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Recalculation of Natural Mortality of American Plaice from the Grand Bank

by

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INTRODUCTION

Huntsman (1918) estimated total mortality rate for combined sexes from the unexploited Gulf of St. Lawrence plaice population (NAFO Div. 4T) at 12.5 (Z = 0.14), however, when his data were used to fit a catch curve (Pitt 1973), instantaneous total mortality (Z) was calculated at 0.21 for ages 9-12 and 0.18 for ages 9-24.

Pitt (1973) presented estimates of instantaneous natural mortality for plaice, males and females separately, using a number of different methods such as catch curves of unexploited stocks, Beverton and Holt's (1957) iterative method, Paloheimo's (1961) linear method, and a modification of the latter using a series of catch curves of cohorts that had passed through the fishery in NAFO Div. 3L and 3N. These estimates indicated that instantaneous natural mortality (M) was about 0.25 and 0.20 for males and females respectively.

Most flatfish stock assessments in the Northwest Atlantic were carried out with the sexes separate, however, in recent years there has been a trend to combine the sexes for purposes of stock assessments. A similar trend has occurred for most North Sea flatfish stock assessments by the ICES Working Group. This paper presents recalculations of M for American plaice with the sexes combined using data from NAFO Div. 3L and 3N.

METHODS

Two estimates of instantaneous natural mortality are presented here: (1) catch curve of an unexploited, or at least lightly exploited stock (Fig. 1) and (2) total mortality from a number of catch curves for series of year-class (1943-62) (numbers caught per 100 hours at age) from divisions 3L and 3N plotted on average effective fishing effort (Paloheimo 1961) (Fig. 2 and 3).

The latter method is similar to that presented for the sexes separate (Pitt 1973) but the series presented here, of course, includes a greater number of year-classes and in addition to the sexes being combined, data for both Div. 3L and 3N are also combined.

As indicated, the calculation of the effective fishing effort is by the method given by Paloheimo (1961) by which the effective effort for each year is calculated by $\frac{1}{2}(f'_i + f'_{i+1})$ and the mean value for the span of years used for the various cohorts is thus:

$$\bar{f}' = \frac{\sum\limits_{n=1}^{r-1} \frac{1}{2}(f'_i + f'_{i+1})}{r-1}$$

where f'_i = effective effort in year i and r = number of age group included (Pitt 1973).

The data used in the effort series came from log records supplied by the Canada(N) otter trawler fleet and is based on tonnage class 5 stern trawlers.

RESULTS AND DISCUSSION

Functional regression analysis (Ricker 1973) of total instantaneous mortality (Z) on mean effective fishing effort produced an intercept of 0.226 (Fig. 2) i.e.

$$Z = 0.226 + 0.0063 \; \bar{f}'$$

The effort series is reasonably complete with the catch for which effort data were available, ranging from 35 to 82% of the total catch (Table 1). Exploitation of Grand Bank plaice started as a Canadian fishery, later other countries, principally the USSR recorded fairly substantial catches, especially from the mid 1960's to the early 1970's. In recent years it has become almost exclusively a Canadian fishery.

The estimate of Z (0.221) from the St. Mary's Bay 1957-60 research vessel data (Fig. 1) represents total mortality from a stock that, at this period, had, at the most, only an extremely small fishery for plaice. With a similar value (0.226) from the other calculation, it appears that a value of about 0.22 is applicable at least to the exploited phase and a value of 0.20 used in two recent assessments is acceptable, (Pitt and Brodie 1980 and Brodie and Pitt 1981) given the probable errors associated both with the assessments and these estimates of M.

REFERENCES

Beverton, R. J. H., and S. J. Holt. 1957. On the dynamics of exploited fish populations. U.K. Min. Agric. Fish., Fish. Invest. (Ser. 2) 19: 533 p.

Brodie, W. B., and T. K. Pitt. 1981. A stock assessment update of American plaice in NAFO Divisions 3L, 3N, and 3O. NAFO SCR Doc. 81/VI/61, No. N345.

Huntsman, A. G. 1918. History of new food fishes. The Canadian plaice. Bull. Biol. Board Can. No. 1, 32 p.

Paloheimo, J. E. 1961. Studies on estimates of mortalities. Comparision of a method described by Beverton and Halt and a new linear formula J. Fish. Res. Board Canada 18: 645-662.

Pitt, T. K. 1973. Assessment of American plaice stocks on the Grand Bank ICNAF Divisions 3L and 3N. ICNAF Res. Bull. No. 10: 63-78.

Pitt, T. K., and W. B. Brodie. 1980. Assessment of American plaice on the Grand Bank. NAFO SCR Doc. 80/VI/110, No. N166.

Ricker, W. E., 1973. Linear regression in fishery science. J. Fish. Res. Board Canada 30: 409-434.

Table 1. Catch and effort data for American plaice for Newfoundland, Divisions
3L and 3N. <u>Directed catch</u> (Column 20 refers to catch directed for plaice by
Canada(N) otter trawls tonnage class 5.

| Year	Directed catch (tons)	CPUE (tons/hr)	Total catch (tons)	Total effort (hours)
1955	5,000	1.200	12,000	10,000
1956	6,005	1.205	12,284	10,194
1957	5,512	1.101	11,682	10,610
1958	8,195	1.114	17,295	15,525
1959	9,451	1.032	17,219	16,685
1960	12,502	1.066	23,291	21,848
1961	9,301	0.942	16,896	17,936
1962	11,777	0.748	16,597	22,188
1963	17,936	0.914	23,977	26,233
1964	19,359	0.947	35,733	37,732
1965	18,082	0.905	51,304	56,836
1966	29,536	0.876	53,270	60,810
1967	34,416	0.818	62,879	76,869
1968	31,344	0.629	59,164	94,060
1969	39,251	0.548	67,322	122,850
1970	24,020	0.516	60,379	117,013
1971	24,439	0.479	60,724	126,772
1972	23,137	0.481	50,717	105,440
1973	20,027	0.517	40,986	79,276
1974	20,957	0.434	37,727	86,929
1975	27,111	0.416	36,479	87,689
1976	35,710	0.430	43,735	101,709
1977	32,117	0.406	40,306	99,275
1978	33,290	0.460	43,588	94,756
1979	30,763	0.495	43,420	87,717
1980	34,982	0.597	46,835	78,451
1981	34,199	0.570	46,831	82,160
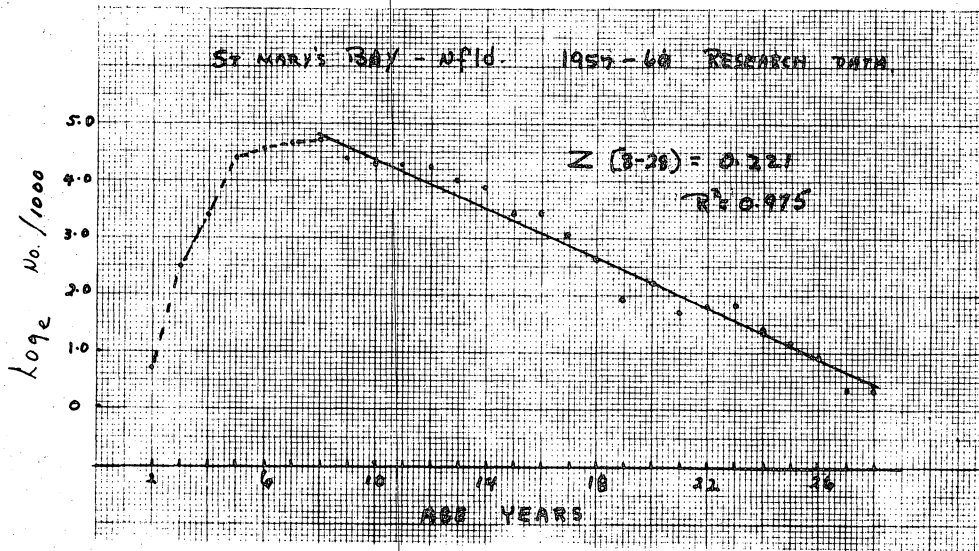
Fig. 1. Catch curve of an unexploited plaice stock – St. Mary's Bay, Newfoundland
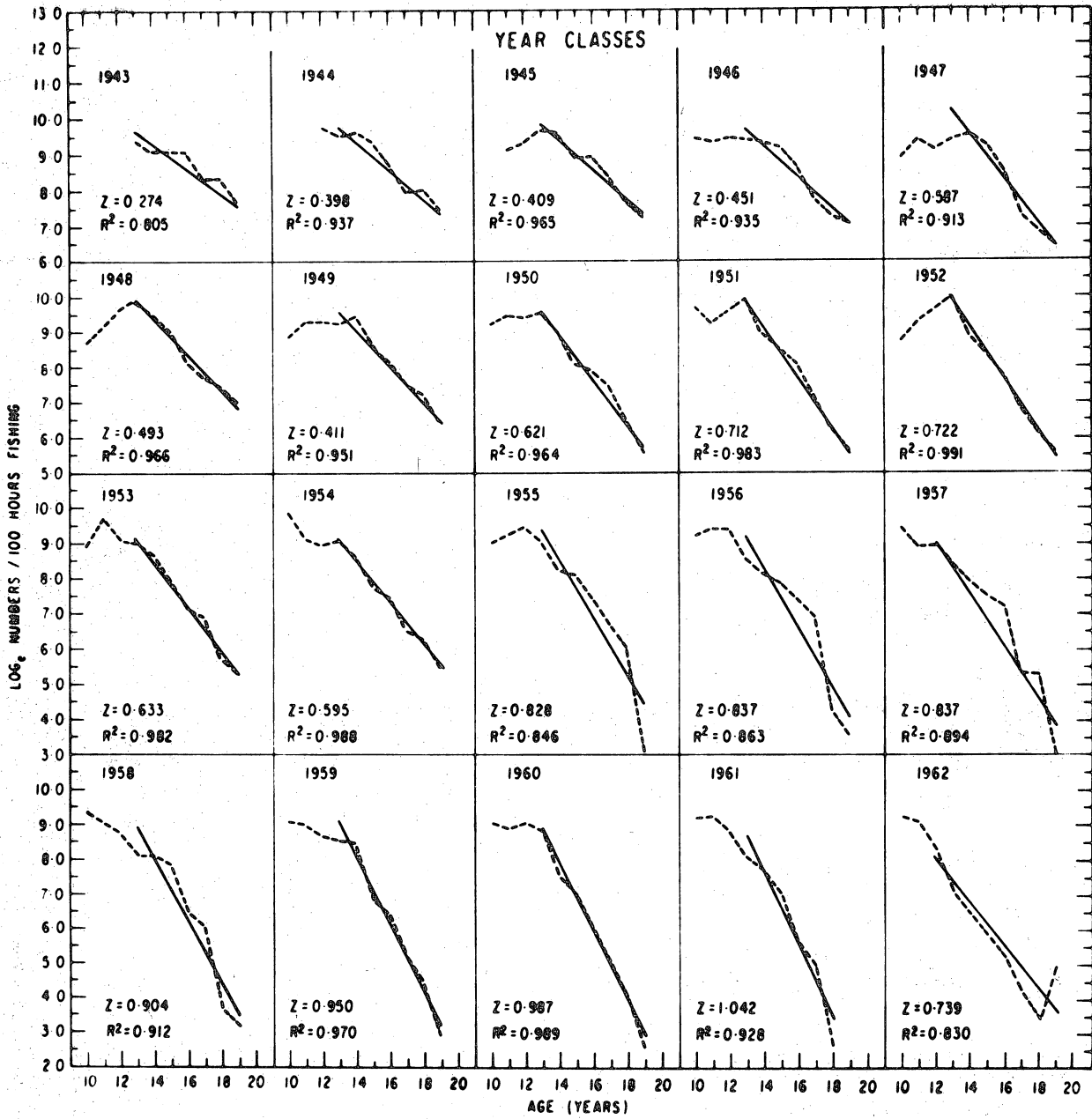(Sexes combined) with estimates of total mortality.

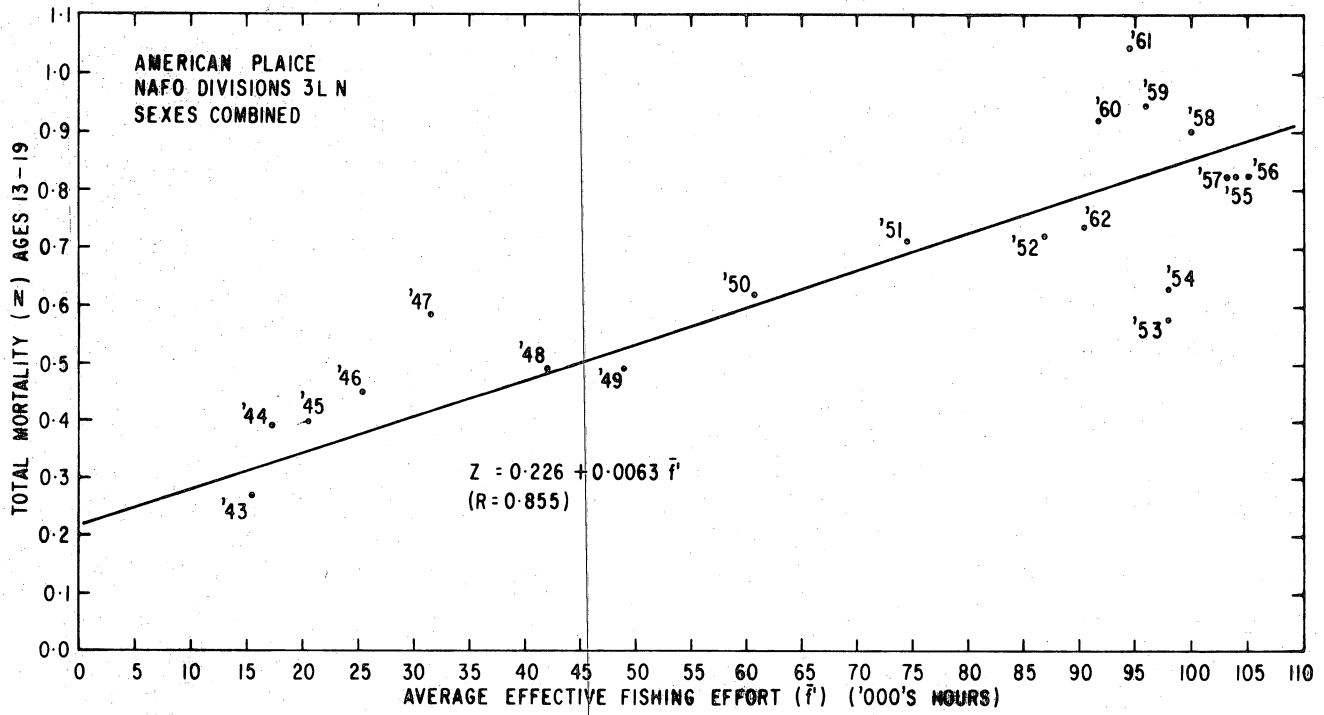Fig. 2. Catch curves for 1943-62 year-classes of American plaice, NAFO Div. 3L and 3N.

Fig. 3. Regression of total instantaneous mortality from the series of catch curves in Fig. 2 on mean effective fishing effort ($\bar{f}'$ [1])