



Serial No. 2625
(D.c.3)

ICNAF Res.Doc.71/126

ANNUAL MEETING - JUNE 1971

Estimation of Fishing Mortality in the Georges Bank Herring Stock

by

A. Schumacher and H. Dornheim
Bundesforschungsanstalt für Fischerei
Institut für Seefischerei*

Material and Methods

In default of own complete details concerning age and weight of the herring caught in Div. 5 Z from 1961-1966 the present paper is partly based on USSR and Polish data. In order to obtain the total catch in terms of numbers of fish caught by year and age group data from the German fishery since 1967 have been included. For the USSR and Polish catches from 1961-1966 and the USSR catches from 1967-1969 the age composition given by Anthony (1971) for the Polish catches 1967-1969 the data given by F. Chrzan and B. Draganik (1967, 1968, 1969), for the German catches (Fed.Rep.) 1967-1969 data from the German fishery reported by K. Schubert (1968, 1969, 1970) have been used.

In order to include-while determining the number of fish per year-class-sufficiently the different weights depending on the stages of maturity of the herring the following weights obtained from measurements of samples from the German fishery 1967-1970 were used:

Age (years)		2	3	4	5	6	7	8	9	9+
Weight (gramms)	I	87	153	188	230	256	273	299	314	334
Weight (gramms)	II	87	159	173	202	220	236	248	276	299

- I First part of the season until September 30th
II Second part of the season from October 1st to
December 31st

By help of these mean weights per age group the number of herring of each age group caught by the different national fleets was calculated on a monthly basis and then summed up for the total

*Hamburg 50, Palmaille 9
Germany

year. The results are given in Table 1.

On the basis of the total number of fish per age group caught in the years 1961-1969 (s. Table 1) the fishing mortality was estimated using the virtual population technique (a detailed description of this method - modified by R. Jones - has been published by Schumacher (1970)). This method requires a constant natural mortality. In order to cover the age groups 4-6 which are mainly contributing to the fishery an M of 0.2 has been used in the calculations in accordance with the values given by Anthony (1970).

The calculation starts with an initial F of 0.8 which is somewhat higher than the values derived from a preliminary analysis of catch per effort data given in the 1970 report of the assessments subcommittee (Redbook 1970, Part I, p.52). From this first step (A in Table 2) the following results - concerning the method - were obtained:

1. In all years the fishing mortality decreased gradually from the older age groups to the younger ones.
2. For 1968 - that year next to the year the constant initial value of F had been applied - the values of F seem to be overestimated because $F = 0.8$ as initial value for the younger age groups is too high.

Therefore the initial value of F had been reduced in a relatively rough way in order to cover the decrease in F to the younger age groups and to prevent underestimation of F in 1968 (B in Table 2). A third run has been undertaken to show the influence of an higher value of natural mortality ($M = 0.3$) on the estimation of F (C in Table 2).

Results and Discussion

The results of the different estimates of F are tabulated in Table 2 together with previous estimates presented by Anthony (1970) (D in Table 2). In general the differences between estimates on the basis of different M are relatively small and of minor importance for stock assessment purposes. The difference between the fishing mortality estimates presented in this paper and the values given by Anthony (1971) are also small. Considering the different basic data and the different initial values the agreement is surprisingly good. There are only larger differences in the older age groups 7-9. These differences are obviously an effect of the use of an extremely high initial F of 2.2 by Anthony. Considering the fact that the different year-classes are contributing to the total catch in different quantities the mean F for the total year has been calculated by weighting the F values of the different age

groups by the number of herring of this age groups in the total catch of this year (Schumacher 1967; Anthony 1970). The mean annual fishing mortality is given on the bottom of Table 2. These values are following naturally the general trend in the fishery: very high F in 1962 (152 000 t), low F in 1965 (40 000 t) and again an increase of F in 1968 (344 000 t). The present level of F might be estimated as the same as the 1968 value and for assessment purposes a range from 0.6 to 0.8 should be acceptable.

The position of this range in the yield per recruit curve shows that even if a low level of natural mortality has been assumed the position of the maximum sustainable yield will not be exceeded. On the other hand the flat top level of the yield curve has been reached and a further increase in fishing mortality (effort) is not desirable and would possibly lead to serious consequences concerning recruitment.

References

- 1) Anthony, V. (1971) United States Herring Assessment Material - 1971, presented at the ICNAF Mid - year Meeting of Assessment Subcommittee, Copenhagen, January 1971
- 2) Chrzan, F. and B. Draganik (1967) Some observations on herring caught in Georges Bank. ICNAF Res. Doc. 68/53 (mimeo)
- 3) " (1968) The results of studies on herring from the region of Nova Scotia, Georges Bank and the Statistical Subarea 6. ICNAF Res.Doc. 69/57 (mimeo)
- 4) " (1969) Length and age composition of herring in Polish catches. ICNAF Res. Doc. 70/62 (mimeo)
- 5) Schubert, K. (1968) German (FRG) Research Report, 1967. C. Subareas 5 and 6. Int.Comm. Northw. Atlant. Fish., Redbook 1968, Part II, p. 60-64
- 6) " (1969) German (FRG) Research Report, 1968. C. Subareas 4, 5 and 6. Int.Comm. Northw. Atlant. Fish., Redbook 1969, Part II, p. 42-51
- 7) " (1970) German (FRG) Research Report, 1969. Subareas 4 and 5 (herring only). Int.Comm. Northw. Atlantic. Fish., Redbook 1970, Part II, p. 60-76
- 8) Schumacher, A. (1970) Bestimmung der fischereilichen Sterblichkeit beim Kabeljaubestand vor Westgrönland. Ber. Dt. Wiss. Komm. Meeresforsch. 21, H. 1-4, S. 248-259.
- 9) " (1967) Bestandskundliche Untersuchungen am Nordseehering (Clupea harengus L.) Ber. Dt. Wiss. Komm. Meeresforsch. 19, H. 1, S. 13-63

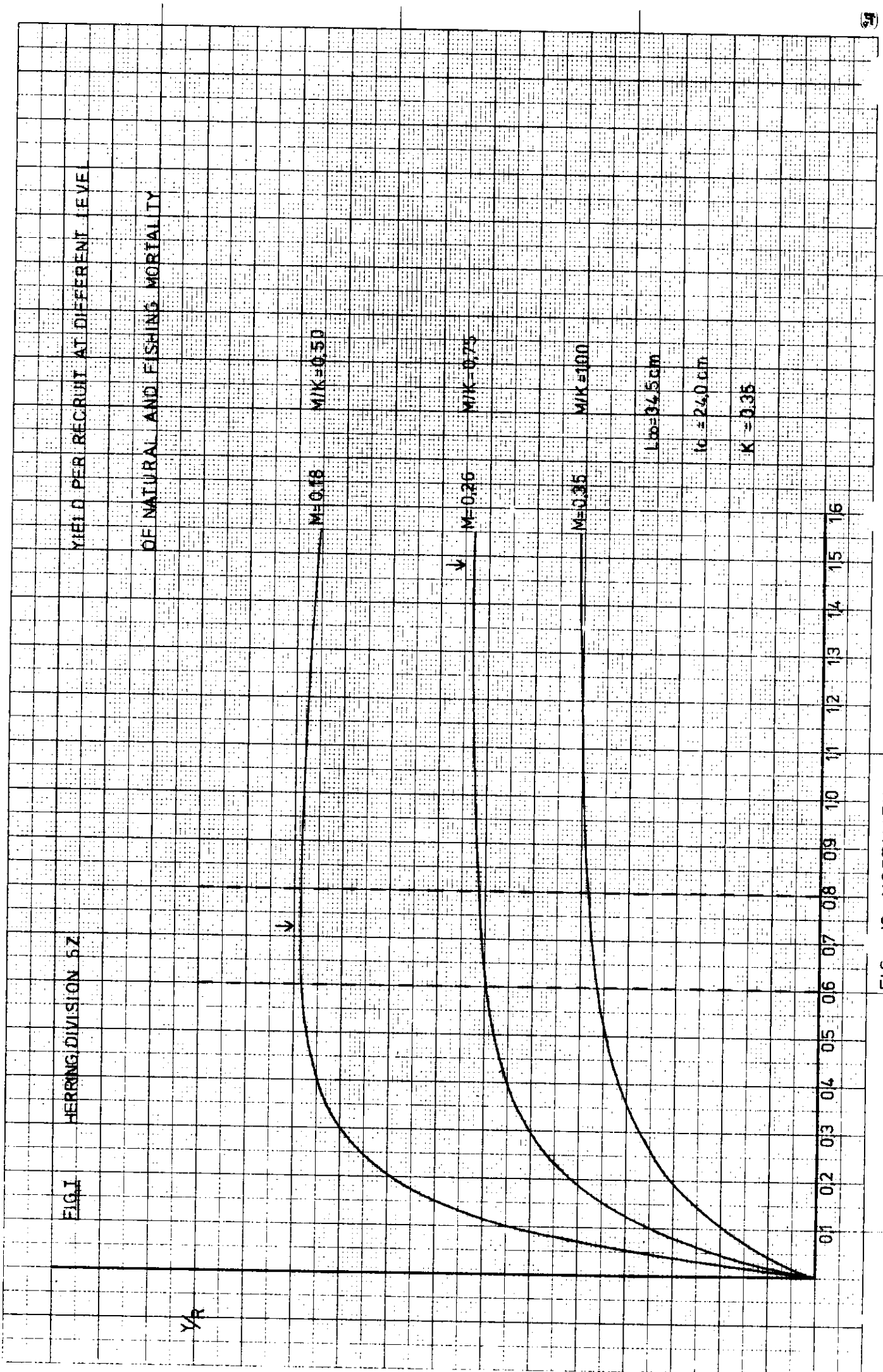
Table 1 Herring, Division 5 Z, Total catch per year and age group in numbers ($\times 10^{-6}$) 1961-1969.

Year Age	1961	1962	1963	1964	1965	1966	1967	1968	1969
2	-	yearcl. 1960	-	16.5	0.4	0.3	1.7	2.4	-
3	13.8	-	190.3	150.8	10.3	12.3	6.7	48.0	30.9
4	45.2	43.4	66.1	230.5	34.9	33.2	59.3	66.4	143.0
5	171.9	99.5	145.6	128.4	103.0	170.7	105.7	309.8	188.0
6	64.1	299.1	67.6	97.5	25.5	268.6	245.5	215.2	188.7
7	13.8	140.4	14.7	34.9	12.7	62.4	371.2	399.1	127.9
8	7.0	18.3	5.9	-	9.3	13.0	48.4	310.3	129.3
9	-	9.7	-	-	2.9	1.9	10.9	20.1	74.5
9 ⁺	-	-	-	-	1.3	0.6	10.1	6.0	16.0
Σ	315.8	610.4	490.3	658.6	200.5	563.0	859.5	1,377.3	898.3
catch(t)	67,655	152,141	97,307	131,026	40,639	136,853	214,030	344,276	207,632

Tab. 2 Herring, Division 5 Z
Fishing mortality (virtual Population Technique)

Age	M	1961	1962	1963	1964	1965	1966	1967	1968	initial F
2-3	A 0.2				0.02	<0.01	<0.01	<0.01		
	B 0.2				0.02	<0.01	<0.01	<0.01		
	C 0.3	—	—	—	0.01	<0.01	<0.01	<0.01	—	—
	D 0.3				0.01					
3-4	A 0.2	0.02		0.06	0.04	0.01	0.01	0.01	0.14	0.80
	B 0.2	0.02		0.06	0.04	0.01	0.01	0.01	0.03	0.10
	C 0.3	0.02	—	0.05	0.06	0.01	0.01	0.01	0.03	0.10
	D 0.3	0.02		0.08	0.05		0.01			
4-5	A 0.2	0.13	0.10	0.11	0.10	0.01	0.04	0.07	0.15	0.80
	B 0.2	0.13	0.10	0.11	0.10	0.01	0.02	0.05	0.08	0.35
	C 0.3	0.11	0.08	0.08	0.08	0.02	0.03	0.04	0.08	0.35
	D 0.3	0.10	0.08	0.15	0.13	0.01	0.03	0.03		
5-6	A 0.2	0.33	0.48	0.52	0.32	0.06	0.12	0.16	0.56	0.80
	B 0.2	0.33	0.48	0.52	0.32	0.06	0.12	0.06	0.40	0.45
	C 0.3	0.33	0.41	0.43	0.25	0.05	0.10	0.13	0.37	0.45
	D 0.3		0.40	0.65	0.48	0.07	0.09	0.10	0.36	2.20
6-7	A 0.2	0.28	1.70	0.71	0.80	0.10	0.21	0.26	0.57	0.80
	B 0.2	0.28	1.70	0.71	0.80	0.10	0.21	0.25	0.49	0.60
	C 0.3	0.25	1.70	0.63	0.66	0.08	0.18	0.22	0.45	0.60
	D 0.3			0.80	1.31	0.15	0.26	0.24	0.47	2.20
7-8	A 0.2		1.80	1.20	1.03	0.22	0.37	0.50	0.87	0.80
	B 0.2		1.80	1.20	1.03	0.22	0.37	0.50	0.82	0.70
	C 0.3	—	1.40	1.13	0.93	0.18	0.31	0.45	0.76	0.70
	D 0.3				1.42	0.53	0.78	0.71	0.92	2.20
8-9	A 0.2			0.67	0.02	0.89	0.37	0.54	1.06	0.80
	B 0.2			0.67	0.02	0.89	0.37	0.54	1.06	0.80
	C 0.3	—	—	0.83	0.02	0.80	0.32	0.48	0.99	0.80
	D 0.3						1.79	2.51	1.90	2.20
9-10	A 0.2				0.02	1.15	0.45	0.60	0.45	0.80
	B 0.2				0.02	1.15	0.45	0.60	0.45	0.80
	C 0.3	—	—	—	0.03	1.08	0.42	0.56	0.42	0.80
	D 0.3									2.20
mean f	A	0.27	1.40	0.33	0.28	0.12	0.19	0.36	0.73	
weighted by	B	0.27	1.40	0.33	0.28	0.12	0.19	0.34	0.66	
year class	C	0.26	1.29	0.29	0.24	0.10	0.17	0.31	0.61	
abundance	D			0.37	0.42	0.07	0.31	0.53	0.74	

A = M = 0.2 initial F = 0.8
 B = M = 0.2 initial F adjusted to the mean F per age group derived from A
 C = M = 0.3 initial F adjusted
 D = M = 0.3 Values presented by V. Anthony to the mid-term meeting of the assessments subcommittee (Initial F = 2.2)



FIS. 16 MORTALITY