Northwest Atlantic Fisheries Organization

Serial No. N7517 **NAFO SCR Doc. 24/013**

SCIENTIFIC COUNCIL MEETING – JUNE 2024

Results for Greenland halibut survey in NAFO Divisions 1C-1D for the period 1997-2017, 2019 and 2022-2023

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2024-05-30

Greenland initiated a survey series in 1997 covering NAFO Divisions 1CD at depths between 400 and 1500 m. The survey was conducted with R/V Paamiut, using and Alfredo III gear. In 2017, R/V Paamiut was retired and no survey was 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 differently at depths > 700m. No vessel has been available during the years 2020 and 2021 to conduct the survey. From 2022 the survey has been carried out with a new vessel owned by the GINR, R/V Tarajoq using also a new trawl gear, Bacalao 476. There were 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 2023, 67 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.

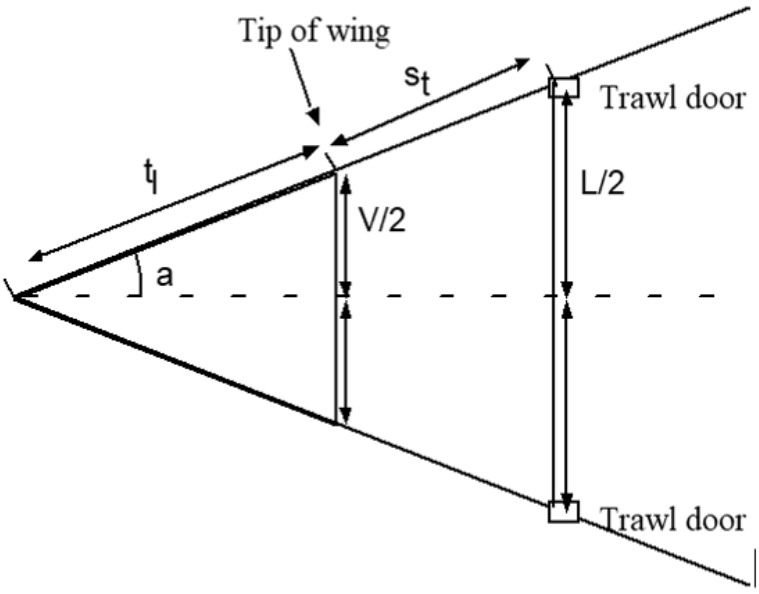
##Swept area calculation

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 67 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. The temporal extend of these surveys is given in Table 2

A total of 84 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, 2014-2019, and 2022-2023); Canada in OB (2000, 2001, 2011, 2013, 2014, 2015, 2016 and 2022-2023), Greenland in Divisions 1CD from 400 to 1500 m (1987-1995 and 1997-2017 and 2019, and 2022-2023), and Greenland in Divisions 1A-1F offshore, from 100 to 600 m (1988-2020, 2022-2023).

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, until 2018 (**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 to decrease the TAC was applied to give advice in 2022.

Greenland halibut was caught in all hauls (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). With R/V Tarajoq, the biomass increased from 2022 (102239 t) to 2023 (133260 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 in the trawl fishery for Greenland halibut. Roughhead grenadier was caught in 51 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). The biomass increased from 2022 (2764 t) to 2023 (3381 t) (Tables 8 and 9, Figure 6). The highest density in 2023 was found between 601-800 in 1C and 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. The abundance also increased from 2022 (4679*10^3) to 2023 was 5851*10^3 (Tables 8 and 9, Figure 6). Pre anal fin length ranged from 3 to 42cm , 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 66 hauls out of 67 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. Biomass increased three-fold from 2022 (794 t) to 2023 (2648 t) (Table 11). The higher density was found between 601-800 m in 1D (Table 12). The abundance increased only 1.7 fold in 2023 (1 141*103 indiv.). (Table 11). Table 13 and Figure 10 show the length distribution from 1997 to 2019 and 2022-2023 weighted to the stratum area. Pre anal fin length ranged from 1 to 17 cm. The modes were found at 5 and 11 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 31 of the 67 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). With the new time-series the biomass increased four times from 2015 to 2022. Biomass increased almost 4 four times from 2022 (20 202 t) to 2023 (75 516 t).(Table 14 and Figure 12). The highest density in 2023 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 2023, the abundance was 99856 $*10^3$ indiv. The length distribution ranged from 6 to 48 cm, with modes at 32, 41 and 44 cm (Table 16 and Figure 13).

Temperature

The bottom temperature, in 2023, ranged from 2.98 to 5.73, around 1ºC higher than in 2022 (1.96 - 5.03 ºC) (Appendix 1). The temperature increased in 1C from 2022 to 2023 around 1ºC in all strata. it also incrased in 4 strata in 1D. It remains almost stable between 601-1000 and 1201-1500 m, in 1D. (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 malfunction	
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 1997-2023. Depth strata are indicated in metres.

Year	Vessel	Tows 1C	Tows 1D	Total tows	Depth strata	Dates
1997	R/V Paamiut	24	39	63	427-1469	Sep 24-Oct 08
1998	R/V Paamiut	28	28	56	500-1494	Sep 23-Oct 07
1999	R/V Paamiut	15	23	38	576-1457	Sep 23-Oct 01
2000	R/V Paamiut	9	22	31	667-1464	Sep 27-Oct 04
2001	R/V Paamiut	17	29	46	468-1458	Nov 05-Nov 15
2002	R/V Paamiut	9	26	35	637-1490	Sep 17-Sep 23
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
2023	R/V Tarajoq	31	36	67	414-1496	Nov 23-December 05

Table 3. Hauls per year, division and stratum in the years from 2012 to 2019.

Div.	Stratum (m)	Area (km²)	2012	2013	2014	2015	2016	2017	2019
1C	401-600	3,366	2	0	1	2	2	0	2
1C	601-800	16,120	3	0	5	6	9	6	10
1C	801-1000	6,066	11	0	12	13	13	7	13
1C	1001-1200	611	2	0	2	2	2	2	2
1D	401-600	903	2	1	1	2	2	2	2
1D	601-800	1,940	1	1	2	2	3	2	2
1D	801-1000	3,874	3	4	3	4	4	4	4
1D	1001-1200	10,140	14	11	15	20	19	16	19
1D	1201-1400	6,195	9	7	13	11	12	10	12
1D	1401-1500	3,091	3	3	4	5	4	4	4
Total			50	27	58	67	70	53	70

Table 4. Hauls per division and per stratum trawled in the 2023 survey with the RV Tarajoq.

Division	Stratum (m)	Area/km2	2022	2023
1C	0401-0600	3,649	4	4
1C	0601-0800	16,831	19	17
1C	0801-1000	5,303	8	9
1C	1001-1200	611	2	1
1D	0401-0600	545	2	3
1D	0601-0800	1,694	2	4
1D	0801-1000	3,303	5	4
1D	1001-1200	10,774	13	13
1D	1201-1400	6,138	6	8
1D	1401-1500	2,113	4	4
Total			65	67

Table 5. Estimates of catch, biomass and abundace for Greenland halibut during surveys performed from 1997 to 2023 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	4,751.0	1,054.4	87.3	55,150	4,566.0
1998	52,306	PA	1,509.4	174.2	78,950	9,113.0	1,383.2	145.9	72,349	7,632.0
1999	50,792	PA	1,274.1	127.1	64,713	6,456.0	1,194.0	118.2	60,646	6,005.0
2000	46,097	PA	1,309.6	131.7	60,368	6,070.0	1,371.4	139.5	63,216	6,430.0
2001	49,463	PA	1,428.7	216.9	70,666	10,729.0	1,502.9	246.5	74,336	12,193.0
2002	46,097	PA	1,569.8	129.8	72,362	5,982.0	1,559.3	133.5	71,881	6,153.0
2003	49,463	PA	1,389.3	129.6	68,718	6,411.0	1,466.9	157.0	72,557	7,764.0
2004	51,403	PA	1,443.6	101.0	74,205	5,191.0	1,428.8	106.0	73,446	5,448.0
2005	52,306	PA	1,554.8	164.4	81,327	8,600.0	1,396.4	144.0	73,042	7,533.0
2006	52,306	PA	1,482.8	117.8	77,560	6,159.0	1,360.9	106.1	71,182	5,550.0
2007	50,366	PA	1,488.2	187.1	74,957	9,421.0	1,338.8	168.7	67,432	8,497.0
2008	52,306	PA	1,610.7	107.3	84,252	5,612.0	1,401.2	98.4	73,293	5,145.0
2009	52,306	PA	1,326.9	90.5	69,407	4,735.0	1,194.2	84.5	62,464	4,422.0
2010	52,306	PA	1,442.9	103.2	75,474	5,397.0	1,240.2	103.0	64,871	5,390.0
2011	52,306	PA	1,667.2	99.2	87,205	5,189.0	1,433.4	90.3	74,976	4,724.0
2012	52,306	PA	1,250.4	199.7	65,403	10,444.0	1,037.1	193.4	54,248	10,116.0
2013	26,143	PA	1,577.6	176.7	41,244	4,620.0	1,243.2	116.2	32,501	3,038.0
2014	52,306	PA	1,121.6	82.9	58,665	4,336.0	859.2	64.8	44,939	3,388.0
2015	52,306	PA	1,520.5	130.8	79,532	6,843.0	1,178.8	116.0	61,657	6,069.0
2016	52,306	PA	1,465.0	92.0	76,629	4,811.0	1,140.9	71.3	59,676	3,729.0
2017	48,940	PA	1,612.0	124.0	78,892	6,070.0	1,228.2	102.8	60,107	5,031.0
2019	52,306	HM	1,585.7	121.1	82,940	6,336.0	1,252.3	84.4	65,501	4,414.0
2022	50,960	TJ	2,008.4	172.9	102,349	8,813.0	1,483.0	137.2	75,575	6,991.0
2023	50,960	TJ	2,615.0	265.5	133,260	13,531.0	1,850.6	165.5	94,308	8,436.0

Table 6. Estimates of catch, biomass and abundance for Greenland halibut during the 2023 survey per depth stratum.

Div.	Stratum (m)	Area (km^2)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
1C	401-600	3,649	4	284.4	1,038	671	320	1,166	922
1C	601-800	16,831	17	1,255.3	21,129	2,058	1,230	20,702	2,618
1C	801-1000	5,303	9	5,226.2	27,713	5,692	3,648	19,344	3,645
1C	1001-1200	611	1	7,228.4	4,417	6,312	4,461	2,726	3,628
1D	401-600	545	3	693.6	378	160	955	521	228
1D	601-800	1,694	4	1,172.0	1,985	718	913	1,546	741
1D	801-1000	3,303	4	6,217.2	20,533	4,753	3,802	12,558	2,199
1D	1001-1200	10,774	13	3,242.5	34,935	8,152	2,080	22,413	4,943
1D	1201-1400	6,138	8	2,277.9	13,981	3,700	1,449	8,895	2,490
1D	1401-1500	2,113	4	3,385.3	7,152	1,704	2,101	4,438	975
TOTAL		50,961	67	265.5	133,261	13,531	166	94,309	8,436

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 1997-2023.

Length Class (3cm)	2015	2016	2017	2019	2022	2023
6	16	6	0	6	0	0
9	0	8	20	0	11	0
12	0	23	0	0	0	11
15	42	98	30	40	75	13
18	0	74	0	60	55	40
21	0	399	0	548	131	45
24	104	286	30	400	100	86
27	98	276	103	270	98	132
30	163	470	31	402	165	245
33	117	267	95	143	123	374
36	281	519	120	686	396	726
39	370	650	458	1,515	1,154	1,608
42	1,303	1,507	1,144	2,106	3,461	4,331
45	3,895	3,977	3,597	3,714	6,752	9,190
48	9,751	7,855	8,337	7,927	10,124	13,260
51	15,292	13,001	14,119	13,206	12,487	16,536
54	14,288	13,122	13,756	14,470	14,752	16,084
57	8,202	7,855	9,441	9,774	11,513	13,207
60	3,220	4,117	4,115	4,372	6,341	7,914
63	1,491	1,727	1,700	2,138	3,193	3,974
66	865	1,177	936	1,339	1,633	2,188
69	514	707	628	741	889	1,356
72	465	401	448	496	559	802
75	292	258	303	216	334	464
78	176	219	110	190	210	366
81	153	120	150	152	117	300
84	118	140	120	130	122	210
87	62	94	58	128	223	251
90	152	154	35	87	107	108
93	47	63	20	94	136	169
96	95	20	28	52	112	115
99	36	31	53	51	82	53
102	31	22	54	14	61	54
105	15	15	52	14	47	33
108	3	7	0	21	0	18
111	0	13	14	0	12	26
114	0	0	0	0	0	17
Abundance	1,179	1,141	1,228	1,252	1,483	1,851
S.E	6,069.0	3,729.0	5,031.0	4,414.0	6,991.0	8,436.0
Mean Number	1,178.8	1,140.9	1,228.2	1,252.3	1,483.0	1,850.7
S.E	116.0	71.0	103.0	84.0	137.0	166.0

Table 8. Estimates of catch, biomass and abundace for roughhead grenadier during surveys performed from 1997 to 2023 in NAFO areas 1C and 1D.

Year	Area	Vessel	MeanbioT	SEMC.kg	Biomass	SE	MeanAbuT	SEMC.num	Abundance	SE
1997	52,306	PA	47.6	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	49,463	PA	94.1	7.7	4,656	380	274.8	24.9	13,593	1,231
2002	46,097	PA	175.7	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	86.3	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	31.5	5.6	1,544	276	70.0	7.2	3,425	351
2019	52,306	HM	68.4	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
2023	50,960	TJ	66.4	6.3	3,381	319	114.8	7.5	5,851	382

Table 9. Estimates of catch, biomass and abundance for roughhead grenadier during the 2023 survey per depth stratum.

Div.	Stratum (m)	Area (km²)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
1C	401-600	3,649.0	4.0	9.9	36.0	26.0	38.0	138.0	53.0
1C	601-800	16,831.0	17.0	56.0	942.0	183.0	110.0	1,856.0	256.0
1C	801-1000	5,303.0	9.0	54.7	290.0	35.0	90.0	477.0	51.0
1C	1001-1200	611.0	1.0	64.0	39.0	50.0	115.0	70.0	133.0
1D	401-600	545.0	3.0	24.3	13.0	8.0	57.0	31.0	16.0
1D	601-800	1,694.0	4.0	79.9	135.0	16.0	120.0	203.0	36.0
1D	801-1000	3,303.0	4.0	37.9	125.0	72.0	73.0	240.0	71.0
1D	1001-1200	10,774.0	13.0	77.9	839.0	153.0	142.0	1,532.0	181.0
1D	1201-1400	6,138.0	8.0	129.3	793.0	175.0	173.0	1,064.0	120.0
1D	1401-1500	2,113.0	4.0	79.5	168.0	69.0	113.0	239.0	59.0
TOTAL		50,961.0	67.0	6.3	3,380.0	319.0	7.5	5,850.0	382.0

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 2015-2023.

length	2015	2016	2017	2019	2022	2023
1	0	14	0	6	0	0
2	8	20	0	0	11	9
3	12	27	0	8	13	0
4	75	34	14	15	93	7
5	81	47	8	6	43	66
6	211	179	78	103	35	73
7	425	174	165	81	59	140
8	369	294	68	226	151	181
9	767	539	217	315	165	148
10	629	284	121	373	112	152
11	806	458	196	557	125	284
12	945	497	327	677	121	325
13	933	531	189	860	138	250
14	605	409	260	812	264	199
15	504	381	278	796	352	354
16	470	565	160	474	486	497
17	555	412	281	732	449	478
18	455	505	331	718	516	695
19	328	344	185	322	381	633
20	270	302	133	243	248	356
21	268	96	51	138	303	180
22	101	133	24	91	92	172
23	94	109	81	80	88	94
24	134	62	22	88	84	130
25	74	79	15	13	23	131
26	67	56	75	81	80	38
27	19	43	67	60	38	44
28	25	69	15	60	44	45
29	29	41	17	22	11	74
30	39	13	0	79	63	0
31	6	19	0	37	0	34
32	13	19	13	28	35	26
33	0	39	0	17	6	0
34	10	21	0	0	6	8
35	7	0	0	10	28	9
36	14	0	29	7	0	0
37	0	0	4	6	7	17
38	0	0	0	0	0	0
39	0	0	0	8	7	0
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	6	0	0
Abundance	179	130	70	156	92	115
S.E	689.0	604.0	351.0	561.0	371.0	382.0

length	2015	2016	2017	2019	2022	2023
Mean Number	178.7	130.3	70.0	155.9	91.8	114.8
S.E	13.0	12.0	7.0	11.0	7.0	7.0

Table 11. Estimates of catch, biomass and abundace for roundnose grenadier during surveys performed from 1997 to 2023 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	49,463	PA	32.1	10.4	1,589	516	502.2	177.6	24,843	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	16.0	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	14.1	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	17.5	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	99.7	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	16.5	5.3	860	275	122.1	34.5	6,389	1,803
2017	48,940	PA	13.7	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	18.0	6,720	920
2023	50,960	TJ	52.0	41.2	2,648	2,099	224.0	112.7	11,415	5,741

Table 12. Estimates of catch, biomass and abundance for roundnose grenadier during the 2023 survey per depth stratum.

Div.	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
1C	401-600	3,649.0	4.0	0.2	1.0	1.0	11.0	41.0	41.0
1C	601-800	16,831.0	17.0	5.8	98.0	43.0	96.0	1,622.0	636.0
1C	801-1000	5,303.0	9.0	6.0	32.0	7.0	124.0	656.0	111.0
1C	1001-1200	611.0	1.0	12.7	8.0	6.0	230.0	141.0	114.0
1D	401-600	545.0	3.0	3.2	2.0	2.0	7.0	4.0	4.0
1D	601-800	1,694.0	4.0	1,283.9	2,175.0	2,098.0	3,680.0	6,233.0	5,668.0
1D	801-1000	3,303.0	4.0	23.1	76.0	13.0	287.0	948.0	471.0
1D	1001-1200	10,774.0	13.0	11.3	122.0	33.0	115.0	1,234.0	404.0
1D	1201-1400	6,138.0	8.0	16.2	100.0	27.0	67.0	414.0	90.0
1D	1401-1500	2,113.0	4.0	17.0	36.0	16.0	58.0	122.0	40.0
TOTAL		50,961.0	67.0	41.2	2,650.0	2,099.0	112.7	11,415.0	5,741.0

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 1997-2023.

length	2015	2016	2017	2019	2022	2023
1	0	0	0	0	0	9
2	37	17	11	11	64	132
3	413	187	34	207	427	709
4	961	660	174	788	653	885
5	1,084	1,201	215	629	857	1,222
6	1,044	923	283	664	1,437	906
7	1,172	557	235	675	1,037	527
8	862	621	223	466	685	514
9	793	726	342	464	447	495
10	407	536	420	294	266	1,183
11	196	508	375	310	193	1,801
12	95	124	750	207	225	1,374
13	76	175	252	217	155	951
14	99	81	239	50	157	477
15	69	28	88	79	30	156
16	14	29	16	8	49	55
17	0	0	0	13	7	19
18	19	0	0	7	12	0
19	0	6	23	0	7	0
20	7	9	0	0	7	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
Abundance	140	122	75	97	132	224
S.E	2,281.0	1,803.0	1,760.0	977.0	920.0	5,741.0
Mean Number	140.5	122.2	75.2	97.3	131.9	224.0
S.E	44.0	34.0	36.0	19.0	18.0	113.0

Table 14. Estimates of catch, biomass and abundance for deep-sea redfish during surveys performed from 1997 to 2023 in NAFO areas 1C and 1D.

Year	Area	Vessel	MeanbioT	SEMC.kg	Biomass	SE	MeanAbuT	SEMC.num	Abundance	SE
1997	52,306	PA	46.6	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	96.4	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	49,463	PA	36.8	13.1	1,822	649	297.1	94.4	14,697	4,670
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	184.0	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	421.7	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	500.6	123.2	25,513	6,276
2023	50,960	TJ	1,481.9	818.7	75,516	41,719	1,959.5	1,015.6	99,857	51,754

Table 15. Estimates of catch, biomass and abundance for deep-sea redfish during the 2023 survey per depth stratum.

Div.	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
1C	401-600	3,649.0	4.0	448.6	1,637.0	1,621.0	718.0	2,620.0	2,459.0
1C	601-800	16,831.0	17.0	303.0	5,100.0	2,382.0	647.0	10,889.0	4,255.0
1C	801-1000	5,303.0	9.0	16.4	87.0	71.0	29.0	154.0	125.0
1C	1001-1200	611.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
1D	401-600	545.0	3.0	143.1	78.0	66.0	988.0	538.0	468.0
1D	601-800	1,694.0	4.0	40,386.6	68,409.0	41,619.0	50,356.0	85,295.0	51,517.0
1D	801-1000	3,303.0	4.0	40.9	135.0	134.0	74.0	245.0	231.0
1D	1001-1200	10,774.0	13.0	6.6	71.0	71.0	11.0	116.0	116.0
1D	1201-1400	6,138.0	8.0	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	67.0	818.7	75,517.0	41,719.0	1,015.6	99,857.0	51,754.0

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 1997-2023.

Length class	2015	2016	2017	2019	2022	2023
6	0	0	0	0	0	12
8	0	0	0	0	0	0
10	0	0	0	0	0	11
12	0	0	0	0	0	0
14	0	0	0	0	0	2
16	0	0	0	0	0	0
18	0	0	0	0	0	48
20	0	0	0	0	0	82
22	5	0	0	0	11	188
24	16	0	0	0	85	731
26	45	0	0	22	221	685
28	192	23	0	0	61	799
30	437	14	0	6	14	456
32	706	23	0	26	11	488
34	1,053	183	0	48	0	219
36	1,850	271	46	80	0	167
38	2,911	690	12	6	11	22
40	3,014	1,139	168	69	14	36
42	2,397	1,474	336	219	28	50
44	7,294	4,257	1,452	1,133	66	316
46	2,410	2,264	1,098	1,340	114	485
48	2,238	1,935	1,161	1,330	467	1,009
50	1,450	2,073	1,251	1,259	951	2,219
52	2,234	1,805	1,489	1,570	1,348	5,193
54	711	1,546	1,382	1,592	2,174	8,121
56	658	1,181	1,539	1,742	2,257	9,596
58	258	1,389	1,398	1,448	2,040	13,710
60	299	1,068	1,059	1,570	1,450	11,680
62	174	1,225	1,200	1,358	1,369	6,435
64	132	679	674	1,183	2,480	4,965
66	412	878	1,303	763	4,695	14,525
68	94	483	652	230	3,699	12,568
70	103	10	123	20	1,540	4,867
72	30	67	31	69	294	161
74	0	0	0	0	103	10
76	0	23	46	0	10	0
78	0	0	0	0	0	0
Abundance	31,478	24,698	16,423	17,086	25,513	99,857
S.E	12,679.0	9,945.0	11,439.0	7,639.0	6,276.0	51,754.0
Mean Number	601.8	472.2	335.6	326.6	500.6	1,959.5
S.E	242.4	190.1	233.7	146.0	123.2	1,015.6

Figures

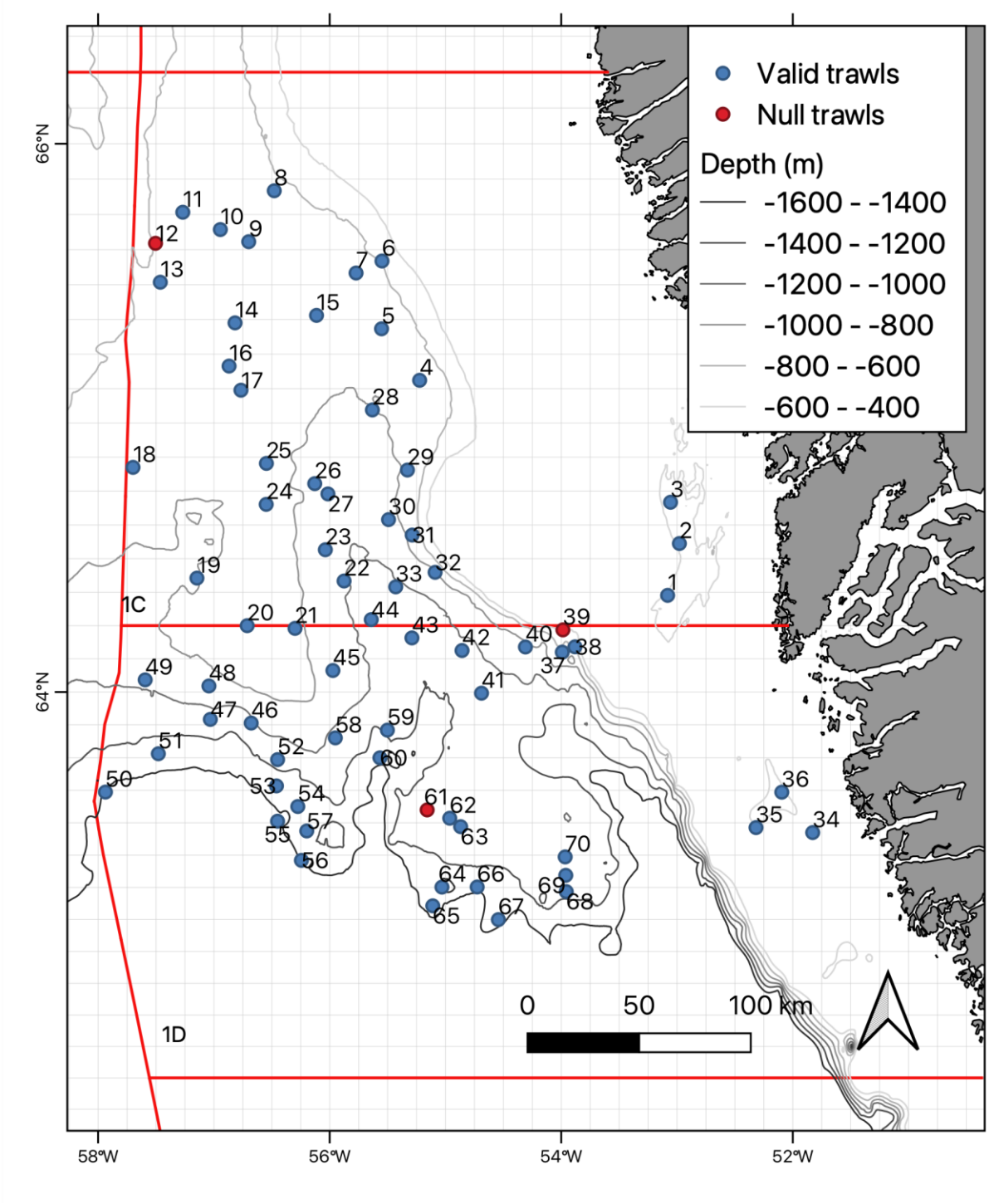


Figure 1. Hauls positions for the West Greenland halibut 2023 survey. Coordinate system is WGS84/Pseudo Mercator EPSG: 3857- Grid in latitude /longitude.

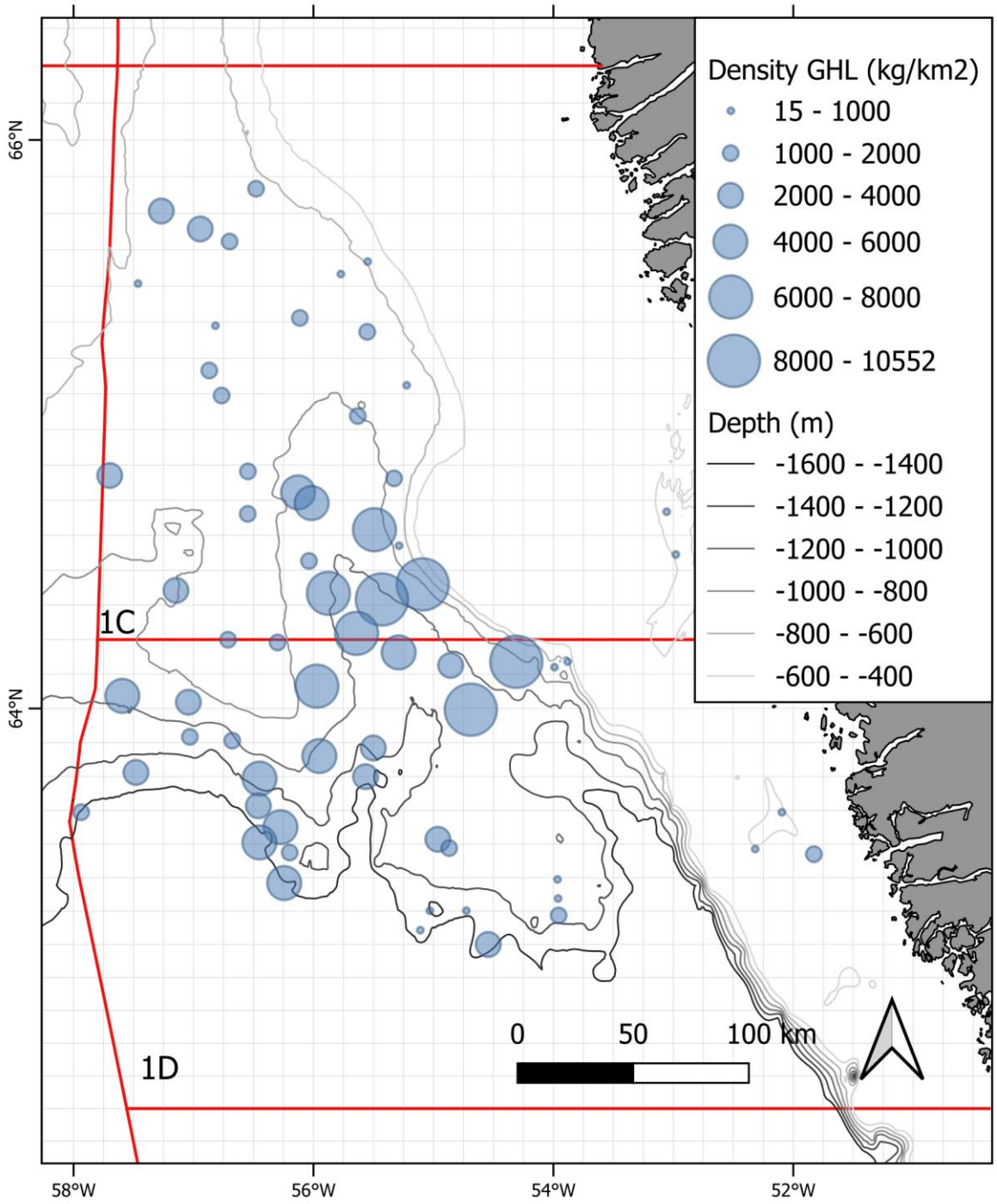


Figure 2. Distribution of catches (kg/km^2) of Greenland halibut in 2023.

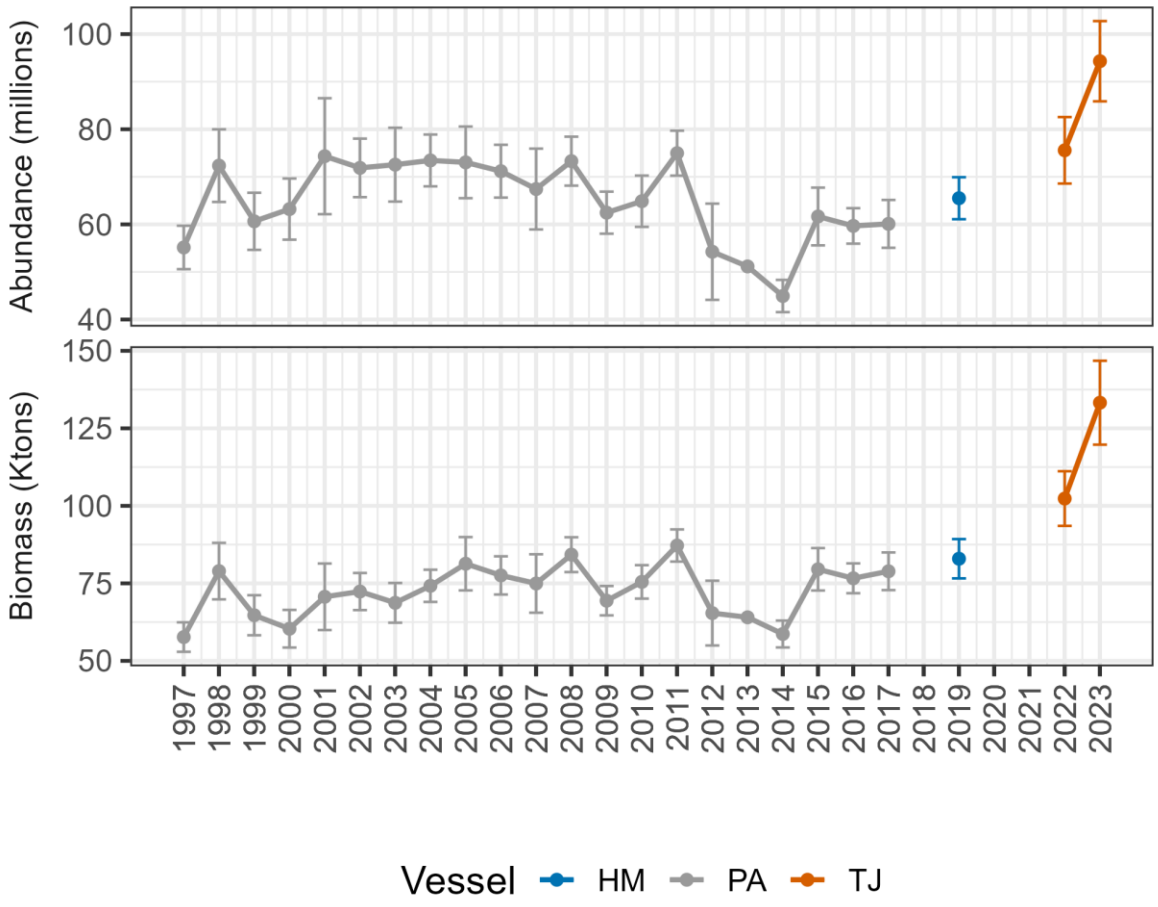


Figure 3. Greenland halibut biomass and abundance calculated by the swept area method per year for the period 1997-2023. Error bars show the standard error. The biomass and abundance in Division 1C, in 2013, were estimated by a GLM including data from 2010-2014 (Biomass = 64049 tons; Abundance = 51160 *10^3 individuals).

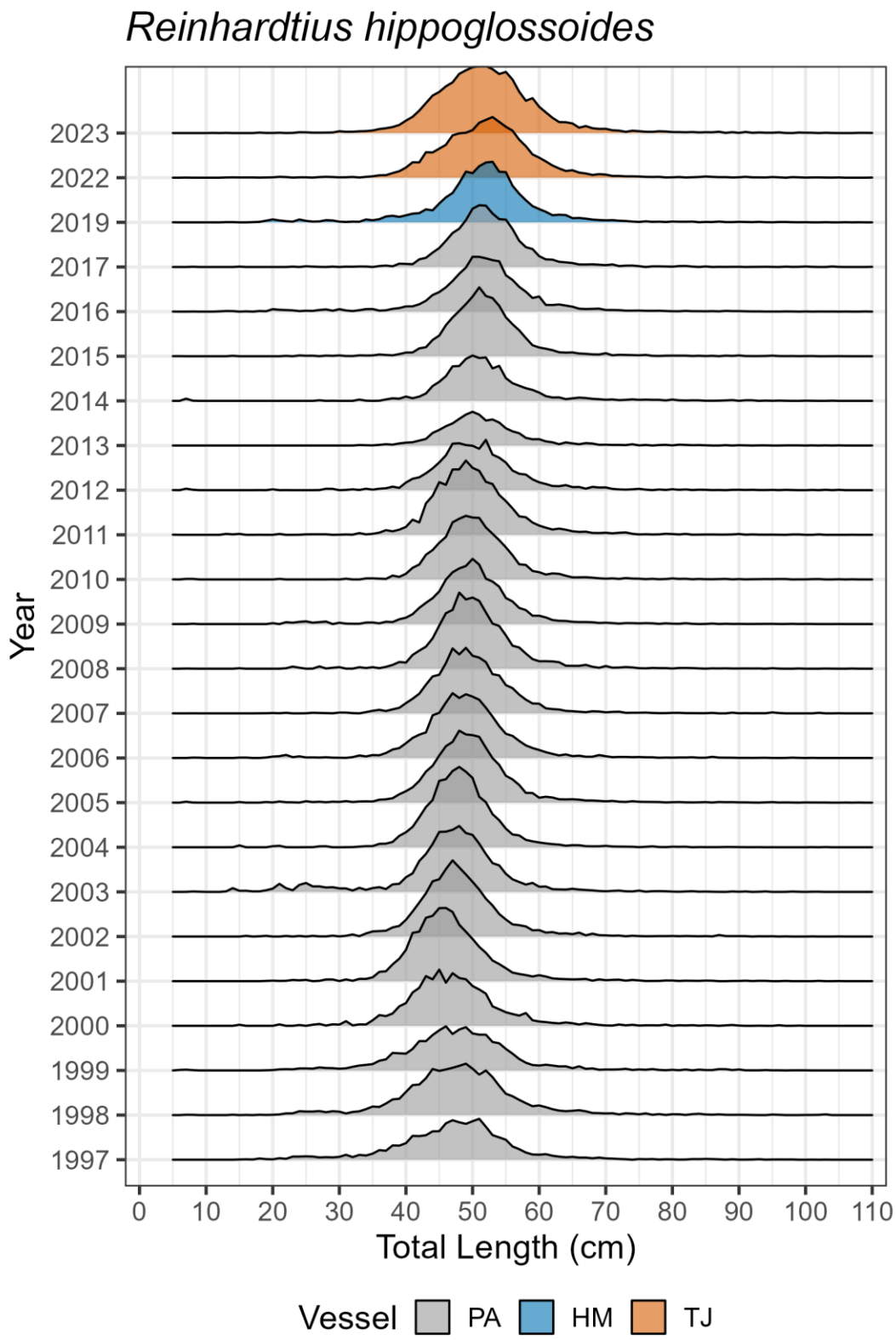


Figure 4. Greenland halibut length distribution (weighted to stratum area), NAFO Div. 1CD, for the period 1997-2023.

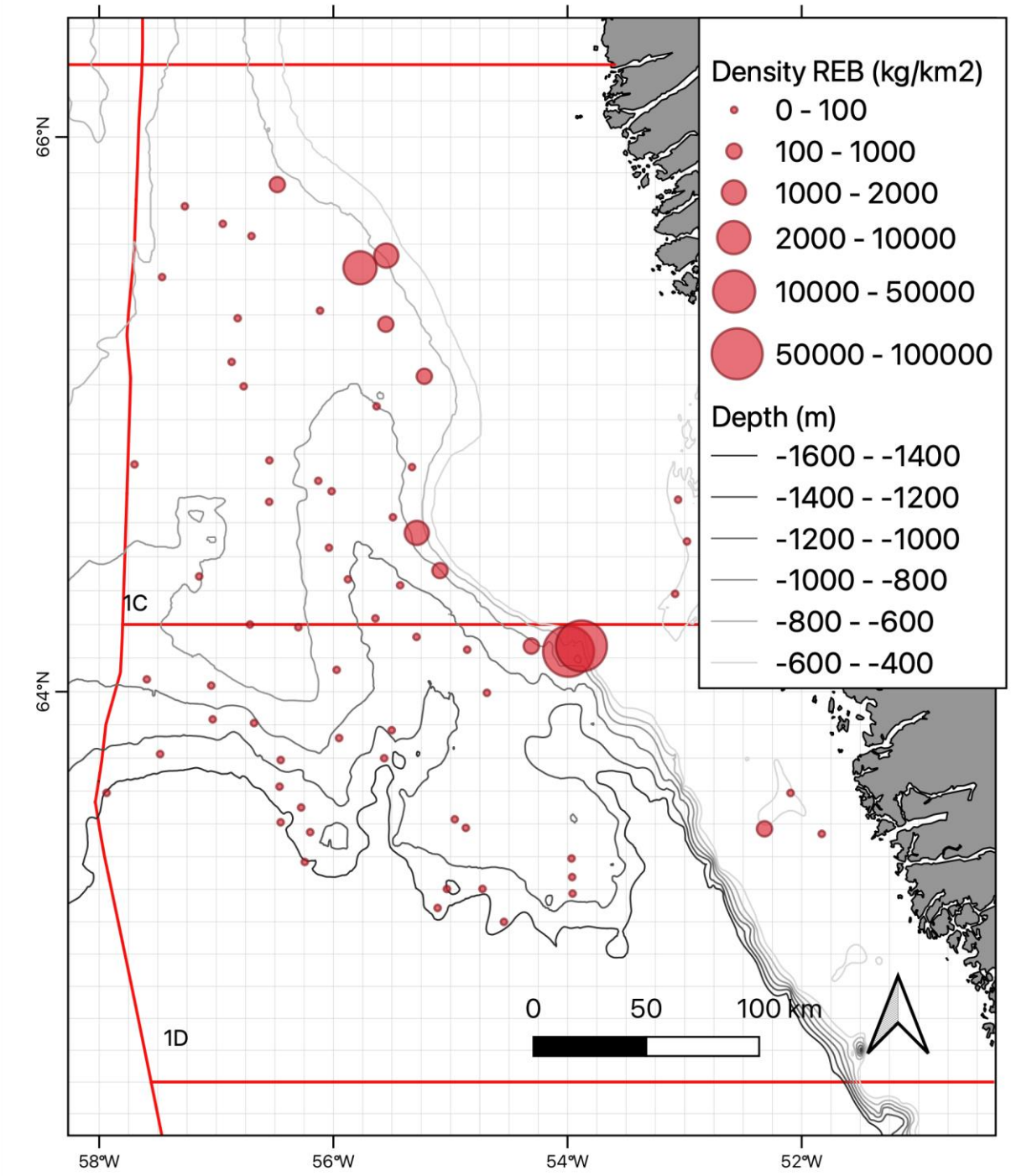


Figure 5. Distribution of catches (kg/km^2) of roughhead grenadier in 2023.

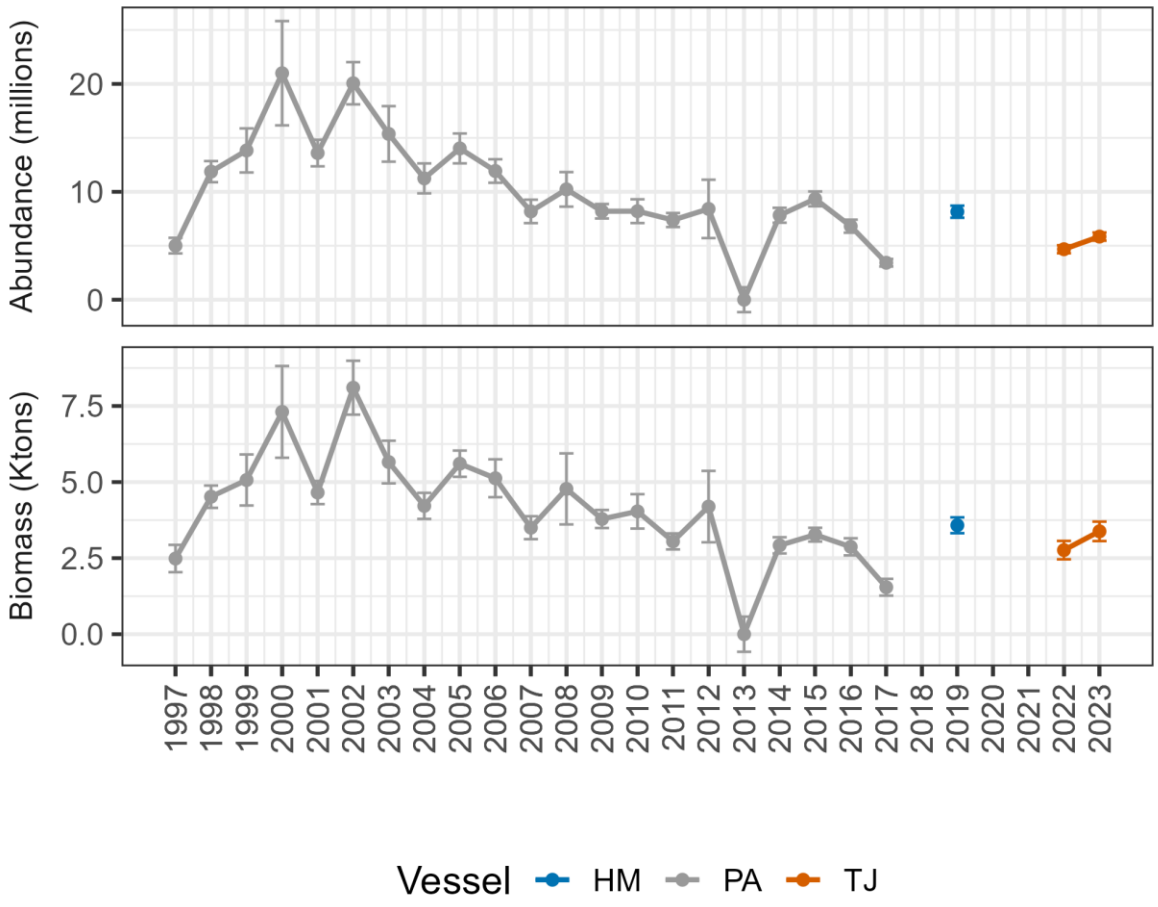


Figure 6. Roughhead grenadier biomass and abundance calculated by the swept area method per year for the period 1997-2023. Error bars show the standard error.

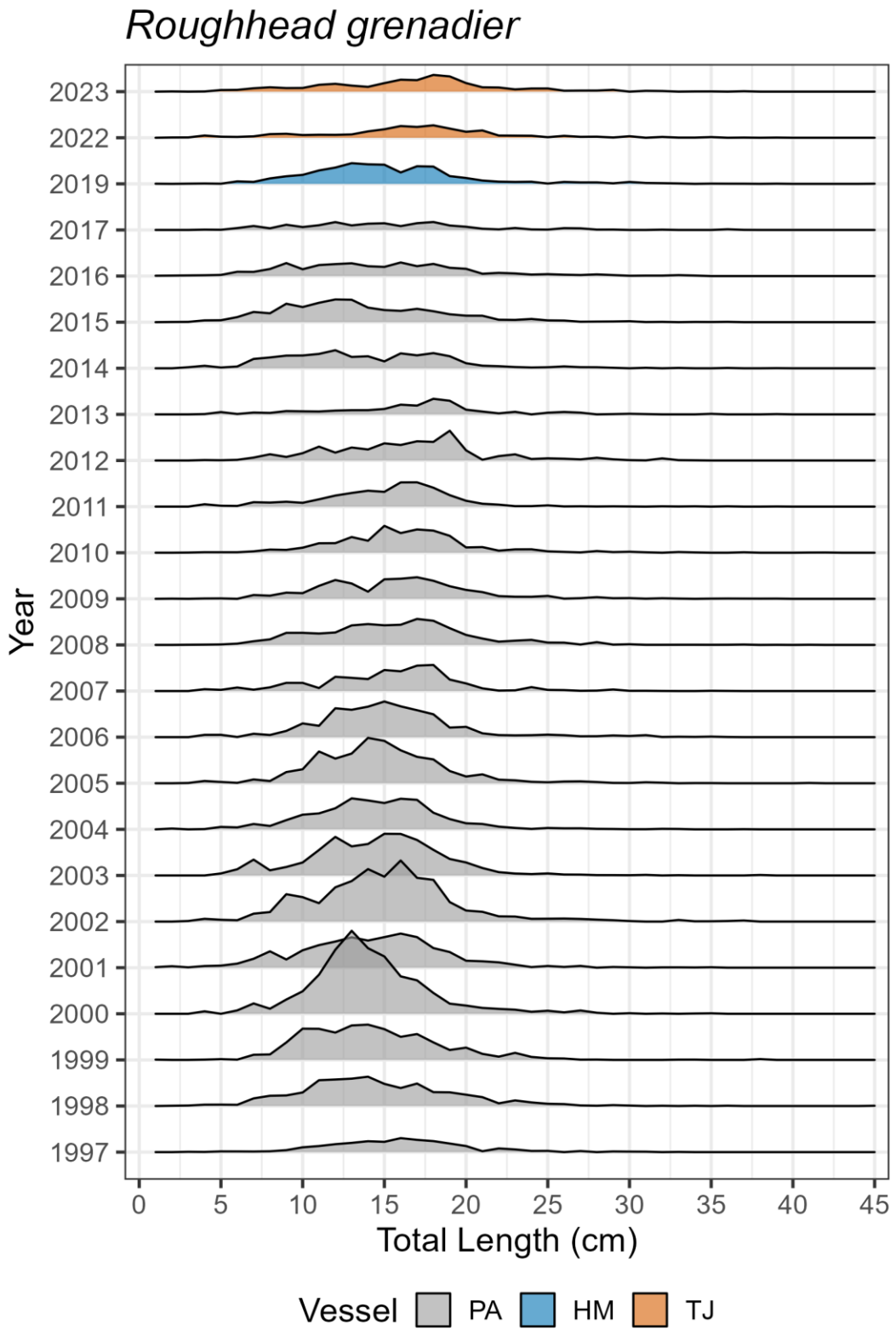


Figure 7. Roughhead grenadier length distribution (weighted to stratum area), NAFO Div. 1CD, for the period 1997-2023.

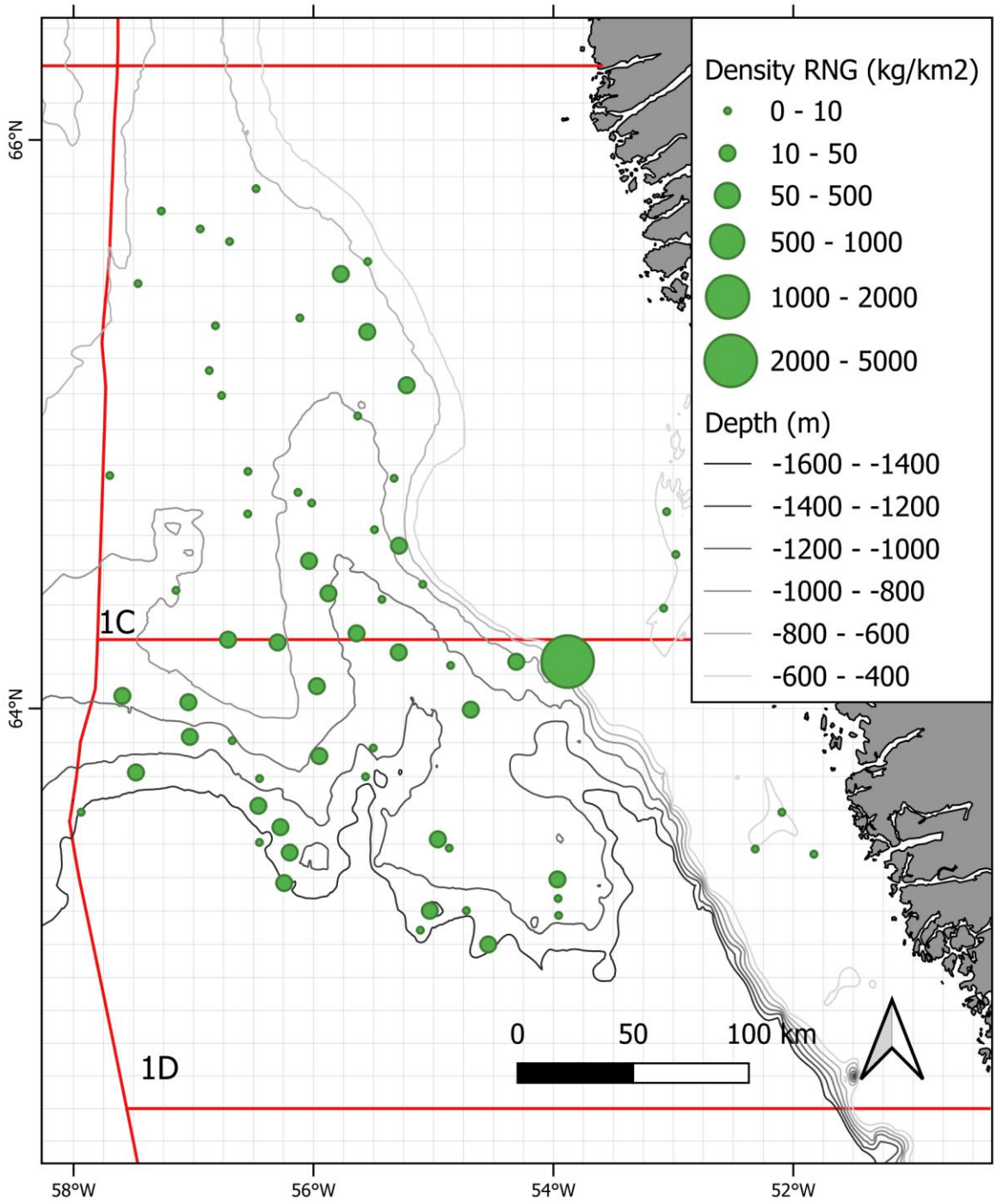


Figure 8. Distribution of catches (kg/km^2) of roundnose grenadier in 2023.

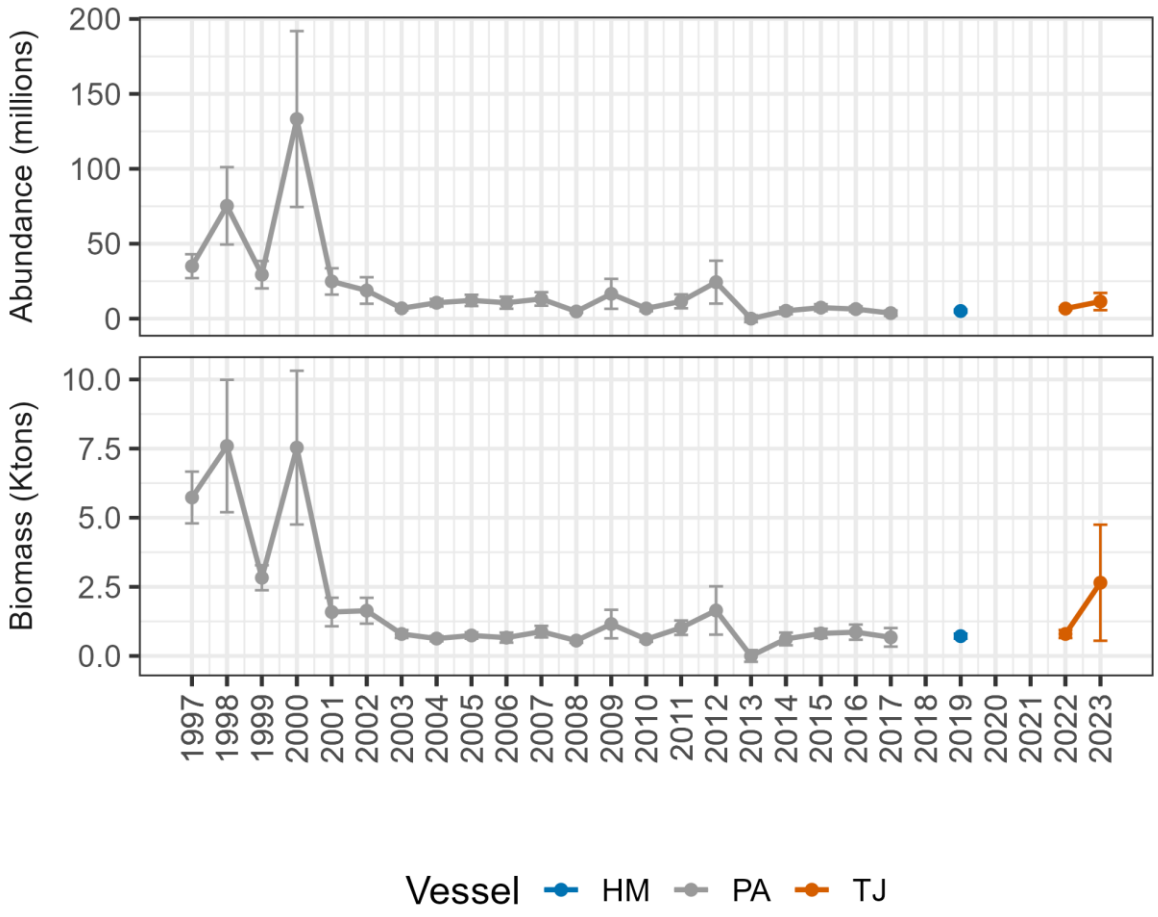


Figure 9. Roundnose grenadier biomass and abundance calculated by the swept area method per year for the period 1997-2023. Error bars show the standard error.

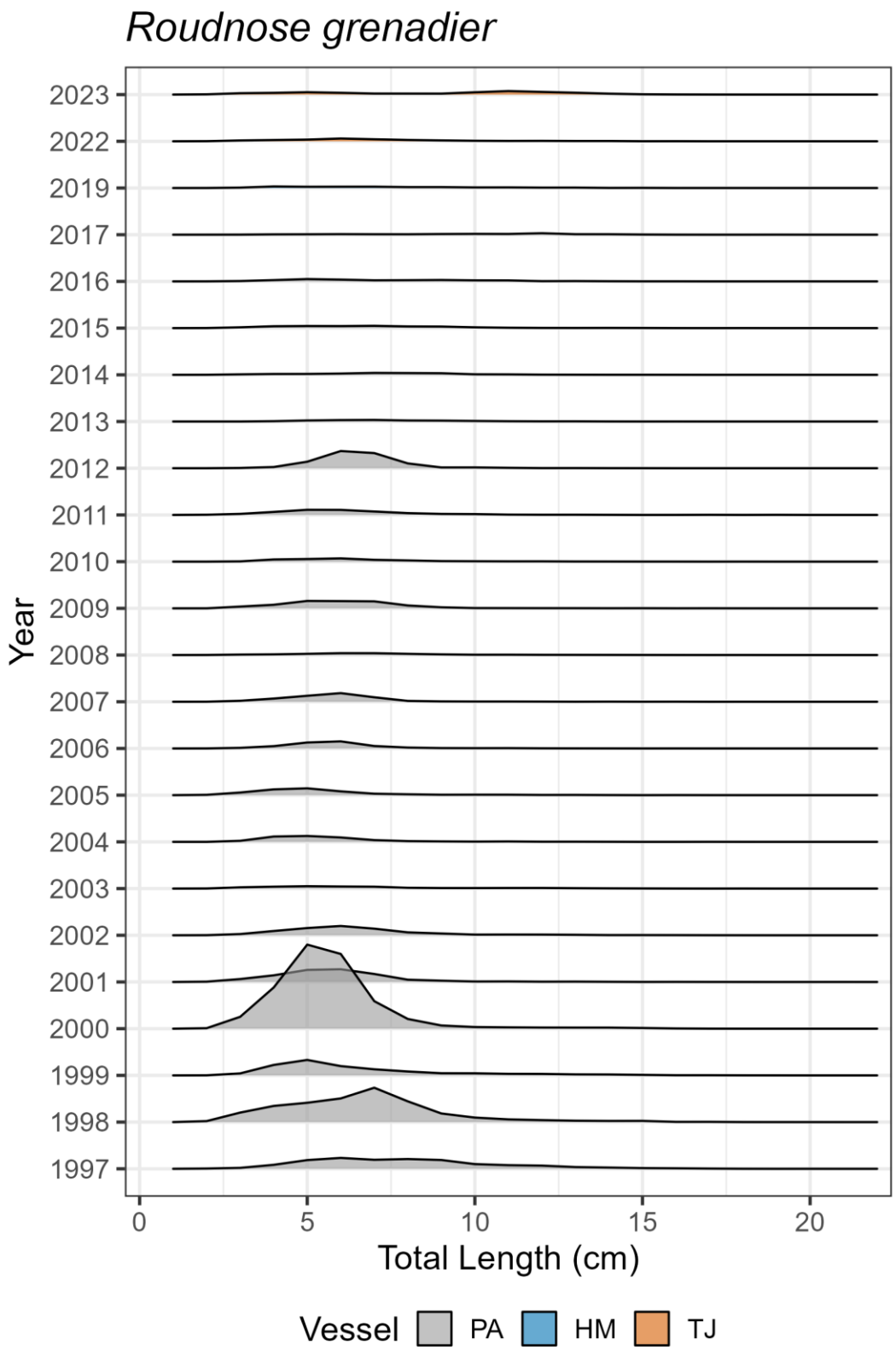


Figure 10. Roundnose grenadier length distribution (weighted to stratum area), NAFO Div. 1CD, for the period 1997-2023.

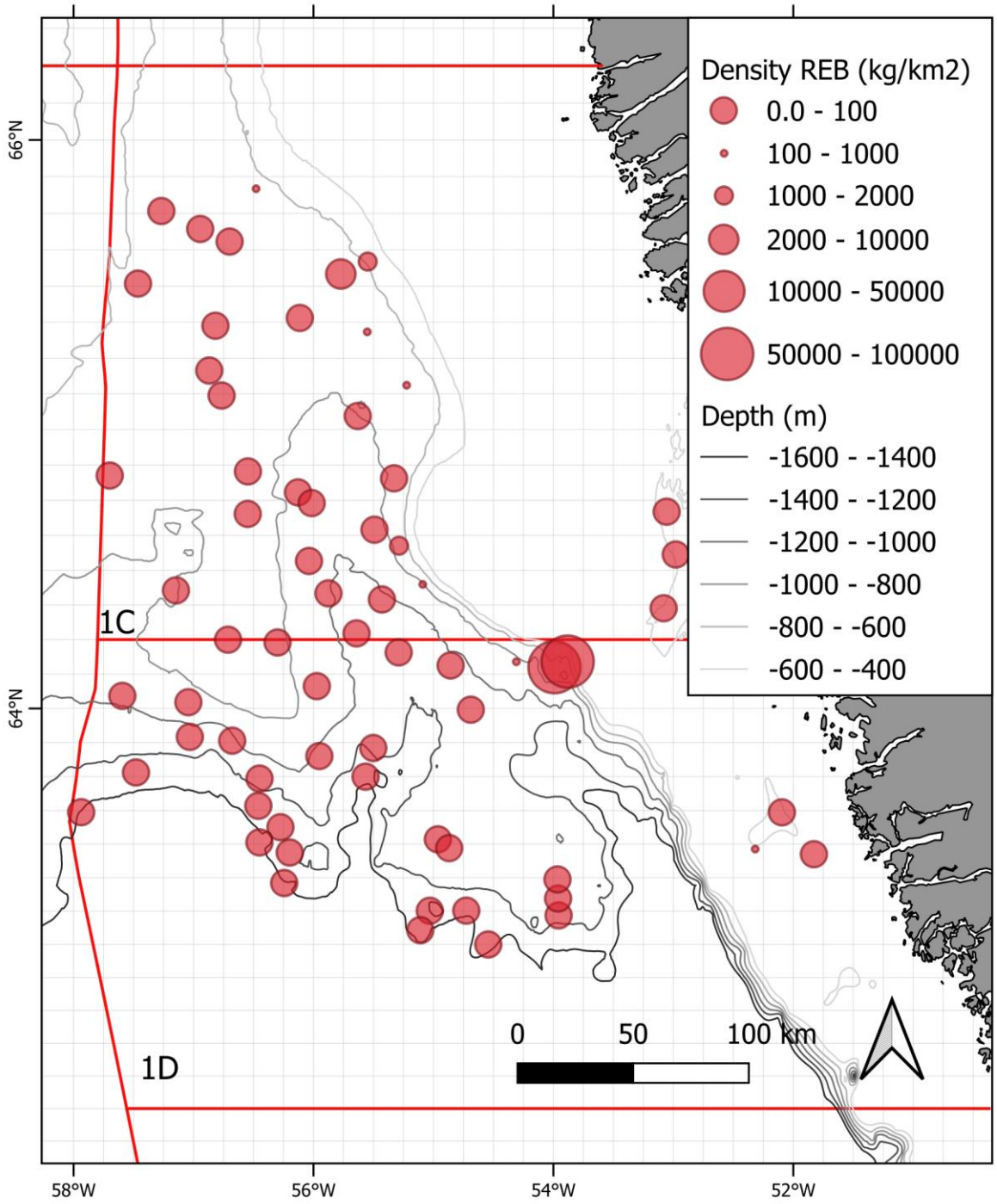


Figure 11. Distribution of catches (kg/km²) of deep-sea redfish in 2023.

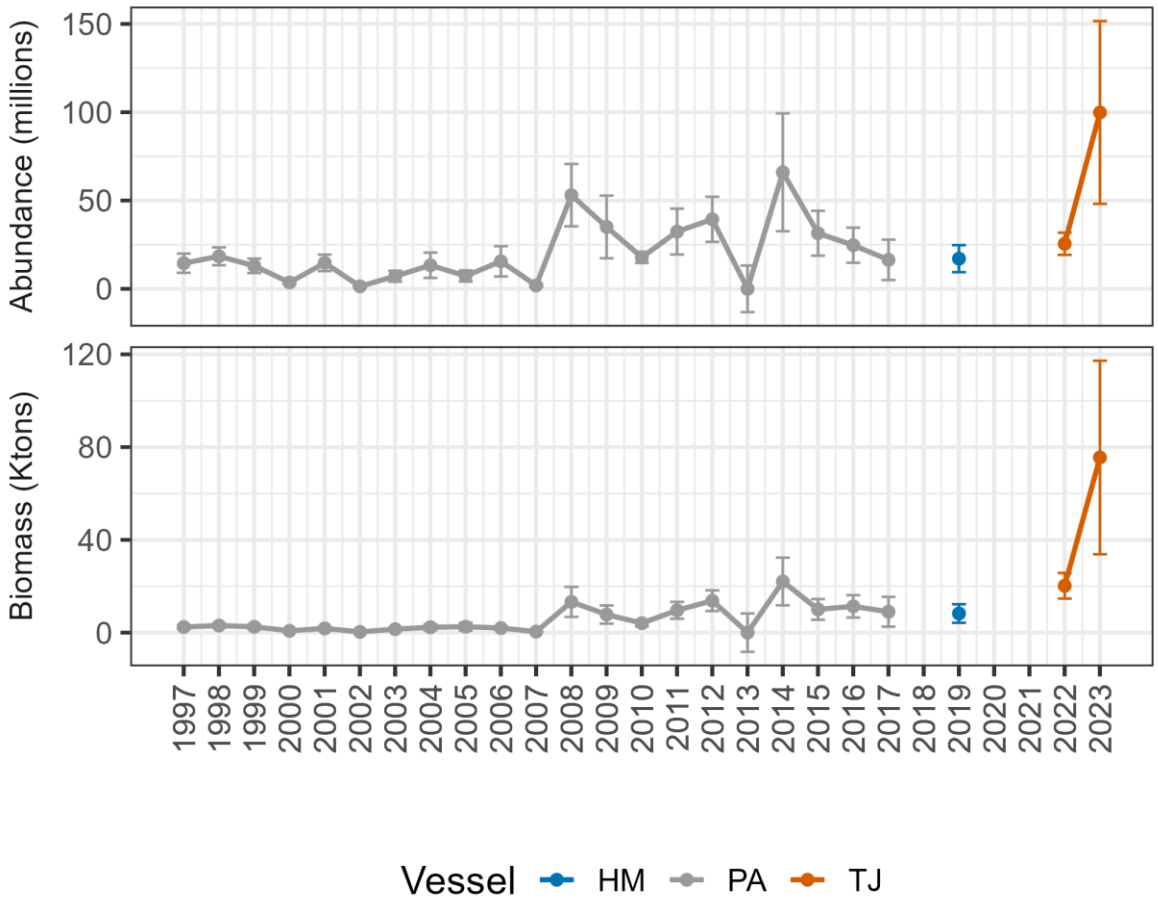


Figure 12. Deep-sea redfish biomass and abundance calculated by the swept area method per year for the period 1997-2023. Error bars show the standard error.

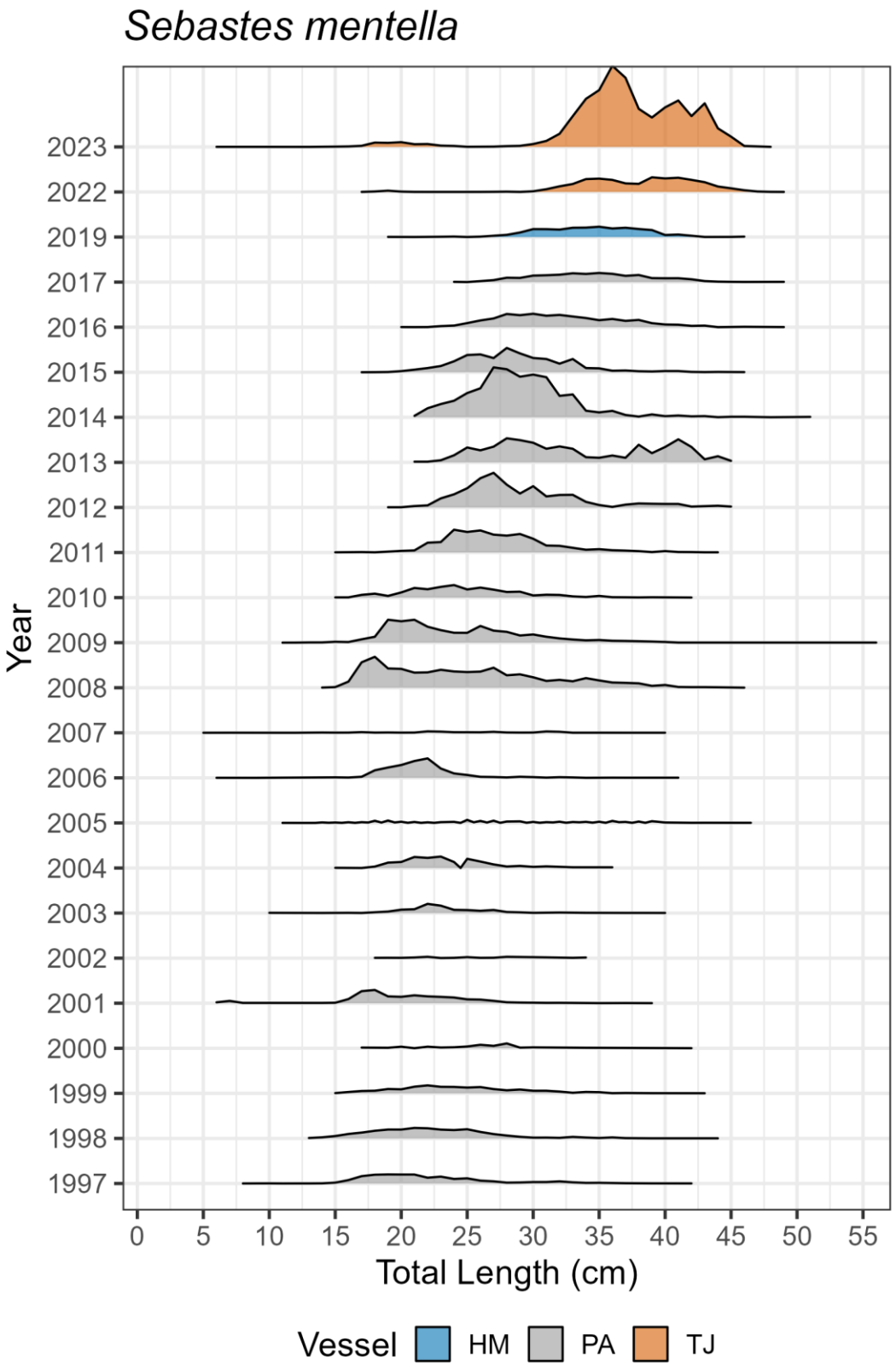


Figure 13. Deep-sea redfish length distribution (weighted to stratum area), NAFO Div. 1CD, for the period 1997-2023.

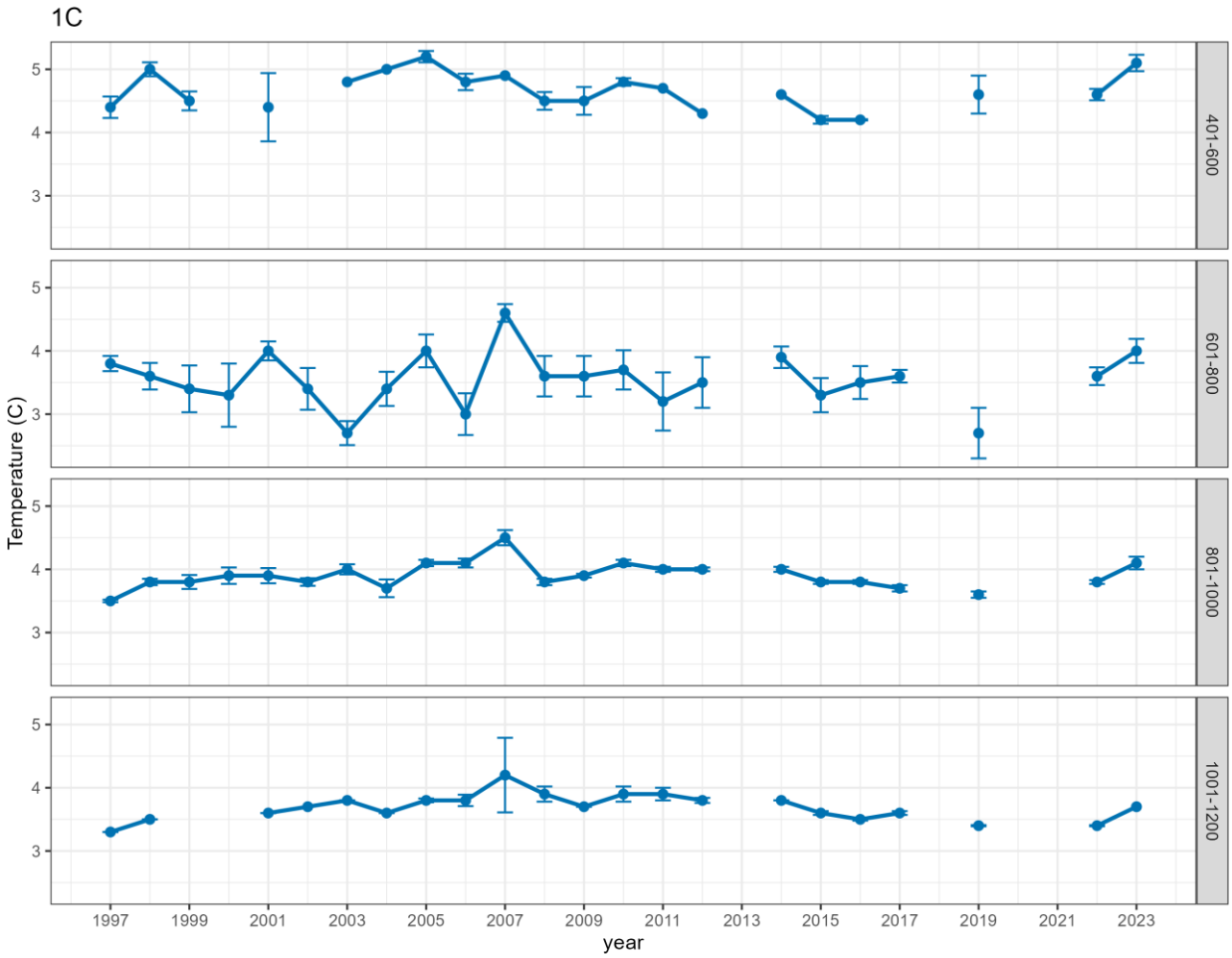


Figure 14. Mean temperatures with S.E. in NAFO division 1C by depth and stratum for the period 1997-2023.

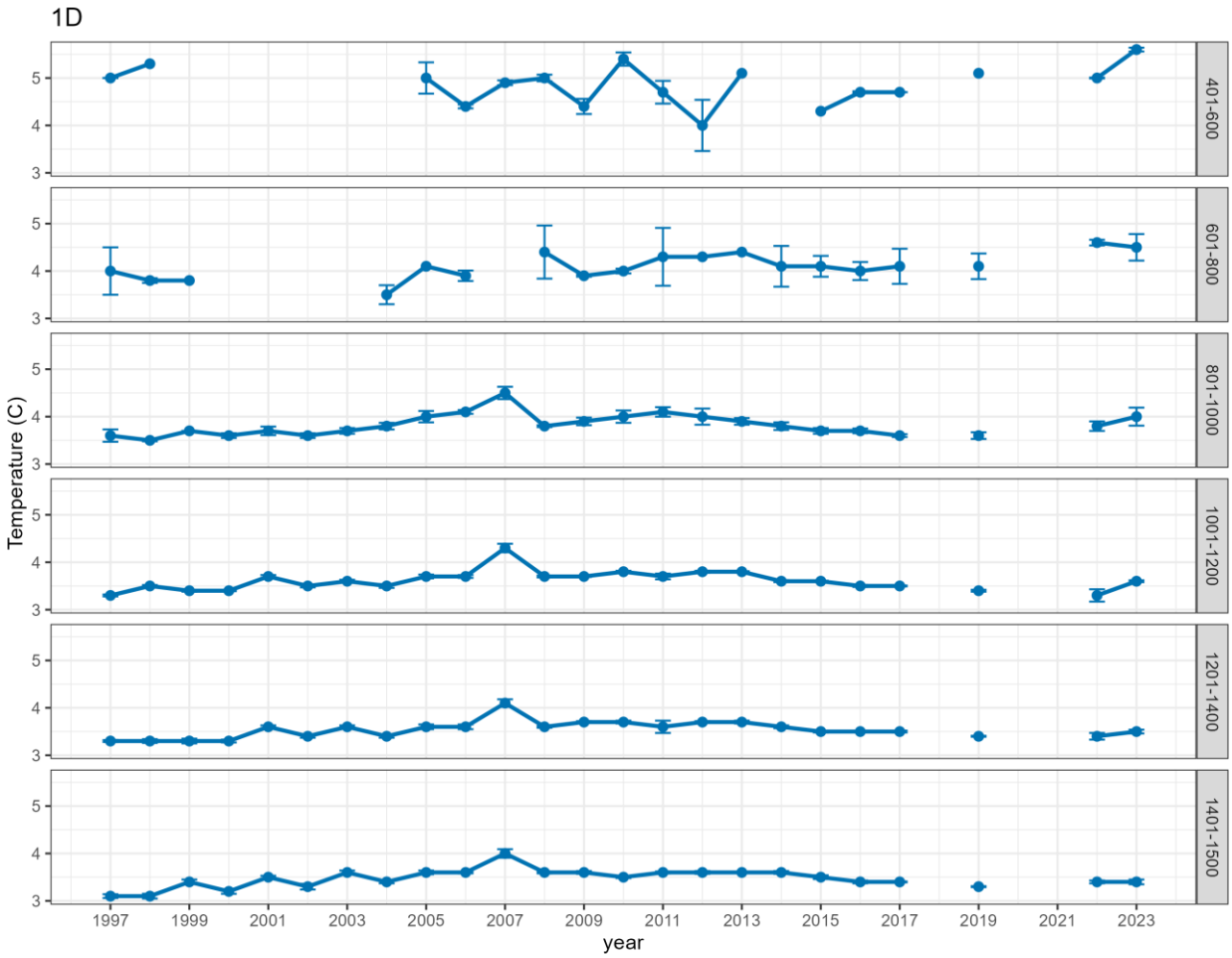


Figure 15. Mean temperatures with S.E. in NAFO division 1D by depth and stratum for the period 1997-2023.

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Appendix A

Table 17. Registered numbers per station for the four species in the 2023 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	1C	418.5	5.1	1.2	2.0	0.0	0.0	0.3	2.0	0.4	4.0
2.0	0.1	1C	443.5	5.3	3.0	2.0	0.0	0.0	0.1	1.0	0.1	1.0
3.0	0.1	1C	493.0	5.3	67.6	90.0	0.0	0.0	0.3	3.0	0.6	6.0
4.0	0.1	1C	704.0	4.1	91.0	75.0	3.5	47.0	3.0	6.0	51.8	85.0
5.0	0.1	1C	724.5	4.7	116.6	98.0	1.0	28.0	4.1	7.0	16.7	26.0
6.0	0.1	1C	580.0	4.7	25.0	14.0	0.1	4.0	2.7	7.0	157.4	242.0
7.0	0.1	1C	680.0	4.7	33.4	30.0	1.6	32.0	5.6	7.0	158.2	266.0
8.0	0.1	1C	629.0	5.0	94.3	94.0	0.0	2.0	2.5	10.0	48.8	214.0
9.0	0.1	1C	654.0	4.0	130.0	136.0	0.0	0.0	18.5	23.0	2.1	13.0
10.0	0.1	1C	651.0	3.3	185.6	199.0	0.0	2.0	5.0	11.0	0.2	2.0
11.0	0.1	1C	634.0	3.3	163.9	209.0	0.0	1.0	2.9	5.0	2.5	15.0
13.0	0.1	1C	610.0	3.0	49.8	59.0	0.0	0.0	4.8	19.0	0.0	0.0
14.0	0.1	1C	622.5	3.0	61.2	61.0	0.0	1.0	5.4	14.0	4.8	60.0
15.0	0.1	1C	729.5	4.2	107.2	108.0	0.0	0.0	3.2	5.0	0.0	0.0
16.0	0.1	1C	614.5	3.5	108.6	106.0	0.0	0.0	1.3	6.0	5.8	20.0
17.0	0.1	1C	628.0	3.7	123.2	129.0	0.0	1.0	1.7	3.0	4.9	18.0
18.0	0.1	1C	721.5	3.7	151.5	148.0	0.1	4.0	5.1	11.0	1.6	3.0
19.0	0.1	1C	801.0	4.1	177.1	149.0	0.2	4.0	4.6	8.0	0.7	1.0
20.0	0.1	1D	703.0	4.2	167.3	145.0	2.0	22.0	5.2	10.0	0.0	0.0
21.0	0.1	1D	743.0	4.1	155.1	138.0	3.6	37.0	6.3	7.0	6.8	11.0
22.0	0.1	1C	971.0	3.6	740.5	470.4	1.3	23.0	4.3	9.0	0.5	1.0
23.0	0.1	1C	913.5	4.1	115.5	86.0	0.9	9.0	6.5	6.0	0.0	0.0
24.0	0.1	1C	697.0	4.0	102.9	83.0	0.6	10.0	2.7	7.0	0.0	0.0
25.0	0.1	1C	683.0	3.1	94.0	86.0	0.1	5.0	6.7	12.0	2.0	9.0
26.0	0.1	1C	857.5	4.1	386.7	303.0	0.5	10.0	4.2	7.0	0.0	0.0
27.0	0.1	1C	893.0	4.0	383.4	272.0	0.1	5.0	3.9	6.0	0.5	1.0
28.0	0.1	1C	808.5	4.4	136.5	114.0	0.6	15.0	3.6	5.0	0.0	0.0
29.0	0.1	1C	746.0	4.9	120.3	84.0	0.2	6.0	5.8	9.0	0.4	1.0
30.0	0.1	1C	850.5	4.3	633.9	468.2	0.3	12.0	3.1	7.0	0.6	1.0
31.0	0.1	1C	720.0	5.6	81.5	56.0	1.6	5.0	3.3	5.0	140.6	190.0
32.0	0.1	1C	814.0	4.6	809.7	563.3	0.1	6.0	8.3	10.0	10.2	18.0
33.0	0.1	1C	814.0	3.7	749.0	451.0	0.7	15.0	4.7	13.0	0.0	0.0
34.0	0.1	1D	414.0	5.7	115.1	161.0	0.0	0.0	0.0	0.0	0.0	0.0
35.0	0.1	1D	437.0	5.6	37.4	45.0	0.9	2.0	4.3	9.0	34.5	243.7
36.0	0.1	1D	487.0	5.6	32.1	48.0	0.0	0.0	2.1	6.0	3.9	22.0
37.0	0.1	1D	670.5	4.6	24.1	4.0	6.1	26.0	7.0	16.0	5,411.6	6,895.0
38.0	0.1	1D	648.0	5.3	50.0	22.0	400.9	1,100.0	8.3	8.0	8,010.0	9,850.0
40.0	0.1	1D	855.5	4.5	858.7	422.4	1.6	63.0	9.1	12.0	14.3	25.0
41.0	0.1	1D	1,105.0	3.6	529.8	314.0	1.4	24.0	10.8	15.0	4.3	7.0
42.0	0.1	1D	1,048.5	3.6	320.4	179.0	0.1	4.0	5.4	10.0	0.0	0.0

					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**
43.0	0.1	1D	1,118.0	3.4	424.2	289.0	0.9	12.0	2.6	8.0	0.0	0.0
44.0	0.1	1C	1,051.0	3.7	753.4	465.0	1.3	24.0	6.7	12.0	0.0	0.0
45.0	0.1	1D	880.0	3.6	592.6	407.0	1.7	13.0	1.5	5.0	0.0	0.0
46.0	0.1	1D	1,003.0	3.5	130.7	89.0	0.1	2.0	9.7	8.0	0.0	0.0
47.0	0.1	1D	1,066.0	3.5	139.8	111.0	1.4	26.0	6.0	14.0	0.0	0.0
48.0	0.1	1D	884.5	4.0	254.6	173.0	1.6	10.0	1.1	5.0	0.0	0.0
49.0	0.1	1D	941.0	3.9	408.1	284.0	2.7	13.0	1.5	3.0	0.1	1.0
50.0	0.1	1D	1,410.5	3.5	143.2	99.0	0.2	1.0	4.6	8.0	0.0	0.0
51.0	0.1	1D	1,285.5	3.6	286.7	177.0	1.2	7.0	10.7	20.0	0.0	0.0
52.0	0.1	1D	1,165.0	3.5	472.6	293.0	0.0	0.0	4.4	9.0	0.0	0.0
53.0	0.1	1D	1,311.0	3.6	235.7	146.0	2.5	7.0	5.9	11.0	0.0	0.0
54.0	0.1	1D	1,363.0	3.4	423.4	284.0	1.2	12.0	3.2	8.0	0.0	0.0
55.0	0.1	1D	1,434.5	3.4	436.1	267.0	0.8	8.0	5.4	12.0	0.0	0.0
56.0	0.1	1D	1,415.0	3.4	315.6	188.0	2.9	6.0	13.3	13.0	0.0	0.0
57.0	0.1	1D	1,221.5	3.5	132.3	92.0	1.6	6.0	25.1	20.0	0.0	0.0
58.0	0.1	1D	1,009.0	3.5	396.6	280.0	1.8	10.0	6.5	16.0	0.0	0.0
59.0	0.1	1D	1,147.0	3.5	292.0	191.0	0.4	6.0	12.4	18.0	0.0	0.0
60.0	0.1	1D	1,252.0	3.5	342.2	223.0	0.3	7.0	11.6	17.0	0.0	0.0
62.0	0.1	1D	1,101.5	3.5	188.4	141.0	1.9	6.0	5.0	10.0	0.0	0.0
63.0	0.1	1D	1,095.0	3.7	158.6	99.0	0.4	6.0	3.7	13.0	0.0	0.0
64.0	0.1	1D	1,319.5	3.4	52.1	26.0	3.0	4.0	13.6	17.0	0.0	0.0
65.0	0.1	1D	1,329.0	3.4	78.0	36.0	0.1	2.0	9.3	12.0	0.0	0.0
66.0	0.1	1D	1,340.5	3.3	24.4	17.0	0.7	1.0	9.0	14.0	0.0	0.0
67.0	0.1	1D	1,495.5	3.2	221.7	140.0	1.6	4.0	2.3	4.0	0.0	0.0
68.0	0.1	1D	1,154.0	3.5	88.7	58.0	0.0	2.0	5.0	8.0	0.0	0.0
69.0	0.1	1D	1,082.0	3.7	61.7	31.0	0.4	8.0	3.7	9.0	0.0	0.0
70.0	0.1	1D	1,042.0	3.6	83.4	47.0	3.1	5.0	5.3	13.0	0.0	0.0

Appendix B

Table 18. Registered numbers per station for the four species in the 2023 survey in NAFO 1CD.

Species	Max. Weight (kg)	Max. Number	Depth Range	Temp. Range	Max. Latitude
Alepocephalus agassizii	147.4	77.0	614-1329	4.2-3.4	65.2
Alepocephalus bairdii	14.5	28.0	629-1496	5.3-3.2	65.8
Alepocephalus sp.	0.7	1.0	683-1434	3.5-3.2	64.8
Anarhichas denticulatus	38.2	5.0	437-1165	5.6-3	65.8
Anarhichas minor	8.2	1.0	444-493	5.3-5.3	64.7
Anoplogaster cornuta	0.1	1.0	880-1496	3.6-3.2	64.2
Antimora rostrata	24.5	28.0	683-1496	4.4-3.2	65.0
Arctozenus risso	1.1	20.0	414-971	5.7-3.6	65.7
Argentina silus	0.0	1.0	634-651	3.3-3.3	65.8
Argyropelecus olfersii	0.0	1.0	1434-1434	3.4-3.4	63.5
Bajacalifornia megalops	0.5	4.0	1147-1415	3.5-3.3	63.9
Bathylagus euryops	5.1	91.0	622-1496	5-3	65.8
Bathyraja spinicauda	21.6	1.0	1320-1320	3.3-3.3	63.2
Benthosema glaciale	8.0	127.0	414-1496	5.7-3	65.8
Borostomias antarcticus	0.4	2.0	704-1496	4.1-3.2	65.2
Careproctus reinhardti	0.1	1.0	418-418	5.1-5.1	64.4
Centroscyllium fabricii	231.5	188.0	580-1147	5.6-3	65.8
Ceratias holboelli	0.1	1.0	680-680	4.7-4.7	65.5
Chaenophryne longiceps	0.0	1.0	1363-1415	3.4-3.4	63.6
Chauliodus sloani	0.2	5.0	493-1410	5.3-3.3	65.8
Chiasmodon harteli	0.1	2.0	814-1410	4.6-3.3	64.8
Chiasmodon niger	0.1	1.0	1003-1003	3.5-3.5	63.9
Chimaera monstrosa	5.3	1.0	1434-1434	3.4-3.4	63.5
Coryphaenoides armatus	0.1	2.0	1102-1102	3.5-3.5	63.5
Coryphaenoides guentheri	1.5	14.0	856-1496	4.5-3.2	64.2
Coryphaenoides rupestris	400.9	1,100.0	437-1496	5.6-3	65.8
Cottunculus microps	0.6	1.0	634-724	4.7-3.3	65.8
Cottunculus thomsonii	1.4	1.0	1118-1118	3.4-3.4	64.2
Cyclopterus lumpus	2.7	1.0	418-1105	5.1-3.5	65.4
Cyclothone braueri	0.0	13.0	628-1252	4.9-3.3	65.8
Cyclothone microdon	0.1	5.0	801-1496	4.1-3.2	64.4
Deleted Species	633.9	2.0	724-858	4.7-3.7	65.4
Gadus morhua	29.2	21.0	414-720	5.7-3.3	65.7
Gaidropsarus argentatus	0.1	4.0	610-971	5-3	65.8
Gaidropsarus ensis	1.3	11.0	614-1496	4.6-3	65.8
Gaidropsarus sp	0.0	2.0	670-670	4.6-4.6	64.2
Glyptocephalus cynoglossus	1.6	1.0	580-580	4.7-4.7	65.6
Halargyreus johnsonii	0.4	2.0	1329-1329	3.4-3.4	63.2
Hippoglossoides platessoides	44.6	210.0	414-814	5.7-3	65.8
Hippoglossus hippoglossus	25.1	1.0	418-580	5.3-4.7	65.6
Holtbyrnia macrops	0.1	1.0	628-628	3.7-3.7	65.1
Hydrolagus affinis	43.2	6.0	1082-1496	3.7-3.2	63.6

Species	Max. Weight (kg)	Max. Number	Depth Range	Temp. Range	Max. Latitude
Lampadena speculigera	0.0	1.0	1415-1415	3.4-3.4	63.4
Lampanyctus macdonaldi	1.6	85.0	414-1434	5.7-3	65.7
Lampanyctus sp.	0.6	55.0	487-1496	5.6-3	65.5
Lepidion eques	0.0	1.0	856-856	4.5-4.5	64.2
Liparidae	0.0	1.0	743-743	4.1-4.1	64.2
Liparis fabricii	0.1	2.0	614-654	4-3.3	65.8
Lycodes paamiuti	0.1	1.0	634-634	3.3-3.3	65.8
Lycodes vahlii	0.6	4.0	414-493	5.7-5.3	64.7
Macrouridae	0.0	3.0	814-1286	4.6-3.5	64.5
Macrourus berglax	25.1	23.0	418-1496	5.6-3	65.8
Magnisudis atlantica	0.5	1.0	724-724	4.7-4.7	65.3
Malacosteus niger	0.1	1.0	724-1410	4.7-3.4	65.3
Micromesistius poutassou	0.9	6.0	648-720	5.6-5.3	64.6
Microstomus kitt	1.0	1.0	654-654	4-4	65.7
Molva dypterygia	16.3	6.0	648-670	5.3-4.6	64.2
Molva molva	4.3	1.0	814-814	4.6-4.6	64.5
Myctophidae	0.3	164.0	614-1434	4.9-3.4	65.7
Myctophum punctatum	0.1	12.0	414-856	5.7-4.5	64.7
Myxine glutinosa	0.1	1.0	720-850	5.6-4.4	64.6
Nansenia groenlandica	0.0	1.0	730-730	4.2-4.2	65.4
New Species No 1	0.3	1.0	703-703	4.2-4.2	64.2
Nezumia bairdii	0.2	1.0	743-1496	4.1-3.2	64.5
Notacanthus chemnitzii	8.6	7.0	580-1434	5.6-3.3	65.8
Notoscopelus kroyeri	3.8	238.0	414-1340	5.7-3.3	65.8
Oneirodes eschrichtii	0.2	1.0	1066-1066	3.5-3.5	63.9
Paraliparis sp.	0.0	2.0	628-722	4.2-3.7	65.1
Poromitra crassiceps	0.0	1.0	1009-1009	3.5-3.5	63.8
Raja fyllae	0.5	1.0	614-971	5-3.5	65.8
Raja radiata	1.8	4.0	437-704	5.6-4.1	65.2
Reinhardtius hippoglossoides	858.7	563.0	414-1496	5.7-3	65.8
Scopelogadus beanii	0.1	1.0	1082-1082	3.7-3.7	63.3
Scopelosaurus lepidus	2.4	21.0	680-1496	4.9-3.2	65.5
Sebastes marinus	84.4	24.0	487-720	5.6-3.5	65.6
Sebastes mentella	8,010.0	9,850.0	418-1105	5.6-3	65.8
Sebastes sp.	28.1	509.0	414-1434	5.7-3	65.7
Serrivomer beanii	0.7	6.0	680-1496	4.7-3.2	65.5
Shrimp	36.2	0.0	414-1496	5.7-3	65.8
Stomias boa	0.2	14.0	414-1410	5.7-3.3	65.8
Stomiidae	0.0	1.0	941-941	3.9-3.9	64.0
Synaphobranchus kaupii	1.8	11.0	610-1496	4.9-3	65.5
Trachyrincus murrayi	3.9	10.0	856-1410	4.5-3.4	64.5
Xenodermichthys copei	0.0	2.0	580-1102	4.7-3.5	65.6

Colophon

This version of the document was generated on 2024-05-30 12:52:07.612754 using the R markdown template for SCR documents from **NAFOdown**.

The computational environment that was used to generate this version is as follows:

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#> ─ Session info ─────────────────────────────────────────────────────────
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#>  setting  value
#>  version  R version 4.3.2 (2023-10-31 ucrt)
#>  os       Windows 10 x64 (build 19045)
#>  system   x86_64, mingw32
#>  ui       RTerm
#>  language (EN)
#>  collate  Spanish_Spain.utf8
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#>  tz       Europe/Madrid
#>  date     2024-05-30
#>  pandoc   3.1.1 @ C:/Program Files/RStudio/resources/app/bin/quarto
/bin/tools/ (via rmarkdown)
#>
#> ─ Packages ─────────────────────────────────────────────────────────────
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#>  package            * version    date (UTC) lib source
#>  askpass              1.2.0      2023-09-03 [1] CRAN (R 4.3.2)
#>  bookdown             0.37       2023-12-01 [1] CRAN (R 4.3.2)
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#>  crul                 1.4.0      2023-05-17 [1] CRAN (R 4.3.2)
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#>  ftExtra            * 0.6.2      2024-02-28 [1] CRAN (R 4.3.2)
#>  gdtools              0.3.6      2024-02-22 [1] CRAN (R 4.3.2)
#>  generics             0.1.3      2022-07-05 [1] CRAN (R 4.3.2)
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#>  highr               0.10       2022-12-22 [1] CRAN (R 4.3.2)
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#>  later               1.3.2      2023-12-06 [1] CRAN (R 4.3.2)
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#>  lubridate         * 1.9.3      2023-09-27 [1] CRAN (R 4.3.2)
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#>  munsell             0.5.0      2018-06-12 [1] CRAN (R 4.3.2)
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NAFOdown@431ec8f)
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#>  pkgload             1.3.4      2024-01-16 [1] CRAN (R 4.3.2)
#>  png                 0.1-8      2022-11-29 [1] CRAN (R 4.3.1)
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#>  remotes             2.4.2.1    2023-07-18 [1] CRAN (R 4.3.2)
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#>  tidyr              * 1.3.1      2024-01-24 [1] CRAN (R 4.3.2)
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#>  withr                3.0.0      2024-01-16 [1] CRAN (R 4.3.2)
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#>  xml2                 1.3.6      2023-12-04 [1] CRAN (R 4.3.2)
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#>  yaml                 2.3.8      2023-12-11 [1] CRAN (R 4.3.2)
#>  zip                  2.3.1      2024-01-27 [1] CRAN (R 4.3.2)
#>
#>  [1] D:/Usuarios/anogueira/AppData/Local/Programs/R/R-4.3.2/library
#>
#> ──────────────────────────────────────────────────────────────────────────────
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