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The cod stocks of the southern Gulf of St. Lawrence
and Sydney Bight (ICNAF Div. 4T-4Vn)¹

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STOCK STRUCTURE

Stock identity studies, particularly tagging experiments, indicate that components of at least three stocks spend part or all of the year in Sydney Bight (ICNAF Div. 4Vn).

The migration of the large Southern Gulf of St. Lawrence cod stock which spends the summer months in the Magdalen Shallows region (ICNAF Div. 4T), to Sydney Bight (Div. 4Vn) to overwinter is well documented (Martin and Jean, 1964; McCracken, 1959; McKenzie, 1956). Movement out of the Gulf of St. Lawrence occurs about December, and throughout January-April the stock is found concentrated along the edge of the Laurentian Channel predominantly in depths of 80-150 fm. The centre of concentration is in Div. 4Vn although it extends into Div. 4T as far north as Bird Rocks and the southern fringe extends into Div. 4Vs. Movement back into the Gulf occurs in April-May.

The eastern Scotian Shelf cod (i.e. those of Sable Island and Banquereau Banks, Div. 4Vs-W) show some movement to the north in spring and summer, and Banquereau cod in particular move as far as Sydney Bight (Div. 4Vn) and even into the southern-most part of the Gulf of St. Lawrence (Martin and Jean, 1964).

Coastal Nova Scotia has a complex of inshore stocks which mix very little with each other or with the larger offshore stocks. Inshore stocks off eastern Cape Breton (Div. 4Vn) are characterised by lower vertebral counts than adjacent offshore stocks and tagging returns show little intermixing with other stocks although some cod from the Scotian Shelf are found on inshore grounds in summer months (McCracken, 1957; McKenzie, 1956; Templeman, 1962).

Thus, in winter the bulk of the cod in Div. 4Vn belong to the southern Gulf of St. Lawrence stock and are fished along the edge of the Laurentian Channel mainly in depths of 80-150 fm by the international fleet. In summer, the northern fringes of the eastern Scotian Shelf stock complex move into Div. 4Vn and support a small trawl fishery. Inshore stocks are fished from spring to fall by small Canadian longline and handline vessels, and to a lesser extent by Danish seiners and gillnet vessels in shallow inshore waters (mainly 20-40 fm) which are largely unsuitable for bottom trawling. Inshore stocks are not fished in winter months due to adverse weather and ice conditions.

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THE FISHERY

The complexity of stock relationships in Div. 4T-V-W creates difficulty in assigning landings to stocks with accuracy. The following simplifying assumptions are made. All cod landings from Div. 4T and Div. 4Vn in the months January to April inclusive are assigned to the migratory (Div. 4T-4Vn (spring)) stock. Otter trawler landings from Div. 4Vn in May to December are assigned to the Div. 4Vs-W cod stock. All landings by inshore traps, seines, long-and handlines, and gillnets in May-December in Div. 4Vn are assigned to the inshore Div. 4Vn stock. As otter trawlers in most part cannot fish inshore grounds as the bottom is too rough, and as gillnetters, long-liners and handliners normally work the inshore grounds, assignment of landings to stocks on this basis should be fairly accurate.

Landings (=nominal catches) from Div. 4T and Div. 4Vn combined declined from about 78,000 metric tons in 1963 to 49,000 tons in 1967, then increased to almost 77,000 tons in 1972 (Table 1). Div. 4T landings, which are largely Canadian, have been fairly stable. After a decline from 53,000 tons in 1962, landings ranged between 34,000 tons and 46,500 tons in 1964-72, with 1972 landings of 42,000 tons (Table 2). Landings from Div. 4Vn have been more variable increasing from almost 23,000 tons in 1962 to 29,500 tons in 1964, declining to less than 15,000 tons in 1967, then increasing to almost 35,000 tons in 1972 (Table 3). [Landings for 1962-71 are from ICNAF Statistical Bulletins Vols. 12-21, and preliminary 1972 landings are from ICNAF Summ. Doc., 73/17 (revised 4 July, 1973)].

January to April landings from Div. 4Vn declined from 19,500 tons in 1963 to 6,600 tons in 1969, but were substantially higher in 1970-72. Preliminary 1972 landings were 26,100 tons (Table 4). However, monthly breakdown of 1972 landings is not yet available and annual landings have been prorated seasonally on the basis of earlier years. Adding these landings to those from Div. 4T (Table 5) gives estimated landings from the southern Gulf of St. Lawrence migratory stock. Landings from the stock declined from 70,000 tons in 1963 to 41,000 tons in 1967, then increased to about 68,000 tons in 1972.

The remainder of the landings from Div. 4Vn, i.e. those in May to December, varied between 7,000 tons and 12,000 tons in 1962-72 (Table 6) averaging 9,360 tons.

Landings from inshore stocks in Div. 4Vn ranged from 4,200 tons to 6,200 tons in 1962-72, averaging 4,920 tons (Table 7). The offshore summer fishery in Div. 4Vn ranged from 2,200 tons to 6,600 tons in 1962-72, averaging 4,440 tons (Table 8).

STATUS OF STOCKS

Div. 4T-4Vn (spring) cod stock

The fishery on this stock has been described in some detail for the 1960-70 period by Halliday (1972 a), and the following updating uses the same methodology.

Numbers of fish removed from the stock by the fishery declined from 48.7 million in 1963 to 25.6 million in 1967, then increased to 40.0 million by 1970 (Table 9). With reduced landings in 1971, numbers removed decreased to 30.1 million. However, landings increased in 1972 and numbers removed rose to 52.0 million fish - the highest removals in the 13 year period studied. About half of the fish removed in 1972 were 4 and 5 years old belonging to the 1967 and 1968 year classes.

Estimated population numbers (from Pope's cohort analysis assuming $M = 0.20$) declined from 433 million fish in 1960 to 197 million in 1966 as a succession of moderate year classes entered the fishery (Table 10). Population then increased to 292 million by 1968 with the entry of the stronger year-classes of 1964 and 1965, declined slightly in 1969 as the 1966 year-class was only of moderate strength, but may have increased to 302 million in 1970 if the 1967 year-class is indeed moderately strong as indicated by the analysis.

Instantaneous fishing mortality, F , (also from cohort analysis) in 1960-68 varied among age groups and years in a way which is consistent with changes in abundance and in landings by different gear categories (Halliday, 1972 a). Increased landings by otter trawlers in 1970 (Table 11) resulted in an increase in F for 7-10 year olds from $F = 0.36$ in 1969 to $F = 0.48$ in 1970 (Table 12) despite increased stock abundance. (Mortality on ages 7-10 results predominantly from the otter trawl fishery). Fishing mortality on the older age groups, which is generated mainly by the gillnet fishery, remained high.

Catch-per-unit-effort (cpe) of Canadian otter trawlers of 26-50 gross tons fishing in Div. 4T reached a peak of 12.8 metric tons per trip in 1970, but declined to 9.2 mt/trip in 1971, then rose to 9.8 mt/trip in 1972. Spanish catch-per-effort in Div. 4Vn (spring) also declined substantially in 1971 (Table 13).

Thus, increased landings in 1970 resulted in part from increased stock abundance, but as mortality rate also increased, there must have been an increase in effort as well. In 1971, Canadian otter trawler cpe declined by 28% (Spanish otter trawler cpe by 43%) and otter trawl landings declined 18%, total landings declining by 13%. In 1971 Canadian cpe increased 7% but otter trawl landings increased 51% (total landings by 21%). The increased landings in 1972 may have depended heavily on small 4 and 5 year old fish of the 1967 and 1968 year-classes (Table 9). However, as only Canadian samples are available for the analysis, but the increase in landings resulted from increased landings by France, Portugal and Denmark, there is some uncertainty about this. Spanish data, which became available too late to be incorporated in this analysis, indicate that the Spanish fishery was based on size and age groups of cod similar to those supporting the Canadian fishery, but contained more large fish of the 1966 year-class.

The complexity of this multi-gear fishery based on a stock which exhibits substantial changes in growth rate and quite variable recruitment makes yield prediction difficult. From cpe data, abundance in 1972 was close to the long-term average ($cpe_{1960-72} = 9.5$ mt/trip, $cpe_{1972} = 9.8$ mt/trip). Landings in 1960-72 averaged 59,400 tons generating a mortality of $F = 0.40-0.50$ on fully recruited age groups. This level of F is at or above the levels which maximise yield in adjacent cod stocks. Thus, it is unlikely that an increase in F would result in any substantial increase in yield. Under the conditions of growth and recruitment in the 1960's and early 1970's, sustainable yield is unlikely to be much greater than 60,000 tons. As stock abundance in 1974 cannot be predicted from available data, it cannot be determined with accuracy whether this or some higher or lower level of removals would be appropriate for that year. Proportional changes in abundance and landings in 1970-72 suggest effort has been increasing and that F has risen above the long-term average. Thus, 1974 catches should probably not exceed 60,000 tons.

Div. 4Vn inshore stocks

Biological sampling of landings from inshore Div. 4Vn stocks is limited to three to six samples from longliners per year. However, the bulk of the removals from the stocks are made by hook and line gear. Thus, these samples give a reasonable indication of total removals by the fishery.

In the 1960-70 period removals averaged 1.9 million fish per year, varying little from year to year (Table 14). Assuming $M = 0.20$, cohort analysis gives population estimates of 17.4-19.8 million fish in 1960-68 (Table 15). Mortality rate for fully recruited age groups (ages 7-11) averaged $F = 0.35$ during the same period (Table 16).

Thus, inshore stocks in Div. 4Vn are small, and population numbers, removals and mortality rate have been stable over the last 10 years or so. The level of $F = 0.35$ is probably close to that maximising yield per recruit, and it is unlikely that these stocks could give a substantially larger yield on a sustained basis.

Div. 4Vn offshore summer fishery

Landings from this fishery, which have averaged approximately 4,500 tons in recent years, are attributable to the Div. 4Vs-W cod stock complex. Previous assessments of this stock did not include this summer Div. 4Vn fishery (Halliday 1972 b). The most recent conclusions of the ICNAF Assessments Subcommittee (ICNAF Redbook 1973, Pt. I, p 71) are that this stock is at least fully exploited and possibly overexploited, and that the current quota level of 60,000 tons may be too high. The fishery in Div. 4Vn is small in relation to that in Div. 4Vs-W and inclusion in the analysis would not result in major changes in conclusions on stock status. Thus, Div. 4Vn landings are from a fully, or over, exploited stock and any substantial increase in landings is unwarranted.

DISCUSSION

For each of the three stocks which are fished in Div. 4Vn (as well as elsewhere), it does not appear that increase in exploitation over recent average levels is desirable from the point of view of stock management. The average landings associated with these exploitation rates are:

Div. 4T-4Vn (spring) stock	- 60,000 tons
Div. 4Vn inshore stocks	- 5,000 tons
Div. 4Vn offshore summer fishery	- 5,000 tons
	(rounded up),

giving a total of 70,000 tons from Div. 4T and Div. 4Vn combined.

In setting up a management regime for these fisheries, attention should be given to ways in which equitable distribution of fishing mortality over stocks can be ensured. Otherwise, overexploitation of some component stocks could result, as could major disruption of fisheries.

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TABLE 1. Division 4T-4Vn Cod - Nominal Catches (metric tons round)

Year	Canada (m & n)	France	Portugal	Spain	U.S.S.R.	U.S.A.	Poland	Den(F)	UK	Norway	Germany	Non-M	Total
1962	59,361	5,642	3,930 *1	6,993	*1	-	-	-	-	-	-	-	75,926
63	60,876	228	4,725	11,976	32	2	-	-	-	-	-	-	77,839
64	59,414	2,501	320	8,765	9	1	-	-	170	-	-	-	71,180
65	65,468	3,851	1,857	3,266	415	-	-	-	160	-	-	9	75,026
66	56,740	4,945	138	2,230	543	-	-	-	-	128	-	-	64,724
67	43,076	1,879	85	3,601	9	-	-	-	258	-	-	33	48,941
68	50,023	572	25	2,983	-	-	-	-	-	-	-	-	53,603
69	54,422	488	307	1,671	-	-	71	-	-	-	-	-	56,959
70	56,055	3,004	2,474	12,807	-	5	7	-	-	-	1	-	74,353
71 *2	56,029	627	126	10,224	-	-	-	-	-	-	-	-	67,006
72	53,841	8,846	3,402	7,471	-	73	1	3,114	82	-	-	-	76,830

*1 Div. 4V unk. catches allocated to subdivision by prorating on allocated part of catches.

*2 Preliminary statistics.

TABLE 2. Div. 4T Cod - Nominal Catches (metric tons round).

<u>Year</u>	<u>Total Can. (m,n)</u>	<u>France</u>	<u>Portugal</u>	<u>Spain</u>	<u>U.S.A.</u>	<u>Den. (F)</u>	<u>U.K.</u>	<u>Total</u>
1962	49,994	594	-	2,630	-	-	-	53,218
63	50,072	-	-	642	1	-	-	50,715
64	40,970	422	-	226	-	-	-	41,618
65	45,453	912	67	39	-	-	-	46,471
66	37,227	1,009	-	12	-	-	-	38,248
67	32,918	481	-	811	-	-	35	34,245
68	37,467	302	-	141	-	-	-	37,910
69	40,624	259	-	22	-	-	-	40,905
70	42,616	520	148	126	-	-	-	43,410
71	40,644	2	-	23	-	-	-	40,669
72*	39,982	495	364	577	-	672	-	42,090

* Preliminary statistics.

TABLE 3. Div. 4Vn Cod - Nominal Catches (metric tons round)

Year	Total Can(m & n)	France	Portugal	Spain	U.S.S.R.	U.S.A.	Poland	Den(F)	UK	Norway	Germany	Non-M	Total
1962	9,367	5,048	3,930 *1	4,363	*1	-	-	-	-	-	-	-	22,708
63	10,804	228	4,725	11,334	32	1	-	-	-	-	-	-	27,124
64	18,444	2,079	320	8,539	9	1	-	-	170	-	-	-	29,562
65	20,015	2,939	1,790	3,227	415	-	-	-	160	-	-	9	28,555
66	19,513	3,936	138	2,218	543	-	-	-	-	128	-	-	26,476
67	10,158	1,398	85	2,790	9	-	-	-	223	-	-	33	14,696
68	12,556	270	25	2,842	-	-	-	-	-	-	-	-	15,693
69	13,798	229	307	1,649	-	-	71	-	-	-	-	-	16,054
70	13,439	2,484	2,326	12,681	-	5	7	-	-	-	1	-	30,943
71	15,385	625	126	10,201	-	-	-	-	-	-	-	-	26,337
72 *2	13,859	8,351	3,038	6,894	-	73	1	2,442	82	-	-	-	34,740

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*1 4V unk. catches allocated to subdivision by prorating on allocated part of catches.

*2 Preliminary statistics.

TABLE 4. Div. 4Vn (January-April Inclusive) Cod Nominal Catches (metric tons round).

Year	Canada (m & n)	France	Portugal	Spain	U.S.S.R.	U.K.	U.S.A.	Norway	Germany	Non-M	Den(F)	Total
1962	1,580	4,619	2,612	4,311	-	-	-	-	-	-	-	13,122
63	3,591	228	4,496	11,172	-	-	-	-	-	-	-	19,487
64	9,024	1,372	-	8,356	6	170	1	-	-	-	-	18,929
65	10,888	1,260	1,325	2,923	-	160	-	-	-	-	-	16,556
66	10,438	3,726	138	2,173	-	-	-	128	-	-	-	16,603
67	2,866	1,398	85	2,470	9	223	-	-	-	18	-	7,069
68	6,214	226	25	2,176	-	-	-	-	-	-	-	8,641
69	5,142	120	307	1,038	-	-	-	-	-	-	-	6,607
70	4,732	2,450	2,326	11,540	-	-	-	-	1	-	-	21,049
71	6,916	624	126	8,040	-	-	-	-	-	-	-	15,706
72*	6,982*	8,351	3,038	5,170*	-	82	73	-	-	Poland 1	2,442	26,139

* Preliminary statistics, Spain 75% of yearly total, Can(n) 80% of yearly total included with Can(m).

TABLE 5. Div. 4T-4Vn (January-April) Cod - Nominal catches (metric tons round).

Year	Canada (m & n)	France	Portugal	Spain	U.S.S.R.	U.K.	U.S.A.	Norway	Germany	Non-M	Den(F)	Total
1962	51,574	5,213	2,612	6,941	-	-	-	-	-	-	-	66,340
63	53,663	228	4,496	11,814	-	-	1	-	-	-	-	70,202
64	49,994	1,794	-	8,582	6	170	1	-	-	-	-	60,547
65	56,341	2,172	1,392	2,962	-	160	-	-	-	-	-	63,027
66	47,665	4,735	138	2,185	-	-	-	128	-	-	-	54,851
67	35,784	1,879	85	3,281	9	258	-	-	-	18	-	41,314
68	43,681	528	25	2,317	-	-	-	-	-	-	-	46,551
69	45,766	379	307	1,060	-	-	-	-	-	-	-	47,512
70	47,348	2,970	2,474	11,666	-	-	-	-	1	-	-	64,459
71	47,560	626	126	8,063	-	-	-	-	-	-	-	56,375
72	46,964	8,846	3,402	5,747	-	82	73	-	-	Poland 1	3,114	68,229

* Preliminary statistics.

TABLE 6. Div. 4Vn (May-December) Cod - Nominal catches (metric tons round)

Year	Total												
	Can(m & n)	France	Portugal	Spain	U.S.S.R.	U.S.A.	Poland	Den(F)	UK	Norway	Germany	Non-m	Total
1962	7,787	429	1,318	52	-	-	-	-	-	-	-	-	9,586
63	7,213	-	229	162	32	1	-	-	-	-	-	-	7,637
64	9,420	707	320	183	3	-	-	-	-	-	-	-	10,633
65	9,127	1,679	465	304	415	-	-	-	-	-	-	9	11,999
66	9,075	210	-	45	543	-	-	-	-	-	-	-	9,873
67	7,292	-	-	320	-	-	-	-	-	-	-	15	7,627
68	6,342	44	-	666	-	-	-	-	-	-	-	-	7,052
69	8,656	109	-	611	-	-	71	-	-	-	-	-	9,447
70	8,707	34	-	1,141	-	5	7	-	-	-	-	-	9,894
71	8,469	1	-	2,161	-	-	-	-	-	-	-	-	10,631
72*	6,877	-	-	1,724	-	-	-	-	-	-	-	-	8,601

* Preliminary statistics

Table 7. Div. 4Vn Cod - nominal catches (metric tons round) Canada (M). Rows 2-8 give May-December landings for gear other than otter trawls = inshore landings. Rows 9 and 10 give other landings from Div. 4Vn, and row 11 gives total annual Div. 4Vn landings.

<u>Gear</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
Longlines	1,730	1,313	2,190	2,606	788	3,798	3,895	2,124	2,455	3,300	3,229	3,725	3,184
Handlines	538	912	960	945	-	-	-	1,398	960	848	495	696	286
Seines	78	60	108	88	69	146	134	207	183	107	83	106	121
Fixed nets	7	41	29	26	-	10	17	44	163	6	99	2	-
Gill nets	-	16	34	110	-	110	105	139	110	115	75	41	248
Unknown	457	479	1,027	457	3,581	1,326	2,038	1,537	554	634	1,054	770	394
Total (May-Dec.)	<u>2,810</u>	<u>2,821</u>	<u>4,348</u>	<u>4,232</u>	<u>4,438</u>	<u>5,390</u>	<u>6,189</u>	<u>5,449</u>	<u>4,426</u>	<u>5,010</u>	<u>5,035</u>	<u>5,340</u>	<u>4,233</u>
Same gear (Jan.-Apr.)	1,680	267	325	726	44	197	162	384	158	344	318	266	155
Otter trawls (Annual)	2,454	1,346	4,541	4,488	6,560	7,838	9,500	3,912	5,771	6,999* ¹	7,161	8,605	8,490* ²
Total (Annual)	6,944	4,434	9,214	9,446	11,042	13,425	15,851	9,745	10,355	12,353* ¹	12,514	14,211	12,878

*¹ Includes 282 m.t. from Table 1 not included in Table 4 (ICNAF Stat. Bull. Vol. 19)

*² Includes 253 m.t. by midwater trawl

Table 8. Div. 4Vn Cod - "offshore" nominal catches (metric tons round), i.e. May-December inclusive minus "inshore".

<u>Year</u>	<u>Canada</u>	<u>France</u>	<u>Portugal</u>	<u>Spain</u>	<u>USSR</u>	<u>USA</u>	<u>Poland</u>	<u>Non-Member</u>	<u>Total</u>
1962	3,439	429	1,318	52	-	-	-	-	5,238
1963	2,981	-	229	162	32	1	-	-	3,405
1964	4,982	707	320	183	3	-	-	-	6,195
1965	3,737	1,679	465	304	415	-	-	9	6,609
1966	2,886	210	-	45	543	-	-	-	3,684
1967	1,843	-	-	320	-	-	-	15	2,178
1968	1,916	44	-	666	-	-	-	-	2,626
1969	3,646	109	-	611	-	-	71	-	4,437
1970	3,672	34	-	1,141	-	5	7	-	4,859
1971	3,129	1	-	2,161	-	-	-	-	5,291
1972*	2,644	-	-	1,724	-	-	-	-	4,368

* Preliminary statistics

Table 9. Div. 4T-4Vn (spring) cod. Numbers removed at age, 1960-72 ($\times 10^{-3}$).

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
2	-	-	22	-	-	-	-	-	-	-	-	-	-
3	75	-	16	255	100	464	1,498	700	310	327	26	2	1,586
4	3,967	3,304	1,720	2,123	970	5,504	7,055	7,068	8,140	4,936	3,395	2,476	15,146
5	8,983	13,921	10,887	4,352	6,728	6,148	10,689	5,503	8,086	12,530	14,972	7,313	11,432
6	12,515	9,475	18,889	16,021	5,863	9,292	4,505	4,586	4,674	3,571	11,925	8,941	7,208
7	7,144	8,313	7,870	14,742	12,038	4,481	3,423	3,040	2,916	2,516	4,194	6,127	8,558
8	1,736	2,661	4,290	6,390	9,261	8,524	1,841	1,735	1,276	2,136	1,905	2,567	5,126
9	795	777	1,480	3,108	3,760	5,534	2,262	407	753	917	1,444	1,237	1,364
10	1,812	506	589	984	1,133	1,845	1,890	1,021	434	785	727	554	729
11	388	741	153	392	347	1,004	867	901	899	212	569	156	447
12	279	385	178	137	149	423	357	383	698	283	360	432	127
13	76	188	37	102	103	150	242	171	259	292	239	42	93
14	93	174	26	37	88	52	76	82	139	55	139	103	34
15	51	33	36	50	24	124	42	23	65	21	30	144	72
15+	39	130	2	35	56	49	79	17	43	40	42	39	64
Totals	37,953	40,608	46,195	48,728	40,620	43,594	34,826	25,637	28,692	28,621	39,967	30,133	51,986

TABLE 10. Div. 4T-4Vn (spring) cod. Population numbers ($\times 10^{-6}$) by age groups, 1960-70, derived by Pope's Cohort Analysis.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
3	134.4	46.0	60.7	41.6	62.9	54.2	64.9	116.1	114.0	69.5	95.9
4	143.8	110.0	37.7	49.7	33.8	51.4	43.9	51.8	94.4	93.1	56.6
5	70.8	114.1	87.1	29.3	38.8	26.8	37.1	29.6	36.0	69.9	71.7
6	47.6	49.8	80.8	61.4	20.1	25.7	16.4	20.7	19.2	22.2	45.9
7	20.0	27.7	32.2	49.1	35.8	11.1	12.6	9.4	12.8	11.5	14.9
8	6.2	9.9	15.1	19.3	26.9	18.4	5.0	7.2	4.9	7.8	7.2
9	2.8	3.5	5.7	8.5	10.0	13.6	7.4	2.5	4.3	2.9	4.5
10	4.5	1.5	2.2	3.3	4.2	4.8	6.1	4.0	1.7	2.9	1.5
11	1.3	2.0	0.8	1.3	1.8	2.4	2.2	3.3	2.3	1.0	1.6
12	0.9	0.7	1.0	0.5	0.7	1.2	1.0	1.1	1.9	1.1	0.6
13	0.5	0.5	0.3	0.7	0.3	0.4	0.6	0.5	0.5	0.9	0.6
14	0.2	0.3	0.2	0.2	0.4	0.2	0.2	0.3	0.3	0.2	0.5
Totals	433.0	366.0	323.8	264.9	235.7	210.2	197.4	246.5	292.3	283.0	301.5

Table 11. Div. 4T-4Vn (spring) cod. Landings (metric tons round) by gear, 1960-70. (Percentage of annual landings in parentheses.)

Year	Otter and pair trawls	Danish and Scottish seines	Long- and hand-lines	Gillnet	Total
1960	41,019 (62)	229 (<1)	25,171 (38)	4 (<1)	66,423
1961	42,808 (65)	716 (1)	21,888 (33)	171 (<1)	65,583
1962	43,526 (65)	1,475 (2)	20,517 (31)	1,146 (2)	66,664
1963	50,862 (72)	1,621 (2)	15,323 (22)	2,396 (3)	70,202
1964	45,325 (75)	1,985 (3)	10,237 (17)	3,000 (5)	60,547
1965	48,373 (77)	2,673 (4)	8,410 (13)	3,571 (6)	63,027
1966	36,684 (67)	2,391 (4)	6,362 (12)	9,414 (17)	54,851
1967	23,982 (58)	2,212 (5)	5,178 (13)	9,942 (24)	41,314
1968	28,217 (61)	982 (2)	4,419 (9)	12,933 (28)	46,551
1969	27,075 (57)	1,204 (3)	9,655 (20)	9,578 (20)	47,512
1970	43,009 (67)	1,721 (3)	9,937 (15)	9,789 (15)	64,456
1971	35,465 (63)	2,208 (4)	9,027 (16)	9,675 (17)	56,375
1972*	53,420 (78)	1,439 (2)	5,498 (8)	7,872 (12)	68,229

*Preliminary statistics

Table 12. Div. 4T-4Vn (spring) cod. Instantaneous fishing mortality (F) by age-group and year, derived by Pope's cohort analysis.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	\bar{F}_{60-70}
3	<.01	<.01	<.01	.01	<.01	.01	.03	.01	<.01	.01	<.01	-
4	.03	.03	.05	.05	.03	.13	.20	.16	.10	.06	.07	0.08
5	.15	.14	.15	.18	.21	.29	.38	.23	.29	.22	.26	0.23
6	.34	.24	.30	.34	.39	.51	.36	.28	.31	.20	.34	0.33
7	.50	.40	.31	.40	.46	.59	.36	.45	.29	.28	.37	0.40
8	.37	.35	.38	.46	.48	.72	.52	.31	.34	.36	.35	0.42
9	.38	.28	.34	.52	.54	.60	.41	.20	.21	.44	.44	0.40
10	.59	.45	.35	.39	.36	.56	.42	.33	.34	.36	.76	0.45
11	.38	.52	.24	.42	.23	.63	.56	.36	.55	.28	.48	0.42
12	.42	.84	.22	.35	.28	.50	.48	.51	.52	.33	1.11	0.51
13	.20	.57	.17	.19	.48	.50	.60	.45	.81	.43	.52	0.45
14	1.13	.92	.14	.25	.25	.47	.51	.41	.81	.39	.38	0.51
\bar{F}_{7-10}	.46	.37	.35	.44	.46	.62	.43	.32	.30	.36	.48	0.42
\bar{F}_{11-14}	.53	.71	.19	.30	.31	.53	.54	.43	.67	.36	.62	0.47
\bar{F}_{7-14}	.50	.54	.27	.37	.39	.58	.49	.38	.49	.36	.55	0.45

Table 13. Div. 4T-4Vn (spring) cod.
Commercial catch-per-effort.

Year	Div. 4T Can. 26-50 g.t. vessels metric tons/trip	Div. 4Vn (spring) Spain 901-1800 g.t. vessels metric tons/hour
1960	8.1	1.37
1961	9.5	1.73
1962	10.9	1.97
1963	10.5	2.96
1964	9.2	2.83
1965	8.8	1.65
1966	6.4	1.08
1967	7.0	1.56
1968	9.1	1.23
1969	12.2	2.33
1970	12.8	2.13
1971	9.2	1.22
1972	9.8	-

Table 14. Div. 4Vn inshore cod - numbers removed at age ($\times 10^{-3}$).

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
3	14	6	15	9	-	5	16	12	7	2	2
4	85	137	46	83	266	143	270	308	164	61	70
5	361	604	461	205	393	130	534	809	670	352	448
6	377	360	503	451	261	369	320	640	635	488	437
7	223	279	578	542	524	253	483	163	169	523	263
8	125	94	269	525	541	237	125	267	203	252	314
9	31	54	39	103	48	383	245	56	112	56	79
10	4	15	37	19	8	217	146	52	17	80	61
11	14	6	4	19	19	29	104	74	19	34	125
12	-	3	5	9	4	47	57	26	16	33	31
13	-	-	3	3	-	19	11	8	16	24	24
14	-	-	2	7	-	-	5	7	5	13	15
15+	-	-	-	6	2	2	13	7	1	5	1
Total	1,234	1,558	1,962	1,981	2,066	1,834	2,329	2,429	2,034	1,923	1,870

Table 15. Div. 4Vh inshore cod. Population numbers at age ($\times 10^{-3}$) from Pope's cohort analysis.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968
3	5,743	2,860	6,465	3,504	4,533	7,046	4,905	4,810	5,200
4	6,592	4,689	2,336	5,279	2,860	3,710	5,764	4,001	3,927
5	4,368	5,320	3,715	1,871	4,247	2,101	2,908	4,475	2,997
6	1,833	3,250	3,809	2,625	1,346	3,121	1,602	1,898	2,932
7	746	1,159	2,335	2,664	1,741	866	2,222	1,022	975
8	402	409	697	1,388	1,690	951	480	1,382	689
9	85	216	250	327	662	894	564	280	890
10	30	42	128	169	174	498	386	240	178
11	43	21	20	71	121	135	211	183	149
12	6	23	11	13	41	82	84	79	83
Totals	19,848	17,989	19,766	17,911	17,415	19,404	19,126	18,370	18,020

Table 16. Div. 4Vh inshore cod. Fishing mortality, F, with age from Pope's cohort analysis.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	\bar{F}_{60-68}
3	-	-	-	-	-	-	-	-	-	-
4	.01	.03	.02	.02	.11	.04	.05	.09	.05	.05
5	.10	.13	.15	.13	.11	.07	.23	.22	.28	.16
6	.26	.13	.16	.21	.24	.14	.25	.47	.27	.24
7	.40	.31	.32	.25	.40	.39	.27	.19	.21	.30
8	.42	.29	.56	.54	.44	.32	.34	.24	.39	.39
9	.51	.32	.19	.43	.08	.64	.65	.25	.15	.36
10	.16	.50	.38	.13	.05	.66	.54	.27	.11	.31
11	.44	.38	.24	.35	.19	.27	.78	.59	.15	.38
12	.17	.16	.63	1.33	.11	.99	1.35	.45	.24	.60
\bar{F}_{7-11}	.39	.36	.34	.34	.23	.46	.52	.31	.20	Mean $\bar{F}_{7-11} = .35$