



# GEORGES BANK ATLANTIC COD (*GADUS MORHUA*) ASSESSMENT TO 2023

## CONTEXT

The Fisheries Management Branch of Fisheries and Oceans Canada (DFO) requested that interim advice for the 2025 fishing year be provided for the [5Zejm Atlantic Cod management area](#) while the assessment framework review is being completed. This Science Advisory Report is from the regional peer review held July 8-12, 2024 on the Framework Review for Atlantic Cod in NAFO Division 5Z: Part 2 - Modelling Review and Interim Advice for Eastern Georges Bank Cod and Stock Assessment of Haddock on Eastern Georges Bank. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

## SCIENCE ADVICE

### Status

- The 2023 stock status is uncertain, as reference points for this stock have not been finalized.

### Trends

- The population spawning stock biomass (SSB) has decreased to a record low in 2023.
- The 2023 fishery catch is at a series low. Fishing mortality reached a series low in 2017, and has since increased slightly to 0.07 in 2023 (Figure 1).
- Size at age has been increasing from the low levels observed throughout the 2010s
- Recruits per SSB in the last three years have been the highest since 1978, within the context of record low spawning stock biomass. However, the higher recruitment has not resulted in an increase in the number of fish at ages 3+.
- Currently, factors other than fishing are limiting stock productivity of total Georges Bank cod. Numbers of older fish in the population continue to decline at a high rate, and natural mortality is inferred to be the primary cause.

### Ecosystem and Climate Change Considerations

- The high rate of decline in numbers of adult Atlantic cod in this stock is attributed principally to natural mortality.
- The most commonly identified contributors to natural mortality for Atlantic Cod in this region are high temperature and predation. Both have undergone substantial changes in recent years, with bottom temperature anomalies registering record highs on Georges Bank and

the grey seal population which has increased considerably over the past several decades. There is no indication that the trends in temperature or predation will reverse in the near future.

### **Stock Advice**

- Reference points, as well as reliable projections of the stock biomass under various fishing scenarios, cannot be provided until the completion of the assessment framework review. In the absence of reference points or reliable projections, interim advice is provided for the 2025 fishing year only.
- Given the trends in recent mortality rates estimated by the model, and in order to constrain risks to the population, catches of eastern Georges Bank Atlantic cod should not increase in the 2025 fishing year.

### **Other Management Questions**

- A method to split the total Georges Bank assessment model outputs to match the eastern Georges Bank management unit was requested by Fisheries Management. The peer reviewed method attributes 93% of the total Georges Bank advice in 2025 to the eastern Georges Bank management unit.

## **BASIS FOR ASSESSMENT**

### **Assessment Details**

#### **Year Assessment Approach was Approved**

The population model was developed and adopted in 2024 (Andrushchenko et al. In Prep). This assessment to provide interim advice was conducted during the peer review meeting when the population model was accepted. The development of projections and reference points will be completed in the next peer-review meeting of the assessment framework review (planned Winter 2025).

#### **Assessment Type**

Full assessment: Full peer-review stock assessment

#### **Most Recent Assessment Date**

1. Last Full Assessment: July 2018 (TRAC 2018; Andrushchenko et al. 2018)
2. Last Interim Year Update: July 2023 (TRAC 2023)

#### **Assessment Approach**

1. Broad category: single stock assessment model
2. Specific category: state-space model

### **Stock Structure Assumption**

Atlantic Cod in DFO statistical unit areas 5Zejmhn comprise of a single stock spanning US and Canadian waters. Although some mixing exists with adjacent stock units, the transboundary Atlantic Cod are currently assessed as a single unit.

## Reference Points

There are no accepted reference points for this stock as they are currently being developed. Previous reference points developed in 2013 are not appropriate for use as the models they were based on have been rejected.

- Limit Reference Point (LRP): NA
- Upper Stock Reference (USR): NA
- Removal Reference (RR): NA
- Target Reference Point (TRP): NA

## Data

Inputs to the population model are:

- DFO Winter Ecosystem Research Vessel Survey (1987–023; except 2022)
- US NMFS Spring Research Vessel Survey (1978–2023; except 2020 and 2023)
- US NMFS Fall Research Vessel Survey (1978–2023; except 2020)
- Canadian Fishery data (1978–2023)
- US Fishery data (1978–2023; except 2021, 2022, and 2023)

## ASSESSMENT

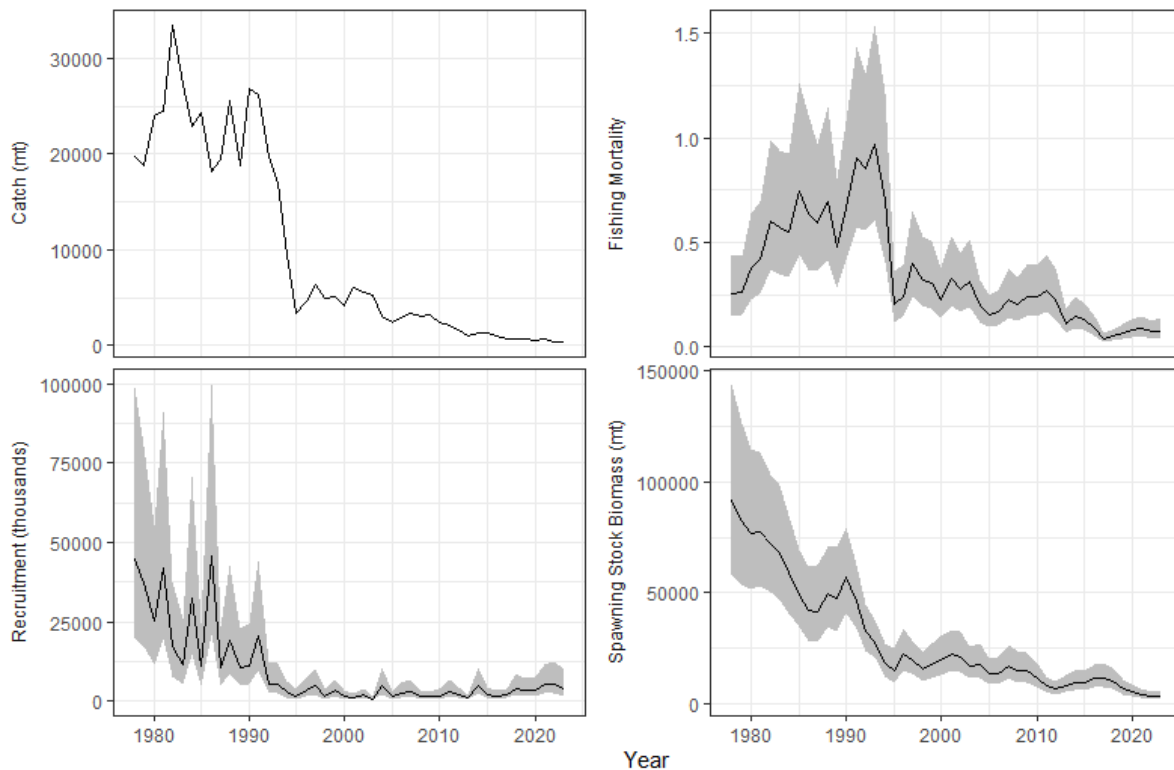


Figure 1. (A) Catch, (B) Spawning Stock Biomass (SSB) (C) Fishing Mortality, and (D) Recruitment (numbers, 000s) for the total Georges Bank model (5ZEjmh).

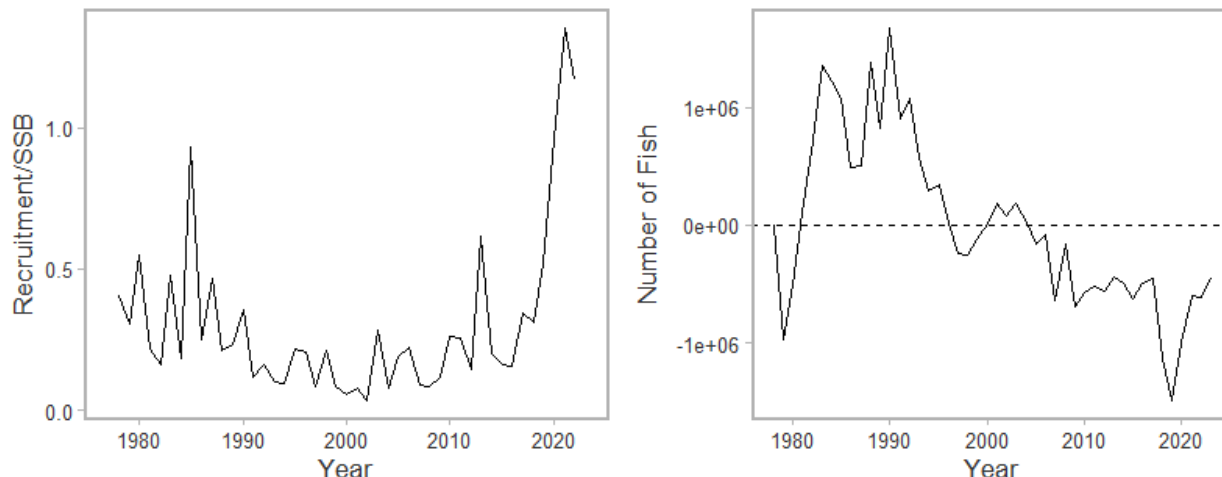


Figure 2. (A) Recruitment rate (recruitment/spawning stock biomass [SSB] in thousands/mt), (B) Total number of fish Ages 5+ gained (positive) or lost (negative) due to process error in the model.

## Stock Status and Trends

### Biomass

Following a notable decrease in SSB in the early 1990s, the stock has experienced a gradual decline and has reached a series low in 2023. A temporary increase in SSB throughout the mid-2010s appears to have been caused by an influx and subsequent departure of fish from outside of the assessment unit (Figure 1).

### Fishing Mortality

Fishing mortality was high in the 1980s (0.25-0.75), but declined throughout the 2000s and 2010s to a series low in 2017 (<0.04). It has since increased to 0.07 (Figure 1). Currently, factors other than fishing are limiting stock productivity of total Georges Bank cod (Figure 2).

### Recruitment

Recruitment has remained low for this stock since the mid-1990s (Figure 1). Recruits per SSB in the last three years have been the highest since 1978, within the context of record low spawning stock biomass (Figure 2). However, the higher recruitment is not resulting in increases in the number of fish at ages 3+.

### Natural Mortality

Numbers of older fish in the population continue to decline at a high rate, and natural mortality is inferred to be the primary cause. There are no indications that the high level of natural mortality will decrease in the near future and appears to be the main factor limiting productivity for this stock.

## History of Landings and Total Allowable Catch

Total catches (includes landings and discards) and total allowable catch (TAC) of Atlantic Cod on total Georges Bank are provided in Table 1. Canadian and US catches and Canadian TAC are based on calendar year (Jan 1–Dec 31). The TAC for the US is based on fishing year (May 1- Apr 30) for the old TGB management unit prior to the revision of stock area boundaries.

Table 1. Catches (includes landings and discards) and total allowable catch (TAC) in metric tons for the total Georges Bank (TGB) Atlantic Cod assessment unit. Total catches from 2004–2014 are provided as an average. Note that United States (US) TAC\* is only available for the old TGB cod unit fishing year (May 1–Apr 30), as the revised TGB unit did not exist prior to 2024. Canadian and US catches and Canadian TAC are for calendar year (Jan 1–Dec 31).

Country	Year	2004-2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Canada	TAC	982	526	488	584	694	461	461	444	411	436
Canada	Total Catches	912	492	440	488	517	396	377	431	326	329
US	TAC*	3,506	1,980	761	665	1,591	1,824	1,291	1,308	343	468
US	Total Catches	2,952	805	645	205	228	239	225	184	98	87

## Projections

Reliable projections cannot be provided until the completion of the current framework planned for Winter 2025.

## Ecosystem and Climate Change Considerations

The model indicates that there is a high rate of decline in numbers of adult Atlantic cod in excess of fishery removals from this stock, and this is attributed principally to natural mortality. The most commonly identified contributors to natural mortality for Atlantic Cod in this region are high temperature and predation (McBride and Smebdol 2022). Both of these have undergone substantial changes in recent years, with bottom temperature anomalies registering record highs on Georges Bank and the grey seal population which has increased considerably over the past several decades. There is no indication that the trend in either contributor will reverse..

From 2015 to 2017, abundance suddenly increased across ages and is interpreted as movement of fish from outside of Georges Bank into and then out of the area.

## OTHER MANAGEMENT QUESTIONS

The provision of a method of splitting TGB assessment model outputs to match the EGB management unit was requested by Fisheries Management. The distribution of cod biomass across the area can be reasonably estimated using the research survey data. The smoothed annual proportion of biomass on EGB averaged across the three surveys provides a means of allocation (Andrushchenko et al. In Prep). The terminal value is taken as the proportion for the advice. The application of this method attributes 93% of the TGB advice in 2025 to the EGB management unit.

## SOURCES OF UNCERTAINTY

Until reliable projections are developed in the next steps of the development of the assessment framework for this stock, the future trajectory of the stock biomass is uncertain.

Natural mortality appears to be the main factor limiting productivity for this stock. Though trends in both temperature and predation accompany the increase in natural mortality, the mechanistic

relationships between the drivers and natural mortality were not explicitly established for this stock.

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### SOURCES OF INFORMATION

Andrushchenko, I, C.M. Legault, R. Martin, E.N. Brooks, and Y. Wang 2018. Assessment of Eastern Georges Bank Atlantic Cod for 2018. TRAC Ref. Doc. 2018/01: 101p.

McBride, R. S. (editor) and Smedbol, R. K. (editor) (2022). [An Interdisciplinary Review of Atlantic Cod \(\*Gadus morhua\*\) Stock Structure in the Western North Atlantic Ocean.](#)

TRAC. 2023. [Eastern Georges Bank Cod](#). TRAC Status Report 2023/03.

TRAC. 2018. [Eastern Georges Bank Cod](#). TRAC Status Report 2018/01.

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