



Serial No. 2081
(D.c.9)

ICNAF Res. Doc. 68/93

ANNUAL REPORT - JUNE 1968

Revision of estimated fishing activity for groundfish
in ICNAF Subareas 2 and 3, 1959-67, with remarks on
some groundfish stocks and fisheries

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INTRODUCTION

Rough estimates of groundfish fishing activity for the various ICNAF Subareas have been calculated for several years to provide a means of rapid recognition of major changes in fishing effort and catch per unit effort. Methods of calculating these estimates vary from one Subarea to another, and within some Subareas methods have been modified from time to time in attempts to refine the estimates.

Estimates of fishing activity for Subareas 2 and 3 have been recalculated for the period 1959-66; with the procedures followed outlined below. Estimates are given in more detail than previously available, e.g. by otter-trawler tonnage classes, allowing a more detailed examination of effort changes. Absolute values of fishing activity are sometimes different from those obtained by previous methods, but relative changes from year to year are not substantially altered.

Recent yields of cod, haddock and flounders in Subareas 2 and 3 are summarized by stock units where these are known, brief descriptions of distribution and seasonal fishing patterns are given, and such data as exist relating to long-term sustained yields are summarized.

ESTIMATES OF FISHING ACTIVITY

Fishing activity for groundfish in days fished was estimated for both Subareas 2 and 3 as follows:

- (1) Days fished and groundfish catches by otter trawlers were extracted from the monthly entries in the Statistical Bulletins and summarized by Division and Tonnage Class for countries reported days fished.
- (2) Summaries of days fished and hours fished were made by Division and Tonnage Class for countries reporting both. Hours fished per day fished was calculated for each Subarea and Tonnage Class.
- (3) Hours fished and groundfish catches were summarized by Division and Tonnage Class for those countries reporting hours fished only. Hours were converted to days for each Division and Tonnage Class from the ratios calculated in (2). These amounts were added to the summaries of (1), and totalled for each Subarea and Tonnage Class. No account was taken of catches for which neither days nor hours were given.
- (4) Tons caught per day fished was calculated for each Subarea and Tonnage Class. Data for Tonnage Classes over 500 GRT were combined and catch per day calculated separately for these combined groups. This value was divided into the total groundfish catch to give days fished in terms of trawlers over 500 GRT.
- (5) In assigning amounts to individual Tonnage Classes, those Tonnage Classes which did not conform to the standard groupings were entered as follows.

<u>Country</u>	<u>Reported TFI</u>	<u>Estimated TFI</u>	<u>Year</u>
Iceland	151-1300	501-900	1960
	501-1300	501-900	1961
	550-1000	501-900	1962
	600-1000	501-900	1963
Portugal	>900	901-1300	1964-65
Germany	>500	501-900	1964-66
	501-1300		
USA	0-500	151-500	1962
USSR	151-900	151-500	1964

The summarized data for Subareas 2 and 3 are presented in Tables 1 and 2 respectively.

TRENDS IN CATCHES AND FISHING ACTIVITY

In Subarea 2, groundfish catches have exceeded 300 thousand tons annually since 1965, as a result of increased effort for cod. Catch per unit effort is variable, but shows no overall trends in the area as a whole on an annual basis. The area is still a relatively new one as far as otter trawl fishing is concerned and the fishery is still developing as more local knowledge is gained by the fleets. In recent years there is a tendency to fish the spring spawning concentrations most heavily, and to extend fishing operations to previously lightly fished areas in the north.

Fishing activity in Subarea 3 declined from 1959 to 1963, but has increased greatly since then. Again this is due almost entirely to increased otter trawl effort. Total fish catches increased from an average 676 thousand tons annually in 1962-66 to over 1 million tons in 1967. Cod catches increased almost 40% to 693 thousand tons in spite of continued decline of the inshore fisheries. Catches of flounders and herring continued to increase at a very rapid pace. Otter-trawl catch per day was at a generally lower level in 1964-66 than previously.

REMARKS ON STOCKS AND FISHERIES

COD

General

Descriptions of stock divisions are given by Templeman (1962). In Subareas 2 and 3 there are at least 5 well defined stock units, with several less well-defined sub-units within some of these. Yield-effort assessments have been made only for a portion of one of these stock units, but this unit as a whole accounts for almost half the recent average yield in Subareas 2 and 3. Such assessments are complicated by possible density-dependent growth in some areas.

Labrador-Newfoundland Stock

The area occupied is 2G to the northern part of 3L. Clines in growth, age at maturity, etc. exist from north to south, but no well-defined stock separation has been demonstrated in this large area. Prevailing migration is east-west; onshore for feeding from late May to early September, returning offshore to spawn in spring. Spawning is earlier in the north than in the south. Some north-south movement to and from described spawning areas in 2G, 2J and 3K is superimposed on the general east-west pattern.

Recent average yield (Table 3) is 376 thousand tons (400 thousand in 1967). Greatest catches have been taken in the 1965-67 period. About 3/4 of the catch is taken by otter trawl, mainly from the spring spawning concentrations, with a secondary peak in autumn as fish move offshore. Traditionally, most fishing has been done in 2J, but catches in 2GH increased from 8 thousand tons in 1964 to 93 thousand tons in 1966. Potential in these northern areas is not known, but is not likely to be great since cod are here approaching the northern limit of their North American range. Long-term yield, based on parameters for 2J only, appears to be at the level of the present fishery (about 400 thousand tons). This might be maintained with as much as 25-30% less effort than at present (May, MS, 1967).

Recruitment variations are relatively small, though occasional year-classes may be as much as twice as abundant as others. USSR carries out regular young fish surveys in the area.

Flemish Cap Stock

This stock is confined within 3M, is fished almost entirely by otter trawl, and supports a relatively small fishery (average 34 thousand tons 1962-66), though catches have tended to increase (54 thousand tons in

1965). Fishing tends to be concentrated in summer and autumn. Recruitment variations appear to be minor.

Division 3L

This is a boundary area between the Labrador-Newfoundland stock and southern Grand Bank stock, and probably contains elements of both. Summer migration occurs to the shallower parts of the Bank as well as inshore. Recent catches are about 1/2 by otter-trawl, 1/3 by inshore gears, with most of the remainder taken by pair trawls and dory fishing. A major increase in the recent average yield (180 thousand tons), occurred in 1967 (255 thousand tons), probably due to increased otter trawl effort.

Southern Grand Bank Stock

This stock occupies Divisions 3N and 3O, tending to be concentrated along the edge of the Grand Bank in winter, and moving over the shallower parts in summer. Fishing is concentrated in the May-September period. Most of the catch, but in varying proportions, is taken by otter trawl and pair trawl, with small amounts by dory fishing. From an average level of 73 thousand tons in 1962-66 the catch tripled to 220 thousand tons in 1967. This was more than double the previous maximum. Beverton (1965) estimates that the 1958 level of effort may have exceeded by a considerable margin that corresponding to the maximum yield. Average annual yield from 1955-58 was 77 thousand tons.

St. Pierre Bank Stocks

These are confined to Division 3Ps. Two stocks appear to inhabit the area, one remaining on the Bank, while the other moves inshore in summer (Templeman, 1962). Cod are distributed on the western and southern slopes in spring; on the shallower parts of the Bank and inshore in summer and autumn. Average annual yield is 52 thousand tons. About 1/4 is taken by otter trawl, 1/2 by inshore gears, and 1/4 by pair trawl. Variations in recruitment are moderate. A separate, small stock is associated with Burgeo Bank.

West Newfoundland Stock

These fish inhabit Division 3Pn in winter-spring and Divisions 4R and 4S in summer-autumn. Average yield is 66 thousand tons, and has not varied much from 1962-67. Most fishing occurs in February-March in southern 4R and 3Pn. Current knowledge is summarized by Wiles and May (1968).

HADDOCK

General

There are no resident stocks in Divisions 2G to 3L, and quantities taken from this area seldom exceed 1 thousand tons annually. There is probably a very small stock in Division 3M, but yields are negligible from this area also. Thus significant quantities are found only in Divisions 3N, 3O, and 3Ps. However, year-class fluctuations are extreme and in the past the fishery has usually been based on no more than two year-classes at any given time.

Southern Grand Bank Stock

Yields have declined since the demise of the 1955 year-class, and averaged only 12.6 thousand tons annually from 1962-66 (8 thousand tons in 1967). No large year-classes have appeared since 1955, and there are no immediate prospects for increasing yield. Haddock spend the winter and spring on the southwest edge of the Grand Bank, moving north and east into shallower areas in summer. Regular surveys of the area are carried out by Canadian research vessels.

St. Pierre Bank Stock

No significant yields have been obtained in Division 3Ps since the 1949 year-class disappeared from the fishery in 1956-57. Recent average annual yield is 2 thousand tons. Again there are no immediate prospects for increased yields.

FLOUNDERS

Four species contribute to the catches: American plaice, Greenland halibut (turbot), witch flounder (greysole), and yellowtail flounder. Of these, plaice contribute most to the catches, but large amounts of unspecified flounders are reported each year.

Of the four species, only plaice appear to be widely distributed over the area in any quantity. However most of the yield comes from Divisions 3L and 3N. These are probably separate stocks. Next in importance is Greenland halibut, but exploitable stocks of this species appear to be present mainly in deep bays along the Newfoundland coast. Witch flounder is widely distributed, but little quantitative data are available. Yellowtail flounder are confined largely to Divisions 3N and 3O.

Significant flounder fisheries have existed only in Divisions 3L and 3N (average annual yield 1962-66 24 thousand tons and 21 thousand tons respectively). Catches increased greatly in 1967 to 54 thousand tons in 3L, 36 thousand tons in 3N, and from an average 6 thousand tons to 40 thousand tons in Division 3O.

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Table 1. Subarea 2 nominal catch, catch per day and fishing activity, 1959-67. + indicates amounts <500 tons or <50 days fished.

Catches (000's tons)	1959		1960	1961	1962	1963	1964	1965	1966	1967
	OTD	41	171	171	246	230	191	197	307	313
Other T.	19	17	17	19	25	25	16	23	24	27
Inshore										
Other							+		1	
Total	60	183	183	265	255	216	213	333	338	295*
Hand set	+			+	-	+	+	+	+	+
Small	53	93	93	26	8	6	27	23	14	17
Medium	+	+	+	+	+	+	+	1	1	3
Large	+	2	2	1	+	+	3	7	3	4
Flourishes	1	6	6	4	2	1	2	12	9	+
Other G.I. (MOTIFIN)										
OTD (MOTIFIN)	177	272	272	296	265	223	245	376	365	312
OTD (MOTIFIN)										
OTHER FISH	+	1	1	1	1	+	6	1	1	1
TOTAL FISH	177	280	280	297	266	223	251	377	366	320
Days fished (000's)										
OT <50 GWT										
" 51-150 "										
" 151-500 "	+	5.1	5.1	3.9	2.7	+	+	0.2	3.9	1
" 501-900 "	0.9	1.2	1.2	0.7	+	+	3.7	4.7	6.1	1
" 901-1300 "	1.0	4.3	4.3	6.0	5.6	5.8	5.6	7.5	6.1	1
" >1300 "	0.2	1.5	1.5	3.0	2.1	0.6	1.9	2.2	3.1	
ALL OT >500 GWT	2.1	7.6	7.6	9.4	7.9	6.4	10.9	13.9	13.0	
Tons/day										
OT <50 GWT										
" 51-150 "										
" 151-500 "	3	6	6	6	12	1	2	9	24	
" 501-900 "	42	36	36	29	46	20	13	21	23	
" 901-1300 "	12	25	25	22	30	29	27	35	34	
" >1300 "	20	31	31	36	26	77	31	37	37	
ALL OT >500 GWT	26	29	29	27	29	31	21	25	26	
Fishing activity for groundfish in Oct's equivalent days by trawlers >500 GWT	4.5	9.9	9.3	10.9	9.3	7.3	11.7	15.1	14.0	

* includes estimated 50,000 tons by non-trawler countries.

Table 2. Area 3 nominal catch, catch per day and fishing activity, 1959-67.
+ indicates amounts <500 tons or <50 days fished.

	1959	1960	1961	1962	1963	1964	1965	1966	1967
Catches (OO's tons)									
OT	160	186	235	175	223	307	262	289	282
Inshore	180	184	136	150	155	177	114	112	102
Other	35	101	90	64	38	130	182	102	102
Total	225	471	461	389	466	581	496	499	493
Haddock	35	67	80	35	15	12	9	11	11
Redfish	245	99	90	61	65	95	112	90	90
Mackerel	3	3	2	2	1	2	1	1	1
Trawlers	25	35	30	27	34	57	22	11	15
Other pelagic	19	17	11	8	7	7	17	11	12
Total pelagic	753	692	674	532	592	751	716	711	693
Herring	5	5	4	5	6	3	8	23	76
Other pelagic	+	+	1	1	1	2	1	1	2
Total pelagic	5	5	5	6	7	5	9	24	30
Other fish	6	7	5	5	4	14	6	7	11
Total fish	764	704	684	539	605	770	731	712	704

Days fished (OO's)	1959	1960	1961	1962	1963	1964	1965	1966	1967
OT	0.5	0.1	+	0.1	0.3	0.1	0.2	0.7	0.7
" 51-150	0.5	0.6	0.5	0.5	0.3	0.5	0.6	0.7	0.7
" 151-500	3.0	11.6	16.7	11.8	13.9	13.3	16.5	12.1	12.1
" 501-900	0.5	0.7	0.3	0.1	0.2	0.3	7.6	3.3	3.3
" 901-1800	7.7	5.9	7.7	5.5	5.0	6.7	7.5	11.1	11.1
" >1800	6.0	5.8	3.6	3.0	3.3	5.5	3.0	3.3	3.6
All OT >500 GRT	20.5	11.0	11.3	7.6	3.5	10.5	13.5	13.3	13.3

Tons/day	1959	1960	1961	1962	1963	1964	1965	1966	1967
OT			3	3	3	3	3	3	3
" 51-150	7	7	7	4	3	3	4	3	3
" 151-500	12	10	9	11	9	8	6	10	10
" 501-900	26	18	17	12	13	11	14	16	16
" 901-1800	17	17	22	22	24	23	17	19	19
" >1800	25	29	23	22	17	19	21	27	27
All OT >500 GRT	19	22	24	22	25	19	16	21	21

Fishing activity for groundfish in OOO's equivalent days by trawlers >500 GRT

39.4 30.7 28.3 23.9 23.5 39.7 14.9 34.5

* includes estimated 30,000 tons taken by Denmark (7) and non-member countries.

Table 3. Recent yields of cod, haddock and flounders in Subareas 2 and 3.

Species	Area	Yields (000's tons)			1967
		1962-66			
		Minimum	Maximum	Average	
COD	2G-3K	338.5	427.7	375.9	400.0
	3L	156.4	215.1	180.6	255.4
	3M	15.9	53.9	34.2	36.3
	3NO	34.4	106.0	73.1	220.2
	3Ps	46.7	64.0	52.1	61.7
	3Pn-4R	57.8	76.9	66.4	71.0
HADDOCK	3NO	5.3	32.8	12.6	8.0
	3Ps	1.5	2.5	2.0	2.4
FLOUNDERS	2G-J	0.4	6.8	2.7	4.4
	3K	0.3	8.7	4.4	7.9
	3L	13.7	31.6	23.5	54.2
	3M	0.2	5.3	2.4	0.1
	3N	4.0	45.7	20.6	36.0
	3O	3.3	15.4	6.3	39.9
	3Ps	1.7	5.4	2.9	8.2
	3Pn	0.1	0.3	0.2	3.8