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The total Polish catch increased to 72,034 metric tons in 1966 from 56,630 tons taken in 1965. This may be attributed both to an increase in fishing effort and the efficiency of the fishery. On different fishing grounds, mainly in Subareas 2 and 3, 17 Polish factory trawlers fished principally for cod and then for redfish. These vessels made 39 trips to the ICNAF Area compared with 26 trips made by 13 factory trawlers in 1965. In addition, 4 stern freezer trawlers (4 trips) operated in Subarea 5, mainly for herring. Comparison of the 1966 and 1965 catches by major species and groups of species is shown in Table 1.

Table 1.

Species	1966		1965	
	tons	percent	tons	percent
Redfish	14,962	20.8	24,709	43.6
Cod	36,448	50.6	21,719	38.4
Flatfish	3,334	4.6	6,341	11.2
Greenland halibut	1,119	1.6	591	1.0
Halibut	168	0.2	443	0.8
Other fish and groundfish	1,334	1.8	1,379	2.4
Herring	14,663	20.4	1,447	2.6
Mackerel	6	-	1	-
Total	72,034	100.0	56,630	100.0

The above data show a decrease in catches of redfish and flatfish and an increase of cod and herring.

Subarea 1.

A. Status of the Fisheries

In January and March in Subarea 1 only 2 factory vessels scouted occasionally for fish concentrations. Results of catch and effort of these ships are shown in Table 2.

Table 2.

ICNAF Div.	Catch in metric tons			No. hours Fishing	No. days Fished
	Redfish	Cod	Flatfish		
1B	6	468	-	137	13
1C	31	196	1	144	16
1D	-	6	-	17	1
1E	9	129	-	109	14
Total	46	799	1	407	44

The scouting vessels found almost exclusively cod and rarely redfish, with a poor yield of both species. The poor catches and the rough bottom which caused rapid and excess wear to the nets made the captains give up further scouting for fish on these fishing grounds.

No research work was carried out in Subarea 1.

Subarea 2

A. Status of the Fisheries

In Subarea 2 a number of factory trawlers operated for 9 months of the year. From July to September there was a period of poor yield and no catches were made in these fishing grounds. Catches and fishing effort in Subarea 2 are shown in Table 3.

Table 3.

ICNAF Div.	Catch in metric tons				No. hours fishing	No. days fished
	Redfish	Cod	Flatfish	Other fish		
2H	474	11,884	290	1	4,312	413
2J	679	17,866	659	-	7,715	655
Total	1,153	29,750	949	1	12,027	1,068

The catch per effort of the factory trawlers in Subarea 2 varied from 10 tons (November in Div.2G) to 44.4 tons daily (January in Div.2J). In the first 5 months of the year, the yield per day was about 30 tons, while in the other months it amounted to about 17 tons. The largest catches were made in Div.2J in the winter months.

B. Research Work

Samples of fish for biological study were obtained in Div.2J in April and May from on board two factory trawlers.

1. Redfish. In May 1,831 redfish (mentella-type) 25 to 44 cm in length were measured. The mean length of males made 33.5 cm, females 35 cm and the mean length of both sexes was 34.2 cm. Examination of these fish showed that 93% of the females had gonads in the resting stage.

2. Cod. In April 3,854 cod were measured. The length of these fish varied from 25 to 93 cm with most in the 45-65 cm range. The mean length was 53.6 cm. Cod caught by the Polish trawlers were mainly 5-8 years of age. Over 85% of the fish caught were immature (Stage I and II), 6.2% had running gonads (Stages VI and VII) and 5.9% were spent fish (Stage VIII). In May measurements made on 3,724 specimens have shown that in Div.2J the fish were considerably smaller than in April. The bulk of the catches consisted of cod 30-50 cm in length and 4-7 years of age. The mean length of cod caught in May was 41.4 cm. Over 95% of these fish were in Stages I and II of maturity. The remaining 4.5% were spent males.

3. Flatfish. On Hamilton Inlet Bank (Div.2J), in May, 3,538 American plaice were measured. The fish were 28-36 cm in length, mean length 34.7 cm. At this time the yield of American plaice, as a bycatch in the cod catches, amounted to about 1,500 kg per day.

At the end of May on the same ground there were good catches of Greenland halibut. The yield amounted to 12-15 tons daily, average 1,200 kg per hour. The 999 fish measured ranged from 32-95 cm in length and their mean length was 60.7 cm.

Subarea 3

A. Status of the Fisheries

In Subarea 3 some factory trawlers were operating throughout the year, though their number was changing. The greatest number of vessels operated in Div. 3K, the fewest in Div.3N.

The yield changed depending on the season. In Div.3K, the lowest yield (10 tons per day) was obtained in October, the highest (32 tons per day) in February. In Div.3N, the mean yield fluctuated from 10 tons in April to 25 tons in August. The best catches were made in Div.3K from March to May. The catches and the yield per unit in Subarea 3 are shown in Table 4.

Table 4.

ICNAF Div.	Catch in metric tons			No. hours Fishing	No. days Fished
	Redfish	Cod	Flatfish		
3K	10,490	4,454	2,563	9,710	765
3L	234	305	947	1,405	112
3M	105	93	20	275	23
3N	2,476	613	78	1,850	159
3O	452	152	47	395	35
3P	-	9	-	38	4
Total	13,757	5,626	3,655	13,673	1,098

B. Research Work

The most important species were sampled mainly in Div.3K on board the factory trawler Feniks during her trip from 15 March to 8 June 1966. From 5 May to 23 August 1966, samples were taken on board the factory trawler Andromeda.

1. Redfish. The results of measuring redfish are shown in Table 5.

Table 5.

Species	Month	No. fish measured	Percentage		Length in cm.	
			♂	♀	Range	Mean
<u>S. mentella</u>	March	1,831	50.6	49.4	27-46	35.0
	April	2,437	43.4	56.6	28-46	36.5
	May	3,997	39.8	60.2	28-45	36.0
<u>S. marinus</u>	April	962	22.0	78.0	40-60	48.9

As the above data show redfish (mentella-type) were the same length range from March to May. A greater number of females was noted. In addition, 49.4% of the females of redfish (mentella-type) were in the running stage and 20.3% were spent.

Observations on the maturity of redfish (marinus-type) have shown that in April in Div.3K 67.1% of the females were in the running stage and 31.0% were spent. These observations indicate that in Div.3K from March to May redfish (mentella-type) as well as redfish (marinus-type) were producing larvae.

2. Cod. From 9 to 23 May in Div.3K, 5,681 cod were measured. These fish were 19 to 117 cm in length. Fish 35-65 cm in length and 4 to 8 years old predominated in the catches. Mean length was 52.7 cm. The examination of the gonads showed that in May 87.2% of the fish were in the juvenile (I) and resting (II) stage of maturity. In addition there were 4.2% in the running stage (VII and VI) and 3.9% spent.

3. Flatfish. On Ritu Bank (Div.3K) the bycatch was made up of flatfish. There were American plaice, witch flounder and Greenland halibut. Measurements of 1,350 of American plaice showed that these fish were 28 to 45 cm in length (average length 38.2 cm). Witch flounder were caught in much smaller quantities and the measurement of 386 specimens showed the length range to be 32-65 cm (average 50.2 cm).

In May and June on Ritu Bank the yield of Greenland halibut was 800-1,000 kg per hour. The 1,455 fish measured ranged in length from 25 to 95 cm. The mean length of these fish was 55.2 cm.

In the beginning of July on Woolfall Bank (Div.3L) there was the yield of 800 kg per hour of American plaice. The length range of these fish was 18 to 64 cm (mean length 34.5 cm).

In July, when scouting for cod on Green Bank-St. Pierre Bank (Div.3Ps) a rather small quantity of American plaice, witch flounder and yellowtail were caught. Results of measurement made on these fish are as follows:

American plaice	:	18-61 cm, mean length 34.5 cm
Witch flounder	:	22-55 cm, " " 33.9 cm
Yellowtail	:	22-54 cm, " " 39.7 cm.

Subarea 4

A. Status of the Fisheries

In Subarea 4 from June to August the factory trawlers occasionally scouted for fish concentrations. The very small catches are shown in Table 6.

Table 6.

ICNAF Div.	Catch in metric tons		No. hours Fishing	No. days Fished
	Cod	Herring		
4X	7	190	8	5

B. Research Work

I. Environmental Studies

During the cruise of R/V Wieczno in November-December 1966, hydrographic studies were carried out in Subarea 4. The results of temperature measurements are given in Table 7.

Table 7. Temperature cross sections in Subarea 4.

Depth (m) Position	Temperatures (°C)						Bottom
	0	25	50	75	100	150	
Southeast from Halifax, 19-20 November 1966							
44°12'N	8.40	8.38	4.02	2.08	-	-	2.90 (90 m)
63°29'W							
43°47'N	9.51	9.51	3.62	2.32	3.15	-	3.85 (140 m)
63°08'W							
43°31'N	9.52	9.55	9.25	3.65	3.12	5.21	5.30 (205 m)
63°05'W							
43°24'N	9.28	9.29	4.04	2.69	2.77	-	2.77 (100 m)
62°49'W							
42°51'N	9.14	9.10	6.28	5.96	7.42	7.44	5.56 (230 m)
62°36'W							
Along the 65°W geogr. Length, 26-27 November 1966							
43°12'N	6.60	6.40	5.41	3.21	3.23	-	3.08 (162 m)
65°00'W							
42°48'N	7.58	7.53	5.78	3.76	-	-	3.78 (95 m)
65°00'W							
42°36'N	7.99	7.38	5.34	3.70	-	-	2.91 (110 m)
65°00'W							
42°20'N	8.61	8.58	3.26	3.16	3.04	3.96	4.77 (500 m)
65°02'W							
Along the 61°W geogr. Length, 12 November 1966							
44°41'N	7.34	7.30	7.44	3.95	2.53	-	1.61 (140 m)
60°58'W							
44°20'N	7.78	8.10	7.61	4.52	-	-	4.31 (85 m)
61°00'W							
44°05'N	7.73	7.72	-	-	-	-	7.17 (56 m)
61°00'W							

Observations show an increase of surface salinity from the shore toward the open sea: from 30.66‰ (position 44°12'N to 63°29'W) to 32.01‰ (position 42°20'N to 65°02'W). It was also found that the salinity increases along the coast of Nova Scotia from the northeast (30.90‰) toward the southwest (31.83‰).

Salinity of the bottom layer varies with the geographical position and depth: from north to south and from the shallow to the deeper waters. Near the Nova Scotia coast the salinity was 32.99‰ and on the slopes of the Shelf it increased to 34.56‰ and 34.61‰.

Oxygen content in the surface water layer varied from 92 to 101% of saturation. Over the shallows (e.g. on the northwestern part of Sable Bank) saturation was 86 to 93%, while in the deeper layers near the slopes of the Shelf the saturation decreased to 55 and 71%.

Phosphate content expressed as P₂O₅ was estimated on the Scotian Shelf along the 65° meridian and from the Halifax light vessel to Sambro Bank. At the end of November the surface waters contained only traces of P₂O₅ and only exceptionally amounted to 5 mg/m³. But, at station 44°12'N, 63°29'W, the content of P₂O₅ amounted to 10 mg/m³. At the bottom, phosphate content amounted to 30-60 mg/m³, and in one case even 90 mg/m³.

II. Biological Studies

Fishing survey by R/V Wieczno in Subarea 4, Browns Bank (Div. 4X). In November catches varied from 20 to 1,000 kg per hour (average 300 kg per hour) in depths of 115 to 320 m. The catch composition included 80% argentine and about 10% cod. Rather good results were obtained at 250 to 300 m depths.

Argentines were found to be concentrated by sizes. In shallower waters (to 260 m) smaller (mean length 26.2 cm) fish were found. In deeper waters (about 300 m) the mean length of argentine was 34.6 cm. On Browns Bank argentine were 18 to 48 cm in length.

Sambro Bank (Div. 4W). In mid-November yields were very low, being from 10 to 90 kg per hour (average 50 kg per hour) at fishing depths of 110-240 m. Haddock made up about 50% of the fish landed. Results were similar in mid-December.

Emerald Bank (Div. 4W). At the end of November, yields were poor varying from 5-45 kg per hour (average 25 kg per hour). American plaice and yellowtail were the main species caught at depths of 115-160 m. The lengths of 113 American plaice ranged from 10 to 48 cm (average 23.9 cm).

Sable Island Bank (Div. 4W). At the end of November on the southern slopes down to 40-50 m, the average yield was 45 kg per hour. In mid-December down to 60-90 m, the yield was 20-240 kg per hour (average 130 kg per hour). American plaice made up the main bulk of the catches in November and December. The length of these fish was 17 to 50 cm (average 27.9 cm).

On the northern slopes of Sable Island Bank at the end of November and about mid-December, the average catch was 60 kg per hour of cod, flatfish and alewife. The lengths of 328 American plaice varied from 9 to 40 cm (average 23.9 cm). There were also 147 alewives which ranged in length from 25 to 33 cm (average 29.8 cm).

On the southwestern slopes of Sable Island Bank at 60-100 m in December, the yield was 290-1,400 kg per hour (average 760 kg per hour). Composition of the catch was haddock (70%), mackerel (12.6%), American plaice (7.8%) and other fish (9.6%). The lengths of 509 haddock varied from 17 to 73 cm (mean length 36.6 cm).

Banquereau Bank (Div. 4V). On this fishing ground in December a few hauls were made at 60-100 m. The yield was from 20 to 175 kg per hour (average 70 kg per hour). More than 70% of catch was haddock and only 7% cod. The length of haddock ranged from 15 to 75 cm (mean length 39.3 cm) and the length of cod from 17 to 49 cm (mean length 28.9 cm).

Subarea 5

A. Status of the Fisheries

Catches and catch per unit effort of Polish factory trawlers and freezer trawlers are given in Table 8.

Table 8.

ICNAF Div.	Catch in metric tons			No. Hours Fishing	No. Days Fished
	Cod	Herring	Other fish & groundfish		
	Factory trawlers				
5Z	171	11,564	82	2,728	335
	Freezer trawlers				
5Z	98	2,909	1,279	1,022	132

The fishing season for trawlers of both types commenced in May. The operations of the freezer trawlers were completed in September, and of the factory trawlers in October. The catches of the factory trawlers oscillated from 21 tons per day in May to 47 tons per day in September. The catches of the freezer trawlers fluctuated from 24 tons per day in May to 36 tons in September. The best catches by both types of vessels were obtained from July to September.

B. Research Work

I. Environmental studies

From 4 November to 7 December 1966, R/V Wieczno, 9 hydrographic sections were completed. The temperatures are shown in Table 9. During the course of these observations catches were made in order to find out in which temperature the greatest concentration of fish occurred. Good catches (2,600 kg per hour) were obtained on 10 November northwest of Cultivator Shoal in bottom water temperatures of 5 to 6°C.

Table 9. Temperature cross sections in Subarea 5

Depth (m) Position	Temperatures (°C)						Bottom
	0	25	50	75	100	150	
Section along 67° meridian - 4-5 November 1966							
40°05'N							
67°00'W	10.51	10.26	9.40	-	-	-	9.09 (73 m)
40°48'N							
67°00'W	10.42	10.31	5.83	5.80	-	-	6.16 (90 m)
40°39'N							
67°05'W	10.16	10.18	8.36	6.05	5.20	7.89	7.22 (200 m)
40°35'N							
67°04'W	10.00	10.00	8.10	5.10	5.14	8.40	5.55 (300 m)
Section along 68° meridian - 6 November 1966							
40°50'N							
68°00'W	10.34	11.05	-	-	-	-	11.01 (50 m)
40°32'N							
68°00'W	10.58	10.62	10.02	8.70	-	-	8.31 (94 m)
40°20'N							
68°00'W	10.70	10.58	9.62	6.07	6.74	8.01	7.55 (200 m)
40°16'N							
68°00'W	11.13	12.08	8.74	9.45	7.22	7.94	4.84 (500 m)
Section along 69° meridian - 6-8 November 1966							
40°04'N							
68°59'W	12.84	12.82	9.88	8.48	8.62	8.85	7.34 (230 m)
40°19'N							
69°00'W	12.32	12.30	9.14	7.32	-	-	7.35 (95 m)
40°40'N							
69°00'W	10.44	10.40	10.34	-	-	-	10.20 (63 m)
41°00'N							
69°00'W	11.54	11.48	9.85	-	-	-	7.50 (58 m)
41°18'N							
69°00'W	10.19	9.52	4.88	4.46	4.44	4.25	-
41°44'N							
69°00'W	10.06	10.11	7.32	3.32	4.27	4.46	4.45 (167 m)
42°06'N							
69°00'W	9.58	8.92	8.63	3.94	3.96	4.62	4.62 (182 m)
42°23'N							
69°02'W	8.84	8.80	8.60	6.60	5.56	4.38	5.80 (230 m)
Section along 68° meridian - 9-10 November 1966							
41°50'N							
68°00'W	11.58	11.44	-	-	-	-	11.43 (45 m)
41°54'N							
68°00'W	11.06	10.94	10.26	9.24	5.00	-	5.80 (140 m)
42°06'N							
67°58'W	9.42	9.14	8.74	7.42	5.20	4.76	6.27 (217 m)
42°28'N							
67°55'W	8.65	8.42	8.18	6.32	5.84	5.96	6.00 (180 m)
Section NW off Cultivator Shoal - 10 November 1966							
41°47'N							
68°40'W	11.48	10.27	9.93	9.07	7.48	4.62	5.40 (200 m)
41°37'N							
68°28'W	12.24	11.60	10.98	4.72	5.16	-	4.96 (120 m)
41°32'N							
68°21'W	12.07	12.04	-	-	-	-	12.00 (40 m)

Table 9. (continued)

Depth (m) Position	Temperature (°C)						Bottom
	0	25	50	75	100	150	
Section Browns Bank-Georges Bank, 27-30 November 1966							
42°25'N 66°35'W	8.86	7.62	7.00	6.45	5.78	6.16	5.93 (250 m)
42°46'N 66°14'W	6.60	6.58	-	-	-	-	6.56 (35 m)
42°51'N 66°06'W	6.94	6.46	6.38	6.22	6.04	-	5.94 (140 m)
43°00'N 66°03'W	7.90	7.80	7.00	6.50	6.30	-	6.30 (106 m)
42°13'N 66°34'W	10.06	10.03	9.24	7.92	7.88	5.22	4.88 (230 m)
41°50'N 66°50'W	9.32	9.28	-	-	-	-	9.25 (60 m)
Section along 67° meridian - 2-3 December 1966							
40°39'N 67°05'W	9.47	9.43	8.45	6.04	-	-	4.12 (105 m)
40°32'N 67°03'W	10.44	10.45	6.15	5.72	5.68	4.24	4.42 (500 m)
41°02'N 67°08'W	8.78	-	-	-	-	-	8.84 (60 m)
Section along 68° meridian - 5-6 December 1966							
40°16'N 68°00'W	14.48	14.54	14.46	14.46	9.78	13.46	4.76 (450 m)
40°19'N 68°00'W	13.71	13.79	14.82	14.98	12.00	8.93	7.89 (190 m)
40°32'N 68°00'W	9.36	9.42	11.56	15.78	-	-	13.93 (110 m)
40°55'N 68°06'W	9.45	9.48	-	-	-	-	9.49 (50 m)
Section along 69° meridian - 6-7 December 1966							
40°02'N 69°02'W	11.14	11.90	13.42	13.18	8.60	8.57	5.77 (500 m)
40°17'N 69°00'W	8.54	8.56	8.64	8.72	-	-	10.32 (95 m)
40°41'N 69°00'W	8.88	8.95	-	-	-	-	8.98 (56 m)
40°59'N 69°00'W	9.05	9.06	8.87	-	-	-	8.65 (80 m)
41°18'N 69°00'W	8.84	8.84	8.24	6.07	5.10	-	4.42 (140 m)

A large herring concentration yielded 1,700 kg per hour at 70 m in temperatures shown in Table 9 for the section along the 67° meridian on 3 December.

Investigations from 4 to 12 November on the southwestern part of Georges Bank have shown the surface salinity to be from 31.8‰ to 33.1‰ (mainly 32.5‰). From 27 November to 7 December on the southern edge of Georges Bank, the surface salinity was 32.6 to 34.8‰. During this same period in the region of Browns Bank the surface salinity was from 32.2 to 32.6‰.

Salinity of the bottom layers was somewhat higher than that of the surface water. From the surface to 100 m, it was from 31.8 to 33.8‰. At 200 to 500 m the salinity was from 34.43 to 34.90‰.

The oxygen content in the surface layers of Georges Bank from 4 to 12 November amounted to 97-105% of saturation. In December the saturation decreased somewhat (89-100%). Oxygen content decreased with depth. On the deep slopes of Georges Bank, the saturation decreased to 70%.

On the shallow part of Georges Bank in surface waters in November, the phosphate content was 15 to 25 mg/m³. Over the deeper slopes the phosphate content decreased to 10 mg/m³. In the bottom layers the phosphate content amounted to 90-120 mg/m³.

II. Biological Studies

Herring. On the southeastern slopes of Georges Bank from 80 to 180 m in December, the R/V Wieczno obtained yields of from 120 - 3,200 kg per hour of pure herring (average 1,880 kg per hour). The lengths of 1,899 herring ranged from 26 to 35 cm (mean length 31.2 cm).

On southwestern slopes of Georges Bank from 60 to 160 m during the first half of November, yields of herring were 200 to 2,520 kg per hour (average 920 kg per hour). The lengths of 1,276 herring were 26-34 cm (mean length 30.4 cm). In the beginning of December on these fishing grounds the yield of herring oscillated from 450 to 3,320 kg per hour, but the average yield decreased somewhat from the November yield (840 kg per hour). The lengths of the fish were a little smaller, varying from 23-34 cm (average 29.1 cm).

On the northwestern slopes of Georges Bank, from 55 to 110 m, in the beginning of November, the yield of herring was from 45 to 1,120 kg per hour (average 300 kg per hour). Herring ranged from 23 to 35 cm in length (average 29.9 cm).

On other parts of Georges Bank the yield of herring was considerably smaller. The size of fish was, however, similar. Only in one case, in the region of northwestern slopes of Georges Bank, were smaller herring (mean length 22 cm) caught.

In November a considerable number of the herring taken were in the spent stage. In December, the majority of the fish were in the resting stage.

Examination of stomach contents indicated a more intensive feeding by herring on the western and northwestern than on the eastern and southeastern slopes of Georges Bank.

Mackerel were caught in small numbers as a bycatch on nearly all the fishing grounds down to 120 m.

Three size groups were distinguished. The larger fish were found on the southwestern and northwestern slopes of Georges Bank (29-42 cm in length, average about 37 cm). The medium-size fish were found on the southwestern slopes of Georges Bank (25-35 cm in length, mean length about 28 cm). The smallest fish (17-24 cm in length, average 21 cm) were found in various places, mostly on southwestern slopes of Georges Bank.

Alewife was caught on the southwestern slopes of Georges Bank as well as on the southern slopes of Sable Island Bank. On Georges Bank these fish were a bycatch (0.5-2.4% of the catch). The lengths of the fish varied from 22 to 33 cm (average 28 cm).

Haddock. Survey cruises for haddock carried out in November-December 1966 showed that on Georges Bank the fish were larger on the deeper fishing grounds (to 140 m) than in the shallower water (to 80 m). On deeper grounds, the lengths of the fish were from 42 to 80 cm (average 66.8 cm), on the shallower grounds, 33-60 cm (average 50 cm).

An analysis of haddock stomach contents from Georges Bank showed that in November and December the stomachs varied from nearly empty to full. Polychaets and crustaceans were the chief food organisms found.

Silver hake were caught mainly on the southwestern and northwestern slopes of Georges Bank. The size of fish was similar on the different fishing grounds. Sizes ranged from 17 to 48 cm (mean length 28.0 to 31.2 cm). Smaller silver hake (mean length 25.7 cm) were caught only on the northwestern slopes of Georges Bank.

Squirrel hake were caught chiefly on the western slopes of Georges Bank at from 65 to 160 m. The length of these fish was 20 to 52 cm (average 35 cm).

The stomach contents of 200 fish were examined during the cruises in November and December. Mainly Gammarid-like crustaceans were found.

American plaice were caught in considerable numbers on the southwestern slopes of Georges Bank. These fish were of 23-33 cm in length (average 30.3 cm). On other fishing grounds, American plaice were caught in smaller numbers and had a mean length of 23.9-27.9 cm.

Butterfish were caught in December only on the southern slopes of Georges Bank at about 100 m. The length of these fish was 15 to 24 cm (average about 21 cm).

Spiny dogfish were caught in considerable numbers in December on the southwestern slopes of Georges Bank. They were from 37 to 63 cm in length with the 50 cm length predominating in the catch. The stomachs of the spiny dogfish contained mainly mackerel.