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The Status of the Northern Gulf of St. Lawrence (3Pn, 4RS) Atlantic cod (*Gadus morhua*) Stock in 2024

Jordan Ouellette-Plante, Hugues P. Benoît and Jean-François Lussier

Fisheries and Oceans Canada
Maurice-Lamontagne Institute
850 Route de la Mer,
Mont-Joli, Quebec G5H 3Z4

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Foreword

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

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ABSTRACT

The status of the Atlantic cod (*Gadus morhua*) stock in the northern Gulf of St. Lawrence (nGSL, NAFO Subdivision 3Pn and Divisions 4RS) was reviewed during the peer review held on February 18 and 19, 2025. This document describes the data and methods used to assess this stock. Specifically, it details the species' biology, some ecosystem characteristics observed in the nGSL, and the inputs to the assessment model.

The spawning stock biomass (SSB) of 3Pn4RS cod, estimated at 15,793 t in 2024, represents 22% of the limit reference point, placing this stock in the critical zone of the precautionary approach since 1990. According to the rebuilding plan's harvest control rule, annual removals from all sources should not exceed 500 t.

SSB projections based on reported catch scenarios ranging from 0 to 1,000 t show very low probabilities of SSB growth over the next four years. These results can be explained principally by high recent natural mortality, along with low recruitment.

Links between feeding intensity, condition and total mortality suggest that recent bottom-up effects of the environment may be important drivers of the low stock productivity.

1. INTRODUCTION

The Atlantic cod[1], *Gadus morhua*, was until the early 1990s the main exploited groundfish species to be landed on the Canadian Atlantic coast. Several cod stocks occur along this coast, including the northern Gulf of St. Lawrence (nGSL) stock which encompasses NAFO[2] Subdivision 3Pn and Divisions 4R and 4S (Figure 1).

Assessments of the status of the stock have been conducted since 1977 (Wells 1977) by Fisheries and Oceans Canada (DFO, Table 1). Since 2012, the stock's status has been assessed every two to four years, with updates to the stock status indicators in the interim years. The most recent full assessment of this stock dates back to February 2023, which determined that the stock was in the critical zone, at 60% of the limit reference point (LRP, DFO 2023a). When updating the indicators in winter 2024, no significant changes in the stock status were noted (DFO 2024a). As this stock is below its LRP, a rebuilding plan was developed in 2024 based on certain scientific elements discussed in October 2023 (Benoît and Ouellette-Plante 2023; DFO 2024b).

Since 2022, no commercial fishing targeting the 3Pn4RS cod has been permitted. The fisheries management division of DFO requested an assessment of the status of the 3Pn4RS cod stock to guide its decisions for the next management cycle of this stock. This research document presents the methods, data, and results of that latest assessment, in addition to acting as a reference for scientific advice on the stock (DFO 2025a).

1.1. COSEWIC STATUS

In 2010, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed cod from the Laurentian North Designatable Unit (DU), which encompasses NAFO Divisions 3P4RS and of which the 3Pn4RS stock is part, as being endangered (COSEWIC 2010). The last recovery potential assessment for cod in this DU dates to 2011 (DFO 2011).

1.2. SPECIES BIOLOGY

The following section is based in part on the summary of the 3Pn4RS cod stock's biology provided in Dutil et al. (2005) and the references cited therein. When necessary, updates are provided based on more recent studies.

1.2.1. General description

Cod is a fish of the order Gadiformes, of the family Gadidae and the sub-family Gadinae. The members of this sub-family are distinguished by their three dorsal fins and two anal fins (Cohen et al. 1990). The colouration of cod is variable, often brownish, greenish or greyish in colour on the dorsal portion and paler ventrally (Cohen et al. 1990). Juveniles can be golden red in colour (Nozères et al. 2010).

1.2.2. Distribution range

Worldwide, cod is distributed in the North Atlantic Ocean and in the Arctic Ocean (Figure 2, Cohen et al. 1990). In the Americas, it is distributed along the coast from Cape Hatteras in North Carolina (United States) to Ungava Bay in Canada. On the European side, it is observed in

[1] The term cod is used hereafter to refer to Atlantic cod.

[2] Northwest Atlantic Fisheries Organization. This stock is hereafter referred to as the 3Pn4RS stock.

Greenland, around Iceland and on the coasts of Europe from the Bay of Biscay in the south to the Barents Sea in the north.

The 3Pn4RS cod stock is distributed in the northern portion of the Gulf of St. Lawrence (GSL), which is a semi-enclosed sea connected to the Atlantic Ocean by two openings: the Cabot Strait to the southeast and the Strait of Belle Isle to the northeast. Four other cod stocks are adjacent to the 3Pn4RS stock: the southern GSL cod stock (Divisions 4T + 4Vn [November to April]) to the south, the 3Ps and 4Vn stocks (May to October) to the southeast, and the northern cod stock (Divisions 2J3KL) at the outlet of the Strait of Belle Isle (Figure 1).

Cod in 3Pn4RS have long been known to undertake annual migrations (Figure 3). In winter, high concentrations were historically found in the deep waters of Subdivision 3Pn. In the spring (April-May), cod begin their northward migration and begin spawning in the Port-au-Port Peninsula area on the west coast of the island of Newfoundland, within the province of Newfoundland and Labrador (NL). The cod then continues to disperse in the coastal and offshore areas of western Newfoundland and the Middle and Lower North Shore of Quebec (QC) during the summer. These migrations are associated with seasonal warming of the waters and food availability (DFO 2003a).

In terms of depth, 3Pn4RS cod is distributed during the summer at depths ranging from about 50 m to more than 500 m. However, most cod are found between 50 and 150 m (Figure 4d). Large cod are found in deeper waters than smaller specimens (Chabot et al. 2008).

1.2.3. Mixing with peripheral stocks

In the early 1990s, DFO winter surveys showed significant movements of the stock to Subdivision 3Ps during the winter, mainly in the Burgeo Bank area (Fréchet and Gagnon 1993; Fréchet et al. 1994). These migrations out of the stock area were then postulated to be the result of regional changes in hydrographic conditions encountered at the usual wintering sites (Ouellet et al. 1997). These observations led to the abandonment of the DFO winter survey conducted since 1978 aboard the MV[3] Gadus Atlantica because the biomass estimates were then skewed downwards.

Results from a genomic population study show that GSL cod are partially distinct from adjacent populations on the Scotian Shelf and Newfoundland/Labrador/Arctic (Puncher et al. 2021). These results suggest reduced genetic connectivity, or little reproduction, between GSL cod and those outside. However, these results do not show a distinction between 3Pn4RS cod and those from the southern GSL (4T + 4Vn stock [November to April]).

In general, the results of several tagging studies show that the 3Pn4RS stock is fairly well isolated from the peripheral stocks. Except for Subdivision 3Ps where recaptures of cod tagged in 3Pn4RS are relatively frequent, recaptures elsewhere outside of 3Pn4RS are rare (Bérubé and Fréchet 2001).

1.2.4. Hypoxia

The level of dissolved oxygen concentration in the surrounding environment at which a decrease in the energy budget for a species is observed, i.e., hypoxia, is known to negatively influence the metabolic capacities of fish. At the physiological level, hypoxic conditions can alter processes in cod such as digestion, in addition to affecting growth, fecundity and body condition

[3] Motor vessel.

(Chabot and Dutil 1999). At the stock level, hypoxic conditions could thus alter spatial distribution, recruitment, abundance and biomass.

In the laboratory, long-term survival of cod is no longer assured when dissolved oxygen saturation levels fall below 20% (Chabot and Claireaux 2008). At levels below 50%, mobility and digestion are severely restricted. During the summer and fall, cod are not found in regions where oxygen saturation is < 30% since this level is lethal to some fish (Figure 4c, Chabot and Claireaux 2008). The hypoxic conditions observed at the head of the Laurentian Channel and in the Anticosti and Esquiman channels in 2023 are therefore unlikely to be favorable to cod (Blais et al. 2024).

1.2.5. Growth

Considered a long-lived species (Trippel 1995), the annual growth of 3Pn4RS cod is not evenly distributed throughout the year. Correlations with body condition measures suggest that 3Pn4RS cod have a period of negative growth (in mass) around the spawning period, followed by strong growth in late summer and early autumn. The 3Pn4RS cod stock is one of the least productive stocks in the North Atlantic in terms of individual growth by weight (Dutil and Brander 2003).

1.2.6. Reproduction and early-life stages

Several sampling campaigns were conducted in the late 1980s and early 1990s to acquire knowledge of decapod invertebrate larvae and fish eggs and larvae in the GSL (Ouellet et al. 1994). Analysis of these data showed that simultaneous spawning events were occurring for cod in all sectors of the nGSL as early as May. However, according to fishing and ichthyoplankton data, spawning occurs mainly off St. George's Bay (Ouellet et al. 1997). This area appears to be the same as that used by spring-spawning Atlantic herring (*Clupea harengus*) for spawning, and is also subject to a fishing restriction from April 1st to June 23rd to promote spawning (Figure 5). Most spawning events would occur below the cold intermediate layer (CIL) at depths > 150 m.

In general, 3Pn4RS cod begin spawning in late March and spawning activity increases in May and continues until June (Ouellet 1997). Larger cod begin spawning before small cod and often produce larger eggs in the laboratory (Trippel 1995). It has been suggested that reproduction coincides with the onset of the spring planktonic bloom, which occurs from April to June in a south-north gradient related to ice retreat. The duration of spawning varies individually depending on the size of the cod. Larger female cod will produce more eggs and have more spawning events than smaller specimens (Trippel 1995). As spawning progresses, their eggs decrease in size (Ouellet 1997). Depending on environmental conditions it has been observed for other stocks that some cod refrain from reproducing despite reaching sexual maturity (Rideout and Rose 2006).

Cod eggs are bathypelagic[4] and disperse with currents. The development time of eggs and larvae is related to the water temperatures observed in their environment (Templeman 1981). When incubated at 0°C, eggs would take about 40 days to develop until hatching, a time that decreases in warmer waters (Templeman 1981; Ouellet 1997). The feeding period of larvae following yolk sac resorption is quite critical, and environmental conditions during this period may influence the survival of these young cohorts and their future importance at the stock level (Rose 2018).

[4] Means that their buoyancy is negative in the upper layer of the water column (Ouellet 1997).

This larval period is followed by a pelagic juvenile phase during which cod of about 17 mm in total length will move deeper into the water column. Upon reaching a total length of about 30 to 60 mm, juvenile cod transition to complex demersal habitats to hide from predators (Rose 2018).

1.2.7. Diet

Cod is a generalist predator. Indeed, 204 different taxa were observed in the 2,004 stomachs collected during the DFO August bottom trawl surveys from 2015-2017, which corresponds to 82% of the total number of taxa observed in the stomachs of all predators for which stomachs were collected and analyzed during this period (Ouellette-Plante et al. 2020). The taxa observed for cod corresponded to 74 different prey families.

In August 2015-2017, cod < 30 cm fed mainly on zooplankton (33%[5], mainly hyperiids of the genus *Themisto* sp.), shrimp (24%, mainly northern shrimp [*Pandalus borealis*]), and fish (22%, mainly capelin [*Mallotus villosus*]). From 30 to 55 cm, the contribution of zooplankton dropped, whereas those of fish, including redfish[6] (*Sebastes* spp.) and capelin, and shrimp, increased. The diet of cod ≥ 55 cm consisted mainly of fish, and redfish were the most important prey. All sizes combined, the three taxa contributing the most to the August diet of cod during this period were 1) capelin, 2) northern shrimp, and 3) redfish. It is noteworthy that during this period, the abundance of small redfish in the nGSL was at levels never observed before (Senay et al. 2023).

Apart from data collected during the DFO August bottom trawl surveys, few data are available to describe the diet of 3Pn4RS cod during the rest of the year. The work of Minet and Perodou (1978) presented the results obtained from 570 and 194 stomachs collected in the winters of 1975-1976 and summer of 1975, respectively. The authors reported that there was very little seasonal variation in cod diet and that it was similar across NAFO divisions in terms of the main species consumed. Their results identified capelin as the most important prey in both summer and winter. This importance of capelin in winter was not observed later following the implementation of the sentinel fisheries program in the fall of 1994 (see section 2.1.3.3). Indeed, after obtaining and analyzing 689 cod stomachs from November 1994 to January 1995, Fréchet et al. (1995) showed that invertebrates contributed more to the cod's diet (in % of the total mass of stomach contents). Atlantic herring was then the fish that contributed the most (6.7%), almost twice the contribution of capelin (3.05%). As for the variation in feeding intensity between months of the year, Fréchet et al. (2003) showed that it decreased from July to August and then resumed in the fall. However, the authors mentioned that the different vessel-gear tandems used to acquire the stomachs could have been a parameter affecting stomach fullness between months. From these works, we note large differences, and it is difficult to explain them since the stomachs collected did not necessarily cover the same places and periods (which could incorporate an effect of prey availability), nor were they sampled during missions using similar protocols and equipment.

During the winter season, several studies have shown that cod fed very little (Turuk 1968; Tyler 1971; Fordham and Trippel 1999; Schwalme and Chouinard 1999). For the 3Pn4RS stock,

[5] Unless otherwise specified, the % values in this section correspond to the contribution of the partial fullness index (PFI) to the total fullness index (TFI), i.e., $\frac{PFI}{TFI} \cdot 100$.

[6] In the text, the term redfish will refer to deepwater redfish (*Sebastes mentella*) and Acadian redfish (*S. fasciatus*).

a lower feeding intensity in the winter months is observable according to condition data obtained from the fixed gear sentinel fishery program (Ouellette-Plante et al. 2022b).

1.2.8. Predators

Cod are preyed upon by several predators throughout their development. The larvae are preyed upon by Atlantic herring, Atlantic mackerel (*Scomber scombrus*) and even other cod larvae (Bromley et al. 1997; Rose 2018). Juvenile cod otoliths have been found in several northern squid stomachs (*Illex illecebrosus*, Dawe et al. 1997). Using stomachs from the nGSL collected during the period 2015–2017, Ouellette-Plante et al. (2020) showed that Atlantic halibut (*Hippoglossus hippoglossus*) and white hake (*Urophycis tenuis*) also fed on cod. Cannibalism is also observed in adult cod (Fréchet et al. 2003; Ouellette-Plante et al. 2020).

The extent of seal predation on 3Pn4RS cod is somewhat uncertain, but has certainly been less significant than that on the neighboring southern GSL stock where the grey seal (*Halichoerus grypus*) is much more abundant (Swain et al. 2019). However, recent aerial surveys have suggested an increase in grey seal abundance at Brion Island (Magdalen Islands, Mosnier et al. 2023). Since some of these seals may occasionally feed in the nGSL according to telemetry work, the level of predation on 3Pn4RS cod may have increased in recent years.

1.3. ECOSYSTEM

1.3.1. Physical and chemical oceanographic conditions

DFO annually assesses the physical oceanographic conditions prevailing in the GSL as part of the Atlantic Zone Monitoring Program (AZMP). Between 2009 and 2022, the deep waters of the GSL have warmed with inward advection from Cabot Strait (Galbraith et al. 2024). The deep water layer (>150 m) originates at the entrance to the Laurentian Channel, where the waters of two currents, the Labrador Current (cold, less saline, highly oxygenated) and the Gulf Stream (warm, more saline, less oxygenated) combine into a water mass for which the temperature, salinity and dissolved oxygen depend on their respective contributions. Temperatures exceeding 7°C have been recorded since 2012 in the GSL near Cabot Strait and have, in recent years, occupied a significant volume of deep waters, including those where cod aggregate in winter. After a record year in 2022 when the various layers of the water column at 150 m and above reached temperature peaks, values decreased slightly in 2023 (Galbraith et al. 2024). From 2021 to 2022, a warming of the waters where cod are caught was observed during the DFO August survey (Figure 4a). In the last two years, there has been a return of catches to colder waters, and the spatial distribution of cod must be related to this (Figures 6- 7). At 150 m depth, the average water temperature in the GSL decreased by almost 1°C from 2022 to 2023, but was still one of the highest values in the series. During the summer, cod live closer to the CIL, a layer of water formed by the surface layer of the previous winter. In recent years, there has been a decrease in the volume and an increase in the temperature of the CIL in the GSL.

In 2023, the dissolved oxygen concentration of the waters at the bottom of the Cabot Strait reached the lowest value observed during the 2002-2023 series (Blais et al. 2024). Since these waters are the main ones feeding the deep-water layers of the GSL and since these take three to four years to reach the estuary, we can expect a further decrease in dissolved oxygen in the deep-water layers of the GSL in the coming years. Indeed, the waters entering the GSL become depleted in dissolved oxygen as they progress due to *in situ* respiration and the oxidation of organic matter. In 2023, hypoxic waters (< 30% dissolved oxygen saturation) were observed at the bottom of the Anticosti and Esquiman channels. After observing a decrease in dissolved oxygen levels at locations where cod were caught during the DFO August survey in 2021 and

2022, since 2023 a return to values consistent with those observed during the 2015-2020 period has been observed (Figures 4c).

1.3.2. nGSL community

The demersal community of the nGSL was, until the early 1990s, dominated by demersal fish (e.g., cod, redfish). Following their collapse, the biomass of several species, including northern shrimp, increased (Savenkoff et al. 2007). Since the mid-2010s, there has been a significant increase in the population of deepwater redfish and Acadian redfish, so much that in 2024, according to the DFO August survey, their biomass represented 81% of the total biomass of all organisms caught during this survey, compared to an average of 15% during the 1995–2012 period (Chamberland et al. 2025).

The DFO August survey also provides inputs for calculating abundance and biomass indices for some cod prey, such as capelin. However, these indices should be interpreted with caution since the survey catchability of pelagic species is not known and is probably very low. That said, in recent years, capelin appear to have been observed less along the west coast of the province of Newfoundland and Labrador (NL) and northeast of Anticosti Island during this survey than historically. In 2024, low catches were observed, mostly in the estuary and Strait of Belle Isle.

1.4. MANAGEMENT MEASURES

This section is largely based on the integrated fisheries management plan developed in January 2017 for groundfish in the GSL (NAFO Subdivisions 3Pn and 4Vn and Divisions 4RST, DFO 2017).

1.4.1. Total allowable catch

A total allowable catch (TAC) has been in place since the expansion of Canada's Exclusive Economic Zone (EEZ) to 200 nautical miles offshore in 1977 (Table 2, Sanguin 1980). The annual TAC is allocated among the different fleets and fleet sectors, according to the sharing agreements in force.

1.4.2. Fishing season

Until 1998, the management year for 3Pn4RS cod was the calendar year. In 1999, a new management cycle was introduced for non-NAFO regulated groundfish stocks. This change was driven by industry requests for a more timely preparation and announcement of the groundfish management plan (DFO 1999). Beginning in 2000, the management year for GSL stocks, including the 3Pn4RS cod stock, was changed from May 15 of the current year to May 14 of the following year. To accommodate this transition, the 1999 management year ran from January 1, 1999, to May 14, 2000.

When a directed commercial fishery for 3Pn4RS cod is permitted, the start and end dates of the season may vary depending on the fleets and are determined in consultation with industry. However, no directed cod fishing is authorized in Divisions 3Pn4RS between January 1st and June 23 of each year in order to ensure the protection of fish during the spawning period (see section 1.4.11). Since bycatch of cod may be reported in other groundfish fisheries, cod catches are monitored year-round.

1.4.3. Fishing gear used

The use of mobile gear in fisheries targeting 3Pn4RS cod has been prohibited since 1994. The configurations and number of fishing gears to be respected (e.g., mesh size of gillnets or hook openings of longlines) are defined in the conservation-oriented fishing plans. For QC fishermen and depending on the fleets, handlines, longlines and gillnets may be authorized. For the NL inshore fixed gear fleet, the types of gear authorized for a directed commercial cod fishery include gillnets, handlines, longlines and cod pots, with restrictions specific to each type of gear.

1.4.4. Fishing restrictions

When a directed commercial fishery for 3Pn4RS cod is permitted, several restrictions apply, often specific to certain fleets. These notably include:

- A prohibition on leaving fixed fishing gear in the water unattended for a continuous period, the duration of which may vary from one fleet to another (maximum 72 hours).
- Harvesters from NL located south of a line from Johnson Cove (48°04'N, 59°09'W, see Figure 5), including those in 3Pn and part of 4Rd, may only use longlines, handlines and cod pots as fishing gear.

1.4.5. At-sea monitoring

At-sea monitoring by approved and independent at-sea observer companies is required for the directed commercial 3Pn4RS cod fishery. This monitoring is funded by the industry. The percentage of fishing trip coverage of fishing trips varies between fleets (5 to 20%).

1.4.6. Dockside monitoring

All landings must be recorded at the dock by a DFO-approved monitoring company. In some years and in remote areas, dockside monitors may not be available. In these rare cases, DFO uses purchase receipts and logbooks as data sources to track quotas and landings (S. Beauchamp, DFO, pers. comm. 2023).

1.4.7. Harvest control

When a directed commercial fishery is permitted, several harvest control measures are in place. These may include, but are not limited to:

- For QC harvesters:
  - An individual transferable quota (ITQ) system for several fixed gear fleets with access to the Quebec 3Pn4RS cod allocation.
  - A minimum initial quantity requirement (including temporary transfers) to be eligible to receive licence conditions for the directed fishery.
  - A variable quantity of authorized gear depending on the fishing location and the individual quota held (including temporary transfers).
- For NL harvesters:
  - A distribution of fixed-gear catch allocation over different periods during the season.
  - Weekly catch limits per licence holder.

Since 2011, DFO has implemented quota reconciliation in groundfish fisheries. This means that any quota overrun in a given year, whether within an individual quota (IQ), enterprise allocation (EA) system or in a competitive fishery, is deducted from the quota or allocation established for the following season.

1.4.8. Precautionary approach

The first reference to a Limit Reference Point (LRP) for this stock is found in the proceedings of the February 2003 zonal assessment meeting (DFO 2003b). The proposed LRPs then ranged from 74 to 275 kt of spawning stock biomass (SSB). Between 2004 and 2008, these values increased to 85–110 kt (DFO 2004). In 2009, the LRP and upper stock reference point (USR) were set at 140 and 200 kt, respectively (Duplisea and Fréchet 2010). Between 2010 and 2022, the LRP and USR values were set at 116 and 180 kt, respectively (Duplisea and Fréchet 2011). These LRP and USR values were used in the development of decision rules for the 3Pn4RS cod fishery from the 2013–2018 rebuilding plan for this stock (unpublished document).

The 3Pn4RS cod stock is part of the first group of large stocks covered by the fish stocks provisions (sections 6.1 to 6.3 of the Fisheries Act). A new assessment model was adopted in May 2022 and a revision of the precautionary approach reference points took place during the February 2023 assessment (DFO 2023a). A summary of the reference points adopted or suggested is provided in Table 3.

1.4.9. Rebuilding plan

The 3Pn4RS cod stock is one of the 30 main stocks (first batch) subject to the fish stocks provisions that came into force through regulations on April 4, 2022. Given that the 3Pn4RS cod stock is below its LRP, DFO is legally required to develop a rebuilding plan for this stock, which was completed in 2024 (Benoît and Ouellette-Plante 2023; DFO 2024b).

As part of this rebuilding plan, a harvest control rule (HCR) was implemented to support the growth of the 3Pn4RS cod stock toward the rebuilding target, established at a SSB of 81,961 t. The HCR recommends the total removals level for 3Pn4RS cod from all fishery-related sources based on the value of the SSB relative to the LRP (Table 4).

1.4.10. Small fish protocol and bycatch

Specific areas may be closed to fishing when the number of undersized fish caught exceeds 15% of the total quantity of the targeted species. For cod, undersized specimens are those less than 43 cm[7].

In addition, areas may be closed to fishing when bycatch levels are considered to be of concern (these levels vary depending on the species targeted, the gear used and the fleet). For groundfish species other than cod that are commercially fished in 3Pn4RS, cod bycatch allocations are established. Exceeding these allocations may result in the closure of these fisheries.

1.4.11. Seasonal and spatial closures

In order to limit the harvest of 3Pn4RS cod that could occur during mixing with the 3Ps stock in winter, commercial fishing for 3Ps cod is prohibited from November 15 to mid-May in the 3Psade unit areas (Figure 5). However, resident fishermen in unit areas 3Psa and 3Psb may target 3Psa cod from mid-May to February 28 of the following year (DFO 2022a).

Within the nGSL, seasonal closures exist to protect the stock during the spawning period (Figure 5). From April 1st to June 23rd, directed fishing for groundfish is prohibited in part of unit areas 4Rc and 4Rd located offshore of St. George's and Port-au-Port Bays in NL, which are

[7] In this document and unless otherwise stated, all lengths are fork lengths.

recognized as a spawning area. This same closure period also applies to directed fishing for cod (when permitted) in the territory covered by Divisions 3Pn4RS.

Although not directly targeting cod, 11 coral and sponge conservation zones were created in December 2017 in the estuary and GSL (Figure 5, DFO 2022b). The main objective is to protect areas where high concentrations of these organisms are recorded. The use of fishing gear touching the sea bottom is prohibited. However, certain scientific activities, including DFO bottom-trawl surveys and the mobile gear sentinel surveys, are permitted (DFO 2018; Benoît et al. 2020).

Finally, the Laurentian Channel Marine Protected Area (MPA) established in April 2019 partially overlaps Subdivision 3Pn. All commercial fishing is prohibited there (Figure 5, Canada 2019; DFO 2019a).

Restrictions on fishing depth also exist and are specific to each target species and/or type of gear used.

1.4.12. Recreational fishing

The terms of the recreational fishing seasons for groundfish in the nGSL, which includes cod, are decided by the *Fisheries Management sector* of two DFO regions:

- The QC region manages the recreational fishery in the waters adjacent to the sector from Pointe-des-Monts to Blanc-Sablon. This sector is divided into two zones:
  - Zone 4S-West, corresponding to the sector from Pointe-des-Monts to Natashquan (including Anticosti Island).
  - Zone 4S-East, corresponding to the sector from Natashquan to Blanc-Sablon. Historically, the terms of the fishing season in this sector have often been based on those granted by the NL region for 3Pn4R.
- The NL region manages the recreational fishery in the waters adjacent to the sector corresponding to Divisions 3Pn4R.

Recreational cod fishing in divisions 3Pn4RS generally occurs from late June to early October. For the 4S-West zone, the fishing season has been combined into a date range comprising six weekends (Table 5, Figure 8). For the 4S-East zone and the 3Pn4R sector, fishing is authorized during a series of several long weekends between early July and early September, followed by a block of days in late September/early October. During the 2023–2024 period, fishing was permitted for a total of 39 days. For sectors where fishing was permitted, the individual daily quota was five cod (QC and NL), and 15 cod per boat (NL only). In NL, special permits for boat tour operators could be requested to increase the quota per trip. There is no reporting of catches in this fishery.

2. METHODS

The period 2023-2024 is often mentioned in the following section. This corresponds to the period since the last full stock assessment, which took place in February 2023 and for which data extended to 2022 (DFO 2023a; Ouellette-Plante et al. 2025).

2.1. DATA INPUTS

2.1.1. Commercial fisheries

2.1.1.1. Landings

The 3Pn4RS cod stock has been exploited since at least the 16th century (Chouinard and Fréchet 1994; Mimeault 1997; Lear 1998). However, it was not until the early 1950s that valid landing statistics were published by fishing sector and not by landing sector (Chouinard and Fréchet 1994). A detailed review of the various data sources for landings is provided in Ouellette-Plante et al. (2022a). Currently, two data sources are compiled to produce the historical series of 3Pn4RS cod landings:

- NAFO 21B data. This dataset is made public by NAFO and the available data start in 1960. These data are generally only used from 1964 in the assessments of this stock, since some landings from 1960–1963 do not provide any information on the month of landing and/or are reported as coming from NAFO Division 3P, which does not allow to distinguish landings from the 3Pn4RS stock from those from the neighboring 3Ps stock (Gascon 1983, Figure 1). The NAFO 21B data provide a breakdown of the landings by year, month, country and gear.
- ZIFF[8] data. Available for Canadian fleets only, these data have the advantage of being reported by fishing trip. These data have been available since 1985.

Two factors come into play in choosing which of these data sources to use for a given year:

- Management year. Beginning in 1999, the management year for this stock was changed and no longer corresponds to the calendar year. See section 1.4.2 for details. Since the NAFO 21B data had a monthly resolution, it was then impossible to separate landings from May to the correct management year starting in 1999 and it was therefore necessary to use the ZIFF data.
- Landings by foreign fleets. Foreign fleets fished 3Pn4RS cod until 1992 (Table 6). Since the ZIFF data only provide data for the Canadian fleet, the use of the NAFO 21B data is required.

Based on these constraints, and in order to have the most accurate data possible, the series of commercial landings is constructed as follows:

- 1964-1984: NAFO 21B data.
- 1985-…:
    - Canadian landings: ZIFF data.
    - Foreign fleet landings: NAFO 21B data.

For this stock assessment, NAFO 21B data were extracted on 8 February 2021. Although this extraction is dated, a validation using the STATLANT 21A online tool was performed to ensure that no 3Pn4RS cod landings had been generated by international fleets since then. As for ZIFF data, they were extracted on December 6, 2024. The 2019-2024 data is considered preliminary.

2.1.1.2. Catch per unit effort

Given the moratorium on commercial fishing directed at 3Pn4RS cod since 2022, it did not seem useful to present catch per unit effort data from commercial fishing in this document. The

[8] *Zonal Interchange File Format*, STACAC (1984).

only information available in recent years is that compiled in fishermen's logbooks during fishing activities targeting other commercial species (data not presented here) or during participation in sentinel surveys.

2.1.1.3. Dockside sampling program

DFO coordinates a dockside sampling program for commercial landings specifically designed to estimate catch composition (Lambert and Ménager 1998; Daigle and Benoît 2007). Each year for cod, representative samples of fishing trips are collected to obtain data on the length and age composition of commercial catches. Otolith readings for age determination are performed by DFO Science Branch.

2.1.1.4. Catch-at-age

Landings of 3Pn4RS cod were divided into *k* strata defined by the combination of year, month, NAFO unit area, and gear category. In the majority of these strata, there were insufficient length frequency (LF) and age readings from the dockside sampling program to infer the LF and age composition of the associated landings. Values were therefore imputed from samples from other strata for these particular cases. Details of the methodology used are provided in Ouellette-Plante et al. (2022c). In summary, sample imputations followed a 12-level decision hierarchy in which the first level corresponded to the stratum itself, and subsequent levels corresponded to samples from increasingly different strata. For each stratum *k*, the aggregation level used depended on a set of criteria *s* to be met. Failure to meet *s* at a given aggregation level resulted in moving to the next level, until reaching the one that met *s*. Here is the 12-level hierarchy used:

1 = year + month + NAFO + gear (corresponds to *k*) = if *s* met, else ↓
2 = year + adjacent months + NAFO + gear = if *s* met, else ↓
3 = year + month + gear = if *s* met, else ↓
4 = year + adjacent months + gear = if *s* met, else ↓
5 = year + gear = if *s* met, else ↓
6 = year = if *s* met, else ↓
7 = adjacent years + months + NAFO + gear = if *s* met, else ↓ 8 = adjacent years + adjacent months + NAFO + gear = if *s* met, else ↓
9 = adjacent years + months + gear = if *s* met, else ↓
10 = adjacent years + adjacent months + gear = if *s* met, else ↓
11 = adjacent years + gear = if *s* met, else ↓
12 = adjacent years

2.1.1.5. At-sea discards

Since December 29, 1992, the Atlantic Fishery Regulations, 1985, prohibit the discarding at sea of groundfish[9] caught in fisheries targeting groundfish (Canada 1993). This prohibition requires that catches be landed and are therefore included in landing statistics. For the most common groundfish fisheries in the nGSL, namely those targeting Greenland halibut (*Reinhardtius hippoglossoides*), Atlantic halibut, redfish, witch flounder (*Glyptocephalus cynoglossus*) and cod, this ban therefore limits potential cod discards. If cod is discarded at sea, these cod are deemed to be spoiled catches as a result of depredation (catch not counted because predated before the gear was lifted) or degradation of the fish (rendered unsaleable by the combined or sole action of scavengers or microbes) (Ouellette-Plante et al. 2022a).

[9] For the list of species considered to be groundfish, see Part 2 of Schedule 1 of the Atlantic Fishery Regulations, 1985.

For other fisheries, including those targeting northern shrimp, discarding groundfish at sea is permitted, making it more difficult to capture the extent of cod bycatch in these fisheries. The use of at-sea observer data is therefore very useful for this purpose. For this stock assessment, at-sea observer data were extracted on December 9, 2024. These did not include data for the 2024 DFO region of NL.

2.1.2. Recreational fishery

Unlike commercial fisheries for which landings are well monitored, there is insufficient information on catches from the recreational groundfish fishery, which include 3Pn4RS cod, for similar monitoring. Although there is regulatory monitoring of compliance with authorized daily quotas, no monitoring of catches and discards (e.g., LF, landed weight) is carried out. Annual values were used for the 2001-2002 (253 t, Fréchet et al. 2003), 2002-2003 (34 t, Fréchet et al. 2003), 2006-2007 (75.3 t, DFO 2008) et 2008-2009 (67 t, Fréchet et al. 2009) fishing seasons, but the provenance of these data could not be validated in the context of this work. A summary of available data and estimates of potential recreational cod harvest were presented in 2021 as part of the stock assessment framework review (Ouellette-Plante et al. 2022a). In the absence of new information for the present assessment, the values of landings from recreational fishing for the years 2023 and 2024 were assumed to be the same as for the 2018-2022 period, i.e. within a range from 253.7 to 600.0 t (Table 7).

2.1.3. Scientific surveys

The spatial coverage of the various 2024 surveys detailed in the next subsections is provided in Figure 9.

2.1.3.1. DFO August survey

An ecosystemic research bottom trawl survey has been conducted annually since 1984 in August in the estuary and the nGSL. The main objective is to obtain biomass estimates for several species, including those targeted by commercial fisheries (cod, Atlantic halibut, Greenland halibut, redfish and northern shrimp). This survey follows a stratified random sampling design (Figure 10). Four vessel–gear tandems were used during the series:

- 1984-1990: CCGS[10] Lady Hammond equipped with a Western IIA trawl.
- 1990-2004: CCGS Alfred Needler equipped with a URI 81’/114’ trawl.
- 2004-2022: CCGS Teleost equipped with a Campelen 1800 trawl with a Rockhopper footgear.
- 2021-2022: CCGS John Cabot equipped with a modified Campelen 1800 trawl with a Rockhopper footgear.

Comparative fishing experiments were conducted in 1990 (two unpublished documents: Gascon et al. 1991[11], Bourdages and Gauthier 2011[12]), 2004–2005 (Bourdages et al. 2007) and in

[10] Canadian Coast Guard Ship.

[11] Gascon, D., Gagnon, P., Bernier, B., and Savard, L. 1991. Le relevé conjoint crevette/poisson de fond du nord du golfe du Saint-Laurent (divisions de l’OPANO 4RST). CSCPCA Document de travail 91/70 (unpublished working document).

[12] Bourdages, H., and Gauthier, J. 2011. Reanalyses of the August 1990 comparative fishing experiment in the northern Gulf of St. Lawrence between the CCGS Alfred Needler and the Lady Hammond, conversion factor for American plaice (unpublished working document).

2021–2022 (Benoît et al. 2024b) to ensure the continuity of the series over the years. A detailed description of the fishing and sampling protocol, as well as the calculation methods are presented in Chamberland et al. (2025). Since NAFO Subdivision 3Pn has not been visited since 2003 during this survey (Figure 11), the 3Pn4RS cod abundance and biomass indices were calculated from the tows conducted in Divisions 4RS. Finally, more coastal strata were added to the sampling plan in 1991. To maintain the integrity of the time series, a series excluding these strata is calculated for the data from 1984 to 2024 (strata 801 to 824 and 827 to 833, hereinafter referred to as the reduced strata series) and a second series including them is calculated for the period 1990-2024 (strata 801 to 824 and 827 to 841 [except 840], hereinafter referred to as the uniform strata series).

Unless otherwise noted, all tables and figures associated with DFO August survey data are presented in vessel-gear equivalent CCGS John Cabot with a modified Campelen trawl.

2.1.3.2. DFO winter surveys

A bottom trawl survey using a stratified random sampling design was conducted from 1978 to 1994 in January (excluding 1982) by the charter vessel MV Gadus Atlantica. The study area included NAFO Divisions 4RST and Subdivision 3Pn. Although a stratification scheme identical to that used in the DFO August survey was employed (Figure 10), the spatial coverage achieved each year was highly variable due to the presence of ice during this period (Fréchet 1986). It was also not possible to account for these changes in the estimation of a standardized abundance index (Rivest et al. 2021). In 1995, this survey was discontinued, primarily because 3Pn4RS cod were found in Subdivision 3Ps during the survey period, resulting in biased estimates of stock biomass (Fréchet and Schwab 1995). Another reason cited was the withdrawal of the MV Gadus Atlantica (Fréchet et al. 1994). Further information on this survey can be found in Benoît et al. (2022) and McCallum and Walsh (1997), and the data will not be presented in this document.

During the winters of 2022 to 2024, a new winter survey since the 1994 MV Gadus Atlantica survey was conducted. The objective of this survey was to determine the recent winter distribution of groundfish species in the deep waters associated with the Laurentian Channel, an information limited by the low level of commercial fishing for these species in winter and the discontinuation of the MV Gadus Atlantica winter survey in 1995. The vessel chartered for this survey is the commercial trawler MV Mersey Venture.

2.1.3.3. Sentinel surveys

The nGSL sentinel survey program began in the fall of 1994 following the first moratorium on directed fishing for 3Pn4RS cod. Since the data normally obtained from the commercial fishery were very scarce, i.e., only those from cod bycatch in other directed fisheries, it was difficult to assess catch rates, size structures, growth and recruitment of the stock, among other things (Fréchet et al. 1995). Also, the winter series of DFO research surveys (1978–1994 series) had just ended and it was imperative to find an alternative source of data to support the only survey remaining at that time, the August bottom trawl survey, which did not offer the same temporal coverage as a normal fishing season.

It is therefore with the objective of monitoring the status of the 3Pn4RS cod stock, but also to a lesser extent other commercial groundfish species, that this program was created. Carried out with the industry, fishing associations who had obtained a contract with DFO through a call for tenders carried out fishing activities following scientific protocols developed by the DFO Science Branch. For the nGSL, the QC DFO region is responsible for the sentinel contracts awarded in NAFO Divisions 4ST, while the NL DFO region manages contracts in the 3Pn4R sector. The nGSL sentinel survey program includes a mobile gear component (bottom trawl) and a fixed gear component (gillnet and longline[13]). The budgets allocated to this program have decreased over the years, contributing to a similar trend in the number of activities (i.e., trawled tows or fixed gear hauls) carried out under this program.

Once the sentinel fishing activities are completed, the validation, analysis and interpretation of the data are carried out by the DFO Science Branch. Although the series begins in 1994, this first year of the program is not included in the analyses since the fishing activities were only carried out in the fall.

Sentinel mobile gear survey

The sentinel mobile gear program is conducted by the ACPG[14] in NAFO Division 4S and by FFAW[15] in 3Pn4R. The summer series of this program is used as an abundance index for 3Pn4RS cod. Conducted annually since 1995 in July, this survey aimed at conducting, in recent years, 240 stations distributed according to a stratified random sampling design (Table 8, Figure 12). The breakdown of successful random tows by year and stratum is provided in Figure 13. The bottom trawl used for this survey is a Star Balloon 300 with a Rockhopper footgear and a 40 mm liner in the codend (Fréchet et al. 1995).

The fishing tows targeted during this survey are 30 min in duration, calculated from the time the winches are stopped after the gear is launched until the time they are restarted to bring the trawl back on board the vessel. The target trawling speed is 2.5 knots. A total of 26 different vessels have participated in the completion of the summer series to date (Figure 14). Annually, the number of participating vessels has varied from nine at the beginning of the series to five in 2022 (Table 8). At the beginning of the survey, a horizontal opening[16] value of 11.89 m (39 feet; ft) provided by the trawl manufacturer, was used in the abundance and biomass calculations (Fréchet et al. 1995; Fréchet 1996). However, the geometry of a trawl, and therefore its general performance, can vary depending on the vessel used according to their specific characteristics (e.g., power). Although the same trawl was used by the different vessels participating in the program, variations of up to 20% in the horizontal opening of the trawl were observed during tests conducted in the fall of 1995 on eight of the nine vessels participating in the program. The use of a horizontal opening of 19.3 m (62 ft) was then suggested, and the installation of a retention cable recommended in order to standardize the horizontal opening between the vessels and the different depths fished (Fréchet 1996). As early as 1996, a study on the effect of a retention cable was conducted, and its use was put forward from then on, using a horizontal opening value of 16.5 m (54 ft, Fréchet 1997). The position of the retention cable was adjusted for each vessel on the warps in order to obtain this standard horizontal opening.

Since 1997, fishing activities in this program have required the use of the retention cable, unless sea conditions compromise safety during fishing. In these situations, a horizontal opening value specific to each vessel is used to calculate the swept area and thus reduce the catches to a standard swept area[17]. These values are provided in Figure 14 and are from calibrations

[13] Other gears were also used early in the program.

[14] *Association des Capitaines propriétaires de la Gaspésie* (translated to Association of Gaspésie Owner Captains).

[15] The Fish, Food and Allied Workers Union.

[16] The distance between the wings of the trawl.

[17] Namely, the calculated area based on a horizontal opening of 54 ft and a towed distance of 1.25 nautical mile.

carried out at the beginning of the series (Fréchet 1996, 1997) or are those of calibrated vessels that most closely match the characteristics (length, power) of non-calibrated vessels.

From 1995 to 2002, the survey only covered strata with a depth of ≥ 20 fathoms (fm, corresponding to 37 m, Figure 13). Starting in 2003, three strata (101-103) with a depth 10–20 fm (18–37 m) were added on the west coast of NL. For this reason, two indices are provided from this sampling program: one series for 1995–2024 (excluding strata 101-103) and one for 2003–2024 (including strata 101-103). In addition to being used for this stock assessment, this survey is useful for work on other commercial species, including Unit 1 redfish, Atlantic halibut, Greenland halibut, and witch flounder in the GSL (4RST). From 1995 to 2006, QC vessels participating in the program were authorized to conduct trawl tows outside the stations specified in the sampling plan in order to identify potential cod aggregation sites (Table 8). These tows, called *discretionary*, are not used in the calculation of the indices.

The data used for the present assessment were extracted from the database on December 20, 2024.

Sentinel fixed gear survey

The sentinel fixed gear survey program was conducted by LNSFA[18] in Division 4S and by FFAW in 3Pn4R. During the 2022-2024 period, nearly 470 fishing activities were carried out annually on average, more than 70% of which used gillnets as fishing gear (Table 9). Over the same period, more than 27 commercial fishing vessels participated in this program. On average, deployment depths are 90 m for longline (#16 “J” hooks and #12 circle hooks) and 80 m for gillnets (5.5-inch [140 mm] mesh size, Figure 15).

The use of fixed gear sentinel fishing activities as an abundance index depends on the assumption that resource abundance is directly proportional to catch rate. However, bias could occur if the fishing gear used became saturated, that is, if the fishing gear reached a catch level such that this catch could not increase further, regardless of resource abundance. As a result, the probability of catching a fish would decrease and the catch rate would no longer be directly proportional to abundance. This aspect of fishing gear saturation is assessed annually for the longline sentinel fisheries program activities (Brulotte and Fréchet 2000) and saturation has not been an issue to date (Figure 16). Additional analyses were conducted by Benoît et al. (2022) and have led to similar conclusions.

Details of the abundance index estimates in this document were given in Benoît et al. (2022). The data used for this assessment were extracted from the database on January 17, 2025. For the 2024 survey, the data used were partially validated. Since very few longline activities are available for the fall index[19] in recent years, it was chosen to limit this index to years prior to 2021.

2.1.3.4. Cod reproductive potential survey

Following the termination of the winter survey aboard the MV Gadus Atlantica in 1994, an alternative data source was required to characterize cod maturity of the 3Pn4RS stock. Although maturation data for cod have been available since 1987 in the DFO August survey, this time of year was not considered optimal for visual examination of gonads at sea since spawning has already occurred. Indeed, a committee of experts had been convened to a zonal meeting on the subject. The document by Trippel et al. (1997), which was one of the outcomes

[18] Lower North Shore Fishermen’s Association.

[19] Activities carried out at sites in Zone 1 and Site 8 in Zone 2 during the period from the 271st to the 365th day of the year. See Benoît et al. (2022).

of this meeting, showed that visual maturity examinations carried out at sea should take place near spawning for the results to accurately reflect what would have been obtained from histological analyses, which are more precise (e.g., those of Morrison 1990). However, this conclusion has recently been challenged by Beaudry-Sylvestre et al. (2025) who demonstrated that macroscopic examinations of the gonads are just as valid in summer as in winter.

A new survey aimed at characterizing the maturity of 3Pn4RS cod at the time of spawning, called the Cod Reproductive Potential (CRP) survey, began in 2002. The CRP survey was established within the framework of the Fisheries Science Collaboration Program (FSCP, in collaboration with FFAW) and follows a systematic sampling plan. Following the 2002 survey, it was repeated annually from 2004 to 2016, and then biannually since (Table 10). This survey is conducted in late April or early May and includes a grid of about forty stations in recent years (Figure 17). The territory historically covered includes NAFO Division 4R and Subdivision 3Pn (Table 10). Since 2011, only Division 4R has been visited during this survey, in the St. George's Bay area near the west coast of the island of Newfoundland.

The CRP survey uses a trawl identical to the one used for the summer series of the sentinel mobile gear survey and aims to determine the maturity level of cod in spring. The targeted trawling duration and speed are the same as for the sentinel mobile survey. However, no retention cable is used in this survey. At each station of the sampling grid, the catch is sorted, weighed and counted by species. Species-specific protocols are then carried out. For cod, length, sex and maturity are recorded for each specimen. For fishing tows where > 350 cod were caught, a maximum of 350 individuals are randomly sampled and measured. During each survey, otoliths are collected for age readings following a length-based stratification. Also following a stratification by length, specimens are collected whole, frozen and brought back to the laboratory for additional measurements (length, total weight, gonad weight, stomach content weight, liver weight) to determine condition.

The data used for this assessment were extracted from the database on December 20, 2024.

2.1.3.5. Unit 2 survey

Since 1997, AGC[20] has conducted a biannual survey of redfish in Unit 2[21]. This survey is the only source of fishery-independent data for assessing redfish stocks in this unit and also provides information on other commercial species, such as cod.

In 2024, a comparative fishing mission between the MV Lery Charles, the trawler involved in the survey since 2020, and the CCGS John Cabot (using the same trawl as in the DFO August survey) was conducted to calibrate fishing data between the two vessels and to provide recent data for the 2025 redfish stock assessment. This calibration proved impossible, and the validity of the data from the MV Lery Charles since 2020 has been questioned (DFO 2025b).

Although the majority of the Unit 2 survey study area lies outside 3Pn4RS, it still provides interesting information on the 3Pn Subdivision in deep waters (> 200 m). Among others things, it is noted that Subdivision 3Pn was last trawled in 2003 as part of the DFO August survey (Figure 11). For the present work, only the 2024 data from the CCGS John Cabot were considered.

[20] Atlantic Groundfish Council.

[21] Management unit which includes the NAFO 3Ps4Vs Subdivisions, the 4Wfgj unit areas and, from June to December, the 3Pn4Vn Subdivisions.

2.2. BIOLOGICAL INDICATORS

2.2.1. Age readings

Cod otoliths are collected during DFO research surveys, sentinel surveys, the reproductive potential survey, and commercial fisheries. Sampling stratification is based on NAFO Divisions, time of year, fishing gear, and fish size. In the laboratory, using an ISOMET™ slow saw, the otolith is sawn in half along its narrow side. Annual growth rings are counted by applying a drop of alcohol to the otolith and using directed lighting on the side of the otolith.

A reference otolith collection is revised annually in preparation for new readings to ensure consistent age readings from year to year.

2.2.2. Condition

Various measurements used in calculations to characterize the condition of cod in the 3Pn4RS stock have been collected each year since 1995 as part of sentinel fixed gear surveys. These measurements are length, total weight, gonad weight, liver weight and stomach content weight. The condition of the harvested cod is then assessed using two indices. The first is the Fulton somatic index (K_{som}) which represents the specific health status of the cod, calculated as:

$$K_{som} = \left(\frac{W_s}{L^3}\right) \cdot 100 \quad (1)$$

where W_s is the somatic weight (in g, corresponding to the total weight minus that of the gonads and stomach contents) and L is the length in cm. The use of somatic weight in the index, and not total weight for example, arises from the fact that feeding intensity (reflected in the weight of stomach contents) and gonad maturation (reflected in the weight of the gonads) can vary widely and independently of the seasonal condition of cod (Lambert and Dutil 1997).

The second index monitored is the hepato-somatic index (HSI). The latter requires knowledge of the liver weight (W_f, in g), and characterizes the lipid energy reserve of the cod. It is calculated as follows:

$$HSI = \left(\frac{W_f}{W_s}\right) \cdot 100 \quad (2)$$

In order to minimize the effect of cod length on the condition index, seasonal changes in cod condition are presented for four 10 cm length classes, respectively centered on the values of 35, 45, 55 and 65 cm. The indices obtained are then interpreted according to the reference thresholds proposed by Dutil et al. (1995).

Data from the DFO August survey have also been used to determine the cod condition at this time of year since 1990. However, scientific protocols at sea changed in the late 2000s, such that gonad and stomach weights are no longer recorded. This change therefore prevented the calculation of individual somatic weight. Although the Fulton index based on total weight (K_{tot}) has the disadvantages mentioned above, the long series of this survey, in addition to the large number of total weight (W_t) measurements, still make it an important source of data. In addition to K_{tot}, annual mass-length relationships were also explored using the approach described in Bourdages and Ouellet (2011).

2.2.3. Maturity

A macroscopic visual examination of the maturity of cod in the 3Pn4RS stock has been conducted since 1987 for the DFO August survey. For the winter series of the MV Gadus Atlantica, these examinations began in 1983. Data on fish maturity are a valuable source of information since they allow for the assessment of the age and length at which fish become sexually mature. Maturity data can be used in several ways, such as assessing whether the age or length at which 50% of the specimens are mature (denoted A_{50} and L_{50}, respectively) has changed over time, which could be a sign of overfishing (Trippel 1995). Maturity data are also required in calculations to estimate SSB.

2.2.3.1. Modelling revised maturity ogives

Beaudry-Sylvestre et al. (2025) recently reviewed the data available to characterize the maturity of 3Pn4RS cod as a function of age and length. They also revised the method used to empirically estimate annual maturity ogives, bringing them in line with the sampling scheme used in data collection and with best practice for estimation based on length-stratified sampling (Morgan and Hoenig 1997). Beaudry-Sylvestre et al. (2025) identified four main surveys that collected maturity data in four or more years and that can be used to estimate annual maturity ogives for 1983 to the present. These surveys include the annual August DFO bottom-trawl survey, which was long suspected of being inappropriate for sampling maturity macroscopically given it occurs in the season opposite the spawning season, although in practice results from that survey are comparable to those from other surveys. Beaudry-Sylvestre et al. (2025) used the acronym SN (Summer Northern Gulf survey) to designate this survey, which we also adopt here. The other surveys are the winter DFO Gadus Atlantica Survey (GA; 1983-1994), surveys undertaken in Cabot Strait (CS) in January of 1994 to 1997, and the cod reproductive potential survey (CRP) undertaken in early spring in a number of years since 2002 (for details see Beaudry-Sylvestre et al. 2025).

The empirical maturity ogives derived by Beaudry-Sylvestre et al. (2025) present two challenges. First, there are many years in which more than one survey-specific ogive is available. In many cases, these ogives originate from surveys with different sampling schemes or sampling intensities, and the best way to combine them empirically to produce a single annual ogive isn't clear. Second, the empirical ogives display some variability among years and surveys that likely constitutes sampling error associated with small sample size. We addressed these two challenges by modelling the maturity at age data for 3Pn4RS cod using a slightly modified version of the mixed-effects beta-binomial approach proposed by Cadigan et al. (2014).

Model description and methods

Cadigan et al. (2014) defined their approach based on two premises. First, cohorts that are alive in the population at the same time are expected to experience similar conditions and therefore have similar maturity trajectories. Second, the proportion of mature individuals in a cohort should be monotonically increasing, i.e., will not decrease from one age to the next. This second premise may not be strictly true, but is not expected to affect model estimates. For instance, if mature individuals at a given age have lower survival than immature individuals, the proportion mature could decline with age at some ages. However, Barot et al. (2004) found that maturation estimates are generally robust to such effects when estimated with a monotonically increasing function and when sample sizes are large (approx. 100 individuals). Reproductive senescence and skipped spawning that is severe enough to make gonads appear to be immature macroscopically could also cause a reduction in the proportion mature at older ages, but both are expected to be sufficiently rare as not to affect the estimates significantly (Rideout et al. 2005; Benoît et al. 2018).

The beta-binomial approach of Cadigan et al. (2014) models the cohort-specific proportion mature at age *a*, $p_c(a)$, using the commonly employed logistic function:

$$p_c(a) = \frac{exp(\beta_{0c} + \beta_{1c}a)}{1 + exp(\beta_{0c} + \beta_{1c}a)} \quad (3)$$

where β_{0c} and β_{1c} are respectively cohort-specific intercept and slope parameters, and logit($p_c(a)$) is a linear function of age. Like the common binomial model, the expected number of mature individuals at age *a* and in cohort *c* for the beta-binomial model is $E(Y_{ac}) = n_{ac} \cdot p_c(a) \cdot [1 - p_c(a)]$, where n_{ac} is the total number at age *a* in cohort *c*. However, unlike the binomial model, the beta-binomial model includes an additional dispersion parameter, ϕ, for the variance: $var(Y_{ac}) = n_{ac} \cdot p_c(a) \cdot [1 - p_c(a)] \cdot [1 + \phi \cdot (n_{ac} - 1)]$, with ϕ>0.

The cohort-specific intercept and slope parameters are considered to be first-order auto-correlated normal random variables:

$$\beta_{0c} = \beta_0 + \delta_{0c} \quad \delta_{0c} \sim N(0\ \sigma_0^2)\ Corr(\delta_{0c=i}\ \delta_{0c=j}) = \rho_0^{|i-j|} \quad (4)$$

$$\beta_{1c} = \beta_1 + \delta_{1c} \quad \delta_{1c} \sim N(0\ \sigma_1^2)\ Corr(\delta_{1c=i}\ \delta_{1c=j})) = \rho_1^{|i-j|} \quad (5)$$

where β_0 and β_1 are respectively the average intercept and slope for all cohorts, and the $\delta_{.c}$ parameters are random cohort effects that each follow a stationary AR(1) process with σ^2 variance and ρ correlation. When implementing the model, age is standardised by subtracting the mean age, which reduces the correlation between slopes and intercepts and eliminates the need to model correlation between δ_{0c} and δ_{1c}(Cadigan et al. 2014). The autocorrelated random effects are useful because they result in some smoothing of maturities, make efficient use of the available data, especially in poorly sampled years, and can be used to project ogives for future years using the cohort-specific parameter estimates to predict maturity at later ages for existing cohorts, and the AR(1) process to estimate parameters for new cohorts.

We modified the Cadigan et al. (2014) beta-binomial approach in two ways to better suit the data for 3Pn4RS cod. First, we accounted for possible survey-specific properties of the maturity data by modelling overdispersion using survey-specific parameters, ϕ_s. It appears reasonable to suppose that overdispersion could differ between surveys, for instance, because some surveys provide better and more representative coverage of the population than others. For example, the August DFO (NE) survey representatively samples nearly the entire population distributional area annually, while the CRP survey is concentrated on presumed spawning aggregations. Alternatively, because macroscopic maturity determination could be more variable during the summer, compared to during periods closer to the spring spawning season, the NE survey could be associated with more dispersion resulting from classification error during sampling. An alternative to accounting for a survey effect via ϕ_s would have been to include a fixed effect for survey in equation 1, acting on either or both the intercept or slopes of the predictor. That approach assumes that surveys sample maturity differentially, which is not expected since all surveys used the same or very similar schemes to differentiate macroscopically mature and immature individuals, and all aim to characterize maturity in the population. Furthermore, there is no evidence of systematic survey-related differences in the empirical estimates of maturity ogives of Beaudry-Sylvestre et al. (2025). To the contrary, with the exception of some within-year variability, annual ogives generally correspond well between surveys.

The second modification to the approach of Cadigan et al. (2014) was to apply weights to the negative log-likelihood used for model fitting to account for both spatial and length-based stratified sampling of cod catches and biological characteristics, namely length, age and maturity (for explanation and details see Beaudry-Sylvestre et al. (2025)). Specifically, the weights applied to each maturity observation were proportional to the product of annual and survey-specific values of

1. the estimated probability *P* of an individual being age *a*, conditioned upon length class *i* and NAFO Division *o*, $\hat{P}(a|oi)$,
2. the mean number of cod by length class *l*, survey stratum *k* and NAFO Division, $\overline{N_{okl}}$, and
3. the surface area of stratum *k* relative to the survey area.

Annual and survey-specific values of this product were standardized to sum to 1 to ensure equal weighting among individual surveys. The resulting weights effectively reflect the weighting inherent in equation 10 of Beaudry-Sylvestre et al. (2025) to produce the annual survey-specific empirical age-maturity ogives. Standardizing the weights by survey and year accounts for the vagaries of the stratified sampling, but does not mean that each survey and year is given equal weight in the analysis, as the sample size of individual cod with age and maturity data still differs between years and surveys.

The model was fit to data for male and female cod separately, and regardless of sex, including data for individuals for which sex could not be determined. Data for ages 16 and above were few and almost exclusively associated with mature individuals, and were therefore grouped with age 15 to improve model fitting. The RTMB package v.1.6 (Kristensen 2023) was used to calculate the marginal negative loglikelihood for the model and model parameters were estimated using the *nlminb()* function in R.

Normalized quantile model residuals (Dunn and Smyth 1996) were produced and plotted using boxplots to visually assess the adequacy of model fit with respect to survey, year, age and sex, and various subsets and combinations of these factors.

The estimated annual maturity ogives are a key input for the estimation of spawning stock biomass (SSB). Using the numbers and stock weights at age estimated during the last assessment for the stock (Ouellette-Plante et al. 2025), we compared the SSB series obtained using the new annual ogives to the SSB series estimated using the previous ogives (2023 assessment). Notably, we needed to establish whether estimated SSB values during the 1980s changed sufficiently to warrant a recalculation of the limit reference point for the stock, which was based on average SSB in that period (Ouellette-Plante et al. 2025).

The current assessment groups the dynamics of older fish into an 11+ age group. Although over 99% of 11-year-old cod are mature, we nevertheless estimated the mature proportion for the 11+ group from a weighted average of the mature proportions for ages 11–15 in the ogives. The weighting factor was the estimated equilibrium abundance of ages 11–15 (stable age distribution), assuming an annual total mortality rate equivalent to that of age 11+ cod in the assessment model.

2.2.4. Total mortality

A modified catch curve analysis was used to estimate annual total mortality *Z* values (Sinclair 2001). Values are available from the different series used in the assessment model: DFO August survey (2 series), sentinel mobile gear survey, sentinel gillnet survey, and sentinel longline survey (2 series). Details are provided in Benoît et al. (2022).

2.2.5. Tagging

3Pn4RS cod tagging activities have been conducted annually since 1995 as part of the nGSL Sentinel Fisheries Tagging Program (Ouellette-Plante et al. 2022a). In parallel, tagging projects have been conducted in Division 4S since 2017. Since the assessment model used since 2023 does not incorporate these data, it was decided not to present the tagging data for this assessment.

2.2.6. Diet

A summary analysis of stomach contents of specimens sampled during the DFO August survey during the period 2017-2024 was conducted for this assessment. The objective was to establish empirical links between diet, condition based on total weight (K_{tot}) and total mortality Z of cod in recent years. The methodology used is the same as that presented in Ouellette-Plante et al. (2020). Only stomachs from cod caught in NAFO Divisions 4RS and in the length range of 30 to 70 cm were considered in the analysis to allow a comparison of diet results with those relating to body condition.

2.3. BEGINNING OF YEAR STOCK WEIGHTS

Beginning of year weights are used to calculate SSB from the product of abundance-at-age estimates and weight-at-age estimates, which are then summed across ages. Beginning of year weights are sometimes termed stock weights (SW), as they are intended to represent a biological characteristic of the stock. The procedure used to estimate SWs for 3Pn4RS cod is fully described in Benoît et al. (2024a).

2.4. STOCK ASSESSMENT MODEL

The nGSL cod stock assessment model used in this stock assessment was developed as part of the 2021-2022 assessment framework review. Model details, including the rationale for the model structure, model sensitivity analyses, and basic simulation tests, are provided in Benoît et al. (2025) and Ouellette-Plante et al. (2025). Throughout the document, the convention *X*+ will be used to designate cod of ages *X* and older.

The only difference from the model used in the February 2023 assessment (Ouellette-Plante et al. 2025) is a change in the modeling of *F* values. Indeed, *F* are modeled as a stochastic process around a small number of mean μ_F values, which are estimated as fixed effects. In the February 2023 assessment, 15 values of μ_F were used, created according to age and year blocks. These parameters account for the large changes in mean *F* that have occurred over time, particularly following moratoria. For this stock assessment, a 16th value of μ_F was used to account for the directed fishing moratorium in effect since 2022 (Figure 18). A different μ_F value than that used for the 1994-1996 and 2003 moratoria was used because the situation in terms of non-directed commercial fishing (bycatch) and recreational fishing was considered different from the two previous moratoria.

2.4.1. Model Inputs

There are six abundance indices used as inputs to the 3Pn4RS cod assessment model:

1. DFO August survey (1985-2024, ages 2-11+).
2. Sentinel mobile survey (1995-2024, ages 2-11+).
3. Sentinel gillnet survey (GNS, 1995-2024, ages 4-11+).
4. Sentinel summer longline survey (LLS1, 1995-2024, ages 3-11+).

5. Sentinel fall longline survey off southwest Newfoundland (LLS2, 1995-2020, ages 3-11+).
6. Minet (1978) bottom trawl surveys (1973-1976, ages 3-11+).

The youngest ages were excluded from some indices because their abundance in the surveys was low and considered too variable. The preparation of these indices is detailed in Benoît et al. (2022) and Benoît et al. (2024a).

Compared to the February 2023 assessment, a change was made to the approach used to calculate the LLS1 index. Previously, this index was calculated by retaining only longline fishing activities occurring in zones 1 to 5 (Figure 15) and between days 210 and 270 of the year (August and September, Benoît et al. 2022). However, it was noted that no activity was retained in zone 4 after 2020. For the present assessment, it was decided to retain only the activities of zones 1 to 3 and 5 from the same time range for the entire series of this index. Tests were carried out and the trends obtained between the index including or excluding zone 4 showed very similar results (Figures B1-3). Given the minor differences, no changes to the parameterization of the assessment model were necessary and the impact on its adjustment can only be minimal.

3. RESULTS

3.1. DATA INPUT

3.1.1. Commercial fisheries

3.1.1.1. Landings

Prior to 1977, there was no annual TAC for the 3Pn4RS cod stock and annual landings ranged from 58,237 t (1972) to 105,465 t (1970, Table 2 and Figure 19). Following the expansion of Canada's exclusive fishing zone to 200 nautical miles offshore in 1977, an initial TAC of 55,000 t was implemented (Sanguin 1980). Both landings and annual TACs then increased until the early 1980s when a maximum of 106,080 t was landed in 1983. The stock subsequently collapsed and there have been three moratoria on directed commercial fishing: 1994-1996, 2003[22] and 2022 to present. Prior to the 2022 directed cod fishing moratorium, the annual TAC for the previous three years was 1,000 t, corresponding to an allocation available to the fishery of 641 t[23]. Preliminary landings for 2023-2024 and 2024-2025, including bycatch and sentinel survey catches, are 156 and 120 t, respectively. Since the management year has not corresponded to the calendar year since 1999, landings for 1999-2024 are also presented by calendar year in Table 11.

Since 1985, approximately 60% of cod landings have come from Division 4R (Table 12, Figure 20a). The majority of landings are from the NL and QC fleets (Figure 20b). At a finer scale, more than 65% of landings over the last ten years (2015-2016 to 2024-2025) have come from Subdivision 3Pn and NAFO unit areas 4Ra and 4Sw (Table 12, Figure 21a). During the last two years, when a moratorium was in place, the majority of landings were generated in Division 4S. Since 1997, landings have mainly taken place from July to September (Figures 21b and 22). Since 2022, landings have been observed to be more distributed over

[22] The 2003 moratorium is the only one of the three where recreational cod fishing was also prohibited.

[23] 1,000 t less the allocation from France (26 t, 2.6 t), scientific (200 t), food, social and ceremonial (FSR, 53 t) and recreational (80 t).

the calendar year, which is due to a greater percentage of total cod landings being bycatch, given the absence of a directed commercial cod fishery (Tables 13- 16).

Since the reopening of the fishery in 1997, after the first moratorium (1994-1996), the directed fishery has been conducted almost exclusively using fixed gear, namely gillnets and longlines (Tables 17- 20, Figure 21c). Gillnets are primarily used in Divisions 4RS, while longlines are mainly used in Subdivision 3Pn.

The various fishing ports where 3Pn4RS cod was commercially landed during the 2024/2025 management year are shown in Figure 23. These are mainly located on the west coast of NL and on the Lower North Shore of QC.

3.1.1.2. Dockside sampling program

During the period 2023-2024, a total of 25 samples of 3Pn4RS cod were collected as part of the DFO commercial sampling program (Table 21). All were from longline fisheries. These samples provided LFs corresponding to nearly 3,000 specimens. The ages of 805 cod were determined from otoliths collected during this period. No samples were provided from NAFO Subdivision 3Pn in the last two years and only four were from Division 4R (all from 2024).

3.1.1.3. Catch-at-age

Based on the dockside sampling program data (LF and age readings), the LF and age composition of landings could be inferred. The aggregation levels to allocate samples to commercial catches for the period 2022-2024 are presented in Table 22. In 2024, LF and age data were matched for 90 unique combinations of year, month, NAFO unit area, and fishing gear category.

Commercial catch-at-age, mean weight-at-age and mean length-at-age are presented in Tables 23 to 25. Commercial catches are mainly composed of cod aged 5–10 years (Figure 24). In the last two years, the 2018 cohort appears to have been the one most heavily represented in commercial fishery landings (Figure 25).

3.1.1.4. Bycatch

Excluding moratorium years and excluding cod landings for which the target species was not specified, on average 92% of 3Pn4RS cod landings came from the directed cod fishery (Table 26, Figure 26). Over the last ten years (2015-2024), the majority of cod caught (and landed) as bycatch came from fisheries targeting Atlantic halibut, Greenland halibut and redfish, for an annual average of approximately 109 t.

By investigating at-sea observer data for the same four target species as those examined in the 2023 stock assessment (northern shrimp, redfish, Atlantic and Greenland halibut), the ratios of cod to target species caught weight were calculated annually to produce a time series for each of the target species considered (Figure 27). For northern shrimp, redfish and Greenland halibut, cod bycatch has average annual ratios < 3%. For Atlantic halibut, on the other hand, this ratio is on average much higher during the period 1999-2024 (~ 15%) and also shows strong annual variations. Spatial variations in these ratios during the period 2020-2024 can be seen in Figures 28- 31. For Greenland halibut, the majority of cod bycatch comes from the Sept-Îles sector in QC.

Of the four target species shown in Figure 27, fisheries targeting northern shrimp are the only ones not subject to the ban on discarding groundfish at sea introduced in December 1992 (Canada 1993). This means that cod bycatch in these fisheries is not counted in the official landing statistics used by DFO (ZIFF data). An update of the work of Bourdages et al. (2022), based on at-sea observer data, showed that cod was caught in just over 20% of monitored shrimp fishing activities. These cod catches are on average < 1 kg per tow and the specimens caught are generally small (< 30 cm, corresponding to ages 1-2 years) given the introduction of the Nordmore grid in 1993 (Figures 32- 33). This device limits the capture of groundfish to individuals of smaller lengths (Savard et al. 2013). Note that there were no at-sea observers in 2024 in the Anticosti and Esquiman areas, and cod bycatch is therefore underestimated.

At-sea observer data can also be used to detect and even track new cohorts of cod. Thus, the 2018 cohort was observed in the first year in at-sea observer data on board shrimp vessels (Figure 34). In 2022, the latter no longer appeared to be caught by shrimp vessels, suggesting that the lengths reached by these cod were greater than those required to be discarded from the catch following contact with the Nordmore separation grid.

3.1.2. Scientific surveys

3.1.2.1. DFO August survey

The mean number of cod per tow (all sizes combined) for both strata series declined significantly between 1991 and 1993 (Figure 35). Following the 1994-1996 moratorium, these indices recovered slightly until the end of the 1990s. Subsequently, the indices were mainly below their historical averages until 2013 (2014 for the series with reduced strata), with an unusual peak in 2003 (moratorium year). From 2015 to 2019, both indices varied around their series average. After three years in which the abundance index from the DFO August survey was increasing (2020-2022), the index has declined over the past two years (especially in 2023) and is now below the series average, at values similar to those observed in the early 2000s. In general, index values using the reduced series of strata are almost always lower than those associated with the uniform series of strata. This difference is explained by the inclusion, in the latter index, of shallow strata in which cod concentrations are generally above average (Benoît et al. 2022).

The spatial distribution of cod along the west coast of NL (Division 4R) remained similar during the period 1990-2024 (Figures 6- 7), while the western part of the Gulf in Division 4S shows a gradual decrease from the period 1990-1996 to that of 1997-2003, then an increase until the period 2017-2022, particularly north and west of Anticosti Island, to then decrease significantly during the period 2023-2024. A decrease in abundance in the Anticosti and Esquiman channels is also observed since the period 2011-2016. This trend may be related to the increase in water temperatures and decrease in dissolved oxygen observed at the bottom of these channels (Blais et al. 2024; Galbraith et al. 2024). In 2024, the largest catches were made along the west coast of NL and in the Strait of Belle Isle (Figures 36- 37).

The annual length frequencies of the two strata series used show similar patterns (Figures 38- 39). In contrast to the series starting in 1990, the one starting in 1984 shows higher abundances of large cod, which indicates strong cohorts during the period 1989-1991. The higher mean numbers per tow for the uniform strata series indicate higher catches in the shallower strata, as mentioned for Figure 35. From 2018 onwards, the abundant 2018 cohort evolved until reaching a modal size of approximately 30 to 42 cm in 2022. This modal size did not increase in 2023 and had an overall contribution to stock abundance reduced to a level below the time series average (Figures 38- 39). In 2024, the abundance of this cohort was at a very low level and its contribution to the stock SSB in the coming years will therefore be very reduced.

In 2024, there were three modes in the distribution of LFs from the DFO August survey: one for cod measuring 15 to 20 cm (juveniles), one for cod around 30 cm (2021 cohort), and one slightly above 40 cm (2018 cohort). Except for juvenile abundance, which was at the historical average, abundances at modal sizes were below the series average. The abundance of larger cod, those contributing most to the stock SSB (and for which a proxy is the biomass of cod

≥ 43 cm), has declined over the last two years. No signs of significant new recruitment were detected in 2023 and 2024.

The raw catch values at age, as well as those standardized in SPAY, are almost identical depending on the data used. The series going back to 1984 provides additional information on important cohorts that would not have been observed in the other series (1975 and 1977 cohorts, for example, Figures 40- 41).

Another way to monitor cohort progression is through catch curves (Figure 42). Indeed, as cohorts age, their abundance decreases. For the DFO August survey data, there are only rare instances where the abundance of a cohort increases for a year (e.g., the 1980 cohort), which is a sign that the survey does not track cohorts well over time. The absence of breaks in years where comparative fishing experiments took place during vessel changes (1990, 2005, and 2022) also demonstrates the effectiveness of the conversion factors developed to perpetuate the time series. The 2018 cohort, in particular, shows a very steep slope in the catch curve, which is indicative of significant total mortality Z.

Another measure for judging the quality of cohort tracking, internal uniformity, can be seen in Figures B4-B5.

3.1.2.2. DFO winter surveys

The survey areas trawled over the three years of the winter survey aboard MV Mersey Venture show only partial overlap from one year to the next (Figures 43- 44). In 2022, sampling effort was mainly concentrated around Cabot Strait, moving further north towards Anticosti Island in 2023. In 2024, the survey included more days at sea, allowing a wider area to be covered, from north of Anticosti Island to the Laurentian Fan in the south. The majority of stations sampled north of the Laurentian Channel included cod in their catches. Since the study areas overlapped those of different cod stocks (Figure 1), genetic work using tissue samples taken during the winter survey should eventually help to separate these catches and better guide fisheries management, particularly with regard to commercial redfish fishing.

3.1.2.3. Sentinel mobile gear survey

The indices in numbers and mean weight per tow from the sentinel mobile survey show no clear trend over the period 1995-2015 (Figure 45). From 2016 to 2019, both indices decreased, rising in 2020 to values close to or above their series average. Since then, both indices have been declining. In 2024, the index in mean weight per tow was the lowest in the 1995-2024 series, while the index in numbers corresponded to the values observed in 2012, the lowest in this series.

Except for a few years (2007, 2008, 2015), the two indices according to the depth strata used provide very similar values. The differences between the indices for these years appear to be caused by generally larger catches (all sizes combined) in shallower waters in 2008 and 2015, while a peak in catches in the 15-20 cm length range was not observed for deeper waters in 2007 (Figure 46).

In 2024, similar to the DFO August survey, catches were mainly reported from the west coast of NL and in the northern sector of Anticosti Island (Figures 36- 37, 47- 48). Cod abundance in the northwestern part of the Gulf (Division 4S) has been declining for several years (Figures 49- 50).

The raw catch-at-age and standardized catch (SPAY) values from the sentinel mobile data show that this survey also allows cohorts to be well monitored (e.g., 2018 cohorts, Figure 51). The 2004 and 2005 cohorts appear to have been better monitored with the sentinel mobile survey than with the DFO August survey. Similar to the DFO August survey, the sentinel mobile survey tracks cohorts well according to the catch curves (Figure 52). The internal uniformity of the cohorts can be seen in Figure B6.

The mean weight values per tow and per stratum are presented in Table 27 and the mean numbers at age and per year are given in Table 28.

3.1.2.4. Sentinel fixed gear survey

Since 1995, the annual coverage of the sentinel longline survey in NAFO Subdivision 3Pn (corresponding to zone 1 in Figure 15) has made it possible to monitor cod migration. Indeed, cod historically arrive in the Gulf via the Cabot Strait in early May and leave from mid-September, reaching a peak CPUE in November (Figure 53). During 2023 and 2024, cod appear to have followed this same migration pattern within 3Pn.

The summer longline abundance index aggregated for individuals aged 3+ has fluctuated over the years (Figure 54). The trend was upward from 1995 to 2006, followed by a decline until 2010, before rising again over the next three years, and has generally been downward since then. In 2024, the index was below the series average, at values close to those of the early 2000s. Cohort tracking is generally good for this index, although some cohorts (e.g., 1991) appear to be less well tracked than with the DFO August survey index (Figure 55). The summer longline index generally follows the cohorts well according to the catch curves (Figure 56), a finding also applicable according to Figure B7.

The gillnet abundance index also fluctuated considerably over the series (Figure 57). After a period of increase from 1995 to 2006, it generally varied around the series average. In 2024, the index was below the series average, at a value comparable to those of the last two years. Like the other indices used, the gillnet index tracked some cohorts from the early 1990s well. In addition, some cohorts (2004-2005) were better tracked by the sentinel gillnet survey than by the DFO August survey (Figures 40- 41 and 58). So far, the 2018 cohort has not been abundant according to this index. The sentinel gillnet index tracks the cohorts well according to the catch curves (Figure 59). The internal uniformity of the cohorts can be seen in Figure B8.

3.1.2.5. Unit 2 survey

Ten stations were trawled in Subdivision 3Pn during the 2024 Unit 2 survey targeting redfish. However, from these ten stations, only one cod was caught (Figures 60- 61).

3.2. BIOLOGICAL INDICATORS

3.2.1. Condition

Monitoring of cod condition carried out under the sentinel fixed gear survey program shows an annual cycle (Figures 62- 63). Historically, both K_{som} and HSI indices are lower in the spring before spawning, then increase from summer to autumn, to be maximal in preparation for winter, a period when cod feed very little (see section 1.2.7). In 2023 and 2024, the K_{som} values of each length class were generally lower than their series average (1995-2022) and, except for a few cases, the observed values would indicate an adequate condition according to the thresholds proposed by Dutil et al. (1995).

In 2023 and 2024, the observed HSI values, representing the recent feeding success of fish, were generally below historical averages, but considered good according to the thresholds proposed by Dutil et al. (1995). Interestingly, HSI values for cod in the 65 cm length class appear to have increased from below the historical average and considered critical in spring to above the historical average from July onwards and considered good according to the thresholds proposed by Dutil et al. (1995).

The cod condition index from the DFO August survey (K_{tot}) is estimated from total weight, which is influenced by stomach fullness and gonad development. Generally, cod from 4S have K_{tot} values that are generally lower than those from 4R. In the 2023 assessment, it was noted that cod condition was particularly poor in 2022, especially in Division 4S (DFO 2023a). Since then, K_{tot} has generally increased to levels near or above the historical average (Figure 64). However, although their K_{tot} values have increased since the 2022 dip, the smallest cod (length classes centered at 35 and 45 cm) from 4S still have values among the lowest in their respective series, and this difference between NAFO Divisions is still more pronounced than historically over the series.

Another way to appreciate the general improvement in condition since the 2022 dip is to investigate the annual mass-length relationships from the DFO August survey (Figure 65), where it appears that the curves for the last two years are shifted more to the left, meaning that for the same length, an individual would have a higher individual weight in 2024 than in 2022 (Figure 66).

3.2.2. Modelling revised maturity ogives

Initial model fits for male cod data did not fully converge and results indicated that the dispersion parameters ϕ_s did not differ between surveys. The model converged when a single common dispersion parameter applicable to all surveys (ϕ) was estimated instead. In models of the data for females and irrespective of sex, the dispersion parameters were smallest for the CS surveys, followed by the SN survey and largest for the GA and CRP surveys (Table 29).

The data included maturity observations beginning in 1983, which in turn included older individuals from cohorts born as early as the late 1960s. However there were few data for individuals born prior to 1977, the vast majority of which were mature, and as a result cohort-specific intercept and slope estimates for earlier cohorts prior to 1977 largely reflected the overall mean values for these parameters (Figures 67- 69). Likewise, estimates for the most recent cohorts, those born in 2022 and 2023 in particular, also tended towards the mean values, which is unsurprising given that the available observations for these cohorts are restricted to young and almost exclusively immature ages and that the autocorrelation in the cohort-specific deviations decays rapidly with time.

The estimates of correlation parameters for the AR(1) process for the intercept, ρ_0, varied between values of 0.62 and 0.65 for females, males and unsexed model fits. Estimate for correlation in random cohort slope effects, ρ_1, were 0.64 for females, 0.39 for males, and 0.61 for unsexed. Random cohort effects on both the intercept and slope parameters varied somewhat periodically, with a roughly 9-10 year period for female and unsexes observations (Figures 67 and 69). There was lower frequency variation for the random cohort effects for males (Figure 68).

The model-estimated annual ogives corresponded well to the empirical survey-specific estimates from Beaudry-Sylvestre et al. (2025) for both females and males (Figures 70- 71). As expected, the model-derives ogives smooth over the variability evident in the empirical ogives (e.g., 1999, 2002, 2013 and 2022 in Figure 70). The predicted annual ogives for 2025 to 2028 for use in projecting SSB for harvest advice are presented in Figure 72.

Normalized quantile residuals from the fit to the data for females indicate adequate model fit, showing no residual patterns as a function of (i) age, cohort and year (Figure B9), (ii) year by age (Figure B10), (iii) age by survey (Figure B11), and (iv) year by survey (Figure B12). Likewise, there were no apparent patterns in residuals for fits to the male and unsexed data (figures not shown to avoid unduly increasing the length of this document).

When the model-estimated ogives were applied to the numbers and weights at age estimated in the 2023 assessment, the resulting SSB estimates based on the female ogives were nearly identical to the former SSB estimates for 1983 to 1993, and very similar to them for the subsequent years (Figure 73). In contrast, the SSB estimates for ogives derived from model fitting irrespective of sex produced SSB values that were larger in all years, with a difference >20% in many years. This is because male cod mature at a lightly younger age compared to females (Figure 71), resulting in greater SSB for a given set of number and weight at age annual values. Given these results, we adopted the ogives based on female maturity for estimating SSB for the current assessment. The reasons for this choice are largely practical.

First, using the female ogive is consistent with what was done previously for this stock (Beaudry-Sylvestre et al. 2025) and with many other such as those of the NAFO Divisions 2J3KL, 3Ps and 4TVn (Brattey et al. 2010; Swain et al. 2019; Ings et al. 2024).

Second, given that the resulting SSB values for the 1980s are nearly identical to those from the previous assessment from 2023, there is no need to update the limit reference point which was established at that assessment. Although the update would merely constitute rescaling the value, the published rebuilding plan for the stock is based on the defined value of 71,970 t (Benoît and Ouellette-Plante 2023; DFO 2024b) and use of a new value could cause confusion.

Third, use of the female ogive is somewhat conservative, given that male and unsexed ogives produce higher SSB, acknowledging that SSB itself is considered a less than ideal proxy of stock reproductive potential anyway (e.g., Kell et al. 2015).

3.2.3. Total mortality

Modified catch curve analyses specific to the different surveys and indices are shown in Figures 74 to 78. Combining the different annual Z values, it can be seen in Figure 79 that the trends over time have been very comparable between the different indices. For the series from the DFO August survey starting in 1984, we note that Z had increased to a peak in values for this series in the early 1990s, which contributed to the subsequent collapse of the stock. Given the virtual absence of fishing during the period 1994-1996 (1st moratorium), we can postulate that the Z value (~0.7) corresponded to natural mortality. Following this first dip, Z values increased, corresponding to the reopening of fishing, then fell again during the 2003 moratorium. A second increase in Z was then observed with the reopening of fishing in 2004.

A difference in amplitude between fishery-independent surveys using bottom trawls and those using fixed gear (longline and gillnet) is observed: the peaks of the indices from fixed gear are higher. This difference had been explained by Benoît et al. (2022) in particular by differences in the age ranges used. Since larger, and therefore older, cod are normally caught by fixed gear, it was necessary to restrict the calculation to higher age values to ensure full recruitment of cod into the fishery using these gears. However, doing this led to a gear effect since these cod are known to face greater fishing mortality, and in addition, senescence increases with age. This would therefore explain why the Z values were higher for the fixed gear surveys. Finally, changes in the distribution of cod between the coastal and offshore sectors could also affect the estimates produced by decreasing or increasing the annual values according to changes in the spatial distribution of cod.

The third moratorium on directed commercial cod fishing, in effect since 2022, appears to have a less pronounced effect on Z than the two previous moratoriums (Figure 79). The cod condition based on total weight (K_{tot}), particularly in 2022, was raised as particularly low, and especially in Division 4S (Figure 64, DFO 2023a). In 2023 and 2024, K_{tot} increased for most length class and NAFO Division combinations, but remained low in 4S. By redoing the modified catch curve analysis with data from the reduced series of strata from the DFO August survey, and this time also by NAFO Division, it appears that total mortality in 4S is higher than that in 4R, and that the level currently reached in 4S would be the maximum value of the series (Figure 80). This higher total mortality in 4S than 4R could be related to the significant decrease in the spatial distribution of cod in the northwest of the Gulf during the period 2023-2024 (Figures 6- 7).

3.2.4. Diet

A total of 3,092 stomachs collected from 2017 to 2024 were retained for the analysis (Figure 81). For the largest sizes, and especially in 4S, the annual numbers are sometimes very limited. Based on the total fullness index, we note that cod from 4R generally have a higher feeding intensity than those from 4S (Figure 82). Capelin appears to be a more important prey for cod in 4S than in 4R, and especially for the two smallest length classes considered. For these two length classes, we also note that the contribution of capelin to the diet in the last three years is very low, or even zero.

3.3. TREATMENT OF CATCH IN THE ASSESSMENT MODEL

The assessment model developed during the last review of the 3Pn4RS cod assessment framework incorporates landings that are not reported by the usual data sources used in traditional stock assessments (i.e., ZIFF data, NAFO data, etc.). These additional catches were estimated following work involving, in particular, a structured questionnaire with current or former fishermen as respondents (Benoît et al. 2021), estimates of discards from commercial fishing from at-sea observer data and estimates of landings generated by recreational fishing (Ouellette-Plante et al. 2022a).

The remainder of this section is essentially an update of the paper by Benoît et al. (2024a) presented at the May 2022 model review. For the estimates of discards from commercial groundfish and shrimp fisheries, a similar approach to that described in Ouellette-Plante et al. (2022a) was used to update the estimates (Table 30, Figures 83- 86).

Until the early 2010s, recreational landing estimates represented only a small proportion of total landings. However, with the TAC reductions of the early 2010s, our recreational catch estimates represent a larger proportion of overall landings, so that with the closure of the commercial cod fishery since 2022, presumed catches from this fishery would now be higher than those from the commercial fishery (Table 2, Figure 83).

The significant contribution of recreational fishing to total mortality in 2024 is not new. Multiple sources of information (Canadian recreational fishing surveys, science surveys, tag returns, etc.) indicate that recreational fishing has expanded since the early 2000s (Ouellette-Plante et al. 2022a). Since no catch monitoring is conducted for this fishery, we assumed for the period 1974-2021 that the age composition of this fishery was the same as that established for the commercial fishery in the same years. For the following years (> 2021), we noted that the age composition of the commercial fishery differed from that resulting from the sentinel longline survey program (summer index, Figure 87). For 2022 to 2024, we assumed that the age composition of the recreational fishery corresponded to that of the summer longline index.

3.4. BEGINNING OF YEAR STOCK WEIGHTS

Age effects explain a large part of the variation in SW (Figure 88). Year effects (range of values from -0.092 to 0.065) were then the most important, followed by year-age interactions (range of values from -0.062 to 0.048, Figure 89) and finally by cohort effects (range of values from -0.048 to 0.052). This result is also observed by the somewhat smaller estimated value of σ_C compared to σ_Y and σ_{AY} (Table 31). The standard errors (SE) associated with log(σ_{AY}) and

$\log(\sigma_Y)$ were relatively large, but nevertheless smaller than in the previous analysis for the 2023 assessment (Ouellette-Plante et al. 2025). This effect, which is evident in the width of the estimated 95% confidence intervals on the year effects (Figure 88), likely resulted in large part from unusually low survey-based weight values in recent years for several of the ages (Figure 90).

The model fitted reasonably well to the average weights in the surveys (Figures 90- 91). The fits were best at the most frequently sampled ages in the survey, generally ages 3 to 8. There were no obvious patterns in the residuals, although the residual variation was somewhat greater at the youngest and oldest ages (Figures 92- 93).

3.5. ASSESSMENT MODEL

3.5.1. Abundance and biomass

The biomass of age 2+ cod and SSB fluctuated without trend after the late 1990s (Figure 94, Table 32). From 2015 onward, the biomass of age 2+ cod declined, before increasing again from 2019 to 2020 with the arrival of the 2018 cohort, and then declining again. From approximately 2017, the trend for the SSB has been downward. The 2024 SSB estimate (15,793 t) is the lowest in the series, followed by that of 1994 (16,256 t), corresponding to the first moratorium. The stock has been in the critical zone of the precautionary approach since 1990 and the SSB of 2024 was at 22% of the PRL (Figure 94b).

Recruitment for this stock declined from a high average level (1973–1990) to a low level (1991-2024) in the early 1990s (Figure 95a, Table 33). Recruitment for the 2019–2022 cohorts, estimated at age two by the assessment model, is below the 1991–2024 average. This contrasts sharply with recruitment for the 2018 cohort, which had been estimated to be the largest since 1990. However, a high mortality rate in this cohort significantly reduced its significance. The log-recruitment deviations estimated from the two means used in the model to account for a major change in recruitment levels (1973-1990 and 1991-2024) appear to follow a cyclic pattern (Figure 95b).

The biomass and log number plots at age show the progression of larger cohorts that have emerged since 1995 (Figure 96). These changes have generally not resulted in a significant increase in biomass or fish numbers at older ages. They were also only associated with moderate increases in the biomass of mature fish (Tables 32- 33).

3.5.2. Fishing and natural mortality

Key model variance and covariance parameters, including those used to estimate *F* and *M* deviations are presented in Table 34.

Average fishing mortality for ages 4 to 6 years and 6 to 9 years peaked in 1993, then fell drastically at the beginning of the first moratorium (Figure 97, Table 35). It subsequently rose again, but to lower values than before 1993, and a succession of progressively smaller peaks followed, around the year 2000, towards the end of the 2000s, and in 2018. These values, which reflect observed (input) catches and, since 2006, additional estimated (censored) catches, have been declining since 2018. Since the early 1990s, fishing mortality has tended to increasingly target older age groups (Figure 98). This is particularly evident when these values are expressed as a function of age 6 to 9 average (Figure 99). For most years since 2010, the fishery has targeted fish aged 9 years and older (orange horizontal line). The gear type permitted in this fishery since the first moratorium may be related (Figure 21c).

Unlike *F*, *M* is estimated to have fluctuated at high values at all ages and in most years since the mid-1990s (Figure 100, Table 36). After a decline in values in 2003 associated with a moratorium on commercial and recreational fishing, during which *M* at most ages reached values comparable to those historically assumed, *M* increased with peaks in the late 2000s, 2017, and 2023. The peak in natural mortality observed in 2023 was particularly significant for younger-aged cod, with *M* values never before observed (ages 4-7), and was mentioned in the 2024 stock status update (DFO 2024a). Compared to 2023, M_{2024} has decreased. Natural mortality in 2024 constituted almost all of *Z*, unlike the 1970s and early 1980s, when *M* represented much less than half of *Z* for ages 6+.

Estimates of *M* for ages 4 to 6 years have increased significantly since 2015, reaching, in 2022-2023, the highest values in the series beginning in 1973 (Figure 101). It is likely that some of this natural mortality actually consists of unaccounted fishing mortality. Average fishing mortality at these ages has been very low since the early 2010s and is considered low compared to natural mortality.

Catches estimated by the model were close to the upper catch bound in 2011-2016 and 2019-2021, when catches were relatively low, and near to the lower bound in 2017-2018, when catches were greater (Figure 102).

3.5.3. Catchability

The estimated catchability-at-age functions for the five surveys are essentially comparable to those estimated by Benoît et al. (2025) and Ouellette-Plante et al. (2025) (Figure 103). Asymptotic catchabilities for the DFO August and sentinel mobile surveys were greater than 1, which can be high based on swept area assumptions. The cause of these high values requires further research (Benoît et al. 2025). All ages appear to be well captured by the DFO August survey, as are ages 3+ in the sentinel mobile survey. Meanwhile, younger ages are not very catchable to the three sentinel fixed gear surveys, particularly the gillnet survey.

3.5.4. Model fit

The model fitted fairly well to the age-specific abundance indices, although at age 3, the model underestimated both sentinel longline indices prior to 2010 and overestimated them thereafter (Figure 104). There were no strong patterns in model residuals that would suggest model misspecification, such as patterns along cohorts or large blocks of similarly sized residuals (Figure 105). There appears to be a slight conflict between the DFO August survey and the sentinel mobile survey over the past few years, with the two surveys showing opposing residual trends. There is evidence of a small survey year effect in the DFO August survey in 2002–2003 and a slightly larger effect for the sentinel mobile survey in 2011–2012, but these do not appear to affect other aspects of the model fit. There is no strong pattern in the residuals of the abundance indices as a function of year and cohort, and none as a function of age (Figure 106).

Model estimated fishery catch proportions at age corresponded well with the input values (Figure 107). With the exception of the fits since 2017 for ages 11+, which corresponded to generally low proportions, the model fit magnitude and fluctuations well. There was no temporal trend in catch-proportions at age residuals (Figure 108). There was no pattern in the continuation ratio logit residuals (crl, Figure 109). Although values tended to be somewhat larger at older ages and in the years surrounding 2020 for ages 4 and 5 (Figure 109), there were no overall patterns as a function of year, age or cohort (Figure 110).

3.5.5. Retrospective analysis

A seven-year retrospective analysis was undertaken and a value of Mohn's rho, which is a measure of systematic retrospective bias, was calculated for several model outputs (Mohn 1999). Sequential peels of the assessment model had a negligible effect on estimates of mean fishing mortality (Figure 111), SSB, and recruitment (Figure 112). Mohn's rho values were very small, indicating little or no bias. Retrospective analyses for *M* show some sensitivity in the last one or two years of an assessment, but no strong bias, i.e., the occurrence and magnitude of overestimations and underestimations are comparable (Figure 113). Consequently, estimates of *M* from the terminal assessment year should be interpreted with some caution, but long-term trends appear reliable within the context of the model.

3.6. PROJECTIONS

Four-year projections (2025-2028) from the fitted model were made for three catch scenarios (0, 500, and 1,000 t) as requested by fisheries management and based on the 3Pn4RS cod rebuilding plan (DFO 2024b). These projections were based on the following conditions and assumptions:

- To project up to December 31, 2024:
  - The 2024 age-specific values for maturity and stock weight were used.
  - The 2024 recruitment and age-specific natural mortality estimates were used.
- To project from January 1st, 2025, to December 31st, 2028:
  - The projected age-specific maturity values up to 2028 were used.
  - The 2024 stock weight values at age were assumed for the following four years.
  - Recruitment was generated from the 2024 estimate, assuming the age and year correlations estimated in the model.
  - Mean age-specific natural mortality estimates for the period 2022–2024 were used.
- For all projection years:
  - The estimated mean fishery selectivity and mean age-specific catch weights for the period 2022–2024 were used.
- The above parameters, along with the estimated abundance for 2024, were simulated using the model parameter estimates and the covariance matrix.

Ten thousand independent simulations were made. From these, the probabilities associated with particular stock outcomes were estimated.

With a catch option of 0 t, there is an estimated 0.0396 probability that SSB will, by the end of the projection period, increase by any amount, and approximately 0.0167 chance of a 10% or greater increase (Table 37, Figure 114). With a catch option of 1,000 t, these probabilities decrease to 0.0128 and 0.0050, respectively. With a catch option of 0 t, there is no chance that SSB will reach or exceed a value of 71,970 t, which is the LRP adopted for the stock. The probabilities of an increase in the abundance of cod age 5+ and of a ≥ 10% increase are 0.4774 and 0.3619, respectively, with no catch, and 0.3789 and 0.2683, respectively, with the 1,000 t option.

The very low probabilities of an increase in the biomass and abundance of adult cod reflect the high estimated natural mortality and low recruitment observed in recent years (Figure 100).

4. DISCUSSION

4.1. ECOSYSTEM AND CLIMATE CHANGE CONSIDERATIONS

Increasing water temperature in the nGSL (Galbraith et al. 2024) and decreasing dissolved oxygen concentration in deep waters (Blais et al. 2024) could affect the distribution and productivity of the 3Pn4RS cod stock.

Based on total fullness index, it is observed that cod from 4R had a higher feeding intensity than those from 4S during the last three years, during which the poor condition of cod in 4S was noted (Figure 115AB, DFO 2023a). A change in prey availability may have negatively affected the condition of 4S cod since 2022 which could have contributed to the increase in recent total mortality in 4S (Figure 115C). While the recent mortality in 4R is comparable to its historical average, the one achieved in 4S represents the maximum value of its series.

Links between feeding intensity, condition and total mortality suggest that recent bottom-up effects of the environment may be important drivers of the low stock productivity. Similar links have been put forward for neighboring Atlantic cod stocks of NAFO 3Ps (southern Newfoundland, DFO 2023b), 2J3KL (northeastern Newfoundland, Regular et al. 2022) and 3NO (southern Grand Banks, Cadigan et al. 2024). In particular, the study of Regular et al. (2022) showed that starvation-induced natural mortality, was linked to prey availability, and more specifically to those of capelin (*Mallotus villosus*) and northern shrimp (*Pandalus borealis*), two important preys of 3Pn4RS cod (Ouellette-Plante et al. 2020).

4.2. PROCEDURE FOR INTERIM YEAR UPDATES

During the 2023 assessment (DFO 2023a), the 43 cm cod biomass index from the DFO August survey was identified as an indicator of SSB for years when a full analytical stock assessment is not conducted (interim years). In the winter of 2024, an update (DFO 2024a) was conducted without such a full analytical assessment, and showed that a significant decline had occurred in 2023, as the SSB indicator was now estimated at 9,525 t, whereas it had been estimated by the model at nearly 42,906 t in 2022 (DFO 2023a).

With the use of the 3Pn4RS cod stock assessment model in this stock assessment, it is possible to update the relationship between the SSB estimated from the assessment model and the SSB indicator (Figure 116). For now, the reliability of this proxy to reflect the SSB status of the 3Pn4RS cod stock in interim years is considered satisfactory.

4.3. SOURCES OF UNCERTAINTY

Several uncertainties exist for this stock, starting with the status of the 2018 cohort. First mentioned in the 2019 assessment (DFO 2019b) and monitored since then due to its high abundance, individuals in this cohort do not appear to have increased in size in 2023. In 2024, the abundance of this cohort was at a very low level and its contribution to the stock's SSB over the next few years will therefore be very reduced.

The magnitude of the recreational fishery, for which no monitoring of catches (quantities, individual sizes and weights) and discards is carried out, is uncertain (Ouellette-Plante et al. 2022a). As the directed commercial fishery has been closed since 2022, it is likely that landings from recreational fishing currently constitute a significant portion of total 3Pn4RS cod landings. Unaccounted mortality resulting from the recreational fishery may contribute to high values of natural mortality estimated by the assessment model.

The link between cod condition and mortality should be further studied, in addition to elucidating the ecosystemic conditions that could be causing it. In particular, the effect of changing oceanographic and ecological conditions in the nGSL, particularly water temperature and dissolved oxygen content, as well as prey availability, represent research priorities.

5. CONCLUSION

This assessment indicates that the 3Pn4RS cod stock remains deeply within the critical zone of the precautionary approach. The SSB estimate for 2024 (15,793 t) represents 22% of the LRP (71,970 t). This is a significant decrease, since in the 2023 assessment, the SSB was estimated by the model at nearly 42,906 t, or 60% of the LRP. According to the harvest control rule in the rebuilding plan, annual removals from all sources should not exceed 500 t.

Four-year projections (2025-2028) based on the fitted assessment model were made for three catch scenarios (0, 500, and 1,000 t) requested by fisheries management. Under these scenarios, the probability of increase in SSB over four years ranges from 0.0396 (0 t) to 0.0128 (1,000 t). The very low probabilities of an increase in the biomass and abundance of adult cod reflect the high estimated natural mortality and low recruitment observed in recent years.

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7. REFERENCES CITED

Barot, S., Heino, M., O'Brien, L., and Dieckmann, U. 2004. Estimating reaction norms for age and size at maturation when age at first reproduction is unknown. Evol. Ecol. Res. 6: 659–678.

Beaudry-Sylvestre, M., Ouellette-Plante, J., and Benoît, H. 2025. Update of the inputs and estimation method for the maturity ogives of Atlantic cod in the Northern Gulf of St. Lawrence (3Pn, 4RS) over the 1983-2023 period. Can. Tech. Rep. Fish. Aquat. Sci. 3671: viii + 32 p.

Benoît, H.P., and Ouellette-Plante, J. 2023. Scientific Elements of the Northern Gulf of St. Lawrence (NAFO 3Pn4RS) Atlantic Cod Rebuilding Plan. DFO Can. Sci. Advis. Sec. Res. Doc. 2023/085: iv + 28 p.

Benoît, H.P., Swain, D.P., Hutchings, J.A., Knox, D., Doniol-Valcroze, T., and Bourne, C.M. 2018. Evidence for reproductive senescence in a broadly distributed harvested marine fish. Mar. Ecol. Prog. Ser. 592: 207–224.

Benoît, H.P., Dunham, A., Macnab, P., Rideout, R., Wareham, V., Clark, D., Duprey, N., Maldemay, É.-P., Richard, M., Clark, C., and Wilson, B. 2020. Elements of a framework to support decisions on authorizing scientific surveys with bottom contacting gears in protected areas with defined benthic conservation objectives. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/011. ix + 98 p.

Benoît, H.P., Brassard, C., Carruthers, E., and Nadeau, P. 2021. Results of a questionnaire to commercial harvesters on historical and current unaccounted catches of Atlantic cod in NAFO areas 3Pn4RS. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/067. vi + 36 p.

Benoît, H.P., Ouellette-Plante, J., Yin, Y., and Brassard, C. 2022. Review of the assessment framework for Atlantic cod in NAFO 3Pn4RS: Fishery independent surveys. DFO Can. Sci. Advis. Sec. Res. Doc. 2022/049. xiii + 130 p.

Benoît, H.P., Cadigan, N., Ouellette-Plante, J., and Brassard, C. 2024a. Review of the Assessment Framework for Atlantic Cod in NAFO 3Pn4RS: Treatment of Catch and Individual weights, and other Assessment Model Considerations. DFO Can. Sci. Advis. Sec. Res. Doc. 2024/045: vii + 47 p.

Benoît, H.P., Yin, Y., and Bourdages, H. 2024b. Results of Comparative Fishing Between the CCGS Teleost and CCGS John Cabot in the Estuary and Northern Gulf of St. Lawrence in 2021 and 2022. DFO Can. Sci. Advis. Sec. Res. Doc. 2024/007. xvii + 229 p.

Benoît, H.P., Cadigan, N., Ouellette-Plante, J., and Brassard, C. 2025. Review of the assessment framework for Atlantic cod in NAFO 3Pn4RS: population modelling and elements relevant to a renewed precautionary approach and rebuilding plan. DFO Can. Sci. Advis. Sec. Res. Doc. 2025/074. xii + 128 p.

Bérubé, M., and Fréchet, A. 2001. Summary of the northern gulf sentinel tagging program with emphasis on recaptures from adjacent management units. DFO Can. Sci. Advis. Sec. Res. Doc. 2001/002. 23 p.

Blais, M., Galbraith, P.S., Lizotte, M., Clay, S.A., and Starr, M. 2024. Chemical and Biological Oceanographic Conditions in the Estuary and Gulf of St. Lawrence During 2023. Can. Tech. Rep. Hydrogr. Ocean Sci. 385: v + 84 p.

Bourdages, H., and Ouellet, J.-F. 2011. Geographic distribution and abundance indices of marine fish in the northern Gulf of St. Lawrence (1990–2009). Can. Tech. Rep. Fish. Aquat. Sci. 2963: vi + 171 p.

Bourdages, H., Savard, L., Archambault, D., and Valois, S. 2007. Results from the August 2004 and 2005 comparative fishing experiments in the northern Gulf of St. Lawrence between the CCGS *NGCC Alfred Needler* and the CCGS *NGCC Teleost*. Can. Tech. Rep. Fish. Aquat. Sci. 2750: ix + 57 p.

Bourdages, H., Roux, M.-J., Marquis, M.-C., Galbraith, P., and Isabel, L. 2022. Assessment of northern shrimp stocks in the Estuary and Gulf of St. Lawrence in 2021: commercial fishery and research survey data. DFO Can. Sci. Advis. Sec. Res. Doc 2022/027. xiv + 195 p.

Brattey, J., Cadigan, N.G., Dwyer, K., Healey, B.P., Morgan, M.J., Murphy, E.F., Maddock Parsons, D., and Power, D. 2010. Assessment of the cod (*Gadus morhua*) stock in NAFO Divisions 2J+3KL in 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/103. viii + 108 p.

Bromley, P.J., Watson, T., and Hislop, J.R.G. 1997. Diel feeding patterns and the development of food webs in pelagic 0-group cod (*Gadus morhua* L.), haddock (*Melanogrammus aeglefinus* L.), whiting (*Merlangius merlangus* L.), saithe (*Pollachius virens* L.), and Norway pout (*Trisopterus esmarkii Nilsson*) in the northern North Sea. ICES J. Mar. Sci. 54(5): 846–853.

Brulotte, S., and Fréchet, A. 2000. Saturation index for longlines and gill nets in sentinel fisheries of cod in the northern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2000/118.

Cadigan, N.G., Morgan, M.J., and Brattey, J. 2014. Improved estimation and forecasts of stock maturities using generalised linear mixed models with auto-correlated random effects. Fish. Manag. Ecol. 21(5): 343–356.

Cadigan, N.G., Weerasekera, S.J.W.W.M.M.P., Regular, P.M., and Rideout, R.M. 2024. Time varying M with starvation mortality in a state-space stock assessment model: Part 2: Atlantic cod (*Gadus morhua*) on the southern Grand Bank of Newfoundland. Fish. Res. 280: 107174.

Canada. 1993. Atlantic Fishery Regulations, 1985, amendment, P.C. 1992-2717, SOR/93-16, 30 December 1992. Canada Gazette, Part II 127(1): 145–149.

Canada. 2019. Laurentian Channel Marine Protected Area Regulations, P.C. 2019-339, SOR/2019-105, April 15 2019. Canada Gazette, Part II 153(9): 1416–1455.

Chabot, D., and Claireaux, G. 2008. Environmental hypoxia as a metabolic constraint on fish: the case of Atlantic cod, *Gadus morhua*. Mar. Pollut. Bull. 57(6-12): 287–294.

Chabot, D., and Dutil, J.-D. 1999. Reduced growth of Atlantic cod in non-lethal hypoxic conditions. J. Fish Biol. 55(3): 472–491.

Chabot, D., Sainte-Marie, B., Briand, K., and Hanson, J.M. 2008. Atlantic cod and snow crab predator-prey size relationship in the Gulf of St. Lawrence, Canada. Mar. Ecol. Prog. Ser. 363: 227–240.

Chamberland, J.-M., Bourdages, H., Desgagnés, M., Galbraith, P., Isabel, L., Ouellette-Plante, J., Roux, M.-J., Scallon-Chouinard, P.-M., and Senay, C. 2025. Preliminary results from the 2024 August Ecosystemic Survey in the Estuary and Northern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2025/032. iv + 101 p.

Chouinard, G., and Fréchet, A. 1994. Fluctuations in the cod stocks of the Gulf of St Lawrence. ICES Mar. Sci. Symp. 198: 121–139.

Cohen, D.M., Inada, T., Iwamoto, T., and Scialabba, N. 1990. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fisheries Synopsis 10(125): 442 p.

COSEWIC. 2010. COSEWIC assessment and status report on the Atlantic Cod (*Gadus morhua*) in Canada. Committee on the Status of Endangered Wildlife in Canada: xiii + 105 p.

Daigle, D., and Benoît, H.P. 2007. Procedures for commercial catch sampling of finfish and shrimp in the southern Gulf of St. Lawrence (Fisheries and Oceans Canada, Gulf Region). Can. Manuscr. Rep. Fish. Aquat. Sci. 2833: iv + 63 p.

Dawe, E.G., Dalley, E.L., and Lidster, W.W. 1997. Fish prey spectrum of short-finned squid (*Illex illecebrosus*) at Newfoundland. Can. J. Fish. Aquat. Sci. 54(S1): 200–208.

DFO. 1999. Atlantic groundfish management measures for the Gulf of St. Lawrence and cod stocks in 2GH and 3Ps. Infoceans 2(9): 15.

DFO. 2003a. The northern Gulf of St. Lawrence (3Pn, 4RS) cod in 2002. DFO Science Stock Status Report 2003/017.

DFO. 2003b. Proceedings of the zonal assessment meeting - Atlantic cod. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2003/021.

DFO. 2004. The Northern Gulf of St. Lawrence (3Pn, 4RS) cod in 2003. DFO Can. Sci. Advis. Sec. Stock Status Rep. 2004/019.

DFO. 2008. Assessment of cod stock in the northern Gulf of St. Lawrence (3Pn, 4RS) in 2007. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/003.

DFO. 2011. Recovery potential assessment for Laurentian North designatable units (3Pn,4RS and 3Ps) of Atlantic cod (*Gadus morhua*). DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2011/026.

DFO. 2017. Integrated Fisheries Management Plan. Gulf of St. Lawrence Groundfish (NAFO Subdivisions 3Pn, 4Vn and Divisions 4RST).

DFO. 2018. Framework to support decisions on authorizing scientific surveys with bottom contacting gears in protected areas with defined benthic conservation objectives. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/043.

DFO. 2019a. Laurentian Channel Marine Protected Area (MPA).

DFO. 2019b. Assessment of the Northern Gulf of St. Lawrence (3Pn, 4RS) Atlantic Cod Stock in 2018. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2019/032.

DFO. 2022a. Conservation Harvesting Plan 2022-23 season NAFO Sub-Division 3Ps - Groundfish fixed gear vessels less than 27.4 metres (90ft.).

DFO. 2022b. Coral and Sponge Conservation Measures in the Estuary and Gulf of St. Lawrence.

DFO. 2023a. Assessment of the Northern Gulf of St. Lawrence (3Pn, 4RS) Atlantic Cod Stock in 2022. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2023/035.

DFO. 2023b. Review of Rebuilding Plan Simulations for Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps Atlantic Cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2023/007.

DFO. 2024a. Update of Stock Status Indicators for the Northern Gulf of St. Lawrence Atlantic Cod Stock (3Pn, 4RS) in 2023. DFO Can. Sci. Advis. Sec. Sci. Resp. 2024/011.

DFO. 2024b. Rebuilding plan: Atlantic Cod, *Gadus morhua* - NAFO Subdivision 3Pn and Divisions 4RS.

DFO. 2025a. Northern Gulf of St. Lawrence (3Pn, 4RS) Atlantic Cod (*Gadus morhua*) Stock Assessment in 2024. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2025/011.

DFO. 2025b. Units 1 and 2 Redfish (*Sebastes mentella* and *Sebastes fasciatus*) Stocks Assessment in 2024. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2025/014.

Dunn, P.K., and Smyth, G.K. 1996. Randomized Quantile Residuals. J. Comput. Graph. Stat. 5(3): 236–244.

Duplisea, D., and Fréchet, A. 2010. Precautionary reference point estimates for northern Gulf of St. Lawrence (3Pn4RS) cod (*Gadus morhua*) and methods for their calculation. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/097: iv + 24 p.

Duplisea, D., and Fréchet, A. 2011. Updated reference point estimates for northern Gulf of St. Lawrence (3Pn4RS) cod (*Gadus morhua*) based on revised beginning of year weights at age. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/003: iv + 8 p.

Dutil, J.-D., and Brander, K. 2003. Comparing productivity of North Atlantic cod (*Gadus morhua*) stocks and limits to growth production. Fish. Oceanogr. 12(4-5): 502–512.

Dutil, J.-D., Lambert, Y., Chouinard, G.A., and Fréchet, A. 1995. Fish condition : What should we measure in cod (*Gadus morhua*)? DFO Atlantic Fisheries Res. Doc. 95/11: 26 p.

Dutil, J.-D., Gauthier, J., Fréchet, A., Castonguay, M., Lambert, Y., and Ouellet, P. 2005. Northern Gulf of St. Lawrence (NAFO 3Pn and 4RS). *In* Spawning and life history information for North Atlantic cod stocks. *Edited by* K. Brander. ICES Cooperative Research Report No. 274. p. 105–113.

Fordham, S.E., and Trippel, E.A. 1999. Feeding behaviour of cod (*Gadus morhua*) in relation to spawning. J. Appl. Ichthyol. 15(1): 1–9.

Fréchet, A. 1986. Assessment of the 4RS, 3Pn cod stock. CAFSAC Res. Doc. 86/105: 62 p.

Fréchet, A. 1990. Catchability variations of cod in the marginal ice zone. Can. J. Fish. Aquat. Sci. 47(9): 1678–1683.

Fréchet, A. 1996. Intercalibration of eight otter-trawlers participating in the sentinel fisheries in the northern Gulf of St. Lawrence (3Pn,4RS) in 1995 through the use of Scanmar sensors. DFO Atl. Fish. Res. Doc. 96/67.

Fréchet, A. 1997. Standardization of otter trawlers participating in the sentinel fisheries in the northern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 97/72.

Fréchet, A., and Gagnon, Y. 1993. Assessment of the biomass of the northern gulf of St. Lawrence cod stock (3Pn, 4RS) in 1992. DFO Atl. Fish. Res. Doc. 93/68. 42 p.

Fréchet, A., and Schwab, P. 1995. Review of the status of the northern gulf of St. Lawrence cod stock (3Pn, 4RS) in 1994. DFO Atl. Fish. Res. Doc. 95/53. 20 p.

Fréchet, A., Gagnon, Y., Schwab, P., D'Amours, D., Dutil, J.-D., Lambert, Y., Bourassa, L., and Rollet, C. 1994. Review of the status of the northern gulf of St. Lawrence cod stock (3Pn, 4RS) in 1993. DFO Atl. Fish. Res. Doc. 94/29. 50 p.

Fréchet, A., Schwab, P., Lambert, Y., Chabot, D., Decker, D., Rowe, G., Nadeau, P., and Collier, F. 1995. The sentinel fisheries of the northern Gulf of St. Lawrence cod stock (3Pn, 4RS) in 1994. DFO Atl. Fish. Res. Doc. 95/54. 31 p.

Fréchet, A., Gauthier, J., Schwab, P., Bourdages, H., Chabot, D., Collier, F., Grégoire, F., Lambert, Y., Moreault, G., Pageau, L., and Spingle, J. 2003. The status of cod in the Northern Gulf of St. Lawrence (3Pn, 4RS) in 2002. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/065. i + 25 p.

Fréchet, A., Gauthier, J., Schwab, P., Lambert, Y., Le Bris, A., Tournois, C., Way, M., and Collier, F. 2009. The status of cod in the Northern Gulf of St. Lawrence (3Pn, 4RS) in 2008. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/090. iv + 104 p.

Galbraith, P.S., Chassé, J., Shaw, J.-L., Dumas, J., and Bourassa, M.-N. 2024. Physical oceanographic conditions in the Gulf of St. Lawrence during 2023. Can. Tech. Rep. Hydrogr. Ocean Sci. 378: v + 91 p.

Gascon, D. 1983. An assessment of the cod stock in NAFO division 4RS 3Pn. CAFSAC Res. Doc. 83/46. 30 p.

Ings, D.W., Varkey, D., Babyn, J., Regular, P.R., Champagnat, J., Kumar, R., Morgan, M.J., Healey, B.P., Rideout, R.M., and Vigneau, J. 2024. Assessing the Status of the Cod (*Gadus morhua*) Stock in NAFO Subdivision 3Ps in 2019. DFO Can. Sci. Advis. Sec. Res. Doc. 2024/002. v + 116 p.

Kell, L.T., Nash, R.D.M., Dickey-Collas, M., Mosqueira, I., and Szuwalski, C. 2015. Is spawning stock biomass a robust proxy for reproductive potential? Fish Fish. 17(3): 596–616.

Kristensen, K. 2023. RTMB: 'R' Bindings for 'TMB'.

Lambert, J.-D., and Ménager, M. 1998. Protocoles d'échantillonnage des captures commerciales de poissons et d'invertébrés marins du golfe du Saint-Laurent. Rapp. tech. can. sci. halieut. aquat. 2208: x + 246 p.

Lambert, Y., and Dutil, J.-D. 1997. Can simple condition indices be used to monitor and quantify seasonal changes in the energy reserves of cod (*Gadus morhua*)? Can. J. Fish. Aquat. Sci. 54(S1): 104–112.

Lear, W.H. 1998. History of Fisheries in the Northwest Atlantic: The 500-Year Perspective. J. Northw. Atl. Fish. Sci. 23: 41–73.

McCallum, B.R., and Walsh, S.J. 1997. Groundfish survey trawls used at the Northwest Atlantic Fisheries Centre, 1971 to present. NAFO Sci. Coun. Studies. 29: 93–104.

Mimeault, M. 1997. Une longue histoire de pêche: La morue du golfe du Saint-Laurent. Cap-aux-Diamants 51: 24–27.

Minet, J.P. 1978. Dynamics and yield assessment of the northeastern Gulf of St. Lawrence cod stock. ICNAF Sel. Pap. 3: 7–16.

Minet, J.P., and Perodou, J.B. 1978. Predation of cod, *Gadus morhua*, on capelin, *Mallotus villosus*, off eastern Newfoundland and in the Gulf of St. Lawrence. ICNAF Res. Bull. 13: 11–20.

Mohn, R. 1999. The retrospective problem in sequential population analysis: An investigation using cod fishery and simulated data. ICES J. Mar. Sci. 56(4): 473–488.

Morgan, M.J., and Hoenig, M. 1997. Estimating maturity-at-age from length stratified sampling. J. Northw. Atl. Fish. Sci. 21: 51–63.

Morrison, C.M. 1990. Histology of the Atlantic cod, *Gadus morhua*: an atlas. Part three. Reproductive tract. Can. Spec. Publ. Fish. Aquat. Sci. 110: 177 p.

Mosnier, A., Dispas, A., and Hammill, M.O. 2023. Spatial distribution and count of harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) in the Estuary and Gulf of St. Lawrence from an aerial survey conducted in June 2019. Can. Tech. Rep. Fish. Aquat. Sci. 3541: v + 60 p.

Nozères, C., Archambault, D., Chouinard, P.-M., Gauthier, J., Miller, R., Parent, E., Schwab, P., Savard, L., and Dutil, J.-D. 2010. Identification guide for marine fishes of the estuary and northern Gulf of St. Lawrence and sampling protocols used during trawl surveys between2004 and 2008. Can. Tech. Rep. Fish. Aquat. Sci. 2866: xi + 243 p.

Ouellet, P. 1997. Characteristics and vertical distribution of Atlantic cod (*Gadus morhua*) eggs in the northern Gulf of St. Lawrence, and the possible effect of cold water temperature on recruitment. Can. J. Fish. Aquat. Sci. 54(1): 211–223.

Ouellet, P., Allard, J.-P., and St-Pierre, J.-F. 1994. Distribution des larves d'invertébrés décapodes (Pandalidae, Majidae) et des œufs et larves de poissons dans le nord du golfe du Saint-Laurent en mai et juin de 1985 à 1987 et 1991-1992. Rapp. tech. can. sci. halieut. aquat 2019: viii + 60 p.

Ouellet, P., Lambert, Y., and Castonguay, M. 1997. Spawning of Atlantic cod (*Gadus morhua*) in the northern Gulf of St. Lawrence: a study of adult and egg distributions and characteristics. Can. J. Fish. Aquat. Sci. 54(1): 198–210.

Ouellette-Plante, J., Chabot, D., Nozères, C., and Bourdages, H. 2020. Diets of demersal fish from the CCGS *Teleost* ecosystemic surveys in the estuary and northern Gulf of St. Lawrence, August 2015-2017. Can. Tech. Rep. Fish. Aquat. Sci. 3383: v + 121 p.

Ouellette-Plante, J., Benoît, H.P., and Brassard, C. 2022a. Review of the NAFO 3Pn4RS Atlantic cod assessment framework: commercial and recreational fisheries catches and tagging program data. DFO Can. Sci. Advis. Sec. Res. Doc. 2022/033. v + 57 p.

Ouellette-Plante, J., Benoît, H.P., Plourde, S., and Chabot, D. 2022b. Preliminary estimates of annual capelin consumption by Atlantic cod and Greenland halibut. DFO Can. Sci. Advis. Sec. Res. Doc. 2022/013. iv + 48 p.

Ouellette-Plante, J., Van Beveren, E., Benoît, H.P., and Brassard, C. 2022c. Details of catchR, an *R* package to estimate the age and length composition of fishery catches, with an application to 3Pn4RS Atlantic cod. DFO Can. Sci. Advis. Sec. Res. Doc. 2022/015. iv + 69 p.

Ouellette-Plante, J., Benoît, H.P., and Lussier, J.-F. 2025. The status of the Northern Gulf of St. Lawrence (3Pn, 4RS) Atlantic cod (*Gadus morhua*) stock in 2022. DFO Can. Sci. Advis. Sec. Res. Doc. 2025/039. xx + 244 p.

Puncher, G.N., Rowe, S., Rose, G.A., Parent, G.J., Wang, Y., and Pavey, S.A. 2021. Life-stage-dependent supergene haplotype frequencies and metapopulation neutral genetic patterns of Atlantic cod, *Gadus morhua*, from Canada's Northern cod stock region and adjacent areas. J. Fish Biol. 98(3): 817–828.

Regular, P.M., Buren, A.D., Dwyer, K.S., Cadigan, N.G., Gregory, R.S., Koen-Alonso, M., Rideout, R.M., Robertson, G.J., Robertson, M.D., Stenson, G.B., Wheeland, L.J., and Zhang, F. 2022. Indexing starvation mortality to assess its role in the population regulation of Northern cod. Fish. Res. 247: 106180.

Rideout, R.M., and Rose, G.A. 2006. Suppression of reproduction in Atlantic cod *Gadus morhua*. Mar. Ecol. Prog. Ser. 320: 267–277.

Rideout, R.M., Rose, G.A., and Burton, M.P.M. 2005. Skipped spawning in female iteroparous fishes. Fish Fish. 6(1): 50–72.

Rivest, L.-P., Boivin, A., and Benoît, H.P. 2021. A Spatiotemporal Investigation of the Cod Stock in the Northern Gulf of St. Lawrence. *In* Applied Statistics and Data Science. Proceedings of Statistics 2021 Canada, Selected Contributions. *Edited by* Y.P. Chaubey, S. Lahmiri, F. Nebebe, and A. Sen. p. 31–52.

Rose, G.A. 2018. Atlantic Cod: A Bio-Ecology. Wiley-Blackwell.

Sanguin, A.-L. 1980. La zone canadienne des 200 milles dans l'Atlantique, un exemple de la nouvelle géographie politique des océans. Études internationales. 11(2): 239–251.

Savard, L., Gauthier, J., Bourdages, H., and Desgagnés, M. 2013. Bycatch in the Estuary and Gulf of St. Lawrence Northern shrimp fishery. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/151. ii + 56 p.

Savenkoff, C., Castonguay, M., Chabot, D., Hammill, M.O., Bourdages, H., and Morissette, L. 2007. Changes in the northern Gulf of St. Lawrence ecosystem estimated by inverse modelling: evidence of a fishery-induced regime shift? Estuar. Coast. Shelf Sci. 73(3): 711–724.

Schwalme, K., and Chouinard, G.A. 1999. Seasonal dynamics in feeding, organ weights, and reproductive maturation of Atlantic cod (*Gadus morhua*) in the southern Gulf of St Lawrence. ICES J. Mar. Sci. 56(3): 303–319.

Senay, C., Rousseau, S., Brûlé, C., Chavarria, C., Isabel, L., Parent, G.J., Chabot, D., and Duplisea, D. 2023. Unit 1 Redfish (*Sebastes mentella* and *S. fasciatus*) stock status in 2021. DFO Can. Sci. Advis. Sec. Res. Doc. 2023/036. xi + 125 p.

Sinclair, A. 2001. Natural mortality of cod (*Gadus morhua*) in the Southern Gulf of St Lawrence. ICES J. Mar. Sci. 58(1): 1–10.

STACAC. 1984. Catch & effort computer file structure for zonal interchange - 1984. STACAC Standard Document 3: 13 p.

Swain, D.P., Ricard, D., Rolland, N., and Aubry, É. 2019. Assessment of the southern Gulf of St. Lawrence Atlantic Cod (*Gadus morhua*) stock of NAFO Div. 4T and 4Vn (November to April), March 2019. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/038. iv + 105 p.

Templeman, W. 1981. Vertebral Numbers in Atlantic cod, *Gadus morhua*, of the Newfoundland and Adjacent Areas, 1947-71, and Their use for Delineating Cod Stocks. J. Northw. Atl. Fish. Sci. 2: 21–45.

Trippel, E.A. 1995. Age at maturity as a stress indicator in fisheries: biological processes related to reproduction in northwest Atlantic groundfish populations that have undergone declines. BioScience 45(11): 759–771.

Trippel, E.A., Morgan, M.J., Fréchet, A., Rollet, C., Sinclair, A., Annand, A., Beanlands, D., and Brown, L. 1997. Changes in age and length at sexual maturity of northwest Atlantic cod, haddock, and pollock stocks, 1972–1995. Can. Tech. Rep. Fish. Aquat. Sci. 2157: xii + 120 p.

Turuk, T.N. 1968. Seasonal changes of cod feeding in the Labrador and Newfoundland area in 1964-1966. Trudy Pinro. 23: 370–382.

Tyler, A.V. 1971. Monthly changes in stomach contents of demersal fishes in Passamaquoddy Bay, N. B. Fish. Res. Bd. Canada Tech. Rep. 288: 118 p.

Wells, R. 1977. Status of the cod stock in the eastern Gulf of St. Lawrence. CAFSAC Res. Doc. 77/15. 9 p.

Yvelin, J.-F., Fréchet, A., and Brêthes, J.-C. 2005. Migratory routes and stock structure of cod from the Northern Gulf of St. Lawrence (3Pn, 4RS). DFO Can. Sci. Advis. Sec. Res. Doc. 2005/055. iii + 50 p.

8. TABLES

Table 1. List of the various 3Pn4RS cod related CSAS publications published since 1996. The Year and Date columns refer to the year and date of the meeting. For documents whose associated meeting could not be traced, the year value corresponds to the year of publication. RD = research document, SAR = scientific advice report, SR = science response, SSR = stock status report, PROC = proceedings.

Year	Date (DD/MM)	RD	SAR	SR	SSR	PROC
1996	-	-	-	-	1996/053	-
1997[a]	03-05/03	1998/055	-	-	-	1997/006
1998	-	1998/018	-	-	1998/127, 1998/A4-01	-
1999[a]	01-12/03	-	-	-	1999/A4-01	1999/005
2000[a]	22-25/02	2000/106	-	-	-	2000/017
2000[a]	16-17/10	-	-	-	-	2000/027
2000	-	2000/118, 2000/150	-	-	2000/A4-01	-
2001	05-09/11	-	-	-	-	2002/003
2001	-	-	-	-	2001/A4-01	-
2002[a]	05-08/11	-	-	-	-	2002/033
2002	-	2002/082	-	-	2002/083, 2002/A4-01	-
2003[a]	17-26/02	2003/060, 2003/065, 2003/066	-	-	2003/017	2003/021
2004	22-24/03	2004/041, 2004/042, 2004/044, 2004/093	-	-	2004/019, 2004/041	-
2004[a]	25-29/10	-	-	-	-	2004/040
2005	16-17/02	2005/019, 2005/055, 2005/060	2005/003	-	-	2005/030
2006	17/01	-	-	2006/001	-	-
2006[a]	6-10/02	-	2006/010	-	-	2007/054
2006[a]	22-24/03	2006/086	-	-	-	2006/013
2007	15-16/02	2007/068	2007/003	-	-	2007/046
2007[a]	31/01-01/02	2007/066	2007/002	-	-	2007/050
2008[a]	25-29/02	2009/012	2008/003	-	-	2008/019
2008[a]	3-5/03	2009/027	-	-	-	-
2009[a]	24/02-06/03	2009/090, 2009/097	2009/010	-	-	2009/050
2010	23-24/02	-	2010/011	-	-	2010/013
2010	15/10	2011/003	-	-	-	2011/006
2010	25-28/10	2011/015	-	-	-	-

Year	Date (DD/MM)	RD	SAR	SR	SSR	PROC
2011[a]	21-25/02	-	2011/026	-	-	2011/048
2012	08-09/03	2012/056	2012/005	-	-	2012/013
2012	17/12	2012/171	-	2012/043	-	-
2013	06/12	-	-	2014/009	-	-
2015	19/02	2016/010	2015/041	-	-	2015/024
2017	23/02	2018/039	2017/042	-	-	2017/036
2019	21-22/02	2019/075	2019/032	-	-	2019/012
2020	14/01	-	-	2020/007	-	-
2021	14/01	-	-	2021/006	-	-
2021	21-22/04, 12/05	2021/067, 2022/015, 2022/033, 2022/049	-	-	-	2022/008
2022	26/01	-	-	2022/009	-	-
2022	24-26/05	2024/045	-	-	-	2023/026
2023	23-24/02	2025/039	2023/035	-	-	2023/039
2023	12/10	2023/085	-	-	-	-
2024	25/01	-	-	2024/011	-	-
2025	18-19	2025/074	2025/011	-	-	-

[a]Zonal meeting.

Table 2. Historical monthly commercial landings statistics (t) for the period 1964-2024. The annual TAC is also provided. Until 1998, the management year corresponded to the calendar year. The 1999/2000 management year began on January 1st, 1999 and ended on May 14th, 2000. Since then, the management year begins on May 15th of the current year and ends on May 14th of the following year. Unk. = unknown. '0' values indicate landings ≤ 0.5 t. Sources: NAFO 21B and ZIFF data.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Unk.	Total	TAC
1964	1,104	24,423	15,760	6,059	3,106	10,349	12,526	5,853	2,154	1,385	864	651	-	84,234	-
1965	791	12,577	21,171	3,698	2,146	5,267	10,421	5,945	3,636	1,359	927	990	-	68,928	-
1966	1,965	22,817	8,929	2,516	1,638	8,371	7,483	4,740	2,493	1,146	1,779	1,208	-	65,085	-
1967	7,873	7,028	14,792	8,448	2,017	7,524	12,665	5,232	7,154	3,314	1,352	1,912	1	79,312	-
1968	725	7,980	22,799	9,060	3,087	10,719	17,214	9,400	4,913	1,784	1,171	819	-	89,671	-
1969	875	4,654	9,675	4,220	5,192	10,958	12,103	8,639	7,866	3,557	2,035	1,366	-	71,140	-
1970	1,635	25,494	18,223	27,886	4,816	6,017	8,963	3,896	2,184	3,114	1,937	1,300	-	105,465	-
1971	845	44,587	7,580	5,265	2,346	5,857	8,427	3,042	2,343	1,600	1,003	915	-	83,810	-
1972	1,494	14,961	5,337	7,400	7,334	4,594	6,818	3,296	2,365	1,406	994	212	2,026	58,237	-
1973	16,472	10,556	7,586	4,826	3,235	5,860	5,125	4,145	2,365	1,459	1,016	567	2,593	65,805	-
1974	12,995	10,753	5,959	5,665	6,231	5,021	6,235	5,396	2,214	1,331	1,009	479	3,148	66,436	-
1975	8,232	19,486	2,702	2,616	5,316	5,122	5,042	4,488	2,767	1,267	819	704	1,672	60,233	-
1976	15,637	15,204	3,610	3,437	7,071	6,930	6,978	4,310	3,348	2,286	1,537	578	6,055	76,981	-
1977	11,143	8,603	3,790	11,312	10,057	7,368	8,133	5,780	3,361	1,751	1,814	454	-	73,566	55,000
1978	20,754	6,307	5,161	3,156	6,717	9,796	13,255	7,000	2,836	1,979	1,309	236	-	78,506	55,000
1979	15,543	4,273	6,475	6,647	8,517	12,890	12,085	8,660	2,971	2,449	1,816	451	-	82,777	75,000
1980	5,280	8,965	9,925	8,087	7,147	14,096	23,158	10,719	5,687	2,773	1,311	431	-	97,579	75,000
1981	9,156	15,368	3,170	3,763	12,835	17,257	16,344	10,343	5,676	2,550	1,172	277	-	97,911	75,000
1982	2,289	11,671	10,122	5,544	12,723	16,826	22,492	9,136	8,412	4,465	1,227	32	-	104,939	93,300
1983	4,152	10,213	11,335	6,251	21,049	18,341	16,228	8,173	5,698	3,956	530	154	-	106,080	100,000
1984	5,002	11,079	9,494	4,260	15,205	13,349	22,300	10,962	5,238	4,644	1,113	997	-	103,643	100,000
1985	2,416	16,369	7,661	3,407	6,904	12,612	13,874	11,414	7,730	3,130	1,005	1,959	-	88,481	100,000
1986	2,468	18,021	10,611	4,847	12,057	7,613	12,739	5,960	4,348	2,962	834	944	-	83,405	92,100
1987	8,264	7,382	5,072	3,945	6,411	8,222	9,060	7,492	5,745	2,842	1,022	1,089	-	66,545	80,300
1988	1,505	2,710	4,270	2,697	9,897	4,971	7,679	6,282	3,264	1,747	1,143	1,536	-	47,702	73,900
1989	6,198	7,500	1,993	2,048	6,520	6,229	6,306	4,797	2,080	2,189	721	181	-	46,762	76,540
1990	5,646	2,537	1,102	394	7,953	7,741	4,664	3,122	1,968	1,554	1,856	464	-	39,000	58,000
1991	1,532	2,001	3,113	3,736	4,229	4,477	5,314	2,891	3,242	2,016	1,810	121	-	34,481	35,000
1992	4,453	2,551	226	1,825	4,696	1,729	3,211	3,538	2,316	1,869	1,868	1,261	-	29,546	35,000
1993[1]	9	51	1,255	1,244	1,489	4,350	3,811	2,234	1,119	1,088	1,173	629	-	18,452	18,000

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Unk.	Total	TAC
1994	14	48	41	7	26	12	14	100	206	28	24	18	-	537	0
1995	-	-	-	0	12	5	26	95	25	21	-	-	-	185	0
1996	0	0	0	0	5	10	150	56	38	33	23	2	-	317	0
1997	0	1	-	2	357	255	1,189	962	815	1,038	145	27	-	4,792	6,000
1998	3	0	0	2	27	247	910	1,053	419	553	22	-	-	3,235	3,000
1999/00	52	132	26	88	99	870	1,985	1,458	1,031	1,014	395	39	-	7,191	7,500
2000/01	86	72	49	33	572	910	1,251	1,536	1,099	762	383	82	-	6,833	7,000
2001/02	110	58	6	10	447	518	1,849	1,269	1,338	865	293	125	-	6,887	7,000
2002/03	0	-	0	0	146	58	2,519	1,484	843	869	393	7	-	6,320	7,000
2003/04	0	-	0	13	8	13	118	131	48	31	39	5	-	405	0
2004/05	0	-	0	14	30	25	1,887	205	537	356	207	13	-	3,274	3,500
2005/06	-	-	0	24	44	69	2,434	628	774	473	22	3	-	4,471	5,000
2006/07	1	0	0	15	19	101	3,285	591	645	298	669	17	-	5,640	6,000
2007/08	-	-	1	7	22	132	3,711	447	1,126	578	447	5	-	6,474	7,000
2008/09	-	-	1	3	45	117	2,973	924	1,240	551	301	2	-	6,157	7,000
2009/10	1	0	2	2	7	176	1,691	693	690	696	687	51	-	4,696	7,000
2010/11	0	0	0	15	10	54	1,362	882	556	499	185	1	-	3,566	4,000
2011/12	0	0	0	12	15	50	1,006	163	315	11	193	9	-	1,773	2,000
2012/13	0	0	0	22	16	40	671	110	296	20	131	3	-	1,310	1,500
2013/14	-	-	-	7	11	34	699	77	220	10	147	3	-	1,208	1,500
2014/15	-	-	-	4	18	16	644	92	344	26	100	23	-	1,266	1,500
2015/16	-	-	-	10	12	19	731	138	187	18	137	13	-	1,264	1,500
2016/17	-	0	0	23	9	27	840	140	156	30	154	7	-	1,387	1,500
2017/18	-	-	-	12	16	30	903	706	637	24	206	129	-	2,664	3,185
2018/19[2]	-	0	0	10	18	19	861	773	323	221	268	74	-	2,569	3,185
2019/20[2]	1	0	-	1	15	23	304	97	167	28	87	38	-	760	1,000
2020/21[2]	1	-	-	20	11	17	383	63	66	117	15	8	-	702	1,000
2021/22[2]	1	1	7	19	13	25	372	65	44	129	3	-	-	678	1,000
2022/23[2]	-	-	0	14	11	15	38	38	27	9	7	2	-	162	0
2023/24[2]	0	-	5	4	8	15	21	37	31	12	17	5	-	156	0
2024/25[2]	-	-	-	-	4	10	50	42	9	5	1	0	-	120	0

[1]The TAC of 18 kt was established in August 1993. It was originally planned to be 35 kt (Fréchet et al. 1994).
[2]Preliminary data.

Table 3. Summary of the reference points of the precautionary approach for the 3Pn4RS cod stock. See DFO (2023a) for details.

Parameter	Value	Unit	Status
Limit Reference Point (LRP)	71,970	Tonnes of SSB	Adopted
Upper stock Reference (PRS)	143,939	Tonnes of SSB	Proposed
Removal reference (RR)	0.49	-	Proposed
Target Reference Point (Flim)	179,924	Tonnes of SSB	Proposed

Table 4. Total removals prescribed under the recovery plan according to the SSB relative to the LRP (% of LRP).

SSB relative to LRP (% LRP)	Total removals (t)
< 25	500
26-49	500
50-59	500
60-69	500
70-79	500
80-89	1,000
90-99	1,500
100-113	2,000

Table 5. Description of the 2023-2024 nGSL recreational cod fishing seasons. Zone 4S-West refers to the area between Pointe-des-Monts and Natashquan. Zone 4S-East refers to the area between Natashquan and Blanc-Sablon. IDQ = individual daily quota, MDQB = maximum daily quota per boat (N/A. = not applicable), D = season duration (d).

Year	Zone	IDQ	MDQB	D	Opening dates (DD/MM)
2023	4S-West	5	N/A	39	24/6-1/8
2023	4S-East	5	N/A	39	1-3/7, 8-10/7, 15-17/7, 22-24/7, 29-31/7, 5-7/8, 12-14/8, 19-21/8, 26-28/8, 2-4/9, 23/9-1/10
2023	3Pn4R	5	15	39	1-3/7, 8-10/7, 15-17/7, 22-24/7, 29-31/7, 5-7/8, 12-14/8, 19-21/8, 26-28/8, 2-4/9, 23/9-1/10
2024	4S-West	5	N/A	39	25/6-2/8
2024	4S-East	5	N/A	39	29/6-1/7, 6-8/7, 13-15/7, 20-22/7, 27-29/7, 3-5/8, 10-12/8, 17-19/8, 24-26/8, 31/8-2/9, 21-29/9
2024	3Pn4R	5	15	39	29/6-1/7, 6-8/7, 13-15/7, 20-22/7, 27-29/7, 3-5/8, 10-12/8, 17-19/8, 24-26/8, 31/8-2/9, 21-29/9

Table 6. Annual landings of 3Pn4RS cod reported by country/entity other than Canada since 1960. Source: NAFO 21B data.

Year	Landings (t)	Country/entity[a]
1960	49,871	1, 2, 3, 4, 5, 6
1961	61,784	1, 3, 5
1962	39,259	1, 3, 5
1963	25,006	1, 3, 5, 7
1964	42,251	1, 3, 4, 5, 6, 7, 8, 9
1965	31,481	1, 3, 4, 5, 6
1966	28,327	1, 3, 4, 5, 6, 8, 10
1967	41,948	1, 3, 4, 5, 6, 7
1968	39,102	1, 3, 4, 5, 6
1969	20,703	1, 3, 4, 5
1970	57,243	1, 3, 4, 5, 9
1971	48,474	1, 3, 4, 5, 9
1972	27,385	1, 3, 4, 5, 6, 11
1973	37,236	1, 3, 4, 5, 11

Year	Landings (t)	Country/entity[a]
1974	32,265	1, 3, 4, 5, 6, 11, 12
1975	31,644	1, 3, 4, 11
1976	34,275	1, 3, 4, 11
1977	18,138	1, 4
1978	15,771	1, 4
1979	13,769	1, 4
1980	9,396	1, 4
1981	12,508	1, 4
1982	12,013	1, 4
1983	10,684	1, 4
1984	11,623	1, 4
1985	9,185	1, 4
1986	13,122	1, 4
1987	1,535	4
1989	2,587	4
1990	2,485	4
1991	2,447	4
1992	2,333	4

[a]1 = France Mainland, 2 = Italy, 3 = Portugal, 4 = Saint Pierre and Miquelon, 5 = Spain, 6 = United Kingdom, 7 = Soviet Union, 8 = Iceland, 9 = United States of America, 10 = Poland, 11 = Faroe Islands, 12 = Norway

Table 7. Summary of the proposed assumptions for recreational fishery removals of nGSL cod, either as an assumed single annual value (in t) for years prior to 2006, or assumed lower (LB) and upper bounds (UB, in t) for a censored value subsequently. The sources for these values are indicated and details on how the estimates were derived from these sources are available in Ouellette-Plante et al. (2022a). ECAN = Canadian recreational fishing survey.

Year(s)	Value	LB	UB	Source
1974-1993	1027.5	-	-	Average, ECAN questionnaires (1974, 1985, 1990).
1994-1997	10	-	-	Assumed given moratorium, corroborated by 1995 ECAN questionnaire estimate of 16.5 t.
1998	294.1	-	-	Derived from northern cod estimate.
1999	339.3	-	-	Derived from northern cod estimate.
2000	226.2	-	-	Derived from northern cod estimate.
2001	395.9	-	-	Derived from northern cod estimate.
2002	113.1	-	-	Derived from northern cod estimate.
2003-2004	0	-	-	No recreational fishing allowed.
2005	40.8	-	-	ECAN questionnaire, noting that there was a moratorium in place and value may have been zero.
2006	-	221.1	500	Capture potential estimate / assumed upper bound.
2007	-	227.7	500	Capture potential estimate / assumed upper bound.
2008-2009	-	182.1	500	Capture potential estimate / assumed upper bound.
2010	-	188.6	500	Capture potential estimate / assumed upper bound.
2011	-	201.6	500	Capture potential estimate / assumed upper bound.
2012-2013	-	214.6	500	Capture potential estimate / assumed upper bound.
2014	-	214.6	600	Capture potential estimate / assumed upper bound.
2015	-	208.1	600	Capture potential estimate / assumed upper bound.
2016-2017	-	299.2	600	Capture potential estimate / assumed upper bound.
2018-2024	-	253.7	600	Capture potential estimate / assumed upper bound.

Table 8. *Summary of the different surveys of the sentinel mobile survey program used in the calculations of the summer series. RS = random stratified set, D = discretionary set, F = failed set, whether random stratified or discretionary.*

Year	Survey	Source	Date (DD-MM)		Duration (d)	Nb. vessels	Number of sets	
			Start	End			Total	Details
1995	3	ACPG	06-08	15-08	10	4	145	136 RS, 0 D, 9 F
		FFAW	25-07	02-08	9	5	181	175 RS, 0 D, 6 F
1996	5	ACPG	21-06	22-07	32	3	168	121 RS, 26 D, 21 F
		FFAW	03-07	18-07	16	5	164	151 RS, 7 D, 6 F
1997	7	ACPG	06-07	21-07	16	4	162	138 RS, 19 D, 5 F
		FFAW	08-07	22-07	15	5	151	147 RS, 0 D, 4 F
1998	9	ACPG	25-06	16-07	22	4	176	147 RS, 27 D, 2 F
		FFAW	06-07	14-07	9	5	144	142 RS, 0 D, 2 F
1999	11	ACPG	25-06	14-07	20	4	168	144 RS, 23 D, 1 F
		FFAW	05-07	09-07	5	5	167	150 RS, 16 D, 1 F
2000	13	ACPG	03-07	18-07	16	4	163	141 RS, 16 D, 6 F
		FFAW	03-07	12-07	10	5	161	150 RS, 9 D, 2 F
2001	15	ACPG	01-07	16-07	16	4	157	125 RS, 26 D, 6 F
		FFAW	05-07	09-07	5	5	160	150 RS, 7 D, 3 F
2002	20	ACPG	29-06	09-07	11	4	135	111 RS, 20 D, 4 F
		FFAW	03-07	19-07	17	5	158	150 RS, 8 D, 0 F
2003	22	ACPG	07-07	28-07	22	4	165	136 RS, 21 D, 8 F
		FFAW	01-07	04-07	4	5	161	159 RS, 0 D, 2 F
2004	25	ACPG	01-07	13-07	13	4	167	132 RS, 22 D, 13 F
		FFAW	01-07	03-07	3	5	150	148 RS, 0 D, 2 F
2005	28	ACPG	06-07	17-07	12	4	153	135 RS, 15 D, 3 F
		FFAW	01-07	08-07	8	5	150	148 RS, 0 D, 2 F
2006	32	ACPG	03-07	17-07	15	4	175	145 RS, 27 D, 3 F
		FFAW	02-07	06-07	5	5	150	150 RS, 0 D, 0 F
2007	34	ACPG	01-07	13-07	13	4	147	141 RS, 0 D, 6 F
		FFAW	30-06	04-07	5	5	150	150 RS, 0 D, 0 F
2008	36	ACPG	02-07	14-07	13	4	143	139 RS, 0 D, 4 F
		FFAW	01-07	04-07	4	5	150	150 RS, 0 D, 0 F
2009	38	ACPG	01-07	19-07	19	4	135	132 RS, 0 D, 3 F
		FFAW	30-06	04-07	5	5	150	150 RS, 0 D, 0 F

Year	Survey	Source	Date (DD-MM)		Duration (d)	Nb. vessels	Number of sets	
			Start	End			Total	Details
2010	40	ACPG	01-07	19-07	19	4	134	130 RS, 0 D, 4 F
2010	40	FFAW	30-06	05-07	6	5	150	150 RS, 0 D, 0 F
2011	42	ACPG	09-07	18-07	10	4	138	135 RS, 0 D, 3 F
2011	42	FFAW	30-06	05-07	6	5	150	150 RS, 0 D, 0 F
2012	44	ACPG	03-07	14-07	12	3	138	127 RS, 0 D, 11 F
2012	44	FFAW	30-06	07-07	8	5	150	150 RS, 0 D, 0 F
2013	46	ACPG	02-07	18-07	17	3	147	142 RS, 0 D, 5 F
2013	46	FFAW	01-07	06-07	6	4	148	148 RS, 0 D, 0 F
2014	48	ACPG	02-07	16-07	15	3	143	139 RS, 0 D, 4 F
2014	48	FFAW	01-07	11-07	11	3	150	149 RS, 0 D, 1 F
2015	50	ACPG	01-07	14-07	14	3	147	142 RS, 0 D, 5 F
2015	50	FFAW	30-06	04-07	5	3	148	146 RS, 0 D, 2 F
2016	52	ACPG	30-06	20-07	21	3	144	144 RS, 0 D, 0 F
2016	52	FFAW	30-06	03-07	4	3	145	145 RS, 0 D, 0 F
2017	53	ACPG	05-07	30-07	26	3	149	145 RS, 0 D, 4 F
2017	53	FFAW	08-07	14-07	7	3	120	120 RS, 0 D, 0 F
2018	55	ACPG	14-07	27-07	14	3	132	130 RS, 0 D, 2 F
2018	55	FFAW	30-06	05-07	6	3	120	120 RS, 0 D, 0 F
2019	56	ACPG	29-06	15-07	17	3	130	126 RS, 0 D, 4 F
2019	56	FFAW	30-06	05-07	6	3	118	117 RS, 0 D, 1 F
2020	58	ACPG	04-07	24-07	21	3	122	106 RS, 0 D, 16 F
2020	58	FFAW	02-07	07-07	6	3	119	114 RS, 0 D, 5 F
2021	59	ACPG	08-07	24-07	17	3	123	116 RS, 0 D, 7 F
2021	59	FFAW	05-07	15-07	11	3	118	113 RS, 0 D, 5 F
2022	61	ACPG	12-07	27-07	16	3	122	114 RS, 0 D, 8 F
2022	61	FFAW	01-07	09-07	9	2	105	105 RS, 0 D, 0 F
2023	62	ACPG	01-07	14-07	14	3	121	117 RS, 0 D, 4 F
2023	62	FFAW	01-07	06-07	6	3	120	119 RS, 0 D, 1 F
2024	64	ACPG	08-07	21-07	14	3	126	104 RS, 0 D, 22 F
2024	64	FFAW	02-07	06-07	5	3	120	111 RS, 0 D, 9 F

Table 9. Number of sentinel fixed gear survey program activities by year, zone, gear and month over the period 2022-2024. Zones are defined in Figure 15 of this document.

		Gillnet (month)						Longline (month)												
Year	**Zone**	**6**	**7**	**8**	**9**	**10**	**Total**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**	**Total**
2022	1	-	-	-	-	-	-	-	-	1	9	2	4	5	9	7	11	8	56	56
	2	-	-	-	1	-	1	-	-	-	-	-	10	4	4	4	5	-	27	28
	3	-	14	16	8	-	38	-	-	-	-	-	-	-	5	9	4	-	18	56
	4	6	16	24	6	5	57	-	-	-	-	-	-	-	-	-	-	-	-	57
	5	6	49	47	31	-	133	-	-	-	-	-	-	24	18	-	-	-	42	175
	6	23	59	60	9	-	151	-	-	-	-	-	-	-	-	-	-	-	-	151
	Total	**35**	**138**	**147**	**55**	**5**	**380**	**0**	**0**	**1**	**9**	**2**	**14**	**33**	**36**	**20**	**20**	**8**	**143**	**523**
2023	1	-	-	-	-	-	-	-	1	-	-	-	1	4	7	23	24	10	70	70
	2	-	-	-	-	-	-	-	-	-	-	-	8	6	4	3	5	6	32	32
	3	-	12	10	16	-	38	-	-	-	-	-	-	2	4	-	-	-	6	44
	4	1	20	22	10	3	56	-	-	-	-	-	-	-	-	-	-	-	-	56
	5	6	43	43	31	3	126	-	-	-	-	-	-	13	18	3	-	-	34	160
	6	9	67	51	15	-	142	-	-	-	-	-	-	-	-	-	-	-	-	142
	Total	**16**	**142**	**126**	**72**	**6**	**362**	**0**	**1**	**0**	**0**	**0**	**9**	**25**	**33**	**29**	**29**	**16**	**142**	**504**
2024	1	-	-	-	-	-	-	1	-	1	2	2	2	1	10	13	14	4	50	50
	2	-	-	-	-	-	-	-	-	-	-	-	4	8	6	-	-	-	18	18
	3	-	10	4	6	-	20	-	-	-	-	-	-	4	8	6	-	-	18	38
	4	1	20	16	18	-	55	-	-	-	-	-	-	-	-	-	-	-	-	55
	5	6	49	44	21	-	120	-	-	-	-	-	-	21	8	-	-	-	29	149
	6	1	40	28	-	-	69	-	-	-	-	-	-	-	-	-	-	-	-	69
	Total	**8**	**119**	**92**	**45**	**0**	**264**	**1**	**0**	**1**	**2**	**2**	**6**	**34**	**32**	**19**	**14**	**4**	**115**	**379**
Total		**59**	**399**	**365**	**172**	**11**	**1,006**	**1**	**1**	**2**	**11**	**4**	**29**	**92**	**101**	**68**	**63**	**28**	**400**	**1,406**

Table 10. Summary of the different surveys aimed at estimating the nGSL cod reproductive potential (CRP). S = systematic set, D = discretionary set, F = failed set, whether systematic or discretionary.

		Date (DD-MM)					Number of sets	
Year	**Survey**	**Start**	**End**	**Duration (d)**	**Nb. vessels**	**NAFO**	**Total**	**Details**
2002	19	29-04	19-05	21	1	3Pn, 4R	63	39 S, 23 D, 1 F
2004	24	05-05	12-05	8	1	3Pn, 4R	46	29 S, 16 D, 1 F
2005	27	16-05	24-05	9	1	3Pn, 4R	41	27 S, 14 D, 0 F

Year	Survey	Date (DD-MM) Start	End	Duration (d)	Nb. vessels	NAFO	Number of sets Total	Details
2006	31	05-05	12-05	8	2	3Pn, 4R	49	49 S, 0 D, 0 F
2007	33	23-05	29-05	7	2	3Pn, 4R	50	50 S, 0 D, 0 F
2008	35	03-05	08-05	6	2	3Pn, 4R	50	50 S, 0 D, 0 F
2009	37	12-05	19-05	8	2	3Pn, 4R	50	50 S, 0 D, 0 F
2010	39	04-05	13-05	10	2	3Pn, 4R	50	50 S, 0 D, 0 F
2011	41	02-05	03-05	2	1	4R	25	25 S, 0 D, 0 F
2012	43	07-05	09-05	3	1	4R	40	40 S, 0 D, 0 F
2013	45	03-05	06-05	4	1	4R	41	41 S, 0 D, 0 F
2014	47	28-05	31-05	4	1	4R	40	40 S, 0 D, 0 F
2015	49	12-05	14-05	3	1	4R	40	40 S, 0 D, 0 F
2016	51	02-05	04-05	3	1	4R	40	40 S, 0 D, 0 F
2018	54	22-05	25-05	4	1	4R	40	40 S, 0 D, 0 F
2020	57	27-05	30-05	4	1	4R	38	38 S, 0 D, 0 F
2022	60	24-05	26-05	3	1	4R	28	28 S, 0 D, 0 F
2024	63	04-05	07-05	4	1	4R	32	31 S, 0 D, 1 F

Table 11. Historical monthly commercial landings statistics (t) for the period 1999-2024, by calendar year. Unk. = unknown. '0' values indicate landings ≤ 0.5 t. Sources: NAFO 21B and ZIFF data.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Unk.	Total
1999	0	0	0	5	91	870	1,985	1,458	1,031	1,014	395	39	-	6,890
2000	52	132	26	83	543	910	1,251	1,536	1,099	762	383	82	-	6,857
2001	86	72	49	33	455	518	1,849	1,269	1,338	865	293	125	-	6,951
2002	110	58	6	10	173	58	2,519	1,484	843	869	393	7	-	6,529
2003	0	-	0	0	5	13	118	131	48	31	39	5	-	389
2004	0	-	0	13	30	25	1,887	205	537	356	207	13	-	3,274
2005	0	-	0	14	43	69	2,434	628	774	473	22	3	-	4,461
2006	-	-	0	24	23	101	3,285	591	645	298	669	17	-	5,652
2007	1	0	0	15	22	132	3,711	447	1,126	578	447	5	-	6,483
2008	-	-	1	7	40	117	2,973	924	1,240	551	301	2	-	6,158
2009	-	-	1	3	13	176	1,691	693	690	696	687	51	-	4,700
2010	1	0	2	2	6	54	1,362	882	556	499	185	1	-	3,552
2011	0	0	0	15	14	50	1,006	163	315	11	193	9	-	1,775
2012	0	0	0	12	19	40	671	110	296	20	131	3	-	1,303

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Unk.	Total
2013	0	0	0	22	10	34	699	77	220	10	147	3	-	1,222
2014	-	-	-	7	10	16	644	92	344	26	100	23	-	1,262
2015	-	-	-	4	21	19	731	138	187	18	137	13	-	1,267
2016	-	-	-	10	9	27	840	140	156	30	154	7	-	1,373
2017	-	0	0	23	12	30	903	706	637	24	206	129	-	2,671
2018	-	-	-	12	18	19	861	773	323	221	268	74	-	2,569
2019[1]	-	0	0	10	20	23	304	97	167	28	87	38	-	774
2020[1]	1	0	-	1	9	17	383	63	66	117	15	8	-	681
2021[1]	1	-	-	20	14	25	372	65	44	129	3	-	-	673
2022[1]	1	1	7	19	15	15	38	38	27	9	7	2	-	180
2023[1]	-	-	0	14	8	15	21	37	31	12	17	5	-	160
2024[1]	0	-	5	4	6	10	50	42	9	5	1	0	-	131

[1]Preliminary data.

Table 12. Reported landings (t) of Atlantic cod in the commercial fishery of the NAFO Divisions 3Pn4RS for the period 1985-2024, by year and NAFO unit area. The last four rows show the contributions (in %) of the different unit areas to the landings reported over different time intervals. Unit areas 4Ru and 4Su correspond to landings recorded in Divisions 4R and 4S respectively, but for which the exact unit area is unknown. Sources: NAFO 21B and ZIFF data.

Year	3Pn	4R						4S								
		4Ra	4Rb	4Rc	4Rd	4Ru	Tot.	4Si	4Ss	4Sv	4Sw	4Sx	4Sy	4Sz	4Su	Tot.
1985	14,320	15,783	11,082	3,551	6,880	17,508	54,804	3,169	776	1,853	4,247	3,003	4,188	2,119	0	19,356
1986	22,612	12,576	12,983	2,519	6,873	8,763	43,713	3,048	958	1,553	1,903	2,772	4,305	2,411	129	17,079
1987	18,349	16,297	5,801	2,936	7,936	804	33,774	2,113	1,004	1,284	1,346	1,810	3,181	2,997	687	14,422
1988	8,939	7,580	5,315	1,862	4,728	10,097	29,583	1,966	569	1,345	1,801	1,013	1,443	979	64	9,180
1989	7,280	9,439	4,124	1,239	6,409	8,213	29,424	1,733	240	1,939	1,814	1,079	2,042	1,161	52	10,058
1990	6,145	6,284	7,481	1,833	5,330	4,431	25,358	2,541	865	1,048	1,283	276	597	708	178	7,496
1991	7,290	6,131	6,099	2,761	4,485	2,143	21,619	1,089	191	831	1,517	360	884	659	41	5,572
1992	9,210	4,941	3,616	4,214	2,594	990	16,356	909	300	581	1,228	262	144	553	4	3,980
1993	3,194	4,071	5,679	2,021	1,723	-	13,494	53	340	342	654	39	88	249	-	1,763
1994	196	67	44	60	114	-	284	2	5	1	17	22	6	3	1	57
1995	35	3	17	5	11	-	35	0	2	62	42	2	1	4	-	115
1996	72	13	22	13	31	-	80	1	5	33	123	0	0	2	0	165
1997	2,006	806	600	593	299	-	2,298	0	7	141	327	7	1	4	-	488
1998	877	387	367	316	637	-	1,706	0	13	78	531	27	0	3	-	652
1999/00	1,382	1,552	1,481	918	1,004	-	4,954	1	29	126	632	44	20	2	1	854

Year	3Pn	4R						4S								
		4Ra	4Rb	4Rc	4Rd	4Ru	Tot.	4Si	4Ss	4Sv	4Sw	4Sx	4Sy	4Sz	4Su	Tot.
2000/01	1,482	1,215	1,466	796	809	0	4,287	1	47	195	714	94	13	1	0	1,065
2001/02	1,712	1,319	1,267	960	720	17	4,283	1	26	246	561	26	12	1	19	892
2002/03	1,521	1,173	1,376	795	590	3	3,938	1	22	123	686	20	7	0	2	861
2003/04	104	36	81	21	70	0	209	1	6	20	60	4	1	1	-	93
2004/05	777	595	642	297	350	1	1,884	0	14	98	442	45	11	1	3	613
2005/06	872	976	701	437	770	68	2,952	0	7	278	293	5	11	3	50	647
2006/07	1,197	1,197	680	434	1,167	193	3,671	0	12	297	427	11	20	2	2	772
2007/08	1,072	1,574	939	748	914	369	4,544	1	15	146	668	11	5	5	9	859
2008/09	1,123	1,705	973	665	832	2	4,177	2	18	194	610	16	14	2	3	858
2009/10	1,360	921	799	424	592	-	2,735	2	12	183	380	14	8	2	-	601
2010/11	710	1,135	546	270	223	1	2,175	4	15	276	346	22	14	4	0	681
2011/12	319	511	188	143	84	0	925	12	17	132	239	115	11	3	-	530
2012/13	195	372	188	105	66	-	730	7	10	73	181	104	5	4	-	385
2013/14	173	365	145	151	99	0	761	8	5	57	163	32	6	4	-	275
2014/15	159	491	138	105	49	-	784	13	10	79	167	41	2	11	0	324
2015/16	150	422	141	85	57	-	705	9	19	123	197	31	3	27	0	408
2016/17	187	510	130	79	81	-	799	8	7	114	150	86	4	32	-	400
2017/18	339	1,202	298	230	135	-	1,866	83	14	69	194	40	1	57	0	459
2018/19	431	1,240	207	105	89	-	1,641	40	6	91	247	32	1	81	-	498
2019/20	143	250	68	20	41	-	379	40	2	22	104	31	1	37	1	239
2020/21	156	194	95	36	53	-	378	8	13	32	91	13	1	10	-	169
2021/22	150	206	72	20	36	-	334	10	7	33	91	32	13	9	-	194
2022/23	30	9	4	2	13	-	29	10	3	9	46	26	2	7	-	104
2023/24	31	14	9	4	17	-	43	5	3	10	50	12	2	0	-	82
2024/25	2	2	4	1	8	-	16	1	3	6	85	4	1	0	2	102
Last 2 years	12.0	6.0	4.6	1.7	9.0	-	21.4	2.3	2.4	5.6	48.9	5.8	0.9	0.1	0.8	66.7
Last 5 years	20.3	23.4	10.2	3.5	7.0	-	44.0	1.9	1.7	4.9	20.0	4.8	1.0	1.4	0.1	35.8
Last 10 years	15.5	38.7	9.8	5.6	5.1	-	59.2	2.1	0.8	4.9	12.0	2.9	0.3	2.5	0.0	25.4
Since 1985	21.5	19.1	14.0	5.9	10.5	9.9	59.4	3.1	1.0	2.6	4.6	2.1	3.2	2.2	0.2	19.1

Table 13. Preliminary landings statistics (t) for Atlantic cod in NAFO Subdivision 3Pn in 2024. NL = Newfoundland and Labrador. Source: ZIFF data.

Province	Gear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
NL	Bottom trawls	-	-	4.4	-	-	-	-	-	-	0.0	-	-	**4.5**
	Longlines	-	-	-	2.5	3.4	-	-	-	-	-	-	-	**5.9**
	Total	**-**	**-**	**4.4**	**2.5**	**3.4**	**-**	**-**	**-**	**-**	**0.0**	**-**	**-**	**10.3**
	Great total	**-**	**-**	**4.4**	**2.5**	**3.4**	**-**	**-**	**-**	**-**	**0.0**	**-**	**-**	**10.3**

Table 14. Preliminary landings statistics (t) for Atlantic cod in NAFO Division 4R in 2024. NB = New Brunswick, NL = Newfoundland and Labrador, NS = Nova Scotia, QC = Quebec. Source: ZIFF data.

Province	Gear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
NB	Mid-water trawls	-	-	-	0.0	-	-	-	-	-	-	-	-	**0.0**
	Total	**-**	**-**	**-**	**0.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.0**
NL	Bottom trawls	-	-	0.0	-	-	-	-	-	-	0.1	0.5	-	**0.7**
	Gillnets	-	-	-	-	-	-	-	-	-	-	0.2	-	**0.2**
	Longlines	-	-	-	0.1	0.2	0.3	2.5	3.4	0.1	2.5	0.1	-	**9.2**
	Mid-water trawls	-	-	0.3	0.1	-	-	-	-	-	-	-	-	**0.4**
	Seines	-	-	-	-	-	-	-	1.4	0.9	0.1	-	-	**2.3**
	Total	**-**	**-**	**0.3**	**0.2**	**0.2**	**0.3**	**2.5**	**4.8**	**1.0**	**2.7**	**0.9**	**-**	**12.8**
NS	Bottom trawls	0.1	-	-	-	-	-	-	-	-	-	-	-	**0.1**
	Longlines	-	-	-	-	-	-	-	0.5	-	-	-	-	**0.5**
	Others and unknown	-	-	-	-	-	0.4	-	-	-	-	-	-	**0.4**
	Total	**0.1**	**-**	**-**	**-**	**-**	**0.4**	**-**	**0.5**	**-**	**-**	**-**	**-**	**1.0**
QC	Bottom trawls	-	-	0.5	-	-	-	-	-	-	-	-	-	**0.5**
	Longlines	-	-	-	0.4	-	-	0.3	0.2	1.2	0.9	-	-	**3.0**
	Total	**-**	**-**	**0.5**	**0.4**	**-**	**-**	**0.3**	**0.2**	**1.2**	**0.9**	**-**	**-**	**3.5**
	Great total	**0.1**	**-**	**0.8**	**0.6**	**0.2**	**0.6**	**2.8**	**5.5**	**2.2**	**3.6**	**0.9**	**-**	**17.3**

Table 15. Preliminary landings statistics (t) for Atlantic cod in NAFO Division 4S in 2024. NS = Nova Scotia, QC = Quebec. Source: ZIFF data.

Province	Gear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
NS	Longlines	-	-	-	-	-	-	-	-	-	0.0	-	-	**0.0**
	Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.0**	**-**	**-**	**0.0**
QC	Bottom trawls	-	-	-	-	-	0.1	0.0	-	-	0.0	0.1	0.0	**0.3**
	Gillnets	-	-	-	-	-	4.1	45.1	33.0	4.8	0.0	0.1	-	**87.0**
	Longlines	-	-	-	0.3	2.2	5.2	2.5	3.1	1.0	1.4	-	-	**15.8**
	Total	**-**	**-**	**-**	**0.3**	**2.2**	**9.4**	**47.7**	**36.0**	**5.9**	**1.5**	**0.1**	**0.0**	**103.1**
	Great total	**-**	**-**	**-**	**0.3**	**2.2**	**9.4**	**47.7**	**36.0**	**5.9**	**1.5**	**0.1**	**0.0**	**103.1**

Table 16. Preliminary landings statistics (t) for Atlantic cod in NAFO Divisions 3Pn4RS in 2024. NB = New Brunswick, NL = Newfoundland and Labrador, NS = Nova Scotia, QC = Quebec. Source: ZIFF data.

Province	Gear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
NB	Mid-water trawls	-	-	-	0.0	-	-	-	-	-	-	-	-	**0.0**
	Total	**-**	**-**	**-**	**0.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.0**
NL	Bottom trawls	-	-	4.5	-	-	-	-	-	-	0.1	0.5	-	**5.2**
	Gillnets	-	-	-	-	-	-	-	-	-	-	0.2	-	**0.2**
	Longlines	-	-	-	2.6	3.6	0.3	2.5	3.4	0.1	2.5	0.1	-	**15.0**
	Mid-water trawls	-	-	0.3	0.1	-	-	-	-	-	-	-	-	**0.4**
	Seines	-	-	-	-	-	-	-	1.4	0.9	0.1	-	-	**2.3**
	Total	**-**	**-**	**4.8**	**2.7**	**3.6**	**0.3**	**2.5**	**4.8**	**1.0**	**2.7**	**0.9**	**-**	**23.1**
NS	Bottom trawls	0.1	-	-	-	-	-	-	-	-	-	-	-	**0.1**
	Longlines	-	-	-	-	-	-	-	0.5	-	0.0	-	-	**0.6**
	Others and unknown	-	-	-	-	-	0.4	-	-	-	-	-	-	**0.4**
	Total	**0.1**	**-**	**-**	**-**	**-**	**0.4**	**-**	**0.5**	**-**	**0.0**	**-**	**-**	**1.0**
QC	Bottom trawls	-	-	0.5	-	-	0.1	0.0	-	-	0.0	0.1	0.0	**0.8**
	Gillnets	-	-	-	-	-	4.1	45.1	33.0	4.8	0.0	0.1	-	**87.0**
	Longlines	-	-	-	0.7	2.2	5.2	2.9	3.3	2.3	2.3	-	-	**18.8**
	Total	**-**	**-**	**0.5**	**0.7**	**2.2**	**9.4**	**48.0**	**36.2**	**7.1**	**2.3**	**0.1**	**0.0**	**106.6**
	Great total	**0.1**	**-**	**5.3**	**3.4**	**5.8**	**10.1**	**50.5**	**41.5**	**8.1**	**5.1**	**1.0**	**0.0**	**130.8**

Table 17. Annual landings statistics (t, calendar year) for the period 1964-2024 in Subdivision 3Pn, by gear categories. '0' values indicate landings ≤ 0.5 t. OTB = Bottom trawls, GNS = Gillnets, LLS = Longlines, OTM = Mid-water trawls, SDN = Seines, LHP = Handlines, FPN = Traps and others, ST = Shrimp trawls, OTHER = Others and unknown. Sources: NAFO 21B and ZIFF data.

Year	OTB	GNS	LLS	OTM	SDN	LHP	FPN	ST	OTHER	Total
1964	6,283	-	3,416	-	-	558	-	-	4,875	15,132
1965	9,104	-	2,702	-	-	113	-	-	4,815	16,734
1966	8,258	-	2,499	-	-	16	-	-	2,851	13,624
1967	16,300	-	657	-	33	-	-	-	3,438	20,428
1968	6,748	-	85	-	12	33	-	-	5,031	11,909
1969	524	429	3,630	-	10	270	-	-	54	4,917
1970	458	612	3,378	-	5	675	44	-	33	5,205
1971	1,555	364	5,574	-	-	217	-	-	134	7,844
1972	3,893	181	5,593	-	545	115	10	-	20	10,357
1973	3,908	175	5,431	2	174	1,515	-	-	95	11,300
1974	10,087	297	2,460	16	58	180	-	-	915	14,013
1975	3,575	61	2,418	9	6	152	-	-	12	6,233
1976	2,747	163	4,467	55	163	225	9	-	636	8,465
1977	1,492	73	5,679	2	119	163	37	-	-	7,565
1978	1,293	34	5,323	25	17	103	7	-	-	6,802
1979	3,215	40	7,338	1	181	116	25	-	-	10,916
1980	2,238	13	6,443	4	18	83	-	-	-	8,799
1981	7,460	3	7,560	3	28	72	4	-	-	15,130
1982	7,707	8	7,670	-	12	87	1	-	-	15,485
1983	9,154	46	6,789	-	20	97	1	-	-	16,107
1984	8,177	129	7,089	-	499	45	2	-	-	15,941
1985	7,740	37	5,633	-	167	25	5	-	714	14,320
1986	17,016	7	5,526	-	17	46	0	-	-	22,612
1987	11,680	24	6,576	29	27	12	-	-	-	18,349
1988	5,510	11	3,326	63	24	4	-	-	-	8,939
1989	5,358	146	1,722	44	1	8	0	-	-	7,280
1990	4,887	231	879	106	19	23	-	1	-	6,145
1991	5,345	280	1,217	349	76	22	0	-	-	7,290
1992	7,587	184	1,156	214	33	35	-	-	-	9,210
1993	1,192	153	1,387	405	0	57	-	-	-	3,194
1994	14	3	6	91	-	81	-	-	-	196
1995	0	13	22	0	0	0	0	-	-	35
1996	1	14	58	-	-	-	-	-	-	72
1997	12	5	1,969	-	-	20	-	-	-	2,006
1998	0	2	859	0	-	15	-	-	-	877
1999	2	2	1,110	-	2	49	-	-	-	1,165
2000	0	3	1,442	-	0	33	-	-	-	1,478
2001	1	2	1,715	-	-	21	-	-	-	1,740
2002	15	0	1,657	-	-	40	-	-	-	1,713
2003	1	1	85	-	-	-	-	-	-	86
2004	0	1	772	-	-	10	-	-	-	783
2005	0	1	851	-	-	4	-	-	-	856
2006	3	1	1,198	-	-	5	1	-	-	1,208
2007	0	3	1,074	-	-	4	-	-	-	1,081
2008	0	3	1,125	-	-	3	-	-	-	1,131
2009	0	6	1,345	-	-	6	-	-	-	1,357
2010	0	2	697	-	-	6	-	-	-	705
2011	0	7	302	-	-	6	1	-	-	316
2012	0	10	176	-	0	2	-	-	-	187

Year	OTB	GNS	LLS	OTM	SDN	LHP	FPN	ST	OTHER	Total
2013	-	1	182	-	0	2	-	-	-	185
2014	0	3	149	-	-	1	-	-	-	153
2015	0	1	153	-	-	0	-	-	-	155
2016	0	0	172	-	-	2	-	-	-	174
2017	0	1	341	-	-	3	-	-	-	345
2018	0	1	427	-	-	5	-	-	-	433
2019	2	2	147	-	-	2	-	-	-	153
2020	1	-	135	-	-	2	-	-	-	137
2021	3	-	142	-	-	2	-	-	0	147
2022	4	5	33	-	-	0	-	-	-	42
2023	1	12	22	0	-	-	-	-	-	35
2024	4	-	6	-	-	-	-	-	-	10

Table 18. Annual landings statistics (t, calendar year) for the period 1964-2024 in Division 4R, by gear categories. '0' values indicate landings ≤ 0.5 t. OTB = Bottom trawls, GNS = Gillnets, LLS = Longlines, OTM = Mid-water trawls, SDN = Seines, LHP = Handlines, FPN = Traps and others, ST = Shrimp trawls, OTHER = Others and unknown. Sources: NAFO 21B and ZIFF data.

Year	OTB	GNS	LLS	OTM	SDN	LHP	FPN	ST	OTHER	Total
1964	39,862	-	123	-	192	-	-	-	18,783	58,960
1965	26,773	-	156	-	144	-	-	-	16,766	43,839
1966	28,422	-	201	-	53	-	-	-	15,532	44,208
1967	28,672	-	207	-	87	-	-	-	20,975	49,941
1968	42,436	289	1,138	-	62	-	-	-	26,116	70,041
1969	32,913	10,905	4,405	-	198	1,622	3,943	-	2,646	56,632
1970	74,946	4,319	5,489	-	239	1,856	2,349	-	1,948	91,146
1971	53,804	3,714	3,076	-	247	1,295	3,790	-	436	66,362
1972	27,729	2,835	1,115	324	16	1,107	1,582	-	2,875	37,583
1973	31,192	3,154	2,564	284	120	1,007	2,007	-	2,766	43,094
1974	27,393	5,182	1,358	1,121	223	1,714	1,789	-	666	39,446
1975	28,615	6,462	978	1,358	221	1,413	2,032	-	490	41,569
1976	37,672	7,671	527	2,750	155	1,445	1,572	-	4,238	56,030
1977	39,624	7,866	1,429	169	147	1,591	2,414	-	147	53,387
1978	33,277	13,235	2,462	1,881	233	1,749	4,103	-	-	56,940
1979	30,978	11,479	5,031	1,760	311	3,138	3,071	-	-	55,768
1980	33,527	11,607	7,768	580	467	2,380	8,354	-	-	64,683
1981	37,883	5,796	8,936	348	384	2,096	5,408	-	327	61,178
1982	38,088	9,465	7,208	790	337	2,126	7,473	-	-	65,487
1983	38,345	11,849	6,614	2	473	5,047	3,415	-	-	65,745
1984	43,622	6,625	7,305	21	-	2,821	2,899	-	-	63,293
1985	33,637	4,390	7,270	-	267	2,294	3,773	496	2,678	54,804
1986	29,118	4,849	4,648	1	700	1,027	2,847	523	-	43,713
1987	20,917	4,951	4,650	21	949	748	1,290	247	-	33,774
1988	18,110	5,438	2,658	335	837	733	980	493	-	29,583
1989	21,154	4,078	1,610	159	772	632	736	283	-	29,424
1990	19,065	1,797	1,929	74	773	863	387	469	-	25,358
1991	11,816	2,532	2,275	362	606	1,187	2,308	532	-	21,619
1992	9,482	1,555	1,686	200	521	1,142	1,471	300	-	16,356
1993	7,473	1,739	566	169	190	846	2,458	52	-	13,494
1994	30	13	69	13	9	148	-	2	-	284
1995	0	14	15	-	4	1	-	0	-	35
1996	1	30	33	-	11	0	4	-	0	80
1997	43	233	1,712	0	8	245	57	0	-	2,298
1998	0	131	1,295	1	30	247	2	0	-	1,706

Year	OTB	GNS	LLS	OTM	SDN	LHP	FPN	ST	OTHER	Total
1999	7	2,801	1,151	-	32	890	0	0	-	4,882
2000	24	2,230	1,491	-	36	515	26	-	0	4,322
2001	23	1,683	1,825	-	64	716	8	-	-	4,320
2002	17	1,939	1,371	-	29	582	-	-	-	3,938
2003	9	80	95	-	25	1	1	-	-	210
2004	28	956	566	-	44	290	0	-	-	1,884
2005	32	1,673	978	-	50	217	1	-	-	2,951
2006	76	1,971	1,412	-	38	174	0	-	-	3,672
2007	0	2,638	1,746	-	31	130	-	-	-	4,544
2008	1	2,285	1,657	-	25	204	0	-	-	4,173
2009	1	1,417	1,129	-	23	166	1	-	-	2,738
2010	2	1,268	648	-	13	244	0	-	-	2,176
2011	1	681	152	-	12	74	0	4	-	923
2012	1	558	101	-	4	67	-	-	-	732
2013	0	464	171	-	2	123	1	0	-	761
2014	2	571	84	-	3	123	0	0	-	783
2015	-	571	89	-	4	42	-	-	-	706
2016	2	613	120	-	5	58	1	-	-	799
2017	3	1,490	204	-	6	163	-	-	-	1,866
2018	3	1,431	151	-	7	49	0	0	-	1,640
2019	5	287	51	-	3	33	-	-	-	379
2020	3	302	47	-	1	23	-	-	0	376
2021	2	283	30	-	4	12	-	-	0	330
2022	5	7	18	-	2	-	-	-	-	33
2023	3	11	27	1	2	-	-	-	-	43
2024	1	0	13	0	2	-	-	-	0	17

Table 19. Annual landings statistics (t, calendar year) for the period 1964-2024 in Division 4S, by gear categories. '0' values indicate landings ≤ 0.5 t. OTB = Bottom trawls, GNS = Gillnets, LLS = Longlines, OTM = Mid-water trawls, SDN = Seines, LHP = Handlines, FPN = Traps and others, ST = Shrimp trawls, OTHER = Others and unknown. Sources: NAFO 21B and ZIFF data.

Year	OTB	GNS	LLS	OTM	SDN	LHP	FPN	ST	OTHER	Total
1964	3,490	-	486	-	-	-	-	-	6,166	10,142
1965	4,060	24	320	-	1	-	3,358	-	592	8,355
1966	3,385	973	441	-	-	-	1,656	-	798	7,253
1967	3,840	1,618	305	-	-	710	2,470	-	-	8,943
1968	2,568	1,127	333	-	-	623	3,070	-	-	7,721
1969	4,450	1,960	262	-	-	607	2,312	-	-	9,591
1970	5,435	846	252	-	-	792	1,789	-	-	9,114
1971	5,163	963	564	1	-	503	2,410	-	-	9,604
1972	5,802	1,418	511	15	-	511	2,040	-	-	10,297
1973	5,632	1,774	402	124	-	470	885	-	2,124	11,411
1974	6,661	2,326	976	348	-	402	200	-	2,064	12,977
1975	5,799	2,072	136	83	-	2,337	579	-	1,425	12,431
1976	6,441	2,900	46	369	-	353	992	-	1,385	12,486
1977	7,229	4,089	36	94	2	303	861	-	-	12,614
1978	8,420	3,626	28	316	2	194	2,178	-	-	14,764
1979	7,667	6,578	148	190	-	467	1,043	-	-	16,093
1980	8,740	1,376	1,796	527	-	-	-	-	11,658	24,097
1981	5,936	364	2,678	17	51	-	3	-	12,554	21,603
1982	8,267	27	3,688	340	3	-	13	-	11,629	23,967
1983	8,295	622	3,890	-	174	2	-	-	11,245	24,228
1984	7,845	8,923	4,301	2	1,694	961	675	-	8	24,409

Year	OTB	GNS	LLS	OTM	SDN	LHP	FPN	ST	OTHER	Total
1985	4,466	6,183	4,325	0	-	893	1,210	1,651	627	19,356
1986	6,356	4,277	2,869	0	120	379	52	3,026	-	17,079
1987	6,908	3,065	2,185	8	46	219	9	1,982	0	14,422
1988	3,281	3,775	1,228	33	28	42	1	793	-	9,180
1989	4,263	3,207	1,394	3	9	377	3	803	-	10,058
1990	3,949	1,824	675	34	12	159	1	842	-	7,496
1991	1,888	1,467	682	15	0	480	48	991	-	5,572
1992	1,967	1,142	345	5	-	78	25	419	-	3,980
1993	796	609	172	18	-	138	-	31	-	1,763
1994	4	7	23	2	-	-	-	3	19	57
1995	1	20	6	-	0	-	-	0	88	115
1996	1	150	7	-	-	-	0	0	6	165
1997	3	300	176	-	-	-	-	1	7	488
1998	3	495	148	0	0	-	-	0	6	652
1999	2	598	214	-	-	30	-	0	-	844
2000	0	813	234	0	-	9	-	0	-	1,057
2001	2	335	413	-	-	136	5	0	-	892
2002	2	733	127	-	1	12	5	0	0	879
2003	1	81	11	-	-	-	0	0	-	93
2004	0	525	71	-	-	11	-	0	-	607
2005	3	612	26	-	0	8	5	0	-	653
2006	5	712	46	-	-	9	-	0	-	772
2007	-	789	48	-	-	21	-	0	-	858
2008	0	739	106	-	-	8	-	0	-	854
2009	0	429	140	-	-	35	1	0	-	605
2010	1	439	218	-	-	13	0	0	-	671
2011	0	316	217	-	-	4	-	0	-	537
2012	1	252	126	-	-	5	-	0	-	384
2013	1	206	61	-	-	6	0	1	-	275
2014	0	210	110	-	-	5	-	0	-	325
2015	1	300	100	-	-	5	-	0	-	406
2016	1	253	141	-	-	4	0	0	-	400
2017	0	256	199	-	-	5	-	0	-	460
2018	2	357	136	-	-	1	-	0	-	496
2019	2	151	85	0	-	4	-	0	-	242
2020	1	126	38	-	-	2	-	0	0	168
2021	-	140	54	1	-	-	-	0	-	195
2022	2	60	42	-	-	-	-	0	-	105
2023	0	54	27	-	-	-	-	0	-	82
2024	0	87	16	-	-	-	-	-	-	103

Table 20. Annual landings statistics (t, calendar year) for the period 1964-2024 in Divisions 3Pn4RS, by gear categories. '0' values indicate landings ≤ 0.5 t. OTB = Bottom trawls, GNS = Gillnets, LLS = Longlines, OTM = Mid-water trawls, SDN = Seines, LHP = Handlines, FPN = Traps and others, ST = Shrimp trawls, OTHER = Others and unknown. Sources: NAFO 21B and ZIFF data.

Year	OTB	GNS	LLS	OTM	SDN	LHP	FPN	ST	OTHER	Total
1964	49,635	-	4,025	-	192	558	-	-	29,824	84,234
1965	39,937	24	3,178	-	145	113	3,358	-	22,173	68,928
1966	40,065	973	3,141	-	53	16	1,656	-	19,181	65,085
1967	48,812	1,618	1,169	-	120	710	2,470	-	24,413	79,312
1968	51,752	1,416	1,556	-	74	656	3,070	-	31,147	89,671
1969	37,887	13,294	8,297	-	208	2,499	6,255	-	2,700	71,140
1970	80,839	5,777	9,119	-	244	3,323	4,182	-	1,981	105,465

Year	OTB	GNS	LLS	OTM	SDN	LHP	FPN	ST	OTHER	Total
1971	60,522	5,041	9,214	1	247	2,015	6,200	-	570	83,810
1972	37,424	4,434	7,219	339	561	1,733	3,632	-	2,895	58,237
1973	40,732	5,103	8,397	410	294	2,992	2,892	-	4,985	65,805
1974	44,141	7,805	4,794	1,485	281	2,296	1,989	-	3,645	66,436
1975	37,989	8,595	3,532	1,450	227	3,902	2,611	-	1,927	60,233
1976	46,860	10,734	5,040	3,174	318	2,023	2,573	-	6,259	76,981
1977	48,345	12,028	7,144	265	268	2,057	3,312	-	147	73,566
1978	42,990	16,895	7,813	2,222	252	2,046	6,288	-	-	78,506
1979	41,860	18,097	12,517	1,951	492	3,721	4,139	-	-	82,777
1980	44,505	12,996	16,007	1,111	485	2,463	8,354	-	11,658	97,579
1981	51,279	6,163	19,174	368	463	2,168	5,415	-	12,881	97,911
1982	54,062	9,500	18,566	1,130	352	2,213	7,487	-	11,629	104,939
1983	55,794	12,517	17,293	2	667	5,146	3,416	-	11,245	106,080
1984	59,644	15,677	18,695	23	2,193	3,827	3,576	-	8	103,643
1985	45,843	10,610	17,228	0	434	3,211	4,987	2,148	4,019	88,481
1986	52,490	9,134	13,043	1	837	1,452	2,899	3,549	-	83,405
1987	39,506	8,039	13,411	58	1,023	979	1,299	2,229	0	66,545
1988	26,901	9,223	7,211	431	889	779	981	1,286	-	47,702
1989	30,775	7,431	4,726	206	782	1,017	739	1,086	-	46,762
1990	27,900	3,852	3,483	214	805	1,045	388	1,312	-	39,000
1991	19,050	4,279	4,174	727	683	1,689	2,357	1,523	-	34,481
1992	19,036	2,881	3,187	419	554	1,254	1,496	718	-	29,546
1993	9,461	2,501	2,124	592	190	1,041	2,458	83	-	18,452
1994	48	23	98	106	9	229	-	5	19	537
1995	1	48	42	0	4	1	0	0	88	185
1996	4	193	97	-	11	0	4	0	6	317
1997	58	538	3,857	0	8	265	57	1	7	4,792
1998	4	628	2,302	1	30	261	2	0	6	3,235
1999	11	3,401	2,475	-	35	968	0	0	-	6,890
2000	24	3,046	3,167	0	36	557	26	0	0	6,857
2001	27	2,020	3,953	-	64	873	13	0	-	6,951
2002	34	2,672	3,155	-	30	634	5	0	0	6,529
2003	10	161	191	-	25	1	1	0	-	389
2004	29	1,482	1,408	-	44	310	0	0	-	3,274
2005	35	2,285	1,855	-	50	229	6	0	-	4,461
2006	84	2,685	2,655	-	38	189	1	0	-	5,652
2007	0	3,430	2,868	-	31	154	-	0	-	6,483
2008	2	3,027	2,889	-	25	215	0	0	-	6,158
2009	2	1,852	2,615	-	23	207	2	0	-	4,700
2010	3	1,710	1,563	-	13	263	0	0	-	3,552
2011	1	1,004	671	-	12	84	1	4	-	1,775
2012	2	820	403	-	4	74	-	0	-	1,303
2013	1	670	415	-	2	131	1	1	-	1,222
2014	2	785	342	-	3	129	0	0	-	1,262
2015	1	872	342	-	4	48	-	0	-	1,267
2016	3	866	433	-	5	64	1	0	-	1,373
2017	3	1,747	744	-	6	171	-	0	-	2,671
2018	5	1,789	714	-	7	54	0	0	-	2,569
2019	9	441	283	0	3	38	-	0	-	774
2020	5	428	219	-	1	27	-	0	0	681
2021	5	423	226	1	4	14	-	0	0	673
2022	11	72	94	-	2	0	-	0	-	180
2023	4	77	76	1	2	-	-	0	-	160
2024	6	87	34	0	2	-	-	-	0	131

Table 21. Description of 3Pn4RS cod samples taken as part of the DFO commercial dockside monitoring program during the period 2023-2024. The last two columns provide the number of cod measured for length (LF) and having been aged (Age). LLS = Longline (anchored).

Year	Sample	Date	State at landing	NAFO	Gear	LF	Age
2023	1	2023-05-06	Gutted head on	4Si	LLS	118	29
	2	2023-05-29	Gutted head on	4Sy	LLS	150	35
	3	2023-06-07	Gutted head on	4Si	LLS	230	39
	4	2023-06-12	Gutted head on	4Si	LLS	84	32
	5	2023-06-22	Gutted head on	4Sx	LLS	163	37
	6	2023-06-28	Gutted head on	4Sx	LLS	151	38
	7	2023-06-30	Gutted head on	4Sx	LLS	156	43
	8	2023-07-04	Gutted head on	4Sx	LLS	150	43
	9	2023-07-08	Gutted head on	4Sy	LLS	211	35
	10	2023-07-17	Gutted head on	4Sx	LLS	80	30
	11	2023-08-03	Gutted head on	4Sx	LLS	98	26
	12	2023-08-17	Gutted head on	4S	LLS	45	32
	12 samples		**-**	**-**	**-**	**1,636**	**419**
2024	13	2024-04-03	Gutted head on	4Rc	LLS	40	0
	14	2024-04-03	Gutted head on	4Rc	LLS	11	0
	15	2024-04-10	Gutted head on	4Si	LLS	32	13
	16	2024-05-08	Gutted head on	4Sv	LLS	150	46
	17	2024-05-24	Gutted head on	4Sv	LLS	159	52
	18	2024-05-24	Gutted head on	4Sx	LLS	153	31
	19	2024-06-05	Gutted head on	4Sx	LLS	150	40
	20	2024-06-05	Gutted head on	4Ss	LLS	160	45
	21	2024-06-06	Gutted head on	4Sx	LLS	162	44
	22	2024-08-13	Gutted head on	4R	LLS	36	34
	23	2024-08-19	Gutted head on	4Sx	LLS	151	38
	24	2024-09-12	Round	4Rd	LLS	8	8
	25	2024-10-02	Gutted head on	4Sv	LLS	151	35
	13 samples		**-**	**-**	**-**	**1,363**	**386**
Total	**25 samples**		**-**	**-**	**-**	**2,999**	**805**

Table 22. Summary of length frequency (LF) and age readings data matches from the k strata used in annual catch-at-age calculations of commercial landings for the 2022-2024 period. See section 2.1.1.4 for details.

	Aggregation level				
Year	**LF**	**Age**	**# k**	**% k**	**% landings**
2022	1	2	2	1.8	9.0
	1	3	1	0.9	0.3
	2	2	1	0.9	1.6
	2	4	5	4.4	5.8
	3	3	8	7.1	2.7
	3	4	12	10.6	4.2
	3	10	1	0.9	0.1
	4	4	13	11.5	7.9
	5	5	19	16.8	20.8
	6	6	51	45.1	47.5
		Total	**113**	**100.0**	**100.0**
2023	1	1	1	0.9	2.9
	1	2	1	0.9	1.3
	1	3	1	0.9	0.8
	2	2	1	0.9	0.2
	2	3	1	0.9	0.7

Year	Aggregation level LF	Age	# k	% k	% landings
	2	4	2	1.8	1.7
	3	3	14	12.3	7.1
	3	4	15	13.2	9.2
	3	10	1	0.9	0.1
	4	5	16	14.0	13.2
	5	5	12	10.5	10.6
	6	6	49	43.0	52.3
		Total	**114**	**100.0**	**100.0**
2024	1	2	1	1.1	1.2
	1	3	1	1.1	1.0
	1	4	1	1.1	0.2
	2	2	2	2.2	0.7
	2	3	1	1.1	1.5
	3	3	14	15.6	4.5
	3	4	6	6.7	2.4
	3	5	10	11.1	5.5
	4	4	15	16.7	6.1
	4	5	7	7.8	3.3
	5	5	1	1.1	0.1
	6	6	31	34.4	73.4
		Total	**90**	**100.0**	**100.0**

Table 23. Catch at age ('000) in the commercial fishery.

Year	2	3	4	5	6	7	8	9	10	11+
1974	0	741	4,069	9,607	13,498	5,303	6,658	2,794	1,509	858
1975	12	35	4,313	7,707	5,091	7,185	2,930	2,757	1,719	1,487
1976	3	217	5,210	12,535	6,323	4,244	5,750	1,991	2,561	1,781
1977	0	14	2,672	10,124	12,756	7,943	2,628	3,274	1,098	1,895
1978	0	61	2,678	10,794	17,616	9,292	2,163	1,064	1,261	1,574
1979	0	70	3,404	13,995	12,871	12,592	4,822	1,429	721	1,282
1980	1	605	3,390	17,515	20,196	11,624	7,064	1,531	483	974
1981	2	316	6,689	8,999	20,054	13,971	4,730	2,154	939	1,075
1982	12	229	3,231	18,782	12,747	13,768	8,673	3,372	2,109	1,041
1983	116	840	4,901	15,255	18,451	10,206	6,002	3,061	1,161	1,438
1984	0	47	2,947	7,733	13,493	20,246	7,394	5,688	2,095	1,598
1985	7	175	2,518	15,909	13,820	10,688	9,818	3,179	2,317	1,193
1986	11	215	2,415	8,534	15,635	11,847	6,024	6,189	2,284	2,536
1987	0	15	1,194	8,426	12,310	11,864	7,210	3,650	1,843	2,696
1988	2	117	1,274	6,037	11,452	6,078	5,145	1,515	656	1,417
1989	0	99	1,750	5,072	7,637	8,365	3,800	2,431	971	1,107
1990	0	225	2,748	6,608	4,636	5,860	4,173	1,806	896	677
1991	0	267	4,218	7,809	6,242	3,283	2,690	2,232	594	711
1992	0	739	4,081	8,822	5,877	2,860	1,409	903	686	389
1993	96	459	3,291	5,336	6,867	2,713	599	262	143	103
1994	14	70	140	165	76	63	21	10	3	2
1995	13	10	13	15	26	29	28	6	2	1
1996	1	17	21	30	37	37	41	17	9	1
1997	65	274	656	495	730	429	398	210	189	41
1998	0	0	107	392	639	457	197	157	152	70
1999	1	0	249	566	1,602	525	726	264	145	120
2000	0	9	213	856	1,093	1,288	329	269	131	30
2001	0	3	475	600	1,014	920	941	285	104	44

Year	2	3	4	5	6	7	8	9	10	11+
2002	0	1	185	457	934	759	813	521	127	65
2003	0	0	6	36	59	49	37	26	8	6
2004	0	2	20	236	401	408	301	203	100	59
2005	0	0	25	81	338	764	442	306	117	196
2006	0	0	37	276	639	663	966	367	147	166
2007	1	13	122	395	637	597	657	533	172	142
2008	0	5	394	505	750	700	448	410	161	92
2009	0	197	725	1,210	746	460	206	156	49	47
2010	0	0	236	389	639	437	229	209	56	38
2011	25	7	62	231	336	313	135	64	31	16
2012	0	1	8	43	161	272	200	57	29	16
2013	5	0	40	52	204	215	147	83	16	5
2014	0	7	43	68	109	118	160	114	53	11
2015	0	1	31	78	143	107	183	99	26	11
2016	0	4	28	104	161	160	67	92	35	35
2017	0	1	29	76	248	345	230	142	52	100
2018	0	1	54	141	250	360	244	90	31	34
2019	0	0	5	9	40	83	89	67	14	29
2020	3	2	67	97	37	82	79	63	21	4
2021	1	2	5	50	77	51	65	49	34	23
2022	1	0	18	18	42	34	10	9	4	1
2023	1	0	2	55	21	22	12	5	2	2
2024	0	0	2	7	56	16	13	4	1	3

Table 24. Mean weights at age in the commercial fishery (kg).

Year	2	3	4	5	6	7	8	9	10	11+
1974	0.00	0.46	0.64	0.99	1.31	1.67	1.98	2.51	2.89	5.04
1975	0.06	0.40	0.72	1.00	1.52	1.89	2.34	2.61	3.08	4.27
1976	0.20	0.44	0.76	1.13	1.68	2.15	2.60	2.90	3.12	4.77
1977	0.00	0.46	0.65	1.02	1.48	2.02	2.52	2.77	3.17	3.78
1978	0.00	0.57	0.75	0.96	1.44	1.98	2.63	3.22	3.32	4.12
1979	0.00	0.35	0.65	0.94	1.42	1.87	2.59	3.40	3.84	4.74
1980	0.27	0.51	0.62	0.93	1.43	1.91	2.41	3.41	4.15	4.60
1981	0.32	0.57	0.79	0.98	1.33	1.85	2.49	3.34	4.55	6.20
1982	0.12	0.45	0.85	1.11	1.44	1.77	2.12	2.66	3.13	4.70
1983	0.13	0.38	0.93	1.30	1.60	1.90	2.18	2.45	3.47	5.11
1984	0.00	0.42	0.79	1.03	1.45	1.77	2.03	2.30	2.71	3.83
1985	0.38	0.63	0.79	0.98	1.22	1.62	1.93	2.15	2.32	3.06
1986	0.36	0.64	0.73	0.98	1.19	1.47	1.92	2.22	2.46	2.78
1987	0.00	0.45	0.60	0.77	1.01	1.31	1.58	2.09	2.65	2.93
1988	0.46	0.51	0.73	0.88	1.20	1.49	1.81	2.27	2.74	3.16
1989	0.00	0.40	0.69	0.94	1.12	1.42	1.67	2.02	2.33	3.27
1990	0.16	0.59	0.75	0.93	1.18	1.39	1.64	1.86	2.16	3.31
1991	0.00	0.42	0.59	0.81	1.08	1.36	1.60	1.94	2.05	3.10
1992	0.00	0.42	0.65	0.85	1.05	1.40	1.63	1.91	2.17	2.72
1993	0.10	0.38	0.57	0.76	0.99	1.26	1.69	1.89	2.24	2.77
1994	0.15	0.33	0.61	1.01	1.29	1.46	1.70	2.06	2.23	2.81
1995	0.10	0.26	0.60	0.93	1.36	1.68	1.88	2.41	2.83	4.42
1996	0.15	0.36	0.71	1.00	1.41	1.68	2.06	2.63	2.25	4.38
1997	0.15	0.44	0.75	1.03	1.40	1.74	2.09	2.17	2.51	3.19
1998	0.10	0.28	0.65	1.07	1.34	1.58	1.90	1.92	1.98	2.59
1999	0.11	0.14	0.81	1.13	1.49	1.81	2.01	2.18	2.34	2.87
2000	0.10	0.53	0.77	1.14	1.47	1.87	2.09	2.31	2.29	3.14

Year	2	3	4	5	6	7	8	9	10	11+
2001	0.10	0.56	0.77	1.06	1.40	1.66	2.07	2.19	2.76	3.27
2002	0.10	0.36	0.65	1.12	1.38	1.71	1.94	2.34	2.49	3.02
2003	0.09	0.17	0.75	1.04	1.37	1.75	2.06	2.51	2.40	3.05
2004	0.16	0.48	0.79	1.22	1.54	1.98	2.15	2.39	2.28	3.14
2005	-	0.41	0.86	1.21	1.49	1.71	2.14	2.35	2.85	2.70
2006	-	-	0.62	1.16	1.41	1.63	1.85	2.08	2.41	2.59
2007	0.11	0.52	0.83	1.28	1.70	1.86	2.28	2.29	2.82	3.29
2008	-	0.44	0.82	1.16	1.66	1.94	2.10	2.44	2.45	3.32
2009	0.10	0.38	0.61	0.96	1.39	1.73	2.36	2.34	3.09	3.90
2010	0.09	0.37	0.86	1.08	1.42	1.82	2.23	2.16	2.60	3.17
2011	0.11	0.53	0.78	0.99	1.25	1.74	1.97	2.14	2.35	3.10
2012	0.09	0.49	0.63	1.05	1.31	1.55	1.92	2.18	2.39	2.65
2013	0.09	0.16	0.69	1.02	1.41	1.64	1.72	2.24	2.66	3.69
2014	0.10	0.44	0.69	1.03	1.44	1.84	2.08	2.34	2.71	3.80
2015	0.09	0.63	0.90	1.30	1.81	1.80	1.97	2.14	2.66	3.75
2016	0.10	0.51	0.84	1.29	1.78	2.17	2.25	2.38	2.84	3.06
2017	-	0.39	0.68	1.02	1.54	1.95	2.44	2.89	3.46	3.65
2018	-	0.45	0.86	1.15	1.61	2.09	2.61	3.27	4.02	4.43
2019	0.10	0.60	0.69	0.90	1.21	1.62	2.22	2.75	4.53	4.60
2020	0.10	0.48	0.77	1.07	1.11	1.50	1.79	2.19	2.98	4.99
2021	0.09	0.52	0.75	1.30	1.49	1.75	1.89	2.35	2.57	3.30
2022	0.10	0.52	0.68	0.92	1.24	1.48	1.83	1.90	2.29	2.76
2023	0.08	0.15	0.58	0.95	1.19	1.59	1.80	2.11	2.61	2.64
2024	-	0.26	0.57	0.67	1.01	1.38	1.71	2.35	4.00	3.41

Table 25. Mean lengths at age in the commercial fishery (cm).

Year	2	3	4	5	6	7	8	9	10	11+
1974	-	36.78	41.06	47.59	52.40	56.69	59.95	64.72	67.16	80.99
1975	-	35.17	42.76	47.91	54.96	59.15	63.23	65.57	68.98	76.75
1976	-	36.11	43.64	49.82	56.85	61.83	65.85	68.24	69.83	79.61
1977	-	37.00	41.35	48.08	54.45	60.53	65.14	67.22	70.09	74.14
1978	-	39.24	43.30	47.21	53.91	60.03	66.13	70.50	70.97	75.53
1979	-	33.25	41.14	46.62	53.67	58.85	65.27	71.65	74.13	79.68
1980	-	38.17	40.67	46.49	53.79	59.20	63.91	71.62	76.39	79.09
1981	-	39.26	44.01	47.47	52.49	58.30	63.96	69.95	77.75	87.81
1982	-	36.49	44.94	49.50	53.95	57.79	61.32	65.82	69.06	79.39
1983	-	33.44	46.37	52.06	55.96	59.08	61.48	63.81	70.99	80.74
1984	-	35.88	44.05	48.23	54.20	57.91	60.42	62.75	65.90	73.37
1985	-	40.65	44.06	47.40	51.03	56.04	59.36	61.28	62.88	67.92
1986	-	41.36	42.93	47.33	50.58	54.10	59.02	61.94	64.00	66.30
1987	-	36.65	40.18	43.83	47.80	52.21	55.24	60.53	65.25	67.25
1988	-	37.97	42.83	45.69	50.65	54.35	58.01	62.09	66.01	68.98
1989	-	41.40	42.98	47.14	50.05	53.85	56.81	60.30	63.44	69.63
1990	-	40.77	43.94	46.79	50.14	53.24	56.04	58.39	62.54	69.12
1991	-	36.50	40.68	45.10	49.52	53.23	56.31	59.77	60.25	67.97
1992	-	36.27	41.85	45.75	48.87	53.52	56.01	58.83	61.23	65.17
1993	22.21	35.04	40.20	44.08	48.11	51.88	56.68	58.48	61.83	65.10
1994	25.92	34.05	41.83	48.96	52.74	55.16	57.80	61.55	62.29	67.84
1995	22.34	29.75	39.94	45.93	52.11	56.05	58.05	62.51	65.77	75.97
1996	25.73	33.05	42.72	47.75	53.51	56.53	60.49	65.16	61.66	77.62
1997	24.84	36.10	43.20	48.05	52.96	56.70	59.90	60.57	63.71	68.08
1998	22.01	31.15	41.85	49.16	53.02	56.00	59.41	59.11	59.29	65.44
1999	23.46	25.05	44.99	50.05	54.82	58.50	60.57	62.37	63.35	67.61

Year	2	3	4	5	6	7	8	9	10	11+
2000	22.63	39.24	44.23	50.18	54.27	58.72	60.96	62.86	62.75	68.54
2001	22.82	39.96	44.03	49.08	53.70	56.79	61.04	62.19	67.08	70.52
2002	22.14	33.85	40.92	48.74	52.36	56.06	58.47	62.06	63.43	67.27
2003	22.00	26.84	43.47	48.16	52.44	56.64	59.72	63.58	62.70	67.41
2004	26.82	37.34	44.09	50.28	54.17	58.54	60.13	62.09	61.03	67.34
2005	-	35.89	44.45	50.05	53.77	56.23	60.39	62.05	65.99	64.71
2006	-	-	41.00	50.45	53.50	56.08	58.52	60.61	63.60	64.81
2007	23.27	39.03	45.41	51.92	56.78	58.46	62.52	62.39	66.78	69.87
2008	-	37.00	45.08	50.22	56.36	59.06	60.58	63.64	63.57	69.54
2009	22.61	35.18	40.46	46.98	53.21	56.86	62.91	62.45	68.29	72.88
2010	22.34	34.97	45.76	49.11	53.48	58.05	61.77	60.98	64.45	69.15
2011	23.71	38.41	44.53	48.03	51.82	57.55	59.60	61.10	62.89	69.20
2012	22.30	38.99	42.11	49.50	53.11	56.05	59.98	62.60	64.10	66.20
2013	22.53	26.91	42.89	48.47	53.87	56.45	56.94	62.28	65.62	72.92
2014	22.85	36.97	42.88	48.71	54.05	58.59	61.05	63.42	66.50	73.53
2015	22.25	41.99	46.77	52.56	58.54	58.33	60.04	61.65	65.64	73.74
2016	22.89	39.35	45.96	52.49	58.53	62.35	62.71	64.13	67.79	69.00
2017	-	36.04	42.99	49.10	56.25	60.56	65.62	68.84	72.46	74.16
2018	-	37.00	45.20	49.63	55.24	59.63	63.57	67.63	72.54	74.89
2019	22.41	41.00	42.69	46.34	50.80	55.62	61.35	65.83	77.07	77.48
2020	23.00	37.74	44.00	48.73	49.29	54.26	57.04	60.79	66.71	79.47
2021	22.41	39.24	43.93	52.45	54.86	57.72	59.18	63.39	64.73	70.05
2022	23.29	40.57	44.15	48.51	53.41	56.70	60.63	61.30	65.37	69.78
2023	21.18	26.30	40.95	47.96	51.47	56.69	58.90	62.16	66.61	65.95
2024	-	31.26	39.85	42.09	47.68	52.71	55.91	61.81	74.18	68.91

Table 26. 3Pn4RS Atlantic cod stock landings by target species for the period 1985-2024. The last column indicates the percentage of landings where the target species was Atlantic cod out of all those for which a target species was specified. COD = Atlantic cod, RED = redfish, ATLH = Atlantic halibut, AMEP = American plaice, WITCH = witch flounder, TURB = Greenland halibut, SHR = northern shrimp, OTHER = other species, UNK = unknown.

Year	COD	RED	ATLH	AMEP	WITCH	TURB	SHR	OTHER	UNK	% targeted
1985	13,119	95	7	-	57	4	1,900	11	73,288	86.3
1986	21,828	233	1	43	15	14	2,598	0	58,673	88.3
1987	17,873	219	1	96	16	35	1,542	1	46,762	90.3
1988	15,444	546	-	88	34	16	795	0	30,779	91.3
1989	20,534	248	0	84	121	13	774	3	24,984	94.3
1990	21,717	263	11	59	36	39	761	30	16,084	94.8
1991	17,715	1,012	55	31	63	19	839	6	14,741	89.7
1992	17,022	647	27	94	129	15	513	6	11,090	92.2
1993	15,048	874	19	52	60	20	59	301	2,020	91.6
1994	20	131	92	1	8	3	3	0	278	7.9
1995	-	0	14	1	4	-	0	0	165	0.0
1996	2	1	14	3	5	1	0	2	289	8.6
1997	435	2	20	3	6	2	2	0	4,322	92.6
1998	2,476	1	48	44	30	30	-	7	600	94.0
1999	6,185	3	171	35	35	41	0	6	415	95.5
2000	6,213	13	214	36	36	35	0	27	283	94.5
2001	6,499	3	147	24	63	25	0	13	177	95.9
2002	6,114	4	61	26	29	10	0	10	274	97.7
2003	196	5	91	44	25	7	0	20	1	50.4
2004	2,987	8	93	33	44	16	0	12	82	93.6
2005	4,150	19	64	35	49	10	-	14	119	95.6
2006	5,327	8	73	2	38	5	0	5	195	97.6

Year	COD	RED	ATLH	AMEP	WITCH	TURB	SHR	OTHER	UNK	% targeted
2007	5,958	0	91	10	31	17	0	7	368	97.4
2008	5,813	0	77	-	25	25	0	4	214	97.8
2009	4,559	2	41	4	23	10	0	1	61	98.3
2010	3,430	2	25	2	12	13	0	2	65	98.4
2011	1,603	1	64	8	12	16	0	1	72	94.1
2012	1,178	2	62	7	4	23	0	0	26	92.2
2013	1,131	1	45	4	2	17	1	1	19	94.1
2014	1,185	1	50	2	3	12	0	0	7	94.5
2015	1,154	1	101	3	4	5	0	0	0	91.1
2016	1,224	2	126	1	5	10	0	2	2	89.3
2017	2,526	3	121	-	6	15	0	-	-	94.6
2018	2,343	5	102	-	7	36	0	0	77	94.0
2019	613	9	99	-	3	23	0	0	26	82.1
2020	596	4	62	-	1	1	0	-	17	89.7
2021	551	6	87	-	4	3	0	0	22	84.8
2022	76	11	90	-	2	0	-	0	-	42.2
2023	81	5	72	-	2	0	-	-	-	50.7
2024	85	6	37	-	2	0	-	-	0	65.1

Table 27. Sentinel mobile gear surveys. Mean cod catch (kg) per tow by stratum and NAFO Division. Strata not sampled in some years are indicated with a dash.

Year	3Pn				4R												
	302	303	304	305	101	102	103	801	802	809	810	811	812	813	820	821	822
1995	32.3	8.7	0.0	0.1	-	-	-	0.7	0.0	0.0	0.0	9.5	1.6	68.8	37.2	73.0	28.1
1996	31.2	8.7	0.3	0.0	-	-	-	1.5	0.0	0.0	0.0	4.9	8.0	18.3	29.8	162.3	68.5
1997	69.6	3.9	0.4	0.0	-	-	-	0.4	0.0	0.0	0.0	5.4	1.2	33.3	78.1	77.2	172.0
1998	45.8	3.7	0.3	0.0	-	-	-	0.3	0.0	0.2	0.7	8.2	6.0	25.8	44.9	66.1	53.6
1999	10.2	2.1	0.5	0.0	-	-	-	0.0	0.0	0.8	0.0	4.7	3.1	12.7	137.7	129.7	37.1
2000	17.3	0.8	0.4	0.0	-	-	-	0.4	0.0	0.0	0.3	0.1	1.5	16.6	23.8	56.4	77.2
2001	121.2	5.1	0.0	0.1	-	-	-	0.0	0.0	0.2	0.0	9.2	3.7	82.5	21.8	76.2	53.4
2002	191.3	10.2	0.0	0.0	-	-	-	2.2	0.0	0.1	0.0	9.9	18.1	14.2	33.0	27.3	29.5
2003	28.0	5.1	0.0	0.0	38.3	580.7	11.0	0.7	0.0	2.1	0.5	7.8	1.8	28.8	32.7	36.5	96.8
2004	26.4	9.4	0.8	0.1	37.3	240.4	174.6	0.0	0.1	0.0	1.1	6.8	3.7	35.4	54.1	28.6	114.8
2005	26.5	14.9	0.0	0.0	37.2	117.0	144.9	0.0	0.4	0.0	0.6	34.6	8.1	5.9	87.1	194.2	86.4
2006	20.9	3.7	0.0	0.0	61.2	126.9	1.5	0.9	0.0	0.5	0.0	46.0	13.0	7.8	34.2	83.2	64.5
2007	11.6	16.1	0.1	0.0	54.6	336.1	15.6	1.2	0.0	0.1	0.0	7.7	9.4	31.7	55.2	34.5	51.2
2008	1.6	0.0	0.0	0.0	23.4	612.6	839.4	2.0	0.0	0.4	0.0	2.0	3.6	17.2	4.2	27.5	24.0
2009	1.5	1.6	0.2	0.0	23.9	62.7	1.5	2.9	0.0	0.0	0.0	2.3	3.4	87.4	7.0	10.5	55.9
2010	1.2	0.1	0.0	0.0	53.5	12.6	359.1	0.2	0.0	0.0	0.0	4.6	3.6	37.5	25.1	9.8	30.5
2011	0.1	0.0	0.0	0.0	0.0	11.7	462.8	0.0	0.0	0.0	0.0	6.9	2.6	1.5	22.1	38.1	28.0
2012	2.4	0.1	0.0	0.0	35.3	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.8	9.2	9.6	12.3
2013	2.5	1.8	0.0	0.0	0.6	21.7	24.9	0.2	0.0	0.9	0.0	1.1	0.3	7.2	2.1	0.6	1.3
2014	1.3	0.1	0.0	0.0	18.2	26.0	9.6	4.2	0.1	0.5	0.0	1.9	26.4	22.0	4.5	15.9	19.5
2015	2.4	0.0	0.0	0.0	676.7	1.6	46.2	3.8	0.0	0.1	0.0	1.9	8.5	4.9	23.8	4.6	14.4
2016	1.7	0.2	0.0	0.0	12.2	39.0	-	0.7	0.0	0.0	0.2	5.4	8.3	7.7	11.0	11.5	13.2
2017	2.3	1.8	0.0	0.0	2.6	34.7	0.7	0.0	0.0	0.0	0.0	0.4	0.8	1.8	17.2	7.1	33.7
2018	3.7	1.0	0.0	0.0	7.5	3.5	34.6	0.0	0.5	0.1	0.0	0.3	0.9	2.0	0.9	0.9	30.5
2019	0.0	0.0	0.0	0.0	26.8	-	0.0	0.2	0.0	0.0	0.0	0.0	0.3	1.9	9.9	4.5	18.6
2020	7.2	0.7	0.0	0.0	10.2	79.6	40.2	-	0.0	0.0	0.0	0.0	0.1	4.5	8.9	15.2	42.1
2021	1.1	0.0	0.0	0.0	37.5	2.6	27.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	14.1	15.5	20.4
2022	0.4	0.0	0.0	0.0	5.8	3.7	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.3	3.7	6.8	25.7
2023	0.9	0.1	0.0	0.0	15.0	10.0	0.6	0.0	0.0	0.0	0.0	0.3	0.1	0.0	2.6	2.5	10.8
2024	1.7	0.0	0.0	0.0	7.0	19.2	7.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	1.5	21.7	6.2

Year	4R							4S									
	823	**824**	**835**	**836**	**837**	**838**	**840**	**803**	**804**	**805**	**806**	**807**	**808**	**814**	**815**	**816**	**817**
1995	158.0	40.1	46.4	31.6	17.4	29.4	0.4	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.5	5.5	14.1
1996	123.9	123.0	67.2	37.8	17.9	8.7	2.6	0.1	0.0	0.0	-	0.2	0.3	8.2	37.6	10.3	5.8
1997	249.4	163.0	78.9	120.3	90.5	58.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.7	0.8	0.3
1998	265.6	541.1	62.3	105.8	211.6	41.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	1.1	0.0
1999	39.8	77.2	77.8	147.0	27.2	11.0	15.2	0.0	0.0	0.0	0.0	1.2	0.0	4.3	2.1	4.2	0.0
2000	74.8	44.0	114.5	195.8	295.7	179.5	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	6.7	0.0
2001	149.6	241.4	105.4	66.1	516.8	58.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.2	0.4
2002	55.5	66.3	79.2	147.3	192.2	98.6	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.0	0.0	0.0	0.3
2003	1240.9	108.8	209.2	57.1	107.9	18.1	4.8	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.5	5.8	0.6
2004	316.0	348.8	89.1	121.3	484.5	9.7	7.3	0.0	0.2	-	0.2	0.0	0.0	0.5	0.7	1.1	0.7
2005	63.2	107.9	59.3	72.1	187.6	213.7	4.9	0.1	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
2006	83.6	8.5	139.1	176.2	278.7	328.1	12.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.1	0.1
2007	31.0	53.1	56.7	38.9	129.3	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.5	33.8	0.2
2008	69.2	36.2	11.1	71.9	196.7	12.8	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.3	4.2	0.4	0.0
2009	46.5	45.8	26.8	65.4	460.7	77.6	0.0	0.0	0.0	0.0	0.2	0.4	0.0	1.6	0.2	1.2	0.3
2010	18.0	4.1	12.6	22.3	141.0	74.2	7.4	0.0	0.0	0.1	0.2	0.0	0.5	9.5	0.5	7.7	0.3
2011	153.3	99.6	13.2	73.0	1079.2	22.8	7.3	0.0	0.0	0.1	0.0	0.0	0.0	53.2	0.2	0.1	3.2
2012	4.6	18.2	6.8	18.1	88.4	26.5	0.5	0.0	0.0	0.0	0.5	0.0	0.0	1.0	0.9	0.1	0.9
2013	16.9	3.4	0.7	137.3	135.8	198.0	200.6	0.0	0.2	0.1	0.0	0.8	0.0	4.8	6.3	2.2	0.5
2014	34.9	49.0	19.4	51.7	633.7	61.8	3.1	0.2	0.4	0.1	1.2	1.2	0.5	5.8	6.7	7.1	0.3
2015	86.1	71.0	35.8	74.7	511.0	146.1	4.5	0.0	0.0	0.1	1.5	0.0	0.0	4.0	3.1	5.9	3.3
2016	30.9	32.4	19.3	77.3	58.6	26.1	0.0	0.0	0.9	0.4	0.4	0.0	0.0	3.6	8.1	15.1	6.1
2017	5.8	86.1	16.0	34.4	53.4	101.8	12.0	0.0	0.1	0.6	0.0	0.1	0.0	0.7	1.9	1.8	26.9
2018	10.7	17.0	4.5	23.7	119.5	2.3	24.7	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.4	0.2	1.1
2019	8.0	32.7	22.6	45.7	33.8	1.7	0.8	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	4.9	1.7
2020	146.2	108.2	65.9	51.9	85.8	3.7	1.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.7	17.6	0.0
2021	9.0	13.3	13.3	57.1	181.7	49.3	0.7	0.0	0.0	0.0	0.4	0.0	0.0	1.4	0.0	0.2	6.1
2022	67.3	3.5	27.6	32.5	14.4	13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.1	0.7	2.3
2023	15.7	0.0	12.4	8.0	25.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.7
2024	17.5	2.0	8.3	9.3	37.4	17.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1

Year	4S											Mean weight per set
	818	819	827	828	829	830	831	832	833	839	841	
1995	0.3	1.0	1.3	3.0	2.4	7.3	6.0	12.5	0.0	-	-	12.8
1996	3.0	0.9	0.0	0.0	27.7	-	12.5	15.3	0.0	0.0	5.2	16.2
1997	0.0	0.9	11.3	-	7.3	22.8	-	4.2	3.0	0.8	2.0	24.6
1998	0.2	11.5	0.3	3.2	22.3	29.6	3.7	8.8	0.6	1.0	0.6	25.1
1999	0.5	0.0	5.4	2.4	44.0	32.2	8.0	5.6	5.0	2.3	0.0	16.9
2000	0.5	0.0	0.6	34.5	12.1	4.3	0.0	5.8	0.0	0.0	1.7	29.7
2001	1.5	-	0.0	-	6.3	-	8.4	3.9	0.3	0.0	2.4	33.1
2002	3.0	3.0	-	0.5	25.0	4.1	0.0	1.8	0.0	0.5	1.2	22.7
2003	3.3	30.5	2.4	0.0	0.0	6.1	0.0	1.8	0.0	0.3	2.8	31.1
2004	3.1	0.3	0.0	0.5	9.8	1.8	5.9	4.8	0.0	0.0	0.0	36.5
2005	2.4	-	2.0	3.7	24.5	11.4	12.0	3.8	0.0	2.2	4.3	28.7
2006	0.7	0.7	0.5	3.9	13.9	3.1	13.6	3.3	5.4	1.6	6.4	35.3
2007	0.2	0.7	7.4	-	0.7	3.8	119.8	14.0	2.7	2.7	11.7	20.3
2008	0.7	0.3	1.0	-	3.6	12.2	18.3	19.0	1.1	0.8	1.0	25.1
2009	8.6	0.0	5.0	3.3	-	22.5	6.0	23.3	0.0	1.7	1.5	26.5
2010	1.8	0.0	4.1	-	22.2	8.9	-	30.9	4.3	10.4	2.2	17.0
2011	5.1	-	0.0	3.9	0.0	51.1	27.7	6.2	0.0	13.7	1.0	40.9
2012	5.0	0.6	6.7	0.0	0.2	8.4	-	10.7	4.2	3.7	-	6.5
2013	4.3	3.7	17.6	3.0	4.3	11.4	26.4	23.6	5.3	1.5	4.2	19.2
2014	3.3	5.7	27.1	-	2.4	38.6	9.8	37.5	2.9	8.1	-	29.5
2015	17.0	4.2	30.7	5.1	35.1	9.7	9.7	46.2	4.1	17.2	1.3	37.6
2016	5.0	12.1	27.1	-	54.7	10.8	33.9	105.1	7.9	185.5	0.9	24.5
2017	10.8	0.0	4.2	23.5	40.3	13.2	14.0	26.5	42.1	2.1	0.5	13.6
2018	3.8	1.2	1.5	56.9	1.9	13.5	0.0	113.9	4.0	10.9	0.0	12.5
2019	0.5	0.0	24.8	21.8	33.1	10.0	6.1	96.3	2.5	0.2	1.5	10.8
2020	0.0	2.0	16.8	64.2	61.1	21.3	1.2	89.1	1.8	2.8	0.0	18.9
2021	3.8	3.1	26.8	29.5	2.5	201.6	0.6	3.4	6.2	8.2	0.0	16.2
2022	1.3	1.1	5.8	247.0	78.8	1.9	2.5	24.8	10.1	8.5	0.0	13.4
2023	0.0	0.0	0.4	9.3	44.7	11.8	8.6	30.9	0.3	9.0	0.1	5.3
2024	0.1	-	6.9	7.3	7.8	15.7	-	1.0	2.8	0.6	0.1	4.0

Table 28. Sentinel mobile gear surveys. Mean numbers at age.

Year	1	2	3	4	5	6	7	8	9	10	11+
1995	1.042	1.959	2.217	4.570	3.050	1.833	1.282	1.122	0.224	0.054	0.031
1996	0.117	1.636	6.962	5.912	4.747	2.296	1.166	0.786	0.618	0.140	0.037
1997	0.000	2.834	5.947	13.425	4.799	4.283	1.661	0.666	0.496	0.159	0.045
1998	0.037	2.013	8.211	6.459	6.921	2.923	2.842	0.930	0.634	0.243	0.187
1999	0.093	2.043	5.091	5.832	3.415	2.943	1.089	0.935	0.190	0.085	0.060
2000	0.359	1.220	7.433	10.218	5.743	3.892	3.485	0.800	0.792	0.281	0.072
2001	1.207	5.632	11.254	9.884	5.021	3.111	1.809	1.373	0.480	0.320	0.153
2002	0.023	0.600	3.035	8.159	4.663	3.783	2.055	1.655	0.880	0.264	0.098
2003	0.051	1.107	4.248	7.426	6.421	3.260	2.438	1.198	0.964	0.751	0.363
2004	0.016	0.728	3.669	6.680	5.738	5.370	3.292	2.134	1.299	0.635	0.615
2005	0.025	1.865	4.837	6.209	4.895	3.321	2.650	1.066	0.707	0.388	0.356
2006	0.962	3.672	4.644	7.686	5.155	3.851	2.423	2.382	1.075	0.531	0.389
2007	9.826	2.724	7.722	6.301	2.871	1.667	1.080	0.664	0.560	0.345	0.410
2008	0.023	4.637	5.882	10.553	4.089	3.034	1.707	1.168	0.813	0.359	0.203
2009	0.056	4.194	6.507	10.426	10.413	2.232	1.692	0.939	0.291	0.162	0.035
2010	0.037	0.395	6.087	6.337	5.382	2.512	0.858	0.562	0.166	0.065	0.021
2011	0.073	1.317	3.315	12.867	8.555	9.565	3.745	2.031	1.032	0.303	0.217
2012	0.908	0.619	1.134	1.145	1.560	1.321	0.926	0.328	0.183	0.036	0.019
2013	2.368	6.081	5.508	6.050	3.065	2.190	1.848	0.995	0.497	0.165	0.212
2014	0.325	7.063	11.675	10.518	6.560	4.384	1.721	1.237	0.642	0.134	0.207
2015	0.431	9.501	22.538	17.732	7.026	3.403	1.584	0.999	0.404	0.290	0.054
2016	0.202	4.501	7.586	9.636	7.818	4.356	1.311	0.610	0.427	0.080	0.097
2017	0.162	3.755	5.100	5.252	4.053	2.809	1.512	0.496	0.239	0.095	0.091
2018	0.322	2.342	3.631	2.452	2.348	1.984	1.777	0.497	0.179	0.128	0.072
2019	0.013	0.632	5.224	3.933	1.560	1.890	1.541	0.775	0.268	0.123	0.070
2020	0.132	9.979	6.773	8.957	4.945	1.939	1.442	1.118	0.618	0.201	0.097
2021	0.108	1.567	18.418	6.802	2.527	1.371	0.472	0.419	0.504	0.203	0.129
2022	0.097	0.318	2.209	14.556	2.231	1.534	0.557	0.230	0.063	0.107	0.110
2023	0.011	0.882	1.400	3.020	5.850	0.491	0.291	0.085	0.038	0.019	0.023
2024	0.375	2.648	2.543	1.239	0.508	1.082	0.254	0.236	0.126	0.022	0.087

Table 29. Estimates of survey specific dispersion parameters for the beta-binomial model fitted to data for females and irrespective of sex (combined sexes). A single common dispersion parameter was estimated for males, at a value of 7.816 (0.709 SE). SE = standard error. See text for description of surveys.

	Females		Combined sexes	
Survey	Estimate	SE	Estimate	SE
SN	4.417	0.418	7.913	0.559
GA	8.564	1.827	21.644	3.858
CS	2.274	0.598	2.447	0.449
CRP	9.854	4.387	11.780	2.888

Table 30. Catch at age (thousands) for ages 2 to 11+, 1974-2024, used as input in the nGSL cod assessment model.

Year	2	3	4	5	6	7	8	9	10	11+
1974	30.7	871.7	4,573.8	10,328.9	14,512.2	5,701.5	7,158.3	3,003.9	1,622.4	922.5
1975	43.5	112.7	4,847.5	8,306.3	5,486.9	7,743.7	3,157.8	2,971.4	1,852.7	1,602.6
1976	33.8	308.0	5,792.9	13,458.4	6,788.8	4,556.6	6,173.6	2,137.7	2,749.7	1,912.2
1977	30.7	90.0	3,068.9	10,873.3	13,700.1	8,530.9	2,822.5	3,516.3	1,179.3	2,035.3
1978	30.7	140.5	3,074.0	11,587.7	18,911.3	9,975.2	2,322.0	1,142.2	1,353.7	1,689.7
1979	30.7	150.1	3,849.3	15,007.1	13,801.8	13,502.6	5,170.7	1,532.3	773.1	1,374.7
1980	31.7	722.6	3,827.9	18,748.6	21,618.4	12,442.7	7,561.5	1,638.8	517.0	1,042.6
1981	32.7	413.3	7,360.5	9,634.6	21,470.3	14,957.7	5,064.1	2,306.1	1,005.3	1,150.9
1982	43.4	320.0	3,655.5	20,092.2	13,636.2	14,728.5	9,278.0	3,607.2	2,256.1	1,113.6
1983	154.7	973.6	5,441.9	16,318.7	19,737.6	10,917.7	6,420.5	3,274.4	1,242.0	1,538.3
1984	30.7	125.3	3,351.6	8,272.2	14,433.9	21,657.7	7,909.6	6,084.6	2,241.1	1,709.4
1985	38.1	262.6	2,898.0	17,052.1	14,813.0	11,456.0	10,523.5	3,407.4	2,483.5	1,278.7
1986	42.4	305.5	2,788.5	9,150.1	16,763.8	12,702.3	6,458.9	6,635.8	2,448.9	2,719.1
1987	61.1	495.3	1,925.1	8,942.4	12,854.1	12,363.8	7,509.9	3,803.7	1,919.2	2,805.8
1988	89.2	850.8	1,789.5	6,529.3	12,130.0	6,430.1	5,431.5	1,600.6	693.0	1,496.0
1989	62.6	1,166.4	2,358.9	5,454.2	8,054.5	8,772.5	3,976.5	2,545.3	1,018.2	1,158.9
1990	68.0	937.9	3,222.2	7,123.7	4,963.0	6,266.5	4,467.3	1,927.2	957.5	724.5
1991	298.5	1,620.5	5,955.2	8,722.7	6,849.5	3,565.2	2,910.4	2,424.0	641.6	766.2
1992	186.2	1,101.6	4,831.5	9,738.2	6,397.2	3,107.2	1,529.3	980.4	742.8	421.9
1993	116.6	519.3	3,547.4	5,735.5	7,375.0	2,912.9	643.6	280.8	153.6	111.0
1994	20.7	100.4	148.9	171.6	78.5	65.5	22.2	10.3	2.7	2.1
1995	79.4	18.4	19.1	17.2	27.2	30.7	29.4	6.6	2.2	0.8
1996	16.6	22.8	22.8	31.4	38.5	38.6	42.6	17.5	9.1	1.2

Year	2	3	4	5	6	7	8	9	10	11+
1997	81.3	278.8	665.1	500.9	739.6	434.4	403.4	213.0	191.0	41.2
1998	20.3	4.7	118.5	429.9	700.8	501.2	215.4	172.3	166.8	76.5
1999	91.3	3.0	265.7	602.5	1,706.0	559.0	773.2	280.9	154.9	127.3
2000	17.9	10.3	226.0	909.6	1,161.6	1,368.6	349.2	286.2	139.3	31.5
2001	29.7	8.4	506.1	639.4	1,080.6	980.4	1,003.4	304.0	110.4	47.3
2002	1.3	8.2	192.9	470.4	961.6	781.1	836.9	535.9	130.7	66.8
2003	81.9	4.9	9.3	38.2	60.4	50.7	38.1	26.6	8.4	6.3
2004	21.0	9.8	21.3	241.1	409.1	415.6	307.2	207.5	101.9	60.6
2005	17.8	1.9	27.6	82.9	345.7	782.2	452.8	313.2	119.4	200.9
2006	20.4	0.2	42.4	312.7	723.7	750.8	1,094.1	415.3	166.4	187.7
2007	29.2	20.8	137.1	441.9	713.2	667.7	735.1	596.8	192.5	158.4
2008	186.1	14.4	446.8	569.4	843.4	787.5	504.4	460.8	181.7	103.7
2009	42.5	227.2	835.1	1,393.3	858.6	529.6	237.4	180.0	56.2	53.8
2010	12.4	2.0	283.7	466.4	765.3	523.6	274.9	250.9	67.1	45.2
2011	71.8	10.4	87.4	325.0	472.7	441.1	190.5	90.4	43.3	22.0
2012	147.3	2.9	14.2	67.5	252.0	424.0	311.8	88.7	45.6	24.3
2013	175.1	4.0	63.8	83.0	325.8	344.2	235.3	132.6	25.6	8.0
2014	124.3	11.8	70.9	112.7	179.6	194.0	262.9	187.9	86.5	18.7
2015	28.7	2.4	51.3	127.3	233.9	175.7	299.8	162.9	43.2	18.2
2016	26.9	6.8	46.8	172.9	268.2	266.1	112.2	153.1	58.8	58.5
2017	63.5	7.2	40.0	102.6	335.8	466.9	311.1	192.2	70.8	134.7
2018	39.2	1.8	73.2	189.5	336.0	483.5	328.1	120.4	41.6	46.3
2019	9.4	1.1	11.5	19.7	85.2	179.2	191.3	145.2	30.0	62.6
2020	8.9	5.5	152.8	221.3	83.8	187.1	179.5	143.4	46.8	8.5
2021	1.7	3.8	12.0	113.2	176.3	115.5	147.8	110.9	76.9	51.8
2022	4.5	0.4	73.7	118.5	148.0	135.7	81.2	77.4	58.8	27.6
2023	14.2	0.5	12.2	177.0	145.3	111.9	110.2	51.1	22.2	49.9
2024	4.3	1.5	16.2	28.1	195.4	127.4	131.9	52.0	37.5	27.1

Table 31. Parameter estimates (Est), standard errors (SE), and negative loglikelihood gradients (GRD) for the stock weights mixed-effects model.

Parameter	Est	SE	GRD
γ_2	-2.663	0.046	-0.000023
γ_3	0.018	0.033	0.000009
γ_4	-0.335	0.047	0.000011
γ_5	-0.630	0.063	0.000019
γ_6	-0.997	0.090	0.000011
γ_7	-1.343	0.128	-0.000002
γ_8	-1.511	0.151	0.000000
γ_9	-1.667	0.176	0.000003
γ_{10}	-1.708	0.184	0.000001
γ_{11+}	-1.247	0.116	-0.000010
$log(\sigma_Y)$	-2.723	0.844	0.000002
$log(\sigma_c)$	-3.359	0.407	-0.000001
$log(\sigma_{AY})$	-3.015	1.321	-0.000002
$logit(\varphi_Y)$	1.683	0.857	-0.000002
$logit(\varphi_c)$	-0.022	1.705	0.000001
$logit(\rho_A)$	2.212	2.818	0.000001
$logit(\rho_Y)$	1.408	0.921	-0.000001

Table 32. Estimates of beginning of year biomass at age, 2+ biomass and spawning stock biomass (SSB), in tonnes.

Year	2	3	4	5	6	7	8	9	10	11+	2+	SSB
1973	39,598	23,685	19,505	44,591	28,750	42,901	25,961	20,326	11,768	15,280	272,365	149,194
1974	49,348	40,475	23,958	21,075	43,313	22,703	30,735	18,924	12,912	21,328	284,771	147,464
1975	45,770	50,441	43,388	25,381	20,543	35,054	16,754	21,591	11,719	21,160	291,801	129,371
1976	55,378	46,783	55,850	47,573	27,729	17,538	26,649	12,350	13,607	23,995	327,453	131,597
1977	62,429	56,605	47,764	56,306	45,536	20,960	11,238	16,946	6,884	19,683	344,351	130,254
1978	45,400	63,813	62,250	51,878	59,585	35,143	12,822	7,836	9,746	16,761	365,234	147,073
1979	67,259	46,405	65,212	62,488	56,369	46,171	22,067	9,301	4,562	19,088	398,922	165,044
1980	43,110	68,750	46,328	69,999	69,112	45,006	29,910	15,795	5,435	14,024	407,470	185,667
1981	40,078	44,065	77,581	51,546	74,465	53,651	28,919	21,985	10,028	16,076	418,395	206,569
1982	42,151	40,965	51,779	80,643	56,588	60,996	34,791	18,826	11,971	14,254	412,964	207,296
1983	31,554	43,083	50,696	56,446	85,505	46,865	41,757	22,812	12,020	19,875	410,612	228,662
1984	40,733	32,239	48,465	45,661	51,407	65,523	30,885	28,091	14,315	16,757	374,076	199,451
1985	37,948	45,580	37,805	59,805	53,361	44,170	45,897	20,680	17,799	17,163	380,208	191,834
1986	34,520	38,137	48,141	43,119	62,256	41,419	28,063	27,180	12,375	20,783	355,993	182,036
1987	42,915	33,783	39,239	52,919	44,546	46,314	24,910	14,882	13,719	16,992	330,219	164,633
1988	51,589	41,031	33,980	35,894	51,620	30,240	25,212	11,384	6,541	13,659	301,151	133,875
1989	44,016	48,806	40,815	22,463	31,680	33,332	16,519	12,000	5,295	7,906	262,833	97,257
1990	24,777	44,406	51,655	24,120	19,027	19,729	17,441	7,666	5,220	4,871	218,911	65,609
1991	10,634	25,649	48,189	25,378	18,583	10,478	8,914	7,492	2,989	3,585	161,892	44,298
1992	6,786	10,733	26,875	23,140	17,670	8,933	4,106	3,323	2,615	2,061	106,244	38,177
1993	8,625	6,957	11,310	9,345	13,950	6,489	2,497	1,071	788	942	61,973	26,863
1994	7,141	9,027	7,523	4,840	5,455	4,917	1,784	652	245	328	41,913	16,256
1995	12,726	7,743	10,235	4,418	4,985	4,363	3,743	1,332	483	310	50,337	23,409
1996	12,386	13,977	8,904	6,742	4,810	3,998	3,332	2,647	938	374	58,108	29,497
1997	15,643	13,258	15,632	6,455	7,423	3,885	3,068	2,289	1,815	606	70,075	36,289
1998	15,075	16,571	14,643	13,519	7,196	5,991	2,847	1,893	1,404	1,068	80,207	40,981
1999	20,406	15,798	18,188	11,849	14,944	5,828	4,458	1,853	1,173	1,131	95,628	45,762
2000	15,838	21,122	17,175	10,963	11,636	10,292	3,602	2,362	914	812	94,717	41,015
2001	12,704	15,778	22,126	10,964	10,613	8,272	6,514	2,123	1,265	753	91,112	38,254
2002	8,795	12,820	16,774	9,837	9,527	6,546	4,529	3,617	1,109	972	74,525	30,017
2003	11,966	9,008	13,820	12,162	10,257	7,292	4,386	2,961	2,220	1,277	75,349	31,986
2004	10,497	12,130	9,618	10,526	13,306	9,021	6,109	3,897	2,608	2,996	80,707	40,693

Year	2	3	4	5	6	7	8	9	10	11+	2+	SSB
2005	11,955	10,743	13,065	8,181	11,878	11,532	7,226	4,857	2,981	3,993	86,412	46,812
2006	19,470	12,160	11,492	10,270	8,975	9,493	8,408	5,059	3,272	4,206	92,805	45,897
2007	17,177	20,193	13,249	10,077	11,773	7,259	6,925	5,543	3,205	4,048	99,448	45,750
2008	21,003	17,445	21,536	9,953	10,691	7,733	4,264	3,447	2,560	2,231	100,864	39,849
2009	11,606	20,873	18,204	15,153	10,097	6,520	4,203	1,947	1,411	1,100	91,114	35,636
2010	9,144	11,720	22,086	12,366	15,250	5,997	3,511	1,932	797	445	83,247	36,625
2011	12,192	9,064	12,189	11,864	11,624	8,488	3,039	1,634	823	249	71,167	32,930
2012	14,954	12,018	9,367	8,633	12,366	8,367	5,690	1,930	997	472	74,793	35,838
2013	23,135	15,200	12,800	6,479	9,174	8,653	5,480	3,541	1,166	715	86,345	35,777
2014	20,735	24,139	16,611	9,521	7,180	6,855	6,101	3,645	2,288	1,036	98,112	37,414
2015	19,393	21,596	26,315	13,616	10,901	5,940	5,369	4,203	2,428	1,935	111,698	44,008
2016	13,220	19,706	22,932	15,000	13,589	7,715	3,973	3,078	2,330	2,154	103,697	43,076
2017	11,495	12,842	19,960	9,760	13,139	9,195	4,925	2,264	1,678	2,156	87,414	36,972
2018	15,201	11,375	13,246	5,372	7,401	7,315	4,730	2,006	868	1,050	68,565	26,413
2019	14,039	15,472	12,074	3,769	4,218	4,815	4,391	2,534	1,022	756	63,089	22,349
2020	35,622	14,111	16,206	6,204	3,602	3,529	3,781	3,185	1,770	1,010	89,019	27,202
2021	9,351	34,694	14,297	8,088	5,694	2,931	2,698	2,755	2,261	1,665	84,435	30,721
2022	6,041	8,957	34,564	5,363	6,719	3,951	1,917	1,631	1,628	1,779	72,551	33,335
2023	9,346	5,982	9,247	9,864	4,185	4,200	2,355	1,111	935	1,491	48,717	23,802
2024	10,364	9,680	6,472	1,366	6,389	2,375	2,276	1,295	605	941	41,762	15,793

Table 33. Estimates of beginning of year abundances-at-age (thousands).

Year	2	3	4	5	6	7	8	9	10	11+	2+	5+
1973	572,348	123,205	52,196	66,377	29,454	33,522	16,276	9,543	4,758	3,156	910,836	163,087
1974	713,282	210,539	64,114	31,371	44,373	17,740	19,269	8,885	5,221	4,406	1,119,200	131,265
1975	661,566	262,383	109,407	37,600	19,753	25,788	9,698	9,856	4,594	5,155	1,145,799	112,444
1976	800,439	243,354	136,880	66,334	25,470	12,068	14,616	5,219	5,300	5,233	1,314,913	134,240
1977	902,359	294,444	126,849	82,618	44,303	14,905	6,265	7,408	2,660	5,417	1,487,226	163,575
1978	656,211	331,942	153,643	78,358	58,666	25,250	6,990	3,060	3,678	4,238	1,322,036	180,240
1979	972,172	241,389	173,184	95,316	55,834	34,149	12,127	3,484	1,594	4,189	1,593,437	206,693
1980	623,117	357,623	125,905	107,304	68,251	32,935	17,059	5,903	1,818	3,170	1,343,086	236,440
1981	579,293	229,213	186,221	77,102	75,816	39,895	16,221	8,348	3,180	2,699	1,217,987	223,260
1982	609,252	213,091	119,369	113,472	55,715	46,353	21,130	8,477	4,655	3,154	1,194,666	252,955
1983	456,084	224,105	111,012	73,091	80,335	34,386	25,024	10,896	4,434	4,050	1,023,420	232,218

Year	2	3	4	5	6	7	8	9	10	11+	2+	5+
1984	588,764	167,700	116,333	66,682	50,463	49,793	19,142	14,027	5,966	4,552	1,083,424	210,627
1985	498,827	216,576	87,456	79,802	49,768	31,093	26,063	9,988	7,293	5,312	1,012,177	209,318
1986	461,008	183,487	112,880	58,855	57,737	29,986	16,016	12,955	5,060	6,475	944,458	187,083
1987	585,221	169,572	95,573	74,979	43,232	34,106	14,949	7,283	5,648	5,386	1,035,949	185,583
1988	775,664	215,254	88,165	53,801	52,839	23,634	15,575	5,913	2,785	4,389	1,238,019	158,937
1989	722,898	285,297	111,763	36,236	34,718	27,860	11,002	6,528	2,438	2,680	1,241,421	121,463
1990	417,104	265,901	148,138	38,758	21,280	16,813	11,876	4,311	2,419	1,722	928,323	97,180
1991	175,140	153,403	138,134	41,757	20,279	8,933	6,067	4,223	1,402	1,247	550,585	83,909
1992	113,612	64,272	78,863	39,063	20,276	7,631	2,870	1,922	1,261	744	330,514	73,767
1993	143,383	41,684	32,767	15,953	16,232	5,758	1,727	629	385	346	258,864	41,030
1994	115,327	52,683	21,396	8,011	6,305	4,343	1,257	370	119	119	209,931	20,525
1995	194,878	42,413	27,430	6,959	5,425	3,719	2,551	749	220	108	284,452	19,732
1996	178,914	71,649	22,127	9,902	4,936	3,182	2,174	1,430	420	122	294,855	22,166
1997	215,013	65,808	37,387	9,048	7,320	3,008	1,930	1,224	807	200	341,746	23,538
1998	200,502	79,049	34,203	18,362	6,804	4,469	1,742	972	615	347	347,065	33,311
1999	261,226	73,749	41,263	15,874	13,811	4,199	2,643	931	496	363	414,555	38,316
2000	204,276	96,057	38,498	14,366	10,656	7,264	2,063	1,147	376	250	374,952	36,122
2001	168,082	75,138	50,139	14,710	9,844	5,988	3,782	1,030	521	234	329,469	36,110
2002	118,141	61,819	39,219	13,135	8,904	4,724	2,655	1,752	450	299	251,097	31,919
2003	160,304	43,461	32,268	16,552	9,451	5,266	2,554	1,448	904	391	272,598	36,566
2004	143,639	58,935	22,684	14,451	12,627	6,491	3,599	1,915	1,085	930	266,357	41,099
2005	163,938	52,827	30,760	11,254	11,272	8,464	4,196	2,386	1,230	1,249	287,577	40,051
2006	272,355	60,299	27,577	14,212	8,592	7,008	5,003	2,458	1,355	1,309	400,167	39,937
2007	232,387	100,184	31,479	13,957	11,118	5,293	4,050	2,691	1,279	1,232	403,670	39,620
2008	283,101	85,471	52,290	13,935	10,301	5,661	2,503	1,669	1,035	664	456,630	35,769
2009	158,061	104,061	44,608	22,152	10,042	4,971	2,527	965	581	340	348,309	41,578
2010	123,798	58,119	54,222	17,947	15,555	4,629	2,154	961	329	138	277,853	41,714
2011	161,246	45,536	30,339	17,569	11,972	6,826	1,916	842	347	78	276,671	39,550
2012	212,764	59,277	23,766	13,046	13,074	6,832	3,757	1,026	437	153	334,132	38,324
2013	338,565	78,183	30,943	9,688	9,609	7,044	3,569	1,917	513	234	480,265	32,575
2014	299,860	124,440	40,812	13,218	7,243	5,376	3,854	1,897	1,000	333	498,033	32,921
2015	265,721	110,226	64,956	19,253	10,214	4,483	3,262	2,118	1,018	616	481,868	40,965
2016	179,491	97,734	57,541	21,893	13,315	5,547	2,381	1,528	969	673	381,070	46,305
2017	158,531	66,013	51,018	15,203	13,953	7,258	2,950	1,162	721	700	317,509	41,948

Year	2	3	4	5	6	7	8	9	10	11+	2+	5+
2018	213,632	58,285	34,457	8,374	8,242	6,151	3,059	1,014	380	347	333,942	27,568
2019	200,726	78,571	30,426	5,807	4,560	4,118	2,938	1,342	427	247	329,162	19,439
2020	516,384	73,836	41,017	9,385	3,899	2,966	2,605	1,767	785	320	652,963	21,726
2021	139,771	189,962	38,543	12,719	6,268	2,556	1,896	1,635	1,092	582	395,024	26,748
2022	95,228	51,418	99,167	9,128	7,803	3,553	1,417	1,000	851	684	270,249	24,436
2023	150,355	35,029	26,842	17,186	5,041	3,806	1,711	683	481	590	241,725	29,498
2024	162,344	55,304	18,287	2,293	7,500	2,126	1,589	747	297	349	250,835	14,901

Table 34. Estimates of key model variance and covariance parameters for the assessment model (estimates for other model parameters are presented graphically). SE = standard error.

Parameter	Estimate	SE
σ_R	0.344	0.050
φ_R	0.335	0.170
$\sigma_{Fa=2-3}$	2.998	0.451
$\sigma_{Fa=4}$	1.628	0.183
$\sigma_{Fa=5}$	0.846	0.120
$\sigma_{Fa=6+}$	0.505	0.050
$\varphi_{F,age}$	0.800	0.034
$\varphi_{F,yr}$	0.842	0.038
$\sigma_{M,4+}$	0.929	0.196
$\varphi_{M,age}$	0.881	0.049
$\varphi_{M,yr}$	0.934	0.031
σ_X	0.280	0.022
φ_X	0.220	0.123
$\sigma_{s=RV}$	0.526	0.021
$\sigma_{s=GNS}$	0.543	0.027
$\sigma_{s=LLS1,4+}$	0.438	0.023
$\sigma_{s=LLS2,4+}$	0.425	0.023
$\sigma_{s=SenTrawl}$	0.577	0.026
$\sigma_{s=LLS1,3}$	1.592	0.212
$\sigma_{s=LLS2,3}$	1.138	0.166

Table 35. Estimated fishing mortality-at-age and mean fishing mortality, expressed as instantaneous rates.

Year	2	3	4	5	6	7	8	9	10	11+	4-6 avg	6-9 avg
1973	0.000	0.003	0.059	0.253	0.357	0.404	0.455	0.453	0.477	0.377	0.205	0.403
1974	0.000	0.005	0.084	0.313	0.393	0.454	0.520	0.510	0.539	0.403	0.233	0.444
1975	0.000	0.001	0.050	0.239	0.343	0.418	0.470	0.470	0.540	0.415	0.128	0.411
1976	0.000	0.002	0.055	0.254	0.386	0.506	0.530	0.524	0.585	0.449	0.149	0.460
1977	0.000	0.000	0.032	0.192	0.412	0.607	0.567	0.550	0.571	0.460	0.150	0.479
1978	0.000	0.001	0.027	0.189	0.391	0.583	0.546	0.502	0.524	0.455	0.144	0.458
1979	0.000	0.001	0.029	0.184	0.378	0.544	0.570	0.500	0.504	0.432	0.134	0.458
1980	0.000	0.003	0.040	0.197	0.387	0.558	0.565	0.469	0.477	0.457	0.175	0.461
1981	0.000	0.002	0.045	0.175	0.342	0.486	0.499	0.434	0.466	0.481	0.141	0.406
1982	0.000	0.002	0.041	0.195	0.333	0.466	0.512	0.498	0.513	0.497	0.158	0.419
1983	0.000	0.006	0.060	0.220	0.328	0.436	0.429	0.452	0.462	0.484	0.186	0.379
1984	0.000	0.001	0.034	0.178	0.354	0.517	0.519	0.522	0.513	0.511	0.144	0.456
1985	0.000	0.002	0.037	0.204	0.370	0.527	0.560	0.541	0.497	0.471	0.175	0.469
1986	0.000	0.002	0.030	0.182	0.379	0.549	0.636	0.678	0.573	0.559	0.157	0.491
1987	0.000	0.004	0.030	0.168	0.390	0.570	0.709	0.743	0.614	0.672	0.151	0.525
1988	0.000	0.005	0.030	0.152	0.313	0.437	0.545	0.561	0.521	0.609	0.140	0.395
1989	0.000	0.005	0.035	0.191	0.342	0.470	0.570	0.626	0.596	0.667	0.124	0.441
1990	0.000	0.005	0.040	0.239	0.399	0.550	0.616	0.705	0.662	0.707	0.114	0.517
1991	0.002	0.015	0.078	0.327	0.502	0.660	0.733	0.792	0.741	0.745	0.173	0.604
1992	0.003	0.024	0.132	0.389	0.635	0.862	0.962	1.050	1.075	0.952	0.278	0.741
1993	0.001	0.017	0.182	0.520	0.772	0.975	1.026	1.152	1.200	0.959	0.412	0.848
1994	0.000	0.003	0.011	0.019	0.016	0.020	0.023	0.025	0.027	0.020	0.014	0.019
1995	0.001	0.001	0.001	0.004	0.008	0.011	0.015	0.015	0.020	0.015	0.003	0.011
1996	0.000	0.000	0.001	0.005	0.010	0.015	0.021	0.018	0.028	0.019	0.003	0.014
1997	0.001	0.004	0.025	0.056	0.133	0.186	0.269	0.272	0.396	0.286	0.045	0.177
1998	0.000	0.000	0.006	0.031	0.110	0.153	0.226	0.272	0.394	0.296	0.025	0.149
1999	0.000	0.000	0.009	0.050	0.153	0.221	0.346	0.417	0.551	0.395	0.046	0.201
2000	0.000	0.000	0.010	0.061	0.154	0.230	0.317	0.411	0.503	0.324	0.046	0.210
2001	0.000	0.000	0.015	0.061	0.157	0.236	0.337	0.396	0.384	0.296	0.043	0.225
2002	0.000	0.000	0.007	0.044	0.133	0.223	0.324	0.380	0.318	0.275	0.033	0.209
2003	0.001	0.000	0.000	0.003	0.007	0.012	0.018	0.018	0.014	0.015	0.002	0.011
2004	0.000	0.000	0.002	0.015	0.049	0.086	0.120	0.152	0.124	0.131	0.018	0.077

Year	2	3	4	5	6	7	8	9	10	11+	4-6 avg	6-9 avg
2005	0.000	0.000	0.001	0.013	0.052	0.102	0.151	0.182	0.147	0.170	0.014	0.096
2006	0.000	0.000	0.002	0.019	0.071	0.135	0.213	0.246	0.191	0.209	0.018	0.140
2007	0.000	0.000	0.006	0.034	0.089	0.163	0.240	0.309	0.245	0.255	0.030	0.158
2008	0.001	0.000	0.011	0.045	0.102	0.179	0.249	0.352	0.286	0.318	0.030	0.163
2009	0.000	0.002	0.024	0.058	0.100	0.162	0.196	0.305	0.263	0.358	0.044	0.141
2010	0.000	0.000	0.007	0.032	0.070	0.129	0.165	0.245	0.239	0.348	0.023	0.098
2011	0.001	0.000	0.004	0.015	0.047	0.083	0.113	0.145	0.156	0.242	0.016	0.068
2012	0.001	0.000	0.001	0.007	0.031	0.062	0.089	0.110	0.117	0.153	0.010	0.051
2013	0.001	0.000	0.002	0.008	0.030	0.053	0.078	0.096	0.091	0.093	0.009	0.051
2014	0.001	0.000	0.002	0.008	0.028	0.048	0.078	0.101	0.090	0.083	0.006	0.052
2015	0.000	0.000	0.001	0.007	0.025	0.048	0.082	0.105	0.082	0.080	0.005	0.048
2016	0.000	0.000	0.001	0.007	0.024	0.049	0.075	0.109	0.084	0.102	0.006	0.041
2017	0.001	0.000	0.002	0.010	0.035	0.080	0.127	0.176	0.139	0.186	0.009	0.065
2018	0.000	0.000	0.003	0.015	0.040	0.085	0.124	0.164	0.138	0.185	0.011	0.076
2019	0.000	0.000	0.001	0.007	0.024	0.052	0.077	0.104	0.095	0.139	0.004	0.053
2020	0.000	0.000	0.003	0.014	0.030	0.055	0.071	0.087	0.082	0.085	0.007	0.055
2021	0.000	0.000	0.001	0.009	0.028	0.050	0.071	0.085	0.086	0.088	0.005	0.047
2022	0.000	0.000	0.001	0.010	0.018	0.031	0.043	0.046	0.045	0.041	0.003	0.026
2023	0.000	0.000	0.001	0.009	0.019	0.029	0.042	0.043	0.045	0.046	0.006	0.027
2024	0.000	0.000	0.001	0.010	0.021	0.032	0.043	0.042	0.049	0.046	0.007	0.027

Table 36. Natural mortality rate at age, assumed (grey background) or estimated by the model, expressed as instantaneous rates.

Year	2	3	4	5	6	7	8	9	10	11+
1973	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1974	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1975	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1976	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1977	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1978	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1979	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1980	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1981	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1982	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1983	1	0.65	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.15

Year	2	3	4	5	6	7	8	9	10	11+
1984	1	0.65	0.34	0.11	0.13	0.13	0.13	0.13	0.17	0.17
1985	1	0.65	0.36	0.12	0.14	0.14	0.14	0.14	0.18	0.18
1986	1	0.65	0.38	0.13	0.15	0.15	0.15	0.15	0.20	0.20
1987	1	0.65	0.54	0.18	0.21	0.21	0.22	0.22	0.28	0.28
1988	1	0.65	0.86	0.29	0.33	0.33	0.33	0.33	0.41	0.41
1989	1	0.65	1.02	0.34	0.38	0.38	0.37	0.37	0.46	0.46
1990	1	0.65	1.23	0.41	0.47	0.47	0.42	0.42	0.52	0.52
1991	1	0.65	1.18	0.39	0.48	0.48	0.42	0.42	0.53	0.53
1992	1	0.65	1.47	0.49	0.62	0.62	0.56	0.56	0.73	0.73
1993	1	0.65	1.23	0.41	0.55	0.55	0.51	0.51	0.74	0.74
1994	1	0.65	1.11	0.37	0.51	0.51	0.49	0.49	0.76	0.76
1995	1	0.65	1.02	0.34	0.53	0.53	0.56	0.56	0.98	0.98
1996	1	0.65	0.89	0.30	0.49	0.49	0.55	0.55	0.97	0.97
1997	1	0.65	0.69	0.23	0.36	0.36	0.42	0.42	0.69	0.69
1998	1	0.65	0.76	0.25	0.37	0.37	0.40	0.40	0.62	0.62
1999	1	0.65	1.05	0.35	0.49	0.49	0.49	0.49	0.75	0.75
2000	1	0.65	0.95	0.32	0.42	0.42	0.38	0.38	0.55	0.55
2001	1	0.65	1.32	0.44	0.58	0.58	0.43	0.43	0.57	0.57
2002	1	0.65	0.86	0.29	0.39	0.39	0.28	0.28	0.35	0.35
2003	1	0.65	0.80	0.27	0.37	0.37	0.27	0.27	0.32	0.32
2004	1	0.65	0.70	0.23	0.35	0.35	0.29	0.29	0.35	0.35
2005	1	0.65	0.77	0.26	0.42	0.42	0.38	0.38	0.48	0.48
2006	1	0.65	0.68	0.23	0.41	0.41	0.41	0.41	0.57	0.57
2007	1	0.65	0.81	0.27	0.59	0.59	0.65	0.65	1.08	1.08
2008	1	0.65	0.85	0.28	0.63	0.63	0.70	0.70	1.31	1.31
2009	1	0.65	0.89	0.30	0.67	0.67	0.77	0.77	1.60	1.60
2010	1	0.65	1.12	0.37	0.75	0.75	0.77	0.77	1.51	1.51
2011	1	0.65	0.84	0.28	0.51	0.51	0.51	0.51	0.85	0.85
2012	1	0.65	0.90	0.30	0.59	0.59	0.58	0.58	0.80	0.80
2013	1	0.65	0.85	0.28	0.55	0.55	0.55	0.55	0.72	0.72
2014	1	0.65	0.75	0.25	0.45	0.45	0.52	0.52	0.68	0.68
2015	1	0.65	1.09	0.36	0.59	0.59	0.68	0.68	0.81	0.81
2016	1	0.65	1.33	0.44	0.58	0.58	0.64	0.64	0.76	0.76
2017	1	0.65	1.81	0.60	0.78	0.78	0.94	0.94	1.25	1.25

Year	2	3	4	5	6	7	8	9	10	11+
2018	1	0.65	1.78	0.59	0.65	0.65	0.70	0.70	0.92	0.92
2019	1	0.65	1.18	0.39	0.41	0.41	0.43	0.43	0.64	0.64
2020	1	0.65	1.17	0.39	0.39	0.39	0.39	0.39	0.56	0.56
2021	1	0.65	1.44	0.48	0.54	0.54	0.57	0.57	0.81	0.81
2022	1	0.65	1.75	0.58	0.70	0.70	0.69	0.69	0.91	0.91
2023	1	0.65	2.46	0.82	0.84	0.84	0.79	0.79	1.08	1.08
2024	1	0.65	1.85	0.62	0.58	0.58	0.50	0.50	0.63	0.63

Table 37. Results of 4-year projections from the assessment model under different catch scenarios, based on 10,000 simulations.

Probability	0 t	500 t	1000 t
... of any increase of SSB	0.0396	0.0252	0.0128
... of a > 10% increase in SSB	0.0167	0.0114	0.0050
... of reaching or exceeding LRP	0.0000	0.0000	0.0000
... of any increase in age 5+ abundance	0.4774	0.4383	0.3789
... of a > 10% increase in age 5+ abundance	0.3619	0.3232	0.2683

9. FIGURES

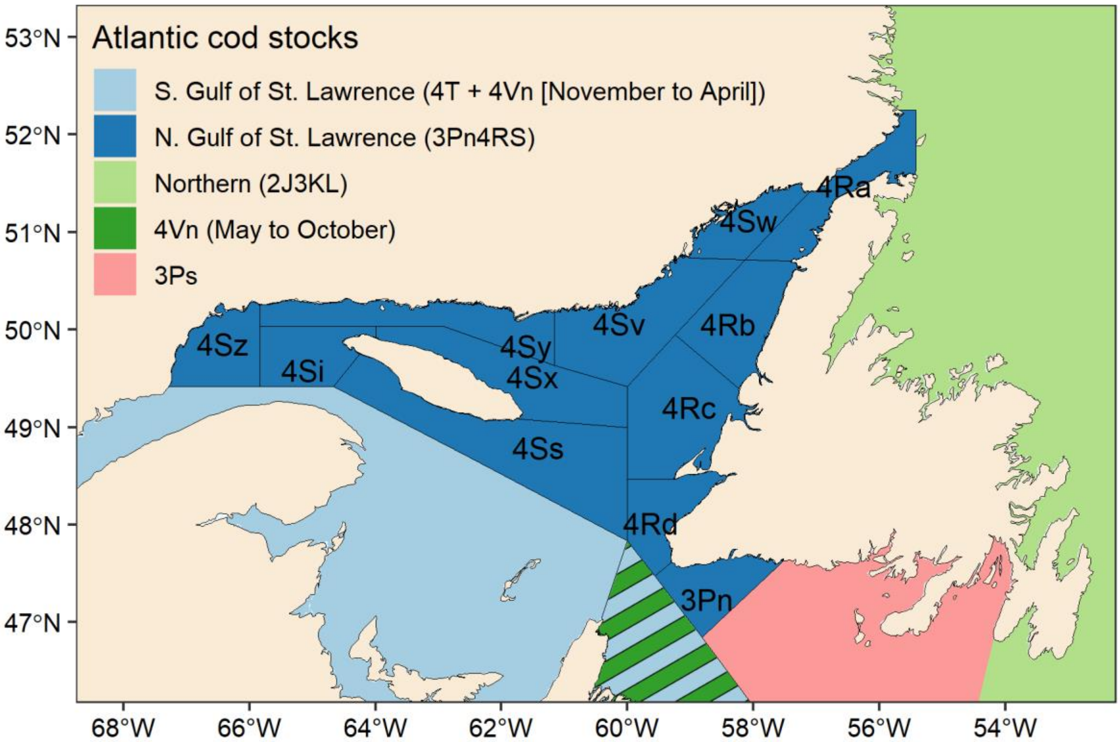

Figure 1. Different stocks of Atlantic cod from the northwest Atlantic surrounding the 3Pn4RS stock. NAFO unit areas for the 3Pn4RS stock are provided.

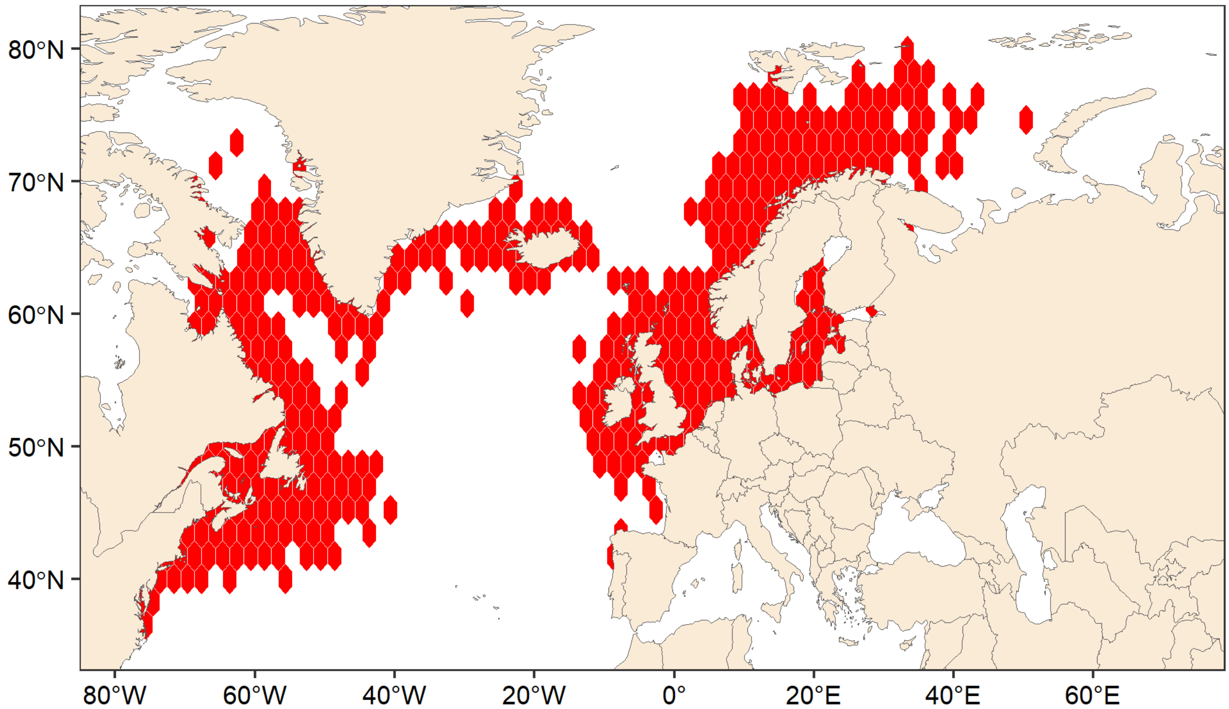

Figure 2. Global distribution area of Atlantic cod, Gadus morhua. Data source: OBIS.

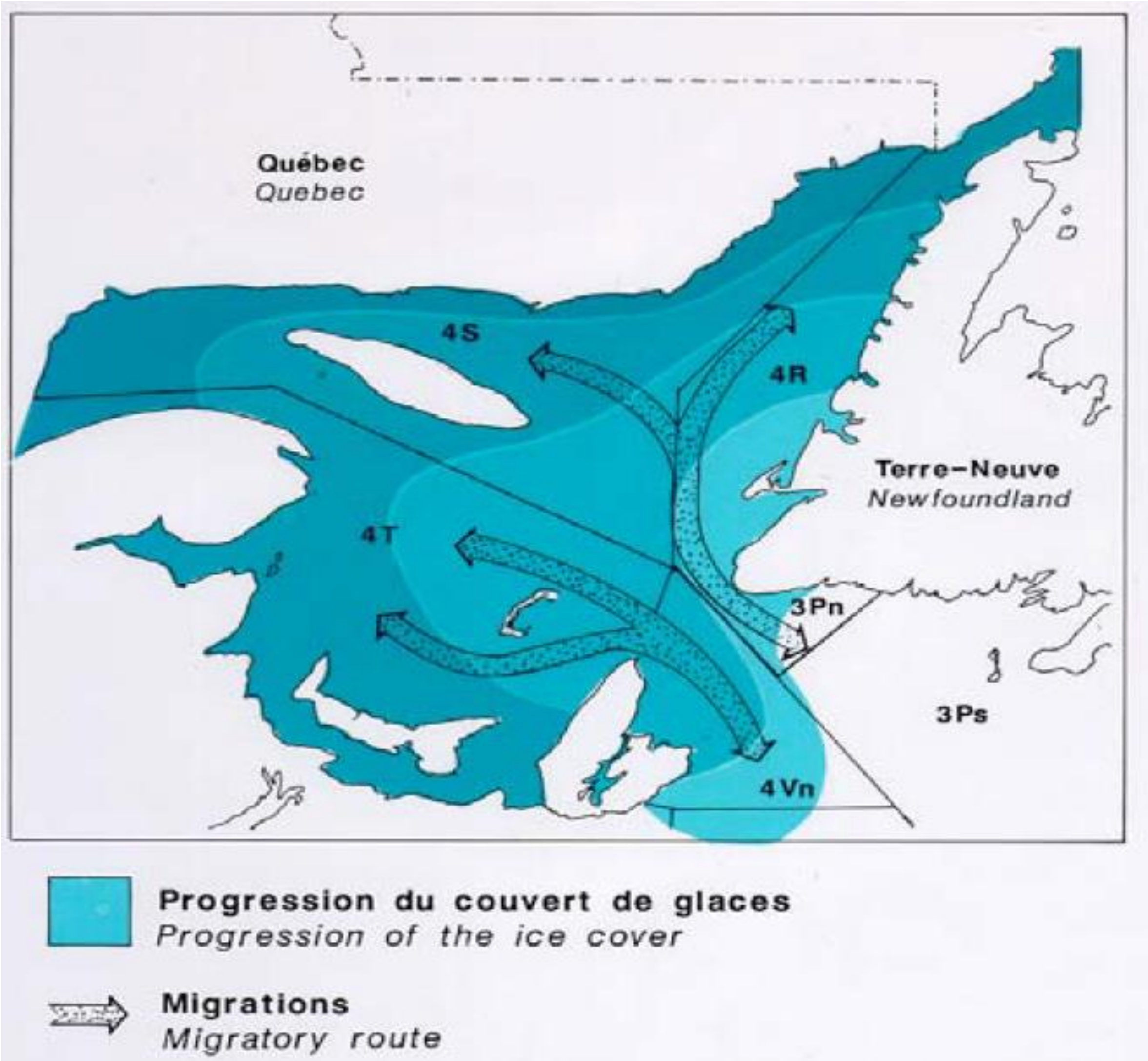

Figure 3. General migration routes of cod from the southern and northern Gulf of St. Lawrence stocks. Figure taken from Yvelin et al. (2005) and from the work of Fréchet (1990).

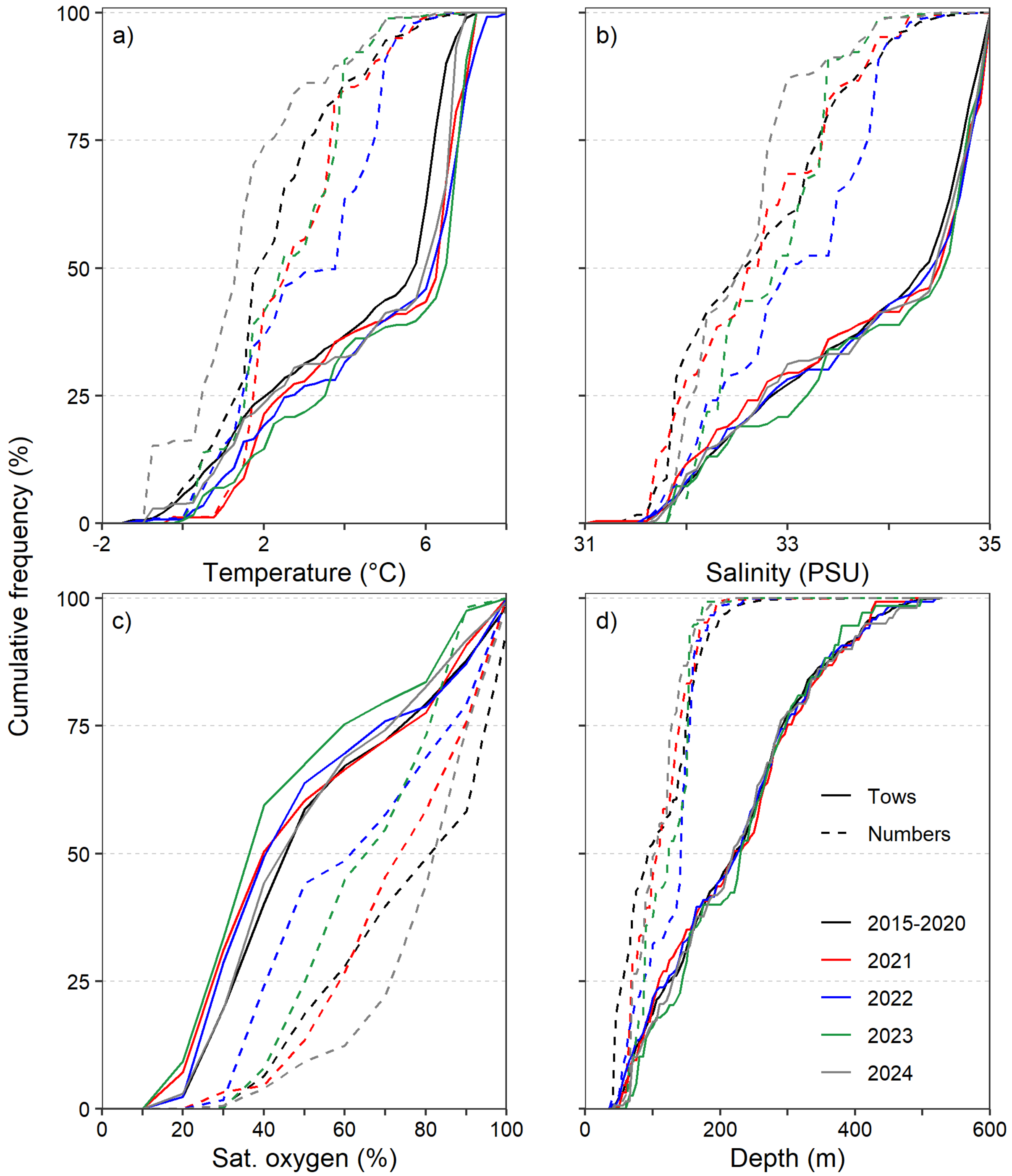

Figure 4. Distribution, expressed as cumulative frequency, of cod catches in numbers (hatched lines), relative to available habitat (solid lines) according to a) bottom temperature, b) bottom salinity, c) bottom oxygen saturation (%) and (d) depth in the DFO August survey during the last 10 years. Only tows performed in NAFO Divisions 4RS were considered.

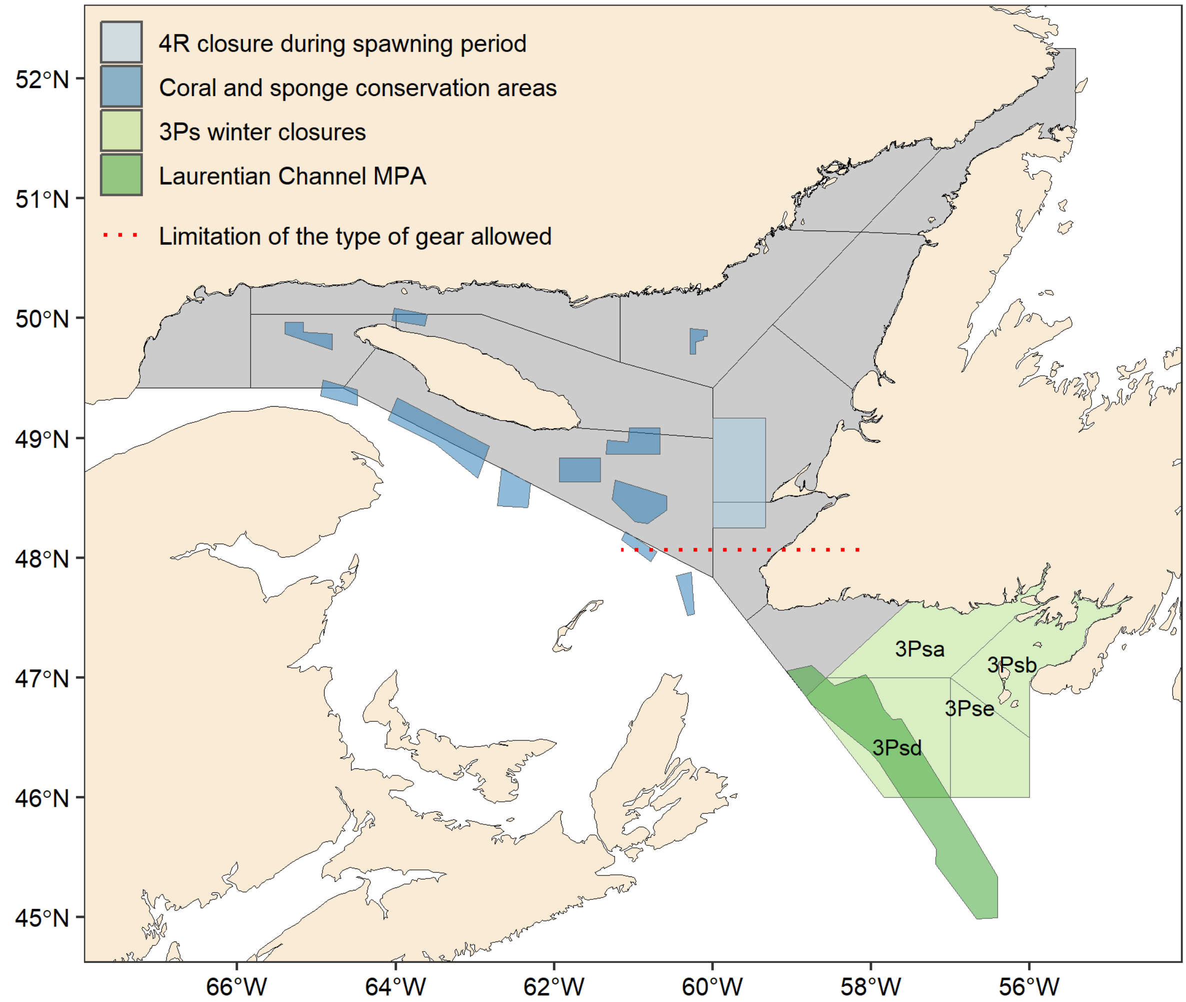

Figure 5. Summary of selected management and conservation measures impacting the nGSL cod stock, the distribution of which is shown in grey. Details are provided in the text. MPA = marine protected area.

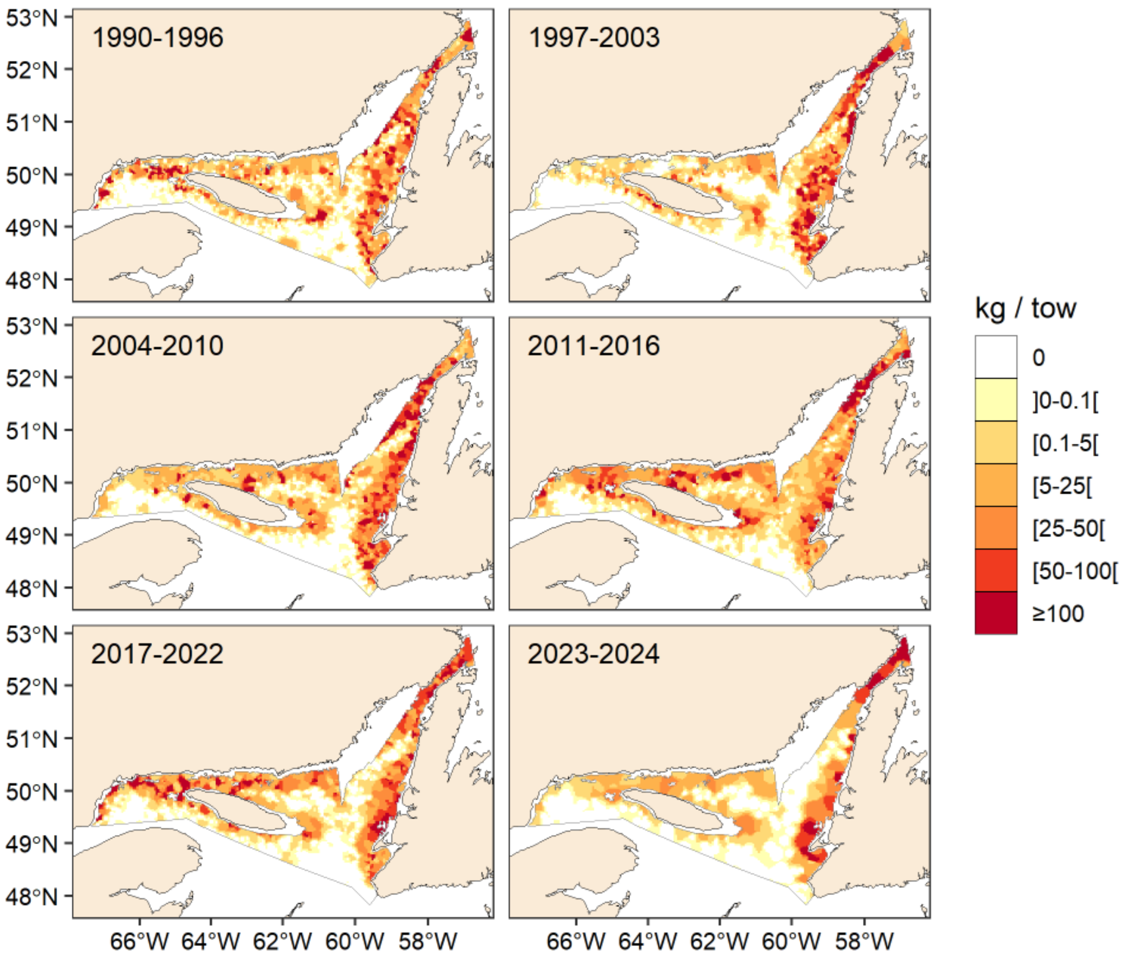

Figure 6. Distribution of cod catch rates (kg per 15 min tow) in the DFO August survey in NAFO Divisions 4RS, by year periods.

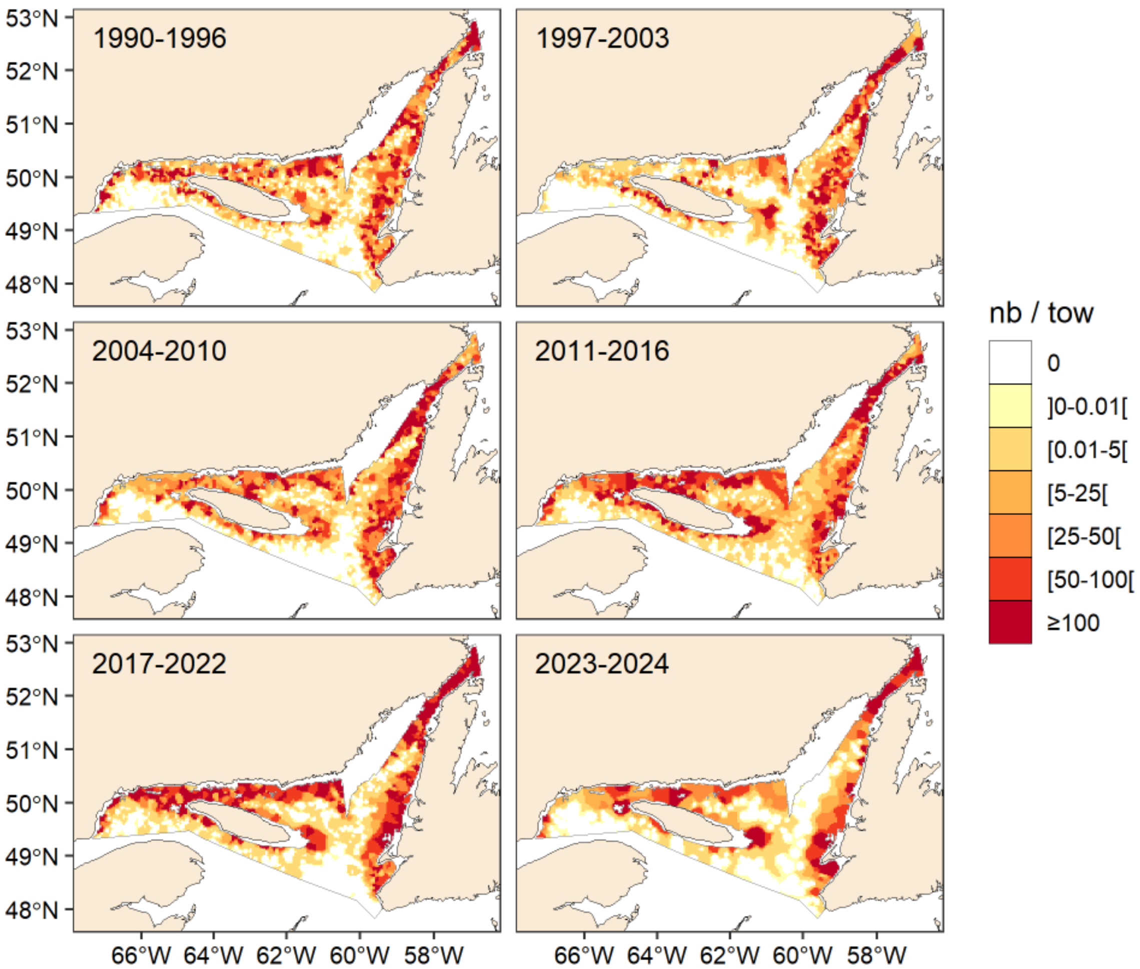

Figure 7. Distribution of cod catch rates (nb per 15 min tow) in the DFO August survey in NAFO Divisions 4RS, by year periods.

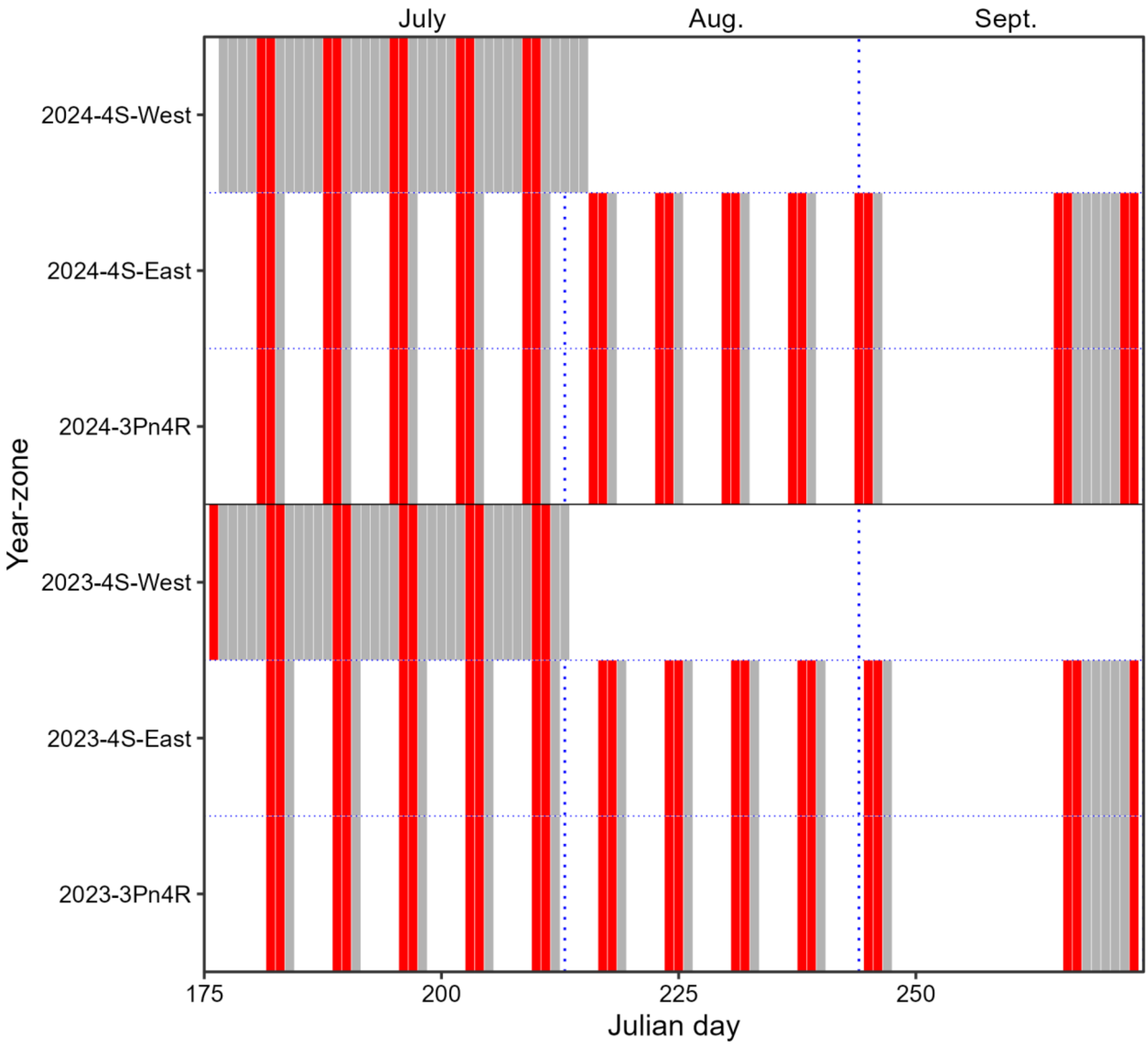

Figure 8. Visualization of the 2023-2024 nGSL recreational cod fishing seasons. Days when recreational fishing was permitted are shown in red (weekend days) and grey (weekdays). Zone 4S-West refers to the area between Pointe-des-Monts and Natashquan. Zone 4S-East refers to the area between Natashquan and Blanc-Sablon.

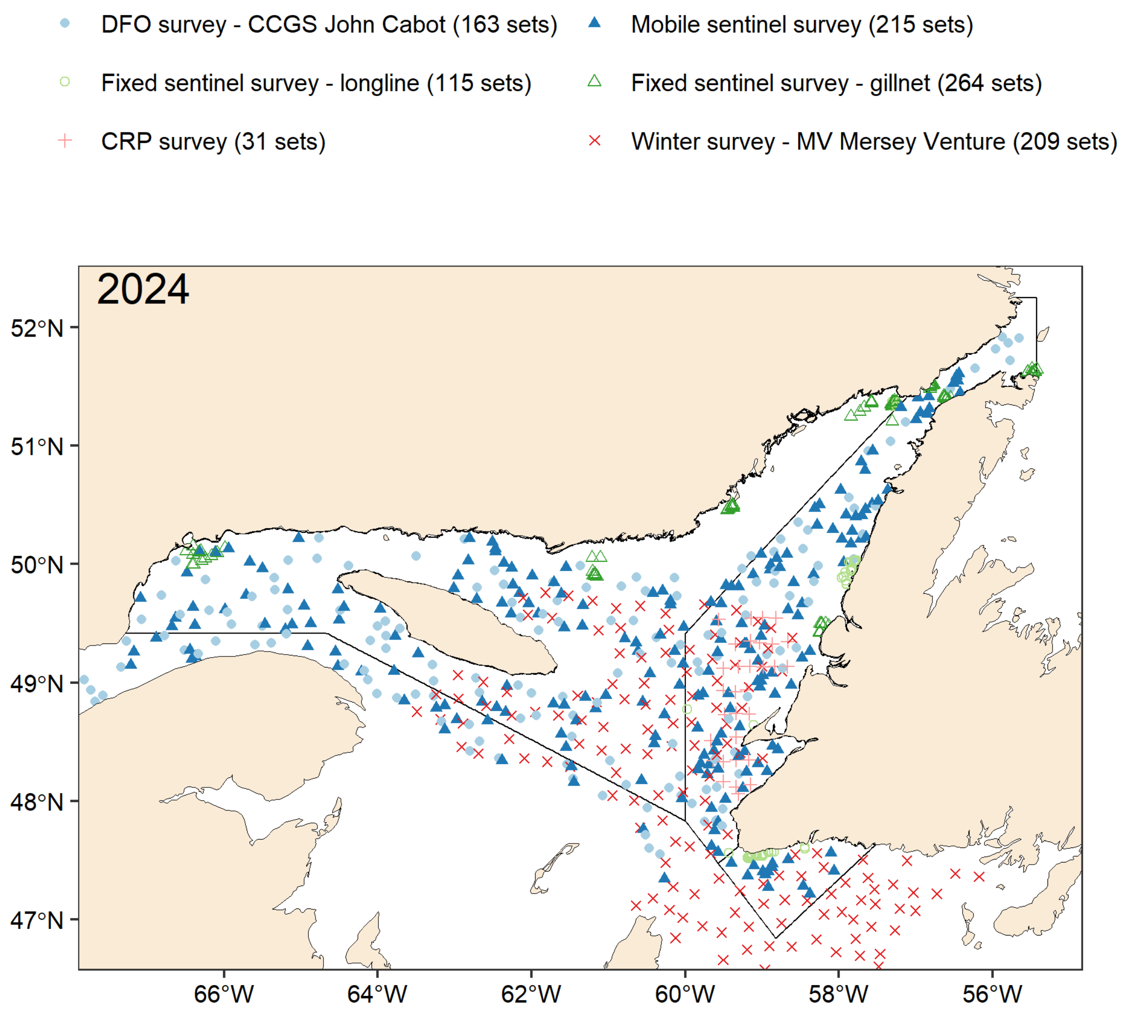

Figure 9. Spatial distribution in 3Pn4RS of the various surveys carried out in 2024 and detailed in this stock assessment.

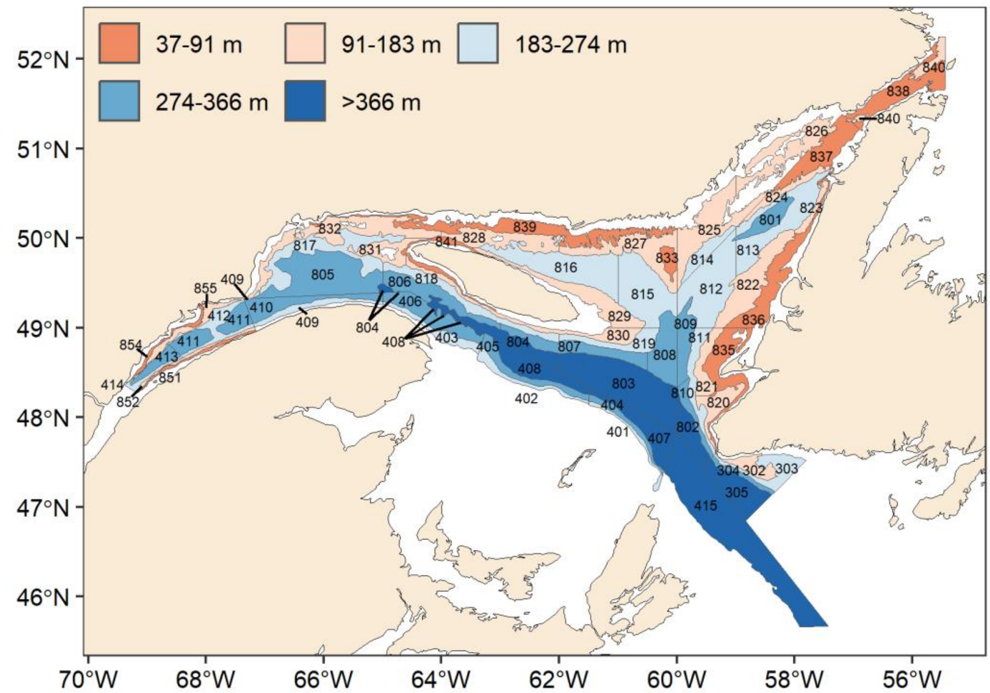

Figure 10. Stratification scheme used for the DFO August survey carried out in the Estuary and northern Gulf of St. Lawrence. Strata are coloured by depth class.

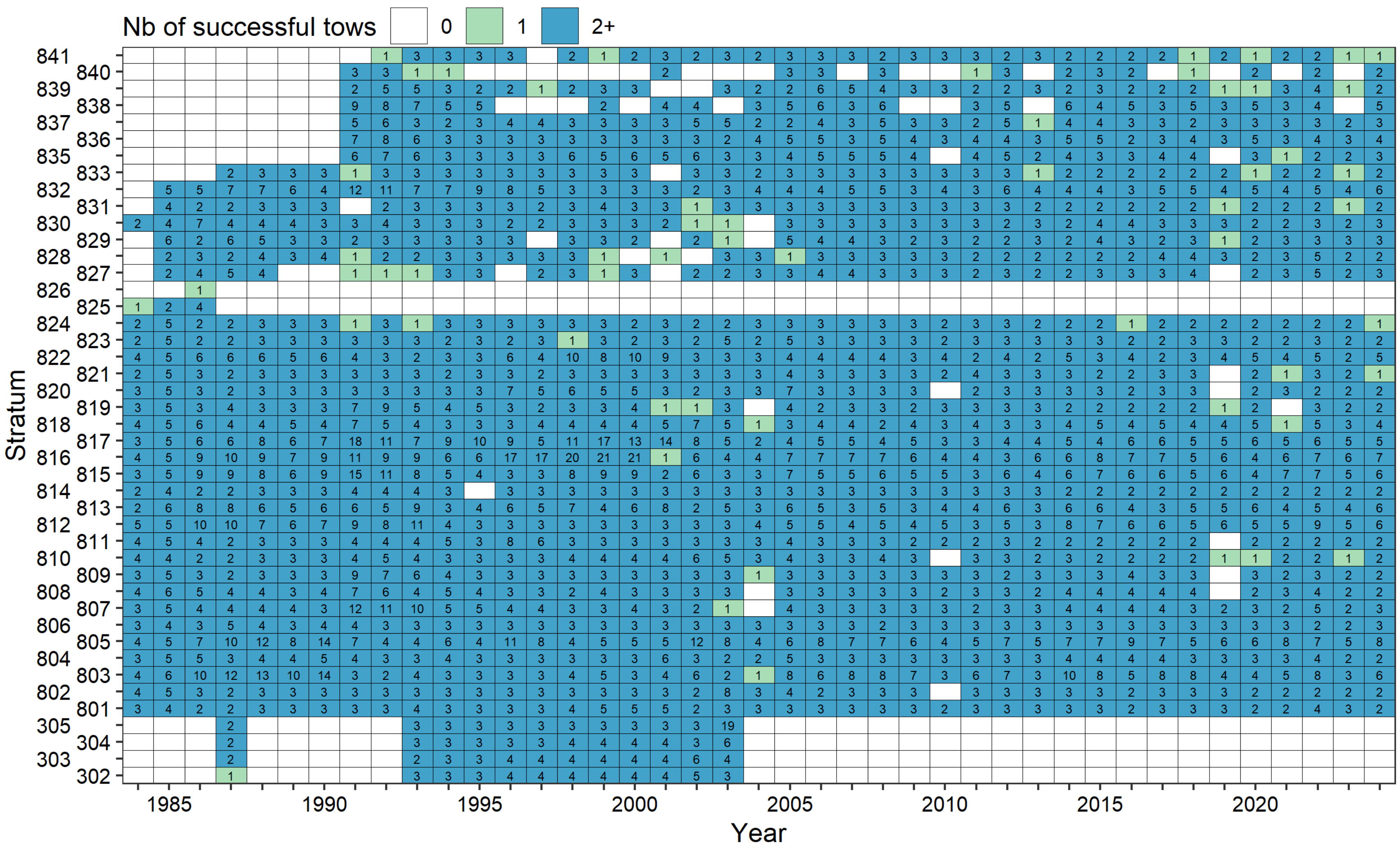

Figure 11. Number of successful tows made in each stratum during the DFO August survey, by year. Only 3Pn4RS strata are shown. For the comparative fishing years (1990, 2004, 2005, 2021 and 2022), the values presented only include one successful tow per trawled station.

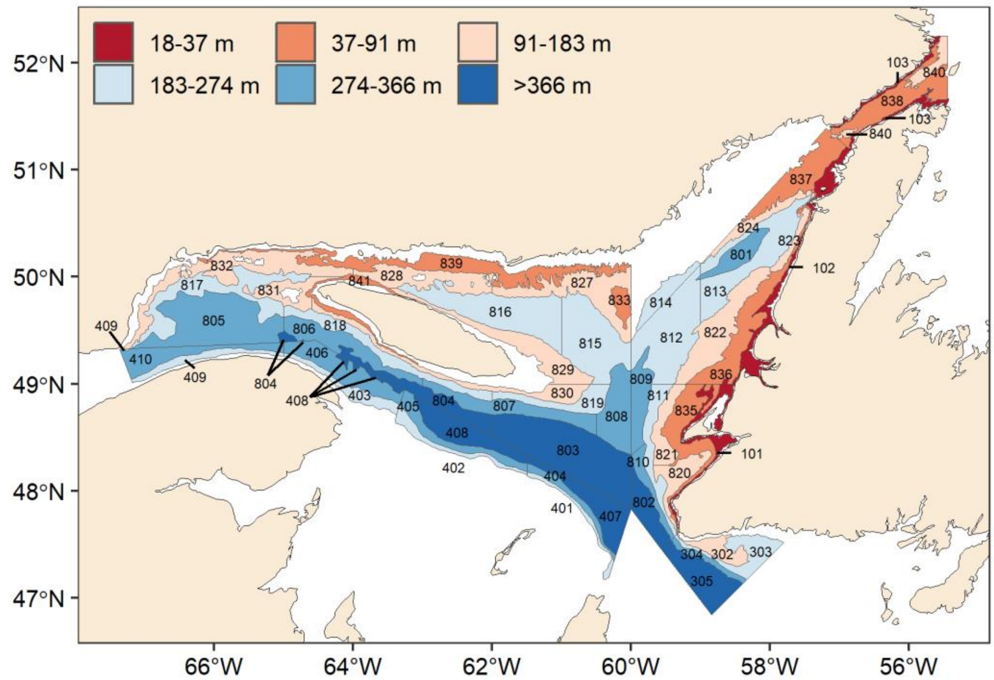

Figure 12. Stratification scheme used for the sentinel mobile survey. Strata 101 to 103 (18-37 m) were added in 2003. Strata are coloured by depth class.

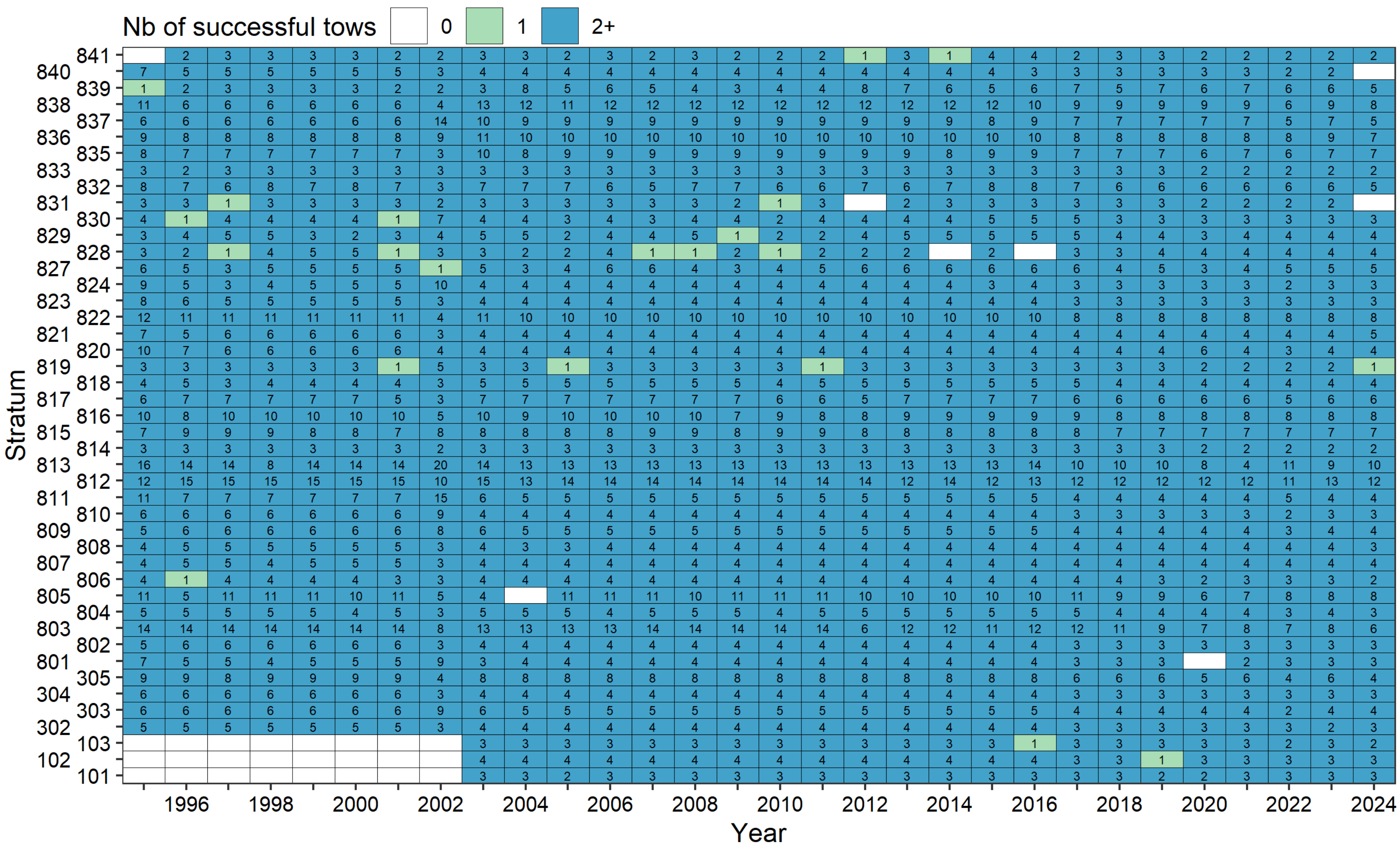

Figure 13. Number of successful tows made in each stratum during the sentinel mobile survey, by year. Only 3Pn4RS strata are shown.

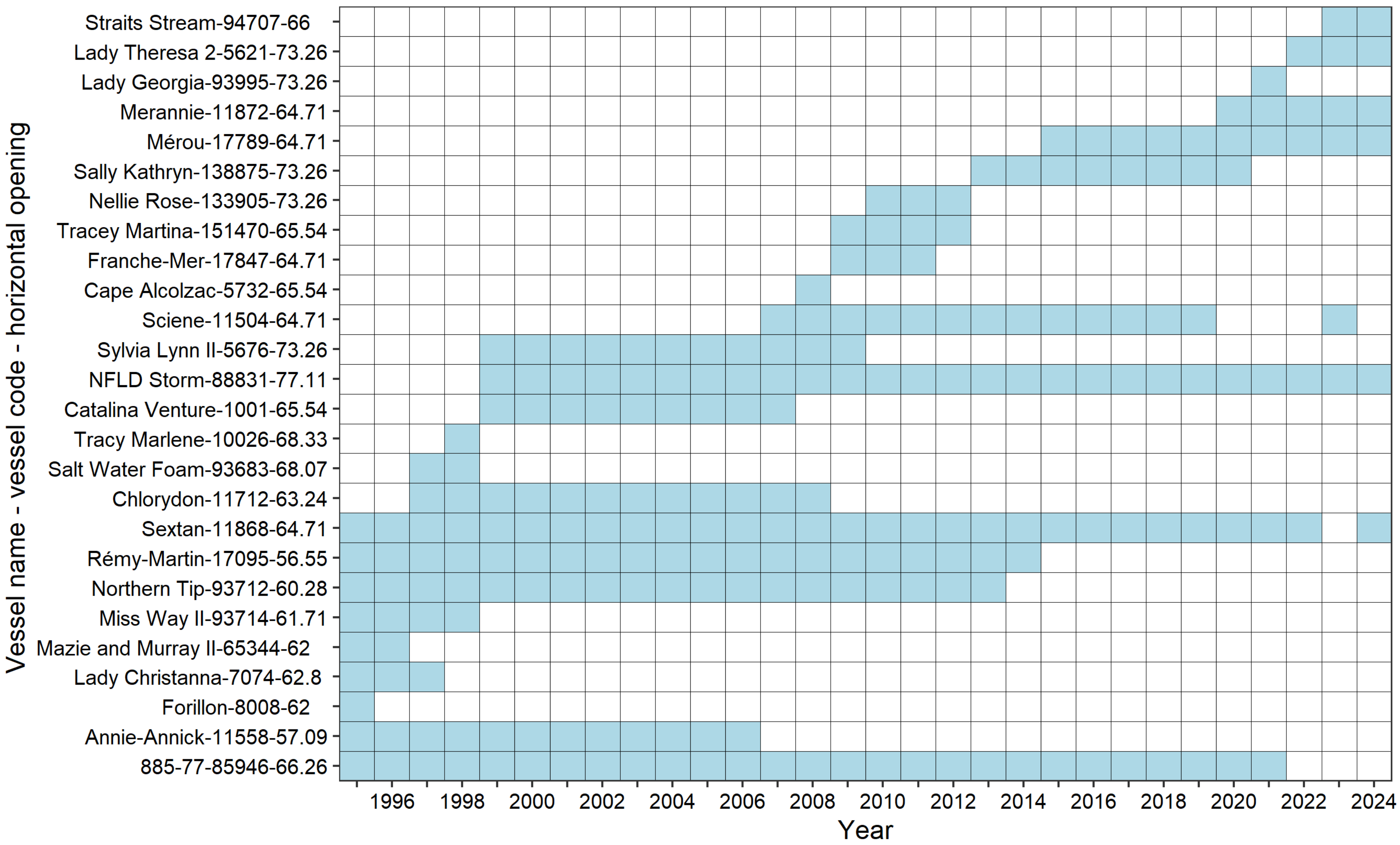

Figure 14. Evolution of vessels used in the July sentinel mobile survey. The horizontal opening values are in ft and correspond to the values used in the calculations for activities where the retention cable was not used.

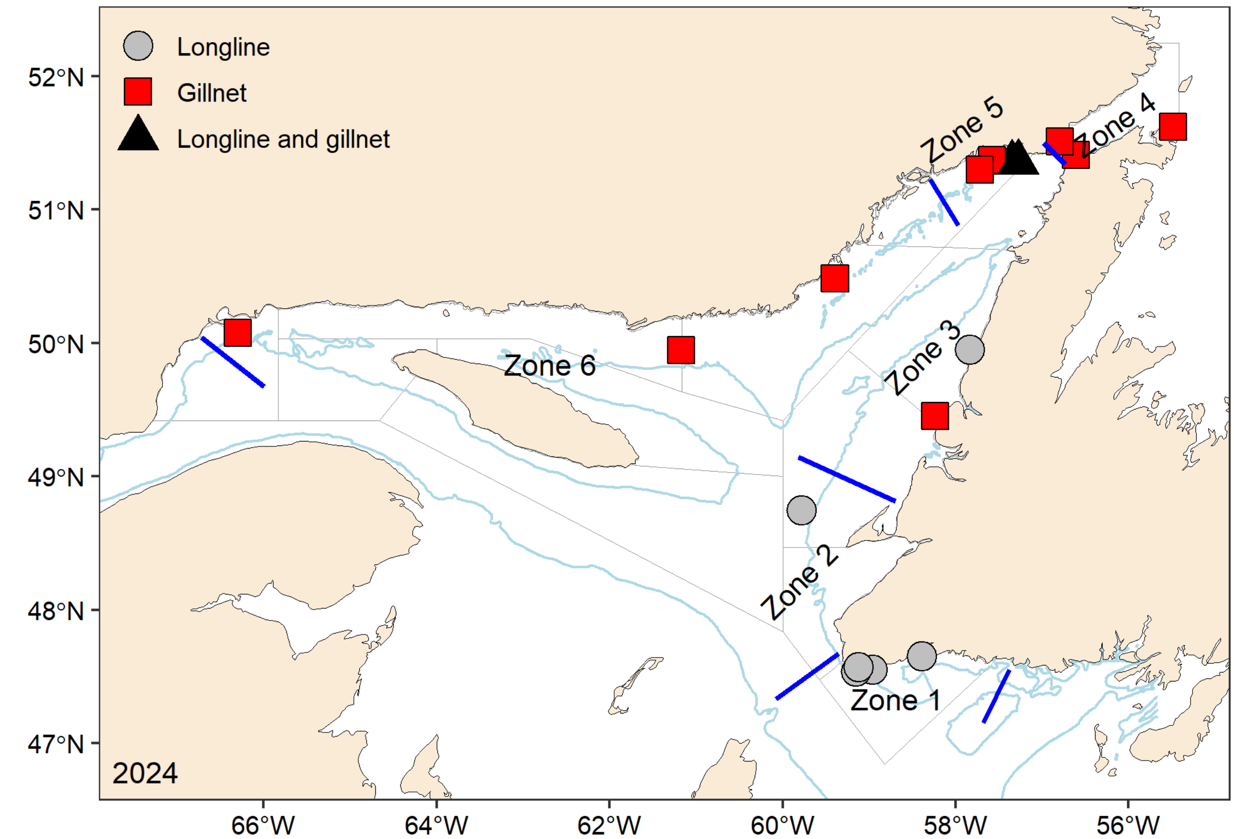

Figure 15. Spatial distribution of sampling effort for sentinel fixed gear survey indices in 2024. The blue lines delimit the six zones.

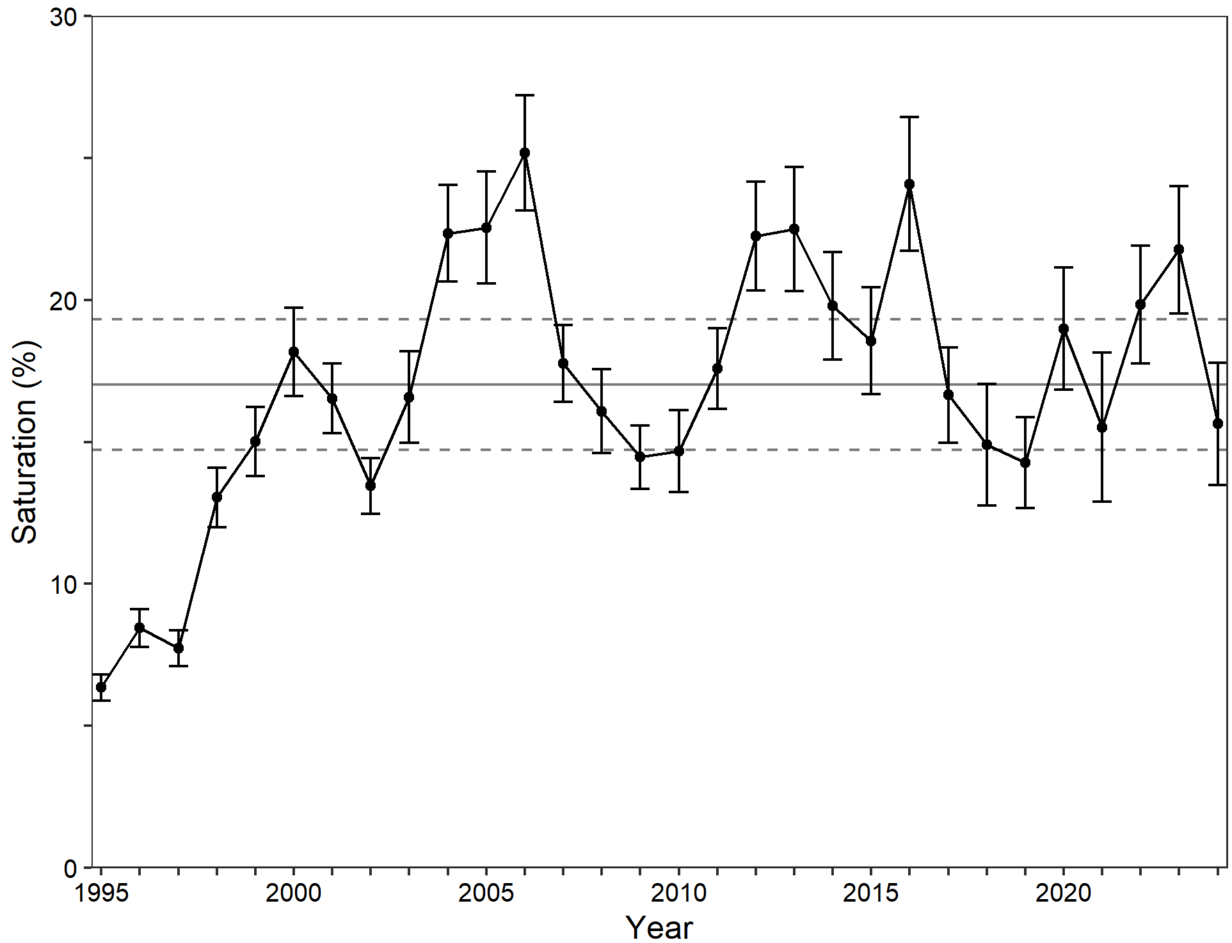

Figure 16. Mean annual saturation (± 95% confidence intervals) of longline fishing activities in the sentinel survey program. The solid horizontal line represents the mean 1995-2024. Hatched horizontal lines represent the series mean ± 0.5 standard deviation.

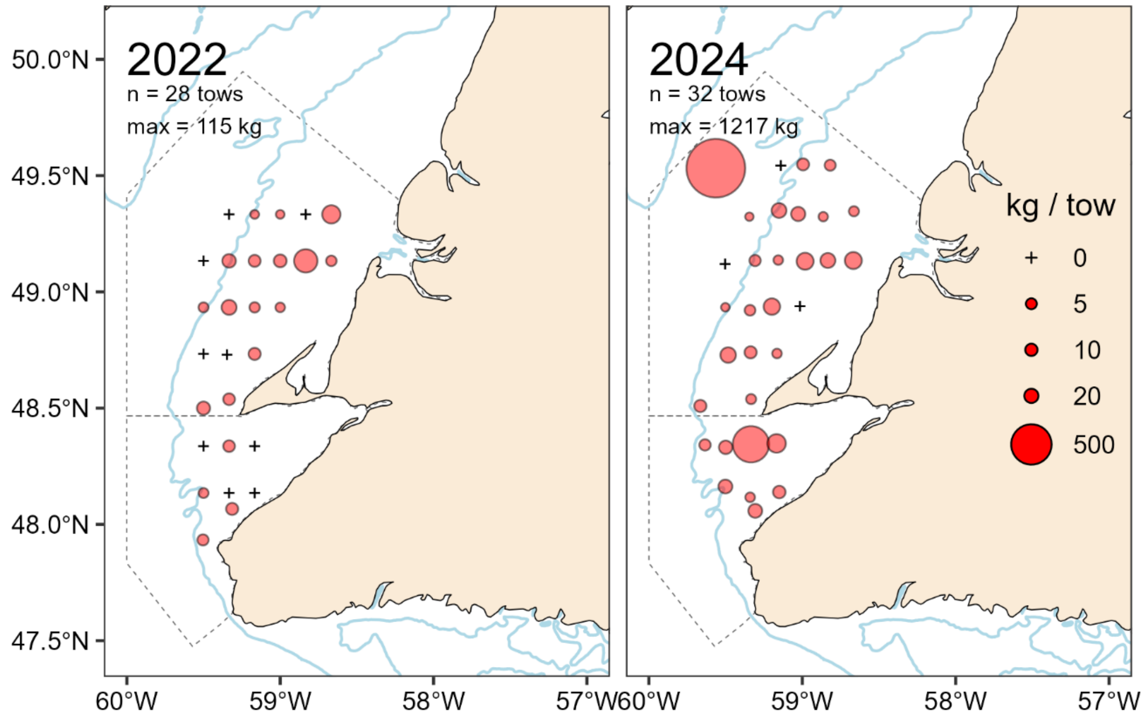

Figure 17. Distribution of cod catch rates (kg per tow) during the May 2022 and 2024 reproductive potential surveys. The 200 m isobath is shown in light blue, as well as the delineation of NAFO unit areas 4Rc and 4Rd in hatched grey.

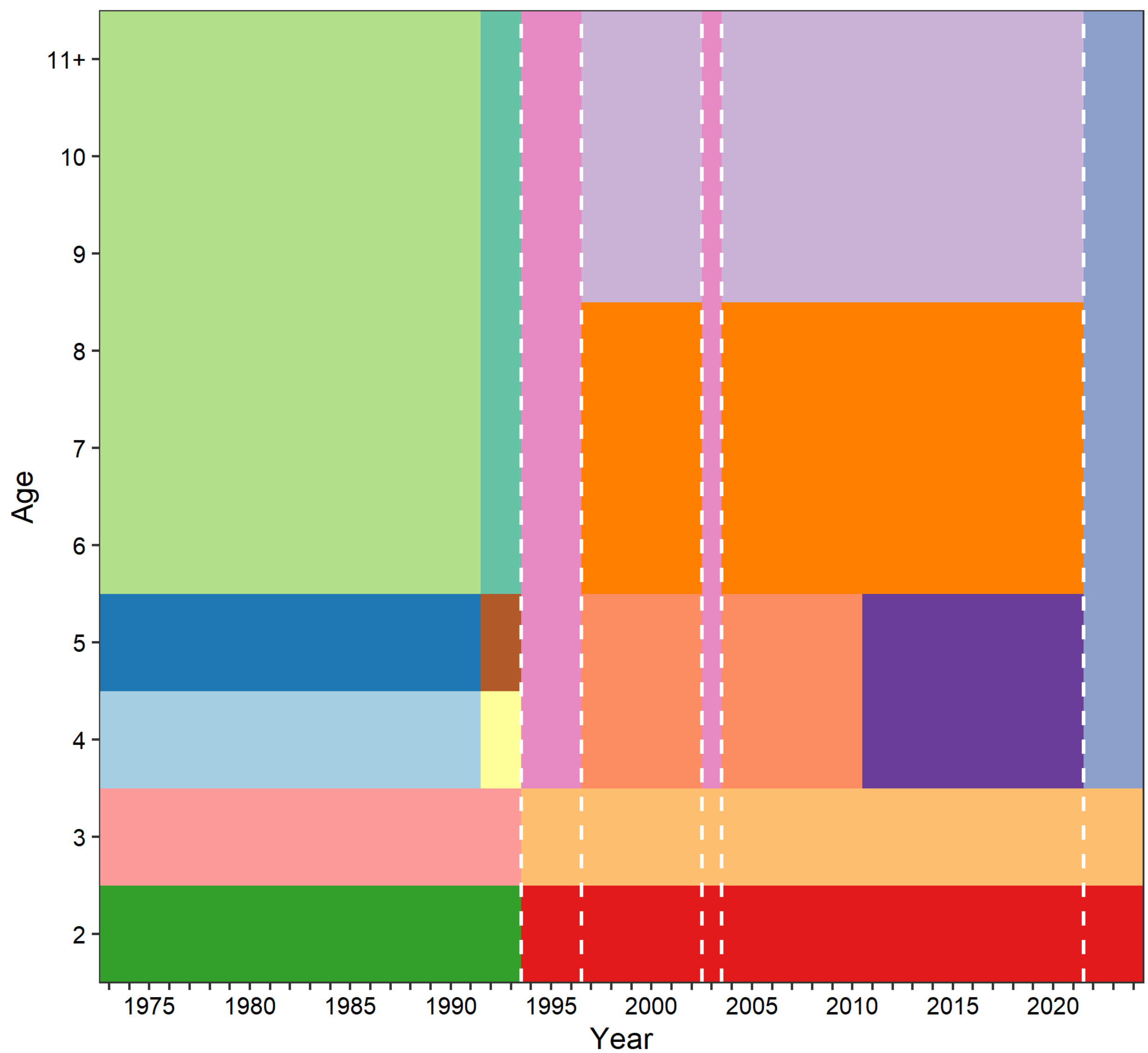

Figure 18. Fishing mortality main fixed effects. Each colour represents a different group for which a parameter value is estimated. The white hatched lines indicate the beginning and end of the various moratoria that occurred during the series.

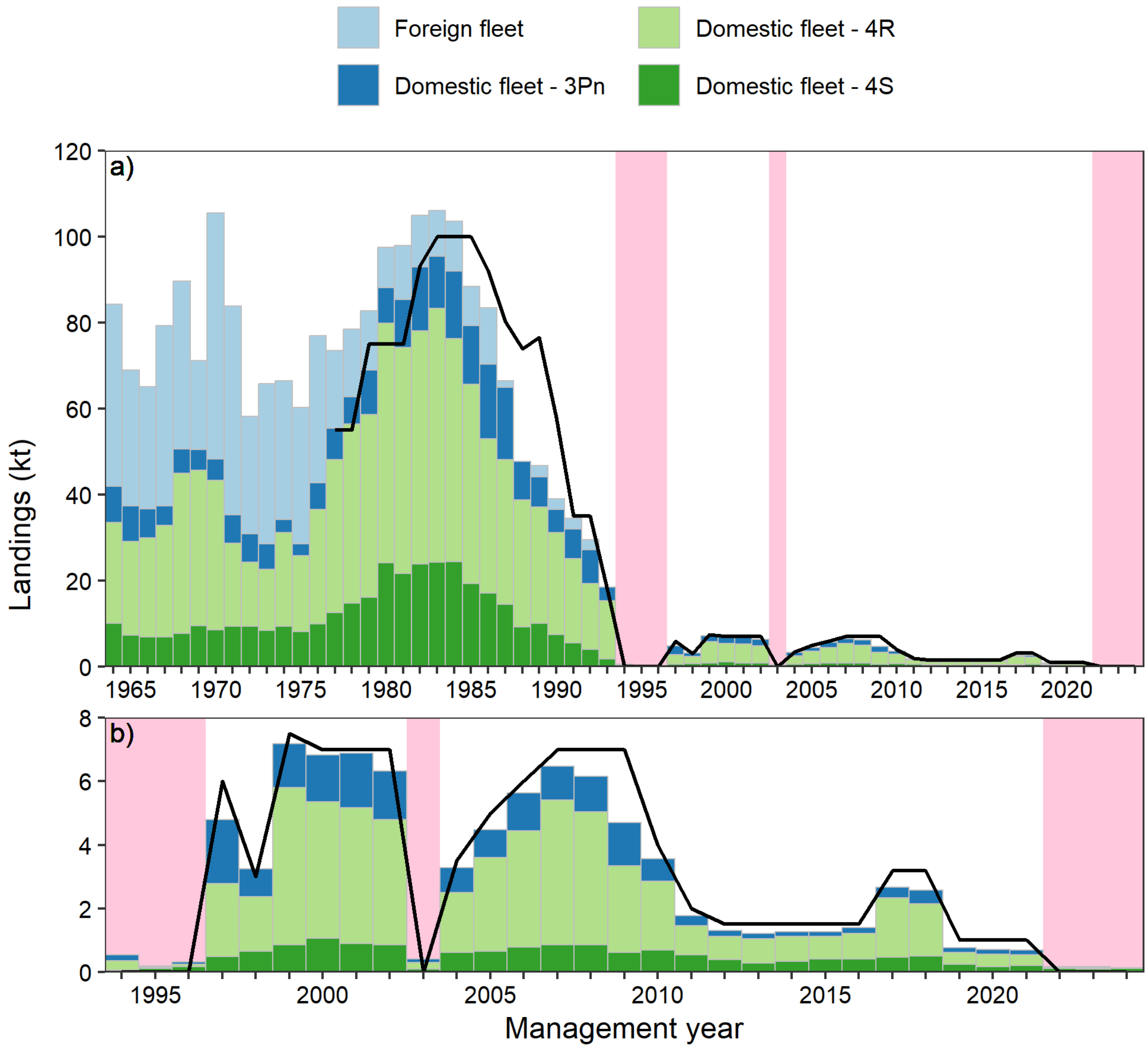

Figure 19. Annual landings of 3Pn4RS Atlantic cod and total allowable catch (TAC, black line) by management year. The complete series is shown in a) and the period 1994-2024 in b). Moratorium years are shaded in pink. Until 1998, the management year corresponded to the calendar year. The 1999/2000 management year began on January 1st, 1999, and ended on May 14th, 2000. Thereafter, the management year begins on May 15th of the current year and ends on May 14th of the following year. Sources: NAFO 21B and ZIFF data.

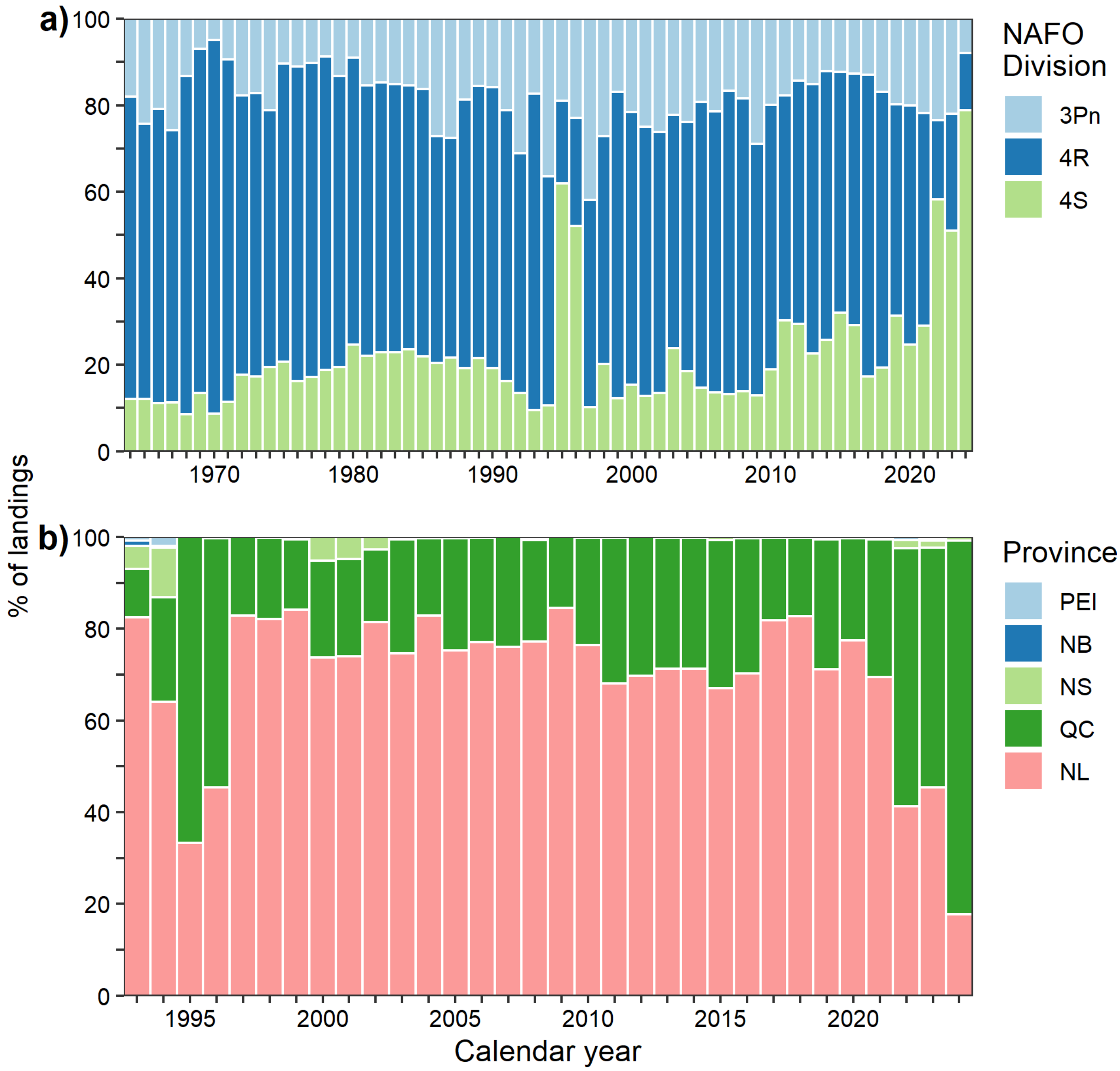

Figure 20. Percentage of reported annual 3Pn4RS Atlantic cod landings by a) NAFO Division and b) province. The series begins in 1993 in b) in order to eliminate foreign fleets landings. PEI = Prince Edward Island, NB = New Brunswick, NS = Nova Scotia, QC = Quebec, NL = Newfoundland and Labrador. Sources: NAFO 21B and ZIFF data.

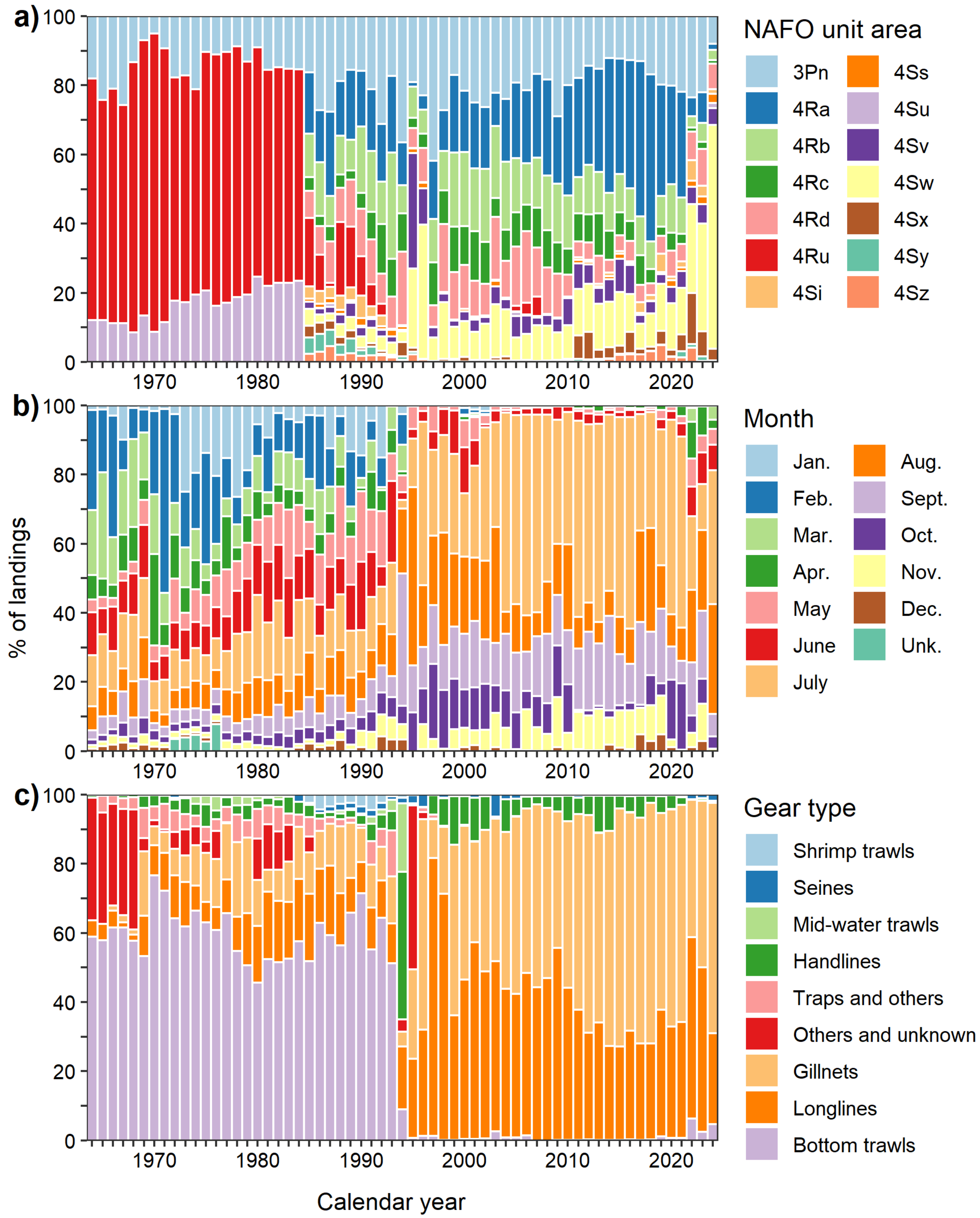

Figure 21. Percentage of annual reported 3Pn4RS Atlantic cod landings by a) NAFO unit area, b) month, and c) type of fishing gear for the period 1964–-2024. In a), unit areas 4Ru and 4Su correspond to landings recorded in Divisions 4R and 4S respectively, but for which the exact unit area is unknown. Data from the last six years are provisional. Sources: NAFO 21B and ZIFF data.

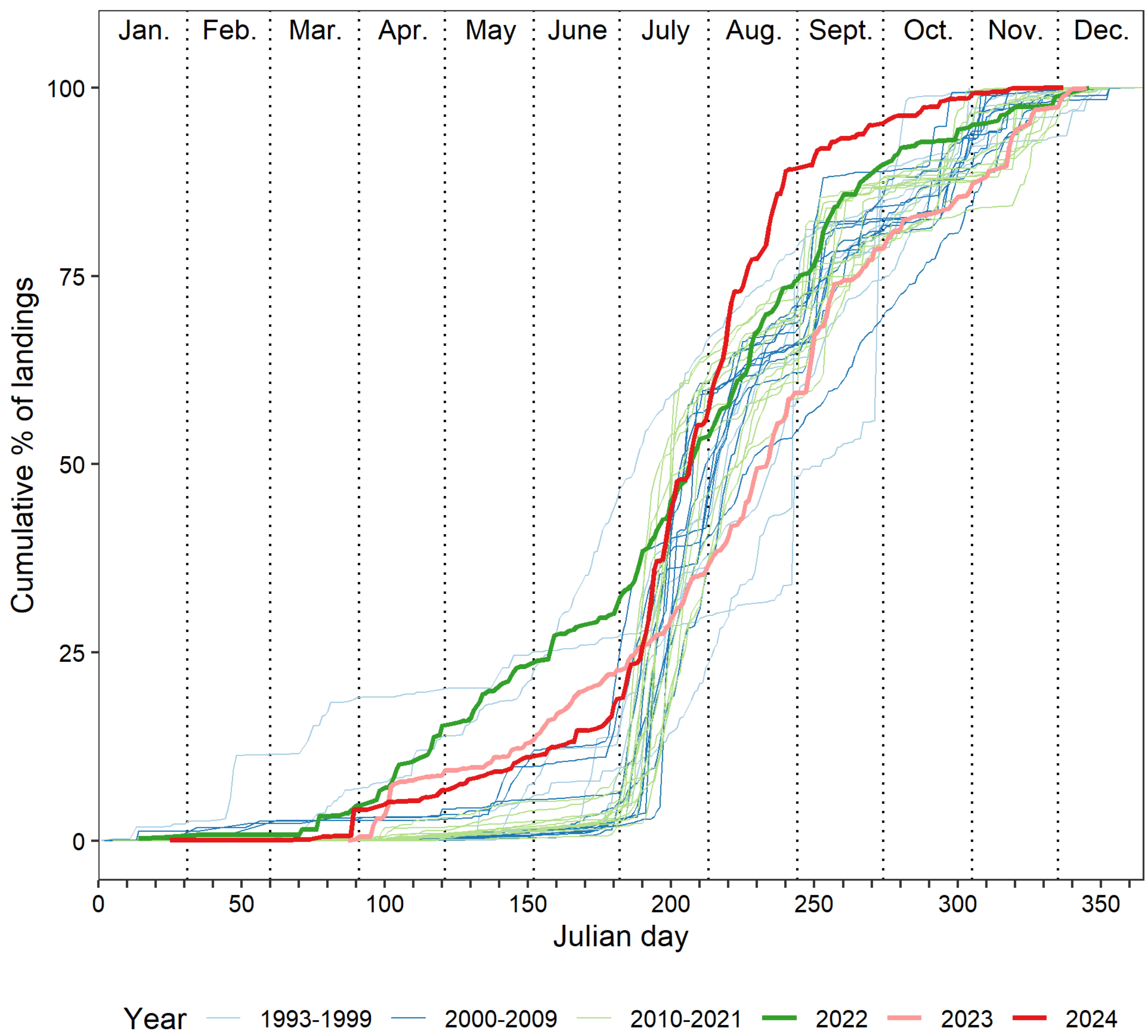

Figure 22. Annual cumulative landings (%) of Atlantic cod from the 3Pn4RS stock as a function of day of year for the period 1993-2024. Source: ZIFF data.

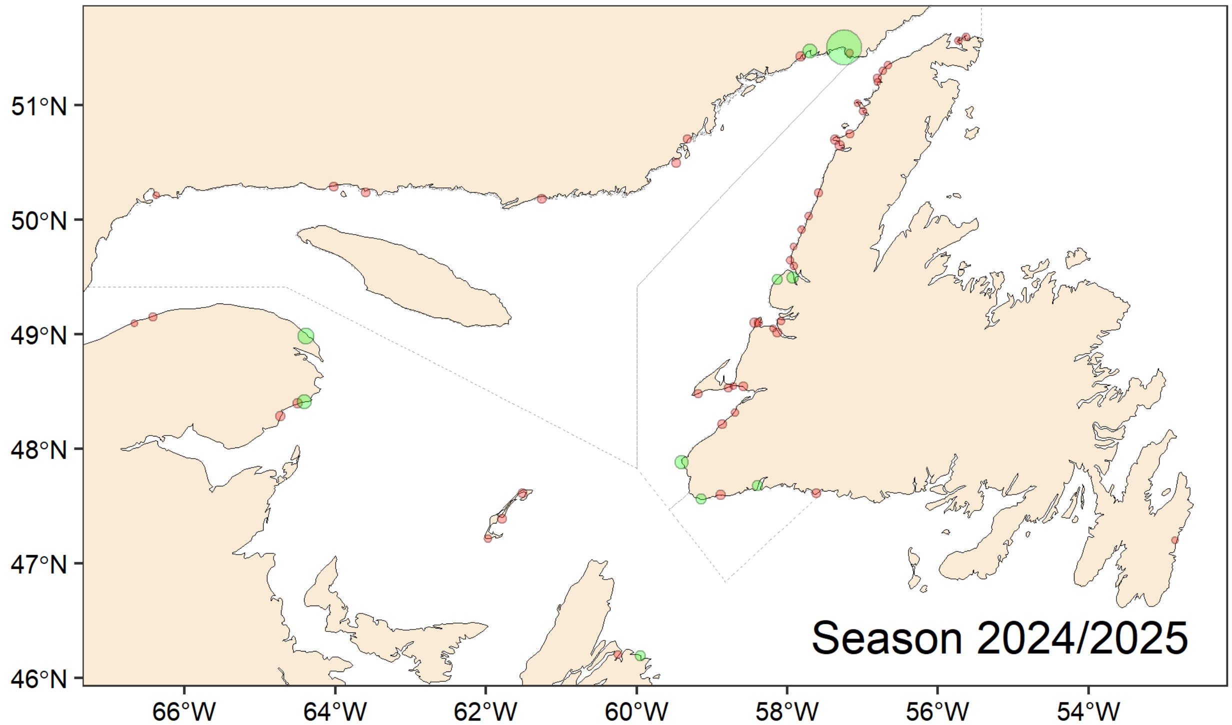

Figure 23. Fishing ports where cod from the 3Pn4RS stock were commercially landed during the 2024/2025 management year. The top 10 ports in terms of landings are shown in green. The size of the points increases according to the reported landings. Source: ZIFF data.

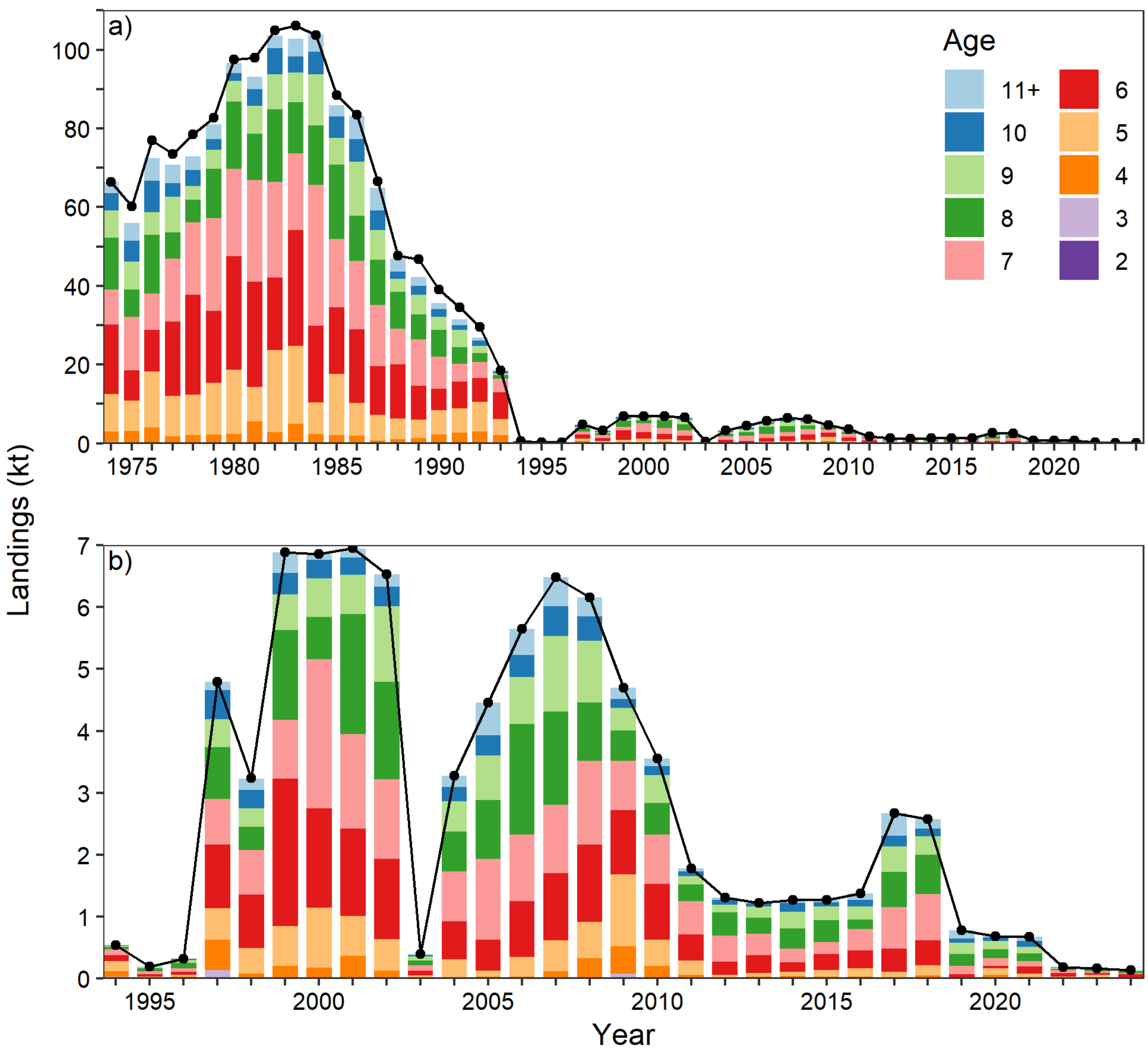

Figure 24. Correspondence between annual landings reported in the ZIFF and NAFO 21B databases (black line) and annual landings at age for the periods a) 1974–2024 et b) 1994–2024.

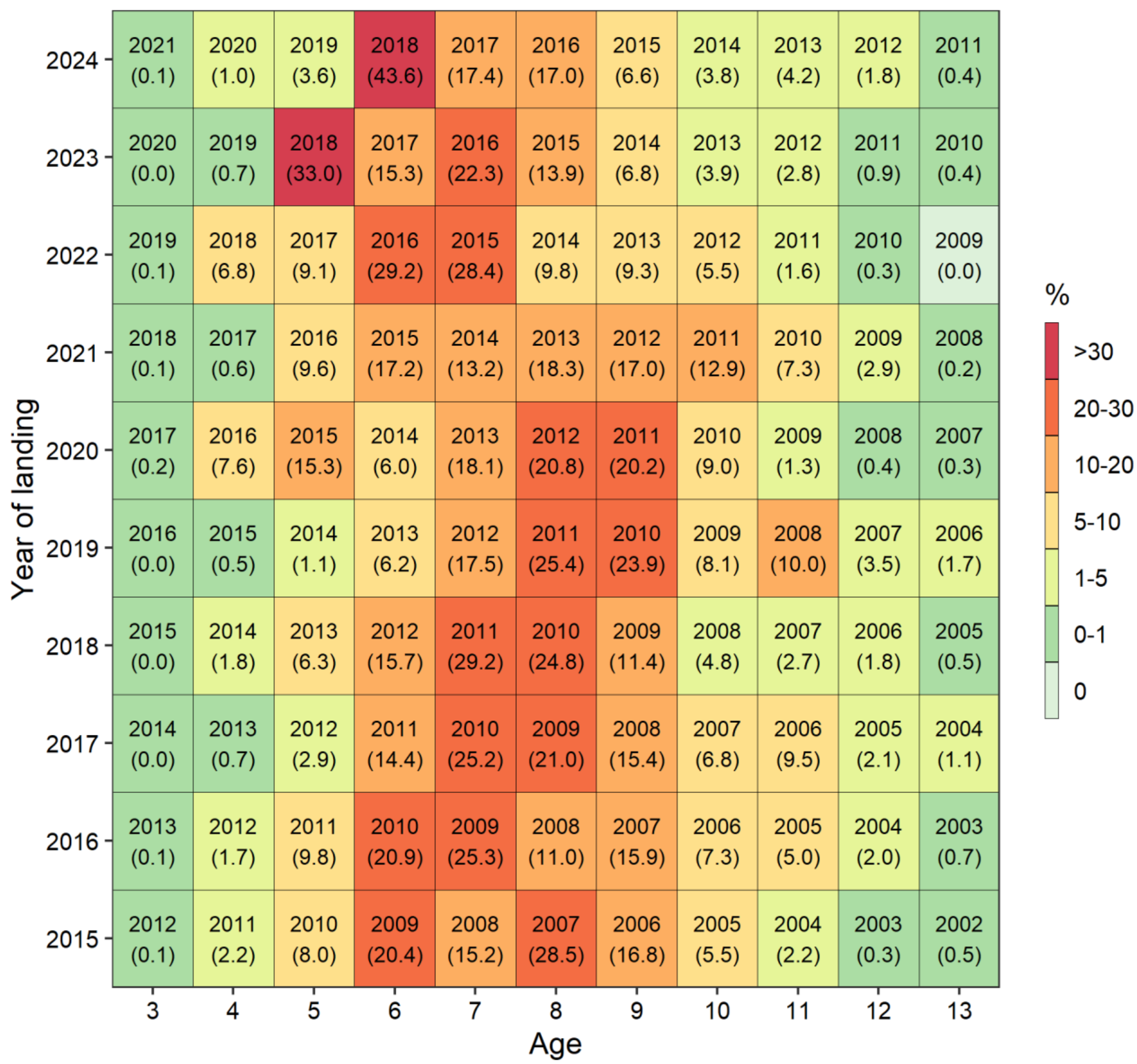

Figure 25. Annual contribution (in %) by age/cohort to the total annual commercial landing of 3Pn4RS cod over the last ten years. In each year-age cell, the year indicated corresponds to the cohort and the value in parentheses is the annual contribution. Ages < 3 and > 13 are not shown.

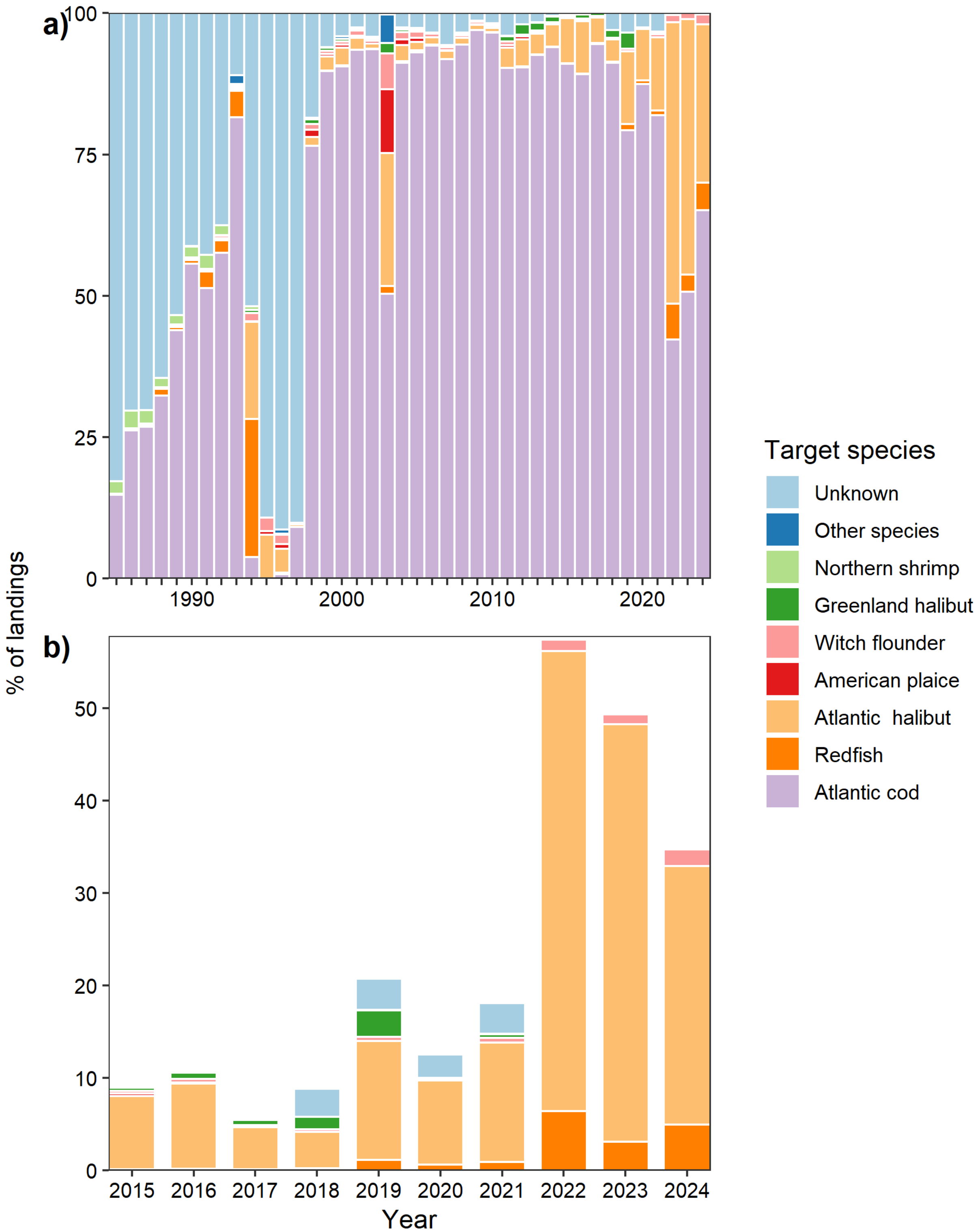

Figure 26. Percentage of annual cod landings by target species for the a) period 1985-2024 and b) last ten years and excluding landings where cod was targeted. Data sources: NAFO 21B and ZIFF.

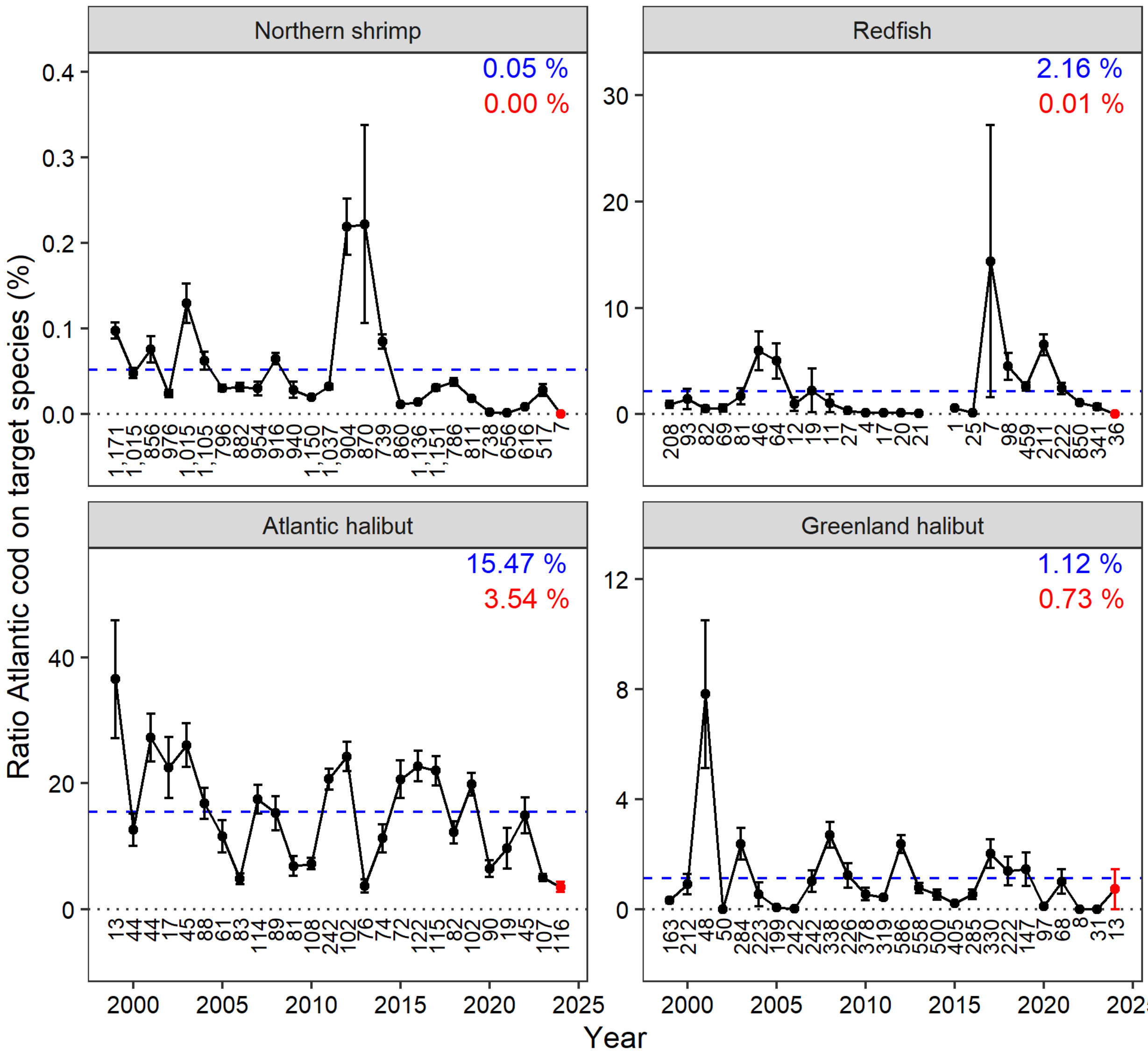

Figure 27. Ratio of the weight caught of cod to that of the target species (panels) during the period 1999-2024 based on at-sea observer data. Each point represents the annual mean (± the standard error) of all fishing activities monitored by at-sea observers for which the target species was caught. The blue value and the horizontal hatched line represent the average annual ratio during the 1999-2024 series. The value of 2024 is provided in red. Below each point, the number of monitored activities used in the calculations is provided.

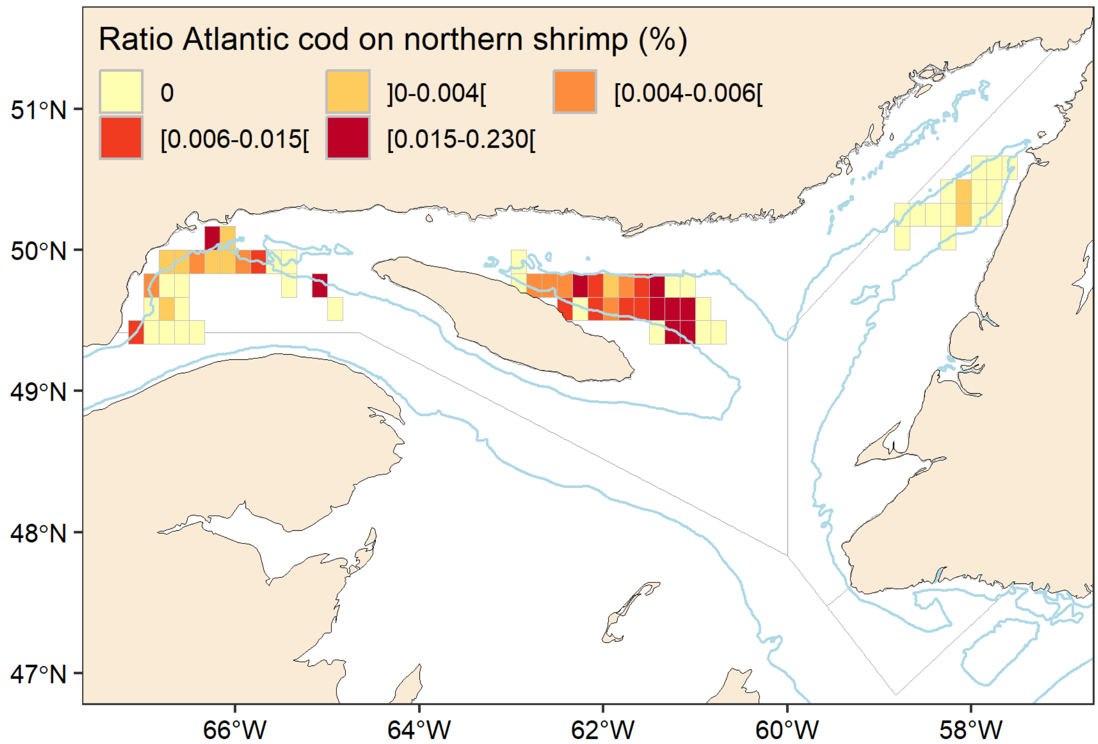

Figure 28. Ratio of the weight of cod caught to that of northern shrimp during the period 2020–2022 in the directed northern shrimp fishery, based on data from at-sea observers. The average ratio associated with a statistical square was calculated from the ratio of each monitored fishing activity found in the latter. For statistical squares whose average ratio is not 0, the ratio categories are based on the observed quartiles. Only statistical squares with at least two monitored activities are shown. The 200 m isobath is shown.

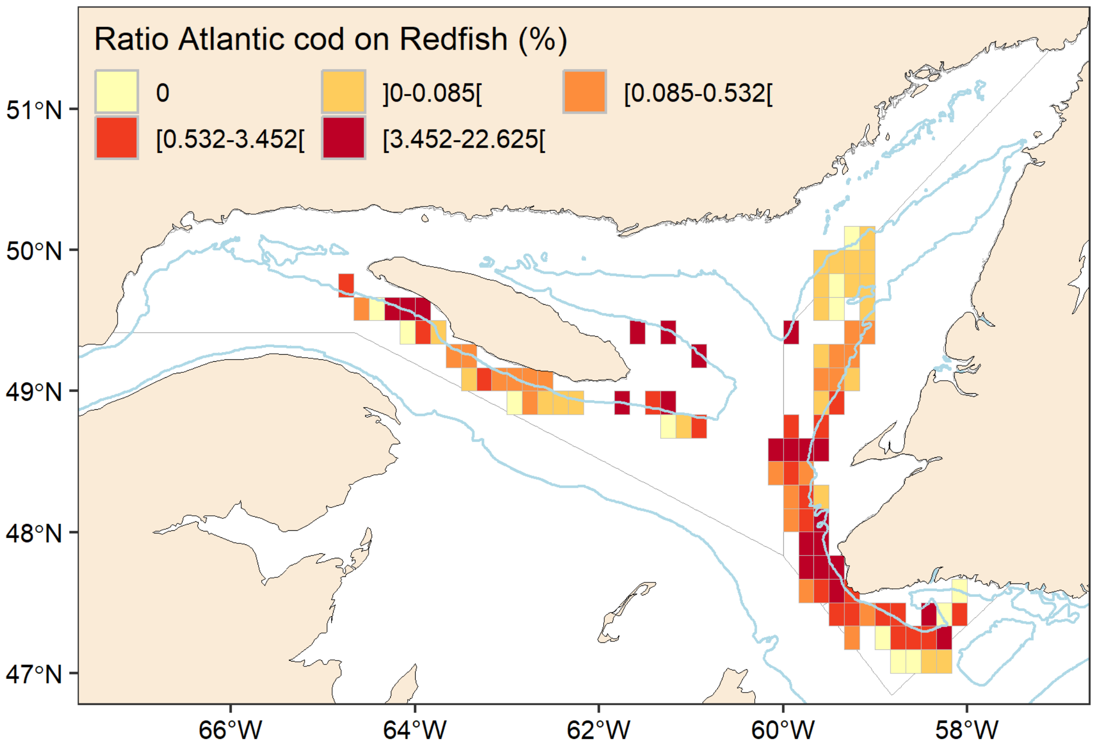

Figure 29. Ratio of the weight caught of cod to that of redfish during the period 2020–2024 in the directed redfish fishery, based on data from at-sea observers. The average ratio associated with a statistical square was calculated from the ratio of each monitored fishing activity found in the latter. For statistical squares whose average ratio is not 0, the ratio categories are based on the observed quartiles. Only statistical squares with at least two monitored activities are shown. The 200 m isobath is shown.

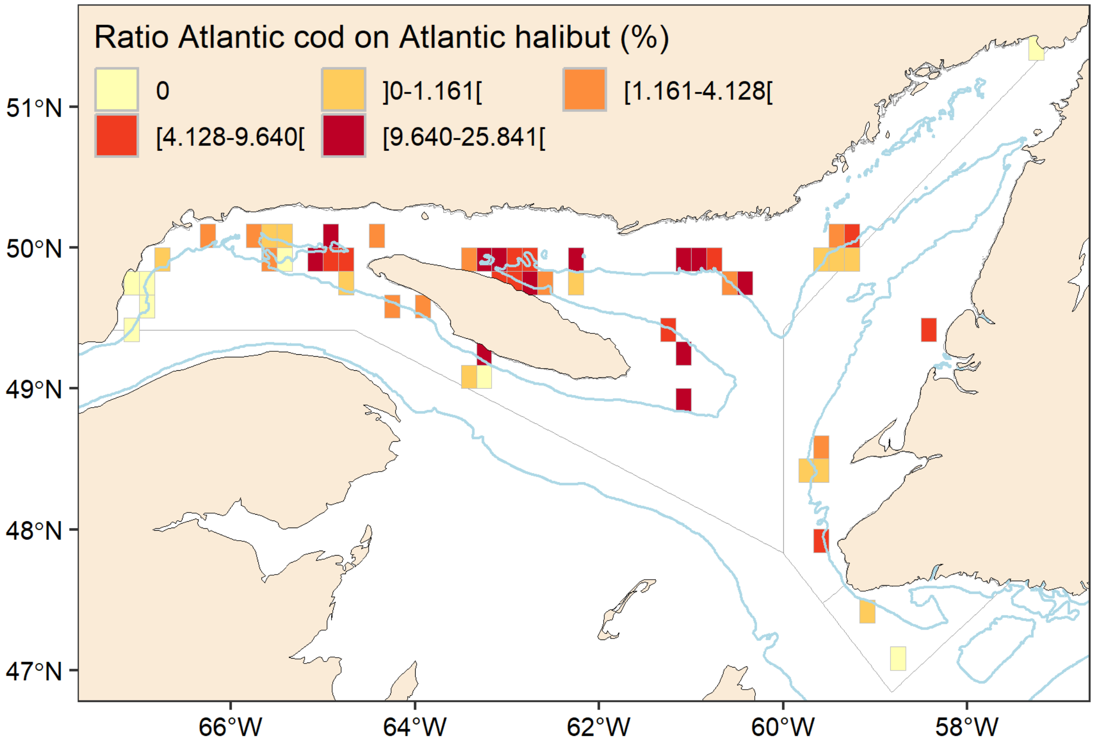

Figure 30. Ratio of the weight caught of cod to that of Atlantic halibut during the period 2020–2024 in the directed Atlantic halibut fishery, based on data from at-sea observers. The average ratio associated with a statistical square was calculated from the ratio of each monitored fishing activity found in the latter. For statistical squares whose average ratio is not 0, the ratio categories are based on the observed quartiles. Only statistical squares with at least two monitored activities are shown. The 200 m isobath is shown.

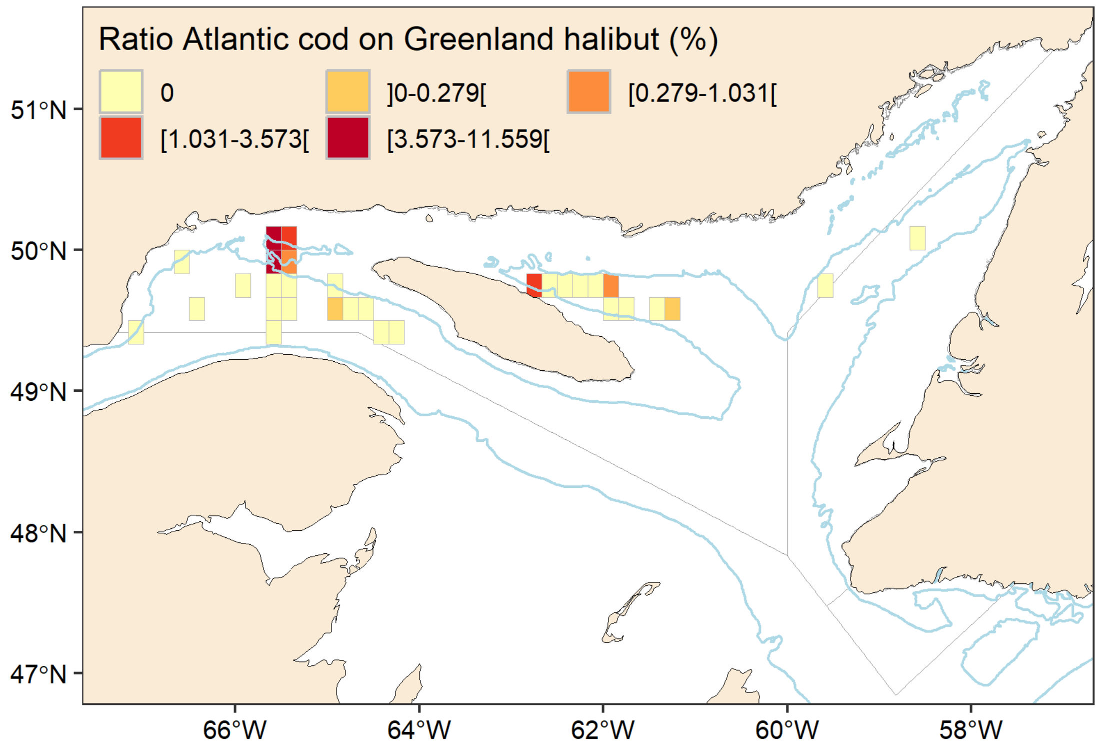

Figure 31. Ratio of the weight caught of cod to that of Greenland halibut during the period 2020–2024 in the directed Greenland halibut fishery, based on data from at-sea observers. The average ratio associated with a statistical square was calculated from the ratio of each monitored fishing activity found in the latter. For statistical squares whose average ratio is not 0, the ratio categories are based on the observed quartiles. Only statistical squares with at least two monitored activities are shown. The 200 m isobath is shown.

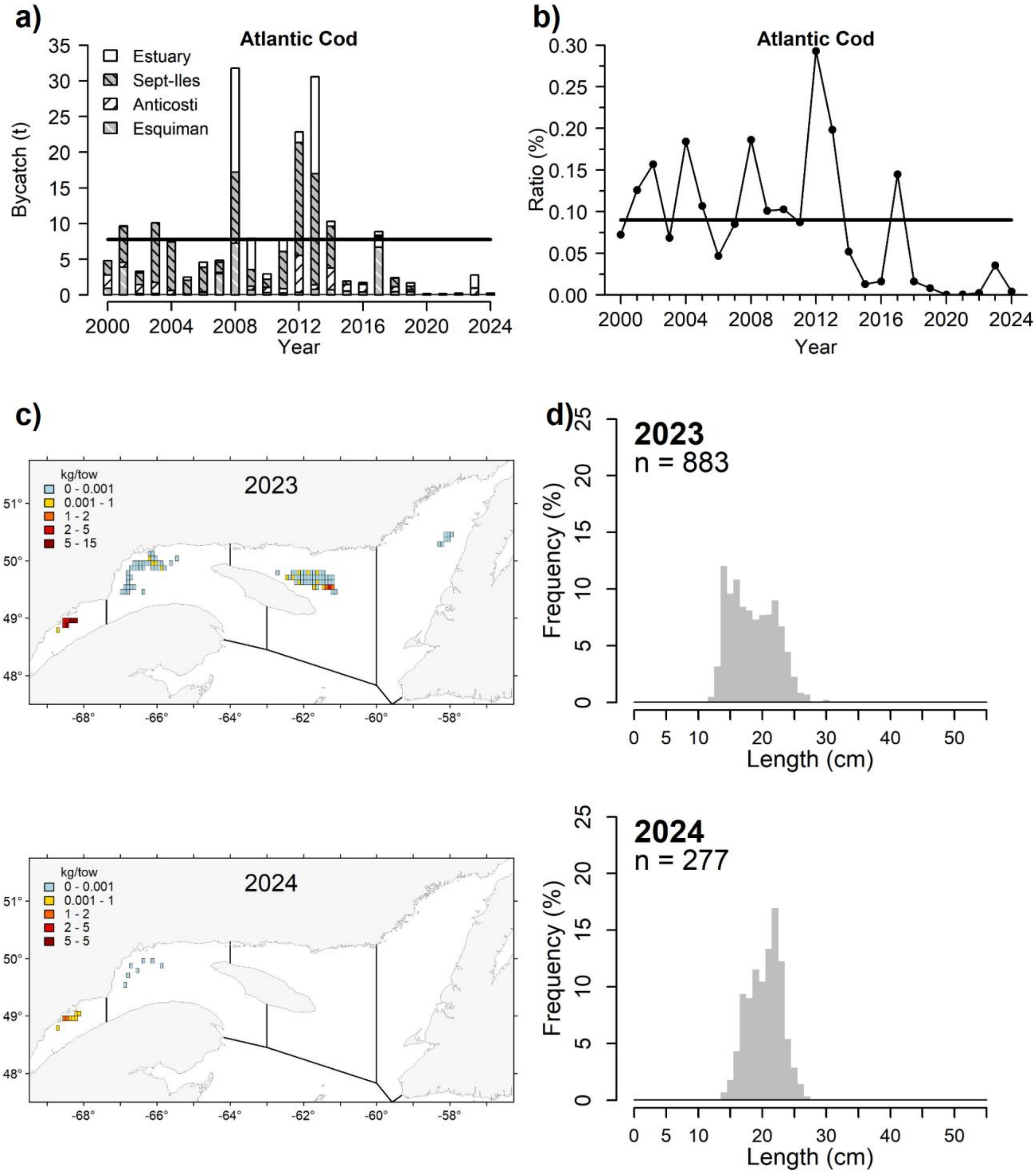

Figure 32. Estimated Atlantic cod bycatch in the northern shrimp fishery by year and fishing area from the at-sea observer program (a). b) Ratio (%) of the bycatch on the biomass estimate from the DFO survey (solid line indicates the average for the years 2000-2022). c) Geographical distribution of bycatch averaged per 5-minute square. d) Length frequency distributions of sampled fish (number (n) of specimens measured is indicated). Updated figure using the approach of Bourdages et al. (2022).

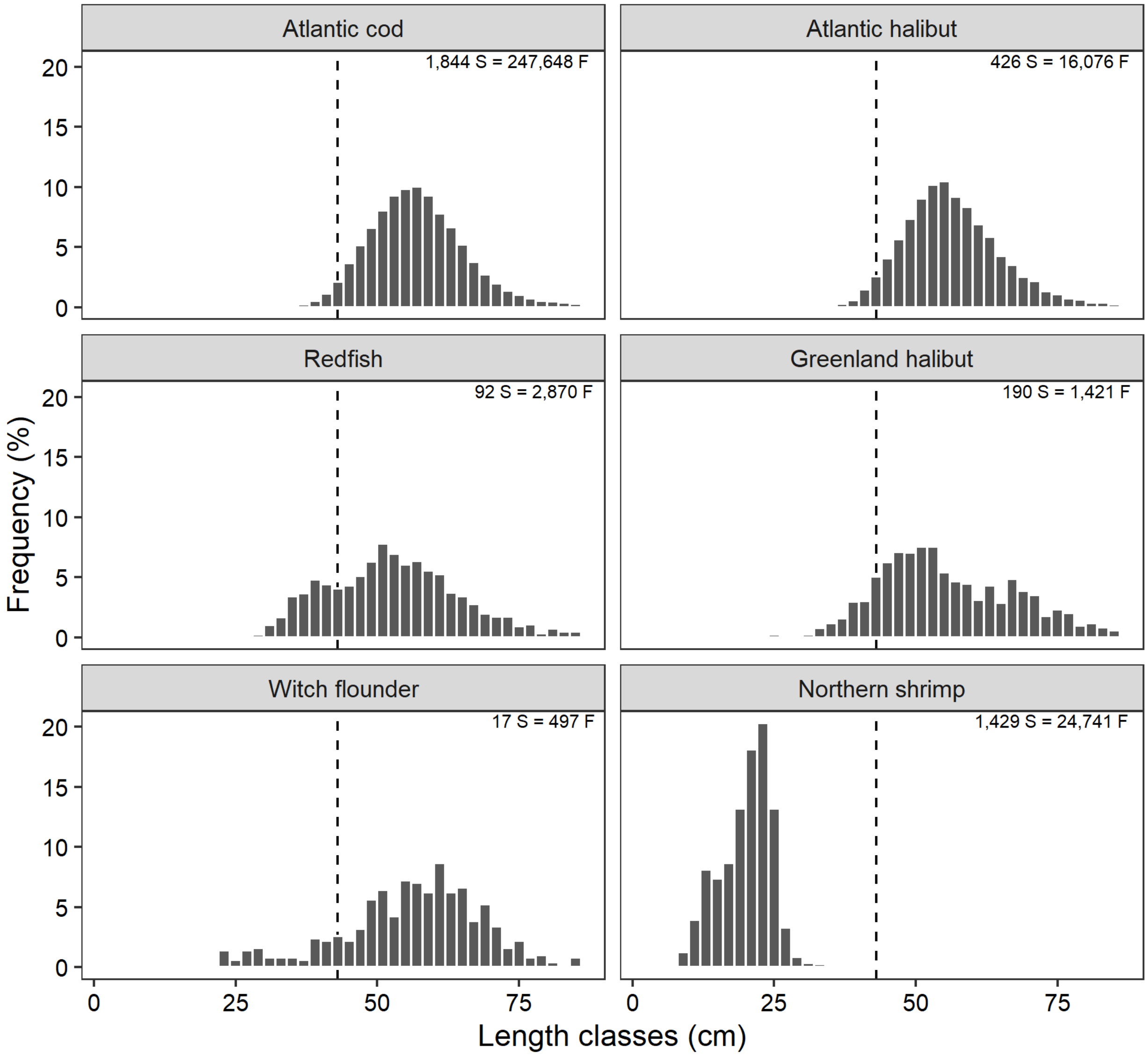

Figure 33. Length frequency distribution of the 3Pn4RS Atlantic cod stock measured since 1999 by the at-sea observer program, by target species (panels). The vertical dotted line represents the 43 cm minimum size of cod relative to the small fish protocol. For each target species, the number of samples (S) from which the fish (F) were measured is indicated. The x-axis is truncated to the right (85 cm) to only show the length classes ≤ 99th percentile.

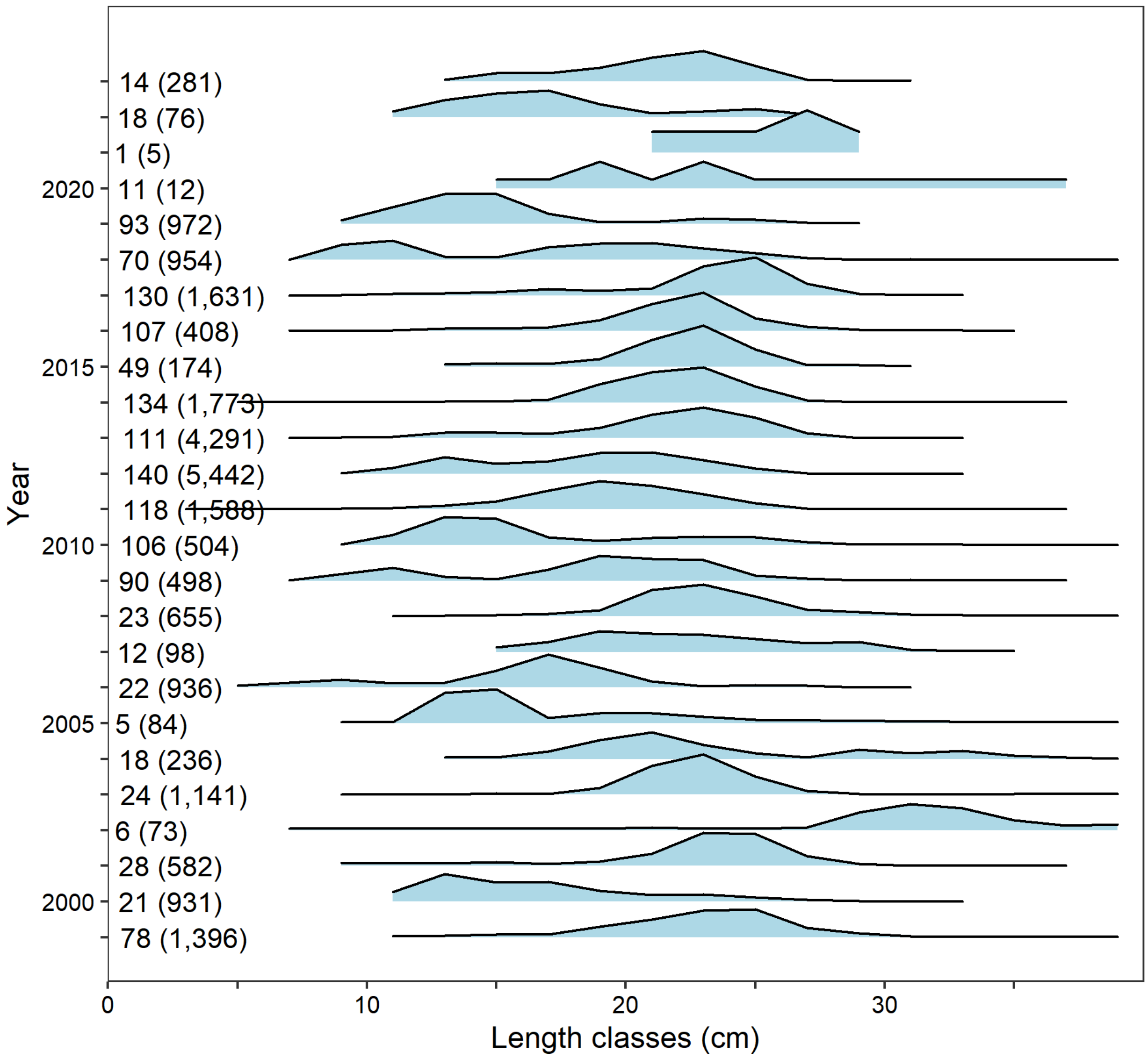

Figure 34. Atlantic cod length frequencies from fishing activities targeting northern shrimp and monitored by at-sea observers. The numbers shown are the annual number of activities monitored where cod lengths were taken and in parentheses the number of cod measured.

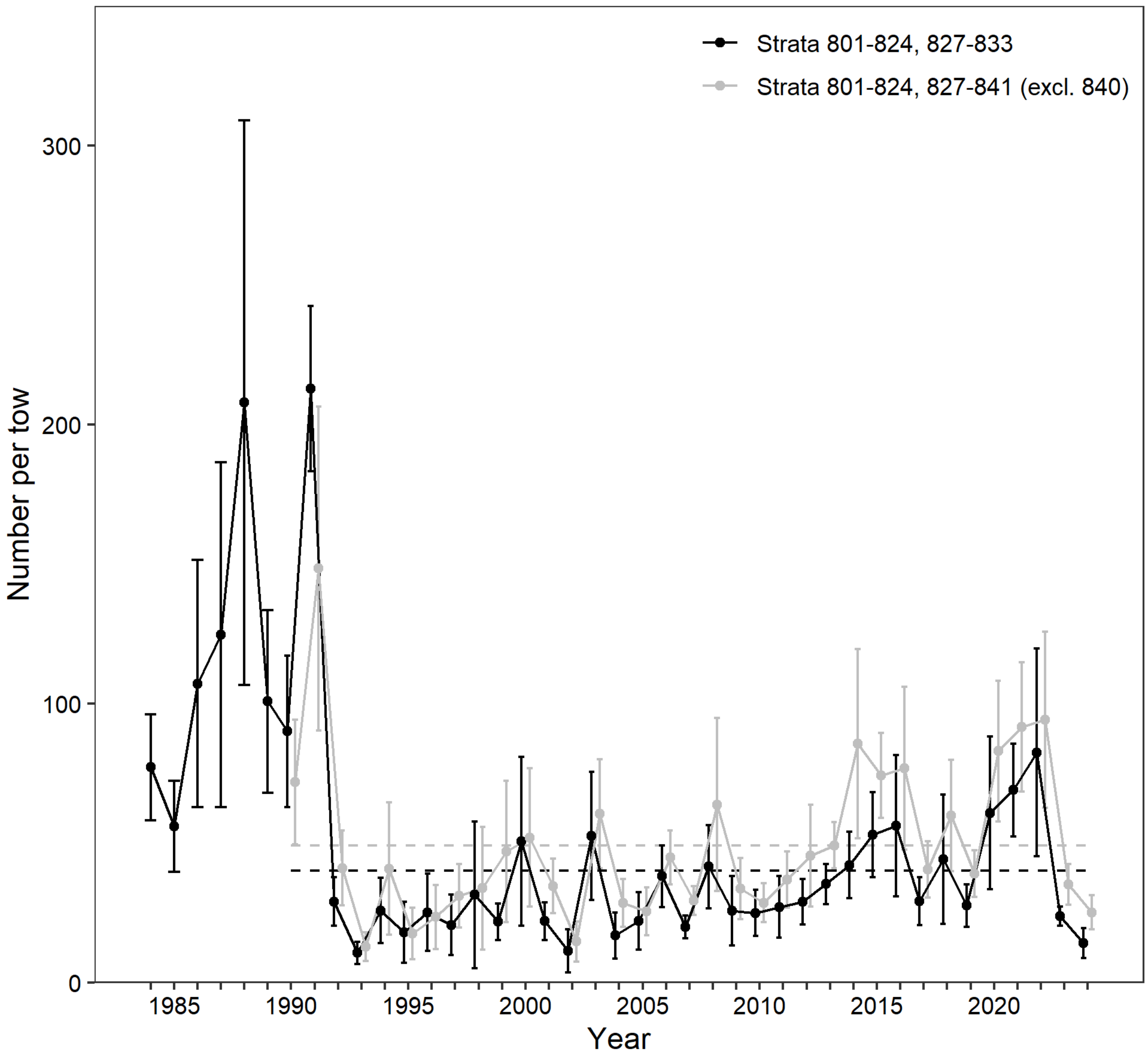

Figure 35. Cod abundance indices, all ages combined, with 95% confidence intervals from the DFO August survey for 1984-2024 based on the reduced suite of strata (black dots) and for 1990-2024 based on all consistently sampled strata (grey dots). The stratum numbers are indicated in the legend. The dashed horizontal lines represent the average of each series over the period 1990-2024.

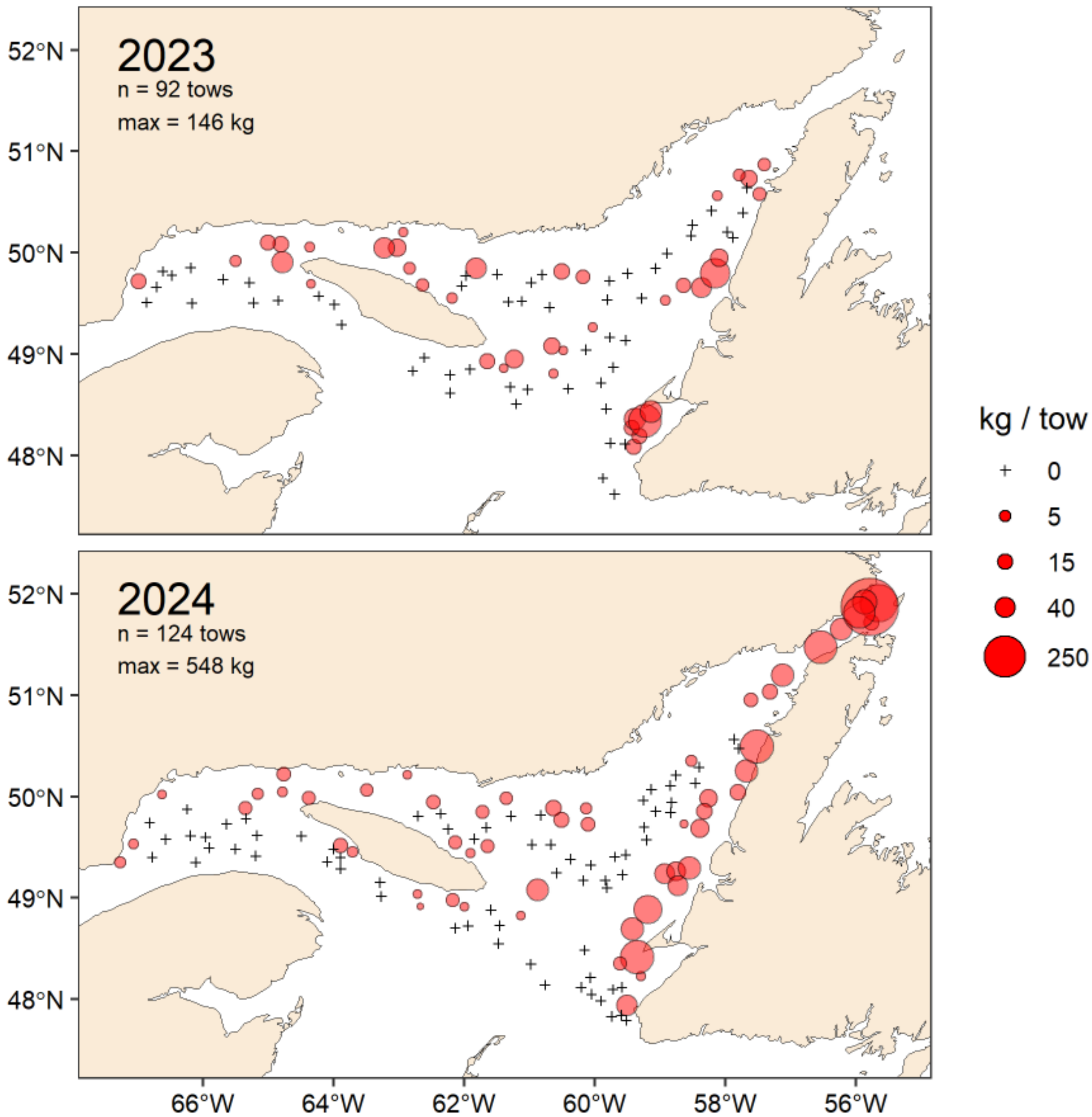

Figure 36. Distribution of cod catch rates (kg per 15 min tow) in the 2023-2024 DFO August survey in NAFO Divisions 4RS.

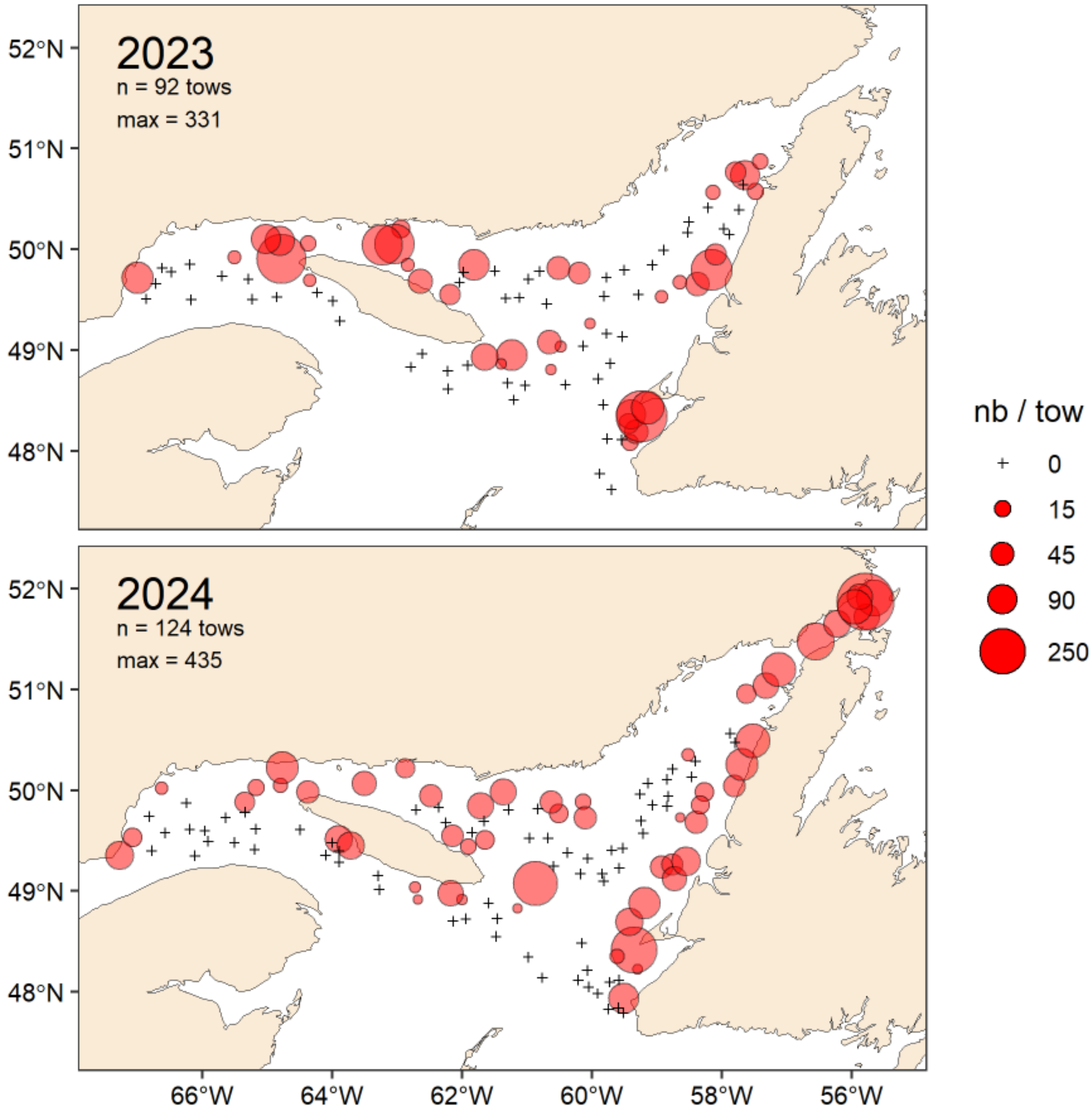

Figure 37. Distribution of cod catch rates (nb per 15 min tow) in the 2023-2024 DFO August survey in NAFO Divisions 4RS.

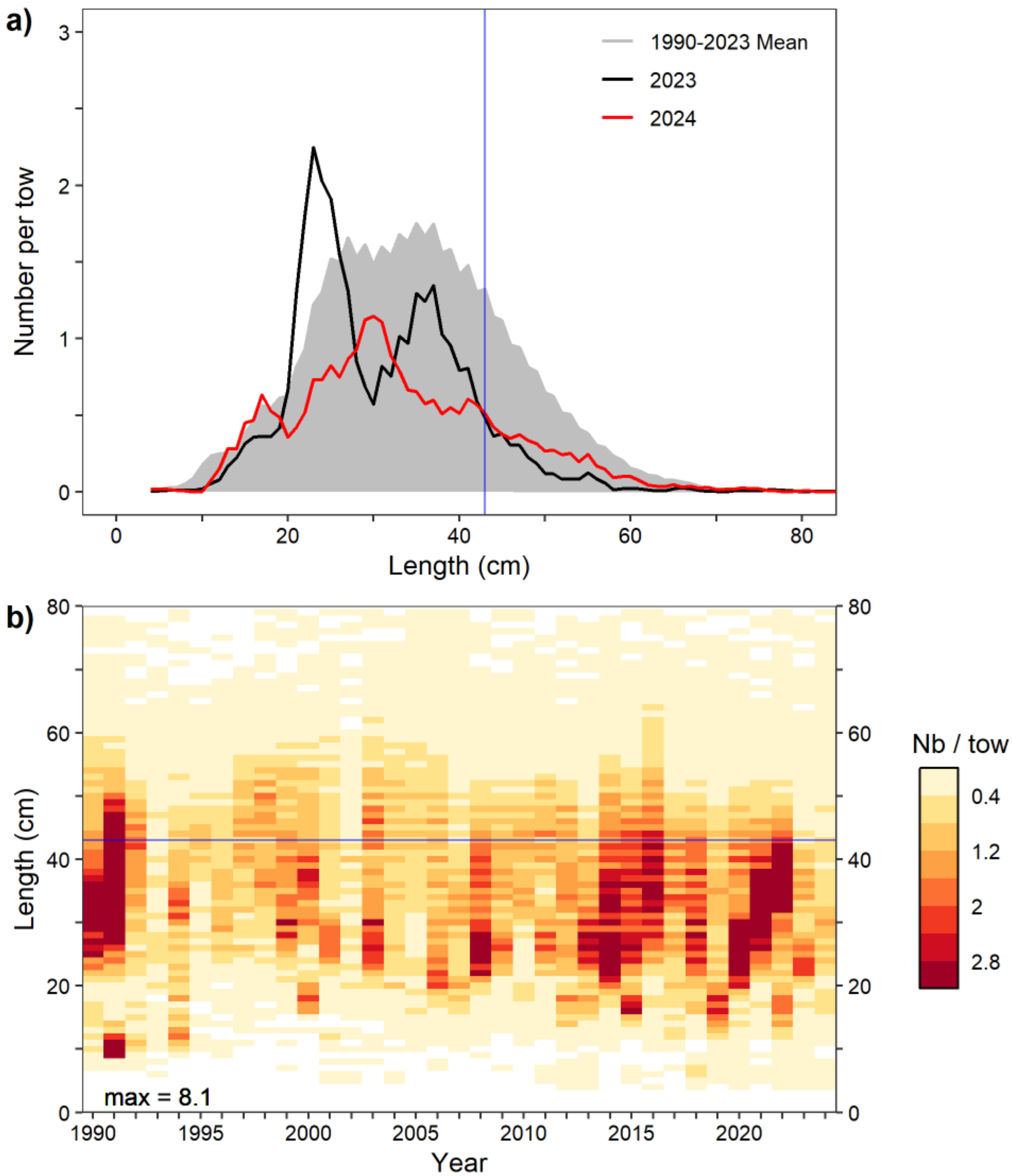

Figure 38. Cod length frequency distributions (mean number per 15 min tow) from the DFO August survey in NAFO Divisions 4RS and based on all consistently sampled strata. In a), the 1990-2023 series average and individually for the years 2023 and 2024 are shown. In b), annual length frequencies are provided for each year of the series in a format allowing cohort tracking. A blue line at 43 cm is provided since the SSB is approximated using an index using cod ≥ 43 cm for years where a full analytical assessment is not conducted.

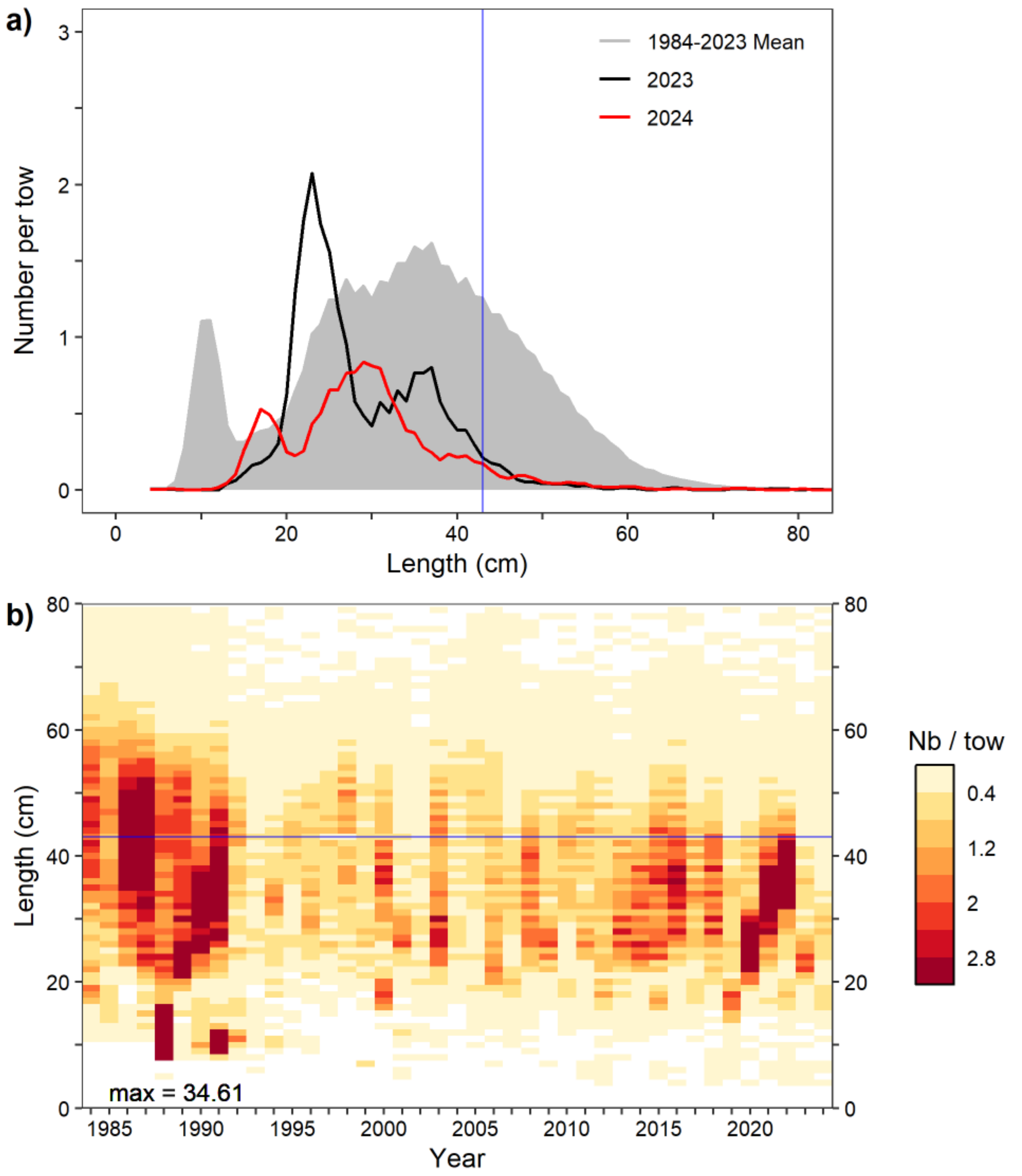

Figure 39. Cod length frequency distributions (mean number per 15 min tow) from the DFO August survey in NAFO Divisions 4RS and based on all consistently sampled strata. In a), the 1984-2023 series average and individually for the years 2023 and 2024 are shown. In b), annual length frequencies are provided for each year of the series in a format allowing cohort tracking. A blue line at 43 cm is provided since the SSB is approximated using an index using cod ≥ 43 cm for years where a full analytical assessment is not conducted.

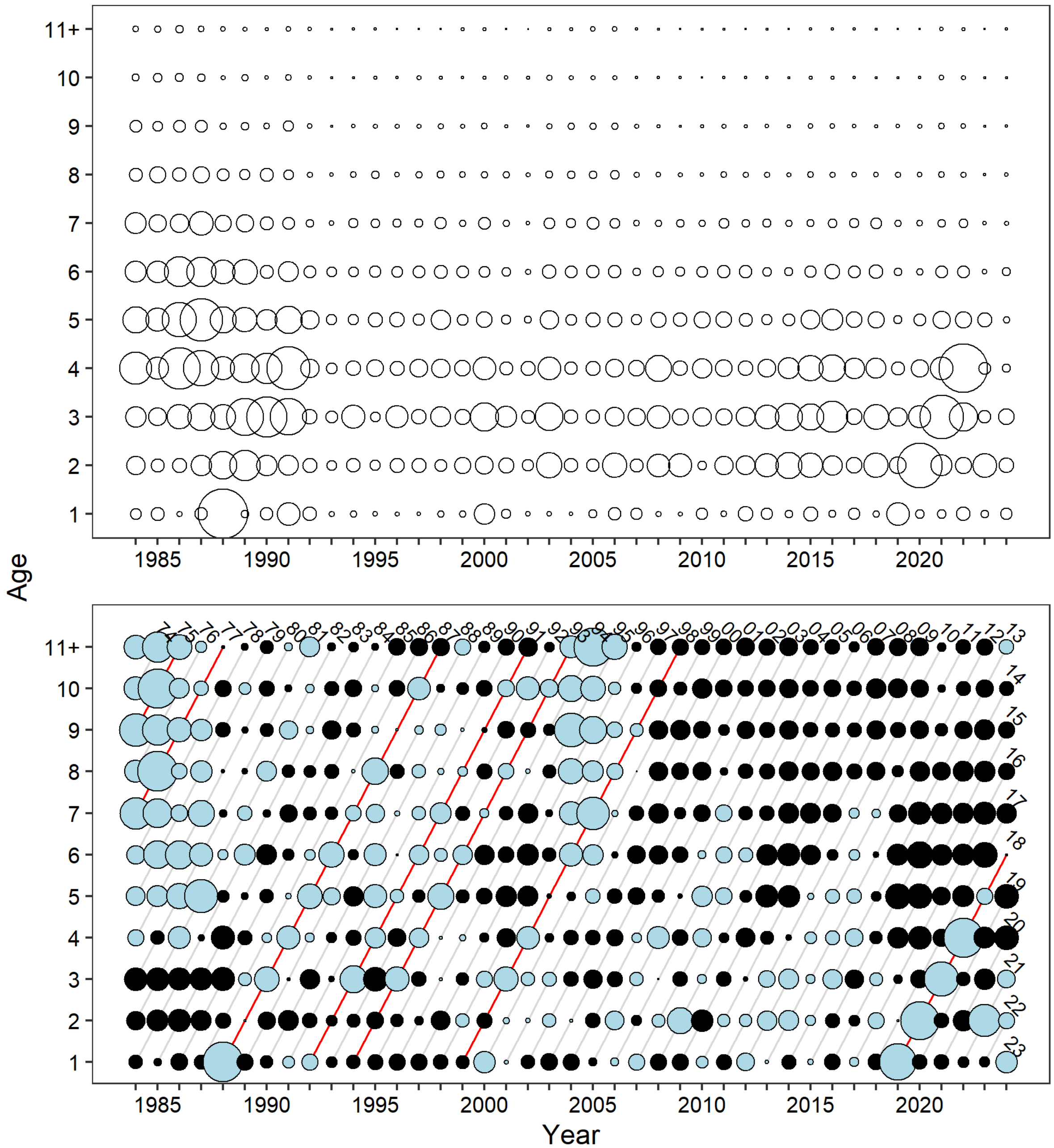

Figure 40. Numbers at age in the DFO August survey for 1984-2024 based on the reduced suite of strata. The top panel shows numbers proportional to circle diameter, while the bottom one shows standardized proportions at age and year (SPAY) with blue and black bubbles indicating above and below average, respectively. The bubble diameter is indicative of the SPAY value. The red lines indicate some consistently tracked above average cohorts in the DFO August survey. Cohort years' last two digits are indicated above bubbles from oldest ages and the ones from the most recent year.

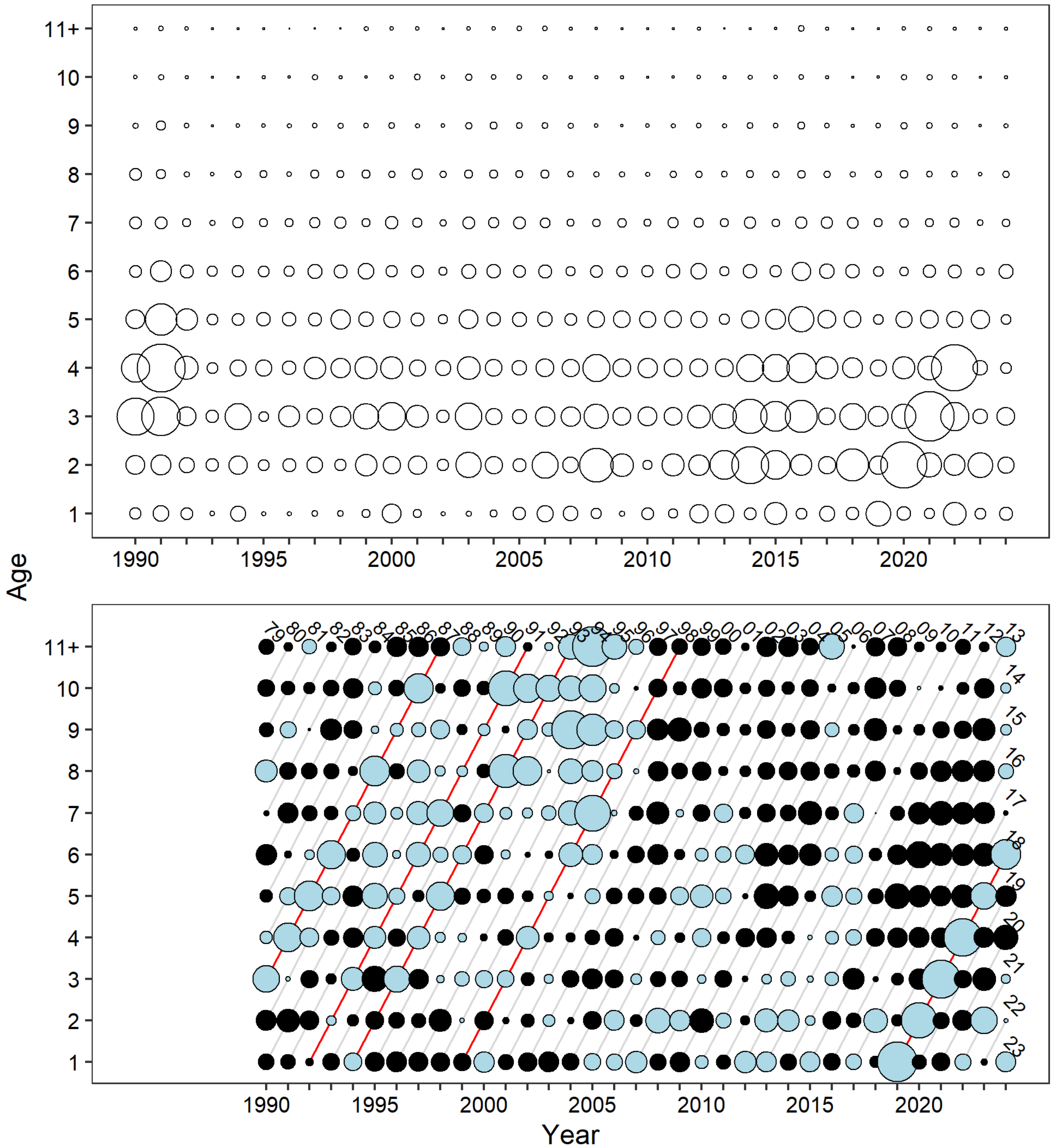

Figure 41. Numbers at age in the DFO August survey for 1990-2024 based on all consistently sampled strata. The top panel shows numbers proportional to circle diameter, while the bottom one shows standardized proportions at age and year (SPAY) with blue and black bubbles indicating above and below average, respectively. The bubble diameter is indicative of the SPAY value. The red lines indicate some consistently tracked above average cohorts in the DFO August survey. Cohort years' last two digits are indicated above bubbles from oldest ages and the ones from the most recent year.

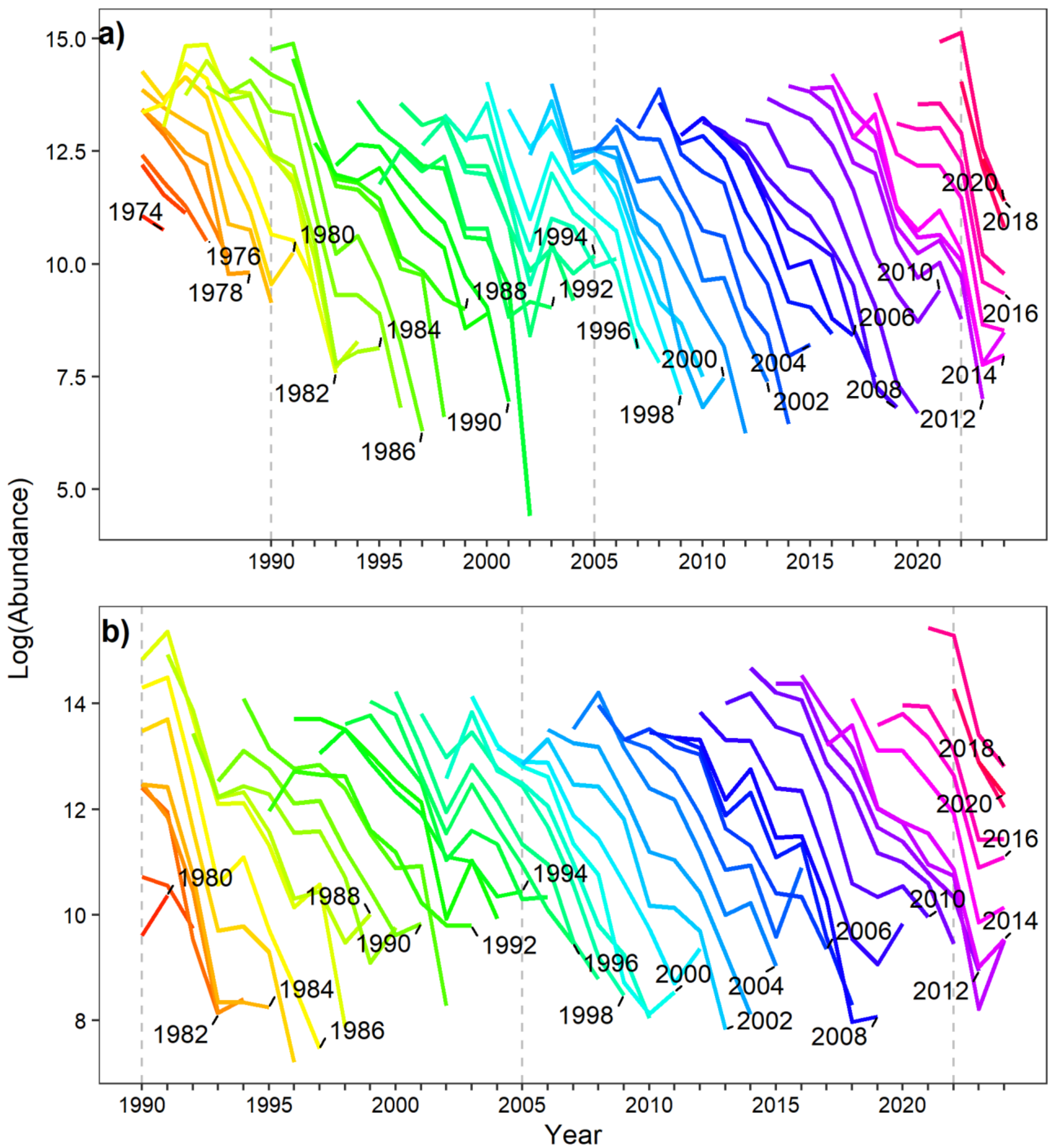

Figure 42. Log-abundance of individual cohorts (ages 3 to 11+) from the DFO August survey catch at age for a) 1984-2024 based on the reduced suite of strata and b) 1990-2024 based on all consistently sampled strata. The years of the 1990, 2005 and 2022 comparative fishing experiments are indicated by a vertical dashed line. Cohorts are identified by birth year for every 2nd year.

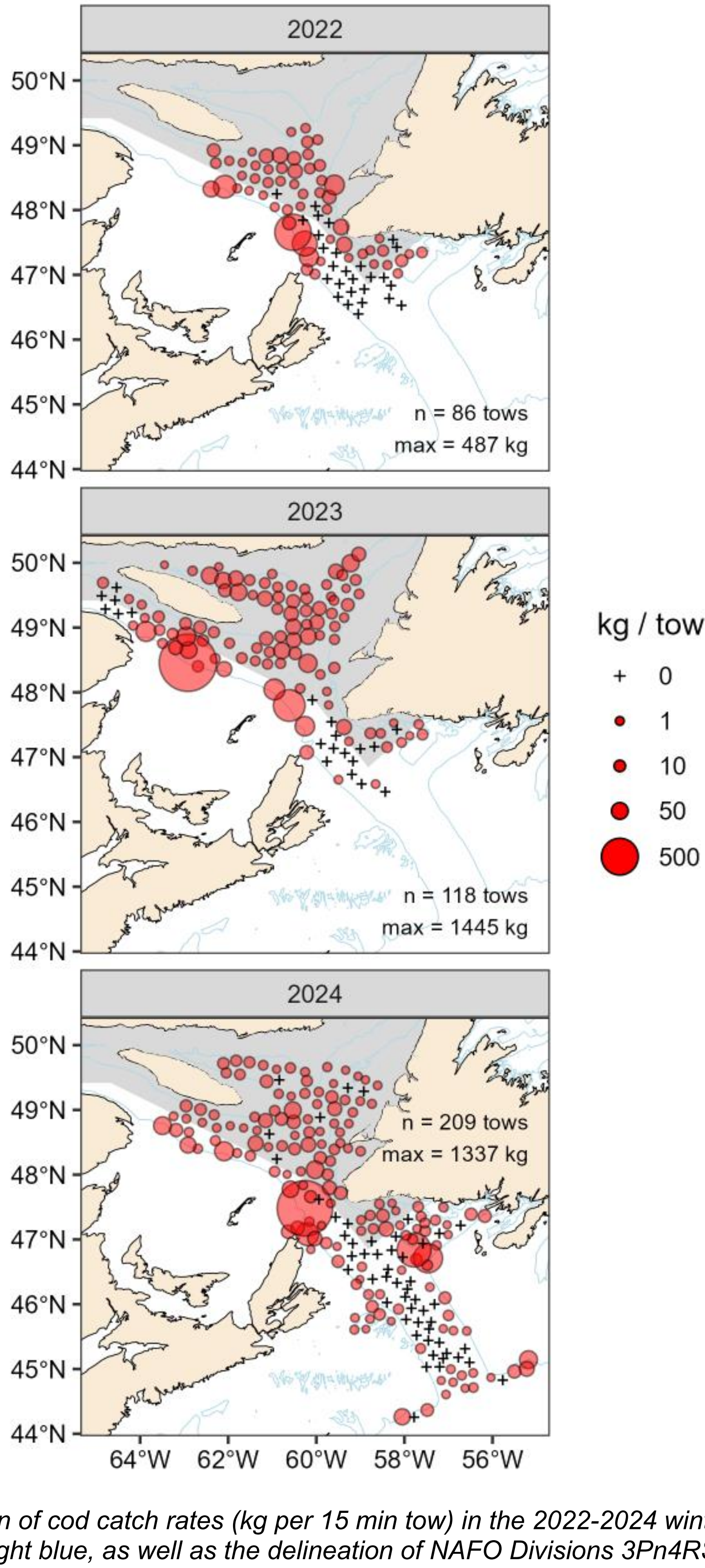

Figure 43. Distribution of cod catch rates (kg per 15 min tow) in the 2022-2024 winter surveys. The 200 m isobath is shown in light blue, as well as the delineation of NAFO Divisions 3Pn4RS in grey.

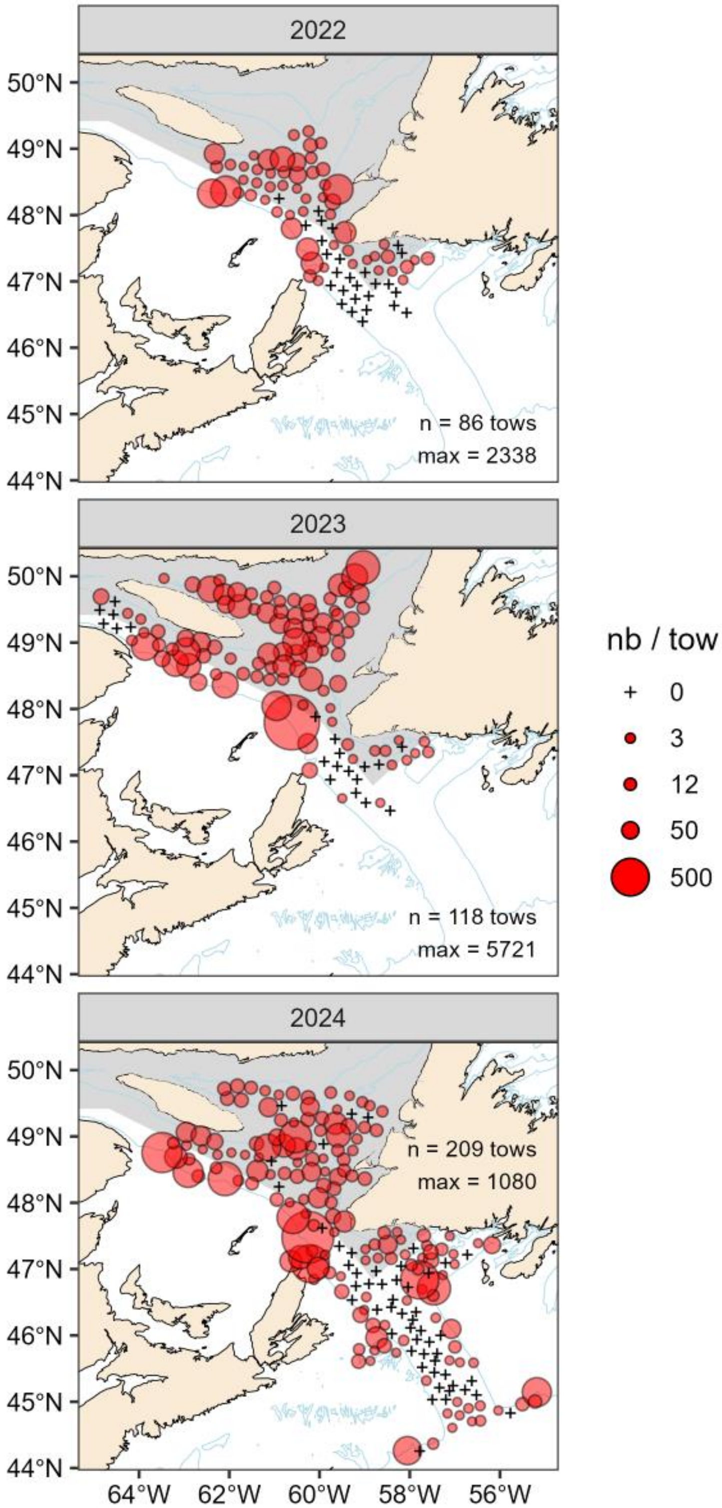

Figure 44. Distribution of cod catch rates (nb per 15 min tow) in the 2022-2024 winter surveys. The 200 m isobath is shown in light blue, as well as the delineation of NAFO Divisions 3Pn4RS in grey.

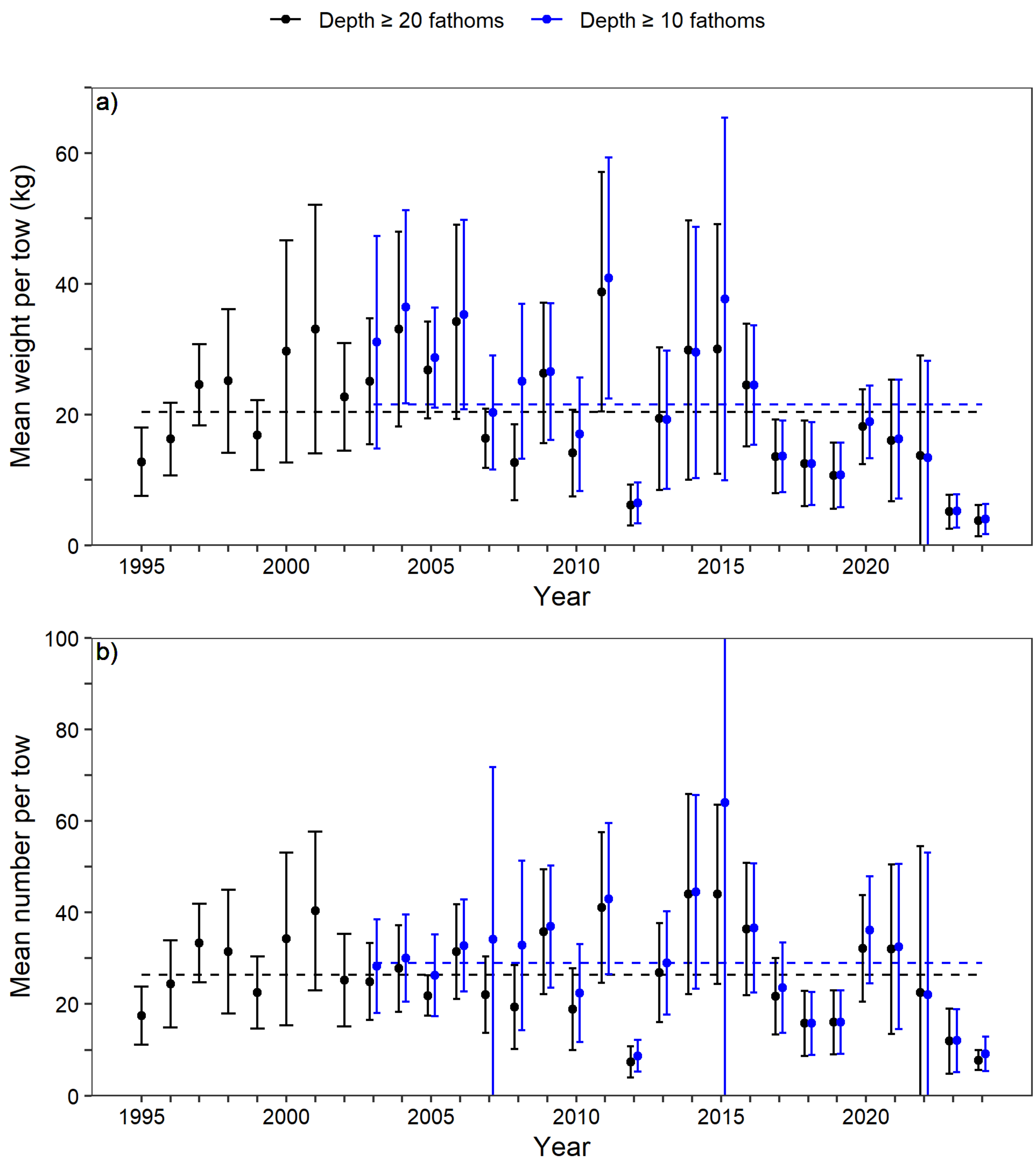

Figure 45. Mean a) weight and b) number per tow in the July sentinel mobile gear surveys for the two series considered in the assessment. Error bars represent the 95% confidence intervals. The dashed line represents the average of each series (1995-2024 and 2003-2024).

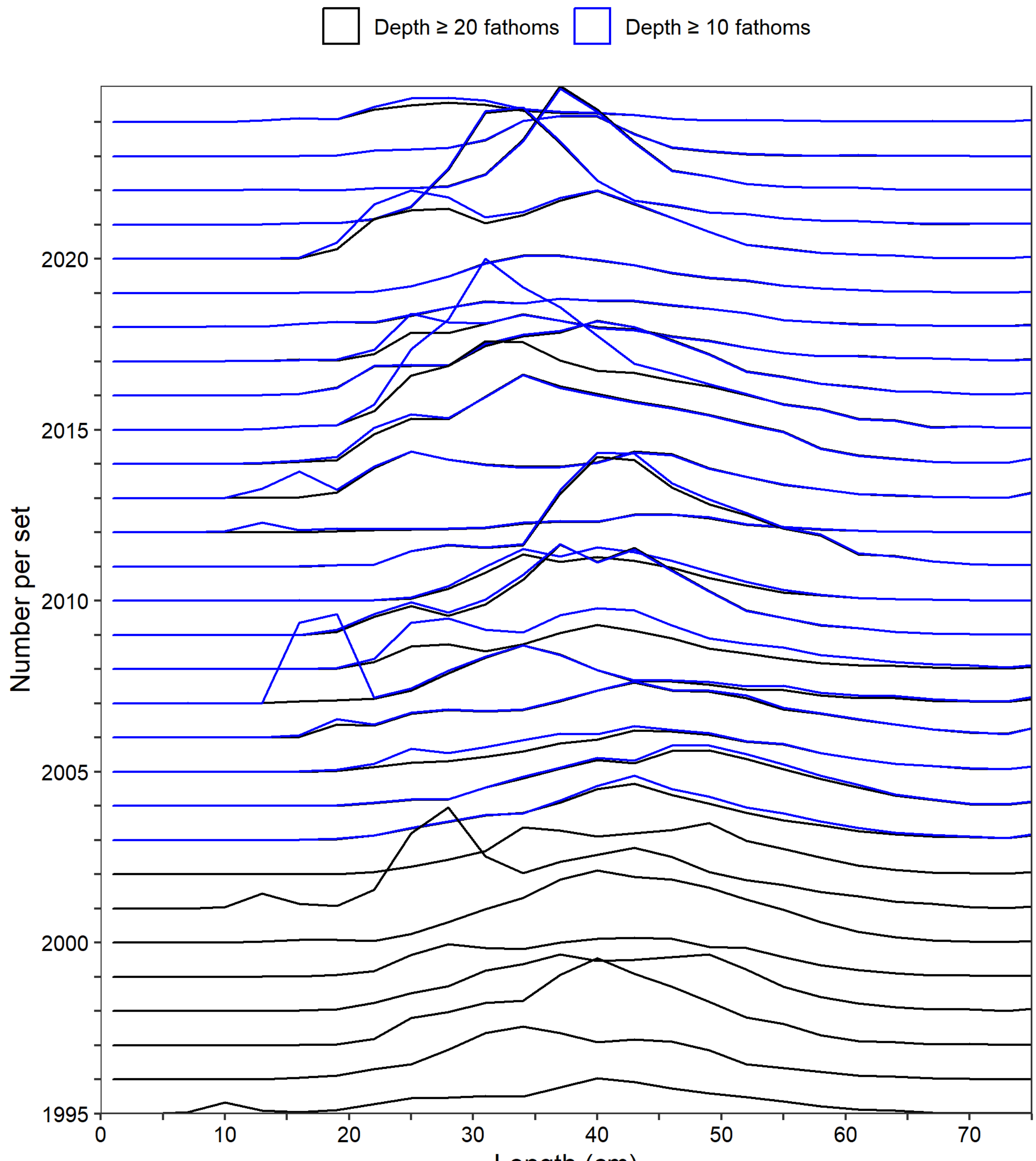

Figure 46. Length frequency distributions (in mean numbers per tow) during the July sentinel mobile gear survey for the two series considered in the assessment model. 3-cm length classes were used for the calculations. Starting in 2003, 10-20 fathom strata were added to the sampling design.

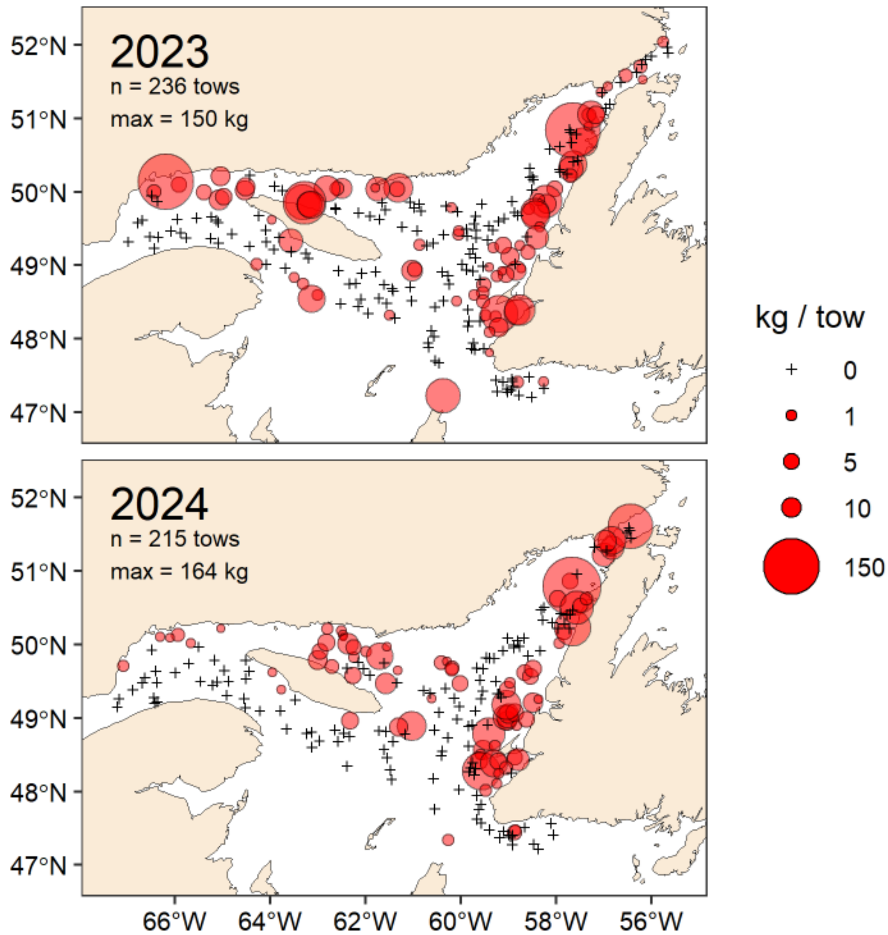

Figure 47. Distribution of cod catch rates (kg per 30 min tow) in the 2023-2024 sentinel mobile gear survey.

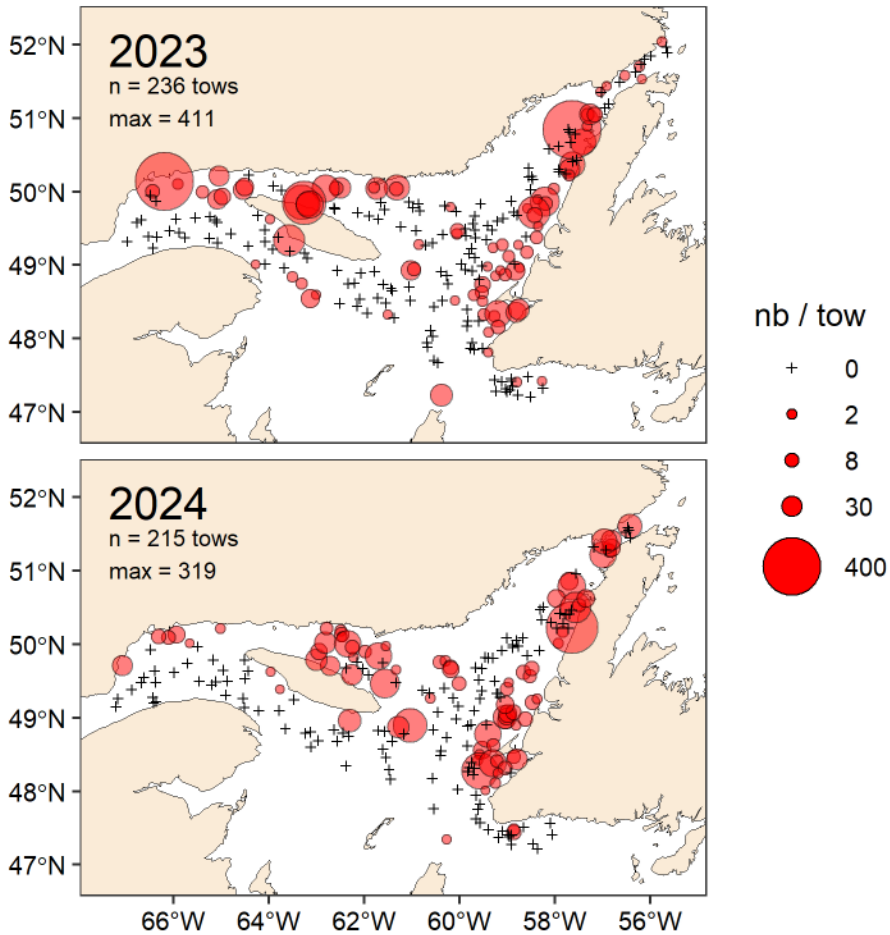

Figure 48. Distribution of cod catch rates (nb per 30 min tow) in the 2023-2024 sentinel mobile gear survey.

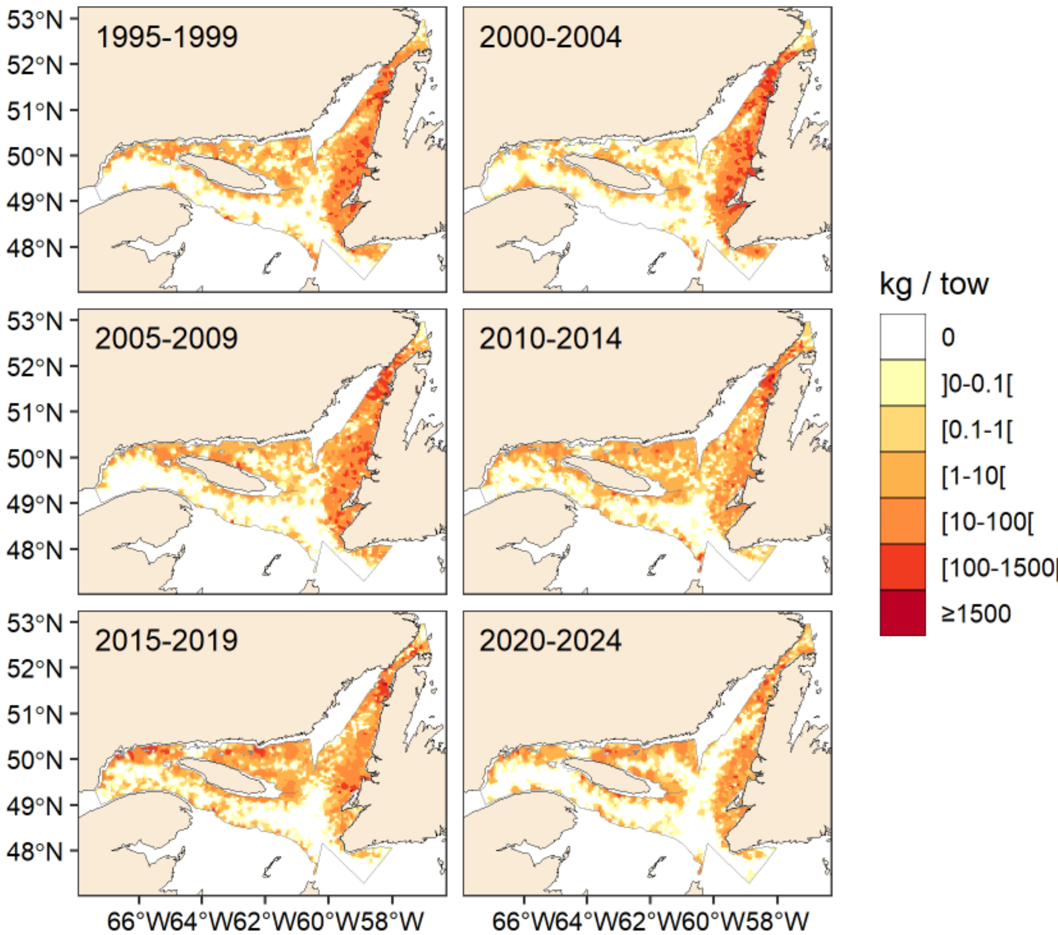

Figure 49. Distribution of cod catch rates (kg per 30 min tow) in the sentinel mobile gear survey, by year periods.

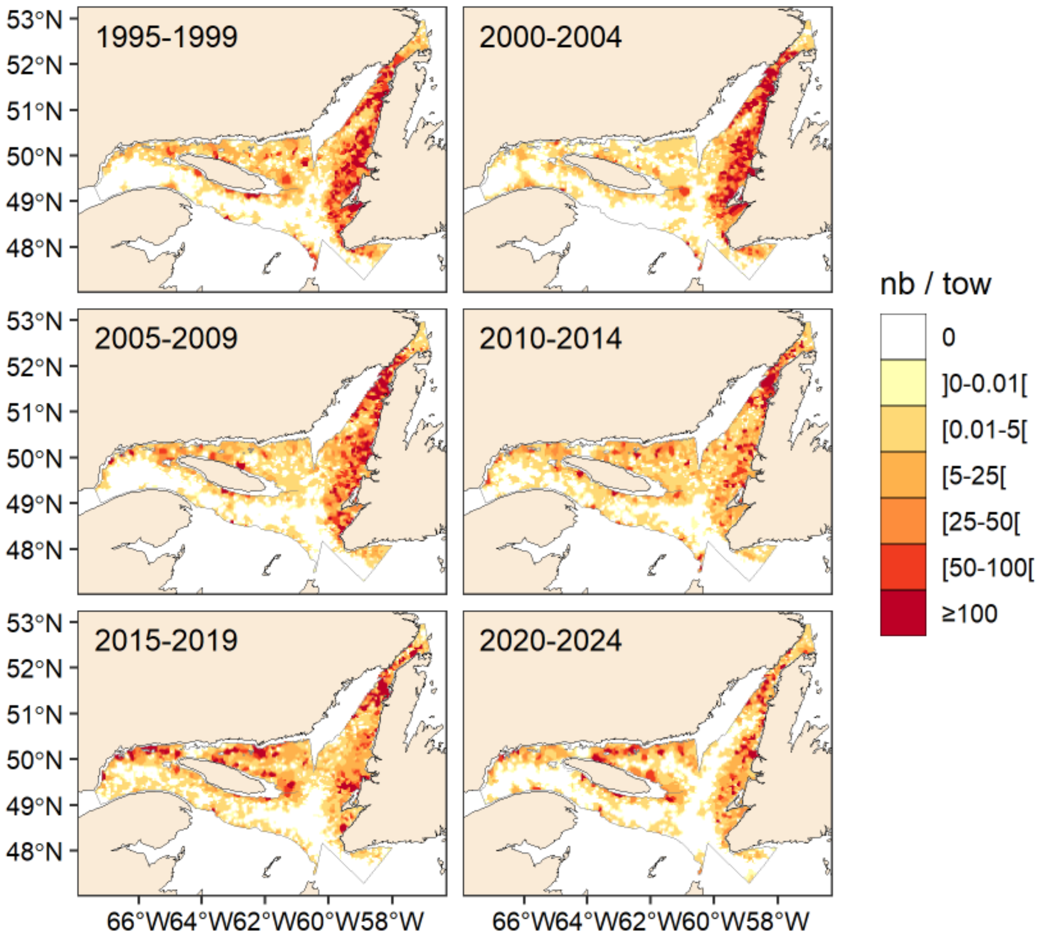

Figure 50. Distribution of cod catch rates (nb per 30 min tow) in the sentinel mobile gear survey, by year periods.

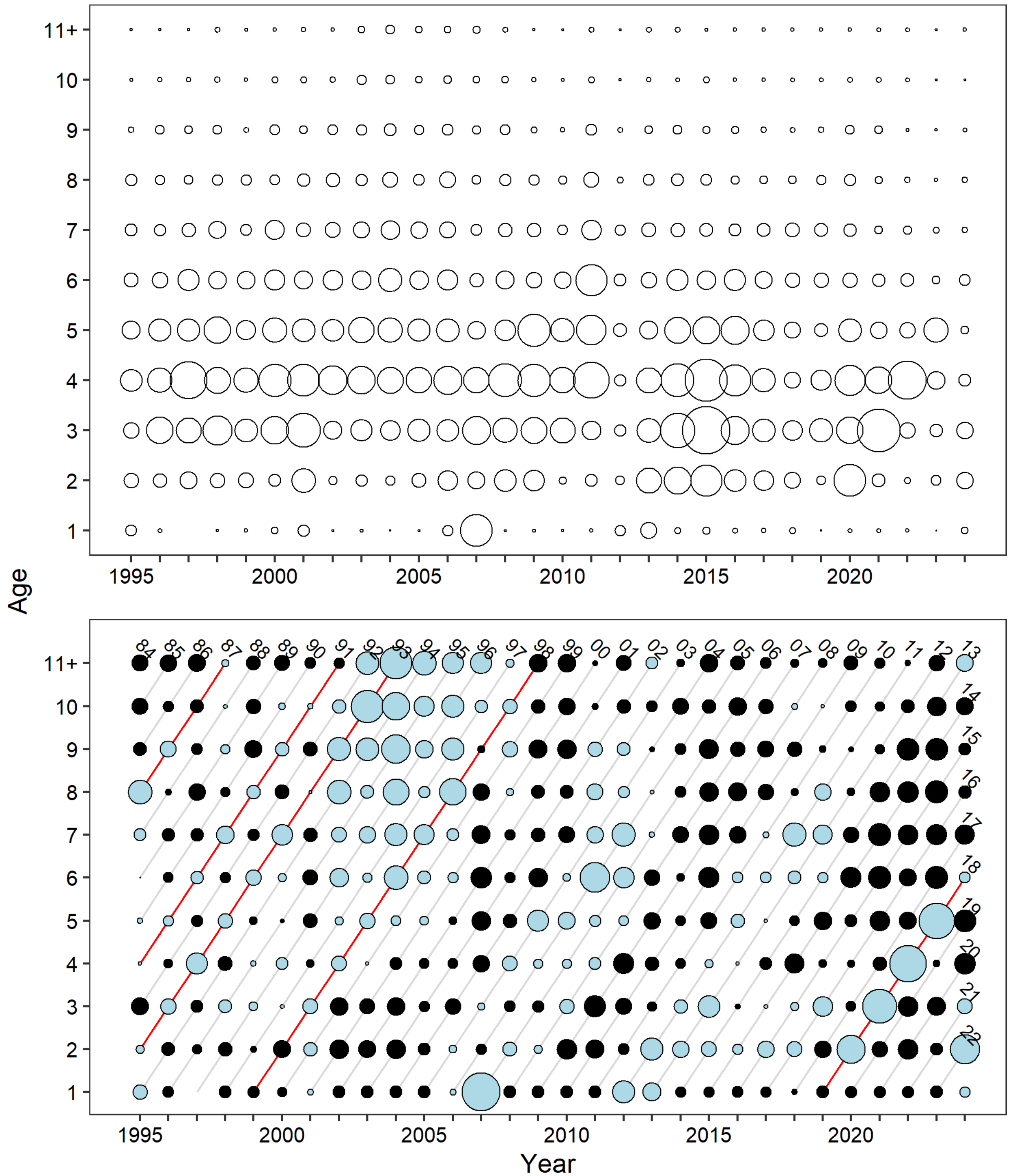

Figure 51. Numbers at age in the sentinel mobile gear survey for 1995-2024. The top panel shows numbers proportional to circle diameter, while the bottom one shows standardized proportions at age and year (SPAY) with blue and black bubbles indicating above and below average, respectively. The bubble diameter is indicative of the SPAY value. The red lines indicate some consistently tracked above average cohorts in the DFO August survey. Cohort years' last two digits are indicated above bubbles from oldest ages and the ones from the most recent year.

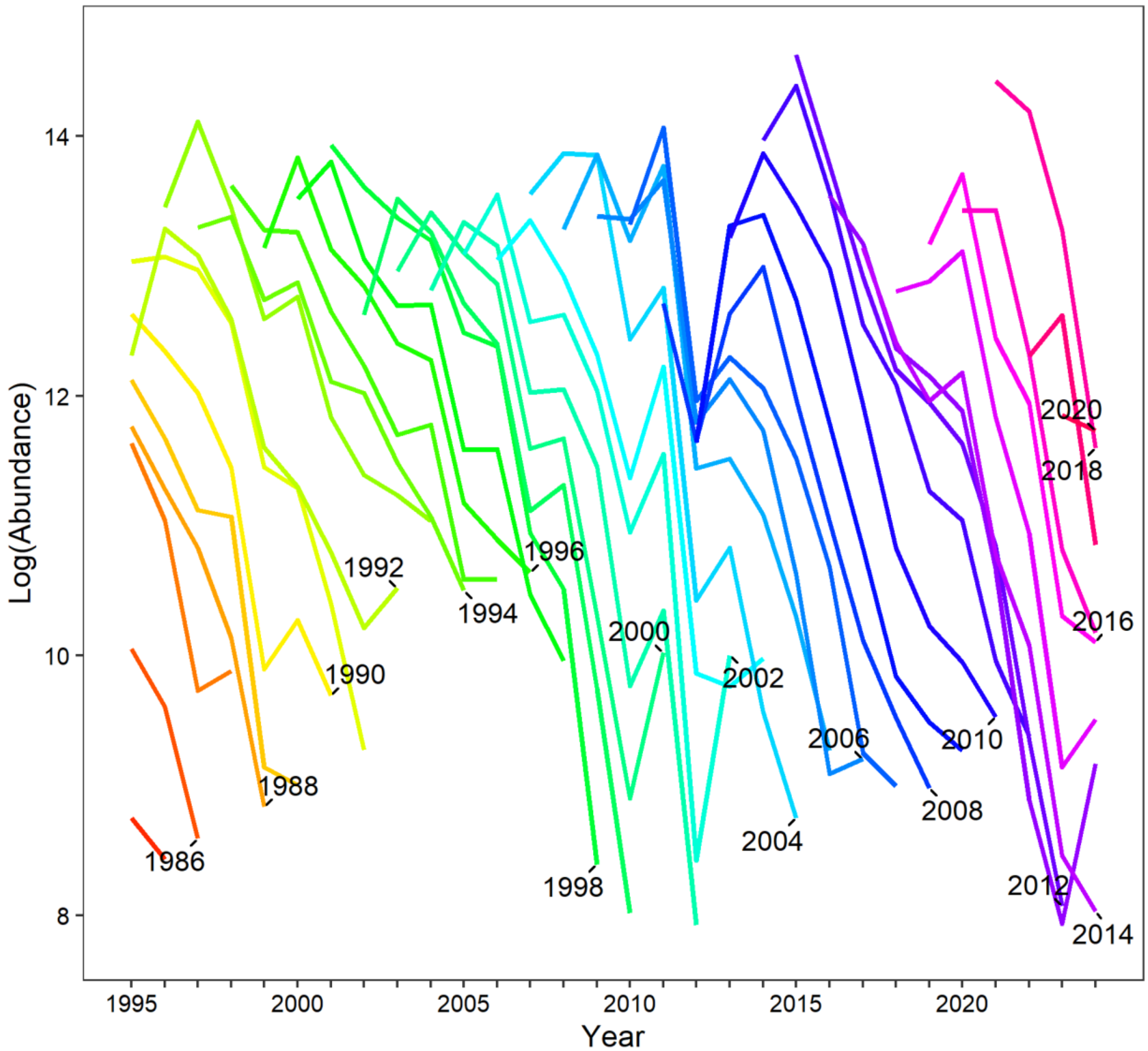

Figure 52. Log-abundance of individual cohorts (ages 3+) from the sentinel mobile gear survey catch at age, 1995-2024. Cohorts are identified by birth year for every 2nd year.

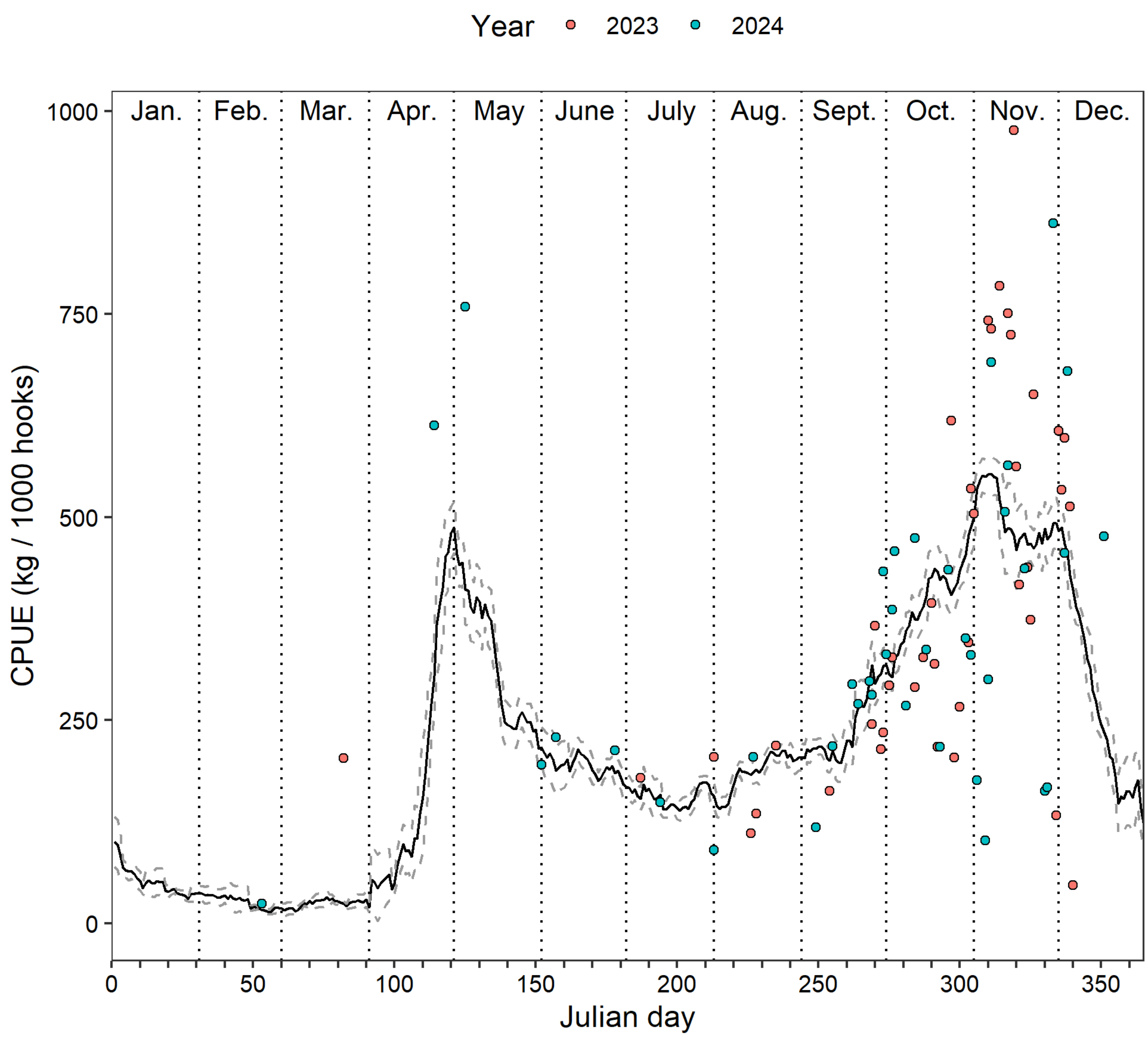

Figure 53. Average daily longline CPUE (kg/1000 hooks) for the sentinel survey program in zone 1 (3Pn) for year 2023 and 2024. The solid line is a 7-day running average of the daily averages for the 1995-2022 series and the dotted lines represent ± ½ standard deviation around this average.

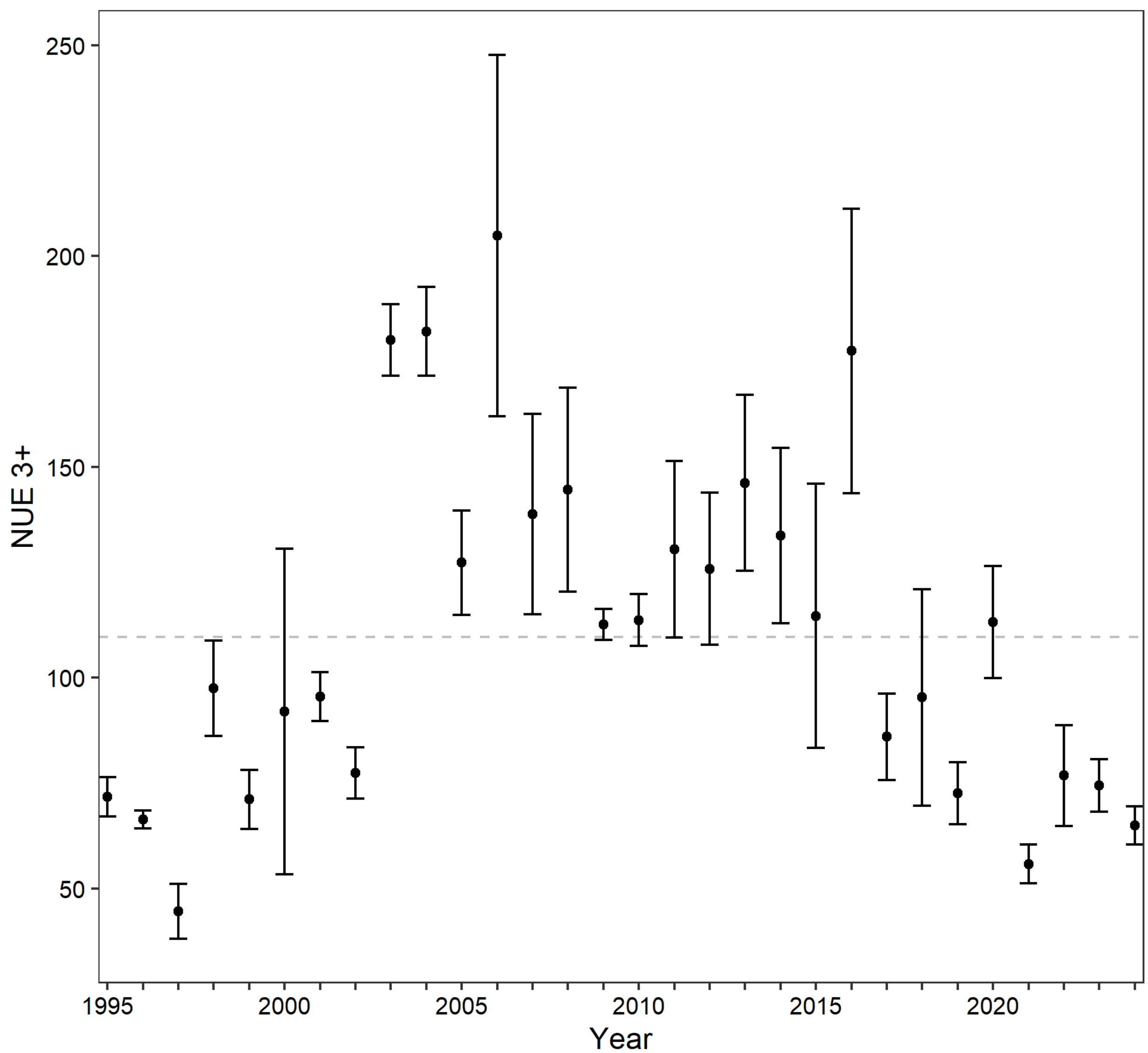

Figure 54. Age 3+ aggregated summer abundance index (number per unit effort [NUE], per 1,000 hooks) with 95% confidence intervals for the sentinel longline program, 1995-2024. The hatched horizontal line represents the average of the 1995-2024 series.

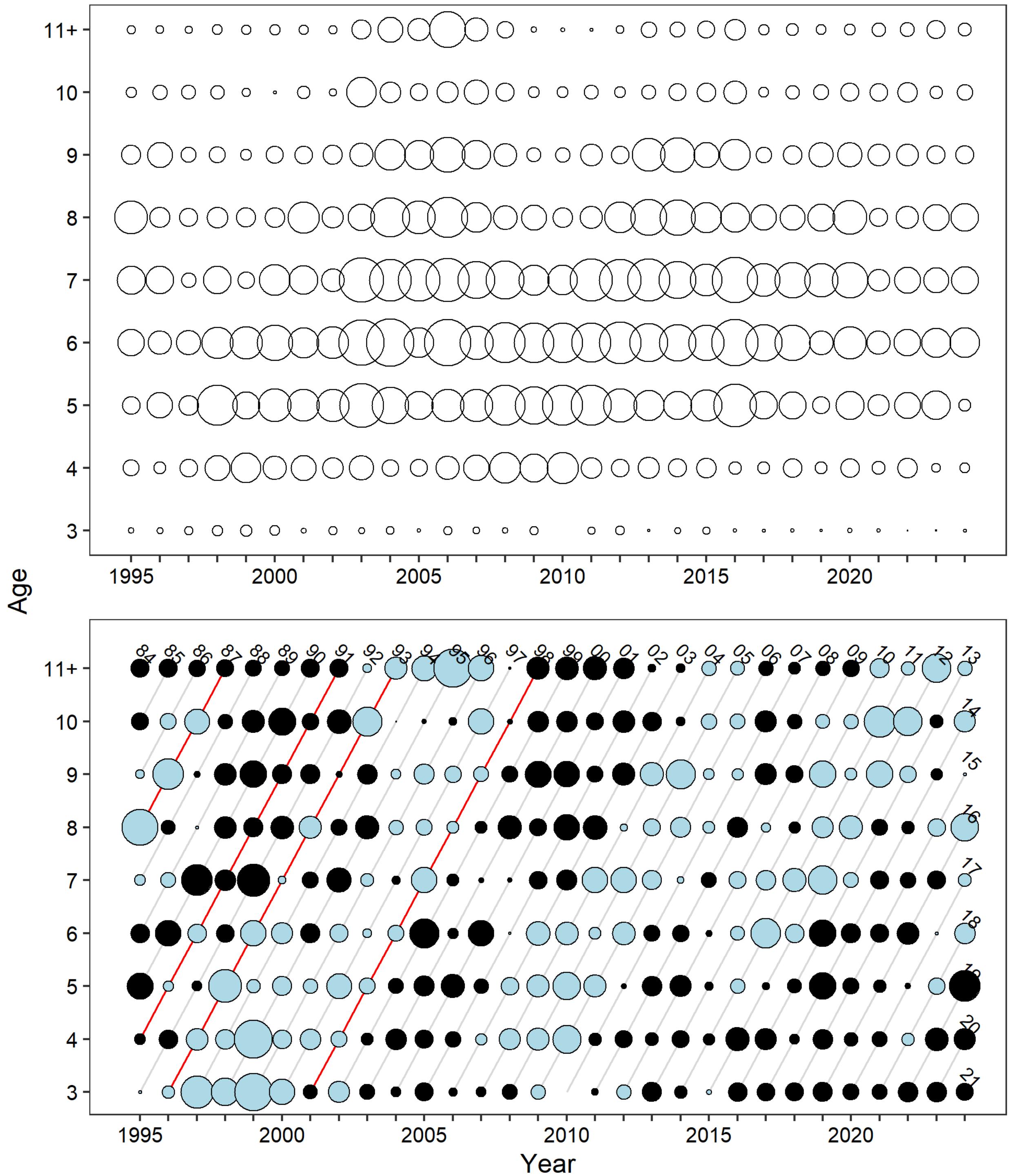

Figure 55. Numbers at age in the sentinel longline survey (summer index) 1995-2024. The top panel shows numbers proportional to circle diameter, while the bottom one shows standardized proportions at age and year (SPAY) with blue and black bubbles indicating above and below average, respectively. The bubble diameter is indicative of the SPAY value. The red lines indicate some consistently tracked above average cohorts in the DFO August survey. Cohort years' last two digits are indicated above bubbles from oldest ages and the ones from the most recent year.

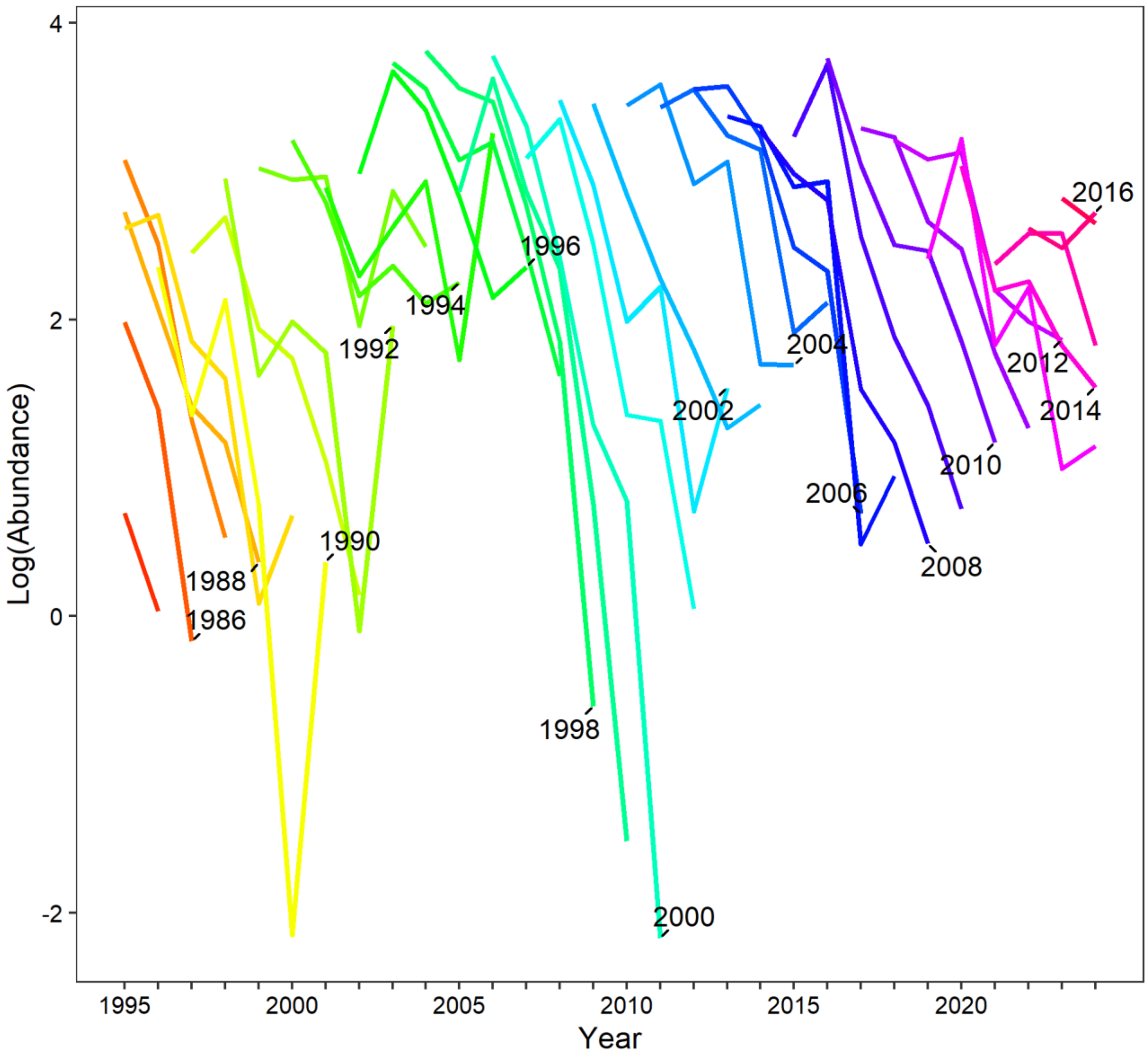

Figure 56. Log-abundance of individual cohorts (ages 6 to 11+) in the sentinel longline survey (summer index) catch at age, 1995-2024. Cohorts are identified by birth year for every 2nd year.

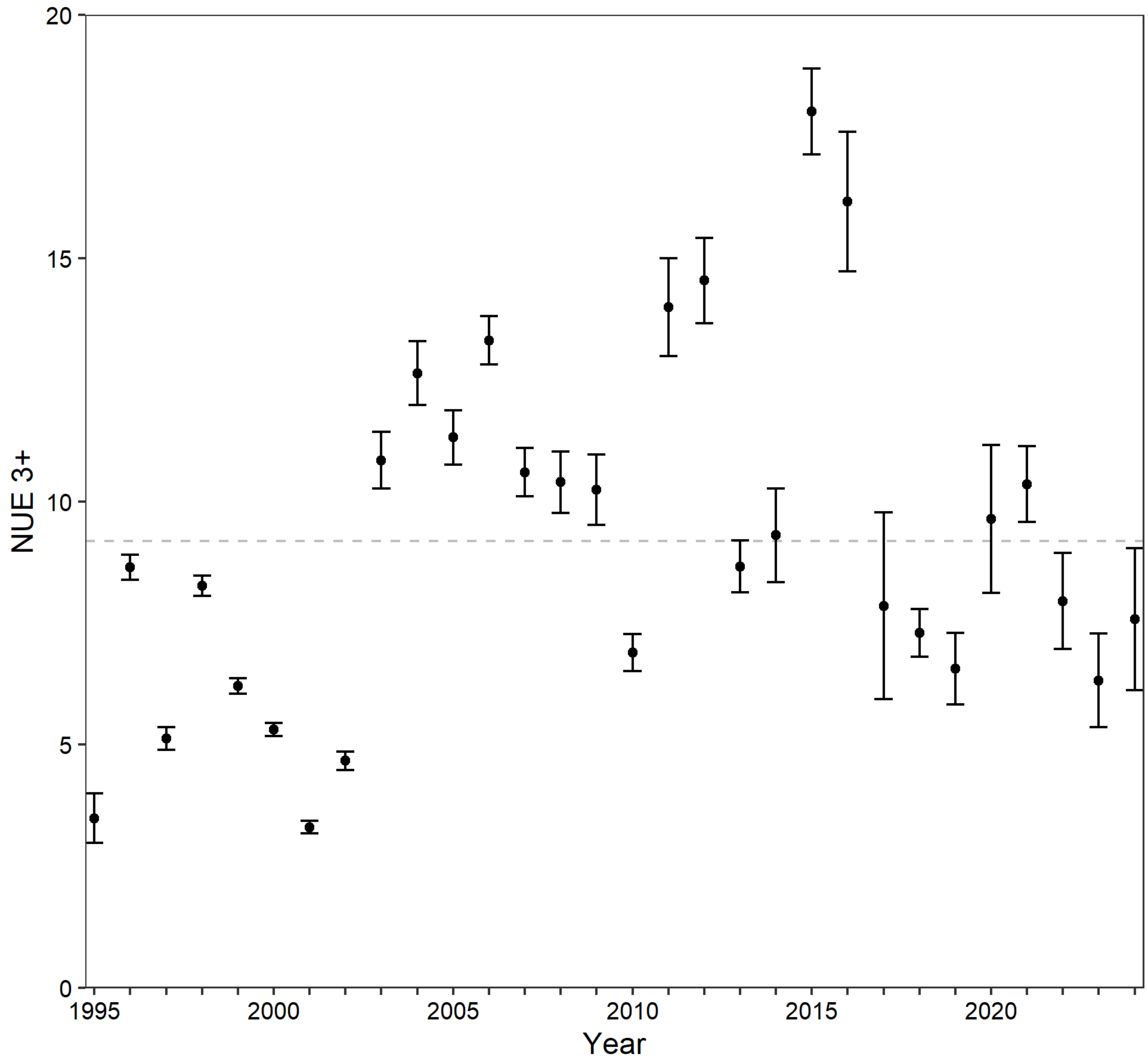

Figure 57. Age 3+ aggregated abundance index (number per unit effort [NUE], per net) with 95% confidence intervals for the sentinel gillnet survey program, 1995-2024. The hatched horizontal line represents the average of the 1995-2024 series.

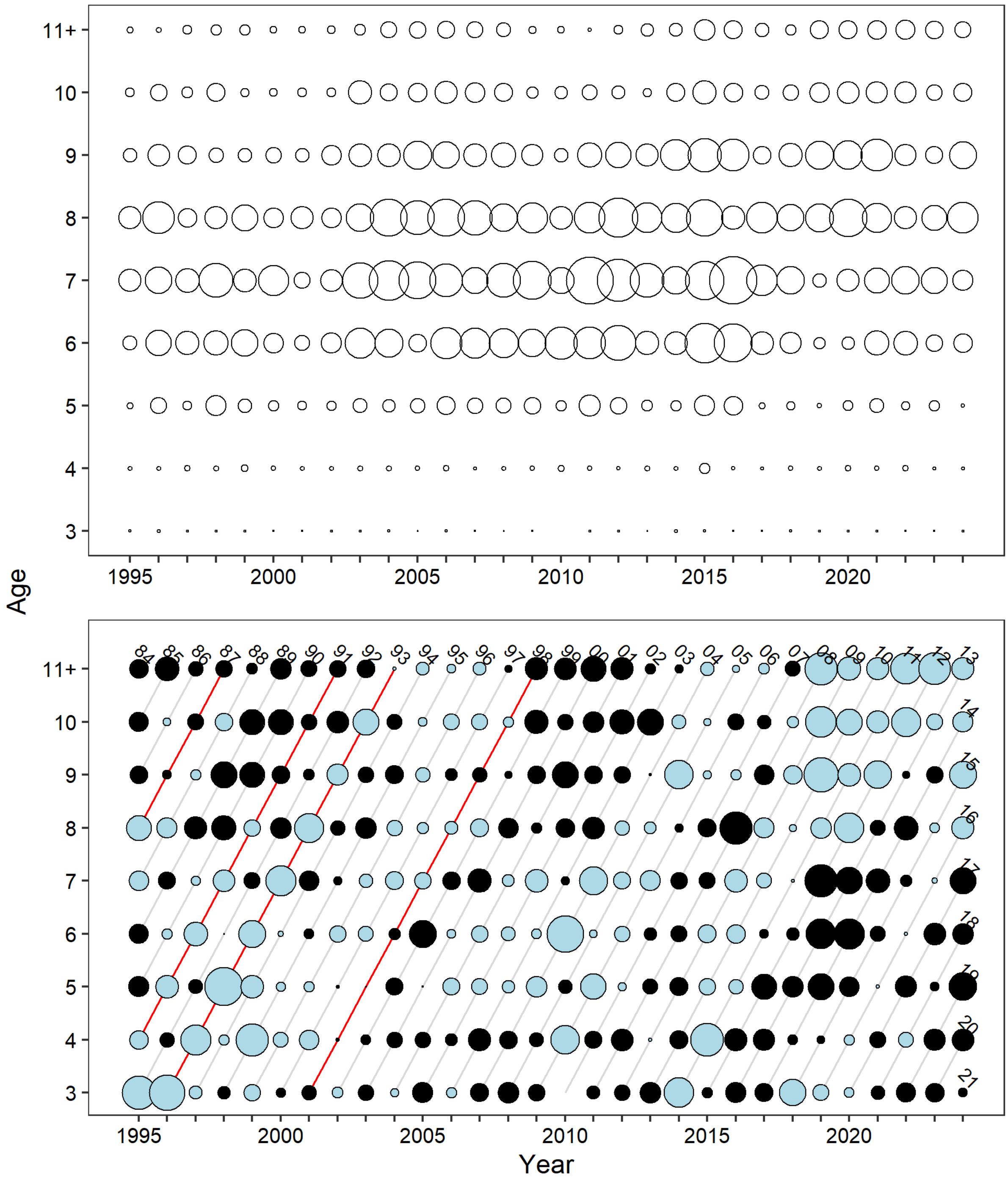

Figure 58. Numbers at age in the sentinel gillnet survey for the period 1995-2024. The top panel shows numbers proportional to circle diameter, while the bottom one shows standardized proportions at age and year (SPAY) with blue and black bubbles indicating above and below average, respectively. The bubble diameter is indicative of the SPAY value. The red lines indicate some consistently tracked above average cohorts in the DFO August survey. Cohort years' last two digits are indicated above bubbles from oldest ages and the ones from the most recent year.

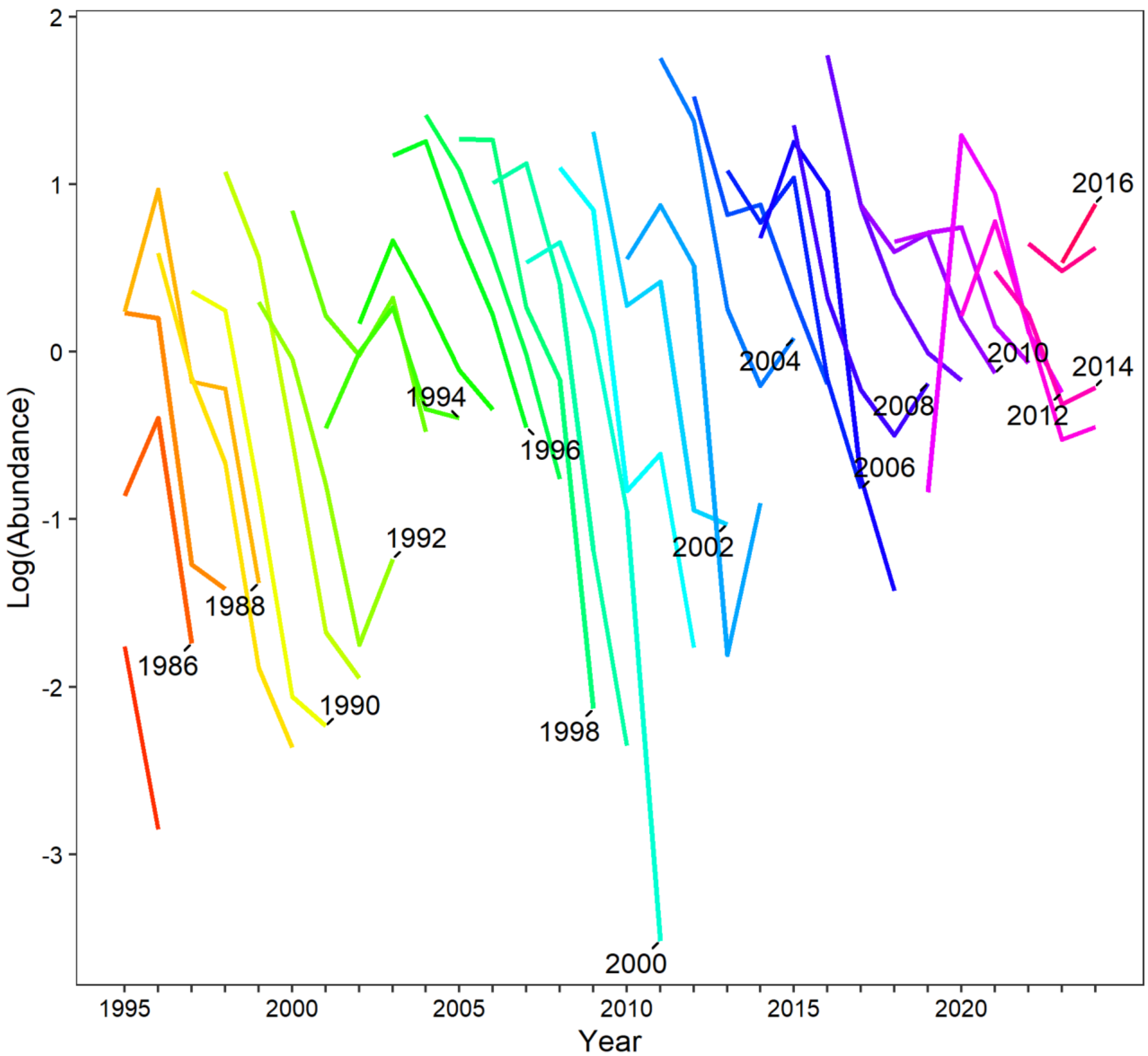

Figure 59. Log-abundance of individual cohorts (ages 7 to 11+) in the sentinel gillnet survey catch at age, 1995-2024. Cohorts are identified by birth year for every 2nd year.

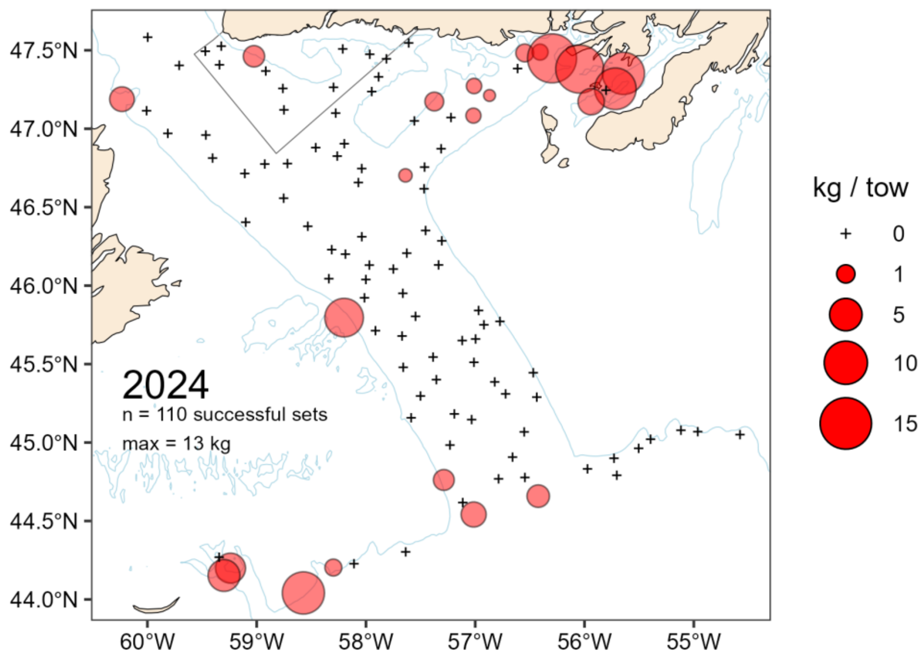

Figure 60. Distribution of cod catch rates (kg per tow) during the May 2022 and 2024 reproductive potential survey. The 200 m isobath is shown in light blue, as well as the delineation of NAFO Subdivision 3Pn in grey.

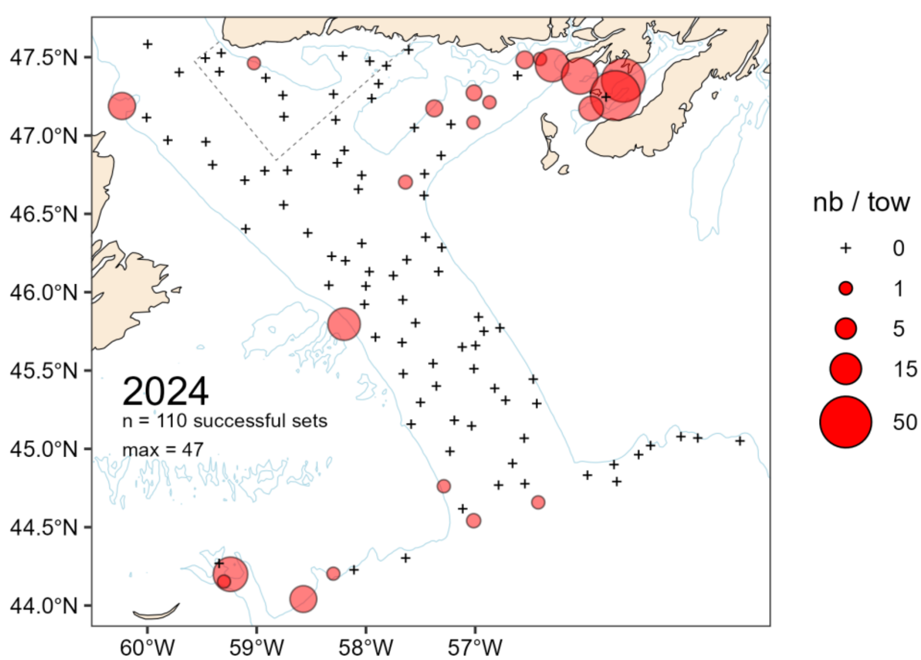

Figure 61. Distribution of cod catch rates (nb per tow) during the May 2020 and 2022 reproductive potential survey. The 200 m isobath is shown in light blue, as well as the delineation of NAFO Subdivision 3Pn in grey.

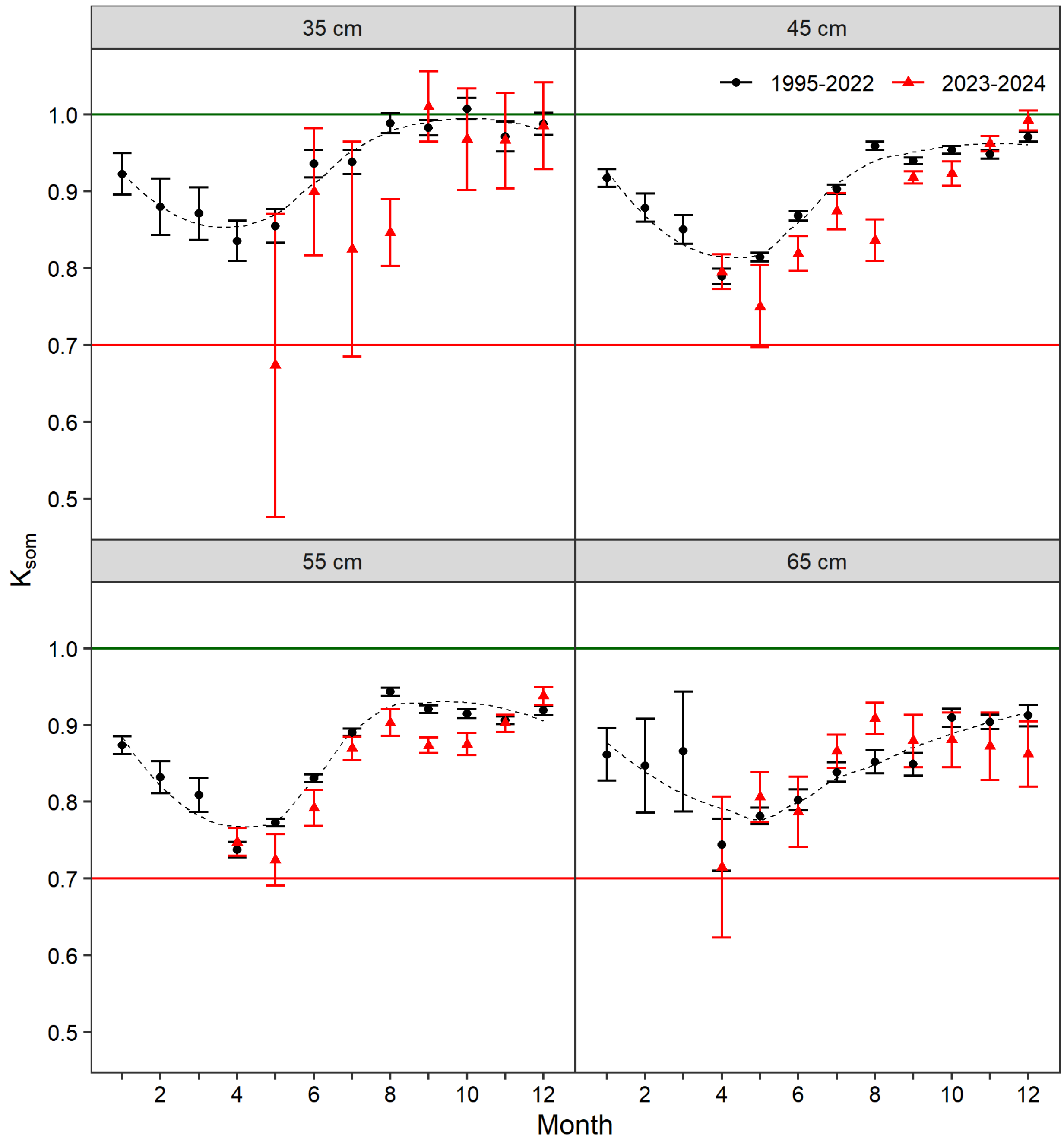

Figure 62. Seasonal changes in mean condition (Fulton Index, K_{som}, ±95% CI) of cod sampled during 2023-2024 compared to 1995-2022 according to four 10 cm length classes respectively centered on the values of 35, 45, 55 and 65 cm (panels), based on the sentinel fixed gear fisheries program. The hatched line represents a smoothing of the monthly averages for the 1995-2022 series. Based on Dutil et al. (1995), K_{som} values > 1, between 0.7 and 1 and < 0.7 represent cod considered in excellent, good, and critical condition respectively.

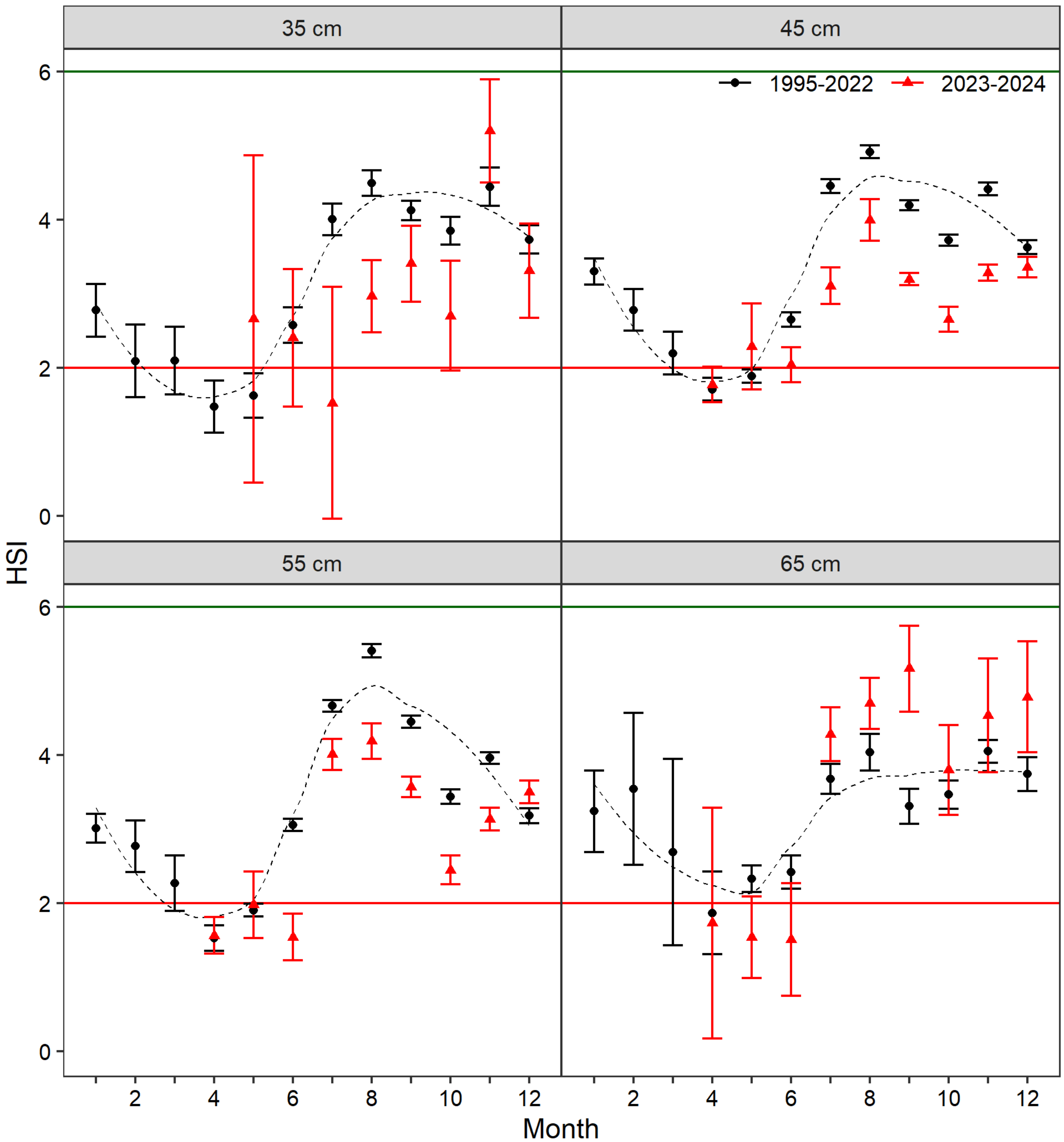

Figure 63. Seasonal changes in mean condition (hepato-somatic index, HSI, ±95% CI) of cod sampled during 2023-2024 compared to 1995-2022 according to four 10 cm length classes respectively centered on the values of 35, 45, 55 and 65 cm (panels), based on the sentinel fixed gear fisheries program. The hatched line represents a smoothing of the monthly averages for the 1995-2022 series. Based on Dutil et al. (1995), HSI values > 6, between 2 and 6 and < 2 represent cod considered in excellent, good, and critical condition respectively.

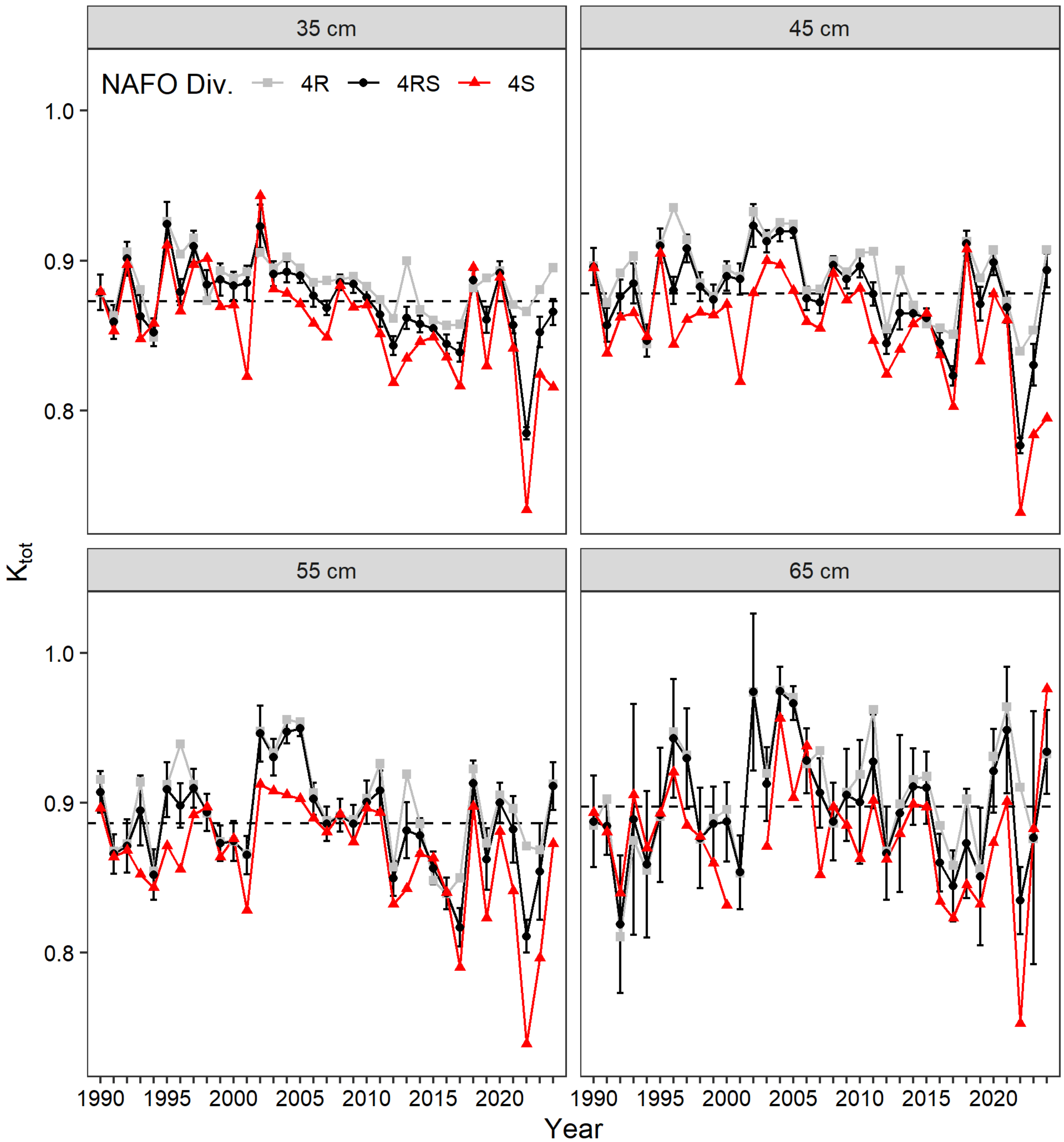

Figure 64. Condition of cod sampled during the DFO August survey, by NAFO Division and according to four 10 cm length classes respectively centered on the values of 35, 45, 55 and 65 cm (panels). Each point represents the annual mean (± 95% CI for the 4RS series only) of the Fulton condition index (K_{tot}). The horizontal hatched line represents the average of the 4RS 1990-2024 series. Based on Dutil et al. (1995), K_{tot} values > 1, between 0.7 and 1 and < 0.7 represent cod considered in excellent, good, and critical condition respectively.

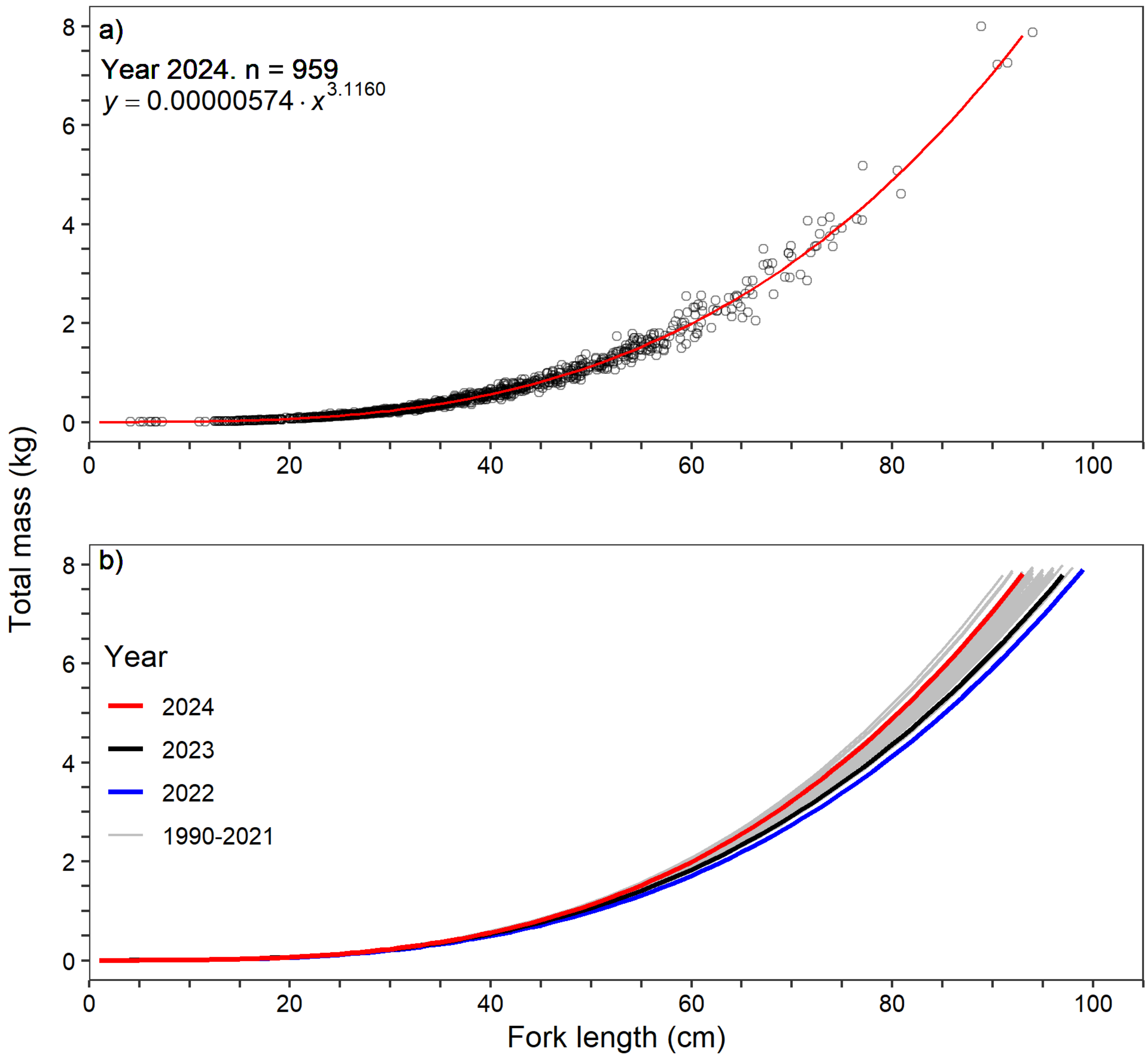

Figure 65. Mass-length relationship from the DFO August survey for a) year 2024 and b) all years in the series (1990-2024).

Figure 66. Evolution of total mass of Atlantic cod of different lengths as a function of year. Masses are calculated from mass-length relationships obtained from the DFO August survey. The dotted horizontal lines represent the average of the 1990-2024 series for each displayed length. For each length, the average total mass is provided.

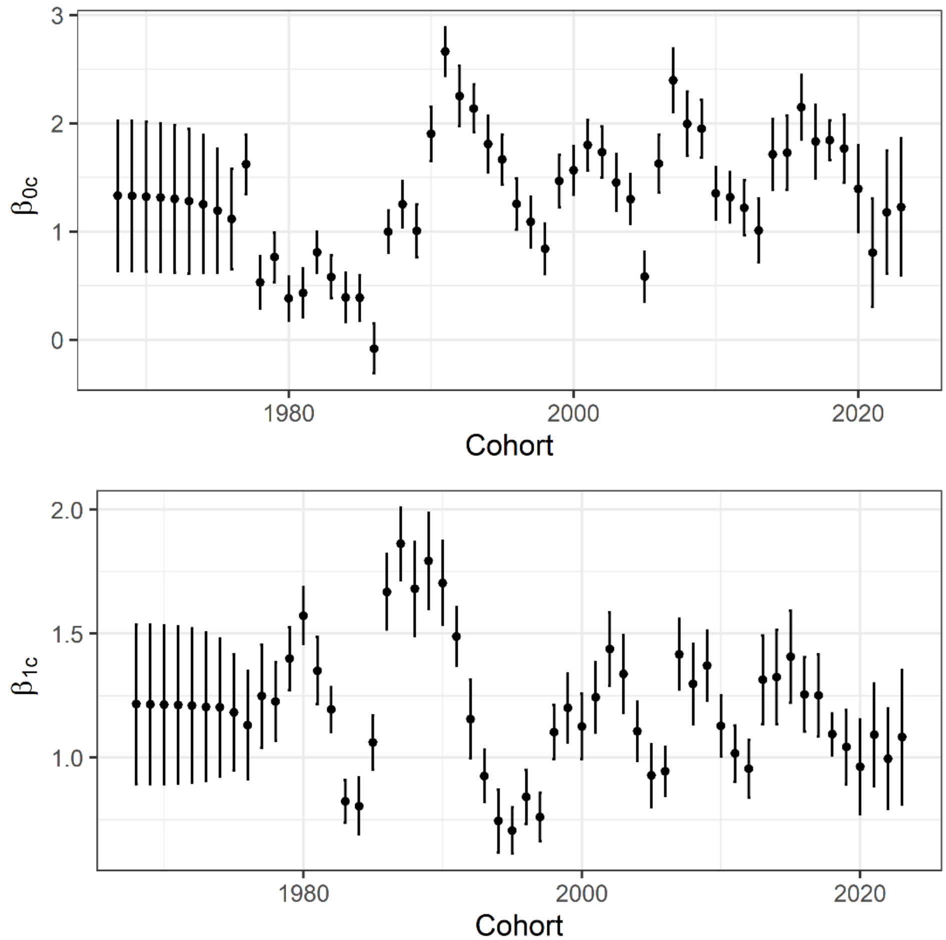

Figure 67. Estimated cohort-specific intercept (β_{0c}) and slope (β_{1c}) parameters for the beta-binomial maturity model for female cod, with standard errors.

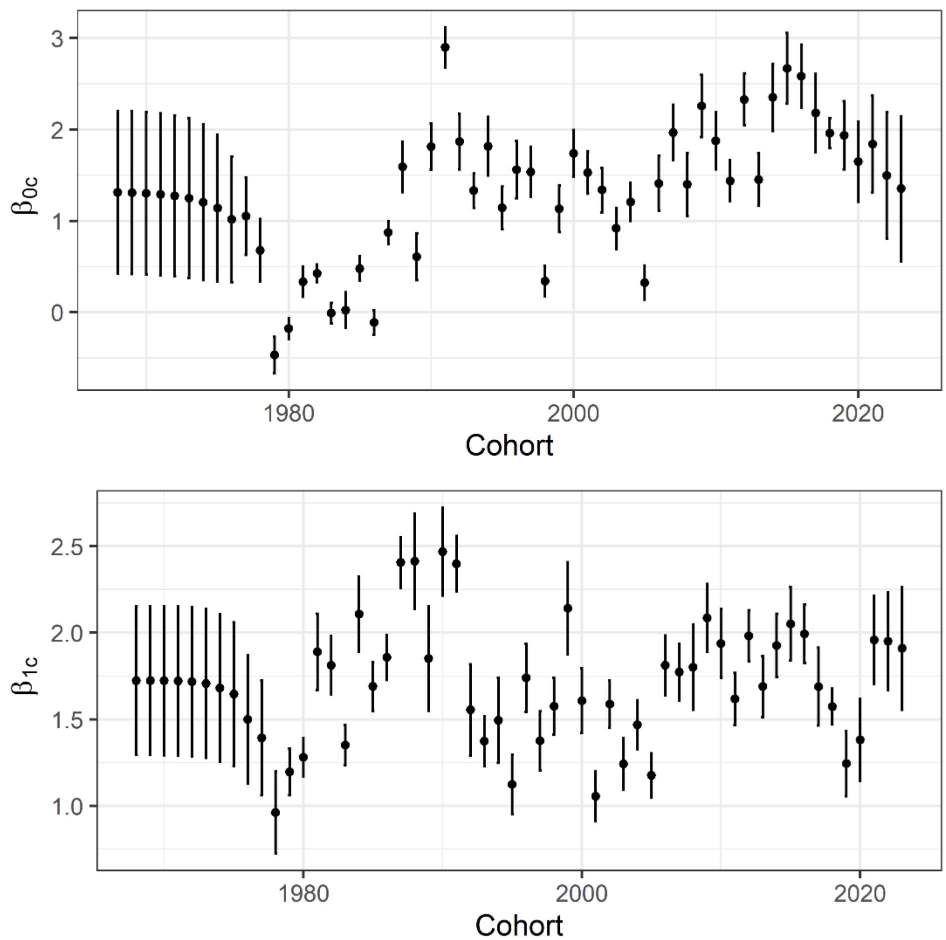

Figure 68. Estimated cohort-specific intercept (β_{0c}) and slope (β_{1c}) parameters for the beta-binomial maturity model for male cod, with standard errors.

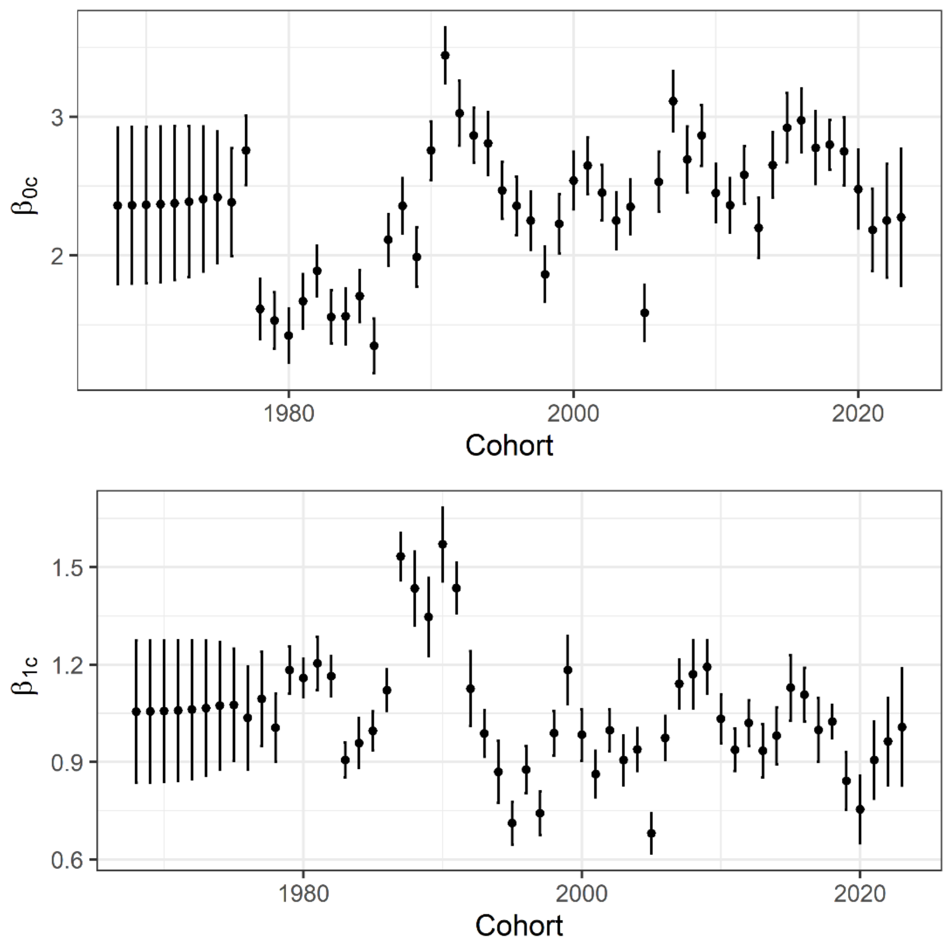

Figure 69. Estimated cohort-specific intercept (β_{0c}) and slope (β_{1c}) parameters for the beta-binomial maturity model for cod, irrespective of sex, with standard errors.

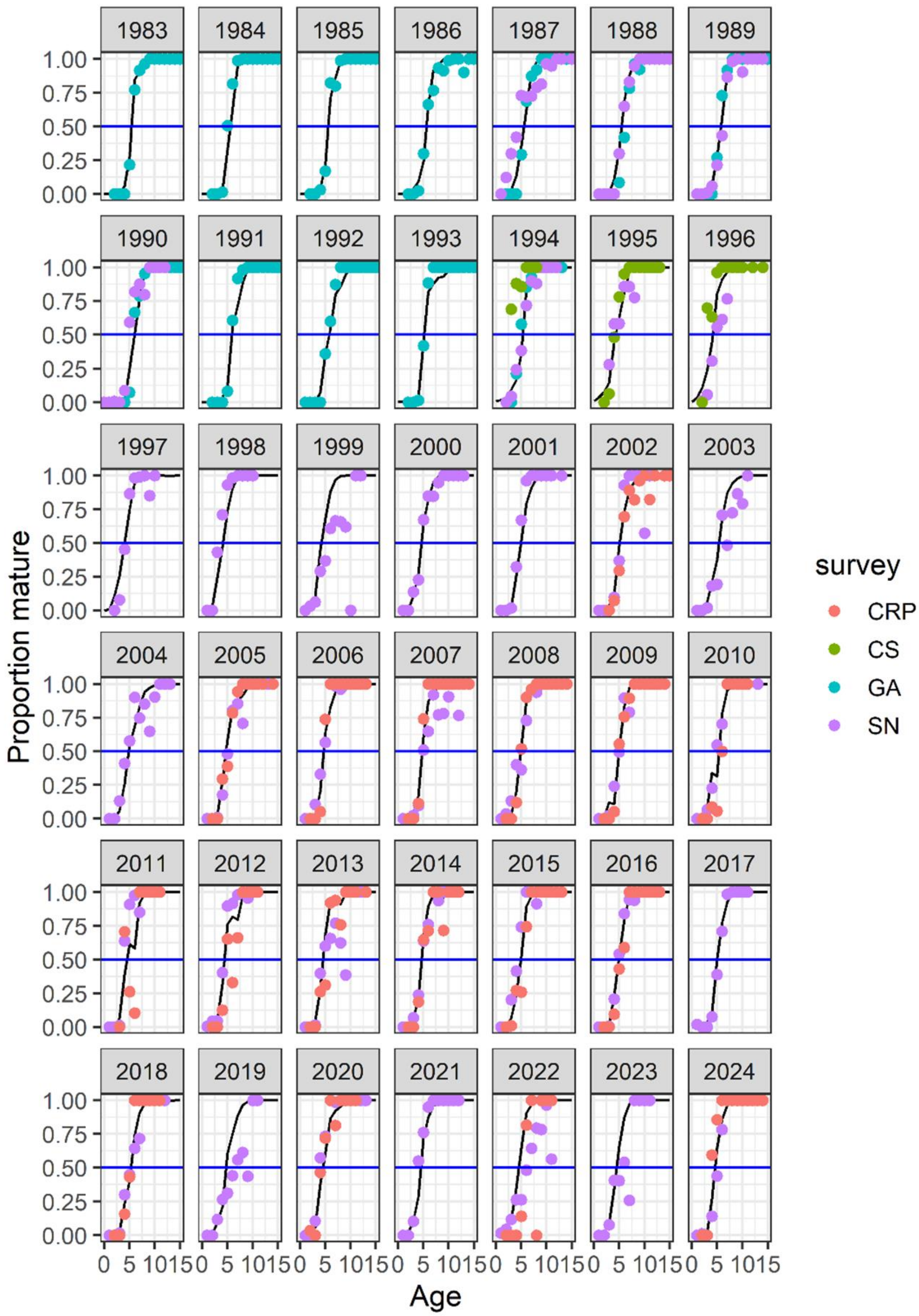

Figure 70. Annual (panels) model-estimated maturity ogives (black line) and empirical maturity ogives estimated by Beaudry-Sylvestre et al. (2025) by survey (coloured points) for female cod. A horizontal blue line is drawn at 0.5 proportion mature for reference. See text for description of surveys.

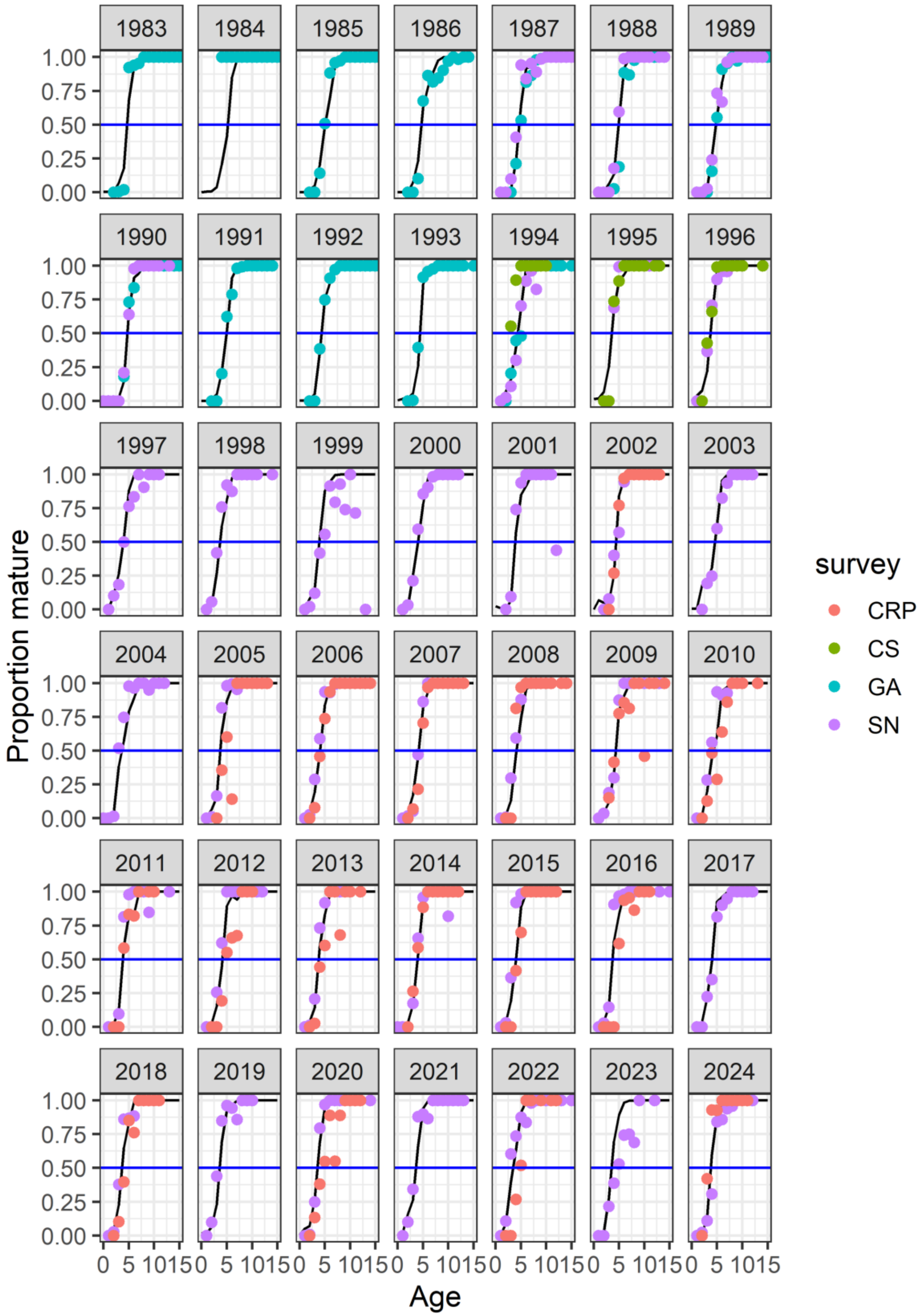

Figure 71. Annual (panels) model-estimated maturity ogives (black line) and empirical maturity ogives estimated by Beaudry-Sylvestre et al. (2025) by survey (coloured points) for male cod. A horizontal blue line is drawn at 0.5 proportion mature for reference. See text for description of surveys.

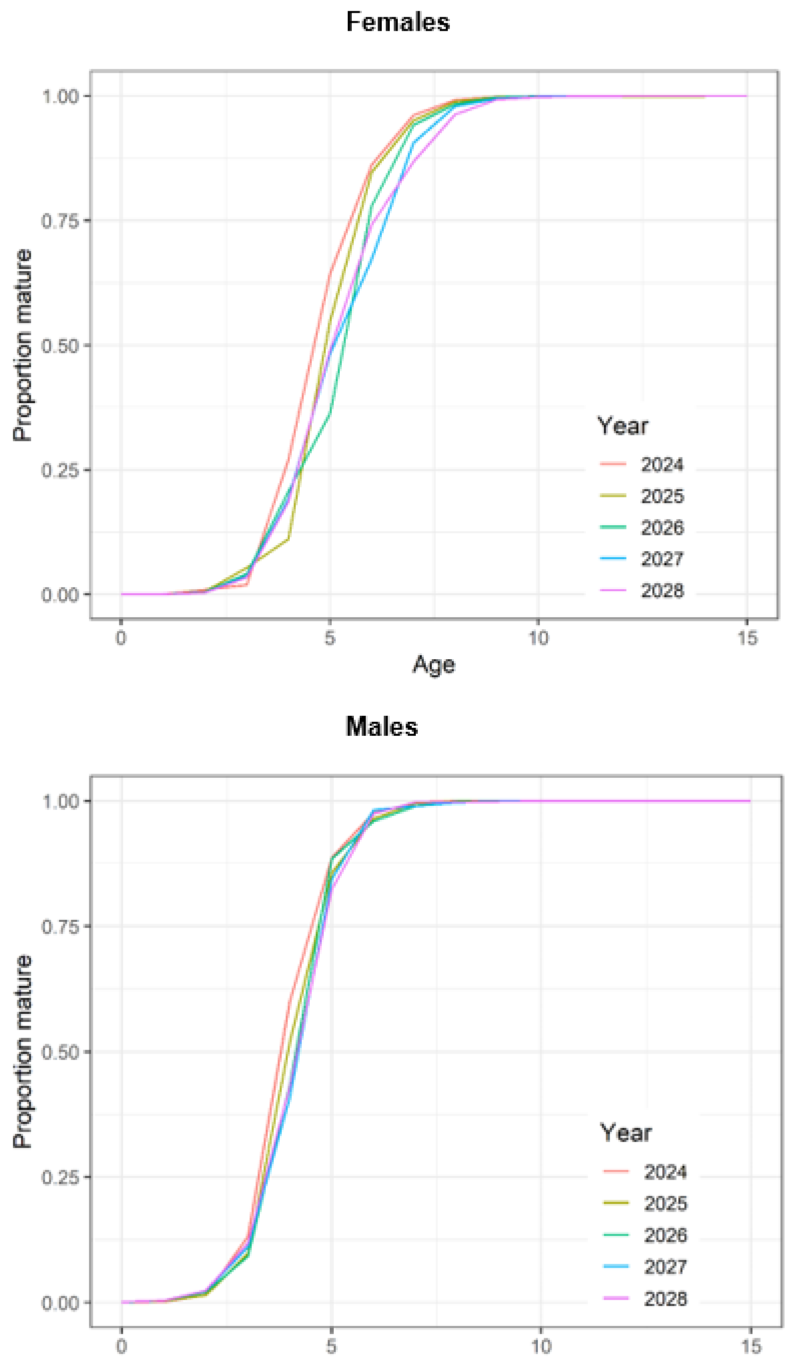

Figure 72. Projected ogives for 2025-2028, along with the estimated 2024 ogive for reference, for female (top panel) and male (bottom panel) cod.

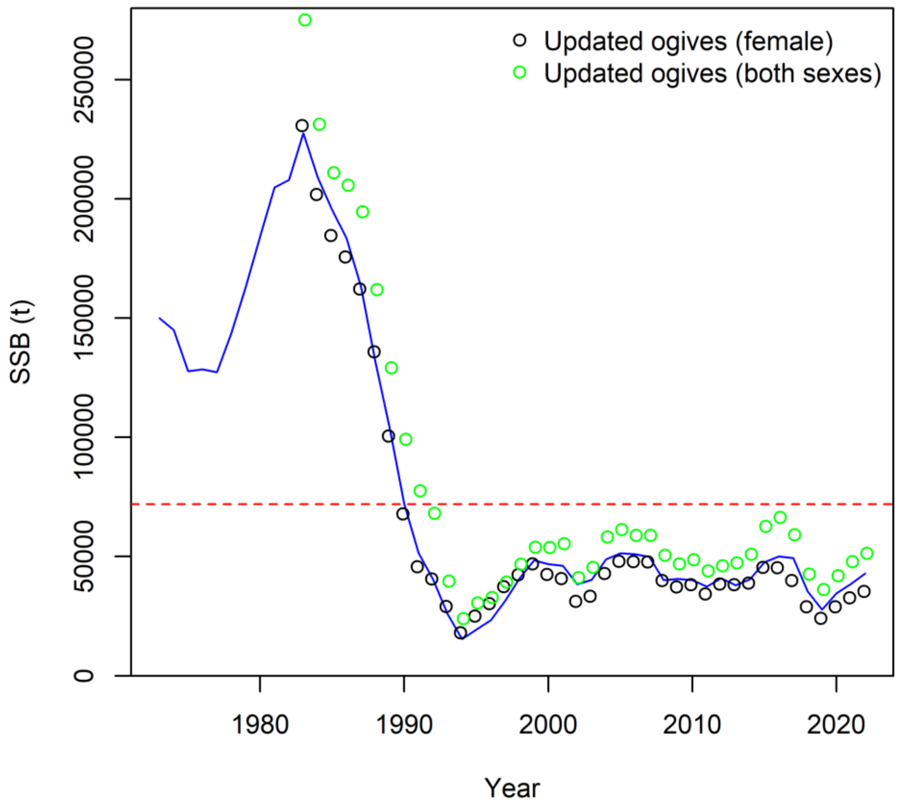

Figure 73. Comparison of estimated spawning stock biomass (SSB, tonnes) from the 2023 assessment (blue line), and SSB revised using the new model-derived maturity ogives for female cod (black circles) and cod, irrespective of sex (green circles). The limit reference point for the stock is indicated by the horizontal dashed red line. Note that the 1983 ogive was used to estimate SSB for 1973 to 1982 in the 2023 assessment, whereas only those years with specific updated ogives are plotted for the updated values.

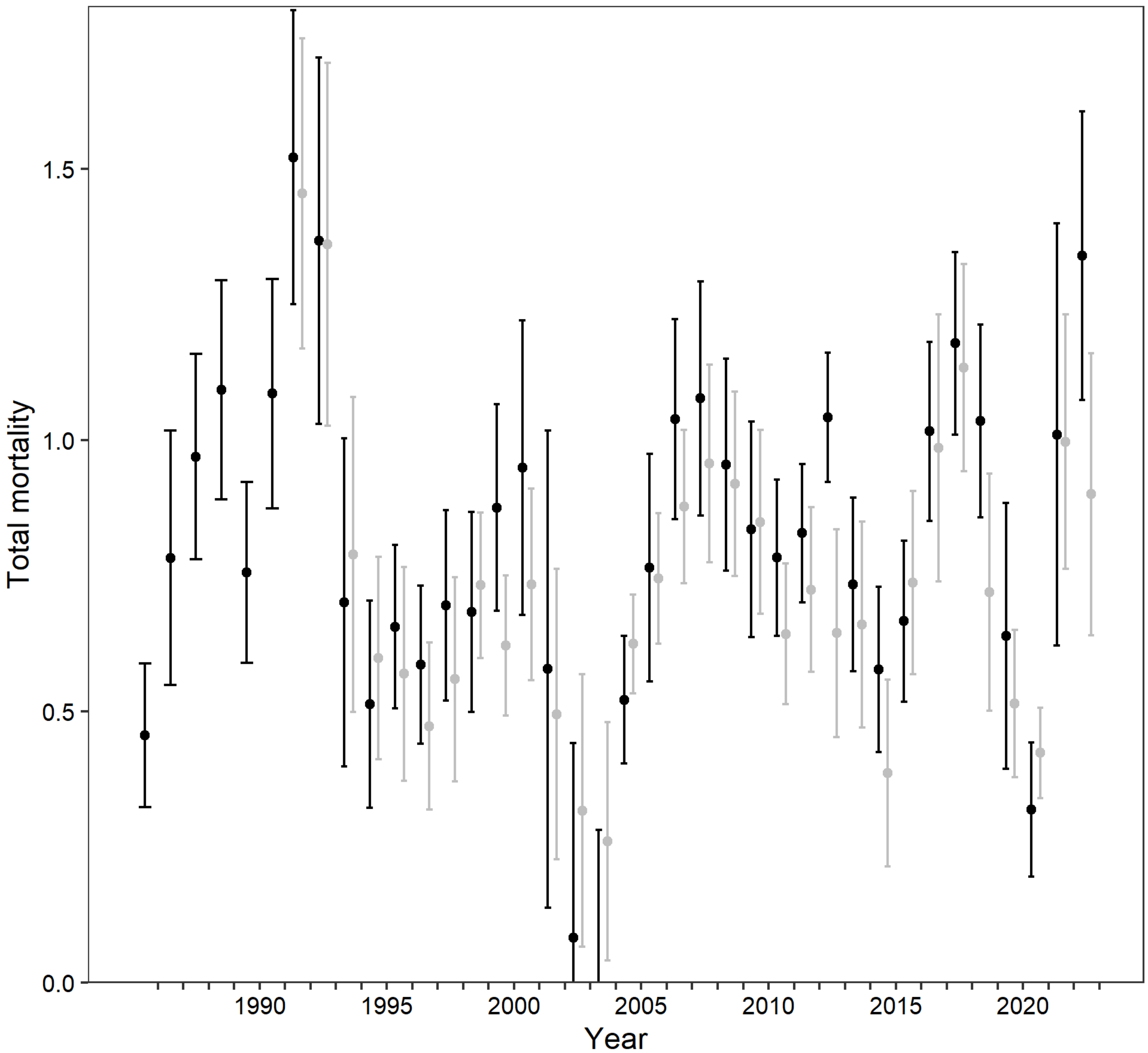

Figure 74. Estimates of total mortality (Z, with 95% confidence intervals) for ages 5 to 10 from the DFO August survey for 1984-2024 based on the reduced suite of strata (black) and 1990-2024 based on all consistently sampled strata (grey).

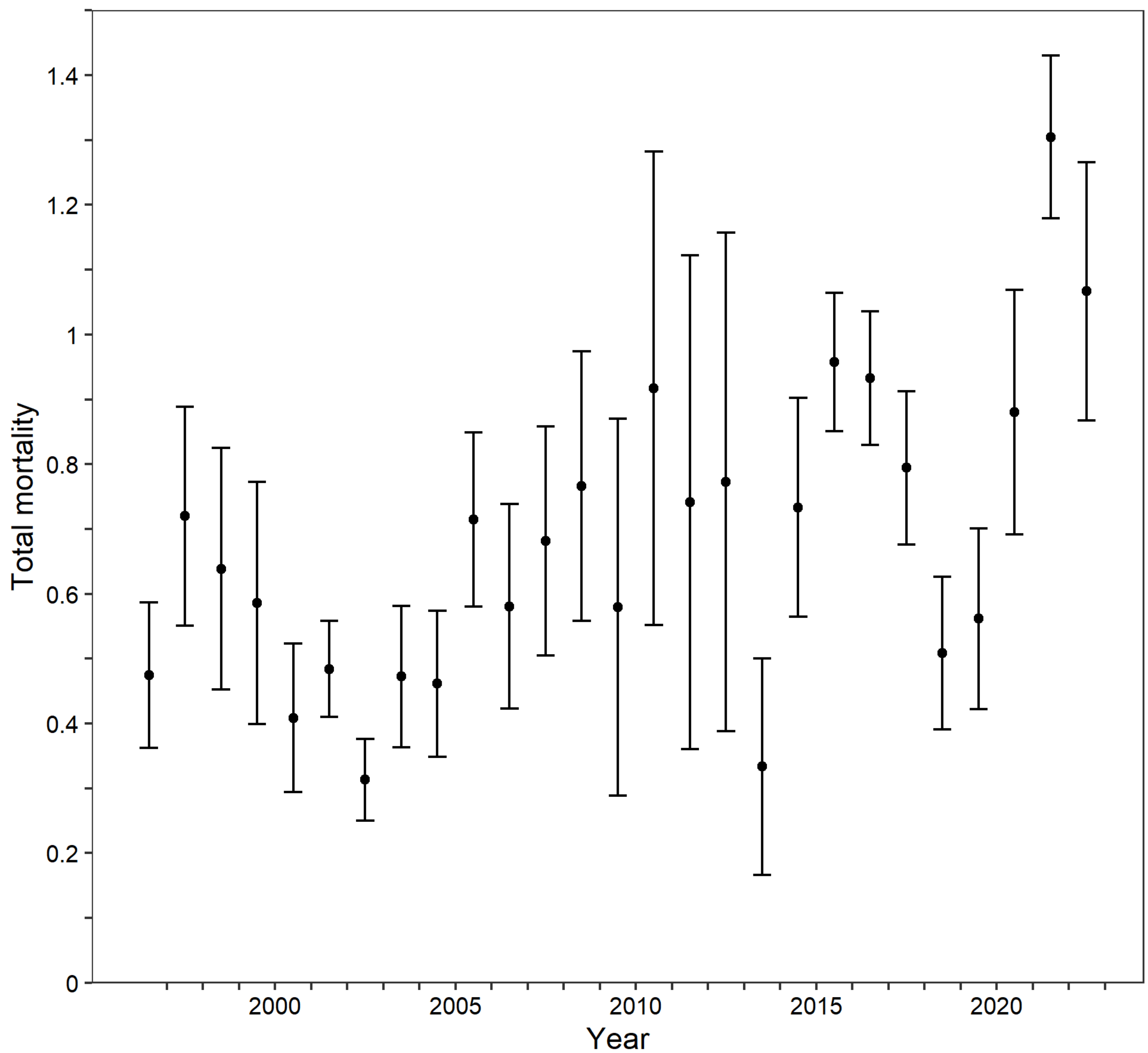

Figure 75. Estimates of total mortality (Z, with 95% confidence intervals) for ages 5 to 10 from the sentinel mobile gear survey, 1995-2024.

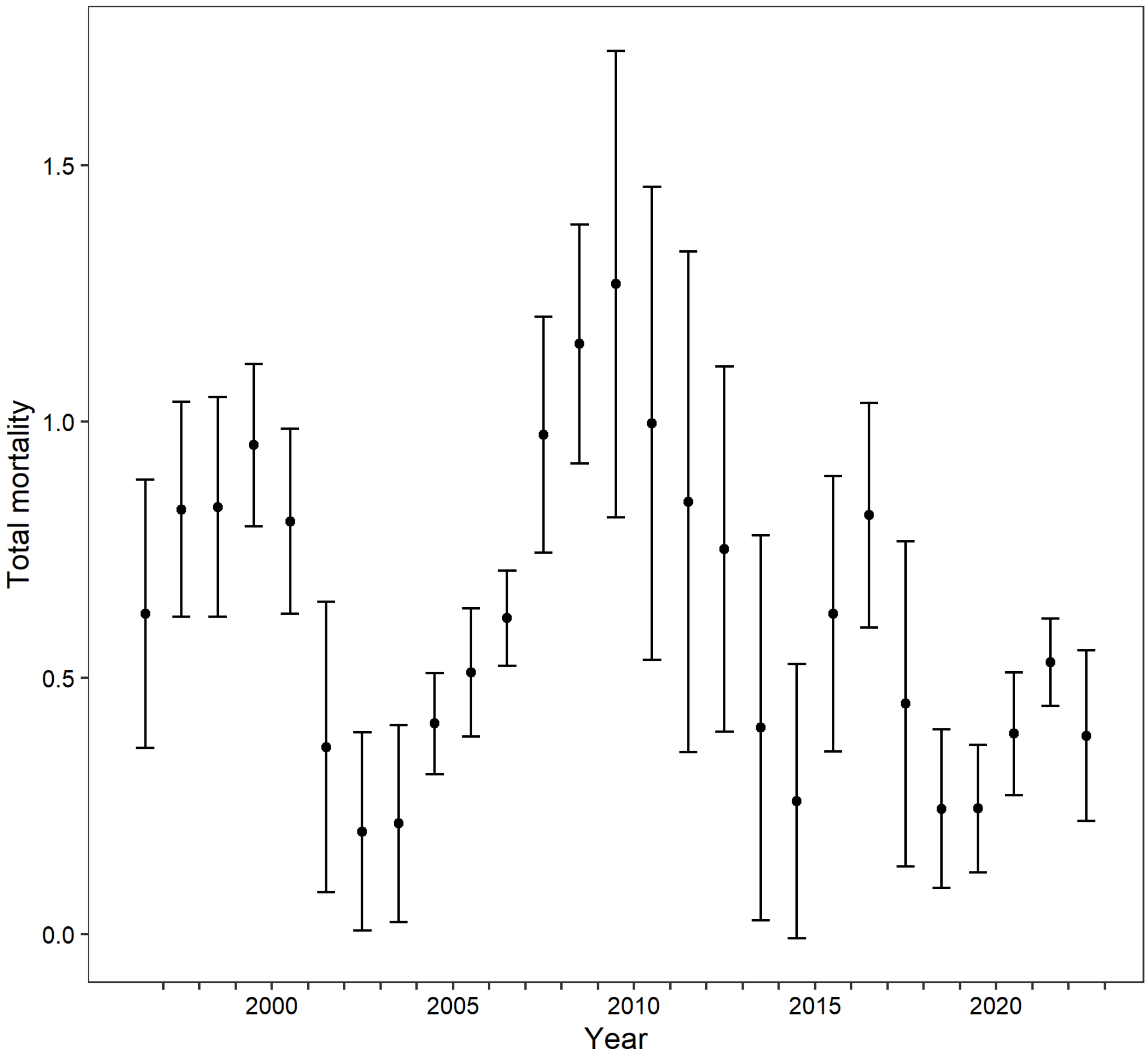

Figure 76. Estimates of total mortality (Z, with 95% confidence intervals) for ages 8 to 12 from the sentinel gillnet survey, 1995-2024.

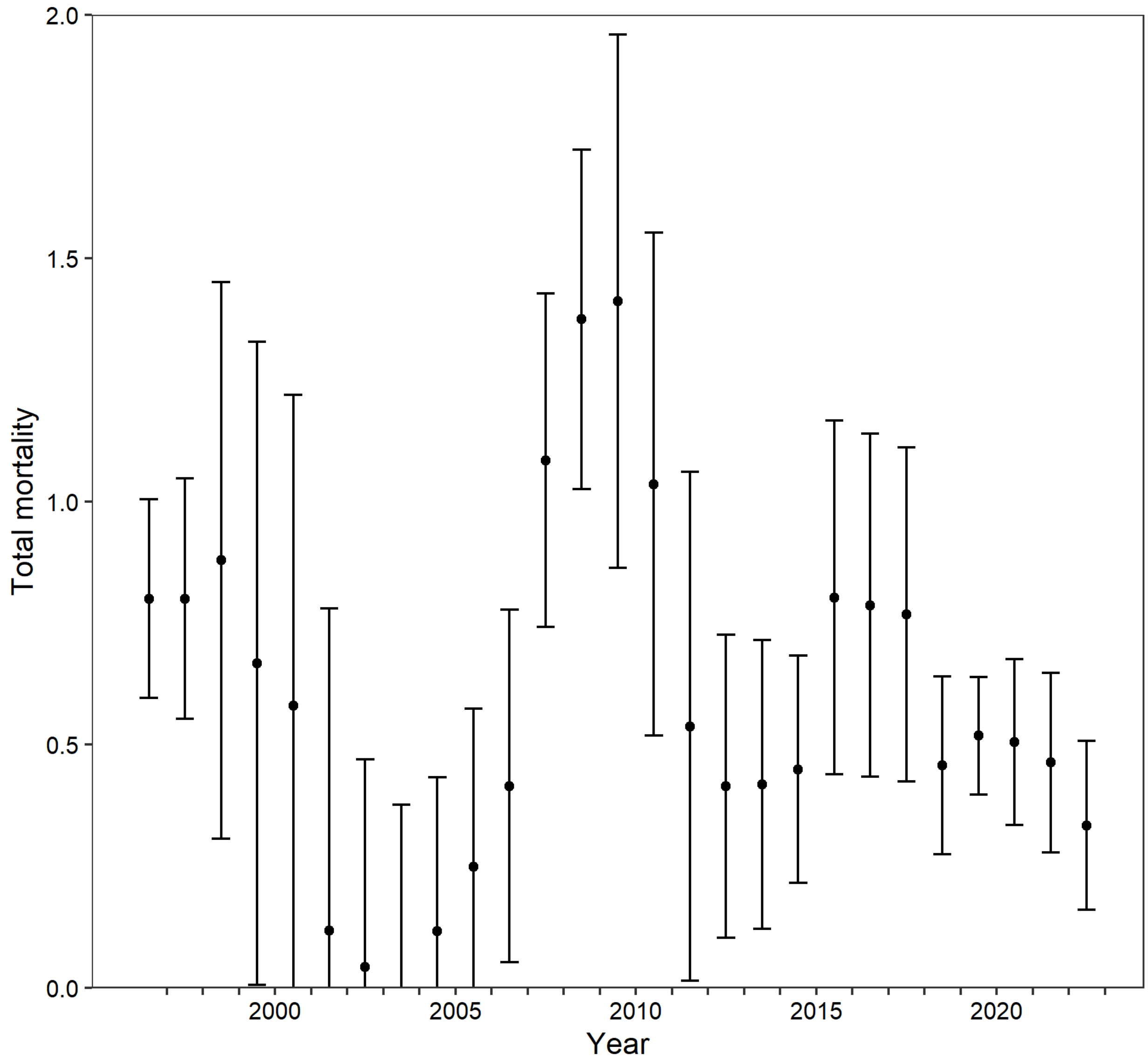

Figure 77. Estimates of total mortality (Z, with 95% confidence intervals) for ages 8 to 12 from the sentinel longline survey (summer index), 1995-2024.

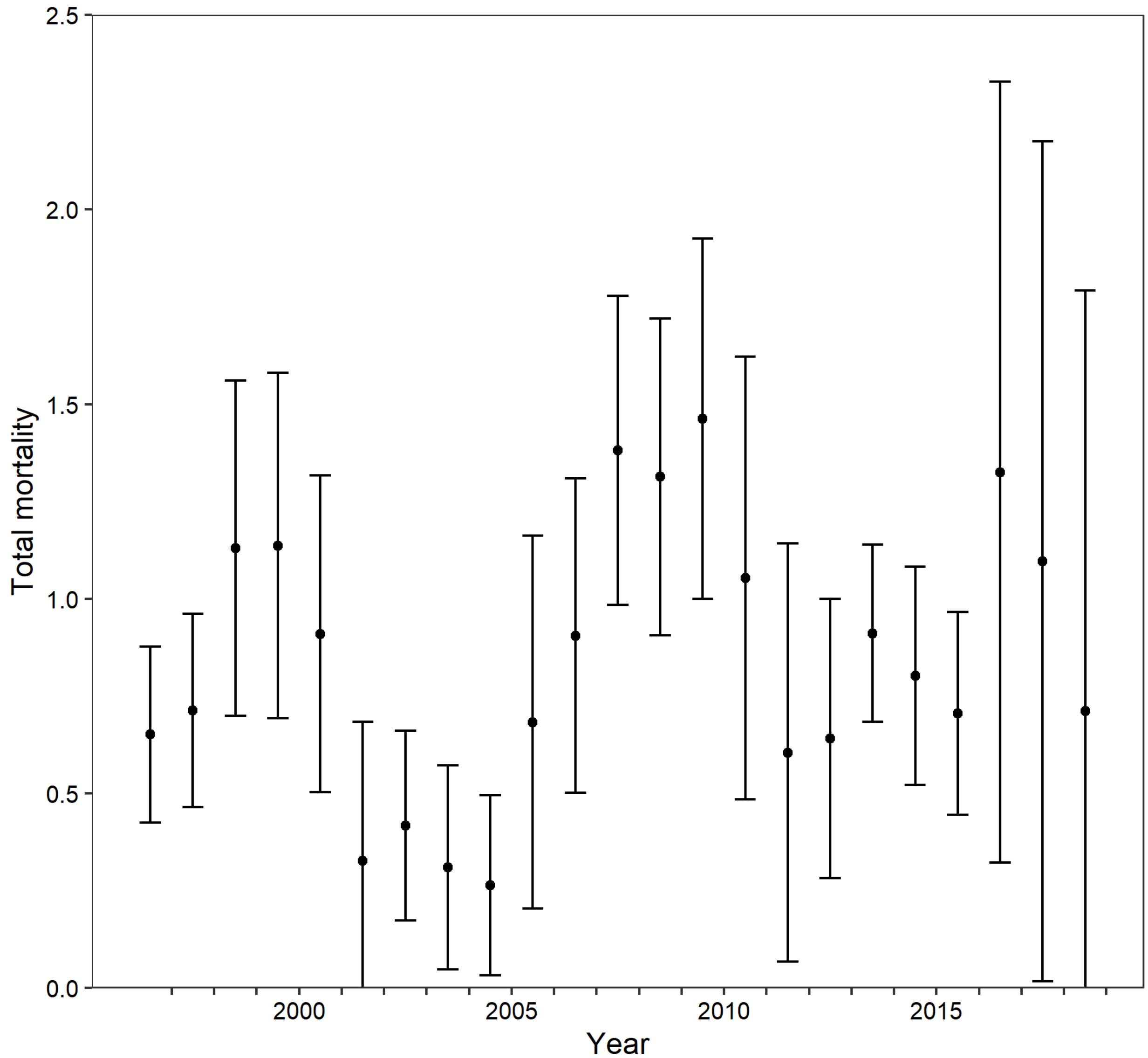

Figure 78. Estimates of total mortality (Z, with 95% confidence intervals) for ages 8 to 12 from the sentinel longline survey (zone 1 fall index), 1995-2020.

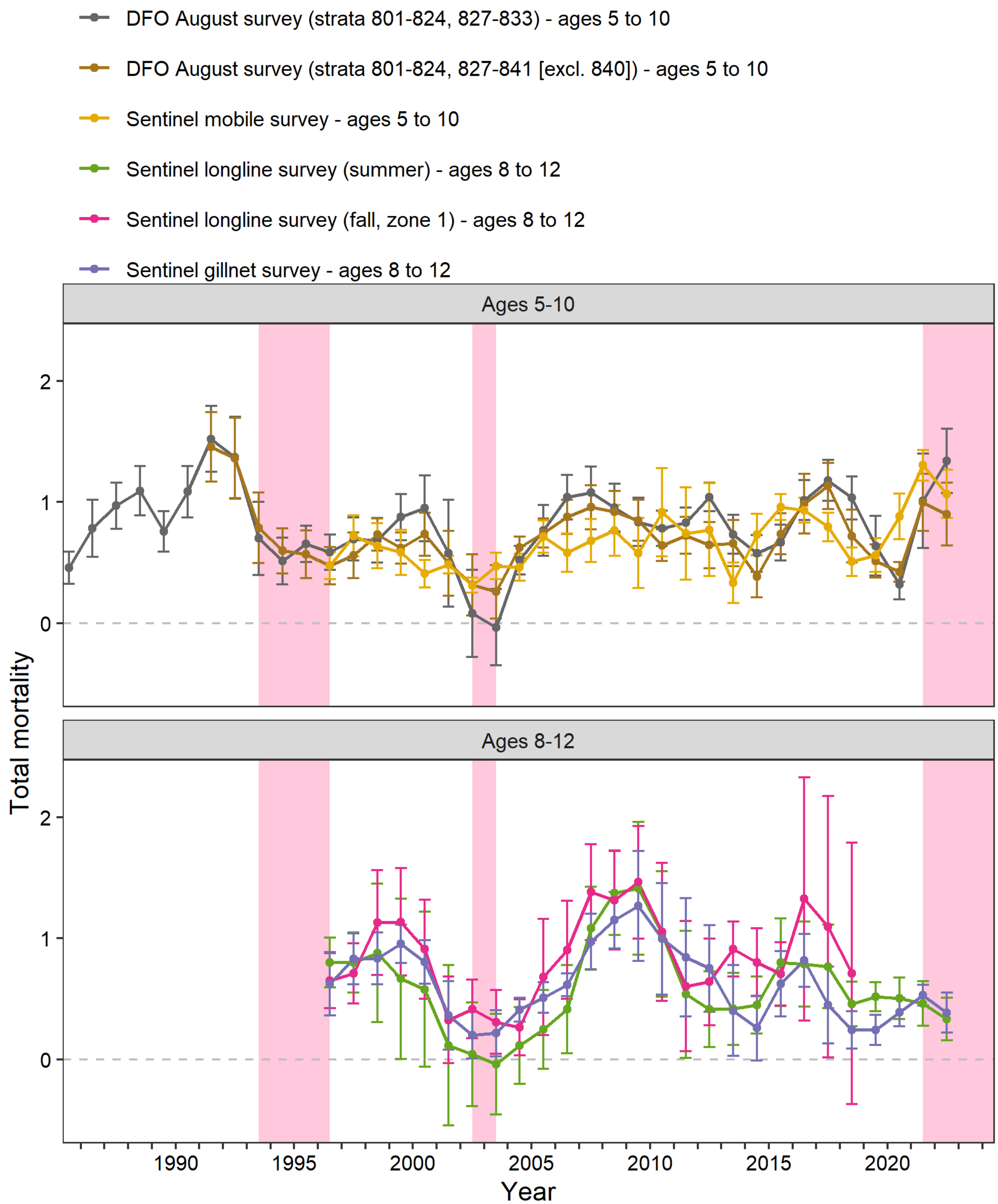

Figure 79. Comparison of total mortality estimates for each of the six principal fishery independent survey indices. Moratorium years are shaded in pink.

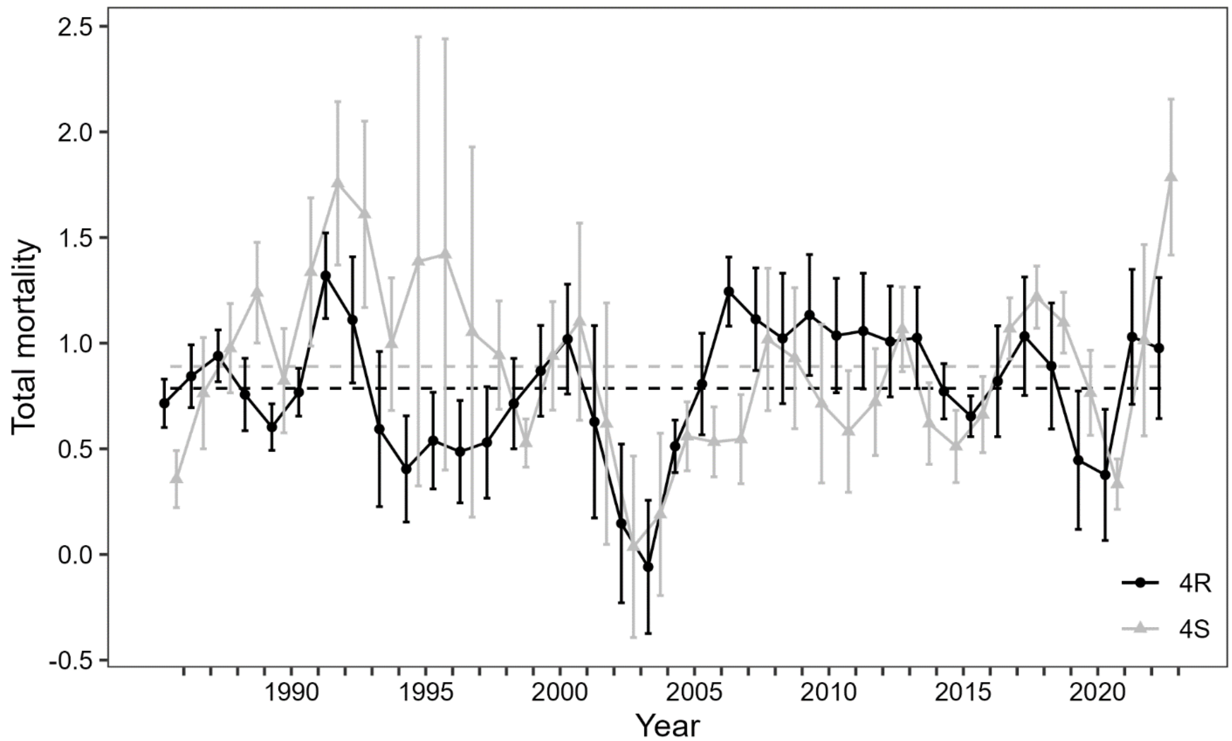

Figure 80. Estimates of total mortality by NAFO Division (Z, with 95% confidence intervals) for ages 5 to 10 from the DFO August survey for 1984-2024 based on the reduced series of strata (strata 801-824, 827-833). The dashed horizontal lines represent the average of each NAFO Division.

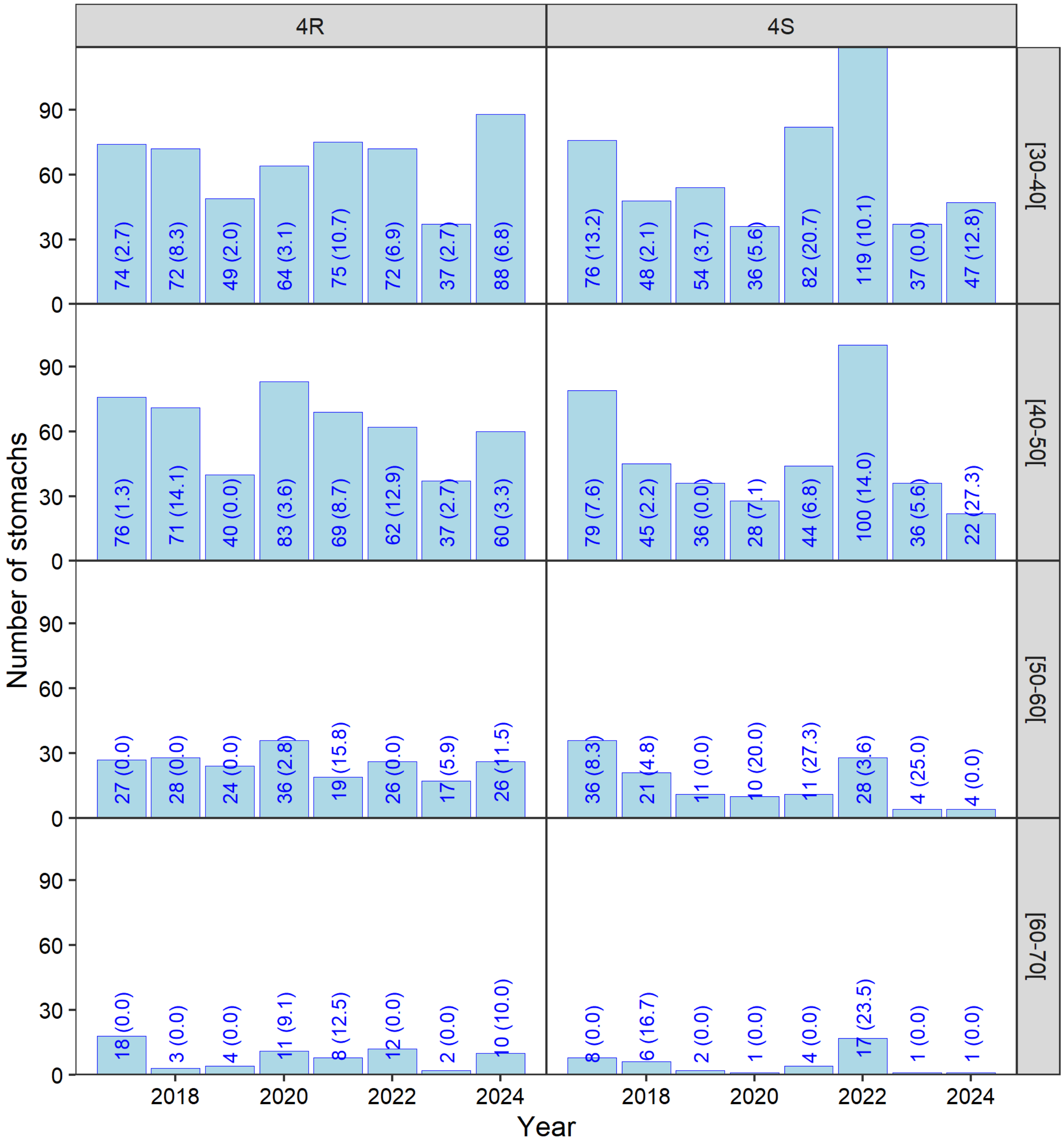

Figure 81. Number of cod stomachs collected in NAFO Divisions 4RS (columns) during the 2017-2024 DFO August surveys, by length class (rows, cm) and year (x-axis). The number of stomachs is provided with the percentage of empty stomachs in parentheses.

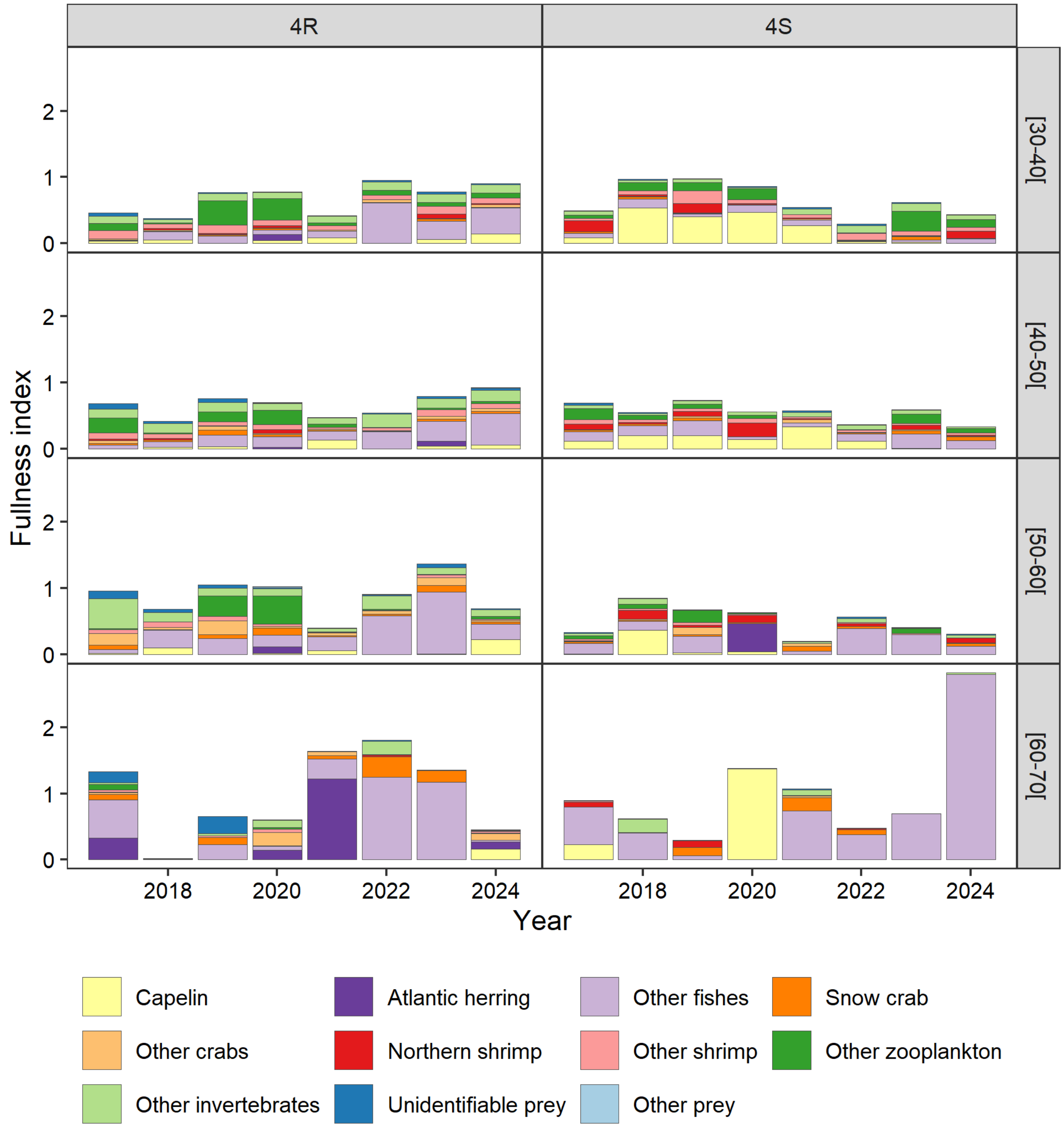

Figure 82. Cod stomach fullness index by NAFO Division (columns), length class (rows, cm), year (vertical bars) and prey group (colour) during the 2017-2024 DFO August surveys.

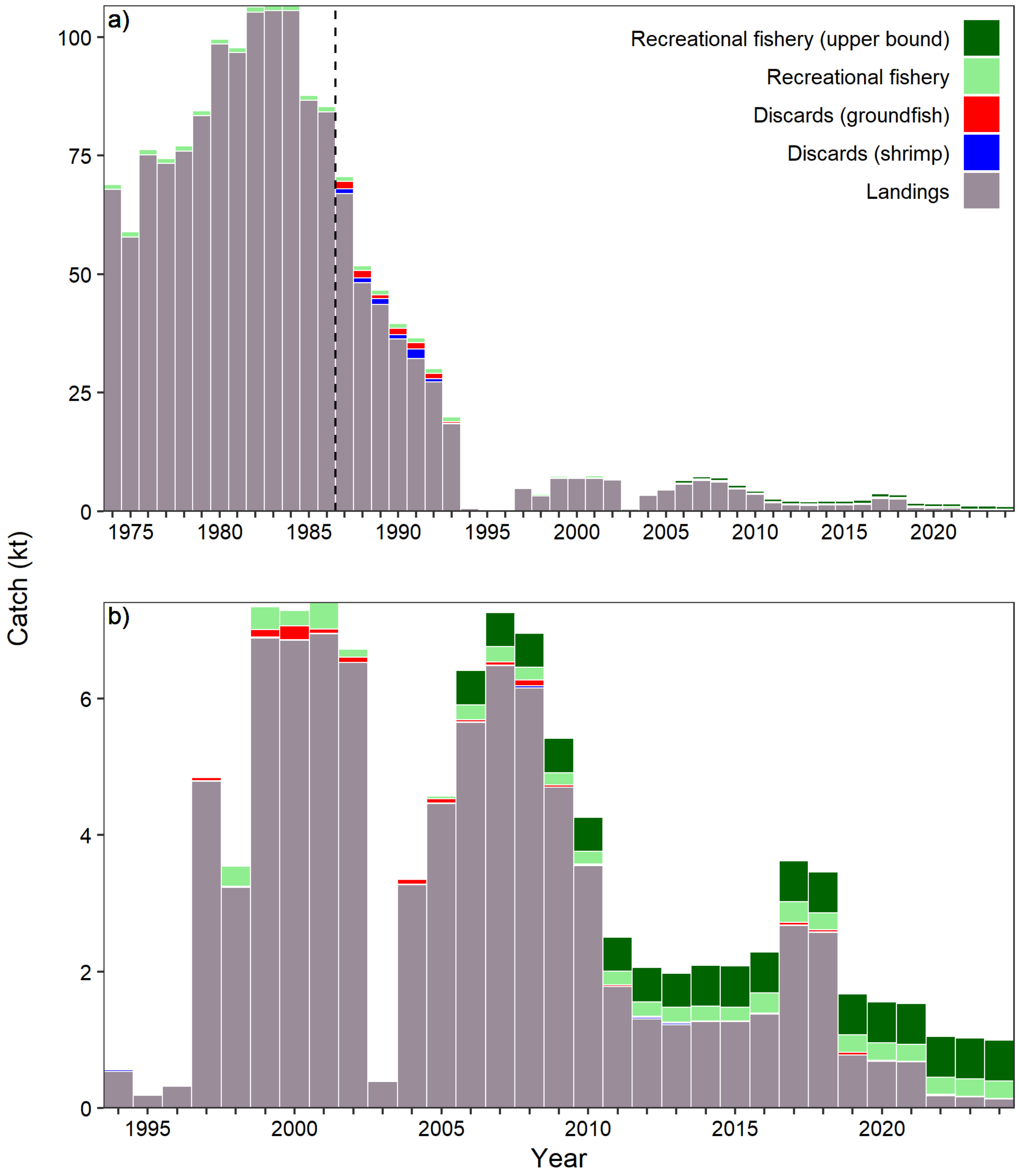

Figure 83. Estimates of annual cod removals in NAFO Divisions 3Pn4RS fisheries from reported landings, estimated discards in shrimp and groundfish fisheries (assuming no post-release survival) and from the recreational fishery. Discard estimates are available from 1987, indicated by the vertical dotted line. Estimated recreational fishery catches added to landings are indicated in light green, while a censored range for recreational fishery catches as of 2006 is indicated in dark green. The figure in b) emphasizes the 1994–2024 period.

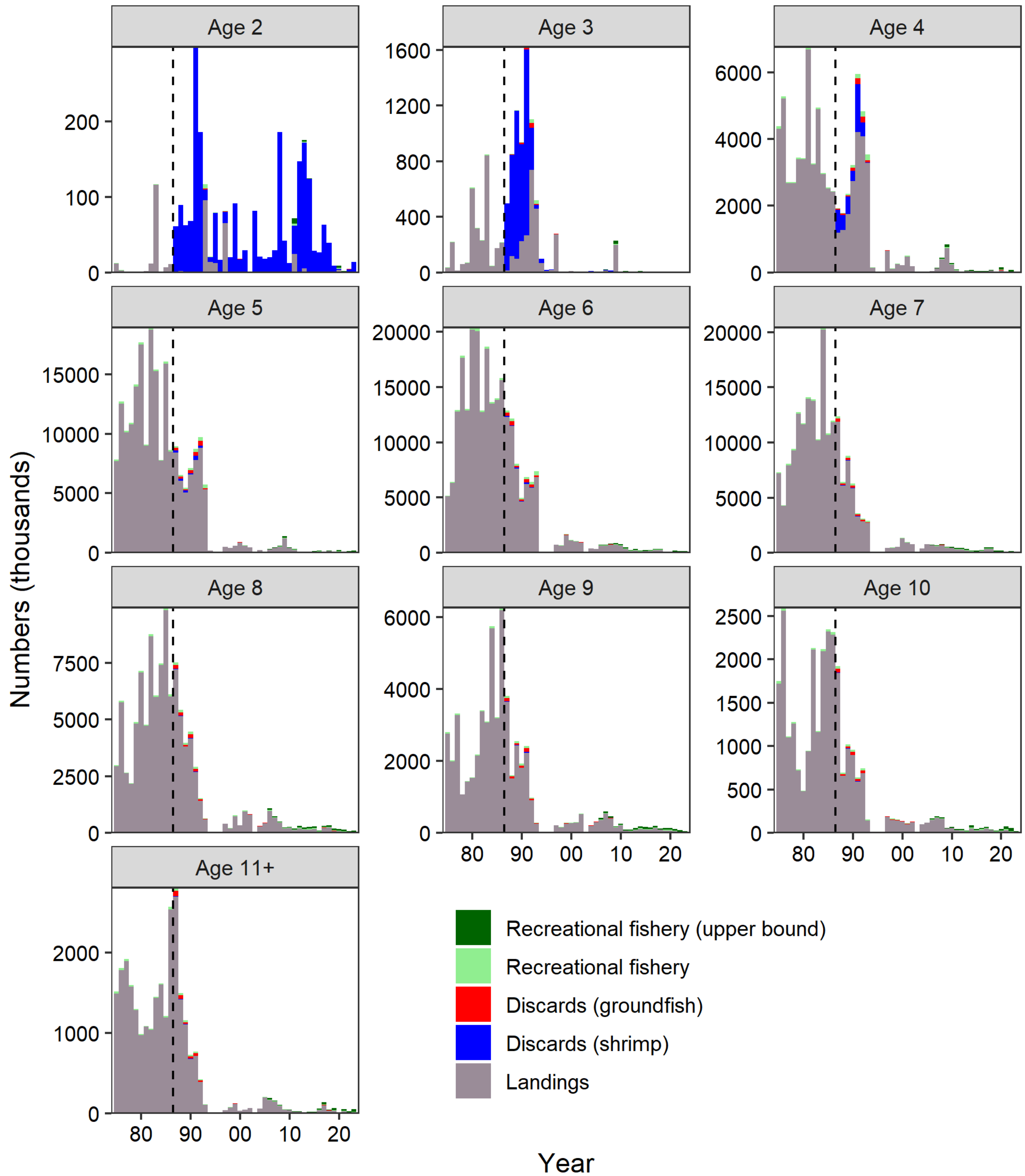

Figure 84. Age-specific estimates of annual cod removals in NAFO Divisions 3Pn4RS fisheries from reported landings, estimated discards in shrimp and groundfish fisheries (assuming no post-release survival), and from the recreational fishery, 1974–2024. Discard estimates are available from 1987, indicated by the vertical hatched line. Estimated recreational fishery catches are indicated in light green, while a censored range for recreational fishery catches as of 2006 is indicated in dark green.

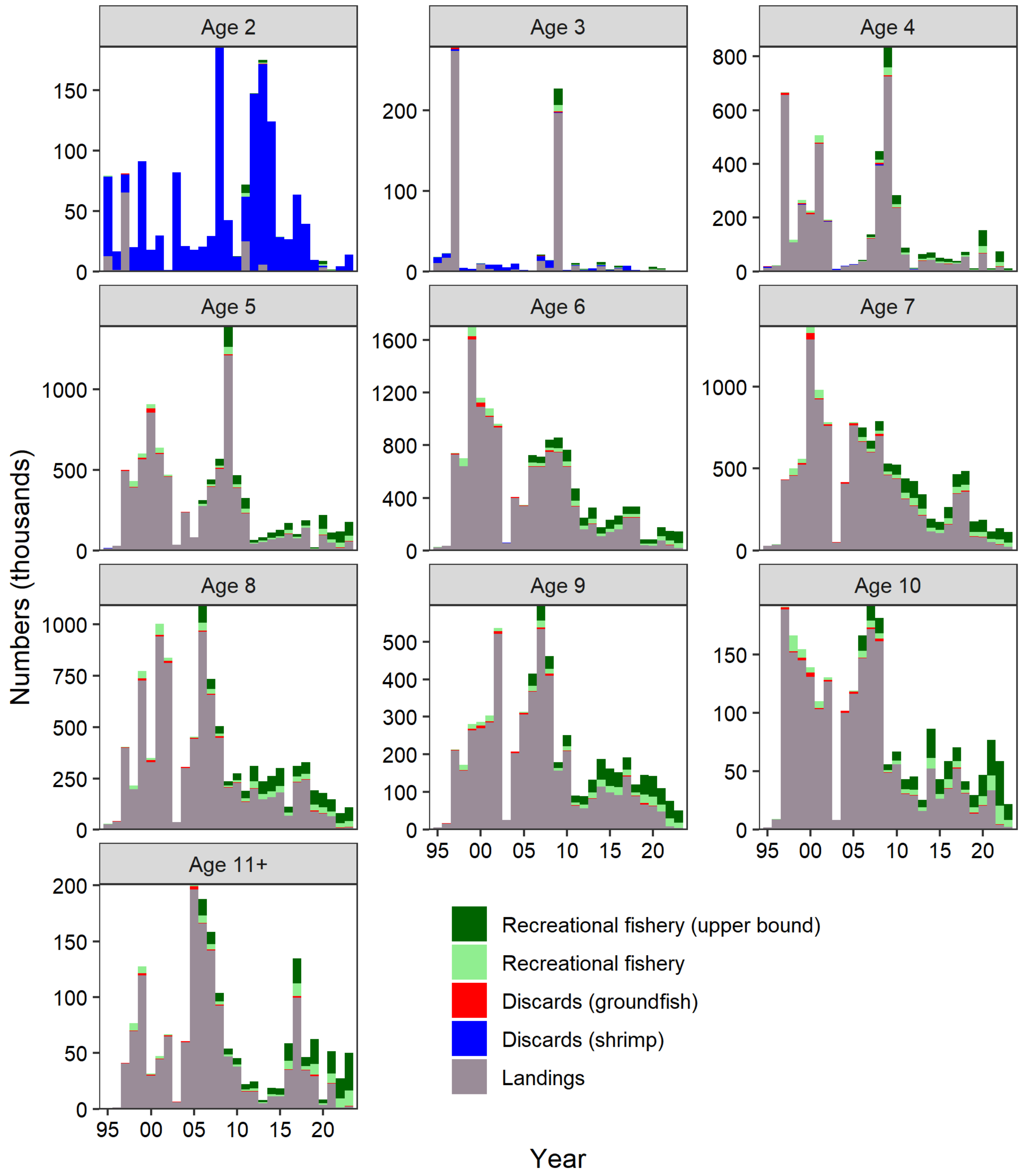

Figure 85. Same results and details as for the precedent figure, but for the 1994-2024 period.

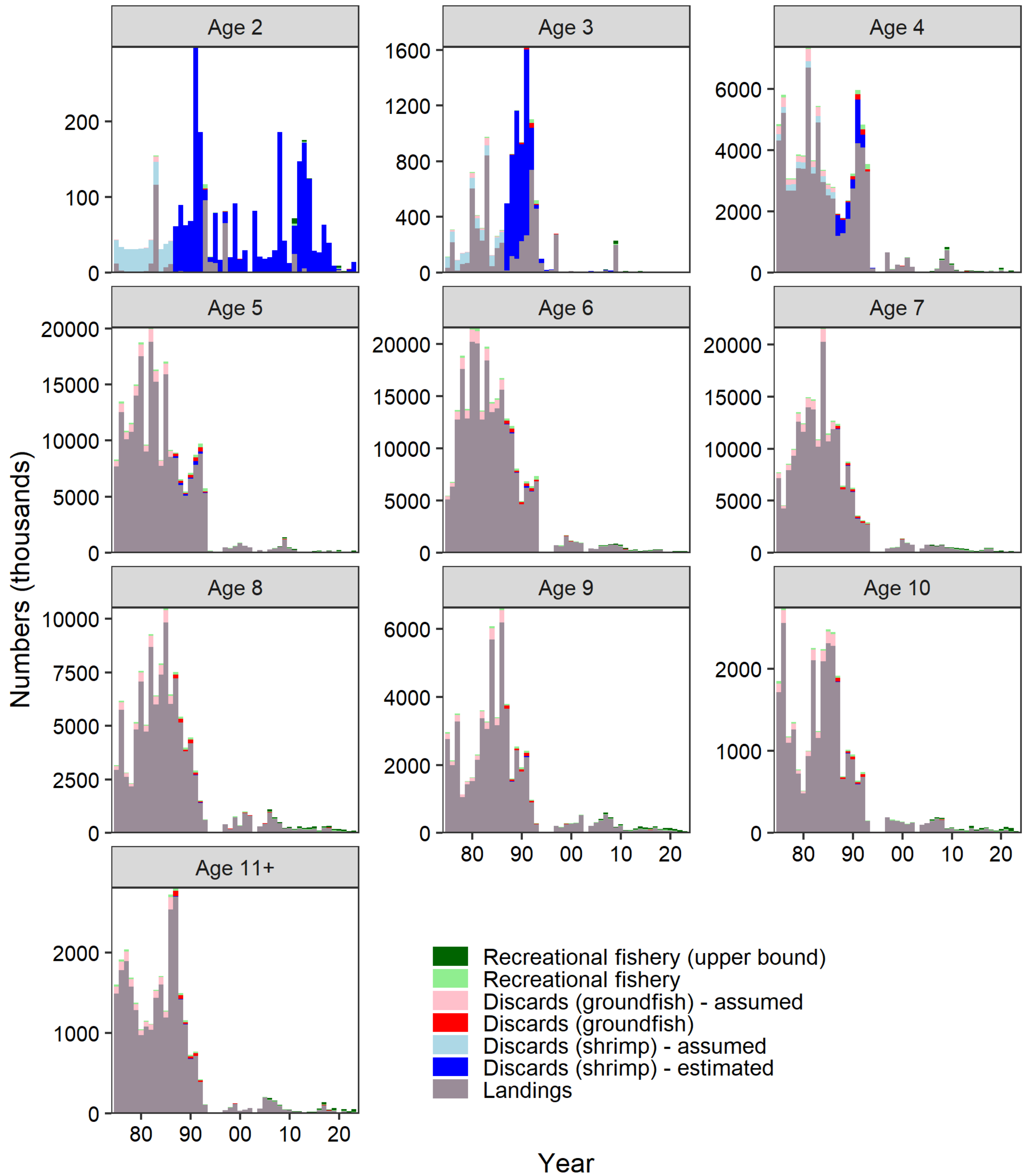

Figure 86. Age-specific estimates of annual cod removals in NAFO Divisions 3Pn4RS fisheries from reported landings, estimated and assumed discards in shrimp and groundfish fisheries (assuming no post-release survival) and estimated catch from the recreational fishery, 1974–2024.

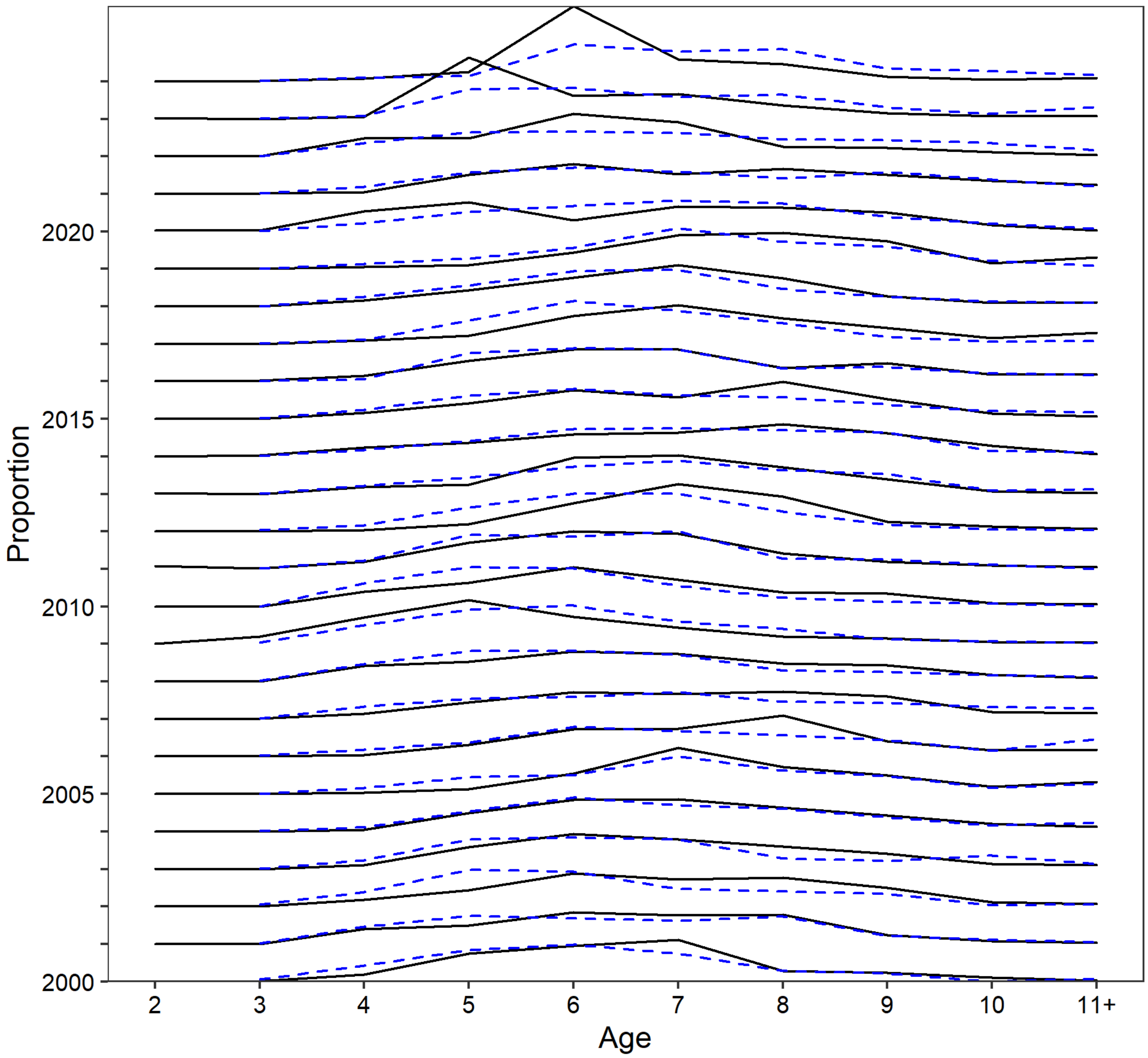

Figure 87. Catch-at-age composition (in proportion) of the commercial fishery (black) and the sentinel longline survey (summer, blue) for the period 2000–2024.

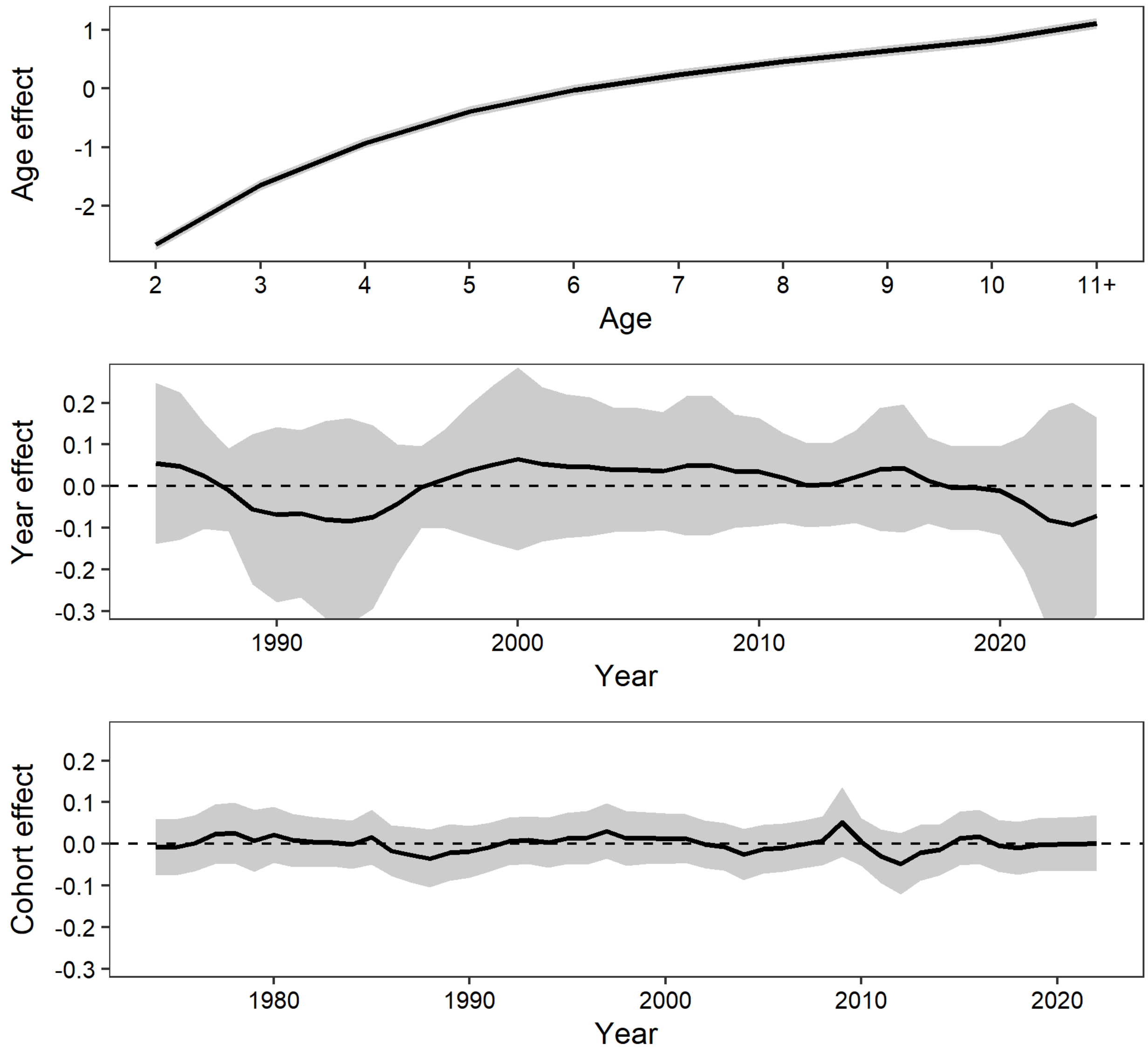

Figure 88. Estimates of the main effects in the weight-at-age model. Shaded regions indicate 95% confidence intervals.

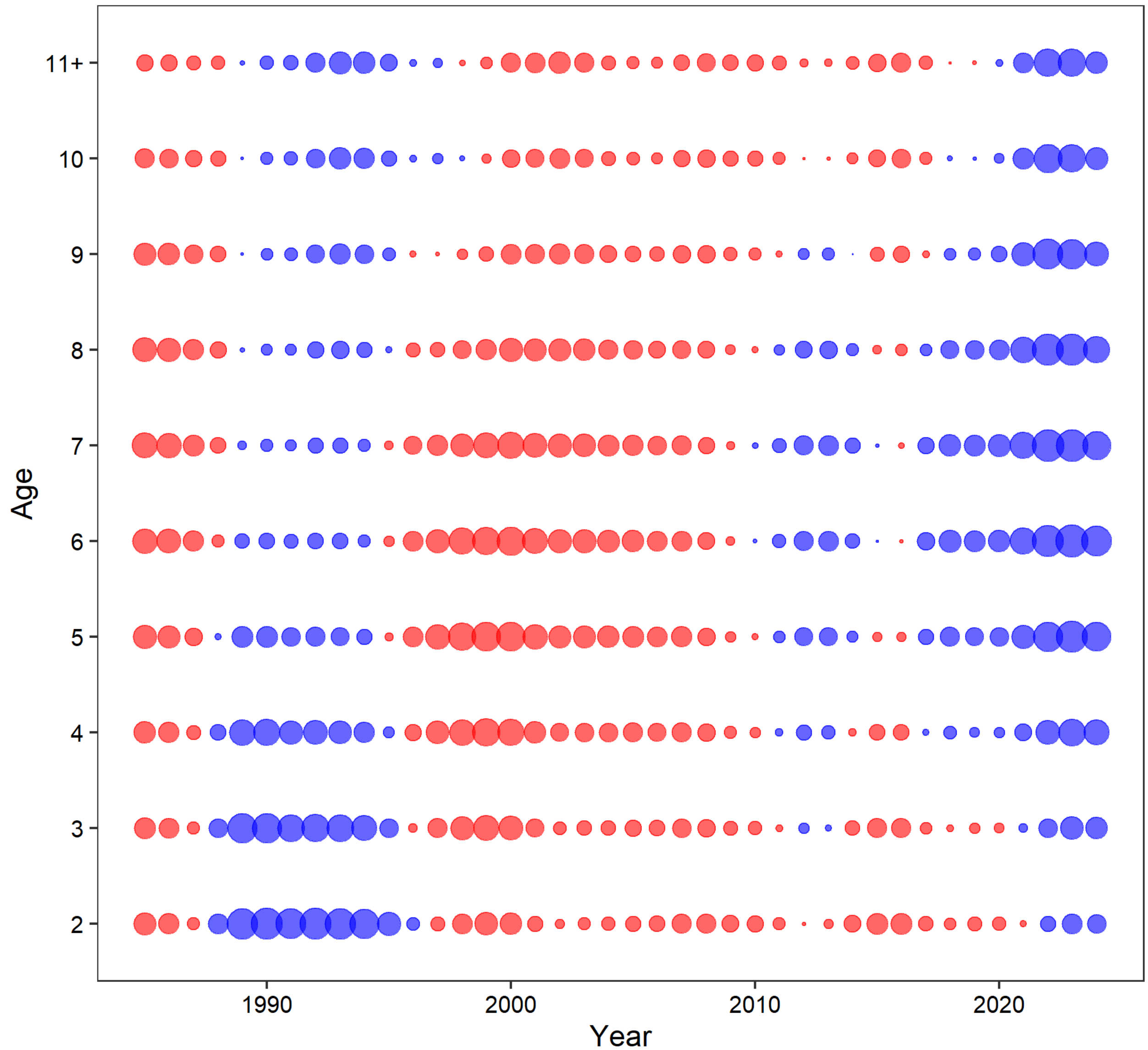

Figure 89. Estimates of the year-age interactions effects in the weight-at-age model. The surface area of the circles is proportional to the absolute value of the effect, and the colour indicates the sign (red +, blue -).

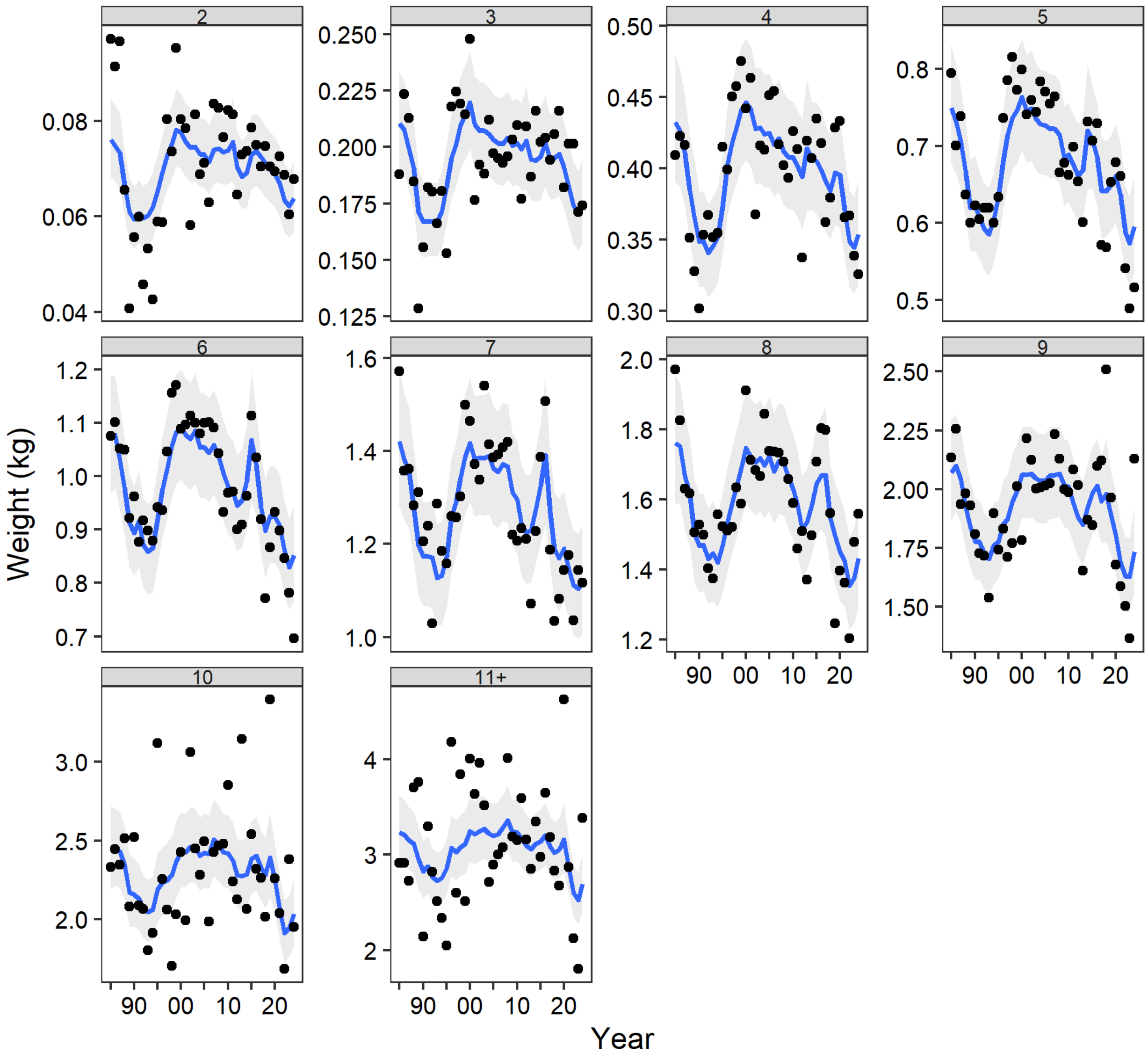

Figure 90. Time-series of observed (points) and average stock weights-at-age (lines) predicted by the weight-at-age model. Each panel is for an age class. Shaded regions indicate 95% confidence intervals.

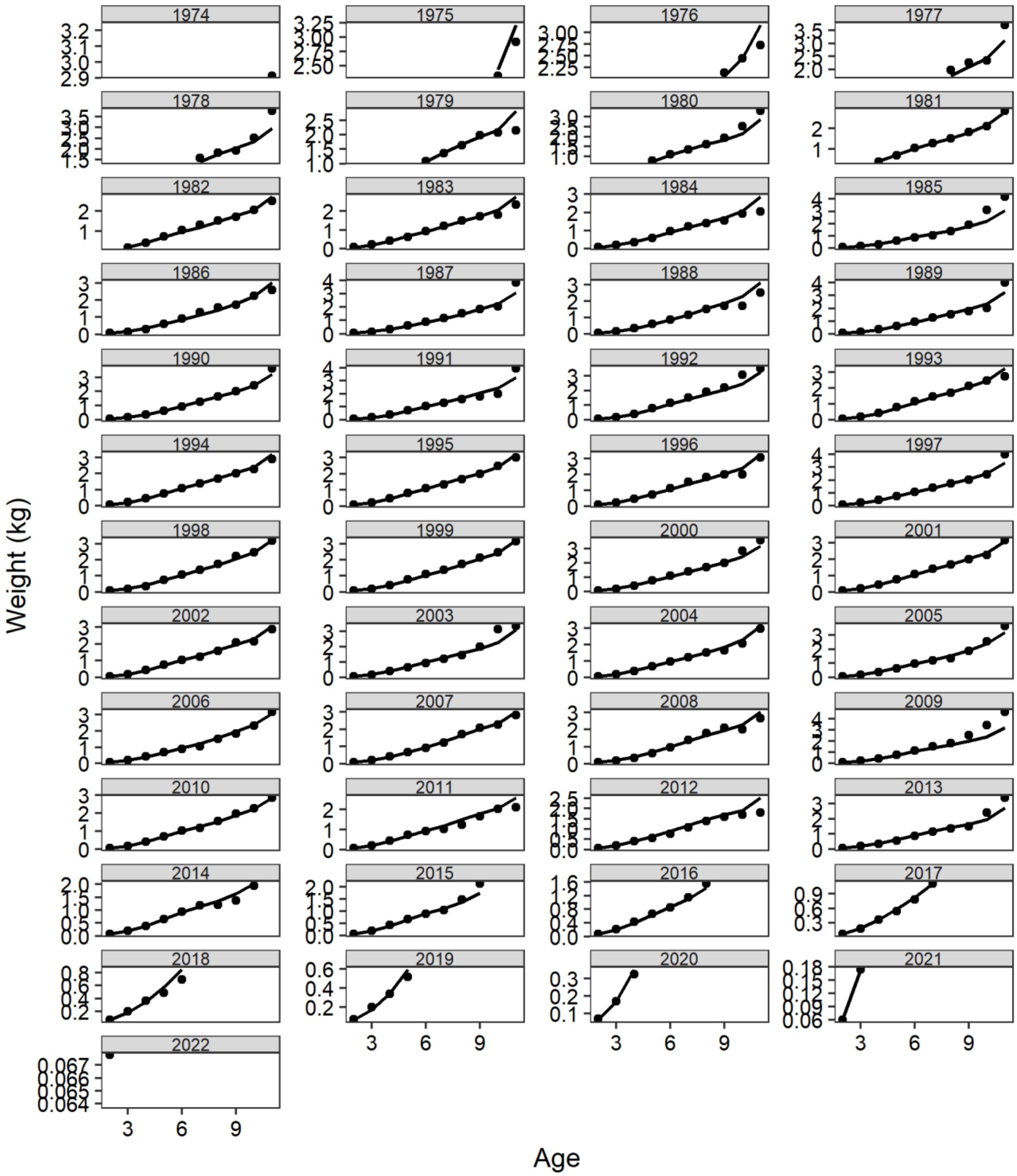

Figure 91. Observed (points) and average stock weights-at-age predicted by the weight-at-age model (lines). Each panel is for a cohort.

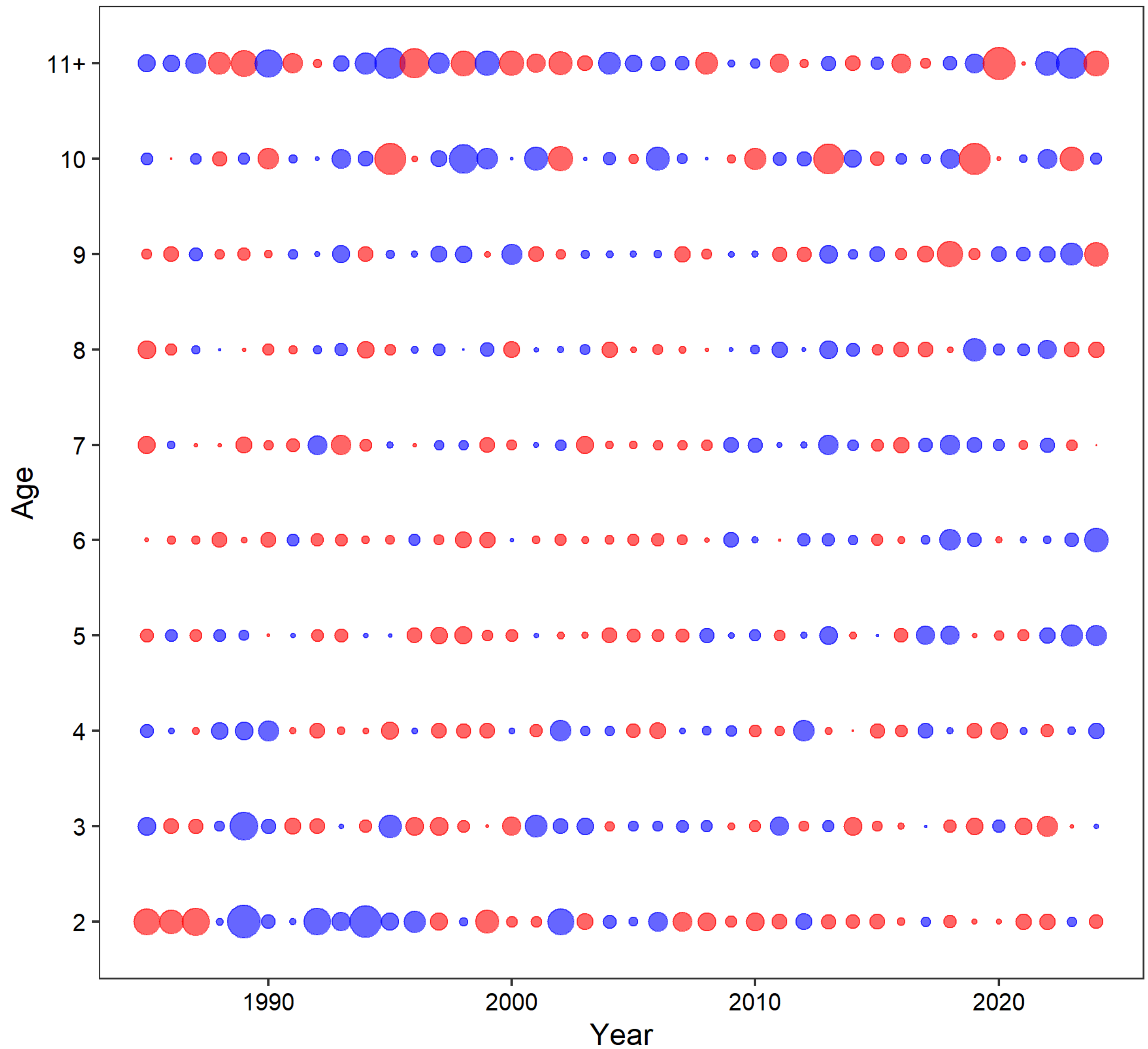

Figure 92. Weight-at-age model standardized residuals. The area of the circles indicates the relative value of the residual and the colour indicates the sign (red +; blue -).

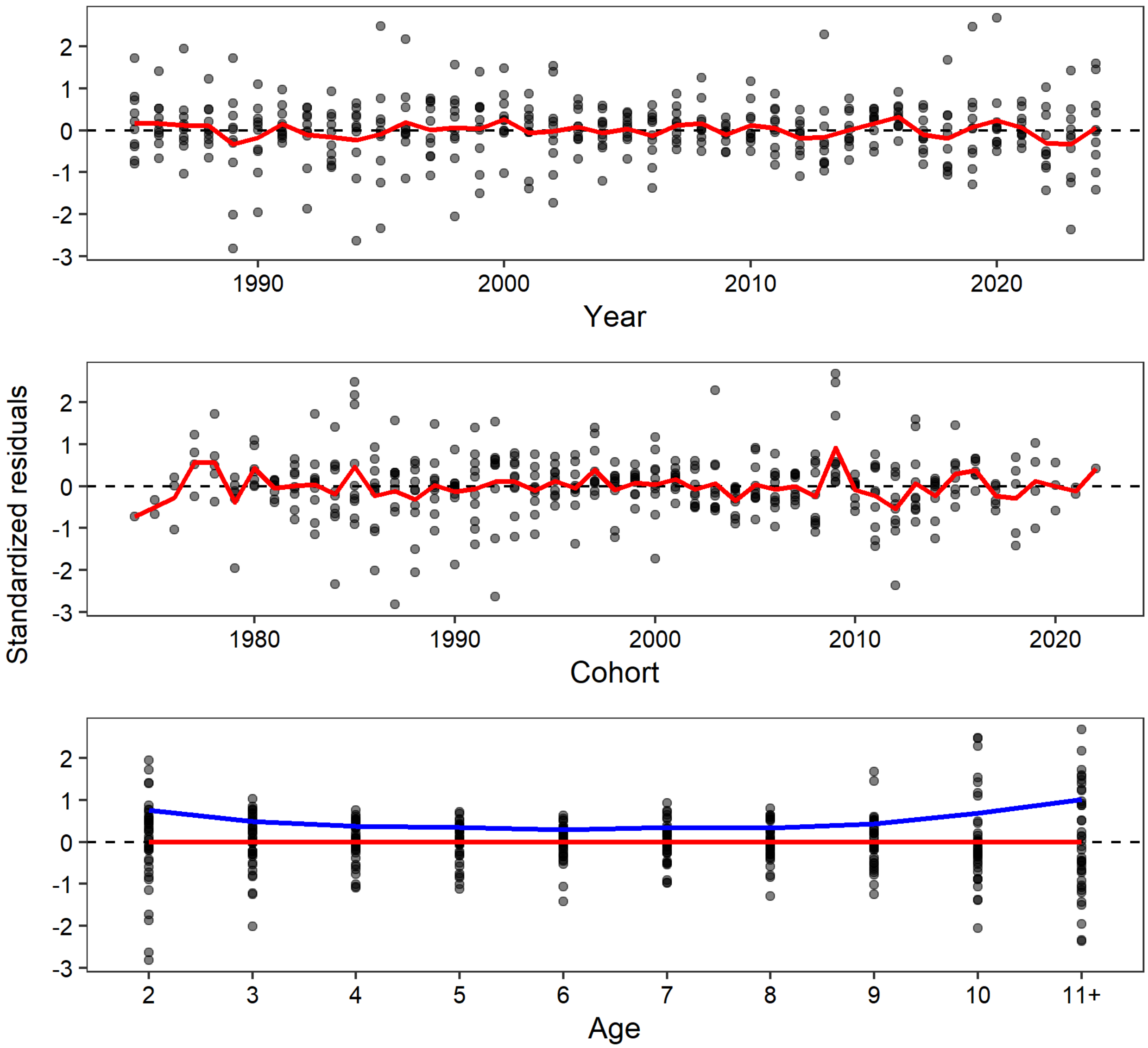

Figure 93. Standardized residuals versus year (top), cohort (middle), and age (bottom) of the weight-at-age model. Red lines indicate the average residual, and the blue line indicates the average absolute residual.

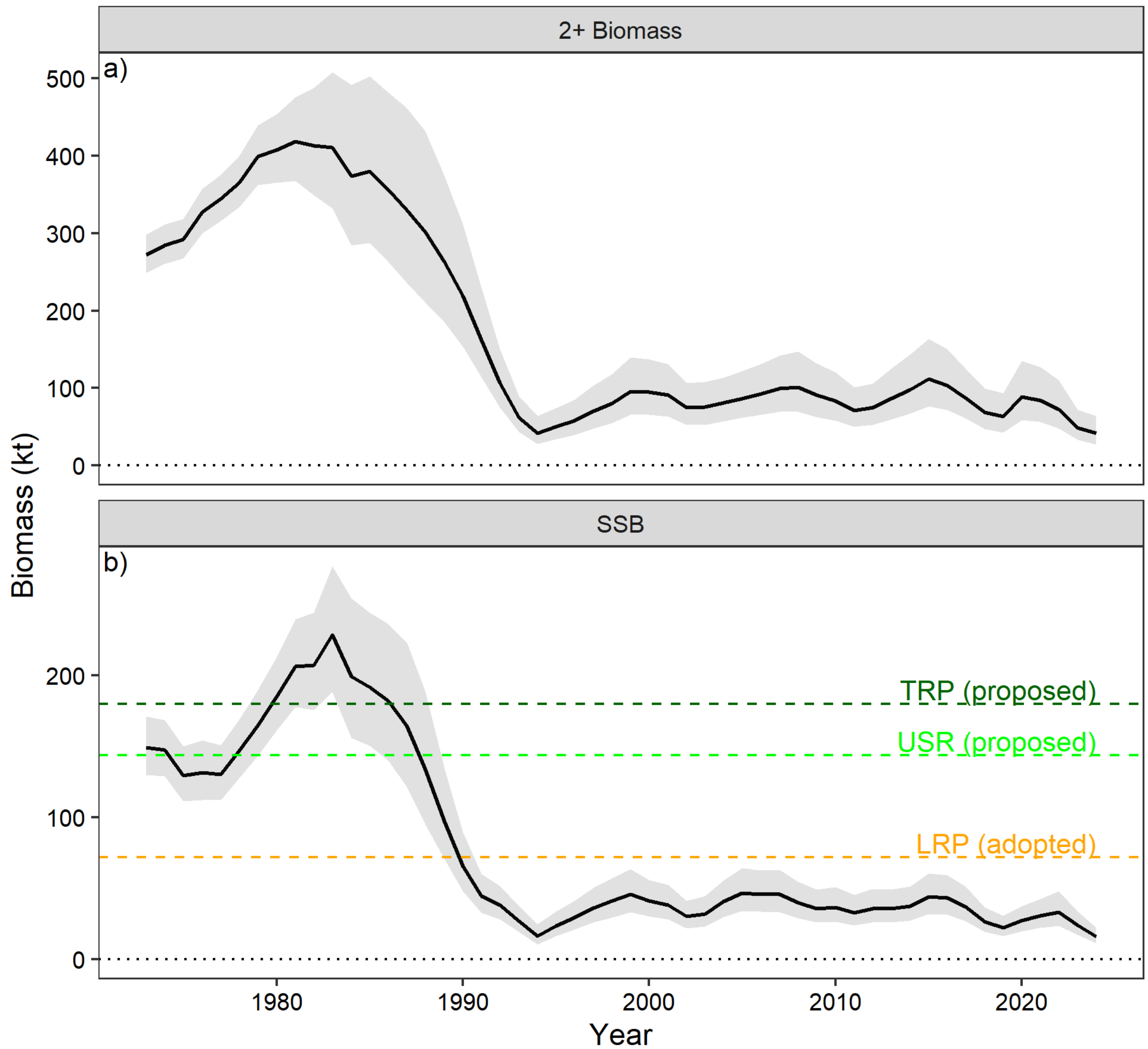

Figure 94. Model estimates of a) age 2+ biomass and b) spawning stock biomass (SSB), with 95% confidence interval (shaded region). In b), the proposed target (TRP, 179,924 t) and upper (USR, 143,939 t) reference points, and the adopted limit reference point (LRP, 71,970 t) are displayed.

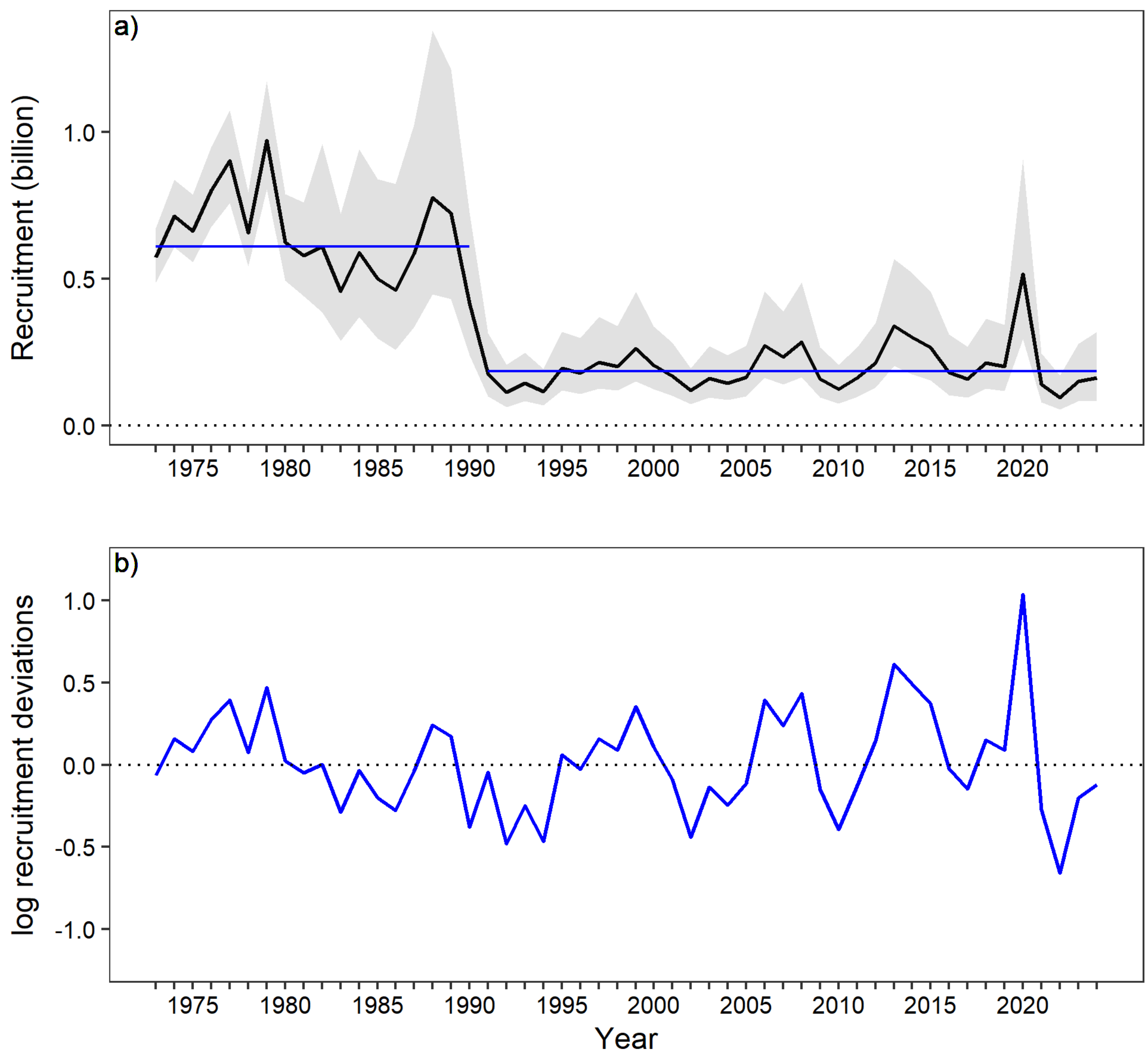

Figure 95. Model estimates of a) recruitment at age 2 with 95% confidence interval (shaded region), along with the model estimated mean recruitment for years ≤1990 and >1990 (blue lines). The model estimated recruitment deviations are shown in b).

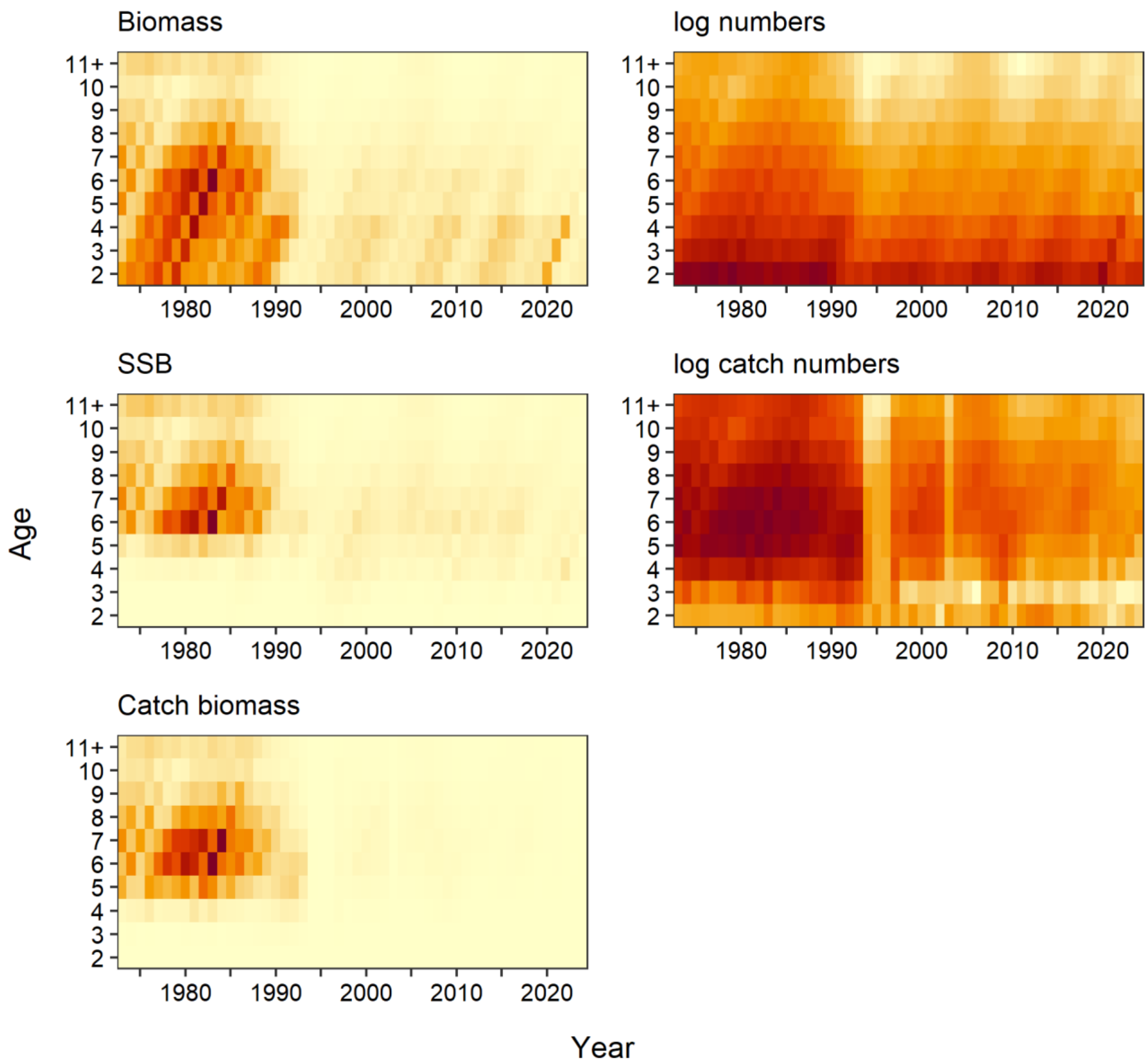

Figure 96. Model estimates of age-based quantities (panels). Darker colours indicate higher estimates. Catches are model predicted, not the input catch.

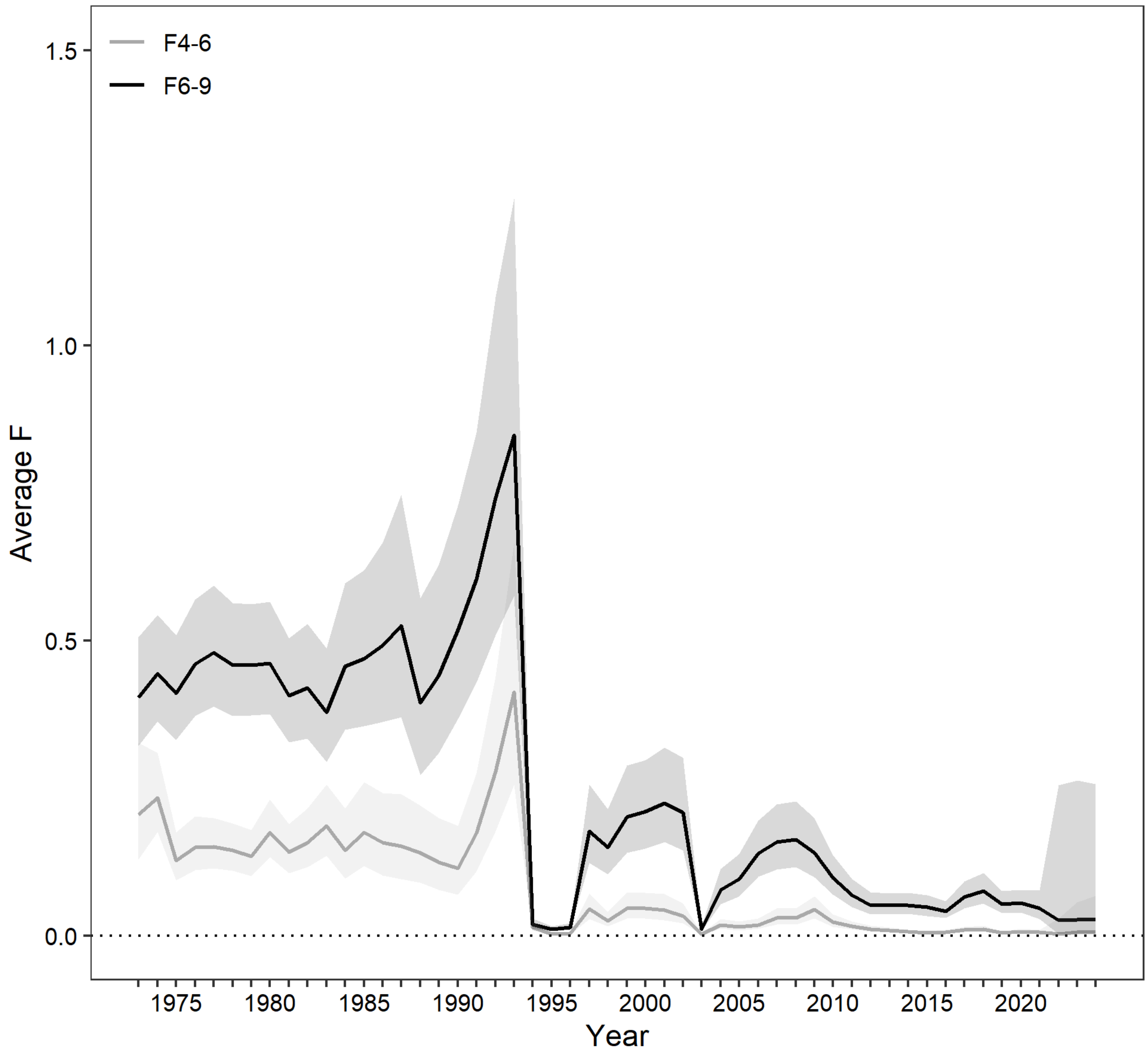

Figure 97. Model estimates of average fishing mortality F at ages 4-6 and 6-9, with 95% confidence interval (shaded region).

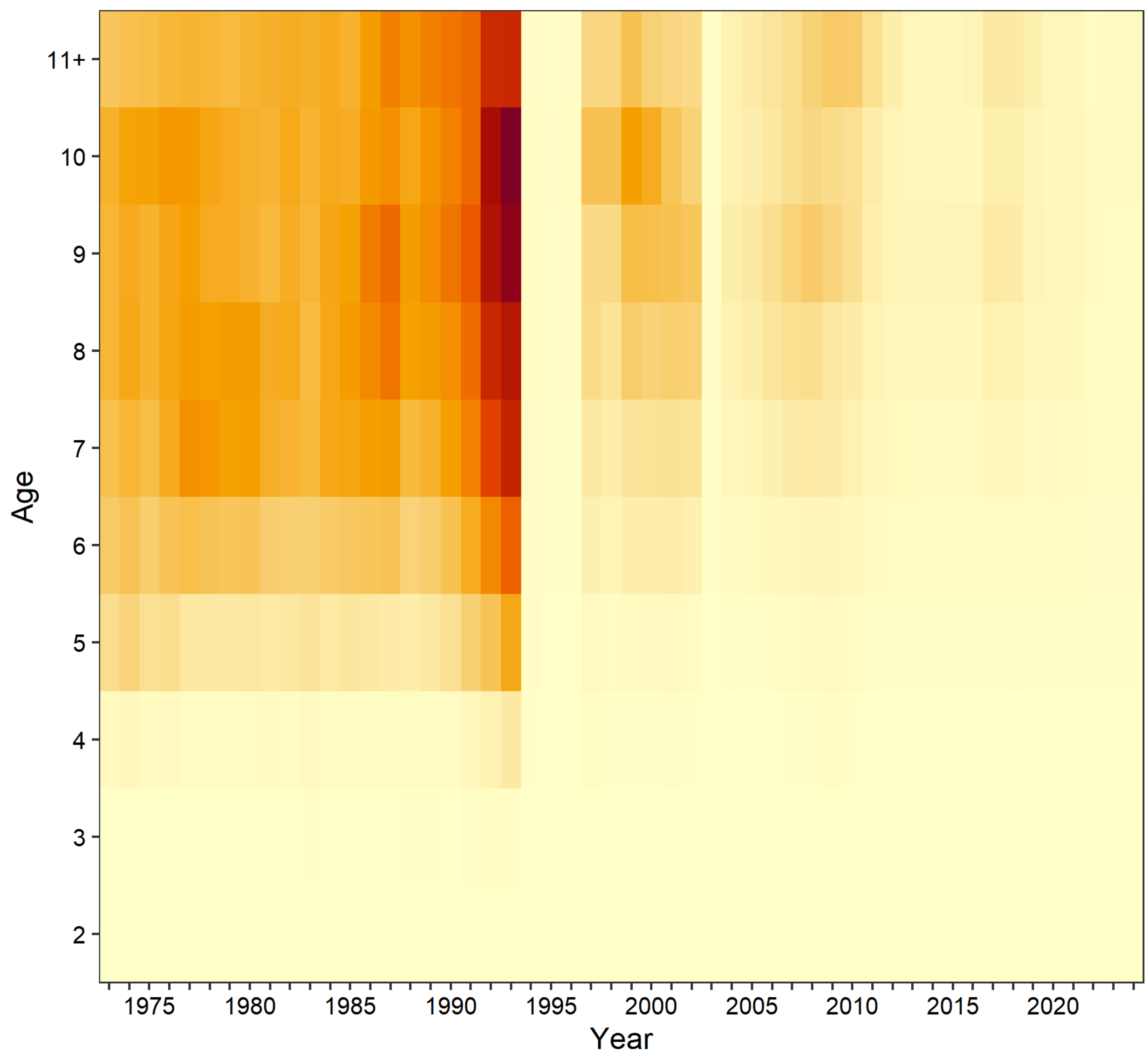

Figure 98. Illustration of model estimates of fishing mortality at age, where darker colours indicate higher values.

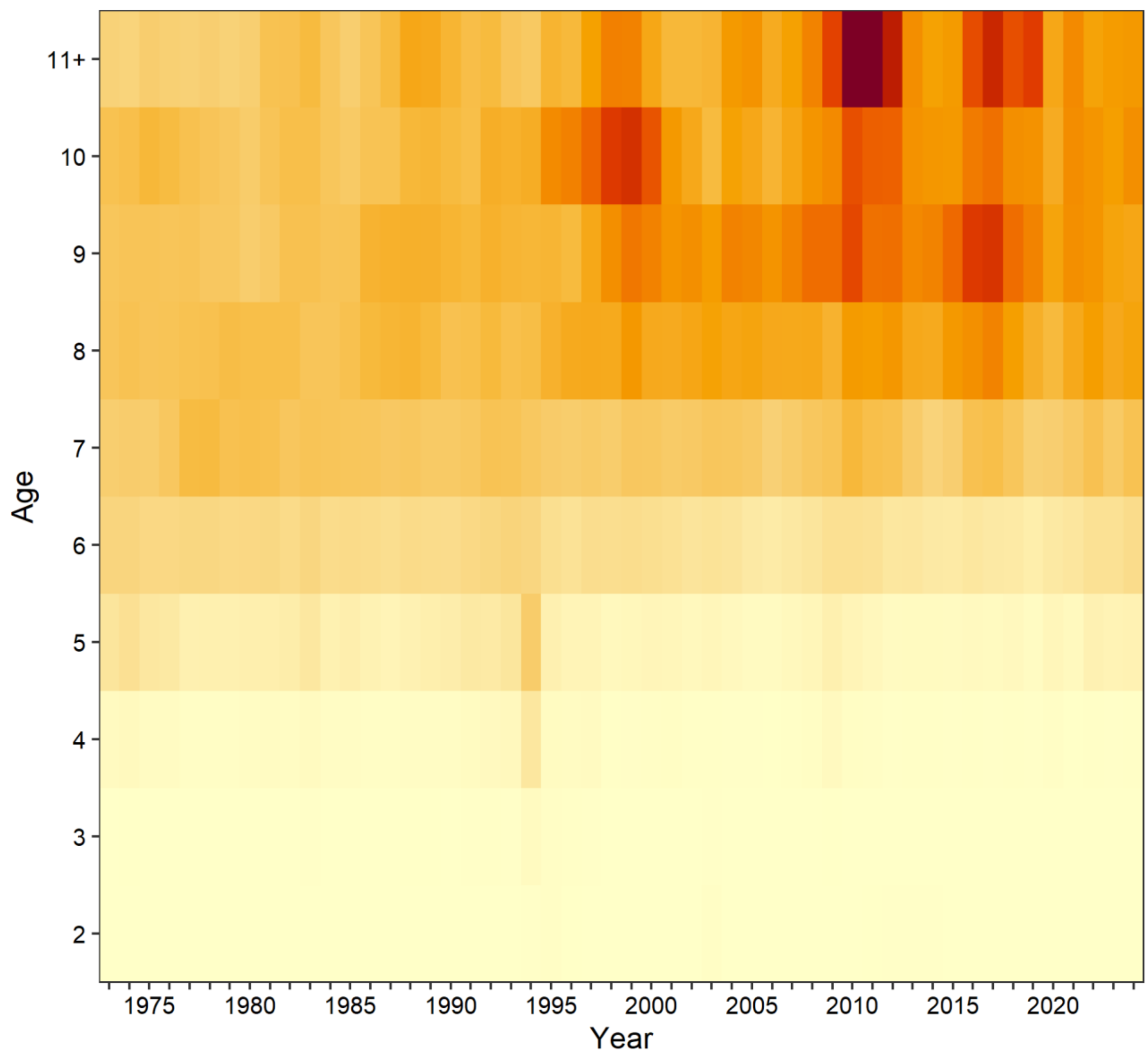

Figure 99. Fishery selectivity, calculated as age-specific F divided by the average F for ages 6-9. Darker colours indicate higher values.

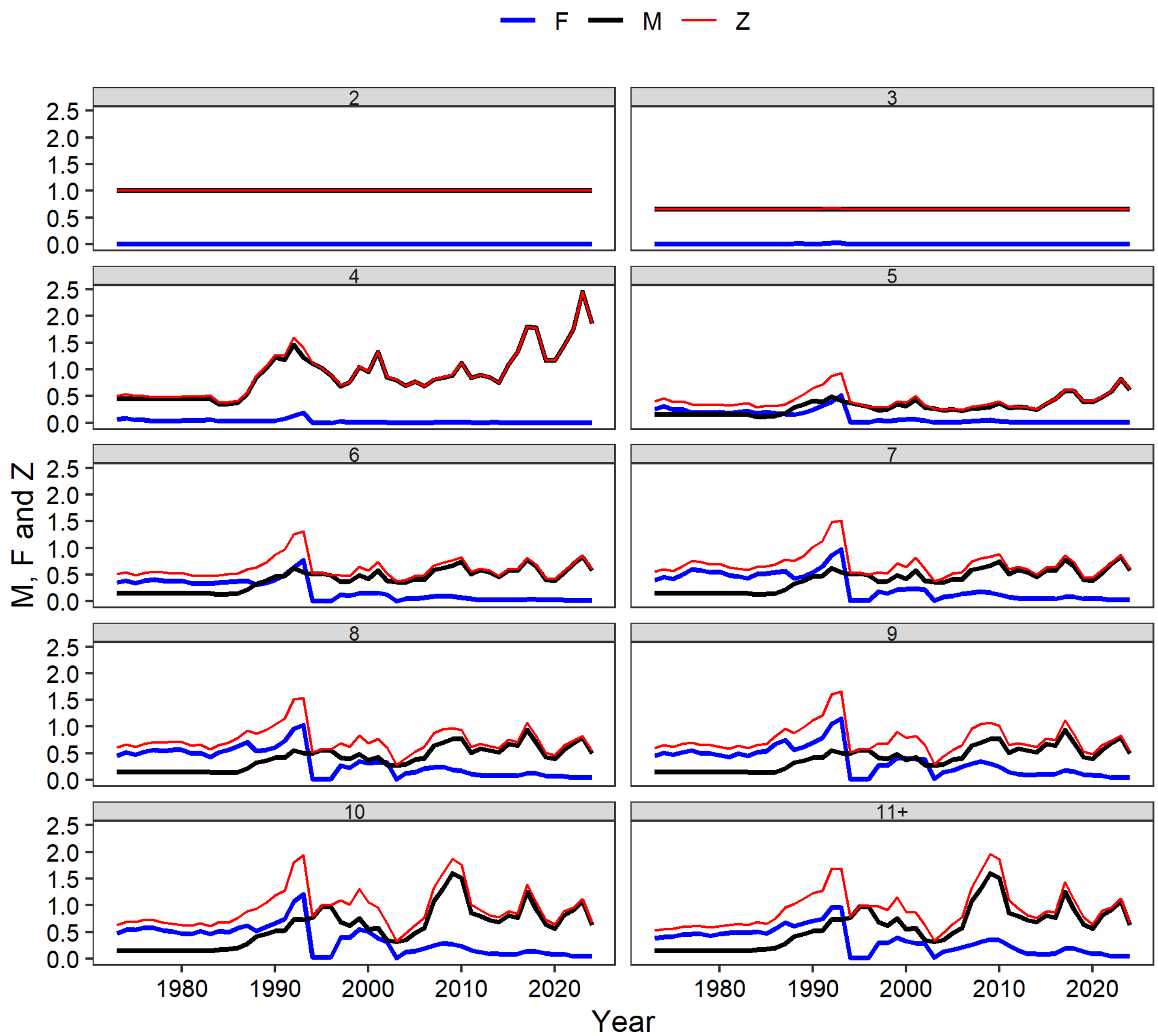

Figure 100. Estimates of age-specific (panels) fishing mortality (F), natural mortality (M) and total mortality (Z = M + F).

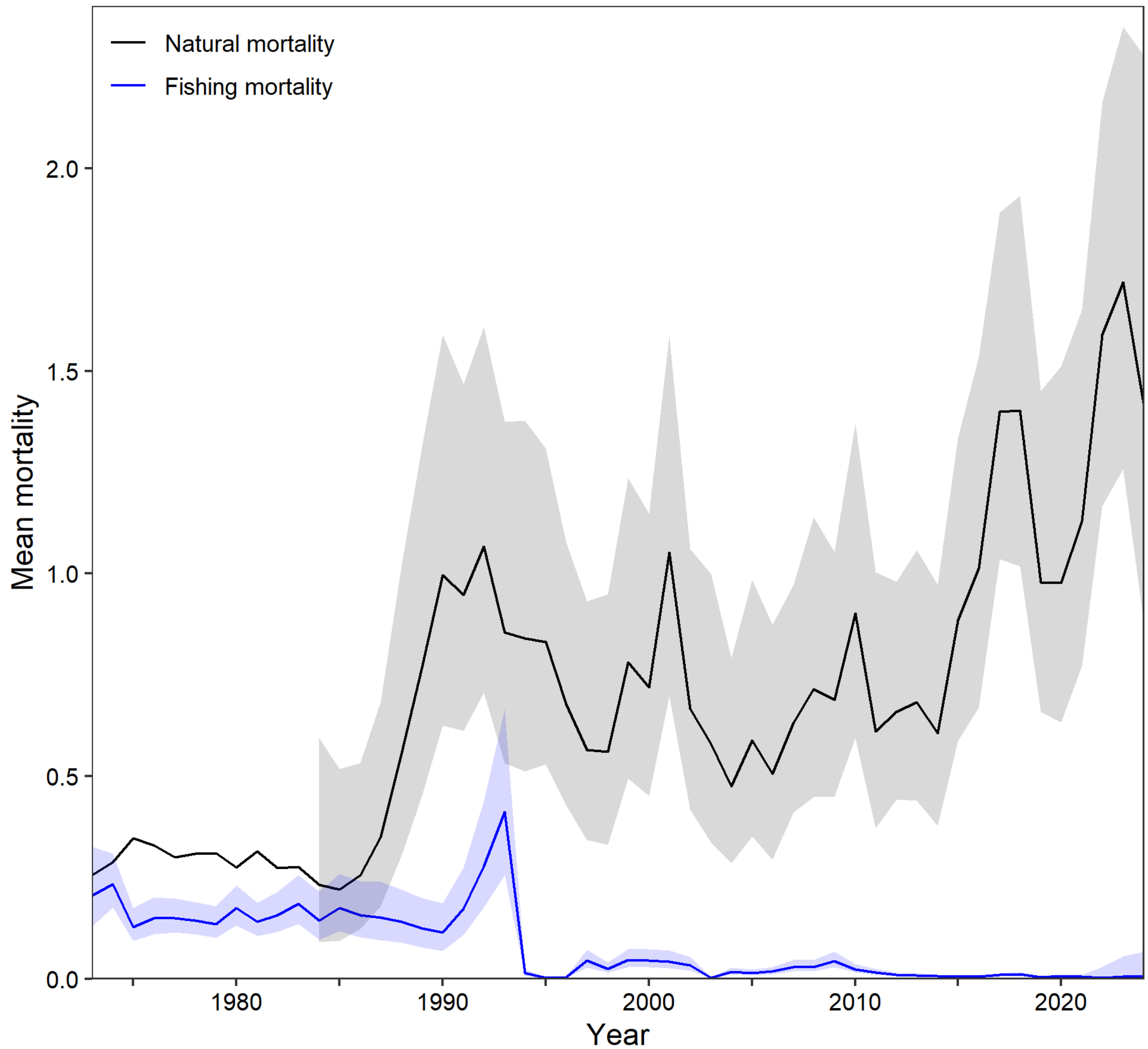

Figure 101. Estimated mean natural mortality (M) and fishing mortality (F) at ages 4-6 with 95% CI. Age-specific M values prior to 1984 are assumed fixed in the assessment and interannual variability for 1973-1983 in the figure only reflects variation in abundance at age used to calculate the mean values.

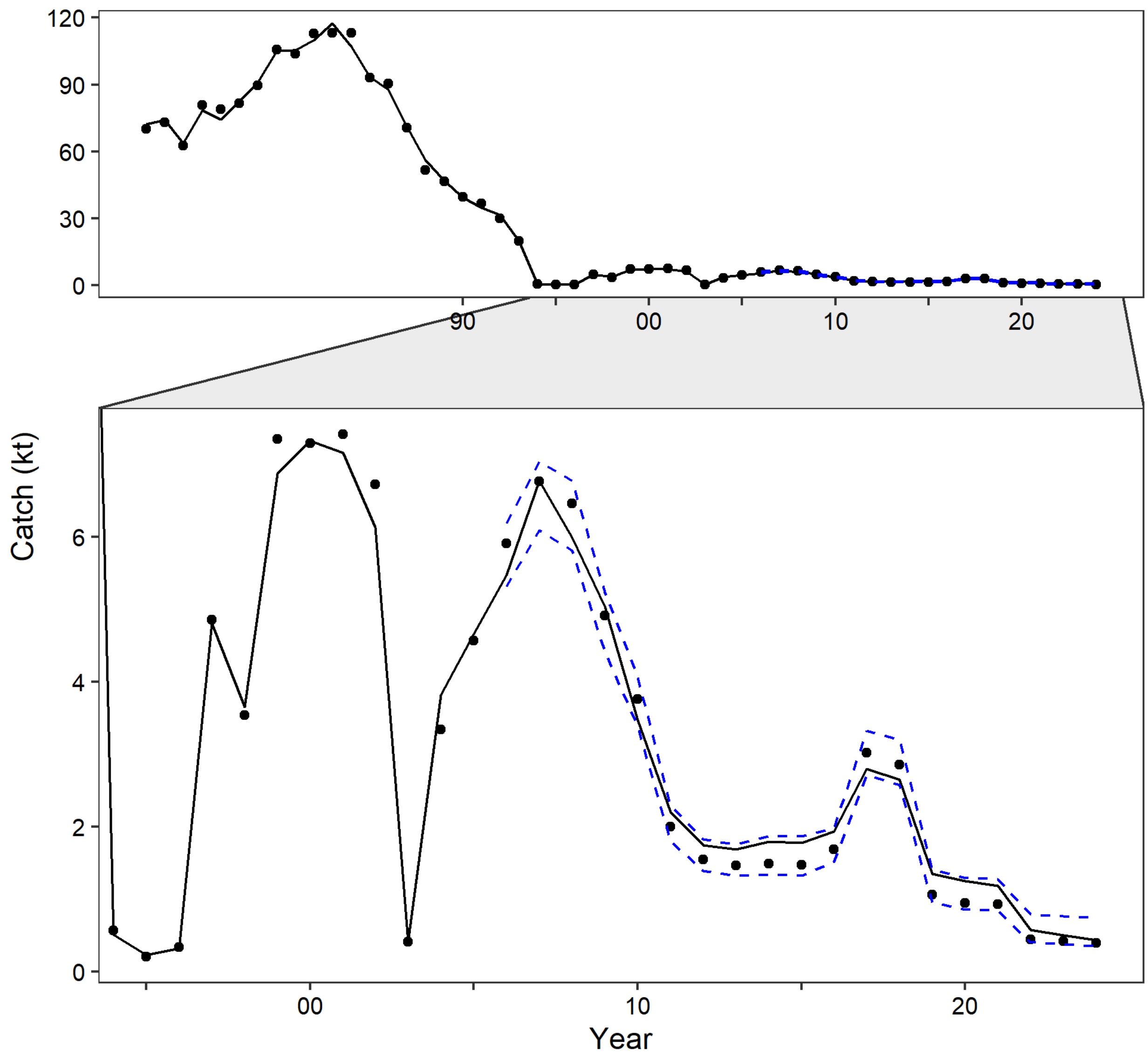

Figure 102. Model predicted catch (black line), compared to input catch (points) and the catch bounds assumed for 2006-2024 (dashed blue lines). The bottom panel shows a close-up for 1995-2024.

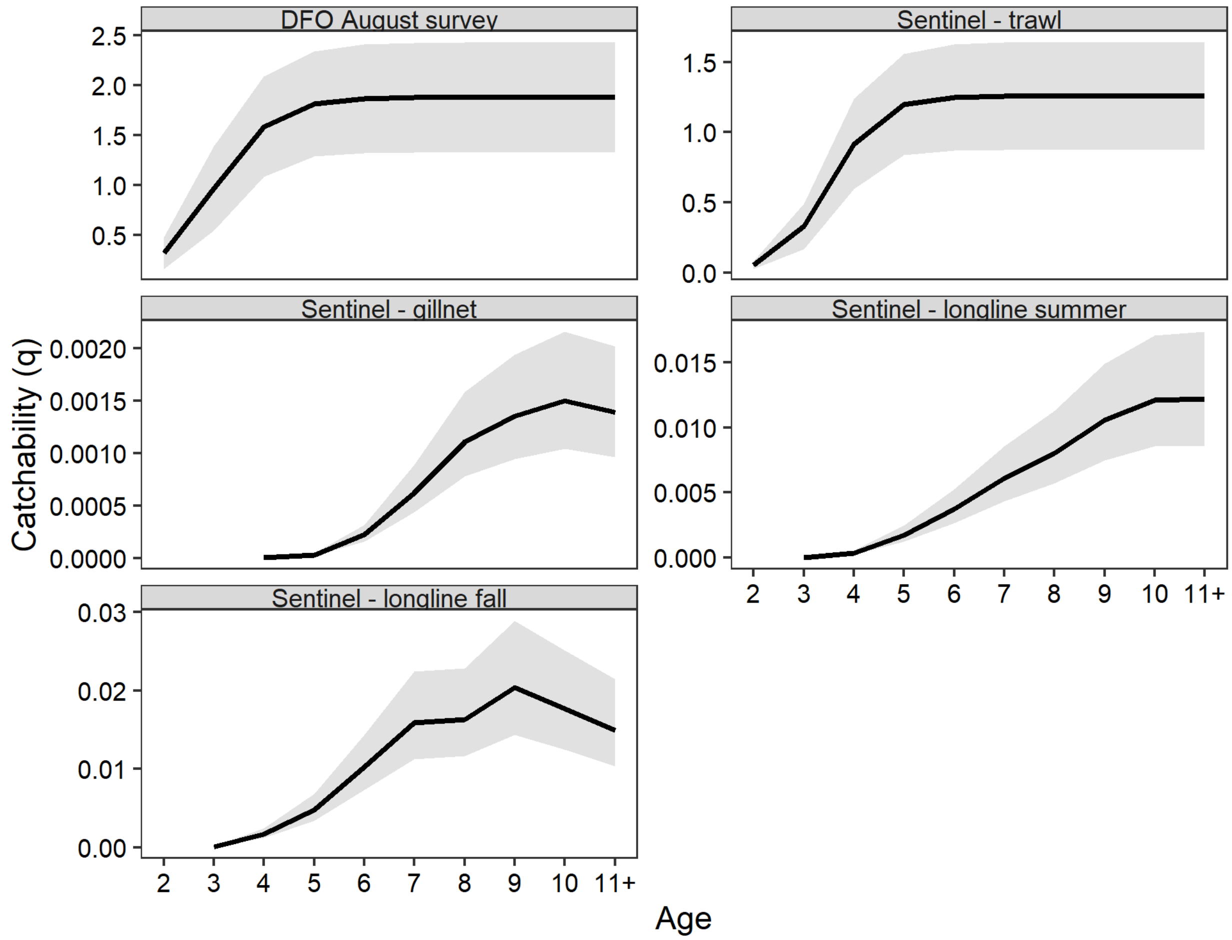

Figure 103. Estimated age-specific catchability to the five main surveys, with 95% confidence intervals (shaded region).

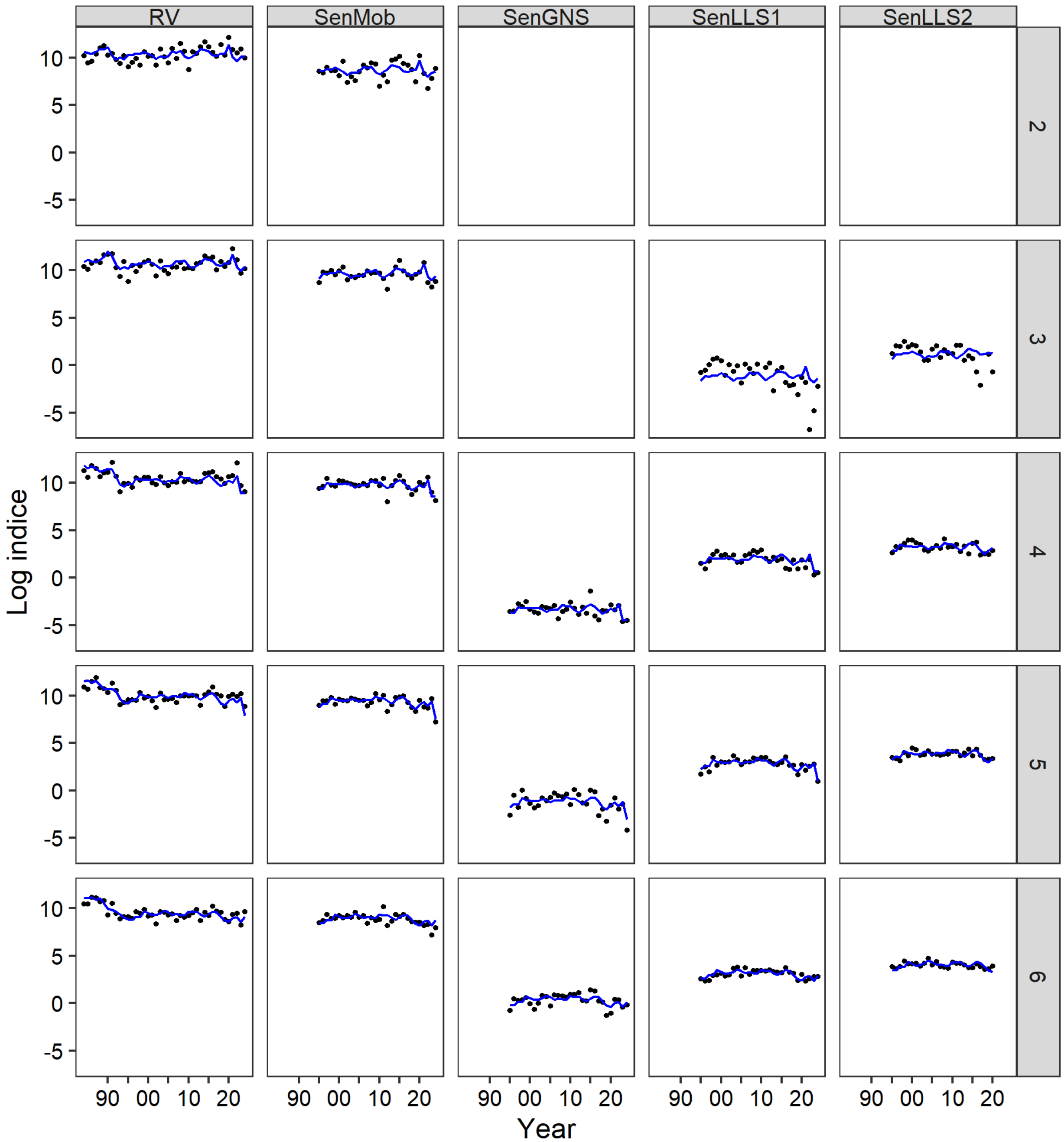

Figure 104. Model fits to the log indices at age (rows) for each of the five major survey indices (columns). Points represent the observations and the line the model fit. Panels are empty when an age is not included in the model for a particular survey. RV indicates the DFO August research vessel survey.

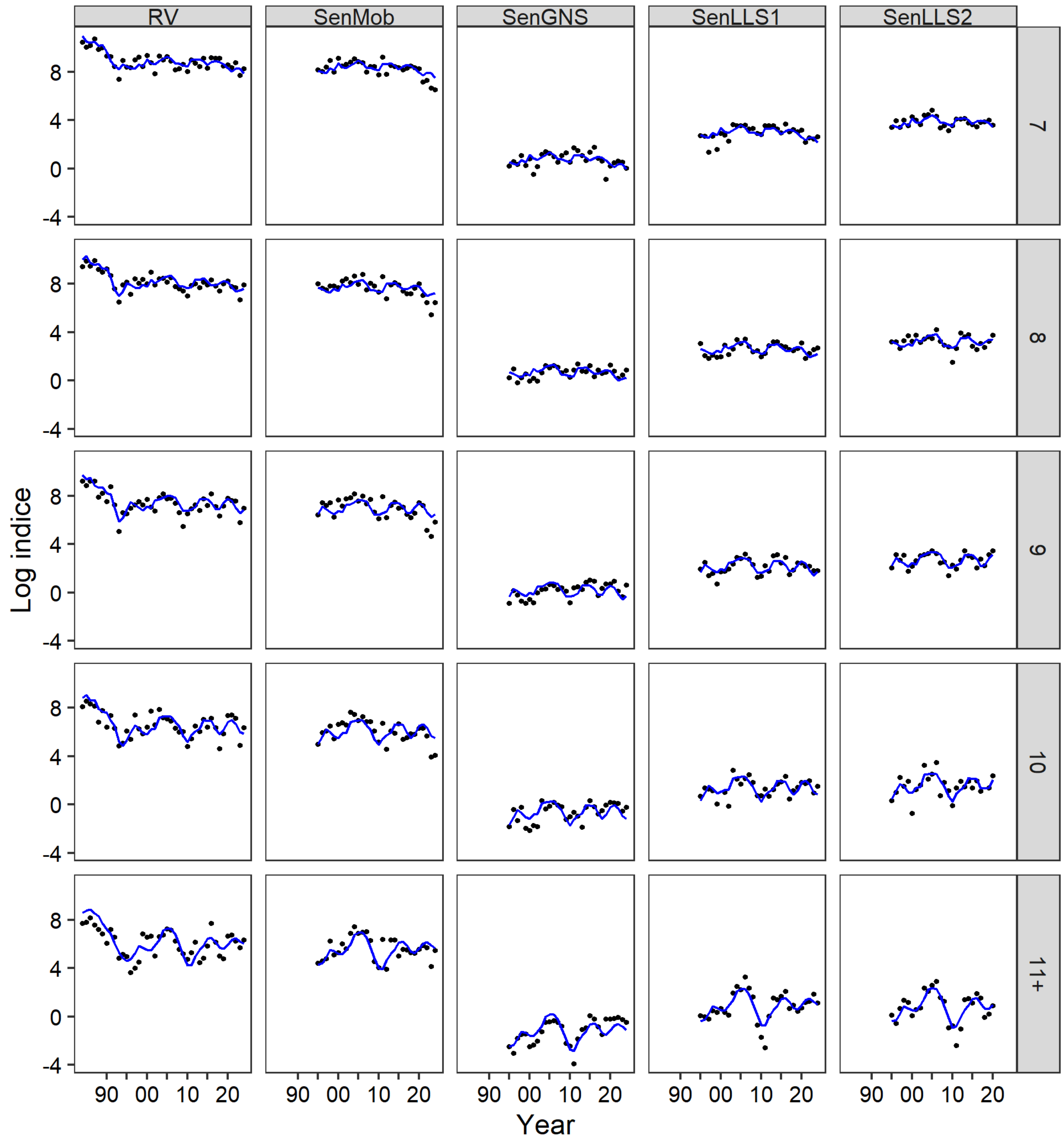

Figure 104. Continued.

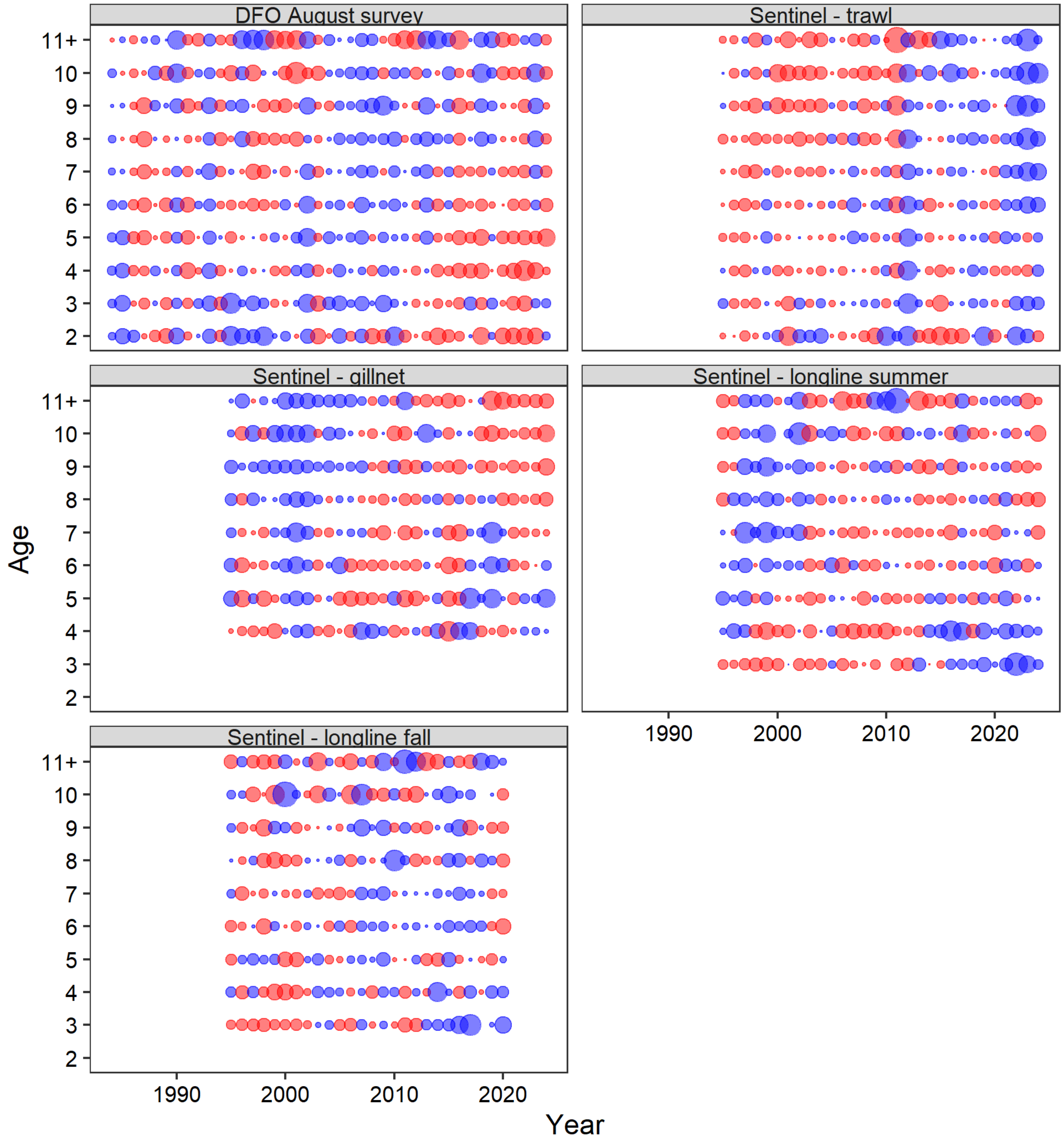

Figure 105. Model residuals for the age-specific abundance indices for each survey (panels). The area of a bubble is proportional to the absolute value. Red is positive and blue is negative.

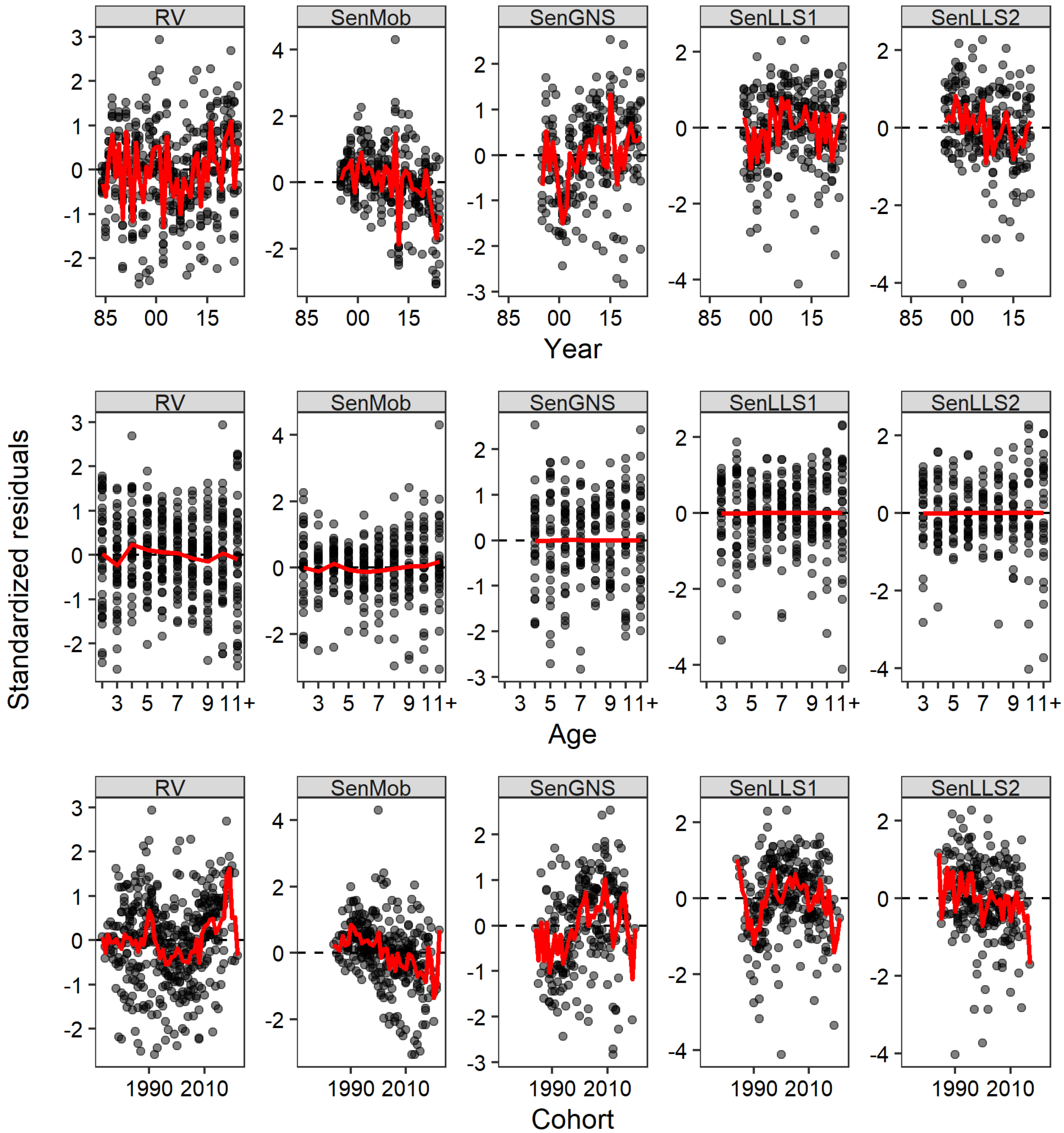

Figure 106. Model residuals for the age-specific abundance indices for each survey (columns) versus year (top row), age (middle row), and cohort (bottom row). Red lines connect the means for age year/age/cohort. RV indicates the DFO August research vessel survey.

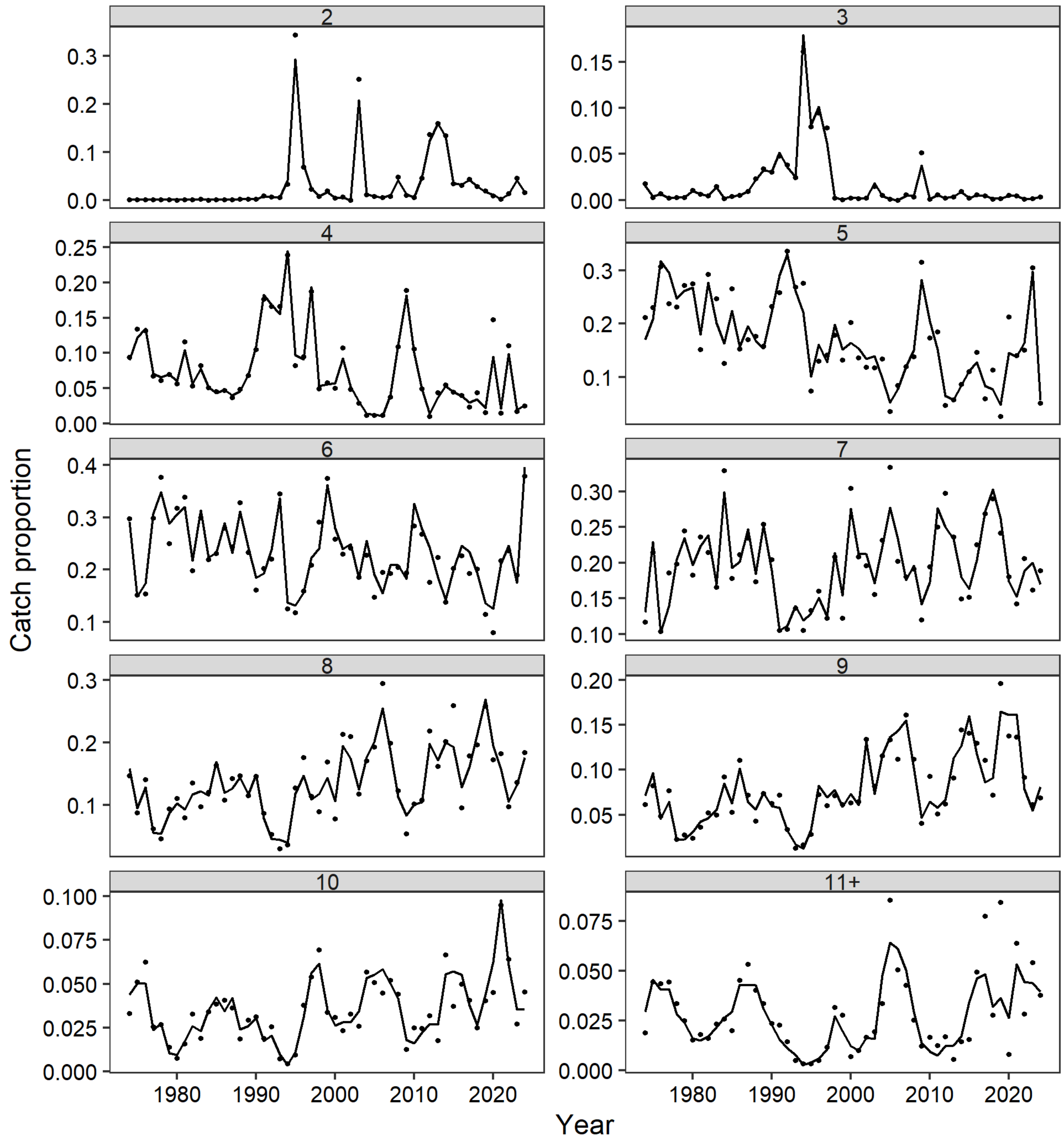

Figure 107. Observed (points) and model predicted (lines) catch proportion-at-age.

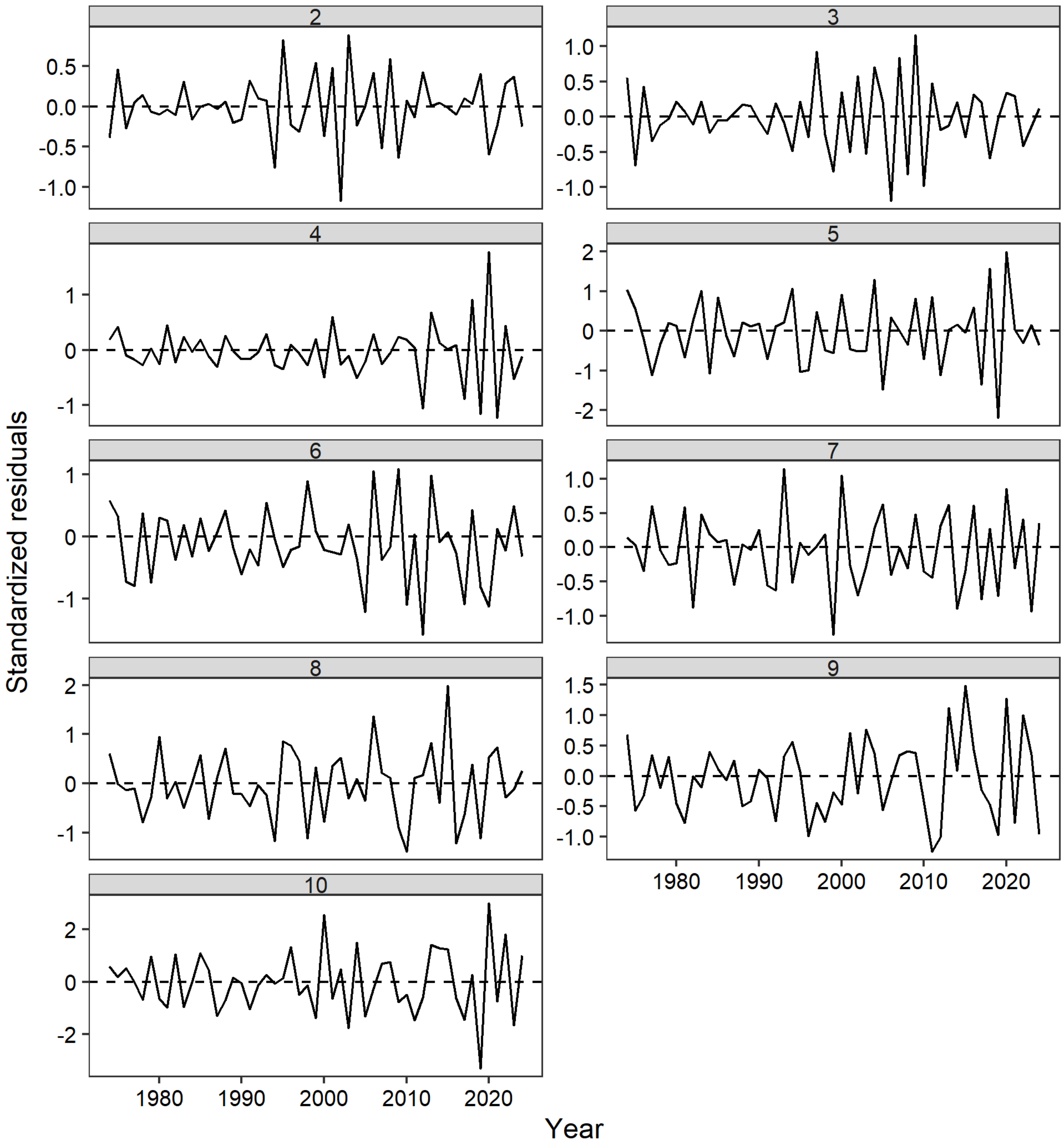

Figure 108. Time series of standardized catch proportions-at-age residuals, by age (panels). Note that the model fits to ages 2-10 only, and proportions for the age 11+ group are derived from the estimates for the other ages.

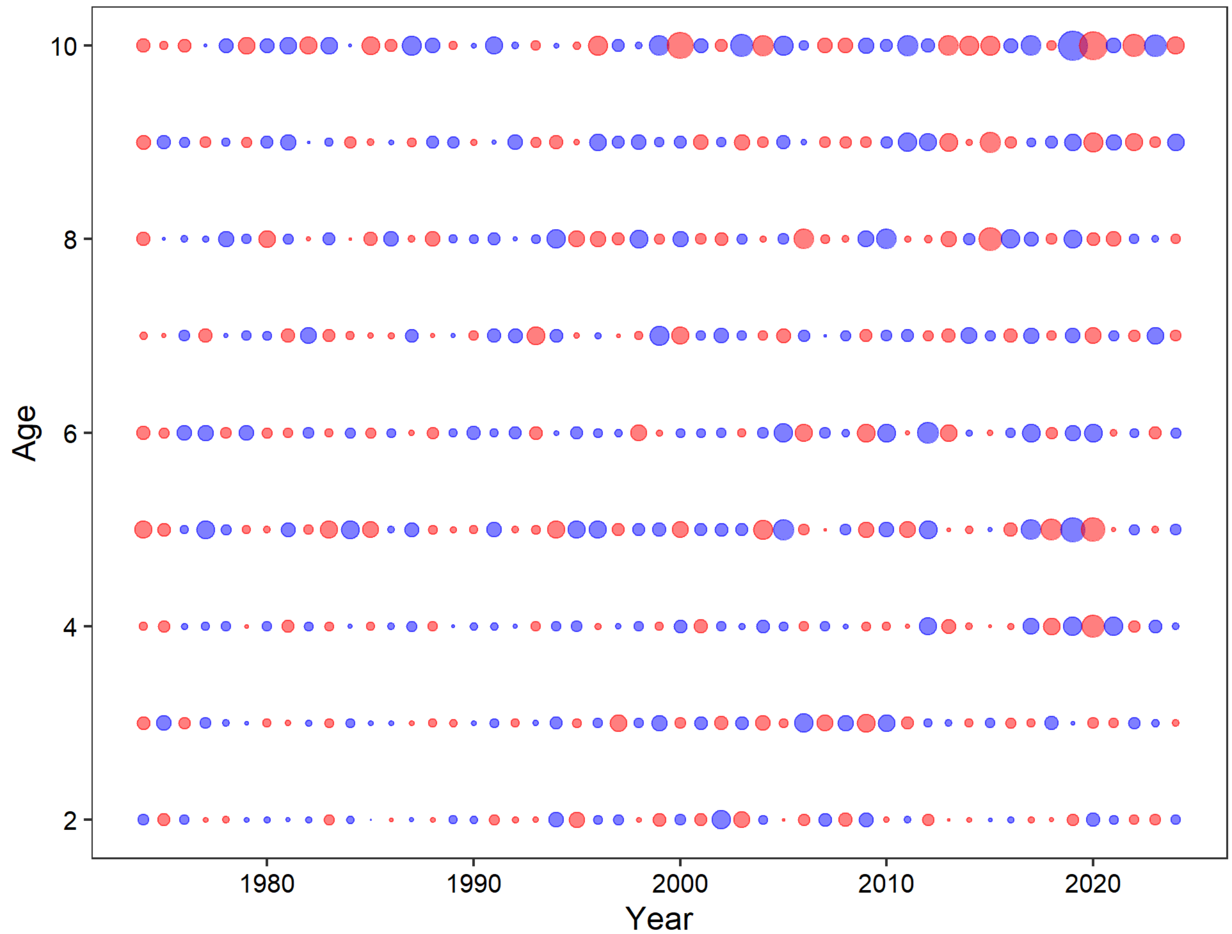

Figure 109. Model catch-at-age composition continuation ratio logit (crl) residuals. The area of a bubble is proportional to the absolute value. Red is positive and blue is negative.

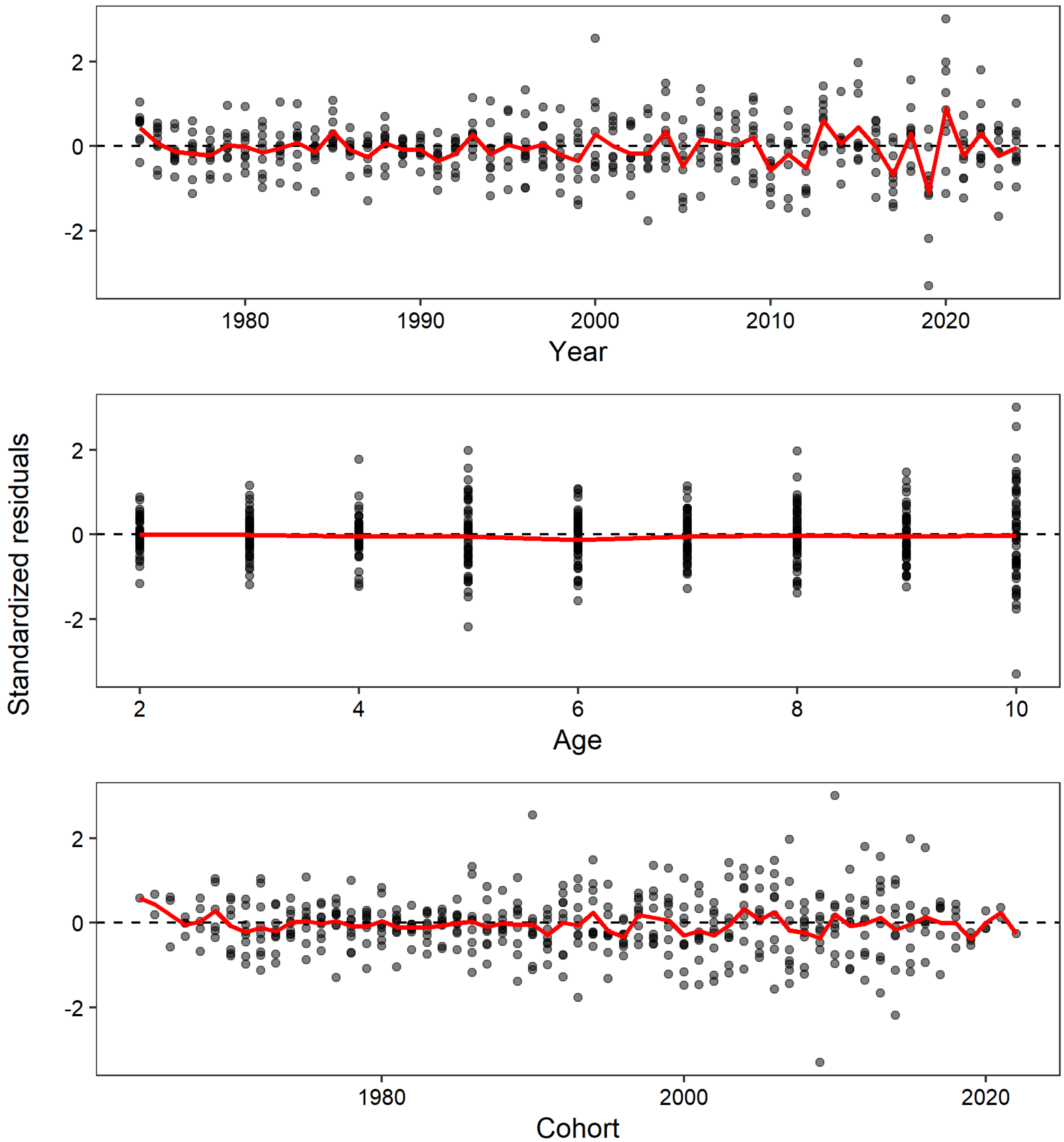

Figure 110. Model catch-at-age composition continuation ratio logit (crl) residuals versus year (top panel), age (middle panel), and cohort (bottom panel). Red lines connect the means for age year/age/cohort.

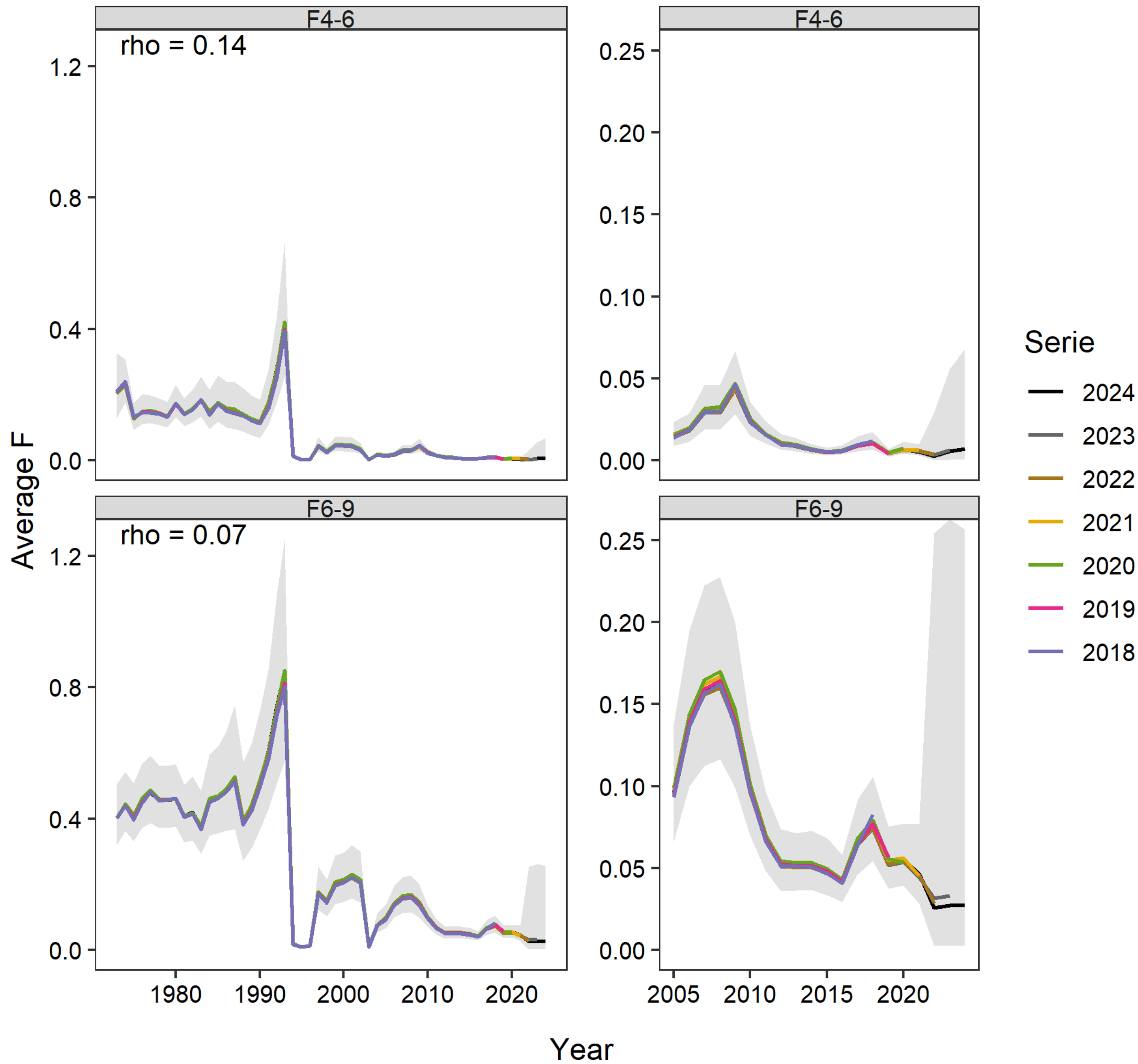

Figure 111. Retrospective estimates of average F at ages 4-6 (top panels) and 6-9 (bottom panels). Shaded regions indicate 95% confidence intervals based on the full time-series of data. The value of Mohn's rho is indicated in the panels. Rightmost panels show trends since 2005.

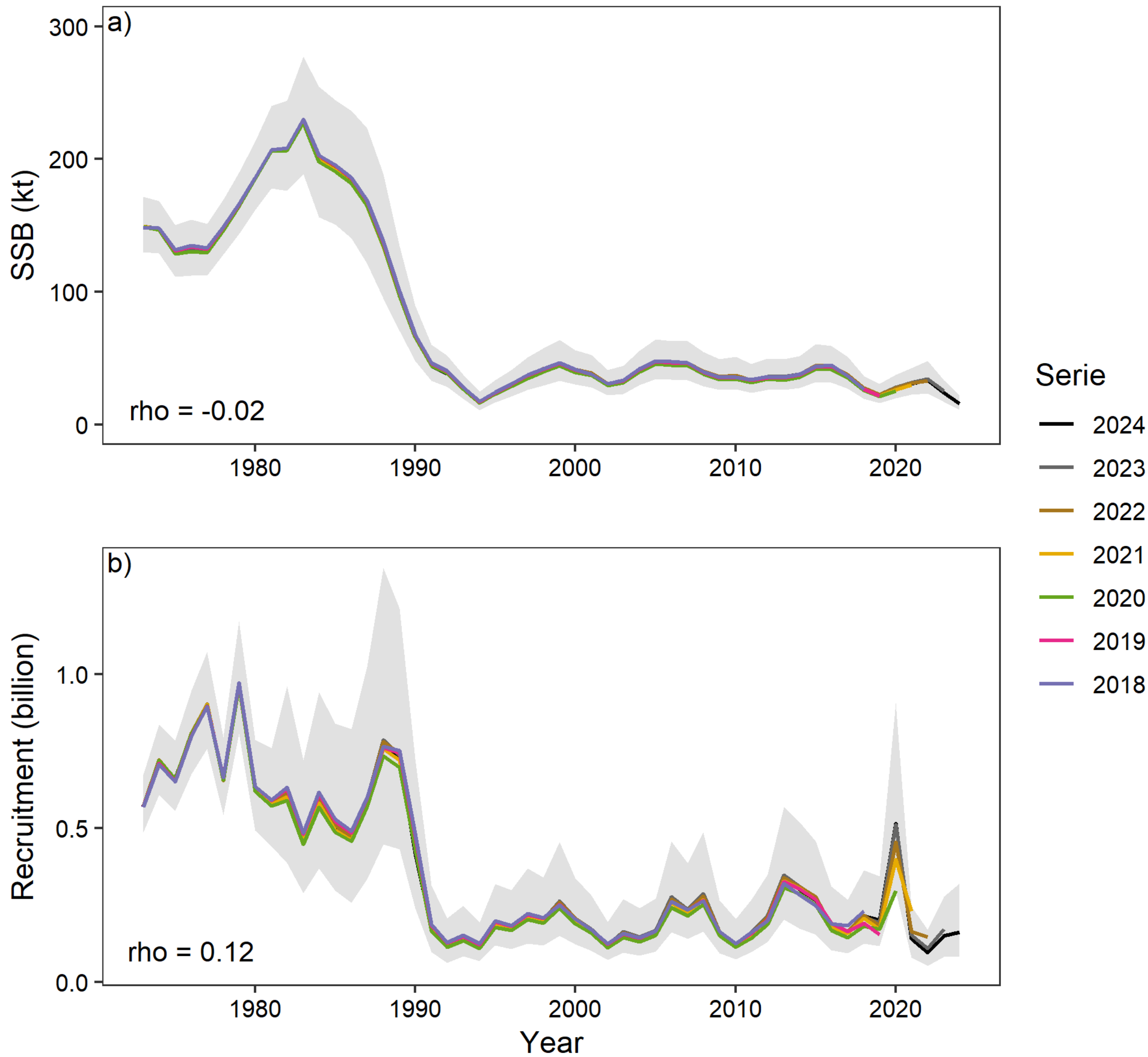

Figure 112. Retrospective estimates of a) spawning stock biomass and b) recruitment. Shaded regions indicate 95% confidence intervals based on the full time-series of data. The value of Mohn's rho is indicated in the panels.

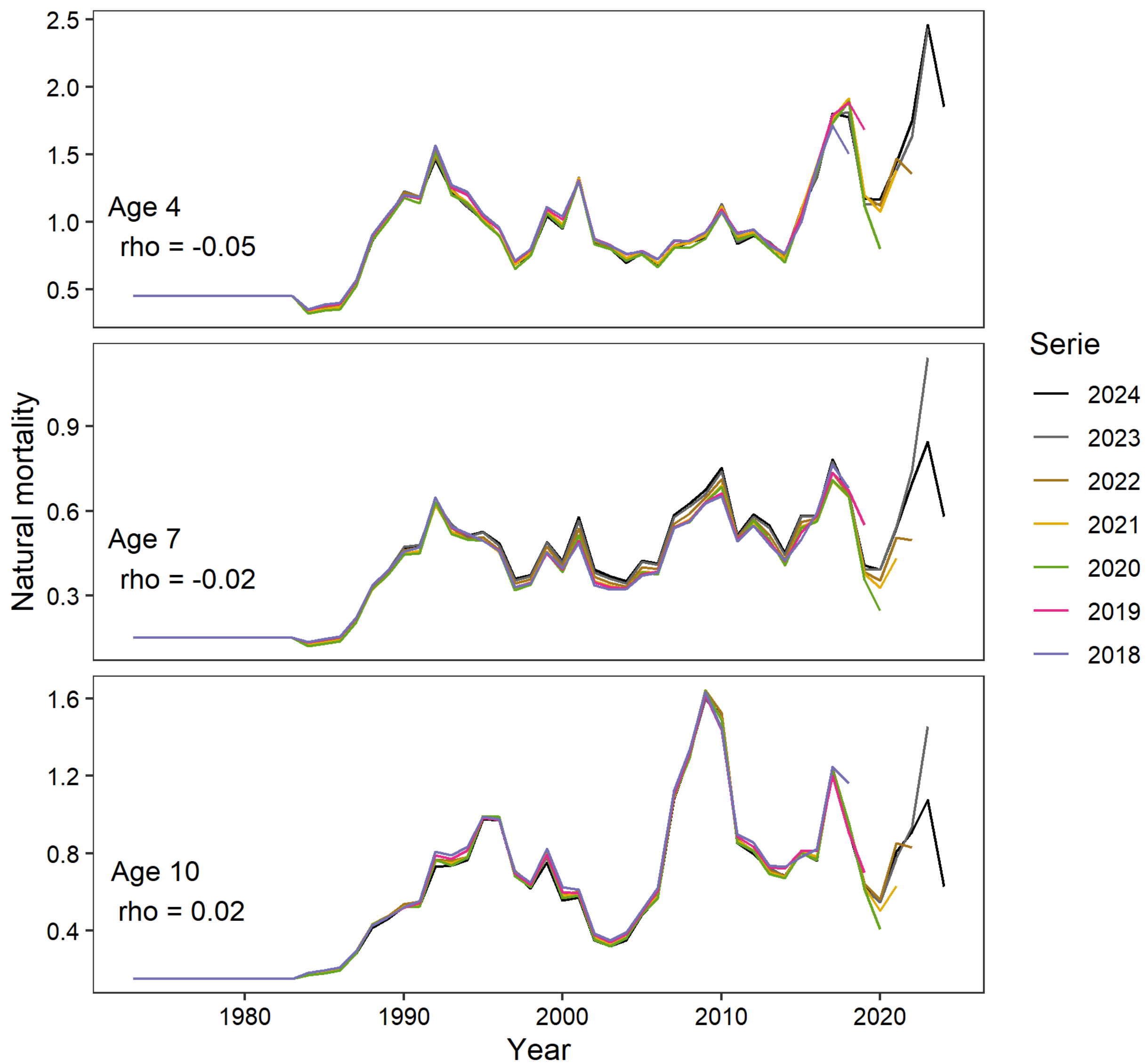

Figure 113. Retrospective estimates of natural mortality for three ages. The value of Mohn's rho is indicated in the panels.

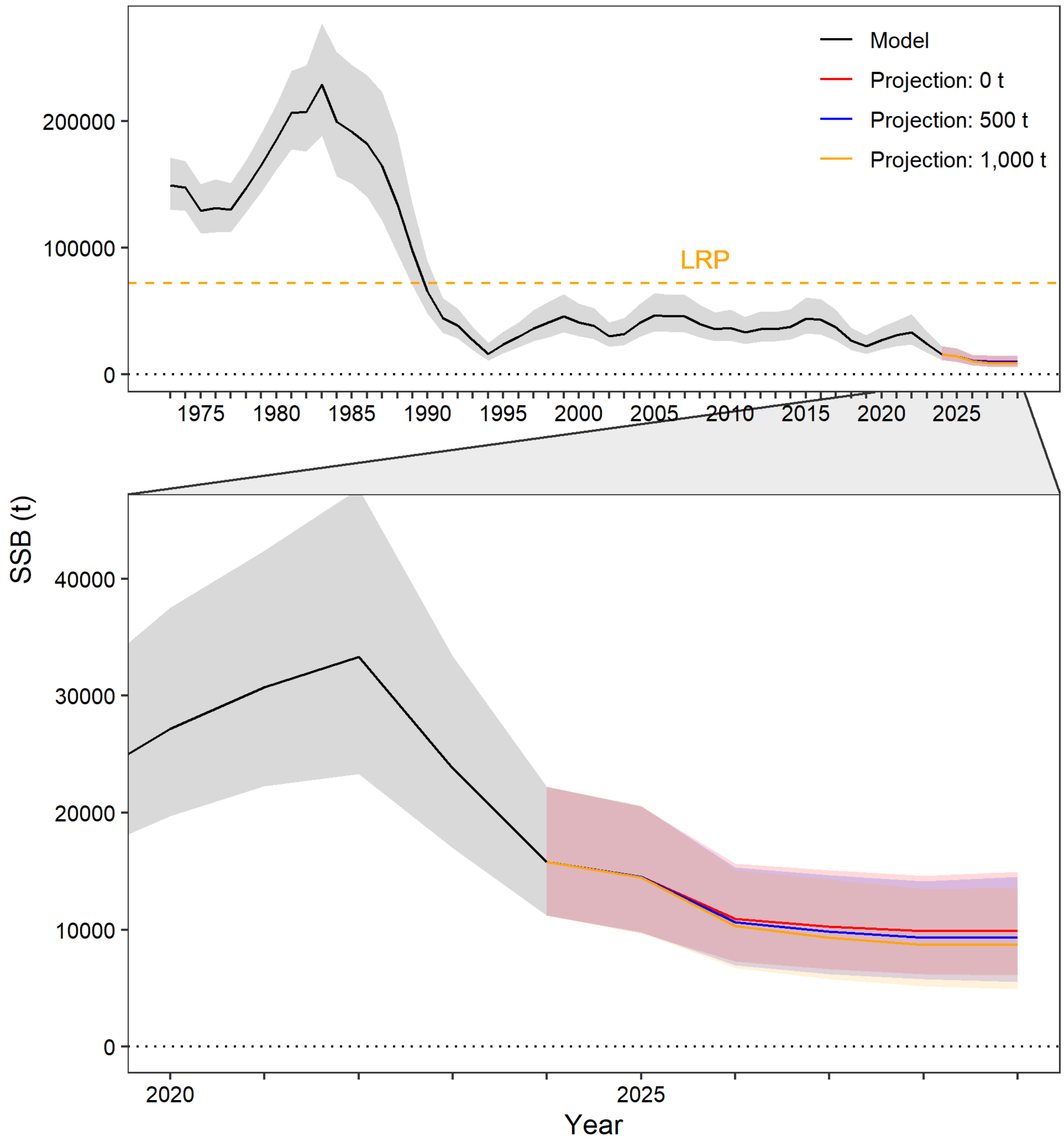

Figure 114. Model estimated spawning stock biomass (black line) and projected spawning stock biomass under different catch scenarios. The shaded areas represent the 95% confidence intervals, using the same colours as for the estimates. The bottom panel shows a close-up of results for the 2020-2028 period.

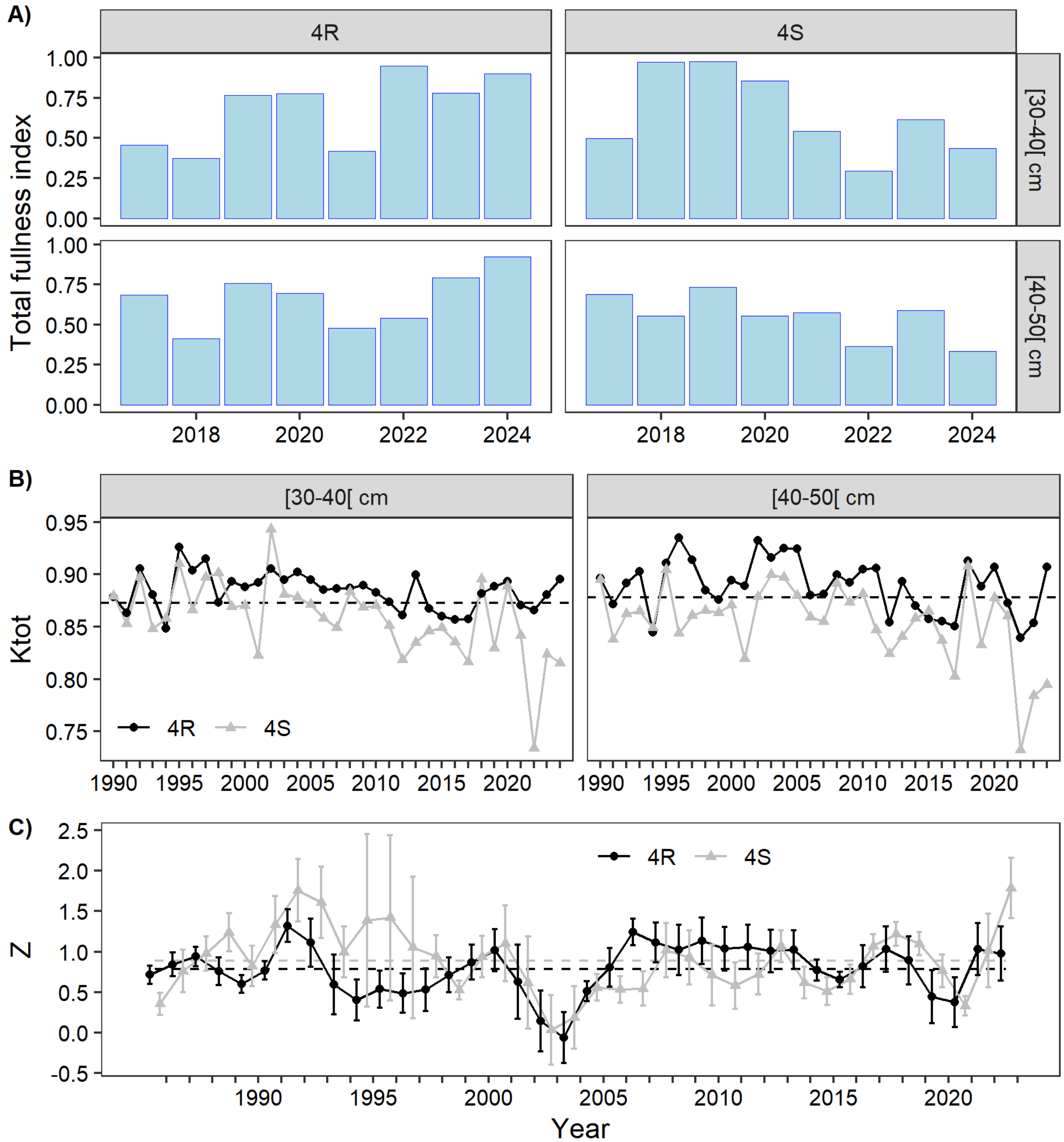

Figure 115. (A) Cod stomach total fullness index by NAFO Division, length class (cm) and year. (B) Fulton cod condition index (Ktot) by NAFO Division and length class (cm). The horizontal hatched line represents the average of the 4RS 1990–2024 series. (C) Estimates of total mortality by NAFO Division (Z, ± 95% CI) for ages 5 to 10. The dashed horizontal lines represent the average of each NAFO Division. Data source: nGSL survey.

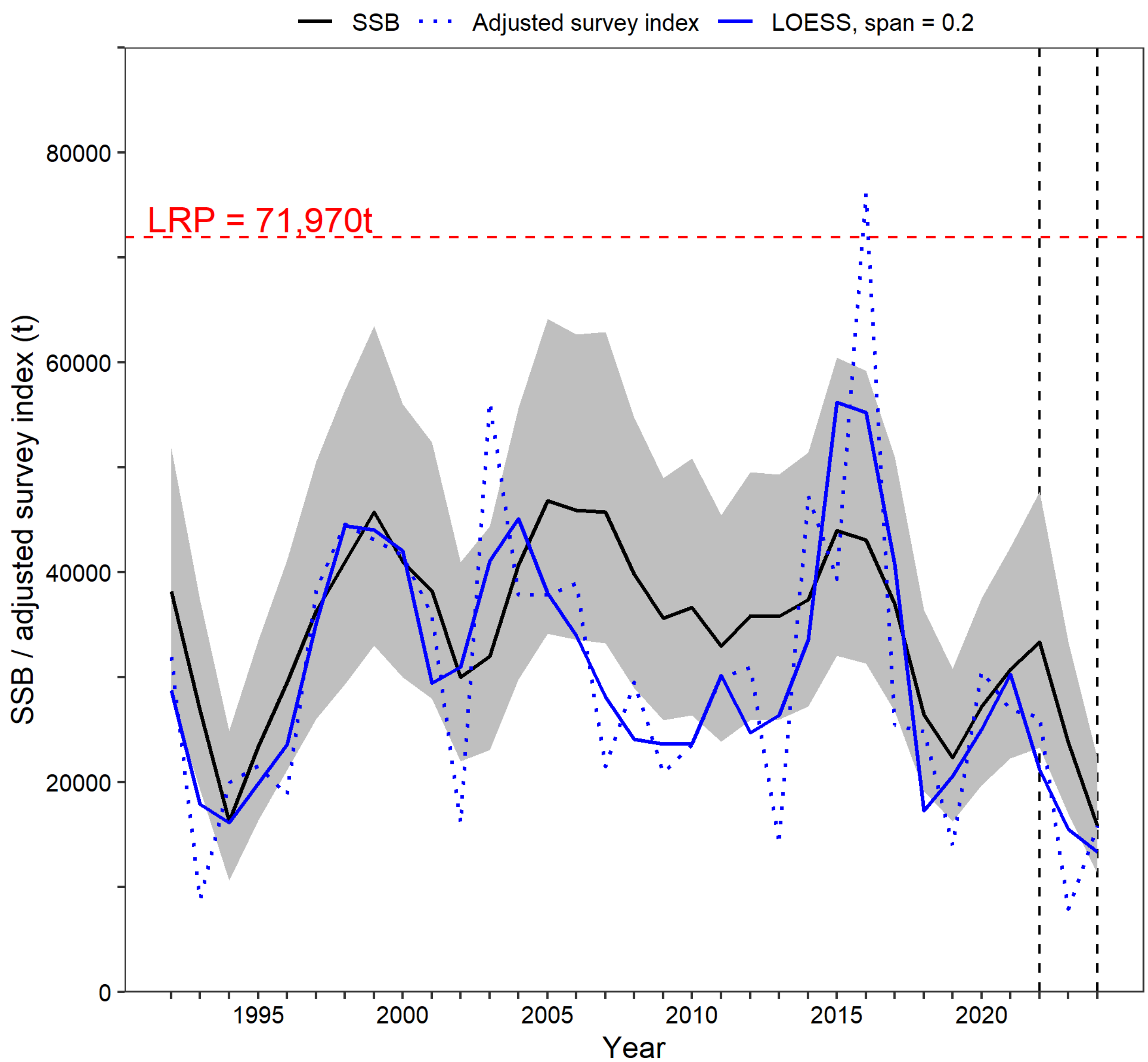

Figure 116. Model estimated spawning stock biomass (SSB, black line with 95% confidence interval), and the adjusted DFO August survey biomass index for cod ≥ 43 cm (dotted blue line) along with a LOESS type smooth of the adjusted index using a span of 0.2 (solid blue line). The vertical hatched lines indicate the terminal year of the assessment model used in the last 2 full stock assessments (February 2023 and February 2025).

APPENDICES

APPENDIX A. 2023-2024 COLLABORATORS

The following collaborators have been involved in work relevant to the assessment of Atlantic cod in the northern Gulf of St. Lawrence.

Industry partners

The sentinel projects and those from the FSCP Program could not have moved forward without the significant contribution of our industry partners:

Organization	Team (alphabetical order)
ACPG	Claudio Bernatchez and Samantha Bois
LNSFA	Frank Collier, Julie Monger, Marty Evans, Maureen Collier and Paul Nadeau
Biorex	France Henry and Gabrielle Chapados
FFAW	Erin Carruthers and Myra Swyers

On the water, the captains and their crews assigned to the work contributed enormously to the various projects through their knowledge of the resource:

Field work	Captains (alphabetical order)
CRP	Rick Genge
FSCP	Jean Savage, Jean-Richard Joncas and Marty Etheridge
Sentinel - fixed gear	Barry Hart, Bernard Barter, Carl Bennett, Carl Hedderson, Colby Cullihall, Curtis Stubbert, Dennis Keats, Douglas Ryland, Dwight Anderson, Ernest H. Rowsell, George Francis, Ian Anderson, Irené Marcoux, Jacob Gallichon, Jean-Yves Mercier, Joseph Brake, Lester Combdon, Marty Etheridge, Peter Francis, Philip Osborne, Randy Gould, Steven Stagg, Troy Hardy and Wade Brag
Sentinel - mobile gear	Dan Genge, Martin Élément, Murray Lavers, Pierre-Luc Dupuis, Samuel Normand, Shawn Dempter and Sébastien Dupuis

DFO colleagues

Finally, several DFO colleagues contributed data that were used in this stock assessment. By type of activity, these colleagues are:

Activity	Team (alphabetical order)
Age readings	Emmanuelle Taillefer and Jean-François Lussier
Commercial sampling	Benoît Chartier, Bernard Chouinard, Caroline Marcotte, Denis Bernier, Louise Girard, Michelle Langford and Yvon Dufresne
DFO August survey	Andrew Smith, Brian Boivin, Bruno St-Denis, Caroline Brûlé, Caroline Chavarria, Caroline Senay, Chantal Méthot, David Poissant, Denis Bernier, Émilie Simard, Éric Parent, Geneviève Côté, Grégoire Cortial, Guillaume Mercier, Hugo Bourdages, Jade Paradis-Hautcoeur, Jean-François Lussier, Jean-Luc Shaw, Jean-Martin Chamberland, Jordan Ouellette-Plante, Laurence Lévesque, Laurie Isabel, Marie-Claude Marquis, Marie-Maude Rondeau, Marie-Pier Boulanger, Mathieu Boudreau, Mathieu Desgagnés, Maureen Chapiteau, Myranda Blouin, Mélanie Boudreau, Pierre-Marc Scallon-Chouinard, Sarah Brown-Vuillemin, Théo Garnier, Tom Bermingham and Véronique Desborbes
Data management	Brian Boivin, Caroline Vanier, Denis Bernier and Marie-Pier Boulanger
Data validation	Emmanuelle Taillefer and Jean-François Lussier
FSCP	Émilie Simard, Jean-François Lussier, Marie-Julie Roux, Mathilde Girard-Robert and Pierre-Marc Scallon-Chouinard
Logbooks	Marty Snooks

Activity	Team (alphabetical order)
Resource management	Magalie Hardy, Nancy Pond and Shelley Dwyer
Unit 2 survey	Caroline Chavarria, Caroline Senay, David Poissant, Emmanuelle Taillefer, Guillaume Mercier, Jean-François Lussier, Jordan Ouellette-Plante, Marie-Claude Marquis, Mathilde Girard-Robert, Samuel Rail, Sarah Brown-Vuillemin and Tom Bermingham
Winter survey	Andrew Darcy, Brian Boivin, Bruno Comeau, Carly Weber, Caroline Chavarria, David Poissant, Émilie Simard, Éric Parent, Jean-François Lussier, Jean-Patrick Bourbonnière, Joeleen Savoie, Jordan Ouellette-Plante, Marie-Claude Marquis, Marie-France Robichaud, Marie-Maude Rondeau, Pierre-Marc Scallon-Chouinard, Sarah Brown-Vuillemin and Tom Bermingham

To all, a huge thank you!

APPENDIX B. SUPPLEMENTAL FIGURES

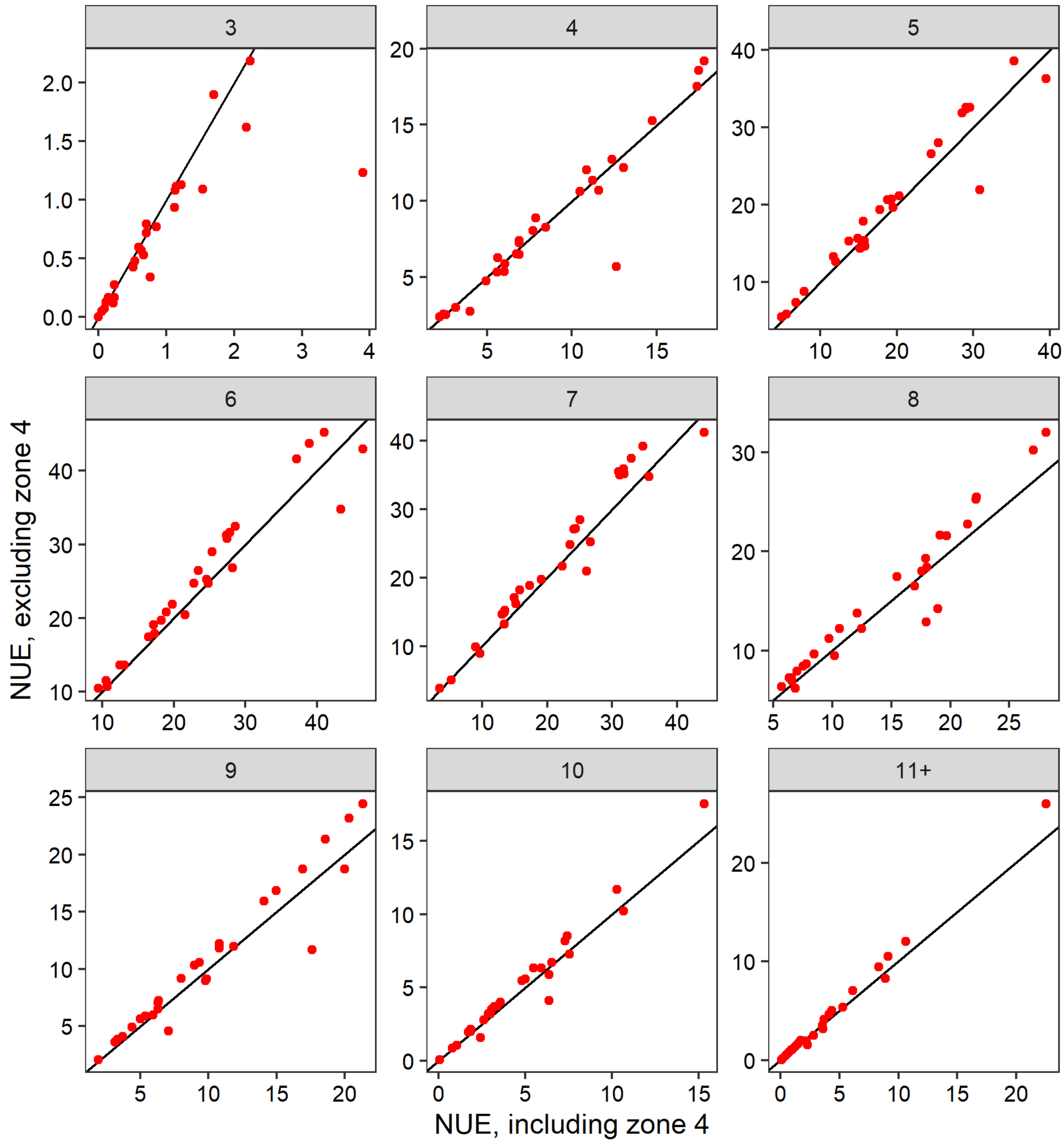

Figure B1: Paired observations of numbers-at-age (panels) per unit effort (NUE, per 1000 hooks) from the sentinel longline survey (1995–2022), according to whether zone 4 was included (x-axis) or excluded (y-axis) from the index. The oblique line represents a slope line of 1.

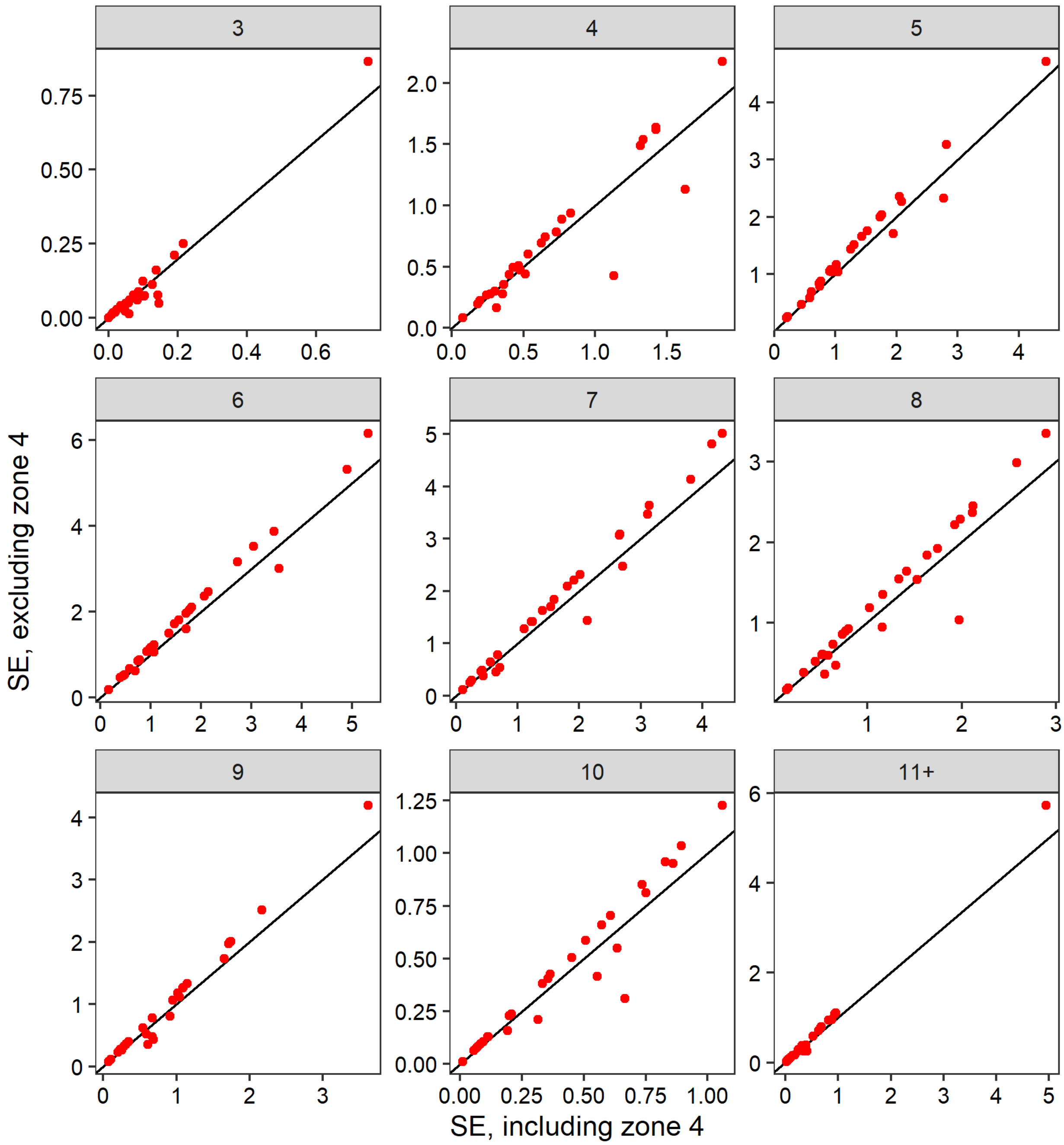

Figure B2: Paired observations of the standard error's (SE) numbers-at-age (panels) per unit effort (per 1,000 hooks) from the sentinel longline survey (1995–2022), according to whether zone 4 was included (x-axis) or excluded (y-axis) from the index. The oblique line represents a slope line of 1.

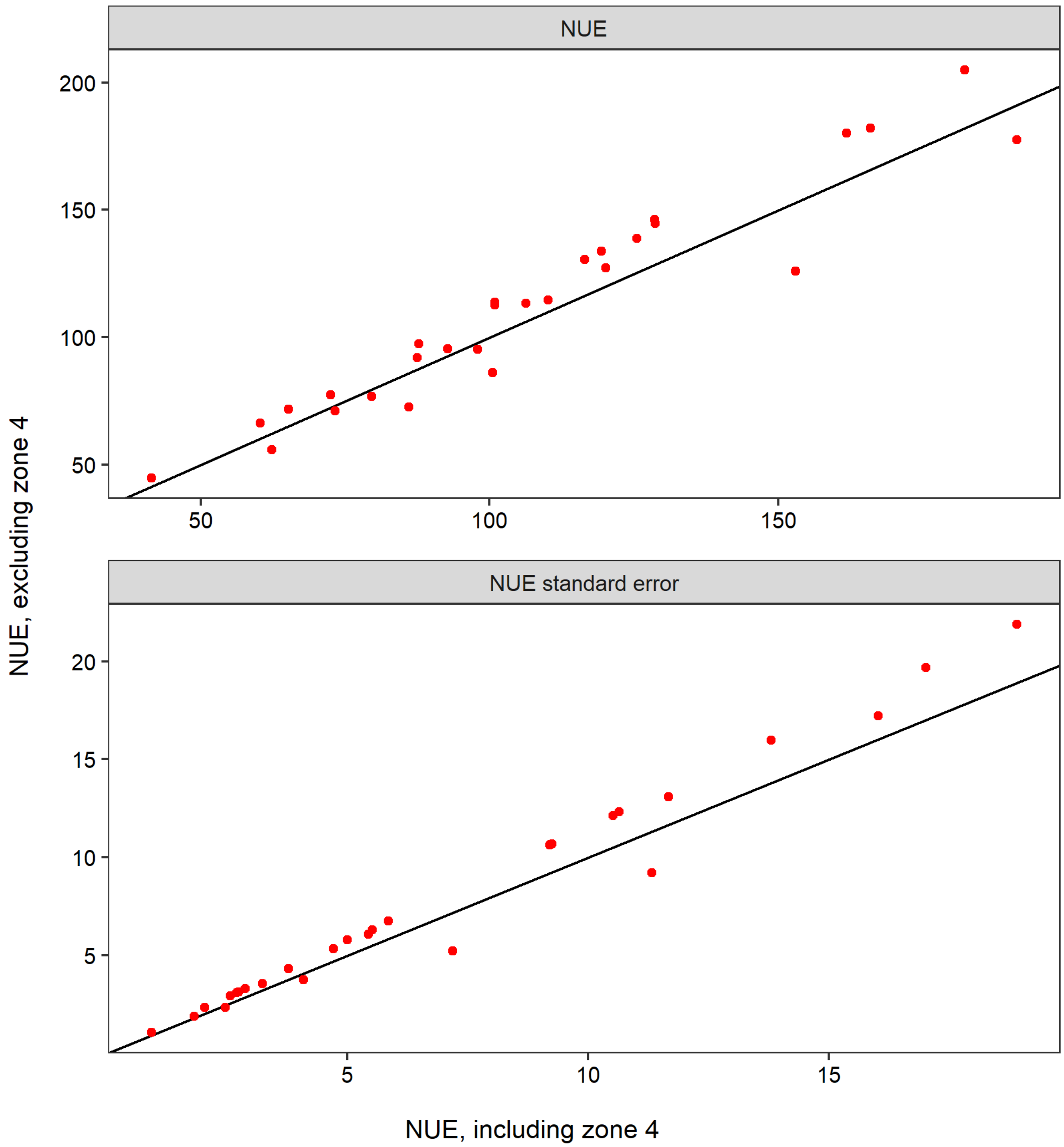

Figure B3: Paired observations of a) age 3+ aggregated summer abundance index (number per unit effort [NUE], per 1,000 hooks) and b) of their associated standard error for the sentinel longline survey (1995-2022), according to whether zone 4 was included (x-axis) or excluded (y-axis) from the index. The oblique line represents a slope line of 1.

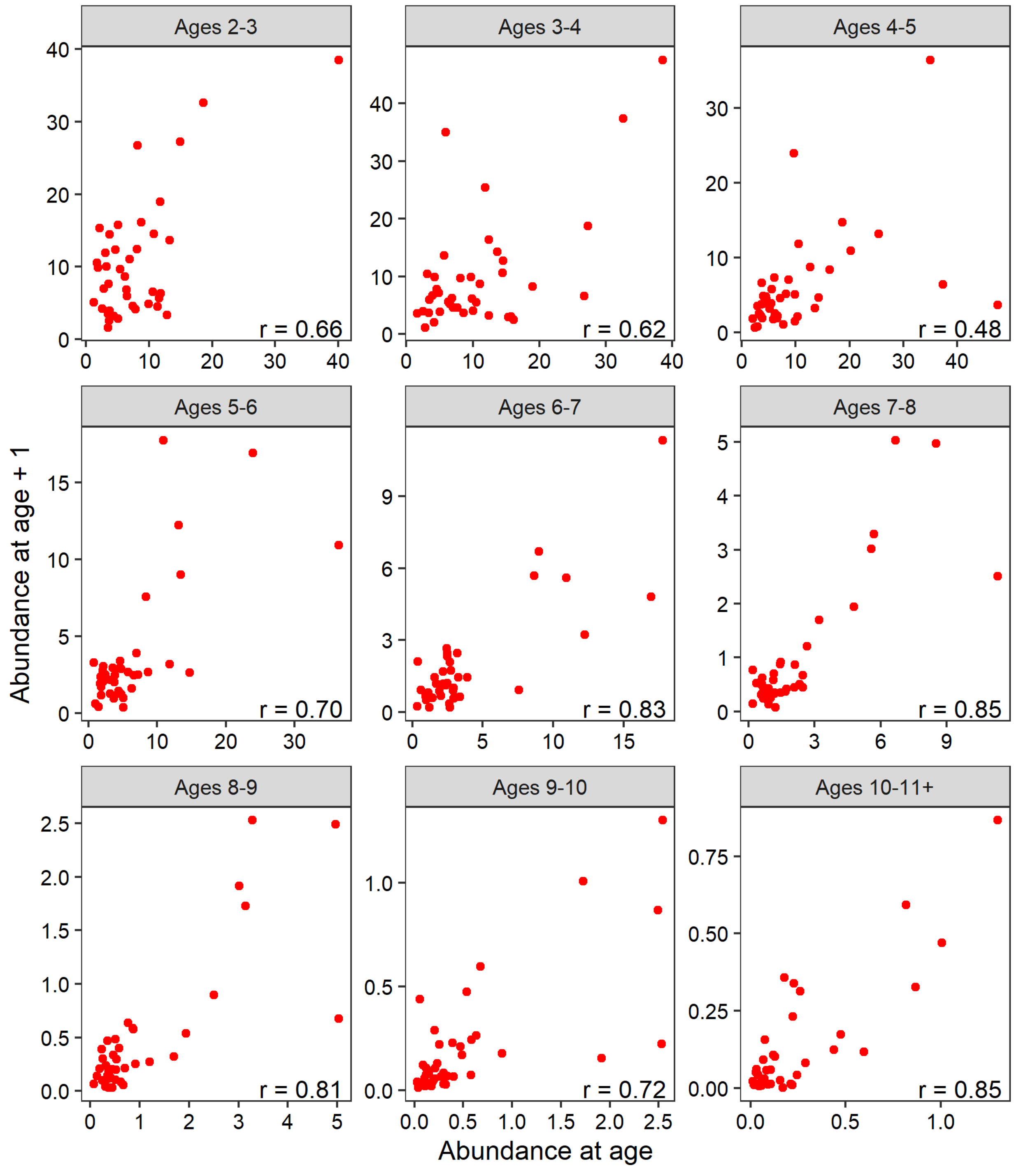

Figure B4: Age-specific abundance of cohorts at a given age and year, as a function of their abundance one year before in the DFO August survey, for 1984-2024. The correlation between the two sets of estimates is indicated in each panel.

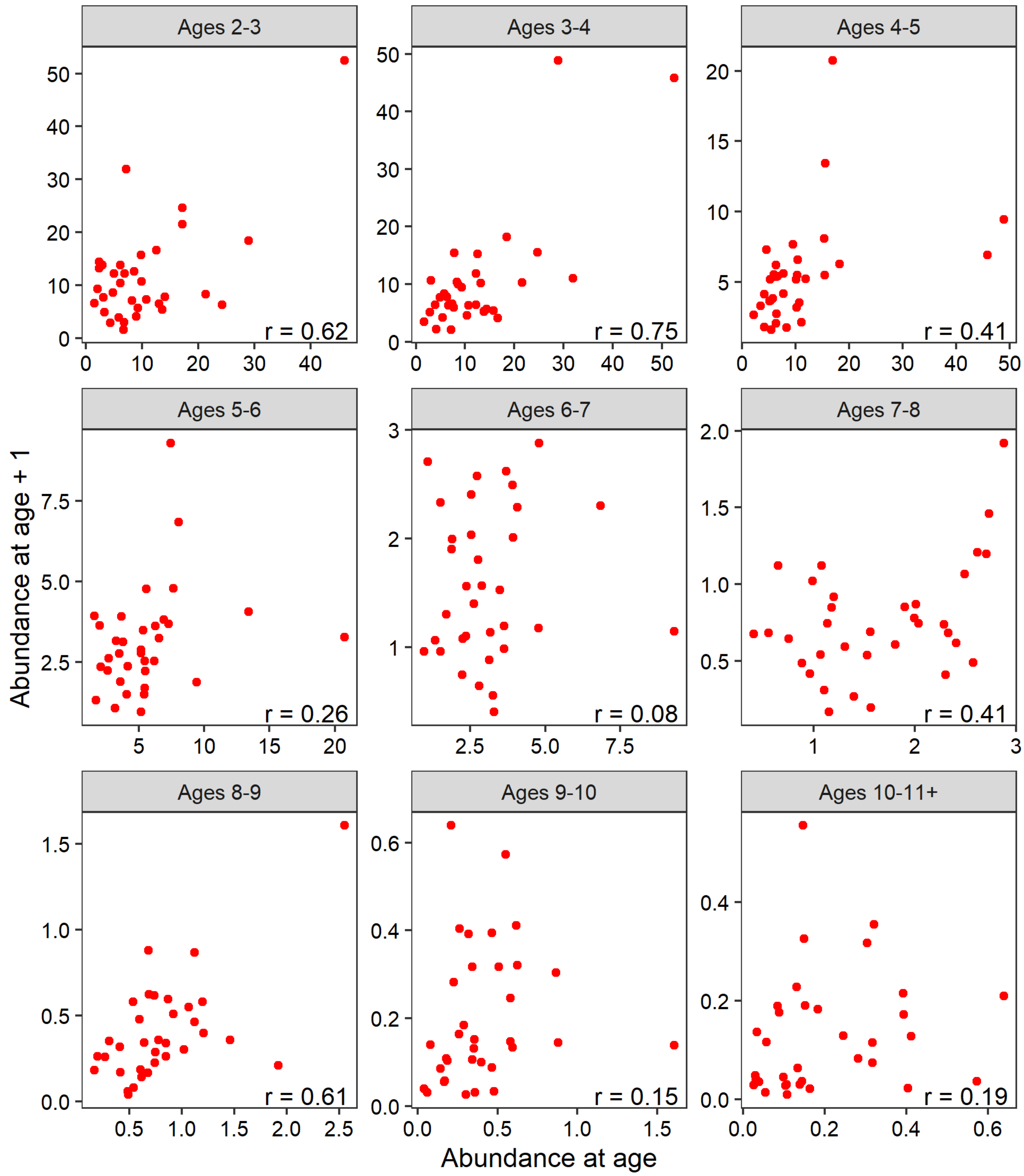

Figure B5: Age-specific abundance of cohorts at a given age and year, as a function of their abundance one year before in the DFO August survey, for 1990-2024. The correlation between the two sets of estimates is indicated in each panel.

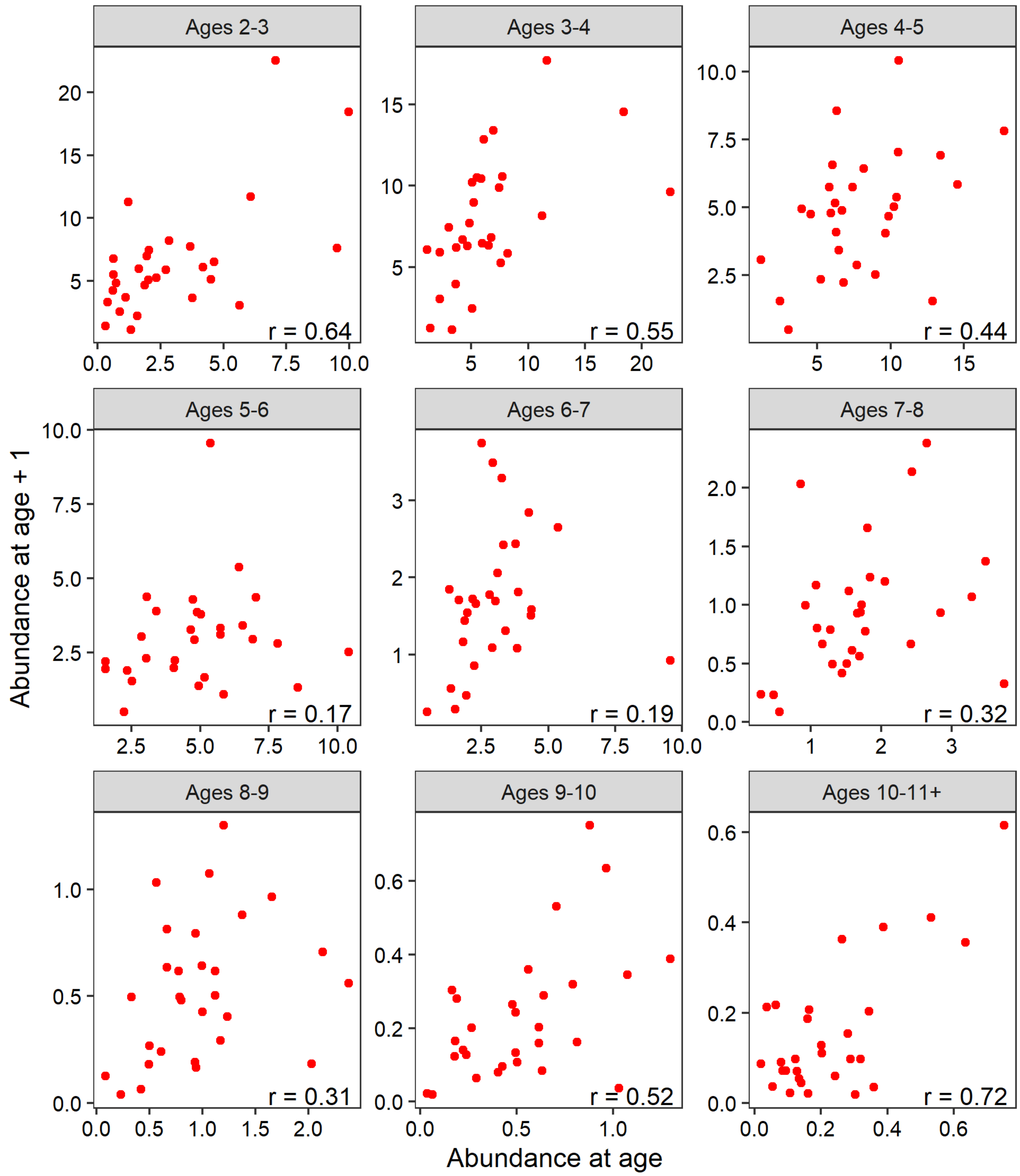

Figure B6: Age-specific abundance of cohorts at a given age and year, as a function of their abundance one year before in the sentinel mobile gear survey, for 1995-2024. The correlation between the two sets of estimates is indicated in each panel.

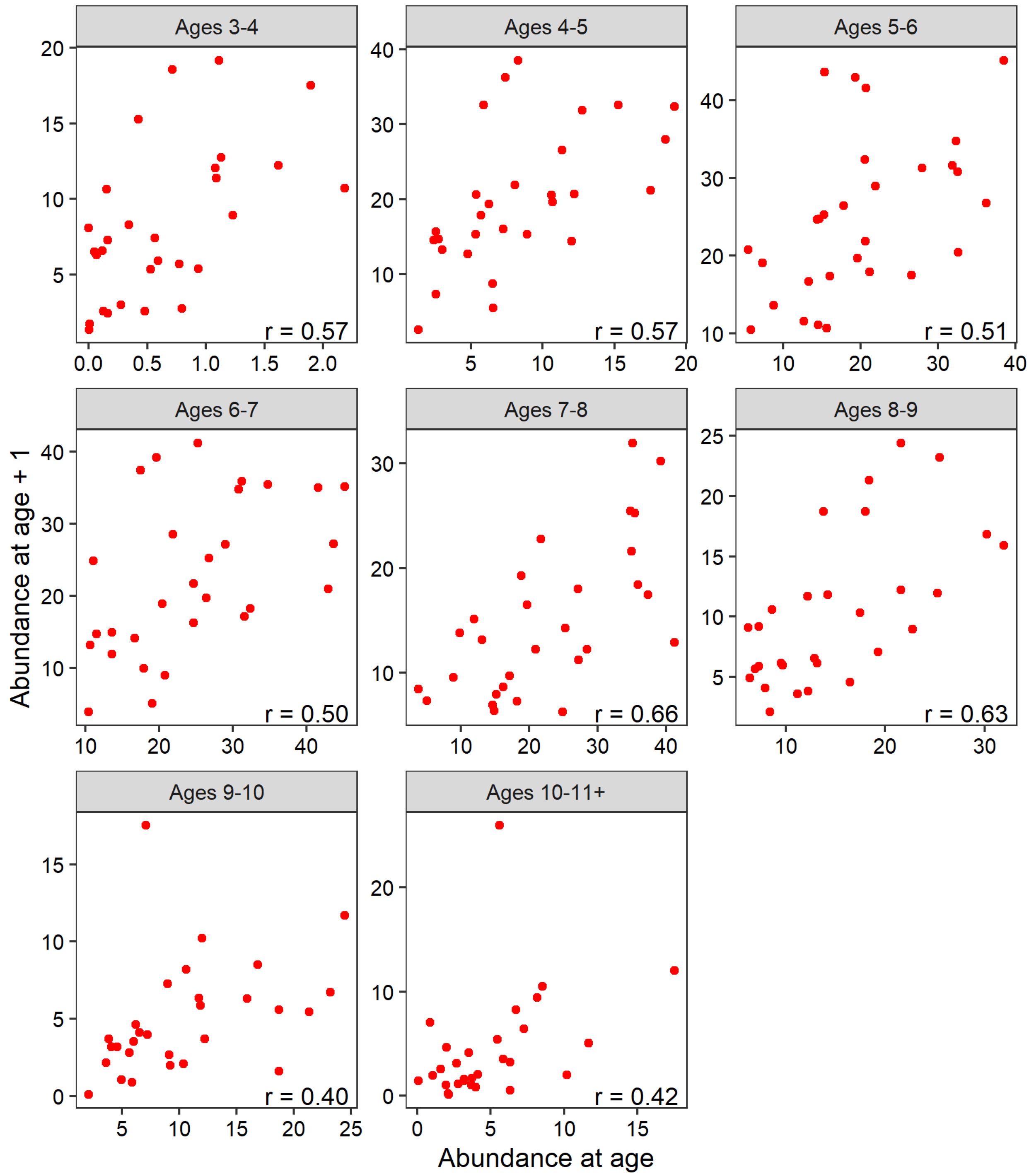

Figure B7: Age-specific abundance of cohorts at a given age and year, as a function of their abundance one year before in the sentinel longline survey (summer index), for 1995-2024. The correlation between the two sets of estimates is indicated in each panel.

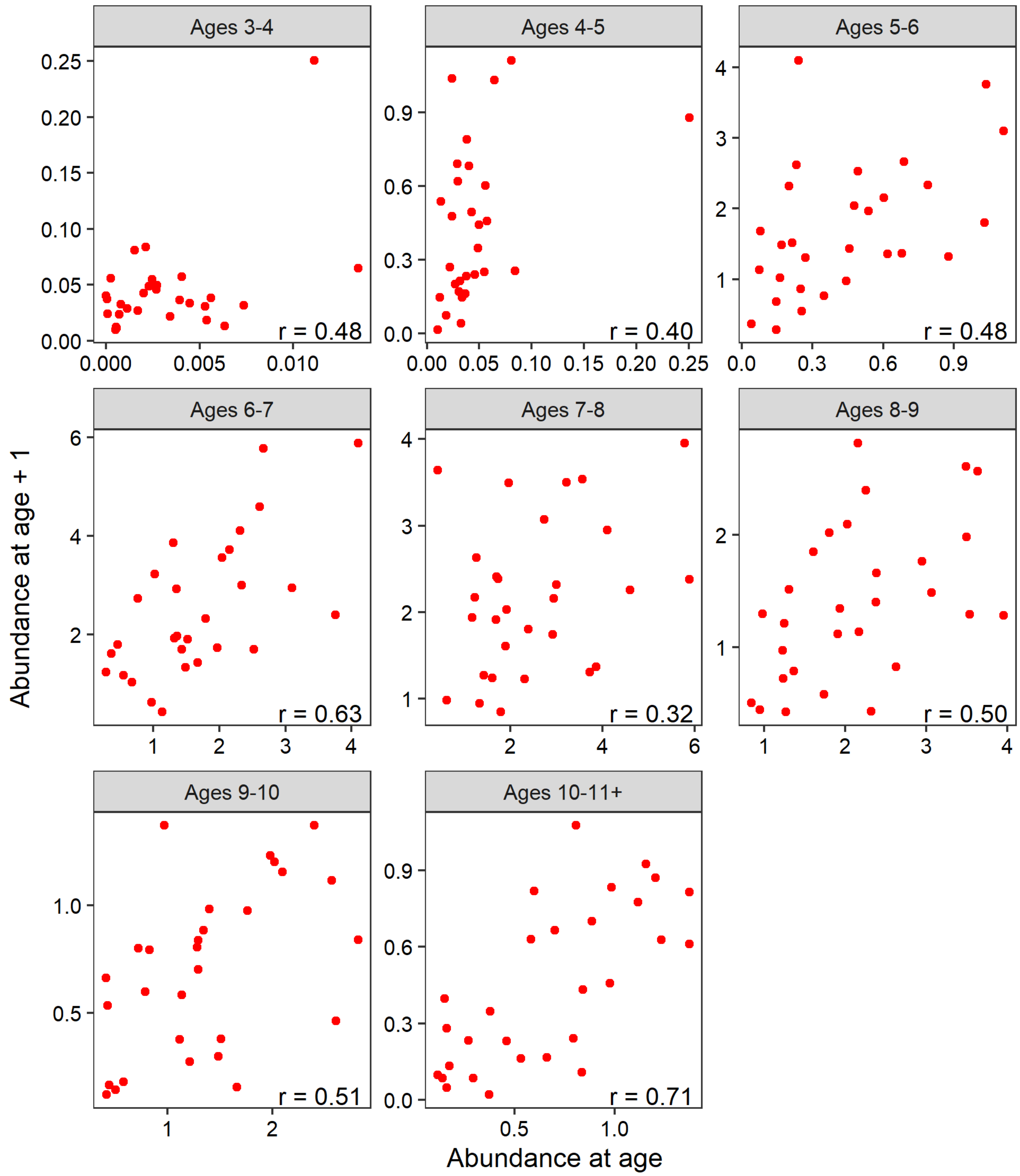

Figure B8: Age-specific abundance of cohorts at a given age and year, as a function of their abundance one year before in the sentinel gillnet survey, for 1995-2024. The correlation between the two sets of estimates is indicated in each panel.

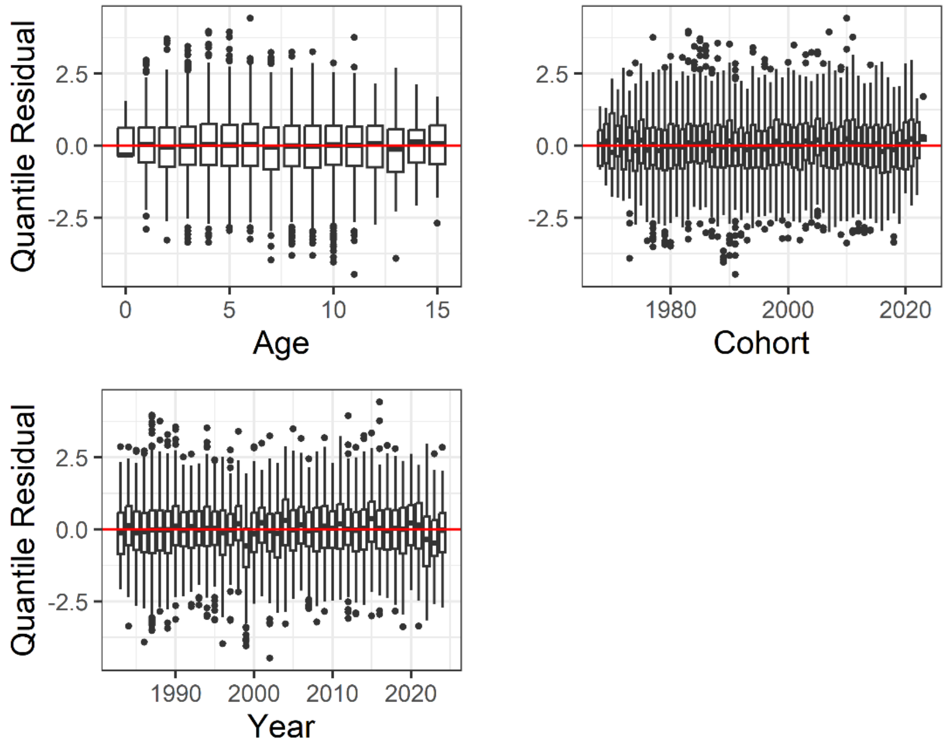

Figure B9: Boxplots of normalized quantile residuals for fits to the female maturity data as a function of age, cohort and year.

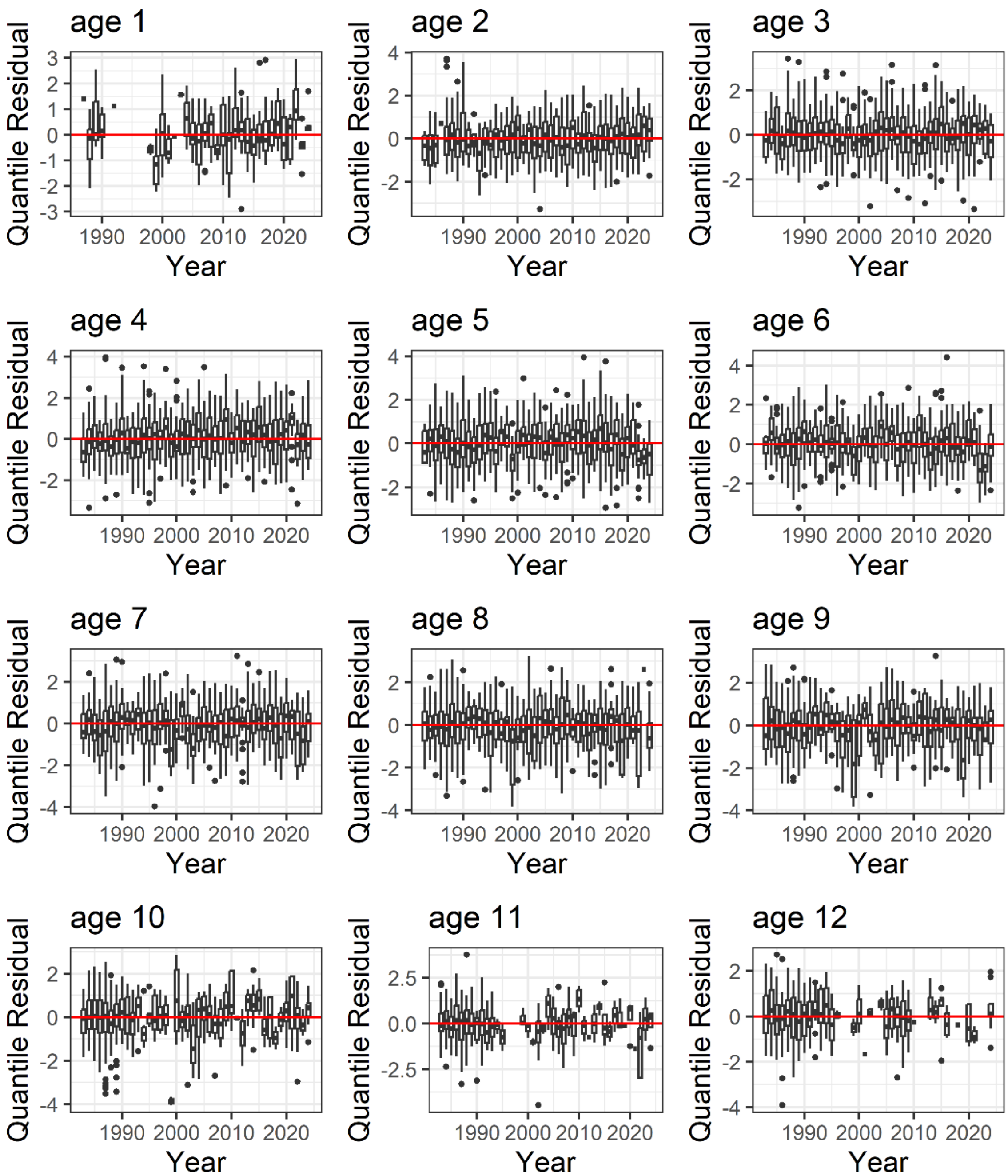

Figure B10: Boxplots of normalized quantile residuals for fits to the female maturity data as a function of year by age (panels).

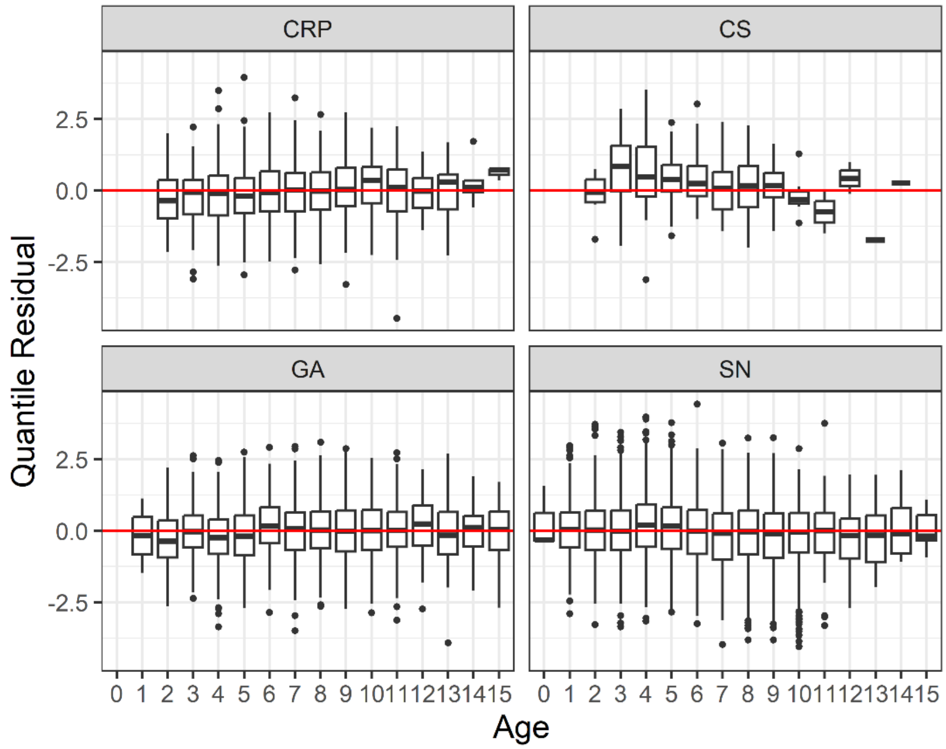

Figure B11: Boxplots of normalized quantile residuals for fits to the female maturity data as a function of age by survey (panels). See text for description of surveys.

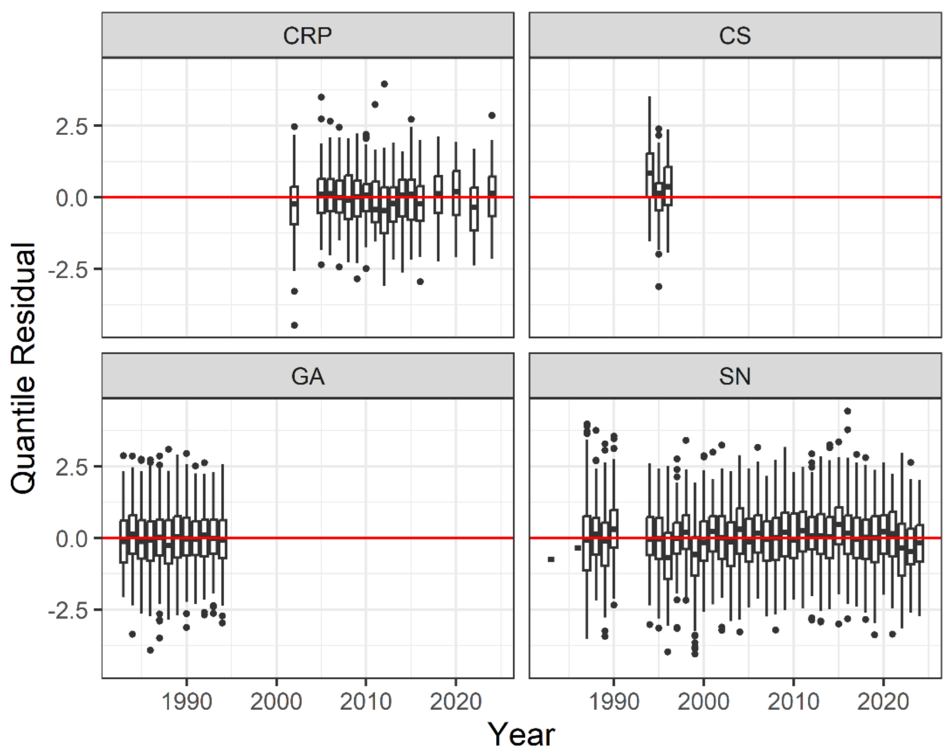

Figure B12: Boxplots of normalized quantile residuals for fits to the female maturity data as a function of year by survey. See text for description of surveys.