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WCPFC-SC2-2006

Prepared by:

UNITED STATES OF AMERICA

2006 Annual Report to the Western and Central Pacific Fisheries Commission

United States of America

PART 1. INFORMATION ON FISHERIES, RESEARCH, AND STATISTICS (For 2005)

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PIFSC Data Report DR-06-005. Issued 21 July 2006.

2006 Annual Report to the Western and Central Pacific Fisheries Commission

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PART 1. INFORMATION ON FISHERIES, RESEARCH, AND STATISTICS (For 2005)

This report presents estimates of annual catches of tuna, billfish, and other pelagic species, vessel participation, and other fishery information for 2001–2005 for U.S. fisheries operating in the western and central Pacific Ocean (WCPO). All statistics for 2005 are provisional. For the purposes of this report the WCPO is defined as the Western and Central Pacific Fisheries Commission (WCPFC) Statistical Area (see WCPFC/SC1/2005/MEETING REPORT, ANNEX VIII, paragraph 8 of Recommendation SC1-ST-1). Information on the fisheries is provided, and pelagic research during 2005 is described. U.S. fisheries include large-scale purse seine, longline, and distant-water troll fisheries operating on the high seas, within the U.S. exclusive economic zone (EEZ), and within the EEZs of other states, and small-scale troll, handline, pole-and-line, and miscellaneous gears operating in nearshore waters in the U.S. EEZ.

The purse seine fishery was the largest U.S. fishery, accounting for 82% of the total U.S. catch[1] of pelagic species in the WCPO during 2005. The longline, distant-water troll, and small-scale fisheries accounted for 14%, 1%, and 3% of the total catch, respectively. The tuna catch in 2005 consisted primarily of skipjack tuna (62%), yellowfin tuna (22%), bigeye tuna (11%), and albacore (5%).

This report was prepared by staff of the Pacific Islands Fisheries Science Center, Pacific Islands Regional Office, and Southwest Fisheries Science Center.

[1] For the most part, U.S. estimates are actually landings. They do not include subsistence or recreational catches, except for some island fisheries other than Hawaii. In the future, the estimates will include available information on at sea discards, landed product not sold, recreational catches, etc.

PIFSC Data Report DR-06-005. Issued 21 July 2006.

1.1 ANNUAL FISHERIES INFORMATION

Table 1a. Estimated landings in (metric) tons by species or species groups and fishing gear for U.S. vessels operating in the WCPO, 2005 (provisional). Small-scale consists of troll, handline, pole-and-line, and miscellaneous gears. A blank cell indicates no reported landings or an estimated landing of less than 0.5 ton.

	Purse seine	Longline	Distant-water troll	Small-scale	TOTAL
Albacore, North Pacific		294	53	183	530
Albacore, South Pacific		2,666	700		3,366
Bigeye tuna	4,848	4,575		169	9,592
Pacific bluefin tuna					
Skipjack tuna	52,410	218		607	53,235
Yellowfin tuna	17,029	1,226		765	19,020
Other tuna				21	21
TOTAL TUNA	74,287	8,979	753	1,745	85,764
Black marlin					
Blue marlin		337		163	500
Sailfish		10		19	29
Shortbill spearfish		201			201
Striped marlin, North Pacific		484			484
Striped marlin, South Pacific		3			3
Other marlin				16	16
Swordfish, North Pacific		1,455			1,455
Swordfish, South Pacific		3			3
TOTAL BILLFISH		2,493		198	2,691
Blue shark					
Mako shark		97			97
Thresher shark		34			34
Other shark		6			6
TOTAL SHARK		137			137
Common dolphinfish		461		337	798
Moonfish		411			411
Oilfish		156			156
Pomfret		273			273
Other fish		215		216	431
TOTAL OTHER		1,516		553	2,069
TOTAL	74,287	13,125	753	2,496	90,661

Table 1b. Estimated landings in (metric) tons by species or species groups and fishing gear for U.S. vessels operating in the WCPO, 2004. Small-scale consists of troll, handline, pole-and-line, and miscellaneous gears. A blank cell indicates no reported landings or an estimated landing of less than 0.5 ton.

	Purse seine	Longline	Distant-water troll	Small-scale	TOTAL
Albacore, North Pacific		356	714	160	1,230
Albacore, South Pacific		2,462	960		3,422
Bigeye tuna	5,031	4,438		279	9,748
Pacific bluefin tuna		1			1
Skipjack tuna	47,896	371		539	48,806
Yellowfin tuna	14,492	1,589		751	16,832
Other tuna		9		44	53
TOTAL TUNAS	67,419	9,226	1,674	1,773	80,092
Black marlin		10			10
Blue marlin		290		178	468
Sailfish		13			13
Shortbill spearfish		182			182
Striped marlin, North Pacific		378		22	400
Striped marlin, South Pacific		2			2
Other marlin				20	20
Swordfish, North Pacific		1,072			1,072
Swordfish, South Pacific		4			4
TOTAL BILLFISHES		1,951		220	2,171
Blue shark		59			59
Mako shark		65			65
Thresher shark		55			55
Other shark		8			8
TOTAL SHARKS		187			187
Common dolphinfish		472		626	1,098
Moonfish		329			329
Oilfish		143			143
Pomfret		321			321
Other fish		449		247	696
TOTAL OTHER		1,714		873	2,587
TOTAL	67,419	13,078	1,674	2,866	85,037

Table 1c. Estimated landings in (metric) tons by species or species groups and fishing gear for U.S. vessels operating in the WCPO, 2003. Small-scale consists of troll, handline, pole-and-line, and miscellaneous gears. A blank cell indicates no reported landings or an estimated landing of less than 0.5 ton.

	Purse seine	Longline	Distant-water troll	Small-scale	TOTAL
Albacore, North Pacific		524	2,419	85	3,028
Albacore, South Pacific		3,931	1,574		5,505
Bigeye tuna	4,470	3,632		237	8,339
Pacific bluefin tuna					
Skipjack tuna	62,907	320		706	63,933
Yellowfin tuna	20,079	1,306		758	22,143
Other tuna		1		15	16
TOTAL TUNAS	87,456	9,714	3,993	1,801	102,964
Black marlin		11			11
Blue marlin		366		207	573
Sailfish		11			11
Shortbill spearfish		241			241
Striped marlin, North Pacific		543		28	571
Striped marlin, South Pacific		4			4
Other marlin				15	15
Swordfish, North Pacific		1,957			1,957
Swordfish, South Pacific		7			7
TOTAL BILLFISHES		3,140		250	3,390
Blue shark		17			17
Mako shark		87			87
Thresher shark		49			49
Other shark		8			8
TOTAL SHARKS		161			161
Common dolphinfish		339		322	661
Moonfish		460			460
Oilfish		116			116
Pomfret		180			180
Other fish		435		256	691
TOTAL OTHER		1,530		578	2,108
TOTAL	87,456	14,545	3,993	2,629	108,623

Table 1d. Estimated landings in (metric) tons by species or species groups and fishing gear for U.S. vessels operating in the WCPO, 2002. Small-scale consists of troll, handline, pole-and-line, and miscellaneous gears. A blank cell indicates no reported landings or an estimated landing of less than 0.5 ton.

	Purse seine	Longline	Distant-water troll	Small-scale	TOTAL
Albacore, North Pacific		525	3,296	235	4,056
Albacore, South Pacific		5,951	1,337		7,288
Bigeye tuna	4,889	4,595		586	10,070
Pacific bluefin tuna		2			2
Skipjack tuna	88,535	371		664	89,570
Yellowfin tuna	27,191	1,063		639	28,893
Other tuna		2		6	8
TOTAL TUNAS	120,615	12,509	4,633	2,130	139,887
Black marlin		1			1
Blue marlin		298		225	523
Sailfish		3			3
Shortbill spearfish		137			137
Striped marlin, North Pacific		226		29	255
Striped marlin, South Pacific		2			2
Other marlin		24		13	37
Swordfish, North Pacific		1,524			1,524
Swordfish, South Pacific		6			6
TOTAL BILLFISHES		2,221		267	2,488
Blue shark		30			30
Mako shark		84			84
Thresher shark		45			45
Other shark		20			20
TOTAL SHARKS		179			179
Common dolphinfish		328		419	747
Moonfish		418			418
Oilfish		88			88
Pomfret		212			212
Other fish		309		202	511
TOTAL OTHER		1,355		621	1,976
TOTAL	120,615	16,264	4,633	3,018	144,530

Table 1e. Estimated landings in (metric) tons by species or species groups and fishing gear for U.S. vessels operating in the WCPO, 2001. Small-scale consists of troll, handline, pole-and-line, and miscellaneous gears. A blank cell indicates no reported landings or an estimated landing of less than 0.5 ton.

	Purse seine	Longline	Distant-water troll	Small-scale	TOTAL
Albacore, North Pacific		1,292	4,261	194	5,747
Albacore, South Pacific		3,260	2,107		5,367
Bigeye tuna	6,176	2,514		226	8,916
Pacific bluefin tuna		6			6
Skipjack tuna	85,539	277		977	86,793
Yellowfin tuna	24,143	1,235		883	26,261
Other tuna		23		13	36
TOTAL TUNA	115,858	8,607	6,368	2,293	133,126
Black marlin		1			1
Blue marlin		414		291	705
Sailfish		3			3
Shortbill spearfish		121			121
Striped marlin, North Pacific		351		42	393
Striped marlin, South Pacific		5			5
Other marlin		16		32	48
Swordfish, North Pacific		1,968			1,968
Swordfish, South Pacific		3			3
TOTAL BILLFISH		2,882		365	3,247
Blue shark		28			28
Mako shark		71			71
Thresher shark		51			51
Other shark		7			7
TOTAL SHARK		157			157
Common dolphinfish		294		389	683
Moonfish		349			349
Oilfish		59			59
Pomfret		117			117
Other fish		239		306	545
TOTAL OTHER		1,058		695	1,753
TOTAL	115,858	12,704	6,368	3,353	138,283

Table 2. Estimated number of active U.S. vessels by gear type in the WCPO, 2001-2005. Small-scale consists of troll, handline, pole-and-line, and miscellaneous gears but does not include boats used for subsistence or recreational fishing. Data for 2005 are provisional.

	2005	2004	2003	2002	2001
Purse seine	15	21	26	29	32
Longline	162	166	180	184	197
Distant-water troll-North Pacific	15	28	69	78	115
Distant-water troll-South Pacific	10	11	14	12	33
Small-scale	1,997	2,044	2,120	2,102	2,215
TOTAL	2,199	2,270	2,409	2,405	2,592

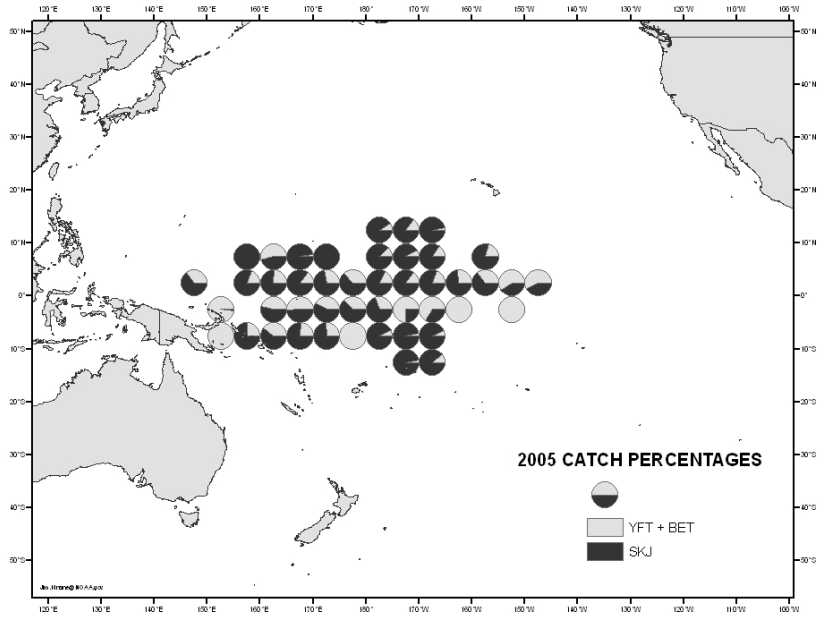


Figure 1a. Spatial distribution of reported logbook catches in the WCPO by U.S. purse seine vessels, by species, 2005 (provisional).

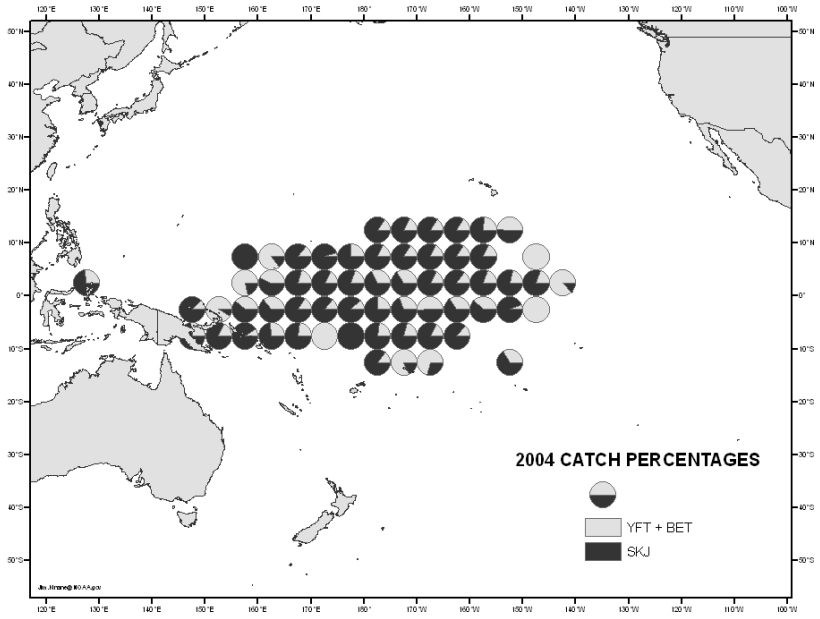
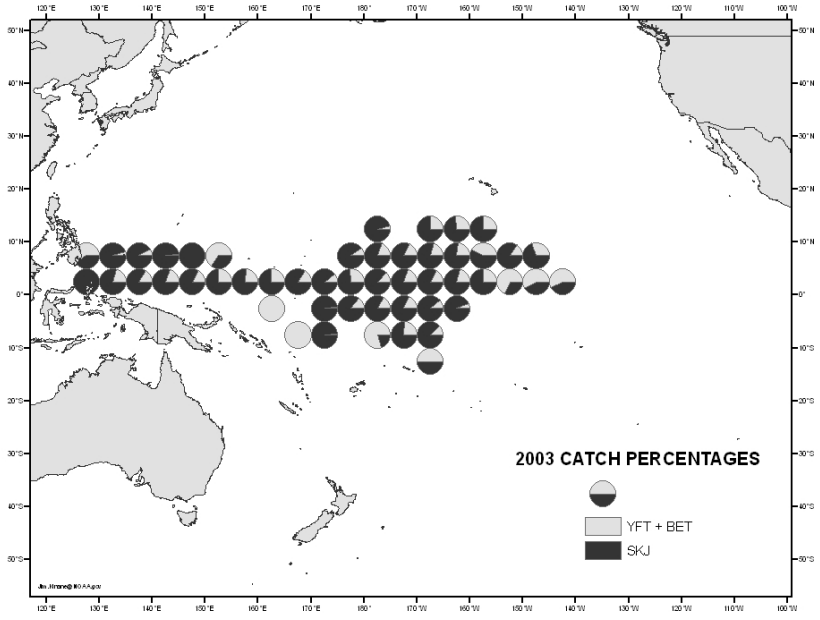


Figure 1b. Spatial distribution of reported logbook catches in the WCPO by U.S. purse seine vessels, by species, 2004.



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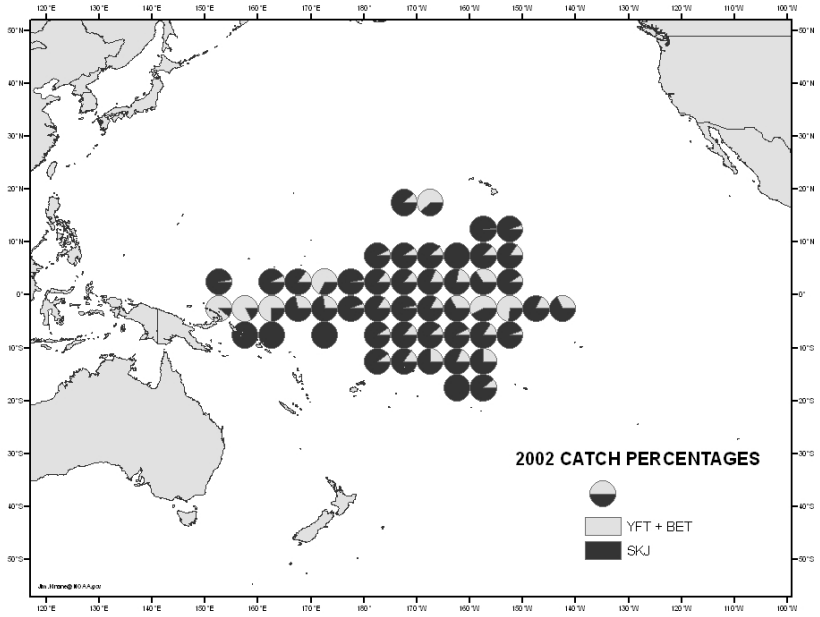

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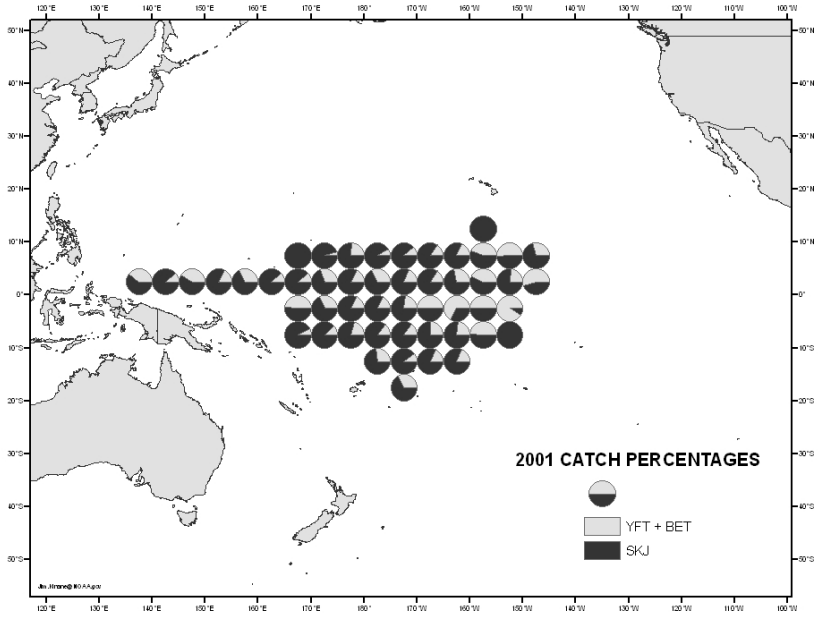


Figure 1e. Spatial distribution of reported logbook catches in the WCPO by U.S. purse seine vessels, by species, 2001.

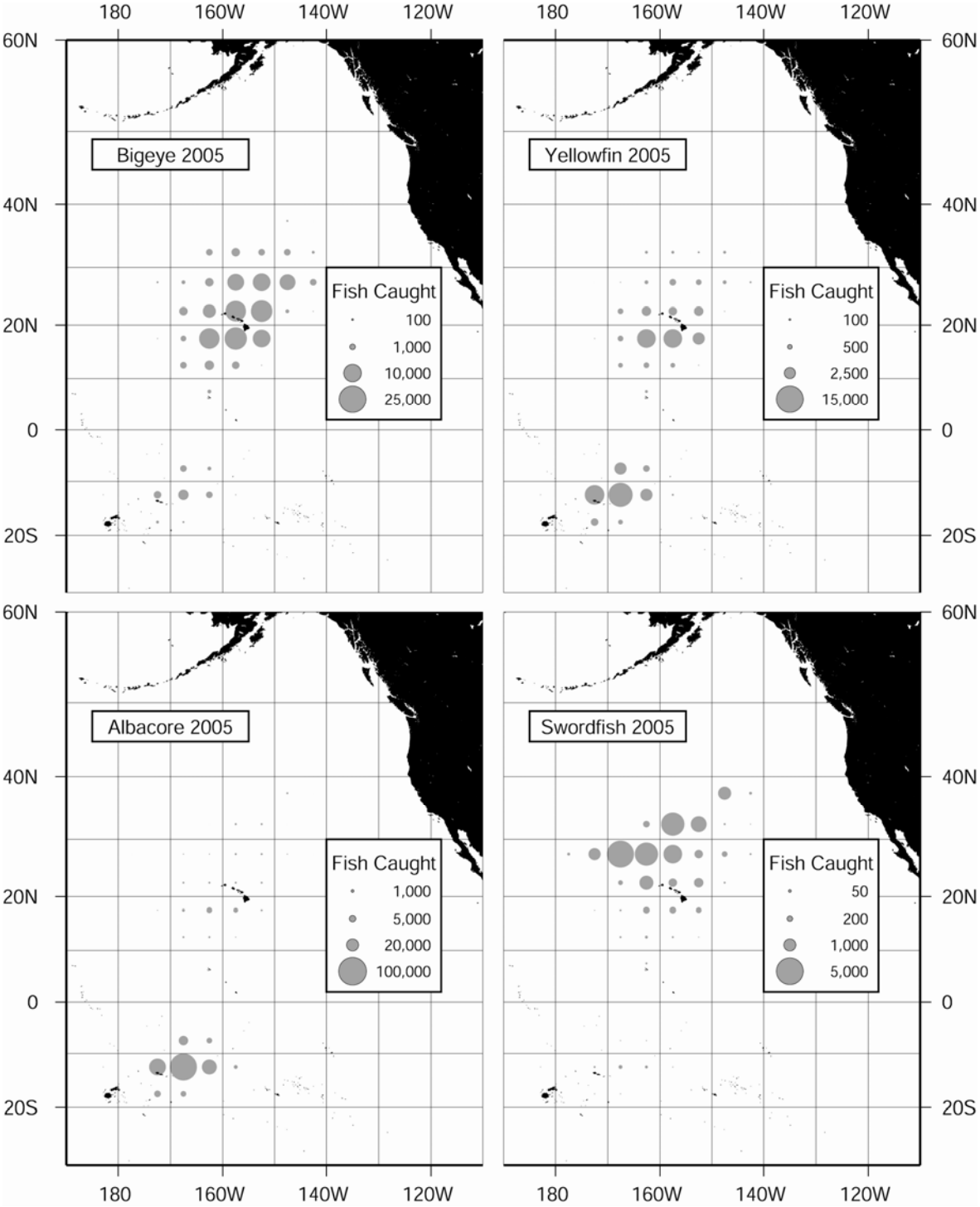


Figure 2a. Spatial distributon of reported logbook tuna catches in the WCPO by the U.S. longline fleet, in number of fish, 2005 (provisional). Catches in some areas are not shown to protect data confidentiality.

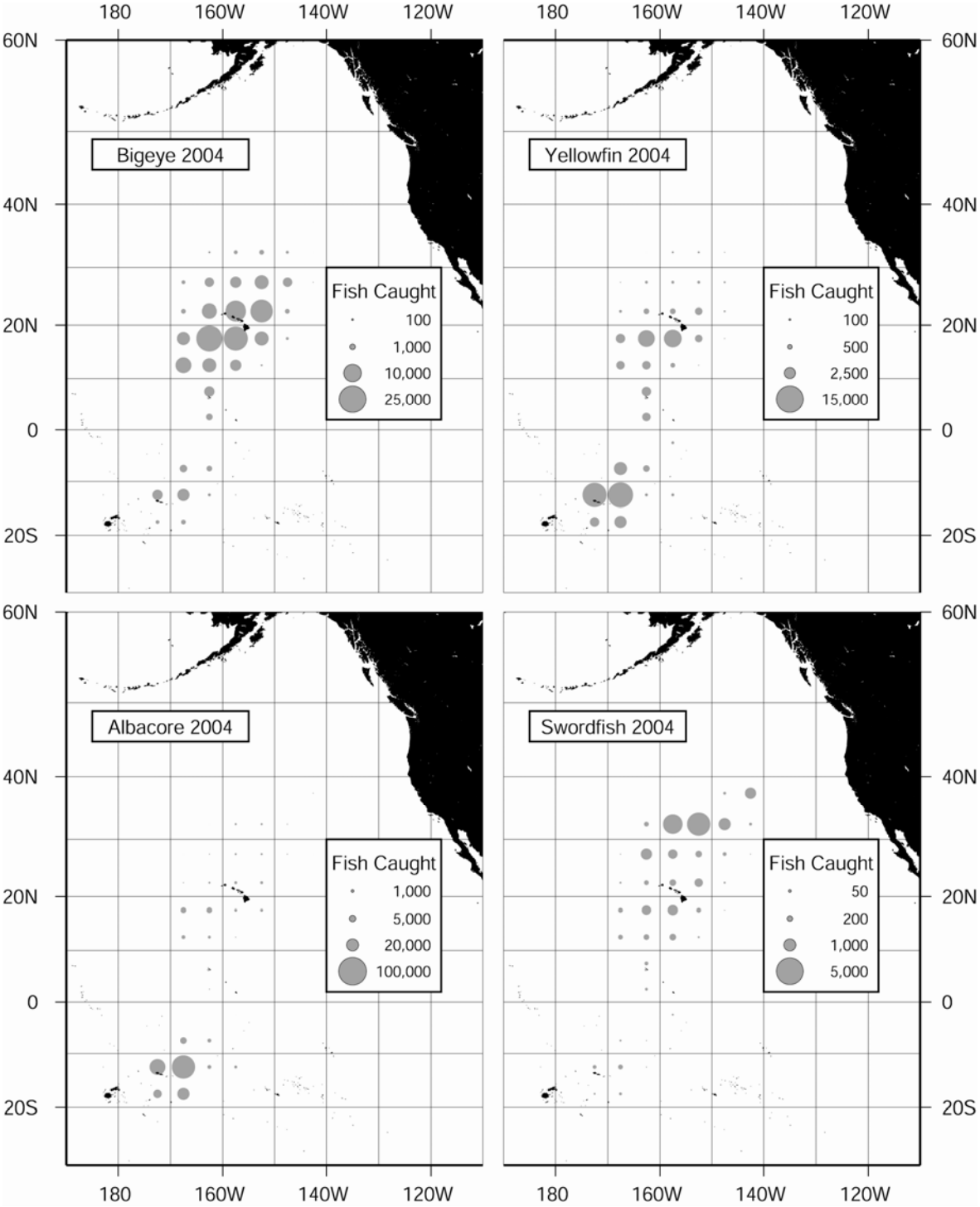
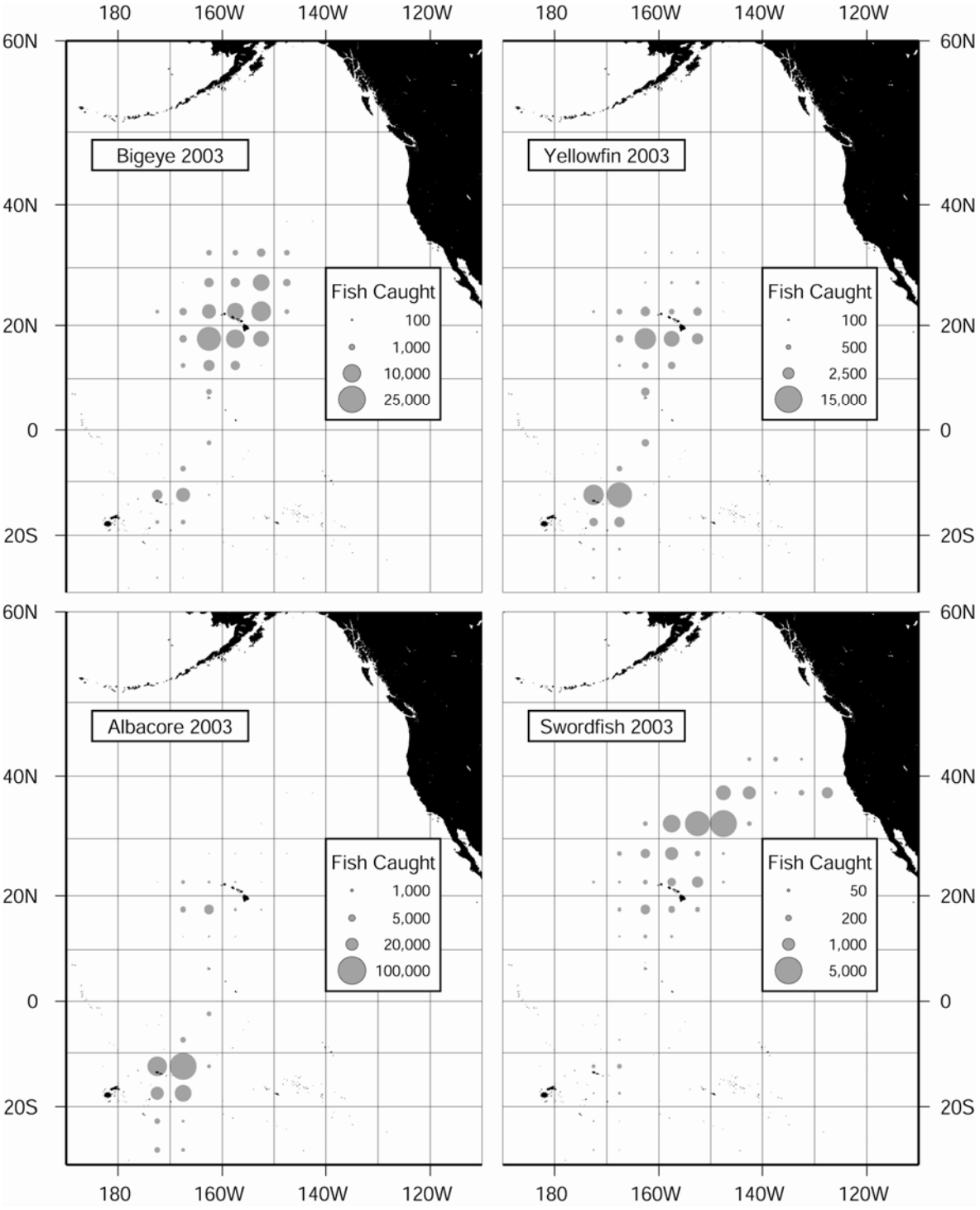


Figure 2b. Spatial distributon of reported logbook tuna catches in the WCPO by the U.S. longline fleet, in number of fish, 2004. Catches in some areas are not shown to protect data confidentiality.



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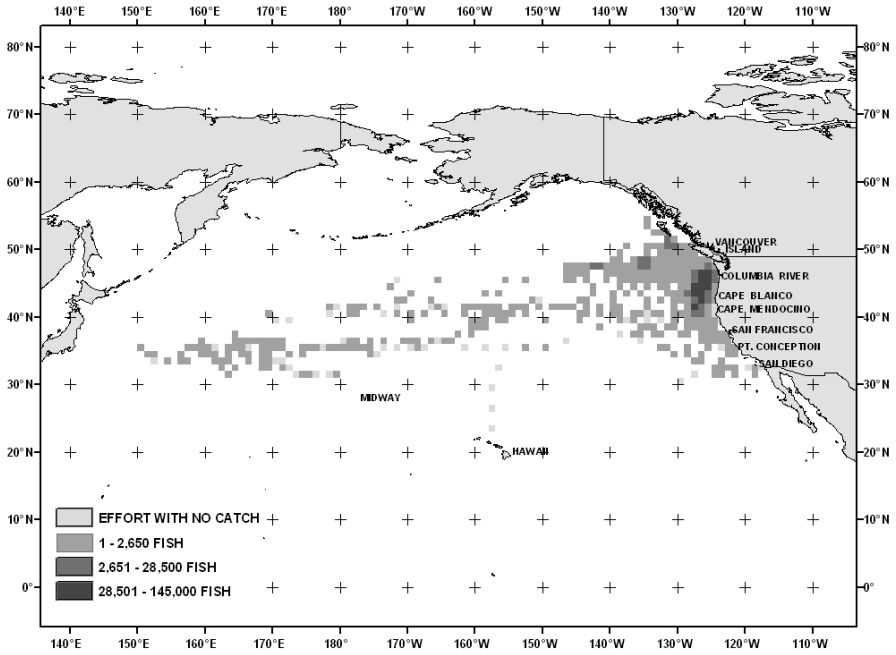


Figure 3a. Spatial distribution of logbook reported North Pacific catches of the U.S. distant-water troll fleet, in number of fish, 2005 (provisional).

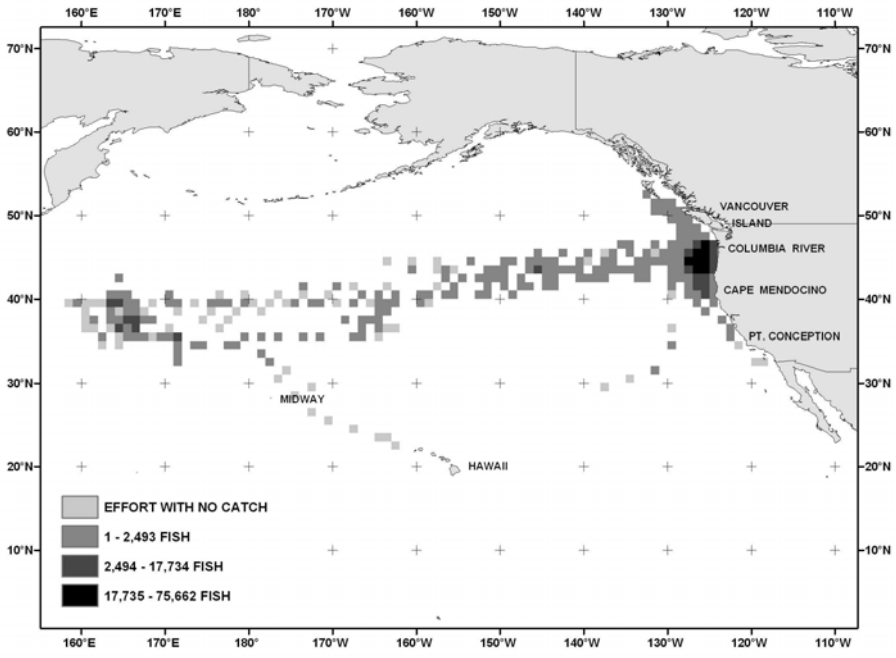
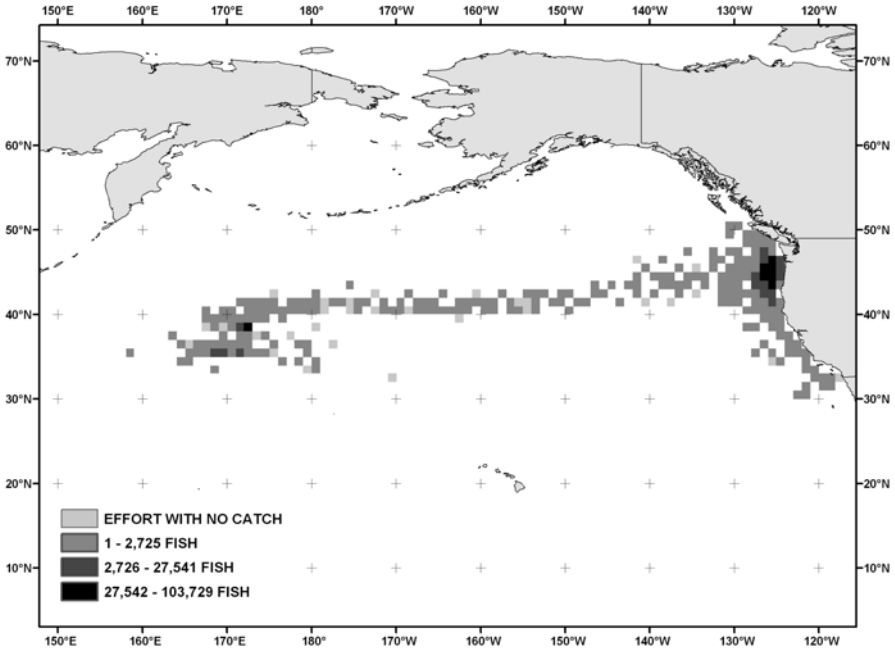


Figure 3b. Spatial distribution of logbook reported North Pacific catches of the U.S. distant-water troll fleet, in number of fish, 2004.



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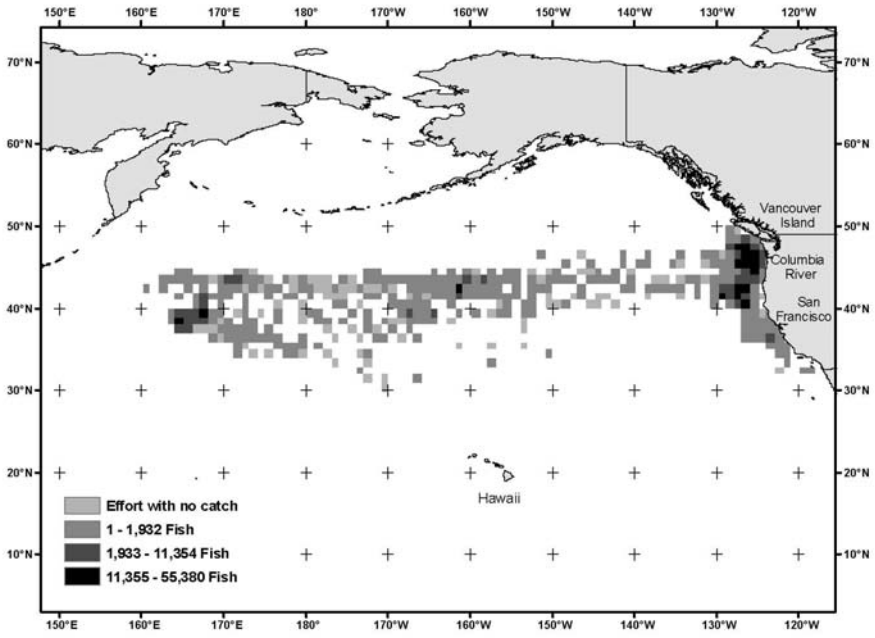

Figure 3d. Spatial distribution of logbook reported North Pacific catches of the U.S. distant-water troll fleet, in number of fish, 2002.

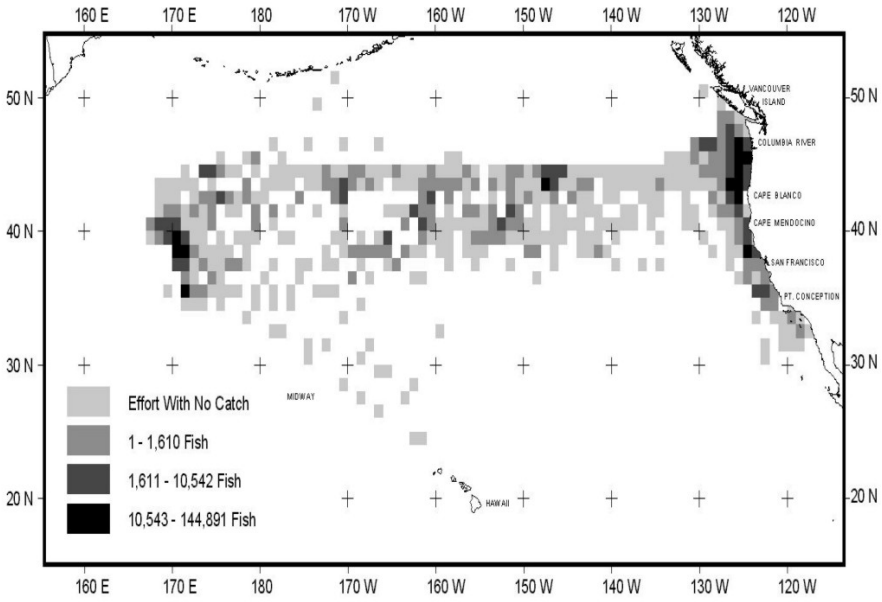

Figure 3e. Spatial distribution of logbook reported North Pacific catches of the U.S. distant-water troll fleet, in number of fish, 2001.

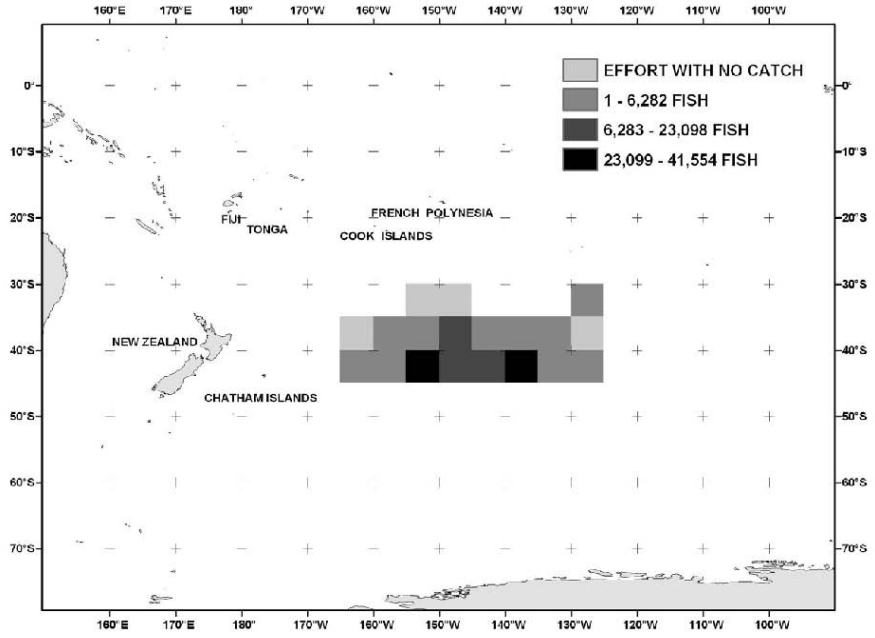

Figure 4a. Spatial distribution of logbook reported South Pacific catches of the U.S. distant-water troll fleet, in number of fish, 2003-2004.

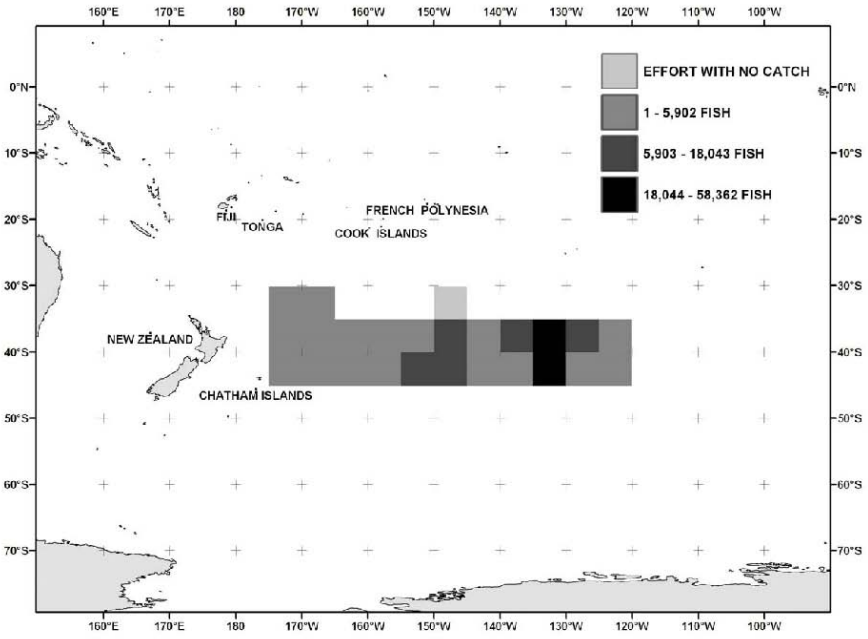

Figure 4b. Spatial distribution of logbook reported South Pacific catches of the U.S. distant-water troll fleet, in number of fish, 2002-2003.

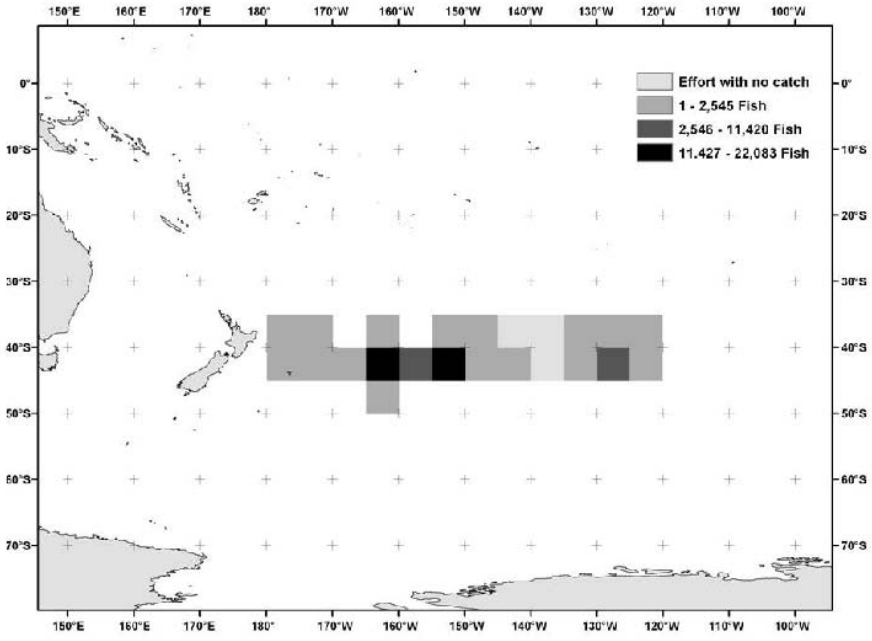

Figure 4c. Spatial distribution of logbook reported South Pacific catches of the U.S. distant-water troll fleet, in number of fish, 2001-2002.

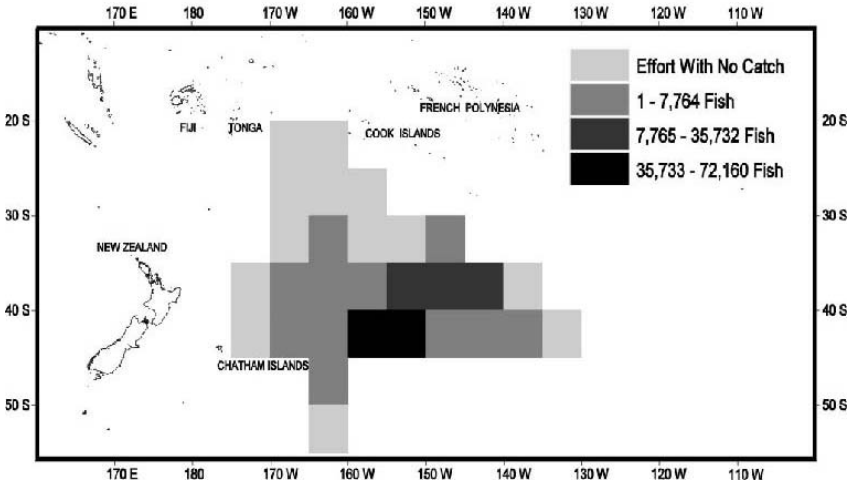

Figure 4d. Spatial distribution of logbook reported South Pacific catches of the U.S. distant-water troll fleet, in number of fish, 2000-2001.

Table 3. Estimated total numbers of fishery interactions (not necessarily resulting in mortalities) with non-fish species (all of which is nontarget, associated, or dependent species) by vessels in the Hawaii-based longline fishery, 2004 and 2005**.** The estimates are made by raising the number of observed interactions by a factor determined according to the design of the observer sampling program. The species listed are those that have been observed. Sources: Pacific Islands Regional Office observer program reports and Pacific Islands Fisheries Science Center Internal Reports IR-05-001 and IR-06-006.

Species	**2004**	**2005**
Marine mammals		
Bottlenose dolphin	0	0
Risso's dolphin	0	4
Spinner dolphin	0	0
Spotted dolphin	0	0
Blainville's beaked whale	0	6
Bryde's whale	0	1
False killer whale	28	6
Humpback whale	6	0
Shortfinned pilot whale	3	6
Sperm whale	0	0
Unidentified whale	0	1
TOTAL MARINE MAMMALS	37	24
Sea turtles		
Green sea turtle	5	0
Leatherback sea turtle	16	12
Loggerhead sea turtle	1	10
Olive ridley sea turtle	46	16
TOTAL SEA TURTLES	68	38
Seabirds		
Black-footed albatross	16	89
Brown booby	0	0
Laysan albatross	11	105
TOTAL SEABIRDS	27	194
Observer information	**2004**	**2005**
Total trips	1355	1483
Observed trips	341	466
Proportion of trips observed	25.2%	31.4%
Observed sets	4,046	6,206
Observed hooks	7,977,431	10,670,657

Table 4. Nontarget fish species catches by U.S. purse seine vessels during 2004 and 2005. Observers were present on 20% of all trips taken. (From the 18th South Pacific Tuna Treaty Formal Consultation)

	2004					2005 (provisional)				
	Sets		CATCH			Sets		CATCH		
Species	Freq.	% Freq.	MT	% discarded	kgs / set[4]	Freq.	% Freq.	MT	% discarded	kgs / set[4]
Billfish										
BLACK MARLIN	81	10.1%	11.81	91.0%	14.74	3	0.7%	0.29	100.0%	0.67
BLUE MARLIN	36	4.5%	5.83	79.3%	7.28	39	9.0%	5.49	83.7%	12.62
SAILFISH (INDO-PACIFIC)	4	0.5%	0.25	35.6%	0.31	5	1.1%	0.21	50.0%	0.48
SHORT-BILLED SPEARFISH	2	0.2%	0.54	92.6%	0.67	-	-	-	-	-
STRIPED MARLIN	8	1.0%	2.63	85.2%	3.28	1	0.2%	0.18	100.0%	0.41
SWORDFISH	1	0.1%	0.11	100.0%	0.14	3	0.7%	0.14	85.7%	0.32
Sharks and Rays										
BIGEYE THRESHER	1	0.1%	0.08	100.0%	0.10	-	-	-	-	-
BLUE SHARK	2	0.2%	0.03	100.0%	0.04	-	-	-	-	-
GALAPAGOS SHARK	-	-	-	-	-	1	0.2%	0.01	100.0%	0.02
HAMMERHEAD SHARKS	3	0.4%	0.46	100.0%	0.57	-	-	-	-	-
MAKO SHARKS	16	2.0%	0.65	99.5%	0.81	11	2.5%	0.21	99.0%	0.48
MANTA RAYS (UNIDENTIFIED)	12	1.5%	0.85	99.5%	1.06	5	1.1%	0.23	100.0%	0.53
OCEANIC WHITETIP SHARK	51	6.4%	3.08	99.9%	3.85	9	2.1%	0.25	98.4%	0.57
PELAGIC STING-RAY	1	0.1%	0.01	50.0%	0.01	2	0.5%	0.01	100.0%	0.02
RAYS, SKATES AND MANTAS	-	-	-	-	-	1	0.2%	1.00	100.0%	2.30
SHARKS (UNIDENTIFIED)	35	4.4%	3.26	98.6%	4.07	-	-	-	-	-
SILKY SHARK	324	40.4%	31.34	99.9%	39.13	135	31.0%	11.65	99.2%	26.78
THRESHER SHARKS NEI	4	0.5%	0.13	98.5%	0.16	-	-	-	-	-
Other tunas, tuna-like species										
ALBACORE	6	0.7%	1.47	0.0%	1.84	5	1.1%	0.41	0.0%	0.94
BULLET TUNA	64	8.0%	7.82	99.9%	9.76	5	1.1%	0.25	8.0%	0.57
FRIGATE AND BULLET TUNAS	1	0.1%	0.03	100.0%	0.04	-	-	-	-	-
FRIGATE TUNA	15	1.9%	0.19	53.7%	0.24	5	1.1%	0.04	20.0%	0.09
KAWAKAWA	2	0.2%	11.00	0.0%	13.73	1	0.2%	0.03	100.0%	0.07
MACKEREL (UNIDENTIFIED)	55	6.9%	8.03	98.5%	10.02	9	2.1%	0.35	100.0%	0.80
TUNA (UNIDENTIFIED)	2	0.2%	0.04	0.0%	0.05	-	-	-	-	-
WAHOO	250	31.2%	13.32	47.0%	16.63	67	15.4%	3.42	35.3%	7.86
Others										
AMBERJACKS	14	1.7%	0.30	19.0%	0.37	-	-	-	-	-
BARRACUDAS (UNIDENTIFIED)	45	5.6%	1.43	28.5%	1.79	6	1.4%	0.87	60.3%	2.00
BATFISHES	7	0.9%	0.09	77.8%	0.11	-	-	-	-	-
BIGEYE TREVALLY	21	2.6%	0.14	17.1%	0.17	12	2.8%	0.24	70.8%	0.55
BLACK TRIGGERFISH	30	3.7%	0.58	97.2%	0.72	5	1.1%	0.24	96.7%	0.55
DRUMMER (BLUE CHUB)	31	3.9%	0.73	59.3%	0.91	23	5.3%	0.51	64.3%	1.17
FILEFISH (SCRIBBLED LEATHERJACKET)	1	0.1%	0.00	100.0%	0.00	1	0.2%	0.01	0.0%	0.02
FILEFISH (UNICORN LEATHERJACKET)	1	0.1%	0.33	0.0%	0.41	1	0.2%	0.00	100.0%	0.00
FILEFISHES	19	2.4%	0.10	49.0%	0.12	3	0.7%	0.09	0.0%	0.21
GIZZARD SHAD (KONOSHIRO)	3	0.4%	0.02	0.0%	0.02	-	-	-	-	-
GREAT BARRACUDA	15	1.9%	1.44	9.9%	1.80	9	2.1%	0.26	0.0%	0.60
MACKEREL SCAD / SABA	100	12.5%	18.24	90.2%	22.77	46	10.6%	8.96	99.7%	20.60
MAHI MAHI / DOLPHINFISH / DORADO	186	23.2%	11.40	34.1%	14.23	105	24.1%	9.28	42.1%	21.33
OCEAN SUNFISH	3	0.4%	1.16	100.0%	1.45	-	-	-	-	-
OCEAN TRIGGERFISH (SPOTTED)	3	0.4%	0.02	100.0%	0.02	31	7.1%	3.70	96.0%	8.51
OCEANIC TRIGGERFISH (UNIDENTIFIED)	251	31.3%	11.36	98.6%	14.18	109	25.1%	6.81	99.8%	15.66
PILOT FISH	1	0.1%	0.00	100.0%	0.00	0	0.0%	0.00	100.0%	0.00
POMFRETS AND OCEAN BREAMS	13	1.6%	0.21	8.6%	0.26	1	0.2%	0.04	100.0%	0.09
PORCUPINE FISH	2	0.2%	0.01	100.0%	0.01	-	-	-	-	-
RAINBOW RUNNER	317	39.6%	86.42	98.3%	107.89	155	35.6%	30.63	93.4%	70.41
RAYS (TORPEDINIDAE, NARKIDAE)	1	0.1%	0.01	50.0%	0.01	-	-	-	-	-
SARGENT MAJOR	28	3.5%	0.16	10.0%	0.20	-	-	-	-	-
SAURY (SANMA)	1	0.1%	0.10	100.0%	0.12	1	0.2%	5.00	100.0%	11.49
SQUIDS	3	0.4%	0.01	30.0%	0.01	1	0.2%	0.00	100.0%	0.00
TREVALLIES (UNIDENTIFIED - JACKS)	29	3.6%	0.54	21.7%	0.67	18	4.1%	1.00	98.6%	2.30
TRIPLE-TAIL	5	0.6%	0.03	0.0%	0.04	1	0.2%	0.00	100.0%	0.00
UNSPECIFIED	28	3.5%	1.56	76.2%	1.95	8	1.8%	0.02	25.0%	0.05
TOTALS			**239.35**					**91.83**		

Table 5. Nontarget, associated, or dependent species catches by U.S. purse seine vessels during 2004 and 2005. Observers were present on 20% of all trips taken. (From the 18th South Pacific Tuna Treaty Formal Consultation)

	2004					2005 (provisional)				
	Sets		CATCH			Sets		CATCH		
Species	Freq.	% Freq.	No.	% discarded	No. / set[5]	Freq.	% Freq.	No.	% discarded	No. / set[5]
Marine Mammals										
MARINE MAMMAL (UNIDENTIFIED)	-	-	-	-	-	2	0.5%	2	100.0%	0.005
RISSO'S DOLPHIN	1	0.1%	2	100.0%	0.002	-	-	-	-	-
Whale Shark										
WHALE SHARK	1	0.1%	1	100.0%	0.001	1	0.2%	1	100.0%	0.002
Marine reptiles										
GREEN TURTLE	-	-	-	-	-	2	0.5%	2	100.0%	0.005

1.1.1 Developments and trends

U.S. Purse Seine Fishery

The number of vessels active in the U.S. purse seine fishery in the WCPO continued to dwindle, declining from 32 in 2001 to 15 in 2005, a 53% decline. Catches also continued to fall off, with a 41.8% decline by 2004 but only a 35.9% decline by 2005 because of increased catch rates and catches. These trends are reportedly due to economics of the fishery. While skipjack tuna remains the dominant species in the catch, the percentage of skipjack in the catch has declined slightly though steadily from 73.8 to 70.6. Correspondingly, the percentage of yellowfin tuna and bigeye tuna has increased modestly.

U.S. Longline Fisheries

The U.S. longline fisheries include vessels based in American Samoa, California, and Hawaii. The total number of longline vessels active in the WCPO decreased from 197 in 2001 to 162 vessels in 2005. Among the three fleets, the Hawaii-based fleet consistently had the highest number of active vessels during 2001-2005 (100 to 125). The Hawaii- and California-based fleets target bigeye tuna and swordfish, and the American Samoa-based fleet targets albacore. The total catches of the U.S. longline fisheries in the WCPO remained fairly steady during the period 2001-2005. The dominant components of the catch in 2005 were bigeye tuna, albacore, swordfish, and yellowfin tuna in descending order of magnitude.

Targeting swordfish in the Hawaii-based longline fishery was prohibited from 2001 until early 2004. During this period, the boats that had been targeting swordfish switched to targeting bigeye tuna. Because swordfish-targeting gear tends to have fewer hooks per length of longline and per set, this switch resulted in an increase in the number of hooks fished per year. The swordfish fishery reopened in April 2004 under restrictions intended to reduce interactions with sea turtles. The California-based longline swordfish fishery was closed concomitantly with the reopening of the Hawaii fishery prompting many longline vessels to relocate to Hawaii. In fact, most of these vessels had been based in Hawaii before the 2001 closure so their movement in 2004 was essentially a return to their prior base of operation.

U.S. Distant-water Troll Fishery

The number of vessels participating in the U.S. distant-water troll fishery in the South Pacific declined from 33 to 12 from 2001 to 2002, a 57.6% decline and then slowly to 10, a 69.7% decline by 2005. In the North Pacific, the number of troll boats has declined from 115 to 15, an 87% decline from 2001 to 2005, the largest percentage decrease among all the U.S. pelagic fisheries in the WCPO. Because of rising fuel costs in 2005 and in 2006, the troll fleet based on the U.S. west coast is fishing proportionally more in the eastern Pacific Ocean (EPO) than in the WCPO. Landings of the distant-water troll fleet, which is composed exclusively of albacore, has declined as effort has.

Small-scale Fisheries

The U.S. small-scale troll, handline, pole-and-line fisheries, and miscellaneous-gear fisheries have not exhibited any major changes during the last 5 years. It is noteworthy that the Hawaii-based pole-and-line fleet has continued to contract in size, with only one boat remaining in the fishery in 2005. For data confidentiality reasons, catches for the Hawaii-based pole-and-line fishery have been aggregated with those of the other small-scale fleets. The largest segment of the small-scale fisheries is located in Hawaii. The total estimated annual catch in the small-scale fisheries ranged from 2,496 metric tons (tons) in 2005 to 3,353 tons in 2001. The catch in these fisheries was composed primarily of yellowfin tuna, skipjack tuna, and dolphinfish.

1.1.2 Disposal of the catch

Most of the U.S. purse seine fleet lands its catch as frozen whole product at the two canneries in Pago Pago, American Samoa. The final product is primarily canned tuna for domestic U.S. markets. Frozen non-tuna catches may be processed locally (e.g., wahoo) or transshipped to foreign destinations (e.g., billfish and shark).

The product form and disposal of the landings of the U.S. longline fishery vary with the landing area. The Hawaii- and California-based longline fleets land their catch as a fresh product that is often partially processed. The fresh product enters retail and restaurant markets, mostly locally, although some is transshipped to other U.S. markets and a small portion is exported. Since December 2004, Hawaii longline landings are gilled and gutted to meet seafood safety regulations. Swordfish are headed, finned, gutted, and tailed. The American Samoa-based large boat longline fleet lands its catch as frozen gilled and gutted product. Albacore is off-loaded to the two canneries in Pago Pago, American Samoa, and other species enter the local market. The small boat longline fleet (*alias*) lands its catch as whole fresh product, with the albacore going to the canneries and other species marketed locally.

The distant-water troll fleets land their South Pacific catch as frozen whole product at the two canneries in Pago Pago, American Samoa and their North Pacific catch as frozen product on the U.S. West Coast. These catches then enter various markets. Some fresh product is landed by vessels fishing closer to the U.S. West Coast and is marketed locally.

The U.S. small-scale fleet lands its catch as fresh product. Large tunas and marlins are gilled and gutted while other species are generally kept whole. The product mainly enters local markets.

1.1.3 Onshore developments

Despite a decline in U.S. purse seine numbers and landings in American Samoa, the canneries continue to operate at or near full capacity. To maintain significant supply, fish are reportedly being obtained from other-than U.S. flagged purse seine vessels landing in American Samoa (e.g., Federated States of Micronesia Arrangement vessels), or loins are shipped from points both east and west of American Samoa. Some concerns have been raised regarding the canneries' future status in American Samoa; however, it appears that decisions to either remain in Pago Pago or terminate operations there will be based on private sector

business decisions that are only open to speculation at this time.

1.1.4 Future prospects

Increasing fuel costs and other operational items without commensurate increases in the price of tunas will continue to constrain the economic performance of the U.S. pelagic fisheries in the WCPO. This situation will affect all U.S. fisheries, and it will likely prevent any increases in the size of the purse seine and distant-water troll fleets resulting in additional declines.

Most of the fishing effort by the Hawaii-based longline fishery will continue to be directed toward bigeye tuna, with a portion of the fleet targeting swordfish seasonally. The American Samoa-based longline fishery is expected to continue targeting albacore and deliver its catch frozen to the canneries.

No major changes are expected for the U.S. small-scale fisheries, although factors such as fish prices and fuel costs may result in declines in effort and resulting catches. Boats in these fisheries are expected to continue to make single-day trips, target tunas, billfish, and other pelagic species, and deliver their catch fresh to local markets.

1.2 RESEARCH AND STATISTICS

1.2.1 Observer and port sampling program

All U.S. longline vessels operating in the WCPO are subject to observer placement as a condition of the fishing permits issued by the National Marine Fisheries Service (NMFS). The program focuses primarily on the collection of high quality scientific data on interactions with protected species (under the Endangered Species Act and other federal laws) and secondarily on the fish catches. Fisheries data are collected for NMFS by trained observers, who are employed by a private contracting firm.

Researchers use the data to estimate protected species interactions that occur throughout the Hawaii deep-set longline fishery and tabulate the same for the shallow-set swordfish fishery. Plans are underway to increase longline observer coverage in American Samoa, where NMFS has augmented existing staff to establish a permanent, full-time presence directed specifically at longline operations.

In 2005, the Hawaii deep-set (tuna) longline fishery coverage rate (on a trip basis) was 26.1% --a total of 479 observer trips or 7,099 sea days. For the swordfish fishery (shallow set), that now has a regulatory requirement of 100% observer coverage as a result of sea turtle bycatch limitations, all 106 trips were observed for a total of 3,294 sea days. Recently, observers have been deployed out of Pago Pago, American Samoa; however, data are unavailable at this time.

U.S. purse seine vessels operating in the WCPO under the Treaty on Fisheries between the Governments of Certain Pacific Island States and the Government of the United States of America (Treaty) pay for, and are monitored by Pacific Island Country (PIC) observers deployed by the Forum Fisheries Agency (FFA). Monitoring includes both the collection of scientific data as well as information on operator compliance with various Treaty-related and PIC-mandated regulations. NMFS has a field station in Pago Pago, American Samoa that

facilitates the placement of FFA-deployed observers on U.S. purse seine vessels. The coverage rate is 20% of trips, and in the last 5 years observer coverage (on a per trip basis) has exceeded target rates.

During the last 2 years, fiscal support has been provided to FFA by the United States government to augment PIC observer training to address protected species and bycatch issues. This has included training on protected species (mammals and turtles) identification, data recording, turtle handling, and mitigation. Support is also provided for equipment and materials required to implement appropriate turtle handling and bycatch mitigation techniques. This support has been augmented with technical assistance from NMFS observer program staff attending in-country training sessions conducted by FFA.

1.2.2 Research activities

U.S. government research on tunas and tuna-like species of the North Pacific Ocean is shared between the Pacific Islands Fisheries Science Center (PIFSC) and the Southwest Fisheries Science Center (SWFSC). Studies are largely carried out from laboratories in Honolulu, Hawaii for the PIFSC and in La Jolla, California for the SWFSC and in collaboration with scientists of other government or university laboratories, both in the U.S. and abroad. Both Centers have studies devoted to stock assessment, biological and oceanographic research, and fishery management issues, but each science center concentrates largely on different species and fisheries in order to minimize duplication. In this section, selected studies that are underway are described and recent results are provided.

Pacific Islands Fisheries Science Center (PIFSC)

The Pacific Islands Fisheries Science Center has been engaged in research on highly migratory fish resources such as tuna, marlins, and associated species and the fisheries that pursue them in the western and central Pacific since 1949. Studies are underway on stock assessment, biology, oceanography, economics, and methods to reduce the incidental catch and mortality of species' special concern in longline fisheries. This research addresses increasing interests domestically by the Western Pacific Regional Fishery Management Council and internationally by the WCPFC, the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC), and the Inter-American Tropical Tuna Commission (IATTC) regarding fishery resource status and sustainability as well as fishery impacts on species of special concern and the ecosystem. The work is conducted by PIFSC staff and affiliated scientists employed by the University of Hawaii Joint Institute for Marine and Atmospheric Research (JIMAR) and colocated at the PIFSC. Many of the studies are funded by JIMAR's Pelagic Fisheries Research Program (PFRP).

Fishery Monitoring and Economics Research -

<u>Fishery Monitoring and Analysis</u>

- In collaboration with NMFS managers, enforcement, and scientists in Hawaii and California, the domestic Western Pacific Regional Fishery Management Council, and the domestic longline industry, PIFSC has developed procedures that will allow in-season accounting of the EPO bigeye catch. The new protocols include dockside

monitoring and manual tallying of logbook data, daily vessel monitoring system counts of longline vessels fishing in the EPO, daily call-ins by observers on vessels in the eastern Pacific Ocean to report the catch rate and average size of bigeye tuna, daily processing of data to update estimates of the cumulative bigeye catch, and in-season prediction of the date when the quota will be reached. The predicted date, based on real-time catch and effort estimates, will change in response to changes in the fishery.

- Research describing statistical models of blue marlin catches, characterized by greater predictive accuracy and comprehensibility with little loss of precision, was presented at the Fourth International Billfish Symposium in November 2005. Related work completed correcting species misidentifications as reported in commercial logbooks for five species of billfishes taken as incidental catch by the Hawaii-based longline fleet from March 1994 through 2004. Completion of the corrections for this closely related guild of economically and ecologically important fishes represents a first major step toward the establishment of a research-quality database at the PIFSC.

- A data collection system was established in August 2004 to collect trip-based expenditure information in Hawaii longline fleet.

Sociological Research

- A sociological study of the Hawaii-based longline fleet is being conducted that was designed to compile a comprehensive social profile of the longline fishing industry of Hawaii and provide the information to decision-makers.

- A study of the impacts of the closure of the Hawaii swordfish fishery on the Vietnamese-American longline fishing community has been completed. A paper has been completed describing the web of financial, psychological, household, and community effects resulting from the closure. Three other papers are in preparation: one on longline fishermen's perceptions of observers and the observer program; one on fishermen's perceptions of regulations and management; and one on socio-cultural characteristics and experiences of Filipino crew working on Hawaii-based longline vessels.

- For domestic management purposes, fishing communities in the western and central Pacific have been defined. These fishing communities are Guam, American Samoa, and the Commonwealth of the Northern Marianas as well as the major inhabited islands of Hawaii (Niihau, Kauai, Oahu, Molokai, Maui, Lanai, and Hawaii). The initial report for this project, to be issued in 2006, will describe each of the broadly defined fishing communities using a wide variety of information sources including a set of more than 40 social, cultural, and economic indicators that can be easily tracked over time to monitor trends. A more detailed study is underway in Guam.

Economics Research

- An ongoing study is to assess fishing technological change and the impact on capacity in the Hawaii based-longline fleet, the fleet that harvested the majority of the pelagic species landed in Hawaii. The research activities include to put together an inventory

on all the possible changes of fishing technology in Hawaii longline fleet during in past 20 years.

- A research project is being conducted to build a regulatory impact analysis framework as a decision support tool for fishery management by spatial modeling of the tradeoff between sea turtle take reduction and economic returns to the Hawaii longline fishery. The bioeconomic model will consist of: (1) a cost function to evaluate regulatory impact(s) on net revenue and profit to the fisheries; (2) flexible and multiple time-area closure scenarios; and (3) updated data from various sources.

- A study on economic evaluation on Hawaii fishing tournaments was conducted to collect cost-benefit information on a different aspect of the fishing tournaments in Hawaii through interviewing tournament participants.

- Beginning in 2005, a study on imported frozen tunas treated with carbon monoxide and its impact to Hawaii fresh tuna market was conducted by PIFSC and JIMAR researchers. The study found that many main supermarket chains in Hawaii sold such imported tunas at a much lower price than domestically caught tuna and labeled them as being treated with tasteless smoke. Some consumers demonstrated ignorance regarding these imported tunas.

Fisheries Biology and Stock Assessment –

Blue shark

In 2001, the PIFSC in collaboration with Japanese scientists reported preliminary results of an ongoing stock assessment of North Pacific blue shark. Preliminary results indicated that fishing mortality was substantially less than the levels producing maximum sustainable yield (MSY). Over the last 2 years, PIFSC/JIMAR and Japanese scientists have worked to update the assessment, incorporating more recent Japanese and Hawaii longline fishery data and better estimates of Taiwanese and Korean catch and effort essential for the assessment. New assessment results based on a Bayesian surplus production model conducted by PIFSC/JIMAR were presented at the recent meeting of the ISC Bycatch Working Group. Future work will include systematic comparison of results using different stock assessment models, which will include updating of the MULTIFAN-CL assessment by NMFS.

Striped marlin

PIFSC and associated researchers at JIMAR collaborated with other ISC Marlin Working Group (MARWG) members to assess the status of North Pacific striped marlin. Three biomass dynamics modeling approaches assuming a single Pacific-wide stock were applied to catch and effort data spanning 1952 to 2003. These included a Bayesian surplus production model by PIFSC/JIMAR, Fox and Logistic models using ASPIC software by SWFSC, and an age-structured biomass dynamics model (Japan). The results of all modeling indicated that striped marlin stock biomass has declined over time. For models that provided estimates of current biomass relative to starting biomass, the results indicated the population has declined to 10-45% of initial biomass. In contrast, other models, which involved a “splitting” of the abundance time series in the mid-1970s to account for an assumed change in targeting, indicated

a more optimistic view, such that current biomass is greater than the equilibrium biomass at MSY, i.e. greater than 50% of initial biomass.

Longline Interactions Estimated

Estimates of the incidental interactions of the Hawaii deep-set longline fishery with sea turtles, seabirds, and marine mammals in 2005 were computed quarterly and annually.

Shark research

- Researchers have undertaken several projects to address shark bycatch on longline gear, including studies of chemical deterrents to bycatch in collaboration with the SharkDefense LLC. Experiments in early 2006 with demersal longline sets in South Bimini using the chemicals, and similar testing of magnets, were quite successful. More field testing is planned for November 2006.

- The NMFS longline observer database is being used to compare shark bycatch rates under different operational factors (e.g., hook type, branch line material, bait type, the presence of light sticks, soak time, etc.). Preliminary results do not indicate that large circle hooks (size 18/0) increase the catch rate of sharks. This contrasts with findings in other fisheries, where studies comparing smaller circle hooks with J shaped hooks found an increased shark catch on circle hooks.

- Research is being conducted at sea to study the release and survivorship of shark bycatch, including the testing of dehookers.

- PIFSC scientists are also collaborating on development of biochemical and physiological profiling techniques to predict the post-release survival of blue sharks. Pop-up satellite archival tags (PSATs) were applied to 32 blue sharks, 8 bigeye thresher sharks, 13 oceanic white-tip sharks, 4 short-fin mako, and 9 silky sharks. Of the 40 PSATs reporting data from released sharks, in only one case was there an indication of mortality after release. A model was developed to predict the long-term survival of released blue sharks based on analysis of the biochemical makeup of their blood. The model successfully categorized 19 of 20 blue sharks (95 percent) of known fate, as indicated by PSAT data, and predicted that 21 of 22 sharks (96 percent) of unknown fate would have survived after release.

- PSATS are also being used to study vertical and horizontal movement patterns of sharks as part of an effort to determine the relationship of oceanographic conditions to shark behavior patterns. Results indicate that bigeye thresher sharks remain in the vicinity of prey organisms comprising the deep Sound Scattering Layer (SSL) during their extensive diel vertical migrations. The SSL comprises various species of squids, mesopelagic fish, and euphausiids that undertake extensive diurnal vertical migrations. In contrast, other shark species tend to stay in the upper 200 m of the water column both night and day. Blue sharks occasionally display vertical movement behaviors similar to those of bigeye thresher sharks.

- For the past 4 years, PIFSC has also been involved in a U.S.-Australian project to describe the movement of whale sharks that arrive seasonally at Ningaloo Reef in NW Australia. Both PSAT and Argos-linked towed and fin tags have been used. A picture is emerging that part of the whale shark population is regional, each year moving back and forth between NW Australia and Indonesia, while another portion of the population leaves NW Australia waters and travels across the Indian Ocean.

Ecosystem and Oceanographic Research -

Ecosystem Science and Management Planning Workshop

To assist domestic regional managers and scientists with the development and implementation of ecosystem-based approach to fisheries management (EAF), the Western Pacific Regional Fishery Management Council and NMFS hosted the Ecosystem Science and Management Planning Workshop in Honolulu, Hawaii from April 18 to 22, 2005. The goal of the workshop was to identify science requirements to support EAF and to develop a blueprint for implementing EAF. Some of the key findings and recommendations from the meeting include: (1) while there exist considerable data that could be used to enable EAF, little progress has been made in doing so; (2) models should be developed with management objectives and alternatives in mind, model output should be couched in the context of risk, and models should be capable of exploring what-if scenarios; (3) a suite of ecosystem indicators was suggested covering a range of technical and ecosystem management perspectives; and 4) a follow-up workshop on sociological issues should be convened in early 2006.

Oceanographic survey of the American Samoa longline fishing grounds for albacore

- During February and March, an oceanographic survey of the American Samoa longline fishing grounds for albacore was conducted. The research cruise was the second part of a 2-year project funded by PFRP to characterize the albacore habitat and fishing grounds in American Samoa. Results from the first part of this project, conducted in 2005, indicate that the eastward flowing, seasonal South Equatorial Counter Current (SECC) has a significant effect on the American Samoa longline fishery performance (catch rates) for albacore. Accordingly, this year's survey was designed to investigate the importance of the SECC for the longline fishery, focusing on the high shear boundary regions between the SECC and the westward flowing South Equatorial Current. During the cruise, survey transects were conducted across the high shear regions of two anticyclonic and cyclonic eddy pairs to study their effects on the distribution and abundance of albacore and the forage of albacore in these regions frequented by the longline fleet. Data were collected using dual frequency (38 and 120 kHz) bioacoustic instruments and an acoustic Doppler current profiler (ADCP; 75 kHz). In addition to collecting bioacoustic backscatter and current information, water temperature, salinity, and the concentration of dissolved oxygen and chloropigments were measured from the sea surface to greater depths in the water column every 15 nmi along the transect lines. Preliminary analysis of the acoustic data indicate that large aggregations of nekton, many of which are likely albacore, were prominent during the day but rarely observed at night. Almost exclusively, all nekton aggregations were found between 200 and 400 m below the surface, apparently feeding on the micronekton composing the scattering layers at those depths.

- Concurrent with the NMFS survey operations, a PIFSC/JIMAR scientist attached pop-up satellite archival transmitting tags (PSATs) to seven albacore caught in the survey area by cooperating commercial longline vessels. Data transmitted by the PSATs will provide information on habitat characteristics such as preferred temperature and depth ranges of individual albacore.

PICES/GLOBEC Symposium supported

PIFSC scientists attended and participated in a symposium on climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis held April 19 – 20 in Honolulu. The symposium was cosponsored by two international science organizations; the North Pacific Marine Science Organization (PICES) and GLOBEC (Global Ocean Ecosystem Dynamics) and supported by PIFSC and the domestic Western Pacific Regional Fishery Management Council (amongst others). PIFSC scientists gave presentations on the *North Pacific ecosystem dynamics investigated with satellite remotely sensed oceanographic data and coupled physical-ecosystem model, 1990-2004* and another on the *apparent link between survival of juvenile Hawaiian monk seals and ocean productivity*.

Marine Mammal Research -

Cetaceans surveyed in Pacific Islands Region

- The PIFSC conducted its first independent surveys of cetaceans. A multidisciplinary team conducted the survey from American Samoa to waters around Johnston Atoll and then to Honolulu. In addition to visual assessment of cetaceans along the cruise track, the scientific crew carried out passive acoustic detection of cetaceans, active acoustic surveys of fish, and synoptic oceanographic surveys en route. A relatively large number of cetaceans were encountered. Biologists collected tissue biopsy samples from cetaceans they encountered on this survey cruise on proceeding local cruises on small boats for genetic stock analysis and took photographs of the animals to help establish a database of individual identities.

- A High Frequency Acoustic Recording Package (HARP) was retrieved from Cross Seamount off the island of Hawaii. In a preliminary analysis of the recorded acoustic data, several species of cetaceans were identified along with a variety of anthropogenic sounds. Further analysis of the data will be conducted in the next few months and retrieval of data from a second HARP at Palmyra Atoll is planned.

Marine Turtle Research -

Marine Turtle Assessment

- A collaborative project is underway to estimate population trends and extinction risks in nesting populations of loggerhead, leatherback, green and olive ridley sea turtles using the Dennis-Holmes model for population viability analysis. Application of the model will be refined to provide metrics useful to management agencies regarding the impacts of fishery takes and IUCN listing criteria.

- An important step in the improvement of turtle population assessment was the recent development of an individual-based stochastic simulation model to generate time

series of data typical of marine turtle populations. The simulated time series can be used to evaluate the applicability of methods used to analyze trends and assess impacts in marine turtle populations. For example, the model can be used to study the effects of variable remigration intervals on population dynamics and nesting beach census data. PIFSC and collaborators are also working on several projects using skeletochronology and histology to assess growth rates and maturity of marine turtles.

Marine Turtle Biology

- In February 2006, PIFSC participated in a Secretariat of the South Pacific Regional Environmental Program (SPREP) sponsored meeting in Apia, Samoa. Local staff was trained in the safe, secure, and successful deployment of satellite tags on nesting sea turtles. Such training is part of the SPREP's 2006 Year of the Sea Turtle campaign to promote increased sea turtle conservation and research throughout the Pacific region.

- Satellite tracking data obtained between 1997 and 2002 from transmitters deployed on Pacific loggerhead and olive ridley sea turtles by NMFS observers in the Hawaii-based longline fishery under the guidance of the PIFSC were reviewed prior to posting on the publicly accessible OBIS-SEAMAP Web site <http://seamap.env.duke.edu/>.

Technical Assistance Workshop on Sea Turtle Bycatch Reduction in Longline Fisheries

Forty-three people from a dozen countries attended the first *Technical Assistance Workshop on Sea Turtle By Catch Reduction Experiments in Longline Fisheries* during April 11-14, 2005 in Honolulu. The workshop was hosted by the Western Pacific Regional Fishery Management Council and sponsored by PIFSC. The workshop was intended to help participants design programs for developing and testing turtle bycatch reduction technology appropriate to longline fishing in their countries. The workshop reviewed the style of longline fishing operations and the amount of turtles caught in fisheries of the participating nations. It also reviewed the opportunities and associated costs of conducting bycatch reduction experiments and providing scientific observer coverage. The NMFS provided a comprehensive presentation on turtle dehooking, handling and release procedures; supported a presentation on efforts to enhance the capacity of the NMFS observer programs to address sea turtle issues; and provided participants from other nations with dehookers, longline bycatch informational compact disks and copies of the Hawaii longline observer manual. The Australia delegation also distributed information on turtle dehooking and handling practices in their fishery.

Southwest Fisheries Science Center (SWFSC)

The Southwest Fisheries Science Center has a long history of research on stocks and fisheries for highly migratory species (HMS). During the past few years, the SWFSC has focused increased resources on research of North Pacific HMS in order to address growing concerns about resource status and sustainability. Studies described in the following section are largely designed to address the growing concerns and are guided by NMFS strategic plan objectives of promoting resource stewardship and building sustainable fisheries.

Stock Assessment Studies − The SWFSC investment in stock assessment research is designed to deliver accurate information on stock status and for providing relevant advice for

managers. During the past year, SWFSC scientists have been conducting assessment related research to support the goals of the ISC Albacore, Marlin, and Bluefin Working Groups.

Albacore

The SWFSC hosted the first meeting of the Albacore Working Group of the International Scientific Committee (ISC-AWG—formerly, the North Pacific Albacore Workshop) that was held in November/December 2005 in La Jolla, CA. Researchers from Japan, Taiwan, Canada, and the Inter-American Tropical Tuna Commission attended that meeting. The meeting addressed four broad areas of research: (1) improvement of stock assessments through critical review of input data and modeling platforms used in population analysis; (2) appropriate biological reference points for potential management of the stock; (3) research studies needed to improve knowledge of albacore biology; and (4) maintenance and improvement of the ISC-AWG data base catalog, which contains catch, length, and catch/effort information collected from the various international fleets that harvest the stock.

Scientists from the SWFSC presented papers that addressed various topics, including stock assessment modeling of the albacore population, issues surrounding the ISC-AWG's scientific information exchange and centralized data bases, ongoing development of fishery statistics applicable to the USA troll and longline fisheries, ongoing research regarding movement and distribution of juveniles based on archival tag deployments, and development of a Pacific Ocean-wide biological sampling program that would generate timely and accurate estimates of maturity. The SWFSC assessment team's efforts along all of these lines are continuing in preparation for the two ISC-AWG meetings scheduled later this year (July and November 2006).

Marlin

In 2005, marlin assessment research at the SWFSC focused on striped marlin in order to meet the ISC Marlin Working Group goal of completing a North Pacific striped marlin assessment in 2005. SWFSC scientists participated in two ISC Marlin Working Group meetings. Prior to and at the first meeting in September, 2005 the SWFSC team helped to prepare the data base of international landings, catch and effort and size frequency. At the meeting, the available data were reviewed, and potential modeling platforms were identified to be used for the assessments. The SWFSC took the lead in developing a fully integrated forward simulation model using Stock Synthesis 2. Results of the Working Group's assessment efforts will be presented at the 2006 ISC Plenary meeting.

Bluefin Tuna

In 2005, SWFSC scientists began assessment efforts on bluefin tuna. Prior to and during the ISC Bluefin Working Group meeting in early 2006, the SWFSC team worked closely with other members of the working group in developing an assessment database, deriving indices of abundance, and exploring alternative stock assessment models. In particular, SWFSC scientists took the lead in developing a fully integrated forward simulation model using Stock Synthesis 2. Much of this work is continuing in efforts to improve the bluefin stock assessment.

Biological and Oceanographic Research − The SWFSC conducts research on the biology of tunas, billfishes, and pelagic sharks. Projects range from behavior and movement of North Pacific albacore to food habits of sharks. A few of the projects are described below.

Albacore

- Since 1971, the SWFSC has had an ongoing partnership with the West-Coast based U.S. albacore fishing industry. Research is conducted in cooperation with the American Fishermen's Research Foundation (AFRF), a private foundation established by the Western Fishboat Owner's Association to promote research on albacore and related fish. Past projects have included exploratory fishing with simultaneous collection of oceanographic data, development of a standard logbook, research into the impact of high seas drift net fishing, onboard and port sampling for size frequencies, and conventional tagging to study movements, growth, and longevity. Since 2001, SWFSC and AFRF have been conducting an archival tagging project to study migratory patterns, depth and temperature preferences of north Pacific albacore. The goal is to deploy 500 tags by the end of 2006. In 2005, 150 more tags were deployed, bringing the total to 427 tags deployed, and 5 more tags were recovered. The data demonstrate extensive movement and diurnal vertical excursions to beyond 200 m during daytime with fish remaining in the upper 50 m at night.

- The SWFSC is also collaborating with PIFSC scientists to better define albacore habitat in the north Pacific. Catches recorded in logbook data from the U.S. albacore troll fishery are being examined in relation to satellite derived images of oceanographic features on a fine scale resolution (sea surface temperature, chlorophyll, and height).

Billfishes

- The SWFSC's Billfish Tagging Program began in 1963 and has provided tagging supplies to recreational billfish anglers for 43 continuous years. Tag release and recapture data are used to determine movement and migration patterns, species distribution, and age and growth patterns of billfish. This volunteer tagging program depends on the participation and cooperation of recreational anglers, sport fishing organizations, and commercial fishers. Since its inception, over 53,000 fish of 75 different species have been tagged and released. Emphasis continues to be on the skillful tagging of billfish and bluefin tuna only. The tagging of other sport fish is not encouraged by this program. Billfish Tagging Report cards received for 2004 indicate that a total of 1,047 billfish and 285 other fish were tagged and released by 761 anglers and 190 fishing captains. In all, 525 blue marlin, 149 striped marlin, 217 sailfish, 137 spearfish, 6 black marlin, and 9 unknown billfish were reported tagged and released in 2004.

- In 2002, National Marine Fisheries Service scientists from the SWFSC and SEFSC joined forces with the Presidential Challenge billfish tournament series conducted off the coasts of Central America and Mexico to establish the Adopt-A-Billfish satellite tagging program. The team deployed 41 satellite archival tags on sailfish in Mexico, Guatemala, Costa Rica, and Panama. Results show that sailfish survive being caught and released when proper tagging protocols are followed. Three of the 41 tagged sailfish died, but only after being at liberty for 28, 63, and

70 days after being tagged. The data also showed significant movements across international boundaries from Mexico to Panama, highlighting the need for international management. Deployments ranged from 5 to 118 days and net movements ranged to 574 nmi. These sailfish spent up to 80% their time above 25 meters and rarely descended to depths greater than 100 meters. Over 75% of their time was in water 28° to 30° C. The program plans to expand sailfish satellite tagging operations into the mouth of the Sea of Cortez, Mexico in the summer of 2006.

- The SWFSC continued monitoring recreational billfish catch in the Pacific through the Billfish Angler Survey. Results for recreational fishing in 2004 were compiled in 2005 and published in the 2005 angler survey. In 2004, 761 billfish anglers reported catching 3,409 Pacific billfish during 4,988 fishing days. The mean catch-per-unit-of-effort (CPUE) for all billfish in the Pacific for 2004 was 0.66 which is lower than the record set in 2003 of 0.87, but above the latest 5-year average of 0.62 (2000 - 2004). This was a new high 5-year average catch rate for the entire time series which extends back to 1969. CPUE times series were extended for each of the main species caught (Pacific blue marlin, striped marlin, Pacific sailfish, and black marlin) in the main fishing areas (Tahiti, Hawaii, Baja, southern California, central Mexico, Guatemala, Costa Rica, Panama, and Australia).

Pelagic Sharks

- A wide range of biological studies are conducted in conjunction with the abundance surveys for juvenile shortfin mako, blue and common thresher sharks. Some past and ongoing efforts include conventional tagging for movement information, taking biopsies for genetics studies, marking with oxytetracycline (OTC) for age and growth studies, blood sampling for condition factors caused by capture stress and/or injury, acoustic and satellite archival tagging for movement and physical habitat pattern descriptions, and a variety of physiological studies addressing cardiac function, swimming performance, and condition factors. During the 2005 surveys 121 blue, 90 shortfin mako and 14 common thresher sharks were caught. Eighty-six sharks were tagged with conventional tags and OTC, and 84 DNA samples were collected. Satellite tags were deployed on nine makos, five threshers, and two blue sharks.

- Since 1997, 502 makos have been injected with OTC, tagged, and released in the southern California Bight during scientific surveys. Thirty-one of the OTC labeled sharks has been recaptured, and vertebral samples were obtained from 14. Time at liberty ranged from 7 to 1594 days and the size of OTC-marked fish ranged from 81 to 189 cm FL at time of recapture. Preliminary analyses of the labeled vertebrae indicate the formation and deposition of two band pairs (opaque and semi-translucent) per year. In addition, growth during the time at liberty from these recovered fish, combined with recapture information from a larger scale conventional tagging effort, demonstrates average growth rates of 18 cm/year for juvenile makos (size range of roughly 90-160 cm FL at the time of tagging).

- SWFSC scientists are also studying the movement and habitat use patterns of common thresher sharks, which are an important target species of the west coast based drift gillnet fishery. A satellite-tagging project was started in 1999 in the

Southern California Bight during the spring-summer occupancy. Satellite-linked telemetry was used on 19 individuals during the years 1999, 2004, and 2005. Results from 11 individuals represent the most detailed fishery-independent information about this species, previously known exclusively from catch data. Depth and temperature records demonstrate that common thresher sharks have a diurnal pattern of swimming behavior foraying into deeper depths of up to 200 m during the daytime, while staying closer to the surface at night. The data are being examined with respect to oceanographic features (bathymetry, surface temperature, water column profile, and surface chlorophyll) in order to quantify the essential habitat of these sharks.

- A food habits study of shortfin mako, blue and common thresher sharks is also underway. All three species are captured in the pelagic drift gillnet fishery operating off the California and Oregon coasts. In order to determine whether the three species feed on common prey in their overlapping habitats, stomach contents of sharks sampled from the pelagic drift gillnet fishery between 2002 and 2005 were examined. Of 115 mako shark stomachs examined, 81 contained prey representing 23 taxa. Jumbo squid (*Dosidicus gigas*) and Pacific saury (*Cololabis saira*) were the two most important prey items. Of 97 blue shark stomachs examined, 67 contained prey representing 24 taxa. Squid of the *Argonauta* spp. and *Gonatus* spp. were the most important prey items. Of 89 thresher shark stomachs examined, 55 contained prey representing 18 taxa. Pacific sardine (*Sardinops sagax*) and northern anchovy (*Engraulis mordax*) were the two most important prey items. Comparing the first 12 prey items ranked by GII for each species, results demonstrate that mako sharks fed on a combination of different taxa of teleosts and cephalopods, blue sharks fed primarily on different squid species, while threshers consumed mostly teleosts, especially coastal pelagic species, and very little squid. The analyses are ongoing to determine whether there were interannual differences in the main prey items consumed and to examine correlations between the diets and potential prey availability or prevailing oceanographic conditions.

Fishery Management Research − A limited but important number of studies at the SWFSC falls into this category of fishery management research. SWFSC researchers are applying different economic models to understand the economics of fishing and factors contributing to overcapacity in tuna fisheries. Included in the studies is analysis of incentives for reducing sea turtles interaction in longline fisheries, such as in the North Pacific.

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Pacific Islands Fisheries Science Center -

Publications

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1.2.3 Statistical data systems

Monitoring of the U.S. purse seine fishery vessels under terms of the Treaty on Fisheries between the Governments of Certain Pacific Island States and the Government of the United States of America consists of collecting catch and effort logbooks, monitoring landings, and conducting a statistically based sampling program to estimate size composition of the landings. Since 1988, the collected logbook (100% coverage), landings, and size composition data have been submitted to the Forum Fisheries Agency in compliance with the treaty.

The Hawaii-based longline fishery is monitored using the NMFS Western Pacific Daily Longline Fishing Log for effort and resulting catch as well as the State of Hawaii Commercial Marine Dealer reporting system for landings in weight and individual fish weights. The California-based longline fishery has been monitored using a series of logbooks (the NMFS Western Pacific Daily Longline Fishing Log most recently and the NMFS High Seas Pelagic Longline Logbook immediately before that) and the California Department of Fish and Game Landing Ticket system for landings in weight. The American Samoa-based longline fishery is monitored using the NMFS Western Pacific Daily Longline Fishing Log for effort and resulting catch of large vessels, the statistically based Territory of American Samoa Creel Survey for catches of small longline vessels, and cannery sample data for size composition of large longline vessels.

Prior to 1995, U.S. distant-water troll vessels targeting albacore voluntarily submitted logbooks records to the NMFS. Since 1995, those troll vessels fishing on the high seas have been required to submit logbooks, and since 2005, all troll vessels on the U.S. West Coast have been required to submit logbooks. Landings are monitored by NMFS and various state fisheries agencies, and coverage is 100% of the fleet. Landings are also measured for fork length by state agency port samplers along the U.S. West Coast and by NMFS technicians in American Samoa; however, coverage rate is quite low especially for American Samoa landings.

The small-scales fisheries in Hawaii, i.e., troll, handline, and pole-and-line are monitored by the State of Hawaii with Commercial Fishermen's Catch data and Commercial Marine Dealer data. The troll fisheries in American Samoa, Guam, and Northern Mariana Islands are monitoring with a combination of territory and commonwealth Creel Survey and Market Monitoring programs.