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Results for Greenland halibut survey in NAFO Divisions 1C-1D for the period 1997-2017, 2019 and 2022

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Greenland initiated a survey series in 1997 covering NAFO Divisions 1CD at depths between 400 and 1500 m. The survey has been conducted with R/V Paamiut, using and Alfredo III gear. In 2017, R/V Paamiut was retired and no survey has been conducted in 2018. In 2019, the annual trawl survey was conducted with a chartered vessel, the C/V Helga Maria. All the standard gear from the research vessel Paamiut were used, in order to make the 2019 survey as identical as possible to the previous years' surveys, but the gear was working different at depths > 700m. No vessel has been available years 2020 and 2021 to conduct the survey. In 2022 the survey is carried out with a new vessel owned with the GINR, R/ Tarajoq using also a new trawl gear, Bacalao 476. There was unfortunately not been any comparative trawling between the old vessel R/V Paamiut and R/V Tarajoq. The survey was designed as a Stratified Random Bottom Trawl Survey aimed primarily at Greenland halibut (*Reinhardtius hippoglossoides*) and roundnose grenadier (*Coryphaenoides rupestris*). The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose grenadier, roughhead grenadier (*Macrourus berglax*), and deep-sea redfish (*Sebastes mentella*) together with a list of recorded fish species. In 2022, 65 valid hauls were conducted.

Introduction

During 1987-1995 the Japan Marine Fishery Resources Research Center (JAMARC) and the Greenland Institute of Natural Resources (GINR), jointly conducted 12 bottom trawl surveys at depths down to 1500 m (**O. A. Jørgensen, 1998a**) and four pelagic surveys (**O. A. Jørgensen, 1997**) at West Greenland, in 1BCD, as part of a joint venture agreement on fisheries development and fisheries research in Greenland waters. The bottom trawl surveys were aimed primarily at Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Div. 1B-1D. In 1997, the GINR continued the bottom trawl surveys series with the Institute's own vessel, the R/V Paamiut, that had been rigged for deep sea trawling. Unfortunately, no calibration experiments between the Japanese research vessel Shinkai Maru and Paamiut were performed, making comparisons between both vessels impossible. The Paamiut survey traditionally covered NAFO Div.1CD, but in 2001 the survey

area was expanded to include Div. 1A (to 74 °N) and Div. 1B, and in 2004 the northernmost part of the Baffin Bay (73° N-77°N) (Div. 1A) was also surveyed. In 2010, Div.1A was surveyed to 75.30 °N (SCR 11/010). In 2013, the survey only covered Div. 1D. In 2018 no survey was undertaken due to the retirement of the R/V Paamiut and the survey in 2019 was conducted with the chartered RV Helga Maria. All the standard gear from the research vessel Paamiut (such as the Alfredo III trawl along its doors, bridles, ect; and the Marport sensors used on doors and headlines) were used, in order to make the 2019 survey as identical as possible to the previous years' surveys (Table 1), but comparative studies of the gear performance between the two vessels show that the gear has been working different at depths > 700m (**Nogueira and Treble, 2020**). In 2022, the new vessel owned by GINR, RV Tarajoq with a Bacalao 476 trawl began a new survey series.

Methods

Stratification

The survey covered NAFO Divisions 1CD between the 3-nm and the mid-line to Canada at depths between 400 and 1500 m. The survey area was stratified within NAFO divisions in 6 depth strata 401-600, 601-800, 801-1000, 1001-1200, 1201-1400, and 1401-1500 m. The depth stratification was based on Greenland Geological Survey's 10 m depth contour maps, Canadian maps and depth soundings made during previous surveys. The area of each stratum was measured using "MapInfo Version 4.0". A list of the number of valid hauls per strata and area is given in Tables 2 3 and 4.

The survey was planned as a Stratified Random Bottom Trawl Survey with a total of 70 hauls. A minimum of two randomly placed trawls were conducted per stratum (**Bishop, 1994**). From 1997 to 2019, the remaining hauls were allocated to strata based on the stratum area and on predictions, from past surveys, of the variability in the catch, in order to minimize the standard error of the total survey biomass estimate of Greenland halibut, given the predicted stratum variances. This method was reviewed in 2020 and realized that because biomass over-represents larger Greenland halibut, it is not optimized for multiple size classes, and small Greenland halibut in particular. That resulted in insufficient coverage in shallow strata where small-sized Greenland halibut are found. It was decided to change the station allocation for a more equitable distribution of stations across strata (**Nogueira and Treble, 2020**). From 2022, the number of station is proportional to the total area (1/750km2), and the survey is planned with 71 hauls. In 2004, the placing of stations independently and randomly was replaced by buffered random sampling. This method combines the use of a minimum between-stations distance rule (buffer zone) with a random allocation scheme (**Kingsley et al., 2004**). Because the seabed in Division 1D stratum 601-800 m is muddy and soft, and generally not suitable for trawling, stations are fixed in that stratum.

Vessel and gear

From 1997 to 2017, the survey was conducted by the 1084 GT trawler Paamiut. However, in the beginning of 2018, it was decided that the old research vessel Paamiut had to be scrapped owing to increasing expenses to maintenance. No survey has been conducted in 2018. In 2019, the survey was carried out with the chartered commercial vessel Helga Maria. All the standard gear has been maintained (Table 1). The survey uses an Alfredo III trawl with a mesh size of 140 mm and a 30-mm mesh-liner in the cod-end. The ground gear is of the rockhopper type. The trawl doors are Greenland Injector weighing 2700 kg. The Injector otter doors replaced the Greenland Perfect doors that have been used until 2003. The average net height was, in 2014, 20 cm higher with the new doors compared to the old, but the difference was not statistically significant (95% level), and

it was concluded that the net performance has not changed by the introduction of the new doors. Further information about trawl and gear is given in Jørgensen (**1998b**). The effect of the vessel change on the 2019 survey was examined by looking at gear performance variables [e.g. net height and door distance; Nogueira and Treble (**2020**)]. Data reviewed for the 1CD survey suggests the change in vessel in 2019 had an effect on the performance of the Alfredo III trawl gear at depths > 701 m, where Greenland halibut are known to be abundant, then indices must be compared with caution. In 2022, R/V Tarajoq (2896 GT) began a new survey series using a Bacalao 476 trawl with a mesh size of 136 mm and a 30-mm mesh-liner in the cod-end (Table 1). The same doors as on R/V Paamiut are used on R/V Tarajoq.

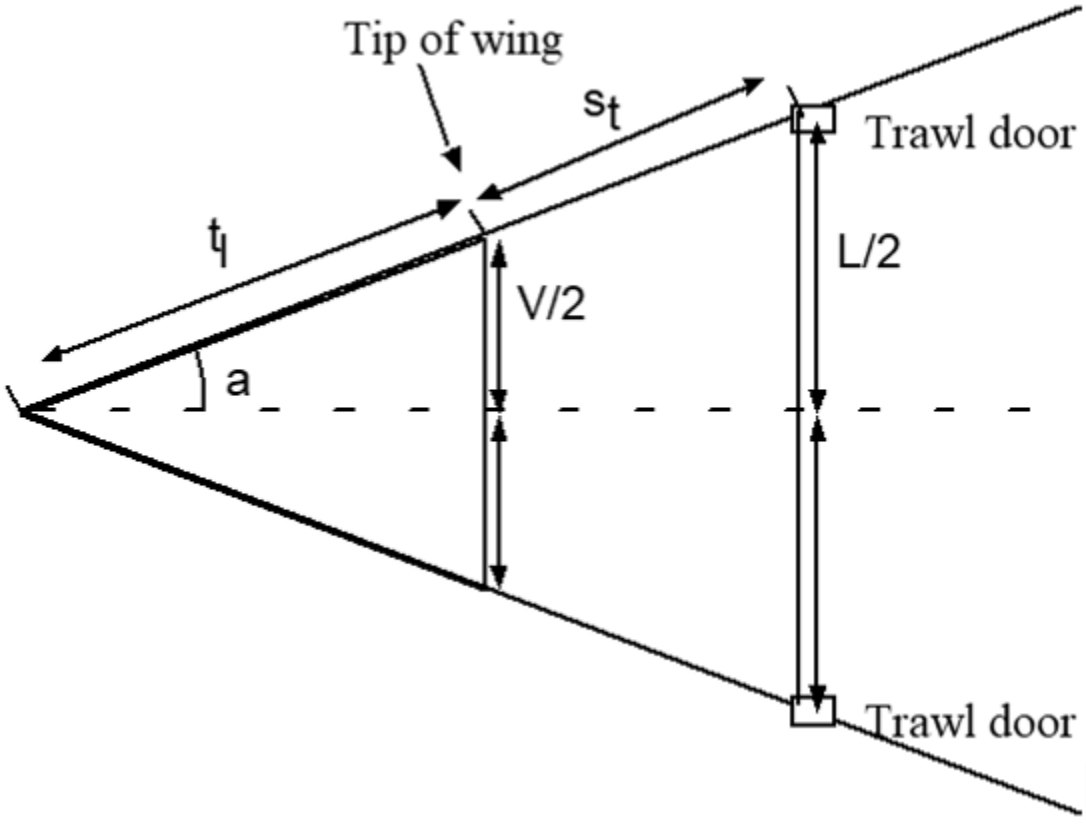
Swept area calculation

A MarPort net sonda mounted on the head rope measured net height. MarPort sensors measured the distance between the trawl doors. Wingspread, taken as the distance between the outer bobbins, was calculated as:

$$DBOB = 10.122 + DBTD * 0.142$$

where DBOB is the distance between outer bobbins, and DBTD is the distance between trawl doors in m. This relationship was estimated based on flume tank measurements of the trawl and rigging used in the survey (**O. A. Jørgensen, 1998b**).

In 2022, the gear was changed to Bacalao 476 gear. The wingspread for a tow was calculated from the mean door spread and the geometry of the trawl as if the shape would be a triangle. V has been calculated as follows; Where the trawl and the trawl plus bridles are assumed to form two similar triangles, bridles and wings making a straight line:



and the lengths of the bridles (s) and the trawl wings (t) are known. The wingspread V is then calculated as:

$$V = (tl * L)/(tl + st)$$

where L is the distance between the doors (doorspread). The trawl wing is 26.83 meters and the length of the bridles is 129 m. Because the shape of the Bacalao gear is not a triangle, a constant based on the sensor' measurements during the Canadian survey at the same depths was applied. Scanmar sensors measured wingspread during the deep Canadian survey in Subarea 0A. The difference between our estimation and the sensors measurement in each depth strata has been added as a constant in our wingspread calculations.

Bottom temperature

Near-bottom temperature was measured, by 0.1 °C, by a Seastar sensor mounted on one of the otter doors.

Trawling procedure

Trawls were towed for 30-min at a speed of 3.0 knots; however, tows down to 15 minutes were considered acceptable. Trawl distance was estimated from the start and the end positions of the haul. Trawling takes place day and night.

Handling of the catch

The catch of each haul was sorted, weighted, and reordered by species. All fish species were measured as total length (TL) to 1.0 cm below. Grenadiers were measured as pre-anal fin length (AFL) to 0.5 cm below from 1997 to 2008, and in 2019, and 1.0 cm below from 2009 to 2017. In case of large catches, subsamples of the catch were measured.

Biomass and abundance

Biomass and abundance estimates were obtained by applying the swept area method (trawled distance * estimated bobbin spread), taking the catchability coefficient as 1.0. All catches were standardized to 1 km2 swept prior to further calculations.

In strata with one haul, the standard deviation (SD) was estimated as:

$$SD = \frac{Meancatch}{MeanCV} * 100$$

Results and discussion

A total of 65 valid hauls were made (Figure 1). Haul by haul information on catches of Greenland halibut, roundnose grenadier, roughhead grenadier, and deep-sea redfish is given in Appendix 1. The distribution of hauls by strata is given in Table 3. Temporal extend of thse surveys are given in Table 2

A total of 79 fish species were recorded (Appendix 2).

Greenland halibut (Reinhardtius hippoglossoides)

The Greenland halibut stock in Subareas 0 and 1 is considered to be part of a biological stock complex, which included Subarea 2 and Div. 3KLMNO. Abundance and biomass indices were available from research vessel surveys by Canada in Subarea 0A South (1999, 2001, 2004, 2006, 2008, 2010, 2012, and 2014-2019); Canada in OB (2000, 2001, 2011, 2013, 2014, 2015, 2016), Greenland in Divisions 1CD from 400 to 1500 m (1987-1995 and 1997-2017 and 2018), and Greenland in Divisions 1A-1F offshore, from 100 to 600 m (1988-2019).

From 1979 to 1994, the assessment included SA 0+1, including Div. 1A inshore. In 1994, it was decided to make a separate assessment for the inshore in Div. 1A and for SA 0-1 Div1 offshore + Div. 1B-F. based on tagging experiments. The TAC has been increasing since then (**Treble and Nogueira, 2018**). In 2020, based on historical catches and taggings experiments, it was also decided to separate, the stocks inshore Div.1B-F, in 3 other different management units 1BC, 1D and 1EF (**Nygaard et al., 2020**).

In 2016 and 2018 the assessment was based on survey indices. The ICES guidance on data-limited stocks (DLS) method 3.3 (**ICES, 2012a**, **2012b**, **2014**) was applied as approach for the advice on SA0+1 Greenland halibut. The index in 2019 could not be used to assess the stock status because its comparability with the earlier time series was questionable, and the assessment in 2020 was qualitative. Because no research surveys were carried out in 2020 and 2021, the precautionary approach was applied to give advice in 2022.

Greenland halibut was caught in all hauls except two (Figure 2 and Appendix 1). From 1997 to 2017, the biomass in 1CD has been almost constant for the whole time series with few fluctuations. A gradual decrease in biomass was observed from 2011 (87223 t) to 2014 (58666 t), but then increased in 2015. The biomass in 2019 with C/V Helga Maria was 82938 t) and in 2022, R/V Tarajoq was 102239 t (Table 3 and Figure 3). The survey in 2013 only covered Division 1D. Total biomass and abundance in Division 1C have been estimated by a GLM (model: $lnbiomass = year * division$) using data from 2010-2014 where the distribution of the biomass has been rather stable with 63-69% of the biomass found in division 1D. The 1CD biomass and abundance in 2013 were estimated to 64049 tons and $51160*10^3$ individuals, respectively.

Roughhead grenadier (Macrourus berglax)

There is not directed fishery for roughhead grenadier. Most of the catches are taken as bycatch both in the trawl fishery for Greenland halibut. Roughhead grenadier was caught in 59 hauls (Figure 5, Appendix 1). The biomass shows an increased trend, from 1997 (1239 t) to 2000 (7369 t), then decreased in 2001, and in 2002 it reached the highest value level of the time series (8101 t). Since 2003, it has been decreasing with some fluctuations until 2015. From 2015 to 2017, the biomass decreased (from 3271 t in 2015 to 1544 t in 2017). In 2022, the biomass was 2764 t (Tables 8 and 9, Figure 6). The highest density in 2022 was found between 1001-1400 m in 1D. The abundance followed a similar trend as the biomass. It increased from 1997 ($5013*10^3$ individuals) to 2000 ($21012* 10^3$ individuals). Since then, it has been decreasing with fluctuations from 2001 to 2015. In 2022, the abundance was $4679*10^3$ (Tables 8 and 9, Figure 6). Pre anal fin length ranged from 2 to 39cm , and the overall length distribution showed minor modes at 4, 9, 16, and 18 cm (Figure 7 and Table 10).

Roundnose grenadier (Coryphaenoides rupestris)

There is not directed fishery for roundnose grenadier. Most of the catches are taken as bycatch in the Greenland halibut fishery subareas 0 and 1 south. Since catches and biomass have been very low for almost two decades, the assessment has not been updated since 2016. Roundnose grenadier has been caught in 40 hauls out of 65 valid hauls (Appendix 1; Figure 8), but catches were very low. The biomass has been very low since 2001 (Tables 11 and 12, Figure 9), and far below the level found in the late 80s. The highest biomass was found from 1997 to 2001, then it sharply decreased by five orders of magnitude, from 7781 t (in 2001) to 1594 (in 2000). Since then, it has maintained low values. In 2022, the biomass was 794 t (Table 11). The higher density was found between 601-800 m in 1D, and 1001-1200 in 1C (Table 12). The abundance, in 2022, was estimated at 6720*103 indiv. (Table 11). Table 13 and Figure 10 show the length distribution from 1997 to 2019 weighted to the stratum area. Pre anal fin length ranged from 2 to 20 cm. The mode was found at 6 cm.

Deep-sea redfish (Sebastes mentella)

There is not directed fishery to the deep-sea redfish stock in West Greenland Divisions 1A-F. Abundance and biomass indices were available from surveys carried out by the Greenland Institute of Natural Resources in Divisions 1CD from 400 to 1500 m (1987-1995 and 1997-2019) and in Divisions 1A offshore and 1B-F from 100 to 600 m (1988-2019). Deep-sea redfish was caught in 27 of the 65 valid hauls (Figure 11, Appendix 1). The biomass was very low from 1997 to 2007 (426 t), then it peaked 2008 (13256 t). Since then, the biomass has fluctuated at a higher level than before 2008. The biomass decreased slightly from 2016 (11336 t) to 2017 (9001 t). In 2022, with the new R/V Tarajow, the biomass was 20202 t, two times the biomass found from 2015 (Table 14 and Figure 12). The highest density in 2019 was found between 601 to 800 m in 1D (Table 15). The abundance followed a similar trend as the biomass. Until 2017 the abundance was very low, then it increased from $1892*10^3$ individuals in 2007, to $5306*10^3$ individuals in 2008. Since 2009, the abundance has been fluctuating, reaching the highest value of the time series in 2014. It decreased by 10 from 2014 ($65975*10^3$) to 2017 ($16422*10^3$) (Table 14 Figure 12). In 2022, the biomass was 25523 t. The length distribution ranged from 6 to 46 cm, with a mode at 36 cm (Table 16 and Figure 13).

Temperature

The bottom temperature ranged from 1.96 to 5.03 ºC (Appendix 1). The mean temperature decreased in 1D with depth as in previous years. Mean temperature increased from 2019 to 2022, in the 600-800 m stratum in both divisions, but it could be due to the different seasons the survey has been conducted (Figure 14 and Figure 15).

Tables

Table 1. Gear specifications and survey discipline for Research Vessels Paamiut and Tarajoq in NAFO areas 1C and 1D.

Procedure	**Specifications**	
Vessel	**R/V Paamiut**	**R/V Tarajoq**
TRB	1084 GT	2896 GT
Dimensions	LOA 58.61m, Beam 11.21 m	LOA 61.4 m, Beam 16.3 m
Main engine	2000BHP, Diesel 257, 1471KW	3943/4896 BHP, Diesel 475, 2900/3600 KW
Survey Area	14b (401- 1500 m)	14b (401- 1500 m)
Years	1998-2016 (no survey 2001)	2022
Time of year	August/September	September/October
Number of days	15	15
Towing speed (knots)	3	3
Tow duration	30 min	30 min
Gear	Alfredo 3	Bacalao 476
Vertical trawl opening (m)	5.6	4.5
Distance between doors (m)	120 -145 m	151.80000000000001
Winds spread	10.122 + distance between the doors * 0.142.	V = (tl *L) / (tl +st) + constant
Mesh size (mm)	140	136
Door until 2003	Greenland Perfect (370*250 cm)	Shark injector (353*273)
Door from 2004	Shark injector (353*273)	
Door type (kg)	2400 kg with extra 20 kg	2850
Mesh size (mm)	44	44
Mesh-line in the cod-end (mm)	30	30
Sampling design	Buffered Random Stratified	Fix stations
Number of Stations	70	71
Number of strata	14	14
Trawling schedule	24 hours	
Criteria for rejecting a haul	Snag of the trawling gear in the bottom	
	Damage in the cod-end or severe damages in large sections of the wings or belly	
	Less than 15 minutes of effective trawling time	
	Gear malfuntion	
Criteria for change haul position	Wrong depth interval	
	Poor bottom conditions	
Sampling species	All fish species and invertebrates	
Target species	Greenland halibut	

Table 2. Greenland halibut survey bottom trawls in NAFO Divisions 1C-D in the period 1997-2022. Depth strata are indicated in metres.

Year	Vessel	Tows 1C	Tows 1D	Total tows	Depth strata	Dates
2003	R/V Paamiut	12	23	35	564-1449	Sep 17-Sep 24
2004	R/V Paamiut	18	33	51	574-1468	Oct 28-Nov 05
2005	R/V Paamiut	23	38	61	412-1485	Aug 31-Sep 11
2006	R/V Paamiut	19	42	61	402-1486	Oct 11-Oct 22
2007	R/V Paamiut	17	33	50	426-1468	Sep 19-Sep 30
2008	R/V Paamiut	21	49	70	417-1458	Sep 19-Oct 01
2009	R/V Paamiut	22	46	68	422-1468	Sep 19-Sep 30
2010	R/V Paamiut	20	46	66	417-1482	Sep 07-Sep 20
2011	R/V Paamiut	22	45	67	484-1472	Sep 01-Sep 17
2012	R/V Paamiut	18	32	50	466-1473	Sep 12-Sep 22
2013	R/V Paamiut	0	27	27	406-1492	Sep 12-Sep 17
2014	R/V Paamiut	20	38	58	404-1464	Aug 31-Sep 16
2015	R/V Paamiut	23	44	67	409-1458	Aug 26-Sep 05
2016	R/V Paamiut	26	44	70	422-1462	Aug 31-Sep 12
2017	R/V Paamiut	15	38	53	450-1476	Oct 10-Oct 21
2019	R/V Helga Maria	27	43	70	417-1451	Jul 31-Aug 12
2022	R/V Tarajoq	33	32	65	434-1480	Oct 13-Oct 26

Table 3. Hauls per year, division and stratum in the years from 1997 to 2019.

Division	Stratum (m)	Area (km²)	2014	2015	2016	2017	2019
1C	401-600	3,366	1	2	2	0	2
1C	601-800	16,120	5	6	9	6	10
1C	801-1000	6,066	12	13	13	7	13
1C	1001-1200	611	2	2	2	2	2
1D	401-600	903	1	2	2	2	2
1D	601-800	1,940	2	2	3	2	2
1D	801-1000	3,874	3	4	4	4	4
1D	1001-1200	10,140	15	20	19	16	19
1D	1201-1400	6,195	13	11	12	10	12
1D	1401-1500	3,091	4	5	4	4	4
Total			58	67	70	53	70

Table 4. Hauls per division and per stratum trawled in the 2022 survey with the RV Tarajoq.

Division	Stratum (m)	Area	2022
1C	0401-0600	3,649	4
1C	0601-0800	16,831	19
1C	0801-1000	5,303	8
1C	1001-1200	611	2
1D	0401-0600	545	2
1D	0601-0800	1,694	2
1D	0801-1000	3,303	5
1D	1001-1200	10,774	13
1D	1201-1400	6,138	6
1D	1401-1500	2,113	4
Total			65

Table 5. Estimates of catch, biomass and abundace for Greenland halibut during surveys performed from 1997 to 2022 in NAFO areas 1C and 1D.

Year	Area	Vessel	SMC.B	SE	Biomass	SE	SMC.A	SE	Abundance	SE
1997	52,306	PA	1,102.6	90.8	57,674	4751	1,054.4	87.3	55,150	4566
1998	52,306	PA	1,509.4	174.2	78,950	9113	1,383.2	145.9	72,349	7632
1999	50,792	PA	1,274.1	127.1	64,713	6456	1,194.0	118.2	60,646	6005
2000	46,097	PA	1,309.6	131.7	60,368	6070	1,371.4	139.5	63,216	6430
2001	59,226	PA	1,368.8	183.2	81,069	10853	1,603.2	218.7	94,948	12950
2002	46,097	PA	1,569.8	129.8	72,362	5982	1,559.3	133.5	71,881	6153
2003	49,463	PA	1,389.3	129.6	68,718	6411	1,466.9	157.0	72,557	7764
2004	51,403	PA	1,443.6	101.0	74,205	5191	1,428.8	106.0	73,446	5448
2005	52,306	PA	1,554.8	164.4	81,327	8600	1,396.4	144.0	73,042	7533
2006	52,306	PA	1,482.8	117.8	77,560	6159	1,360.9	106.1	71,182	5550
2007	50,366	PA	1,488.2	187.1	74,957	9421	1,338.8	168.7	67,432	8497
2008	52,306	PA	1,610.7	107.3	84,252	5612	1,401.2	98.4	73,293	5145
2009	52,306	PA	1,327.0	90.5	69,407	4735	1,194.2	84.5	62,464	4422
2010	52,306	PA	1,442.9	103.2	75,474	5397	1,240.2	103.0	64,871	5390
2011	52,306	PA	1,667.2	99.2	87,205	5189	1,433.4	90.3	74,976	4724
2012	52,306	PA	1,250.4	199.7	65,403	10444	1,037.1	193.4	54,248	10116
2013	26,143	PA	1,577.6	176.7	64,049	-	1,243.2	116.2	51,160	-
2014	52,306	PA	1,121.6	82.9	58,665	4336	859.1	64.8	44,939	3388
2015	52,306	PA	1,520.5	130.8	79,532	6843	1,178.8	116.0	61,657	6069
2016	52,306	PA	1,465.0	92.0	76,629	4811	1,140.9	71.3	59,676	3729
2017	48,940	PA	1,612.0	124.0	78,892	6070	1,228.2	102.8	60,107	5031
2019	52,306	HM	1,585.7	121.1	82,940	6336	1,252.3	84.4	65,501	4414
2022	50,960	TJ	2,008.4	172.9	102,349	8813	1,483.0	137.2	75,575	6991

Table 6. Estimates of catch, biomass and abundance for Greenland halibut during the 2022 survey per depth stratum.

Subarea	Stratum (m)	Area (km^2)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
1C	401-600	3,649	4	388.9	1,419	929	419	1,528	1,174
1C	601-800	16,831	19	1,246.1	20,973	2,834	1,181	19,872	2,908
1C	801-1000	5,303	8	3,516.1	18,645	5,588	2,557	13,557	4,104
1C	1001-1200	611	2	3,151.5	1,926	115	2,124	1,298	58
1D	401-600	545	2	803.5	438	81	966	527	168
1D	601-800	1,694	2	407.7	691	591	188	318	254
1D	801-1000	3,303	5	2,372.8	7,837	502	1,672	5,521	467
1D	1001-1200	10,774	13	2,834.4	30,538	5,394	1,901	20,486	4,324
1D	1201-1400	6,138	6	2,003.4	12,296	1,993	1,242	7,625	1,141
1D	1401-1500	2,113	4	3,591.3	7,587	1,963	2,293	4,844	1,372
Total		50,961	65	172.9	102,350	8,813	137	75,576	6,991

Table 7. Length distribution (3 cm groups) and total abundance (Ab) estimated number (000's) with SE (weighted by survey area), and stratified mean number (N) with SE, for Greenland halibut, in Division 1CD, for the period 1997-2022.

Length class	2014	2015	2016	2017	2019	2022
6	0	16	6	0	6	0
9	204	0	8	20	0	11
12	0	0	23	0	0	0
15	0	42	98	30	40	75
18	0	0	74	0	60	55
21	0	0	399	0	548	131
24	0	104	286	30	400	100
27	52	98	276	103	270	98
30	9	163	470	31	402	165
33	110	117	267	95	143	123
36	28	281	519	120	686	396
39	529	370	650	458	1,515	1,154
42	953	1,303	1,507	1,144	2,106	3,461
45	3,499	3,895	3,977	3,597	3,714	6,752
48	7,972	9,751	7,855	8,337	7,927	10,124
51	11,020	15,292	13,001	14,119	13,206	12,487
54	9,388	14,288	13,122	13,756	14,470	14,752
57	4,706	8,202	7,855	9,441	9,774	11,513
60	2,709	3,220	4,117	4,115	4,372	6,341
63	984	1,491	1,727	1,700	2,138	3,193
66	641	865	1,177	936	1,339	1,633
69	558	514	707	628	741	889
72	283	465	401	448	496	559
75	308	292	258	303	216	334
78	291	176	219	110	190	210
81	201	153	120	150	152	117
84	124	118	140	120	130	122
87	45	62	94	58	128	223
90	113	152	154	35	87	107
93	107	47	63	20	94	136
96	55	95	20	28	52	112
99	9	36	31	53	51	82
102	25	31	22	54	14	61
105	16	15	15	52	14	47
108	0	3	7	0	21	0
111	0	0	13	14	0	12
Ab	44,939	61,657	59,678	60,105	65,502	75,575
S.E	3,388	6,069	3,729	5,031	4,414	6,991
N	859.2	1,178.8	1,140.9	1,228.2	1,252.3	1,483.0
S.E	64.8	116.0	71.3	102.8	84.4	137.2

Table 8. Estimates of catch, biomass and abundace for roughhead grenadier during surveys performed from 1997 to 2022 in NAFO areas 1C and 1D.

Year	Area	Vessel	MeanbioT	SEMC.kg	Biomass	SE	MeanAbuT	SEMC.num	Abundance	SE
1997	52,306	PA	47.5	8.6	2,487	448	95.8	13.8	5,013	723
1998	52,306	PA	86.4	7.0	4,519	367	226.9	18.7	11,868	979
1999	50,792	PA	99.8	16.5	5,068	839	272.4	40.2	13,835	2,043
2000	46,097	PA	158.5	32.7	7,307	1,507	455.4	104.8	20,991	4,833
2001	59,226	PA	80.4	6.5	4,763	384	233.1	20.8	13,808	1,234
2002	46,097	PA	175.8	19.2	8,101	885	435.2	42.5	20,063	1,958
2003	49,463	PA	114.4	14.2	5,658	701	310.7	52.0	15,367	2,573
2004	51,403	PA	82.0	8.3	4,217	429	218.8	27.0	11,245	1,388
2005	52,306	PA	107.1	8.2	5,604	431	268.1	26.5	14,022	1,384
2006	52,306	PA	98.0	11.9	5,125	622	228.0	20.8	11,928	1,088
2007	50,366	PA	69.5	7.5	3,501	376	162.5	21.6	8,185	1,085
2008	52,306	PA	91.3	22.3	4,776	1,167	195.5	30.6	10,226	1,601
2009	52,306	PA	72.4	5.7	3,787	297	156.8	12.8	8,200	671
2010	52,306	PA	77.2	10.8	4,037	565	156.9	21.1	8,205	1,101
2011	52,306	PA	58.3	5.0	3,050	264	141.2	12.4	7,385	650
2012	52,306	PA	80.2	22.4	4,194	1,173	160.9	51.7	8,416	2,705
2013	26,143	PA	86.2	22.1	2,255	578	159.1	44.0	4,159	1,151
2014	52,306	PA	55.8	5.1	2,921	266	149.6	13.2	7,827	692
2015	52,306	PA	62.5	4.3	3,271	226	178.7	13.2	9,346	689
2016	52,306	PA	54.9	5.4	2,872	282	130.3	11.5	6,814	604
2017	48,940	PA	31.6	5.6	1,544	276	70.0	7.2	3,425	351
2019	52,306	HM	68.5	5.0	3,580	260	155.9	10.7	8,156	561
2022	50,960	TJ	54.2	5.9	2,764	302	91.8	7.3	4,679	371

Table 9. Estimates of catch, biomass and abundance for roughhead grenadier during the 2022 survey per depth stratum.

Subarea	Stratum (m)	Area (km^2)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
1C	401-600	3,649.0	4.0	6.6	24.0	15.0	10.0	37.0	13.0
1C	601-800	16,831.0	19.0	29.1	489.0	95.0	70.0	1,186.0	216.0
1C	801-1000	5,303.0	8.0	43.5	231.0	130.0	65.0	343.0	119.0
1C	1001-1200	611.0	2.0	42.3	26.0	7.0	87.0	53.0	7.0
1D	401-600	545.0	2.0	8.2	4.0	4.0	16.0	9.0	9.0
1D	601-800	1,694.0	2.0	78.8	134.0	33.0	117.0	198.0	35.0
1D	801-1000	3,303.0	5.0	45.1	149.0	43.0	78.0	258.0	32.0
1D	1001-1200	10,774.0	13.0	73.2	788.0	147.0	130.0	1,397.0	221.0
1D	1201-1400	6,138.0	6.0	90.5	556.0	162.0	134.0	820.0	139.0
1D	1401-1500	2,113.0	4.0	172.1	364.0	120.0	179.0	379.0	77.0
Total		50,961.0	65.0	5.9	2,765.0	302.0	7.3	4,680.0	371.0

Table 10. Length distribution (1 cm groups) and total abundance estimated number (000's) with SE (weighted by survey area), and stratified mean number (N) with SE, for roughhead grenadier, in Division 1CD, for the period 1997-2022.

Length class	2014	2015	2016	2017	2019	2022
1	0	0	14	0	6	0
2	0	8	20	0	0	11
3	44	12	27	0	8	13
4	104	75	34	14	15	93
5	32	81	47	8	6	43
6	74	211	179	78	103	35
7	389	425	174	165	81	59
8	450	369	294	68	226	151
9	527	767	539	217	315	165
10	532	629	284	121	373	112
11	597	806	458	196	557	125
12	751	945	497	327	677	121
13	472	933	531	189	860	138
14	500	605	409	260	812	264
15	287	504	381	278	796	352
16	620	470	565	160	474	486
17	538	555	412	281	732	449
18	630	455	505	331	718	516
19	502	328	344	185	322	381
20	210	270	302	133	243	248
21	108	268	96	51	138	303
22	86	101	133	24	91	92
23	52	94	109	81	80	88
24	33	134	62	22	88	84
25	43	74	79	15	13	23
26	78	67	56	75	81	80
27	46	19	43	67	60	38
28	43	25	69	15	60	44
29	22	29	41	17	22	11
30	0	39	13	0	79	63
31	22	6	19	0	37	0
32	0	13	19	13	28	35
33	16	0	39	0	17	6
34	0	10	21	0	0	6
35	0	7	0	0	10	28
36	15	14	0	29	7	0
37	0	0	0	4	6	7
38	0	0	0	0	0	0
39	6	0	0	0	8	7
40	0	0	0	0	0	0
41	0	0	0	0	0	0
42	0	0	0	0	0	0
43	0	0	0	0	0	0
44	0	0	0	0	0	0
45	0	0	0	0	6	0
Ab	7,829	9,348	6,815	3,424	8,155	4,677
S.E	692	689	604	351	561	371

Length class	2014	2015	2016	2017	2019	2022
N	149.6	178.7	130.3	70.0	155.9	91.8
S.E	13.2	13.2	11.5	7.2	10.7	7.3

Table 11. Estimates of catch, biomass and abundace for roundnose grenadier during surveys performed from 1997 to 2022 in NAFO areas 1C and 1D.

Year	Area	Vessel	MeanbioT	SEMC.kg	Biomass	SE	MeanAbuT	SEMC.num	Abundance	SE
1997	52,306	PA	109.6	17.9	5,731	936	669.5	152.2	35,020	7,964
1998	52,306	PA	145.2	45.8	7,593	2,395	1,439.2	493.7	75,279	25,823
1999	50,792	PA	55.7	8.9	2,828	452	577.8	180.2	29,349	9,154
2000	46,097	PA	163.4	60.3	7,534	2,780	2,890.0	1,273.2	133,222	58,690
2001	59,226	PA	26.9	8.7	1,593	516	420.3	148.3	24,892	8,783
2002	46,097	PA	35.5	10.1	1,635	467	407.7	191.9	18,793	8,845
2003	49,463	PA	16.1	2.9	794	142	139.5	25.7	6,901	1,272
2004	51,403	PA	12.2	1.9	629	97	206.3	49.2	10,605	2,529
2005	52,306	PA	14.2	2.2	740	115	232.9	71.6	12,181	3,747
2006	52,306	PA	12.7	3.5	662	182	203.4	76.9	10,641	4,020
2007	50,366	PA	17.4	4.2	879	209	261.4	89.4	13,164	4,505
2008	52,306	PA	10.6	1.6	555	81	91.2	13.3	4,770	698
2009	52,306	PA	22.1	9.9	1,154	516	316.8	191.1	16,568	9,998
2010	52,306	PA	11.5	1.8	603	93	129.7	34.3	6,784	1,796
2011	52,306	PA	19.5	5.0	1,021	260	221.2	88.8	11,572	4,644
2012	52,306	PA	31.4	16.7	1,644	874	465.5	273.5	24,348	14,307
2013	26,143	PA	18.8	8.1	490	212	150.3	88.5	3,930	2,314
2014	52,306	PA	11.8	4.4	615	230	99.8	43.0	5,217	2,249
2015	52,306	PA	15.6	3.2	814	168	140.5	43.6	7,348	2,281
2016	52,306	PA	16.4	5.3	860	275	122.2	34.5	6,389	1,803
2017	48,940	PA	13.8	6.9	673	337	75.2	36.0	3,682	1,760
2019	52,306	HM	13.7	1.7	716	90	97.3	18.7	5,089	977
2022	50,960	TJ	15.6	2.9	794	145	131.9	18.1	6,720	920

Table 12. Estimates of catch, biomass and abundance for roundnose grenadier during the 2022 survey per depth stratum.

Subarea	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
1C	401-600	3,649.0	4.0	1.2	4.0	4.0	3.0	12.0	12.0
1C	601-800	16,831.0	19.0	6.5	110.0	62.0	50.0	848.0	411.0
1C	801-1000	5,303.0	8.0	5.1	27.0	10.0	109.0	578.0	242.0
1C	1001-1200	611.0	2.0	6.2	4.0	2.0	105.0	64.0	49.0
1D	401-600	545.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
1D	601-800	1,694.0	2.0	133.9	227.0	42.0	1,661.0	2,814.0	108.0
1D	801-1000	3,303.0	5.0	22.9	76.0	38.0	183.0	605.0	483.0
1D	1001-1200	10,774.0	13.0	14.3	154.0	92.0	112.0	1,204.0	510.0
1D	1201-1400	6,138.0	6.0	21.8	134.0	72.0	81.0	498.0	333.0
1D	1401-1500	2,113.0	4.0	28.1	59.0	17.0	46.0	97.0	34.0
Total		50,961.0	65.0	2.9	795.0	145.0	18.1	6,720.0	920.0

Table 13. Length distribution (1 cm groups) and total abundance estimated number (000's) with SE (weighted by survey area), and stratified mean number with SE, for roundnose grenadier, in Division 1CD, for the period 1997-2022.

Length class	2014	2015	2016	2017	2019	2022
1	0	0	0	0	0	0
2	22	37	17	11	11	64
3	238	413	187	34	207	427
4	436	961	660	174	788	653
5	458	1,084	1,201	215	629	857
6	648	1,044	923	283	664	1,437
7	985	1,172	557	235	675	1,037
8	907	862	621	223	466	685
9	811	793	726	342	464	447
10	264	407	536	420	294	266
11	219	196	508	375	310	193
12	89	95	124	750	207	225
13	58	76	175	252	217	155
14	29	99	81	239	50	157
15	26	69	28	88	79	30
16	16	14	29	16	8	49
17	0	0	0	0	13	7
18	6	19	0	0	7	12
19	6	0	6	23	0	7
20	0	7	9	0	0	7
21	0	0	0	0	0	0
22	0	0	0	0	0	0
Ab	5,218	7,348	6,388	3,680	5,089	6,715
S.E	2,249	2,281	1,803	1,760	977	920
N	99.7	140.5	122.1	75.2	97.3	131.9
S.E	43.0	43.6	34.5	36.0	18.7	18.1

Table 14. Estimates of catch, biomass and abundance for deep-sea redfish during surveys performed from 1997 to 2022 in NAFO areas 1C and 1D.

Year	Area	Vessel	MeanbioT	SEMC.kg	Biomass	SE	MeanAbuT	SEMC.num	Abundance	SE
1997	52,306	PA	46.5	14.9	2,435	780	277.5	103.9	14,514	5,435
1998	52,306	PA	58.3	17.3	3,052	907	352.2	96.5	18,424	5,045
1999	50,792	PA	49.5	19.1	2,515	972	256.3	80.4	13,016	4,083
2000	46,097	PA	17.1	5.6	790	256	77.5	20.4	3,571	941
2001	59,226	PA	52.6	14.5	3,117	858	448.1	118.2	26,538	7,003
2002	46,097	PA	6.9	0.9	317	41	30.3	7.2	1,395	332
2003	49,463	PA	30.2	13.8	1,493	684	144.2	62.2	7,130	3,077
2004	51,403	PA	45.3	24.5	2,330	1,259	259.7	139.5	13,348	7,172
2005	52,306	PA	48.7	32.2	2,546	1,683	139.0	60.4	7,268	3,159
2006	52,306	PA	37.9	13.8	1,981	720	297.6	163.7	15,565	8,564
2007	50,366	PA	8.5	3.6	426	181	37.6	15.1	1,892	762
2008	52,306	PA	253.4	123.7	13,255	6,468	1,014.1	337.5	53,046	17,654
2009	52,306	PA	149.1	74.9	7,797	3,917	670.0	338.9	35,044	17,724
2010	52,306	PA	77.8	25.4	4,069	1,330	341.0	60.6	17,834	3,171
2011	52,306	PA	184.1	69.3	9,627	3,624	620.0	248.2	32,432	12,983
2012	52,306	PA	263.2	85.0	13,768	4,446	752.6	244.0	39,365	12,765
2013	26,143	PA	974.7	316.2	25,482	8,265	1,780.4	504.6	46,544	13,191
2014	52,306	PA	421.8	196.6	22,060	10,286	1,261.4	637.9	65,978	33,365
2015	52,306	PA	191.5	85.2	10,017	4,458	601.8	242.4	31,478	12,679
2016	52,306	PA	216.7	92.3	11,334	4,829	472.2	190.1	24,698	9,945
2017	48,940	PA	183.9	131.3	9,001	6,425	335.6	233.7	16,423	11,439
2019	52,306	HM	157.7	76.5	8,249	4,004	326.6	146.0	17,086	7,639
2022	50,960	TJ	396.4	108.7	20,202	5,541	500.8	123.2	25,523	6,278

Table 15. Estimates of catch, biomass and abundance for deep-sea redfish during the 2022 survey per depth stratum.

Subarea	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
1C	401-600	3,649.0	4.0	735.2	2,683.0	1,369.0	1,338.0	4,882.0	2,271.0
1C	601-800	16,831.0	19.0	439.2	7,392.0	4,665.0	575.0	9,674.0	5,225.0
1C	801-1000	5,303.0	8.0	546.5	2,898.0	2,588.0	540.0	2,865.0	2,526.0
1C	1001-1200	611.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
1D	401-600	545.0	2.0	10.0	5.0	0.0	110.0	60.0	5.0
1D	601-800	1,694.0	2.0	4,262.4	7,220.0	609.0	4,742.0	8,033.0	759.0
1D	801-1000	3,303.0	5.0	1.1	4.0	4.0	2.0	8.0	8.0
1D	1001-1200	10,774.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0
1D	1201-1400	6,138.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
1D	1401-1500	2,113.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		50,961.0	65.0	108.7	20,202.0	5,541.0	123.2	25,522.0	6,278.0

Table 16. Length distribution (2 cm groups) and total abundance estimated number (000's) with SE (weighted by survey area), and stratified mean number with SE, for deep-sea redfish, in Division 1CD, for the period 1997-2022.

Length class	2014	2015	2016	2017	2019	2022
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	5	0	0	0	11
18	0	16	0	0	0	85
19	0	45	0	0	22	221
20	0	192	23	0	0	61
21	247	437	14	0	6	14
22	1,531	706	23	0	26	11
23	2,240	1,053	183	0	48	0
24	2,800	1,850	271	46	80	0
25	4,101	2,911	690	12	6	11
26	4,905	3,014	1,139	168	69	14
27	8,439	2,397	1,474	336	219	28
28	8,123	4,109	2,230	744	369	55
29	6,863	3,185	2,027	708	764	11
30	7,222	2,410	2,264	1,098	1,340	114
31	6,781	2,238	1,935	1,161	1,330	467
32	3,628	1,450	2,073	1,251	1,259	951
33	3,865	2,234	1,805	1,489	1,570	1,348
34	1,115	711	1,546	1,382	1,592	2,174
35	834	658	1,181	1,539	1,742	2,257
36	1,090	258	1,389	1,398	1,448	2,040
37	395	299	1,068	1,059	1,570	1,450
38	125	174	1,225	1,200	1,358	1,369
39	491	132	679	674	1,183	2,480
40	195	207	457	648	342	2,289
41	306	205	421	655	421	2,406
42	166	64	220	477	219	2,046
43	205	30	263	176	11	1,653
44	24	61	10	77	0	923
45	95	42	0	46	20	617
46	100	30	67	31	69	294
47	0	0	0	0	0	82
48	16	0	0	0	0	22
49	0	0	23	46	0	10
50	0	0	0	0	0	0
51	76	0	0	0	0	0

Length class	2014	2015	2016	2017	2019	2022
52	0	0	0	0	0	0
53	0	0	0	0	0	0
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	0	0
Ab	65,978	31,123	24,700	16,421	17,083	25,514
S.E	33,365	12,679	9,945	11,439	7,639	6,278
N	1,261.4	601.8	472.2	335.6	326.6	500.8
S.E	637.9	242.4	190.1	233.7	146.0	123.2

Figures

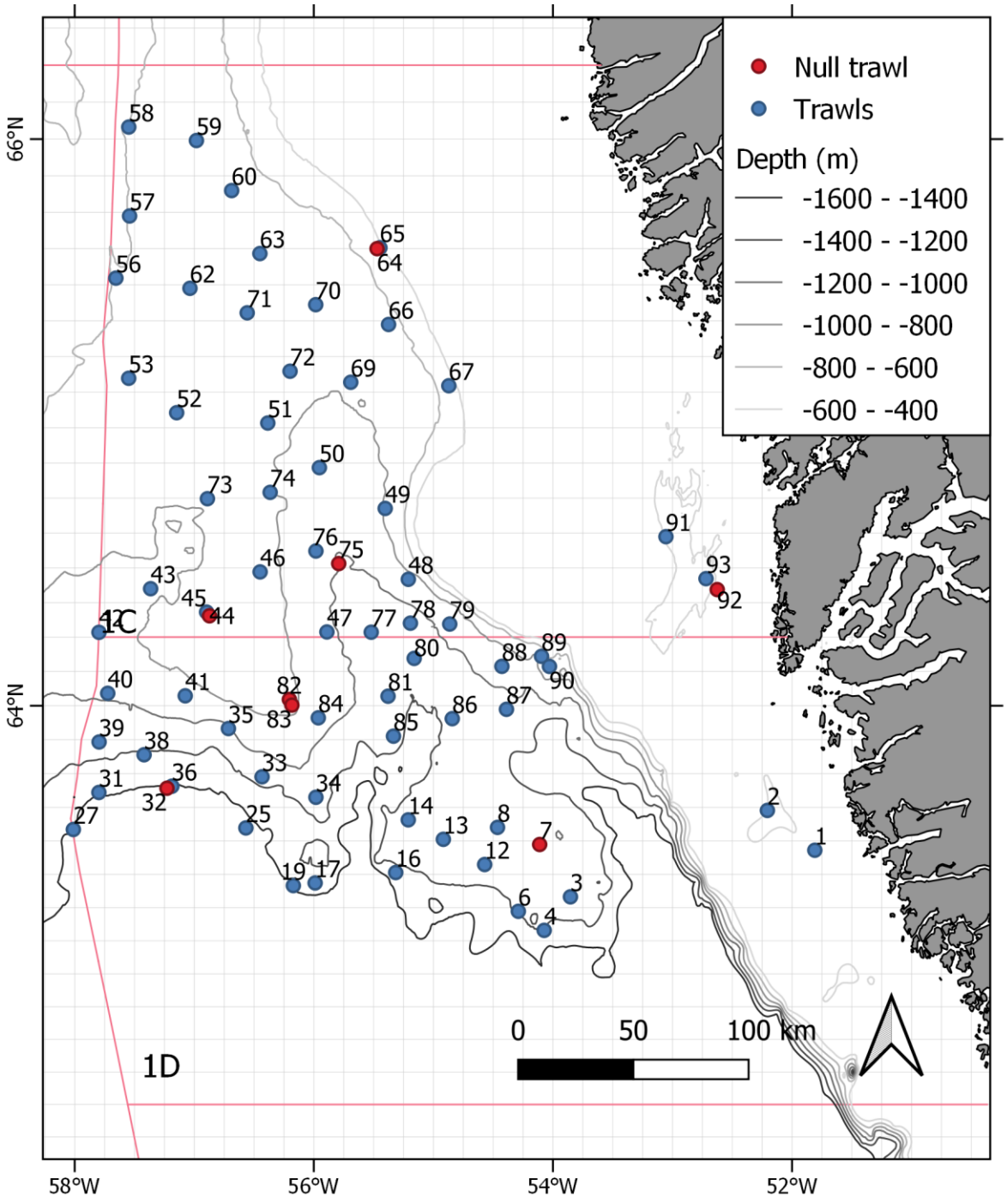


Figure 1. Hauls positions for the West Greenland halibut 2022 survey. Coordinate system is WGS84/Pseudo Mercator EPSG: 3857- Grid in latitude /longitude.

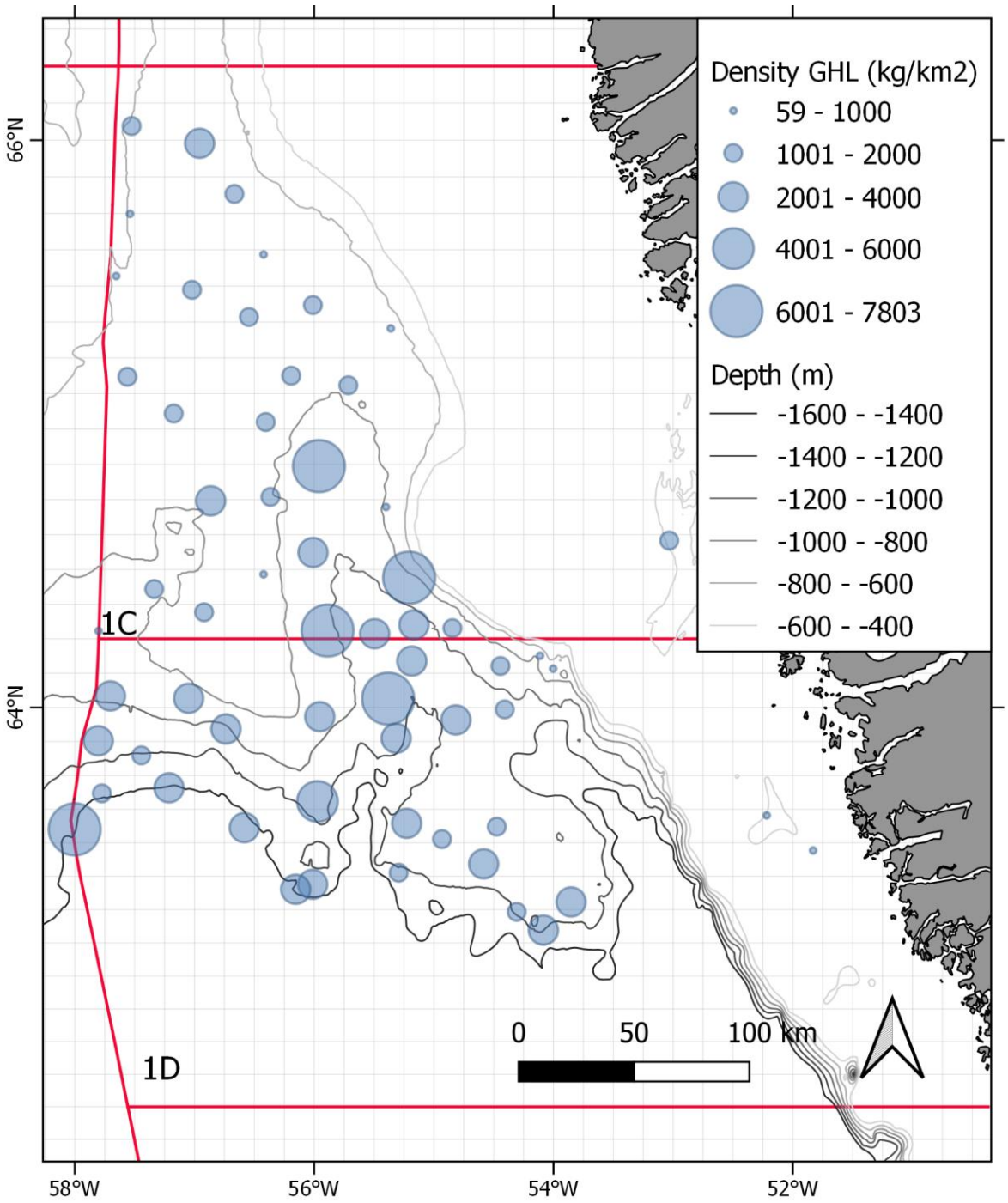


Figure 2. Distribution of catches (kg/km^2) of Greenland halibut in 2022.

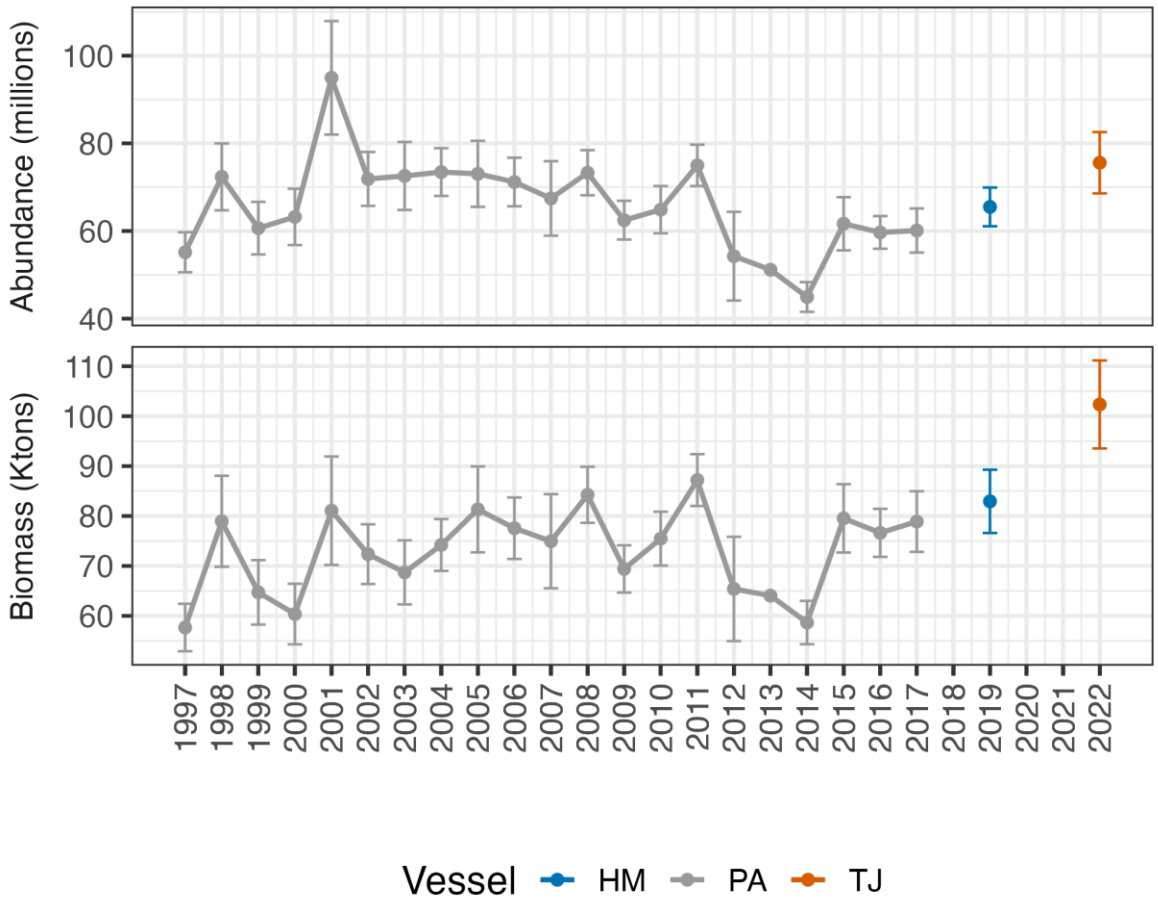


Figure 3. Greenland halibut biomass and abundance calculated by the swept area method per year for the period 1997-2022. Error bars show the standard error. The biomass and abundance in Division 1C, in 2013, were estimated by a GLM including data from 2010-2014 (Biomass = 64049 tons; Abundance = 51160 $*10^3$ individuals).

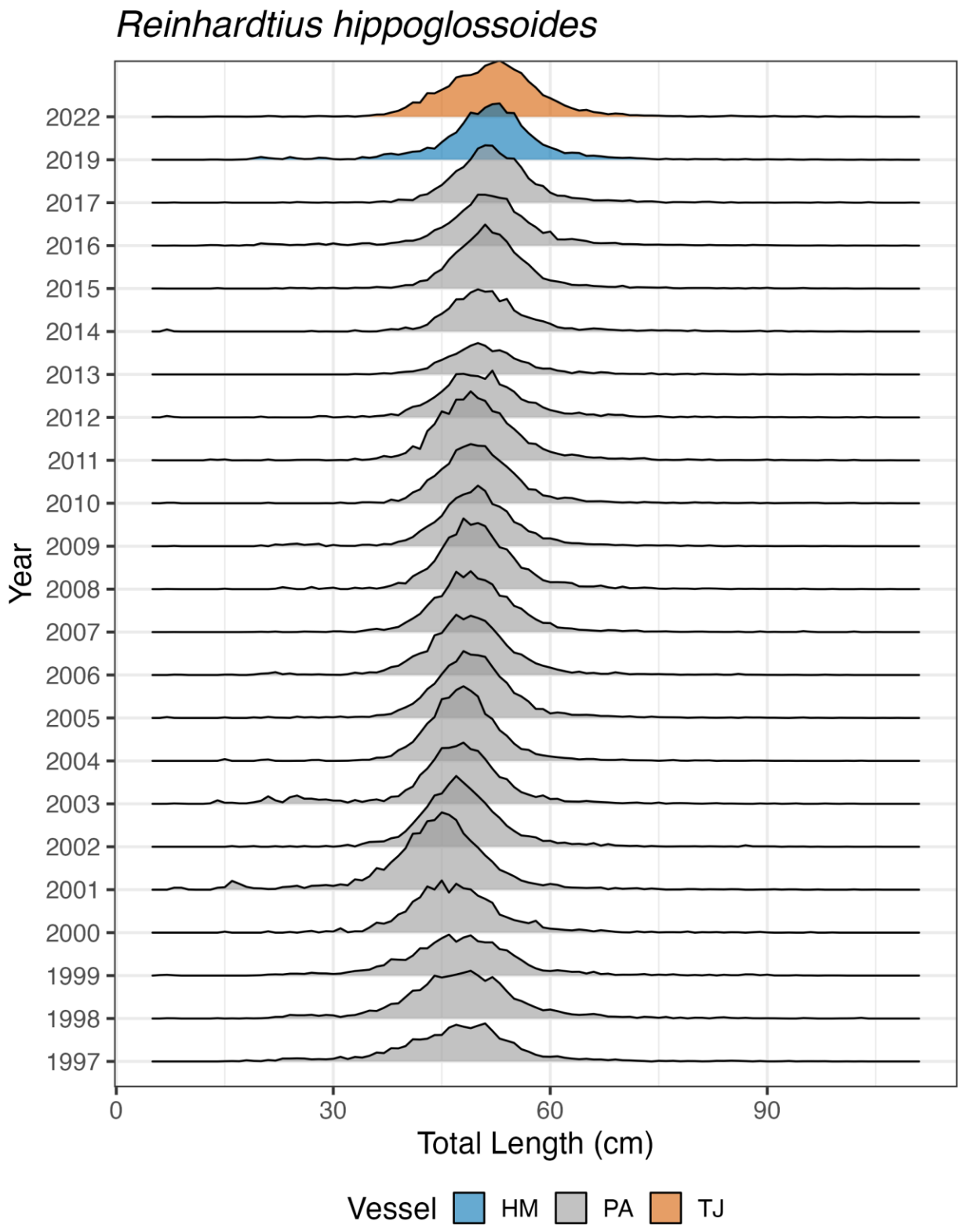


Figure 4. Greenland halibut length distribution (weighted to stratum area), NAFO Div. 1CD, for the period 1997-2022.

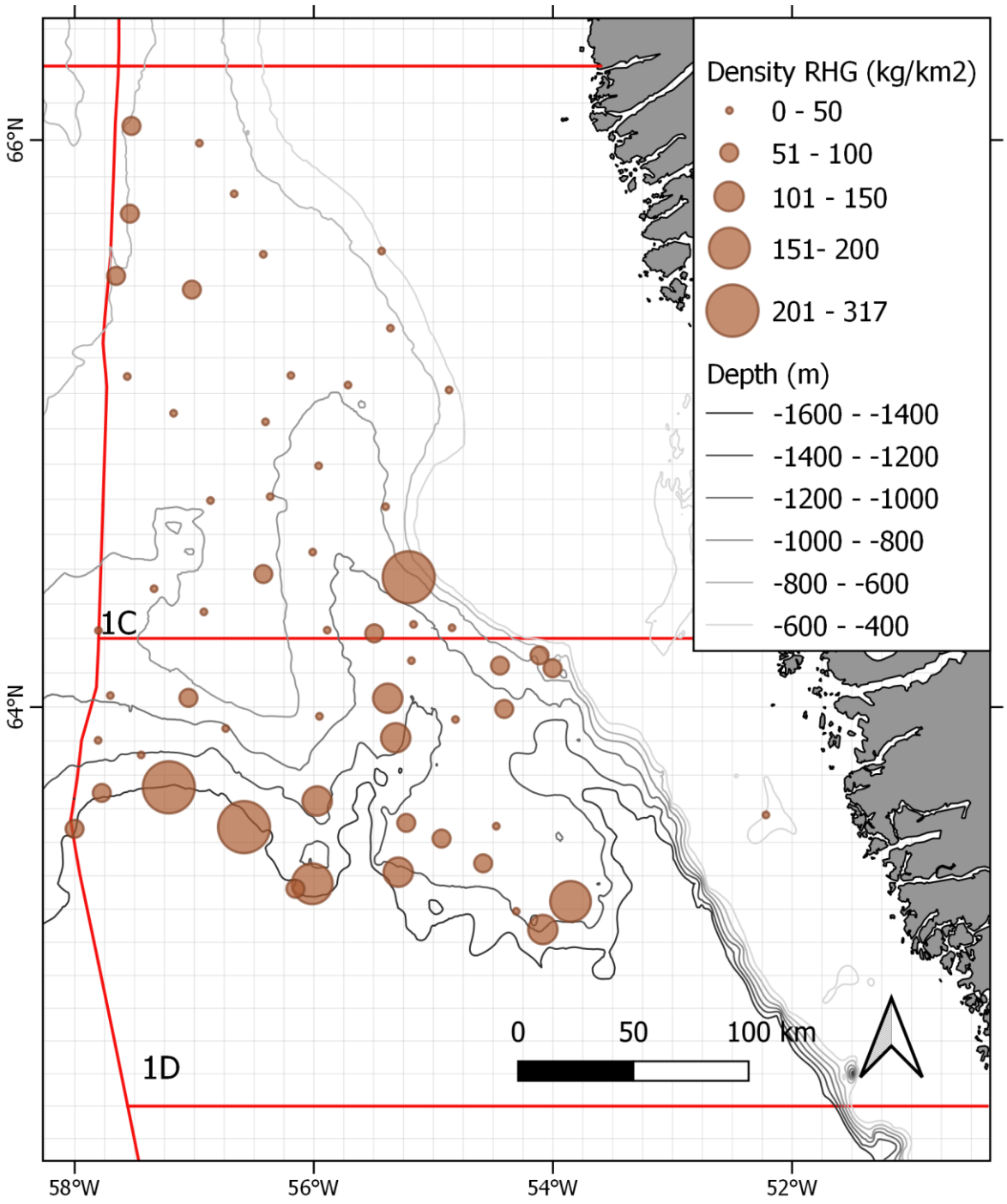


Figure 5. Distribution of catches (kg/km^2) of roughhead grenadier in 2022.

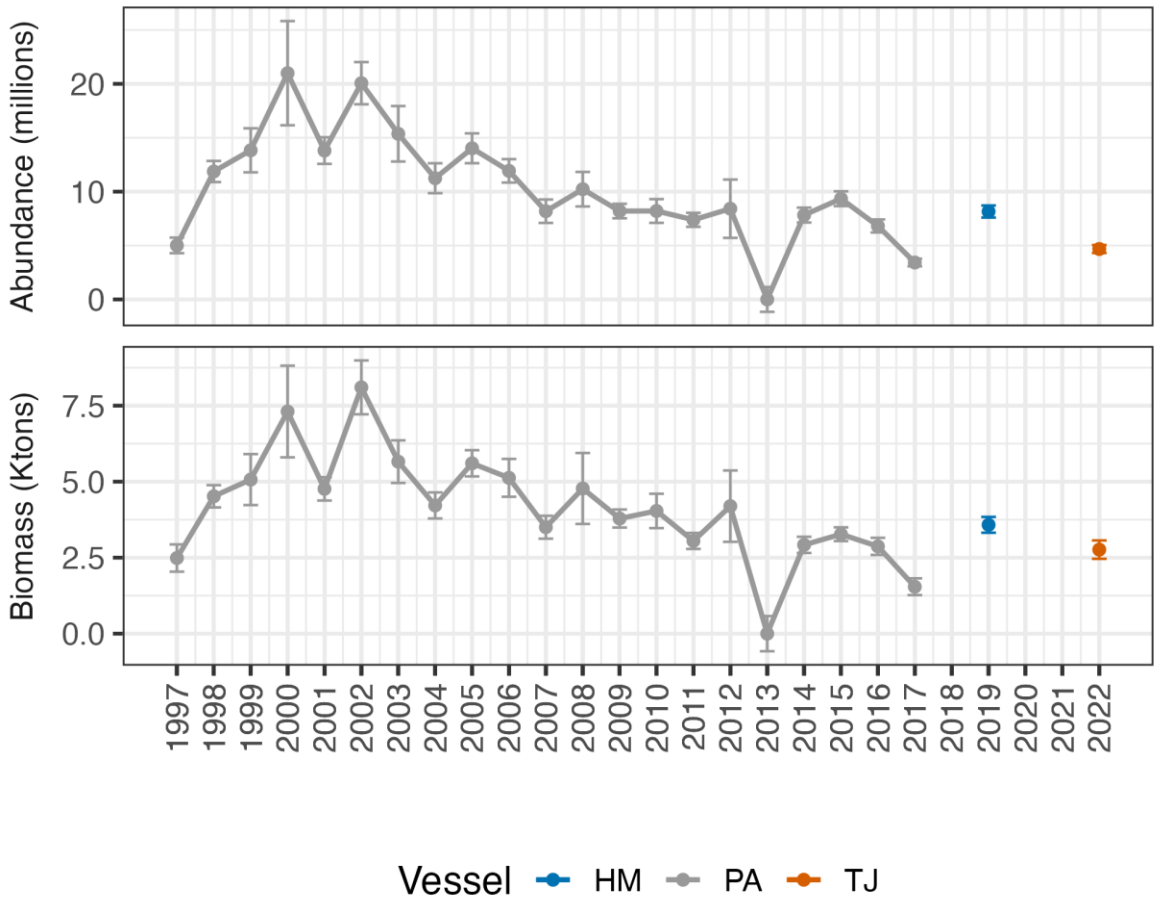


Figure 6. Roughhead grenadier biomass and abundance calculated by the swept area method per year for the period 1997-2022. Error bars show the standard error.

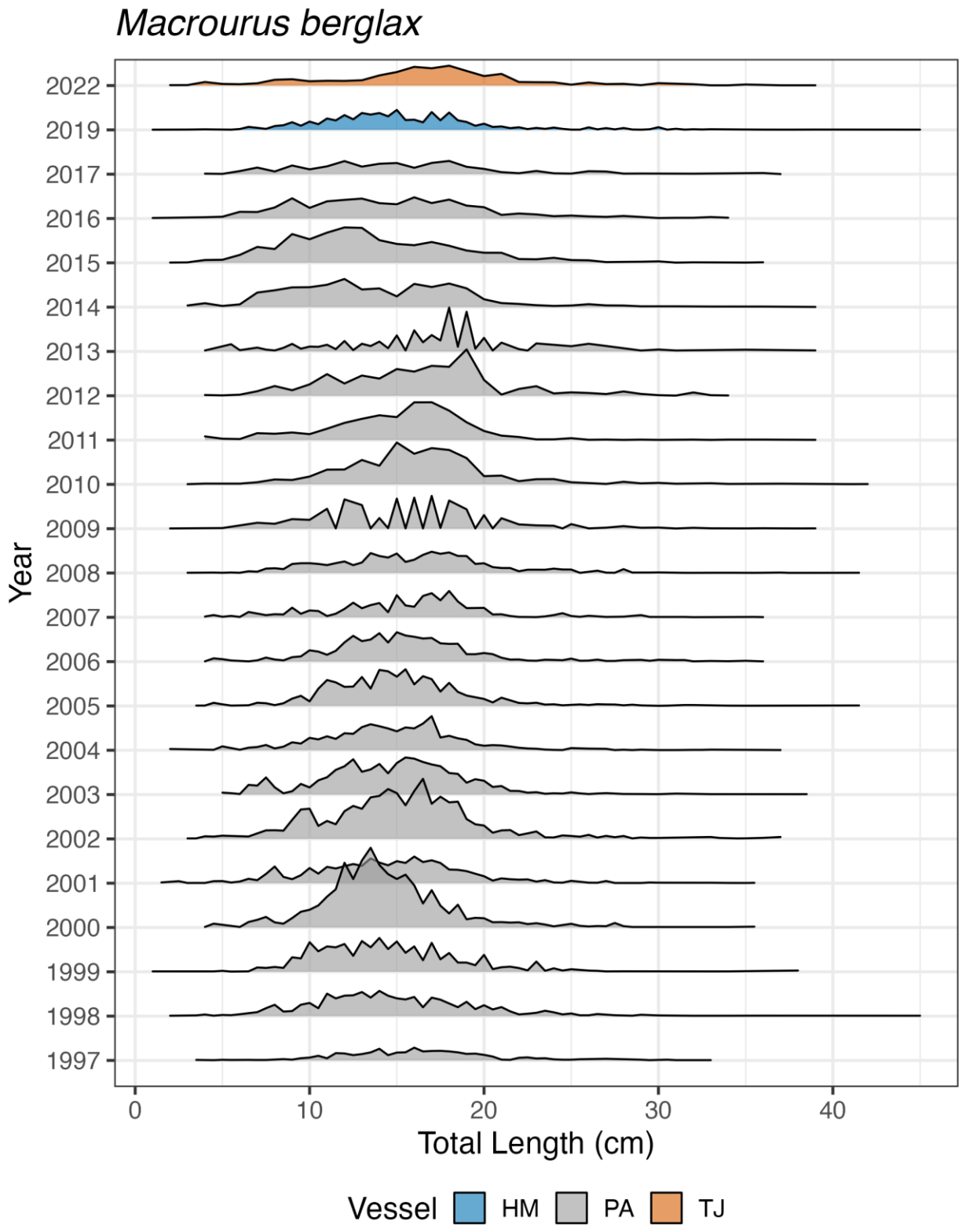


Figure 7. Roughhead grenadier length distribution (weighted to stratum area), NAFO Div. 1CD, for the period 1997-2022.

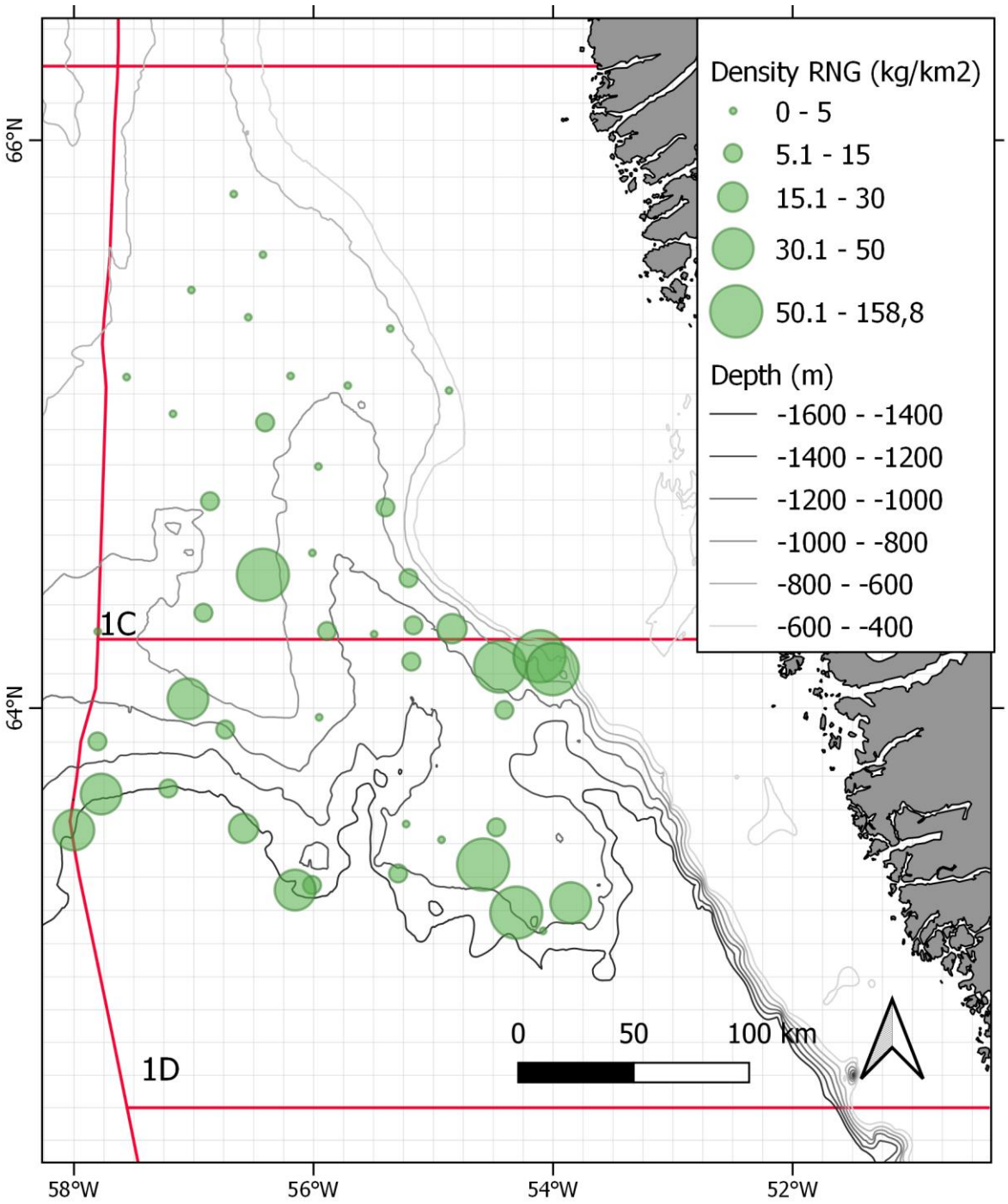


Figure 8. Distribution of catches (kg/km^2) of roundnose grenadier in 2022.

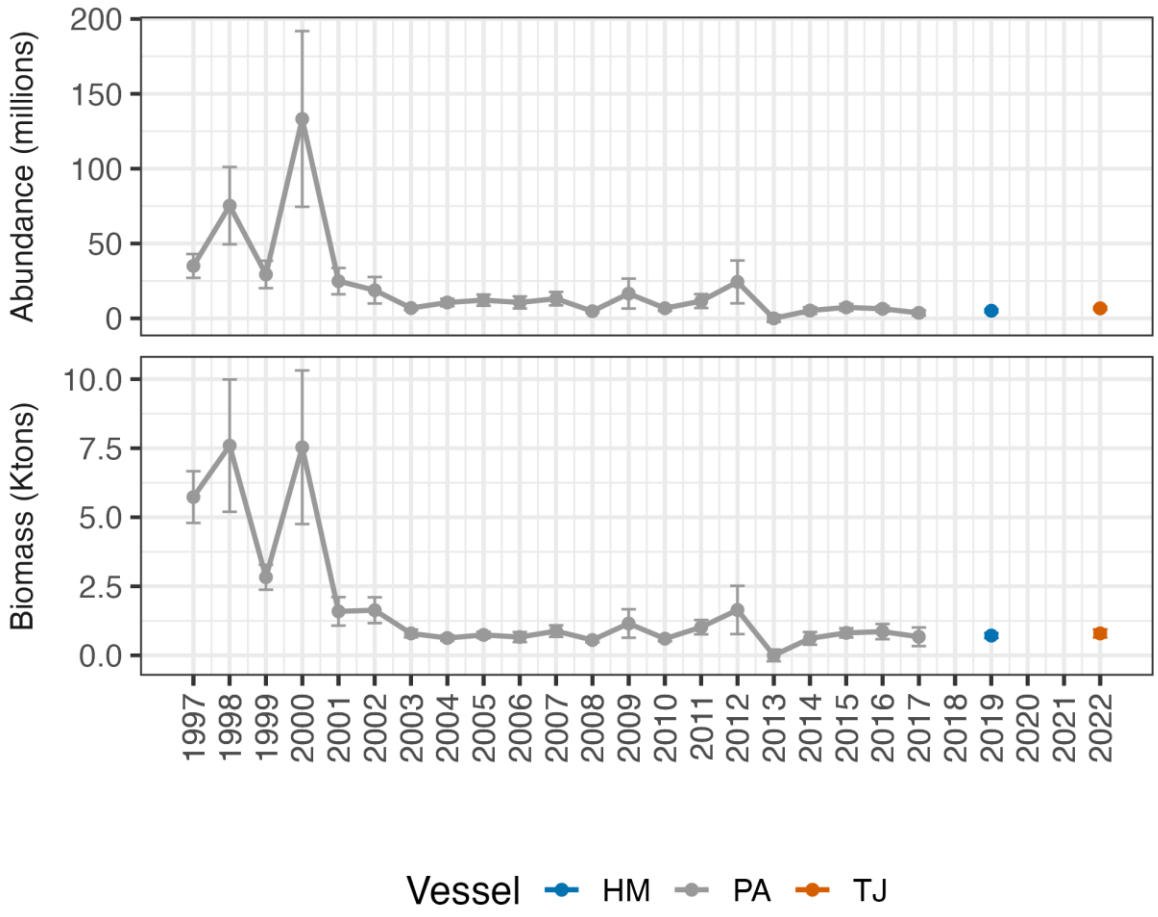


Figure 9. Roundnose grenadier biomass and abundance calculated by the swept area method per year for the period 1997-2022. Error bars show the standard error.

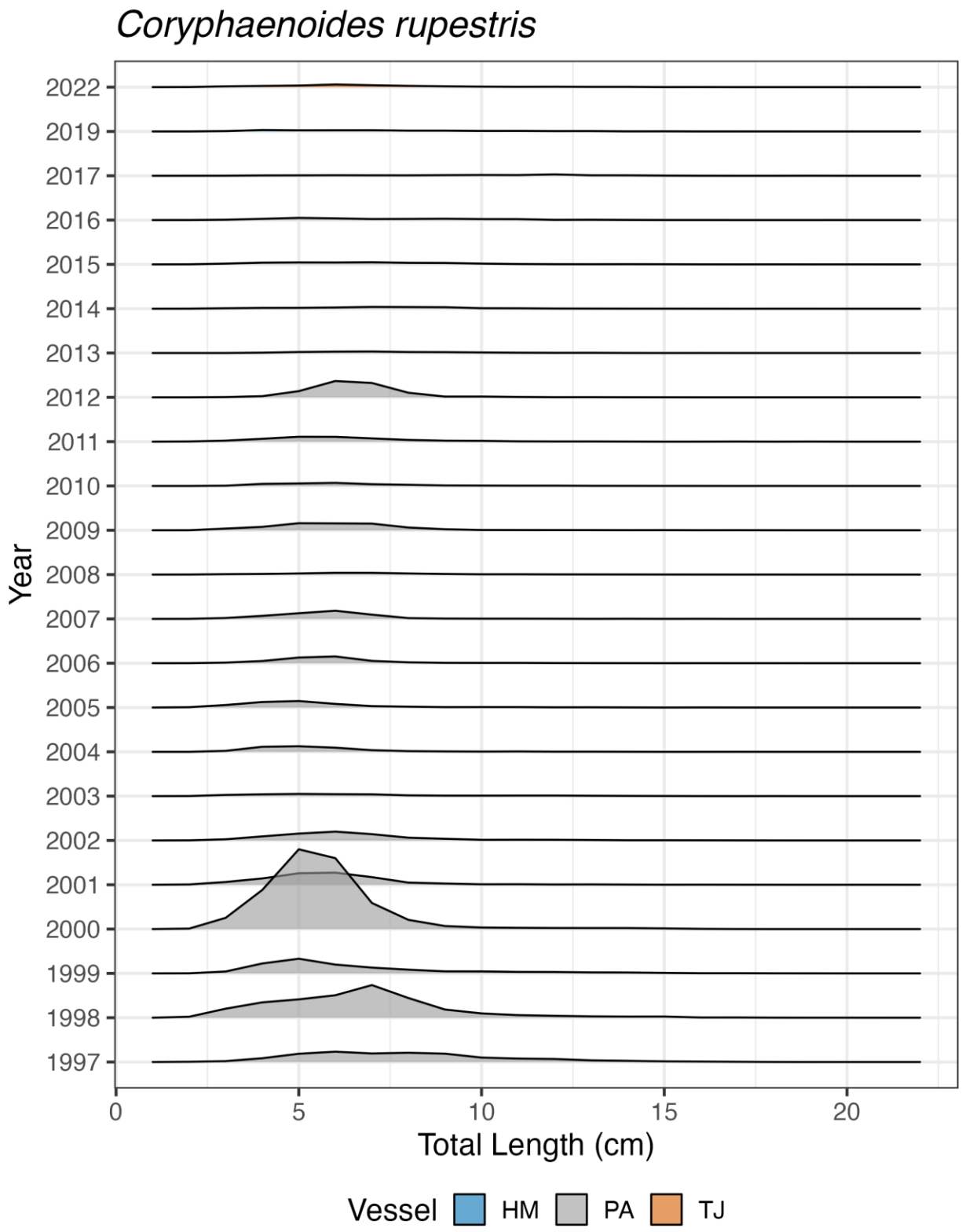


Figure 10. Roundnose grenadier length distribution (weighted to stratum area), NAFO Div. 1CD, for the period 1997-2022.

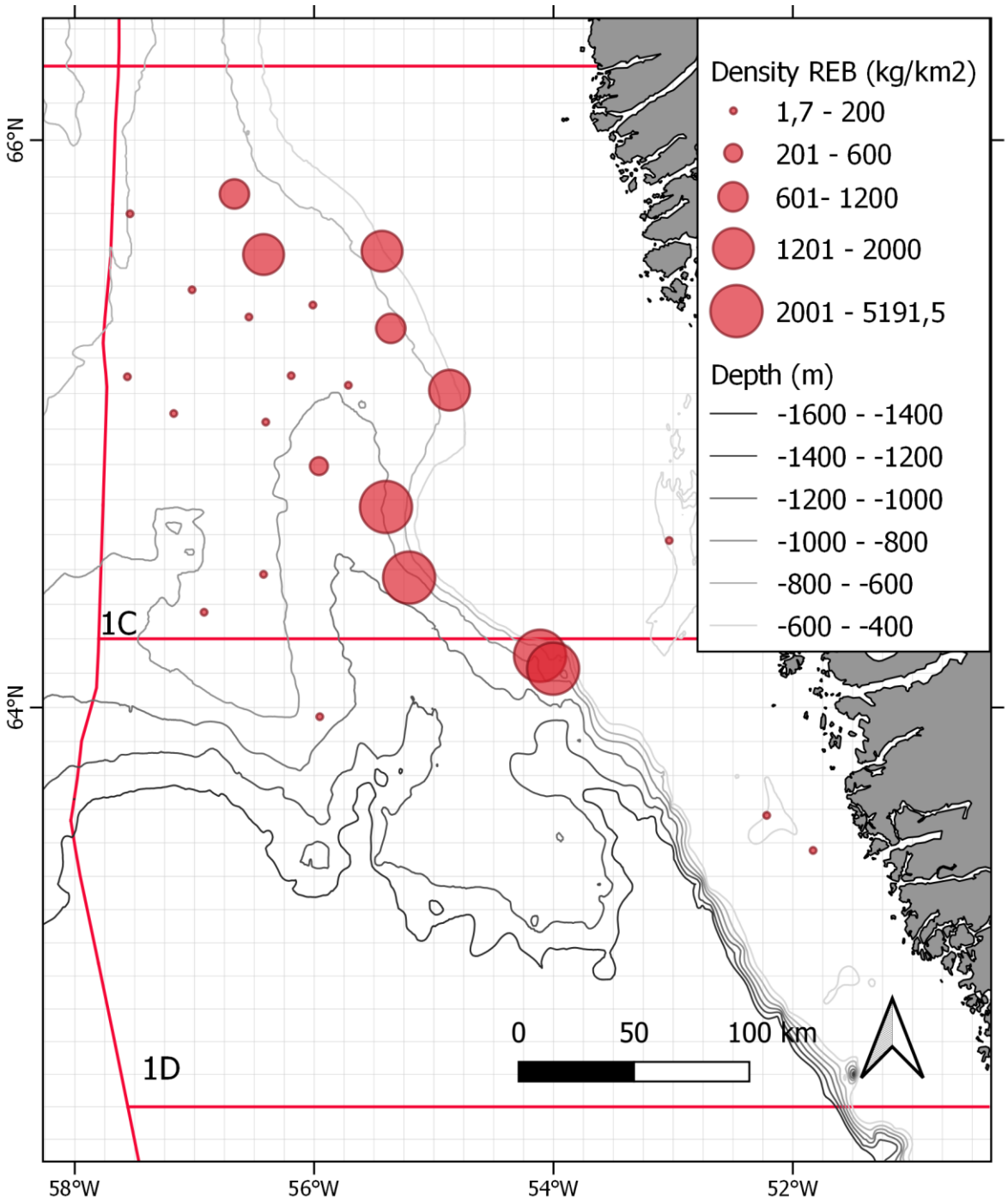


Figure 11. Distribution of catches (kg/km^2) of deep-sea redfish in 2022.

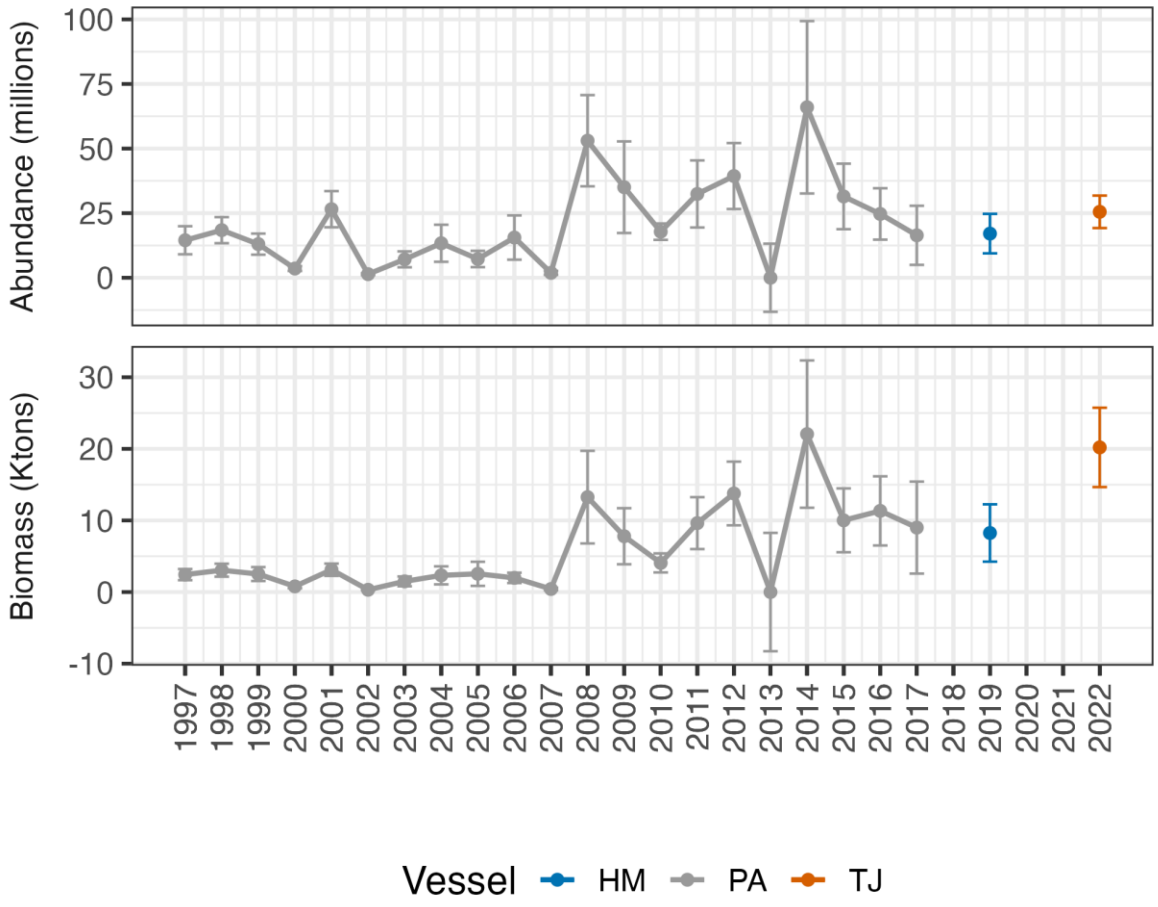


Figure 12. Deep-sea redfish biomass and abundance calculated by the swept area method per year for the period 1997-2022. Error bars show the standard error.

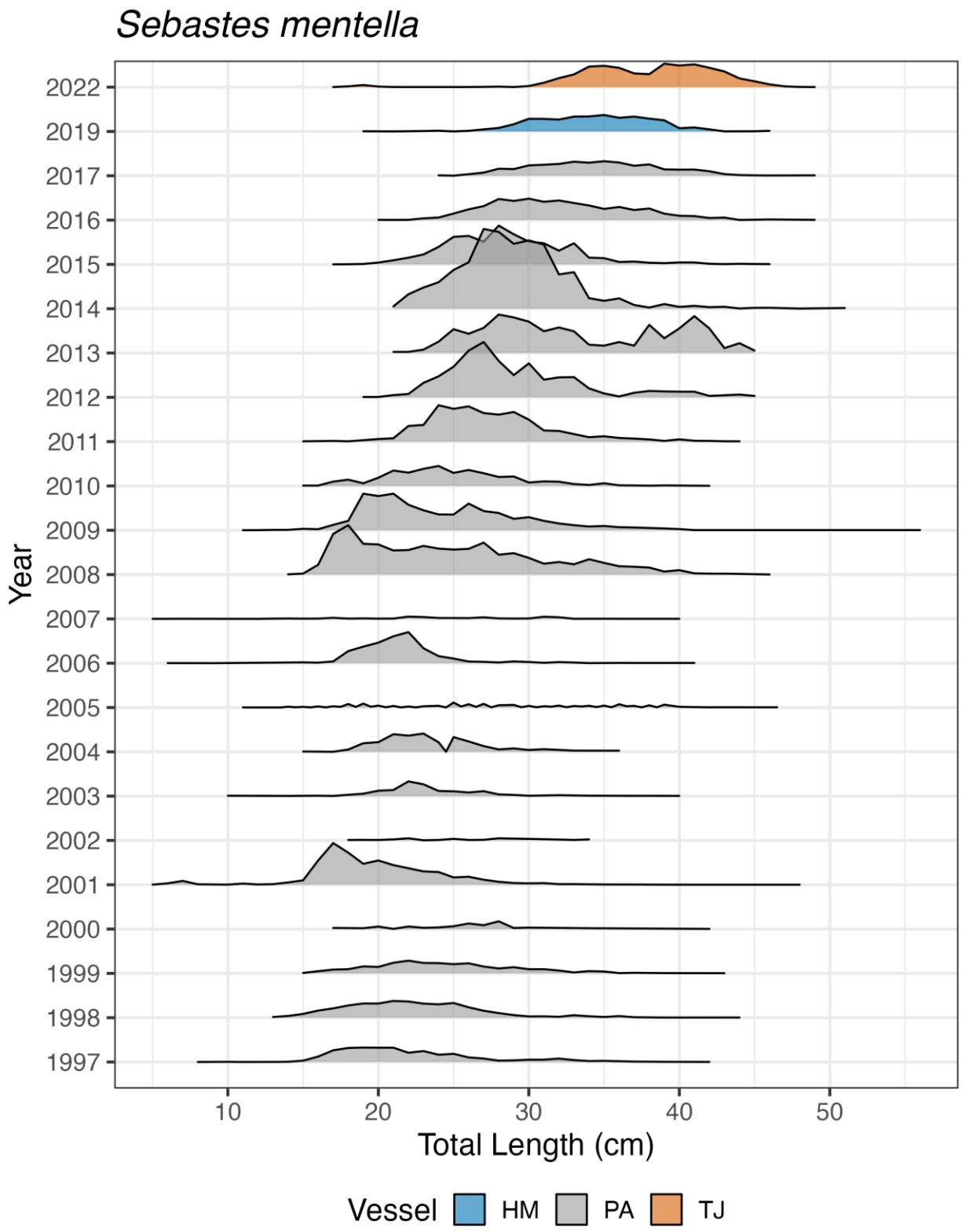


Figure 13. Deep-sea redfish length distribution (weighted to stratum area), NAFO Div. 1CD, for the period 1997-2022.

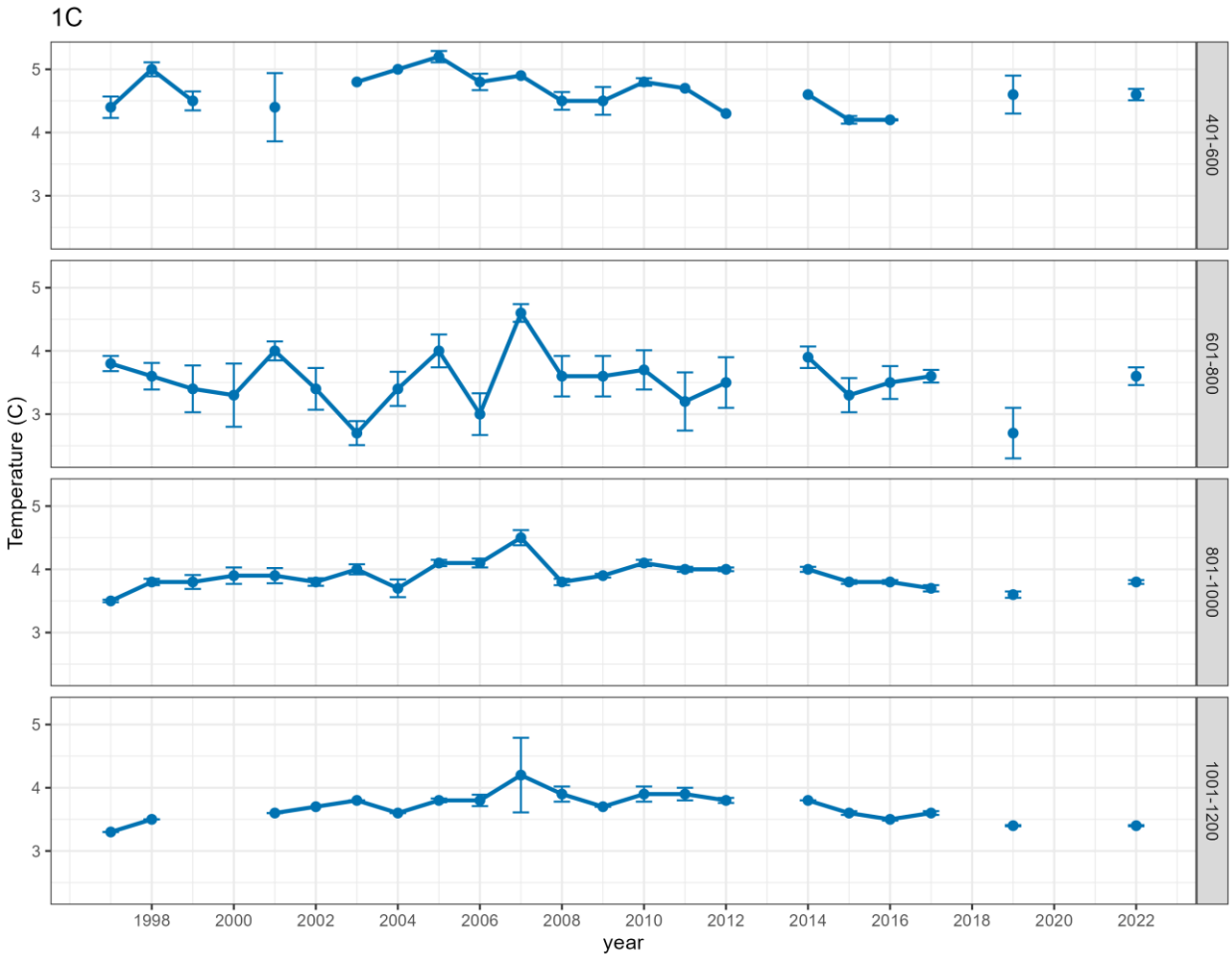


Figure 14. Mean temperatures with S.E. in NAFO division 1C by depth and stratum for the period 1997-2022.

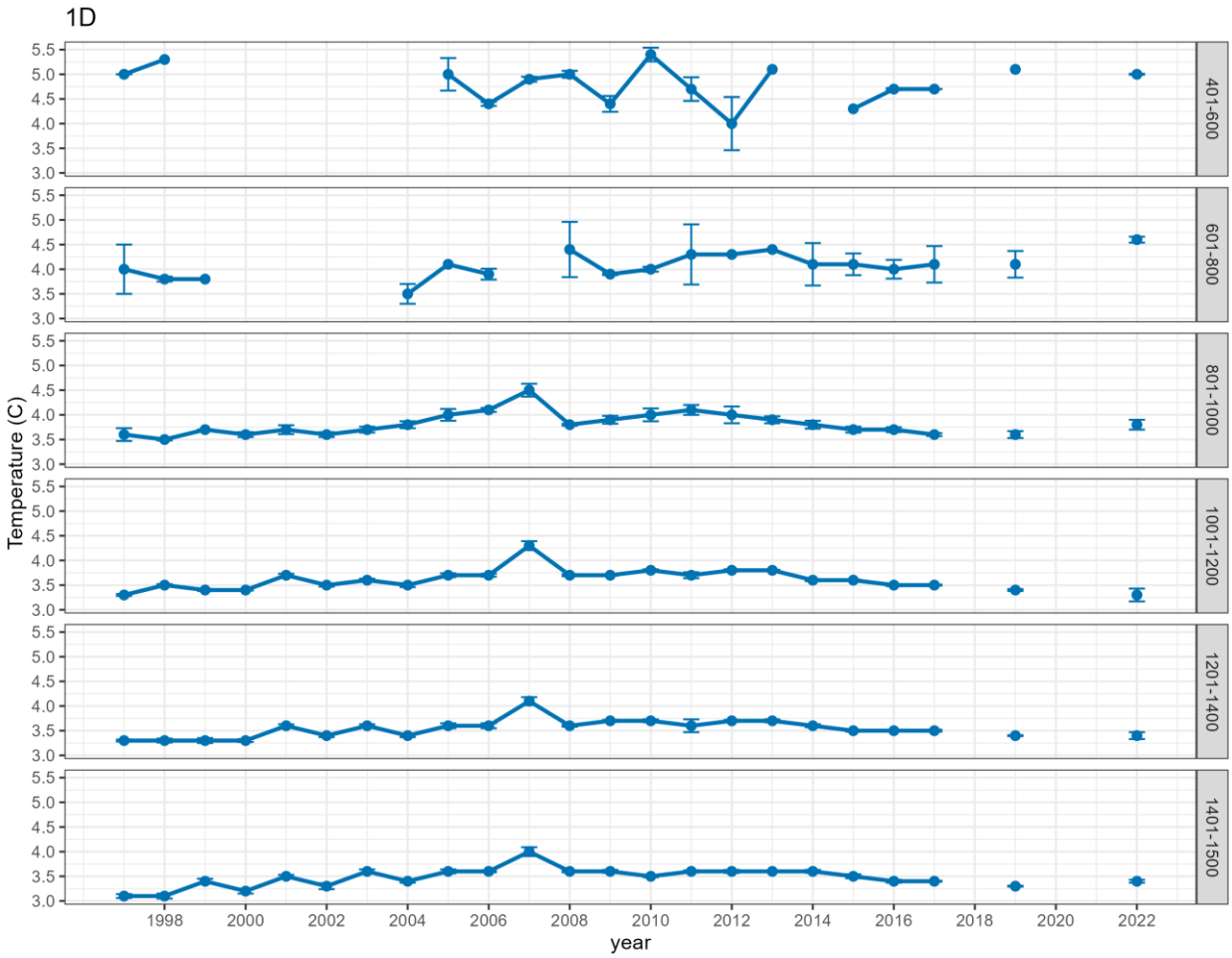


Figure 15. Mean temperatures with S.E. in NAFO division 1D by depth and stratum for the period 1997-2022.

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Appendix A

Table 17. Registered numbers per station for the four species in the 2022 survey in NAFO 1CD.

					R. hippoglossoides		*M. berglax*		*C. rupestris*		*S. mentella*	
St. No	**Swept Area**	**Division**	**Depth**	**Bottom Temp.**	**Weight (kg)**	**Number**	**Weight (kg)**	**Number**	**Weight (kg)**	**Number**	**Weight (kg)**	**Number**
1.0	0.1	1D	434.0	5.0	74.6	100.0	0.0	0.0	0.0	0.0	0.8	8.0
2.0	0.1	1D	495.0	5.0	60.8	61.0	0.0	0.0	1.5	3.0	0.8	11.0
3.0	0.1	1D	1,100.0	2.9	244.4	129.0	2.8	22.0	12.7	17.0	0.0	0.0
4.0	0.1	1D	1,284.0	3.5	145.1	88.0	0.2	2.0	10.2	8.0	0.0	0.0
6.0	0.1	1D	1,235.0	3.7	117.6	71.0	4.9	23.0	2.2	7.0	0.0	0.0
8.0	0.1	1D	1,117.0	3.8	100.0	42.0	0.9	12.0	1.0	3.0	0.0	0.0
12.0	0.1	1D	1,146.5	2.0	260.5	171.0	9.1	49.0	7.5	13.0	0.0	0.0
13.0	0.1	1D	1,120.0	3.5	133.7	93.0	0.0	4.0	7.1	14.0	0.0	0.0
14.0	0.1	1D	1,158.5	3.5	137.7	98.0	0.1	4.0	3.6	7.0	0.0	0.0
16.0	0.1	1D	1,258.5	3.4	147.8	78.0	0.6	1.0	11.5	17.0	0.0	0.0
17.0	0.1	1D	1,304.5	3.2	270.7	163.0	0.9	3.0	12.7	16.0	0.0	0.0
19.0	0.1	1D	1,412.0	3.3	219.4	127.0	3.1	6.0	5.2	7.0	0.0	0.0
25.0	0.1	1D	1,480.5	3.5	193.7	121.0	1.9	2.0	23.6	20.0	0.0	0.0
27.0	0.1	1D	1,454.0	3.4	403.4	269.0	2.4	4.0	6.0	10.0	0.0	0.0
31.0	0.1	1D	1,382.0	3.4	99.1	74.0	2.9	5.0	4.5	8.0	0.0	0.0
33.0	0.1	1D	1,184.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34.0	0.1	1D	1,092.5	3.6	359.0	224.0	0.0	0.0	6.8	14.0	0.0	0.0
35.0	0.1	1D	984.5	3.5	206.2	161.0	1.0	2.0	3.5	6.0	0.0	0.0
36.0	0.1	1D	1,433.0	3.4	198.0	129.0	0.5	1.0	16.8	16.0	0.0	0.0
38.0	0.1	1D	1,227.0	3.5	154.1	107.0	0.0	0.0	1.2	7.0	0.0	0.0
39.0	0.1	1D	1,140.5	3.5	200.2	170.0	0.5	1.0	3.5	7.0	0.0	0.0
40.0	0.1	1D	968.5	4.1	155.8	112.0	0.0	0.0	1.9	5.0	0.0	0.0
41.0	0.1	1D	898.0	3.6	240.8	163.0	3.1	9.0	4.5	6.0	0.0	0.0
42.0	0.1	1C	884.5	3.8	55.9	51.0	0.1	1.0	1.1	2.0	0.0	0.0
43.0	0.1	1C	835.5	3.8	100.0	78.0	0.0	0.0	2.2	4.0	0.0	0.0
45.0	0.1	1C	763.0	3.9	149.7	125.0	0.9	15.0	2.6	6.0	0.8	1.0
46.0	0.1	1C	730.5	4.0	63.2	56.0	5.9	38.0	5.2	12.0	2.8	6.0
47.0	0.1	1C	974.0	3.7	523.7	367.2	0.6	7.0	1.0	2.0	0.0	0.0
48.0	0.1	1C	837.5	4.0	535.5	357.5	0.8	26.0	17.1	17.0	313.9	306.8
49.0	0.1	1C	671.5	4.2	15.0	9.0	1.0	4.0	0.7	1.0	377.4	401.0
50.0	0.1	1C	887.5	3.8	602.0	477.0	0.2	5.0	1.5	4.0	26.1	27.0
51.0	0.1	1C	753.5	3.9	105.4	88.0	0.9	5.0	3.3	4.0	1.0	1.0
52.0	0.1	1C	729.0	3.8	90.0	73.0	0.1	1.0	1.2	4.0	0.5	1.0
53.0	0.1	1C	681.0	3.6	93.0	89.0	0.0	1.0	1.7	8.0	0.5	1.0
56.0	0.1	1C	617.5	2.0	66.3	81.0	0.0	0.0	6.4	15.0	0.0	0.0
57.0	0.1	1C	616.0	2.6	78.9	106.0	0.0	0.0	4.4	10.0	0.9	1.0
58.0	0.1	1C	616.0	2.6	81.6	92.0	0.0	0.0	4.3	7.0	0.0	0.0
59.0	0.1	1C	671.0	3.4	290.2	298.0	0.0	0.0	2.4	6.0	0.0	0.0
60.0	0.1	1C	657.5	4.0	117.0	108.0	0.0	1.0	2.3	6.0	77.3	146.0
62.0	0.0	1C	655.5	3.5	57.0	64.0	0.0	1.0	2.7	7.0	4.6	9.0

					R. hippoglossoides		*M. berglax*		*C. rupestris*		*S. mentella*	
St. No	**Swept Area**	**Division**	**Depth**	**Bottom Temp.**	**Weight (kg)**	**Number**	**Weight (kg)**	**Number**	**Weight (kg)**	**Number**	**Weight (kg)**	**Number**
63.0	0.1	1C	695.0	3.9	61.6	58.0	0.0	1.0	2.1	4.0	101.3	175.0
65.0	0.1	1C	435.0	4.7	0.0	0.0	0.0	0.0	1.1	1.0	78.2	150.0
66.0	0.1	1C	664.5	4.3	23.1	13.0	0.4	2.0	0.7	2.0	68.3	100.0
67.0	0.1	1C	515.5	4.8	0.0	0.0	0.4	1.0	0.7	1.0	117.5	190.0
69.0	0.1	1C	811.5	3.9	84.8	64.0	0.2	6.0	0.7	3.0	6.7	9.0
70.0	0.1	1C	750.5	3.9	88.6	84.0	0.0	0.0	0.0	0.0	0.4	1.0
71.0	0.1	1C	695.0	3.5	84.8	63.0	0.0	1.0	0.0	0.0	0.4	1.0
72.0	0.1	1C	762.5	3.9	141.2	116.0	0.2	1.0	0.1	2.0	0.5	1.0
73.0	0.1	1C	788.0	3.8	179.9	169.0	0.6	7.0	2.0	7.0	0.0	0.0
74.0	0.1	1C	795.5	3.8	93.3	78.0	0.0	0.0	0.1	1.0	0.0	0.0
76.0	0.1	1C	938.5	3.8	215.2	159.0	0.1	1.0	2.7	3.0	0.0	0.0
77.0	0.1	1C	1,096.5	3.4	238.0	163.0	0.3	2.0	4.3	6.0	0.0	0.0
78.0	0.1	1C	1,058.0	3.5	270.9	180.0	0.7	15.0	2.5	8.0	0.0	0.0
79.0	0.1	1C	957.0	3.9	137.2	85.0	1.3	24.0	1.9	7.0	0.0	0.0
80.0	0.1	1D	1,141.5	3.4	236.9	168.0	0.5	10.0	1.9	5.0	0.0	0.0
81.0	0.0	1D	1,123.0	3.5	149.9	122.0	0.0	0.0	3.0	5.0	0.0	0.0
84.0	0.1	1D	920.5	3.7	201.0	142.0	0.3	2.0	1.1	5.0	0.5	1.0
85.0	0.1	1D	1,193.0	3.5	158.0	96.0	0.0	0.0	6.0	9.0	0.0	0.0
86.0	0.1	1D	1,174.0	3.4	241.3	158.0	0.0	0.0	3.9	6.0	0.0	0.0
87.0	0.1	1D	1,100.5	3.6	116.9	52.0	0.9	11.0	5.2	11.0	0.0	0.0
88.0	0.1	1D	943.0	3.9	131.6	82.0	4.3	53.0	6.3	8.0	0.0	0.0
89.0	0.1	1D	739.0	4.7	4.7	3.0	12.7	128.1	7.9	11.0	370.4	416.0
90.0	0.1	1D	701.5	4.5	62.7	28.0	9.0	143.0	4.9	8.0	323.6	356.0
91.0	0.1	1C	478.0	4.4	91.6	116.0	0.0	0.0	0.0	1.0	16.9	46.0
93.0	0.1	1C	590.5	4.5	29.0	19.0	0.0	0.0	0.0	0.0	0.1	1.0

Appendix B

Table 18. Registered numbers per station for the four species in the 2022 survey in NAFO 1CD.

Species	Max. Weight (kg)	Max. Number	Depth Range	Temp. Range	Max. Latitude
Alepocephalus agassizii	9.8	20.0	763-1480	3.9-3.2	64.3
Alepocephalus bairdii	14.2	40.0	664-1433	4.7-3.3	65.3
Anarhichas denticulatus	22.1	2.0	434-1433	5-2	65.4
Anarhichas minor	1.5	1.0	616-656	3.5-2.6	65.8
Anoplogaster cornuta	0.2	1.0	884-1142	3.8-3.4	64.3
Antimora rostrata	39.1	43.0	884-1480	4.1-2	64.6
Arctozenus risso	0.2	2.0	590-1100	4.5-2	65.8
Argentina silus	0.3	8.0	435-664	4.7-4.3	65.6
Bajacalifornia megalops	1.0	7.0	702-1235	4.5-3.7	65.2
Bathylagus euryops	6.1	161.0	616-1480	4.7-2	66.0
Bathyraja spinicauda	26.1	1.0	672-1146	4.2-2	64.7
Benthosema glaciale	0.4	182.0	434-1480	5-2	66.0
Borostomias antarcticus	0.6	4.0	434-1480	5-3.3	65.2
Brosme brosme	4.4	2.0	739-739	4.7-4.7	64.2
Caristius opalescens	0.1	1.0	754-754	3.9-3.9	65.0
Centroscyllium fabricii	53.2	34.0	435-1227	4.7-2	65.8
Ceratias holboelli	0.2	1.0	656-1100	3.6-3.5	65.5
Chauliodus sloani	0.2	3.0	434-1258	5-2	65.6
Chiasmodon harteli	0.1	3.0	658-1480	4.1-3.4	65.8
Coryphaenoides guentheri	0.8	6.0	681-1480	4.5-2	65.2
Coryphaenoides mediterraneus	0.2	1.0	1454-1454	3.4-3.4	63.5
Coryphaenoides rupestris	12.7	143.0	516-1480	4.8-2	65.8
Cottunculus microps	0.4	1.0	616-812	3.9-2.6	65.8
Cryptopsaras couesii	0.4	1.0	1235-1235	3.7-3.7	63.2
Cyclopterus lumpus	2.5	2.0	681-1382	3.9-3.4	65.2
Cyclothone braueri	0.0	18.0	671-1433	4.7-3.3	66.0
Cyclothone microdon	0.0	4.0	658-1100	4-3.6	65.8
Eurypharynx pelecanoides	0.1	1.0	434-884	5-3.8	64.3
Gadus morhua	71.9	43.0	434-495	5-4.4	64.6
Gaidropsarus argentatus	0.8	2.0	495-1433	5-2.6	66.0
Gaidropsarus ensis	1.5	6.0	616-1480	4.7-2	66.0
Gonostoma sp.	0.0	1.0	884-1158	4.1-3.5	64.3
Hippoglossoides platessoides	79.2	392.0	434-796	5-2.6	66.0
Hippoglossus hippoglossus	8.7	2.0	434-590	5-4.5	64.5
Holtbyrnia anomala	0.2	2.0	763-1382	3.9-3.4	64.3
Hydrolagus affinis	29.3	4.0	1235-1480	3.7-3.2	63.6
Lampanyctus crocodilus	0.0	2.0	702-1412	4.5-3.3	65.0
Lampanyctus macdonaldi	3.4	183.0	478-1480	5-2	66.0
Lepidion eques	0.4	1.0	702-957	4.5-3.9	64.3
Liparis fabricii	0.1	2.0	616-788	3.8-2	66.0
Lophodolos acanthognathus	0.0	1.0	968-1158	4.1-3.5	64.0
Lycenchelys paxillus	0.0	1.0	1227-1227	3.5-3.5	63.8

Species	Max. Weight (kg)	Max. Number	Depth Range	Temp. Range	Max. Latitude
Lycodes eudipleurostictus	0.0	1.0	616-616	2.6-2.6	65.8
Lycodes squamiventer	0.0	1.0	616-616	2.6-2.6	66.0
Lycodes vahlii	3.4	25.0	434-495	5-5	63.6
Macrourus berglax	23.6	20.0	435-1480	5-2	66.0
Malacosteus niger	0.2	1.0	754-1454	3.9-3.4	65.0
Melanolagus bericoides	0.0	2.0	1058-1058	3.5-3.5	64.3
Micromesistius poutassou	0.0	1.0	1146-1146	2-2	63.4
Molva dypterygia	3.5	2.0	702-730	4.5-4	64.5
Molva molva	1.4	1.0	739-739	4.7-4.7	64.2
Myctophum punctatum	4.7	423.0	434-1304	5-3.2	64.0
New Species No 1	0.0	1.0	754-754	3.9-3.9	65.0
Nezumia bairdii	0.1	1.0	1092-1092	3.6-3.6	63.6
Notacanthus chemnitzii	7.7	8.0	656-1480	4.7-2	65.6
Notoscopelus kroyeri	12.5	631.0	434-1382	5-2	65.8
Oneirodes eschrichtii	0.4	1.0	754-796	3.9-3.8	65.0
Oneirodes macrosteus	0.2	1.0	1058-1227	3.5-3.5	64.3
Paraliparis copei	0.0	2.0	658-968	4.1-3.6	65.8
Paraliparis garmani	0.0	2.0	884-884	3.8-3.8	64.3
Photostylus pycnopterus	0.0	1.0	729-729	3.8-3.8	65.0
Polyacanthonotus rissoanus	0.2	1.0	1227-1382	3.5-3.4	63.8
Raja fyllae	0.4	1.0	762-762	3.9-3.9	65.2
Raja jenseni	28.5	1.0	1058-1058	3.5-3.5	64.3
Raja radiata	1.9	2.0	434-681	5-3.6	65.6
Reinhardtius hippoglossoides	602.0	477.0	434-1480	5-2	66.0
Rhadinesthes decimus	0.0	1.0	920-920	3.7-3.7	64.0
Rouleina attrita	0.1	1.0	1120-1120	3.5-3.5	63.5
Scopelosaurus lepidus	1.0	7.0	702-1480	4.5-2	64.8
Searsia koefoedi	0.1	1.0	968-1123	4.1-3.5	64.0
Sebastes marinus	123.9	37.0	434-672	5-4.2	65.6
Sebastes mentella	377.4	416.0	434-920	5-2.6	65.8
Sebastes sp.	7.2	133.0	434-1480	5-2.6	65.8
Serrivomer beanii	0.7	5.0	656-1480	4.7-2.8	65.5
Shrimp	2.7	0.0	434-1454	5-2	66.0
Stomias boa	0.1	3.0	434-1304	5-2.8	66.0
Synaphobranchus kaupii	2.3	12.0	478-1480	4.7-2	65.8
Trachyrincus murrayi	4.1	12.0	884-1433	4.1-2.8	64.3
Xenodermichthys copei	0.0	1.0	695-1433	3.9-3.4	65.6