RESTRICTED

International Commission for the Northwest Atlantic Fisheries

Serial No. 3690
(D.c.3)

ICNAF Res.Doc. 74/IX/137

SEVENTH SPECIAL COMMISSION MEETING - SEPTEMBER 1975

Status of Division 3P redfish

by

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Introduction

In response to the request to STACRES to review information on Division 3P redfish at the 1975 September Special Meeting, this document summarizes pertinent information presented at the 1973, 1974 and 1975 meetings of the Assessments Subcommittee (Parsons and Parsons, MS 1973, 1974; Parsons, MS 1975), with some additional observations on the status of this stock.

Trends in Catch and Catch per Unit Effort

Figure 1 depicts trends in catch, effort and catch per unit effort from 1959 to 1974.

Redfish catches in Division 3P increased gradually from less than 5000 tons in 1955 to about 14,000 tons in 1964, with a substantial increase during the mid-to-late 1960's to a peak of 37,000 tons in 1970. Nominal catches from this stock were at a relatively high level during 1969-72, averaging approximately 31,000 tons but declined from 27,500 tons in 1971 and 26,000 tons in 1972 to 18,000 tons in 1973. Approximately 22,000 tons were taken in 1974, the first year that this stock was under quota regulation with a TAC of 25,000 tons.

Catch per hour fished by Canadian otter trawlers of 151-500 tons exhibited a steady decline from a high of more than 0.9 tons per hour in 1965 to about 0.5 tons per hour in 1974; there was a slight levelling off in 1972 but a continued decline in 1973 and 1974. Preliminary catch and effort statistics for January-July of 1975 indicate that the catch per hour trawled in 1975 has remained the same as in 1974, about 0.5 tons per hour, the lowest in the history of the fishery for this stock.

Standardized commercial catch per unit effort values (Fig. 1) indicate a high level of redfish abundance in Division 3P during the mid-to-late 1960's with above-average recruitment during this period; hence, the improvement in catch per unit effort during 1962-65 at a fairly stable level of fishing effort.

Sustainable Yield

The general production model of Schaefer, as modified by Gulland (1961), was previously used by Parsons and Parsons (MS 1973) to derive an estimate of maximum sustainable yield from catch and fishing effort data. In that analysis effort was averaged over 6-year periods and a linear regression of catch per hour against mean effort computed. Based on this 6-year running average of effort, the sustainable yield for this stock was estimated to be 23,000 tons at the recruitment levels experienced during 1965-71. However, 6-, 8- and 10-year running averages of effort were previously utilized to derive a range of estimates of maximum sustainable yield for the Subarea 2 + Division 3K and Division 3M redfish stocks. Accordingly, we have calculated sustainable yield estimates for Division 3P redfish using 8- and 10-year, as well as 6-year, running averages and incorporating catch per unit effort and effort data for 1972, 1973 and 1974 in addition to the 1965-71 data used previously (Fig. 2). The estimated MSY based on a 6-year running average remained unchanged from the earlier analysis at about 23,000 tons (Fig. 3). Estimates of 21,000 and 20,000 tons were derived from the 8-year and 10-year running averages of effort.

These curves did not take into account any increases in efficiency which may have occurred during this period. To allow for such changes, a steady rate of increase in efficiency was incorporated into the model. Overall best fit was obtained with a 10-year averaging period and a 4% increase in efficiency. This produced a MSY estimate of 18,000 tons. Best fits for 6-year and 8-year averaging periods were with assumptions of 4% and 3% increases in efficiency respectively, giving MSY estimates of 22,000 and 20,000 tons.

An assessment of this stock on the basis of a nominal yield-per-recruit model (Parsons and Parsons, MS 1974) previously indicated that the average level of fishing mortality during 1964-73, when catches averaged approximately 24,000 tons annually, was beyond $F_{0.1}$ (Fig. 4), which suggested a sustainable yield at the $F_{0.1}$ levels of less than 24,000 tons at the recruitment levels experienced during the late 1960's. Estimates of fishing mortality derived from numbers caught per hour by commercial trawlers in 1973 and 1974 indicate that the level of fishing mortality in 1973-74 (average catch 20,000 tons) was beyond $F_{0.1}$ (Fig. 4).

Recruitment

It is apparent from the trends in commercial CPUE (Fig. 1 and 2) that recruitment to this stock was considerably higher during 1965-71 than during the 1959-64 period. From a 1965 research survey in 3P (Fig. 5 and 6) and commercial length frequencies for 1966 and 1967, it is evident that the improved catch per unit effort resulted from several strong year-classes (1953-58) recruiting to the fishery during the mid-1960's. These year-classes were still supporting the fishery as late as 1973-74 (Fig. 7). The 1973, 1974 and 1975 research surveys in 3P indicate that several year-classes of moderate strength are about to enter the fishery (Fig. 5 and 6). A crude comparison of average year-class strength suggests that these new year-classes (8 to 12 years old in 1975) are slightly less than half as abundant as the mid-1950's year classes which apparently supported the 3P fishery during 1965-74, the period from which sustainable yield estimates of 20,000 - 23,000 tons were derived. If we assume no change in the pattern of exploitation with age, the sustainable yield from these new year-classes which began to appear in commercial otter trawl catches during 1974 and 1975 (Fig. 8) would be expected to be substantially less (perhaps 12,000 tons or less) than that supported by the earlier level of recruitment.

With decreased stock size there could be density dependent changes in growth, hence altering the yield-per-recruit curves and resulting in a higher maximum yield-per-recruit than that estimated for the 1965-73 period. If such were to occur, the sustainable yield from these year-classes would perhaps be somewhat more than half of that estimated from the 1965-74 recruitment level. However, the observed length-at-age of these year-classes of the mid-1960's appears to be less than that observed for the dominant year-classes of 1953-58.

Discussion

The expansion of the Division 3P redfish fishery during 1965-70 was supported by the influx of several strong year-classes (1953-58), producing a recruitment level substantially greater than that prevailing during the late 1950's - early 1960's. The commercial catch per unit effort increased to 0.9 tons per hour in 1965, close to that obtained during the initial fishery on a virgin stock, and thereafter decreased steadily to a low of about 0.5 tons per hour in 1974, apparently remaining at that level in 1975. The observed decrease in CPUE suggests that these 1953-58 year-classe are now substantially reduced in abundance and that during the next several years the fishery will be largely dependent upon the 1964, 1965, 1966 and adjacent year-classes which already began to appear in otter trawl catches in 1974 and 1975.

Estimates of sustainable yield of 20,000 - 23,000 tons based on catch per unit effort and effort during a period of above-average recruitment (1965-74) undoubtedly represent an over-estimate of the long-term maximum sustainable yield from this stock, as was pointed out in the 1974 Assessments Subcommittee Report.

Comparisons of research survey catches in 1965 and during 1973-75 indicate that the 1964, 1965, 1966 and adjacent year-classes are probably not more than half as abundant, at similar ages, as those year-classes which supported the fishery during 1965-74. Hence, the sustainable yield from these year-classes of the mid-1960's can be expected to be substantially less than, perhaps no more than half, the 20,000 - 23,000 tons estimated on the basis of the recruitment level prevailing during 1965-74.

Total allowable catches for 1974 and 1975 of 25,000 tons are greater than the level of sustainable yield--23,000 tons--initially estimated on the basis of a 6-year running average and the 20,000 - 21,000 tons indicated by 10-year and 8-year running averages of effort, as previously utilized to establish a range of MSY estimates for the Subarea 2 + Division 3K and Division 3M redfish stocks. A total allowable catch of 20,000 tons for 1976 would not represent a significant decrease from the estimated sustainable yield of 20,000 - 23,000 tons at the recruitment level prevailing during 1965-74, particularly in view of the substantially diminished recruitment prospects for the remainder of the 1970's. The limited available data suggest that the sustainable yield from those year-classes now entering the fishery will be considerably less than 20,000 tons.

If recruitment should prove better than anticipated, there would be virtually no loss in maximum yield per recruit up to age 13 or 14 because of the low natural mortality of redfish and the fact that there is still significant increase in length and weight up to about 15 years of age. Hence, a significant reduction in total allowable catch now could prevent over-exploitation of recruiting year-classes if these are substantially less abundant than those which supported the fishery during 1965-74, as now seems apparent, without resulting in any appreciable loss in yield if recruitment should prove better than expected because the total allowable catch could be adjusted upwards within two or three years to take advantage of improved recruitment if such should materialize.

References

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MS 1974. Yield per recruit assessment of ICNAF Division 3P redfish. Intern. Comm. Northw. Atlant. Fish. Annual Meet. Res. Doc. 74/80, Ser. No. 3313, 11 p.

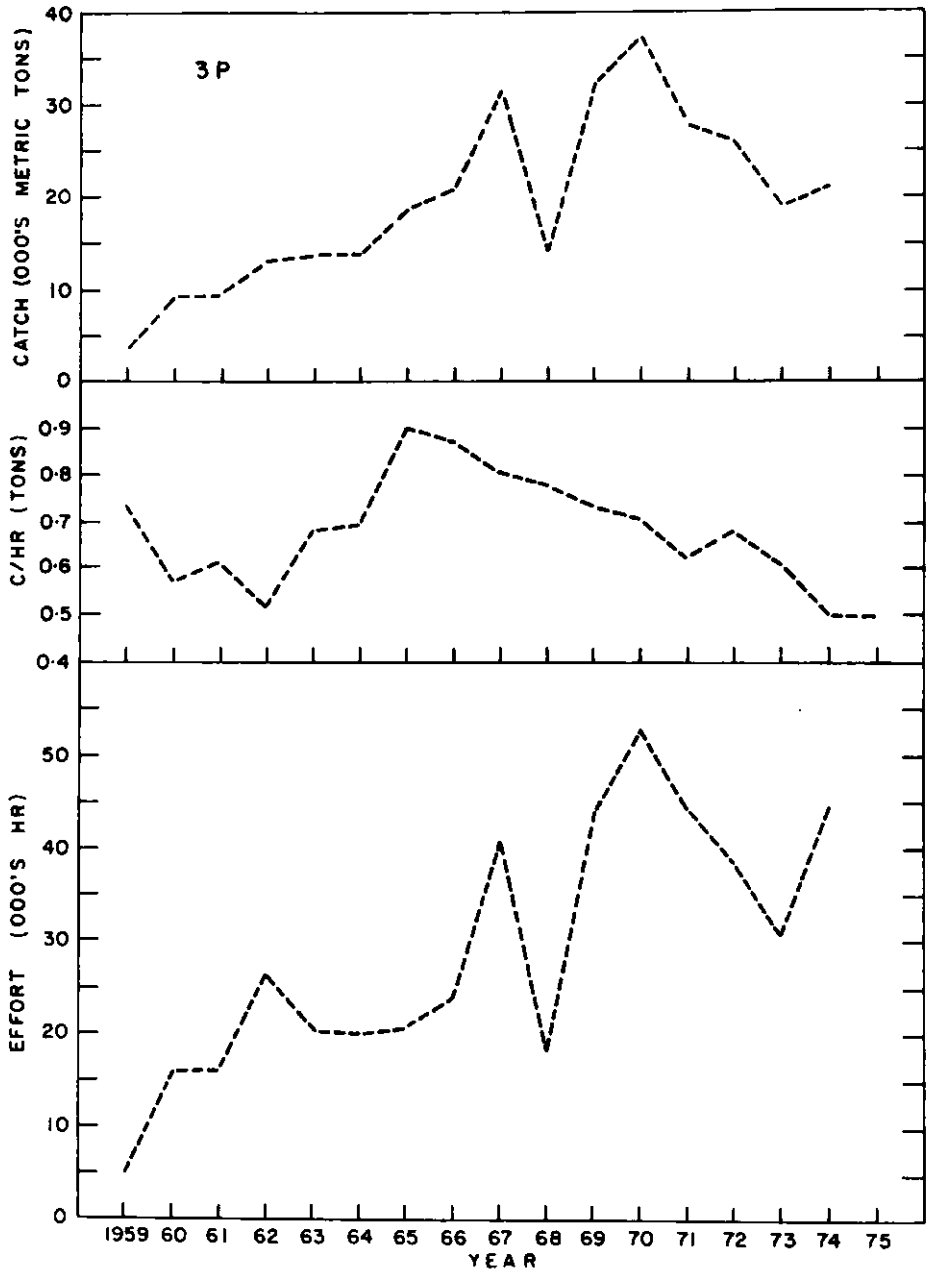

Fig. 1. Trends in nominal catches, effort and catches per unit effort in standard trawler units - Canada (Nfld.) tonnage class 4 - for Division 3P redfish during 1959-74.

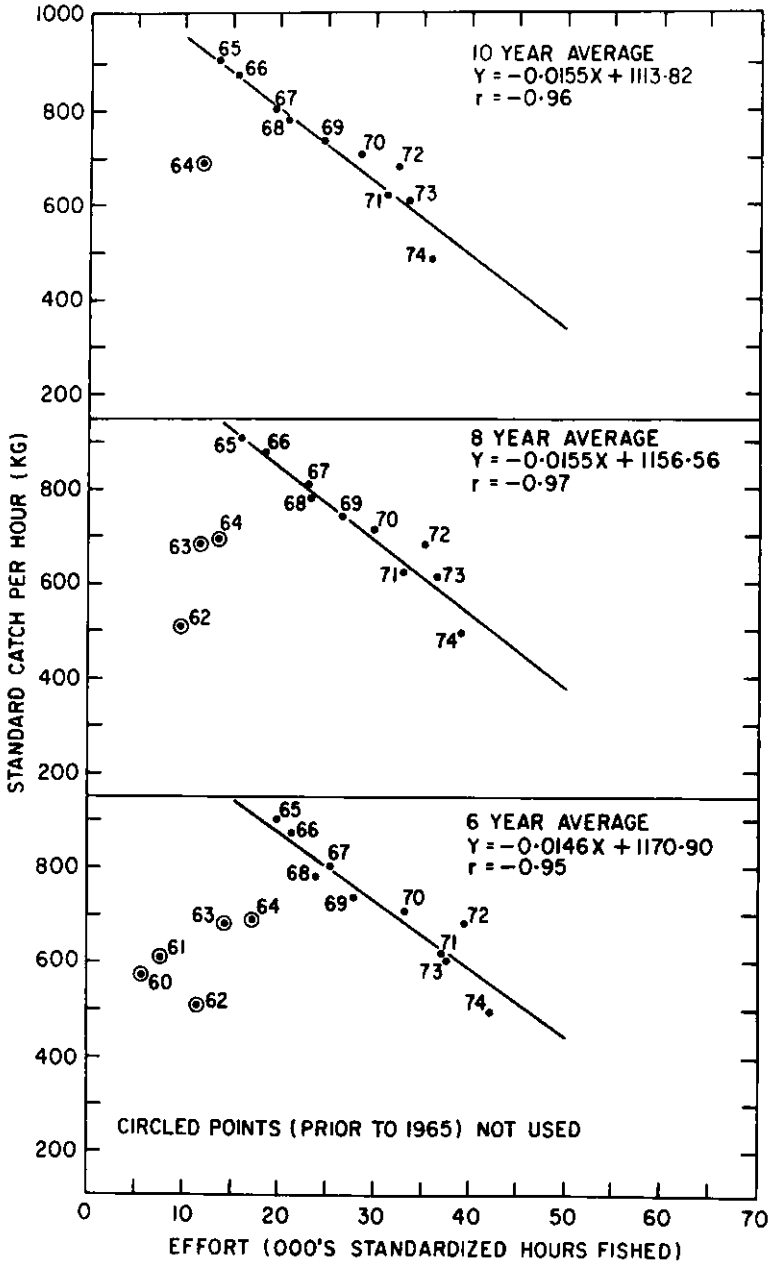

Fig. 2. Catch per standard hour fished versus 6-year, 8-year and 10-year running averages of standard days fished, redfish, Division 3P.

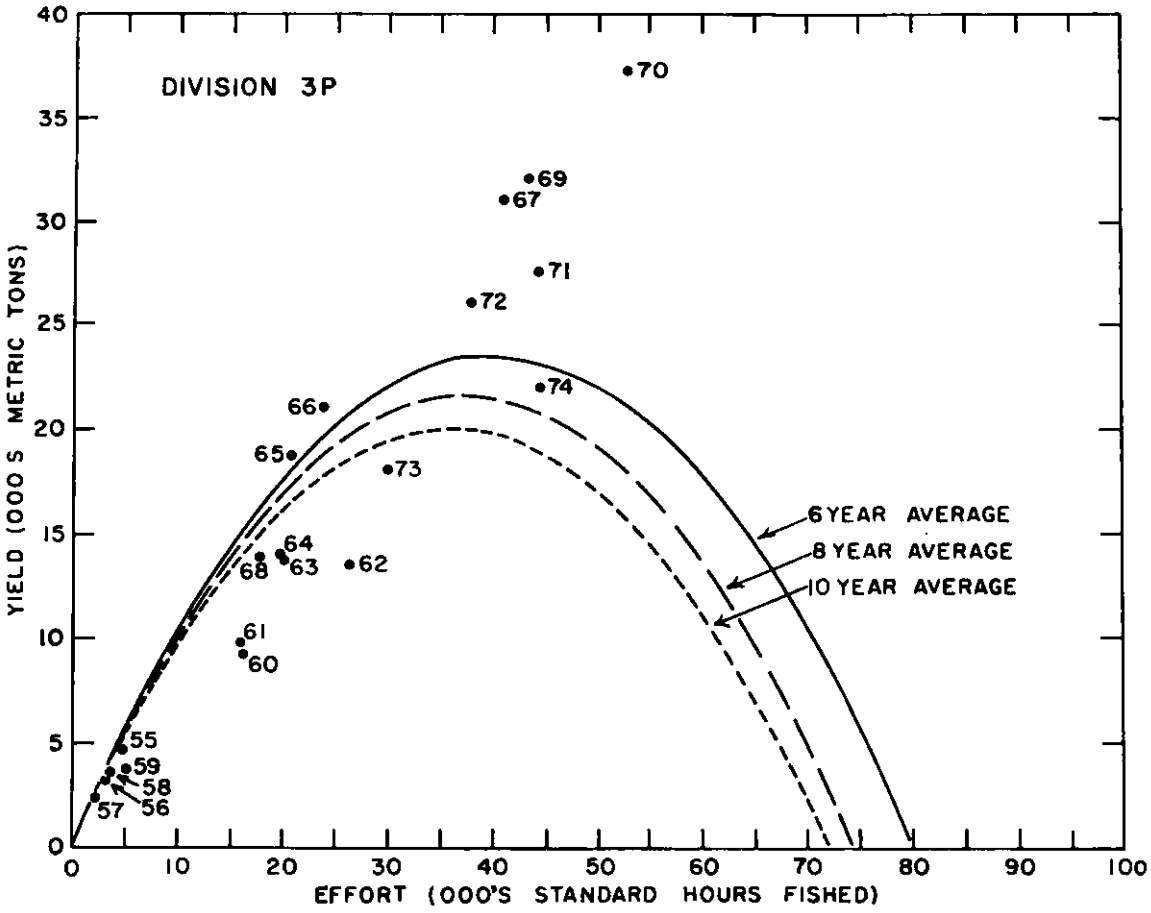

Fig. 3. Yield curves derived from the catch per unit effort/effort relation using 6-year, 8-year and 10-year running averages of standard hours fished, redfish, Division 3P.

NOTE: Points (•) represent annual catches plotted against actual effort in the indicated years rather than against running averages of effort.

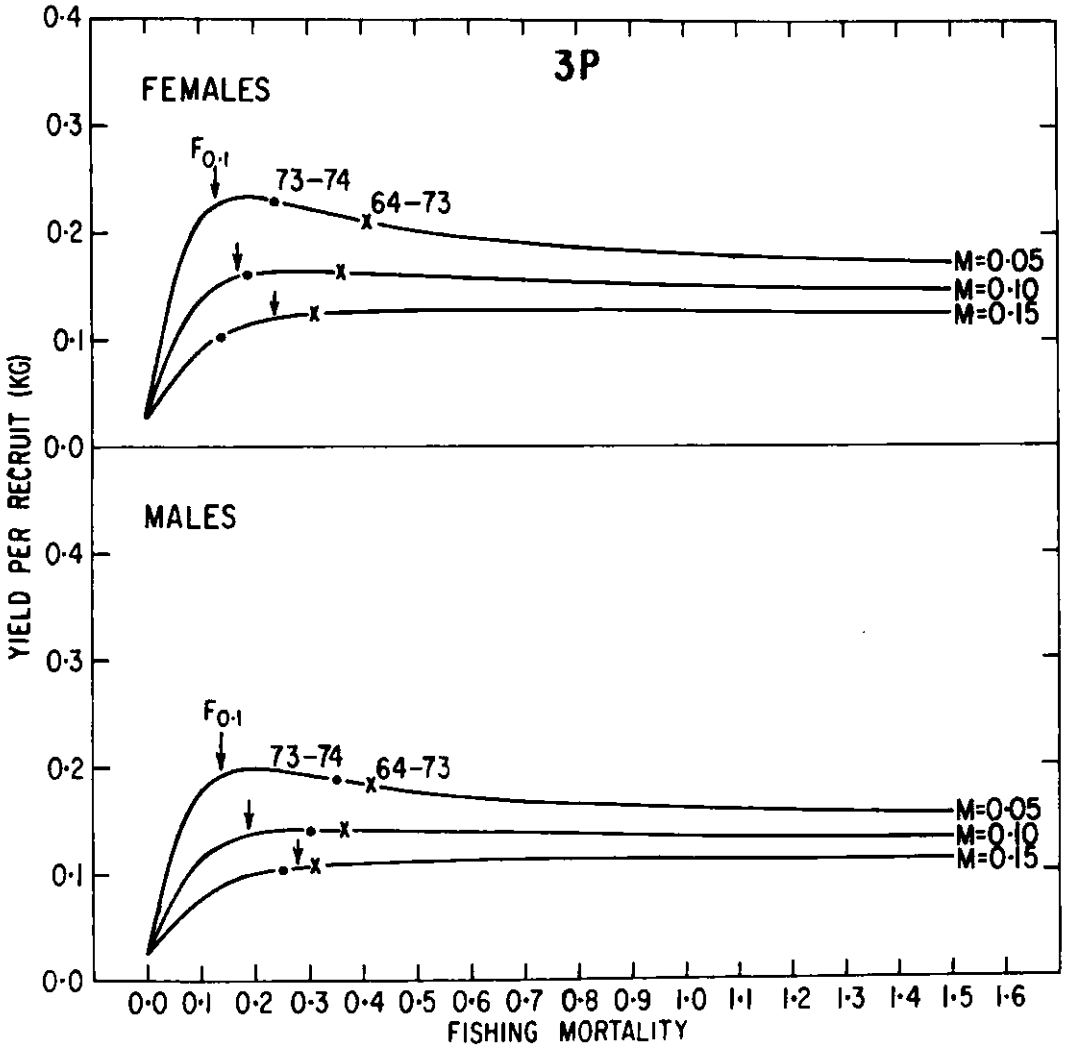

Fig. 4. Yield per recruit curves for male and female mentella-type redfish from Division 3P. X's indicate fishing mortality estimates from 1973 commercial catch curve data; •'s indicate fishing mortality estimates from numbers caught at age per hour fished by commercial trawlers during 1973 and 1974.

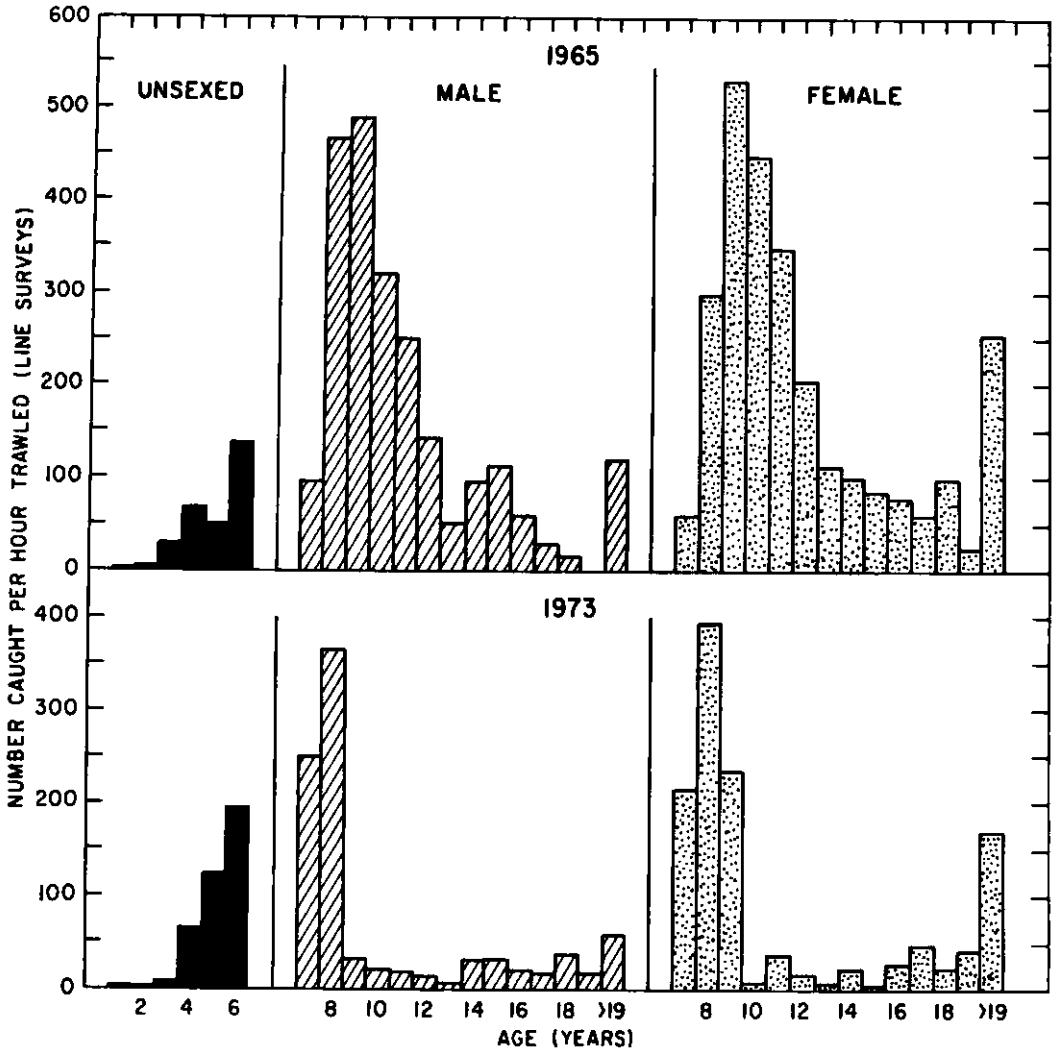

Fig. 5. Numbers caught at each age per hour trawled by the Canadian research vessel A. T. Cameron in 1965 and 1973 line surveys for redfish in Division 3P.

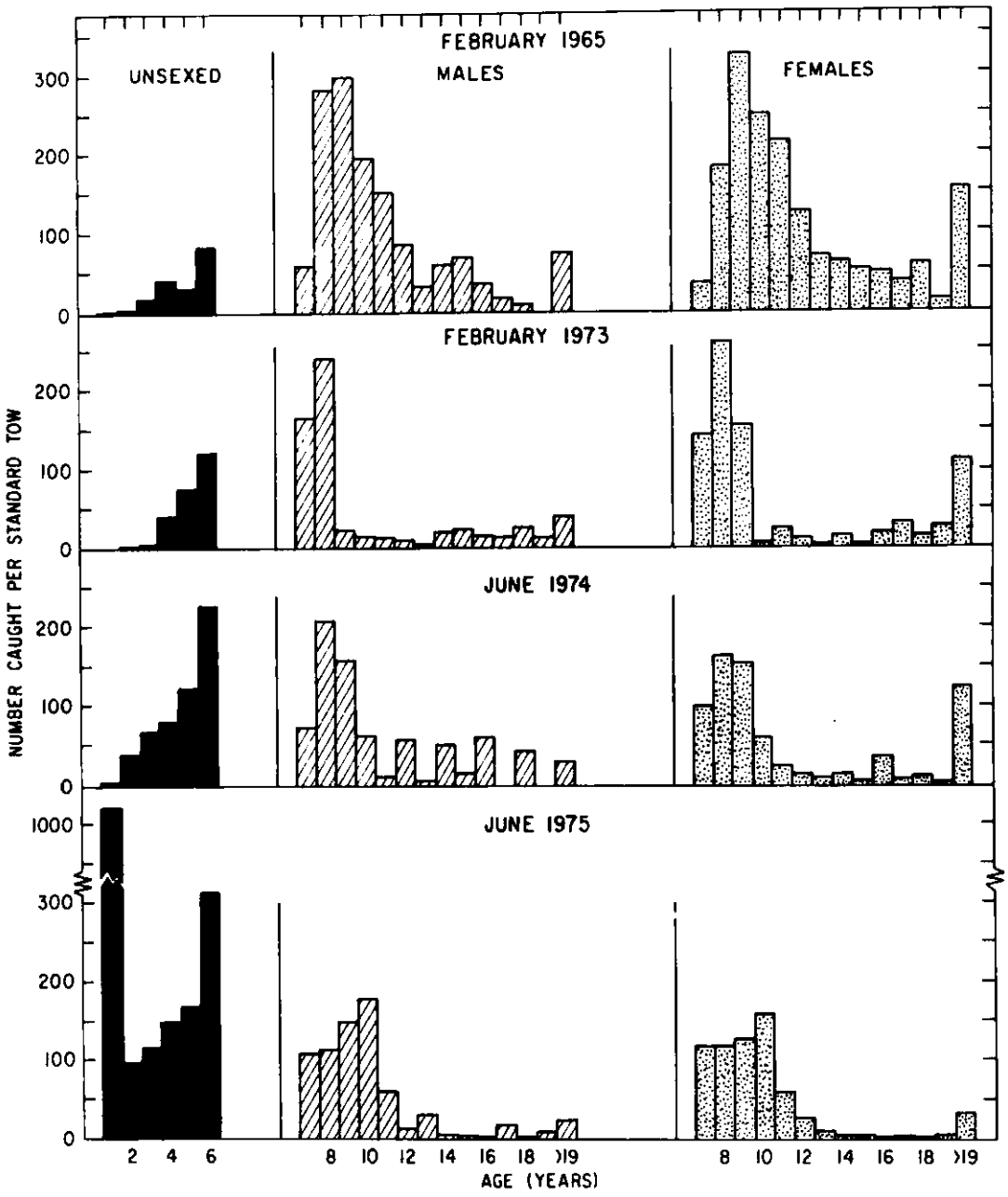

Fig. 6. Numbers caught at each age per standard 30-minute tow in 1965 and 1973 post-stratified surveys and 1974 and 1975 stratified-random surveys of Division 3P by the Canadian research vessel A. T. Cameron.

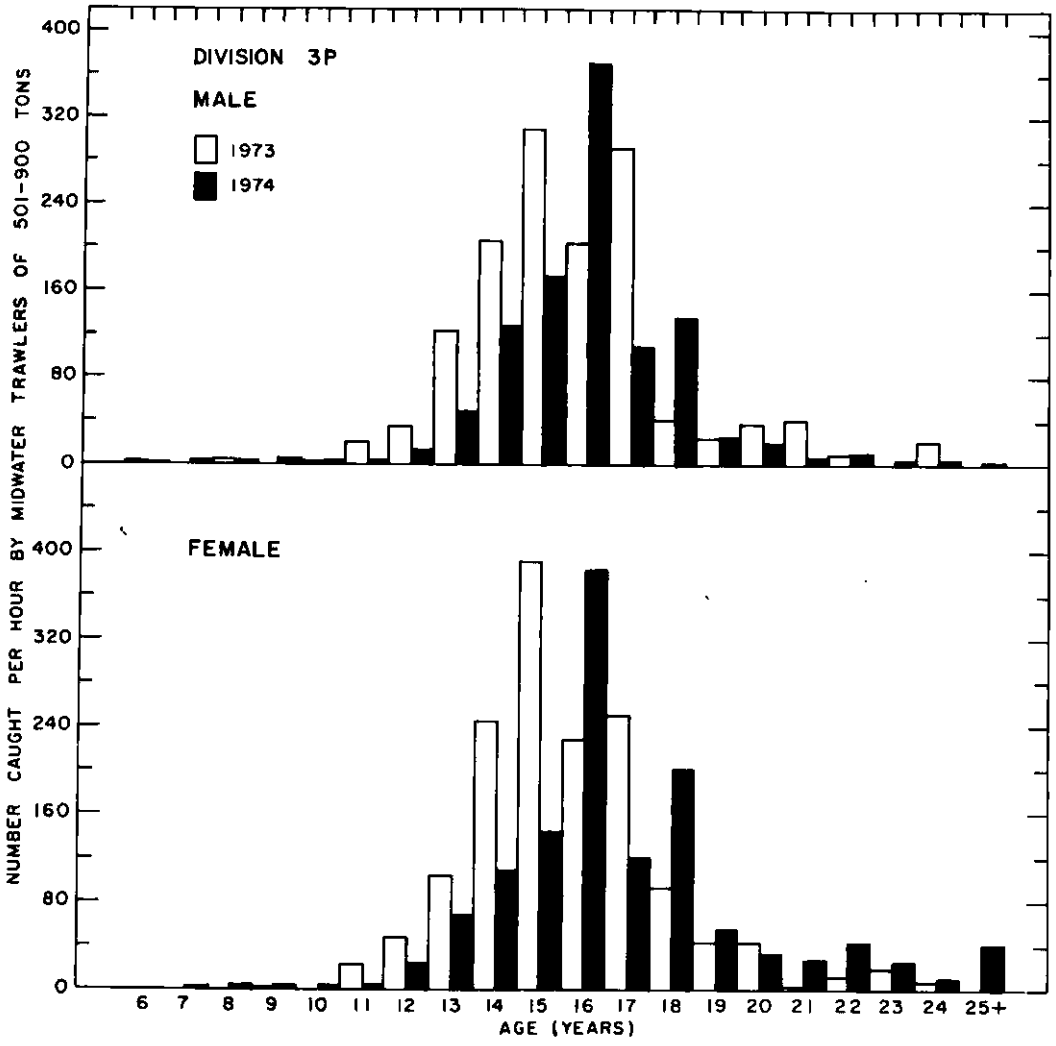

Fig. 7. Numbers caught at each age per hour trawled by Canada (Nfld.) midwater trawlers of 501-900 tons in Division 3P during 1973 and 1974.

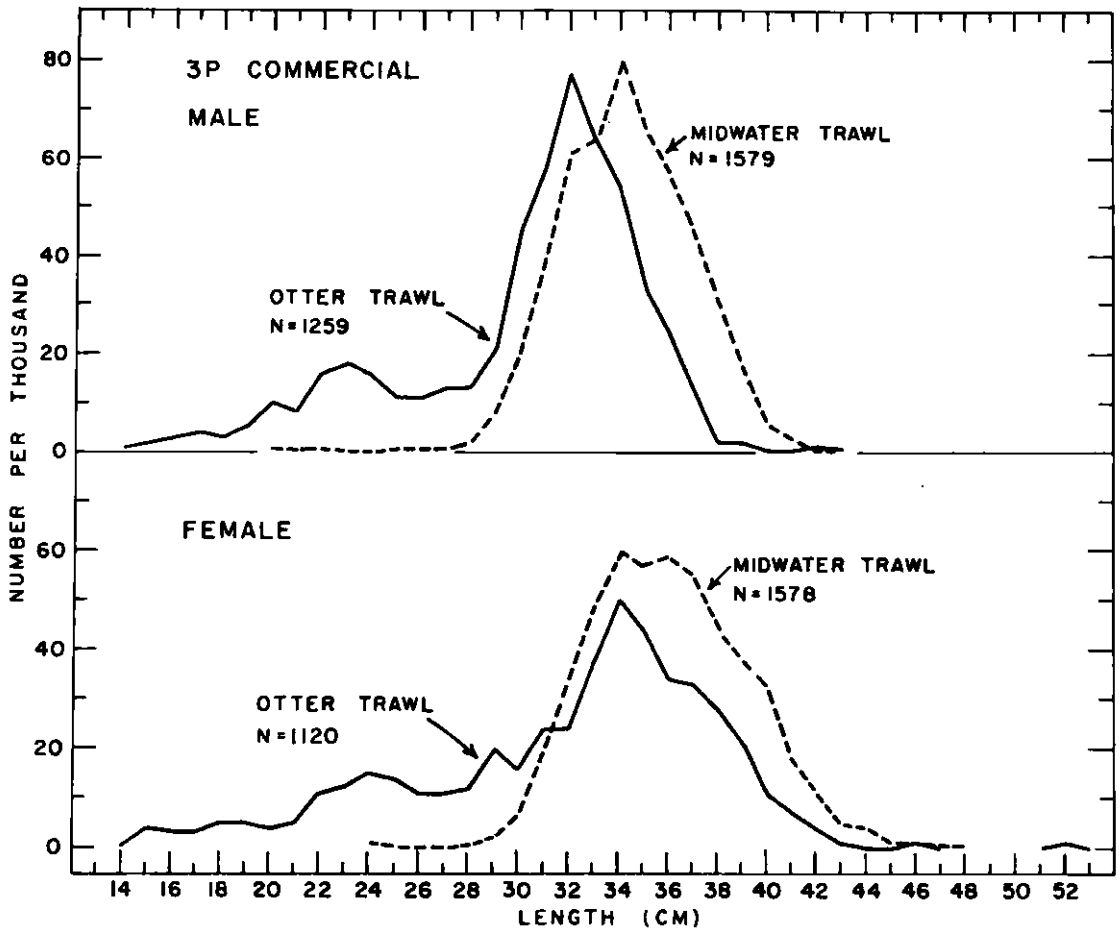

Fig. 8. Preliminary length distributions of 1975 Canada (Nfld.) otter trawl and midwater trawl catches of redfish in Division 3P.