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Minimum Estimates of Abundance of Arctic cod (*Boreogadus saida*) in
NAFO Divisions 2J, 3K, and 3L from Research Vessel Surveys

by

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INTRODUCTION

Arctic cod (*Boreogadus saida*) occur in the Newfoundland-Labrador area and are distributed along the Labrador coast, off the east coast of Newfoundland and on the northern part of the Grand Bank (Lear 1979). Up to the present there has been no attempt made to estimate their abundance, based on research vessel surveys for groundfish. Miller (1979) reported an acoustic estimate of about 90,000 t of young-of-the-year arctic cod from a sampled area of 32,591 square kilometers in NAFO Div. 2J and 3K during October 1978.

The aim of this paper is to present the biomass estimates of arctic cod as determined from otter trawls fished on the bottom using a random-stratified design currently used for groundfish. These estimates represent bare minima and may be only indices of abundance of the larger arctic cod, which occur near the bottom, in view of the pelagic nature of arctic cod distribution and their vertical distribution in the water column (Lear 1979; Bain and Sekerak 1978).

RESULTS AND DISCUSSION

Research vessel surveys of random-stratified design were conducted by the GADUS ATLANTICA in NAFO Div. 2J during autumn 1977-84 and in Div. 3K during autumn 1978-84 (Table 1). Spring surveys were conducted by the A.T. CAMERON in NAFO Div. 3L during 1971-82. Summer-autumn surveys were conducted by the A.T. CAMERON during 1971, 1981 and 1982 and by the WILFRED TEMPLEMAN during 1983 and 1984.

The estimates of abundance (numbers) during 1977 to 1984 in NAFO Div. 2J varied from 6.6 million in 1978 to 75.4 million in 1979 (Table 2). The strata where arctic cod occurred in significant abundance each year were mainly in the 101-200 m and 201-300 m depth zones, namely 201, 202, 205, 206, 207, 209, and 234 which are the areas within the influence of the cold Labrador current on the central and inside part of Hamilton Bank, coastal zone of Labrador and in Hawke Channel (Fig. 1). Estimates of biomass (t) show a similar pattern (Table 3). Generally, the estimated trawlable biomass of arctic cod in Div. 2J varies from about 200 to 1000 t based on the autumn groundfish surveys. The confidence limits around the abundance and biomass estimates were large in most years.

The estimates of abundance (Table 4) and biomass (Table 5) for NAFO Div. 3K, based on autumn surveys, displayed considerable annual fluctuations. The estimates of numbers, although subject to wide confidence limits, varied during 1978 to 1984 from less than one million to about 26 million individuals while the biomass estimates ranged from 18 to 974 t. The strata of highest abundance during most years were 620, 621, 628, and 629 which is mainly the coastal shelf off northern Newfoundland and the inside slopes of Funk Island Bank (Fig. 2). Stratum, 619 which was surveyed for the first time in 1984, also had a good index of abundance of arctic cod.

Estimates of abundance (Table 6) and of biomass (Table 7) from spring surveys during 1971-82 in NAFO Div. 3L were lower than those in 2J and 3K although there was an estimate of 19 million individuals during 1974. In other years the numbers varied from 0 to 7 million but were generally less than one million. The estimates of biomass varied from 0 to 197 t. The largest catches of arctic cod during the spring cruises occurred in strata 341, 344, 347, 348, and 349 which are on the northwestern Grand Bank, Avalon Channel, and the shoreward, cooler areas of the Grand Bank (Fig. 3).

Abundance (Table 8) and biomass (Table 9) estimates of arctic cod in NAFO Div. 3L during summer-autumn surveys during 1971, 1981-84 varied from 295,000 to 4.5 million fish and from 13 to 197 t although the confidence limits were large. The greater estimates during 1981-84 over those of 1971 are a reflection of greater coverage during recent years.

The overall biomass estimates for Div. 2J were generally higher than those of 3K but there was no parallel between the catches in the same year. For 1979, 1980, 1981, 1983, and 1984 these were in reverse order (Fig. 4). Generally, however, the abundance estimates during autumn in 3L although lower, followed the same trend, as those of 3K during 1981-84.

REFERENCES

- Bain, H. and A. D. Sekerak. 1978. Aspects of the biology of arctic cod, (Boreogadus saida), in the central Canadian arctic. Unpubl. Rept. by LGL Ltd. for Polar Gas Project, 104 p.
- Lear, W. H. 1979. Distribution, size, and sexual maturity of arctic cod (Boreogadus saida) in the Northwest Atlantic during 1959-78. CAFSAC Res. Doc. 79/17. 40 p.
- Miller, D. S. 1979. An acoustic estimate of juvenile arctic cod (Boreogadus saida) abundance in ICNAF Divisions 2J and 3K, 1978. CAFSAC Res. Doc. 79/12. 11 p.

Table 1. List of research vessel surveys of random-stratified design during 1977-84 by the GADUS ATLANTICA in NAFO Divisions 2J and 3K, during 1971-82 by the A. T. CAMERON and 1983-84 by the WILFRED TEMPLEMAN in NAFO Division 3L.

Vessel	Trip	Year	Months	NAFO Divisions surveyed
GADUS ATLANTICA	3	1977	Nov.-Dec.	2J
	15	1978	Nov.	3K, 2J
	29	1979	Nov.-Dec.	3K, 2J
	44	1980	Nov.-Dec.	3K, 2J
	58	1981	Nov.	3K, 2J
	59	1981	Dec.	3K
	71	1982	Oct.-Nov.	3K, 2J
	72	1982	Nov.-Dec.	3K
	86	1983	Oct.-Nov.	3K, 2J
	87	1983	Nov.	3K, 2J
	88	1983	Nov.-Dec.	3K, 2J
	101	1984	Oct.-Nov.	3K, 2J
	102	1984	Nov.	3K, 2J
	103	1984	Nov.-Dec.	3K
A. T. CAMERON	187	1971	June	3L
	191	1971	Oct.	3L
	199	1972	May	3L
	208	1973	Apr.	3L
	209	1973	Apr.-May	3L
	222	1974	May	3L
	233	1975	May	3L
	246	1976	Apr.-May	3L
	262	1977	May	3L
	276	1978	May	3L
	290	1979	May-June	3L
	304	1980	Apr.-May	3L
	305	1980	May-June	3L
	317	1981	Apr.	3L
	318	1981	Apr.-May	3L
	323	1981	Sept.-Oct.	3L
	324	1981	Oct.	3L
	325	1981	Nov.	3L
329	1982	May	3L	
333	1982	Oct.-Nov.	3L	
334	1982	Nov.-Dec.	3L	
WILFRED TEMPLEMAN	7	1983	Oct.	3L
	8	1983	Oct.-Nov.	3L
	9	1983	Nov.	3L
	16	1984	July-Aug.	3L
	17	1984	Aug.	3L
	18	1984	Aug.-Sept.	3L

Table 2. Arctic cod abundance estimates (No. x 10⁻³) from research vessel surveys in NAFO Division 2J during autumn 1977-84.

Depth range (m)	Stratum number	Stratum area (mi. ²)	GADUS 3 1977	GADUS 15 1978	GADUS 29 1979	GADUS 44 1980	GADUS 58 1981	GADUS 71 1982	GADUS 86-88 1983	GADUS 101-103 1984
101-200	201	1,427	54	3,213	536	214	6,009	2,892	1,250	2,178
	205	1,823	7,937	718	31,337	4,618	2,993	2,212	2,651	1,916
	206	2,582	53	28	35,105	0	2,749	4,102	388	581
	207	2,246	472	211	809	1,484	2,829	4,320	4,206	4,022
Total		8,078	8,516	4,170	67,787	6,316	14,580	13,526	8,495	8,697
201-300	202	440	611	1,734	760	611	8,670	4,310	1,139	5,730
	209	1,608	17	121	5,016	5,130	19,192	7,275	1,976	4,414
	210	774	0	0	0	0	232	252	0	145
	213	1,725	0	0	0	0	2,115	1,644	0	0
	214	1,171	0	0	0	0	88	835	44	352
	215	1,270	24	76	620	0	381	2,140	2,252	6,006
	228	1,428	0	-	0	0	0	0	0	0
	234	508	11,554	477	858	0	12,241	2,631	2,237	2,601
Total		8,924	12,206	2,408	7,254	5,741	42,919	19,087	7,648	19,248
301-400	203	480	739	-	-	144	2,504	1,141	1,117	1,657
	208	448	0	0	269	0	488	1,368	118	0
	211	330	0	0	74	0	0	1,226	0	0
	216	384	0	-	0	0	0	0	0	0
	222	441	0	0	0	0	0	0	0	0
	229	567	0	0	0	0	0	0	0	0
Total		2,650	739	0	343	144	2,992	3,735	1,235	1,657
401-500	204	354	53	-	-	-	0	18	381	890
	217	268	0	-	-	-	0	0	0	-
	223	180	0	-	-	-	0	0	0	0
	227	686	0	-	-	-	0	0	0	0
	235	420	0	-	-	-	0	42	95	0
Total		1,908	53	-	-	-	0	60	476	890
501-750	212	664	0	-	-	-	25	0	0	0
	218	420	0	-	-	-	0	0	0	0
	224	270	0	-	-	-	0	0	0	0
	230	237	0	-	-	-	0	0	0	0
Total		1,591	0	-	-	-	25	0	0	0
751-1000	219	213	-	-	-	-	0	-	0	-
	231	182	0	-	-	-	-	0	0	0
	236	122	0	-	-	-	0	0	0	0
Total		517	0	-	-	-	0	0	0	0
1001-1250	220	324	-	-	-	-	-	-	-	-
	225	177	0	-	-	-	-	-	-	-
	232	236	0	-	-	-	-	-	-	-
Total		737	0	-	-	-	-	-	-	-
1251-1500	221	268	-	-	-	-	-	-	-	-
	226	180	-	-	-	-	-	-	-	-
	233	180	-	-	-	-	-	-	-	-
Total		628	-	-	-	-	-	-	-	-
101-200		8,078	8,516	4,170	67,787	6,316	14,580	13,526	8,495	8,697
201-300		8,924	12,206	2,408	7,254	5,741	42,919	19,087	7,648	19,248
301-400		2,650	739	0	343	144	2,992	3,735	1,235	1,657
401-500		1,908	53	-	-	-	0	60	476	890
501-750		1,591	0	-	-	-	25	0	0	0
751-1000		517	0	-	-	-	0	0	0	0
1001-1250		737	0	-	-	-	-	-	-	-
1251-1500		628	-	-	-	-	-	-	-	-
Total		25,033	21,514	6,578	75,384	12,201	60,516	36,408	17,854	30,492
Upper limit			51,945	14,870	219,635	28,431	104,873	46,996	25,838	51,830
Lower limit			-8,919	-1,714	-68,868	-4,028	16,157	25,822	9,869	9,156

Table 3. Arctic cod abundance estimates (†) from research vessel surveys in NAFO Division 2J during autumn 1977-84. († indicates a weight less than 500 kg.)

Depth range (m)	Stratum number	Stratum area (mi. ²)	GADUS 3 1977	GADUS 15 1978	GADUS 29 1979	GADUS 44 1980	GADUS 58 1981	GADUS 71 1982	GADUS 86-88 1983	GADUS 101-103 1984
101-200	201	1,427	3	81	7	7	109	34	18	28
	205	1,823	219	34	450	34	60	22	59	79
	206	2,582	3	1	183	0	51	39	13	21
	207	2,246	20	15	12	22	83	69	129	222
Total		8,078	245	131	652	63	303	164	219	350
201-300	202	440	24	46	12	12	132	160	26	116
	209	1,608	6	4	53	106	353	116	67	218
	210	774	0	0	0	0	8	2	0	7
	213	1,725	0	0	0	0	24	23	0	0
	214	1,171	0	0	0	0	2	9	+	8
	215	1,270	1	2	17	0	6	31	74	97
	228	1,428	0	-	0	0	0	0	0	0
	234	508	298	26	16	0	153	81	102	172
Total		8,924	329	78	98	118	678	422	269	618
301-400	203	480	30	-	-	2	45	18	29	27
	208	448	0	0	3	0	8	15	2	0
	211	330	0	0	2	0	0	15	0	0
	216	384	0	-	0	0	0	0	0	0
	222	441	0	0	0	0	0	0	0	0
	229	567	0	0	0	0	0	0	0	0
Total		2,650	30	0	5	2	53	48	31	27
401-500	204	354	2	-	-	-	0	+	6	13
	217	268	0	-	-	-	0	0	0	-
	223	180	0	-	-	-	0	0	0	0
	227	686	0	-	-	-	0	0	0	0
	235	420	0	-	-	-	0	+	2	0
Total		1,908	2	-	-	-	0	+	8	13
501-750	212	664	0	-	-	-	1	0	0	0
	218	420	0	-	-	-	0	0	0	-
	224	270	0	-	-	-	0	0	0	0
	230	237	0	-	-	-	0	0	0	0
Total		1,591	0	-	-	-	1	0	0	0
751-1000	219	213	-	-	-	-	0	-	0	-
	231	182	0	-	-	-	-	0	0	0
	236	122	0	-	-	-	0	0	0	0
Total		517	0	-	-	-	0	0	0	0
1001-1250	220	324	-	-	-	-	-	-	-	-
	225	177	0	-	-	-	-	-	-	-
	232	236	0	-	-	-	-	-	-	-
Total		737	0	-	-	-	-	-	-	-
1251-1500	221	268	-	-	-	-	-	-	-	-
	226	180	-	-	-	-	-	-	-	-
	233	180	-	-	-	-	-	-	-	-
Total		628	-	-	-	-	-	-	-	-
101-200		8,078	245	131	652	63	303	164	219	350
201-300		8,924	329	78	98	118	678	422	269	618
301-400		2,650	30	0	5	2	53	48	31	27
401-500		1,908	2	-	-	-	0	+	8	13
501-750		1,591	0	-	-	-	1	0	0	0
751-1000		517	0	-	-	-	0	0	0	0
1001-1250		737	0	-	-	-	-	-	-	-
1251-1500		628	-	-	-	-	-	-	-	-
Total		25,033	606	209	755	183	1,035	634	527	1,008
Upper limit†			1,428	401	5,145	529	1,807	823	777	1,435
Lower limit†			-217	17	-3,632	-165	262	449	279	578

Table 4. Arctic cod abundance estimates (No. x 10⁻³) from research vessel surveys in NAFO Division 3K during autumn 1978-84.

Depth range (m)	Stratum number	Stratum area (mi. ²)	GADUS 15 1978	GADUS 29 1979	GADUS 44 1980	GADUS 58, 59 1981	GADUS 72 1982	GADUS 86-88 1983	GADUS 101-103 1984
100-200	618	1,455	-	-	-	-	-	-	1,993
	619	1,588	-	-	-	-	-	-	12,686
Total		3,043	-	-	-	-	-	-	14,679
201-300	620	2,709	0	988	1,627	2,623	3,446	17,549	1,958
	621	2,859	552	2,495	30,831	3,326	7,254	6,854	3,372
	624	668	0	0	0	0	0	0	13
	632	447	0	0	0	0	0	0	-
	634	1,618	0	40	0	17	375	0	0
	635	1,274	0	19	167	0	-	96	84
	636	1,455	0	22	0	0	11	0	0
	637	1,132	0	42	0	0	0	51	0
Total		12,162	552	3,606	32,625	5,966	11,086	24,550	5,427
301-400	623	1,027	0	51	501	0	108	0	1,295
	625	850	0	0	0	0	0	0	26
	626	919	0	575	0	55	0	0	2,575
	628	1,085	16	1,792	448	136	1,018	1,303	151
	629	495	0	843	612	0	1,498	0	187
	630	544	-	20	0	225	-	20	0
	633	2,179	0	0	0	0	0	0	0
	638	2,059	0	155	0	0	34	0	0
	639	1,463	0	110	0	0	0	0	0
Total		10,621	16	3,546	1,561	416	2,658	1,323	4,234
401-500	622	632	-	-	-	0	0	0	0
	627	1,194	-	-	-	0	317	30	89
	631	1,202	-	-	-	0	-	0	0
	640	198	-	-	-	0	0	-	0
	645	204	-	-	-	0	0	0	0
Total		3,430	-	-	-	0	317	30	89
501-750	641	584	-	-	-	0	0	0	0
	646	333	-	-	-	0	0	0	0
Total		917	-	-	-	0	0	0	0
751-1000	642	931	-	-	-	0	0	-	0
	647	409	-	-	-	0	0	-	-
Total		1,340	-	-	-	0	0	-	0
1001-1250	643	1,266	-	-	-	-	-	-	-
	648	232	-	-	-	-	-	-	-
Total		1,498	-	-	-	-	-	-	-
1251-1500	644	954	-	-	-	-	-	-	-
	649	263	-	-	-	-	-	-	-
Total		1,217	-	-	-	-	-	-	-
101-200		3,043	-	-	-	-	-	-	14,679
201-300		12,162	552	3,606	32,625	5,966	11,086	24,550	5,427
301-400		10,621	16	3,546	1,561	416	2,658	1,323	4,234
401-500		3,430	-	-	-	0	317	30	89
501-750		917	-	-	-	0	0	0	0
751-1000		1,340	-	-	-	0	0	-	0
1001-1250		1,498	-	-	-	-	-	-	-
1251-1500		1,217	-	-	-	-	-	-	-
Total		34,228	568	7,152	34,186	6,382	14,061	25,903	24,429
Upper limit			1,919	10,180	71,728	10,297	20,351	48,383	34,106
Lower limit			-783	4,124	-3,355	2,468	7,771	3,423	14,755

Table 5. Arctic cod abundance estimates (+) from research vessel surveys in NAFO Division 3K during autumn 1978-84. (+ indicates a weight less than 500 kg.)

Depth range (m)	Stratum number	Stratum area (ml. ²)	GADUS 15 1978	GADUS 29 1979	GADUS 44 1980	GADUS 58, 59 1981	GADUS 72 1982	GADUS 86-88 1983	GADUS 101-103 1984
100-200	618	1,455	-	-	-	-	-	-	120
	619	1,588	-	-	-	-	-	-	382
Total		3,043	-	-	-	-	-	-	502
201-300	620	2,709	0	17	21	61	77	683	62
	621	2,859	17	37	440	112	176	233	55
	624	668	0	0	0	0	0	0	+
	632	447	0	0	0	0	0	0	-
	634	1,618	0	2	0	2	9	0	0
	635	1,274	0	1	2	0	-	5	1
	636	1,455	0	1	0	0	+	0	0
	637	1,132	0	2	0	0	0	1	0
Total		12,162	17	60	463	175	262	922	118
301-400	623	1,027	0	1	6	0	2	0	34
	625	850	0	0	0	0	0	0	+
	626	919	0	6	0	1	0	0	37
	628	1,085	1	19	5	6	16	50	4
	629	495	0	9	9	0	24	0	3
	630	544	-	1	0	11	-	2	0
	633	2,179	0	0	0	0	0	0	0
	638	2,059	0	2	0	0	2	0	0
	639	1,463	0	5	0	0	0	0	0
Total		10,621	1	43	20	18	44	52	78
401-500	622	632	-	-	-	0	0	0	0
	627	1,194	-	-	-	0	6	+	2
	631	1,202	-	-	-	0	-	0	0
	640	198	-	-	-	0	0	-	0
	645	204	-	-	-	0	0	0	0
Total		3,430	-	-	-	0	6	+	2
501-750	641	584	-	-	-	0	0	0	0
	646	333	-	-	-	0	0	0	0
Total		917	-	-	-	0	0	0	0
751-1000	642	931	-	-	-	0	0	-	0
	647	409	-	-	-	0	0	-	-
Total		1,340	-	-	-	0	0	-	0
1001-1250	643	1,266	-	-	-	-	-	-	-
	648	232	-	-	-	-	-	-	-
Total		1,498	-	-	-	-	-	-	-
1251-1500	644	954	-	-	-	-	-	-	-
	649	263	-	-	-	-	-	-	-
Total		1,217	-	-	-	-	-	-	-
101-200		3,043	-	-	-	-	-	-	502
201-300		12,162	17	60	463	175	262	922	118
301-400		10,621	1	43	20	18	44	52	78
401-500		3,430	-	-	-	0	6	+	2
501-750		917	-	-	-	0	0	0	0
751-1000		1,340	-	-	-	0	0	-	0
1001-1250		1,498	-	-	-	-	-	-	-
1251-1500		1,217	-	-	-	-	-	-	-
Total		34,228	18	103	483	193	312	974	700
Upper limit			59	143	1,035	309	450	1,870	974
Lower limit			-24	66	-68	78	173	79	429

Table 6. Arctic cod abundance estimates (No. x 10⁻³) from research vessel surveys in NAFO Division 3L during spring 1971-82.

Depth range (fath)	Stratum number	Stratum area (mi. ²)	ATC 187 1971	ATC 199 1972	ATC 208-209 1973	ATC 222 1974	ATC 233 1975	ATC 246 1976	ATC 262 1977	ATC 276 1978	ATC 290 1979	ATC 304-305 1980	ATC 317-318 1981	ATC 329 1982
31-50	350	2,071	0	0	0	0	0	0	0	0	0	0	0	0
	363	1,780	0	0	0	0	0	0	0	0	0	0	0	0
	371	1,121	0	0	-	0	-	-	0	0	0	0	0	0
	372	2,460	0	0	0	0	0	0	0	0	0	0	0	0
	384	1,120	0	0	0	0	-	-	0	0	0	0	0	0
Total		8,552	0	0	0	0	0	0	0	0	0	0	0	
51-100	328	1,519	-	-	-	-	-	-	72	-	0	-	0	38
	341	1,574	-	-	0	-	-	-	30	0	0	0	1,536	0
	342	985	-	-	-	-	-	-	22	0	0	11	-	0
	343	525	-	-	-	-	-	-	256	0	0	10	335	0
	348	2,120	0	0	-	16,709	2,282	345	0	27	0	0	91	0
	349	2,114	0	0	-	79	420	0	0	0	0	0	1,785	0
	364	2,817	0	0	-	106	0	0	0	0	0	0	0	0
	365	1,041	0	0	-	0	0	0	0	0	0	0	0	0
	370	1,320	0	0	-	165	33	0	0	0	0	0	0	0
	385	2,356	0	0	0	0	91	0	0	0	0	0	0	0
	390	1,481	0	0	0	74	37	-	0	0	0	0	0	0
	Total		17,452	0	0	0	17,133	2,863	345	380	27	0	21	3,747
101-150	344	1,494	-	-	-	-	-	30	0	0	168	860	2,826	0
	347	983	0	-	-	2,066	76	0	25	0	0	118	18	0
	366	1,394	0	-	-	0	29	0	0	-	0	26	0	0
	369	961	0	-	-	0	25	0	0	0	0	0	0	0
	386	983	0	-	-	74	25	0	0	0	0	0	0	0
	389	821	0	0	0	21	31	0	0	0	0	0	0	0
	391	282	-	0	0	0	0	-	0	0	0	0	0	0
Total		6,918	0	0	0	2,161	186	30	25	0	168	1,004	2,844	0
151-200	345	1,432	-	-	-	-	-	0	0	0	0	258	54	0
	346	865	-	-	-	-	65	0	0	-	0	411	0	0
	368	334	0	-	-	0	0	0	0	-	0	38	0	0
	387	718	0	-	-	0	27	0	0	0	0	0	54	0
	388	361	0	-	0	9	0	0	0	0	0	0	0	0
	392	145	-	-	0	0	0	-	0	0	0	0	0	0
Total		3,855	0	-	0	9	92	0	0	0	0	707	108	0
201-300	729	90	-	-	-	-	-	-	-	-	-	-	-	-
	731	117	-	-	-	-	-	-	-	-	-	-	-	-
	733	312	-	-	-	-	-	-	-	-	-	-	-	-
Total		679	-	-	-	-	-	-	-	-	-	-	0	-
301-400	730	93	-	-	-	-	-	-	-	-	-	-	-	-
	732	96	-	-	-	-	-	-	-	-	-	-	-	-
	734	160	-	-	-	-	-	-	-	-	-	-	-	-
	736	114	-	-	-	-	-	-	-	-	-	-	-	-
Total		463	-	-	-	-	-	-	-	-	-	-	-	-
31-50		8,552	0	0	0	0	0	0	0	0	0	0	0	0
51-100		17,452	0	0	0	17,133	2,863	345	380	27	0	21	3,747	38
101-150		6,918	0	0	0	2,161	186	30	25	0	168	1,004	2,844	0
151-200		3,855	0	-	0	9	92	0	0	0	0	707	108	0
201-300		679	-	-	-	-	-	-	-	-	-	-	0	-
301-400		463	-	-	-	-	-	-	-	-	-	-	-	-
Total		37,919	0	0	0	19,303	3,141	375	405	27	168	1,732	6,699	38
Upper limit			0	0	0	62,012	7,649	971	2,301	95	2,306	5,781	12,193	202
Lower limit			0	0	0	-23,406	-1,367	-222	-1,493	-42	-1,969	-2,318	1,205	-126

Table 7. Arctic cod abundance estimates (t) from research vessel surveys in NAFO Division 3L during spring 1971-82. (+ indicates a weight less than 500 kg.)

Depth ranges (fath)	Stratum number	Stratum area (mi. ²)	ATC 187 1971	ATC 199 1972	ATC 208-209 1973	ATC 222 1974	ATC 233 1975	ATC 246 1976	ATC 262 1977	ATC 276 1978	ATC 290 1979	ATC 304-305 1980	ATC 317-318 1981	ATC 329 1982
31-50	350	2,071	0	0	0	0	0	0	0	0	0	0	0	0
	363	1,780	0	0	0	0	0	0	0	0	0	0	0	0
	371	1,121	0	0	-	0	-	-	0	0	0	0	0	0
	372	2,460	0	0	0	0	0	0	0	0	0	0	0	0
	384	1,120	0	0	0	0	-	-	0	0	0	0	0	0
Total		8,552	0	0	0	0	0	0	0	0	0	0	0	0
51-100	328	1,519	-	-	-	-	-	-	5	-	0	-	0	2
	341	1,574	-	-	0	-	-	-	1	0	0	0	30	0
	342	366	-	-	-	-	-	-	1	0	0	+	-	0
	343	525	-	-	-	-	-	-	30	0	0	+	10	0
	348	2,120	0	0	-	158	77	24	0	5	0	0	5	0
	349	2,114	0	0	-	2	8	0	0	0	0	0	48	0
	364	2,817	0	0	-	5	0	0	0	0	0	0	0	0
	365	1,041	0	0	-	0	0	0	0	0	0	0	0	0
	370	1,320	0	0	-	3	3	0	0	0	0	0	0	0
	385	2,356	0	0	0	0	22	0	0	0	0	0	0	0
	390	1,481	0	0	0	2	2	-	0	0	0	0	0	0
Total		17,452	0	0	0	170	112	24	37	5	0	1	95	2
101-150	344	1,494	-	-	-	-	-	1	0	0	5	4	50	0
	347	983	0	-	-	25	5	0	1	0	0	1	1	0
	366	1,394	0	-	-	0	1	0	0	-	0	+	0	0
	369	961	0	-	-	0	1	0	0	0	0	0	0	0
	386	983	0	-	-	1	1	0	0	0	0	0	0	0
	389	821	0	0	0	1	3	0	0	0	0	0	0	0
	391	282	-	0	0	0	0	-	0	0	0	0	0	0
Total		6,918	0	0	0	27	11	1	1	0	5	5	51	0
151-200	345	1,432	-	-	-	-	-	0	0	0	0	6	4	0
	346	855	-	-	-	-	3	0	0	-	0	3	0	0
	368	334	0	-	-	0	0	0	0	-	0	1	0	0
	387	718	0	-	-	0	1	0	0	0	0	0	3	0
	388	361	0	-	0	+	0	0	0	0	0	0	0	0
	392	145	-	-	0	0	0	-	0	0	0	0	0	0
Total		3,855	0	-	0	+	4	0	0	0	0	10	7	0
201-300	729	90	-	-	-	-	-	-	-	-	-	-	-	-
	731	117	-	-	-	-	-	-	-	-	-	-	-	-
	733	312	-	-	-	-	-	-	-	-	-	-	-	-
	735	160	-	-	-	-	-	-	-	-	-	-	0	-
Total		679	-	-	-	-	-	-	-	-	-	-	0	-
301-400	730	95	-	-	-	-	-	-	-	-	-	-	-	-
	732	96	-	-	-	-	-	-	-	-	-	-	-	-
	734	160	-	-	-	-	-	-	-	-	-	-	-	-
	736	114	-	-	-	-	-	-	-	-	-	-	-	-
Total		465	-	-	-	-	-	-	-	-	-	-	-	-
31-50		8,552	0	0	0	0	0	0	0	0	0	0	0	0
51-100		17,452	0	0	0	170	112	24	37	5	0	1	95	2
101-150		6,918	0	0	0	27	11	1	1	0	5	5	51	0
151-200		3,855	0	-	0	+	4	0	0	0	0	10	7	0
201-300		679	-	-	-	-	-	-	-	-	-	-	0	-
301-400		465	-	-	-	-	-	-	-	-	-	-	-	-
Total		37,919	0	0	0	197	127	25	38	5	5	16	151	2
Upper limit			0	0	0	593	271	70	338	17	69	29	299	10
Lower limit			0	0	0	-196	-16	-19	-280	-7	-59	4	1	-6

Table 8. Arctic cod biomass estimates (No. x 10⁻³) from research vessel surveys during summer-autumn in NAFO Division 3L.

Depth range (fath)	Stratum number	Stratum area (ml. 2)	ATC 191 1971	ATC 323-325 1981	ATC 333-334 1982	WT 7-9 1983	WT 16-18 1984
31-50	350	2,071	-	26	0	0	0
	363	1,780	27	0	0	0	0
	371	1,121	0	21	0	0	0
	372	2,460	-	0	0	0	0
	384	1,120	-	0	0	0	0
Total		8,552	27	47	0	0	0
51-100	328	1,519	-	-	-	-	1,653
	341	1,574	-	0	975	207	189
	342	585	-	15	234	22	44
	343	525	39	374	-	486	315
	348	2,120	40	106	286	1,910	477
	349	2,114	40	68	190	582	125
	364	2,817	0	70	77	0	0
	365	1,041	26	20	59	47	59
	370	1,320	-	0	0	0	14
	385	2,356	-	0	22	0	177
	390	1,481	-	0	0	0	37
Total		17,452	145	653	1,843	3,254	3,090
101-150	344	1,494	-	224	0	897	449
	347	983	123	0	480	295	74
	366	1,394	0	105	0	26	38
	369	961	-	0	0	12	10
	386	983	-	0	0	-	0
	389	821	-	-	0	-	10
	391	282	-	-	0	0	0
Total		6,918	123	329	480	1,230	581
151-200	345	1,432	-	242	90	67	123
	346	865	-	0	16	13	0
	368	334	-	0	0	-	0
	387	718	-	0	0	-	0
	388	361	-	-	0	-	0
	392	145	-	-	0	0	0
Total		3,855	-	242	106	80	123
201-300	729	90	-	-	-	-	0
	731	117	-	-	-	-	0
	733	312	-	-	-	-	0
	735	160	-	-	0	-	0
Total		679	-	-	0	-	0
301-400	730	93	-	-	-	-	0
	732	96	-	-	-	-	0
	734	160	-	-	-	-	0
	736	114	-	-	-	0	-
Total		463	-	-	-	0	0
31-50		8,552	27	47	0	0	0
51-100		17,452	145	653	1,843	3,254	3,090
101-150		6,918	123	329	480	1,230	581
151-200		3,855	-	242	106	80	123
201-300		679	-	-	0	-	0
301-400		463	-	-	-	0	0
Total		37,919	295	1,271	2,429	4,564	3,794
Upper limit			587	1,879	3,641	7,645	8,914
Lower limit			2	662	1,216	1,482	-1,325

Table 9. Arctic cod biomass estimates (+) from research vessel surveys during summer-autumn in NAFO Division 3L. (+ indicates a weight less than 500 kg.).

Depth range (fath)	Stratum number	Stratum area (ml.2)	ATC 191 1971	ATC 323-325 1981	ATC 333-334 1982	WT 7-9 1983	WT 16-18 1984
31-50	350	2,071	-	+	0	0	0
	363	1,780	1	0	0	0	0
	371	1,121	0	+	0	0	0
	372	2,460	-	0	0	0	0
	384	1,120	-	0	0	0	0
Total		8,552	1	+	0	0	0
51-100	328	1,519	-	-	-	-	45
	341	1,574	-	0	17	12	5
	342	585	-	+	1	2	1
	343	525	2	25	-	17	10
	348	2,120	2	2	5	74	18
	349	2,114	4	1	2	33	1
	364	2,817	0	+	2	0	0
	365	1,041	1	+	2	5	1
	370	1,320	-	0	0	0	+
	385	2,356	-	0	+	0	3
	390	1,481	-	0	0	0	+
Total		17,452	9	28	29	143	84
101-150	344	1,494	-	20	0	34	14
	347	983	3	0	6	15	1
	366	1,394	0	1	0	1	+
	369	961	-	0	0	1	+
	386	983	-	0	0	-	0
	389	821	-	-	0	-	1
	391	282	-	-	0	0	0
Total		6,918	3	21	6	51	16
151-200	345	1,432	-	4	4	2	2
	346	865	-	0	+	1	0
	368	334	-	0	0	-	0
	387	718	-	0	0	-	0
	388	361	-	-	0	-	0
	392	145	-	-	0	0	0
Total		3,855	-	4	4	3	2
201-300	729	90	-	-	-	-	0
	731	117	-	-	-	-	0
	733	312	-	-	-	-	0
	735	160	-	-	0	-	0
Total		679	-	-	0	-	0
301-400	730	93	-	-	-	-	0
	732	96	-	-	-	-	0
	734	160	-	-	-	-	0
	736	114	-	-	-	0	-
Total		463	-	-	-	0	0
31-50		8,552	1	+	0	0	0
51-100		17,452	9	28	29	143	84
101-150		6,918	3	21	6	51	16
151-200		3,855	-	4	4	3	2
201-300		679	-	-	0	-	0
301-400		463	-	-	-	0	0
Total		37,919	13	53	39	197	102
Upper limit			25	95	59	322	245
Lower limit			2	11	19	73	-42

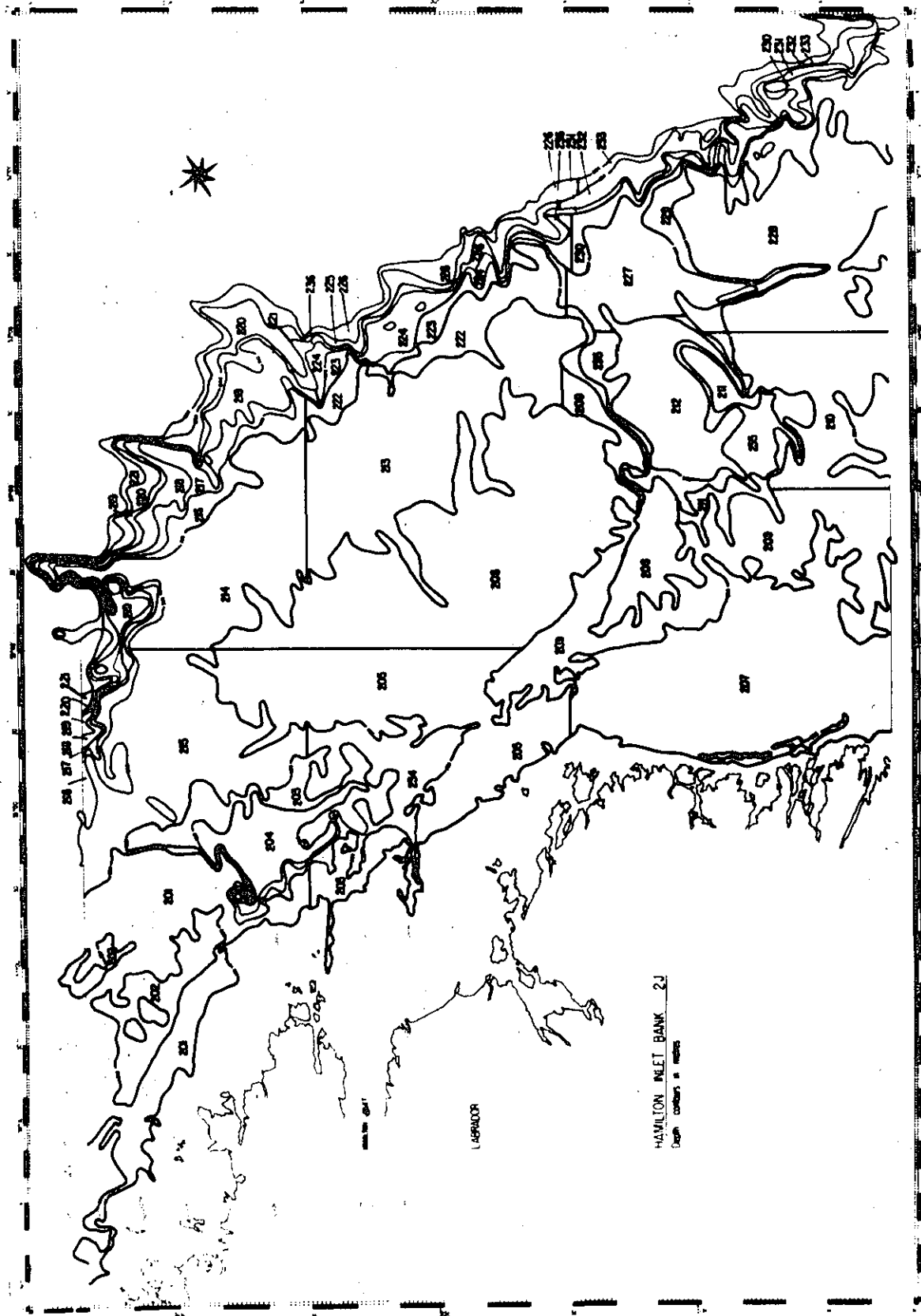


Fig. 1. Stratification chart for NAFO Division 2J.

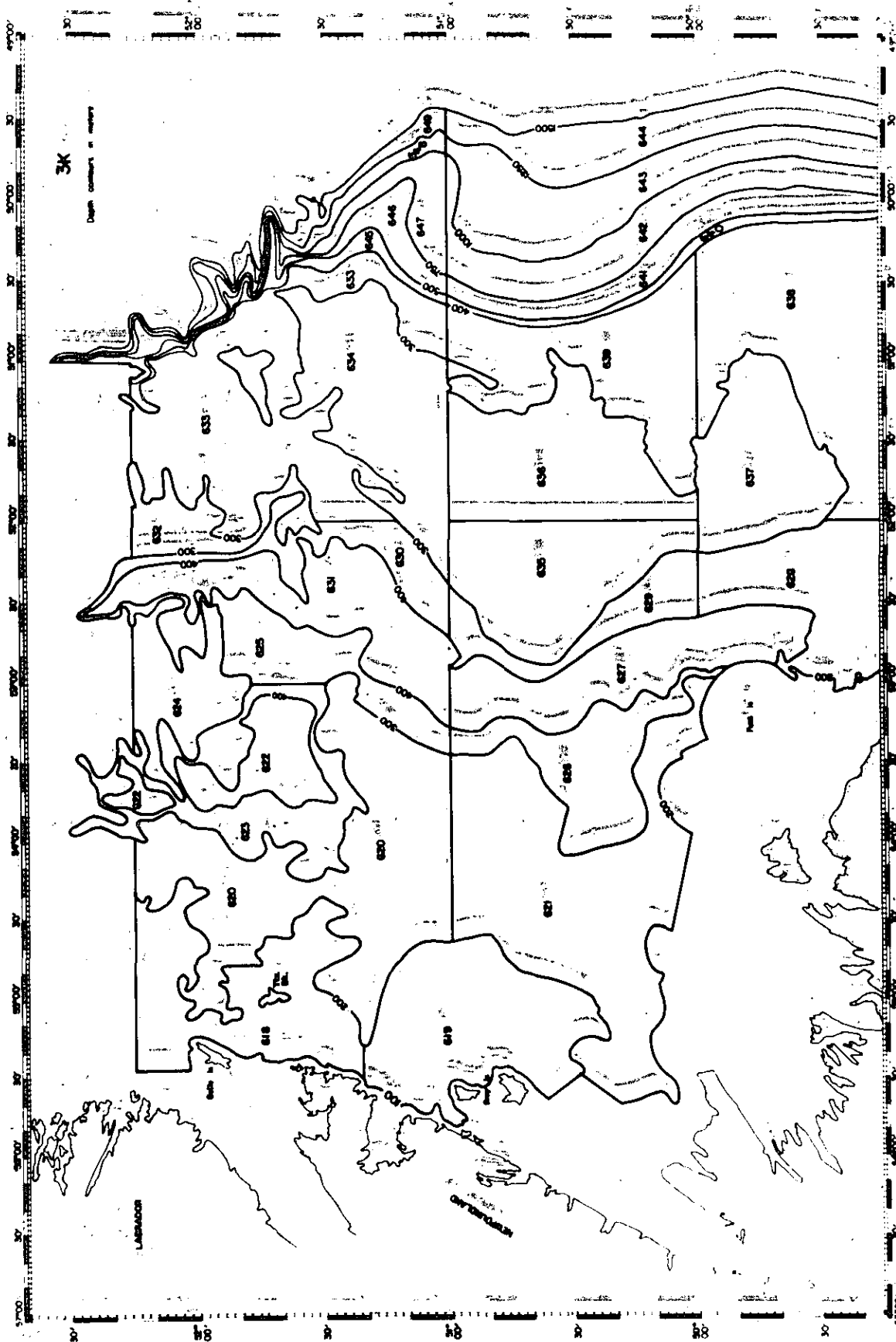


Fig. 2. Stratification chart for NAFO Division 3K.

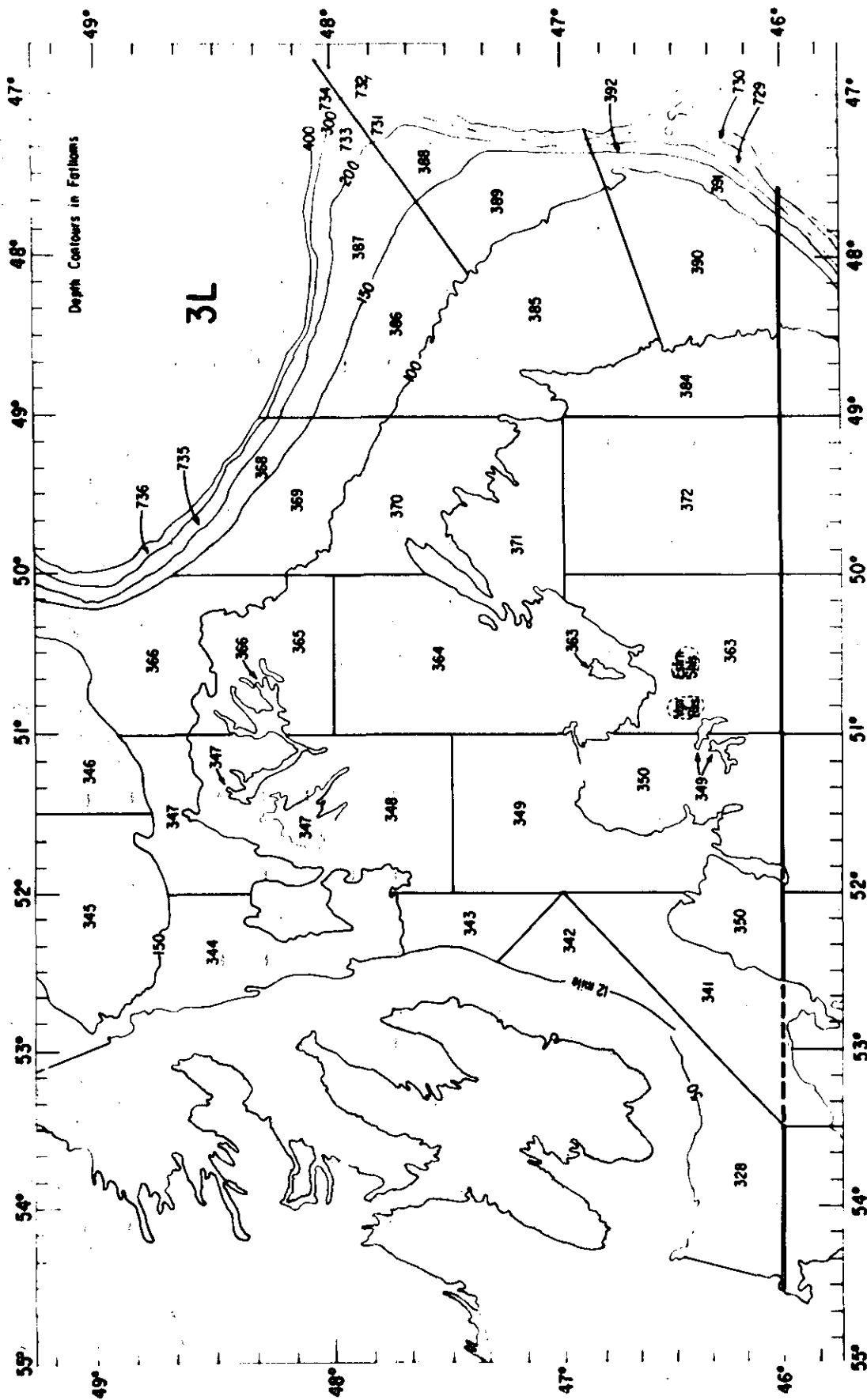


Fig. 3. Stratification chart for NAFO Division 3L.

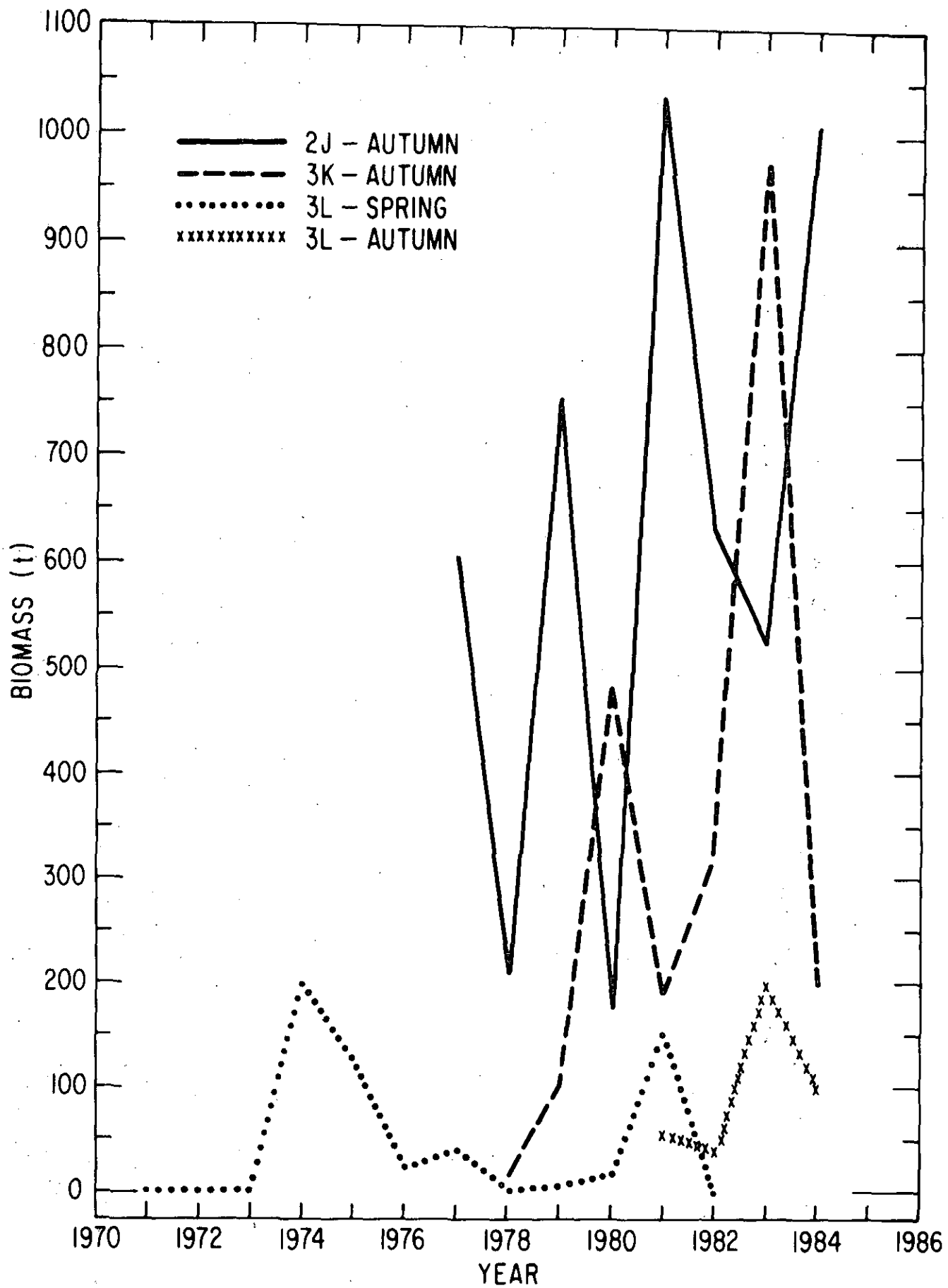


Fig. 4. Biomass estimates (t) of Arctic cod from NAFO Divisions 2J, 3K, and 3L.