Review of Japanese catch, effort and size data of porbeagle (*Lamna nasus*) in the southern hemisphere.

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Abstract

Japan has collected the catch and effort data of porbeagle (*Lamna nasus*) caught by Japanese distant-water longliners since 1994. For the basic information on the stock assessment of the porbeagle caught in the SBT fishery, log-book data of porbeagle caught in the southern hemisphere as well as the size data collected in the scientific observer program for SBT was summarized. Considering the distribution area of porbeagle in the southern hemisphere, the calculation of logbook data was conducted for the area south of 30°S. Total of 30,000 porbeagles were recorded in the logbook data between 1994 and 2012. Total of 13,550 porbeagles were recorded in the observer program between 1992 and 2012 and size data from 11,203 individuals were available. The distribution of catch and size data on spatial and temporal scale is described in this document.

1. Introduction

The porbeagle (*Lamna nasus*) is a lamnid shark that inhabits temperate, subarctic, and subantarctic waters. Semba *et al*. (2012) and Semba *et al*. (2013) indicated a circumglobal distribution across the southern hemisphere and pointed out that stock status of this population should be assessed using information from the areas of its major distribution, including pelagic waters, and international coordination across oceans is necessary. This document summarizes the temporal and spatial distribution of Japanese logbook data in the southern hemisphere including SBT fishery and other tuna longline fishery, and size data collected in the scientific observer program for SBT fishery.

2. Materials and methods

2.1 Data set used

Regarding the distribution of catch and effort data, logbook data recorded by Japanese longliners between 1994 and 2012 was used for the calculation. Semba *et al* 2012, Semba *et al*. 2013 revealed that porbeagles are caught not only by longline fishery targeting SBT but also by the other pelagic longline fisheries (including driftnet research operation) operated in higher latitudinal areas in the southern hemisphere. Based on this, the distribution area of porbeagle in the southern hemisphere is assumed to be in the area south of 30°S in this document. Regarding size data, data collected by onboard scientific observers between 1992 and 2012 were used for the calculation. For each individual, precaudal length (PCL) was measured to the nearest centimeter on board and sex was determined except for the individuals released by cutting the lines.

2.2 Calculation

The catch and effort (i.e. hook number) data used in this document was obtained from logbook data of Japanese distant-water tuna longliners operated in the area south of 30°S in the period between 1994 and 2012, which was compiled in National Research Institute of Far Seas Fisheries. General trend on spatial distribution of catch, effort, and CPUE (i.e. catch number per 1000 hooks) was calculated by 5 by 5 degrees grid, after aggregating years and months. Seasonal change of distribution of effort and CPUE was calculated for 5 by 5 degrees grid by dividing year into quarter1 (October to December), quarter2 (January to March), quarter3 (April to June), and quarter4 (July to September). Temporal change of effort, catch number, catch weight, and nominal CPUE was also calculated.

Size data of porbeagle was divided by modified CCSBT statistical area (Figure 1) and length frequency by sex was indicated for each area.

3. Results and discussion

3.1 Summary of fishery data

Total of 30,444 porbeagles were recorded in the logbook data of Japanese tuna longline fishery between 1994 and 2012. Spatial distribution of hook, catch number, and nominal CPUE by 5 by 5 degrees grid was shown in Figure2. More than 90% of effort and catch was recorded in area7,8 and 9 (Table1). In area7, 8, and 9, moderate CPUE was indicated in the area south of 40°S (Figure2). In area 6 and 12 (South Pacific), large CPUE was indicated also in the area south of 40°S, but note that CPUE >0.5 was recorded in the area south of 50°S (for detailed discussion , see Semba *et al*. 2013).

The annual change of hook number, catch number, catch weight, and nominal CPUE of porbeagle by area was shown in Figure3. The hook number in area7 rapidly declined from 2003 and 2007, while that in area 8 rapidly increased from 1994 and 1996 and then consistently declined until 2002, followed by stable trend between 2003 and 2010 with slight decreasing trend after that. Hook number in area 9 showed consistent decreasing trend with spike between 2002 and 2007. Historical catch trend suggests that catch in the area9 accounts for consistent part almost throughout the period. Catch in area 6 and 7 was recorded until early 2000s, however, almost no catch was recorded after that albeit consistent amount of effort since then. Some amount of catch was recorded after 2007 in area 8 and area9. Temporal distribution of effort by season (not indicated here) did not suggest large shift of operation area and no clear change of operation pattern was suggested. Change of retention pattern possibly due to socio-economic pattern may affect this trend, but further investigation would be necessary to interpret this trend. Generally, nominal CPUE fluctuated below 0.05 in most areas except area9 and 12. Large CPUE in area12 in 1994 was due to the high catch in the area south of

50°S. Regarding the reason for high CPUE in area9 since 2007, the change of retention pattern would be one factor as indicated above and further investigation is necessary.

Seasonal distribution of effort and nominal CPUE were shown in Figure 4 and Figure5, respectively. In most area, fishing effort was observed almost exclusively in quarter3 and quarter4 except area8 in which fishing effort was also observed in quarter1. In area 9 (around the Cape of Good Hope), moderate CPUE was observed between 30°S and 45°S in quarter1 and quarter2, which appeared to shift southward in quarter3 and quarter4.

3.2 Summary of size data

Total of 11,203 records of size data (83%) from 13,550 records was available from the scientific observer program between 1992 and 2012. The distribution of size data by sex and area, and by season and area was shown in Table1. Most of sex-specific size data was obtained in area9 and area8 and moderate number of data was obtained in area 7. Amount of size data in area 6 is relatively small and needs to be enriched. From the perspective of season, most of the size data was obtained in quarter3 and quarter4 with moderate amount of data in quarter1. Amount of size data in quarter2 is very small probably due to the limitation of fishing season for SBT. Annual number of size data by area is shown in Table2.

Considering the spatial distribution of sex-specific size data (Table1), length frequency was shown for area6, 7, 8, and 9 (Figure6). Generally, both males and females were recorded almost evenly in each area and more than 70% of the individuals were smaller than 100 cm, which corresponds to juvenile according to Francis and Stevens (2000). Mode of size frequency in area6, 7, and 9 is 70-80 cm in both sexes except female in area 6 (60-80cm), while mode in area 8 is 70-80 cm for males and 80-90 cm for females. Individuals between 60 and 80 cm correspond to 0-1 years old according to Francis *et al*. (2007). Assuming that the pupping season (June to July) indicated in the South Pacific (Francis and Stevens 2000) is also applicable throughout the southern hemisphere, this length frequency and the seasonal distribution of fishing effort, especially in area6, 7 and 9 (Figure 4), suggest that the operation of SBT fishery overlaps with the pupping season of porbeagle in the southern hemisphere.

Conclusion

This document summarized the catch, effort and size data of porbeagle caught by Japanese tuna longline fishery including SBT longline fishery and other tuna longline fishery in the southern hemisphere, as the basic information on the stock assessment of this population. Although Japanese logbook data and observer data covers wide range of SBT fishery, data in the area east of 120°E is relatively small which needs to be enriched in the future. Collaboration among the countries for incorporation of the fishery and size data would be necessary to progress the reliable stock assessment of porbeagle in the southern hemisphere.

References

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Table 1. Number of available size data compiled from the scientific observer program for SBT by sex and area (left), by season and area (right).

	Male	Female	Unknown	Sum
Area6	63	60	3	126
Area7	240	306	57	603
Area8	1,524	1,775	133	3,432
Area9	3,121	3,513	396	7,030
Area10	5	7	0	12
Sum	4,953	5,661	589	11,203

	Quarter1	Quarter2	Quarter3	Quarter4
Area6	3	0	72	51
Area7	13	4	510	76
Area8	1,763	14	73	1,582
Area9	69	1	5,204	1,756
Area10	12	0	0	0
Sum	1,860	19	5,859	3,465

Table 2. Number of available size data compiled from the scientific observer program for SBT by area and year.

	Area6	Area7	Area8	Area9	Area10	Sum
1992	112	30	164	185	0	491
1993	0	6	153	137	0	296
1994	0	23	216	84	0	323
1995	0	20	470	357	0	847
1996	1	4	162	221	0	388
1997	0	75	223	99	0	397
1998	5	19	183	158	0	365
1999	5	59	28	267	0	359
2000	0	186	63	537	0	786
2001	0	31	55	325	0	411
2002	0	45	64	528	0	637
2003	3	11	123	758	0	895
2004	0	23	63	372	0	458
2005	0	3	452	668	0	1,123
2006	0	0	238	762	0	1,000
2007	0	0	131	319	0	450
2008	0	5	180	270	0	455
2009	0	2	78	356	0	436
2010	0	0	97	160	0	257
2011	0	51	286	145	3	485
2012	0	10	3	322	9	344

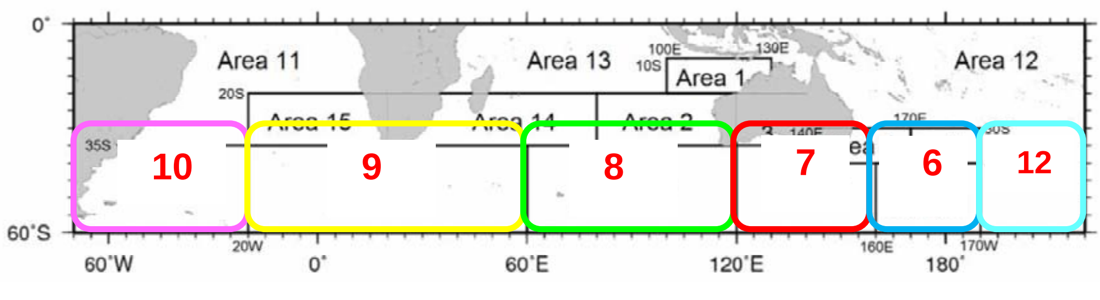

Figure1. Subarea used for the description of size frequency of porbeagle (Area 6,7,8,9,10,12) in this document. Modified figure from Sakai *et al*. (2013). Area 12 extends from 170W to 70W.

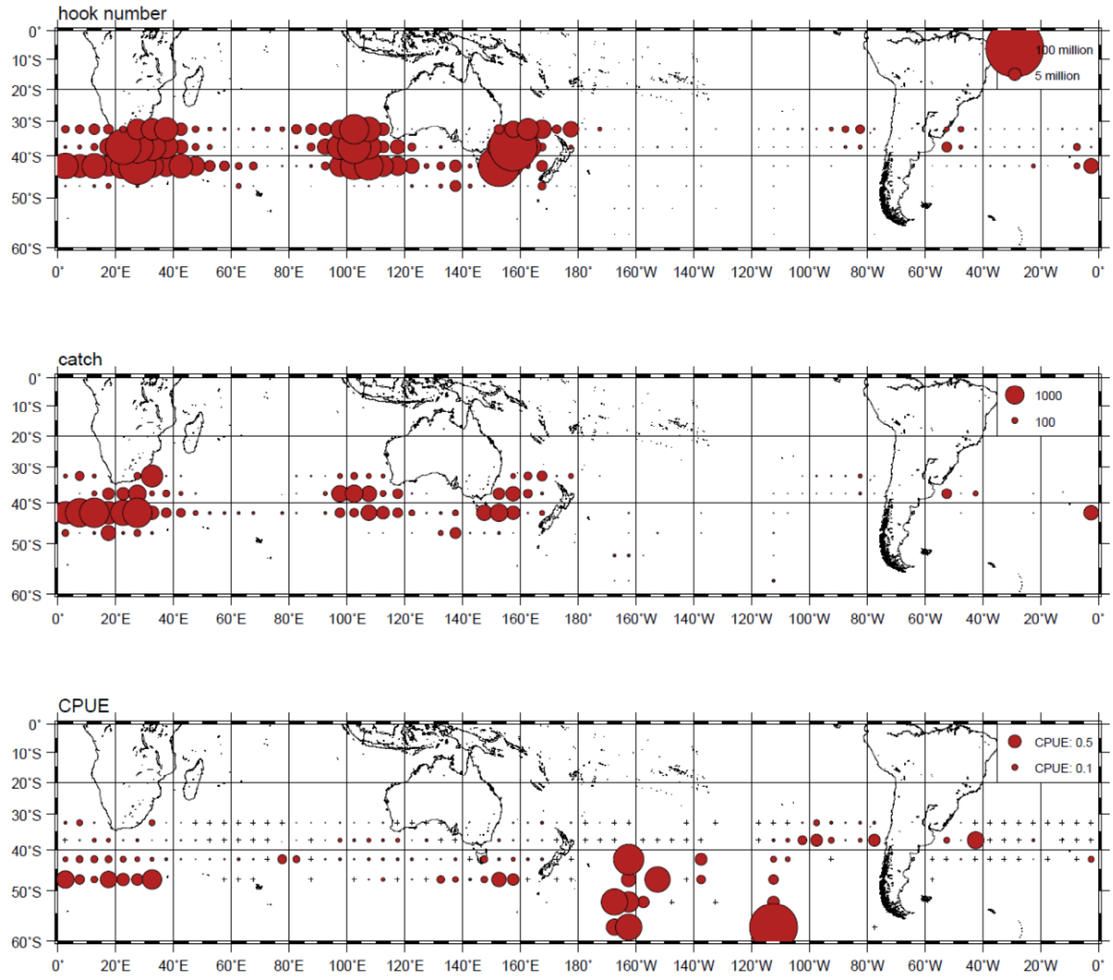

Figure 2. Spatial distribution of aggregated effort (top), catch number (middle), and CPUE (below) recorded in logbook data of Japanese tuna longline fishery between 1994 and 2012. Year and months are combined for all figures. Crosses denote no catch.

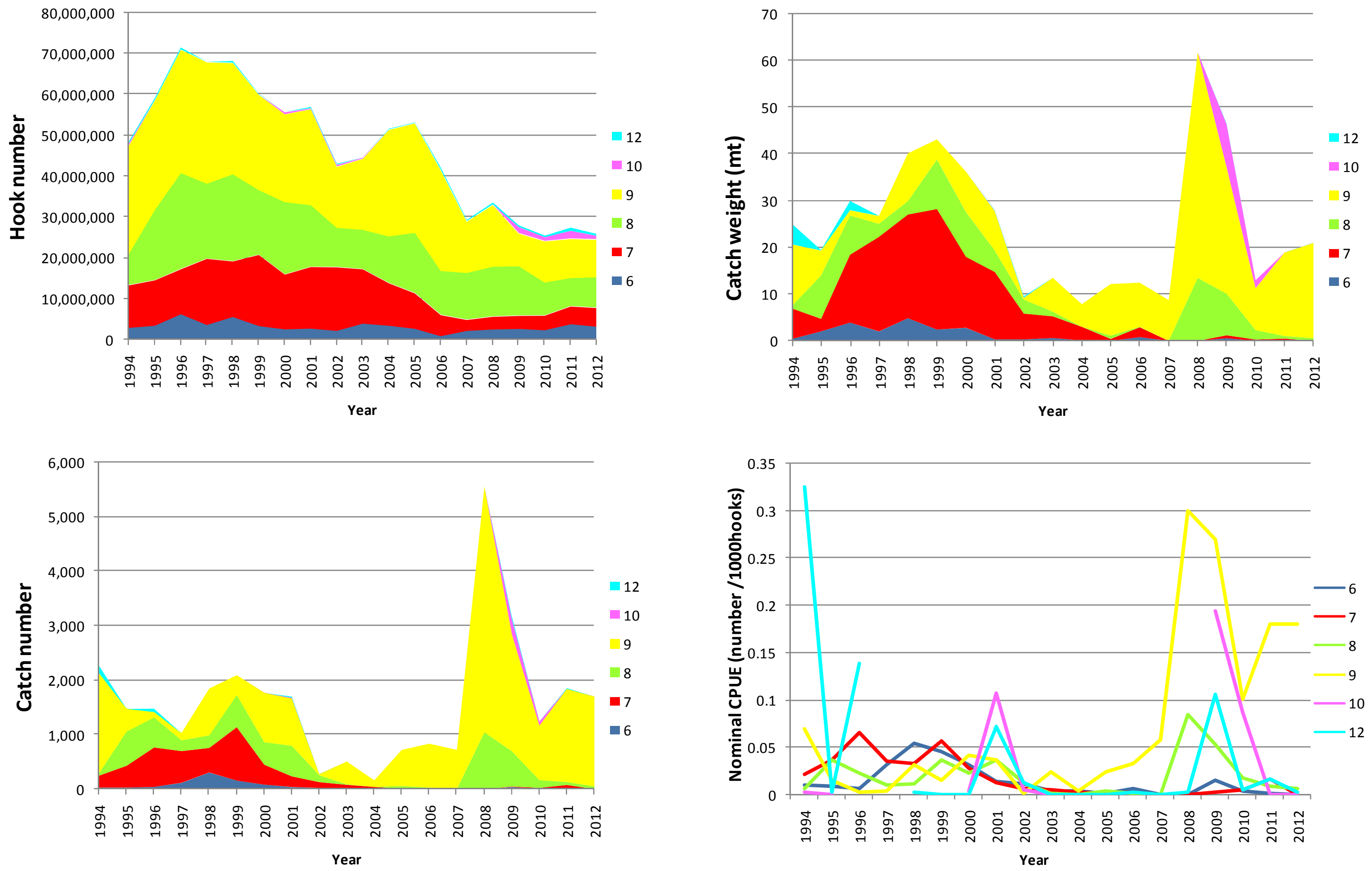

Figure 3. Annual change of hook number (left top), catch number (left below), catch weight (right top), and nominal CPUE of porbeagle (bottom) by area calculated from logbook data of Japanese tuna longline fishery between 1994 and 2012. Note that only annual trend on catch weight was calculated based on the raised catch data.

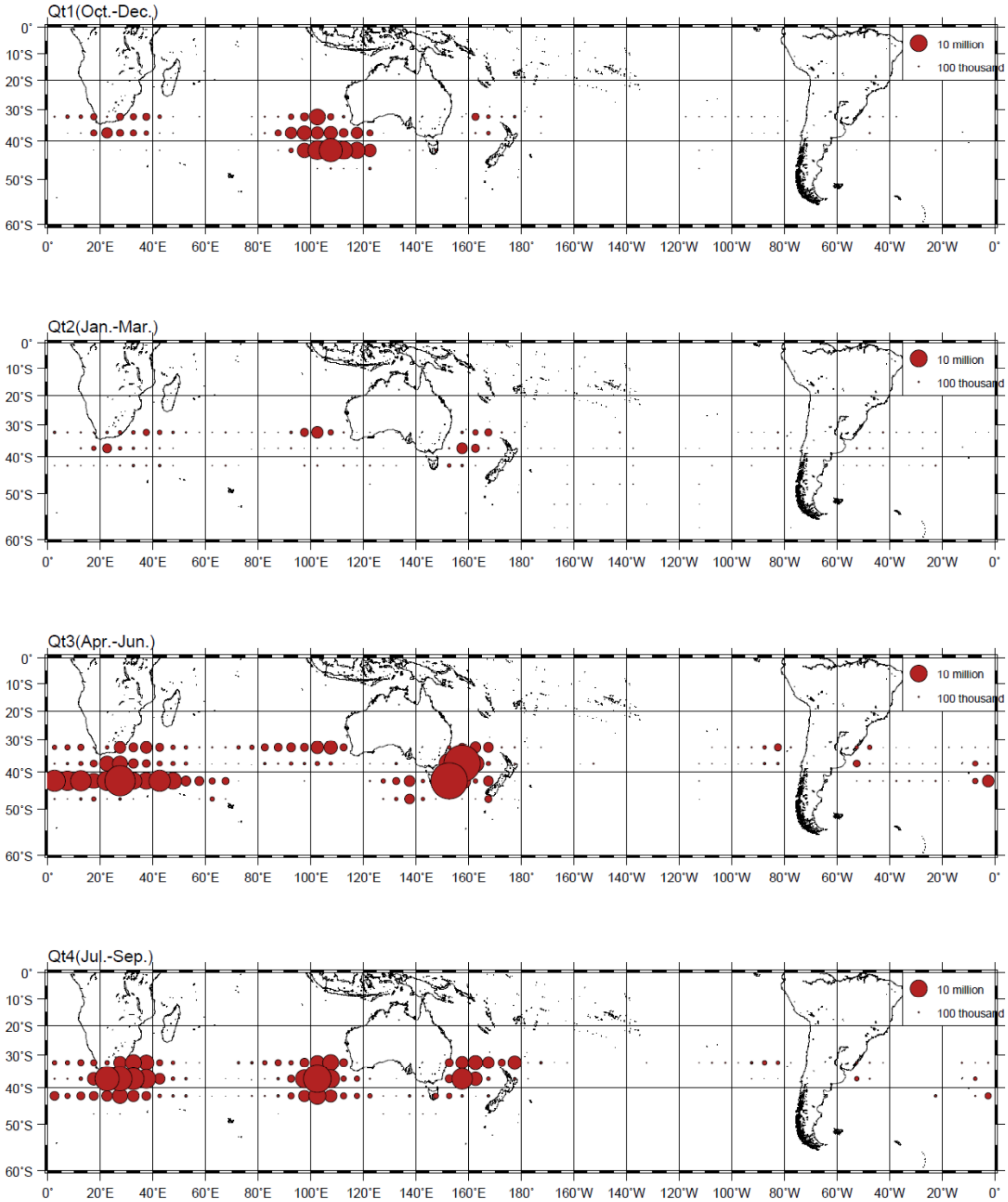

Figure 4 Seasonal distribution of effort by 5-degree squares calculated from the logbook data of Japanese tuna longline fishery between 1994 and 2012. Year was combined.

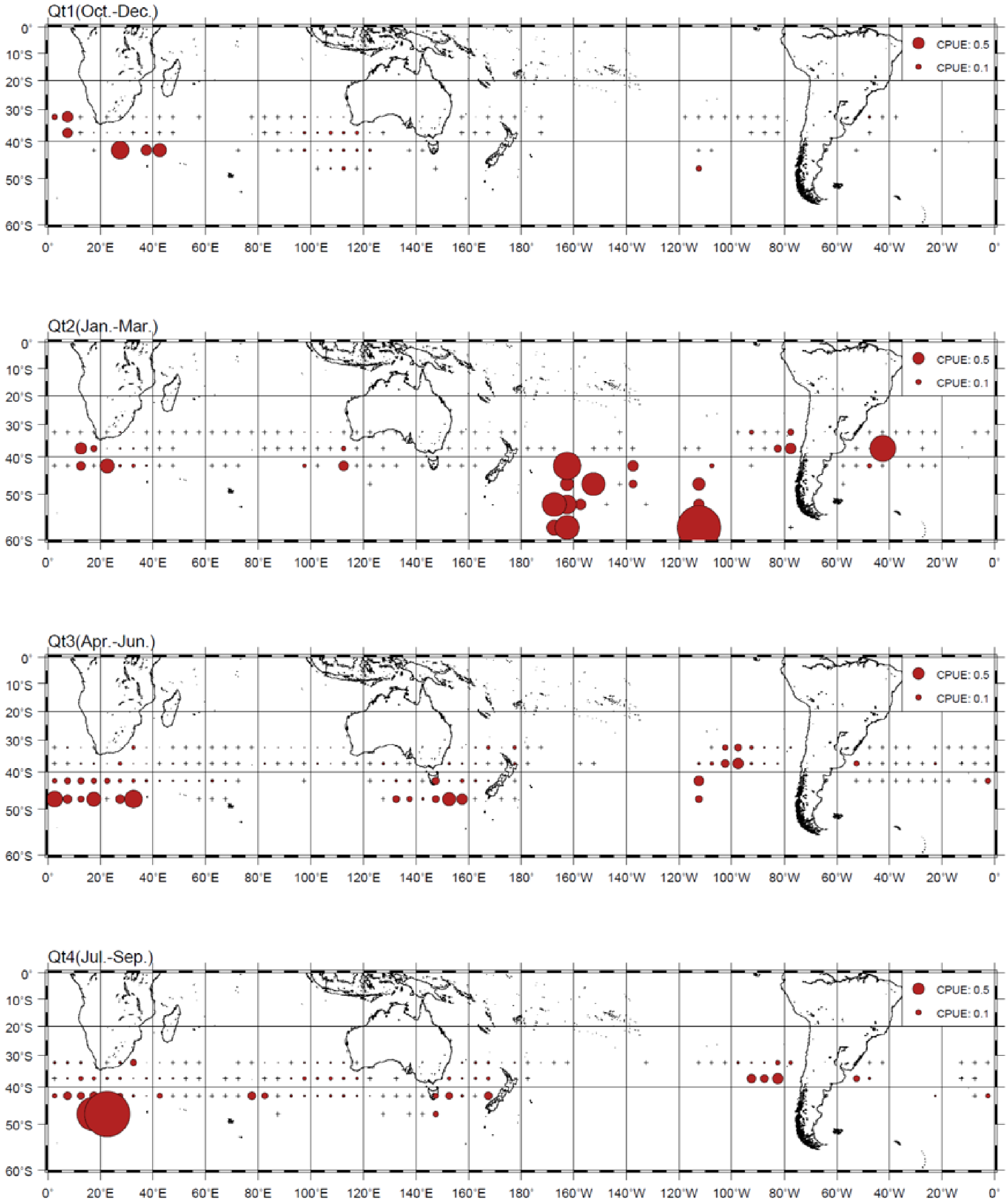

Figure 5 Seasonal distribution of CPUE by 5-degree squares calculated from the logbook data of Japanese tuna longline fishery between 1994 and 2012. Year was combined and crosses denote no catch.

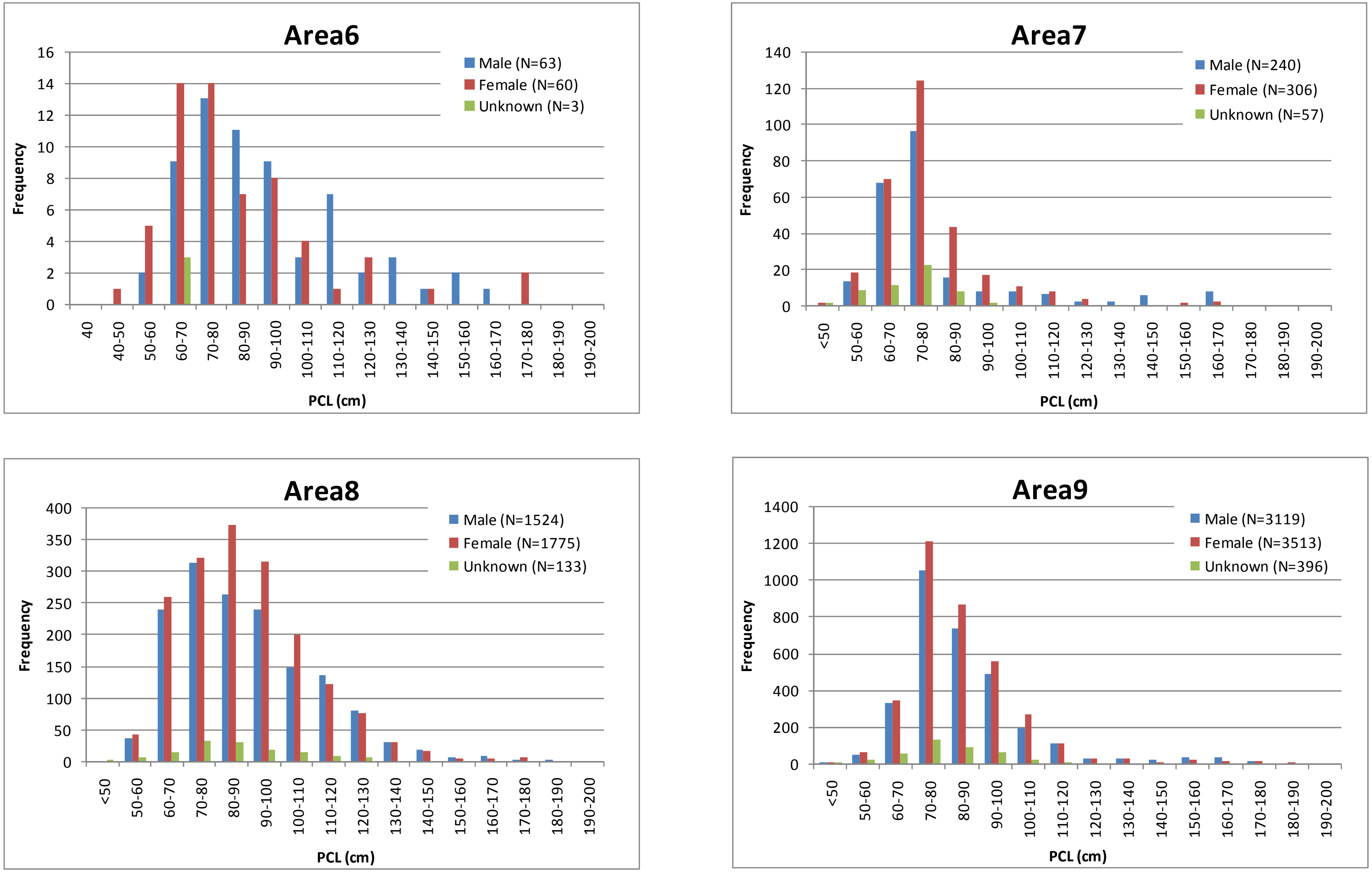

Figure 6. Length frequency of porbeagle by sex for area6,7,8,and 9, calculated from scientific observer data for SBT from 1992-2012.