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Science Advisory Report 2021/027

ASSESSMENT OF THE ESTUARY AND GULF OF ST. LAWRENCE (DIVISIONS 4RST) CAPELIN STOCK IN 2020

Figure 1. Adult male and female capelin (Source : Claude Nozères – DFO).

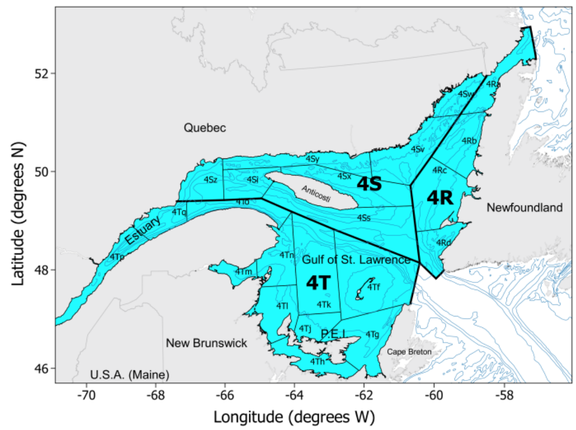

Figure 2. Map of NAFO Divisions 4RST (Estuary and the Gulf of St. Lawrence).

Context:

Atlantic capelin (Mallotus villosus, Figure 1) is a small, schooling, forage fish that plays an important role in the ecosystems of the estuary and the northern Gulf of St. Lawrence (GSL). Traditionally, in eastern Canada, capelin have been fished recreationally on beaches during the spawning season for consumption and are also used as fertilizer, bait, as well as for their oil. Towards the end of the 1970s, the emergence of an Asian market for roe-bearing females resulted in rapid growth in the fishery, with average landings increasing from around 662 t to nearly 10 000 t per year. In NAFO Divisions 4RST (Figure 2), most capelin catches are made on the West coast of Newfoundland by a fleet of small and large purse seiners, as well as by tuck seiners and traps. Capelin are also caught using purse seines and traps on Quebec's Lower North Shore and weirs in the St. Lawrence Estuary. Capelin is a regular bycatch of shrimp trawlers and in multidisciplinary groundfish and shrimp surveys conducted annually by Fisheries and Oceans Canada in the estuary and GSL. Although the structure of capelin populations in the estuary and GSL is not clearly defined, capelin in Divisions 4RST is currently managed as a single stock.

A total allowable catch (TAC) of 9 295 t was applied to the entire stock for the 2018, 2019 and 2020 seasons. This TAC is divided as follows: 8 005 t for Division 4R and 1 290 t for all 4ST.

The last capelin stock assessment in Divisions 4RST was carried out in 2018. The purpose of this document is to provide recommendations on the status of capelin in Divisions 4RST based on the best available data.

August 2021

SUMMARY

- Since 2000, average annual capelin landings in NAFO Divisions 4RST were 7 973 t. In 2018, 2019 and 2020, landings were 8 503, 8 487 and 9 848 t respectively (last two years are preliminary), principally from the 4R seine fishery (93% of total landings).
- The Division 4R seiner performance index increased from 2004 to 2010, and subsequently varied, above the time series average.
- Length frequencies from the bottom trawl surveys indicate regional differences in size structure. Compared to length frequencies from the commercial fishery targeting spawning fish, the surveys capture smaller sized capelin on average. Based on known life history characteristics and inferred low fishing mortality in the Gulf of St. Lawrence (GSL), a large proportion of the capelin targeted by the commercial fishery is likely not available to the surveys because of mortality due to post spawning senescence.
- The survey index in the northern GSL was elevated and somewhat increasing over the 1990s, declining to lows during the first half of the 2000s, before increasing gradually to a peak in 2011 and subsequently declining to relatively low levels. In the southern GSL, the index was low in the in the 1990s and 2000s, rising rapidly to series highs in the 2010s and declining to around average levels since.
- Variations in capelin abundance indices derived from bottom trawl surveys were associated with environmentally-driven variations in capelin condition during the previous two years, consistent with proposed bottom-up regulation of capelin survival and cohort strength.
- Simulations performed using a newly developed Qualitative Network Model suggest that recent ecosystem conditions are generally favourable to capelin productivity.
- Plausible inferred fishery exploitation rate levels were at least one order of magnitude smaller than natural mortality (M) calculated based on life history traits. At the stock level, current fishing mortality for 4RST capelin is therefore unlikely to be deleteriously affecting the population.

INTRODUCTION

Species Biology

Capelin (Figure 1) are part of the *Osmeridae* family. Formerly viewed as a single circumpolar species, Atlantic (*Mallotus villosus*) and Pacific (*M. catervarius*) capelin are now considered distinct species with complex population structures (Mecklenburg et al. 2018, Mecklenburg and Steinke 2015). In the Northwest Atlantic Fisheries Organization Divisions (NAFO) 4RST (Figure 2), which cover the estuary and GSL, Atlantic capelin (hereafter capelin) is currently managed as a single stock with two distinct management areas, 4R and 4ST.

During the spawning season, there is a clear sexual dimorphism among capelin where males have larger fins and are typically larger than females (Figure 1). Capelin have two modes of spawning, beach and demersal, that is preceded by inshore migrations to coastal and intertidal waters. In the former case, capelin are said to "roll" onto sandy or fine gravel beaches where the males and females deposit their milt and eggs that then adhere to the sandy substrate. In the GSL, the spawning period on beaches generally begins in April-May in the west of the estuary and then progresses eastwards throughout the GSL to end in July-August along the Lower North Shore of Quebec and the West coast of Newfoundland. The specific location and timing of spawning is variable but depends on water temperature and the available substrate. Egg and larval development and mortality is temperature dependent. Similar to beach spawners, demersal spawners tend to spawn on sites composed of sandy or fine gravel substrate but are exposed to generally lower and more constant temperatures and higher salinities than on beaches. Post-spawning mortality in both beach and demersal spawners is high, especially among males. Upon hatching, larvae adopt a planktonic life in the upper layers of the water column. Most growth in capelin occurs in their first year of life and they reach sexual maturity around 2-3 years of age.

Overview of the Fishery

In the estuary and GSL (NAFO Divisions 4RST, Figure 2), the capelin fishing season is generally short and corresponds with the pre-spawning period for the seine fishery and with the spawning period for the trap and weir fisheries. Seiners and trap fisheries target mature females destined for export to Asian markets. The emergence of these markets is the cause of the marked increase in landings observed at the end of the 1970s (Grégoire et al. 2013). Whereas they were once released or used as fishmeal or fertilizer, males are now also marketed as a food fishery and are also sold to zoos and marine parks in the United States and China.

Capelin fishing in the estuary and GSL is managed by a total allowable catch (TAC). Since 1999, the TAC has been shared among the different fleets in the GSL (Table 1). The main fishing gears used are the purse seine, the tuck seine, and the trap. NAFO Division 3Pn is included in the Integrated Fisheries Management Plan (IFMP) for Divisions 4RST, but has never been included in the stock assessment.

Table 1. Sharing arrangements of capelin TAC in the estuary and GSL by NAFO Division and gear type. Capelin fishing areas (CFA) are indicated in brackets.

NAFO Division	Gear	Type of quota	Sharing arrangement (%)
4R (12*-14)	Fixed gear	Competitive	37.82
	Mobile gear < 65’	Individual	24.15
	Mobile gear ≥ 65’	Competitive	24.15
4ST (15-16)	All gear types	Competitive	13.88

*CFA 12 includes NAFO Division 3Pn.

ANALYSIS

Commercial Fishery

Description of fishing activities

From 1985 to 2020, annual landings varied considerably (mean 6 903 t, standard deviation ± 3 422 t) and were characterized by a number of years in which no or very few landings are reported (*e.g.*, 1982, 1987, 1994, 1995, 2001, and 2017). Data from 2017 to 2020 indicate that landings increased from 2 044 t in 2017 to 8 503 t, 8 487 t and 9 848 t respectively over the past 3 years (Figure 3). During the assessment of capelin 4RST 2018, the low landings in 2017 were attributed to the later sea ice retreat in some areas and to poor weather conditions, limiting the possibilities of harvest (DFO 2018). The TAC for this fishery was exceeded in 1992, 1993 and 2020 (Figure 3).

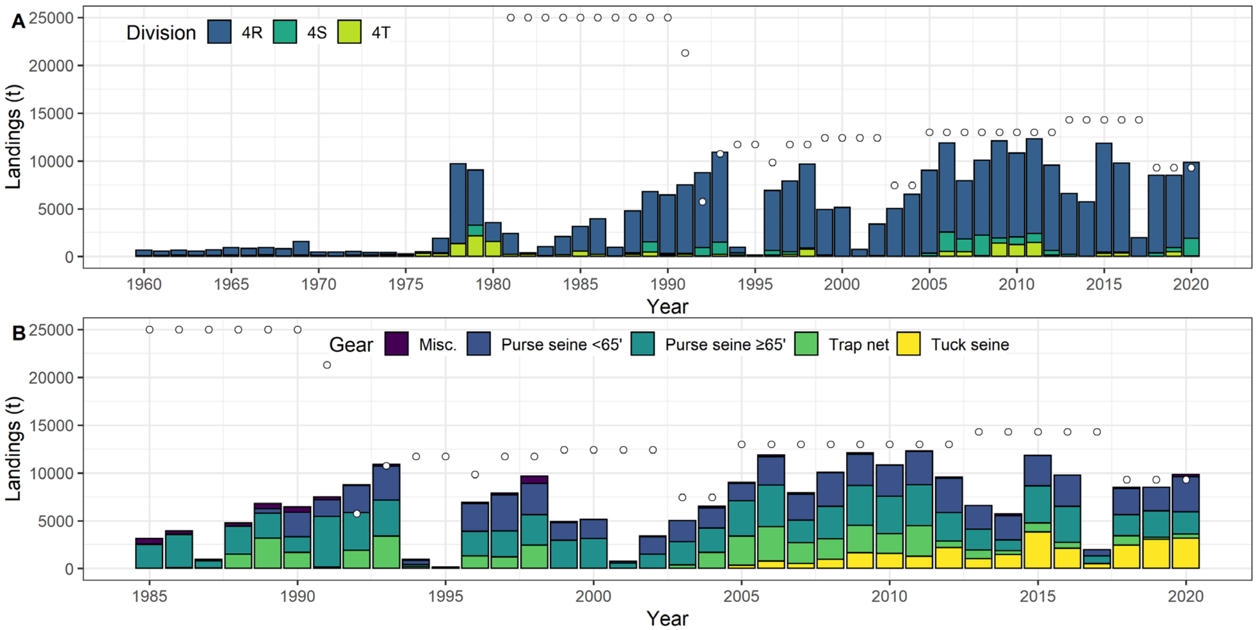

Figure 3. Capelin landings (t) by (A) NAFO Division from 1960 to 2020 and (B) by main fishing gear for the 1985-2020 period. The white circles represent the TAC. 2019 and 2020 landings are preliminary.

Capelin landings are dominated by the seine fleet (small and large purse seiners) in NAFO 4R taking 93% of the total landings from 2000 to 2020 (Figure 3). An increase in fixed gear landings has been observed since the mid-2000s. This increase is largely attributable to the arrival of Tuck seine in the fleet, which is considered a fixed gear despite its mobility (Figure 3).

Within NAFO Division 4R, landings were generally from unit areas 4Rabc and were more evenly distributed from 2018 to 2020 than in previous years. Since 2012, large and small purse seiners have landed similar proportions of the TAC and landings with traps represent a lower proportion of the total catches in this Division.

Purse and tuck seine fishery performance in Division 4R

A fishery performance index, expressed in tonnes per boat per day, is estimated through a standardization of catch rates for the purse and tuck seine fishery in Division 4R. The performance index increased rapidly from 2004 to reach the time series maximum in 2013 at 57.9 t / day following a 12-year period in which it was below the long-term average (30.7 t / day). The performance index subsequently remained above the long-term average varying between a maximum value of 55.0 t / day (2014) and a minimum of 37.0 t / day (2017) to stand at 44.0 t / day in 2020 (Figure 4).

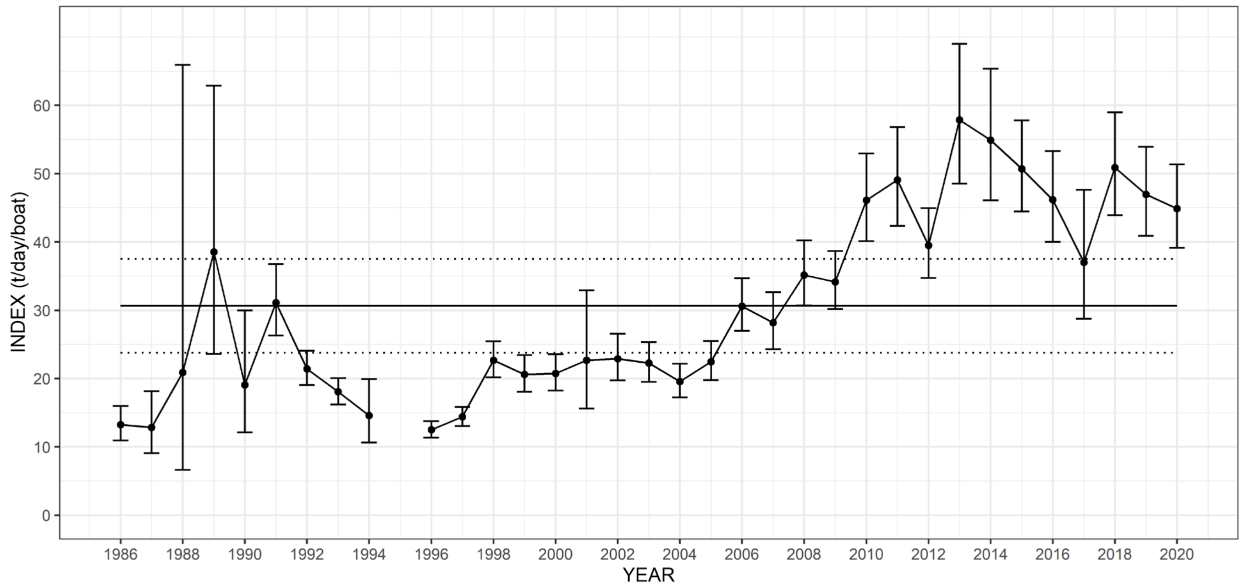

Figure 4. NAFO Division 4R purse and tuck seine performance index, 1986 to 2020.

Fishery Independent Data

Capelin in the southern and northern gulf bottom trawl surveys

The relative catchability of capelin in DFO bottom trawl surveys was analyzed in relationship with habitat characteristics and demersal predators to determine if the data from these surveys could provide information on the relative abundance of capelin. These analyses revealed that capelin were relatively abundant and captured consistently in hauls made in areas of the GSL where the cold intermediate layer (CIL) touches the sea floor. Although the presence of predators may decrease the catchability of capelin near the bottom, their inclusion brought negligible improvement in model fit. These results therefore suggest that it seems possible to use the tows data from the surveys, particularly those carried out in the CIL, to estimate relative abundance indices.

Capelin caught in the southern GSL (sGSL) and northern GSL (nGSL) surveys are on average smaller than those caught in the commercial fishery (Figure 5). Capelin caught in the sGSL survey in September are on average smaller than those caught in the nGSL survey. Comparison of the length frequencies of capelin in the surveys with historical length-at-age data from the commercial fishery in the GSL suggests that the capelin captured in the sGSL survey would be predominantly composed of individuals aged 1 and 2 years old while those caught in the nGSL survey would be mostly 2 years old with a low proportion of 1 and 3 years old (Figure 5). These observations suggest that the sGSL acts as a nursery for capelin in the GSL, a hypothesis that has been proposed previously in the literature.

The differences in size structure between the 2 surveys are unlikely to be caused by differences in selectivity, as capelin of very similar sizes are caught in the area where the two surveys overlap. The differences in size structure observed in the nGSL and sGSL surveys therefore suggest regional differences in the demographic structure.

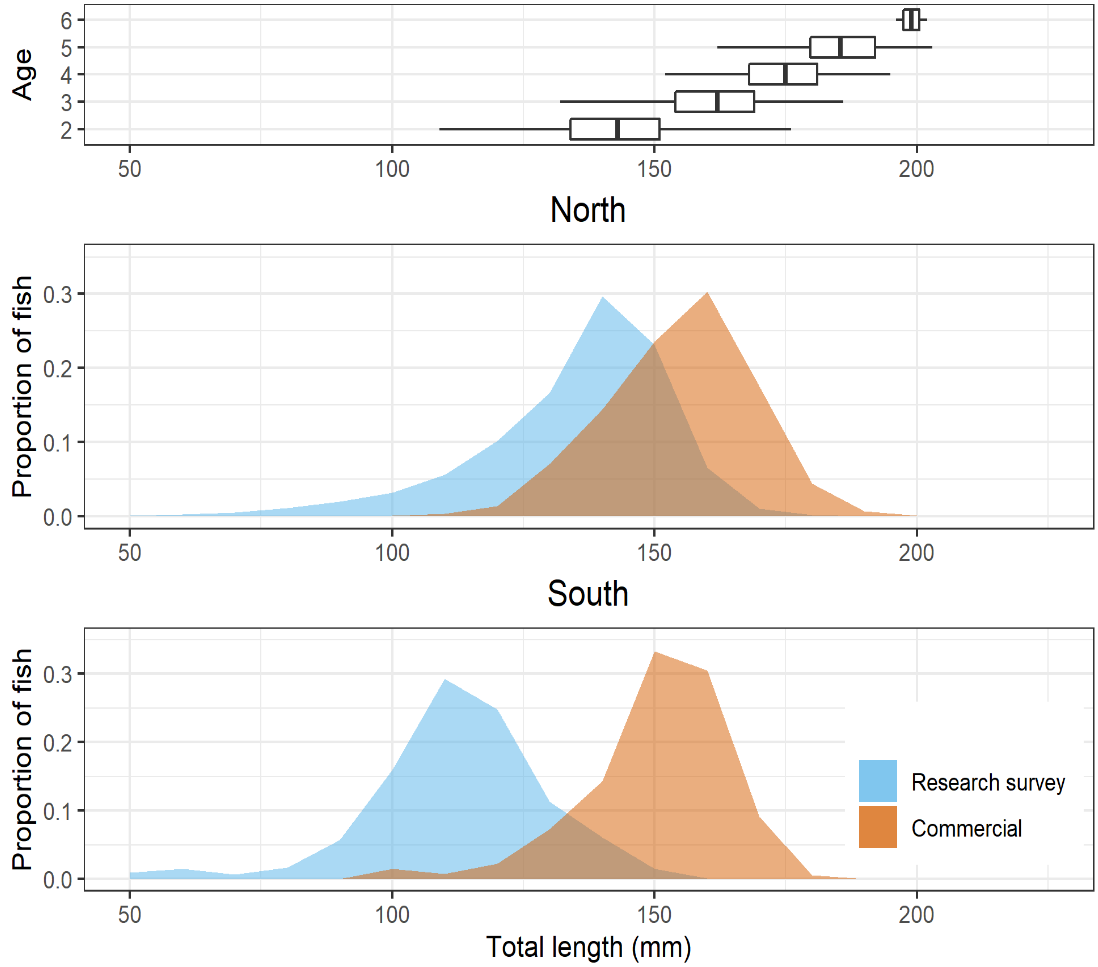

Figure 5. Length-at-age (top panel, 1984-1993 data from the Gulf of St. Lawrence, GSL) and relative frequency distribution of the length of capelin caught in the northern and southern surveys of the GSL (blue), compared to those observed in the commercial fishery (orange).

Based on known life history traits and inferred low fishing mortality in the GSL (see next section), the difference in size frequencies of capelin caught during surveys in late summer and by commercial fishing in the spring and early summer indicate that a large proportion of the individuals targeted by the latter are probably no longer available for surveys due to mortality caused by post-spawning senescence.

Two capelin abundance indices were calculated for each of the sGSL and nGSL bottom trawl surveys. The first index was based on all tows performed in the core survey strata (strata that were consistently part of the sampling plan over the survey series, 1971-2020 for the sGSL, and 1990-2020 for the nGSL). The second index only considered tows performed in the preferred habitat of capelin, mainly the CIL, and assumed that capelin density in this habitat (50 to 120 m for the sGSL survey and 50 to 175 m for the nGSL survey) was more or less homogeneous.

In the nGSL, the abundance index based on the core strata was high and increased somewhat during the 1990s, to decrease to very low values during the first half of the 2000s. Afterwards, it gradually increased to peak in 2011 (as in the sGSL). The abundance index subsequently declined and, with the exception of 2017, fluctuated around a relatively low level until 2020. The indices based on the assumption of homogeneous density in the CIL followed a similar trend (Figure 6).

In the sGSL survey, capelin were rarely caught and only in small quantities prior to 1990 (not shown), suggesting that capelin were scarce and / or less available to bottom trawl due to the high abundance of cod in 4T during the period preceding its collapse in the early 1990s. These results, therefore, do not allow us to interpret the variation in abundance before 1990. The abundance index for the core strata was stable at low levels in the 1990s, peaked in 1999, then declined until the mid-2000s, and increased again to reach maximum values of the time series in 2010 and 2011 (Figure 6). The abundance index subsequently declined to remain generally above the long-term average until 2020. The index based on the assumption of homogeneous capelin density in the CIL followed a similar trend (Figure 6).

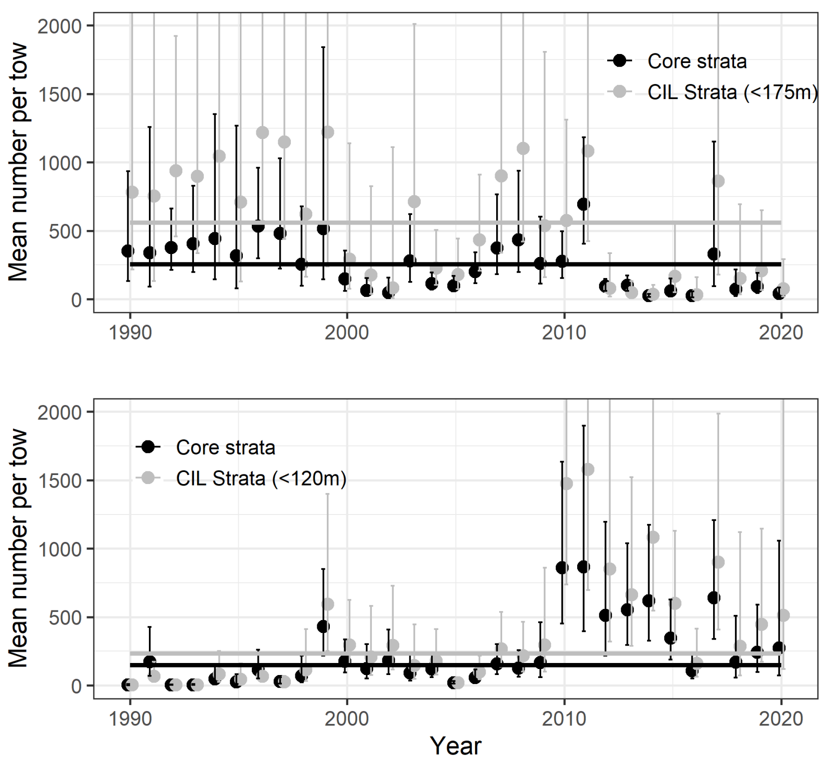

Figure 6. Capelin abundance indices estimated for the northern (top panel) and southern (bottom panel) Gulf of St. Lawrence (GSL) surveys calculated from the core strata (black) and from the tows performed in capelin preferred habitat (CIL strata). Vertical bars represent 95% confidence intervals. Indices for the southern GSL before 1990 are not shown.

The choice of whether to estimate annual survey stratum means for deeper strata directly from catches in those strata or to assume that those means are equal to the means from strata in the preferred habitat does not affect the perception of long-term trends in capelin abundance. However, trends at a finer scale (*e.g.*, semi-decadal) may be affected to some degree by this choice.

Estimated order of magnitude of fishing mortality

The order of magnitude of fishing mortality for the whole stock (4RST) was estimated using data from bottom trawl surveys, catchability coefficients (*q*) from the literature for small pelagic in this type of survey and average landings over the last 3 years (2018-2020). Considering only the trawlable biomass, the exploitation rate estimates varied between 16 and 36% (respectively F = 0.17 and F = 0.44) depending on the choice of the abundance index and their interannual variation. By considering an estimate of the order of magnitude of the total biomass calculated from the trawlable biomass and a maximum value of *q* identified in the literature (*q* = 0.0045, herring in the sGSL survey, Benoît and Swain 2008), the estimated exploitation rates varied between 0.07 and 0.16% (respectively F = 0.0007 and F = 0.0016). In comparison, the natural mortality estimated from the maximum age of capelin would vary between 46 and 56% (respectively M = 0.62 and M = 0.82) according to conservative estimates (Table 2). Plausible levels of the inferred fishery exploitation rate are considered low when compared to those of other cautiously managed small pelagic stocks. For example Patterson (1992) compiled data for 28 stocks of 11 species of small pelagics and concluded that F smaller or equal to 2/3 M would prevent a decline in biomass. The estimated order of magnitude of capelin fishing mortality for the years 2018–2020 were at least an order of magnitude lower than assumed natural mortality rates.

Table 2. Estimates of capelin natural mortality using different methods based on a maximum age of 7 years old (conservative estimates). M: instantaneous fishing mortality rate.

M	Reference
0.62	Hoenig (1983)
0.77	Hamel (2015)
0.82	Then et al. (2014)

Ecosystemic Approach

Preliminary estimates of capelin consumption by two demersal predators

The consumption of capelin by two important predators in the nGSL, Atlantic cod (*Gadus morhua*) and Greenland halibut (*Reinhardtius hippoglossoides*), was considered from two perspectives. First, the interannual variation in the proportion of capelin in the diet of these predators was considered as a potential indicator of capelin abundance with the premise that these predators would consume capelin in proportion to their availability in the ecosystem. According to this premise, the average proportion of capelin in the diet of predators estimated from the sampling carried out during the bottom trawl surveys of the nGSL should reflect their relative abundance. Second, the total annual consumption of capelin by these two predators was estimated and considered to represent the lower limit of total consumption by all predators in the nGSL. By comparing these estimates to fishing removals, an upper bound of the ratio of fishing mortality to natural mortality can be determined, which in turn can be used as an indicator of the sustainability of the fishery. The interannual variations in the proportion of capelin in the diet of predators generally corresponded to those of landings, suggesting common changes in the availability of capelin to both predators and the commercial fishery. In addition, preliminary results showed that the total annual consumption of capelin by Atlantic cod and Greenland halibut would be on average 8 times higher than landings from the commercial fishery. Since capelin consumption by these two predators only represents a portion of what is consumed annually in the nGSL, fishing mortality would therefore only represent a small proportion of total mortality.

Relationship between interannual variations in capelin abundance indices and environmental indicators of the bottom-up regulation of survival and cohort strength

Interannual variations in spring 2-year-old capelin capelin biomass (t0) in NAFO Divisions 3KL are determined by the abundance of larvae produced 2 years earlier (age 0, t-2) and by winter and spring survival during the second year of life approximated by the autumnal body condition (Kn) of capelin (age 1, t-1) and the timing of the ice retreat the following spring (age 2, t0) (Buren et al. 2014, Lewis et al. al. 2019). This empirical model of capelin survival in 3KL implicitly considers the effect of bottom-up processes associating environmental conditions, capelin prey availability, its Kn and its survival. A similar conceptual model was applied to 4RST capelin using the new abundance indices developed from DFO bottom trawl surveys and specific environmental conditions observed in the northeastern GSL (neGSL), northwestern GSL (nwGSL) and sGSL.

A first step in the analysis tested the hypothesis of bottom-up relationships between environmental conditions and capelin Kn. Correlations between the timing of ice retreat and spring phytoplankton bloom were identified in neGSL, nwGSL and sGSL. The abundance and timing of surface development of the arctic, large-sized *Calanus hyperboreus* copepod was generally related to these variables, while the abundance and timing of the subarctic copepod *C. finmarchicus* was mainly associated with variations in the spring surface water temperature. Capelin Kn in the spring and late summer were associated with the timing of ice retreat, surface water temperature, and *Calanus* phenology, supporting the hypothesis of capelin bottom-up control of body condition (Lewis et al. 2019).

The second step of analysis tested the hypothesis of capelin abundance regulation by the bottom-up processes described above. Variations in Kn (or its environmental proxies) explained a high percentage (49% in the neGSL, 51% in the nwGSL and 61% in the sGSL) of the interannual variations of the new abundance indices in the GSL. In the neGSL, the Kn of 2-year-old capelin (t-1) were positively associated with the abundance index (age 3, t0) while the relationship with the timing of ice retreat (age 1, t-2) was bell-shaped, suggesting the existence of an optimal window for ice retreat and prey availability in this region (Figure 7, top panel). In the nwGSL, the Kn of 2-year-old capelin (t-1) had a generally positive association with abundance (age 3, t0) (Figure 7, second panel). In the sGSL, the time of ice retreat for 2 year olds (t0) and the summer surface temperature experienced by 1 year olds (t-1) had a negative and positive association on the capelin abundance index (age 2, t0) respectively (Figure 7, bottom panel). The model predictions fit the observed increase in abundance during the 2000s and their subsequent decrease reasonably well (Figure 7, left panels). The patterns in the abundance indices estimated from bottom trawl surveys in the GSL from 1990 to 2020 were therefore somewhat consistent with those that would be expected in response to the environmental variation known to regulate cohort strength for this species in 3KL (Lewis et al. 2019).

Qualitative network modeling

Qualitative network modeling was applied to capelin in order to assess the relative importance of top-down and bottom-up ecosystem effects on stock productivity. A conceptual model (network) making it possible to describe capelin's role in the estuary and GSL ecosystem was defined based on available knowledge in the scientific literature and in consultation with experts (Figure 8). Building a network involves identifying the variables of interest and / or importance, as well as defining the direction (positive, negative or neutral) of the links (effects) between the variables. The GSL capelin network was made up of 25 variables classified into 6 categories including among others stock productivity parameters, environmental variables, the main competitors and predators of capelin as well as fishing activities (Figure 8). Qualitative modeling consists in translating this network into a matrix of interaction coefficients for each pair of variables. The effect of a sustained change (disturbance) in one or more components of the network was evaluated for the variables of interest (*e.g.*, abundance of capelin). More than forty disturbance scenarios, each based on a large number of simulations, were carried out in order to assess the potential effects of changes observed in the GSL ecosystem on the productivity of the capelin stock, in combination with an increase or decrease in directed fishing. These ecosystem changes included, among others, an increase in water temperature, a decrease and early retreat of the ice cover, an increase in the biomass of redfish (*Sebastes spp.*) and gray seals (*Halichoerus grypus*), and a decrease in the biomass of Atlantic mackerel (*Scomber scombrus*) and Greenland halibut.

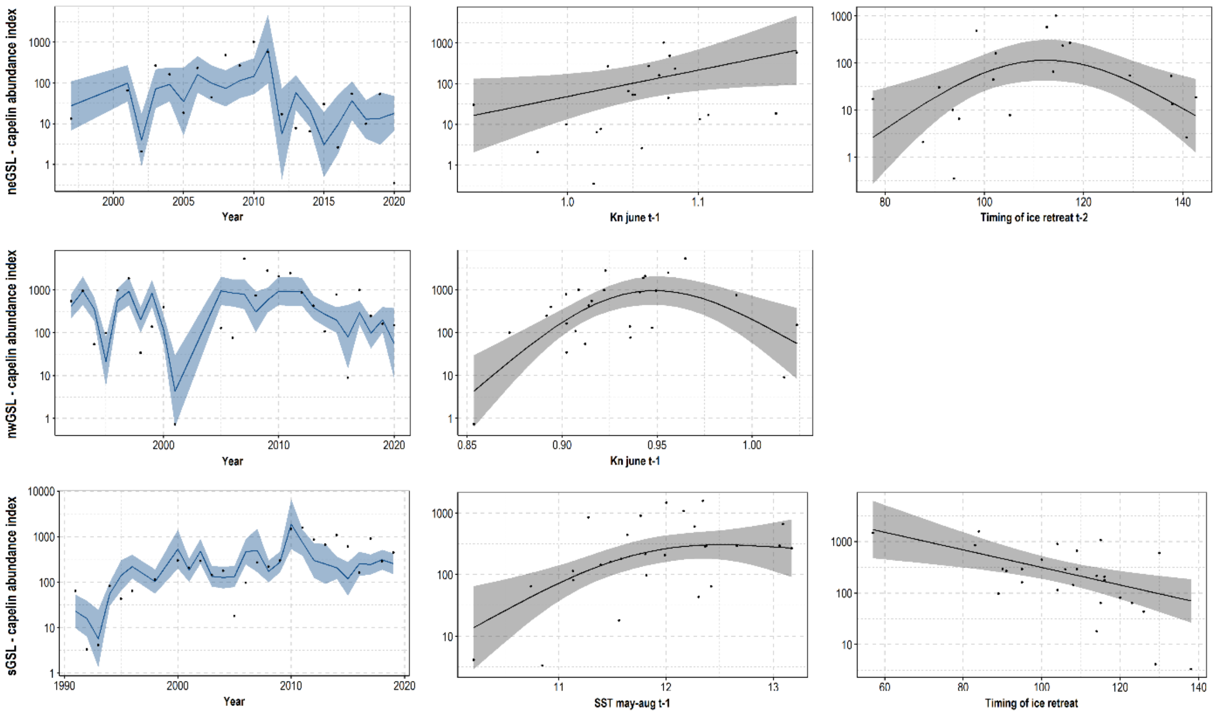

Figure 7. Selected models linking capelin abundance indices to factors influencing their survival for the northeastern Gulf of St. Lawrence (GSL; top panel), the northwestern GSL (second panel) and the southern GSL (bottom panel). Figures on the left show the predicted abundance index (blue line) and 95% confidence intervals (blue area) for each region. The black dots represent the index values for all panels. The right panels represent the model calibration (black line) and 95% confidence intervals (gray area) for each selected variable.

The results obtained indicated a positive effect of an increase in water temperature coupled with a decrease in ice cover on the abundance of capelin. Even when combined with changes in prey, competitors and / or predators of capelin, the increase in water temperature and the decrease in ice cover generated an increase in capelin abundance in the majority of the simulations. Only an increase in directed fishing slightly decreased the probability of an increase in capelin abundance, but the positive effect of environmental variables remained predominant.

These results need to be further corroborated by sensitivity analyses and robustness tests. Qualitative modeling makes it possible to explore the potential outcomes of ecosystem hypotheses in a multivariate context, taking into account the complexity of the links and interactions that link stocks to their environment

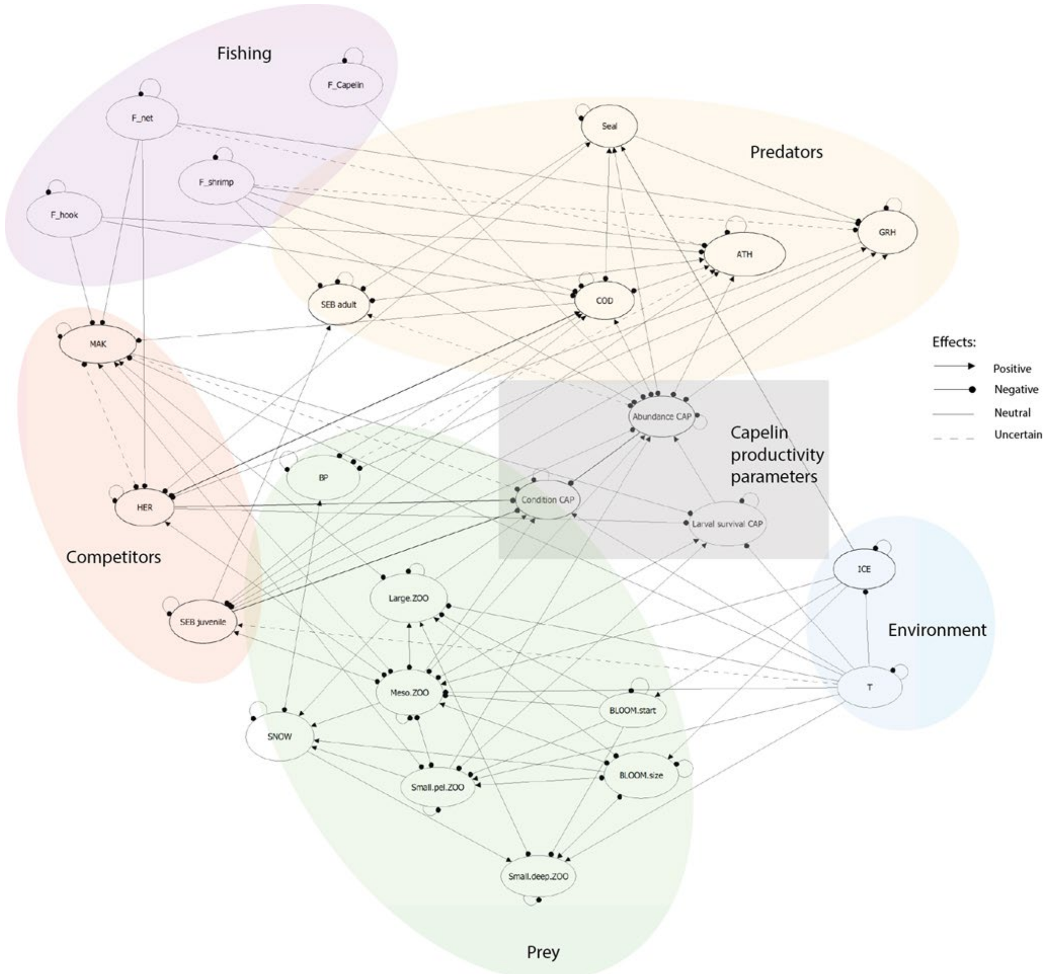

Figure 8. Conceptual model of capelin in the GSL ecosystem, including stock productivity parameters (gray box), environmental variables (blue bubble), lower GSL trophic levels (green bubble), a set of key competitors and predators (respectively orange and yellow bubbles) and fishing activities (purple bubble). Arrows indicate positive links and dots indicate negative links. The uncertain links correspond to links randomly included or excluded from the interaction matrices during the simulations. CAP : capelin; T: surface water temperature; ICE : ice cover: extent and date of retreat; BLOOM.start : Start date of plankton bloom; BLOOM.size: Amplitude of bloom/abundance of phytoplankton; Small.pel.ZOO : Small size zooplankton/pelagic types (small calanoids including pseudocalanus spp., Acartia spp., Temora longicornis); Small.deep.ZOO : Small size zooplankton/demersal types (including Microcalanus spp., Scolecithricella sp., cycloipoids (Oithona spp. and Triconia spp.)); Meso.ZOO : Medium size zooplankton (large calanoids (Calanus spp. and Metridia spp.); Large.ZOO : Macrozooplankton (euphausiids, hyperiid amphipods, chaetognaths, cnidarians, etc.); SNOW : Organic matter in sedimentation, including small (marine snow/organic aggregates of various origins) and large (carcasses, faeces, soil debris, etc.) particles; BP : Benthic preys; Seal : Grey seal (Halichoerus grypus); COD : Atlantic cod; SEB adult : Adult sebastes; ATH :Atlantic halibut (Hippoglossus hippoglossus); GRH : Greenland halibut; MAK : Atlantic mackerel; HER : Atlantic herring (Clupea harengus); SEB juvenile : Juveniles sebastes spp.; F_Capelin : Directed capelin fishing; F_shrimp : Directed shrimp (Pandalus borealis) fishing bottom trawl; F_hook : Longline fishing activities; F_net : Net and / or seine fishing activities (excluding directed capelin fishing).

Sources of Uncertainty

The development of abundance indices from scientific bottom trawl surveys represents an improvement compared to previous assessments, but several sources of uncertainty associated with the indices presented will need to be addressed in the future. In particular, there is uncertainty as to whether the density of capelin is horizontally homogeneous in the CIL, or if the densities in this habitat are lower when the CIL is found above deeper depths. Resolving this would inform assumptions made when devising an abundance index. An examination of trawl mensuration data from the surveys to determine how trawl opening is reduced as the trawl moves through the water column during retrieval could reduce this uncertainty. The in-depth analysis of the acoustic data collected during the bottom trawl surveys could also be useful to validate the hypothesis of homogeneous horizontal density in the CIL and possibly lead to the development of an acoustic abundance index.

The catchability of capelin did not appear to be greatly affected by predation indices or habitat characteristics sampled in the sGSL, but the analyzes did not allow this effect to be quantified for the nGSL survey (violation of model premises). Also, changes in the characteristics of the CIL have not been linked to the catchability of capelin in the surveys and could bias the abundance indices. Additional analyzes would be needed to examine the effects of these changes and reduce the uncertainties associated with possible variations in capelin catchability in the surveys.

Finally, another source of uncertainty relates to the fact that the fishery, concentrated on the West coast of Newfoundland, has been linked to indices of abundance at the GSL scale. There is therefore a risk of local depletion and this uncertainty has not been addressed for the moment.

CONCLUSIONS AND ADVICE

The sGSL survey abundance indices were slightly above average for the years 2018 to 2020. The nGSL abundance indices were at low levels and below average for the past 3 years.

Because capelin have a short lifespan and populations consist of only a few age groups, their abundance is subject to large fluctuations. As these variations mostly regulated by environmental factors, it is currently difficult to accurately estimate the impact of fishing on GSL capelin. However, plausible levels of the inferred exploitation rate from the fishery were at least an order of magnitude lower than natural mortality (M) calculated based on life history traits and at least 8 times lower than natural mortality caused by predation. It is therefore unlikely that the current fishing mortality will adversely affect the capelin stock in NAFO Divisions 4RST.

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SOURCES OF INFORMATION

This Science Advisory Report is from the March 18-19, 2021 Regional Advisory Meeting on the Assessment of capelin in the Estuary and Gulf of St. Lawrence (NAFO 4RST) in 2020. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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