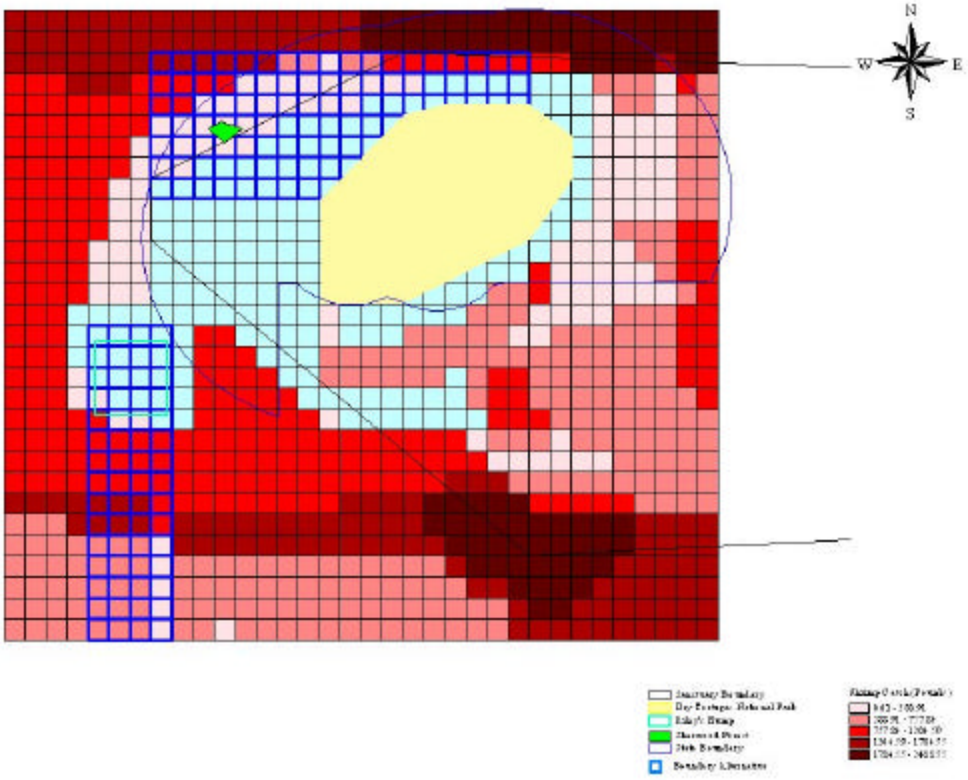
Appendix C. Reef Fish Catch and Alternative 5



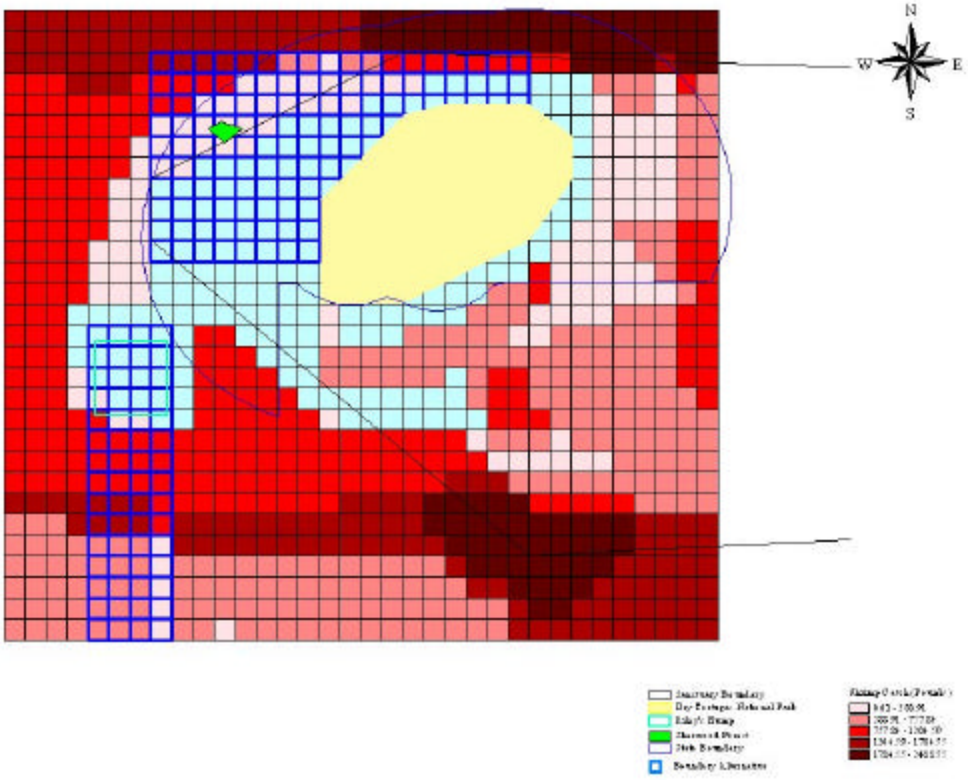
Appendix C. Shrimp Catch and Alternative 2



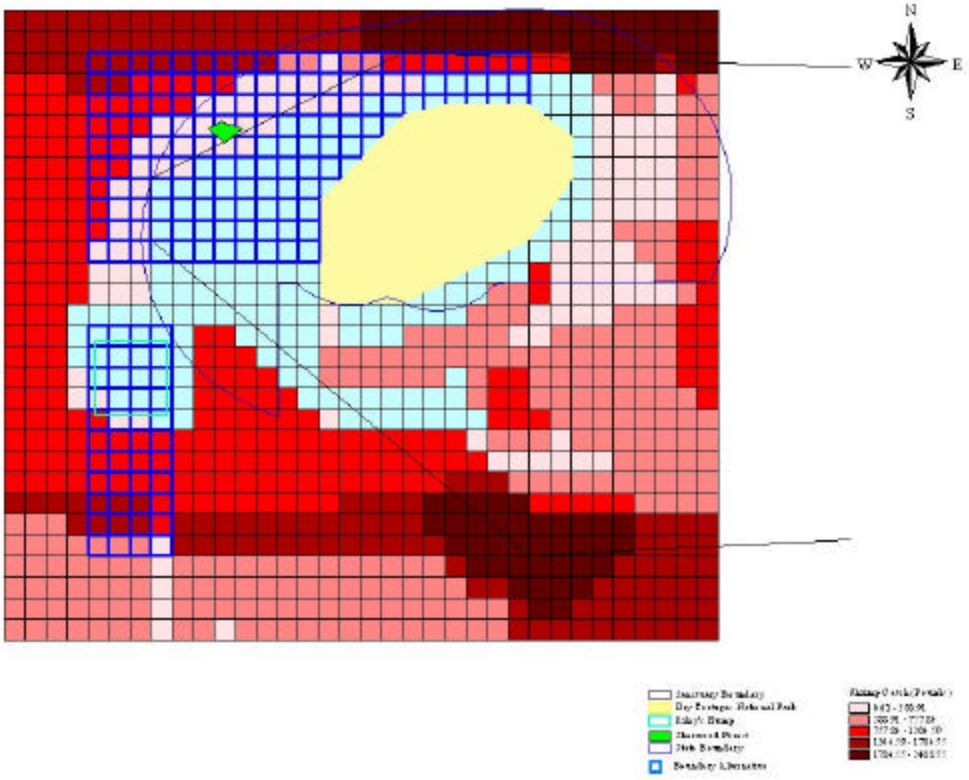
Appendix C. Shrimp Catch and Alternative 3 (preferred)



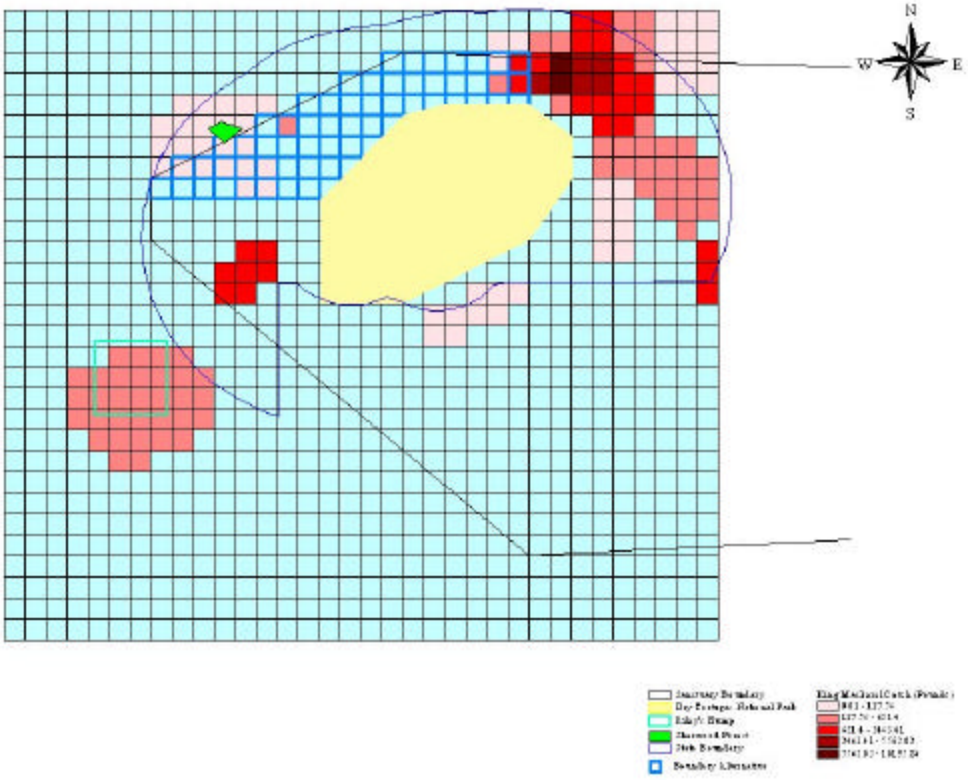
Appendix C. Shrimp Catch and Alternative 4



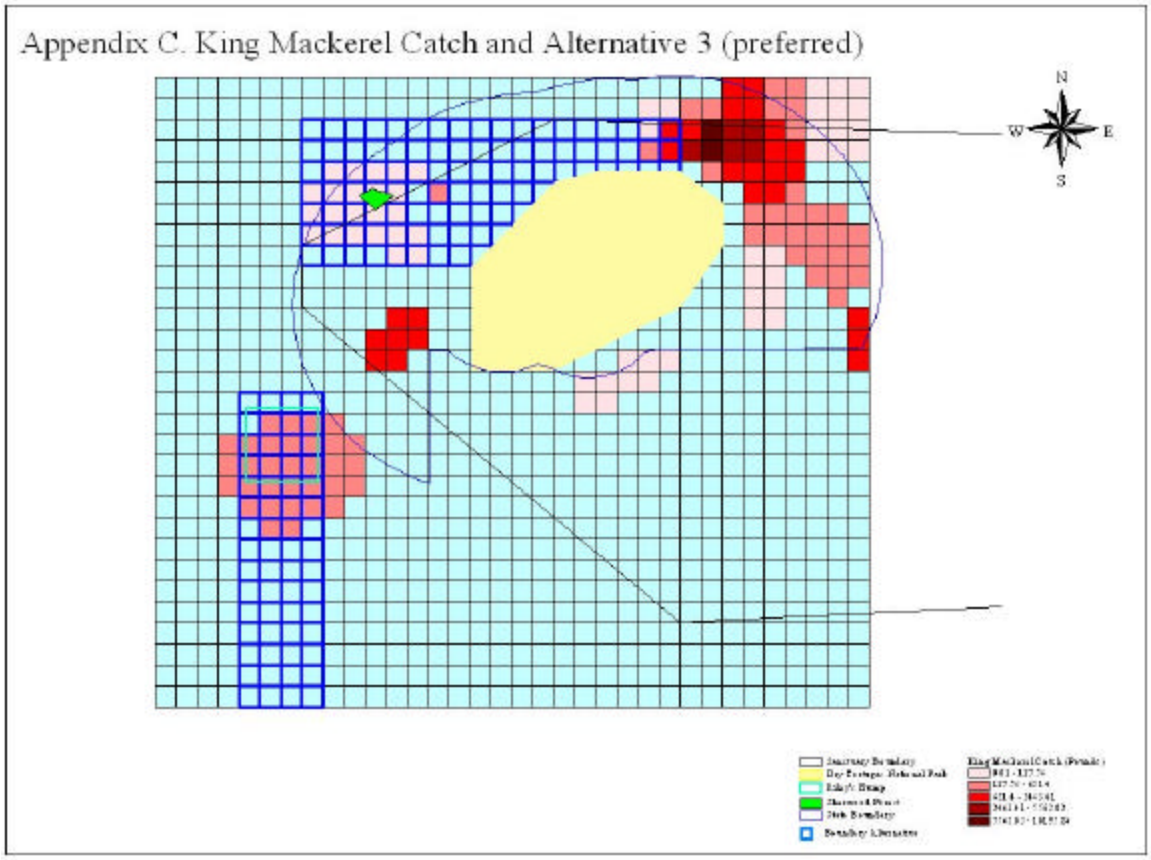
Appendix C. Shrimp Catch and Alternative 5



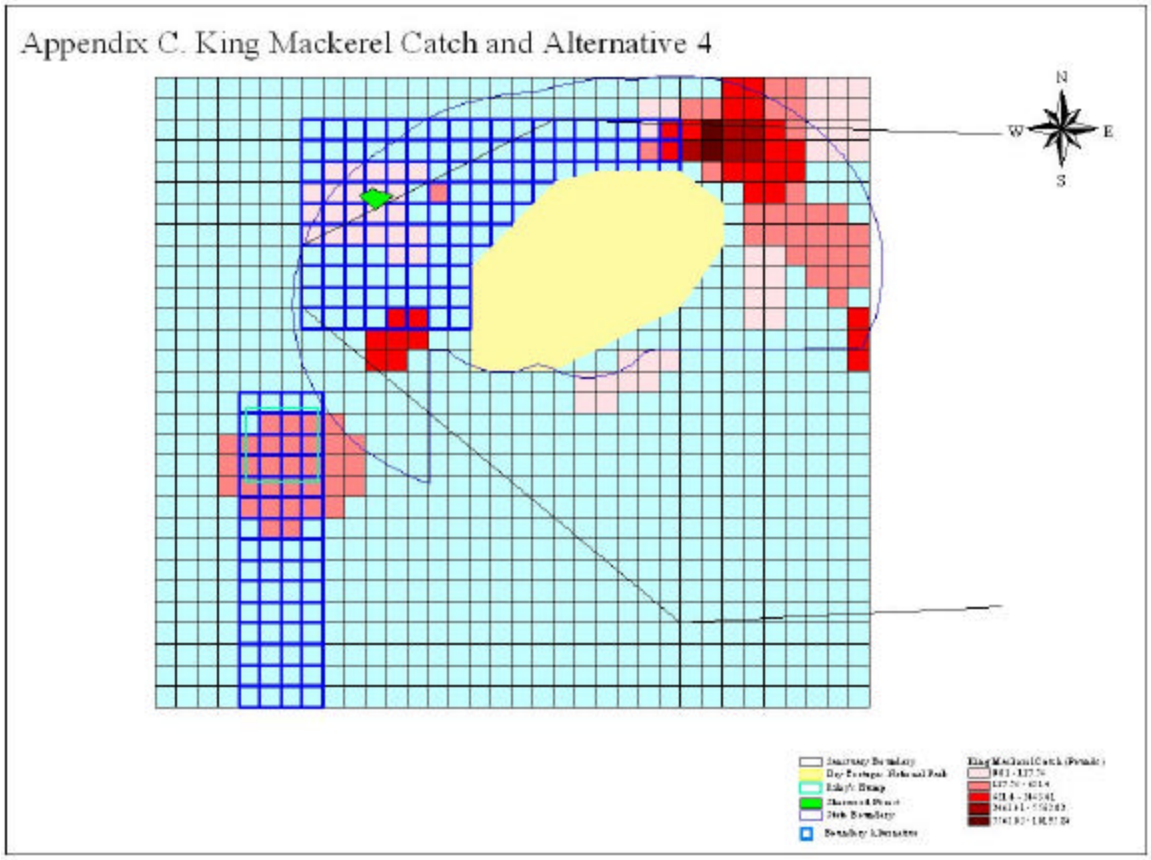
Appendix C. King Mackerel Catch and Alternative 2



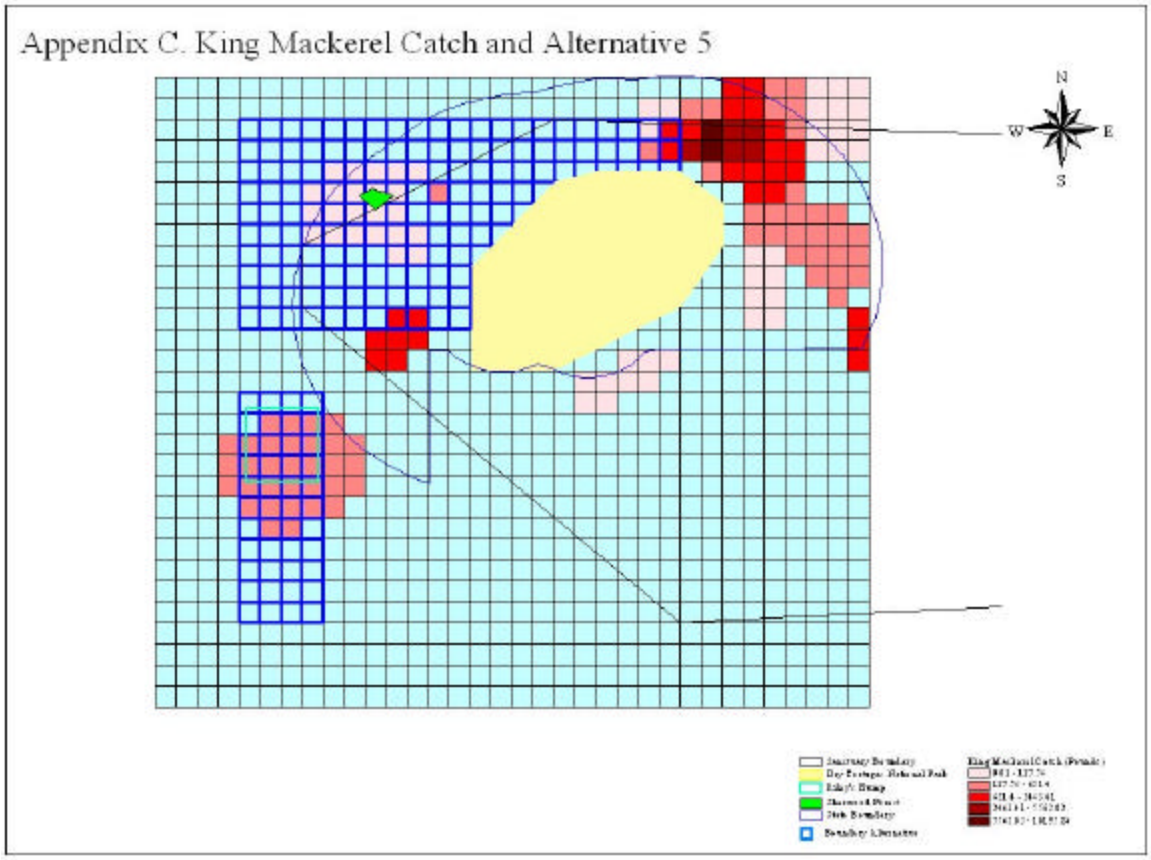
Appendix C. King Mackerel Catch and Alternative 3 (preferred)



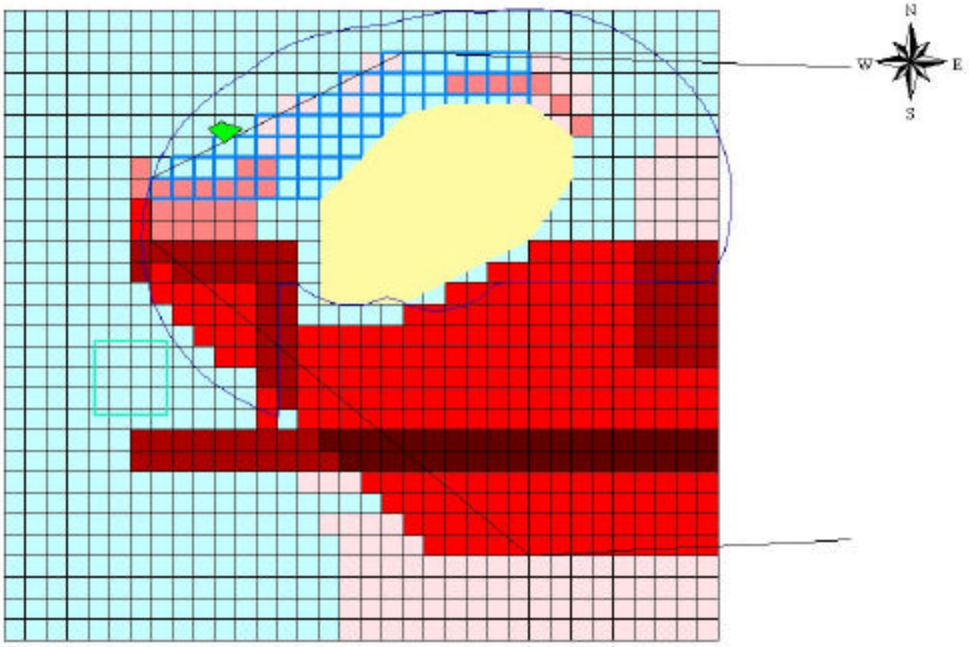
Appendix C. King Mackerel Catch and Alternative 4



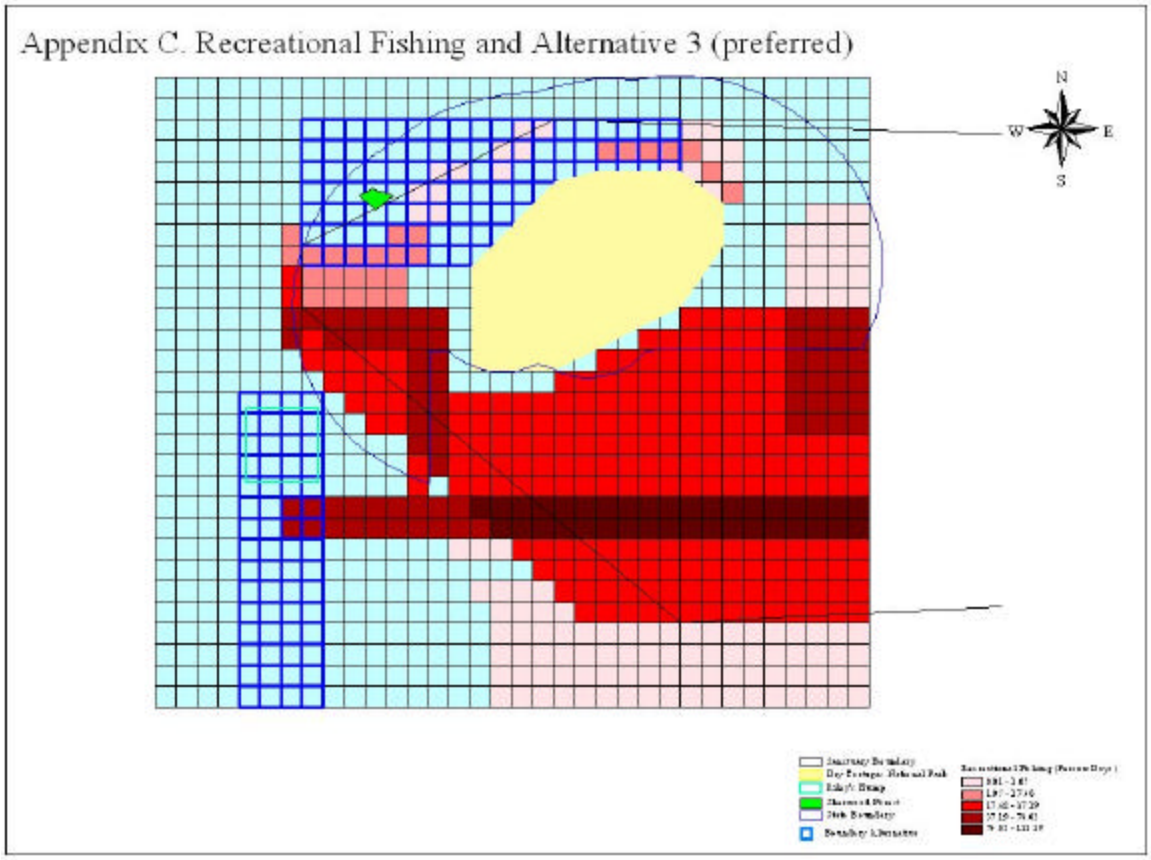
Appendix C. King Mackerel Catch and Alternative 5



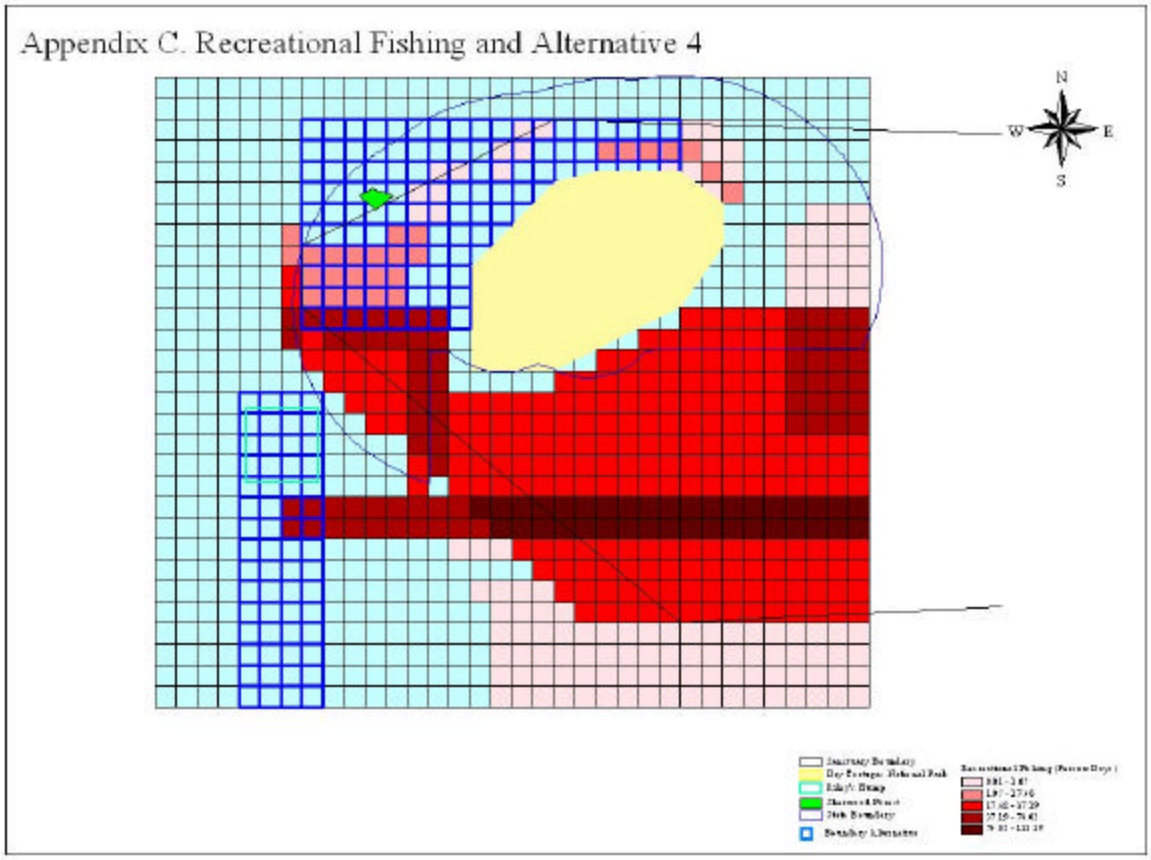
Appendix C. Recreational Fishing and Alternative 2



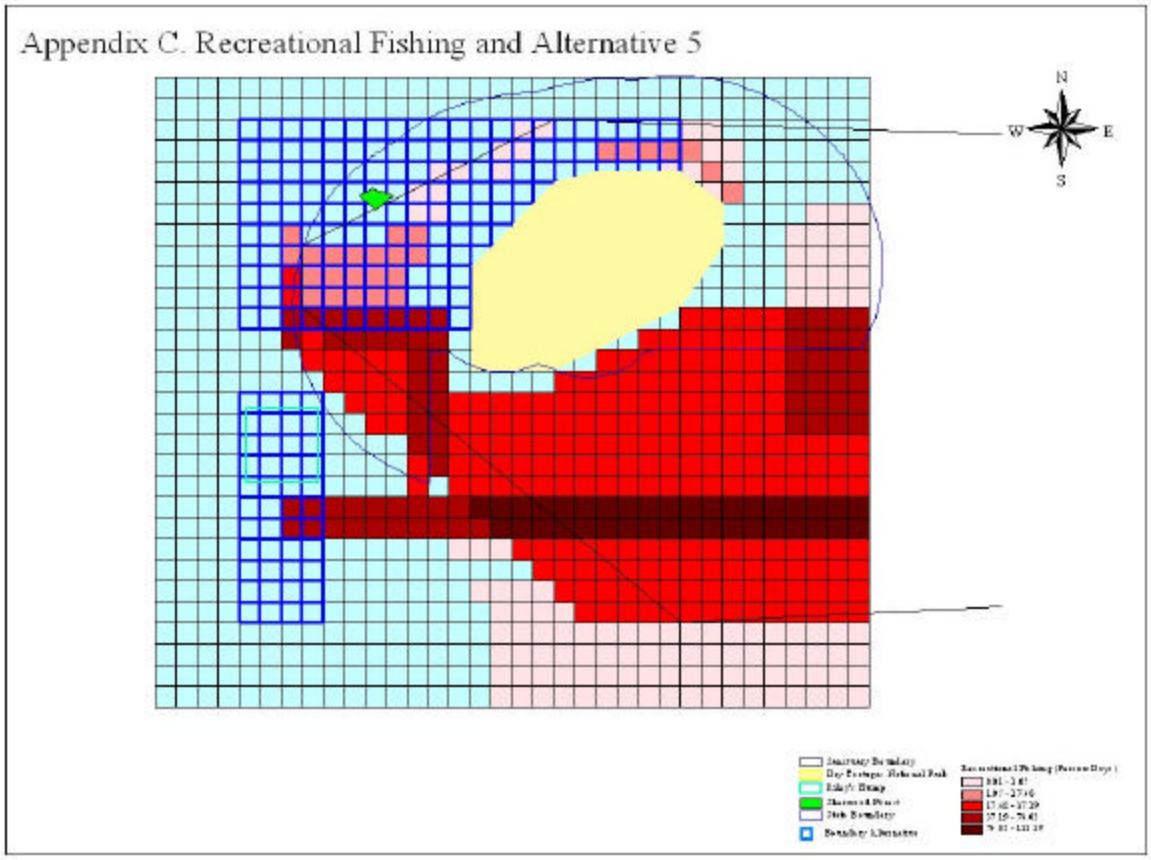
Appendix C. Recreational Fishing and Alternative 3 (preferred)



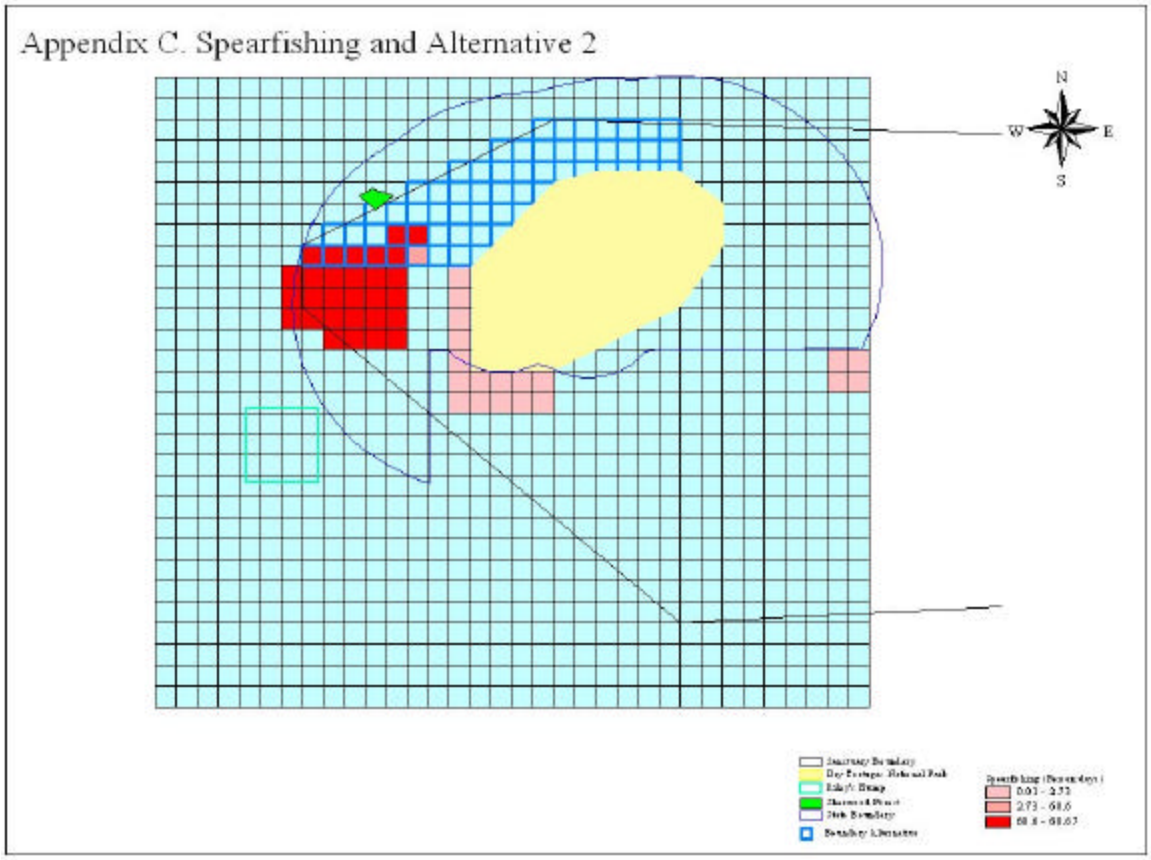
Appendix C. Recreational Fishing and Alternative 4



Appendix C. Recreational Fishing and Alternative 5



Appendix C. Spearfishing and Alternative 2



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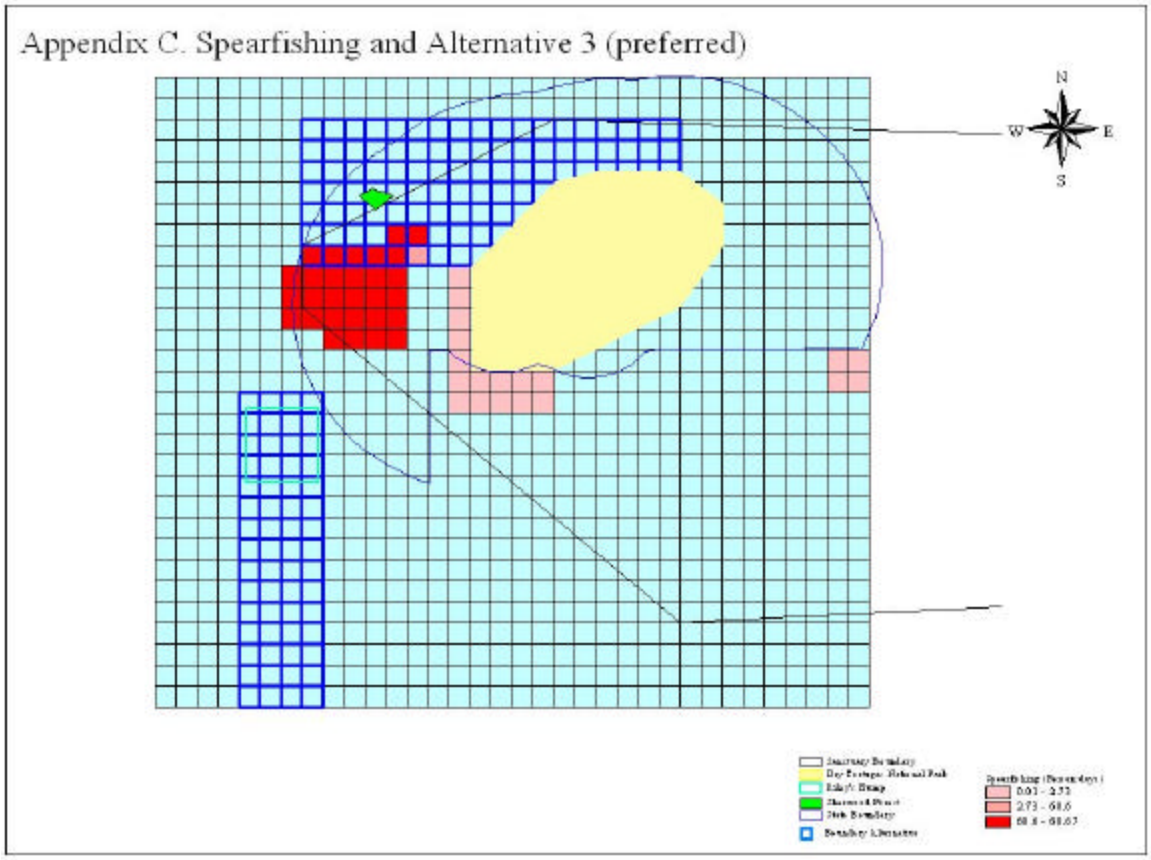
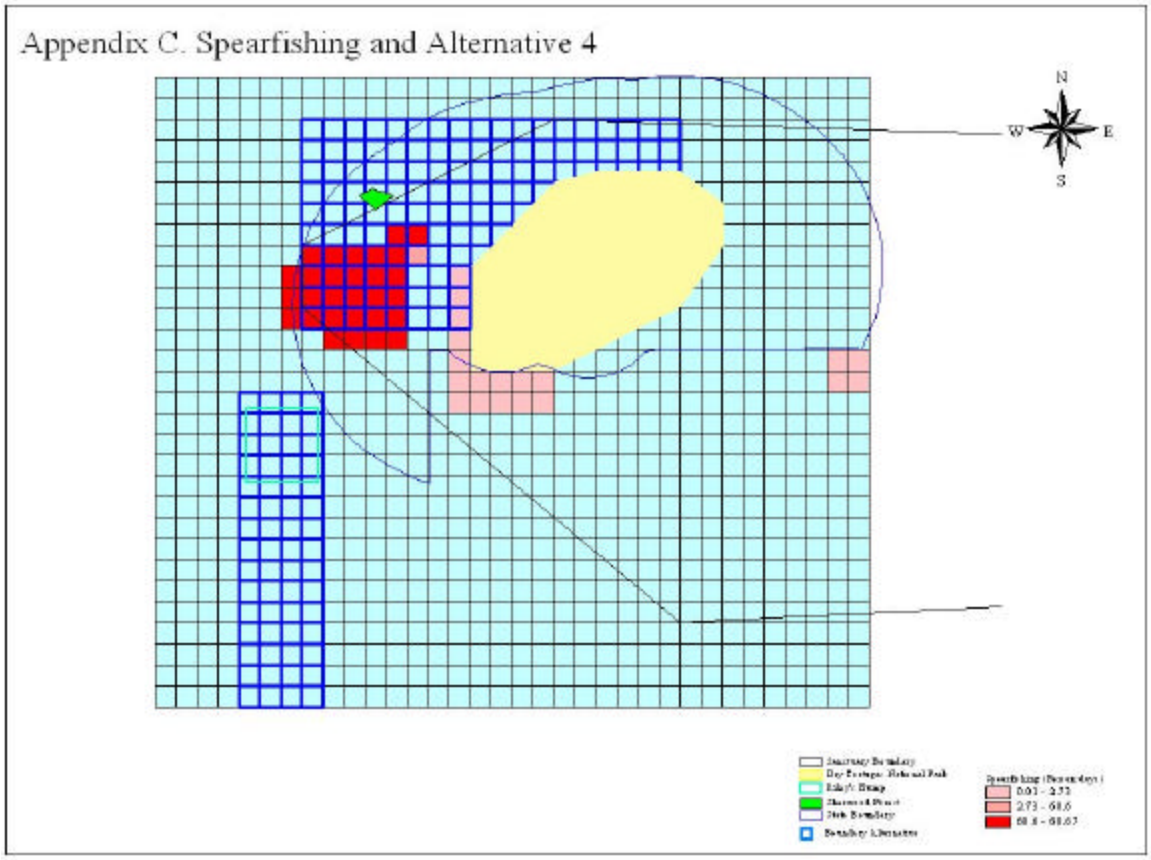
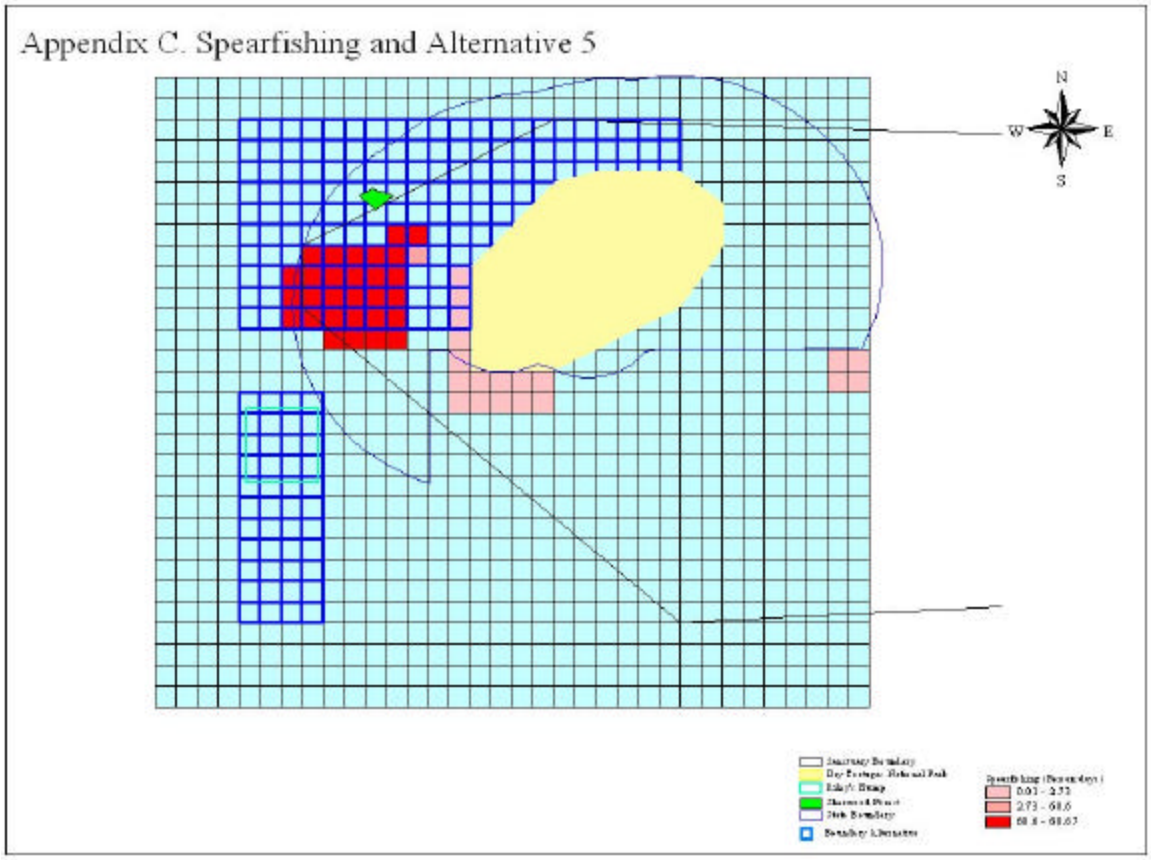


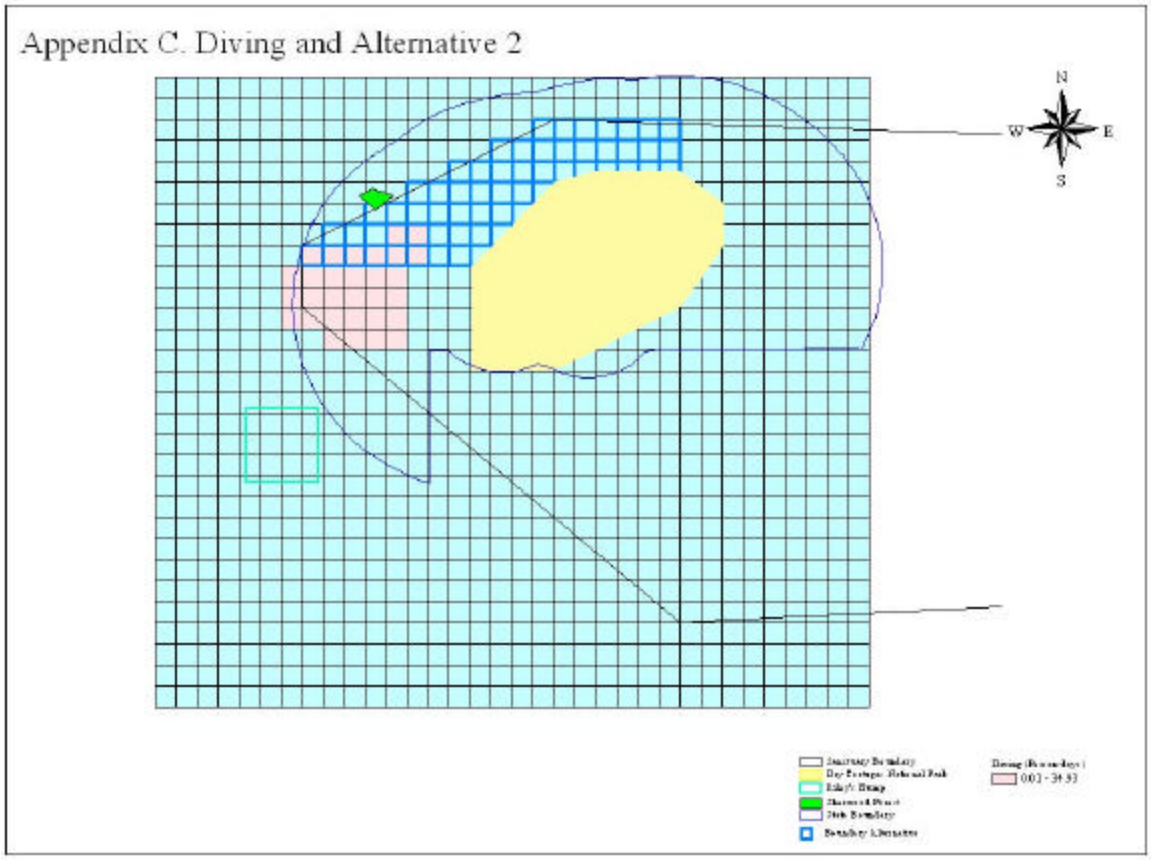
Appendix C. Spearfishing and Alternative 4



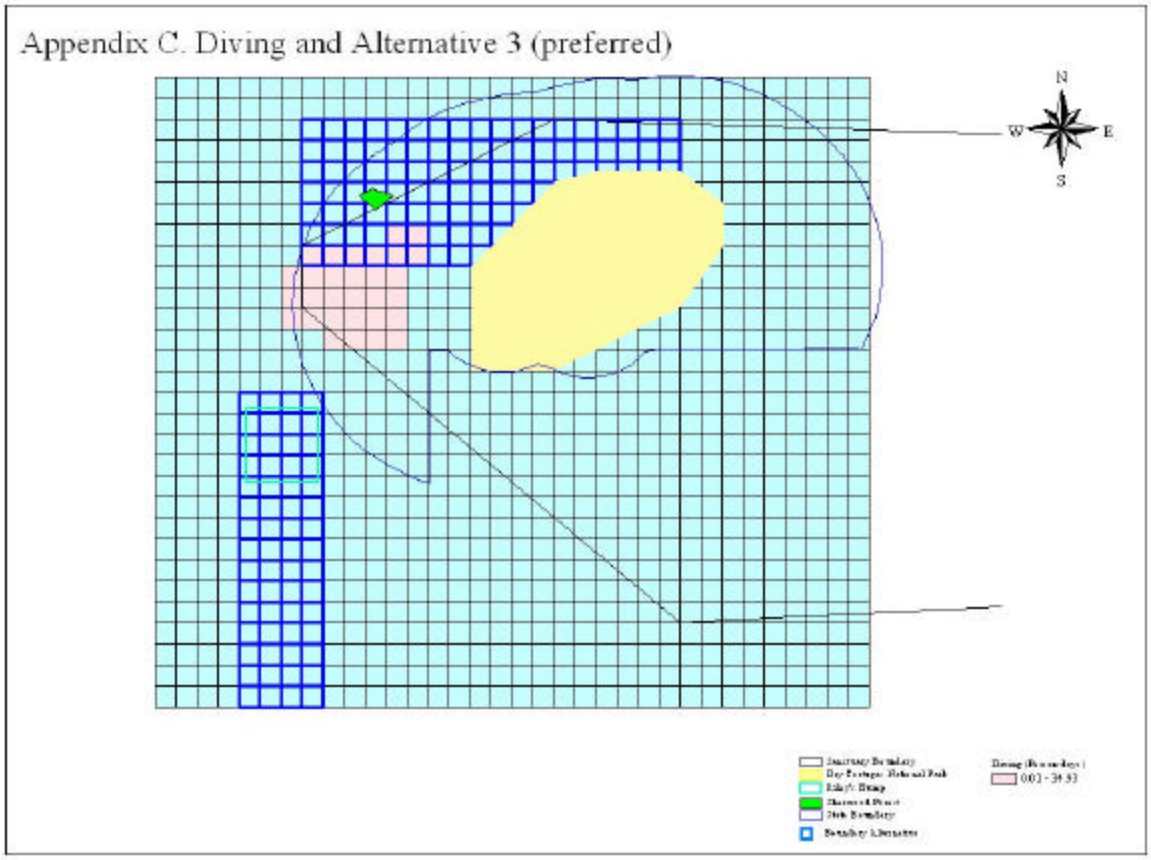
Appendix C. Spearfishing and Alternative 5



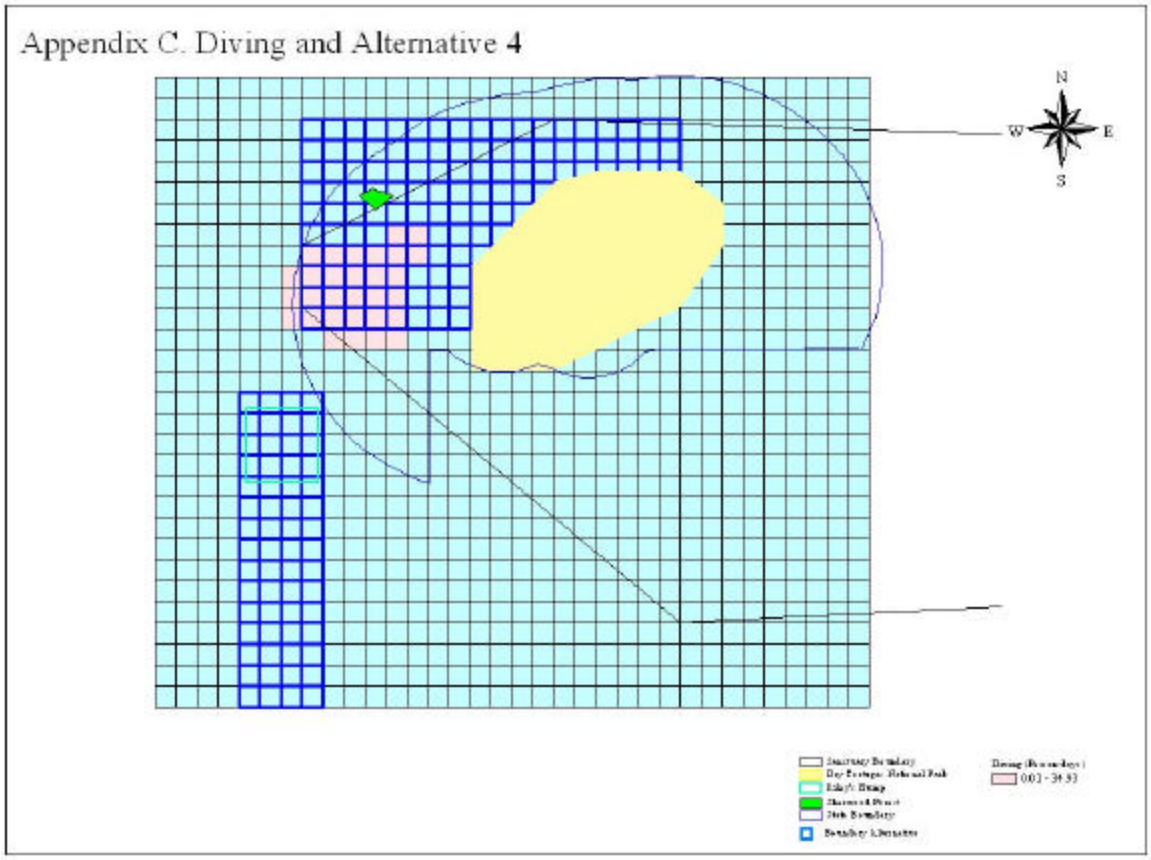
Appendix C. Diving and Alternative 2



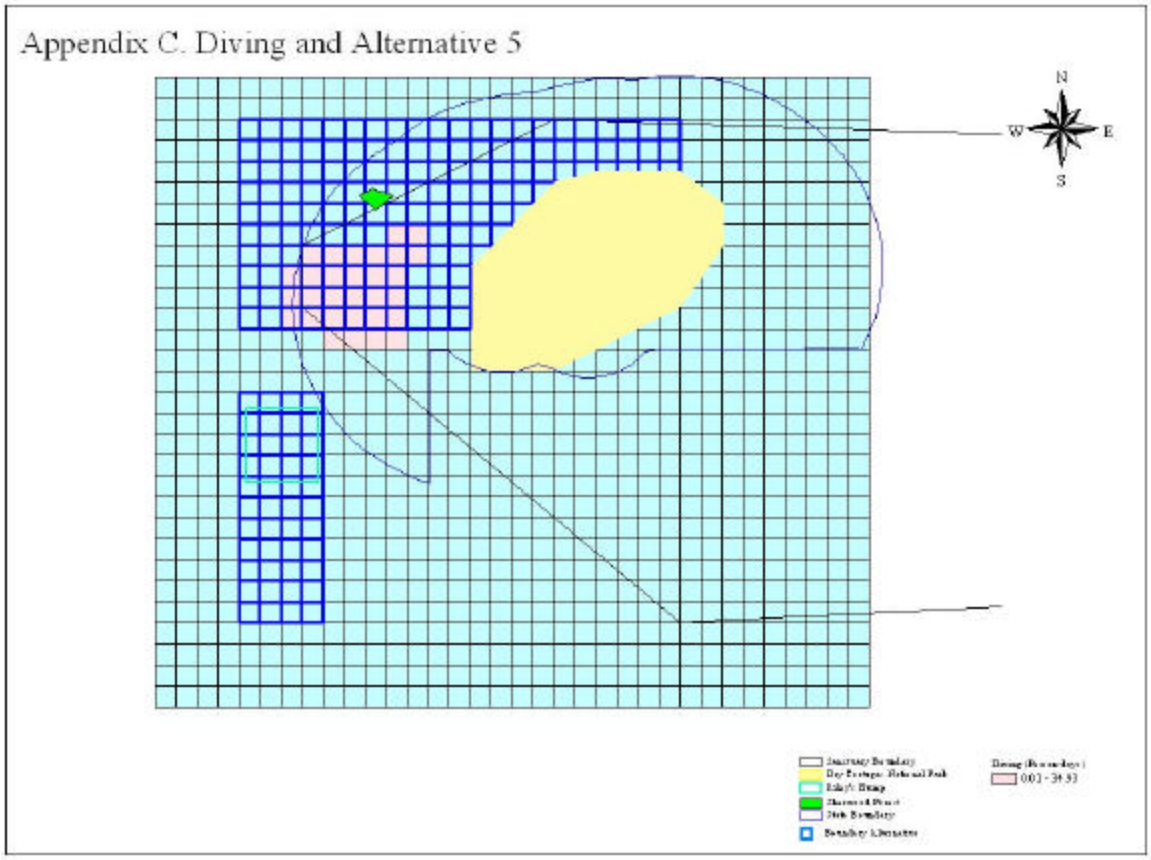
Appendix C. Diving and Alternative 3 (preferred)



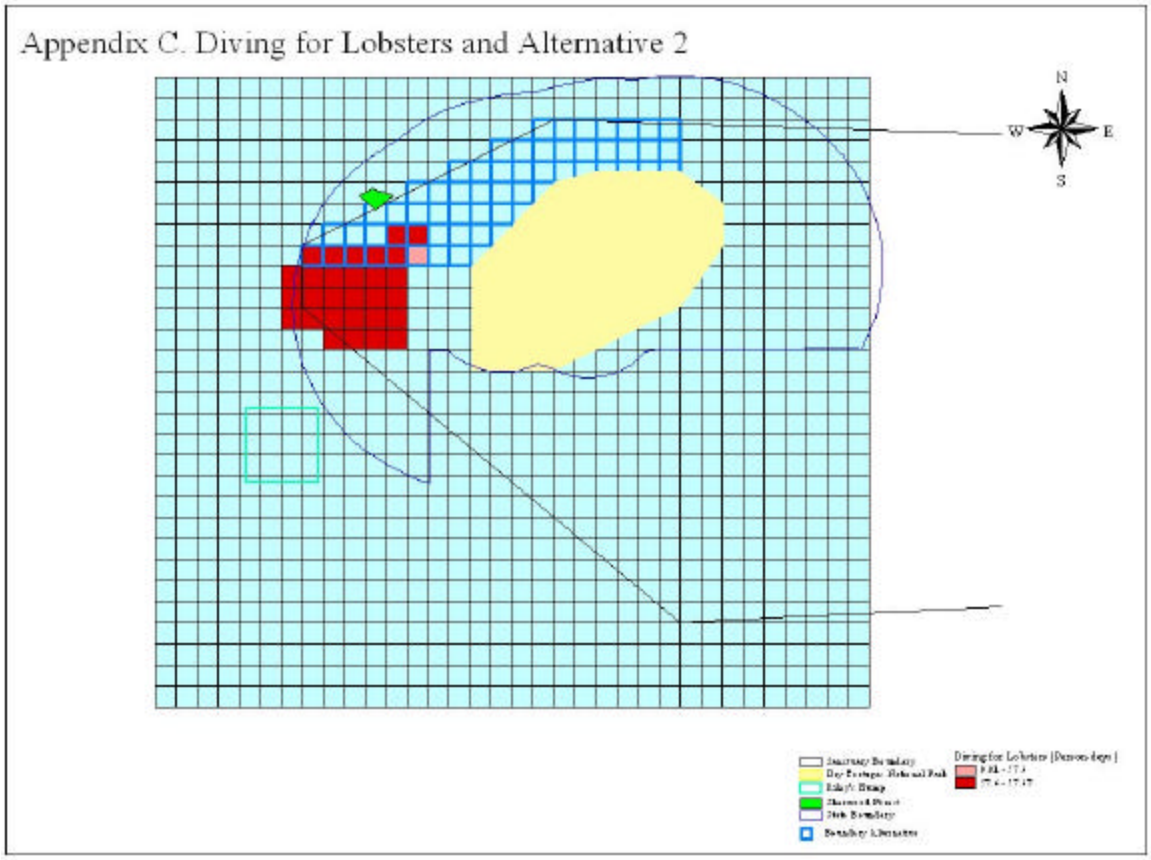
Appendix C. Diving and Alternative 4



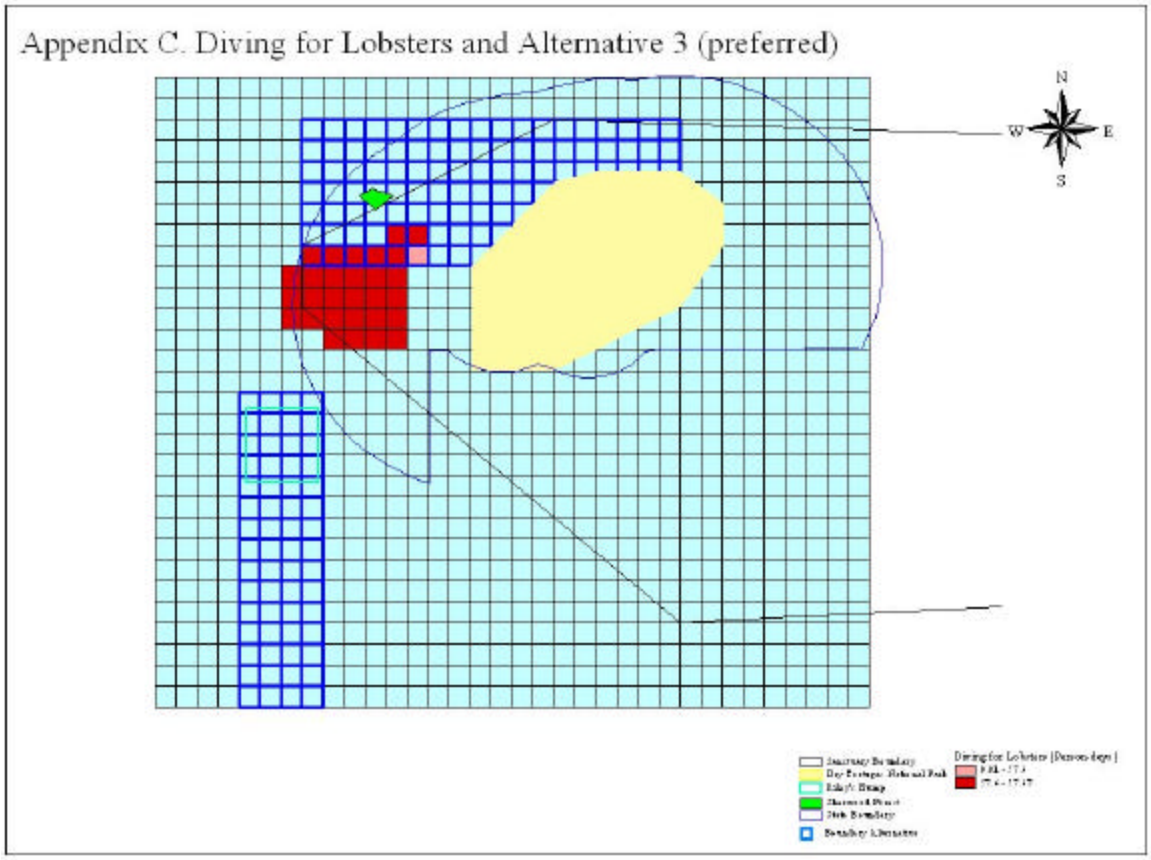
Appendix C. Diving and Alternative 5



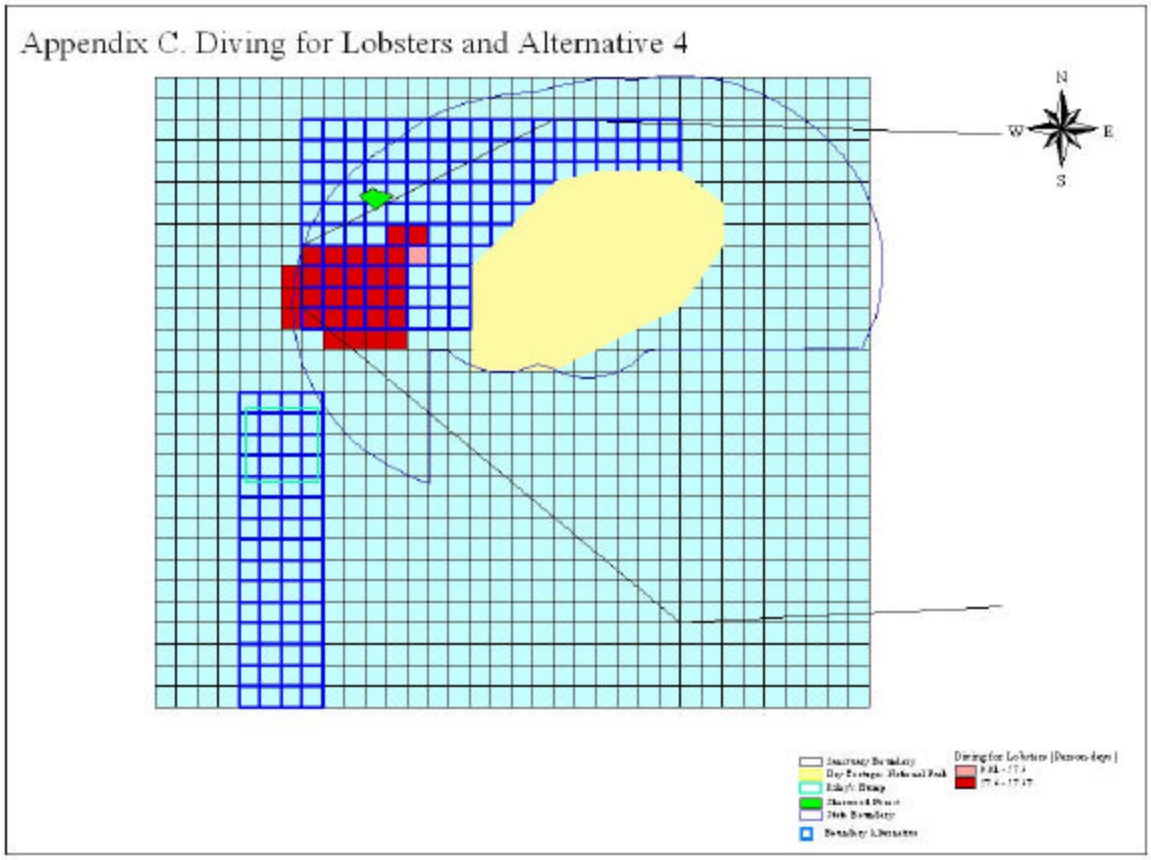
Appendix C. Diving for Lobsters and Alternative 2



Appendix C. Diving for Lobsters and Alternative 3 (preferred)



Appendix C. Diving for Lobsters and Alternative 4



Appendix C. Diving for Lobsters and Alternative 5