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Observations on Squid Stocks of ICNAF Subarea 5 and Statistical Area 6

by

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INTRODUCTION

Squid species in the Northwest Atlantic, I.C.N.A.F. Subarea 5 and Statistical area 6, represent a potential resource which until the late 1960's supported only a small coastal bait fishery (1000-2000 Metric Tons). Since the entry of distant water fleets into the fishery(beginning in 1964) reported landings have increased from 1000 MT to 48,707 MT in 1972 (preliminary 1973 statistics show 32,469 MT landed). A total allowable catch of 71,000 MT, for ICNAF Subareas 5 and 6, was adopted for 1974 at the October 1973 ICNAF Committee meeting. This paper provides a summary of landings statistics, length frequency distributions, and relative abundance indices of squid to aid in the preliminary assessment of the squid stocks in ICNAF Subarea 5 and Statistical Area 6.

BIOLOGY

There are two species of squid which are of general importance to the New England fishery, Loligo pealei (common, winter, or longfinned squid), comprises about 85-90% of the fishery. The other, Illex illecebrosus (summer or shortfinned squid) is a more northern species, fished primarily in Newfoundland waters. This paper will deal primarily with Loligo, as it is the species which is of more importance in the areas to be studied.

SPAWNING AND MIGRATIONS

Summers has done studies on spawning and migration of Loligo pealei, here is a summary from his two papers (Summers, 1969, 1971).

Loligo pealei has been reported from New Brunswick, Canada to Columbia, but is most common from Cape Cod to Cape Hatteras (within ICNAF Areas 5 and 6). Seasonal migrations of up to 200 km. allow Loligo to remain in water generally greater than 8°C. In the winter and early spring, concentrations are in deep waters (60-100 fathoms) along the continental shelf, from Cape Hatteras to Georges Bank. In late spring onshore spawning migrations begin, arriving in the Cape Hatteras-Delaware area in late April, and in the Massachusetts and Southern Georges Bank areas by early May. Corroborating his findings, the greatest concentrations of squid during this period, as indicated by commercial landings, are in June, in ICNAF division 5Zw.

The majority of the eggs, spawned in May, hatch around the beginning of July, but size differences in young of the year indicate an extended hatching period of up to seven months (Summers, 1971), with the possibility of a second spawning in late August. These late spawners may be 1 or 2 year olds which were themselves spawned late, consequently delaying their maturity. The possibility of two spawning 'seasons' is further indicated by the significant numbers of small (2-6 cm.) individuals taken from south of Hudson Canyon in late winter when most of the stock is found off the edge of the continental shelf.

Sexual maturity occurs in most 1 year olds, especially by the end of their second summer. Two year olds are mature and arrive inshore to spawn in early May, while the one year olds do not arrive until early June.

AGE AND GROWTH

Squid lack hard body parts which are normally used in age studies; they do not survive well in captivity; and they are too fragile for tagging studies. Consequently, age and growth studies must be based on length frequency distributions and biological observations. Summers (1971) describes a growth pattern for two "broods" of Loligo, hatched in July and November, with males growing slightly larger and living longer than females. Sexual dimorphism is evident beginning

at about 11 months, with males averaging 18 cm. and females 16 cm. Summers proposes that the average maximum length and age for females is 27 cm. at 24 months, and for males 45 cm. at 36 months (Table 1).

Growth seems to be continuous throughout life, averaging 1.5 cm. per month. Females' growth slows to about 1 cm. per month after age 10 months; while males do not slow down until 14 months.

COMMERCIAL LANDINGS

United States squid catches off the New England coast have been reported since the late 1800's. These landings have undergone considerable fluctuations, probably reflecting changing fishing interests as much as species abundance. Landings between 1900 and 1960 averaged 1498 MT, varying between 6 MT (in 1926) and 3597 MT (in 1928); during the period 1961-1973 the average total annual catch (landed) for the United States was 1323 MT. Total landings from 1963 to 1972 have increased 20 fold (Table 2); from 2105 MT in 1963, with only the United States reporting, to 48,707 MT in 1972, with 11 countries participating in the fishery (1973 preliminary landing reports are 32,469 MT). Intensified fishing pressure was begun by the U.S.S.R. and Japan, in 1968, and by Spain in 1970.

CATCH AND EFFORT

Commercial catch-effort data can be used as an index of relative abundance, but it was not until 1972 that squid were reported as a main species to which effort could be applied. This data is still scarce, but in the future catch-per-day statistics may be compared among years as an indication of population size and availability to the fishery.

In 1972 catch-effort data was reported in the ICNAF Statistical Bulletin by Spain, France, the Federal Republic of Germany, and the United States. Most of this effort was exerted by otter trawl, though the F.R.G. reports landings and effort for mid-water trawls, in Statistical Area 6 (Table 3).

United States effort for squid is concentrated in Division 5Zw, with side otter trawls, classes 2 and 3 (50-150 tons), fishing primarily in May and June with small amounts of effort throughout the

year by the smaller boats. In 1972 Spain fished in Division 5Ze during February, and in 5Zw from January to April. Spain also fished Statistical Area 6 throughout the year, as did France. The F.R.G. only reported effort for squid during October-December, in SA6.

LENGTH COMPOSITION OF COMMERCIAL LANDINGS

U.S. commercial length samples for squid, from the otter trawl fishery, are not available prior to July 1972; monthly samples since then indicate that a majority of the squid landed are in the 10 to 24 cm. range (dorsal mantle length) (Figs. 1a-f). The mean size of squid taken by a commercial vessel working with the National Marine Fisheries Service, was 13 cm. These are young, immature squid (Loligo) from the Hudson Canyon area in January, prior to their first spawning migration. Samples taken at various ports from commercial vessels indicate high landings of these immature Loligo throughout the year; with catches of larger, mature squid being very much lower.

Some landings of mature 2-3 year olds are made from Divisions 5Zw and 6A during March and April, presumably as they migrate shoreward for spawning. Landings in Division 6A seem to be the most well balanced with strong landings of larger squid, even to 41 cm., during March and April, and some in the 18-22 cm. range in the late summer.

RESEARCH VESSEL SURVEYS

Stratified mean L_n catches per tow of squid for U.S. Groundfish Survey Cruise (Grosslein, 1969) data were briefly examined (Table 4), with the areas of the stratas used as the weighting factors for these abundance indices. The generalized distribution of Loligo from the surveys is given in Figures 2A, B, C, D. The inshore-autumn, offshore-spring, movement is clearly evident. Using strata sets roughly approximating the areas of the Middle-Atlantic (61-76), Southern New England (1-12), Southern (13-15), Eastern (16-18), and Northern Georges Bank (19-25) (Figure 3), from Fall and Spring cruises, over a seven year period (1967-1973), L_n mean numbers and weights (Fig. 4A, B) per tow generally show an increase in abundance in years when temperatures were higher, and decreased when temperatures were lower than seasonal norms. The relationship of this phenomena

to abundance, and to availability to gear cannot be separated at this time. Loligo indices in the fall, when the water temperatures are highest, are about ten times their spring values (Illex shows about a twenty-fold increase in fall over spring, though Loligo's indices are about 40 times those of Illex in this study area).

SURVEY LENGTH COMPOSITION

Length composition of Loligo from survey data, stratified mean number at length per tow (Fig. 5a-j), indicates two strong size modes in the spring (4-7 cm. and 12-16 cm.). These correspond to the two 'broods' (Summers, 1971) of the '0' age class. The mean number per tow in all strata sets in spring (March and April) is low, indicating that onshore spawning movement has not yet begun.

In the fall (October and November) the mean numbers per tow increase in all areas. The most abundant size group at this time prior to the offshore migration, is 3-6 cm., indicating recruitment of the '0' age class. There is another small mode at 10-12 cm. but only a very few larger, to 30 cm.

The mean numbers per tow for Illex were always low in these areas (less than 2 in most cases), but when these numbers were expanded ($x10^3$) modes could be observed at about 4-6 cm., 18-19 cm., and 20-23 cm., in the fall, with observations at length in the spring too few to determine modes.

DISCUSSION

Increased interests in developing the squid fishery in Subarea 5 and Statistical Area 6 have prompted ICNAF to set a quota on their landings. Though squid catches over the past ten years have been on a continual rise, the relationship to a maximum sustainable yield is not known. These are short-lived species (2-3 years), and fishing pressure on larger squid, which have already spawned (18-30 cm.) should not have an effect on stock size. However, both commercial and survey vessel length compositions indicate that catches center around small, immature individuals, rather than the larger squid. Japan divides its catch of squid into eight size categories (Ikeda and Nagasaki, 1973) of these only four (averaging just 20% of the catch)

are in the range of mature individuals. United States commercial data shows that a large majority of U.S. squid landings are also immature.

Japanese mesh selection studies (1) indicate a selection factor for Loligo of 1.92; the 50% point for retention in 60 mm. mesh was 11.5 cm. squid, and for 62 mm. mesh 11.9 cm. Using this selection factor, in order to retain only larger, mature Loligo (≥18 cm.) mesh sizes of 95 mm. or greater would have to be used. At present most U.S. fishermen harvesting squid are using mesh sizes in the 38-50 mm. range. Japanese vessels in the squid fishery use nets with openings of 48-63 mm.and the F.R.G. vessels 45 mm. (ICNAF Redbook, 1973, Part 1). If a fishery is based on immature individuals, as landings of squid indicate, it cannot be maintained for an extended period of time. Before squid are exploited to a greater degree than they are at present, an accurate assessment must be made of the stock's strength, and possibilities of mesh regulations should be investigated.

LITERATURE CITED

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Summers, W. C., 1971. Age and growth of Loligo pealei, a population study of the common Atlantic coast squid. Biol. Bulletin, 141: 189-201.

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(1) Ikeda, I., 1973. Personal communication with Dr. M. Grosslein.

Table 1. Age at length estimates for Loligo pealei (Summers, 1971), showing two 'broods'.

Age (months)	Date, first of month July (Broods)	Nov.	Mean length, cm. Doral mantle Females	Males
0	July	Nov.	0.2	0.2
2	Sept.	Jan.	4	4
4	Nov.	Mar.	7	7
6	Jan.	May	10	10
8	Mar.	July	12	12
10	May	Sept.	14	15
12	July	Nov.	16	18
14	Sept.	Jan.	18	21
16	Nov.	Mar.	20	23
18	Jan.	May	21	25
20	Mar.	July	23	28
22	May	Sept.	25*	30
24	July	Nov.	27*	32
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34-36	May-July	--	--	45

*Extrapolated from observed data.

Table 2. Annual squid landings in metric tons, 1963-1972, by country. ICNAF Areas 5 and 6.

		COUNTRY												
Areas	Year	Canada	Bulgaria	France	Fed. Rep. Ger.	Japan	Italy	Spain	Poland	Romania	USSR	USA	FDR	Total
5 & 6	1963											2,105		2,105
	1964										4	929		933
	1965										176	1,154		1,330
	1966										389	1,173		1,562
	1967					6					833	1,829		2,662
	1968					1,731					3,176	1,762	10	6,679
	1969					7,122					1,340	1,461	1	9,924
	1970					13,639		4,510			655	1,061	20	19,885
	1971	1	90			10,602		4,187			6,138	1,182		22,210
	1972		499	296	463	18,691	3,200	11,859	5,428	67	6,976	1,214	14	48,707
5Z	1970												20	20
	1971	1				4,661					4,692	394		9,748
	1972			6	63	7,862			5,042	28	6,301	422		19,724
6	1963											895		895
	1964											740		740
	1965											767		767
	1966										48	980		1,028
	1967					6					503	916		1,425
	1968					1,619					761	859		3,239
	1969					3,398					158	722		4,278
	1970					8,276					---	578		8,854
	1971		10			5,941		3,941			479	471		10,988
	1972		19	290	400	10,829	3,200	6,063	836	39	595	748		22,569

Table 3. 1972 catch and effort for squid in ICNAF areas 5 and 6 (as reported in the 1972 ICNAF Statistical Bulletin).

Area	Gear	Country	Days Fished	(MT) Landings	c/E
5Ze	Otter trawl	Spain	272	3,916	14.40
		France(m)	3	6	2.00
5Zw	" "	U.S.A.	29	132	4.55
		Spain	221	1,886	8.53
		F.R.G.	7	63	9.00
6A	" "	U.S.A.	10	35	3.50
		Spain	80	638	7.98
		France(m)	7	66	9.43
		F.R.G.	35	291	8.31
"	Mid-water trawl	F.R.G.	7	23	3.29

Table 4. Stratified L_n mean catches per tow (in pounds); and temperature for Loligo pealei, from U.S. survey vessel, spring and fall cruises, 1967-1973.

			SPRING		FALL	
Area	Strata	Year	Log $\bar{w}$t/tow	Temp.°C**	Log $\bar{w}$t./tow	Temp.°C
Mid-Atl.	61-76	1967	---	---	2.18	13.3
		1968	.28	5.7	2.32	13.6
		1969	.14	5.5	2.29	15.5
		1970	.35	7.5	1.46	10.0
		1971	.44	6.9	1.18	13.1
		1972	1.47	8.7	2.68	16.0
		*1973	.82	8.0	2.62	14.4
		1974				
So. New England	1-12	1967	---		.74	9.6
		1968	.45	5.0	1.92	11.1
		1969	.49	5.7	2.47	12.1
		1970	.41	6.1	1.41	10.6
		1971	.76	6.3	1.45	10.8
		1972	.85	7.0	1.48	12.7
		1973	.75	6.8	2.71	13.0
		1974				
So. Georges Bank	13-15	1967	---	---	.66	8.4
		1968	.63	6.3	.57	12.6
		1969	1.02	6.8	1.26	12.7
		1970	.36	5.9	.80	10.8
		1971	.63	5.8	.89	11.9
		1972	.89	7.3	.69	11.8
		1973	1.23	8.9	1.81	13.2
		1974				
East Georges Bank	16-18	1967	---	---	.41	8.2
		1968	.00	3.9	.54	10.3
		1969	.18	5.4	.60	10.1
		1970	.13	4.8	.85	9.2
		1971	.05	4.6	.37	10.8
		1972	.06	5.8	.19	10.2
		1973	.00	6.2	1.87	11.9
		1974				
N. Georges Bank	19-25	1967	---	---	.02	7.1
		1968	.00	4.7	.18	9.7
		1969	.00	4.7	.36	8.9
		1970	.00	5.0	.39	9.9
		1971	.00	4.8	.60	11.2
		1972	.00	5.0	.73	10.5
		1973	.00	5.4	1.25	11.0
		1974				

*Spring 1973 cruises were made with a 41 trawl, instead of Yankee 36; relative abundances are not comparable.

**Mean temperatures per strata set.

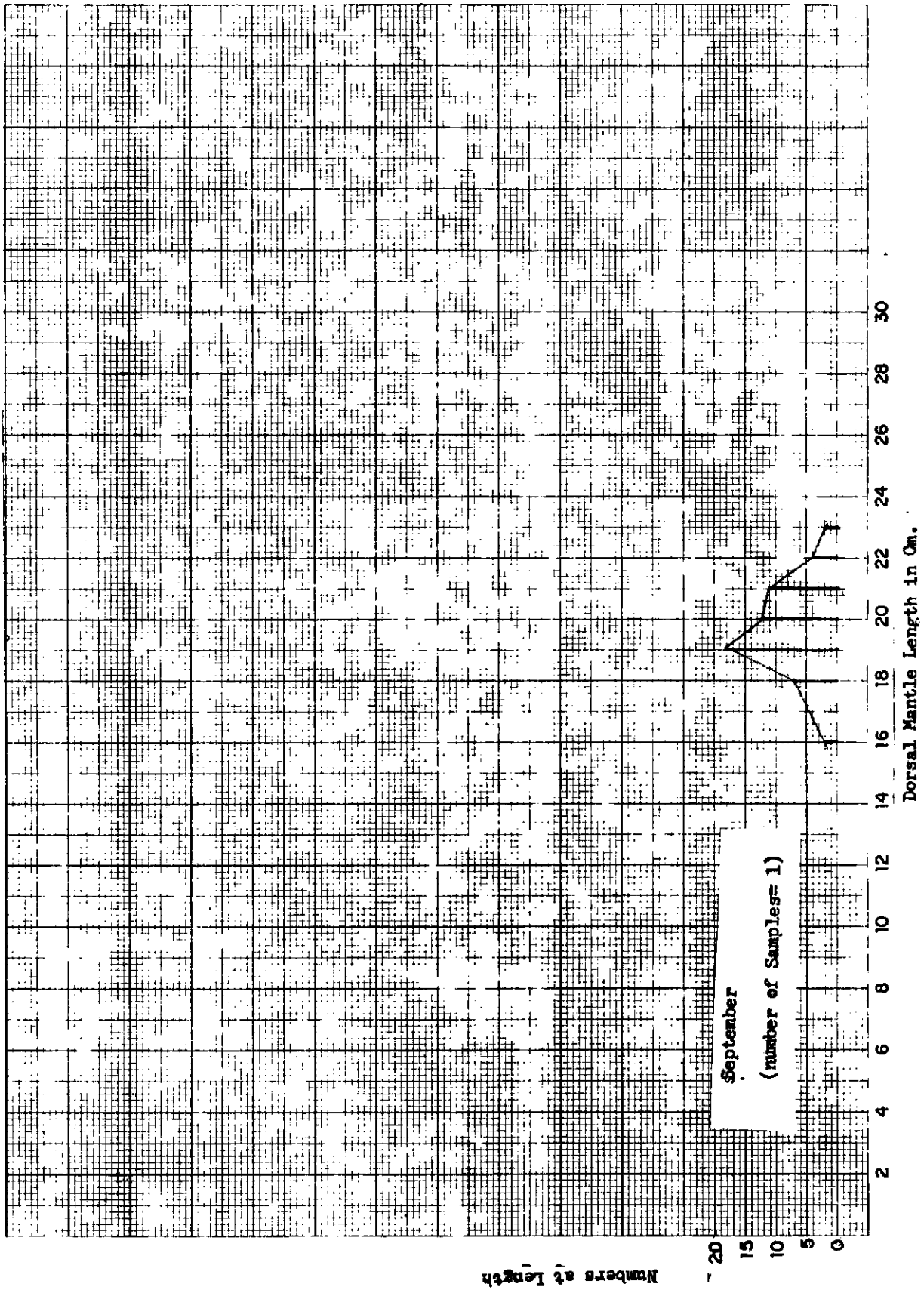
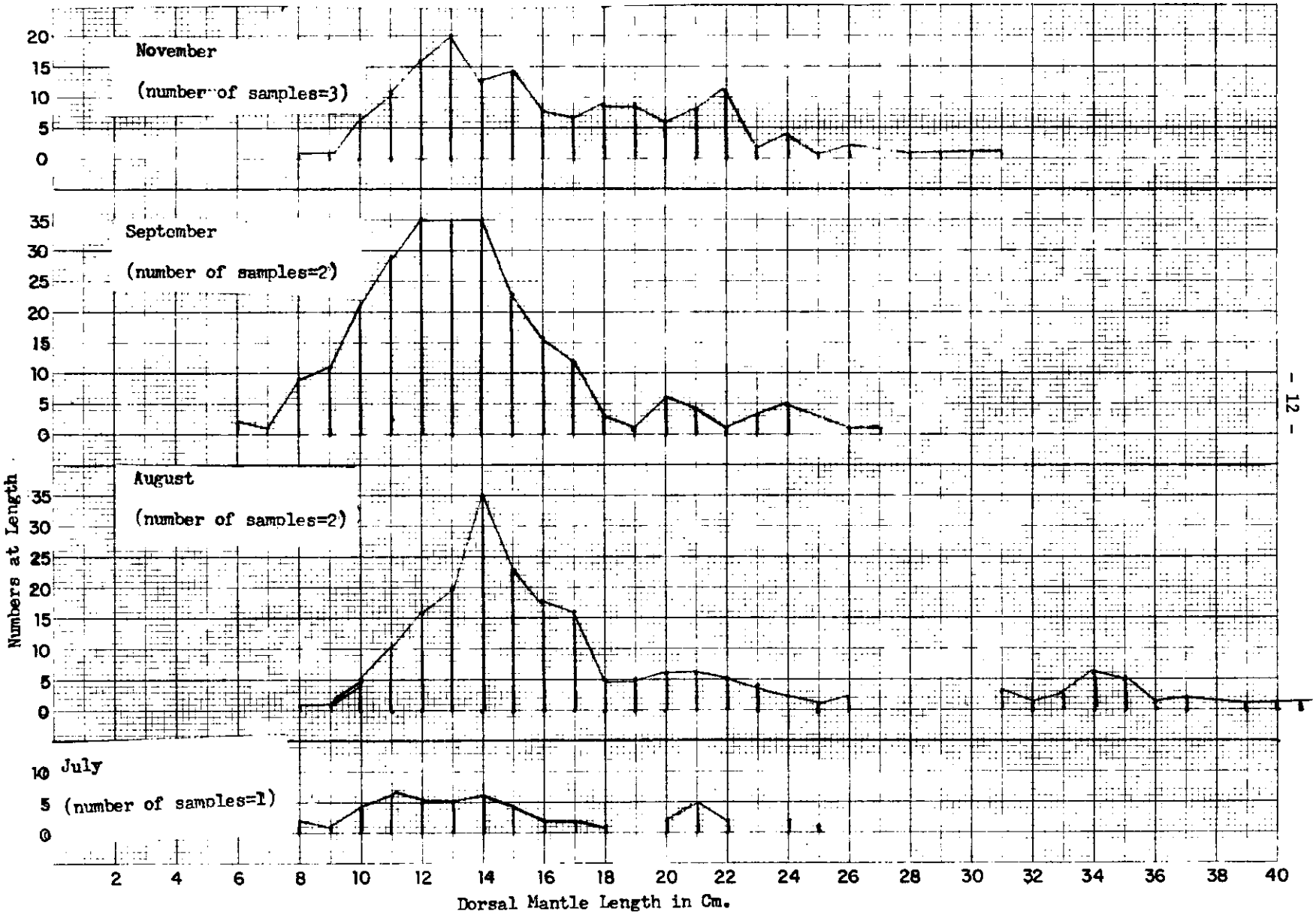


Figure 1A. 1972 Loligo Commercial Length-Frequency Samples, Division 5Y.

SEE 20x20 TO INCH

Figure 1B. 1972 Loligo Commercial Length-Frequency Samples, Division 52w.



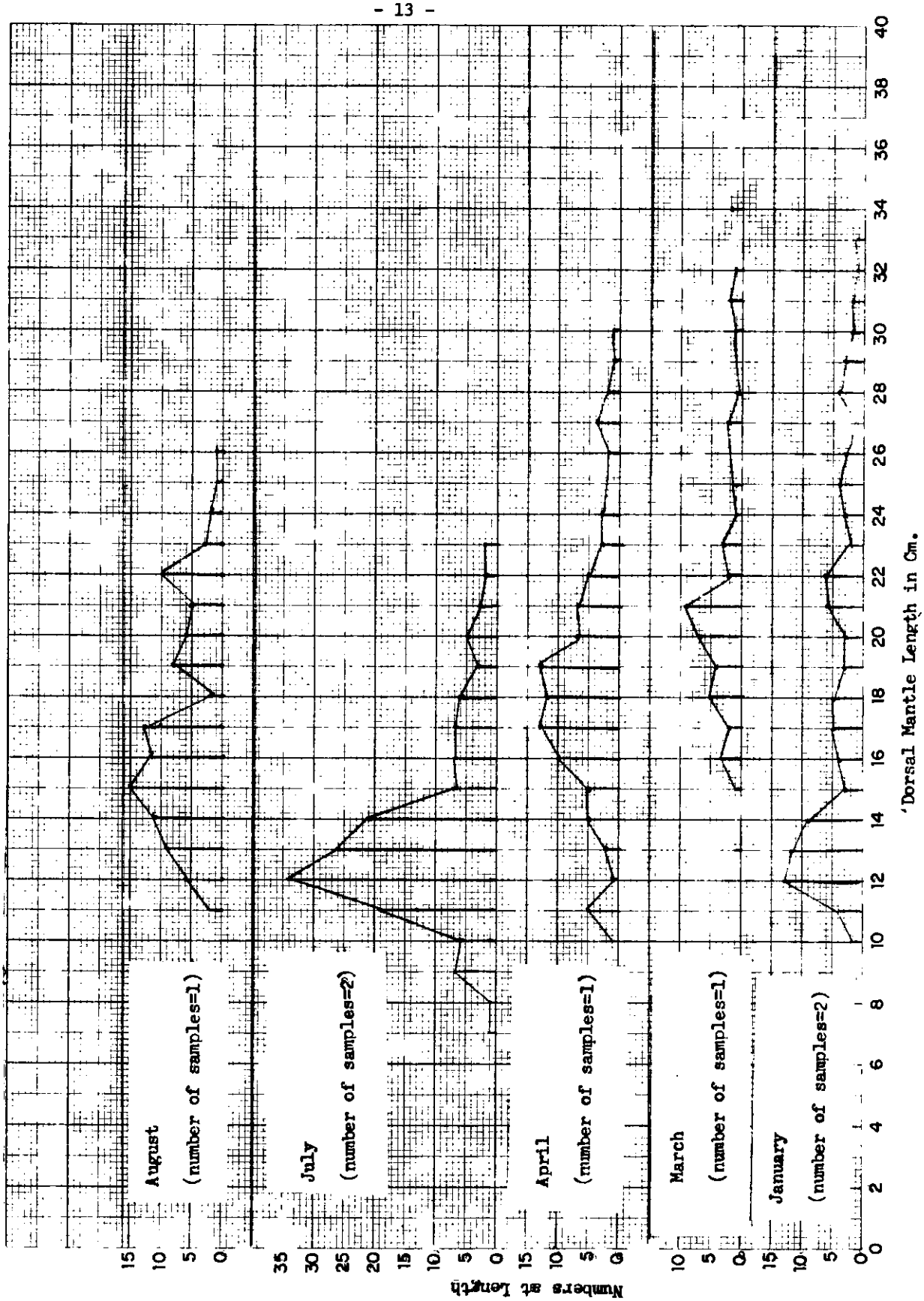


Figure 1C. 1973 Loligo Commercial Length-Frequency Samples, Division 5Zw.

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Figure 1D. 1972 Loligo Commercial Length-Frequency Samples, Division 6A.

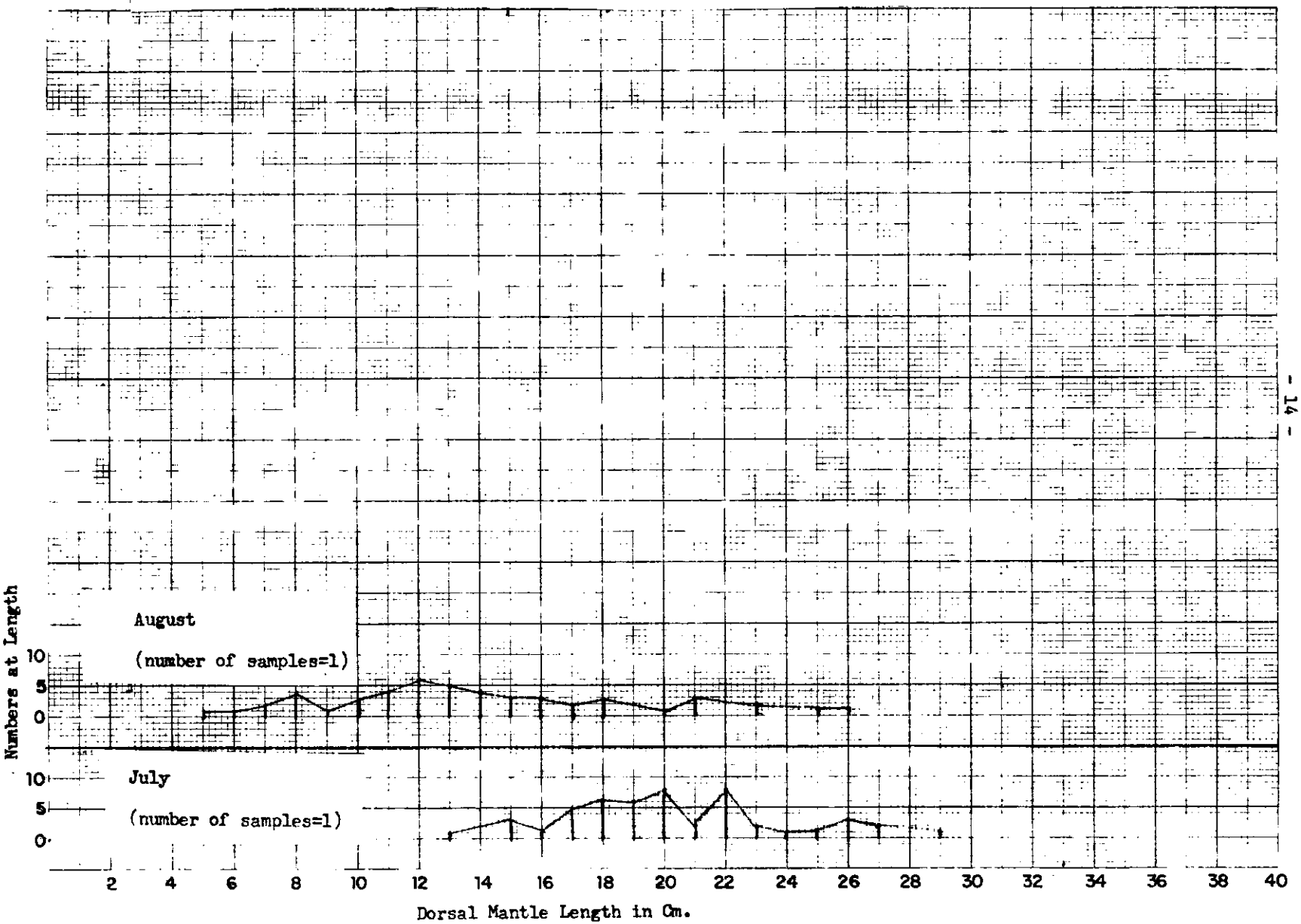

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Figure 1E. 1973 Loligo Commercial Length-Frequency Samples, Division 6A.

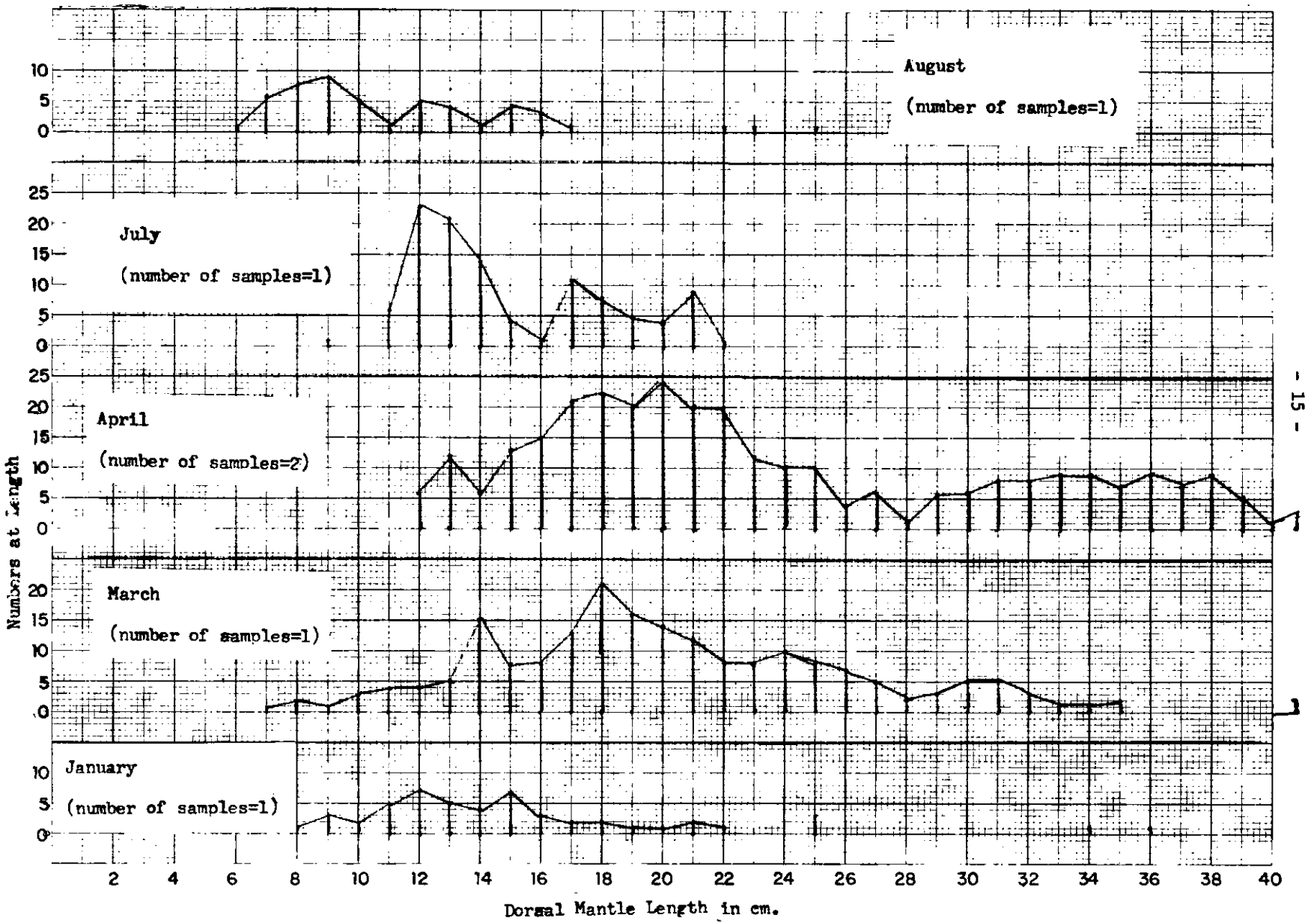

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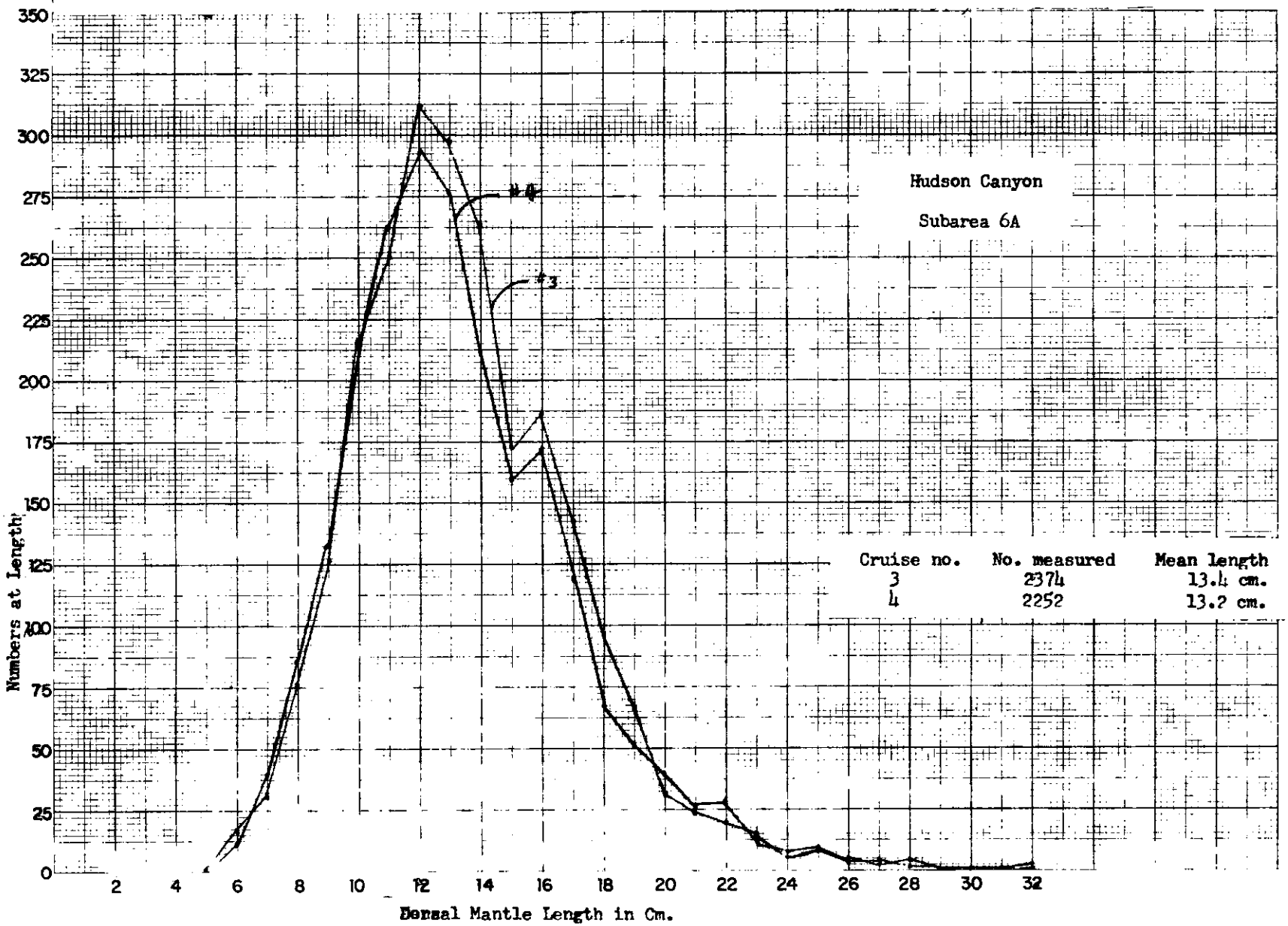
Figure 1F. Jan.-Feb.,1974 Loligo Length-Frequency Samples, F/V Valykrie(For New England Fishery Development Program)



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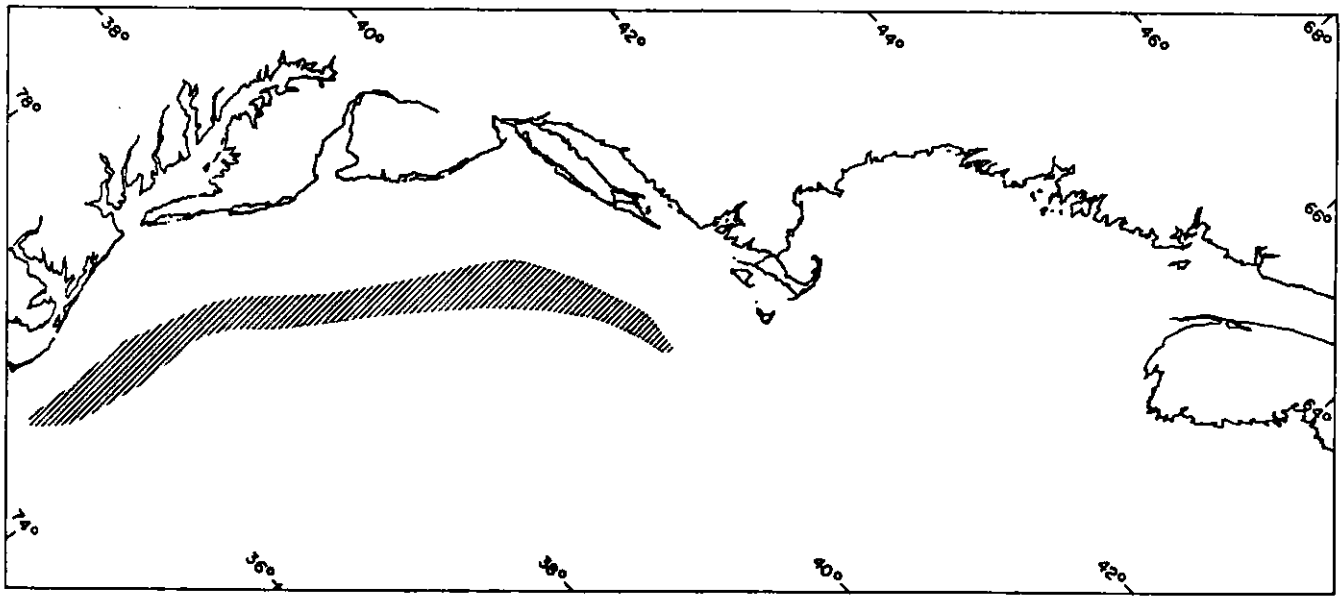


Figure 2a. Distribution of Loligo pealei; Spring Surveys 1970-1971, Albatros IV.

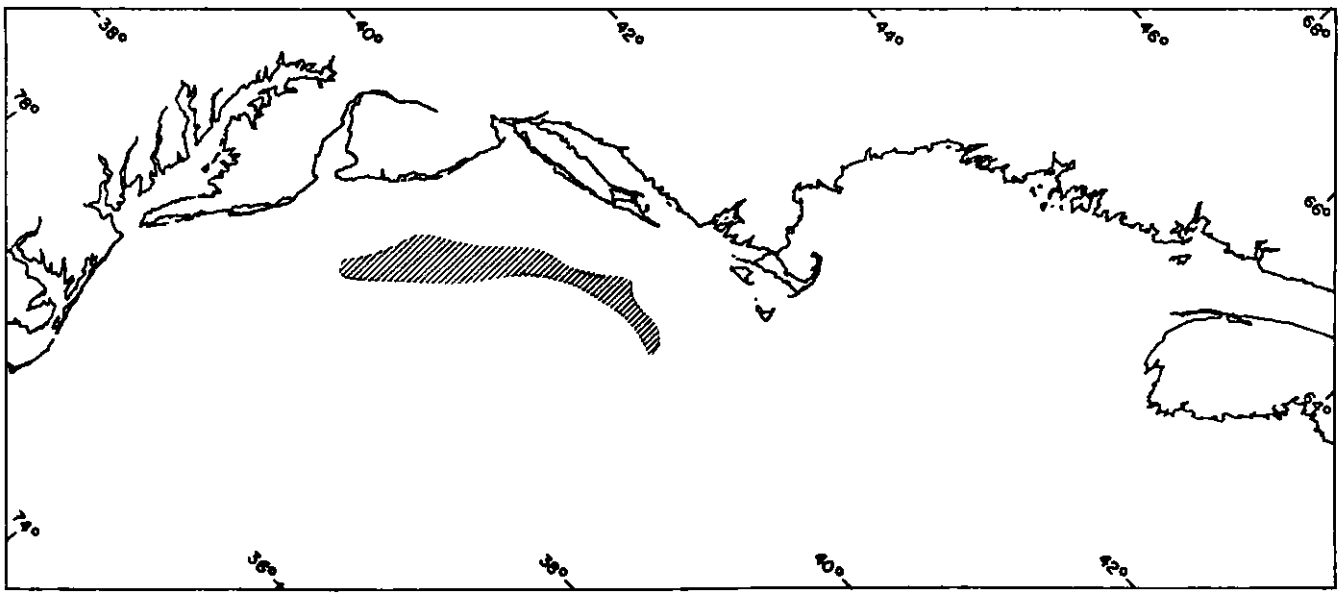


Figure 2b. Distribution of Loligo pealei; Spring Surveys 1972-1973, Albatros IV.

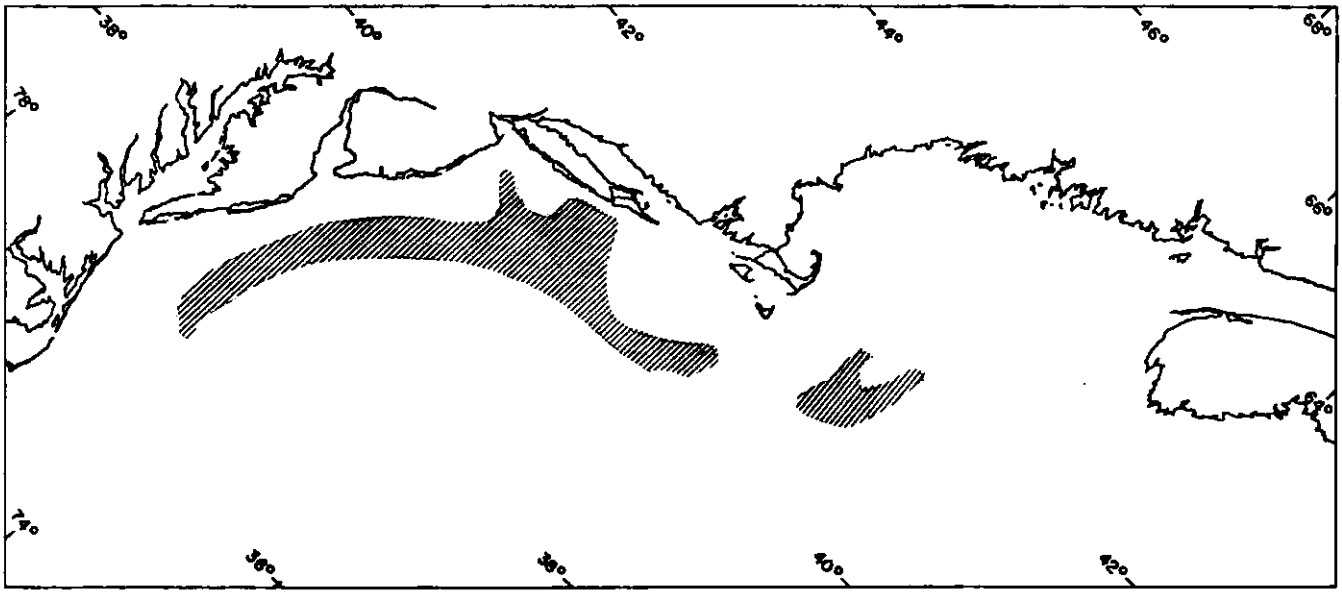


Figure 2c. Distribution of Loligo pealei; Autumn Surveys 1972-1973, Albatros IV.

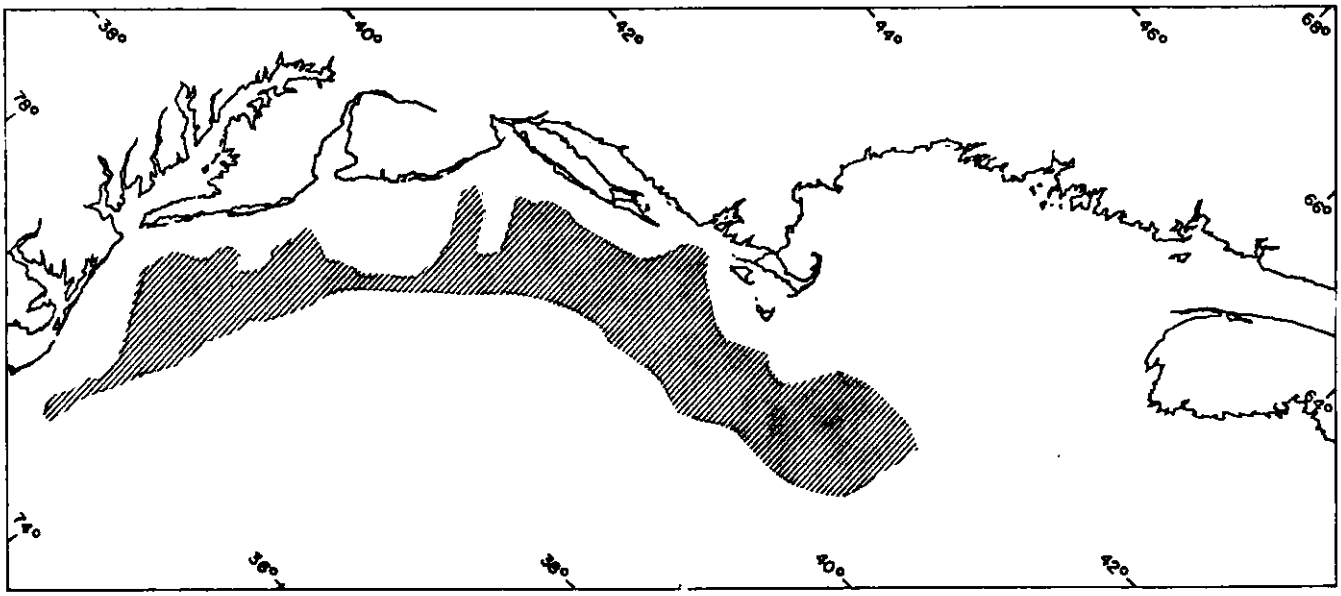


Figure 2d. Distribution of Loligo pealei; Autumn Surveys 1970-1971, Albatros IV.

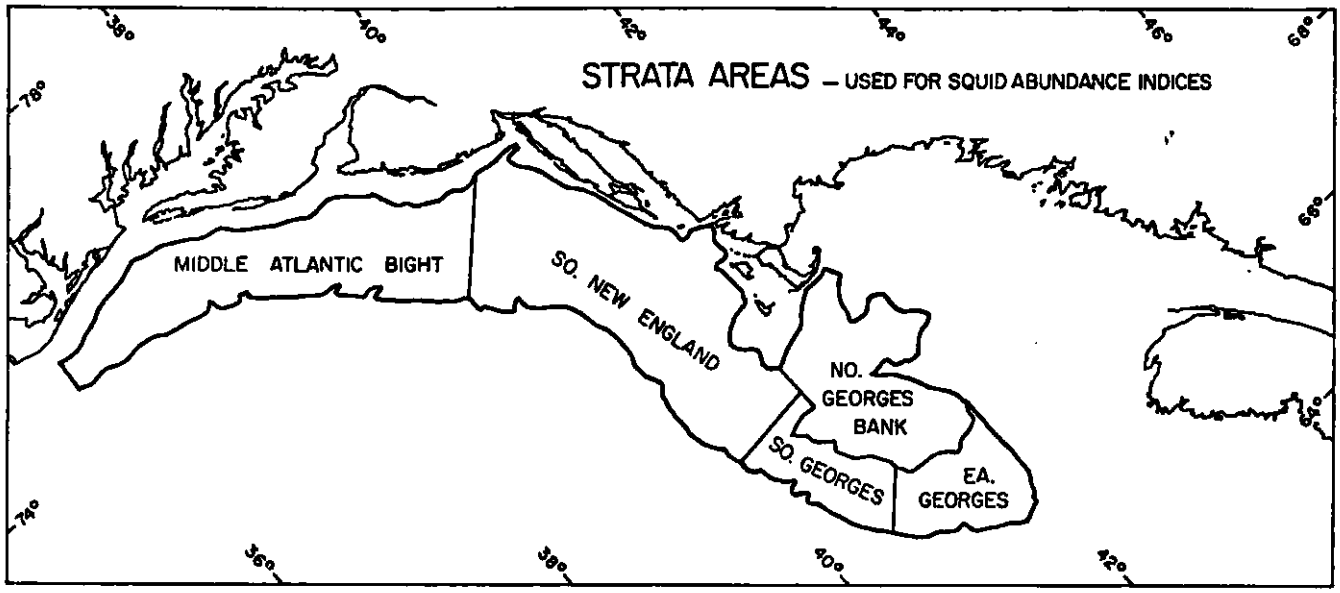
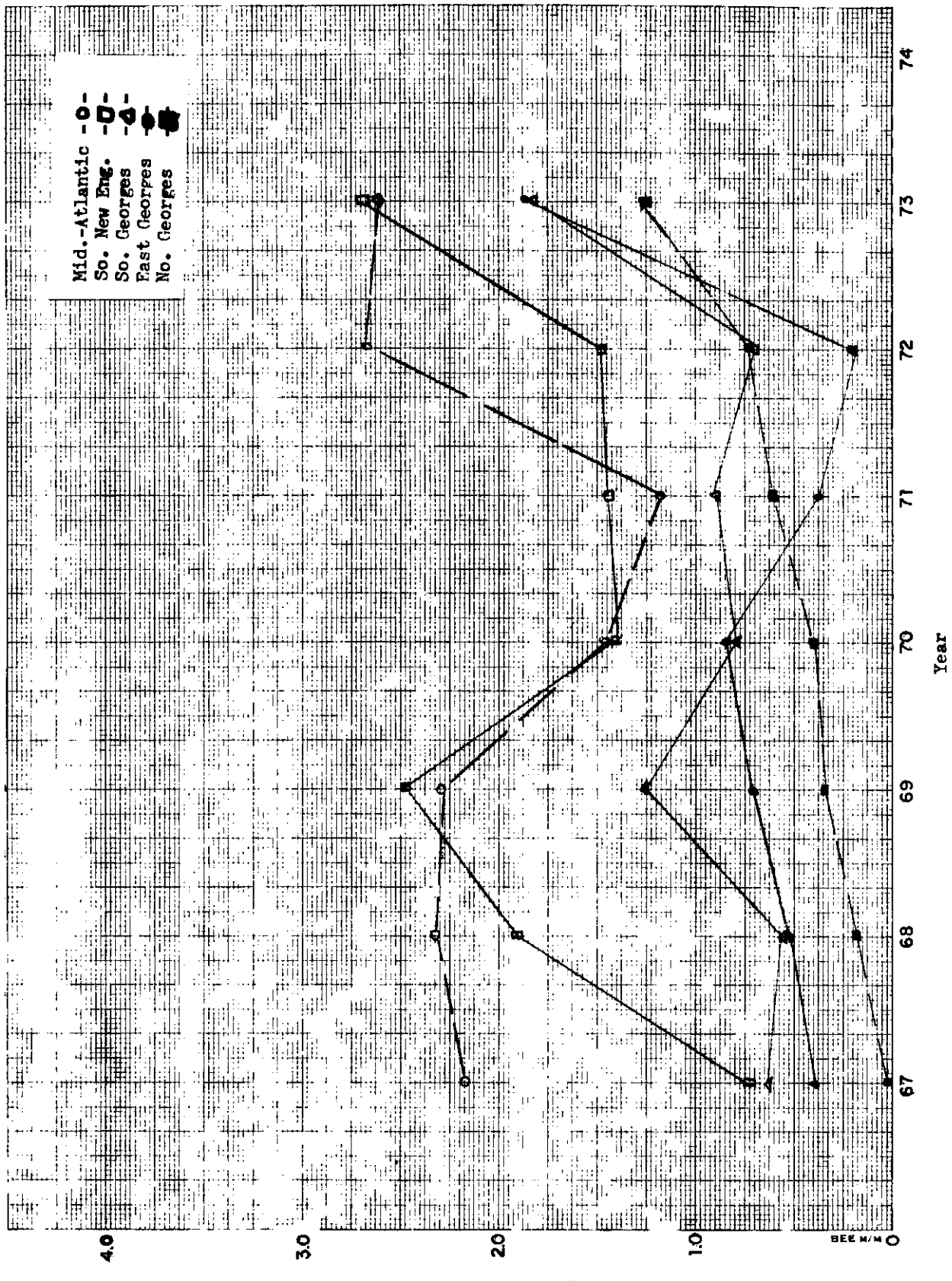


Figure 3. Areas representing strata sets used in calculations of abundance indices for Loligo pealei.

Figure 4a. Autumn Abundance Indices- Loligo- Mean ln pounds per tow



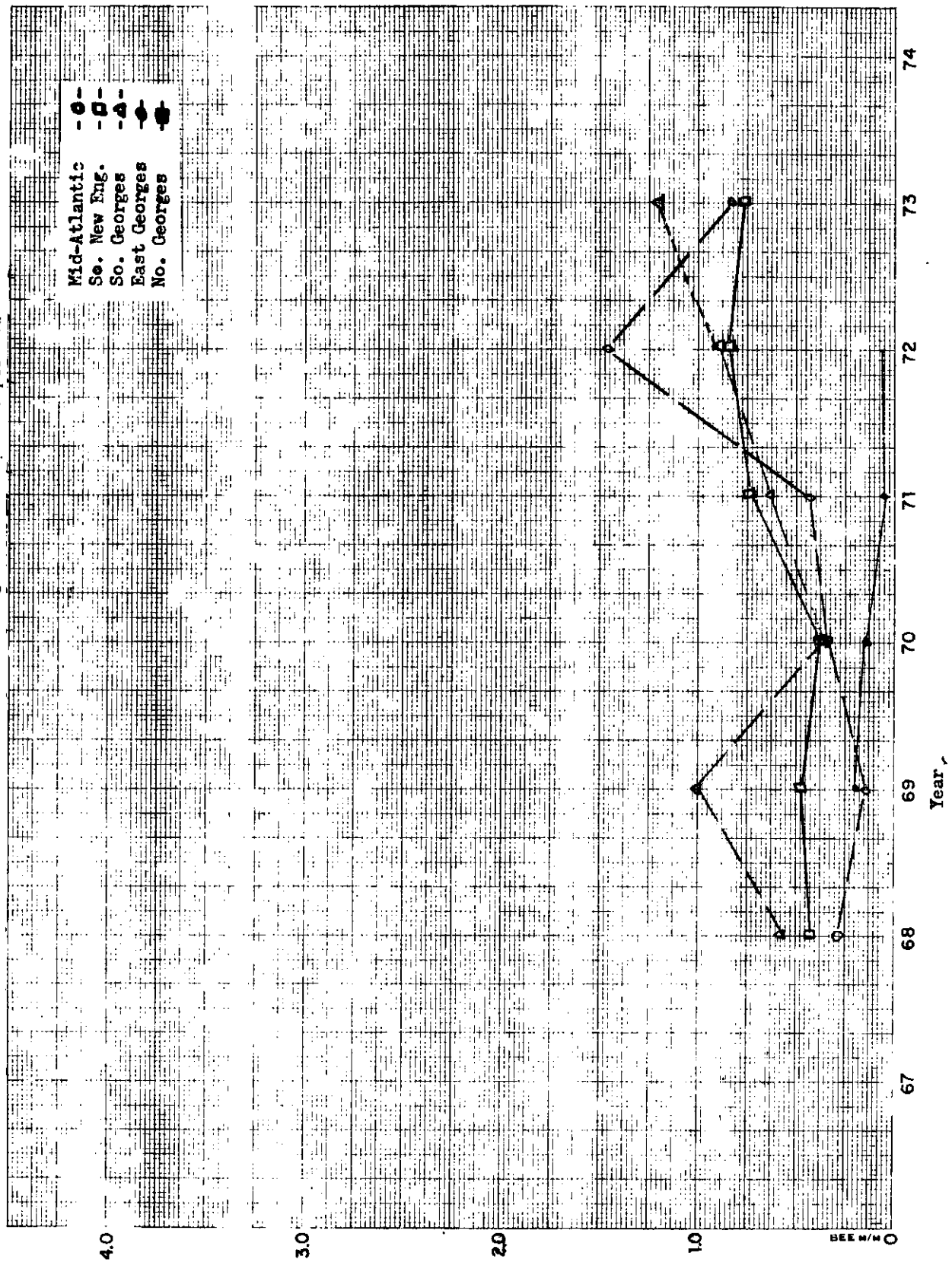


Figure 4b. Spring Abundance Indices - Loligo - Mean ln pounds per tow

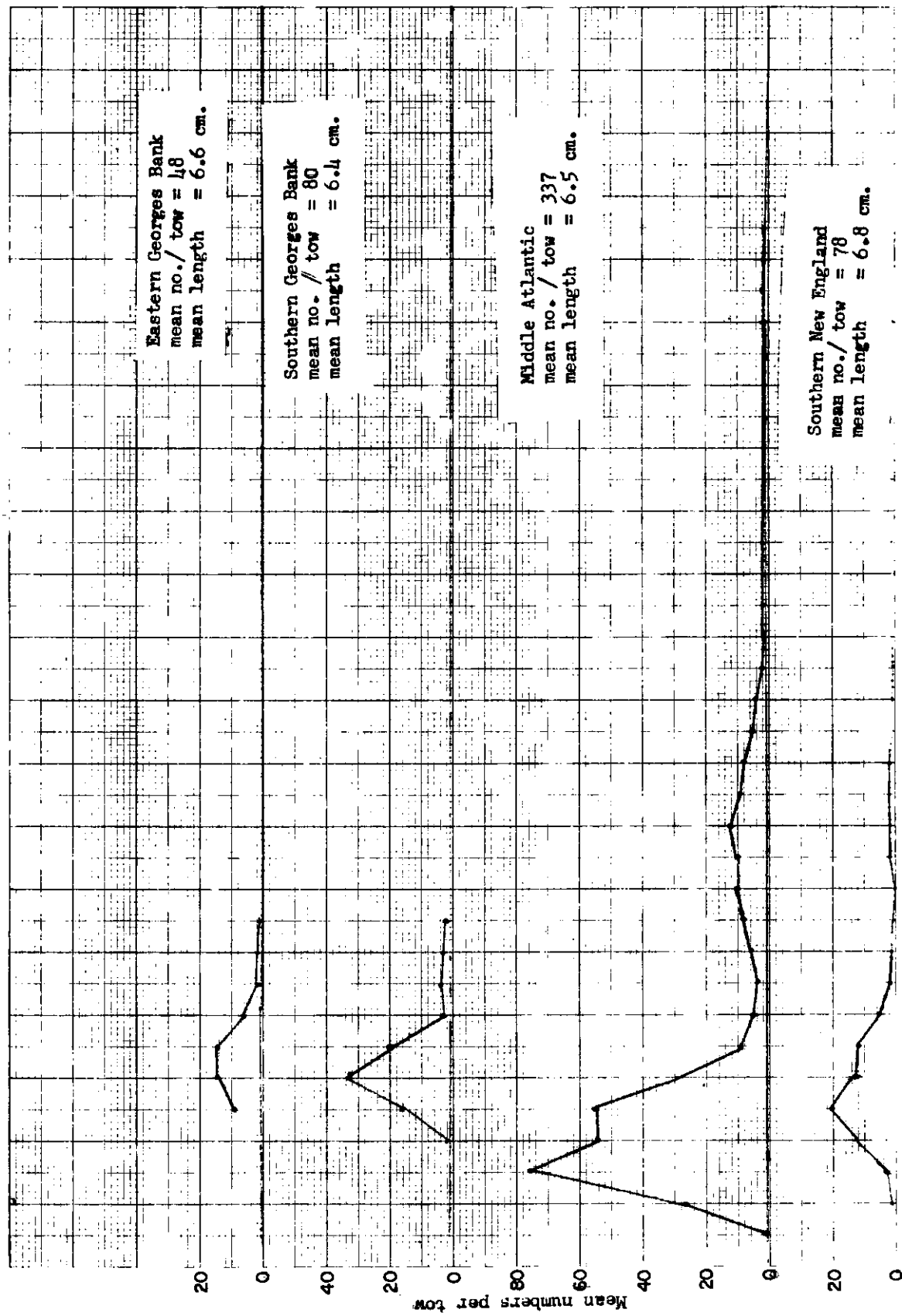


Figure 5a. Loligo length-frequency, from Autumn, 1967 Survey Cruise

BEE 20x20 TO INCH

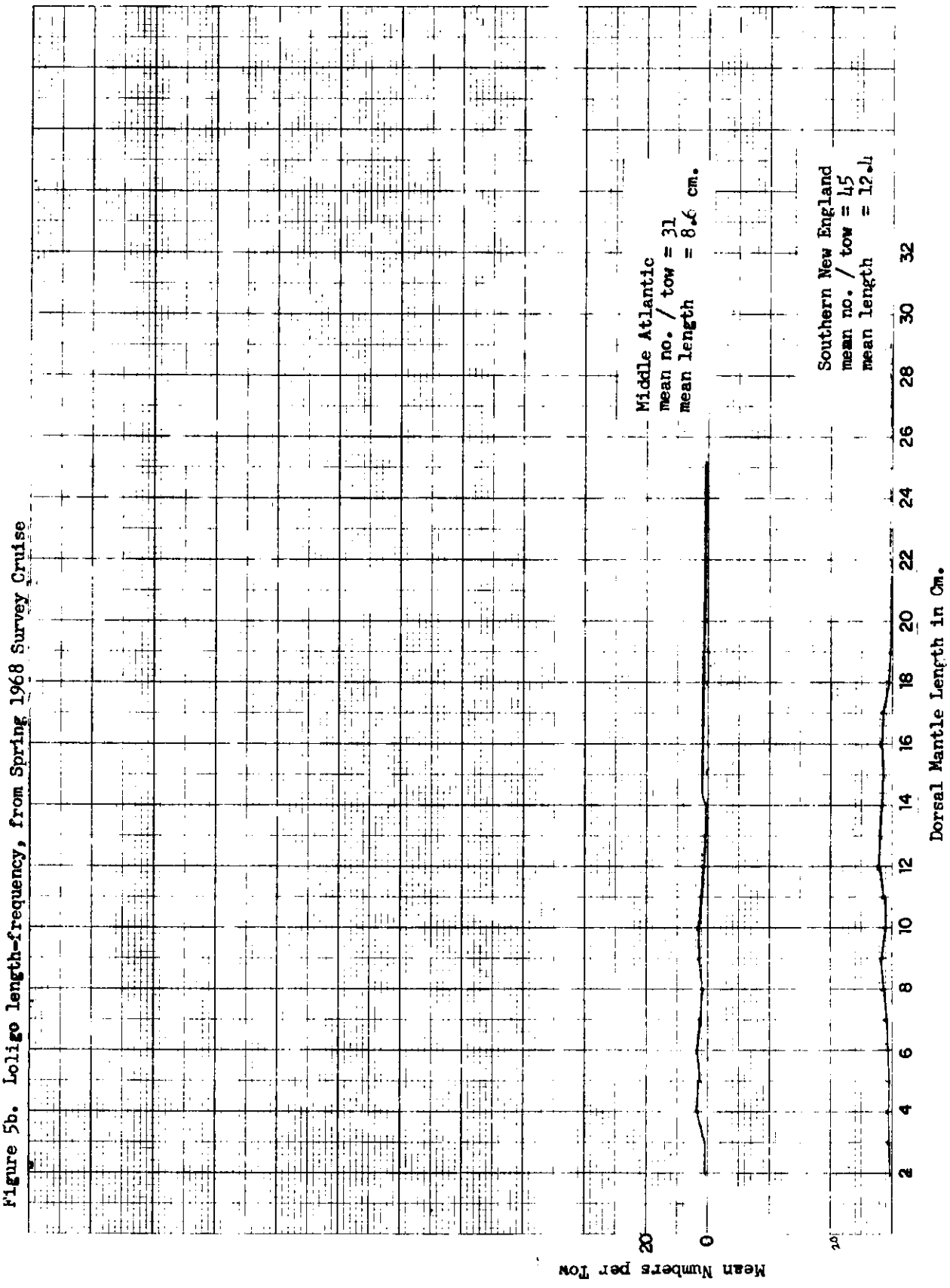


Figure 5b. Loligo length-frequency, from Spring 1968 Survey Cruise

BEE 20x20 TO INCH

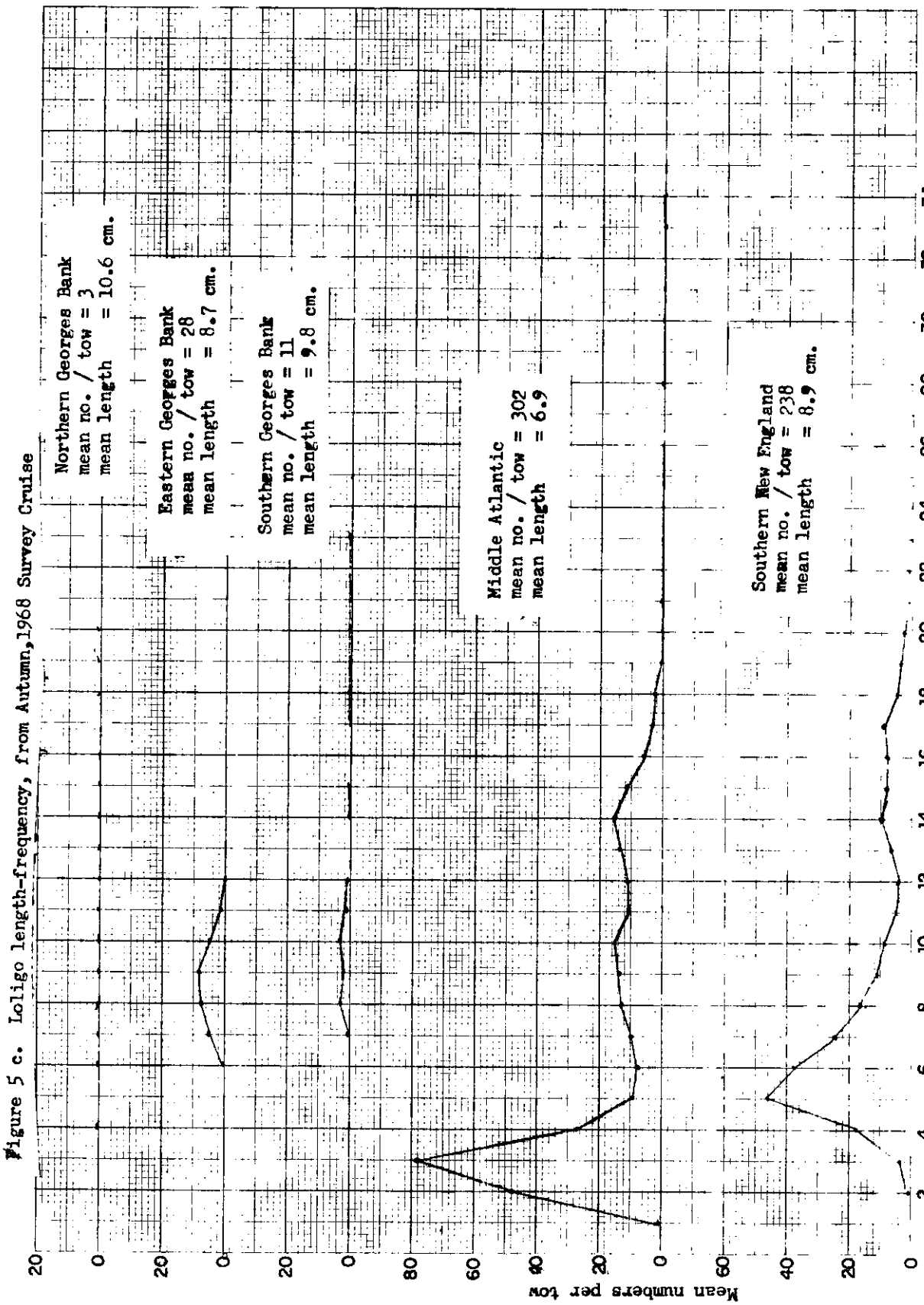


Figure 5 c. Loligo length-frequency, from Autumn, 1968 Survey Cruise

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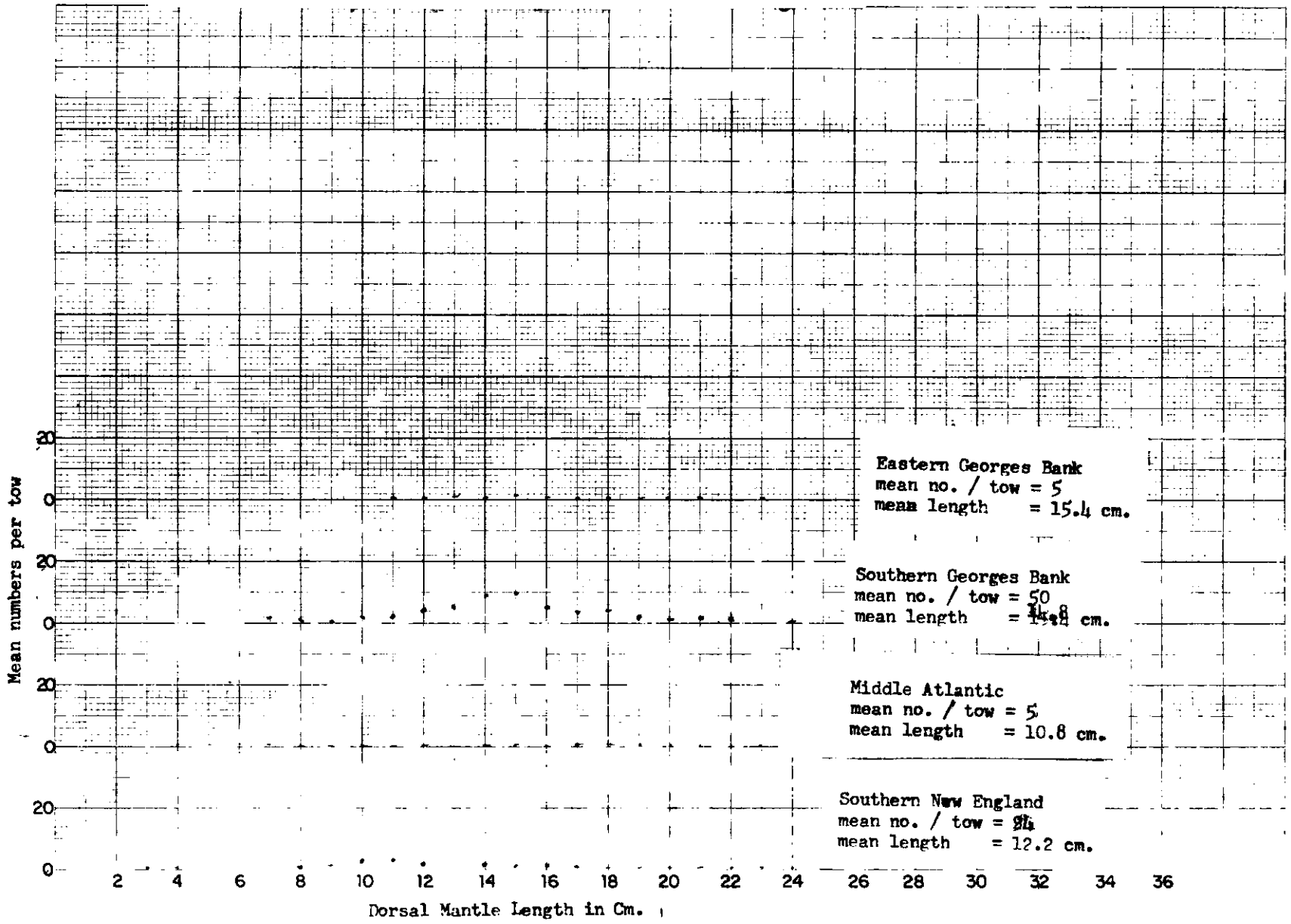
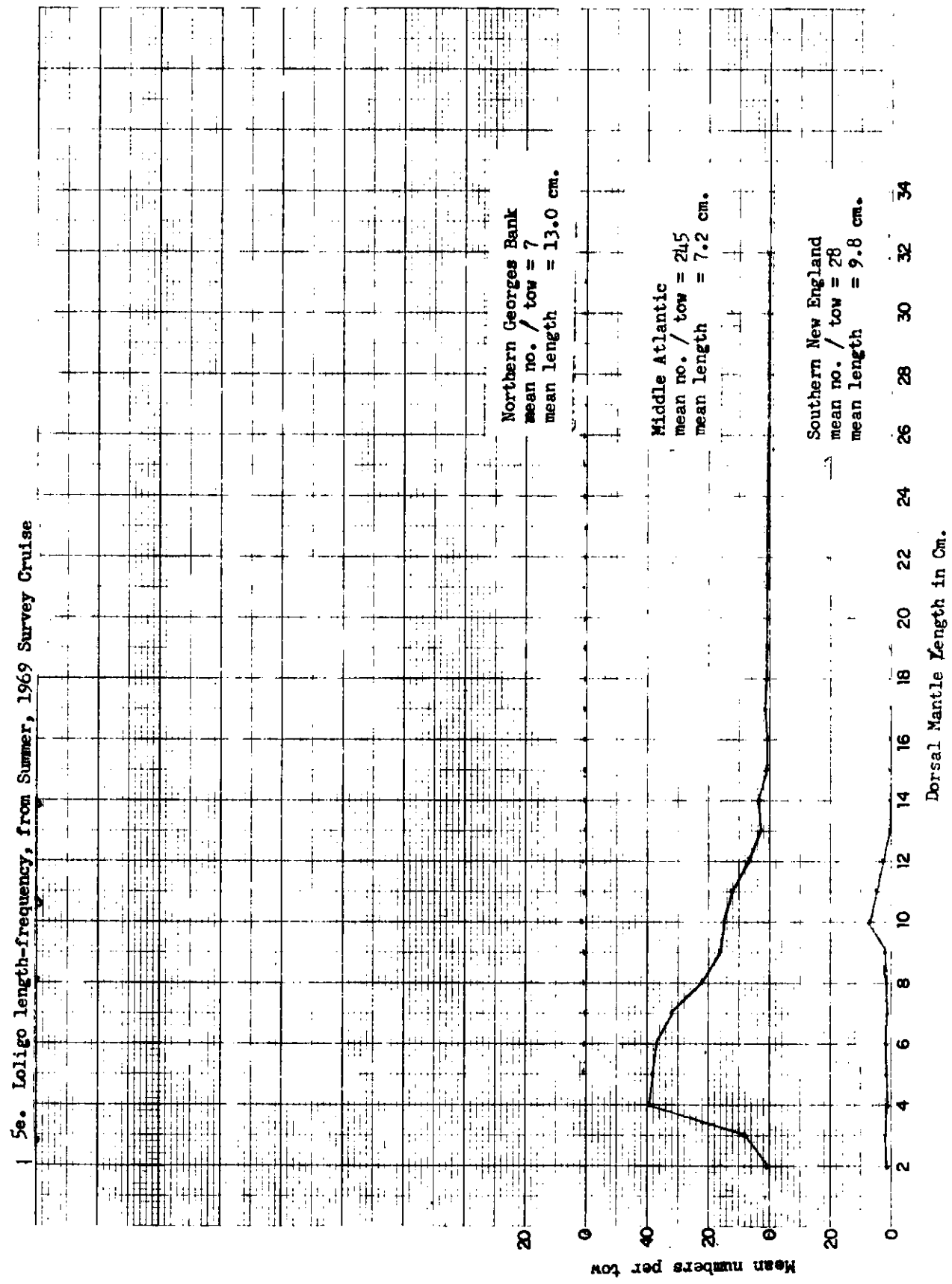
Figure 5d . Loligo length-frequency from Spring 1969 Survey Cruise





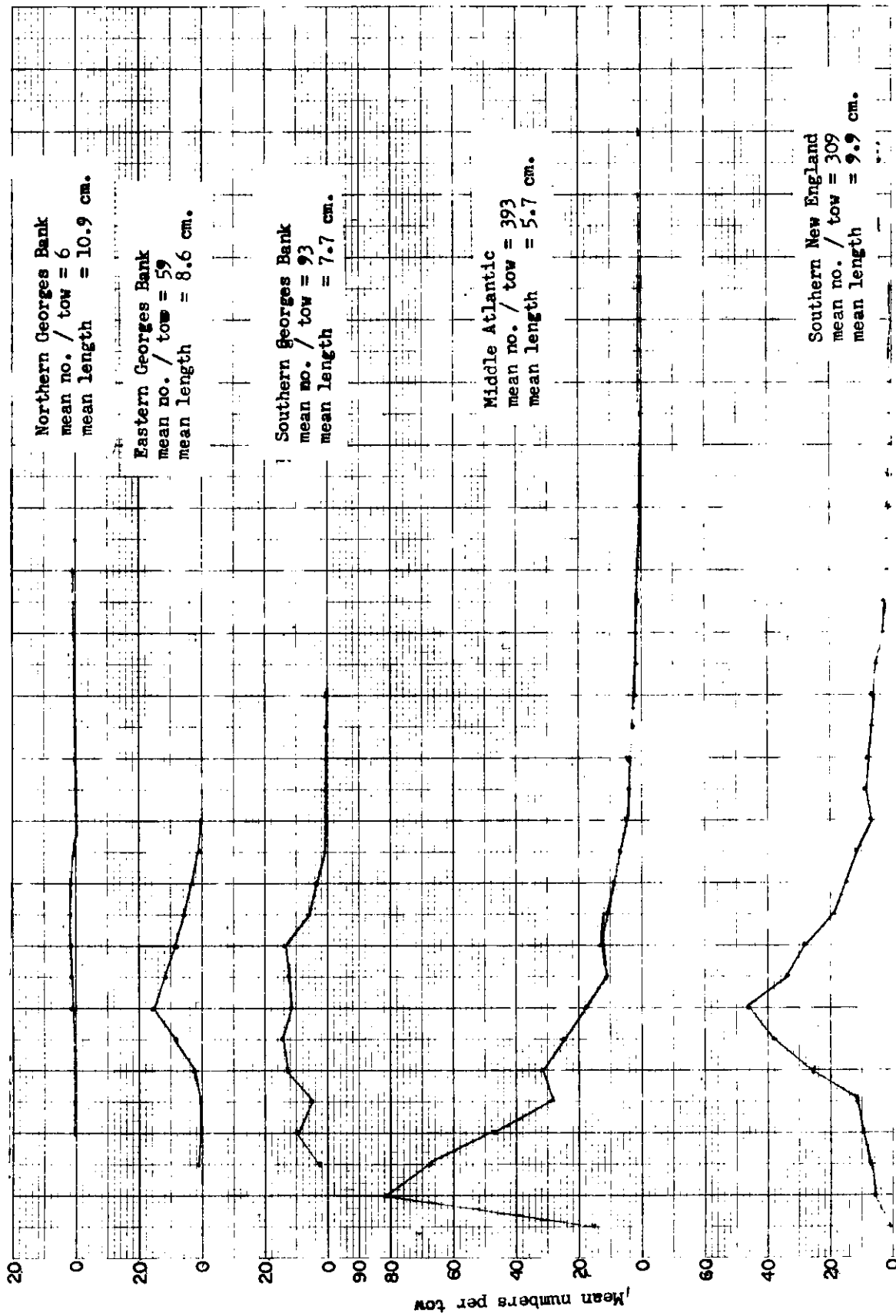


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Figure 5f. Loligo length-frequency, from Autumn, 1969 Survey Cruise

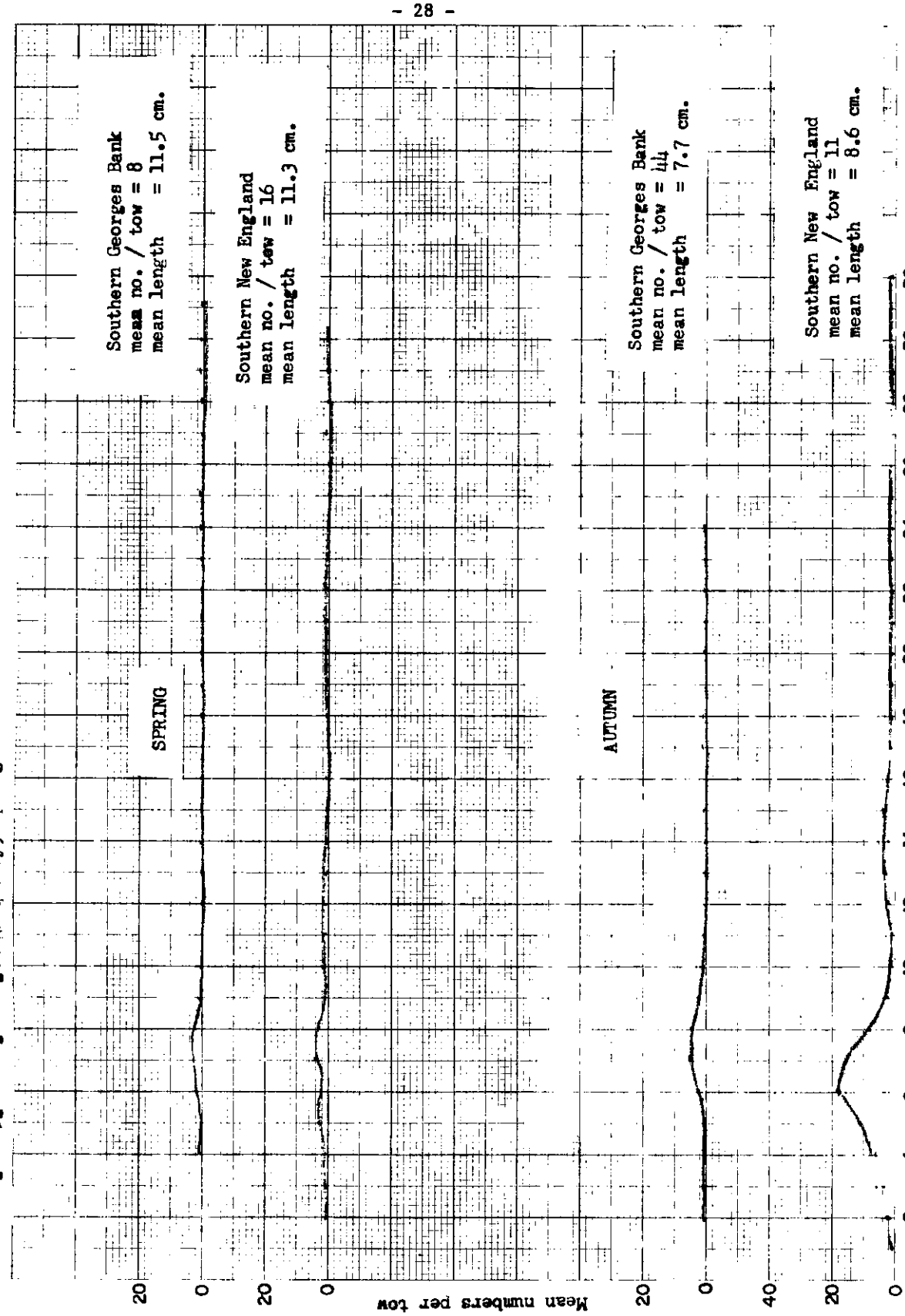

Figure 5g. Loligo length-frequency, Spring and Autumn 1970 Survey Cruises

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Figure 5h. Loligo length-frequency, Spring and Autumn, 1971 Survey Cruises

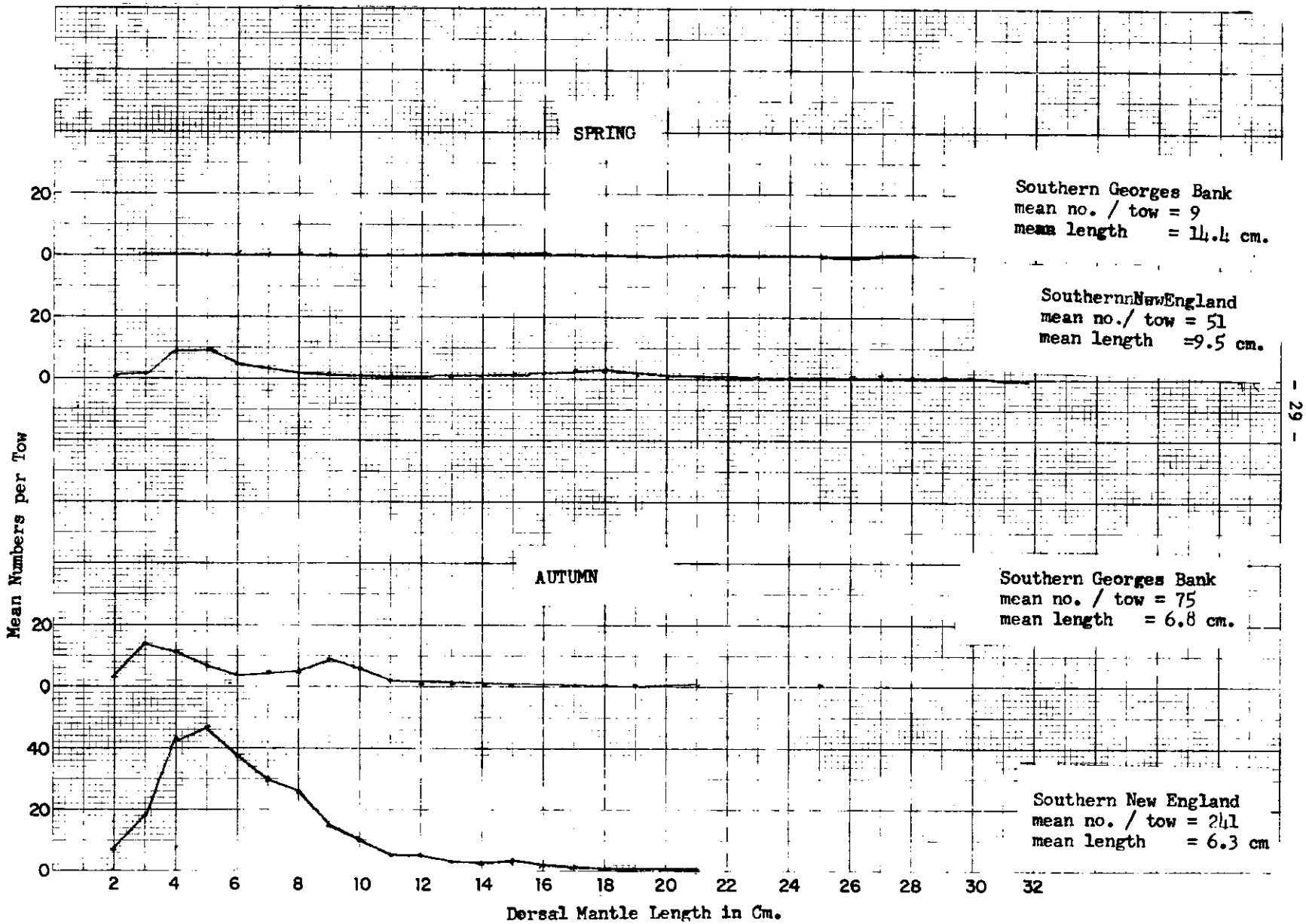

Figure 5i. Loligo length-frequency, Spring and Autumn, 1972 Survey Cruises

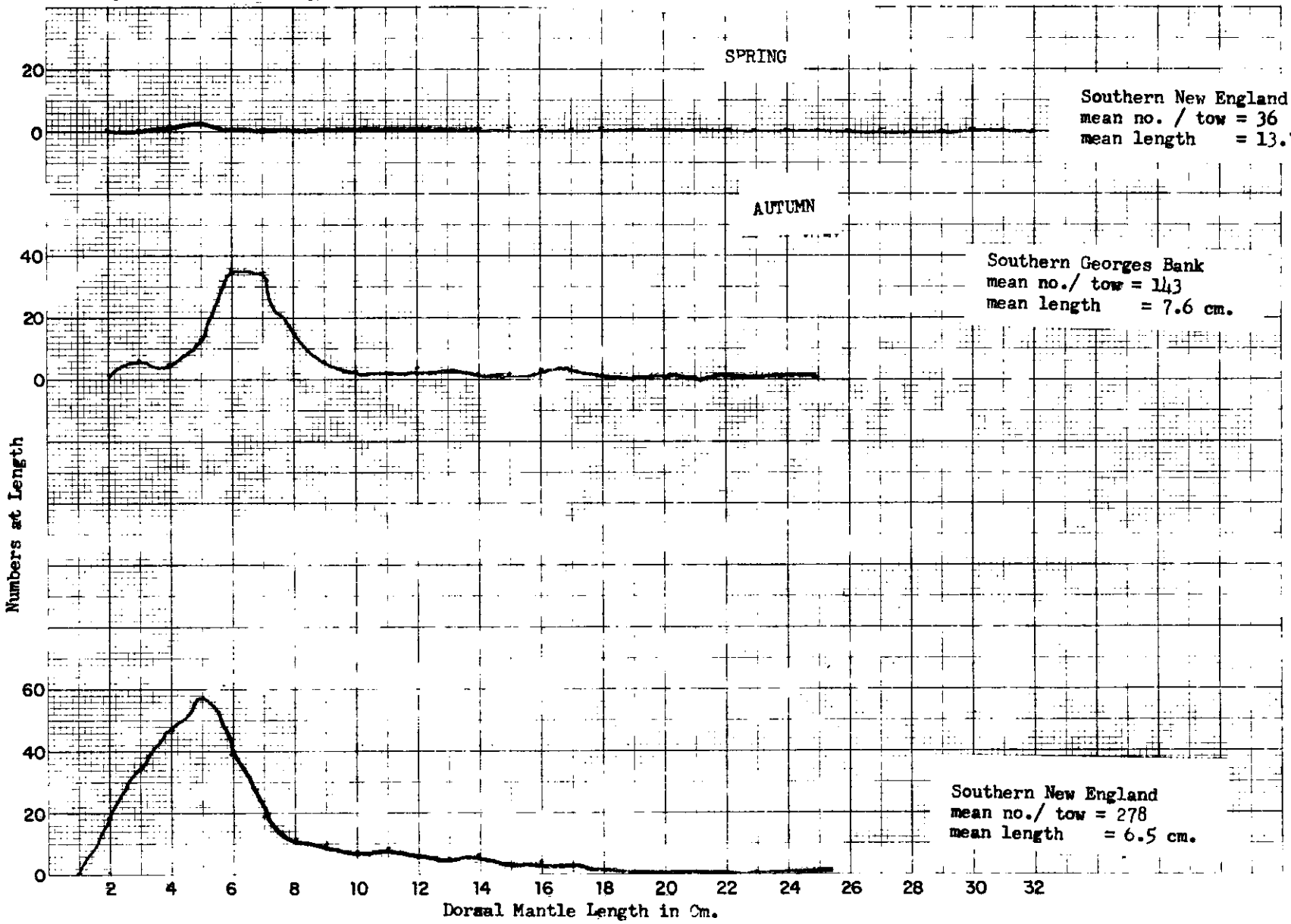

Figure 5j. Loligo length-frequency, Spring and Autumn 1973, Survey Cruises