

SPECIES COMPOSITION AND CPUE OF PELAGIC SHARKS OBSERVED BY JAPANESE OBSERVERS FOR TUNA LONGLINE FISHERIES IN THE ATLANTIC OCEAN

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SUMMARY

Species composition, CPUE (number of catches per 1,000 hooks) of sharks, and length frequency of dominant species caught in the Atlantic Ocean are discussed using Japanese observers data for tuna longline fisheries in 1995-2000.

Pelagic sharks, 9,921 individuals of 16 species were observed. Dominant species caught in the all areas was blue shark, and especially in the area of 40-60°N, the proportion of blue shark was more than 90%. Bigeye thresher, tiger shark, and porbeagle were frequently observed in the areas near the equator, coastal region of 30-40°N, and north of 50°N, respectively. The highest CPUE of blue shark was observed around the area of 40°N, and shortfin mako shark showed a similar tendency. The CPUEs of bigeye thresher, tiger shark, and porbeagle were higher in the area near the equator, coastal region of 30-40°N, and north of 50°N, respectively. It is considered that the area, 30-40°N, where many younger sharks were observed are nursery grounds of the species. It was also indicated that blue shark had different distribution by sex and growth stage. The length frequency of shortfin mako shark similarly suggests that high latitude area of 30-40°N was considered as nursery grounds for the species.

RÉSUMÉ

Le présent document examine la composition spécifique et la CPUE (nombre capturé par millier d'hameçons) des requins, ainsi que la fréquence de tailles des espèces prédominantes capturées dans l'Atlantique, d'après les données japonaises d'observateurs de la pêche thonière en 1995-2000.

Les requins pélagiques, 9.921 poissons de 16 espèces, ont été observés. L'espèce qui prédominait dans les prises de toutes les zones était le requin peau bleue, dont la proportion, surtout dans la zone des 40-60°N, atteignait plus de 90%. Le requin à gros yeux, le requin-tigre commun et le requin-taupe commun ont été fréquemment observés respectivement dans les zones proches de l'équateur, dans la région côtière à 30-40°N et au nord de 50°N. La CPUE la plus élevée du requin peau bleue a été observée aux alentours de 40°N; celle du requin-taupe bleu montrait une tendance similaire. La CPUE du requin à gros yeux, du requin-tigre commun et du requin-taupe commun était plus élevée respectivement dans les zones proches de l'équateur, dans la région côtière à 30-40°N et au nord de 50°N. Il est estimé que la zone des 30-40°N, où de nombreux juvéniles de requins ont été observés, constitue une nursery de cette espèce. Il a également été observé que la croissance du requin peau bleue

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montrait un dimorphisme sexuel. Les fréquences de taille du requin-taupe commun suggèrent aussi que les hautes latitudes à 301-401N constituait une nursery de l'espèce.

RESUMEN

En este documento se examina la composición por especies, la CPUE (número de capturas por 1.000 anzuelos) de los tiburones y la frecuencia de tallas de las principales especies capturadas en el océano Atlántico utilizando los datos de los observadores japoneses sobre la pesquería de palangre de túnidos entre 1995 y 2000.

Se observaron 9.921 especímenes de 16 especies e tiburones pelágicos. La principal especie capturada en todas las zonas fue el tiburón azul, y sobre todo en la zona de 40-60° N la proporción de tiburón azul superó el 90%. El zorro ojón, el tiburón tigre y el marrajo sardinero se observaron a menudo en zonas cercanas al Ecuador, regiones costeras de situadas en 30°-40° N y al norte de 50° N, respectivamente. La CPUE más elevada de tiburón azul se observó en torno a la zona de 40° N, y el marrajo dientuso presentó una tendencia similar. Las CPUE del zorro ojón, tiburón tigre y marrajo sardinero fueron más elevadas en zonas cercanas al Ecuador, en regiones costeras situadas en torno a 30°-40° N y al norte de 50° N, respectivamente. Se considera que la zona comprendida entre 30° y 40° N, donde se ha observado una mayor presencia tiburones juveniles, es una zona de cría de estas especies. También se observó que el tiburón azul presentaba una distribución diferente por sexos y fases de crecimiento. Las frecuencias de talla del marrajo dientuso sugieren d que la zona de latitudes altas de 30°-40 ° N se considera una zona de cría para esta especie.

KEYWORDS

By catch, Long lining, Pelagic sharks, Body size, Distribution

1. INTRODUCTION

The observer program for high sea fishery is necessary to obtain detailed data for more comprehensive stock assessment and management studies. Therefore, Fishery Agency of Japan has conducted the observer program for Japanese tuna longline fishery in the Atlantic Ocean since 1995, and has been collecting the data for all species caught.

In this paper, we added the data to previous work done by Matsunaga and Nakano (1998), and examined species composition by area and CPUE of sharks caught by Japanese tuna longline fishery. The length frequency by species by area was also discussed.

2. MATERIALS AND METHODS

Japanese observer data for tuna longline fishery in the Atlantic Ocean collected from 1995 to 2000 was used for the analysis. The all positions of fishing operation were divided into 5 areas (Fig. 1). The total number of trips was 20, operations was 886, and observed hooks was 2,026,049 during the six years. The summery of observer trips are shown in Table 1 by area.

The data includes position, date, the number of hook used, catch by species, precaudal length (PCL) and sex. The species composition of sharks, and length frequencies of fishery important species,

blue shark (*Prionace glauca*) and shortfin mako shark (*Isurus oxyrinchus*), were compared among areas. The average CPUEs by species per set were also examined.

3. RESULTS AND DISCUSSION

3.1 Proportion of sharks among bycatch species

Figure 2 shows the composition of bycatch species groups caught in each area without tunas. Sharks consist with 20-80% of species composition in number. Particularly, the highest proportion of sharks was recorded in the area 4 (82.6%).

3.2 Species composition and CPUE of sharks

Sharks of 9,921 individuals in 16 species (including unidentified thresher shark, requiem shark, and hammerhead shark) were observed (Table 2).

Blue shark was dominant species among all areas. In the area 4 and 5, its proportions were over 90%. Bigeye thresher (*Alopias superciliosus*), tiger shark (*Galeocerdo cuvieri*), and porbeagle (*Lamna nasus*) were frequently observed in area 1 (7.9%) and 2 (5.2%), area 3 (24.5%), and area 5 (6.0%), respectively. Tiger shark and porbeagle were only observed in the area 3 and 5, respectively (Fig. 3).

The CPUE of sharks, species combined, were significantly different among areas (One-way ANOVA, $p < 0.05$), except for the case between the area 1 and 3. The highest CPUE of species combined was in the area 4 (avg=10.5, SD=10.7, range : 0-92.9). As regarding the CPUE by species, the CPUE of blue shark was the highest in the area 4 (avg=9.6, SD=10.3, range : 0-91.7), and it was about 4 times higher than those of other areas (avg. : 0.6-2.6). The CPUE of shortfin mako shark was also the highest in the area 4. The CPUE of Bigeye thresher, tiger shark, and porbeagle were higher in the area 1 (avg=0.22, SD=0.53, range:0-7.72) and 2 (avg=0.09, SD=0.22, range:0-1.49), the area 3 (avg=0.87, SD=1.03, range:0-0.44), and the area 5 (avg=0.04, SD=0.13, range:0-0.59), respectively (Fig. 4).

It is suggested that blue shark widely distributed all areas, especially in the area of 40-60°N. Bigeye thresher, tiger shark, and porbeagle were frequently occurred in the area near the equator, coastal region of 30-40°N, and the area north of 50°N, respectively. These distribution of sharks are in accordance with the observation of Nakano (1996), which classified blue shark as the temperate, bigeye thresher as the tropical, and tiger shark as the tropical coastal species in the north Pacific Ocean. The distribution of porbeagle has been described in the region where water temperature is under 18°C (Compagno 1984), and it only appeared in the high latitudinal area.

3.3 Length frequencies of dominant species

3.3.1. Blue shark

Blue shark length frequency distribution by area and sex are shown in Figure 5. It is considered that blue shark reaches maturity at 180-190cm fork length (FL) for female, and at 183cm FL for male in the north Atlantic Ocean (Pratt 1979). Converting these values (FL) into PCL by the formula of Hazin *et al.* (1991), the maturity length in PCL are 164-172cm for female, and 167cm for male. Therefore in the area 1, 2, and 3, the most of them were considered as adult, because the modes of length frequencies were about 180cm for female, and about 200cm for male. In the area 3, small

sharks less than 100cm PCL were considered as juvenile. In the area 4, the mode of length frequency for female shifted to larger (about 200cm), and that for male shifted to smaller (about 160cm). And the smaller sharks less than 160cm including both sexes occupied 56% in the area 4, were considered as immature. In the area 5, the mode for female shifted to smaller, and the most of them were considered as subadult (less than 160cm). Although observation was few (N=6), the mode for male shifted to larger one.

These results suggest that the northern areas with high CPUE and many small sharks observed was recognized as nursery grounds of species as same as Nakano (1994) suggested in the north Pacific Ocean. Although the observations were obtained from limited areas, it could be hypothesized that female sifts their habitat to the north, and male moves to the south according to growth from subadult stage as shown in Figure 5. It is considered that the reason why subadult female selected different habitat from male is adaptation to avoid biting behavior of mature male for mating (Pratt 1979). The same tendency was observed in this study. After reaching maturity, female expands their habitat to the south as male do so. These tendencies, segregation by sex and growth stage, are according with the pattern found by Suda (1953), Strasburg (1958), and Nakano (1994) in the Pacific Ocean.

3.3.2. Shortfin mako shark

Shortfin mako shark reaches maturity at 260cm FL, and male at 160cm FL in the north Atlantic Ocean (Pratt and Casey 1983). Converting these values (FL) into PCL by the following equation, $PCL \cong 0.9FL$ (unpublished data), the maturity length in PCL are 230cm for female, and 160cm for male. In the area 3 and 4 where are high density of CPUE, small sharks were also observed and considered immature. It is considered that high latitude area of 30-40°N may be nursery grounds for the species.

4. Reference

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Table 1. Summary of the operations observed in each area.

year	area1				area2				area3			
	number of trips	number of operatio ns	total number of hooks	observed number of hooks	number of trips	number of operations	total number of hooks	observed number of hooks	number of trips	number of operation s	total number of hooks	observed number of hooks
1995	1	46	124.780	124.780	1	13	33.199	23.999	1	1	2.970	797
1996												
1997					1	42	49.650	49.650	2	13	31.712	29.422
1998									2	78	190.504	182.554
1999					2	260	656.378	630.582				
2000					2	50	134.992	111.610				
total	1	46	124.780	124.780	6	365	874.219	815.841	5	92	225.186	212.773

year	area4				area5			
	number of trips	number of operatio ns	total number of hooks	observed number of hooks	number of trips	number of operations	total number of hooks	observed number of hooks
1995	2	40	86.097	58.163				
1996								
1997	3	193	455.890	432.591				
1998	2	55	131.930	127.440				
1999								
2000	1	40	122.961	103.581	2	55	156.824	150.880
total	8	328	796.878	721.775	2	55	156.824	150.880

Table 2. Bycatch species of sharks caught in each area.

English name	Scientific name	area1	area2	area3	area4	area5
Bigeye thresher	<i>Alopias superciliosus</i>	28	80	2	3	0
Thresher shark	<i>Alopias vulpinus</i>	0	1	0	0	0
Unidentified thresher shark	Alopiidae	0	4	0	5	0
Unidentified requiem shark	Carcharhinidae	0	1	4	0	0
Silky shark	<i>Carcharhinus falciformis</i>	0	1	18	0	0
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	1	4	9	0	0
Tiger shark	<i>Galeocerdo cuvieri</i>	0	0	185	0	0
Shortfin mako shark	<i>Isurus oxyrinchus</i>	3	26	75	635	3
Longfin mako shark	<i>Isurus paucus</i>	2	9	3	9	0
Porbeagle	<i>Lamna nasus</i>	0	0	0	0	6
Blue shark	<i>Prionace glauca</i>	266	964	458	6.519	91
Crocodile shark	<i>Pseudocarcharias kamoharai</i>	38	339	0	0	0
Scalloped hammerhead	<i>Sphyrna lewini</i>	0	3	0	0	0
Smooth hammerhead	<i>Sphyrna zygaena</i>	1	21	0	0	0
Unidentified hammerhead shark	Sphyrnidae	0	2	1	0	0
Velvet dogfish	<i>Zameus squamulosus</i>	17	83	0	0	0
total		356	1.538	755	7.171	100

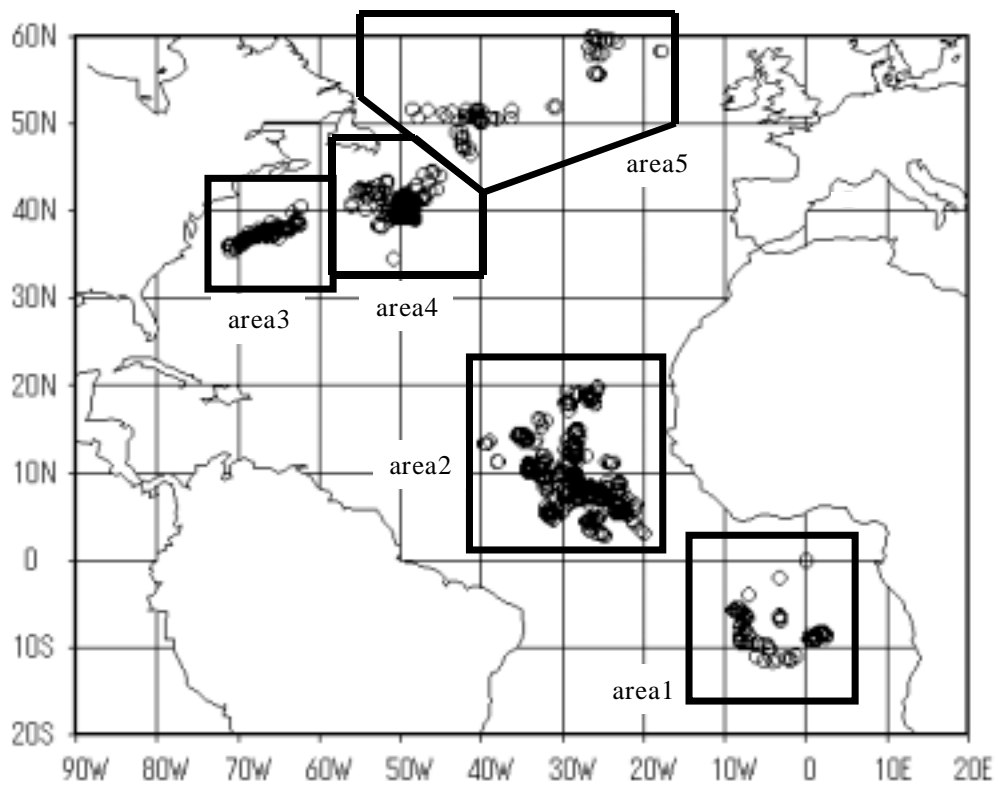


Fig. 1. Positions of operations for observer cruise in the Atlantic from 1995 to 2000, and area classification used for the analysis.

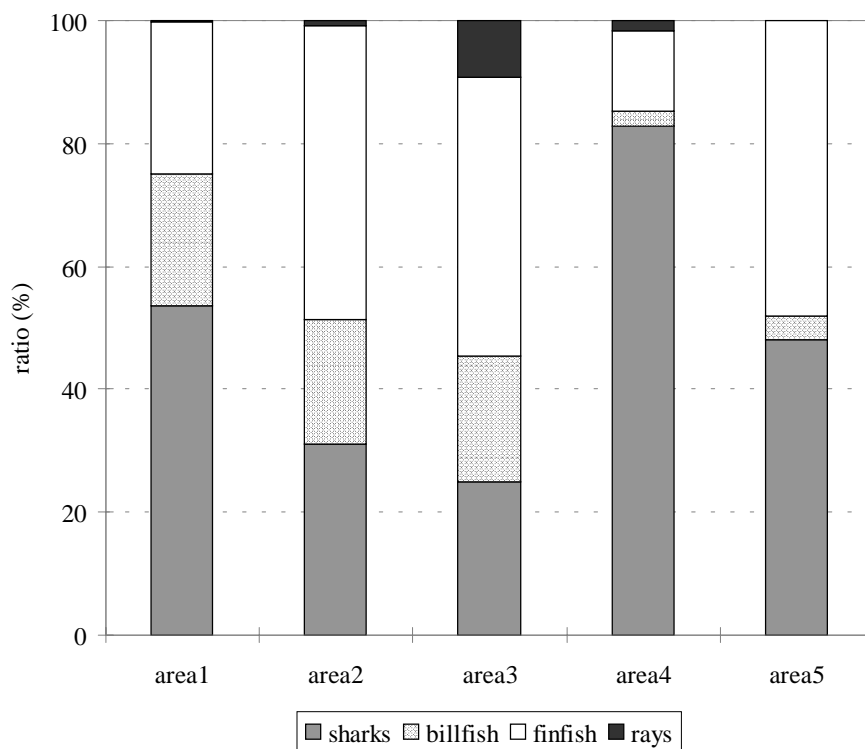


Fig. 2. The composition of bycatch species groups caught in each area.

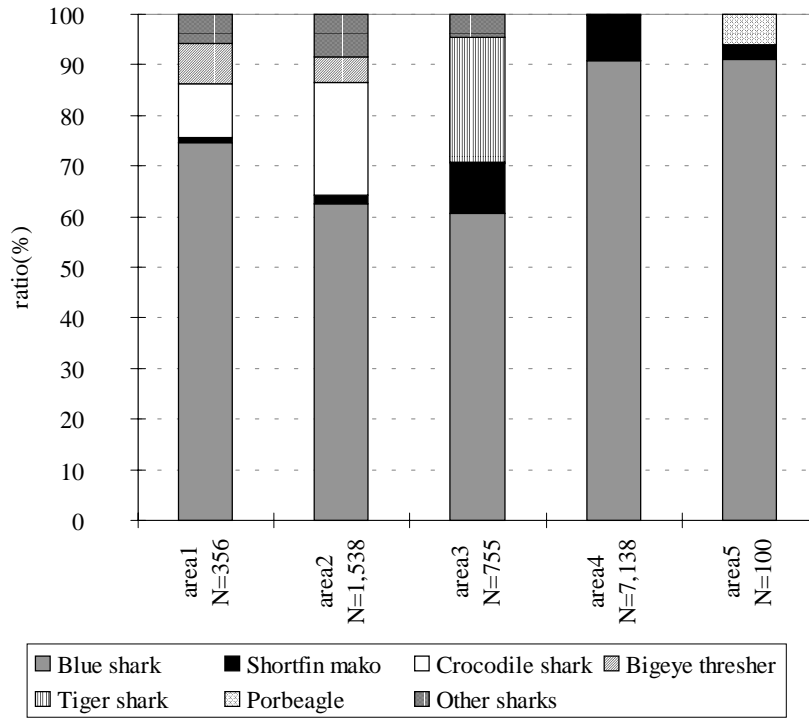


Fig. 3. Species composition of sharks caught in each area.

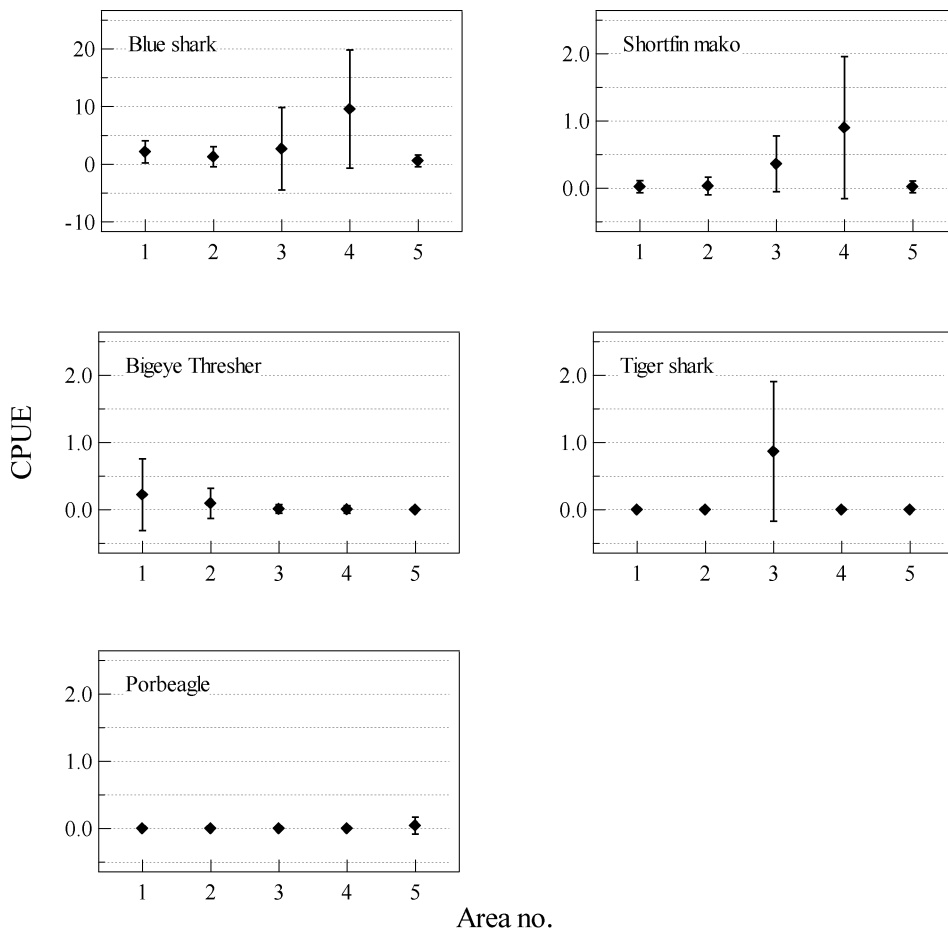


Fig. 4. The average CPUE by set of major bycatch species of sharks in each area. Vertical bars indicate standard deviation.

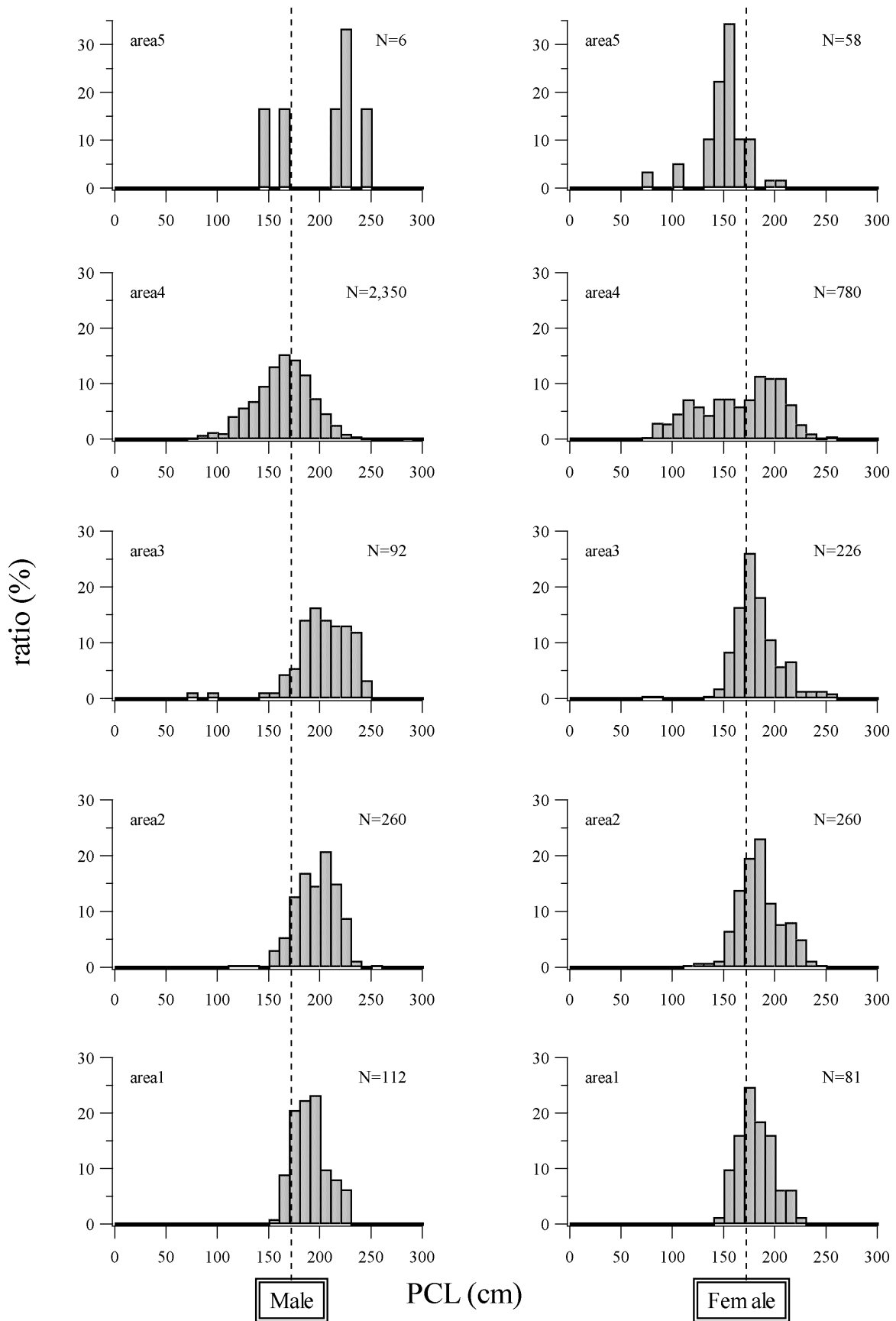


Fig. 5. Length frequencies of blue shark by sex caught in each area. The dotted line indicates the maturity size.

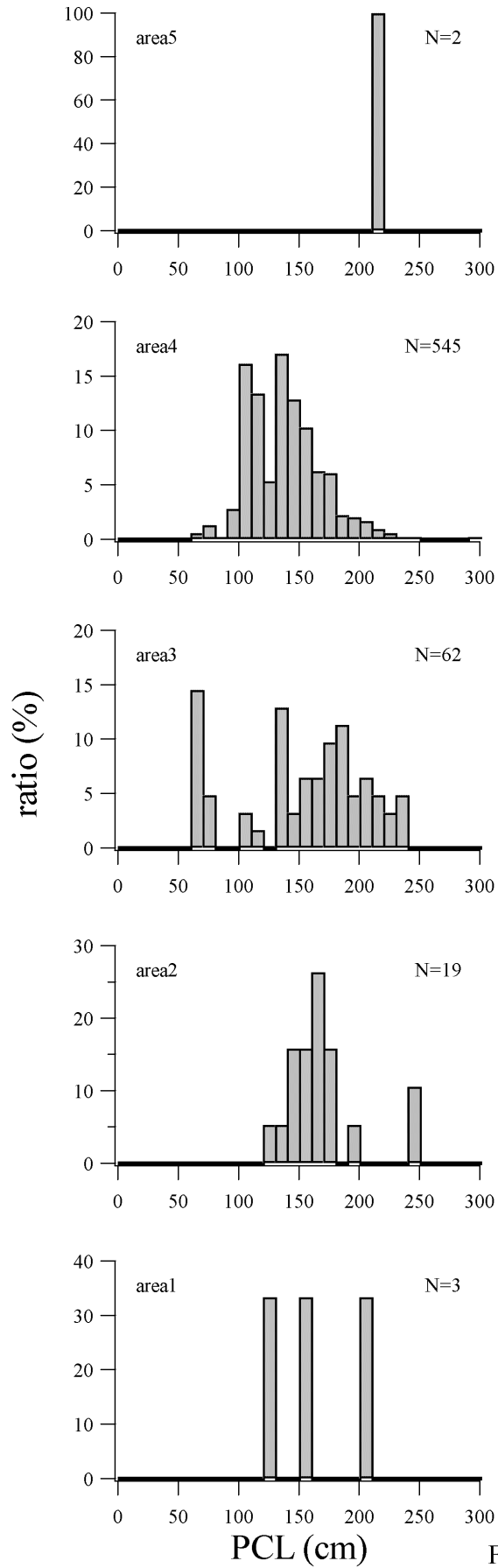


Fig. 6. Length frequencies distribution of shortfin mako shark caught in each area.