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DIVISION 4X HADDOCK STOCKS - STATUS REPORT, 1972

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Introduction

An updating of parts of several former documents and reports is presented to provide for a current assessment of the status of the haddock stocks in the 4X area. Data from both commercial landings and R/V Albatross IV surveys are included.

Commercial Landings

Commercial landings continue to show a downward trend from the high of 40,200 metric tons caught in 1966, to an estimated catch of only 16,000 metric tons in 1971 (Table 1). The fishery remains predominately Canadian with 90 percent or more of the total catch being taken by that country. The catch of only 751 metric tons by the U.S. fishery represents the lowest catch on record since 1931. The catch for all other countries combined continues to be a small percentage of the total.

The decline in the stock is also evident in the U.S. landings per day (Table 2), for sampling area 42 (Figure 1). Although catch rates increased slightly in 1970, the downward trend since 1962 continued through the 1971 season and resulted in the lowest rate of catch for the U.S. fleet since 1956: 2.6 metric tons per day. The magnitude of this decline has been such as to reduce the rate of catch 76 percent during those 16 years. Total catch for all countries combined in 1971 accounted for 89 percent of the annual quota established for haddock in the 4X area.

Survey Analysis

The analysis of survey data since 1963 presented here does not include the Bay of Fundy area. (Sampling Area 41, Figure 1), and hence, is more directly comparable to the sampling area 42 data in the analysis of commercial landings. Also, the first six cruises in 1963 and 1964 did not cover the La Have Bank area (strata 41-42). Following 1964, strata 31-34, 41, and 42 are included in the 4X area (Figure 2).

Population Estimates

The relative population changes, measured in terms of numbers caught per tow, are presented in Table 3, Figure 3. The strong 1962 and 1963 year classes that led to high total abundance in the years 1963 and 1964 have been reduced through harvest and have not been replaced by new year classes of any magnitude. Only the 1969 and 1971 year classes show recruitment potential while the 1967 and 1970 year classes are almost nonexistent (Figure 4). The fishable population, age 4+ fish, follows a similar trend of decrease from 1963 to 1966, Figure 3. 1967 and 1968 show a small increase in numbers resulting from the recruitment of the 1963 year class, but following 1968 the decreasing trend continues into 1971.

The direct stratified estimate of total numbers of fish (Table 3) averages about 20 million fish of age four and older over the 1965-1969 period. This compares to average annual landings over the same period of 17 million fish. Survey estimates would be biased downwards, if anything. Since 1969 stratified estimates of harvestable fish show the population to average only about 12 million fish; and as mentioned above, landings have also declined. It is safe to say that removals were very high relative to total population.

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The entire area was not covered in 1963 and 1964. A sample adjustment of these data indicates a population of about 40 million fish, age four and older, during this period. Annual landings during these two years averages 10.8 million fish.

Age Composition and Mortality

Age composition of the surveyed population in the autumn season for 1963-1970 are presented in Table 4. Three items are worthy of note. First, the decline in abundance of older age groups. Second, the dominance of the 1963 and 1962 year classes. Third, the presence of weak year classes since 1963.

Total mortality coefficients by year and age group (Table 5) have been estimated from the series of data for two seasons. Some seasonal adjustment of data would otherwise be required.

The averages for age 4 and older fish are 0.76 and 0.59 (1963-1971) for the autumn and winter (spring) series, respectively. The estimates are rather consistent from year to year and among age groups. The difference between 1964 and 1965 in the autumn series is caused by the apparent low availability in autumn 1964 (c.f. Figure 3).

The coefficients for age groups 1 to 4 are of some interest, since these are not generally landed to any extent with a 4½ inch mesh fishery. Presumably this indicates very little fishing mortality, although actual catch data for these age groups are not available. The average total mortality coefficients for age groups I and II are rather higher than expected. Assuming no fishing, there must have been a rather high natural mortality, particularly in the 1962 and 1963 year classes, which dominate the data because of large numbers.

The mortality coefficients for age group III, 0.31 and 0.25 are close to previous estimates of natural mortality, considering that there is some fishing on this group. Therefore, a natural

mortality rate of 0.2 for the exploited age groups which has been used in most previous studies is reasonable.

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Table 1. -- Division 4X haddock landings by Canada, the United

States, and other countries 1931-1971 (Metric tons

x 10^{-3})

Year	United States	Canada	Other Countries	All countries Total landings
1931	15.1	6.5		21.6
1932	9.8	5.3		15.1
1933	13.2	5.1		18.3
1934	8.5	6.5		15.1
1935	10.3	6.3		16.6
1936	11.0	6.2		17.2
1937	9.6	5.8		15.4
1938	13.0	8.1		21.2
1939	10.8	7.8		17.6
1940	7.6	8.1		15.7
1941	5.1	7.1		12.2
1942	4.8	6.5		11.3
1943	2.1	6.9		9.0
1944	5.1	6.1		11.2
1945	8.3	7.4		15.7
1946	4.1	6.9		11.0
1947	7.8	7.3		15.1
1948	8.4	10.1		18.5
1949	8.5	8.3		16.7
1950	10.2	8.6		18.8
1951	7.8	12.7		20.5
1952	11.7	8.5		20.2
1953	8.7	7.5		16.2
1954	14.1	6.7		20.8
1955	11.3	8.3		19.8
1956	12.1	8.8		20.9
1957	7.2	5.4		16.6
1958	12.1	9.2		21.3
1959	5.5	9.3		14.8
1960	8.3	7.5		15.8
1961	9.3	8.2		17.5
1962	6.4	10.9		17.3
1963	7.2	14.9	.7	22.8
1964	8.5	25.0	1.1	34.6
1965	3.7	21.5	2.4	27.6
1966	2.5	28.0	9.7	40.2
1967	5.0	30.4	.2	35.6
1968	3.2	27.4	.5	31.1
1969	1.8	26.7	.5	29.0
1970	1.7	15.2	.4	17.3
1971	0.8	14.9	.3	16.0

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Table 2.--Landings and landings/day for United States, for sampling area 42 (large otter trawlwers, quarters 1 and 2)

Year	UNITED STATES Landings/day (metric tons)	Days fished
1956	11.0	298
1957	8.4	202
1958	8.7	311
1959	5.6	80
1960	6.9	295
1961	6.7	326
1962	8.3	149
1963	7.1	117
1964	7.6	206
1965	6.9	13
1966	5.1	85
1967	5.5	178
1968	4.2	259
1969	3.6	160
1970	4.3	115
1971	2.6	57

Table 3.--Average numbers of fish caught per tow and total
population estimated from <u>Albatross IV</u> surveys,
southeast Nova Scotia (STRATA 31,32,33,34,41,42).

Year	Season	No's. per tow			Pop. No's. (X10^{-6})	
		Total	Age 4+	(%)	Age 0+	Age 4+
1963	summer*	104	31	(0.30)	57.7	17.1
	autumn*	193	34	(0.18)	106.7	19.2
1964	winter*	181	45	(0.25)	100.3	25.1
	summer*	147	37	(0.25)	81.1	20.3
	autumn*	44	13	(0.30)	23.0	6.9
1965	winter*	100	22	(0.22)	55.4	12.2
	summer	86	19	(0.22)	88.7	19.5
	autumn	55	13	(0.24)	56.5	13.6
1966	winter	59	9	(0.15)	61.2	9.2
	autumn	39	14	(0.36)	40.4	14.5
1967	autumn	37	30	(0.81)	36.2	29.3
1968	spring	28	25	(0.89)	29.5	26.2
	autumn	21	14	(0.66)	21.8	14.4
1969	spring	28	15	(0.54)	28.8	15.5
	summer	17	9	(0.49)	17.3	8.5
	autumn	23	5	(0.23)	22.5	5.2
1970	spring	29	18	(0.59)	28.4	16.8
	autumn	14	6	(0.45)	13.4	6.0
1971	spring	23	14	(0.59)	22.9	13.5
	autumn	25	-	-	24.6	-

*Do not include strata 41,42 (LeHave Banks Area).
Population numbers for whole area should be approximately double those given.

Table 4.--Relative age strengths measured by autumn <u>Albatross IV</u>
surveys. (No./tow)

Year	AGE									
	0	1	2	3	4	5	6	7	8	9
1963	83.13	46.84	15.55	14.02	19.43	7.48	3.19	1.46	1.16	.76
1964	.19	14.14	10.62	3.40	4.44	7.08	2.07	.60	.71	.33
1965	.51	6.03	25.66	9.67	3.51	3.19	4.11	1.24	.29	.37
1966	.71	1.16	1.46	21.40	7.14	2.16	1.51	2.20	.81	.53
1967	.09	3.47	1.30	2.48	22.86	4.29	1.00	.92	.46	.20
1968	2.15	.98	2.77	1.19	.39	9.05	3.22	.35	.43	.55
1969	10.26	4.23	.78	2.21	.32	.08	2.91	1.22	.13	.33
1970	0	4.52	2.21	.68	1.28	.20	.71	2.42	.81	.25

Table 5.--Total mortality coefficients for haddock of data from

Albatross IV surveys, southeast Nova Scotia (STRATA

31, 32, 33, 34, 41, 42).

I. Autumn to Autumn

Age Group	63-64	64-65	65-66	66-67	67-68	68-69	69-70	Pooled Avg. 63-70
I	1.485	-0.600	1.419	-0.114	0.225	-0.268	0.649	.540
II	1.524	0.092	0.183	-0.530	0.088	0.226	0.634	.349
III	1.148	-0.032	0.303	0.068	1.850	-0.965	0.546	.308
IV	1.008	0.331	0.486	0.510	0.928	-3.467	2.748	.802
V	1.284	0.544	0.748	0.770	0.287	1.135	2.867	.764
VI	1.671	0.513	0.625	0.495	1.050	0.970	0.184	.699
VII	0.720	0.727	0.426	1.565	0.761	-3.090	0.410	.786
VIII	1.257	0.652	-0.603	1.398	-0.179	-1.952	3.426	.444
Pooled Average(4-9)	1.109	0.482	0.537	0.699	0.775	1.057	0.060	.761

II. Winter to Winter

Age Group	64-65	65-66	66-68*	68-69**	69-70	70-71	Pooled Avg. 64-71
I	0.621	-0.126	0.421	-5.649	0.069	-0.147	0.450
II	0.527	0.363	0.758	-0.858	0.737	0.180	0.397
III	-0.045	0.320	0.602	-0.293	0.358	0.221	0.252
IV	0.658	0.909	0.994	-0.731	0.218	0.099	0.508
V	1.029	1.339	1.136	0.695	-0.315	0.233	0.807
VI	0.853	1.235	1.309	0.657	0.090	0.778	0.587
VII	0.986	1.701	0.904	0.593	0.278	0.261	0.592
VIII	-0.490	0.536	-	-0.239	-0.091	-0.005	-0.061
Pooled Average(4-9)	0.803	1.137	1.052	0.535	0.079	0.234	0.586

 * Winter 66 - Spring 68, t = 2

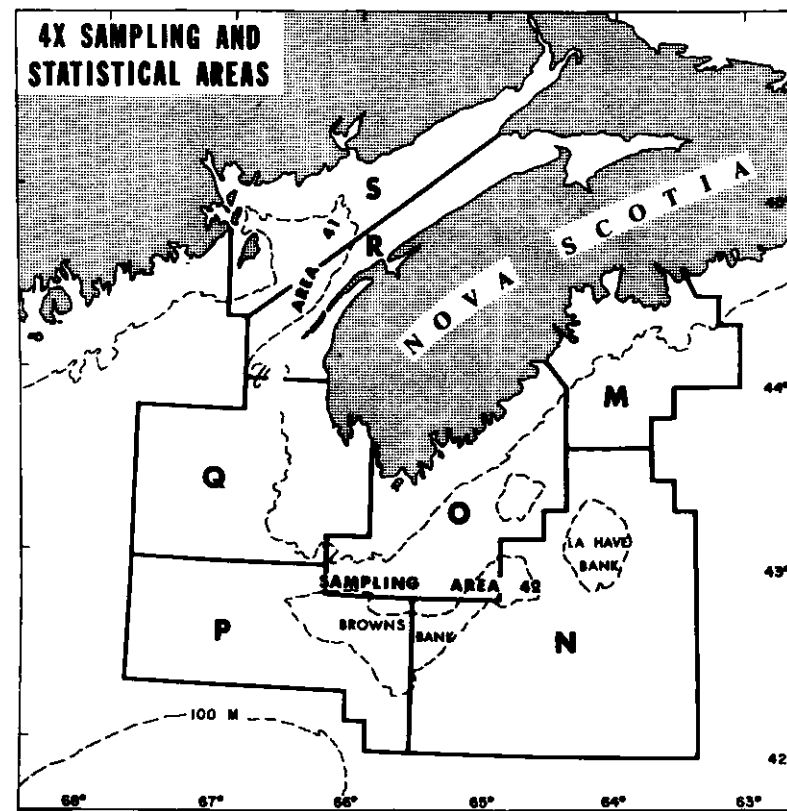** Spring 68 - Spring 69

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Fig. 1. Commercial sampling and statistical areas of Division 4X.

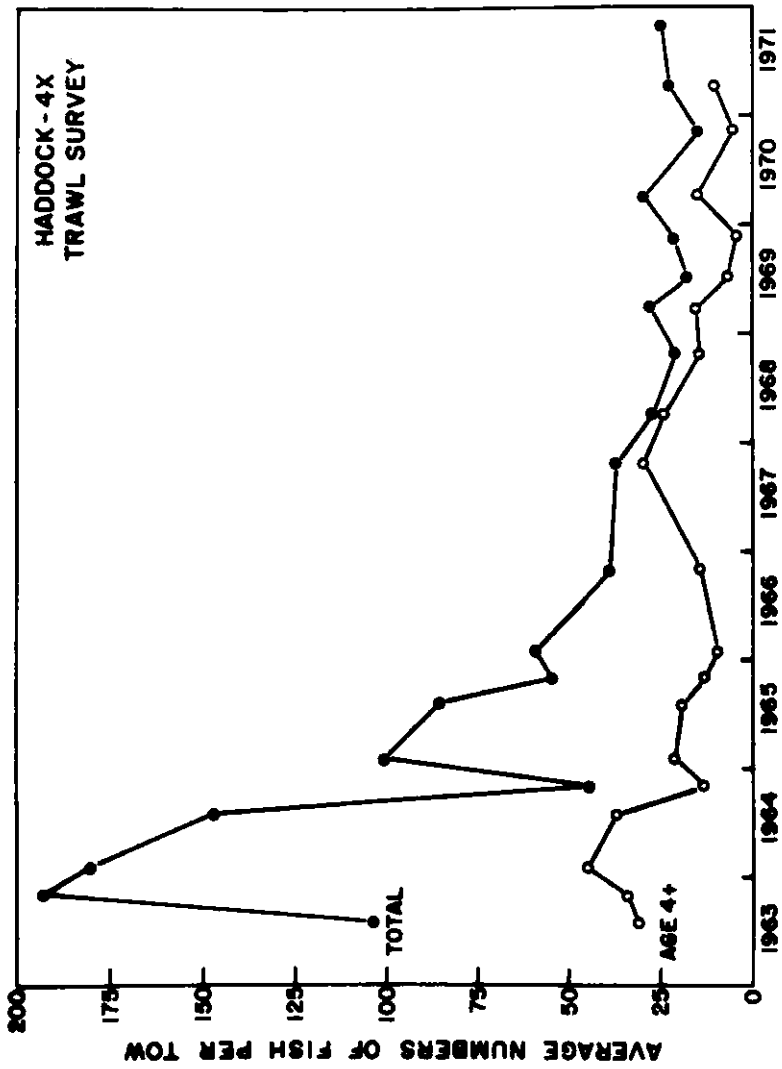Fig. 2. Research survey sampling and statistical strata.

Fig. 3. Relative abundance of haddock in Division 4X estimated from U. S. research vessel trawl surveys.
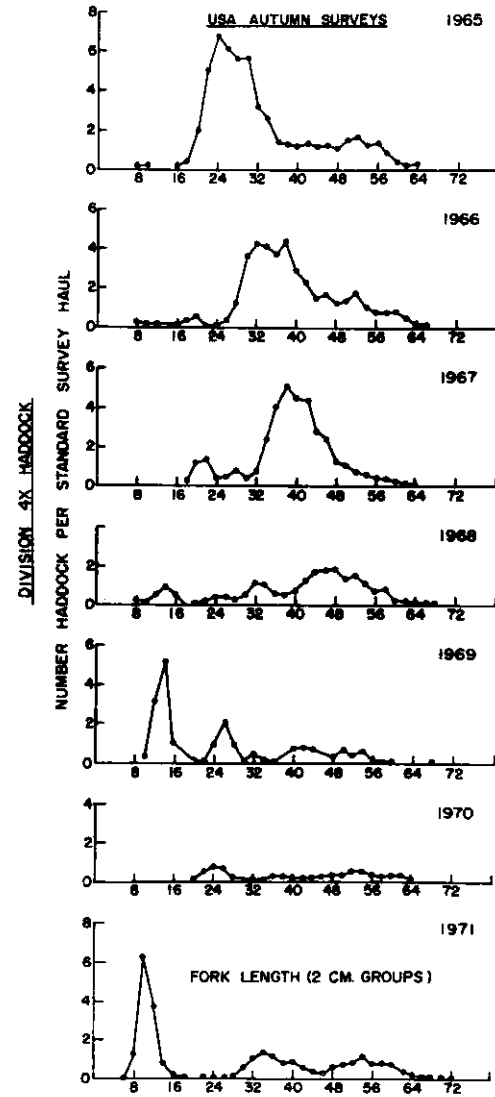
Fig. 4. Length frequency distribution of
haddock in autumn surveys.