Fisheries and Oceans Canada | Pêches et Océans Canada
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Pacific Region

Canadian Science Advisory Secretariat
Science Advisory Report 2026/052

ASSESSMENT OF DOVER SOLE IN THE CANADIAN PACIFIC EXCLUSIVE ECONOMIC ZONE IN 2026

CONTEXT

Fisheries and Oceans Canada (DFO) Groundfish Management Unit (GMU) has requested an assessment of Dover Sole (*Microstomus pacificus*) in Canadian Pacific waters relative to reference points that are consistent with the DFO Precautionary Approach (DFO 2009). Dover Sole is a commercially important species of flatfish found in each Pacific Marine Fisheries Commission[1] (PMFC) area within the Canadian Exclusive Economic Zone (EEZ). Key results from the stock assessment for the Canadian Pacific EEZ (PMFC areas 3CD+4B+5ABCDE) in 2026 are reported here. Harvest advice is required to determine if current harvest levels are sustainable and compliant with DFO's Decision-Making Framework Incorporating the Precautionary Approach.

This Fisheries Science Advisory Report is from the regional peer review meeting of January 14 – 15, 2026, on the Assessment of Dover Sole in the Canadian Pacific Exclusive Economic Zone in 2026. 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

- Status is characterized relative to fishery reference points based on unfished female spawning stock biomass (SSB_0). There is a high probability (> 99%) that female spawning stock biomass (SSB) at the beginning of 2026 is greater than both the limit reference point (LRP: 0.1 SSB_0) and the candidate upper stock reference point (USR: 0.2 SSB_0), placing the stock in the Healthy Zone of the Precautionary Approach (PA) framework.
- Current stock status (SSB_{2026} / SSB_0) is 0.70 (0.50, 0.94). (Results are presented as medians of the posterior distribution, with 95% highest density intervals in parentheses).
- There is a high probability (> 99%) that the fishing mortality rate (F) in 2025 was below the candidate removal reference (RR: fishing mortality rate that reaches 0.25 SSB_0 in equilibrium) rate of $F_{MSYproxy}$.

Trends

- Annual relative biomass (SSB_y / SSB_0) for Dover Sole trended consistently downward between 1950 and 2014, dropping from 1.0 in 1950 to 0.51 in 2014. Since then, it has trended consistently upward to the current estimate in 2026 of 0.70. At no time did the lower bound of the 95% credibility interval fall below the candidate USR.

[1] PMFC areas are similar to but differ slightly from GMU areas.

- Above-average age-1 recruitment in 2014 and 2015 has likely contributed to the recent increase in SSB.
- The fishing mortality rate generally increased between 1950 and 1995, with a peak value of 0.055 (below the median $F_{MSYproxy}$ at 0.062) reached in 1995. Since then, it has decreased to 0.009 in 2025.

Ecosystem and Climate Change Considerations

- No identifiable relationships between recruitment and environmental variables were found.

Stock Advice

- Decision tables based on relative spawning biomass reference points and using constant-catch policies up to 2,735 t/y (MSY_{proxy}) show:
  - > 99% probability of remaining above the LRP and candidate USR in 10 years at catches ≤ 2,735 t/y;
  - ≥ 97% probability of remaining below the candidate RR rate associated with the candidate TRP (0.25 SSB_0) in 10 years at catches ≤ 2,735 t/y;

Other Management Questions

- No biological justification was found to support assessing the stock at a finer spatial scale than the coastwide level (including PMFC area 4B).

BASIS FOR ASSESSMENT

Assessment Details

Year Assessment Approach was Approved

2026 (Terms of Reference)

Assessment Type

Full Assessment: peer-reviewed stock assessment

Most Recent Assessment Date

1. Last Full Assessment: 1999 (Fargo 1999)
2. Last Interim-Year Update: N/A

Stock Assessment Approach

1. Broad category: single stock assessment model
2. Specific category: Statistical catch-at-age (fitted to data using the Stock Synthesis 3 platform)

Ecosystem and Climate Change Assessment Approach

A suite of environmental variables that were hypothesized to be important for Dover Sole egg and larval survival based on available information on spawn timing were considered as part of an environmental analysis. The potential effects of these variables on recruitment of Dover Sole were evaluated utilizing univariate linear and quadratic regression models.

Operating Models

A single base case statistical catch at age assessment model was adopted as the preferred approach after review of multiple model structures and both single and ensemble approaches. Additional models were reviewed as part of a sensitivity analysis (Figure A1).

Stock Structure Assumption

- One stock coastwide that encompasses all of Canada's Pacific EEZ, corresponding to the PMFC boundaries 3CD + 4B + 5ABCDE.
- Given that Dover Sole are thought to experience a pelagic larval phase lasting up to two years (Fargo 1999; Markle et al. 1992), are caught consistently throughout the Canadian Pacific EEZ, and do not show consistent differences in estimated biological parameters across management areas, there was lack of evidence for finer stock structure than at the coastwide level.
- Both PMFC and Groundfish Management Unit (GMU) reporting areas resemble each other, with small differences between the two area definitions, primarily for the inshore areas. It is not expected that these small differences will cause a mismatch in advice between the assessed and managed areas at the scale of this analysis.

Reference Points

Given the assessment model is highly uncertain about the level of steepness for Dover Sole in Canada, and that the MSY-based default provisional reference points are highly dependent on this parameter, it is recommended that reference points based on the level of equilibrium unfished spawning biomass are utilized in their stead.

- Limit Reference Point (LRP): 0.1 SSB_0
- Candidate Upper Stock Reference (USR): 0.2 SSB_0
- Candidate Removal Reference (RR): $F_{MSYproxy}$ (F that reaches TRP in equilibrium)
- Candidate Target Reference Point (TRP): 0.25 SSB_0

A proxy for SSB_{MSY} of $0.25SSB_0$ was chosen and proposed as the candidate TRP based on the default relative spawning biomass-based proxy used for flatfish species on the US West Coast, including Dover Sole (Wetzel and Berger, 2021). The recommendation of a LRP of $0.1SSB_0$ and a candidate USR of $0.2SSB_0$ is then consistent with the DFO PA Policy provisional reference point of $0.4SSB_{MSY}$ and $0.8SSB_{MSY}$ when a SSB_{MSY} proxy ($SSB_{MSYproxy}$) of 25% SSB_0 is assumed. While the 25% proxy value is lower than that used for other groundfish species groups, it is considered appropriate for highly productive flatfish species such as Dover Sole (Wetzel and Punt 2017). Flatfish have high productivity relative to other groundfish species (Thorson 2020), with Dover Sole noted to be one of the most productive (Wetzel and Punt 2017). In addition, other jurisdictions have recommended or set similar limit reference points, such as New Zealand's hard limit of $0.1SSB_0$, below which closure of fisheries are considered (MF 2008), or ICES (2022) recommendation that the LRP equivalent should be no less than $0.1SSB_0$.

Data

The main data sources for the stock assessment were:

- Catch time series (catch + groundfish fishery discards + shrimp fishery bycatch + survey catch) from 1950-2025 for the entire Canadian Pacific region (fit as known in the assessment);
- Abundance indices from five fishery-independent surveys, including four synoptic bottom trawl surveys operating in different areas of the coast (2000 – 2025) and the Hecate Strait Multispecies Assemblage series (1984 – 2003);
- Age composition data from two bottom trawl fishery fleets (Winter and Rest-of-Year; 1990-2019) and five fishery-independent surveys (1996-2024);
- Fixed biological parameters (e.g., growth, maturity) estimated externally using all data collected on Dover Sole in the Pacific Region (from all surveys and fisheries).

ASSESSMENT

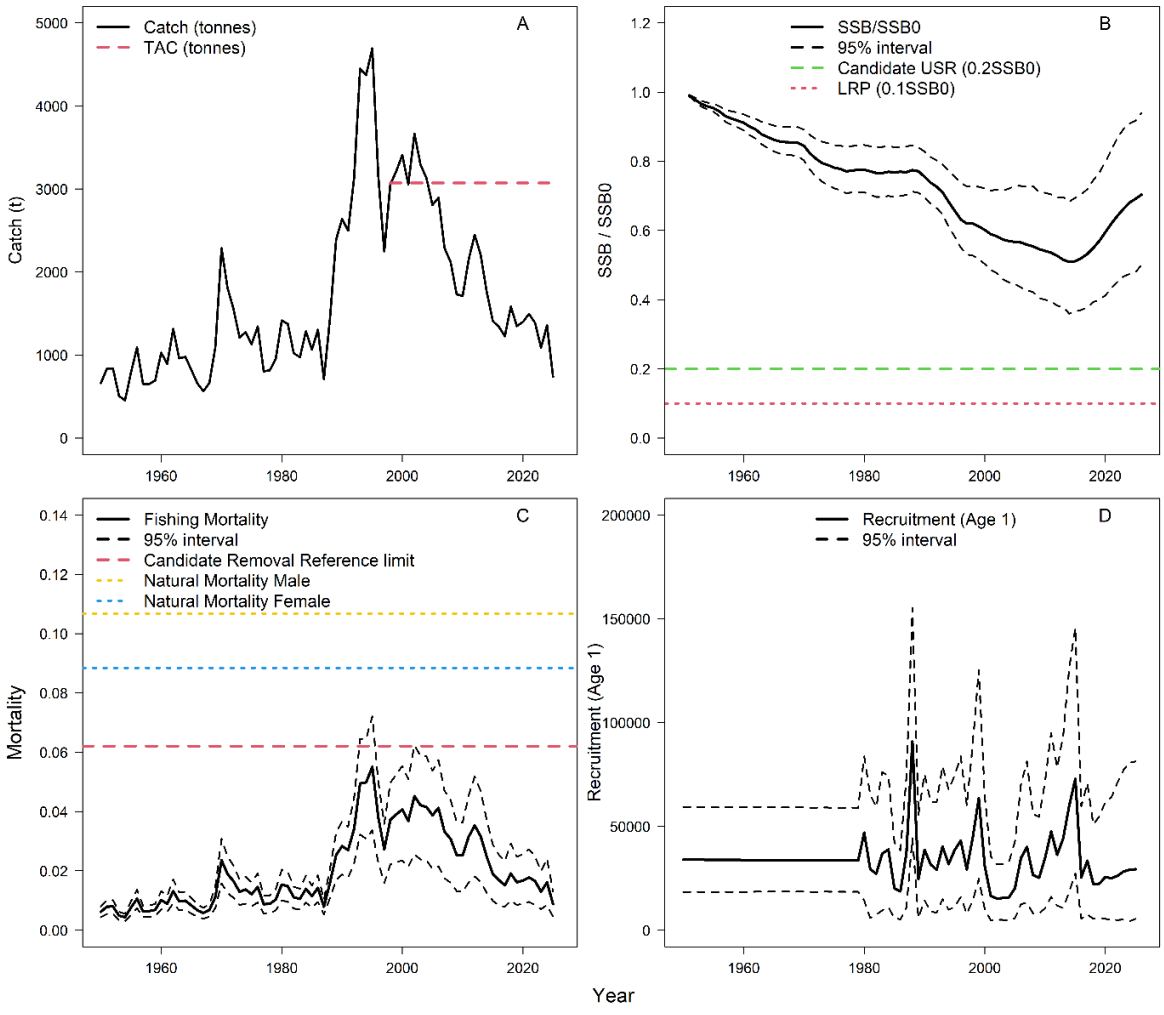


Figure 1. (A – upper left panel) Catch and Total Allowable Catch, (B – upper right panel) Female Spawning Stock Biomass (SSB) relative to the unfished equilibrium SSB (SSB_0), with the Limit Reference Point (LRP; red dotted line) and candidate Upper Stock Reference (USR; green dotted line), (C – bottom left panel) Fishing Mortality (black line) in relation to the candidate Removal Reference (red dashed line) and the median Natural Mortality scalar parameters (male in dotted yellow line, female in dotted blue line), (D – bottom right panel) Recruitment (age-1 fish). Median values in panels B - D appear as solid black lines, and the 95% highest density intervals are delimited by dashed black lines.

Stock Status and Trends

Spawning Stock Biomass

The female spawning stock biomass trajectory exhibits a decrease from an unfished equilibrium in 1950 to a low in 2014, followed by an increase to the terminal year in 2026 (Figure 1).

Recruitment

Recruitment deviations were variable with larger age-1 year classes in 1988, 1999, 2014, and 2015, and a general flat trend throughout the time series (Figure 1). Above average age-1 recruitments in 2014 and 2015 are likely contributing to the recent increases in female spawning stock biomass of the Dover Sole stock.

Current Status

The median stock status (SSB_y / SSB_0) was estimated to be at 0.7 at the start of 2026, within the Healthy Zone (Table 1). The MSY_{proxy}, a constant catch level that produced a median equilibrium long-term SSB of 25% of SSB_0 for the base case assessment, was 2,735 t. The resulting median $F_{MSYproxy}$ was 0.062**Error! Reference source not found.**. The ratio $F_{2025}/F_{MSYproxy}$ reached a median estimate of 0.14. At the start of 2026, the stock is estimated to be above all three relative SSB-based reference points (LRP, candidate USR, and candidate TRP) with high probability (>99%). In addition, the current fishing mortality in 2025 is estimated to be below the candidate removal reference limit ($F_{MSYproxy}$) with high probability (>99%).

Table 1. Derived quantities of interest estimated in the base case assessment. The outputs $F_{MSYproxy}$ and MSY_{proxy} are point estimates and do not include distributions and uncertainty, as they are based on the catch level (MSY_{proxy}) that would produce a median SSB/SSB_0=0.25 in equilibrium. The $F_{MSYproxy}$ is then the median F level corresponding to that MSY.

Derived Output	Estimate (95% Highest Density Interval)
SSB_{2026}	35,294 t (20,183 - 56,051)
SSB_0	49,975 t (41,419 - 63,642)
SSB_{2026}/SSB_0	0.70 (0.50 - 0.94)
$F_{MSYproxy}$	0.062
MSY_{proxy}	2,735 t
$F_{2025}/F_{MSYproxy}$	0.14 (0.07 – 0.21)
LRP ($0.1SSB_0$)	4,997 t (4,142 – 6,364)
Candidate USR ($0.2SSB_0$)	9,994 t (8,284 – 12,728)
Candidate TRP ($0.25SSB_0$)	12,494 t (10,355 – 15,910)
SSB_{2026} / 0.1 SSB_0	7.04 (4.96 - 9.38)
SSB_{2026} / 0.2 SSB_0	3.52 (2.48 – 4.69)

History of Management

Annual catch limits were implemented in the 5CDE fishery in 1981. Similarly, trip limits and annual catch limits were set for the 3CD fishery in 1992. In area 5AB (Queen Charlotte Sound), annual catch limits for Dover Sole have been set since at least 1998. In 1996, the multispecies trawl fishery in the Canadian Pacific EEZ transitioned to an individual transferable quota (ITQ) system, and total allowable catches (TACs) for areas 3CD, 5AB, and 5CDE have been set annually since then. The coastwide TAC has remained constant since 1998 at 3,073 t, of which 30-54% has been caught annually since the 2019-2020 fishing year.

Ecosystem and Climate Change Considerations

We evaluated the potential effects of a variety of environmental indices on recruitment of Dover Sole using univariate linear and quadratic regressions. No identifiable relationships between recruitment and environmental indices were found, but future work on this is recommended. Given the lack of a clear or strong relationship linking environmental conditions to recruitment, there is no basis for incorporating climate-change considerations into management advice for Dover Sole at this time. Furthermore, given that the Canadian Pacific EEZ is situated in the middle of the Dover Sole species range (distributed from Baja California to the Bering Sea, Hart, 1973), climate-driven latitudinal range shifts inside Canadian waters seem unlikely in the near-term.

Stock Advice

Projections show that the model estimates a >99% probability of the stock exceeding the LRP ($0.1SSB_0$) and candidate USR ($0.2SSB_0$) during the 10-year projection period under all constant catch levels presented (Tables 2-3, Figure 2). Projections show that at the highest projected catch level (the MSY_{proxy} estimate = 2,735 t, given the stock is currently in the Healthy Zone), there is at least a 97% probability of fishing mortality being below the candidate removal reference limit in every year of the projection (Table 3, Figure 3).

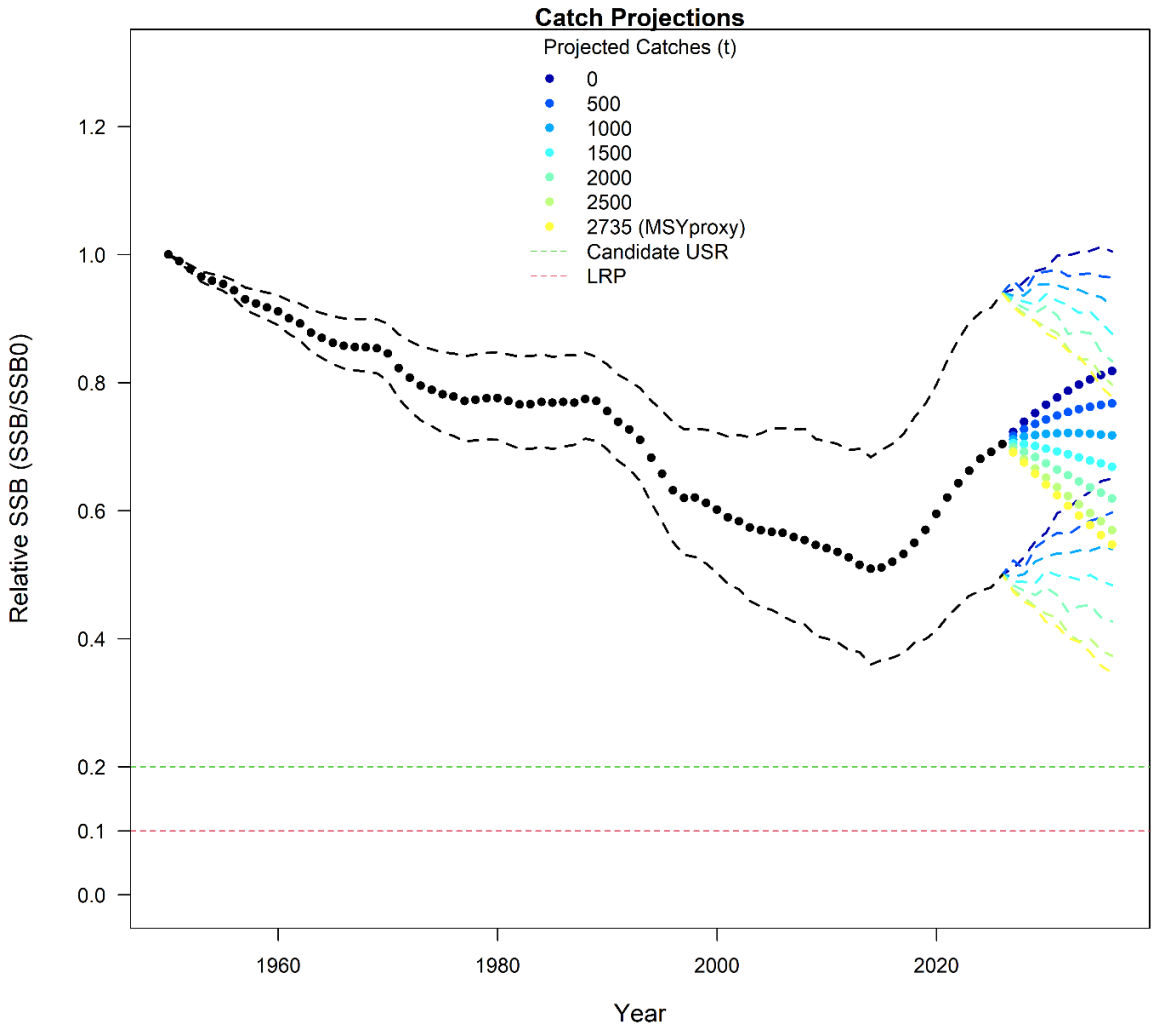


Figure 2. Female spawning stock biomass relative to the unfished level under various constant catch levels. Shown as points are the medians of the posterior distribution and dashed lines depict 95% highest density intervals. The horizontal dotted lines depict the candidate upper stock reference and limit reference point ($0.2SSB_0$ and $0.1SSB_0$).

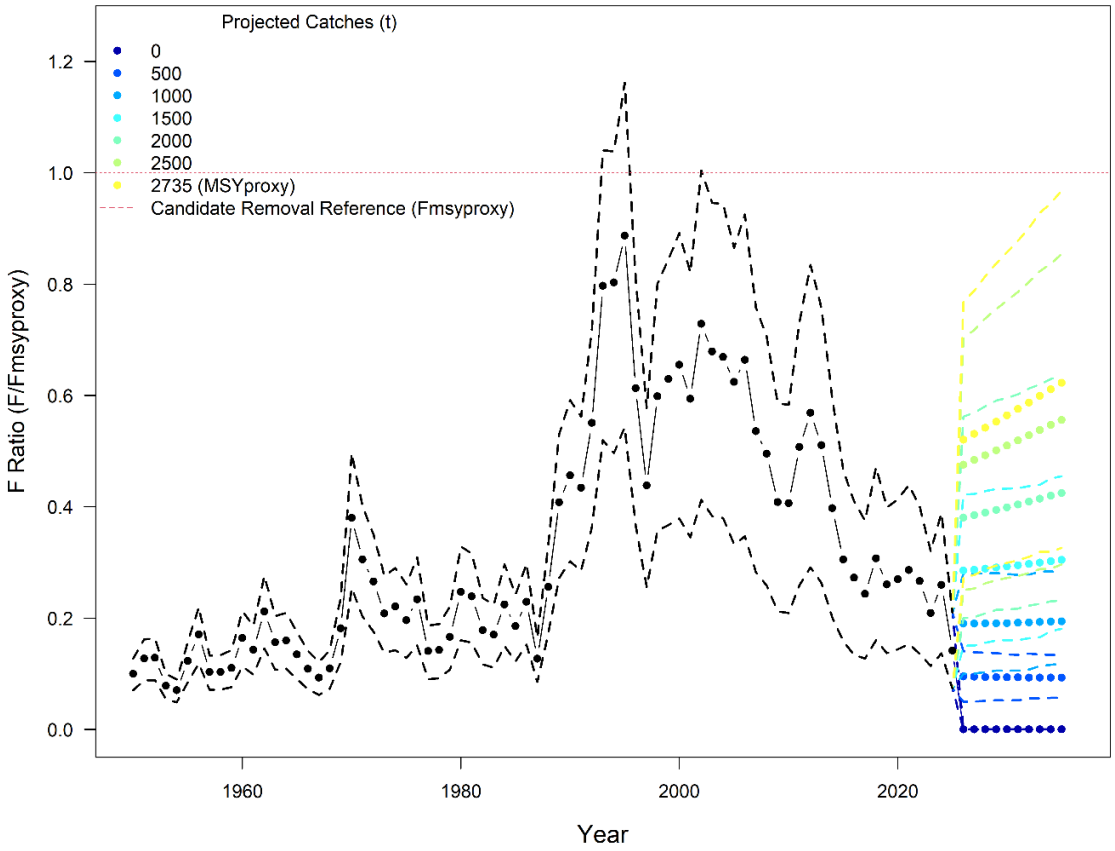


Figure 3. Fishing mortality ratio under various constant catch levels. Shown as points are the medians of the posterior distribution and dashed lines depict 95% highest density intervals. The horizontal dotted line at 1 references when the fishing mortality is equal to $F_{MSYproxy}$, the median fishing mortality that in equilibrium resulted in SSB=0.25SSB$_0$.

Table 2. Probability that female spawning stock biomass in the projection exceeds the limit reference point (0.1SSB$_0$) at the start of each year for varying annual catch levels.

Catch (t/y)	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
0	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
500	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
1000	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
1500	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
2000	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
2500	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
2735	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99

Table 3. Probability that female spawning stock biomass in the projection exceeds the candidate upper stock reference point ($0.2SSB_0$) at the start of each year for varying annual catch levels.

Catch (t/y)	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
0	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
500	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
1000	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
1500	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
2000	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
2500	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
2735	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99

Table 4. Probability that fishing mortality for each year in the projection is below the candidate removal reference ($F_{MSYproxy}$) under the HCR and the current stock status for varying annual catch levels.

Catch (t/y)	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
0	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
500	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
1000	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
1500	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
2000	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99
2500	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	0.99	0.99
2735	>0.99	>0.99	>0.99	>0.99	0.99	0.99	0.99	0.98	0.98	0.97

Harvest Decision Rule

Given the stock is assessed to be in the Healthy Zone, the Harvest Control Rule for Dover Sole implies a candidate removal reference limit of $F_{MSYproxy}$.

Table 5. Harvest control rule for Dover Sole according to results from the current base case assessment. The estimates used in developing the HCR correspond to the median of the posterior distribution.

Stock Status	Corresponding Female SSB	Fishing Mortality Limit
Healthy	Median at or above 9,995 t	Fishing mortality limit = $F_{MSYproxy}$ = 0.062
Cautious	Median between 4,998 t and 9,995 t	Fishing mortality limit to be scaled linearly to SSB levels through this range according to $F_{limit} = F_{MSYproxy}\frac{\widehat{SSB} - LRP}{USR - LRP}$
Critical	Median at or below 4,998 t	Harvest rate to be reduced to zero as a result of directed fishing and other removals reduced at a level consistent with growth criteria identified to allow the stock out of the Critical zone within a reasonable timeframe.

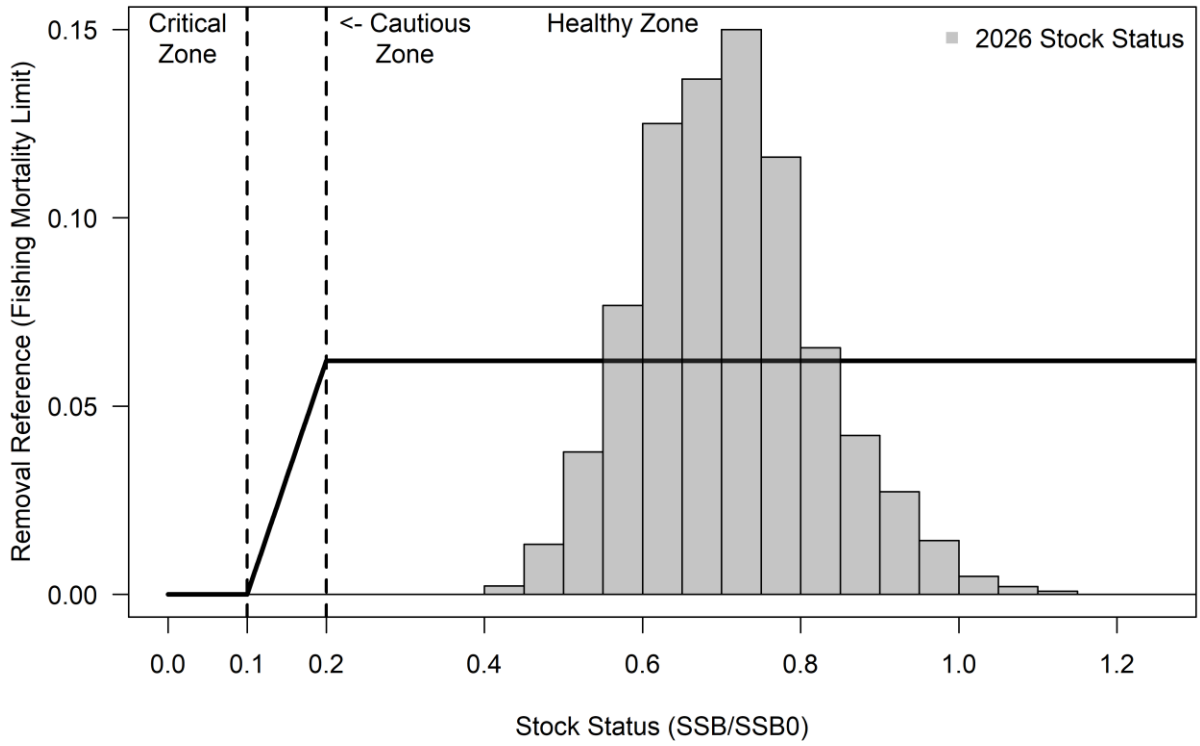


Figure 4. Depiction of the Harvest Control Rule for the candidate fishing mortality limit according to the assessment of Dover Sole under the relative SSB-based reference points. The dark black line depicts the fishing mortality limit at various stock status levels, and the histogram depicts the posterior distribution of the estimated stock status in 2026 (SSB_{2026} / SSB_0).

Evaluation of Assessment Triggers

It is recommended that formal stock assessments occur every ten years, but could be advanced if triggers in the intervening years are met. During intervening years, abundance trends can be tracked using indices from the synoptic surveys using the groundfish synopsis report (Anderson et al. 2025). It is recommended that the model-based coast-wide index presented annually in that report, which is estimated using a geostatistical model, be used as a basis for an early-assessment trigger. If a 50% change in the 3-year running average of the coast-wide geostatistical index relative to the 2024 value (Anderson et al. 2025) is observed, an early reassessment of Dover Sole should be brought forward for consideration. In addition, if the distribution of catch between the Winter and Rest-of-year fishery fleets were to change markedly from the current 5-year average ratio of approximately 50:50 without a decrease in annual catch, this could mark a trigger for reassessment consideration, as the projections are based on this distribution to allocate catches between the fleets.

SOURCES OF UNCERTAINTY

The main uncertainty in the assessment is the estimate of steepness and thus the productivity of the Dover Sole stock in Canada. Better estimation of steepness would likely require more contrast in spawning stock biomass levels than is estimated to have occurred so far for Dover Sole in Canada. While steepness was estimated using an informed prior in this assessment, a likelihood profile on steepness was used to explore uncertainty, including the sensitivity of estimated time series of stock status. Results show that the ratio of SSB_{2026} / SSB_0, which was

used as a basis for characterizing Dover Sole stock status, is relatively insensitive to assumed steepness.

Sensitivity analyses, which explored a range of uncertainties, did not differ substantially from the base case assessment and all resulted in stock status being in the Healthy Zone (Appendix A).

One key uncertainty for the Dover Sole assessment regards the choice of asymptotic selectivity compared to dome-shaped selectivity for the fleets in the rest-of-year season (June-December). Dome-shaped selectivity would suggest there is some portion of the age range of Dover Sole that is not fully vulnerable to the rest-of-year fishery fleet and the surveys. The descending parameters for the dome-shaped selectivities were not well estimated and thus asymptotic selectivity was chosen. Future assessments should re-evaluate this assumption ideally in light of any new data concerning the depth distribution-at-age for Dover Sole.

Other key uncertainties explored through sensitivity analyses included historical catch data and, to a lesser extent, the separation of the fishery into seasonal fleets. In the case of the former, assuming a 50% increase in historical catch data resulted in lower estimates of spawning stock biomass and stock status relative to SSB_0 in all years; however, the assumed 50% increase was an extreme case meant to bracket uncertainty rather than serving as a credible alternative scenario. The base case catch time series represents the most credible catch series, with a wider range of mortality sources accounted for than other recent flatfish assessments in the Canadian Pacific EEZ (DFO 2025a., DFO 2023), including foreign catch and shrimp fishery bycatch. In the case of the separation of the fishery into seasonal fleets, sensitivity analyses to this model specification showed the assessment model was largely insensitive.

An additional uncertainty exists due to variability in length-at-age, which appears to differ between fishery observations and survey observations. This may affect the conversion from abundance to biomass in fitting catch within the assessment model. In addition, there was limited age composition data from the fishery fleets in recent years, as a result of both limited capacity at the Pacific Biological Station Schlerochronology lab, and a drop in commercial fishery sampling post-2019. This has the effect of reducing the ability to estimate recent recruitment events and fishery selectivity in the stock assessment.

Although transboundary adult movement north and south appears limited (Westrheim et al. 1992), it remains unclear whether or not significant amounts of larval transports are received from or sent to US waters, and the level of genetic connection between Alaskan, Canadian, and West Coast US Dover Sole populations, as previous analyses have been uncertain (Stepien, 1999).

OTHER EVIDENCE-BASED INTERPRETATIONS

The candidate target reference point of $0.25SSB_0$ used for Dover Sole in this assessment is lower than was suggested for the Outside Lingcod stock assessment in the Pacific Region (another species with SSB_0-based reference points), which ranged from 0.5 to $0.4SSB_0$ (DFO 2025a). Since this candidate target reference point was set at the assumed proxy for SSB_{MSY}, the use of the $0.25SSB_0$ ratio also had implications for the candidate USR and LRP which were scaled relative to $SSB_{MSYproxy}$ in accordance with the DFO PA policy provisional ratios of 0.8 and 0.4, respectively. The candidate TRP of $0.25SSB_0$ is also lower than a suggested value of $0.5SSB_{max}$ (in the Dover case would result in $0.5SSB_0$) identified in the DFO PA policy when SSB_{MSY} cannot be reliably estimated. These differences led some meeting participants to question whether the candidate target reference point and thus resulting LRP was too low, noting that Dover sole is estimated to be longer lived with lower natural mortality rates (as evidenced by a large number of old fish in the age frequency data), and have older age at maturity than some other flatfish species.

General consensus at the meeting was that the rationale for a SSB_{MSY} proxy of $0.25SSB_0$ was justified, as:

1. It is the same approach used for Dover Sole on the US West Coast.
2. Harvest control rules based on it that are similar to the one applied for Dover Sole in this assessment have been evaluated using simulation modelling (Wetzel and Punt, 2017).
3. The stock is currently in the Healthy Zone with a very low probability of dropping below the candidate USR and LRP in the next 10 years.

However, further research on the suitability of these proposed reference points within the context of a harvest control rule for Dover Sole was recommended, which may result in a change in reference points for the next stock assessment.

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APPENDIX

Table A1. Sensitivity models examined in the assessment and their convergence/diagnostic criteria. OSA = One-Step Ahead Residuals.

Sensitivity Model	Converged?	Passed Index fit Diagnostic?	Passed OSA Diagnostic?
Age- and size-structured model fit to length and conditional age-at-length data	**Yes**	**Yes**	**No**
Model allowing for error in catch	**Yes**	**Yes**	**Yes**
Model assuming more historical catch	**Yes**	**Yes**	**Yes**
Model fit to Fishery CPUE as well	**Yes**	**No**	**No**
Model without prior on steepness	**No**	**NA**	**NA**
Model fit without prior on natural mortality	**Yes**	**Yes**	**Yes**
Model fit without prior on SD of recruitment	**Yes**	**Yes**	**Yes**
Model fit allowing for dome-shaped selectivities in rest-of-year season (all surveys and ROY fishery) for males	**Yes**	**Yes**	**Yes**
Model fit with all available surveys	**Yes**	**Yes**	**No**
Model fit without extra SDs for index data	**Yes**	**No**	**Yes**
Model fit with age-invariant M rather than Lorenzen M	**Yes**	**Yes**	**Yes**
Model fit to all the length composition data as well	**Yes**	**Yes**	**No**
Model fit without seasonal distinction	**Yes**	**Yes**	**Yes**
Model assuming 10% less catch prior to 1996	**Yes**	**Yes**	**Yes**

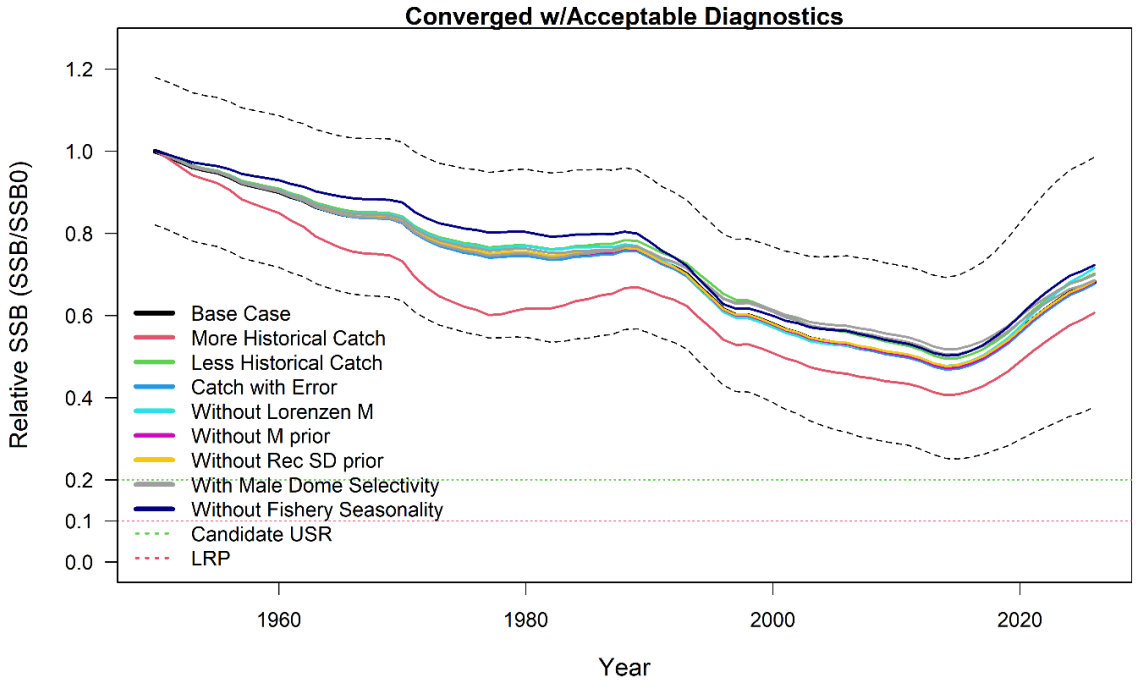


Figure A1. Timeseries of relative SSB (female spawning stock biomass divided by the unfished female spawning stock biomass) from each sensitivity model. In black is the base case assessment with 95% confidence intervals shown as dashed lines. The other colors depict the sensitivity models identified in the legends. Depicted for each model are the penalized maximum likelihood estimates (including the base case). The horizontal dotted lines depict the upper stock reference and the limit reference point. Results from the sensitivity models that did not converge or have acceptable model diagnostics are not shown.

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