

**CATCH AND OVERALL FISHING INTENSITY OF THE ATLANTIC BILLFISHES, 1956-1980**

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## SUMMARY

Catch and overall fishing intensity for the Atlantic blue marlin and white marlin were updated using the Japanese statistics as a base. Historical Japanese and Taiwanese catch and intensity estimates for blue and white marlins and swordfish were updated and compared.

## RESUME

Les prises et l'intensité globale de pêche des makaires bleus et blancs de l'Atlantique ont été mises à jour en prenant comme base les statistiques japonaises. Les prises historiques japonaises et taiwanaises, ainsi que les estimations de l'intensité de pêche portant sur les makaires bleus et blancs, sont actualisées et comparées.

## RESUMEN

Se actualizaron los datos de captura e intensidad global de pesca de aguja azul y aguja blanca en el Atlántico, en base a las estadísticas japonesas. Se actualizan y comparan las estimaciones históricas de Japón y Taiwan, de captura e intensidad de pesca de la aguja azul, aguja blanca y pez espada.

Our previous report (Kikawa and Honma 1982) on the Atlantic blue and white marlins was updated. Initially, we intended to estimate overall fishing intensity from the two sources, the Japanese and Taiwanese fisheries, as this reduces the raising factor a great deal. However, as shown later, cpue data from both fisheries are not collated and hence the Taiwanese data were not used as base for the total estimates. For the billfishes, the trends in longline cpue is important in general to be monitored, because of very few biological information that will allow us to make better approach to the situations of stocks. Therefore, we updated cpue data for blue and white marlin and also for swordfish. Assumptions and procedures we followed here are the same as those in the previous report.

#### Trends in effective cpue

Effective cpue of blue marlin and white marlin by the Japanese longline fishery was computed under the two stock structure hypotheses that there are separate North and South Atlantic stocks and there is the single Atlantic-wide stock. Table 1 shows the annual change in the average cpue for three consecutive years in all these cases. The 1980 cpue, for example, represents the average for three years, 1978-1980.

#### Blue marlin

In all three cases, as shown in table 1, cpue in recent years is at a very low level comparing to levels in earlier years, especially prior to about 1965. From 1977 to 1980, cpue is at the lowest and levels off in all these cases. The recent three years average (1980 cpue in Table 1) is 60 % of the level in the late 1960's (1967-1969) in the North Atlantic and 70 % in the South Atlantic stock. It is, in the Atlantic-wide stock, 55 % of the earlier level (1967-1969).

#### White marlin

Generally, cpue is in a decreasing trend since about 1967. In the South Atlantic stock, the recent three years average of cpue is of an all-time low and 36 % of the earlier level. In the North Atlantic stock and in the case of the Atlantic-wide stock, the 1979 and 1980 cpue's are nearly the same and a little below the half of the earlier level.

For blue marlin, the intensive harvest from the late 1950's to the early 1960's affected considerably the longline cpue in later years, especially after the mid 1960's. After once dropped, it still decreased gradually until it nearly leveled off in recent several years. For white marlin, there is generally a gradual and consistent decrease in the longline cpue since the early 1960's. However, it could not be judged at this moment whether the longline cpue for the North Atlantic stock or for the Atlantic-wide stock nearly levels off in recent three years or is still decreasing.

#### Swordfish

Table 2 shows the change in average cpue of swordfish for three consecutive years in all three cases as in the foregoing marlins. For swordfish, Japan's share of the total Atlantic catch is so small throughout the history that it is not likely that the trend in the longline cpue will reflect the general situation of the stock(s). In all three cases, the trends in cpue are stable, suggesting superficially no such a situation as being affected by the large total Atlantic catch of swordfish.

In Figs. 1 - 3 are shown the changes in effective cpue of both Japanese and Taiwanese longline fisheries for blue marlin, white marlin and swordfish, respectively. The Taiwanese effective cpue is based on the Japanese data in the estimation of its effective effort. In all three cases, the Taiwanese cpue is much lower than the Japanese cpue and generally the difference becomes increasingly great with the lapse of time. An another point noted in Taiwanese data is the extremely low cpue from 1976 to 1978. This difference in effective cpue will not be explained fully by the difference in effort distribution between the two fisheries. The trends in Taiwanese cpue agree well with those shown by Farber and Conser (1981).

#### Stock conditions

The total catch and overall fishing intensity for blue marlin and white marlin since 1956 were updated as shown in Tables 3 and 4. The total catch by all Atlantic fisheries is available from the ICCAT billfish catch data

base and overall fishing intensity is estimated from the Japanese effort and catch statistics as base. These tables are prepared for the separate North Atlantic and South Atlantic stocks and for the single Atlantic-wide stock. Blue and white marlin catches from 1978 to 1980 in the tables are the figures corrected from the Japanese quarterly report of billfishes hooked and released within the U.S. Fishery Conservation Zones.

#### Blue marlin

The catch and fishing intensity plot from Table 3 is shown in Fig. 4. In the North Atlantic stock, the fishing intensity, except for the early years, increased rapidly during the early and mid 1970's. In the late 1970's, however, it decreased consistently. The reduced level of fishing intensity and nearly constant catch from 1978 to 1980 suggest the increased level of abundance comparing to the mid 1970's. The similar situation is seen in the South Atlantic stock or the Atlantic-wide stock.

The production model analysis for blue marlin using the PRODFIT resulted in Table 5, where the MSY and the corresponding fishing intensity ( $f_{opt}$ ) under the three assumptions on the number of major age groups fished ( $K$ ) are indicated. In the North Atlantic stock, the MSY and  $f_{opt}$  are roughly between 2100 mt and 2700 mt and between 370,000 hooks and 520,000 hooks/5°sq., respectively and in the South Atlantic stock, between 1700 mt and 2400 mt and between 460,000 hooks and 650,000 hooks/5°sq., respectively. In the case of the single Atlantic-wide stock, the estimated MSY and  $f_{opt}$  are roughly between 4000 mt and 4800 mt and between 350,000 hooks and 490,000 hooks/5°sq., respectively.

#### White marlin

The catch and fishing intensity plot from Table 4 is shown in Fig. 5. In the North Atlantic stock, fishing intensity fluctuated without virtual changes in catch from the late 1960's to the mid 1970's. From 1977 to 1980, it again changed without changes in catch as in the earlier years but the catch level during the recent four years is at the lowest. The similar situation is observed in the case of the Atlantic-wide stock. In the South Atlantic stock, the 1980 estimate is exceptionally large. In that year, the Japanese white marlin catch in the South Atlantic was down to half the catch in the previous year with the greater effort and remained 1.6 % of the total South Atlantic catch. In consequence, a very large extrapolation was made for the 1980 estimate. For white marlin, no information about the

MSY is obtained, for the available data do not fit the model as already reported (Kikawa and Honma 1982, Farber 1982).

#### Literature cited

- Farber, M.I. and R.J. Conser 1981. An assessment of the status of stock of blue marlin (Makaira nigricans) and white marlin (Tetrapturus albidus) in the Atlantic Ocean. Coll. Vol. Sci. Pap., Vol. XV (SCRS-1980), 387-406.
- Farber, M. 1982. An assessment of the status of stocks of blue marlin (Makaira nigricans) and white marlin (Tetrapturus albidus) in the Atlantic Ocean through 1971. Coll. Vol. Sci. Pap., Vol. XVII (SCRS-1981), 395-414.
- Kikawa, S. and M. Honma 1982. A review of the stock status of the Atlantic marlins. Coll. Vol. Sci. Pap., Vol. XVII (SCRS-1981), 380-394.

Table 1 Three consecutive years averages of cpue (Fish/100 effective hooks) of blue marlin and white marlin

Year	Blue marlin			White marlin		
	North Atlantic	South Atlantic	Atlantic-wide	North Atlantic	South Atlantic	Atlantic-wide
1958	0.347	0.217	0.276	0.030	0.040	0.035
1959	0.216	0.158	0.196	0.036	0.057	0.048
1960	0.131	0.127	0.153	0.027	0.063	0.054
1961	0.146	0.144	0.186	0.067	0.144	0.154
1962	0.186	0.145	0.204	0.117	0.195	0.220
1963	0.197	0.145	0.199	0.145	0.232	0.251
1964	0.176	0.094	0.147	0.140	0.174	0.188
1965	0.111	0.064	0.097	0.136	0.151	0.163
1966	0.077	0.045	0.068	0.152	0.127	0.158
1967	0.064	0.036	0.055	0.160	0.143	0.174
1968	0.060	0.036	0.054	0.156	0.141	0.174
1969	0.067	0.040	0.059	0.154	0.136	0.168
1970	0.068	0.041	0.061	0.149	0.106	0.144
1971	0.066	0.040	0.057	0.143	0.095	0.131
1972	0.053	0.037	0.047	0.120	0.085	0.115
1973	0.049	0.040	0.044	0.122	0.084	0.119
1974	0.049	0.043	0.045	0.127	0.092	0.124
1975	0.052	0.043	0.046	0.123	0.085	0.122
1976	0.045	0.032	0.040	0.116	0.073	0.119
1977	0.037	0.025	0.032	0.083	0.069	0.087
1978	0.029	0.024	0.026	0.080	0.078	0.083
1979	0.031	0.028	0.028	0.073	0.085	0.073
1980	0.038	0.026	0.031	0.079	0.051	0.074

Table 2 Three consecutive years average of cpue (Fish/100 effective hooks) of swordfish

Year	North Atlantic	South Atlantic	Atlantic-wide
1958	0.013	0.041	0.028
1959	0.014	0.039	0.026
1960	0.011	0.033	0.021
1961	0.018	0.040	0.029
1962	0.025	0.050	0.038
1963	0.036	0.064	0.051
1964	0.038	0.068	0.054
1965	0.045	0.069	0.057
1966	0.045	0.067	0.056
1967	0.048	0.069	0.059
1968	0.046	0.076	0.062
1969	0.047	0.089	0.071
1970	0.047	0.103	0.077
1971	0.049	0.096	0.075
1972	0.051	0.083	0.068
1973	0.053	0.072	0.063
1974	0.055	0.077	0.066
1975	0.052	0.084	0.066
1976	0.047	0.080	0.060
1977	0.046	0.087	0.061
1978	0.056	0.074	0.066
1979	0.058	0.075	0.069
1980	0.058	0.083	0.071

Table 3 Annual catch and fishing intensity estimates of blue marlin by Japanese and all Atlantic fisheries, 1956-1980

1. North Atlantic stock					2. South Atlantic stock						
Year	Japan		All countries		Year	Japan		All countries			
	C	F	C	F		C	F	C	F		
1956	7	+	7	+	1956	32	2	32	2	16.00	
1957	91	+	91	5	18.20	1957	673	64	673	64	10.32
1958	340	47	240	47	5.11	1958	532	41	532	41	6.37
1959	231	76	231	76	3.04	1959	610	218	610	218	2.50
1960	581	74	484	37	7.86	1960	1131	298	1131	298	7.15
1961	379	40	647	68	9.51	1961	1389	362	1470	366	9.37
1962	1223	300	3446	321	10.74	1962	1321	767	1356	774	4.95
1963	4759	513	513	554	9.27	1963	1841	300	1896	311	4.30
1964	4434	739	4806	855	5.62	1964	1156	845	1201	377	3.65
1965	1330	599	1660	652	5.56	1965	2421	739	2473	755	3.23
1966	1677	310	2033	376	5.41	1966	1693	305	1819	543	3.35
1967	433	130	1137	113	1.73	1967	568	257	1057	466	2.29
1968	474	124	1333	150	1.82	1968	472	175	1090	404	2.70
1969	658	150	1595	461	3.45	1969	302	157	1490	773	1.92
1970	758	216	1839	524	1.51	1970	247	104	1019	429	2.38
1971	1271	494	2111	853	2.47	1971	172	87	1086	549	1.98
1972	335	165	1333	647	2.03	1972	85	49	1060	611	1.73
1973	229	100	1615	705	2.29	1973	117	52	1555	682	2.29
1974	267	100	1731	648	2.67	1974	17	3	1101	515	2.13
1975	551	252	1924	915	2.10	1975	57	31	1106	602	1.84
1976	260	156	1243	746	1.67	1976	4	4	846	946	1.00
1977	113	76	1171	754	1.55	1977	17	11	1051	860	1.55
1978	111	52	905	424	2.13	1978	15	9	790	474	1.67
1979	109	45	823	340	2.42	1979	66	33	925	763	2.00
1980	233	66	929	263	3.53	1980	113	84	534	397	1.15

1. Atlantic-wide stock					
Year	Japan		All countries		
	C	F	C	F	
1956	39	1	39	1	39.00
1957	764	27	764	27	28.30
1958	772	59	772	59	13.03
1959	841	128	841	128	6.57
1960	2712	156	2215	162	17.38
1961	1268	153	4077	171	23.34
1962	7044	471	7302	438	14.96
1963	8600	618	9034	649	13.92
1964	7590	817	8007	882	9.29
1965	5751	650	6153	695	8.35
1966	3370	381	3322	425	8.84
1967	1073	176	2234	366	6.10
1968	946	143	2428	387	6.62
1969	950	178	3025	572	5.39
1970	1023	175	2858	458	5.74
1971	1395	345	3197	791	4.04
1972	420	122	2373	639	3.44
1973	346	52	3100	734	4.22
1974	284	66	2532	653	4.30
1975	604	178	3050	437	3.42
1976	264	101	2133	937	2.52
1977	135	52	2222	356	2.60
1978	126	36	1595	484	3.50
1979	175	41	1353	318	4.27
1980	346	72	1483	204	4.51

Table 4 Annual catch and fishing intensity estimates of white marlin by Japanese and all Atlantic fisheries, 1956-1980.

1. North Atlantic stock						2. South Atlantic stock							
Year	Japan		All countries				Year	Japan		All countries			
	C	F	C	F	U	C		F	C	F	U		
1956	4	+	4	+		15	1	15	1	15.00			
1957	25	3	25	3	8.23	135	17	135	17	7.94			
1958	62	42	62	42	1.48	23	99	23	23	4.30			
1959	16	98	16	98	0.16	99	139	96	139	0.69			
1960	25	43	85	146	0.58	225	189	225	189	1.21			
1961	30	22	101	74	1.36	662	183	722	200	1.61			
1962	271	165	376	229	1.84	1644	533	1683	648	2.60			
1963	754	350	912	423	2.16	1664	421	1700	430	1.95			
1964	1493	849	1690	961	1.76	2002	1025	2041	1046	1.95			
1965	1913	497	2324	552	3.35	2713	750	2779	767	3.62			
1966	1417	398	1787	500	3.57	1585	474	1714	513	1.34			
1967	174	124	576	412	1.40	494	245	838	416	2.01			
1968	273	115	681	287	2.57	915	309	1355	514	2.54			
1969	451	116	1190	359	3.31	392	152	1042	431	2.42			
1970	419	201	1036	497	2.08	284	217	1049	302	1.31			
1971	915	377	1335	632	2.43	65	29	711	317	2.24			
1972	339	170	1198	501	1.99	101	61	1133	684	1.66			
1973	328	126	990	380	2.61	27	17	789	497	1.59			
1974	381	120	1211	381	3.18	9	2	538	119	4.50			
1975	404	222	1084	596	1.82	14	16	486	555	0.88			
1976	540	181	1047	351	2.98	3	2	763	509	1.50			
1977	80	87	499	543	0.92	26	3	558	172	3.24			
1978	103	88	502	429	1.17	87	3	530	303	1.75			
1979	107	67	545	341	1.60	15	10	530	353	1.50			
1980	125	129	529	546	0.97	7	17	438	1064	0.41			

3. Atlantic-wide stock						
Year	Japan		All countries			
	C	F	C	F	U	
1956	19	1	19	1	19.00	
1957	160	9	160	9	17.78	
1958	161	34	161	34	4.74	
1959	112	116	112	116	0.97	
1960	253	106	313	131	2.37	
1961	692	92	823	109	7.55	
1962	1915	368	2059	396	5.20	
1963	2418	381	2612	412	6.34	
1964	3495	926	3731	989	3.77	
1965	4631	607	4903	643	7.63	
1966	3002	430	3501	501	6.99	
1967	668	176	1416	373	3.80	
1968	1088	200	2036	374	5.44	
1969	843	147	2232	389	5.74	
1970	703	208	2085	617	3.38	
1971	980	226	2246	518	4.34	
1972	440	123	2331	652	3.38	
1973	355	79	1779	396	4.49	
1974	390	69	1747	309	5.65	
1975	418	133	1570	500	3.14	
1976	543	103	1810	343	5.28	
1977	106	53	1057	529	2.00	
1978	117	53	1032	467	2.21	
1979	122	42	1075	370	2.91	
1980	132	81	967	393	1.63	

Table 5 PRODFIT parameter estimates for blue marlin (1956-1980)

Stock hypothesis	K	α	σ <sup>2</sup>	F <sub>000</sub>	MSY
Separate	4	0	0.37	∞	3242
North Atlantic stock	4	1	0.61	523	2271
	4	2	0.64	383	2480
	5	0	0.68	∞	2713
	5	1	0.74	428	2155
	5	2	0.77	460	2401
	6	0	-	-	-
	6	1	0.32	373	2120
	6	2	0.33	450	2312
Separate	4	0	0.52	∞	2390
South Atlantic stock	4	1	0.50	621	2064
	4	2	0.47	645	2182
	5	0	0.63	∞	1941
	5	1	0.60	532	1969
	5	2	0.55	573	2091
	6	0	0.66	∞	1747
	6	1	0.62	467	1868
	6	2	0.57	535	1972
Atlantic-wide stock	4	0	0.66	∞	4835
	4	1	0.68	465	4279
	4	2	0.69	485	4849
	5	0	-	-	-
	5	1	0.78	405	4154
	5	2	0.79	466	4693
	6	0	-	-	-
	6	1	0.84	358	4087
	6	2	0.83	457	4481

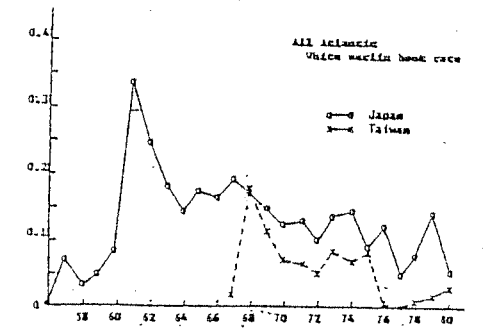
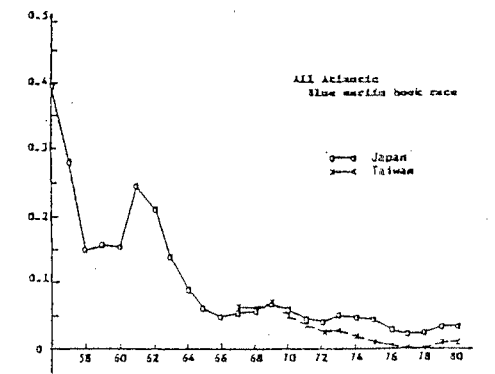
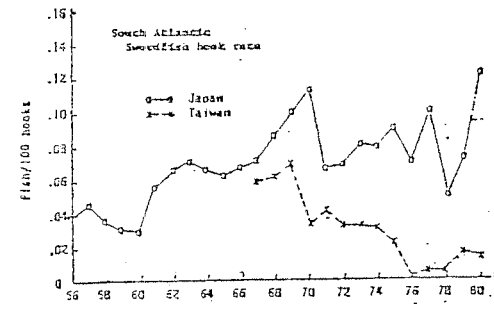
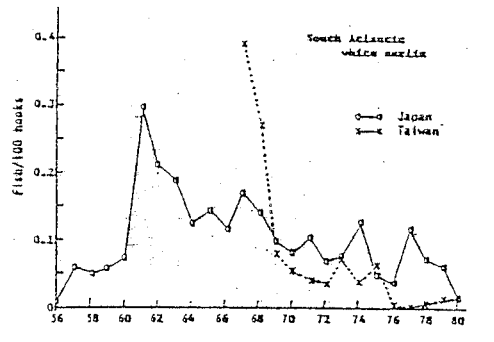
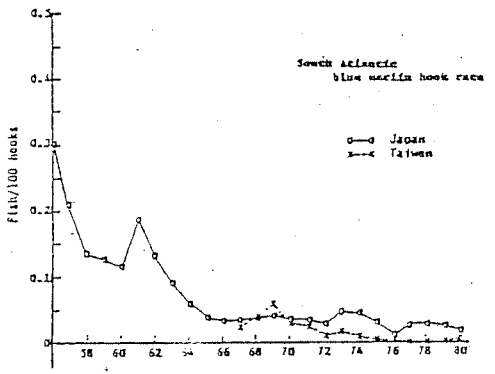
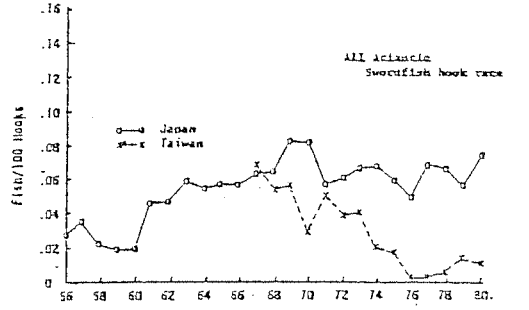
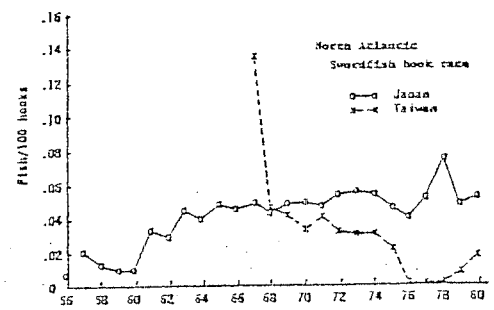
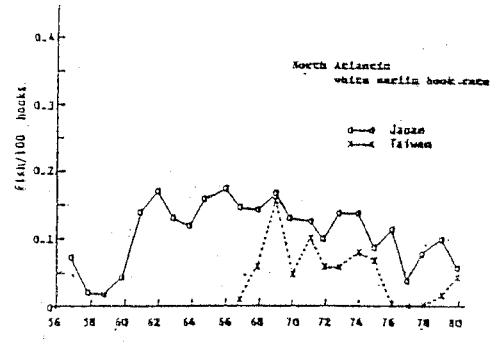
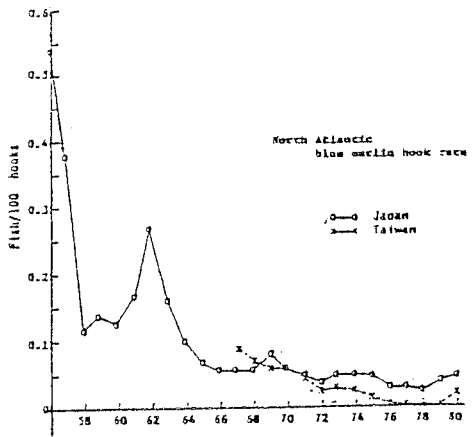


Fig. 3 Change in hook rate (effective cpue) of swordfish

Fig. 1 Change in hook rate (effective cpue) of blue marlin

Fig. 2 Change in hook rate (effective cpue) of white marlin

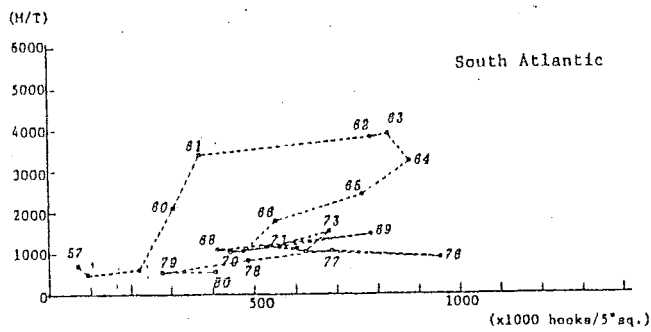
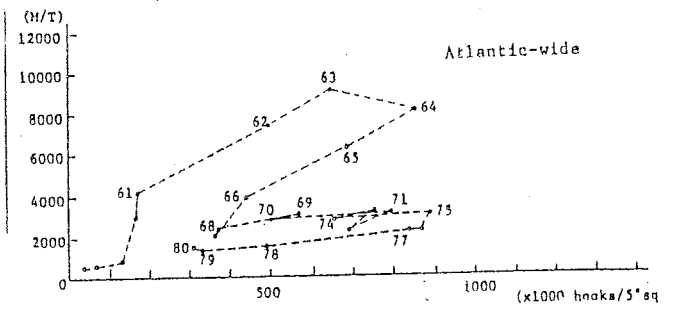
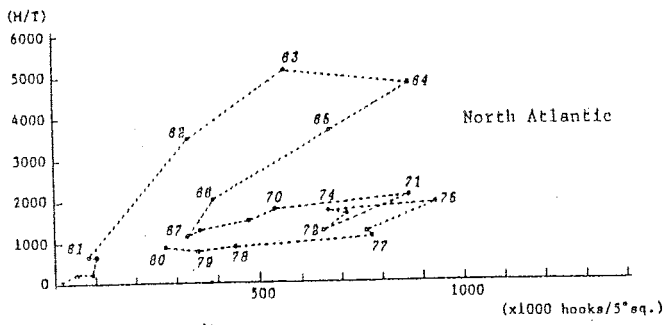


Fig. 4 Catch/fishing intensity plots for blue marlin (1956-1980)

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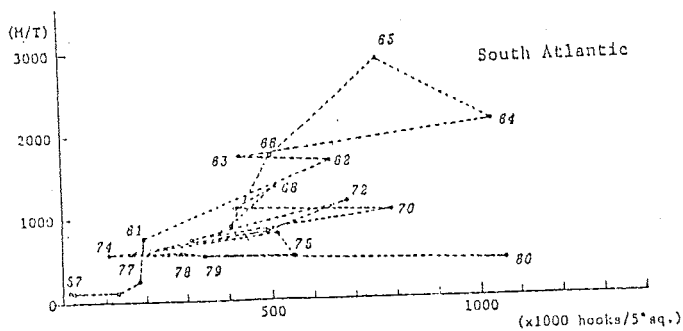
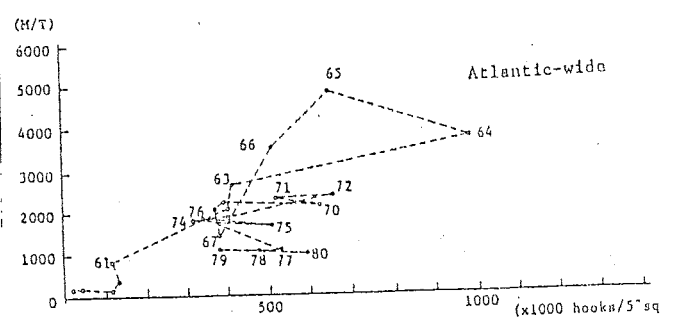
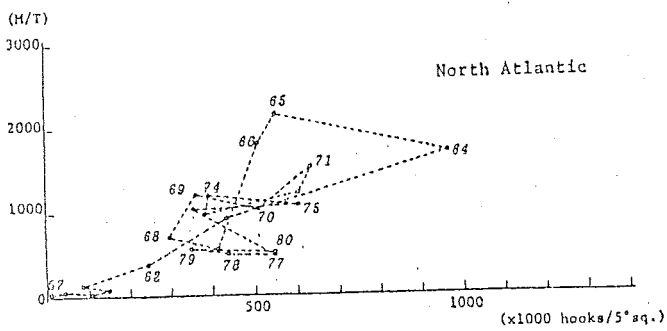


Fig. 5 Catch/fishing intensity plots for white marlin (1956-1980)