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The Sustainable Yield of *Pandalus borealis* in the Denmark Strait Area

by

Unnur Skúladóttir

Marine Research Institute, P.O. Box 390
121 Reykjavik, Iceland

One of the models used for assessments is the socalled general production model first described by Schaefer (1954). This was modified by Gulland (1961) into using a straight line for the relationship between catch per unit of effort and average effort. This average effort should correspond to the average time of the animal spent in the fishery. Fox (1970) modified the method further and used an exponential curve for the relationship. That version has been used for many years in the Icelandic inshore shrimp fishery. Moreover, this method has been previously used for calculating MSY of the Denmark Strait shrimp stock and presented at NAFO Scientific Council meetings. In this the catch per effort is fitted against average effort of every 3 years by least aquares to the curve

$$U = a \exp(bf) \qquad (1)$$

Where U is the catch per unit effort (kg/hr) of one year.
f is the effort in trawling hours of e.g. 3 years.
exp is the exponential function.
The sustainable yield is calculated by multiplying both sides of the equation by the effort f. Thus as

$$U = Y/f \qquad (2)$$

Where Y is the catch of the year.
The resulting curve becomes

$$Y = af \exp(bf) \qquad (3)$$

the maximum sustainable yield (MSY) is found by differentiation of equation (3)

$$Y = a \exp(bf) + baf \exp(bf)$$
$$0 = a \exp(bf) + baf \exp(bf)$$

f at MSY is thus

$$f = -1/b \qquad (4)$$

The MSY can then be found by calculating U from equation (1) by using the f calculated by equation (4) and then multiplying these together

In short the lower curve in fig. 1 is the curve fitted to the data of U and f by equation (1). The upper curve is the resulting yield curve fitted by equation (3), plotted by multiplying the coordinates in the equation (1) together.

The data used for the estimation of the sustainable yield shown in the Figure came from all nations except for the first two years, when the Icelandic data for catch and effort were used. The CPUE for the years 1980 to 1983 in the Table is simply kg per trawling hours for each year. The calculations for this were as follows: The effort for each nation was calculated by dividing the nation's total catch in that month by the kg per hour for the same nation for that month. Then the effort for all nations was calculated in a particular month. The effort and catches were added separately and then the total catch of all nations for that month was divided by the sum total of effort for the same month to get the kg per hour. In the same manner, the whole year was compiled. The results are shown in the table. As far as we know, there were no data given on effort by the Norwegian before 1980 and the Icelandic fishery seems to be far less efficient in the year 1980 than that of other nations. The kg per trawling hour needed an adjustment for all nations that were to be included in the years 1980 and onwards. The kg per trawling hour by the Icelanders was compared to that of all nations in the year 1980. The kg per trawling hour was thus transferred into CPUE in kg using the constant 2.22. This was obtained by dividing the CPUE of all nations in the year 1980 by kg per hour of Icelanders alone in the same year. From the yearly effort data, moving averages of 2 or 3 years can be calculated respectively. In this paper, the 3 year average effort gives a slightly better fit than that for the 2 year average effort. The correlation coefficients were 0.888 against 0.880. The former gives a maximum of 4,880 tons but the latter about 5,400 tons. It is also useful to look at what 4-year moving averages of catch point to. In this, the kg per hour in 1 year can be looked upon as an indication of the stock that is left after 4 years fishing. The more taken, the less should be left. From the table, it appears that no drastic change in CPUE is seen at an average catch of 4,800 tons in the years from 1979 to 1982 (see the CPUE in 1983). From this, it appears that the

fishery can endure about 5,000 tons.

References

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Table 1. Catch and effort.

Year	Effort (hours)	Catch (tons)	CPUE (kg/hr)	Average effort (2 yr)	(3 yr)	Mean catch (4 yr)
1978	563	363.6	645.4	282	188	91
1979	2562	1285.0	501.5	1563	1042	412
1980	47457	8404.7	177.1	25010	16861	2513
1981	20450	4912.0	240.2	33954	23490	3741
1982	23620	4717.0	199.7	22035	30509	4830
1983	22211	4129.0	185.9	22916	22094	5541

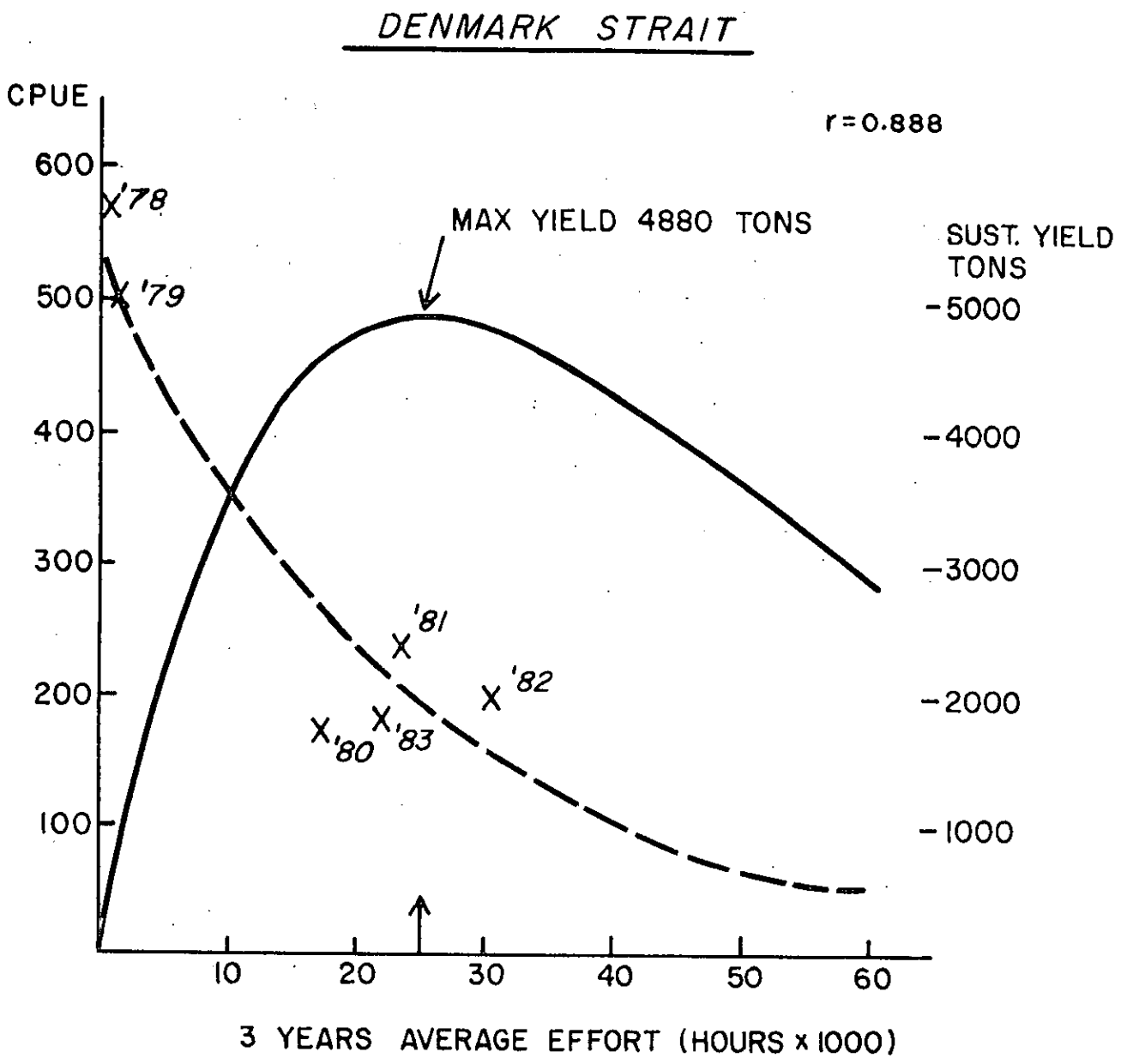

Fig. 1. The curve fitted to the data of CPUE and f by equation (1) is shown here as broken line. The correlation factor is denoted by r. The solid line curve is calculated by equation (3) (see the text) and presents the yield. In 1978 and 1979 only icelandic data were available, so the kg per trawling hour was multiplied by 2.22 in those years, after the comparison of kg per tr. hr. of Icelanders to that of all other nations in 1980 fishing in the area.