FISHERY MANAGEMENT PLAN FOR U.S. WEST COAST FISHERIES FOR HIGHLY MIGRATORY SPECIES AS AMENDED

APPENDIX C

BYCATCH OF FISH IN HMS FISHERIES

Note: This appendix comprises chapter 5.0 from the FMP/FEIS published in August 2003

C.1 Introduction

Bycatch has become a central concern of fishing industries, resource managers, scientists, and the public, both nationally and globally. A 1994 report of the Food and Agriculture Organization (FAO) of the United Nations estimated that the nearly one-quarter (27 million mt) of the total world catch by commercial fishing operations was discarded (Alverson *et al.*, 1994). Bycatch from recreational fisheries was not quantified in the FAO report, but anglers also discard (dead and alive) millions of fish each year. Bycatch can result in death or injury to the discarded fish, and it is essential that this component of total fishing-related mortality be incorporated into fish stock assessments and evaluation of management measures.

Bycatch precludes other more productive uses of fishery resources; it is particularly important to minimize the waste associated with bycatch when so many of the world's fisheries are either fully exploited or overexploited. Although not all discarded fish die, when bycatch becomes a source of fishing mortality it can slow the rebuilding of overfished stocks. Bycatch imposes direct and indirect costs on fishing operations by increasing sorting time and decreasing the amount of gear available to catch target species. Incidental catch concerns also apply to populations of marine mammals, sea turtles, seabirds and other components of ecosystems for which there are no commercial or recreational uses. Interactions with protected species are addressed in Chapter 6.

In 1998, NMFS developed a national bycatch plan, *Managing the Nation's Bycatch* (NMFS, 1998), which includes programs, activities, and recommendations for federally managed fisheries. That plan establishes a definition of bycatch as fishery discards, retained incidental catch, and unobserved mortalities resulting from a direct encounter with fishing gear.

C.2 Bycatch Reduction and the Magnuson-Stevens Act

National Standard 9 of the Magnuson-Stevens Act requires that fishery conservation and management measures shall, to the extent practicable, minimize bycatch and minimize the mortality of bycatch that cannot be avoided. In many fisheries, it is not practicable to eliminate all bycatch and bycatch mortality. The Magnuson-Stevens Act defines bycatch as fish that are harvested in a fishery, but are not sold or kept for personal use, and includes economic discards and regulatory discards. Bycatch does not include fish released alive under a recreational catch and release fishery management program.

Some relevant examples of fish caught in West Coast HMS fisheries that are included in the Magnuson-Stevens Act's definition of bycatch are marlin caught and discarded by commercial fishing gear; tunas caught and discarded by recreational or commercial fishers; species for which there is little or no market and are therefore discarded, such as blue sharks; and most sharks that are not landed (including fish hooked and lost, or fish released at the boat - whether or not the fish was tagged).

There are many benefits associated with the reduction of bycatch, including the reduction of uncertainty concerning total fishing-related mortality, which improves the ability to assess the status of stocks, to determine the appropriate relevant controls, and to ensure that overfishing levels are not exceeded. It is also important to consider bycatch of HMS, especially sharks, as a source of mortality from fisheries that target species other than HMS. To maintain sustainable fisheries, it makes sense to work with fishery constituents on an effective, flexible bycatch strategy. This strategy may include a combination of management measures in the domestic fishery, and if appropriate, will incorporate multi-lateral measures recommended by international fora (e.g., MHLC, FAO Shark Global Plan of Action). The bycatch in each fishery will be summarized annually in the SAFE report for HMS fisheries. The effectiveness of the bycatch reduction measures will be evaluated based on this summary. Any regulatory changes will be made using a framework procedure.

A limited number of options are currently available for bycatch reduction in HMS fisheries, some of which are being used. These are the measures:

Commercial
1. Gear Modifications
2. Time/Area Closures
3. Full Retention of Catch
4. Performance Standards
5. Education
6. Effort Reduction
7. Limited Soak Time
8. Forbidden to Set on Floating Objects

Recreational
1. Use of Dehooking Devices (Mortality Reduction Only)
2. Use of Circle Hooks (Mortality Reduction Only)
3. Full Retention of Catch
4. Formal Voluntary Catch-and Release Program for all Fish
5. Formal Voluntary Catch-and Release Program for Striped Marlin Only

There are probably no fisheries in which there is no bycatch because none of the currently legal fishing gears are perfectly selective for the target of each fishing operation (with the possible exception of the swordfish harpoon fishery). Therefore, to eliminate bycatch of every species in HMS fisheries would require eliminating fishing. That is not practicable. The challenge becomes one of managing the kinds of gear, their configuration, and how, when, and where they are operated; and the disposition of each species caught in such a way that the unintended catch is reduced, the survival of the released fish is maximized, and the

sustainable use of bycatch is achieved where appropriate. HMS fisheries are currently limited to the following gear types: rod and reel and other handheld gear, surface hook and line, purse seine, harpoon, longline, and drift gillnets. Possible gear modifications that may reduce bycatch and bycatch mortality are being researched and considered (e.g., circle hooks, artificial baits).
Managing when and where fisheries operate can be an effective tool for reducing bycatch. Recent attempts to close important habitats to protect fish from directed and incidental fishing gear have been successful. Southern California and inshore areas off Oregon are closed to drift gillnet fishing to protect pregnant thresher sharks and their pups (Stick *et al.*, 1990).

Establishing uses for bycatch species may encourage fishers to retain such species. Often, catch is discarded in a fishery because of undesirable species, size, sex, or quality, or for other reasons, including economic discards (e.g., blue sharks). If certain species could be marketed, then they would be retained, not discarded, and therefore would not be considered bycatch.

A recreational catch and release fishery management program is one in which the retention of a particular species caught with recreational fishing gear is prohibited (Title 50, Code of Federal Regulations, Section 600.350). However, since this is a guideline and not a regulation, it may be modified to accommodate a voluntary catch and release program. Amendment 1 to the Atlantic Billfish Fishery Management Plan has instituted a voluntary catch and release program to allow anglers to release their billfish without classifying those fish as bycatch. A similar program can be used in West Coast recreational fisheries.

C.3 Evaluation and Monitoring of Bycatch

The identification and quantification of bycatch in HMS fisheries is the first step in reducing bycatch and bycatch mortality. In the following subsections, bycatch is examined on a fishery by fishery basis.

Bycatch will be monitored on a continuing basis, and bycatch information will be summarized in the annual SAFE report (see section 4.3 in the FMP). Bycatch reporting is addressed in section C.5.

C.3.1 Drift Gillnet Fishery

The drift gillnet fishery for swordfish and sharks, using stretched mesh nets with a diameter greater than 14 inches, has existed off the West Coast since 1977 (Hanan *et al.*, 1993). Beginning in 1980, CDFG started collecting logbooks, a practice which continues to the present. The logs are released to NMFS for analysis. Since 1980, with the exception of a few years, either CDFG or NMFS has fielded an observer program to record catch and the impact on protected species. These observer programs have also provided data on bycatch.

With the implementation of the Pacific Offshore Cetacean Take Reduction Plan in 1997 that required changes in drift gillnet fishing methods to reduce the take of marine mammals, NMFS observer data from 1998-99 through the 2001-02 seasons provides the most reliable picture of bycatch from the current fishery. Data from 1991-92 through 1997-98 seasons are presented for comparison with post Take Reduction Plan catches. Data from the 1990-91 season are presented in Table 5-1 but were omitted from the analysis because all fish were returned as unknown, not alive, dead or unknown as in subsequent observer reports.

Tables 5-1 through 5-12 (NMFS, unpublished data) present catch and bycatch data for observed sets in the fishery from the start of the observer program in 1990 to present. The tables list all fish observed during each set. During the twelve year period the following species, in addition to the proposed management unit species, were observed in the drift gillnet fishery: blue marlin, black marlin, sailfish, Pacific angel shark, prickly shark, salmon shark, six gill shark, seven gill shark, smooth hammerhead shark, soupfin shark, spiny dogfish shark, bay pipefish, bat ray, big skate, blacksmith, bullet mackerel, California barracuda, California needlefish, common mola, jack mackerel, louvar, manta, mobula, northern anchovy, oarfish, opah, Pacific bonito, Pacific electric ray, Pacific hake, Pacific herring, Pacific mackerel, Pacific pomfret, Pacific sardine, pelagic stingray, remora, round stingray, white seabass, and yellowtail. In addition, the three sharks proposed as prohibited species, basking, white, and megamouth sharks were also taken.

Table 5-1 NMFS California/Oregon observer program, observed catch - 1990/1991 fishing season, May 1, 1990, through January 31, 1991

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	509	494			15	56	2.610
Striped Marlin	13	2			11	2	0.067
Albacore	62	45			17	20	0.318
Bluefin Tuna	54	41			13	19	0.277
Skipjack Tuna	40	37			3	3	0.205
Yellowfin Tuna	1				1	1	0.005
Common Thresher Shark	330	329			1	26	1.692
Bigeye Thresher Shark	18	16			2		0.092
Pelagic Thresher Shark	1	1					0.005
Shortfin Mako Shark	245	243			2	6	1.256
Blue Shark	759	13			746	71	3.892
Bay Pipefish	1				1		0.005
Bullet Mackerel	216	112			104	48	1.108
Common Mola	1234	1			1233	7	6.328
Louvar	19	17			2	9	0.097
Opah	75	75				6	0.385
Other Identified Fish	2				2		0.010
Pacific Bonito	67	50			17	21	0.344
Pacific Electric Ray	2				2		0.010
Pacific Hake	1				1		0.005
Pacific Mackerel	58	37			21	2	0.297
Pacific Pomfret	1				1		0.005
Pelagic Stingray	2				2		0.010
Unidentified Fish	28	10			18	5	0.144
Unidentified Ray	1				1		0.005
Yellowtail	3	2			1		0.015

The above table summarizes the total catch and final disposition, by species, of all fish observed caught in the California/Oregon drift gillnet fishery during the 1990/1991 fishing season. Data were collected at sea by NMFS observers, and represents a total of 195 sets. Estimated total fishing effort for the season is 4,327 sets

Table 5-2 NMFS California/Oregon observer program, observed catch - 1991/1992 fishing season, May 1, 1991, through January 31, 1992

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	753	749		4		44	1.579
Striped Marlin	40	19		21		1	0.084
Albacore	307	288		19		56	0.644
Bigeye Tuna	8	8				1	0.017
Bluefin Tuna	25	20		5		8	0.052
Skipjack Tuna	392	325	2	65		101	0.822
Yellowfin Tuna	38	38				5	0.080
Common Thresher Shark	412	403	1	8		23	0.864
Bigeye Thresher Shark	65	62		3			0.136
Shortfin Mako Shark	501	495	4	2		6	1.050
Blue Shark	716	44	218	423	31	22	1.501
Pacific Angel Shark	3		1		2	1	0.006
Salmon Shark	1			1			0.002
Unidentified Shark	1				1		0.002
Bat Ray	3		2		1	1	0.006
Bullet Mackerel	71	26		43	2	19	0.149
Common Mola	2090	6	1957	49	78	3	4.382
Jack Mackerel	33	30		3			0.069
King of the Salmon	1	1					0.002
Louvar	49	47		2		9	0.103
Northern Anchovy	1			1			0.002
Opah	111	108	1	1	1	9	0.233
Other Identified Fish	34	6	26	2		1	0.071
Pacific Bonito	5	4		1			0.010
Pacific Electric Ray	1				1		0.002
Pacific Hake	12			12		2	0.025
Pacific Herring	2	2					0.004
Pacific Mackerel	813	522	14	277		36	1.704
Pacific Pomfret	19	16		3			0.040
Pacific Sardine	4	2		2		1	0.008
Pelagic Stingray	1			1			0.002
Remora	3		3				0.006
Unidentified Fish	12		1	11		5	0.025
Unidentified Ray	4			3	1		0.008
Unidentified Skate	1		1				0.002
Yellowtail	4	4					0.008

The above table summarizes the total catch and final disposition, by species, of all fish

observed caught in the California/Oregon drift gillnet fishery during the 1991/1992 fishing season.

Data were collected at sea by NMFS observers, and represents a total of 477 sets.

Estimated total fishing effort for the season is 4,652 sets.

Table 5-3 NMFS California/Oregon observer program, observed catch - 1992/1993 fishing season, May 1, 1992, through January 31, 1993

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	1891	1877		14		116	2.865
Striped Marlin	13	2		11		2	0.020
Shortbill Spearfish	1	1				1	0.002
Albacore	1071	906		165		260	1.623
Bluefin Tuna	131	108		23		35	0.198
Skipjack Tuna	251	143		108	87		0.380
Yellowfin Tuna	23	19		4		5	0.035
Common Thresher Shark	383	382		1		4	0.580
Bigeye Thresher Shark	38	35		3			0.058
Shortfin Mako Shark	483	474	4	4	1	1	0.732
Blue Shark	2373	5	746	1578	44	89	3.595
Prickly Shark	1		1				0.002
Salmon Shark	9	9					0.014
Smooth Hammerhead Shark	6	1		5			0.009
Soupfin Shark	2	2					0.003
Bat Ray	2		2				0.003
Bullet Mackerel	175	119		56		18	0.265
Common Mola	3513		3390	97	26	4	5.323
Jack Mackerel	6	3		3		1	0.009
Louvar	97	85		12		32	0.147
Manta	1		1				0.002
Oarfish	1	1					0.002
Opah	290	285		5		33	0.439
Other Identified Fish	11		5	6		2	0.017
Pacific Bonito	36	26		10		5	0.055
Pacific Electric Ray	5		4		1		0.008
Pacific Hake	39	2	12	25		6	0.059
Pacific Mackerel	510	17	15	476	2	2	0.773
Pacific Pomfret	67	19	1	47		4	0.102
Pelagic Stingray	16		9	5	2		0.024
Remora	3		3				0.005
Unidentified Fish	9	2	2	5		5	0.014
Unidentified Ray	2	1	1				0.003

The above table summarizes the total catch and final disposition, by species, of all fish

observed caught in the California/Oregon drift gillnet fishery during the 1992/1993 fishing season.

Data were collected at sea by NMFS observers, and represents a total of 660 sets.

Estimated total fishing effort for the season is 4,634 sets.

Table 5-4 NMFS California/Oregon observer program, observed catch - 1993/1994 fishing season, May 1, 1993, through January 31, 1994

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	1696	1690		6		88	2.240
Striped Marlin	44	7	1	36		1	0.058
Blue Marlin	2	1		1			0.003
Black Marlin	4			4			0.005
Albacore	3432	2919		513		663	4.534
Bigeye Tuna	2	2					0.003
Bluefin Tuna	196	187		9		33	0.259
Skipjack Tuna	1083	207		876		282	1.431
Yellowfin Tuna	3	3					0.004
Common Thresher Shark	503	503				3	0.664
Bigeye Thresher Shark	45	37		8			0.059
Pelagic Thresher Shark	1	1					0.001
Shortfin Mako Shark	294	287	3	4		3	0.388
Blue Shark	1648	13	507	1087	41	48	2.177
Basking Shark	1			1			0.001
Salmon Shark	2	1		1			0.003
Smooth Hammerhead Shark	15	2		13			0.020
Unidentified Hammerhead Shark	1	1					0.001
Bat Ray	1		1				0.001
Bullet Mackerel	4	3		1			0.005
Common Mola	4969	2	4668	265	34	3	6.564
Jack Mackerel	5	2		3			0.007
Louvar	35	31		4		13	0.046
Mobula	1		1				0.001
Oarfish	1			1			0.001
Opah	344	341		3		27	0.454
Other Identified Fish	12	1		7	4		0.016
Pacific Bonito	3			3		2	0.004
Pacific Electric Ray	1		1				0.001
Pacific Hake	119		6	113		10	0.157
Pacific Mackerel	79	10	1	68			0.104
Pacific Pomfret	38	6		21	1	2	0.050
Pacific Sardine	11	1		10		2	0.015
Pelagic Stingray	22	1	15	6		1	0.029
Remora	1		1				0.001
Unidentified Fish	72		1	71		60	0.095
Yellowtail	4	4					0.005

The above table summarizes the total catch and final disposition, by species, of all fish

observed caught in the California/Oregon drift gillnet fishery during the 1993/1994 fishing season.

Data were collected at sea by NMFS observers, and represents a total of 757 sets.

Estimated total fishing effort for the season is 5,696 sets.

Table 5-5 NMFS California/Oregon observer program, observed catch - 1994/1995 fishing season, May 1, 1994, through January 31, 1995

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	977	974		3		46	1.476
Striped Marlin	65	14	2	48	1	4	0.098
Blue Marlin	4			4			0.006
Black Marlin	1			1			0.002
Sailfish	1			1			0.002
Other Identified Billfish	1			1			0.002
Albacore	659	592		67		123	0.995
Bluefin Tuna	161	161				7	0.243
Skipjack Tuna	54	48		6		3	0.082
Yellowfin Tuna	6	6					0.009
Common Thresher Shark	585	583		2		8	0.884
Bigeye Thresher Shark	48	41	1	6			0.073
Pelagic Thresher Shark	1			1			0.002
Shortfin Mako Shark	334	328	3	3			0.505
Blue Shark	993	16	272	683	22	20	1.500
Prickly Shark	1		1				0.002
Salmon Shark	1	1					0.002
Sevengill Shark	1	1					0.002
Smooth Hammerhead Shark	2	2					0.003
Big Skate	1		1				0.002
California Barracuda	2	2					0.003
Common Mola	2218	13	2087	90	28	5	3.350
Jack Mackerel	24	9	1	14		3	0.036
Louvar	38	35		3		8	0.057
Northern Anchovy	2		1	1			0.003
Oarfish	3			3		2	0.005
Opah	222	215		6	1	13	0.335
Other Identified Fish	22	5	2	14	1	1	0.033
Pacific Bonito	2	2				1	0.003
Pacific Electric Ray	3	1	1	1			0.005
Pacific Hagfish	1			1			0.002
Pacific Hake	47	4		43		3	0.071
Pacific Mackerel	1151	225	11	914	1	61	1.739
Pacific Pomfret	73	66		7		2	0.110
Pacific Sardine	2			2		1	0.003
Pelagic Stingray	31		25	4	2		0.047
Remora	12		11		1		0.018
Round Stingray	2		1	1			0.003
Unidentified Fish	18			18		16	0.027
Unidentified Ray	1		1				0.002
Yellowtail	3	2		1			0.005

The above table summarizes the total catch and final disposition, by species, of all fish

observed caught in the California/Oregon drift gillnet fishery during the 1994/1995 fishing season.
Data were collected at sea by NMFS observers, and represents a total of 662 sets.
Approximate total fishing effort for the season is 4,248 sets.

Table 5-6 NMFS California/Oregon observer program, observed catch - 1995/1996 fishing season, May 1, 1995, through January 31, 1996

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	1265	1252		13		136	2.155
Striped Marlin	21	5		16			0.036
Blue Marlin	5	1		4			0.009
Albacore	434	369		65		105	0.739
Bigeye Tuna	2	2					0.003
Bluefin Tuna	450	373		77		164	0.767
Skipjack Tuna	1947	906	1	1040		784	3.317
Yellowfin Tuna	23	22		1		5	0.039
Common Thresher Shark	130	130				1	0.221
Bigeye Thresher Shark	55	48	1	6		2	0.094
Shortfin Mako Shark	466	460	4	1	1	5	0.794
Blue Shark	2655	7	630	1972	46	119	4.523
Bat Ray	1		1				0.002
California Barracuda	9	9					0.015
Common Mola	3668	14	3549	97	8	15	6.249
Louvar	57	44		13		32	0.097
Oarfish	1			1		1	0.002
Opah	301	291		10		30	0.513
Other Identified Fish	28	1	18	8	1		0.048
Pacific Bonito	59	11		48		43	0.101
Pacific Electric Ray	1				1		0.002
Pacific Hake	6	3		3			0.010
Pacific Mackerel	514	133	9	372		2	0.876
Pacific Pomfret	8	2		5	1	1	0.014
Pelagic Stingray	22		19	2	1	1	0.037
Remora	24		24				0.041
Unidentified Fish	121	1	1	119		119	0.206
Unidentified Ray	1		1				0.002
White Seabass	5	4		1		1	0.009
Yellowtail	1	1					0.002

The above table summarizes the total catch and final disposition, by species, of all fish

observed caught in the California/Oregon drift gillnet fishery during the 1995/1996 fishing season. Data were collected at sea by NMFS observers, and represents a total of 587 sets. Approximate total fishing effort for the season is 3,673 sets.

Table 5-7 NMFS California/Oregon observer program, observed catch - 1996/1997 fishing season, May 1, 1996, through January 31, 1997

Species	Total Caught	Total Kept	Returned Alive	Returned Dead	Returned Unknown	Number Damaged	Catch per Set
Swordfish	817	813		4		50	1.749
Striped Marlin	15	10	1	4			0.032
Blue Marlin	9			9			0.019
Albacore	747	672		75		186	1.600
Bluefin Tuna	553	541		12		94	1.184
Skipjack Tuna	130	82		48		41	0.278
Yellowfin Tuna	21	19		2		6	0.045
Common Thresher Shark	535	534		1		8	1.146
Bigeye Thresher Shark	29	28		1			0.062
Shortfin Mako Shark	483	466	10	6	1	4	1.034
Blue Shark	1691	4	477	1189	21	62	3.621
Salmon Shark	8	2		6			0.017
Smooth Hammerhead	5	5					0.011
Unidentified Shark	1			1			0.002
White Shark	1	1					0.002
Bay Pipefish	2			2			0.004
Bullet Mackerel	13	9		4			0.028
California Barracuda	1	1					0.002
Common Mola	2302	2	2244	46	10	11	4.929
Jack Mackerel	6	5		1		1	0.013
Louvar	51	44	1	6		13	0.109
Northern Anchovy	1			1			0.002
Opah	571	554		16	1	35	1.223
Other Identified Fish	2			2			0.004
Pacific Bonito	6	4		2		1	0.013
Pacific Electric Ray	3		3				0.006
Pacific Hake	16			16		2	0.034
Pacific Mackerel	688	145	4	539		15	1.473
Pacific Pomfret	25	13	1	11		1	0.054
Pacific Sardine	2			2		1	0.004
Pelagic Stingray	20		11	8	1		0.043
Remora	21		19	2			0.045
Unidentified Fish	13	4	1	8		12	0.028
Unidentified Ray	1		1				0.002
Yellowtail	4	4					0.009

The above table summarizes the total catch and final disposition, by species, of all fish

observed caught in the California/Oregon drift gillnet fishery during the 1996/1997 fishing season. Data were collected at sea by NMFS and contract observers, and represents a total of 467 sets. Approximate total fishing effort for the season is 3,246 sets.

Table 5-8 NMFS California/Oregon observer program, observed catch - 1997/1998 fishing season, May 1, 1997, through January 31, 1998

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	1809	1766		43		296	2.418
Striped Marlin	76	1		75		10	0.102
Blue Marlin	14			13	1		0.019
Other Identified Billfish	2		1	1		1	0.003
Albacore	1293	1141		152		272	1.729
Bigeye Tuna	8	8				1	0.011
Bluefin Tuna	676	639		37		139	0.904
Skipjack Tuna	1407	700		707		461	1.881
Yellowfin Tuna	88	77		11		29	0.118
Common Thresher Shark	628	628				16	0.840
Bigeye Thresher Shark	76	76				2	0.102
Pelagic Thresher Shark	73	72		1			0.098
Shortfin Mako Shark	940	916	9	14	1	7	1.257
Blue Shark	2319	2	737	1549	31	133	3.100
Prickly Shark	1		1				0.001
Smooth Hammerhead Shark	6			6			0.008
Soupfin Shark	1	1					0.001
White Shark	2	1		1			0.003
Bat Ray	1		1				0.001
Bullet Mackerel	1917	512	5	1400		133	2.563
California Barracuda	11	3	1	7		3	0.015
Common Mola	2112	2	2003	89	18	6	2.824
Dolphinfish	1	1					0.001
Jack Mackerel	16	3	1	12		7	0.021
Louvar	59	48		10	1	21	0.079
Manta	9		2	6	1		0.012
Mobula	3	2	1				0.004
Oarfish	2			2			0.003
Opah	495	473	1	21		79	0.662
Other Identified Fish	43	8	2	33		3	0.057
Pacific Bonito	95	55		40		29	0.127
Pacific Electric Ray	5		4	1			0.007
Pacific Hake	1			1			0.001
Pacific Mackerel	444	222	8	212	2	35	0.594
Pacific Pomfret	28	26		2		3	0.037
Pacific Sardine	20	2		18		5	0.027
Pelagic Stingray	36		29	6	1		0.048
Remora	22		21		1		0.029
Round Stingray	1		1				0.001
Unidentified Fish	89		7	82		77	0.119
Unidentified Mackerel	26	7		19		5	0.035
Yellowtail	7	7					0.009

The above table summarizes the total catch and final disposition, by species, of all fish

observed caught in the California/Oregon drift gillnet fishery during the 1997/1998 fishing season.
Data were collected at sea by contract observers, and represents a total of 748 sets.
Approximate total fishing effort for the season is 3,039 sets.

Table 5-9 NMFS California/Oregon observer program, observed catch - 1998/1999 fishing season, May 1, 1998, through January 31, 1999

Species	Total Caught	Total Kept	Returned Alive	Returned Dead	Returned Unknown	Number Damaged	Catch per Set
Swordfish	1069	1051		18		112	2.147
Striped Marlin	2			2		1	0.004
Albacore	1918	1652		266		424	3.851
Bluefin Tuna	342	308		34		77	0.687
Skipjack Tuna	1814	499	1	1314		430	3.643
Yellowfin Tuna	16	13		3		3	0.032
Common Thresher Shark	393	391	2			1	0.789
Bigeye Thresher Shark	15	14		1			0.030
Pelagic Thresher Shark	1	1					0.002
Shortfin Mako Shark	312	302	8	2		5	0.627
Blue Shark	2260	1	761	1472	26	70	4.538
Salmon Shark	1			1			0.002
Smooth Hammerhead Shark	1			1			0.002
Soupfin Shark	1	1					0.002
Spiny Dogfish	1			1			0.002
Unidentified Shark	1			1			0.002
Bat Ray	1		1				0.002
Blacksmith	1		1				0.002
Bullet Mackerel	444	70		374		6	0.892
California Barracuda	6	6					0.012
California Needlefish	2		1	1			0.004
Common Mola	4397	1	4266	119	11	8	8.829
Louvar	47	39	1	7		17	0.094
Manta	4		2	2			0.008
Northern Anchovy	1			1			0.002
Opah	303	293		10		40	0.608
Other Identified Fish	15	4	8	3		1	0.030
Pacific Bonito	64	47		17		17	0.129
Pacific Electric Ray	3		3				0.006
Pacific Hake	2			2			0.004
Pacific Mackerel	65	33	2	29	1	2	0.131
Pacific Pomfret	19	12		7		2	0.038
Pelagic Stingray	21		18	3			0.042
Remora	3		2		1		0.006
Round Stingray	1		1				0.002
Unidentified Fish	38			37	1	37	0.076
Unidentified Rockfish	2		1	1			0.004
Yellowtail	12	12					0.024

The above table summarizes the total catch and final disposition, by species, of all fish observed caught in the California/Oregon drift gillnet fishery during the 1998/99 fishing season.

Data were collected at sea by contract observers, and represents a total of 498 sets.
Approximate total fishing effort for the season is 2,951 sets.

Table 5-10 NMFS California/Oregon observer program, observed catch - 1999/2000 fishing season, May 1, 1999, through January 31, 2000

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	1070	1060		10		95	2.027
Striped Marlin	12			12			0.023
Blue Marlin	4			4			0.008
Albacore	2903	2111	13	779		763	5.498
Bluefin Tuna	208	189		19		47	0.394
Skipjack Tuna	26	20		6		5	0.049
Yellowfin Tuna	4	3		1		2	0.008
Common Thresher Shark	146	144	1		1	7	0.277
Bigeye Thresher Shark	10	9		1			0.019
Shortfin Mako Shark	374	358	8	8		2	0.708
Blue Shark	2559	2	1131	1379	47	100	4.847
Megamouth Shark	1		1				0.002
Pacific Angel Shark	1		1				0.002
Prickly Shark	1			1			0.002
Salmon Shark	61	8		53			0.116
Soupfin Shark	1			1			0.002
Spiny Dogfish	2		2				0.004
Bullet Mackerel	45	8		37		7	0.085
Common Mola	1739	51	1669	13	6	2	3.294
Jack Mackerel	2	1		1			0.004
Louvar	61	43		18		32	0.116
Northern Anchovy	1	1					0.002
Opah	289	270	3	16		39	0.547
Other Identified Fish	2			2		1	0.004
Pacific Bonito	9	7	1	1			0.017
Pacific Electric Ray	5		3	2			0.009
Pacific Hake	1			1		1	0.002
Pacific Mackerel	19	2	1	16		1	0.036
Pacific Pomfret	106	83		22	1	9	0.201
Pacific Sardine	1			1			0.002
Pelagic Stingray	42		33	8	1		0.080
Remora	6	1	5				0.011
Round Stingray	3		3				0.006
Unidentified Fish	4			4		4	0.008
Unidentified Mackerel	67			67			0.127
Unidentified Ray	1			1			0.002
Unidentified Skate	1			1			0.002

The above table summarizes the total catch and final disposition, by species, of all fish observed caught in the California/Oregon drift gillnet fishery during the 1999/2000 fishing season.

Data were collected at sea by contract observers, and represents a total of 528 sets.
Approximate total fishing effort for the season is 2,375 sets.

Table 5-11 NMFS California/Oregon observer program, observed catch - 2000/2001 fishing season, May 1, 2000, through January 31, 2001

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	985	971		14		103	2.218
Striped Marlin	6			6		1	0.014
Blue Marlin	2			2			0.005
Albacore	1524	1294		230		414	3.432
Bluefin Tuna	427	395		32		96	0.962
Skipjack Tuna	17	1		16		11	0.038
Yellowfin Tuna	51	39		12		23	0.115
Common Thresher Shark	327	326	1			7	0.736
Bigeye Thresher Shark	9	9					0.020
Shortfin Mako Shark	391	365	8	18		8	0.881
Blue Shark	1452	3	637	793	19	66	3.270
Salmon Shark	1			1			0.002
Sixgill Shark	1		1				0.002
Smooth Hammerhead	7			7			0.016
Unidentified Shark	1				1		0.002
Big Skate	1		1				0.002
Bullet Mackerel	56	4		52		18	0.126
Common Mola	4003	24	3881	84	14	2	9.016
Dolphinfish	1	1					0.002
Jack Mackerel	43	41		2		2	0.097
Louvar	57	46	1	10		27	0.128
Northern Anchovy	1		1				0.002
Opah	170	161	2	7		22	0.383
Other Identified Fish	4		1	3			0.009
Pacific Bonito	5	5				1	0.011
Pacific Electric Ray	3		1		2		0.007
Pacific Hake	10			10			0.023
Pacific Mackerel	433	106	5	322		103	0.975
Pacific Pomfret	50	33	1	16		1	0.113
Pelagic Stingray	27	1	21	3	2		0.061
Remora	4		4				0.009
Unidentified Fish	21			21		20	0.047
White Seabass	2	2					0.005
Yellowtail	9	9				1	0.020

The above table summarizes the total catch and final disposition, by species, of all fish

observed caught in the California/Oregon drift gillnet fishery during the 2000/2001 fishing season. Data were collected at sea by contract observers, and represent a total of 444 sets. Approximate total fishing effort for the season is 1,948 sets.

Table 5-12 NMFS California/Oregon observer program, observed catch - 2001/2002 fishing season, May 1, 2001, through January 31, 2002

	Total		Returned			Number	Catch
Species	Caught	Kept	Alive	Dead	Unknown	Damaged	per Set
Swordfish	364	353		11		51	1.127
Striped Marlin	15			15		1	0.046
Blue Marlin	9			9			0.028
Unidentified Billfish	1			1			0.003
Albacore	1214	1070		143		170	3.759
Bluefin Tuna	32	23		9		15	0.099
Skipjack Tuna	109	60		49		33	0.337
Yellowfin Tuna	189	159		30		48	0.585
Unidentified Tuna	3			3		3	0.009
							0.000
Common Thresher Shark	316	313	1	2		6	0.978
Bigeye Thresher Shark	5	4		1			0.015
Shortfin Mako Shark	347	303	11	33		2	1.074
Blue Shark	553	17	218	315	3	28	1.712
Megamouth Shark	1		1				0.003
Salmon Shark	15	1	3	11		2	0.046
Sevengill Shark	1		1				0.003
Bullet Mackerel	21	1	1	19		2	0.065
Common Mola	2459		2265	180	14	4	7.613
Jack Mackerel	6		2	4			0.019
Louvar	37	32		5		14	0.115
Opah	235	224		11		35	0.728
Other Identified Fish	2	2					0.006
Pacific Bonito	6	2		4			0.019
Pacific Electric Ray	1			1			0.003
Pacific Hake	1			1			0.003
Pacific Mackerel	60	5	2	53		2	0.186
Pacific Pomfret	19	10		9		1	0.059
Pelagic Stingray	13		11	2			0.040
Remora	2		2				0.006
Round Stingray	1		1				0.003
Unidentified Fish	1				1		0.003
Yellowtail	4	4					0.012

The above table summarizes the total catch and final disposition, by species, of all fish

observed caught in the California/Oregon drift gillnet fishery during the 2001/2002 fishing season. Data were collected at sea by contract observers, and represent a total of 323 sets. Preliminary estimated total fishing effort for the season is 1,486 sets.

During the eleven year period from 1991-2002, observer data (Tables 5-1 through 5-12) shows that albacore, skipjack tuna, blue shark, and common mola were the major bycatch species taken in drift gillnets. Bullet mackerel occasionally were taken in large numbers in the fishery during El Nino events, but not on a sustained basis as with other species. While not shown in the summary table, the bycatch of albacore is associated with economic discards; the fish are either small or heavily damaged by sharks and/or sea lions (NMFS, unpublished data). The high total discard rates (discards/total catch) for significant bycatch species such as common mola (> 99%), blue shark (> 99%), and skipjack (> 60%) are associated with the lack of marketability or low prices paid for the fish. Under current conditions, there is little or no market for common mola or whole blue sharks while skipjack commands a low price. An estimated 97% of the common mola and 36% of the blue sharks were released alive.

The effects of the Take Reduction Team's recommendations on the discarded dead rate in the DGN fishery are shown in Table 5-13. The Take Reduction Team's recommendations have been successful in reducing overall marine mammal bycatch and the number of dead fish discarded per set for major bycatch species except for albacore, which showed over a twofold increase. However, none of the catch rates either before or after implementation appear high enough to be a management problem or a threat to the resource. Using an average thrown back dead rate of 1.819 albacore per set for the period after take reduction regulations were implemented, 1,488 total sets in 2001/02 and an average weight of 20 pounds, 25.0 mt were thrown back dead during the past season. The higher catch rate may reflect the rebuilding of the stock in the 1990's (See Chapter 3, section 3.3.1). With observer coverage providing good estimates of bycatch, the amount discarded dead can be used in stock assessments. Using the same expansion method for skipjack, but with an average weight of 10 pounds, yields an estimated 12.0 mt of fish discarded dead. Again, using the same expansion method for blue sharks, but with an average weight of 50 pounds, yields an estimated 171.0 mt of discarded dead fish. Finally, expanding the discarded dead catch rate for common mola yields an estimated 372 fish thrown back dead.

The catch of striped marlin by the drift gillnet fishery averaged 29.8 fish per year after implementation of the take reduction regulations. Lowering drift gillnets to 6 fms may be responsible for the lower catch since striped marlin spend most of their time very near the surface. While this number of discards is not biologically significant, there may be some concerns with intercepting fish which might contribute to the sport fishery in southern California (Squire and Suzuki, 1990). Blue marlin catches were noted although there are few verified reports of fish taken off California.

Table 5-13 Average dead discards per set from the DGN fishery - pre and post Take Reduction Team recommendations

Species	1992-1998 Seasons	1998-2002 Seasons
Striped Marlin	0.155	0.045
Albacore	0.774	1.819
Skipjack Tuna	2.152	1.776
Blue Shark	6.213	5.076
Common Mola	0.537	0.508
Total Fish	9.831	9.223

C.3.2 Surface Hook & Line Fishery (troll and live bait)

The surface hook-and-line fishery targets albacore primarily in the eastern and central Pacific ocean. Few data are available on bycatch in the fishery. What is available comes from either logbooks or an extremely limited observer program run by NMFS (27 trips in 8 years). Since observers were not required to collect bycatch data and observer placement was not made in a systematic fashion, a complete analysis of bycatch is not possible. However, albacore, skipjack tuna, bluefin tuna, dorado, and billfish were observed as bycatch. Preliminary analysis of the bycatch data (Norm Bartoo, NMFS La Jolla, pers. comm.) indicated 10% of the albacore less than 59 cm in length were immediately thrown back upon landing. Overall, albacore less than 59 cm in length account for 5% of total catch so the bycatch is low (< 0.5% of total catch). These fish were considered economic discards since they did not command the higher price associated with larger fish. The few remaining fish were either eaten by the crew or discarded.

There are no observer data or logbook data for live bait boats fishing for albacore off the West Coast. However, because the fishery focuses on larger fish, economic discards are probably not a bycatch issue. While fishing for albacore, other species of tuna may be taken which would not be considered bycatch if landed.

Bycatch mortality in the surface troll fishery is unknown but observations by NMFS personnel conducting tagging studies in the 1980s did differentiate survival rate of tagged fish depending on whether the hook was in the upper or lower jaw. Early results showed the tag recovery rate, and hence survival of the fish, was doubled for albacore hooked in the lower jaw. The results were so dramatic that once the trend was apparent, no further tagging took place when the fish was hooked in the upper jaw. Unfortunately, 85% of the fish were hooked in the upper jaw, the result of the fact that traditional double jig hooks travel with the point on the top.

C.3.3 Pelagic Longline Fishery

Pelagic longline vessels have operated out of West Coast ports for many years. Because of state prohibitions in California and Washington, there has been no authorized commercial longline fishery within the EEZ except for the area greater than 25 miles from the coast of Oregon. Even though authorized by Oregon, there has been no longline fishing out of Oregon ports. There have been limited attempts through experimental fishing to determine what might be taken in a fishery within the EEZ. NMFS conducted a limited night time experimental fishery (11 sets, 3,856 hooks) in 1968 off southern California and caught 2 swordfish, 1,530 blue sharks and 2 mako sharks. No striped marlin were taken. CDFG authorized an experimental fishery by the F/V Tiffany Vance in 1987. The vessel fished off Point Arguello and Monterey during a 19 day period. There were 400 to 600 hooks per set but the number of sets is unknown. The vessel caught 32 swordfish, 2,360 blue sharks, 78 pelagic stingrays and 4 bigeye threshers. The Department also authorized an experimental cable longline fishery for sharks inside the Channel Islands from 1988 through 1991 (O'Brien and Sunada, 1994). During the first two years observers were placed aboard the vessels. Results from the first year showed blue sharks accounted for 62% of the catch, mako sharks 29% and pelagic stingrays 8%. Some sea lions, turtles, giant sea bass and hammerhead sharks were also hooked. The second year produced similar results with blue sharks accounting for 62% of the catch, mako sharks 29% and pelagic stingrays 9%. A few hammerheads were also taken. No trips were observed after the second year and the experimental fishery was terminated in 1991.

The scientific staff of NMFS in Hawaii has analyzed part of their longline fishery logbook data base (which includes some vessels that fished in the WPFMC area and landed in California) to provide a picture of bycatch in the central Pacific. The data have been combined into Table 5-14. Although the number of individual boats was not tracked from year to year (the maximum in any year was 31 vessels) the vessels did report fishing 3,662 days and setting 2,892,759 hooks (Ito and Machado, 1999).

Table 5-14 Western Pacific longline logbook summary from January 1995 through December 1999 (3,662 sets and 2,892,759 hooks)

Species	Kept	Released	Species	Kept	Released
albacore	6,468	6,219	striped marlin	4	89
bigeye tuna	11,247	576	swordfish	43,044	2,239
bluefin tuna	2,409	43	blue marlin	4,292	187
yellowfin tuna	620	279	black marlin	0	0
other tuna	5	4,046	spearfish	74	19
dorado	7,300	1,933	other billfish	2	34
blue shark	787	32,315	opah	2,478	633
mako shark	503	853	wahoo	109	15
thresher shark	1,048	242	oilfish	423	478
other shark	581	1,167	other fish	-	-

In an effort to gain better knowledge about longline catches in the eastern Pacific, Dr. Chris Boggs, NMFS, Hawaii Laboratory, generated Table 5-15. The table is a combination of four different logbooks covering the period from 1997 through 1999.

The most striking difference in the table is the ten-fold decrease in longline effort as you move east of 150^o W longitude. Even more striking is the decline in the total catch of most of the marketable species. These data would support the hypothesis that the eastern Pacific, at least that portion east of 150^o W longitude and outside of the EEZ of the West Coast, is not as productive as the central Pacific. However, when you look at the catch per set of swordfish and blue sharks, vessels fishing east of 150^o W longitude have a much higher CPUE for these species. The CPUE of vessels fishing for swordfish shows an increase of almost 400% over boats fishing west of 150^o W longitude. While this table does not quantify bycatch, it does suggest that the total bycatch in the eastern Pacific would probably be lower than the central Pacific simply because fewer fish are caught due to lower effort.

Table 5-15 Hawaiian based longline logbook data for catches East and West of 150° W longitude in number of fish landed and (catch per set)

Species	1999 West	1999 East	1998 West	1998 East	1997 West	1997 East
albacore	64,359 (5.320)	4,493 (3.580)	46,268 (3.947)	4,257 (3.654)	69,464 (6.102)	3,456 (3.905)
bigeye tuna	77,448 (6.402)	4,307 (8.342)	96,259 (8.212)	4,209 (3.613)	78,707 (6.914)	2,751 (3.108)
bluefin tuna	9 (0.001)	0 (0.000)	159 (0.014)	882 (0.757)	223 (0.023)	55 (0.062)
skipjack tuna	22,082 (1.828)	188 (0.150)	8,701 (0.742)	66 (0.057)	12,061 (1.060)	0 (0.000)
yellowfin tuna	16,779 (1.387)	256 (0.204)	21,340 (1.821)	470 (0.403)	28,957 (2.544)	131 (0.148)
blue shark	74,179 (6.132)	9,444 (7.525)	84,477 (7.207)	9,722 (8.345)	77,272 (6.788)	8,061 (9.108)
mako shark	1,534 (0.127)	271 (0.216)	1,284 (0.1100	258 (0.221)	1,119 (0.098)	231 (0.261)
thresher shark	3,707 (0.306)	43 (0.034)	3,836 (0.327)	15 (0.013)	2,321 (0.204)	70 (0.079)
other shark	4,136 (0.342)	15 (0.012)	3,439 (0.293)	58 (0.050)	2,327 (0.204)	5 (0.006)
dorado	40,788 (3.371)	6,308 (5.026)	21,898 (1.868)	447 (0.384)	48,588 (4.268)	1,233 (1.393)
black Marlin	571 (0.047)	13 (.010)	947 (0.081)	8 (0.007)	1,129 (0.099)	1 (.001)
blue marlin	4,864 (0.402)	70 (0.056)	5,301 (0.452)	48 (0.041)	8,239 (0.724)	20 (0.023)
striped marlin	14,034 (1.160)	392 (0.312)	14,119 (1.204)	214 (0.049)	12,611 (1.108)	1 (0.001)
sailfish	613 (0.051)	5 (0.004)	619 (0.053)	1 (0.001)	588 (0.052)	11 (0.012)
shortbill spearfish	15,736 (1.301)	186 (0.148)	9,871 (0.842)	57 (0.049)	7,308 (0.642)	1 (0.001)
swordfish	32,168 (2.659)	12,177 (9.703)	35,471 (3.026)	12,818 (11.003)	34,287 (3.012)	11,738 (13.263)
oilfish	93 (0.008)	788 (.628)	2,532 (0.216)	157 (0.135)	1705 (0.150)	42 (0.047)
opah	11,798 (0.975)	634 (0.505)	8,927 (0.762)	263 (0.226)	8,240 (0.724)	65 (0.073)
pomfret	2,421 (0.200)	266 (.212)	14,687 (1.253)	78 (0.067)	10,433 (0.917)	1 (0.001)
wahoo	10,140 (0.838)	138 (0.110)	8,172 (0.697)	98 (0.084)	8,275 (0.727)	134 (0.151)
SETS	12,098	1,255	11,722	1,165	11,383	885
HOOKS (Thousands)	18,396	1,167	16,668	970	15,203	685

The IATTC placed observers on two longline vessels departing and returning to California ports during 1994. The two boats made 13 sets and fished 10,013 hooks (Table 5-16a). The trips occurred during June and September. Swordfish and dorado were the principal market species taken. Blue sharks were the principal bycatch species. One leatherback turtle was discarded alive while one bobbie(*sic*)/gannet was discarded dead. No other trips were observed.

Table 5-16a. IATTC observer program data for 1994 (13 sets and 10,015 hooks)

Management Unit Species	Caught	Kept	Alive	Returned Dead	Tagged
albacore	6	5	1	0	0
dorado	133	130	2	1	0
thresher shark	1	0	1	0	0
blue shark	52	0	9	43	0
mako shark	6	4	0	2	0
swordfish	46	40	1	3	2
Monitored Species					
blue marlin	6	2	2	0	2
escolar	5	0	0	0	0
opah	6	6	0	0	0

During late 2001 and early 2002, NMFS was able to place observers on vessels departing from the West Coast and fishing outside the EEZ (Table 5-16b). These vessels generally fished out to 1,000 nm from the West Coast. The reported bycatch was similar to sets observed by the IATTC with blue sharks the principal bycatch species. However, among fish discarded dead, the longnose lancetfish dominated. A total of 42 sets were observed. One loggerhead turtle was returned alive and one black-footed albatrose was returned dead.

Table 5-16b Observed catch in the U.S. West Coast pelagic longline fishery, October 2001 - February 2002, NMFS, Southwest Region, Fishery Observer Management

	Total		Returned			Catch
Species	Caught	Kept	Alive	Dead	Unknown	per Set
Swordfish	409	352	15	39	3	9.738
Striped Marlin	1		1			0.024
Albacore	31	30		1		0.738
Bigeye Tuna	4	4				0.095
Bluefin Tuna	8	8				0.190
Blue Shark	395		370	14	11	9.405
Bigeye Thresher Shark	1	1				0.024
Shortfin Mako Shark	25	1	17	7		0.595
Unidentified Shark	1		1			0.024
Common Mola	16		15		1	0.381
Dorado	1	1				0.024
Escolar	56	48	2	5	1	1.333
Longnose Lancetfish	29			28	1	0.691
Oilfish	30		17	11	2	0.714
Opah	3	3				0.071
Pacific Pomfret	10	8		2		0.238
Pelagic Stingray	8		4	4		0.190
Remora	2	0	1	1		0.048
Unidentified Fish	5	4		1		0.119

The above table summarizes the total catch and final disposition, by species, of all fish observed caught in the U.S. West Coast Pelagic Longline fishery from October 2001 through February 2002. Data were collected at sea by contract observers, and represents a total of 42 sets.

C.3.4 Harpoon Fishery

The deliberate fishing nature of harpoon gear is such that bycatch is expected to be low. Neither the California Department of Fish and Game nor NMFS have an observer program for this fishery. CDFG does collect logbook data from harpoon vessels but they only record effort and number of swordfish (Coan *et al.*, 1998). Based on reports from harpoon fishers, there are some economic discards associated with shark or sea lion damage to harpooned fish. The overall total is not known but again, based on comments by fishers, it is probably less than one fish per vessel during the season.

Total effort in this fishery is very low with only 38 vessels registered in FY 2001/2002. The last year for which the landings of harpoon vessel taking swordfish could be identified was 1999. During that year 80 mt were landed, compared to the drift gillnet fleet which landed 573 mt.

C.3.5 Tropical Tuna Purse Seine Fishery (> 400 short tons)

All of the purse seiners with carrying capacity greater than 400 short tons fishing under this HMS plan in the eastern Pacific Ocean (EPO) are regulated by NMFS under the authority of the Tuna Conventions Act of 1950, in carrying out the recommendations of the Inter-American Tropical Tuna Commission (IATTC). The Commission is open to governments whose nationals fish for tropical tunas and tuna-like species in the EPO (see, section 1.6.1 in the FMP). As part of the most recent (1998) Agreement on the International Dolphin Conservation Program (AIDCP), IATTC continues to maintain 100% observers coverage on board Class-6 purse seiners (> 400 short tons capacity). In addition to documenting dolphin mortality, observers also collect data on bycatch and discards. The IATTC defines bycatch as fish other than commercially-important tunas, which are discarded dead at sea while "discards" are defined as commercially-important tunas which are discarded dead at sea. This is done to fulfill one of the objectives under AIDCP, specifically "avoiding, reducing and minimizing bycatch and discards of juvenile tunas and non-target species." The Commission is concerned about documenting and reducing bycatch and discards because of the recent shift in effort towards setting on floating objects and their associated elevated bycatch levels. Tables 5-17 through 5-21 shows the results of observed sets from 1997 through 2001.

The most striking conclusion that can be derived from the table is that the vast majority of bycatch and discards comes from sets on floating objects. Of the individual species identified in the table only bonito, swordfish and sailfish were taken with greater frequency when not fishing on floating objects.

IATTC has also initiated a full retention program in 2001to better document bycatch and as an incentive for vessels to avoid bycatch because of the economic penalty associated with having to land fish of little value. At the IATTC Working Group on Bycatch meeting in June 2002, there was a report that incomplete logbook reporting and dumping of fish in spite of the resolution, were jeopardizing the program since economic incentives to avoid bycatch (full retention) were not working. However, the program will be continued with efforts to improve compliance and effectiveness in 2003 and 2004.

The IATTC passed a Resolution on Bycatch reaffirming continuation of the full retention program, urged participating parties to ensure their fishers comply with the full retention requirement, strive for ways to reduce juvenile tuna catch, determine ways by which the bycatch of billfish and sharks could be reduced, and include observer coverage on small purse seiners. They also included a statement on sea turtles which called for better data collection and greater attention to releasing sea turtles alive.

Table 5-17 Estimated 1997 discards and bycatch from observed trips (all nations) in the purse seine fishery in the EPO - tuna discards in short tons, bycatch species by individuals landed (source, IATTC 2000b Annual Report, tables 11a-11c)

	Set Type			
Species	Dolphin	Floating Object	Unassociated	Total
yellowfin tuna	620	4,594	417	5,631
skipjack	127	30,718	1,022	31,867
bigeye tuna	0	5,620	8	5,627
black skipjack	84	2,109	389	2,582
bullet mackerel	25	2,756	626	3,407
other tuna	-	-	3	3
bonito	-	4	-	4
swordfish	14	16	21	51
blue marlin	88	926	173	1,188
black marlin	45	726	74	845
striped marlin	73	120	151	345
short billed spearfish	7	12	0	19
sailfish	325	112	438	875
unidentified marlin	6	54	8	68
unidentified billfish	2	10	4	16
dorado	64	470,768	6,178	477,010
wahoo	3,125	474,399	774	478,298
rainbow runner	1	54,969	2,044	57,014
yellowtail	9,136	118,636	4,275	132,046
other large teleost fish	68	28,467	14,684	43,219
trigger fish	321	725,714	752	726,788
other small teleost fish	16,217	1,216,287	65,011	1,297,515
sharks and rays	3,813	61,828	10,965	76,607
unidentified fish	0	5,725	1,381	7,106
Observed Sets	6,339	5,614	2,881	14,834

Table 5-18 Estimated 1998 discards and bycatch from observed trips (all nations) in the purse seine fishery in the EPO - tuna discards in short tons, bycatch species by individuals landed (source, IATTC 2000b Annual Report, tables 11a-11c)

	Set Type			
Species	Dolphin	Floating Object	Unassociated	Total
yellowfin tuna	709	3,203	806	4,718
skipjack	34	21,091	1,731	22,856
bigeye tuna	0	2,839	14	2,853
black skipjack	91	1,593	1273	1,857
bullet mackerel	32	1,033	168	1,233
other tuna	-	-	-	-
bonito	0	2	3	4
swordfish	11	3	11	25
blue marlin	76	1,094	73	1,243
black marlin	61	698	81	840
striped marlin	99	102	55	256
short billed spearfish	1	12	1	14
sailfish	1,011	14	461	1,486
unidentified marlin	13	54	9	76
unidentified billfish	336	19	4	359
dorado	225	346,286	4,774	351,267
wahoo	418	211,143	316	211,877
rainbow runner	18	130,935	136	131,089
yellowtail	8	116,555	5,038	121,601
other large teleost fish	44	75,095	27,796	102,601
trigger fish	2,352	2,011,658	5.562	2,019,662
other small teleost fish	16,239	655,865	73,994	746,098
sharks and rays	7,129	58,615	5,488	71,232
unidentified fish	87	2,950	50	3,087
Observed Sets	10,645	5,481	4,631	20,757

Table 5-19 Estimated 1999 discards and bycatch from observed trips (all nations) in the purse seine fishery in the EPO - tuna discards in short tons, bycatch species by individuals landed (source, IATTC 2000a Annual Report, tables 11a-11c)

	Set Type			
Species	Dolphin	Floating Object	Unassociated	Total
yellowfin tuna	471	5,363	794	6,628
skipjack	125	23,321	3,367	26,813
bigeye tuna	0	5,158	8	5,166
black skipjack	2	3,049	361	3,412
bullet mackerel	29	2,594	473	3,096
other tuna	0	0	542	542
bonito	0	0	0	0
swordfish	21	5	19	44
blue marlin	82	1,578	144	1,804
black marlin	73	936	149	1,158
striped marlin	67	280	75	422
short billed spearfish	4	13	6	23
sailfish	713	89	583	1,385
unidentified marlin	13	114	20	148
unidentified billfish	21	5	4	30
dorado	210	658,250	1,803	660,263
wahoo	35	304,433	268	304,736
rainbow runner	3	136,234	202	136,439
yellowtail	0	45,149	29,692	74,841
other large teleost fish	20	10,983	5,330	16,333
trigger fish	292	1,468,734	9,540	1,478,567
other small teleost fish	5,944	549,074	9,654	564,672
sharks and rays	3,634	46,842	7,301	57,777
unidentified fish	22	4,842	1,466	6,331
Observed Sets	6,536	4,513	4,633	15,682

Table 5-20 Estimated 2000 discards and bycatch from observed trips (all nations) in the purse seine fishery in the EPO - tuna discards in short tons, bycatch species by individuals landed (source, IATTC 2000a Annual Report, tables 11a-11c)

	Set Type			
Species	Dolphin	Floating Object	Unassociated	Total
yellowfin tuna	427	5,570	799	6,796
skipjack	16	20,052	5,780	26,298
bigeye tuna	0	5,571	52	5,624
black skipjack	156	1,659	55	1,870
bullet mackerel	21	1,280	185	1,486
other tuna	-	-	-	-
bonito	-	-	-	-
swordfish	19	3	22	45
blue marlin	81	903	207	1,191
black marlin	87	459	180	726
striped marlin	54	88	86	229
short billed spearfish	13	10	6	30
sailfish	786	124	904	1,813
unidentified marlin	17	23	9	50
unidentified billfish	1	4	4	9
dorado	673	558,170	18,583	577,426
wahoo	122	179,894	501	180,517
Rainbow runner	63	78,280	2,197	80,540
yellowtail	10	14,527	11,236	25,772
other large teleost fish	24	6,019	3,637	9,680
trigger fish	32,140	405,913	699	438,752
other small teleost fish	20,558	440,903	26,757	488,218
sharks and rays	2,085	28,912	8,093	39,091
unidentified fish	2	551	143	695
Observed Sets	6,087	3,701	3,926	13,714

Table 5-21 Estimated 2001 discards and bycatch from observed trips (all nations) in the purse seine fishery in the EPO - tuna discards in short tons, bycatch species by individuals landed (source, IATTC preliminary tables 11a-11c)

	Set Type			
Species	Dolphin	Floating Object	Unassociated	Total
yellowfin tuna				Not available
skipjack				Not available
bigeye tuna				Not available
black skipjack				Not available
bullet mackerel				Not available
other tuna				Not available
bonito				Not available
swordfish				Not available
blue marlin				Not available
black marlin				Not available
striped marlin				Not available
short billed spearfish				Not available
sailfish				Not available
unidentified marlin				Not available
unidentified billfish				Not available
dorado	571	705,019	10,988	716,578
wahoo	52	456,980	969	458,001
rainbow runner	4	81,838	170	82,012
yellowtail	45	29,444	54	29,543
other large teleost fish	12	19,187	8,743	27,942
trigger fish	0	326,506	3,077	329,583
other small teleost fish	580	187,416	25,123	213,119
sharks and rays	6,075	25,488	3,561	35,123
unidentified fish	8	429	0	437
Observed Sets	5,403	4,789	1,997	12,189

C.3.6 Coastal Purse Seine Fishery (< 400 short tons)

Purse seiners with carrying capacity less than or equal to 400 short tons fishing under this HMS plan in the eastern Pacific Ocean (EPO) are also regulated by NMFS under the authority of the Tuna Conventions Act of 1950, in carrying out the recommendations of the Inter-American Tropical Tuna Commission (IATTC). Most U.S. vessels in this fleet segment are also involved in the Council regulated fishery for coastal pelagics, they seldom venture far from port, are not required to carry observers and bycatch information is currently not available. During the season, generally May through October, they will fish for bluefin tuna. During warm water periods they may also take yellowfin, bigeye and skipjack tuna. Very rarely, usually in the year following a major El Nino event they will land significant amounts of albacore. Generally they fish off southern California or outside the EEZ of Mexico. Occasionally, they will fish for bluefin tuna off central California. The IATTC hopes to expand observer coverage to monitor this fleet and will consider the matter at their 2003 annual meeting.

When fishing for bluefin tuna, the fish are usually free-swimming (not associated with floating objects). Based on observer data from the tropical tuna purse seine fishery, these seiners probably encounter little bycatch during these sets. If they are setting fish working a baitball, other species of tuna along with some sharks might be taken and this could be considered bycatch if discarded. However, anecdotal evidence indicates these vessels will land all tunas taken in a set since they have some economic value and only discard blue sharks while retaining the marketable mako and thresher sharks. Some vessels do set floating objects (usually kelp paddies) and probably do have some bycatch based on the observations aboard the larger vessels. However, without observers the extent of the assumed bycatch is unknown. Anecdotal information from partyboat skippers and private boat recreational anglers indicate that yellowtail and dorado are often found in conjunction with yellowfin and skipjack tuna found in association with kelp paddys. They would probably be taken in a set on a kelp paddy. Under California law, the yellowtail would have to be discarded since it is illegal to land them when taken with purse seine gear. No prohibition exists for dorado so they could be landed as an incidental catch. In summary, bycatch in this fishery is not known.

C.3.7 Party/Charter Boat Fishery

The Marine Recreational Fisheries Statistics Survey (MRFSS), sponsored by NMFS and administered by the Pacific States Marine Fisheries Commission on the West Coast, provides the only data base which encompasses most HMS taken in the party/charter recreational fishery. Within California, mandatory logbooks provided by the state allow skippers to report fish thrown back so it is possible to estimate bycatch using logbooks. However, the data have never been tabulated to determine bycatch. Washington has an ocean boat sampling program and a voluntary logbook program which collects catch and bycatch data. The Washington data are added to the MRFSS data base as part of an agreement for recreational sampling in the state. Oregon collects vessel catch data during the summer (July and August) and has added it to the MRFSS since 1997. Since the MRFSS collects data on HMS anglers, and is a depository for state data which is collected when the MRFSS is not sampling, it was used to look at angler catch and bycatch. While it provides reliable estimates of take and discards for species that are commonly taken and, because the directed take of most HMS species is a relatively rare event, the catch and discard estimates can have a high degree of variability. The only HMS fishery for Washington, Oregon and northern California is the albacore fishery. In southern California, private boat recreational anglers fish for most HMS species while party/charter vessels, because of their nature, tend to concentrate on tunas and dorado with a limited amount of directed shark fishing. Because of targeting on these species there is almost no bycatch of billfish or sharks, blue sharks being the exception. Table 5-22 lists individual HMS species and treats thresher sharks as a group, although none were reported taken or released.

The MRFSS has been criticized for over estimating catches because of inaccurate estimates of effort from the random telephone survey of the general public. To overcome this, NMFS has initiated a program to call party/charter boats directly to determine the number of passengers and frequency of trips. The new survey has produced significantly lower effort estimates and brought them in line with CDFG logbook effort when it is adjusted for under reporting. Another factor which can affect bycatch estimates from MRFSS is the reliance on anglers to determine how many fish were thrown back. In essence, you create a bias similar to logbook bias where the person doing the reporting may not report accurately. This is partially mitigated by the fact that samplers are aboard the vessels and intentional under reporting is probably not a problem since the sampler has a sense of what the bycatch rate is, and the anglers are aware of this when they are interviewed to supply catch information. The major strengths of the MRFSS are it's time series (1980 to present) and the ability to provide estimates of bycatch within 2-3 months of the collection date.

Data from the MRFSS also faces a severe limitation in that it does not routinely estimate effort or catch of southern California anglers fishing in the EEZ of Mexico. In some years, 90% of the HMS catch in the party/charter fishery may be taken off Mexico. This can result in a large reported catch from California's party/charter fleet but only a small catch reported by the MRFSS. When examining catch from the two data bases, care must be taken to exclude the Mexican portion of the party/charter vessel catch when comparing the results.

Table 5-22 Estimated total number of fish landed and released (with percent standard error) by the West Coast party/charter fleet based on data from the Marine Recreational Fisheries Statistics Survey 1993-2001

Species	Number Landed	Number Released	Percent Released
albacore	305,000 (7%)	0	-
bigeye tuna	0	0	-
bluefin tuna	0	0	-
skipjack	35,000 (15%)	9,000 (25%)	20
yellowfin tuna	132,000 (12%)	0	-
dorado	34,000 (22%)	0	-
blue shark	1,000 (40%)	26,000 (18%)	96
mako shark	0	0	-
thresher shark	0	0	-
striped marlin	0	0	-
swordfish	0	0	-

Under the two categories listed in Table 5-22 (also Table 5-23 below) for disposition of fish, number landed includes all fish retained by the angler and also those thrown back dead. The number of fish released includes only live releases. The data are available to determine the number thrown back dead but are not readily accessible. Among the tuna taken by party/charter vessels only skipjack has a significant bycatch. This occurs because they are often taken while fishing for more desirable tuna species, or, in fact, a few anglers may be catching them with the intent of releasing the fish. The high bycatch of blue sharks usually occurs while fishing for tunas or dorado. Since the fish are not desirable for these anglers, they are usually released alive. Occasionally, there is a party/charter boat "shark" trip targeting the three species listed in Table 5-22 but blue sharks usually are the only species encountered and they are almost always released alive since anglers are not interested in keeping this species.

C.3.8 Private Recreational Boat Fishery

The MRFSS provides the only coastwide estimate of bycatch for private recreational boat anglers. Washington samples private ocean boat anglers to collect catch and bycatch data. The Washington data are added to the MRFSS data base as part of an agreement for recreational sampling in the state. Oregon also collects ocean boat angler catch and bycatch data during the summer (July and August) and has added it to the MRFSS since 1997. Since the MRFSS collects data on HMS anglers, and is a depository for state data which is collected when the MRFSS is not sampling, it was used to look at angler catch and bycatch. There is little private boat fishing for HMS in Washington or Oregon. Unfortunately, because the directed take of most HMS species is a relatively rare event, this can lead to catch estimates with a high degree of variance. This is further compounded by the fact that large private vessels, boats most capable of pursuing HMS, are usually not available to be sampled because they are in private slips, off-limits to most samplers. Table 5-23 lists individual HMS species and treats thresher sharks as a group because of identification problems. However, given that most sport fishing for thresher shark take place inshore, common threshers probably make up the majority of the catch. Most of the private boat catch data comes from interviews at launch ramps and public marinas. Anglers fishing from private marinas or docks are not sampled because of trespass issues. The lack of access to private facilities probably biases the sample towards anglers on smaller boats, vessels which because of their size (< 28 ft), may not fish as intensively for HMS as larger vessels that are usually found berthed at private docks.

Table 5-23 Estimated total number of fish landed and released (with percent standard error) by the private boat fleet based on data from the Marine Recreational Fisheries Statistics Survey 1993-2001

Species	Number Landed	Number Released	Percent Released
albacore	470,000 (8%)	16,000 (33%)	3
bigeye tuna	0	0	-
bluefin tuna	3,000 (39%)	0	-
skipjack	77,000 (18%)	82,000 (19%)	52
yellowfin tuna	88,000 (15%)	1,000 (100%)	1
dorado	103,000 (26%)	3,000 (49%)	3
blue shark	12,000 (22%)	203,000 (9%)	94
mako shark	37,000 (11%)	30,000 (15%)	45
thresher shark	15,000 (17%)	13,000 (21%)	46
striped marlin	1,000 (47%)	2,000 (49%)	67
swordfish	0	0	-

Bycatch in the private boat fishery is varied. It is difficult to discuss "bycatch" because many fishers value the experience of fishing and may not be targeting a particular pelagic species. Recreational "marlin" or "tuna" trips may yield dorado, tunas or sharks. However, given that the definition of bycatch "means fish which are harvested in a fishery, but which are not sold or kept for personal use", private recreational anglers do have a significant amount of bycatch of some HMS species. Among the tunas, only skipjack appears to have a large bycatch. This occurs because they are often taken while fishing for more desirable tuna species, or, in fact, anglers may be catching them with the intent of releasing the fish. Dorado have a low bycatch because they are highly desirable food fish. Those that are released are generally small fish (< 3 pounds). Sharks as a group have the highest bycatch rate. Over 94% of all blue sharks taken by private boat are released. While there is some directed fishing for blue sharks, most are taken while anglers are pursuing mako or thresher sharks. The bycatch of mako and thresher sharks in this fishery is high because most of the sharks anglers catch are juveniles. Because of their small size, and angler awareness of the value in releasing these fish to grow to adults, most are returned alive. Interestingly, very large sharks are also released because of their perceived breeding potential and peer pressure not to kill large females because of that potential.

While the MRFSS does provide an estimate of striped marlin landed and released, its value is questionable because of the extremely rare nature of taking a marlin. Data from the MRFSS shows that 67% of the marlin caught during the past 7 years were released alive. This figure is probably low and does not reflect the true percent of fish released. A more accurate data base to judge the percent of fish released is available from various fishing clubs and weigh stations. The Balboa Angling Club (Newport Beach), San Diego Marlin Club and weight station in Avalon Harbor, Santa Catalina Island report most of the marlin taken/released in southern California. Data taken from the Balboa Angling Club and San Diego Marlin yearbooks show that anglers release between 67% and 90% of all fish reported to the clubs. There is a growing trend over the years towards releasing more striped marlin.

C.4 Bycatch Mortality

C.4.1 Introduction

The reduction of bycatch mortality is an important component of National Standard 9. Physical injuries may not be apparent to the fisher who is quickly releasing a fish because there may be injuries associated with the stress of being hooked or caught in a net. Little is known about bycatch mortality for the species in this FMP but some data do exist from other fisheries. Information on bycatch mortality of these fish will continue to be collected, and in the future, will account for bycatch mortality in stock assessments. An analysis of efforts which might reduce bycatch and bycatch mortality is contained in C.6.

C.4.2 Mortality by Fishery

C.4.2.1 Drift Gillnet Fishery

It is difficult to consider reducing post release mortality in the pelagic drift gillnet fishery due to the nature of the gear. Most finfish are dead when the net is hauled, although the data in Tables 5-1 thought 5-12 would indicate that some blue sharks and almost all common molas can be released alive. However, the long-term survival of these individuals is not known.

C.4.2.2 Surface Hook & Line Fishery (troll and live bait)

No data are available on the mortality of fish released alive in this fishery although tagging studies suggest that where the fish is hooked (upper versus lower jaw) does affect survivability to the extent that fish hooked in the lower jaw show 50% higher survival based on tag recovery rates.

C.4.2.3 Pelagic Longline Fishery

NMFS collects information regarding the bycatch mortality of dead finfish in the pelagic longline fishery Preliminary data from a study by Berkeley and Edwards (1997), suggests that hook damage and entanglement with the gangion may be important factors causing mortality in longline caught bycatch. The study indicated that it may be possible to modify hook type and gangion material to reduce billfish mortality in longline fisheries. To follow up on this study, NMFS is supporting a study to consider the use of circle hooks in the pelagic longline fishery, and NMFS has considered reducing the soak time in this fishery. Very often, gear modifications are not easily enforced, and therefore NMFS encourages pelagic longline fishers to take voluntary steps to increase survival of released finfish.

The survival rate of billfish on pelagic longline gear in the Atlantic Ocean is validated by results from a study by Berkeley and Edwards (1997), stating that 20 to 75 % of billfish were alive 12 hours after being hooked . After accounting for live releases, the effective billfish fishing mortality (i.e., discarded dead) was 0.4 % of the total pelagic longline catch (blue marlin - 0.12 %; white marlin - 0.15 %; sailfish - 0.08 %; and spearfish - 0.03 %). Total bycatch mortality impact of Atlantic pelagic longline gear cannot be determined since the release mortality is unknown for the hooked billfish fish that are released alive. Billfish, however, tend to have higher survival rates on a pelagic longline (Berkeley and Edwards, 1997) compared to other HMS species such as swordfish and tunas. No data are available to estimate mortality in the eastern Pacific longline fishery.

C.4.2.4 Harpoon Fishery

As stated in C.3.4 , the deliberate fishing nature of harpoon gear is such that bycatch is expected to be low. Since bycatch approaches zero in this fishery, it follows that bycatch mortality is near zero.

C.4.2.5 Tropical Tuna Purse Seine Fishery (> 400 short tons)

There are no data on bycatch mortality in the purse seine fishery, although there is growing concern for the need to know the mortality rate as the floating object fishery continues to take greater numbers of fish as bycatch (IATTC 2000b). A quote from the 1998 IATTC Annual Report (page 90) sums up the available knowledge:

> “The information available on the biology of the species listed in Table 41 is insufficient to determine the effects of their capture by the purse-seine fishery. If any of them are seriously affected, it is most likely to be one or more species of sharks or ray, as their fecundities are low, and removing substantial amounts of these are likely to reduce their recruitment in subsequent years.”

Table 41 mentioned in the quote was used to develop Tables 5-17 through 5-21 in C.3.5 on the purse seine fishery for boats greater than 400 tons.

C.4.2.6 Coastal Purse Seine Fishery (< 400 tons)

No data are available on bycatch mortality in the coastal purse seine fishery. However, it is reasonable to estimate that mortality rates are lower than with large purse seine sets as fish can be handled and discarded more rapidly in small purse seine sets and they would more likely survive.

C.4.2.7 Party/Charter Fishery

No studies exist on bycatch mortality of skipjack tuna and blue shark, the only species reported as bycatch from the party/charter fishery (Table 5-22). There are some data from the Atlantic Ocean on bluefin tuna. Results from one of those studies indicate that immediate fishing mortalities in recreational hook and line-caught juvenile bluefin tuna can be substantial (29.2 %) due to injuries or predation (Belle, 1997). This is likely to be a conservative estimate because scientific personnel in the study were professionally trained and had extensive experience in fish handling techniques designed to reduce mortality. Mortality often occurs ten minutes or longer after the fish is released under normal circumstances. Injuries may not be readily apparent to the angler and seemingly minor capture injuries may be related to substantial internal injuries. Forty % of sampled tuna that died during that study did not have injuries that would be apparent to the angler in the boat. Skomal and Chase (1996) provide evidence that the extreme stress of rod- and- reel angling did not cause immediate post-release mortality in larger bluefin tuna (50 to 150 kg). However, they do document metabolic and pH disturbances in bluefin tuna sampled off of Hatteras, NC. The physiological consequences of angling stress are poorly understood for several species of large pelagic fishes (Skomal and Chase, 1996). While these studies were for bluefin tuna in the Atlantic, they do provide insight into the potential bycatch mortality of tunas. Skipjack tuna may or may not exhibit similar mortality rates.

Quantitative estimates of post-release mortality rates of blue sharks in the party/charter fishery are not currently available, although this mortality is generally believed to be low since sharks are seldom removed from the water when the hook is removed or the leader cut..

C.4.2.8 Private Recreational Boat Fishery

Private boat anglers have high release rates for skipjack tuna, blue shark, mako shark, thresher shark and striped marlin (Table 5-23). The same caveats on bycatch mortality apply to this fishery as apply to the party/charter fishery. Because of the lack of local data, the Council must use studies from other areas. The only exception to this is striped marlin. Tagging studies with acoustical tags on more than 15 fish revealed all the fish were alive after vessel tracks of 5 to 48 hours (Holts and Bedford, 1990). The authors felt that most fish were traumatized (wildly swimming about) by tagging but returned to normal behavior (swimming slowly near the surface) within two hours of tagging.

C.4.3 Code of Angling Ethics

NMFS developed a Code of Angling Ethics as part of implementing Executive Order 12962 - Recreational Fisheries. NMFS implemented a national plan to support, develop, and implement programs that were designed to enhance public awareness and understanding of marine conservation issues relevant to the well-being of marine recreational fishing. This code is consistent with National Standard 9, minimize bycatch and bycatch mortality, and is therefore reproduced below. These guidelines are discretionary, not mandatory, and are intended to inform the angling public of NMFS's views regarding what constitutes ethical angling behavior. Part of the code covers catch and release fishing and is directed towards minimizing bycatch mortality.

Code of Angling Ethics

- Promotes, through education and practice, ethical behavior in the use of aquatic resources.
- Values and respects the aquatic environment and all living things in it.
- Avoids spilling, and never dumps any pollutants, such as gasoline and oil, into the aquatic environment.
- Disposes of all trash, including worn-out lines, leaders, and hooks, in appropriate containers, and helps to keep fishing sites litter-free.
- Takes all precautionary measures necessary to prevent the spread of exotic plants and animals, including live baitfish, into non-native habitats.
- Learns and obeys angling and boating regulations, and treats other anglers, boaters, and property owners with courtesy and respect.
- Respects property rights, and never trespasses on private lands or waters.
- Keeps no more fish than needed for consumption, and never wastefully discards fish that are retained.
- Practices conservation by carefully handling and releasing alive all fish that are unwanted or prohibited by regulation, as well as other animals that may become hooked or entangled accidentally.
- Uses tackle and techniques which minimize harm to fish when engaging in "catch and release" angling.

C.5 Standardized Reporting of Bycatch

Section 303(a)(11) of the Magnuson-Stevens Act,16 U.S.C. 1853(a)(11), requires that a fishery management plan establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery. This section will describe the standardized methodology proposed under this FMP.

As discussed in the previous sections, each HMS fishery sector has different gear and operating characteristics and different bycatch levels and rates. For example, longline fishing results in more bycatch of more species than harpoon fishing, and drift gillnet fishing likely has more bycatch of more species than recreational fishing. Similarly, longline and drift gillnet fishing gear and techniques are different from harpoon and recreational gear and techniques. Further, the vessels involved have different characteristics and capabilities. Finally, the fisheries are of different sizes and geographic spread. It is important that these factors be taken in to account when determining the appropriate level of use of different data collection and reporting requirements for each fishery sector to assess bycatch in the different sectors. There is no single set of data collection techniques that will work equally well to establish reliable estimates of bycatch.

There are several potential mechanisms for obtaining total catch and catch disposition data and deriving estimates of bycatch in the HMS fisheries. Daily fishing logbooks have long been used in several fisheries and can be used to record details of fishing location and time of fishing, amount of gear deployed, catch by species, and retained catch by species. Current logbook requirements are as follows:

1. Drift Gillnet - State logbooks for California and Oregon
2. Surface Hook and Line - NMFS logbook for high seas fishery
3. Pelagic Longline - NMFS logbook for high seas fishery
4. Harpoon - State logbook for California
5. Tropical Tuna Purse Seine - IATTC logbook when fishing for HMS or high seas logbook
6. Small Vessel Purse Seine - IATTC logbook when fishing for HMS or high seas logbook
7. Party/Charter Boats - State logbooks for California

Currently used logbook forms are shown in Appendix D. The advantage of logbooks is that a great deal of information can be collected for analysis and use at little cost to the government. The disadvantages are that there is little incentive for the fisher to report completely and accurately, the fisher may not be able to identify all incidental catch by species (especially for some sharks or juvenile tuna), and the fisher may not accurately report all requested information such as discards or protected species interactions. Experience under the central and Western Pacific Pelagics FMP indicates that logbook reports are not reliable when taken alone for assessing bycatch in the longline fishery and, even when observers are on board the vessel, there are occasional differences between observer records and logbook entries.

Landings receipts have been required by West Coast states for many years. The receipts generally record and report amount of fish by species in the landing, the gear used, the price paid per pound for the fish sold, and in some cases the area fished. Advantages of landings receipts are that they are tax documents (and thus may result in severe penalties if falsified), that fishers and buyers are all familiar with them and appear to be comfortable with the receipt process, and that they appear to provide a generally reliable count of landings. Disadvantages are that non-landed fish (bycatch) are not recorded or reported, that gear type may be inaccurately reported, that area of fishing is generally not going to be accurate for trips that covered more than one statistical area, and that species composition of mixed species landings may not be accurately determined. When used in conjunction with logbooks, however, it may be possible to derive estimates of total bycatch by vessels of the same type and using the same gear if the logbook records are accurate.

Another mechanism to refine estimates of catch and bycatch is the use of shore side or shore based samplers and interviewers to inspect the catch or landings and ask questions of the fishers to obtain details about the trip and catches. Records collected by shoreline sampling and interviews will ensure more accurate species identification of landed species. When viewed in conjunction with observers' records as well as landings and/or logbook records of similar vessels and gear types that carried observers, shore based sampling and interviews also can be used to confirm logbook records of catch and discards by similar vessels that were not observed. If there were substantial differences between observers' records and logbook records for vessels sampled at port, it would suggest either that there was misreporting or that the unobserved vessel experienced unusual conditions. Port samplers also can question the captain or crew to determine if there were unusual events or conditions on the trip or if there were substantial discards and, if so, of what species. This could be especially useful when interviewing a captain or crew while reviewing a logbook for completeness and accuracy of entries.

At-sea observers are likely the most reliable method to determine total catch and disposition of catch for several HMS fishery sectors. Observers can not only accurately report catch, effort and operational conditions (weather, sea state, time, location); they can be relied on for more complete and accurate species identification data and can take and record biological data and samples that could not reasonably be expected of vessel operators or crew. There is a long history or observer use on HMS fisheries off the West Coast, including the purse seine fishery (now conducted by the IATTC), the drift gillnet fishery (California state observers in the past and NMFS observers presently), and occasional observers on West Coast longline and albacore troll vessels. The disadvantages of observer programs are the cost ($350 or more per observer day), possible disruption of normal vessel operations (especially for small vessels), the logistical difficulty of placing observers on long trips, and safety (some small vessels find it difficult to meet Coast Guard health and safety requirements).

Taken together, it is clear that no single data collection mechanism will generally be sufficient alone for every fishery sector, and that the appropriate approach is to combine different elements of a monitoring program to assess bycatch tailored to the vessels and operating characteristics of each HMS fishery sector. Therefore, under this FMP, there are standard data collection and reporting components as follows to ensure that estimates of total catch and bycatch for each sector will be reliable, with the mix of components varying to suit the fishery sector.

C.5.1 At-Sea Observers

It is acknowledged that some level of observer placements will be necessary to ensure reliable bycatch assessments in most if not all sectors. Logbooks alone are not likely to result in complete and accurate information on total catches and discards (alive or dead). Landings receipts only document fish actually brought to shore or transshipped. Interviews can fill some gaps. However, at least some at-sea observer coverage is necessary in most cases to obtain accurate records on total catches and discards from a sample large enough to provide reliable extrapolations of total catches and discards. What will vary is the level of observer coverage needed by fishery sector. NMFS would be required to place observers on a sample of fishing vessels in each sector to document total and retained catch, bycatch, and disposition of bycatch (released alive, released injured, released dead) by species, and protected species interaction data. If practicable, consistent with the need to collect bycatch and protected species interaction data, the observer also would collect other fishery dependent data (e.g., size, sex ratio, biological samples). The sample level in each sector will depend on the characteristics of the fishery, the likelihood of bycatch, the magnitude of bycatch and potential associated mortality, and the extent to which other monitoring elements are likely to result in reliable estimates of bycatch and bycatch mortality. The sampling designs would be developed by the National Marine Fisheries Service, in consultation with the Council, the states, and industry, but the sampling program must be at a level sufficient (in combination with other monitoring efforts) to provide reliable estimates of bycatch in each sector.

C.5.1.1 Harpoon

The harpoon fishery for swordfish is expected to have virtually no bycatch. The operator knows exactly at what fish/species the harpoon is directed and presumably would not throw a harpoon at an animal that is not intended to be captured for later sale or personal consumption. There could be an instance in which a fish is harpooned and subsequently damaged by marine mammal or shark predation, such that the harpooned animal is unsuitable for sale or consumption. In this fishery sector, while an observer placement might be useful to confirm information about operational aspects of the sector, there is little reason to expect that any bycatch (as defined by the Act) would be documented even at a 100% coverage level.

C.5.1.2 Drift Gillnet

Bycatch in the drift gillnet fishery for swordfish and sharks can be estimated based on NMFS observer program that has been in effect since 1990 and has documented catch and disposition of the catch at a level of 20% or more the past 5 years (see Tables 5-1 thru 5-12 for annual summaries of observer records 1991-2002). Observer coverage for this fishery should continue to obtain reliable information reflecting changes in regulations for this fishery and to determine if regulatory changes have resulted in changes in time, area, or manner of fishing such that bycatch rates or composition may have changed.

C.5.1.3 Longline

Based on experience in the central and western Pacific, it is certain that there would be significant bycatch in the longline fishery, but there is a limited basis for estimating what the levels and species composition would be for fishing out of the West Coast. There has been very little observer coverage of longline fishing out of West Coast ports, although some vessels that landed in California in recent years began their trips in Hawaii with observers on board. Those vessels were not subject to any of the regulations that would be implemented under this FMP and therefore their fishing could represent results from an unregulated fishery. However, there are good reasons (e.g., differences in oceanic temperatures, temperature fronts, and currents between areas fished by western Pacific vessels and areas fished by West Coast vessels) to hypothesize that catch and catch rates by species in waters closer to the West Coast (i.e., east of the 150° W. meridian) would differ from rates farther west (See Table 5-15). Observer data are needed to determine the bycatch and protected species interaction rates for West Coast vessels' fishing areas and to provide a basis for determining if the conservation and management measures under this FMP are having the intended effects. Therefore, it is important that the West Coast longline fishery be covered at an adequate sampling level soon after the FMP is implemented. NMFS currently has a study underway to determine sampling design and level of observer coverage necessary to adequately sample longline bycatch.

C.5.1.4 Purse Seine

The tropical tuna purse seine fishery has bycatch that varies depending on the fishing strategy being used (see C.3.5). A pilot program for reducing bycatch in this fishery is currently in place. The IATTC and its member nations have had a 100 % coverage level for Category V and VI purse seine vessels (i.e., 363 mt or larger carrying capacity) for many years, and it is expected that this will continue in the future. This FMP does not propose any changes in that program.

There has been very little observer coverage of smaller purse seiners (< 363 mt carrying capacity). It is likely but not certain that the bycatch by large purse seiners generally fishing in waters south of the U.S. West Coast differs from the bycatch experienced by smaller vessels fishing in the EEZ. The smaller vessels are opportunistic in targeting tuna when they are available nearer to or in U.S. waters in selected periods of the year. While it is likely that this will happen (if at all) in late summer and fall, it is not predictable whether the catch will be principally yellowfin, skipjack or bluefin tuna. It also is not known if the smaller vessels fish principally on free-swimming schools of tuna or set on floating objects, though the former appears more likely. In any event, it is clear that observers will be required for this sector. The United States is cooperating with the IATTC in exploring ways in which the IATTC and its members can get coverage of these small vessels, but no action has yet been taken. It is important that the small purse seine vessel fishery be covered at an adequate sampling level when this FMP is approved. NMFS currently has a study underway to determine sampling design and level of observer coverage necessary to adequately sample small purse seine bycatch.

C.5.1.5 Surface Hook and Line

Some members of the albacore fleet have maintained logbooks on a voluntary basis for years, and there have been occasional placements of observers on a voluntary basis as well. While it is known and acknowledged by the fleet that there is occasional bycatch, the extent of bycatch is not well documented, and additional observer placements are needed. NMFS should differentiate between vessels that fish mainly in coastal waters and vessels that make much longer trips across the north Pacific as both bycatch rates and species composition are likely to vary by area. NMFS currently has a study underway to determine sampling design and level of observer coverage necessary to adequately sample surface hook and line bycatch.

C.5.1.6 Party/Charter (CPFV) Fleet

As a general rule, there is little bycatch in this sector other than sharks (especially juveniles) that are released alive (see Table 5-22). The party/charter fleet has occasionally been observed by state personnel, as well as being regularly covered under the MRFSS program. NMFS should evaluate the level of observer coverage on HMS trips and should work with the NMFS contractor to ensure that observers are regularly collecting bycatch/discard data on such trips. This will be especially important to provide a basis for evaluating the effects and effectiveness of the "catch and release" program proposed under this FMP. Part of NMFS current study to determine sampling design and level of observer coverage necessary to adequately sample bycatch is focused on the party/charter fleet. It is noted that bycatch would likely decline substantially if there is approval and adoption of the "catch and release" program proposed in this FMP.

C.5.1.7 Private Recreational Fleet

It is expected that there would be little bycatch other than fish in excess of personal consumption capacity or sharks that are of little or no personal value. While Table 5-23 indicates fairly substantial discards, especially of sharks and skipjack tuna; it is unknown what the condition of these fish is upon release or the likelihood of survival after release. However, it is believed that the condition on release is generally supportive of a conclusion that mortality is low. Determining the bycatch and disposition of fish by private boat recreational anglers with certainty would be extremely difficult. At sea observations are generally impractical to schedule because of the size of the vessels, the diversity of departure sites and unpredictable times of departure. On the other hand, HMS fishers tend to be better equipped and on larger vessels than many other coastal recreational fishers, and at least in southern California, there are a number of organized clubs and associations oriented principally at HMS. NMFS should work with these recreational fishing clubs and associations to develop a systematic program that could include at-sea observations as well as targeted interviews and focus groups to determine the extent of bycatch and bycatch mortality. NMFS should also explore the potential for the MRFSS to provide an ongoing opportunity to sample private boat anglers for HMS. Part of NMFS current study to determine sampling design and level of observer coverage necessary to adequately sample bycatch is focused on the private recreational fleet. It is noted that bycatch would likely decline substantially if there is approval and adoption of the "catch and release" program proposed in this FMP.

As more information and experience are gained, it would likely be necessary and appropriate to adjust observer coverage among different sectors reflecting any significant changes in fishery regulations because such changes can cause changes in fishing practices or times and areas of operation, and in turn affect bycatch rates.

C.5.2 Logbooks

Under this FMP, each commercial fishery sector and the CPFV sector would be required to maintain and submit to the Regional Administrator logbooks that document daily fishing effort, gear used, catch (by species), disposition of catch (retained, released alive, released injured, released dead), and other information about the fishing activity and results. While they may not be reliable alone for estimating bycatch, logbooks can provide a sound foundation for estimating total fishing effort of the fleet (a component in estimating total catch and bycatch) and comparing reported and observed levels of bycatch by sector. Logbook records can be checked against observers' reports to determine if there are any consistent biases in logbooks that need to be corrected, either through improved logbook forms or through data system and expansion algorithms, after which logbooks might provide a more sound basis for estimating total catch and bycatch. In the future, logbooks used to monitor HMS fisheries will need to be more inclusive as to the disposition of fish thrown back. Currently, some logbooks only list fish landed and those returned to the sea; the condition of the returned fish is not noted. Listing the condition (alive, dead, injured) of fish on all logbooks is essential to fulfilling the requirement of Magnuson-Stevens for determining bycatch mortality. Beyond the disposition issue, logbooks currently in use appear to provide adequate data on catch and location, two of the major data elements of the logbook programs. A vessel monitoring system(VMS) can be used to supplement and check against reported locations for covered vessels (see section C.5.5 below).

C.5.3 Shoreside Observers

Port biologists from the states and possibly NMFS should be assigned to monitor landings and observe the amount and composition of commercial landings and their condition by vessel, port area, species, and time. These staff can also conduct recreational port interviews and obtain measurements from fish landed and biological samples. Shoreside sampling records could be checked against logbooks and landings receipts to provide an indication of the accuracy and completeness of those records. Discrepancies can indicate a need to adjust logbooks, observer coverage, or other monitoring activities to obtain more complete or accurate records and derive more reliable bycatch estimates. It is expected that NMFS will continue the MRFSS program on the West Coast; this is vital to ensuring good data on recreational catches and may be the principal method for determining recreational sector catches and possibly bycatch.

C.5.4 Dockside Inspections

NMFS enforcement or other NMFS officials would make spot checks of vessels as they make landings. Actual landings could be compared to logbook reports for consistency in terms of amount of landing by species. Vessel operators or crew could be interviewed to determine whether there were particular conditions that resulted in unusual incidence of bycatch or protected species interactions or particular areas with high bycatch or protected species interactions that might not be fully reflected in logbooks.

C.5.5 Vessel Monitoring Systems (VMS)

Automated vessel monitoring systems can supplement observer and reporting requirements and in some cases provide a sound basis for estimating bycatch in selected fisheries. For example, VMS information could be used to confirm reported area of catch information from logbooks and support a comparison of reported bycatch information from observed and unobserved vessels fishing in similar areas and times. If there are substantial differences, it would suggest a need to expand the observer program as well as to engage in outreach with fishers to ensure that they understand that these differences exist and that, if correct data are not being reported, this can ultimately result in inappropriate management decisions due to inadequate or incomplete data to their disadvantage. VMS would initially be required in the West Coast longline fishery as a tool to enforce the EEZ closure.

C.5.6 Other Activities

In addition, as noted, each state requires that every landing of fish for commercial sale be recorded on a landing receipt indicating species, gear, area of fishing, price paid, and other data elements. These are official tax documents, and misreporting or misrepresentation can result in significant civil and even criminal penalties. Therefore, landing receipts can provide a supplementary source of information for checking against logbooks and other records of catch. Although they will not be very useful for assessing bycatch as such, they may be indicative of fishing effort and/or strategies that likely resulted in catches and bycatches that were not fully revealed by logbook records and of a need for changes in observer coverage. As deemed appropriate, NMFS would work with other agencies to review the full range of information on the fisheries and their performance to determine whether the overall approach needed to be changed for one or more sectors. It is expected that, as experience is gained in monitoring the fisheries, there will be a better basis for shifting the relative reliance on the different monitoring components to improve the estimates of bycatch.

In summary, the FMP proposes that the standardized elements of the methodology to assess bycatch and bycatch mortality in the HMS fisheries are at-sea observers, logbooks, landings receipts and shoreline observations. VMS will initially be used in the longline fishery and may be used in other sectors in the future. The reliability of specific levels of observer coverage has to be determined through sampling design by NMFS, in consultation with the Council and industry for specific fishery sectors. Under the FMP, NMFS will be required to place observers as necessary, in coordination with other measures, to obtain reliable estimates of bycatch and bycatch mortality in the HMS fisheries.

C.6 Bycatch Reduction in HMS Fisheries

Section 303(a)(11) of the Magnuson-Stevens Fishery Conservation and Management Act requires a fishery management plan to "establish a standardized reporting methodology to assess the amounts and types of bycatch occurring in the fishery, and include conservation and management measures, that to the extent practicable and in the following priority–

(A) minimize bycatch; and
(B) minimize the mortality of bycatch which cannot be avoided.

Section 303(a)(12) requires the plan to "assess the type and amount of fish caught and released alive during recreational fishing under catch and release fishery management programs and the mortality of such fish, and include conservation and management measures that, to the extent practicable, minimize mortality and insure extended survival of such fish." Section C.5 has already covered standardized reporting methodologies. The remainder of this section will examine methods which can be used to either reduce bycatch or the mortality associated with bycatch.

C.6.1 Commercial Fisheries

C.6.1.1 Potential Methods Considered to Reduce Bycatch and Bycatch Mortality

1. Gear Modifications: Bycatch and bycatch mortality can be reduced in some instances by modifications in the fishing gear or the way the gear is fished. For example, mesh size in nets might be modified to avoid bycatch of certain size fish or suspenders could be used to fish nets at certain depths as in the shark/swordfish drift gillnet fishery, thus avoiding fish near the surface.

2. Time/Area Closures: Time area/closures could be used to prohibit fishing in certain geographical areas and/or certain times of the year to avoid bycatch problems. The spring closures off the Channel Islands for the shark/swordfish drift gillnet fishery are an example of this type of bycatch reduction method.

3. Full Retention of Catch: Full retention of the catch would reduce bycatch to zero by definition; all fish would have to be landed. This is the approach IATTC has implemented to document and reduce bycatch of small tunas. It does not, however, reduce fishing mortality.

4. Performance Standards: This method would reward fishers for decreasing their bycatch and/or bycatch mortality. Under a program using performance standards, goals could be set to reduce bycatch, (as an example 10% of the current bycatch of a particular species) and fishers who meet the goal would be rewarded with some incentive (an example might be additional time on the water). The same could apply for a reduction in bycatch mortality. Under such a program, incentives could be offered for both reducing bycatch and bycatch mortality.

5. Education: Under this option, fishers would attend educational seminars to learn how to reduce bycatch or bycatch mortality. Currently this method is in use in the shark/swordfish drift gillnet fishery. This could include fish handling and release guidelines in recreational fisheries.

6. Effort Reduction: Restricting effort in the fishery by its very nature serves to reduce overall bycatch by capping the amount of effort that can take place in a fishery. Assuming bycatch rates and mortality remain constant, a 50% reduction in fleet effort would result in a 50% reduction in bycatch and mortality. This could include limited entry.

7. Limit Time of Gear in Water: Restricting the time that gear might be in the water could be used to prevent bycatch of many species. In the shark/swordfish drift gillnet fishery, nets can only be set 2 hours before sunset and must be out of the water two hours after sunrise. This is done to reduce the take of striped marlin which would have to be discarded as bycatch because they cannot be landed commercially.

8. **Prohibit Setting on Floating Objects:** Under this option purse seiners would be prohibited from setting on floating objects such as kelp paddies, floating logs, clumps of marine debris, etc.

C.6.1.2 Fishery Discussion of Bycatch Reduction Measures

For a summary of bycatch reduction measures by fishery and how they should be applied to a specific fishery, see Table 5-24.

Drift Gillnet:

1. Gear modification measures are already in place as part of NMFS Take Reduction Team recommendations to reduce the take of marine mammals. Mesh sizes greater than 14 inches, 36 foot suspenders to sink the net, and pingers to drive off the animals have shown good results in reducing the take of marine mammals. The gear modifications have also reduced the bycatch (discarded dead) of striped marlin, skipjack tuna, blue shark and common mola. However, they have increased the bycatch (discarded dead) of albacore, Whether this is statistically significant is unknown. Further modifications to reduce the bycatch of fish might increase the take of marine mammals, making this option one to be considered carefully. This is a potentially practicable option but care must be taken not to increase the bycatch of marine mammals. The FMP recommends research and gear development to determine the practicability of additional gear modifications to reduce bycatch. However, it does not appear that gear modifications for reducing bycatch mortality is practicable at this time.

2. Time/area closures already exist for this fishery at the state level and are proposed in the FMP. The closures are to protect juvenile and adult sharks, thus reducing the bycatch of these species by reducing economic discards. Time/area closures also exist to protect sea turtles, and since they reduce effort, tend to reduce the overall bycatch of other fish (sea turtles are classified as fish under the Magnuson-Stevens Act). This is a practicable option and should be continued.

3. Full retention of catch currently is not applied to this fishery by the States of California or Oregon. In light of the response the IATTC is receiving to their full retention program, without very careful laws governing the landing of all fish, this option does not appear to be practicable. Blue sharks may prove to be an exception in the future as markets are developing in Mexico and could offer a possible commercial outlet.

4. Performance standards in the shark/swordfish drift gillnet fishery would require extensive study before they could be applied. The objectives would need to be identified, rewards for achieving the goal would need to be identified, rules would have to be implemented by the Council, observers would need to be employed to evaluate the success of the program as logbooks would not provide reliable data. Because of this, at this time, performance standards are not a practicable option to reduce bycatch or bycatch mortality.

5. NMFS currently has an educational program for skippers of drift gillnet vessels. While the focus is on avoiding interactions with marine mammals and sea turtles, some discussion of avoiding blue sharks does take place. Future workshops could be expanded to include more information on avoiding bycatch of fish (assuming known ways exist) and on decreasing bycatch mortality. This option appears to be a practicable way to reduce bycatch and bycatch mortality.

6. Effort reduction through limited entry and permit reduction already exist at the state level for this fishery. California and Oregon limit the number of permits. California also has a program to reduce permits through attrition. With these two measures, effort will be reduced and there should be an associated reduction in bycatch and mortality. This option appears to be a practicable way to reduce bycatch and bycatch mortality.

7. Limiting soak time is currently employed in California to avoid the bycatch of striped marlin. This measure is proposed in the FMP and should continue the current practice with its assumed bycatch reduction benefits. This is a practicable option which should be continued.

8. Prohibiting sets on floating objects - This measure only applies to the coastal purse seine fishery.

PROPOSED ACTION

Include the current bycatch and bycatch mortality reduction measures (gear modifications, time/area closures, education, effort reduction and limited soak time) in the FMP.

Surface-Hook-and Line:

1. Gear modifications may be a possibility, especially in the design of a hook which travels with the point facing down. However, gear evolution has dictated the hook pointing up because it produces higher catch rates; one pointing down would probably produce lower catch rates. NMFS studies conducted in conjunction with tagging albacore have shown lower hooking mortality on fish hooked in the lower jaw (Norm Bartoo, NMFS La Jolla, pers. comm.). NMFS should consider undertaking a hook design study if it is determined that bycatch and bycatch mortality are at unacceptable levels (observers will be needed to determine this). Without better data, this does not appear to be a practicable option.

2. Time/area closures offer the possibility to reduce interactions with juvenile fish, which, because of their small size are discarded for economic reasons. However, since juvenile fish range over wide areas of the ocean at differing times of the year, this alternative probably is not practicable since the times and boundaries would constantly be changing.

3. Full retention of catch would avoid the bycatch issue completely. However, it would increase the cost to fishers by forcing them to land small fish in favor of larger, more profitable fish. In deliveries where small fish (less than 4 kg) constitute greater than 5% of the catch, canneries pay significantly less for the fish. This can lead to discarding of fish at sea for economic reasons. There would also be a problem of enforceability because, without an observer program, most fishers would discard small fish in favor of larger ones. The bycatch of small albacore in the north Pacific constitutes less than one-half of one percent (60 mt) of total catch (12,000 mt) and does not constitute a resource issue. Because of these issues, this option does not appear to be practicable.

4. Performance standards in this fishery would require extensive study before they could be applied. The objectives would need to be identified, rewards for achieving the goal would need to be identified, rules would have to be implemented by the Council, and observers would need to be employed to evaluate the success of the program as logbooks would not provide reliable data. Because of this, at this time, performance standards are not a practicable option to reduce bycatch or bycatch mortality.

5. An educational program on how to avoid areas of small fish, what to do when you find small fish and how to successfully release them would help to reduce bycatch and associated mortality. NMFS would need to institute a study to determine if this is feasible. Fishers currently voluntarily avoid areas of small fish because of the economic loss associated with fishing for something you are going to throw back or commands a low price. Until NMFS completes a study of the problem this option is not a practicable way to reduce bycatch and mortality.

6. Effort reduction through limited entry and permit reduction could be used to reduce the total amount of effort in the fishery. Whether this would reduce total bycatch is unknown since the remaining vessels might simply increase their effort to make-up for the reduction in fleet size. One positive thing that might happen is the reduction in bycatch and bycatch mortality that might occur as less skilled fishers are eliminated from the fishery through limited entry or permit reduction regulations. This assumes that older, more experienced fishers would qualify for limited entry while newer, less experienced fishers would not. Without better data, it would be difficult to implement and it is not practicable.

7. Limiting soak time - This measure does not apply to this fishery.

8. Prohibiting sets on floating objects - This measure only applies to the coastal purse seine fishery.

PROPOSED ACTION

There are no proposed actions to reduce bycatch or bycatch mortality in the surface hook-and-line fishery.

Pelagic Longline:

1. Gear modifications may be a possibility, although what has been done in the Hawaiian longline fishery to limit the take of birds and sea turtles (shooters to get baits down fast to avoid birds and minimal depth of set to avoid sea turtles) will apply to only longline vessels operating from the West Coast which fish west of 150^o W longitude. West coast longline vessels fishing east of 150^o W longitude will not be restricted to a minimal depth requirement. Because of this, NMFS would have to undertake a study to determined if fish bycatch and bycatch mortality could further be reduced by additional gear modifications. At this time this option is not practicable.

2. Time/area closures already exist in the Hawaiian fishery and are proposed for vessels fishing west of 150^o W longitude. The closures are to protect sea turtles and sea birds. Since they reduce effort, they tend to reduce the overall bycatch of fish. New closures may be warranted east of 150^o W longitude under this FMP, but the extent of those closures is yet to be determined. Incorporating the Hawaiian restrictions west of 150^o W longitude is a practicable option.

3. Full retention of catch would avoid the bycatch issue completely. However, it would increase the cost to fishers by forcing them to land small fish rather than larger, more profitable fish. There would also be a

problem of enforceability because, without an observer, most fishers would discard small fish in favor of larger ones. This option does not appear to be practicable.

4. Performance standards in this fishery would require extensive study before they could be applied. The objectives would need to be identified, rewards for achieving the goal would need to be identified, rules would have to be implemented by the Council, and observers would need to be employed to evaluate the success of the program as logbooks would not provide reliable data. Because of this, at this time, performance standards are not a practicable option to reduce bycatch or mortality.

5. An educational program on how to avoid bycatch species, what to do when you find them, and how to successfully release them could help to reduce bycatch and associated mortality. NMFS could institute a program similar to the one for the shark/swordfish drift gillnet fishery. In this way, the option appears as a practicable way to reduce bycatch and mortality.

6. Effort reduction through limited entry and permit reduction could be used to reduce the total amount of effort in the fishery. Whether this would reduce total bycatch is unknown since the remaining vessels might simply increase their effort to make up for the lost effort. One positive thing that might happen is the reduction in bycatch and mortality that might occur as less skilled fishers are eliminated from the fishery through limited entry or permit reduction regulations. This assumes that older, more experienced fishers would qualify for limited entry while newer, less experienced fishers would not. Without better data, it would be difficult to implement and it is not practicable.

7. Limiting soak time is a possibility in the longline fishery but NMFS would need to do a study to determine if there was any benefit due to fish bycatch reduction or decrease in mortality. Forcing vessels to pick up their longlines sooner than is the current practice without data to support this action is not practicable.

8. Prohibiting sets on floating objects - This measure only applies to the coastal purse seine fishery.

PROPOSED ACTION

Include the current Western Pacific Council bycatch and bycatch mortality reduction measures (gear modifications, time/area closures and education) for West Coast vessels fishing west of 150^{o} W longitude in the FMP. This action would restrict fishing west of 150^{o} W longitude, thus preventing an increase in bycatch and bycatch mortality from the area.

Harpoon:

The harpoon fishery is excluded from this discussion because there is no expectation of bycatch in the fishery as harpoons are directed only at swordfish and do not incidentally take any other species. Some economic discards do occur whenever swordfish are damaged by sealions or sharks.

PROPOSED ACTION

There are no proposed actions to reduce bycatch or bycatch mortality in the harpoon fishery at this time.

Tropical Tuna Purse Seine:

The tropical tuna purse seine fishery is excluded from this discussion for the following reasons. The U.S. purse seine tuna fishery is currently required to comply with regulations implementing an IATTC recommendation that addresses bycatch concerns. Under those regulations (50 CFR 300.29), a purse seine vessel operator must retain on board all tuna brought on board from a set, except any fish that are not suitable for human consumption; must promptly release all non-tuna in a manner intended to promote survival; and must use special handling and release procedures for any sea turtles caught in a purse seine set. IATTC and member nations' observers are collecting data on the effects and effectiveness of this pilot program that will last through 2002. The IATTC has a Bycatch Working Group that reviewed the initial results of the program in June 2002. The intent of the program is to provide an incentive to either reduce or abort sets that capture large amounts of juvenile tuna (and thus reduce yield per recruit in the fishery as well as possibly reduce future spawning potential) or to ensure that discards of juvenile tuna are fully accounted for in the determination of fishing mortality and stock assessments. Unfortunately, most vessels fish under foreign flags and initial reports indicate the program is not working because of poor compliance with logbook requirements to document catch and the loop-hole which allows fish to be dumped if not fit for human consumption. U.S. vessels fishing under IATTC authority are 100% observed so bycatch data are available for the U. S. fleet.

The Council is not aware of any other practicable measures that could reduce bycatch or minimize unavoidable bycatch mortality in this fishery. The Council will be apprised of the results of the IATTC pilot program and may consider adopting it (or similar measures) under the authority of the FMP in the future.

PROPOSED ACTION

There are no proposed actions to reduce bycatch or bycatch mortality in the tropical tuna purse seine fishery at this time.

Coastal Purse Seine:

1. Gear modifications to reduce bycatch appear impractical in this fishery. The current practice of using mackerel or tuna nets allows for no modification. First, it would need to be determined if there was a bycatch problem in the fishery since currently nothing is known. NMFS would have to undertake such a study to determine if bycatch and bycatch mortality could be reduced by gear modifications. At this time the option doesn't appear to be a practicable option until NMFS could undertake such a study.

2. Time/area closures would be impractical until a bycatch study is initiated to determine if a problem exists in the coastal purse seine fishery. Until that happens, this option is not practicable.

3. Full retention of catch would avoid the bycatch issue completely. However, it would increase the cost to fishers by forcing them to land small fish instead of larger, more profitable fish. There would also be a problem of enforceability because, without an observer, most fishers would discard small fish in favor of larger ones. The retention of yellowtail, white seabass and barracuda would be a violation of California state law, thus placing this option in conflict with state law. Because of these issues, this option does not appear to be practicable.

4. Performance standards in this fishery would require extensive study before they could be applied. The objectives would need to be identified, rewards for achieving the goal would need to be identified, rules would have to be implemented by the Council, observers would need to be employed to evaluate the success of the program as logbooks would not provide reliable data. Because of this, at this time, performance standards are not a practicable option to reduce bycatch or mortality.

5. An educational program on how to avoid bycatch species, what to do when you find them and how to successfully release them would help to reduce bycatch and associated mortality. NMFS could institute a program similar to the one for the shark/swordfish drift gillnet fishery. In this way, the option appears as a practicable way to reduce bycatch and mortality.

6. Effort reduction through limited entry and permit reduction could be used to reduce the total amount of effort in the fishery. Whether this would reduce total bycatch is unknown since the remaining vessels might simply increase their effort to make-up for the lost effort. One positive thing that might happen is the reduction in bycatch and mortality that might occur as less skilled fishers are eliminated from the fishery through limited entry or permit reduction regulations. This assumes that older, more experienced fishers would qualify for limited entry while newer, less experienced fishers would not. There is already de facto limited entry since, south of 39^{o} N lattitude, most California vessels already possess a Coastal Pelagic Species (CPS) limited entry permit. California vessels without a CPS limited entry permit cannot operate economically on HMS alone, therefore the de facto limited entry. The few vessels that do not possess the CPS permit are vessels which fish under IATTC regulations and it is unlikely more will enter this fishery. This is not a practicable option.

7. Limiting soak time - This measure does not apply to this fishery.

8. Prohibiting sets on floating objects - Based on IATTC data, setting on free swimming schools of tuna does not produce significant bycatch of fish. NMFS would need to do a study on the fishery, collecting data with observers, before this measure could be implemented, assuming bycatch or mortality was a problem. Without further study, this is not a practicable option.

PROPOSED ACTION

There are no proposed actions to reduce bycatch or bycatch mortality at this time.

C.6.2 Recreational Fisheries

C.6.2.1 Potential Methods Considered to Reduce Bycatch and Bycatch Mortality

1. Use of De-hooking Devices for Sharks: Under this option, shark fishers or any angler with a reasonable expectation of catching a shark that is to be discarded would be required to have a de-hooking device on the vessel and use it as necessary. Further, the angler would have to know how to use the device.

2. Use of Circle Hooks: This style of hook has been proven to significantly reduce hooking mortality on fish that are to be released. On the West Coast, anglers that are mooching for salmon (drifting with dead bait) are required to use circle hooks because of the proven reduction in mortality. Applying the same principle to HMS anglers would assure that the lowest possible mortality would occur if a fish were thrown back.

3. Full Retention of Catch: All anglers would be required to land all HMS. Full retention of the catch would reduce bycatch to zero by definition; all fish would have to be landed. This is done in many invertebrate fisheries, where the first number of animals harvested must be retained to avoid waste. However, in this instance, it is done to avoid bycatch.

4. Formal Voluntary Catch and release Program for All Species: This type of formal program where anglers voluntarily release their catch would provide for a meaningful angling experience while reducing bycatch by definition. The program would hinge on developing a successful educational component which would inform anglers on how to avoid the catch of non-target HMS and how to minimize mortality of any released fish.

5. Formal Mandatory Catch and release for Striped Marlin Only: This would authorize a formal catch and release program for recreational anglers in which no striped marlin could be retained. Fish brought dead to the vessel must be released.

C.6.2.2 Fishery Discussion of Bycatch Reduction Measures

Bycatch by recreational anglers on party/charter boats and private vessels is significant for only a few species. Skipjack tuna and blue shark make up the vast majority of the bycatch. Both resources are healthy, and the magnitude of bycatch is documented by the MRFSS. To the extent that the Magnuson-Stevens Act calls for the reduction of bycatch when practicable, the fleets are currently complying with the law. Some options listed below could serve to reduce bycatch mortality by increasing the survivability of released fish. The major concern of the fleets is the definition of bycatch under the National Standard Guidelines which makes mandatory the release of all fish released alive under a formal catch and release program. The Magnuson-Stevens Act only states that "Such term (*bycatch*) does not include fish released alive under a recreational catch and release fishery management program." This more liberal interpretation would cover the existing practice of voluntary catch and release of HMS along the West Coast.

Party/Charter Boats:

1. Use of de-hooking devices for sharks would serve to reduce mortality on sharks by allowing anglers to successfully retrieve their hooks without significantly traumatizing the animals. The devices provide a leverage point which allows for a successful release without undo risk to either the angler or shark. Several devices are on the commercial market at this time. However, no studies have occurred to document their use or effectiveness. Because no data are available to evaluate the effectiveness of these devices, this option is not practicable as a way to reduce bycatch mortality.

2. Use of circle hooks could decrease mortality on bycatch species by decreasing hooking trauma since almost all fish are hooked in the corner of the mouth, an area where little damage occurs and fish can easily be released. However, currently the only study on Pacific species relates to salmon. While the study did show hooking mortality was reduced, it was specific to these fish. Work in the Atlantic on tuna does offer some insight into tuna survival. However, pending the outcome of a hooking study for HMS on the West Coast, this option is not a practicable way to reduce bycatch mortality.

3. Full retention of catch is one method that could be used to reduce bycatch. Under this option, all anglers would be required to keep and land all HMS. It would meet the requirements of Magnuson-Stevens Act by eliminating bycatch among party/charter boat anglers. However, it would create a problem of waste as anglers dump the undesirable part of their catch after returning to port. Because of the potential for dumping, this option is not practicable.

4. A formal voluntary catch-and release program for all species would hinge on developing a successful educational component which would inform anglers on how to avoid non-directed bycatch (HMS taken when fishing for other species and not retained) and how to minimize mortality of any HMS bycatch. National Standard Guideline 50 CFR 600.350(c) calls for the release of all fish taken under a formal catch-and -release program. Since these are guidelines, a formal voluntary program with an educational component to reduce bycatch where practical and bycatch mortality if that is not possible, would appear to mitigate for the intent of the guideline, reduction of bycatch by forcing the release of all fish whether dead or alive. With this caveat, this option is practicable.

5. Formal voluntary catch and release for striped marlin only would be similar to a program currently in use in the Atlantic Plan for Tuna and Billfishes. It is in compliance with National Standard Guideline 50 CFR 600.350(c) which calls for the release of all fish taken under a formal catch and release program. For party/charter boats with their extremely low catch rate (< 10 fish per year) of striped marlin, enforceability would be an issue. Further, discarding a fish which comes up dead would be wasteful when there is no biological reason not to keep the fish since the resource is healthy and the current take is below MSY. This option is practicable because of the low catch rate and effort to avoid waste of fish.

PROPOSED ACTION

Implement a voluntary catch and release program for all species.

Private Vessels:

1. Use of de-hooking devices for sharks would serve to reduce mortality on sharks by allowing anglers to successfully retrieve their hooks without significantly traumatizing the animals. The devices provide a leverage point which allows for a successful release without undo risk to either the angler or shark. Several devices are on the commercial market at this time. However, no studies have occurred to document their use or effectiveness. Because no data are available to evaluate the effectiveness of these devices, this option is not practicable as a way to reduce bycatch mortality.

2. Use of circle hooks could decrease mortality on bycatch species by decreasing hooking trauma since almost all fish are hooked in the corner of the mouth, an area where little damage occurs and fish can easily be released. However, currently the only study on Pacific species relates to salmon. While the study did show hooking mortality was reduced, it was specific to these fish. Work in the Atlantic on tuna does offer some insight into tuna survival. However, pending the outcome of a hooking study for HMS on the West Coast, this option is not a practicable way to reduce bycatch mortality.

3. Full retention of catch is one method that could be used to reduce bycatch. Under this option, all anglers would be required to keep and land all HMS. It would meet the requirements of the Magnuson-Stevens Act by eliminating bycatch among party/charter boat anglers. However, it would create another problem, what would anglers do with undesirable species such as blue shark? Undoubtedly, it would result in significant waste as anglers dump the undesirable part of their catch after returning to port. Further, since private vessels operate differently than party/charter boats where peer pressure significantly increases compliance with the law, the lack of peer pressure on private vessels would undoubtably lead to undesirable fish being thrown back. Because of the potential for dumping and fish being thrown back because of lack of enforcement, this option is not practicable.

4. A formal voluntary catch-and release program for all species would hinge on developing a successful educational component which would inform anglers on how to avoid non-directed bycatch (HMS taken when fishing for other species and not retained) and how to minimize mortality of any bycatch. National Standard Guideline 50 CFR 600.350(c) calls for the release of all fish taken under a formal catch-and -release program. Since these are guidelines, a formal voluntary program with an educational component to reduce bycatch where practical and bycatch mortality if that is not possible, would appear to mitigate for the intent of the guideline, reduction of bycatch by forcing the release of all fish whether dead or alive. With this caveat, this option is practicable.

5. Formal catch and release for striped marlin only would be similar to a program currently in use in the Atlantic Plan for Tuna and Billfishes. It is in compliance with National Standard Guideline 50 CFR 600.350(c) which calls for the release of all fish taken under a formal catch-and -release program. For the private boat fishery where the vast majority of fish are released, it would not be a hardship. However, since some marlin die while being caught, it would create some bycatch although that bycatch would be less than the current "bycatch" associated with California's voluntary program where the vast majority of fish are released alive. The

discarding of fish would be wasteful when there is no biological reason not to keep the fish since the resource is healthy and the current take is below MSY. However, since this complies with the letter of the law, it is a practicable option.

PROPOSED ACTION

Implement a voluntary catch and release program for all species.

Table 5-24. Summary of potential bycatch reduction measures by gear type and whether the option is practicable at this time

Gear Type	Proposed Action							
COMMERCIAL	Gear Modifications	Time/Area Closures	Full Retention of Catch	Performance Standards	Education	Effort Reduction	Limit Soak Time	Cannot Set Floating Object
Drift Gillnet	Yes[1]	Yes[1]	No	No	Yes[1]	Yes[1]	Yes[1]	Does Not Apply
Surface Hook-and-Line	No	No	No	No	No	No	Does Not Apply	Does Not Apply
Pelagic Longline	Yes[2]	Yes[2]	No	No	Yes[2]	No	No	Does Not Apply
Harpoon	NO MEASURES NECESSARY - NO BYCATCH BECAUSE OF THE NATURE OF THE FISHERY							
Large Tuna Purse Seines	NO MEASURES NECESSARY - REGULATED BY INTERNATIONAL TREATY THROUGH INTER-AMERICAN TROPICAL TUNA COMMISSION							
Coastal Purse Seines	No	No	No	No	No	No	Does Not Apply	No
Gear Type	Proposed Action							
RECREATIONAL	Use of Dehooking Devices For Sharks	Use of Circle Hooks	Full Retention of Catch	Formal Voluntary Catch and release Program for all Species	Formal Voluntary Catch and release Program for Marlin			
Party/Charter Boats	No	No	No	Yes	Yes			
Private Vessels	No	No	No	Yes	Yes			

1 Already in effect as part of the state restrictions on the DGN fishery

2 Already in effect for Western Pacific Council vessels fishing under their HMS FMP

C.7 Voluntary Catch and Release Recreational Fishery

C.7.1 Background

Amendment 1 to the Atlantic Billfish Fishery Management Plan established a recreational catch-and-release fishery management program. The following factors supported the establishment of a catch-and-release program in the Atlantic recreational billfish fishery: (1) the exclusive recreational nature of the Atlantic billfish fishery, (2) the already existing high rate of release of live fish in the recreational fishery,(3) the high rate (likely in excess of 90 %) of survival of recreationally caught and released fish and(4) the high economic benefit of each fish caught. Furthermore, the plan authors believed that establishing a catch-and-release fishery in this situation would further foster the already existing catch-and-release ethic of recreational billfish fishers, thereby increasing release of billfish caught in the fishery.

The drafters noted a 1997 ICCAT recommendation to promote the voluntary release of Atlantic blue and white marlin. In addition, they looked at National Standard Guideline 50 CFR 600.350(c) which states"[a] catch and release fishery management program is one in which the retention of a particular species is prohibited." They pointed out this definition is a guideline and is only an example of management measures which may be used to establish a recreational catch-and-release program. In their conclusion establishing the Atlantic catch-and-release billfish program the drafters stated "The establishment of a catch-and-release fishery management program for recreational Atlantic billfish fishery is a final action because it meets the objectives of the FMP amendment as well as National Standard 9 and the 1997 ICCAT recommendation." The recreational fishery which releases fish in southern California meets the same criteria used to establish the catch-and release program in the Atlantic. While tuna and sharks are a shared resource with commercial fishers, the dorado fishery is almost exclusively a recreational fishery and striped marlin is currently reserved for recreational anglers by law in California.

Several of the species taken in the recreational fishery already have a high rate of live releases, and many of those species have a high rate of survival. This produces high economic benefit for each fish caught. Since there is wide-spread support for a voluntary catch-and-release program which allows the angler the option to land a fish, the FMP proposes such a program. In this manner, bycatch and bycatch mortality would be reduced.

C.7.2 Catch and Release Alternatives

Alternative 1: (No Action): Status quo. No bycatch and/or catch and release programs would be implemented under this FMP. Under this option all highly migratory fish released would be considered bycatch

Alternative 2: (Proposed Action): The FMP would establish a framework procedure for bycatch reduction, and adopts a formal voluntary “catch and release” program for HMS recreational fisheries to promote the handling and release of fish in a manner that minimizes the risk of incidental mortality, and encourages the release of small fish. Released fish under this program would no longer be classified as bycatch.

Under Alternative 2, NMFS and the states jointly would develop and implement an educational program to inform anglers on how to avoid bycatch of HMS, or if that was not practicable, ways to release fish which minimize bycatch mortality. The details of the program would be announced by NMFS shortly after implementation of the FMP. NMFS already has moved in this direction under Executive Order 12962 - Recreational Fisheries. Under the order, NMFS has established a national plan to support, develop, and implement programs that are designed to enhance public awareness and understanding of marine conservation issues relevant to the well-being of marine recreational fishing. NMFS could build on their current conservation efforts by including information on how to avoid bycatch when fishing for HMS or for other fish where HMS might be incidentally taken. In addition, information on how to successfully release HMS so as to minimize mortality would be part of the program. The program would be voluntary since the angler would retain the alternative to keep the fish.

The main focus of the program will be NMFS employees dealing with recreational fisheries issues, primarily through the Pacific Recreational Fisheries Coordinator of the Office of Constituent Services, Recreational Fisheries Division. Notice of the policy regarding catch and release and development of materials for dissemination to anglers and angler clubs will be completed when an opportunity permits. There will be opportunities to provide such information through the following:

- Recreational symposia
- Southwest Fisheries Science Center's Billfish Newsletter
- Fish tagging programs
- Fishing tournaments

Currently, the magnitude of bycatch in recreational fisheries is very low. In the party/charter vessel fishery, only blue sharks and skipjack tuna are discarded (Table 5-22). For the private recreational fishery, striped marlin, skipjack, and blue, mako and thresher sharks comprise most of the bycatch (Table 5-23). NMFS and the states could develop two plans for bycatch and bycatch mortality reduction. One would be aimed at party/charter skippers and the other at private recreational anglers. For party/charter skippers the emphasis would be on avoiding the unintended take of skipjack and blue sharks, or if they are taken incidentally or as a result of catch and release, how to successfully release the fish with the lowest possible mortality. The private recreational angler program would do the same for striped marlin, skipjack, and blue, mako and thresher sharks. Once educational programs were developed, NMFS and the states would need to inform the public of their existence and the necessity to participate. Party/charter vessels skippers could attend mandatory workshops to learn about bycatch reduction measures. Private recreational anglers would be more difficult to reach but public information programs carried out through press releases, articles in popular sport fishing publications and seminars at local angling clubs would reach most HMS anglers. Under a voluntary catch and release program, NMFS would take on added educational responsibilities which would have additional costs. These costs are unknown at this time.

Establishing a formal voluntary catch and release program would increase angler awareness of the necessity to avoid needless bycatch, and if bycatch did occur, propose release methods which minimize bycatch mortality. The benefit to the HMS resources would be significant since anglers would know how to avoid bycatch and how to reduce bycatch mortality. By establishing a voluntary program versus a mandatory catch and release, waste of fish could be avoided as the angler would be able to retain injured fish subject to state bag limits.

Alternative 3: Would establish a bycatch reduction program; does not authorizes a formal voluntary catch and release program for recreational fisheries. Under this option all highly migratory fish released would be considered bycatch.

Alternative 4: Establishes a formal voluntary catch and release program for striped marlin. Under this option all other highly migratory fish released would be considered bycatch.

C.7.3 Analysis of Catch and Release Alternatives

Alternative 1 would continue the current practice in West Coast states of no formal measures to reduce bycatch nor any formal measure to reduce bycatch mortality. Since this is in conflict with the Magnuson-Stevens Act, adoption of this option is not practicable under this FMP.

Alternative 2 would establish a voluntary recreational catch and release program for all HMS in order to reduce the probability of present and future overfishing, maximize access to and reduce overall mortality on resources which are available to West Coast anglers in relatively short time frames and small geographic areas, and to conform to bycatch reduction requirements mandated in the Magnuson-Stevens Act. This voluntary catch and release program would be implemented in recognition of the recreational nature of many West Coast HMS species where current trends are moving towards increasing release rates on recreationally caught fish. The program would be adopted after consideration of the high survival rates for released HMS and the high economic benefits associated with distributing these resources among the greatest number of participants.

The benefits from this program will be maximized by increasing outreach efforts to West Coast anglers through cooperative efforts with organizations like the United Anglers of Southern California, The Billfish Foundation, angling clubs and individual anglers to provide information on the use of fishing gear, practices and techniques which will increase the survival rates of released fish. The use of de-hooking devices, circle hooks, proper handling techniques, and other angling practices can increase survivability of released fish. Further studies on release survival within the areas affected by this program should be used to incorporate all sources of mortality into stock assessments (Goodyear 2002, Nelson 2002).

The utilization of voluntary catch and release fishing practices by anglers targeting striped marlin, tunas and sharks from the highly populated coast of southern California has increased dramatically over the last decade (B. Hoose, Tuna Club, Avalon, CA, pers. comm. and K. Poe, Balboa Angling Club, Newport Beach, CA, pers.

comm.). This practice has been shown to have efficacy as a management tool in situations where population growth has increased both the total number of potential anglers and the number of angling trips (Nelson 2002).

Mortality on HMS species is reduced by this practice. Studies attempting to document survival in hook-and-line caught marlin and sailfish across a broad spectrum of fishing methods have yielded results ranging from 0% to 50% not accounting for overestimation due to tag shedding (Goodyear 2002) with likely mean mortality from such practices around 10% to 15% (Hinman 2001). Similarly both physiological and traditional and archival tagging studies have shown low mortalities associated with the release of tuna species (Block et al 2001, Brill, et al. 2003; Skomal et al. 2003). Encouraging the release of fish reduces mortality on the stock and reduces the probability of localized or regional stock depletions. Consistent use of this form of fishing can provide insurance against future overfishing.

Most HMS species occur seasonally in the waters off southern California and are often available in pulses. Temporal increases in local availability attract increased angling participation. Keeping large quantities of HMS during each trip limits participation to those first reaching the concentrations of fish and applies the greatest potential mortality per unit effort. Catch and release fishing allows access to the resource to be available to a greater number of people while maintaining higher levels of local abundance. This form of resource sharing increases the economic benefits obtainable from each unit of resource.

While the National Standard Guidelines suggest that a catch and release program should be established for species where retention is prohibited (CFR 600.350(c), they also advise that the consideration of the practicability of bycatch reduction measures must take into account consistency with other national standards and the maximization of net benefits to the nation (CFR 600.350(d). A catch and release program has been put into place for Atlantic Billfishes where, as is the case in this FMP, release is not mandatory. Furthermore, requiring the release of all Pacific HMS species is not warranted by existing scientific information on stock status and would likely cause significant reductions in participation in recreational HMS fisheries with loss of economic benefits. On the other hand, categorizing voluntarily released fish as bycatch would tend to force the retention of more fish and increase fishing mortality while reducing the availability of these resources to a larger number of anglers. This result would be inconsistent with National Standard 1 and its direction to prevent overfishing while optimizing yield. Establishing a voluntary recreational catch and release program for the HMS covered in this FMP serves, on the whole, to balance optimal harvest with a precautionary approach to reduce potential mortality on these stocks.

Alternative 3 would authorize no formal catch and release program. Under this alternative the catch of recreational anglers would need to be monitored to determine bycatch and bycatch mortality. NMFS would then have to determine if the resource was being impacted as a result of recreational bycatch, and if there was an impact, develop methods to reduce bycatch, or reduce bycatch mortality if actual bycatch could not be reduced. Given the status of the stocks of fish taken in the recreational fisheries and the small portion recreational anglers contribute to overall mortality, NMFS would probably find bycatch and bycatch mortality were not of concern in the recreational fishery. Initiating no formal catch and release would put an additional unnecessary burden on NMFS ,so this option is not practicable.

Alternative 4 calls for a formal catch and release program for striped marlin only. All fish would have to be released per National Standard Guideline 50 CFR 600.350(c) which states "[a] catch and release fishery management program is one in which the retention of a particular species is prohibited." It would also place the remaining HMS in a category equivalent to alternative 3. While placing striped marlin in this category would approximate the current practice of recreational anglers in southern California, it would waste fish which are now utilized since dead fish could not be retained. Further, the discard of dead fish would not be as well documented as it is under the current practice where anglers report the disposition of fish to NMFS and local angling clubs. Bycatch would be eliminated by definition. Not having a formal catch and release for other HMS would create the same problems encountered in alternative 3. While this option is practicable for the striped marlin fishery, it only focuses on one species and is therefore less desirable than option 2.

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