

INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC ADVISORY COMMITTEE

TENTH MEETING

San Diego, California (USA)

13-17 May 2019

DOCUMENT SAC-10-05

THE FISHERY ON FISH-AGGREGATING DEVICES (FADs) IN THE EASTERN PACIFIC OCEAN

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CONTENTS

1. FADs: characteristics and dynamics..... 2

2. Patterns of FAD distribution in the EPO 2

3. FAD depth 4

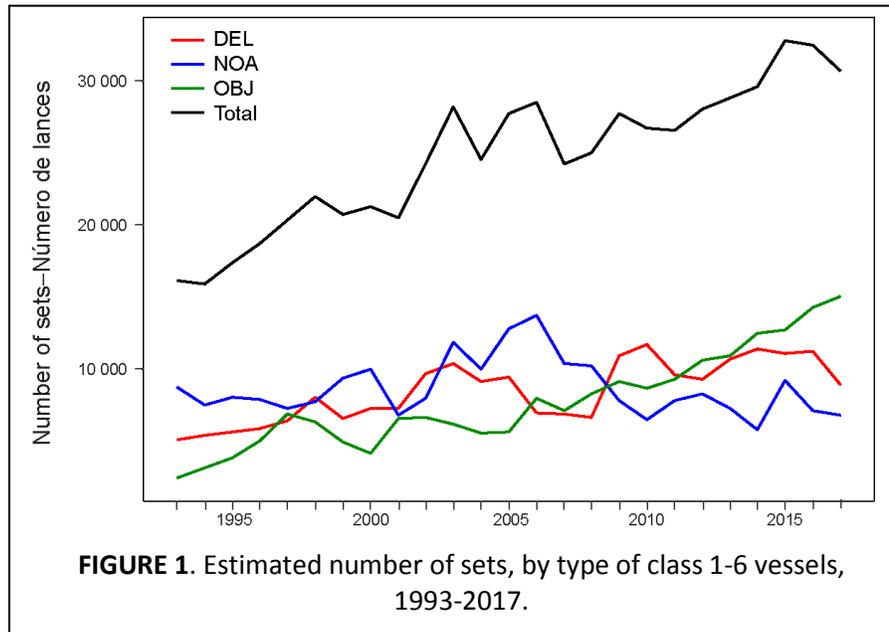
4. Definitions used in the bycatch section..... 4

5. Species compositions of captures in FAD sets..... 5

6. Bycatches 6

As part of their data collection duties, observers aboard purse-seine vessels record the characteristics and use of fish-aggregating devices (FADs), both those fabricated and deployed for the sole purpose of attracting fish and those that are improvised at sea from flotsam to which the fishers attach a variety of materials that will make them more attractive to the fish. In recent years, the proportion of objects deployed has grown, and the proportion of sets on objects encountered at sea is very low. The information presented in this document

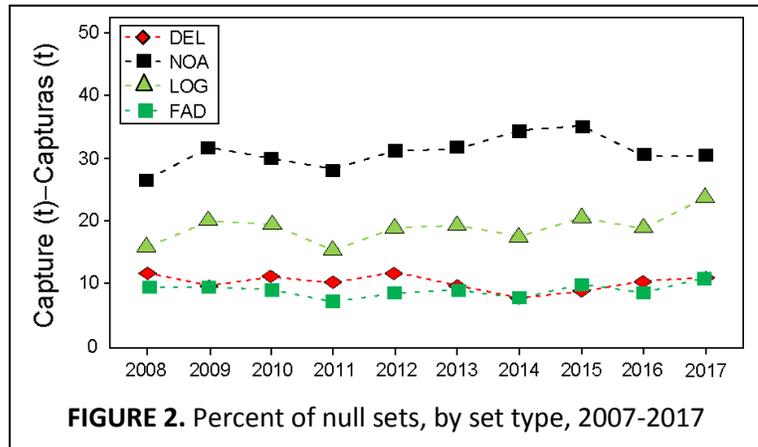
is based on observer records; as such, it is predominantly from Class-6¹ purse-seine vessels, but also includes data from a small number of Class-5 vessels that have carried observers. The database up



¹ Carrying capacity greater than 363 tons; Class-5 vessels are of carrying capacities between 273 and 363 tons

to 2017 is complete, so the results are provided up to that year.

After increasing to a historic high in 2015, the total number of sets of all types has declined in 2016 and 2017 (Figure 1). A decline in the number of dolphin sets, more than compensated for an increase in floating object sets. School sets were unchanged. Geographically, the fishery continued to expand its area mainly to the South.

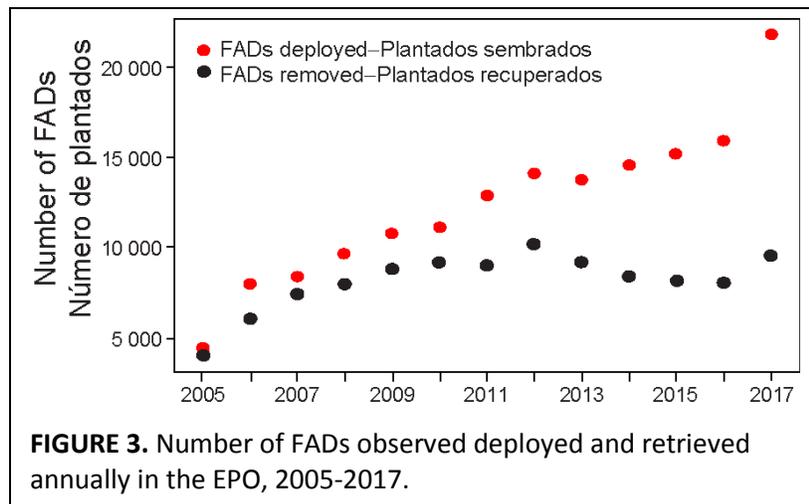


1. FADS: CHARACTERISTICS AND DYNAMICS

The number of null sets (without significant catches) has been monitored as a way to assess the impact of technological changes. No clear trends have been observed over the last decade (Figure 2).

FAD deployments: Figure 3 shows the deployments and retrievals of FADs

recorded by observers up to 2017. The total number of FADs deployed per year has had a very large increase in 2017 to well over 20,000, a new record level. But the jump from the steady growth of previous years is very significant. The number of FADs recovered has increased, but not in proportion to the increase in deployments, so the difference between deployments and recoveries has also grown significantly. This gap reflects a variety of situations: lost FADs, abandoned FADs, active FADs (including those entering the Western Pacific).

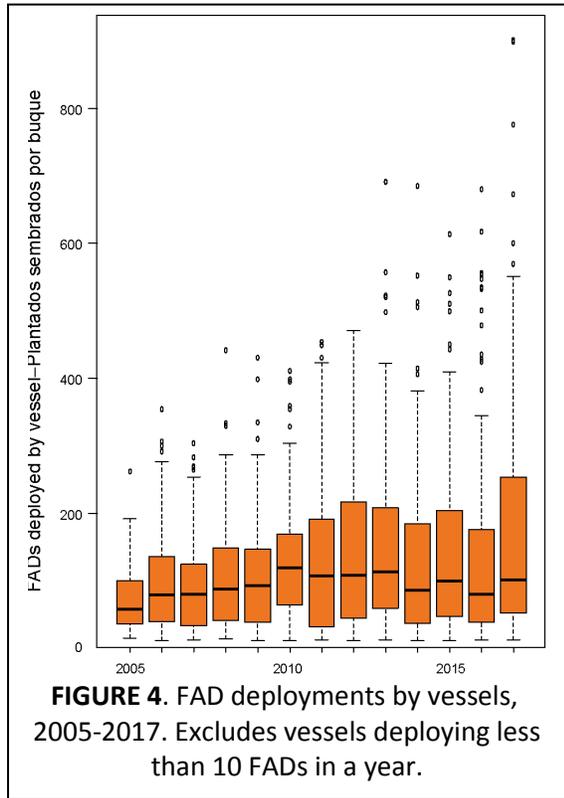


The IATTC staff has been evaluating options for enhanced monitoring and data collection regarding use of FADs that will be subject of ample discussions in other meeting such as the coming FAD Working Group, and the all-tuna-RFMO meeting. The box plots of the number of FADs deployed per vessel (Figure 4) shows a median close to previous years, but the tail on the high side is expanding, showing that the

increase in number of deployments comes from vessels with high numbers of deployments rather than all fleet increasing their averages.

2. PATTERNS OF FAD DISTRIBUTION IN THE EPO

In FAD deployments in the more recent period show an increase in activity off Peru in the first months of the year, reaching as far south as 20 S. In the second quarter, the fleet leaves the Humboldt area and the deployments move towards the Equatorial area, just along the Equator. Even though there are



deployments in the Galapagos region in this quarter, there are fewer now than in the earlier period. After June, the activity concentrates in the area west of Galapagos. Interestingly, a few trips to deploy FADs in the Humboldt system happen as early as August and September. The deployments off Peru show a major increase in the recent period going much farther to the south than previously, almost to 25 S. In November-December, the deployments in the Equatorial region decline, as many of the boats switch fishing to the Humboldt system.

Humboldt Current system: The season off Peru has the largest numbers of sets, grouped in the period October – March, reaching 25°S, mostly within 1,000 km of the coast, and outside the 200-mile boundary). The operations continue to be restricted to this season, but they are increasing in numbers, and cover a longer period. A warm-water tongue intruding from the north in the first quarter brings the more tropical species to these very productive waters. Surface current speeds in this system are slow, and FADs do not move long distances. The increase in the activity in this region reported before continues to intensify.

Galapagos system: This system occupies the area west of 85°W and east of 100°W between 3°N and 5°S. FADs are deployed here year-round, with the largest numbers deployed in June to November

Offshore Equatorial area: Deployments in this area, between about 100°W to the western boundary of the IATTC Convention Area at 150°W, occur North and South of the Equator. Some fleets fish this area all year round, while others enter this region when the Humboldt System season ends.

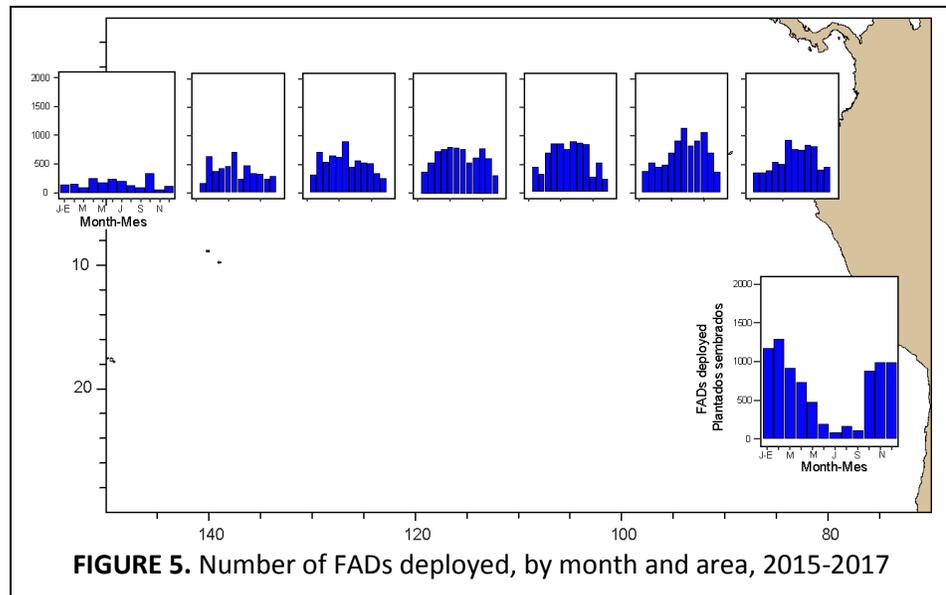


Figure 5 shows the number of FADs deployed, by month and region, during 2015-2017.

3. FAD DEPTH

After a period of relative stability, the median depth has increased after 2010. Boats fishing further to the west tend to have deeper nets because the thermoclines are deeper there (Figure 6). Again here there is an increase in the median depth, and an expansion of the upper side of the distribution. More boats are building deeper FADs. This increases the problems of entanglements, ghost fishing, and the negative responses when lost or abandoned FADs are potentially stranded on beaches or reefs.

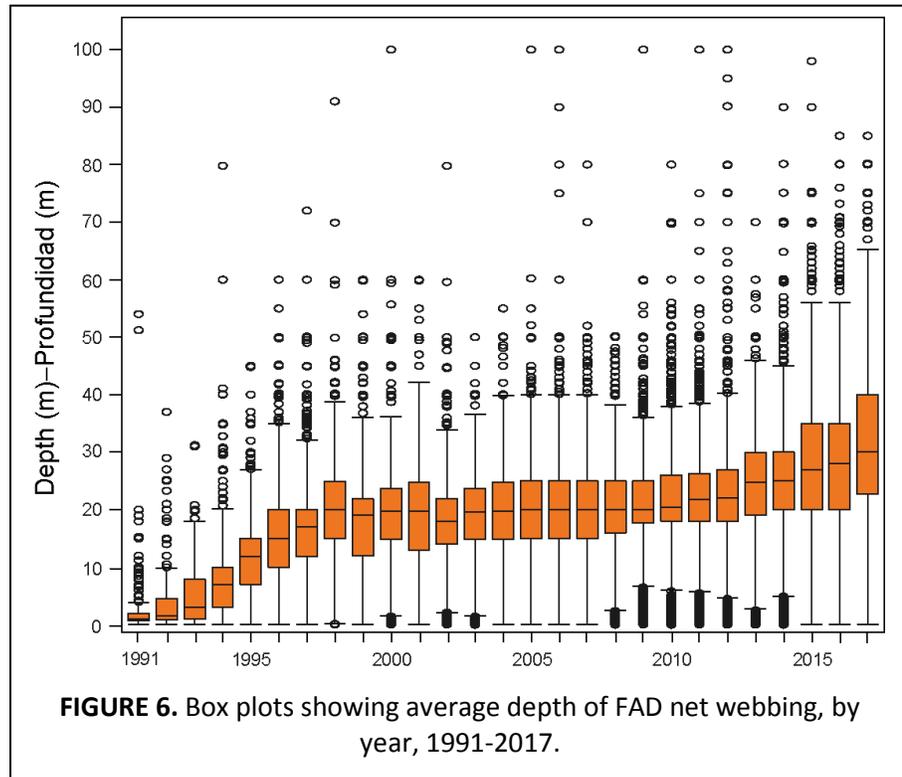


FIGURE 6. Box plots showing average depth of FAD net webbing, by year, 1991-2017.

4. DEFINITIONS USED IN THE BYCATCH SECTION

TOTAL CAPTURE, or CAPTURE for short, is the product of the physical action of encircling in the net (for a purse seine), and the action itself. It can be intentional or incidental (*e.g.* a whale may swim into the seine). The total number of individuals or biomass encircled of any species (target or not) is the CAPTURE. [Spanish: CAPTURA TOTAL]

CATCH or RETAINED CATCH is the portion of the CAPTURE that is retained for utilization by the crew (*e.g.* for food or bait) or sale. The CATCH can be legal or illegal, depending on the permits the vessel has. The bycatch section definitions of CATCH do not imply any recognition by IATTC of the legality of the operation; it is simply a statement of fact identifying the fate of a portion of the CAPTURE. [Spanish: CAPTURA RETENIDA]

BYCATCH is the portion of the biomass or the numbers of individuals encircled in the net that is not retained, and is discarded dead, either from the net or from the deck. The BYCATCH of the major tuna species object of the fishery is synonymous with DISCARDS, and it has been used that way in IATTC tables.

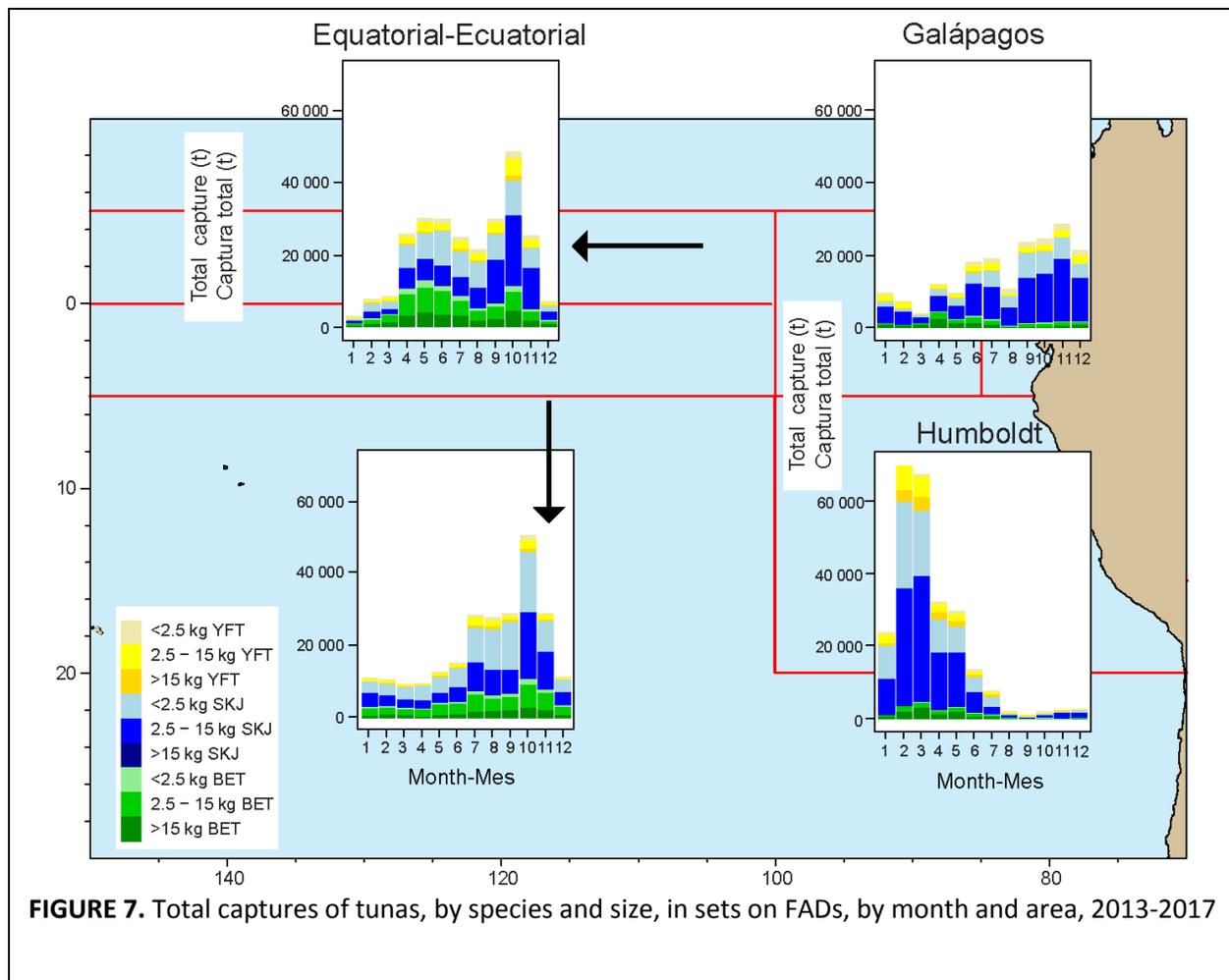


FIGURE 7. Total captures of tunas, by species and size, in sets on FADs, by month and area, 2013-2017

It is presumed to be dead, even if it is returned to the sea, so it is considered among the impacts of the fishery. [Spanish: MORTALIDAD INCIDENTAL or DESCARTES MUERTOS].

Individuals that are captured in the net intentionally or incidentally can be released alive. This fraction is called the RELEASE (e.g. almost all dolphins in dolphin sets) and they are not included in the BYCATCH because they are expected to survive their release. [Spanish: CAPTURA LIBERADA]

5. SPECIES COMPOSITIONS OF CAPTURES IN FAD SETS

Total tuna captures: Figure 7 shows aggregate FAD set captures in four regions, by size and species. These data are useful for management because they show that some species or sizes are absent or infrequent in some regions or periods, and it is possible to develop a spatial strategy to take advantage of that. In the Humboldt region, the predominance of catches in February – March is becoming more pronounced. Most of the catches in both Equatorial regions are of skipjack or medium/large yellowfin. The majority of the bigeye catches in the EPO come from these regions, so spatial management options could consider these figures. Small skipjack constitute the bulk of the Equatorial offshore captures for most of the year. We should clarify that when the categories small, medium and large were established, they were based on the yellowfin tuna, but applied to all tunas, so the category medium skipjack represents most of the larger sizes of skipjack taken.

6. BYCATCHES

Tuna bycatches (Discards): Tuna discards have continued to decline, and 2018 shows the lowest discards in the period covered by our database (1993-2018), at less than 1300 MT. The policies of retention (Resolutions [C-00-08](#), [C-13-01](#)) and the price of the contributed to this reduction. For comparison, at its peak in the late 1990's, the discards amounted to over 40,000 MT. On a per-set basis, discards amounted to 0.4 % in sets on floating objects, 0.2 % in school sets, and 0.0% (less than 0.05%) in dolphin sets. Skipjack constituted almost 75% of the discards.

Recent developments and current levels of bycatch: [Table 1a](#) shows observer data on total captures in numbers, average of 1993 – 2018, and [Table 1b](#) shows figures for 2018 for the main non-tuna groups (billfishes, sharks, mobulid rays, large pelagics). [Table 2a](#) shows the bycatches (dead discards) for the same time periods. This allows a comparison with the long-term averages and the most recent figures. Dolphins are excluded from these tables. Sea turtle mortalities have been 0 or 1 individual in recent years, and all of them were olive ridleys. The ease of their release has helped reduce the mortalities to very low values. The total captures were over 1300 individuals, including 4 leatherback sea turtles, the species of most concern.

Billfishes: All billfish species show discards of less than 100 individuals. There is a high level of utilization of these species.

Sharks: Almost 90% of the shark bycatches are silky sharks. The mortality declined to 24,172, from a much higher 33,357 in 2017. The vast majority of the sharks are taken in sets on floating objects: floating kelp patties in the north, and FADs or logs in the South. The mortality of oceanic whitetip sharks remains low (108 individuals), very far from the peaks of close to 9,000 in the mid 1990's. Almost all are caught on FAD and log sets.

Mobulid rays: These are species of conservation interest because their spatial stock structure is not well known, and although the total impacts may not seem high in populations widely distributed, local impacts may be significant. In spite of efforts to improve observer training in their identification, many remain unidentified. Improved release methods should allow us to correct the estimate of mortality, currently based on the assumption of no survival because of the characteristics of the previously used release techniques. These species are taken in roughly equal numbers in all types of sets. They are the second largest bycatch of species of conservation interest in dolphin and school sets.

Large pelagic finfish: The largest numbers in the bycatch, as usual, come from the group of large pelagic finfish species (mahi-mahi, wahoo, yellowtail, and rainbow runners). Utilization of these species has increased markedly, but still some individuals may be too small for the market. The use of improved sorting grids may help us reduce these discards.

TABLE 1a. Capture per set and observed total captures in numbers 1993 – 2018 average

All years (1993-2018)		Bycatch per set			Estimated total bycatch in the EPO			
Size class 6 only		DEL	NOA	OBJ	DEL	NOA	OBJ	All
Species								
Sailfish		0.070	0.091	0.012	676.92	486.30	80.77	1,244.00
Blue marlin		0.008	0.023	0.181	85.34	117.77	1,150.36	1,353.47
Black marlin		0.008	0.015	0.084	80.34	79.26	542.43	702.03
Striped marlin		0.009	0.021	0.020	96.51	110.98	137.28	344.76
Other/Unid billfish		0.010	0.013	0.032	94.83	61.49	219.78	376.10
Silky shark		0.191	0.617	3.770	2,024.65	3,344.56	26,123.20	31,492.41
Oceanic whitetip shark		0.007	0.025	0.303	86.45	146.38	2,014.31	2,247.15
Scalloped hammerhead		0.002	0.017	0.047	21.22	94.98	308.15	424.35
Smooth hammerhead		0.001	0.013	0.052	12.04	64.95	324.94	401.93
Other/Unid HH shark		0.006	0.025	0.078	58.15	157.90	522.25	738.30
Other/Unid shark		0.066	0.141	0.480	677.85	741.84	3,331.01	4,750.69
Giant manta		0.002	0.024	0.001	15.77	105.35	4.71	125.84
Spinetail manta		0.010	0.019	0.003	80.90	85.23	21.72	187.85
Chilean devil ray		0.004	0.006	0.001	32.36	26.49	5.17	64.02
Smoothtail manta		0.007	0.058	0.002	63.46	257.16	13.05	333.67
Munk's devil ray		0.002	0.007	0.001	16.85	32.09	3.56	52.50
Unid Manta/devil rays		0.043	0.200	0.012	379.19	1,199.64	81.66	1,660.49
Pelagic stingray		0.023	0.067	0.019	220.47	580.28	124.30	925.06
Other/Unid rays		0.002	0.000	0.000	15.77	1.31	0.73	17.81
Mahi mahi		0.041	1.460	66.860	371.61	7,678.49	434,325.56	442,375.67
Wahoo		0.021	0.149	33.657	206.07	814.56	215,399.11	216,419.75
Rainbow runner		0.002	0.193	10.442	13.62	850.27	66,369.70	67,233.59
Yellowtail		0.028	3.118	3.932	334.62	16,437.20	29,818.60	46,590.42
Other large fish		0.008	1.097	1.024	74.58	9,167.80	6,582.82	15,825.20

TABLE 1b. Bycatch per set and observed total captures 2018 in numbers

Year: 2018								
Size class 6 only (except dolphins)								
Species	Bycatch per set			Estimated total bycatch in the EPO				
	DEL	NOA	OBJ	DEL	NOA	OBJ	All	
Sailfish	0.047	0.018	0.002	463.63	74.38	18.02	556.02	
Blue marlin	0.009	0.009	0.098	86.12	37.61	1,169.17	1,292.90	
Black marlin	0.002	0.002	0.013	22.03	8.04	152.31	182.38	
Striped marlin	0.004	0.011	0.004	43.06	44.22	47.32	134.60	
Other/Unid billfish	0.041	0.028	0.068	400.55	118.13	814.38	1,333.06	
Silky shark	0.056	0.077	1.949	547.51	328.41	23,456.98	24,332.90	
Oceanic whitetip shark	0.000	0.000	0.009	1.00	0.00	107.33	108.33	
Scalloped hammerhead	0.000	0.002	0.015	4.00	9.01	175.21	188.22	
Smooth hammerhead	0.001	0.000	0.015	8.01	2.00	180.15	190.16	
Other/Unid HH shark	0.000	0.001	0.011	3.00	4.01	124.67	131.68	
Other/Unid shark	0.007	0.058	0.165	73.10	241.13	1,946.03	2,260.26	
Giant manta	0.000	0.002	0.001	1.00	7.00	11.26	19.27	
Spinetail manta	0.006	0.012	0.003	56.00	48.20	36.53	140.73	
Chilean devil ray	0.000	0.000	0.001	2.00	2.00	8.00	12.01	
Smoothtail manta	0.001	0.007	0.001	5.00	29.13	6.01	40.14	
Munk's devil ray	0.001	0.001	0.002	12.01	4.01	22.03	38.05	
Unid Manta/devil rays	0.017	0.032	0.013	169.15	134.36	150.90	454.42	
Pelagic stingray	0.013	0.015	0.021	123.10	61.23	249.24	433.58	
Other/Unid rays	0.000	0.000	0.001	0.00	0.00	11.01	11.01	
Mahi mahi	0.132	0.397	36.225	1,294.87	1,646.01	428,064.47	431,005.36	
Wahoo	0.001	0.056	9.548	9.01	234.56	113,093.55	113,337.11	
Rainbow runner	0.000	0.046	1.353	0.00	191.85	16,083.58	16,275.43	
Yellowtail	0.000	0.150	3.009	0.00	622.77	35,537.08	36,159.85	
Other large fish	0.001	0.007	0.259	5.01	31.07	3,071.36	3,107.44	

TABLE 2a. Total bycatches (Dead discards) Average 1993 – 2018 in numbers

All years (1993-2018) Size class 6 only (except dolphins)	Bycatch per set			Estimated total bycatch in the EPO			
	Species	DEL	NOA	OBJ	DEL	NOA	OBJ
Sailfish	0.021	0.044	0.006	191.80	217.96	40.07	449.84
Blue marlin	0.000	0.002	0.018	4.61	10.51	116.73	131.85
Black marlin	0.001	0.003	0.016	11.79	15.50	107.63	134.92
Striped marlin	0.001	0.002	0.004	7.26	10.75	25.49	43.50
Other/Unid billfish	0.002	0.003	0.007	18.89	13.63	53.74	86.26
Silky shark	0.088	0.398	2.768	885.16	2,141.58	18,432.71	21,459.44
Oceanic whitetip shark	0.005	0.021	0.272	62.17	122.23	1,796.90	1,981.30
Scalloped hammerhead	0.001	0.010	0.040	7.29	48.05	262.33	317.68
Smooth hammerhead	0.001	0.005	0.041	5.85	24.14	257.08	287.08
Other/Unid HH shark	0.002	0.015	0.062	25.32	87.32	410.32	522.96
Other/Unid shark	0.045	0.087	0.347	448.01	419.84	2,360.69	3,228.54
Giant manta	0.002	0.024	0.001	15.50	105.14	4.64	125.28
Spinetail manta	0.009	0.019	0.003	77.87	84.24	21.06	183.17
Chilean devil ray	0.004	0.006	0.001	30.16	26.10	5.01	61.27
Smoothtail manta	0.007	0.058	0.002	60.77	255.18	12.89	328.84
Munk's devil ray	0.002	0.007	0.001	16.00	31.87	3.56	51.43
Unid Manta/devil rays	0.038	0.194	0.012	341.85	1,158.32	79.55	1,579.73
Pelagic stingray	0.023	0.066	0.019	217.16	575.64	121.94	914.74
Other/Unid rays	0.002	0.000	0.000	15.77	1.04	0.73	17.54
Mahi mahi	0.009	0.605	31.592	82.87	3,158.30	206,535.69	209,776.86
Wahoo	0.006	0.043	13.328	73.53	262.74	86,440.36	86,776.63
Rainbow runner	0.001	0.144	9.815	8.68	627.49	62,275.56	62,911.74
Yellowtail	0.017	1.135	2.790	227.36	5,924.00	21,461.72	27,613.08
Other large fish	0.007	0.701	0.641	60.92	5,770.99	4,135.41	9,967.32

TABLE 2b. Total bycatches (Dead discards) 2018 in numbers

Year: 2018							
Species	Bycatch per set			Estimated total bycatch in the EPO			
	DEL	NOA	OBJ	DEL	NOA	OBJ	All
Sailfish	0.007	0.000	0.000	64.31	0.00	0.00	64.31
Blue marlin	0.000	0.001	0.001	1.00	4.02	7.84	12.86
Black marlin	0.000	0.000	0.000	0.00	0.00	0.57	0.57
Striped marlin	0.001	0.000	0.000	8.01	0.00	4.28	12.29
Other/Unid billfish	0.001	0.001	0.005	10.29	4.73	56.76	71.77
Silky shark	0.056	0.075	1.937	544.51	320.72	23,306.54	24,171.77
Oceanic whitetip shark	0.000	0.000	0.009	1.00	0.00	107.33	108.33
Scalloped hammerhead	0.000	0.002	0.015	4.00	9.01	175.21	188.22
Smooth hammerhead	0.001	0.000	0.015	8.01	2.00	180.15	190.16
Other/Unid HH shark	0.000	0.000	0.010	3.00	2.01	123.67	128.68
Other/Unid shark	0.007	0.058	0.161	69.87	241.13	1,905.38	2,216.38
Giant manta	0.000	0.002	0.001	1.00	7.00	11.26	19.27
Spinetail manta	0.006	0.012	0.003	56.00	48.16	36.53	140.69
Chilean devil ray	0.000	0.000	0.001	2.00	2.00	8.00	12.01
Smoothtail manta	0.001	0.007	0.001	5.00	28.76	6.01	39.77
Munk's devil ray	0.001	0.001	0.002	12.01	4.01	21.97	37.99
Unid Manta/devil rays	0.017	0.032	0.013	166.19	133.51	150.52	450.22
Pelagic stingray	0.012	0.013	0.021	119.97	53.15	244.96	418.08
Other/Unid rays	0.000	0.000	0.001	0.00	0.00	11.01	11.01
Mahi mahi	0.002	0.089	9.948	24.04	368.72	117,371.36	117,764.12
Wahoo	0.000	0.000	1.095	0.00	1.00	12,958.83	12,959.83
Rainbow runner	0.000	0.003	0.974	0.00	11.00	11,544.01	11,555.01
Yellowtail	0.000	0.065	2.103	0.00	271.00	24,818.85	25,089.85
Other large fish	0.000	0.006	0.063	4.00	23.07	747.34	774.42