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The abundance of American plaice spawning stock on the Grand Bank, ICNAF Divisions 3L and 3N in 1970 and 1971

by

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Introduction

The nature of the distribution of American plaice pelagic eggs on the Grand Bank allows an assessment of the abundance of the spawning stock. The spawning areas and seasons and the drifting paths of the pelagic eggs and larvae were determined by the authors previously (Nevinsky and Serebriakov, 1973). This report is an attempt to estimate the abundance of American plaice spawning on the Grand Bank.

Materials and Methods

Sixty-five ichthyoplankton stations were observed in 1970, and 75 in 1971. Conical nets with 80-cm (IKS - 80) openings were used; hauls were from the bottom or 500 m to the surface. Egg numbers in different stages of development were determined for each sample.

Determination of total eggs in the area was done following Buchanan-Wollaston (1926), using only Stage I eggs for simplicity and to avoid the problem of egg mortality. A net efficiency of 0.62 was used (Shapiro, 1971).

Total egg density was calculated by mapping isolines of densities, and the resultant areas were determined with a planimeter (Figs. 1 and 2). The total eggs were then

$$M = \frac{T}{t}\left(\sum_{i=1}^{6} S_i \cdot d_i\right),$$

where M = total eggs in the area,
T = period of mass spawning (assumed to be evenly distributed through time),
t = duration of Stage I of egg development,
S_i = area with a certain egg density,
d_i = density of eggs in a certain area, and
i = density class (6 classes were used).

From M, an estimate of spawning stock can be determined knowing the fecundity of that stock. From Pitt (1964), the fecundity may be predicted from length:

$$F = .002103\ L^{3.1709},$$

where F = fecundity of the fish, and
L = length of the fish in millimeters.

As the 1970 and 1971 spawning population females were 35-55 cm long, a mean value of 40 cm yields 3.86×10^5 eggs/female. The sex ratio is 1:1 in the spawning stock.

The spawning stock is calculated as

$$S = \frac{N}{n}(r)$$

where S = spawning stock as numbers of fish,
N = total number of eggs in the area investigated,

n = average fecundity of a female, and
r = sex ratio correction to give males and females.

Results

In 1970 the total number of eggs for one day appeared to be 9.4045×10^8, while a comparable figure for 1971 was 7.5172×10^8. Using 75 days for the spawning season, and 3 days for the duration of the egg stage counted, for the whole period of mass spawning there were 2.3511×10^{10} eggs of Stage I in 1970 and 1.8793×10^{10} in 1971.

Using an average weight of 700 g to convert S as numbers to tons of biomass, B, the spawning stock calculations are summarized as follows:

Year	Area (km^2)	Catchability coefficient	Total eggs in the area	S (numbers)	B (tons)
1970	154,017	0.6	$2.3511 \cdot 10^{10}$	$1.2182 \cdot 10^6$	852,700
1971	153,280	0.6	$1.8793 \cdot 10^{10}$	$9.735 \cdot 10^6$	681,400

Discussion

In 1970 and 1971 the total landings of American plaice for this area were 60,305 and 60,723 tons. A TAC of 60,000 tons was recommended for Div. 3L and 3N by ICNAF as the intensity of fishing increased in this area. This TAC was determined from the data of Pitt (1973), who estimated American plaice abundance by the virtual population method.

His results suggested 1970 average fishing mortality rates of 0.65 (males) and 0.48 (females) for Div. 3L, and 0.50 (males) and 0.48 (females) in Div. 3N.

These figures served as a basis for recommending that the annual landings of American plaice should not exceed 40,000 in Div. 3L and 20,000 tons in DIv. 3N.

According to our data, the abundance of the spawning stock for 1970 and 1971 is three times higher than that of 1968 (Pitt, 1973).

Assuming the condition of the American plaice stock has not significantly changed during 1968-1971, the assessment of the stock size and determination of the TAC clearly need additional verification, and, probably, revision.

The authors of this report are of the opinion that the total catch limit may be increased at least threefold, i.e., up to 180,000 tons for Div. 3L and 3N.

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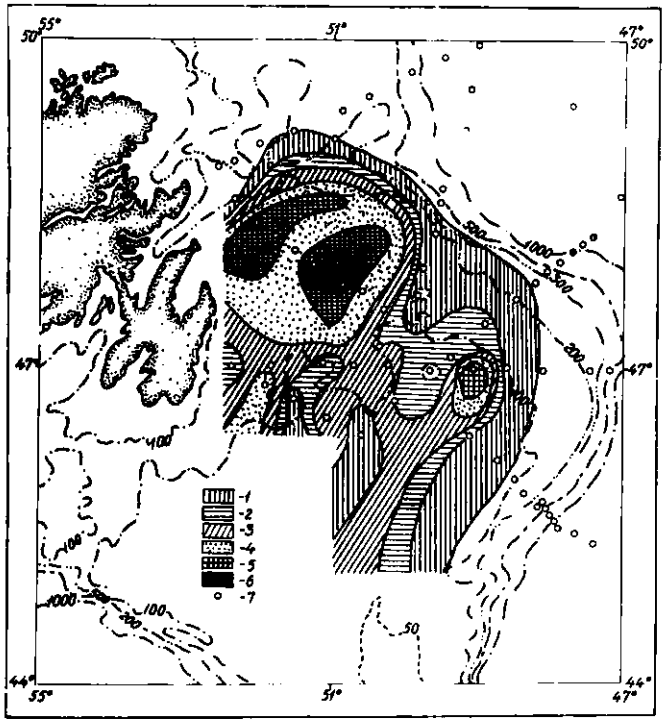

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Fig. 1. Density of distribution of American plaice eggs in stage I of development, May-June 1970.

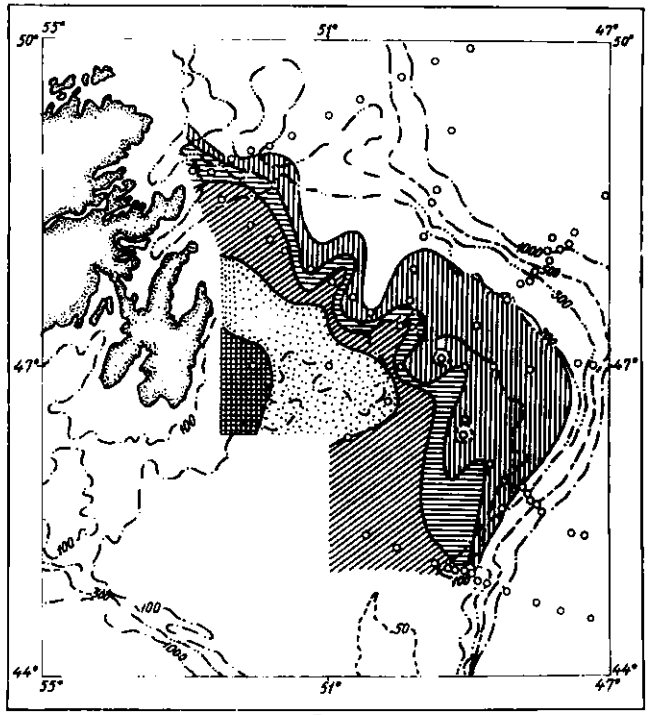

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Fig. 2. Density of distribution of American plaice eggs in stage I of development, April-June 1971.

Conventional signs:

1. from one up to ten eggs per m^2;
2. from eleven up to twenty eggs per m^2;
3. from twenty-one up to fifty eggs per m^2;
4. from fifty-one up to one hundred eggs per m^2;
5. from one hundred and one to two hundred eggs per m^2;
6. eggs number exceeds two hundred eggs per m^2;
7. stations, where ichthyoplankton collections were accomplished.