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Observations on the Squid (*Illex illecebrosus*) and Silver Hake (*Merluccius bilinearis*) fisheries on the Scotian Shelf in 1979

by

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Introduction

The Canadian government conducted an observer program during 1979 similar to those in 1977 and 1978 (Waldron, 1978 and 1979). During the months of May to November observations were made primarily on those foreign fleets operating on the Scotian Shelf. Overall daily coverage during the program was 52 percent representing an increase from the 30% and 15% coverage levels of 1978 and 1977 respectively.

The 1977 joint Canada-USSR and Cuba study was continued in 1979 but at a reduced sampling level. Only one Cuban and two Soviet vessels were given exemptions to the small mesh gear line (SMGL) (Fig. 1).

A regulated codend mesh size of 60 mm for bottom and midwater trawls was applied to both the silver hake and squid fisheries in 1979. Special consideration was made for the use of off-bottom chain trawls both to the seaward side of the SMGL and in the extended box (Fig. 1). All vessels not fishing with off-bottom chain trawls were required to restrict their activities to the seaward side of the SMGL.

This paper provides a cursory look at randomly selected subsets of the data collected and how it compares to that obtained since 1977.

Results and Dicussion

1979 Squid and Silver hake fishery:

The Silver hake fishery commenced on April 15 and the squid fishery opened on July 1. Observer coverage did not begin until the early part of May. Fishing activity during the month of April was negligable with the bulk of the foreign fleet arriving in July for the squid fishery.

The USSR Silver hake fishery was conducted with bottom trawls from April to October. The total USSR catch of 45,000 t was predominately caught from May to July inclusive (Table 1). Cuba had relatively little success in the Silver hake fishery and caught a total of 2,000 t. Bulgaria caught 4,639 t concentrated during the months of June and July.

Monthly catch rates for the USSR remained fairly constant throughout the length of the fishery with a yearly average of 2.0 t/hr. (Table 2). The Cuban Silver hake fishery was directed by bottom trawls with an average catch rate of 1.5 t/hr. (Table 2). Cuban vessels experienced the highest catch rates later in the year when they fished landward of the SMGL.

The 1979 USSR squid fishery used 2 types of gear, bottom and midwater. From the data analysed, 29% of the total directed catch was caught with midwater trawls. Catch rates for midwater trawls averaged 4.0 t/hr. and bottom trawls averaged 1.9 t/hr. (Table 3). The Cuban squid fishery used predominately bottom trawls and had a yearly CPUE of 2 t/hr. (Table 4).

The Japanese squid fishery used 3 gears, - bottom, off-bottom chain and off-bottom bobbin. Bottom trawls had a lower catch rate (1.0 t/hr.) than that observed for off-bottom chain trawls which were the highest (1.4 t/hr.) (Table 5). This is the reverse of what was reported in the 1977 Canada-Japan experiment (Waldron and Gray, 1978).

Gear and Area Effects - (1979)

Three areas and four gear types were studied. Areas were to the landward and seaward directions of the SMGL and areas identified as the extended box. (Fig. 1). The four gears used included midwater, bottom, off-bottom bobbin and off-bottom chain trawls.

The area fished appears to have little effect on the overall catch rates for illex. (Table 6). There are however differences in CPUE for each gear. Midwater trawls have the highest CPUE 4.1 t/hr. and off-bottom bobbins have the lowest at 0.9 t/hr. Bottom trawls and midwater trawls have very similar directed catch rates for squid, 1.3 and 1.5 t/hr. respectively. Seaward of the SMGL both bottom and off-bottom chain trawls had similar squid catch rates. Off-bottom chain trawls had slightly higher catch rates in the extended box area as appeared to those observed seaward of the SMGL.

The data set sampled suggests that only bottom trawls are used to catch silver hake. The highest catch rates (2.4 t/hr.) for silver hake were observed landward of the SMGL while the lowest (1.5 t/hr.) was observed in the extended box area (Table 7).

Yearly trends in CPUE - (1977-1979)

SQUID - The directed CPUE for squid had been increasing since 1977 in areas landward and seaward of the SMGL (Table 8). Overall CPUE has remained relatively constant in 1977 and 1979 (Fig. 2). The apparent decrease in CPUE during 1978 could reflect a decreasing squid biomass.

Observed catch rates for the USSR squid directed fishery have remained constant at 2.3 t/hr. since 1977. The Cuban directed squid CPUE has increased from 1.5 t/hr. in 1977 to 2.2 t/hr. in 1978 and then decreased to 2.0 t/hr. in 1979. The directed squid CPUE for all vessels fishing national allocations remained stable at 2.0 t/hr. for 1977 and 1979. In 1978 the CPUE dropped to 1.7 t/hr. (Table 8).

The Japanese fleet caught four times as much squid while under charter to Canadian firms as opposed to fishing their national allocation in 1979. The catch rate for those vessels under charter was substantially different also, Japanese charter vessels in 1979 had a CPUE of 3.1 t/hr., nearly double that for Japanese vessels under national allocation.

SILVER HAKE - Catch rates for the 1977-1979 USSR and Cuban silver hake directed fisheries indicate an overall increasing trend (Table 9). Catch rates have gone from 1.2 to 1.7 t/hr. on the average. In some areas, catch rates have increased dramatically, in particular catch rates landward of the SMGL have more than doubled since 1977 (Fig. 2). Increasing catch rates are predominately due to mesh size effects. When the major silver hake fleets utilized 45 mm. and smaller gears they caught predominately 1 and 2 year old silver hake. This selection of juveniles continued in 1977 and in 1978. However, in 1979 the shift to predominately 2 and 3 year old fish was noted (Clay, 1980).

BY-CATCH: Squid fishery

By-catch ratios for the directed squid fisheries were calculated (Table 10). Overall by-catch for all countries have changed relatively little during the period 1977 to 1979. However there are some slight variations that do have ramifications on specific species.

The USSR directed squid fishery has an observed increase in by-catch of gadoids since 1977. In particular, cod has increased to 1.1% of the

directed squid catch while the pollock by-catch has risen to reportable levels. The by-catch of silver hake in a directed squid fishery has increased from 4.0% to 12.0% in 1979. This could be linked to what appears to be a very large biomass of illex present on the Scotian Shelf in 1979.

The Cuban directed squid fishery has had an observed decrease in by-catches of all gadoids except pollock. The decrease in the by-catch of cod and haddock appears to be related to the restriction of Cuban vessels to the seaward side of the SMGL. The observed decrease in the 1978 by-catch ratio of silver hake, then the subsequent increase in 1979 reflects previous observations on squid CPUE. If it is assumed that squid directed CPUE reflects biomass for this species then it could be speculated that the relative biomass of squid affects the by-catch of silver hake. In years when the squid biomass is high the by-catch of silver hake in a directed squid fishery is also high. This reinforces the interactive nature of these two stocks.

Comparison of by-catch ratios in the three major areas, - landward, seaward of the SMGL and in the extended box, indicates that the by-catch in the extended box is extremely low (Table 11). Both the haddock and pollock by-catches are highest in areas landward of the SMGL. The data set compared is only 30% of that actually collected in 1979. Therefore, these ratios may change as more data becomes available.

Silver hake fishery -

The by-catch of squid in the total directed silver hake fishery has increased in 1979 to a level similar to that observed in 1977 (Fig. 2, Table 12). Haddock by-catches have decreased to the 1977 level while cod has increased to 1.0%. Pollock by-catch has remained constant at 1.3% since 1978. All other species noted a decrease in the by-catch ratio since 1977.

Comparison of by-catch ratios for the 1979 Cuban and Soviet directed silver hake fisheries are summarized in Table 13. Gadoid by-catches are lower to the landward side as opposed to those observed seaward of the SMGL. This is the reverse situation reported in 1977 and 1978 (Waldron 1978, 1979). Since the calculations presented here represent only a subset of the data, these observations may change when more data is available. The data for Cuba does indicate that when a directed silver hake fishery is conducted in the extended box area with bottom gear by-catches of cod, haddock, pollock and redfish increase dramatically.

Distributional aspects of the 1979 Fishery

Squid - The highest catches of squid were taken by Japanese vessels fishing on developmental charters using off-bottom chain (OBC) gear. When fishing in the same area the charter vessels had catch rates generally twice that of the national allocation vessels (Figures 3 & 4). Approximately 99% of the OBC effort was expended in the extended box. The trend in catch rates in this area suggest an east-west movement of squid in the Gully area of the extended box located at approximately 59°00'W (Table 14). While the catch rates were dropping east of 59°00' they were increasing west of that line. At the end of the fishery all effort was concentrated west of the 59°00'.

Off-bottom bobbin (OBB) effort by Japanese national allocation vessels was sporatic in July but more concentrated in August. Catch rates were highest south of Emerald Bank, between 61°50' and 62°40', and decreased in an easterly direction (Figure 5).

OBB effort by Japanese developmental charter vessels was concentrated close to the eastern end of the small mesh gear box in both August and September. Again, as with OBC gear, catch rates were higher by charter vessels than those on national allocations (Figure 6).

Silver hake - The 1979 USSR silver hake fishery was carried out along the full extent of the SMGL. In May the fishery was carried out in Division 4X south of Baccaro Bank and in Division 4W south of Emerald Bank (Figure 7). The fishery extended to the Sable Island Bank area in June with less effort expended in 4X (Figure 8). By July the fishery

was concentrated in 2 areas, south of Emerald Bank and south of Sable Island (Figure 9). While catch rates remained fairly steady in the Emerald Bank area, they decreased in 4X and increased in the Sable Island area.

From August through October effort was concentrated in Emerald Basin (Figure 10). Catch rates were close to 2.6 t/hr. in August and September, and fell to 2.0 t/hr. in October.

SUMMARY

Monthly catch rates for the 1979 directed silver hake fishery remained relatively constant. The fishery was conducted primarily to the seaward side of the SMGL with bottom trawls. Observed catch rates for this fishery were highest to the landward side of the SMGL and lowest within the extended box.

Four gear types and three areas were observed during the 1979 Scotian Shelf squid fishery. Catch rates were highest for midwater trawls and lowest for off-bottom bobbin gears. Both bottom and off-bottom chain trawls had similar catch rates. Directed squid CPUE was relatively constant for all areas.

Comparison of yearly CPUE for directed squid fisheries has been increasing since 1977. The overall directed squid CPUE in 1979 is similar to that observed in 1977. Silver hake directed CPUE has been steadily increasing since 1977. Catch rates have doubled in areas to the landward side of the SMGL. It is suggested that these increasing catch rates relate to a shift in size selection by the fleet due to larger mesh size.

By-catch ratios in the squid fishery have varied relatively little since 1977. During the period 1977-79, increased by-catches of gadoids in the squid fishery has been observed for the USSR while Cuba had a decrease. By-catch ratios for the squid fishery are lowest in the extended box area. However, as more data becomes available these relationships may change.

Observations on the directed Silver hake fishery since 1977 noted a decrease in haddock and an increase in cod by-catches. Pollock by-catch remained constant in 1978 and 1979 and all other species had decreased by-catches.

Squid CPUE by Japanese developmental charters was approximately twice that of the national allocation vessels with both OBB and OBC. The trend in CPUE by OBC gear suggested an east-west movement of squid in the Gully area of the extended box. The OBB squid fishery was carried out in two main areas, south of Emerald Bank and close to the eastern end of the SMGL box.

Silver hake CPUE by USSR OTB vessels showed an eastward movement of the fishery from Division 4X to south of Sable Island Bank in Division 4W. The late summer fishery was concentrated mainly in Emerald Basin.

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Waldron, D. E. MS. 1978. Catch Compositions during the 1977 Scotian Shelf international fishery with emphasis on the silver hake and squid (*Illex*) fisheries. ICNAF Res. Doc. 78/II/9. 23 p.

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Table I. Provisional Catch Statistics (1980) from ICNAF Circular Letters (from Clay, 1980)

SILVER HAKE CATCH (TONNES)

COUNTRY	National Allocation	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
CANADA	10,000			8				87[a]	56[a]	1[a]		1		153
USSR	44,940				2,190	12,932	14,947	11,617	2,541	713				44,940
CUBA	8,070					23	209	483	266	173	258	360		1,772
BULGARIA	6,860						2,387	2,156	96					4,639
JAPAN								13	7	5	23	2		50
FRANCE (SPM)	100													-
USA	2													-
OTHER	30													12[b]
TOTALS	70,002			8	2,190	13,000	17,515	14,198	2,842	881	378	246		51,566

a - Japanese developmental charters from Canada.
b - Taken from Flash Information System. Total represents the by-catches from Fed. Rep. Germany, Italy, Poland and Spain

Table 2. 1979 S. Hake C/E (kg/hr.) for both the Cuban and USSR Fisheries in 4VWX

CUBA	LANDWARD		SEAWARD		EXTENDED	
	MWT	BTM	MWT	BTM	MWT	BTM
MAY	-	-	-	-	-	-
JUNE	-	-	-	1908	-	-
JULY	-	-	-	1161	-	-
AUG.	-	-	-	-	-	-
SEPT.	-	-	-	-	-	-
OCT.	-	1954	-	-	-	1491
NOV.	-	2974	-	-	-	-
YEARLY	-	2464	-	1535	-	1491

USSR	LANDWARD		SEAWARD		EXTENDED	
	MWT	BTM	MWT	BT	MWT	BTM
MAY	-	-	-	2010	-	-
JUNE	-	-	-	1439	-	-
JULY	-	-	-	2187	-	-
AUGUST	-	2476	-	1893	-	-
SEPTEMBER	-	2024	-	-	-	-
OCTOBER	-	2450	-	-	-	-
YEARLY	-	2317	-	1882	-	-

Table 3. 1979 Squid C/E (kg/hr) for the USSR fishery in 4VWX

	LANDWARD		SEAWARD		EXTENDED	
	MWT	BT	MWT	BTM	MWT	BTM
MAY	-	-	-	-	-	-
JUNE	-	-	-	166	-	-
JULY	-	-	-	2748	-	-
AUG.	-	2032	5104	1702	-	-
SEPT.	-	-	3542	1040	2547	-
OCT.	-	-	-	-	5174	-
YEARLY	-	2032	4323	1414	3861	-

Table 4. 1979 Squid C/E (kg/hr) for the Cuban Fishery in 4VWX

	LANDWARD			SEAWARD		EXTENDED	
	BTM	OBB	OBC	MWT	BTM	MWT	BTM
JULY	-	-	-	-	-	-	-
AUG.	-	-	-	-	-	-	-
SEPT.	-	-	-	-	-	-	-
OCT.	-	-	-	-	-	-	-
NOV.	-	-	-	-	-	2935	-
YEARLY	-	-	-	-	1984	2935	-

Table 5. 1979 C/E (kg/hr) Squid Fishery for Japan in 4VWX

	LANDWARD			SEAWARD			EXTENDED		
	BTM	OBB	OBC	BTM	OBB	OBC	BTM	OBB	OBC
JULY	-	-	-	-	1093	1098	-	-	-
AUG	-	-	-	-	354	-	-	-	-
SEPT.	-	-	-	1115	1499	1254	-	883	1644
OCT.	-	-	-	886	-	-	-	-	1592
NOV.	-	-	-	1073	-	-	-	-	1402
DEC.	-	-	-	-	-	-	-	-	-
YEARLY	-	-	-	1025	1499	1254	-	883	1456

Table 6. Squid C/E (kg/hr) for ALL COUNTRIES fishing in 4VWX.

	LANDWARD				SEAWARD				EXTENDED				ALL AREAS				ALL GEARS & AREAS	ALL GEARS		
	MWT	BT	OBB	OBC	MWT	BT	OBB	OBC	MWT	BT	OBB	OBC	MWT	BT	OBB	OBC		Landward	Seaward	Extend
MAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JUNE	-	-	-	-	-	166	-	-	-	-	-	-	-	166	-	-	166	-	166	-
JULY	-	-	-	-	-	2748	1093	-	-	-	-	-	-	2748	1093	-	1921	-	1921	-
AUG.	-	2032	-	-	5104	1702	354	-	-	-	-	-	4104	1867	354	-	2442	2032	2387	
SEPT.	-	-	-	-	3542	1078	1499	1254	2547	-	883	1644	3045	1078	1191	1449	1691	-	1843	1692
OCT.	-	-	-	-	-	886	-	-	5174	-	-	1592	5174	886	-	1592	2551	-	886	3383
NOV.	-	-	-	-	-	1073	-	-	2935	-	-	1402	2935	1073	-	1402	1803	-	1073	2169
YEARLY	-	2032	-	-	4323	1276	982	1254	3553	-	883	1546	4065	1303	879	1481	1932	2032	1959	1994

Table 7. S. hake C/E (kg/hr) for ALL COUNTRIES fishing in 4VWX

	Landward		Seaward		Extended		ALL AREAS		ALL GEAR & AREAS	ALL GEARS		
	MWT	BT	MWT	BT	MWT	BT	MWT	BT		LANDWARD	SEAWARD	EXTENDED
MAY	-	-	-	2010	-	-	-	2010	2010	-	2010	-
JUNE	-	-	-	1674	-	-	-	1674	1674	-	1674	-
JULY	-	-	-	1674	-	-	-	1674	1674	-	1674	-
AUG.	-	2476	-	1893	-	-	-	2185	2185	2476	1893	-
SEPT.	-	2024	-	-	-	-	-	2024	2024	2024	-	-
OCT.	-	2202	-	-	-	1491	-	1847	1847	2202	-	1491
NOV.	-	2974	-	-	-	-	-	2974	2974	2974	-	-
YEARLY	-	2419	-	1813	-	1491	-	2055	2055	2419	1813	1491

Table 8. Yearly directed Squid CPUE (kg/hr) for the Scotian Shelf fishery

	1977				1978				1979			
COUNTRY	Landward[1]	Seaward[1]	Extended	ALL	Landward	Seaward	Extended[1]	ALL	Landward	Seaward	Extended	ALL
CUBA	-	-	-	1536	2128	2195	-	2149	-	-	2935	1984
JAPAN	-	-	2908	2019	2221	1641	-	1931	-	1259	1215	1696
USSR	-	-	-	2375	4669	2260	-	2255	2032	2869	3861	2251
ALL	607	992	2908	1977	968	1783	483	1560	2032	1959	1994	2051

[1] Data by country not available at time of publication.

Table 9. Yearly directed Silver hake CPUE (kg/hr) for the Scotian Shelf Fisheries.

	1977				1978				1979			
COUNTRY	Landward[1]	Seaward[1]	Extended[1]	ALL	Landward	Seaward	Extended[1]	ALL	Landward	Seaward	Extended	ALL
BULGARIA[2]	-	-	-		-	-	-	-	-	-	-	1558
CUBA	-	-	-	894	1127	609	-	1098	2464	1535	1491	1541
USSR	-	-	-	1340	2052	1375	-	1770	2317	1882	-	1983
ALL	1019	925	457	1154	1723	1298	1516	1574	2419	1813	1491	1873

[1] Data for some countries not available at time of publication.

[2] Bulgaria was not sampled in 1977. Data for 1979, other than by total area, is not available at time of publication.

Table 10. By-catch Ratios from observations of the 1977-1979 non-Canadian directed Squid Fishery in NAFO Divisions 4VWX.

COUNTRY	YEAR	HADDOCK	S. HAKE	SQUID	ARGENTINE	COD	REDFISH	POLLOCK	MACKEREL
USSR	1977	.000[1]	.036	1.000	.000	.003	.000	.000	.001
	1978	.001	.042	1.000	.000	.002	.000	.000	.005
	1979	.001	.123	1.000	.002	.011	.000	.002	.000
CUBA	1977	.007	.087	1.000	.000	.002	.003	.001	.018
	1978	.001	.022	1.000	.002	.002	.000	.000	.001
	1979	.000	.062	1.000	.000	.001	.000	.007	.001
JAPAN	1977	.004	.025	1.000	.014	.000	.001	.001	.000
	1978	.002	.016	1.000	.017	.001	.000	.001	.002
	1979	.001	.010	1.000	.010	.000	.000	.000	-
	1979[2]	.000	.004	1.000	.000	.000	.000	.001	-
ALL COUNTRIES[3]	1977	.004	.050	1.000	.003	.001	.002	.000	.001
	1978	.001	.021	1.000	.002	.001	.001	.000	.002
	1979	.001	.033	1.000	.002	.002	.000	.001	.000

[1] A zero value indicates by catch quantities too small for reporting in this table.

[2] Canada (Japan) Developmental Charter catches - primarily in the extended box region from August to November.

[3] Includes all countries fishing national allocations including the 3 described above.

Table 11. Squid ratios from Observations on the 1979 non-Canadian fishery in 4VWX.

COUNTRY	AREA	Dir. Catch (kg)	Total Catch (kg)	% Catch of all areas	S. Hake	Squid	Arg.	Cod.	Haddock	Mackerel	Pollock	Redfish
CUBA	Ext.	98800	181830	100	.010	1.000	-	-	-	-	.005	.001
USSR	Landward	30299	168005	10	.143	1.000	-	-	.021	-	.013	-
	Seaward	921163	1476275	84	.038	1.000	.004	.005	.001	.000	.000	.000
	Ext.	98465	98465	6	.000	1.000	-	-	-	-	-	-
JAPAN	Seaward	345463	398590	64	.007	1.000	.022	.001	.003	-	.000	.000
	Ext	220341	222056	36	.001	1.000	-	-	-	-	-	-

Table 12. By-catch ratios from observations of the 1977-1979 non-Canadian directed Silver Hake fishery in NAFO Divisions 4VWX.

COUNTRY	YEAR	HADDOCK	S. HAKE	SQUID	ARGENTINE	COD	REDFISH	POLLOCK	MACKEREL
USSR	1977	.003	1.000	.065	.003	.004	.009	.001	.003
	1978	.009	1.000	.024	.004	.007	.003	.009	.008
	1979	.005	1.000	.102	.003	.009	.001	.015	.005
CUBA	1977	.010	1.000	.271	.011	.003	.001	.005	.008
	1978	.036	1.000	.011	.002	.004	.016	.051	.006
	1979	.009	1.000	.105	.000	.002	.002	.014	.027
ALL[1]	1977	.005	1.000	.124	.005	.004	.007	.002	.004
	1978	.014	1.000	.024	.004	.006	.006	.013	.008
	1979	.005	1.000	.102	.002	.010	.001	.013	.006

[1] Includes all countries fishing national allocations.

Table 13. S. hake ratios from Observations on the 1979 non-Canadian fishery in 4VWX.

COUNTRY	AREA	Dir. Catch (kg)	Total Catch (kg)	% Catch of all areas	S. Hake	Squid	Arg.	Cod.	Haddock	Mackerel	Pollock	Redfish
CUBA	Landward	396380	396380	45	1.000	.001	-	-	.001	.020	.020	-
	Seaward	299200	316100	36	1.000	.062	.000	.001	.002	.000	.000	.003
	Ext	128525	164975	19	1.000	.269	-	.003	.043	-	.009	.014
USSR	Landward	1706222	1745091	28	1.000	.090	.001	.000	.000	-	.000	.015
	Seaward	4172262	4403024	72	1.000	.084	.002	.006	.001	.004	.008	.001

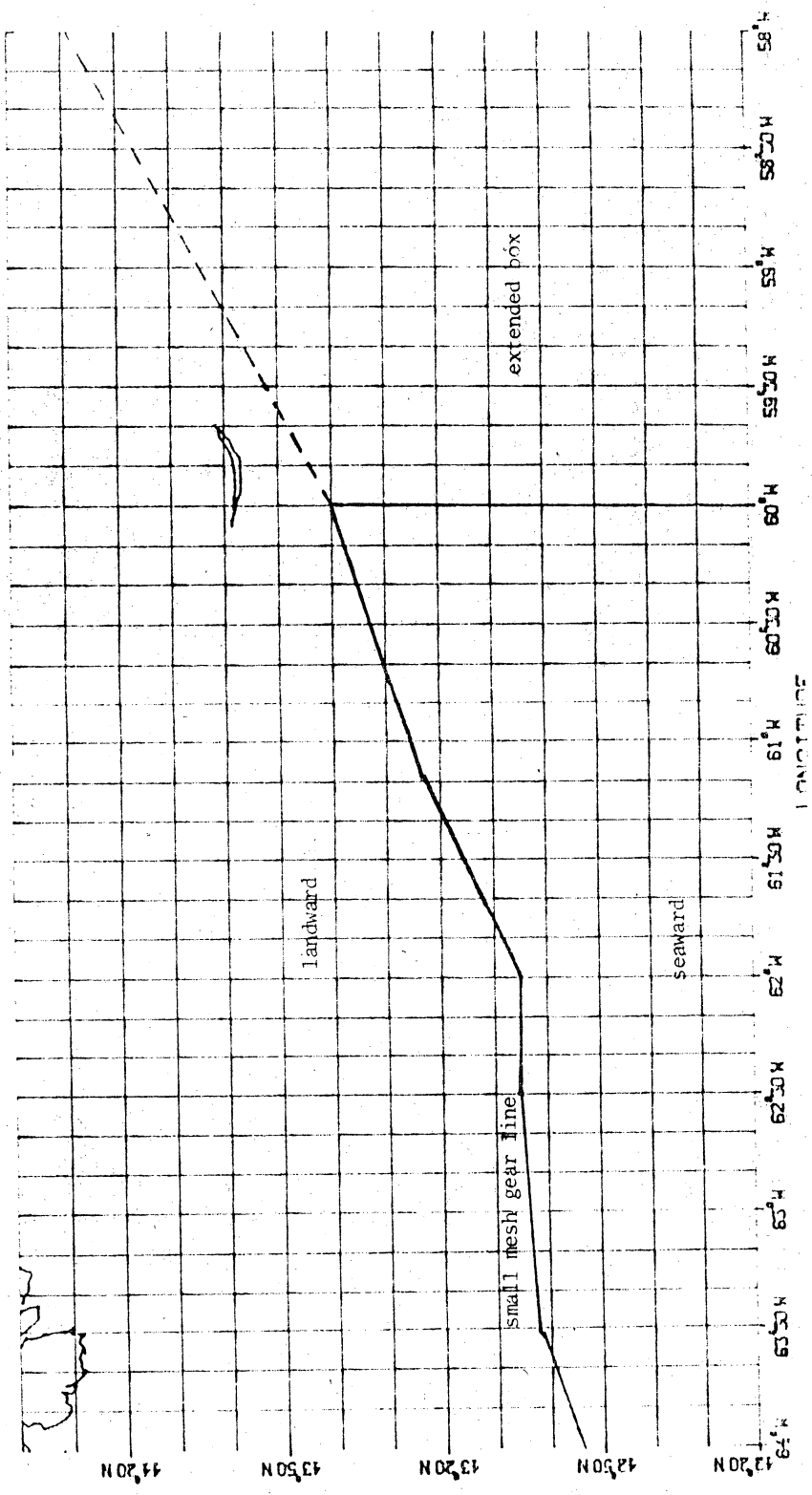
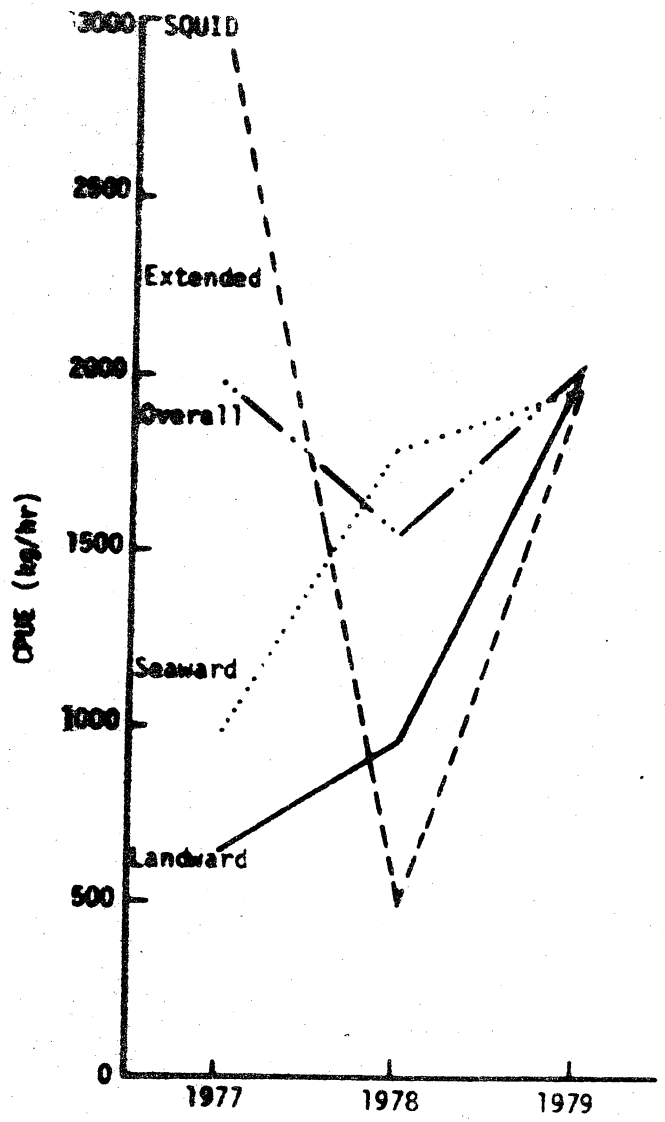


Figure 1. Areas observed during the 1979 Scotian Shelf Silver hake and Squid fishery.



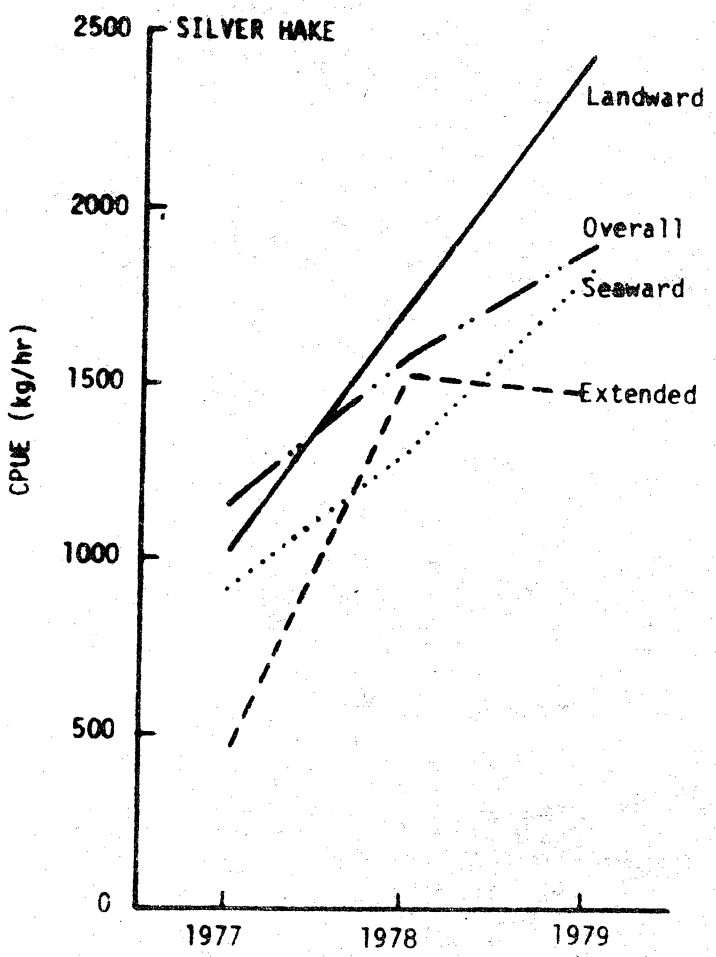


Fig. 2. 1977-79 Directed Squid and Silver Hake Catch per unit effort by major area.

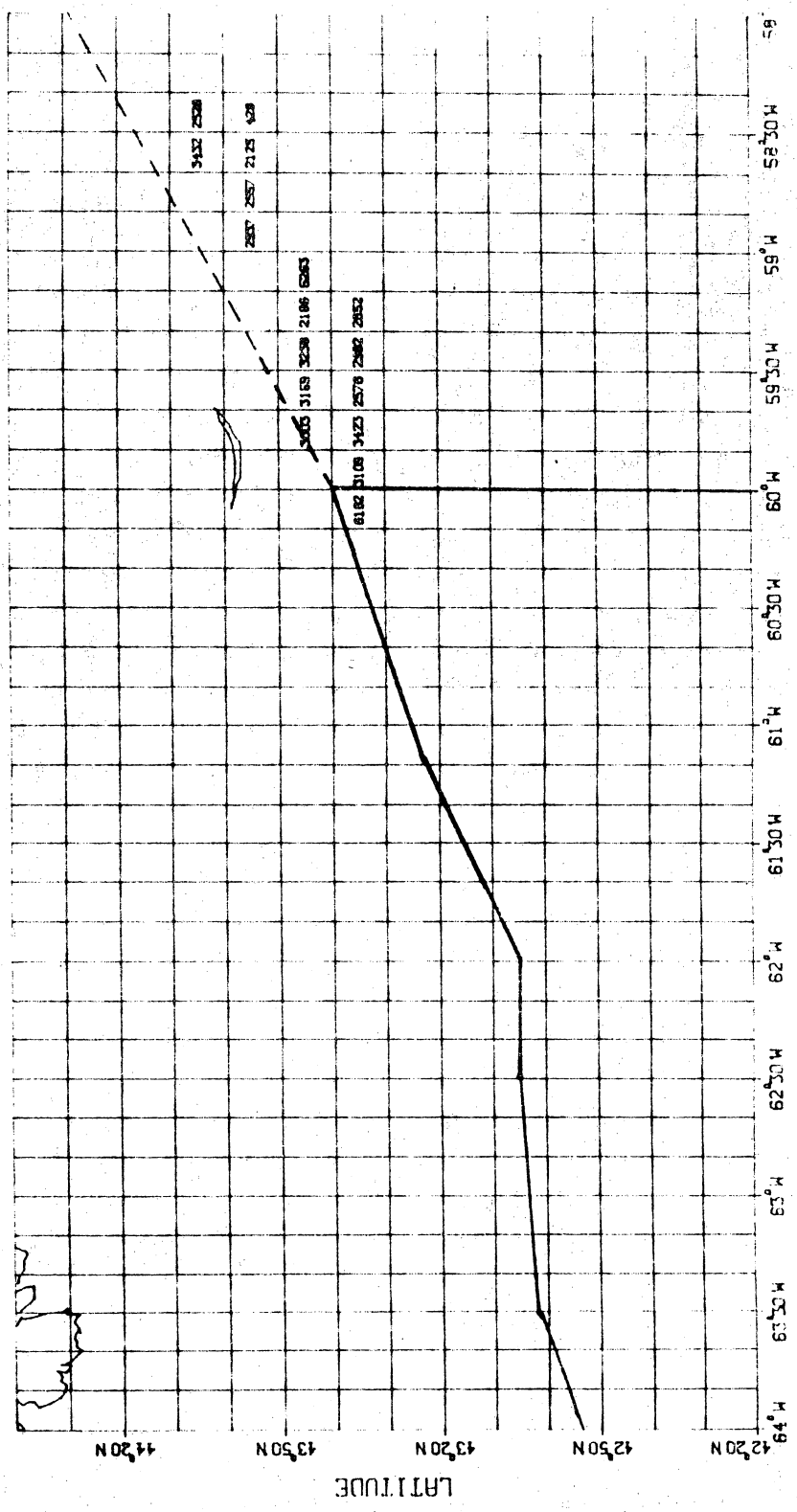


Figure 3. C/E (kg/hrr.) of Squid by Japanese developmental charter vessels with off-bottom chain gear in October 1979.

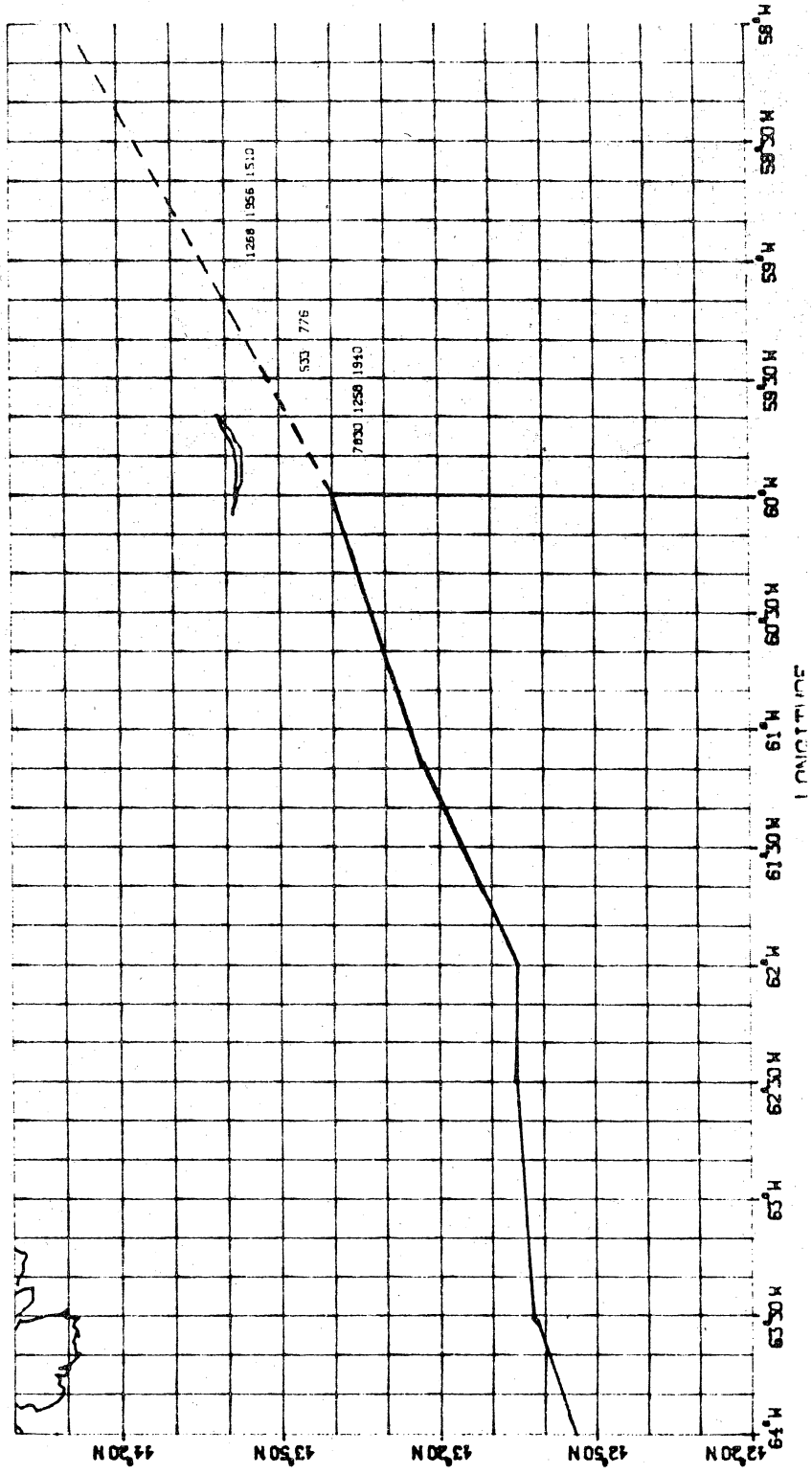


Figure 4. C/E (kg/hr.) of Squid by Japanese national allocation vessels with off-bottom chain gear in October 1979.

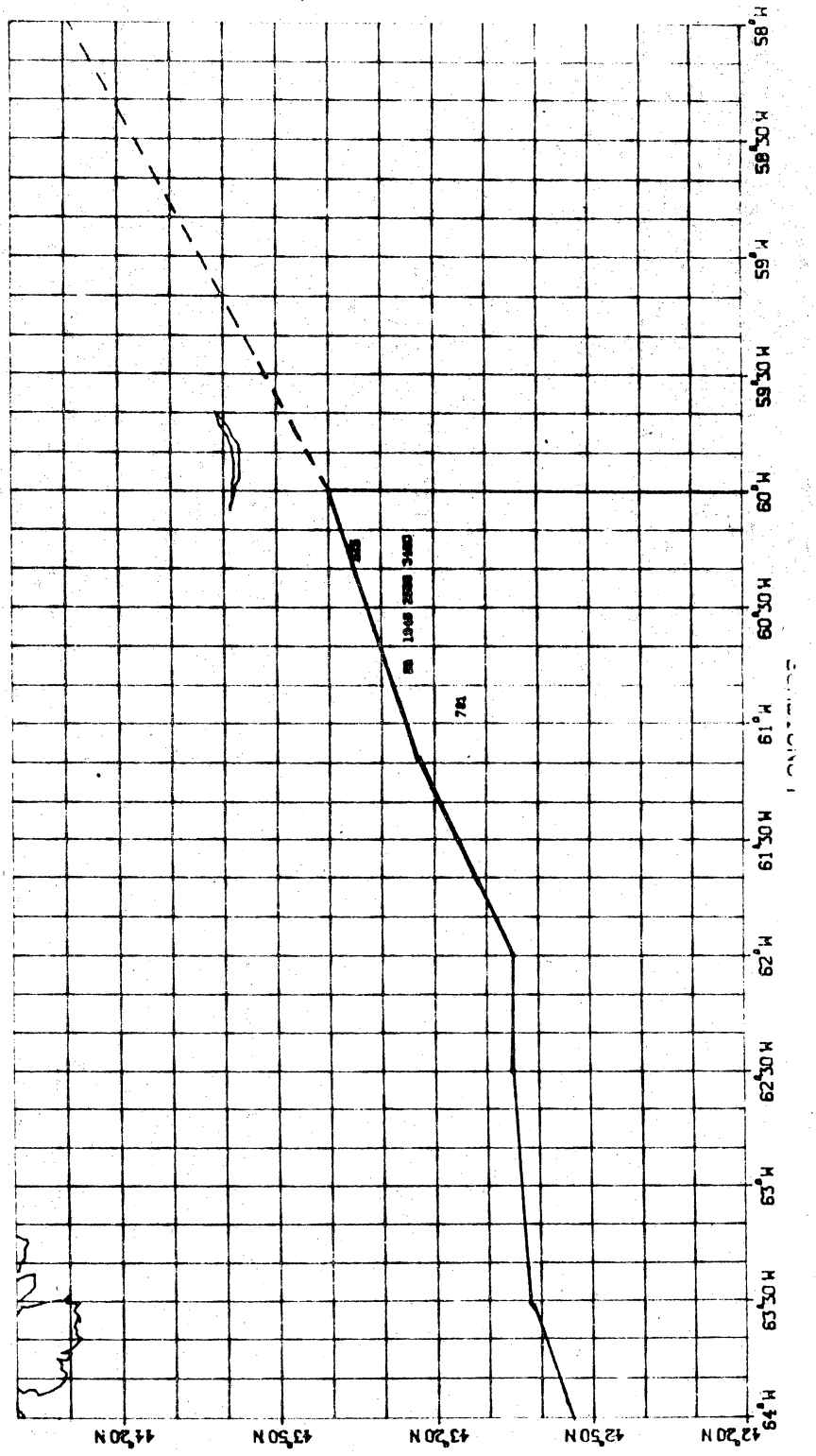


Figure 5. C/E (kg/hr.) of Squid by Japanese National allocation vessels with off-bottom bobbin gear in August 1979.

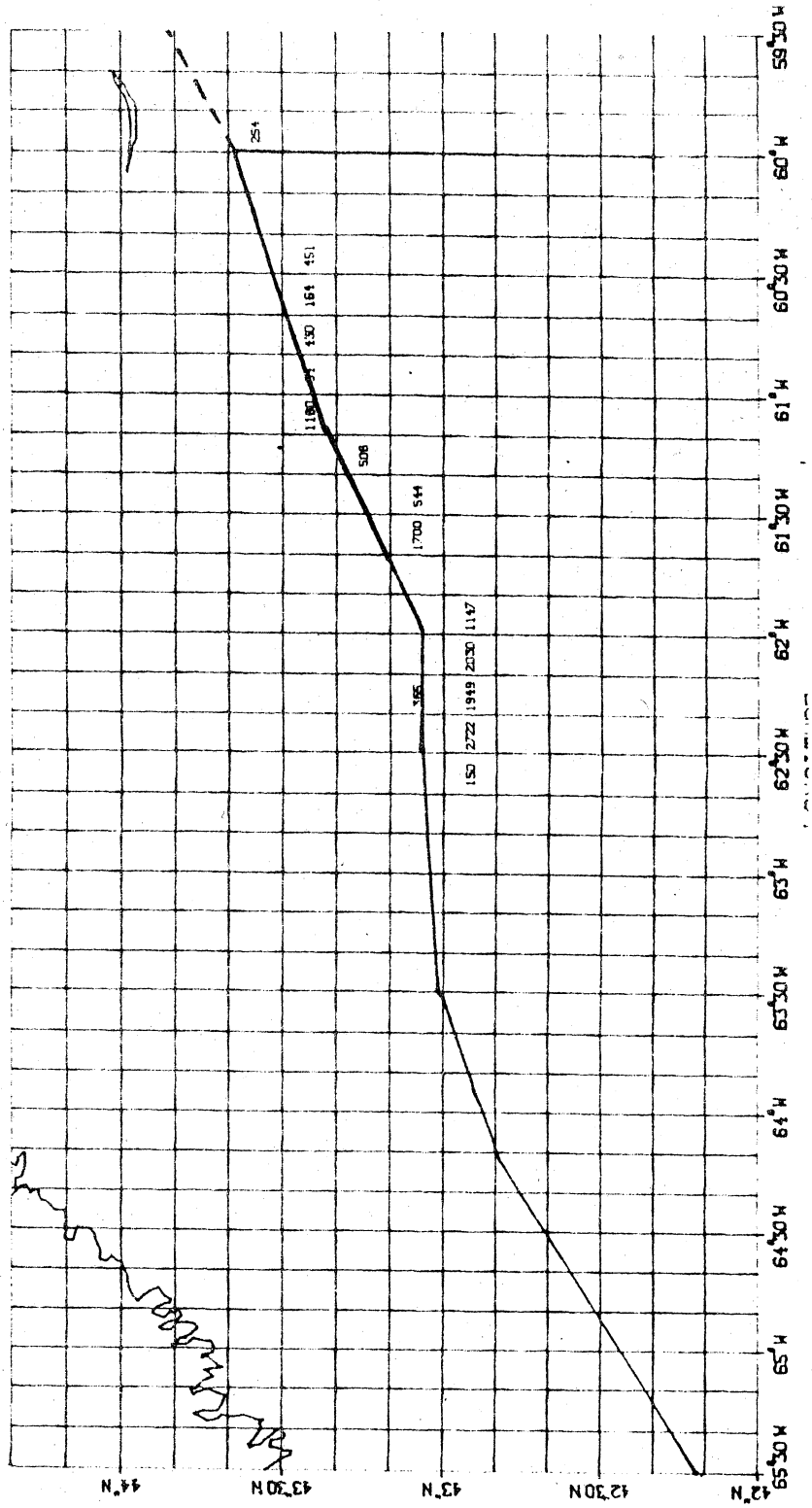


Figure 6. C/E (kg/hr.) of squid by Japanese developmental charter vessels with off-bottom bobbin gear in August 1979.

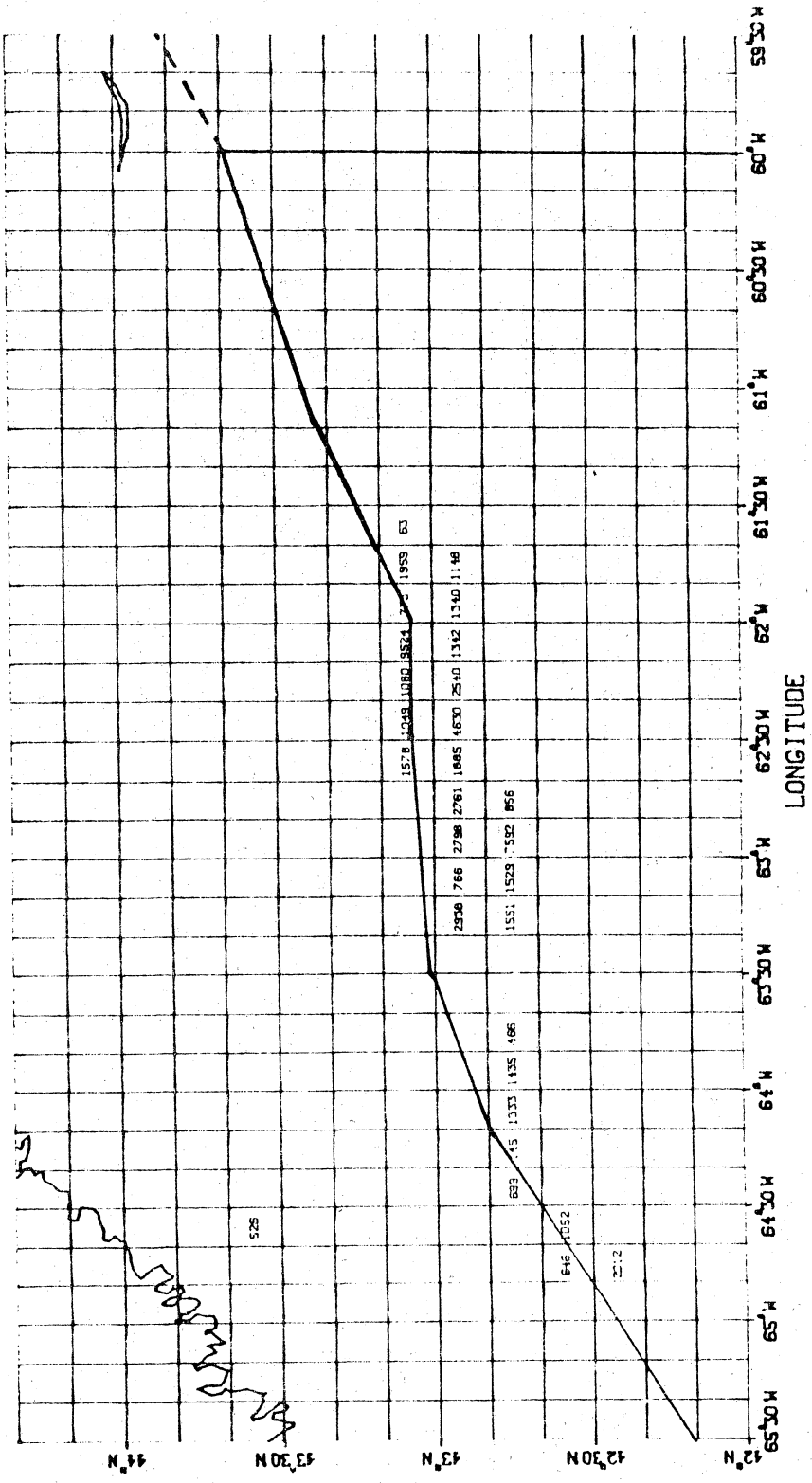


Figure 7. C/E (kg/hr.) of Silver hake by USSR OTB trawlers May 1979.

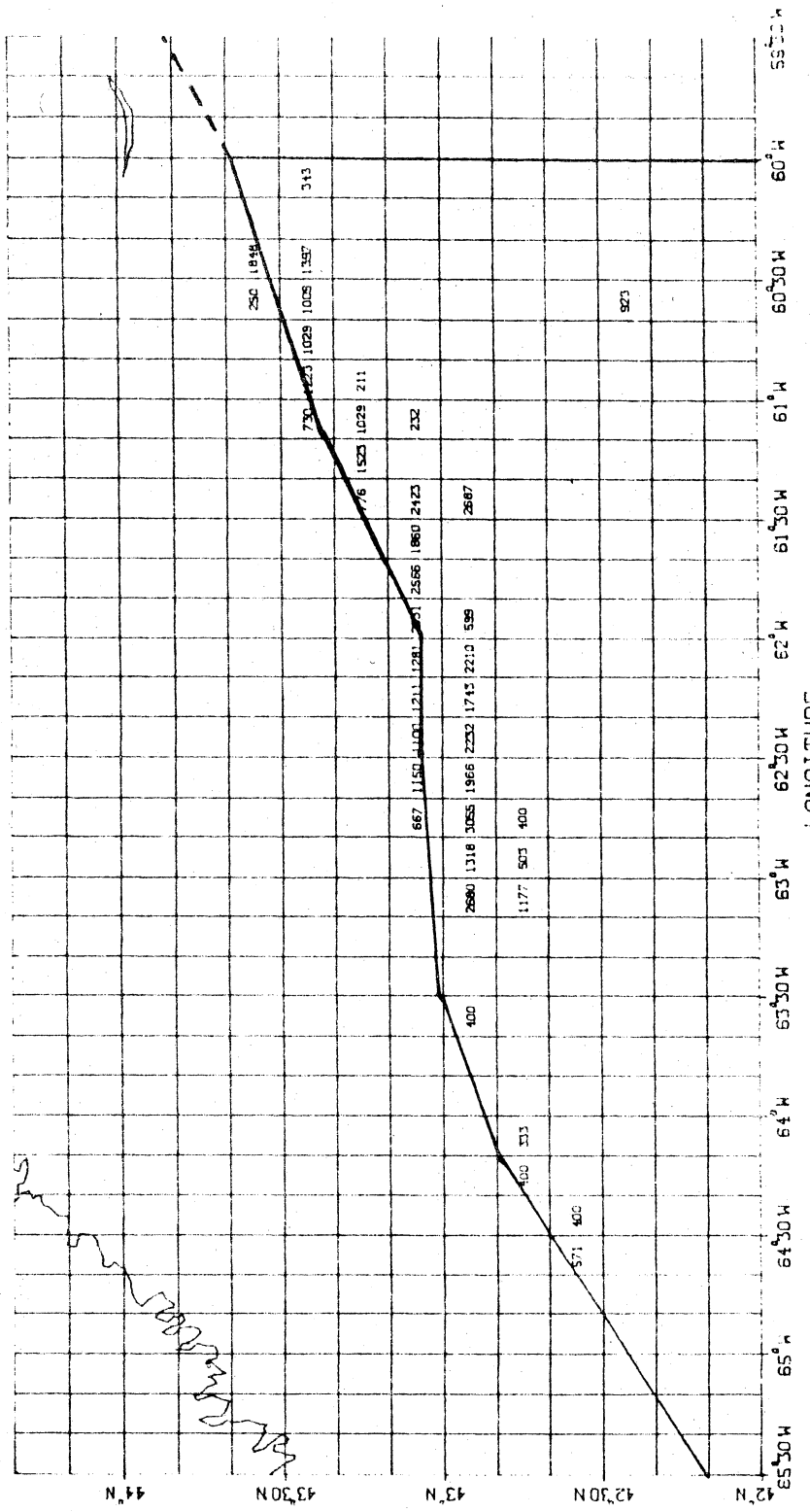


Figure 8. C/E (kg/hr.) of Silver hake by USSR OTB trawlers June 1979.

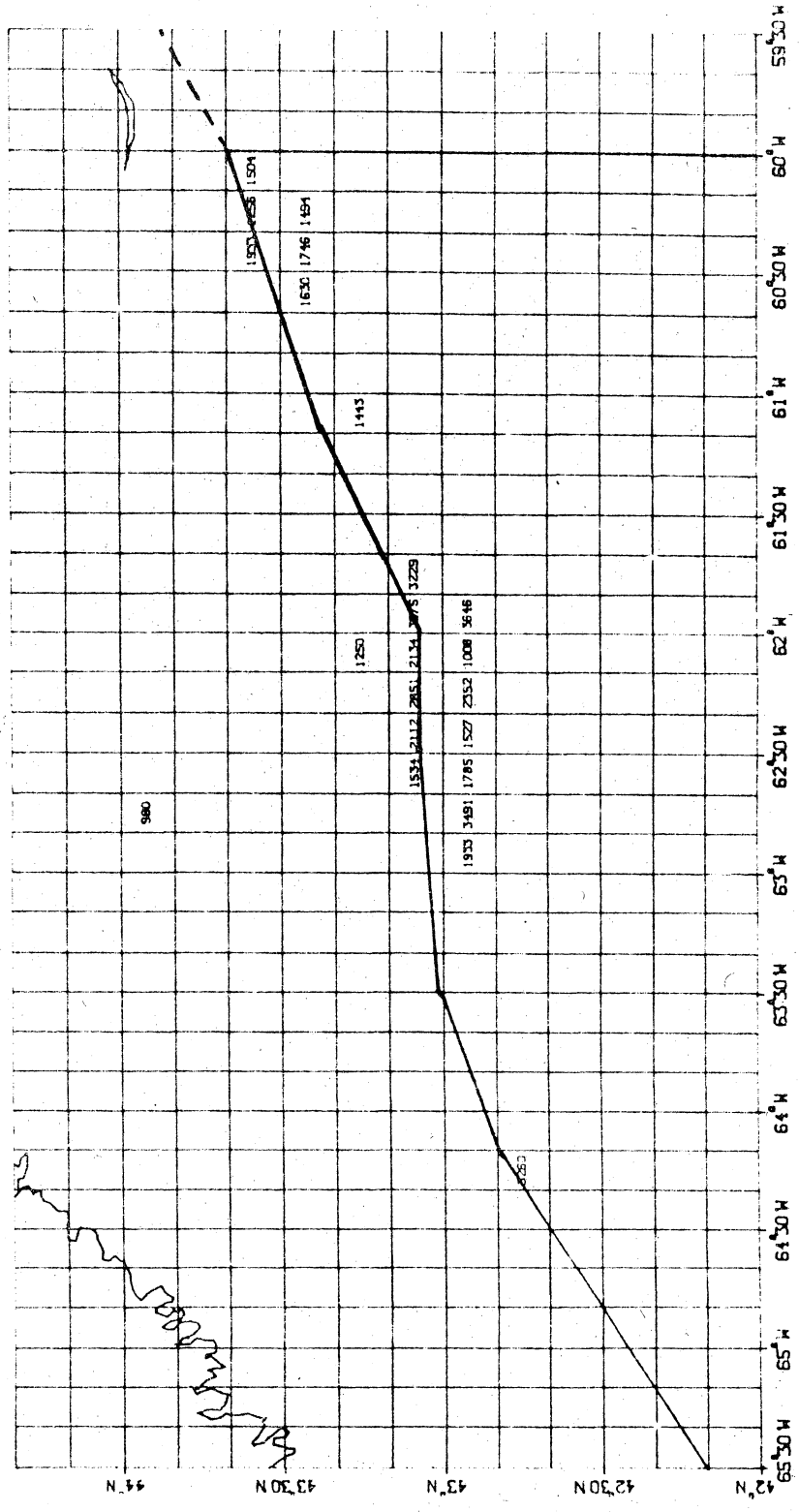


Figure 9. C/E (Kg/hr.) of Silver hake by USSR OTB trawlers July 1979.

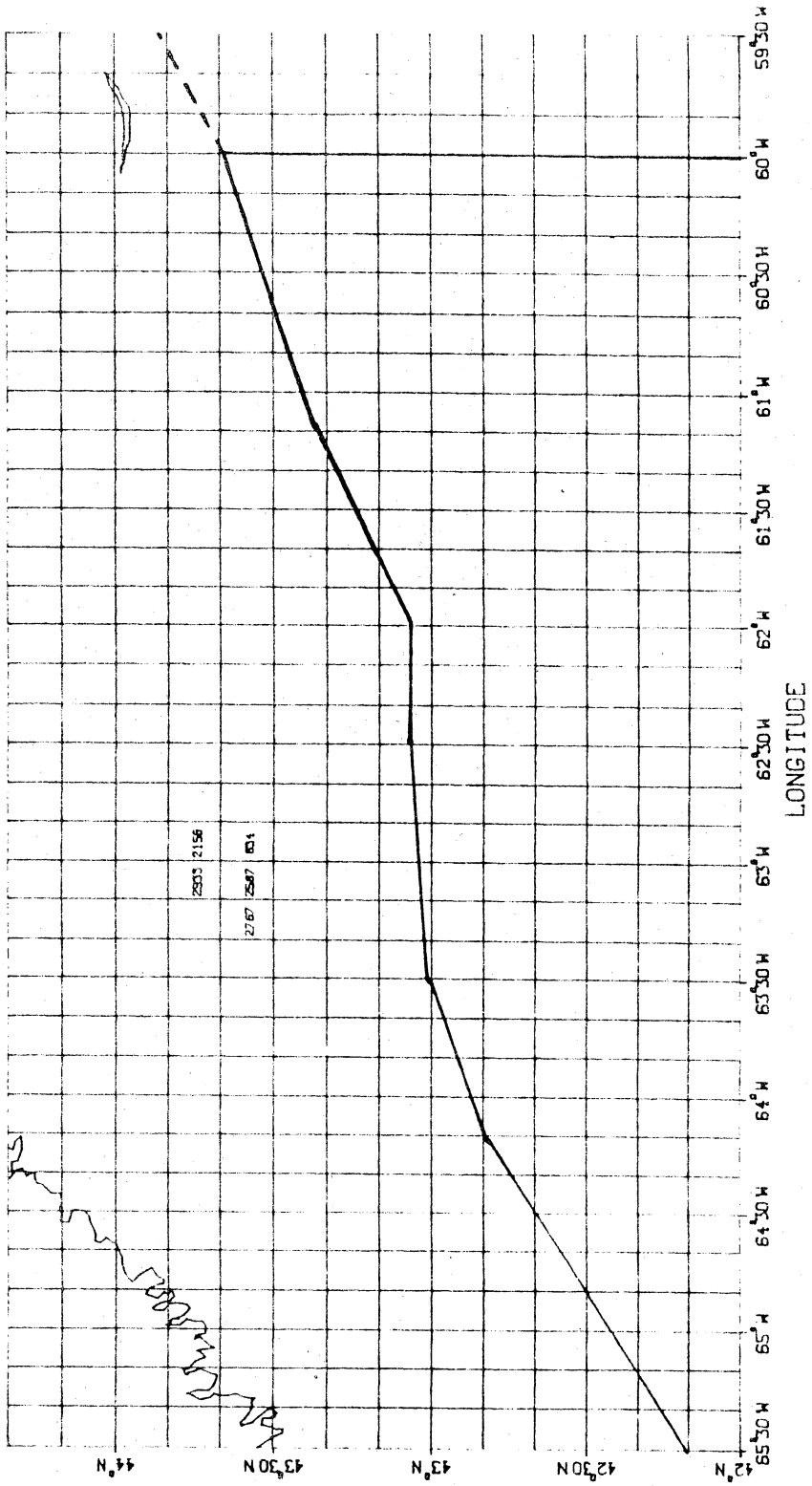


Figure 10. C/E (kg/hr) of Silver hake by USSR OTB trawlers August 1979.