

#### 4.0 CAPACITY LIMITS

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##### 4.1 MAXIMUM SUSTAINABLE YIELD (MSY) IN U.S. ATLANTIC WATERS

The status of shark resources was assessed from statistics of the fisheries currently occurring within the U.S. Atlantic EEZ (Parrack, 1990) and as result comments from the public, commercial fishermen, fish dealers/processors, and several state agencies during the comment period held on the proposed FMP and on the proposed implementing rule. Significant new fishery information was received from fishermen, and several state fishery agencies. This new information included: (1) data showing fishery removals in recent years higher than those used as a basis for determining MSY and stock conditions in the Parrack 1990 stock assessment; (2) records on the size frequency of shark species caught in commercial fisheries; and (3) information on the commercial fishing fleet. Parrack (1992) reviewed this new information and incorporated these new data in the stock assessment for the large coastal resource. To ensure that all FMP management measures are based upon the best scientific information available, a revised assessment of the condition of the large coastal species group was completed. The revised assessment was reviewed by a scientific peer committee consisting of both outside scientific experts and NMFS scientists. The Review Committee issued its final report on November 23, 1992 (see Appendix II, Report of the Atlantic Coastal Shark Fishery Analysis Review, November 23, 1992). The conclusions concerning the small coastal and pelagic species groups remain unchanged.

Both assessments defined several gear-specific and area-specific fisheries and three species groups. Each gear-specific fishery exploits one of the three species groups. A directed shark longline/gillnet fishery and a southern area tournament fishery both target large coastal sharks. Small coastal sharks are targeted by rod-and-reel fishermen and are also a significant bycatch of the shrimp fishery in the Gulf of Mexico. Pelagic sharks are most often taken by longline vessels incidental to tuna and swordfish, although rod-and-reel fishermen and commercial fishing vessels in northern areas sometimes target these species.

The species compositions of commercial landings were not recorded, and only a general knowledge of the species most often encountered in each fishery exists. The species included in each group (Table 2.1) are thus sharks that are caught by particular gear-specific fisheries; they are not ecological groups.

The status of the small coastal sharks and pelagic sharks species groups were assessed separately using 1986-1989 fishery statistics. Due to the transoceanic nature of pelagic shark

catches and the international fleets that exploit them, the necessary fisheries information was not complete enough to assess that resource. Instead, reported U.S. landings from 1986-1989 for small coastal sharks and updated information through 1991 for the pelagic sharks were viewed as a gross indicator of current EEZ resource production levels.

Parrack (1992) incorporated new data on landings, catch, catch-per-unit-effort, and other information provided from fishermen and others during the public review process into the stock assessment for the large coastal resource. Data from fisheries exploiting the coastal sharks were complete enough to yield assessments of resource production and status.

The method used to assess the small coastal shark groups was based on the probability distribution of the average weights of caught fish observed in each fishery; corresponding yields and fishing efforts were auxiliary (independent) variables. The 1990 stock abundances (numbers of sharks), biological rates of population increase (in numbers), and fishing gear efficiency coefficients that maximize the probability of obtaining the average weights observed in each fishery [i.e., maximum likelihood estimates, (MLE)] were obtained. The method combines all gains and losses to the stock that are not observed (i.e., those other than the reported landings) into a single statistic: an intrinsic rate of unobserved change. These gains and losses are due to the entry of newly born sharks into the stock, emigration and immigration, death from predation and disease, unreported landings, and sharks caught and discarded.

These MLE's were then used to compute various statistics of interest including stock sizes during 1986-89, annual fishing mortalities, annual productions in numbers of fish, and catch-to-production ratios. Abundance estimates were multiplied by annual average weights to transform them to estimates of exploited biomass. This FMP uses the maximum of annual production estimates during the period of data (1986-1989) as a biological reference point by assuming that any annual production, including the maximum, is sustainable. Therefore, first approximations of maximum sustainable yields were taken as the maximum of the annual production estimates during the period 1986-1989.

This estimation method was used since species compositions of catches were not recorded. Estimates of mortality and production rates are therefore for species aggregations. Since some species within a species group are less abundant than others, some species within the aggregation will be more at risk than others because the group is managed as a whole.

The method estimates sustainable production in numbers of fish, not weight. These were converted to weight (after maximum likelihood estimation) to obtain MSY. The conversions were based

**Table 4.1**  
**Various Characteristics of the Three**  
**Species Groups**

	Large Coastal Sharks	Small Coastal Sharks	Pelagic Sharks
Migrations	Extensive	Limited	Extensive
Commercial Fishery	Directed	Limited	Bycatch
Recreational Fishery	Limited	Limited	Extensive
MSY Jan. 1 Abundance Level (Number of Fish)	1,361,485	3,737,000	na
MSY-Biomass (Dressed Weight [mt])	14,900	3,475	na
MSC (Maximum Sustained Catch Number of Fish)	346,691	2,454,500	na
Mean Dressed Weight (lbs)	24.14	2.05	na
MSY-Surplus Weight (mt)	3,800	2,590	1,560 <sup>1</sup>
Fishing Mortality Rate ( $F_{MSY}$ ) <sup>2</sup>	0.25	0.48	na
1986-1991 Mean F	0.26 <sup>3</sup>	0.43	na
Current Status	Over- exploited	Fully utilized	Fully utilized
1993 Optimum Yield Dressed Weight (mt)	2,900	2,590	1,560

<sup>1</sup> 1,560 mt is the average annual U.S landings from 1986-1991. Better estimates can be derived when future catch statistics include the species and weight of individual fish.

<sup>2</sup> Fishing mortality rate that results in MSY.

<sup>3</sup> Does not include discards and other unreported mortalities.

on observed average weights of landings. These average weights will probably change in the future, thus projections of future yields (weight caught) are difficult.

Despite the limitations and uncertainties of the data, the analyses provided statistics necessary for developing harvest limitations and management advice. The results of that advice are summarized in the following sections.

#### **4.1.1 LARGE COASTAL SHARKS, STATUS, AND MSY**

Large coastal sharks are those normally targeted by commercial shark longline and gillnet fisheries, and by the southern shark tournament fisheries (Table 4.1). Typical species in this group include sandbar, blacktip, dusky, bull, tiger, hammerhead, lemon, white, spinner, bignose, silky, and night sharks. Many of these make extensive migrations along the U.S. Atlantic coast.

During the public comment periods held on the proposed FMP and on the proposed rule, significant new information was received from fishermen, fish buyers, and state fishery management agencies. This information included: (1) fishery removals not previously recorded; (2) sizes of caught sharks; and (3) the numbers of commercial fishing vessels targeting sharks. The additional information significantly changed the analytic results of the last stock assessment done in 1990 (see Parrack, M.L., 1990, A Study of Shark Exploitation in U.S. Atlantic Coastal Waters during 1986-1989).

To ensure that all FMP management measures are based upon the best scientific information available, a revised assessment of the condition of the large coastal species group was completed. The revised assessment was reviewed by a scientific peer committee consisting of both outside scientific experts and NMFS scientists. The Review Committee issued its final report on November 23, 1992 (see Appendix II, Report of the Atlantic Coastal Shark Fishery Analysis Review, November 23, 1992).

The Review Committee reported evidence of overfishing for the large coastal group during 1986 through 1992 (except for 1987 and 1990, Table 4.2). The Committee recommended that calendar year 1993 landings for the large coastal should be reduced below the calendar year 1991 landings level of 4,319 mt dressed weight (see Appendix II).

Based on the Committee Report, NMFS estimates that the MSY for the large coastal species group is 3,800 mt dressed weight. The MSY stock biomass level is estimated to be about 14,900 mt dressed weight.

Table 4.2

Abundance, Production, Catch, and  
Fishing Mortality for Large Coastal Sharks

Year	Avg. Wt (Pounds Dressed)	Jan. 1 Abundance	Production		Catch		Fishing Mortality Rate	Catch to <sup>1</sup> Production
			Numbers	MT	Numbers	MT		
1986	21.06	1,578,368	194,916	1,862	215,338	2,057	0.18	1.10
1987	27.33	1,158,144	678,271	8,408	270,867	3,358	0.21	.40
1988	21.85	1,489,091	271,921	2,695	476,788	4,725	0.30	1.75
1989	25.42	1,302,961	377,078	4,348	488,301	5,629	0.31	1.29
1990	23.51	1,234,302	670,047	7,145	418,773	4,467	0.30	.62
1991	25.72	1,406,042	350,891	4,090	370,458	4,319	0.27	1.06

<sup>1</sup> Catch/Production ratio greater than one indicates overfishing.

Parrack 1992.

Table 4.3

Abundance, Production, Catch, and  
Fishing Mortality for Small Coastal Sharks

Year	Avg. Wt. <sup>1</sup> (Pounds Dressed)	Jan. 1 Production Abundance	Catch <sup>2</sup> Numbers	Mortality Production		Fishing Rate	Catch to Ratio	
				MT	Numbers			MT
1986	2.66	3,072,877	2,018,181	3,385	1,631,734	2,736	0.38	0.81
1987	1.88	3,370,674	2,213,767	2,624	3,006,581	3,563	0.65	1.36
1988	1.32	3,373,061	2,215,334	1,844	3,419,214	2,845	0.73	1.54
1989	2.35	3,737,084	2,454,415	3,637	1,889,998	2,800	0.37	0.77
1990	2.05 <sup>3</sup>	4,199,176	2,757,904	3,564	2,486,882 <sup>4</sup>	3,214	0.48	0.90
1991	2.05 <sup>3</sup>	4,573,275	3,003,500	3,882	3,003,580			

<sup>1</sup> Dressed wt. X 1.39 = whole weight.

<sup>2</sup> Whole weight.

<sup>3</sup> 1986-1989 average dressed weight = 2.05 lbs.

<sup>4</sup> 1986-1989 Mean Catch = 2,486,882

**Table 4.4**  
**MSY Estimates; Commercial Quotas and**  
**Domestic Annual Harvest for 1993**  
(Dressed Weight - Metric Tons)

	<u>Large<sup>1</sup></u> <u>Coastal</u>	<u>Small</u> <u>Coastal</u>	<u>Pelagic</u>	<u>Domestic</u> <u>Annual Harvest</u>
Commercial	2,436	No quota <sup>2</sup>	580	-
Recreational	464	No quota <sup>3</sup>	980	-
Total	2,900	2,590	1,560	7,050
MSY Estimates	3,800	2,590 <sup>4</sup>	1,560 <sup>5</sup>	

<sup>1</sup> Landings are based on a rebuilding program.

<sup>2</sup> Past commercial landings are negligible (see footnote <sup>4</sup>).

<sup>3</sup> 1986-1989 average of recreational landings of small coastal species group was less than 200 mt.

<sup>4</sup> 1986-1989 average of shrimp trawl discards is estimated to be 2,014 mt of the MSY (Parrack, 1990).

<sup>5</sup> 1986-1991 average of pelagic shark landings.

#### **4.1.2 SMALL COASTAL SHARKS, STATUS AND MSY**

Small coastal sharks are typically caught in recreational fisheries (headboats and privately owned boats) and as discarded bycatch in the Gulf of Mexico penaeid shrimp trawl fishery (Table 4.1). The largest component of the catch, by far, is the shrimp trawl bycatch. The predominant species in this group are the sharpnose, with bonnethead, blacknose, finetooth, and smalltail.

Results of the analysis show a high degree of estimation uncertainty, even more than that for the large coastal species (Parrack, 1990). Estimates suggest that catches exceeded production in 1987 and 1988 and not in 1986 and 1989; hence, a reduction in abundance over the period 1986-1989 is not indicated. These statistics indicate that small coastal sharks appear to be fully utilized. The estimate of annual production potential for these sharks is high (Parrack, 1990), indicating that abundance would rapidly increase if present sources of fishing mortality were eliminated. These analyses suggest that 1990 production was greater than the 1989 catch, thus abundance was probably not reduced by fishing during 1990.

The maximum stock production during 1986-1989 was 2,617 mt (Table 4.3). The MSY for the small coastal sharks is estimated at 2,590 mt.

#### **4.1.3 PELAGIC SHARKS, MSY**

Pelagic sharks are a bycatch of the commercial tuna and swordfish longline fisheries and are directly exploited by recreational fisheries from Virginia to New York. Typical species in this group include makos, threshers, blues, oceanic whitetips, and porbeagles. Trans-Atlantic migrations of these sharks are common. Therefore, this species group is exploited by several nations, removals often occur outside of U.S. territorial waters, and discarding at sea is common, but not recorded. For the above reasons, data were not available to develop production estimates, as was done for the large and small coastal sharks. The average annual U.S. commercial landings of this species group during 1986-91 was about 580 mt (with an unknown amount of discards). The average recreational pelagic shark landings in the southern area is estimated to have been about 94 mt. Recreational shark landings in the northern area are estimated to have averaged about 885 mt. The sum of these (1,559 rounded to 1,560 mt) is the estimate of MSY for this species group (Table 4.1). Note, however, that it is based upon a short-term average.

#### **4.2 OPTIMUM YIELD (OY) GOAL**

The national goal is to maintain abundance in each of the three species groups in U.S. waters to produce MSY, and to manage shark resources throughout their range in cooperation with the major shark fishing nations.

Within U.S. jurisdiction, the OY goal is to maintain fishing mortality at the level that will produce MSY on a continuing basis ( $F_{MSY}$ ). Therefore, OY is the total annual level of fishing mortality on sharks in the management unit under the management measures in this FMP. This level of harvest is estimated at 7,050 mt, the sum of the commercial and recreational harvests of 2,900 mt of large coastal sharks, 2,590 mt of small coastal sharks, and 1,560 mt of pelagic sharks.

As necessary and appropriate, NMFS will prepare new stock assessments that will provide an estimate of the MSYs for the different species groups based on the latest available scientific information. When each assessment is completed and available to the public, NMFS will consider appropriate additional management measures (i.e., commercial quotas and recreational bag limits) based on the condition of shark resources as documented by the revised stock assessment. These additional measures will be implemented expeditiously and will, along with the current management measures, ensure that the fishing mortality is held at or reduced to a level that will produce MSY on a continuing basis. To ensure maintenance of MSY and prevention of overfishing, the framework procedure (Section 7.1.4) will adjust the quotas, trip limits, bag limits, MSYs, management unit, species groups, fishing year, species size limits, and permitting and reporting requirements, based on the best available information.

#### **4.3 OPTIMUM YIELD FOR U.S. ATLANTIC WATERS**

Statistics of coastal shark fisheries (for both large and small sharks) were extensive enough to gain a general knowledge of biological production potential, and OY is based on that knowledge. Though limited, these data are the best available scientific information.

OY for coastal sharks is defined as the appropriate harvest level that will produce MSY, or that will allow rebuilding of the stock level to the level that will produce MSY. MSY is defined in 50 CFR 602.11(d)(1) as the largest average annual catch or yield that can be taken over a significant period of time. Therefore, OY is the total annual level of fishing mortality on sharks in the management unit under the management measures in this FMP.

#### **4.4 DEFINITION OF OVERFISHING**

Title 50 CFR 602.11(c)(1) requires that an objective and measurable definition of overfishing be prepared for each stock or stock complex managed under an FMP. Overfishing, as generically defined by the 602 guidelines, is a level or rate of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce MSY on a continuing basis. The definition is required to guide management in determinations of whether the capacity of a fish stock to maintain itself through

reproduction might be destroyed by fishing. The definition may be stated as a population level at which a stock will be in jeopardy, or as a rate of fishing that will precipitate such a population level, or both.

There is reason to be especially concerned about overfishing of large coastal sharks and the pelagic sharks. Reproductive capacities of these species are small (Section 2.0) and exploitation histories of shark stocks that have been quickly overfished are documented (Section 3.0).

Given these concerns, the following definition of overfishing will be applied in this FMP:

1. When a stock size is at a level that is determined, based on the best scientific information available, to be sufficient to produce MSY on a continuing basis, overfishing is defined as a fishing mortality rate (F) that exceeds the fishing mortality rate that would produce MSY on a continuing basis ( $F_{MSY}$ ).
2. When the stock size is below the level that is determined, based on the best scientific information available, to be sufficient to produce MSY on a continuing basis, overfishing is defined as a fishing mortality rate that exceeds the rate that is consistent with a rebuilding program established under this FMP.

There are a number of points that should be noted in regard to the definition. First, the present data do not allow addressing the biological reproduction potential of individual species; only of species aggregates. Therefore, a high fishing mortality rate will increase the risk that an individual species within the aggregation will be adversely affected. Conversely, stocks with abundance levels at or slightly below that which would produce MSY are often not at great risk. However, the determination of MSYs for the three species groups of sharks for this FMP was based upon the supposition that maximum sustainable productions were observed during the 1986-1991 period for the large coastal and pelagic species groups, and during the 1986-1989 period for the small coastal species group. If the true MSY-level is higher than the production observed during the 1986-1991 or the 1986-1989 periods, then present estimates of MSY are low and the likelihood of a species stock being considered overfished (before it actually is) under the present definition is increased. The balance of the above factors supports the selection of the above definition as a reasonable approach to overfishing concerns.

In the event that the stock size is overfished as defined above, the OT will advise the Assistant Administrator for Fisheries and recommend a strategy designed to provide for the recovery of each stock or stock complex within a reasonable period. Section 7.1.4 contains the framework regulatory adjustment procedure designed

**Table 4.5**

**Overfishing of Large Coastal Species**  
(Dressed Weight - Metric Tons)

<u>Year</u>	<u>Production</u>	<u>Landings</u>	<u>Difference</u>	<u>Ratio</u> <u>Landings</u> <u>Production</u>
1986	1,862	2,057	-195	1.10
1987	8,408	3,358	5,050	.40
1988	2,695	4,725	-2,030	1.75
1989	4,348	5,629	-1,281	1.29
1990	7,145	4,467	2,678	.62
1991	4,090	4,319	-229	1.06

Source: Parrack 1992

**Table 4.6**

**Rebuilding Program for Large Coastal Species**  
(Dressed Weight - Metric Tons)

<u>Year</u>	<u>Total Allowable Catch</u>	<u>Commercial</u>	<u>Allocation</u> <u>Recreational</u>
1993	2,916	2,449	467
1994	3,062	2,572	490
1995	3,800*	3,192	608
1996	3,800	3,192	608
1997	3,800	3,192	608
1998	3,800	3,192	608
1999	3,800	3,192	608
2000	3,800	3,192	608
2001	3,800	3,192	608
2002	3,800	3,192	608

Source: Parrack 1992

\* Estimated MSY level.

to make timely annual changes to the management measures in the regulations in response to new information about the fishery.

#### 4.4.1. OVERFISHING, LARGE COASTAL SHARKS

The draft Shark FMP (October 28, 1991) concluded that the large coastal resource was overfished. NMFS selected an array of quotas and bag limits to rebuild this resource.

During the public comment periods held on the proposed FMP and on the proposed rule, significant new fishery information was received from fishermen, fish dealers/processors, and several state fishery management agencies. This new information included: (1) data showing higher fishery removals in recent years than those used as a basis for determining MSY and stock conditions in the NMFS 1990 shark stock assessment; (2) records on the size and frequency of shark species caught in commercial fisheries; and (3) information on the commercial fishing fleet. NMFS reviewed this new information and determined that it could result in significantly revised conclusions about the abundance, productivity, and condition of the managed shark species from those in the proposed FMP that were based on the NMFS 1990 stock assessment for Atlantic coast sharks (see Parrack, M.L., A Study of Shark Exploitation in U.S. Atlantic Coastal Waters during 1986-1989, 1990).

To ensure that all final FMP management measures are based upon the best scientific information available, NMFS undertook and completed a revised assessment of the condition of the large coastal shark species group using the above new/corrected information provided by the states and fishermen. The revised assessment was subjected to a peer review by a Review Committee consisting of both outside scientific experts and other NMFS stock assessment biologists; the Committee issued its final report on November 23, 1992 (see Appendix II, Report of the Atlantic Coastal Shark Fishery Analysis Review, November 23, 1992).

The Committee Report concludes, among several things, that the large coastal group is overfished (overfishing occurred in all years from 1986 through 1992 except for 1987 and 1990) and that calendar year 1993 landings for the large coastal should be reduced below the calendar year 1991 landings level of 4,319 mt dressed weight (see Table 4.5 and Appendix II). The Committee Report establishes three options for the calendar year 1993 landings limit (recreational and commercial combined) for the large coastal group; each option provides a specific degree of conservation benefits.

To ensure that the large coastal group is rebuilt to the MSY level, NMFS has selected the Committee's recommended second option (see Table 4 of the Committee Report) establishing 1993 total landings of 2,900 mt dressed weight (a 34 percent reduction

from the 1991 landings; a 29 percent reduction from the 1986-1991 annual average landings). Under this option, stock abundance will rebuild 5 percent each year back to the MSY level by 1995. The rebuilding schedule shows that annual fishery yields would increase each year and would be equal to MSY by 1999. Under the Committee's first option for 1993 calendar year total landings (3,520 mt dressed weight), the stock would not rebuild to the MSY level (14,900 mt). Option 3 of the Committee Report requires a 1993 landings limit of 2,311 mt (a 50 percent reduction from the 1991 level; a 44 percent reduction from the 1986-1991 annual average). This option achieves a 10 percent annual increase in stock abundance until the MSY level is reached. NMFS determined that this option would involve unacceptable short term costs in lost fishery revenues, and is not necessary to achieve stock rebuilding in a reasonable time period.

Based on the Committee Report, NMFS estimates that the MSY for the large coastal species group is 3,800 mt dressed weight. The MSY stock biomass level is estimated to be about 14,900 mt dressed weight. See Table 4.4 for a summary of the MSY estimates, as well as commercial quotas and total expected landings for calendar year 1993 for the three species groups.

#### **4.4.2 OVERFISHING, SMALL COASTAL SHARKS**

The small coastal species group will be considered overfished when the stock abundance level will not produce MSY on a sustainable basis. For the small coastal species group, MSY equals the annual production during 1989. In that year, an initial abundance of 3,737,000 sharks (Tables 4.1 and 4.3) produced a surplus (production) of 2,454,500 sharks. Based on the 1989 average dressed weight of 2.05 pounds, the annual production (MSY) is established at 2,590 mt.

The 1986 catch of approximately 1,632,000 individuals was 20 percent less than the estimated production of approximately 2,018,000 individuals; thus, abundance increased from 1986 to 1987 (Table 4.3). Catch was 36 percent higher than production in 1987 and 54 percent higher in 1988, but 1989 catch was 23 percent less than 1989 production. An approximation of the 1990 catch level based on the 1986-1989 average is 2,487,000 fish, 10 percent less than production, thus, abundance probably increased since 1989. The resulting 1991 abundance level is projected to be at the MSY level; the resource should be able to sustain MSY-level removals (about 3,600 mt) with the equilibrium fishing mortality rate at MSY ( $F=0.48$ ).

#### **4.4.3 OVERFISHING, PELAGIC SHARKS**

Maximum sustainable yield of pelagic sharks was specified as 1,560 mt dressed weight (average 1986-1991 landings, Section 4.1.3). No evidence is available to suggest that this level is being exceeded.

#### 4.5 REMOVAL LIMITS (TACS), REBUILDING, AND MONITORING

##### 4.5.1 REMOVAL LIMITS (TAC'S), REBUILDING, AND MONITORING: LARGE COASTAL SHARKS

During the public comment periods held on the proposed FMP and on the proposed rule, significant new information was received from fishermen, fish buyers, and state fishery management agencies. This information included: (1) fishery removals not previously recorded; (2) sizes of caught sharks; and (3) the numbers of commercial fishing vessels targeting sharks. The additional information significantly changed the analytic results of the last stock assessment done in 1990 (see Parrack, M.L., 1990, A Study of Shark Exploitation in U.S. Atlantic Coastal Waters during 1986-1989).

To ensure that all FMP management measures are based upon the best scientific information available, a revised assessment of the condition of the large coastal species group was completed. The revised assessment was reviewed by a scientific peer review committee consisting of both outside scientific experts and NMFS scientists. The Review Committee issued its final report on November 23, 1992 (see Appendix II, Report of the Atlantic Coastal Shark Fishery Analysis Review, November 23, 1992).

The Review Committee reported evidence of overfishing for the large coastal group during 1986 through 1992 (except for 1987 and 1990). The Committee recommended and that calendar year 1993 landings for the large coastal should be reduced below the calendar year 1991 landings level of 4,319 mt dressed weight (see Appendix II and Table 4.5). The Committee Report establishes three options for the calendar year 1993 landings limit (recreational and commercial combined) for the large coastal group; each option provides a specific degree of conservation benefits.

Under the Committee's first option for the 1993 calendar year total landings (3,520 mt dressed weight), the large coastal stock would not rebuild to the MSY level (14,900 mt). To ensure that the large coastal group is rebuilt to the MSY level, NMFS has selected the Committee's recommended second option (Option 2--see Table 4 of the Committee Report) establishing 1993 total landings of 2,900 mt dressed weight (a 34 percent reduction from the 1991 landings; a 29 percent reduction from the 1986-91 annual average landings). Under this option, stock abundance will rebuild 5 percent each year back to the MSY level (estimated by NMFS to be 14,900 mt dressed weight) by 1995. The Review Committee's rebuilding schedule shows that annual fishery yields would increase about 5 percent each year but would not equal MSY until 1999. Option 3 of the Committee Report requires a 1993 landings limit of 2,311 mt (a 50 percent reduction from the 1991 level; a 44 percent reduction from the 1986-91 annual average). This option achieves a 10 percent annual increase in stock abundance

until the MSY level is reached. NMFS determined that this option would cause unacceptable short-term costs in lost fishery revenues, and is not necessary to achieve stock rebuilding in a reasonable time period.

While NMFS adopted option 2 for stock rebuilding and will implement the recommended calendar year total landings (and derived calendar year commercial quotas) from 1993 to 1995, NMFS believes that the large coastal species group will be rebuilt by 1995 and at that point the stock size should be sufficient to provide MSY. NMFS does not agree with the Committee Report's conclusion that MSY yields will not occur under its rebuilding schedule until 1999.

The 1993 calendar year commercial quota for the large coastal group is determined based on the historical commercial average annual share (percent of average total annual landings) for the period 1986 through 1991; this average annual share is 84 percent (see Table 4.7). The same approach was used in the proposed FMP to determine commercial quotas. The recreational share of the total 1993 landings will also be based on the historical average annual percentage share from 1986 through 1991; this value is 16 percent (see Table 4.7). The bag limits for large coastal (and pelagic) species have been changed to four fish per trip to ensure that 1993 commercial and recreational landings are reduced by about the same percent (29 percent) over their respective recent annual averages.

#### **4.5.2 REMOVAL LIMITS AND MONITORING: SMALL COASTAL SHARKS**

The abundance of small coastal shark species is estimated to be at the MSY level. Removals will be limited to the MSY level (2,590 mt dressed weight), thus imposing the equilibrium fishing mortality rate ( $F=0.48$ ). If an annual fishing mortality rate exceeds this level, overfishing will have occurred and a rebuilding program will be necessary.

There is evidence that the abundance of this resource has been somewhat constant in recent years, but since it is heavily impacted by bycatch of the shrimp fishery, careful monitoring is prudent. Such monitoring is being carried out in the Gulf of Mexico through the SEAMAP program. These research cruise fishery-independent data will be used to monitor the relative abundance of this resource.

#### **4.5.3 REMOVAL LIMITS AND MONITORING: PELAGIC SHARKS**

The production potential for pelagic sharks cannot be estimated. Until the data become available to make statistical estimates of resource production, an annual landing of 1,560 mt dressed weight (average 1986-1991 landings) will be used as the removal limit for pelagic sharks. The effect of that yield on resource abundance is not known.

#### 4.6 ANNUAL TOTAL ALLOWABLE CATCH (TAC)

The proposed allocation of Total Allowable Catch (TAC) is designed to be fair to commercial and recreational fishermen while safeguarding the resource for future generations. The expansion of the commercial fishery will be halted and landings reduced. Recreational bag limits will be imposed. Based on the 1986-1991 average percentages of commercial versus recreational landings, the large coastal species group allocation is 84 percent commercial and 16 percent recreational (Table 4.7).

The total TAC includes commercial and recreational landings of all three species groups. For 1993, total TAC is set at 7,050 mt, which is 890 mt below total MSY (Table 4.4).

The 1993 commercial quotas are 3,016 mt (approximately 39 percent of total MSY): 2,436 mt of the large coastal species group, and 580 mt of the pelagic species group. As each species group quota is reached, the commercial fishery on those species will be closed. The quotas halt the previously unrestricted growth of the commercial shark fishery. Commercial landings peaked in 1989 with 5,124 mt and have declined since.

Recreational catches are estimated by the MRFSS which are generally available one or two years after the fishing year. Therefore, there is no way to know when the recreational TAC has been reached. A recreational fishing trip limit will be used instead. The rebuilding policy requires that the fishing mortality level ( $F$ ) not exceed 0.16. Thirty-one percent of the catch is allocated to the recreational fishery so the  $F$ , due to recreational fishing, must exceed 31 percent of 0.16 or 0.05. A trip limit will not limit the amount of fishing ( $f$ ) but it will decrease the "effectiveness" of fishing ( $q$ ). Any percent decrease in catch caused by a trip limit will cause an equal percent decrease in fishing effectiveness (because  $qf = C/N$  where  $N$  is abundance and  $C$  is catch). Table 4.6 shows trip interview data and the resulting percent catch reductions that these data imply will occur from several trip limit options. A four fish trip limit will reduce the catch, and thus fishing effectiveness is estimated to be  $0.227 \times 10^{-6}$  (Parrack, 1990), thus with a four fish trip limit, it will be reduced by 28 percent to  $0.163 \times 10^{-6}$ . Assuming that recreational effort is constant in the future at the 1986-89 average of 376,616 directed trips, since the fishing mortality level is equal to the product of effectiveness and the amount of fishing ( $F = qf = 0.163 \times 10^{-6} \times 376,616 = 0.06$ ), the four fish trip limit will achieve the target fishing mortality level and, therefore, restrict the recreational catch to the TAC listed in Table 4.8.

A recreational bag limit more conservative than one-shark per person per day (proposed in the initial draft FMP) was the consensus of comments received at public hearings. A two-shark per boat-trip limit was adopted in the Shark FMP (October 28,

1991). Due to information received during the public review process, the final bag limit was raised to four shark per trip limit for combined large coastal species and pelagic species, coupled with other management measures (Section 7.0), is expected to result in landings of approximately 1,331 mt (Table 4.4).

There is no recreational or commercial quota for the small coastal species group. Current information (Parrack, 1990) does not suggest that these sharks are overexploited, yet they may be fully exploited. However, their small size limits their commercial value and the potential for significant directed exploitation.

The proposed 1993 allocation to the recreational sector catching large coastal sharks is 464 mt. Established catches by that sector in 1989 were 44,386 fish (Parrack, 1990), equivalent to 464 mt dressed weight. Data for 1990 indicate that commercial landings were 16 percent less than for the same period in 1989 (Snell, personal communication). If that percent reduction were exhibited by the recreational sector as well, then the projected 1990 recreational yield would be 395 mt. If the recreational landings were not reduced in 1990 and stayed the same as in 1989, then the projected 1990 catches would be 464 mt.

The recreational allocation of pelagic species is 867 mt, based on the average landings from 1986-1989. The four per boat per trip limit should keep landings within this allocation. It is interesting to note, however, that the one-shark bag limit per person proposed in the initial draft was regarded as overly generous by the majority of commenting recreational fishermen at the public hearings. It is concluded, therefore, that the bag limit should meet the needs of most fishermen with respect to shark meat for home consumption.

In summary, commercial large coastal shark landings will be reduced 29 percent from the average 1986-1991 level of 3,444 to 2,436 mt and commercial pelagic shark landings will remain at the historical level of 580 mt during the first full year under management. There are no constraints on the small coastal species group at present because landings are believed to be near MSY. The combined effect of the management actions on the commercial and recreational shark fisheries is an estimated reduction in landings to or below the projected total allowable catch (TAC) of 7,050 mt (Table 4.4).

#### **4.7 DOMESTIC ANNUAL HARVEST (DAH) CAPACITY**

Domestic recreational and commercial fishermen have the capacity to harvest more than the annual OY level of 7,050 mt based on historic landing levels (Section 4.3).

**Table 4.7**

**Commercial and Recreational Landings for Large Coastal Species**  
(Dressed Weight - Metric Tons)

Year	Commercial	Recreational	Total
			Landings
1986	1,301	755	2,507
1987	2,451	907	3,358
1988	4,057	668	4,725
1989	5,013	616	5,629
1990	3,830	637	4,467
<u>1991</u>	<u>4,010</u>	<u>310</u>	<u>4,319</u>
Total	20,662	3,893	24,555
% of Total	84	16	100
Average	3,444	649	4,093

Source: Parrack, 1992.

**Table 4.8**

**Impacts of Alternative Trip Limits**

Sampled Recreational Fishing Trips			Catches with Five Different Trip Limits				
Sharks Per Trip	No. of Trips	Total Caught	1 Shark	2 Sharks	3 Sharks	4 Sharks	5 Sharks
1	71	71	71	71	71	71	71
2	17	34	17	34	34	34	34
3	9	27	9	18	27	27	27
4	3	12	3	6	9	12	12
5	1	5	1	2	3	4	5
6 or more	11	118	11	22	33	44	55
Total	112	267	112	153	177	192	204
% Reduction In Catch			58	43	34	28	24

Source: See Table 7.3.

#### **4.8 DOMESTIC ANNUAL PROCESSING (DAP) CAPACITY**

The domestic processing sector has the capacity to fully process shark resources harvested annually at OY levels, based on past performance.

#### **4.9 TOTAL ALLOWABLE LEVEL OF FOREIGN FISHING (TALFF)**

There is no surplus of shark stocks for foreign fishing because the demand and capacity of the domestic fleets surpass the available resources. The TALFF is zero in the U.S. EEZ.

#### **4.10 STRATEGY TO ACHIEVE OPTIMUM YIELD GOAL**

The strategy for achieving OY is specified in Section 7.