

Small redfish by-catch in the shrimp fishery at Port au Choix, Newfoundland

by

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INTRODUCTION

The possible effect of the Gulf shrimp fishery upon the stock of small, unmarketable redfish has been in question since the early 1970's. Parsons (1978) presented preliminary findings of investigations carried out in the Port au Choix (Esquiman Channel) region of Newfoundland dealing with the problem. This paper is an update of that work and attempts to further assess the present and future prospects in light of the increased data base.

MATERIALS AND METHODS

The materials and methods are identical to those of Parsons (1978). Again in 1978 the Port au Choix shrimp fishery was monitored on a monthly basis. Also in 1978 a biomass survey of young redfish and shrimp was carried out in the Gulf of St. Lawrence using the M.V. Beothic Venture. The 1976 biomass estimate was recalculated using a modified stratification scheme as follows: Parsons (1978) post stratified the area covered by the 1976 survey

by combining adjacent strata to yield the minimum two sets per stratum. Because post stratification of the 1978 survey similar to the scheme of Parsons (1978) resulted in the discarding of a large number of the 1978 sets and a resulting poor survey in relation to 1976, a new stratification scheme was devised that resulted in maximum use of sets from both 1976 and 1978 as well as allowing a direct comparison of the two surveys. This resulted in a substantial increase in area covered in Zone 1 in 1976. Two year estimates of mortality-at-age were then determined for young redfish in the Gulf. Certain other modifications were made to Parsons' (1978) analysis of the 1976 and 1977 data and these were carried on through 1978. The modifications were as follows: Parsons (1978) determined the total number and numbers-at-age of small redfish by totalling the Port au Choix sampling results over the entire year and then relating these to the annual reported shrimp landings. For this report, each monthly sampling result was compared to the month's reported shrimp landings. The year's result is a summation of these sub-totals.

RESULTS AND DISCUSSION

Modifications to the 1976 abundance estimates resulted in less than 10% difference in the estimates for the entire Gulf. However, in Zone 1 (Fig 1), the new estimate was 73% higher due to the increased area covered by the present stratification scheme and the large numbers of small redfish caught in sets that were excluded in Parsons' (1978) estimates. A comparison of his estimates and the revised estimate can be seen in Table 1.

Modification in the method used to determine the numbers removed at age by the shrimp fishery also resulted in differences and these are shown in Table 2. It should be noted that although the numbers-at-age are somewhat different, the totals estimated for the entire year are quite close.

Parsons (1978) reported a ten fold decrease in the number of small redfish caught per unit effort between 1976 and 1977. The results for 1978 show another five fold decrease (Fig 2,3,4). These are summarized in Fig 5. Figure 6 shows that there has also been a decrease in the weight caught per unit effort although the drop is not as great in magnitude, as the weight of the individual fish caught has been increasing over the three year period examined as shown in Figure 7. This is perhaps indicative of growth of the stronger early 70's year-classes with no strong year-classes appearing in the past half decade.

Figure 8 indicates that during the three years of this study, the weight of small redfish caught per kilogram shrimp has continued to decrease. In 1978, Parsons concluded that an upper limit of "3.5% by numbers and 2.5% by weight of the biomass estimated from the Esquiman Channel were removed in the 1976 by-catch." He noted that on a year-class basis, only the one year-olds appeared to be removed at a rate higher than this. Table 3 repeats his calculations using both the revised abundance estimate for 1976 as well as the revised numbers at-age in the by-catch. It can be seen both that the percent of the abundance removed as by-catch is lowered (although the upper limit is higher due to high variance in 5 of the 8 strata

in this zone in 1976) and that the percent of one year-olds removed is greatly reduced.

Table 4 is a comparison of the 1978 abundance estimate for the Esquiman Channel with the estimated numbers removed as by-catch. It can be seen that the percentage removal in 1978 is slightly lower than in 1976 both in number and weight. The 1978 95% confidence limits show an upper value of 2% for both numbers and weight, the same as that for 1976 weight but much less than the 19% upper limit for numbers in 1976. Although only a small percentage of the total numbers appears to be removed by the shrimp fishery, an estimated 16% of the one year-olds and greater than 4% of the two and three year-olds were removed in 1978 while only an insignificant percentage of these year-classes was removed in 1976. The reasons for this are presently unknown but under investigation.

Table 5 shows the estimates of 2-year mortality based upon comparison of the 1976 and 1978 abundance data. It is possible that the low mortality from one to three years of age is due to incomplete estimates of the numbers of one year-olds as discussed by Parsons (1978). If this is true, then the 16% of one year-olds estimated to have been removed in 1978 by the shrimp fishery may be greatly exaggerated. On the other hand, Parsons (1978) didn't calculate mortality from age one to two (based on catch per hour at-age in the Port au Choix shrimp fishery) because "It is assumed that the availability at such age/size is incomplete" This can also be seen in Table 6. Examination of the by-catch in 1978 on a month by month basis indicates that 80% of the one year-old catch occurred in the month of August, approximately the same time as the biomass survey was carried out. The same gear, towing speed, etc. were used in both cases so it may be assumed that the catchability of the one year-olds was also similar. If the availability of these fish is incomplete both to the biomass

estimate and the shrimp fishery by-catch, then the level of 16% removal must be considered to be quite possible until further study resolves the question.

A comparison of the 1978 abundance estimates at-age calculated from the Beothic Venture and the A.T.Cameron (survey run approximately 2 months later) suggest a decreasing catchability of eight, nine and ten year-olds by the Beothic Venture gear. This coupled with an increasing fishing mortality rate probably account for high estimates of $M (=Z)$ at these ages. (The mortality from four to six years of age could not be estimated. This is due to an unexplained low number of four year-olds in the 1976 biomass estimates or high number of six year-olds in 1978). These estimates of two year mortality were lower than those estimated by Parsons (1978) and Table 6 estimates based on catch per hour at-age at Port au Choix. This is probably due to movements of young redfish from Zone 1 to Zones 3 and 4 as revealed by comparisons of the 1976 and 1978 biomass estimates by Zone. Thus estimates based on catch per hour are of availability to the shrimp fishery and include both mortality and migration.

Table 7 shows the results of the 1976 and 1978 biomass estimates for the entire Gulf of St. Lawrence broken down by Zone (see Fig 1). It is interesting to note that although the abundance (numbers) is lower in 1978 by 59%, the 1978 biomass estimate by weight is slightly greater than that for 1976. This again suggests growth of the younger redfish with no significant recruitment.

CONCLUSIONS

The removal of small redfish by the shrimp fishery constitutes only a small percentage of the total biomass both in 1976 and 1978. However, from the 1978 data it appears that this removal may represent a significant (16) percent of a particular year-class. This high removal may coincide with

marginal or poor year-classes and thus render them even weaker. Further study of this problem is suggested with expansion to other areas of the Gulf so that the movement of small redfish can be considered. In 1976, the one year-olds in Zone 1 represented 73% of the total at age one in the Gulf whereas in 1978 those in Zone 1 represented only 30% of the total. Movement out of shrimp fishing areas may protect these young fish but movement from one shrimp fishery to another within the Gulf may result in a continued and potentially significant susceptibility.

REFERENCES

Parsons, D.G. 1978. Effects of a by-catch of young redfish in the Port au Choix shrimp fishery - first implications. CAFSAC Res. Doc. 78/8.

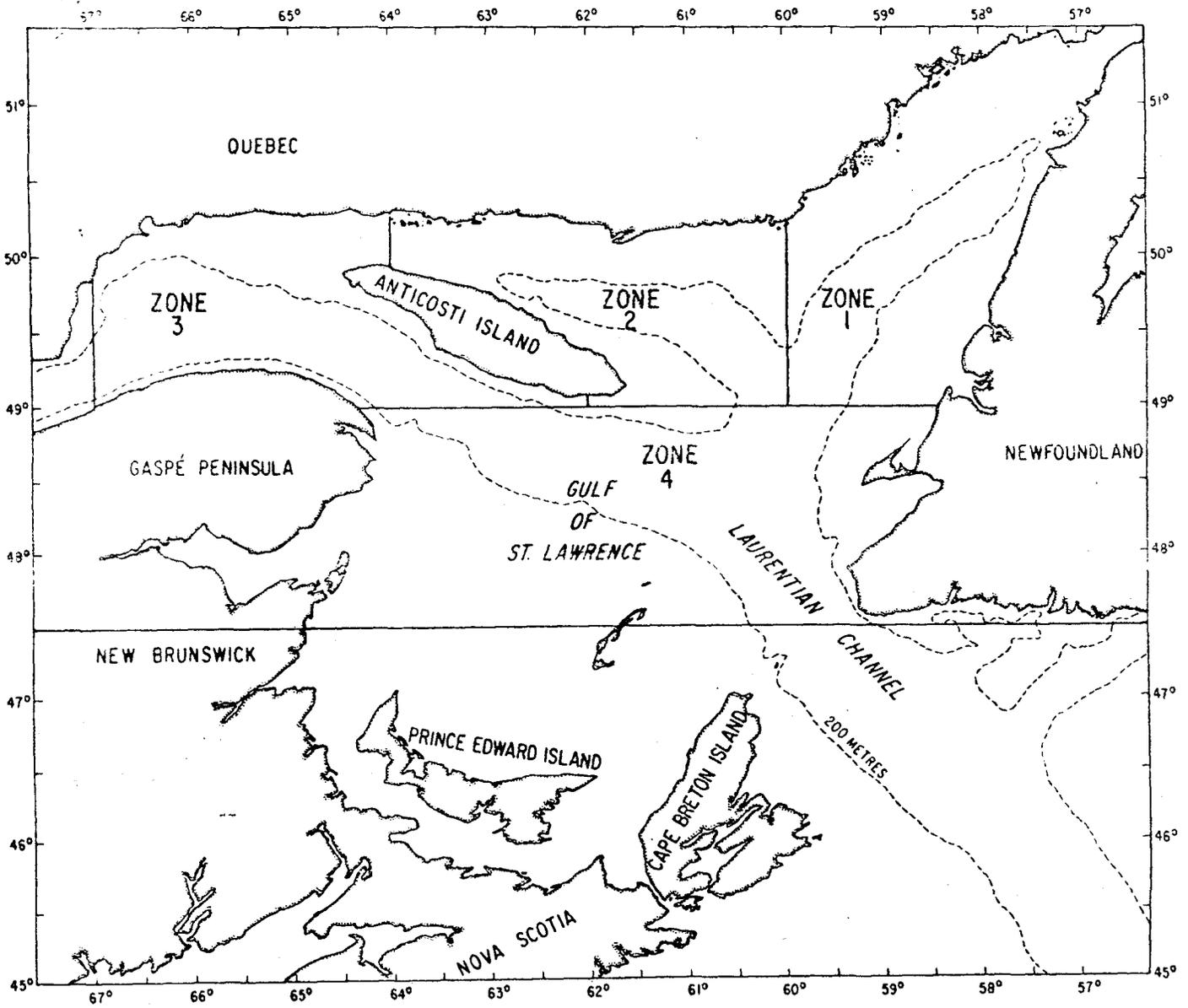


Fig. 1. Gulf of St. Lawrence Zones used in Stratification Scheme (From Parsons, 1978).

Table 1. Comparison of 1976 Zone 1 abundance estimates at-age ($\times 10^6$) by the two methods of stratification.

From Parsons (1978)					Revised Stratification			
AGE	NO SEX	MALE	FEMALE	TOTAL	NO SEX	MALE	FEMALE	TOTAL
1	8.0			8.0	23.9			23.9
2	2304.0			2304.0	5202.3			5202.3
3	1578.1			1578.1	3071.5			3071.5
4	692.3	12.1	16.0	720.4	879.4	11.6	15.4	906.4
5	431.9	292.2	404.5	1128.6	477.7	282.4	406.5	1166.6
6	75.9	132.9	128.2	337.0	78.8	129.0	125.8	333.6
7	19.4	64.2	104.0	187.6	19.9	62.8	103.1	185.8
8		13.5	24.1	37.6		13.2	24.1	37.3
9		4.1	2.1	6.2		4.0	2.1	6.1
10		1.1	0.1	1.2		1.1	0.2	1.3
				<u>6308.7</u>				<u>10,934.8</u>

Table 2. Comparison of Estimates of Numbers of small redfish removed by the Port au Choix Shrimp fishery in 1976 and 1977 ($\times 10^3$)

<u>AGE</u>	<u>PARSONS (1978)</u>		<u>REVISED</u>	
	<u>1976</u>	<u>1977</u>	<u>1976</u>	<u>1977</u>
1	600	1	110	1
2	57,700	948	51,510	1,425
3	33,600	10,401	34,049	13,635
4	8,900	8,288	13,277	9,968
5	5,900	3,957	7,155	3,654
6	1,300	3,576	1,172	2,080
7	600	1,290	621	630
8	100	873	123	333
9		342	24	112
10		145	6	48
11		25	3	7
	<u>108,700</u>	<u>29,846</u>	<u>108,050</u>	<u>31,893</u>

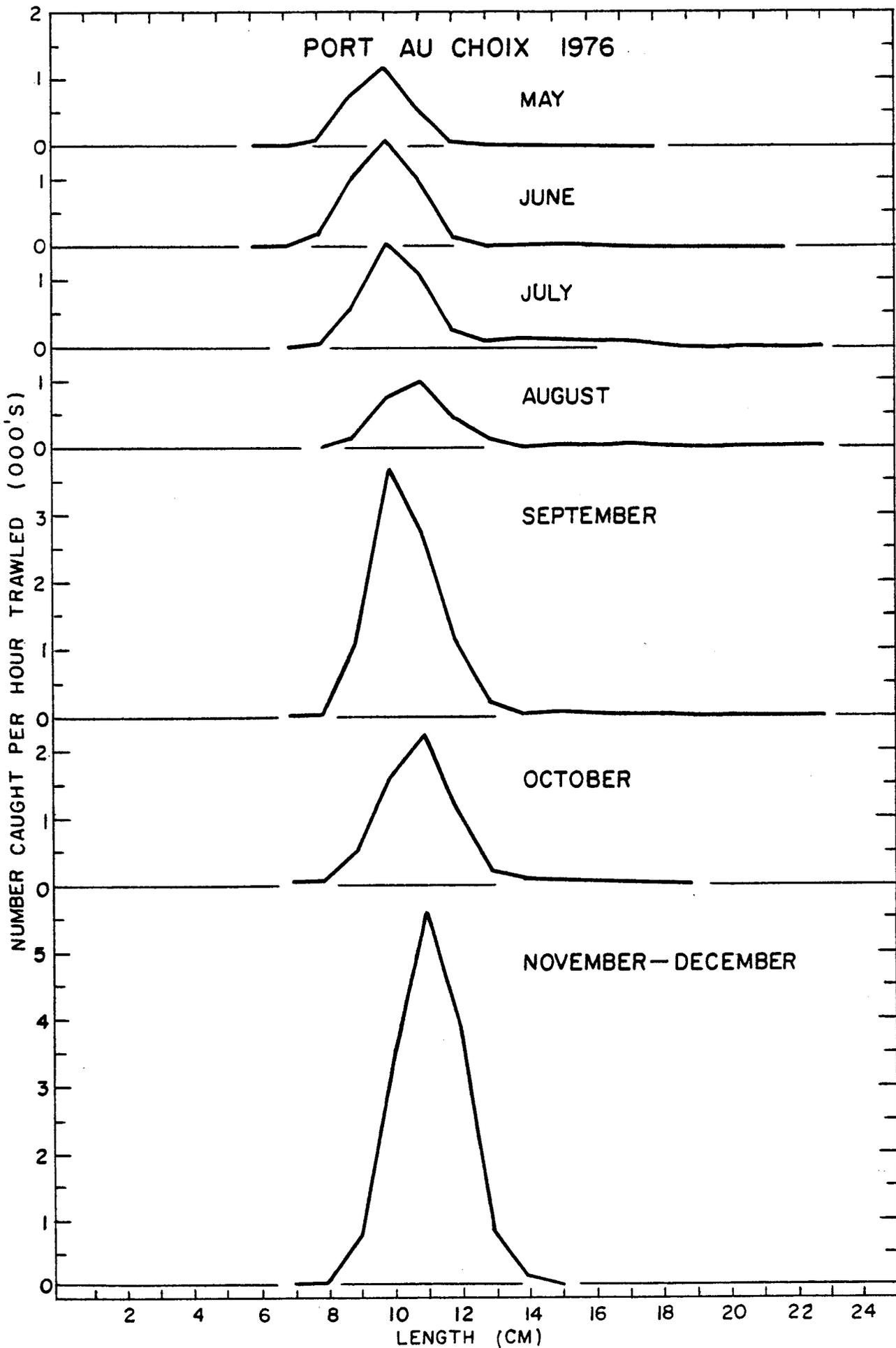


Fig. 2. Monthly commercial catch per effort in each length group, 1976. (From Parsons, 1978).

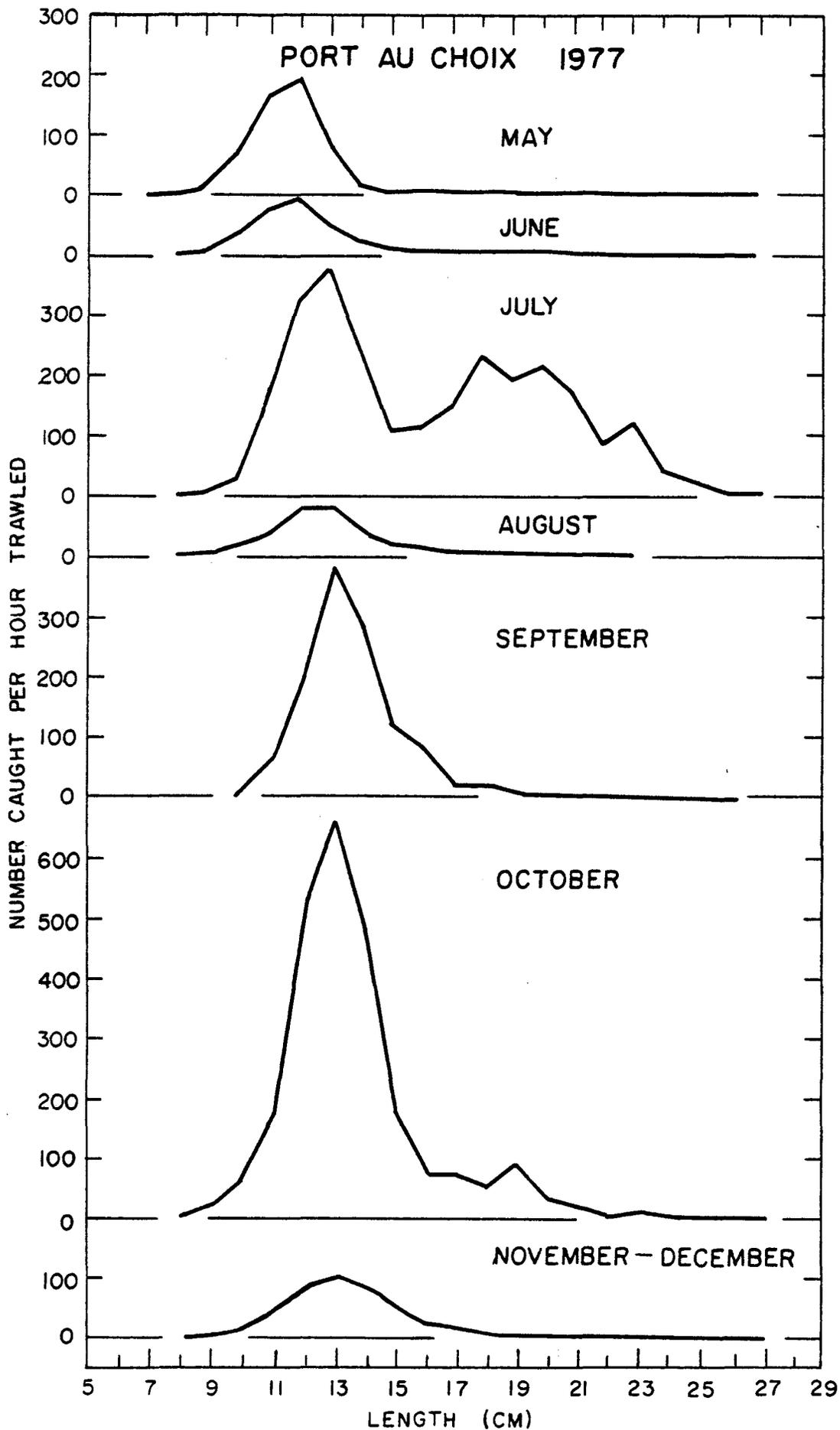


Fig. 3. Monthly commercial catch per effort, in each length group, 1977. (From Parsons, 1978).

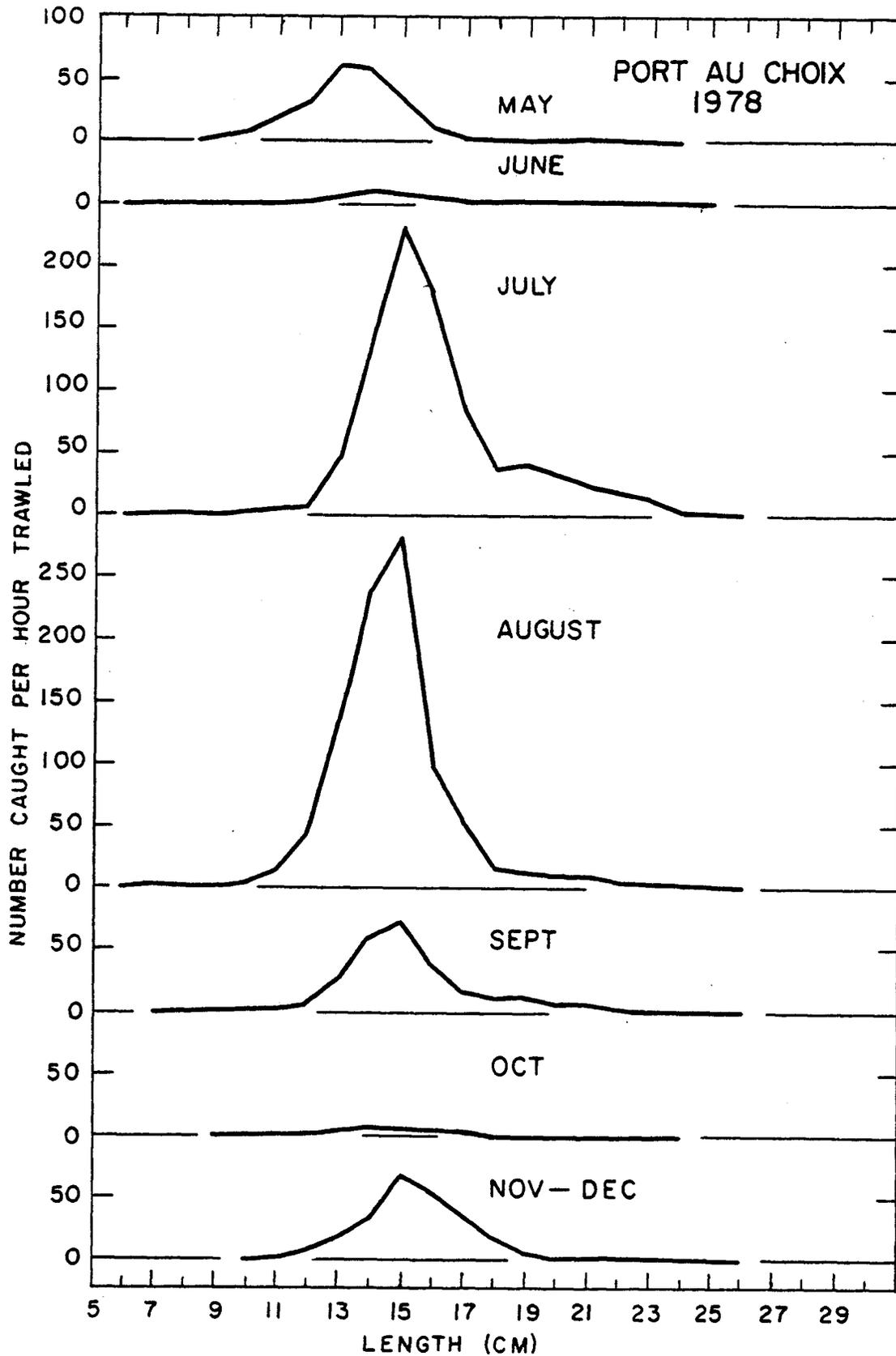


Fig. 4. Monthly commercial catch per effort, in each length group, 1978. (From Parsons, 1978).

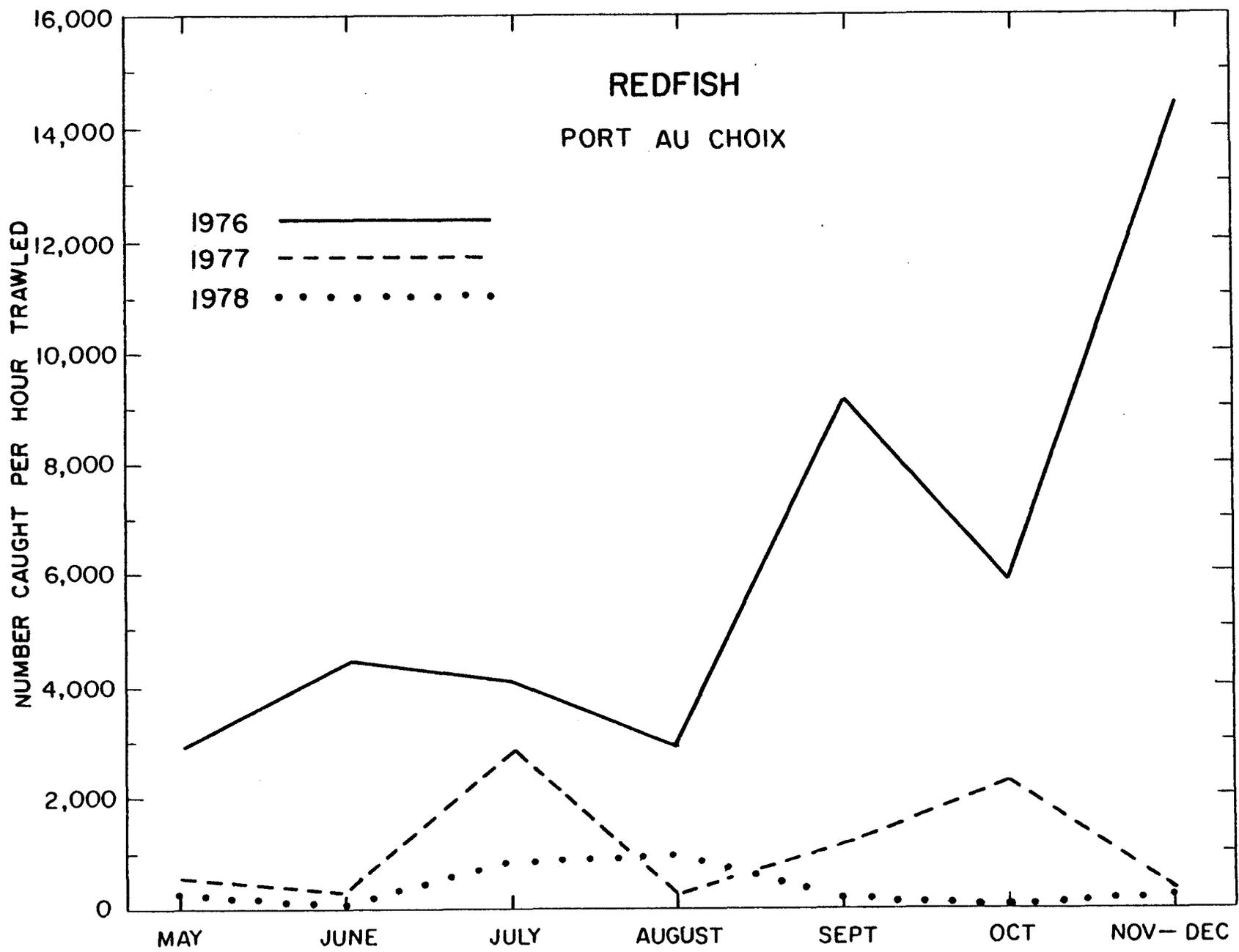


Fig. 5. Monthly catch (numbers) per effort -- 1976, 1977, 1978 (Adapted from Parsons, 1978)

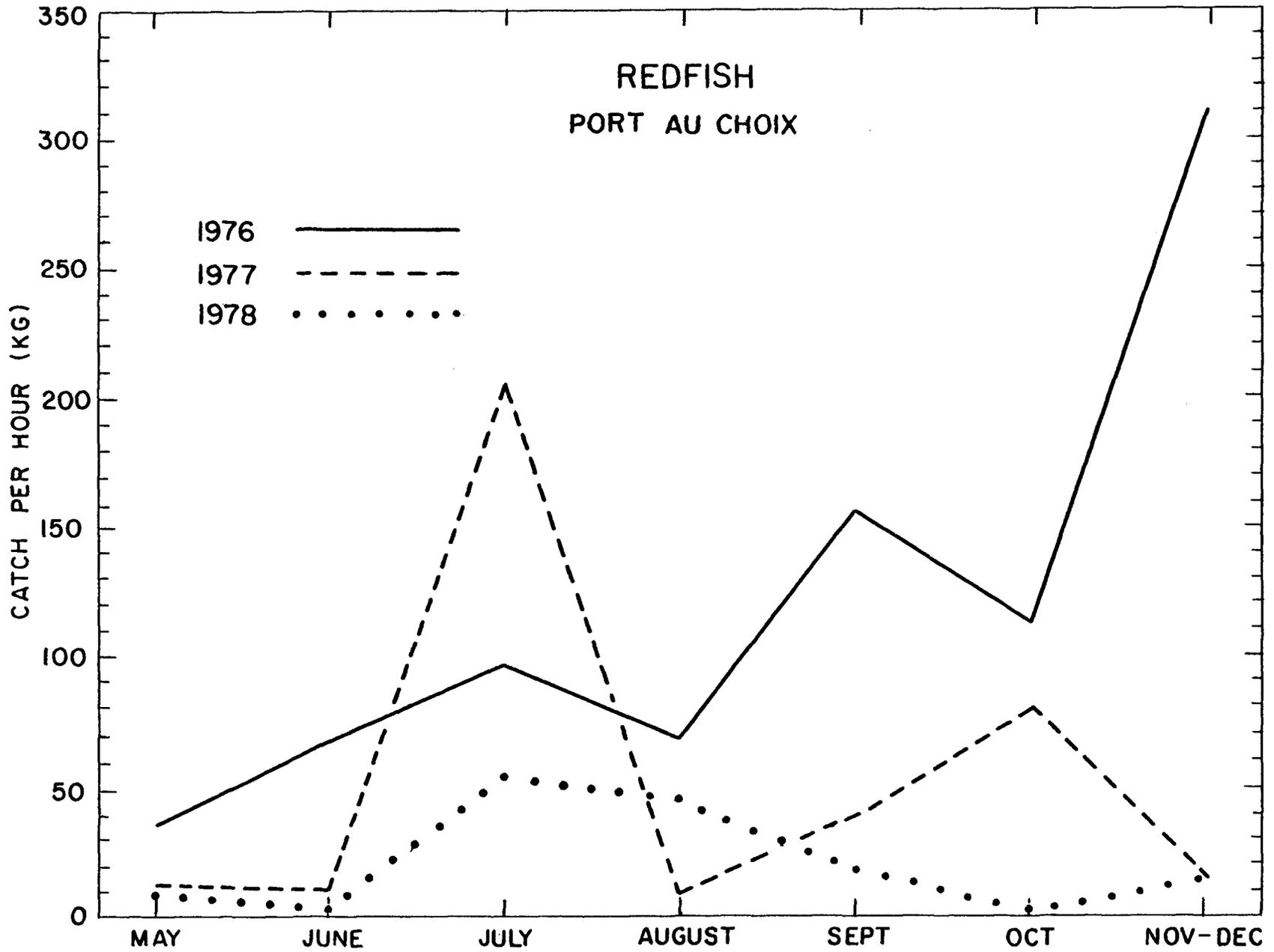


Fig. 6. Monthly catch (kg) per effort-- 1976,1977, 1978 (adapted from Parsons, 1978)

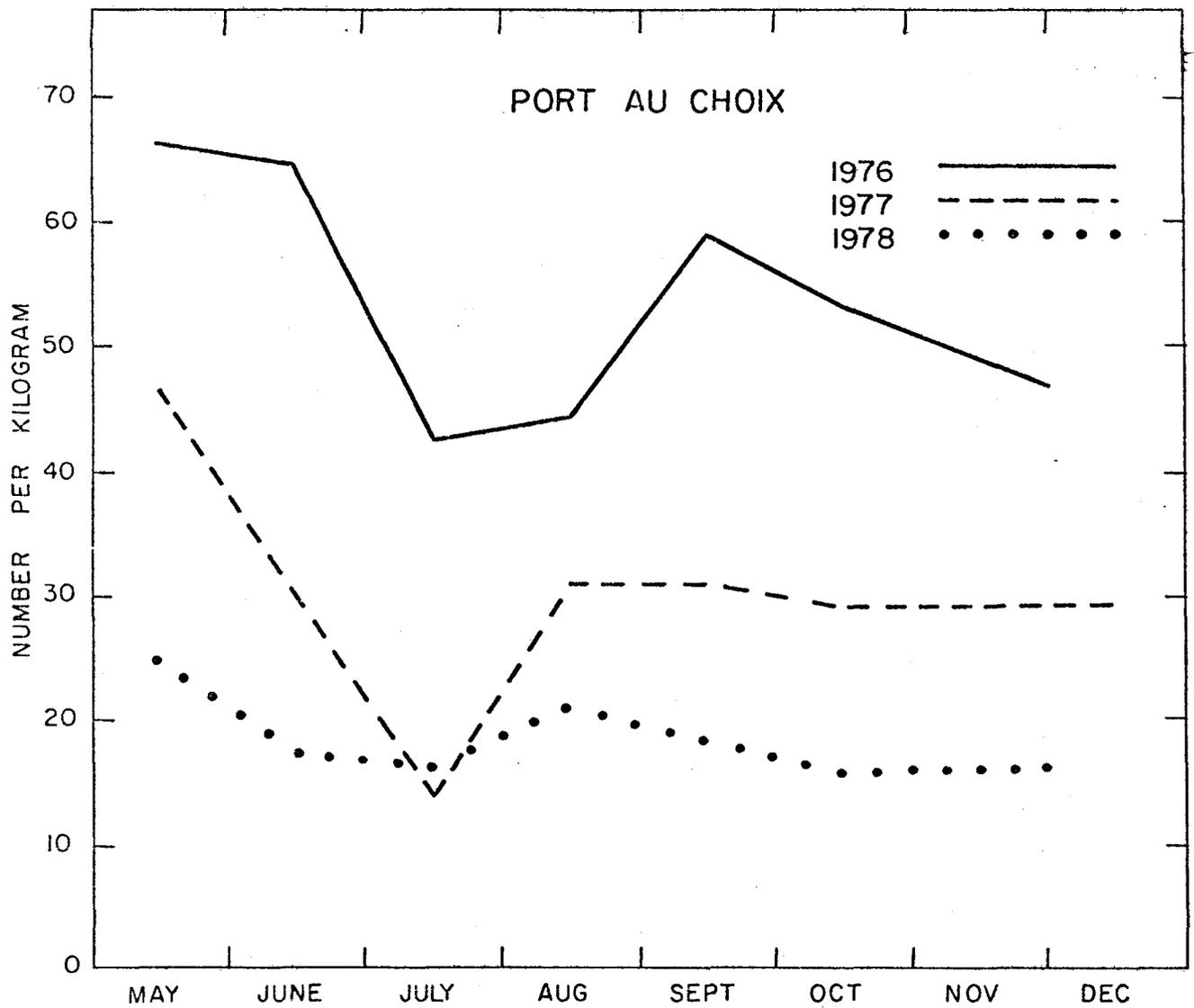


Fig. 7. No. small redfish/kg small redfish by month, 1976-1978.

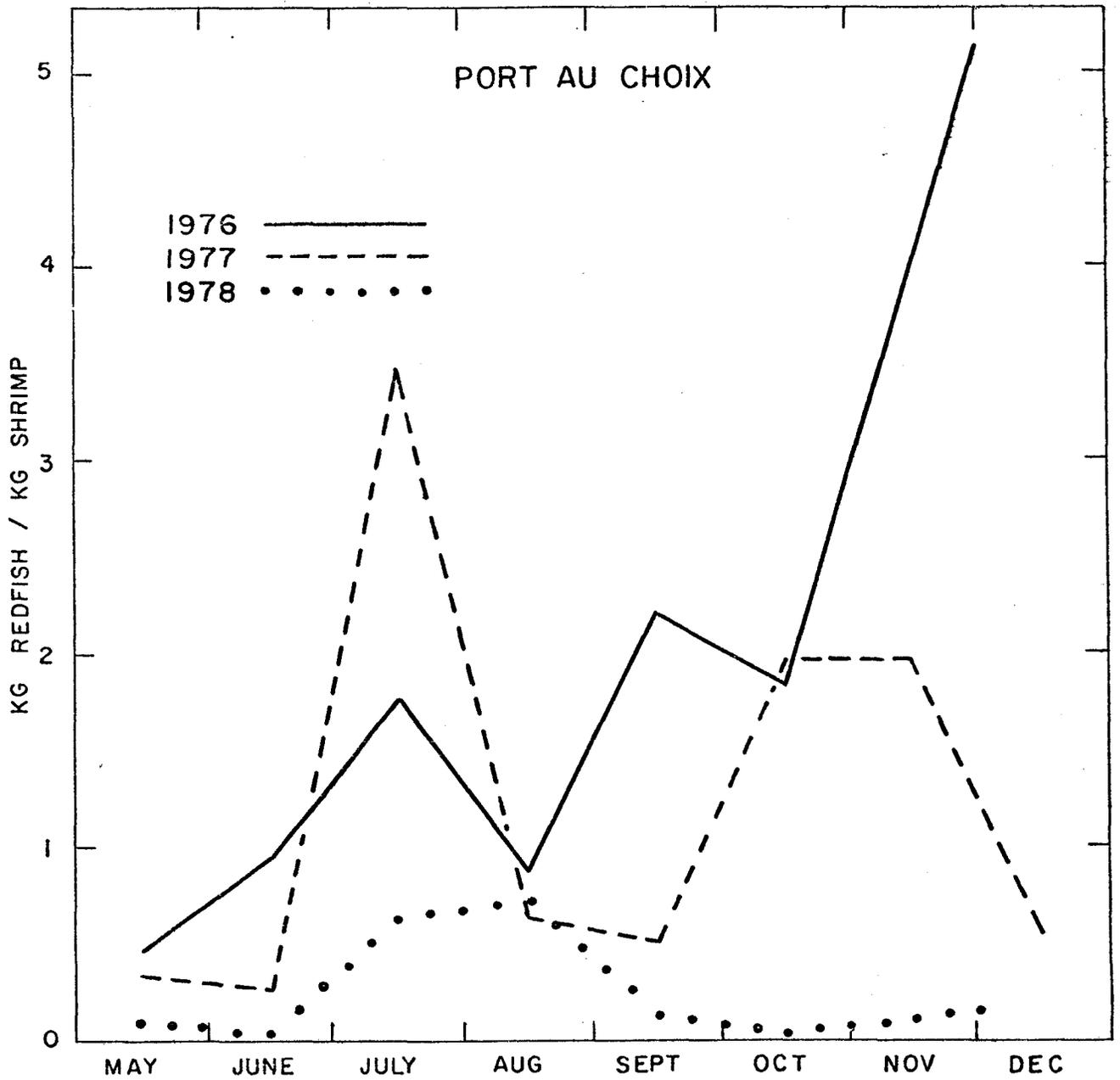


Fig. 8. Kg small redfish/kg shrimp by month, 1976-1978.

Table 3. 1976 abundance at-age, by-catch at-age and catch per biomass from commercial and research data (revised from Parsons, 1978)

ABUNDANCE (MILLIONS OF FISH) ESQUIMAN CHANNEL (ZONE 1)

	1	2	3	4	5	6	7	8	9	10
NO SEX	23.9	5202.3	3071.5	879.4	477.7	78.8	19.9			
MALE				11.6	282.4	129.0	62.8	13.2	4.0	1.1
FEMALE				15.4	406.5	125.8	103.1	24.1	2.1	0.2
TOTAL	23.9	5202.3	3071.5	906.4	1166.6	333.6	185.8	37.3	6.1	1.3
1976 CATCH AT-AGE	0.1	51.5	34.0	13.3	7.2	1.2	0.6	0.1	0.1	0.1
CATCH/TOTAL ABUNDANCE	0.004	0.010	.011	.015	.006	.004	.003	.003	.003	.005
%	0.4	1.0	1.1	1.5	0.6	0.4	0.3	0.3	0.3	0.5

1976 ESTIMATED PERCENT TOTAL LOSS DUE TO BY-CATCH

NUMBERS:

Abundance Est. Zone 1, 1976 = $10,927 \times 10^6$ small redfish
 Amount removed as by-catch = 108×10^6 small redfish
 Removal/Abundance = 0.0098 ≈ 1%
 95% confidence limits 0.5% to 19%

WEIGHT:

Biomass (Metric Tons) Zone 1, 1976 = 253,059
 Amount removed as by-catch = 1967
 Removal/biomass = 0.0078 ≈ 0.8%

95% confidence limits 0.5% to 2%

Table 4. 1978 Abundance at-age, by-catch at-age and catch per biomass from commercial and research data.

	ABUNDANCE (MILLIONS OF FISH) ESQUIMAN CHANNEL (ZONE 1)									
	<u>AGE</u>									
	1	2	3	4	5	6	7	8	9	10
NO SEX	0.1	0.5	8.8	209.1	253.4	206.6				
MALE				19.8	201.2	174.7	120.0	28.3	7.0	2.9
FEMALE				22.0	171.9	269.1	101.3	50.4	16.3	8.5
TOTAL	0.1	0.5	8.8	250.8	626.5	650.5	221.2	78.7	23.2	11.4
1978 CATCH AT-AGE	0.02	0.02	0.36	2.89	3.36	2.65	0.45	0.16	0.03	0.02
CATCH / TOTAL ABUNDANCE	0.160	0.047	0.041	0.012	0.005	0.004	0.002	0.002	0.001	0.002
%	16.0	4.7	4.1	1.2	0.5	0.4	0.2	0.2	0.1	0.2

1978 ESTIMATED PERCENT TOTAL LOSS DUE TO BY-CATCH

NUMBERS:

Abundance Est. zone 1, 1978 = 1845×10^6 small Redfish
 Amount removed as by-catch = 11.8×10^6 small Redfish
 Removal/ Abundance = $0.0064 \approx 0.6\%$
 95% Confidence limits 0.4% to 2%

WEIGHT:

Biomass (Metric Tons) Zone 1, 1978 = 135,344
 Amount removed as by-catch = 653
 Removal/biomass = $0.0048 \approx 0.5\%$
 95% Confidence limits 0.3% to 2%

Table 5. Estimates of 2 year mortality for small redfish 1976-1978.

AGE	NUMBERS (X 10 ⁶)			Z-M	ROUNDED ESTIMATES
	1976	1978			
1	30.4				
2	6,196.0				
3	4,055.2	16.5	.61		2.40 *
4	1,514.5	565.4	2.39		2.40
5	2,113.5	1699.4	0.87		0.90
6	655.0	2315.8	-		0.60 *
7	372.1	1192.0	0.57		0.60
8	99.4	346.7	0.64		0.60
9		104.7	1.27		0.60*
10		55.4	0.58		0.60

* ESTIMATED MINIMUM

Table 6. Catch (numbers) of small redfish at-age in the Port au Choix shrimp fishery, 1976 and 1978 with estimates of two year mortality.

AGE	1976	1978	$Z \approx M$
1	5		
2	2490		
3	1646	18	
4	642	145	2.84
5	346	168	2.28
6	57	133	1.57
7	30	23	2.71
8	6	8	1.96
9		1	3.40
10		1	1.79

Table 7. Abundance and biomass of small redfish in the Gulf of St. Lawrence in 1976 and 1978.

ZONE	ABUNDANCE ($\times 10^{-6}$)		BIOMASS (metric tons)	
	1976	1978	1978	1978
1	10,927.97	1845.21	253,059	135,344
2	2,592.10	1222.56	86,249	78,846
3	791.61	1356.71	30,824	100,898
4	741.85	1798.74	39,986	161,988
TOTAL	15,053.53	6223.22	410,118	477,076
95% CONF. LIMITS	4838.37 to 25,268.69	3630.21 to 8816.23	241,178 to 579,058	280,708 to 673,442