ANNUAL MEETING - JUNE 1967

Biological data for bio-economic

assessment of Subarea 2 cod

by A. W. May

Introduction

The Labrador-Newfoundland cod stock complex, extending from ICNAF Divisions 2G to 3L (northern Labrador to the northern Grand Bank, cannot yet be separated into distinct components. Differences in growth and size at maturity from north to south indicate that random mixing over this vast area does not take place, though cod from several ICNAF Divisions are known to occur together in certain spawning areas. The situation is perhaps best described in terms of a series of intergrading or partially separated stocks. Assessments might best be made for 2G-3L as a whole, but are complicated by the north-south differences noted above.

For lack of data, no detailed assessments of the Subarea 2 cod fishery have previously been made. Parameters for Divisions 3K and 3L, on which the 1955-58 assessments were based, are out of date and no detailed analyses have since appeared. Estimates of various parameters for Division 2J, up to and including 1964, are available in ICNAF documents from the 1966 Annual Meeting. Recent data on year to year changes in growth indicate a possible stock separation between 2GH and 2J, and the 2GH fishery was relatively minor to 1964 (less than 10,000 tons annually). For these reasons it was considered most useful (and expedient) for the moment to limit the analysis to Division 2J for the period 1963-64.

Catches, Effort and C/E

Details of catch, estimated effort and catch per unit effort from 1954 are listed in Table 1. The inshore fishery, of several hundred years duration, reached very low levels in the mid-1950's but catches more than doubled by the early 1960's. Offshore fishing by European trawler fleets began in the early 1950's. By far the greater part of the catch is taken in Division 2J and the trawl catch, at 257 thousand tons in 1965, is about 10 times that taken inshore. Most of the inshore catch is taken in July and August. The trawl fishery operated only in the Autumn to 1958. The large increase in landings since 1959 is due to heavy fishing in Spring on the spawning and post-spawning concentrations.

Trawl effort was estimated in standard (Portuguese) trawler hours following the method used by Hodder (1965, ICNAF Res. Bull. No. 2, pp. 31-41). Effort by the Spanish fleet was adjusted to the standard by a factor derived from comparisons of catch per hour of each fleet on a monthly basis since 1954. Effort by all trawlers was estimated by dividing the total trawl catch, on a monthly basis, by the standard C/E for the month. Total effort in standard hours was estimated by dividing the residual landings (inshore) by the annual standard trawler C/E and adding the result to trawl effort.

Catch per hour in the January-June period is about 2.5 times that in July-December. C/E on an annual basis more than doubled from 1958 to 1960 in association with the spring trawler fishery which began in 1959. The autumn C/E exhibits a fairly steady decline since 1959. Catch per man in the inshore fishery declined about 50% from 1960-1965. The relatively low values of C/E in 1964 may be related more to decreased availability (ice, distributional anomalies) than to increased fishing.

Assessment of Changes in Effort (F)

Values of the parameters used in making the assessment, with upper and lower limits where appropriate, are listed in Table 2. Taking $M/K = 1.0$, $c = .60$ and $F/M = 4.5$, and entering the FAO yield tables, gives the present effort (F) as 28% greater than that giving the maximum yield per recruit; the maximum being 0.6% greater than the present value. However, if c were as low as .54 the present F becomes almost double that giving Y_{MAX}, which now is 3.4% greater than the present value. Though values of most of the parameters are more or less uncertain it appears that present effort is at or beyond the level giving maximum sustained yield. Specific changes (percentages) in long term yield for a possible range of values of c and F/M (assuming M = 0.2) are tabulated below for reductions of 10%, 20%, and 30% in F.

		Reduction in F		
c	F/M	10%	20%	30%
.60	3.5	-0.1	-0.2	-0.7
	4.0	+0.1	+0.1	0
	4.5	+0.3	+0.5	+0.5
	5.0	+0.3	+0.7	+0.9
	5.5	+0.4	+0.8	+1.1
.54	3.5	+0.7	+1.1	+1.4
	4.0	+0.7	+1.5	+2.1
	4.5	+0.9	+1.7	+2.6
	5.0	+0.9	+1.9	+2.9
	5.5	+1.0	+2.2	+3.2

The fishery does not strictly meet the steady state criteria implied in the calculations in that there was a major increase in fishing from 1958-61, and an apparently associated increase in growth from 1959 at least to 1964. Year-class survival is also variable, occasional age-groups being present in at least double the proportion of those on either side in annual random samples.

Table 1. Catch, effort and catch per unit effort since 1954.

	Cod Catch, '000 Metric Tons				Effort (Standard Trawler Hours) Division 2J		Trawl Catch/Hr.(Tons) - 2J		
	Subarea 2	Div. 2J	Trawl, 2J	Inshore, 2J	Trawl	Total	Jan.-June	July-Dec.	Annual
1954	19.1	17.4	7.4	10.0	3,325	6,694	-	2.98	2.98
1955	25.8	25.1	15.3	9.8	11,147	18,270	-	1.37	1.37
1956	34.3	34.1	25.6	8.5	14,678	19,563	-	1.74	1.74
1957	32.1	31.2	20.5	10.7	14,132	21,531	-	1.45	1.45
1958	40.2	37.7	28.2	9.5	27,466	36,692	-	1.03	1.03
1959	60.0	57.0	39.5	17.5	26,631	38,478	2.62	1.44	1.48
1960	188.2	179.6	164.2	15.4	78,260	85,602	3.19	1.36	2.10
1961	265.0	260.7	243.2	17.5	110,181	118,120	3.02	1.22	2.21
1962	255.2	250.3	226.9	23.4	101,028	111,439	3.02	1.28	2.25
1963	215.7	211.7	187.9	23.8	78,858	88,844	3.63	1.24	2.38
1964	212.8	204.2*	189.4*	14.8	101,907	109,900	2.94	1.12	1.85
1965	331.5	282.0+	256.8+	25.2					

* Includes 9.2 thousand tons 2NK (Non-member)

+   "   30.2   "   "   2NK (Non-member)

Table 2. Values of parameters used in 2J assessments.

Period	Parameter	Assumed Value	Probable Range	Source
1963-64	L_∞	74	-	May, 1966 ICNAF Doc. 66-24
1963-64	K	0.2	-	as above
1963-64	L_c	44	40-45	Commercial Length Samples, ICNAF Samp. Yearbooks Vols. 8 & 9
1950-58	Z	0.4	0.3-0.5	ICNAF Assess. Rept. & Doc. 66-26
1963-64	Z	1.1	0.9-1.3	May, 1966 ICNAF Doc. 66-26
-	M	0.2	0.1-0.3	as above
1950-58	F	0.2	0.1-0.3	-
1963-64	F	0.9	0.7-1.1	-
1963-64	L_c/L_∞ (c)	.60	.54-.61	-
1963-64	M/K	1.0	0.5-1.5	-
1963-64	F/M	4.5	3.5-5.5	-