OVERALL FISHING INTENSITY AND CATCH BY LENGTH CLASS OF ALBACORE IN JAPANESE ATLANTIC LONGLINE FISHERY, 1956-1970

by
T. Shiohama

SUMMARY

Honma's methods for calculations were applied to the albacore data for estimating fishing intensity between 1956 and 1970, and catch by length class between 1965 and 1970 in Japanese fishery. The results, as well as yield by the whole longline fleet during the period, provide information on the status of albacore stock in the Atlantic Ocean.

Japanese fishing intensity increased until 1962, and stayed at high levels for three successive years from 1964 to 1966. After a gradual decline, the intensity was doubled from 1969 to 1970. An increase in fishing intensity was accompanied by a reduction in hook rate from about five percent in 1957-1961 to two percent in 1965-1970. A recent increase in the fishing intensity of the whole fleet did not decrease the total number of catches, and recruitment to the albacore population did not appear to have decreased. During this period, large sized fish from 80 cm to 120 cm comprised the major portion of catches in adult fishing grounds covering equatorial and temperate waters. Immatures less than 80 cm were taken in latitudes higher than 30º in both hemispheres. Successively collected data on southern immatures and northern adults showed no reduction in the size of the fish caught.

INTENSITE DE LA PECHE DANS SON ENSEMBLE ET CAPTURES PAR CLASSES DE TAILLES DE GERMON DE LA PECHERIE PALANGRIERE JAPONAISE DANS L'ATLANTIQUE, 1956-1970

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RESUME

Les méthodes de calcul de Honma ont été appliquées aux données sur le germon pour évaluer l'intensité de pêche de 1956 à 1970, et les captures par classes de tailles de 1965 à 1970, dans la pêcherie japonaise. Ces résultats, ainsi que le volume de production de l'ensemble de la flotte palangrière au cours de la même période, fournissent une information sur l'état du stock de germon dans l'Atlantique.

L'intensité de pêche japonaise a augmenté jusqu'en 1962, et est demeurée élevée pendant trois ans de suite, de 1964 à 1966. Après avoir graduellement baissé, l'intensité a doublé de 1969 à 1970. L'augmentation de l'intensité de pêche a été accompagnée d'une diminution du taux de prises par hameçon, d'environ 5 % en 1957-1961 à 2 % en 1965-1970. L'augmentation récente de l'intensité de pêche de l'ensemble de la flotte n'a pas diminué le volume total des prises. Le recrutement de la population de germon ne semble donc pas avoir baissé. Au cours de cette période, la plus grande partie des prises effectuées dans les

bancs d'adultes dans les eaux tempérées et équatoriales était composée de poissons de grande taille, de 80 à 120 cm. Des jeunes de moins de 80 cm ont été pêchés aux latitudes supérieures à 30º dans les deux hémisphères. Les données recueillies ultérieurement sur des immatures dans le sud et des adultes au nord n'ont pas montré de réduction de la taille du poisson pêché.

INTENSIDAD PESQUERA TOTAL Y CAPTURAS POR CLASES DE TALLAS DE LA ALBACORA EN LA PESQUERIA JAPONESA CON PALANGRE EN EL ATLANTICO, 1956-1970

por
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RESUMEN

Los métodos de cálculo de Honma fueron aplicados a los datos sobre albacora para estimar la intensidad pesquera en los años 1956 a 1970, y las capturas por clases de tallas de 1965 a 1970, en la pesquería japonesa. Los resultados, así como la producción del conjunto de la flota palangrera durante dicho periodo revela la situación del stock de albacora en el Atlántico.

La intensidad pesquera de Japón aumentó hasta 1962, y se mantuvo a niveles altos durante los tres años siguientes, de 1964 a 1966. Después de haber descendido gradualmente, la intensidad se duplicó de 1969 a 1970. El aumento de la intensidad pesquera fué pareja con una reducción del índice de capturas por anzuelo, de un 5 % aproximadamente en 1957-1961 a un 2 % en 1965-1970. El reciente aumento de la intensidad pesquera del conjunto de la flota no ha mermado el número total de capturas, y no parece, por tanto, que el reclutamiento en la población de albacora haya disminuído. Durante este período, la mayor parte de las capturas comprendieron peces de gran tamaño, de 80 à 120 cm, y fueron efectuadas en bancos de peces adultos, en aguas ecuatoriales y templadas. Los peces inmaduros, de talla inferior a los 80 cm, fueron capturados en latitudes superiores a los 30º en ambos hemisferios. Los datos recogidos posteriormente sobre ejemplares inmaduros del sur y ejemplares adultos del norte no revela una reducción de tallas de los peces capturados.

Overall fishing intensity and catch by length class of albacore in Japanese Atlantic longline fishery, 1956-1970.

Toshio Shiohama

Recent development of tuna fisheries in the Atlantic Ocean requires to promote studies of assessment of major stocks therein. The Far Seas Fisheries Research Laboratory is compiling semi-processed data ready to be used in the co-operative studies according to requirement of the International Commission for the Conservation of Atlantic Tunas (1971b). The present report covers such data on albacore as (1) amount of effective fishing effort and overall fishing intensity of Japanese longline fleet, (2) Japanese longline catch in terms of number by length class, and (3) relations between the fishing intensity and either hook rate, catch in number or yield in weight in the whole Atlantic longline fishery. The calculations on albacore are based on the same data and methods adopted in comparable researches on yellowfin tuna by Honma (ms).

1. Amount of effective fishing effort and overall fishing intensity on albacore of Japanese longline fishery, 1956-1970

1.1. Extent of fishing ground and period for calculations.

Albacore is widely distributed in between Lat. 45°N and 45°S in the Atlantic Ocean. Koto (1969) inferred that the population comprises north and south stocks probably delineated by the South Equatorial Current. The immatures appear in higher latitude and the adults in lower latitude. Immatures of the south stock expands their distribution range toward the Indian Ocean in summer. In the present report the Atlantic Ocean is bounded by Lat. 50°N and 50°S, by Long. 20°E and coast lines of Africa and Europe, and by coast lines of South and North America (Fig. 1).

"The average years" are defined as five years from 1966 to 1970 for albacore. Mean densities in hook rate by month and by 5° square were calculated not only for the average years, but also for two five-year periods, 1956 to 1960 and 1961 to 1965. The data in the preceding periods substituted some density indices in some month and 5° square, in which no boat operated in the average years.

1.2. Results.

(1) Table 1 gives monthly extent of fishing ground in the average years, and amount of effective fishing effort in 1,000 hooks and overall fishing intensity in 1,000 hooks per 5° square in 15 years from 1956 to 1970. There is an increasing trend of extent of fishing ground in the southern winter. The area in October reaches 1.36 times as wide as that in March.

(2) Resultant fishing intensity shows very close year-to-year fluctuation with that in fishing effort by Shiohama (1971), at a correlation coefficient of 0.9960 for 14 years up to 1969 (Fig. 2).

(3) The fishing intensity exceeded 250,000 hooks per 5° square in 1962, and stayed high levels over 500,000 hooks for three years from 1964 to 1966. After the following gradual decline, the intensity is doubled from 160,100 hooks per 5° square in 1969 to 320,200 hooks in 1970. Such change of fishing intensity for albacore reflects shift of species preference of Japanese longline fishery as outlined by Shiohama (1971).

2. Catch of albacore in terms of number by length class in Japanese longline fishery, 1965-1970.

2.1. Division of fishing ground.

The Atlantic Ocean is divided into four areas inhabited by immatures and adults of north and south stocks as given in Fig. 1 and Table 2. However, sampling was very poor in the northern North Atlantic (Table 3).

2.2. Results.

Table 4 gives catch in number of fish for each 1-cm interval of body length compiled by area and by quarter. There appears areal variation in year-to-year change of catch. In S-1 area of southern adults, the Japanese longliners caught 180,000 to 550,000 fish per year during 1965 through 1968. Catch therein decreased to only 50,000 to 60,000 fish in the following two years. Number of fish taken in S-2, where immatures dominate, reached a peak of 900,000 in 1966, and then gradually decreased, repeating up in even years and down in odd years. Adults in northern ground, N-1, decreased from 360,000 in 1965 to 95,000 in 1968, and turned upward since then, having reached 190,000 in 1970. Catch of immatures in N-2 area showed decrease from 196,000 fish in 1965 to 46,000 fish in 1969, and recovered, one year later than in N-1, to 160,000 fish in 1970.

Percentage length composition is given in Fig. 3. Large-sized fish from 80 cm to 120 cm comprise major portion of catch in both adult fishing grounds of south and north stocks, S-1 and N-1. Smaller immatures appear in southern catch than in northern catch; i.e. major group ranged from 70 cm to 110 cm in N-2, while 55 cm to 110 cm in S-2. No decrease in size of catch was noticed in the length composition from S-2 and N-1 areas. Data from the other two areas were too poor to trace year-to-year change of length composition (Table 3).

3. Relations between overall fishing intensity for albacore and either hook rate, catch or yield in the whole Atlantic longline fishery, 1956-1970.

Recent increase of albacore caught by non-Japanese longliners makes it necessary to comprise the whole longline data for assessment of albacore stock in the fishery (Table 5). Because of limited information, the Japanese estimates are converted to those of the whole longline fleet having operated in the Atlantic Ocean simply basing on statistics of yields as in the comparable study on yellowfin tuna (Honma ms).

Table 5 provides hook rate of albacore in Japanese longline fishery, and catch and overall fishing intensity in the whole fleet, together with relevant basic data. As pointed above, share of Japanese fleet decreased rapidly after 1965 and then comprised only one-third of total yield in 1969 and 1970. The whole fishing intensity has been on the increase even after 1965, and then reached a peak of 1,036,000 hooks per 5^{0} square in 1970.

Increase of fishing intensity accompanied a reduction of hook rate from about 5.0 percent in 1957-1961 to 2.0 percent in 1965-1970 (Fig. 4). It appears that recent increase of fishing intensity did not deplete total number of catch, and then that recruitment to albacore population did not decrease yet. Further examination of data is required to explain the rises of fishing intensity and catch in 1970, which failed to accompany increase of yield.

4. Postscript

Japanese biologists dealing with the Atlantic tuna stocks could pay

less attention on albacore than on yellowfin tuna, because the former species did not decrease as sharply as the latter in the longline fishery. International co-operative studies have been also focussed to yellowfin and bluefin tunas rather than to albacore (e.g. ICCAT 1971b).

Recent decrease of catch of albacore in French surface fishery (e.g. Letaconnoux 1971, Dao 1971) as well as the hook rate in longline fishery makes it necessary to advance fishery biology on this stock. The present compilation of catch and length data is a step for better understanding of not only fluctuation in abundance but also ecological aspects inclusive of migration, distribution and structure of albacore population, and itself subjects to modification. It is to be added that the Japanese Fisheries Agency commenced a length measurement program on board of commercial long-liners in 1972 for improving the biological survey (Hayasi ms).

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TABLE 1 - Extent of fishing ground in 5² square in "average years from 1965 to 1970", and amount of effective effort in thousand hooks, and overall fishing intensity in thousand hooks per 5² square of Japanese longline fishery for albacore in the Atlantic Ocean, 1956-1970.

Month	Area	1956		1957		1958		1959		1960	
		X X f	f	X Xf	f	X	f	X	f	X	f
Total	(1,668.82)	(55)	0.4	(545)	3.8	(2,008)	14.0	(5,911)	42.4	(8,228)	58.7
1	134.34	-	-	-	-	64	0.5	497	3.7	901	6.7
2	137.79	-	-	6	0.0	224	1.6	497	3.6	392	2.8
3	115.33	-	-	3	0.0	82	0.7	130	1.1	108	0.9
4	131.36	-	-	13	0.1	55	0.4	153	1.2	172	1.3
5	135.97	-	-	80	0.6	115	0.8	232	1.7	170	1.3
6	151.41	7	0.0	68	0.4	370	2.4	357	2.4	197	1.3
7	140.73	10	0.1	16	0.1	98	0.7	128	0.9	144	1.0
8	142.57	15	0.1	44	0.3	62	0.4	36	0.3	278	2.0
9	144.17	7	0.0	112	0.8	145	1.0	86	0.6	290	2.0
10	156.71	10	0.1	79	0.5	466	3.0	499	3.2	954	6.1
11	141.76	1	0.0	45	0.3	201	1.4	1,084	7.6	1,868	13.2
12	136.68	6	0.0	80	0.6	126	0.9	2,212	16.2	2,753	20.1

See Fig. 1 for extent of the Atlantic Ocean.

Table 1. Continued.

Month	1961		1962		1963		1964		1965	
	X	f	X	f	X	f	X	f	X	f
Total	(9,850)	70.8	(37,188)	265.4	(35,198)	250.0	(73,436)	518.5	(82,257)	580.9
1	1,253	9.3	4,870	36.3	7,362	54.8	6,477	48.2	7,603	56.6
2	631	4.6	1,634	11.9	2,041	14.8	3,244	23.5	3,082	22.4
3	332	2.9	392	3.4	703	6.1	1,186	10.3	1,511	13.1
4	236	1.8	416	3.2	782	6.0	1,835	14.0	2,872	21.9
5	367	2.7	424	3.1	2,432	17.9	7,869	57.9	9,194	67.6
6	969	6.4	1,986	13.1	7,842	51.8	11,119	73.4	14,915	98.5
7	923	6.6	4,472	31.8	6,088	43.3	8,526	60.6	13,969	99.3
8	388	2.7	4,225	29.6	1,830	12.8	5,253	36.8	8,348	58.6
9	141	1.0	1,454	10.1	861	6.0	5,655	39.2	4,020	27.9
10	625	4.0	2,285	14.6	1,452	9.3	7,125	45.5	6,311	40.3
11	1,044	7.4	6,094	43.0	1,780	12.6	6,775	47.8	5,510	38.9
12	2,941	21.5	8,936	65.4	2,026	14.8	8,371	61.2	4,922	36.0

Month	1966		1967		1968		1969		1970	
	X	f	X	f	X	f	X	f	X	f
Total	(74,287)	530.9	(30,789)	221.6	(41,508)	295.8	(21,964)	160.1	(43,762)	320.2
1	8,039	59.8	3,333	24.8	2,338	17.4	1,348	10.0	2,787	20.7
2	3,517	25.5	2,034	14.8	804	5.8	1,909	13.9	3,511	25.5
3	1,496	13.0	2,188	19.0	1,526	13.2	2,314	20.1	4,948	42.9
4	7,144	54.4	2,542	19.4	4,453	33.9	2,398	18.3	6,332	48.2
5	11,969	88.0	2,698	19.8	6,618	48.7	2,875	21.1	5,855	43.1
6	12,513	82.6	2,787	18.4	7,559	49.9	3,004	19.8	5,751	38.0
7	8,255	58.7	2,666	18.9	5,987	42.5	2,903	20.6	3,895	27.7
8	6,516	45.7	2,900	20.3	3,746	26.3	1,518	10.6	2,434	17.1
9	3,094	21.5	2,483	17.2	2,455	17.0	828	5.7	1,041	7.2
10	3,399	21.7	3,103	19.8	2,807	17.9	898	5.7	2,265	14.5
11	4,186	29.5	1,982	14.0	1,609	11.4	788	5.6	2,979	21.0
12	4,158	30.4	2,071	15.2	1,606	11.8	1,182	8.6	1,964	14.4

Table 2. Quadrangles representing four areas of the Atlantic Ocean for calculation of length composition of albacore.

Area	Habitat	Quadrangles
N-2	North stock Immatures	30N-80W, 30N-60W, 40N-60W, 30N-40W, 40N-40W, 30N-20W, 40N-20W, 30N-00W 40N-00W
N-1	North stock Adults	00N-80W, 10N-80W, 20N-80W, 00N-60W, 10N-60W, 20N-60W, 00N-40W, 10N-40W 20N-40W, 00N-20W, 10N-20W, 20N-20W, 30N-20W, 00N-00W, 10N-00W, 20N-00W 30N-00W
S-1	South stock Adults	20S-40W, 00S-40W, 00N-40W, 20S-20W, 10S-20W, 0QS-20W, 00N-20W, 20S-00W 10S-00W, 00S-00W, 00N-00W, 10S-00E, 00S-00E, 00N-00E
S-2	South stock Immatures	40S-60W, 30S-60W, 40S-40W, 30S-40W, 40S-20W, 30S-20W, 40S-00W, 30S-00W 40S-00E, 30S-00E, 20S-00E, 10S-00E

Numerals denote the smallest figures of latitude and longitude of each quadrangle. For instance, 00N-60W represents a quadrangle extending between Lat. 0° N and 10° N, and between Long. 60° W and 80° W.

Table 3. Sample size and substitution of data for calculating catch by length class, 1965-1970.

Area	Year	Quarter			
		I	II	III	IV
N-2	1965	(II, 1965)	239	133	(III, 1965)
	1966	(III, 1965)	1,886	298	(I, 1967)
	1967	188	(II, 1966)	(III, 1966)	(I, 1967)
	1968	(I, 1967)	(II, 1966)	10 (III, 1966)	(I, 1967)
	1969	(I, 1967)	(II, 1966)	(III, 1966)	(I, 1967)
	1970	(I, 1967)	(II, 1966)	(III, 1966)	(I, 1967)
N-1	1965	189	703	28 (II, 1965)	2 (II, 1965)
	1966	90	229	410	103
	1967	148	394	324	(III, 1967)
	1968	20 (III, 1967)	36(III, 1968)	179	412
	1969	(IV, 1968)	(III, 1968)	(III, 1968)	24 (IV, 1968)
	1970	(IV, 1968)	(III, 1968)	(III, 1968)	(IV, 1968)
S-1	1965	858	68	1,150	1,156
	1966	1,733	54	126	660
	1967	11 (IV, 1966)	(IV, 1966)	20 (IV, 1966)	122
	1968	120	48	271	328
	1969	9 (IV, 1968)	(IV, 1968)	(IV, 1968)	(IV, 1968)
	1970	(IV, 1968)	(IV, 1968)	(IV, 1968)	(IV, 1968)
S-2	1965	(II, 1965)	5,464	4,203	578
	1966	802	11,165	3,953	(IV, 1965)
	1967	(I, 1966)	(II, 1966)	(III, 1966)	476
	1968	(IV, 1967)	5,872	493	108
	1969	314	2,560	2,675	1,825
	1970	367	791	(II, 1970) 14	(IV, 1969)

Numerals in parentheses denote substitutions of data.
(1) Roman numerals; substituted data of the given quarter.
(2) Arabic numerals; substitued data of the given year.

Table 4. Catch in number of albacore taken by Japanese longline fleet in the Atlantic Ocean, 1965 - 1970. See Fig. 1 for division of area.

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Table 5. Hook rate, catch in number of fish, yield in weight, and overall fishing intensity of albacore in Japanese longline fishery, and catch, yield and overall fishing intensity in the whole longline fishery operated in the Atlantic Ocean, 1956-1970.

Year	Hook rate in percent	Japanese fleet			Whole fleet		
		Catch in number of fish	Yield in tons	Intensity in 1,000 hooks per 5° square	Catch in 1,000 fish	Yield in 1,000 tons	Intensity in 1,000 hooks per 5° square
1956	1.96	1,071	..	0.4	1	..	0.4
1957	5.80	31,585	860	3.8	32	0.9	3.8
1958	4.96	99,516	1,992	14.0	100	2.0	14.0
1959	6.03	356,626	3,614	42.4	357	3.6	42.4
1960	5.50	452,317	9,804	58.7	452	9.8	58.7
1961	4.37	430,572	9,273	70.8	431	9.3	70.8
1962	2.98	1,107,384	22,138	265.4	1,107	22.1	265.4
1963	3.22	1,133,821	29,692	250.0	1,283	33.6	282.8
1964	2.91	2,133,771	39,451	518.5	2,323	43.0	564.4
1965	2.15	1,768,851	42,634	580.9	1,885	45.4	619.1
1966	2.13	1,585,866	26,883	530.9	2,063	35.0	690.8
1967	2.23	687,679	12,490	221.6	1,430	26.0	460.9
1968	2.21	916,900	15,163	295.8	2,039	33.8	657.8
1969	1.77	389,640	11,048	160.1	1,116	31.5	458.5
1970	1.85	810,763	11,773	320.2	2,625	38.2	1,036.6

Yields by Japanese and whole Atlantic longline fleet are taken from Hayasi et al. (ms).

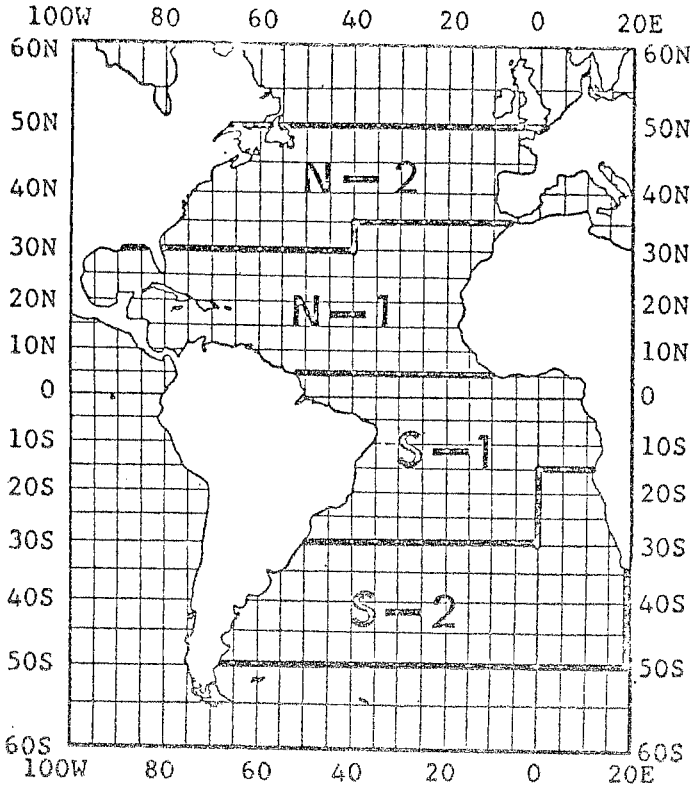


Fig. 1. Definition and division of the Atlantic Ocean for calculating amount of fishing effort and catch by length class of albacore in Japanese longline fishery, 1956-1970.

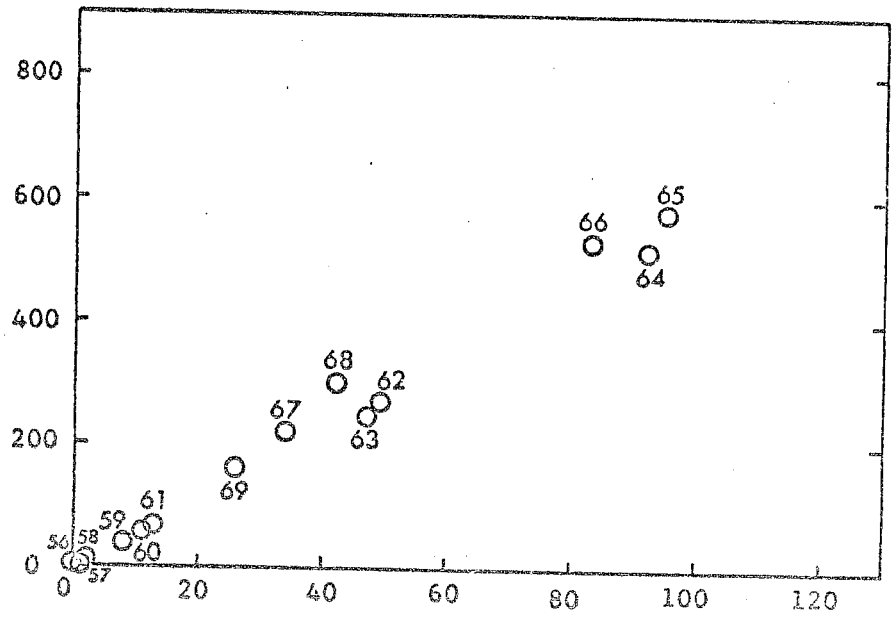
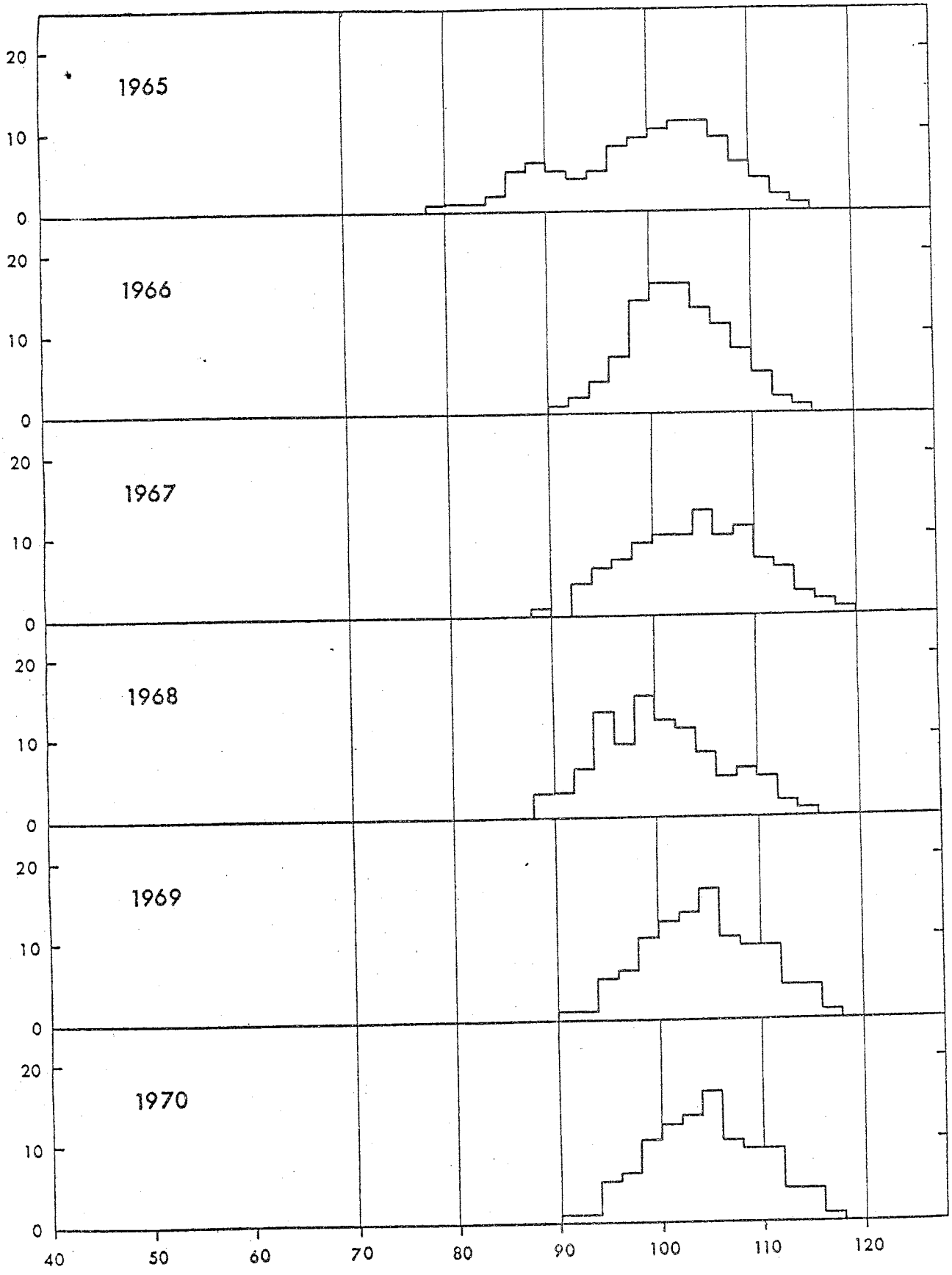


Fig. 2. Relation between amount of fishing effort in million hooks by Shiohama (1971) on ordinate and present estimates of overall fishing intensity in thousand hooks per 5° square on abscissa, of Japanese longline fishery for albacore in the Atlantic Ocean, 1956-1969.



3. Percentage length composition of albacore caught by Japanese longline fishery in the Atlantic Ocean, 1965 - 1970. See Fig. 1 for division of area. A. S - 1 Area.

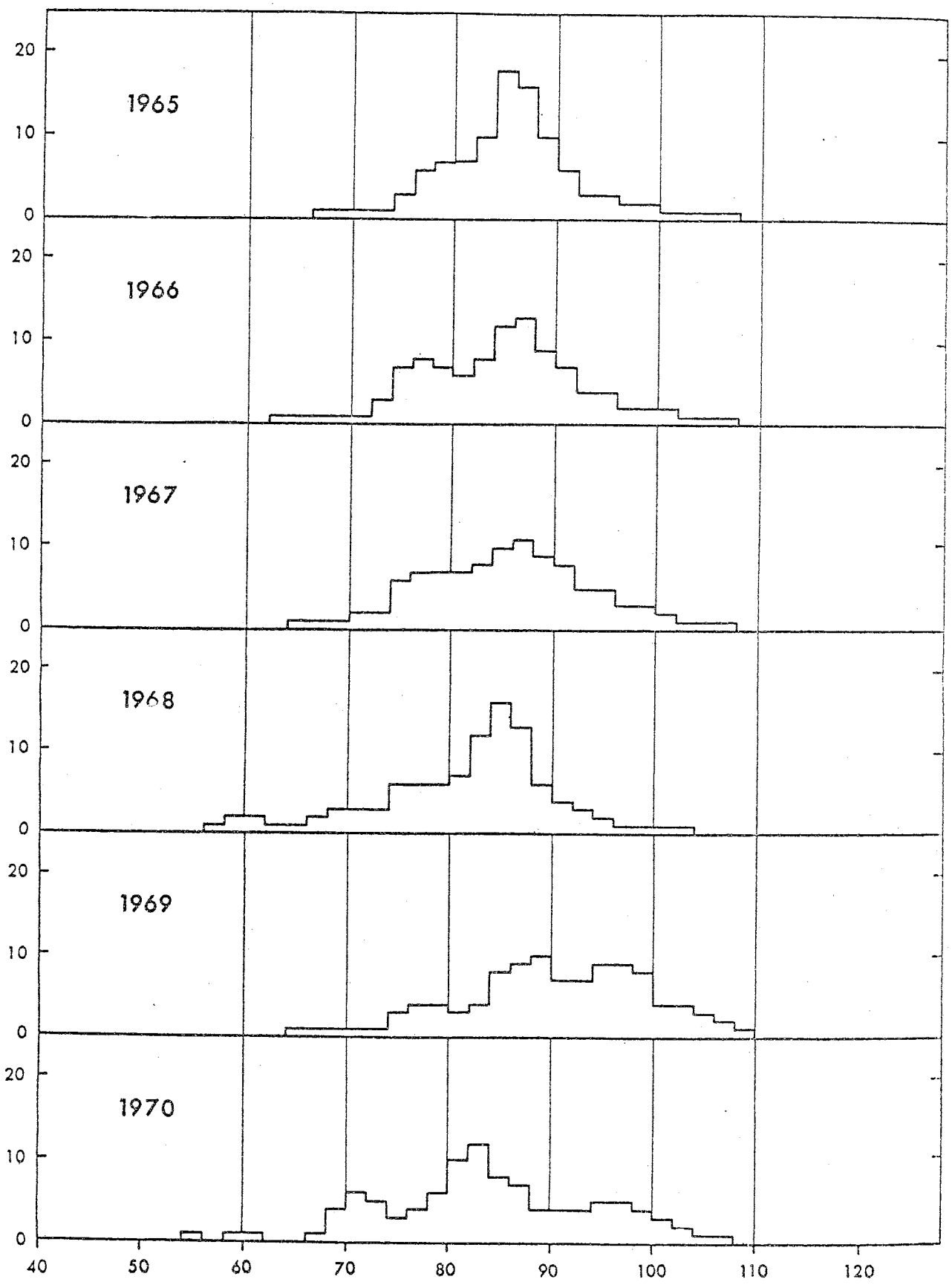


Fig. 3. Percentage length composition of albacore caught by Japanese longline fishery in the Atlantic Ocean, 1965 - 1970. See Fig. 1 for division of area. B. S - 2 Area.

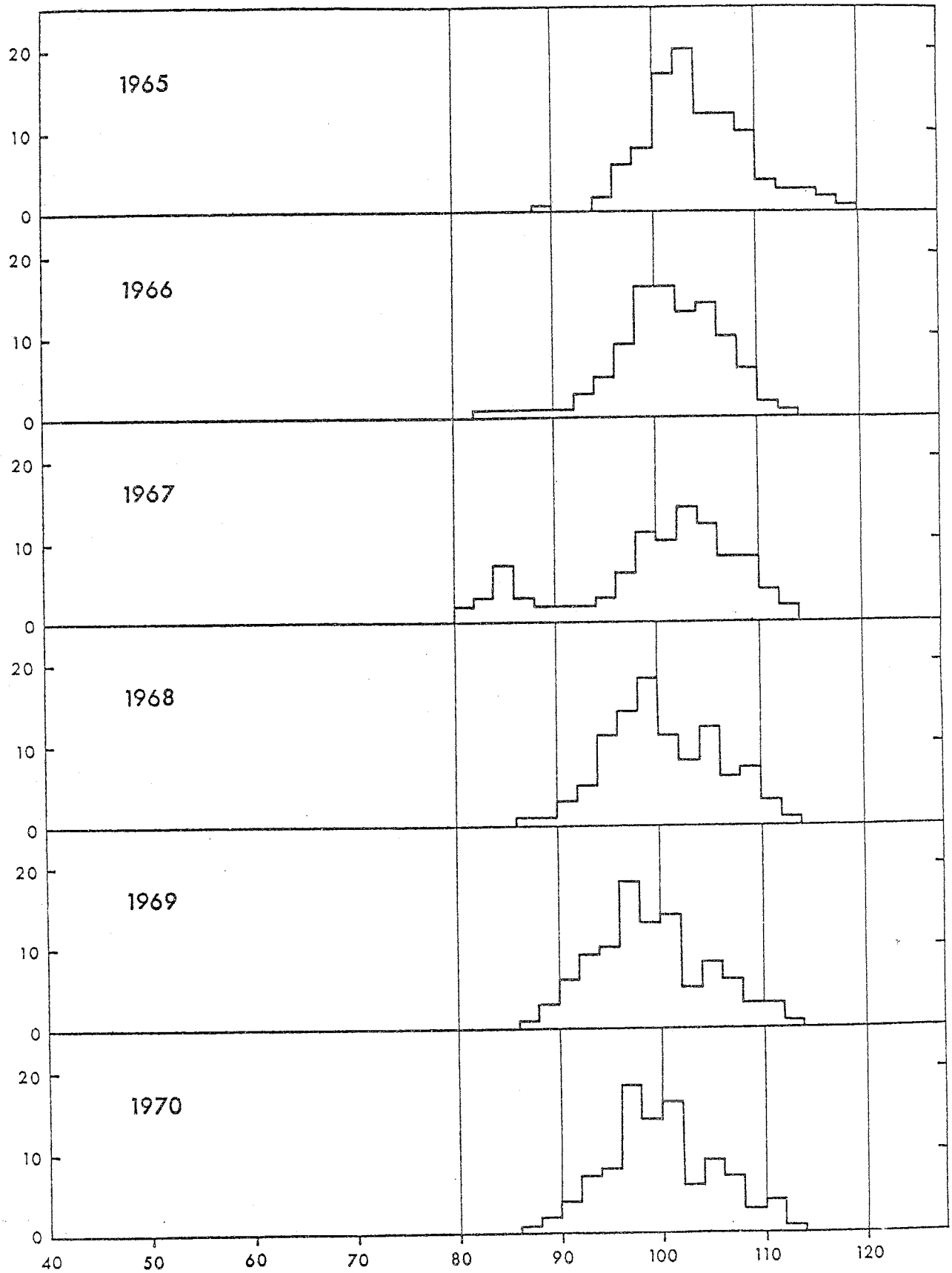


Fig. 3. Percentage length composition of albacore caught by Japanese longline fishery in the Atlantic Ocean, 1965 - 1970. See Fig. 1 for division of area. C. N - 1 Area.

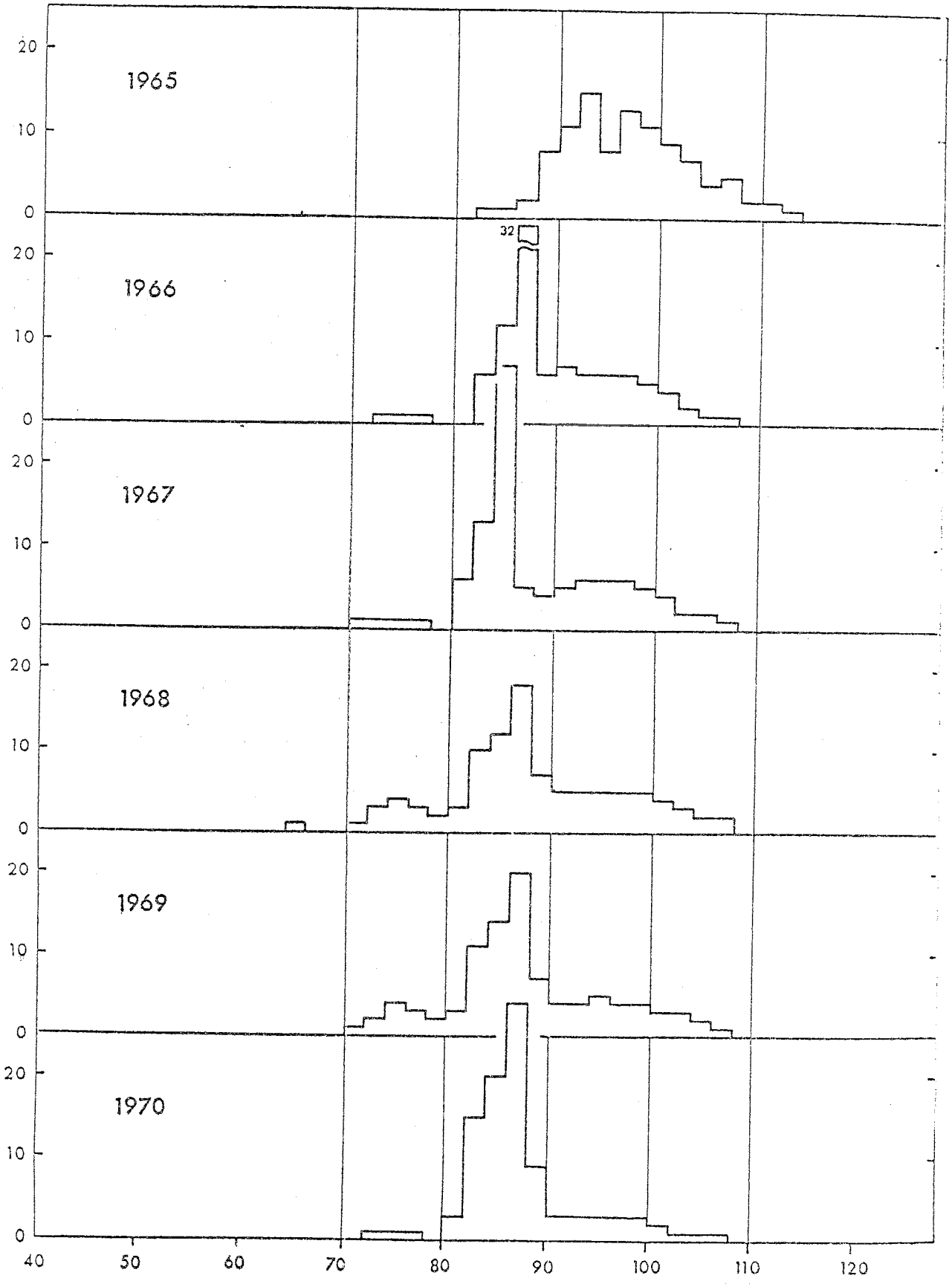


Fig. 3. Percentage length composition of albacore caught by Japanese longline fishery in the Atlantic Ocean, 1965 - 1970. See Fig. 1 for division of area. D. N - 2 Area.

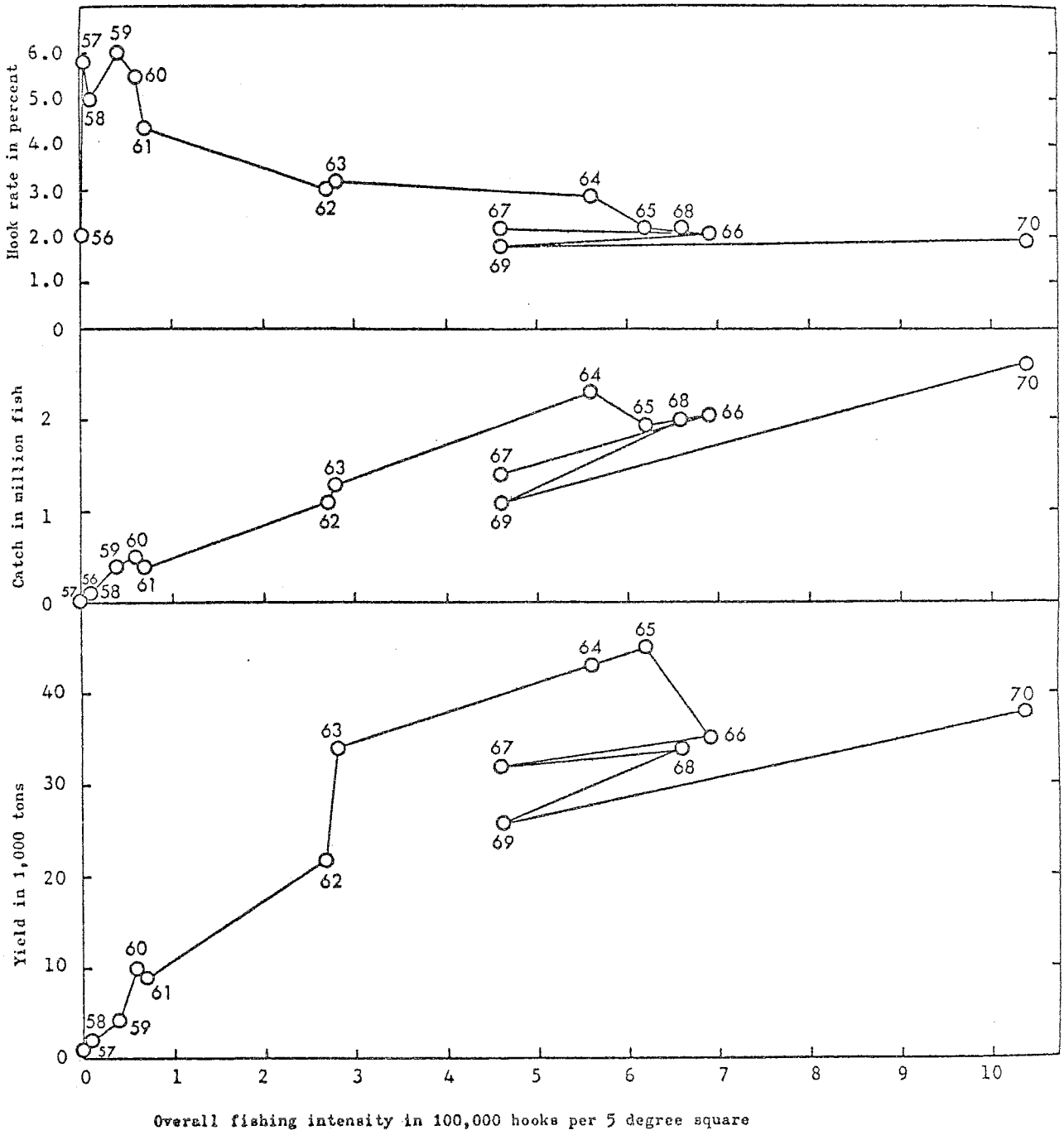


Fig. 4. Hook rate in percent, catch in number, and yield in weight of albacore, against overall fishing intensity in the Atlantic longline fishery, 1956-1970.

See footnote of Table 5 for source of data.