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ANNUAL REPORT TO THE COMMISSION
PART 1: INFORMATION ON FISHERIES, RESEARCH, AND STATISTICS

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UNITED STATES OF AMERICA

2017 Annual Report to the Western and Central Pacific Fisheries Commission

United States of America

PART I. INFORMATION ON FISHERIES, RESEARCH, AND STATISTICS [1]
(For 2016)

National Oceanic and Atmospheric Administration National Marine Fisheries Service

Scientific data was provided to the Commission in accordance with the decision relating to the provision of scientific data to the Commission by 30 April 2016	**YES**
If no, please indicate the reason(s) and intended actions:	

Summary

Large-scale fisheries of the United States and its Participating Territories for highly migratory species (HMS) in the Pacific Ocean include purse seine fisheries for skipjack tuna (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*); longline fisheries for bigeye tuna (*Thunnus obesus*), swordfish (*Xiphias gladius*), albacore (*Thunnus alalunga*), and associated pelagic fish species; and a troll fishery for albacore. Small-scale fisheries include troll fisheries for a wide variety of tropical tunas and associated pelagic species, handline fisheries for yellowfin and bigeye tuna, a pole-and-line fishery for skipjack tuna, and miscellaneous-gear fisheries. Associated pelagic species include other tunas and billfishes, mahimahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), moonfish (*Lampris* spp.), escolar (*Lepidocybium flavobrunneum*), and pomfrets (Bramidae). The large-scale fisheries operate on the high seas, within the U.S. exclusive economic zone (EEZ), and within the EEZs of other nations. The small-scale fisheries operate in nearshore waters off Hawaii and the U.S. Territories of American Samoa and Guam, and the Commonwealth of the Northern Mariana Islands (CNMI).

Overall trends in total retained catch by the United States and U.S.-associated Participating Territory fisheries in the Western and Central Pacific Fisheries Commission (WCPFC) Statistical Area in 2016 are dominated by the catch of the purse seine fishery. Preliminary 2016 purse seine catch estimates total 178,284 t of skipjack, 18,162 t of yellowfin, and 4,706 t of bigeye tuna. The estimate of total U.S. purse-seine catch in 2015 has been revised to 238,180 t from last year's preliminary

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[1] PIFSC Data Report DR-17-029.
Issued 07 July 2017.

estimate. Longline retained catch increased slightly in 2016. Total longline catch in the North Pacific Ocean (NPO) in 2016 was higher than any other year of the 2012-2016 time period. Longline retained catch by American Samoa in the South Pacific Ocean (SPO) decreased slightly from 2015 and was the lowest level recorded during the 2012-2016 time period. Bigeye tuna longline catch by the United States and its Territories increased to 6,270 t in 2016. Albacore longline catch by the United States and its Territories decreased slightly to 1,802 t in 2016. Excluding catch attributed to the U.S. Participating Territories (i.e., American Samoa, Commonwealth of the Northern Mariana Islands, and Guam), longline catch of bigeye tuna by U.S. longline vessels increased to 3,761 t in 2016. Total bigeye tuna catch estimates by the U.S. longline fishery were 207 t above the limit of 3,554 t for 2016. The annual bigeye catch limits were established in U.S. fishery regulations (50 *CFR* Part 300) pursuant to the provisions of WCPFC Conservation and Management Measure (CMM) 2008-01 for bigeye and yellowfin tuna during 2009 through 2011, CMM 2011-01 in 2012, CMM 2012-01 in 2013, CMM 2013-01 in 2014, CMM 2014-01 in 2015, and CMM 2015-01 in 2016.

The longline catch of swordfish by the United States and its Territories in the NPO decreased to 638 t in 2016. Small-scale (tropical) troll and handline vessels operating in nearshore waters represented the largest number of U.S.-flagged vessels but contributed only a small fraction of the catch. The longline fleet was the next largest fleet, numbering 151 vessels in 2016, while there were 37 purse seine vessels in 2016.

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries Service) conducted a wide range of research on Pacific tuna and associated species at its Southwest and Pacific Islands Fisheries Science Centers and in collaboration with scientists from other organizations. NOAA Fisheries conducts fishery monitoring and research, including biological and oceanographic research, fish stock assessment research, and socio-cultural studies on fisheries for tunas and billfishes. The monitoring and research also address animals caught as bycatch in those fisheries. In 2016, socio-economic studies addressed measuring cost earnings in the Hawaii longline fishery, non-commercial fishermen attitudes and opinions, and potential economic impacts of the recent Papahānaumokuākea Marine National Monument expansion. Stock assessment research was conducted almost entirely in collaboration with members of 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). The 2016 stock assessment work is not described in this report but is detailed in other publications (Carvalho et al., 2017; Dichmont et al., 2016, Lee et al., 2017).

NOAA Fisheries biological and oceanographic research on tunas, billfishes, and sharks addressed use of observer data to provide indices of stock abundance and the effects of biological, economic and management factors on tuna and billfish stocks. Research on Pacific Bluefin tuna covered migration patterns, stock structure, and reproductive maturity. Oceanographic studies in the central North Pacific focused on oceanographic change effects on habitat preferences, the transition zone chlorophyll front, and climate change impacts on future abundance. Bycatch mitigation studies focused on the longline fishery and included research on sea turtles, pelagic sharks, and cetaceans.

Tabular Annual Fisheries Information

This report presents estimates of annual catches of tuna, billfish, and other highly migratory species (HMS), and vessel participation during 2012–2016 for fisheries of the United States and its Participating Territories operating in the western and central Pacific Ocean (WCPO). All statistics for 2016 are provisional. Statistics for 2015 have been updated from those reported provisionally in the submission of 2014-2015 U.S. fishery statistics for the WCPO (NOAA, NMFS 2015). Statistics for 2012–2014 have not been updated. For the purposes of this report, the WCPO is defined as the Western and Central Pacific Fisheries Commission (WCPFC) Statistical Area. For the most part, U.S. estimates of catch by weight are estimates of retained catches due to lack of data on weights of discarded fish.

The purse seine fishery remains the largest U.S. fishery in terms of total catch. It accounts for about 93% of the total catch of HMS by the United States and its Participating Territories in the WCPO. The longline, tropical troll, handline and albacore troll fisheries account for 6.1%, 0.8%, 0.2%, and 0.1% of the total catch, respectively.

Fisheries of the United States and its Participating Territories for tunas, billfishes and other HMS produced an estimated catch of 216,757 t in 2016 (Table 1a), down from 253,557 t in 2015 (Table 1b). The catch consisted primarily of skipjack tuna (83%), yellowfin tuna (9%), bigeye tuna (5%), and albacore (1%). Catches of skipjack tuna decreased in 2016 due to lower purse seine catches, but bigeye and yellowfin tuna catch increased from the previous year due to higher purse seine and longline catches.

Further discussion of the tabular fisheries information is provided in the following section on flag state reporting.

Table 1a. Estimated weight (in metric tons) of catch by vessels of the United States and its Participating Territories (American Samoa, Guam, and Commonwealth of the Northern Mariana Islands) by species and fishing gear in the WCPFC Statistical Area, for 2016 (preliminary). Totals may not match sums of values due to rounding to the nearest metric ton (< 0.5 t = 0). Purse seine species composition estimates have not been adjusted for 2016.

Species and FAO code	Purse seine	Longline	Albacore troll	Tropical troll	Handline	Total
Albacore (ALB), North Pacific		244		1	31	275
Albacore (ALB), South Pacific		1,558	145			1,703
Bigeye tuna (BET)	4,706	6,270		34	183	11,193
Pacific bluefin tuna (PBF)		1	0			1
Skipjack tuna (SKJ)	178,284	259		405	5	178,953
Yellowfin tuna (YFT)	18,162	1,469		528	264	20,423
Other tuna (TUN KAW FRI)		0		6	1	7
TOTAL TUNAS	201,152	9,801	145	975	484	212,556
Black marlin (BLM)	2	1		3		6
Blue marlin (BUM)	3	517		157	2	679
Sailfish (SFA)		20		2		22
Spearfish (SSP)		281		16		297
Striped marlin (MLS), North Pacific		329		12		341
Striped marlin (MLS), South Pacific		2				2
Other marlins (BIL)		1				1
Swordfish (SWO), North Pacific		638			4	642
Swordfish (SWO), South Pacific		7				7
TOTAL BILLFISHES	5	1,796		190	6	1,997
Blue shark (BSH)		1				1
Mako shark (MAK)		46				46
Thresher sharks (THR)		4				4
Other sharks (SKH OCS FAL SPN TIG CCL)		0		1		1
TOTAL SHARKS		51		1		52
Mahimahi (DOL)	1	234		361	9	605
Moonfish (LAP)		380				380
Oilfish (GEP)		190		0		190
Pomfrets (BRZ)		386		1	16	402
Wahoo (WAH)	2	407		145	5	560
Other fish (PEL PLS MOP TRX GBA ALX GES RRU DOT)	5	9		2		16
TOTAL OTHER	8	1,606		508	30	2,153
TOTAL	**201,165**	**13,254**	**145**	**1,674**	**520**	**216,757**

Table 1b. Estimated weight (in metric tons) of catch by vessels of the United States and its Participating Territories (American Samoa, Guam, and Commonwealth of the Northern Mariana Islands) by species and fishing gear in the WCPFC Statistical Area, for 2015 (updated). Totals may not match sums of values due to rounding to the nearest metric ton (< 0.5 t = 0). Purse seine species composition estimates have not been adjusted for 2015.

Species and FAO code	Purse seine	Longline	Albacore troll	Tropical troll	Handline	Total
Albacore (ALB), North Pacific		217	0	2	62	281
Albacore (ALB), South Pacific		1,855	156			2,011
Bigeye tuna (BET)	1,595	5,840		59	202	7,696
Pacific bluefin tuna (PBF)		6				6
Skipjack tuna (SKJ)	219,550	254		401	5	220,210
Yellowfin tuna (YFT)	17,019	1,041		558	401	19,019
Other tuna (TUN KAW FRI)		0		15	1	16
TOTAL TUNAS	238,164	9,213	156	1,035	671	249,239
Black marlin (BLM)	3	0		4		7
Blue marlin (BUM)	6	526		197	3	732
Sailfish (SFA)		15		3		18
Spearfish (SSP)		204		11		215
Striped marlin (MLS), North Pacific		414		11		425
Striped marlin (MLS), South Pacific		3				3
Other marlins (BIL)	1	1				2
Swordfish (SWO), North Pacific		690		1	5	696
Swordfish (SWO), South Pacific		8				8
TOTAL BILLFISHES	10	1,862		227	8	2,107
Blue shark (BSH)		1				1
Mako shark (MAK)		39				39
Thresher sharks (THR)		6			1	7
Other sharks (SKH OCS FAL SPN TIG CCL)				1		1
TOTAL SHARKS		45		1	1	47
Mahimahi (DOL)	1	226		404	13	644
Moonfish (LAP)		336				336
Oilfish (GEP)		185				185
Pomfrets (BRZ)		419			13	432
Wahoo (WAH)	1	340		203	9	554
Other fish (PEL PLS MOP TRX GBA ALX GES RRU DOT)	4	9		1		14
TOTAL OTHER	6	1,515		608	35	2,164
TOTAL	**238,180**	**12,635**	**156**	**1,871**	**715**	**253,557**

Table 1c. Estimated weight (in metric tons) of catch by vessels of the United States and its Participating Territories (American Samoa, Guam, and Commonwealth of the Northern Mariana Islands) by species and fishing gear in the WCPFC Statistical Area, for 2014. Totals may not match sums of values due to rounding to the nearest metric ton (< 0.5 t = 0). Purse seine species composition estimates have not been adjusted for 2014.

Species and FAO code	Purse seine	Longline	Albacore troll	Tropical troll	Handline	Total
Albacore (ALB), North Pacific		186	0	3	49	238
Albacore (ALB), South Pacific		1,430	445			1,875
Bigeye tuna (BET)	2,802	5,141		143	206	8,292
Pacific bluefin tuna (PBF)		3				3
Skipjack tuna (SKJ)	269,243	291		370	8	269,912
Yellowfin tuna (YFT)	40,959	1,021		582	385	42,947
Other tuna (TUN KAW FRI)				14	2	16
TOTAL TUNAS	313,004	8,072	445	1,112	650	323,283
Black marlin (BLM)	5	1		3		9
Blue marlin (BUM)	4	486		160	4	654
Sailfish (SFA)		17		1		18
Spearfish (SSP)		175		8		183
Striped marlin (MLS), North Pacific		357		12		369
Striped marlin (MLS), South Pacific	1	7				8
Other marlins (BIL)	1					1
Swordfish (SWO), North Pacific		880		1	7	888
Swordfish (SWO), South Pacific		10				10
TOTAL BILLFISHES	11	1,932		185	11	2,139
Blue shark (BSH)		1				1
Mako shark (MAK)		37				37
Thresher sharks (THR)		6		1		7
Other sharks (SKH OCS FAL SPN TIG CCL)				1		1
TOTAL SHARKS		43		2		45
Mahimahi (DOL)	2	263		535	26	827
Moonfish (LAP)		408				408
Oilfish (GEP)		182				182
Pomfrets (BRZ)		392		0	19	411
Wahoo (WAH)	3	336		259	10	608
Other fish (PEL PLS MOP TRX GBA ALX GES RRU DOT)	2	6		1		10
TOTAL OTHER	7	1,587		796	55	2,445
TOTAL	**313,022**	**11,635**	**445**	**2,095**	**716**	**327,913**

Table 1d. Estimated weight (in metric tons) of catch by vessels of the United States and its Participating Territories (American Samoa, Guam, and Commonwealth of the Northern Mariana Islands) by species and fishing gear in the WCPFC Statistical Area, for 2013. Totals may not match sums of values due to rounding to the nearest metric ton (< 0.5 t = 0). Purse seine species composition estimates have not been adjusted for 2013.

Species and FAO code	Purse seine	Longline	Albacore troll	Tropical troll	Handline	Total
Albacore (ALB), North Pacific		298		2	46	346
Albacore (ALB), South Pacific	1	2,128	390			2,519
Bigeye tuna (BET)	8,157	4,534		148	393	13,232
Pacific bluefin tuna (PBF)		3				3
Skipjack tuna (SKJ)	226,609	288		539	14	227,450
Yellowfin tuna (YFT)	23,277	1,083		531	442	25,333
Other tuna (TUN KAW FRI)		0		5	1	6
TOTAL TUNAS	258,044	8,335	390	1,224	896	268,889
Black marlin (BLM)		1		3		4
Blue marlin (BUM)		378		137	3	518
Sailfish (SFA)		12		2		14
Spearfish (SSP)		177		11		188
Striped marlin (MLS), North Pacific		328		8		336
Striped marlin (MLS), South Pacific		4				4
Other marlins (BIL)		1				1
Swordfish (SWO), North Pacific		583		1	6	590
Swordfish (SWO), South Pacific		11				11
TOTAL BILLFISHES		1,493		161	9	1,664
Blue shark (BSH)		2				2
Mako shark (MAK)		39				39
Thresher sharks (THR)		5			1	6
Other sharks (SKH OCS FAL SPN TIG CCL)		0		1		1
TOTAL SHARKS		46		1	1	48
Mahimahi (DOL)		293		406	22	721
Moonfish (LAP)		450				450
Oilfish (GEP)		216				216
Pomfrets (BRZ)		359		0	20	379
Wahoo (WAH)		274		206	8	487
Other fish (PEL PLS MOP TRX GBA ALX GES RRU DOT)		10		1		11
TOTAL OTHER		1,602		613	50	2,265
TOTAL	**258,044**	**11,476**	**390**	**1,999**	**956**	**272,865**

Table 1e. Estimated weight (in metric tons) of catch by vessels of the United States and its Participating Territories (American Samoa, Guam, and Commonwealth of the Northern Mariana Islands) by species and fishing gear in the WCPFC Statistical Area, for 2012. Totals may not match sums of values due to rounding to the nearest metric ton (< 0.5 t = 0).

Species and FAO code	**Purse seine**	**Longline**	**Albacore troll**	**Tropical troll**	**Handline**	**Total**
Albacore (ALB), North Pacific		595		3	253	851
Albacore (ALB), South Pacific	42	3,147	235			3,423
Bigeye tuna (BET)	5,503	5,162		155	298	11,118
Pacific bluefin tuna (PBF)		7				7
Skipjack tuna (SKJ)	215,702	490		385	12	216,589
Yellowfin tuna (YFT)	31,679	1,196		648	381	33,903
Other tuna (TUN KAW FRI)		0		18	1	19
TOTAL TUNAS	252,925	10,596	235	1,209	945	265,911
Black marlin (BLM)		3		3		6
Blue marlin (BUM)		313		141	2	456
Sailfish (SFA)		9		1		10
Spearfish (SSP)		147		12		159
Striped marlin (MLS), North Pacific		263		11		274
Striped marlin (MLS), South Pacific		7				7
Other marlins (BIL)		1				1
Swordfish (SWO), North Pacific		900		1	6	907
Swordfish (SWO), South Pacific		14				14
TOTAL BILLFISHES		1,656		169	8	1,833
Blue shark (BSH)		18				18
Mako shark (MAK)		50			1	51
Thresher sharks (THR)		13			1	14
Other sharks (SKH OCS FAL SPN TIG CCL)		1		1		2
TOTAL SHARKS		82		1	2	85
Mahimahi (DOL)		351		508	32	891
Moonfish (LAP)		445				445
Oilfish (GEP)		228				228
Pomfrets (BRZ)		270			5	275
Wahoo (WAH)		241		222	7	470
Other fish (PEL PLS MOP TRX GBA ALX GES RRU DOT)		9		4		13
TOTAL OTHER		1,545		734	44	2,323
TOTAL	**252,925**	**13,879**	**235**	**2,114**	**999**	**270,152**

Table 1f. Longline retained catch in metric tons (t) by species and species group, for U.S. and American Samoa vessels operating in the WCPFC Statistical Area in 2012–2015. Totals may not match sums of values due to rounding to the nearest metric ton (< 0.5 t = 0). Catch in North Pacific Ocean = NPO and catch in South Pacific Ocean = SPO.

	U.S. (NPO)					CNMI (NPO)				Guam (NPO)		American Samoa (NPO)					American Samoa (SPO)					Total				
	2016	2015	2014	2013	2012	2016	2015	2014	2013	2016	2015	2016	2015	2014	2013	2012	2016	2015	2014	2013	2012	2016	2015	2014	2013	2012
Vessels	133	135	140	135	127	117	117	109	113	118	112	23	22	17	17	115	20	21	23	22	25	151	156	162	157	153
Species																										
Albacore, NPO	209	197	178	265	480				23			35	19	8	11	115						244	217	186	298	595
Albacore, SPO		0															1,558	1,855	1,430	2,128	3,147	1,558	1,855	1,430	2,128	3,147
Bigeye tuna	3,761	3,427	3,823	3,654	3,660	884	999	1,000	492	939	856	588	441	236	305	1,338	98	116	82	84	164	6,270	5,840	5,141	4,534	5,162
Pacific bluefin tuna*	0	0		0	0												0	6	3	2	7	1	6	3	3	7
Skipjack tuna	183	176	167	188	115				25			25	11	9	9	123	50	67	116	66	251	259	254	291	288	490
Yellowfin tuna	1,098	681	567	568	576				93			175	105	30	32	272	195	255	424	390	348	1,469	1,041	1,021	1,083	1,196
Other tuna	0	0		0	0				0			0							0			0	0		0	0
TOTAL TUNA	5,252	4,482	4,734	4,674	4,831	884	999	1,000	633	939	856	823	577	283	357	1,849	1,902	2,299	2,055	2,671	3,916	9,801	9,213	8,072	8,335	10,596
Black marlin	1	0	1	1	1								0	0	0	0				0	2	1	0	1	1	3
Blue marlin	429	445	428	305	226				20			58	55	31	22	50	31	25	28	31	36	517	526	486	378	313
Sailfish	15	11	15	7	5				3			2	2	0	1	3	2	2	2	2	1	20	15	17	12	9
Spearfish	251	188	163	133	111				34			28	15	11	9	35	2	1	1	1	1	281	204	175	177	147
Striped marlin, NPO	281	378	343	262	209				42			48	36	14	23	54			0			329	414	357	328	263
Striped marlin, SPO		0															2	3	7	4	7	2	3	7	4	7
Other marlins	1	1		1	1				0				0			0						1	1		1	1
Swordfish, NPO	595	665	865	558	862				8			43	24	15	17	38						638	690	880	583	900
Swordfish, SPO		0															7	8	10	11	14	7	8	10	11	14
TOTAL BILLFISH	1,573	1,688	1,813	1,266	1,414				107			180	133	72	72	180	43	40	47	48	62	1,796	1,862	1,932	1,493	1,656

* Pacific bluefin tuna catches are reported on longline logsheets for the American Samoa fishery, however the species may be misidentified.

Table 1f. (Continued.)

	U.S. (NPO)					CNMI (NPO)				Guam (NPO)		American Samoa (NPO)					American Samoa (SPO)					Total				
	2016	**2015**	**2014**	**2013**	**2012**	**2016**	**2015**	**2014**	**2013**	**2016**	**2015**	**2016**	**2015**	**2014**	**2013**	**2012**	**2016**	**2015**	**2014**	**2013**	**2012**	**2016**	**2015**	**2014**	**2013**	**2012**
Blue shark				1	12							0		0		2	1	1	1	1	3	1	1	1	2	18
Mako shark	37	35	35	31	42				3			9	4	2	4	8					0	46	39	37	39	50
Thresher	3	5	5	5	9				0			0	1	1	0	3					0	4	6	6	5	13
Other sharks	0			0	0											0						0			0	1
Oceanic whitetip shark				0	1																				0	1
Silky shark																										
Hammerhead shark	0																					0				
Tiger shark																										
Porbeagle																										
TOTAL SHARKS	40	40	40	37	65				3			10	5	2	5	14	1	1	1	1	4	51	45	43	46	82
Mahimahi	202	199	236	238	288				9			28	21	15	27	52	4	6	12	19	11	234	226	263	293	351
Moonfish	304	279	385	377	356				37			74	55	22	35	86	2	2	1	2	3	380	336	408	450	445
Oilfish	160	165	169	171	169				28			29	20	13	17	59	2	0	0	1	0	190	185	182	216	228
Pomfret	339	380	373	315	215				26			46	39	18	18	56	0	0	0			386	419	392	359	270
Wahoo	309	256	243	154	117				17			47	27	18	15	39	52	58	75	87	85	407	340	336	274	241
Other fish	7	7	6	9	8				0			1	1	0	0	1	1	1	0	0	0	9	9	6	10	9
TOTAL OTHER	1,322	1,285	1,411	1,263	1,154				117			224	164	87	113	292	60	66	89	109	99	1,606	1,515	1,587	1,602	1,545
GEAR TOTAL	**8,187**	**7,495**	**7,999**	**7,241**	**7,464**	**884**	**999**	**1,000**	**860**	**939**	**856**	**1,237**	**878**	**445**	**546**	**2,335**	**2,007**	**2,405**	**2,192**	**2,828**	**4,081**	**13,254**	**12,635**	**11,635**	**11,476**	**13,880**

Table 1g. Estimated catch of tropical troll fishery in metric tons (t) for Hawaii, Guam, CNMI, and American Samoa vessels by species and species group, for U.S. vessels operating in the WCPFC Statistical Area in 2012–2016. Totals may not match sums of values due to rounding to the nearest metric ton (< 0.5 t = 0). NPO = North Pacific Ocean and SPO = South Pacific Ocean.

	Hawaii					**Guam**					**CNMI**					**American Samoa**					**Total Tropical Troll**				
	2016	**2015**	**2014**	**2013**	**2012**	**2016**	**2015**	**2014**	**2013**	**2012**	**2016**	**2015**	**2014**	**2013**	**2012**	**2016**	**2015**	**2014**	**2013**	**2012**	**2016**	**2015**	**2014**	**2013**	**2012**
Vessels	1,401	1,576	1,649	1,662	1,698	408	372	447	496	351	9	9	19	28	35	12	11	22	13	9	1,830	1,968	2,137	2,199	2,093
Species					-																				
Albacore, NPO	1	2	3	2	3																1	2	3	2	3
Albacore, SPO																									
Bigeye tuna	34	59	143	148	155																34	59	143	148	155
Pacific bluefin tuna																									
Skipjack tuna	116	96	78	149	109	198	273	177	227	142	87	29	109	159	130	4	3	6	3	4	405	401	370	539	385
Yellowfin tuna	457	492	555	488	597	58	51	15	24	13	9	13	8	16	33	4	2	3	3	4	528	558	582	531	648
Other tunas	4	15	12	4	4	0		0	0	2	1		2	1	13	1					6	15	14	5	18
TOTAL TUNAS	612	664	791	791	868	256	324	192	251	157	97	42	120	176	176	10	5	9	6	8	975	1,035	1,112	1,224	1,209
Black marlin	3	4	3	3	3																3	4	3	3	3
Blue marlin	137	179	144	128	131	20	17	13	7	6			3	1	4		1	1			157	197	160	137	141
Sailfish	2	2	1	1	1			0	1				0	0			1	0			2	3	1	2	1
Spearfish	16	11	8	11	12																16	11	8	11	12
Striped marlin, NPO	12	11	12	8	11																12	11	12	8	11
Striped marlin, SPO																									
Other billfish																									
Swordfish, NPO		1	1	1	1																	1	1	1	1
Swordfish, SPO																									
TOTAL BILLFISHES	170	208	169	152	159	20	17	13	8	6			3	1	4		2	1			190	227	185	161	169
Blue shark																									
Mako shark																									
Thresher sharks			1																				1		
Other sharks	1	1	1	1	1																1	1	1	1	1
TOTAL SHARKS	1	1	2	1	1																1	1	2	1	1
Mahimahi	245	329	408	290	452	79	72	87	75	38	36	3	39	41	18	1		1	0	0	361	404	535	406	508
Moonfish																									
Oilfish																0					0				
Pomfrets						1					0		0	0		0					1		0	0	
Wahoo	122	189	211	180	194	15	14	42	23	20	2		5	2	8	6	0	0	1	0	145	203	259	206	222
Other pelagics		1	1	1	1			0		2					1	2					2	1	1	1	4
TOTAL OTHER	367	519	620	471	647	95	86	130	98	60	38	3	44	43	27	8	0	1	1	0	508	608	796	613	734
GEAR TOTAL	**1,150**	**1,392**	**1,582**	**1,415**	**1,675**	**371**	**427**	**335**	**357**	**223**	**135**	**45**	**167**	**220**	**207**	**18**	**7**	**11**	**7**	**9**	**1,674**	**1,871**	**2,095**	**1,999**	**2,114**

Table 1h. Estimated catch of swordfish, and number of U.S. vessels fishing for swordfish, south of 20° S in the WCPFC Statistical Area in 2012–2016, to fulfill the reporting requirements of WCPFC CMM 2009-03.

	U.S.-flagged Vessels South of 20° S	
Year	Catch (t) by all vessels	Number of vessels fishing for swordfish
2012	confidential	0
2013	confidential	0
2014	0	0
2015	< 1	0
2016	0	0

Note: The catch is only reported for years when 3 or more vessels fished in the area, although the number of vessels fishing for swordfish may be less than the number that fished. The United States does not have any longline vessels operating under charter or lease as part of its domestic fishery south of 20° S nor does it have any other vessels fishing within its waters south of 20° S.

Table 2a. Estimated number of United States and Participating Territories vessels operating in the WCPFC Statistical Area, by gear type, from 2012 to 2016. Data for 2016 are preliminary.

	2016	**2015**	**2014**	**2013**	**2012**
Purse seine	37	39	40	40	39
Longline (N Pac-based) [1]	133	135	140	135	127
Longline (American Samoa-based)	23	22	17	17	115
Total U.S. Longline [2]	151	156	162	157	153
Albacore troll (N Pac) [3]		4	3		2
Albacore troll (S Pac) [3]	6	6	13	6	9
Tropical troll	1,830	1,968	2,137	2,199	2,093
Handline	420	478	499	534	576
Tropical Troll and Handline (combined)[4]	1,927	2,057	2,212	2,304	2,196
TOTAL	**2,121**	**2,258**	**2,427**	**2,507**	**2,397**

[1] Includes Hawaii- and California-based vessels that fished west of 150° W.

[2] Some longline vessels fished in both Hawaii and American Samoa, and are counted only once in this U.S. total.

[3] Some vessels fished on both sides of the equator, and are counted only once in the bottom line TOTAL.

[4] Some vessels used both tropical troll and handline gear but were counted only once in this combined total.

Table 2b. Estimated number of United States and Participating Territories purse seine, longline, pole-and-line, and albacore troll vessels operating in the WCPFC Statistical Area, by gross registered tonnage categories, from 2012 to 2016. Data for 2016 are preliminary.

Gear and year	0-50	51-200	201-500	501-1000	1001-1500	1500+
2012 Purse seine				1	17	21
2013 Purse seine					19	21
2014 Purse seine					19	21
2015 Purse seine					17	22
2016 Purse seine					15	22
2012 Longline	15	138				
2013 Longline	15	142				
2014 Longline	13	149				
2015 Longline	13	143				
2016 Longline	12	139				
	0-50	**51-150**	**150+**			
2012 Pole and line		1				
2013 Pole and line	1	1				
2014 Pole and line	1	1				
2015 Pole and line	1	1				
2016 Pole and line	1	1				
2012 Albacore Troll		6	5			
2013 Albacore Troll		4	2			
2014 Albacore Troll		9	7			
2015 Albacore Troll		5	4			
2016 Albacore Troll		4	2			

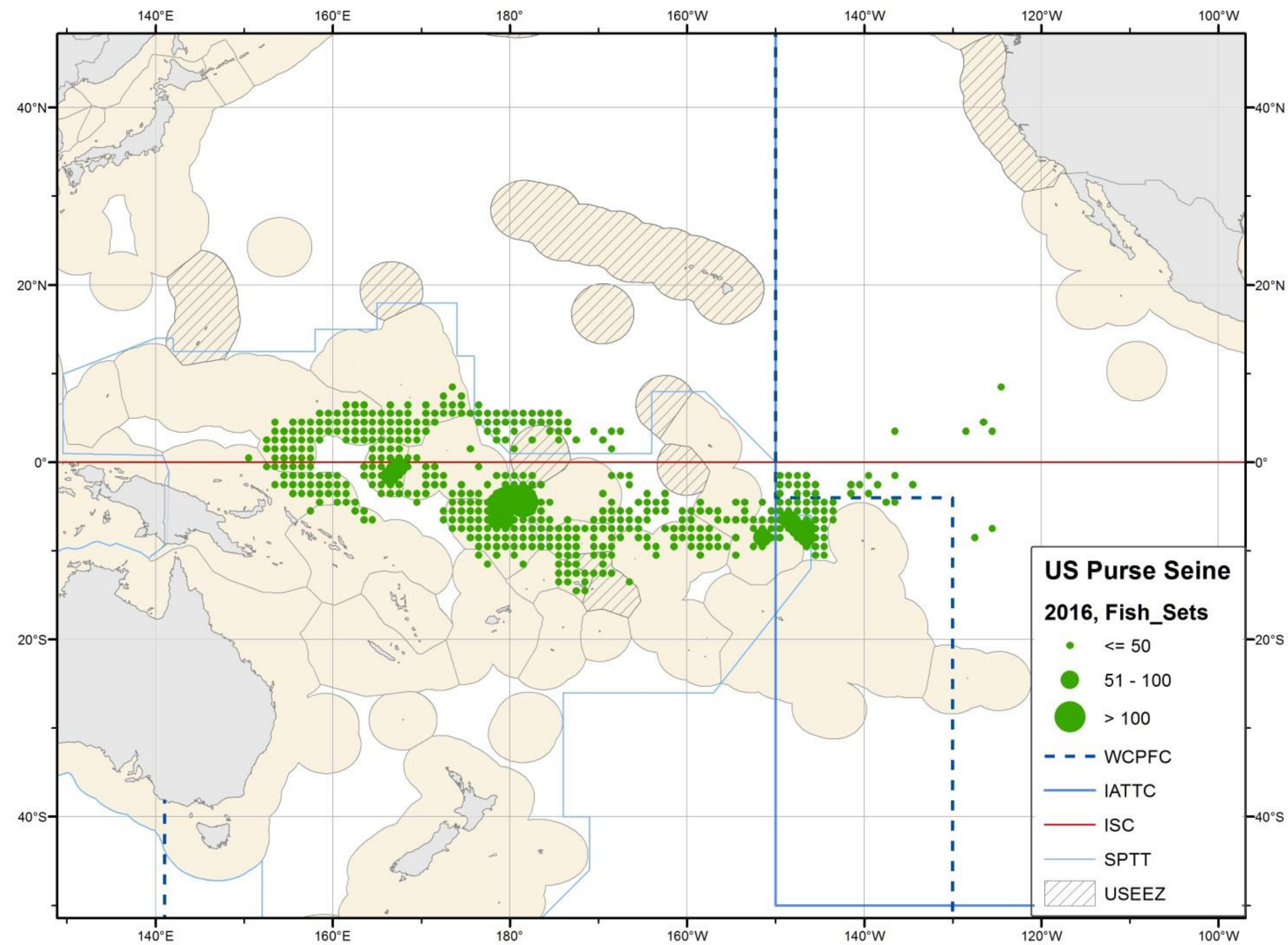

Figure 1. Spatial distribution of fishing effort (fishing sets) reported in logbooks by U.S.-flagged purse seine vessels the Pacific Ocean in 2016 (preliminary data). Effort in some areas is not shown to preserve data confidentiality.

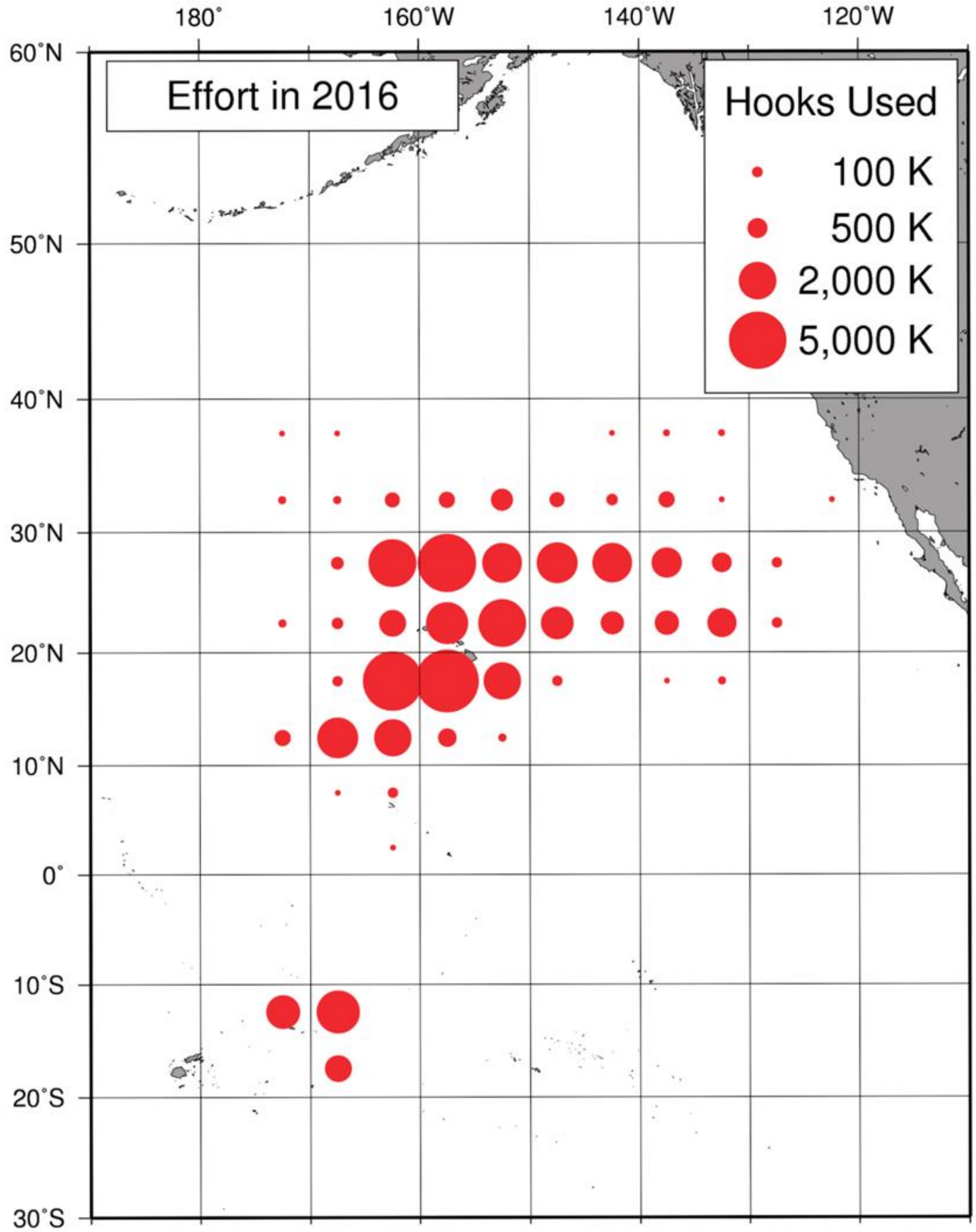

Figure 2a. Spatial distribution of fishing effort reported in logbooks by U.S.-flagged longline vessels, in 1000s of hooks (K), in 2016 (preliminary data). Area of circles is proportional to effort. Effort in some areas is not shown to preserve data confidentiality.

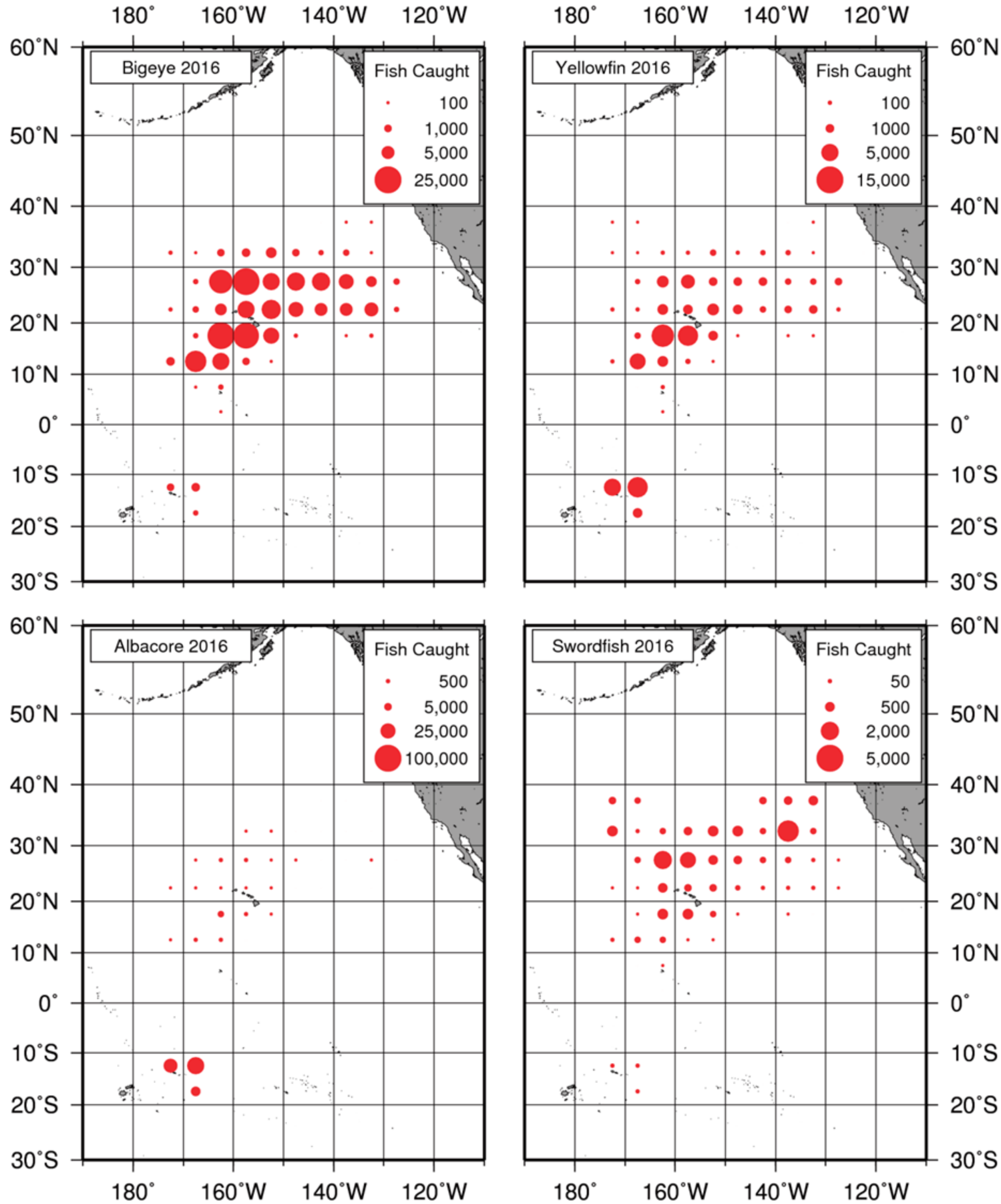

Figure 2b. Spatial distribution of catch reported in logbooks by U.S.-flagged longline vessels, in numbers of fish (includes retained and released catch), in 2016 (preliminary data). Area of circles is proportional to catch. Catches in some areas are not shown to preserve data confidentiality.

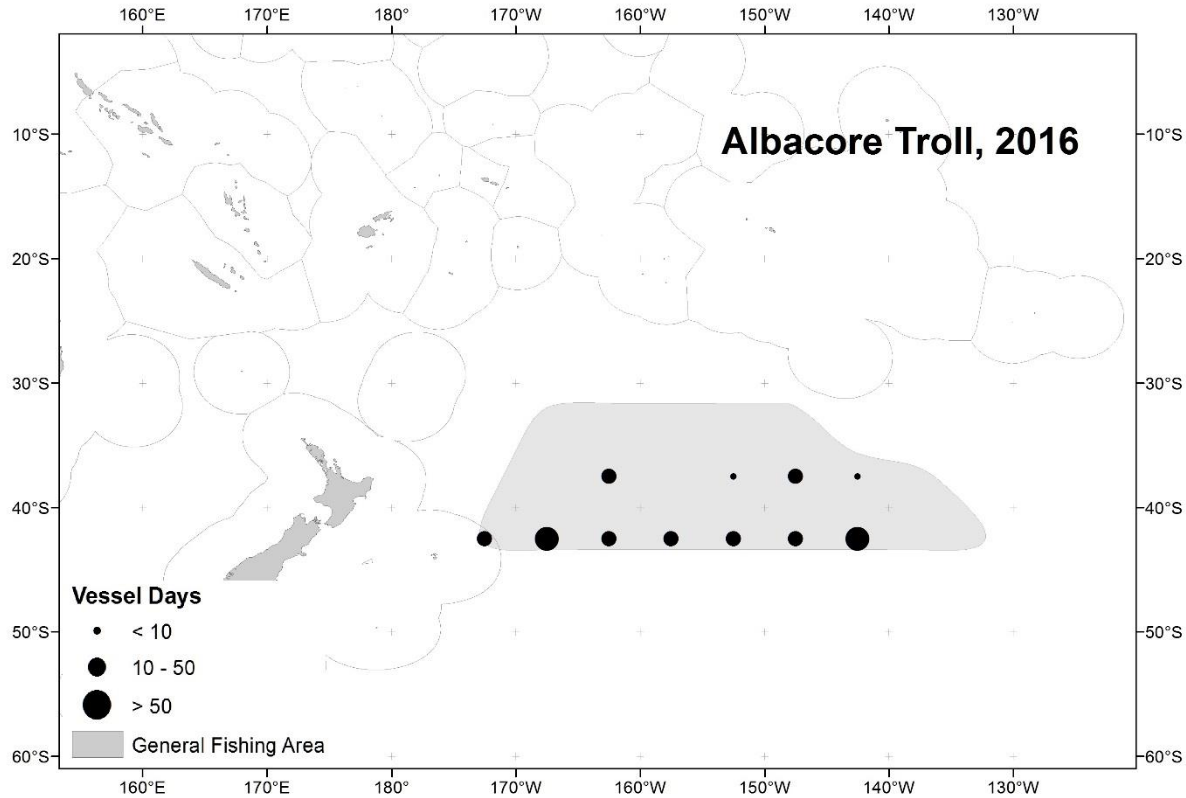

Figure 3a. Spatial distribution of reported logbook fishing effort (vessel-days fished) by the U.S. albacore troll fleet in the SPO in 2016 (preliminary data). Effort in some areas is not shown to preserve data confidentiality.

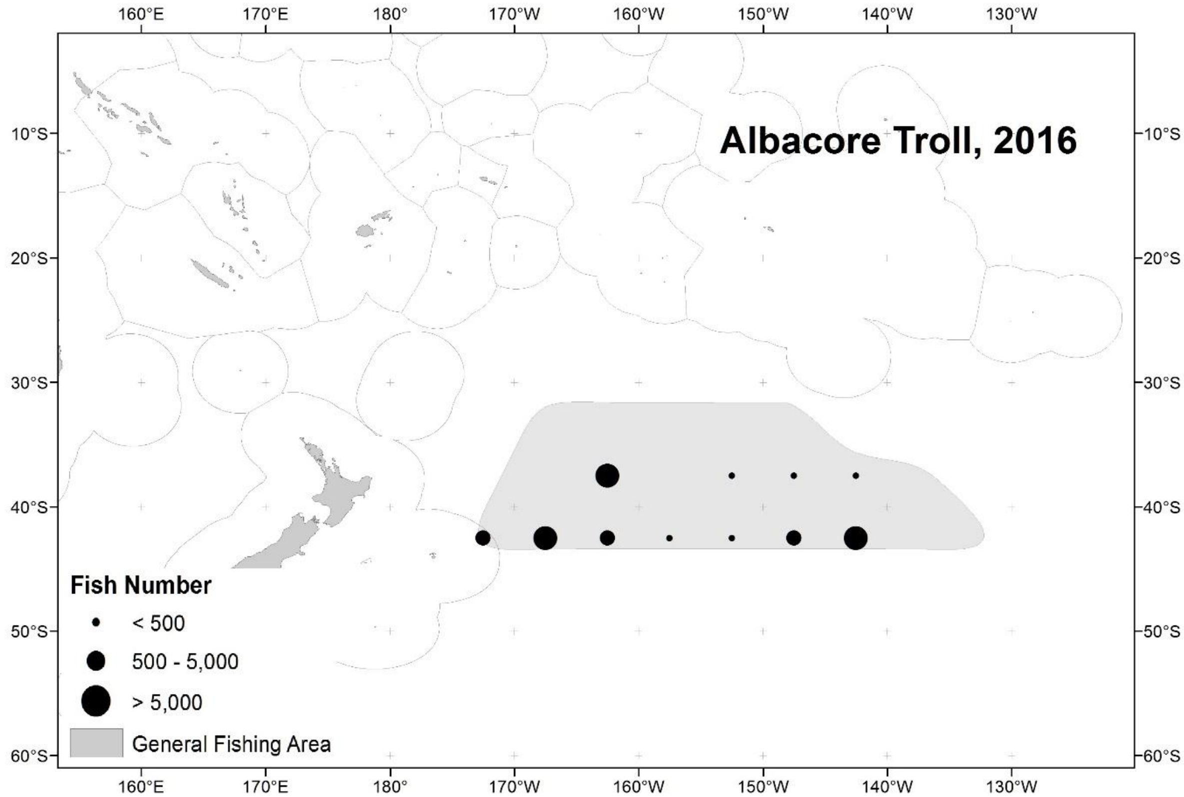

Figure 3b. Spatial distribution of reported logbook fishing catch (number of fish caught) by the U.S. albacore troll fleet in the SPO in 2016 (preliminary data). Catch in some areas is not shown to preserve data confidentiality.

Background [n/a]

Flag State Reporting of National Fisheries

U.S. Purse seine Fishery

The U.S. purse-seine catch of tunas in the WCPO was 201,152 t in 2016 compared to 238,164 t in 2015, and was primarily composed of skipjack tuna, with smaller catches of yellowfin and bigeye tuna. The total catches of tunas have fluctuated over the past 5 years (Tables 1a-1e). The number of licensed vessels in 2016 was 37 vessels, 2 less than in 2015 (Table 2a). The fishery operated further eastward, and not as far northward as in the prior years, mainly in areas between 5° N and 15° S latitude and 155° E and 135°W longitude (Figure 1).

U.S. Longline Fisheries

The longline fisheries of the United States and the Territory of American Samoa in the WCPO include vessels based in Hawaii, California, and American Samoa. The total number of longline vessels active in the WCPO during 2012–2016 ranged from 151 vessels in 2016 to 162 vessels in 2014 (Table 2). The U.S. longline fishery in the NPO consistently had the highest number of vessels in operation with 133 in 2016. Participation in the American Samoa-permitted fleet operating in the South Pacific declined from 25 vessels in 2012 to 20 vessels in 2016. A few vessels occasionally operated in both the Hawaii-permitted and American Samoa-permitted longline fisheries during 2012–2016. Longline catches made outside of the U.S. EEZ in NPO by vessels operating with both American Samoa and Hawaii longline permits and landing their fish in Hawaii belong to the longline fishery of American Samoa and not to the U.S. longline fishery in the NPO in accordance with federal fisheries regulations (50 *CFR* 300.224).
These American Samoa longline landings in the NPO (labeled as American Samoa in the NPO in Table 1f) are shown separately from U.S. longline catches in the NPO. The table entries for American Samoa (Table 1f) include its catches in the South Pacific landed in American Samoa. The overall American Samoa fishery total is the sum of its catches in the South Pacific and in the NPO attributed to American Samoa. In 2011, the Consolidated and Further Continuing Appropriations Act (CFCAA), (Pub. L. 112-55, 125 Stat. 552 et seq.) was passed. Pursuant to this act and NMFS regulations under 50 *CFR* 300.224, if the U.S. vessel landing the fish was included in a valid arrangement under Sec. 113(a) of the CFCAA, its catch during those periods was attributed to the fishery of American Samoa in the NPO from 2011 to 2012, to CNMI during 2013 through 2016, and to Guam in 2015 and 2016. Under these arrangements in 2014, 2015, and 2016 only bigeye tuna were attributed, the other species remained as U.S. catch.

The U.S. longline fishery in the NPO operated mainly from the equator to 40° N latitude and from 120° W to 175° W in 2016 (Figure 2a). The American Samoa-based longline fishery operated mostly from 10° S to 20° S latitude and 165° W to 175° W longitude in 2016 (Figure 2a). The U.S. longline fishery in the NPO fishery targeted bigeye tuna and swordfish, with significant landings of associated pelagic species, whereas the American Samoa longline fishery in the SPO targeted and landed albacore but also produced a noteworthy amount of yellowfin tuna. Pacific bluefin tuna catches are reported on longline log sheets for the American Samoa fishery, however the species may be misidentified (Tables 1a-1f). The dominant components of the longline catch by the United States and its Territories in 2016 were bigeye tuna, albacore, yellowfin tuna, and swordfish (Table 1a, Figure 2b). The total catch of all species during the past 5 years ranged from a low of 11,476 t in 2013, to a high of 13,779 t in 2012 with catch at 13,254 t in 2016 (Tables 1a-1e).

Most of the U.S. longline fishery in the NPO involved deep-set longline effort directed towards tunas. High ex-vessel tuna prices along with relatively lower operating expenses in this sector of the U.S. longline fishery in the NPO motivated longline fishers to continue targeting bigeye tuna. U.S. longline landings of swordfish in the NPO (including Territories) varied substantially from 583 t in 2013 to 900 t in 2012 and 638 t in 2016. The shallow-set U.S. longline fishery for swordfish accounts for the majority of the swordfish catch and has operated under the allowable number of sea turtle interaction limits in 11 out of 13 years since its reopening in 2004.

U.S. Albacore Troll Fisheries

In recent years, the U.S. troll fisheries for albacore in the WCPO have experienced a significant decline in participation. Six vessels participated in the South Pacific albacore troll fishery in 2016 (Table 2). The South Pacific albacore troll fishery operates mostly between 30° S and 45° S latitude and 130° W and 175° W longitude (Figure 3a). The catch in this fishery is composed almost exclusively of albacore (Figure 3b). The South Pacific albacore troll catches in the WCPO decreased from 156 t in 2015 to 145 t in 2016 (Tables 1a-1e).

Other Fisheries of the United States and Participating Territories

Other fisheries of the United States and Participating Territories include the small-scale tropical troll, handline, and pole-and-line fleets, as well as miscellaneous recreational and subsistence fisheries. In American Samoa, Guam, and CNMI these fisheries are monitored by creel surveys, and the data are included in the tropical troll statistics, as this fishing method is the one most commonly used in the recreational and subsistence fisheries in these areas. Most of the vessels comprising the United States and Participating Territories tropical troll fishery, and all of the U.S. handline and pole-and-line vessels are located in Hawaii. The total catch by these fisheries was 2,194 t in 2016. The catch was composed primarily of yellowfin tuna, skipjack tuna, bigeye tuna, and mahimahi.

Coastal State Reporting

[n/a]

Socioeconomic Factors and Trends in the Fisheries

Socio-economic Surveys and Analyses

NMFS staff and colleagues have conducted surveys and analyses to better understand the socioeconomic considerations of U.S. fisheries in the WCPO. The following summaries describe recent investigations in this area.

Economic cost earnings of pelagic longline fishing in Hawaii. This NOAA report presents findings from a cost-earnings study of the Hawaii-based longline fleet. Fleet-wide expenditures and revenue are assessed for the 2012 operational calendar year. Captains or owners of 115 of the 126 vessels active at the time of the study voluntarily participated in the face-to-face survey, resulting in a response rate of 91 percent. This report also compares 2012 results with the previous cost-earnings studies of the Hawaii longline fleet that examines the economic profiles of the fleet for 2000 and 2005 operations. Based on survey responses, the average indirect net returns for Hawaii-based longline operations were $72,855 with a direct net cash flow of $56,522 in 2012. Direct net cash flow represents a 233 percent change over 2005 ($16,955 adjusted value in 2012 dollars), when the last cost-earnings survey was conducted. However, economic performance varied widely in 2012. Not all owners earned a profit in 2012, with nearly one-third of study participants realizing negative net returns for the operating calendar year. In addition, vessel operators exclusively targeting bigeye tuna (deep set) generated relatively higher net returns than vessel operators who pursued only swordfish (shallow set) or a combination of swordfish and bigeye tuna during the fishing year. While vessel operators that targeted swordfish during the year generated relatively higher gross revenues than those who targeted only bigeye tuna, higher operating costs offset these gains. Analysis also indicates that vessel size tended to correlate with gross and net revenue in 2012, in that owners and captains of larger vessels generated more revenue and profit than did captains and owners of smaller vessels (Kalberg and Pan, 2016).

Attitudes and preferences of Hawaii non-commercial fishermen. During the summer of 2015, the PIFSC Socioeconomics Program completed a survey to better understand what matters most to Hawaii's non-commercial fishermen. The survey results provide valuable insights from the non-commercial fishing community into their: (a) motivations for fishing, (b) preferences towards fisheries management strategies, (c) satisfaction with Hawaii fisheries management, and (d) perceptions towards ecosystem conditions and threats to the marine environment. There were three primary groups of fishermen that participated in the survey: (1) vessel owners that indicated that they use their vessel for offshore non-commercial fishing, (2) fishermen that fish in offshore waters and have registered with the National Saltwater Angler Registry, and (3) shore-based fishermen who volunteered to participate in the survey through outreach efforts. Fishing for food was one of the most important reasons cited for fishing, and 68% of survey respondents consider catching enough fish for home/personal consumption to be the most important aspect of a fishing trip. Nearly 80% of fishermen indicated that they always or often share catch with family and/or friends and approximately 36% of respondents indicated that their catch is extremely important or very important to their regular diet (Madge et al., 2016).

Potential economic impacts of the Papahānaumokuākea Marine National Monument expansion. This NOAA report provides an overview of presentations given at the 124th Scientific and Statistical Committee and 168th Council Meeting. All potential economic impact estimates presented herein should be considered upper bound estimates as the Monument expansion did not directly restrict current fishing activity, but did modify the spatial extent to which the fishery could operate. The potential direct and indirect revenue loss estimates are provided under the assumption that catch from the Northwestern Hawaiian Islands (NWHI) is completely "lost", which is likely an overly restrictive assumption. It is difficult to quantify the true direct or indirect effects of the Monument expansion as many effects will take time to materialize. Fishermen will no longer have access to these traditional domestic fishing grounds within the United States EEZ, which may incur additional costs on the fleet as they reallocate their future effort elsewhere. The report outlines multiple existing economic monitoring programs: (a) longline economic data collection program and (b) economic performance metrics that will provide insights to assess future changes in fishing costs and economic performance metrics as related to the Monument expansion. In addition to economic impacts, potential sociocultural impacts of the Monument expansion may warrant future research. While this report presented a fishery-level analysis, there is the potential for differential impacts among subgroups in the fishery (target species, vessel size, and/or ethnicity). The shallow-set longline fishery appears to have a nominally higher share of catch, effort, and revenues from the NWHI relative to the deep-set fishery. In addition to the potential for increased costs associated with fishing outside the EEZ there could be effects on the overall quality of the domestic product which could affect domestic market share and longer trips could impact both seafood safety and safety at sea for domestic fishing vessels

How do fishery policies affect Hawaii's longline fishing industry? This study presents a vessel and target-specific positive mathematical programming model (PMP) for Hawaii's longline fishing fleet. Although common in agricultural economics, PMP modeling is rarely attempted in fisheries. To demonstrate the flexibility of the PMP framework, we separate tuna and swordfish production technologies into three policy-relevant fishing targets. We find the model most accurately predicts vessel-specific annual bigeye catch in the Western Central Pacific Ocean (WCPO), with an accuracy of 12%–35%, and a correlation between 0.30 and 0.53. To demonstrate the model's usefulness to policy makers, we simulate the impact to individual vessels from increasing and decreasing the bigeye catch limit in the WCPO by 10%. Our results suggest that such policy changes will have moderate impacts on most vessels, but large impacts on a few generating a fat-tailed distribution. These results offer insights into the range of winners and losers resulting from changes in fishery policies, and therefore, which policies are more likely to gain widespread industry support. As a tool for fishery management, the calibrated PMP model offers a flexible and easy-to-use framework, capable of capturing the heterogeneous response of fishing vessels to evaluate policy changes (Sweeney et al., 2017).

Relevant Publications

Kalberg KO, Pan M. 2016. 2012 economic cost earnings of pelagic longline fishing in Hawaii. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-56, 60 p. http://dx.doi.org/10.7289/v5/tm-pifsc-56.

Lee HH, Thomas LR, Piner KR, Maunder MN. 2017. Effects of age-based movement on the estimation of growth assuming random-at-age or random-at-length data. Journal of Fish Biology, 90: 222-235.

Madge L, Hospital J, Williams ET. 2016. Attitudes and Preferences of Hawaii Non-commercial Fishermen: Report from the 2015 Hawaii Saltwater Recreational Fishing Survey, Volume 1. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-58, 85 p. http://dx.doi.org/10.7289/V5/TM-PIFSC-58.

Sweeney R.J., R.E. Howitt, H.L. Chan, M. Pan, P.S. Leung. 2017. How do fishery policies affect Hawaii's longline fishing industry? Calibrating a positive mathematical programming model. Natural Resource Modeling. 18 April 2017. http://dx.doi.org/10.1111/nrm.12127.

Disposition of Catch

The purse seine catch is stored onboard as a frozen whole product. Most of the catch has historically been off-loaded to canneries in Pago Pago, American Samoa; however, most vessels now transship their catches in the ports of other Pacific Island countries to canneries in Southeast Asia and Latin America. Cannery products from American Samoa are typically destined for U.S. canned tuna markets. Catches of non-tuna species are consumed onboard the vessel or discarded at sea.

U.S. longline vessels in the NPO store their catch on ice and deliver their product to the market as a fresh product. Large tunas, marlins, and mahimahi are gilled and gutted before storage on the vessel, swordfish are headed and gutted, and the rest of the catch is kept whole. These products are primarily sold fresh locally in Hawaii to restaurants and retail markets, or air freighted to U.S. mainland destinations with a very small proportion of high quality bigeye tuna exported to Japan. The American Samoa-based longline albacore catch is gilled and gutted and delivered as a frozen product to the cannery in Pago Pago, American Samoa. Other associated catch is either marketed fresh (for vessels making day trips) or frozen (for vessels making extended trips).

The catch in the albacore troll fishery in the South Pacific is frozen whole. In recent years, most vessels transported their catches to Vancouver, Canada for sale. The other fisheries store their catch in ice. Large tunas and marlins are gilled and gutted while other species are kept whole. The small-scale tropical troll fisheries chill their products with ice and sell it fresh, mainly to local markets.

Onshore Developments

[n/a]

Future Prospects of the Fisheries

Due to the high demand for tunas in Hawaii and the mainland, the future prospect for the U.S. longline fishery in the NPO is likely to continue to have a greater proportion of effort in the deep-set sector targeting tunas. This sector of the longline fishery is constrained by catch limits for bigeye tuna in the WCPO & EPO. The U.S. longline fishery bigeye tuna limit in the WCPO was reduced from 3,763 t in 2014 to 3,554 t in 2015 and 2016. Bigeye tuna catch limits in the eastern Pacific Ocean (EPO) established pursuant to decisions of the Inter- American Tropical Tuna Commission (IATTC) is limited to 500 t for vessels greater than 24 m. About 25 Hawaii-permitted and California longline vessels greater than 24 m were affected by the bigeye tuna limit in the EPO in 2016. Bigeye tuna catch in the EPO by longline vessels greater than 24 m was 334 t in 2016, 166 t below the 500 t limit.

The effort by shallow-set sector targeting swordfish declined during 2012–2016 despite the removal of the effort restriction in 2006 and revised sea turtle interaction limits in 2012. The bigeye tuna catch limits does not affect the shallow-set longline fishery as adversely as the deep-set sector since this species represents only a small proportion of its catch. The shallow-set longline fishery for swordfish is highly seasonal and will continue to operate under strict regulations to limit interactions with sea turtles.

Fuel costs held steady throughout 2016 while prices for supplies and goods remained constant or increased slightly. The price of fuel remained stable in 2017 which should help the fishery operating under a predictable cost environment. This should benefit the economic performance of most U.S. pelagic fisheries. Other issues facing both sectors of the U.S. longline fishery in the NPO are exceeding false killer whales (*Pseudorca crassidens*) interaction limits in the main Hawaiian Islands EEZ and the expansion on the NWHI Monument out to the 200-mile EEZ. The U.S. longline fishery in the NPO is expected to continue targeting bigeye tuna and swordfish as well as catch of other associated pelagic species and deliver them fresh to service local and mainland markets.

Catches by the American Samoa longline fishery in the South Pacific decreased from years 2012 to 2014 and were at a 5-year low in 2016 (Table 1f). Despite declining catches, the American Samoa longline fishery in the South Pacific is expected to continue targeting albacore and delivering their catch frozen. However, in December 2016, one of the two canneries in Pago Pago Harbor closed.

The prospect of participation and catch from the U.S. small-scale troll and handline fisheries is expected to be fairly stable although these fisheries are challenged by a shortage of crew due to an improving economy, low unemployment rate and the uncertainty of fish prices. Fuel prices dropped dramatically in 2015, remained low in 2016 into 2017, and should help with the cost of operations for this fishery. These fisheries are expected to continue to make single-day trips targeting tunas, billfish, and other pelagic fish, and deliver their catch fresh to local markets.

Status of Fisheries Data Collection Systems

Logsheet Data Collection and Verification

Various sources of data are used to monitor U.S. pelagic fisheries. The statistical data systems that collect and process fisheries data consist of logbooks and fish catch reports submitted by fishers, at-sea observers, and port samplers; market sales reports from fish dealers; and creel surveys. The coverage rates of the various data systems vary considerably.

The primary monitoring system for the major U.S. fisheries (purse seine, longline, and albacore troll) in the WCPO consists of the collection of federally mandated logbooks that provide catches (in numbers of fish or weight), fishing effort, fishing location, and some details on fishing gear and operations. U.S. purse seine logbook and landings data are submitted as a requirement of the South Pacific Tuna Treaty (100% coverage) since 1988. The Hawaii, California, and American Samoa-based longline fisheries are monitored using the NOAA Fisheries Western Pacific Daily Longline Fishing Logs for effort and resulting catch. The coverage of logbook data is assumed to be complete (100%); for the American Samoa fishery, there may be under-reporting of a very small percentage of trips which can be estimated via a creel survey that monitors catch by small longline vessels. Beginning in 1995, all U.S. vessels fishing on the high seas have been required to submit logbooks to NOAA Fisheries.

In Hawaii, fish sales records from the Hawaii Division of Aquatic Resources (DAR) Commercial Marine Dealer Report database are an important supplementary source of information, covering virtually 100% of the Hawaii-based longline landings. The Western Pacific Fisheries Information Network (WPacFIN) has recently improved its procedures for integrating Hawaii fisheries catch data (numbers of fish caught, from logbooks) and information on fishing trips from fishermen's reports with fish weight and sales data from the dealers' purchase reports. As a result, data on the weight and value of most catches on a trip level can be linked. This integration of data provides average fish weight data by gear type, time period, and species that are used to estimate total catch weights for the Hawaii fisheries in this report. Other enhancements to this integration are under development, such as linking the weight of longline-caught fish from the Hawaii Marine Dealer Report records with the Hawaii-based longline logbook data to approximate the weight of catch by geographic location. In addition, species misidentifications on a trip level have been corrected by cross-referencing the longline logbook data, the Hawaii Marine Dealer Report data, and data collected by NOAA Fisheries observers deployed on Hawaii-based longline vessels (see below). Information on these corrections has been published, but is not yet operationally applied to routine data reporting (i.e., the data reported here).

Small-scale fisheries in Hawaii, i.e., tropical troll, handline, and pole-and-line, are monitored using the Hawaii DAR Commercial Fishermen's Catch Report data and Commercial Marine Dealer Report data. The tropical troll fisheries in American Samoa, Guam, and CNMI are monitored with a combination of Territory and Commonwealth creel survey and market monitoring programs, as part of WPacFIN.

Observer Programs

U.S. purse seine vessels operating in the WCPO under the Treaty on Fisheries between the Governments of Certain Pacific Island States and the United States of America (The South Pacific Tuna Treaty) pay for, and are monitored by, observers deployed by the Pacific Islands Forum Fisheries Agency (FFA). Monitoring includes both the collection of scientific data as well as information on operator compliance with various Treaty- related and Pacific Island country (PIC)-mandated requirements. These data are not described here. NOAA Fisheries has a field station in Pago Pago, American Samoa, that facilitates the placement of FFA-deployed observers on U.S. purse seine vessels.

Starting on January 1, 2010, the observer coverage rate in the U.S. purse seine fishery in the Convention Area has been 100%. The data collected under this arrangement by FFA-deployed observers are currently provided directly to the WCPFC.

Under the Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region established under the Magnuson-Stevens Fishery Conservation and Management Act, observers are required to be placed aboard Hawaii-based pelagic longline vessels targeting swordfish (shallow set, 100% coverage) and tunas (deep set, 20% coverage) and American Samoa-based longline vessels targeting tuna (deep set, 20% coverage).

The main focus of the longline observer program is to collect scientific data on interactions with protected species. The observer program also collects relevant information on the fish catch and on the biology of target and non-target species. Fish catch data collection now includes measurement of a systematic subsample of 33% of all fish brought on deck, including bycatch species. Prior to 2006, observers attempted to measure 100% of tunas, billfishes and sharks brought on deck, but not other species. Researchers use observer-collected protected species data to estimate the total number of interactions with those species.

For the U.S. longline fishery in the NPO, there were observers on 284 trips out of a total of 1,411 deep-set trips, as well as on all 42 shallow-set trips, resulting in coverage rates of 20.1% and 100%, respectively in 2016. For the American Samoa-based longline fishery, 2016 was the tenth full calendar year monitored by observers. The coverage rate was 19.4% for a total of 13 trips out of 67 trips. These coverage statistics are from 2016 reports of the NOAA Pacific Islands Regional Observer Program (PIROP) and are based on longline trips that departed with observers in calendar year 2016. Detailed information on the U.S. Pacific Islands Regional Observer Program can be found at: http://www.fpir.noaa.gov/OBS/obs_qrtrly_annual_rprts.html.

Per reporting requirements agreed to at WCPFC 11, Table 3 contains estimates on observer coverage in U.S. longline fisheries for 2016 in the WCPFC Area exclusive of the U.S. EEZ.

Table 3. Observer coverage in 2016 of the U.S. longline fisheries in the WCPFC Area exclusive of the U.S. EEZ. None of the 5 American Samoa trips exclusive of the U.S. EEZ in 2016 had observer coverage.

Fishery	Number of Hooks			Days Fished			Number of Trips		
	Total estimated	Observed	%	Total estimated	Observed	%	Total estimated	Observed	%
Hawaii and California-based	26,814,287	5,779,061	22	10,385	2,430	23	1,032	233	23
American Samoa	63,162	0	0	22	0	0	5	0	0

Fishery Interactions with Protected Species

Information on estimated fishery interactions with non-fish species by the Hawaii-based longline fishery during 2012–2016 is provided in Table 4. For the American Samoa-based component of the U.S. longline fishery, scientists have not yet provided rigorous estimates of the total interactions with protected species.

CMM 2011-01 requires CCMs to report instances in which cetaceans have been encircled by purse seine nets of their flagged vessels. In 2016, purse seine vessels reported 5 instances of interactions with 12 individual marine mammals. This included 1 spinner dolphin (*Stenella longirostris*) found dead in net, 8 false killer whales (all released alive), and 3 bottlenose dolphins (*Tursiops truncatus*) with condition information unknown. Interaction location and date were recorded by vessels in their logbooks, but are not included here for confidentiality reasons.

CMM 2011-04 requires CCMs to estimate the number of releases of oceanic whitetip sharks including their status upon release. For the U.S. purse seine fishery, limited observer data has been processed for 2016, and information available as of June 9, 2017 indicate that there were 50 oceanic whitetip sharks released in 2016. In the longline fishery, observer data indicate that 422 oceanic whitetip sharks were released (300 alive and 122 dead) in the Hawaii-based deep set fishery, 32 oceanic whitetip sharks were released (29 alive and 3 dead) in the Hawaii-based shallow-set fishery (100% observer coverage), and 169 oceanic whitetip sharks were released (106 alive and 63 dead) in the American Samoa-based fishery.

CMM 2012-04 requires CCMs to report instances in which whale sharks have been unintentionally encircled by purse seine nets of their flagged vessels. In 2016, purse seine vessels reported 19 instances (5 associated with drifting FADs and 14 on unassociated sets) of interactions with 19 individual whale sharks (*Rhincodon typus*), all released alive. Interaction locations were recorded by vessels in their logbooks, but are not included here for confidentiality reasons.

CMM 2013-08 requires CCMs to estimate the number of releases of silky sharks, including their status upon release. For the U.S. purse seine fishery, limited observer data has been processed for 2016, and information available as of June 9, 2017, indicate that there were 3,619 silky sharks released in 2016. In the longline fishery, observer data indicate that 488 silky sharks were released (335 alive and 153 dead) in the Hawaii-based deep set fishery (21% observer coverage), 2 silky sharks were released (alive) in the Hawaii-based shallow set fishery (100% observer coverage), and

380 silky sharks were released (224 alive and 156 dead) in the American Samoa-based fishery (22% observer coverage).

(226 alive and 77 dead) in the Hawaii-based deep set fishery (21% observer coverage), 1 silky shark was released (dead) in the Hawaii-based shallow set fishery (100% observer coverage), and 343 silky sharks were released (231 alive and 112 dead) in the American Samoa-based fishery (22% observer coverage).

Table 4. Estimated total numbers of fishery interactions (not necessarily resulting in mortalities or serious injury) with non-fish species by shallow-set and deep-set (combined) longline fishing in the Hawaii-based fishery during 2012–2016[2]. Estimates of total marine mammal interactions by the deep-set fishery in 2016 have not yet been completed; only the observed values are included here. Seabird CPUE (number per1000 hooks) are shown parenthetically for 2016.

Species	2012	2013	2014	2015	2016
Marine mammals					
Striped dolphin (S*tenella coeruleoalba*)	1	0	2	4	1
Common dolphin (*Delphinus delphis, D. capensis*)	0	0	1	0	0
Bottlenose dolphin (*Tursiops truncatus*)	1	13	4	2	2
Risso's dolphin (*Grampus griseus*)	0	3	6	13	2
Blainville's beaked whale (*Mesoplodon*	0	0	0	0	0
Bryde's whale (*Balaenoptera edeni*)	0	0	0	0	0
False killer whale (*Pseudorca crassidens*)	16	22	54	17	7
Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens)*	0	0	0	1	0
Humpback whale (*Megaptera novangliae*)	0	0	5	1	0
Shortfinned pilot whale (*Globicephala macrorhynchus*)	0	4	0	4	0
Spotted dolphin (*Stenella attenuate*)	0	0	0	0	0
Rough-toothed dolphin (*Steno bradenensis*)	0	6	0	0	1
Sperm whale *(Physeter macrocephalus*)	0	0	0	0	0
Northern elephant seal (*Mirounga angustirostris*)	0	1	1	0	0
Pygmy killer whale (*Feresa attenuate)*	0	5	0	0	0
Pygmy sperm whale (*Kogia Breviceps*)	0	0	10	0	0
Fin whale *(Balaenoptera physalus*)	0	0	0	1	0
Guadalupe fur seal (*Arctocephalus townsendi*)	0	0	0	0	1
Unspecified Mesoplodont beaked whale	0	1	0	0	0
Unspecified false killer or shortfinned pilot whale	5	0	0	6	0
Unidentified Cetacean (*Cetacea*)	7	3	13	0	2
Unidentified Pinniped *(Pinnipedia*)	0	0	0	3	0
Unspecified member of beaked whales (*Ziphiidae*)	0	1	0	0	1
Unspecified pygmy or dwarf sperm whales	0	0	0	0	0
Unspecified eared seal (*Otariidae*)	0	0	1	0	0
Total marine mammals	**30**	**59**	**97**	**52**	**17**
Sea turtles					
Loggerhead turtle (*Caretta caretta*)	5	16	13	24	23
Leatherback turtle (*Dermochelys coriacea*)	13	22	57	24	20
Olive Ridley turtle (*Lepidochelys olivacea*)	34	42	51	70	162
Green turtle (*Chelonia mydas*)	0	5	17	4	5
Unidentified hardshell turtle (Cheloniidae)	0	1	1	0	5
Total sea turtles	**52**	**86**	**139**	**122**	**215**

[2] 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 (http://www.fpir.noaa.gov/OBS/obs_qrtrly_annual_rprts.html) and Pacific Islands Fisheries Science Center Internal Reports IR-08-007, IR-09-011, IR-10-009, IR-11-005, IR-12-012, IR-13-014, IR-13-029, and IR-14-022. Hawaii-based longline logbook reported data on fish discards are available at http://www.pifsc.noaa.gov./fmsd/reports.php

Table 4. (Continued.)

Species	**2012**	**2013**	**2014**	**2015**	**2016 (CPUE)**
Albatrosses					
Blackfooted albatross (*Phoebastria nigripes*)	194	285	204	582	525 (0.0101)
Laysan albatross (*Phoebastria diomedia*)	163	282	113	164	192 (0.0037)
Total albatrosses	**357**	**567**	**317**	**746**	**717 (0.0139)**
Other seabirds					
Red-footed booby (*Sula sula*)	0	0	0	6	12 (0.0002)
Brown booby (*Sula leucogaster*)	0	0	0	0	0
Unidentified shearwater (Procellariidae)	36	45	8	21	21(0.0004)
Total other seabirds	**36**	**45**	**8**	**27**	**33 (0.0006)**
Observer information					
Total trips	1,380	1,379	1,380	1,525	1462
Observed trips	338	324	352	367	326
Proportion of trips observed	24.49%	23.50%	25.51%	24.07%	22.30%
Observed sets	4,966	4,742	5,180	5,410	4,658
Observed hooks	10,187,571	10,278,217	11,117,964	12,121,568	10,722,120

Port Sampling

Less than 2% of the fish caught by U.S. purse seine, and longline fisheries in the WCPO are measured (fork length) by NOAA Fisheries personnel as vessels are unloading in American Samoa and by SPC port samplers in ports where transshipping takes place. Species composition samples are also taken for more accurately determining catches of yellowfin tuna and bigeye tuna from U.S. purse-seine vessel landings.

Unloading / Transshipment

Information on the quantities transshipped and the number of transshipments by the U.S. longline and purse-seine fisheries in 2016 is provided in Table 5.

For the U.S. purse-seine fishery in the WCPFC Statistical Area in 2016, approximately 50% of the total landings of yellowfin, skipjack, and bigeye were transshipped to foreign ports for processing in 2016. There were an estimated 165 transshipments of purse-seine-caught fish in port in 2016, as compared to 263 transshipments in 2015.

There was no available information on transshipments for the longline fishery, albacore troll fishery, or any other HMS gear type in 2016.

Table 5. Information on quantities transshipped and numbers of transshipments of HMS species by U.S. purse seine fisheries in 2015 to satisfy reporting requirements of CMM 2009-06.

Gear Type		Purse Seine	
		Quantities Transhipped	Number of Transshipments
Offloaded	Transshipped in Port	104,799	165
	Transshipped at sea in areas of national jurisdiction	0	0
	Transshipped beyond areas of national jurisdiction	0	0
Received	Transshipped in Port	0	0
	Transshipped at sea in areas of national jurisdiction	0	0
	Transshipped beyond areas of national jurisdiction	0	0
Transshipped inside the Convention Area		104,799	165
Transshipped outside the Convention Area		0	0
Caught inside the Convention Area		208,652	165
Caught outside the Convention Area		10,824	0
Species	BET	1,966	
	SKJ	90,818	
	YFT	12,015	
Product Form	Fresh	0	
	Frozen	104,799	

Scientific Survey Data

Cooperative data collection program for North Pacific albacore. NOAA Fisheries has been collaborating with the American Fishermen's Research Foundation (AFRF) and the American Albacore Fishing Association (AAFA) on research and monitoring programs for North Pacific albacore. Since 1961, a port sampling program has employed state fishery personnel to collect size data from albacore landings made by the U.S. and Canadian troll fleets along the U.S. Pacific Coast. Since 2001 NOAA Fisheries and American Fishermen's Research Foundation (AFRF) have collaborated on an archival tagging program to study migration patterns and stock structure of juvenile (3-5 year old) albacore in the North Pacific. As of June, 2016, 1,043 archival tags have been deployed on albacore off the west coast of North America and 31 tags have been recovered. Two tagged albacore were recaptured in 2016. Both tagged fish were at liberty for approximately one year.

International billfish angler survey. NOAA Fisheries has been collaborating with the billfish angling community since 1963 to study various aspects of billfish biology and to obtain an index of angler success in the Pacific Ocean. The International Billfish Angler Survey, initiated in 1969, provides a greater than 40-year time series of recreational billfish angling catch and effort (number caught per angler fishing day), and is the only billfish survey independent of commercial fisheries in the Pacific Ocean. The main fishing areas include Hawaii, southern California, Baja California (Mexico), Guatemala, Costa Rica, Panama, Tahiti, and Australia.

Central and Western Pacific fisheries monitoring. WPacFIN collects and manages data from most of the U.S. central and western Pacific fisheries (Hawaii, American Samoa, Guam, and Commonwealth of the Northern Mariana Islands). This includes longline, skipjack pole-and-line, tropical troll, and tropical handline fisheries. In 2016, WPacFIN completed and published the 29th edition of Fishery Statistics of the Western Pacific (Lowe et al., 2016). Several years of quarterly and annual reports for the Hawaii-based longline fishery and the American Samoa longline fishery were also published in 2016.

Relevant Publications

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Dichmont CM, Deng RA, Punt AE, Brodziak J, Chang Y-J, Cope JM, Ianelli JN, Legault CM, Methot Jr RD, Porch CE, Prager MH, Shertzer KW. 2016. A review of stock assessment packages in the United States. Fisheries Research. 183:447-460. http://dx.doi.org/10.1016/j.fishres.2016.07.001.

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Research Activities

Biological and Oceanographic Research - TUNAS

Pacific bluefin tuna otolith microchemistry studies. To understand the temporal and spatial dynamics of Pacific bluefin tuna distribution throughout their life cycle including characterizing connectivity between western Pacific spawning grounds and foraging grounds in the WPO, EPO and SWPO, NOAA Fisheries is conducting collaborative studies with National Research Institute of Far Seas Fisheries in Shizuoka. These studies will focus on using multiple techniques to distinguish among spawning and foraging grounds throughout the Pacific including biogeochemical markers and morphometrics. Goals will be to (1) Identify and track chemical signatures in otoliths from young-of-the-year (age-0) PBF from both spawning grounds over multiple years using trace elements and stable isotopes; (2) Determine relative contribution of both spawning grounds to sub-adults (ages 1-3) collected throughout EPO and WPO and characterize variability over time by examining core signatures. (3) Identify and track chemical signatures at the outer margins of otoliths from Age 3+ fish on the foraging grounds (EPO, WPO) over multiple years. Samples are currently being processed and results should follow shortly.

Influence of hook type on catch of commercial and bycatch species in an Atlantic tuna fishery. In this study, experimental sets were conducted on a Taiwanese deep set-longline fishing vessel operating in the tropical Atlantic Ocean to evaluate the effects of relatively wide circle hooks vs. Japanese tuna hooks with respect to catch rates of both target and incidental species. On circle hooks there were significantly higher catch rates of bigeye tuna, yellowfin tuna, swordfish, and blue sharks as compared to tuna hooks. Significantly higher rates of albacore and longbill spearfish (*Tetrapterus pfluegeri*) were caught on Japanese tuna hooks as compared to circle hooks. Overall, 55 sea turtles were incidentally captured, most (n = 47) of which were leatherback turtles, and capture rates were similar between hook type. Immediate survival rates (percentage alive) when landed were statistically similar for all major target fish species and sea turtles independent of hook type. This international collaboration was initiated in direct response to regional fisheries management organization recommendations that encourage member countries to conduct experiments aimed to identify means to reduce bycatch in longline fishing gear (Huang et al., 2016).

Applications of Hawaii longline fishery observer and logbook data for stock assessment and fishery research. This NOAA report provides a detailed record of the primary analytical methods used for stock assessment and fishery research that have been applied to the operational and catch data collected from the Hawaii-based pelagic longline fishery by the Pacific Islands Region Observer Program (PIROP) and the National Marine Fisheries Service (NMFS) of NOAA Fisheries. The primary purpose of this memorandum is to document assessment-related research using the Hawaii longline data and also to provide a basis for the continued application and future improvement of analytical methods by serving as a user's manual. The contents of this report summarize data preparation, evaluation, and stock assessment analysis as conducted throughout two decades (1995-2015). The PIROP data include many operational fishing parameters that provide important information for conducting analyses such as standardizing the observed catch-per-unit-effort (CPUE) of pelagic fishes. The estimates of standardized CPUE using the operational parameters as covariates provide indices of relative stock abundance through time which, in turn, can be used as input information for conducting stock assessments. The PIROP data also provide information needed to measure the consistency of the self-reported logbook data, which comprise a much larger body of less detailed records using graphical and statistical methods of comparison between observer- and self-reported commercial longline data. Thus, the quality and interpretation of the information in the logbook database depends, to some extent, on the observer information (Walsh and Brodziak, 2016).

Climate change is projected to reduce carrying capacity and redistribute species richness in North Pacific pelagic marine ecosystems. This NOAA study investigates impacts of climate change on marine ecosystems, including fisheries, by using output from a suite of 11 earth system models to examine projected changes in two ecosystem-defining variables: temperature and food availability. In particular, researchers examined projected changes in epipelagic temperature and, as a proxy for food availability, zooplankton density. They find that under RCP 8.5, a high business-as-usual greenhouse gas scenario, increasing temperatures may alter the spatial distribution of tuna and billfish species richness across the North Pacific basin. Furthermore, warmer waters and declining zooplankton densities may act together to lower carrying capacity for commercially valuable fish by 2–5% per decade over the 21st century. These changes have the potential to significantly impact the magnitude, composition, and distribution of commercial fish catch across the pelagic North Pacific. Such changes will in turn ultimately impact commercial fisheries' economic value. Fishery managers should anticipate these climate impacts to ensure sustainable fishery yields and livelihoods (Woodworth-Jefcoats et al., 2016).

Ecological and economic consequences of ignoring jellyfish. This NOAA study investigates the fact that gelatinous zooplankton can dominate the dynamics of marine ecosystems; can have major ecological, social, and economic impacts; are often indicative of broader ecosystem perturbations; and are increasingly being harvested by humans. Yet fisheries scientists typically do not monitor these taxa on a regular basis, despite the existence of clear rationales and even mandated authorizations to do so. Notably, the costs of monitoring jellyfish during regular fisheries research cruises would be a small increase over the cost of running a large fishery survey and a small fraction of the costs caused by impacts from these taxa. As ecosystems experience increasing pressures from climate change and fisheries, the authors recommend considering routine monitoring before some future jellyfish-associated crisis arises (Brodeur et al., 2016).

The Transition Zone Chlorophyll Front updated: advances from a decade of research. The dynamic ocean feature called the Transition Zone Chlorophyll Front (TZCF) was first described 15 years ago based on an empirical association between the apparent habitat of loggerhead sea turtles and albacore tuna linked to a basin-wide chlorophyll front observed with remotely sensed ocean color data. Subsequent research has provided considerable evidence that the TZCF is an indicator for a dynamic ocean feature with important physical and biological characteristics. New insights into the seasonal dynamics of the TZCF suggest that in the summer it is located at the southern boundary of the subarctic gyre while its position in the winter and spring is defined by the extent of the southward transport of surface nutrients. While the TZCF is defined as the dynamic boundary between low and high surface chlorophyll, it appears to be a boundary between subtropical and subarctic phytoplankton communities. Furthermore, the TZCF is also characterized as supporting enhanced phytoplankton net community production throughout its seasonal migration. Lastly, the TZCF is important to the growth rate of neon flying squid and to the survival of monk seal pups in the northern atolls of the Hawaiian Archipelago. This paper reviews these and other findings that advance our current understanding of the physics and biology of the TZCF from research over the past decade (Polovina et al., 2017).

Biological Research – BILLFISHES

Effects of biological, economic and management factors on tuna and billfish stock status. Commercial tunas and billfishes (swordfish, marlins and sailfish) provide considerable catches and income in both developed and developing countries. These stocks vary in status from lightly exploited to rebuilding to severely depleted. Previous studies suggested that this variability could result from differences in life-history characteristics and economic incentives, but differences in exploitation histories and management measures also have a strong effect on current stock status. Although the status (biomass and fishing mortality rate) of major tuna and billfish stocks is well documented, the effect of these diverse factors on current stock status and the effect of management measures in rebuilding stocks have not been analyzed at the global level. This study demonstrates that, particularly for tunas, stocks were more depleted if they had high commercial value, were long-lived species, had small pre-fishing biomass and were subject to intense fishing pressure for a long time. In addition, implementing and enforcing total allowable catches (TACs) had the strongest positive influence on rebuilding overfished tuna and billfish stocks. Other control rules such as minimum size regulations or seasonal closures were also important in reducing fishing pressure, but stocks under TAC implementations showed the fastest increase of biomass. Lessons learned from this study can be applied in managing large industrial fisheries around the world. In particular, tuna regional fisheries management organizations should consider the relative effectiveness of management measures observed in this study for rebuilding depleted large pelagic stocks (Pons et al., 2016).

Blue marlin (Makaira nigricans) longevity confirmed with bomb radiocarbon. NOAA scientists are investigating the longevity parameters of blue marlin (*Makaira nigricans*) as they remain unresolved. The use of fin spines and sagittal otoliths for age reading has led to unconfirmed longevity estimates near 20 years. Age validation has been elusive because large individuals are rare and a technique that can be applied to structures that provide estimates of age was absent. Use of otolith chemical signatures has been limited by sagittal otoliths that are very small—whole otolith mass of adult blue marlin reach just 10 mg for the largest fish. Recent advances in the detection limits of radiocarbon (^{14}C) with accelerator mass spectrometry—coupled with recently acquired knowledge of marine bomb ^{14}C signals spanning the tropical Pacific Ocean—have led to an opportunity to age blue marlin from small amounts of otolith material. In this study, otoliths from a recently collected 1245 lb. (565 kg) female blue marlin at a measured 146 inches (371 cm) lower jaw fork length (LJFL) were analyzed for ^{14}C. Estimated longevity was either 17 ± 4 years or 38 ± 6 years based on ^{14}C bomb dating. Using multiple lines of evidence, it was hypothesized that the young age scenario was most likely, with evidence for an age closer to 20 years using a series of deductions in the bomb ^{14}C dating method (Andrews et al., 2017).

Biological Research – PELAGIC SHARKS

Blue shark electronic tagging studies. NOAA has been deploying satellite tags on blue sharks since 2002 to examine movements and habitat use in the eastern North Pacific. To date, a total of 100 sharks (51 males and 49 females) have been tagged with some combination of SPOT (n = 95) and/or PSAT tags (n = 60), with 55 sharks carrying both tag types. The majority of sharks were tagged in the SCB, although 14 sharks were tagged off Baja California Sur, Mexico, and another 12 off southwest Canada. While the sample size is too small to draw conclusions about differences in migration patterns, the two females with longer tracks were far to the south the following summer. Additional tracks will be needed to determine if these patterns are consistent for females and large males for migrations greater than one year, and if so, if they are related to sex or maturity. Data transmitted and recovered from the PSAT tags provide information on vertical and thermal habitat use. Blue sharks occupied waters from 4.4^{o} to 29.8^{o}C, with sea surface temperature ranging from 10.8^{o} to 29.8^{o}C.

Blue shark age validation studies. Age validation work on blue sharks in the northeast Pacific Ocean culminated in a 2016 publication which demonstrated that blue sharks lay down one vertebral band pair per year. Vertebrae from 26 blue sharks were used to validate 1 growth band per year for blue sharks for sharks of ages 1 to 8 years. Length-frequency modal analysis from 26 years of research and commercial catch data also supported annual band pair deposition in blue sharks. Annual research surveys provide an opportunity to tag animals with OTC. When the shark is recaptured and the vertebrae recovered, the number of bands laid down since the known date of OTC injection can be used to determine band deposition periodicity. Since the beginning of the program in 1997, more than 4000 individuals have been injected with OTC. During the 2016 surveys, 3 mako sharks, 1 blue shark, and 141 threshers were injected with OTC and released.

Research on Bycatch and Fishing Technology – SEA TURTLES

Active dispersal in loggerhead sea turtles. Few studies have explored how young at-sea turtles navigate their pelagic environment, but advancements in satellite technology and numerical models have shown that active and passive movements are used in relation to open ocean features. In this study, NOAA scientists simultaneously combine a high-resolution physical forcing ocean circulation model with long-term multi-year tracking data of young, trans-oceanic North Pacific loggerhead sea turtles during their ‘lost years’ at sea. For the years 2010 to 2014, researchers compared simulated trajectories of passive transport with empirical data of 1–3 year old turtles released off Japan (29.7–37.5 straight carapace length cm). After several years, the at-sea distribution of simulated current-driven trajectories significantly differed from that of the observed turtle tracks. These results underscore current theories on active dispersal by young oceanic-stage sea turtles and give further weight to hypotheses of juvenile foraging strategies for this species. Such information can also provide critical geographical information for spatially explicit conservation approaches to this endangered population (Briscoe et al., 2016).

Effects of a hook ring on catch and bycatch in a Mediterranean swordfish longline fishery. The purpose of this NOAA study was to investigate the effects of a circle hook ring on catch rates of target fish species and bycatch rates of sea turtles, elasmobranchs, and non-commercial fish in a shallow-set Italian swordfish longline fishery. Results were compared from 65 sets from 6 commercial fishing vessels totaling 50,800 hooks in which ringed and non-ringed 16/0 circle hooks with a 10° offset were alternated along the length of the longline. In total, 464 individuals were caught in the 4 years of experiment, with swordfish (*Xiphias gladius*) comprising 83% of the total number of animals captured. Catch rates of targeted swordfish were significantly higher on ringed hooks (CPUEringed hooks = 8.465, CPUEnon-ringed hooks = 6.654). Results indicate that ringed circle hooks captured significantly more small-sized swordfish than non-ringed circle hooks (27.7% vs. 19.5%, respectively). For species with sufficient sample sizes, the odds ratio (OR) of a capture was in favor of ringed hooks; significantly for swordfish (OR = 1.27 95%CI 1.04–1.57), and not significantly for bluefin tuna (Thunnus thynnus) (OR = 1.50, 95%CI 0.68–3.42) nor for pelagic stingray (*Pteroplatytrigon violacea*) (OR = 1.13, 95%CI 0.54–2.36). All 6 loggerhead turtles (*Caretta caretta*) and 3 of the 4 blue sharks (*Prionace glauca*) were captured on ringed hooks. Results from this study suggest that the addition of a ring to 16/0 circle hooks confers higher catchability for small-sized commercial swordfish, and does not significantly reduce catch rate of bycatch species and protected species in a Mediterranean shallow pelagic longline fishery. These findings should motivate fisheries managers to consider factors in addition to hook shape when aiming to promote sustainable fishing practices (Piovano and Swimmer, 2016).

Marine macrophytes and plastics consumed by green turtles. This study reports the first identification of marine macrophytes consumed by green turtles in Hong Kong, South China Sea: 6 red algae species (*Pterocladiella tenuis*, *Gelidium pusillum*, *Chondrus ocellatus*, *Gracilaria chorda*, *Grateloupia filicina*, and *Amansia glomerata*), 1 brown alga species (*Lobophora variegata*), and 1 sea grass (*Halophila ovalis*) were identified. Plastics and other foreign materials were also found in the stomach contents of 2 of the 8 individuals sampled (Ng et al., 2016).

Time in tortoiseshell: a bomb radiocarbon-validated chronology in sea turtle scutes. Some of the most basic questions of sea turtle life history are also the most elusive. Life span, maturity, population spatial structure, and growth rates can all be challenging variables to estimate, yet are critical in assessing conservation status. This NOAA study examines the ecological record in the keratinized hard tissues of the hawksbill (Eretmochelys imbricata) carapace and use bomb radiocarbon dating to assess growth and maturity. Scutes have previously been established to contain a reliable dietary record, and the large keratin deposits of hawksbills suggest scutes may contain additional ecological information. The authors sectioned, polished, and imaged posterior marginal scutes from 36 individual hawksbills representing all life stages, several Pacific Ocean populations, and spanning 70 years then fit von Bertalanffy Growth Function (VBGF) models to the results, producing a range of age estimates for each turtle. The find that hawksbills form 8 growth lines annually (range 5–14). For Hawaii hawksbills, model ensembles suggest a somatic growth parameter (k) of 0.13, with first breeding at 29 years (range 23-36). Bomb radiocarbon values from recent decades also suggest shifting trophic status, which may reflect the long-term declines in Hawaii coral reef ecosystems and factor in the critically low hawksbill population levels today (Van Houtan et al., 2016).

The developmental biogeography of hawksbill sea turtles in the North Pacific. High seas oceanic ecosystems are considered important habitat for juvenile sea turtles, yet much remains cryptic about this important life-history period. Recent progress on climate and fishery impacts in these so-called lost years is promising, but the developmental biogeography of hawksbill sea turtles (*Eretmochelys* *imbricata*) has not been widely described in the Pacific Ocean. This knowledge gap limits the effectiveness of conservation management for this globally endangered species. This NOAA study addresses this with 30 years of stranding observations, 20 years of bycatch records, and recent simulations of natal dispersal trajectories in the Hawaiian Archipelago. The authors find that hawksbills 0–4 years of age, measuring 8–34 cm straight carapace length, are found predominantly in the coastal pelagic waters of Hawaii. Unlike other species, they find no direct evidence of a prolonged presence in oceanic habitats, yet satellite tracks of passive drifters (simulating natal dispersal) and small sample sizes suggest that an oceanic phase for hawksbills cannot be dismissed. Importantly, despite over 600 million hooks deployed and nearly 6000 turtle interactions, longline fisheries have never recorded a single hawksbill take (Van Houtan et al., 2016).

Research on Bycatch and Fishing Technology – CETACEANS

Acoustically monitoring the Hawai`i longline fishery for interactions with false killer whales. This NOAA study presents the results of a field experiment on false killer whales (*Pseudorca crassidens*) which feed primarily on several species of large pelagic fish, species that are also targeted by the Hawaiʻi-permitted commercial deep-set longline fishery. False killer whales have been known to approach fishing lines in an attempt to procure bait or catch from the lines, a behavior known as depredation. This behavior can lead to the hooking or entanglement of an animal, which currently exceeds sustainable levels for pelagic false killer whales in Hawaiʻi. Passive acoustic monitoring (PAM) was used to record false killer whales near longline fishing gear to investigate the timing, rate, and spatial extent of false killer whale occurrence. Acoustic data were collected using small autonomous recorders modified for deployment on the mainline of longline fishing gear. A total of 90 fishing sets were acoustically monitored in 2013 and 2014 on a chartered longline vessel using up to five acoustic recorders deployed throughout the fishing gear. Of the 102 odontocete click and/or whistle bouts detected on 55 sets, 26 bouts detected on 19 different fishing sets were classified as false killer whales with high or medium confidence based on either whistle classification, click classification, or both. The timing of false killer whale acoustic presence near the gear was related to the timing of fishing activities, with 57% of the false killer whale bouts occurring while gear was being hauled, with 50% of those bouts occurring during the first third of the haul. During three fishing sets, false killer whales were detected on more than one recorder, and in all cases the whales were recorded on instruments farther from the fishing vessel as the haul proceeded. Only 3 of the 19 sets with acoustically-confirmed false killer whale presence showed signs of bait or catch damage by marine mammals, which may relate to the difficulty of reporting depredation. PAM has proven to be a relatively inexpensive and efficient method for monitoring the Hawaiʻi longline fishery for interactions with false killer whales (Bayless et al., 2017).

Abundance estimates of cetaceans from a line-transect survey within the U.S. Hawaiian Islands Exclusive Economic Zone. A NOAA ship-based line-transect survey was conducted during the summer and fall of 2010 to obtain abundance estimates of cetaceans in the U.S. Hawaiian Islands Exclusive Economic Zone (EEZ). Given the low sighting rates for cetaceans in the study area, sightings from 2010 were pooled with sightings made during previous line-transect surveys within the central Pacific for calculating detection functions, which were estimated by using a multiple-covariate approach. The trackline detection probabilities used in this study are the first to reflect the effect of sighting conditions in the central Pacific and are markedly lower than estimates used in previous studies. During the survey, 23 cetacean species (17 odontocetes and 6 mysticetes) were seen, and abundance was estimated for 19 of them (15 odontocetes and 4 mysticetes). Group size and Beaufort sea state were the most important factors affecting the detectability of cetacean groups. Across all species, abundance estimates and coefficients of variation range from 133 to 72,528 and from 0.29 to 1.13, respectively. Estimated abundance is highest for delphinid species and lowest for the killer whale (*Orcinus orca*) and rorqual species. Overall, cetacean density in the Hawaiian Islands EEZ is low in comparison with highly productive oceanic regions (Bradford et al., 2016).

Cetacean monitoring in the Mariana Islands Range Complex. Researchers at NOAA have been conducting visual surveys for cetaceans in the waters surrounding Guam and the Commonwealth of the Northern Mariana Islands (CNMI) as part of an ongoing effort to develop a record of cetacean occurrence in the region. Visual surveys have been conducted aboard small boats (7.6 – 12.2 m) since 2010 off the southernmost islands of the Mariana Archipelago (Guam, Rota, Saipan, Tinian, and Aguijan). These surveys include the collection of photographs for individual identification, tissue samples for genetic analysis of population structure, and the deployment of satellite tags for assessment of individual movements throughout the broader region. These surveys are conducted in partnership with the Commander, U.S. Pacific Fleet Environmental Readiness Division, which is mandated by Letters of Authorization and Biological Opinions issued under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA) to monitor cetaceans within the Mariana Islands Training and Testing (MITT) study area. Data sets from the small boat survey efforts are used to evaluate the distribution, stock structure, and movements of cetaceans within the study area. This report includes a summary of the most recent visual surveys that were conducted in the “winter” (March) and “summer” (May-June) of 2016 (Hill et al., 2017, Hill et al. 2016).

Using line acceleration to measure false killer whale click and whistle source levels during pelagic longline depredation. False killer whales (*Pseudorca crassidens*) depredate pelagic longlines in offshore Hawaiian waters. On January 28, 2015, a depredation event was recorded 14 m from an integrated GoPro camera, hydrophone, and accelerometer, revealing that false killer whales depredate bait and generate clicks and whistles under good visibility conditions. The act of plucking bait off a hook generated a distinctive 15-Hz line vibration. Two similar line vibrations detected at earlier times permitted the animal's range and thus signal source levels to be estimated over a 25-min window. Peak power spectral density source levels for whistles (4–8 kHz) were estimated to be between 115 and 130 dB re 1 $\mu Pa^2/Hz$ @ 1 m. Echolocation click source levels over 17–32 kHz bandwidth reached 205 dB re 1 μPa @ 1 m pk-pk, or 190 dB re 1 μPa @ 1 m (root-mean-square). Predicted detection ranges of the most intense whistles are 10 to 25 km at respective sea states of 4 and 1, with click detection ranges being 5 times smaller than whistles. These detection range analyses provide insight into how passive acoustic monitoring might be used to both quantify and avoid depredation encounters (Thode et al., 2016).

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