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An Assessment of Divisions 3LN Redfish Using a Production Model

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Abstract

In the present paper, the status of the redfish stock from Divisions 3LN is evaluated by using a modified production model. Estimates of maximum sustainable yields ranged from 25 000 to 29 000 ton. A standardization of the fishing effort was made taking into account USSR-Poland vessels tonnage class 7 as standard.

Introduction

The status of the redfish fisheries in the above mentioned Divisions have been analized by different authors; Parsons and Parson (1975), Mc Kone and Parsons (1977) and Mc Kone (1978), using the Schaefer yield model (1954). In the present paper, an analysis of the fisheries for this species (Sebastes mentella and Sebastes marinus) during the period 1956-1976 is made, using the Schaefer yield model (op. cit.) as modified by Gulland (1961), in order to give approximate estimates of maximum sustainable yields for diferent levels of exploitation.

For assesment purposes and due to the lack of adequate evidence indicating that the redfish from Division 3L and 3N constitute different stocks, data from both Divisions were combined as Divisions 3LN (Parsons and Parsons, op. cit.).

Materials and methods

Catch and effort data from the ICNAF Statistical Bulletin for the period 1956-1976 were used, and the information was compiled by Division, country, vessel tonnage class and month.

Redfish catches which were the 50% or higher than the total fish caught in one month and for a specific vessel tonnage class were selected in order to impute the fishing effort as being directed to the catch of this species. Catch per unit effort was subsequently calculated by month and vessel tonnage class.

The above mentioned general production model was used with Gulland modification (1961) which takes into account the number of years in which a given year-class significantly contributes to commercial catches.

Due to the amount of countries and vessel tonnage classes involved in commercial fisheries during the 1956-1976 period, it was necessary to standardize the fishing effort. For this purpose, catch and effort data from Division 3LN during this period of time were analyzed, and the USSR-Poland 7 tonnage class was taken as standard. It was assumed that these vessels had similar effective fishing intensity as indicated by the analyses of Brown et. al. (1973) for Subarea 5 and Statistical Area 6. Analyses of the historical series of catch and effort data showed that the USSR vessels of tonnage class 7 were heavily involved and fished consistently for redfish during 1957-1960 and 1969-1976, while the ones from Poland also fished intensely during 1961-1969, so both data were combined to fully cover the whole considered period (1956-1976). Thus, the catch per hour fished of these vessels (i.e. USSR-Poland tonnage class 7) was considered as the standard in this period. The remaining vessel tonnage classes by countries which were remarkable in the catches and efforts expended were: USA tonnage class 4, CAN (Newfoundland) tonnage class 4, CAN (Maritimes) tonnage class 4, USSR tonnage class 4 and CAN (Newfoundland) tonnage class 5 trawlers. Out of them, it was only possible to adjust the effort of CAN (Newfoundland) and CAN (Maritimes) tonnage class 4 trawlers to that of USSR 7-Poland 7 by a conversion factor of 0.897 and 0.484 respectively. Efforts of USA vessels could not be converted to the standard one because they reported effort in days fished. On the other hand, no adequate conversion factor could be determined to adjust effort of USSR tonnage class 4 and CAN (Newfoundland) tonnage class 5 trawlers to that of USSR-Poland tonnage class 7 because of the lack of comparative data.

The above mentioned conversion factors (fig.1) were obtained by plotting catches per hour fished for CAN (Newfoundland) and CAN (Maritimes) tonnage class 4 trawlers against catches per hour for USSR-Poland tonnage class 7 trawlers respectively, for each month in which both fished. Catch per hour points resulting from extreme effort values (maximum or minimum) and which were

out of the main concentration area, were not taken into account, for considering them as not representative of the mean values obtained in the fishery. A straight line passing through the origin was fitted to the points, and its slope was used as a factor to convert the amount of effort of each tonnage class to the standard. Effort hours obtained in each case were added to find the total number of standard hours fished, and the catches corresponding to these efforts were also added to obtain the total catch of redfish. This allowed to compute the standard catch per unit of hour. Finally, the annual standard hours fished were calculated by dividing the total catches by all countries into the previously determined standard catch per hour.

Trends in catch, effort and catch per unit of effort

Catches in Division 3LN have fluctuated irregularly during the period 1956-1976 (fig.2), attaining a peak of 44 000 tons in 1959 and a posterior decrease with a minimum of 7 000 ton in 1964. Henceforth, there is a continuos increase until 1967 and subsequently, some rises and falls until reaching a second and third peak of 34 000 and 33 000 tons in 1971 and 1973 respectively, Catches in 1974 and 1975 decreased to 22 000 and 18 000 ton respectively, showing an increase to 20 000 tons in 1976. Estimates of effort also show great fluctuations, and a peak of 28 000 hrs in 1959 which is reflected in an increased catch to 44 000 tons is observed. From 1960 to 1963, effort remained relatively stable to a level of 18 000 hrs, decreasing to 7 000 hrs in 1964. A considerable increasing to 65 000 hrs can be observed in the estimate of fishing effort in 1968, which did not agree with a rising of catch. This situation was due to the low catch per unit of hour attained by the USSR-Poland tonnage class 7 vessels in that year. During 1969 and 1970, estimates of effort decreased, then rising again to 33 000 hrs in 1973 which brought about another increase in catch to 33 000 tons. After this last year, that is, from 1974 to 1976, effort has experimented a continuos decrease.

Standard catch per hour values have shown wide variations in the analyzed period (fig.2), with a peak of 2.5 tons in 1958 and a posterior decrease until 1961 (1.1 ton). Henceforth, the standard catch per hour begins to rise again, reaching 1.4 ton in 1965, and then diminishing later continuosly to the low figure of 0.2 ton in 1968. In 1969, an increase to 1.2 was noted, attaining again a maximum of 1.5 ton in 1971. From 1972 to 1975 the standard catch per hour remained almost constant to a mean level of 1.0 ton. Finally, an increase to 1.6 ton occurred in 1976.

Yield-effort relationship

Schaefer (op.cit.) production model with Gulland (op. cit.) modification was used to derive estimates of maximum sustainable yields. For this purpose, the catch per hour fished was related with the effort for the 6 year, 8 year and 10 year running averages of standard hour fished using the least squares linear regressions technique (fig.3). Once the corresponding equations for the straight lines were obtained, it was proceeded to convert their parameters to those of the equilibrium yield versus effort, resulting in curves depicted in fig.4.

Results and discussion

The yield parabolas derived offered estimates of maximum sustainable yields which ranged from 25 000 to 29 000 tons (table 1), which are higher than the ones obtained by Parsons and Parsons (op.cit.), Mc Kone and Parsons (op.cit.) and Mc Kone (op.cit.).

During the 21-years period analyzed in this paper, it is observed that in years 1959, 1971 and 1973, values of catch were above the level of maximum sustainable yield (MSY) predicted in this paper. In the remaining years, however, the amount of catch remained near this level or below it.

The highest correlation coefficient was obtained for the 6 year running average (r=0.848), also being very similar for the 8 year running average (r=0.813).

According to the above mentioned and bas d on the analysis of the coefficients of determination obtained, a TAC of 29 000 ton for the redfish from Division 3LM might be recomended. An analysis of the two-thirds effort corresponding to the equilibrium yields derived was also made, thus indicating a TAC of 24 000 ton. Taking into account these two figures, a TAC of 26 700 ton is proposed, which neither would cause a serious damage to the stock nor its recovering.

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Table 1 Maximum sustainable yields, efforts, correlation coefficients and coefficients of determination according to the different periods considered.

Averaging period (yrs)	MSY		r	r^2
	catch (ton)	effort (hr)		
6	28 904	33 955	0.848	0.719
8	28 657	31 744	0.813	0.661
10	25 505	26 301	0.779	0.607

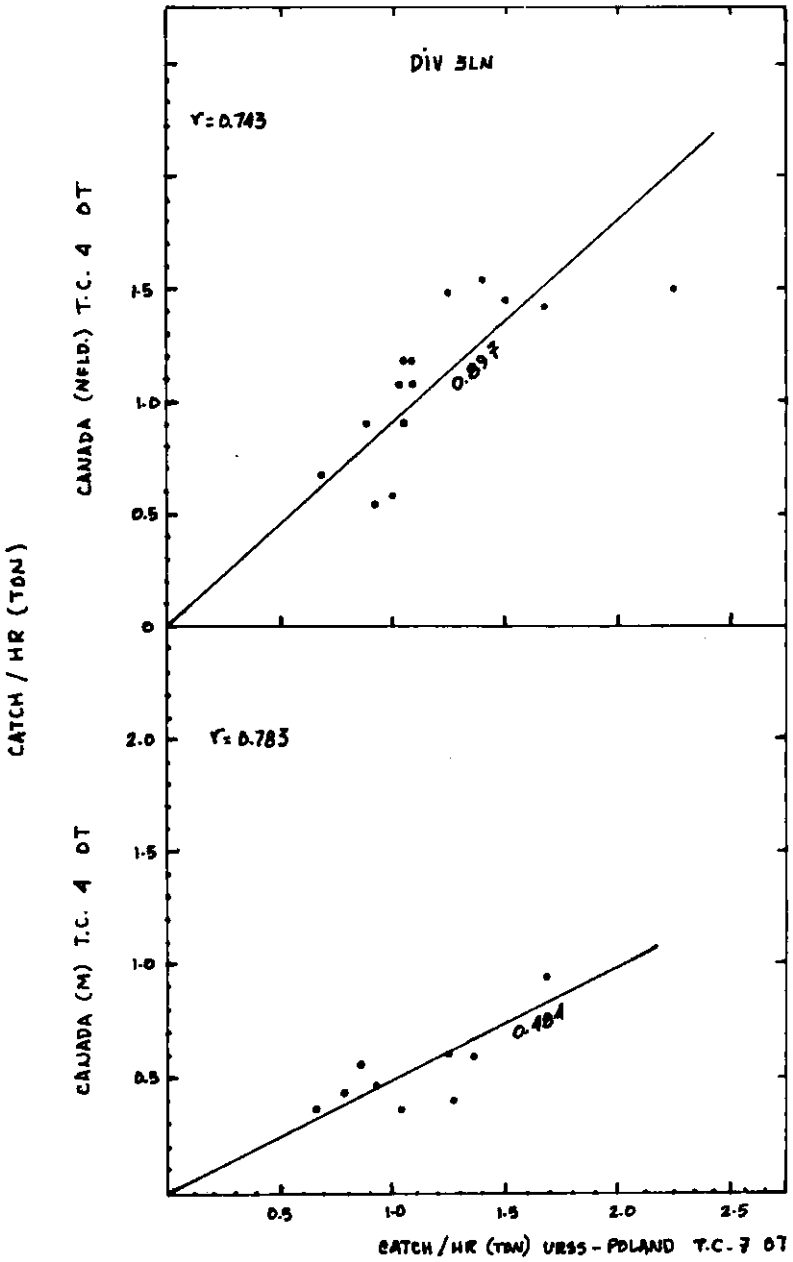

Fig. 1. Relation of redfish catches per hour fished by Canada (M) tonnage class 4, Canada (Nfld.) tonnage class 4 trawlers vs. catches per hour fished of USSR-Poland tonnage class 7 trawlers.

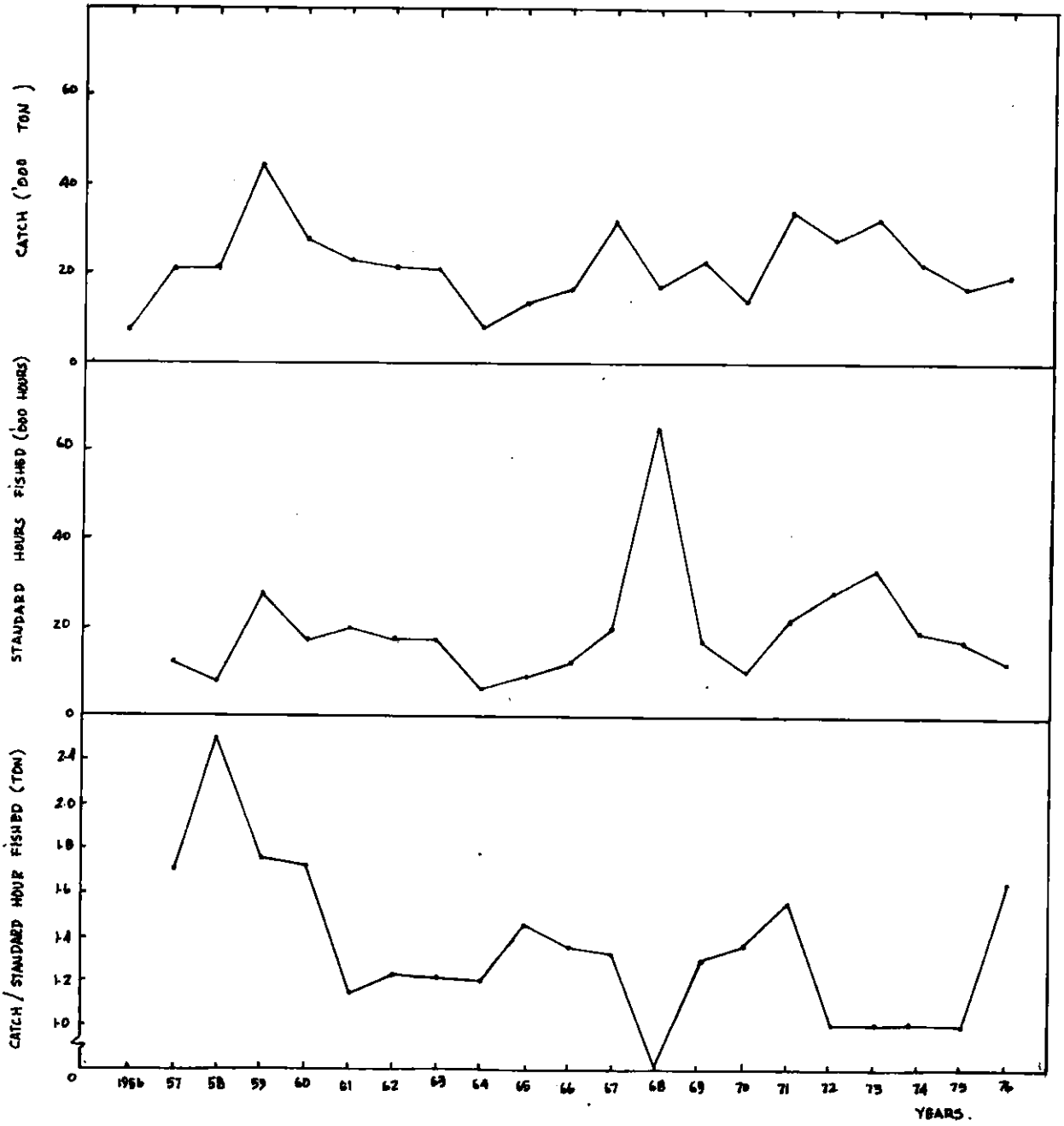

Fig. 2. Trends in nominal catches, effort and catch per unit effort in standard trawler units (USSR-Poland tonnage class 7) for redfish in Div. 3LN during 1956-1976.

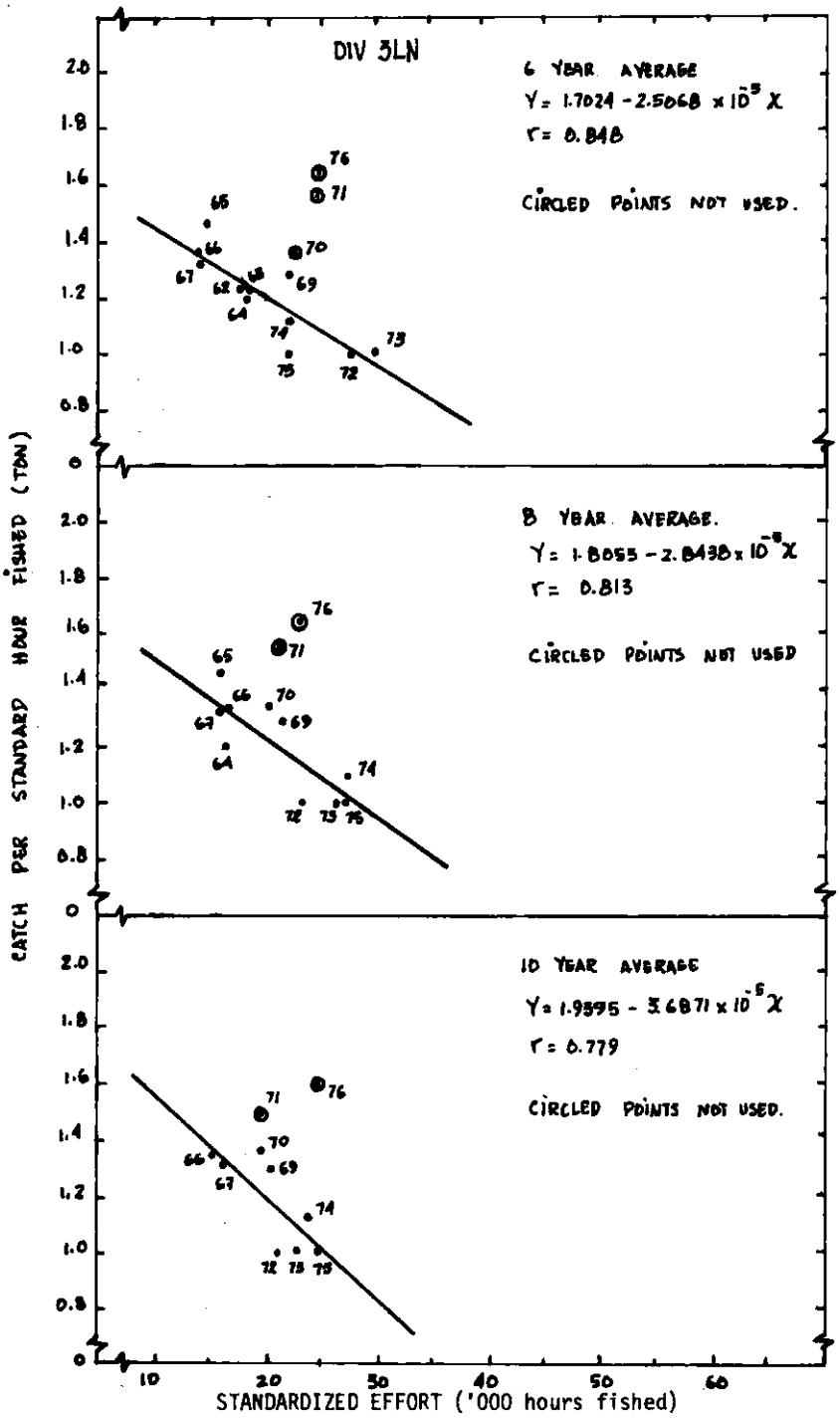

Fig. 3. Relation between standardized catch per hour fished versus 6-, 8-, and 10-year running averages of standard hour fished for redfish in Div. 3LN.

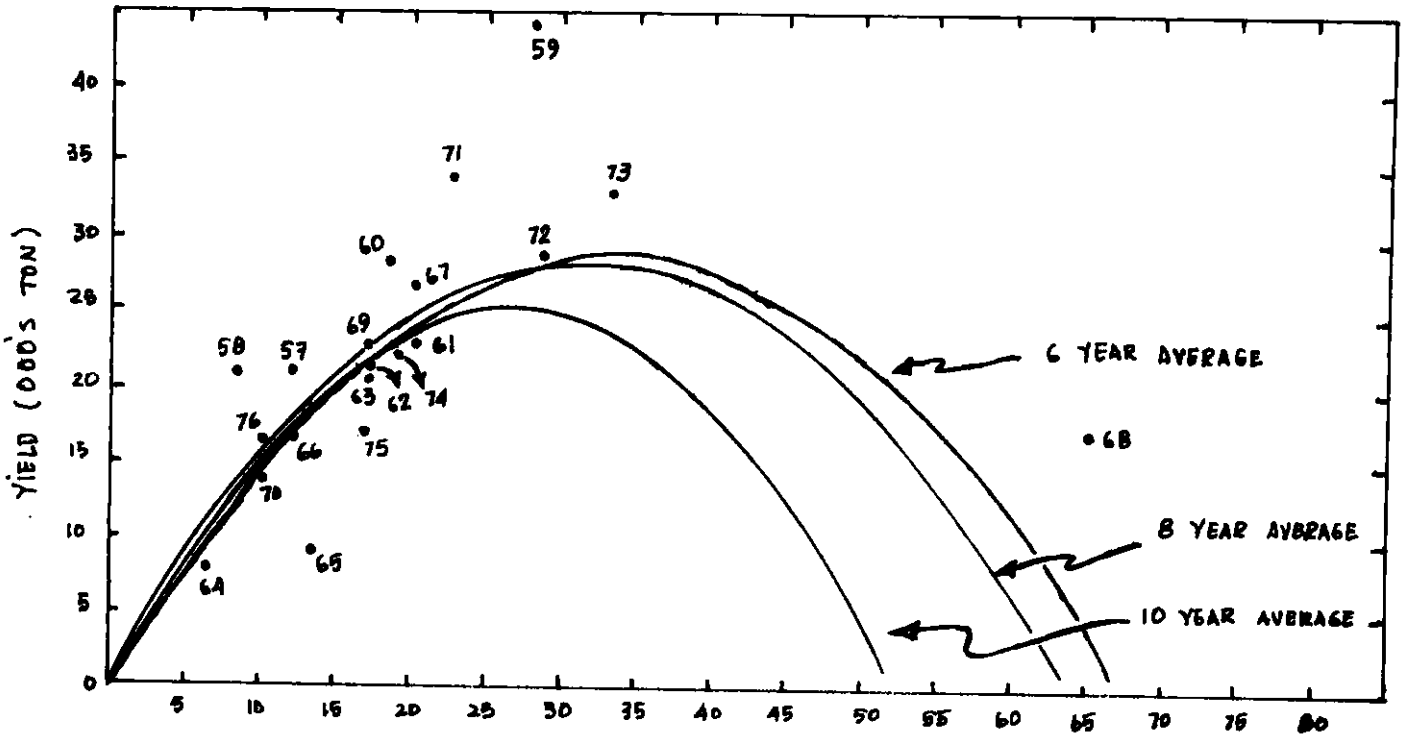

Fig. 4. Yield curves derived from the catch per unit effort/effort relation for redfish in Div. 3LN.