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Newfoundland and Labrador Region

Canadian Science Advisory Secretariat
Science Advisory Report 2018/011

STOCK ASSESSMENT OF WITCH FLOUNDER (*GLYPTOCEPHALUS CYNOGLOSSUS*) IN NAFO SUBDIVISION 3PS

Image: Witch Flounder (Glyptocephalus cynoglossus).

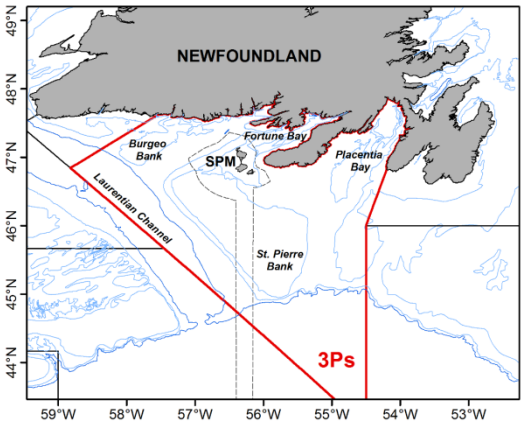

Figure 1. NAFO Subdivision 3Ps (red line) with economic zone around the French islands of St. Pierre and Miquelon (SPM; dashed line).

Context:

Witch Flounder (Glyptocephalus cynoglossus) is a deepwater flatfish that reaches its northern limit of distribution in the Northwest Atlantic near Hamilton Bank off Labrador, and extends to the east coast of the southern United States of America. In the Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps, it is primarily distributed along the slope around St. Pierre Bank and in through Hermitage Channel, and in Hermitage Bay and Fortune Bay on Newfoundland's South Coast.

It is a long-lived, slow growing species and has been aged at over 20 years, however, the number of age groups comprising the Witch Flounder stock in Subdivision 3Ps was reduced substantially after the mid-1970s, with fish older than 13 years rarely seen in either the commercial or survey catches by the early-1990s. Current age structure is unknown.

The present assessment is the result of a request for science advice from the Fisheries Management Branch (Newfoundland and Labrador [NL] Region). The main objective was to evaluate the status of the stock.

This Science Advisory Report is from the December 4-5, 2017 Assessment of 3Ps Witch Flounder. During this meeting, 3LNO Haddock was also assessed. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- From 2014/15 to 2016/17, total annual landings averaged 472 t, over twice the average of the previous 3-year period, though remaining below the 650 t total allowable catch (TAC).
- Size composition from the fishery has remained stable, primarily composed of fish 30-50 cm, with a peak near 40 cm.
- Spring research vessel (RV) survey biomass and abundance indices in 2016 and 2017 are at or among the highest in the time series. However, each of these indices is highly influenced by a single large survey tow resulting in high uncertainty.
- Pre-recruit abundance (16-30 cm) from the RV survey has varied without trend since 1996.
- An interim Limit Reference Point (LRP) proxy of 40% B_{MSY} was adopted and is based on the geometric mean of the survey biomass from 1983-93 winter surveys.
- The stock is currently above the LRP, and has been in most years of the time series (1983-2017). This stability indicates the stock was able to sustain the range of harvest rates over this time period.

BACKGROUND

Oceanography and ecosystem overview

Oceanographic conditions in the area of NAFO Subdivision 3Ps are influenced by several factors including local atmospheric climate conditions, advection by the Labrador Current from the east and the warmer and saltier Gulf Stream waters from the south as well as 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 for over two decades.

Compared with the period 1998 to 2017, the spring phytoplankton bloom was observed later, of shorter duration, and reduced in magnitude during 2015 to 2017. During this period, zooplankton biomass was also the lowest in the time-series.

The overall biomass of the fish community in Subdivision 3Ps has been relatively stable since the mid-1990s, whereas the overall abundance has increased due mainly to an increase in small planktivorous (plankton-eating) fishes (e.g. sandlance). However, both overall biomass and abundance were reduced over 2015 to 2017. Across all fish functional groups, average fish size declined in the mid-late 2000s and has remained at reduced levels. Overall, the ecosystem signals observed in 3Ps indicate that the structure of this ecosystem is changing, and likely experiencing low productivity conditions.

Species biology

Witch Flounder (*Glyptocephalus cynoglossus*) is a long lived, right-eye flounder that is distributed in the western Atlantic from Labrador to North Carolina. This species was known to live to 22 years in NAFO Subdivision 3Ps in the mid-1970s, but the maximum age observed declined to 14 years old by 1980s (Bowering 1993). Age data has been unavailable since 1994 in this area. Witch Flounder in NAFO Subdivision 3Ps are most commonly associated with shelf slope waters along the eastern edge of the Laurentian Channel and the south eastern slope of St. Pierre Bank, occupying depths primarily between 100-500 m, but to as deep as 900 m, and occurring predominantly in water temperatures ranging from 4-7°C. An inshore component of the stock occupies the deep water areas (to >250 m) around Fortune Bay and Hermitage Bay.

Spawning of Witch Flounder in NAFO Subdivision 3Ps occurs from January through May, with the highest intensity of spawning from January-March. This species forms dense aggregations in the spawning season, with offshore fisheries historically targeting these concentrations (Templeman 1966; Bowering 1990).

The fishery

The Witch Flounder fishery in NAFO Subdivision 3Ps consists of an inshore and offshore component, using primarily Danish seines and otter trawls, respectively. Generally, total landings of the 3Ps stock fluctuated between 500 and 1,500 t from the early-1970s to the early-1990s, and between 200 and 600 t from the mid-1990s to the present (Fig. 2). During the past three years, annual landings have averaged 472 t, accounting for approximately 73% of the annual 650 t TAC. This is an increase over the previous 3 year period when landings were among the lowest in the time series, averaging 196t.

Size composition of the commercial catch was stable over 2014-16 and was similar to that seen in the previous assessment of this stock (2014). However, commercial sampling has been unavailable from the Danish Seine fishery since 2014, therefore recent size compositions are based on catches from the otter trawl fishery only. Most of the annual Witch Flounder catches were comprised of fish in the range of 30-50 cm with modes near 40 cm (Fig. 3).

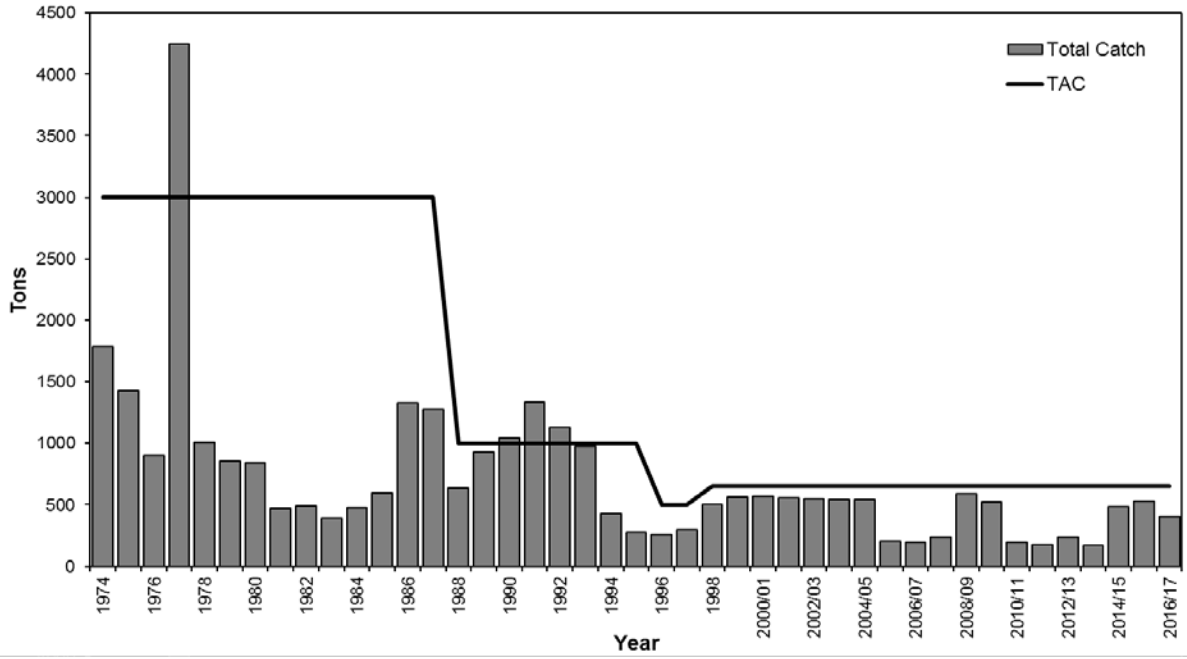

Figure 2. Landings and TACs during 1974-2016/2017. Management changed from calendar year to quota year (April 1 – March 31) in 2000. Landings combined for Canada and France.

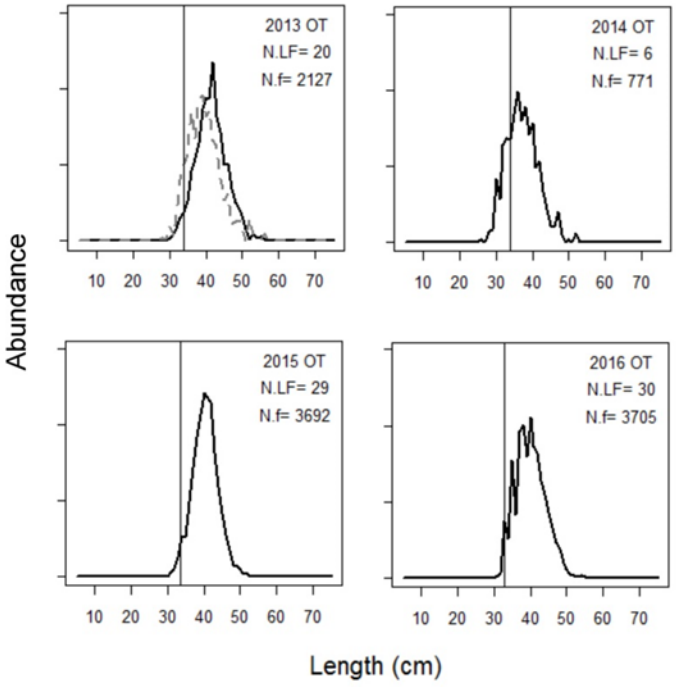

Figure 3. Length distribution of commercial otter trawl (OT) catch, as measured from observer programs (solid lines) and port sampling (dashed lines). Vertical lines indicate length at 50% maturity as determined from annual DFO spring RV surveys N.LF = Number of length frequencies recorded. N.f = number of fish measured.

ASSESSMENT

Research Vessel spring survey (1983-2017)

Age data from Witch Flounder in the DFO RV surveys have not been available since 1994. This precludes the use of any age-based assessment tools to evaluate stock parameters such as mortality, growth, and maturity rates.

Survey coverage was expanded in 1997 to cover additional strata in the inshore area. The survey indices from 1983-96 were adjusted based on the mean proportion of biomass and abundance found in inshore strata (1997-2017), in order to account for the potential underestimation of stock size prior to expansion of the survey coverage. The 2006 survey was incomplete and is therefore excluded from analyses.

Abundance and **biomass** (Fig. 4) indices from RV surveys have varied without trend throughout the time series. In the most recent years (2016-17), these indices have shown an increase to values at or among the highest in the time series. However, these two years are disproportionally influenced by the presence of a single large set in each of the 2016 (Fortune Bay; 37.1% of survey abundance, 59.3% of survey biomass) and 2017 (SE slope of St. Pierre Bank; 31.8% of survey abundance, 51.0% of survey biomass) surveys (Fig. 3).

Consistent with previous assessments, recent (2014-2017) survey catches of Witch Flounder in NAFO Subdivision 3Ps have been located primarily along the shelf slope of St. Pierre Bank. In 2016, an anomalously large portion of the survey catch was recorded inshore in Fortune Bay (Fig. 5).

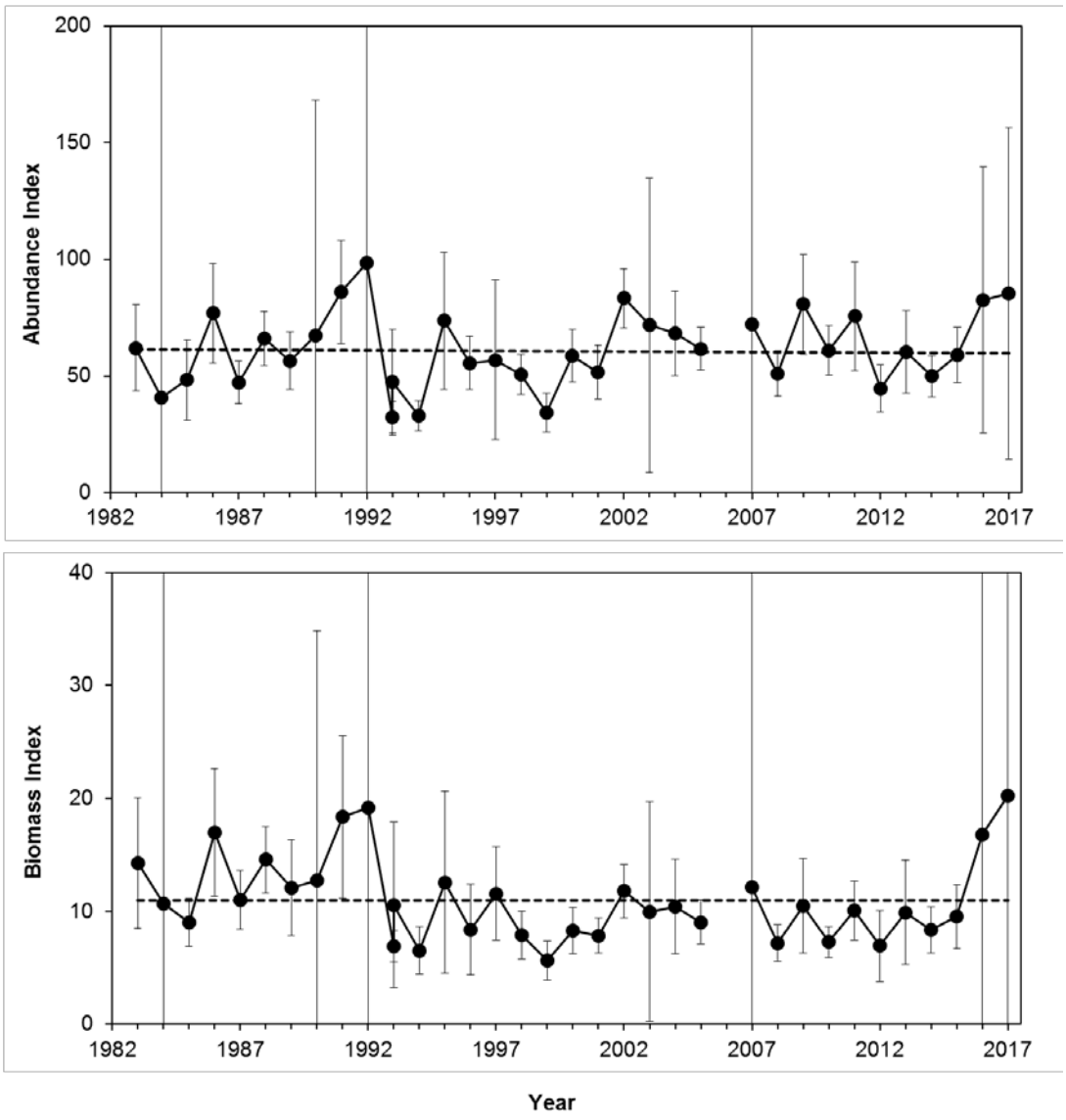

Figure 4. Abundance (top) and biomass (bottom) indices from spring RV surveys in NAFO Subdivision 3Ps. Dashed lines indicate time series mean. 2006 survey was incomplete

Recruitment trends were evaluated using indices of abundance of pre-recruit fish (16 to 30 cm) from RV survey data (Fig. 6), with multiple cohorts included in each index value due to the slow growth of this species. Following a period of relatively high pre-recruit abundance from 2009 to 2011, recruitment has been lower than average since 2012, with the exception of 2016 which was approximately 6% above the long term mean. However, the relationship between this pre-recruit size group and future exploitable biomass remains unclear.

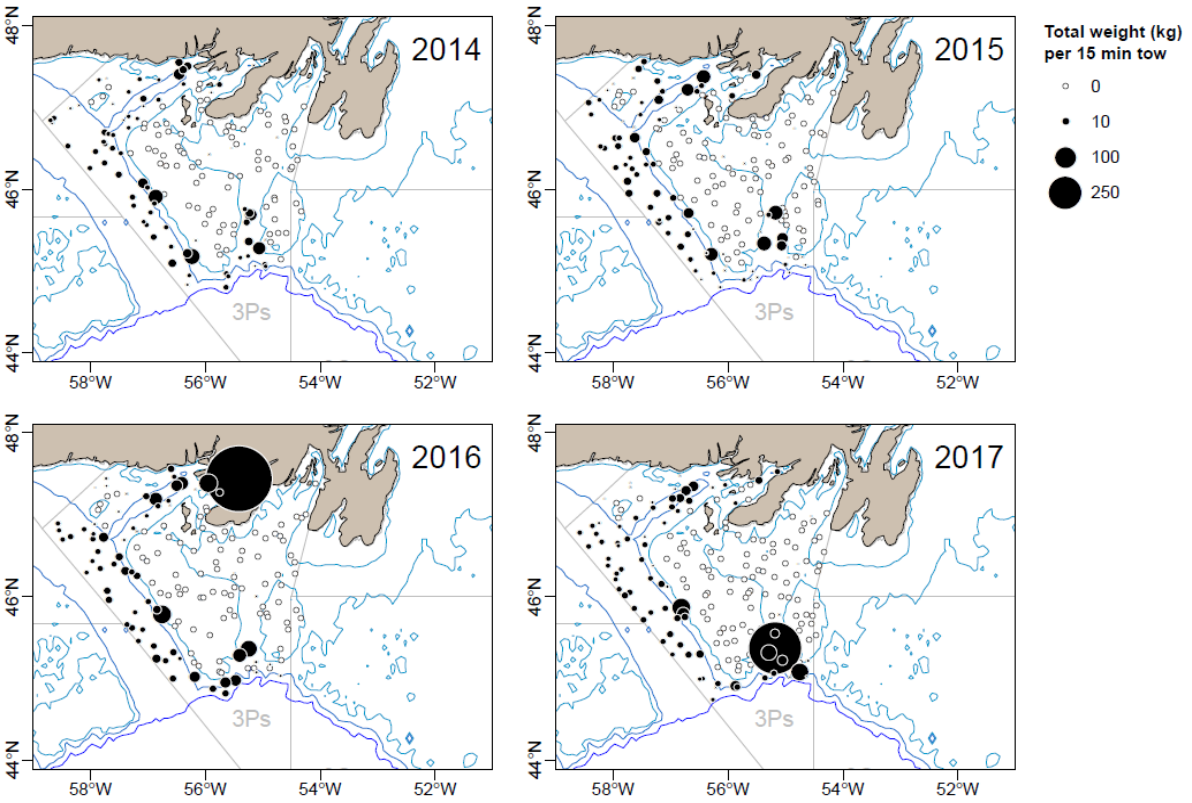

Figure 5. Distribution of Witch Flounder catch (kg/set) during 2014-17 spring RV surveys.

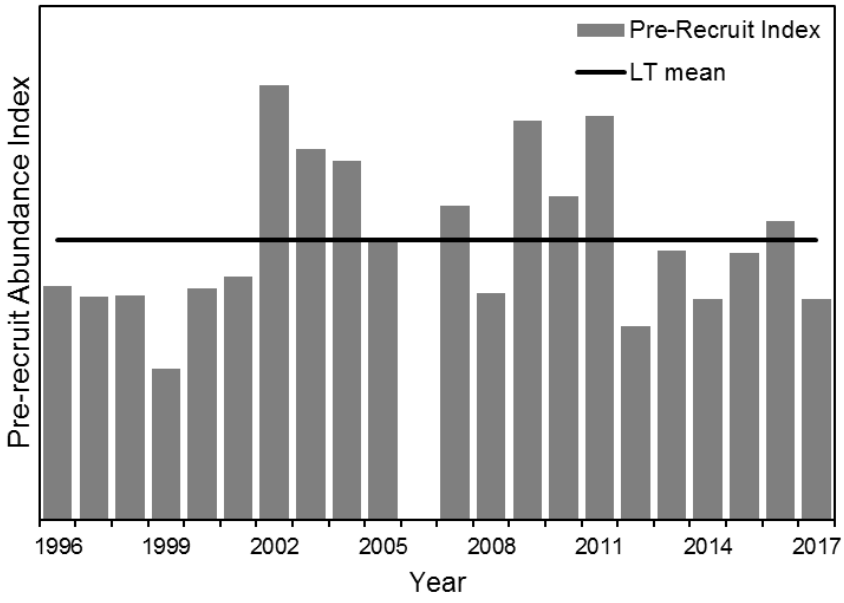

Figure 6. Pre-recruit (16-30 cm) abundance index from spring surveys during 1996-2017. Horizontal line is the time series average; 2006 survey was incomplete.

Length composition from the RV survey is presented as abundance at length (Fig. 7). Witch Flounder up to 50 cm were present in all surveys since 2000, with most of the abundance occurring from 20 to 40 cm. These observations are consistent with those presented in earlier assessments of the stock (e.g. Bowering 1999). Generally, there has been an increase in the mode of the length frequency since 2011, with an increase in the proportion of fish >40 cm in recent years (2016-17).

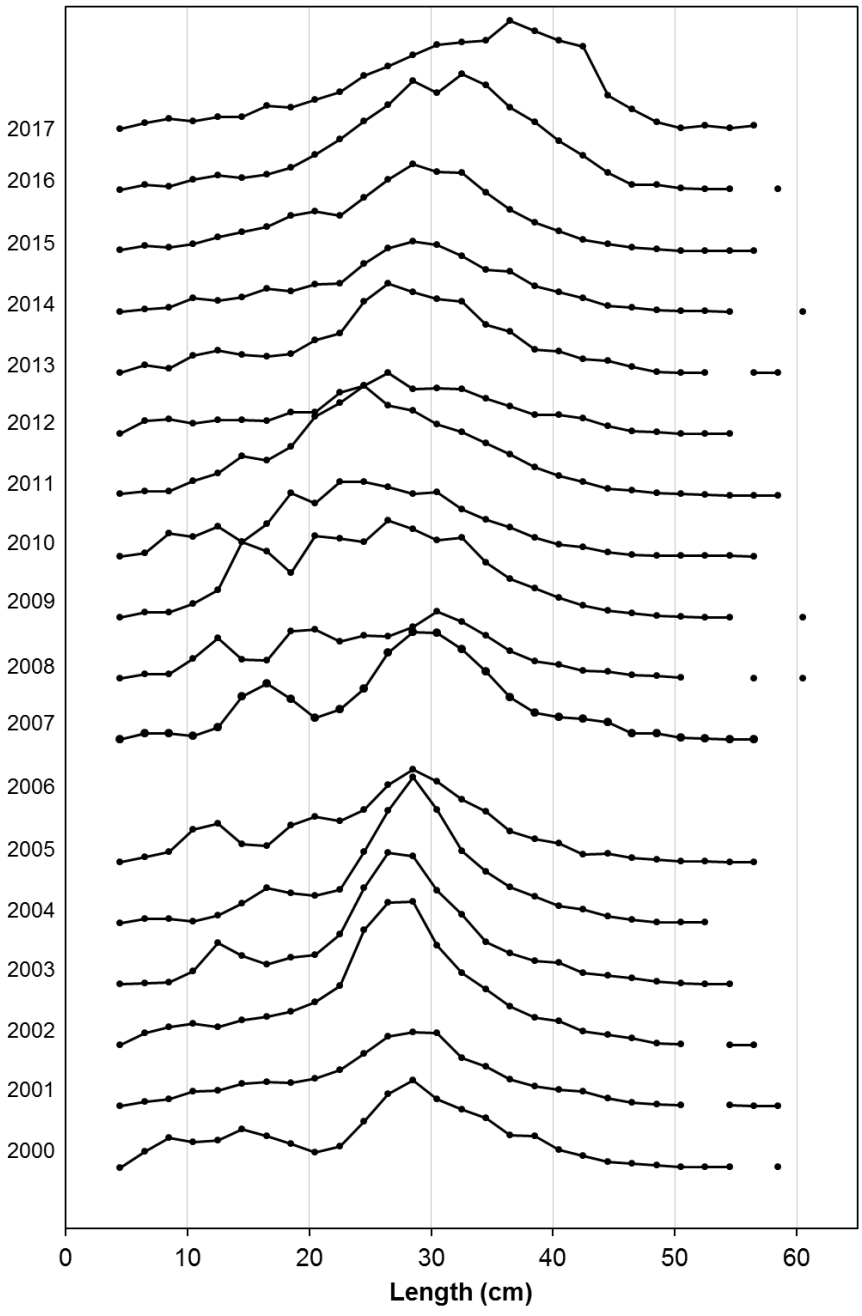

Figure 7. Length frequency of Witch Flounder captured during the spring RV survey in NAFO Subdivision 3Ps; 2006 survey was incomplete.

A proxy for **fishing mortality** was calculated as the ratio of commercial landings to RV spring survey biomass index (Fig. 8) in the same year. This proxy indicates that fishing mortality has generally fluctuated without trend throughout the time series (1983-2016), with a time series high in 1993 at 0.14, and a low in 2013 at 0.017. However, it should be noted that a relatively large portion of the stock distribution (i.e. the Laurentian Channel) exists outside the area targeted by the directed Witch Flounder fishery and therefore the use of the catch/biomass index as a proxy for fishing mortality may not be appropriate in this case.

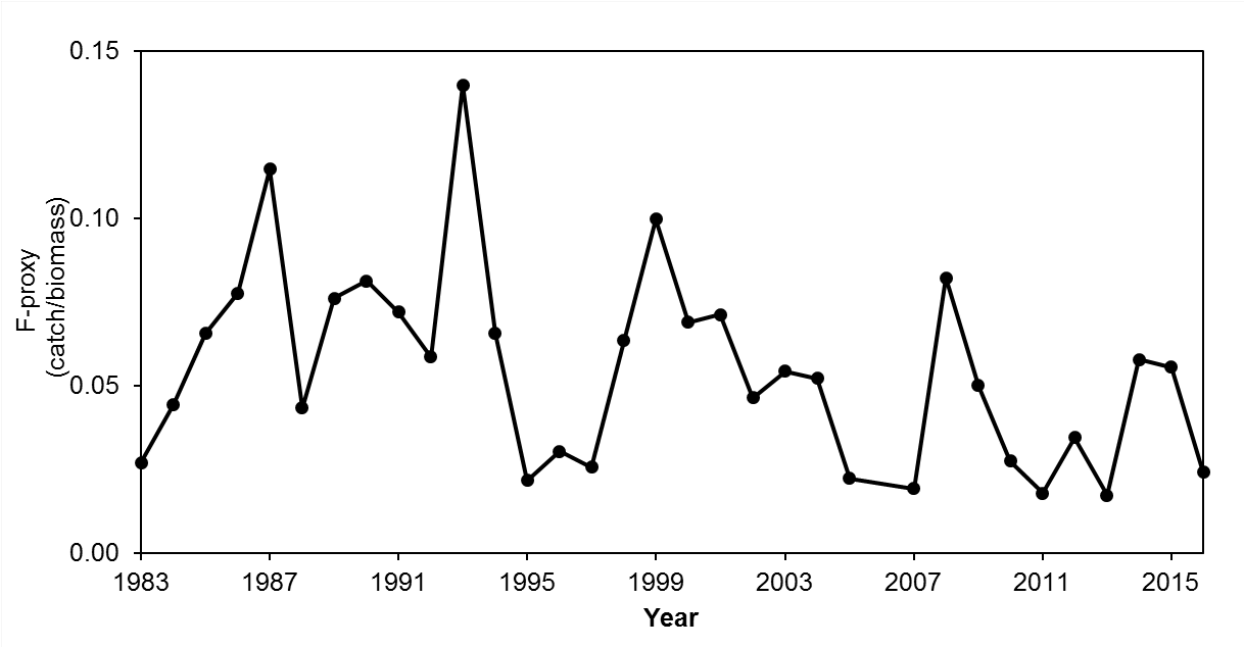

Figure 8. Fishing mortality (F) proxy, calculated as the ratio of commercial landings to survey biomass. 2006 survey was incomplete.

Limit reference point

Several candidate Limit Reference Points (LRP) were proposed based on assumptions about the potential level of stock biomass that would produce the Maximum Sustainable Yield (B_{MSY}). As model-based estimates of B_{MSY} are not available for this stock, interim proxies were calculated based on the RV survey index of stock biomass. Five options were considered as potential B_{MSY} candidates based on annual RV survey biomass indices from:

1. Entire RV survey time series (1983-2017), with pre-1997 converted for reduced inshore survey coverage;
2. Spring survey series (1993-2017), pre-1997 converted for reduced inshore survey coverage;
3. RV series during the time period with full inshore coverage (1997-2017);
4. RV series from 1983-93 winter(w), adjusted for reduced inshore survey coverage;
5. The highest annual biomass estimate (B_{MAX}) from the full time series (1983-2017).

From 1983 to 1993 the stock was not observed to decline under the range of harvest levels exerted on the stock, therefore this period was considered the most appropriate proxy for B_{MSY}. A proxy B_{MSY} was therefore calculated as the geometric mean of survey biomass indices from 1983-1993(w), with values adjusted to account for increased survey coverage inshore after 1996. Consequently – and consistent with the DFO decision making policy – an interim LRP was accepted at 40% B_{MSY}.

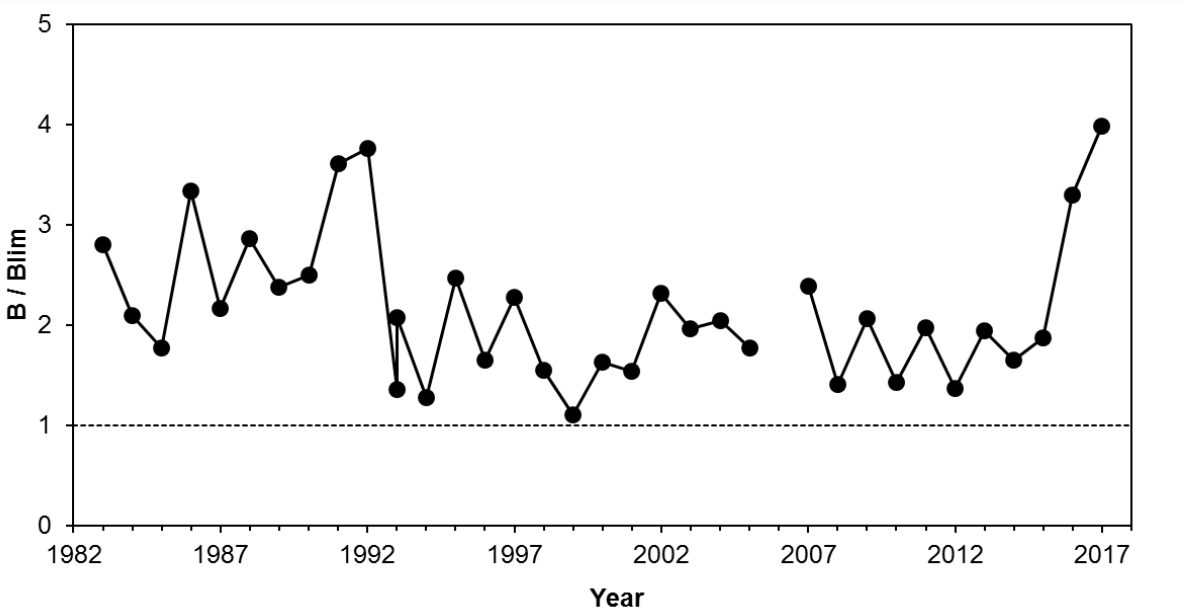

Figure 9. Survey biomass index relative to interim limit reference point (B_{lim}) at 40% B_{MSY}. A proxy for B_{MSY} was adopted at the geometric mean of survey biomass from 1983 to 1993(winter).

Sources of Uncertainty

Spatial and temporal analysis of landings data by target fishery and gear type could not be reported due to *Privacy Act* provisions. There were insufficient numbers of vessels, enterprises or buyers to report findings except as annual totals while ensuring that private information could not be extracted from landings and catch information. In addition, bycatch within the directed Witch Flounder fishery could not be reported on.

Aging data are unavailable for this stock since 1994. This precludes the use of any age-based analytical assessment methods. As a slow growing, long lived flatfish, it is often difficult to track Witch Flounder cohorts through the available length frequency information.

Witch Flounder often display a patchy distribution at the time of the RV survey, resulting in high variation in catches among survey tows. The high abundance and biomass indices observed in 2016 and 2017 were driven by single large survey tows. The index values in these most recent years are therefore associated with a high degree of uncertainty.

The limit reference point was adopted based on survey biomass observed from 1983-93 as a proxy for B_{MSY}. Survey timing in this period differed somewhat from current spring surveys, with surveys ranging from April to May at the start of the time series (1983-87), to a sustained period of winter surveys (January/February) from 1988-93. The impact of this variation in survey timing on the scale of the survey indices is uncertain. Witch Flounder form dense aggregations during the pre-spawning and spawning period, which, in NAFO Subdivision 3Ps, spans the current survey timing. The degree of aggregation in the stock at the time of the survey is likely to impact variation in catches within the survey, and uncertainty in resulting biomass and abundance indices. However, the survey is thought to cover the entire stock area, and therefore indices should be a reflection of overall stock status, irrespective of species aggregation. It should be noted that in 1993 both a winter and spring survey were undertaken, with higher abundance and biomass indices in the spring survey, and similar geographic distribution of the catch in both surveys (Fig. 10). Notwithstanding this uncertainty, it was agreed that the proxy limit reference point be established at a level corresponding to 40% of the B_{MSY} level.

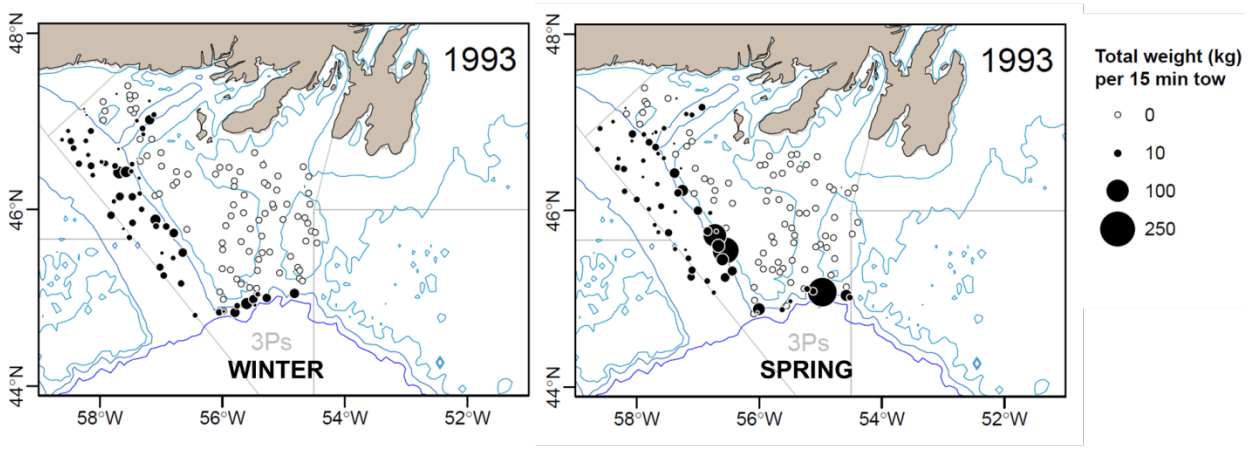

Figure 10. Survey biomass by set in 1993 winter (left) and spring (right) surveys.

CONCLUSIONS AND ADVICE

The stock is currently above the LRP, and has been in most years of the time series (1983-2017). This stability indicates the stock was able to sustain the range of harvest rates over this time period.

MANAGEMENT CONSIDERATIONS

This stock is not currently on a defined assessment schedule and updates on stock status are not provided on an interim basis. The current meeting recommended that the stock be placed on a regular interval of assessment, with a 4-year interval being considered appropriate for this stock. Potential triggers for interim year assessments were considered; however, based on the variability and degree of uncertainty in survey indices, none were accepted.

SOURCES OF INFORMATION

This Science Advisory Report is from the December 4-5, 2017 Assessments of 3LNO Haddock and 3Ps Witch Flounder. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Bowering, W.R. 1990. Spawning of Witch Flounder (*Glyptocephalus cynoglossus* L.) in the Newfoundland-Labrador area of the northwest Atlantic as a function of depth and water temperature. Fisheries Research, 9:23-39.

Bowering, W.R. 1993. The Status of the Witch Flounder Stock in Subdivision 3Ps. DFO Atlantic Fisheries Research Document 93/50.

Bowering, W.R. 1999. Stock status of Witch Flounder in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 99/144, 31p.

DFO. 2014. Stock Assessment of NAFO Subdivision 3Ps Witch Flounder. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/077.

Maddock Parsons, D. and R. M. Rideout. 2014. Update on Witch Flounder (*Glyptocephalus cynoglossus*) in NAFO Subdivision 3Ps: Catch and Survey Information for 2005-2013. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/012. v + 26p.

Templeman, W. 1966. Marine resources of Newfoundland. Bull. Fish. Res. Board Can. 154: 170p.

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Center for Science Advice (CSA)
Newfoundland and Labrador Region
Fisheries and Oceans Canada
PO Box 5664
St. John's, NL A1C 5X1

Telephone: 709-772-3332
E-Mail: DFONLCentreforScienceAdvice@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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