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The Sustainable Yield of *Pandalus borealis* in the
Denmark Strait Area Based on Data for the Years 1980-89

by

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The assessment of the shrimp in the Denmark Strait stock can be done by using a general stock production model. In this paper the Fox version (1970) of the general production model is used. The Fox version has been used earlier for the shrimp stock in the Denmark Strait or in 1985 (Skuladottir, 1985). The Fox version has its forerunner in the fitting of a simple line between average effort of several years against CPUE in the last year. The number of years should correspond to the average time the animals are subject to fishing. This method and the resulting sustainable yield (Gulland, 1961) have evolved from the Schaefer surplus yield model (1954).

Materials and Methods

The Fox model consists of two simple steps which can be carried out by a calculator i.e. the first step is fitting the exponential least squares regression between moving averages of effort e.g. every 3 years against the CPUE in the third year. The resulting curve is in the second step multiplied by the effort to get the yield curve.

The basic data are obtained from Table 1, except for the estimated effort of the years 1978 and 1979. The estimation was done by assuming the same CPUE as was calculated as overall for the year 1980 and dividing the nominal catches of 1978 and 1979 by this CPUE.

Results and Discussion

The annual effort and CPUE data are presented in Table 1. In Table 2 are presented the average of every 2 or 3 years as well as the CPUE in the second or third year.

In Figures 1 and 2 the regressions of effort vs CPUE are presented. The fit is slightly better when using 3 years averages, $r = 0.9055$, as compared to that of 2 years, $r = 0.8936$. Both are however highly significant.

The yield curve is somewhat lower in case of the 3 years average, giving rise to a maximum sustainable yield of 10 thousand tons as compared to about 11 thousand tons MSY in case of 2 year averages (Table 3, Figs. 1 and 2). The difference in sustainable yield of 2/3 effort at MSY is somewhat less giving the results of 9,300 tons and 10,150 tons for 3 years and 2 years average effort respectively.

At the present stage the effort has passed the point of 2/3 MSYf as a moving average and had already done so in 1988. MSYf is nearby. In fact the effort of 1989 alone was 109 thousand trawling hours. So even if the catch will be the same for 1990, the CPUE is likely to decline further.

In this paper no account has been taken of variation in year-class strength of which little is known at present nor the possibility of a change in discard rates. The effects of a possible increase in discard rate in e.g. the last 2 years might have had, are twofold: firstly, the CPUE would be underestimated, secondly the nominal catch would also be underestimated. The effort, however, would remain the same. The effect of this would be to increase the MSY by a small amount. How much, is impossible to estimate unless the discard rate is known.

Conclusion

The annual removals from the shrimp stock in Denmark Strait seem to have reached the limit beyond which it is not advisable to increase. It is also possible that TAC should be lowered from the previously advised 10 thousand tons.

References

- FOX, W. W., Jr. 1970. An exponential surplus-yield model for optimizing exploited fish populations. *Trans. Am. Fish. Soc.*, 99: 80-8.
- GULLAND, J. A. 1961. Fishing and the stocks of fish at Iceland, 1961. *Fishery Invest. Lond. Ser. 2*, 23(4): 52 pp.
- SCHAEFER, M. B. 1954. Some aspects of the dynamics of populations important to the management of the commercial marine fisheries. *Bull. Interam. Trop. Tuna Comm.*, 1(2): 25-56.
- SKÚLADÓTTIR, U. 1979. The experience of the catch per effort versus average effort, the methods of Gullard and Fox, in *Pandalus borealis* fisheries at Iceland. In Proceedings of the international Pandalid shrimp symposium, February 13-15, 1979, T. Frady (ed), *U.S. Sea Grant Rep.*, No. 81-3: 181-195.
1985. The sustainable yield of *Pandalus borealis* in the Denmark Strait area. *NAFO SCR Doc.*, No. 15, Serial No. N949, 4 p.
1990. A review of the shrimp fishery (*Pandalus borealis*) in the Denmark Strait, in the years 1978-1989. *NAFO SCR Doc.*, No. 82, Serial No. N1804, 15 p.

Table 1. CPUE, effort and catch by years.

Year	CPUE kg/hr	Effort tr.hrs	Catch tons
1980	243	34,633	8404.7
1981	245	19,588	4791.9
1982	212	23,072	4900.0
1983	176	23,670	4175.4
1984	211	31,974	6730.8
1985	158	51,391	8110.0
1986	200	54,753	10,964.0
1987	169	72,137	12 178.0
1988	128	97,739	12,540.0
1989	99	109,153	10,747.1

Table 2. The mean effort of several years against CPUE in the 2nd or 3rd year respectively.

2 Years	Mean effort tr hours	3 Years	Mean effort tr hours	2nd or 3rd year	CPUE kg/hr
1979-80	19964	1978-80	13800	1980	243
1980-81	27111	1979-81	19834	1981	245
1981-82	21330	1980-82	25764	1982	212
1982-83	23371	1981-83	22110	1983	176
1983-84	27822	1982-84	26239	1984	211
1984-85	41683	1983-85	35678	1985	158
1985-86	53110	1984-86	46064	1986	200
1986-87	63483	1985-87	59452	1987	169
1987-88	84938	1986-88	74901	1988	128
1988-89	103446	1987-89	93010	1989	99

Table 3. The results of the Fox model for 2 years average effort, or 3 years average effort against CPUE in the 2nd or 3rd year respectively.

	2 years	3 years
r	0.8936	0.9055
a	268.57	268.48
b	-0.000008858	-0.000009875
MSY f (tr hrs)	112892	101266
MSY CPUE (kg)	98.8	98.8
MSY (tons)	11154	10001
2/3 f (tr hrs)	75261	67511
CPUE at 2/3 MSY f(kg)	130.0	137.8
y at 2/3 MSY f(tons)	10150	9306

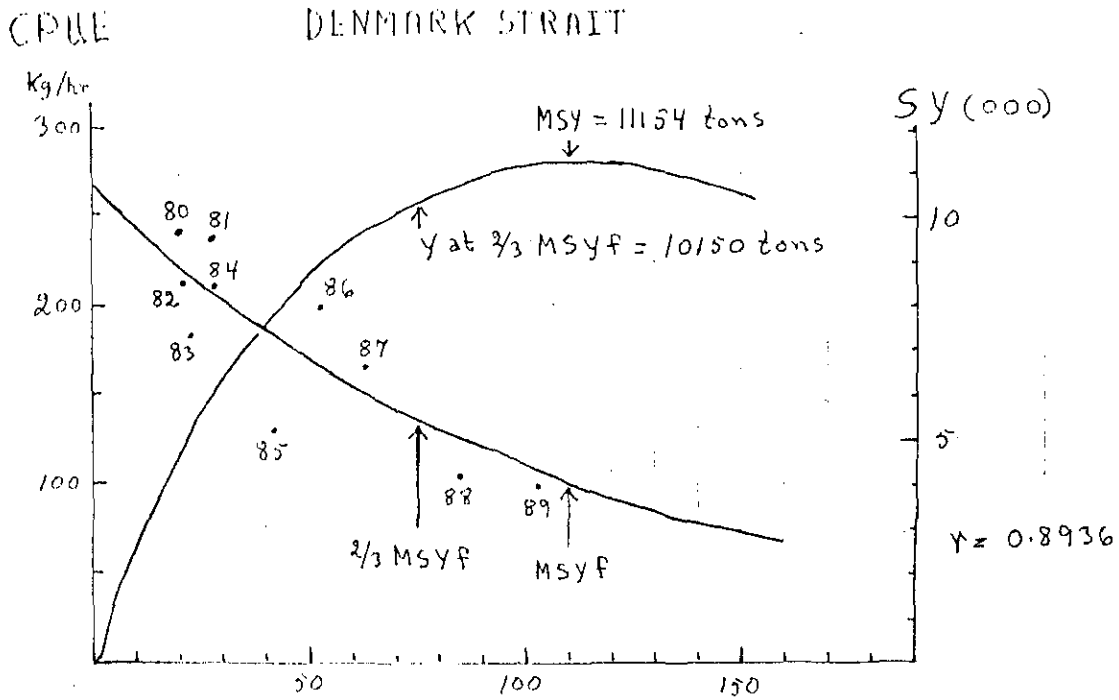


Fig. 1. The exponential regression of average effort every 2 years against the CPUE in the 2nd year, and the resulting sustainable yield curve.

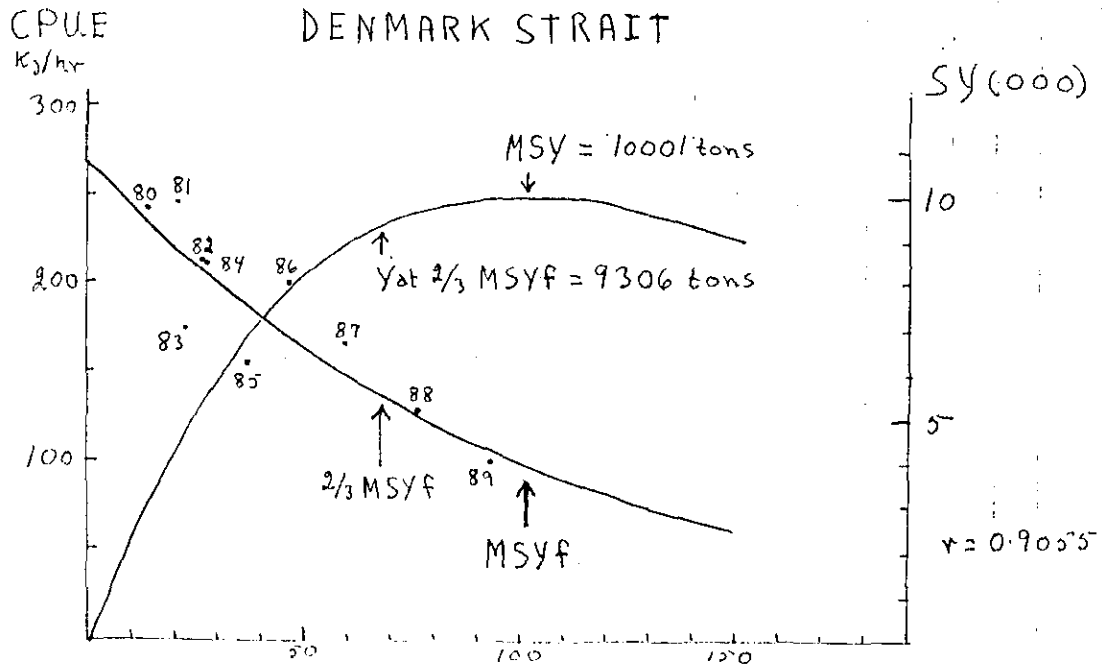


Fig. 2. The exponential regression of average effort every 3 years against the CPUE in the 3rd year, and the resulting sustainable yield curve.