

A HISTORICAL REVIEW OF JAPANESE LONGLINE FISHERY AND BILLFISH CATCHES IN THE ATLANTIC OCEAN

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SUMMARY

A history of Japanese longline fishery in the Atlantic Ocean was reviewed briefly laying stress on the development of deep longline operations and general catch trend of billfishes. It was described based on the database of the Japanese longline fishery.

RESUME

L'évolution de la pêche palangrière japonaise dans l'océan Atlantique est brièvement passée en revue en mettant l'accent sur le développement des opérations de palangre de profondeur, et la tendance générale des prises d'istiophoridés est décrite à partir de la base de données de la pêcherie palangrière japonaise.

RESUMEN

Se examina brevemente la historia de la pesquería de palangre japonesa en el Atlántico, poniendo particular énfasis en el desarrollo de las operaciones de palangre profundo y se describe la tendencia general de la captura de marlines, basándose en la base de datos de la pesquería japonesa de palangre.

1. GENERAL VIEW OF JAPANESE LONGLINE FISHERY IN THE ATLANTIC OCEAN

The Japanese commercial longline fishery in the Atlantic Ocean commenced in 1956 at the western equatorial water. Then fishing ground had expanded into the whole tropical area in the mid-1960s (Fig. 1). The fishing effort, in terms of nominal hook numbers, increased rapidly to the peak of 97 million in 1965 (Table 1). In the early period the target species was yellowfin, but it was changed to albacore from around 1962. After 1965 some parts of Japanese longliners had shifted to the Indian and Pacific Oceans. Then, the efforts in the Atlantic Ocean decreased rapidly to 30 millions in 1969. It was only 30% of that in 1965.

In the early-1970s, as development of super cold freezer on board made possible to supply raw meat of the Atlantic tunas for the materials of "sashimi" in the Japanese market, the fishing effort increased again and fluctuated between 32-56 millions in this decade. The target species were shifted to bluefin, southern bluefin and bigeye tunas. The efforts were concentrated mainly in the four area, off Nova Scotia, off Morocco/Sahara, off Angola and off South Africa (Fig. 1). The effort decreased drastically in the western tropical Atlantic, especially in southwest Atlantic. The efforts were concentrated in the eastern Atlantic in this decade.

The deep longline operation was developed to target bigeye tuna in the equatorial Pacific and Indian Oceans from the late 1970s and it was introduced in the Atlantic Ocean in 1976 (Koido and Yonemori, 1986). But it occupied very minor portion of the total efforts in this decade.

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In the 1980s the fishing effort increased gradually and attained to about 90 millions in 1989 with some fluctuations. The catch of bigeye tuna increased gradually with development of deep longline and recently has occupied more than 70% of total Japanese catch in the Atlantic Ocean (Table 1). By contrast the catch of albacore and yellowfin tunas gradually decreased. Most of efforts were distributed in the tropical waters off Africa in the 1980s (Fig. 1).

2. DEVELOPMENT OF DEEP LONGLINE OPERATION.

The deep longline (DLL) was developed to fish in deeper water below thermocline by the extension of main line between floats. The extension of main line resulted in increase of number of branch lines between floats, as the distance between branch lines was generally constant. Generally the number of branch lines ranges from 4 to 6 between floats in the regular gear and from 7 to 15 in deep one. The calculated theoretical maximum hook depths were around 170m and 300m in the typical regular longline (RLL) with 6 branch lines and DLL with 13 branch lines (Suzuki et. al. 1977). In this paper Japanese longline gears were classified arbitrarily into three types, RLL, DLL-1 and DLL-2 which have 4-7, 8-11 and 12-15 branch lines between floats, respectively.

2.1 Historical change of the gear composition.

Table 2 shows the historical change of gear composition (%) from 1975 to 1989. In 1975-79, more than 90% of total effort (number of hooks) were composed of RLL. In 1980-84, the DLL-1 increased rapidly and occupied around 50% of the total, while the amount of RLL decreased to around 50%. In this period DLL-2 appeared but occupied still minor portion. In 1985-89, DLL-2 increased rapidly and occupied major portion, while the percentages of DLL-1 decreased to about 20%.

The nominal hook number of RLL after 1985 has been stable between 23-26 millions and this value was about 50% of that in 1960s. By the contrary nominal hook number of RLL-2 increased rapidly nearly three times from 17 millions in 1987 to 47 millions in 1989. The DLL-1 fluctuated between 10 and 23 millions in the recent five years.

2.2 Geographical distributions of the gears in the Atlantic Ocean and catch composition by the gears.

Fig. 2 shows the geographical distributions of three gear types on 5° x 5° basis in 1985-89, when DLLs had been developed well. The distribution of RLL was restricted in the two latitudinal bands which located in 35-45°N and in 35-45°S. On the contrary DLL-2 was distributed in the eastern equatorial water between 5°N and 15°S. The distribution of DLL-1 was the intermediate one of the former two gears.

The percentages of the catch by species in three gear types were shown in Table 3. Almost all catch of bluefin and southern bluefin tunas were obtained by RLL, and more than half of albacore catch was also obtained by RLL. On the contrary, most of bigeye and yellowfin tunas catches were obtained by DLLs.

These figures and table showed clearly that RLL has targeted bluefin and southern bluefin tunas in the temperate waters after DLLs have developed, while DLLs have targeted bigeye and yellowfin tunas in the tropical waters.

3. CATCH TREND OF BILLFISHES BY JAPANESE LONGLINE FISHERY

The billfishes, white marlin, blue marlin, sailfish and spearfish have been caught as bycatches of Japanese longline fishery, which targeted yellowfin and albacore in the earlier period, and bigeye, bluefin and southern bluefin tunas in the recent period. In this section, the catch trends of billfishes in each decade from 1960 to 1989 were described.

3.1 White marlin

Fig. 3-1 shows the cpue distribution of white marlin in $5^{\circ} \times 5^{\circ}$ basis in the 1960s when the efforts were distributed widely and uniformly over the almost entire Atlantic Ocean. This figure may reflect the geographical distribution of white marlin well, compared with the cpue distributions in the other decades. The high cpues were obtained in the western Atlantic Ocean, especially around $20-30^{\circ}\text{N}$ and $20-30^{\circ}\text{S}$, while no high cpue was observed in the eastern Atlantic.

The catch increased rapidly since 1956 when the Japanese longline fishery commenced and attained to 163 thousands in 1964 (Fig. 4). Most of catch was obtained around $10-30^{\circ}\text{N}$ and $10-30^{\circ}\text{S}$ in the western Atlantic in the 1960s (Fig. 3-2). The catch of white marlin occupied about 3% of the total catch in average in this decade. After 1965 the catch decreased sharply year by year to 27 thousands in 1969 with the decrease of total efforts and change of effort distribution.

In the 1970s the catch continued to decrease and attained to only two thousands in 1979. The catch of this species occupied less than 2% of the total catch. Most of catch was obtained from northwest Atlantic (Fig. 3-3). In the 1980s the catch increased slightly to around five thousands, but occupied only about 0.5% of the total catch. The catches were distributed sparsely in the Atlantic (Fig. 3-4), though the efforts were concentrated in the some particular areas.

About 70% of the white marlin catch were obtained by DLLs in 1985-89 (Table 3). This result was reflected by the geographical distributions of the gears in this period. Namely most of RLL were operated out of the major distribution area of white marlin, while DLLs were operated within the distribution area (Figs. 2 and 3).

The distribution of efforts in the last two decades were clearly opposite to the cpue distribution of white marlin. This discrepancy may be one of the causes that the catch of white marlin has not increased, though efforts have increased gradually since 1970 with several fluctuations.

The size compositions by north and south Atlantic were shown in Fig. 5 from 1970 to 1990, though there were no sufficient samples. Most of the years observed had a broad uni-modal size compositions. Generally the fish in the south Atlantic were larger than in north Atlantic as demonstrated by the past papers (Ueyanagi et. al., 1970, Kikawa and Honma, 1979). There was no clear trend of the modal size for both North and south Atlantic during the years observed.

3.2 Blue marlin

Fig. 6-1 shows the cpue distribution of blue marlin in the 1960s. The high cpues were obtained in the western Atlantic Ocean, especially around $10-30^{\circ}\text{N}$ and $10-30^{\circ}\text{S}$, while no high cpue was observed in the eastern Atlantic. The distribution pattern of this species was similar to that of white marlin.

The catch increased rapidly since 1956 and attained to 112 thousands in 1962 (Fig. 4). Most of catch was obtained around $10-20^{\circ}\text{N}$ and $10-20^{\circ}\text{S}$ in the western Atlantic in the 1960s (Fig. 6-2). The catch of blue marlin occupied about 2% of the total catch in average in this decade. The catch began to decrease sharply from 1963 and attained to only nine thousands in 1968.

In the 1970s the catch continued to decrease and attained to only one thousands in 1977. The catch of this species occupied less than 1% of the total catch. Most of catch was obtained from northwest Atlantic (Fig. 6-3). In the 1980s the catch increased and fluctuated between five and 17 thousands. The catches were distributed in the tropical waters between 15°N and 10°S . About half of the catch was obtained from the African side in contrast with the catch in the 1970s.

Almost all of the white marlin catch were obtained by DLLs in 1985-89 (Table 3). This result was same as white marlin. The discrepancy between the distributions of cpue and effort was also similar to the case of white marlin.

The size compositions by north and south Atlantic were shown in Fig. 7 from 1970 to 1990, though there were no sufficient samples. In most of the years, the size compositions had no distinct mode, but

was broad and flat. No clear difference was observed between north and south Atlantic. No definite trend in size composition was indicated for both areas.

3.3 Sailfish and spearfish

The Japanese catches of sailfish and spearfish have been reported as combined. Therefore, the catch trend was described as a species group here.

Fig. 8-1 shows the cpue distribution of sailfish and spearfish in 1960s. The high cpues were obtained widely from the tropical waters between 30°N and 30°S.

The catch increased rapidly since 1956 and attained to 118 thousands in 1964 (Fig. 4). Most of catch was obtained between 15°N and 30°S in the western Atlantic and a part of tropical African side in the 1960s (Fig. 8-2). The catch of sailfish and spearfish occupied about 3% of the total catch in average in this decade. The catch decreased sharply from 1965 and attained to 28 thousands in 1969.

In 1970s the catch continued to decrease and attained to only one thousands in 1978. The catch of this group occupied less than 1% of the total catch. Most of catch was obtained from tropical waters between 10°N and 10°S (Fig. 8-3). In the 1980s the catch increased slightly and fluctuated between three and 10 thousands. The catch distribution was as same as in the 1970s.

4. GENERAL DISCUSSION

The catch of billfishes occupied about 8% of the total Japanese catch in number in the 1960s, but this percentage continued to decrease and attained only 2% in the last decade.

The catch trend of each billfish species mentioned above were basically similar to each other. Namely catches increased rapidly just after commencement of the Japanese fishery in the Atlantic Ocean. Then they decreased rapidly after the mid-1960s and were more or less stable in 1970-80, though the effort fluctuated several times in these decades.

Catch have been affected by several factors. Changes in population abundance and distribution pattern of the stocks have important effects on catch. Changes of characteristics of fishery, however, have also significant role on catch.

The Japanese longline fishery shifted the target species from yellowfin to albacore in the early period and to bigeye tuna after 1975 with the development of deep longline operations. These change in target species and operations resulted in the major concentration of effort in the tropical eastern Atlantic where billfishes do not have major distribution area. The most catch of billfishes by the Japanese longline fishery have been obtained from the marginal area of billfish distributions in recent decades.

In recent years, as the prices of marlins have continued low, the fishery have little interest in billfishes. Their low economic values resulted in discards of unknown amount

5. REFERENCES

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- KOIDO, T. AND Y. YONEMORI, 1986. Trend in hook rate of Atlantic swordfish. ICCAT, CVSP. Vol. XXVI: 396-401.
- UEYANAGI, S., S. KIKAWA, M. UTO AND Y. NISHIKAWA, 1970. Distribution, spawning and relative abundance of billfishes in the Atlantic Ocean. Bull. Far Seas Fish. Res. Lab., No. 3 : 15-55.

Table 1. Historical catch and effort of Japanese longline fishery in the Atlantic Ocean.

YEAR	EFFORT (in 1000 Hooks)	CATCH (in 1000 fish)									
		BFT	SBF	TUNAS			BILLFISHES				SAI+SPF
				ALB	BET	YFT	SWO	WHM	BUM	BLM*	
56	131	0	0	1	0	12	0	0	1	0	0
57	3376	0	0	32	9	259	1	1	9	0	3
58	8001	0	0	100	15	746	1	1	10	0	4
59	15312	3	0	357	45	1098	2	7	23	0	6
60	20727	7	0	452	71	1159	3	11	27	0	12
61	26673	4	0	431	244	980	11	38	43	1	28
62	54963	54	0	1107	368	990	20	114	112	1	69
63	55004	67	0	1134	285	886	24	87	96	1	51
64	84998	63	0	2134	344	879	31	163	84	0	118
65	97581	60	0	1769	650	927	44	129	45	0	118
66	53814	29	0	1586	232	395	22	89	22	0	65
67	31154	5	0	688	181	366	16	43	11	0	59
68	30255	2	7	917	205	274	17	43	9	0	52
69	29676	1	32	390	264	242	57	27	14	0	28
70	41580	1	132	811	189	190	57	32	11	0	39
71	55873	8	39	552	395	292	29	36	18	0	23
72	44139	3	80	211	347	159	32	15	5	0	11
73	35976	8	47	109	391	109	20	13	5	0	8
74	38495	45	45	133	458	95	25	12	4	0	7
75	58701	40	19	115	449	116	32	15	9	0	9
76	32837	40	19	93	171	104	15	16	3	0	7
77	32501	43	81	59	190	41	14	3	1	0	2
78	44747	23	125	44	210	56	15	2	1	0	1
79	55458	25	154	88	271	63	16	2	1	0	2
80	59846	33	54	94	455	70	38	4	3	0	3
81	71985	40	40	154	472	112	39	6	5	0	5
82	77018	23	18	104	704	138	66	5	12	0	9
83	43837	27	10	84	352	53	32	2	5	0	4
84	64779	24	33	52	524	92	63	3	8	0	6
85	72525	29	26	90	676	125	73	5	11	0	6
86	54280	15	6	82	500	83	44	4	5	0	5
87	46739	21	17	52	419	84	39	5	6	0	3
88	70355	25	8	75	691	144	70	6	8	0	4
89	91507	12	9	73	861	173	89	6	17	0	10

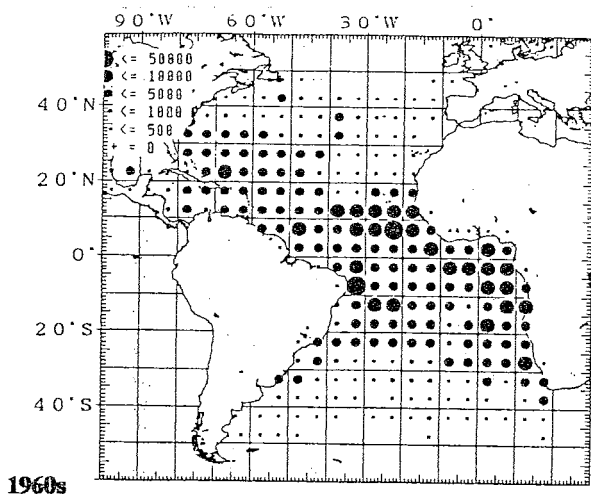
* Other marlins may be included.

Table 2. Historical change of gear composition. Gears were classified into three groups (RLL, DLL-1, and DLL-2) which have 4-7, 8-11 and 12-15 branch lines between floats, respectively.

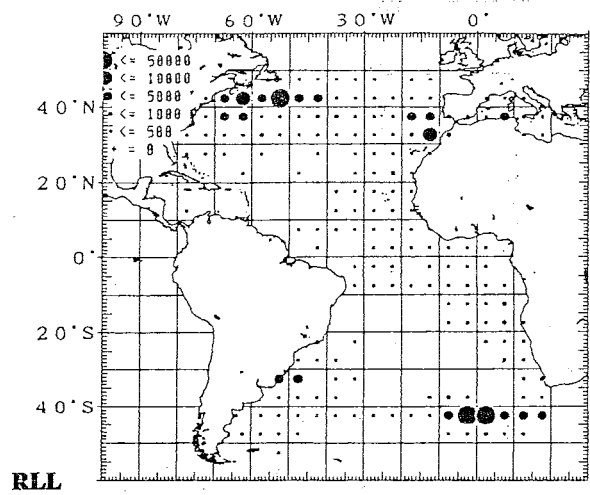
Year	GEARS			TOTAL EFFORT (million hooks)
	RLL	DLL-1 (%)	DLL-2	
75	100	0	0	59
76	97	3	0	33
77	100	0	0	33
78	97	3	0	45
79	96	3	1	55
80	74	24	2	60
81	67	32	2	72
82	24	58	7	77
83	47	47	6	44
84	44	43	14	65
85	34	31	35	73
86	46	23	30	54
87	49	22	29	47
88	36	20	43	70
89	29	21	50	92

Table 3. Catch composition by three types of gears in each species in 1985-89 in the Atlantic Ocean.

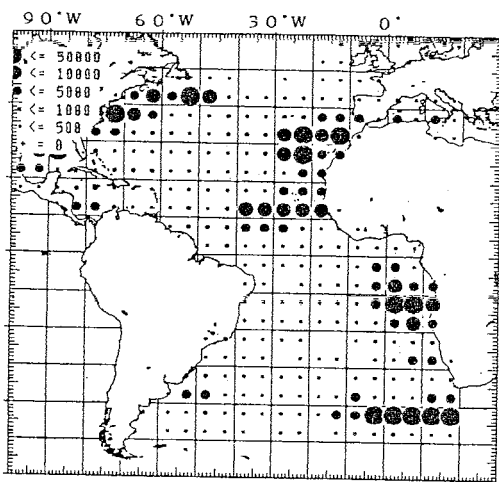
Gear	RLL	DLL-1	DLL-2
	4-7	8-11	12-15
Number of branch lines			
	-- in percent --		
Number of Hooks (in %)	38	24	39
Bluefin	92	7	1
Southern bluefin	99	1	0
Albacore	66	22	11
Bigeye	12	29	59
Yellowfin	24	32	45
Swordfish	17	20	62
White marlin	31	38	32
Blue marlin	3	29	68
Sailfish and spearfish	13	39	49
Total	22	28	51



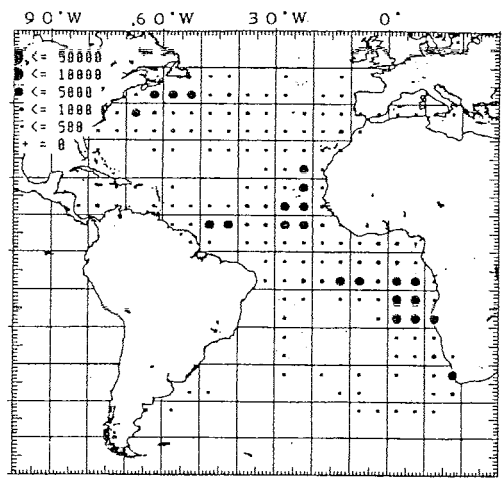
1960s



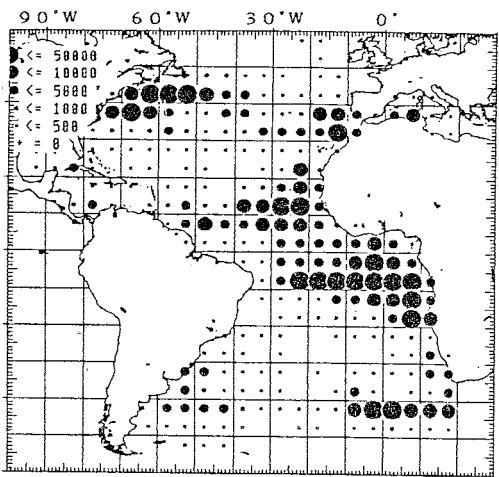
RLL



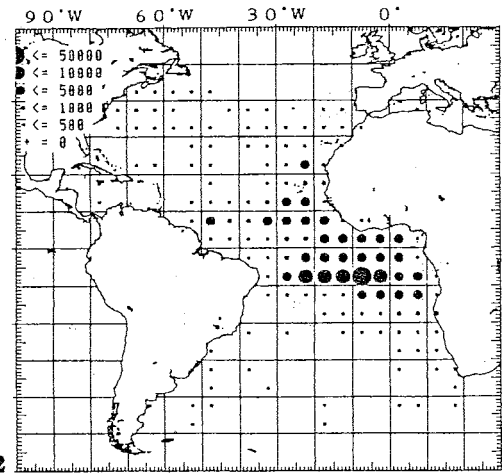
1970s



DLL-1



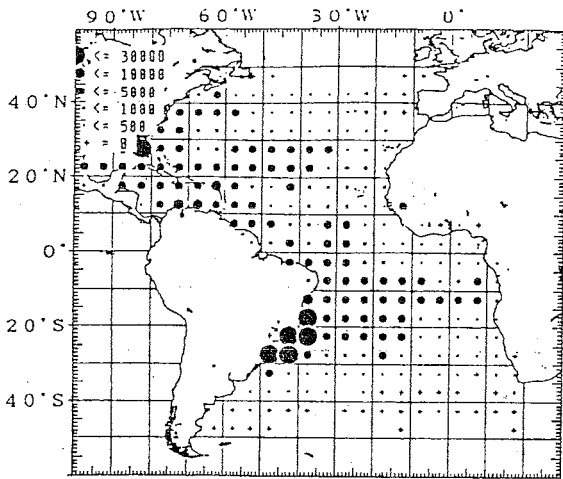
1980s



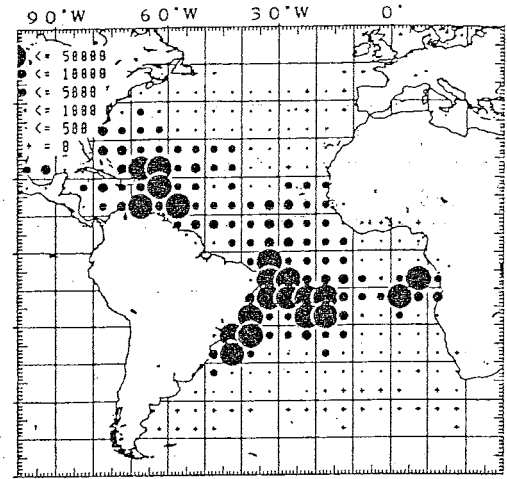
DLL-2

Figure 1.
Distribution of Japanese longline effort in the Atlantic by decade, 1960 - 1989. Numbers in keys indicate accumulated nominal number of hooks in thousand during the decade.

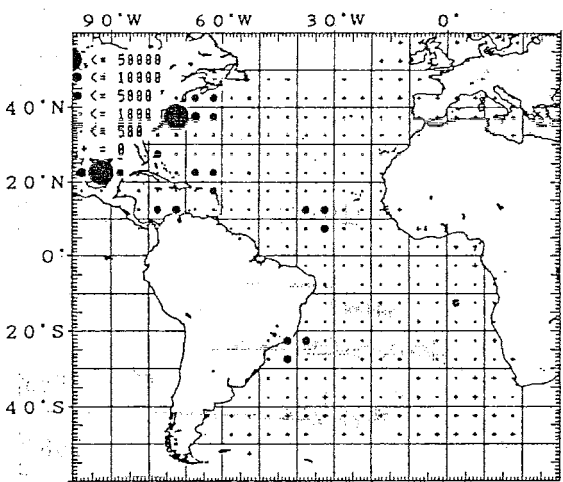
Figure 2.
Distribution of Japanese longline fishing effort, by gear types in 1985 - 89. RLL, DLL-1, and DLL-2 have 4-7, 8-11, and 12-15 branch lines between floats, respectively.



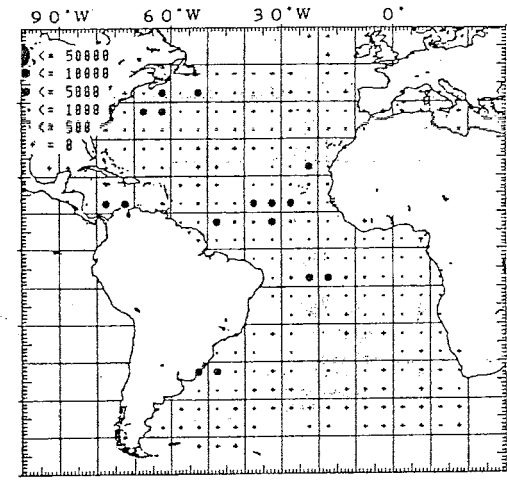
A. CPUE in the 1960s



B. Accumulated catches in the 1960s



C. Accumulated catches in the 1970s



D. Accumulated catches in the 1980s

Figure 3. Distribution of CPUE and catch of white marlin. A: CPUE (catch in number per 1,000,000 hooks) in the 1960s; and B-D: accumulated catches (in number of fish) in each decade from 1960 to 1989.

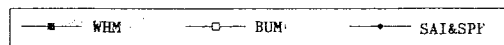
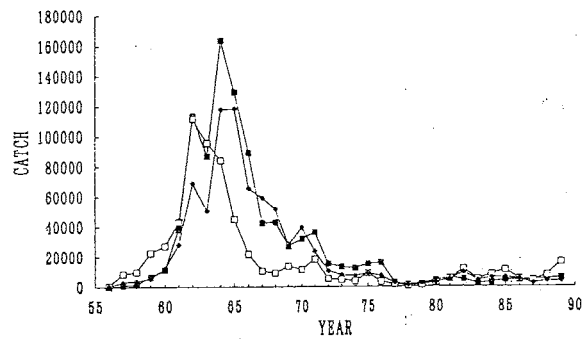
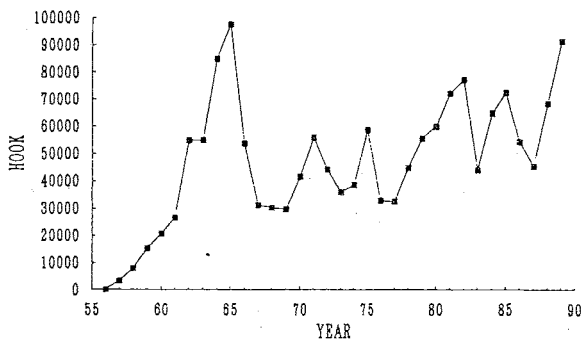
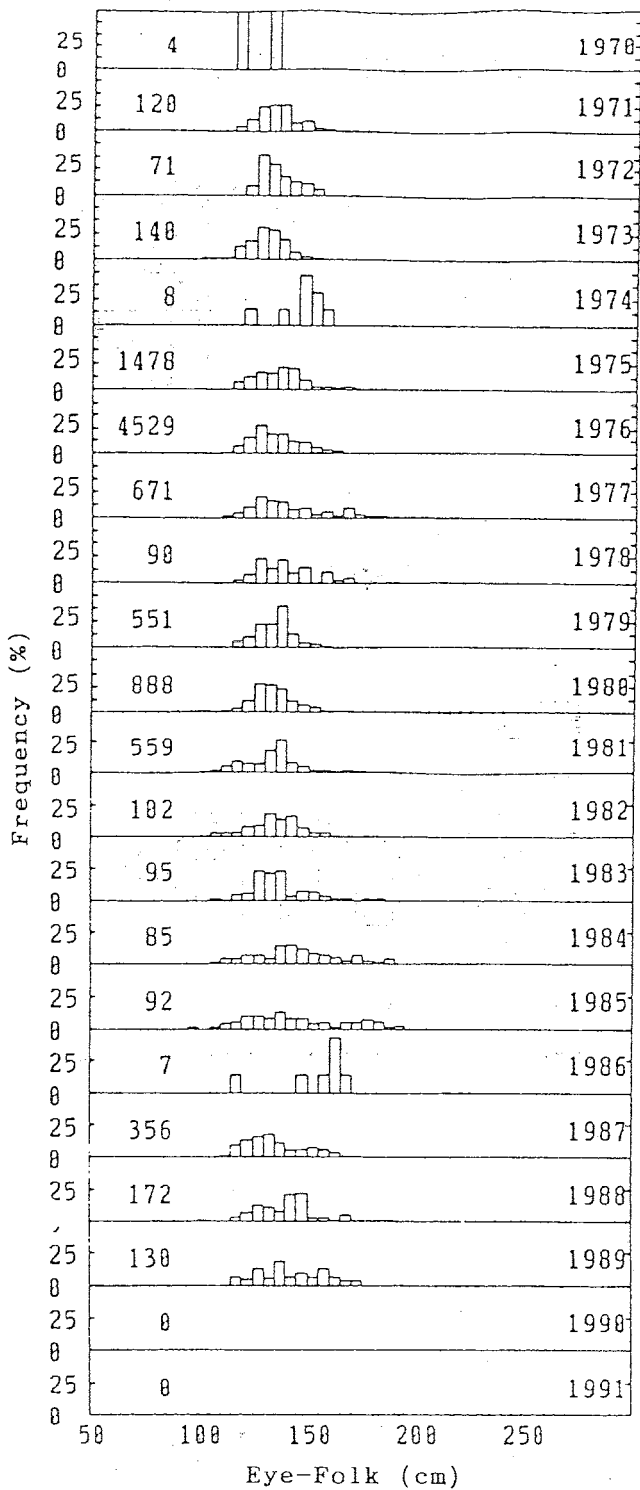
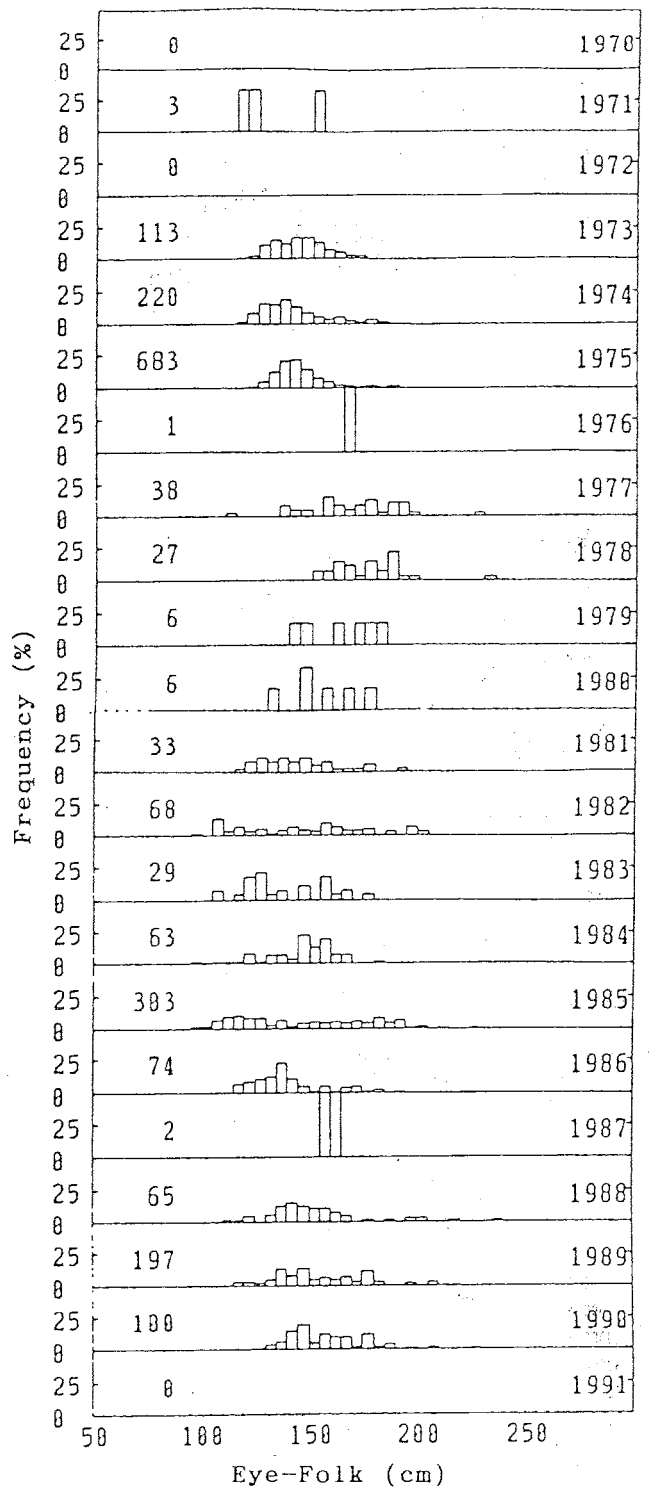


Figure 4. Historical changes of Japanese longline effort and billfish catches in the Atlantic Ocean from 1956 to 1989. Left: nominal number of hooks in thousands. Right: catch in number of fish.

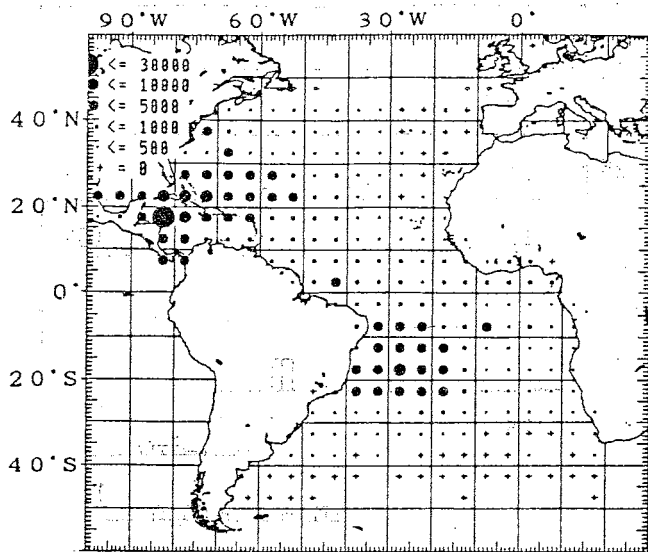


North Atlantic

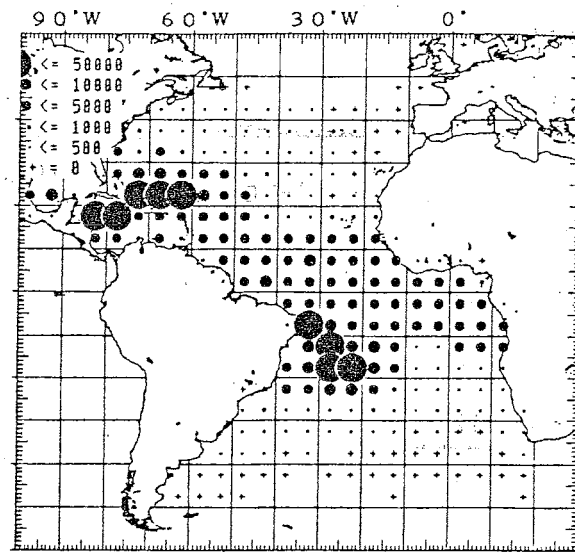


South Atlantic

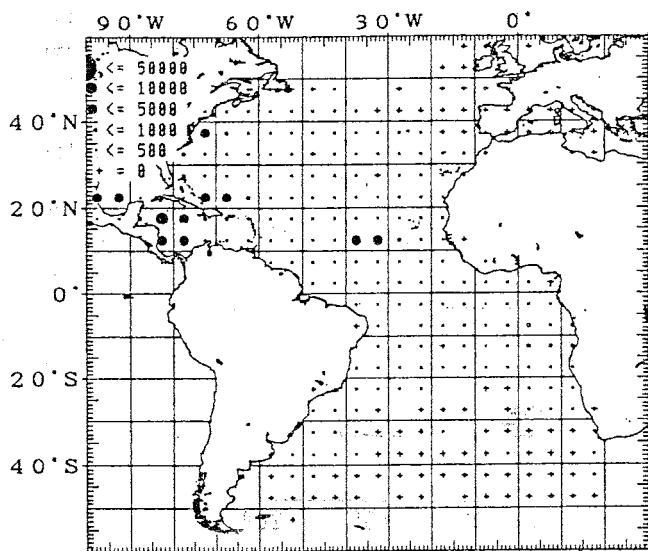
Figure 5. Size composition of white marlin for north and south Atlantic for 1970 through 1990. Numbers in left side denote the number of fish measured.



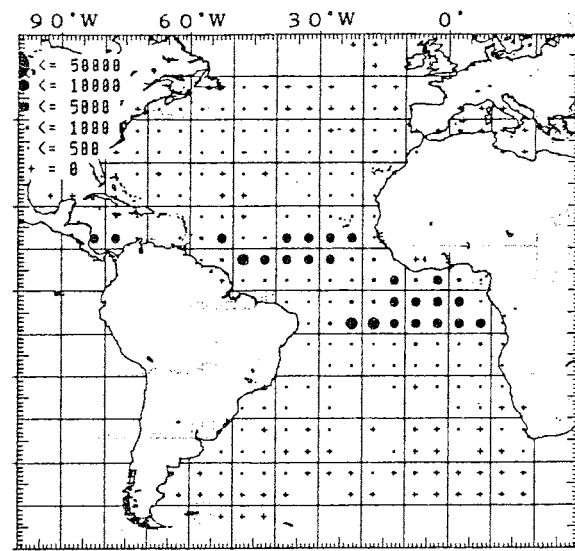
A. CPUE in the 1960s



B. Accumulated catch in the 1960s

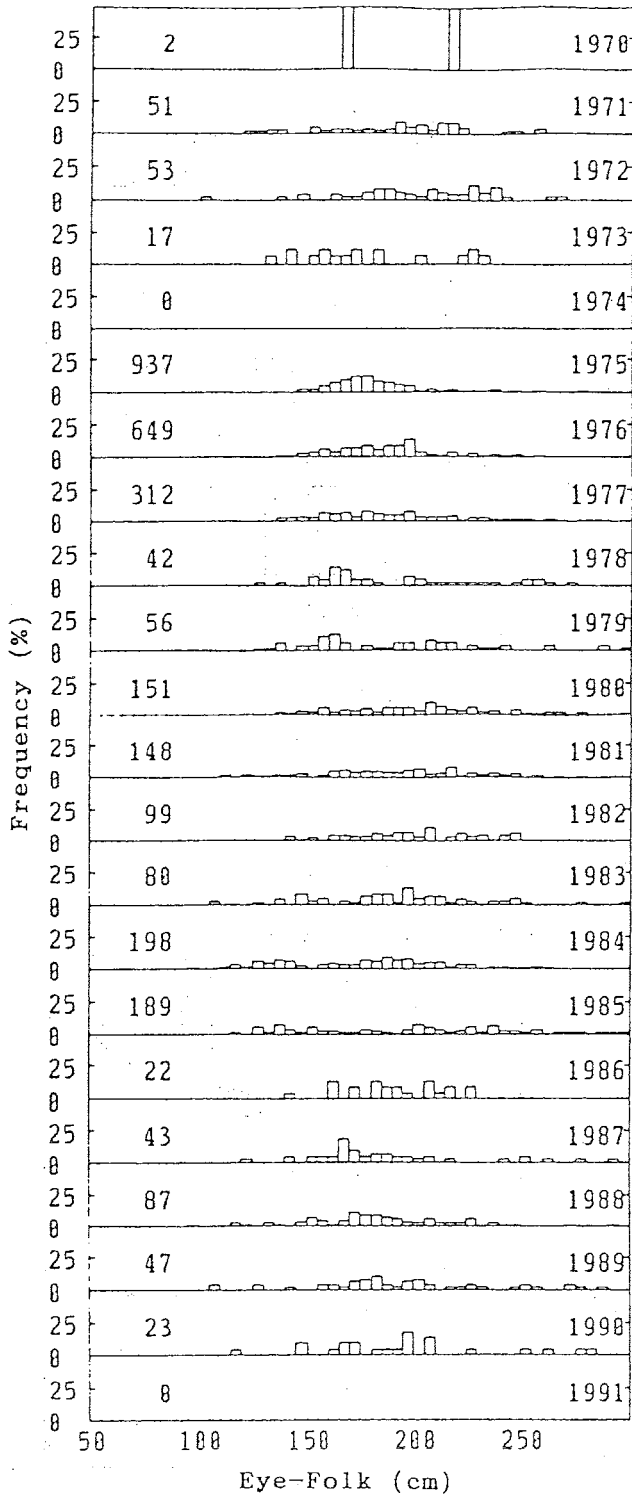


C. Accumulated catch in the 1970s

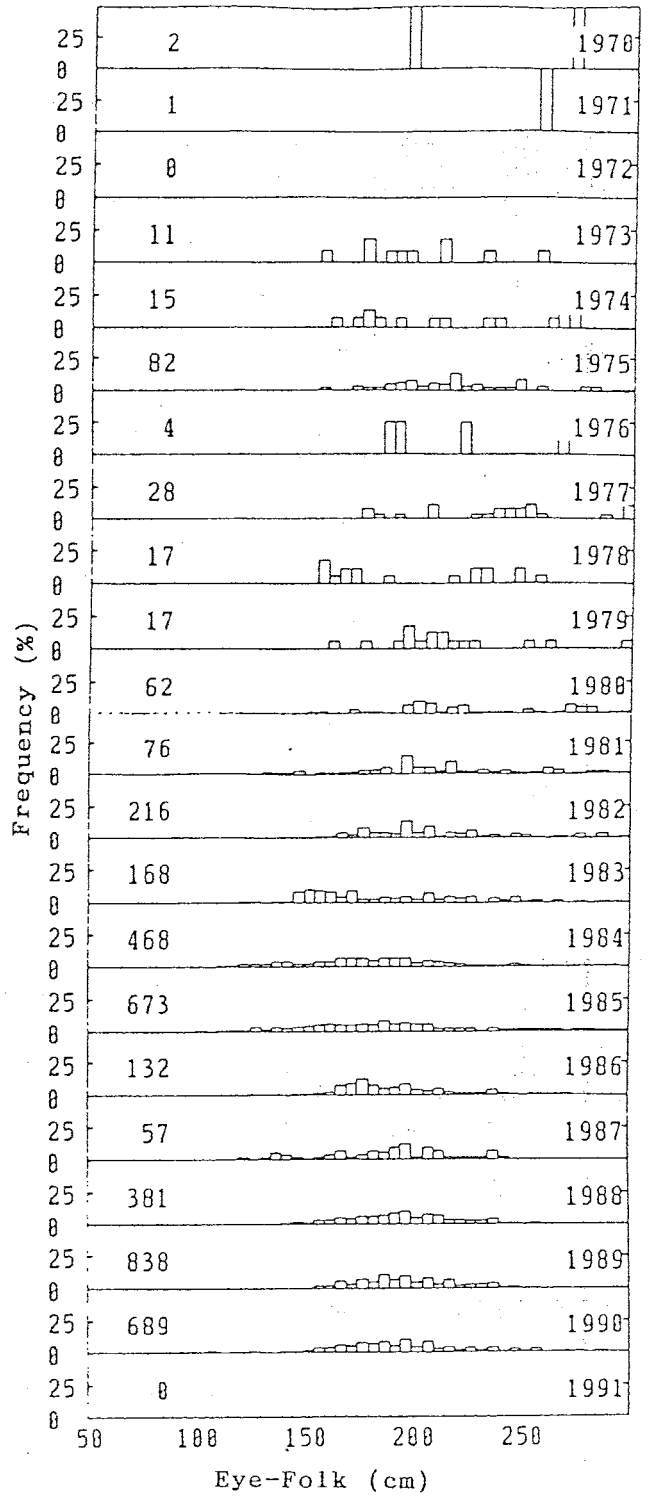


D. Accumulated catch in the 1980s

Figure 6. Distribution of CPUE and catch of blue marlin. A: CPUE (catch in number per 1,000,000 hooks) in the 1960s; and B-D: accumulated catches (in number of fish) in each decade from 1960 to 1989.

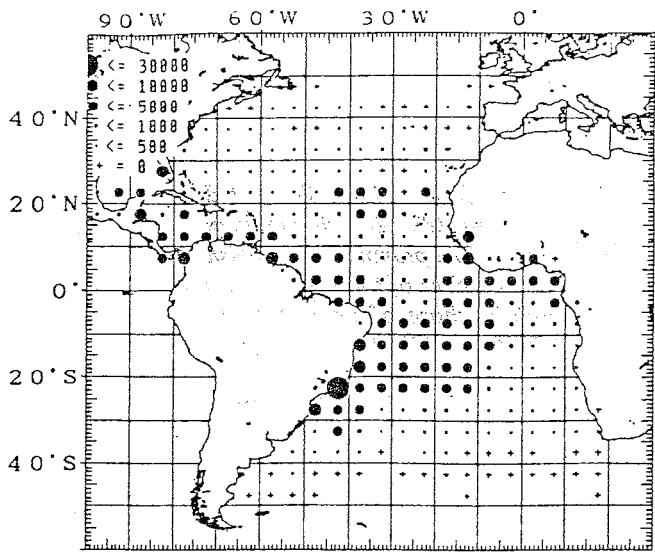


North Atlantic

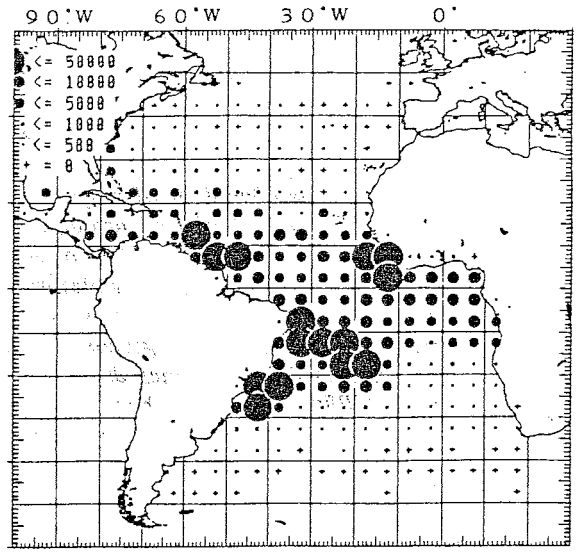


South Atlantic

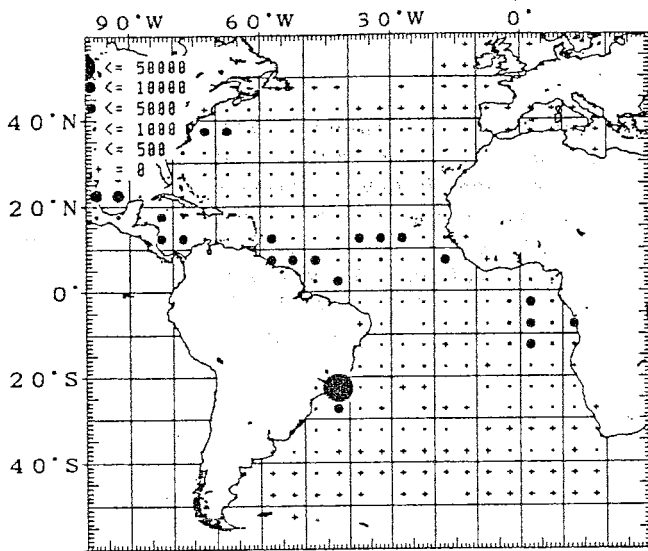
Figure 7. Size composition of blue marlin for north and south Atlantic for 1970 through 1990. Numbers in left side denote the number of fish measured.



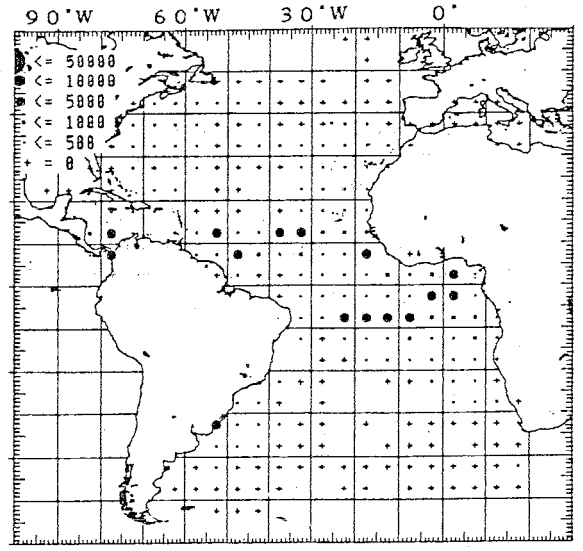
A. CPUE in the 1960s



B. Accumulated catch in the 1960s



C. Accumulated catch in the 1970s



D. Accumulated catch in the 1980s

Figure 8. Distribution of CPUE and catch of sailfish and spearfish. A: CPUE (catch in number per 1,000,000 hooks) in the 1960s; and B-D: accumulated catches (in number of fish) in each decade from 1960 to 1989.