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The delineation of American plaice stocks with special
reference to ICNAF Divisions 3LNO

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Introduction

The management of plaice stocks in the ICNAF Convention Area, particularly in Subareas 2 and 3 is based on more or less arbitrary groupings according to ICNAF Divisions. At present in these Subareas, 4 stocks are managed each with a TAC and quota allocation, Subarea 2-3K, 3LNO, 3M and 3Ps.

This document suggests that the conservation of the 3LNO stock would be enhanced by possibly assigning separate TAC's to the three Grand Bank Divisions or possibly some combination such as Divisions 3L and 3NO.

The other problems discussed here are the difficulties arising from the collection of data by the present ICNAF Divisions on the Grand Bank and suggests that accuracy in assessment of the stocks would be improved by having data reported by smaller units.

Stock Separation

Vertebral numbers

An analysis of vertebral numbers (Pitt 1963) indicated that although there was significant heterogeneity throughout the whole Northwest Atlantic from Labrador Shelf to Nova Scotia (Fig. 1) significant differences could not be demonstrated between vertebrae samples caught in most of Subareas 2 and 3. No significant differences were found between any of the Grand Bank samples, but the averages from this area were significantly higher than averages calculated for the Gulf of St. Lawrence, Labrador Shelf, Flemish Cap and Fortune Bay (Fig. 1).

Anal fin rays

Average number of anal fin rays were calculated from samples taken from many of the same localities for which vertebral counts were available. No significant differences were found between any of the averages of samples from northeast Newfoundland Shelf (Division 3K) over all of the Grand Bank St. Mary's Bay and St. Pierre Bank (Fig. 1).

Tagging

In the Newfoundland area of the Northwest Atlantic, 4633 plaice were tagged with Petersen disks at six locations on the Grand Bank and one in St. Mary's Bay. Total return ranged from 1.4% for the latter location to 41.6% for the eastern slope (Tagging site E, Fig. 2). Details of tagging procedure are contained in Pitt, 1969.

Generally, plaice tagged on the Grand Bank moved very little. Most recoveries, even up to seven years after release, were made less than 30 miles (40 km) from the release locality (Fig. 2). There was no evidence of substantial migrations between bank areas and Newfoundland inshore localities, however, up to 1964 there was only a relatively small inshore plaice fishery and this would probably preclude recoveries from the 1954 tagging on the northern part of the Grand Bank if indeed any did move inshore.

Figure 3 summarizes the results of the Grand Bank tagging and indicates relatively slight dispersal of plaice from the tagging area with no great intermingling from widely separate areas. This summary suggests that plaice on the eastern and northeastern slope of the bank could be divided into three groups (a) northern group comprising the north and northeast slopes, (b) a southern group and (c) a central group between (a) and (b) receiving some migrations from both north and south, but possibly with more intermingling from the southern group. However, the ICNAF Divisions thus include the northern group in Division 3L and the other group in 3N. Unfortunately no tagging data were available from the more westerly parts of the bank.

Growth differences

Although differences in growth rate and size at age may not necessarily be indicative of separate stocks, this parameter may point to the non-intermingling at least at the adult level.

Age-length data collected on random stratified research cruises in 1973 and 1974 were combined by splitting Divisions 3N and 3Ø into northern and southern components (Fig. 4) and von Bertalanffy curves fitted (Fig. 5). Plaice from the two more southerly groups 3Ns and 3Øs were larger at comparable ages than those from the other groups. The samples from 3L and 3Øn gave almost identical growth curves and those from 3Nn lay between the two other groups.

Discussion

Partitioning Divisions 3LNO TAC's

Generally speaking, vertebral and fin ray counts are not very useful in delineating American plaice stocks. There may be a number of contributing factors such as lack of inherent variability of the meristic parts, so that when a number of year-classes were combined, differences in fin ray and vertebral numbers resulting from the influence of varying environmental conditions may cancel each other out. Then also with a relatively long spawning period (Pitt 1965) there could be a range of environmental conditions influencing developing embryos throughout the developing period.

Most fish migrations are associated with spawning or feeding patterns or with changes in environmental conditions or perhaps a combination of all three. On the slopes of the Grand Bank, a variety of temperature and feeding conditions is available thus requiring very little movement for plaice to find their preferred temperature when conditions change. Tagging data thus indicate very little intermingling of adult plaice and it appears that instead of large aggregate populations, plaice on the Grand Bank occur in relatively isolated groups.

The meristic data suggest that there could be considerable intermingling at the egg and larvae stages. Plaice spawn throughout the Northwest Atlantic from Davis Strait to Georges Bank including the coastal waters of Newfoundland.

Because of the strong southward flow of the Labrador current, there could be considerable movement of eggs from the more northerly localities such as the northeast Newfoundland Shelf (Division 3K) to the Grand Bank. There is a possibility then that the Grand Bank is stocked both from local spawning and larval drift from the north. Nevinsky and Serebryakov (1973) found eggs and larvae on the Grand Bank in the spawning localities and concluded that loss beyond the continental shelf was minimal.

The general picture then seems to be that whereas during the pre-metamorphosis period there is probably considerable intermingling over the whole of the Grand Bank at least, but when they have settled, there appears to be very little intermingling between the different sections.

The present management of plaice on the Grand Bank involves the setting of a single TAC for Divisions 3LNØ. This means conceivable that all of the TAC could be removed from a single division. The first analytic assessments of Grand Bank plaice (Pitt 1971 and 1973) gave recommended removal levels for Divisions 3L and 3N separately. However, the final allocation of quotas for 1973 were based on a single stock concept for 3LNØ.

The implications of the single stock concept for Divisions 3LNØ could be serious since such a concept would imply interchange of fish between the different divisions at least. Such, however, is apparently not the case and in fact there appears to be little or no interchange beyond the early life stages.

Canada and the USSR take most of the plaice TAC from the Grand Bank. For Canada, plaice and yellowtail are the primary species sought on the Grand Bank. In the case of the USSR and other countries reporting plaice, the latter is primarily incidental to the directed cod fishery. In Table 1 the effort for Canada and the USSR in which flatfish (plaice only in 1972 and 1973) were reported is listed for Divisions 3L, 3N and 3Ø and the percentage of total effort in each division calculated. Obviously there was considerable fluctuation of effort between divisions; thus, for example, in 1964 effort was divided 46%, 17% and 37% between 3L, 3N and 3Ø respectively, whereas in 1966 the corresponding approximate percentages were 29, 52 and 19. Within the divisions, potential effort for plaice ranged from 23% to 48%; in 3N the range was 17% to 52% and in 3Ø from 18% to about 50%.

What is suggested here is that because of the possibility of a large proportion of the effort being directed into any one division, it would be desirable to assign TAC's to the individual divisions or combination of one or two divisions since under the present scheme, although the fishery might be at a desirable level of fishing mortality for the whole of the bank, within a particular division the exploitation rate might be too high and during a particular period considerable damage could be done to the stock in that division. The following text table compares the estimated fully recruited stock size in Divisions 3L and 3N (millions of fish):

<u>YEAR</u>	<u>DIVISION 3L</u>	<u>DIVISION 3N</u>
1963	48.3	23.7
1964	43.7	26.5
1965	42.5	27.1
1966	37.7	26.8
1967	39.6	26.6
1968	31.9	24.8
1969	31.8	20.8
1970	26.7	18.9
1971	22.5	15.9
1972	21.7	12.8

When the ICNAF Divisions were established in the early 1950's, American plaice were of little commercial importance so that the main concern at this time was the reporting of cod, haddock and redfish. On the Grand Bank the main concern was divisions that would accommodate cod and haddock. Obviously, it was impossible to divide the whole area into boundaries that would delineate all stocks even if the limits of these stocks were known. However, with management techniques becoming more precise, it is necessary to look at schemes that will provide data on which assessment of

the stocks are based in smaller units that can be grouped in a manner that more closely represents the stock limits.

The difference of size at age between the northern and wouthern portions of Divisions 3N and 3Ø are illustrative of the difficulties encountered in using data collected under the present system. Obviously age-length keys and age-weight relationships for samples collected in 3Øn and 3Øs (Fig. 4) are not comparable, yet the data being submitted could come from any part of the division under the present reporting system. The implementation of the 30 x 30 min areas for the Grand Bank would be especially useful for American plaice and yellowtail management since in addition to solving some of the difficulties with size at age differences the reporting by smaller units may be of assistance in sorting out the flatfish mix.

References

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Table 1. Hours fished when flatfish* was recorded from ICNAF Statistical Bulletins. Otter trawler data only.

YEAR	Division 3L		Division 3N		Division 3Ø		Total Effort
	Effort ('000 hrs)	%	Effort ('000 hrs)	%	Effort ('000 hrs)	%	
1963	29.9	32.6	16.2	17.6	45.5	49.6	91.6
1964	55.9	46.0	20.7	17.0	44.7	37.0	121.3
1965	90.8	43.2	42.1	20.6	76.9	36.6	209.8
1966	41.4	28.7	75.3	52.3	27.5	19.0	144.2
1967	86.8	29.4	75.3	25.5	132.6	44.9	294.7
1968	62.0	23.3	105.9	39.8	97.8	36.8	265.7
1969	91.3	41.6	52.6	24.0	75.1	34.2	219.0
1970	85.9	47.9	61.6	34.3	31.8	17.7	179.3
1971	92.5	36.1	95.9	37.4	67.4	26.3	255.8
1972	70.6	39.2	66.1	36.1	43.0	23.9	179.7*
1973	57.6	30.7	93.8	50.1	35.7	19.0	187.1*

*Plaice recorded in the catch (1972 and 1973).

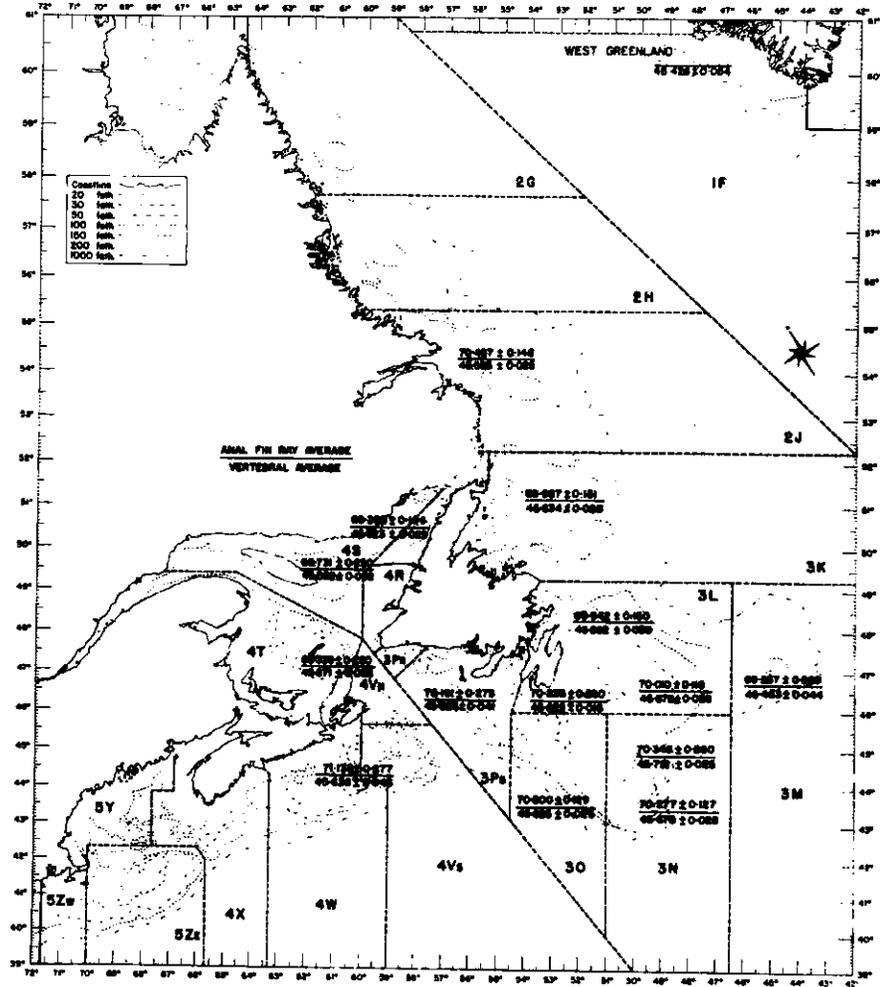


Fig. 1. Anal fin and vertebral averages for plaice from the Northwest Atlantic.

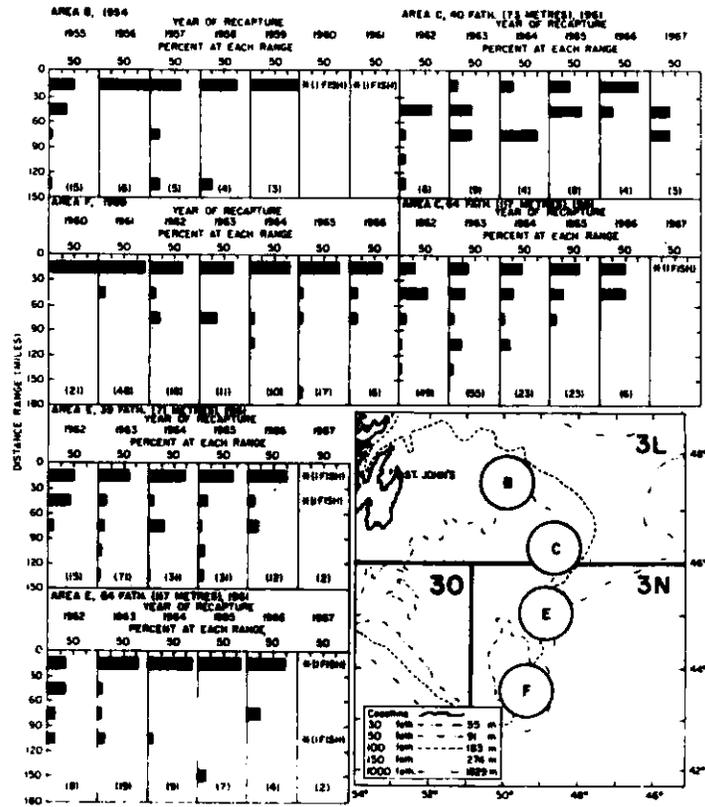


Fig. 2. Percentages of recovered tags that were taken in various years within various distances for a number of tagging experiments.

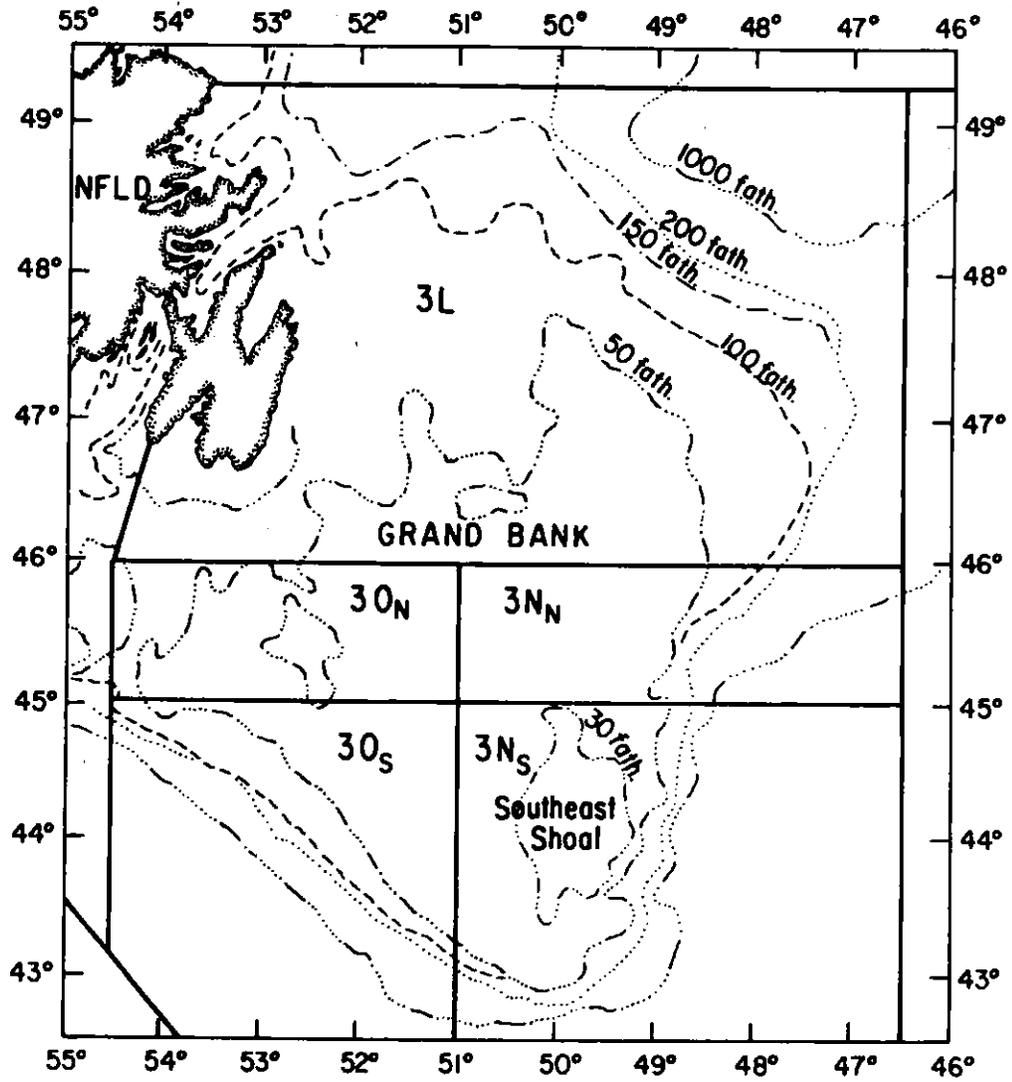


Fig. 4. Division of Divisions 3N and 30 into northern and southern components.

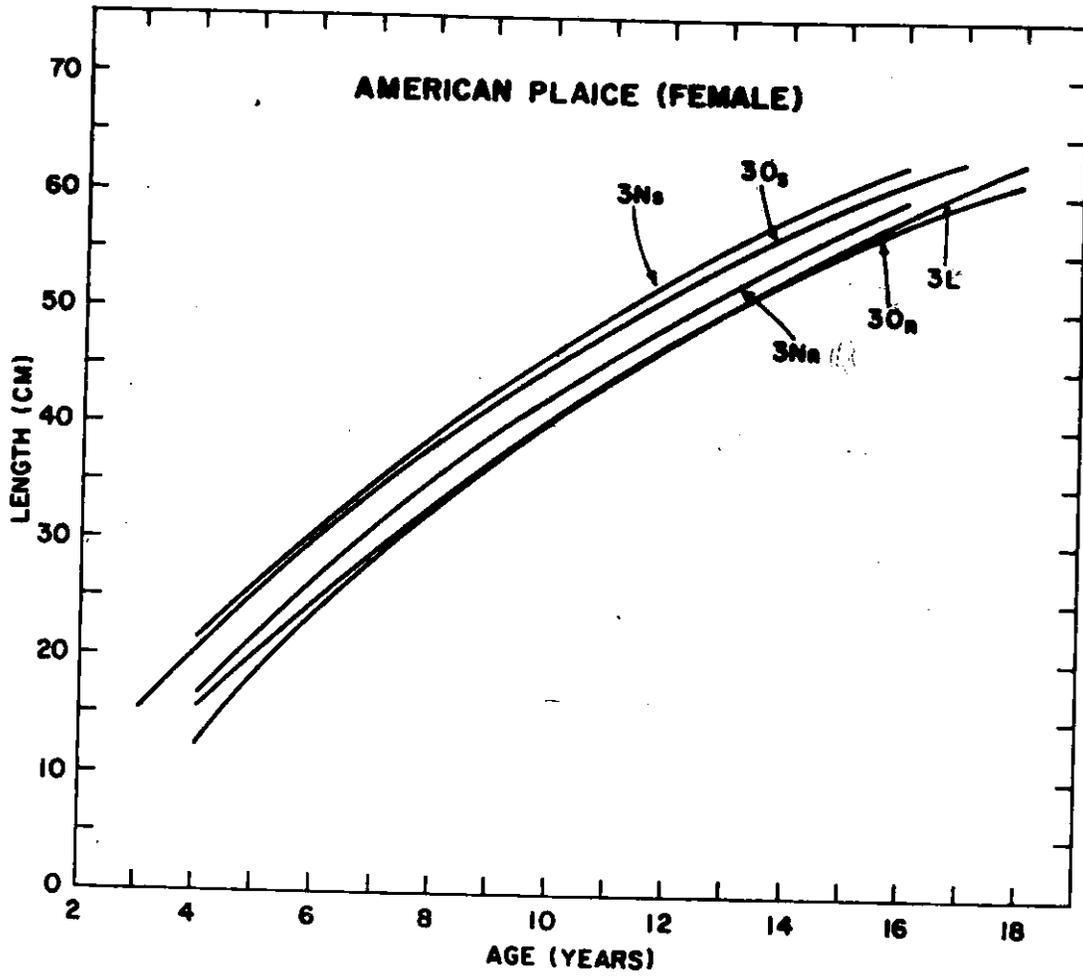


Fig. 5. Growth curves of plaice for a number of Grand Bank localities. (see Fig. 5).