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An Evaluation of the Status of Flemish Cap Cod Fishery

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ABSTRACT

The status of ICNAF Div. 3M cod fishery is evaluated, utilizing the Schaefer production model, maximum sustainable yield (MSY) estimates of metric tons for Div. 3M cod fishery were derived from catch and effort data.

Recent levels of cod catches from this stock have been below the maximum sustainable yield level. The Flemish Cap cod fishery was at a very low level during 1973-75.

For this stock the high catches of 1964, 1965 and 1972 were far above any sustainable level.

INTRODUCTION

The most recent assessments of Div. 3M cod were made by Wells (1973) using data from the 60's and Marf and Terré (1976) with data from 1963-1974.

The present paper presents an analysis of the fishery from 1957 to 1975 using a production model to obtain estimates of sustainable catch at different exploitation levels.

MATERIALS AND METHODS

Approximately since 1956, different countries, members of ICNAF have operated in Flemish Cap and adjacent waters, fishing the species of major commercial importance and among them the cod.

The catch and effort data used were obtained from the Statistical Bulletins for the period 1957-1975 for each country, month, tonnage class and species.

In some cases there were not data on hours fished or days fished in the Bulletins with the consequent loss of useful information. To overcome this problem, conversion factors between the two effort measurements were found, in this way increasing the information available. The conversion factor found for each vessel tonnage class was the slope of each straight line relating the amount of hours fished to days fished.

The method used was Schaefer (1954) with the modification of Gulland (1961).

Effort data were modified by an efficiency factor.

STANDARDIZATION OF FISHING EFFORT

The fishing effort expressed in days fished was calculated by the conversion factor computed (Table 1) in those cases where it was only reported in hours fished.

The effort was standardized, in agreement with catch and effort data taking into account the different tonnage class referred to a standard one, in our case the vessel tonnage class was over 1800 GRT. For the 151-500 tonnage class the conversion factor found by Marí and Terré (1977) was used.

The analysis of the data showed that vessels over 1800 tons, fished more frequently in years 1957, 1960-1962, 1965, 1970 and 1975, while in the intervening years fishing activity was practically constant but also considerable.

The method used was to plot the catch per unit effort for each vessel category versus the same index for the standard tonnage class.

A straight line passing through the origin was fitted to the points determined for each vessel category and its slope was used as a factor to convert the amount of fishing effort from each tonnage class to the standard (Fig. 1).

The days fished so found for each category were added to find the total number of standard days fished. Cod catches in each category were then added to find the catch per standard days fished.

There have been an appreciable increase in fishing efficiency. It has been possible through increases in size and power of vessels within tonnage categories, gear, navigational and acoustic equipment improvements, and improvements in vessel design, better fishing gear and greater knowledge on the behavior of commercial species.

To take these changes into account an efficiency factor described by Brennan *et al.* (1975) was applied to correct the fishing effort with changes in efficiency. The method is to express the adjusted fishing effort in the following way:

$$f(t, \text{adj}) = f(t, \text{rep}) \exp(kt)$$

where

k = annual percent change in efficiency

$f(t, \text{rep})$ = standardized days fished per year t , where t takes on the values $t = 0, 1, \dots, n$, corresponding to the years in the analyzed period.

Data were generated using a value of $k = -0.03$. The negative values of k allow the effort to be expressed in standardized units as of calendar year 1975.

The catch per unit of adjusted effort was then computed with the new values found.

TRENDS IN CATCH, EFFORT AND CATCH PER UNIT EFFORT

The cod fishery in Flemish Cap began in the year when a catch of 17,800 tons was reported.

The cod catch reached its maximum in 1965 when more than 60,000 tons were taken (Fig. 2). There was another high value of over 57,000 tons in 1972, falling since 1973-1975 to values between 22,000-25,000 tons. It should be noticed that during recent years the catch has been under the quota regulations.

The behavior of fishing effort expressed in days fished is similar to the catch with the exceptions of years 1962, 1963, 1965 and 1974 when the increments in fishing effort were not in agreement with those of catch.

The two maximums in fishing effort were in 1964 and 1972 with values of standard days fished for vessels over 1800 tons of 3085 and 3872 days fished respectively, in agreement with catch peaks observed in the historical series.

The catch per unit effort reached its highest values in years 1963 and 1969 with 37.3 and 35.1 tons per day fished, without coincidence with the two maximum catch values reported in the historical series.

In the years analyzed from the 70's decade, the catch per unit effort values ranged from 21.4 and 11.1 tons per day fished, and its lowest value was not preceded by a maximum in fishing effort.

YIELD - EFFORT RELATIONSHIP

The Schaefer (1954) model with Gulland (1961) modifications were used to obtain the estimates of maximum sustainable catch.

The linear regression technique was used to relate the catch per days fished and the 3 year, 4 year and 5 year running averages of standard days fished for the cod in Div. 3M (Fig. 3). The parameters of the above mentioned regressions were converted to those of the equilibrium yield versus effort curves which are depicted in Fig. 4. The results of this computation are shown in Table 2.

RESULTS AND DISCUSSION

The catch values for the last three years used in this paper have not been very close to the theoretical equilibrium values predicted by the model used, and with the exception of year 1972 no values have been over the curves in 70's decade.

Before the above mentioned decade, in years 1963, 1964, 1965, 1967 and 1968, cod catches were considerably over the values of equilibrium catch found, and ranged from a minimum of 38,216 tons in 1963 to a maximum of 60,313 tons in 1965 (Fig. 2).

The fishing effort expressed in standard days fished in 1967 and 1968 was very close to the level of F_{MSY} suggested by the computations, and while in 1965 and 1964 exceeded notably the suggested level, while in 1963 was below.

The catch per unit standard effort showed a considerable variation for the mentioned years, being its lowest value in 1972 with 14.9 tons per standard days fished and its maximum in 1963 with 37.3 tons per days fished.

The highest correlation coefficient ($r = 0.74$) for the models used was obtained for the case of 4 year running average using 3% of increment in efficiency.

Taking into account the behavior of the catch per standard days fished, standard effort and catch during the last years, seem to be that a TAC between 17,000-20,000 tons will not affect the rebuilding of the stock in Div. 3M.

ACKNOWLEDGMENT

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REFERENCES

- BRENNAN, J.A., B.E. BROWN, and J.E. PALMER. 1975. Effects of increased vessel efficiency on effort regulations. *Annu. Meet. int. Comm. Northw. Atlant. Fish.*, Res.Doc. No. 132, Serial No. 3684 (mimeographed).
- GULLAND, J.A. 1961. Fishing and the stocks of fish at Iceland. *Fish. Invest.*, Lond (2), 23(4): 52 p.
- MARI, A., and J.J. TERRE. 1976. General production assessment of the cod stock in ICNAF Div. 3M. *Annu. Meet. int. Comm. Northw. Atlant. Fish.*, Res.Doc. No. 33, Serial No. 3817 (mimeographed).
1977. Assessment of the Flemish Cap redfish fishery. *Annu. Meet. int. Comm. Northw. Atlant. Fish.*, Res.Doc. No. 7, Serial No. 5026 (mimeographed).
- SCHAEFER, M.B. 1954. Some aspects of the dynamics of populations important to the managements of the commercial marine fisheries. *Bull. Inter-Amer. trop. Tuna Comm.*, No. 1, p. 26-56.
- WELLS, R. 1973. Virtual population assessment of the cod stock in ICNAF Div. 3M. *Annu. Meet. int. Comm. Northw. Atlant. Fish.*, Res.Doc. No. 105, Serial No. 3068 (mimeographed).

Table 1. Conversion factors between days and hours fished for each vessel tonnage class and the correlation coefficients obtained.

Tonnage class	Conversion factors		Correlation coefficients
	days fished	hours fished	r
4	0.10068	9.9328	0.99
5	0.07832	12.7680	0.99
6	0.07678	13.0242	0.93
7	0.07918	12.6293	1.02 ?

Table 2. Cod MSY catch and effort from combination of averaging periods and % increase in efficiency producing best correlation (r) of CPUE versus effort given together with the methods. (SDF = standard days fished).

Effort units used	MSY		Averaging period (1) and % increase in efficiency (2)		CPUE tons per day fished	(r)
	Catch	Effort	(1)	(2)		
SDF	40350	1600	3	3	25.2	0.68
SDF	39000	1400	4	3	27.8	0.74
SDF	37000	1600	5	3	26.3	0.66

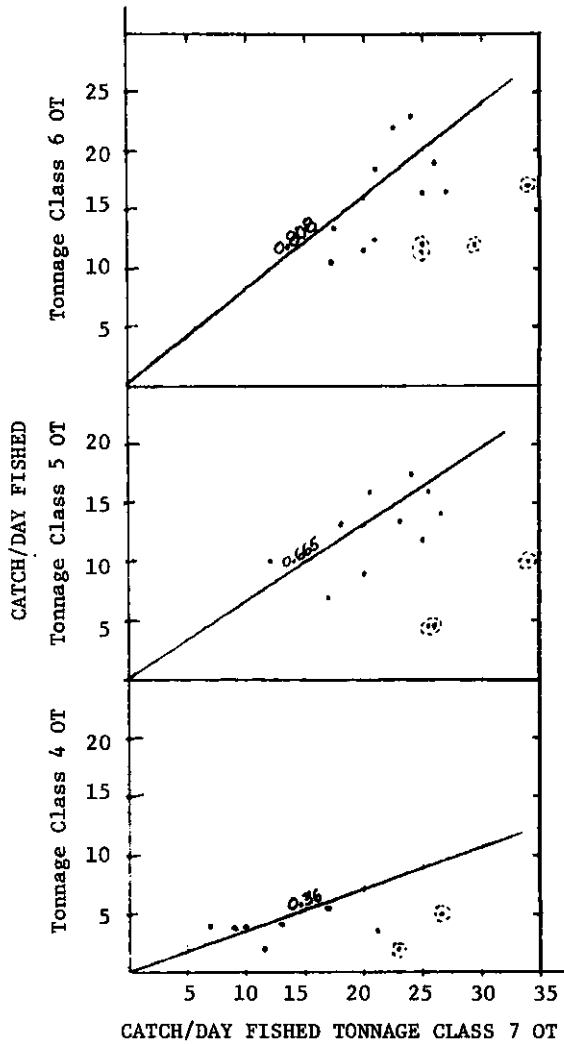


Fig. 1. Relation of catch per day fished by vessels in tonnage class 5 and 6 versus 7. Relation of redfish catches per day fished by tonnage class 4 and the corresponding catches per day fished of tonnage class 7 trawlers.

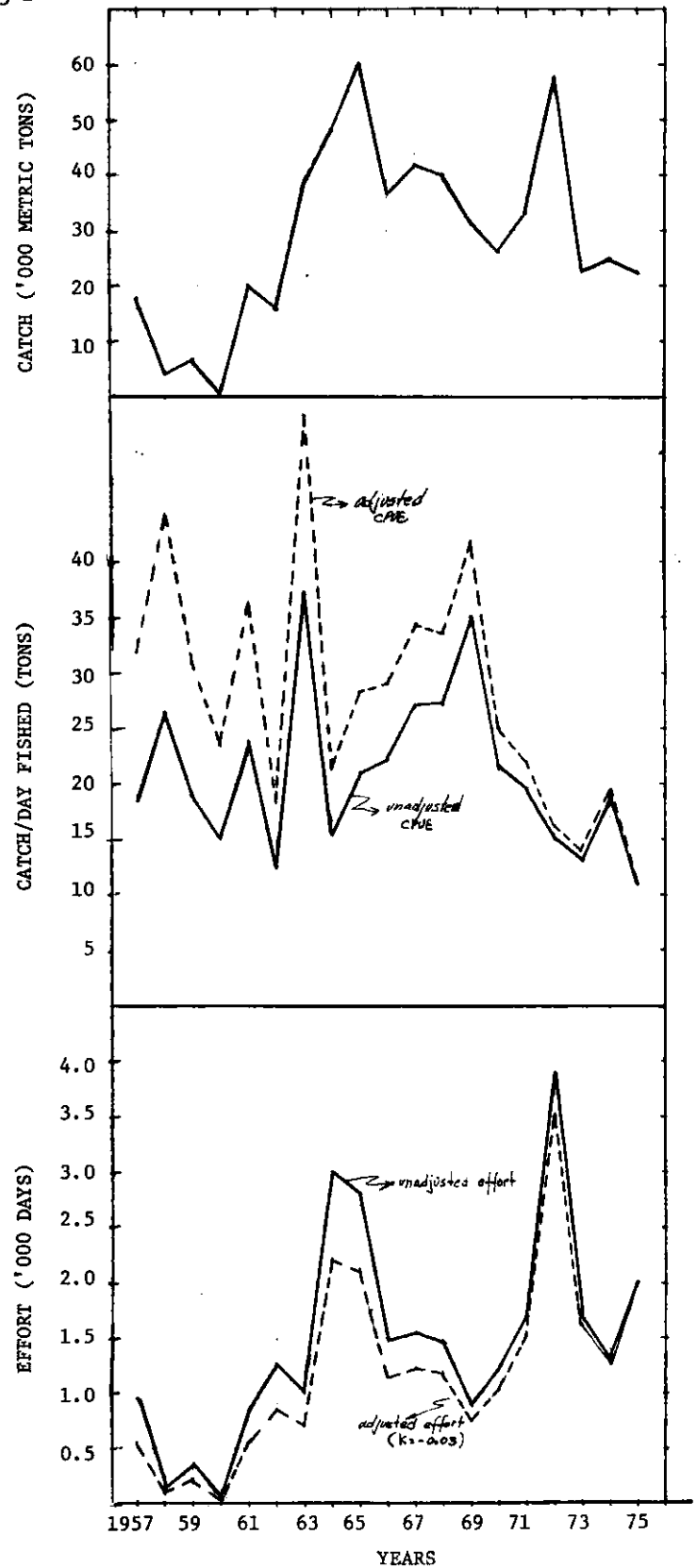


Fig. 2. Trends in nominal catches, effort, and catches per unit effort in standard trawler units - vessels of tonnage class 7 - for cod in Div. 3M during 1957-75. Broken lines represent the effort and catch-per-unit-effort adjusted for an efficiency factor $K = -0.03$.

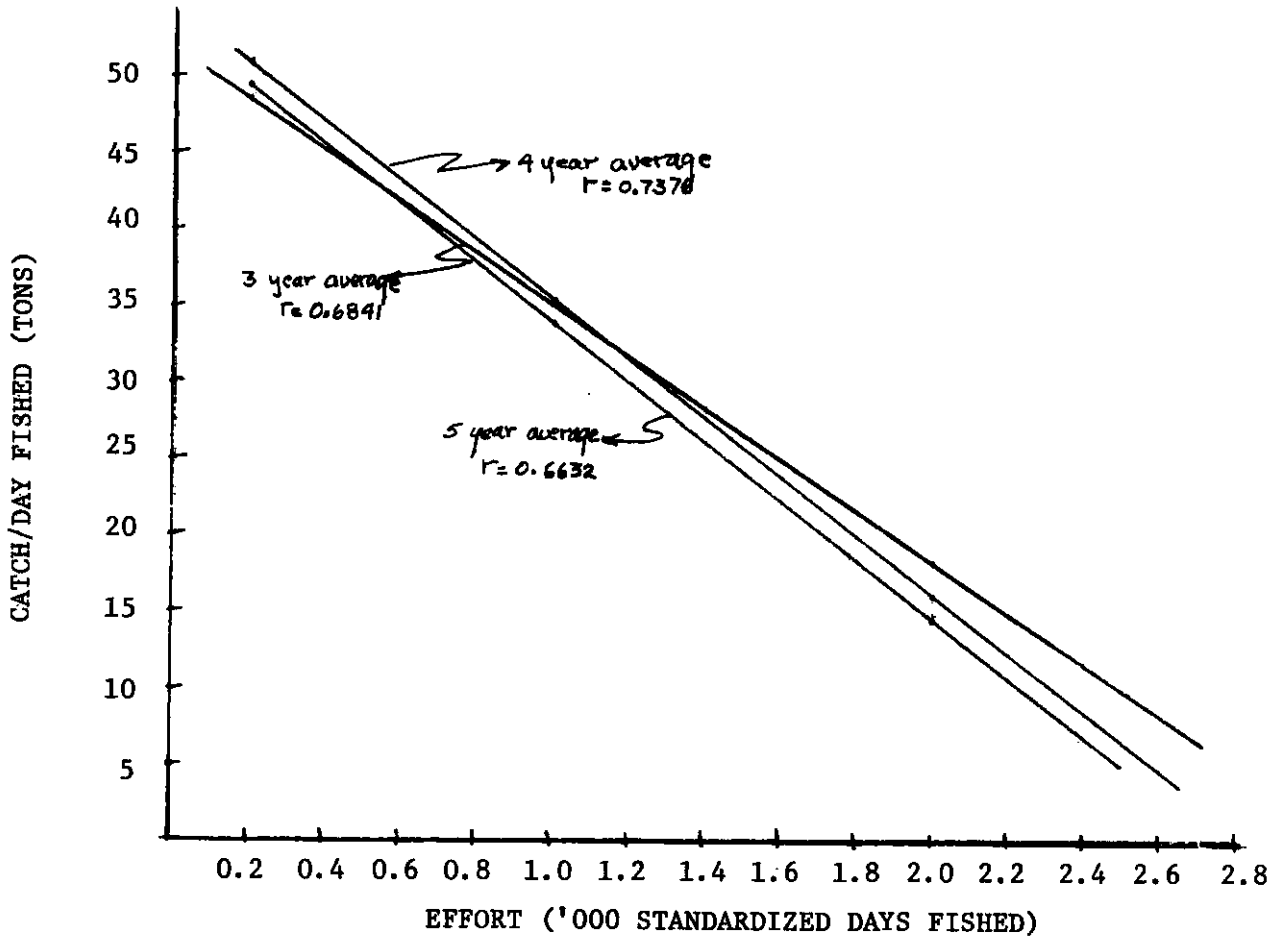


Fig. 3. Relation between standardized catch per day fished and 3-year, 4-year, and 5-year running averages of standard days fished - cod - Div. 3M.

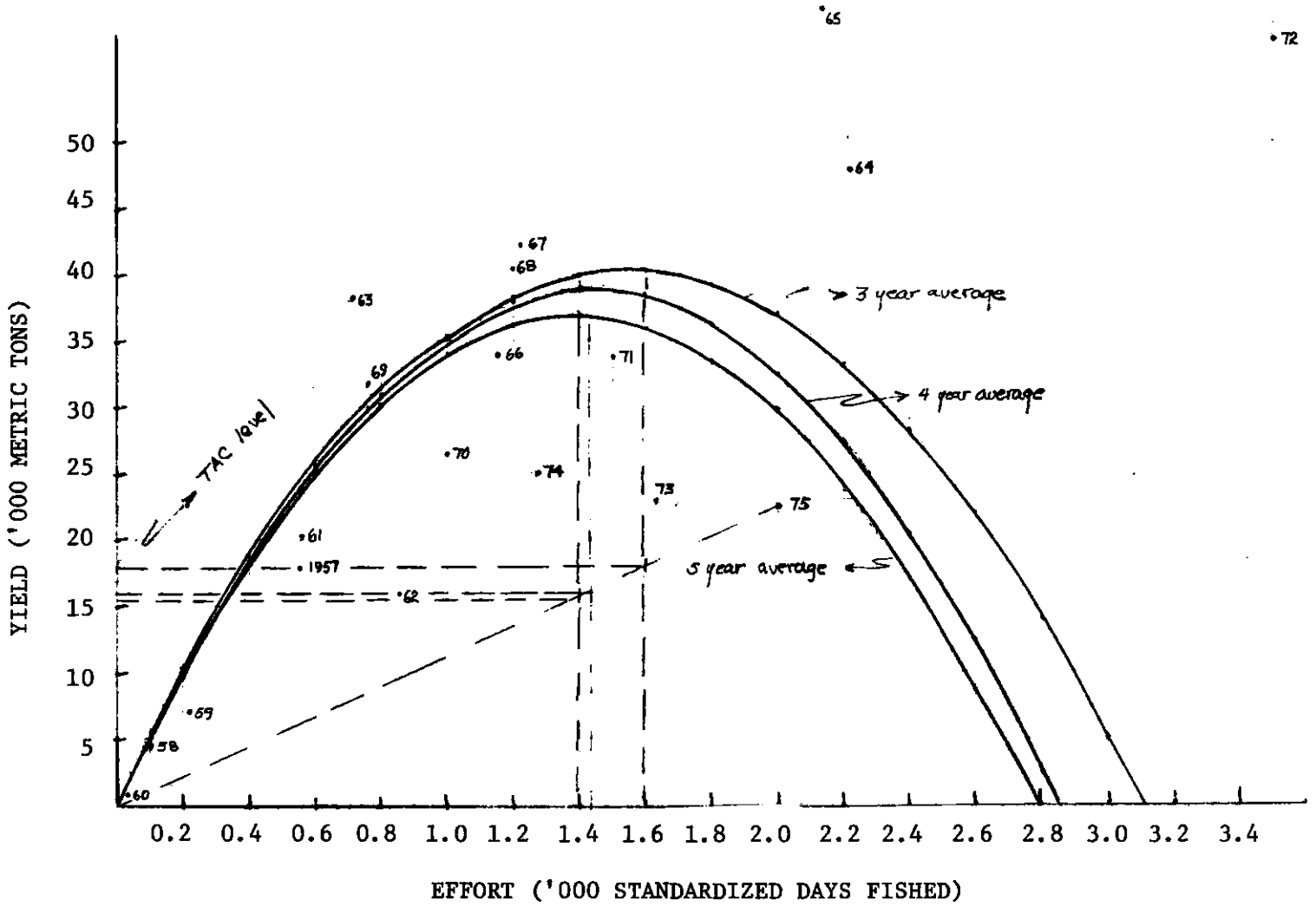


Fig. 4. Yield curve derived from the catch-per-unit-effort/effort relation for Div. 3M cod.

