Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Research Document 2020/024

Newfoundland and Labrador Region

Assessment of Haddock (*Melanogrammus aeglefius)* in NAFO Subdivision 3Ps

L. Wheeland, B. Rogers, R. Rideout

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

July 2020

Canada

Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

ISSN 1919-5044

Correct citation for this publication:

Wheeland, L., Rogers, B., and Rideout, R. 2020. Assessment of Haddock (*Melanogrammus aeglefinus)* in NAFO subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/024. iv + 32 p.

Aussi disponible en français :

Wheeland, L., Rogers, B., et Rideout, R. 2020. Évaluation du stock d'aiglefin (Melanogrammus aeglefius) de la sous-division 3Ps de l'OPANO. Secr. can. de consult. sci. du MPO. Doc. de rech. 2020/024. iv + 34 p.

TABLE OF CONTENTS

ABSTRACT

Information available to evaluate stock status of Haddock (*Melanogrammus aeglefinus*) in NAFO Subdivision 3Ps consisted of commercial landings data (1953-2017) and information from Canadian spring RV trawl surveys (1972-2018). The commercial fishery on this stock has historically harvested a few large year classes, with landings peaking in the early 1950s, reaching a high of 58,000 t, largely due to the exceptional 1949 year class. A smaller peak occurred in the mid-1980s driven by the 1982 year class. A moratorium on directed fishing for this stock has been in place since 1993. Landings from bycatch averaged 332 t over (2013-17). Survey indices of biomass and abundance have been at or below the series average for the last four years (2015-18). Spawning stock biomass (SSB) has been variable through the Campelen series, with peaks in 1998, 2004 and 2013-14. Recruitment is sporadic in this stock, with few large recruitment events observed, defined here as recruitment (<20cm TL) anomalies amongst the 90th percentile. No incoming recruits were caught in the RV survey in 2017 or 2018. A Limit Reference Point was defined for this stock based on the highest SSB index to yield a large recruitment event. The stock is currently below the LRP, in the critical zone.

INTRODUCTION

This document is the result of a 2018 assessment of NAFO Subdivision 3Ps Haddock (*Melanogrammus aeglefinus*), as requested by Fisheries Management. This stock was last assessed in 2014 (DFO 2014). Information available for the assessment included total landings (1949-2017) and annual spring RV surveys (1972-2018). Information from RV surveys provide distributional data, indices of biomass and abundance, length frequencies, maturities at length, spawning stock biomass based on length data, and a recruitment index (fish <20.5 cm). Oceanographic and ecosystem information were used to provide context for stock status and productivity.

COMMERCIAL FISHERY

PRIVACY STATEMENT

To ensure that private information cannot be extracted from fishery landings and catch information, the Department can no longer provide landings and catch information for a specific fishery when that fishery has fewer than five fishing enterprises, five fishing vessels and five buyers participating in a fishery. This measure is being taken to protect the privacy and economic interests of participants in the fishery. Data are combined to address these privacy concerns.

DESCRIPTION OF THE FISHERY

The directed commercial haddock fishery in NAFO Subdivision 3Ps occurred mainly in the 1950s (Figure 1). A peak in landings from 1954 to 1956, reaching 58,000 t in 1955, was due mainly to the exceptionally abundant 1949 year class. Fishing efforts were largely focused on St. Pierre Bank, with the fishery prosecuted mainly by Canada with increased effort by Spain and France (St. Pierre and Miquelon) over this period. From 1958 to 1983 the fishery fluctuated between 150 and 4,300 t. The relatively abundant 1981 year class recruited to the fishery in 1984 and catches peaked in 1985 at 7,500 t before showing a steady decrease to 22 t in 1994. There has been no directed fishing on this stock since 1993.

Over the past five years (2013-17) landings from bycatch (Table 1) have averaged 332 t, with bycatch primarily taken in the Atlantic Cod fishery (Figure 2).

LENGTH COMPOSITION

Observer and port sampled length frequencies from 2014 to 2017 were analyzed to inform on the size structure of haddock bycatch in commercial otter trawl fisheries (Figure 3). Sample sizes were small, with 3-4 length frequencies available each year (736-986 fish measured per year). Distributions indicate haddock caught were typically 40-70 cm, generally consistent with previous assessments. However, catch length distribution has been shown to vary among gear types (Dwyer et al. 2014).

BIOLOGY OF HADDOCK

Haddock is a benthic gadoid species, ranging in the Western Atlantic from Newfoundland to Cape Hatteras. Several stocks exist in the Northwest Atlantic, with two stocks defined in Newfoundland waters: the Grand Bank Haddock stock (NAFO Divisions 3LNO) and the St. Pierre Bank stock (NAFO Subdivision 3Ps) (Begg 1998). Stocks off Newfoundland are thought to be at, or near, the northern limit of their range and temperature preferences in the Northwest

Atlantic. Haddock off the south coast of Newfoundland have been shown to be temperature keepers (Rogers et al. 2016a), generally occupying waters between 4-8°C. In general, haddock on St. Pierre Bank (3Ps) are faster growing and have a greater mean length-at-age and length at first-maturity than those on the Grand Bank (Div. 3LNO) (Templeman et al., 1978a,b; Templeman and Bishop, 1979a,b; Rogers et al. 2016b). In both stock areas, males reach maturity at a smaller size than females. The diet of haddock consists largely of benthic invertebrates including brittle stars and polychaetes, with larger individuals feeding also on fish, including capelin *Mallotus villosus* and sandlance *Ammodytes sp.* (Rockwood 2016).

RESEARCH VESSEL SURVEYS

SURVEY BIOMASS AND ABUNDANCE INDICES

Annual spring research vessel (RV) surveys have been conducted by Fisheries and Oceans Canada in Subdiv. 3Ps since 1972 (Figure 4).

Vessels and sampling gear have varied across the survey history. From 1972-1983 a Yankee 41.5 otter trawl was used and towed at 3.5 knots for 30 minutes. In 1984, in Div. 3Ps, the research vessel was fitted with an Engel 145 otter trawl and this gear was used until 1996, when it was changed to a commercial shrimp trawl. This trawl, the Campelen 1800, was utilized in order to accommodate a multispecies survey and is towed at a speed of 3.0 knots for 15 minutes.

Although comparative fishing was carried out between these gears, no conversion factors have been developed for haddock. It is expected that, in general, the Campelen trawl catches more small fish (Warren et al. 1997). Therefore the time series from each gear cannot be compared directly.

The survey covered only a few strata deeper than 400 m before 1979; since then depths of up to 750 m are surveyed annually. Survey coverage was expanded in 1994 and again in 1997 to cover additional strata in the inshore area. Survey timing has changed as well, with the time period prior to 1994 being carried out in some years in winter (February – March) but since 1994 being carried out in spring (April – June).

The 2006 survey was incomplete and is therefore excluded from analyses. In the 2018 spring survey 3 strata were incomplete (strata 707,708,715; Figure 5). These are not considered to have an impact on the 2018 indices for this stock, as a total of only 17 haddock have been caught in these strata throughout the Campelen series.

Age data have been unavailable for this stock since 2004.

Indices of biomass (Tables 2-4) and abundance (Tables 5-7) are obtained from these stratified bottom trawl surveys (Figures 6-7). Details on the calculation of indices from these surveys can be found in Smith and Somerton (1981). Indices of both abundance and biomass in the Yankee series (1972-1982) varied without trend at a low level, with the exception of a notable increase in abundance in 1982 as the relatively strong 1981 year class entered the survey.

In the Engel period (1983-1995), indices peaked in 1985, again driven by the 1981 year class, before decreasing to 1990 and remaining at a low level to 1995.

Indices have varied without trend throughout the Campelen series (1996-2018), though both abundance and biomass have been below the series average for the last 4 years. Two peaks in abundance were observed in this series: a steady increase from 1998 to 2000 as the relatively strong 1998 year class entered the survey and matured; and a peak in 2007 resulting from a single large tow of small (<20 cm) haddock, though significant uncertainty is associated with the

abundance index from that year. A data error was located within the 2007 survey catch for haddock. This resulted in a downward revision of the 2007 abundance index by approximately 60%, relative to that reported in the previous assessment, though remaining the highest in the Campelen series.

DISTRIBUTION

The spatial distribution of haddock in the RV spring survey from 2015-18 is presented as distribution maps of mean weight per tow by survey strata (Figure 8) and standardized numbers per tow (Figure 9). Distribution is primarily along the shelf edge on the southwest slope of St. Pierre Bank, and at the southern end of Halibut Channel and southwest slope of the Grand Bank along the border between Subdivision 3Ps and Division 3O. This is consistent with previous assessments of the stock.

Biomass has generally been distributed in depths shallower than 400m, with peaks typically near 200 m (Figure 10). These depths are associated with a shift in water temperatures generally observed between 100 m (at or near 0°C) and 200 m (>4°C) (Figure 11). This is consistent with known thermal preferences of haddock in this area (Rogers at al. 2016a).

Design-weighted survey area proportions by temperature within Subdivision 3Ps were calculated for each year from 1973 to 2018 based bottom temperature records from trawl-mounted CTDs during the spring RV survey following:

$$\mathrm{w} = \frac{\mathrm{a}_s \,/\, \mathrm{A}}{\mathrm{n}_\mathrm{s}}$$

where, *w* is proportion of the surveyed area represented by a set in strata *s*, *a* is the area of strata *s*, *A* is the total surveyed area, and *n* is the number of sets in strata *s*.

Proportional sets areas were summed by temperature groupings, following:

$$\mathrm{P} = \sum_{\mathrm{t}=1}^{\mathrm{T}} \mathrm{w}_t$$

Where *P* is the proportion of surveyed area within temperature grouping *t*, with temperatures grouped by: <0°C, 0-2°C, 2-4°C, 4-6°C, 6-8°C, ≥8°C.

There was a general decrease in the proportion of the survey area between 4-8°C from 1980 to 2000, with increasing proportions of area <4°C (Figure 12). Since 2000, the proportion of area from 4-8°C has remained relatively steady near 35% of the surveyed area, with an increasing proportion of this area >6°C. While haddock are known to prefer this range (Rogers et al. 2016a), no direct link is apparent between trends in survey indices and amount of available thermal habitat in this preferred range in 3Ps (Figure 13).

SIZE COMPOSITION

Size distribution of haddock is examined using numbers at length annually (Figure 14). The 1998 year class is seen entering the survey in 1999 at a length around 20 cm, tracking through the length frequencies year over year, and reaching a mode around 50 cm by 2004. Through this time, no other notable recruitment events were observed in the survey until the strong 2007 recruitment. Length distribution was very limited through much of the series, with values from 1999 to 2005 consisting near solely of the 1998 year class. From 2010 to 2016 the length distribution has been wider than previous years, with both older fish and incoming recruitment evident in the stock. However, no fish <25 cm were observed in 2017 or 2018 surveys.

SPAWNING STOCK BIOMASS

The index of spawning stock biomass (SSB) from the spring RV survey was calculated from numbers at length, converted to weights at length and then multiplied by proportion mature. This SSB index has been variable during the Campelen period (Figure 15), with peaks in 1998, 2004, and 2013-14.

Length at 50% mature in 3Ps has been stable over time, with median L50 for females at 49.9 ± 4.6 cm, and for males at 42.1 ± 2.6 cm (Rogers et al. 2016b).

RECRUITMENT

Recruitment Index

In the absence of recent aging data, a proxy for recruitment in this stock is considered to be the number of fish less than 20.5 cm total length, a proxy for age 1 fish. This stock is characterized by sporadic recruitment events, with few strong pulses observed in the recruitment index over the survey series (Figure 16). The 1981, 1988, 1998 and 2006 year classes were the strongest across all surveys.

No haddock <20.5 cm were observed in the 2017 or 2018 RV surveys. This is consistent with observations in the adjacent 3LNO Haddock stock for which no recruits were reported in the 2016 or 2017 surveys (DFO 2018).

Linking Recruitment and the Environment

On the Scotian Shelf, plankton bloom conditions have been linked to haddock larval survival, with late spring blooms leading to poor larval survival (Platt et al. 2003). In Subdivision 3Ps, satellite remote sensing data indicate that the spring bloom was lower in intensity and magnitude during 2015-18. The timing of peak magnitude of the bloom has been later than average over 2013-17, but returned to near normal in 2018 (Figure 17). This period of late blooms may suggest poor conditions for haddock larval survival.

An index of larval survival was calculated following Platt et al. (2003), with a survival index (SI) calculated as,

$$SI_y = \frac{R_{y+1}}{SSB_y}$$

Where R is the recruitment index in year $i+1$, and SSB is spawning stock biomass in year i. SI is then related to spring bloom timing anomalies in year i.

However, no clear relationship between the Survival Index and anomalies in spring bloom timing is apparent in 3Ps (Figure 17). The sporadic nature of recruitment in this stock may limit the ability to detect environmental effects on recruitment in this area.

LIMIT REFERENCE POINT

A Limit Reference Point (LRP) was proposed based on the ICES guidelines (ICES 2017) for “spasmodic stocks” – stocks which are characterized by sporadic, large recruitment events. For such stocks, a B_{LIM} is recommended based on the lowest SSB where large recruitment is observed.

For Subdivision 3Ps Haddock, “large” recruitment was defined as a recruitment index anomaly amongst the 90th percentile. Recruitment anomalies (Figure 18) were calculated as the percent

difference from the series mean, with means calculated separately for the Yankee, Engel and Campelen series, as conversion factors are not available for this stock. The 90th percentile was chosen to constitute above average recruitment levels, while not being so high as to represent only the largest recorded recruitment events. Given that the distribution of the data is skewed towards very low recruitment with a number of years at or near zero, lower percentiles examined (i.e. below the 85th percentile, where the 85th percentile = +1.7% difference from mean recruitment) extended into negative anomalies indicating levels of below average recruitment. Recruitment indices in 1982, 1988, 1989, 1999, and 2007 were within the 90th percentile, and therefore classified from this method as “large” recruitment events in this stock.

In order to be comparable to ongoing surveys, only values within the Campelen series were considered within the selection of B_{LIM}, as no gear conversion factors are available for this stock. Note that due to an incomplete survey in 2006, the SSB value that resulted in the strong 2007 recruitment index is unavailable and could therefore not be included in the selection of the LRP. A stock-recruit scatter (Figure 19) indicated that the lowest SSB to create a large recruitment event during the Campelen series occurred from the SSB in 1998, resulting in the strong recruitment observed in the survey in 1999. The value of SSB from 1998 was therefore adopted as B_{LIM} for this stock. The stock is currently at 35% of B_{LIM} and therefore in the critical zone.

As this Limit Reference Point is based on the single lowest SSB value to yield large recruitment (and the only available value in the Campelen series which resulted in large recruitment), the level of the LRP should be re-evaluated when another large recruitment event is observed in the RV survey.

SUMMARY

- This stock has been under moratorium since 1993. Bycatch of Haddock averaged 332 t from 2014-17, with the largest proportion taken in the Atlantic Cod fishery.
- The ecosystem in Subdivision 3Ps remains under reduced productivity conditions. Spring bloom magnitude and zooplankton biomass have shown very low levels since 2014, with late spring blooms from 2013-17. These conditions could negatively impact transfer of energy to higher trophic levels.
- Abundance, biomass, and SSB from the RV survey have been at or below the Campelen series (1996-2018) average for the last 4 years.
- This stock is characterized by sporadic large recruitment events. The last significant recruitment index (<20.5 cm) was observed in 2007. No recruits were caught during RV surveys in 2017 or 2018.
- A Limit Reference Point (LRP) was accepted for this stock with B_{LIM} defined at the lowest SSB in the Campelen series where a large recruitment event was observed (B_{LIM} = SSB 1998). The stock is currently at 34% of B_{LIM}. The LRP will be re-evaluated when the next large recruitment event is observed.
- This stock is currently in the Critical Zone. Consistent with the DFO decision-making framework incorporating the precautionary approach, removals from all sources must be kept at the lowest possible level until the stock clears the critical zone.

REFERNCES CITED

Begg, G. A. 1998. A Review of Stock Identification of Haddock, *Melanogrammus aeglefinus*, in the Northwest Atlantic Ocean. Mar. Fish. Rev. 60(4): 15 pp.

DFO. 2014. Stock Assessment on Subdivision 3Ps Haddock (*Melanogrammus aeglefinus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/044.

DFO. 2018. Stock Assessment of NAFO Divisions 3LNO Haddock. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/009.

Dwyer, K.S., Ings, D.W., Rideout, R.M., Healey, B.P., Morgan, M.J., and D. Power. 2016. Status of Haddock (*Melanogrammus aeglefinus*) in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/054. v + 27 p.

ICES 2017. ICES Advice Technical Guidelines, 12.4.3.1 ICES fisheries management reference points for category 1 and 2 stocks. 20 January 2017. DOI: 10.17895/ices.pub.3036.

Platt, T., Fuentes-Yaco, C., and K.T. Frank. 2003. Spring algal bloom and larval fish survival. Nature, 423: 398-399.

Rockwood, H. 2016. Southern Newfoundland Waters Under Changing Ocean Conditions: Diets and Spatial Distributions of Emerging and Re-Emerging Gadoids Within NAFO Subdivision 3Ps. MSc Thesis, Memorial University of Newfoundland. St. John's, NL.

Rogers, R., Rowe, S., and M.J. Morgan. 2016a. Depth and temperature associations of haddock *Melanogrammus aeglefinus* off southern Newfoundland. Journal of Fish Biology, 89(5): 2306-2325.

Rogers, R. and M.J. Morgan. 2016b. Lack of life history change in two over-exploited haddock (*Melanogrammus aeglefinus*) stocks. Fisheries Research, 181:77-83.

Smith, S.J., and G.D. Somerton. 1981. STRAP: A user-oriented computer analysis system for groundfish research trawl survey data. Can. Tech. Rep. Fish. Aquat. Sci. 1030: iv + 66 p.

Templeman, W. and C. A. Bishop. 1979a. Age, growth, year-class strength, and mortality of Haddock, *Melanogrammus aeglefinus*, on St. Pierre Bank in 1948–75 and their relation to the Haddock fishery of this area. Int. Comm. Northwest Atl. Fish. Res. Bull. 14: 85–99.

Templeman, W. and C. A. Bishop. 1979b. Sexual maturity and spawning in Haddock, *Melanogrammus aeglefinus*, of St. Pierre Bank. Int. Comm. Northwest Atl. Fish. Res. Bull. 14: 77–84.

Templeman, W., Hodder, V. M., and R. Wells. 1978a. Age, growth, year-class strength, and mortality of the Haddock, *Melanogrammus aeglefinus*, on the southern Grand Bank and their relation to the Haddock fishery of this area. Int. Comm. Northwest Atl. Fish. Res. Bull. 13: 31–52.

Templeman, W., Hodder, V. M., and R. Wells. 1978b. Sexual maturity and spawning in Haddock, *Melanogrammus aeglefinus*, of the southern Grand Bank. Int. Comm. Northwest Atl. Fish. Res. Bull. 13: 53–65.

Warren, W., Brodie, W., Stansbury, D., Walsh, S., Morgan, J.M., and D. Orr. 1997. Analysis of the 1996 comparative fishing trial between the Alfred Needler with the Engel 145 trawl and theWilfred Templeman with the Campelen 1800 trawl. NAFO SCR Doc., No. 68, Serial No.N2902. 12 p.

TABLES

Table 1. Landings (t) of Haddock in NAFO Subdivision 3Ps. Landings from 2000 onwards are by quota year (April to March). 2015-2017 values are preliminary.

Year	Total Landings (t)	Year	Total Landings (t)
1953	5849	1986	5413
1954	27179	1987	2687
1955	57797	1988	2387
1956	29940	1989	2920
1957	6079	1990	1857
1958	959	1991	734
1959	2750	1992	611
1960	4084	1993	142
1961	2757	1994	22
1962	1481	1995	67
1963	1856	1996	152
1964	2096	1997	84
1965	1438	1998	621
1966	1999	1999	110
1967	2362	2000	183
1968	2766	2001	220
1969	3498	2002	349
1970	4333	2003	400
1971	1477	2004	330
1972	901	2005	337
1973	650	2006	216
1974	388	2007	493
1975	147	2008	297
1976	245	2009	233
1977	793	2010	108
1978	603	2011	153
1979	251	2012	159
1980	448	2013	243
1981	445	2014	306
1982	309	2015*	430
1983	474	2016*	430
1984	2748	2017*	253
1985	7498	-	*preliminary

*Table 2. Biomass estimates (tons) of Haddock by stratum for DFO spring RV Surveys – Yankee series (1972-1983). Cells noted by * and shading were not sampled.*

Depth	Stratum	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
<=56	**314**	0	*	0	*	7	0	0	*	0	0	7	63
<=56	**320**	*	0	*	*	0	*	*	*	0	0	105	94
57-91	**293**	*	*	*	*	*	*	*	*	*	*	*	*
57-91	**308**	*	0	0	0	0	0	0	0	0	19	0	0
57-91	**312**	7	*	0	0	0	0	0	0	*	0	0	5
57-91	**315**	0	0	0	*	0	0	*	0	0	0	0	31
57-91	**321**	0	0	*	*	0	*	0	*	8	0	0	0
57-91	**325**	*	*	*	*	0	*	0	0	0	0	0	0
57-91	**326**	*	*	*	*	*	*	0	0	0	0	0	0
57-91	**783**	*	*	*	*	*	*	*	*	*	*	*	*
92-183	**294**	*	*	*	*	*	*	*	*	*	*	*	*
92-183	**297**	*	*	*	*	*	*	*	*	*	*	*	*
92-183	**307**	314	0	152	111	0	30	12	19	74	0	342	22
92-183	**311**	113	0	85	22	392	221	0	1	0	1	0	20
92-183	**317**	148	3	89	13	92	204	2	20	0	87	333	192
92-183	**319**	17	12	3	141	84	1357	201	0	0	0	293	633
92-183	**322**	*	*	*	*	3	*	0	0	0	0	0	0
92-183	**323**	4	*	*	*	0	0	0	*	0	0	0	0
92-183	**324**	*	*	*	*	0	*	*	0	0	*	0	0
92-183	**781**	*	*	*	*	*	*	*	*	*	*	*	*
92-183	**782**	*	*	*	*	*	*	*	*	*	*	*	*
184-274	**295**	*	*	*	*	*	*	*	*	*	*	*	*
184-274	**298**	*	*	*	*	*	*	*	*	*	*	*	*
184-274	**300**	*	*	*	*	*	*	*	*	*	*	*	*
184-274	**306**	*	*	26	0	86	0	14	137	0	142	28	67
184-274	**309**	262	87	2	10	0	0	25	10	0	7	0	15
184-274	**310**	*	*	75	215	*	2	23	14	0	0	213	7
184-274	**313**	205	56	160	79	202	103	57	40	133	149	152	929
184-274	**316**	61	99	168	*	35	74	10	80	106	31	*	156
184-274	**318**	*	5	0	9	0	3	0	14	105	*	69	51
184-274	**779**	*	*	*	*	*	*	*	*	*	*	*	*
184-274	**780**	*	*	*	*	*	*	*	*	*	*	*	*
275-366	**296**	*	*	*	*	*	*	*	*	*	*	*	*
275-366	**299**	*	*	*	*	*	*	*	*	*	*	*	*
275-366	**705**	528	0	60	0	37	0	37	6	0	0	0	0
275-366	**706**	44	231	51	*	*	112	0	87	373	0	0	0
275-366	**707**	0	*	0	0	0	0	0	307	0	*	*	0
275-366	**715**	0	*	11	20	0	0	4	37	29	12	26	59
275-366	**716**	69	*	31	*	*	0	40	0	0	25	0	0
367-549	**708**	*	*	*	0	*	0	*	0	0	*	*	0
367-549	**711**	*	*	*	*	*	*	*	*	0	0	0	0
367-549	**712**	*	*	*	*	*	*	*	0	0	0	0	0
367-549	**713**	*	*	*	0	*	*	*	*	0	0	0	0
367-549	**714**	*	*	*	*	*	*	0	*	0	0	0	0
550-732	**709**	*	*	*	*	*	*	*	*	*	*	*	*
550-732	**709**	*	*	*	*	*	*	*	*	*	*	*	0
550-732	**710**	*	*	*	*	*	*	*	*	*	*	*	0

*Table 3. Biomass estimates (tons) of Haddock by stratum for DFO spring RV Surveys – Engel series (1984-1995). Cells noted by * and shading were not sampled.*

Depth	Stratum	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
<=56	**314**	0	0	0	0	0	0	0	0	0	0	0	0
<=56	**320**	111	0	0	0	0	0	0	0	0	0	0	0
57-91	**293**	*	*	*	*	*	*	*	*	*	*	*	*
57-91	**308**	32	0	0	0	0	0	0	0	0	0	0	0
57-91	**312**	1327	0	0	0	0	0	0	0	0	0	0	0
57-91	**315**	1	0	0	0	1	0	0	0	0	0	0	0
57-91	**321**	0	0	0	0	0	0	0	8	0	0	0	0
57-91	**325**	0	0	0	0	0	0	0	0	0	0	0	0
57-91	**326**	0	*	0	0	0	0	0	0	0	0	0	0
57-91	**783**	*	*	*	*	*	*	*	*	*	*	0	*
92-183	**294**	*	*	*	*	*	*	*	*	*	*	*	*
92-183	**297**	*	*	*	*	*	*	*	*	*	*	*	*
92-183	**307**	185	12	390	1408	331	30	0	2	0	0	0	0
92-183	**311**	1178	9	4	0	90	0	8	0	0	0	0	0
92-183	**317**	56	0	0	0	1	0	0	0	0	0	0	0
92-183	**319**	3509	1108	129	164	332	74	*	0	0	6	0	17
92-183	**322**	0	5	0	0	0	0	0	0	0	0	0	0
92-183	**323**	0	3	0	2	0	0	0	0	0	0	0	0
92-183	**324**	0	0	0	0	1	0	0	0	0	0	0	0
92-183	**781**	*	*	*	*	*	*	*	*	*	*	0	0
92-183	**782**	*	*	*	*	*	*	*	*	*	*	0	0
184-274	**295**	*	*	*	*	*	*	*	*	*	*	*	*
184-274	**298**	*	*	*	*	*	*	*	*	*	*	*	*
184-274	**300**	*	*	*	*	*	*	*	*	*	*	*	*
184-274	**306**	0	1195	105	841	307	15	102	0	0	1	11	0
184-274	**309**	0	354	239	286	527	217	34	24	0	98	0	0
184-274	**310**	0	4105	762	1180	116	43	0	0	0	79	117	0
184-274	**313**	0	917	511	2598	19	508	7	26	5	0	8	28
184-274	**316**	28	493	401	362	38	158	36	8	55	55	14	5
184-274	**318**	9	*	7878	307	42	194	*	129	23	128	6	1094
184-274	**779**	*	*	*	*	*	*	*	*	*	*	0	0
184-274	**780**	*	*	*	*	*	*	*	*	*	*	0	0
275-366	**296**	*	*	*	*	*	*	*	*	*	*	*	*
275-366	**299**	*	*	*	*	*	*	*	*	*	*	*	*
275-366	**705**	0	3026	2357	139	176	0	193	3	0	161	174	158
275-366	**706**	0	670	1237	907	652	665	603	102	409	74	13	43
275-366	**707**	0	*	1817	234	960	576	*	240	502	149	5	73
275-366	**715**	5	*	37	25	67	69	60	3	42	43	25	0
275-366	**716**	0	20392	1912	1243	1380	3070	2089	4	0	0	101	26
367-549	**708**	0	*	37	211	176	83	*	0	0	0	2597	7
367-549	**711**	0	0	393	113	0	0	0	24	0	0	0	0
367-549	**712**	*	61	32	37	0	0	26	0	0	0	0	0
367-549	**713**	*	0	14	36	0	0	0	15	0	0	0	0
367-549	**714**	*	*	54	0	27	49	0	0	9	0	0	0
550-732	**709**	*	*	*	*	*	*	*	*	*	*	0	0
550-732	**709**	0	*	*	*	*	0	*	0	*	0	*	*
550-732	**710**	0	0	0	*	0	*	*	0	*	0	0	*

*Table 4. Biomass estimates (tons) of Haddock by stratum for DFO spring RV Surveys – Campelen series (1996-2018). Cells noted by * and shading were not sampled.*

Depth	Stratum	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<=56	314	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<=56	320	0	0	0	6	2	0	0	0	0	0	0	0	0	0	13	1	0	40	0	0	0	186
57-91	293	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-91	308	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-91	312	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-91	315	0	0	0	0	12	0	0	0	0	0	0	0	0	0	120	79	0	99	0	0	0	32
57-91	321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
57-91	325	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
57-91	326	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-91	783	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92-183	294	*	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0
92-183	297	*	0	0	0	17	0	0	0	0	270	0	0	0	136	0	1	0	0	0	0	0	127
92-183	307	0	0	0	45	5	6	0	0	0	0	0	0	0	9	51	0	0	180	0	24	0	0
92-183	311	0	0	0	595	0	0	0	0	0	1	1	0	6	407	194	0	1	539	0	43	0	58
92-183	317	0	0	0	9	0	0	0	0	0	31	1	41	4	608	0	78	1	25	0	193	0	7
92-183	319	768	1	4347	427	4017	1607	4092	6	5226	3128	168	69	1044	2607	1601	854	3319	1912	1345	1163	359	611
92-183	322	0	0	0	0	0	0	0	0	0	0	2	0	0	0	19	2	11	32	0	0	0	0
92-183	323	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	0	97	0	0	0
92-183	324	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	7	0	0	0	0	0
92-183	781	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
92-183	782	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
184-274	295	*	0	0	0	5	0	0	0	0	0	0	0	0	0	*	0	0	0	0	0	0	0
184-274	298	*	0	171	0	159	3	12	0	60	1	29	2	89	0	0	1	2	13	30	0	4	0
184-274	300	*	0	0	0	0	0	0	0	0	0	7	0	187	57	0	0	3	8	0	0	5	0
184-274	306	0	0	0	0	0	0	0	0	0	0	0	14	6	14	0	0	0	11	144	0	0	43
184-274	309	0	0	67	0	0	22	0	0	0	0	0	0	0	0	0	0	6	0	0	156	0	0
184-274	310	26	36	0	1	0	109	0	8	0	19	73	67	4	0	0	0	132	128	151	184	497	196
184-274	313	0	47	0	77	13	82	137	208	0	67	0	157	179	63	68	233	54	544	4	61	163	61
184-274	316	1	12	183	0	0	292	173	214	313	281	931	51	0	36	0	76	421	279	19	1	4	0
184-274	318	32	3	0	1	0	65	300	359	19	65	28	0	0	14	0	0	0	185	33	0	0	105
184-274	779	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	4	0	0	0	0
184-274	780	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275-366	296	*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275-366	299	*	0	0	0	0	0	0	0	26	0	54	0	0	0	0	0	6	90	0	0	0	0
275-366	705	118	0	197	0	0	0	0	64	93	0	137	0	44	0	0	0	332	0	0	0	0	0
275-366	706	0	0	48	0	0	0	28	56	0	0	0	0	0	0	0	0	63	130	0	0	110	0
275-366	707	13	4	0	0	0	0	11	0	0	0	0	0	0	4	0	0	0	0	0	0	0	*
275-366	715	32	34	0	22	0	9	0	0	18	0	28	0	0	0	0	0	0	0	0	1	0	*
275-366	716	199	0	0	76	0	0	0	0	0	0	0	194	0	13	0	0	474	343	0	0	65	0
367-549	708	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	*	0	*
367-549	711	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
367-549	712	0	0	0	0	0	0	0	0	34	0	0	0	0	0	0	0	0	0	0	0	36	0
367-549	713	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
367-549	714	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
550-732	709	0	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	0	0
550-732	709	0	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	0	0
550-732	710	*	*	*	0	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

*Table 5. Abundance estimates (000s) of Haddock by stratum for DFO spring RV Surveys – Yankee series (1972-1983). Cells noted by * and shading were not sampled.*

Depth	Stratum	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
<=56	**314**	0	*	0	*	73	0	0	*	0	0	88
<=56	**320**	*	0	*	*	0	*	*	*	0	0	1982
57-91	**293**	*	*	*	*	*	*	*	*	*	*	*
57-91	**308**	*	0	0	0	0	0	0	0	0	4	0
57-91	**312**	31	*	0	0	0	0	0	0	*	0	0
57-91	**315**	0	0	0	*	0	0	*	0	0	0	0
57-91	**321**	0	0	*	*	0	*	0	*	18	0	0
57-91	**325**	*	*	*	*	0	*	0	0	0	0	0
57-91	**326**	*	*	*	*	*	*	0	0	0	0	0
57-91	**783**	*	*	*	*	*	*	*	*	*	*	*
92-183	**294**	*	*	*	*	*	*	*	*	*	*	*
92-183	**297**	*	*	*	*	*	*	*	*	*	*	*
92-183	**307**	346	0	106	46	0	44	13	22	44	0	356
92-183	**311**	113	0	116	6	262	173	0	36	0	24	0
92-183	**317**	554	25	92	7	83	453	11	5	0	51	7364
92-183	**319**	37	15	37	136	55	812	111	0	0	0	2416
92-183	**322**	*	*	*	*	29	*	0	0	0	0	29
92-183	**323**	35	*	*	*	0	0	0	*	0	0	0
92-183	**324**	*	*	*	*	0	*	*	0	0	*	0
92-183	**781**	*	*	*	*	*	*	*	*	*	*	*
92-183	**782**	*	*	*	*	*	*	*	*	*	*	*
184-274	**295**	*	*	*	*	*	*	*	*	*	*	*
184-274	**298**	*	*	*	*	*	*	*	*	*	*	*
184-274	**300**	*	*	*	*	*	*	*	*	*	*	*
184-274	**306**	*	*	10	0	47	0	7	75	0	126	10
184-274	**309**	144	74	6	4	0	0	17	7	0	33	0
184-274	**310**	*	*	21	160	*	2	57	19	0	0	1059
184-274	**313**	142	613	62	70	120	44	45	25	37	68	266
184-274	**316**	64	350	177	*	14	19	17	113	43	21	*
184-274	**318**	*	42	0	12	0	3	0	14	46	*	1020
184-274	**779**	*	*	*	*	*	*	*	*	*	*	*
184-274	**780**	*	*	*	*	*	*	*	*	*	*	*
275-366	**296**	*	*	*	*	*	*	*	*	*	*	*
275-366	**299**	*	*	*		*	*	*	*	*	*	*
275-366	**705**	329	0	26	0	7	0	9	4	0	0	0
275-366	**706**	18	71	10	*	*	38	0	36	161	0	0
275-366	**707**	0	*	0	0	0	0	0	171	0	*	*
275-366	**715**	0	*	2	15	0	0	2	26	10	5	10
275-366	**716**	40	*	13	*	*	0	27	0	0	10	0
367-549	**708**	*	*	*	0	*	0	*	0	0	*	*
367-549	**711**	*	*	*	*	*	*	*	*	0	0	0
367-549	**712**	*	*	*	*	*	*	*	0	0	0	0
367-549	**713**	*	*	*	0	*	*	*	*	0	0	0
367-549	**714**	*	*	*	*	*	*	0	*	0	0	0
550-732	**709**	*	*	*	*	*	*	*	*	*	*	*
550-732	**710**	*	*	*	*	*	*	*	*	*	*	*

*Table 6. Abundance estimates (000s) of Haddock by stratum for DFO spring RV Surveys – Engel series (1984-1995). Cells noted by * and shading were not sampled.*

Depth	Stratum	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
<=56	314	209	0	0	0	0	0	0	0	0	0	0	0	0
<=56	320	368	163	0	0	0	0	0	0	0	0	0	0	0
57-91	293	*	*	*	*	*	*	*	*	*	*	*	*	*
57-91	308	0	17	0	0	0	0	0	0	0	0	0	0	0
57-91	312	7	1756	0	0	0	0	0	0	0	0	0	0	0
57-91	315	8	12	0	0	0	10	0	0	0	0	0	0	0
57-91	321	0	0	0	0	0	0	0	0	16	0	0	0	0
57-91	325	0	0	0	0	0	0	0	0	0	0	0	0	0
57-91	326	0	0	*	0	0	0	0	0	0	0	0	0	0
57-91	783	*	*	*	*	*	*	*	*	*	*	*	0	*
92-183	294	*	*	*	*	*	*	*	*	*	*	*	*	*
92-183	297	*	*	*	*	*	*	*	*	*	*	*	*	*
92-183	307	30	193	10	217	870	200	20	0	10	0	0	0	0
92-183	311	95	1785	6	71	0	946	0	8	0	0	0	0	0
92-183	317	1173	159	0	0	0	22	0	7	0	0	0	0	0
92-183	319	2395	3545	1256	185	205	286	46	*	0	0	12	0	9
92-183	322	0	0	18	0	0	0	0	0	0	0	0	0	0
92-183	323	0	0	17	0	9	0	7	0	0	0	0	0	0
92-183	324	0	0	0	0	0	9	0	0	0	0	0	0	0
92-183	781	*	*	*	*	*	*	*	*	*	*	*	0	0
92-183	782	*	*	*	*	*	*	*	*	*	*	*	0	0
184-274	295	*	*	*	*	*	*	*	*	*	*	*	*	*
184-274	298	*	*	*	*	*	*	*	*	*	*	*	*	*
184-274	300	*	*	*	*	*	*	*	*	*	*	*	*	*
184-274	306	110	0	1085	73	480	173	52	63	0	0	8	8	0
184-274	309	15	0	348	189	156	296	122	11	22	0	56	0	0
184-274	310	13	0	3756	466	683	72	172	6	0	0	26	38	0
184-274	313	1965	0	898	334	1263	12	1994	31	25	31	0	6	25
184-274	316	113	14	629	135	241	19	3310	184	28	227	19	7	7
184-274	318	163	9	*	11149	309	65	78	*	896	50	92	15	702
184-274	779	*	*	*	*	*	*	*	*	*	*	*	0	0
184-274	780	*	*	*	*	*	*	*	*	*	*	*	0	0
275-366	296	*	*	*	*	*	*	*	*	*	*	*	*	*
275-366	299	*	*	*	*	*	*	*	*	*	*	*	*	*
275-366	705	0	0	3045	1493	73	59	0	51	7	0	37	34	37
275-366	706	0	0	572	679	436	241	214	179	45	100	14	9	18
275-366	707	0	0	*	1874	150	520	264	*	321	286	106	19	36
275-366	715	20	5	*	20	15	30	25	59	15	25	17	5	0
275-366	716	0	0	18628	1295	580	566	890	566	16	0	0	16	8
367-549	708	0	0	*	26	167	97	44	*	0	0	0	2407	5
367-549	711	0	0	0	224	52	0	10	0	9	0	0	0	0
367-549	712	0	*	61	8	18	0	0	15	0	0	0	0	0
367-549	713	0	*	0	14	18	0	0	0	9	0	0	0	0
367-549	714	0	*	*	18	0	10	18	0	0	26	0	0	0
550-732	709	0	0	*	*	*	*	0	*	0	*	0	0	0
550-732	710	0	0	0	0	*	0	*	*	0	*	0	0	*

*Table 7. Abundance estimates (000s) of Haddock by stratum for DFO spring RV Surveys – Campelen series (1996-2018). Cells noted by * and shading were not sampled.*

Depth	Stratum	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<=56	314	0	0	0	0	0	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0
<=56	320	0	0	0	101	17	0	0	0	0	0	0	0	0	0	38	18	0	45	0	0	0	50
57-91	293	*	0	0	11	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0
57-91	308	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-91	312	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-91	315	0	0	0	0	49	0	0	0	0	0	0	0	0	0	81	1056	0	114	0	0	0	16
57-91	321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0
57-91	325	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0
57-91	326	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-91	783	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92-183	294	*	0	8	0	0	0	0	0	0	0	102	0	0	0	0	25	0	0	0	0	0	0
92-183	297	*	0	0	9	54	0	0	0	0	94	0	0	0	167	0	9	0	0	0	0	0	84
92-183	307	0	0	0	96	18	16	0	0	0	0	0	0	0	16	36	0	0	272	0	18	0	0
92-183	311	0	0	0	6861	0	0	0	0	0	44	15	0	15	478	75	0	17	523	0	233	0	17
92-183	317	0	0	0	186	0	0	0	0	0	13	13	345	53	767	0	1155	15	186	0	1102	0	13
92-183	319	355	17	1709	2819	13055	3164	4247	17	3986	1644	152	34	1686	2576	1908	863	4680	2560	1523	1202	220	406
92-183	322	0	0	0	0	0	0	0	0	0	0	63	0	0	0	34	33	124	54	0	0	0	0
92-183	323	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	191	0	85	0	0	0
92-183	324	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	17	45	0	0	0	0	0
92-183	781	0	0	0	0	0	0	0	0	0	0	46	0	0	0	0	0	0	0	0	0	0	0
92-183	782	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0
184-274	295	*	0	0	0	14	0	0	0	0	0	13	0	0	0	*	0	0	0	0	0	0	0
184-274	298	*	0	42	0	365	12	10	0	24	12	31	12	31	0	0	10	13	21	24	0	12	0
184-274	300	*	0	0	0	0	0	0	0	0	0	15	0	124	72	0	0	13	15	0	0	17	0
184-274	306	0	0	0	0	0	0	0	0	0	0	0	76	15	13	0	0	0	50	166	0	0	33
184-274	309	0	0	18	0	0	41	0	0	0	0	0	0	0	0	0	0	20	0	0	143	0	0
184-274	310	12	10	0	12	0	84	0	12	0	10	210	58	9	0	0	0	94	83	199	117	187	58
184-274	313	0	11	0	11	34	108	79	159	0	32	0	57	40	19	34	102	32	644	11	23	477	23
184-274	316	13	26	52	0	0	208	104	169	127	117	18173	26	0	10	0	156	169	117	30	13	12	0
184-274	318	9	9	0	6	0	160	373	364	9	27	25	0	0	37	0	0	0	222	27	0	0	64
184-274	779	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	13	26	0	0	0	0
184-274	780	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275-366	296	*	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275-366	299	*	0	0	0	0	0	0	0	15	0	15	0	0	0	0	0	33	15	0	0	0	0
275-366	705	24	0	36	0	0	0	0	36	48	0	36	0	12	0	0	0	82	0	0	0	0	0
275-366	706	0	0	16	0	0	0	16	33	0	0	15	0	0	0	0	0	16	29	0	0	35	0
275-366	707	5	5	0	0	0	0	15	0	0	0	0	0	0	5	0	0	0	0	0	0	0	*
275-366	715	16	18	0	9	0	16	0	0	8	0	9	0	0	0	0	0	0	0	0	9	0	*
275-366	716	38	0	0	16	0	0	0	0	0	0	0	37	0	15	0	0	297	181	0	0	25	0
367-549	708	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	*	0	*
367-549	711	0	0	0	0	0	0	0	0	0	0	26	0	0	0	0	0	0	0	0	0	0	0
367-549	712	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	17	0
367-549	713	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
367-549	714	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
550-732	709	0	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	0	0
550-732	710	*	*	*	0	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

FIGURES

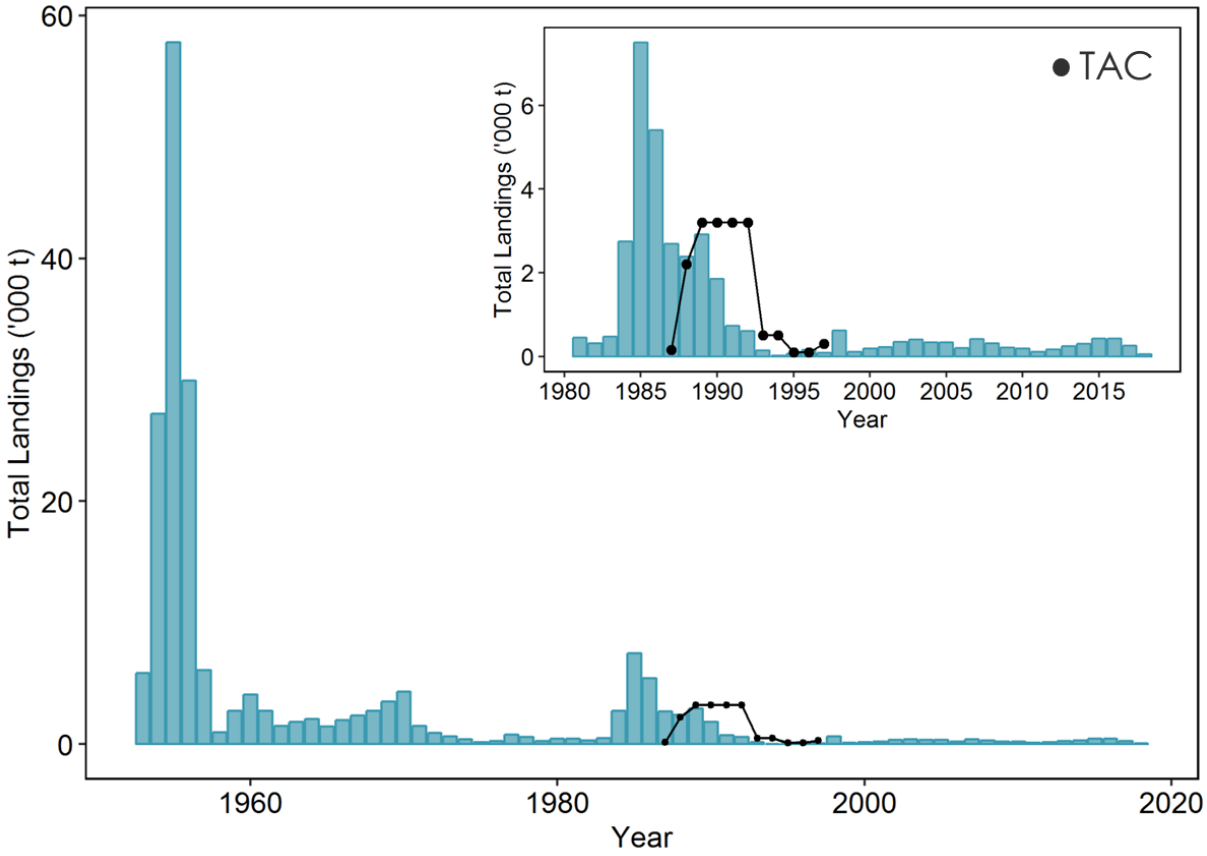

Figure 1. Total landings of Haddock in NAFO Subdivision 3Ps (Note: 2015-2017 landings data are provisional. Landings from 2000 onwards are presented by quota year (April – March)). Inset graph shows the period since 1980.

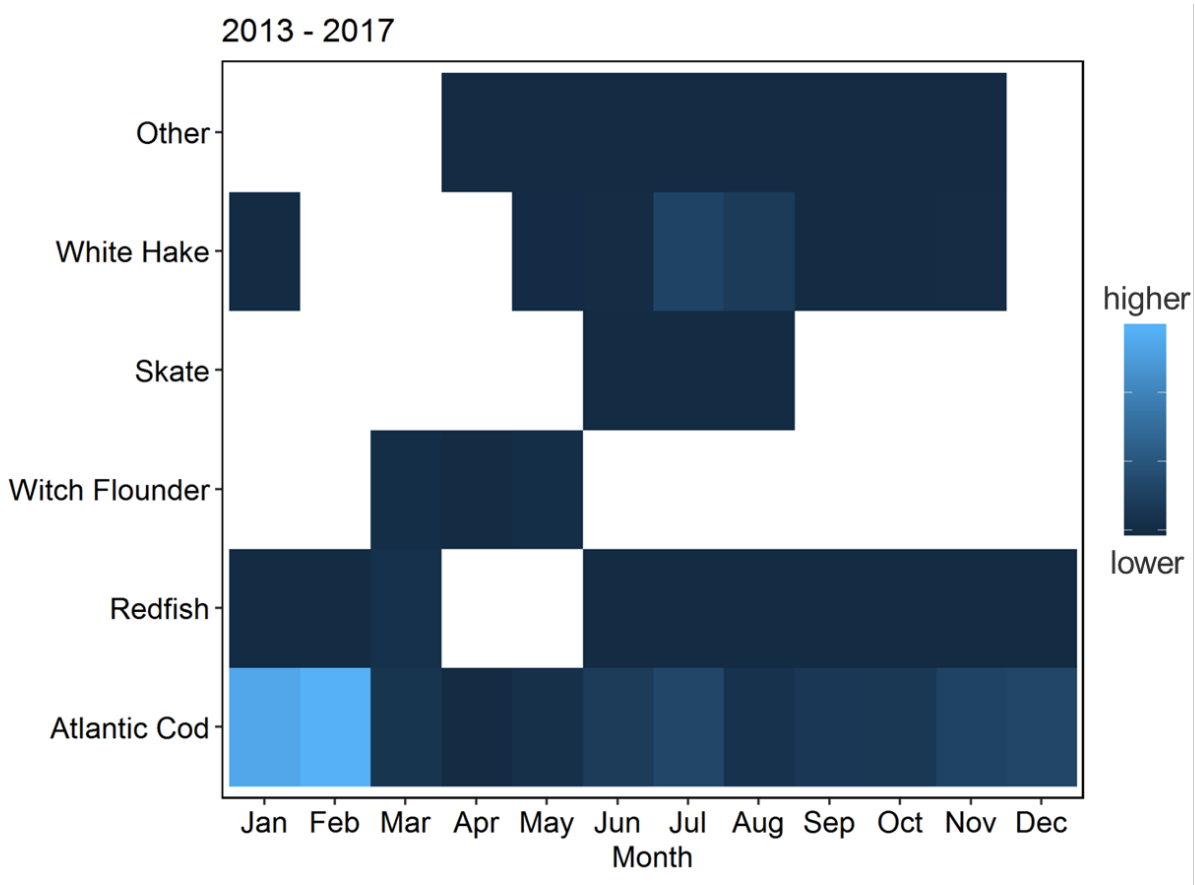

Figure 2. Relative distribution of haddock landings (Canada – Newfoundland) by target species and month from NAFO Subdivision 3Ps over 2013 to 2017.

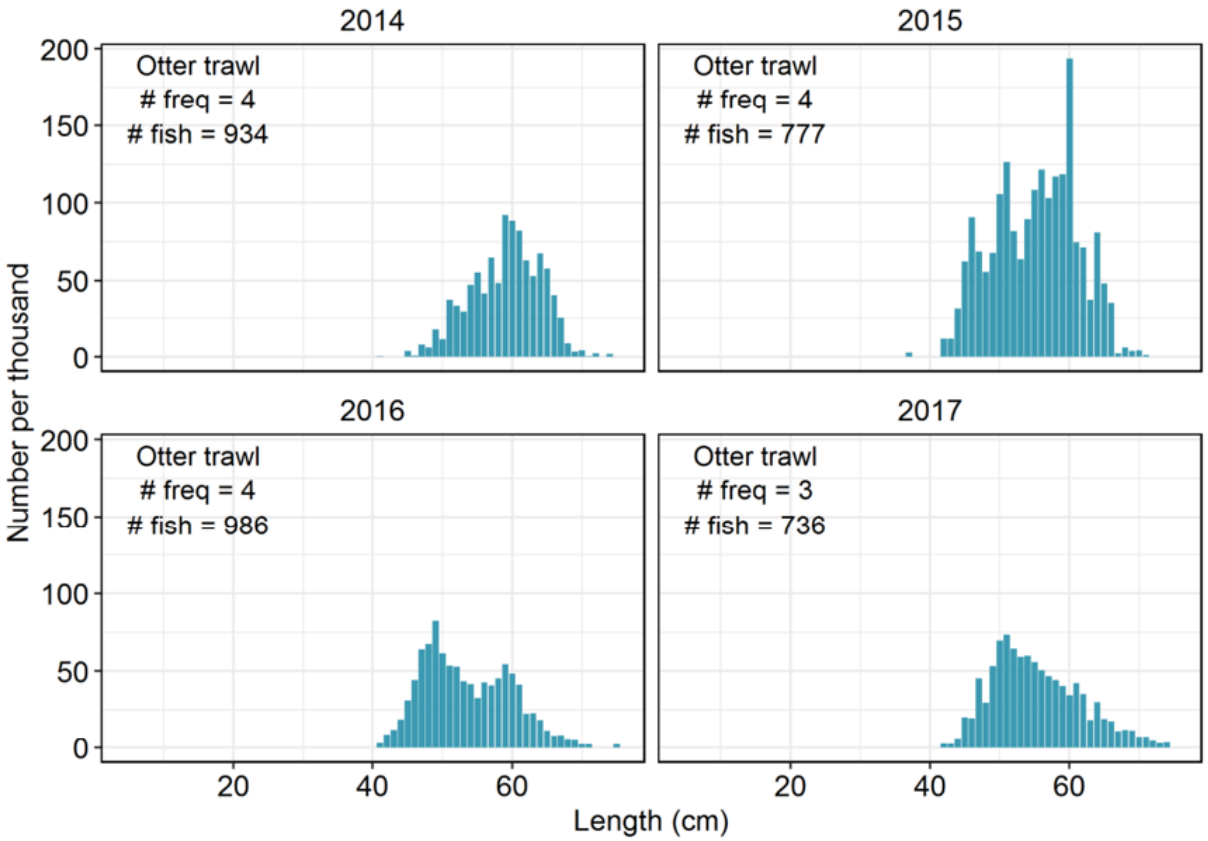

Figure 3. Length frequencies of haddock bycatch measured from observer and port sampling during commercial otter trawl fisheries.

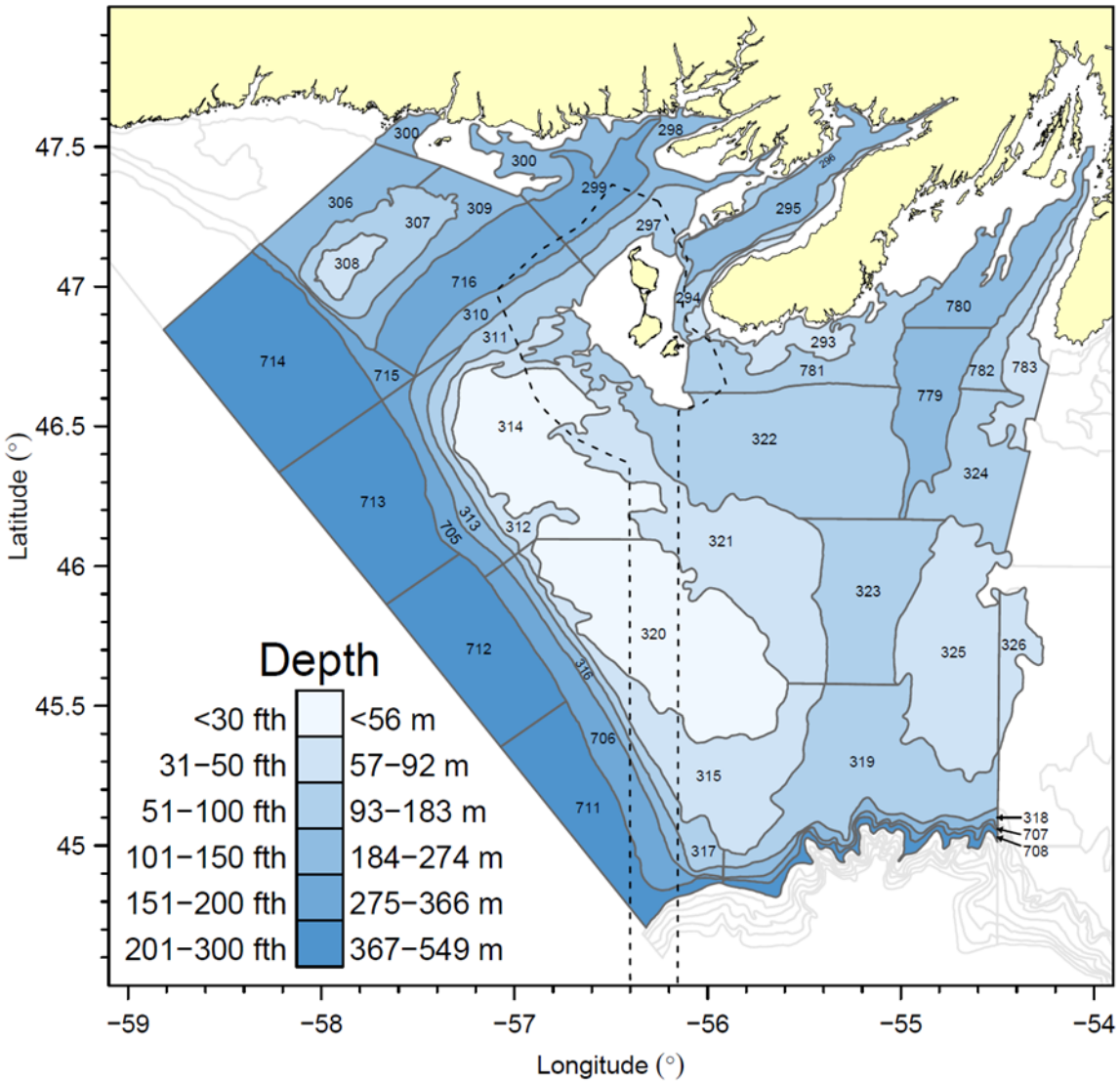

Figure 4. The survey area in NAFO Subdivision 3Ps showing strata boundaries currently used in the spring DFO RV bottom trawl survey.

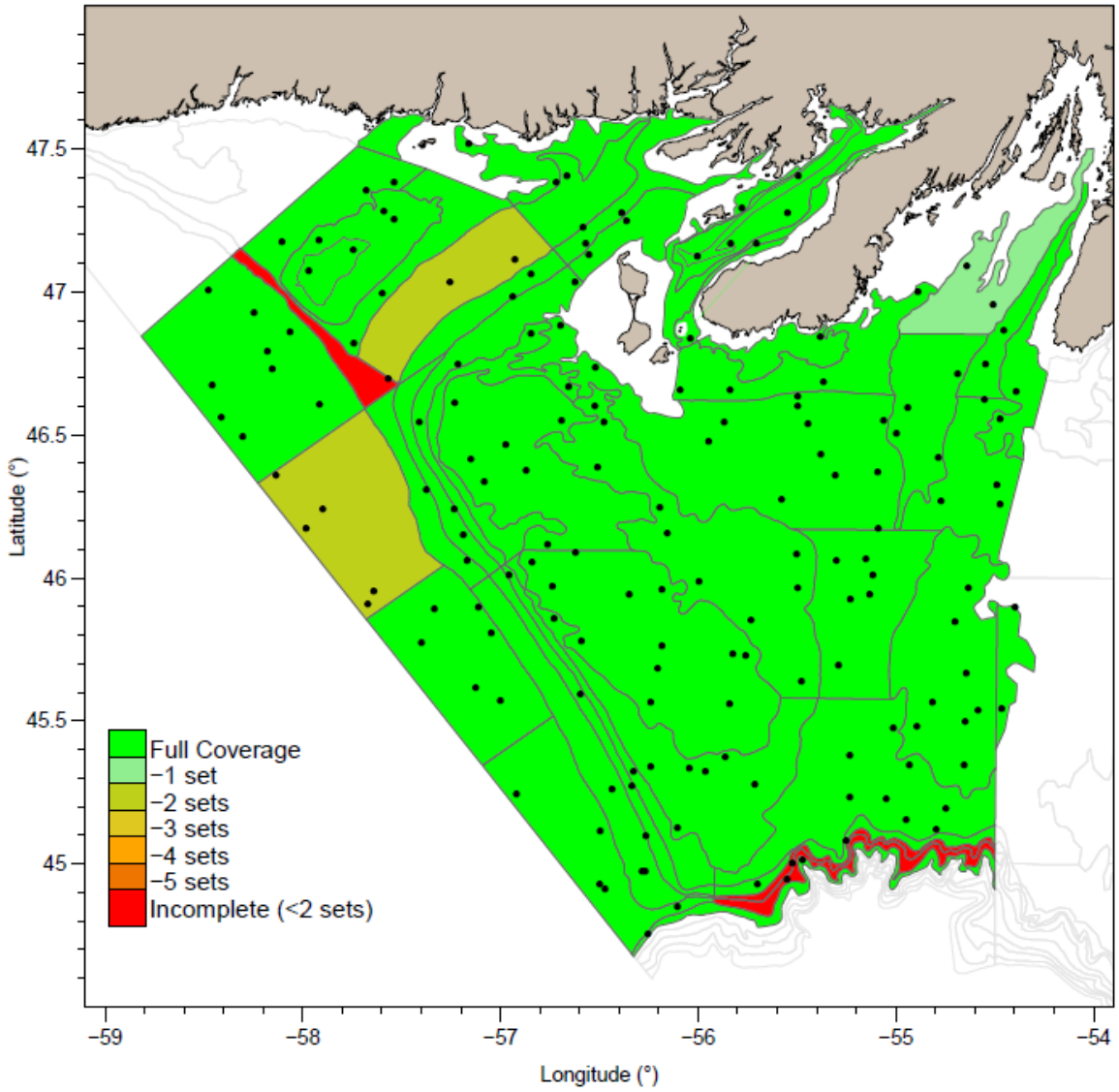

Figure 5. Coverage of survey strata during the 2018 DFO spring RV survey in NAFO Subdivision 3Ps. Symbols indicate set locations, and strata are coloured based on the number of sets successfully completed vs. the number intended. Bright green strata were fully covered, while incomplete strata (i.e. strata with fewer than 2 successful sets) are red. Incomplete strata are excluded from all analyses for 2018.

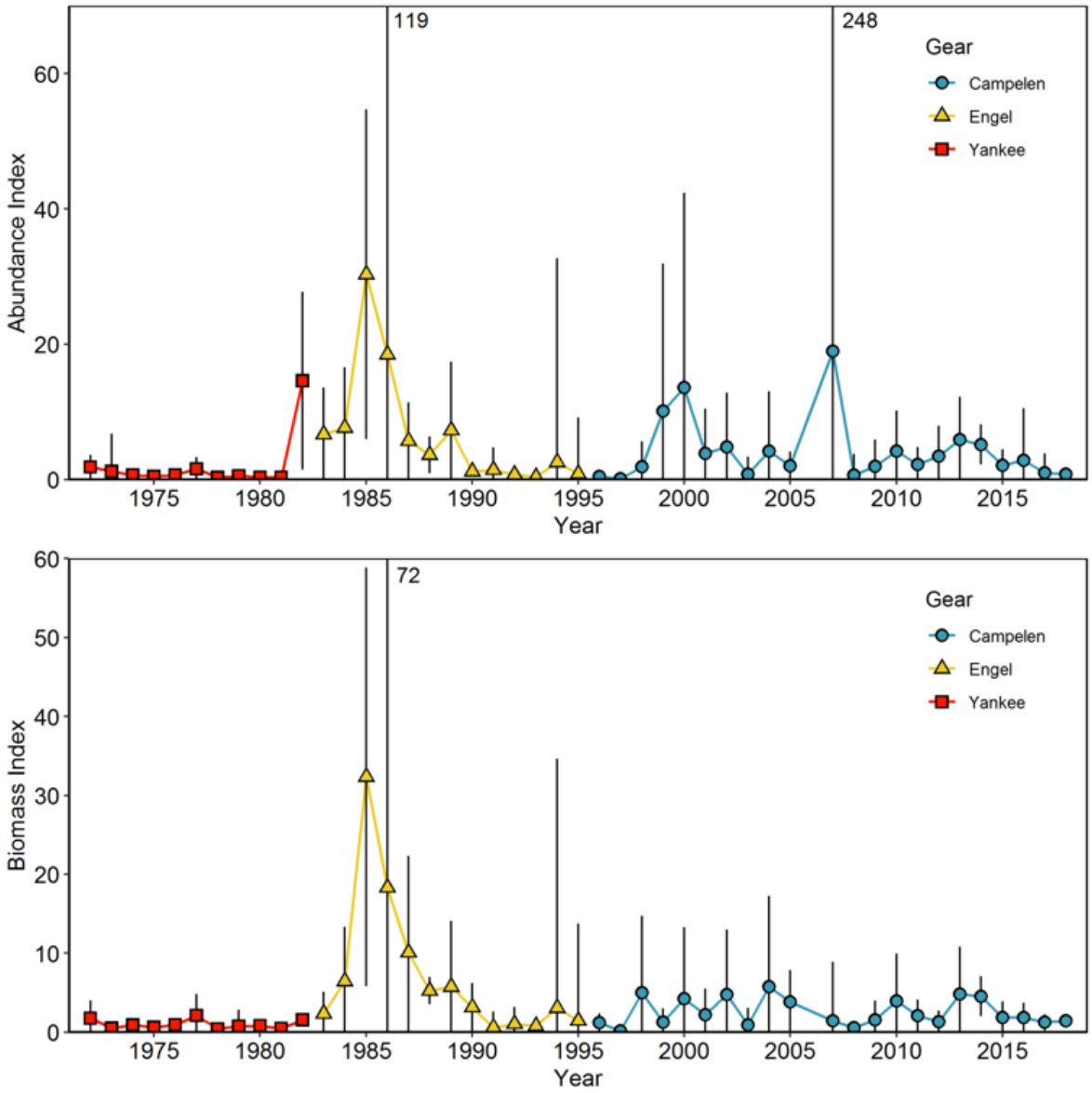

Figure 6. Abundance (top) and biomass (bottom) indices from annual fall DFO RV survey in NAFO Subdivision 3Ps. Survey series are presented by gear type (Yankee = red; Engel = yellow; Campelen = blue). As no conversion factors exist between gears for this stock, series cannot be directly compared and should be considered independently.

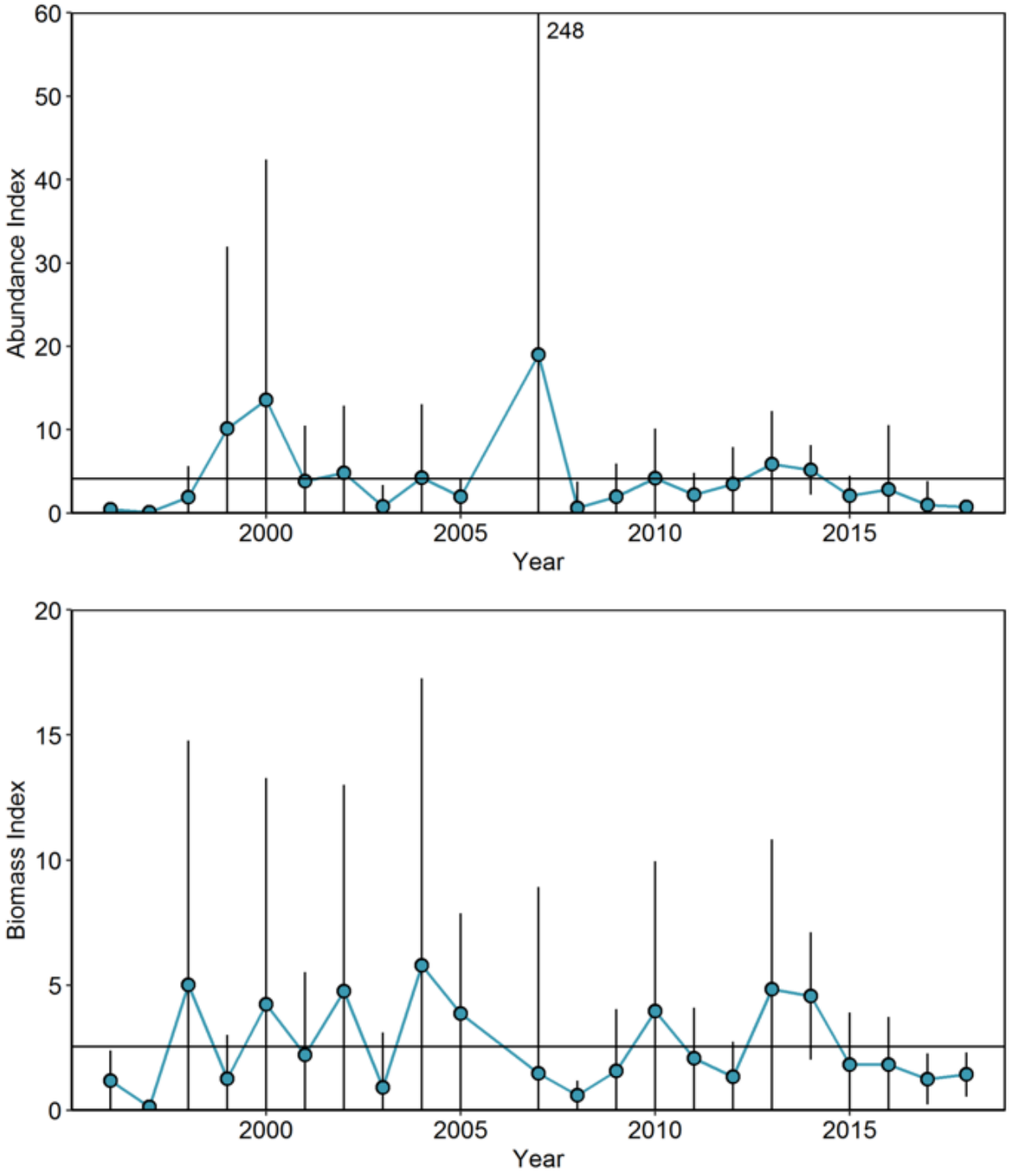

Figure 7. Abundance (top) and biomass (bottom) indices from annual fall DFO RV survey in NAFO subdivision 3Ps for the Campelen series only (1996-2018). Horizontal lines indicate series average.

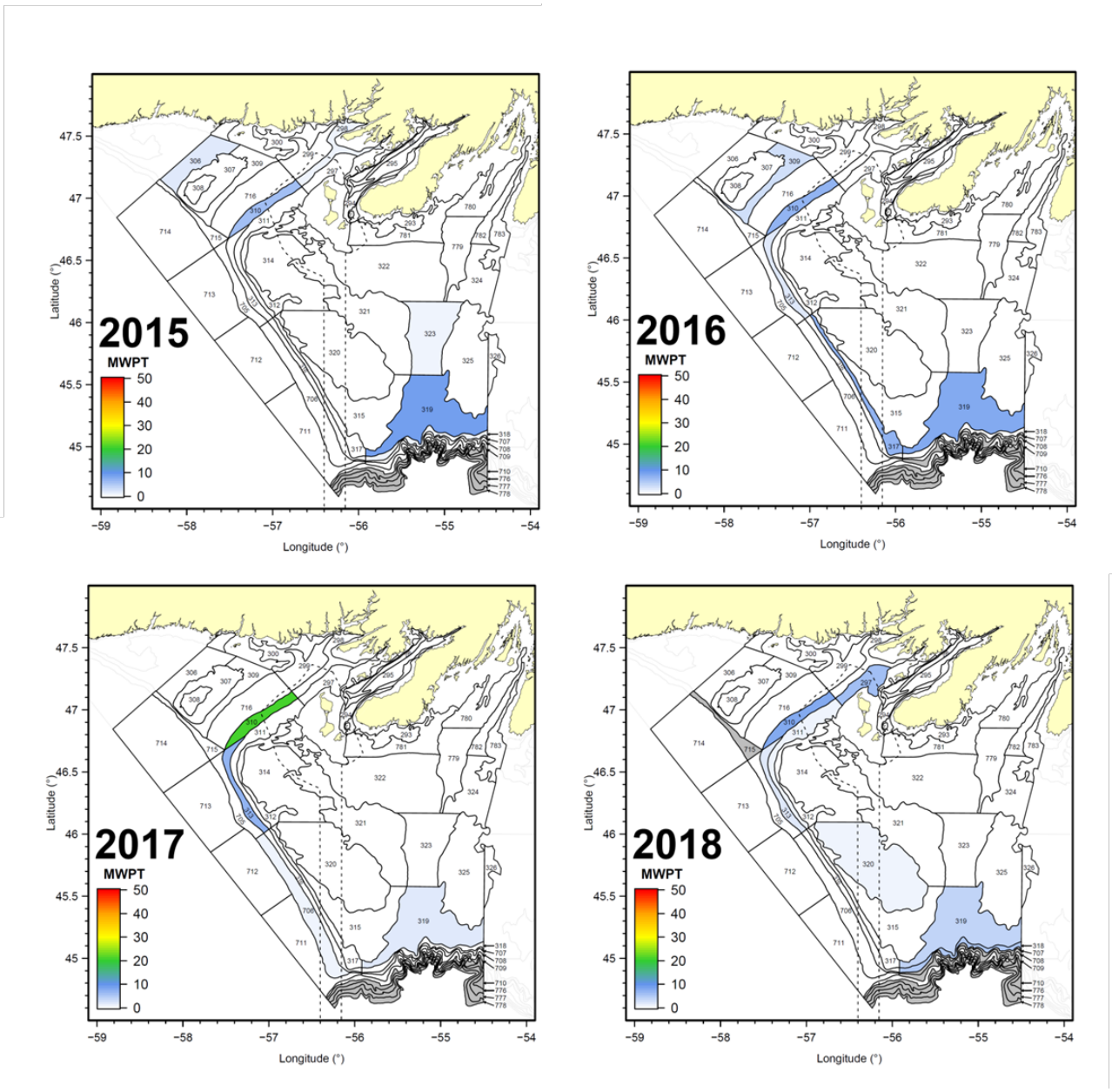

Figure 8. Distribution of haddock biomass (mean weight per tow; MWPT) by survey strata from DFO spring RV surveys 2015-2018.

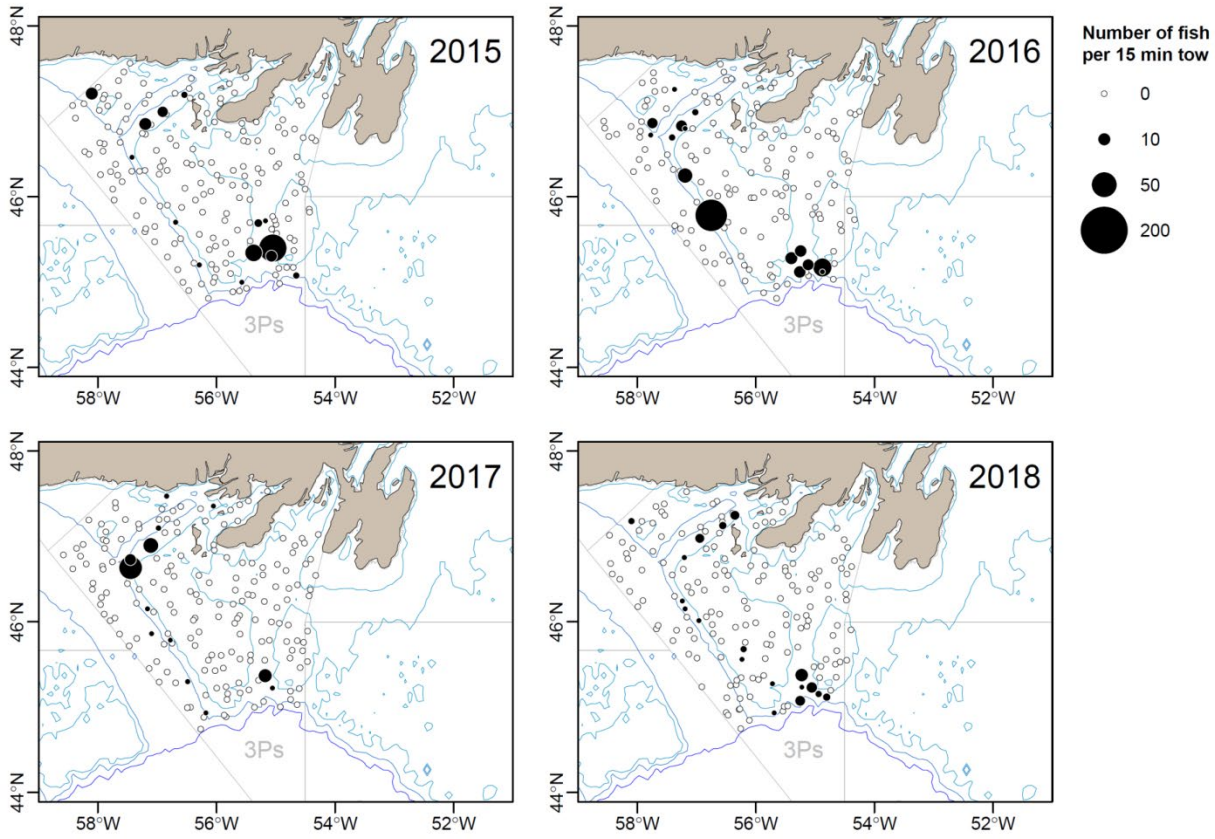

Figure 9. Set-by-set distribution of haddock catch abundance (numbers) from DFO spring RV surveys (2015-2018)

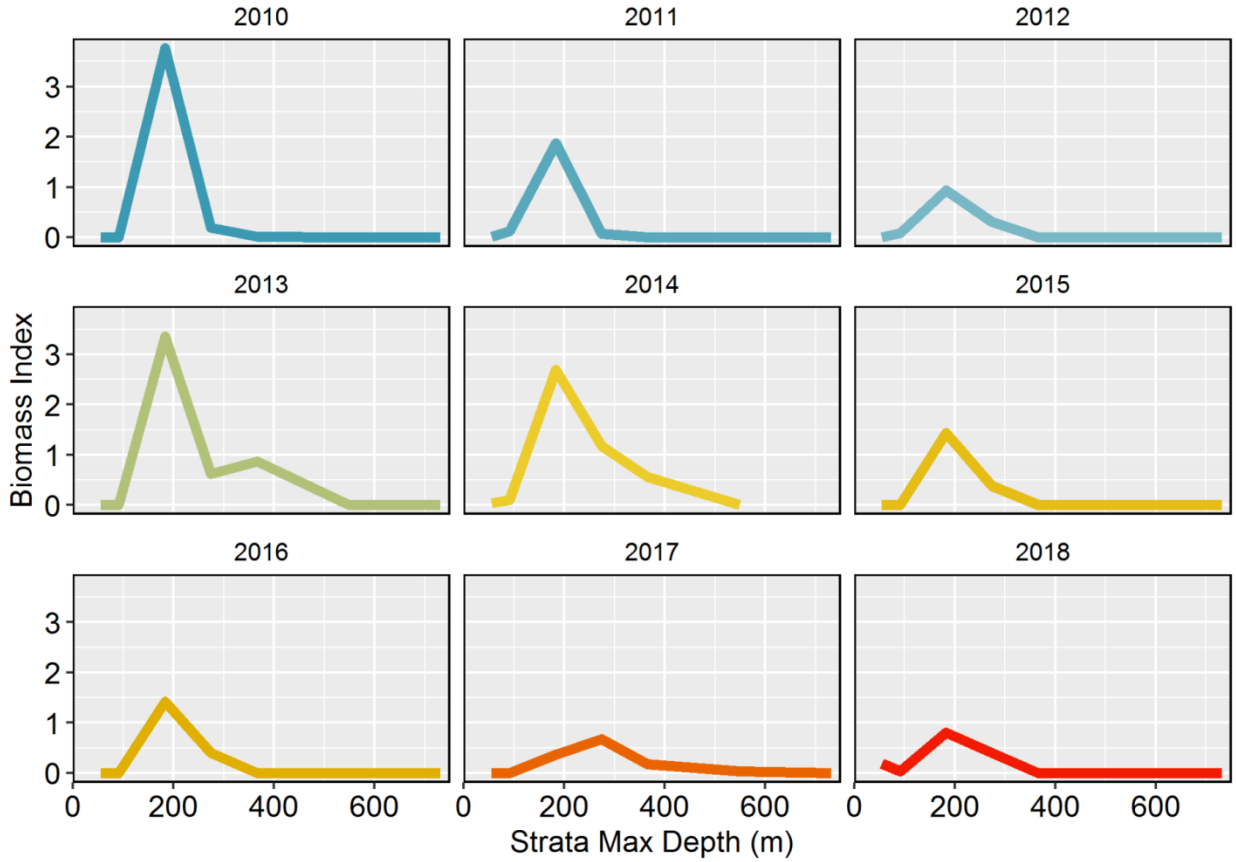

Figure 10. Survey biomass index by strata depth indicate haddock in 3Ps are generally found between 100-400m, with a peak near 200m.

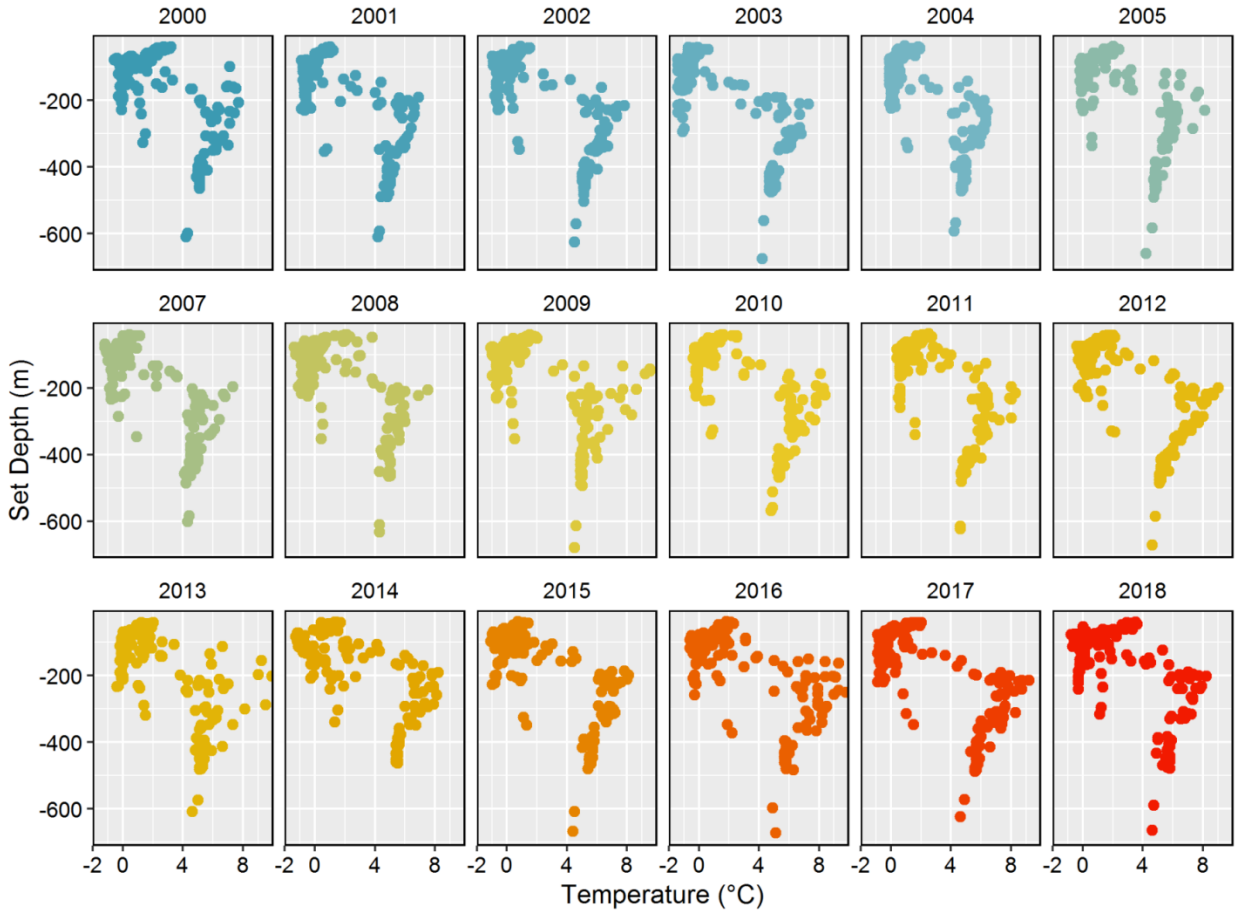

Figure 11. Bottom water temperature by depth as recorded from a trawl-mounted CTD from spring surveys from 2000 to 2018.

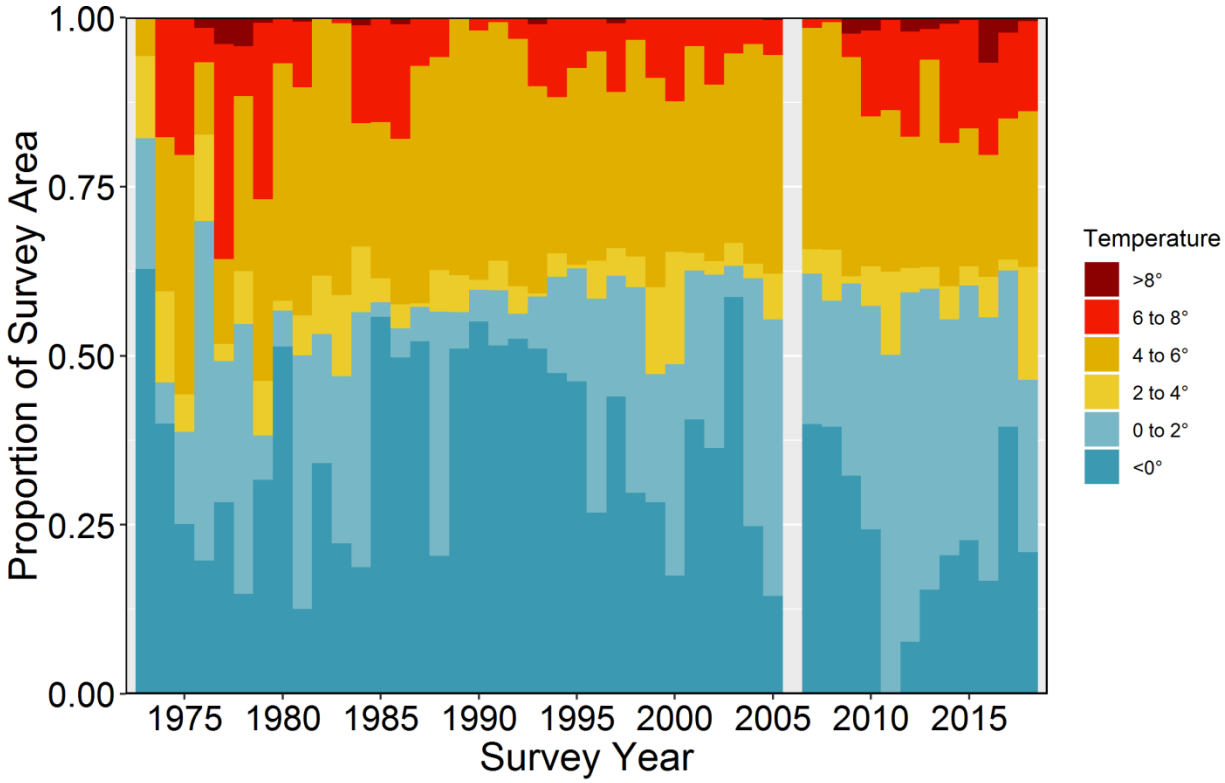

Figure 12. Proportion of Subdivision 3Ps survey area by temperature as determined from trawl-mounted CTDs during the spring surveys from 1973-2018.

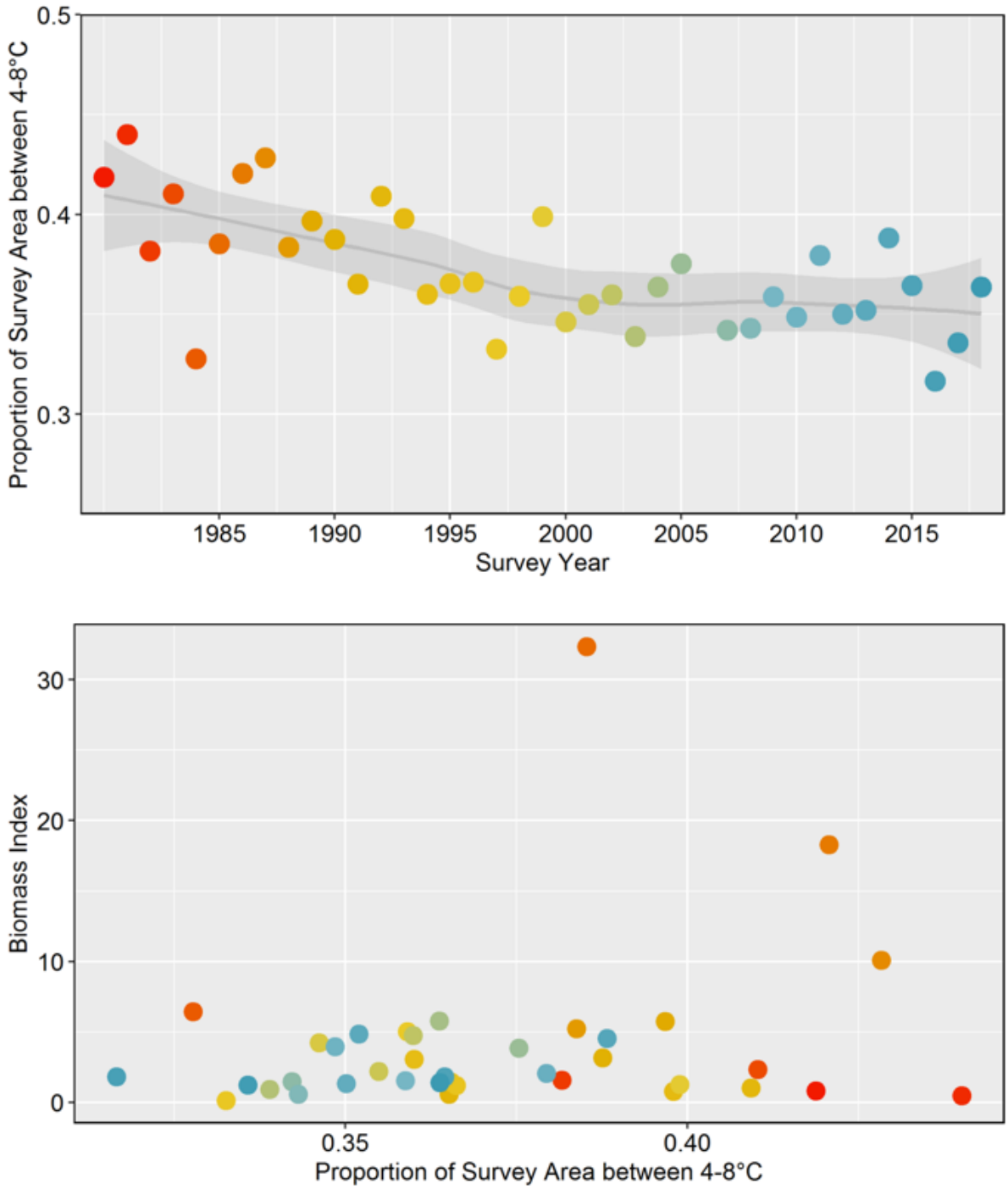

Figure 13. Top: Proportion of survey area within haddock's preferred temperature range in 3Ps (4-8°C; Rogers et al. 2016b) since 1980. Bottom: Subdivision 3Ps Haddock biomass index in relation to proportion of survey area within this preferred temperature range.

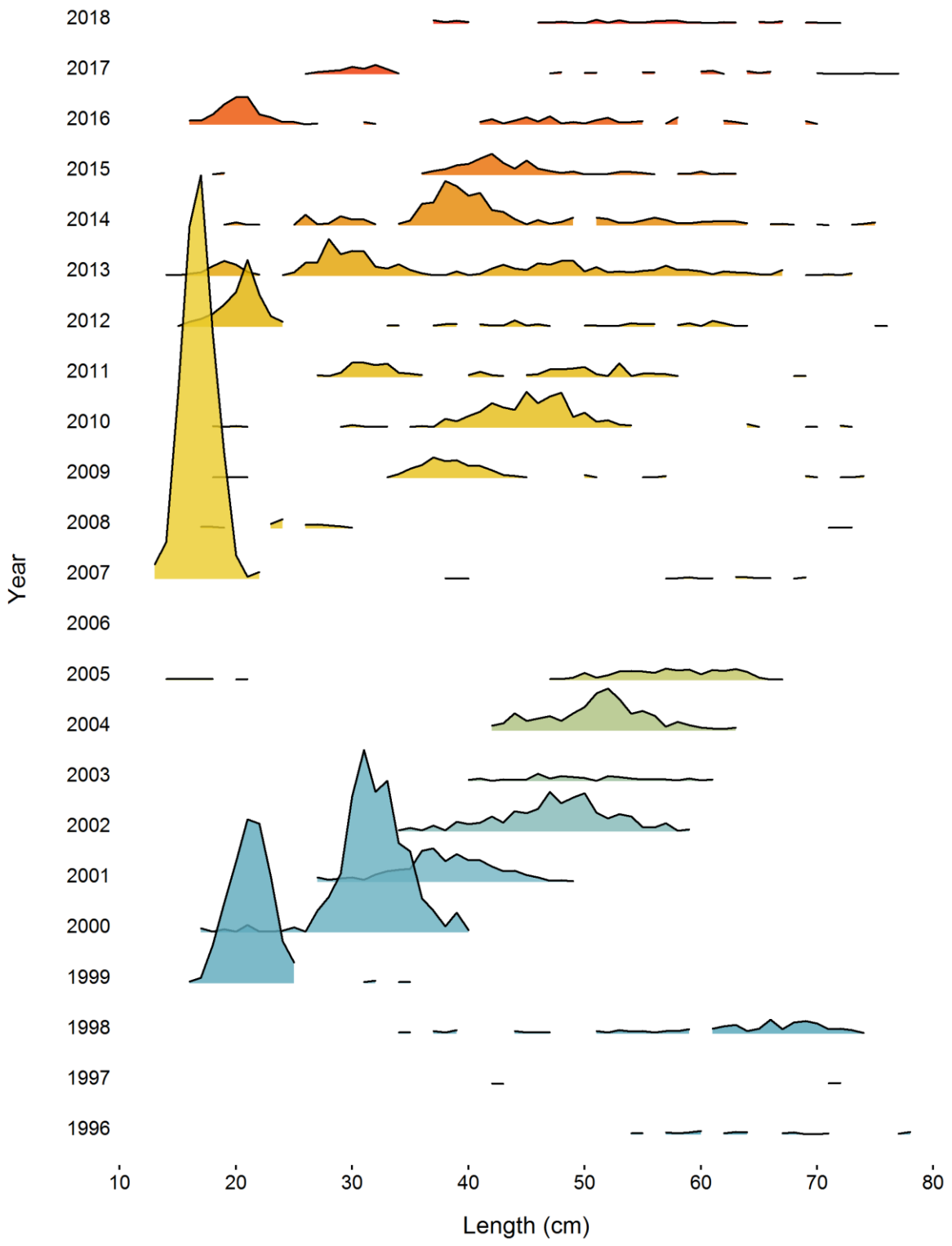

Figure 14. Abundance at length for haddock from the spring DFO RV survey Campelen series (1996-2018).

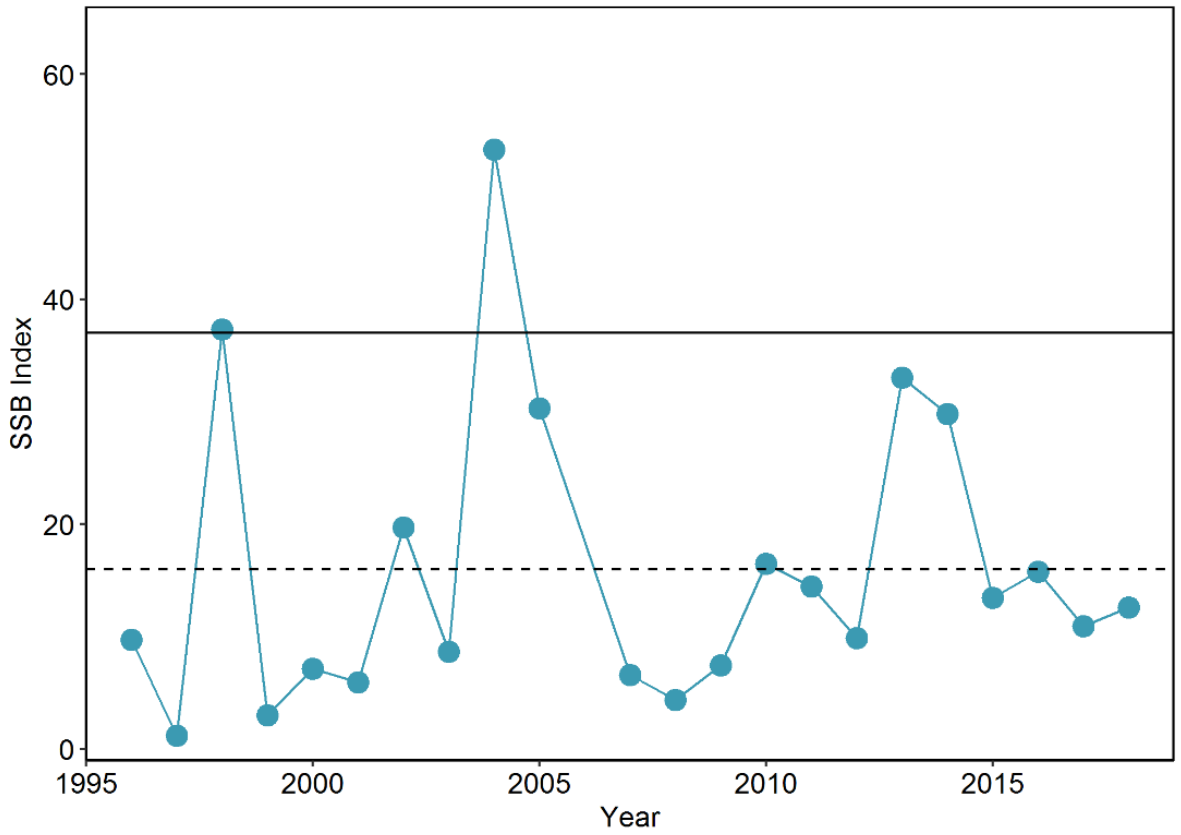

Figure 15. Spawning stock biomass (SSB) for Subdivision 3Ps Haddock in the Campelen Series. Dashed line indicates the series average. Solid line indicates the LRP at SSB index from 1998.

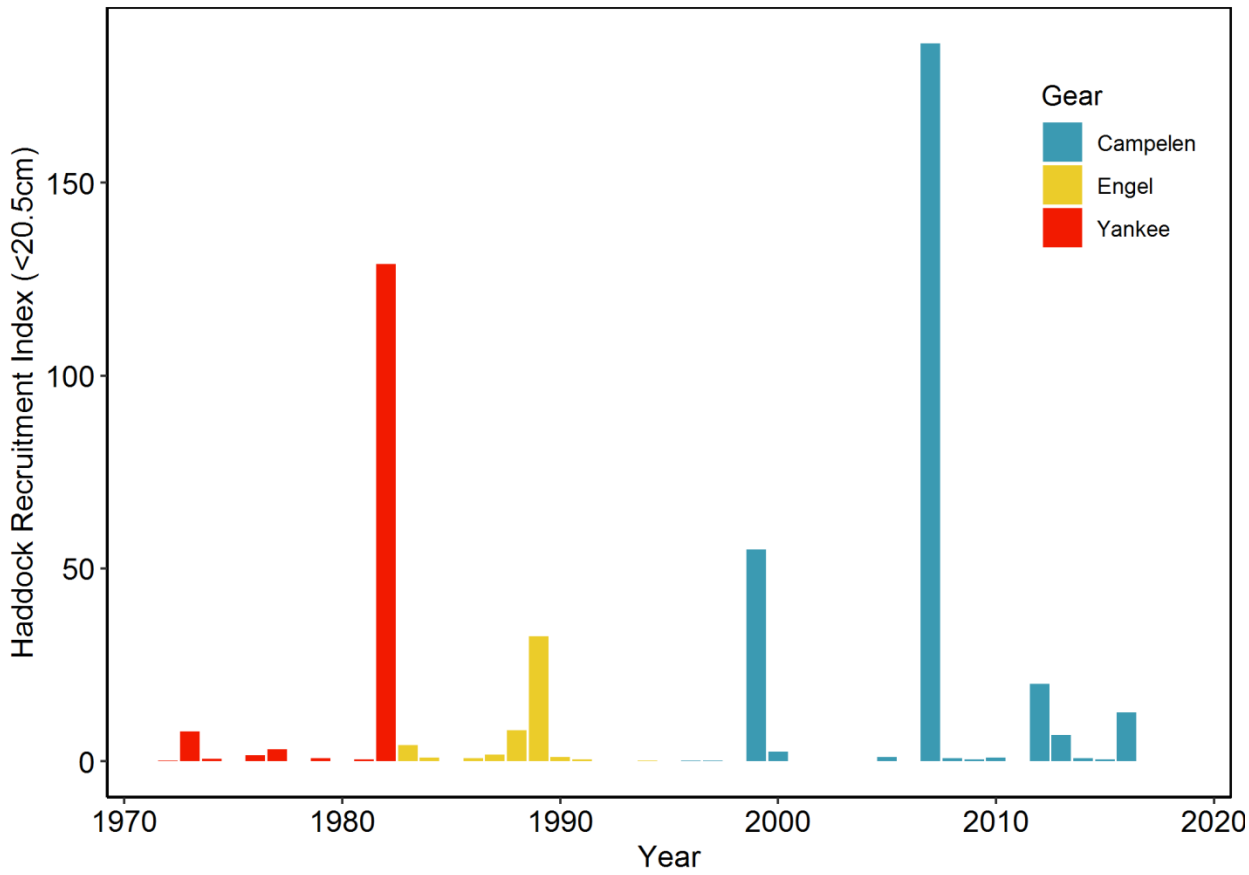

Figure 16. Recruitment proxy (≤20.5cm) from RV surveys in 3Ps. As no conversion factors exist between gears for this stock, series cannot be directly compared and should be considered independently.

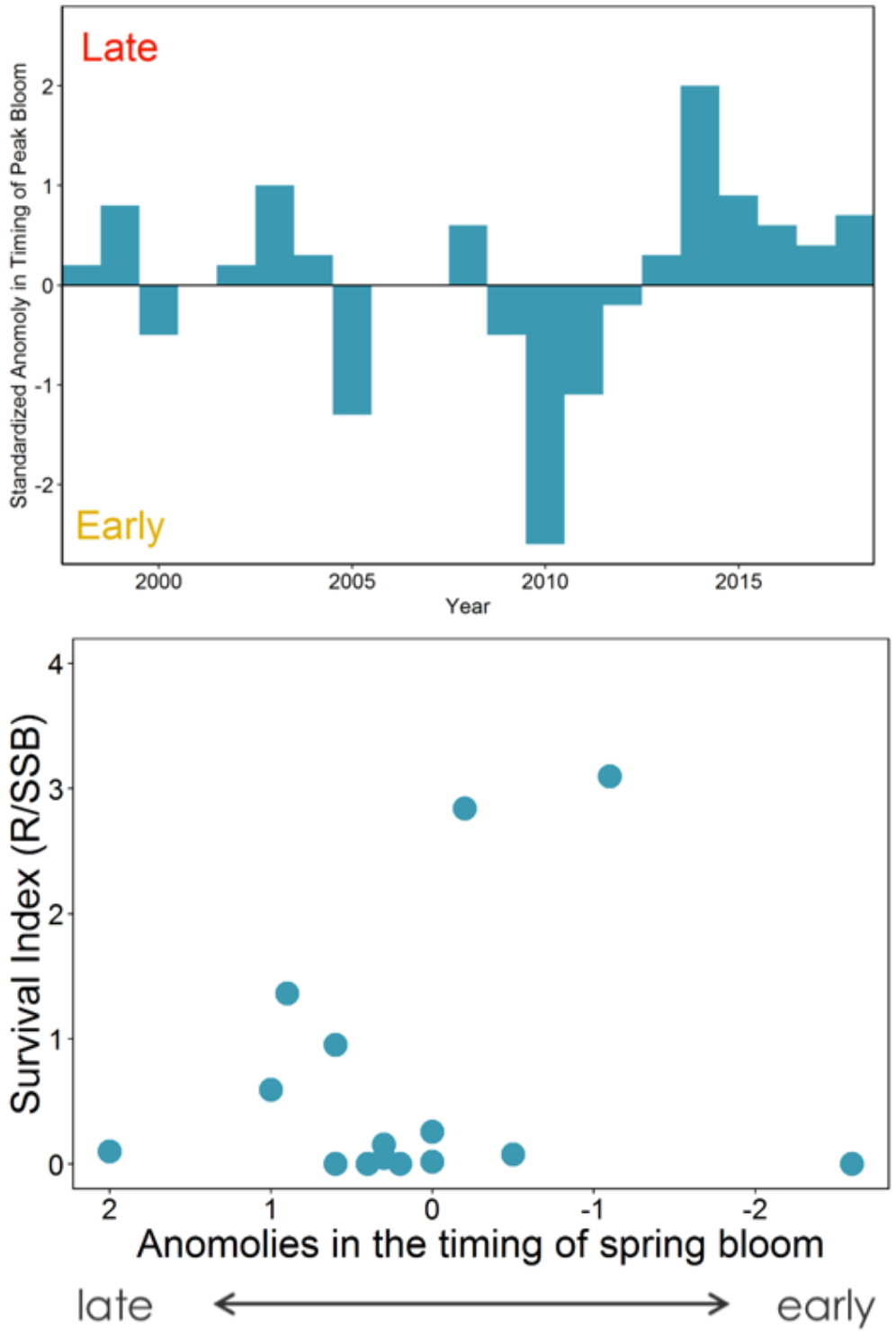

Figure 17. Standardized anomalies in the timing of the spring plankton bloom in Subdivision 3Ps (top), and haddock survival index (R/SSB) relative to spring bloom timing (bottom)

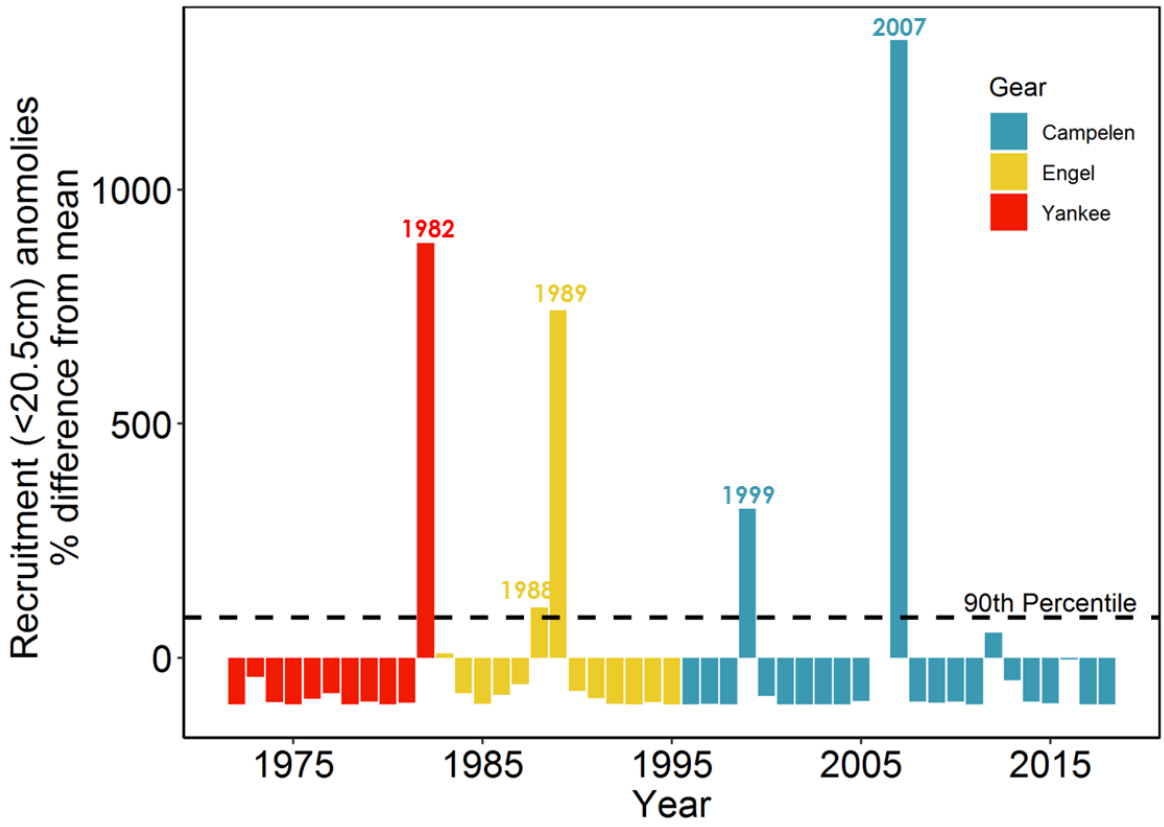

Figure 18. Recruitment proxy anomalies with the 90th percentile indicating the cut-off above which recruitment events were considered to be "large recruitment" events.

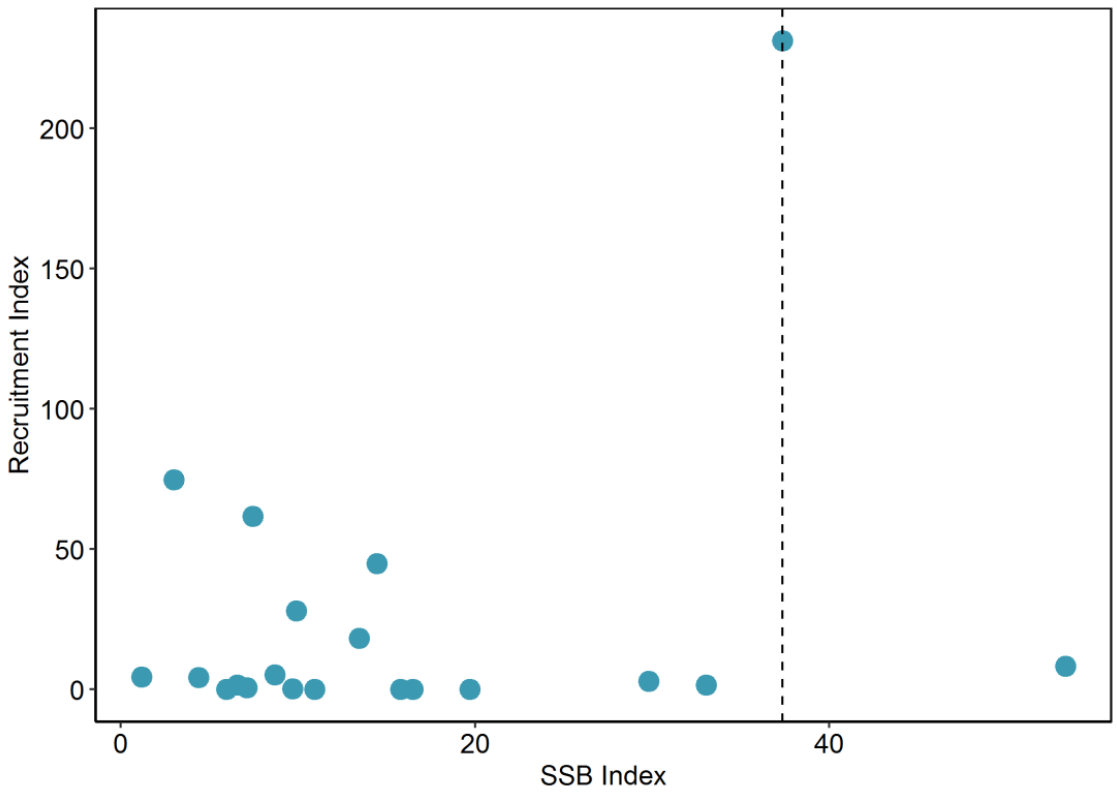

Figure 19. Stock-Recruit Scatter for Subdivision 3Ps Haddock for the Campelen series (bottom; 1996-2018). Note that due to an incomplete survey in 2006, the SSB for that year, and subsequent recruitment index for 2007, are not reflected in this plots.