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Preliminary Estimation of Total Mortality for Shrimp (P. Borealis)
in the Anticosti Channel

by

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Abstract

Data from surveys made by the Direction générale des pêches maritimes, Quebec in 1978 and Research and Resource Services, Newfoundland in 1978-1980 were anlaysed to estimate year-class strength and mortality for the shrimp stock of the Anticosti Channel. The estimates of biomass for these years were broken down by age class using modal separation of length frequency distributions.

For fully recruited age groups (females) total mortality was estimated at 0.62 between 1978 and 1979 and 0.91 between 1979 and 1980. Results indicated that a dominant year-class (possibly 1978) was present. The relative strength of this particular age group should improve the 1981 catch rate in this area as these animals become fully recruited.

Résumé

    Les effectifs de classes d'âge et la mortalité du stock de

crevettes du chenal d'Anticosti ont été estimés à partir de données

recueillies lors de relevés effectués par la Direction générale des

pêches maritimes du Québec en 1978 et par les Services de recherche et

des ressources de Terre-Neuve en 1978-1980. Les biomasses observées pour

ces années ont pu être scindées par classe d'âge à partir des classes

modales observées sur la distribution de fréquence de tailles.

    La mortalité totale des groupes d'âge (femelles) pleinement

recrutés a été estimée à 0,62 de 1978 à 1979 et à 0,91 de 1979 à 1980.

D'après les résultats, le classe d'âge de 1978 serait plus abondante que

les autres; l'abondance relative de cette classe d'âge devrait améliorer

les taux de capture en 1981, à mesure que ces crevettes deviendront

pleinement recrutées.

INTRODUCTION

Information leading to the estimation of mortality in the northwestern Gulf of St. Lawrence has indicated a range between 0.5 and 0.8 for fully recruited sizes (Fréchette and Labonté, 1981). Data collected for the Anticosti Channel in recent years provide additional estimates using similar techniques. This paper interprets mortality for the fishable stock which includes male and female age groups.

METHODS AND METERIALS

Data on shrimp length distribution and biomass were collected from research surveys by the Direction générale des pêches maritimes, Québec, in October-November, 1977, and by Research and Resource Services, Newfoundland, in July-August 1978-80. Gear used by the former was a Yankee 41 shrimp trawl with 38 mm mesh and a 20 mm liner in the codend. The latter surveys employed a #36 shrimp trawl of similar mesh size lined with 13 mm mesh. The horizontal opening for the Yankee 41 is estimated at 44 ft and the #36 trawl at 35 ft. It is assumed that the relative efficiency of the two trawls for catching shrimp is similar (0.75). All surveys utilized a stratified random design. The stratification scheme of Fréchette (unpublished data) was modified to facilitate data from all years. Totals of 53, 30, 15 and 28 sets were made in the 1977-1980 surveys, respectively.

Carapace lengths for shrimp in 1977, 1979 and 1980 were measured to 0.1 mm and combined to 0.3 to which moving averages of 3 were applied. Measurements in 1978 were taken to 0.5 mm. Size distributions by stratum were accumulated in each year and modes separated by NORMSEP (Abramson, 1971). Using the weight-length relationship for the Sept-Iles area ($W = 0.000930L^{2.910}$ - Fréchette, unpublished), biomass by stratum was expressed in numbers and split into age groups. Numbers at age were then accumulated for all strata.

Annual total mortality was calculated by the formula $Z = \ln N_2/N_1$ using age groups II+ in year n and III+ in year n + 1 and III+ in year n and IV+ in year n + 1.

RESULTS AND DISCUSSION

Figure 1 shows a typical fitting by the NORMSEP program which also estimates the mode and abundance of each group. The sample used shows two age groups of females (III and IV+). These were separated both by NORMSEP and by presence or absence of sternal spines (McCrary, 1971). The sternal spines are used to distinguish first-time spawners from multiple spawners. The results of NORMSEP were similar to the actual situation observed from sternal spines indicating the relative accuracy of the method. The proportions of ages III and IV+ estimated by NORMSEP were 13.7% and 14.0%

respectively. These compare to actual percentages of 14.0 and 12.0 for the same age groups separated by sternal spines.

Results of age interpretation by NORMSEP and separation of females by sternal spines are given in Table 1. It is obvious that availability is a problem for age classes 0 and I since calculated mortality is negative. For age class II, it seems that availability may also be a problem as indicated by the negative mortality between age class II in 1979 and age class III in 1980. There is no indication of availability being an important factor beyond age II. It is possible that these differences may be due to selectivity in other parts of the trawl. Total mortality rates (Z) for age groups III+ to IV+ are estimated at 0.62 between 1978 and 1979 and 0.91 between 1979 and 1980. This assumes that the IV+ group is an accumulation of older age groups. Therefore, the estimation produced represents the mean total mortality for all the females age groups. It is not known if this mortality varies greatly between age groups. These estimates are representative of the fully-recruited stock based on selectivity patterns of the shrimp trawls (Labonté and Fréchette, 1978).

Mortality rates for shrimp in the North Anticosti area have previously been estimated between 0.71 and 0.86 by interpreting the parameter of the Von Bertalanffy growth equation (Labonté, 1980). The average of these is 0.79 which

compares favourably with the average of 0.77 for the estimates given in this paper. Fishing mortality (F) is relatively low in the area and based on comparison of annual catch to biomass is estimated at 0.10. Our resulting natural mortality rates are also close to values obtained for the Sept-Iles area which indicated mortality between 0.50 and 0.80 for female age groups (Fréchette and Labonté, 1981).

Males which comprise age class II also occur frequently in the catch and animals of this size are approximately 80% recruited. Total mortality between the II+ and III+ was calculated at 0.87 between 1977 and 1978, 0.45 between 1978 and 1979, and 0.42 between 1979 and 1980. The first estimate was subjected to more error since the surveys in these two years occurred at different times (November vs. August) and different vessels and gear were used. The latter two values are similar and suggest the mortality for males may be less than that for females. However, this may be a spurious conclusion since we have shown previously that availability of the age II group is less than for females.

If the age group IV+ comprises a very large proportion of age IV animals, then mortality between ages III and IV can be interpreted to be relatively low while that between IV and V relatively high. Biomass-at-age for 1979 and 1980 indicate that if this assumption is true, total mortality for first-year females could be as low as 0.41 (M= 0.31).

Aside from mortality, Table 1 also provides an index of relative year class strength. Consistent in the data is the occurrence of the 1978 year class which shows much stronger than adjacent cohorts. At age II, these animals appear to be roughly twice as strong as the same age group in previous years. It is interesting to note that Parsons and Sandeman (1981) also observed a strong age class of similar size in 1978 in the northern Esquiman Channel. This could indicate that the two areas in question are areas of concentration for the same shrimp population.

CONCLUSIONS

Natural mortality for shrimp in the Anticosti Channel has been esti-mated between 0.5 and 0.8 for female (fully recruited)age groups. At present, we do not know the natural mortality rate for the oldest males which represent an important part of the landings. We also recognize the possibility that mortality for first-year females may be lower than for older females. Therefore, it could be advisable (all things considered) to use the lower end of the above range which then can be interpreted as an estimate of natural mortality for the fishable stock.

The relative strength of the 1978 year class indicates that catch rates should improve in 1981 as these animals become fully recruited.

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Table 1.   Biomass (numbers x 10^{-6}) by age class estimated by NORMSEP and sternal spines.

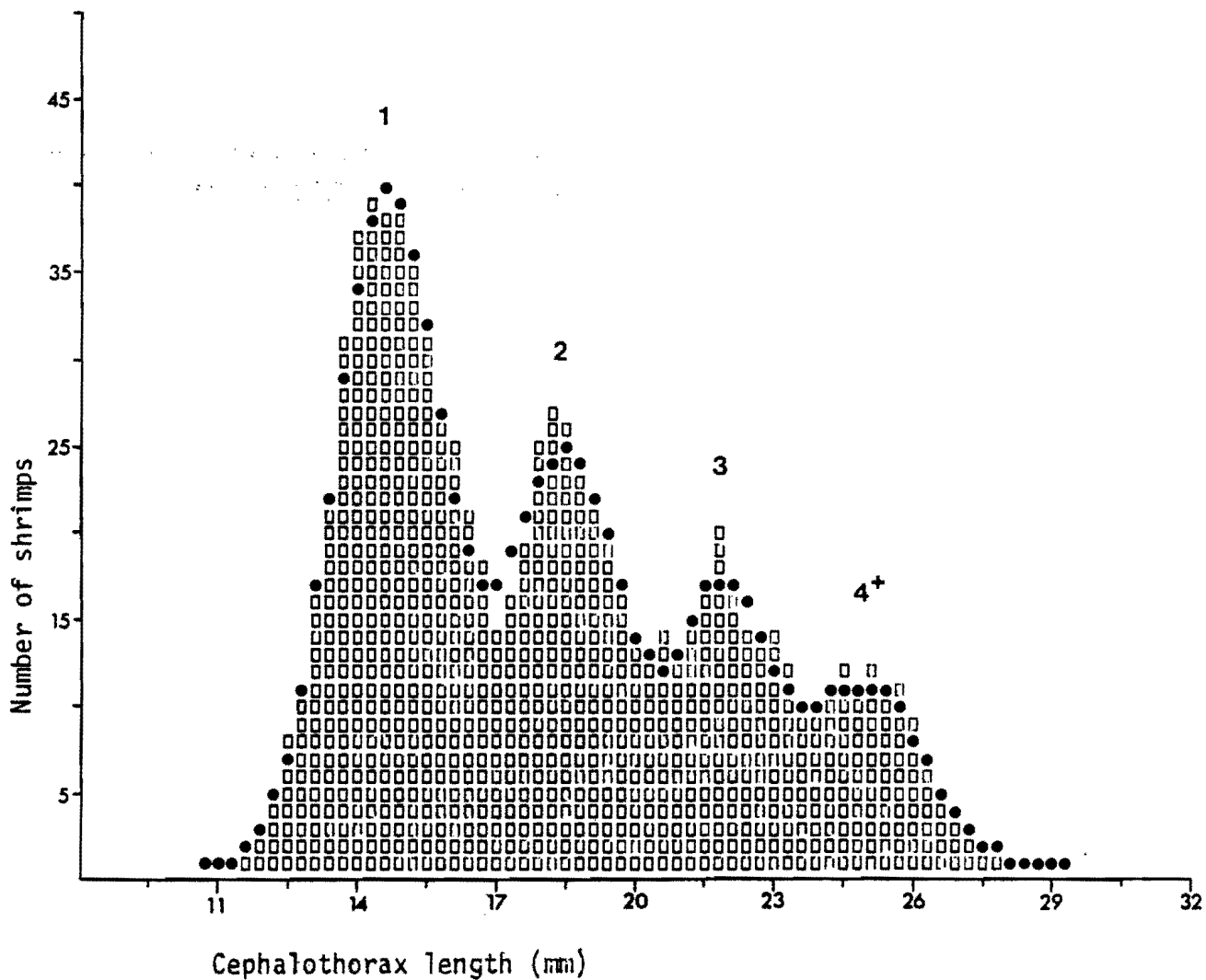|	0	I	II	III or III +	IV +
1977	53	486	653	545	
1978	266	368	720	626	
1979	90	731	579	517	337
1980	23	202	1230	597	344

Fig. 1. Application of NORMSEP to length frequency data.