International Commission for   the Northwest Atlantic Fisheries

ANNUAL MEETING – JUNE 1977

As assessment of the Div. 4VWX silver hake fishery incorporating
1976 provisional nominal catch statistics reported to 18 April 1977

by

W.G. Doubleday and J.J. Hunt
Department of Fisheries and Environment
Biological Station
St. Andrews, N. B.

The catch at age column for 1978 in Table 5 should read:

Age	Catch (metric tons)
1	1,650
2	48,136
3	20,655
4	4,317
5	1,125
6	570
Calculated Catch	76,453
Corrected Catch	80,581

The corrected catch for 1979 is 84,645 metric tons.

In Table 6, the stock size shown for 1977 should be the same as in Table 5 and the stock size shown for 1978 should be that shown for 1977.

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Introduction

Doubleday and Hunt presented a comprehensive assessment of this stock at the Special ICNAF Meeting in Tenerife (ICNAF Res.Doc. 76/XII/160). Since that date, new data on provisional national catch statistics, sampling data, and results on mesh selection have become available. This document revises the authors' earlier assessment to incorporate these new data.

Commercial Catches

Table 1 shows reported commercial catches for silver hake (*Merluccius bilinearis*) as reported to ICNAF by 18 April 1977. A USSR length frequency sample from December 1976 has been subjected to modal analysis indicating 28.3% age 1 with mean length 24.2 cm, 66.5% age 2 with mean length 31.5 cm, and 5.2% older fish. This composition was applied to USSR nominal catches for October to December and then combined with previous estimates of catch at age for the USSR fleet. The USSR catch composition was then pro-rated to the total reported catch for all nations. The results are shown in Table 2.

Virtual Population Analysis

Virtual population analysis was carried out on the data of Table 2 using $m = 0.4$. The starting F's were increased from those of ICNAF Res.Doc. 76/XII/160 in proportion to the increased total catch. The results are shown in Tables 3 and 4.

Mesh Selection

To consider the possible effects of the 55-mm mesh restriction to be imposed in 1977, the data of Jensen (1966) were re-examined to obtain estimates of mean selection sizes (L_{50}). A curve was fitted to these data to give a selection factor of 5.12 which yields an L_{50} of 28.15 cm for 55-mm mesh size and is shown in Fig. 1. The effects of various mesh sizes using this selection factor are shown in Fig. 2.

To illustrate the possible effect of 40-mm and 55-mm meshes relative to 33-mm mesh, a length frequency of silver hake from a research cruise in July 1976 was adjusted by the selection curve of these mesh sizes and results are shown in Fig. 3. These indicate a sharp reduction in the number of fish less than 30 cm retained in the net.

Catch Projections

Table 5 shows a catch projection based on recruitments of 1×10^9 fish at age 1 in 1976 and beyond and a continuation of recent patterns of selection at age. It was assumed that the 1977 quota would be taken and that $F_{0.1} = 0.5$ would apply in 1978 and 1979. The estimated catch for 1978 is 71,000 tons and for 1979 is 80,000 tons.

Table 6 shows a catch projection incorporating possible effects of a 55-mm minimum mesh size on selection at age. It was assumed that age-groups zero and one would be practically excluded from the fishery and that the age of 50% recruitment would be 2, while older fish would be fully recruited. It was also assumed that $F_{0.1}$ would increase from 0.5 to 0.65 as at the Tenerife Meeting. Recruitment of 1×10^9 fish at age one was assumed for 1976 on. The 1977 TAC, if taken, might result in a fishing

mortality averaged over ages 2 to 5 of 0.98 and fishing at F = 0.65 in 1978 and 1979 might correspond to catches of 61,000 tons and 82,000 tons, respectively.

Conclusions

In the light of the newly available data, the authors' previous assessment has been revised to predict a 1978 catch of 71,000 tons associated with fishing at $F_{0.1}$ with recent patterns of selection at age. The effects of a minimum mesh size of 55 mm might be to reduce this catch to 61,000 tons in 1978 with an increase to 82,000 tons in 1979.

Recovery of the fishery to the high level of 1973 is dependent on exceptional new recruitment for which there is currently no evidence.

References

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JENSEN, A.C., and R.C. HENNEMUTH. 1966. Size selection and retainment of silver and red hake on nylon codends of trawl nets. *Res. Bull. int. Comm. Northw. Atlant. Fish.*, No. 3, p. 86-101.

Table 1. Silver hake landings from ICNAF Div. 4VWX by Division and Country (metric tons round).

Year	4Vn	4Vs	4W	4X	Total	Canada	Japan	USSR	USA	Others
1960	-	-	-	187	187	-	-	-	187	-
1961	-	-	-	2	2	-	-	-	2	-
1962	-	-	8,825	29	8,854	-	-	8,825	29	-
1963	168	-	116,388	6,472	123,028	-	-	123,023	5	-
1964	32	-	62,905	18,210	81,147	-	-	81,147	-	-
1965	180	2	49,461	379	50,022	5	-	49,987	27	3[2]
1966	40	0	3,860	6,423	10,323	-	-	10,323	-	-
1967	-	-	1,834	643	2,483	-	6[1]	2,476	1	-
1968	2	237	3,150	58	3,523	5	76[1]	3,441	1	-
1969	-	1,230	43,563	1,558	46,564	-	213[1]	46,323	-	28[3]
1970	-	5,116	158,938	4,991	169,045	-	129	168,916	-	-
1971	11	3,000	119,452	6,190	128,653	-	8	128,633	1	11[4]
1972	-	75	108,769	5,204	114,048	-	63	113,774	-	211[5]
1973	-	3,431	265,105	30,085	298,621	-	88	298,533	-	-
1974	-	712	86,927	8,106	95,745	11[1]	67	95,371	-	296[6]
1975[8]	-	1,468	95,385	15,713	112,566	100	54	108,398	7	1,698[7]
1976[8]	...	...	...	...	97,086	28	78	81,216	1	15,763

[1] Not recorded by Division
[2] France (SP)
[3] GDR
[4] Spain
[5] FRG 10 mt, Cuba 201 mt
[6] FRG
[7] Bulgaria
[8] Preliminary Statistics
[9] Cuba 9,464, FRG 83

Table 2.   Age composition of commercial catches of silver hake in Div. 4W, 1965-74 and 4WX 1975-76.

Year	Numbers at age $(\times 10^{-3})$					
	1	2	3	4	5	6
1966	10220	9795	406	34	9	13
1967	-	7576	804	67	18	26
1968	84	18218	1910	159	43	61
1969	21456	242169	19474	2154	740	90
1970	208319	702322	68653	6234	2026	1013
1971	65461	553957	202177	14761	3802	3131
1972	149692	414279	102440	13167	5074	-
1973	102212	1449980	118398	12715	4512	1094
1974	80432	405044	49437	5087	2115	457
1975	143125	376358	42256	4347	1807	391
1976	78480	480015	39762	4195	1504	138

Table 3.   Estimated population numbers at age for 4VXW Silver hake 1966-76.

Population numbers at age (x10^{-6})

Year	1	2	3	4	5	6	Biomass 1+ (mt)
1966	85.18	28.22	1.42	0.57	0.21	0.07	9,647
1967	145.26	48.83	11.09	0.63	0.36	0.13	18,776
1968	693.60	97.80	26.61	6.78	0.37	0.22	61,433
1969	1847.32	470.35	50.87	16.29	4.42	0.21	192,667
1970	1539.04	1221.02	124.20	18.57	9.18	2.36	322,042
1971	1127.82	863.43	267.50	29.27	7.46	4.52	288,324
1972	2775.49	703.48	147.44	24.61	7.97	2.00	310,567
1973	977.22	1739.40	147.09	19.64	6.12	1.39	379,628
1974	905.93	571.76	76.68	8.92	3.27	0.64	164,271
1975	1328.21	542.13	71.00	12.97	1.99	0.55	180,394
1976	725.48	774.01	72.78	14.55	5.22	0.48	189,665

Table 4.   Fishing Mortality Estimates for Scotian Shelf Silver Hake 1966-76.

Year	Age 1	2	3	4	5	6
1966	0.156	0.534	0.419	0.075	0.055	0.100
1967		0.207	0.092	0.138	0.063	0.100
1968		0.254	0.091	0.029	0.153	0.150
1969	0.014	0.932	0.608	0.174	0.225	0.300
1970	0.178	1.118	1.045	0.512	0.308	0.300
1971	0.072	1.367	1.986	0.902	0.916	0.900
1972	0.067	1.165	1.616	0.991	1.349	-
1973	0.136	2.722	2.403	1.392	1.859	1.500
1974	0.113	1.686	1.377	1.100	1.388	1.000
1975	0.140	1.608	1.185	0.511	1.025	1.000
1976	0.140	1.281	1.025	0.423	0.423	0.423

Table 5. Population numbers and catch projections for Scotian Shelf silver hake, 1976-78.

Age	1976 Stock size (10^{-6})	1976 F	1976 Catch (10^{-3} tons)	1977 Stock size (10^{-6})	1977 F	1977 Catch (10^{-3} tons)	1978 Stock size (10^{-6})	1978 F	1978 Catch (10^{-3} tons)	Mean weight kg
1	1,000	.06	2,559	1,000	0.04	1,625	1,000	0.04	1,650	0.051
2	774	1.27	75,948	630	0.80	46,528	644	0.80	47,023	0.159
3	73	1.02	10,697	146	0.64	15,661	190	0.64	15,842	0.270
4	15	0.42	1,793	18	0.27	1,455	52	0.27	1,475	0.426
5	5	0.42	952	6	0.27	789	9	0.27	800	0.635
6	0.5	0.42	130	2	0.27	386	3	0.27	392	0.905
$\bar{F}$ 2-5		0.78			0.50			0.50		
Calculated catch			92,080			66,414			67,182	
Corrected catch			97,086			70,000			70,809	
Corrected catch in 1979						80,230 metric tons				

Table 6. Population number and catch projections with possible effects of 55-mm mesh selection.

Age	1976 Stock size (10^{-6})	1976 F	1976 Catch (10^{-3} tons)	1977 Stock size (10^{-6})	1977 F	1977 Catch (10^{-3} tons)	1978 Stock size (10^{-6})	1978 F	1978 Catch (10^{-3} tons)	Mean weight kg
1	1,000	0.06	2,559	1,000	0.001	47	1,000	0.001	27	0.051
2	774	1.27	75,948	670	0.56	35,964	670	0.33	24,608	0.159
3	73	1.02	10,697	241	1.12	22,631	324	0.65	26,218	0.270
4	15	0.42	1,793	32	1.12	4,280	84	0.65	5,430	0.426
5	5	0.42	952	4	1.12	2,336	11	0.65	971	0.635
6	0.5	0.42	130	1	1.12	1,146	1	0.65	510	0.905
$\bar{F}$ 2-5		0.78			0.98			0.57		
Calculated catch			92,080			66,414			57,764	
Corrected catch			97,086			70,000			60,883	
Corrected catch in 1979						81,736 metric tons				

$$SF = 26.11/5.1 = \underline{5.12}$$

$$L_{50} @ 55mm = \underline{28.15} \, cm.$$

51 MM/31 MM

RATIO OF NUMBER CAUGHT

26.11

$$LN \ Y = -4.50 + .1450 \ X$$

LENGTH IN CM
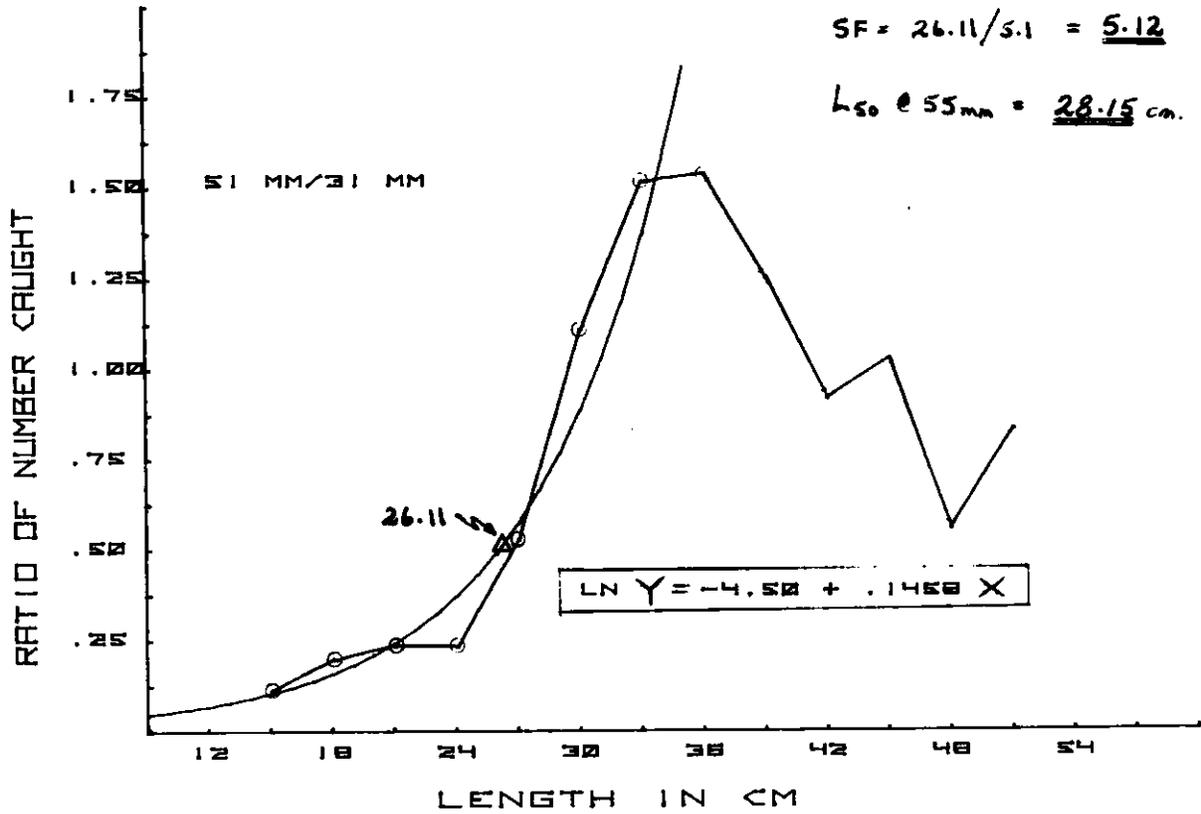
Fig. 1. Effect of mesh restrictions on retention at Silver Lake. Data from Jensen (1966)
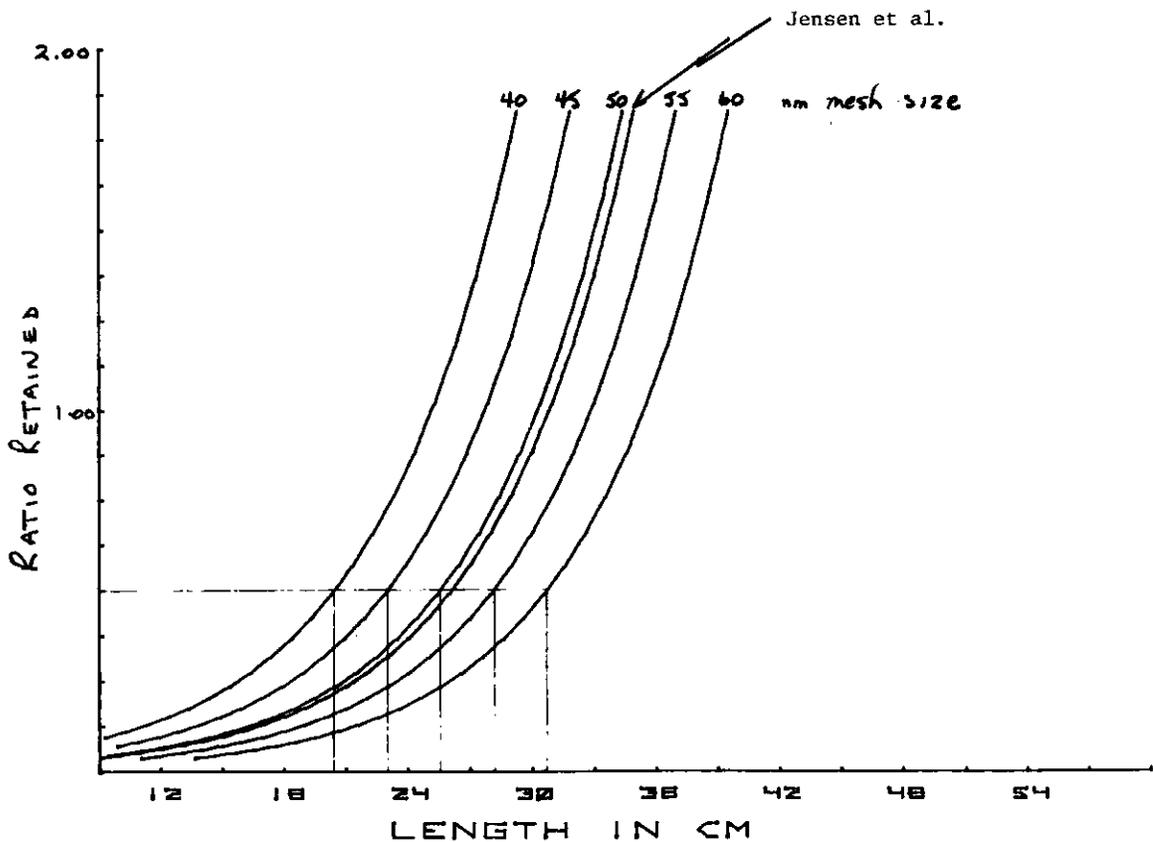
Jensen et al.

40 45 50 55 60   nm mesh size

RATIO RETAINED

LENGTH IN CM

Fig. 2. Selection Curves for Various Mesh Sizes Relative to 33 mm.
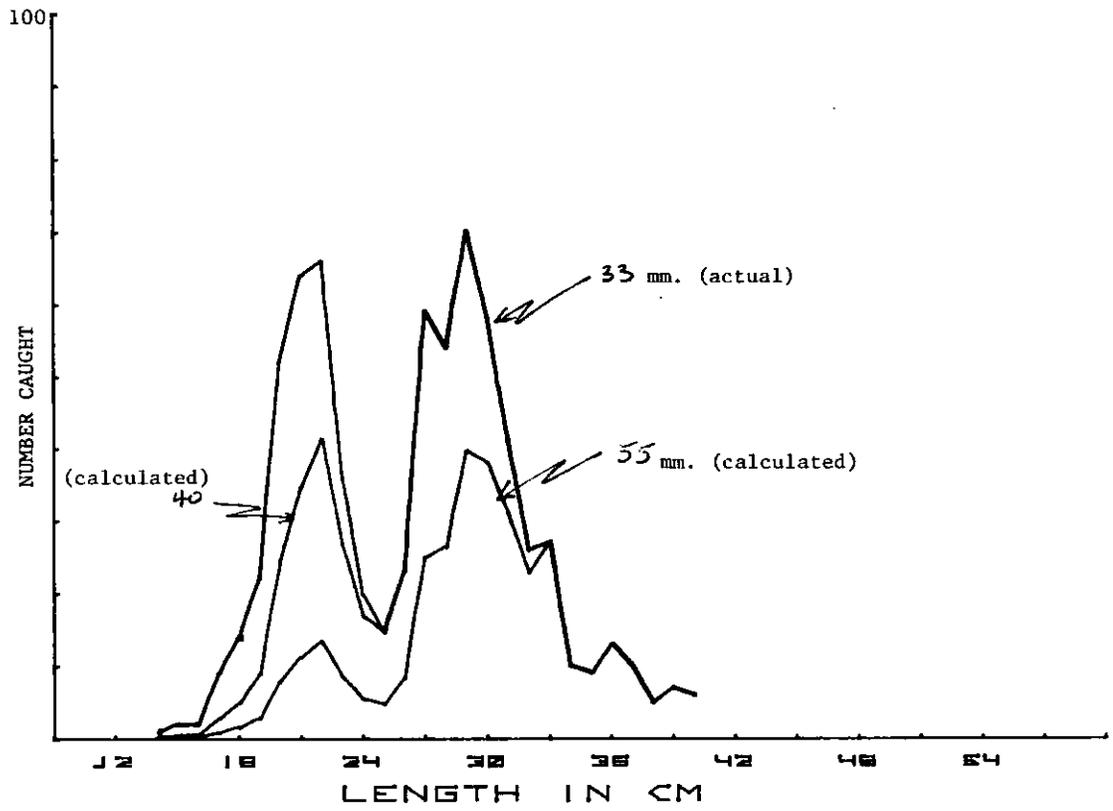
Fig. 3. Calculated Effect of Mesh Size on Retention in a Canadian Survey Length Frequency.