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National Report of Mexico

Instituto Nacional de Pesca (INAPESCA)

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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 Aquaculture and Fisheries (Instituto Nacional de Acuacultura y Pesca, INAPESCA, Formerly INP), was created more that 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 monitored 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).

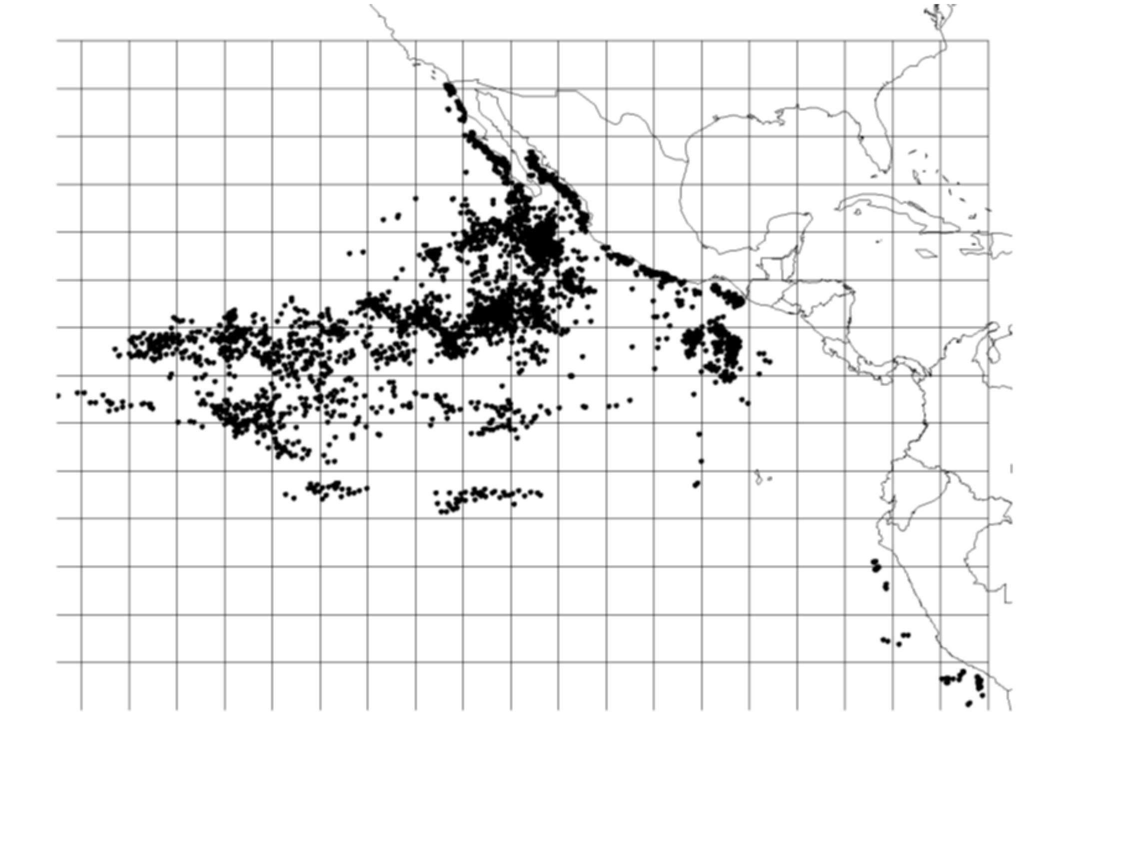

Figure 1. Fishing grounds of the Mexican purse seine fleet. 2017

The recorded levels of tuna catches in the EPO area by the Mexican fleet from 1980 till 2017 are shown in figure 2.

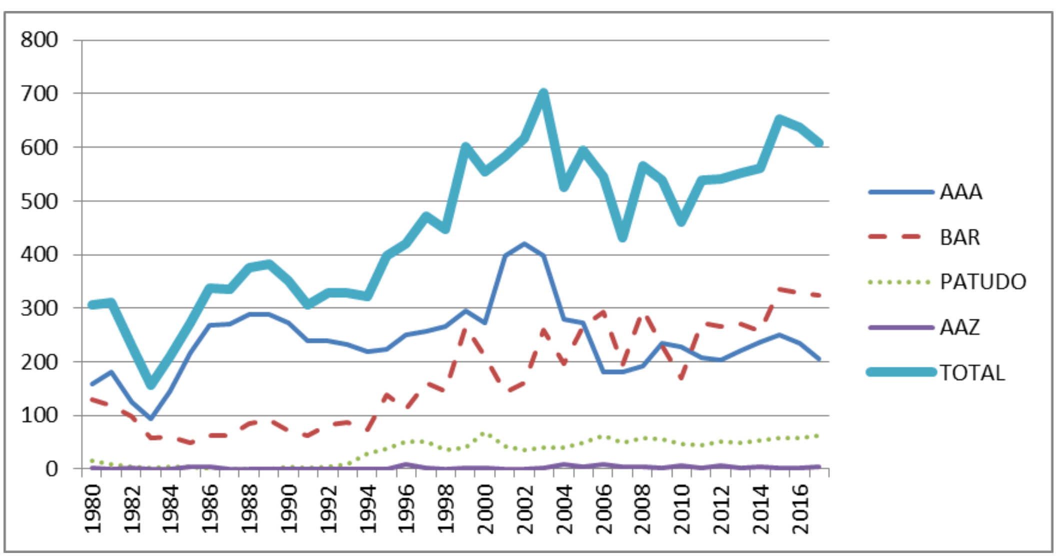

Figure 2. Mexican tuna catch of yellowfin tuna (YFT), skipjack (SKJ) and bluefin tuna (BFT), 1980-2017

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 2018 catches are improving probably due to higher recent recruitments.

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 2017, 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

Table 2. Total tuna landings of YFT, SKJ ALB by the Mexican fishery (2005-2017)

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

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. In recent years fishing season started later (may-june)

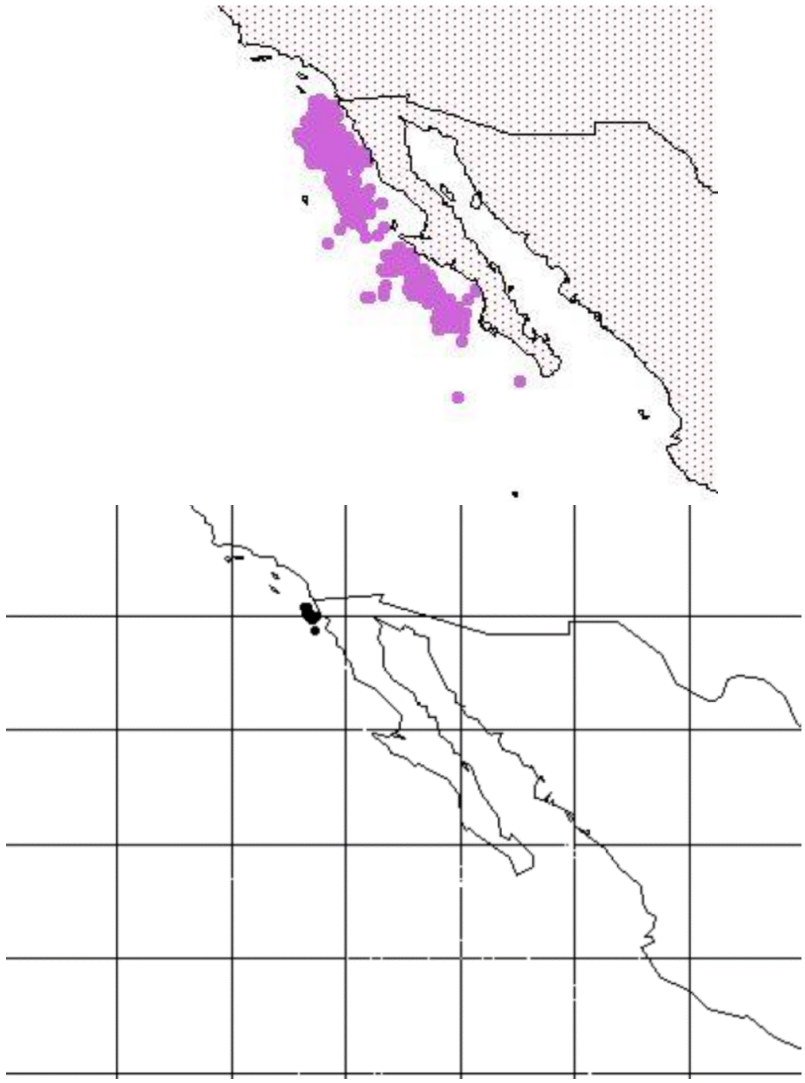

Figure 3. Fishing Zone for bluefin tuna in the Northwest region of Mexico, offshore the Baja California peninsula, several years top, and 2017 fishing ground bottom.,

The time series of bluefin tuna captured by the Mexican tuna purse seine boats from 2005-2017 is presented in Table 3 and in figure 4, the 1980-2017 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 of Mexico, 2005-2017

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

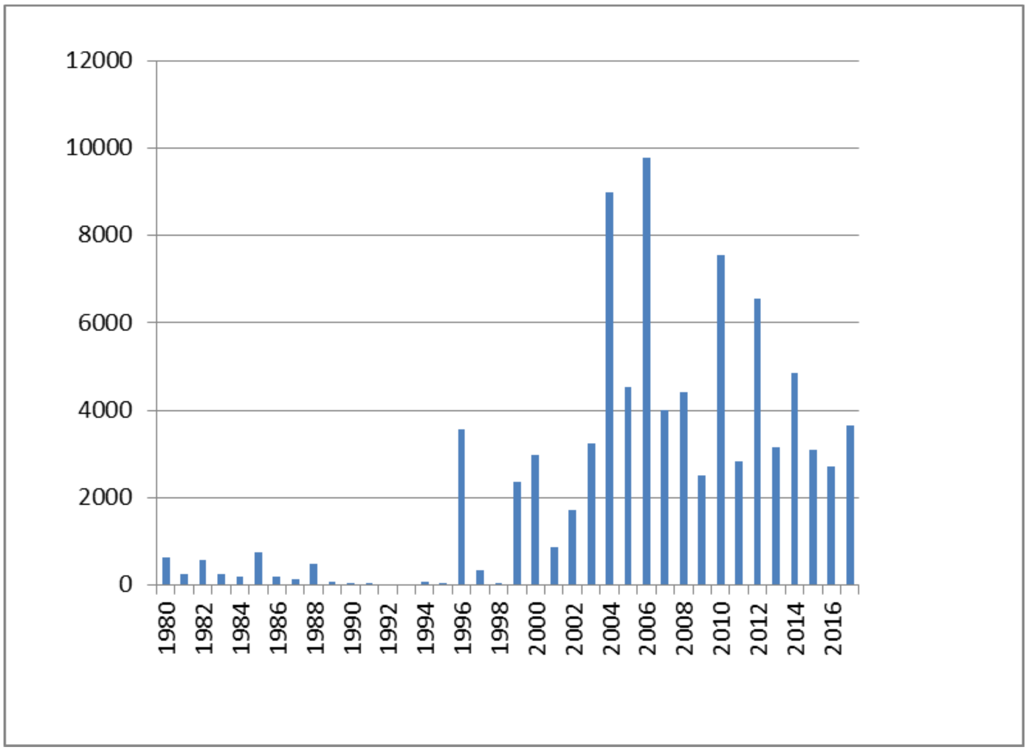

Figure 4. Mexican purse seine catch in the EPO (ISC area) from 1980 to 2017.

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 28 sets and 47 sets devoted to PBF catch in 2016 and 2017 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.

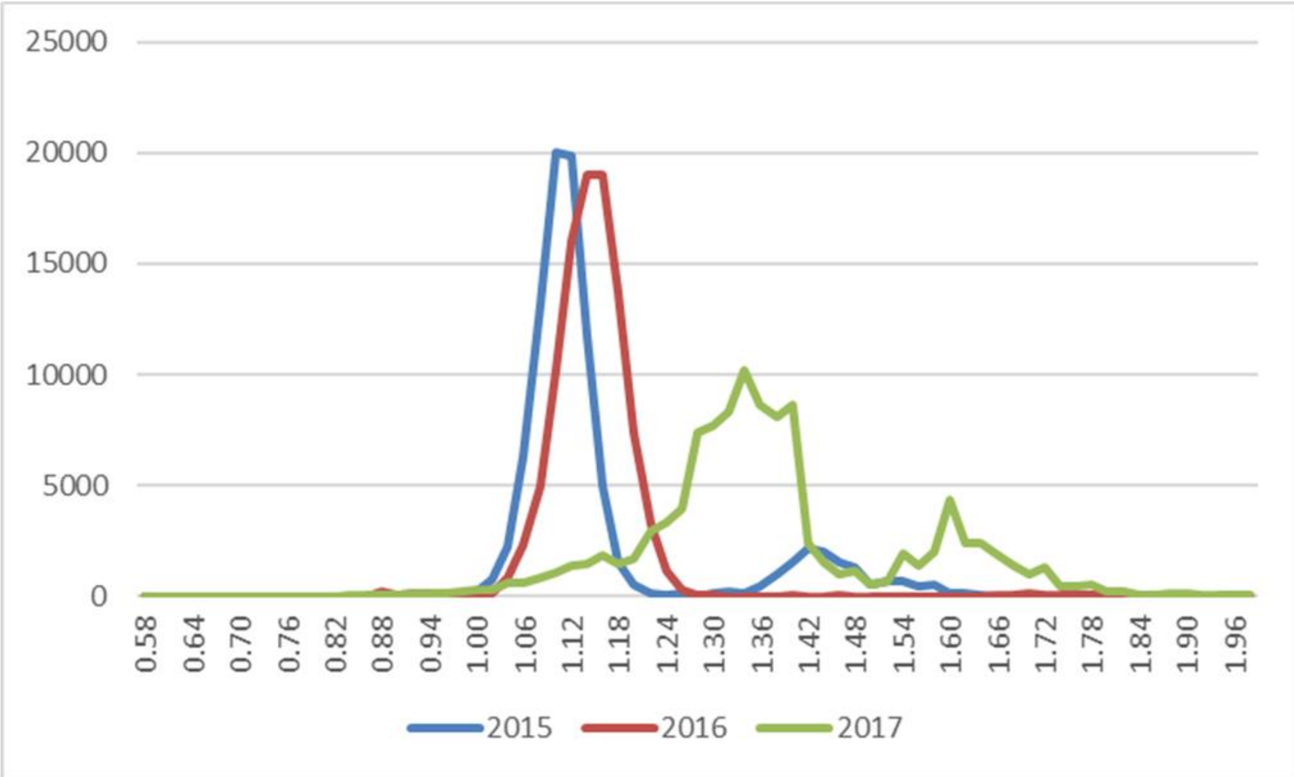

Figure 5. Size composition of Mexican catch 2015-2017

Albacore (T. alalunga)

The related Mexican information for this fishery has been reported constantly to ISC and IATTC. Catches are limited to a small area in northern Mexico. Recently there has been no catch reported by purse seine fleet but the main component of albacore catch in Mexican waters comes from US sport fishery (and reported by the US).

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 Ctch 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 weekly and based on the quota and catch amount information is reported daily 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 abstracts every year, or from the INP-PNAAPD sources. 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 started sampling last year but samples came from 2016 and 2017 catches. We have completed 750 tissue samples per year for those two years.

Sharks

During the period reported here Mexico collaborated activally in two tasks in the Shark Working Group (SHARKWG): 1) the collaborative research to develop a growth curve for the shortfin mako, *Isurus oxyrinchus* (SFM) from northern Pacific Ocean and 2) the stock assessment of the shortfin mako, *Isurus oxyrinchus*, from northern Pacific.

Collaborative work on age and growth of shortfin mako between ISC Delegations

The Mexican delegation was invited to participate in the "ISC-Shark Aging Workshop", held on 19–24 October 2017 at the National Research Institute of Far Seas Fisheries (NRIFSF) in Shimizu, Shizuoka, Japan, where the current situation of age and growth study of shortfin mako shark (Isurus oxyrinchus) in the North Pacific was discussed, including the final analysis of a cross-readings for shortfin mako shark reference vertebrae experiment undertaken among USA, Japan, and Mexico. The results of such comparison indicated similar growth band counts between scientists from USA and Mexico. Mexico also submitted and presented an updated for age and growth estimates of the shortfin mako shark caught in the Mexican Pacific Ocean, for the periods 2001–2003 and 2008–2016 (Rodriguez-Madrigal *et al.* 2017a), as well as the preliminary results of a collaborative work on age and growth of shortfin mako shark in the North Pacific Ocean between Mexico and Japan, initiated during a visit of a researcher from the

National Fisheries and Aquaculture Institute (INAPESCA) from Mexico to NRIFSF in May 2007 (Rodriguez-Madrigal et al. 2017b). Moreover, monthly and annual length composition of shortfin makos caught in Mexican waters from 2006 to 2016 were provided to ISC to determine the birth season and birth size of shortfin mako in the Eastern Pacific Ocean. Finally, a growth meta-analysis (including several candidate growth curves) was developed using seven age and length frequency datasets from four delegations: Japan, USA, Taiwan and Mexico (Takahashi et al. 2017). It was agreed that the two-parameter von Bertalanffy Growth function should be used for the meta-analysis and that the results of such analysis would be used in the stock assessment of the species in 2018.

Short fin mako stock assessment

The shortfin mako, *Isurus oxyrinchus* is the second shark in importance in terms of numerical catches of the Ensenada longline shark and swordfish fishery which operate along the west coast of Baja California (BC) Peninsula (Godinez-Padilla, et al. 2016; Castillo-Geniz et al. 2014). It is a high valuable shark species because its meat is exported to the seafood markets off California, USA.

The Mexican Shark Observer Program (POT in Spanish) since 2006 has been collecting fishery and biological data (size and sex, and occasionally maturity data) from large pelagics, including sharks and swordfish on board of medium-size longline commercial fishery vessels from Ensenada and Mazatlan. The fishery grounds of the Mexican industrial longline fleet cover practically the entire northern and central Mexico´s EEZ. Shortfin mako is also fished along the BC Peninsula by several artisanal small boats with surface longlines and bottom gillnets (Cartamil et al., 2011; Ramírez-Amaro, et al., 2013). Historically the Mexican industrial longline fleet has been operating in two fishing areas principally 1) North (> 27° LN) a common fishery ground for the Ensenada-based fleet and 2) South (≤ 27° LN), that is the traditional fishing area of the Mazatlan fleet that include the entrance of the Gulf of California and central Pacific. Recently both fleets has been expanding their fishery grounds, the Ensenada fleet fishing further south reaching the tip of the BC Peninsula and the Mazatlan fleet extended its operations to more oceanic waters and covering almost the southern part of the Peninsula until north of Gulf of Ulloa. Although *I. oxyrinchus* is a common shark species observed in landings from coastal and pelagic fisheries limited information has been collected and published on its life history from Mexican pacific waters.

Spatial dynamics of shortfin mako structure

Spatially explicit size and sex data were available through the POT operating on board of the Ensenada and Mazatlan fleets. In general terms the POT has observed 5328 longline sets from the Mexican longline fishery industry fleet during 2006-2016, which represented 9.1% of the total effort (58759 sets)(Table 1). From the total of longlines sets observed by POT (5724 sets) during a decade, shortfin mako was captured in 39.5%

(positive sets). Separating the data by fleets, Ensenada and Mazatlan, proportions change. Individuals of *I. oxyrinchus* were caught in 54.8% of the sets observed from the Ensenada fleet and from 29.8% of the sets reported by observers in fishery boats of Mazatlan (Fig. ?) (Table 2). A total of 5721 shortfin makos were measured by observers during 2006-2016 but 69.9% of those measurements included pre-caudal lengths (PCL). Those sharks with PCL measurements were 2280 females (57%) and 1720 males (43%). Females had a range of 43-341 cm PCL (average= 119.4 ± 0.6 cm PCL) and males 51-270 cm PCL (average= 120.1 ± 0.7 cm PCL) , (figure 6).

Table 4. Number of commercial fishery trips and sets observed by the Mexican shark observer program (SOP) that operated onboard of the longline industrial fleets during 2006-2016, along the northern and central Mexican Pacific coast.

Year	No. Trips	No. Sets	No. Trips Obser	No. Sets Obser	% Sets Obser
2006	462	6316	46	326	5.2
2007	191	2138	88	885	41.4
2008	445	6086	72	706	11.6
2009	271	3034	37	447	14.7
2010	401	5356	51	884	16.5
2011	428	5815	30	480	8.3
2012	419	5665	5	99	1.7
2013	422	5784	21	342	5.9
2014	444	5936	34	574	9.7
2015	535	7196	24	314	4.4
2016	433	5433	19	271	5.0

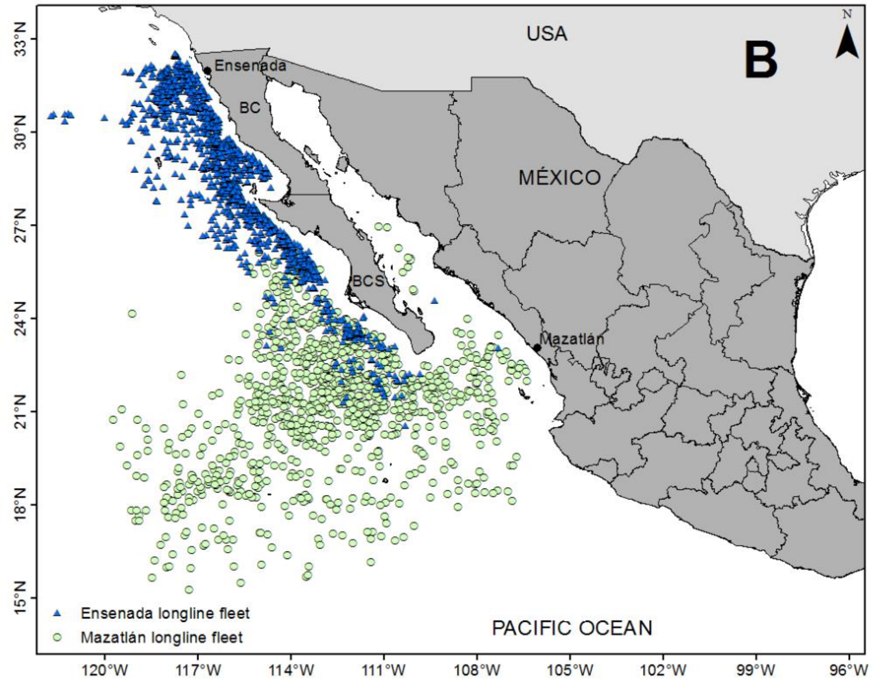

Figure 6. Total observed longline positive sets with shortfin makos 2006-2016 documented in both Mexican longline fleets of Ensenada (BC) and Mazatlán (Sinaloa) which operate in nort and central Pacific waters.

The spatial and seasonally distribution of the positive fishery sets with catches of shortfin mako in the Mexican industrial longline fleet indicate this species is available in a year-round basis in northern and central Pacific regions of Mexico. Size and sex data collected by observers during 2006-2016 indicated the fishery is sustained principally juveniles of both sexes where females dominated the catches in a sex ratio 2:1 (Figure 7).

Standardized catch rates for shortfin mako shark in the Mexican Pacific longline

Mexico submitted to the SHARKWG data on SFM numerical catch, size catch data with coordenates per individual and an abundance index by fleet. The standardized index was focused on the longline component of the shark fishery with medium size vessels in the northwest region of the Mexican Pacific. Driftnet operations were banned in 2009, while longline fishing has prevailed through the years of operation of the scientific observer program, so the longline time series June 2006-December 2016 is complete. In particular, only data from the Ensenada and San Carlos longline fleets were used in the analysis, as they are the ones with better observer coverage and operating within the main mako shark distribution area in the Mexican Pacific. In this first stage, many zero-catch data – belonging to fleets operating outside this area or scarcely sampled– were

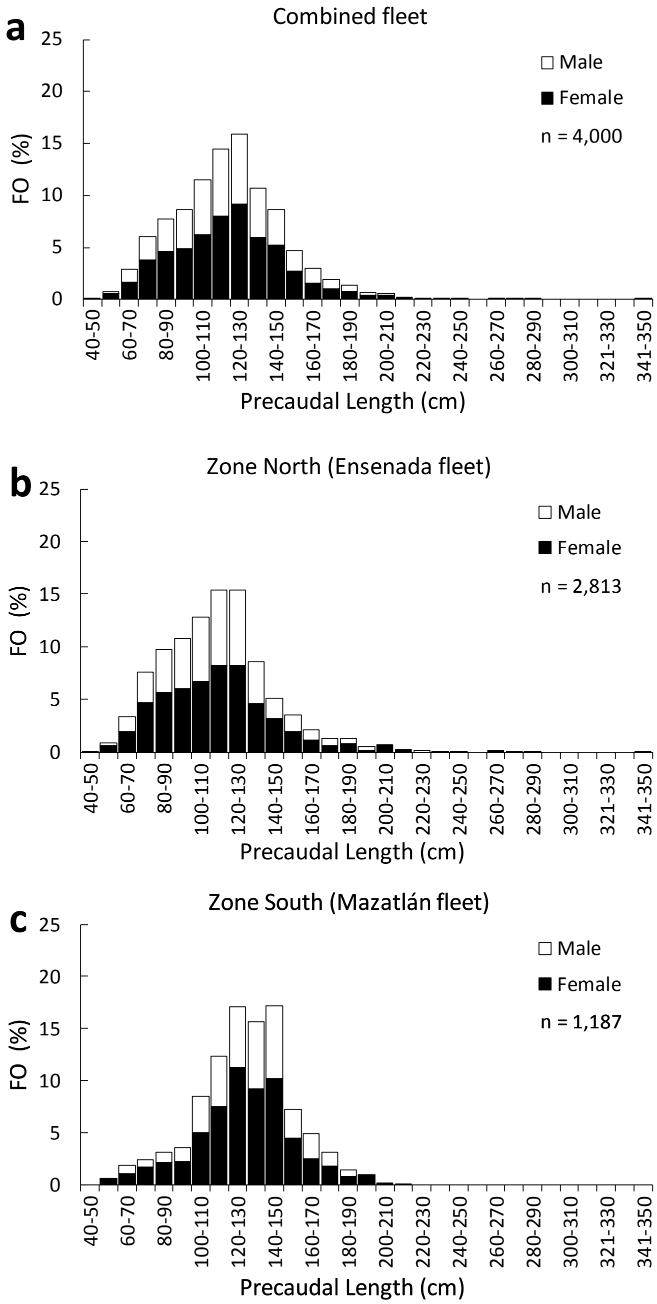

Figure 7. Sex-length frequency distributions of blue sharks caught in the Mexican Pacific; a) Fleets combined; b) Ensenada, BC port-based fleet; and c) Mazatlan, Sinaloa port-based fleet.

excluded from the analysis. Then, data were subjected to a preliminary analysis, looking for missing values, incomplete information and inconsistencies. In this way, from an initial total of 5,766 longline sets, just 2,183 validated sets were retained to be used in the analysis. The proportion of zero-catch sets in this

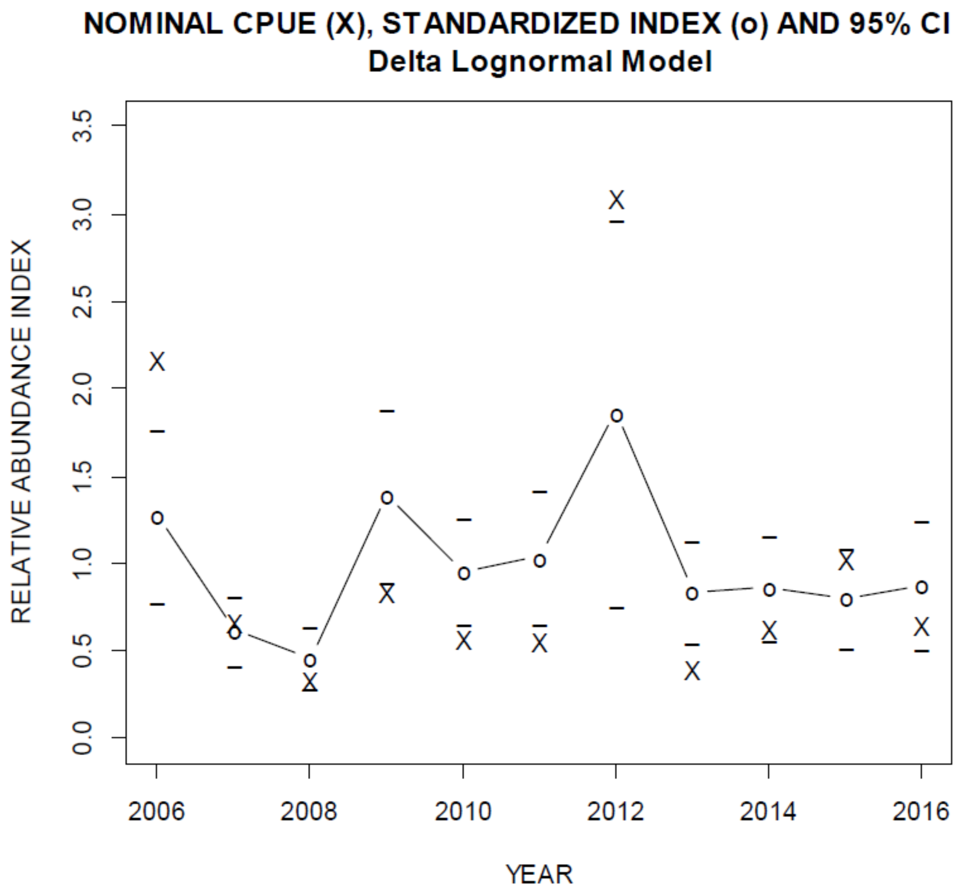

Figure 8: Relative abundance indices for shortfin mako with approximate 96% confidence intervals. Delta lognormal model for years 2006-2016.

subsample was 44.75%, pointing to the use of a two-part, Delta model for the analysis, with a c log-log link for the binomial GLM.

Standardized indices of relative abundance of mako shark were developed based on two generalized linear models (GLMs), figure 8. 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 backtransformed year effects from the two GLMs. The Delta model was set with the Delta-GLM function in *R* from SEDAR (2006).

In this updating, similar to an analysis made in 2014 (González-Ania *et al.* 2014), we included the distance to the closest continental shore that previously showed to have a significant relationship with blue shark catch rate (Fernández-Méndez *et al.*, 2016). In this analysis the interaction DF:ZONE had a significant relationship both with catch probability and catch rate pointing to the importance of specific areas, relatively near to the shore, of the Baja California peninsula. The importance of temperature in specific geographic areas in relationship with catch rate (hinted by the interaction TF:DF:ZONE) should be taken into account but the effect of other factors (such as primary productivity in a coastline characterized by local upwellings) should be investigated in further analysis.

It is possible that the biggest inter-annual differences observed in the abundance index (for example in the years 2006 and 2012) could be a result, at least in part, from inter-annual differences in sample sizes. Taking into account the uncertainty, the results of this analysis point at the abundance index trends being close to stability in the analized period, in particular since the year 2013.

Preliminary demographic analysis of shortfin mako shark

Finaly the Mexican delegation presented a preliminary demography analysis of *I. oxyrinchus* population caught in the Mexican Pacific, incorporating new available information on age and growth for the region, as well as the catch composition obtained from the Mexican observer´s program on board industrial longline shark fishing vessels during the last decade (Modragón-Sánchez,*et al*., 2018) The basic demographic parameters were estimated using life tables and age-based matrices. Elasticity matrices were used to determine the contribution of each age group to the population growth rate and the effect of different fishing mortality rates (*F*) evaluated. In addition, the rebound potential was calculated. The analyses indicated increasing population rates of the species in the Mexican Pacific Ocean under natural conditions for different scenarios of longevity and breeding seasonality. The juveniles produced the biggest change in population growth rates (r and λ), followed by the adults. However, the influence of the age groups commonly caught by the Mexican fishery (2–4 years) to r and λ was considerably lower than that from the rest of the juveniles and adults, suggesting that the fishery may not have such a serious impact on the population of *I. oxyrinchus* if the rates of fishing mortality are adequate. The population tolerate up to an F=0.5 if catches focus on 2–4 age groups. Our results demonstrate that the recovery capacity for the species after being subject to F was lower than that reported previously. The impact of management measurements adopted to date in Mexico on the demography of the species need to be addressed in the future. The full understanding of the population dynamics of the species in Mexican waters is necessary to achieve sustainability.

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Billfishes

Billfish retained catches in recreational fisheries of Mexico: 1990 – 2016

Fisheries on billfish in the Pacific Mexican EEZ has more than fifty years history where both, recreational and commercial fleets have gotten benefits. Origins of recreational fisheries started by 1930, when US-anglers aboard their own boats used to come to Mexican waters, mainly near Cabo San Lucas and La Paz, off the southern Baja California peninsula (Talbot and Wares 1975). As communication ways developed another sites as Guaymas, Mazatlan and Acapulco became attractive centers for anglers (mainly US citizens) who lacked private vessels and could access to the Gulf of California and the southern Mexican Pacific coast. Nowadays, most recreational fleets concentrate at the mouth of the Gulf of California, just in the proximity of the main population center of striped marlin in the eastern Pacific, whereby recreational fisheries depend to a large degree on the abundance of this species in the region. Despite the eight decades long history, it was until 90's beginning that recreational fisheries in Mexico had a noticeable effort and catch increment (Figure 9). In the other side, commercial exploitation, started after Japanese longline fleets expanded their fishing grounds to the Eastern Pacific at the end of 50's, around the equatorial fringe until 10° N. In 1963, the fleets expanded to the north reaching the vicinity of southern Baja California peninsula, where catches of striped marlin, as well as sailfish and swordfish, were abundant even as much as tuna catches (Kume and Schaefer, 1966; Talbot and Wares, 1975). By 70's decade, Mexico decreed its own EEZ while a transition to Mexican fleets focused on tuna, shark and finfish occurred and billfish were an important proportion of incidental catches. In 1983, it was decreed a 50 nautical miles fringe contiguous to the coastal line, where billfish along with dolphinfish and roosterfish, were reserved for recreational fisheries. In 1984, the first commercial permits were issued for billfish in Mexico, and striped marlin composed most of the catches. In 1987, two additional exclusion areas were implemented where commercial billfish fishing was not allowed. One of them is at the mouth of the Gulf of California (which extends northward, just along the western coast of Baja California peninsula) and the other is at the Gulf of Tehuantepec (figure 10). By 1991, billfish commercial permits were not issued anymore and those fleets focused to spearfish commercial fishing. Eventually, most of the vessels turned to shark fishing, so that billfish (other than spearfish) is only incidentally caught by these fleets since the beginning of 90's.

Data Sources

Since 1987 INAPESCA through the Monitoring Program for Recreational Fisheries, systematically collects catch and effort records of recreational fleets operating in three sites: Cabo San Lucas and Buenavista in Baja California Sur and Mazatlan in Sinaloa. Because we have no access to the whole fleets, total catch in each site was estimated with the next equation:

$$C_{TOT} = CPUE_{rec} \cdot \hat{f}$$

where C_{TOT} is the estimated total catch in a specific month at one particular site; $CPUE_{rec}$ is the mean catch rate of those vessels recorded during monthly sampling at each site and $\hat{f}$ is the total effort in number of trips in the same month at the same site. Effort from Cabo San Lucas, was obtained from monthly records of the Port administration; when these records were not available, $\hat{f}$ was estimated with the mean number of daily trips recorded during sampling and multiplied by the number of days the port was open for fishing after Port reports. Effort from Buenavista, was estimated as the mean number of daily trips after fleets' reports, multiplied by the number of days the port was open for fishing. Effort data from Mazatlán were used directly after fleets' reports.

Estimated Retained Catches

Historical records (1990 – 2016) of recreational fleets operating around the mouth of the Gulf of California indicate multispecies composition of catches and billfish are an important proportion of them, about 22% in number of organisms (Figure11). Six species account for 90% of catches, two of them are billfish: striped marlin (*Kajikia audax*) (17%) and sailfish (*Istiophorus platypterus*) (~ 4%). The other four are: common dolphinfish (*Coryphaena hippurus*) (~ 35%), yellowfin tuna (*Thunnus albacares*) (29%), Pacific sierra (*Scomberomorus sierra*) (~ 5%) and roosterfish (*Nematistius pectoralis*) (1%). Other tunids such as skipjacks and bonitas (*Katsuwonus pelamis, Euthynus lineatus y Sarda spp.*) (~ 4%) and blue marlin (*Makaira mazara*) (1%) account for aditional 5%. Other species such as wahoo (*Acanthocybium solandri*), yellowtail amberjack (*Seriola lalandi*), along with a variety of sharks and demersal fish (snapper, grouper and bass) contribute with about 3% while other billfish such as black marlin (*Makaira indica*), swordfish (*Xiphias gladius*) and shortbill spearfish (*Tetrapturus angustirostris*) represent less than 0.1% of the catch.

This species composition figure is based on total catch, which takes into account both catch-retained individuals (landed at harbor) and catch-released individuals. Catch and release practice in recreational fisheries is of paramount importance for billfish because it represent most of the catch records. Catch and release proportion is variable depending on the year and the species. On average the highest proportion of catch and release is found in striped marlin (~ 82%), followed by sailfish (~ 78%), blue marlin (~ 62%), black marlin (~ 51%) and swordfish (~ 33%). It should be considered, however, that little is known about survival of released individuals. The paper of Domier *et al*. (2003) is the only known document which reports an estimated survival rate of 74 – 91% for striped marlin. These results indicate that even in released individuals there is a marginal mortality, which must be added to retained catches for population variability analysis. Under this context, table 1 shows the retained catch (and landed) during 1990 – 2016.

Table 5. Annual effort and retained catch by species in recreational fisheries from the mouth of the Gulf of California región (Cabo San Lucas, Buenavista y Mazatlán)

		No. of individuals				
Year	**Effort (trips)**	**Striped Marlin**	**Blue Marlin**	**Sailfish**	**Black Marlin**	**Swordfish**
1990	31,514	2,649	492	7,734	7	68

1991	35,334	3,097	442	6,953	10	34
1992	30,023	1,809	946	4,212	13	1
1993	29,243	2,014	687	3,596	20	1
1994	29,227	2,154	478	3,109	14	20
1995	25,306	2,452	336	2,620	7	5
1996	29,048	5,735	792	4,674	22	18
1997	32,625	4,525	512	3,532	31	99
1998	34,932	5,450	1,126	3,710	39	39
1999	40,042	4,269	987	3,797	32	54
2000	41,844	5,368	965	3,480	39	65
2001	38,034	3,489	689	2,227	17	39
2002	44,355	3,769	709	1,934	8	5
2003	47,634	4,335	514	2,543	32	7
2004	48,863	4,948	473	2,312	22	31
2005	56,767	7,646	628	2,310	16	32
2006	55,975	6,456	706	1,334	32	12
2007	55,453	7,896	393	1,032	12	13
2008	50,128	4,654	285	1,268	9	10
2009	43,309	3,827	316	761	9	6
2010	39,817	2,717	217	533	13	9
2011	38,310	3,365	302	316	14	4
2012	38,540	2,323	221	508	5	24
2013	39,469	11,102	297	1,677	9	4
2014	37,172	4,634	419	566	27	0
2015	36,879	6,008	645	1,082	12	-
2016	35,072	3,720	515	126	18	-

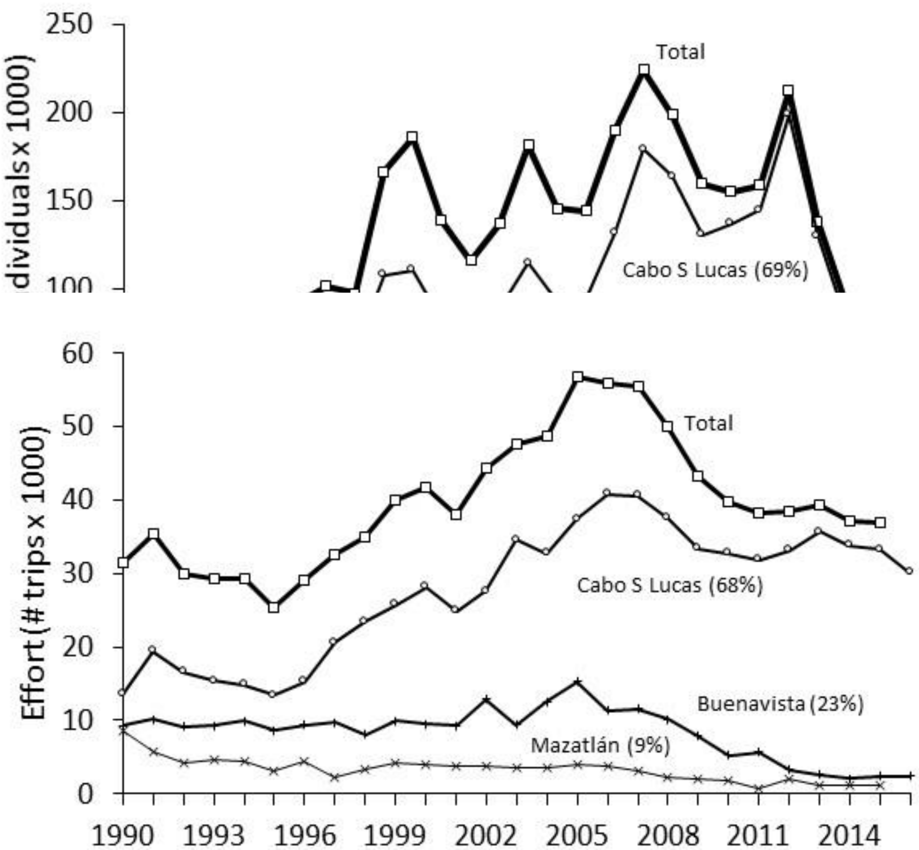

Figure 9. Total catch (retained + released) and effort of recreational fleets in the mouth of the Gulf of California: 1990 – 2016.

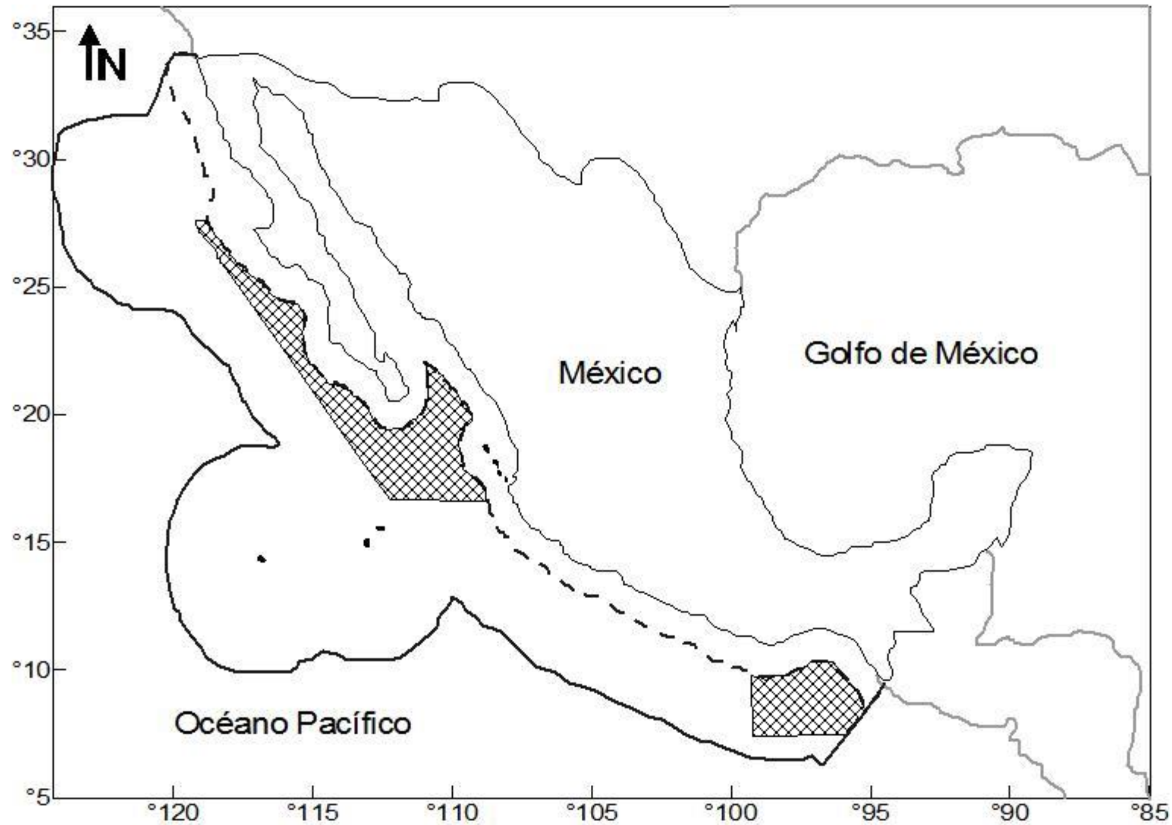

Figure 10. Exclusion zones of commercial billfish fishing. Dashed line represents the 50 nm fringe where billfish along with dolphinfish and roosterfish, are reserved for recreational fisheries. Grid areas represent exclusion zones of commercial fleets focused on billfish after 1987 Agreement (Diario Oficial de la Federación, August 28th, 1987). Continuous line points out the limit of Mexican EEZ.

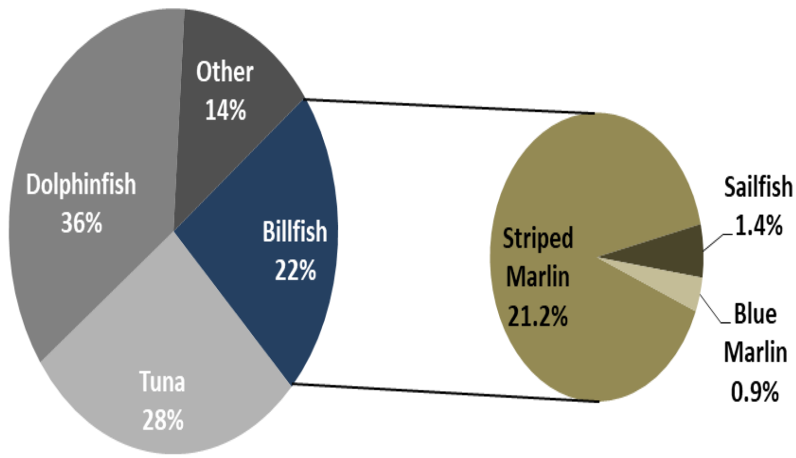

Figure 11. Historical species composition (1990-2016) of recreational fisheries catches at the mouth of the Gulf of California (Cabo San Lucas, Buenavista and Mazatlan).

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