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National Report of Mexico

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Mexico

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INTRODUCTION

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 National Institute of Fisheries and Aquaculture (Instituto Nacional de Pesca y Acuacultura, INAPESCA, Formerly INP), was created more than fifty years ago to systematically conduct scientific work and fisheries research with the marine resources of Mexico. The INAPESCA 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 fisheries centers (CRIPs) which are the centers and laboratories in charge of data collecting, sampling, monitoring and assesment of the main fisheries and aquaculture activities on a regional scale. Since 1992, the INAPESCA 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.

Tunas

In this region the Mexican fleet concentrates mainly in the yellowfin (<u>Thunnus albacares)</u>, 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. YFT represents for its large volumes the main component of the catch by Mexico. Other tuna species which are also caught, but contrastingly in lower proportions are: the skipjack, (<u>Katsuwonus pelamis</u>), the black skipjack (<u>Euthynnus lineatus</u>) and more recently, in northerly zones of the Mexican EEZ, the bluefin (<u>Thunnus orientalis</u>) which is targeted by some vessels and sporadically the albacore (<u>Thunnus alalunga</u>). 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 I). 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 2).

Table 1. 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
2018	53	48	5	0
2019	51	46	5	0
2020	48	44	4	0

Table 2. 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	3266

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, inside the ZEE of Mexico, 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 (2019-2021).

The time series of bluefin tuna captured by the Mexican tuna purse seine boats from 2005-2020 is presented in Table 2. This catch represents only a very small proportion of the total tuna caught by the Mexican. 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 being a foremost significant 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 incidental. However, more recently, in the 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.

Effort

There were 21 sets and 40 sets devoted to PBF catch in 2019 and 2020 respectively.

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, basically 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.

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.

Research

Since 1998 the INAPESCA and the PNAAPD have also organized an annual scientific meeting in Mexico to review the research activities developed by Mexican and other scientists. These studies are related with tunas, large pelagic and other oceanic species. Available information of those scientific meetings could be obtained directly from the authors listed in the journal "El Vigia" of the PNAAPD (see www.fidemar.org) that lists the presentation abstracts of every yearly meeting. That information is not a complete list of all research performed in Mexico related to those fishes and fisheries.

Mexico is participating in Close Kin sampling program. We have stored 750 tissue samples from 2016 to 2020.

Sharks

Annual catches of shortfin mako

During 2020 and early 2021, the Mexican Delegation collaborated with the SHARKWG, in the intermediate population assessment of the shortfin mako, *Isurus oxyrinchus*, providing annual fishery production data for the period 1976-2019 (Fig. 1) for the Mexican Pacific and split by coastal states where this species is caught. Industrial and artisanal fleets caught shortfin mako sharks with surface longlines along the west coast of Mexico (Castillo-Géniz et al. 2014, Godínez-Padilla et al. 2016). The annual catches for the period 1976 to 2013 were estimated following the methodology described by Sosa-Nishizaki et al. (2014 and 2017), and the annual production for the remaining period 2014-2019 was provided by the Mexican fisheries authority (CONAPESCA). The average annual catch of I. oxyrinchus in the Mexican Pacific during 43 years was 488 t, with the largest annual catch reported in 2019 with 1,795 t (Table 3). Since early 2000s, catches of the shortfin mako have grown steadily, especially along the western coast of the Baja California Peninsula and waters off the mouth of the Gulf of California (Godínez-Padilla, et al. 2016, Sosa-Nishizaki et al. 2017).

Several factors may be influencing this positive trend such as: 1) a better statistical record of shark catches, 2) the application since 2007 of new fisheries regulation measures for shark fishing, and 3) the expansion of traditional fishing areas. In the last 10 years, shortfin mako shark catches have exceeded one thousand tons. Baja California (BC) has been historically the state with the highest reported captures, which main fishing port is Ensenada (Godínez-Padilla et al. 2016).

Abundance index of shortfin mako

During the virtual workshop (webinar) held from February 22 to 26, 2021, Mexico presented an update of the abundance index of *I. oxyrinchus* in the northwest Mexican Pacific for the period 2006-2019 (González-Ania *et al.* 2021), updating similar analyses made in 2014 and 2017 (González-Ania *et al.* 2014, 2017). Individual longline set catch per unit effort data, collected by the Shark Observers Program (POT) were analyzed to assess effects of environmental factors, such as sea surface temperature, distance from mainland coast and time-area factors.

Standardized indices of relative abundance of mako shark were developed based on two generalized linear models (GLMs). The first model estimates the probability of a positive observation using a quasi-binomial likelihood to model any potential bias because of overdispersion (phi<>1), and a complementary log-log (c log-log) link function. The second model (the "positive" model) estimates the mean response for those non-zero observations, assuming that the error distribution is (in this case) lognormal. The final index is the product of the back-transformed year effects from the two GLMs (Fig. 2). The Delta model was set with the Delta-GLM function in R from SEDAR (2006).

The importance of sea surface temperature as an explanatory variable in the analysis, points to the potential utility of exploring other possible relationships between probability of catch or catch rate and mesoscale oceanic features.

In this updating, the detection of a significant relationship between probability of catch and the quarter:temperature (QUARTER:TF) interaction was due –at least in part– to the space-time scale used and it could be explained in terms of seasonal temperature variations.

Despite the lack of significance of the terms containing temperature (TF) in relationship with catch rate, temperature as main effect (TF) was retained in the model to allow the calculations involving the effects of the two models to proceed.

It is possible, however, that the relationships found between probability of catch and temperature may not only be due to specific temperature preferences by mako shark, especially because most of the sets analyzed occurred in waters with surface temperatures below 28°C, considered to be the thermal maximum for the distribution of this species (Castro 2011).

In addition to temperature, other environmental factors can affect the distribution and abundance of mako shark in the area of study. High primary productivity on the Pacific coast of the Baja California Peninsula is usually related to coastal upwelling activity that injects nutrients into the euphotic zone and could explain, at least in part, the significance of terms containing the distance to the coast (DF).

In the analysis, the interactions QUARTER:DF, QUARTER:ZONE, DF:ZONE had a significant relationship with catch rate pointing to the importance of specific seasons and areas of the Baja California peninsula, relatively near to the shore.

The results of this analysis point at the abundance index trends being close to stability in the analyzed period, taking into account the uncertainty involved.

Table 3. Annual production of short-fin mako shark, *Isurus oxyrinchus* in the Mexican Pacific coast by coastal states (1976-2019).

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
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

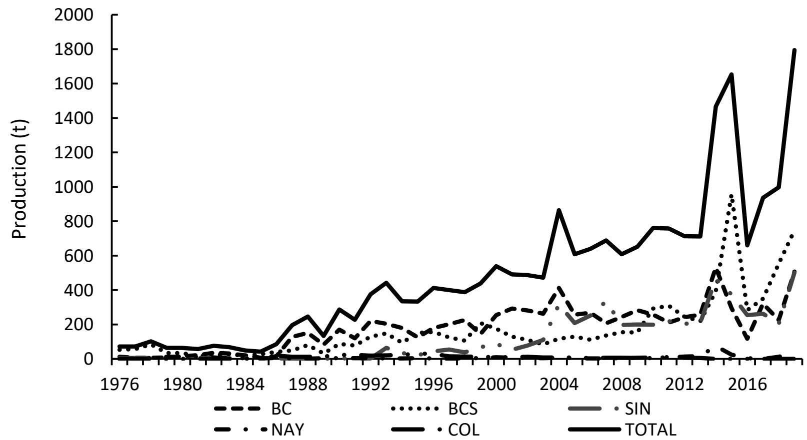

Figure 1. Estimated historical series of the annual production of short-fin mako shark, *Isurus oxyrinchus* in the Mexican Pacific coast by coastal states (1976-2019): BC= Baja California, BCS= Baja California Sur, SIN= Sinaloa, NAY= Nayarit, and COL= Colima

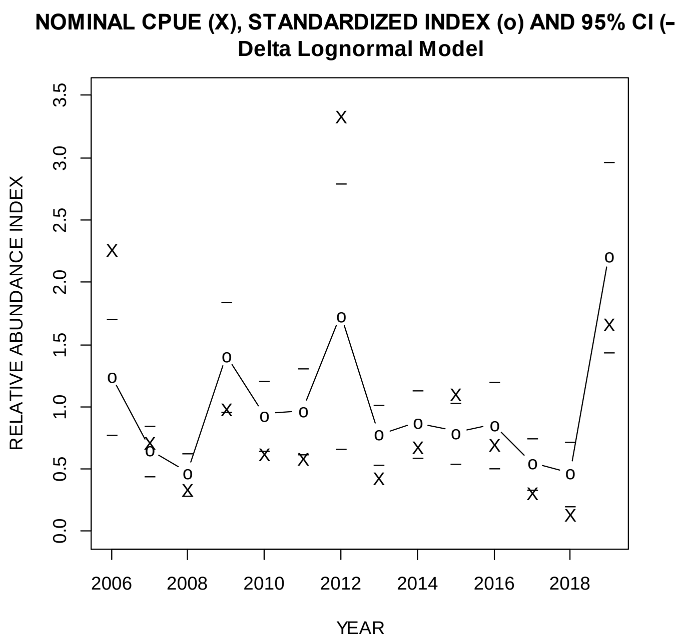

Figure 2. Relative abundance indices for shortfin mako with approximate 95% confidence intervals. Delta-Lognormal model for years 2006-2019.

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This document was elaborated by: José Leonardo Castillo-Géniz[1], M, Dreyfus-Leon[2], Horacio Haro-Ávalos[1], Luis Vicente González-Ania[1], José Ignacio Fernández-Méndez[1], Georgina Ramírez-Soberón[1] and Luis Fleischer[2]

1 INAPESCA

2 FIDEMAR