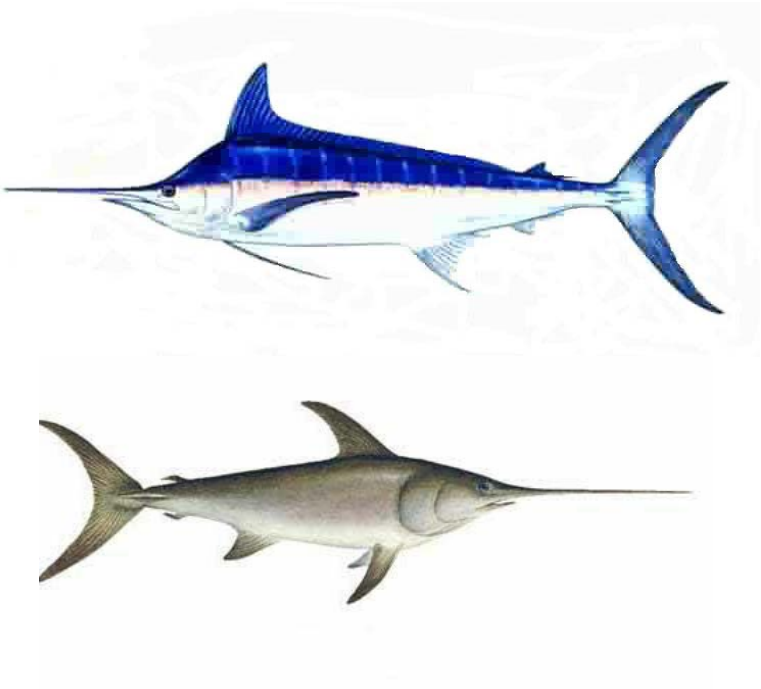
Review of Size Data for Blue Marlin Caught by Japanese Fisheries in the Pacific Ocean since 1970s[1]

Ai Kimoto and Kotaro Yokawa
National Research Institute of Far Seas Fisheries
Shimizu, Shizuoka, Japan



[1]Working document submitted to the ISC Billfish Working Group Workshop, 2-9 April 2012, Shanghai, China. Document not to be cited without author's written permission.

Review of size data for blue marlin caught by Japanese fisheries in the Pacific Ocean since 1970s

Ai Kimoto and Kotaro Yokawa

National Research Institute of Far Seas Fisheries (NRIFSF)

Abstract

This document reviewed a total of 750,000 available size data, in eye fork length (EFL, cm) or processed weight (kg), of blue marlin caught by Japanese fisheries in the Pacific Ocean between 1970 and 2010. These size data were mainly collected from distant-water, offshore, and shallow-setting longline, and drift net, and were measured on boat, or at several fishing ports. All size composition data showed a similar trend among decennial periods. The frequency distributions in processed weight were similar between distant-water and offshore longline, and between shallow-setting longline and drift net. Size of blue marlin were larger for the offshore and shallow settings than the distant-water longline and drift net, and these observed results were supposed to be due to the differences in target species, depth of fishing gear, and operational areas. It was also revealed that some unrealistic data existed such as a large number of quite small fishes, though the number of size data seemed relatively abundant among marlins caught by Japanese fisheries in the Pacific Ocean. Thus it was suggested that further investigation and careful consideration would be required when these data were utilized for the stock assessment of blue marlin.

Introduction

Size data is one of key factors on integrated stock assessment methods as well as catch and effort data and biological parameters. Japan has collected size data of many species caught by several different fishereis since 1970s. To contribute the stock assessment of blue marlin in the Pacific Ocean scheduled by the ISC Billfish Working Group throught the cooperations with IATTC and WCPFC, this document provides a review of size composition of blue marlin caught by Japanese fisheries in the Pacific Ocean.

Material and Method

National research institute of far seas fisheries (NRIFSF) has collected and compiled size data, in eye fork length (EFL, cm) or processed weight (kg) of blue marlin caught in the entire Pacific Ocean by various Japanese fisheries since 1970s (Table 1). Size data of blue marlin by each fishery were measured on boat, or at fishing ports in Katsuura, Kesennuma, Yaizu, Tokyo, Shimizu, and Kagoshima (Table 2). In this document, a total of 750,000 measured size data of blue marlin caught by distant-water, offshore, and shallow-setting longline fisheries, and drift net were used for the analysis.

The EFL data were basically measured in 1 or 5cm unit, and the processed weight was

measured in nearest 1kg. The frequency was depicted in 5 cm or 5 kg interval according to the measurement unit of the data used in each analysis. The entire Pacific Ocean was divided into 4 larger areas: North Temperate, North Tropical, South Tropical and South Temperate areas (Figure 1-a, abbreviation; NTemp, NTrop, STrop, and STemp, respectively), and also into 17 smaller areas by 20x40 degree blocks (Figure 1-b).

Results and Discussion

Distant-water longline

A total of 220,000 samples of blue marlin caught by distant-water longline were measured in EFL in the period between 1970 and 2010, and 500,000 samples in processed weight were collected which were mainly obtained from the auction records in the whole sale market at the fishing ports (Table 1). Samples in EFL or processed weight since the 1980s were measured mainly on boat, or at whole sale market in Katsuura fishing port, respectively, whereas sampling site were unrecorded in the 1970s for both types of data (Table 2).

Size data in EFL were collected mainly in NTrop2 and NTrop3 through whole periods (Figure 2-a), while some data were collected in STrop3 since 1980s. Size data in processed weight were also collected mainly in NTrop2 through whole periods (Figure 2-b). The percentage of samples in processed weight was increased in NTemp1 and 2 since 1980s. Sex data of samples in length has gradually collected since 1980s (Figure 3-a), and most of sex-recorded samples were male. All samples in processed weight were sex-unrecorded (Figure 3-b).

Figure 4 shows the size composition (a) in EFL and (b) in processed weight of all blue marlin caught by distant-water longline by decade and larger area (Figure 1-a). Almost all samples in EFL were in a range between 100 and 300 cm with its peak between 150 and 170 cm in all areas. Size of female ranged between 125 and 250 cm with the mode between 180 and 200 cm which was larger than male ranged between 125 and 190 cm. Size composition by sex in all areas did not differ largely among periods (Figure 8-a). The size composition of male in NTemp and STrop had a wider range than those in Ntrop, whereas female showed a similar size composition among areas (Figure 8-b). Although the number of male samples was small in STemp, the data might contain misidentifications of sex because it is rare that large male blue marlins were caught in the temperate area. The difficulty of sex identification of blue marlin have been frequently pointed out by on-board observers and researchers due to the small differences on its figuration and color of the gonad and testis (Suzuki, personal comm.). Thus the use of sexed size data generally are not recommended without further detailed analysis.

In NTemp as well as in the tropical areas, the size data in processed weight showed similar composition which were ranged between 25 and 200 kg with their peak of the mode in between 35 and 45 kg (Figure 4-b). The size range in NTrop was slightly narrower than other three areas. Processed weight data in STemp showed a different composition compared to the other areas, and contained many extraordinary smaller size samples ranged between 0 and 5 kg (Figure 9-b), that occurred in the 1970s and 1980s. Because blue marlin smaller than 1 m is rarely caught in the Japanese longline

fishery (Nishikawa, personal comm.), the record of large number of 0 – 5 kg of blue marlins supposed to be unrealistic. Thus further study should be necessary for the use of Japanese size data. Size composition in processed weight in all areas did not differ among periods (Figure 9-a).

Offshore longline

A total of 600 samples of blue marlin caught by offshore longline was measured in EFL, while 2,000 samples were in processed weight (Table 1). Size data were collected mainly through late 1990s to early 2000s, and were measured at Kesennuma and Katsuura fishing ports for length and processed weight data (Table 2). Most of size data in EFL were measured in NTemp2 both in the 1990s and 2000s (Figure 2-c). Size in processed weight was also measured mainly in NTemp2 since 1990s, and some samples were obtained in NTrop2 (Figure 2-d). All samples both in EFL and processed weight were sex-unrecorded (Figures 3-c and 3-d).

Figure 5 shows decennial frequency distribution of blue marlin caught by offshore longline (a) in EFL and (b) in processed weight. Size range in EFL was between 125 and 250 cm with the mode between 150 and 205 cm, and processed weight range was between 25 and 150 kg with the mode between 35 and 45 kg. Size composition in EFL and in processed weight did not differ among periods and areas (Figures 8-a and 9-a).

Shallow-setting longline and Drift net

Size data in processed weight of blue marlin caught by shallow-setting longline and drift net had a similar character, and a total of 7,000 and 5,000 samples of blue marlin were collected so far, respectively. Almost all data were measured mainly in the 1970s and 1980s, and only in processed weight (Table 1). Sampling site was not recorded for the most of samples before 1980s, and samples were collected at Yaizu port in 1980s and thereafter (Table 2). All samples was measured in NTemp1 (Figure 2-e, f), and all samples were unsexed (Figure 3-e, f). Size range of blue marlin was between 50 and 200 kg with the mode between 100 and 135 kg (Figures 6 and 7). Size composition in processed weight did not differ among periods for both fisheries (Figure 9-a).

Comparison among types of fisheries

Size composition in EFL or processed weight were compared among fisheries in NTemp1 and NTemp2, where size data by all fisheries were available (Figure 10). Size of blue marlin in EFL and in processed weight caught by offshore lonline showed similar size range and composition to those by distant-water longline. Though offshore longliners caught larger blue marlin, ranged 185 and 205 cm, compared to distat-water longliners, it could be biased because of their small sample size. In the north Pacific, offshore and distant water longliners share their fishing ground, but these differences might occurred in finer areas because Ntemp1 and Ntemp2 covers north and south side of subtropical frontal zone where oceanic condition largely changes by relatively shorter distance than in the tropical areas. Generally, Japanese longliners believe larger blue marlins can migrate to higher latitudinal and colder areas than smaller ones. Meanwhile, size composition in processed weight by shallow-setting

longline was similar compared to those by drift net, and the blue marlin size by these fisheries was larger than those by distant-water and offshore lonline. This difference could be related to the differences in target species, depth of fishing gear, and operational areas.

Conclusion

In this paper, all available size data collected and compiled by NRIFSF were analyzed, and it was revealed that some problems might be contained in the data. It was pointed out that processed weight data included extreme small size ranged 0 and 5 kg which is seldom caught by longline fishery. It was also found that data could be contained misidentification of sex, because large male that normally stays in the tropical area and is smaller than female, was found in the temperate area. It was suggested that further investigation and careful consideration would be required when these data would be utilized for the stock assessment of blue marlin.

Table 1. Annual number of length in EFL (cm) or processed weight (kg) data of blue marlin caught in the Pacific Ocean by type of fishery for the period between 1970 and 2010. Others mainly contains purse seine and trap net fishery.

Year	Distant-water longline	Distant-water longline	Offshore longline	Offshore longline	Shallow-set longline	Drift net	Trolling	Others	Total
	Length	Weight	Length	Weight	Weight	Weight	Weight	Weight/Length	
1970	6734	5883	0	0	0	0	0	0	12617
1971	3750	9513	0	0	0	0	0	0	13263
1972	4979	9603	0	0	0	0	0	0	14582
1973	4259	9475	0	0	0	0	0	0	13734
1974	3952	9151	0	0	0	0	0	0	13103
1975	3167	5097	0	0	0	0	0	0	8264
1976	3861	4767	0	0	2778	0	0	0	11406
1977	3898	11843	0	0	1408	155	0	7	17311
1978	5998	13621	0	0	1167	867	0	8	21661
1979	5543	9390	0	0	245	776	0	0	15954
1980	5823	10729	0	0	0	26	4	1	16583
1981	3725	6304	0	0	70	12	0	6	10117
1982	4803	12622	0	0	141	26	0	0	17592
1983	5353	18418	0	0	624	1145	5	0	25545
1984	7458	20976	0	0	123	554	8	0	29119
1985	5531	18808	0	0	206	466	8	0	25019
1986	7804	27957	1	0	79	311	2	0	36154
1987	7602	24548	0	0	69	24	5	0	32248
1988	8558	23686	0	0	20	133	20	0	32417
1989	8765	18224	0	0	57	42	17	0	27105
1990	10048	10149	0	0	131	3	10	0	20341
1991	10803	13657	0	0	0	0	9	6	24475
1992	7365	16410	0	0	57	4	16	0	23852
1993	9285	16963	0	0	7	230	14	1	26500
1994	9731	17938	0	0	15	1	6	0	27691
1995	7438	20889	0	0	41	13	17	0	28398
1996	4673	13057	0	0	7	0	9	1	17747
1997	6732	12022	0	1	2	0	5	0	18762
1998	3344	16685	1	1392	27	27	0	0	21476
1999	2709	13662	235	613	3	1	2	2	17227
2000	2764	14421	232	45	13	0	8	0	17483
2001	2630	16778	130	21	4	0	1	0	19564
2002	2691	11093	3	0	0	0	2	0	13789
2003	2740	9496	0	0	0	2	7	0	12245
2004	2136	19	0	0	0	0	4	1	2160
2005	2933	6210	0	63	1	0	1	0	9208
2006	3235	4055	1	81	3	0	3	0	7378
2007	4539	4035	0	0	6	0	18	2	8600
2008	5184	6289	0	0	3	0	0	5	11481
2009	4676	5871	0	0	10	0	0	6	10563
2010	4296	6735	0	0	4	0	0	1	11036
Total	221515	507049	603	2216	7321	4818	201	47	743770

Table 2. Decennial number of length in EFL (cm) or processed weight (kg) data of blue marlin caught in the Pacific Ocean, by type of fishery and sampling site between 1970s and 2000s. Year 2010 was included in the 2000s.

a) distant-water longline (Length)

	1970s	1980s	1990s	2000s
On boat	0	32729	71830	21348
Katsuura	0	0	0	16361
Kesennuma	0	0	297	115
Yaizu	0	0	0	0
Tokyo	0	0	0	0
Shimizu	0	0	0	0
Kagoshima	0	0	1	0
Unrecorded	46141	32693	0	0
Total	46141	65422	72128	37824

b) distant-water longline (Weight)

	1970s	1980s	1990s	2000s
On boat	0	6851	9073	78
Katsuura	0	41692	106180	80231
Kesennuma	0	12293	31325	4609
Yaizu	0	19173	4671	84
Tokyo	0	12000	183	0
Shimizu	0	2406	0	0
Kagoshima	0	0	0	0
Unrecorded	88343	87857	0	0
Total	88343	182272	151432	85002

c) offshore longline (Length)

	1970s	1980s	1990s	2000s
On boat	0	1	1	0
Katsuura	0	0	0	0
Kesennuma	0	0	235	366
Yaizu	0	0	0	0
Tokyo	0	0	0	0
Shimizu	0	0	0	0
Kagoshima	0	0	0	0
Unrecorded	0	0	0	0
Total	0	1	236	366

d) offshore longline (Weight)

	1970s	1980s	1990s	2000s
On boat	0	0	0	0
Katsuura	0	0	123	144
Kesennuma	0	0	1883	66
Yaizu	0	0	0	0
Tokyo	0	0	0	0
Shimizu	0	0	0	0
Kagoshima	0	0	0	0
Unrecorded	0	0	0	0
Total	0	0	2006	210

e) shallow-setting longline (Weight)

	1970s	1980s	1990s	2000s
On boat	0	0	0	0
Katsuura	0	0	0	0
Kesennuma	0	0	0	0
Yaizu	0	225	290	44
Tokyo	0	0	0	0
Shimizu	0	0	0	0
Kagoshima	0	0	0	0
Unrecorded	5598	1164	0	0
Total	5598	1389	290	44

f) drift net (Weight)

	1970s	1980s	1990s	2000s
On boat	0	0	0	0
Katsuura	0	0	0	0
Kesennuma	0	0	0	0
Yaizu	0	510	279	2
Tokyo	0	0	0	0
Shimizu	0	0	0	0
Kagoshima	0	0	0	0
Unrecorded	1798	2229	0	0
Total	1798	2739	279	2

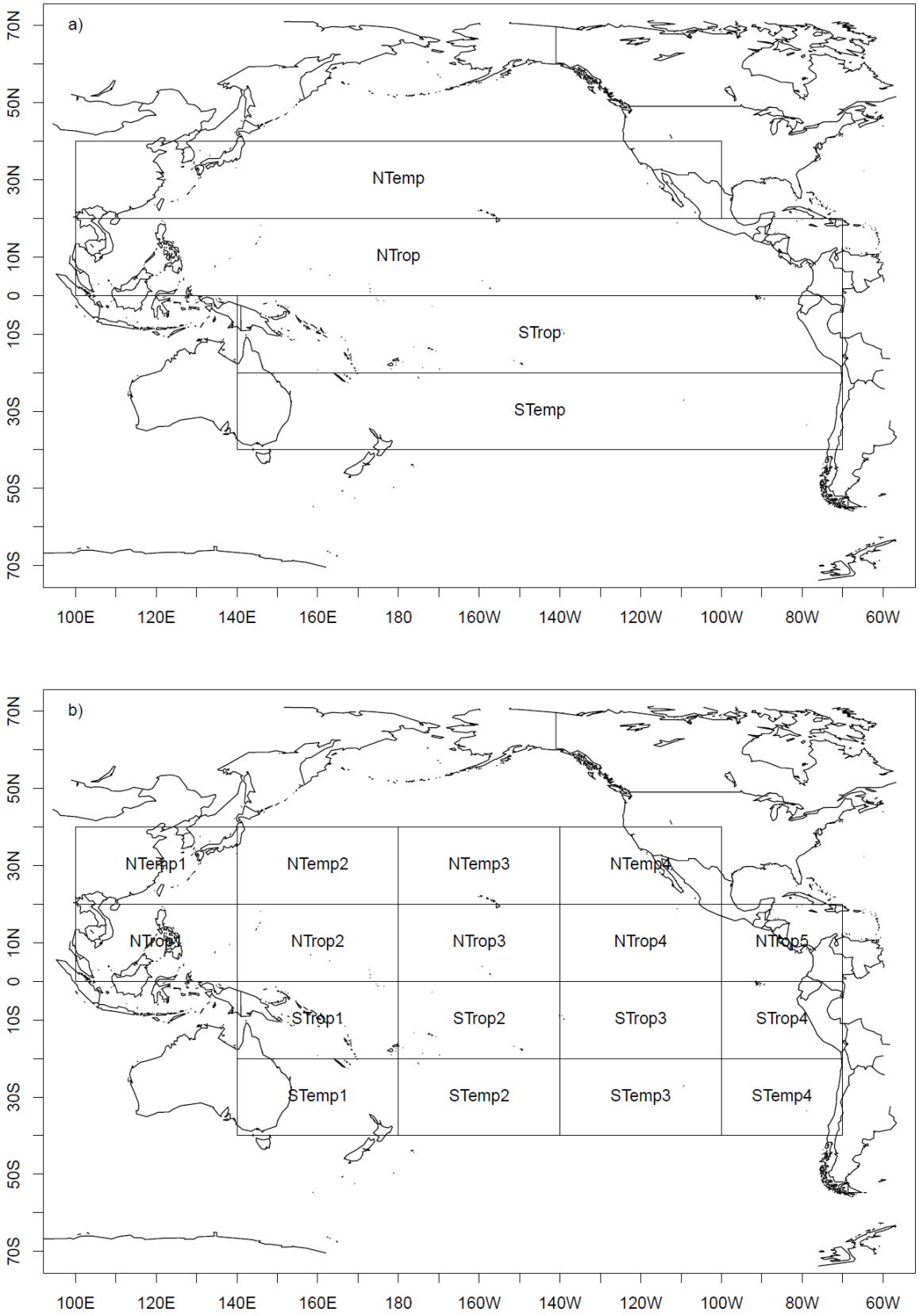


Figure 1. Two types of area stratification: a) 4 areas and b) 17 small areas.

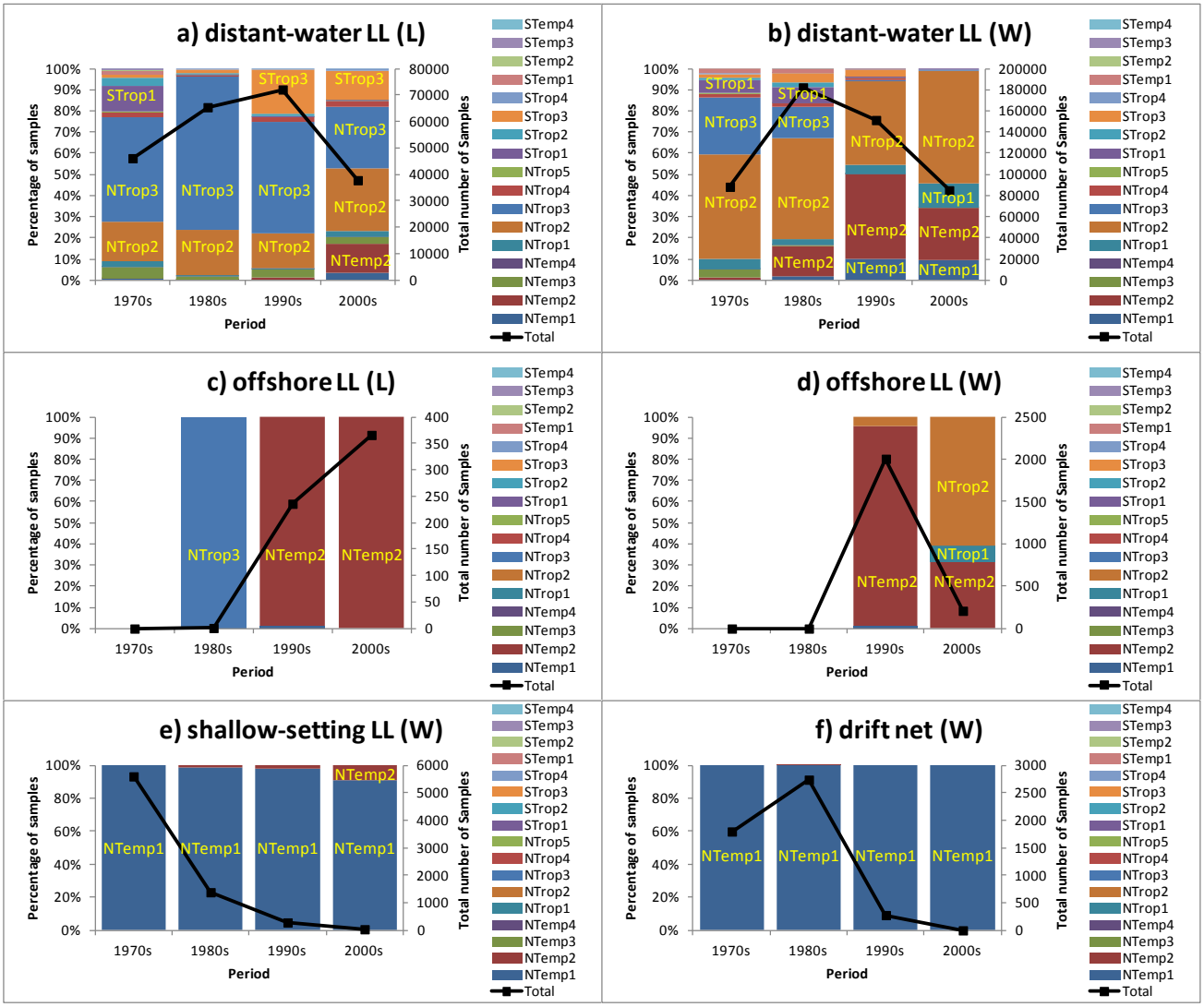


Figure 2. Decennial number of length in EFL (cm) or processed weight (kg) data of blue marlin caught in the Pacific Ocean, by type of fishery and by small area (Figure 1-b) for the period between 1970s and 2010s. Year 2010 was included in the 2000s. Distant-water and offshore longline collected both length (a, c) and processed weight data (b, d).

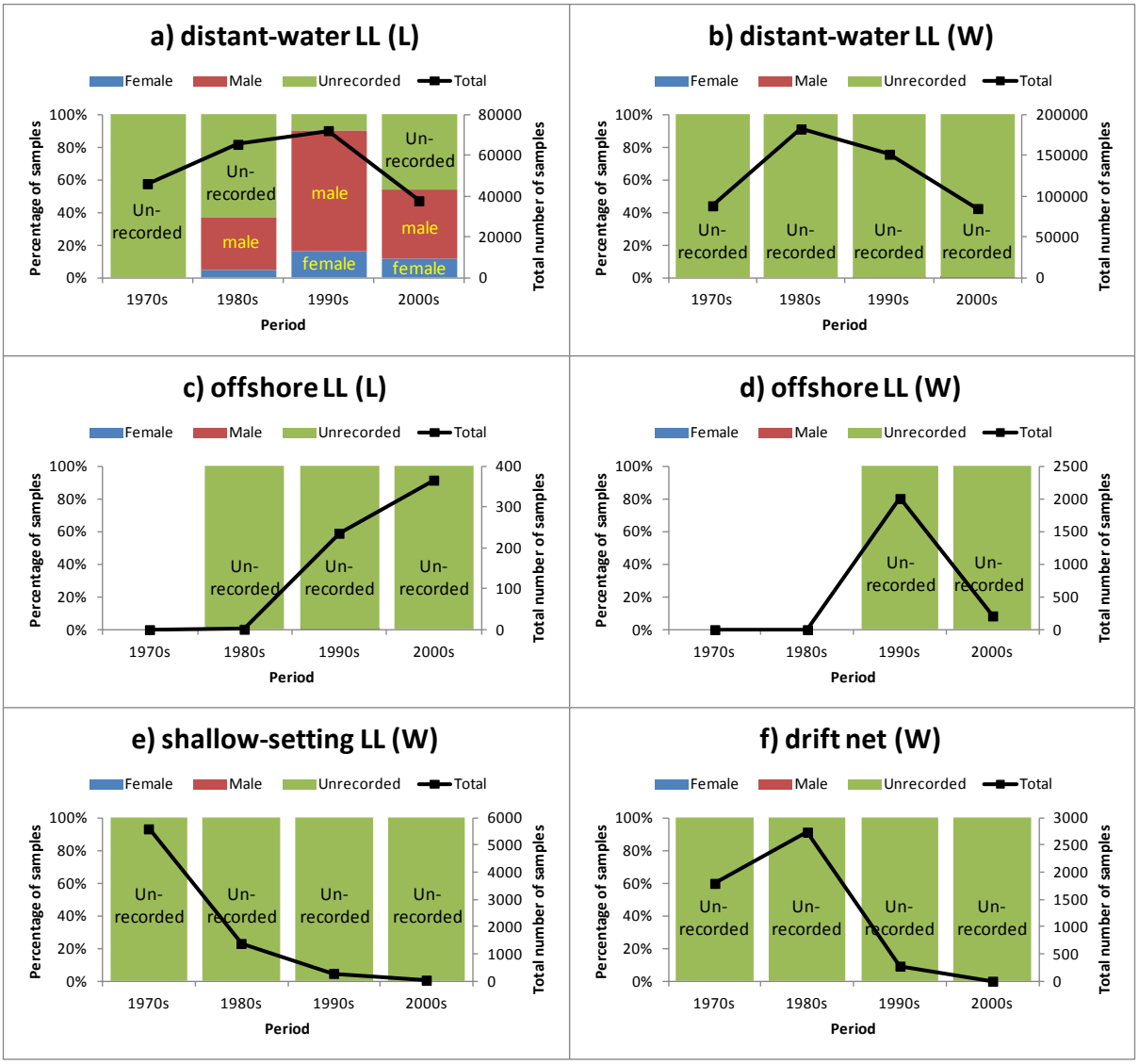


Figure 3. Decennial number of length in EFL (cm) or processed weight (kg) data of blue marlin caught in the Pacific Ocean, by type of fishery and by sex for the period between 1970s and 2010s. Year 2010 was included in the 2000s. Distant-water and offshore longline collected both length (a, c) and processed weight data (b, d).

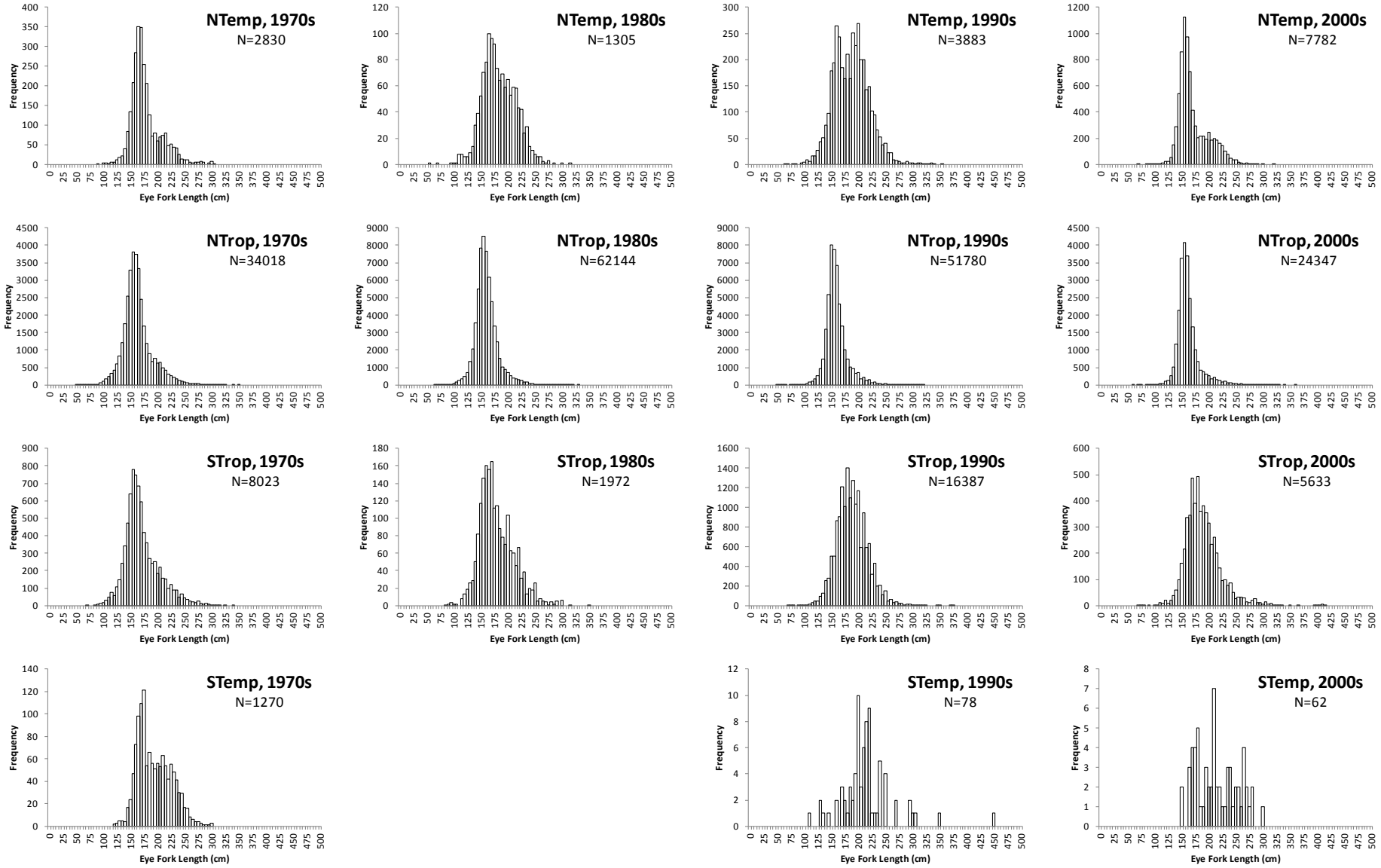


Figure 4-a. Decennial frequency distribution in EFL (cm) of blue marlin caught by distant-water longline by area (Figure 1-a) between 1970s and 2000s. Year 2010 was included in the 2000s.

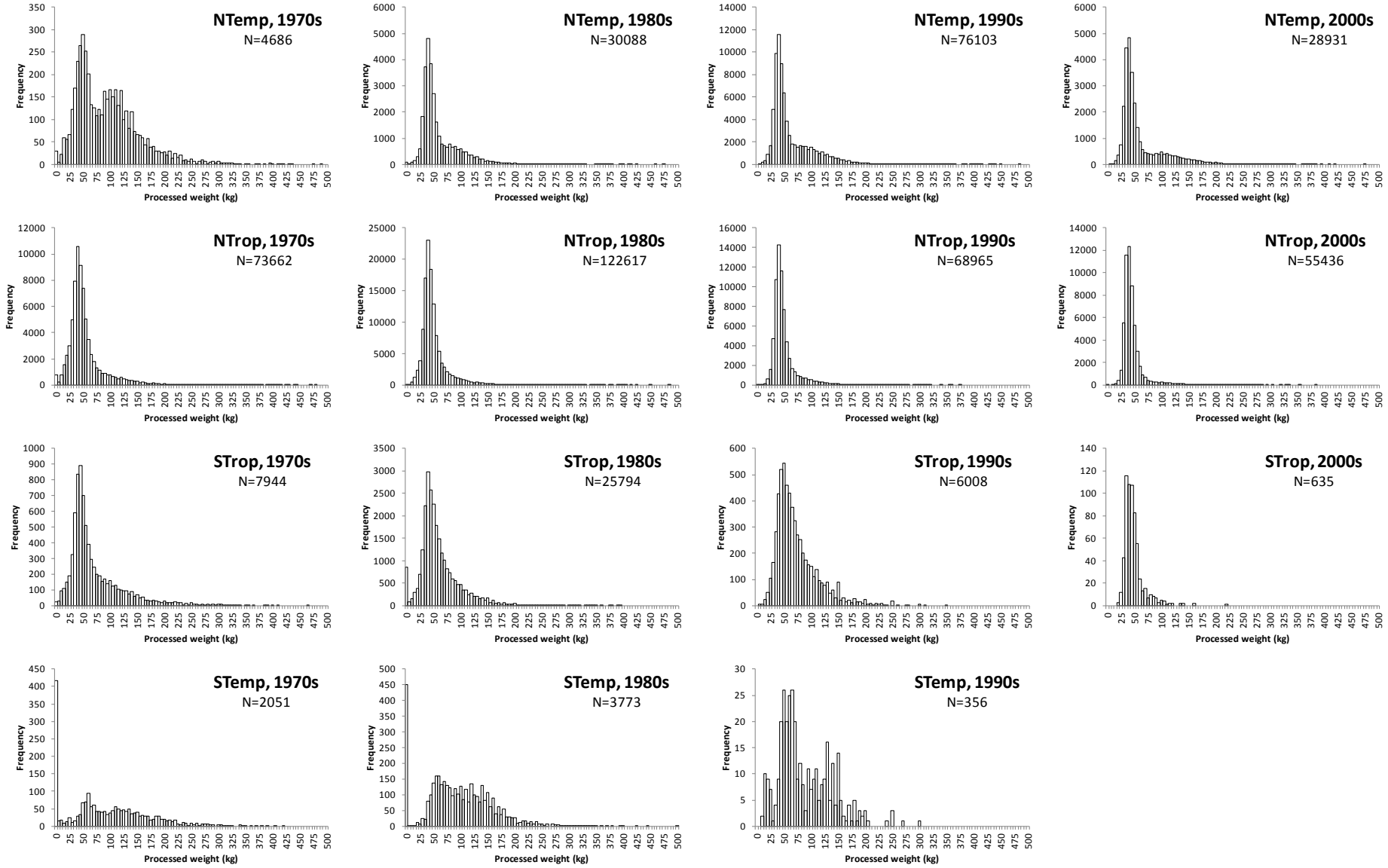


Figure 4-b. Decennial frequency distribution in processed weight (kg) of blue marlin caught by distant-water longline by area (Figure 1-a) between 1970s and 2000s. Year 2010 was included in the 2000s.

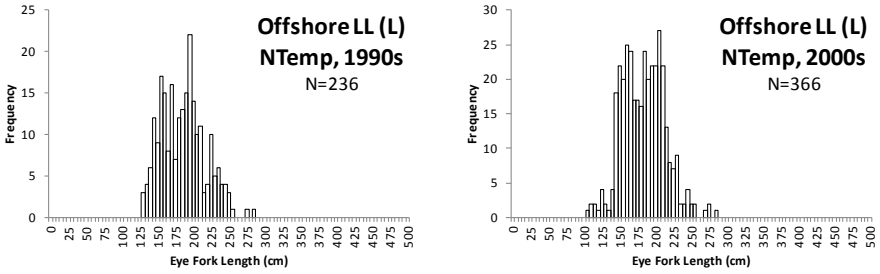


Figure 5-a. Decennial frequency distribution in EFL (cm) of blue marlin caught by offshore longline between 1990s and 2000s in the North temperate area (Figure 1-a). Year 2010 was included in the 2000s.

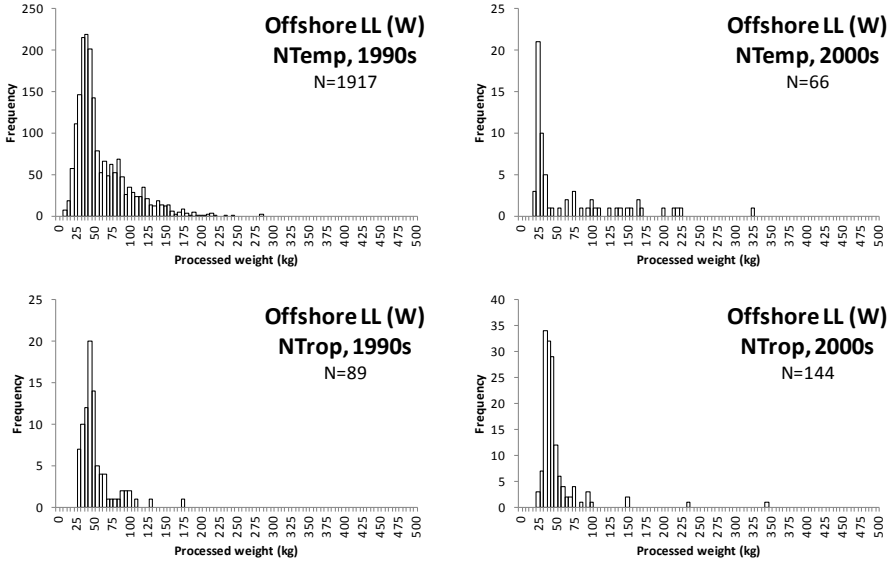


Figure 5-b. Decennial frequency distribution in processed weight (kg) of blue marlin caught by offshore longline between 1990s and 2000s in the North temperate and tropical areas (Figure 1-a). Year 2010 was included in the 2000s.

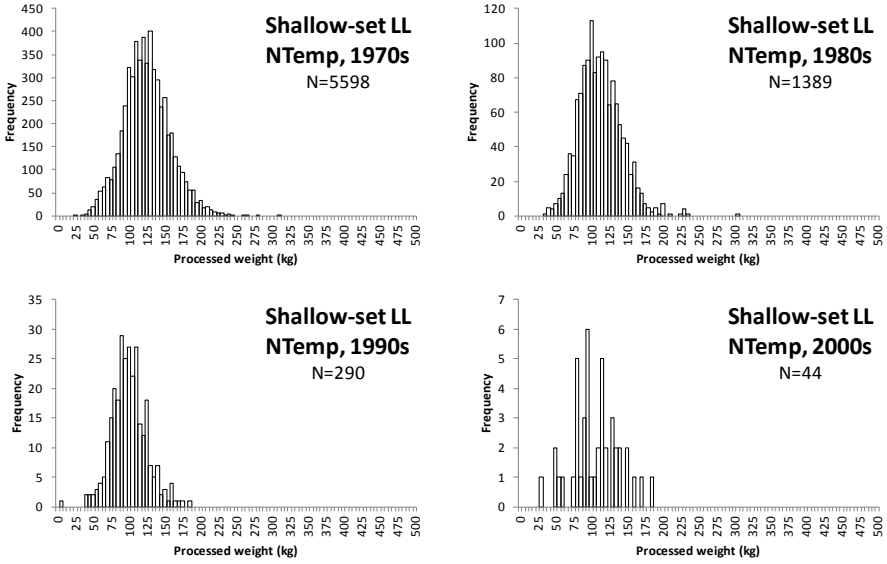


Figure 6. Decennial frequency distribution in processed weight (kg) of blue marlin caught by shallow-setting longline between 1970s and 2000s in the North temperate area (Figure 1-a). Year 2010 was included in the 2000s.

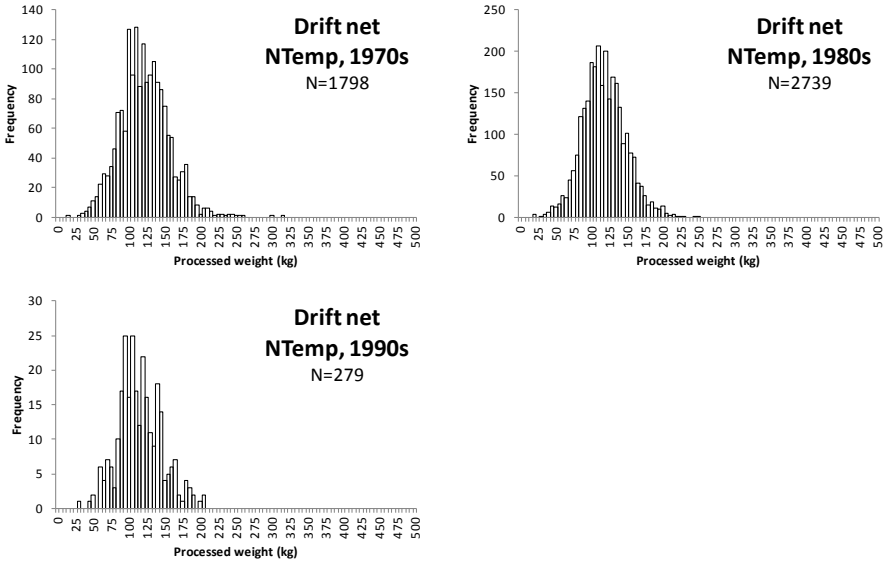


Figure 7. Decennial frequency distribution in processed weight (kg) of blue marlin caught by drift net between 1970s and 1990s in the North temperate area (Figure 1-a).

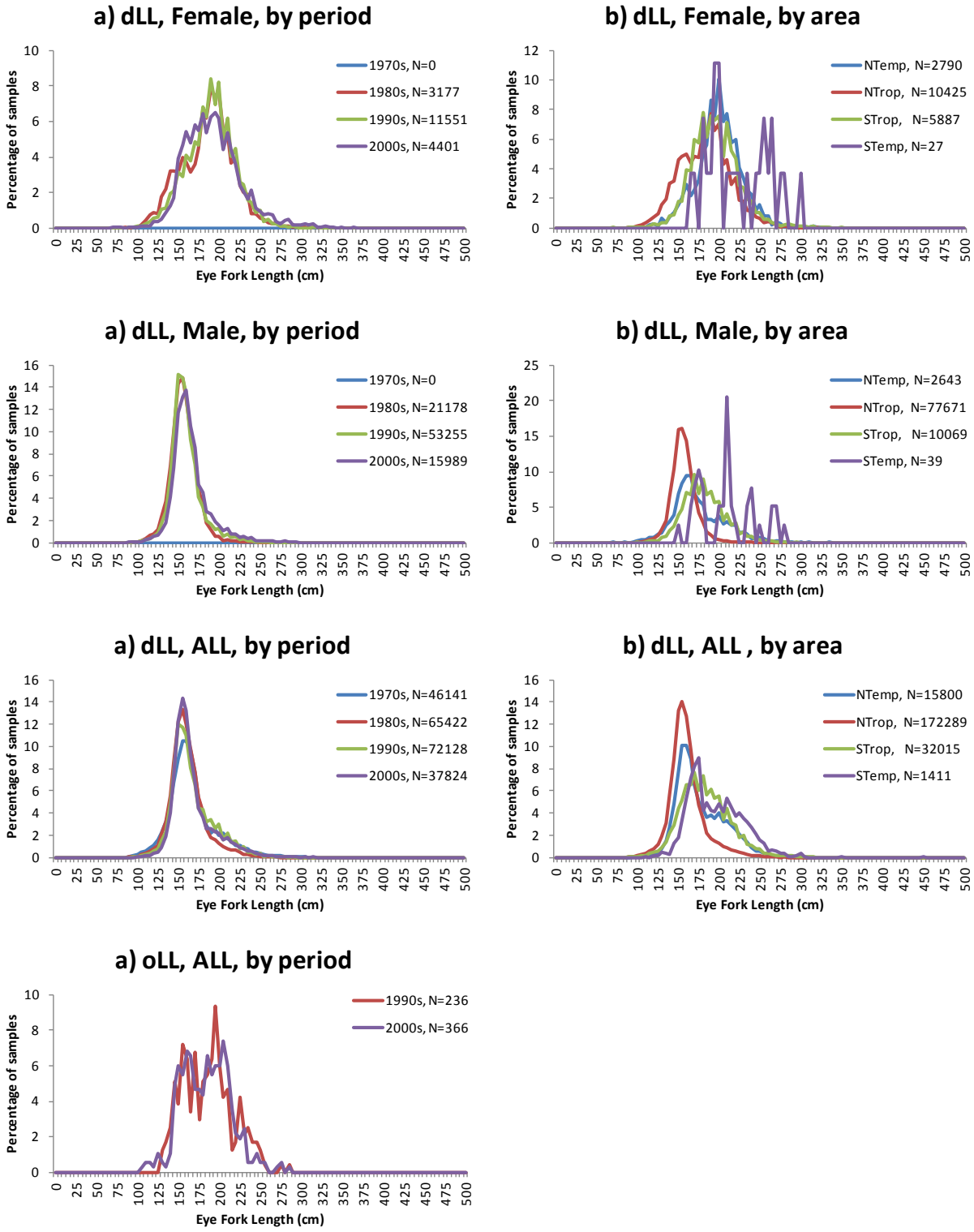


Figure 8. Comparison of length composition by sex (female, male, all) of blue marlin caught by distant-water (dLL) or offshore longline (oLL), by period (a) or by area (b). Each y-axis shows percentage of samples. All data contains female, male and unrecorded data. Year 2010 was included in the 2000s (a). No area comparison and only sex-unrecorded data for offshore longline, that caught blue marlin only in the North temperate area.

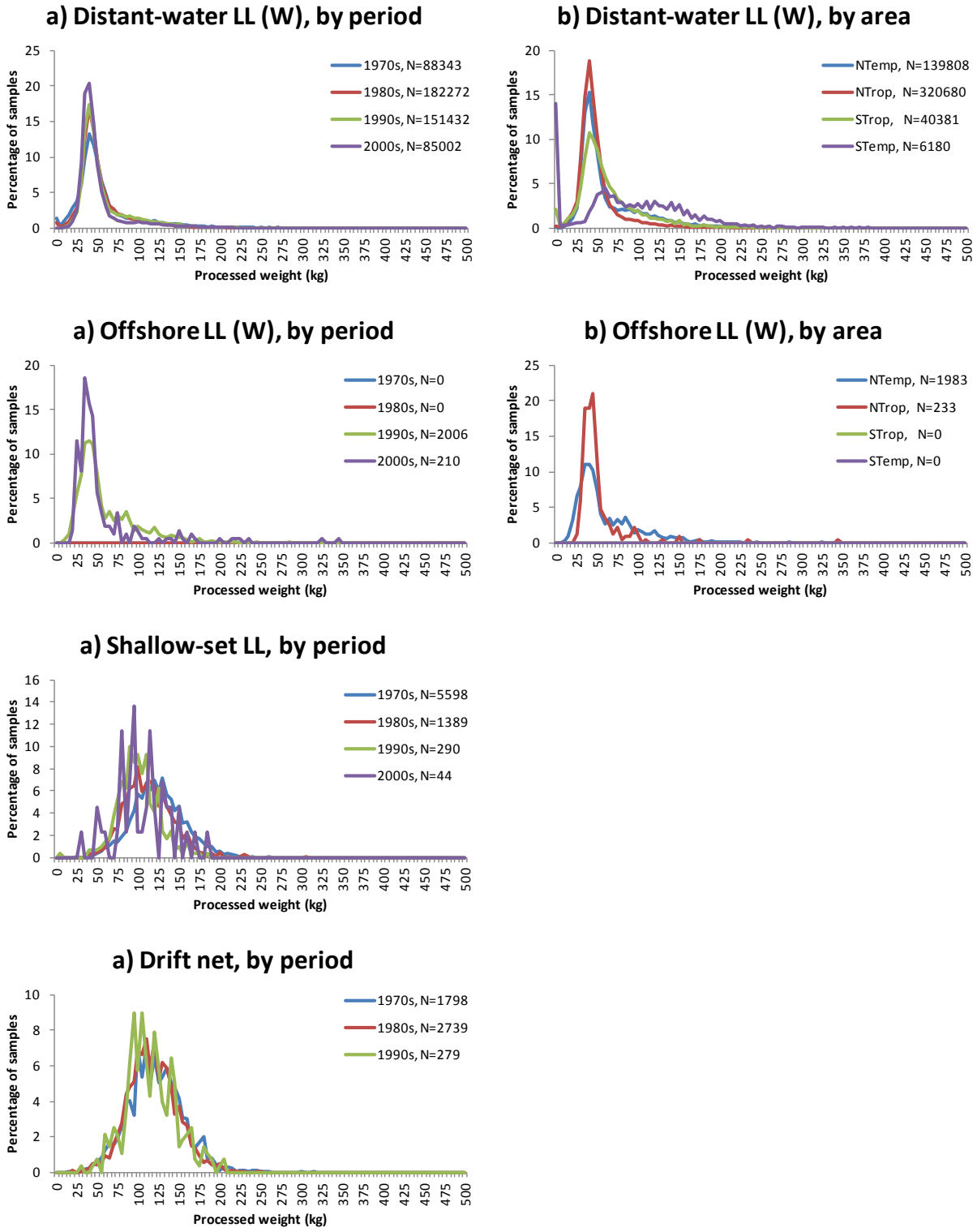


Figure 9. Comparison of processed weight (kg) data by period (a) or by area (b). Each y-axis shows percentage of samples. Year 2010 was included in the 2000s (a). No area comparison for shallow-setting longline and drift net, that caught blue marlin only in the North temperate area.

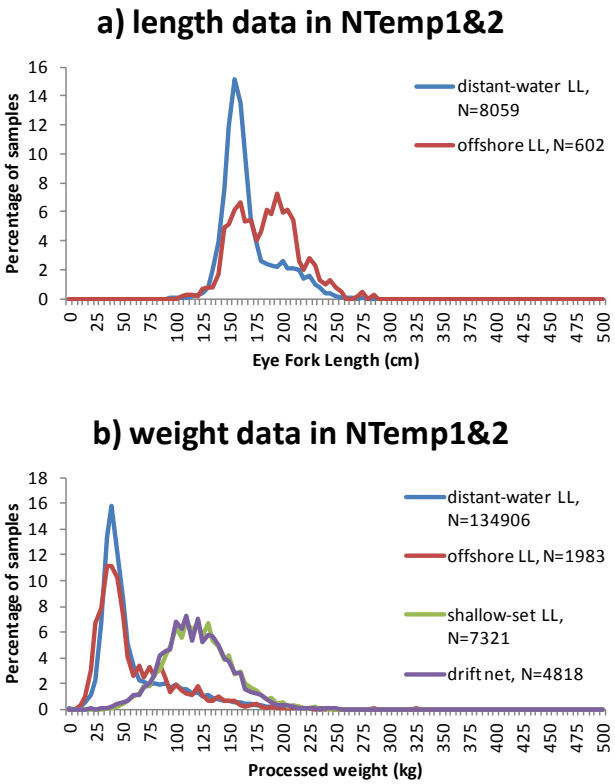


Figure 10. Comparison of all length (a) or processed weight (b) data by gear in NTemp1 and NTemp2 (Figure 1-b). Each y-axis shows percentage of samples.