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NATIONAL REPORT OF MEXICO: MEXICAN TUNA AND TUNA-LIKE FISHERIES IN THE NORTH PACIFIC OCEAN IN 2023

Instituto Mexicano de Investigación en Pesca y Acuacultura Sustentables (IMIPAS) and FIDEMAR

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SUMMARY

This national report describes the recent trends of the Mexican tuna fishery for the tuna and tuna-like species in ISC area.

In Mexico, the Mexican Institute of Sustainable Fisheries and Aquaculture Research (Instituto Mexicano de Investigación en Pesca y Acuacultura Sustentables, IMIPAS, formerly INAPESCA and INP), was created more than sixty years ago to systematically conduct scientific work and fisheries research with the marine resources of Mexico. The IMIPAS is responsible of providing the scientific bases for the management advice to the fisheries authorities in México and has stablished along its coastal states, in both, Pacific and Gulf of Mexico, 14 regional aquaculture and fisheries centers (CRIAPs) which are the centers and laboratories in charge of data collecting, sampling, monitoring and assessment of the main fisheries and aquaculture activities on a regional scale. Since 1992, the IMIPAS incorporated to this effort, the work of the National Tuna-Dolphin Program (Programa Nacional de Aprovechamiento del Atún y Protección del Delfín, PNAAPD of FIDEMAR), which closely monitors and study the tuna fishery of its purse seine and longline national fleets. The data here reported is based on the combined efforts from these different and unified groups.

1. SHARKS

Mexico participated in an 8-day hybrid workshop on data preparatory for the stock assessment of the North Pacific shortfin mako (*Isurus oxyrinchus*) in 2024, organized by the Shark Working Group (SHARKWG) of ISC. The workshop was held in Yokohama, Japan from November 29 to December 7, 2023 with virtual participation of the Mexican delegation though Microsoft Teams. In the workshop, delegates from Canada, Taiwan, the Inter-American Tropical Tuna Commission (IATTC), Japan, Mexico, and the United States of America (USA) participated

Mexico presented the working paper "Update on standardized catch rates for mako shark (*Isurus oxyrinchus*) in the 2006-2022 Mexican Pacific longline fishery based upon a shark scientific observer program" (ISC/23/SHARKWG-1/11), by José Ignacio Fernández-Méndez, Luis Vicente González-Ania, Georgina Ramírez-Soberón, José Leonardo Castillo-Géniz, and Horacio Haro-Ávalos. In this working paper abundance indices (Catch per unit of effort, CPUE) for shortfin mako shark in the mentioned region and period were estimated using data obtained through a pelagic longline observer program, updating similar analyses made in 2014 and 2021. Individual longline set catch per unit effort data, collected by scientific observers, were analyzed to assess effects of environmental factors such as sea surface temperature (SST), distance from land coast, including islands and time-area factors, year, area fished, quarter and fraction of night hours in the fishing set. Standardized CPUE were estimated by applying hurdle (delta) models. The first part of the model estimates the probability of a positive observation using a binomial likelihood, and a logit link function. The second part of the model (the "count" or "positive" model) estimates the mean response for those non-zero observations, assuming a negative binomial distribution with a log link function. The importance of factors included in the models were also discussed. The results of this analysis point at the abundance index trends being close to stability in most of the analyzed period, with a low value in the last year of the series.

The impact of environmental factors in the model used for the standardization of the Mexican CPUE, like SST primarily impacting catchability or population dynamic processes like recruitment or survival of pups instead, was discussed by the SHARKWG. The future use of spatiotemporal models as a method to improve the catch rates standardization was also recommended. The

convenience of this abundance index in the stock assessment in 2024 was suggested to investigate, due to the concern with the likely switch in targeting away from sharks towards swordfish around 2016 and thus potential change of catchability and selectivity.

In the present model, the presence/absence of swordfish in the catch of the fishing set was used as a predictor, as a proxy for the characteristics of the fishing set that result in increasing swordfish catch (like the use of light-sticks changes in the depth of the fishing set on which no data are available at present). The SHARKWG noted that although the presence of swordfish in the catch is negatively associated with shortfin mako shark CPUE, the standardization failed in "filtering" the effect of the target species shifting, resulting in a low CPUE value at the end of the series. One suggestion is to end the index in 2016, the year in which targeting appears to have started switching away from sharks with then concerned of eliminating this index from the end of the time series.

For the following stock assessment of the mako shark, Mexico updated its historical series of annual catches incorporating the years 2021–2023, which were provided by the Mexican administrative fisheries authority (CONAPESCA) based on official statistics that report specifically mako shark. The total historical mako shark catch provided by Mexico cover the period of 1976–2022 (Table 1). Mako shark catches in the Pacific have experienced a sustained gradual growth that began in 1990 with 287 t until 2020, when it reached the record figure of 1,877 t. In the following years, there was a decrease in the annual catches, reaching a minimum of 471 t in 2022. It's plausible that this decrease is related to the oceanographic phenomena of ocean warming that have been observed in recent years in that region.

In addition, it can be postulated that some effects of a possible change in fishing strategies in part of the Mexican fleet can be also involved. It appears that some fleets are increasing their proportion of night sets in an effort to catch other species (like swordfish), with an associated fall in catch of mako shark (Figure 1).

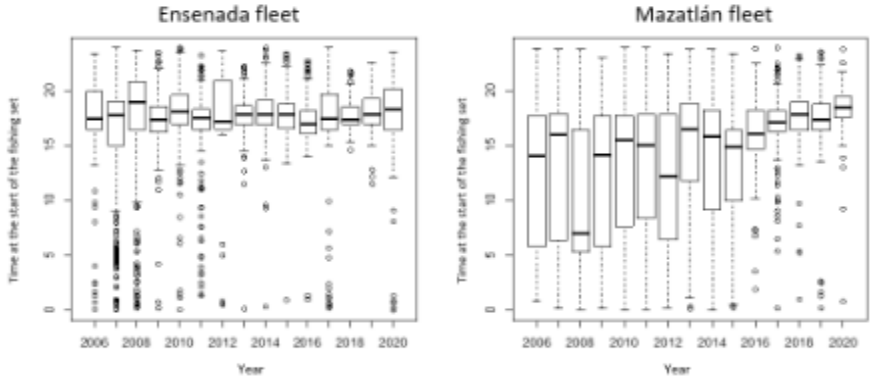

Fig. 1. Changes in time at start of the fishing set (from 0 to 24 hours) in the Ensenada and Mazatlán fleets, 2006-2020.

Mexican shark catch statistics by species were not available until 2006, so past blue shark catches had to be estimated. For the period of 1975 to 2006, estimations assume that mako shark havebeen represented in total catches with different proportions over time. The values of the blue mako catch proportions were obtained from diverse sources as published articles, grey literature, and more detailed local statistics (Sosa-Nishizaki, 2013) and catches provided by CONAPESCA (Sosa-Nishizaki and Castillo-Géniz, 2016). The main states where mako shark captures were reported in 2022 in the Mexican Pacific are: Baja California (BC) 60%, Baja California Sur (BCS) 3%, Sinaloa (SIN) 36%, and Nayarit (NAY) .3%.

Table 1. Historical series of annual catches (tons) of mako shark reported by State in the Mexican Pacific period 1976–2022. Sources: Period 1976–2014 Sosa-Nishizaki and Castillo-Géniz, 2016; Period 2015–2022 CONAPESCA.

Year	BC	BCS	SIN	NAY	COL	TOTAL
1976	13	53	6	1	0	73
1977	7	57	6	2	0	72
1978	7	85	6	5	0	103
1979	8	35	8	13	0	64
1980	16	35	1	12	1	65
1981	22	16	5	13	1	57
1982	36	25	5	9	1	76
1983	32	26	4	5	1	68
1984	21	19	4	4	2	50
1985	7	28	3	3	1	42
1986	16	41	3	6	20	86
1987	128	49	3	3	13	196
1988	151	80	2	2	12	247
1989	83	31	2	4	14	134
1990	170	87	3	4	23	287
1991	120	78	3	4	23	228
1992	221	129	3	4	19	376
1993	205	149	65	3	21	443
1994	180	94	34	3	24	335
1995	125	151	22	4	32	334
1996	180	157	44	3	29	413
1997	202	126	55	2	16	401
1998	226	106	38	4	14	388
1999	144	209	68	4	13	438
2000	255	176	88	10	10	539
2001	293	129	53	7	10	492
2002	282	110	78	6	12	488
2003	263	85	111	5	8	472
2004	412	118	318	7	9	864
2005	258	130	208	4	8	608
2006	268	112	252	3	5	640
2007	207	137	335	3	7	689
2008	244	156	197	5	7	609
2009	284	154	201	7	6	652
2010	257	293	199	8	4	761
2011	211	309	219	8	11	758
2012	243	245	205	14	7	714
2013	258	220	211	17	6	712
2014	531	394	466	75	1	1467
2015	296	957	375	25	0	1653

Year	BC	BCS	SIN	NAY	COL	TOTAL
2016	117	284	255	4	0	660
2017	322	350	263	1	0	936
2018	226	554	205	13	0	998
2019	508	748	502	37	0	1795
2020	293	1068	513	3	0	1877
2021	443.9	13.3	101.9	0.6	0	559.7
2022	285.7	13.8	170.4	1.6	0	471.5

Participation of Mexican scientists in ISC shark activities is a priority for Mexico but it has relied on web participation due to economic constraints.

Management

The most important aspect of shark conservation measures in Mexico, is a 3-month closure to all shark fisheries. The time closure was decided with the aim of covering as much as posible the reproduction period of shark species involved in Mexican catches.

2. SWORDFISH

Swordfish (*Xiphias gladius*) is a high valuable resource for the Ensenada and Mazatlan medium size longline fishing fleets. It is the only species reserved by law for the sportfishing with commercial fishing permits in the northwest of the Mexican Pacific. Commercial fishing is conducted outside of the fifty miles along the west coast of the Baja California Peninsula. The longline fleets catching swordfish also capture other resources like diverse pelagic and coastal shark species, tunas, jacks, and dolphin fish. An update table of catch information is presented in the following table.

Table 2. Swordfish catch

Year	Catch	Year	Catch	Year	Catch
1952	189.701383	1976	48.7803556	2000	3149.04296
1953	189.701383	1977	130.080948	2001	1018.96743
1954	108.40079	1978	612.464465	2002	140.921027
1955	200.541462	1979	233.061699	2003	813.005927
1956	476.963477	1980	579.944228	2004	1138.2083
1957	601.624386	1981	314.362292	2005	1333.32972
1958	764.225571	1982	336.04245	2006	1799.45312
1959	428.183121	1983	802.165848	2007	1203.24877
1960	265.581936	1984	666.66486	2008	1317.0696
1961	195.121422	1985	92.1406717	2009	1246.60909
1962	48.7803556	1986	726.285295	2010	1154.46842
1963	81.3005927	1987	959.346994	2011	926.826757
1964	140.921027	1988	1062.32774	2012	823.846006
1965	151.761106	1989	1192.40869	2013	1111.1081
1966	157.181146	1990	1376.69004	2014	1555.55134
1967	178.861304	1991	1804.87316	2015	1078.58786
1968	97.5607112	1992	1219.50889	2016	775.06565
1969	363.142647	1993	845.526164	2017	1105.68806
1970	482.383517	1994	325.202371	2018	1376.69004
1971	59.6204346	1995	373.982726	2019	1636.85193
1972	108.40079	1996	390.242845	2020	1772.35292
1973	130.080948	1997	368.562687	2021	695.746
1974	168.021225	1998	612.464465	2022	760.58175
1975	238.481739	1999	444.44324	2023	658.41825

3. TUNAS

In this region the Mexican fleet concentrates mainly in the yellowfin (*Thunnus albacares*), which is the prime target tuna species. The Mexican tuna purse seine fishery is one of the largest in the (ETP) since the mid 1980's. Due to its large volumes, YFT represents the main component of the catch by Mexico. Other tuna species that are also caught, but contrastingly in lower proportions are: the skipjack, (*Katsuwonus pelamis*), the black skipjack (*Euthynnus lineatus*) and more recently, in northerly zones of the Mexican EEZ, the bluefin (*Thunnus orientalis*) which is targeted by some vessels and sporadically the albacore (*Thunnus alalunga*). The fishing operations of the Mexican purse seine fishery comprise a vast area in the EPO, under the IATTC convention area.

The total tuna landings of Mexico in 2003 were 183199 mt. Catch which represents the highest historic record for this fishery. Comparatively, the lowest recorded capture in this fishery during recent years was in the 2006 season, with only 102472 mt., value which is closer to the 1980's development phase. After 2008, catch levels recovered. The fleet has compensated partially its catches primarily with skipjack.

These high consistent reported catches are the result of the combination of the fishing experience and performance of the fleet as well as the effect of high recruitments in previous years and are not related with any significant increase in the fishing effort or a greater expansion of its carrying capacity during the corresponding years. Lower catches in 2006 and 2007 are probably related to a decrease in population levels of yellowfin tuna (lower recruitment) and excessive catches of juvenile tunas in coastal areas in the EPO. In recent years catches have recovered to average levels.

The purse seine fleet is subdivided in purse seine vessels, most of them with observers on board all tuna fishing trips and a small quantity of pole and line vessels (Table 3). The whole fleet is quite stable in number, composition and carrying capacity since the 1990´s.

Yellowfin tuna always has been the primary catch, and skipjack is always second in volume. Other tuna species have high values because the fleet has compensated lower yellowfin catches with other tunas, basically with skipjack but a slight increase is related also with Bluefin tuna catches (Table 4).

Table 3. Size, composition and carrying capacity of the active Mexican tuna fleet from 2007 to 2020, in EPO and ISC area.

Year	**No. of active tuna boats**	**No. of m PSeiners > 400 m3**	**No. of PSeiners < 400 m3**	**No. of active Bait Boats**
2007	55	42	11	2
2008	49	39	8	2
2009	46	38	6	2
2010	42	36	3	3
2011	43	38	3	2
2012	45	39	3	3
2013	43	37	3	3
2014	47	42	3	2
2015	47	42	3	1
2016	47	42	3	1
2017	51	46	5	0

Year	No. of active tuna boats	No. of m PSeiners > 400 m3	No. of PSeiners < 400 m3	No. of active Bait Boats
2018	53	48	5	0
2019	51	46	5	0
2020	48	44	4	0
2021	51	46	5	0
2022	52	47	5	0
2023	53	49	4	0

Table 4. Total tuna landings of YFT, SKJ ALB by the Mexican fishery (2005-2020)

YEAR	YFT	SKJ	ALB	PBF
2005	113279	32985	0	4542
2006	68644	18655	109	9806
2007	65834	21970	40	4147
2008	85517	21931	10	4407
2009	99157	9310	17	3019
2010	101523	6090	25	7746
2011	102887	8600	0	2731
2012	93686	18259	0	6668
2013	113619	17185	0	3154
2014	120986	8777	0	4862
2015	106188	23497	0	3082
2016	93904	13286	0	2709
2017	80747	21400	0	3643
2018	102000	16700	0	2840
2019	106000	19700	0	2249*
2020	102295	7240	0	3285
2021	108043	7995	0	3027
2022	119555	15609	0	3194
2023	140853	10900	0	3407

*this amount includes 245 tons of PBF released alive

4. BLUEFIN TUNA

All the fishing zones for bluefin tuna used by the Mexican fleet are located in the Northwest side of the Baja California peninsula, within Mexico's Exclusive Economic Zone (EEZ), and have been closer to the ranching locations in recent years. Recorded catches of PBF are registered from march to September, time in which the transpacific migration of this stock is closer to the Mexican Pacific coast, due to oceanographic factors. Sea conditions together with the presence of the specie permitted the development of this new fishery predominantly related to ranching activities in the Mexican Northwestern coastal area. Temperature is an important factor defining areas were PBF is to be found. The fishing season has shifted from may-june to the first quarter in recent years (2019-2023).

The time series of bluefin tuna captured by the Mexican tuna purse seine boats from 2005-2022 is presented in Table 3 This represents a small proportion of the Mexican tuna catch, although very valuable. The 3,700 mt. catch reported in 1996 was the first historic highest record for this fishery and the first year bluefin tuna has been targeted by the fleet. Again, in 2004 and 2006 new records were established for this tuna specie in Mexico. In 2007 the catch returned closer to the average. In 2009 due to the international economic crisis many companies did not operate and catches were below average. In 2010 catches increased again and since 2012, management measures were implemented in IATTC area limiting the PBF catch. The catch in the Eastern Pacific nevertheless is below the historic highs observed in the 1960's and 1970's. The information provided makes clear that fishing for bluefin has not been a significant important activity in Mexico for many years. It also shows that even in some fishing seasons there were no captures on this stock, or those were only of low levels. Therefore, it is clear that fishing bluefin in Mexico was considered only oportunistic. However, for more than 25 years (1996-to present time) there has been a greater interest devoted to this species, mainly for the ranching activities developed in the Northwest region of Mexico.

The catches of bluefin for ranching are performed only with commercial purse seiners (normally searching for YFT) with a deeper purse seine net. Bluefin tunas are transferred from the purse seine net to "transfer" nets then to the enclosures and fattening nets located in northern Baja California peninsula.

There is also a US sport fishery that operates in Mexican EEZ that is reported by the US.

4.1. Effort

Only 6 vessels participated in the purse seine-farming fishery in 2023 plus 3 artisanal vessels that caught 8 tons.

4.2. Ranching Activities

Ranching activities started in 1996 but fully developed until 2001. Catch before 2012 (quotas implemented since that year) have been variable, making evident that oceanographic conditions and the eastern distribution of the specie are limiting factors for the Mexican bluefin fishery. In 2005, 2006 an estimated 80% of the catch was transported to the ranching companies and the other 20% went to the Mexican market. In recent years, all PBF is used in ranching activities. This represents an economic incentive for the Mexican tuna fishery and has a regional economic impact especially in northwestern Mexico.

The size composition of the PBF catch for farming is obtained from stereoscopic cameras that are used during transfer operations. Information is available, used to estimate size composition of the catch and shared with ISC as well as IATTC.

4.3. Management

Management of the tuna fishery is done within the framework of the IATTC. For tropical tunas the main aspect of regulation is a time closure and for PBF a Catch quota. The catch of PBF is closely monitored by 100% scientific observer's coverage on board all the fishing activities (both a national and IATTC observer programs). All information is reported and shared between observer programs and based on the quota and catch amount information is reported daily to Mexican authority and IATTC to ensure a quick response from managers and timing of the closure season. All catch is within catch limits established in current IATTC resolution C-21-05. Part of the PBF catch limit authorized for Mexico has been cut from the available amount for purse seiners in order to give permits for artisanal vessels. Very few permits have been authorized yet.

4.4. Research

Some of the research related to tuna and tuna like species can be obtained by contact with authors of documents published in “El Vigia” of the PNAAPD (see www.fidemar.org)

In relation to Close Kin program, Mexico is still collecting tissue samples, starting in 2016 and up to the present year

4.5. Climate Change

There is a small group of scientists in IMIPAS involved in climate change with the aim to incorpórate in stock assesments and management advice. IMIPAS has participated internally within the Mexican government to address this topic as well as in la iontergovernmental l latinamerican fórum.

ACKNOWLEDGEMENTS

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