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Limit reference point for Witch Flounder in NAFO Divisions 2J+3KL

By

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Abstract

The limit reference point (LRP) for Witch Flounder in NAFO Divs. 2J+3KL was revised. The previous BLIM was based on 15% of survey BMAX. However, given the catch history of the stock prior to the start of the survey time series, a LRP based on a proxy for BMSY was deemed to be a more appropriate reference for this stock. A new reference point was defined with BLIM at 30% BMSY, with 1983-84 being used as a proxy for BMSY. The LRP is therefore set at BLIM =19 000t of survey biomass.

Introduction

The limit reference point (LRP) for Witch Flounder in NAFO Divisions 2J+3KL is a survey based LRP, with survey biomass obtained from Canadian autumn RV surveys. Scientific Council (SC) defined this LRP based on a proxy for B_{LIM} calculated at 15% of the highest observed survey biomass estimate ($B_{MAX} = B_{1984}$ = 9 800t; Maddock Parsons 2007). This was later adjusted to account for differences in survey coverage between 1984 and more recent surveys. This adjustment was defined from the average proportion of the biomass index that occurred outside of the strata sampled in the 1984 survey, from 1996 when the addition of the deep water strata (>1000m in 2K3L, >730m in 3L) occurred, to 2009. It was therefore agreed by SC that the LRP be revised to be 15% B_{MAX} * 1.48 = 14 500t (Maddock Parsons 2011, 2016).

This LRP was defined following recommendations from NAFO SCS Doc. 04/12, which states that "for data-poor stocks, the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{LIM}". However, further in the document it states that this is appropriate "if

the highest value of the index coincides with what is thought to be the unexploited state of the stock." The fishery began on this stock in the early 1960s and grew quickly, with peak landings of >23 000t in 1973 (Fig. 1). This was followed by a rapid decline in landings to around 2 800t in 1980. Landings fluctuated between 2 500 and 5 000t until 1992. The survey value for 1984 should therefore not be considered to represent an unexploited state, and the use of 15% B_{MAX} for defining a reference point (as outlined in NAFO SCS 04/12) is not appropriate for this stock.

Updating the Limit Reference Point

The survey index for the stock begins in 1983 (Fig. 2), as this is the point at which Campelen equivalent series of survey biomass and abundance are available for all three Divisions within the stock. However, in Divs. 2J and 3K, comparable surveys are available since 1977 and 1978, respectively (Fig. 3). Given that the bulk of the stock has historically been in Division 3K, these earlier values allow for a look at trends in the stock before the complete index was established. From 1978 to 1985, biomass index values for Divs. 2J and 3K appear to have varied without trend, suggesting a relatively stable period of stock size.

Given the stability in both biomass indices and landings during this period of the late 1970s - early 1980s, following the earlier peak in the fishery, Scientific Council agreed that the survey indices at the start of the combined time series can be considered a proxy for B_{MSY} level. (B_{MSY} = mean survey biomass 1983-1984 = 63 500t). The LRP is set at 30% B_{MSY} = B_{LIM} = 19 000t of survey biomass.

However, it should be noted that the true B_{MSY} for this stock is likely to vary from this proxy value, though it cannot be determined given the current data available and the survey index based assessment of the stock.

Survey coverage conversion

The previous LRP was adjusted to account for changed in survey coverage throughout the time series, with survey biomass adjusted based on the average proportion of the biomass index from 1996-2009 that occurred outside of the strata sampled in 1984. The survey in 1984 did not include deep strata (>1000m in 2J and 3K, >730m in 3L) inshore strata along the coast of the island of Newfoundland (Fig. 4), and missed some additional strata in Div. 2J. The proportion of survey biomass outside of the area of the 1984 survey varied without trend through much of the period used for adjustment, ranging from 29% to 69%, with a mean of 48%, but has generally declined since 2002 (Fig. 5). While this proportion has been declining since 2002, the estimate of biomass within these strata has been relatively constant since the late 1990s (Fig. 6); these strata represented an increased proportion of total survey biomass when the stock in other areas of the survey declined. Full details on biomass by survey strata can be found in Maddock Parsons et al. (2016).

There have been large scale changes in the distribution of Witch Flounder in Div. 2J+3KL (Fig. 7). In the early 1980s the stock was widespread on the shelf, in deep channels, and on the shelf edge. As the stock declined its distribution was restricted to the shelf edge. Since the mid-2000s the stock has been moving back into the deep channels and onto the shelf areas. With this expansion in distribution with increasing stock size, the strata that were not sampled in 1984 period have had decreasing influence on the overall survey index for this stock.

Recent poor survey coverage in the deep water (>730m) in Div. 3L introduces uncertainty into the understanding of trends in the proportion of the survey index outside of the strata from 1984. See Rideout

and Ings (2018), and references therein for full details on Canadian RV survey coverage. Sampling of the deep strata in Div. 3L has only been completed in 3 of the last 10 years. In addition, inshore strata have not been fully covered since 2005. Without consistent coverage, it remains unknown precisely how much of the stock has been outside of the 1984 strata. However, in three most recent five years surveyed (2006, 2007, 2009, 2010, 2014) the proportion of total survey biomass located in 3L deep averaged 1.5% (Table 1), and the amount of biomass in similar depths (>750m) in Divs. 2J and 3K has generally been very low (Fig. 8).

Conclusion

The start of the Canadian autumn survey time series for Divs. 2J+3KL (1983, 1984) is considered to be a proxy for B_{MSY} for this stock, with this proxy value calculated as the mean of survey biomass in these two years. The LRP is set at 30% B_{MSY} = B_{LIM} = 19 000t of survey biomass.

References:

Maddock Parsons. 2007. Witch Flounder Population Trends in NAFO Divisions 2J, 3K and 3L. NAFO SCR Doc. 7/27, Ser. No. N5378: 23p.

Maddock Parsons. 2011. Witch Flounder, American Plaice and Yellowtail Flounder in Canadian Spring and Autumn Surveys: Time Series Stock Distribution. NAFO SCR Doc. 11/37, Ser. No. N5922: 130p.

Maddock Parsons, D., D. Ings, B. Healey, F. Tulk, and R. M. Rideout. 2016. Witch Flounder in NAFO Divisions 2J, 3K and 3L. NAFO SCR Doc. 16/061.

NAFO SCS Doc. 04/12. Report of the NAFO Study Group on Limit Reference Points Lorient, France, 15-20 April, 2004.

Rideout, R. and D. Ings, 2018. Temporal And Spatial Coverage Of Canadian (Newfoundland And Labrador Region) Spring And Autumn Multi-Species RV Bottom Trawl Surveys, With An Emphasis On Surveys Conducted In 2017. NAFO SCR Doc. No. 18/017

Table 1. Survey biomass for the whole surveyed area, and for those strata not sampled in 1984

Year	Survey Biomass (t)		Percent of total biomass located outside of the 1984 strata
	Total	Outside 1984 strata	
1983	62.03	0.99	1.6
1984	65.15	N/A	N/A
1985	46.60	0.52	1.1
1986	38.02	0.85	2.2
1987	32.49	0.14	0.4
1988	28.98	0.20	0.7
1989	18.23	0.23	1.3
1990	31.10	0.81	2.6
1991	12.22	1.65	13.5
1992	6.10	0.30	4.9
1993	2.73	0.94	34.3
1994	1.97	0.37	18.6
1995	1.12	0.28	24.8
1996	3.03	1.65	54.5
1997	2.68	1.62	60.5
1998	3.81	1.91	50.2
1999	2.46	0.85	34.6
2000	2.67	0.92	34.6
2001	2.68	1.34	50.0
2002	3.30	2.17	65.8
2003	1.84	1.27	68.9
2004	3.57	1.72	48.2
2005	4.53	2.14	47.2
2006	5.84	2.61	44.7
2007	7.76	3.02	38.9
2008	8.08	2.36	29.2
2009	9.62	4.25	44.2
2010	9.65	4.23	43.9
2011	8.30	1.50	18.1
2012	8.97	1.28	14.3
2013	12.76	0.99	7.7
2014	13.05	2.30	17.6
2015	13.67	3.27	23.9
2016	17.60	4.54	25.8
2017	17.19	1.38	8.1

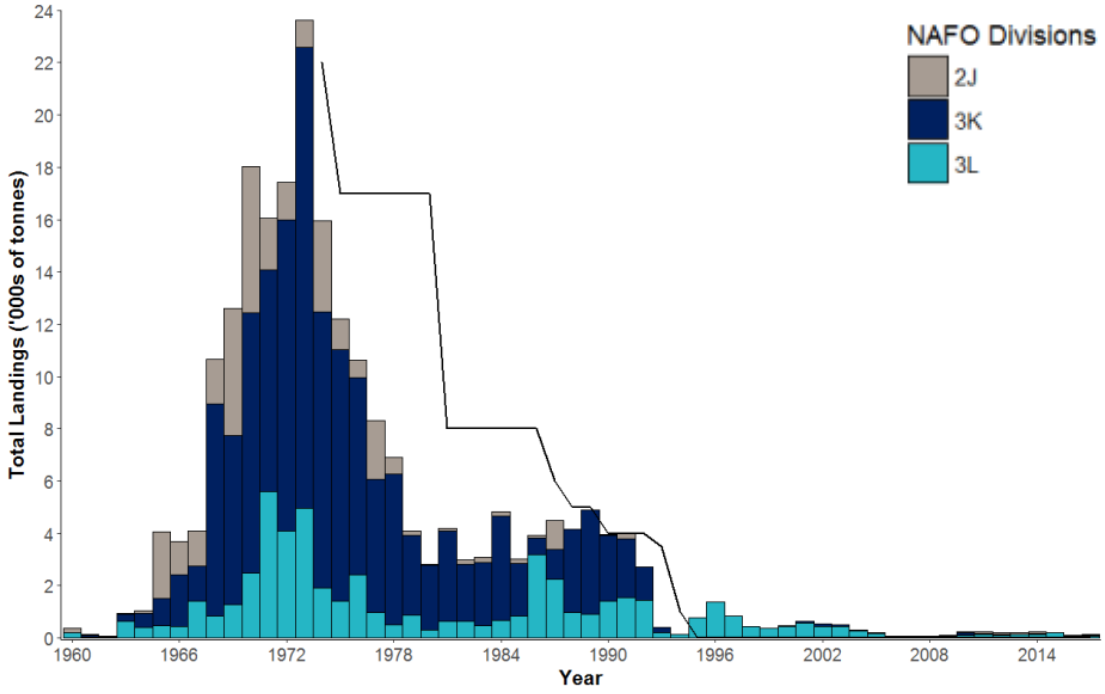

Fig. 1. Commercial landings of Witch Flounder in NAFO Divs. 2J+3KL

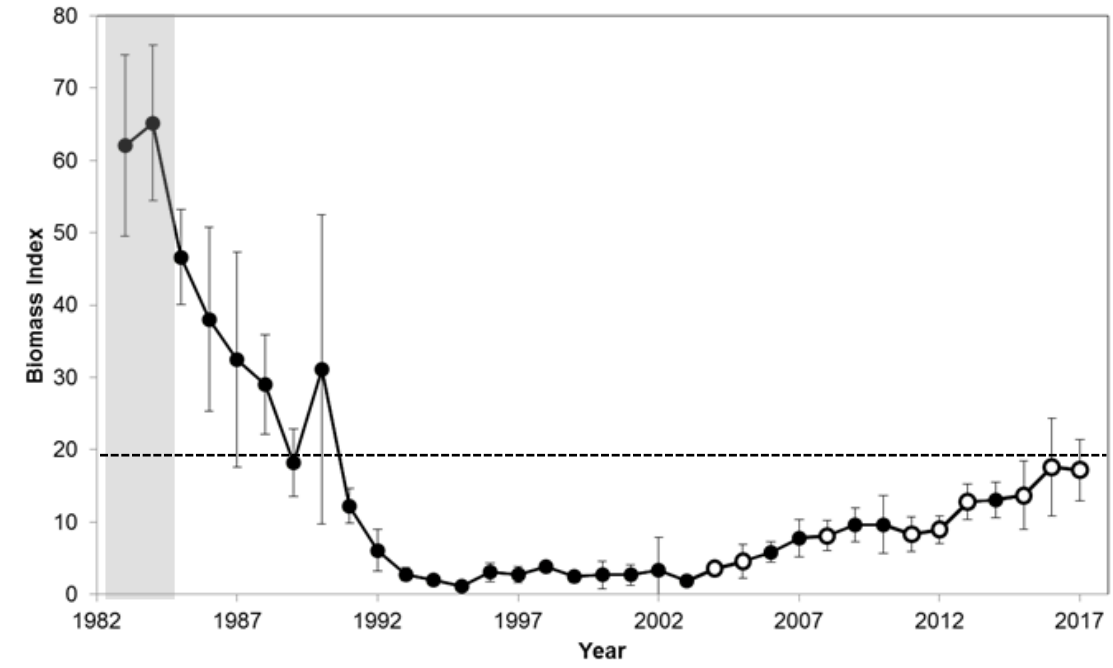

Fig. 2. Fall survey biomass index for Witch Flounder in NAFO Divs. 2J+3KL (open circles indicate years with no coverage in 3L deep). Grey bars highlight the 1983-1984 period for comparison to individual indices in Fig. 3. Horizontal line indicates B_{LIM} = 19 000t.

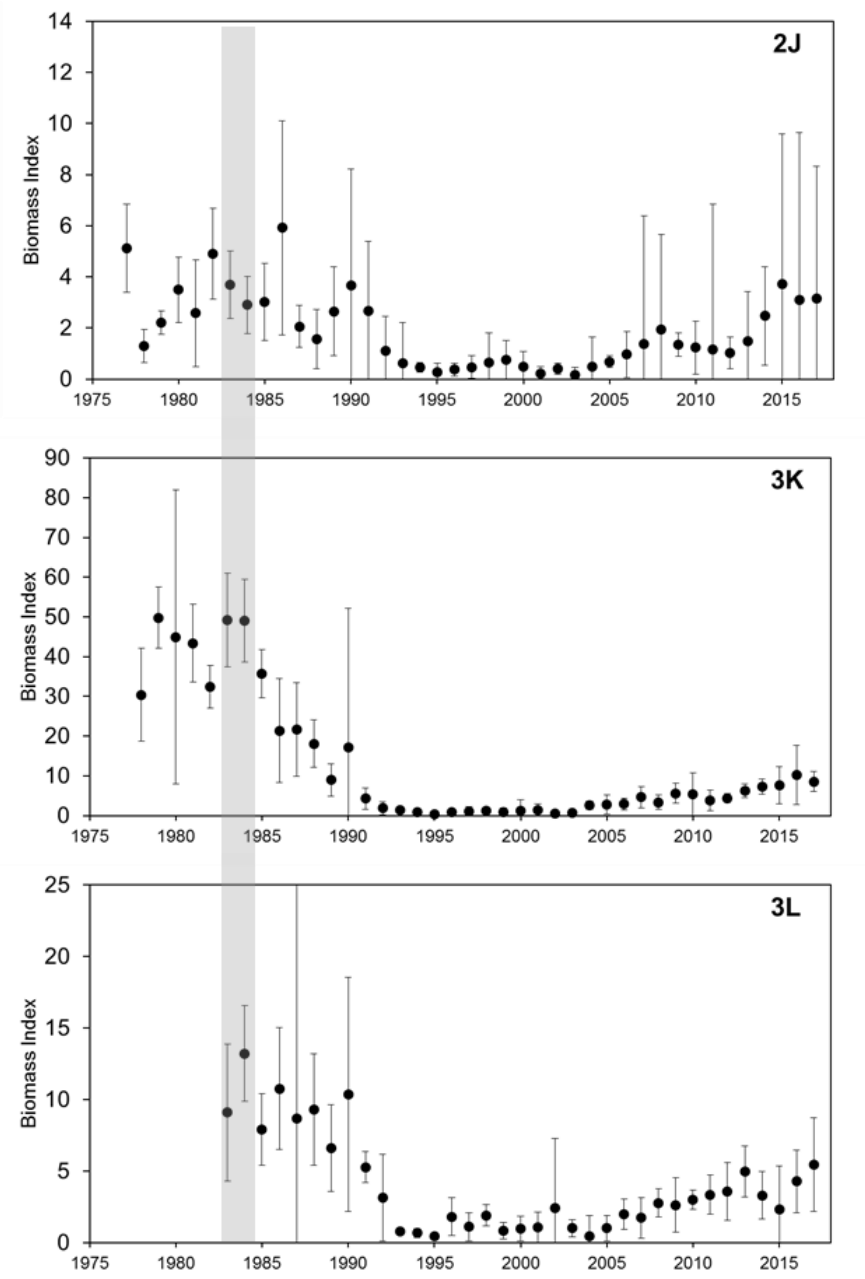

Fig. 3. Survey biomass indices by NAFO Division, since the start of the Campelen equivalent series in each division. Grey bars indicate the 1983-1984 period that is the start of the combined Divs. 2J+3KL series.

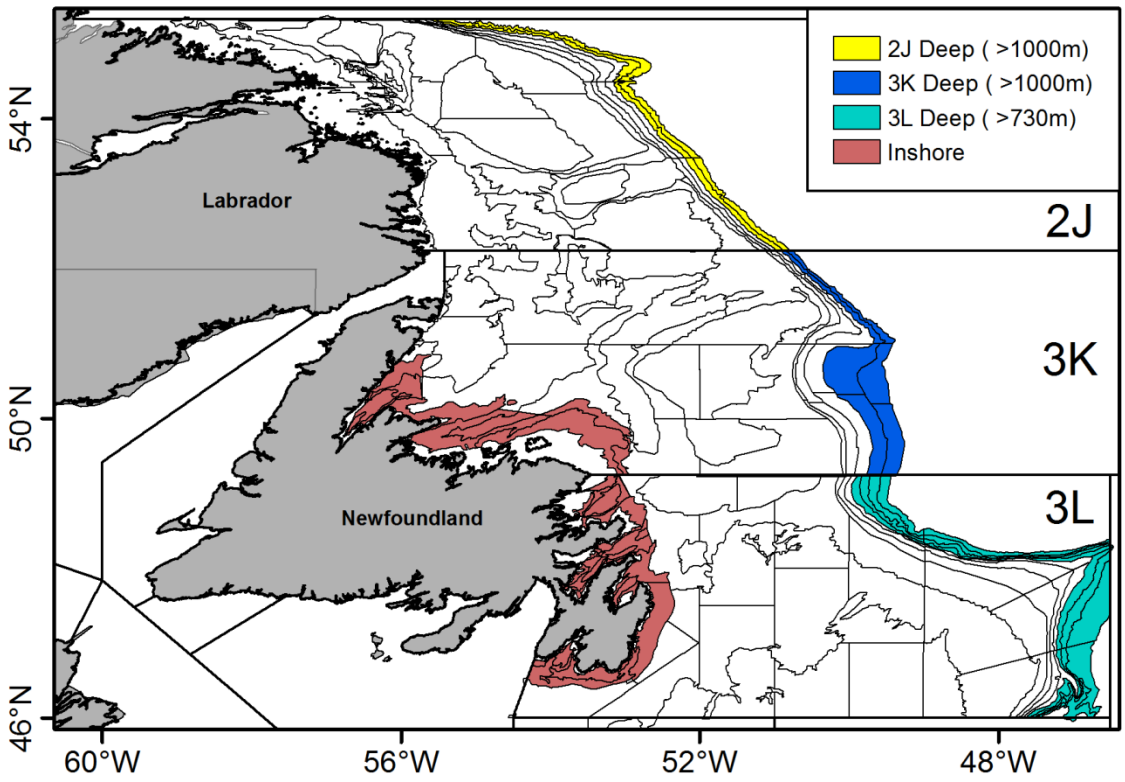

Fig. 4. Stratficiation sheme for the Canadian autumn RV surveys indicating strata that are considered to be "inshore" or "deep" (>730m in 3L, >1000m in 2J, 3K).

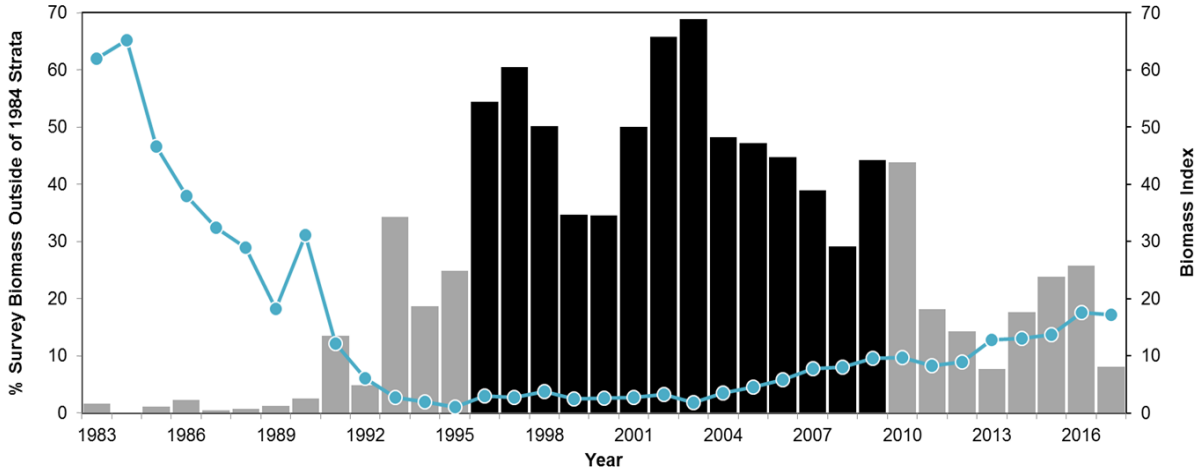

Fig. 5. Proportion of survey biomass outside of the strata covered in 1984 (bars). Black bars indicate the time period previously used in the LRP conversion factor. Blue dots/lines indicate biomass index values for each year.

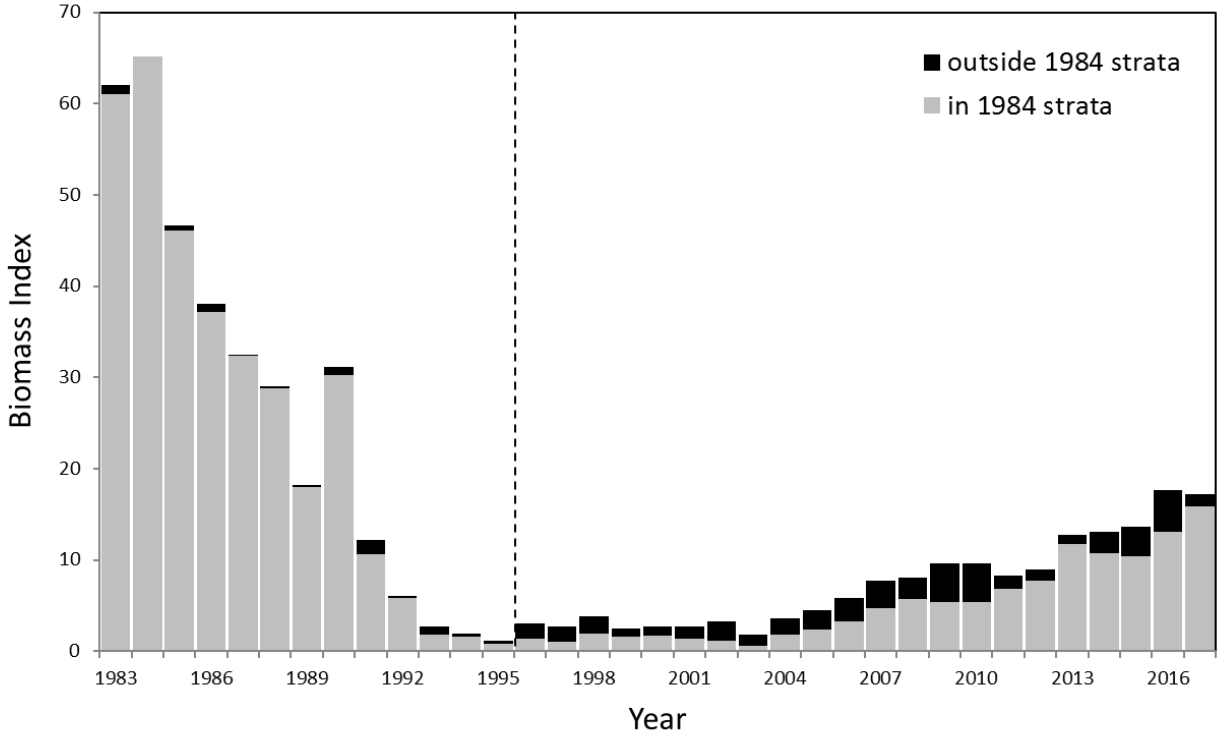

Fig. 6. Annual survey biomass index from Canadian autumn surveys in Div. 2J+3KL. Grey bars indication the amount of the biomass index from the strata that were included in the 1984 survey. Black bars indicate the amount of biomass index from strata not covered in 1984. The vertical line at 1996 indicates the year when the deep strata (>730m in Div. 3L, >1000m in Div. 2J+3K) were added to the survey.

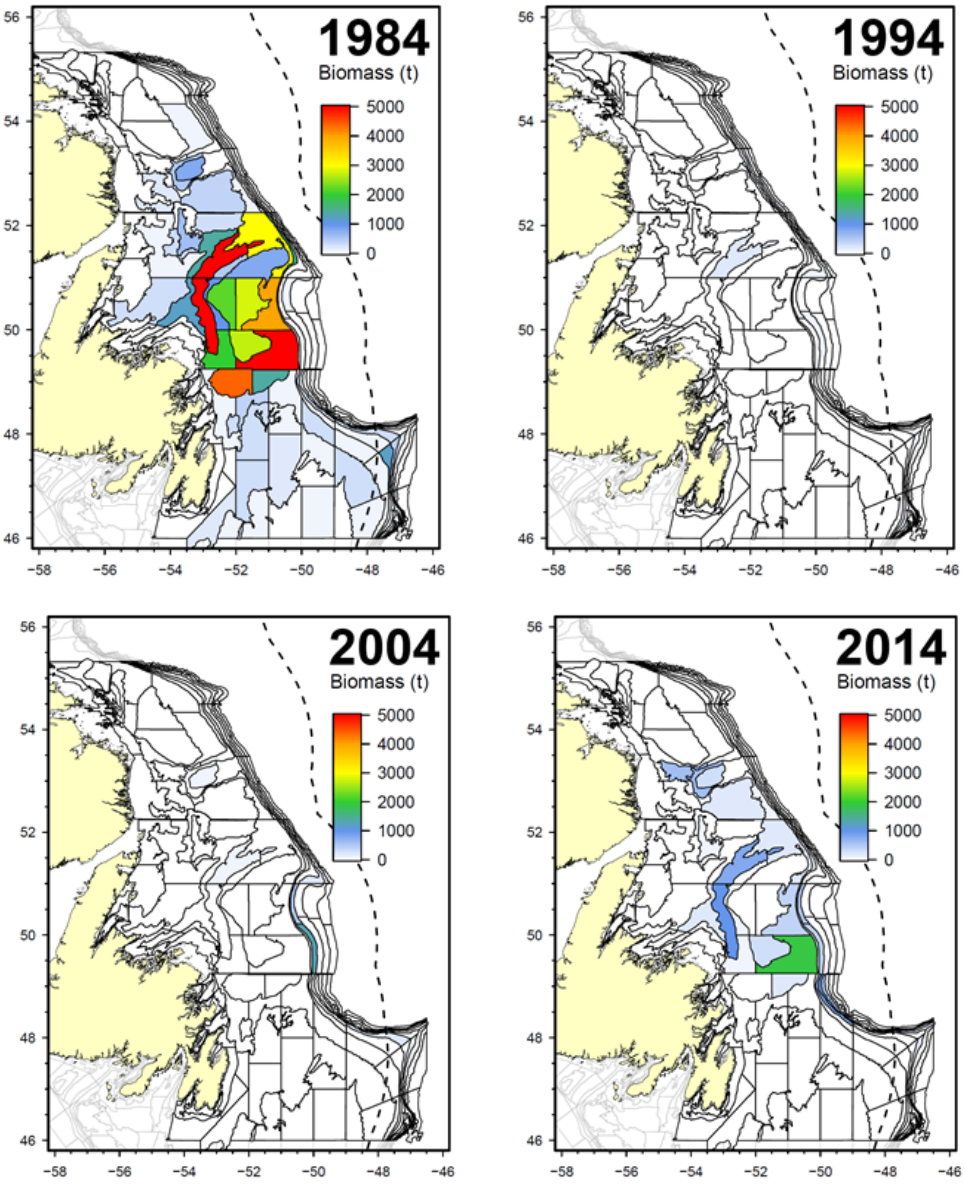

Fig. 7. Distribution of survey biomass by strata across the time series.

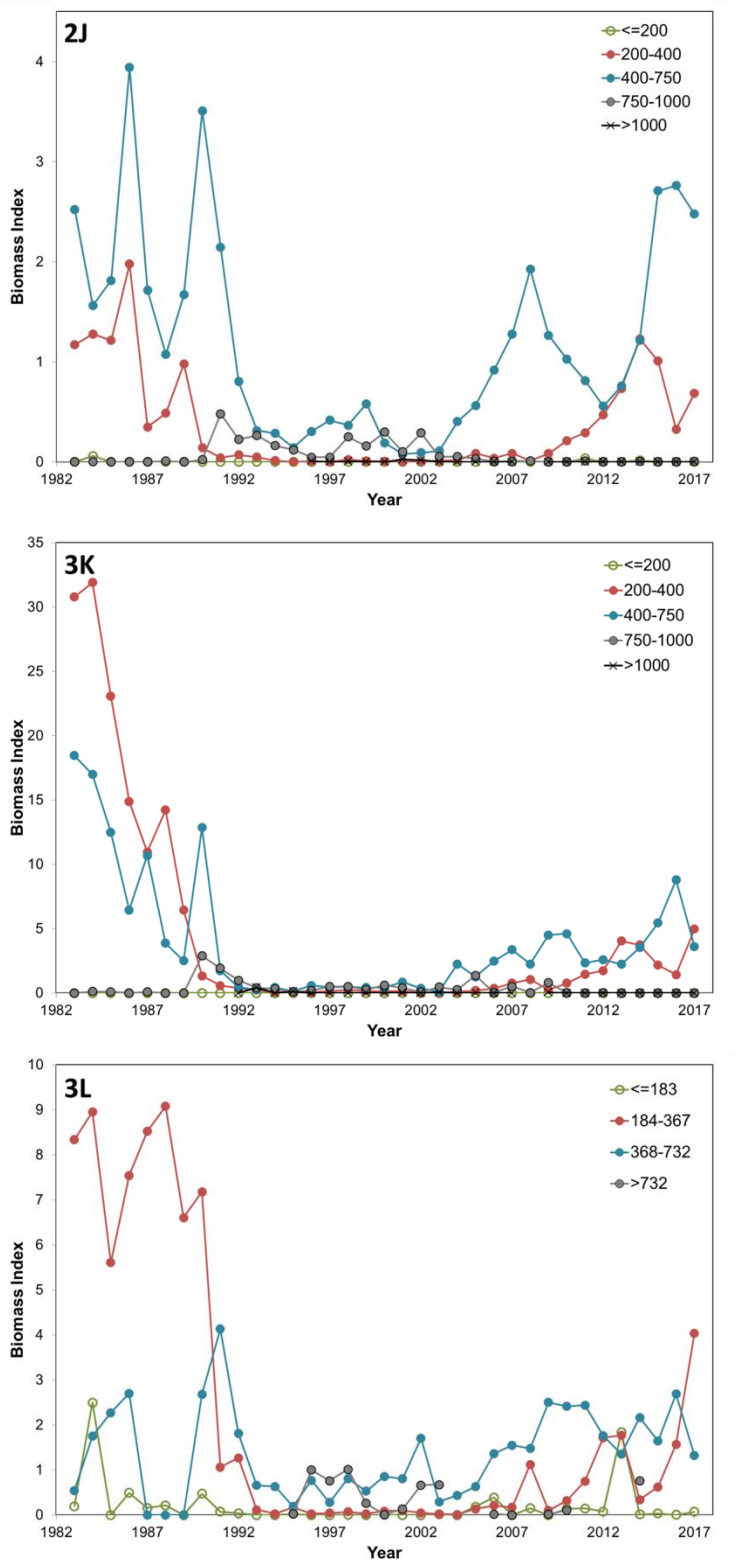

Fig. 8. Biomass by Depth in by Division for NAFO Divs. 2K, 3K, and 3L, from Canadian autumn surveys from 1983-2017. Note that each Division is independently scaled.