Northwest Atlantic Fisheries Organization

Serial No. N5083 **NAFO SCR Doc. 05/8**

SCIENTIFIC COUNCIL MEETING – JUNE 2005

A Description of the Autumn Multispecies Surveys in SA2+ Divisions 3KLMNO from 1995-2004

by

W. Brodie

Science Branch, DFO, P. O. Box 5667,
St. John's, Canada A1C 5X1

Abstract

Stratified random multispecies trawl surveys have been conducted during autumn by the Department of Fisheries and Oceans in the Newfoundland and Labrador Region annually since 1977. Since 1990 these surveys have covered the offshore areas of NAFO Divisions 2J, 3K, 3L, 3N, and 3O. During 1995, the Campelen 1800 shrimp trawl was adopted as the standard survey gear, and coverage was extended to include the inshore areas of Div. 3K and 3L, parts of Div. 3M, Div. 2GH, and areas deeper than 1 000 m.

Some changes, planned and unplanned, have occurred to the survey series since 1995. Many of these unplanned changes have occurred because vessel breakdowns have not allowed full or timely completion of the entire survey area. The main problems with the 2004 survey were the complete absence of survey sets deeper than 731 m in Div. 3LMNO, the lack of coverage in several other strata in Div. 3L, the reduction in coverage in some strata in Div. 3K, and the extension of the timing until February 1, 2005. The 645 sets fished in 2004/05 is the lowest number since the 1995 survey.

There are at least three sources of uncertainty resulting from the problems encountered during the fall surveys of recent years: gaps in coverage (missed strata, reduced numbers of sets); changes in timing (survey coverage extended later, coverage of some strata/Divisions often spread out over a much longer period than planned); and vessel effects (no direct comparisons of the 3 vessels used, using vessels in areas where they have little or no coverage in previous years).

Careful attention to survey gear and fishing protocols, along with set-by-set monitoring with trawl sensors ensures minimal variability during tows. However, the problems with survey coverage and timing have introduced a further degree of uncertainty into the survey estimates for many species.

Introduction

Annual stratified random trawl surveys have been conducted during autumn in the Newfoundland and Labrador area by the Canadian Department of Fisheries and Oceans since 1977. The main objectives are to determine the distribution and abundance of various groundfish and shellfish species and to collect biological samples. Over time, these surveys have expanded, and from 1990 onward have covered the offshore areas of Div. 2J, 3K, and 3LNO (Table 1).

In 1995, the RV *Gadus Atlantica* was replaced with the RV *Teleost*. As a result of this change, it was decided to replace the Engel 145 trawls used on both the *Gadus* and RV *Wilfred Templeman* with a Campelen 1800 shrimp trawl, in order to improve estimates of abundance for numerous species, as well as for smaller fish of many species (McCallum and Walsh, 1996). Conversion factors based on extensive comparative fishing experiments were derived for most of the main commercial fish species, to allow some comparability between the old and new survey series

(Warren, 1997; Warren *et al*., MS 1997; Morgan *et al*., 1998).

Since the change in vessel and gear, there have been some additions to the fall survey, including coverage in Div. 2GH, Div. 3M, new strata in inshore areas of Div. 3KL, and coverage of strata deeper than 1 000 m in most areas.

Methods

From 1995, fall surveys were generally scheduled to run from late September to mid-December. The survey design is stratified random, with the allocation of sets proportional to stratum area within a Division, and a minimum of 2 sets in all strata. Coverage was usually planned to a maximum depth of about 1500 m in all Divisions, which is substantially deeper than the maximum depth fished in virtually all previous fall surveys. A maximum of 903 sets was possible each year using the Divisional allocations in Table 2, covering a maximum area of about 180,000 square nautical miles, at a density of roughly 1 set per 200 square nautical miles. Figures 1-10 show the stratification schemes used in each Division.

The survey is designed to be carried out by two vessels, both using an identical Campelen trawl, monitored with Scanmar trawl sensors. The usual plan was for the RV *W. Templeman* to survey Div. 3LNO out to 731 m (400 fm), as well as a substantial part of Div. 3K, generally the inshore and western strata. The RV *Teleost* was usually scheduled to survey Subarea 2, most of Div. 3K, Div. 3LNO (deeper than 731 m), and the 9 deep strata in Div. 3M (Flemish Pass and adjacent area). On two occasions (1996, 2001), RV *Alfred Needler*, outfitted with an identical Campelen 1800 trawl, was used in the survey.

Results of 2004 survey

The survey began almost on schedule, in October 2004 in Div. 2H, on the *Teleost*. The start of the survey on the *Templeman* was delayed by about 4 weeks due to mechanical problems. Subsequent breakdowns on the *Teleost* resulted in the loss of several weeks of survey time. These two factors resulted in incomplete coverage in the 2004 survey, and timing being extended until February 1, 2005, the latest in the time series (Table 3). The coverage on a stratum-by-stratum basis can be seen in Tables 5-12. The main problems with this survey are the complete absence of survey sets deeper than 731 m in Div. 3LMNO, the lack of coverage in several other strata in Div. 3L (e.g. 365-69, 386-87, see Table 9 and Fig. 5), the reduction in coverage in some strata in Div. 3K, and the extension of the timing. The 645 sets fished in 2004/05 was the lowest number for a fall survey since 1995.

Results of previous fall surveys

The coverage in the surveys from 1995-2004 has undergone some changes over the years, some planned and some unplanned (Brodie, MS 1996). For example, a decision was made after 1999 that Div. 2G would no longer be included in this survey, and that Div. 2H would be surveyed every second year. Also, a survey of most of Div. 3M was carried out only in 1996; since then only the deep strata in the western and northern areas of Div. 3M have been included in the survey design. Vessel breakdowns and other problems resulted in missed coverage in some years, notably 2004, as well as the extension of the survey into January of the following year on 4 occasions, including the last three years (Table 3).

The following is a brief synopsis of each survey from 1995-2003:

1995: Late start, no coverage of Div. 2GH, 3M, and inshore Div. 3KL. Coverage in Div. 2J and 3K lower than other years. Coverage extended into January for first time in fall series. Lowest number of sets (552) in fall Campelen series.

1996: Low coverage in Div. 2G, no deepwater coverage in Div. 3NO. RV *Alfred Needler* used for 69 sets in Div. 3NO. Most complete survey of Div. 3M. First year of inshore coverage in Div. 3KL. Highest number of sets ever completed in fall survey (838).

1997: No shallow coverage in Div 2GH, no deepwater coverage in Div. 3NO. In Div 3M, only deepwater strata surveyed from this year onward.

1998: Poor coverage in Div. 2G. Some coverage of deep strata in Div. 3NO. Over 800 sets in total for third consecutive year.

1999: No deep coverage in Div 2G, no inshore coverage in Div. 3KL, reduced coverage in Div. 3M, no deep coverage in Div. 3NO. 744 sets completed in total.

2000: No coverage of Div. 2G from 2000 onward. Div 2H not surveyed. Some sets missed in Div. 3K and 3L. First complete coverage of deepwater sets in Div. 3NO. 672 sets in total.

2001: Poor coverage in Div 2H, and later than usual. RV *Alfred Needler* used for 126 sets in Div. 2J and 3KL. 764 sets completed in total.

2002: Div. 2H not surveyed. All other scheduled coverage completed, but 128 sets of 717 total were done in January 2003, after scheduled date of survey.

2003: Div. 2H not surveyed. A few sets dropped in Div. 3K. Almost no deep coverage in Div 3NO. 31% of 668 sets completed in January 2004.

Results of spring surveys in 3LNO

For comparison, coverage and timing of the spring surveys (1996-2004) in Div. 3LNO, conducted with the same vessel (*Templeman*) and Campelen trawl, are shown in Table 4. These surveys cover strata out to a maximum depth of 731 m, and the Campelen trawl has been used from 1996 onward. Coverage has been relatively constant in recent years, with a mean of 321 sets per year. The surveys have begun as early as April 27 and ended as late as June 30, and there is minimal variation in survey timing or depth fished. Detailed stratum by straum coverage in these surveys has been presented in many recent NAFO assessment documents, such as Walsh *et al.* (MS 2004) on yellowtail flounder.

Discussion

There are perhaps three major sources of uncertainty resulting from the problems encountered during the fall surveys of recent years: gaps in coverage (missed strata, reduced numbers of sets), changes in timing (survey coverage extended later, coverage of some strata/Divisions often spread out over a longer period than planned), and vessel effects (no comparisons of the 3 vessels used, using vessels in areas where they have little or no coverage in previous years).

On the first point, the major gaps in the survey in 2004 have been described above. Deep-water coverage in Div. 3NO was cancelled in both 2003 and 2004. Several other key strata in Div. 3L were missed in 2004, and this impacted abundance and biomass estimates for a number of shellfish and groundfish stocks. Other notable gaps include poor coverage in Div. 2G (none after 1999), spatial and temporal gaps in Div. 2H, no inshore strata fished in Div. 3KL in 1995 and 1999, and generally poor coverage of deep strata in Div. 3NO (except in 1998, 2000-02).

Regarding changes in timing, the surveys of 1995, and 2002 to 2004 were all extended into the following year. This did not happen at all in the earlier survey series, from 1977-1994. The timing of coverage in Div. 2GH (Tables 5 and 6) was generally variable, ranging from late September (1996) to mid-December (2004). In Div. 2J (Table 7), the usual timing of late October to mid-November was generally followed in 1996-2000 and 2004, but was later in 1995 and 2001-03. In Div 3K, the timing of the surveys affected most were those of 1995, and 2002-04. In addition, the coverage in 2004 was spread out over a period of 81 days, by far the longest in the time period (Table 8). In Div 3L, only in 1995 and 2003 did coverage extend into the following January (Table 9), and this has not occurred at all in Div. 3NO (Tables 11 and 12).

Estimates of abundance and biomass in the survey are calculated assuming that there are no vessel effects, i.e. all three vessels are treated equally. If there was no variation in the coverage by vessel, this would not be an issue. However, because of vessel breakdowns, it has often been necessary for a vessel to survey an area normally covered by the other. Examples include the RV *Alfred Needler* sets in 1996 and 2001, and sets by RV *W. Templeman* in Div. 2J in the 2002 survey (Table 3). As well, Div. 3K is often a mixed bag, with the proportion of sets done by *Teleost vs. Templeman* varying over time (e.g. no *WT* sets in 1999 and 2000, and 100+ in 1995 and 2002). In general, the shallow sets in Div. 3LNO are done by the RV *W. Templeman*, and the deeper sets by *Teleost*, although exceptions

to this are frequent.

With respect to possible vessel effects, all three vessels used in the fall surveys from 1995 onward have used the same version of the Campelen 1800 trawl, which undergoes an extensive mensuration program before and during each survey trip (McCallum and Walsh, 1996). As well, standard survey protocols are followed strictly for each tow, and each set is monitored with a set of Scanmar trawl sensors, and the data collected and analysed. Despite these controls, McCallum and Walsh (MS 2002) found that there were differences in trawl performance between vessels, and sometimes between surveys on the same vessel. They concluded that some of this difference was likely due to depth and bottom type, and some was due to different vessel characteristics of the three research vessel. They concluded that further analysis of the trawl data was required. Effects of these differences on abundance and biomass estimates are not known. In any case, the standard tow parameters (Tow = 15 minutes @ 3.0 knots) have been used in all analyses, and are not adjusted by observed differences in the tow data collected. To look for vessel effects, some comparative fishing has been conducted during the spring 2005 survey in Div. 3P between *Alfred Needler* and *W. Templeman*, both using the standard Campelen trawl, and additional comparisons are planned during the fall 2005 survey.

It is difficult to measure the effects on survey results that these problems have caused. Surveys are intended to be carried out using the same methodology and timing to minimise the design effects on the populations being studied. Changes in biology (maturation, growth), migration, etc. are factors which would be influenced by changes in survey timing. The effects of these delays and shifts in timing cannot always be quantified, but often they have destroyed the synoptic two-vessel element in survey coverage which is part of the design. As well, these problems have introduced a further degree of uncertainty into the survey estimates, and therefore into the assessments of stocks such as crab, shrimp, cod, and Greenland halibut.

Acknowledgments

Thanks to Gus Cossitt for the survey stratification maps.

References

BRODIE, W. MS 1996. A description of the 1995 fall groundfish survey in Div. 2J3KLNO. *NAFO SCR Doc*., No. 27, Serial No. N2700, 7 p.

MCCALLUM, B., and S. J. WALSH. MS 2002. An update on the performance of the Campelen 1800 during bottom trawl surveys in Subareas 2 and 3 in 2001. *NAFO SCR Doc*., No. 32, Serial No. N4643, 16 p.

MCCALLUM, B. R., and S. J. WALSH. 1996. Groundfish survey trawls used at the Northwest Atlantic Fisheries Centre, 1971-present. *NAFO Sci. Coun. Studies*, **29**: 93-104.

MORGAN, M. J., W. B. BRODIE, W. R. BOWERING, D. MADDOCK PARSONS, and D. C. ORR. MS 1998. Results of data conversions for American plaice in Div. 3LNO from comparative fishing trials between the Engel Otter Trawl and the Campelen 1800 Shrimp Trawl. *NAFO SCR Doc*., No. 70, Serial No. N3062, 10 p.

WALSH, S. J., M. F. VEITCH, W. B. BRODIE, and K. S. DWYER. MS 2004. Canadian bottom trawl survey estimates of the distribution and abundance of yellowtail flounder (*Limanda ferruginea*) on the the Grand Bank, in NAFO Divisions 3LNO, from 1984-2003. *NAFO SCR Doc*., No. 36, Serial No. N4986, 50 p.

WARREN, W. G. 1997. Report on the comparative fishing trial between the *Gadus Atlantica* and *Teleost*. *NAFO Sci. Coun. Studies*, **2**: 81-92.

WARREN, W. G., W. BRODIE, D. STANSBURY, S. WALSH, J. MORGAN, and D. ORR. MS 1997. Analysis of the 1996 comparative fishing trial between the *Alfred Needler* with the Engel 145 trawl and the *Wilfred Templeman* with the Campelen 1800 trawl. *NAFO SCR Doc*., No. 68, Serial No. N2902, 12 p.

Table 1. Information on Canadian autumn surveys, Div. 2J3KLNO, 1977-94.

Div.	Years surveyed	Research Vessel*	Usual Max. Depth(m)	# sets (min, max)
2J	1977-94	GA	1000	53 - 157
3K	1978-94	GA	1000	69 - 181
3L	1981-94	ATC (81,82), WT/AN (83-94)	731	99 - 231
3M	-	-	-	-
3N	1990-94	WT	731	34 - 80
3O	1990-94	WT	731	54 - 91

* GA = *Gadus Atlantica*
ATC = *A.T.Cameron*
WT = *Wilfred Templeman*
AN = *Alfred Needler*

Table 2. Stratified Random surveys, NF Region, autumn 1995 to present.
Area of NAFO Divisions, set allocations, and Campelen tow parameters.

Div.	Area (sq n mi)	# of sets	# of strata
2G	16749	103	29
2H	11776	83	35
2J	25272	117	40
3K	37051	175	46
3L	46338	206	69
3M (F.Pass)	3381	26	9
3N	19523	94	35
3O	20176	99	36
Total	180266	903	299

Tow parameters, Campelen 1800 trawl

Tow time = 15 minutes
Tow Speed = 3 knots
Tow distance = 0.75 n. mile
Standard Wingspread = 55.25 feet

Based on 1 n.mi = 6076.11 feet, 1 standard tow covers 0.00682 square n. miles.

Table 3. Summary of sets in Campelen autumn surveys in SA 2+3 in 1995-2004. Depth range is given in meters, numbers of sets appear in parentheses. Only successful survey sets are shown here.

Year	Division	Ship				Year	Division	Ship			
		Teleost	*W.Templeman*	*A.Needler*	***Total***			*Teleost*	*W.Templeman*	*A.Needler*	***Total***
1995	2G	Not surveyed in 1995				2000	2G	Not surveyed in 2000			
	2H						2H				
	2J	145-948 (84)			84		2J	127-1400 (117)			117
	3K	166-1444 (31)	162-494 (100)		131		3K	113-1379 (159)			159
	3L	733-1210 (5)	63-640 (161)		166		3L	152-1430 (74)	42-447 (102)		176
	3M	Not surveyed in 1995					3M	764-1401 (26)			26
	3N		40-650 (90)		90		3N	747-1419 (24)	46-642 (70)		94
	3O		63-730 (81)		81		3O	752-1424 (24)	62-654 (76)		100
	1995 autumn survey extended into January 1996 (66 sets)				**552**						**672**
1996	2G	127 - 1436 (47)			47	2001	2G	Not surveyed in 2001			
	2H	122 - 1415 (77)			77		2H	999-1466 (8)		117-655 (49)	57
	2J	126 - 1410 (117)			117		2J	120-1389 (49)		105-574 (71)	120
	3K	111 - 1368 (115)	126 - 472 (60)		175		3K	146-1479 (106)	128-439 (55)	170-252 (4)	165
	3L	805 - 1433 (31)	51 - 671 (180)		211		3L	146-1457 (34)	38-702 (169)	187-203 (2)	205
	3M	784 - 1400 (18)	127 - 707 (68)		86		3M	763-1407 (26)			26
	3N	390 - 1147 (13)		37 - 309 (54)	67		3N	739-1410 (24)	45-660 (70)		94
	3O	68 - 690 (24)	65 - 139 (19)	63 - 304 (15)	58		3O	803-1391 (22)	67-703 (75)		97
					838						**764**
1997	2G	201-1209 (69)			69	2002	2G	Not surveyed in 2002			
	2H	220-1382 (71)			71		2H				
	2J	123-1488 (117)			117		2J	102-1372 (98)	136-572 (19)		117
	3K	143-1431 (155)	117-421 (20)		175		3K	156-1395 (64)	121-481 (111)		175
	3L	161-1436 (71)	35-714 (134)		205		3L	763-1431 (30)	35-670 (176)		206
	3M	799-1379 (26)			26		3M	818-1403 (26)			26
	3N		41-769 (74)		74		3N	811-1429 (24)	44-675 (70)		94
	3O		62-611 (73)		73		3O	775-1504 (24)	65-696 (75)		99
					810		2002 autumn survey extended into January 2003 (128 sets)				**717**
1998	2G	143-1488 (34)			34	2003	2G	Not surveyed in 2003			
	2H	98-1473 (83)			83		2H				
	2J	126-1398 (118)			118		2J	123-1404 (116)			116
	3K	122-1415 (154)	121-346 (17)		171		3K	151-1474 (118)	115-489 (50)		168
	3L	691-1437 (32)	34-675 (172)		204		3L	753-1446 (30)	32-702 (175)		205
	3M	768-1436 (26)			26		3M	795-1455 (26)			26
	3N	834-1447 (12)	37-1079 (78)		90		3N		43-727 (70)		70
	3O		82-1076 (87)		87		3O	761-1382 (8)	63-650 (75)		83
					813		2003 autumn survey extended into January 2004 (210 sets)				**668**
1999	2G	142-1415(69)			69	2004	2G	Not surveyed in 2004			
	2H	104-1454(81)			81		2H	109-1415 (87)			87
	2J	109-1375(115)			115		2J	127-1365 (115)			115
	3K	146-1477(154)			154		3K	112-1412 (135)	212-549 (16)		151
	3L	1366(1)	63-1407 (169)		170		3L	151-522 (4)	44-653 (143)		147
	3M	853-1403(12)			12		3M	Not surveyed in 2004			
	3N		39-664(68)		68		3N		40-659 (69)		69
	3O		58-692(75)		75		3O		63-634 (76)		76
					744		2004 autumn survey extended into February 2005 (36 sets)				**645**

Table 4. Number of successful sets, spring surveys 1996-2004 (Campelen time-series)

All surveys conducted by *RV Wilfred Templeman*
Range of dates (earliest to latest day each year) shown in last 2 columns of upper panel.
Depth range of survey sets shown in lower panel.

Year	Div. 3L	# of inshore sets included	Div. 3N	Div. 3O	Total	earliest	latest
1996	188	0	82	86	356	7-May	27-Jun
1997	158	0	71	81	310	30-Apr	26-Jun
1998	163	8	88	93	352	12-May	30-Jun
1999	177	32	82	86	377	11-May	29-Jun
2000	134	0	81	83	298	11-May	29-Jun
2001	154	12	79	79	324	29-Apr	24-Jun
2002	146	4	79	79	308	27-Apr	22-Jun
2003	155	14	79	79	327	8-May	26-Jun
2004	151	12	79	79	321	12-May	26-Jun
mean	*158.4*		*80.0*	*82.8*	*321.2*		

Depth range (m), Campelen spring surveys 1996-2004.

	Div. 3L		Div. 3N		Div. 3O	
Year	min	max	min	max	min	max
1996	66	664	42	665	65	685
1997	60	681	35	689	62	669
1998	53	721	38	682	64	657
1999	41	692	40	659	62	679
2000	61	681	45	664	61	694
2001	34	695	40	650	74	699
2002	42	710	40	641	63	628
2003	62	698	39	681	63	726
2004	47	710	44	675	61	636

Table 5. Summary of coverage, by stratum, in Div. 2G during 1995-2004 fall surveys

Stratum	Area (sq n mi)	Depth (m)	1996 Se 30 - Oc 8	1997 Oct 1-9	1998 Oct 1-7	1999 Oct 12-27
901	1213	201-300	4	8	1	5
902	120	301-400	2	3	2	2
903	80	401-500	0	3	2	2
904	153	501-750	0	2	2	2
905	164	751-1000	0	1	2	2
906	229	1001-1250	0	2	2	2
907	360	1251-1500	0	0	1	2
908	585	201-300	2	4	2	3
909	2773	<=200	8	0	2	12
910	2339	<=200	6	0	2	9
911	692	201-300	3	5	3	3
912	73	301-400	0	2	2	2
913	62	401-500	0	2	2	2
914	113	501-750	0	2	2	2
915	96	751-1000	0	0	1	0
916	146	1001-1250	0	1	2	0
917	165	1251-1500	0	0	1	0
918	515	1251-1500	1	0	0	0
919	316	1001-1250	1	2	0	0
920	172	751-1000	1	1	0	0
921	142	501-750	1	2	1	2
922	186	401-500	0	2	1	2
923	186	301-400	2	2	0	2
924	756	201-300	2	5	0	3
925	1804	<=200	4	0	1	4
926	433	201-300	2	3	0	2
927	832	301-400	2	6	0	2
928	783	401-500	3	3	0	2
929	1261	501-750	3	8	0	0
Total	16749		47	69	34	69

Table 6. Summary of coverage, by stratum, in Div 2H during 1995-2004 fall surveys

Stratum	Area (sq n mi)	Depth (m)	1996 Sep 18-30	1997 Oct 9-19	1998 Oct 7-30	1999 Oc 22-No 9	2001 Dec 8-15	2004 Oct 8-26
930	1028	<=200	4	0	5	4	3	5
931	276	201-300	2	2	2	2	0	2
932	55	301-400	2	2	2	2	0	2
933	50	501-750	2	2	2	2	0	2
934	78	501-750	2	2	2	2	0	2
935	96	751-1000	1	2	2	2	0	2
936	78	1001-1250	1	2	2	1	2	2
937	94	1251-1500	1	2	2	1	2	2
938	191	1251-1500	2	2	2	2	2	2
939	130	1001-1250	2	2	1	2	1	2
940	97	751-1000	2	2	2	2	1	2
941	89	501-750	2	2	2	2	2	2
942	55	501-750	2	2	2	2	2	2
943	354	201-300	2	2	2	2	0	2
944	860	301-400	3	6	4	4	1	4
945	461	501-750	2	3	2	2	2	2
946	721	501-750	3	5	4	4	3	4
947	227	501-750	2	2	2	2	2	2
948	246	501-750	2	2	2	1	2	1
949	206	301-400	2	2	0	1	2	2
950	261	201-300	2	2	0	2	2	2
951	234	501-750	2	2	2	2	2	2
952	177	301-400	2	2	2	2	2	2
953	291	201-300	2	2	2	2	2	2
954	971	<=200	4	0	5	4	3	5
955	389	201-300	2	3	2	2	2	2
956	1051	<=200	3	0	5	4	4	5
957	1371	<=200	5	0	7	7	5	7
958	294	201-300	2	2	2	2	2	2
959	178	301-400	2	2	2	2	2	2
960	107	501-750	2	2	2	2	2	2
961	211	501-750	2	2	2	2	2	2
962	242	751-1000	2	2	2	2	0	2
963	265	1001-1250	2	2	2	2	0	2
964	342	1251-1500	2	2	2	2	0	2
Total	11776		77	71	83	81	57	87

Table 7. Summary of coverage, by stratum, in Div. 2J during 1995-2004 fall surveys

Stratum	Area (sq n mi)	Depth (m)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
			De 4 - Ja 22	Oc 22 - No 7	Oc 19 - No 4	Oc 20 - No 4	Nov 6-25	Nov 1-14	No 21 - Dec 8	De 7 - Ja 12	Dec 1-17	Oc 27 - No 19
201	633	<=200	0	2	2	2	2	2	2	2	2	2
202	621	201-300	2	2	2	2	2	2	2	2	2	2
203	487	301-400	2	2	2	2	2	2	2	2	2	2
204	288	501-750	2	2	2	2	2	2	2	2	2	2
205	1594	<=200	0	6	6	6	6	6	6	6	6	6
206	1870	<=200	5	7	7	7	7	7	7	7	7	7
207	2264	<=200	8	9	9	9	9	9	9	9	9	8
208	588	301-400	2	2	2	2	2	2	2	2	2	2
209	680	201-300	2	3	3	3	3	3	3	3	3	2
210	1035	201-300	3	4	4	4	4	4	4	4	4	4
211	251	301-400	2	2	2	2	2	2	3	2	2	2
212	557	501-750	2	2	2	2	2	2	2	2	2	2
213	1583	201-300	6	6	6	6	6	6	6	6	6	6
214	1341	201-300	4	5	5	5	5	5	6	5	5	5
215	1302	201-300	2	5	5	5	5	5	5	5	5	5
216	360	301-400	2	2	2	2	2	2	2	2	2	2
217	241	501-750	2	2	2	2	2	2	2	2	2	2
218	362	501-750	3	2	2	3	2	2	2	2	2	2
219	283	751-1000	2	2	2	2	2	2	2	2	2	2
220	303	1001-1250	0	2	2	2	1	2	2	2	2	2
221	330	1251-1500	0	2	2	2	2	2	2	2	2	2
222	450	301-400	2	2	2	2	2	2	3	2	2	2
223	158	501-750	2	2	2	2	2	1	2	2	2	2
224	228	501-750	3	2	2	2	2	2	2	2	2	2
225	195	1001-1250	0	2	2	2	2	2	2	2	2	2
226	201	1251-1500	0	2	2	2	2	2	2	2	2	2
227	598	501-750	2	2	2	2	2	3	2	2	2	2
228	2196	201-300	7	8	8	8	8	8	7	8	8	8
229	536	301-400	2	2	2	2	2	2	2	2	2	2
230	185	501-750	2	2	2	2	2	2	2	2	2	2
231	186	751-1000	2	2	2	2	2	2	2	2	2	2
232	228	1001-1250	0	2	2	2	2	2	2	2	2	2
233	237	1251-1500	0	2	2	2	2	2	2	2	2	2
234	530	201-300	0	2	2	2	2	2	2	2	2	2
235	414	501-750	2	2	2	2	2	2	2	2	2	2
236	193	751-1000	2	2	2	2	2	2	2	2	2	2
237	733	<=200	3	3	3	3	3	3	4	3	3	3
238	778	<=200	0	3	3	3	2	3	3	3	2	3
239	120	501-750	2	2	2	2	2	2	2	2	2	2
240	133	501-750	2	2	2	2	2	2	2	2	2	2
Total	25272		84	117	117	118	115	117	120	117	116	115

Table 8. Summary of coverage, by stratum, in Div. 3K during 1995-2004 fall surveys

Stratum	Area (sq n mi)	Depth (m)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
			No 28 - Ja 25	Nov 7-26	No 4- De 19	Nov 4-30	No 20 - De 11	No 14 - De 18	No 27 - De 18	De 1 - Ja 14	De 17- Ja 31	No 13 - Fe 1
608	798	<=200	0	3	3	3	0	3	2	3	2	3
609	342	201-300	0	2	2	2	0	2	2	2	2	2
610	256	301-400	0	2	2	2	0	2	2	2	2	2
611	573	201-300	0	3	3	2	0	2	2	2	2	2
612	445	<=200	0	2	2	2	0	2	2	2	2	2
613	30	501-750	0	2	2	2	0	2	2	2	2	2
614	263	301-400	0	2	2	2	0	2	2	2	2	2
615	251	201-300	0	2	2	2	0	2	2	2	2	2
616	250	<=200	0	2	2	2	0	2	2	2	2	2
617	593	301-400	2	3	3	3	3	3	3	3	3	3
618	1347	<=200	5	6	6	4	6	6	3	6	4	6
619	1753	<=200	4	7	7	6	6	8	8	8	6	8
620	2545	201-300	3	11	11	11	11	11	11	11	11	8
621	2537	201-300	6	11	11	11	11	11	6	11	11	8
622	691	501-750	3	3	3	3	3	3	3	3	3	3
623	494	301-400	2	2	2	2	2	2	2	2	2	2
624	1105	201-300	4	5	5	5	5	5	5	5	5	5
625	888	301-400	3	4	4	4	4	4	4	4	4	4
626	1113	301-400	4	5	5	5	5	5	4	5	5	4
627	1255	501-750	5	5	5	5	5	5	3	5	5	4
628	1085	301-400	5	5	5	5	5	5	3	5	5	5
629	495	301-400	2	2	2	2	2	2	3	2	2	2
630	332	301-400	2	2	2	2	2	2	3	2	2	2
631	1321	501-750	5	6	6	6	6	6	10	6	6	4
633	2067	301-400	8	9	9	9	9	9	9	9	9	9
634	1555	201-300	7	7	7	7	7	7	7	7	5	2
635	1274	201-300	6	5	5	5	5	5	5	5	5	2
636	1455	201-300	7	6	6	6	6	6	6	6	6	3
637	1132	201-300	5	5	5	5	5	1	5	5	5	5
638	2059	301-400	9	9	9	9	8	5	8	9	9	9
639	1463	301-400	7	6	6	6	7	3	5	6	6	3
640	69	501-750	2	2	2	2	2	2	2	2	2	2
641	230	501-750	2	2	2	2	2	1	2	2	2	2
642	418	751-1000	2	2	2	2	2	2	2	2	2	2
643	733	1001-1250	3	3	3	3	3	2	3	3	3	3
644	474	1251-1500	2	2	2	2	2	2	2	2	2	2
645	216	501-750	2	2	2	2	2	2	2	2	2	2
646	325	501-750	2	2	2	2	2	2	2	2	2	2
647	360	751-1000	2	2	2	2	2	2	2	2	2	2
648	228	1001-1250	0	2	2	2	2	2	2	2	2	2
649	212	1251-1500	0	2	2	2	2	2	2	2	2	2
650	134	501-750	2	2	2	2	2	0	2	2	2	2
651	359	501-750	2	2	2	2	2	1	2	2	2	2
652	516	751-1000	2	2	2	2	2	2	2	2	2	2
653	531	1001-1250	2	2	2	2	2	2	2	2	2	2
654	479	1251-1500	2	2	2	2	2	2	2	2	2	2
Total	37051		131	175	175	171	154	159	165	175	168	151

Table 9. Summary of coverage, by stratum, in Div. 3L during 1995-2004 fall surveys

Stratum	Area (sq n mi)	Depth (m)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
			Oc 3 - Ja 25	Oc 9 - De 5	Oc 23 - De 20	No 2 - De 15	No 7 - De 12	Oc 24 - De 18	Oc 4 - De 6	Oc 23 - De 2	No 7 - Ja 20	No 24 - De 19
328	1519	92-183	6	5	5	5	5	5	5	5	5	5
341	1574	92-183	6	6	4	5	5	5	5	5	5	4
342	585	92-183	2	2	2	2	2	2	2	2	2	2
343	525	92-183	2	2	2	2	2	2	2	2	2	2
344	1582	184-274	5	6	5	5	5	3	4	5	5	5
345	1432	275-366	7	5	5	5	5	3	5	5	5	5
346	865	275-366	3	3	3	2	3	3	3	3	2	3
347	983	184-274	4	3	3	3	3	3	3	3	3	2
348	2120	92-183	7	7	7	6	7	4	7	7	7	7
349	2114	92-183	9	7	7	7	7	7	7	7	7	7
350	2071	56-91	8	7	7	7	7	7	7	7	7	7
363	1780	56-91	7	6	6	6	6	4	6	6	6	6
364	2817	92-183	9	10	9	9	9	2	9	9	9	9
365	1041	92-183	4	4	3	3	3	1	3	3	3	0
366	1394	184-274	5	5	5	5	5	2	5	5	5	0
368	334	275-366	2	3	2	2	2	2	2	2	2	0
369	961	184-274	3	2	3	3	3	2	3	3	3	0
370	1320	92-183	5	4	4	4	4	4	4	4	4	1
371	1121	56-91	5	4	4	4	4	3	4	4	4	4
372	2460	56-91	10	9	8	8	8	2	8	8	8	8
384	1120	56-91	5	4	4	4	4	4	4	4	4	4
385	2356	92-183	9	9	8	8	8	8	8	8	8	8
386	983	184-274	4	3	3	3	3	3	3	3	3	0
387	718	275-366	3	2	2	2	2	2	2	2	2	0
388	361	275-366	2	2	2	2	2	2	2	2	2	2
389	821	184-274	3	3	3	3	3	3	3	3	3	3
390	1481	92-183	6	5	5	5	5	5	5	5	5	5
391	282	184-274	2	2	2	2	2	2	2	2	2	2
392	145	275-366	2	2	2	2	2	2	2	2	2	2
729	186	367-549	2	2	2	2	2	2	2	2	2	2
730	170	550-731	2	2	2	2	2	2	2	2	2	2
731	216	367-549	2	1	2	2	2	2	2	2	2	2
732	231	550-731	2	2	2	2	2	2	2	2	2	2
733	468	367-549	2	3	2	2	2	2	2	2	2	2
734	228	550-731	2	2	2	2	2	2	2	2	2	0
735	272	367-549	2	2	2	2	2	2	2	2	2	0
736	175	550-731	2	2	2	2	2	2	2	2	2	0
737	227	732-914	2	2	2	2	2	2	2	2	2	0
738	221	915-1097	2	2	2	2	2	2	2	2	2	0
739	254	1098-1280	1	2	2	2	2	2	2	2	2	0
740	264	1281-1463	0	2	2	2	2	2	2	2	2	0
741	223	732-914	0	2	2	2	2	2	2	2	2	0
742	206	915-1097	0	2	2	2	2	2	2	2	2	0
743	211	1098-1280	0	2	2	2	3	2	2	2	2	0
744	280	1281-1463	0	2	2	2	1	2	2	2	2	0
745	348	732-914	0	2	2	2	2	2	2	2	2	0
746	392	915-1097	0	2	2	2	2	2	2	2	2	0
747	724	1098-1280	0	3	2	2	2	2	2	2	2	0
748	159	732-914	0	2	2	2	2	2	2	2	2	0
749	126	915-1097	0	2	2	2	1	2	2	2	2	0
750	556	1098-1280	0	2	2	2	2	2	2	2	2	0
751	229	1281-1463	0	2	2	2	1	2	2	2	2	0
784	268	<=55	0	2	2	2	0	2	2	2	2	2
785	465	56-91	0	2	2	2	0	2	2	2	2	2
786	84	92-183	0	2	2	2	0	2	2	2	2	2
787	613	92-183	0	2	2	2	0	2	2	2	2	2
788	261	92-183	0	2	2	2	0	2	2	2	2	2
789	72	275-366	0	2	2	2	0	2	2	2	2	2
790	89	92-183	0	2	2	2	0	2	2	2	2	2
791	227	184-274	0	2	2	2	0	2	2	2	2	2
792	50	367-549	0	2	2	2	0	2	2	2	2	2
793	72	92-183	0	2	2	2	0	2	2	2	2	2
794	216	92-183	0	2	2	2	0	1	2	2	2	2
795	164	184-274	0	2	2	2	0	2	2	2	2	2
796	175	275-366	0	2	2	2	0	2	2	2	2	2
797	98	92-183	0	2	2	2	0	2	2	2	2	2
798	100	275-366	0	2	2	2	0	2	2	2	2	2
799	72	92-183	0	2	2	2	0	2	2	2	2	2
800	81	275-366	0	0	2	2	0	2	2	2	2	2
Total	46338		166	211	205	204	170	176	205	206	205	147

Table 10. Summary of coverage, by stratum, in Div. 3M during 1995-2004 fall surveys

Stratum	Area (sq n mi)	Depth (m)	1996 Se 25 - De 4	1997 Dec 1-15	1998 Dec 9-13	1999 Dec 11-12	2000 Oct 24-29	2001 Oct 8-13	2002 Oct 24 - No 5	2003 Jan 13-18 (2004)
501	342	<=146	2	0	0	0	0	0	0	0
502	838	147-183	6	0	0	0	0	0	0	0
503	628	184-256	4	0	0	0	0	0	0	0
504	348	184-256	2	0	0	0	0	0	0	0
505	703	184-256	5	0	0	0	0	0	0	0
506	496	184-256	3	0	0	0	0	0	0	0
507	822	257-366	5	0	0	0	0	0	0	0
508	646	257-366	4	0	0	0	0	0	0	0
509	314	257-366	2	0	0	0	0	0	0	0
510	951	257-366	6	0	0	0	0	0	0	0
511	806	257-366	5	0	0	0	0	0	0	0
512	670	367-549	4	0	0	0	0	0	0	0
513	249	367-549	2	0	0	0	0	0	0	0
514	602	367-549	4	0	0	0	0	0	0	0
515	666	367-549	3	0	0	0	0	0	0	0
516	634	550-731	4	0	0	0	0	0	0	0
517	216	550-731	2	0	0	0	0	0	0	0
518	210	550-731	2	0	0	0	0	0	0	0
519	414	550-731	3	0	0	0	0	0	0	0
520	525	732-914	0	0	0	0	0	0	0	0
521	517	915-1097	0	0	0	0	0	0	0	0
522	533	1098-1280	0	0	0	0	0	0	0	0
523	284	1281-1463	0	0	0	0	0	0	0	0
524	253	732-914	0	0	0	0	0	0	0	0
525	226	915-1097	0	0	0	0	0	0	0	0
526	177	1098-1280	0	0	0	0	0	0	0	0
527	171	1281-1463	0	0	0	0	0	0	0	0
528	530	732-914	2	3	3	1	3	3	3	3
529	488	915-1097	2	3	3	2	3	3	3	3
530	1134	1098-1280	2	7	7	5	7	7	7	7
531	203	1281-1463	2	2	2	2	2	2	2	2
532	238	915-1097	2	2	2	2	2	2	2	2
533	98	732-914	2	2	2	0	2	2	2	2
534	486	915-1097	2	3	3	0	3	3	3	3
535	92	1098-1280	2	2	2	0	2	2	2	2
536	112	1281-1463	2	2	2	0	2	2	2	2
537	102	367-549	0	0	0	0	0	0	0	0
538	194	550-731	0	0	0	0	0	0	0	0
539	133	732-914	0	0	0	0	0	0	0	0
Total	17051		86	26	26	12	26	26	26	26

Table 11. Summary of coverage, by stratum, in Div. 3N during 1995-2004 fall surveys

Stratum	Area (sq n mi	Depth (m)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
			Se 27 - Oc 26	No 25 - De 13	Oc 8 - No 5	Oc 16 - De 16	Nov 3-22	Oc 17 - De 5	Se 28 - Oc 29	Oct 13-26	Oc 21 - No 7	Nov 11-23
357	164	275-366	2	2	2	2	1	2	2	2	2	2
358	225	184-274	2	2	2	2	2	2	2	2	2	2
359	421	92-183	2	2	2	2	2	2	2	2	2	2
360	2992	56-91	17	6	9	8	8	8	8	8	8	8
361	1853	56-91	11	5	5	5	5	5	5	5	5	5
362	2520	56-91	5	6	7	7	7	7	7	7	7	7
373	2520	56-91	5	7	7	7	6	7	7	7	7	7
374	931	56-91	2	2	3	3	3	3	3	3	3	3
375	1593	<=55	9	4	4	4	4	4	4	4	4	4
376	1499	<=55	9	4	5	4	4	4	4	4	4	4
377	100	92-183	2	2	2	2	2	2	2	2	2	2
378	139	184-274	2	2	2	2	2	2	2	2	2	2
379	106	275-366	2	2	2	2	2	2	2	2	2	2
380	116	275-366	2	2	2	2	2	2	2	2	2	2
381	182	184-274	2	2	3	2	2	2	2	2	2	2
382	647	92-183	2	2	2	2	2	2	2	2	2	2
383	674	56-91	2	2	2	2	2	2	2	2	2	2
723	155	367-549	2	2	3	2	2	2	2	2	2	2
724	124	550-731	2	2	2	2	2	2	2	2	1	2
725	105	367-549	2	2	2	2	2	2	2	2	2	1
726	72	550-731	2	2	2	2	2	2	2	2	3	2
727	160	367-549	2	2	2	2	2	2	2	2	2	2
728	156	550-731	2	2	2	2	2	2	2	2	2	2
752	134	732-914	0	0	0	2	0	2	2	2	0	0
753	138	915-1097	0	0	0	2	0	2	2	2	0	0
754	180	1098-1280	0	1	0	2	0	2	2	2	0	0
755	385	1281-1463	0	0	0	2	0	2	2	2	0	0
756	106	732-914	0	0	0	2	0	2	2	2	0	0
757	102	915-1097	0	0	0	2	0	2	2	2	0	0
758	99	1098-1280	0	0	0	2	0	2	2	2	0	0
759	127	1281-1463	0	0	0	2	0	2	2	2	0	0
760	154	732-914	0	0	0	2	0	2	2	2	0	0
761	171	915-1097	0	0	0	2	0	2	2	2	0	0
762	212	1098-1280	0	0	0	0	0	2	2	2	0	0
763	261	1281-1463	0	0	0	0	0	2	2	2	0	0
Total	19523		90	67	74	90	68	94	94	94	70	69

Table 12. Summary of coverage, by stratum, in Div. 3O during 1995-2004 fall surveys

Stratum	Area (sq n mi)	Depth (m)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
			Se 26 - Oc 20	No 24 - De 17	Se 26 - Oc 19	Oc 10 - De 13	Oc 13 - No 13	Oc 11 - No 24	Se 22 - Oc 14	Oct 5-16	Se 23 - Oc 21	Oc 31 - No 10
329	1721	92-183	5	5	5	5	5	5	5	5	5	5
330	2089	56-91	5	6	6	6	6	6	6	6	6	7
331	456	56-91	2	2	2	2	2	2	2	2	2	2
332	1047	92-183	3	2	3	3	3	3	3	3	3	3
333	147	184-274	2	0	2	2	2	2	2	2	2	2
334	96	275-366	2	0	2	2	2	2	2	2	2	2
335	58	275-366	2	2	2	2	2	2	2	2	2	2
336	121	184-274	2	2	2	2	2	2	2	2	2	2
337	948	92-183	2	2	3	3	3	3	3	3	3	3
338	1898	56-91	5	2	5	5	5	5	5	5	5	5
339	585	92-183	2	3	2	2	1	2	2	2	2	2
340	1716	56-91	4	5	5	5	7	5	5	5	5	5
351	2520	56-91	7	6	7	7	6	7	7	7	7	7
352	2580	56-91	17	5	6	7	7	7	7	7	7	7
353	1282	56-91	3	2	4	4	4	4	4	4	4	4
354	474	92-183	2	2	2	2	2	2	2	2	2	2
355	103	184-274	2	2	2	2	2	2	2	2	2	2
356	61	275-366	2	2	2	2	2	2	2	2	2	2
717	166	367-549	2	0	2	2	2	2	2	2	2	2
718	134	550-731	2	0	2	2	2	2	2	2	2	2
719	76	367-549	2	2	2	2	2	3	2	2	2	2
720	105	550-731	2	2	1	2	2	2	2	2	2	2
721	76	367-549	2	2	2	2	2	2	2	2	2	2
722	93	550-731	2	2	2	2	2	2	2	2	2	2
764	105	732-914	0	0	0	2	0	2	2	2	0	0
765	124	915-1097	0	0	0	2	0	2	2	2	0	0
766	144	1098-1280	0	0	0	0	0	2	2	2	0	0
767	158	1281-1463	0	0	0	0	0	2	2	2	0	0
768	99	732-914	0	0	0	2	0	2	2	2	0	0
769	138	915-1097	0	0	0	2	0	2	2	2	0	0
770	128	1098-1280	0	0	0	0	0	2	2	2	0	0
771	175	1281-1463	0	0	0	0	0	2	2	2	0	0
772	135	732-914	0	0	0	2	0	2	0	2	2	0
773	128	915-1097	0	0	0	2	0	2	2	2	2	0
774	135	1098-1280	0	0	0	0	0	2	2	2	2	0
775	155	1281-1463	0	0	0	0	0	2	2	2	2	0
Total	20176		81	58	73	87	75	100	97	99	83	76

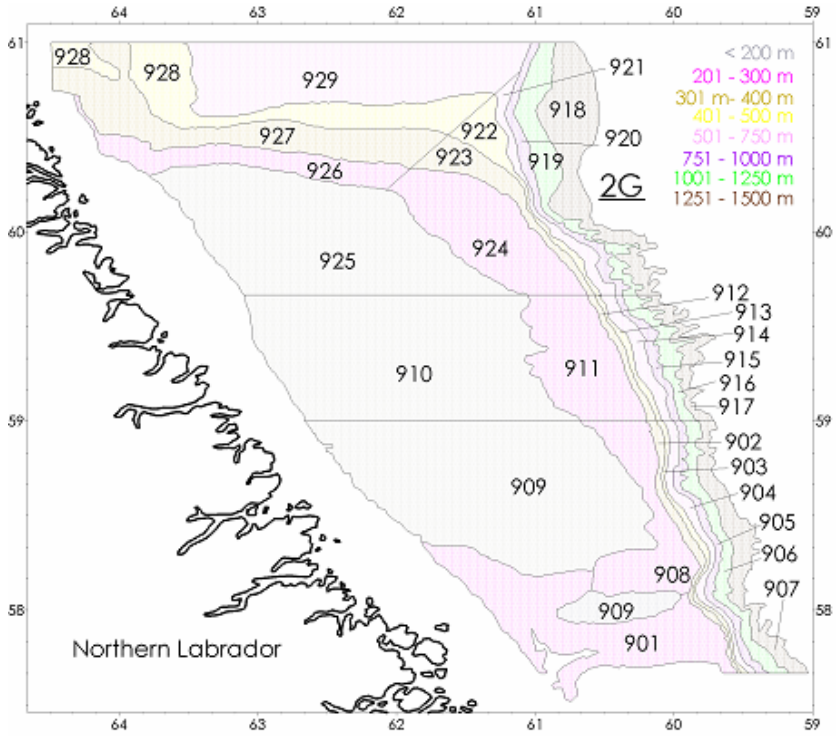

Fig 1. Stratification of Div. 2G.

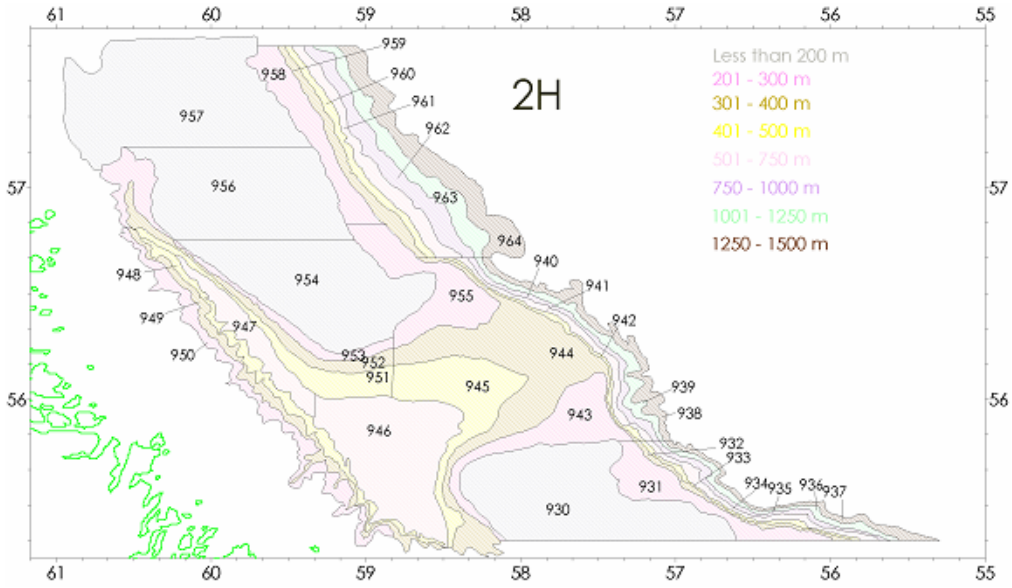

Fig 2. Stratification of Div. 2H.

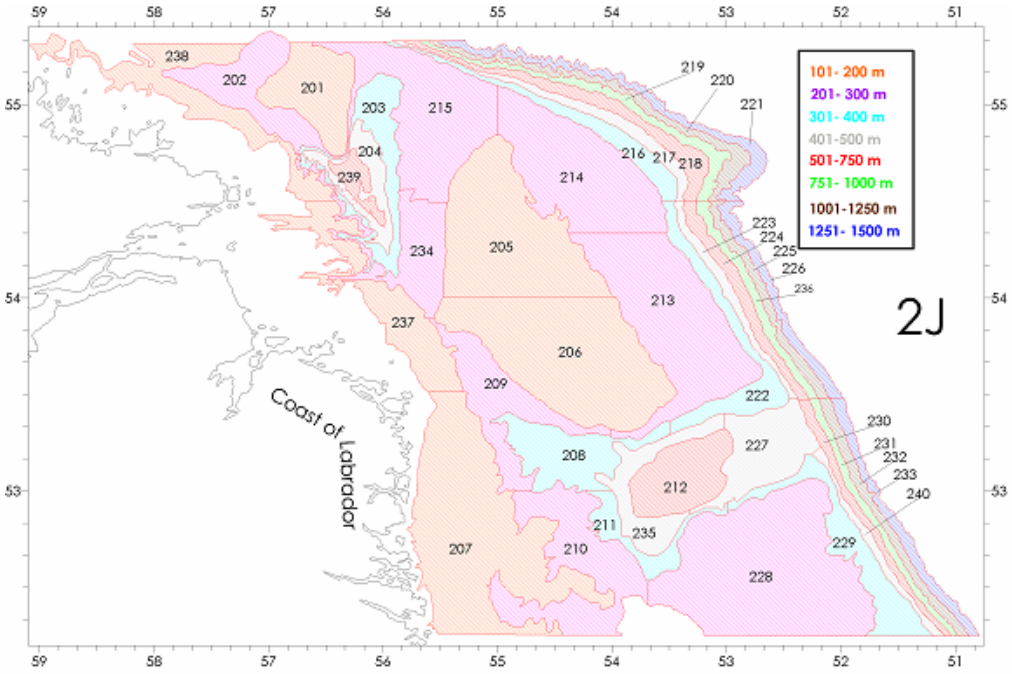

Fig 3. Stratification of Div. 2J.

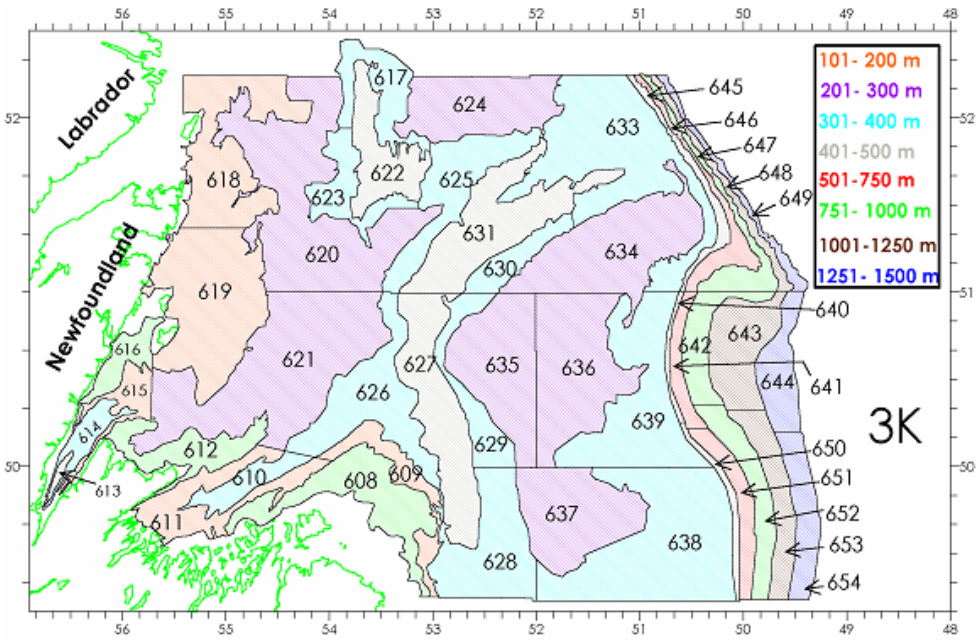

Fig 4. Stratification of Div. 3K.

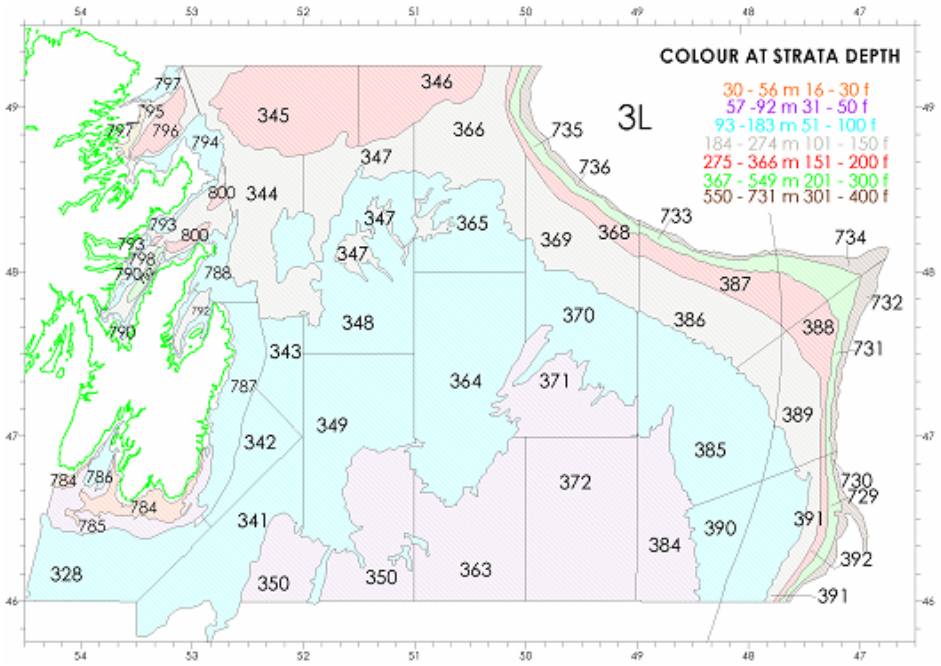

Fig. 5. Stratification of Div. 3L.

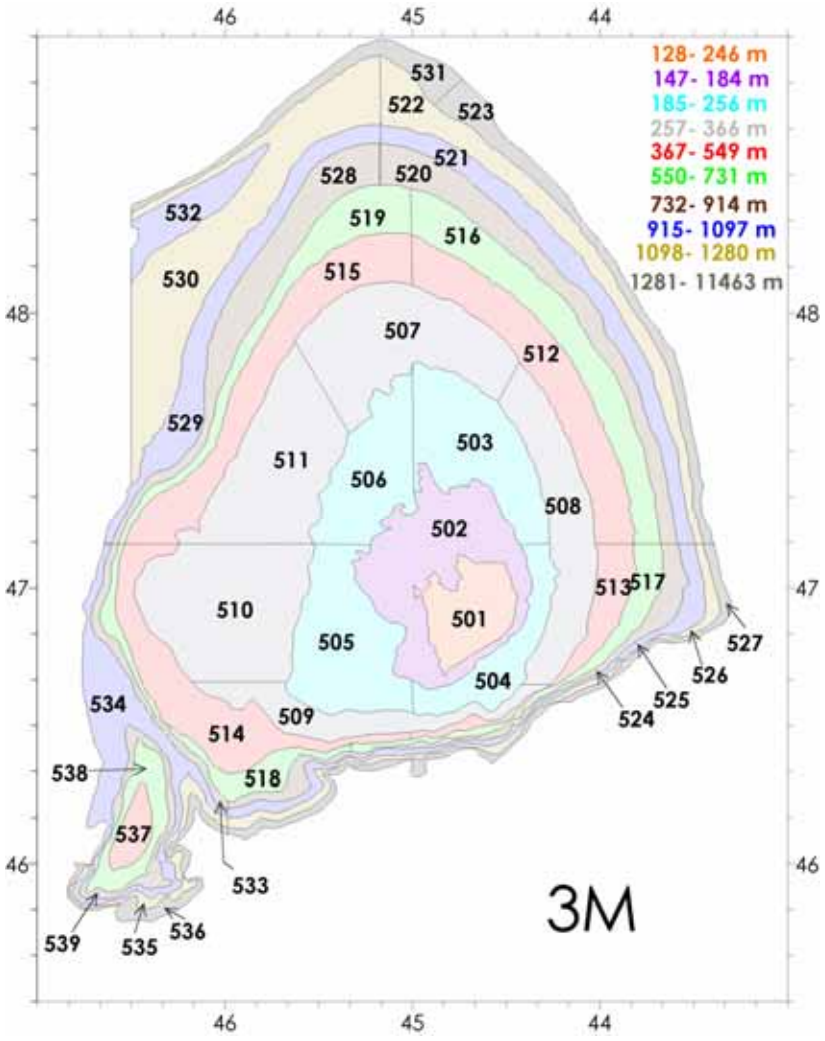

Fig. 6. Stratification of Div. 3M.

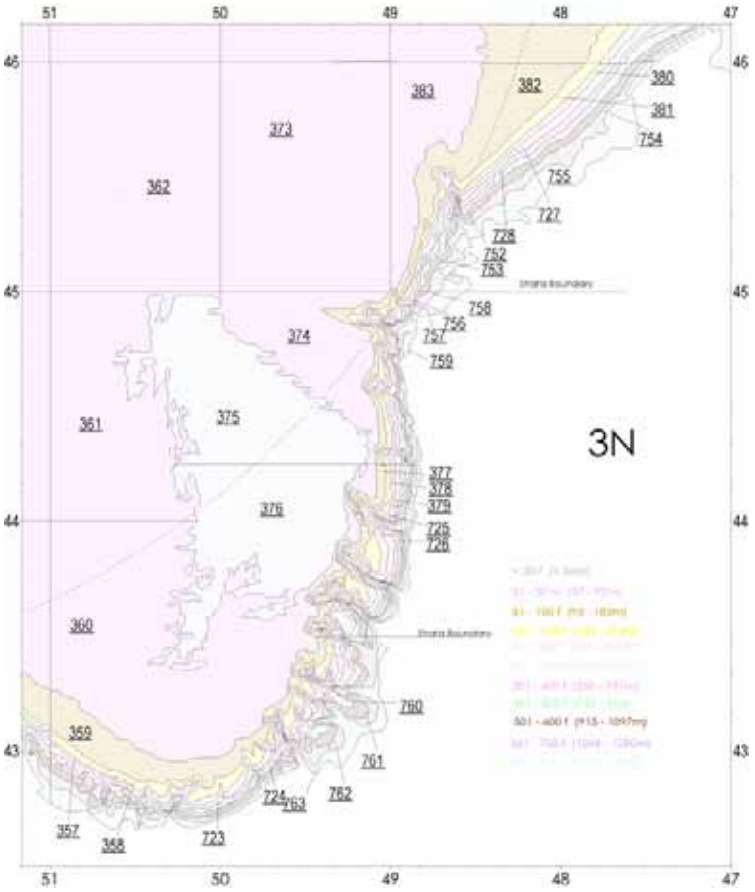

Fig. 7. Stratification of Div. 3N.

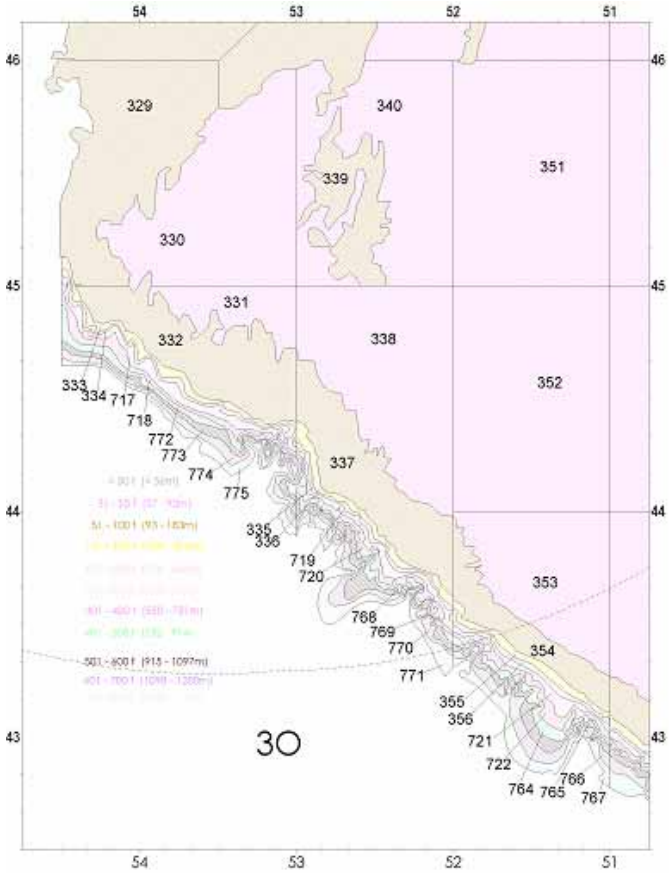

Fig. 8. Stratification of Div. 3O.

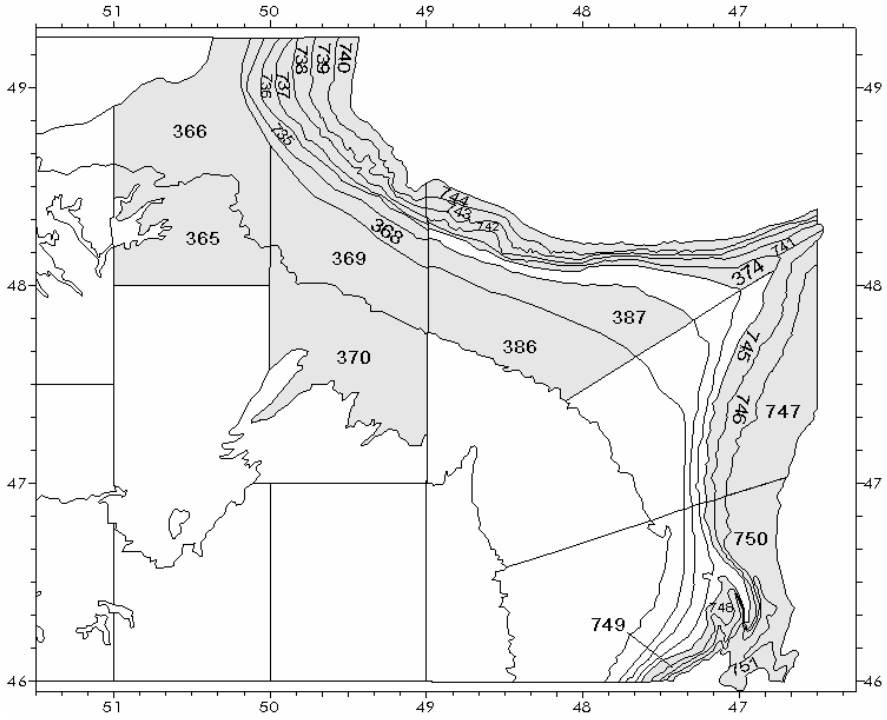

Fig. 9. Division 3L - shaded strata were not surveyed in fall 2004 Canadian survey.

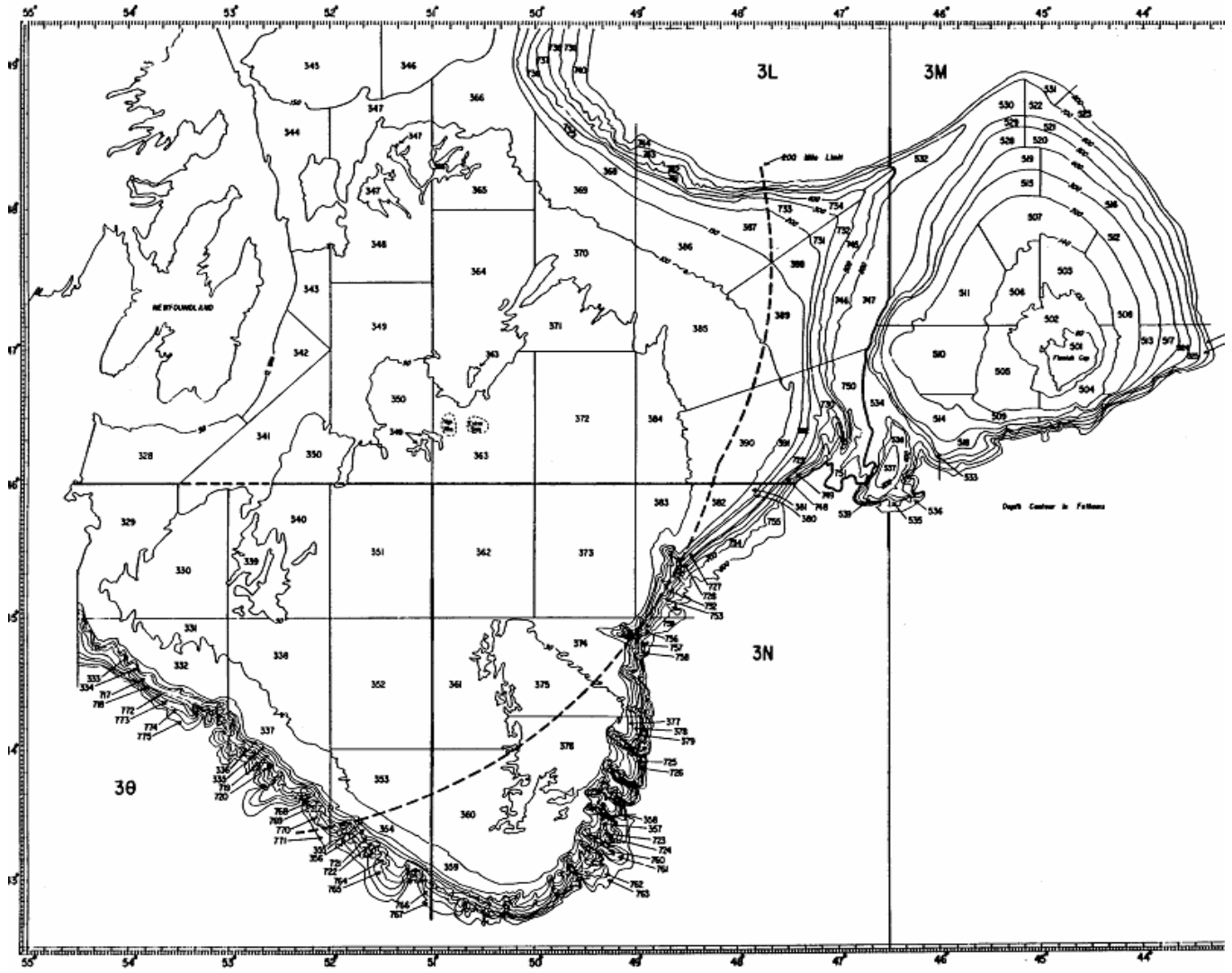

Fig. 10. Divisions 3LMNO, with 200-mile limit.