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An Assessment of the Status of the Redfish in NAFO Divisions 3LN

by

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Abstract

There are two species of redfish, the deep-sea redfish (*Sebastes mentella)* and the Acadian redfish (*Sebastes fasciatus*) that have been commercially fished and reported collectively in fishery statistics in Div. 3LN. After peaking at an historical high of 79 000 tons in 1987 catches declined to a minimum about 500 tons in 1996, being kept at a low level since then. Catch on the last years of open fishery (1990-1997) and by-catch on the moratorium years (1998-2004) are analyzed against recent trends of survey indices. The 1991-2004 Canadian spring and autumn surveys are the main source of information used in this work to assess the relative abundance and dynamics of the beaked redfish population on Div. 3LN. The surveys demonstrate considerable inter-annual variability, the changes frequently being the result of single large catches being taken in different years. Sex ratio and maturity ogives at length were applied to survey abundance at length, for each division and survey series, in order to estimate survey female spawning stock biomass.

Instead of looking to the survey indices on a year-to-year basis, trends of the respective mean values were analysed on a broader time scale. The assemblage of Div. 3L and 3N survey indices suggests that stock has been increasing from the early 1990s to the mid-2000s in terms of abundance, biomass, and female spawning biomass. However the magnitude of this increase remains difficult to quantify. Estimates of exploitation rate suggest that fishing mortality should be at a very low level when compared to the first half of the 1990s.

Introduction

There are two species of the genus *Sebastes* that have been commercially fished in Div. 3LN, the deep sea redfish (*Sebastes mentella)*, with a maximum abundance at depths greater than 300m, and Acadian redfish (*Sebastes fasciatus*), preferring shallower waters of less than 400 m. Due to their external resemblance *S. mentella* and *S. fasciatus* are commonly designated as beaked redfish.

Beaked redfish are viviparous with the larvae eclosion occurring right before or after birth, long living and slow growing, with females attaining size of 50% maturity at 30-34 cm (Power, 2001). Both species have pelagic and demersal concentrations as well as a long recruitment process to the bottom. Their external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as “redfish” in the commercial fishery statistics. For the same reason *S. mentella* and *S. fasciatus* are treated as a single species in the Grand Bank surveys carried out by Canada, Russia and more recently by EU-Spain.

This redfish assessment regards the beaked redfish in Div. 3LN as a management unit composed of two Grand Bank fish populations of two very similar species. Nevertheless, it is accepted that in this management unit *S. mentella* is the dominant population, representing almost 100% of the commercial catch and the major proportion of the exploitable redfish biomass in Divisions 3L and 3N below 400 m depth. Only from 1991 onwards two series of stratified bottom trawl surveys covered almost the entire area of the 3LN beaked redfish distribution on a regular annual basis and this justifies the present assessment being focused on the recent history of this stock over the past fifteen years. Length structure of catch (1990-1997) and by-catch (1998-2004) is analyzed and compared with survey abundance at length structure. Recruitment indices are derived from those two sets of data. Recent trends are estimated for several survey indices and finally a fishing mortality index is calculated using the 1991-2004 spring survey biomass.

Nominal catches and TACs

Reported catches still averaged 25 900 tons on 1990-1993, after peaking at an historical high of 79 000 tons in 1987. Catch dropped to a level about 3 900 tons on 1994-1995 and fall again in 1996-1998 to a minimum average level of 660 tons. After a small increase to around 2 500 tons in 1999-2000, catches decline again: first to an average level of 1 300 tons over the first years of the present decade (2001-2003), and finally to the former minimum level in 2004 (Table 1a, Fig. 1a). TACs were progressively reduced, from 25 000 tons (1990) to 14 000 tons (1991) and 11 000 tons (1996-1997). The NAFO Fisheries Commission implemented a moratorium on directed fishing for this stock in 1998 and has extended it to 2004. Till 1993 reported catches exceeded TACs, but in the rest of the years prior to the moratorium catches fell well bellow annual TACs (Table 1a).

Description of the fishery

In the early 1990s Russia, fishing mid-water trawl together with the fleets from the Baltic countries, South Korea and Portugal, fishing bottom trawl, were the primary fleets directing for redfish (Table 1bc, Fig 1b). By that time the area southwest of the Flemish Cap was prominent and the Russian and Baltic fleets that fished the Div. 3LMN border on the "Beothuk Knoll" accounted for most of the mid-water trawl catch.

However, from 1994 onwards a number of countries had reduced effort substantially on Div. 3LN. The reasons for the reduced effort varied amongst the fleets involved: Russia reduced its directed effort and subsequently targeted other species and redfish in Div. 3O. The Baltic countries reduced their fleet and directed toward shrimp in Div. 3M. EU/Portugal directed predominantly to Div. 3O redfish because of insufficient quota in Div. 3LN and also targeted other species in the NAFO Regulatory Area. And finally South Korea left the area by the end of 1993.

Since 1994 most of the redfish catches in NAFO Divisions 3L and 3N were taken as by-catch of the Greenland halibut fishery pursued from the northern slopes of the Sackville Spur in Div. 3L, through Flemish Pass till the canyons of southern Grand Bank in Div. 3N. Fishing with bottom trawl gear, EU-Spain fleet followed by EU-Portugal became the main fleets responsible for the 3LN redfish by-catch on the moratorium years.

Commercial Fishery Data

Catch and Effort

There is no new information to include in the catch rate standardization since the last analysis (Power, MS 1997) because catches since 1998 have been taken as by-catch. However, these data were not considered reflective of year to year changes in stock abundance (ANON 1996) and are of little value in determining current stock status.

Commercial fishery sampling

Most of the commercial length sampling data available for the 3LN beaked redfish stocks came, since 1990, from the Portuguese fisheries and has been annually included in the Portuguese research reports on the NAFO SCS Document series (Vargas *et al.*, 2005). Taking into account that the majority of the length sampling was from depths greater than 400 m, these data should represent *S. mentella* catches. Length sampling data from Spain and Russia were used to estimate the length composition of the commercial catches for those fleets in 2003 and 2004 (González *et al*., 2005; Vaskov *et al*., 2005). The 1990-2004 per mille length composition of the Portuguese trawl

catch was applied to the rest of the commercial catches (Table 2a). In all cases the 3LN beaked redfish length weight relationships (Alpoim and Vargas, 2004; Vargas *et al*., 2005) used to compute each absolute length frequency vector of the 3LN redfish commercial catch, were derived from individual length /weight observations collected annually through the sampling on board of the Portuguese by-catches from both Div. 3L and 3N. The 1998 length weight relationship was applied to the previous years, back to 1990. All relations were adjusted to the observed mean weights at length (Table 2b).

The annual mean length of the catch was calculated as a weighted mean of catch numbers at length for each year (Table 2a). The overall mean length of the 1990-2004 catch (arithmetic mean of the annual mean lengths of the commercial catch) was used to derive the anomalies in the mean length on the 3LN beaked redfish commercial catch over this period (Table 2a, Fig. 2). The proportion of small redfish (less than 20 cm) in the catch is presented as well, in Table 2a. The purpose of the first exercise was to detect eventual shifts in the length structure of the commercial catch or by-catch that could reflect changes in the exploitable stock structure. As for the second exercise, a sudden and important increase on the proportion of small redfish in the catch could be regarded as signal of the income of a good recruitment.

On the first half of the 1990s most length anomalies were negative, while on the second half and on the present decade the opposite occurred. As for the proportion of small redfish in the catch, besides 1991-1992 and again 2003, this proportion is close to zero. The weight of small redfish in the commercial catch of 2003 is the second highest of the 1990-2004 period. The shift from most negative to most positive length anomalies, when passing from the first to the second half of the 1990s, suggest that the cohorts entering the exploitable 3LN redfish stock were allowed to grow and survive, appearing in the commercial catch and by-catch for several years.

Research Surveys

From 1978 till 1990 several stratified-random bottom trawl surveys have been conducted by Canada in various years and seasons in Div. 3L, in which strata up to a maximum of 732 m (400 fathoms) were sampled. However only since 1991 two Canadian series of annual stratified-random surveys covered both Div. 3L and Div. 3N on a regular annual basis: a spring survey (May-Jun.) and an autumn survey (Sep.-Oct. 3N/Nov.-Dec. 3L for most years). The design of these surveys was based on a stratification scheme down to 732 m for Div. 3LN. Recently the stratification scheme has been updated to include depths out to 1 464 m (800 fathoms) but only the autumn surveys since 1996 have had some sampling of stations over 732 m, most on Div. 3L.

Up until the autumn of 1995 the Canadians surveys were conducted with an Engels 145 high lift otter trawl with a small mesh liner (29 mm) in the codend and tows planned for 30 minute duration. Starting with the autumn 1995 survey in Div. 3LN, a Campelen 1800 survey gear was adopted with a 12 mm liner in the codend and 15 minute tows utilizing SCANMAR. Only Campelen data and Engel data converted into Campelen equivalents are reported in this assessment. A comparison of the generated data with the original Engel data suggested overall trends in abundance were the same except that the relative measure of abundance estimated for the Campelen trawl conversions were higher (Power and Maddock Parsons, MS 1998).

In 1995 EU-Spain started a new stratified-random bottom trawl spring (May-June) survey on NAFO Regulatory Area of Div. 3NO. Despite changes on the depth contour of the survey, all strata in the NRA till 732 m were covered every year following the standard stratification (Bishop, 1994). From 1998 onwards the Spanish survey was extended to 1 464 m (with the exception of 2001, with a 1 116 m depth limit) and in 2004 expanded to the Regulatory Area of Div. 3L. From 1995 till 2000 the survey was carried out by the Spanish stern trawler *C/V Playa de Menduiña* using a *Pedreira* bottom trawl net. In 2001 the *R/V Vizconde de Eza* , trawling with a *Campelen* net, replaced the commercial stern trawler. In order to maintain the data series obtained since 1995, comparative fishing trials were conducted in spring 2001 to develop conversion factors between the two fishing vessel and gear combinations. Survey mean catch and biomass, abundance and abundance at length were transformed from C/V *Playa de Menduíña* series to R/V *Vizconde de Eza* series. For American plaice and Greenland halibut those results were presented at the June meeting of NAFO Scientific Council (*González et al*., 2004) but not for beaked redfish. That is the main reason why this series is not yet included in the 3LN redfish assessment.

Russia also conducted a spring bottom trawl survey in Div. 3L (1984-1994) and Div. 3N (1984-1993). Comparison of the winter/spring Canadian and spring Russian bottom trawl surveys in Div. 3L indicate a similar trend of decline in density estimates from 1984 to 1990 and stability at a low level till 1994. The situation is unclear for Div. 3N

with both 1991-1993 summer/autumn Canadian and spring Russian surveys showing dramatic year to year changes of their indices but of opposite sign (Power, 2003). Russian survey series on Div. 3L and Div. 3N ended more than a decade ago.

For the reasons described above as regards Canadian, Spanish and Russian survey series on Div. 3L and Div. 3N, the 1991-2004 bottom trawl Canadian spring and autumn survey series are the source of information used in this work to assess the relative abundance and dynamics of the beaked redfish population on Div.3LN, despite the large inter-annual variability of these survey data.

Estimation of Stock Indices and Parameters from Survey Data

Abundance at length

Spring and autumn survey abundance at length, for Div. 3L and Div. 3N combined, are presented in Table 3a and b. Survey abundance at length for each division, year and survey is derived from the correspondent mean number per tow at length expanded to the survey abundance estimated by the swept area method. The overall 1991-2004 mean length for each survey series (arithmetic mean of the annual mean lengths of the survey abundance at length) was used to derive the spring and autumn length anomalies for the 3LN beaked redfish stock over this period (Table 3a and b, Fig. 3a and b). As on the commercial catch, on either survey series almost all length anomalies during the first half of the 1990s were negative and most were positive 1995 onwards. This shift on the spring and autumn survey stock structure at length seems to confirm the relatively high survival of the year-lasses through the 1990s and early 2000s, though no signs of a pulse on recruitment are detected (Fig. 3b).

In order to estimate for each year of the interval the weight of female spawners in stock biomass, the 3LN survey biomass has been recalculated as a sum of products (SOP) using the 3M *Sebastes sp.* length weight relationships with both sexes combined (Troncoso and Casas, *pers. comm.*, 2005). From the available length weight relationships with both sexes combined, the ones adjusted to the individual length/weight observations from the sampling of the redfish catches of both species on board of the EU Flemish Cap survey, gave the closest approach between swept area and sum of products survey stock biomass, regardless the division and survey considered. The comparison between SOP and swept area survey biomass is presented on the bottom of Table 3a and b. Length weight relationships are presented on Table 3c.

Sex ratio at length

From the survey data files available until recently, Div. 3L beaked redfish survey catch at length data were assigned to male, female and unsexed categories between 1991 and 1997, on both spring and autumn surveys. The same split of the redfish survey catch data occurred in Div. 3N on the 1991-1995 spring surveys and on the 1991-1994 and 1997 autumn surveys. For each division the ratio between female and total survey abundance at length (combined for all available years and surveys) gave an observed sex ratio at length vector (female proportion at length) that was finally smoothed by moving averages (3 cm intervals, starting at 16 cm length) and applied to the rest of the unsplit survey catch at length data (Table 4 and Fig. 4).

A gradual increase in the female proportion with length is observed on either division up to 31-32 cm. This increasing proportion should be expected: dimorphism on redfish species is not so marked as on Grand Bank flatfishes such as Greenland halibut or American plaice, but redfish females still grow slightly faster and to relatively larger sizes than males. However, beginning at lengths of 31-32 cm (at, or close to, the mean length of female first maturity in Div. 3L and Div. 3N, Power 2001) a decline in the female proportion is observed up to sizes of 41 cm for Div. 3N, and 43 cm for Div. 3L. Such unexpected decline may suggest that during part of their maturity stage redfish females tend to concentrate in the water column, more far away from the sea bottom and so less available to survey bottom trawl. If that is the case, both spring and autumn Canadian surveys on Div. 3LN should underestimate the weight of female spawners in redfish survey biomass. On Div. 3L and Div. 3N sex ratio increase again rapidly through the largest lengths caught by the spring and autumn surveys.

Female maturity at length

The results of the maturity studies regarding male and female beaked redfish were included on the 2001 assessment of redfish on NAFO Div. 3LN (Power, 2001). From 1972 to 1995 redfish sampled for otolith collection (**A**ge and **G**rowth sampling) on board of Canadian surveys were classified as mature or immature based on the visual examination of the fresh gonad at sea. From 1996 to 2000 redfish sampled on a set by set basis on board of the spring and autumn Canadian surveys for length and sex were classified as "mature and will spawn this year" against "immature or will not spawn this year" (**L**ength, **S**ex, **M**aturity sampling). A logistic model was fit to those two sets of maturity data and for each division, 3L and 3N, two female maturity ogives are available: a former one, derived from the A&G data and used to estimate the 1991-1995 female spawning stock survey biomass (survey SSB); and a recent one, derived from LSM data and used to estimate female survey SSB over the more recent years, 1996-2004 (Table 5 and Fig. 5a and b). The LSM curves have a much less sigmoid shape than their older relatives, the A&G curves, suggesting that on the second half of the nineties female maturation has become a longer process, namely on Div. 3L where the L_{50} shifted from 30.52 cm (A&G) to 34.71 cm (LSM).

Under constant length/weight growth and constant criteria to define sexual maturity, increasing length of first maturity is usually considered a sign of improvement on the reproductive potential of an exploited fish population. However the differences observed between the A&G and LSM curves should be apparent, since they were determined just by the broader criteria used in 1996-2000 to classify female redfish as "immature" (including in this category females that are already mature but would not spawn the year they were caught). And if that is the case the magnitude of the 1996-2004 survey female stock biomass derived with the LSM curve will be under estimated when compared to the estimate of survey SSB for the former 1991-1995 interval derived with the A&G curve.

Survey indices of biomass, female spawning biomass and abundance

Sex ratio and maturity ogives were applied to survey abundance at length, for each division and survey series. The female spawning stock survey biomass was then calculated as sum of products, using the female spawners at length and the same 3M *Sebastes sp.* length weight relationships already used to estimate SOP survey stock biomass. The SOP survey SSB/SOP survey biomass ratios were finally applied to the swept area survey biomasses to give an estimate of the 1991-2004 swept area survey SSB for beaked redfish in NAFO Div. 3LN.

Survey indices (biomass and female SSB; abundance and female spawners; mean weight per tow and associated standard error) for Div. 3L, Div. 3N and combined are presented on a year-to-year basis on Tables 6a and 6b and Fig. 6a to 6f. For spring and autumn survey series, combined mean weight per tow for Div. 3LN is the average between the mean weights per tow for Div. 3L and Div. 3N weighted by the swept area of the selected strata of each division.

In order to detect eventual changes in the stock that can be masked by the high inter annual variability of the surveys, biomass and abundance indices were averaged for three periods: 1991-1994, 1995-1999 and 2000-2004 (Table 6c and Fig. 6g to 6j). The anomalously high magnitude of the 1992 autumn survey indices when compared to the neighbouring indices of the 1991-1994 period and of the standard error associated with the mean weight per tow (the highest for the two series and divisions) justified the exclusion of that year from the computation of the averages of the autumn survey indices for the first half of the 1990s. Average distribution of the stock biomass within the northern and southern NAFO Divisions over time is also presented on Table 6c.

High errors produced high confidence intervals and kept the 1991-2003 mean weights per tow flat at a low level, with either spring or autumn series suggesting that no changes occurred on the status of this stock over the past fifteen years (Table 6c and Fig. 6a and b). However, when mean weights and mean numbers per tow are converted to Div. 3L and Div. 3N biomass and abundance and finally summed up to give a picture of the relative size of this redfish management unit as a whole, both surveys suggest an increase in the size of the stock from 1996 onwards despite the wide inter annual fluctuations of the indices. This suggestion becomes clearer when instead of looking to the survey indices on a year-to-year basis we look at the step-by-step increase of their mean values on a broader time scale. Both survey indices related with female spawning stock (female SSB and female spawners) are increasing as well though at more moderate rate, influenced namely in Div. 3L by the change of maturity curve used, occurring between 1995 (A&G) and 1996 (LSM) (Table 6c, Fig. 6g to 6j).

Finally, as regards stock distribution within Div. 3L and Div. 3N, there are no signs of a shift in biomass from one division to the other over time (Table 6c). A higher proportion of survey stock biomass has always been encountered in southern Div. 3N but the difference between the two divisions is larger in autumn than in spring. The reason for this seasonal change is unclear.

Catch/Biomass ratio

Ratios of catch to spring survey biomass were calculated for Div. 3L and Div. 3N combined and are considered an index of fishing mortality. Spring survey series was chosen since is usually carried out on Div. 3L and Div. 3N during May till the beginning of June, and so can give an index of the average biomass at the middle of each year more appropriate than the biomass from the autumn survey (carried out on most of the years in Div. 3L in November-December and in Div. 3N in September-October). Systematic discrepancy in the order of magnitude of the two survey series unadvised the use of average biomass indices. The 3LN STACFIS catch was used together with a spring survey biomass series smoothed by 3- year interval moving averages (Table 7 and Fig. 7).

Catch/Biomass ratio decline continuously from 1991 to 1996, with a drop between 1993 and 1994. From 1996 onwards the fishing mortality index is kept at a level close to zero.

State of the Stock

The assemblage of Div. 3L and 3N survey indices suggests that stock has been increasing from the early 1990's to the mid 2000's in terms of abundance, biomass, and female spawning biomass. However the considerable inter-annual variability of the survey indices, together with generally high (or very high, for some years) associated errors, makes difficult to quantify the relative magnitude of this increase. Stock length structure as been improving from small to medium size fish as well, confirming the survival of recent year-classes regardless their chronically low sizes and the lack of good recruitment over almost two decades.

Estimates of exploitation rate suggest that fishing mortality should be at a very low level when compared to the first half of the 1990's and that recent level of catches have not altered the upward trend of the stock, as shown by both spring and autumn surveys.

Reference Points under a Precautionary Approach

There is no new information on which to establish reference points with respect to a precautionary approach.

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Table 1a: Summary of catches and TAC's of redfish in Divsions 3LN estimated by STACFIS from various sources

Division	1990	1991	1992	1993[1]	1994[1]	1995	1996	1997	1998	1999	2000[1]	2001	2002	2003	2004
3L	18268	10620	8545	8391	820	292	112	151	494	654	1775	664	755	584	401
	63%	41%	31%	39%	14%	15%	25%	24%	55%	28%	68%	46%	62%	44%	63%
3N	10837	15195	18738	12917	4921	1697	339	479	405	1664	842	778	461	751	236
	37%	59%	69%	61%	86%	85%	75%	76%	45%	72%	32%	54%	38%	56%	37%
3LN	**29105**	**25815**	**27283**	**21308**	**5741**	**1989**	**451**	**630**	**899**	**2318**	**2617**	**1442**	**1216**	**1334**	**637**
TAC	25000	14000	14000	14000	14000	14000	11000	11000	Moratorium	Moratorium	Moratorium	Moratorium	Moratorium	Moratorium	Moratorium

[1] catch could not be precisely estimate due to discrepancies in figures from available sources: average of the range of the different catch estimates.

Table 1b. Nominal reported catches (t) of redfish in Division 3L by country and year since 1990.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 [a]	2001 [a]	2002 [a]	2003 [a]	2004 [a]
Canada (M)	73	37	86	-	-	3	-	-	-	-	-	-	-	-	3
Canada (N)	947	362	656	6	-	-	-	20	-	-	33	22	48	9	
EU/Germany	646	1151	1,455	-	-	-	-	-	-	-	-	-	-	-	
Japan	151	84	67	37	82	47	74	69	98	141	107	109	88	86	61
EU/Portugal	4,820	5,099	769	-	4	-	37	47	62	177	105	126	103	67	60
EU/Spain	837	681	625	29	128	242	1	13	313	191	245	249	262	284	237
Russia	7,003	1,032	571	2,407	22	-	-	-	8	5	156	107	126	48	39
Lithuania	-	-	-	676	29	-	-	-	-	-	-	-	3		
Latvia	-	-	-	2,156	55	-	-	-	-	-	-	-	-	-	2
Estonia	-	-	-	-	88	-	-	-	-	-	11	40	21	28	28
South Korea	1,061	420	370	586	-	-	-	-	-	-	-	-	-	-	
Others [b]	-	26	31	-	-	-	-	2	13	4	-	-	-	-	
TOTAL	15538	8892	4630	5897	408	292	112	-151	494	518	657	653	651	522	430

[a] Provisional

[b] Others include France (SPM), EEC-UK.

Table 1c. Nominal reported catches (t) of redfish in Division 3N by country and year since 1990.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 [a]	2001 [a]	2002 [a]	2003 [a]	2004 [a]
Canada (M)	-	-	-	-	110	-	-	-	-	-	-	-	-	-	
Canada (N)	11		1	40	-	-	-	1	7	5	-	18	-	-	
Japan	4	4	1	-	-	-	-	-	-	-	-	-	-	-	
EU/Portugal	1,235	3,275	1,149	255	60	78	199	102	174	339	93	78	120	242	61
EU/Spain	416	956	119	7	106	200	106	1	224	772	307	142	136	231	112
Russia	359	4,821	3,009	3,212	1,998	1,419	34	375	-	202	404	7	71	15	48
Lithuania	-	-	-	1,116	-	-	-	-	-	-	-	-	-	1	
Latvia	-	-	-	1,247	-	-	-	-	-	-	-	-	-	-	
Estonia	-	-	-	1,926	-	-	-	-	-	-	15	-	-	14	30
Cuba	2,456	1,378	1,308	1,152	-	-	-	-	-	-	-	-	-	-	
South Korea	4,640	2,276	4,560	122	-	-	-	-	-	-	-	-	-	-	
Others [b]	96	13	6	-	-	-	-	-	-	-	-	-	-	-	
TOTAL	9217	12723	10153	9077	2274	1697	339	479	405	1318	819	245	327	503	251

[a] Provisional

[b] Others include Denmark (GRL), EU/Germany

Table 2a: Length composition (absolute frequencies in '000s) of the 3LN redfish commercial catch, 1990-2004.

Length	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
10															
11														0.03	
12	12													0.03	
13	6													1	
14	21													1	
15	28	28												5	
16	73	103	9									1	0	8	
17	199	394	28			2				0	1	2	1	21	1
18	286	1034	412		5	2		0	1		1	1	1	44	2
19	445	2157	1291	5	6	3	1	0	2	16	4	4	3	90	6
20	720	3313	2375		16	14	4	2	13	47	6	18	14	151	15
21	1309	3780	2943	235	287	9		11	57	80	10	52	41	218	28
22	2081	4922	3600	714	683	65	6	17	151	150	26	102	81	269	35
23	3212	7340	4358	1141	594	64	17	34	277	128	46	118	101	277	41
24	4164	7575	5552	2565	708	99	9	64	296	120	85	114	132	258	54
25	5216	6944	4981	5237	944	100	9	98	248	178	195	114	154	261	85
26	5560	5981	5145	5115	1297	277	12	118	221	318	364	126	204	309	157
27	5410	6197	4579	5433	1404	330	35	144	218	555	546	170	248	324	190
28	5217	5322	4063	5004	1182	300	75	114	173	712	943	188	289	286	184
29	4712	3354	4637	4437	1188	263	76	114	154	673	1003	179	289	245	184
30	4751	4043	3911	3283	1011	310	182	114	120	520	1027	236	294	225	178
31	4551	2695	3711	2964	912	313	197	154	129	413	564	289	295	204	107
32	3943	2478	2187	2313	944	309	98	146	119	434	315	303	276	189	108
33	3082	1582	1355	2291	596	226	67	131	110	383	237	298	216	196	95
34	2737	1179	1569	1527	526	189	30	71	66	268	217	218	132	149	73
35	2100	928	1604	1059	363	182	35	24	19	141	129	212	83	112	51
36	1681	831	1895	923	202	106	23	19	18	89	60	121	37	62	36
37	1416	580	1571	766	196	160	7	14	11	82	78	82	18	41	17
38	1128	482	1303	807	158	171	5	10	8	51	50	55	11	22	10
39	729	363	1114	489	124	100	11	3	3	37	47	30	3	14	9
40	458	292	790	505	69	144	2	4	3	23	23	18	2	7	5
41	321	188	558	320	49	63	3	1	2	19	12	10	1	2	2
42	255	117	420	306	23	1	1	1	0.09	13	15	7	2	3	1
43	227	68	203	137	15	3	2	2	0.10	3	9	4	2	2	2
44	157	83	85	175	7	3	2	1	1	3	1	3	1	2	1
45	84	33	76	107	1	3	2	0.07			2	1		0.1	1
46	58	8	32	9	3			0.10	0.02	0.24	1	1		2	0.2
47	24		9	47	0.22						0.48	0.20		0.04	0.80
48	11	2	8	5		3		0.15							
49	6		1		0.07										
50															
51	1	25			2									0.26	
52	2														
53	1														
54	2													0.31	
no ('000)	66410	74421	66375	47918	13517	3815	910	1411	2422	5457	6020	3075	2929	3999	1681
weight (tons)	29105	25815	27283	21308	5741	1989	451	630	899	2318	2617	1442	1216	1334.1	636.7
mean weight (g)	438	347	411	445	425	521	496	446	371	425	435	469	415	334	379
mean length	29.3	26.6	28.4	29.6	29.1	31.6	31.2	29.8	27.4	29.9	30.1	30.8	29.5	27.5	29.5
length anomalies	-0.03	-2.76	-0.97	0.27	-0.26	2.26	1.89	0.47	-1.94	0.53	0.75	1.48	0.14	-1.84	0.09
%lengths <20cm	1.6%	**5.0%**	**2.6%**	0.0%	0.1%	0.2%	0.1%	0.0%	0.1%	0.3%	0.1%	0.2%	0.2%	**4.2%**	0.5%

Table 2b: length weight relationships from 3LN Sebastes sp. commercial sampling survey data used in the computation of 3LN catch parameters (Alpoim and Vargas, 2004; Vargas et al., 2005)

Sebastes sp.	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
a	0.1115	0.1115	0.1115	0.1115	0.1115	0.1115	0.1115	0.1115	0.1115	0.0689	0.0979	0.0769	0.0447	0.0095	0.0208
b	2.4353	2.4353	2.4353	2.4353	2.4353	2.4353	2.4353	2.4353	2.4353	2.5588	2.4602	2.5298	2.6885	3.1279	2.8851

Table 3a: 3LN spring survey abundance at length, 1990-2003 (thousands).

Length	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
5												62		31
6						466		20	16	185	109	170	293	804
7						228		39	656	795	1512	472	2059	2399
8						149	685	8	3280	378	1302	1072	1684	1236
9	849					298	360	39	5878	89	484	1525	1525	2208
10	1149			500		296	251	113	1343	166	240	2517	1202	4106
11	798	381	122	316		478	730	533	309	402	116	1085	418	2910
12	558	2988	1304	501		806	722	455	430	191	451	1645	1449	1653
13	2523	7925	2397	462	108	919	540	172	517	412	346	853	1102	1330
14	321	5192	5646	494	272	408	1871	561	369	353	1073	533	1279	639
15	698	2862	11061	1228	278	712	1859	895	179	1207	1741	766	2631	1235
16	2249	382	13648	1611	967	846	1129	1505	774	2063	1666	1371	3567	1335
17	3864	419	8798	2831	2852	1592	1201	2045	703	2651	3337	2595	6196	2764
18	6225	1111	2720	2801	4295	4354	1860	2124	3440	2954	5241	6444	8659	3668
19	7747	2480	2475	1266	5026	9475	3280	2848	2989	6491	8252	8160	15503	8994
20	4521	2574	3841	763	2708	10903	4711	9468	5395	11472	9589	11325	21130	11904
21	3481	3559	5756	853	1818	12106	6367	24836	16819	22819	14394	13957	23795	16955
22	5146	1690	5304	717	1337	13832	7008	34249	31066	42444	15553	14930	19308	16583
23	7250	1732	5713	1132	1259	16619	8191	31104	38231	52730	15592	15596	15146	20421
24	6185	2721	4761	1439	1361	12491	10669	28361	45397	54039	14842	16048	10830	17002
25	3365	2865	3400	1700	1005	8315	9469	21270	21478	34955	10153	12608	8066	14655
26	1963	3250	3703	1522	1601	5648	7757	19508	30238	27243	10044	11223	6898	24394
27	1426	2411	4481	1014	1694	5102	4047	16076	21651	21635	11334	8886	5109	38931
28	952	1834	3286	775	1437	4897	2760	12714	15676	14299	10225	7495	3557	43212
29	1037	1506	2877	699	1154	4260	1871	9626	14330	15399	10373	6418	2782	24423
30	607	1048	2607	461	722	3320	1801	6118	6697	13924	9530	3736	2705	18143
31	534	1014	2970	304	474	2229	1354	6512	5727	13111	10453	3588	2199	13712
32	417	810	3088	234	548	1563	995	6155	4310	13224	8903	2238	2360	9705
33	369	825	2621	132	265	757	637	5685	3259	6491	5180	1378	1979	3487
34	399	540	2161	146	144	337	438	3286	2039	5984	3032	980	1015	5390
35	251	544	1503	102	105	167	160	970	877	3590	975	455	642	2248
36	190	366	880	132	113	105	77	659	537	1019	300	212	228	476
37	222	216	696	121	151	117	42	402	269	663	382	93	82	877
38	159	219	669	78	101	32	88	82	102	504	101	43	35	75
39	130	300	726	28	70	59	4	82	67	186	140	59	32	43
40	118	220	483	46	62	28		216	79	199	23		94	23
41	45	77	371		15	15		15	51	16		15		4
42	88	85	216	8	46	4		20	66	31	63	15		15
43	69	85	83	47	27	35	15	201		31	28		15	15
44	45	77	189	27	31		31	12	27	31	28			
45	57	62				15	15	15		31	15			8
46		46	51			15	46		31	15				
47		4	20		15		15							
48	11	31	31											
49		31												
50														
abundance (millions)	66.0	54.5	110.7	24.5	32.1	124.0	83.1	249.0	285.3	374.4	187.1	160.6	175.6	318.0
biom SOP ('000 tons)	11.7	11.2	24.9	4.6	6.4	25.7	18.1	63.7	67.9	98.6	50.3	35.3	30.1	92.2
biom SURV ('000 tons)	10.6	10.1	22.6	4.2	5.9	22.8	14.9	59.4	61.5	87.8	41.6	31.0	27.7	79.6
SOP/SURV (%)	10%	11%	10%	11%	10%	13%	21%	7%	10%	12%	21%	14%	9%	16%
mean weight (g)	153.0	158.4	173.4	155.7	171.5	190.1	194.4	236.9	218.2	245.7	237.8	194.2	148.6	257.1
mean length (cm)	21.6	21.6	22.6	21.6	22.7	23.4	23.5	25.1	24.7	25.5	25.2	23.5	22.0	25.7
length anomalies	-1.9	-1.9	-0.9	-1.9	-0.8	-0.1	0.0	1.7	1.2	2.0	1.7	0.0	-1.4	2.2

Table 3b: 3LN autumn survey abundance at length, 1990-2003 (thousands).

Length	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
5				15	243	66	75	17		118	440	233	1090	34
6					259	419	626		251	482	937	932	2428	85
7	203				139	103	16	39	50	675	755	868	2185	61
8	1299				111	76	227	47	37	603	2114	1624	2715	620
9	1237				241	168	918	251	438	622	3147	1292	2096	1281
10	7273		92	31	293	291	1613	214	171	389	4324	1131	2863	1720
11	22263	371	64	31	214	406	1070	203	402	232	2846	2846	1838	1047
12	62498	62	371		242	118	373	275	786	202	1283	2257	1124	1132
13	109476	3189	456	335	305	293	768	595	868	321	1056	2086	1497	1437
14	33919	27936	1768	551	515	1434	1017	894	2472	589	445	2560	1457	1015
15	14047	104299	1332	2362	969	739	926	1736	1548	3653	407	1896	1950	538
16	7819	113967	3258	3697	1617	969	1037	1377	717	4668	11014	2146	8394	880
17	7870	106449	5285	12985	9655	863	1386	7058	1143	5483	31422	4703	15466	1985
18	16212	95897	8711	28686	37959	2335	1767	12588	3183	7038	57684	9077	26300	5471
19	32254	71578	6427	29297	72230	5280	8721	10094	6551	11929	74240	13656	39434	8226
20	27223	113848	3908	15293	78338	6758	23419	40553	9087	31700	80546	12557	46149	9796
21	15830	148631	5308	7702	43446	6878	49398	75450	15328	50192	65583	16499	43651	13141
22	7924	153399	6377	5120	27694	6418	52015	103747	23115	66827	130049	20161	40404	13640
23	6144	89709	6578	6494	20177	6963	46245	103927	28995	60122	118401	23556	40085	16741
24	8384	28664	5161	5456	10338	5086	37485	71785	26962	53001	85166	25378	32339	15467
25	8951	14231	3944	6807	12971	4598	35505	42836	29823	50556	64492	21327	21740	13073
26	6607	13420	4115	8670	8576	4519	33288	23682	27500	40214	39712	19867	18303	10438
27	4025	14708	4357	7830	17498	2987	26053	23132	25590	21893	33741	16414	17872	9402
28	3779	8777	4235	8402	17645	2829	13431	21289	24786	17449	20399	10516	14177	12141
29	2528	4861	3500	7625	16465	2807	5507	15372	16315	16404	14954	7233	7874	13958
30	2112	3344	2760	6195	12821	2379	4260	9646	11341	12158	11078	5064	4974	12274
31	1961	3232	1945	4553	16433	3516	2886	6359	7621	10211	9148	5083	3803	9071
32	1315	2391	1897	2710	10724	2300	2434	5377	6313	7170	5257	4618	3559	6791
33	1213	3301	1668	1603	7330	1280	1310	4524	5641	5032	4337	3830	3377	4639
34	1117	1433	1283	916	3477	583	636	4940	4544	3391	2777	2678	2199	2961
35	1288	717	1042	610	1985	230	346	2537	3255	1306	1662	1440	1183	1761
36	1185	596	799	297	1180	135	382	1097	1538	1111	675	581	508	1260
37	1005	386	459	211	338	74	320	606	339	516	631	334	200	765
38	1167	401	427	257	401	16	120	199	184	330	282	82	113	392
39	787	228	308	274	576	24	142	112	272	228	215	62	116	666
40	663	93	237	119	75	24	97	35	67	151	180	129		308
41	221	124	154		20	24	163	40	82	67	85			76
42	135	77	132	15	20					67		16		232
43	102	31	37	32	32			35	50		4	19		99
44	129	46	99			49	67	17	50	4		16		
45	46	15	69	15	36	33	34	17	50	76		16		
46	24	46			12	16	17			18	17			
47	15	15	15	8		12			17					
48									17					
49		15												
50	15													
abundance (millions)	422.3	1130.5	88.6	175.2	433.6	74.1	356.1	592.7	287.5	487.2	881.5	244.8	413.5	194.6
biomass SOP ('000 tons)	43.0	160.7	21.3	35.7	90.7	17.0	77.8	129.2	76.9	112.4	169.5	56.3	72.6	55.5
biom SURV ('000 tons)	37.9	136.4	19.2	31.8	90.7	16.0	70.7	112.2	72.0	100.5	132.6	50.1	71.9	49.9
SOP/SURV (%)	13%	18%	11%	13%	0%	6%	10%	15%	7%	12%	28%	12%	1%	11%
mean weight (g)	71.0	122.7	191.0	168.1	171.9	191.1	192.8	192.1	234.3	203.2	165.3	188.8	144.3	234.5
mean length (cm)	16.4	19.7	23.4	22.2	22.7	23.5	23.5	23.5	25.3	23.9	22.3	23.3	21.8	24.9
length anomalies	-6.2	-2.9	0.8	-0.4	0.1	0.9	0.9	0.9	2.7	1.3	-0.3	0.7	-0.8	2.3

Table 3c: length weight relationships from Sebastes sp. Flemish Cap survey data used in the computation of 3LN survey biomass (SOP) and other stock related parameters (Casas, *pers. comm*. 2005).

Sebastes sp.	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
a	0.0269	0.0302	0.0167	0.0212	0.0132	0.0209	0.0149	0.0140	0.0182	0.0223	0.0145	0.0138	0.0117	0.0119
b	2.8140	2.7879	2.9652	2.8958	3.0340	2.8903	3.0009	3.0192	2.9280	2.8738	3.0083	3.026	3.0553	3.0742

Table 4: beaked redfish female proportion at length in Div. 3Land Div. 3N fom Canadian spring and autumn surveys.

Length	3L Spring 1991-97	3LAutumn 1991-97	**3L Mov. Ave.**	3N Spring 1991-95	3N Autumn 1991-94,97	**3N Mov. Ave.**
5		0.04	**0.35**			**0.34**
6			**0.35**			**0.34**
7			**0.35**			**0.34**
8			**0.35**			**0.34**
9			**0.35**			**0.34**
10		0.01	**0.35**			**0.34**
11	0.03		**0.35**			**0.34**
12			**0.35**			**0.34**
13		0.06	**0.35**			**0.34**
14		0.02	**0.35**		0.00	**0.34**
15	0.03	0.01	**0.35**		0.00	**0.34**
16	0.41	0.38	**0.35**	0.41	0.38	**0.34**
17	0.30	0.30	**0.37**	0.36	0.29	**0.37**
18	0.38	0.42	**0.36**	0.37	0.45	**0.38**
19	0.41	0.37	**0.40**	0.36	0.42	**0.43**
20	0.41	0.44	**0.43**	0.41	0.44	**0.42**
21	0.51	0.44	**0.45**	0.44	0.40	**0.46**
22	0.45	0.43	**0.47**	0.46	0.53	**0.54**
23	0.45	0.51	**0.47**	0.41	0.68	**0.61**
24	0.47	0.50	**0.48**	0.34	0.63	**0.62**
25	0.50	0.47	**0.47**	0.40	0.59	**0.58**
26	0.43	0.47	**0.45**	0.35	0.57	**0.57**
27	0.45	0.39	**0.41**	0.33	0.61	**0.56**
28	0.45	0.33	**0.40**	0.47	0.57	**0.58**
29	0.46	0.43	**0.44**	0.44	0.63	**0.60**
30	0.47	0.55	**0.55**	0.49	0.66	**0.63**
31	0.53	0.72	**0.63**	0.42	0.74	**0.64**
32	0.46	0.72	**0.68**	0.46	0.69	**0.67**
33	0.50	0.76	**0.68**	0.55	0.80	**0.65**
34	0.58	0.71	**0.65**	0.46	0.71	**0.64**
35	0.58	0.57	**0.63**	0.59	0.61	**0.58**
36	0.54	0.66	**0.57**	0.60	0.50	**0.52**
37	0.48	0.53	**0.55**	0.35	0.48	**0.48**
38	0.38	0.55	**0.54**	0.31	0.59	**0.47**
39	0.57	0.63	**0.58**	0.49	0.51	**0.43**
40	0.58	0.65	**0.60**	0.26	0.38	**0.41**
41	0.54	0.60	**0.56**	0.30	0.53	**0.38**
42	0.50	0.47	**0.54**	0.34	0.53	**0.49**
43	0.50	0.60	**0.52**	0.67	0.62	**0.55**
44	0.59	0.50	**0.57**	0.36	1.00	**0.52**
45	0.67	0.62	**0.64**	0.50	0.17	**0.52**
46	0.78	0.67	**0.66**	1.00		**0.61**
47		1.00	**0.67**	0.83	1.00	**0.75**
48	1.00		**0.67**			**0.75**
49	1.00	1.00	**0.67**			**0.75**
50		1.00	**0.67**			**0.75**
51			**0.67**			**0.75**
52			**0.67**			**0.75**
53			**0.67**			**0.75**

Table 5: beaked refish female length maturity ogives for Div. 3L and Div. 3N (from Power, 2001)

Length	Div.3L-A&G 1991-1995	Div. 3L-LSM 1996-2003	Div.3N-A&G 1991-1995	Div. 3N-LSM 1996-2003
5	0.00	0.01	0.00	0.01
6	0.00	0.01	0.00	0.02
7	0.00	0.02	0.00	0.02
8	0.00	0.02	0.00	0.02
9	0.00	0.02	0.00	0.03
10	0.00	0.03	0.00	0.03
11	0.00	0.03	0.00	0.04
12	0.00	0.03	0.00	0.04
13	0.01	0.04	0.01	0.05
14	0.01	0.05	0.01	0.06
15	0.01	0.05	0.01	0.07
16	0.01	0.06	0.02	0.08
17	0.02	0.07	0.02	0.10
18	0.03	0.08	0.03	0.11
19	0.04	0.09	0.04	0.13
20	0.05	0.10	0.05	0.15
21	0.06	0.12	0.07	0.17
22	0.08	0.14	0.09	0.20
23	0.11	0.16	0.11	0.23
24	0.14	0.18	0.15	0.26
25	0.18	0.20	0.19	0.29
26	0.23	0.22	0.24	0.33
27	0.29	0.25	0.31	0.37
28	0.35	0.28	0.37	0.41
29	0.42	0.31	0.45	0.45
30	0.50	0.35	0.52	0.49
31	0.57	0.38	0.60	0.54
32	0.64	0.42	0.67	0.58
33	0.71	0.45	0.73	0.62
34	0.77	0.49	0.79	0.66
35	0.82	0.53	0.84	0.69
36	0.86	0.57	0.87	0.73
37	0.89	0.60	0.90	0.76
38	0.92	0.64	0.93	0.79
39	0.94	0.67	0.95	0.82
40	0.95	0.71	0.96	0.84
41	0.96	0.74	0.97	0.86
42	0.97	0.76	0.98	0.88
43	0.98	0.79	0.98	0.90
44	0.99	0.81	0.99	0.91
45	0.99	0.84	0.99	0.93
46	0.99	0.86	0.99	0.94
47	0.99	0.87	0.99	0.95
48	1.00	0.89	1.00	0.95
49	1.00	0.90	1.00	0.96
50	1.00	0.92	1.00	0.97
51	1.00	0.93	1.00	0.97
52	1.00	0.94	1.00	0.98
53	1.00	0.94	1.00	0.98

Table 6a: Campellen converted (1991-1995) and Campellen (1996-2004) spring survey biomass, female SSB and abundance indices.

		Campellen converted					Campellen								
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	biomass ('000 ton)	6.3	7.4	6.5	2.3	3.3	16.8	9.3	27.6	21.3	36.2	26.2	9.1	10.5	14.4
	female SSB ('000 ton)	1.0	2.0	1.5	0.4	0.7	1.9	1.2	4.4	3.3	7.2	4.5	1.2	1.1	2.1
	% female SSB	16%	27%	23%	19%	20%	11%	13%	16%	15%	20%	17%	13%	10%	14%
Div. 3L Spring	abundance (millions)	34.5	23.6	23.2	10.0	15.1	83.3	44.5	90.4	73.4	120.6	101.2	50.3	72.2	71.8
	female spawners (millions)	2.6	4.1	3.4	1.1	1.6	7.5	4.3	11.6	9.4	18.3	13.6	4.2	4.9	6.5
	mean weight per tow (Kg/tow)	5.6	4.8	4.2	1.5	2.1	10.9	6.0	17.9	13.8	23.4	16.9	5.9	6.8	9.3
	SE Kg/tow	3.1	3.6	12.0	0.4	0.2	4.6	1.7	39.8	28.4	22.2	8.1	2.4	3.2	29.5
	biomass ('000 ton)	4.4	2.7	16.1	1.9	2.6	6.0	5.7	31.8	40.2	51.7	15.4	21.8	17.2	65.3
	female SSB ('000 ton)	0.5	0.3	4.3	0.3	0.4	1.0	0.9	5.9	7.4	9.5	3.2	4.1	3.0	16.1
	% female SSB	12%	11%	26%	14%	14%	16%	17%	19%	19%	18%	20%	19%	17%	25%
Div. 3N Spring	abundance (millions)	31.5	30.8	87.5	14.5	17.0	40.7	38.6	158.6	211.9	253.8	85.9	110.3	103.4	246.2
	female spawners (millions)	1.7	0.9	9.2	0.7	1.1	4.1	4.5	23.6	32.1	40.2	12.2	16.2	12.0	50.6
	mean weight per tow (Kg/tow)	11.1	7.0	40.8	4.1	6.5	15.2	15.1	80.5	101.7	130.8	39.0	55.3	43.5	165.2
	SE Kg/tow	7.7	1.7	153.1	0.6	2.3	6.2	6.6	59.9	436.1	201.8	8.5	168.4	106.5	831.0
	biomass ('000 ton)	10.6	10.1	22.6	4.2	5.9	22.8	14.9	59.4	61.5	87.8	41.6	31.0	27.7	79.6
	female SSB ('000 ton)	1.5	2.3	5.8	0.7	1.0	2.9	2.1	10.4	10.8	16.7	7.7	5.3	4.1	18.2
	% female SSB	14%	23%	26%	17%	17%	13%	14%	17%	17%	19%	18%	17%	15%	23%
Div. 3LN Spring	abundance (millions)	66.0	54.5	110.7	24.5	32.1	124.0	83.1	249.0	285.3	374.4	187.1	160.6	175.6	318.0
	female spawners (millions)	4.3	5.0	12.6	1.9	2.7	11.6	8.8	35.2	41.4	58.6	25.7	20.4	16.9	57.1
	mean weight per tow (Kg/tow)	6.7	5.2	11.6	2.0	3.0	11.8	7.9	30.7	31.7	45.3	21.4	16.0	14.3	41.1
	SE Kg/tow	8.3	4.0	153.6	0.7	2.3	7.7	6.8	72.0	437.0	203.1	11.7	168.4	106.6	831.5
	upper 95% CI	16.2	7.8	301.0	1.4	4.5	15.1	13.3	141.1	856.6	398.0	23.0	330.1	208.9	1629.8

Table 6b: Campellen converted (1991-1994) and Campellen (1995-2004) autumn survey biomass, female SSB and abundance indices.

		Campellen converted					Campellen								
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	biomass ('000 ton)	13.7	13.4	6.0	7.2	50.1	4.7	19.5	18.5	38.9	24.9	28.6	11.9	15.0	9.3
	female SSB ('000 ton)	4.0	3.2	1.8	1.2	13.6	0.7	2.3	3.3	5.6	4.0	4.5	1.9	2.3	1.3
	% female SSB	29%	24%	29%	17%	27%	16%	12%	18%	14%	16%	16%	16%	15%	14%
Div. 3L Autumn	abundance (millions)	43.3	45.3	20.6	27.7	129.4	21.3	88.7	69.8	142.5	90.0	106.0	61.0	79.3	45.6
	female spawners (millions)	7.7	7.5	3.8	3.5	27.1	2.0	8.3	9.4	16.5	11.1	11.8	5.6	6.7	4.0
	mean weight per tow (Kg/tow)	8.8	8.7	3.9	4.6	31.8	3.2	11.7	11.1	23.2	14.9	17.0	7.1	9.0	11.0
	SE Kg/tow	3.3	2.1	2.1	2.1	181.8	1.0	23.2	7.6	72.5	7.5	46.1	2.7	5.2	4.1
	biomass ('000 ton)	24.2	123.0	13.2	24.6	40.7	11.3	51.1	93.7	33.1	75.5	104.0	38.2	56.9	40.6
	female SSB ('000 ton)	1.3	6.5	2.5	4.3	3.3	2.4	8.3	15.1	7.5	13.4	14.9	7.6	8.7	10.4
	% female SSB	6%	5%	19%	17%	8%	22%	16%	16%	23%	18%	14%	20%	15%	26%
Div. 3N Autumn	abundance (millions)	378.9	1085.2	68.0	147.5	304.2	52.8	267.4	522.9	145.0	397.2	775.5	183.8	334.2	149.0
	female spawners (millions)	5.8	34.3	6.8	12.5	13.4	8.2	36.2	70.6	25.4	57.2	89.9	28.3	38.5	29.8
	mean weight per tow (Kg/tow)	81.0	468.8	35.4	62.2	102.9	28.5	129.4	208.6	88.9	168.1	231.5	96.8	150.5	106.7
	SE Kg/tow	15.0	1827.6	55.9	48.9	412.0	66.1	300.2	462.4	42.4	358.5	669.4	179.9	100.3	65.4
	biomass ('000 ton)	37.9	136.4	19.2	31.8	90.7	16.0	70.7	112.2	72.0	100.5	132.6	50.1	71.9	49.9
	female SSB ('000 ton)	5.3	9.6	4.3	5.5	16.9	3.2	10.5	18.3	13.1	17.4	19.4	9.5	11.0	11.7
	% female SSB	14%	7%	22%	17%	19%	20%	15%	16%	18%	17%	15%	19%	15%	24%
Div. 3LN Autumn	abundance (millions)	422.3	1130.5	88.6	175.2	433.6	74.1	356.1	592.7	287.5	487.2	881.5	244.8	413.5	194.6
	female spawners (millions)	13.6	41.7	10.6	15.9	40.5	10.3	44.6	80.0	41.9	68.3	101.7	33.8	45.2	33.8
	mean weight per tow (Kg/tow)	23.6	102.4	10.3	16.4	46.3	8.4	35.6	51.3	36.6	46.1	60.7	25.4	37.8	30.5
	SE Kg/tow	15.4	1827.6	55.9	48.9	450.4	66.1	301.1	462.5	84.0	358.5	671.0	179.9	100.4	65.5
	upper 95% CI	30.2	3582.1	109.6	95.9	882.7	129.6	590.1	906.5	164.7	702.7	1315.2	352.7	196.9	128.4

Table 6c: average survey indices for the 1991-1994, 1995-1999 and 2000-2004 time interval

		1991-1994	1995-199	2000-2004
Div. 3LN Spring	biomass ('000 ton)	**11.9**	**32.9**	**53.5**
	CV	19%	29%	22%
	female SSB ('000 ton)	**2.6**	**5.4**	**10.4**
	% female SSB	22%	16%	19%
	abundance (millions)	**64**	**155**	**243**
	CV	56%	70%	40%
	female spawners (millions)	**6**	**20**	**36**
	3L proportion	47%	48%	44%
	3N proportion	53%	52%	56%
		1991,1993-1994	1995-199	2000-2004
Div. 3LN Autumn	biomass ('000 ton)	**29.6**	**72.3**	**81.0**
	CV	32%	49%	44%
	female SSB ('000 ton)	**5.0**	**12.4**	**13.8**
	% female SSB	17%	17%	17%
	abundance (millions)	**229**	**349**	**444**
	CV	76%	55%	61%
	female spawners (millions)	**13**	**43**	**57**
	3L proportion	30%	36%	23%
	3N proportion	70%	64%	77%

Table 7: Fishing mortality index using Canadian spring survey biomass (moving average biomass, 1991-2004)

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Div. 3LN	**Spring biomass ('000 ton)**	10.4	14.4	12.3	10.9	10.9	14.5	32.4	45.3	69.6	63.6	53.5	33.4	46.1	53.7
	STACFIS catch ('000 ton)	25.8	27.3	21.3	5.7	2.0	0.45	0.63	0.90	2.32	2.62	1.44	1.22	1.14	0.64
	Catch/Biomass ratio	2.49	1.89	1.74	0.53	0.18	0.03	0.02	0.02	0.03	0.04	0.03	0.04	0.02	0.01

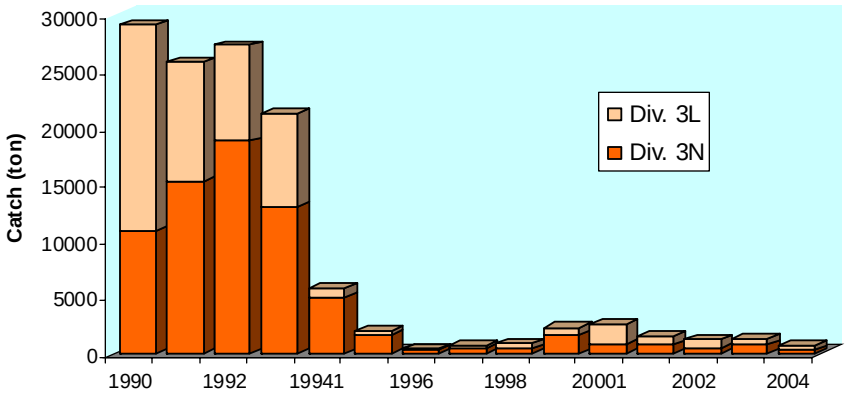

Fig. 1a: Catch estimated by STACFIS in Divisions 3L and 3N

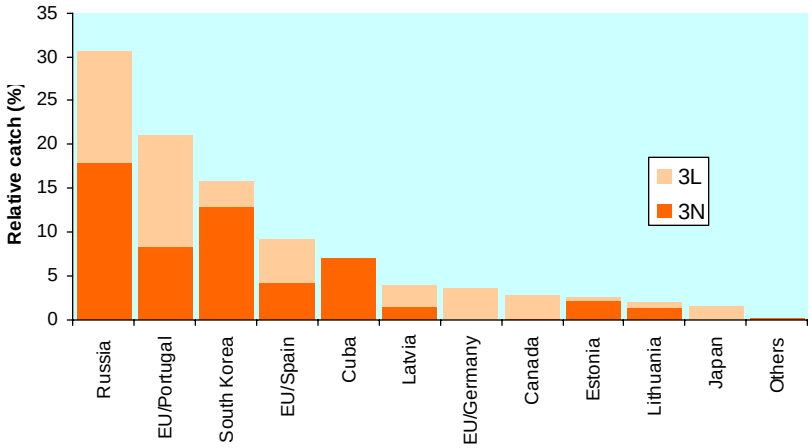

Table 1b: Relative catch (%) by country in Div. 3L and 3N, 1990-2003

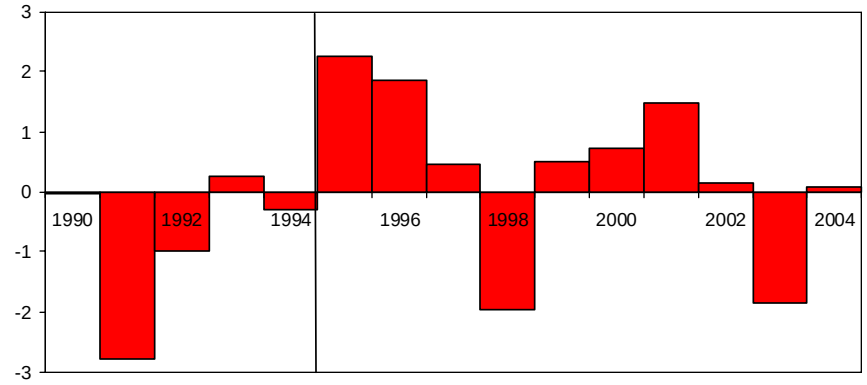

Fig. 2: Annual annomalies of the mean length on the commercial catch, 1990-2004

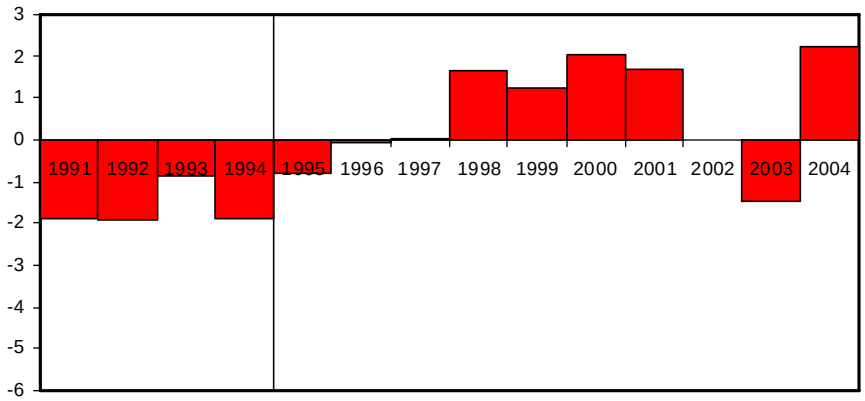

Fig. 3a: Annual annomalies of the mean length on the spring survey stock, 1991-2004

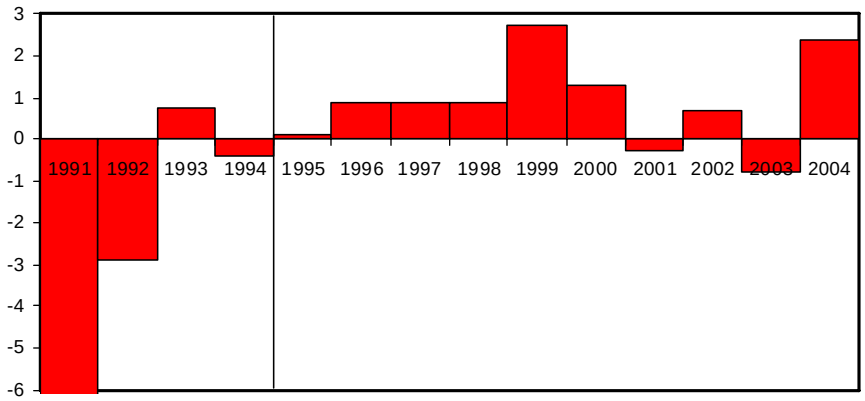

Fig. 3b: Annual annomalies of the mean length on the autumn survey stock, 1991-2003

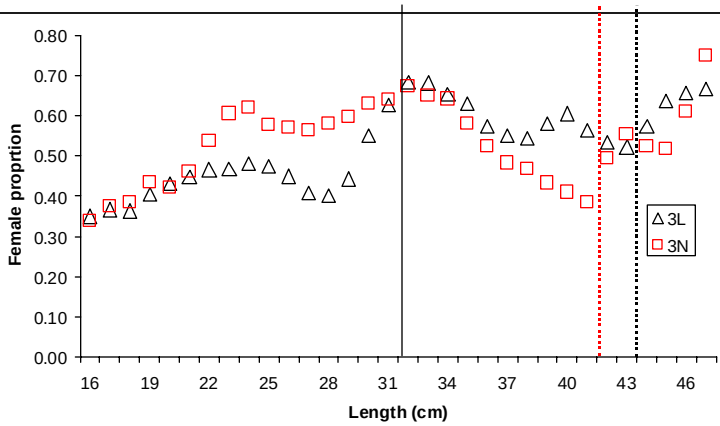

Fig. 4: female proportion at length in Div. 3L and Div. 3N

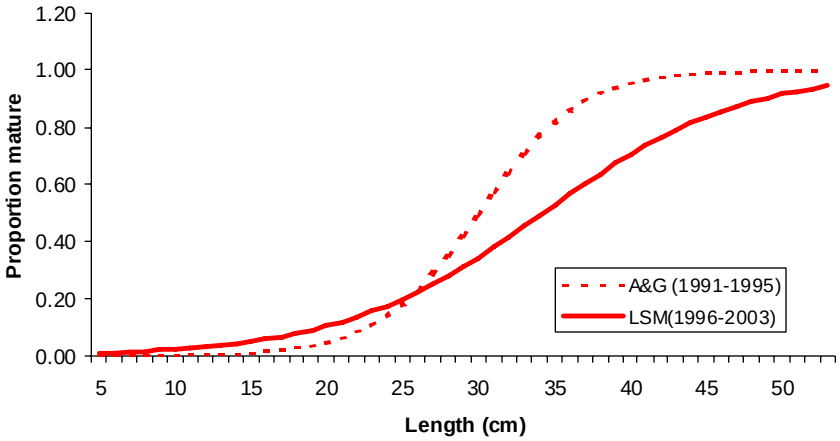

Fig. 5a: female maturity ogives at length for Div. 3L (from Power, 2001)

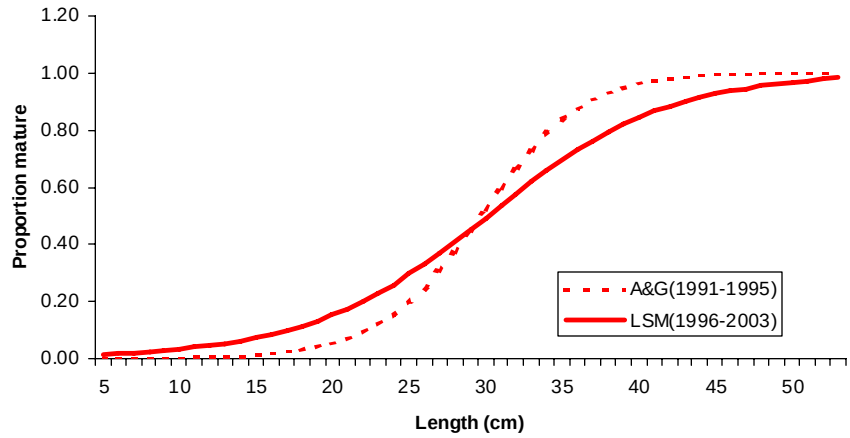

Fig. 5b: female maturity ogives at length for Div. 3N (from Power, 2001)

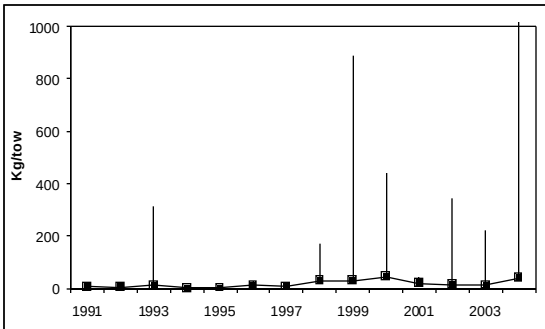

Fig. 6a: mean catch per tow for Div. 3LN combined, with upper 95% CI (Canadian spring survey, 1991-2004)

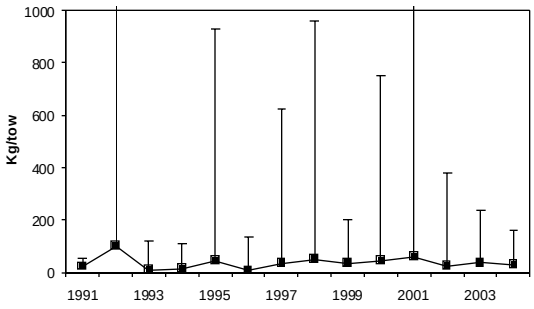

Fig. 6b: mean catch per tow for Div. 3LN combined, with 95% CI (Canadian autumn survey, 1995-2004)

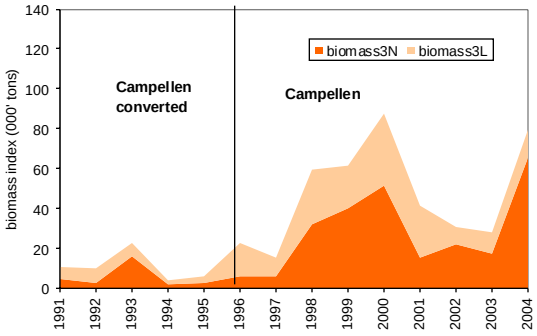

Fig. 6c: spring survey biomass (1991-2004)

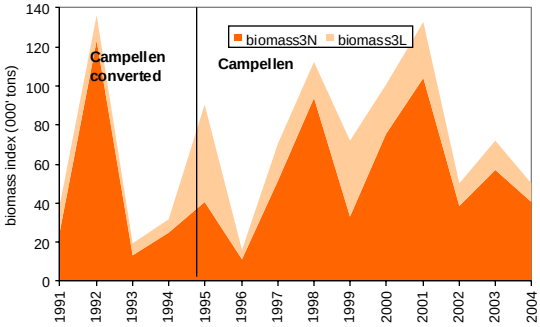

Fig. 6d: autumn survey biomass (1991-2004)

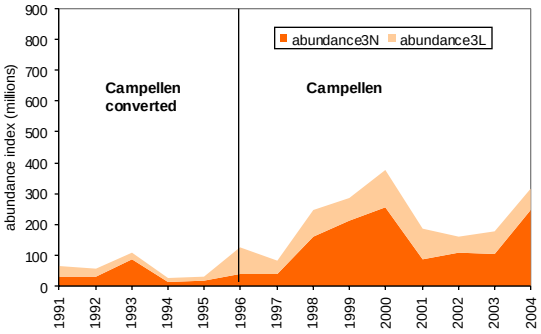

Fig. 6e: spring survey abundance (1991-2004)

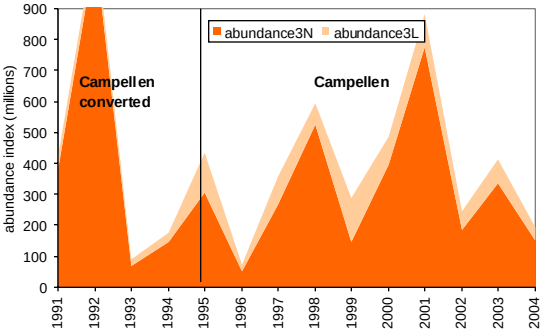

Fig. 6f: autumn survey abundance (1991-2004)

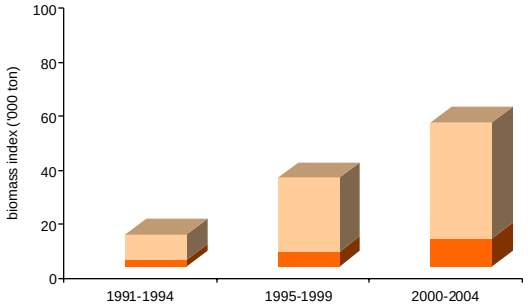

Fig. 6g: 3LN average spring survey biomass (darker portion=female SSB)

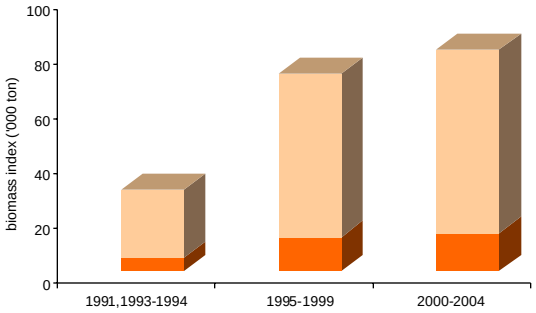

Fig. 6h: 3LN average autumn survey biomass (darker portion =female SSB)

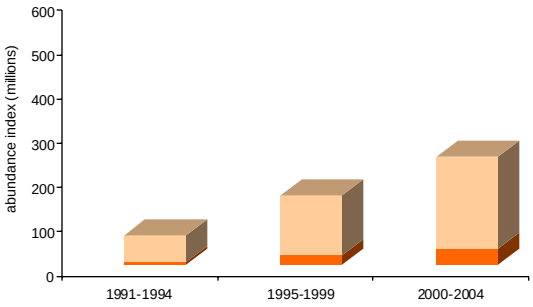

Fig. 6i: 3LN average spring survey abundance (darker portion=female spawners)

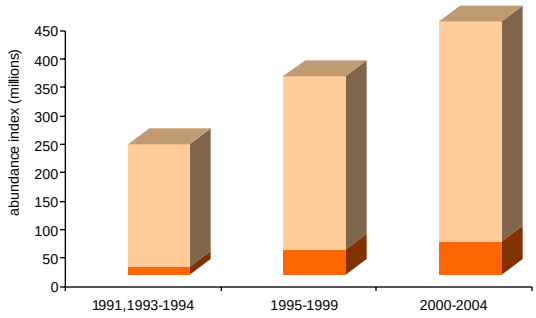

Fig. 6j: 3LN average autumn survey abundance index (darker protion=female spawners)

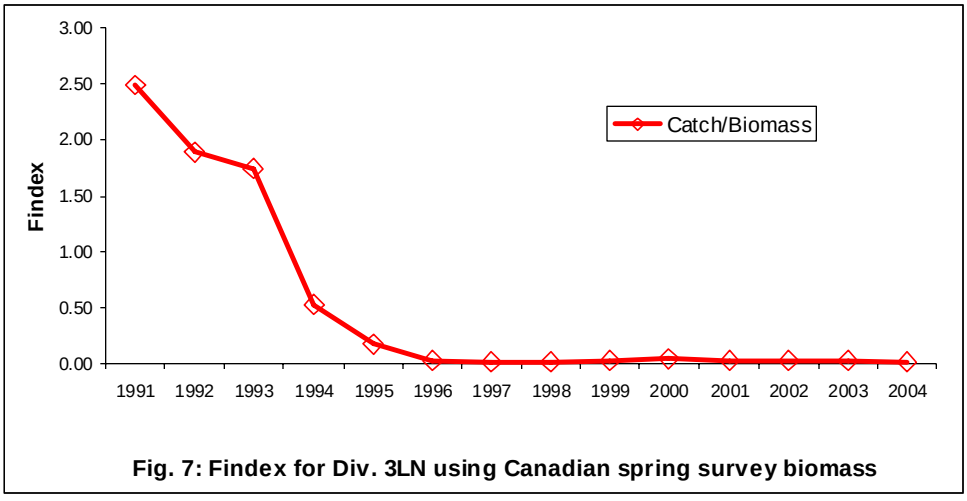

Fig. 7: Findex for Div. 3LN using Canadian spring survey biomass