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PLENARY 08

20th Meeting of the
International Scientific Committee for Tuna
and Tuna-Like Species in the North Pacific Ocean
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July 15-20, 2020

NATIONAL REPORT OF MEXICO

Instituto Nacional de la Pesca y Acuacultura (INAPESCA)

July 2020

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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), 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 (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. 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, (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, (figure 1).

The recorded levels of tuna catches in the EPO area by the Mexican fleet from 1980 till 2019 are shown in figure 2.

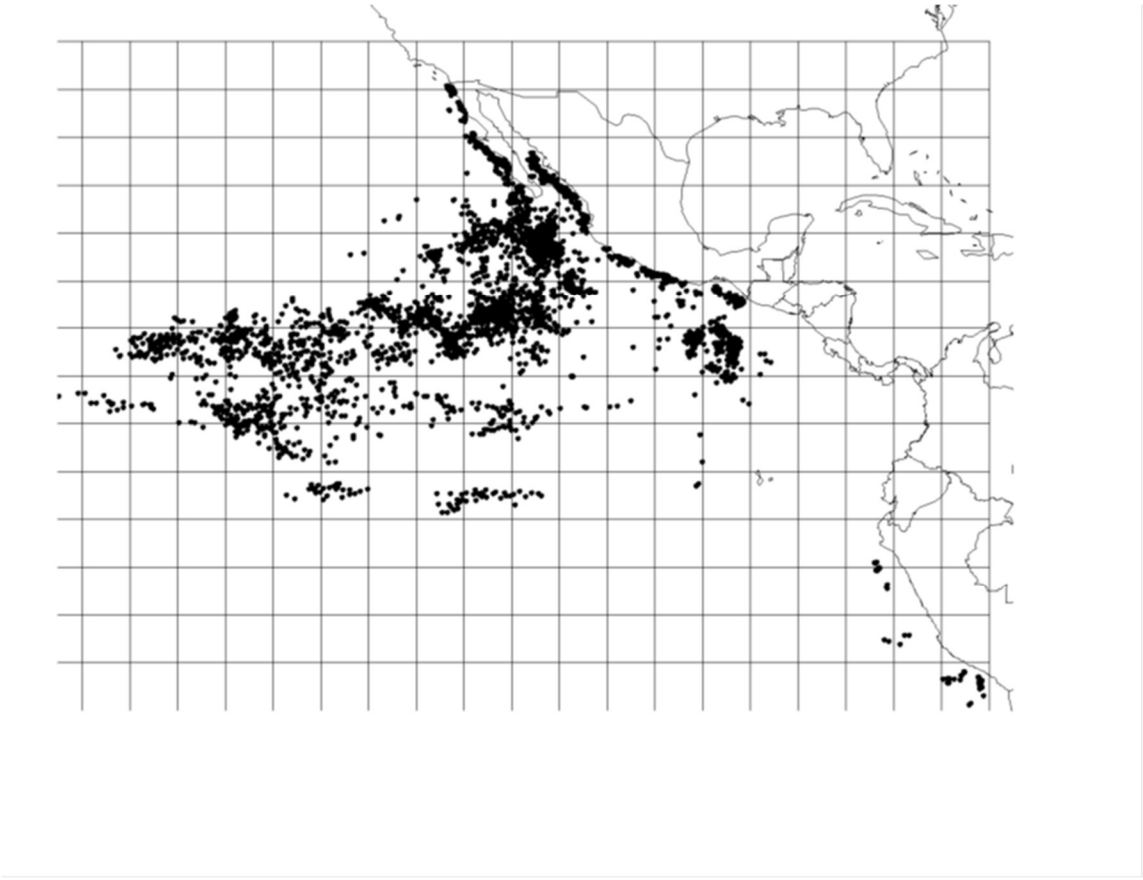


Figure 1. Fishing grounds of the Mexican purse seine fleet. 2017

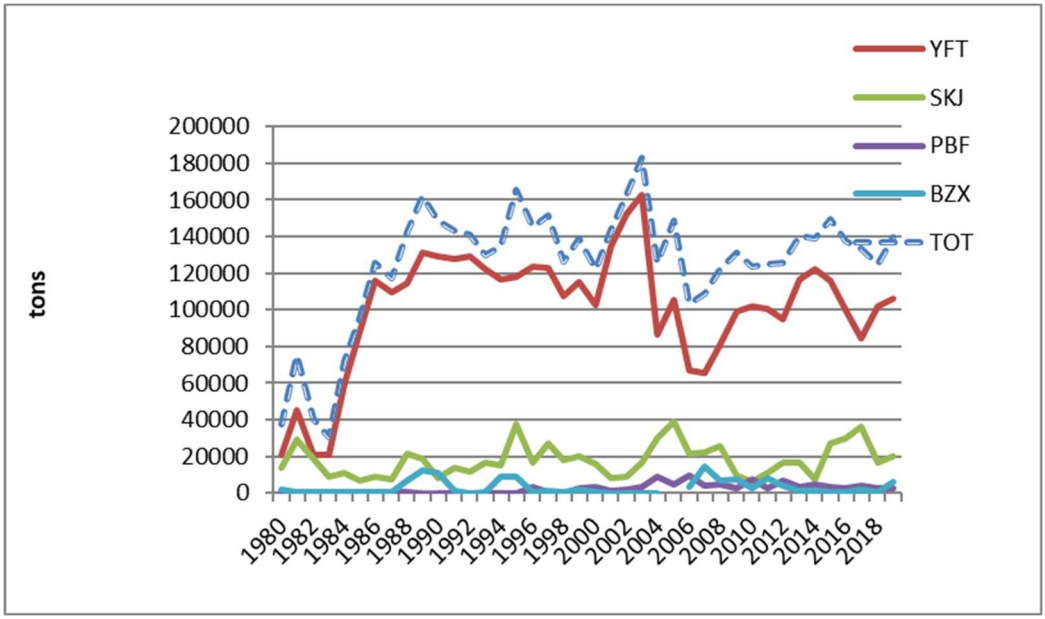


Figure 2. Mexican tuna catch of yellowfin tuna (YFT), skipjack (SKJ) and bluefin tuna (BFT), 1980-2019

The total tuna landings of Mexico in 2003 were 183199 mt. Value 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 2019, 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**

Table 2. Total tuna landings of YFT, SKJ ALB by the Mexican fishery (2005-2019)

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

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 (figure 3), 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 of the year in 2019.

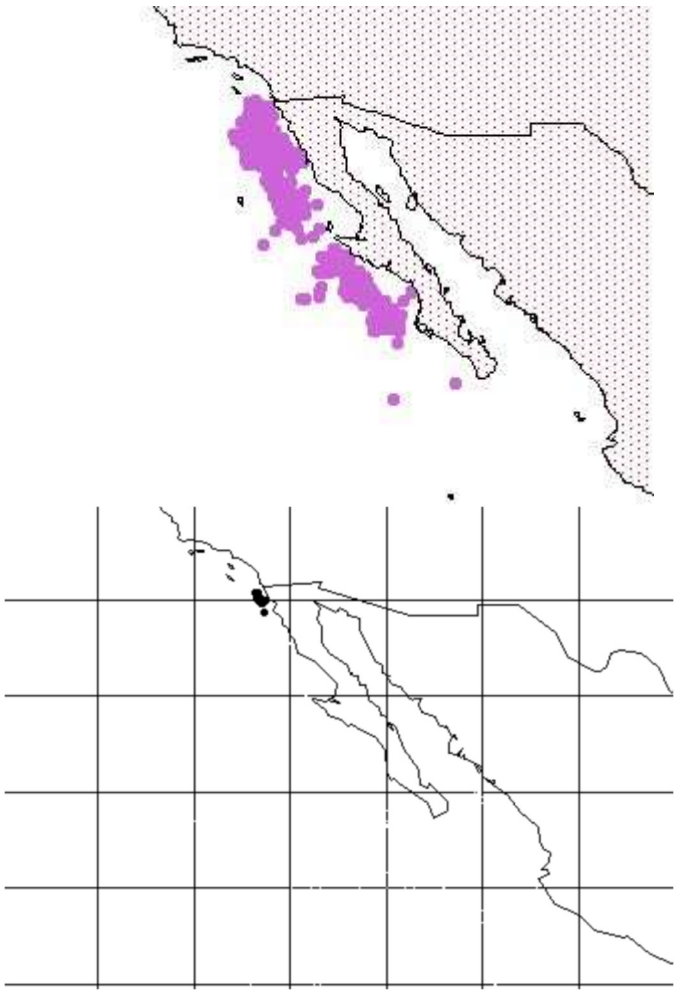


Figure 3. Fishing Zone for bluefin tuna in the Northwest region of Mexico, offshore the Baja California peninsula, several years top, and 2017 fishing ground bottom.

The time series of bluefin tuna captured by the Mexican tuna purse seine boats from 2005-2019 is presented in Table 3 and in figure 4, the 1980-2019 catch serie is shown. 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. 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.

Table 3. Bluefin tuna catch (t) of Mexico, 2005-2019

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
4542	9806	4147	4407	3019	7746	2731	6668	3154	4862	3082	2709	3643	2840	2249

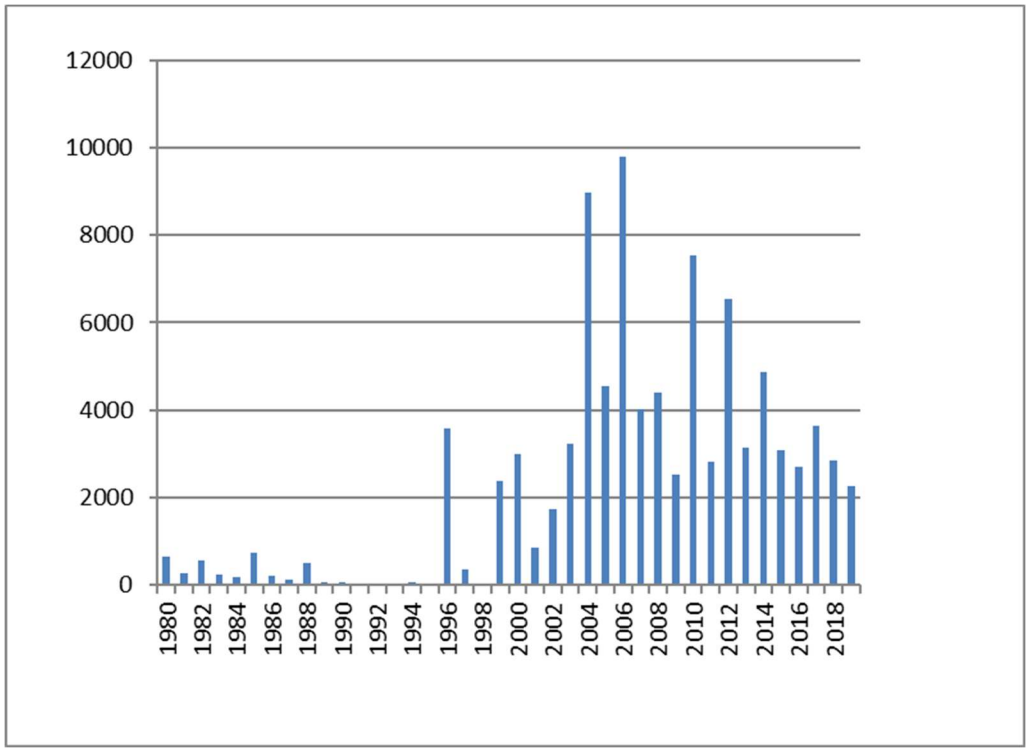


Figure 4. Mexican purse seine catch in the EPO (ISC area) from 1980 to 2019.

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 34 sets and 21 sets devoted to PBF catch in 2018 and 2019 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. In figure 5 size composition of the recent years is presented.

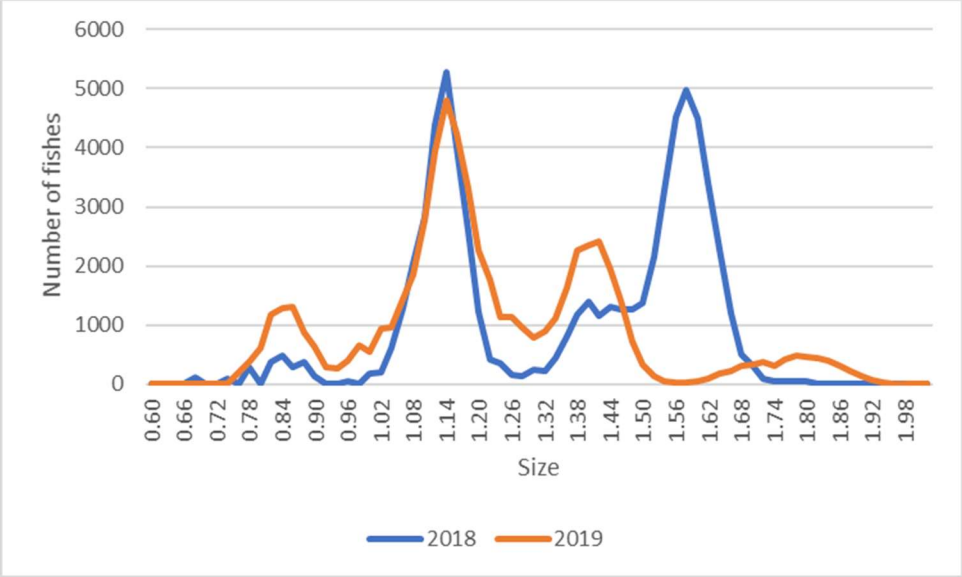


Figure 5. Size composition of Mexican catch 2018-2019

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 2019. The 2020 sampling will start in July.

SHARKS

The National Fisheries Institute of Mexico (INAPESCA) during the period 2019-2020 continued its efforts in monitoring shark catches and landings on the Pacific coast. Shark fisheries in Mexican waters continue to be a priority to the federal government in terms of research and management. Mexico continues collaborating in the Shark Working Group of ISC in the stock assessments of the blue shark, *Prionace glauca*, and the shortfin mako, *Isurus oxyrinchus,* that inhabits waters of the North Pacific.

Shark production is ranked 10th in Mexico´s national fishing total production; the average annual growth rate of production in the last ten years is 7.8%. In the period 1976-2017, the national annual average shark production (including small sharks) was 28,976 t, which placed Mexico among the central shark-producing countries in the world, according to Fischer et al. (2012). In 2017, the total national production of shark reached 42,704 t, which represented 1.96% of the total fishing production in Mexico, with a commercial value of more than three hundred million pesos. The average annual production of shark in the Mexican Pacific for the period 1976-2017 was 21,223 t. In 2017, Pacific shark production reached 34,746 t (figure 6), which constituted 80.12% of the total shark production in Mexico (SAGARPA, 2017).

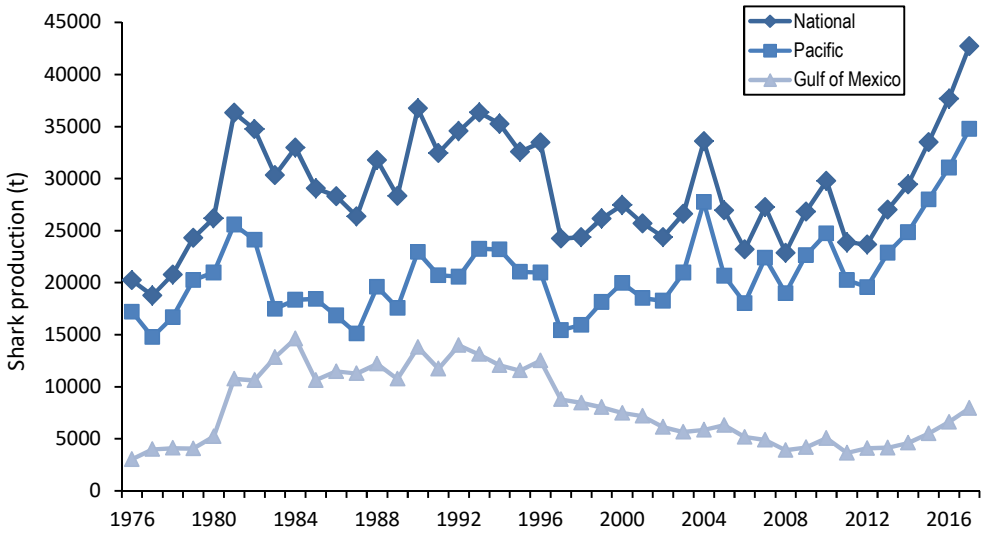


Figure 6. Historical shark (large+small sharks) production of Mexico period 1976-2017 broken down by regions. Source: Mexico´s Official Statistical Fishing Yearbooks.

Since 2007, Mexico has implemented numerous fishing management and conservation measures for sharks, including regulations for fishing equipment, fishing zone restrictions, annual temporary closures where shark fishing is not allowed, among others (DOF, 2007, 2012).

Shark fishery research

Since 2018 the INAPESCA continues the reproductive study of blue shark along the west coast of the Baja California Peninsula and the central Pacific region to determine the duration of the reproductive cycle in the northeastern Pacific. More than 500 sharks have been examined in 2.5 years with the collaboration of the commercial shark longline fleets of Ensenada and Mazatlán. Every shark has been examined following the methodology of Fujinami et al. (2017). More than 90 gravid females had been examined in the laboratory. Because of the shark closure during May-July of every year in Mexican waters, it has been difficult to obtain samples from that season, which is the courtship and fertilization period of the blue shark.

Age and growth studies

Isurus oxyrinchus

An update of growth estimations of *I. oxyrinchus* from the Mexican Pacific was presented by the Mexican delegation from the ISC at the 17th ISC meeting held in Shizuoka, Japan, from November 28 –4 December 2017. The study was based on standardized age estimations of 130 females (65–302 cm of total length, TL)

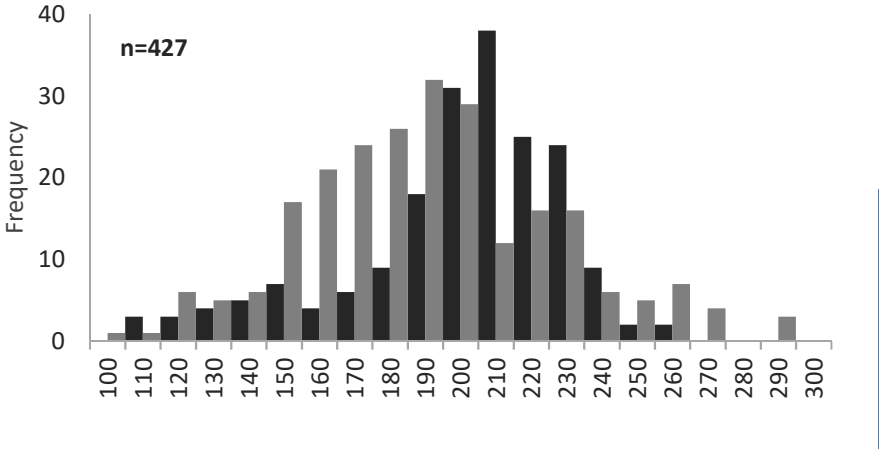
and 126 males (64–267 cm of TL), caught during 2001–2003 and 2008–2016 (Rodríguez-Madrigal et al. 2017a,b).

An increase of sample size from vertebrae of sharks caught during 2017–2019, as well as newly available information on vertebral intracolumn differences in centrum morphology (size and structure) and growth band counts (Natanson et al. 2018), made imperative a new update of age and growth estimations. Newly available samples include 102 vertebrae of 58 females ranged 117–219 cm of TL and 44 males of 88–187 cm of TL. All vertebrae have been processed following the standardized methods used previously by Rodríguez-Madrigal et al. (2017a,b). The precision of growth band counts, verification of growth band periodicity through marginal increment and edge analyses, and growth curves will be updated in the future after the inclusion of the newly available information.

Prionace glauca

A total of 578 vertebrae of *P. glauca,* caught in the Northwest of the Mexican Economic Exclusive Zone in the Pacific Ocean during 2017–2019, were obtained to re-estimate age and growth of the population in the region. The collection and process of the vertebrae were undertaken by INAPESCA in collaboration with the Fisheries Laboratory at the Mazatlán facilities of the Marine and Limnology Sciences Institute of the National Autonomous University of Mexico (UNAM).

Most of the samples (427) were obtained from the industrial vessels, including 190 females of 103–260 cm of TL ($\bar{x}$= 196 s.d.=30.85) and 237 males of 100–290 cm of TL ($\bar{x}$= 186 s.d.=36.19) (Fig. 2). Some Samples (151) were also obtained from artisanal vessels, including 82 females of 108–230 cm of TL ($\bar{x}$= 173 s.d.=25.2) and 69 males of 117–242 cm of TL ($\bar{x}$= 187 s.d.=30.03) (figure 7).



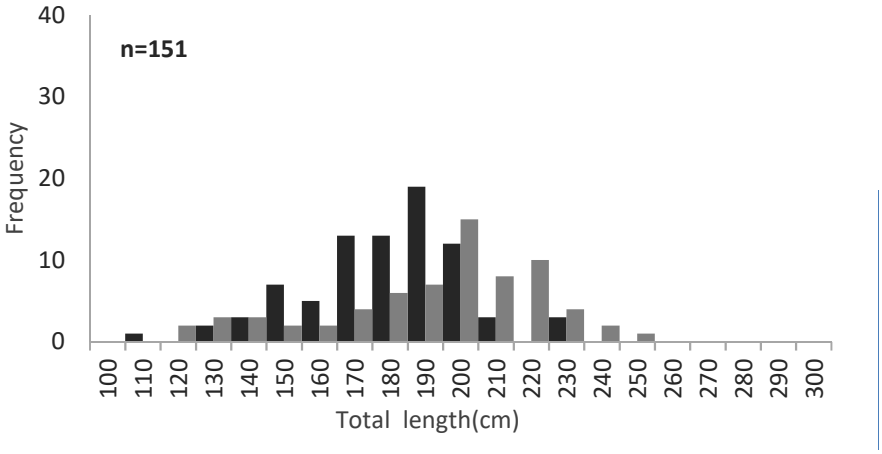


Figure 7. Size frequency of *P. glauca* vertebrae sampled from the landings of industrial (upper) and artisanal (lower) vessels, caught in Mexican Pacific waters. Females are represented by black bars and males by the grey bars.

The process of the vertebrae involved cleaning them manually with a scalpel and hot water and sagittal sections obtained with an Isomet low speed saw (Buehler), following digitalization with an Axiocam ERc 5s-5 MP camera adapted to a ZEISS Stemi 508 microscope, using the ZEN BLUE® program (figure 8a). Some vertebrae have also been processed with X-ray following the methods proposed by Officer et al. (1996) and Wells et al. (2013), to compare growth band counts obtained with different methods (figure 8b and 8c).

a)

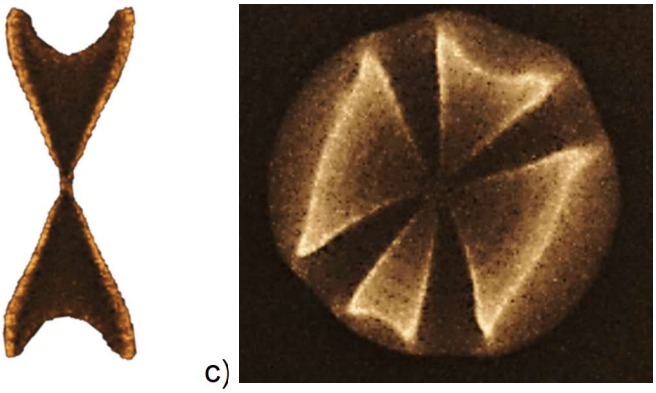


Figure 8. Sagittal section (a) of 500 µ and X-rays (sagittal, b, and transversal, c) of P. glauca vertebrae.

To estimate growth, several models will be adjusted in the future to the length-at-age data obtained, including traditional models such as von Bertalanffy, Gompertz, and logistic. Models recently developed that consider the cost of reproduction (Minte-Vera et al. 2016) or with a stochastic approach (Troynikov y Walker 1999, Tovar Ávila et al. 2014) will also be considered.

Indices of relative abundance

The results of a previous analysis made in the Mexican Pacific showed a reduction in the standardized abundance indices of blue shark in the ten-year period 2006 – 2015 (Fernández-Méndez et al. 2016). However, it was noted that most of this decrease happened in the last two years of the series, when an ENSO event occurred, so it was proposed that the results of the analysis should be considered within the context of biology of the species and the concurrent oceanographic events in the area. Population structure of blue shark is known to be complex, with different life history and habitat preferences by size class and sex. The longline fishery for sharks in the northwestern Mexican Pacific operates in two regions with different oceanographic and biogeographical characteristics: The temperate California Current System at the north and tropical waters southward. Size and sex composition of the blue shark is quite different in those areas.

In view of this, the standardized abundance indices of the blue shark were updated for the 2006-2018 Mexican Pacific longline fishery, modeling relative abundance indices trends for the northern (temperate) and southern (tropical) zones separately, to assess the relative importance of the concurrent ocean warming episode to explain variations in the abundance indices of both zones (Fernández-Méndez et al. 2019). Several predictor variables (related to environmental factors and fishing strategies), not included in the previous analysis, were considered as having a possible influence on the variation of the response variable. Three different GLM models (with Gamma, Negative-binomial and Log-normal error structures) were set for each zone as a function of these

factors. The proportion of zero-catch sets is around 3% in the northern zone and 10% in the southern zone.
In the preliminary results, the inclusion of the additional variables (to the ones used in the previous standardization) results in more stable standardized abundance indices. Recommendations made by members of the Working Group, regarding methods of model selection will be incorporated in coming analysis.

Shark Working Group

The Mexican delegation on sharks participated remotely (video-conference) during 2019 and 2020 in two inter-sessions webinars (November 6, 2019, and March 3, 2020, and in a working group meeting (December 4-10, 2019). During the first webinar, Mexico agreed to the proposal to change the stock assessment cycle for blue shark and shortfin mako shark from 3 to 5 years. We also agreed that the SHARKWG conduct the update of the stock assessment using future projection of stock synthesis with updated catch data in the years following the last benchmark stock assessment. For the mid-term stock assessment of the blue shark, Mexico provided the annual catches for the period 2015-2018. For the blue shark data preparation meeting in 2019, Mexico provided a complete blue shark historical caught size structure (2006-2018).
During the working group meeting, Mexico presented an updated abundance index (CPUE standardization) for the blue shark.
Regarding future collaborations, Mexico agreed with Japan, Taiwan, and the USA to start a study on stable isotope analysis during 2020 to investigate the spatial distribution of the blue shark in the North Pacific Ocean. Mexico has already initiated the official procedures with the national environmental authorities to request permission to provide 50 tissue muscle samples for the isotope study.

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