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BLUE SHARK (*Prionace glauca*) LENGTH COMPOSITION FROM INDONESIAN LONGLINE FLEET IN THE INDIAN OCEAN : PERIOD 2005 – 2014

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ABSTRACT

Blue sharks (*Prionace glauca*) are large, highly migratory, pelagic carcharhinids found throughout the oceans in all tropical and temperate waters. In Indonesian longline fleet in the Indian Ocean, blue sharks are the single most common bycatch species caught in the tuna surface longline fishery. The aims of this paper were to presents the information about length composition, spatiotemporal distribution and relative abundance (No. fish/100 hooks) obtained from data base Research Instituted for Tuna Fisheries scientific observer program. Data from tuna longline fishery in the Indian Ocean has collected by scientific observers from Research Institute for Tuna Fisheries during 2005 – 2014, comprising of a total of 93 trips with an average of 24 days/trip. Mean length of the blue shark Showed little variation between years (147.66 - 194.30 cmFL . Geographical distribution of blue shark CPUE (# fish / 100 hooks) more caught during Southeast monsoon than Northwest monsoon.

INTRODUCTION

Blue sharks (*Prionace glauca*) are large, highly migratory, pelagic carcharhinids found throughout the oceans in all tropical and temperate waters, with are slender in build, rarely exceeding 3 m in total length and 200 kg in weight. They feed opportunistically on a range of living and dead prey, including bony fishes, smaller sharks, squids, and carrion (Manning & Francis, 2005). In Indonesian longline fleet in the Indian Ocean, blue sharks are the single most common bycatch species caught in the tuna surface longline fishery (Novianto *et al*., 2014). Ariyogagautama & Prawira, (2014) concluded that at least recorded from 4.182 longline setting in the Indian Ocean were 694 setting caught shark with a total number of 1.277 sharks during period 2006 to 2014 (July) with at least average gained 8-9 sharks every trips wherein blue shark and thresher shark dominated species of sharks. This paper presents information about length

composition, spatiotemporal distribution and relative abundance (No. fish/1,000 hooks) obtained from data base Research Instituted for Tuna Fisheries scientific observer program.

MATERIAL & METHODS

Data from tuna longline fishery in the Indian Ocean has collected by scientific observers from Research Institute for Tuna Fisheries during 2005 – 2014. The data were collected from August 2005 to November 2014 comprising of a total of 93 trips with an average of 24 days/trip. The data informing a fishing position, date, the number of hooks used, catch number by species, Fork length (cmFL) and sex of each shark. These data were plotted according to longitude, latitude, period of fishing, location of deployment, number of operated hooks in daily deployed, catch in number and length (FL). The length frequency was aggregated and the average length was analyzed throughout the period of observation. The nominal fishing effort of tuna longline fishery was described as the number of hooks used on certain area of fishing, while hook rates (CPUE) calculated as number of fishes caught per 100 hooks. Range of hook rates on each hauls were pooled and plotted according to its geo-reference to describe the geographical distribution of blue shark.

RESULTS AND DISCUSSION

The scientific observer program has been deployed for 10 years since its first initiated in August 2005. Of total 1.801 samples of blue shark from 93 trips and 2,121 days at sea have been successfully retrieved (Table 1). The area of fishing operation was which highly concentrated at the south of Indonesian waters (Figure 1). The Eastern Indian Ocean region (4^0 - 16^0S and 105^0 - 120^0 E) has long been considered as an important area for potensial fishing ground for indonesia tuna longline fleets .Wudianto *et al*. (2003), stated fishing ground tuna longliners from Cilacap and Benoa port are South central of Java island between 108^0 - 118^0 E and 8^0 - 22^0 S and fishing operation of tuna longliners (>70%) was mostly outside the EEZ of Indonesia. There are two zones of tuna longliners fishing ground base on Benoa port position, ie the zone in the southeastern (south and east) and the zone of southwestern (south and west), intensity of longliners more focused operating in the area southwestern of the Benoa port wherein this area is

a potential fishing ground for frozen tuna fleet and reported many of sharks caught in these area (Novianto et al. 2009).

Due to unique geographic location, the region (4^0 - 16^0 S and 105^0 - 120^0 E) causes the variability of oceanographic, where the monsoonal system plays a great role in determining the oceanographic variability. There are two major monsoon which influence heavily on it's variability, Southeast monsoon and Northwest monsoon (Hendiarti, 2003; Tomczak and Godfrey, 2001). Usually during southeast monsoon period, movement of the wind can trigger upwelling process on coastal area, particulary on coastal of southern Java-Bali and coastal of southern Sumatra (Hendiarti, 2003; Hendiarti et al., 2004; Susanto and Marra, 2005; Susanto et al., 2006). Geographical distribution of blue shark CPUE (# fish / 100 hooks) more caught during Southeast monsoon than Northwest monsoon (Figure 2). Hendiarti *et al.* (2005) concluded that the "pelagic fish season" develops during the southeast monsoon where maximum and minimum peaks during Jun.-Sep. and Nov.-Jan. respectively. Higher CPUE of blue shark concentrated between 31^0 – 34^0 S and 85^0 and 104^0 E (Figure 4 & 5).

Figure 5 shown the annual CPUE of blue shark fluctuated between 0.015 - 1.34 (# fish/1000hks) and mean of CPUE betwen 0.09 – 0.23 (#fish/100hks). Low CPUE occurred in 2011 this is due to a coverage area the fewest compared to other years, while the highest CPUE occurred in 2012 which coverage area until higher latitudinal. Monthly CPUE of blue shark shown in November and February had the highest CPUE 0.34 and 0.29 respectively, and in december and January had the lowest CPUE (Figure 6). Kanaiwa *et al*., 2014, stated that the level of blue shark stock in the Indian Ocean does not change largely during 1992 to 2012, but in generally CPUE index of blue shark in the Indian Ocean has decrease for the more recent years (Coelho *et al*.,2014).

The descriptive statistics and the number of observations per year of blue shark shown in Table 2. The number of sharks were caught varied during the study period due to the different types of fleets (fresh tuna and frozen tuna) and their fishing ground. Fishing ground of frozen tuna fleets were between 16^0 - 35^0 S and catch more blue shark, because blue shark is known to abundant in higher than tropical latitudinal area (FAO, 1984). While fresh tuna fleets catch in the Indonesia waters. Total catches in 2006, 2007, 2008 and 2012 was a trip in which the scientific observer conduct research on frozen tuna fleet so lots of blue shark data was recorded. While other years a trip that follows a fleet of fresh tuna with a number of blue shark catches a bit.

Mean length of the blue shark Showed little variation between years (147.66 - 194.30 cmFL) except 2011, which is only recorded two blue shark without measurement so that no information on the length of this year. In 2011, a scientific observer program only follow one fishing company that only observation area at the same location (12^0 -15^0S - 115^0-120^0E).

Figure 7 shown the annual length frequencies of blue shark showed that the size composition varies every year except in 2011 were not recorded. Length distribution of blue shark between 60 - 312 cmFL, wherein adult size for blue shark ranges from 180-281 TL (Compagno, 1984). Using estimation of catches at size for IOTC species (IOTC, 2015), the results of the conversion cmTL to cmFL 180 cmTL = 149.7 cmFL and 281cmTL = 232.7 cmFL. 14:35% as many fish < 150 cmFL indicate that the blue shark caught by Indonesian longline fleet is dominated by adult size. Figure 8 shown monthly length frequencies (combined years) consists of a variety of the same size, which during the month of December until February did not have a small sample size and the frequency of length blue shark in 2006 and 2007 is wider than the other years.

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Appendix

Table 1. Activity summary of scientific observer in Eastern Indian Ocean during 2005 to 2014.

Year	Trip	Day at Sea	Lattitude	Longitude
2005	9	117	12-16	107-116
2006	13	401	4-31	103-128
2007	13	258	9-33	79-115
2008	16	404	9-18	76-119
2009	13	288	0-14	95-119
2010	5	152	9-15	110-120
2011	4	111	12-15	115-120
2012	8	192	1-32	85-117
2013	6	198	9-13	100-121
2014	6	265	6-13	100-120

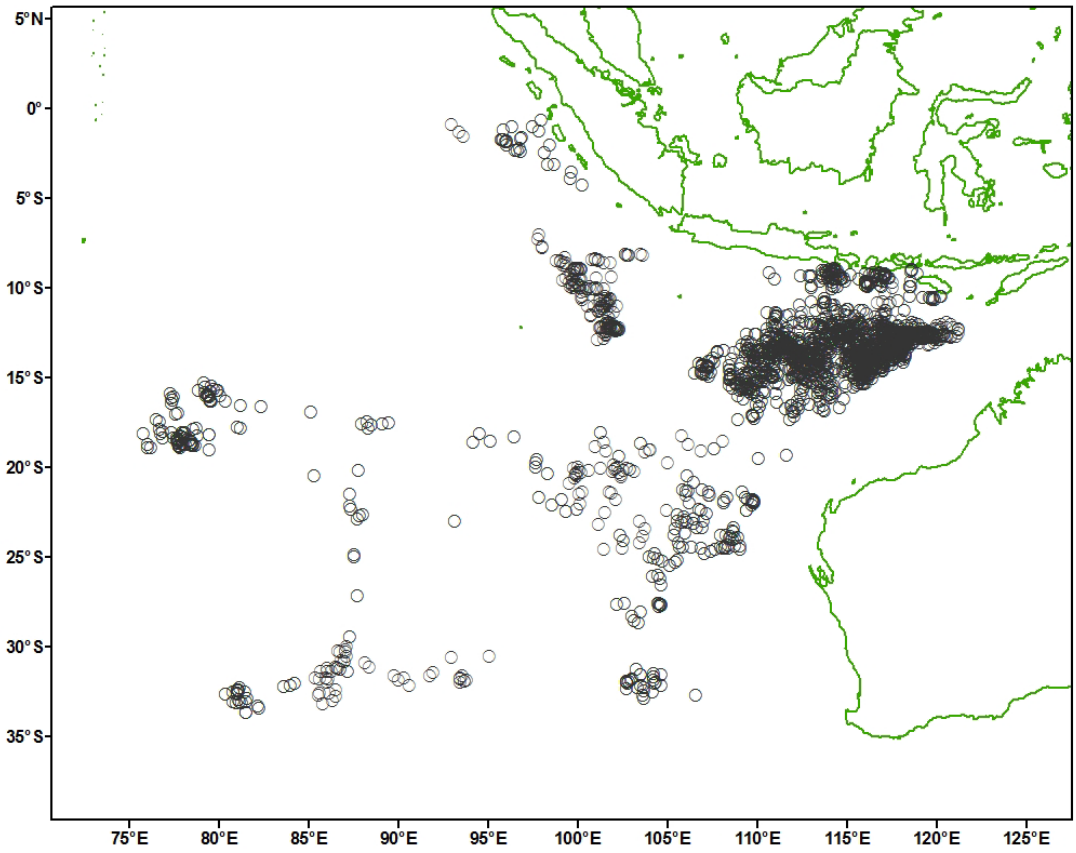

Figure 1. Location of the Indonesia tuna longliners fishing ground of blue shark in eastern Indian Ocean based on observer data from 2005 to 2014.

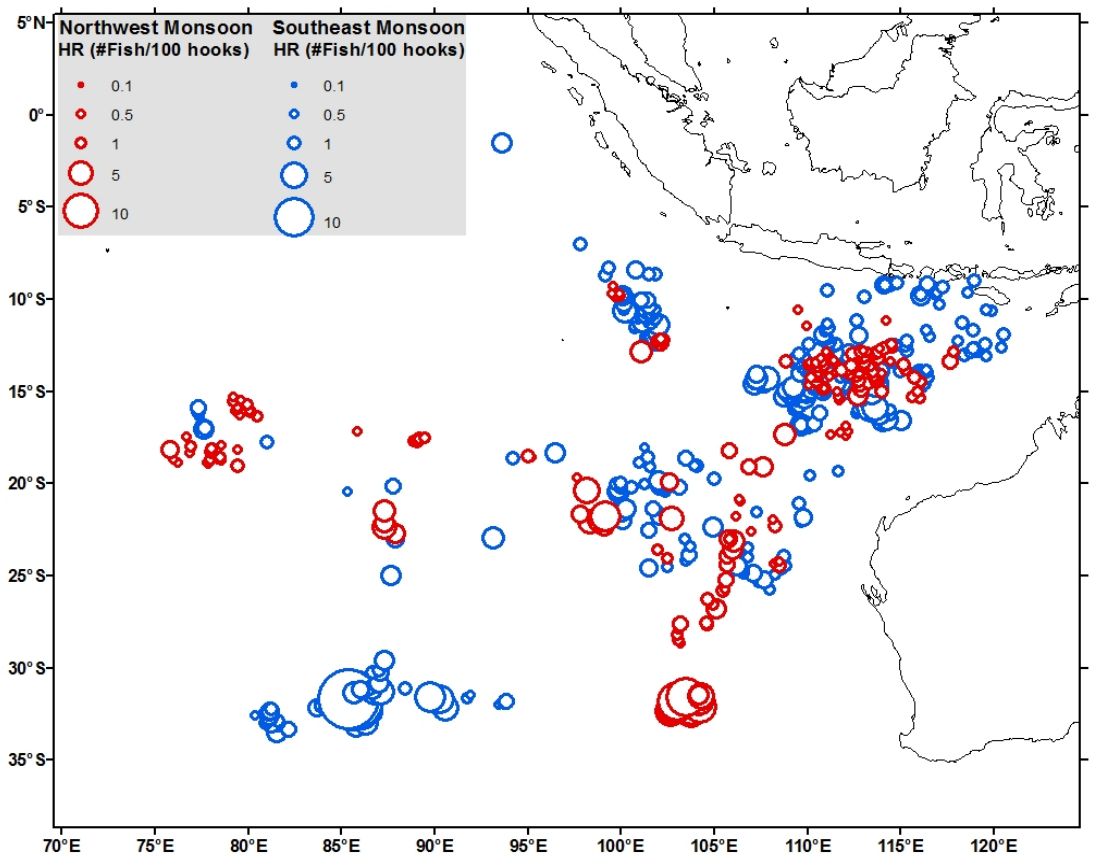

Figure 2. Geographical distribution of blue shark CPUE (#fish/100 hooks) by Monsoon based on RITF Pelagic Longline Scientific observer data for 2005-2014.

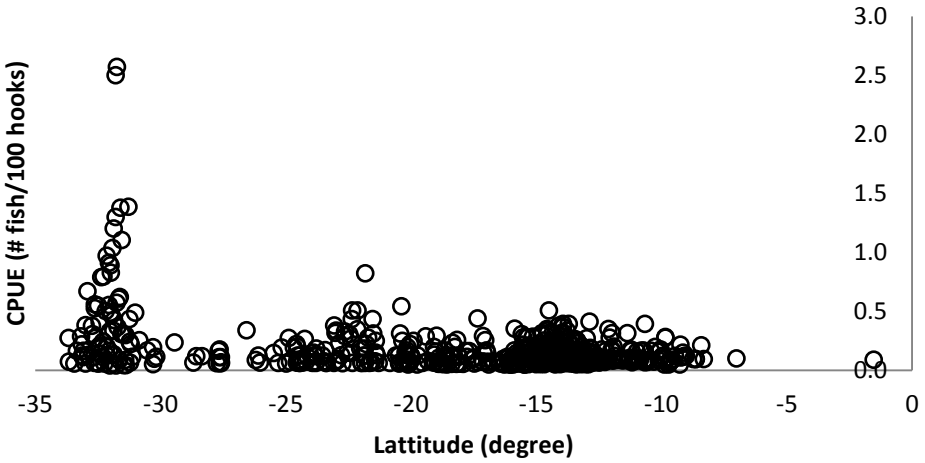

Figure 3. Average of annual nominal CPUE (No. of fish/100 hooks) of blue shark based on RITF Pelagic Longline Scientific observer data for 2005-2014

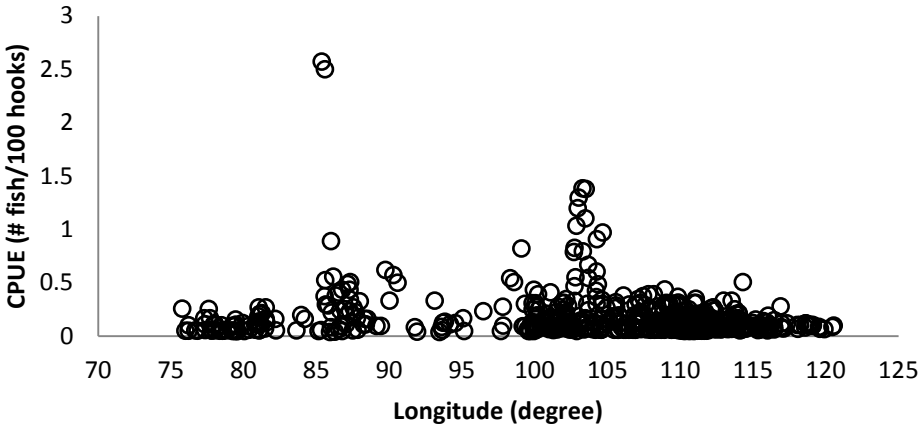

Figure 4. Average of annual nominal CPUE (No. of fish/100 hooks) of blue shark based on RITF Pelagic Longline Scientific observer data for 2005-2014

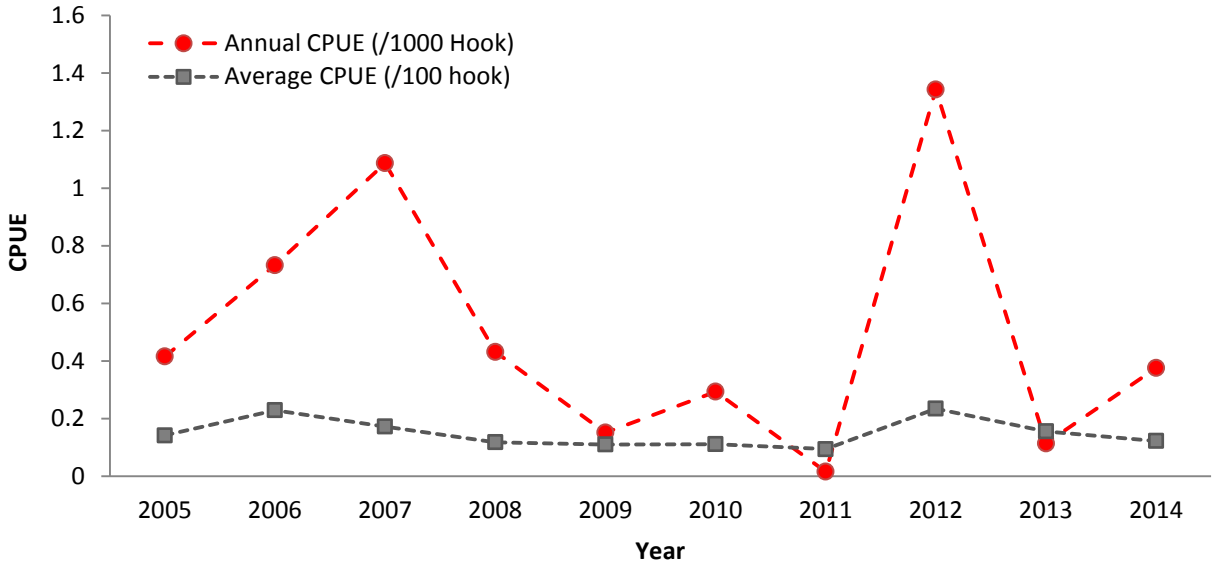

Figure 5. Average of annual nominal CPUE of blue shark based on RITF Pelagic Longline Scientific observer data during 2005-2014.

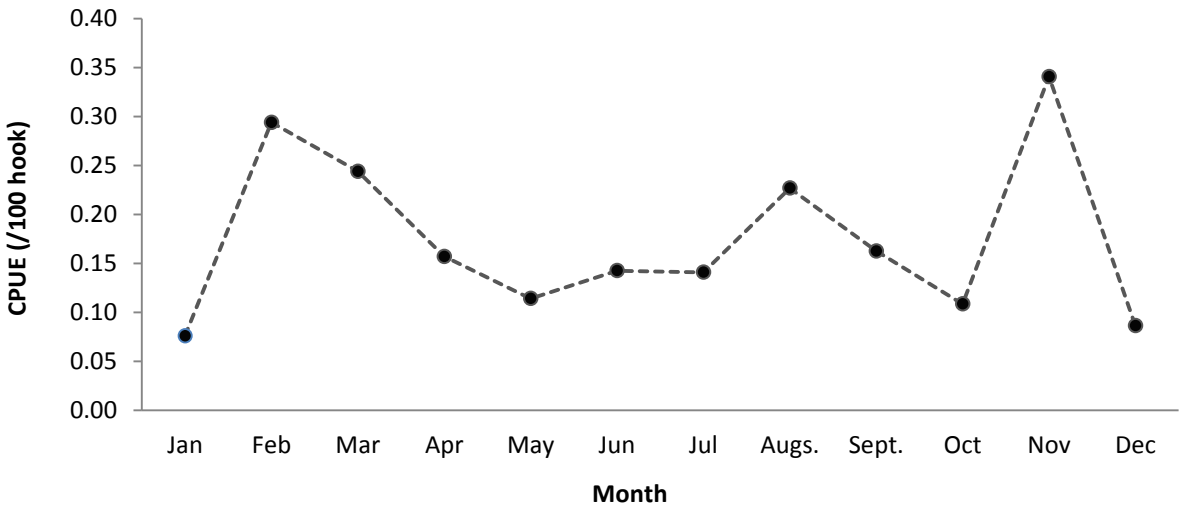

Figure 6. Average of monthly nominal CPUE of blue shark based on RITF Pelagic Longline Scientific observer data during 2005-2014.

Table 2. Sample size and descriptive statistics by year of blue shark caught by Indonesian pelagic longline fleet in The Indian Ocean during the 2005-2014 period.

YEAR	NUMBERS of BSH	NUMBER of Samples	MEAN FL(cm)	s.e.	FL C.I.		FL (cm)		Total	EFFORT	CPUE
					95% low	95% up	Min	Max	Setting	(Hooks)	#1000 h
2005	59	41	191.85	5.26	181.22	202.48	88	268	97	141961	0.42
2006	473	345	164.72	2.73	159.35	170.09	60	312	452	645552	0.73
2007	427	302	194.30	1.78	190.79	197.80	80	306	263	393013	1.09
2008	221	209	184.32	1.96	180.45	188.18	108	278	391	511930	0.43
2009	53	25	192.72	5.12	182.16	203.28	150	240	309	350952	0.15
2010	80	77	168.57	2.27	164.04	173.10	70	220	187	272882	0.29
2011	2	-	-	-	-	-	-	-	169	130224	0.02
2012	381	150	157.89	3.00	151.97	163.80	75	254	192	283713	1.34
2013	44	44	163.92	3.46	156.92	170.93	134	230	226	386178	0.11
2014	61	53	147.66	2.28	143.09	152.23	90	181	137	162372	0.38

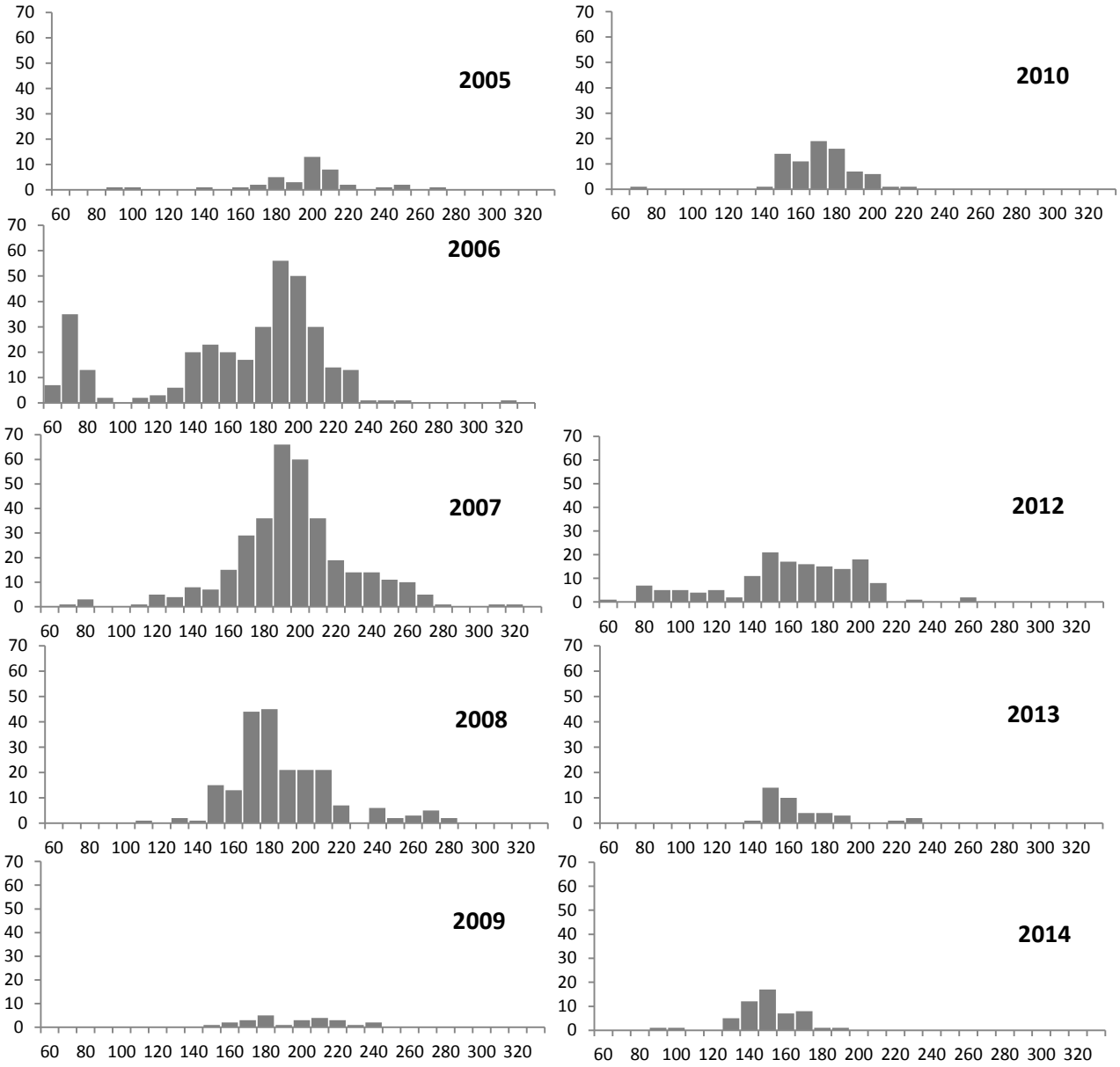

Figure 7. Length frequencies (in numbers) of annual blue shark catches based on the Indonesian Pelagic Longline Scientific observer data.

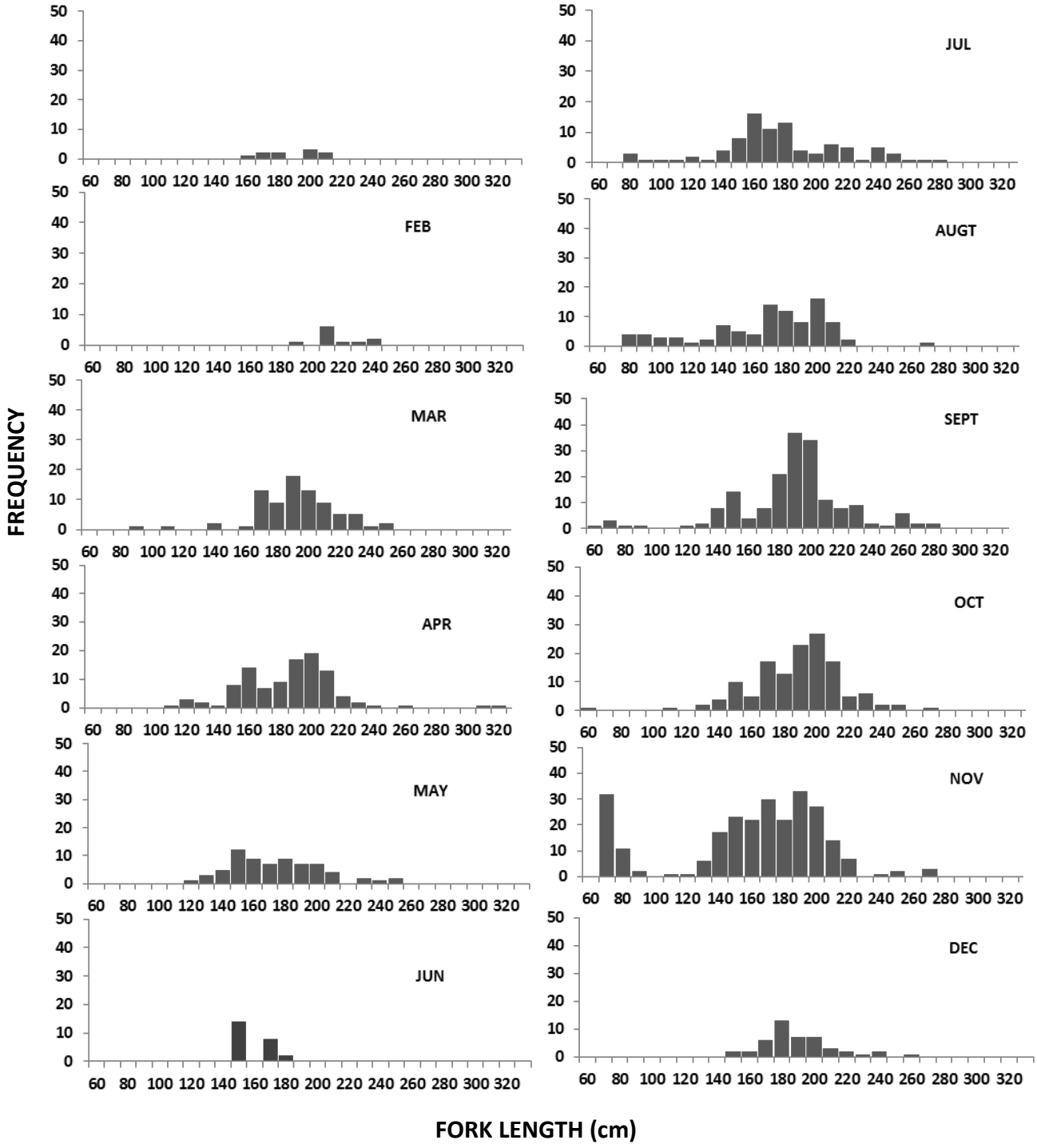

Figure 8. Length frequencies (in numbers) of monthly blue shark catches for all years combined (2005-2014) based on RITF Pelagic Longline Scientific observer data.