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# Divisions 3LNO Northern shrimp (*Pandalus borealis*) – Interim Monitoring Update

By

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**Abstract**

This document updates some of the indices for northern shrimp (*Pandalus borealis*) harvested within NAFO Divisions 3LNO. A full assessment for this resource was completed, within Scientific Council during autumn 2007, and management advice was provided for the years 2008 and 2009. The catch table (to September 2008) and biomass estimates (autumn 1995-spring 2008) are updated within this report. Preliminary data indicate that 23 077 t of shrimp were taken against an annual TAC of 22 000 t in 2007 while 22 223 t were taken in 2008 against an annual TAC of 25 000 t. It is anticipated that the 2008 TAC will be taken. The autumn 2007 3LNO biomass index was estimated to be 286,000 t, the highest in the autumn time series, while the spring 2008 biomass index was estimated to be 232,000 t, the second highest in the spring time series.

## Fishery and Management

*TAC regulation*

Prior to 2004, TACs were set at 15% of the average lower confidence interval of the survey biomass indices for the most recent four consecutive surveys. However, during 2004, Scientific Council (SC) felt it was necessary to base advice upon a new methodology due to the highly variable nature of the spring surveys. The TAC within an adjacent Canadian stock had been 12% of the fishable biomass since 1997. Applying this percentage to the inverse variance weighted average fishable biomass from the autumn 2002-spring 2004 surveys resulted in a TAC of 22 000 t. Had this new method been used in 2003, it is likely that the advised TAC for 2005 would have been around 22 000 t instead of the 13 000 t actually advised. Scientific Council noted that the TAC recommendation for this stock has always included advice that "the development of any fishery in the Div. 3L area take place in a gradual manner with conservative catch limits imposed and maintained for a number of years in order to monitor stock response." The initial TAC of 6 000 t was in place for 3 years (1999-2001), however the TAC of 13 000 t had been in place since the beginning of 2003. A two year period was insufficient to determine the impact of a 13 000 t catch level upon the stock; therefore SC recommended that the 13 000 TAC be maintained through 2005. Scientific Council recommended that the TAC for shrimp in Div. 3LNO in 2006 should not exceed 22 000 t. At that time, SC reiterated its recommendation that the fishery be restricted to Div. 3L and that the use of a sorting grate with a maximum bar spacing of 22 mm be mandatory for all vessels in the fishery. During the September 2007 Scientific Council meeting, SC was asked to estimate the exploitation that would result from various catch options. As done in 2004, the various options were determined using the inverse variance weighted average of the most recent four survey fishable biomasses. Ultimately this work would be used in establishing the TAC for 2008 (NAFO 2008).

*Catch trends*

Catches increased dramatically since 1999, with the beginning of a regulated fishery. Table 1 and the following discussion provide the available numbers to date. Over the period 2000-2006, catches increased from 4 711 to 25 137 t. NAFO Division 3L northern shrimp catches totaled 23 077 t in 2007. By September of 2008, 22 223 t of shrimp were taken in 3L and it is anticipated that the 25 000 t quota will be taken. As per NAFO agreements, Canadian vessels took most of the catch during each year. Canadian catches increased from 4 050 t in 2000 to 18 312 t in 2007. By September 2008, Canadian vessels took 19 866 t of shrimp and it is anticipated that the 21 102 t Canadian quota will be taken. Catches by other contracting parties increased from 661 t in 2000 to 7 009 t in 2006. Preliminary data indicate that non Canadian vessels took 4 756 t of northern shrimp in 2007 and by September 2008, had taken 2 357 t of shrimp. It is anticipated that the 3 898 t quota for non Canadian vessels will be taken by December 2008. Table 1 provides a breakdown of catches by contracting party and year since 1999, while figure 1 indicates catches and TAC since 1993.

**Canadian Multi-species Bottom Trawl Research Survey Trends**

Spring and autumn multi-species research surveys have been conducted onboard the Canadian Coast Guard vessels *Wilfred Templeman*, *Teleost* and *Alfred Needler* since 1995. Shrimp data have been available from autumn survey since 1996 while shrimp data have been available from spring surveys since 1999. Fishing sets of 15 minute duration, with a tow speed of 3 knots, were randomly allocated to strata covering the Grand Banks and slope waters to a depth of 1 462 m in the autumn and 731 m in the spring, with the number of sets in a stratum proportional to its size (Figure 2). All vessels used a Campelen 1800 shrimp trawl with a codend mesh size of 40 mm and a 12.7 mm liner. SCANMAR sensors were employed to monitor net geometry. Details of the survey design and fishing protocols are outlined in (Brodie, 1996; McCallum and Walsh, 1996).

Prior to autumn 2003, shrimp were frozen and returned to the Northwest Atlantic Fisheries Centre where species identifications were made, and number and weight per set were calculated. Beginning with the autumn 2003 survey, most of the shrimp samples have been processed at sea. Samples that could not be processed at sea were frozen and processed in the Northwest Atlantic Fisheries Centre upon return. Abundance and biomass indices were estimated *via* OGive MAPping calculations (Evans *et al.*, 2000). We refer to Orr *et al*. (2007) to provide the full comparison of Ogmap and areal expansion indices as presented during the October 2007 NAFO-ICES Pandalus Assessment (NIPAG) meeting.

It must be noted that deepwater strata (deeper than 731 m) within Divisions 3LNO as well as several shallow water strata within Division 3L were not surveyed during autumn 2004 (Brodie, 2005; Healey and Dwyer, 2006). Historically very few northern shrimp have been taken from the deepwater strata; therefore, the impact of not sampling the deepwater was felt to be negligible. Strata that were missed, in Division 3L, (autumn 2004) are highlighted in figure 5; however, all NAFO Regulatory Area (NRA) strata containing significant quantities of northern shrimp have been surveyed consistently throughout the time series.

Analyses of the autumn survey data indicate that the shallow (93-549 m) 3L strata missed in 2004 are important in determining the biomass indices. Typically these strata account for 25-61% of the 3L biomass (Orr *et al.* 2007). Figure 6 confirms the importance of these strata and that catches, within these strata, vary annually. Therefore, it was not appropriate to use a multiplicative model to estimate 3L biomass and abundance indices from the autumn 2004 survey.

All important shrimp strata were surveyed in autumn 2007. The autumn 2007 biomass estimate for NAFO Divisions 3LNO was 286,400 t (95% confidence range = 219,700 – 358,400 t), the highest biomass index in the autumn time series (Table 2; Figure 3).

The spring 2007 3L biomass estimate was 231,600 t (95% confidence bounds = 167,500 – 290,800 t) (Table 3; Fig. 4). Throughout the history of the spring survey, it was possible to survey all important NAFO Division 3L strata (100 m - 751 m). However, due to operational difficulties it was not possible to survey all of the strata within NAFO Divisions 3NO during spring 2006. Strata 373 and 383 as well as most strata deeper than 92 m were not surveyed (Figure 7). Analyses from the spring 1999 - 2007 surveys indicated that greater than 96% and 50% of the 3N and 3O biomass respectively may be attributed to the strata that were missed (Orr *et al.* 2007). Therefore

biomass and abundance indices were not determined for NAFO Divisions 3NO during spring 2006. Historically, at least 95.9% of the 3LNO shrimp biomass has been found within Division 3L (Table 5); therefore, the spring 2006 indices were for NAFO Divisions 3L only. All 3LNO strata were surveyed during spring 2008. The spring 2008 survey biomass index was 231,600 t (95% confidence bounds = 167,500 – 290,800 t), the second highest in the spring time series.

Between 90.5 and 99.8% of the total 3LNO biomass was found within Division 3L, mostly within depths from 185 to 550 m. Over the study period, the area outside 200 Nmi accounted for between 11 and 28% of the estimated total 3LNO biomass (Tables 5 and 6; Figs. 6 and 7; Orr *et al.* 2007). Three year running averages were estimated in order to smooth the peaks and troughs within the data. They indicate that 12.5 – 20.1% of the total 3LNO autumn biomass was within the NRA (Table 5). Over the period 1995 – 2007 the overall average autumn percent biomass within the NRA was 17.5%. However, during the spring, the percent biomass within the NRA ranged between 19.4 and 25.4% (Table 6). Over the period 1999 – 2008 the average spring percent biomass with the NRA was 21.3%. It must be noted that variances around the spring indices are greater than around autumn indices (Tables 2 and 3; Figs. 3, 4, 6 and 7).

In all surveys, Division 3N accounted for 0.2-10.6% of the total 3LNO biomass (Tables 5 and 6). Between 49.7 and 77.3% of the 3N biomass was found outside the 200 Nmi limit. Division 3O accounted for less than 1% of the 3LNO biomass. A negligible amount of the Division 3O biomass was found outside the 200 Nmi limit.

## Conclusions

Preliminary data indicate that 22 223 t of shrimp had been taken in the 3L shrimp fishery by September 2008 and it is anticipated that the entire 25 000 t quota will be taken by the end of December 2008.

The autumn 2007 NAFO Divisions 3LNO biomass index was 286,400 t, the highest in the autumn survey time series. The spring 2008 Divisions 3LNO biomass index was 231,600 t, the second highest in the spring survey time series. However the spring biomass indices are thought to be less precise. Based on the information available, no change is proposed for the Scientific Council advice for a TAC of 25 000 t in 2009.

## Acknowledgements

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Table 1. Annual nominal catches (t) by country of northern shrimp (*Pandalus borealis*) caught in NAFO Div. 3L between 1999 and September 2008.

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Canada | 78[1] | 4,050[2] | 4,984[2] | 5,417[2] | 10,701[2] | 10,560[2] | 11,109[2] | 18,128[2] | 18,312[2] | 19,866[2] | |
| Cuba | | | 46[1] | 70[1] | 146[3] | 145[3] | 136[1] | 239[1] | 240[1] | 207[3] | |
| Estonia | | 64[1] | 2,264[4] | 450[5] | 117[1] | 144[1] | 281[1] | 485[1] | 670[1] | | |
| European Union | | | | | | | | | | 670[3] | |
| Faroe Islands | 706[1] | 42[1] | 2,052[4] | 620[5] | 25 | 1050[1] | 1055[1] | 1521[1] | 1798[1] | 354[3] | |
| France (SPM) | | 67[1] | 67[1] | 36[1] | 144[1] | | 147[1] | | 245[1] | 177[3] | |
| Greenland | | 34[1] | | | 671[1] | 299[1] | 311[1] | 453[8] | 455[8] | 488[3] | |
| Iceland | | 99[1] | 55[7] | 54[7] | 133[7] | 105[7] | 140[1] | 226[7] | | | |
| Latvia | | 64[1] | 67[1] | 59[1] | 144[1] | 143[1] | 144[1] | 244[1] | 310[1] | | |
| Lithuania | | 67[1] | 67[1] | 67[1] | 142[1] | 144[1] | 216[1] | 486[1] | 245[1] | | |
| Norway | | 77[1] | 78[6] | 70[6] | 145[9] | 148[1] | 144[1] | 245[1] | 246[1] | | |
| Poland | | 40[1] | 54[1] | | 145[1] | 144[1] | 129[1] | 245[1] | | | |
| Portugal | | | 61[5] | | | | | | | | |
| Russia | | 67[1] | 67[1] | 67[1] | | 141[1] | 146[1] | 248[1] | 112[1] | 278[3] | |
| Spain | 11[1] | 40[1] | 699[4] | | 151[1] | 140[1] | 154[1] | 251[1] | 190[1] | | |
| Ukraine | | | 57[1] | | 144[1] | 145[1] | | 121[1] | | | |
| USA | | | 66[1] | 57[1] | 144[1] | | 136[1] | 245[1] | 245[1] | 183[3] | |
| Estimated additional catch | | | | | | | | 2,000[5] | | | |
| **GRAND TOTAL** | 795 | 4,711 | 10,684 | 6,967 | 12,952 | 13,162 | 14,101 | 25,137 | 23,077 | 22,223 | |
| **TAC (tons)** | | 6,000 | 6,000 | 6,000 | 13,000 | 13,000 | 13,000 | 22,000 | 22,000 | 25,000 | 25,000 |

Sources:

1 NAFO Statlant 21A
2 Canadian Atlantic Quota Report, or other preliminary sources
3 NAFO monthly records of provisional catches
4 Value agreed upon in Stacfis
5 Canadian surveillance reports
6 Observer datasets
7 Icelandic logbook dataset.
8 Greenlandic logbook dataset.
9 Norwegian logbook dataset.

Table 2. Northern shrimp biomass estimates in NAFO divisions 3LNO from annual autumn Canadian multi-species bottom trawl surveys, 1995 – 2007. Offshore strata only (standard 15 min. tows). Please note that autumn 2004 indices were not determined due to missing strata. All indices were calculated using Ogive Mapping calculations.

| | Biomass (tons) | | | Abundance (numbers x $10^6$) | | | Survey |
|---|---|---|---|---|---|---|---|
| | Lower C.I. | Estimate | Upper C.I. | Lower C.I. | Estimate | Upper C.I. | Sets |
| 1995 | 7,132 | 8,500 | 14,830 | 2,108 | 2,733 | 4,800 | 337 |
| 1996 | 20,170 | 24,700 | 35,150 | 5,324 | 6,575 | 9,370 | 304 |
| 1997 | 32,410 | 44,000 | 61,940 | 7,545 | 9,911 | 13,860 | 318 |
| 1998 | 48,310 | 60,700 | 76,640 | 11,950 | 14,975 | 19,120 | 347 |
| 1999 | 43,160 | 54,900 | 72,390 | 10,620 | 12,993 | 16,510 | 313 |
| 2000 | 83,990 | 107,000 | 139,200 | 20,890 | 27,898 | 35,830 | 337 |
| 2001 | 155,300 | 215,400 | 259,600 | 36,890 | 51,730 | 62,040 | 362 |
| 2002 | 135,500 | 191,700 | 239,500 | 31,100 | 44,472 | 54,750 | 365 |
| 2003 | 143,300 | 191,100 | 244,600 | 30,310 | 39,515 | 49,240 | 316 |
| 2004 | is | | | is | | | |
| 2005 | 182,600 | 223,700 | 259,000 | 37,250 | 45,272 | 52,620 | 333 |
| 2006 | 172,900 | 215,400 | 252,000 | 36,460 | 47,051 | 55,710 | 312 |
| 2007 | 219,700 | 286,400 | 358,400 | 44,360 | 58,099 | 72,980 | 361 |

is = incomplete survey

Table 3. Northern shrimp biomass estimates in NAFO divisions 3LNO from annual spring Canadian multi-species bottom trawl surveys, 1999 – 2008. Offshore strata only (standard 15 min. tows). Please note that strata deeper than 93 m were not surveyed in 3NO during spring 2006. Historically more than 97% of the shrimp have been attributed to strata within 3L therefore the spring 2006 estimates are for 3L. All indices were calculated using Ogive Mapping calculations.

| | Biomass (tons) | | | Abundance (numbers x $10^6$) | | | Survey |
|---|---|---|---|---|---|---|---|
| | Lower C.I. | Estimate | Upper C.I. | Lower C.I. | Estimate | Upper C.I. | Sets |
| 1999 | 27,080 | 49,500 | 76,520 | 6,592 | 11,437 | 17,310 | 313 |
| 2000 | 65,710 | 113,300 | 176,700 | 13,150 | 21,356 | 31,590 | 298 |
| 2001 | 52,680 | 82,500 | 117,000 | 12,240 | 19,714 | 28,540 | 300 |
| 2002 | 87,390 | 133,800 | 204,700 | 20,730 | 31,260 | 47,660 | 300 |
| 2003 | 118,300 | 169,600 | 237,500 | 26,210 | 38,998 | 57,840 | 300 |
| 2004 | 40,030 | 100,900 | 172,300 | 7,830 | 19,444 | 34,480 | 296 |
| 2005 | 87,970 | 133,400 | 181,100 | 17,120 | 25,541 | 34,710 | 289 |
| 2006 | 105,700 | 176,500 | 241,300 | 21,490 | 34,038 | 46,670 | 195 |
| 2007 | 190,200 | 288,600 | 379,200 | 35,340 | 54,304 | 72,790 | 295 |
| 2008 | 167,500 | 231,600 | 290,800 | 35,020 | 48,064 | 60,580 | 273 |

Area compared each year = 272,766.3 sq. km.

Table 4. NAFO Divisions 3LNO *Pandalus borealis* biomass estimates for entire divisions and outside the 200 Nmi limit. Shrimp were collected during the 1996 – 2007 autumn Canadian multi-species surveys using a Campelen 1800 shrimp trawl (standard 15 min tows). All indices were estimated using Ogmap calculations.

| | | Entire Division | | | Outside 200 Nmi limit | | | |
|---|---|---|---|---|---|---|---|---|
| Season | Year | Division | Biomass estimate (t) | Percent by division | Biomass estimate (t) | Percent biomass by division | percent biomass in NRA | 3 year running average percent biomass in NRA |
| Autumn | 1995 | 3L | 7,700 | 90.59 | 1,100 | 64.71 | 14.29 | 14.29 |
| Autumn | 1996 | 3L | 22,900 | 92.71 | 4,000 | 85.11 | 17.47 | 15.88 |
| Autumn | 1997 | 3L | 43,400 | 98.64 | 5,500 | 91.67 | 12.67 | 14.81 |
| Autumn | 1998 | 3L | 56,000 | 92.26 | 8,900 | 81.65 | 15.89 | 15.34 |
| Autumn | 1999 | 3L | 54,500 | 99.27 | 8,000 | 96.39 | 14.68 | 14.41 |
| Autumn | 2000 | 3L | 105,800 | 98.88 | 22,100 | 98.22 | 20.89 | 17.15 |
| Autumn | 2001 | 3L | 213,700 | 99.21 | 40,800 | 97.14 | 19.09 | 18.22 |
| Autumn | 2002 | 3L | 187,800 | 97.97 | 35,200 | 92.39 | 18.74 | 19.57 |
| Autumn | 2003 | 3L | 185,300 | 96.96 | 35,300 | 91.69 | 19.05 | 18.96 |
| Autumn | 2004 | 3L | is | is | is | is | is | is |
| Autumn | 2005 | 3L | 222,300 | 99.37 | 26,200 | 97.40 | 11.79 | 15.42 |
| Autumn | 2006 | 3L | 213,700 | 99.21 | 27,100 | 96.44 | 12.68 | 12.23 |
| Autumn | 2007 | 3L | 282,400 | 98.60 | 54,500 | 98.55 | 19.30 | 14.59 |
| Autumn | 1995 | 3N | 900 | 10.59 | 600 | 35.29 | 66.67 | 66.67 |
| Autumn | 1996 | 3N | 2,000 | 8.10 | 700 | 14.89 | 35.00 | 50.83 |
| Autumn | 1997 | 3N | 700 | 1.59 | 500 | 8.33 | 71.43 | 57.70 |
| Autumn | 1998 | 3N | 4,700 | 7.74 | 2,000 | 18.35 | 42.55 | 49.66 |
| Autumn | 1999 | 3N | 500 | 0.91 | 300 | 3.61 | 60.00 | 57.99 |
| Autumn | 2000 | 3N | 700 | 0.65 | 400 | 1.78 | 57.14 | 53.23 |
| Autumn | 2001 | 3N | 1,700 | 0.79 | 1,200 | 2.86 | 70.59 | 62.58 |
| Autumn | 2002 | 3N | 4,000 | 2.09 | 2,900 | 7.61 | 72.50 | 66.74 |
| Autumn | 2003 | 3N | 4,700 | 2.46 | 3,200 | 8.31 | 68.09 | 70.39 |
| Autumn | 2004 | 3N | 2,600 | is | 2,100 | is | is | is |
| Autumn | 2005 | 3N | 1000 | 0.45 | 700 | 2.60 | 70.00 | 69.04 |
| Autumn | 2006 | 3N | 1500 | 0.70 | 1000 | 3.56 | 66.67 | 68.33 |
| Autumn | 2007 | 3N | 1,400 | 0.49 | 800 | 1.45 | 57.14 | 64.60 |
| Autumn | 1995 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 1996 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 1997 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 1998 | 3O | 100 | 0.16 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 1999 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 2000 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 2001 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 2002 | 3O | 100 | 0.05 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 2003 | 3O | 200 | 0.10 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 2004 | 3O | 200 | is | 0 | is | is | is |
| Autumn | 2005 | 3O | 100 | 0.04 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 2006 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 2007 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Autumn | 1995 | all divisions | 8,500 | 101 | 1,700 | 100 | 20.00 | 20.00 |
| Autumn | 1996 | all divisions | 24,700 | 101 | 4,700 | 100 | 19.03 | 19.51 |
| Autumn | 1997 | all divisions | 44,000 | 100 | 6,000 | 100 | 13.64 | 17.55 |
| Autumn | 1998 | all divisions | 60,700 | 100 | 10,900 | 100 | 17.96 | 16.87 |
| Autumn | 1999 | all divisions | 54,900 | 100 | 8,300 | 100 | 15.12 | 15.57 |
| Autumn | 2000 | all divisions | 107,000 | 100 | 22,500 | 100 | 21.03 | 18.03 |
| Autumn | 2001 | all divisions | 215,400 | 100 | 42,000 | 100 | 19.50 | 18.55 |
| Autumn | 2002 | all divisions | 191,700 | 100 | 38,100 | 100 | 19.87 | 20.13 |
| Autumn | 2003 | all divisions | 191,100 | 100 | 38,500 | 100 | 20.15 | 19.84 |
| Autumn | 2004 | all divisions | is | | is | | is | is |
| Autumn | 2005 | all divisions | 223,700 | 100 | 26,900 | 100 | 12.03 | 16.09 |
| Autumn | 2006 | all divisions | 215,400 | 100 | 28,100 | 100 | 13.05 | 12.54 |
| Autumn | 2007 | all divisions | 286,400 | 99 | 55,300 | 100 | 19.31 | 14.79 |

is = incomplete survey

Table 5.NAFO Divisions 3LNO *Pandalus borealis* biomass estimates for entire divisions and outside the 200 Nmi limit. Shrimp were collected during the 1999 – 2008 spring Canadian multi-species surveys using a Campelen 1800 shrimp trawl (standard 15 min tows). Please note that strata deeper than 93 m were not surveyed in 3NO during spring 2006. Historically more than 97% of the shrimp have been attributed to strata within 3L therefore the spring 2006 estimates are for 3LAll indices were estimated using Ogmap calculations.

| | | Entire Division | | | Outside 200 Nmi limit | | | |
|---|---|---|---|---|---|---|---|---|
| Season | Year | Division | Biomass estimate (t) | Percent by division | Biomass estimate (t) | Percent biomass by division | Percent biomass in NRA | 3 year running average percent biomass in NRA |
| Spring | 1999 | 3L | 47,500 | 95.96 | 10,200 | 85.71 | 21.47 | 21.47 |
| Spring | 2000 | 3L | 108,700 | 95.94 | 23,800 | 88.15 | 21.90 | 21.68 |
| Spring | 2001 | 3L | 82,700 | 100.24 | 11,400 | 99.13 | 13.78 | 19.05 |
| Spring | 2002 | 3L | 128,100 | 95.74 | 34,300 | 90.33 | 26.78 | 20.82 |
| Spring | 2003 | 3L | 165,400 | 97.52 | 29,900 | 86.92 | 18.08 | 19.55 |
| Spring | 2004 | 3L | 99,500 | 98.61 | 27,100 | 97.48 | 27.24 | 24.03 |
| Spring | 2005 | 3L | 133,200 | 99.85 | 14,200 | 94.67 | 10.66 | 18.66 |
| Spring | 2006 | 3L | 176,500 | is | 42,500 | is | 24.08 | 20.66 |
| Spring | 2007 | 3L | 282,100 | 97.75 | 78,200 | 97.02 | 27.72 | 20.82 |
| Spring | 2008 | 3L | 231,000 | 99.74 | 34,200 | 99.13 | 14.81 | 22.20 |
| Spring | 1999 | 3N | 2,200 | 4.44 | 1,700 | 14.29 | 77.27 | 77.27 |
| Spring | 2000 | 3N | 4,700 | 4.15 | 3,200 | 11.85 | 68.09 | 72.68 |
| Spring | 2001 | 3N | 300 | 0.36 | 100 | 0.87 | 33.33 | 59.56 |
| Spring | 2002 | 3N | 5,800 | 4.33 | 3,670 | 9.67 | 63.28 | 54.90 |
| Spring | 2003 | 3N | 5,400 | 3.18 | 4,500 | 13.08 | 83.33 | 59.98 |
| Spring | 2004 | 3N | 1,200 | 1.19 | 700 | 2.52 | 58.33 | 68.31 |
| Spring | 2005 | 3N | 1,400 | 1.05 | 800 | 5.33 | 57.14 | 66.27 |
| Spring | 2006 | 3N | is | is | is | is | is | 57.74 |
| Spring | 2007 | 3N | 3,100 | 1.07 | 2,400 | 2.98 | 77.42 | 67.28 |
| Spring | 2008 | 3N | 500 | 0.22 | 300 | 0.87 | 60.00 | 68.71 |
| Spring | 1999 | 3O | 100 | 0.20 | 0 | 0.00 | 0.00 | 0.00 |
| Spring | 2000 | 3O | 100 | 0.09 | 0 | 0.00 | 0.00 | 0.00 |
| Spring | 2001 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Spring | 2002 | 3O | 100 | 0.07 | 0 | 0.00 | 0.00 | 0.00 |
| Spring | 2003 | 3O | 200 | 0.12 | 0 | 0.00 | 0.00 | 0.00 |
| Spring | 2004 | 3O | 200 | 0.20 | 0 | 0.00 | 0.00 | 0.00 |
| Spring | 2005 | 3O | 100 | 0.07 | 0 | 0.00 | 0.00 | 0.00 |
| Spring | 2006 | 3O | is | is | is | is | 0.00 | 0.00 |
| Spring | 2007 | 3O | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| Spring | 2008 | 3O | 0 | 0.00 | 0 | 0.00 | | |
| Spring | 1999 | all divisions | 49,500 | 100.61 | 11,900 | 100.00 | 24.04 | 24.04 |
| Spring | 2000 | all divisions | 113,300 | 100.18 | 27,000 | 100.00 | 23.83 | 23.94 |
| Spring | 2001 | all divisions | 82,500 | 100.61 | 11,500 | 100.00 | 13.94 | 20.60 |
| Spring | 2002 | all divisions | 133,800 | 100.15 | 37,970 | 100.00 | 28.38 | 22.05 |
| Spring | 2003 | all divisions | 169,600 | 100.83 | 34,400 | 100.00 | 20.28 | 20.87 |
| Spring | 2004 | all divisions | 100,900 | 100.00 | 27,800 | 100.00 | 27.55 | 25.40 |
| Spring | 2005 | all divisions | 133,400 | 100.97 | 15,000 | 100.00 | 11.24 | 19.69 |
| Spring | 2006 | all divisions | is | is | is | is | is | 19.40 |
| Spring | 2007 | all divisions | 288,600 | 98.82 | 80,600 | 100.00 | 27.93 | 19.59 |
| Spring | 2008 | all divisions | 231,600 | 99.96 | 34,500 | 100.00 | 14.90 | 21.41 |

is = incomplete survey

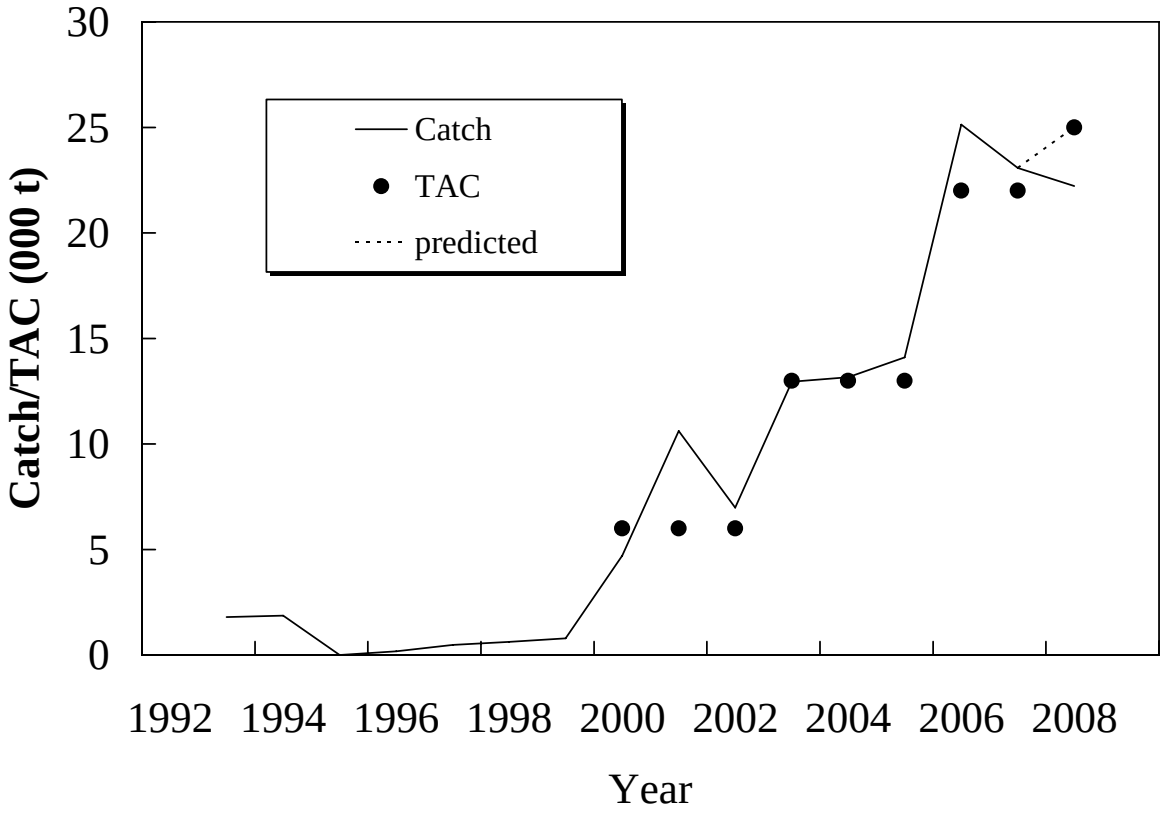


Figure 1. Trends in NAFO Div. 3LNO northern shrimp (*Pandalus borealis*) catch (t) and TAC over the period 1993-2008.

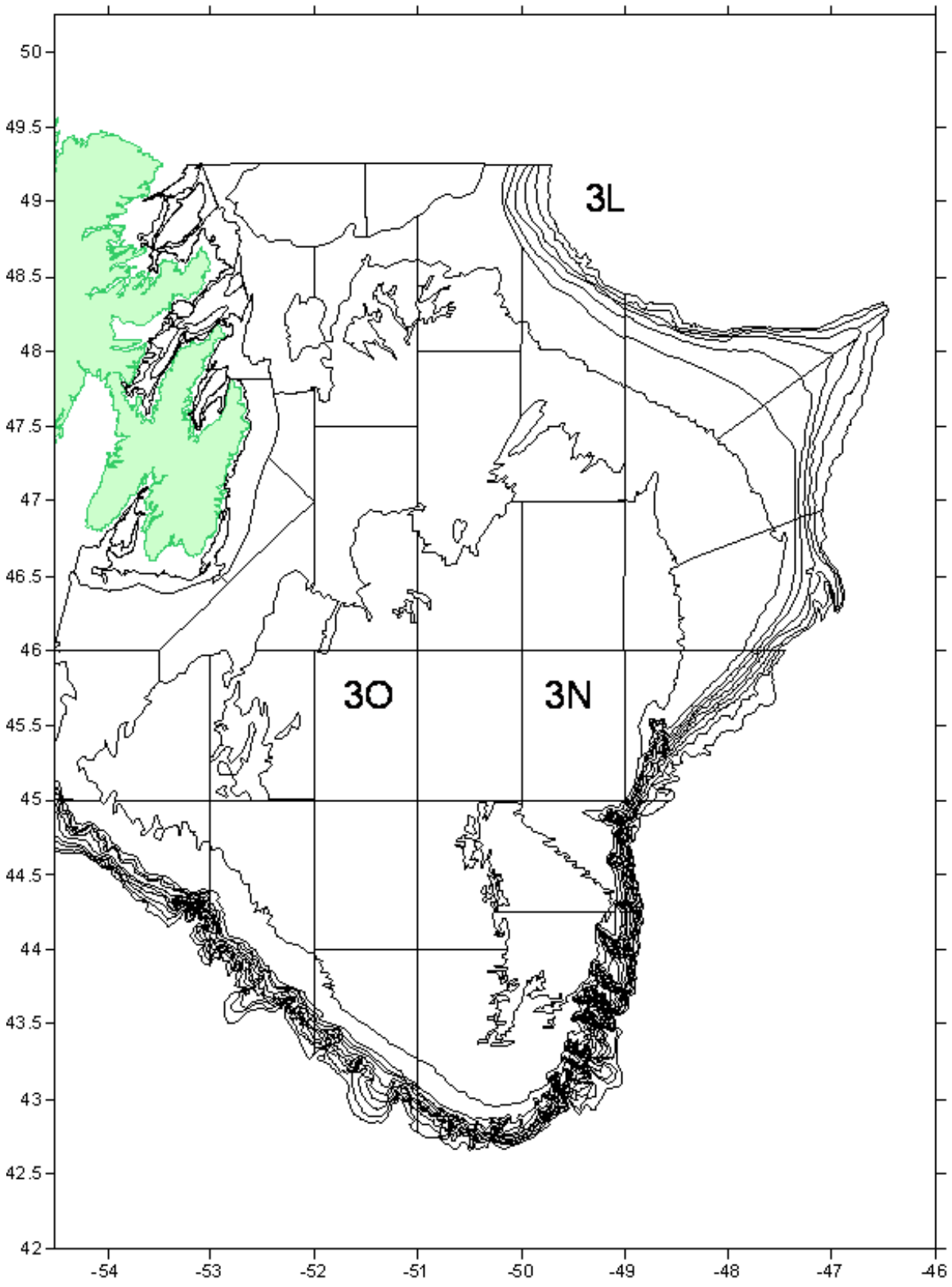


Figure 2. The NAFO 3LNO stratification scheme used in Canadian research bottom trawl survey set allocation.

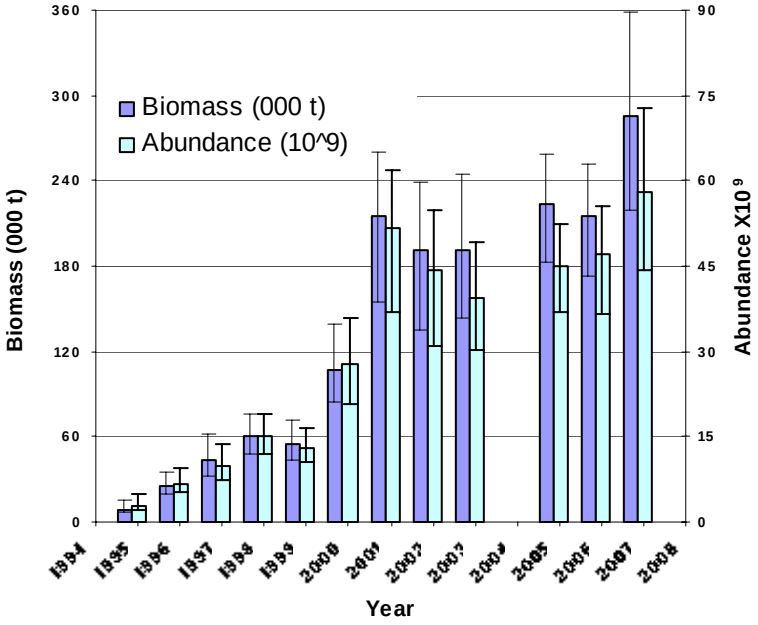


Figure 3. Autumn northern shrimp (*Pandalus borealis*) abundance and biomass estimates within NAFO Div. 3LNO. Data were from Canadian multi-species bottom trawl surveys using a Campelen 1800 trawl. (Standard 15 min. tows.)

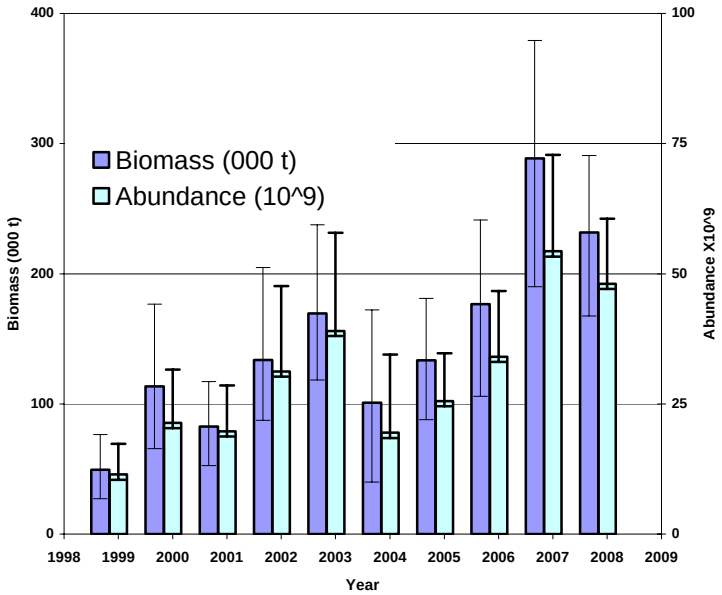


Figure 4 Spring northern shrimp (*Pandalus borealis*) abundance and biomass estimates within NAFO Div. 3LNO. Please note that due to operational problems, it was not possible to survey all of Div. 3NO during spring 2006. The indices for 2006 are for Div. 3L only. Data were from Canadian multi-species bottom trawl surveys using a Campelen 1800 trawl. (Standard 15 min. tows.)

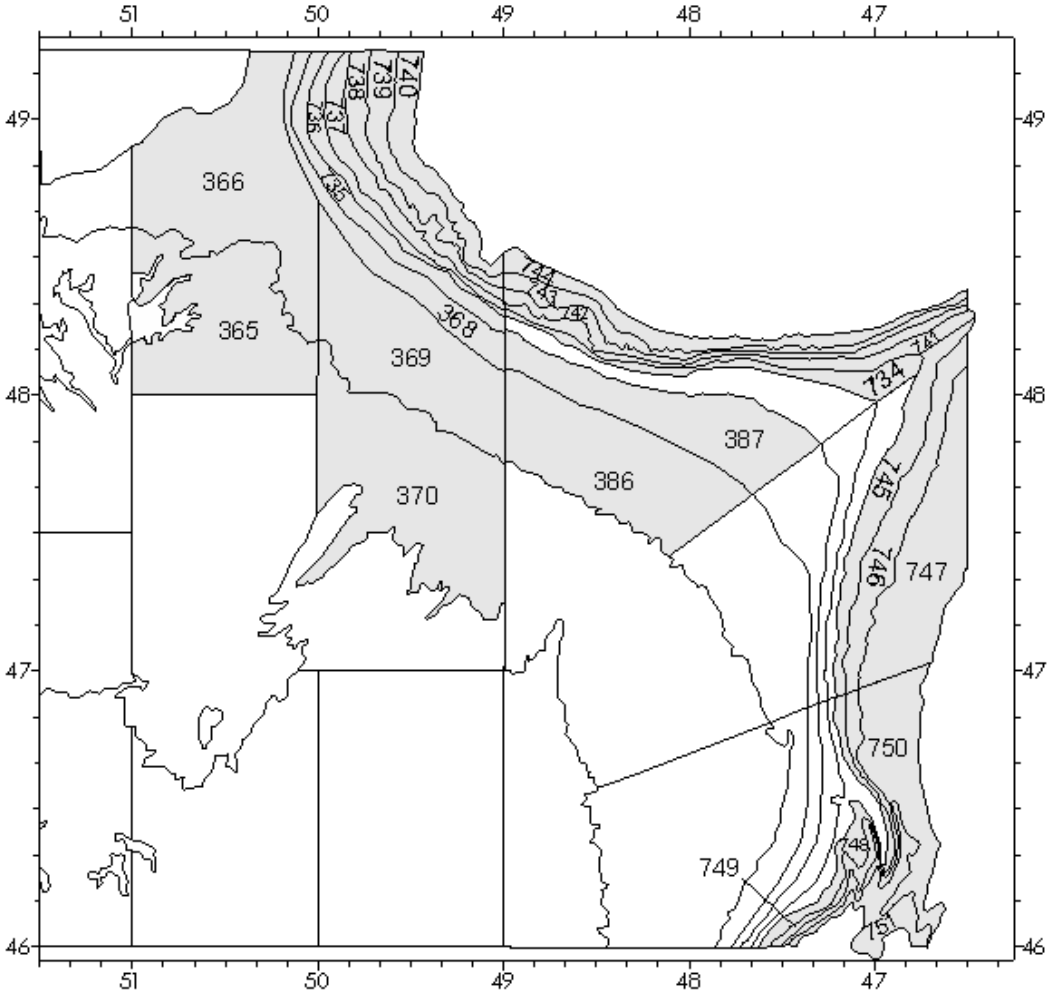


Figure 5. Strata in Div. 3L that were not surveyed (numbered and shaded area) during autumn of 2004.

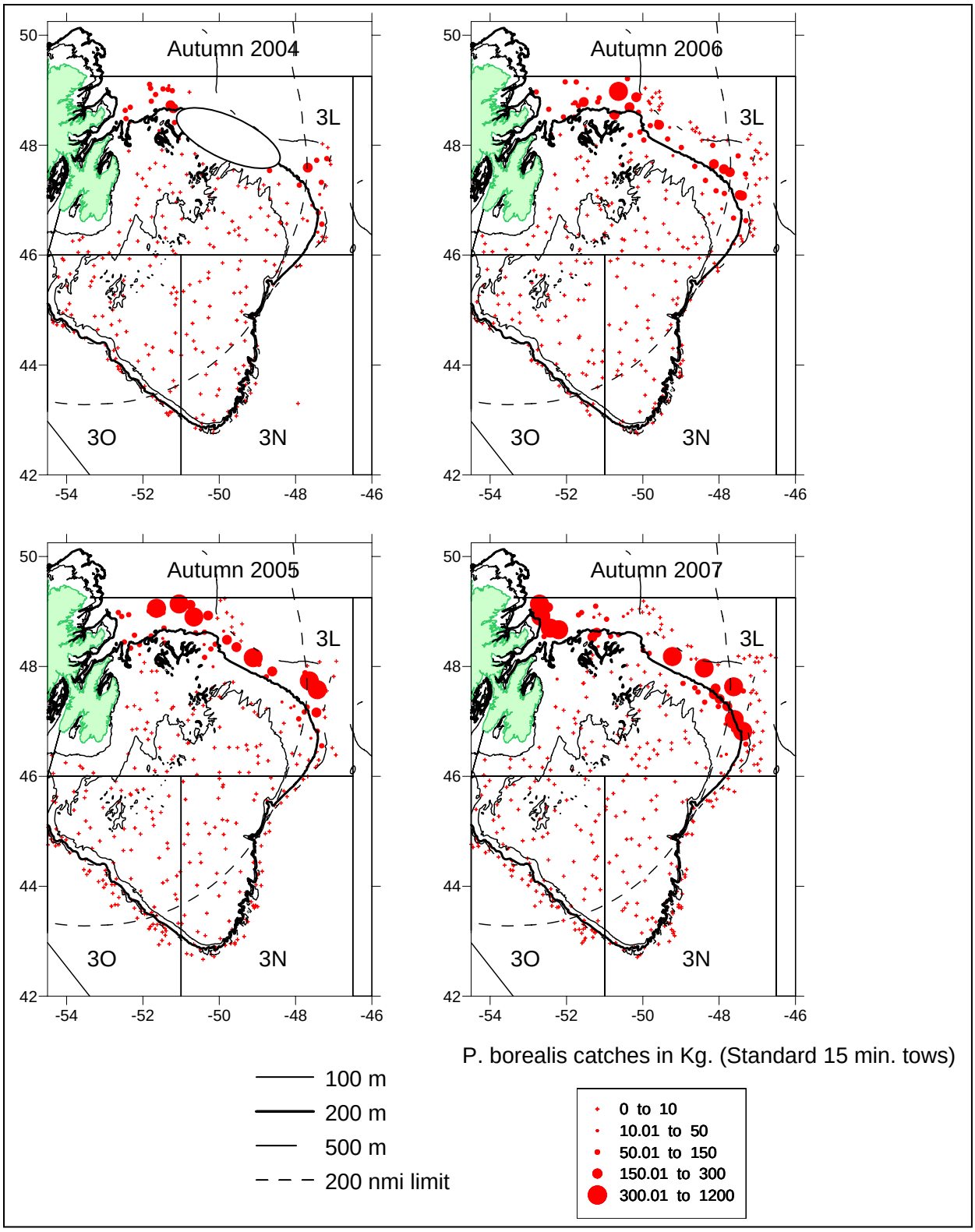


Figure 6. Distribution of NAFO Div. 3LNO northern shrimp (*Pandalus borealis*) catches kg/tow) as obtained from autumn research bottom trawl surveys conducted over the period 2004-2007. The ellipse within the 2004 map indicates the missing area that was missed during the 2004 autumn survey.

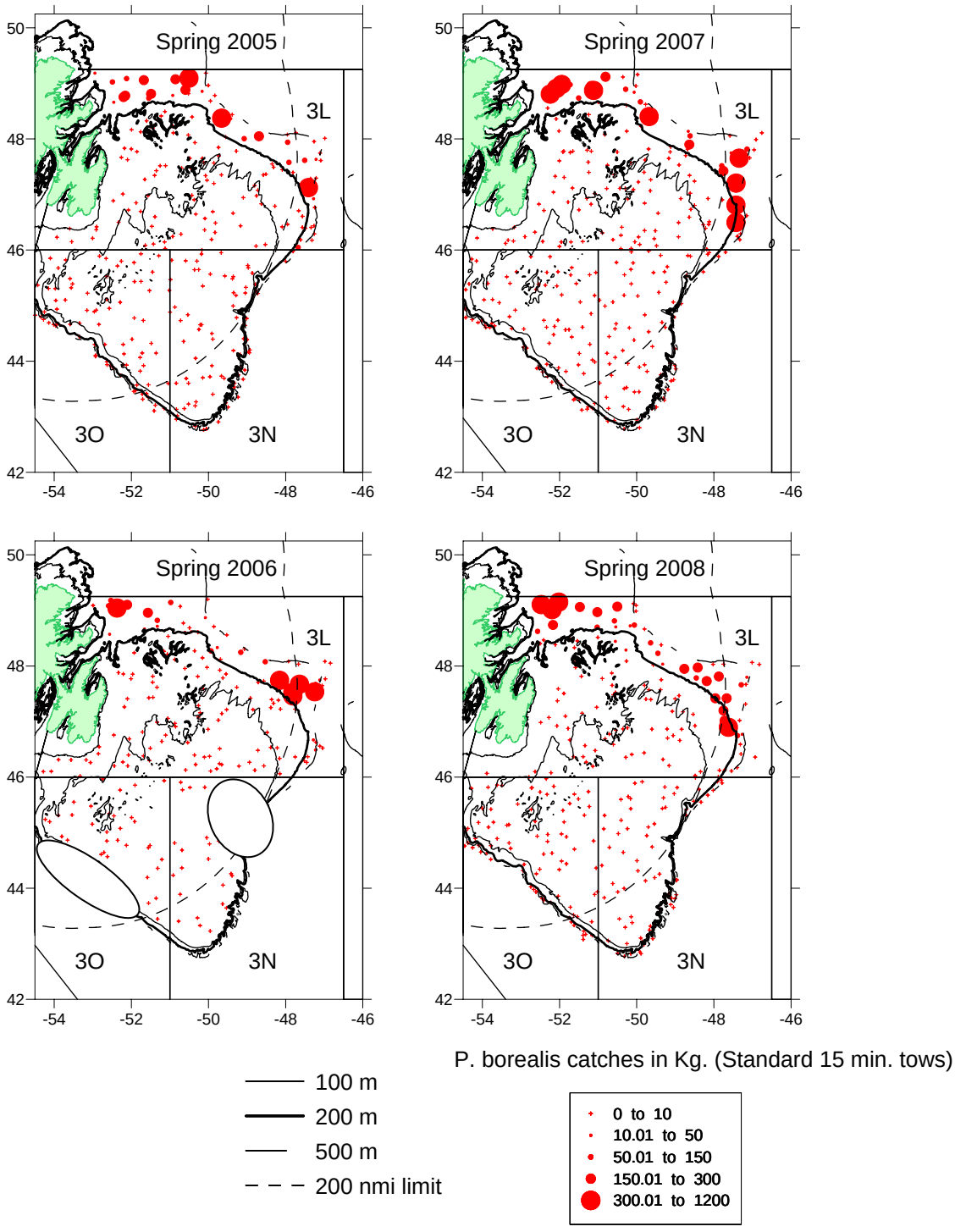


Figure 7. Distribution of NAFO Div. 3LNO northern shrimp (*Pandalus borealis*) catches kg/tow) as obtained form spring research bottom trawl surveys conducted over the period 2005-2008. Ellipses indicate strata not surveyed during spring 2006.