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Assessment of the Cod Stock in Divisions 3NO

by

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Introduction

In 1967 the largest catch of 226,784 tons was recorded for this stock. Since then catches have declined fairly steadily. Presently there is a ban on the directed cod fishery in Canada because the stock was believed to be in poor state. Historically the Spanish fleet has taken the bulk of the catch.

Methods

The same approach was taken with this stock as was used for the cod stock in 3M. The only difference was that an additional category type, divisions was included.

Results

After applying the same methods as those discussed for 3M cod the categories within each category type were grouped as shown in Table 1. The results from the regression with the grouped categories are summarized in Table 2. The inclusion of each of the category types in the model was significant as was the entire regression. The estimates of catch rate and effort for 1959 to 1979 are presented in Table 3 and Fig. 1. For the purpose of estimation the second country-gear group and the second month group in Table 1 were used as standards. The large fluctuations in catch rate during the mid sixties and the persistent decline in the ensuing years is important to note here.

A fairly good fit to the data was obtained with the generalized production analysis (Fig. 2). The maximum sustainable yield that resulted was 125,000 tonnes. Fig. 3 shows the change in biomass from 1959-79. Also indicated is the equilibrium biomass which the population would have attained if the effort

of that year had been sustained for a long time. The graph demonstrates how in years when fishing pressure was low the equilibrium biomass was larger than the actual biomass and the biomass tended towards that equilibrium value. Conversely between 1967 and 1975 the equilibrium biomass was zero because of the large fishing effort and the population biomass declined. The equilibrium biomass which results in the maximum sustainable yield is 830,000 tonnes. The equilibrium yield curves are given in Fig. 4 and 5. Looking at the path we see that in general the biomass and yield increased when the line was below the equilibrium curve but when the yield was greater than the equilibrium yield, this caused a subsequent reduction in biomass. Similarly when effort greatly exceeded that required to keep the population in equilibrium there was a subsequent drop in yield.

Discussion

The trend shown by the catch rates served as a warning that all was not well with the stock. Examination of the results from the generalized production analysis gives further insight into the events that have occurred.

As early as 1959 the stock biomass was lower than the equilibrium biomass for MSY, possibly due to large catches in the early and mid fifties. The effort in the early 60's however was generally low enough that the stock was slowly recovering. From 1967 to 1975 the effort on the stock was increased beyond the point which would lead the stock to extinction. The standing biomass was substantially reduced in those years. There are indications now that the stock may be recovering as a result of low quotas since 1976 however the biomass is still at a very low level. In view of these results it is recommended that the quota be kept as low as possible.

Table 1. Grouping of the regression coefficients for categories within category types for cod in ICNAF Divisions 3N0.

Country-Gear	InP	Month	InP
Spain PT-5	0.74	June	0.29
Spain PT-4	0.59	Jan	0.00
Spain PT-6		Feb	
Port OT-7		Mar	
Port OT-6	0.30	May	0.00
USSR OT-7		July	
CanM OT-5		Sept	
ROM OT-7		Nov	
Spain OT-6	0.00	Apr	-0.22
CanN OT-3			
CanM OT-4			
CanN OT-5		Oct	
UK OT-6			
BuL OT-7			
Norw LL-4			
		<u>Divisions</u>	<u>InP</u>
CanN OT-4	-0.40	3N	0.00
USSR OT-5		30	
USSR OT-6			
France OT-6	-0.67		
UK OT-5			
Icel OT-5			
USSR OT-4	-1.93		
Port DV-4	-3.04		
Port DV-5			
Port DV-6			

Table 2. Results from the regression after grouping the categories for the cod stock in ICNAF Divisions 3N0.

Multiple R = 0.84
Multiple R² = 0.71

Analysis of Variance

Source	d.f.	Sums of Squares	Mean Squares	F-value	P
C-gear*	7	1449.07	207.01	379.61	<.001
Months*	2	23.75	11.88	21.78	<.001
Years*	20	234.17	11.70	21.47	<.001
Regression	29	1782.87	61.47	112.74	<.001
Residuals	1360	741.64	0.55		
Total	1389	2524.52			

* The sums of squares for these are conditional on the remaining category types being included in the model.

Table 3. A summary of the catch, effort and catch rate for the 3NO cod stock during 1959-1979.

Year	Reported Directed Catch (t)	Total Catch (t)	Estimated Catch Rate (t./hr.)	"Standardized" Effort (hrs.)
1959	22657	62459	1.2343	50611
1960	48894	79677	1.2076	65980
1961	44082	72724	1.2779	56909
1962	23149	34948	1.2810	27282
1963	49975	69742	2.0261	34422
1964	45907	64461	1.6116	39998
1965	73053	99187	1.1779	84207
1966	64438	108919	1.7340	62814
1967	207855	226784	1.9171	118295
1968	77809	165512	1.4004	118189
1969	77682	117705	1.1299	104173
1970	68833	111561	1.2186	91548
1971	90745	126296	1.1909	106051
1972	76879	103374	1.0505	98405
1973	42887	80429	0.8114	99124
1974	38484	73389	0.6839	107310
1975	17296	44174	0.6082	72631
1976	12302	24283	0.9253	26243
1977	9961	17575	0.4869	40227
1978	8294	14738	0.2964	49723
1979	4421	19948	1.0033	19881

Note: Data for 1959-77 was obtained from ICNAF files, for 1978 from the statlant reports and for 1979 from the FOP reports, Canadian Newfoundland preliminary reports and FLASH.

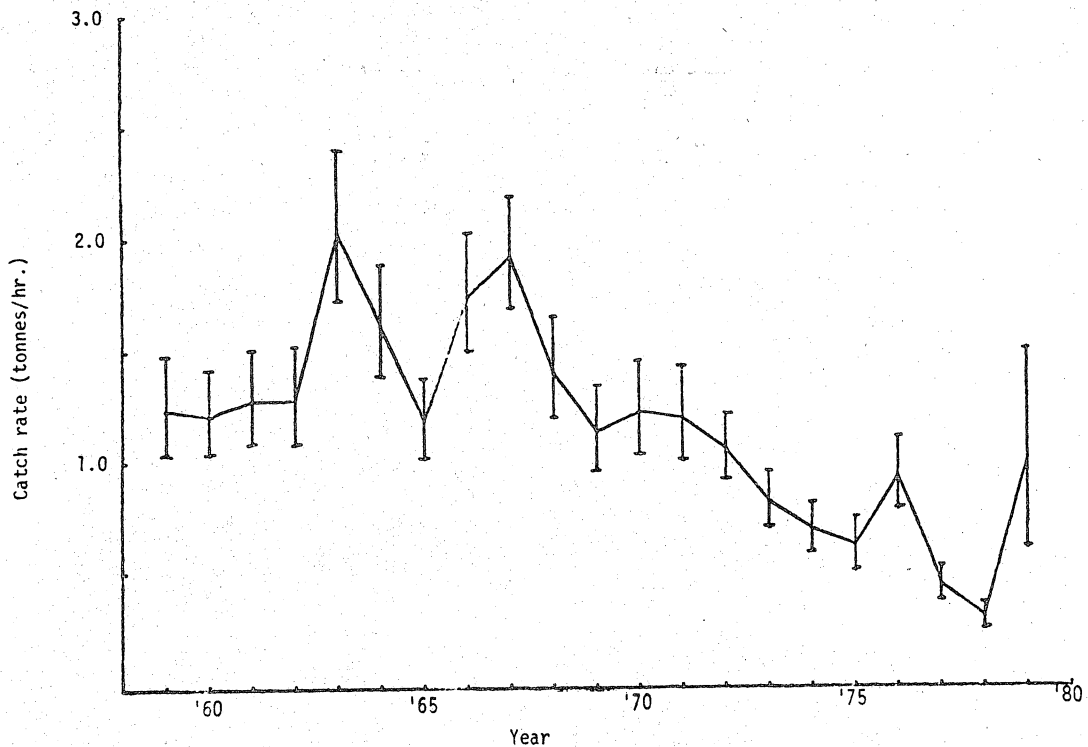


Fig. 1. Standardized catch rate for cod in ICNAF divisions 3NO with approximate 90% confidence intervals (Land, 1972).

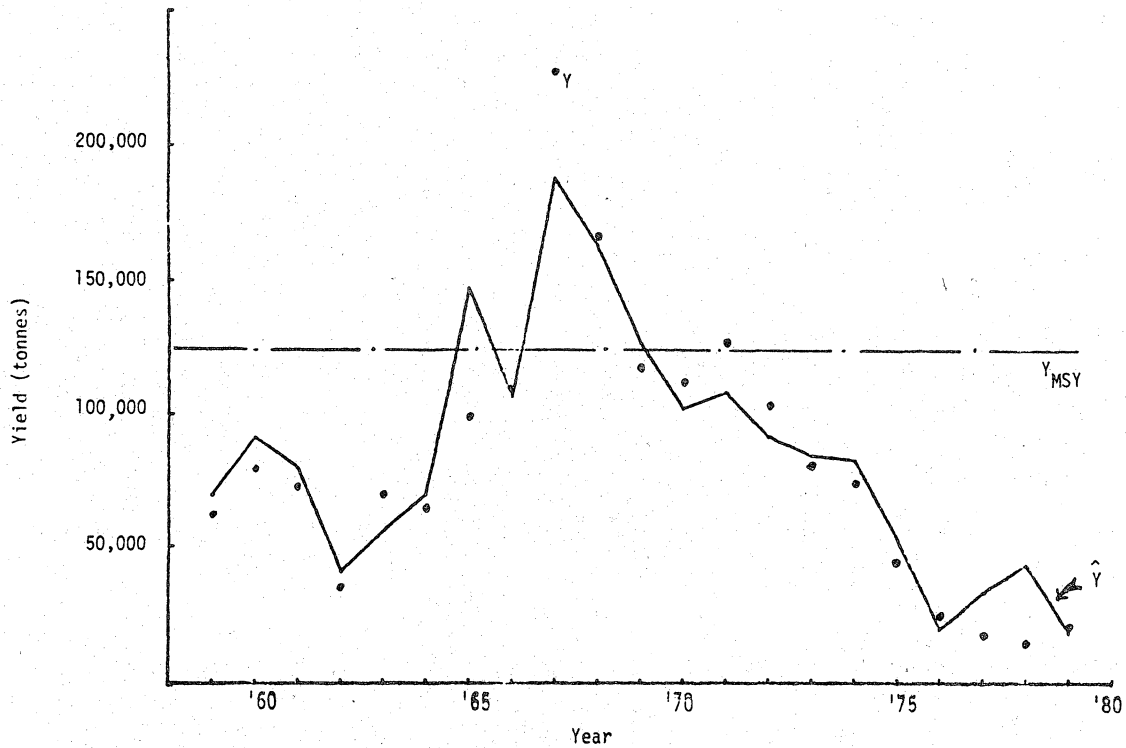


Fig. 2. The predicted and observed values of the dependent variable, yield, for cod in ICNAF divisions 3NO.

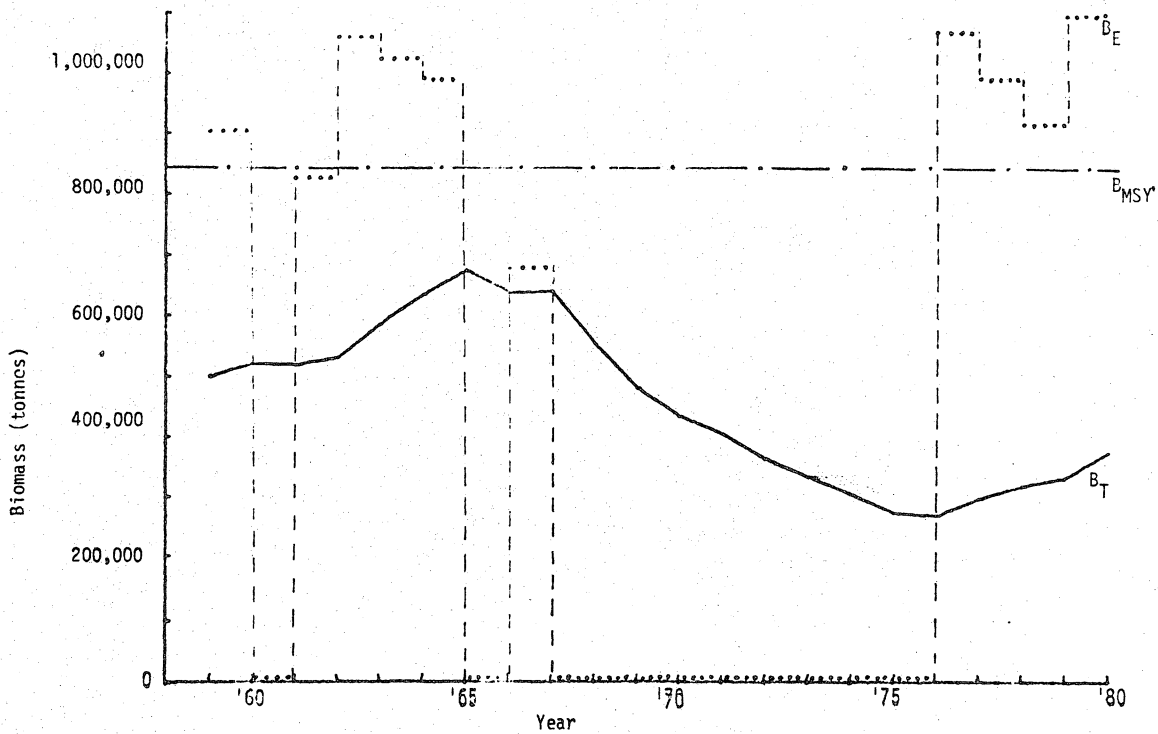


Fig. 3. Trend in biomass over time and the equilibrium biomass associated with the effort for that year for cod in ICNAF divisions 3NO. The equilibrium biomass at MSY is also shown.

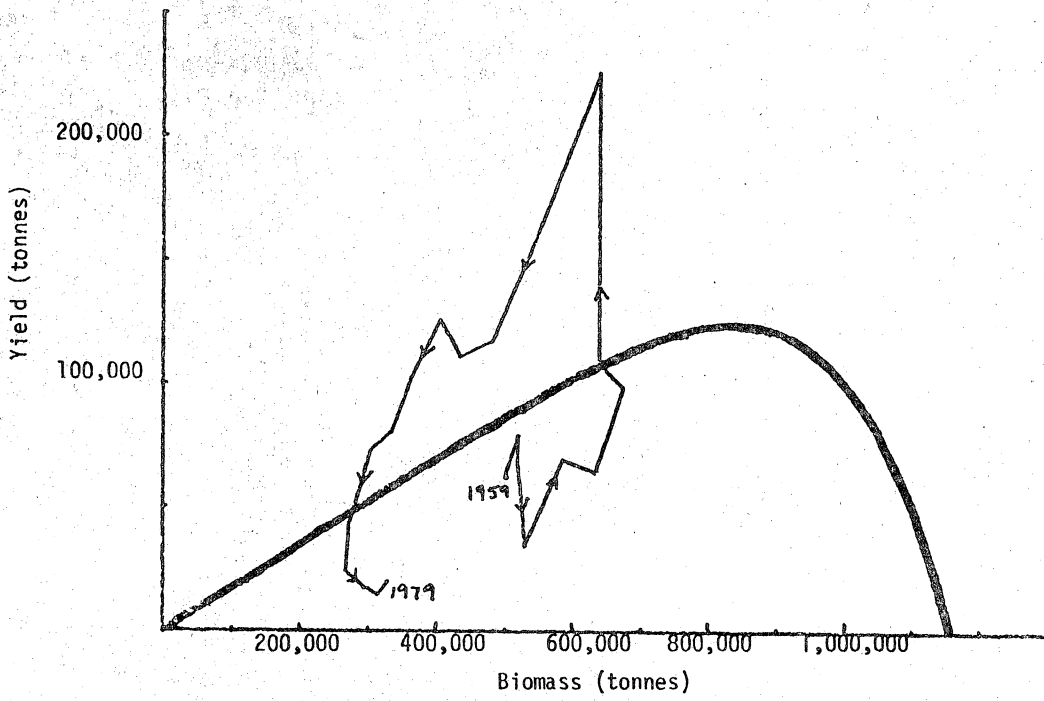


Fig. 4. Equilibrium curve of yield vs biomass and path from 1959-1979.

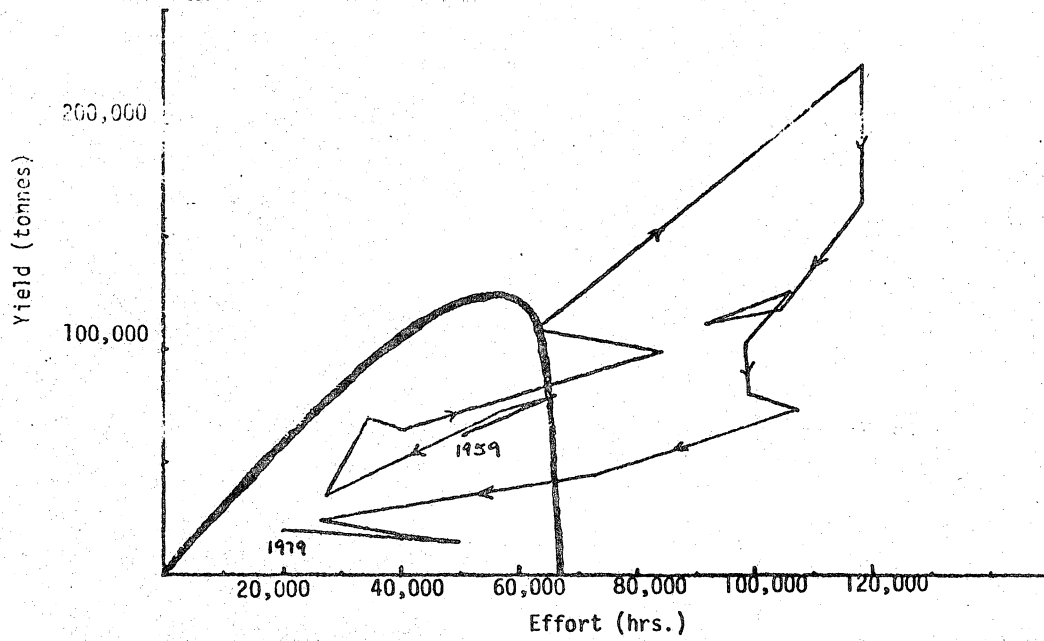


Fig. 5. Equilibrium curve of yield vs effort and path from 1959-1979.