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An Assessment of the Status of Redfish in NAFO Division 3O

Danny W Ings, Paul Regular, Divya Varkey, Rick Rideout & Laura Wheeland

Science Branch, Department of Fisheries and Oceans P. O. Box 5667, St. John's, NL, Canada A1C 5X1

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Abstract

Two species of redfish are commercially fished and reported collectively as "Redfish" in fishery statistics in Div. 3O, the deep-water redfish (*Sebastes mentella*) and the Acadian redfish (*S. fasciatus*). Nominal catches have ranged from 3 000 tonnes to 35 000 tonnes since 1960, with the peak in 1988. After 1988 catches generally declined, reaching a low of 3,000 tonnes in 1995. Catch increased over the next five years to a high of 20 000 tonnes in 2001, and subsequently decreased. Catch has remained below 10,000 t since 2008 with a mean of approximately 3500 t taken annually during 2022-2024. Assessment of this stock is based primarily on research vessel (RV) survey data. Indices from Canadian-Spring, Canadian-Autumn, and EU-Spain RV surveys in Div. 3O suggest the stock may have increased between the early and mid-1990s, fluctuated at a higher level in the mid- to late-1990s, then declined to the early 2000s. Indices increased to time series highs in the early 2010s, but have declined to lower levels since. The biomass limit reference point for the stock was updated as the Canadian autumn survey, which was used in calculations along with the Canadian spring survey, could not be converted or rescaled to be comparable with data from newer vessels. The updated Limit Reference Point was considered to represent 0.30 B_{MSY} and calculated as the median of a Gamma Distribution of the rescaled Canadian spring survey time-series. Other reference points accepted for the stock included $B_{trigger,}$ calculated as 0.75 B_{MSY} and F_{target},, calculated as 0.85 F_{MSY} (median of F_{proxy} time-series). With application of the new reference points, 3O Redfish is in the Critical Zone. In 2024, the stock was below B_{lim} with a 0.62 probability and the fishing mortality proxy was above F_{target} [$P(F_{2024}>F_{target})>0.58$] and F_{lim} [$P(F_{2024}>F_{lim})>0.53$]. There is concern that there has been little sign of pre-recruit sized fish in recent surveys; the last strong year class evident in the survey data was born in the early 2000s.

Introduction

Two species of redfish are commercially fished in Div. 3O: the deep-water redfish (*Sebastes mentella*) and the Acadian redfish (*S. fasciatus*). The two species are difficult to distinguish based on external characteristics, and as a consequence are reported collectively as "redfish" in the commercial fishery statistics. Most of the redfish stock area in Div. 3O lies within Canada's 200 mile exclusive fishery zone and has been subject to management regulation since 1974. Approximately 8% of the area within Div. 3O that is considered to be "redfish habitable area" lies within the NAFO Regulatory Area (NRA) and was brought under Total Allowable Catch (TAC) regulation starting in 2005.

Nominal catches have ranged between 2 700 tonnes and 35 000 tonnes since 1960 (Table 1, Fig. 1). Catches averaged 13 000 t up to 1986 and then increased to 27 000 t in 1987 and 35 000 t in 1988 (exceeding TACs by 7 000 t and 21 000 t, respectively). Catches declined to 16 000 t by 1993 then to about 3 000 t in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 20 000 t by 2001 and subsequently declined to 4000 t in 2008 and have been in the 2500 to 9000 t range since 2008. The large redfish catches in 1987 and 1988 were due mainly to increased activity in the NRA by South Korea and Non-Contracting Parties (NCPs), primarily Panama. There has been no activity by NCPs in the NRA since 1994. Estimates of under-reported catch which have occurred primarily before 1995 (Shelton and Atkinson 1994), have ranged from 200 tonnes to 23 500 tonnes. There have also been estimates of over-reported catch in the recent period since 2000, with a maximum value of 4 300 t in 2003. There were no alternate sources of catch estimates available until 2016 to compare with the reported catch. A TAC of 16 000 tonnes was first implemented by Canada within its 200-mile limit in 1974. The TAC was increased in 1978 to 20 000 tonnes and generally remained at that level through to 1987. The TAC for 1988 was reduced to 14 000 tonnes and remained unchanged until 1994 when it was reduced to 10 000 tonnes as a precautionary measure and maintained at that level to 2003. In September 2004, the NAFO Fisheries Commission adopted TAC regulation for redfish in 3O, implementing a level of 20 000 tonnes for the entire division in 2005; this TAC level has remained in effect up to 2025.

The assessment for 3O Redfish is based on survey indices and fishery data. Canada has conducted annual surveys of Division 3O during spring and autumn since 1991 using two different vessels, the CCGS Alfred Needler and CCGS Teleost, that were assumed to have the same catchability. However, data collected during the recent comparative fishing program indicate that the catchability of the Teleost and Needler was not always equal (DFO in press) as previously assumed, though differences cannot be directly estimated. As a result, the spring and autumn time-series have ended. Options for developing a continuous spring time-series were explored during this assessment, focusing on rescaling the Needler data to make it comparable with data from the Teleost and newer vessels, for which there are conversion factors. The autumn time-series could not be converted or rescaled as vessel use did not overlap in Div. 3O.

The interim Limit Reference Point (LRP) for the stock was considered a proxy for B_{MSY} (Wheeland *et al*. 2022). It was calculated as 30% of the average of a Gamma distribution that was generated using shape and scale parameters derived from the annual means and variances of biomass estimates from the Canadian spring and autumn bottom trawl surveys. Because the autumn time-series could not be converted or rescaled, an update to the LRP is needed. There are no other reference points for the stock. SC agreed in December 2024 (NAFO, 2024) that the Designated Experts (DEs) for the stocks that are scheduled to undergo a full assessment in a given year would work towards the development of reference points that can be used in the revised Precautionary Approach Framework that year.

Fishery and Catches

Description of the Fishery

Russia predominated in the 3O redfish fishery until 1993 and generally caught about 50% of the total non-Canadian allocation, which accounted for about 2/3 of the Canadian TAC. Russia and Cuba, impacted by the reduction and eventual elimination of foreign allocations by Canada, ceased directed fishing in 1994. Russia resumed directed fishing in 2 000, rapidly increasing their catch from 2 200 tonnes to about 11 000 tonnes from 2001-2003 before a large reduction in catch to only 240 t in 2004 (Table 2). Russian catches increased from 50 t in 2007 to about 2 000 tonnes in 2016, but decreased to 350 tonnes in 2018. Generally, Russian

catches have been low since then, varying between 30 tonnes and 750 tonnes with 150 tonnes reported in 2024.

Portugal began fishing redfish in Div. 3O in 1992 and catches averaged about 1 800 tonnes between 1992 and 1998. Portuguese catches increased to 5 500 tonnes in 1999 and have ranged between 800 – 6 400 tonnes thereafter with catches decreasing from 4 300 tonnes in 2020 to about 800 tonnes in 2024. This is the lowest level since 1997.

Spain, which had taken less than 50 tonnes before 1996, increased catches from 1 200 tonnes in 1997 to a peak of 4 500 tonnes in 1999 with a subsequent decline to 300 tonnes in 2004. Since then, Spanish catch ranged between 600 – 2 000 tonnes with about 860 tonnes taken in 2024.

Canadian fleets have had limited interest in a redfish fishery in Div. 3O, reportedly because of small sizes of redfish encountered in areas suitable for trawling. Canadian landings were less than 200 tonnes annually from 1983-1991. In 1994, Canada took 1 600 tonnes which is attributed to improved markets related to lobster bait, but reduced catch to less than 200 tonnes in 1995. Between 1996 and 1999 Canadian catches alternated between levels of about 8 000 tonnes and 2 500 tonnes based on market acceptance for redfish near the 22 cm minimum size limit regulated within Canada. From 2000-2006 Canada averaged about 3 600 tonnes, followed by a decrease to 1 000 tonnes in 2007. Canadian landings decreased further in 2008 and remained near or below 500 tonnes until 2024 when landings of 900 tonnes were reported.

Estonia has been an active participant in the fishery for redfish in Div. 3O since 2007, averaging 261 tonnes in annual catch (Table 2).

The redfish fishery in Div. 3O typically occurs throughout the year (Ings and Rideout 2019). The vast majority (>90%) of catch has been taken via bottom trawling by Canadian, Portuguese, Russian and Spanish fleets (Table 2). Catches via midwater trawl prior to 2005 were taken predominantly by Russia. Since 2011, an average of 94% of the catch has been taken within the NRA portion of Div. 3O.

Commercial Fishery Data

Sampling of the redfish fisheries was conducted by Spain (González-Costas *et al*. 2025), Portugal (Alpoim *et al.* 2025) and Russia (Fomin and Pochtar 2025) from the 2024 trawl fishery. In 2024, catches sampled by Russia were generally between 15 and 38cm. Catches from Spain and Portugal were generally between 19 and 30cm. In the recent period there has rarely been length sampling available from Canadian catches (Rogers and Simpson 2022); since 2011, length samples were only available in 2018 and 2022 and only for catches landed in the Newfoundland and Labrador region. A compilation of catch at length from various fleets from 1995 to 2004 suggested that the size composition has changed over the time period with fleets catching a smaller portion of fish >25 cm since 1998 (Power 2005). Size compositions were converted to catch at length; 2017 to 2024 are presented in Figure 2, while earlier years can be found in Ings and Rideout (2019) and Wheeland *et al*. (2022). Generally the fishery after 1998 has caught primarily redfish 15 to 30cm, with few caught >30cm.

Research Survey Data

Abundance and Biomass Indices

Stratified random groundfish surveys (see Figure 3 for stratification scheme) have been conducted by Canada in the spring and autumn in Div. 3O since 1991, with regular coverage of depths to 730 m and sporadic coverage of deeper strata in the autumn. In addition, a summer survey was conducted in 1993. Data are also

available from EU-Spain spring surveys conducted in the NAFO regulatory area (NRA) of Div. 3O from 1997 to 2024 (Garrido *et al*. 2025).

Canadian surveys utilized an Engel 145 otter trawl (1.75 n. mi. standard tow) from 1991 to spring 1995 and a Campelen 1800 shrimp trawl (0.75 n. mi. standard tow) from autumn 1995 to the present. The Engel 145 data were converted into Campelen 1800 trawl equivalent data based on comparative fishing trials (see Power and Atkinson 1998b). Vessel problems during the 2006 spring survey resulted in the completion of only a single tow in redfish depths. There was no autumn survey in 2014, 2021, or 2022 and no spring survey in 2006, 2020 or 2021. See Rideout *et al.* (2025) for details of recent Canadian surveys. Abundance (Tables 3 and 5) and biomass (Tables 4 and 6) estimates based on spring and autumn data from the Canadian surveys demonstrate large fluctuations between seasons and years for some strata. This is usually due to the influence of one or two large sets. It is difficult to reconcile year to year changes in the indices, but generally, the survey biomass indices from both surveys (Figures 4 and 5) suggest the stock increased between the early and mid-1990s, and subsequently declined to the early 2000s. The stock then stayed at a low level to the mid-2000s before increasing to around 2010. The stock has subsequently decreased and survey indices remain at a low level.

It should be noted that the 1996 Canadian autumn estimate does not include important strata that were not sampled due to problems on the survey, and the low 1997 Canadian spring biomass index is considered to be a sampling anomaly (Power and Atkinson 1998a).

Estimates of the proportion of survey biomass within the NRA are variable in both the spring and autumn, but on average less than 20% of the survey biomass is in the NRA (Tables 4 and 6).

Spatial distribution in the Canadian surveys is presented in Fig. 6 and 7. Survey length frequencies are found in Fig. 8 and discussed in the Recruitment section below.

EU-Spain surveys

Data were available from EU-Spain spring surveys conducted in the NAFO Regulatory Area (NRA) of Div. 3O from 1995 to 2019 and in 2021 to 2024 (Fig. 9). These surveys use the same stratification scheme as the Canadian surveys. The area of redfish habitat in Div. 3O that is covered by the EU-Spain survey is estimated at less than 8% of that covered by Canadian surveys. During many years, less than 20% of the biomass in the Canadian surveys is observed in the NRA and therefore, the EU-Spain survey may not reflect stock trends. The EU-Spain surveys covered depths to 1500m (800 fathoms) with the exception of 1995-1996 when complete coverage was not achieved. Until 2001, these surveys were conducted using a Pedreira type bottom trawl and thereafter with a Campelen trawl similar to that used in Canadian surveys. The data prior to 2001 were converted into Campelen equivalent units.

For distribution of redfish in the EU-Spain 3O survey see Garrido et al. (2025).

Summary of biomass indices

Results of bottom trawl surveys for redfish in Div. 3O have shown a considerable amount of variability, making it difficult to interpret year to year changes. However, trends across the three survey series are consistent and show indices generally at or above the time-series mean during two periods: the mid to late 1990s, and during 2009 to 2015. All available surveys since 2018 have been below their long term mean (Fig.

10). The converted Canadian spring series is used to determine the state of the stock (see reference points section).

Recruitment

Size distributions from the Canadian spring and autumn surveys plus the EU-Spain survey indicated that there was a relatively large pulse near 17cm in the 2007 surveys, corresponding to a year class born in the early 2000s that remained the dominant mode until 2018 (Fig. 8). This pulse fully recruited to the fishery by 2018. No recent strong recruitment pulses are apparent at smaller sizes in the Canadian or EU-Spain surveys.

The size distributions of the survey catches indicate only a narrow range of sizes caught each year in Div. 3O. Generally, fish smaller than about 10 cm and larger than about 25 cm are absent in survey catches from 1991-2000 which cover strata down to 732 m (400 fathoms). It is well documented that the Engel survey gear (e.g. Power 1995) and the Campelen survey gear (e.g. Power and Atkinson, 1998b) can catch both smaller (than 10 cm) and larger (than 25 cm) redfish. Length sampling from the commercial fisheries in the mid-1990s revealed a higher proportion of fish greater than 25 cm than was observed in the survey catches (see Power 2005). However, in the recent period size ranges have been relatively consistent between the surveys and the fishery; both have recorded few fish over 30cm.

A recruitment index was developed for the stock in 2022, based on fish between 10 cm and 15 cm in both the Canadian spring and autumn surveys (Wheeland *et al.* 2022). However, the historical autumn time-series cannot be rescaled or converted to modified Campelen units and an attempt to rescale the Canadian spring survey data using the same approach used to rescale the spring biomass indices was not accepted. Therefore, indices of recruitment in the spring Campelen and modified Campelen time-series were kept separated.

The Canadian spring survey time-series was used as the basis for recruitment indices in this assessment. As conversion factors (rho=1) are available to convert data from the CCGS Teleost to the new survey vessels, the relevant recruitment time-series extends from 2014 to 2024 (Fig. 10), although only six years of data are available. As in the previous recruitment index, only fish between 10 and 15 cm length were included. Recruitment in 2024 was above the median of comparable survey values since 2014, but the short time series limits confidence in interpreting this as a meaningful trend (Fig. 11).

Estimation of Stock Parameters

Catch/Biomass ratio

A fishing mortality (F) proxy was derived by calculating simple catch to survey biomass ratios. Most of the catch for this fishery is taken in the last three quarters of the year. Therefore to derive an F proxy, the catch in year “y was divided by the average of the rescaled Canadian Spring (year = y) survey biomass estimates to better represent the relative biomass at the time of the year before the catch was taken. All fish sizes were included in the survey biomass estimate. The results (Fig. 12) suggest that relative fishing mortality increased from 1998 to the highest estimate in the series in 2002. This relatively high value was maintained in 2003 but declined substantially in 2004. In 2005, relative fishing mortality increased once more and was around the series average. In 2007-2008 the estimate of fishing mortality dropped to some of the lowest levels since the mid-1990s and remained at similar levels up to 2014. Estimates since increased to near the time series average in 2016, and have continued to increase to 2024.

Reference Points

Rescaling biomass indices

For the Canadian spring series, comparative fishing indicated that data from the Teleost are comparable to the new time series for redfish in Div. 3O. Years with complete/near-complete coverage with the Teleost (2014, 2016, 2018) have been removed from the 1991-2019 Campelen series, and included in a new spring time series which also includes the new survey series known as the modified Campelen (Figure 4).

The spring and autumn surveys were completed in Div. 3O in 2023 and 2024. However, Canadian autumn data for 2023 and 2024 (Figure 5) are not comparable to the earlier years due to absence of conversion factors and inability to rescale autumn Campelen data.

To develop a standardized spring biomass series, Campelen data were rescaled to be comparable to modified Campelen data using the ratio of the means of survey values (modified Campelen / Campelen) during a period of overlap (2013-2019). Rescaling resulted in an increase in the Campelen data by a factor of 1.26 (Figure 13).

Updated and new reference points

The biomass limit reference point for this stock (Wheeland *et al* 2022) was updated. Only the rescaled CAN-spring survey data are now used to estimate this reference point and assign stock status as the autumn data were excluded. The theoretical basis for the LRP has not changed as the average of the survey time series is considered a proxy for B_{MSY} (Duplisea *et al*. 2012) and the methodologies for estimating the LRP and probability values are also similar. To account for sampling variance plus the positive and skewed nature of the indices, annual stratified means and variances were integrated using the properties of the variance and translated to shape and scale parameters for use in the Gamma distribution (see Regular *et al.* 2022 for computational details). This same approach was applied to account for the uncertainty in the B_{MSY} proxy by applying the Gamma distribution informed by averaged point estimates of mean and variance. The resultant distributions for the biomass index and B_{MSY} proxy can be used to assess stock status with probabilities, as in the previous assessment.

Consistent with the new PA, B_{lim} was defined at 30% of the proxy-B_{MSY} level and $B_{trigger}$ was defined as 75% of the proxy B_{MSY} level. The corresponding average of the fishing mortality proxy (F_{proxy}) time-series represents F_{MSY}. While uncertainty around annual estimates could not be calculated, the mean and variance of the F_{proxy} values were used to characterize uncertainty around the reference point using the Gamma distribution. The median of this distribution was defined as $F_{MSY} = F_{lim}$ and, following the new PA, a target reference point (F_{target}) was set as 85% of F_{lim}. Probabilities of differing from these reference points were estimated from the gamma distribution.

Stock status

Redfish in 3O are in the Critical Zone (Figure 14). Biomass in 2024 was below the limit reference point (B_{lim} = 0.3 B_{MSY} proxy) with a moderate probability [$P(B_{2024} < B_{lim}) = 0.62$] and the fishing mortality proxy was above F_{target} [$P(F_{2024}>F_{target}) = 0.58$] and above F_{lim} [$P(F_{2024}>F_{lim}) = 0.53$ (Figure 15). The stock trajectory since 1991 is shown in Figure 16.

Recruitment in 2024 was above the median of comparable survey values since 2014, but the short time series limit confidence in interpreting this as a meaningful trend.

References

Alpoim, R., S. Dores and P. Gonçalves 2025. Portuguese research report for 2024. NAFO SCS Doc. 25/08.

Duplisea, D.E., D. Power, and P. Comeau. 2012. Reference points for eastern Canadian redfish (Sebastes) stocks. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/105 ii + 22 p.

Fomin, K. Y., and M. V. Pochtar. 2025. Russian research report for 2024. NAFO SCR Doc. 25/009.

Garrido, I., D. González-Troncoso, F. González-Costas, E. Román and L. Ramilo. 2025. Results of the Spanish Survey in NAFO Divs. 3NO. NAFO SCR Doc. 25/006

González-Costas, F., G. Ramilo, E. Román, J. Lorenzo, D. González-Troncoso, M. Sacau, P. Duran, J. L. del Rio, M. Casas, M., and I. Garrido. 2025. Spanish Research Report, NAFO SCS Doc. 25/05.

Ings, D.W. and R. M. Rideout, An Assessment of the Status of Redfish in NAFO Division 3O. NAFO SCR Doc. 19/038.

NAFO. 2024. Report of the Scientific Council Intersessional and Precautionary Approach Working Group Meeting, 5 December 2024, via Webex. NAFO SCS Doc. 24/21.

Power, D. 1995. Status of redfish in Subarea 2 + Division 3K. DFO Atl. Fish. Res. Doc. 95/25, 25 p.

Power, D., and D. B. Atkinson. 1998a. Update on the status of Redfish in 3O. CSAS Res. Doc. 98/110, 20 p.

Power, D., and D. B. Atkinson. 1998b. The status of Redfish in Unit 2 (Laurentian Channel Management Unit). CSAS Res. Doc. 98/21, 41 p.

Power, D., 2005. An Assessment of the status of Redfish in NAFO Division 3O. NAFO SCR Doc. 05/59. Serial No. N5145, 19 p.

Regular, P., M. Koen-Alonso, S. Yalcin, A.M.J. Perreault, L. Wheeland. 2022. Approximating uncertainty around indices from stratified-random trawl surveys using the Gamma distribution. NAFO SCR Doc. 22/043

Rideout, R. M., L. Wheeland, A. Perreault, P. Regular, K. Skanes, S. Trueman, L. Simms, J. Makrides. 2025 Canadian (Newfoundland And Labrador Region) Multi-Species Research Vessel Bottom Trawl Survey Report for Surveys Conducted in 2024NAFO SCR Doc. 25/028.

Rogers, B., and M. Simpson. 2022. Canadian research report for 2021. NAFO SCS Doc. 22/10.

Shelton, P.A., and D.B. Atkinson (Editors). 1994. Proceedings of the Regional Groundfish Assessment Review for Newfoundland, May 9-13, 1994 . Can. Tech. Rep. Fish. Aquat. Sci. 2020: 100 p.

Wheeland, L. E. Novaczek, P. Regular, R. Rideout, and B. Rogers. 2022. An assessment of redfish in NAFO Division 3O. NAFO SCR Doc 22/044.

Tables

Table 1. Estimated catches (t) and TACs of redfish in Div. 3O.

Year	Canada	Others	Catch [a]	TAC	Year	Canada	Others	Catch	a TAC
1960	100	4900	5000		1993	698	12522	15720	14000
1961	1000	10000	11000		1994	1624	3004	5428	10000
1962	1046	6511	7557		1995	177	2637	3214	10000
1963	2155	7025	9180		1996	7255	2390	9845	10000
1964	1320	14724	16044		1997	2554	2558	5112	10000
1965	203	19588	19791		1998	8972	4380	14052	10000
1966	107	15198	15305		1999	2344	10249	12593	10200
1967	645	18392	19037		2000	2206	10584	10003	10000
1968	52	6393	6445		2001	4893	17681	20274	10000
1969	186	15692	15878		2002	3000	16453	17234 [b]	10000
1970	288	12904	13192		2003	3125	18466	17246	10000
1971	165	19627	19792		2004	2616	3848	3753	10000
1972	508	15609	16117		2005	5501	6409	11305	20000
1973	133	8664	8797		2006	3580	7455	12610	20000
1974	91	13033	13124	16000	2007	1053	6472	5179	20000 [c]
1975	103	15007	15110	16000	2008	203	4816	4020	20000
1976	3664	11684	15348	16000	2009	255	6233	6431	20000
1977	2972	7878	10850	16000	2010	260	6285	5234	20000
1978	1841	5019	6860	16000	2011	97	5875	5972	20000
1979	6404	11333	17737	20000	2012	0	6967	6967	20000
1980	1541	15765	17306	21900	2013	75	7720	7795	20000
1981	2577	10027	12604	20000	2014	374	7150	7524	20000
1982	491	10869	11360	20000	2015	283	8073	8356 d	20000
1983	7	7133	7340	20000	2016	199	8818	9017 d	20000
1984	167	9861	16978	20000	2017	245	7267	7512 d	20000
1985	104	8106	12860	20000	2018	411	5710	6120 d	20000
1986	141	10314	11055	20000	2019	513	6042	6555	20000
1987	183	12837	27170	20000	2020	467	6876	7343	20000
1988	181	11111	34792	14000	2021	358	5219	5577	20000
1989	27	11029	13256	14000	2022	570	3336	3906	20000
1990	155	8887	14242	14000	2023	687	3034	3721	20000
1991	28	7533	8461	14000	2024	925	1803	2728	20000
1992	1219	12149	15268	14000					

[a] Totals from 1983 to 2010 may include adjustments for estimated catches from various sources

[b] Midpoint of estimates ranging between 16100-18400

[c] Prior to 2005 TACs were set by Canada within its fisheries jurisdiction

d Based on daily catch reports from the NRA and Statlant 21A data for Canada

Table 2. Reported and estimated catches (t) of redfish in Div. 3O by country and year since 1992.

Year	Canada	Cuba	Estonia	Faroe Islands	France (SPM)	Japan	Latvia	Lithuania	Portugal	Russia	South Korea	Spain	Ukraine	Total	TAC
1992	1219	2776	-	-	-	125	-	-	1468	5845	1935	-	-	15268	14000
1993	698	665	-	-	-	159	-	-	4794	6887	17	-	-	15720	14000
1994	1624	-	-	-	-	-	-	-	2918	60	-	26	-	5428	10000
1995	177	-	-	-	-	264	-	-	1935	416	-	22	-	3214	10000
1996	7255	-	-	-	-	417	-	-	1635	-	-	338	-	9845	10000
1997	2554	-	-	-	134	285	-	-	894	-	-	1245	-	5112	10000
1998	8972	-	-	-	266	355	-	-	1875	-	-	1884	-	14052	10000
1999	2344	-	-	-	-	-	-	-	5469	231	-	4549	-	12593	10200
2000	2206	-	49	-	-	-	-	-	4555	2233	-	3747	-	10003	10000
2001	4893	-	9	-	-	-	-	-	3537	11343	-	2792	-	20274	10000
2002	3000	-	-	-	-	-	-	1	4610	11182	-	660	-	17234	10000
2003	3125	-	-	-	-	-	-	-	6382	10794	-	1289	1	17246	10000
2004	2616	-	2	-	-	2	-	-	3279	242	-	320	3	3753	10000
2005	5501	-	-	-	-	1	-	-	4555	170	-	1683	-	11305	20000
2006	3580	-	-	-	-	0	-	-	5184	977	-	1294	-	12610	20000
2007	1053	-	100	-	-	61	-	-	4755	54	-	1502	-	5179	20000
2008	203	-	42	100	-	-	-	139	3850	82	-	603	-	4020	20000
2009	255	-	100	-	-	-	-	-	4273	169	-	1691	-	6431	20000
2010	260	-	103	163	-	-	-	-	3853	474	-	1692	-	6545	20000
2011	97	-	121	-	-	-	82	5	4006	570	-	1661	-	6542	20000
2012	0	-	181	101	-	-	-	-	4142	971	-	1572	-	6967	20000
2013	75	-	269	58	-	-	-	-	4820	1438	-	1135	-	7795	20000
2014	374	-	227	-	-	-	-	-	4720	1271	-	932	-	7524	20000
2015	283	-	817	-	-	-	-	-	4659	1086	-	1510	-	8355	20000
2016	199	31	701	-	-	29	-	-	4348	2031	-	1678	-	9017	20000
2017	245	-	603	-	-	6	-	-	4079	753	-	1826	-	7512	20000
2018	411	-	522	-	-	5	-	-	3019	350	-	1813	-	6120	20000
2019	513	-	280	-	-	-	-	-	3827	44	-	1891	-	6555	20000
2020	467	-	242	-	-	1	-	-	4259	414	-	1960	-	7343	20000
2021	358	-	336	-	-	-	-	-	3066	733	-	1084	-	5577	20000
2022	570	-	257	-	-	-	-	-	1812	332	-	935	-	3906	20000
2023	687	-	-	-	-	-	-	-	1175	32	-	1828	-	3721	20000
2024	925	-	-	-	-	-	-	-	794	153	-	856	-	2728	20000

[a] Prior to 2005 TACs were set by Canada within it's fisheries jurisdiction

Table 3. Mean number per standard tow from Canadian Autumn surveys in Div. 3O covering strata from 93 to 731 m. Dashes (--) represent unsampled strata. Number of successful sets in brackets. Data from previous years can be found in Wheeland et al (2022) and Ings et al. (2019).

Stratum	Depth Range (M)	Area sq mi	Area within NRA sq mi	% Area within NRA	Sep-Oct 2015-Q4 A458-60	Sep 2016-Q4 A466-467	Sep 2017-Q4 A484	Sep 2018-Q4 A500	Sep-Oct 2019-Q4 A514-515	Aug-Sep 2020-Q4 A528	2021-Q4	2022-Q4	Oct 2023-Q4 R	Oct 2024-Q4 C
329	093-183	1721	0	0.00	0.0 (5)	1.2 (5)	38.2 (5)	0.2 (5)	0.2 (5)	91.3 (3)			1.7 (3)	165.0 (3)
332	093-183	1047	0	0.00	121.0 (3)	0.0 (3)	21.7 (3)	26.7 (3)	74.7 (3)	108.0 (2)			0.5 (2)	11.0 (2)
337	093-183	948	0	0.00	208.0 (3)	2.0 (2)	101.7 (2)	73.0 (3)	69.3 (3)	37.5 (2)			12.6 (2)	44.2 (2)
339	093-183	585	0	0.00	0.0 (2)	0.5 (2)	0.0 (2)	0.0 (2)	0.5 (2)	20.5 (2)			0.5 (2)	2.2 (2)
354	093-183	474	246	0.52	513.0 (2)	4.0 (2)	42.9 (2)	1.5 (2)	285.5 (2)	131.0 (2)	N	N	22.0 (2)	61.5 (2)
333	185-274	151(147)	0	0.00	296.5 (2)	145.5 (2)	39.5 (2)	5.5 (2)	25.0 (2)	40.6 (2)	O	O	48.4 (2)	2712.0 (2)
336	185-274	121	0	0.00	456.0 (2)	(2)	180.0 (2)	89.0 (2)	16.8 (2)	66.7 (2)			70.6 (2)	165.5 (2)
355	185-274	103	74	0.72	531.7 (2)	278.3 (2)	352.0 (2)	62.0 (2)	65.0 (2)	107.9 (2)	S	S	210.0 (2)	159.5 (2)
334	275-366	92(96)	0	0.00	1000.5 (2)	638.3 (2)	243.0 (2)	253.1 (2)	215.0 (2)	297.7 (2)	U	U	501.5 (2)	271.6 (2)
335	275-366	58	0	0.00	1728.9 (2)	443.0 (2)	3957.8 (2)	1920.4 (2)	167.2 (2)	745.3 (2)	R	R	3345.3 (2)	518.5 (2)
356	275-366	61	47	0.77	179.9 (2)	139.0 (2)	257.5 (2)	101.0 (2)	73.4 (2)	201.0 (2)	V	V	1069.7 (2)	998.0 (2)
717	367-549	93(166)	0	0.00	1751.8 (2)	1650.3 (2)	2044.0 (2)	5412.6 (2)	1520.5 (2)	2020.7 (2)	E	E	3937.6 (2)	1230.4 (2)
719	367-549	76	0	0.00	1616.5 (2)	6113.1 (2)	1319.3 (2)	4504.9 (2)	7417.9 (2)	8775.6 (2)	Y	Y	2528.0 (2)	3394.0 (2)
721	367-549	76	58	0.76	4672.6 (2)	197.5 (2)	1399.1 (2)	1922.2 (2)	1234.6 (2)	367.6 (2)			1533.0 (2)	1279.4 (2)
718	550-731	111(134)	0	0.00	146.0 (2)	73.5 (2)	2804.0 (2)	574.8 (2)	2756.2 (2)	432.6 (2)			348.7 (2)	2298.5 (2)
720	550-731	105	0	0.00	588.9 (2)	1815.0 (2)	343.4 (2)	749.0 (2)	735.8 (2)	1627.2 (2)			500.9 (2)	2643.0 (2)
722	550-731	93	71	0.76	1089.7 (2)	504.5 (2)	---	6.7 (2)	113.5 (2)	40.0 (2)			1.1 (2)	1299.6 (2)
	Total:	6350	601	9.46										
Upper (95% CI)					525.2	309.7	602.4	429.8	480.5	391.4			319.7	572.5
Weighted mean (by area)					312.7	195.7	252.7	299.7	281.8	291.4			238.3	363.6
Lower (95% CI)					100.1	81.7	-97.0	169.5	83.2	191.5			156.9	154.8
SURVEY ABUNDANCE(x106)					258.5	158.5	205.7	247.8	233.1	241.0			197.0	300.7
ABUNDANCE within NRA					71.9	10.4	17.9	16.7	21.8	10.2			22.0	33.1
% within NRA					27.8	6.5	8.7	6.8	9.3	4.2			11.2	11.0

Table 4. Mean weight (kg) per standard tow from Canadian Autumn surveys in Div. 3O covering strata from 93 to 731 m. Dashes (--) represent unsampled strata. Number of successful sets in brackets. Data from previous years can be found in Wheeland et al (2022) and Ings et al. (2019).

Stratum	Depth Range (M)	Area sq mi	Area within NRA sq mi	% Area within NRA	Sep-Oct 2015-Q4 A458-60	Sep 2016-Q4 A466-467	Sep 2017-Q4 A484	Sep 2018-Q4 A500	Sep-Oct 2019-Q4 A514-515	Aug-Sep 2020-Q4 A528	2021-Q4	2022-Q4	Oct 2023-Q4 R	Oct 2024-Q4 C
329	093-183	1721	0	0.00	0.0 (5)	0.0 (5)	1.1 (5)	0.0 (5)	0.0 (5)	8.0 (3)			0.0 (3)	31.6 (3)
332	093-183	1047	0	0.00	17.2 (3)	0.0 (3)	0.2 (3)	0.1 (3)	6.3 (3)	9.8 (2)			0.0 (2)	0.9 (2)
337	093-183	948	0	0.00	31.0 (3)	0.2 (2)	17.2 (2)	4.1 (3)	8.0 (3)	2.0 (2)			1.5 (2)	1.4 (2)
339	093-183	585	0	0.00	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.1 (2)			0.0 (2)	0.2 (2)
354	093-183	474	246	0.52	85.1 (2)	0.0 (2)	3.7 (2)	0.0 (2)	2.9 (2)	12.3 (2)	N	N	0.1 (2)	10.9 (2)
333	185-274	151(147)	0	0.00	13.6 (2)	17.6 (2)	5.1 (2)	0.5 (2)	1.3 (2)	4.7 (2)	O	O	5.8 (2)	371.1 (2)
336	185-274	121	0	0.00	29.7 (2)	(2)	13.3 (2)	7.5 (2)	2.5 (2)	9.3 (2)			7.2 (2)	19.4 (2)
355	185-274	103	74	0.72	65.5 (2)	34.8 (2)	44.9 (2)	10.0 (2)	6.4 (2)	11.1 (2)	S	S	13.1 (2)	7.6 (2)
334	275-366	92(96)	0	0.00	172.0 (2)	123.9 (2)	40.8 (2)	55.3 (2)	46.7 (2)	52.8 (2)	U	U	75.6 (2)	56.1 (2)
335	275-366	58	0	0.00	243.6 (2)	64.8 (2)	685.0 (2)	357.3 (2)	23.0 (2)	119.5 (2)	R	R	687.2 (2)	59.9 (2)
356	275-366	61	47	0.77	26.8 (2)	26.1 (2)	40.8 (2)	16.0 (2)	11.0 (2)	30.1 (2)	V	V	193.2 (2)	78.5 (2)
717	367-549	93(166)	0	0.00	321.0 (2)	301.4 (2)	411.7 (2)	1225.9 (2)	351.0 (2)	435.1 (2)	E	E	930.1 (2)	300.7 (2)
719	367-549	76	0	0.00	249.0 (2)	1061.1 (2)	237.3 (2)	993.0 (2)	1415.5 (2)	1850.3 (2)	Y	Y	596.6 (2)	698.1 (2)
721	367-549	76	58	0.76	838.5 (2)	33.7 (2)	253.6 (2)	352.4 (2)	267.5 (2)	85.2 (2)			336.5 (2)	243.5 (2)
718	550-731	111(134)	0	0.00	38.5 (2)	23.7 (2)	741.7 (2)	207.9 (2)	787.8 (2)	156.5 (2)			110.7 (2)	823.9 (2)
720	550-731	105	0	0.00	153.7 (2)	470.4 (2)	103.0 (2)	192.9 (2)	198.5 (2)	446.4 (2)			164.0 (2)	755.9 (2)
722	550-731	93	71	0.76	257.1 (2)	123.6 (2)	---	1.6 (2)	31.1 (2)	15.0 (2)			0.5 (2)	446.0 (2)
	Total:	6350	601	9.46										
Upper (95% CI)					91.2	62.6	174.9	94.6	94.2	83.5			91.5	170.5
Weighted mean (by area)					52.1	37.5	48.9	64.4	56.3	56.1			53.4	80.8
Lower (95% CI)					13.0	12.4	-77.2	34.2	18.5	28.7			15.3	-8.8
SURVEY BIOMASS(tons)					43117.6	30394.2	39768.1	53238.8	46594.1	46398.7			44140.9	66838.5
BIOMASS within NRA					12921.2	2000.0	2868.9	3033.4	2673.8	1551.9			4074.8	7251.4
% within NRA					30.0	6.6	7.2	5.7	5.7	3.3			9.2	10.8

Table 5. Mean number per standard tow from Canadian Spring surveys in Div. 3O covering strata from 93 to 731 m. Dashes (--) represent unsampled strata. Number of successful sets in brackets. Data from previous years can be found in Wheeland et al (2022) and Ings et al. (2019).

Stratum	Depth Range (M)	Area sq mi	Area within NRA sq mi	% Area within NRA	May 2015-Q2 A452-53	Apr-May 2016-Q2 T-169	May 2017-Q2 A479-80	May 2018-Q2 A496, T194	May 2019-Q2 A508-509	2020-Q2	2021 -Q2	Apr-Jun 2022-Q2 C	Apr-May 2023-Q2 C, T	May 2024-Q2 C
329	093-183	1721	0	0.00	188.0 (5)	0.8 (5)	70.8 (5)	0.0 (5)	0.0 (5)			0.0 (2)	0.0 (2)	119.7 (2)
332	093-183	1047	0	0.00	243.0 (3)	2.0 (3)	503.7 (3)	134.3 (3)	11.7 (3)			5.0 (3)	0.0 (2)	62.5 (2)
337	093-183	948	0	0.00	716.3 (3)	1730.5 (2)	2161.0 (2)	170.3 (3)	151.3 (3)			14.5 (2)	119.4 (2)	28.5 (2)
339	093-183	585	0	0.00	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)			0.5 (2)	0.0 (2)	0.7 (2)
354	093-183	474	246	0.52	1638.0 (2)	0.0 (2)	0.0 (2)	5.1 (2)	30.0 (2)	N	N	14.571 (2)	171.5 (2)	38.5 (2)
333	185-274	151(147)	0	0.00	2305.5 (2)	1065.5 (2)	662.6 (2)	856.0 (2)	1844.0 (2)	O	O	281.5 (2)	520.5 (2)	1106.3 (2)
336	185-274	121	0	0.00	1333.5 (2)	4425.6 (2)	2074.2 (2)	407.0 (2)	2992.1 (2)			231.36 (2)	1395.5 (2)	893.8 (2)
355	185-274	103	74	0.72	1551.5 (2)	3633.0 (2)	2345.7 (2)	612.0 (2)	60.4 (2)	S	S	23 (2)	449.0 (2)	350.0 (2)
334	275-366	92(96)	0	0.00	3098.1 (2)	1217.8 (2)	1587.0 (2)	2729.5 (2)	1417.2 (2)	U	U	1267.8 (2)	256.4 (2)	1158.0 (2)
335	275-366	58	0	0.00	3701.5 (2)	909.0 (2)	622.0 (2)	1073.3 (2)	4195.4 (2)	R	R	---	192.4 (2)	404.7 (2)
356	275-366	61	47	0.77	810.5 (2)	159.0 (2)	627.0 (2)	502.5 (2)	2196.9 (2)	V	V	265.5 (2)	192.0 (2)	2350.5 (2)
717	367-549	93(166)	0	0.00	1320.1 (2)	---	1810.5 (2)	928.5 (2)	552.4 (2)	E	E	1053.5 (2)	662.4 (2)	455.0 (2)
719	367-549	76	0	0.00	629.4 (2)	538.9 (2)	487.4 (2)	1559.3 (2)	3668.2 (2)	Y	Y	---	1168.1 (2)	700.8 (2)
721	367-549	76	58	0.76	1787.5 (2)	473.7 (2)	68.5 (2)	3992.5 (2)	3551.8 (2)			252.7 (2)	143.3 (2)	324.5 (2)
718	550-731	111(134)	0	0.00	30.0 (2)	---	62.7 (2)	191.2 (2)	---			295.3 (2)	---	82.4 (2)
720	550-731	105	0	0.00	18.7 (2)	298.7 (2)	5.7 (2)	114.5 (2)	17.8 (2)			---	23.5 (2)	191.8 (2)
722	550-731	93	71	0.76	12.5 (2)	346.6 (2)	53.5 (2)	72.0 (2)	162.5 (2)			0.0 (2)	13.5 (2)	19.3 (2)
	Total:	6350	601	9.46										
Upper (95% CI)					899.6	3664.9	3915.5	416.0	580.2			103.8	202.4	305.2
Weighted mean (by area)					609.7	530.6	644.0	252.5	336.9			81.339	127.1	181.1
Lower (95% CI)					319.9	-2603.7	-2627.4	89.1	93.6			58.883	51.8	56.9
SURVEY ABUNDANCE(x106)					504.2	416.8	532.5	208.8	272.4			64.584	102.8	149.7
ABUNDANCE within NRA					90.9	45.2	29.0	42.2	45.8			4.5	12.9	22.8
% within NRA					18.0	10.8	5.4	20.2	16.8			6.9	12.5	15.3

Table 6. Mean weight (kg) per standard tow from Canadian Spring surveys in Div. 3O covering strata from 93 to 731 m. Dashes (--) represent unsampled strata. Number of successful sets in brackets. Data from previous years can be found in Wheeland et al (2022) and Ings et al. (2019).

Stratum	Depth Range (M)	Area sq mi	Area within NRA sq mi	% Area within NRA	May 2015-Q2 A452-53	Apr-May 2016-Q2 T-169	May 2017-Q2 A479-80	May 2018-Q2 A496, T194	May 2019-Q2 A508-509	2020-Q2	2021 -Q2	Apr-Jun 2022-Q2 C	Apr-May 2023-Q2 C, T	May 2024-Q2 C
329	093-183	1721	0	0.00	22.0 (5)	0.0 (5)	10.6 (5)	0.0 (5)	0.0 (5)			0.0 (2)	0.0 (2)	11.0 (2)
332	093-183	1047	0	0.00	30.3 (3)	0.1 (3)	67.6 (3)	3.7 (3)	0.1 (3)			0.5 (3)	0.0 (2)	4.4 (2)
337	093-183	948	0	0.00	84.2 (3)	253.0 (2)	334.2 (2)	1.9 (3)	15.1 (3)			0.3 (2)	25.8 (2)	0.4 (2)
339	093-183	585	0	0.00	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)			0.0 (2)	0.0 (2)	0.1 (2)
354	093-183	474	246	0.52	301.1 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.6 (2)	N	N	0.27 (2)	20.8 (2)	0.3 (2)
333	185-274	151(147)	0	0.00	311.7 (2)	160.4 (2)	114.1 (2)	142.5 (2)	314.4 (2)	O	O	47.51 (2)	90.4 (2)	206.1 (2)
336	185-274	121	0	0.00	177.8 (2)	657.1 (2)	351.2 (2)	52.8 (2)	383.1 (2)			38.299 (2)	257.2 (2)	147.4 (2)
355	185-274	103	74	0.72	221.5 (2)	580.8 (2)	400.5 (2)	81.0 (2)	8.5 (2)	S	S	2.865 (2)	77.6 (2)	44.7 (2)
334	275-366	92(96)	0	0.00	492.0 (2)	193.5 (2)	323.9 (2)	486.4 (2)	273.6 (2)	U	U	242.8 (2)	67.2 (2)	292.9 (2)
335	275-366	58	0	0.00	526.6 (2)	140.9 (2)	112.9 (2)	183.0 (2)	766.5 (2)	R	R	---	38.9 (2)	82.2 (2)
356	275-366	61	47	0.77	122.3 (2)	25.9 (2)	126.4 (2)	92.0 (2)	372.4 (2)	V	V	50.03 (2)	47.7 (2)	423.9 (2)
717	367-549	93(166)	0	0.00	256.4 (2)	---	461.1 (2)	222.9 (2)	165.6 (2)	E	E	286.21 (2)	173.1 (2)	131.4 (2)
719	367-549	76	0	0.00	138.5 (2)	104.0 (2)	134.7 (2)	335.8 (2)	846.2 (2)	Y	Y	---	349.5 (2)	210.6 (2)
721	367-549	76	58	0.76	454.2 (2)	116.7 (2)	16.0 (2)	878.3 (2)	803.2 (2)			81.0 (2)	42.9 (2)	113.9 (2)
718	550-731	111(134)	0	0.00	8.7 (2)	---	15.9 (2)	54.7 (2)	---			86.0 (2)	---	32.5 (2)
720	550-731	105	0	0.00	4.0 (2)	73.0 (2)	1.5 (2)	35.8 (2)	4.1 (2)			---	8.7 (2)	74.6 (2)
722	550-731	93	71	0.76	2.1 (2)	107.2 (2)	17.075 (2)	28.0 (2)	52.0 (2)			0.0 (2)	4.0 (2)	11.2 (2)
	Total:	6350	601	9.46										
Upper (95% CI)					134.6	530.7	597.9	76.4	106.5			22.279	45.7	51.8
Weighted mean (by area)					92.7	81.5	107.1	41.1	61.2			18.09	26.9	32.5
Lower (95% CI)					50.7	-367.6	-383.7	5.8	15.9			13.901	8.1	13.2
SURVEY BIOMASS(tons)					76615.1	64055.9	88539.7	34011.4	49483.3			14364	21769.4	26852.8
BIOMASS within NRA					16879.4	8058.1	5188.7	8702.1	9431.7			1008.3	2183.7	4225.1
% within NRA					22.0	12.6	5.9	25.6	19.1			7.0	10.0	15.7

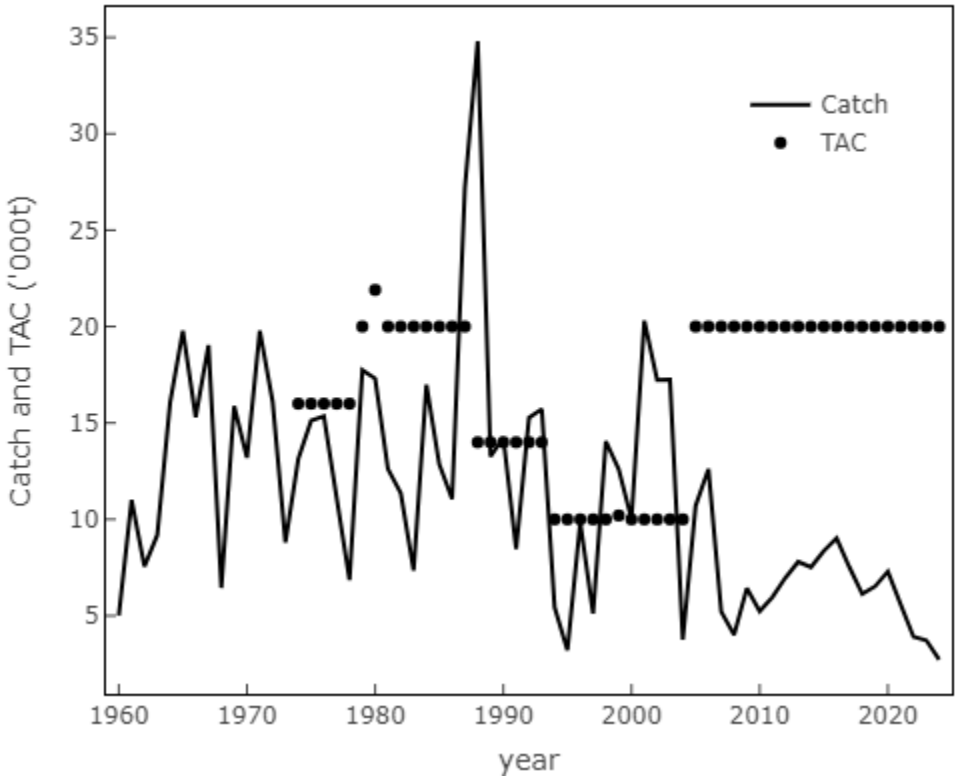

Figure 1. Nominal catches and TACs of Redfish in Div. 3O. TAC to 2004 was only for Canadian fishery zone.

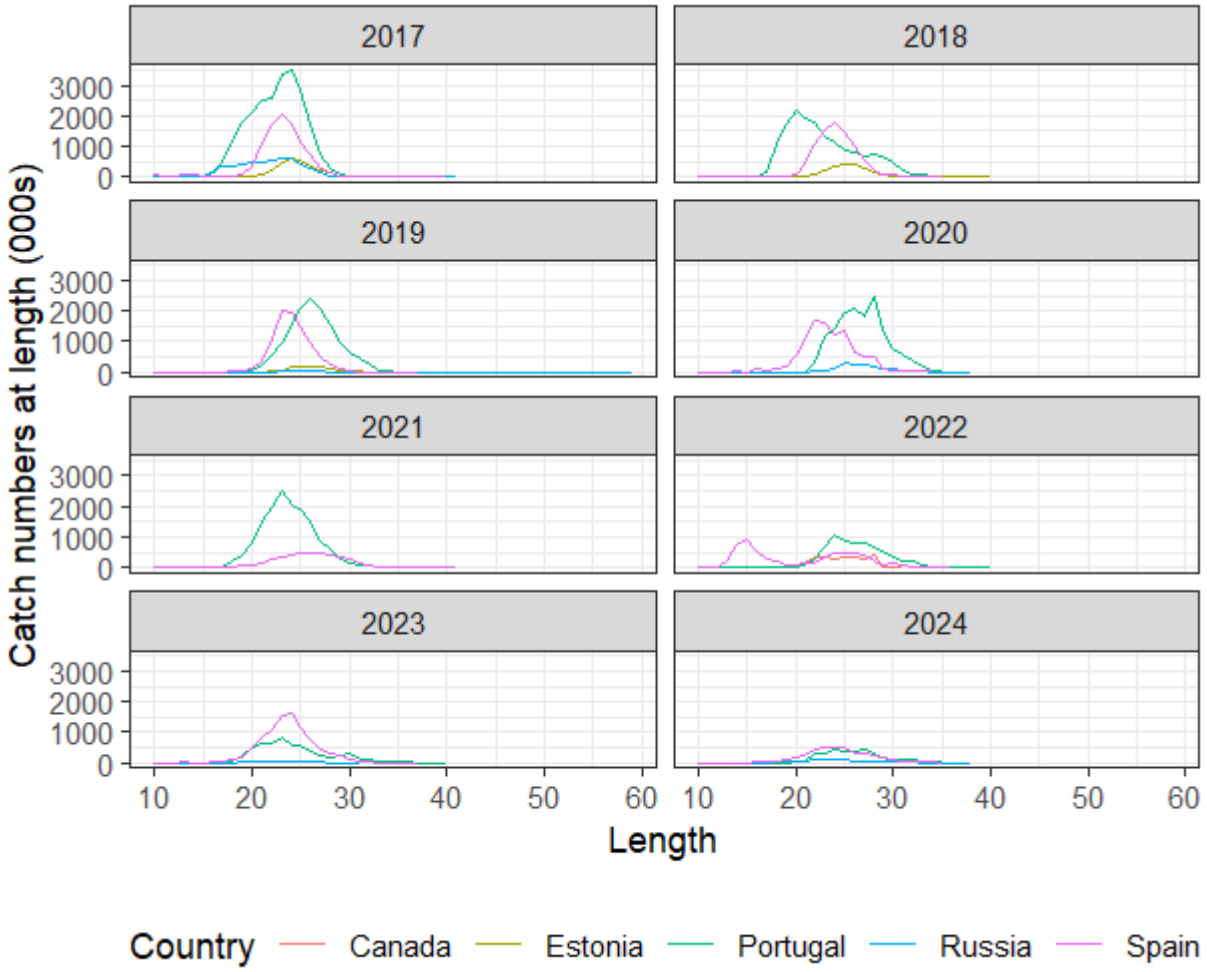

Figure 2. Commercial fishery catch numbers at length ('000s).

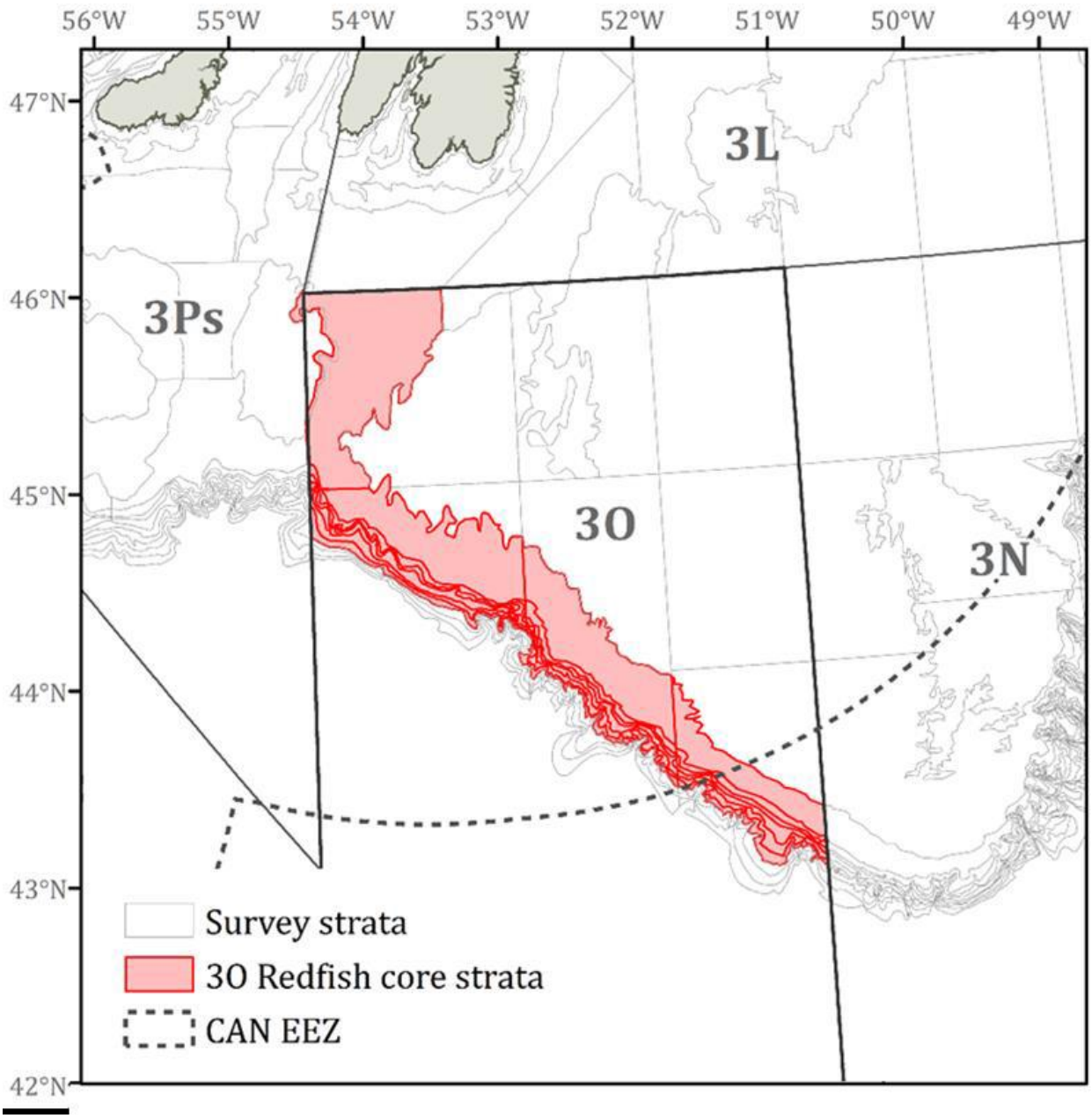

Figure 3. Map of the index ("core") strata (red) in Div. 3O that are used for indices from the Canadian spring and Canadian autumn surveys in Div. 3O.

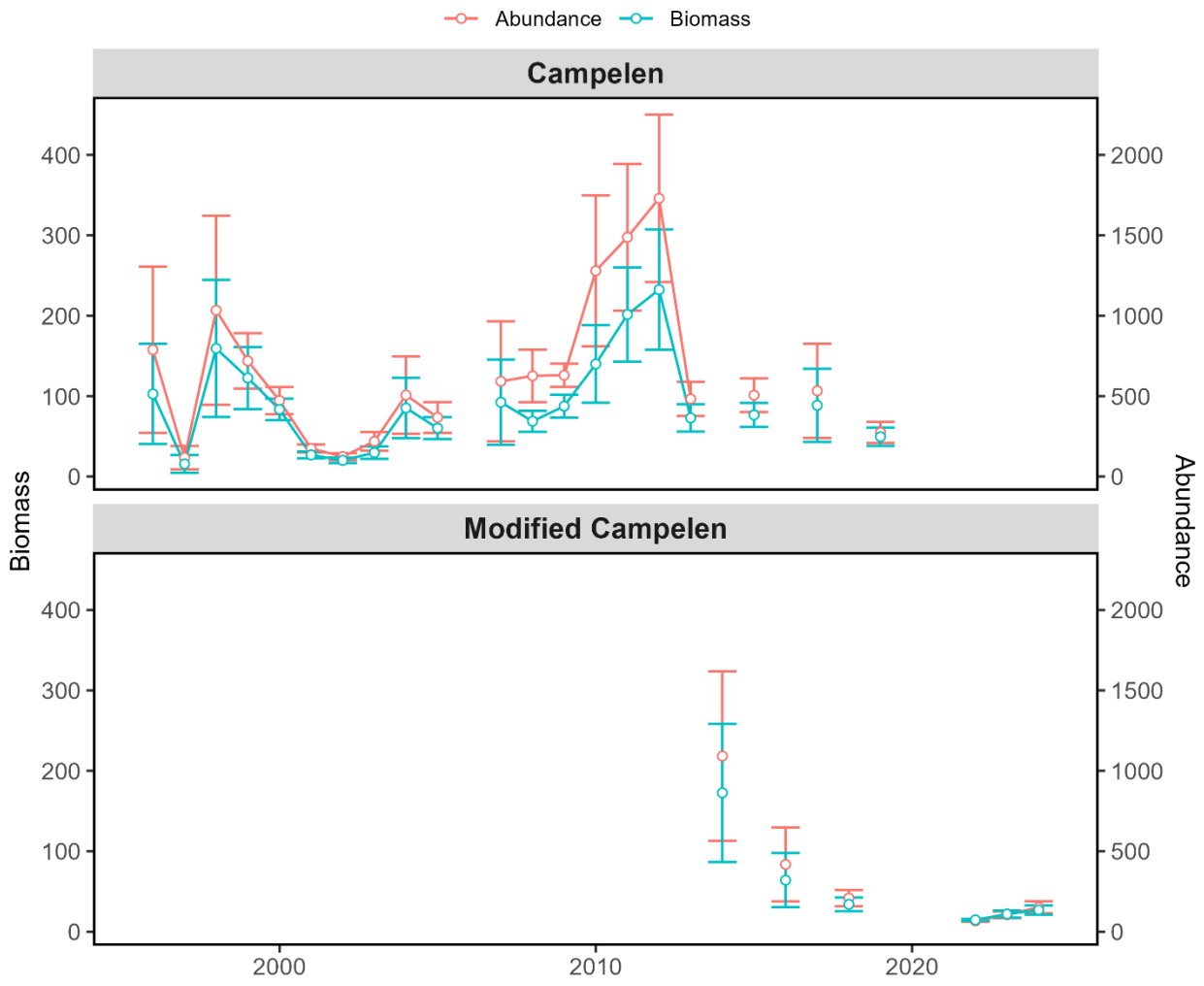

Figure 4. Biomass and abundance indices for redfish in Div. 3O for CAN-spring surveys from 1991 - 2025 with 95% CI. There were no Canadian RV surveys in Div. 3O in spring of 2006, 2020 or 2021. Surveys prior to 1995 utilized an Engel trawl. Estimates were converted to Campelen equivalents based on comparative fishing trials.

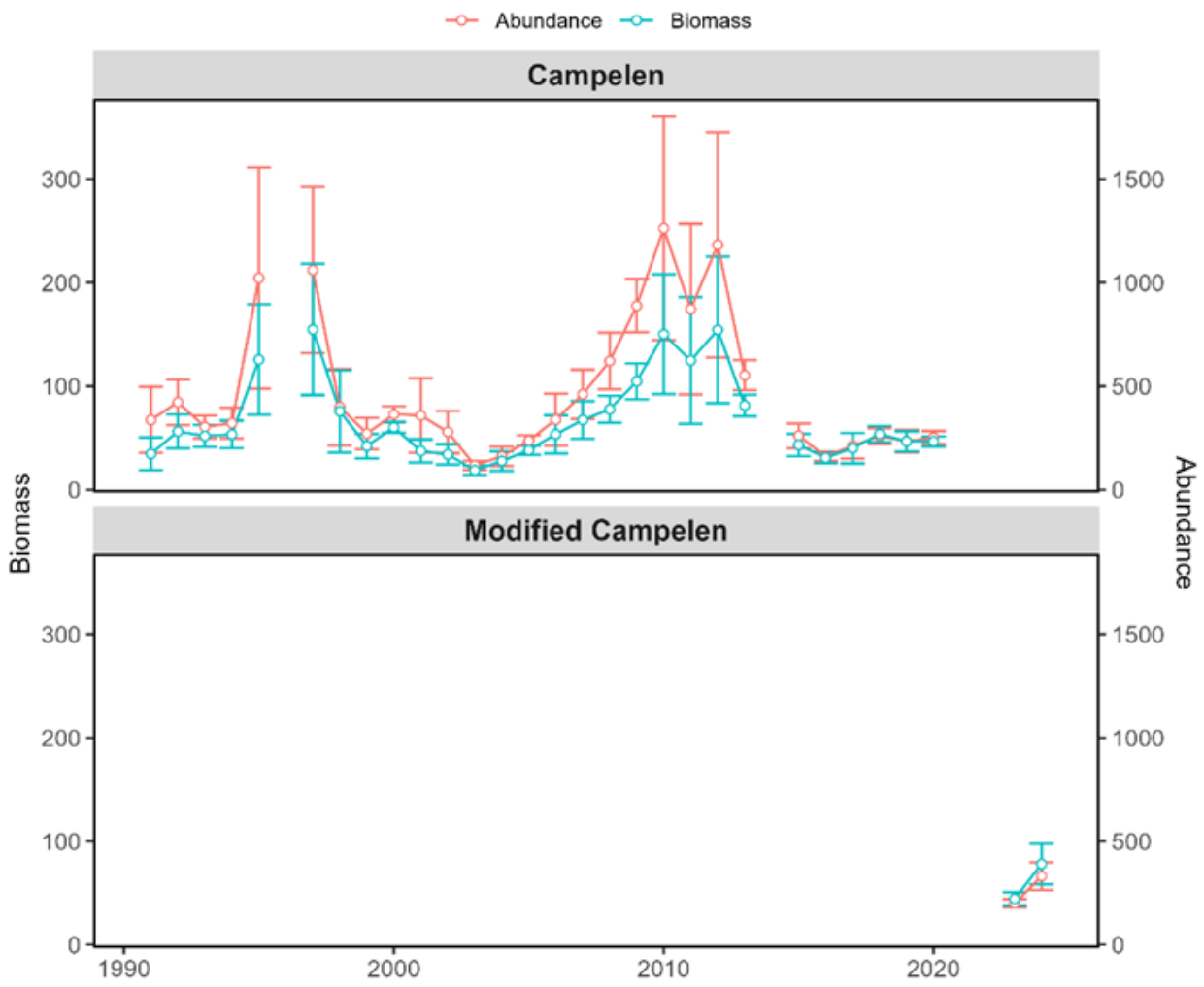

Figure 5. Biomass and abundance indices for redfish in Div. 3O for CAN-autumn surveys from 1991 - 2025 with 95% CI. There were no Canadian RV surveys in Div. 3O in autumn of 2014, 2021 or 2022. Surveys prior to 1995 utilized an Engel trawl. Estimates were converted to Campelen equivalents based on comparative fishing trials.

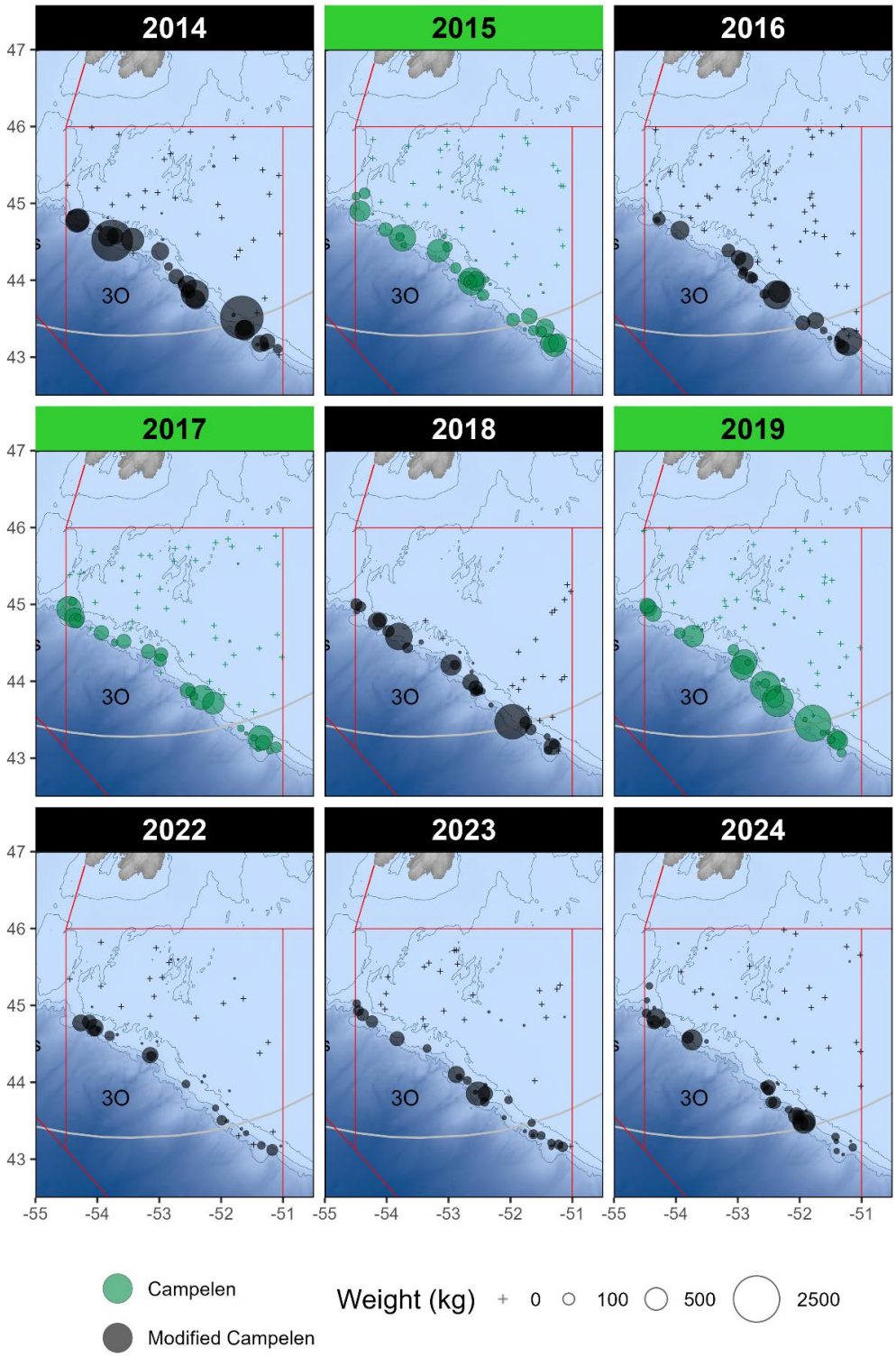

Figure 6. Distribution of redfish catches (kg per tow) in the Canadian Spring RV survey in Div. 3O.

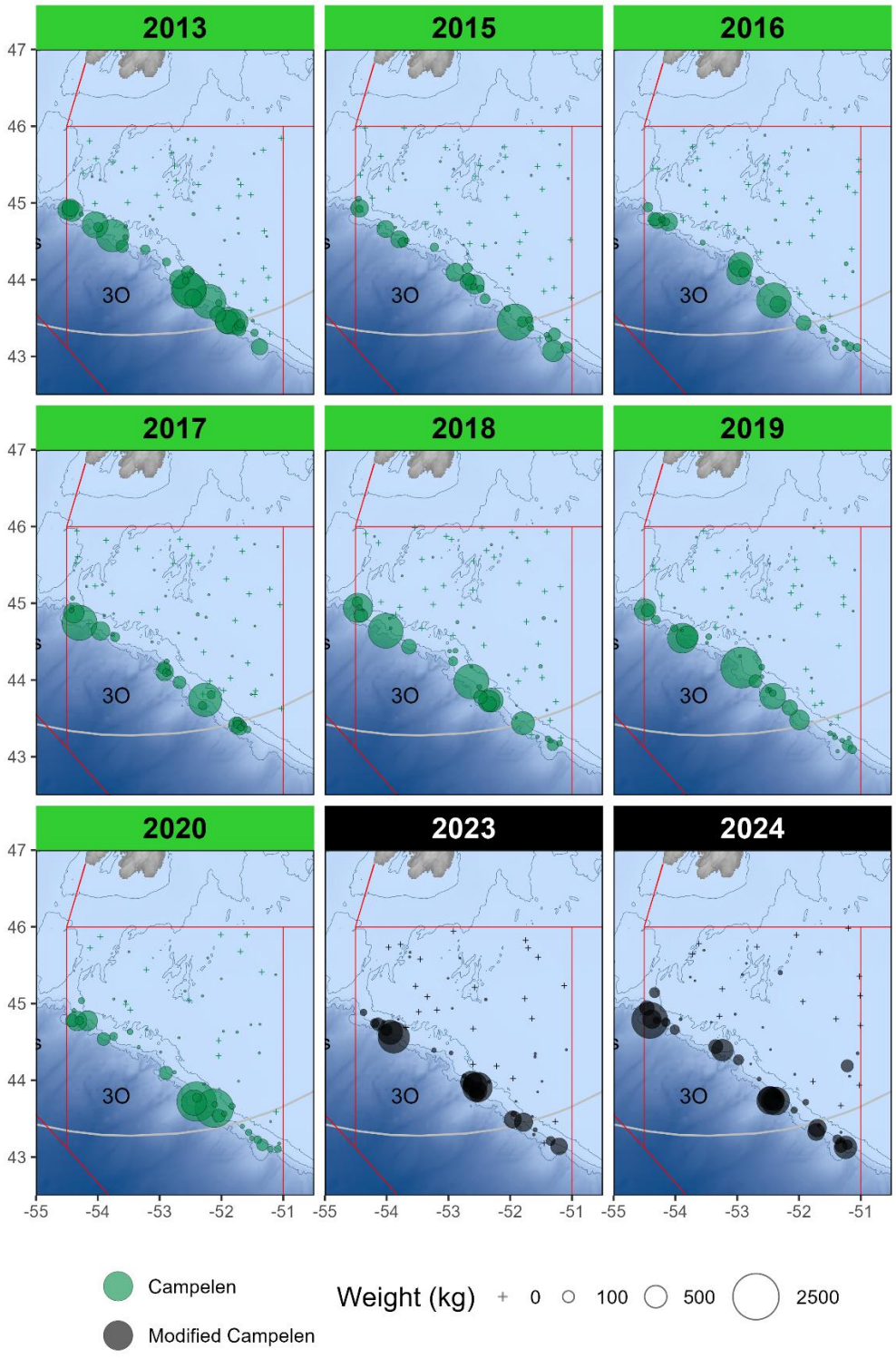

Figure 7. Distribution of redfish catches (kg per tow) in the Canadian Autumn RV survey in Div. 3O.

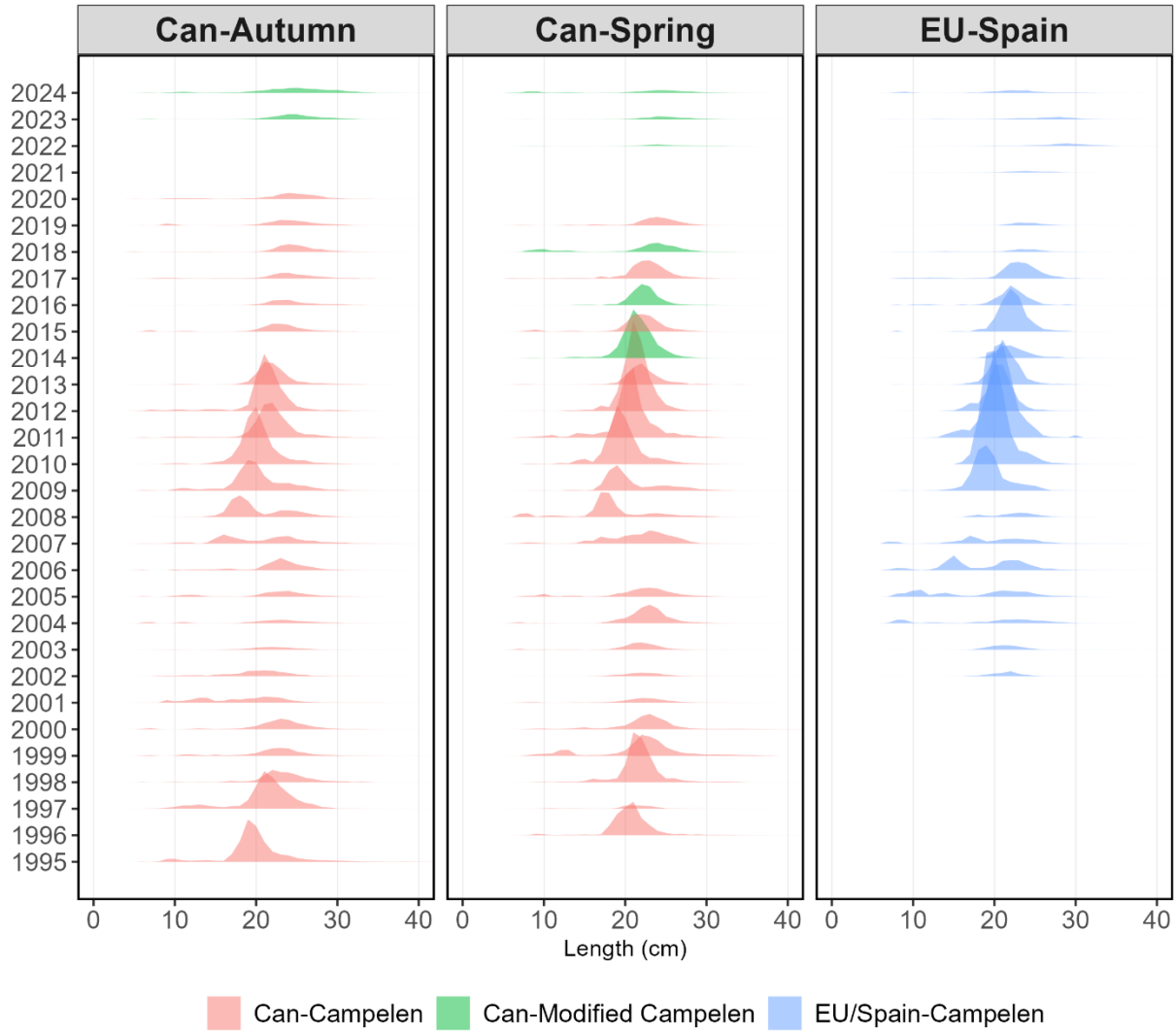

Figure 8. Length distributions (abundance at length) from Canadian RV surveys in Div. 3O during spring and autumn since 1995 (Campelen time series) and the EU-Spain survey since 2004.

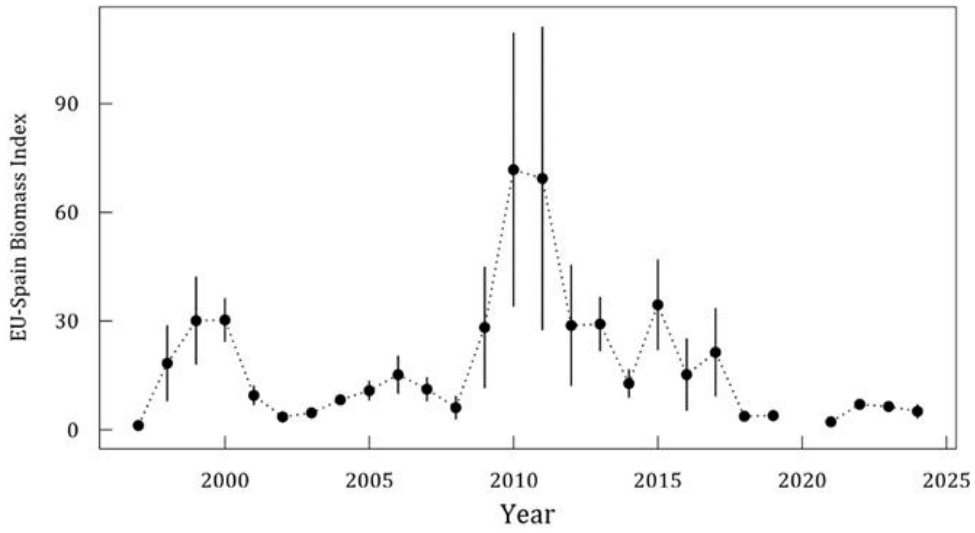

Figure 9. Survey biomass indices (error bars are one standard deviation) from EU-Spain Spring surveys in Campelen equivalent units for surveys prior to 2002.

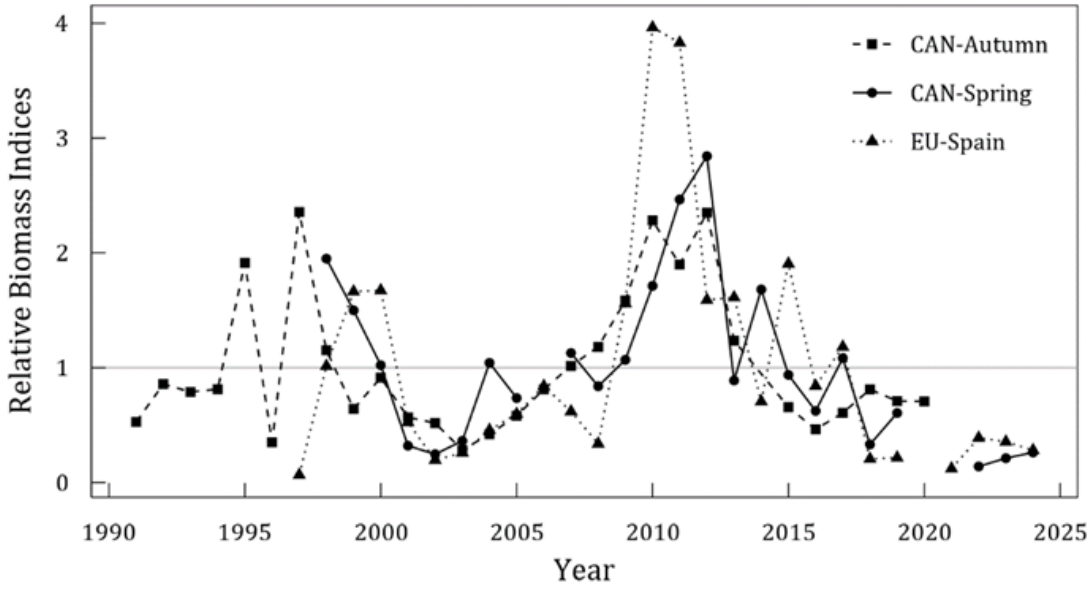

Figure 10. Survey biomass indices from Canada (Spring and Autumn) and EU-Spain. Indices were normalized by dividing each series by its mean. The Canadian Autumn 2023 and 2024 indices were excluded as they could not be made relative.

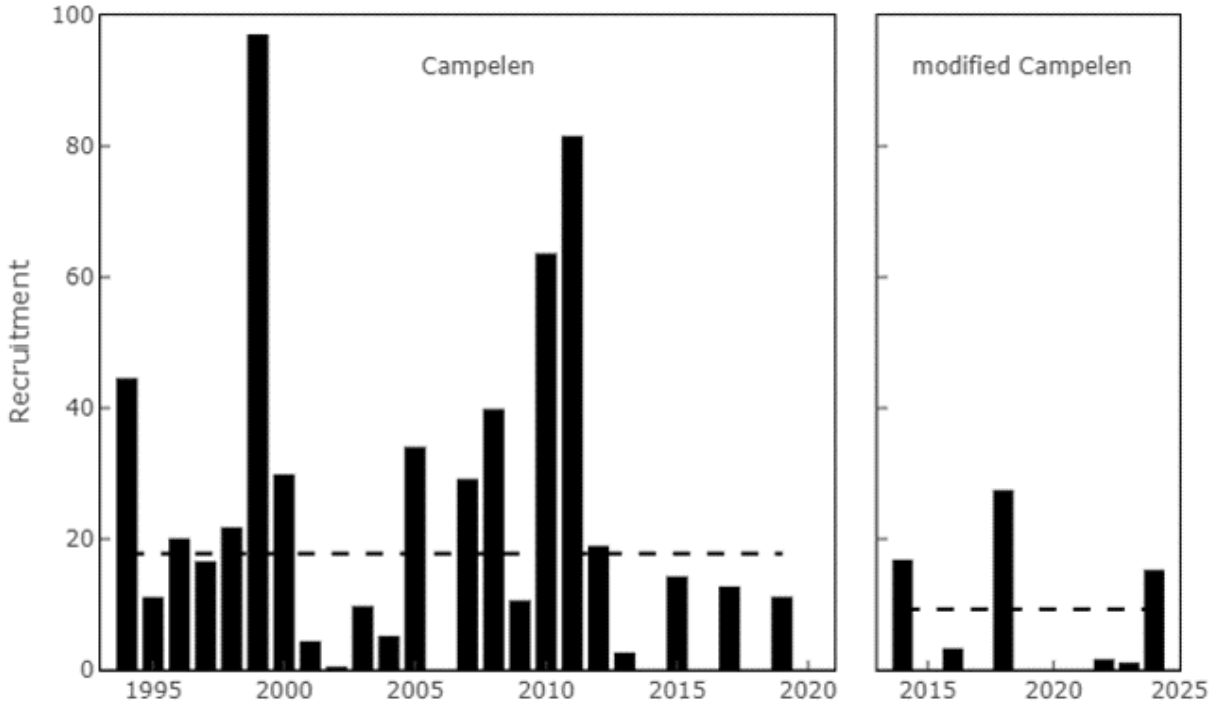

Figure 11. Recruitment indices for Redfish in Division 3O, defined as the abundance of redfish 10-15 cm in the Canadian Spring surveys. Horizontal dashed lines are time-series medians.

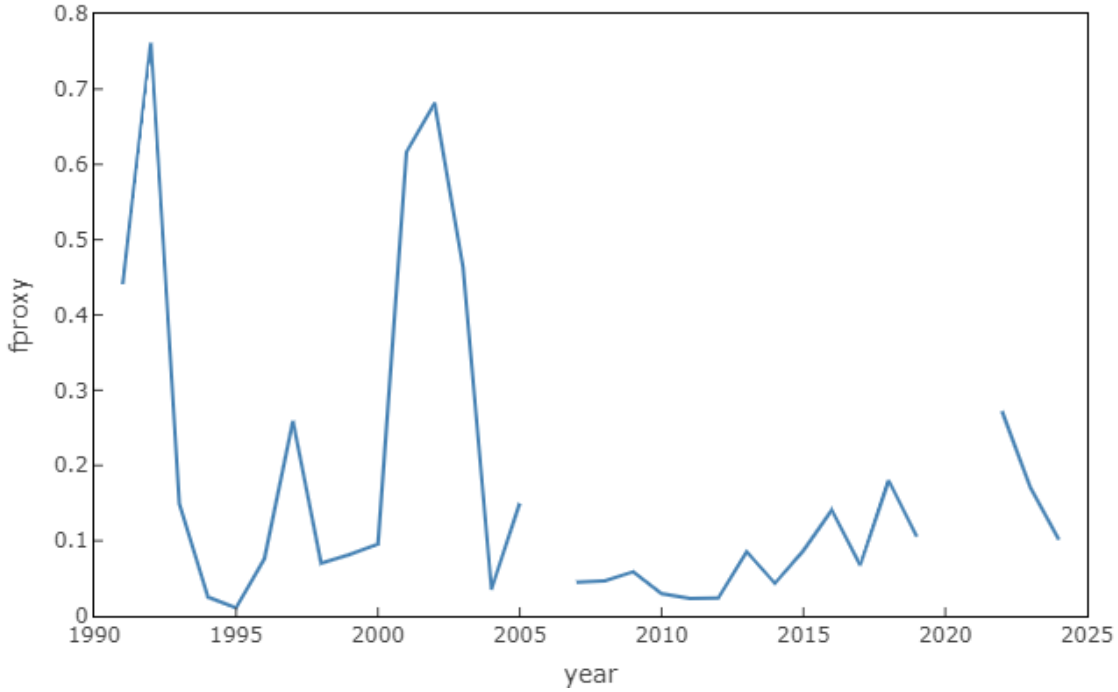

Figure 12. Fishing mortality proxy for Redfish in Div. 3O, calculated as the catch biomass ratio in the Canadian Spring survey. Campelen data are rescaled to be comparable with the modified Campelen time-series.

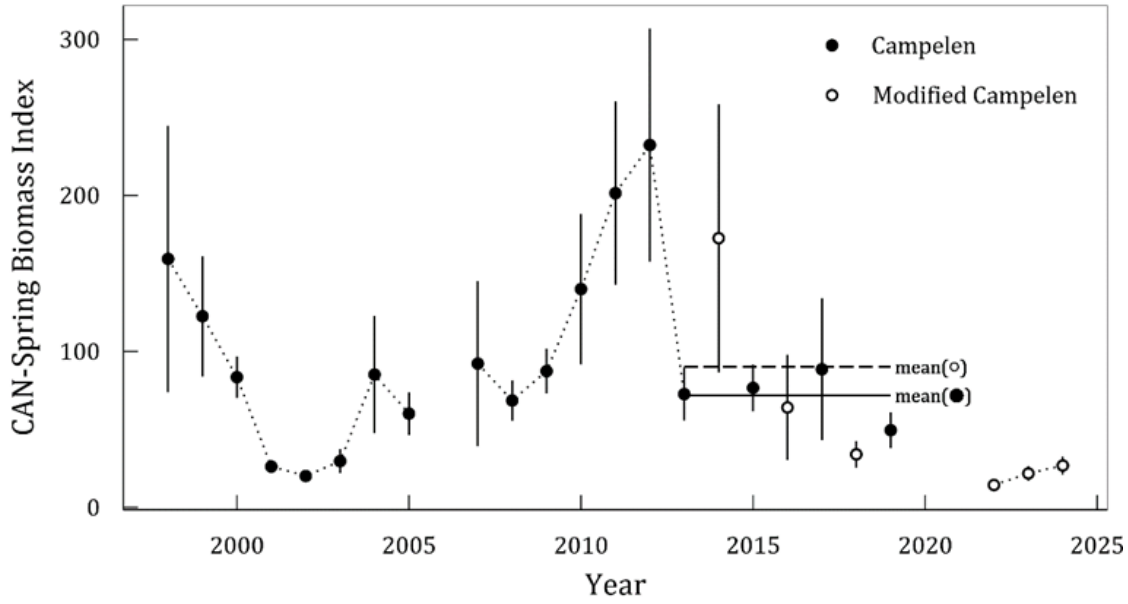

Figure 13. Biomass indices from the Canadian Spring surveys of 3O. Means of both the Campelen and modified Campelen data series are shown for the period of overlapping (2013-2019).

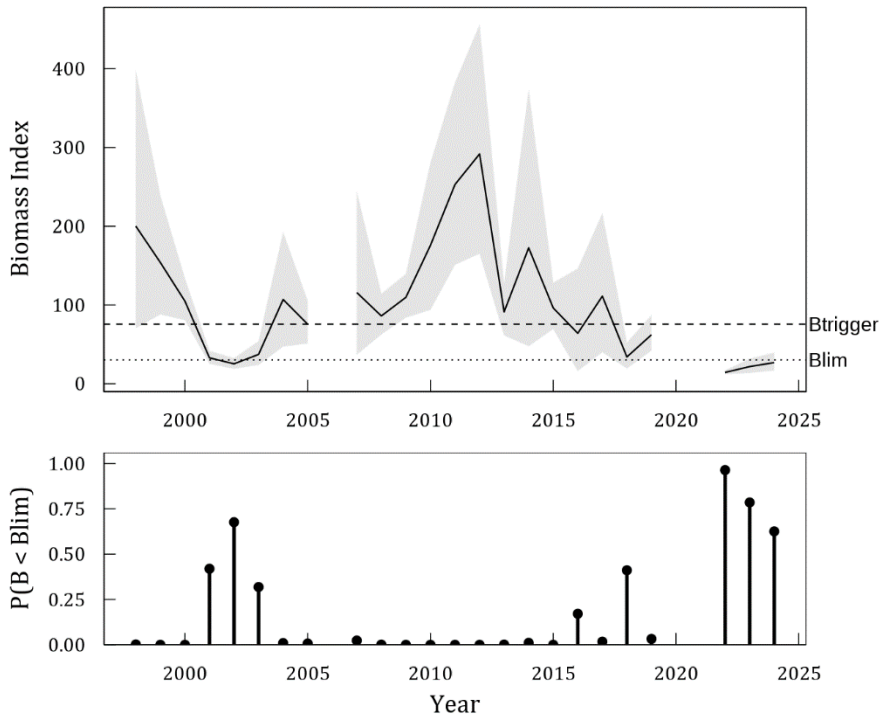

Figure 14. CAN-Spring biomass index with 80% confidence intervals calculated using a gamma distribution. Horizontal thin and thick dashed lines indicate B_{lim} =0.3 B_{MSY} -proxy and $B_{trigger}$ = 0.75 B_{MSY} -proxy, respectively. Probability of By< B_{lim} is presented below.

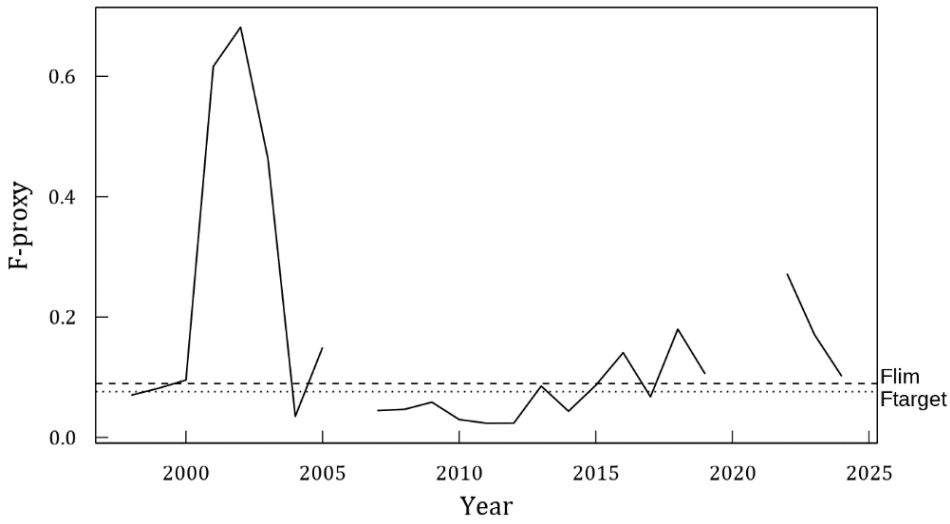

Figure 15. Catch/survey biomass ratios. F_{target} and F_{lim} are shown as thin and thick dashed lines respectively (see reference points section for details).

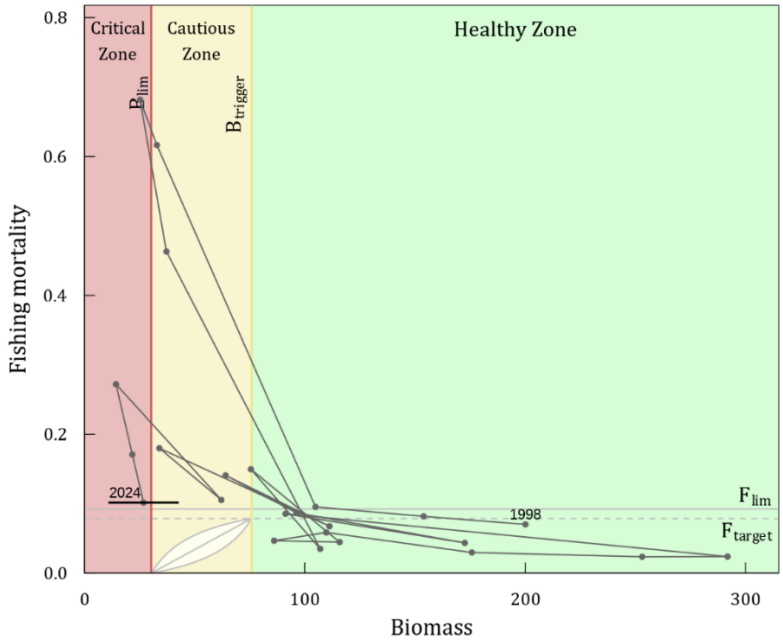

Figure 16. Stock trajectory estimated using the Canadian spring biomass and F_{proxy} indices, under the Precautionary Approach Framework (80% CL on 2024).