ISC/04/MARLIN-WG/ 1

Size composition and sex ratio for Pacific blue marlin, *Makaira mazara*, and striped marlin, *Tetrapturus audax*, caught by Japanese longliner in the Pacific[1]

Hirokazu Saito and Kotaro Yokawa[1]
National Research Institute of Far Seas Fisheries
5-7-1, Shimizu-Orido, Shizuoka 424-8633, Japan

January 2004

[1] Working document submitted to the Marlins Working Group for the Fourth Meeting of the Interim Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC), 26 January - 4 February 2004, Honolulu, Hawaii, USA. Document not to be cited without author's permission.

Introduction

Japanese offshore and distant water longliners have been catching pacific blue marlin and striped marlin mostly as bycatches. National Research Institute of Far Seas Fisheries (NRIFSF) is collecting biological information, such as length-frequency distributions, body weights and sex, which could important indices for estimating the amount of the resource of fish.

Some report suggested that these two species show seasonal latitudinal migration patterns, whose spawning ground are in the tropical warm waters (Anraku and Yabuta 1959; Shiohama 1969). Their size compositions of longline catches change by year, season, region and sex (Kume and Joseph 1969; Ueyanagi, S 1953).

This document reviewed the size data of Pacific blue marlin and striped marlin caught by Japanese offshore and distant water longliners, to examine their qualitative and quantitative limitations for the input of the age structured stock assessment model such as MULTIFAN-CL (Fournier et al. 1998).

Materials and Methods

The data for this study were obtained from the Japanese longline fishery statistics which include commercial fishing boat (CF) for 1975-2002 and training vessel (TV) for 1975-2000 compiled at NRIFSF. The data of TV in the periods after 2000 are preparing now. This data has the information of catch number, sex and the type of ship, and level of spatial-temporal resolutions. In the present study, we picked up data with resolution higher than month and 5x5 degree.

Designations of areas used in this study (Figure 1) were decided arbitrarily based on the distribution pattern of nominal effort and CPUE of Pacific blue marlin/striped marlin of Japanese longline fishery (Uosaki et al. 1997). These are one of key information in deciding area stratification. As for the Pacific blue marlin, high CPUE were recorded roughly in two regions of 10°N to 20°N between 140°E and 170°W, and 10°S to 30°S west of 130°W. As for striped marlin, relatively high CPUE were recorded roughly in three regions, 20°N to 25°N between 170°E and 150°W, 20°S to 30°S west of 140°W and east of 130°W.

In this study, sex specific size data are used, but unsexed data are eliminated. The coverage of size data were also checked using the same categories.

Result

Table 1 shows the amount of size data by the type of ship, sex and area. The number of sex specific size data of Pacific blue marlin was 14 thousands by CF and 134 thousands by TV. As for the striped marlin, the sex specific size data was 12 thousands and 144 thousands by CF and TV, respectively. Both sex specific size data of fish caught by CF was only 0.1 times than that of fish caught by TV. The catch number of Pacific blue marlin was about 2.8 millions. The main fishing grounds for Pacific blue marlin was Area 4 (1.3 millions in catch number). The coverage of sex specific size data for Pacific blue marlin was different from the main fishing ground, calculated as 5%. As for the coverage of sex specific size data in each area, Area 3 recorded higher value (16%) where was not the main fishing grounds. Other areas were roughly less than 5%. The catch number of striped marlin was about 3.4 millions. The main fishing grounds for striped marlin was Area 2 (707 thousands in catch number). The coverage of sex specific size data for striped marlin had same tendency as Pacific blue marlin. As for the coverage of sex specific size data in each area, Area 3 recorded higher value (24%). Other areas were roughly less than 6%.

Figure 2 shows length frequency distribution of Pacific blue marlin and striped marlin. The patterns of the length frequency distributions were clearly different between CF and TV for these species.

Figure 3 shows length frequency distributions for Pacific blue marlin and striped marlin in each area. The data which had less than 50 individuals by area and the type of boat was deleted. As for the Pacific blue marlin, length frequency distribution was almost corresponding in Areas 3, 5 and 9 (Figure 3-1). Areas 2, 4 and 10 had different distribution pattern though the number of individuals not few. The length frequency distribution was not always the same each other. In areas 1, 6, 7 and 8, the size of data were too small to compare appropriately. As for the striped marlin, length frequency distribution was almost corresponding in Areas 1, 5, 6, 9 and 10. Areas 2, 3 and 4 had different distribution pattern though the number of individuals not few. The length frequency distribution was not always the same each other. In areas 6, 7 and 8, the size of data were too small to compare appropriately.

Figure 4 shows the percentage of female for Pacific blue marlin and striped marlin in each area. The data which had less than 10 individuals by area, length class (10cm) and the type of boat was deleted. As for Pacific blue marlin, the data obtained by TV had specific nonlinear

trajectory, and a ratio of female was roughly below 0.2 by smaller length class than 180cm. On the other hand, the data obtained by CF had relatively linear trajectory and different value from TV's one. A ratio of male did not correspond between CF and TV. As for striped marlin, the difference of a ratio of male was smaller than that of Pacific blue marlin.

Discussion

The highest coverage of sex specific data was obtained in Area 3 for both Pacific blue marlin and striped marlin, although the main fishing ground for Pacific blue marlin and striped marlin were Area 4 and Area 2, respectively. The reason why high coverage was recorded in Area 3 is that Area 3 is main fishing ground of TV (Table 1). The factor which TV decide the fishing ground and season is the easiness of the operation and syllabus. One should be careful in using size data by TV, because Area 3 is outside of main fishing ground of CF.

The shapes of length frequency distribution or the sex ratio were not always in accordance with between CF and TV. These differences between CF and TV were caused by various factors such as year and rough area stratification. To verify this result, it is necessary to carry out researches to confirm real situation.

Further biological analyses is helpful to verify the data used in this study, especially in the main fishing grounds. It is also effective to test some analyses by using stock assessment model with experimental dataset which has assumed length frequency distributions and/or sex ratio.

Literature cited

Anraku, N. and Y. Yabuta. 1959. seasonal migration of black marlin. Report of Nankai Regional Fisheries Research Laboratory (10): 63-71.

Fournier, D.A., J. Hampton and J. R. Sibert. 1998. MULTIFAN-CL: a length-based, age-structured model for fisheries stock assessment, with application to South Pacific albacore, *Thunnus alalunga*. Can. J. Aquat Sci. (55): 2105-2116.

Hill. K. T., G. M. Cailliet and R. L. Radtke. 1989. A comparative analysis of growth zones in four calcified structures of Pacific blue marlin, Makaira nigricans. Fish. Bull., U.S. (87) 829-843.

Kume, S. and J. Joseph. 1969. Size composition and sexual maturity of billfish caught by the Japanese longline fishery in the Pacific Ocean east of 130°W

Shiohama, T. 1969. A note on the marlins caught by tuna longline fishery in the eastern Pacific Ocean east of 130°W. Far Seas Fish. Res. Lab. Bull., (1): 5-34.

Skillman, R. A., and Yong. M. Y. Y. 1974. Length-weight relationships for six species of billfishes in the central Pacific Ocean. U.S. Nat. Mar. Fish. Serv., NOAA Tech. Rep. NMFS SSRF-675 (2): 126-137.

Ueyanagi, S. 1953. The sexual difference of the sizes of marlins. Report of Nankai Regional Fisheries Research Laboratory (1): 5pp.

Uosaki, K., T. Ito, I. Warashina, T. Shiohama, N. Miyabe, H. Okamoto, H. Nakano, Y. Uozumi and H. Matunaga. Atlas of catch rates for tunas and billfishes caught by Japanese longline fishery, 1967-1992. Fisheries Agency of Japan.

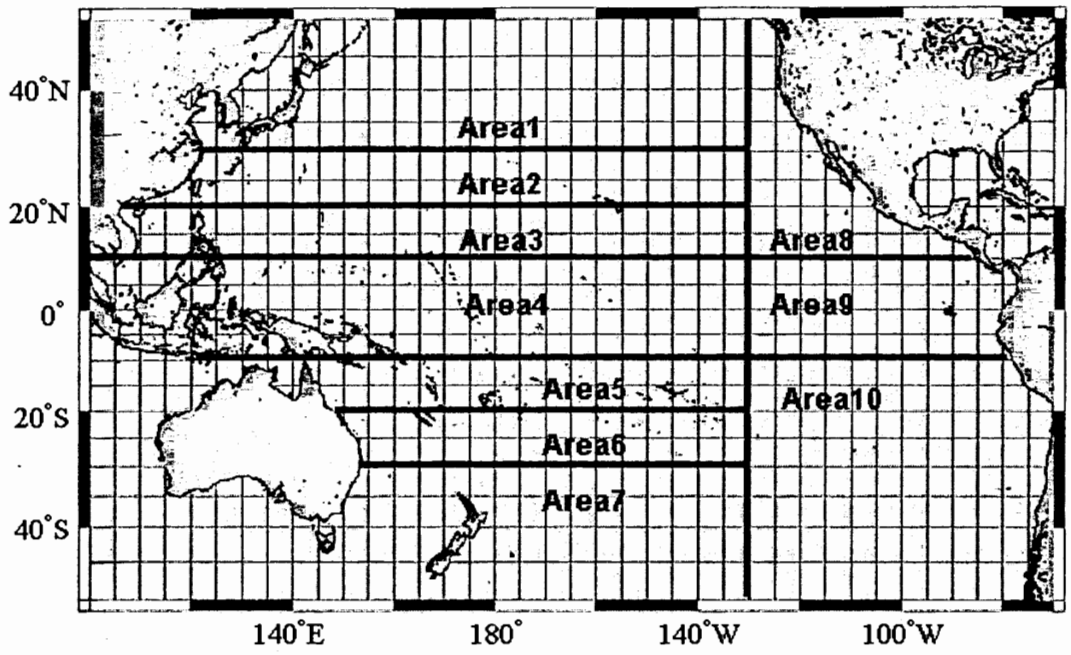

Figure 1. The designation of the sub-areas used in this study.

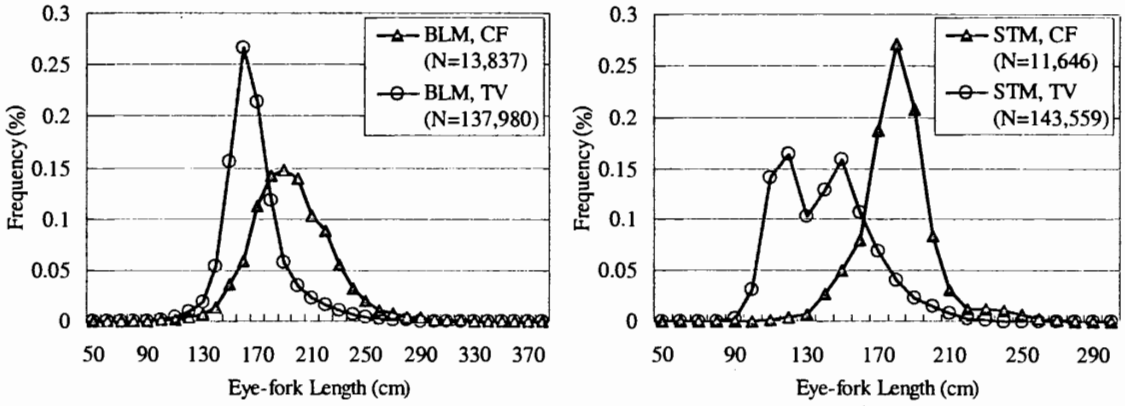

Figure 2. Length frequency distributions of Pacific blue marlin (left) and striped marlin (right) which include sex data caught by Japanese distant water and offshore longline fishery. N indicates the number of fish used in this study.

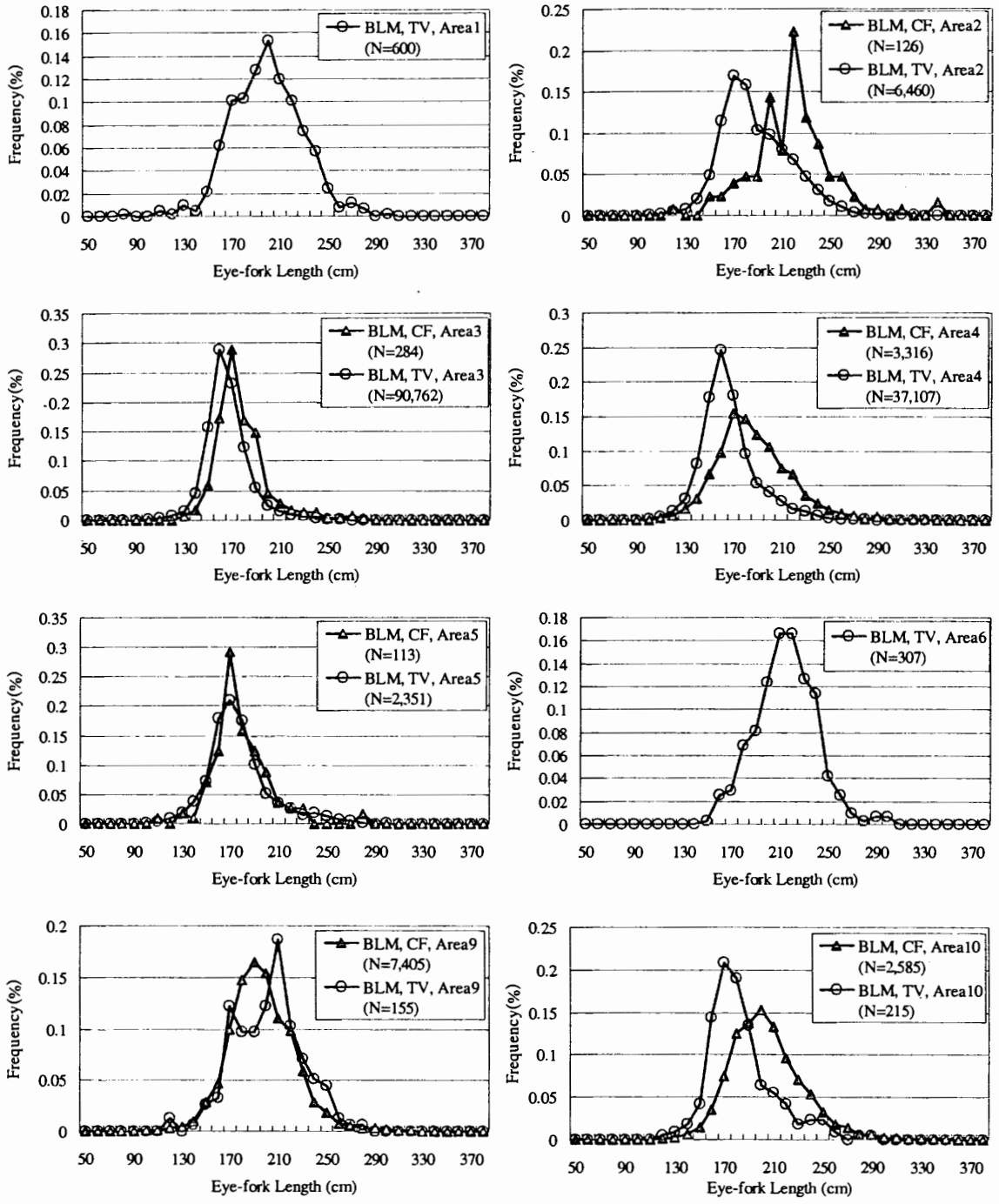

Figure 3-1. Length frequency distributions of Pacific blue marlin caught by Japanese commercial fishing boat (CF) and training vessel (TV) in each area. Data which had less than 50 individuals in each type of fishing boat was deleted. N indicates the number of fish used in this study.

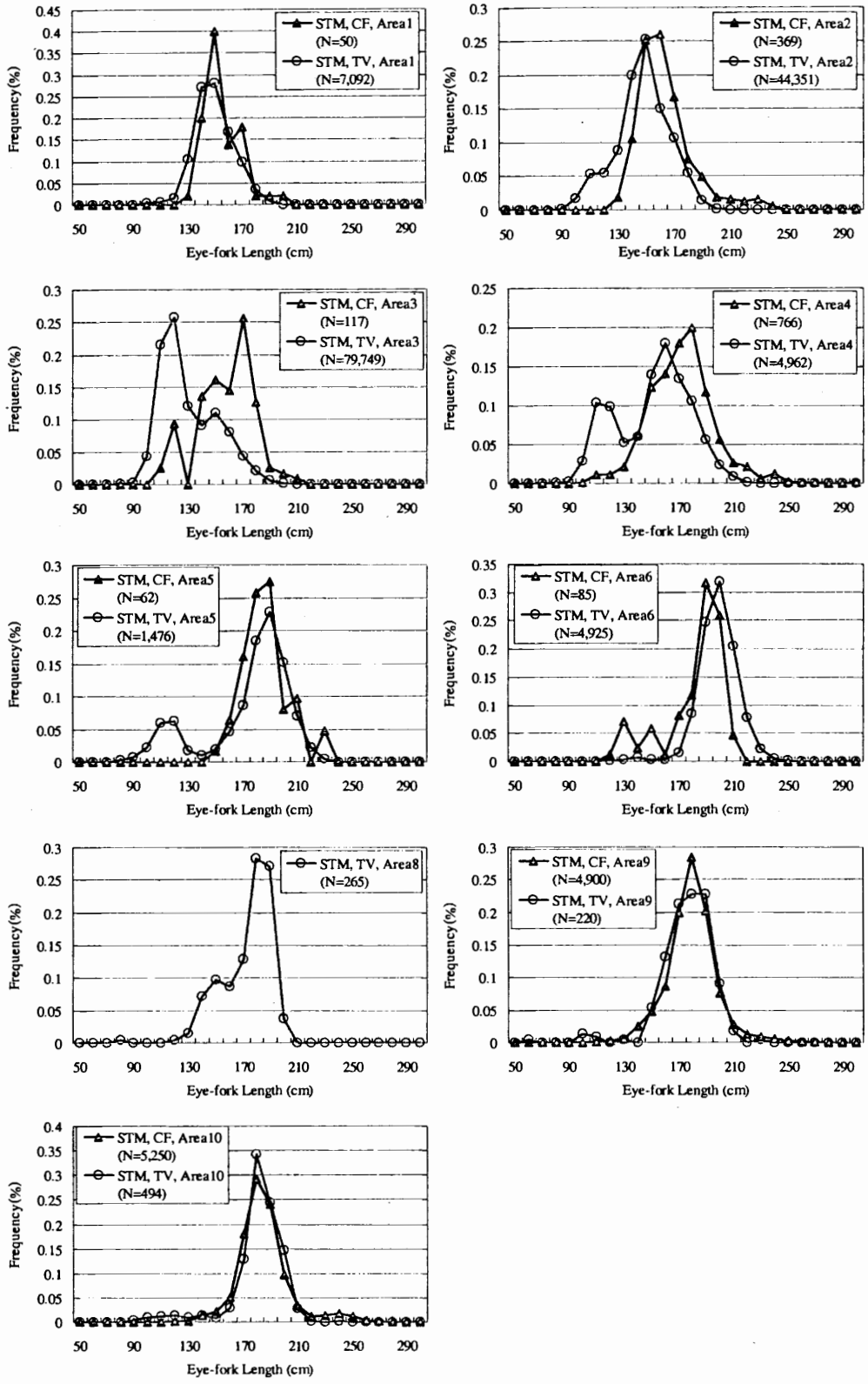

Figure 3-2. Length frequency distributions of striped marlin caught by Japanese commercial fishing boat (CF) and training vessel (TV) in each area. Data which had less than 50 individuals in each type of fishing boat was deleted. N indicates the number of striped marlin used in this study.

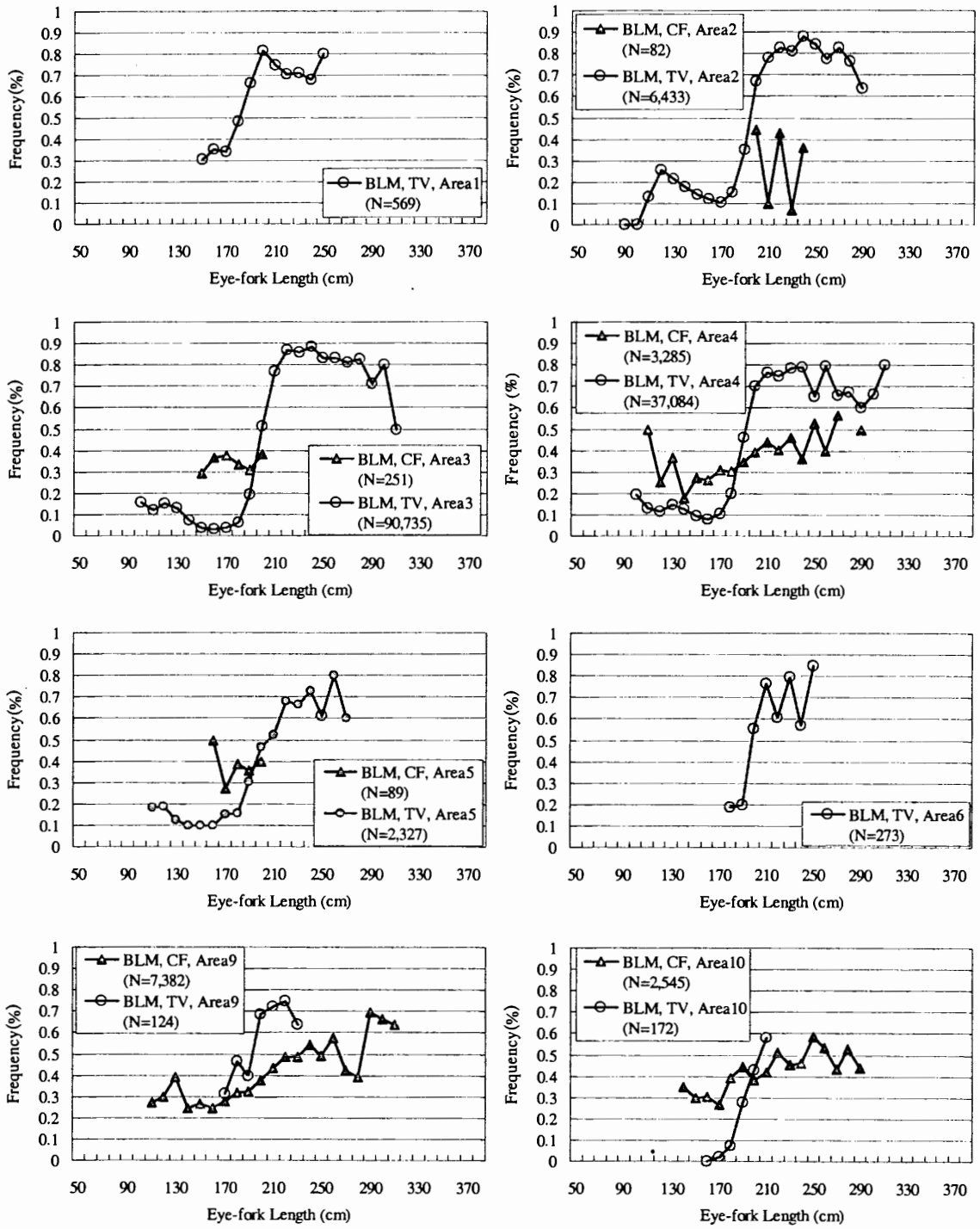

Figure 4-1. Percentage of male for Pacific blue marlin caught by Japanese commercial fishing boat (CF) and training vessel (TV) in each area. Data which had less than 10 individuals in each class (10cm) was deleted. N indicates the number of Pacific blue marlin used in this figure.

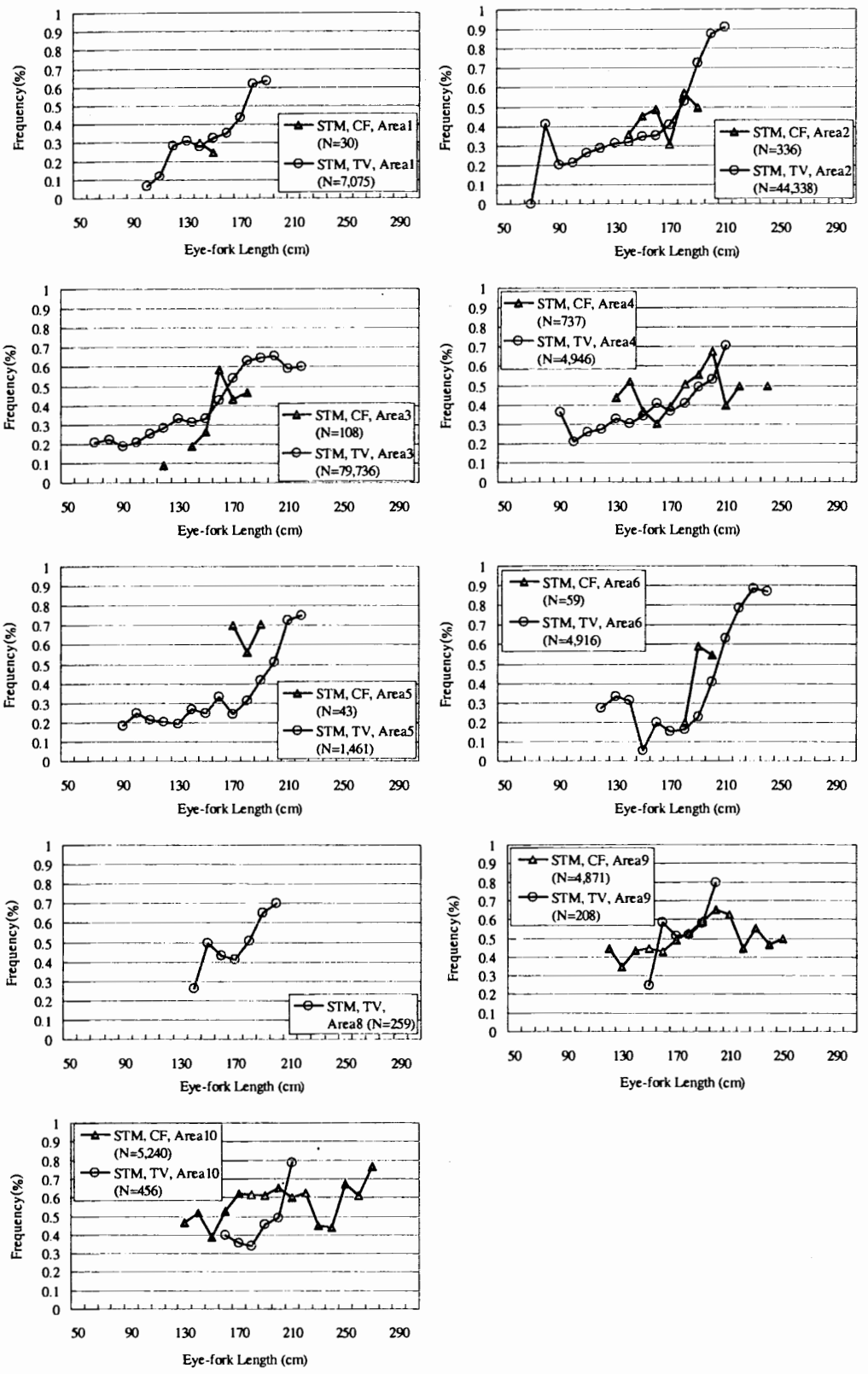

Figure 4-2. Percentage of female for striped marlin caught by Japanese commercial fishing boat (CF) and training vessel (TV) in each area. Data which had less than 10 individuals in each class (10cm) was deleted. N indicates the number of striped marlin used in this figure.

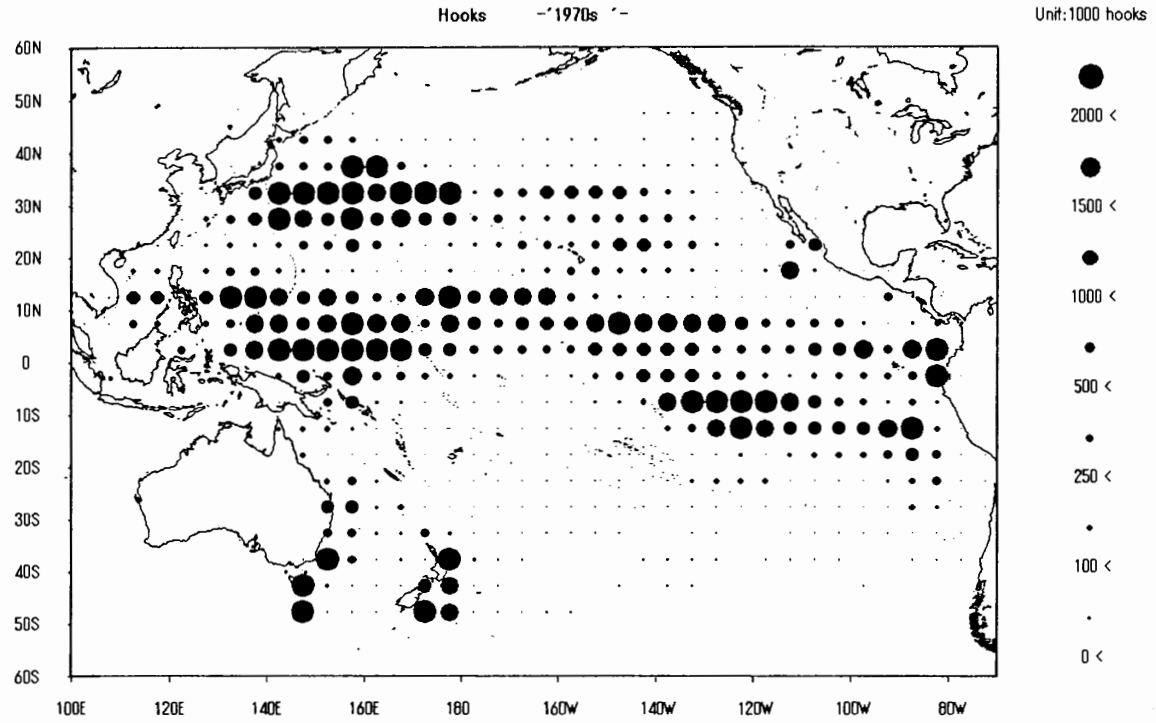

Figure 5-1. Effort distribution (1970's)

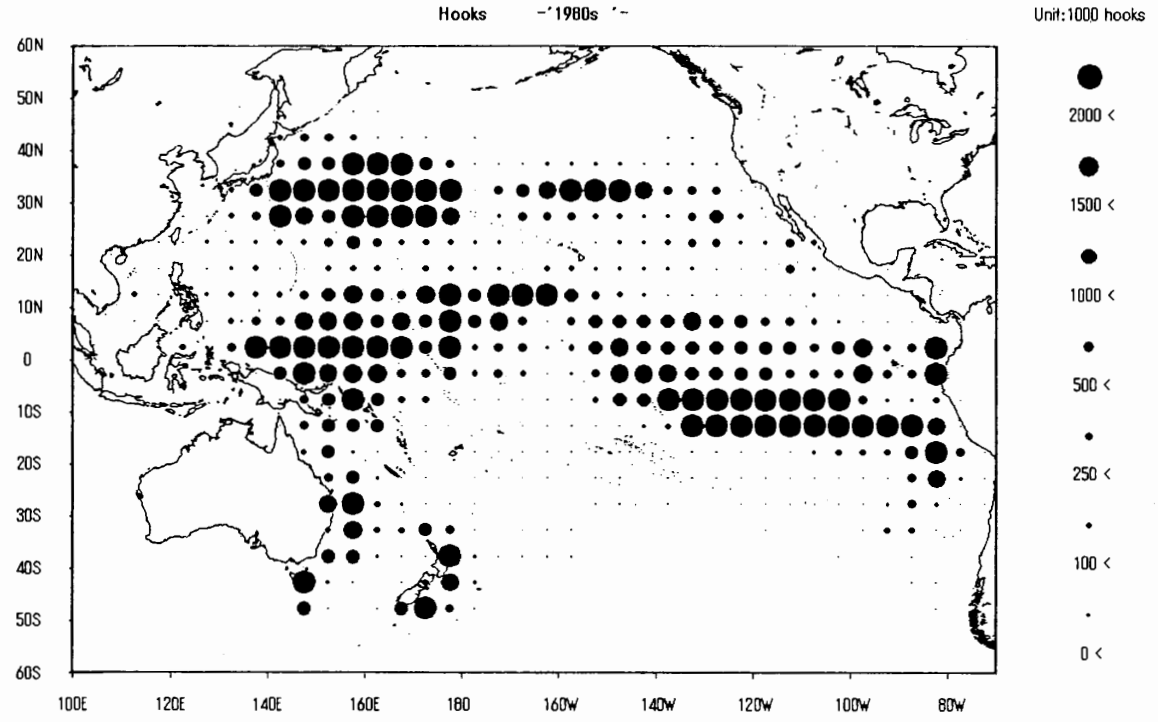

Figure 5-2. Effort distribution (1980's)

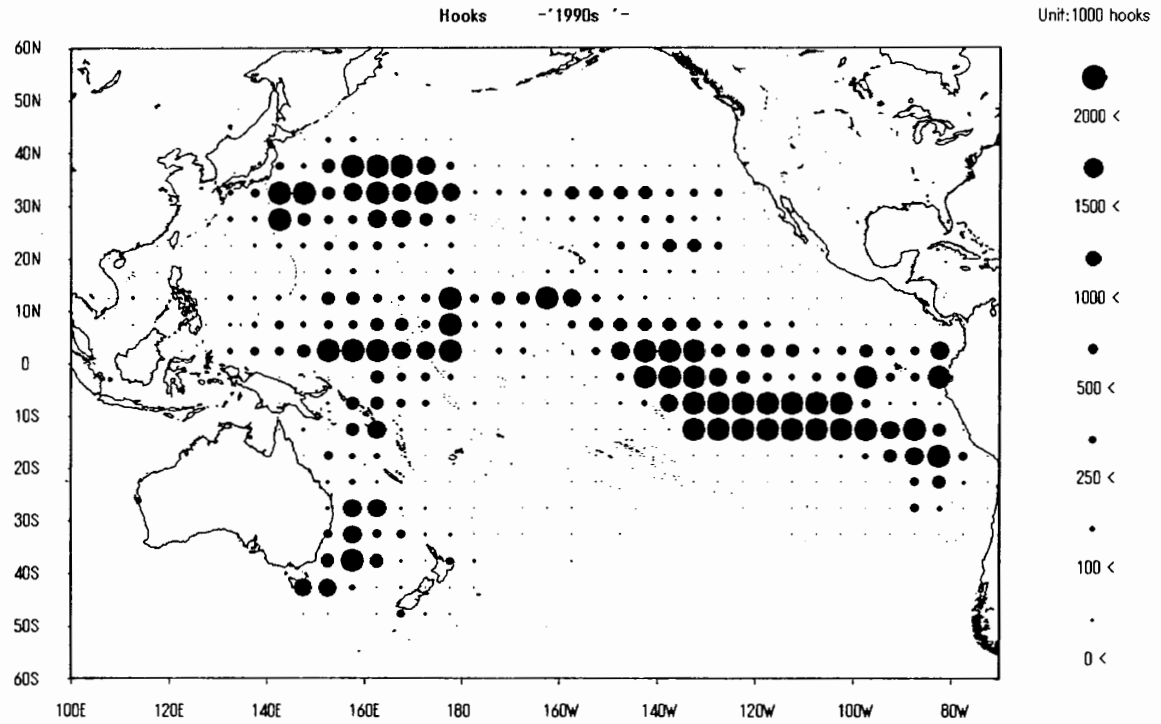

Figure 5-3. Effort distribution (1990's)

Table 1. Size data coverage of Japanese distant water and offshore longline fishery for Pacific blue marlin in the period between 1975 and 2002.

Area	Catch number	Amount of sex specific size data												Coverage of sex specific size data (%)
		Commercial Fishing boat				Training Vessel				Total				
		Male	Female	Total	Sex ratio (%)	Male	Female	Total	Sex ratio (%)	Male	Female	Total	Sex ratio (%)	
1	32,242	2	0	2	0.0	228	372	600	62.0	230	372	602	61.8	1.87
2	111,725	89	37	126	29.4	3,942	2,518	6,460	39.0	4,031	2,555	6,586	38.8	5.89
3	551,965	182	102	284	35.9	82,060	8,702	90,762	9.6	82,242	8,804	91,046	9.7	16.49
4	1,304,927	2,177	1,139	3,316	34.3	29,691	7,416	37,107	20.0	31,868	8,555	40,423	21.2	3.10
5	102,451	72	41	113	36.3	1,810	541	2,351	23.0	582	1,882	2,464	76.4	2.41
6	23,725	3	2	5	40.0	132	175	307	57.0	177	135	312	43.3	1.32
7	2,699	0	0	0	No data	0	1	1	100.0	1	0	1	0.0	0.04
8	11,020	1	0	1	0.0	17	5	22	22.7	18	5	23	21.7	0.21
9	525,732	4,632	2,773	7,405	37.4	65	90	155	58.1	4,697	2,863	7,560	37.9	1.44
10	176,321	1,493	1,092	2,585	42.2	166	49	215	22.8	1,659	1,141	2,800	40.8	1.59
Total	2,842,807	8,651	5,186	13,837	37.5	118,111	19,869	137,980	14.4	125,505	26,312	151,817	17.3	5.34

Table 2. Size data coverage of Japanese distant water and offshore longline fishery for striped marlin in the period between 1975 and 2002.

Area	Catch number	Amount of sex specific size data												Coverage of sex specific size data (%)
		Commercial Fishing boat				Training Vessel				Total				
		Male	Female	Total	Sex ratio (%)	Male	Female	Total	Sex ratio (%)	Male	Female	Total	Sex ratio (%)	
1	543,357	30	20	50	40.0	4669	2423	7,092	34.2	4,699	2,443	7,142	34.2	1.31
2	706,922	206	163	369	44.2	28793	15558	44,351	35.1	28,999	15,721	44,720	35.2	6.33
3	336,809	73	44	117	37.6	54142	25607	79,749	32.1	54,215	25,651	79,866	32.1	23.71
4	180,958	421	345	766	45.0	3182	1780	4,962	35.9	3,603	2,125	5,728	37.1	3.17
5	25,251	25	37	62	59.7	912	564	1,476	38.2	937	601	1,538	39.1	6.09
6	168,289	44	41	85	48.2	2828	2097	4,925	42.6	2,872	2,138	5,010	42.7	2.98
7	89,205	22	16	38	42.1	17	8	25	32.0	39	24	63	38.1	0.07
8	525,160	4	5	9	55.6	131	134	265	50.6	135	139	274	50.7	0.05
9	277,380	2306	2594	4,900	52.9	99	121	220	55.0	2,405	2,715	5,120	53.0	1.85
10	572,516	2085	3165	5,250	60.3	293	201	494	40.7	2,378	3,366	5,744	58.6	1.00
Total	3,425,847	5,216	6,430	11,646	55.2	95,066	48,493	143,559	33.8	100,282	54,923	155,205	35.4	4.53