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Greenland halibut *(Reinhardtius hippoglossoides)* in NAFO Subarea 2 and Divisions 3KLMNO: stock trends based on annual Canadian research vessel survey results.

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Abstract

Greenland halibut are a deep-water species with wide distribution throughout NAFO Subarea 2 and Divisions 3KLMNO. An overview of survey results for Greenland Halibut from Canadian spring and fall surveys through 2014 is provided, focusing on the indices used in the assessment of the stock. The biomass index from the Canadian fall survey of Divs. 2J3K increased from 2010 to 2014 to reach the highest levels of the time series. The abundance index from the fall survey increased from 2012- 2014, but remains below the series average. The biomass index from the Canadian spring survey of Divs. 3LNO has declined since 2012 to the lowest level of the time series. The abundance index from the Canadian spring survey of Divs. 3LNO has been at a low level since 2011, with the values in 2013 and 2014 being among the lowest in the series. In 2012, 2013 and 2014, index values for ages 1 through 4 are all below the Campelen time-series average. In the spring survey of Divs. 3LNO, total abundance over ages 1-4 has been low since the good year classes of the mid 1990s. These results indicate that there has been no good recruitment in recent years

Introduction

Greenland halibut are widely distributed throughout the waters adjacent to Labrador and eastern Newfoundland. During the late 1970's and most of the 1980's they were found in relatively high abundance along the deep slopes of the continental shelf, particularly in Division 2G. They were likewise plentiful in the deep channels running between the fishing banks especially in Divisions 2H, 2J and 3K. By 1991 distribution in the northern areas was greatly reduced and most of the resource was located in Division 3K. In Divisions 2HJ and 3K where most of the Greenland halibut resource presently resides, the stock biomass was relatively stable until the mid 1980's after which it declined substantially to reach an all time low in the early 1990's largely precipitated by the disappearance of older fish from the population. From about 1995 the stock began to increase and continued to improve to 1999 based upon several strong, successive year-classes particularly those of 1993-95. Recruitment following the strong 1993-95 year-classes appeared weaker at younger ages. In contrast to these results, many of the cohorts of the late 1990s and early 2000s have been measured as being average or even above average at older (commercially selected) ages in Divisions 2J and 3K, leading to increases in survey estimates of stock biomass until 2007.

Abundance and biomass estimates for Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO from random-stratified spring and autumn multi-species trawl surveys conducted by Canada are updated with results from spring and fall surveys conducted during 2014. Stratified mean number and weight per tow are updated for the two Canadian indices used in the assessment, as are age-disaggregated survey indices.

Methods

Canadian Research Vessel Surveys

The current survey design is random-stratified, with the survey area stratified by depth in each NAFO division. The number of survey sets allocated to each stratum is proportional to the area of that stratum, with at least two sets in each survey stratum. A Campelen 1800 shrimp-trawl with a 44 mm codend mesh size and 12.7 mm liner is towed for 15 minutes at a speed of 3.0 knots after bottom-contact is established. The gear geometry is monitored constantly throughout each tow using net-mounted sensors. McCallum and Walsh (1996) provide further technical specifications of the Campelen 1800 survey trawl (as well as previous trawls employed in Canadian surveys).

Survey Coverage and Timing

Survey coverage details by NAFO division and depth zone for the *Campelen 1800* surveys (spring and fall) over 1996-2011 are detailed elsewhere (Healey et *al.*, 2012; Healey and Brodie, 2009). Some of the coverage deficiencies of the Canadian surveys in recent years are of particular significance in assessing the status of this stock: sporadic coverage of Division 2H during fall surveys, irregular coverage of both Div. 3M and the deep-water strata of Divisions 3NO. Further, various additional strata have been missed in some surveys. The impact of these deficiencies on the assessment, has been considered elsewhere (Healey and Mahé, 2009; Healey and Dwyer, 2005). The history and recent performance of these Canadian research vessel (RV) surveys are reviewed in Power et al (2014), Healey (2013), Healey et al. (2012), Healey and Brodie (2009) and Brodie and Stansbury (2007). These authors provide an overview of the Canadian spring and autumn RV multi-species surveys, with details on coverage and timing of each survey conducted over 1995-2014. Healey et al. (2012) also provide illustrations of the current survey stratification scheme used in Canadian surveys.

During the fall of 2013, gaps in survey coverage of relevance to the assessment of Greenland Halibut include no coverage in the deep-water strata of Divs. 3LNO, and a portion of Div. 2H was not completed (strata 937, 942, 949, 950). The remainder of the offshore survey area, as well as the inshore strata in Div. 3K, was completed. In 2014, major mechanical issues with one vessel caused it to be out of service for the entire fall survey. In advance of the survey, it was decided that that Division 2H would not be surveyed beyond 750m. In 2014, major mechanical issues with the spring survey vessel required an *apriori* reduction of 46 sets (primarily from Divisions 3NO) as well as the deployment of our second research vessel. However, all strata were covered (Power et al, 2014).

Trends in Stock Size

Survey estimates of abundance and biomass and mean numbers and weights per tow are computed using standard stratified estimators. Approximate confidence intervals (95%) are provided for the stratified mean number and weight per tow; computational details can be found in Smith and Somerton (1981). Note that there are several instances when the lower confidence bound of these indices is negative. This is incorrect (obviously, the lower bound should always be greater than or equal to zero) and is a consequence of violating the distributional assumptions used to produce these confidence intervals. This result commonly arises when a limited number of large catches are taken by the survey.

For the age-disaggregated results in Divisions 2J3K combined, otoliths from Divisions 2J and 3K only were applied. To produce divisional survey results at-age from spring surveys, an age-length key from all samples in Divisions 3LNO were used.

Results and Discussion

Trends in Stock Size

Figure 1 shows the area covered by Canadian surveys and includes place names referred to in the text.

The biomass index from the Canadian fall survey of Divs. 2J3K increased from 2010 to 2014 to reach the highest levels of the time series (Figure 2). The abundance index from the fall survey increased from 2012- 2014, but remains below the series average.

The biomass index from the Canadian spring survey of Divs. 3LNO has declined since 2012 to the lowest level of the time series (Figure 3). The abundance index from the Canadian spring survey of Divs. 3LNO has been at a low level since 2011, with the values in 2013 and 2014 being among the lowest in the series.

Age and Size Composition

It should be noted that ageing of this species is problematic and has been considered in several workshops (e.g. Treble and Dwyer, 2006). Recent work (Treble et al, 2008; Dwyer et al., 2013) suggest that current aging techniques – reading of whole otoliths - may underestimate ages for individuals of length greater than 60cm. This corresponds to a whole otolith age of about 10 years old. Therefore the age-disaggregated results for fish older than 9 years old are likely to be biased, and multiple cohorts may be within the assigned ages. Considerable efforts continue to be directed towards improving methodologies and results; and to incorporate these methods into current aging protocols (see ICES, 2011; Dwyer et *al*., 2013; Albert et *al*., 2009).

Annual stratified mean number per tow at age compositions from the Divisions 2J and 3K combined time series from 1978-2014 are presented in Table 3. Survey catches are typically dominated by fish aged 1 to 6 years old. In 2012, 2013 and 2014, index values for ages 1 through 4 are all below the Campelen time-series average. Indices for ages 6-11, results are well above average.

Age compositions for the Div 3LNO combined spring series (Table 4) demonstrate that in most years, younger age groups (ages 1-6) are typically most abundant in this survey. Larger, older fish are generally found in depths greater than those covered by the spring survey (732m). The total abundance over ages 1-4 has been low since the good year classes of the mid 1990s.

Figure 4 shows trends in mean numbers per tow for Greenland halibut <30 cm, between 31-69 cm and >=70 cm over 1996-2014. The value of 30 cm was chosen as it is approximately equal to the mean length at age 4 for Greenland halibut surveyed in Divisions 2J and 3K; it represents the pre-recruitment trend. The value of 70 cm was chosen because it is considered to be an approximation of the length at 50% maturity in female Greenland halibut.

The recruitment signal (< 30cm class) from Divs. 2J3K combined was low in 2012 -2014, with 2012 and 2013 being the lowest in the time series. The MNPT values for the 30-70cm group increased fairly steadily from 2010 to 2013 as the higher numbers of fish in the <30 cm size class in 2009-2011 grew. The number in the 30-70 cm size group was at about the same level in 2014 as 2013. Although the magnitude of the indices for the greater than 70 cm class is small compared to the other size classes, the abundance of this size class has increased so that the 2012-2014 values are the highest in the 1996-2014 time series.

Distribution

The distribution of Greenland halibut biomass by depth is given in Tables 5-9. These tables also give an overview of the survey coverage in each year. In the fall survey in Div. 2J most of the biomass is found in 200-750 m depth. The main distribution has a narrower depth range in Div. 3K, with the bulk of the biomass being found between 300 and 500 m. In Div. 3L in the spring the bulk of the biomass in most years is in 275-731 m. From 2005-2007 there was also a significant biomass in 184-274 m. In most years in the spring survey in Div. 3N the bulk of the biomass is found between 367 and 731 m. In the spring survey in Div. 3O Greenland halibut distribution is more variable from year to year. In general there are two peaks of distribution, the first between 93 and 274 m and the second in the deepest strata surveyed from 550-731 m. The deepest strata are not surveyed in the spring and the presence of a large proportion of the biomass in the 550-731 m depth range in each of the Divisions indicates that there are fish deeper than the survey.

Conclusions

The biomass index from the Canadian fall survey of Divs. 2J3K increased from 2010 to 2014 to reach the highest levels of the time series. The abundance index from the fall survey increased from 2012- 2014, but remains below the series average. The biomass index from the Canadian spring survey of Divs. 3LNO has declined since 2012 to the lowest level of the time series. The abundance index from the Canadian spring survey of Divs. 3LNO has been at a low level since 2011, with the values in 2013 and 2014 being among the lowest in the series. In 2012, 2013 and 2014, index values for ages 1 through 4 are all below the Campelen time-

series average. In the spring survey of Divs. 3LNO, total abundance over ages 1-4 has been low since the good year classes of the mid 1990s. These results indicate that there has been no good recruitment in recent years.

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Table 1. Summary of successful sets in fall surveys in Sub-Areas 2+3 in 2014. Depth range is given in meters, number of sets appear in parentheses. All sets conducted in the survey are included.

Fall 2014

Division	Ship		Total
	Teleost	*A.Needler*	
2G	Not surveyed		
2H	101-667(66)		66
2J	118-1402 (110)		110
3K	132 - 1469 (154)		154
3L	62-721(91)		91
3N	Not surveyed		
3O	Not surveyed		
			421

Table 2. Summary of successful sets in spring surveys in Divs. 3LNO in 2014. Depth range is given in meters, number of sets appear in parentheses. All sets conducted in the survey are included.

Spring 2014

Division	Ship		Total
	Teleost	*A.Needler*	
3L	64-321 (63)	65 - 702 (72)	135
3N	47-662 (60)		60
3O	61-662 (59)		59
			254

Table 3. Greenland halibut stratified mean number per set at age from Canadian fall surveys conducted in Divisions 2J and 3K combined during 1978-2014. Only otolithscollected in Div. 2J or 3K are used in the analysis. Numbers expressed in Campelen 1800 units.

Age (yrs)	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.48	0.00	0.00	0.00	0.00	0.00	0.00	1.20	1.06	0.00	2.17	0.66	0.00	0.00
1	9.61	10.81	6.78	19.39	4.75	1.66	4.47	24.59	17.21	5.04	8.82	7.10	1.34	13.80
2	40.24	18.07	6.53	22.99	5.10	4.45	7.11	14.67	13.96	11.21	10.54	12.54	5.26	5.59
3	33.37	13.47	6.20	15.42	12.78	10.56	9.56	8.71	16.62	29.44	15.04	23.84	9.95	6.08
4	19.52	7.15	5.58	6.01	10.81	11.41	10.29	6.87	14.64	12.17	17.03	25.22	23.39	13.32
5	12.50	7.47	7.07	6.58	8.09	10.45	15.34	9.50	9.49	9.62	14.90	17.40	15.38	9.05
6	8.34	7.21	7.56	7.25	5.76	7.45	7.74	8.86	11.04	6.89	7.82	9.95	9.21	5.41
7	5.15	3.50	4.72	5.15	6.06	7.56	5.44	5.98	9.54	6.39	5.65	5.34	4.81	1.29
8	2.26	1.41	1.59	2.21	6.29	5.67	3.50	2.26	3.19	3.27	1.65	1.36	0.83	0.26
9	1.27	0.67	0.71	1.02	2.65	2.19	1.70	1.03	1.00	1.25	0.43	0.40	0.21	0.08
10	0.96	0.64	0.56	0.59	1.02	0.65	0.74	0.75	0.34	0.37	0.16	0.11	0.10	0.05
11	0.81	0.42	0.63	0.48	0.60	0.46	0.35	0.30	0.26	0.19	0.10	0.08	0.09	0.02
12	0.49	0.37	0.41	0.22	0.38	0.33	0.24	0.27	0.23	0.19	0.06	0.02	0.05	0.01
13	0.32	0.31	0.27	0.12	0.27	0.24	0.20	0.12	0.12	0.10	0.05	0.00	0.03	0.00
14	0.10	0.15	0.15	0.06	0.28	0.16	0.18	0.13	0.07	0.08	0.04	0.01	0.02	0.00
15	0.07	0.10	0.06	0.04	0.18	0.07	0.09	0.08	0.08	0.05	0.03	0.01	0.01	0.00
16	0.05	0.09	0.03	0.00	0.09	0.02	0.06	0.04	0.04	0.03	0.02	0.00	0.00	0.00
17	0.03	0.03	0.01	0.00	0.01	0.00	0.03	0.04	0.01	0.02	0.01	0.00	0.00	0.00
18	0.00	0.02	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ages 0-20	135.55	71.89	48.87	87.52	65.12	63.33	67.04	85.44	98.91	86.32	84.53	104.03	70.69	54.94
Ages 1-4	102.74	49.50	25.09	63.81	33.44	28.08	31.43	54.84	62.43	57.86	51.43	68.70	39.94	38.79
Ages 5+	32.33	22.39	23.78	23.71	31.68	35.25	35.61	29.40	35.42	28.46	30.93	34.68	30.74	16.16
Ages 6-9	17.01	12.78	14.58	15.62	20.76	22.86	18.38	18.14	24.77	17.81	15.55	17.04	15.06	7.02

Age (yrs)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
0	0.92	1.05	16.90	10.95	4.92	2.18	1.52	6.46	3.09	8.49	8.30	9.94	4.15	5.07
1	5.69	8.08	29.79	49.93	98.68	28.05	23.35	15.99	38.57	43.90	40.67	45.70	32.49	16.06
2	23.78	43.64	21.62	51.10	47.82	58.62	25.07	34.42	21.94	22.72	24.08	26.67	32.93	16.15
3	20.40	64.00	22.61	15.13	32.01	43.61	31.19	24.07	16.43	17.00	12.50	11.69	13.89	8.56
4	13.59	19.28	18.90	6.03	9.54	21.13	21.87	28.28	13.20	14.07	9.68	9.49	12.31	13.84
5	4.84	5.56	7.22	6.63	6.28	10.37	10.86	20.04	13.76	9.77	6.03	6.39	9.21	10.98
6	3.11	1.76	1.32	1.99	2.47	5.01	4.45	10.53	7.21	7.59	1.97	2.27	2.68	6.85
7	1.27	0.74	0.61	0.39	0.84	2.00	2.07	3.81	2.16	3.40	0.72	0.89	1.20	3.96
8	0.12	0.23	0.19	0.12	0.19	0.64	0.57	0.70	0.50	0.69	0.19	0.27	0.36	0.66
9	0.02	0.03	0.03	0.02	0.18	0.20	0.13	0.14	0.06	0.11	0.04	0.04	0.08	0.12
10	0.01	0.00	0.01	0.01	0.04	0.06	0.06	0.07	0.03	0.02	0.01	0.02	0.03	0.03
11	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.02	0.02	0.01	0.00	0.01	0.01	0.03
12	0.00	0.02	0.00	0.00	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.01
13	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.03	0.00	0.01	0.00	0.00	0.01	0.01
14	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ages 0-20	73.76	144.39	119.19	142.30	203.02	171.93	121.20	144.57	116.98	127.80	104.20	113.38	109.36	82.33
Ages 1-4	63.46	135.00	92.92	122.19	188.05	151.41	101.48	102.76	90.14	97.69	86.93	93.55	91.62	54.61
Ages 5+	9.37	8.34	9.37	9.16	10.05	18.34	18.20	35.35	23.75	21.62	8.97	9.90	13.58	22.65
Ages 6-9	4.52	2.76	2.14	2.51	3.67	7.85	7.22	15.18	9.93	11.80	2.92	3.47	4.32	11.59

Age (yrs)	2006	2007	2008	2009	2010	2011	2012	2013	2014
0	3.75	2.21	9.15	5.49	19.54	4.81	5.16	0.1	3.10
1	32.34	32.61	15.98	50.62	50.94	44.14	12.28	24.32	22.08
2	17.98	14.51	11.71	19.15	39.25	42.06	9.61	12.92	30.41
3	8.50	12.81	8.20	11.40	14.81	20.97	11.27	6.74	11.39
4	17.60	18.77	9.57	8.42	9.45	18.79	11.86	7.4	4.54
5	13.03	9.57	7.57	9.89	6.74	10.32	10.96	10.91	7.96
6	9.11	10.35	6.25	5.40	3.77	5.50	9.03	9.09	7.38
7	4.18	6.17	3.51	3.59	2.20	3.15	4.31	7.76	8.92
8	1.15	2.14	1.68	1.39	1.02	1.26	1.69	3.96	6.62
9	0.18	0.34	0.20	0.25	0.18	0.33	0.29	0.5	0.97
10	0.03	0.08	0.03	0.08	0.07	0.13	0.11	0.15	0.20
11	0.02	0.04	0.02	0.02	0.04	0.06	0.05	0.04	0.04
12	0.01	0.02	0.00	0.01	0.02	0.02	0.02	0.02	0.02
13	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.01
14	0.00	0.01	0.00	0.00	0.00	0.01	0.02	0.01	0.01
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.01
16	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
									0.00
Ages 0-20	107.89	109.64	73.87	115.73	148.03	151.55	76.67	83.94	103.67
Ages 1-4	76.42	78.70	45.46	89.59	114.45	125.96	45.02	51.38	68.42
Ages 5+	27.72	28.73	19.26	20.65	14.04	20.78	26.49	32.46	32.15
Ages 6-9	14.62	19.00	11.64	10.63	7.16	10.24	15.31	21.31	23.89

Table 4. Greenland halibut stratified mean number per set at age from Canadian spring surveys conducted in Div. 3LNO combined during 1996-2014. Only otoliths collected in 3L, 3N, or 3O are used in the analysis. Numbers in Campelen 1800 units.

Age (yrs)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
1	1.62	1.16	0.22	0.29	0.79	0.57	0.64	0.93	0.66	0.35		1.60	0.44	0.27	0.77	1.96	0.32	0.29	1.62
2	4.24	3.92	0.81	0.55	1.07	0.71	0.57	2.14	0.57	0.31		0.52	0.77	0.22	0.66	1.40	0.80	0.68	1.19
3	4.60	5.16	3.85	1.15	1.07	0.74	0.60	1.66	1.18	1.09		0.80	0.96	0.19	0.52	0.92	2.48	0.05	0.32
4	2.18	3.23	6.19	1.98	1.51	0.68	0.58	1.57	1.18	0.95		0.40	0.71	0.39	0.40	0.65	1.40	0.37	0.20
5	0.83	1.46	4.96	3.39	1.95	0.80	0.61	1.06	1.16	1.37		1.41	1.25	0.45	0.84	0.62	1.16	0.61	0.24
6	0.28	0.51	1.24	1.09	2.04	0.72	0.21	0.21	0.26	0.82		1.49	0.75	0.26	1.08	0.29	0.50	0.24	0.24
7	0.06	0.10	0.33	0.24	0.56	0.28	0.05	0.05	0.04	0.21		1.12	0.64	0.13	0.35	0.16	0.18	0.11	0.14
8	0.00	0.01	0.07	0.05	0.03	0.02	0.01	0.01	0.02	0.03		0.18	0.28	0.07	0.14	0.10	0.06	0.04	0.06
9	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00		0.02	0.02	0.01	0.02	0.01	0.02	0.00	0.01
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Ages 1-4	12.64	13.47	11.07	3.98	4.44	2.69	2.40	6.30	3.60	2.70		3.31	2.89	1.06	2.34	4.92	5.01	1.39	3.33
Ages 5+	1.17	2.08	6.60	4.78	4.59	1.81	0.87	1.32	1.48	2.43		4.22	2.96	0.92	2.45	1.18	1.92	1.00	0.68
Ages 1-10	13.81	15.56	17.67	8.75	9.03	4.51	3.27	7.62	5.08	5.13		7.54	5.85	1.99	4.79	6.10	6.94	2.39	4.01

No Survey

Table 5. Biomass (tons) by stratum (converted to Campelen units from 1978-94) from Canadian fall surveys in Div. 2J 1978-2014

Depth Range (m)	V1 Area	V4 Area	Stratum	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
101 - 200	1427	633	201	257	91	486	439	1620	524	913	91	206	42	21	171	103	34	0
	1823	1594	205	1753	2385	1007	2591	4878	2748	1521	502	283	113	168	126	87	104	16
	2582	1870	206	3384	2279	3315	9691	5703	2647	3370	1545	1399	250	590	217	335	99	75
	2246	2264	207	6538	2707	2153	4177	2601	1921	1526	627	352	93	58	14	0	0	0
	.	733	237	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	778	238	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
201 - 300	440	621	202	1007	1437	1673	1778	1915	1307	4167	563	448	867	.	32	246	164	79
	1608	680	209	4481	15830	15100	8547	19662	8897	5183	6062	2398	1491	1997	2003	1488	574	454
	774	1035	210	956	782	960	549	1845	3694	2268	566	374	281	786	654	908	266	373
	1725	1583	213	2686	1921	4701	5070	6550	4853	3547	6427	3754	1918	1146	494	609	84	301
	1171	1341	214	5954	2893	1904	6928	9277	5862	7527	7489	1398	1923	2598	862	883	176	425
	1270	1302	215	3247	1181	2407	1842	5350	1967	5528	2829	2056	1920	1265	896	1445	750	869
	1428	2196	228	528	1406	3057	1289	1643	1817	2615	1119	1392	889	330	1034	1517	475	424
	508	530	234	7009	4357	3916	3492	5306	2665	4868	1143	922	454	1426	853	386	226	141
301 - 400	480	487	203	2311	4188	1296	2925	3502	11077	12390	1400	6043	1586	2104	4732	2108	2424	587
	448	588	208	7045	4799	6542	10304	15563	5125	19043	17885	8229	4397	3640	9245	8660	2572	2006
	330	251	211	3152	1736	2734	1256	1821	4216	1912	5424	3300	1992	3049	1016	6051	922	352
	384	360	216	2832	6574	6969	2551	7456	4258	6788	3213	1460	2197	170	487	447	166	167
	441	450	222	3064	3243	3729	2527	7887	5835	2964	1850	128	1506	1847	407	865	70	154
	567	536	229	1024	1412	1464	2017	1261	2235	681	1021	985	371	208	233	152	545	783
401 - 500	354	288	204	21544	12476	.	9195	11739	9016	8750	728	8930	6466	6227	20968	5584	3045	2276
	268	241	217	4717	1845	3767	1192	1694	1595	.	3480	2589	1325	1349	181	1012	164	100
	180	158	223	1711	1208	2623	1635	1622	1106	1893	1358	2065	462	1134	306	574	72	75
	686	598	227	6618	2186	5935	3056	3822	2768	2565	2912	1652	3068	2352	4044	3232	1101	1937
	420	414	235	5146	4006	5923	2000	4265	10840	3224	3269	7547	4825	2789	6721	8779	661	609
	.	133	240	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
501 - 750	664	557	212	11338	15580	7520	9579	9423	3113	4609	7201	23242	21891	4953	2937	5488	1658	2331
	420	362	218	11403	.	5223	6388	1767	1695	.	1461	3151	2308	2513	859	2077	1096	174
	270	228	224	2250	3012	1067	2825	1182	1438	1167	847	5782	1554	1661	89	374	248	191
	237	185	230	2124	.	4016	1823	769	2452	629	766	2386	1369	1273	1063	1268	903	1647
	.	120	239	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
751 -1000	213	283	219	.	.	.	1005	.	2120	.	1664	6187	1872	1104	791	2015	293	253
	182	186	231	2634	.	3261	.	1805	1117	1842	2372	580	791	2975	.	2131	574	730
	122	193	236	.	.	.	640	946	1287	718	1113	2478	1199	182	.	1390	1501	593
1001 -1250	324	303	220	1571	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	177	195	225	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	236	228	232	870	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1251 -1500	286	330	221	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	180	201	226	99	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	180	237	233	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total Biomass (t)				129254	99533	102747	107311	142873	110193	112208	86927	101716	69422	49917	61433	60215	20968	18121

Depth Range (m)	V1 Area	V4 Area	Stratum	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
101 - 200	1427	633	201	6	27	.	82	26	91	0	65	27	133	11	135	50	27	491	33	79	87	507	154	159	22
	1823	1594	205	6	14	.	514	35	502	532	281	863	754	706	1055	990	245	1769	530	469	630	1051	343	4504	860
	2582	1870	206	28	132	399	1120	404	349	403	357	1367	1586	890	813	1079	404	617	835	384	2870	2184	587	1869	239
	2246	2264	207	0	33	1	56	51	74	192	16	208	35	192	118	30	15	160	51	5	717	754	3570	207	239
	.	733	237	0	0	0	1	4	19	320	0	5	42	3	0	37	0	280	17	0	111	.	5	96	0
	.	778	238	.	7	.	15	0	79	0	53	27	6	54	81	18	8	696	43	8	62	713	1	44	83
	Sub-Total			*40*	*213*	*400*	*1789*	*519*	*1115*	*1447*	*771*	*2498*	*2556*	*1856*	*2202*	*2205*	*697*	*4012*	*1508*	*946*	*4478*	*5210*	*4659*	*6880*	*1444*
201 - 300	440	621	202	8	307	95	89	157	593	1685	574	2215	491	871	2260	898	797	901	876	164	947	2996	2909	1711	7724
	1608	680	209	384	123	360	1059	424	282	2204	694	291	1061	1475	811	379	2560	1775	250	1204	790	1153	1115	223	3308
	774	1035	210	589	121	2708	3904	893	1047	613	661	1140	3314	1861	626	285	828	981	443	1397	1281	3088	2746	4573	3596
	1725	1583	213	302	422	236	1338	1146	1962	1426	893	2332	1336	1950	1163	1325	3620	2343	2776	952	1911	2730	2031	2704	2932
	1171	1341	214	1064	507	327	4057	1258	1502	1883	1204	1930	485	1337	2500	2520	3241	2087	1904	1631	1690	2633	2154	8797	2875
	1270	1302	215	1349	855	1370	1247	1448	1889	1986	1139	1967	3499	1360	1592	3091	1633	1920	909	2691	4767	1983	7065	2087	5366
	1428	2196	228	967	2749	2219	5478	3666	4356	2566	2870	2803	1850	1175	2858	3626	3389	3339	891	2473	1452	1735	1478	762	1589
	508	530	234	895	129	.	163	753	352	311	122	349	75	1237	54	1367	327	671	337	304	363	16749	1449	2987	583
	Sub-Total			*5557*	*5214*	*7315*	*17335*	*9744*	*11982*	*12675*	*8157*	*13026*	*12111*	*11267*	*11864*	*13491*	*16394*	*14017*	*8387*	*10816*	*13200*	*33066*	*20945*	*23846*	*27973*
301 - 400	480	487	203	1856	1404	387	946	2233	3303	2553	2200	4090	1134	2846	6523	1792	2581	2064	1548	4950	6055	13207	3089	12619	5620
	448	588	208	1025	4820	4799	3707	12593	6479	11101	9423	5230	7812	2894	8453	5500	20207	3983	2086	4542	10744	11136	8229	31005	22176
	330	251	211	1628	871	1400	1343	1875	870	3541	640	2964	2336	2016	2414	5397	3626	1353	615	1388	1752	3960	4575	2129	10983
	384	360	216	331	392	64	506	1090	1631	881	1103	1076	397	957	697	641	1457	348	1274	1192	1376	890	2534	1222	1781
	441	450	222	170	535	122	1672	930	382	751	995	1151	1086	322	371	164	593	289	637	404	86	155	1252	2319	1317
	567	536	229	246	1202	1799	3900	1940	2514	1206	1639	1591	1123	2336	439	728	3408	625	1607	1041	1552	360	188	1277	700
	Sub-Total			*5255*	*9223*	*8571*	*12074*	*20660*	*15179*	*20032*	*16001*	*16101*	*13888*	*11371*	*18897*	*14222*	*31873*	*8662*	*7766*	*13516*	*21566*	*29708*	*19866*	*50571*	*42577*
401 - 500	354	288	204	2512	3442	1437	3823	7941	6171	3707	4652	5240	1762	7283	8250	8979	5950	2949	4064	4711	5412	3633	8443	3548	6119
	268	241	217	270	226	131	932	676	621	704	628	1983	458	395	433	1027	444	190	234	716	210	307	676	264	924
	180	158	223	130	168	162	438	425	598	505	.	346	419	179	699	424	475	224	161	116	135	91	367	212	323
	686	598	227	1648	2009	909	5850	9244	1793	13071	3628	4226	1316	6852	1325	6381	31416	4173	1936	1043	4561	915	2293	1446	1875
	420	414	235	810	1042	3895	4373	8365	3256	4183	3929	4170	4733	5739	1990	2852	3286	3384	477	1387	2354	1218	3053	2694	10860
	.	133	240	85	118	632	537	501	251	643	204	413	552	178	194	186	629	190	136	334	325	283	132	121	33
	Sub-Total			*5455*	*7004*	*7167*	*15953*	*27152*	*12692*	*22813*	*13041*	*16379*	*9240*	*20626*	*12891*	*19849*	*42200*	*11110*	*7008*	*8305*	*12997*	*6447*	*14964*	*8286*	*20134*
501 - 750	664	557	212	5048	1485	5499	4940	10735	4375	14447	4366	3802	7126	4898	3595	4086	4733	6766	6429	12166	7310	3818	4583	3677	3574
	420	362	218	248	136	693	1783	1207	1319	1019	690	1413	732	456	844	661	731	237	100	1489	407	455	491	687	694
	270	228	224	85	309	214	702	625	401	293	701	360	130	205	356	538	372	190	248	764	612	206	193	873	900
	237	185	230	135	379	652	1350	1589	547	2230	786	569	560	383	356	242	629	502	442	1405	458	552	348	786	580
	.	120	239	1917	1411	1676	2586	2725	4867	4064	1959	1945	867	3470	3389	1776	3456	2219	2746	2165	2337	1460	4572	2766	2086
	Sub-Total			*7434*	*3720*	*8734*	*11360*	*16880*	*11508*	*22052*	*8501*	*8088*	*9415*	*9413*	*8540*	*7302*	*9922*	*9914*	*9965*	*17989*	*11124*	*6491*	*10188*	*8789*	*7835*
751 -1000	213	283	219	639	1579	2021	405	1727	2249	1402	1731	1297	621	1248	1156	374	761	1083	.	1703	687	1081	132	866	426
	182	186	231	613	604	376	1013	651	1635	1744	2828	2820	1603	432	720	612	1561	1865	1384	1284	433	924	468	625	667
	122	193	236	886	230	1007	698	381	725	1107	592	937	881	533	344	468	642	925	.	749	221	697	230	805	375
	Sub-Total			*2138*	*2413*	*3405*	*2116*	*2758*	*4609*	*4252*	*5151*	*5054*	*3105*	*2213*	*2220*	*1454*	*2963*	*3873*	*1384*	*3737*	*1341*	*2702*	*830*	*2296*	*1469*
1001 -1250	324	303	220	.	.	.	1296	503	1196	.	568	786	749	1480	1116	871	472	3420	.	353	374	480	306	154	495
	177	195	225	.	.	.	835	693	655	478	175	1219	65	171	112	481	186	408	319	563	111	446	51	126	0
	236	228	232	.	.	.	717	935	627	1787	1063	1146	626	56	714	502	300	1001	666	1276	440	374	32	267	367
	Sub-Total			*0*	*0*	*0*	*2848*	*2132*	*2478*	*2265*	*1805*	*3151*	*1440*	*1706*	*1942*	*1854*	*958*	*4829*	*984*	*2192*	*925*	*1300*	*389*	*547*	*862*
1251 -1500	286	330	221	.	.	.	131	1246	692	567	401	268	654	124	166	249	17	469	.	488	725	237	192	34	472
	180	201	226	.	.	.	277	407	1313	626	400	368	243	756	217	217	334	185	.	326	96	138	54	91	132
	180	237	233	.	.	.	889	596	542	418	628	844	938	438	195	233	566	662	442	273	289	237	78	52	146
	Sub-Total			*0*	*0*	*0*	*1298*	*2249*	*2548*	*1611*	*1430*	*1480*	*1835*	*1317*	*578*	*699*	*916*	*1316*	*442*	*1087*	*1109*	*612*	*324*	*177*	*750*
Total Biomass (t)				25880	27786	35591	64772	82095	62111	87147	54858	65777	53590	59769	59135	61078	105925	57733	37444	58589	66740	85535	72165	101392	103044

Table 6. Biomass (tons) by stratum (converted to Campelen units from 1978-94) from Canadian fall surveys in Div. 3K 1978-2014

Depth Range (m)	V1 Area	V4 Area	Stratum	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
101 - 200	.	798	608	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	445	612	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	250	616	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	1455	1347	618	.	.	.	.	.	.	263	874	49	17	31	70	0	0	0	0	8
	1588	1753	619	.	.	.	.	.	.	685	401	108	41	26	78	0	0	0	0	0
	Sub-Total			*0*	*0*	*0*	*0*	*0*	*0*	*948*	*1275*	*157*	*58*	*57*	*148*	*0*	*0*	*0*	*0*	*8*
201 - 300	.	342	609	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	573	611	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	251	615	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	2709	2545	620	18712	9129	9090	9404	7175	6302	4074	5095	4164	2108	3737	583	451	899	152	53	1113
	2859	2537	621	41597	36475	15203	11844	6287	12035	6600	12389	2323	4458	3166	4278	485	1151	2264	972	1021
	668	1105	624	837	878	491	305	467	232	527	434	298	445	196	310	288	335	413	1017	754
	447	.	632	204	147	620	344	426	187	.	394	133	86	49	81	384	111	267	.	.
	1618	1555	634	1482	1819	1196	1233	3348	1410	1293	1157	877	1919	776	587	707	526	296	990	962
	1274	1274	635	1548	960	3092	2074	3013	1388	1668	773	1924	1932	910	1335	307	46	88	99	41
	1455	1455	636	1650	872	2155	2163	3642	792	1299	861	806	353	852	701	401	240	282	829	398
	1132	1132	637	723	575	907	1180	1366	2275	662	1780	1441	1349	700	466	818	293	144	435	119
	Sub-Total			*66753*	*50855*	*32753*	*28545*	*25722*	*24620*	*16123*	*22883*	*11965*	*12649*	*10386*	*8341*	*3842*	*3601*	*3905*	*4395*	*4407*
301 - 400	.	256	610	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	263	614	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	593	617	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5604	2993
	1027	494	623	16992	3898	9646	10319	16038	24364	29298	8090	18912	14251	17661	11384	4603	5417	2598	1672	1931
	850	888	625	1915	1387	1530	3242	822	5794	3856	4936	3449	5773	3204	847	3881	2176	484	3229	2385
	919	1113	626	7394	4470	14225	6023	11576	11302	20810	13944	16278	8319	12970	11682	3365	3698	5003	3469	4263
	1085	1085	628	4700	4183	8400	2305	1867	5126	4652	9824	9477	5858	6368	4150	2513	902	590	1438	1372
	499	495	629	532	834	1790	2004	4063	3706	1779	1335	2978	5191	7176	4634	1053	385	1058	1324	1337
	544	332	630	2056	800	1368	7048	.	4258	485	2244	1861	4436	4313	3075	2065	2188	917	1274	1331
	2179	2067	633	2393	2472	4271	2834	2296	3115	3219	3432	4445	5532	3380	5842	5285	3440	2813	4511	2868
	2059	2059	638	4198	3427	2615	4854	4801	4371	2922	7321	5983	4382	3057	2972	6809	1993	2625	2804	1908
	1463	1463	639	1031	1254	1385	1266	3321	2174	436	872	1288	703	653	511	854	766	1175	1718	872
	Sub-Total			*41211*	*22724*	*45229*	*39896*	*44783*	*64210*	*67457*	*51996*	*64670*	*54445*	*58782*	*45096*	*30427*	*20964*	*17263*	*27042*	*21258*
401 - 500	.	30	613	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	632	691	622	16724	8517	3448	10766	7914	14953	8922	4742	36448	12755	17950	13695	30531	6256	4326	6993	3921
	1184	1255	627	11452	5878	9820	24040	16903	27637	38222	18219	33516	21372	21502	37862	18637	10870	4355	31882	7308
	1202	1321	631	8523	3909	4910	8787	5115	8693	12698	9456	8334	15010	11317	17190	4993	16791	3570	9779	9453
	198	69	640	835	.	1177	756	531	.	344	398	204	417	163	225	367	310	130	77	111
	204	216	645	462	.	336	534	434	97	1157	1055	.	613	351	81	460	103	213	110	108
	.	134	650	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	193	338
	Sub-Total			*37996*	*18304*	*19692*	*44883*	*30898*	*51380*	*61344*	*33870*	*78502*	*50166*	*51283*	*69053*	*54988*	*34330*	*12595*	*49034*	*21238*
501 - 750	584	230	641	776	1647	2245	1521	1622	3609	3924	1384	.	1367	.	.	2661	651	440	411	109
	333	325	646	2231	3156	1852	2656	590	2959	3167	2337	.	1143	.	.	449	1083	375	105	463
	.	359	651	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	704	894
	Sub-Total			*3008*	*4802*	*4097*	*4177*	*2212*	*6568*	*7091*	*3721*	*0*	*2510*	*0*	*0*	*3110*	*1734*	*816*	*1219*	*1467*
751 -1000	931	418	642	2417	.	3824	1134	3305	.	8496	3279	.	2722	.	.	4475	4484	9225	1541	2336
	409	360	647	7096	2019	3855	3634	1817	.	.	4473	.	.	.	.	3857	1197	655	2413	1829
	.	516	652	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2242	1445
	Sub-Total			*9513*	*2019*	*7679*	*4768*	*5122*	*0*	*8496*	*7753*	*0*	*2722*	*0*	*0*	*8332*	*5680*	*9880*	*6196*	*5610*
1001 -1250	1266	733	643	1254	1364	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	232	228	648	406	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	531	653	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1718	.
	Sub-Total			*1660*	*1364*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1718*	*0*
1251 -1500	954	474	644	1890	783	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	263	212	649	366	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	479	654	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Sub-Total			*2256*	*783*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Total biomass (t)				162396	100851	109450	122269	108737	146777	161458	121498	155294	122551	120508	122638	100699	66310	44458	89603	53988

Table 6 cont'd

Depth Range (m)	V1 Area	V4 Area	Stratum	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
101 - 200	.	798	608	.	0	44	37	.	0	8	4	0	5	14	0	.	.	.	79	.	.	.	.
	.	445	612	.	0	135	0	.	1	0	38	0	0	2	0	.	.	.	65	.	.	1	.
	.	250	616	.	0	4	23	.	0	0	0	0	0	.	0	.	.	.	.	.	.	.	.
	1455	1347	618	286	19	11	15	1	59	0	49	109	55	2	3	39	0	6	113	481	35	50	20
	1588	1753	619	18	29	57	0	0	13	0	30	109	62	1	2	1	0	1	149	1855	98	40	22
	Sub-Total			*304*	*48*	*250*	*74*	*2*	*72*	*8*	*122*	*218*	*122*	*19*	*4*	*39*	*0*	*7*	*406*	*2337*	*134*	*90*	*42*
201 - 300	.	342	609	.	117	386	202	.	177	8	8	86	96	43	68	.	.	42	135	.	.	.	.
	.	573	611	.	113	265	162	.	41	43	164	465	144	34	372	.	.	.	469	.	.	.	.
	.	251	615	.	39	67	176	.	23	20	0	37	1	34	22	.	.	.	222	.	.	323	.
	2709	2545	620	790	4213	1275	1171	1367	3389	992	1280	594	1012	794	905	673	61	2247	3829	13352	1187	3393	1874
	2859	2537	621	1068	3967	1320	2524	858	1495	113	1149	1870	1856	185	639	1221	565	1361	4305	14581	5218	4733	3353
	668	1105	624	508	2516	1610	1752	1805	1186	2358	1027	258	1950	2825	723	1112	420	451	852	2185	375	394	899
	447	.	632	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	1618	1555	634	727	2370	2144	1321	1933	1197	2195	1493	455	497	1930	3313	2820	1813	1808	770	912	1117	581	1438
	1274	1274	635	128	1344	1545	1266	971	491	215	125	167	0	1052	.	1008	334	431	428	658	962	1732	1053
	1455	1455	636	1393	2336	1171	1054	1002	1015	641	699	303	747	1138	1948	2052	5157	487	360	429	299	1987	1031
	1132	1132	637	179	1722	869	2008	1145	.	526	393	403	1095	983	1138	734	472	1442	323	1879	1186	740	1379
	Sub-Total			*4794*	*18736*	*10651*	*11636*	*9082*	*9013*	*7111*	*6339*	*4637*	*7398*	*9017*	*9127*	*9620*	*8822*	*8268*	*11691*	*33996*	*10344*	*13883*	*11026*
301 - 400	.	256	610	.	344	630	1638	.	1000	1924	183	796	483	521	241	.	.	.	2925	.	.	.	.
	.	263	614	.	154	399	184	.	164	16	12	120	683	274	303	.	.	.	256	.	.	2322	.
	.	593	617	3844	2464	4941	3865	2919	2227	7873	1476	3044	3603	2680	6949	12226	3141	1199	1811	8302	6474	7237	3067
	1027	494	623	308	3588	1938	6167	3346	4322	5040	3698	1732	4159	1152	591	2533	2215	2496	3906	4008	8985	8145	1929
	850	888	625	1437	4381	3075	3944	6783	3649	6294	917	649	6723	3701	1394	3747	1935	2479	2689	4128	3821	1648	9312
	919	1113	626	1962	5453	10283	9604	18305	3890	2111	3683	4768	6046	2328	5332	28371	15373	6645	6899	5429	6165	19534	28639
	1085	1085	628	529	1799	2685	3116	10764	5142	2763	719	1366	2837	4019	4444	5761	7311	891	8831	2593	922	6370	2596
	499	495	629	2682	6569	2179	6214	5900	4291	1429	622	354	518	3839	7928	5502	4226	1846	537	1628	4396	774	8859
	544	332	630	858	4800	3261	1561	5114	3821	4474	1429	1226	1100	3012	2633	2286	2900	3146	1228	2660	4137	6418	5286
	2179	2067	633	4649	3487	6739	4178	7634	3474	6544	3178	3528	2288	6802	7941	8104	3911	2343	3587	2335	3688	856	881
	2059	2059	638	1750	3952	7031	8115	2400	4792	2535	1686	2512	3399	5441	2775	9432	3905	4335	1272	3479	1513	5616	6950
	1463	1463	639	1520	1381	1556	1266	1183	2362	2114	1330	1120	1667	937	862	1830	5228	1179	404	405	111	1024	864
	Sub-Total			*19538*	*38372*	*44717*	*49851*	*64348*	*39135*	*43117*	*18932*	*21215*	*33506*	*34705*	*41393*	*79791*	*50144*	*26559*	*34344*	*34967*	*40213*	*59945*	*68383*
401 - 500	.	30	613	.	51	192	92	.	64	6	6	47	511	43	72	.	.	.	59	.	.	195	.
	632	691	622	2638	6896	11901	10364	13165	10064	11830	4285	5965	12425	7972	5578	12750	21597	6792	5107	5238	23531	13563	17532
	1184	1255	627	18946	15576	22176	25568	45497	42775	11732	11721	12754	18257	22914	21080	36798	22020	23204	23619	28132	16741	29604	42129
	1202	1321	631	10094	25499	14500	13683	18514	23958	20494	15856	13580	8550	17899	15925	20469	14880	17306	11464	15341	20091	18444	17316
	198	69	640	179	105	59	37	39	144	103	44	96	39	25	165	56	54	39	11	38	45	17	34
	204	216	645	357	192	162	75	114	446	253	242	140	180	186	387	123	80	151	107	372	137	78	80
	.	134	650	252	147	242	224	39	.	18	109	162	20	193	188	64	167	40	28	132	36	38	53
	Sub-Total			*32466*	*48465*	*49232*	*50042*	*77367*	*77451*	*44436*	*32263*	*32743*	*39982*	*49232*	*43395*	*70261*	*58798*	*47532*	*40396*	*49252*	*60580*	*61938*	*77144*
501 - 750	584	230	641	227	394	197	369	1020	.	558	62	602	192	151	1382	329	280	993	1030	112	37	216	414
	333	325	646	327	564	1180	158	84	436	811	205	323	239	122	291	717	130	134	514	251	129	331	298
	.	359	651	1222	321	1361	1016	734	.	2603	899	754	199	508	1104	1595	407	788	493	1118	474	1239	872
	Sub-Total			*1777*	*1278*	*2739*	*1543*	*1838*	*436*	*3973*	*1166*	*1679*	*630*	*781*	*2777*	*2641*	*817*	*1916*	*2037*	*1481*	*639*	*1787*	*1584*
751 -1000	931	418	642	1741	760	2036	2513	3081	2134	2677	892	1074	942	4877	1962	1991	1268	3535	1336	448	585	492	873
	409	360	647	1087	749	2025	2961	2191	2465	3228	1301	1503	819	4436	1835	1434	.	2029	1135	1360	1312	1065	770
	.	516	652	2366	3585	2575	4843	3246	2591	6162	1366	2990	2034	3554	1247	2807	1169	2343	2480	1049	1293	674	1885
	Sub-Total			*5193*	*5094*	*6636*	*10317*	*8518*	*7190*	*12067*	*3560*	*5567*	*3794*	*12868*	*5044*	*6232*	*2438*	*7907*	*4951*	*2856*	*3190*	*2232*	*3527*
1001 -1250	1266	733	643	1487	2121	6830	5453	3480	1537	4660	2815	890	1865	2469	5074	3120	.	1935	2059	288	1096	1060	2844
	232	228	648	.	1641	1118	1687	1552	624	2891	763	475	376	186	422	1274	.	1628	868	601	761	1105	258
	.	531	653	1583	2306	1643	3660	3927	3045	2514	477	933	668	542	1344	1787	937	3309	654	703	84	557	1622
	Sub-Total			*3071*	*6068*	*9590*	*10800*	*8959*	*5207*	*10064*	*4055*	*2298*	*2910*	*3197*	*6839*	*6181*	*937*	*6872*	*3581*	*1592*	*1941*	*2723*	*4725*
1251 -1500	954	474	644	688	870	2036	2845	1480	1917	2084	137	998	760	1082	735	2436	.	2507	1158	1021	646	94	635
	263	212	649	.	387	1083	282	681	622	908	174	1125	427	437	87	172	.	209	15	430	22	140	324
	.	479	654	1376	1016	3612	4808	3358	2287	4953	252	973	981	1241	773	1722	.	2253	911	1251	1261	881	653
	Sub-Total			*2063*	*2274*	*6732*	*7934*	*5519*	*4825*	*7944*	*563*	*3095*	*2168*	*2761*	*1595*	*4331*	*0*	*4969*	*2084*	*2702*	*1930*	*1115*	*1612*
Total biomass (t)				69206	120336	130547	142196	175632	143329	128721	67000	71453	90509	112580	110175	179096	121955	104031	99490	129183	118971	143712	168044

Table 7. Biomass (tons) by stratum from Canadian spring surveys in Div. 3L 1996-2014

Depth Range (m)	V1 Area	V4 Area	Stratum	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
30 - 56	.	268	784	.	.	0	0	.	0	0	.	0	.	.	.	.	.	.	.	.	.	.
57 - 92	2071	2071	350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1780	1780	363	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1121	1121	371	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2460	2460	372	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1120	1120	384	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	465	785	.	.	0	0	.	0	0	.	0	.	.	.	.	.	.	.	.	.	.
	Sub-Total			*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
93 - 183	1519	1519	328	0	0	0	0	18	0	0	0	1	13	0	0	.	0	0	0	0	8	5
	1574	1574	341	2	0	14	0	26	0	0	0	0	0	0	0	0	0	2	0	8	0	216
	585	585	342	0	0	5	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	46
	525	525	343	0	0	2	0	0	0	0	0	0	30	0	0	0	0	.	7	0	0	4
	2120	2120	348	1	9	0	0	0	0	0	0	0	0	1	5	0	0	5	1	0	6	6
	2114	2114	349	1	0	11	0	14	2	0	0	0	5	0	0	0	0	0	3	41	0	4
	2817	2817	364	0	6	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	7
	1041	1041	365	1	0	0	14	0	0	0	0	0	45	41	0	1	0	6	6	0	14	10
	1320	1320	370	0	0	0	0	0	0	0	0	0	0	0	43	0	1	0	1	0	1	1
	2356	2356	385	0	0	0	0	0	0	0	0	12	0	0	0	4	0	0	0	0	2	5
	1481	1481	390	0	24	0	0	6	0	0	0	0	9	0	0	0	0	0	0	0	1	0
	.	84	786	.	.	0	0	.	0	.	.	0	.	.	.	.	.	.	0	.	.	.
	.	613	787	.	.	0	0	.	0	.	.	0	.	.	.	.	.	.	0	.	.	.
	.	261	788	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	89	790	.	.	.	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	72	793	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	216	794	.	.	.	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.
	.	98	797	.	.	.	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.
	.	72	799	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.
	Sub-Total			*5*	*39*	*32*	*26*	*64*	*4*	*0*	*2*	*13*	*103*	*42*	*49*	*6*	*3*	*13*	*19*	*50*	*32*	*303*
184 - 274	1494	1582	344	3	59	0	21	24	3	0	31	34	23	0	2	44	0	0	7	93	19	6
	983	983	347	1	5	0	0	1	0	0	0	0	32	0	665	3	0	1	63	9	8	20
	1394	1394	366	6	169	10	30	0	1	48	148	255	236	44	861	10	209	9	80	.	20	13
	961	961	369	1	2	79	17	0	1	0	464	0	199	943	1078	48	4	70	12	85	46	12
	983	983	386	1	84	11	633	0	0	0	0	115	494	2078	309	5	0	151	96	95	185	115
	821	821	389	38	435	122	435	1070	143	3	2	36	994	909	1595	692	1	295	379	1042	2	75
	282	282	391	9	3	43	0	4	3	16	58	0	238	274	872	65	3	33	6	68	33	8
	.	164	795	.	.	.	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.
	.	72	789	.	.	.	18	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.
	.	227	791	.	.	.	113	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	100	798	.	.	.	23	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.
	Sub-Total			*58*	*758*	*267*	*1291*	*1099*	*150*	*67*	*702*	*440*	*2214*	*4249*	*5381*	*866*	*217*	*559*	*644*	*1392*	*313*	*249*
275 - 366	1432	1432	345	335	892	302	926	891	495	566	441	1953	429	333	3510	347	533	208	2495	1426	1450	864
	865	865	346	354	1372	639	338	366	513	245	307	469	789	645	2372	100	662	273	592	2384	507	726
	334	334	368	137	216	263	228	456	311	327	703	241	362	1826	638	147	894	169	127	1396	189	62
	718	718	387	208	2514	2585	2026	4356	439	97	359	724	2967	2600	3783	3905	390	546	380	5341	513	410
	361	361	388	304	382	1404	464	482	220	223	608	989	332	483	1413	894	433	432	147	793	100	135
	145	145	392	288	117	464	100	143	85	74	248	111	356	122	303	157	20	59	25	118	34	27
	.	175	796	.	.	.	7	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.
	.	81	800	.	.	.	210	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Sub-Total			*1626*	*5494*	*5658*	*4299*	*6694*	*2064*	*1532*	*2667*	*4488*	*5235*	*6009*	*####*	*5549*	*2932*	*1686*	*3766*	*11458*	*2793*	*2224*
367 - 549	186	186	729	803	236	3921	1351	1286	555	407	589	724	292	187	802	798	164	.	203	157	556	127
	216	216	731	897	299	3531	1284	1725	664	217	1336	496	288	507	437	367	296	488	302	266	180	32
	468	468	733	3016	3003	7556	3311	2290	1139	847	3444	1138	2315	943	2067	2456	8	1446	283	1562	745	413
	272	272	735	302	4063	5100	4332	4656	2186	939	598	1207	1685	977	1027	1658	374	2128	220	1835	444	1125
	.	50	792	.	.	.	533	.	903	.	148	.	.	.	.	.	.	.	.	.	.	.
	Sub-Total			*5019*	*7601*	*####*	*####*	*9958*	*5447*	*2410*	*6115*	*3566*	*4580*	*2614*	*4334*	*5279*	*843*	*4062*	*1008*	*3821*	*1925*	*1698*
550 - 731	170	170	730	245	0	1693	292	745	772	177	53	54	129	160	120	559	1157	683	50	31	87	78
	231	231	732	462	1420	3220	1219	996	1173	533	465	560	354	105	560	957	331	731	.	361	89	357
	228	228	734	1327	1361	4169	1324	2887	621	362	367	592	459	255	466	.	81	5239	453	622	123	47
	175	175	736	791	1793	5037	3463	4372	2804	1378	1747	259	1923	915	5514	4945	35	1976	2582	450	994	786
	Sub-Total			*2826*	*4574*	*####*	*6297*	*9001*	*5370*	*2449*	*2632*	*1466*	*2865*	*1434*	*6659*	*6461*	*1604*	*8629*	*3086*	*1463*	*1293*	*1269*
732 - 1463				***Deepwater Strata not sampled during spring surveys.***																		
Total Biomass (t)				9533	18467	40182	22724	26815	13035	6459	12118	9973	14997	14348	28442	18162	5599	14949	8523	18184	6355	5743

Table 8. Biomass (tons) by stratum from Canadian spring surveys in Div. 3N 1996-2014

Depth Range (m)	V1 Area	V4 Area	Stratum	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
<=56	1593	1593	375	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	1499	1499	376	12	0	0	0	0	1	0	0	0	70	0	1	0	0	0	0	0	0	0
57 - 92	2992	2992	360	19	349	130	471	183	23	0	0	71	62	0	0	0	0	0	5	0	3	0
	1853	1853	361	0	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
	2520	2520	362	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	2520	2520	373	0	0	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	1
	931	931	374	9	0	0	0	0	0	73	0	0	0	0	0	0	0	0	0	0	0	0
	674	674	383	0	0	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0
	Sub-Total			*41*	*349*	*131*	*471*	*183*	*28*	*73*	*2*	*71*	*132*	*0*	*1*	*0*	*0*	*0*	*5*	*0*	*3*	*2*
93 - 183	421	421	359	145	133	31	165	96	19	0	2	4	133	.	0	30	0	58	17	17	0	5
	100	100	377	6	4	0	321	0	0	0	0	0	25	.	51	12	1	0	4	3	0	0
	647	647	382	0	0	76	0	20	0	0	0	1	356	.	0	49	0	0	1	0	3	3
	Sub-Total			*151*	*136*	*107*	*486*	*116*	*19*	*0*	*2*	*6*	*514*	*0*	*51*	*91*	*1*	*58*	*22*	*20*	*4*	*8*
184 - 274	225	225	358	259	677	413	458	46	17	29	118	51	27	.	5	0	0	31	80	1	4	30
	139	139	378	48	37	49	719	4	14	6	82	7	15	.	120	21	8	12	31	6	36	0
	182	182	381	178	90	10	217	33	7	0	41	0	92	.	610	285	35	71	0	5	9	49
	Sub-Total			*485*	*805*	*471*	*1394*	*82*	*38*	*35*	*240*	*58*	*133*	*0*	*734*	*306*	*43*	*113*	*111*	*12*	*48*	*78*
275 - 366	164	164	357	57	82	375	17	4	43	0	13	134	26	.	12	2	17	179	325	113	0	3
	106	106	379	85	183	170	1047	312	28	88	736	16	29	.	297	6	1	10	2	80	15	25
	116	116	380	117	162	58	43	53	28	19	287	72	220	.	176	135	21	4	9	37	9	1
	Sub-Total			*260*	*427*	*603*	*1107*	*368*	*98*	*107*	*1036*	*221*	*275*	*0*	*484*	*144*	*39*	*193*	*337*	*230*	*24*	*28*
367 - 549	155	155	723	333	134	300	68	173	71	24	60	27	25	.	35	15	0	61	12	19	165	36
	105	105	725	242	952	130	37	289	150	68	153	15	201	.	148	14	53	37	439	97	14	71
	160	160	727	389	1482	1499	328	843	358	22	315	219	174	.	348	431	0	45	34	106	218	192
	Sub-Total			*964*	*2568*	*1928*	*433*	*1305*	*578*	*114*	*527*	*261*	*400*	*0*	*531*	*461*	*53*	*143*	*484*	*221*	*397*	*299*
550 - 731	124	124	724	196	142	368	575	114	95	201	142	72	24	.	92	.	308	107	210	.	73	52
	72	72	726	93	254	1463	63	257	139	52	125	91	45	.	36	61	90	553	176	203	21	126
	156	156	728	1226	.	576	1475	1804	1088	222	686	642	79	.	428	1082	543	787	193	363	307	185
	Sub-Total			*1514*	*396*	*2407*	*2113*	*2175*	*1323*	*475*	*954*	*805*	*149*	*0*	*556*	*1143*	*941*	*1447*	*579*	*566*	*400*	*363*
732 - 1463				***Deepwater Strata not sampled during spring surveys.***																		
Total Biomass (t)				3415	4681	5647	6003	4228	2084	805	2761	1422	1603	0	2357	2144	1078	1955	1538	1050	875	779

Table 9. Biomass (tons) by stratum from Canadian spring surveys in Div. 3O 1996-2014

Depth Range (m)	V1 Area	V4 Area	Stratum	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
57 - 92	2089	2089	330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	456	456	331	0	0	16	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0
	1898	1898	338	478	40	62	0	0	0	2	0	13	0	9	0	0	0	0	9	0	0	0
	1716	1716	340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2520	2520	351	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	2580	2580	352	114	48	0	0	0	0	3	0	0	0	0	0	0	0	0	0	75	1	0
	1282	1282	353	119	146	331	2	25	0	3	0	1	84	57	0	0	1	0	16	0	0	8
	Sub-Total			*710*	*234*	*409*	*2*	*25*	*0*	*8*	*0*	*14*	*84*	*66*	*1*	*0*	*1*	*0*	*26*	*75*	*2*	*8*
93 - 183	1721	1721	329	1	13	0	0	1	1	0	0	0	14	.	0	0	28	0	0	1	12	44
	1047	1047	332	148	376	475	0	4	0	1	6	24	62	.	0	0	0	2	47	0	0	17
	948	948	337	179	139	4	0	3	31	1	91	17	37	.	13	1	0	0	0	15	0	0
	585	585	339	0	2	8	0	0	33	0	0	0	0	21	26	17	4	0	4	0	10	1
	474	474	354	807	122	330	3	0	11	22	8	25	43	.	1	6	5	2	29	0	6	0
	Sub-Total			*1135*	*651*	*817*	*3*	*8*	*76*	*24*	*106*	*67*	*157*	*21*	*39*	*24*	*37*	*4*	*80*	*16*	*28*	*63*
184 - 274	151	147	333	5	62	23	0	9	0	8	0	2	12	.	0	10	1	5	0	0	1	0
	121	121	336	100	168	11	0	7	3	8	11	6	15	.	0	16	0	7	2	0	0	0
	103	103	355	249	168	20	0	3	84	5	46	42	13	.	26	12	11	12	12	0	0	2
	Sub-Total			*355*	*398*	*54*	*0*	*18*	*87*	*21*	*57*	*50*	*40*	*0*	*26*	*38*	*12*	*24*	*14*	*0*	*1*	*2*
275 - 366	92	96	334	20	39	6	2	1	0	1	0	0	3	.	0	1	2	1	1	0	0	1
	58	58	335	9	92	15	0	2	0	0	0	1	1	.	1	0	0	4	0	0	0	0
	61	61	356	161	68	47	1	0	3	1	7	1	3	.	34	17	6	1	1	2	0	0
	Sub-Total			*190*	*199*	*68*	*3*	*3*	*3*	*3*	*7*	*2*	*7*	*0*	*34*	*17*	*8*	*5*	*1*	*2*	*0*	*2*
367 - 549	93	166	717	42	165	55	0	0	1	0	0	6	0	.	0	0	18	1	19	25	0	0
	76	76	719	9	24	29	1	8	0	21	0	23	18	.	0	14	5	1	45	0	1	1
	76	76	721	161	59	112	5	30	1	8	2	7	3	.	0	0	28	2	67	20	2	14
	Sub-Total			*212*	*248*	*196*	*7*	*39*	*3*	*30*	*2*	*36*	*20*	*0*	*0*	*14*	*51*	*4*	*131*	*45*	*3*	*15*
550 - 731	111	134	718	70	116	154	11	26	8	41	60	73	56	.	35	338	45	27	136	35	63	92
	105	105	720	29	61	111	4	45	23	3	12	63	122	.	36	148	117	27	.	45	0	7
	93	93	722	57	176	203	23	120	23	43	3	86	51	.	240	187	42	160	368	116	188	126
	Sub-Total			*156*	*353*	*467*	*37*	*191*	*55*	*87*	*74*	*222*	*230*	*0*	*310*	*673*	*204*	*213*	*504*	*195*	*251*	*226*
732 - 1463				***Deepwater Strata not sampled during spring surveys.***																		
Total Biomass (t)				2757	2084	2010	53	284	224	173	245	391	538	88	412	766	313	250	755	333	284	315

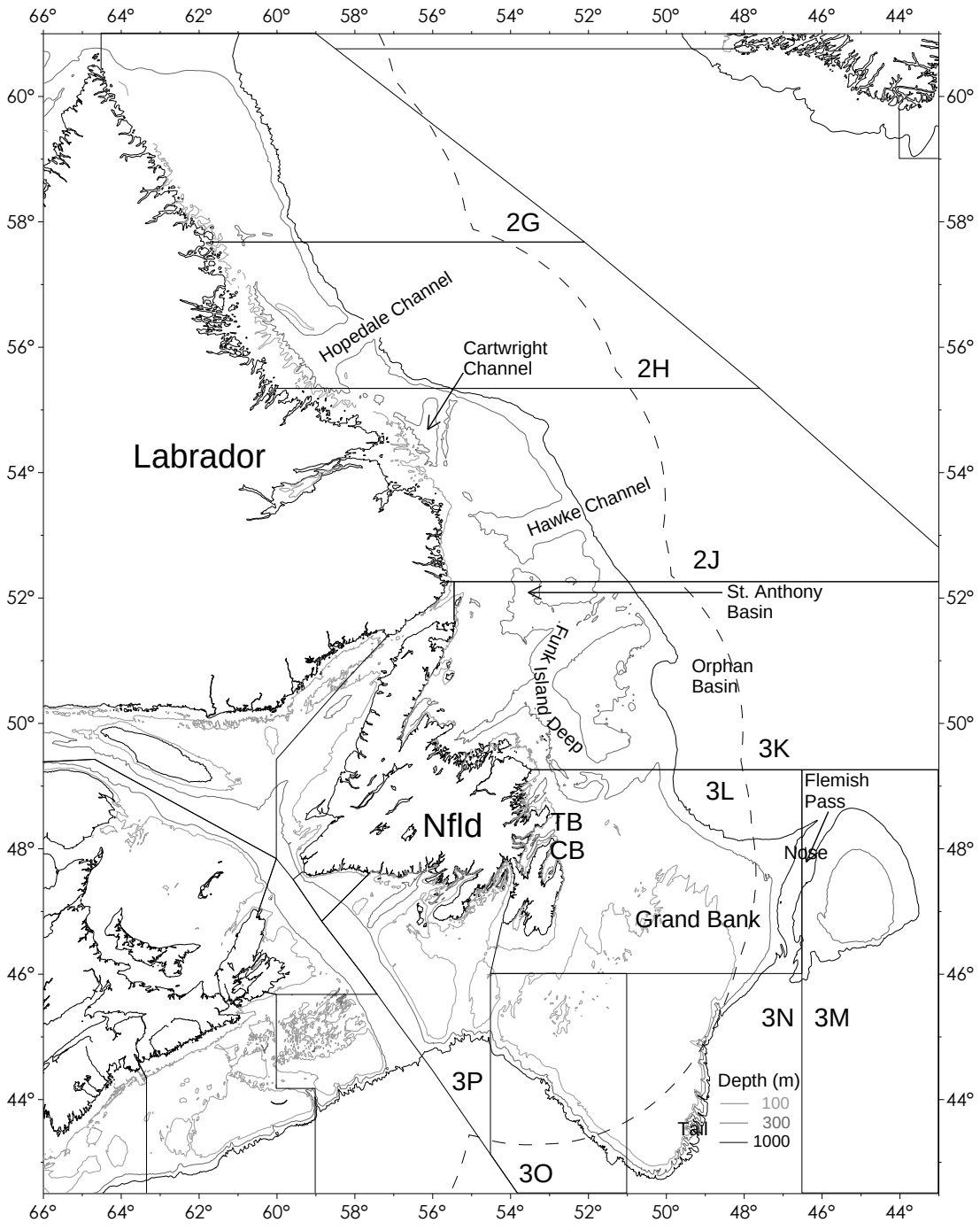

Figure 1. Map of stock area, with NAFO dividing lines, select isobaths, and names referred to in the text. TB and CB refer to Trinity and Conception Bays, respectively.

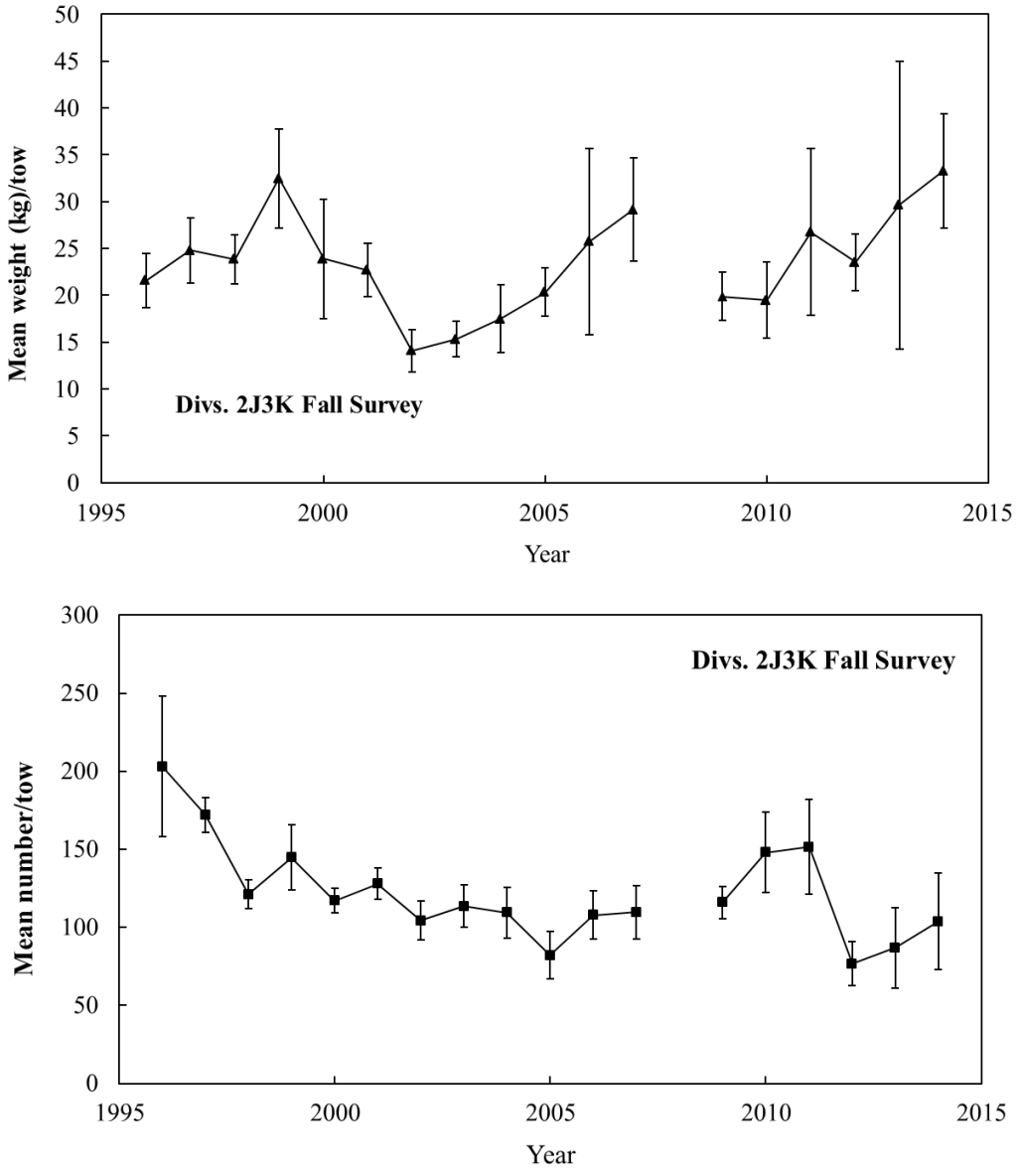

Figure 2. Mean weight (Kg) and mean number per tow from Canadian autumn surveys of Div. 2J3K from 1996-2014.

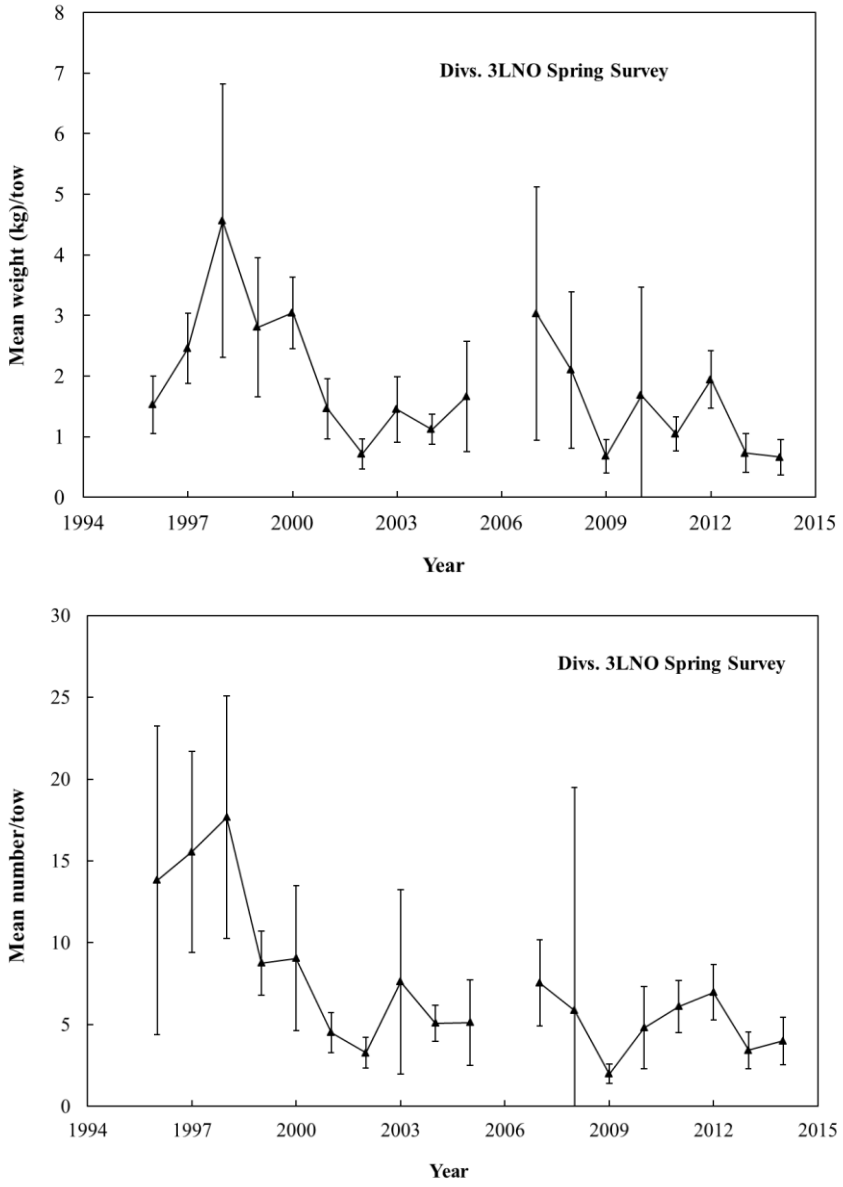

Figure 3. Mean weight (Kg) and mean number per tow from Canadian spring surveys of Div. 3LNO from 1996-2014.

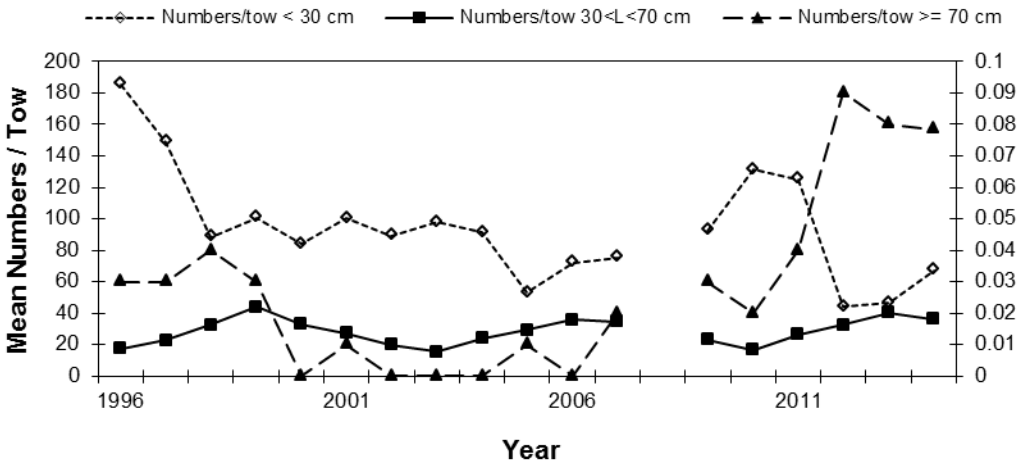

Figure 4. Mean number per tow by size class from Canadian autumn surveys of Div. 2J3K from 1996-2014. Mean number per tow for the >= 70cm category is given on the right y-axis.