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Abundance, Age Composition and Survival of Haddock  
from Southern Nova Scotian Grounds 1962-1968

by

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Introduction

The haddock fishery in Division 4X (Figure 1) of the International Commission for the Northwest Atlantic Fisheries Convention Area has been the subject of a cooperative study by scientists of the United States and Canada since 1956. The effects of fishing on 4X haddock is of prime concern to both countries. An earlier study (Hennemuth, et al, 1964) provided estimates of vital fishery statistics from 1956 to 1961.

From 1931 to 1963 annual haddock landings (Figure 2 and Table 1) varied between 15 and 20 thousand metric tons. Landings began to increase in 1963, and by 1966 had climbed to almost 41 thousand tons. Landings dropped slightly in 1967, and U. S. -Canadian landings dropped again in 1968. The increase in landings from 1964 to 1966 was primarily a result of increased Canadian landings. U. S. landings decreased during this period. The USSR removed about 10 thousand tons of haddock from 4X in 1966, but otherwise landings by countries other than the U. S. and Canada during the study period were negligible.

The largest portion of all haddock landed in recent years have been caught by otter trawlers. Line trawlers, while formerly accounting for 30 to 50 percent of landings, have nearly disappeared from the fishery. In this study line trawl landings are included in the total landings and are not treated separately as they were in the earlier study.

Methods

Because of possible stock differences, Division 4X was divided into two sampling areas comprised of seven smaller statistical areas (Figure 1). From 1956 to 1961 sampling area 41 (SA 41) included statistical areas R and S, and sampling area 42 (SA 42) contained statistical areas M through Q. Because of similarities of age and length compositions, Q was included in SA 41 from 1962 to 1968.

Data from 1956 to 1961 were grouped by haddock year (February to January). From 1962 to 1968 data were tabulated by calendar year.

Abundance indices from 1956 to 1961 for sampling area 41 were based on landings per day fished. In this study the unit of effort was number of trips. Other than these differences, all methods of sampling and analysis followed procedures as outlined by Hennemuth, et al. (1964).

Table 1. --Division 4X haddock landings by Canada, the United States, and other countries 1931-1968.

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		19.6
1956	12.1	8.8		20.9
1957	7.2	5.4		12.6
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	---	---

## Results

### Sampling Area 42

Relative abundance of haddock in SA 42 has been measured by estimated landings per unit effort for first and second quarters combined for both Canadian and U. S. fishing vessels (Table 2 and Figure 3). The U. S. index has trended downward since 1956, except for a temporary increase from 1959-1962, decreasing from about 10 tons per day in 1956 to about 5 tons per day in 1965. The trend of U. S. and Canadian abundance indices since 1964 is much the same. Both U. S. and Canadian effort showed an increase from 1965 to 1968. Landings per day leveled off from 1966 to 1968 as a result of recruitment of the 1962 and 1963 year classes which were more abundant than the average.

Estimates of abundance at age for U. S. -Canadian landings are given in Table 3. The relative strengths of the 1959 and 1963 year classes were quite high. The 1962 and 1963 year classes supported about 80 percent of the landings in 1967 and 1968. The 1964 year class appeared to be relatively weak. A decrease in abundance among the older fish in recent years is also noticeable (Figure 4).

Average survival during the 1964-68 period was estimated at 49 percent (Table 4). This is the same value estimates in the previous 1956-61 period. There are differences in survival among years and age groups, but these data do not demonstrate an increase in mortality which might be expected because of recent increased fishing in SA 42.

### Sampling Area 41

Annual haddock landings from SA 41 by Canada and the United States averaged about 34 hundred tons from 1956 to 1961 (Figure 5). In 1962 haddock landings more than doubled, and they continued to increase until by 1967 they had reached 17 thousand tons. This increase was mainly a result of increased Canadian landings, although U. S. landings did increase slightly. There has been a trend toward increasing effort by Canadian medium otter trawlers (51-150 gross tons) (Figure 6). Small otter trawlers (25-50 gross tons), on which the abundance estimates were based in the previous study, did not show an increase in effort until 1966.

Landings per trip for both medium and small otter trawlers show an increase since 1960 (Figure 6). Quarterly indices (Figure 7) show definite seasonal differences. Abundance was usually greatest in the third quarter, the time when landings were also greatest. The increase in landings per day in 1965 and 1966 was a result of strong 1962 and 1963 year classes entering the fishery.

Estimated numbers landed per trip by age groups (Table 5) are given for third quarter landings. The 1959, 1962, and 1963 year classes were all strong. The 1964 and 1965 year classes appear relatively weak. Survival was estimated at 43 percent for four to nine year olds (Table 6). Data for the years 1956-61 were not available to estimate survival for those age groups.

## Discussion

In SA 42 abundance of older fish has declined slightly in recent years and the fishery in 1967 and 1968 has been dependent on the strong 1962 and 1963 year classes. Despite a 50 percent increase in landings from 1962, estimated mortality rate has not increased above the 1956-61 level of about 52 percent. It would appear that increased landings has been coincident with increased recruitment in recent years. Grosslein

Table 2. --Landings and landings/day for Canada and the United States for sampling area 42 (large otter trawlers).

Year	United States		Canada		Total landings Thousands of Metric tons
	Landing/day Metric tons	Days Fished	Landing/day Metric tons	Days Fished	
1956	11.0	298			15.1
1957	8.4	202			11.8
1958	8.7	311			15.8
1959	5.6	80			9.8
1960	6.9	295			11.8
1961	6.7	326			12.7
1962	8.3	149			9.6
1963	7.1	117	3.6	278	12.5
1964	7.6	206	5.8	1326	23.3
1965	6.9	13	4.2	937	15.7
1966	5.1	85	3.9	1105	13.0
1967	5.5	178	3.2	1378	16.1
1968	5.1	507	3.8	2054	----

Table 3. --Numbers per day at age for sampling area 42 haddock.

YC	Age										
	3	4	5	6	7	8	9	10	11	12	
1962	59	----	149	1334	1135	1597	876	598	217	209	122
1963	60	51	1160	1361	935	806	323	278	110	73	54
1964	61	58	610	2072	823	519	488	250	190	103	94
1965	62	69	398	1333	1981	748	318	278	102	62	52
1966	63	44	811	404	516	1135	276	136	183	45	49
1967	64	6	2084	1690	380	284	288	48	23	25	17
1968	65	1	54	2290	1132	160	92	140	41	14	23

Table 4. --Percent survival and mortality (z) for sampling area 42 haddock.

	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	Avg 6-12
1962-63	----	9.13	.70	.71	.19	.31	.18	.31	.23	.35
1963-64	11.96	1.79	.61	.55	.60	.77	.67	.90	1.29	.65
1964-65	6.86	2.19	.93	.57	.37	.43	.64	.49	.82	.65
1965-66	11.75	1.02	.39	.52	.37	.43	.64	.49	.82	.52
1966-67	97.36	2.84	.94	.53	.25	.17	.14	.16	.40	.29
1967-68	9.00	1.00	.67	.42	.32	.49	.89	.61	.92	.45
Average	18.90	1.46	.73	.63	.36	.44	.49	.29	.60	.49
								Z = .71		
Avg.										
56-61	5.25	1.57	1.06	.45	.56	.47	.58	.38	.29	.48
								Z = .71		

Table 5. --Numbers per day at age for sampling area 42 haddock.

	YC	Age							
		2	3	4	5	6	7	8	9
1962	60	0	152	486	241	108	87	70	33
1963	61	77	367	1237	310	65	52	14	13
1964	62	108	437	506	881	181	28	26	27
1965	63	518	2152	530	163	273	68	24	16
1966	64	89	4222	1242	121	72	98	7	8
1967	65	0	272	3330	436	23	20	35	3
1968	--	---	----	-----	----	--	--	--	--

Table 6. --Estimated survival of SA 41 haddock.

	2-3	3-4	4-5	5-6	6-7	7-8	8-9	Avg. 3-7	Avg. 4-9
1962-63	----	8.14	.64	.27	.48	.16	.19	1.68	.46
1963-64	5.68	1.38	.72	.59	.43	.50	.52	.81	.68
1964-65	19.93	1.21	.32	.31	.37	.86	.62	.52	.33
1965-66	8.25	.58	.23	.44	.36	.10	.34	.49	.29
1966-67	3.06	.78	.35	.19	.28	.36	.43	.67	.34
Average	7.01	.90	.48	.36	.39	.33	.50	.70	.43
57-61 Avg.		.42	.32	.55	.50			.50	

(1969) indicates that 1964-68 year classes are probably failures on the basis of young-of-the-year surveys. Present results also indicate that the 1964 year class is poor.

In SA 41 the fishery is dependent on younger fish, the 1963 year class dominating the fishery as early as 1967. Mortality estimates for fully recruited age groups average 57 percent. Recruitment predictions for this area are similar to those for SA 42 (Grosslein, 1969).

With little possibility of substantial recruitment to the 4X haddock stock before 1974, a continuation of the present high level of fishing effort must be expected to result in a drastic decline in stock abundance. Although we cannot establish now the exact status of this fishery, some limit on removals to prevent a possibly serious reduction in stock should be considered.

#### Literature Cited

- Hennemuth, R. C., M. D. Grosslein, and F. D. McCracken. 1964. Abundance, age composition of landings, and total mortality of haddock caught off Southern Nova Scotia, 1956-1961. ICNAF Res. Bull. No. 1, 1964.
- Grosslein, M. D. 1969. Haddock recruitment predictions from bottom trawl catches of 0-group fish in Subarea 5 and Division 4X. ICNAF Res. Doc. 69/ .

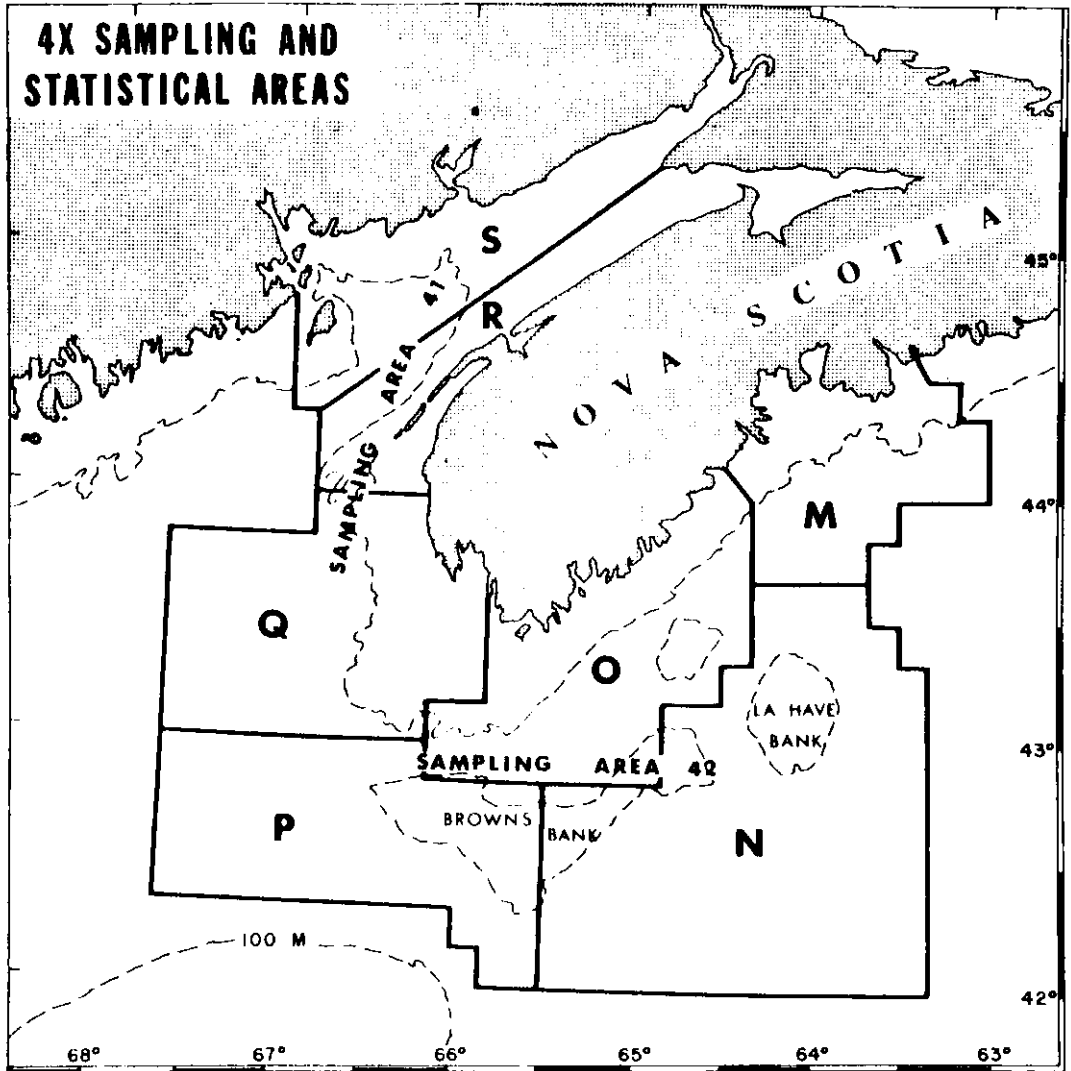


Figure 1. --Sampling and statistical areas of Division 4X.

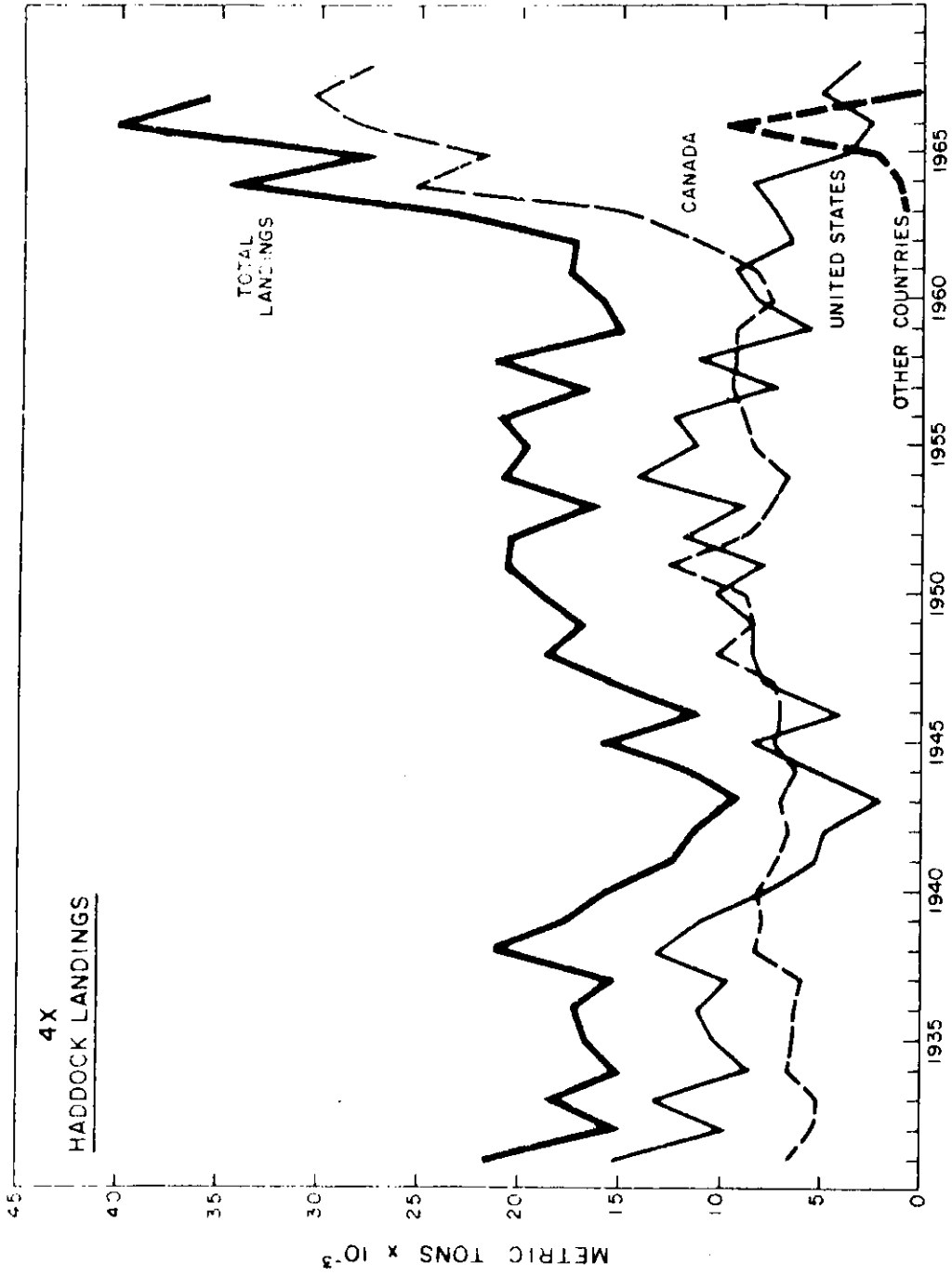


Fig. 4. Fig. 4A haddock landings by Canada, the United States, and other countries, 1935-1965 in thousands of metric tons / round weight/.



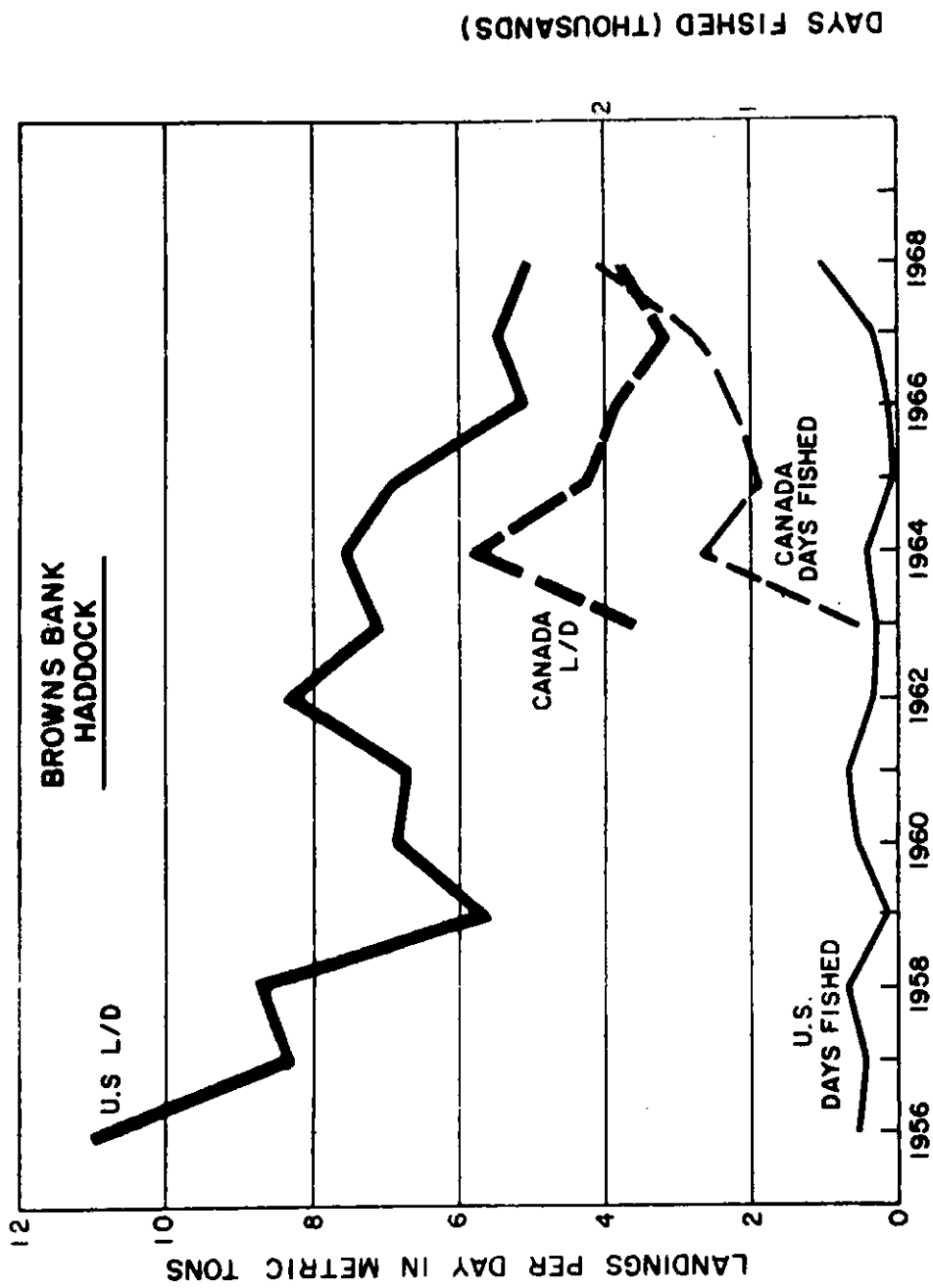


Fig. 3. United States and Canadian landings per day and effort for sampling area 42.

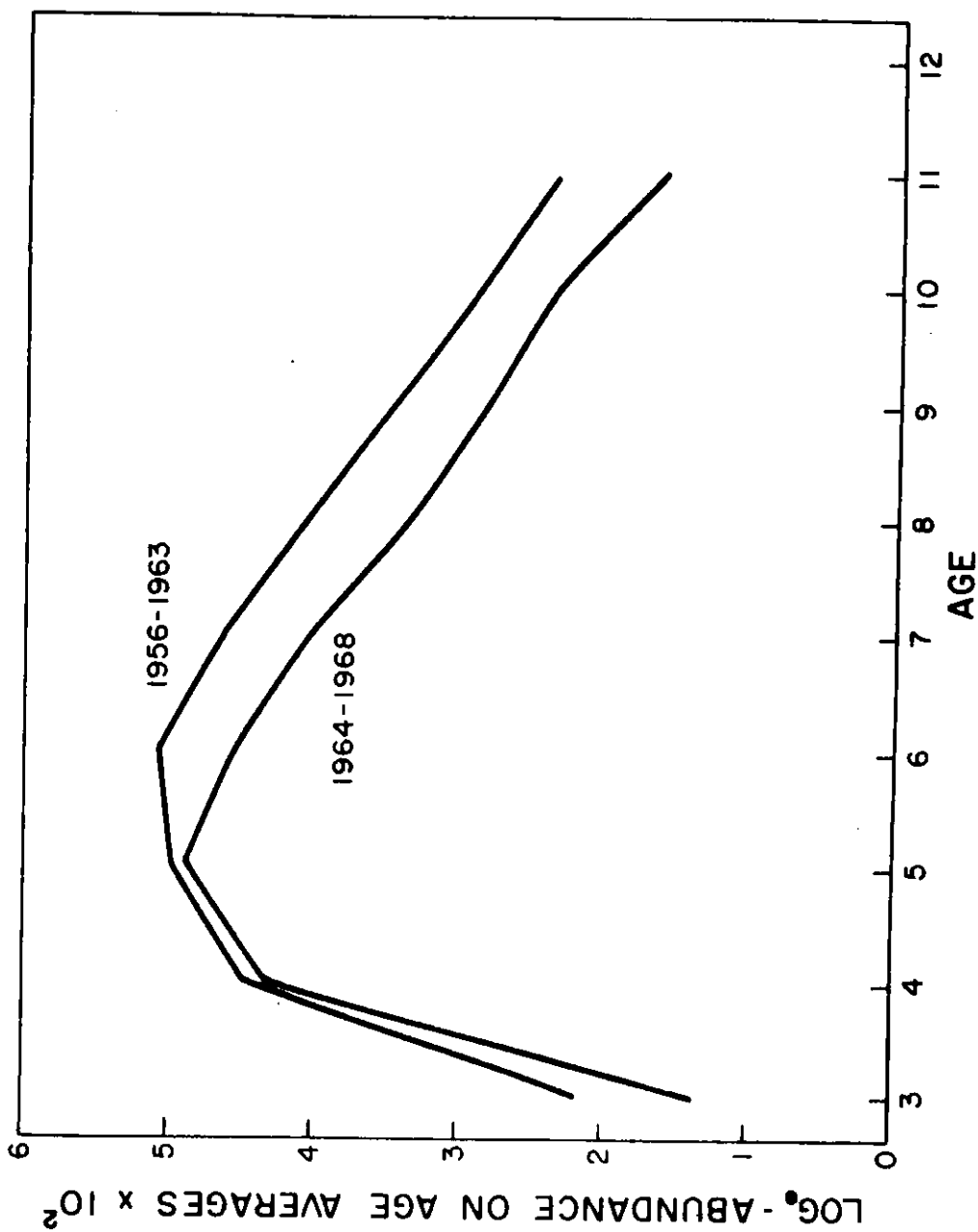


FIG. 4. Average abundance at age for sampling area 42 haddock,

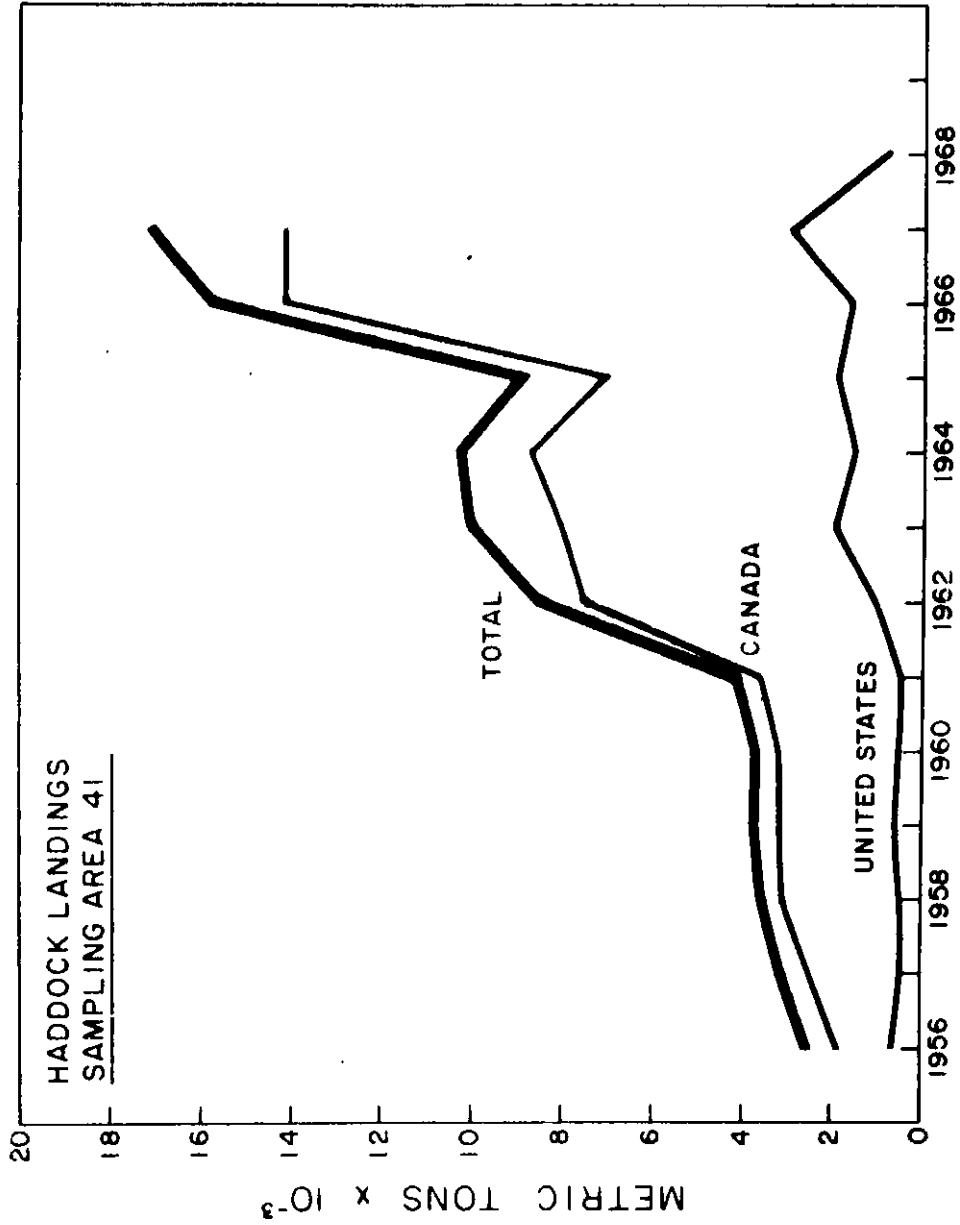


Fig. 5. Other trawl landings by Canada and the United States from sampling area 41.

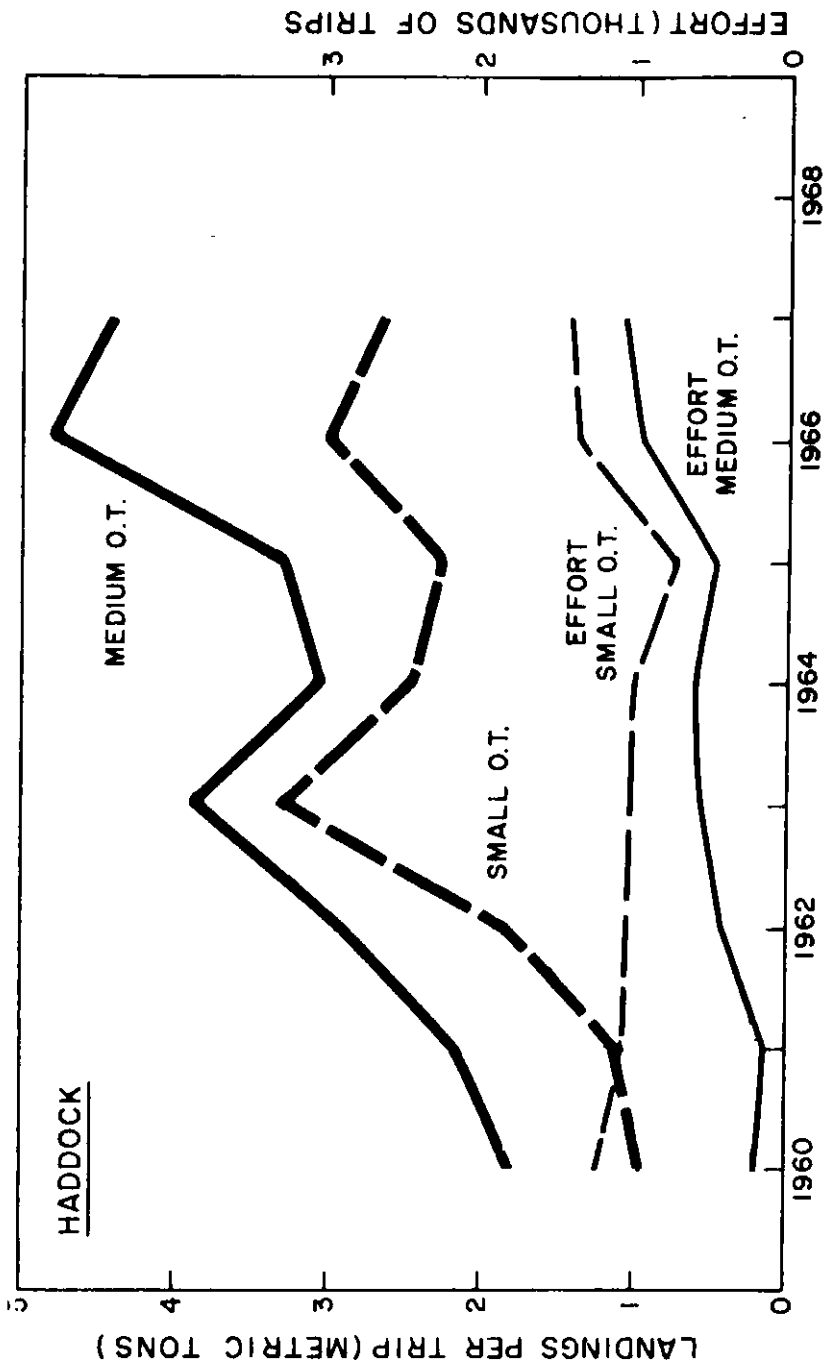


Fig. 6. Landings per trip and effort for Canadian small and medium otter trawlers in sampling area 41.

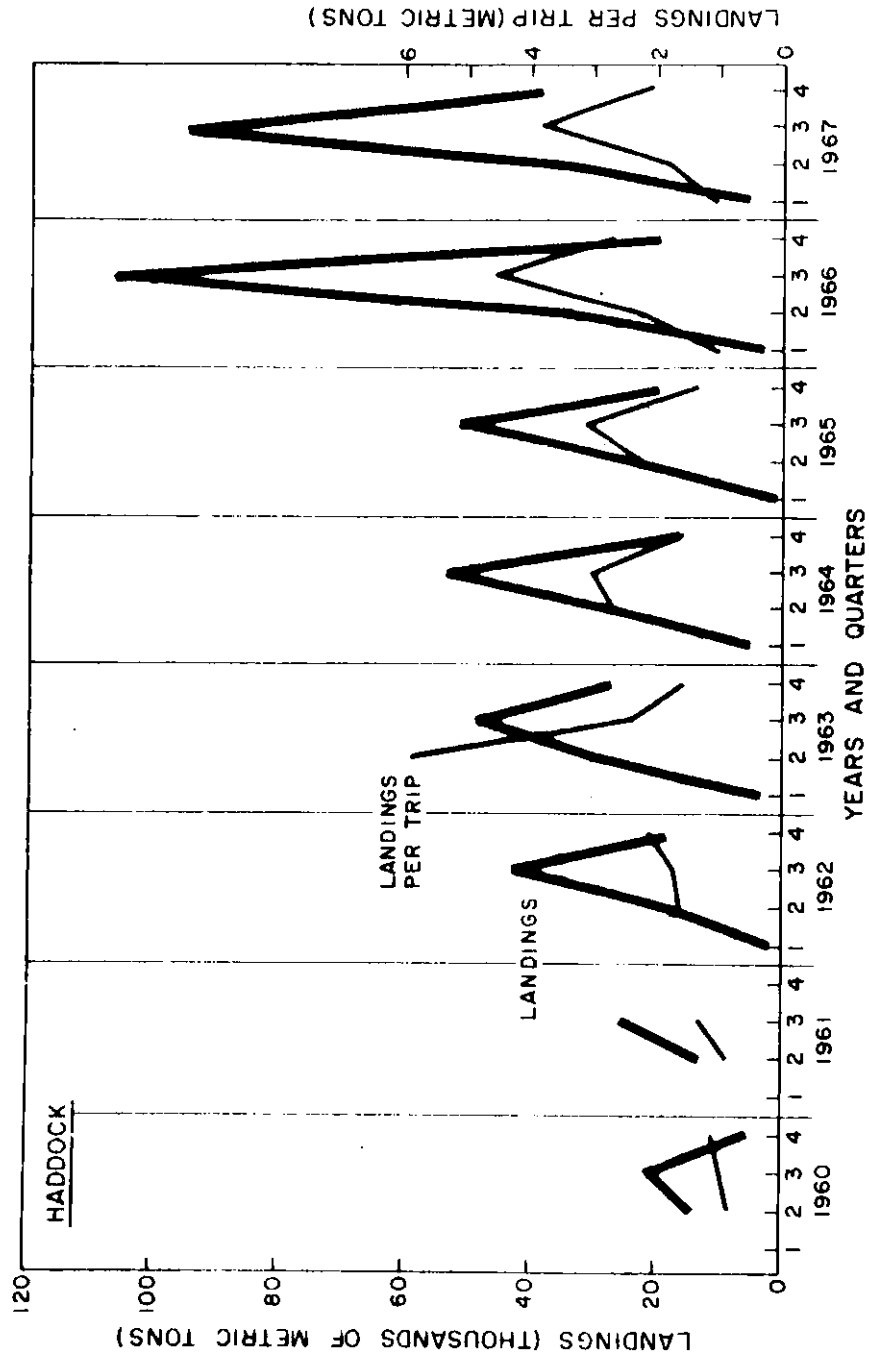


Fig. 7. Total quarterly landings for sampling area 41 and landings per trip for Canadian small otter trawlers.