OVERALL FISHING INTENSITY OF JAPANESE ATLANTIC LONGLINE FISHERY FOR BLUE MARLIN, 1972 EDITION, WITH ADDITIONAL INFORMATION ON RELATIVE ABUNDANCE OF WHITE MARLIN.

by

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SUMMARY

Preliminary estimates of fishing intensity on blue marlin fished by the whole Atlantic longline fleets as well as the Japanese fleet from 1956 to 1972 are given. Fishing intensity was at its peak in 1964 and then decreased by the late 1960's. The recent increase in fishing activities after 1970, however, has not resulted in the increased catches of blue marlin up to the level in earlier years.

For the Japanese longline fleet in the main billfish areas in the Carribean and eastward of Brazil, the hook rate of white marlin has fluctuated considerably with no clear tendency to decrease until very recently, while the hook rate of blue marlin has been at a low level since 1966.

RESUME

Des estimations préliminaires sont fournies sur l'intensité de pêche du macaire bleu pêché par l'ensemble des flottilles palangrières atlantiques, ainsi que la flottille japonaise, de 1956 à 1972. L'intensité de pêche a atteint son maximum en 1964, puis a diminué à la fin des années 60. L'accroissement récent des activités de pêche à partir de 1970, n'a cependant pas donné d'augmentation des prises de macaire bleu jusqu'au niveau des années antérieures.

En ce qui concerne la flottille palangrière japonaise dans les principaux secteurs à xiphiidés dans les Caraïbes et à l'est du Brésil, le taux par hameçon du macaire blanc a oscillé de façon considérable sans montrer de tendance nette à la baisse jusqu'à ces derniers temps, alors que le taux par hameçon du macaire bleu s'est situé à un niveau faible depuis 1966.

RESUMEN

Se dan las estimaciones preliminares de la captura de aguja azul por todas las flotas palangreras en el Atlántico, así como de la flota japonesa durante el período 1956-1972. La intensidad pesquera alcanzó su punto culminante en 1964, y después descendió hacia finales de los años 60. Sin embargo, el reciente aumento en la actividad pesquera después de 1970 no ha repercutido en un aumento de las capturas de aguja azul hasta el nivel de años anteriores.

En el caso de la flota palangrera japonesa que faena en las principales zonas del marlín en el Caribe y al este de Brasil, el índice de capturas con anzuelo de aguja blanca ha fluctuado considerablemente sin una clara tendencia al descenso hasta muy recientemente, mientras que el índice de capturas por anzuelo de aguja azul se ha mantenido a un nivel bajo desde 1966.

This report is the first issue of a series of study on fishing intensity of the Atlantic billfish. It contains the study on blue marlin, Makaira nigricans, as well as information on recent changes in relative abundance of white marlin, Tetrapturus albidus, as compared with blue marlin in their main fishing grounds.

1. Billfish yields and fisheries

During the past decade, annual yields of billfish including swordfish from the Atlantic fisheries have been between 16,000 and 27,000 metric tons. The ICCAT statistical report (ICCAT Stat. Bul., vol.4, 1974) indicates that these groups of fishes account, on the average, for approximately 6 per cent of the total Atlantic tuna and billfish yields, which have fluctuated between 310,000 and 420,000 metric tons from 1963 to 1972.

The billfish have been harvested virtually by the commercial longline fleets in the Atlantic Ocean, although swordfish are taken by means of various fishing methods. The Japanese longline fishery started in the equatorial Atlantic in 1956 and was at its peak stage in fishing activity in 1964. Since then, the fishery has undergone changes in fishing strategy that were well documented (Shiohama et al. 1965, Wise 1968, Wise and Fox 1969, Hayasi et al. 1970, Shiohama 1971 and Honma 1974). Throughout the course of this fishery, blue marlin have been fished more often together with yellowfin tuna than with bigeye tuna or albacore and the drop in its relative abundance by the mid 1960's has been noted (Ueyanagi et al., 1970).

2. Fishing intensity on blue marlin

Distribution: On the longline fishery, blue marlin are more densely distributed in the western part of the tropical Atlantic Ocean with the equatorial area of less abundance. The fishing seasons are from May to October in the Gulf of Mexico and the Carribean Sea and from November to April in the area off Brazil. Ueyanagi et al. (1970) considered the fish in these areas to be the spawning groups in the light of available information. The question then arises whether the fish occurring north of the equator and those south of it should be treated independently or combined from the viewpoint of their stock structure. Previous studies suggest no conclusive views on this point.

Areas for data processing: Taking the above distribution of blue marlin into account, hook rate, catch in number and fishing intensity for the Japanese fleet were given in this paper on two cases separately, e.g. for the North and South Atlantic Oceans as divided by the equator and for the all Atlantic Ocean. Fishing intensity for the Atlantic longline fisheries including fleets of Japan, Taiwan, Korea and other countries was roughly estimated on the latter case using conversion factor as described below.

Estimation of fishing intensity: Procedures for calculation employed in this paper are those described by Honma (1974a) for the Atlantic yellowfin tuna.

The longline fleets from many countries are now operating in the Atlantic Ocean but the breakdown by billfish species on catch data is not available except for Japanese statistics. Therefore, any estimate given here for the whole Atlantic fleets is undoubtedly not a conclusive one. To make a rough estimation of the total blue marlin yields, ratios of yellowfin tuna yields by the whole Atlantic fleets to those by the Japanese fleet were calculated from yearly estimates by Honma (1974b) and used as conversion factor to obtain them. The same factor, having different yearly values, was also used to get yearly estimates of fishing intensity for the whole fleets as well. Plotting the annual catches of billfish species against those of major tuna species from Japanese statistical data from 1962 to 1972 indicates a high correlation between catches in number of blue marlin and yellowfin tuna as well as between white marlin and yellowfin tuna or albacore (Tab.1). Such a correlation would allow us to use above conversion factor for a rough estimation of the total blue marlin yields and fishing intensity for the whole Atlantic fleets, provided there has been a general coincidence between the areas fished by Japanese fleet and those by the fleets of other countries. A gap that has actually existed in areas fished by Japanese fleet and Taiwanese and Korean fleets may have caused much biases in these estimates for the whole Atlantic fleets.

Result: Hook rate, catch in number and fishing intensity for Japanese fleet is shown in Table 2 for the North and South Atlantic Oceans separately. Fishing intensity by all Japanese fleet and that estimated for the whole Atlantic fleets are given in Table 3.

Fishing intensity on blue marlin was at its peak already in 1964 and then decreased considerably by the late 1960's. Hook rate dropped clearly in 1964 and was down, in 1966, to 30 per cent of the average level in earlier years (1958-1963) (Fig.1).

According to relations between fishing intensity and either one of catch in number or yield in tons as estimated for the whole Atlantic fleets (Figs. 2 and 3), the increased amount of fishing in later years after the diminution of the fishery in 1967 and 1968 did not result in the increased blue marlin catches or yields up to the levels as observed in earlier years.

3. Relative abundance of blue marlin and white marlin

Areas for data processing: The main fishing grounds for white marlin and blue marlin are very similar in location. These fishing grounds are here delimited as shown in Figures 4 and 5. They are overlapping in large extent and may be called the northern area and southern area for convenience sake.

Yearly fluctuation in hook rate: Catch and effort data on five-degree squares from Japanese statistics were compiled for these particular areas to examine yearly trend in hook rate. Fishing effort is not standardized in this treatment, because of limited areas. The yearly fluctuation in hook rate of white marlin and blue marlin from 1957 to 1972 are shown in Figures 6 - 9.

For the northern and southern areas of these two species, hook rate of white marlin has remained high in contrast with the blue marlin hook rate after 1964 when the drop in its hook rate was clear. It is noted, however, that the white marlin hook rate has been subjected to very large yearly fluctuation until very recently.

For the fishing grounds of white marlin (Figs. 7 and 8), there seems to be a general tendency that the peak years in hook rate for the northern area roughly correspond to the trough years for the southern area and vice versa. Such a reverse relation in hook rate between the two areas has been observed from about 1965 to very recently except in 1972 when the hook rate of white marlin was down to the very low level for both the northern and southern areas.

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Table 1 Relations between annual catches of billfish species and those of major tuna species in Japanese Atlantic longline fishery, 1962-1972

Species		Yellowfin	Bigeye	Albacore
Blue marlin	r	0.9133	0.3058	0.5426
	b	0.1082	0.0897	0.0357
	a	-16.1983	10.5007	2.1353
White marlin	r	0.8896	0.4895	0.9349
	b	0.1295	0.1765	0.0756
	a	0.6921	14.8892	-7.0561
Swordfish	r	-0.2323	0.1733	-0.1376
	b	-0.0104	0.0192	-0.0034
	a	36.9176	25.5918	35.1222

r Correlation coefficient
b Regression coefficient
a Y-intersection

Table 2 Hook rate, catch in number, yield in tons and overall fishing intensity of blue marlin in Japanese longline fishery, as given for the North Atlantic and South Atlantic Oceans separately, 1956-1972

Year	North Atlantic			South Atlantic		
	Hook rate	Catch in number	Fishing intensity	Hook rate	Catch in number	Fishing intensity
1956	2.41	434	2.1	0.81	65	1.3
1957	1.95	8,472	51.9	1.28	232	3.2
1958	0.75	6,693	103.9	6.75	3,269	8.1
1959	0.82	11,463	164.4	2.05	11,144	7.4
1960	0.64	9,012	161.0	1.57	18,068	162.6
1961	0.76	9,088	133.9	2.36	33,913	219.5
1962	1.50	57,729	417.6	1.51	53,908	511.8
1963	0.97	55,352	613.6	1.23	40,361	482.9
1964	0.62	55,690	969.7	0.79	28,292	498.2
1965	0.44	31,792	796.6	0.47	13,146	411.1
1966	0.36	12,609	373.5	0.39	9,066	335.5
1967	0.38	6,919	206.3	0.41	3,686	128.5
1968	0.38	5,764	165.7	0.43	3,316	109.7
1969	0.50	11,416	249.0	0.44	2,204	77.5
1970	0.41	9,662	249.6	0.42	1,739	64.0
1971	0.33	16,546	559.6	0.41	1,609	66.8
1972	0.27	4,515	185.9	0.37	841	35.9

Fishing intensity in 1,000 hooks per 5-degree square.

Table 3 Hook rate, catch in number, yield in tons and overall fishing intensity of blue marlin in Japanese Atlantic longline fishery and those estimated for the whole Atlantic longline fisheries, 1956-1972.

Year	Hook rate	Japanese longline fleets			All Atlantic longline fleets		
		Catch in number	Yield in tons	Fishing intensity	Catch in number	Yield in tons	Fishing intensity
1956	1.92	499	-	1.7	-	-	-
1957	1.92	8,704	-	29.3	9,139	-	30.8
1958	1.06	9,962	722	61.1	10,266	744	62.9
1959	1.16	22,607	847	127.0	23,511	881	132.1
1960	1.06	27,080	1,517	167.7	28,163	1,578	174.4
1961	1.64	43,001	2,790	174.2	45,151	2,930	182.9
1962	1.51	111,637	4,091	489.0	121,682	4,459	533.0
1963	1.07	95,713	7,338	587.7	109,111	8,365	670.0
1964	0.67	83,982	7,590	813.1	91,492	8,273	886.3
1965	0.45	44,938	5,751	649.7	48,520	6,211	701.7
1966	0.37	21,675	3,448	378.0	25,360	4,034	442.3
1967	0.39	10,605	1,073	178.0	16,862	1,706	283.0
1968	0.40	9,080	946	150.0	16,980	1,769	280.5
1969	0.49	13,620	960	185.7	39,226	2,765	534.8
1970	0.41	11,401	1,005	180.2	48,459	4,271	765.9
1971	0.34	18,155	1,398	342.7	46,563	3,565	873.9
1972	0.28	5,356	424	126.8	19,282	1,526	456.5

Fishing intensity in 1,000 hooks per 5-degree square.

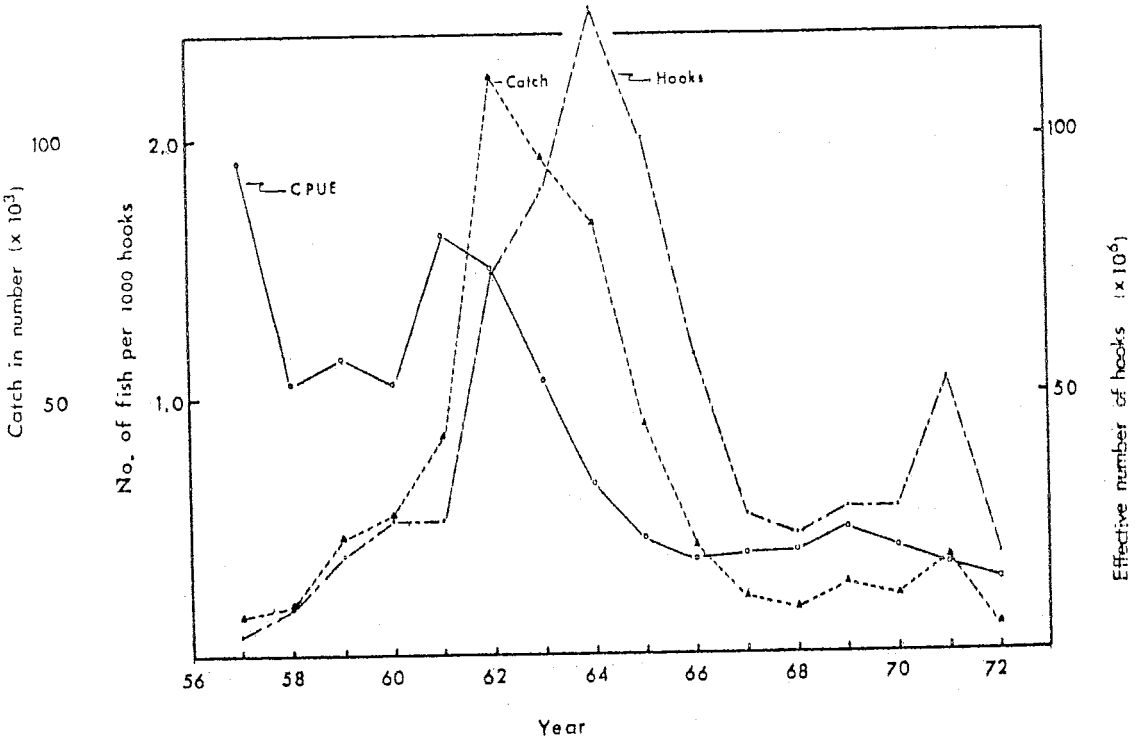


Figure 1 Catch, effective number of hooks and hook rate of blue marlin in Japanese Atlantic longline fishery, 1957-1972.

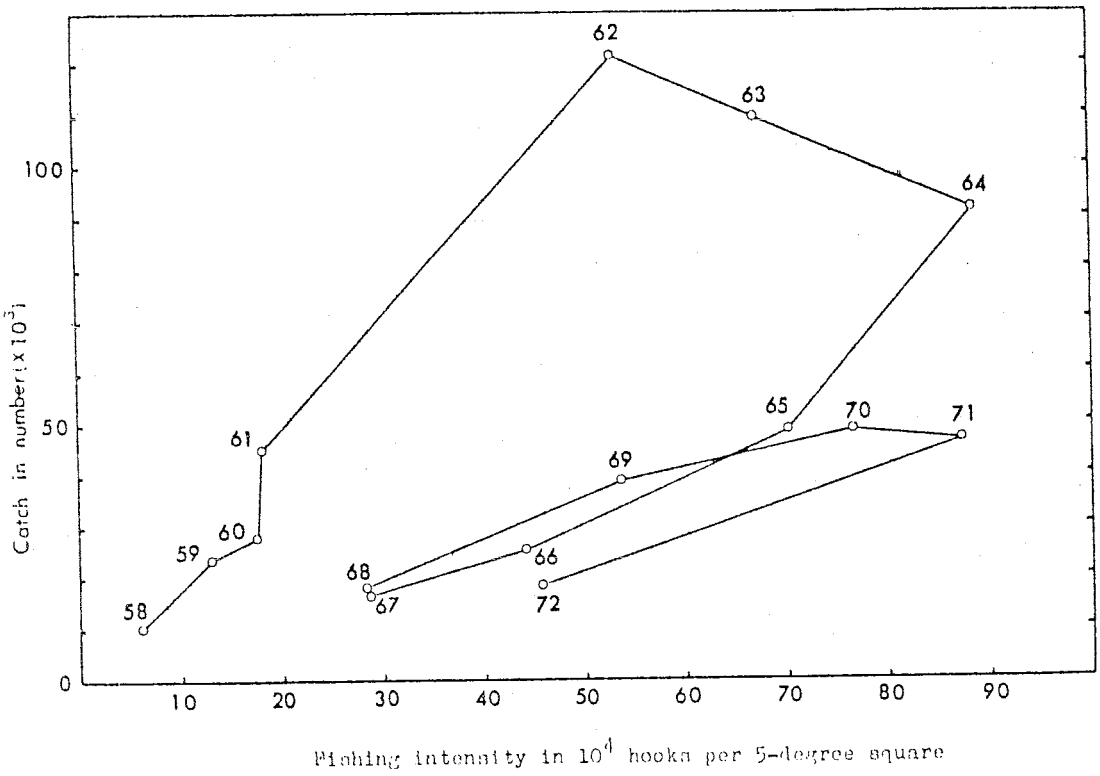


Figure 2 Catch in number of blue marlin plotted against overall fishing intensity estimated for the whole Atlantic longline fisheries, 1956-1972.

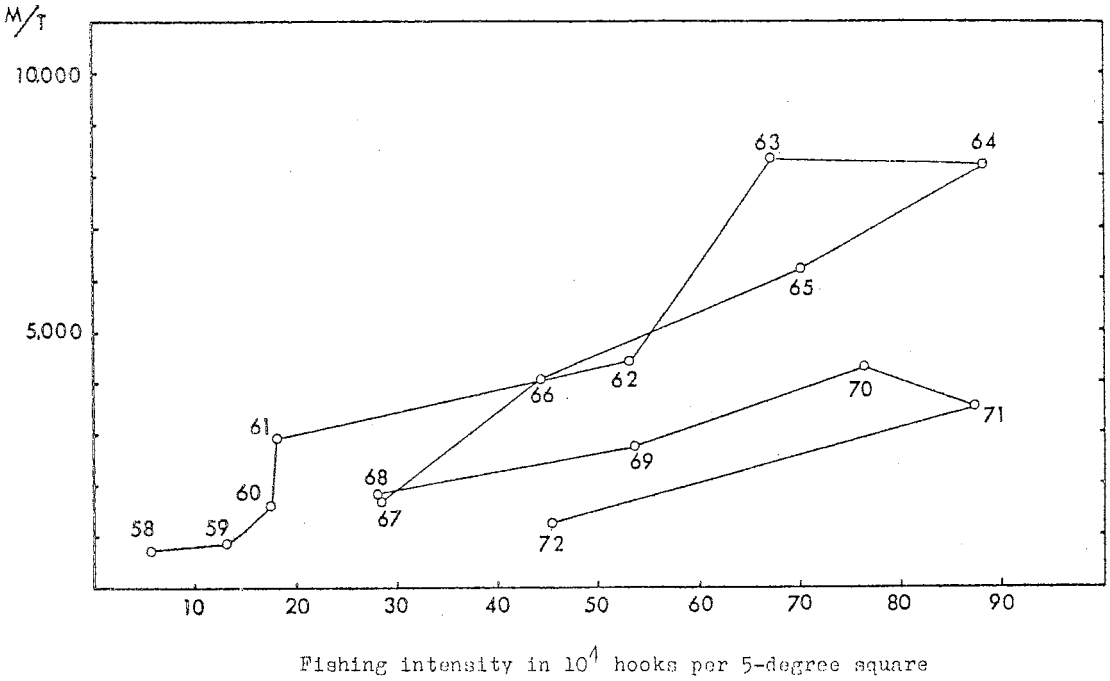


Figure 3 Yield in tons of blue marlin plotted against overall fishing intensity estimated for the whole Atlantic longline fisheries, 1958-1972.

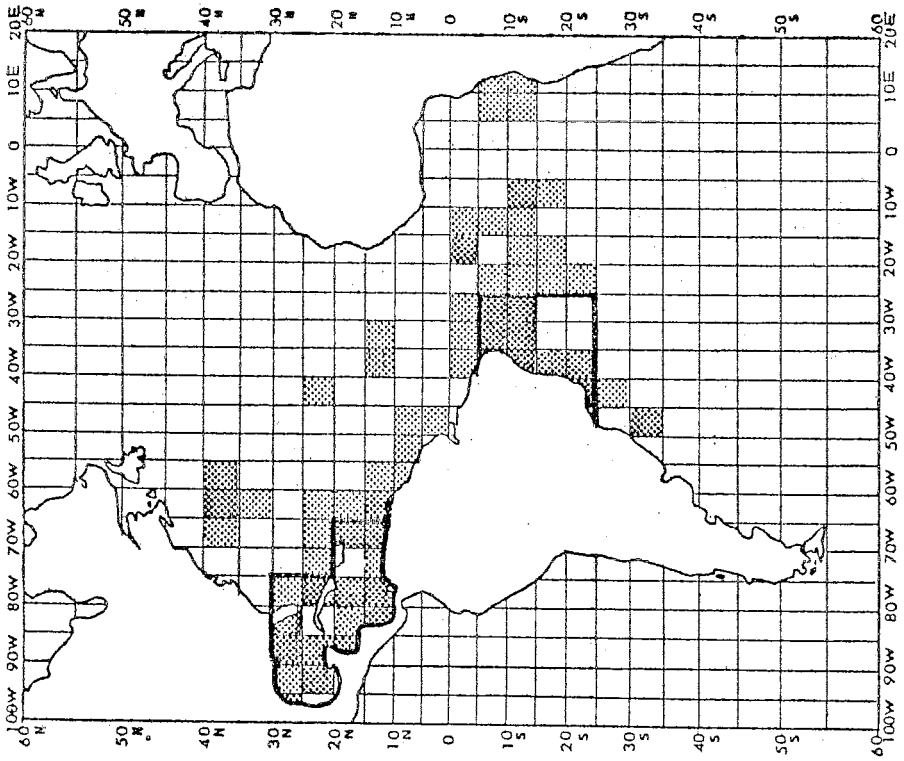


Figure 4 Delimited main fishing grounds of white marlin and 5-degree squares marked with 0.5 fish per 1,000 hooks and greater. (Data from Ueyanagi et al., 1970)

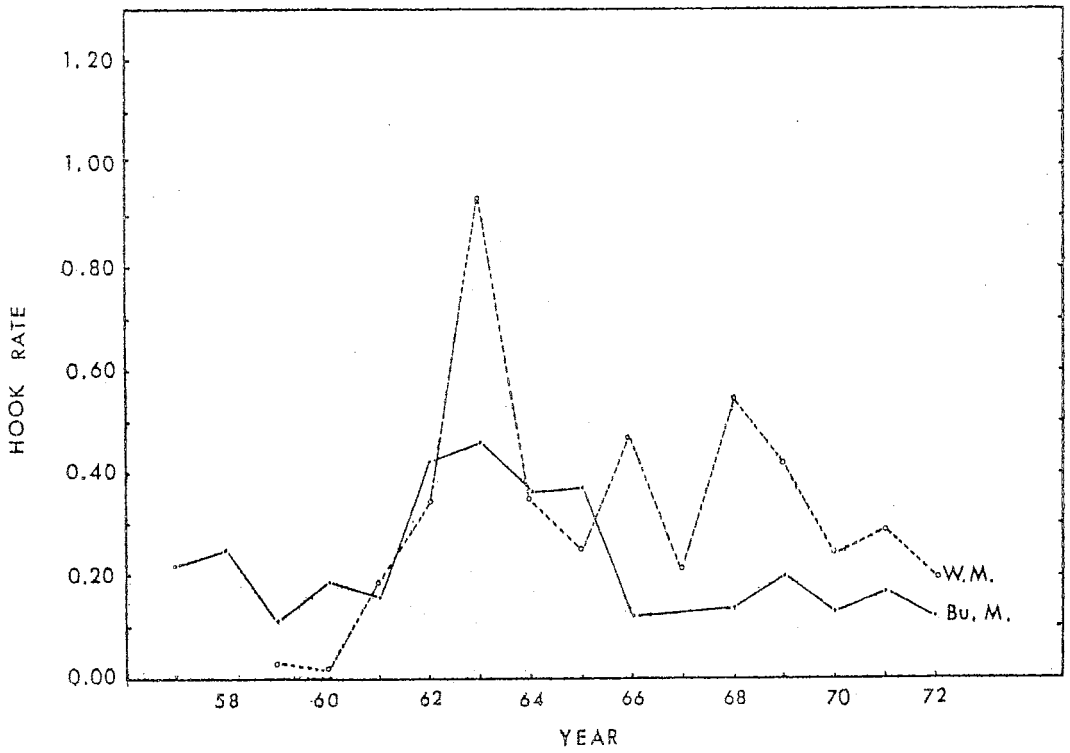


Figure 6 Hook rate in the northern white marlin area, 1957-1972.

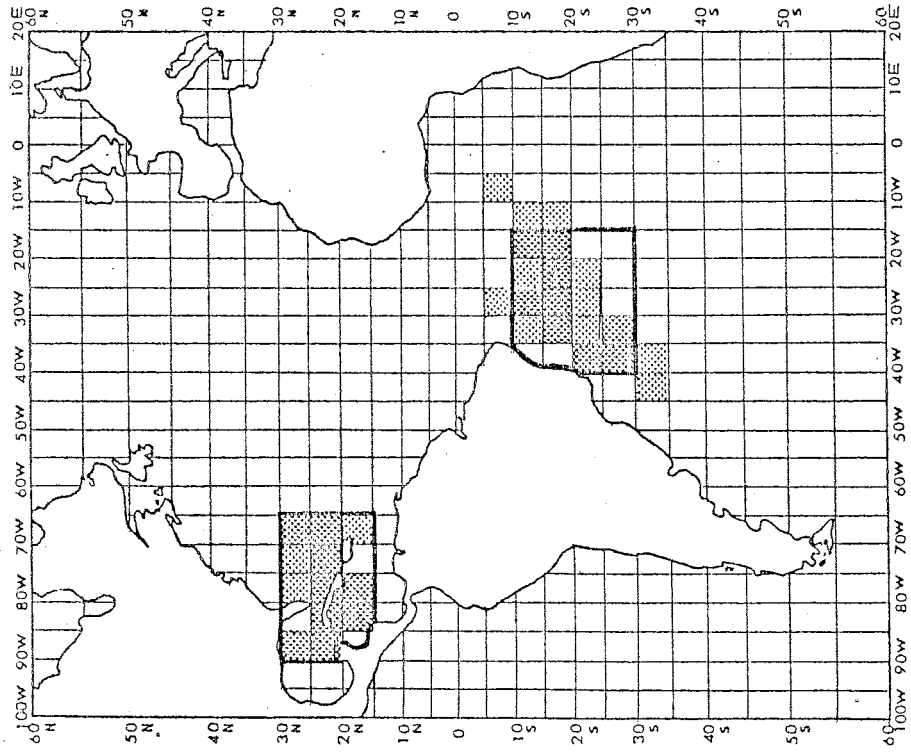


Figure 5 Delimited main fishing grounds of blue marlin and 5-degree squares marked with 0.5 fish per 1,000 hooks and greater. (Data from Ueyanagi et al., 1970)

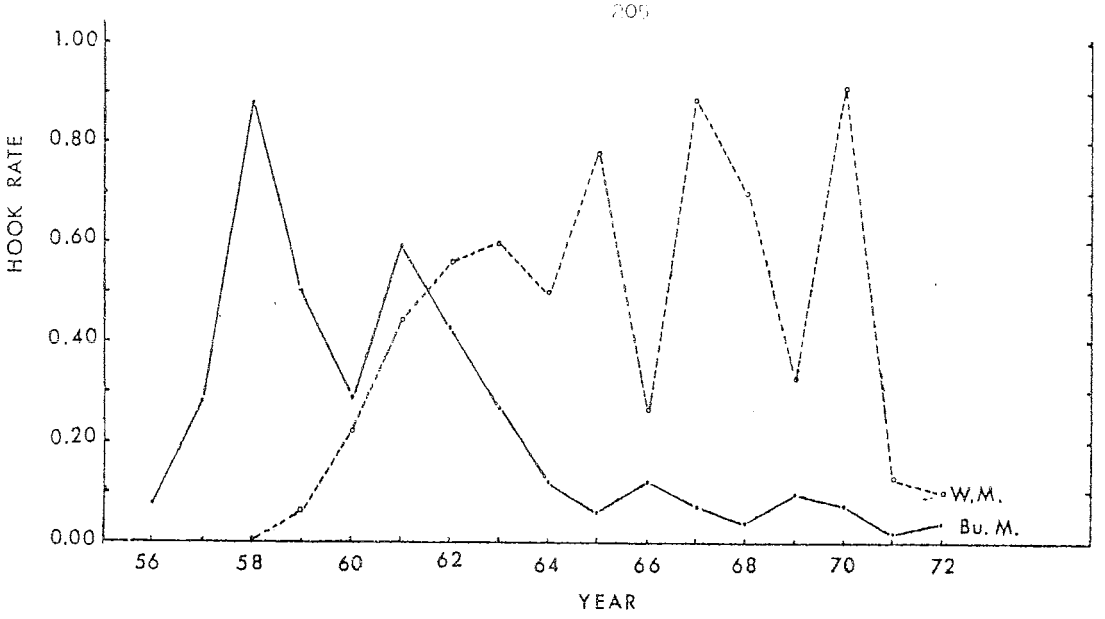


Figure 7 Hook rate in the southern white marlin area, 1956-1972.

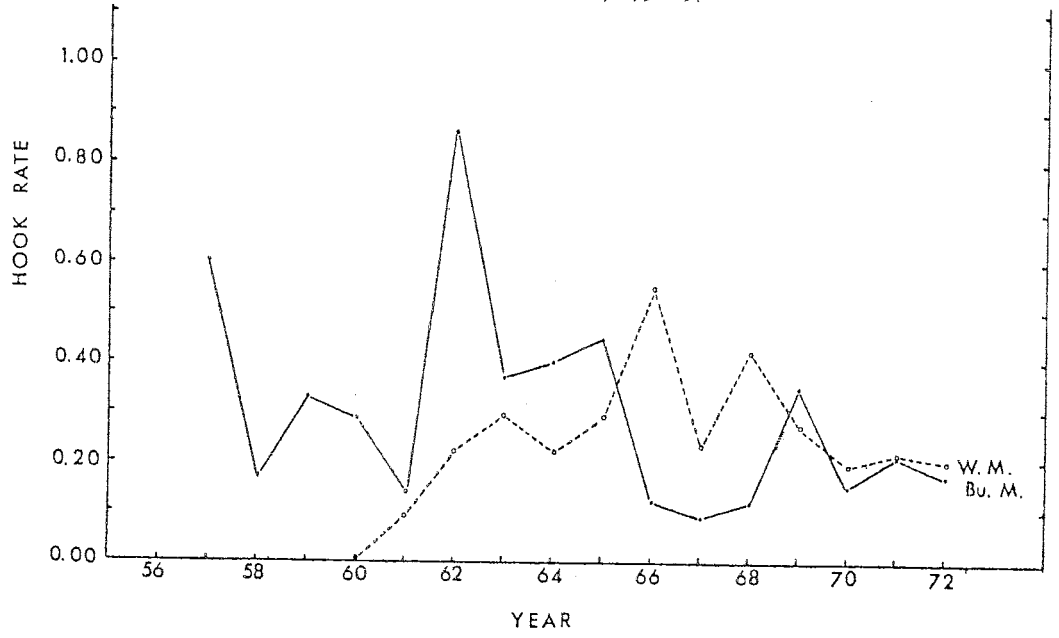


Figure 8 Hook rate in the northern blue marlin area, 1957-1972.

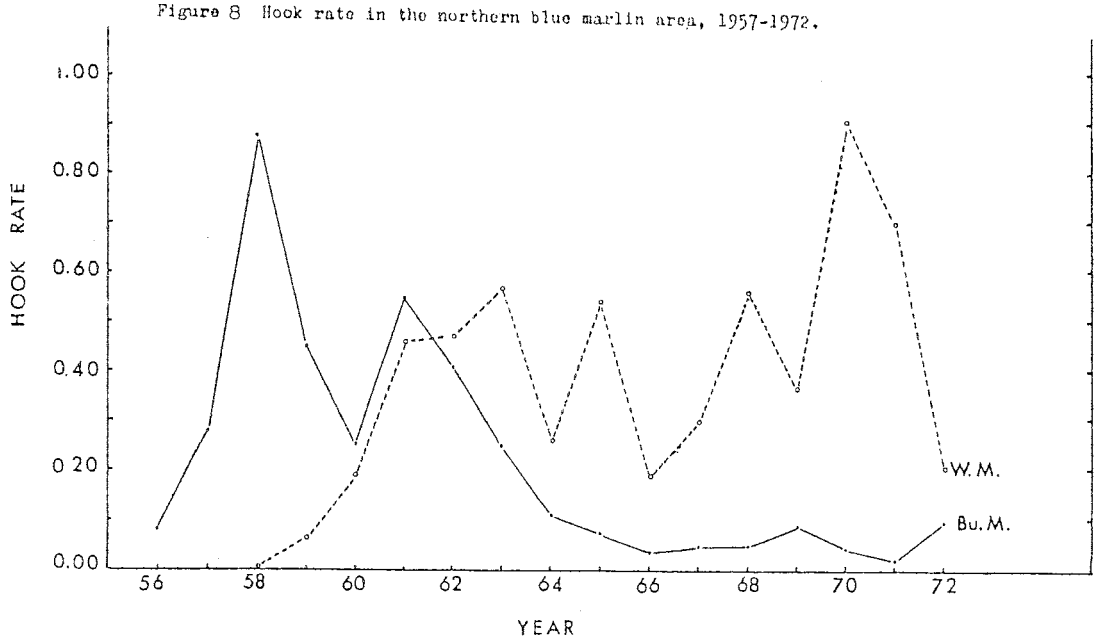
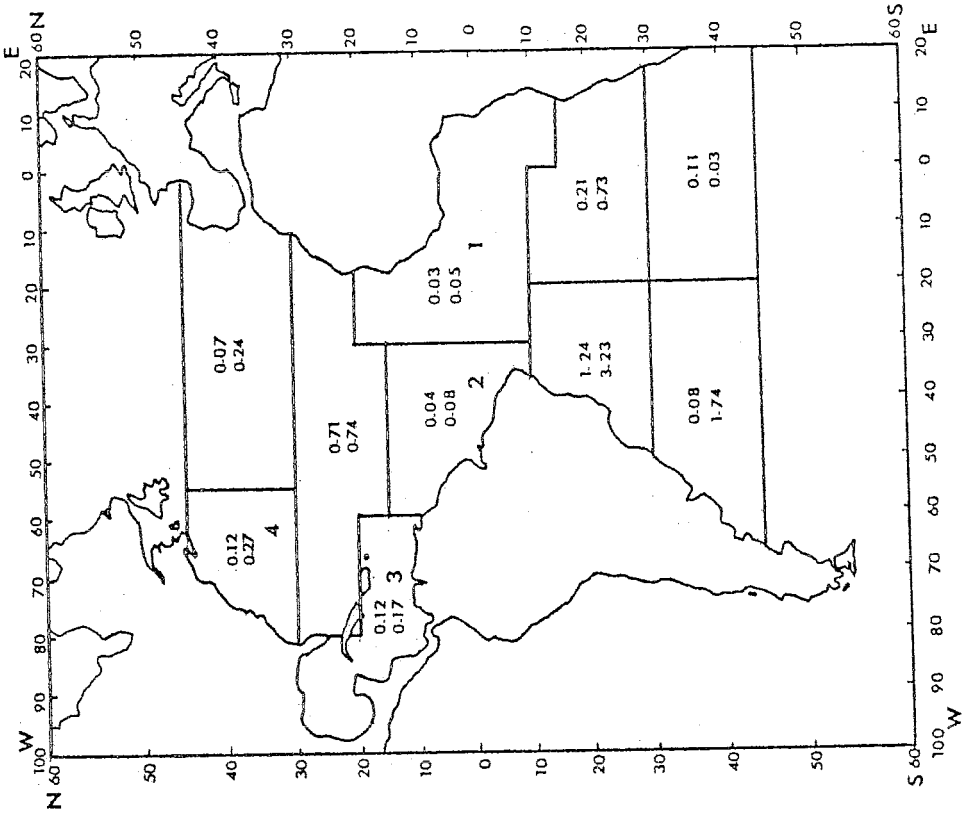
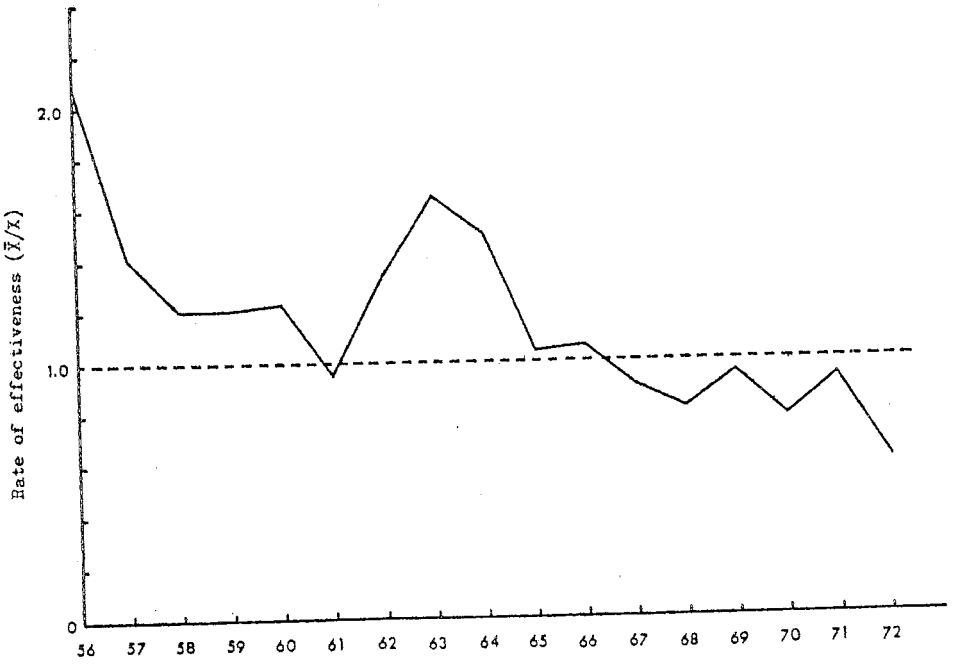


Figure 9 Hook rate in the southern blue marlin area, 1956-1972.



Appendix figure 2 Catch ratios of blue marlin to yellowfin tuna and of white marlin to yellowfin tuna by areas for Japanese longline fishery (shown by average values in 1962-1966). Areas 1 - 4 are delineated as principal area for yellowfin tuna by the longline fishery.

Upper, Blue marlin
Lower, White marlin



Appendix figure 1 Annual change in the rate of effectiveness of fishing effort for blue marlin in Japanese Atlantic longline fishery

Appendix table 1 Billfish yields from the Atlantic fisheries, 1963-1972
(From ICCAT Stat. Bul., vol.4, 1974)

Year	All Atlantic fisheries			Longline fisheries	
	Total tuna, billfishes & swordfish	Billfishes	Swordfish	Billfishes	Swordfish
1963	317.1	12.4	12.0	12.4	9.2
1964	323.8	12.7	13.8	12.7	9.9
1965	368.8	13.5	12.9	13.5	8.3
1966	322.9	8.9	11.7	8.9	7.2
1967	340.8	4.8	12.3	4.8	6.5
1968	357.9	6.5	12.3	6.4	6.1
1969	390.2	6.2	14.2	6.1	7.9
1970	359.5	5.9	14.5	5.8	9.0
1971	407.9	6.9	9.1	6.4	2.2
1972	412.8	7.0	10.2	7.0	2.8

Appendix table 2 Total estimates for hooks and catch in number by billfish species in the Japanese Atlantic longline fishery, 1956-1972.
(Data filed at Far Seas Fish. Res. Lab.)

Year	Hooks	Swordfish	White marlin	Blue marlin	Black marlin	Sailfis & Spearfish
1956	131,300	17	5	500	11	44
1957	3,375,784	899	828	8,704	115	3,006
1958	8,001,030	1,268	1,355	9,967	108	3,868
1959	15,311,549	2,349	6,779	22,607	365	5,510
1960	20,727,015	3,443	11,306	27,080	76	12,247
1961	26,672,573	10,730	38,114	43,001	1,210	27,879
1962	54,963,327	19,521	113,657	111,635	1,219	68,914
1963	55,003,951	24,351	86,934	95,711	514	50,637
1964	84,997,983	30,982	163,382	83,938	209	117,745
1965	97,580,590	43,676	129,362	44,926	309	118,338
1966	53,814,005	21,752	89,186	21,675	379	65,226
1967	31,154,024	15,666	42,510	10,605	63	59,042
1968	30,246,797	16,543	42,957	9,080	19	51,621
1969	29,675,972	57,390	26,981	13,620	51	28,041
1970	41,579,525	56,622	31,791	11,406	22	39,411
1971	55,873,158	28,922	36,362	18,260	39	23,445
1972	44,138,682	32,053	15,334	5,356	23	10,592

Appendix table 3 Average year's extent of distribution range of blue marlin in 5-degree square and the effective effort and overall fishing intensity in thousand hooks per 5-degree square for the Japanese Atlantic longline fishery, 1956-1972.

Month	Area	1956		1957		1958		1959		1960	
		X	f	X	f	X	f	X	f	X	F
Total	-	(261)	1.7	(4,531)	29.2	(9,374)	61.2	(19,458)	126.9	(25,632)	167.7
1	156.90	-	-	-	-	1,046	6.7	783	5.0	2,066	13.2
2	152.83	-	-	59	0.4	745	4.9	1,062	6.9	1,957	12.8
3	122.70	-	-	26	0.2	623	5.1	713	5.8	948	7.7
4	140.91	-	-	111	0.8	504	3.6	1,654	11.7	1,900	13.5
5	155.12	-	-	562	3.6	697	4.5	1,672	10.8	1,664	10.7
6	162.22	37	0.3	272	1.7	1,095	6.8	1,426	8.8	1,773	10.9
7	148.13	32	0.2	551	3.7	776	5.2	1,009	6.8	1,734	11.7
8	148.21	63	0.4	274	1.8	248	1.7	623	4.2	1,034	7.0
9	160.99	45	0.3	437	2.7	697	4.3	741	4.6	1,313	8.2
10	166.79	33	0.2	752	4.5	1,453	8.7	2,706	16.2	2,480	14.9
11	150.07	12	0.1	1,167	7.8	847	5.6	3,040	20.3	3,759	25.0
12	155.97	39	0.2	320	2.0	643	4.1	4,029	25.8	5,004	32.1

Month	1961		1962		1963		1964		1965		1966	
	X	f	X	f	X	f	X	f	X	f	X	f
Total	(26,277)	174.1	(74,161)	489.0	(89,834)	587.8	(125,224)	813.0	(99,948)	649.7	(57,932)	377.9
1	3,128	19.9	7,465	47.6	14,350	91.5	15,018	95.7	10,312	65.7	11,153	71.1
2	2,625	17.2	5,018	32.8	9,472	62.0	7,893	51.6	9,646	63.1	6,228	40.8
3	1,952	15.9	3,923	32.0	4,340	35.4	3,790	30.9	4,853	39.6	3,145	25.6
4	2,527	17.9	4,918	34.9	6,510	46.2	5,745	40.8	6,074	43.1	3,540	25.1
5	3,360	21.7	3,539	22.8	6,780	43.7	13,686	88.2	6,733	43.4	5,179	33.3
6	2,780	17.1	5,486	33.8	17,969	110.8	20,407	125.8	17,453	107.6	10,435	64.3
7	2,193	14.8	10,433	70.4	11,564	78.1	13,654	92.2	9,028	60.9	3,586	24.2
8	813	5.5	6,358	42.9	2,708	18.3	8,455	57.0	3,742	25.2	2,979	20.1
9	420	2.6	5,783	35.9	4,080	25.3	9,759	60.6	10,542	65.5	3,758	23.3
10	969	5.8	4,149	24.9	4,317	25.9	9,857	59.1	9,803	58.8	2,748	16.5
11	1,553	10.3	5,696	38.0	3,993	26.6	9,520	63.4	5,383	35.9	1,459	9.7
12	3,957	25.4	11,393	73.0	3,743	24.0	7,440	47.7	6,379	40.9	3,722	23.9

Month	1967		1968		1969		1970		1971		1972	
	X	f	X	f	X	f	X	f	X	f	X	f
Total	(27,123)	178.0	(22,978)	149.8	(27,977)	185.7	(27,789)	180.2	(53,807)	342.7	(19,166)	126.9
1	3,878	24.7	2,573	16.4	1,283	8.2	1,798	11.5	587	3.7	813	5.2
2	1,802	11.8	1,427	9.3	762	5.0	1,011	6.6	898	5.9	830	5.4
3	1,514	12.3	1,198	9.8	1,303	10.6	795	6.5	1,414	11.5	1,065	8.7
4	2,271	16.1	1,045	7.4	1,557	11.1	1,004	7.1	1,665	11.8	1,803	12.8
5	1,826	11.8	1,776	11.4	3,003	19.4	2,160	13.9	2,230	14.4	2,379	15.3
6	2,649	16.3	4,285	26.4	3,459	21.3	8,232	50.7	5,255	32.4	1,617	10.0
7	2,219	15.0	2,494	16.8	7,217	48.7	5,630	38.0	5,811	39.2	2,964	20.0
8	1,624	11.0	1,301	8.8	4,774	32.2	2,306	15.6	5,388	36.4	2,798	18.9
9	1,756	10.9	1,777	11.0	824	5.1	2,041	12.7	13,181	81.9	3,858	24.0
10	2,446	14.7	1,379	8.3	1,372	8.2	1,466	8.8	15,262	91.5	375	2.2
11	2,138	14.2	1,673	11.1	1,330	8.9	917	6.1	1,767	11.8	278	1.9
12	3,000	19.2	2,050	13.1	1,093	7.0	429	2.7	349	2.2	386	2.5