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Newfoundland and Labrador Region

Canadian Science Advisory Secretariat
Science Advisory Report 2020/017

STOCK ASSESSMENT OF NAFO SUBDIVISION 3PS AMERICAN PLAICE IN 2019

Image: American Plaice (Hippoglossoides platessoides)

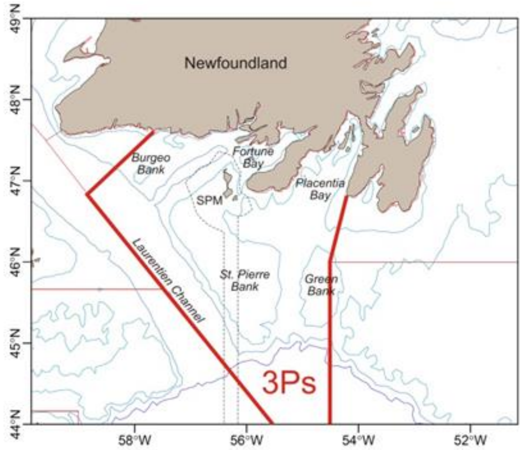

Figure 1. Subdivision 3Ps management area and economic zone around the French islands of St. Pierre et Miquelon (SPM) (dashed line).

Context:

The stock was last assessed in 2014. The assessment was requested by Resources Management to provide the Minister with advice that will inform the management decisions for the 2020-2023 fishing seasons. The specific request was to:

- *Provide an oceanographic and environmental overview for the stock area. If possible, this information should be integrated into the advice.*
- *Assess and report on the current status of the 3Ps American Plaice stock. In particular, assess current biomass with respect to its Limit Reference Point (LRP).*
- *Analyze length frequencies to provide an indication of recent year class strength.*
- *Provide annual projections to 2023 of biomass relative to the LRP (with 95% CIs) under scenarios of F=0, F current, and F current ± 15%, as a well as associated risk analyses.*
- *DFO's Precautionary Approach (PA) Framework indicates there is a zero tolerance for preventable decline when the stock is in the critical zone. Identify the level of removals that provide a high probability (0.95) of stock growth over the short to medium-term (three to five years).*
- *Highlight major sources of uncertainty in the assessment.*

This Science Advisory Report is from the November 19-22, 2019 3Ps American Plaice and 3Ps cod Stock Assessment. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada (DFO) Science Advisory Schedule](#) *as they become available.*

SUMMARY

- Biomass of the stock in 2019 is estimated to be 35% of B_{lim} (B_{lim}=40% B_{MSY}) and therefore the stock is in the Critical Zone. The probability of being below B_{lim} is high (0.98). Current median fishing mortality is estimated to be 24% of F_{lim} and the probability of being above F_{lim} (F_{MSY}) is low (0.03).
- The stock has shown little or no growth since 2008.
- Despite the appearance of relatively strong year classes in 2008 and 2013, these have resulted in few fish greater than 30 cm, indicating that this recruitment has not survived to older ages.
- Bottom temperatures in 3Ps remain above normal which may contribute to low productivity in American Plaice. The spring bloom continues to be reduced in magnitude. Zooplankton biomass in 3Ps was near normal in 2017 and 2018 after four years of low production, with an increased proportion of smaller species. Data were unavailable from 2019. Ongoing warming trends, together with an increased dominance of warm water fishes, indicate that this ecosystem continues to experience structural changes.
- Projections of stock size were conducted to the beginning of 2023 under conditions of zero catch, current F, current F plus 15%, and current F minus 15%. Although the stock is projected to grow under all scenarios, at the end of the projection period there is a high probability(>0.88) of being below B_{lim} in all cases.
- There is no level of catch which gives a high (95%) probability of stock growth.
- Consistency with the DFO decision-making framework incorporating the Precautionary Approach requires that removals from all sources must be kept at the lowest possible level until the stock clears the critical zone.

INTRODUCTION

History of the Fisheries

Annual catches from this stock were highest from 1968 to 1973, exceeding 12,000 t in three years during this period (Figure 2). Since 1977 only Canada and France have been involved in this fishery (Figure 1). Catches averaged just under 4,000 t during the 1980’s but rapidly declined after 1991. There has been a moratorium on directed fishing of American Plaice since September of 1993. Catches of American Plaice since that time have been by-catch in other fisheries. Catch increased substantially after 1995, and was over 1,000 t in each year from 2001 to 2003. However, catch declined since then and has been less than 200 t in all but one year (2017) since 2011. Over the 2014-2018 period 70-90% of the American Plaice bycatch came from the directed cod fishery, while the directed witch flounder fishery accounted for 10-22% of the bycatch. Catch values for 2019 were only available until October at the time of the assessment. Complete year catch for 2019 was estimated based on the percentage of total year catch taken until that date in the last three years.

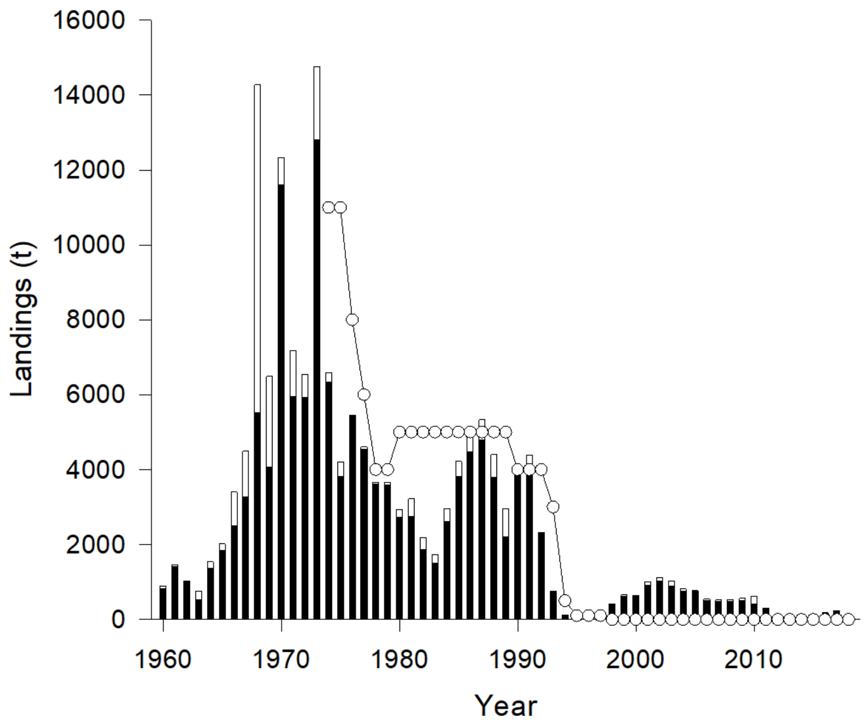

Figure 2. Landings and total allowable catch (TAC) in tons of American Plaice in Subdivision 3Ps by year. The bars show the landings with the black portion of the bars indicating Canadian landings and the white portion the landings by other countries. The line with dots indicates the TAC.

Species Biology

American Plaice is a benthic marine flatfish. When young fish hatch from the egg at or near the surface they have the 'normal' fish orientation. During development they undergo a metamorphosis resulting in lateral compression so that they swim on their side and both eyes are on the upper side of the body, facing right. The eyed side is typically red to grayish brown and uniform in colour, whereas the blind side is white. The head is generally small but with a relatively large mouth.

American Plaice are usually considered a cold-water species with reported catches in temperatures from -1.5 to 13˚C, but they are most numerous within a temperature range from just below zero to around -1.5˚C. Once settled, adults and juveniles frequently inhabit the same areas over depths ranging from 20 to 700 m with a preference for depths in the range of 100 to 300 m.

American Plaice are generally a slow growing and moderately long-lived species with a maximum age of about 30 years. The species exhibits sexual dimorphism in that the females grow faster and are larger than the males for any given age. Spawning in Subdiv. 3Ps is widespread.

American Plaice are highly opportunistic feeders throughout their life cycle, feeding on whatever prey items are available in appropriate sizes for ingestion and varying with fish size, locality and seasonally. Adults and juveniles feed on polychaetes, echinoderms, molluscs, crustaceans and fish (Capelin, sand lance, other flatfish, etc.).

ECOSYSTEM INFORMATION

Physical and Biological Oceanography

Oceanographic conditions in Subdivision 3Ps are influenced by several factors, including local atmospheric climate conditions, advection by the Labrador Current from the east, the warmer and saltier Gulf Stream waters from the south, and the complex bottom topography in the region. Near bottom temperatures, while showing significant variability from one year to the next, have experienced a general warming trend since 1980.

Bottom temperatures continue to remain above normal in the area in recent years although the 2019 bottom temperatures were not available at the time of the assessment.

Standing stocks of phytoplankton and nitrate inventories which provide the primary energy inputs to the base of the food web, were not available in 2019 within 3Ps. Observations from the Grand Bank, upstream of 3Ps, indicate near normal deep nitrate inventories and enhanced phytoplankton biomass in 2019 compared to lower levels observed during the 2011-2016 period. Satellite remote sensing data indicate continued lower magnitude of the spring phytoplankton bloom in 3Ps, consistent with observations on the Grand Bank in 2019. The duration of the spring bloom was longer than normal on the Grand Bank in 2019 but has remained near normal in 3Ps over the past decade. Delayed timing of the spring bloom observed during 2014-2017 has now returned to near normal in 3Ps in 2018-2019.

No spring zooplankton data is available in 3Ps for abundance and biomass indices during 2019. Observations on the Grand Bank during 2019 indicate near-normal abundance of keystone copepod taxa but a reduction in biomass. The limitations of biological data within 3Ps during spring 2019 does not permit us to comment on the overall state of productivity in the lower trophic levels within the stock area in that year.

Fish Community

The overall biomass of the fish community has remained relatively stable since the mid 1990's, with slight recent increases in 2018-2019 mostly driven by plankpiscivores (Redfish *Sebastes sp.*), and to a lesser extent, piscivores. Increases in piscivores were driven by Silver Hake *Merluccius bilinearis* becoming as dominant as Atlantic Cod *Gadus morhua* in the 2010s, and Spiny Dogfish *Squalus acanthias* driving the positive signal in 2019. The overall abundance of fish has increased since the mid 1990's mainly due to increases in small planktivorous fishes (e.g. sand lance *Ammodytes sp.*). Large benthivore biomass remains fairly stable since the 2000s, dominated by Thorny Skate *Amblyraja radiata* and American Plaice. American Plaice used to be the dominant species of this functional group, but saw a major reduction in dominance in favor of Thorny Skate starting in the late 1980s or early 1990s. In recent years there has been an increase in warm water species such as Silver Hake and Spiny Dogfish. This indicates change in the community structure in 3Ps. Although there are some positive indicators (e.g. improvements in biomass and abundance), these signals are not widespread nor fully consistent across the fish community. The 3Ps ecosystem likely remains at reduced productivity conditions. Ongoing warming trends, together with an increased dominance of warm water species and reduced fish sizes across many fish functional groups, indicate that this ecosystem continues experiencing structural changes.

ASSESSMENT

Survey Trends

From the mid-1980s to 1990 there was a large decline in both biomass and abundance indices for American Plaice (Figure 3). Indices of stock size were lowest in the early 1990s. There was a general increase over the 1992-2011 period for both biomass and abundance, with both indices since varying generally without trend. The average abundance over the last three years is only 39% and biomass only 21% of the average from 1983-1985.

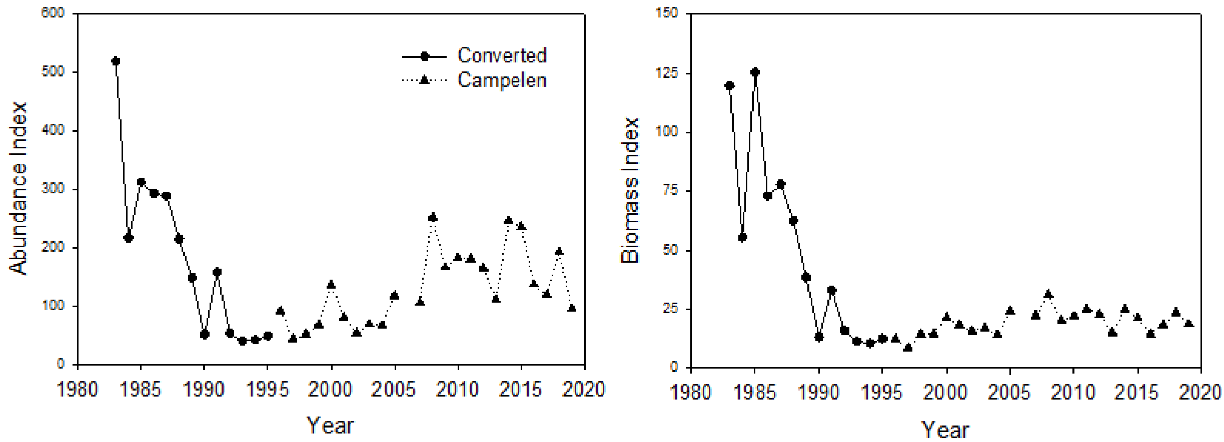

Figure 3. Research vessel survey indices of abundance and biomass for 3Ps American Plaice from 1983to 2019. The solid lines (dots) are Engel data converted to Campelen equivalent while the dashed lines (triangles) are Campelen. The survey in 2006 was incomplete and results are not shown.

Ageing is not available for this stock for the last several years. Therefore, length frequencies from the survey from 1983-2019 were examined for indications of recruitment in recent years (Figure 4). In recent years a year class can be followed from 2008 and another from 2013.These year classes appear to be less abundant than the year classes of the mid 1980s at equivalent lengths. Despite the appearance of these year classes, from 2008-2019 there are few fish greater than 30 cm, indicating that these year classes have not survived to older ages.

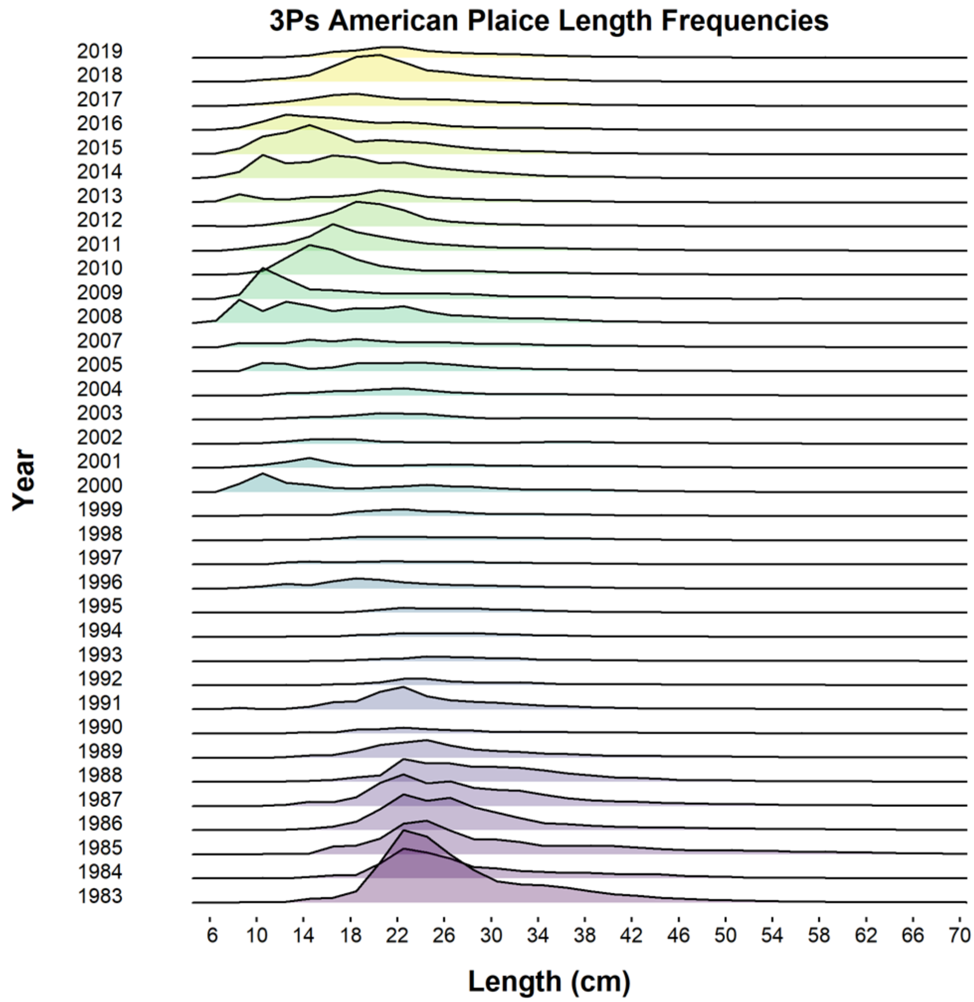

Figure 4. Length frequencies from research vessel survey for 3Ps American Plaice from 1983-2019. The survey in 2006 was incomplete and results are not shown.

Assessment Model

A Bayesian Surplus Production Model was applied to catch data from 1960-2019 and survey data from 1980-2019. Production models estimate relative levels of biomass and fishing mortality more precisely than absolute levels. This means that the ratio of biomass to the biomass giving maximum sustainable yield (B_{MSY}) and the ratio of fishing mortality to the fishing mortality giving maximum sustainable yield (F_{MSY}) are more precise than biomass and fishing mortality themselves. For this reason, stock trajectories and reference points are usually reported as these ratios (B_{ratio} and F_{ratio}) and status determined relative to F_{MSY} and B_{MSY}, with the biomass limit reference point set as a percentage of B_{MSY}. Consistent with the DFO PA framework, B_{lim} (the biomass limit reference point) is 40% B_{MSY}, (where B_{MSY} is the equilibrium biomass that can produce the maximum sustainable yield), the upper stock reference is 80% B_{MSY} and F_{lim} (the removals reference point) is F_{MSY} (the equilibrium fishing mortality that can produce B_{MSY}). Stock status relative to these reference points was estimated from the model.

The production model estimates that an MSY of 2,879 t can be taken from a biomass of 70,290 t at a fishing mortality of 0.041. Stock size estimated from the surplus production model decreased fairly steadily from the late 1960s to a low in 1994 of less than 10% of B_{MSY}. Biomass increased slowly from 1994 to 2008 but has not increased since (Figure 5). Biomass in 2019 is estimated to be only 35% of B_{lim}, with a probability of 0.98 of being below B_{lim}. Therefore the stock is in the Critical Zone. Fishing mortality reached a peak in 1991 after which it declined for several years. Fishing mortality increased again to above F_{MSY} in the late 1990s when landings started to increase (Figure 6). It has been below F_{MSY} since 2011 with current median fishing mortality estimated to be 24% of F_{lim}. The probability of being above F_{lim} is low (0.03).

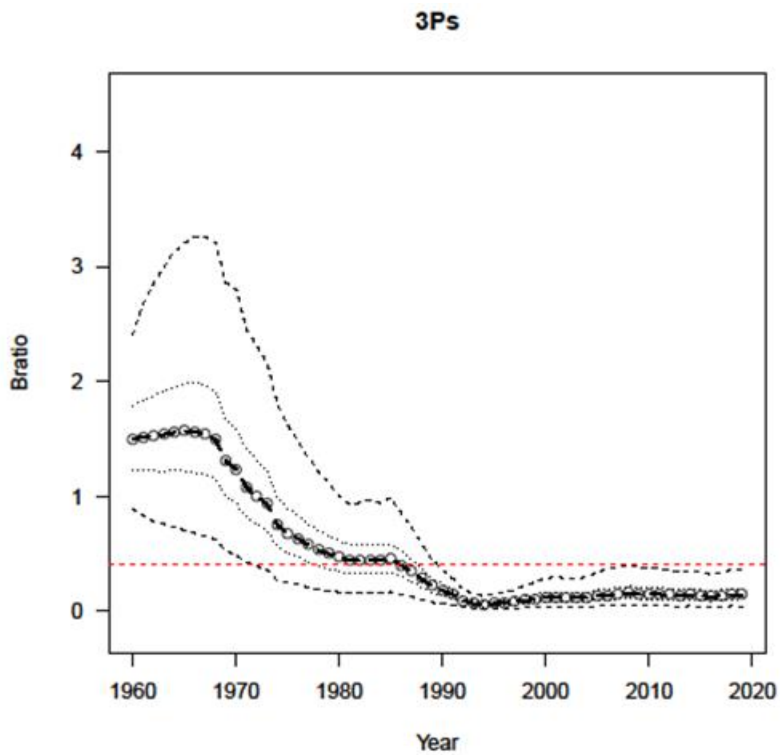

Figure 5. Estimated ratio of stock biomass to B_{MSY} from surplus production model of American plaice from 1960 to 2019. The median, 50% and 95% credible intervals are shown. The red horizontal line is B_{lim} (i.e. 40% of B_{MSY}).

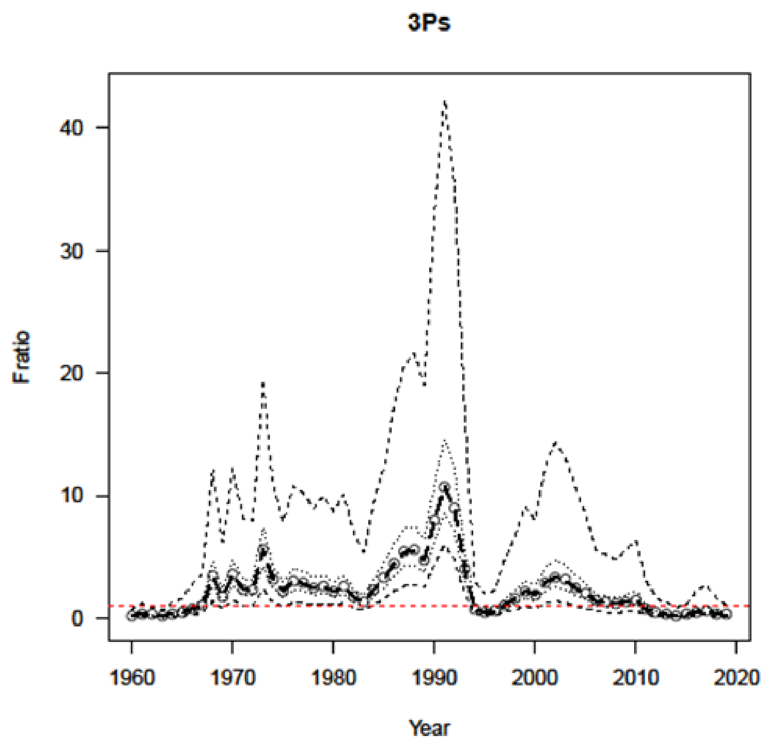

Figure 6. Estimated ratio of fishing mortality to F_{MSY} from surplus production model of American plaice from 1960 to 2019. The median, 50% and 95% credible intervals are shown. The red horizontal line is F_{lim} (where F_{ratio}=1).

Projections of stock size were conducted to the beginning of 2023 under conditions of zero catch, current F, current F plus 15%, and current F minus 15% (Table 1). All projections made the same assumption about catch in 2019 as the assessment, that is catch in 2019 is 97 t. Although the stock is projected to grow under all scenarios, at the end of the projection period there is a high probability of being below B_{lim}, even under zero catch. As current F is low, there is little difference in projection results among the different scenarios. There is no level of catch that would result on stock growth with a 95% probability.

Table 1. Results of projections of stock size for Subdivision 3Ps American Plaice from 2019 to 2022 at different fishing mortality levels. All scenarios assume that catch in 2019 is 97 t.

	B_{ratio}	$p<B_{lim}$	$p>F_{MSY}$	p>B2019	Catch (t)
F=0	-	-	-	-	-
2020	0.15	0.96	-	0.56	-
2021	0.16	0.94	-	0.62	-
2022	0.18	0.92	-	0.68	-
2023	0.19	0.89	-	0.72	-
$F_{current}$=0.0096	-	-	-	-	-
2020	0.15	0.96	0.04	0.56	104
2021	0.16	0.94	0.05	0.61	110
2022	0.17	0.92	0.05	0.66	117
2023	0.18	0.89	-	0.70	-
F+15%=0.011	-	-	-	-	-
2020	0.15	0.96	0.05	0.56	119
2021	0.16	0.94	0.06	0.61	126
2022	0.17	0.92	0.07	0.66	134
2023	0.18	0.89	-	0.69	-
F-15%=0.0082	-	-	-	-	-
2020	0.15	0.96	0.03	0.56	88
2021	0.16	0.94	0.03	0.62	94
2022	0.17	0.92	0.04	0.66	100
2023	0.18	0.89	-	0.70	-

Sources of Uncertainty

Although catch has been low in recent years, the stock has shown very little growth. This indicates that productivity may have declined in this stock. It is not known if productivity will continue to change.

Lack of ageing data makes conclusions about recruitment difficult and means that individual growth cannot be estimated.

Sampling of commercial catch for length frequencies is inadequate to draw any conclusions about the size distribution of the catch.

CONCLUSIONS AND ADVICE

Biomass of the stock in 2019 is estimated to be 35% of B_{lim} (B_{lim}=40% B_{MSY}) and therefore the stock is in the Critical Zone. The probability of being below Blim is high (0.98). Current median fishing mortality is estimated to be 24% of F_{lim} and the probability of being above F_{lim} (F_{MSY}) is low (0.03).

The stock has shown little or no growth since 2008.

Despite the appearance of relatively strong year classes in 2008 and 2013, these have resulted in few fish greater than 30 cm, indicating that this recruitment has not survived to older ages.

Bottom temperatures in 3Ps remain above normal which may contribute to low productivity in American Plaice. The spring bloom continues to be reduced in magnitude. Zooplankton biomass in 3Ps was near normal in 2017 and 2018 after four years of low production, with an increased proportion of smaller species. Oceanographic data were unavailable from 2019. Ongoing warming trends, together with an increased dominance of warm water fishes, indicate that this ecosystem continues to experience structural changes.

Projections of stock size were conducted to the beginning of 2023 under conditions of zero catch, current F, current F plus 15%, and current F minus 15%. Although the stock is projected to grow under all scenarios, at the end of the projection period there is a high probability (>0.88) of being below B_{lim} in all cases.

There is no level of catch which gives a high (95%) probability of stock growth.

Consistency with the DFO decision-making framework incorporating the precautionary approach requires that removals from all sources must be kept at the lowest possible level until the stock clears the critical zone.

SOURCES OF INFORMATION

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