Brief review of Japanese striped marlin and swordfish catch in the North Pacific[1]

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Introduction

This document is briefly reviews the Japanese catch data of striped marlin and swordfish in the north Pacific. In addition, some biological information of these two species which recently collected by NRIFSF are also shown.

Materials and Methods

Catch data of striped marlin and swordfish by Japanese offshore and distant-water longliners in the north Pacific was obtained from the Japanese longline fishery statistics compiled at the National Research Institute of Far Seas Fisheries for 1952-2005. In the period before 1971, only catch number aggregated by 5 degree x 5 degree x month were available. In the period between 1971 and 1993, catch weight of billfishes were estimated for each 5 degree x 5 degree x month block based on size data collected by both commercial and training longline vessels. Since 1994, a new log-book system introduced which contain the average weight of tunas and billfish for each set.

Annual catch amount of striped marlin and swordfish for the fisheries other than offshore and distant-water longliners were obtained from annual report of catch statistics on fishery and aquiculture published by statistics and survey division, ministry of agriculture, forestry and fishery (Year Book), in the period between 1951 and 2004.

Results and Discussions

(1) Average weight of catches by Japanese offshore and distant-water longliners

The statistics of Japanese offshore and distant-water longliners contains catch weight information since 1971. To describe the annual trend of average weight of swordfish and striped marlin, the north Pacific (north of equator) was divided into three areas longitudinally, west of 180E (area 1), 180W – 135W (area 2), and east of 135W (area 3). Figure 1 shows the trend of average weight of swordfish and striped marlin by area and quarter. The average weight showed unrealistic up and down in the period before 1994 for both species. This should be caused by the quality of size data used in the estimation of catch weight. Generally, the number of size data of billfishes is rather small as most of them were obtained by fisherman's reports and they do not pay much attention to collect billfish size data as billfishes are by-catch species for most of them. Though the average weight shown in Fig. 1 calculated from the Japanese official statistics, the quality of size data used in the estimation of catch weight shall be revisited to confirm the annual trend shown in Fig. 1 truly reflect the actual catch.

(2) Estimation of catch weight by by Japanese offshore and distant-water longliners before 1971

In the former stock assessment of swordfish by production model (Yokawa, 1999), catch amount of swordfish by Japanese longliners in the period before 1971 estimated using data in FAO statistics and Year Books. But this method seemed to be not so reliable as boundary of FAO statistic area are different from the equator and many extrapolation steps were needed to obtain catch estimation in the north Pacific (Year Book also did not have the statistical area of "North Pacific"). In the present study, the catch amounts of swordfish and striped marlin in 1952 – 1970 were estimated using catch number by 5 degree x 5 degree x month appeared in the official statistics, and the average weight by area and quarter for 1971 – 1975 (Table 1). Tables 2 and 3 shows the annual swordfish and striped marlin catch amount (ton) in the north Pacific by fishery. Total Japanese swordfish catch fluctuated between 7,500 tons and 1000 tons since the mid 1990s, while total catch of striped marlin shows steady decreasing trend since the mid 1990's. These differences in the trends of total annual catches observed in recent years can mainly be attributed

to the differences in the number of fishing vessels targeting swordfish and striped marlin. More than 20 offshore longliners operating swordfish directed fishery now, and some of coastal longliners, harpooners and drift netters also targets also targets swordfish seasonally, while the quite limited number of coastal longliners and drift netters operates striped marlin directed operation seasonally.

(3) Distribution of CPUE, catch and effort of swordfish caught by Japanese offshore and distant-water longliners

Figures 2 and 3 shows the decadal average of CPUE (n/1000 hooks), catch number and effort (hooks) of swordfish caught by Japanese offshore and distant-water longliners in the period between the 1950s and the 2000s. Higher CPUE and catch number of swordfish obtained in the temperate and up-welling areas in the north Pacific, and the amount of effort of Japanese longliners in the north eastern Pacific has almost disappeared in the 2000s. The distribution of the quarterly average CPUE, catch and effort in the 1960s and in the 1980s are shown in Figs. 4 and 5. Higher CPUEs were observed in the 1^{st} and 4^{th} quarters in the north Pacific.

(4) Relationship between length and processed weight of swordfish

NRIFSF is conducting port sampling program of swordfish at main fishing port of Japanese offshore surface lognline fleet (Kesennuma port). Relationship between length (Eye-fork in cm) and processed weight (gilled and gutted in kg) of swordfish were tentatively analyzed using these data. As many fishers indicate that the shape of swordfish in the coastal area and offshore area are different, the northwest Pacific was divided into two areas, coastal (140E – 155E) and offshore (160E – 180E). The relationship was analyzed by the SAS GLM procedure and the model used in the analysis is;

Log (Processed weight) = year + month + Log(length) + Log(length)*month +Log(length)*year + year*month + error

In the period between January 1999 and December 2001, about 59,000 swordfish were measured and weighted, and they were used in the analysis. Figure 6 shows the estimated relationship by area and month. In both areas, the results of analysis indicates the effects of month and year are significant ($p<0.0001$). Figure 7 shows the estimated processed weight by month and area of swordfish in 150 cm eye-fork length. The estimated processed weight of 150cm individual change largely by month and the difference between areas is not so large. The estimated processed weight generally peaked in winter – early spring seasons and dropped in late spring – early summer seasons. Because most of Japanese size data of swordfish were collected in the style of processed weight in the period before the mid 1990s and the relationship between length and processed weight of swordfish significantly changed by month and year, conversion of Japanese swordfish weight data into length data should be done carefully and relationship between processed weight and length should be monitored until enough information for the conversion were obtained.

(5) Relationship between length and round weight of striped marlin

During longline research cruise in the north eastern Pacific in 2004 targeting striped marlin, 161 striped marlins were weighted and measured. Figure 8 shows the relationship between eye-fork length and round weight, and eye fork length and lower jaw fork length. Though the number of sample used in the calculation is small but it contains 28 small sized (less than 100 cm EFL) individuals, which rarely reported by fisherman.

References

Yokawa, K., 1999. Standardized catch rate for swordfish caught by Japanese longliner in the north Pacific and the tentative trial of production model. ISC2/99/SFWG/21. 25p.

Yokawa, K. 2003. Preliminary results of study on the effect of gear configuration in CPUE standardization by GLM methods. ICCAT SCRS DOC, SCRS/2003/035, 19pp.

Table 1. Average weight (kg) of swordfish and striped marlin by area and quarter, caught by Japanese offshore and distant-water longliners in the period between 1971 and 1975.

Swordfish

	1st qt	2nd qt	3rd qt	4th qt
area 1	50.0	44.8	51.0	53.0
area 2	51.6	46.7	46.0	54.6
area 3	65.8	58.8	59.2	65.0

Striped marlin

	1st qt	2nd qt	3rd qt	4th qt
area 1	28.6	26.2	33.6	33.8
area 2	30.7	29.0	33.1	33.9
area 3	39.2	37.9	39.5	40.2

Table 2. Japanese annual catch amount (ton) of swordfish in the north Pacific by fishery.

	Offshore and distant-water longline	Coastal longline	Other longline	Squid drift net	Drift net	Bait fishing	Net fishing	Trap net	Others1)	Total
1951	7246		115		10	88	10	78	4131	11678
1952	8890		152		0	6	6	68	2569	11691
1953	10796		77		0	20	87	21	1407	12408
1954	12563		96		0	104	17	18	813	13611
1955	13064		29		0	119	41	37	821	14111
1956	14596		10		0	66	7	31	775	15485
1957	14268		37		0	59	11	18	858	15251
1958	18525		42		0	46	21	31	1069	19734
1959	17236		66		0	34	10	31	891	18268
1960	20058		51		1	23	7	67	1191	21400
1961	19715		51		2	19	11	15	1335	21147
1962	10607		78		0	26	18	15	1371	12115
1963	10322		98		0	43	16	17	747	11243
1964	7669		91		4	42	28	17	1006	8858
1965	8742		119		0	26	182	14	1908	10991
1966	9866		113		0	41	4	11	1728	11764
1967	10883		184		0	33	5	12	891	12008
1968	9810		236		0	41	9	14	1539	11649
1969	9416	286	10		0	42	5	11	1557	11327
1970	7324	391	36		0	36	1	9	1748	9545
1971	7037	332	18		1	17	0	37	473	7915
1972	6796	520	11		55	20	1	1	282	7686
1973	7123	404	10		720	27	2	23	121	8430
1974	5983	508	146		1304	27	1	16	190	8175
1975	7031	602	18		2672	58	2	18	205	10606
1976	8054	691	59		3488	170	1	14	313	12790
1977	8383	834	46		2344	71	1	7	201	11887
1978	8001	984	47		2475	110	1	22	130	11770
1979	8602	973	65		983	45	1	15	161	10845
1980	6005	824	25		1746	30	1	15	398	9045
1981	7039	675	52		1848	59	0	10	129	9812
1982	6064	839	35		1257	58	0	7	195	8456
1983	7692	955	44	71	962	30	2	9	166	9931
1984	7177	1141	36	82	971	98	0	13	117	9635
1985	9335	980	19	107	1026	69	0	10	191	11737
1986	8721	960	77	94	1170	47	0	9	123	11201
1987	9495	819	41	141	910	45	0	11	87	11549
1988	8574	665	13	186	1048	19	0	8	173	10686
1989	6690	742	10	199	1397	21	0	10	362	9431
1990	5833	687	3	48	1026	13	0	4	128	7742
1991	4809	799	8	74	424	20	0	5	153	6292
1992	7234	1173	8	47	840	16	0	6	381	9705
1993	8298	1394	0		292	43	1	4	309	10341
1994	7366	1357	0		421	37	0	4	308	9493
1995	6422	1386	1		561	17	0	7	440	8834
1996	6916	1063	4		428	9	0	4	633	9057
1997	7002	1213	1		365	11	0	5	396	8993
1998	6233	1186	4		471	9	0	2	535	8441
1999	5557	1047	2		724	2	0	5	461	7798
2000	6180	1112	9		808	7	1	5	539	8661
2001	6932	899	9		732	5	0	15	255	8848
2002	6230	955	10		1164	8	0	11	222	8440
2003	5352	1034	5		1198	10	0	4	167	7562
2004[2)]	6165	1452	2		1339	33	1	23	33	8559
2005[3)]	6972									

1); It contains trolling and harpoon but majority of catch obtained by harpoon.
2); Catch of 2004 and 2005 are preliminary.
3): Catch by fisheries other than distant-water & offshore longliners are not estimated.

Table 3. Japanese annual catch amount (ton) of striped marlin in the north Pacific by fishery.

	Offshore and distant-water longline	Coastal longline	Other longline	Squid drift net	Drift net	Bait fishing	Net fishing	Trap net	Others1)	Total
1951	2494		673		0	39	0	92	1149	4447
1952	2901		722		0	39	1	203	1321	5187
1953	2138		47		0	26	10	126	793	3139
1954	3068		52		0	67	0	82	938	4208
1955	3082		28		0	46	36	106	850	4149
1956	3729		59		0	40	1	133	1822	5785
1957	3189		119		0	48	28	71	2312	5766
1958	4106		277		3	69	58	82	2704	7301
1959	4152		156		2	153	47	87	2905	7501
1960	3862		101		4	74	13	161	1689	5905
1961	4420		169		2	58	40	161	1538	6388
1962	5739		110		8	36	72	197	1607	7770
1963	6135		62		17	243	49	92	1527	8124
1964	14304		42		2	24	17	81	2223	16691
1965	11602		19		1	47	28	81	2640	14418
1966	8419		112		2	26	7	227	1313	10106
1967	11698		127		3	38	37	82	1394	13379
1968	15913		230		3	39	16	71	914	17186
1969	8544	600	3		3	40	3	71	2516	11780
1970	12996	690	181		3	149	1	55	824	14899
1971	10965	667	259		10	280	1	61	1674	13917
1972	7006	837	145		243	90	1	72	827	9221
1973	6299	632	118		3265	74	0	80	476	10944
1974	6625	327	49		3112	104	0	90	581	10888
1975	5193	286	38		6534	88	0	105	492	12736
1976	4996	244	34		3561	93	0	37	441	9406
1977	2722	256	15		4424	106	1	103	337	7964
1978	2464	243	27		5593	114	1	93	210	8745
1979	4898	366	21		2532	133	0	66	327	8343
1980	5871	607	5		3467	60	0	80	397	10488
1981	3957	259	12		3866	65	0	88	385	8632
1982	5211	270	13		2351	116	11	52	476	8500
1983	3575	320	10	22	1845	121	0	124	547	6564
1984	3335	386	9	76	2257	177	0	144	398	6782
1985	3698	711	24	40	2323	151	1	81	499	7528
1986	5178	901	33	48	3536	97	0	131	343	10267
1987	5439	1187	6	32	1856	167	0	102	244	9033
1988	5768	752	7	54	2157	205	0	63	400	9406
1989	4582	1081	13	102	1562	145	0	47	345	7877
1990	2298	1125	3	19	1926	192	1	65	287	5916
1991	2677	1197	3	27	1302	130	0	56	320	5712
1992	2757	1247	10	35	1169	94	0	71	137	5520
1993	3286	1723	1		828	107	1	27	308	6281
1994	2911	1284	1		1443	90	2	73	218	6022
1995	3494	1840	3		970	13	2	58	204	6585
1996	1951	1836	4		703	26	1	39	86	4646
1997	2120	1400	3		813	14	0	34	115	4499
1998	1784	1975	2		1092	12	1	34	257	5157
1999	1608	1551	4		1126	8	0	28	148	4472
2000	1152	1109	8		1062	3	0	41	253	3628
2001	985	1326	11		1077	6	1	51	180	3636
2002	764	795	5		1264	10	0	80	200	3119
2003	1008	826	3		1064	10	1	41	151	3104
2004[2)]	761	964	2		1339	33	1	23	33	3155
2005[3)]	803									

1); It contains trolling and harpoon but majority of catch obtianed by harpoon.
2); Catch of 2004 and 2005 are preliminary.
3): Catch by fisheries other than distant-water & offshore longliners are not estimated.

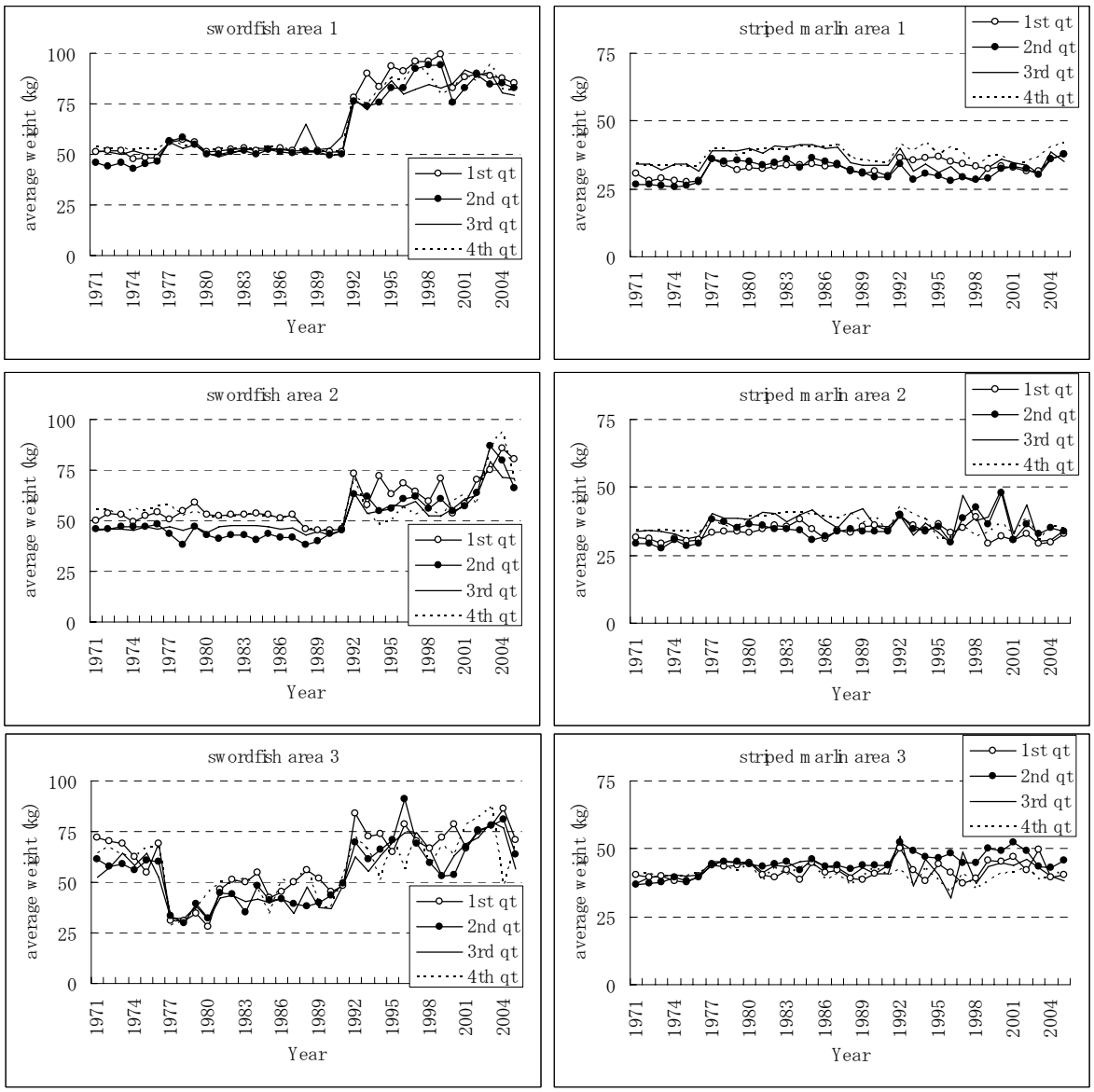

Fig. 1. Average weight of swordfish (left) and striped marlin (right) caught by Japanese offshore and distant water longliners in the north Pacific in the period between 1971 and 2005 by area and quarter. The north Pacific was longitudinally divided into three areas, west of 180E (area 1, top), 180W – 135W (area 2, middle), and east of 135W (area 3, bottom).

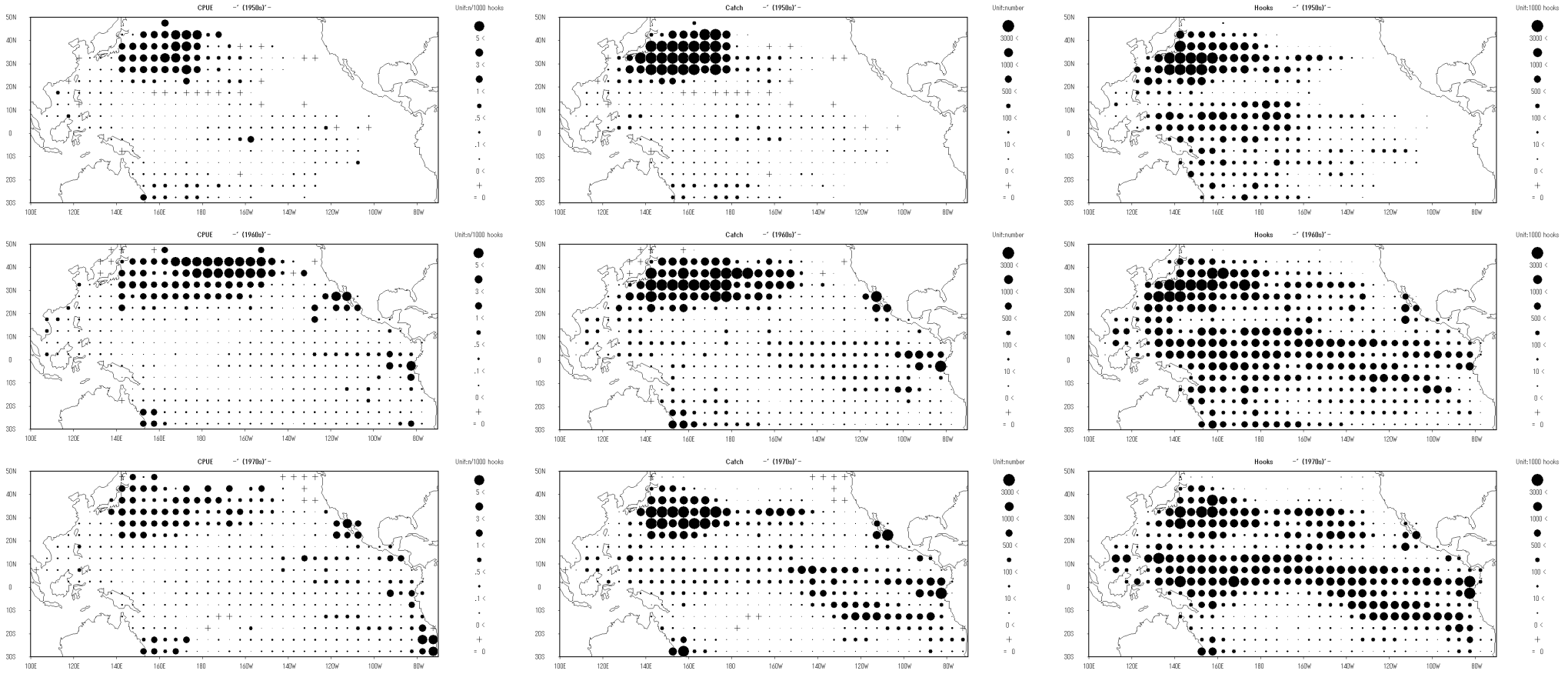

Fig. 2. Distribution of decadal average CPUE (n/1000 hooks, left), catch number (middle), and amount of effort (hooks, right) of swordfish caught by Japanese offshore and distant-water longliners in the 1950's (top), the 1960's (middle), and the 1970's.

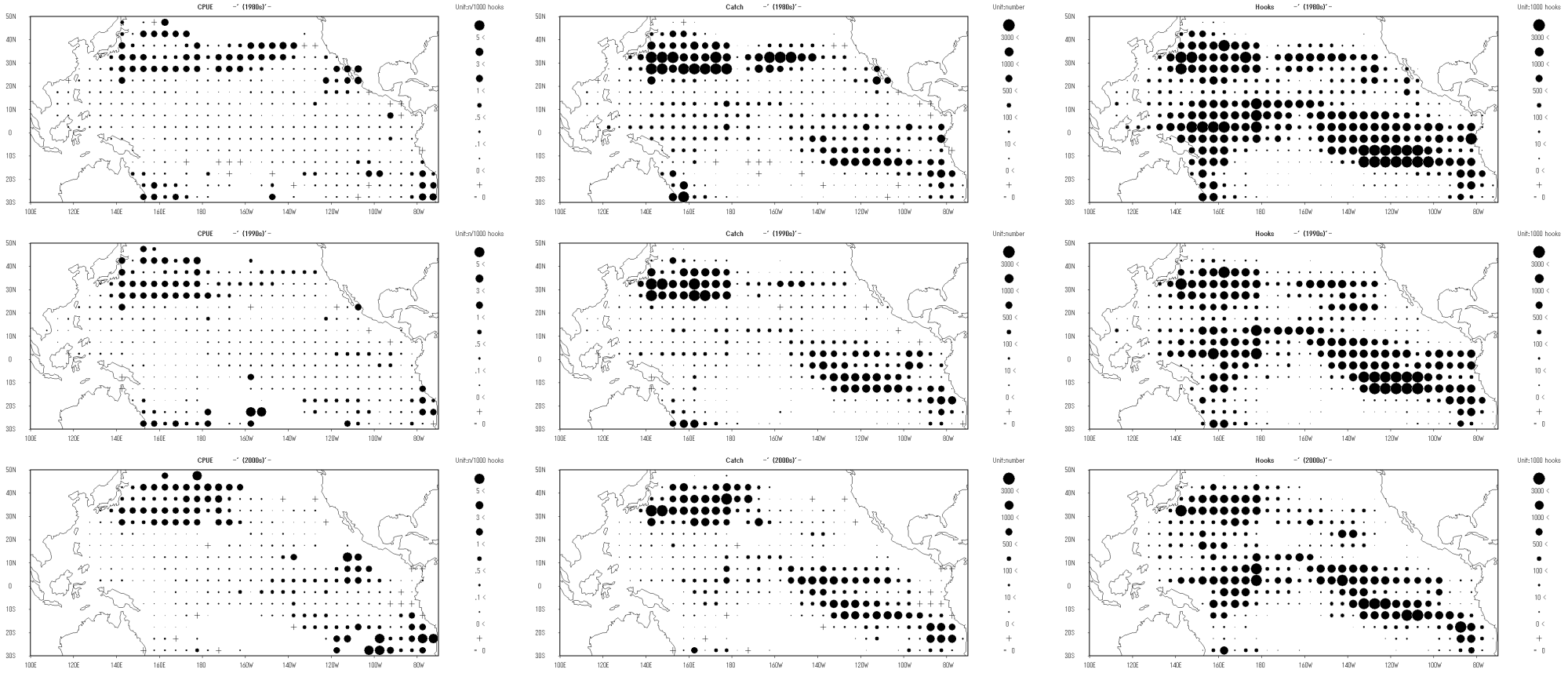

Fig. 3. Distribution of decadal average CPUE (n/1000 hooks, left), catch number (middle), and amount of effort (hooks, right) of swordfish caught by Japanese offshore and distant-water longliners in the 1980's (top), the 1990's (middle), and the 2000's.

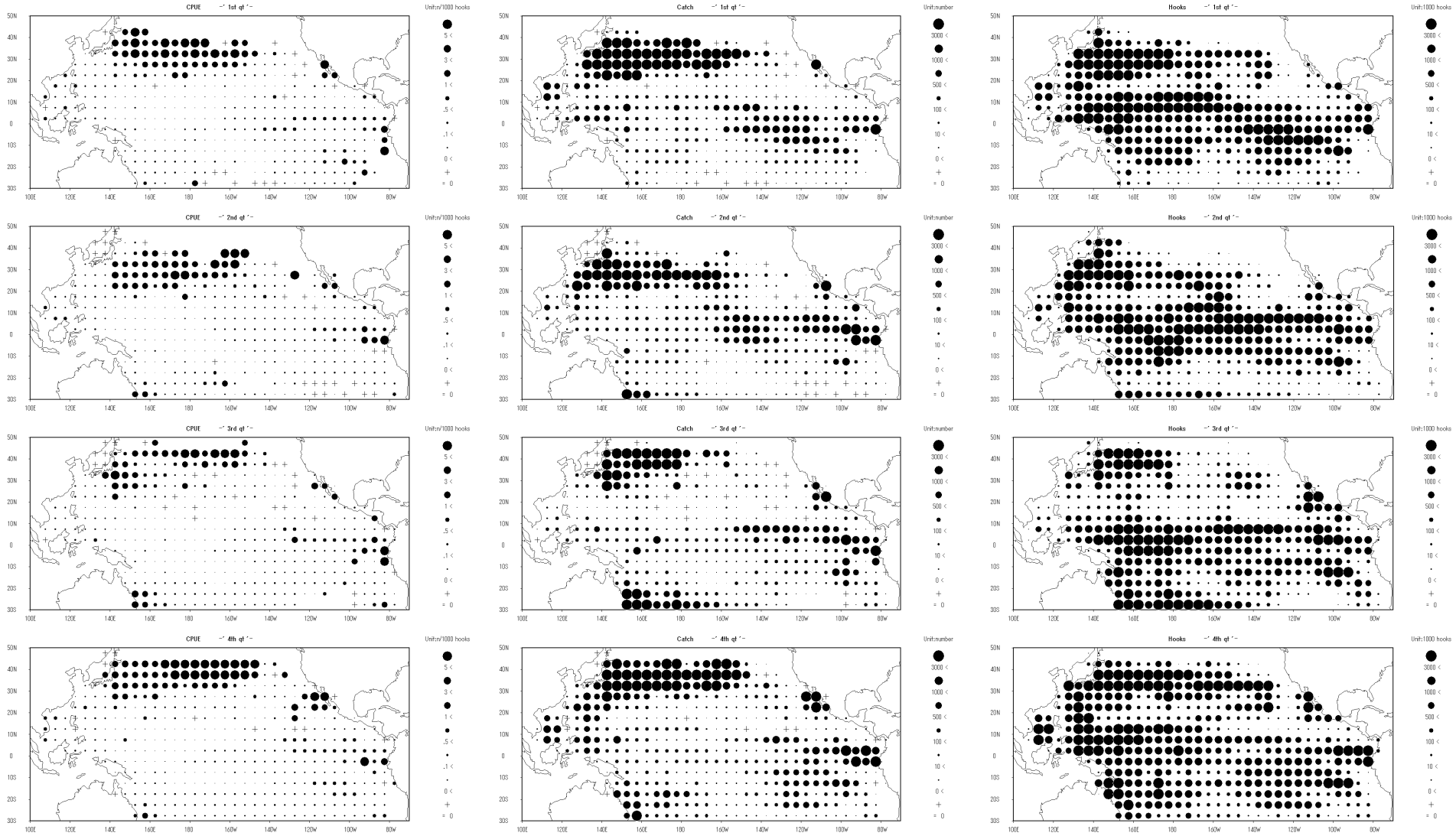

Fig. 4. Distribution of quarterly average CPUE (n/1000 hooks, left), catch number (middle), and amount of effort (hooks, right) of swordfish caught by Japanese offshore and distant-water longliners in the 1960's. First top – bottom panels shows distribution of 1st, 2nd, 3rd and 4th quarter respectively.

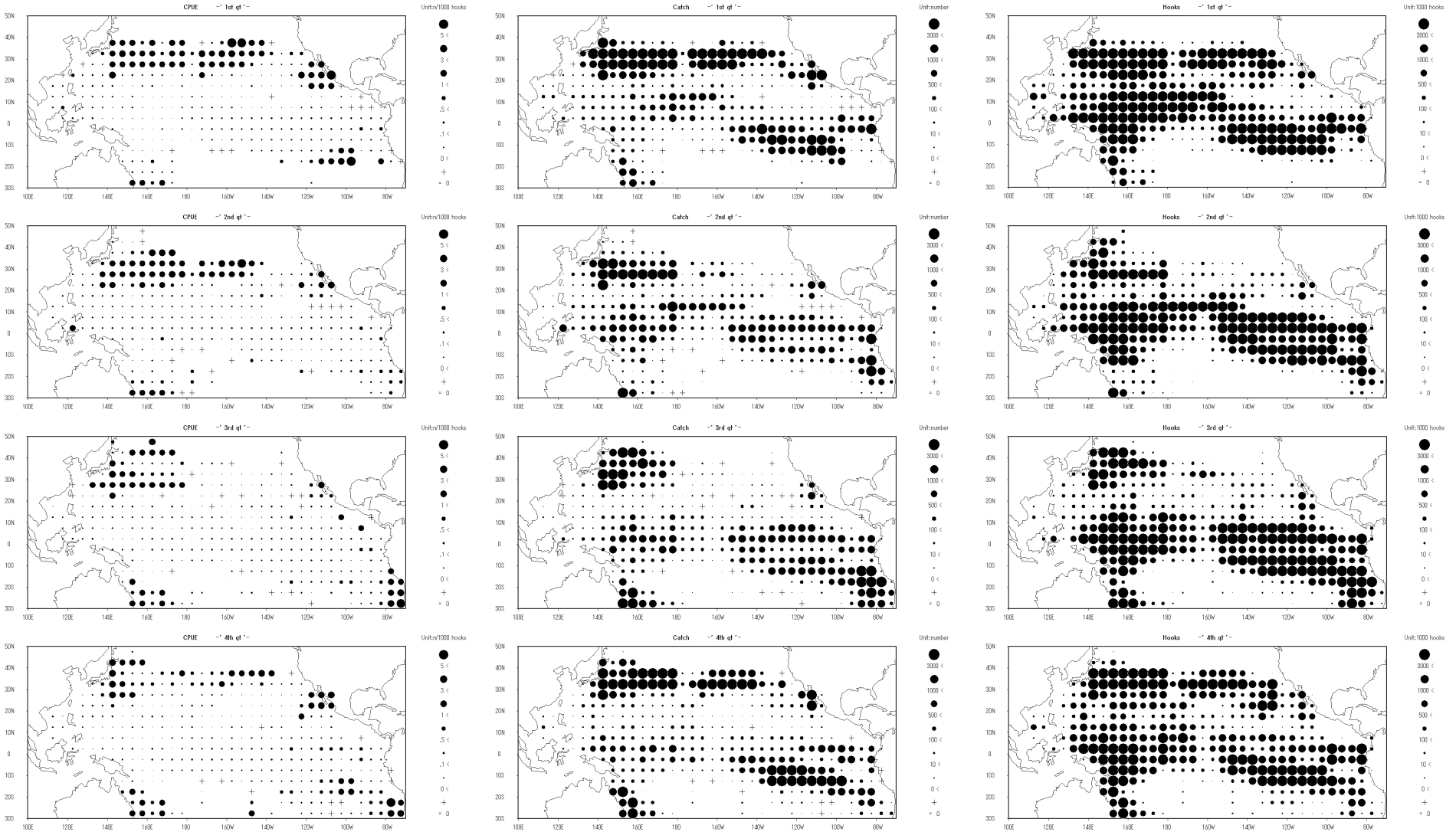

Fig. 5. Distribution of quarterly average CPUE (n/1000 hooks, left), catch number (middle), and amount of effort (hooks, right) of swordfish caught by Japanese offshore and distant-water longliners in the 1980's. First top – bottom panels shows distribution of 1st, 2nd, 3rd and 4th quarter respectively.

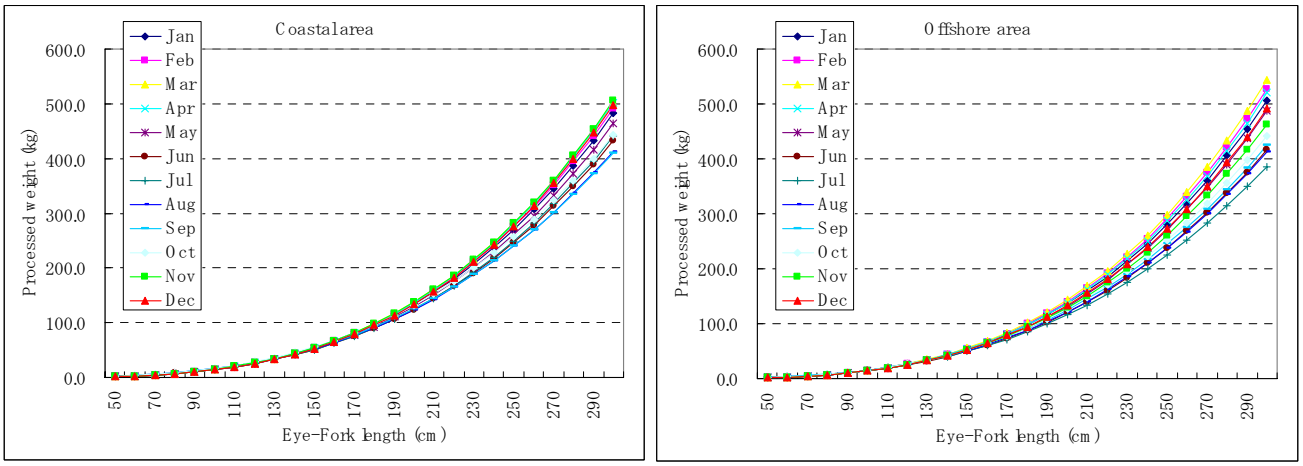

Fig. 6. Estimated length – processed weight relationship by area and month of swordfish caught by Japanese offshore surface longliners in the northwest Pacific. Coastal area (left) is the area of 140E – 155E and offshore area (right) is the area of 160E – 180E.

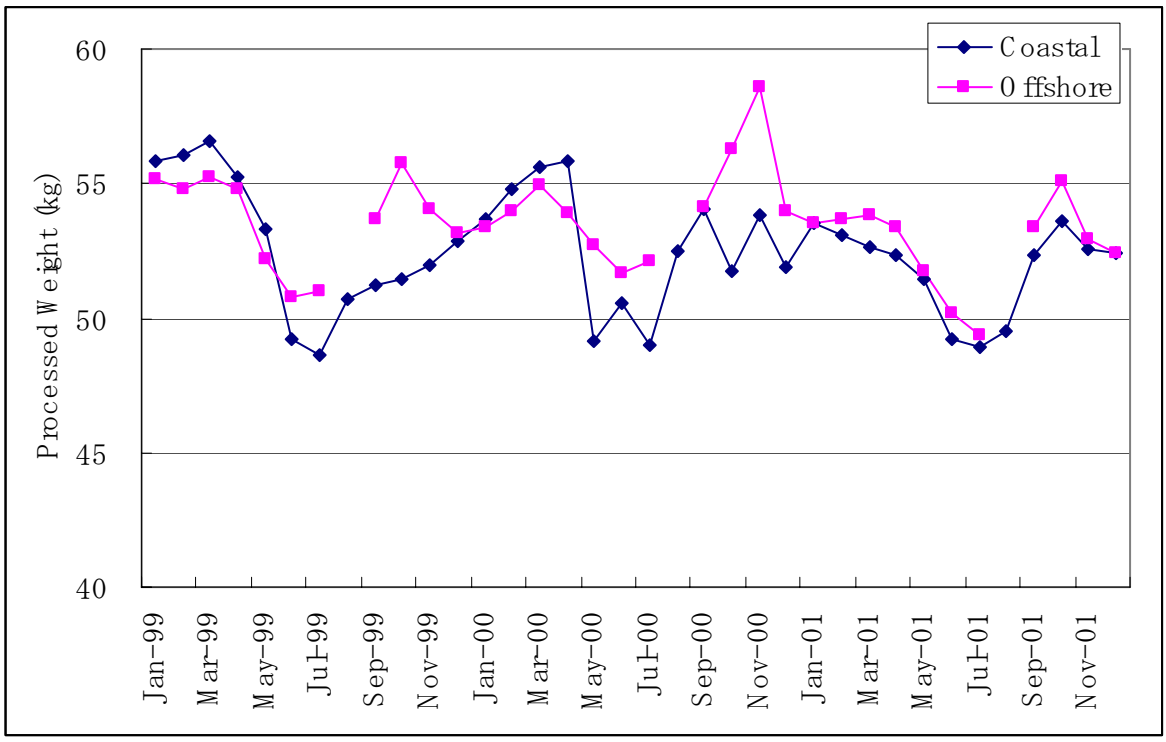

Fig. 7. Estimated monthly processed weight of swordfish in 150 cm EFL by area for the period between January 1999 and December 2001.

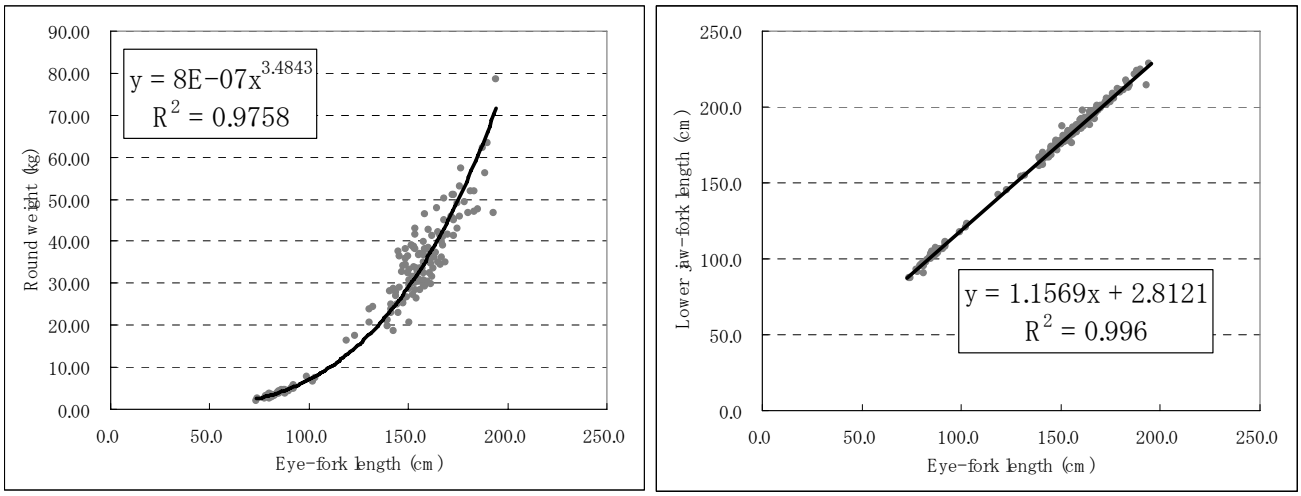

Fig. 8. Relationship between eye-fork length and round weight, and between eye-fork length and lower jaw fork length of striped marlin (n=161) caught during the longline research cruise in the northeastern Pacific in 2004.