

Northwest Atlantic



Fisheries Organization

Serial No. N552

NAFO SCR Doc. 82/VI/59

SCIENTIFIC COUNCIL MEETING - JUNE 1982

Analysis of Data on Redfish in Divisions 3LN

by

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INTRODUCTION

Insufficient data are available for an analytical assessment of this stock. In the past the general production model has been used but recent evaluation of the catch rate data suggests that the significance of the regressions is dependent upon the 1968 and 1974 data points, the values of which are questionable.

METHODS AND RESULTS

Nominal catches are shown in Table 1 and Fig. 1. In only a few years was the catch in 3L as great or greater than that from 3N. Commercial frequencies (Fig. 2-5) indicate a wide range of lengths being caught by Newfoundland vessels in 3L except in November-December when a mode of about 30 cm was observed. In May, Maritime vessels caught fish ranging from 20 to 30 cm in 3L, while the June frequency for 3N shows fish 20-27 cm. In 3N, USSR frequencies show catches ranging from 20 to 30 cm while Newfoundland catches ranged between 29-40 cm.

Again this year, the multiplicative model (Gavaris 1980) was used to standardize catch rates and effort. The results (Table 2) indicate that the assumptions of the model have been met.

The catch rates were made relative to that of the first year (1959) and are shown along with the effort in Table 3 and Fig. 6 and 7. It should be noted that the 1968 and 1974 CPUE's are out of line with the other years and an examination of Table 3 indicates that catch/effort data were available for only 2.2% and 0.3% of the total catches in these years. The catch rates in 1980 and 1981 are the highest recorded in this fishery.

A series of regressions were run using unlagged values as well as 6-, 8-, and 10-year running averages. These were first done using the actual values from the multiplicative model then using adjusted values for 1968 and 1974. The catch rates in these years was set at the average of the previous and following years and the effort adjusted accordingly.

It can be seen from the results (Fig. 8-15) that the only significant relationships are the unlagged and 6-yr lagged incorporating the actual values for 1968 and 1974. It is these two years, particularly 1974, that make the regression.

Catch curves were constructed from Canadian research vessel surveys to 3LN in 1978 and 1979 and to 3L in 1980 and 1981. The results (Tables 4 and 5 and Fig. 16-19) indicate that all regressions were significant except that of 1980 but the results were variable. The estimated Z's for 3L were .13, .12, and .18 for 1978, 1979, and 1981 respectively. Only in 1979 was a Z obtained for 3N and this was .30. The estimated Z's for 3LN combined were .12 and .22 for 1978 and 1979. The 1979 survey had much better coverage of 3N than did the 1978 survey.

Biomass estimates from these surveys are as follows:^a

	1978	1979	1980	1981
3L	111,850	79,456	28,303	100,894
3N	22,140	258,738		
3LN	133,990	338,194		

^aMetric tons.

Again the results are quite variable indicating the problems of random stratified surveys for redfish.

Finally Paloheimo Z's were calculated from the numbers caught at age per tow during the research cruises. The results are shown in Table 6 and can be seen to fluctuate widely.

The results of Canadian and USSR research cruises to 3LN are shown in Fig. 20-24. The Canadian surveys suggest predominately younger fish in 3N with an accumulation of older fish in 3L. The USSR survey results suggest a predominance of fish 25-35 cm in 3L but the fishing depths were very limited.

DISCUSSION

The questions that exist concerning the 1968 and 1974 catch rates suggest that they should be omitted from any analysis. With these points omitted, the regressions of catch rate on effort are not significant and, thus, the general production model cannot be used.

Catch curves suggest a range of Z's for 3L between .12 and .18 indicating F's of 0.02 to 0.08 ($M = 0.10$). For 3N the only estimate of F is 0.20, while for 3LN estimates of F are 0.02 and 0.12. Assuming a flat-topped partial recruitment vector with fully recruited ages at 13-14+, $F_{0.1}$ would be in the range of 0.15. Thus, if one accepts the 1979 survey as having the best coverage of the area and, thus, yielding the best results, fishing has been slightly below $F_{0.1}$ during the period before 1979. The average catch from 1959-78 was 22,246 MT, approximately 3,000 MT below the present TAC of 25,000 MT. The 1979 catch curves also suggest that F has been greater in 3N than in 3L. Historically, 63% of the landings were caught in 3N.

Paloheimo Z's suggest a wide range of F's. It is interesting to note that between 1978 and 1979 for 3LN combined, $F = 0.12$ although when examined by division, the results are questionable.

Although the data available do not allow the determination of a suggested TAC, indications are that fishing has not been excessive and is perhaps at a level slightly below $F_{0.1}$. The historical average catch is slightly below the present TAC and without specific information being available, it is suggested that the TAC remain at its present level of 25,000 MT.

REFERENCES

Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37: 2272-2275.

Table 1. Redfish catches in 3LN separated by division.

Year	3L	3N	Total	TAC
1959	34,107	10,478	44,585	
1960	11,463	16,547	28,010	
1961	8,349	14,826	23,175	
1962	3,425	18,009	21,434	
1963	8,191	12,906	21,097	
1964	3,898	4,206	8,104	
1965	9,451	4,042	13,493	
1966	6,927	10,047	16,974	
1967	7,684	19,504	27,188	
1968	2,348	15,265	17,613	
1969	927	22,142	23,069	
1970	1,029	13,359	14,388	
1971	10,043	24,310	34,353	28,000
1972	3,095	25,838	28,933	20,000
1973	4,709	28,588	33,297	20,000
1974	11,419	10,867	22,286	20,000
1975	3,838	14,033	17,871	16,000
1976	15,971	4,541	20,512	16,000
1977	13,452	3,064	16,516	16,000
1978	6,318	5,725	12,043	16,000
1979	5,584	8,483	14,067	18,000
1980	4,367	11,662	16,029	25,000
1981			22,711	25,000

^aProvisional

Table 2. REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.823
MULTIPLE R SQUARED.....0.677

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.391E0	3.391E0	
REGRESSION	37	8.920E1	2.411E0	26.623
TYPE 1	7	2.430E1	3.472E0	38.337
TYPE 2	7	8.529E0	1.218E0	13.454
TYPE 3	1	8.078E-1	8.078E-1	8.920
TYPE 4	22	1.231E1	5.596E-1	6.179
RESIDUALS	471	4.265E1	9.056E-2	
TOTAL	509	1.352E2		

Table 3. Nominal catches, relative CPUE, and effort for 3LN redfish.

PREDICTED RELATIVE POWER

YEAR	TOTAL CATCH	FPROP.	RELATIVE POWER MEAN	S.E.	EFFORT
1959	44585	0.504	1.000	0.000	44585
1960	28010	0.141	0.836	0.087	33492
1961	23175	0.239	1.019	0.105	22734
1962	21434	0.444	1.037	0.098	20676
1963	21097	0.517	1.003	0.093	21043
1964	8104	0.397	0.911	0.100	8899
1965	13493	0.220	0.818	0.099	16505
1966	16974	0.213	1.080	0.137	15721
1967	27188	0.088	1.037	0.151	26217
1968	17613	0.022	0.365	0.073	48303
1969	23069	0.833	0.840	0.063	27455
1970	14388	0.339	0.834	0.089	17250
1971	34353	0.350	0.700	0.059	49044
1972	28933	0.791	0.935	0.071	30930
1973	33297	0.080	0.902	0.188	36926
1974	22286	0.003	0.256	0.102	86973
1975	17871	0.550	0.855	0.074	20890
1976	20512	0.535	0.752	0.059	27273
1977	16516	0.645	0.789	0.064	20926
1978	12043	0.643	0.612	0.054	19672
1979	14067	0.726	0.715	0.063	19675
1980	16029	0.789	1.207	0.111	13284
1981	22711	0.314	1.187	0.123	19134

AVERAGE C.V. FOR THE MEAN: 0.116

Table 4. Regressions from catch curves from 1978 Canadian research vessel survey of 3LN.

3L 1978 16+

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.82849
-5.12491	1.00000

MEAN OF DEPENDENT VARIABLE 15.65071

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		18.53912	0.57258	32.37845
1	22.50000	-0.12837	0.02505	-5.12491

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	3429.22801		
REGRESSOR;X 1	1	3.74915	3.74915	26.26466
RESIDUAL	12	1.71294	0.14275	
TOTAL	14	3434.69010		

COEFFICIENT OF DETERMINATION (R^2).....	0.6863947312
CORRECTED R^2 (R^2).....	0.6602609588
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 12)	26.2646632320
STANDARD ERROR OF THE ESTIMATE.....	0.3778162140
DURBIN-WATSON STATISTIC.....	2.1059336614
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%)	2.4140509316

3N 1978 17+

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.67502
-3.03440	1.00000

MEAN OF DEPENDENT VARIABLE 14.23154

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		15.87313	0.54811	28.95998
1	23.00000	-0.07137	0.02352	-3.03440

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	2632.97693		
REGRESSOR;X 1	1	0.92714	0.92714	9.20760
RESIDUAL	11	1.10763	0.10069	
TOTAL	13	2635.01170		

COEFFICIENT OF DETERMINATION (R^2).....	0.4556503964
CORRECTED R^2 (R^2).....	0.4061640688
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 11)	9.2076017459
STANDARD ERROR OF THE ESTIMATE.....	0.3173220080
DURBIN-WATSON STATISTIC.....	2.7472031847
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%)	2.2297098014

3LN 1978 16+

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.81808
-4.92766	1.00000

MEAN OF DEPENDENT VARIABLE 15.87786

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		18.53484	0.54778	33.83616
1	22.50000	-0.11809	0.02396	-4.92766

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	3529.48886		
REGRESSOR;X 1	1	3.17243	3.17243	24.28185
RESIDUAL	12	1.56780	0.13065	
TOTAL	14	3534.22910		

COEFFICIENT OF DETERMINATION (R^2).....	0.6692561192
CORRECTED R^2 (R^2).....	0.6416941291
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 12)	24.2818503883
STANDARD ERROR OF THE ESTIMATE.....	0.3614558475
DURBIN-WATSON STATISTIC.....	2.2103495583
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%)	2.2764775134

Table 5. Regressions from catch curves from 1979 Canadian research vessel survey of 3LN.

3L	1979	9+
CORRELATION MATRIX (WITH T-VALUES)		
1.00000	0.97013	
-17.43112	1.00000	
MEAN OF DEPENDENT VARIABLE	15.65571	
VARIABLE	MEAN	ESTIMATED COEFFICIENT
CONSTANT TERM		17.94731
1	19.00000	-0.12061
SOURCE OF VARIATION	DF	SUM OF SQUARES
MEAN	1	5147.12919
REGRESSOR:X 1	1	11.20109
RESIDUAL	19	0.70043
TOTAL	21	5159.03070
COEFFICIENT OF DETERMINATION (R ²)		0.9411480434
CORRECTED R ² (E ²)		0.9380505720
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 19)		303.8439815302
STANDARD ERROR OF THE ESTIMATE		0.1920015628
DURBIN-WATSON STATISTIC		1.3740421899
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%)		1.2263992517
3N	1979	8+
CORRELATION MATRIX (WITH T-VALUES)		
1.00000	0.96757	
-17.12924	1.00000	
MEAN OF DEPENDENT VARIABLE	15.67455	
VARIABLE	MEAN	ESTIMATED COEFFICIENT
CONSTANT TERM		21.30435
1	18.50000	-0.30431
SOURCE OF VARIATION	DF	SUM OF SQUARES
MEAN	1	5405.21025
REGRESSOR:X 1	1	82.00348
RESIDUAL	20	5.58967
TOTAL	22	5492.80340
COEFFICIENT OF DETERMINATION (R ²)		0.9361860320
CORRECTED R ² (E ²)		0.9329953336
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 20)		293.4110076561
STANDARD ERROR OF THE ESTIMATE		0.5286618095
DURBIN-WATSON STATISTIC		0.5726604625
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%)		3.3727409262
3LN	1979	8+
CORRELATION MATRIX (WITH T-VALUES)		
1.00000	0.95355	
-14.15628	1.00000	
MEAN OF DEPENDENT VARIABLE	16.56091	
VARIABLE	MEAN	ESTIMATED COEFFICIENT
CONSTANT TERM		20.70570
1	18.50000	-0.22404
SOURCE OF VARIATION	DF	SUM OF SQUARES
MEAN	1	6033.80162
REGRESSOR:X 1	1	44.44787
RESIDUAL	20	4.43591
TOTAL	22	6082.68540
COEFFICIENT OF DETERMINATION (R ²)		0.9092560350
CORRECTED R ² (E ²)		0.9047188367
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 20)		200.4003318025
STANDARD ERROR OF THE ESTIMATE		0.4709515998
DURBIN-WATSON STATISTIC		0.3763479349
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%)		2.8437545139

Table 6. Paloheimo Z's (catch/tow) from Canadian research vessel survey, 1978-81.

Age	Ages 15-25 in 1978							
			Number/tow					
	1978 3LN	1979 3LN	1978 3L	1979 3L	1980 3L	1981 3L	1978 3N	1979 3N
15	23.54	23.79	23.04	11.08	2.22	16.58	37.60	187.07
16	25.23	14.83	23.74	8.14	2.09	21.19	66.53	100.74
17	19.08	16.47	16.94	10.67	2.33	12.51	78.53	91.06
18	12.16	13.66	10.21	8.84	2.14	7.35	66.09	75.52
19	12.49	12.58	10.72	8.74	1.51	3.39	61.53	61.87
20	8.55	11.53	6.98	8.13	1.09	3.92	52.20	55.26
21	6.79	10.62	5.52	7.51	.90	5.71	41.95	50.49
22	9.82	11.99	8.06	9.24	1.13	2.61	58.40	47.40
23	11.32	6.29	9.19	5.10	.67	2.13	70.27	21.60
24	2.99	4.33	2.38	3.55	1.41	2.63	19.92	14.42
25	6.50	4.83	5.16	4.01	1.41	1.87	43.60	15.28
26	4.72	3.54	3.79	3.09	2.28	2.39	30.54	9.29
27	4.68	3.91	3.71	2.84	2.85	2.92	31.51	17.74
28	7.42	3.01	5.90	2.68	1.95	1.81	49.45	7.20
Total 15-25	138.47		121.94	85.01	16.90	79.89	596.62	
16-26		110.67		77.02	16.96	65.70		542.93
17-27					17.72	47.43		
18-28						36.73		
Z ₇₈₋₇₉	.22		.46	1.61	-1.136		.09	
M	.10		.10	.1	.1		.10	
F	.12		.36	1.51	-1.236		-.01	
Z ₇₉₋₈₁	.58	Z ₇₈₋₈₁	1.20					
			.20				.30	
			.38				.90	

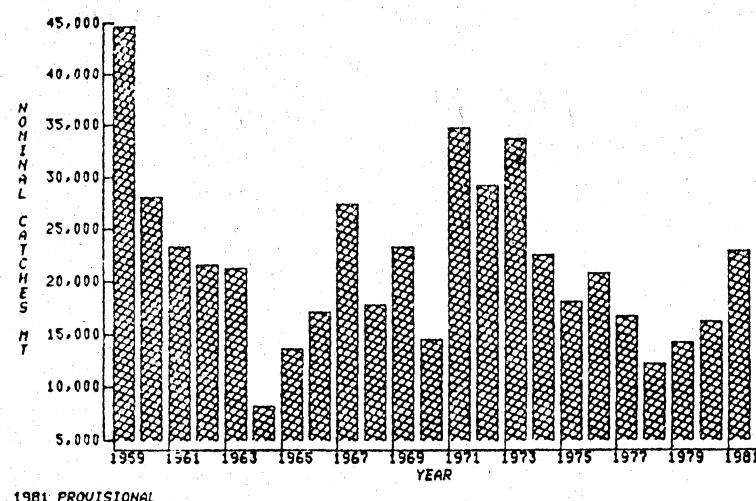


Fig. 1. Div. 3LN redfish: nominal catches, 1959-81.

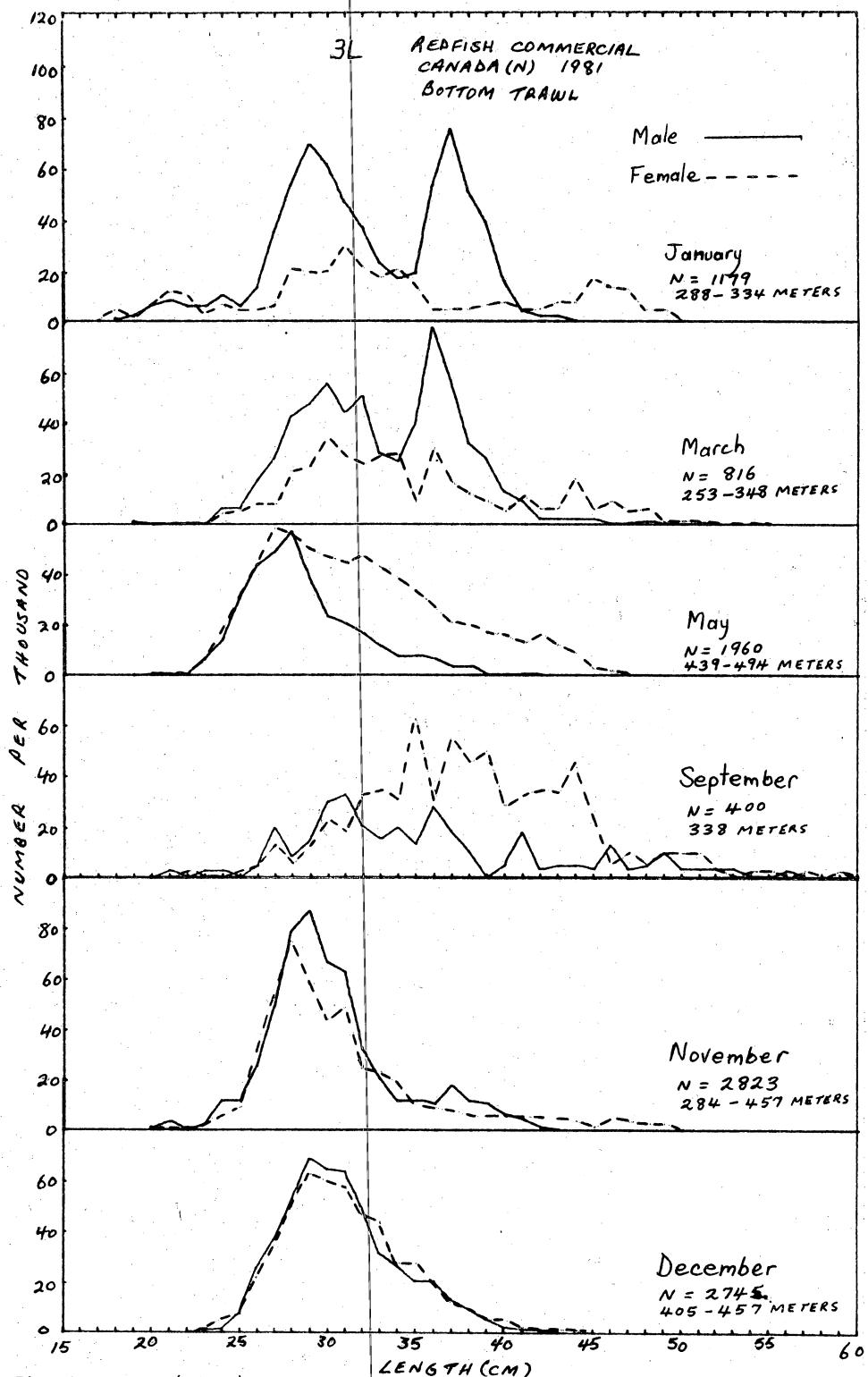


Fig. 2. Canada(Nfld.) commercial frequencies 3L, 1981.

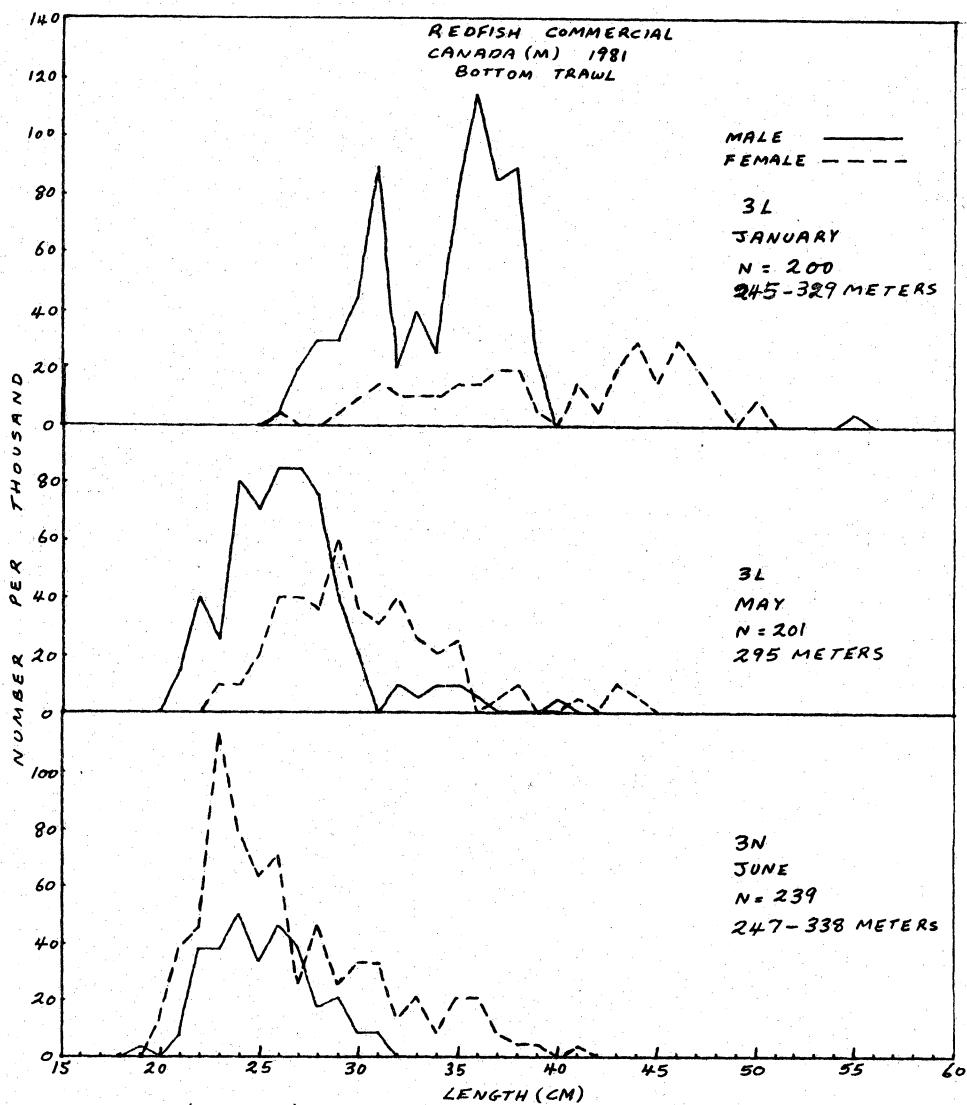


Fig. 3. Canada(Maritime) commercial frequencies 3LN, 1981.

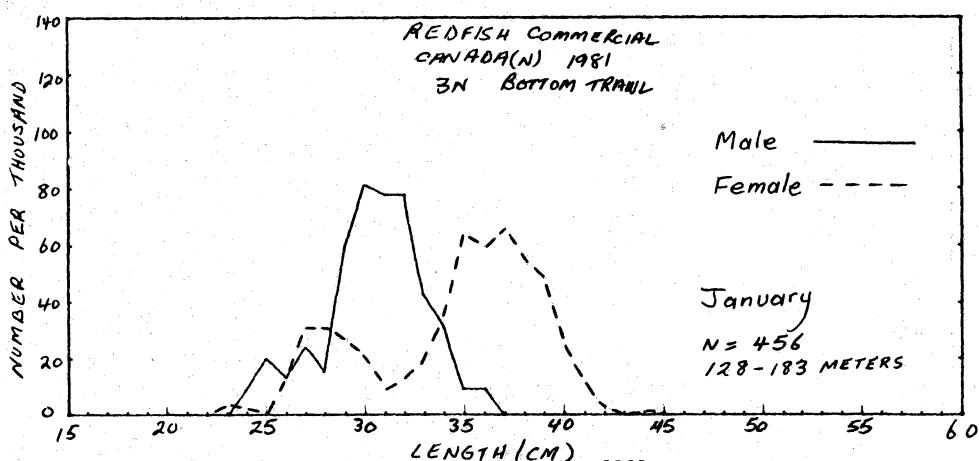


Fig. 4. Canada(Nfld.) commercial frequencies 3N, 1981.

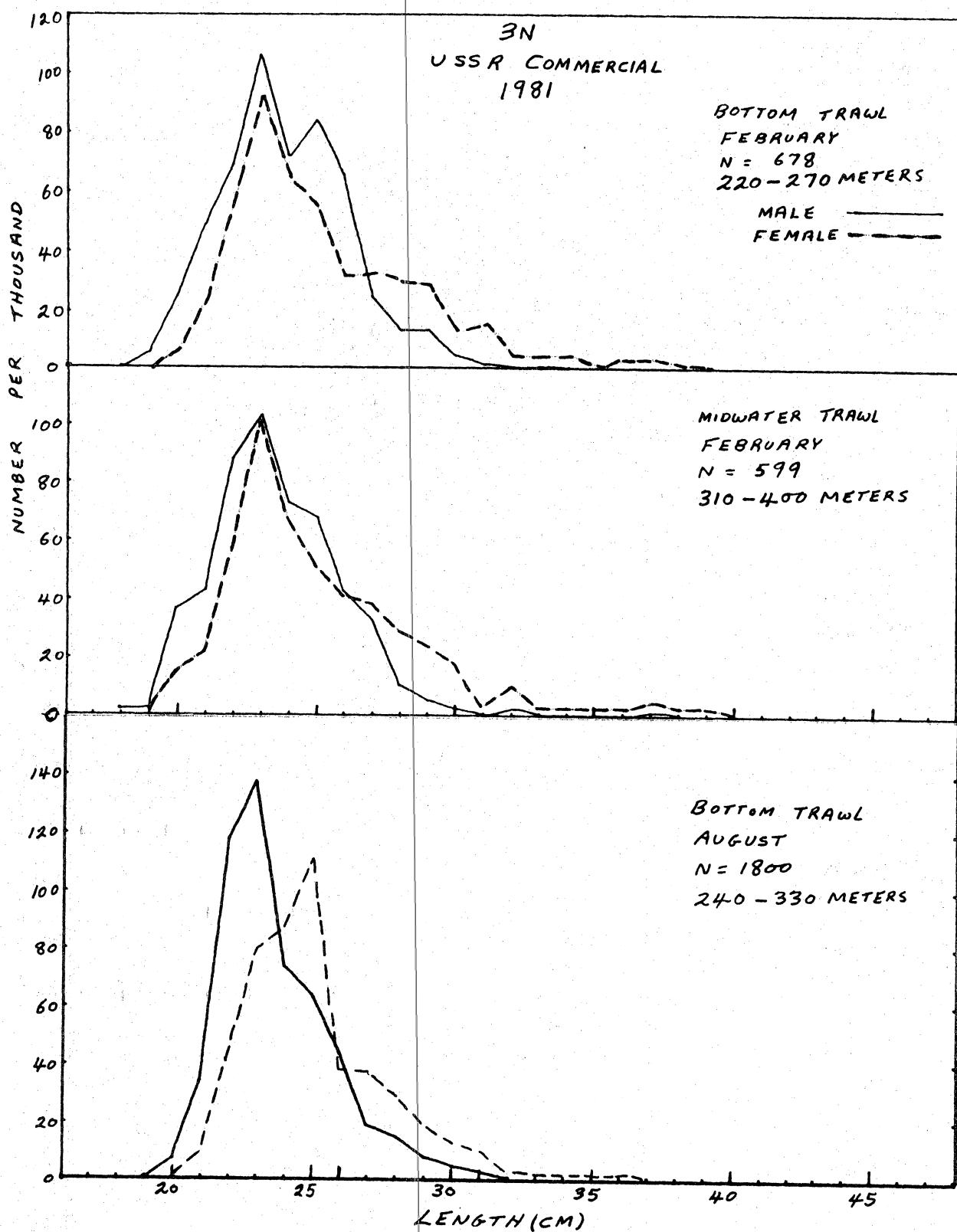
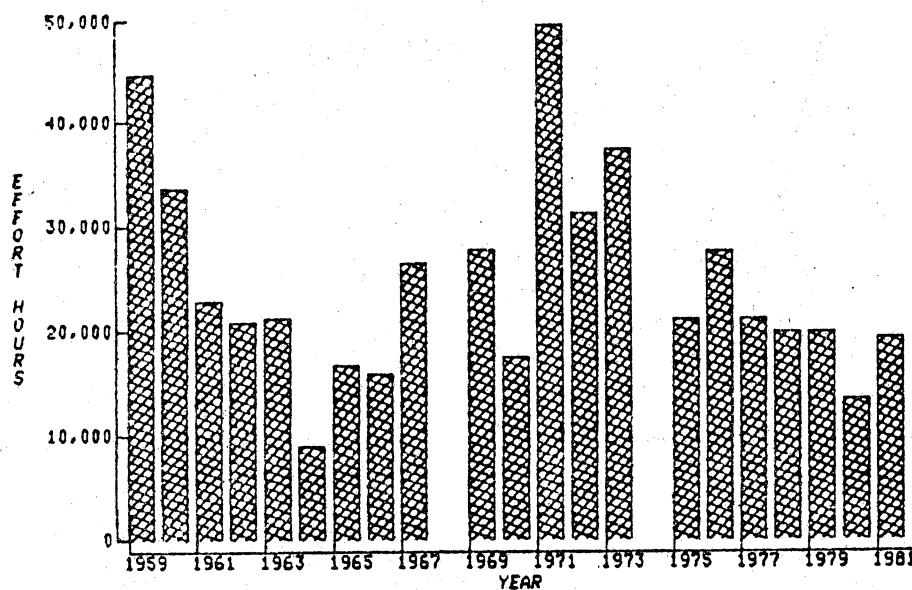


Fig. 5. USSR commercial frequencies 3N, 1981.



1968 AND 1974 POINTS OMITTED

Fig. 6. Div. 3LN redfish: standardized effort (hrs), 1959-81.

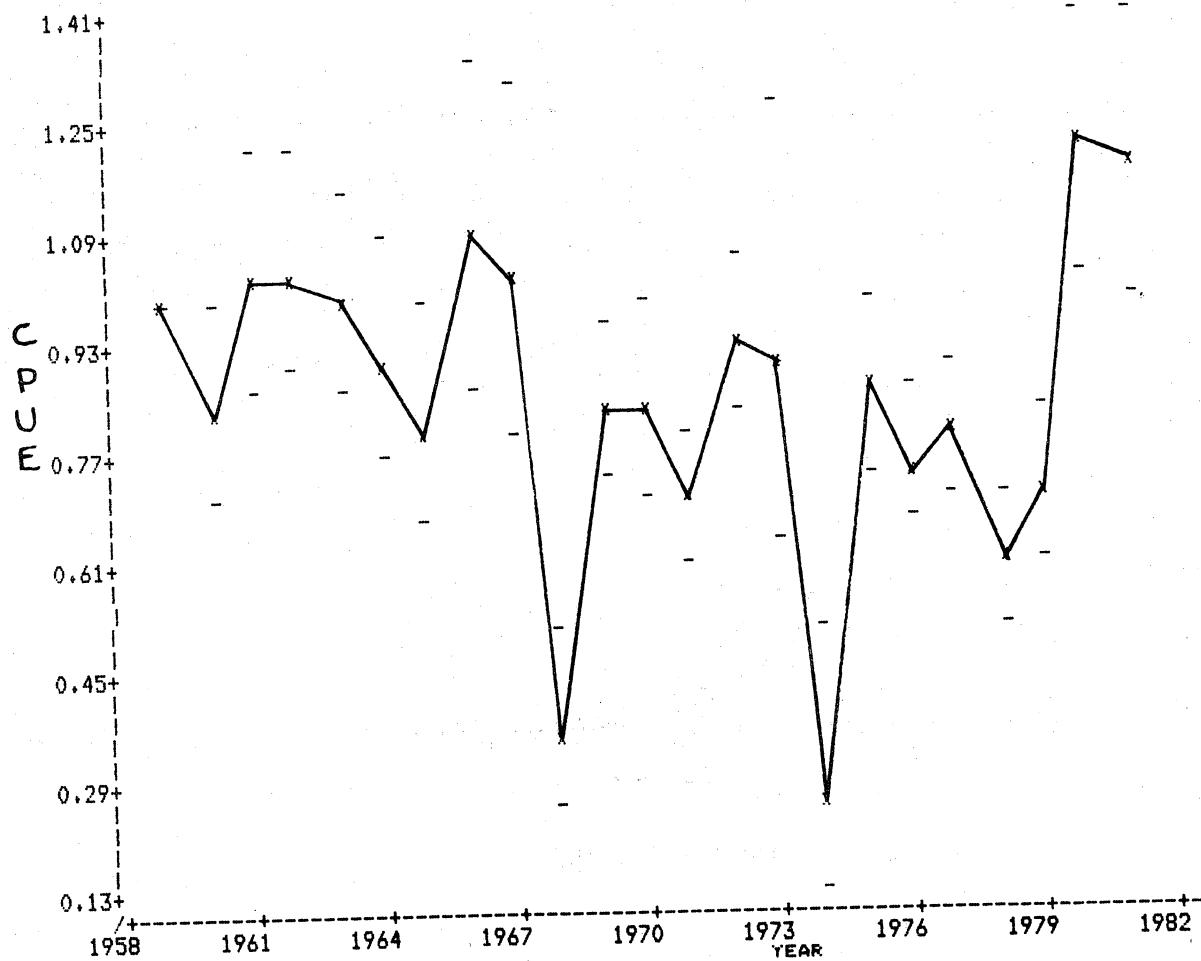


Fig. 7. Relative CPUE, 3LN redfish.

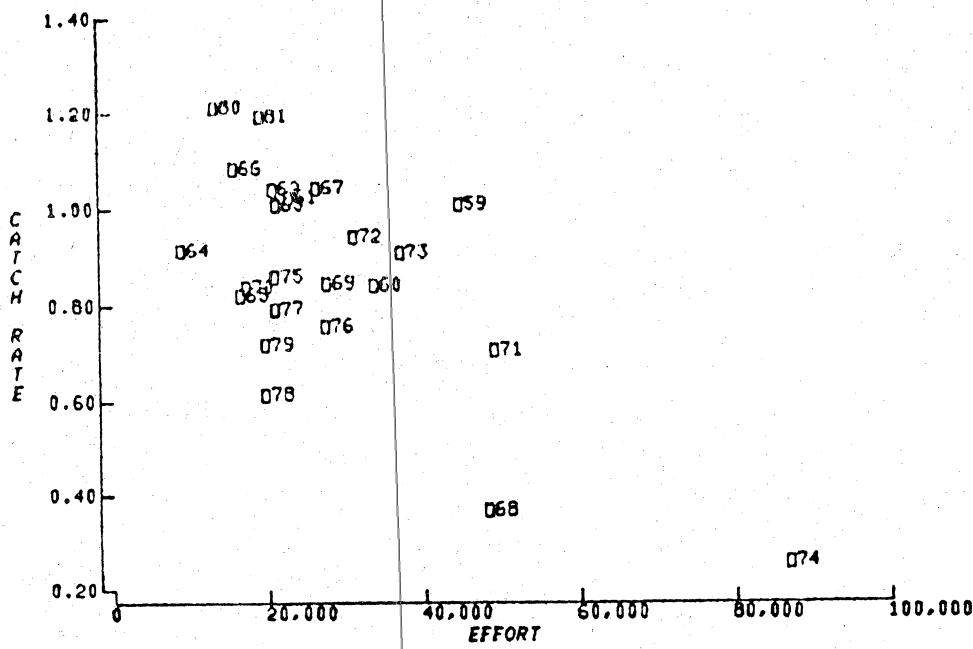


Fig. 8. Div. 3LN redfish: CPUE US effort unlagged
(actual values for 1968 and 1974).

CORRELATION MATRIX (WITH T-VALUES)

1.00000	0.67339
-4.17413	1.00000

MEAN OF DEPENDENT VARIABLE

0.85609

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		1.11538	0.07184	15.52486
1	28156.82609	-0.00001	0.00000	-4.17413

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	16.85635		
REGRESSOR:X 1	1	0.52215	0.52215	17.42333
RESIDUAL	21	0.62933	0.02997	
TOTAL	23	18.00783		

COEFFICIENT OF DETERMINATION (R^2).....	0.4534570533
CORRECTED R^2 (\bar{R}^2).....	0.4274311987
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 21)	17.4233299968
STANDARD ERROR OF THE ESTIMATE.....	0.1731133921
DURBIN-WATSON STATISTIC.....	1.2718919921
COEFFICIENT OF VARIATION (AT THE MEAN OF Y)...(%)	20.2214729258

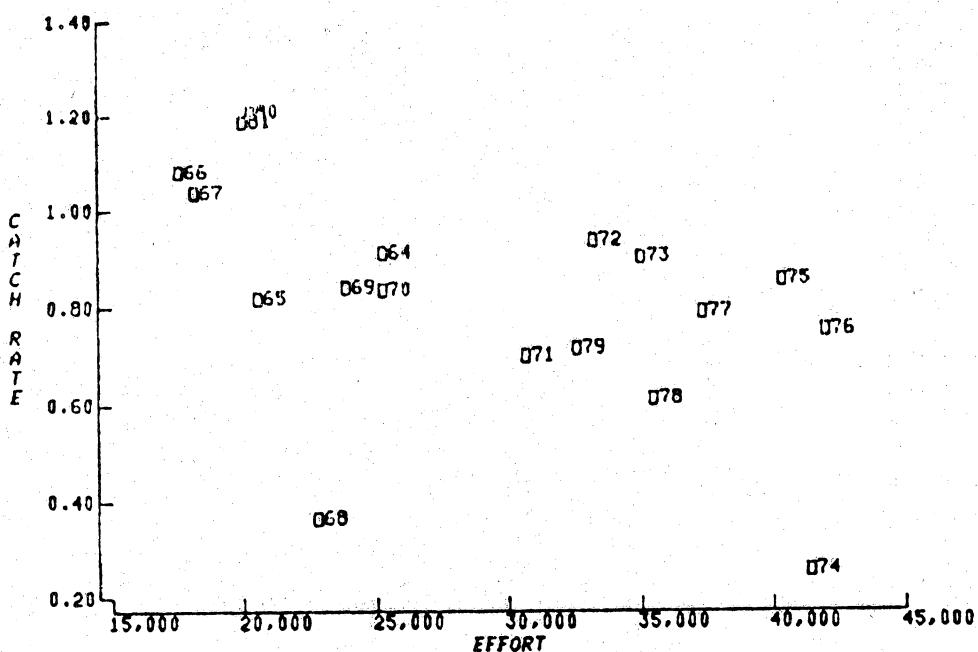


Fig. 9. Div. LN redfish CPUE US effort lagged 6 years
(actual values for 1968 and 1974).

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.52182
-2.44680	1.00000

MEAN OF DEPENDENT VARIABLE

0.82194

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		1.26455	0.18794	6.72856
1	28982.00000	-0.00002	0.00001	-2.44680

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	12.16067		
REGRESSOR:X 1	1	0.28006	0.28006	5.98683
RESIDUAL	16	0.74847	0.04678	
TOTAL	18	13.18920		

COEFFICIENT OF DETERMINATION (R^2).....	0.2722916610
CORRECTED R^2 (R^2).....	0.2268098898
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 16)	5.9868306328
STANDARD ERROR OF THE ESTIMATE.....	0.2162852702
DURBIN-WATSON STATISTIC.....	2.0596943441
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%)	26.3138551123

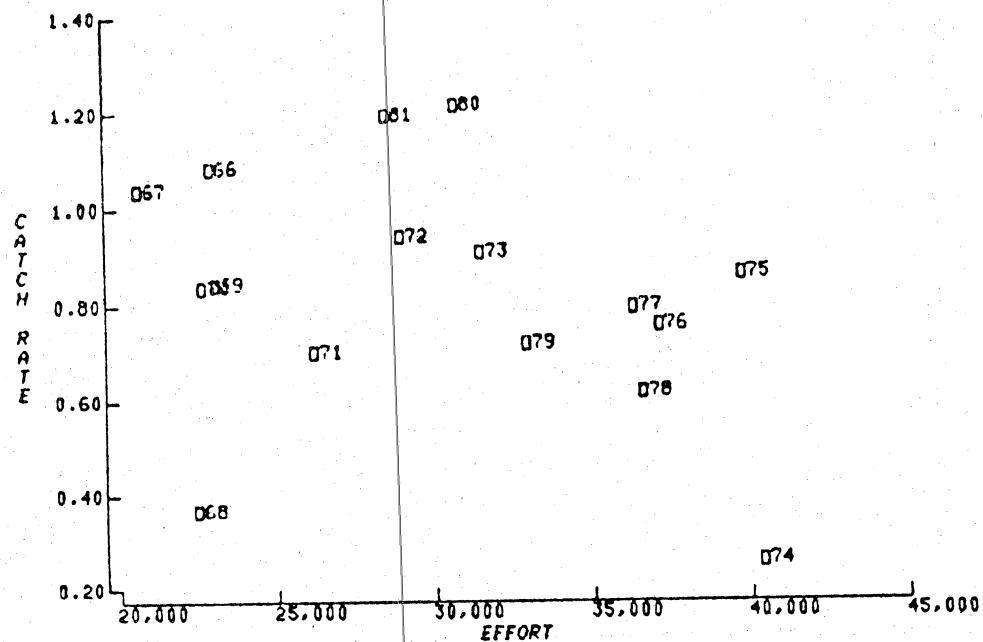


Fig. 10. Div. 3LN redfish CPUE US effort lagged 8 years
(actual values for 1968 and 1974).

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.32355
-1.27943	1.00000

MEAN OF DEPENDENT VARIABLE

0.81662

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		1.19910	0.30569	3.92266
1	30039.62500	-0.00001	0.00001	-1.27943

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	10.67002		
REGRESSOR: X 1	1	0.10679	0.10679	1.63695
RESIDUAL	14	0.91334	0.06524	
TOTAL	16	11.69015		

COEFFICIENT OF DETERMINATION (R^2).....	0.1046845685
CORRECTED R^2 (E^2).....	0.0407334662
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION (1, 14)	1.6369470549
STANDARD ERROR OF THE ESTIMATE.....	0.2554181316
DURBIN-WATSON STATISTIC.....	1.7977735298
COEFFICIENT OF VARIATION (AT THE MEAN OF Y) ..(%)	31.2772853639

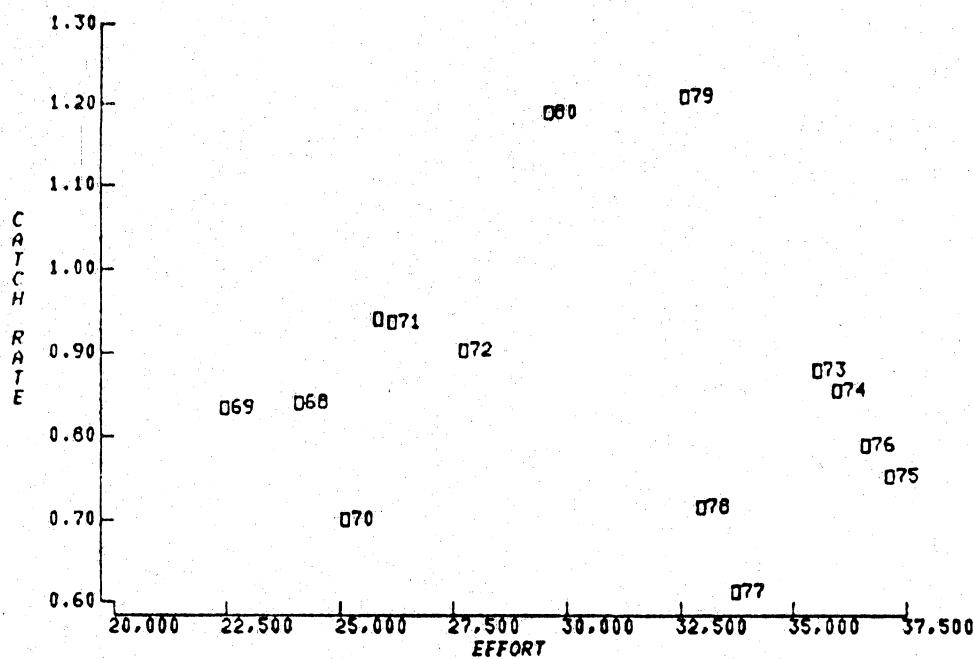


Fig. 11. Div. 3LN redfish CPUE US effort lagged 10 years
(actual values for 1968 and 1974).

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.11598
-0.40449	1.00000

MEAN OF DEPENDENT VARIABLE

0.78207

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		0.96175	0.45002	2.13713
1	30387.07143	-0.00001	0.00001	-0.40449

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	8.56290		
REGRESSOR; X 1	1	0.01191	0.01191	0.16362
RESIDUAL	12	0.87357	0.07280	
TOTAL	14	9.44838		

COEFFICIENT OF DETERMINATION (R^2).....	0.0134512227
CORRECTED R^2 (\bar{R}^2).....	0.0687611754
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 12)	0.1636155011
STANDARD ERROR OF THE ESTIMATE.....	0.2698104428
DURBIN-WATSON STATISTIC.....	1.4991747144
COEFFICIENT OF VARIATION (AT THE MEAN OF Y)...(%)	34.4994629567

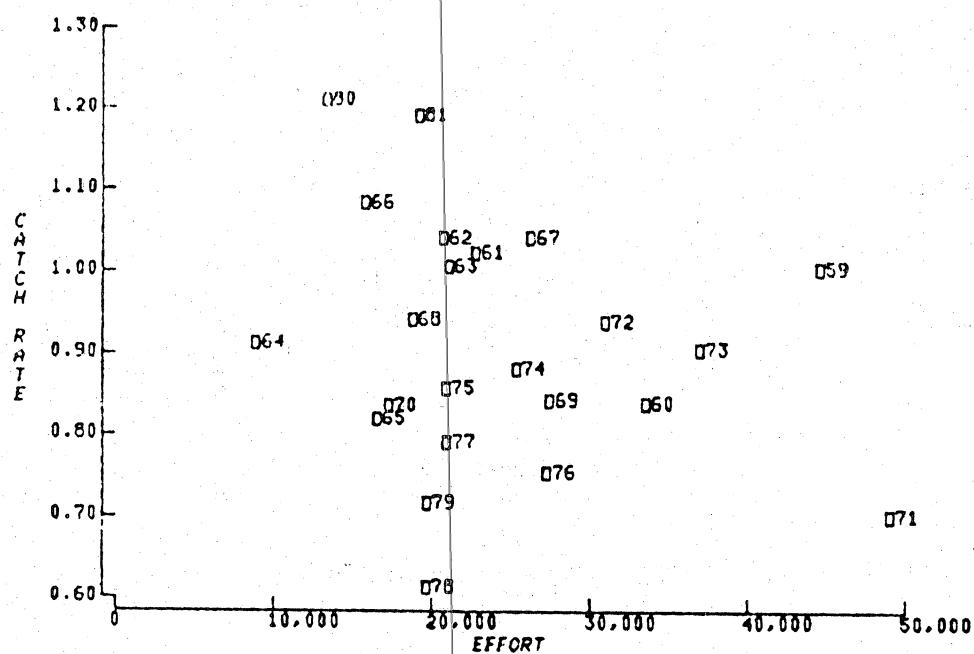


Fig. 12. Div. 3LN redfish CPUE US effort unlagged
(adjusted values for 1968 and 1974).

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.24023
-1.13408	1.00000

MEAN OF DEPENDENT VARIABLE

0.90813

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		0.99898	0.08593	11.62546
1	24193.13043	0.00000	0.00000	-1.13408
SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	18.96812		
REGRESSOR:X 1	1	0.02858	0.02858	1.28614
RESIDUAL	21	0.46673	0.02223	
TOTAL	23	19.46343		

COEFFICIENT OF DETERMINATION (R^2).....

0.0577104588

CORRECTED R^2 (R^2).....

0.0128395282

F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 21)

1.2861435692

STANDARD ERROR OF THE ESTIMATE.....

0.1490809768

DURBIN-WATSON STATISTIC.....

1.0276073597

COEFFICIENT OF VARIATION (AT THE MEAN OF Y)

16.4162515800

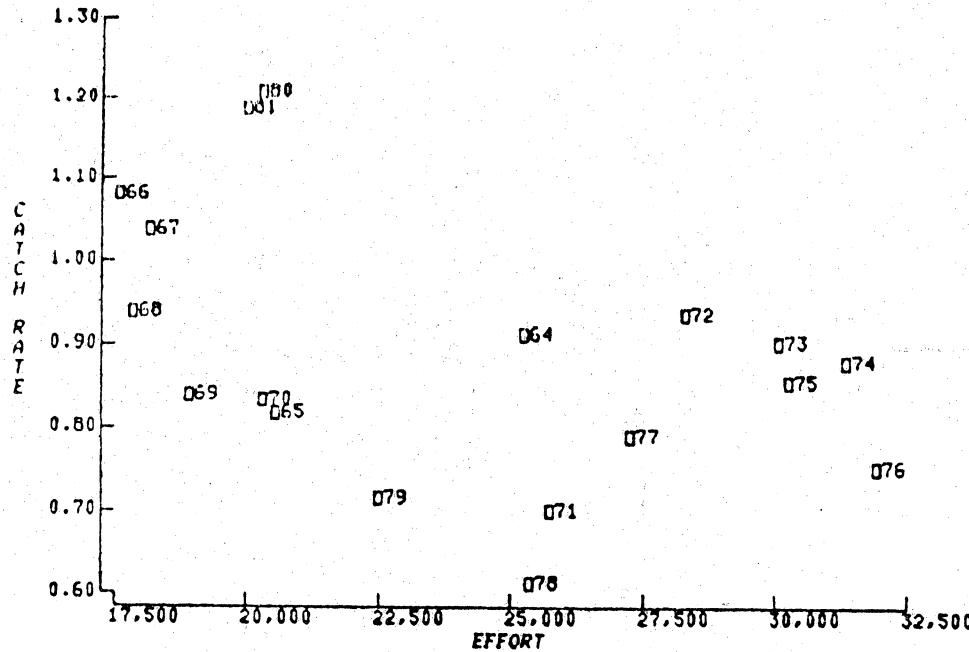


Fig. 13. Div. 3LN redfish CPUE US effort lagged 6 years
(adjusted values for 1968 and 1974).

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.43421
-1.92808	1.00000

MEAN OF DEPENDENT VARIABLE 0.88844

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		1.22275	0.17690	6.91212
1	23980.11111	-0.00001	0.000001	-1.92808

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	14.20800		
REGRESSOR; X 1	1	0.08235	0.08235	3.71750
RESIDUAL	16	0.35444	0.02215	
TOTAL	18	14.64480		

COEFFICIENT OF DETERMINATION (R^2).....	0.1885381082
CORRECTED R^2 (\bar{R}^2).....	0.1378217400
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION (1, 16)	3.7175001834
STANDARD ERROR OF THE ESTIMATE.....	0.1488375890
DURBIN-WATSON STATISTIC.....	1.2319054093
COEFFICIENT OF VARIATION (AT THE MEAN OF Y), (%)	16.7526050607

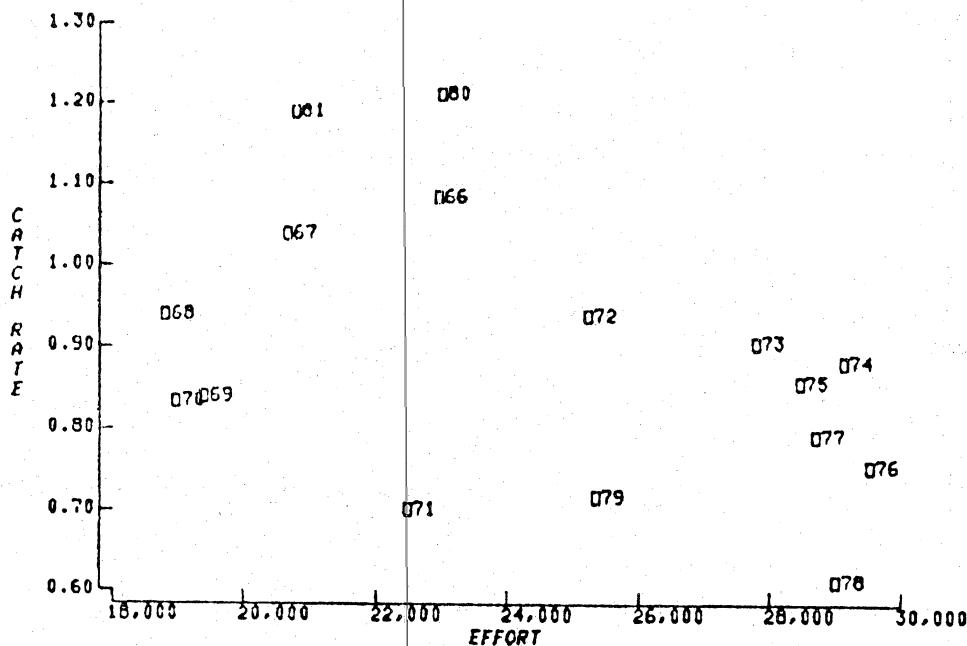


Fig. 14. Div. 3LN redfish CPUE US effort lagged 8 years
(adjusted values for 1968 and 1974).

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.43477
-1.80640	1.00000

MEAN OF DEPENDENT VARIABLE

0.89144

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		1.34234	0.25272	5.31156
1	24395.00000	-0.00002	0.00001	-1.80640
SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	12.71457		
REGRESSOR; X 1	1	0.08150	0.08150	3.26309
RESIDUAL	14	0.34968	0.02498	
TOTAL	16	13.14575		
COEFFICIENT OF DETERMINATION (R^2).....		0.1890210551		
CORRECTED R^2 (R^2).....		0.1310939876		
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 14)		3.2630869008		
STANDARD ERROR OF THE ESTIMATE.....		0.1580411002		
DURBIN-WATSON STATISTIC.....		1.0403643891		
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%)		17.7287919973		

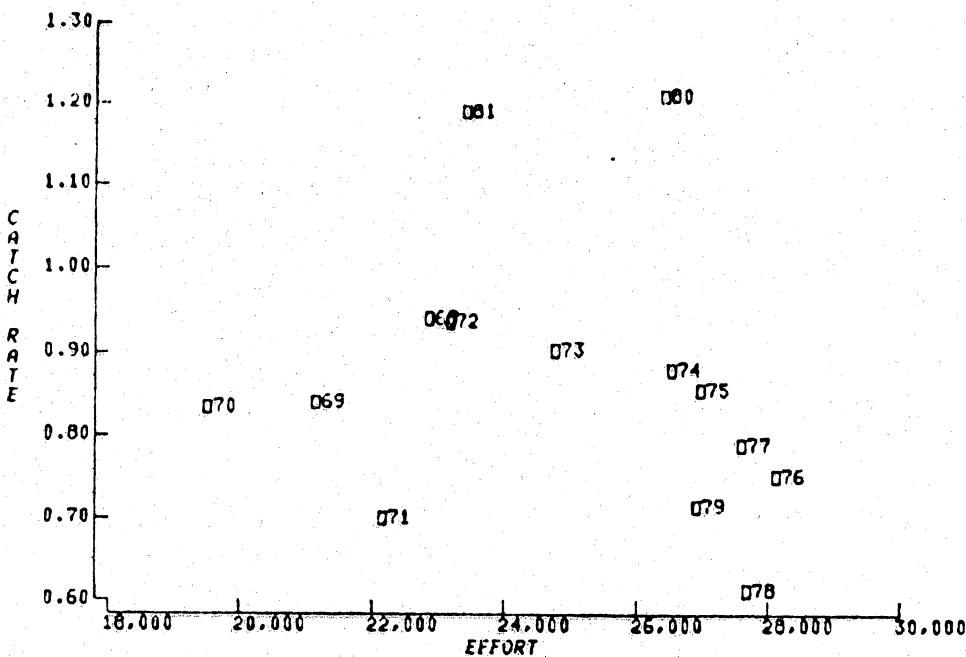


Fig. 15. Div. 3LN redfish CPUE US effort lagged 10 years
(adjusted values for 1968 and 1974).

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.18345
-0.64646	1.00000

MEAN OF DEPENDENT VARIABLE 0.86757

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		1.14542	0.43224	2.64995
1	24804.07143	-0.00001	0.00002	-0.64646

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	10.53752		
REGRESSOR; X 1	1	0.01233	0.01233	0.41791
RESIDUAL	12	0.35413	0.02951	
TOTAL	14	10.90398		

COEFFICIENT OF DETERMINATION (R^2).....	0.0336534700
CORRECTED R^2 (E^2).....	0.0468754075
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 12)	0.4179056144
STANDARD ERROR OF THE ESTIMATE.....	0.1717868665
DURBIN-WATSON STATISTIC.....	1.0592564547
COEFFICIENT OF VARIATION (AT THE MEAN OF Y)...(%)	19.8008902559

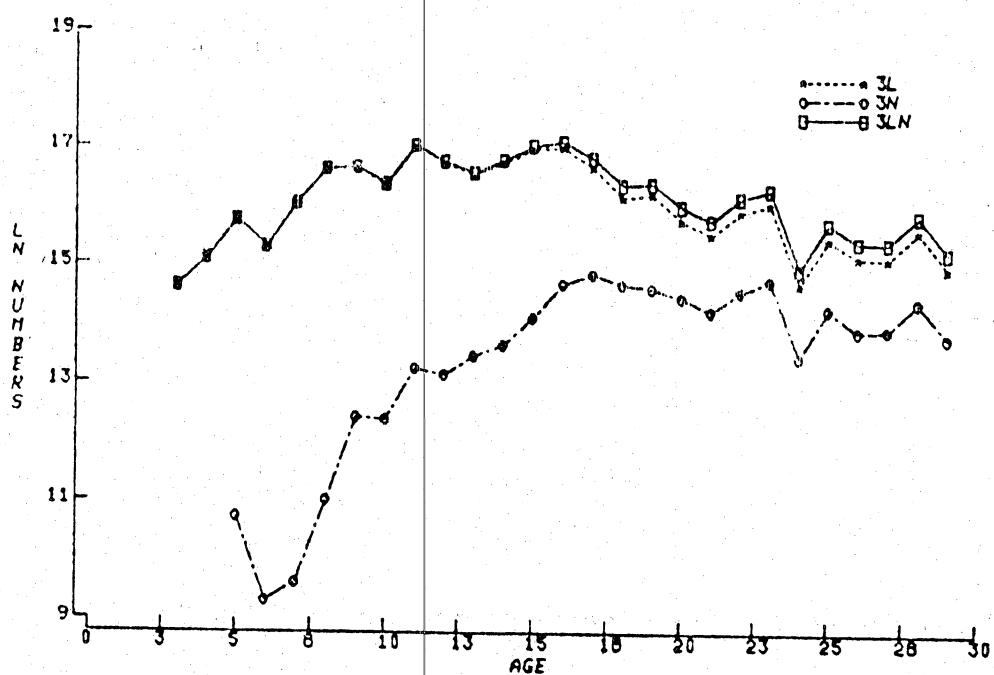


Fig. 16. Div. 3LN redfish catch curve for 1978 research vessel cruise.

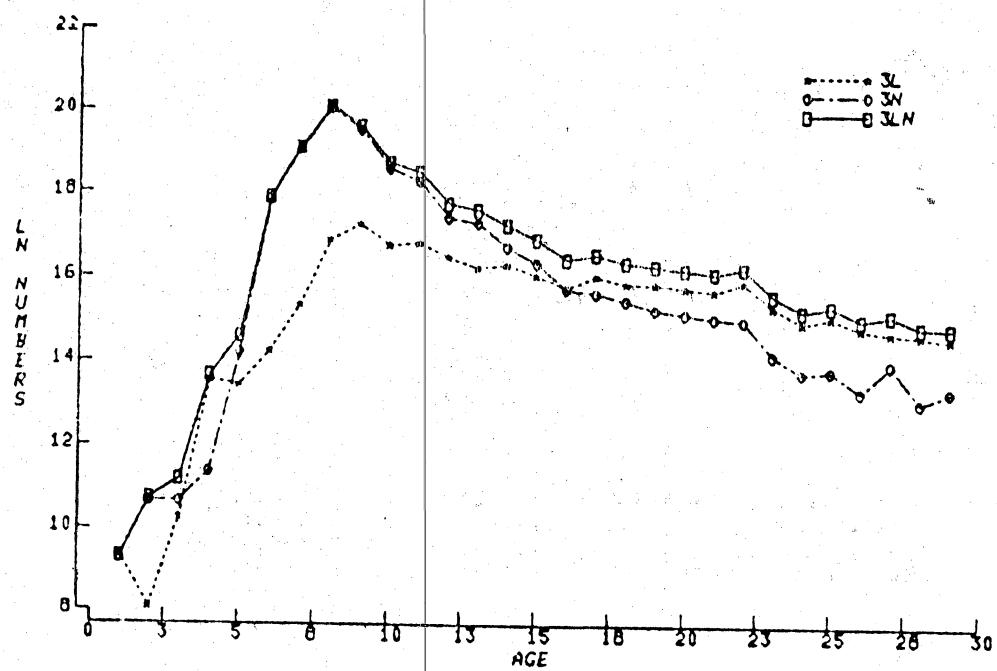


Fig. 17. Div. 3LN redfish catch curve for 1979 research vessel cruise.

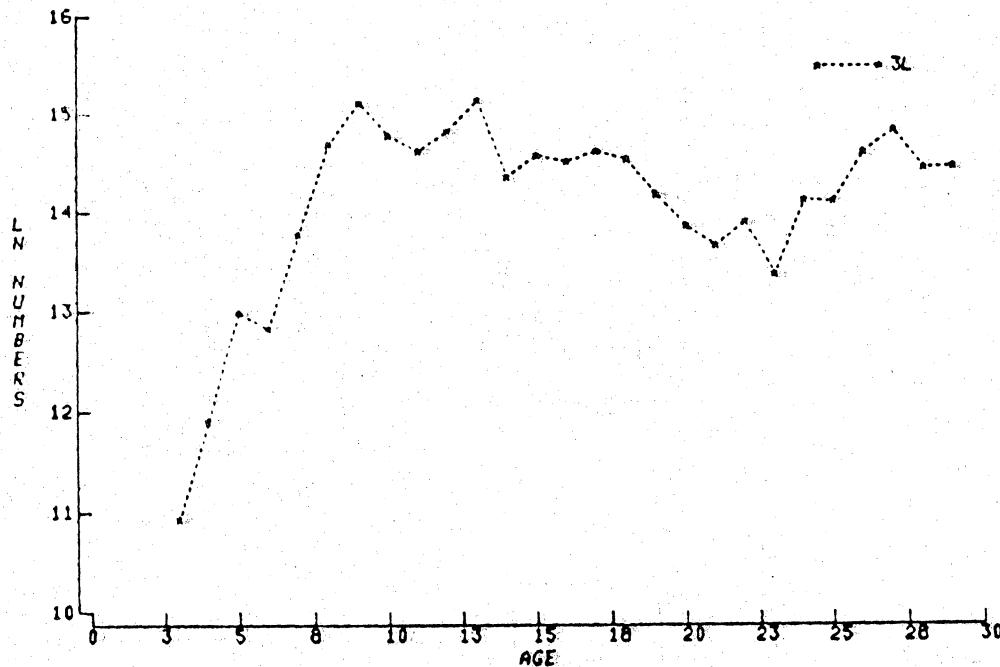


Fig. 18. Div. 3LN redfish catch curve for 1980 research vessel cruise.

13+

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.21866
-0.86785	1.00000

MEAN OF DEPENDENT VARIABLE

14.27706

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		14.67544	0.47137	31.13350
1	21.00000	-0.01897	0.02186	-0.86785

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	3465.18495		
REGRESSOR: X 1	1	0.14683	0.14683	0.75316
RESIDUAL	15	2.92432	0.19495	
TOTAL	17	3468.25610		

COEFFICIENT OF DETERMINATION (R ²).....	0.0478101728
CORRECTED R ² (E ²).....	0.0156691490
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 15)	0.7531613678
STANDARD ERROR OF THE ESTIMATE.....	0.4415367548
DURBIN-WATSON STATISTIC.....	0.7646077316
COEFFICIENT OF VARIATION (AT THE MEAN OF Y) ..(%)	3.0926310545

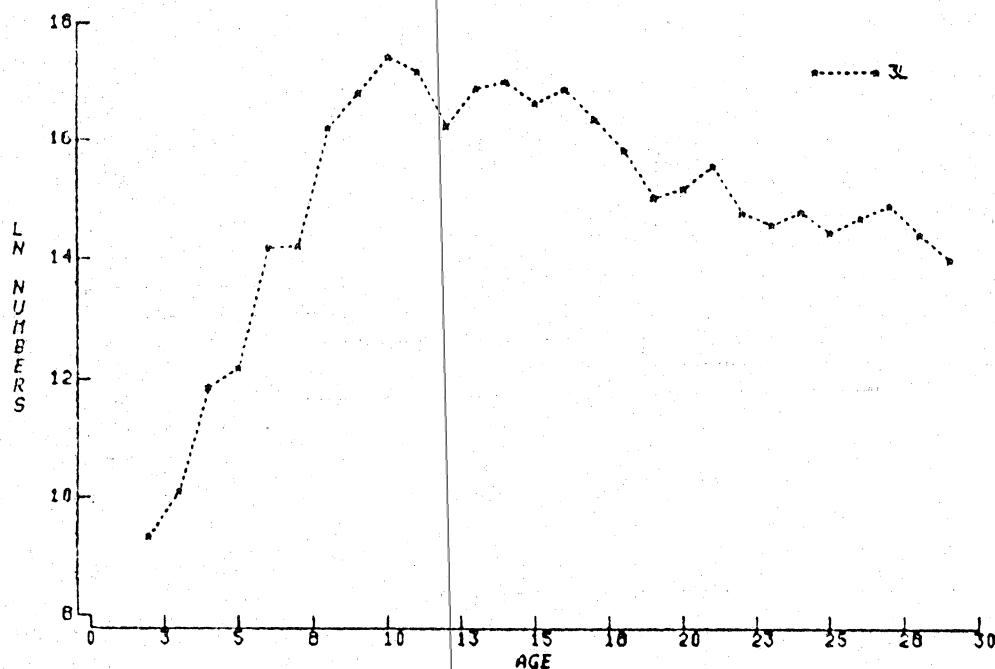


Fig. 19. Div. 3 LN redfish catch curve for 1981 research vessel cruise.

14+

CORRELATION MATRIX (WITH T-VALUES)

1.00000	-0.91757
-8.63524	1.00000

MEAN OF DEPENDENT VARIABLE

15.23625

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		19.16253	0.46501	41.20843
1	21.50000	-0.18262	0.02115	-8.63524
SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-STATISTIC
MEAN	1	3714.29302		
REGRESSOR: X 1	1	11.33873	11.33873	74.56729
RESIDUAL	14	2.12885	0.15206	
TOTAL	16	3727.76060		
COEFFICIENT OF DETERMINATION (R ²).....		0.8419280907		
CORRECTED R ² (R _c ²).....		0.8306372400		
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 14)		74.5672859934		
STANDARD ERROR OF THE ESTIMATE.....		0.3899491994		
DURBIN-WATSON STATISTIC.....		1.0457217564		
COEFFICIENT OF VARIATION (AT THE MEAN OF Y), (%)		2.5593515429		

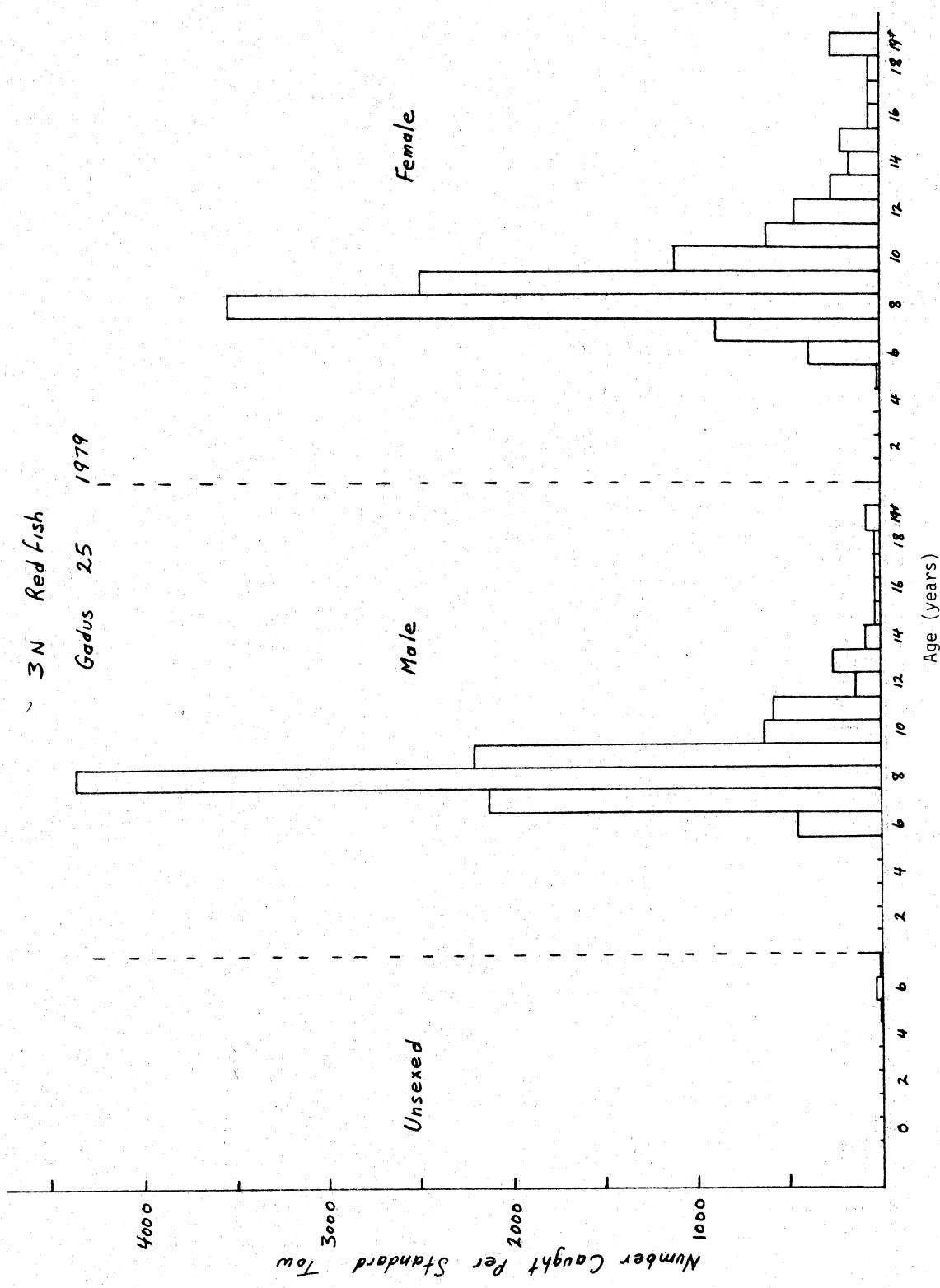


Fig. 20. Numbers caught at age per tow during Canadian research vessel survey to 3N, 1979.

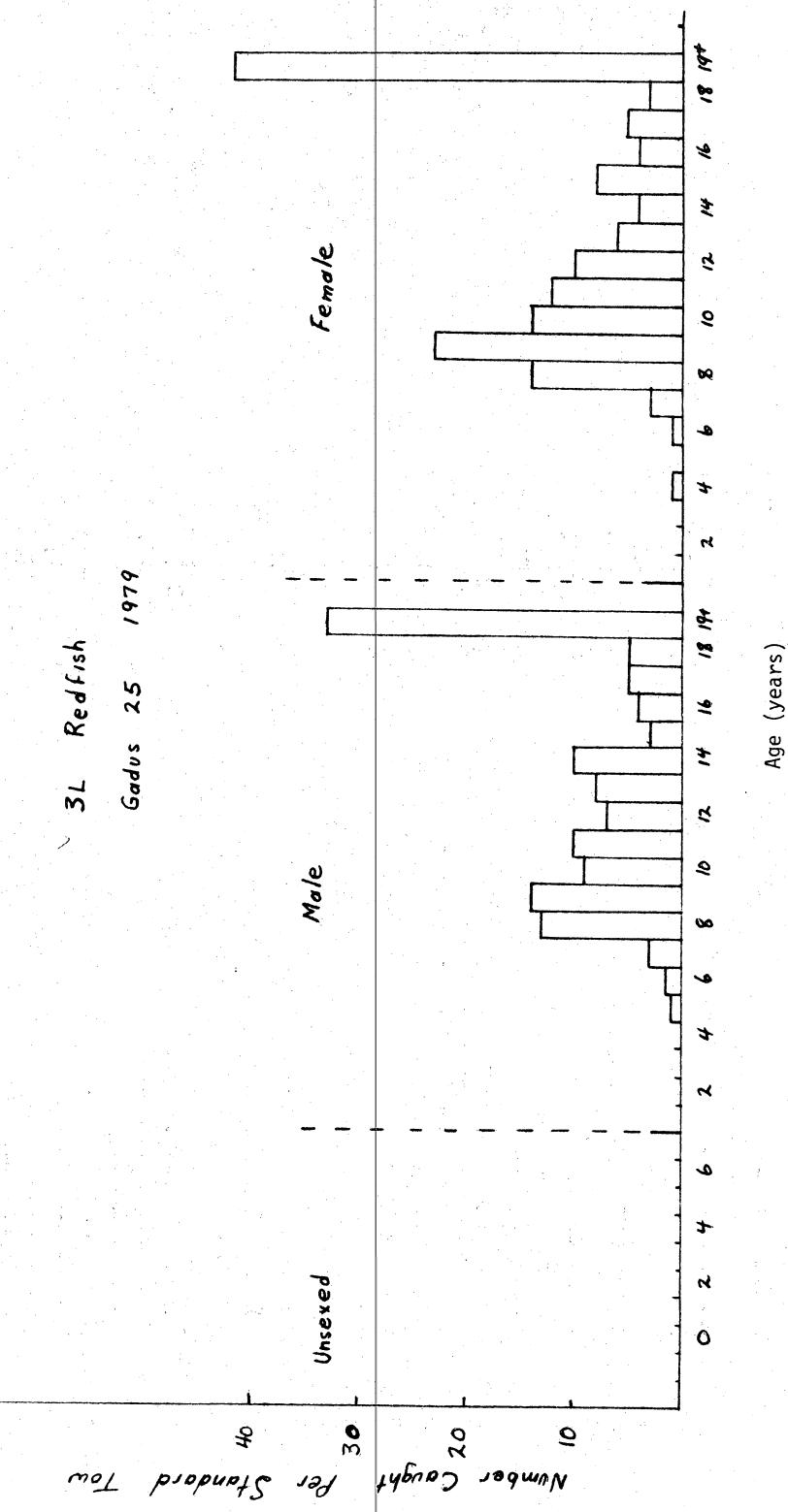


Fig. 21. Numbers caught at age per tow during Canadian research vessel survey to 3L, 1979.

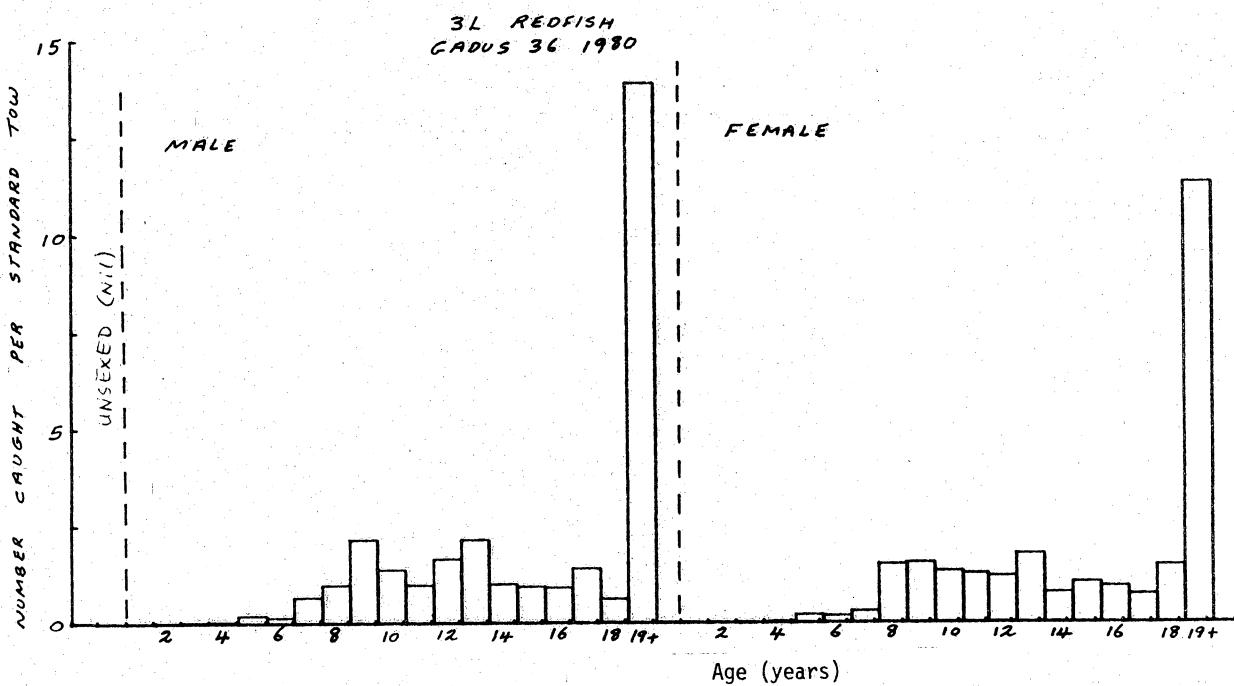


Fig. 22. Numbers caught at age per tow during Canadian research vessel survey to 3L, 1980.

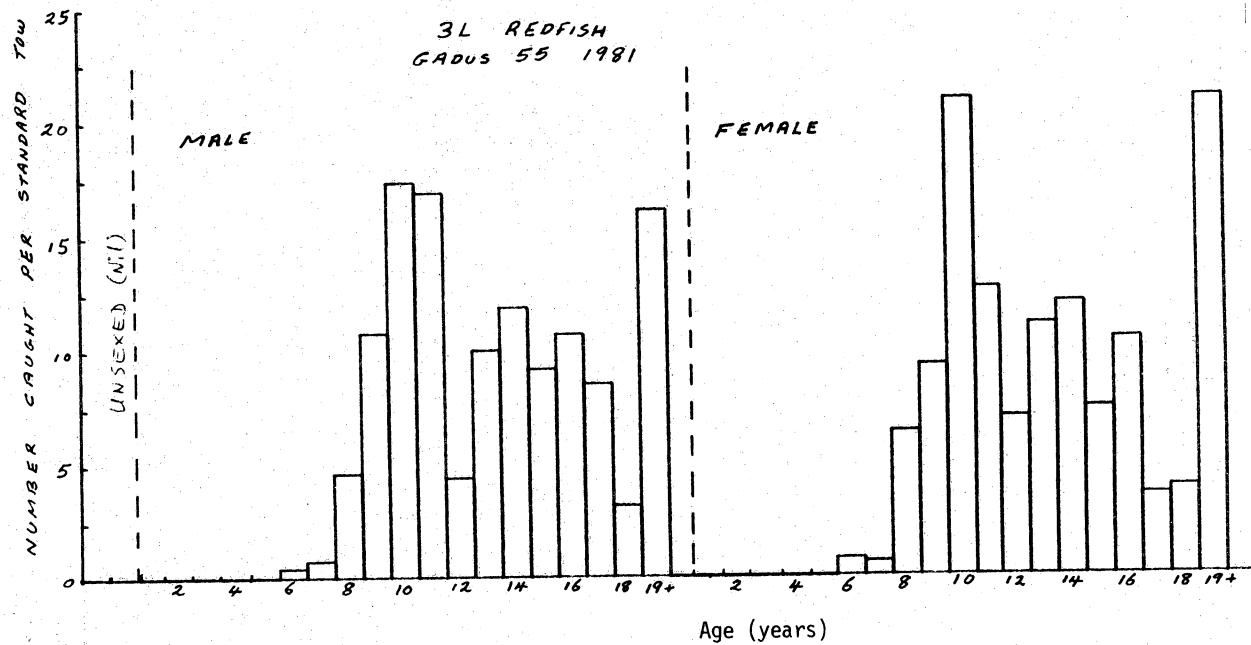


Fig. 23. Numbers caught at age per tow during Canadian research vessel survey to 3L, 1981.

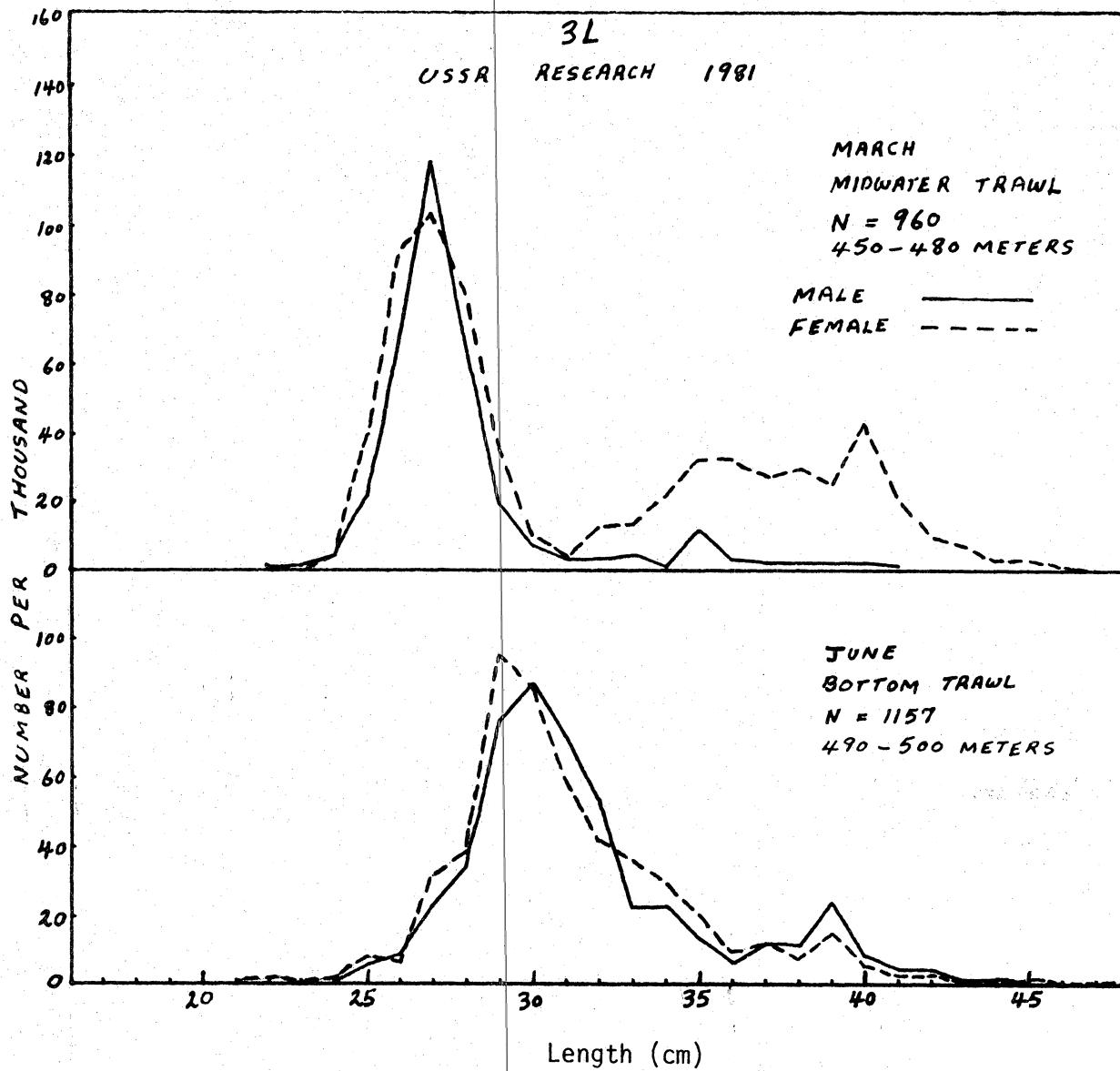


Fig. 24. USSR length frequencies (#/1000) from research survey of 3L, 1981.