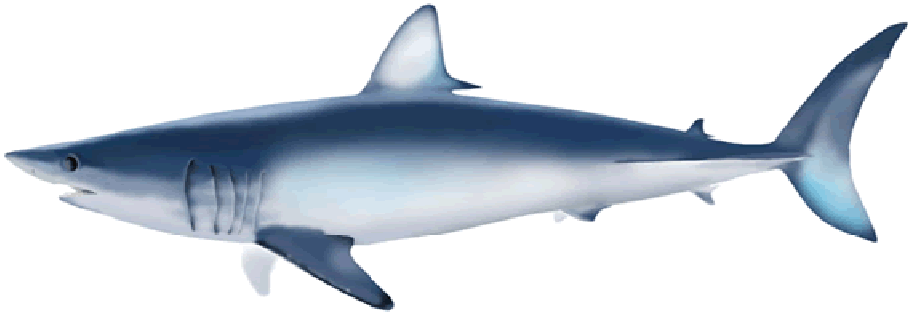
Catch data for shortfin mako shark reported by fishery observers from Mexican shark longline and driftnet fisheries in the North Pacific in 2006-2014[1]

Jose Leonardo Castillo-Geniz[1]
Carlos Javier Godinez-Padilla[1]
Hector Alejandro Ajás-Terriquez[1]
Luis Vicente González-Ania[2]

[1]Instituto Nacional de Pesca
(National Fisheries Institute of Mexico)
Centro Regional de Investigación Pesquera de
Ensenada, Baja California
Carr. Tijuana-Ensenada, km 97.5, El Sauzal de Rodriguez,
C.P. 22760, Ensenada, Baja California, México
e-mail: leonardo.castillo@inapesca.gob.mx

[2]Oficinas Centrales
Pitágoras 1320, Col. Santa Cruz Atoyac
C.P. 03310, México, D.F., México



[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

Summary

Data from the 2006-2014 activities of the Mexican Shark Scientific Observer Program (SSOP) indicated that the shortfin mako, *I. oxyrinchus* is an important numerical component in the shark catches from pelagic, offshore and coastal fisheries in northern Mexican Pacific. The present working paper provide a general insight of the mako catches obtained from 11,316 sets (73.9% longline and 26.1% driftnes sets) during 670 commercial fishing trips from the fleets of Ensenada (EN), Mazatlán (MZ), San Carlos (SC), Puerto Peñasco (PP), Salina Cruz (SZ) and Topolobampo (TB), during June 2006 through April 2014. During the first five years (2006-2010) the number of fishing trips with observers were > 50, reaching a peak in 2007 with 132 trips. Sharks as a group comprised 94.3% of the numerical catch in the total observed longline sets during 2006-2014 in all the fleets, meanwhile in the driftnet sets accounted 97.4%. A total catch of 11,190 shortfin makos was reported during 2006-2014, 73% from longline sets (8,357) and 27% was caught in driftnets (3,019). The largest numerical catches were observed in the Ensenada and Mazatlán fleets, with both fishery gears. The highest numerical mako catches were observed in the Ensenada (MZ) longline fleet with 1.7 – 4.9 sharks per set during the third and fourth quarters of the year. The catch/set rates from the longline Mazatlan-based fleet were 0.9-2.4 shark per set.

Introduction

The **Mexican Official Standards NOM-029-PESC-2006, Shark and Rays Responsible Fisheries. Specifications for its exploitation** is the principal legal management instrument which regulate the exploitation of shark, rays and skates species in federal territorial waters of the Mexican United States, on the high seas and in foreign territorial waters, with vessels flying the Mexican flag, was published in February 14, 2007 in the Federal Gazzete (SAGARPA, 2007). The purposes of these Standards are to protect sharks and related species and ensure their sustainable exploitation, in addition to fostering the conservation of elasmobranch species subject to special protection. The Standards are of mandatory observation for holders of permits, concessions and authorizations pertaining to the fishery for sharks and related species; for those who catch the aforesaid species incidentally as well as all those who carry out fishing operations on the high seas and in foreign territorial waters with vessels flying the Mexican flag. Among several regulations the NOM-029-PESC-2006 established fishing areas for all shark fisheries, delineating specific exploitation areas for shark fleets and since August 2009 the Shark Standards Rules banned the use of driftnets in all commercial shark vessels longer than 10 m. One of the most valuable contributions of the NOM-029-PESC-2006 was the implementation of the scientific observer program onboard shark vessels by the National Fisheries and Aquaculture Commission (CONAPESCA) on a voluntary basis in offshore and pelagic waters. A summary of shark fishery regulations contained in NOM-029 was compiled by Castillo-Geniz et al. (2008)

The shark scientific observer program (SSOP) was established in June 2006 in Mexican Pacific waters. The SSOP was designed by the National Fisheries Institute of Mexico (INAPESCA) and it was implemented through the National Research Trust for the National Development Program of Tuna Utilization and Dolphin Safety

and Others Around Protected Aquatic Species (FIDEMAR). In the last two decades the INAPESCA has systematically conducted surveys and monitored shark catches and landings in both, artisanal and industrial fisheries, with the objective of providing scientific bases for management advice. The FIDEMAR shark observers, trained by INAPESCA shark biologists and technicians, record numerical catches by species and operational details (e.g., position, number of sets per trip, number of hooks per set, haul times, target species, bait type), which permit to know onboard catch and by-catch composition and catch trends of multiple species. They also collect biometric (size and sex) and biological data (maturity stage) of the main shark target species. INAPESCA is responsible to analyze the data generated by SSOP. Tovar-Avila et al. (2011) provided an initial comprehensive outline on the catch and effort data of pelagic sharks caught by the Mexican shark longline fishery in the North Pacific from data collected during the first years of SSOP operations 2006-2008.

As a result of its eight years of operation (2006-2014), SSOP has been two major contributions in the establishment of recent additional shark fishery regulations. The first was the Agreement by which the volume of permitted by-catch of recreational fishery species was set during commercial shark and ray fishery operations in waters of federal jurisdiction of Mexican United States in the Pacific Ocean (SAGARPA, 2008). Results of SSOP allowed the estimation of reduced and allowable rates of by-catch that do not negatively impact the health of the populations of those recreational species. The other SSOP major input was the collected data on number and occurrence of shark gravid females caught by the pelagic longline fleets, mainly from Ensenada and Mazatlan ports, in the Mexican Pacific waters. This data was used by INAPESCA to determine the peak catch months for gravid females of the most representative pelagic and coastal-pelagic shark species in Mexican Pacific waters. The analysis of this data as well the data from coastal and artisanal shark fisheries generated diverse scenarios for a shark fishery closure which protects the large extension of the reproductive seasons of diverse commercial sharks and rays species. Finally, CONAPESCA published in in the Federal Gazzete in June 11, 2012 (SAGARPA, 2012) the legal notice for the definitive period for the shark and ray fisheries closure for the Mexican Pacific: May 1 to July 31, for each year.

Holts et al. (1998) and Holts and Sosa-Nishizaki (1998) published a comprehensive and detailed description of the beginning of pelagic fisheries targeting swordfish, sharks and other large pelagic species in northern Mexican Pacific. In the last decade Mexican coastal-pelagic shark fisheries conducted by medium size commercial longliners (length > 10 m and < 27 m) from Ensenada (Baja California, BC) and particularly from Mazatlán (Sinaloa, SIN) has expanded its fishery operations towards more oceanic waters in the Mexican Pacific Economic Exclusive Zone (EEZ). Comparing BC and Sinaloa´s mean total annual shark landings from 1990 to 2014 the first state has doubled its shark production meanwhile Sinaloa has experimented an increased in almost 400%. (Fig. 1). This growth in the shark landings figures is probably caused by the captures and landings of pelagic sharks caught in the EEZ by the Mazatlan and Ensenada longline fleets. Corro-Espinosa (unpublish data) conducted a recent analysis on the commercial logbooks from the Mazatlan longline fleet from the years 2009-2012. Corro-Espinosa documented a total numerical catch of 182,482 sharks from 11 species caught in 8,447 sets. The blue,

Prionace glauca (64.6%), thresher, *Alopias vulpinus* (9.4%), bigeye thresher, *A. superciliosus* (9.3%), pelagic thresher, *A. pelagicus* 7.7% and the shortfin mako, *Isurus oxyrinchus* (1.7%) were the most frequently pelagic sharks caught. With similar approach Ortega-Salgado *et al.* (unpublish data) examined the commercial logbooks of 124 fishery trips and 1,404 longline sets from the swordfish and shark fleet of Ensenada conducted during 2001-2013. The logbooks reported a capture of 42,814 sharks belong to six shark species, being the most abundant species, blue (86.5%), shortfin mako (11.9%) and thresher (0.73%) sharks respectively.

In the west coast of the Baja Peninsula *I. oxyrinchus* represents an important commercial species because its meat is sold to the asian seafood markets in California, USA, meanwhile the meat of *P. glauca* is distribute domestically in BC (Tijuana, Mexicali, Ensenada). Beside the offshore longline fisheries, shortfin mako is also targeted along the west coast of the Baja Peninsula by several artisanal small boats using longlines and bottom gillnets (Cartamil et al., 2011, Ramirez-Amaro, et al. 2013).

This paper provides a general description of the catch data for mako sharks from both Ensenada and Mazatlan based pelagic longline fisheries reported by SSOP observers from August 2006 through April 2014. These fleets represent the major fishery effort that target mako sharks in oceanic and offshore northern Mexican Pacific waters.

Materials and Methods

Mako catch and size data were gathered by SSOP observers on 11,316 sets (73.9% longline and 26.1% driftnet sets) during 670 commercial fishing trips (longline 76.3% y driftnet 23.7%)from different fleets during June 2006 through April 2014 (Table 1). Fleets were denominated by their port-base: Ensenada (EN), Mazatlán (MZ), San Carlos (SC), Puerto Peñasco (PP), Salina Cruz (SZ) and Topolobampo (TB) (Fig. 2). The present study consist in provided a general description of the catch and effort data on shortfin mako sharks during observed fishing trips from diverse medium-size fleets targeting shortfin makos in Mexican Pacific coastal and pelagic waters. From June 2006 through August 2009 both fleets used driftnets to catch swordfish and sharks so observers reported catches per set and species composition resulted from those trips. Finally the NOM-029 ban regulation for driftnets in all commercial vessels > 10 m length went into effect in August 2009. For the above reason the analysis of catch and size mako data was split by fishery gear: longlines and driftnets. The initial quality control of the catch data was conducted by FIDEMAR . The data were first entered and checked by the observer and then re-checked by a debriefer. Later INAPESCA specialists reviewed the data collected by the observers comparing notes, photographs and published and unpublished distributional accounts, focused on species identifications and catch sizes. All catch statistics were computed with these corrected data.

Because this document is a first description and not a complete and detailed statistical analysis on the mako shark catch and size data, only descriptive statistical parameters were estimated using the Excel® routine for descriptive statistics. CPUE was calculated as simple as catch/sets and denominated “nominal CPUE”. This index

was not standardized by 1000 hooks . At the moment of writing this report, data on the number of hooks per set were not available. In this case fishery effort utilized was number of sets.

The spatial and temporal distribution of sets and mako catches were displayed in maps using ArcGis v10.1.

Results and Discussion

Observer coverage

During the 9 years of the operation SSOP has showed a very variable level of effort in the different pelagic loglines fisheries in the Mexican Pacific Ocean. In the first five years (2006-2010) fishing trips with observers were > 50, reaching a peak in 2007 with 132 trips. In recent years (2012-2014) the level of observer program has decrease greatly (Table 2). One factor affecting SSOP operations is the shark and ray fishery closure in Mexican Pacific waters during the period May-July since 2012. This technical measure is mandatory for all fisheries targeting shark and rays including those with elasmobranch by-catch (SAGARPA, 2012).

The allocation of the observer effort between fleets changed markedly but it was concentrated on the largest three (in term of number of vessels) MZ, EN and PP. The number of fishing trips with observers in SC, SZ and TB were very lower (Table 2). Observer coverage percentage by fleet were estimated indirectly using mandatory commercial logbooks and administrative catches and landing reports by trip ("avisos de arribo") because there is not available specific statistics on number fishing trips by fleets by month and year. Tables 3, 4 and 5 present the SSOP percentage coverage in the principal fleets of EN, MZ and PP. Figure 3 showed the observer coverage by fleet during the period analyzed.

The largest amount of the total observer effort (45.5% of observer sets) was conducted in the first three years of SSOP operation (2006-2008) (Table 2). The observer effort exclusively on longline sets showed similar pattern, 61.5% on the first three years, with the top number of sets observed in 2007 and 2008 with 1,997and 1,806, respectively.

Catch composition

Sharks comprised 94.3% of the observed catch in the total longline sets during 2006-2014 in all the fleets, and 97.4% in the driftnet sets. The shark catch from all fleets with both fishing gears included 32 species from eight families and five orders. The genus more representative was *Carcharhinus* with 10 species. The shark species more representative in the longline sets were brown smoothhound, *Mustelus henlei* (42.5%), blue shark, *Prionace glauca* (33.9%) and angel shark, *Squatina californica* (5.4%). In observed longline sets during the study period 2006-2014, mako shark *I. oxyrinchus*, accounted 1.6% . The numerical dominance of *M. henlei* in the observed total longline sets was influence by their numerous catches obtained by the Puerto Peñasco-based fleet in the Gulf of California.

Were documented 23 shark species from 7 families and 4 orders in the observed driftnet sets. The most abundant shark species were *S. californica* (26.1%), *M. henlei* (26%) and the Pacific sharpnose shark, *Rhizoprionodon longurio* (19.7%). Mako accounted for 4.2%.

The observer effort on the Ensenada-based fleet allowed document the shark catch composition with two fishery gears, driftnet coastal hauls during 2006-2009 and from the pelagic longline sets through 2006-2014. The observers recorded 7 shark species during the driftnet fishing trips. The most abundant species caught in the driftnet sets were mako (33.8%), thresher (28%) and blue (26.8%) sharks (Fig. 4). Nineteen shark species were document in the longline fishing trips. A numerous catch of blue shark (94.6%) was reported followed by *I. oxyrinchus* with 4.3% (Table 6).

In the Mazatlan-based fleet were also documented fishing trips using driftnes and longlines by the observers. In the driftnet sets were reported a shark composition of 14 species, the pelagic thresher, *Alopias pelagicus*, account 33./%, silky shark, *Carcharhinus falciformis* 12.3%, *P. glauca* account 10% and mako reached 9.9% (Fig. 4). Twenty shark species were reported by SSOP in the longine sets, blue sharks outnumbered the catch with 67.7%, followed by *A. pelagicus* (10.5%). Mako accounted for 2.7% (Table 6).

The observed effort on driftnet sets from the PP-based fleet documented a shark species composition dominated by small sharks, *M. henlei* (73%), *S. californica* (9%) and *R. longurio* (7%) (Fig. 3). In longline sets the species composition was similar, *M. henlei* (73%) and S. californica (9%) and *M. californicus* (7%) (Table 6). The mako catch percentage in longline and driftnets were 0.3.2% and 0.2%, respectively. This fleet historically was oriented to the use of driftnets in the Gulf of California, but with the NOM-029 driftnet ban took place in 2009, some vessels tried to switch to longlines but the intent in the follow years apparently was unsuccessful.

The observer effort included some fishing trips conducted by a few number of fishery vessels based in San Carlos, which also used as an alternative landing port Ensenada. The observer effort on SC-based boats accounted for similar shark compositions and catch with the Ensenada-based vessels. Blue sharks (84.7%) followed by makos (3.2%) were the most representative species.

Shortfin mako catches and catch/set indices

The observes reported a total numerical catch of 11,190 shortfin makos, during 2006-2014, 73% caught from longline sets (8,357) and 27% from driftnets (3,019). Mako was taken on 27.4% of the total observed longline sets and in 12% of the driftnet sets. The mako catch data was ordered by quarters for each year separated by fishing gear. The higher longline mako catches were observed in Q3 and Q4 (Table 7). In contrast with the longline catch rates, the catch/set index in the driftnet fishing trips during 2007 and 2008, were 2- 6.5 makos per set among quarters (Table 8). The percentage of sets with zero mako catches accounted 74.6 (Fig. 7). The majority of the longline catches caught between 1-5 and 6-10 makos per set with 23.5% and 2.3%, respectively (Fig. 7).

During the period examined few sets were observed with numerical catches >10 sharks. A significant majority (72.6%) of observed sets caught zero makos. The decreasing pattern in the number of set with zero mako catch along the years could be influenced for the gradually decrease of observed effort after 2008 (Fig. 8). Comparing the annually catch/set mean trend in the observed longline sets throught the years, 2012 presented the higher mean, but this is caused because of the lower observed level (111 sets) with a higher catch (416 makos) (Fig. 9). In Figure 10 is observed that fall and winter months had the higher indices cath/set for the observed longline sets through months and years during 2006-2014. This is congruent with the empiric knowledge of the commercial fishing crews that mentioned that the best season to catch makos is the end of the year (Q3 and Q4).

Analyzing by fleet and quarters the mako catch/set indices calculated for 2006-2014 it can be observed that the higher numerical catches were observed in the observer sets of the Ensenada (MZ) longline fleet with 1.7 – 4.9 sharks per set (Table 9) being Q3 and Q4 the periods with higher rates. The catch/set rates from the longline Mazatlan-based fleet were lowers than those observed in vessels from EN, its interval was 0.9-2.4 shark per set. In the vessels from SC were SSOP observers participate catch data per set were also lower 0.3-1.3 sharks per set. Finally the observer effort at the PP based-fleet operating with longlines reported very few catches and its numbers were in average 0.2 mako shark per set (Table 9). Why the observers reported larger catches of mako per set in the Ensenada fleet in comparison with the other fleets and fisheries zones? Because the west coast of peninsula of BC is a highly productive oceanographic region that sustain diverse commercial fisheries for Mexico, like lobster, squid and tuna fisheries. Should be mentioned that the Mazatlan-based fleet operated in more warmer waters and their fishing areas has been expanded toward the edge of the EEZ in the last decade.

During the years the observers collected data from the driftnet sets in both fleets (EN and MZ) the catch rates range between 0.3 and 7 makos per set. The driftnet sets were deployed at more coastal waters along the peninsula of BC and in the Gulf of California. This highly productive semi-closed sea lured large numbers of top marine predators like shortfin makos and white sharks *Carcharodon carcharias*. The observers catch data from PP-based fleet from 2006-2009 reported a total numerical catch 2,418 makos. In August 2009 the use of driftnets targeting sharks and other large pelagics by medium-size commercial vessels was forbidden, affecting diverse fisheries including PP-based.

The observed fishery effort targeted shortfin makos in the northern Mexican Pacific coast was delimited latitudinally between 15°N and 32°N and between 121°W and 104° W, longitudinally (Fig. 11). The effort was concentrated around the tip of the peninsula of BC, considerate as a highly productive region. Mapping the fishery effort in terms of numerical catch per set two main regions stand out with higher catch sets, the above mentioned area between 20°N and 25°N and the west coast along the peninsula of BC between the tip and the upper area near to the BC/USA border (Fig. 12).

The catch per effort data that is showed in the present working paper will be properly treated statistically in the follow months to obtain CPUE indices.

Shortfin mako size structure catches

The SSOP collected size data (total length) from 2,093 females and 1,440 males shortfin makos from the longline sets, during 2006-2014. Table 10 summarized basic statistics of length data for each sex by year. The reported size range for females was 70-408 cm TL and 70-344 cm TL for males. Mean annual TL range 133-166 cm was estimated for females and 135.4-166.9 cm TL for males. Comparing annual mean size of the makos caught by Mexican medium-vessels in northern Pacific by years do not present a significant variation between years. The size structure indicated that juveniles comprise the larger proportion of the catches suggesting that the west coast of peninsula of Baja California, Mexico could be a nursery and growth area for *I. oxyrinchus*. The observer program has reported the capture of very few shortfin makos > 250 m TL (Fig. 13).

Conclusions

The shark scientific observer program (SSOP) is one of the most effective instruments to collect detailed and precise data on shark catches from pelagic fisheries in northern Mexican Pacific. The nine years of SSOP operation has been very productive in obtain detailed data on shark catch, species composition, size structure, and reproductive stages. Also it has provided valuable information on the spatial-temporal dynamics of the fleets targeting pelagic sharks like the shortfin mako. Data result from SSOP database has been used for several INAPESCA institutional technical responsibilities like the formulation of a proposal for a shark commercial fishery closure for the Mexican Pacific shark and rays fisheries. The proposal for this shark regulation became law in 2012.

Data on the shortfin mako catches provided by SSOP indicated that this species is widely caught along the northern Pacific, including the Gulf of California, with longlines and driftnets, in coastal, offshore and oceanic waters. Data from SSOP indicated that *I. oxyrinchus* is an important numerical component in pelagic commercial fisheries which operated in central and northern Pacific. Mako was caught year-round for diverse fleets, showing an extended residence time in Mexican waters. The Ensenada (EN) and Mazatlan (MZ) based fleets caught the largest numbers of makos during this period, but the catches from Puerto Peñasco (PP), both with longline and driftnet gears, were significant. The catch data by quarters showed that higher numerical catch and catch rates were observed in autumn and winter months. The oceanic and offshore regions in front and around the tip of the peninsula of BC were observed as the fishery grounds with higher mako catches. The gradually decrease of the observer effort in the last years definitely affect the analysis of possible trends and patterns on data. Figures like the annually mean catch/set index and the percentage of sets with zero mako catch were affected for the low observed effort since 2009. Because of the benefits it's important that SSOP continue operating on Mexican Pacific pelagic fisheries and should be considerate in a near future as a mandatory program in the management shark legislation.

References

Cartamil, D., Santana-Morales, O., Escobedo-Olvera, M., Kacev, D., Castillo-Geniz, J.L., Graham, J.B., Rubin, R.D., Sosa-Nishizaki, O. 2011. The artisanal elasmobranch fishery of the Pacific coast of Baja California, Mexico. *Fisheries Research* 108: 393-403

Castillo-Géniz, J. L., Soriano-Velásquez, S. R., y Villaseñor-Talavera, R. 2008. Capítulo No. 9 "Pesquerías mexicanas de tiburón en el Océano Pacífico", 211-241. *In*: *Pesquerías Latinoamericanas*, Machii, T y Flores, O.J. (eds), Comisión Nacional de Acuacultura y Pesca, SAGARPA, México.

Holts, D.B., Julian, A., Sosa-Nishizaki, O., Bartoo, N.W. 1998. Pelagic fisheries along the west coast of the United Sates and Baja California, Mexico. Fisheries Research 39, 115-125.

Holts, D.B.and Sosa-Nishizaki, O. 1998. Swordfish fisheries of the eastern north Pacific, NOAA Technical Report, NMFS 142.

Tovar-Avila, J., González-Ania, L.V., Liedo-Galindo, A., Márquez-Farías, J.F.. 2011. Outline of new available catch and effort data of pelagic Shark caught by the Mexican longline fishery in the North Pacific. Working document subtmitted to ythe ISC Shark Working Group Workshop, 18-20 March 2011, National Research Institute of Far Sea Seas Fisheries, Fisheries Research Agency, Shimizu, Japan.

Ramirez-Amaro, S.S., Cartamil, D., Galvan-Magaña, F., González-Barba, Gerardo, Graham, J.B., Carrera-Fernandez, M., Escobar-Sanchez, O., Sosa-Nishizaki, O., Rochin-Alamillo, A. 2013. The artisanal elasmobranch fishery of the Pacific coast of Baja California Sur, Mexico, management implications. Scientia Marina 77 (3): 473-487.

SAGARPA. 2007. Norma Oficial Mexicana PROY-NOM-029-PESC-2006, Pesca Responsable de Tiburones y Rayas, Especificaciones para su Aprovechamiento. Diario Oficial de la Federación (Federal Gazette) February 14, 2006.

SAGARPA. 2008. Acuerdo mediante el cual se establece el volumen de captura incidental permitido en las operaciones de pesca de tiburón y rayas en aguas de jurisdicción federal de los Estados Unidos Mexicanos ubicadas en el Océano Pacífico**.** Diario Oficial de la Federación (Federal Gazette) September 12, 2008.

SAGARPA. 2012. Acuerdo por el que se modifica el Aviso por el que se da a conocer el establecimiento de épocas y zonas de veda para la pesca de diferentes especies de la fauna acuática en aguas de jurisdicción federal de los Estados Unidos Mexicanos, publicado el 16 de marzo de 1994 para establecer los periodos de veda de pulpo en el Sistema Arrecifal Veracruzano, jaiba en Sonora y Sinaloa, tiburones y rayas en el Océano Pacífico y tiburones en el Golfo de México. Diario Oficial de la Federación (Federal Gazette) June 11, 2008.

Table 1. Summary of number of fishing trips with observers per year, number of sets, vessels and observers 2006-2014. Source: SSOP database (INAPESCA/FIDEMAR).

Year	# Fishing Trips	# Sets	# Vessels	# Observers
Longline				
2006	78	1336	39	32
2007	130	1997	49	37
2008	103	1806	46	32
2009	51	823	30	17
2010	59	974	32	19
2011	43	614	25	20
2012	7	111	6	6
2013	24	398	15	12
2014*	16	298	10	9
Driftnet				
2006	36	655	18	19
2007	48	917	23	17
2008	49	1031	21	20
2009	18	335	9	8
2010	7	16	6	6
2011	-	2	-	-
2012	1	3	1	1

* January-April, 2014

Table 2. Number of fishing trips conducted with SSOP observers by fleets in the northern coastal and pelagic fisheries during 2006-2014. Ensenada (EN), Mazatlan (MZ), Puerto Peñasco (PP), San Carlos (SC), Salina Cruz (SZ) and Topolobampo (TB). Source SSOP database (INAPESCA/FIDEMAR).

Year	EN	MZ	PP	SC	SZ	TB	Total
2006	15	31	32				78
2007	38	50	30	14			132
2008	26	46	26	4	3		105
2009	13	24	15				52
2010	11	40	8				59
2011	10	20	8			1	43
2012	2	3	2				7
2013	12	9					24
2014	4	12					16
Total	131	235	121	25	3	1	516

Table 3. Sumary of observed effort in the Ensenada-based driftnet and longline coastal-pelagic fishery, June 2006 – March 2014. Ttrips= monthly total commercial fishing trips conducted; Otrips= number of fishing trips with observers.

	2006			2007			2008			2009			2010			2011			2012			2013			2014		
	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)
Jan	**17**	____	____	16	3	18.8	15	5	33.3	20			13	1	7.7	15			13			18	1	5.6	17	1	
Feb	**17**	____	____	13	6	46.2	17	7	41.2	19			14	2	14.3	14			9			15			24	2	
Mar	**17**	____	____	16	2	12.5	18	3	16.7	19			26			19			15				1			1	
Apr	**16**	____	____	10	3	30.0	17	4	23.5	15			19	1		24	1	4.2	15			8	1	12.5			
May	**20**	____	____	13	3	23.1	12	3	25.0	16			11	2	18.2	19	1	5.3	13			2					
Jun	11	2	18.2	15	4	26.7	14	2	14.3	16			12		0.0	12			3								
Jul	11	4	36.4	15	3	20.0	12	0	0.0	11			14	1	7.1	17						2	2	100.0			
Aug	8	2	25.0	11	2	18.2	11	2	18.2	11	1	9.1	12	2	16.7	11			11			6	1	16.7			
Sep	10	1	10.0	13	3	23.1	19			17	4	23.5	14	2	14.3	8			20			20	2	10.0			
Oct	26			20	4	20.0	17			30	2	6.7	17			14			27			12	1	8.3			
Nov	16	4	25.0	25	4	16.0	23			30	3	10.0	24			14	3	21.4	17	2	11.8	6	2	33.3			
Dec	29	2	6.9	23	1	4.3	19			39	3	7.7	27			25	5	20.0	39			24	1	4.2			
Total	**111**	**15**	**13.5**	**190**	**38**	**20.0**	**194**	**26**	**13.4**	**243**	**13**	**5.3**	**203**	**11**	**5.4**	**192**	**10**	**5.2**	**182**	**2**	**1.1**	**113**	**12**	**10.6**	**4**		

Table 4. Sumary of observed effort in the Mazatlán-based driftnet and longline coastal-pelagic fishery, June 2006 – March 2014. Ttrips= monthly total commercial fishing trips conducted; Otrips= number of fishing trips with observers.

	2006			2007			2008			2009			2010			2011			2012			2013			2014		
	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)
Ene		____	____		4			4					14	6	43	10			41			15	1	6.7		2	
Feb		____	____		2			8		1			21	3	14				54			18	3	16.7		2	
Mar		____	____		4			6		33	2	6	17	4	24				52			26				5	
Abr		____	____		7			6		25	5	20	6	7		1	3		31			48				3	
May		____	____		6			8		1	7		15	3	20	10	7	70	37								
Jun		7			5			6		3	5		13			19	2	11	12								
Jul		6			6			6		1	1	100	16	3	19	20	4	20	0			6	5				
Ago		5						2		2			2			11	2	18	10			4					
Sep		1			1					1				3		3			21			18					
Oct		2			6					1			2	2	100	3			3			5					
Nov		6			6					1	4		11	5	45	1	2		8	2	25.0	7					
Dic		4			3					4			9	4	44	6			23	1	4.3	7					
Total		**31**			**50**			**46**		**73**	**24**	**32.9**	**126**	**40**	**31.7**	**84**	**20**	**23.8**	**292**	**3**	**1.0**	**154**	**9**	**5.8**		**12**	

Table 5. Sumary of observed effort in the Puerto Peñasco-based driftnet and longline coastal-pelagic fishery, June 2006 – March 2014. Ttrips= monthly total commercial fishing trips conducted; Otrips= number of fishing trips with observers.

	2006			2007			2008			2009			2010			2011			2012			2013			2014		
	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)	Ttrips	Otrips	Cover (%)
Ene		0			0			0			0			0			0		2	0	0.0	7	0	0.0	10	0	
Feb		0			0			2			0			0			0		2	0	0.0	10	2	20.0	17	0	
Mar		0			3			4			2			1			0		4	0	0.0	10	0	0.0	6	0	
Abr		0			5			5			2			3			0		2	2	100.0	17	0	0.0	6	0	
May		1			5			4			3			2			1		5	0	0.0	0	0	0.0		0	
Jun		12			5			4			3			0			2		12	0	0.0	0	0	0.0		0	
Jul		10			5			5			5			1			0		0	0	0.0	1	0	0.0		0	
Ago		8			4			2			0			1			3		15	0	0.0	20	1	5.0		0	
Sep		0			3			0			0			0			1		12	0	0.0	13	0	0.0		0	
Oct		0			0			0			0			0			0		12	0	0.0	9	0	0.0		0	
Nov		1			0			0			0			0			0		12	0	0.0	9	0	0.0		0	
Dic		0			0			0			0			0			1		6	0	0.0	6	0	0.0		0	
Total	**0**	**31**		**0**	**30**		**0**	**26**		**0**	**15**		**0**	**8**		**0**	**8**		**84**	**2**	**2.4**	**102**	**3**	**2.9**		**0**	

Table 6. Summary for number and percentage observed sharks catches by species in the different pelagic longline and coastal drifnet fisheries in Mexican northen Pacific. EN= Ensenada, SC= San Carlos, PP= Puerto Peñasco, MZ= Mazatlan, TB=Topolobampo and SZ= Salina Cruz.

	LONGLINE												DRIFTNET							
	EN		SC		PP		MZ		TB		SZ		EN		PP		MZ		SZ	
Species	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Alopias pelagicus	270	0.2	157	2.4	74	0.0	11799	10.5	1	0.3	83	29.0			869	1.2	3265	33.7	81	30.5
Alopias superciliosus	23	0.0	18	0.3	468	0.1	2588	2.3	12	3.8	1	0.3	4	0.9	973	1.3	374	3.9	1	0.4
Alopias vulpinus	245	0.2	54	0.8	288	0.1	627	0.6			18	6.3	129	28.0	746	1.0	108	1.1	18	6.8
Carcharhinus albimarginatus							32	0.0												
Carcharhinus altimus	1	0.0			3	0.0									3	0.0				
Carcharhinus brachyurus					5	0.0	8	0.0							5	0.0				
Carcharhinus falciformis	82	0.1	203	3.1	223	0.1	4506	4.0			107	37.4			157	0.2	1192	12.3	92	34.6
Carcharhinus leucas	1	0.0			8	0.0	89	0.1							5	0.0	50	0.5		
Carcharhinus limbatus			26	0.4	80	0.0	2312	2.1			2	0.7			348	0.5	401	4.1	2	0.8
Carcharhinus longimanus							133	0.1									2	0.0		
Carcharhinus obscurus			2	0.0	14	0.0	768	0.7							5	0.0				
Carcharhinus porosus	14	0.0			1	0.0									1	0.0				
Carcharhinus spp	10	0.0	256	3.9	1113	0.3	6793	6.0	22	7.0	2	0.7	4	0.9	1298	1.8	785	8.1	2	0.8
Carcharodon carcharias	2	0.0					15	0.0												
Galeocerdo cuvier							8	0.0												
Galeorhinus galeus	71	0.1											1	0.2						
Heterodontus francisci					17	0.0									2	0.0				
Heterodontus mexicanus					320	0.1									51	0.1				
Isurus oxyrinchus	**4820**	**4.3**	**208**	**3.2**	**525**	**0.2**	**3032**	**2.7**	**7**	**2.2**	**7**	**2.4**	**159**	**34.5**	**2315**	**3.2**	**960**	**9.9**	**7**	**2.6**
Isurus paucus			1	0.0																
Lamna ditropis	98	0.1					1	0.0												
Mustelus californicus					22264	6.9									21519	29.7				
Mustelus henlei					235191	72.9														
Mustelus lunulatus					6448	2.0														
Prionace glauca	105598	94.6	5535	84.7	1	0.0	76126	67.7	269	85.4	22	7.7	126	27.3			973	10.0	22	8.3
Rhizoprionodon longurio	17	0.0			21609	6.7									16285	22.5				
Sphyrna lewini	135	0.1	35	0.5	876	0.3	1778	1.6			28	9.8			3085	4.3	918	9.5	25	9.4
Sphyrna mokarran	117	0.1	5	0.1	2275	0.7	537	0.5			10	3.5					36	0.4	10	3.8
Sphyrna tiburo							1	0.0												
Sphyrna zygaena	93	0.1	33	0.5	1177	0.4	1342	1.2	4	1.3	6	2.1	38	8.2	3148	4.3	631	6.5	6	2.3
Squalus suckleyi	1	0.0																		
Squantina californica	1	0.0	1	0.0	29820	9.2	7	0.0							21578	29.8	7	0.1		

Table 7. Summary statistics for observed mako shark catches by quarter in Mexican pelagic longline fisheries in northern Pacific, period 2006-2014.

Year	Q1			Q2			Q3			Q4		
	Catch	Sets with catch	Catch/set	Catch	Sets with catch	Catch/set	Catch	Sets with catch	Catch/set	Catch	Sets with catch	Catch/set
2006				453	33	13.7	589	111	5.3	664	65	10.2
2007	260	109	2.4	609	185	3.3	933	107	8.7	336	153	2.2
2008	436	140	3.1	771	165	4.7	136	63	2.2	0	0	
2009	12	8	1.5	147	78	1.9	275	97	2.8	312	72	4.3
2010	162	90	1.8	277	101	2.7	109	38	2.9	126	56	2.3
2011	23	11	2.1	289	132	2.2	153	39	3.9	167	47	3.6
2012	10	1	10.0	4	1	4.0				461	49	9.4
2013	173	73	2.4	24	11	2.2	164	59	2.8	159	46	3.5
2014	246	103	2.4	77	39	2.0						

Table 8. Summary statistics for observed driftnet mako shark catches by quarter in Mexican driftnet fisheries in northern Pacific, period 2006-2009.

Year	Q1			Q2			Q3			Q4		
	Catch	Sets with catch	Catch/set	Catch	Sets with catch	Catch/set	Catch	Sets with catch	Catch/set	Catch	Sets with catch	Catch/set
2006				262	13		127	32				
2007	8	2		312	65		90	26		47	23	
2008	84	13		442	85		66	27				
2009				1070	34		929	34				

Table 9. Summary statistics for observed longline and driftnet shortfin mako shark catches by fleet and quarter in northern Mexican Pacific, period 2006-2014.

Longline

EN

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1	372	187	631	1.7	50.3
Q2	292	154	644	2.2	52.7
Q3	328	224	1615	4.9	68.3
Q4	406	276	1520	3.7	68.0

MZ

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1	823	334	668	1.2	40.6
Q2	1541	452	1628	0.9	29.3
Q3	945	184	453	2.1	19.5
Q4	660	190	278	2.4	28.8

SC

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1	58	9	15	0.3	15.5
Q2	106	41	83	0.8	38.7
Q3	62	29	83	1.3	46.8
Q4	67	17	23	0.3	25.4

PP

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1	172	4	8	0.0	2.3
Q2	1341	94	289	0.2	7.0
Q3	1106	81	226	0.2	7.3
Q4	26				

TB

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1					
Q2					
Q3					
Q4	18	4	7	0.4	22.2

Driftnet

EN

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1					
Q2					
Q3	30	19	110	3.7	63.3
Q4	37	22	47	1.3	59.5

MZ

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1	78	15	92	0.8	19.2
Q2	291	113	835	0.3	38.8
Q3	231	23	33	7.0	10.0
Q4	27				

SC

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1					
Q2					
Q3					
Q4					

PP

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1	167				
Q2	1203	79	1244	1.0	6.6
Q3	845	77	651	0.8	9.1
Q4	20				

SZ

Quarter	Total sets	Sets with catch	Catch	Catch/set	% Mako/set
Q1					
Q2	34	4	7	0.2	11.8
Q3					
Q4					

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

Table 9. Summary size data statistics by sex and year of shortfin mako reported by scientific observers in longline sets during 2006-2014 in northern Mexican Pacific.

Year/ sex		Mean	Stand Error	Median	Stand Desv	Smaller Size	Larger Size	Sample Size
2006	F	140.0	2.0	138.0	36.7	70.0	399.0	332
	M	135.4	4.3	136.0	33.3	84.0	260.0	61
2007	F	140.1	1.8	137.0	40.1	70.0	362.0	497
	M	142.7	2.0	140.0	39.3	72.0	300.0	390
2008	F	158.2	2.9	157.0	40.5	72.0	408.0	185
	M	157.9	2.7	163.0	33.7	91.0	278.0	152
2009	F	156.3	2.3	157.0	28.9	91.0	248.0	159
	M	166.9	3.3	162.5	39.3	92.0	274.0	138
2010	F	161.6	2.1	159.0	40.9	72.0	336.0	375
	M	157.5	2.3	155.0	38.0	70.0	344.0	272
2011	F	137.3	1.8	139.0	31.2	71	261.0	297
	M	136.3	2.2	133.0	33.7	71.0	255.0	220
2012	F	133.0	3.2	126.0	36.9	81.0	312.0	134
	M	143.7	2.8	140.5	33.8	81.0	239.0	142
2013	F	166.1	3.6	162.0	38.6	70.0	345.0	114
	M	155.4	5.1	155.5	41.0	90.0	249.0	64

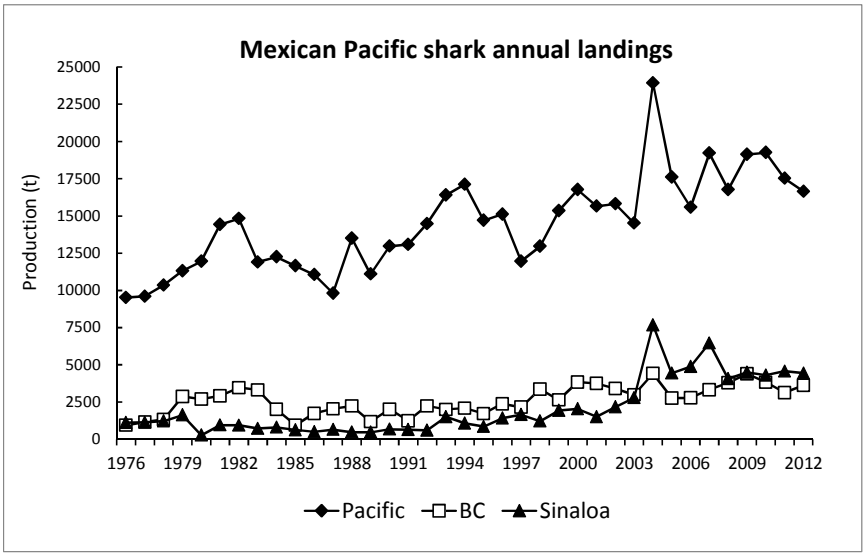
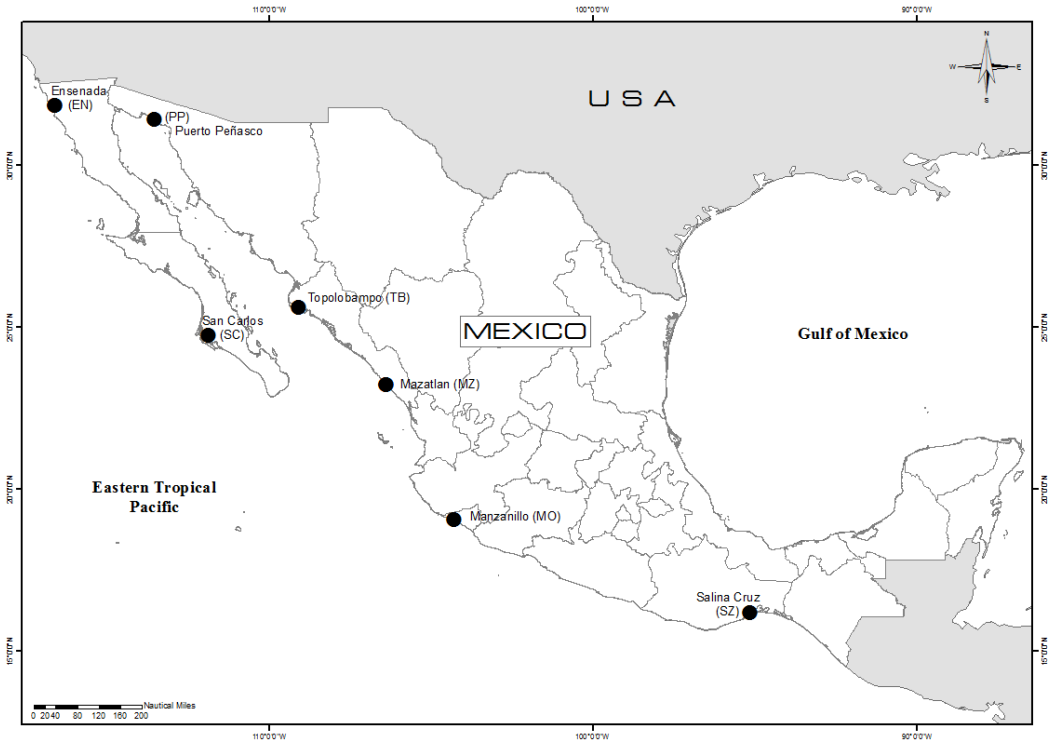


Figure 1. Total annual shark production from the Pacific Mexican during 1976-2012 in comparison with the shark landings reported to BC and Sinaloa states during the same period (Source: Fisheries Statistic Yearbooks of Mexico).



[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

Document not to be cited without author's permission.

Figure 2. Geographical location of the port -based Mexican longline fishing fleets where SSOP operated during 2006-2014. Although Manzanillo's pelagic longline fishery (MO) was not included in SSOP operations, it commonly targeted in a seasonal basis, blue and mako sharks.

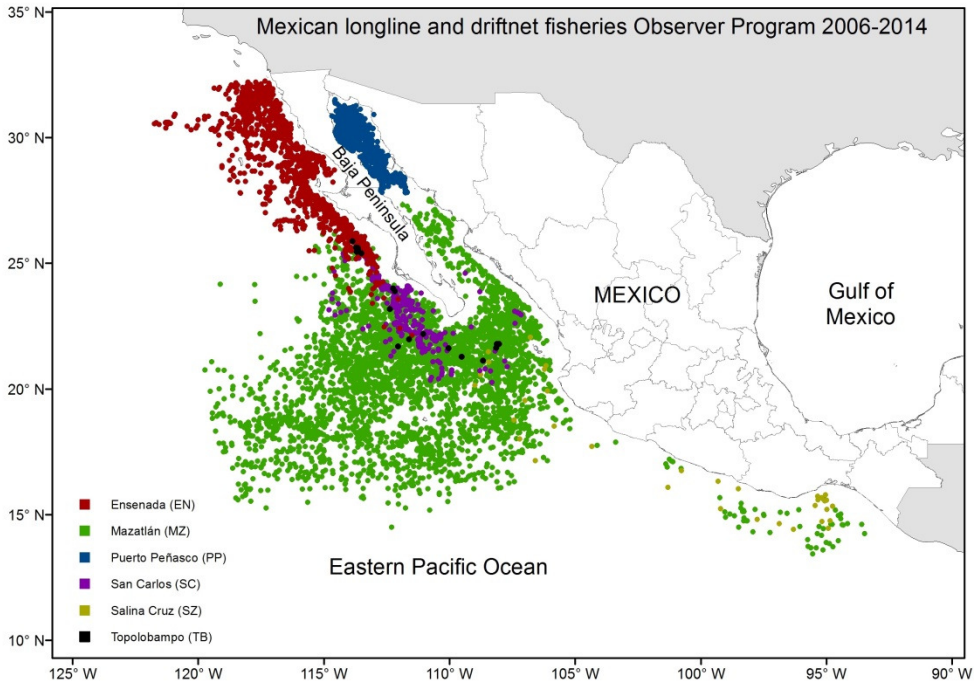


Figure 3. Observer effort in the different Mexican pelagic fisheries during 2006-2014.

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

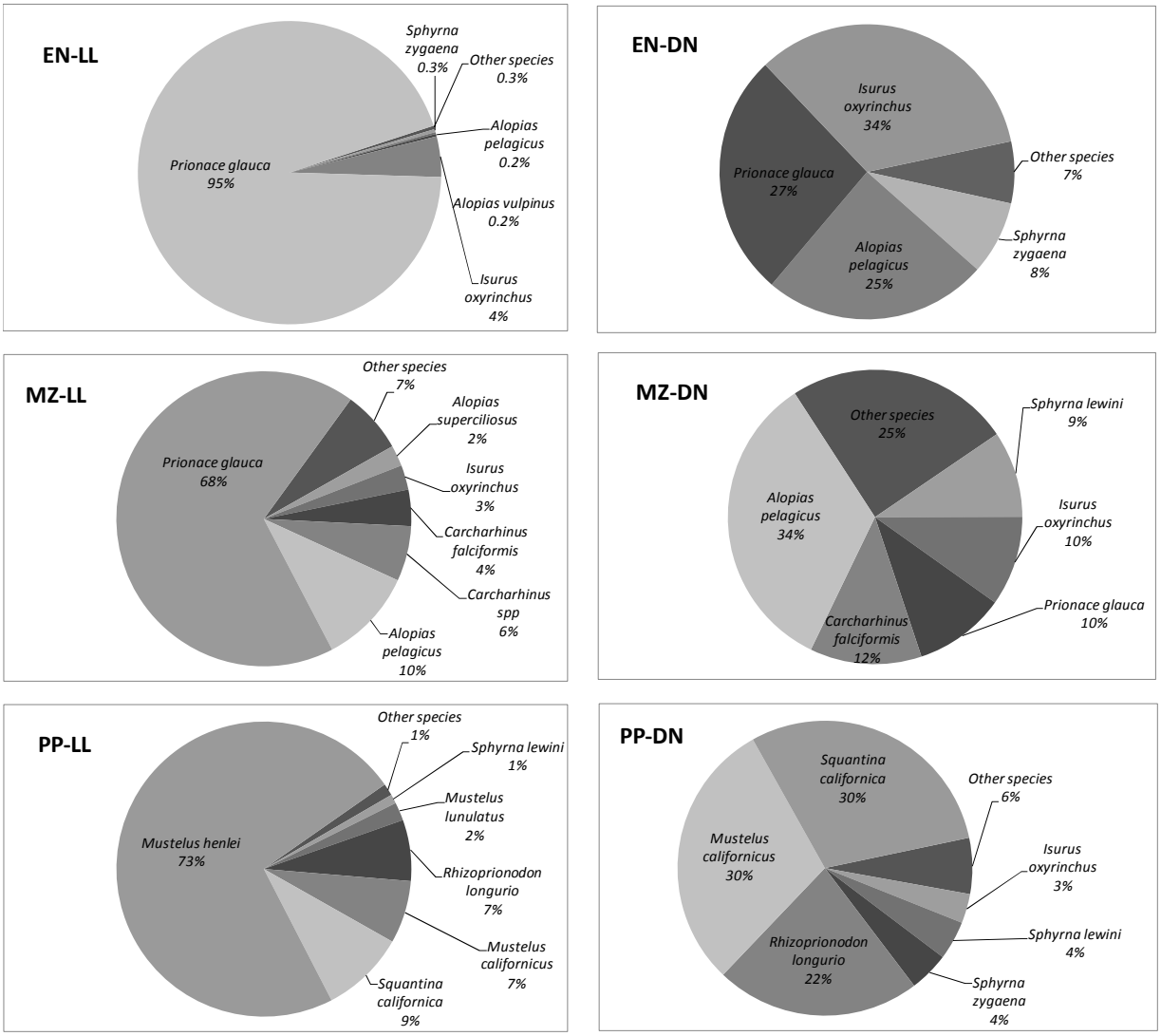


Figure 4. Observed shark species composition for the principal longline and driftnet fisheries in northern Mexican Pacific fisheries during 2006-2014. EN= Ensenada, MZ= Mazatlan and PP= Puerto Peñasco.

---

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

Document not to be cited without author's permission.

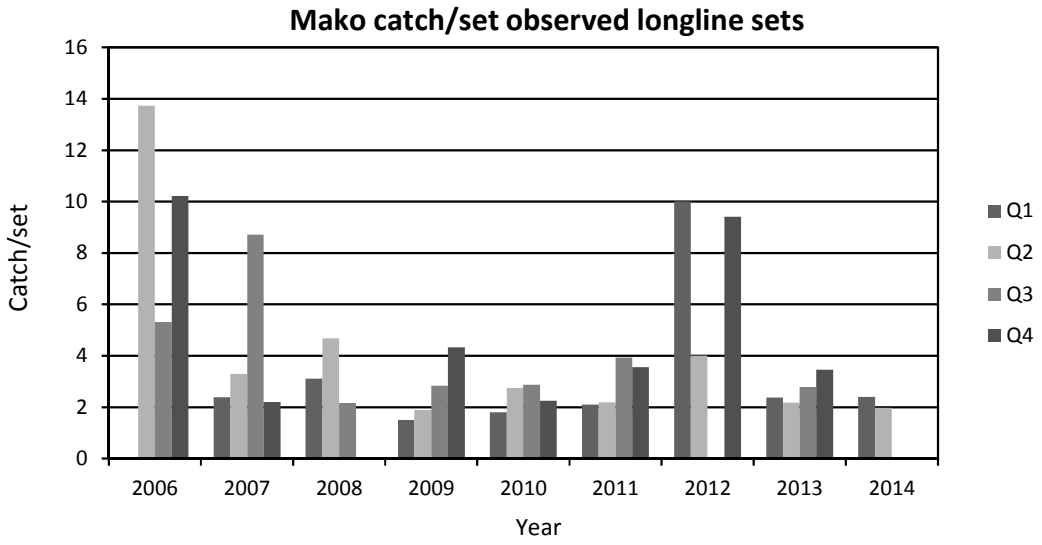


Figure 5. Observed shortfin mako longline catch/set ratio by quarters during 2006-2014. Bars represented each quarter of the year.

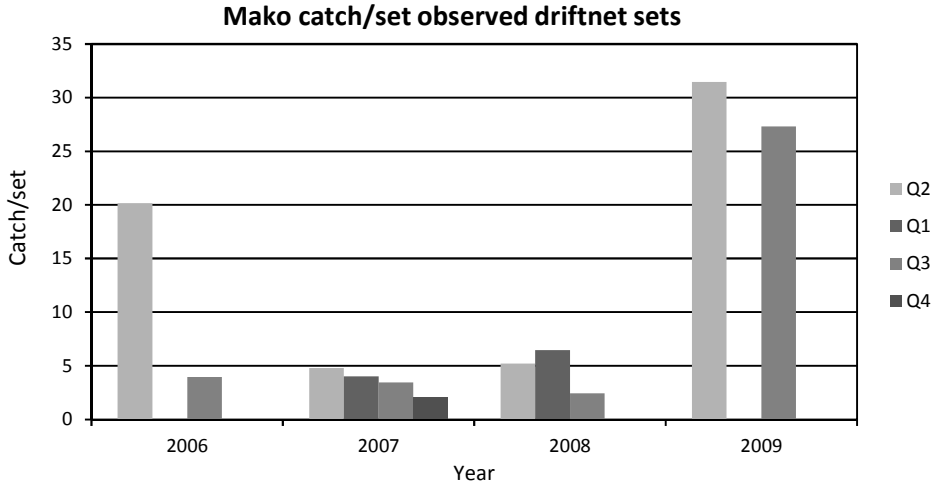


Figure 6. Observed shortfin mako driftnet catch/set ratio by quarters during 2006-2009. Bars represented each quarter of the year.

---

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

Document not to be cited without author's permission.

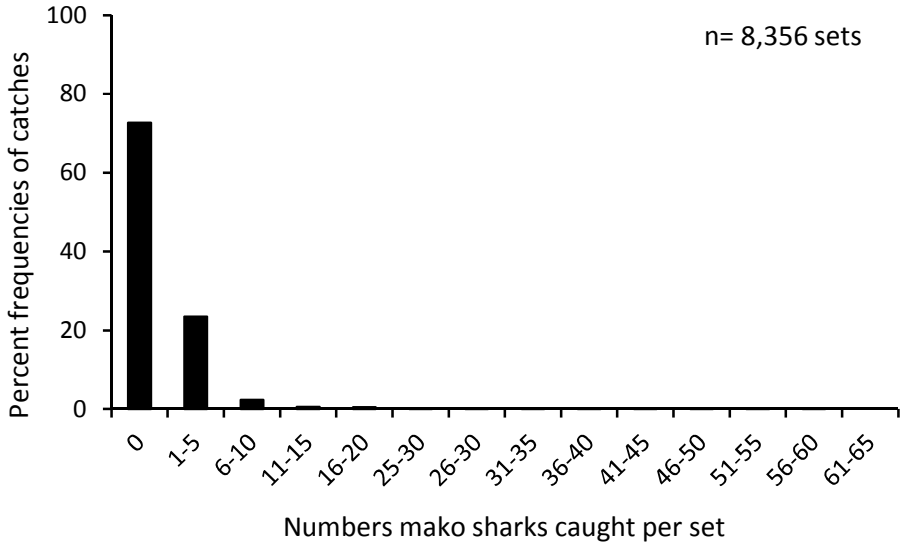


Figure 7. Percent frequency plot of shortfin mako catches in the Mexican pelagic longline fisheries 2006-2014.

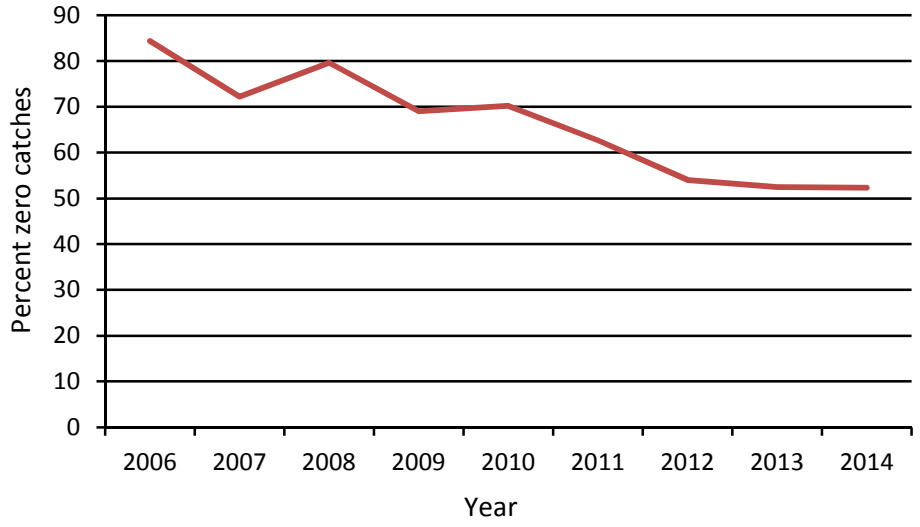


Figure 8. Percentages of sets with zero catches in the Mexican pelagic longlines fisheries during 2006-2014.

---

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

Document not to be cited without author's permission.

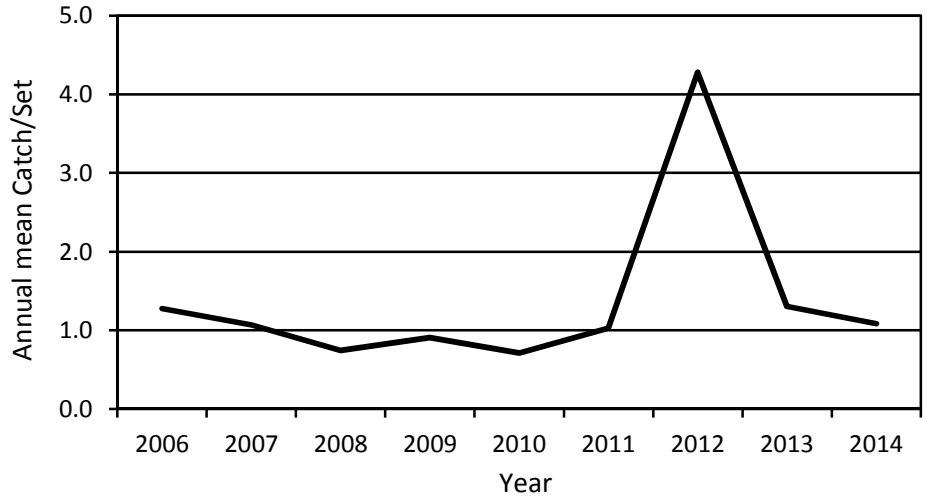


Figure 9. Shortfin mako shark annual mean catch/set for the longline fisheries off northern Mexican Pacific in 2006-2014.

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

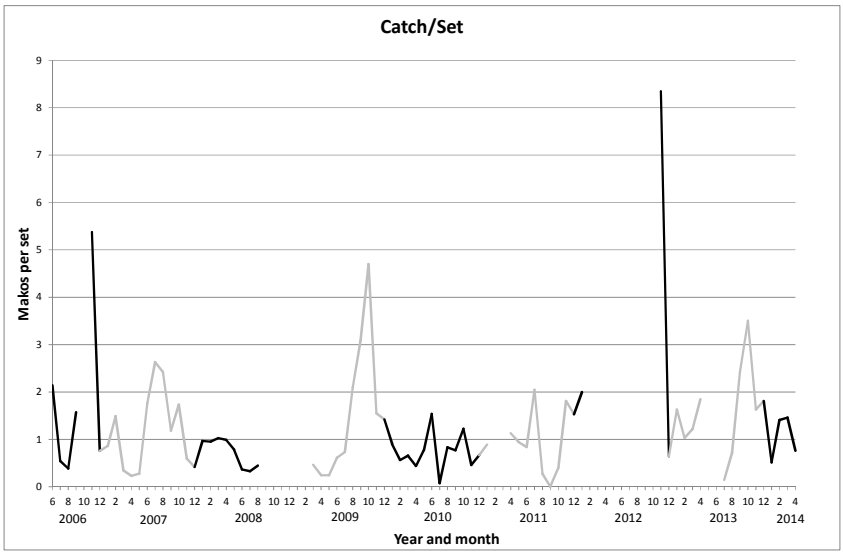


Figure 10. Shortfin mako shark annual mean catch/set for the longline fisheries off northern Mexican Pacific in 2006-2014.

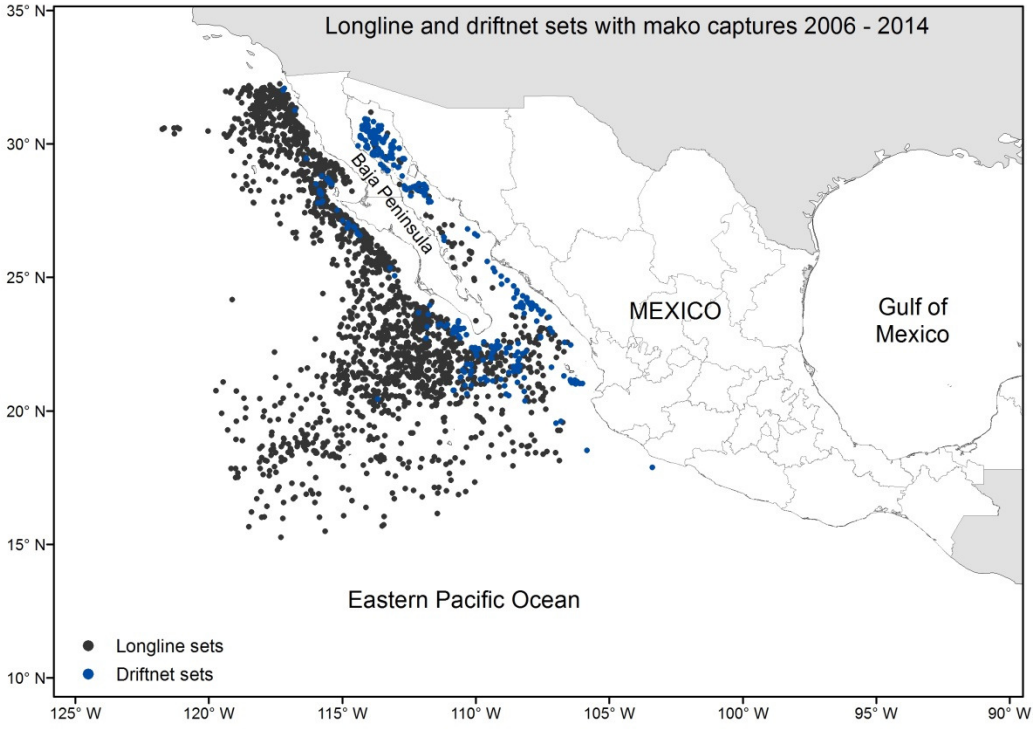


Figure 11. Observer fishery effort targeted shortfin mako in northern Mexican Pacific during 2006-2014. Black dots= longline sets; Blue dots= driftnet sets (2006-2009).

---

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

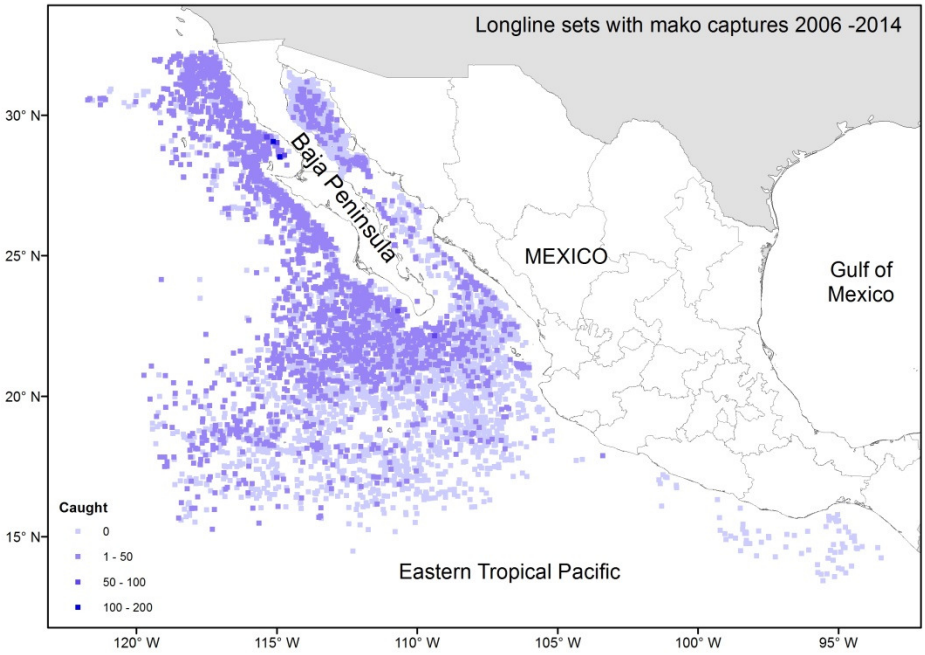


Figure 12. Mako shark numerical catches observed on longline sets in northern Mexican Pacific during 2006-2014.

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

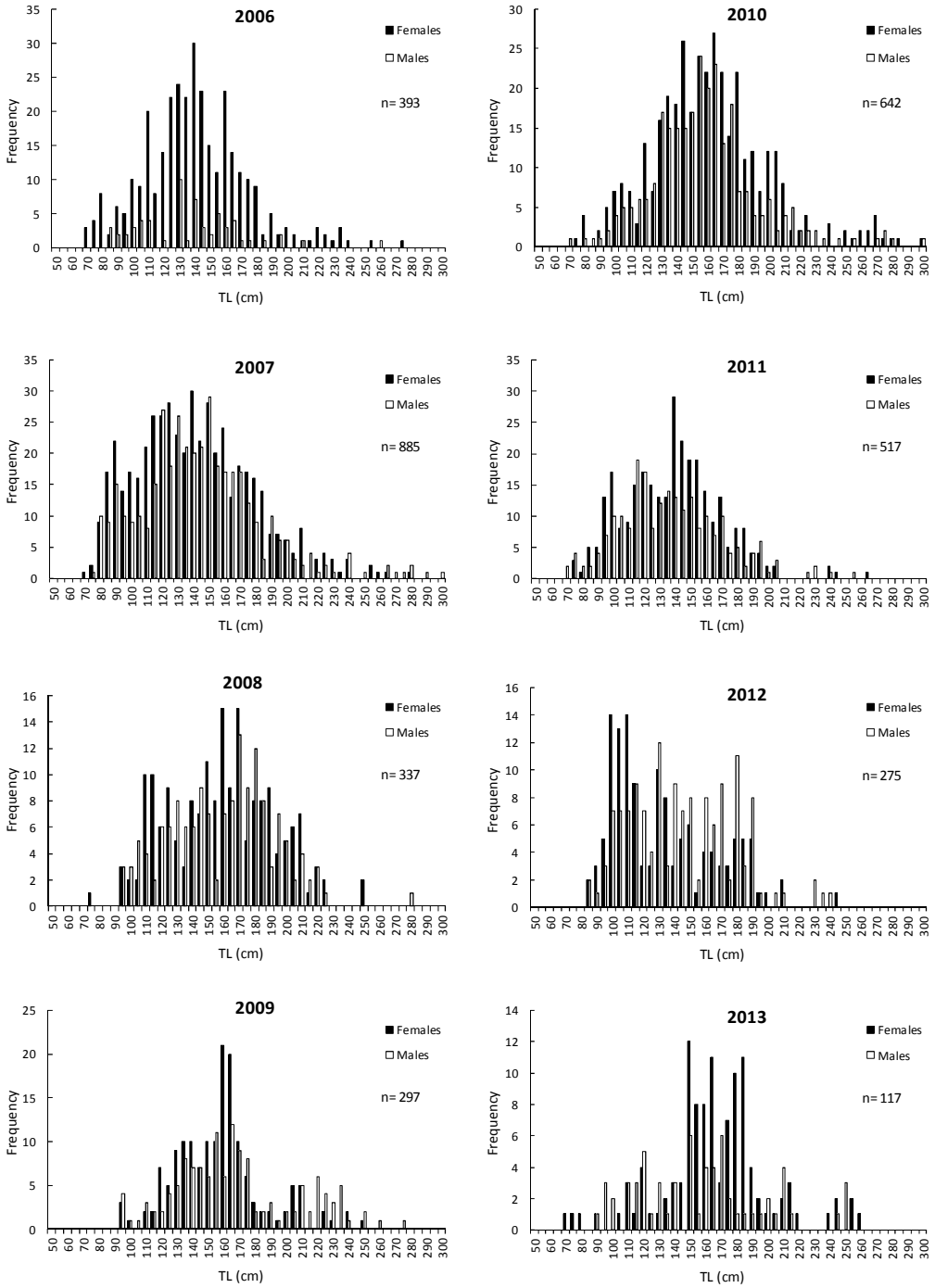


Figure 13. Annual total length distributions by sex of the shortfin mako reported by SSOP on longline sets along the northern Mexican Pacific during 2006-2014. Individuals > 300 TL cm are not included in the histograms.

---

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico

[1]Working document submitted to the ISC Shark Working Group Workshop, 19-26 November 2014, Puerto Vallarta, Jalisco, Mexico