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NAFO SUBDIVISION 3PS ATLANTIC COD (*GADUS MORHUA*) STOCK ASSESSMENT IN 2025

CONTEXT

The Fisheries Management Branch of Fisheries and Oceans Canada (DFO) has requested updated advice on the status of North Atlantic Fisheries Organization (NAFO) Subdivision 3Ps Atlantic Cod to inform decisions for this stock for the 2026/27 management period. This stock is prescribed under section 6 of the Fisheries Act. A management procedure to inform the annual Total Allowable Catch (TAC) has been adopted as part of a Rebuilding Plan, for this stock. This Science Advisory Report is from the regional peer review of November 4–7, 2025, 3Ps Atlantic Cod Assessment. 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 2026 Spawning Stock Biomass (SSB) is projected to be below the Limit Reference Point (LRP) with a greater than 99% probability. The stock remains in the Critical Zone.

Trends

- The stock has been in the Critical Zone since 2000, with SSB near time series lows between 19 kt and 30 kt since 2009. SSB for 2026 is estimated at 26.7 kt (95 % Confidence Interval [CI] = 20.7 to 34.3), which is 40% (95% CI = 31 to 52 %) of the LRP (66 kt).

- The stock has not achieved the growth expected under the Rebuilding Plan.

- Recruitment has been impaired since the early-1990s. Persistently low recruitment at a critically depleted stock size suggests the potential for stock growth will remain low.

- Natural mortality (M) increased considerably from the early-2000s to the 2010s, reaching a time series high in 2019, but has decreased since, reflecting improvements in cod condition. The average M estimate for ages 5–8 in 2025 is 0.31 (95% CI = 0.31 to 0.32), near time-series average levels (0.33).

- Fishing mortality (F) has declined since the early 2000s. Average F for ages 5–8 been low (range = 0.02 to 0.04) since 2020.

Ecosystem and Climate Change Considerations

- The ecosystem in 3Ps is undergoing structural changes associated with changing ocean climate. Ongoing oceanographic changes are important drivers of observed community shifts.

- The low level of cod biomass, its decline in dominance among piscivores, and declining weights at age indicate that cod productivity in 3Ps remains hindered.

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- Cod productivity in 3Ps is expected to be negatively impacted as ocean warming continues.

Stock Advice

- Following the management procedure, the maximum total allowable catch would be 1,465 t for 2026. However, as current stock size is likely overestimated there is heightened risk that removals at this level would exceed the maximum F defined in the Rebuilding Plan.

- Shifts in stock distribution and reduced growth have led to a major change in the understanding of this stock. As such, multi-year projections were not provided and a review of the Rebuilding Plan and the associated management procedure is warranted.

- Given the low status and productivity of the stock, removals from all sources should be at the lowest possible level until the stock clears the Critical Zone.

BASIS FOR ASSESSMENT

Assessment Details

Year Assessment Approach was Approved

2019 (Varkey et al. 2022)

Assessment Type

Full Assessment

Most Recent Assessment Date

1. Last Full Assessment: 2024 (DFO 2025)

2. Last Interim-Year Update: N/A; this stock is assessed annually.

Stock Assessment Approach

1. Broad category: Stock assessment model

2. Specific category: State-space age-based stock assessment model

This assessment uses a custom state-space age-based stock assessment model (Hybrid, Varkey et al. 2022) to estimate stock trends since 1959. The model incorporates fisheries and survey data to estimate time-varying processes in F and M. Cod condition informs trends in M.

A complementary State-Space Assessment Model (SAM; Champagnat et al. 2024) is also examined in this assessment as a consistency check and showed similar trends to the Hybrid assessment model. In the terminal year, SAM shows a decrease in recruitment not evident in Hybrid.

Ecosystem and Climate Change Assessment Approach

The physical environment was characterized by examining trends in ocean climate using oceanographic indicators, and the Newfoundland and Labrador Climate Index (NLCI). Food web components examined included:

1. lower trophic levels, characterized using primary production, and zooplankton indicators,

2. status and trends of the fish community, and

3. a review of available seabird and marine mammal information.

The characterization of ecological and environmental interactions included fish diets, and estimations of food consumption. Habitat considerations included information on biological diversity, Significant Benthic Areas, and area-based management measures. Aggregated fisheries metrics considered included fishing footprint, and the risk of ecosystem overfishing. Pathways for climate change impacts explored the link between ocean climate and ecosystem productivity, and the potential impact of changes in NLCI variability. A mortality index informed by cod condition is used to incorporate bottom-up processes into the assessment model.

Stock Structure Assumption

Stock structure of Atlantic Cod in NAFO Subdivision 3Ps is complex, including inshore and offshore, and migratory and non-migratory components. Tagging and genetic studies show some mixing with adjacent stocks though the extent of this is unknown. These stock components are managed collectively as a single stock with one Limit Reference Point (LRP).

Reference Points

- Limit Reference Point (LRP): 66 kt. The LRP was determined based on visual evaluation of recruitment and Spawning Stock Biomass (SBB) scatter to determine the point below which only low recruitment has been observed, and was supported by break-point analyses (DFO 2020).

- Upper Stock Reference (USR): N/A; not defined.

- Removal Reference (RR): N/A; not defined.

- Target Reference Point (TRP): N/A; not defined.

Management Objectives

This stock is subject to a Rebuilding Plan, the primary objective of this Rebuilding Plan is to promote stock growth out of the Critical Zone (i.e. grow the stock above the LRP), by ensuring removals from all fishing sources are kept to the lowest possible level until the stock has cleared this zone. In support of this Rebuilding Plan the stock assessment evaluates:

- whether the median SSB estimates from the updated model fall within the 75% probability envelope from the rebuilding projections under prevailing productivity conditions (DFO 2023),

- whether there has been a sustained decline in the stock of three or more years, and

- whether scientific information indicates a major change in the understanding of the stock.

Data

- DFO Canadian Research Vessel (RV) survey (1983–2005, 2007–19, 2021–22, 2024–25)

- France ERHAPS survey (1978–91)

- GEAC industry survey (1997–2005)

- Sentinel line trawl and gill net surveys (1995–2024)

- Commercial fishery landings and catch at age (1959–2024)

- Atlantic Zone Monitoring Program (2008–25)

- MODIS/Aqua surface chlorophyll (2003–25)

- Mark-recapture tagging data (2001–24)

Data changes:

- Stock weights applied in the assessment model were previously estimated using only offshore strata of the RV survey. Given changes to the relative distribution of cod in recent surveys and differences in size-at-age across the survey area, these have been revised to incorporate both inshore and offshore strata, changing stock weight estimates since the early 1990s. This has led to a significant decrease in estimated size-at-age and SSB (Figure 2D).

- Commercial catch-at-age for 2023 was re-estimated following a small correction.

- Sentinel index standardization was expanded to include additional data.
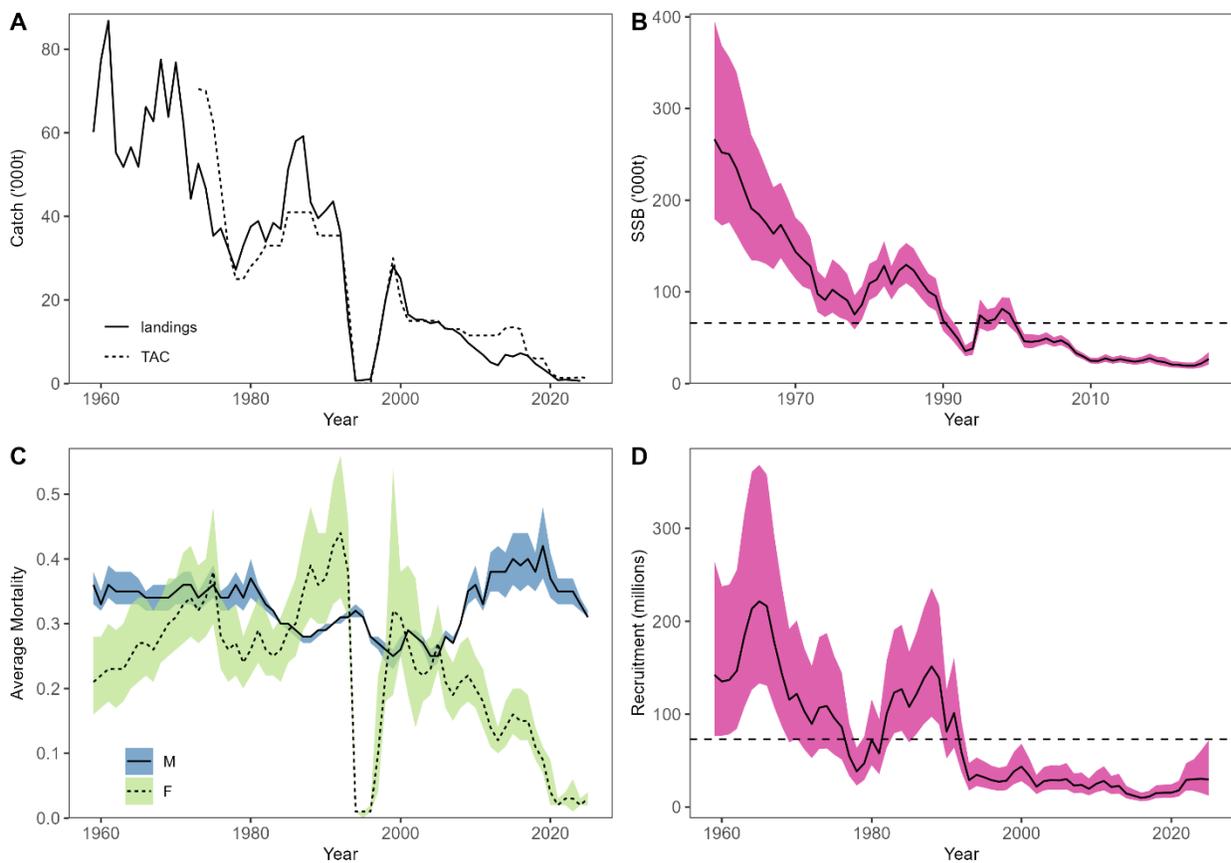
ASSESSMENT

Figure 1. A) Reported annual landings (solid) and Total Allowable Catch (TAC) (dashed). B) Estimates of SSB (solid black line = median estimate; shaded area = 95% confidence interval) relative to the LRP (dashed line; LRP = 66 kt SSB). C) Average Natural (M; solid line) and Fishing (F; dashed line) mortality, ages 5–8; estimates with shaded 95% confidence intervals. D) Estimated recruitment (median estimate of age-2 abundance, with 95% confidence interval), with the time-series mean (dashed horizontal line = 73 million).
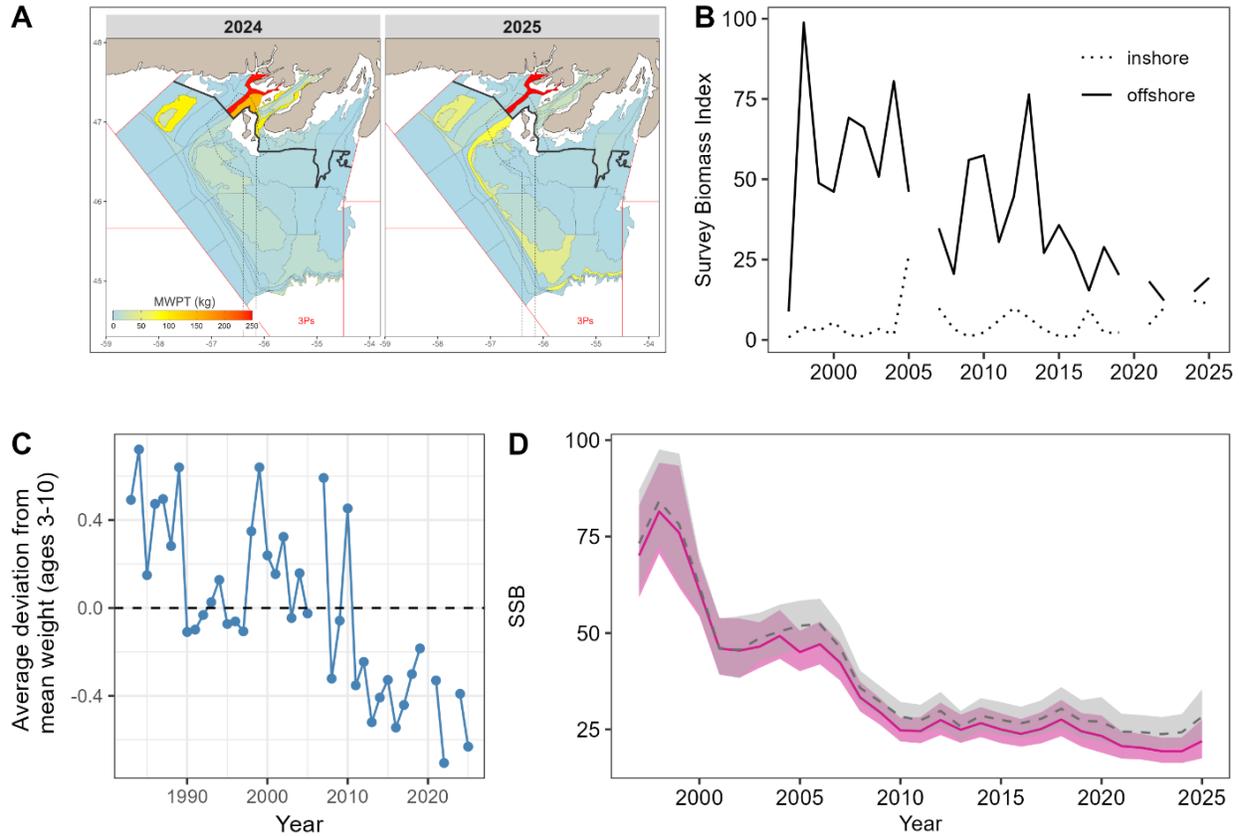
Figure 2. A) Mean weight per tow (MWPT, kg) by survey strata from 2024 and 2025 shows a continued shoreward distribution of this stock. The solid grey line denotes the boundary between "inshore" and "offshore" strata. The survey area was expanded to include the inshore strata in 1994 and 1997. B) Survey biomass indices since 1997 for inshore (dotted) and offshore (solid) strata show significant declines in the offshore. C) Average deviation in mean weight-at-age for cod ages 3–10 in the RV survey, with negative deviations indicating smaller sizes. D) Comparison in SSB estimates using stock weights calculated from fish in offshore strata only (grey dashed line with 95% CIs) as used in previous assessments, and with the weights updated to include inshore strata (pink solid line as in Figure 1B) for use in the current assessment and going forward.

Stock Status and Trends

Table 1. Estimates of recent 3Ps cod population size and mortality rates from the Hybrid assessment model.

Year	SSB. median, 95%CI (000 t)	SSB/Blim (median)	Recruits. median, 95%CI (millions)	Average M (ages 5–8)	Average F (ages 5–8)
2021	20.7 (17.5, 24.5)	31%	17.9 (11.4, 28.3)	0.35	0.02
2022	20.2 (17.2, 23.8)	31%	29.3 (18.1, 47.4)	0.35	0.03
2023	19.4 (16.4, 22.9)	29%	30.0 (17.4, 51.5)	0.35	0.03
2024	19.3 (16.3, 22.9)	29%	30.5 (15.2, 61.2)	0.33	0.02
2025	22.0 (17.5, 27.5)	33%	29.7 (12.2, 71.9)	0.31	0.03
2026	26.7 (20.7, 34.3)	40%	-	-	-

Biomass

The SSB was below the LRP (66 kt) from 1991 to 1994, with a low in 1993 around 35 kt (Figure 1). The stock increased through the mid- to late- 1990s while a moratorium on directed fishing was in place (1993–97), but by 1999 started declining again following a re-opening of the fishery. From 2001–06, SSB was relatively stable at values between 45 and 50 kt. Further decreases followed and SSB has generally been around 20-25 kt since 2009.

Stock levels to 2026 are determined based on current fishing selectivity and an assumed catch of 1.251 kt (i.e., the Total Allowable Catch [TAC]) in 2025. The 2026 SSB is projected to be below the Limit Reference Point (LRP) with a greater than 99% probability, estimated at 26.7 kt (95% CI = 20.7 to 34.3), which is 40% (95% CI = 31 to 52 %) of the LRP (66 kt).

The age structure of the population is truncated, with few older fish observed. A consistent retrospective in the model and assessment suggests that current SSB is likely over-estimated.

Recruitment

Recruitment (abundance at age 2) has been impaired since the early-1990s. Estimates have been below the long-term average (73 million) over this period and in the last decade reached historic lows (10–12 million over 2015–17). Recruitment increased slightly from these lows and has been near 30 million since 2022, about average for the period of impaired recruitment (Table 1; Figure 1D). Given low SSB and recruitment, truncated age structure of the population, small size-at-age, and early age at maturity, short term prospects for improved recruitment are limited. Persistently low recruitment at a critically depleted stock size suggests the potential for stock growth will remain low.

Removal Rate

The population weighted F estimate (ages 5–8, F_{5-8}) was <0.02 during the moratorium (August 1993–May 1997) when removals were from bycatch and recreational fisheries, and then rapidly increased to 0.3 in 1999 and 2000 after the reopening of the fishery. F_{5-8} has been declining since that time, coinciding with a series of reductions in TAC and participation in the fishery, and has ranged from 0.02 to 0.04 since 2020. Catches since the implementation of the management procedure have been within the range specified by the Management Procedure (MP).

Natural Mortality

M, ages 5–8 increased considerably from the early 2000s to the 2010s and averaged 0.38 over 2010–20 (time series high at 0.42 in 2019). M decreased through the early 2020s, coinciding with improvements in cod condition. M is estimated at 0.31 in 2025 which is near time-series average levels (0.33).

Spatial Distribution

The RV survey has shown a steady decline in biomass in the offshore strata, with offshore indices in 2022 and 2024 at the lowest levels observed since 1998. This, coupled with small increases in some inshore strata, has resulted in a high proportion of survey biomass inshore (Figure 2). Causes of this distribution change are not known. These declines may adversely impact the overall resilience of the stock.

Fish harvesters report recent changes in timing, cod availability, and movement patterns which may be linked to ongoing changes in ecosystem and oceanographic conditions in 3Ps.

Growth

There have been significant declines in size at age (Figure 2). Recent weights at ages for cod 6+ (2021–25 = 2.83 kg) are on average 57 % smaller than in the mid-1980s (1983–

87 = 6.57 kg). Fish caught inshore during the RV survey are slower growing than those in offshore strata, and make up an increased proportion of the stock in recent years. This reduced growth is negatively impacting stock productivity.

Current Status

The 2026 SSB is estimated to be below the LRP with a greater than 99% probability. The stock remains in the Critical Zone.

History of Landings & TAC

Table 2. Commercial TAC and landings by management year (thousand metric tonnes). TAC is shared between Canada (84.4%) and France (St. Pierre et Miquelon; 15.6%). Landings are provisional over the last five years.

Management Year	14–15	15–16	16–17	17–18	18–19	19–20	20–21	21–22	22–23	23–24	24–25	25–26
TAC	13.22	13.49	13.04	6.50	5.98	5.98	2.69	1.35	1.35	1.30	1.55	1.25
Canada	5.80	5.90	5.20	4.90	4.50	3.30	1.75	0.80	0.90	0.80	0.62	N/A
France	1.60	0.90	1.10	0.20	0.20	0.20	0.03	0.02	0.01	0.01	0.01	N/A
Totals	7.30	6.80	6.30	5.10	4.70	3.50	1.78	0.83	0.91	0.81	0.62	N/A

The current MP has been used to inform the TAC since the 2023/24 fishing season. Catches are largely concentrated in the Placentia Bay area (Unit area 3Psc).

There are no direct measures of recreational/food fishery catches. Mark-recapture data are used to estimate these catches, with annual Canadian recreational catch estimated to be near 0.2 kt on average (range 0.13–0.31 kt from 2016–23). A low number of tag returns precluded the estimation of recreational catches from 2024.

Ecosystem and Climate Change Considerations

The ecosystem in 3Ps continues to undergo changes associated with warming ocean climate. Ocean temperature has increased since 1990, and remained warm in 2025 following record high bottom temperatures in 2021 and 2022. The spring phytoplankton bloom was earlier than average in 2025. Total zooplankton biomass and biomass of large copepods – key for energy transfer up the food web – were above average for the first time in 10 years. Following declines observed in the early 1990s, there have been no significant trends in total biomass of the fish community in the RV survey.

With rising temperatures, changes in fish community composition have been observed, including increases in more temperate species. Atlantic Cod was historically the most abundant species among predatory fishes in the 3Ps RV survey. However, its dominance has been markedly reduced over the last decade as Silver Hake (*Merluccius bilinearis*) increased in the warm shelf edge waters and became the most abundant species of this functional group. This shift in dominance seems to be driven by temperature preferences rather than direct competition, as spatial and diet overlap between Atlantic Cod and Silver Hake are currently limited in this area. As this ecosystem warms, overlap between these species is expected to increase as seen on the Scotian Shelf.

Food limitation is apparent in diet analyses of key fish predators, including Atlantic Cod. In conjunction with overall declines in weight-at-age, limited growth, and periods of poor cod condition, it is evident that food limitation negatively impacts stock productivity, indicating

bottom-up effects. To account for this, a condition-based index of mortality is incorporated in the assessment model, directly linking poor fish condition to increased periods of M.

Cod productivity in 3Ps is expected to be negatively impacted as ecosystem and biological changes occur in a changing ocean climate.

Projections

While multi-year projections were requested, there has been a consistent overestimation of stock size and model diagnostics suggest that this is likely to continue. Recent projections have had low accuracy. Multi-year projections were not considered reliable and are not provided.

Management Procedure

A F-based MP is used to inform the maximum annual TAC. The calculation of this MP is detailed in the Rebuilding Plan, with F remaining at a fixed level (F = 0.065 for ages 9+, decreasing for younger ages following DFO 2023) while the stock is in the Critical Zone. As stated in the Rebuilding Plan, given the current stock status, low productivity, and sources of uncertainty, the TAC level established for 3Ps cod during the Rebuilding Plan implementation period may be lower for conservation purposes than the recommended maximum TAC determined by the MP.

Following the MP, the maximum TAC would be 1.465 kt. However, the model is likely overestimating current SSB, and removals at this level are expected to exceed the maximum F defined in the Rebuilding Plan.

There has been a major change in our understanding of the stock since the adoption of the Rebuilding Plan (see OTHER MANAGEMENT QUESTIONS), warranting review of this plan and the associated MP.

OTHER MANAGEMENT QUESTIONS

The stock assessment also evaluated metrics associated with the Rebuilding Plan (see Management Objectives above).

Our understanding of the stock has changed significantly since the adoption of the Rebuilding Plan.

- Updates to stock weights used in the current assessment led to decreases in recent estimates of stock size not accounted for in the rebuilding simulations.

- Stock size is now estimated at 40% of the LRP. The rebuilding simulations did not evaluate fishing scenarios below this level, and the performance of the adopted MP at these levels is unknown.

The stock has not achieved the growth expected under the Rebuilding Plan.

There has not been a sustained decline since the MP was first applied (2023/24).

SOURCES OF UNCERTAINTY

There has been a consistent retrospective pattern in the assessment that has led to a series of downward revisions in SSB as new data are integrated. However, this has not impacted interpretation of stock status. Model diagnostics suggest this pattern is likely to continue into the next assessment. The timing of the assessment contributes to this as not all data sources are available to inform the terminal year at the time of the assessment.

The assessment framework does not explicitly account for spatial differences across the stock area. Given recent indications of changes in stock distribution, known differences in biological parameters across the management area, and ongoing environmental and ecosystem changes, the current assessment model cannot capture smaller scale dynamics which may impact our understanding of stock productivity and growth potential. The collection of length and age information from fishery catches is required to accurately calculate the age distribution of removals used to inform the assessment. There have been significant gaps in commercial sampling in recent years and the recreational fishery is not sampled, increasing uncertainty in the assessment. Catch-at-age cannot be reliably estimated If gaps in fishery sampling worsen, putting the use of the current assessment framework at risk.

In the current assessment, recruitment estimates have been revised downward for both the Hybrid and SAM models compared to the previous assessment. The Hybrid model indicates no further increase in recruitment since 2022, while the SAM model shows a decline. This aligns with the lower age-2 abundance observed in the 2025 DFO RV survey since 2022, suggesting reduced recruitment and increased uncertainty in short-term stock growth and rebuilding potential.

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