



## **UPDATED INDICES OF ABUNDANCE TO 2019 FOR WINTER FLOUNDER FROM NAFO DIV. 4T, WITCH FLOUNDER FROM NAFO DIVS. 4RST AND WHITE HAKE FROM NAFO DIV. 4T**

### **Context**

Fisheries and Oceans Canada (DFO) Ecosystems and Fisheries Management has instituted a multi-year management approach for the Winter Flounder stock of the southern Gulf of St. Lawrence (sGSL; NAFO Div. 4T) and the Witch Flounder stock of the Gulf of St. Lawrence (GSL; NAFO Div. 4RST). The last full assessments of the Winter Flounder stock of the sGSL (Surette and Rolland 2019) and the Witch Flounder stock of the GSL (Ricard and Swain 2018) were completed in March 2017 with advice for the May 2017 to May 2022 fisheries period. Following on the advice of DFO (2016a) and as identified in the respective science advisory reports for Winter Flounder (DFO 2017a) and Witch Flounder (DFO 2017b), an update of indicators of stock status is to be provided at the end of the year 2019, mid-way in the five-year assessment and fisheries management cycle. In line with this advice, this Science Response Report, resulting from the Science Response Process of December 12, 2019, provides an update of indices of abundance to 2019 for Winter Flounder of the sGSL and Witch Flounder of the GSL, assessed and managed by DFO Gulf Region. For both Winter Flounder and Witch Flounder, the analysis of the indicator relative to an identified trigger value is presented to determine if a full stock re-assessment may be warranted earlier than March 2022, the next scheduled assessments of the five-year stock assessment cycle for these two species.

DFO Fisheries and Aquaculture Management has also requested an update of indicators for the White Hake population of the sGSL (NAFO Div. 4T). The most recent stock status information is from the Recovery Potential Assessment (RPA) of the Southern Gulf of St. Lawrence Designatable Unit completed in 2016 (DFO 2016b; Swain et al. 2016). DFO (2016b) indicated that the estimated spawning stock biomass (SSB) of White Hake in 2013 was about 30% of the proposed abundance recovery target (12,800 t, 40% of the SSB producing the maximum surplus production of recruits) and that the estimated SSB has been below the abundance recovery target since 1995. Additionally, DFO (2016b) proposed a distribution recovery target corresponding to the return of White Hake to inshore waters of the southern Gulf of St. Lawrence, the areas where they predominantly occurred in summer from the 1970s to the mid-1990s. A review and advice on the status using an indicator of adult abundance (or SSB) from the September multi-species research vessel survey relative to the proposed abundance recovery target (DFO 2016b) is presented. The distribution information of adult White Hake in the sGSL relative to the distribution recovery objective proposed in DFO (2016b) is also presented.

## Background

Directed commercial fishing for Winter Flounder (*Pseudopleuronectes americanus*) and Witch Flounder (*Glyptocephalus cynoglossus*) is permitted with an annual Total Allowable Catch (TAC) of 300 t and 500 t respectively (Table 1). The White Hake (*Urophycis tenuis*) stock of the sGSL is currently under commercial fishery moratorium (directed fisheries are closed) with a bycatch allocation of 30 t per year (Table 1).

Table 1. Total allowable catch (TAC) values (t) and Limit Reference Point (LRP) values expressed in kg per tow and in trawlable biomass (t), in effect during 2017 to 2019 for Winter Flounder in NAFO Div. 4T, Witch Flounder in NAFO Div. 4RST, and White Hake in NAFO Div. 4T. For White Hake, the TAC is a bycatch allocation for fisheries directing for other groundfish species and the reference point values correspond to the abundance recovery target as defined in the RPA rather than a LRP.

Species	Scientific name	Total Allowable Catch (t)	LRP (kg per tow)	LRP Trawlable Biomass (t)
Winter Flounder	<i>Pseudopleuronectes americanus</i>	300	3.82	6,609
Witch Flounder	<i>Glyptocephalus cynoglossus</i>	500	5.37	10,483
White Hake	<i>Urophycis tenuis</i>	30	1.04	12,800

### Southern Gulf of St. Lawrence survey

The September research vessel (RV) survey of the sGSL follows a stratified random sampling design (Figure 1) and samples fish and invertebrates species captured with a bottom trawl. The RV survey was designed to provide abundance trends for fish and invertebrates distributed between depths of about 20 m to 350 m. This survey, conducted annually since 1971, is the primary source of data for monitoring trends in species distribution, abundance, and biological characteristics (e.g., size and age composition, growth) in the sGSL (for details see Savoie (2016)). The same stratification scheme has been used since 1971, with the exception of the addition of three inshore strata (401 to 403) in 1984. The analyses are presented here for the 24 strata (415 to 439) sampled since 1971. The survey indices have been standardized for changes in survey vessels, gears, and protocols which have occurred over the time series (Benoît and Swain 2003; Benoît 2006). Survey indices are expected to be proportional to abundance for most species.

### Northern Gulf of St. Lawrence survey

For Witch Flounder, data from the Northern Gulf (4RS) survey are required. The August research vessel (RV) survey of the Northern Gulf of St. Lawrence (nGSL) also follows a stratified random sampling design (54 strata) and covers the waters of the Laurentian Channel, from the Lower Estuary in the west to the Strait of Belle Isle and the Cabot Strait in the east (Figure 1). This survey has been conducted since 1984, however, Witch Flounder length frequency data (required for standardization between the two surveys) is available only since 1987. More details on this survey are available in Bourdages et al. (2019). For 2019, the following Northern Gulf strata (808, 809, 811, 820, 821, 827) were not covered but were accounted for as described in the Witch Flounder section below.

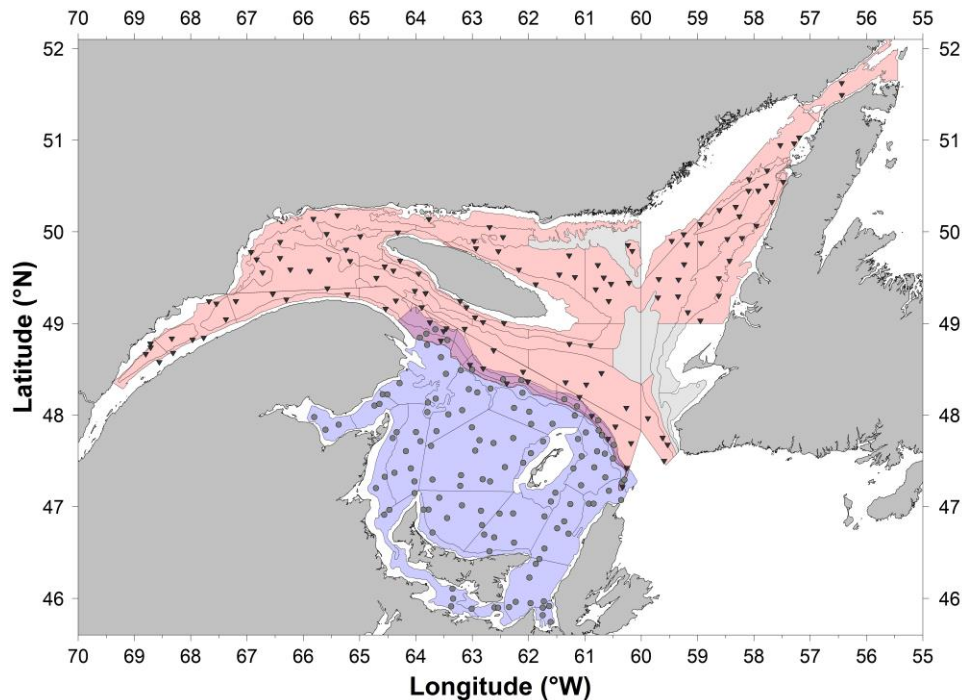


Figure 1. Location of the fishing sets from the southern Gulf of St. Lawrence September RV survey (survey area and strata boundaries appear in blue with set locations indicated by grey dots,  $n = 123$  tows in all strata and  $n = 114$  tows in strata 415 to 439) and the August RV survey (survey area and strata boundaries appear in red with set locations indicated by black triangles,  $n = 109$  in strata 401-414, 801-824 and 827-832) in 2019. The area in purple represents the overlap between the two surveys. Strata that were not sampled in the 2019 August RV survey are indicated in light grey (strata 808, 809, 811, 820, 821 and 827).

## Analysis and Response

### Indices by species

As part of the full assessment for Witch Flounder and Winter Flounder stocks, DFO indicated that an interim year update would be provided mid-way in the five-year assessment cycle, no later than early December 2019, to allow sufficient time to complete a full assessment and plan the peer review if the species-specific indicator signaled that a re-assessment was warranted in winter 2020 (DFO 2017a, 2017b).

For White Hake of NAFO Div. 4T, a review and advice on the status is presented using an indicator of adult abundance (or SSB) from the September RV survey relative to the proposed abundance recovery target (DFO 2016b). A review of the distribution information of adult White Hake in the sGSL relative to the distribution recovery objective proposed in DFO (2016b) is also provided.

### Winter Flounder

The last full assessment of the Winter Flounder stock of the sGSL, NAFO Div. 4T, was completed in March 2017 with advice for the May 2017 to May 2022 fisheries period (DFO 2017a; Surette and Rolland 2019). In that assessment it was indicated that the three-year moving average of the RV survey biomass index for commercial-sized Winter Flounder

( $\geq 25$  cm total length) would be used as the indicator of stock status in the interim years of the multi-year management cycle. This index is to be compared to the Limit Reference Point (LRP) value for this stock, adjusted to the scale of the biomass index which is not corrected for survey gear catchability. The re-scaled LRP is 6,609 t of trawlable biomass in September, equivalent to a catch rate from the survey of 3.82 kg per tow.

An assessment before the scheduled five-year cycle would be recommended if the three-year moving average of the RV biomass index for commercial-sized Winter Flounder exceeded the re-scaled LRP of trawlable biomass. For 2019, the three-year (2017 to 2019) average value of the index is 1,107 t of trawlable biomass which is equivalent to a catch rate from the survey of 0.64 kg per tow (Figure 2). This value is 83% below the threshold value of 3.82 kg per tow.

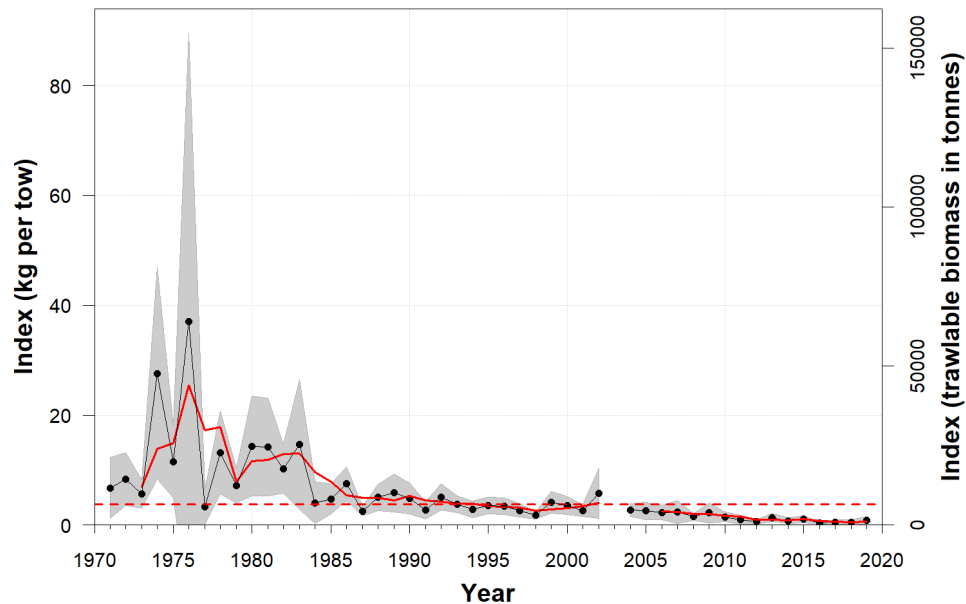


Figure 2. Annual RV survey index (kg per tow) of commercial size ( $\geq 25$  cm total length) Winter Flounder from strata 415-439 in the southern Gulf of St. Lawrence, 1971 to 2019. The black circles and solid black line are the stratified mean estimates and the grey shading denotes the 95% confidence intervals of the annual means. The red solid line is the three-year moving average shown in correspondence to the third year of the block of years. The horizontal dotted line is the threshold value of 6,609 t of trawlable biomass in September, equivalent to a catch rate from the survey of 3.82 kg per tow. Data from 2003 is omitted from the figure as an uncalibrated vessel was used in that year.

### Witch Flounder

The last full assessment of the Witch Flounder stock of the GSL, NAFO Divs. 4RST, was completed in March 2017 with advice for the May 2017 to May 2022 fisheries period (DFO 2017b; Ricard and Swain 2018). In that assessment it was indicated that the three-year moving average of the combined biomass indices for commercial-sized ( $\geq 30$  cm total length) Witch Flounder from the RV surveys conducted in the northern and southern Gulf of St. Lawrence would be used as the indicator of stock status in the interim years of the multi-year management cycle. This index is to be compared to the Limit Reference Point (LRP) value for this stock, adjusted to the scale of the survey biomass index which is not corrected for catchability. The re-scaled LRP of trawlable biomass in September is 10,483 t, equivalent to a combined catch rate of 5.37 kg per tow.

An assessment before the scheduled five-year cycle could be undertaken if the three-year moving average of the RV survey biomass index for commercial-sized Witch Flounder decreased below the LRP equivalent value of 5.37 kg per tow. For 2019, the three-year (2017 to 2019) average value of the index is 8.65 kg per tow (Figure 3).

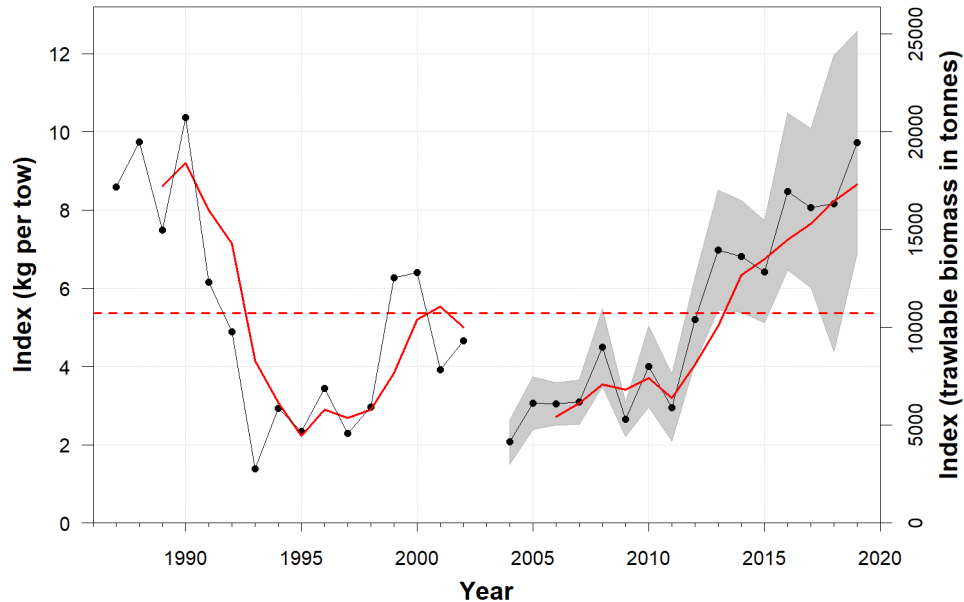


Figure 3. Annual combined northern and southern Gulf RV survey index (kg per tow) of commercial-sized ( $\geq 30$  cm total length) Witch Flounder calculated using a set of strata sampled in most years (415-439) in the September survey and strata 401-414, 801-824, and 827-832 in the August survey. The black circles and solid black line are the stratified mean estimates and the grey shading denotes the 95% confidence intervals of the annual means. The red solid line is the three-year moving average shown in correspondence to the third year of the block of years. The horizontal dotted line is the threshold value of 5.37 kg per tow, which is equivalent to 10,483 t of trawlable biomass in September. Data from 2003 is omitted from the figure as an uncalibrated vessel was used in that year.

## White Hake

The most recent Recovery Potential Assessment of the White Hake, Southern Gulf of St. Lawrence Designatable Unit, was completed in 2016 based on data up to 2013 (DFO 2016b). In that assessment, an abundance target corresponding to a sustained increase in Spawning Stock Biomass (SSB) to a level equal to or above 40% of the SSB producing the maximum surplus production of recruits was proposed. This target was estimated to be 12,800 t of SSB, which is equivalent to a re-scaled trawlable biomass index in September of 1.04 kg per tow. For 2019, the three-year (2017 to 2019) average value of the index for commercial-sized ( $\geq 45$  cm total length) White Hake, is 0.46 kg per tow (Figure 4). This value is 44% of the re-scaled index corresponding to the abundance target for recovery defined in DFO (2016b).

DFO (2016b) also proposed the return of White Hake to inshore waters of the sSGL as a distribution target for recovery. In the 1970s, about 70% of adult White Hake occurred in shallow inshore areas ( $\leq 50$  m depth) in September. By the 2000s, the proportion of adults occurring in these shallow areas in September had declined to about 5%. The most recent (2017-2019) spatial distribution of commercial-sized ( $\geq 45$  cm) White Hake, did not provide any sign of return into shallow waters (Figure 5).

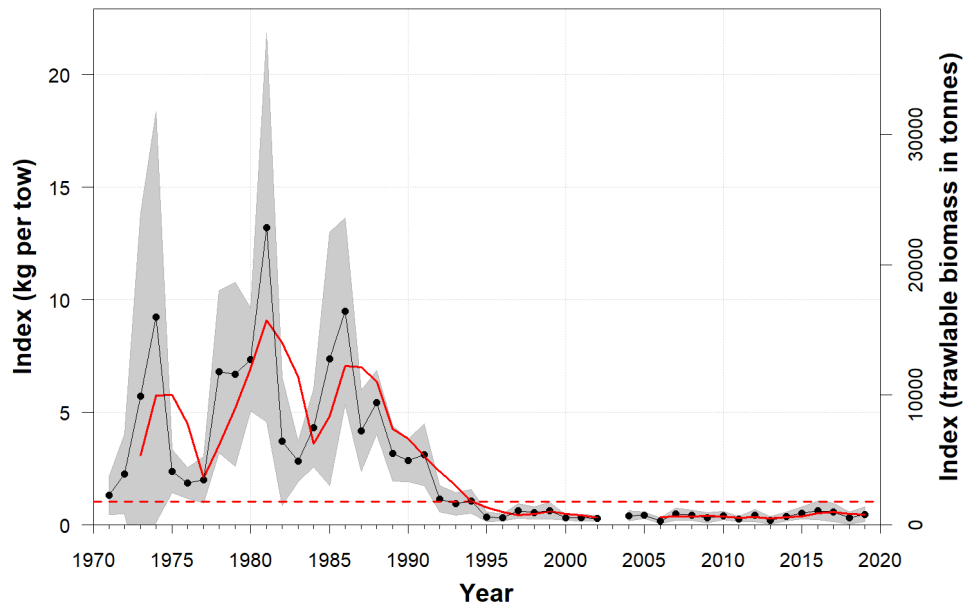


Figure 4. Annual RV survey index (kg per tow) of commercial-sized ( $\geq 45$  cm total length) White Hake from strata 415-439 in the southern Gulf of St. Lawrence, 1971 to 2019. The black circles and solid black line are the stratified mean estimates and the grey shading denotes the 95% confidence intervals of the annual means. The red solid line is the three-year moving average shown in correspondence to the third year of the block of years. The horizontal dotted line is the threshold value of 1.04 kg per tow. Data from 2003 is omitted from the figure as an uncalibrated vessel was used in that year.

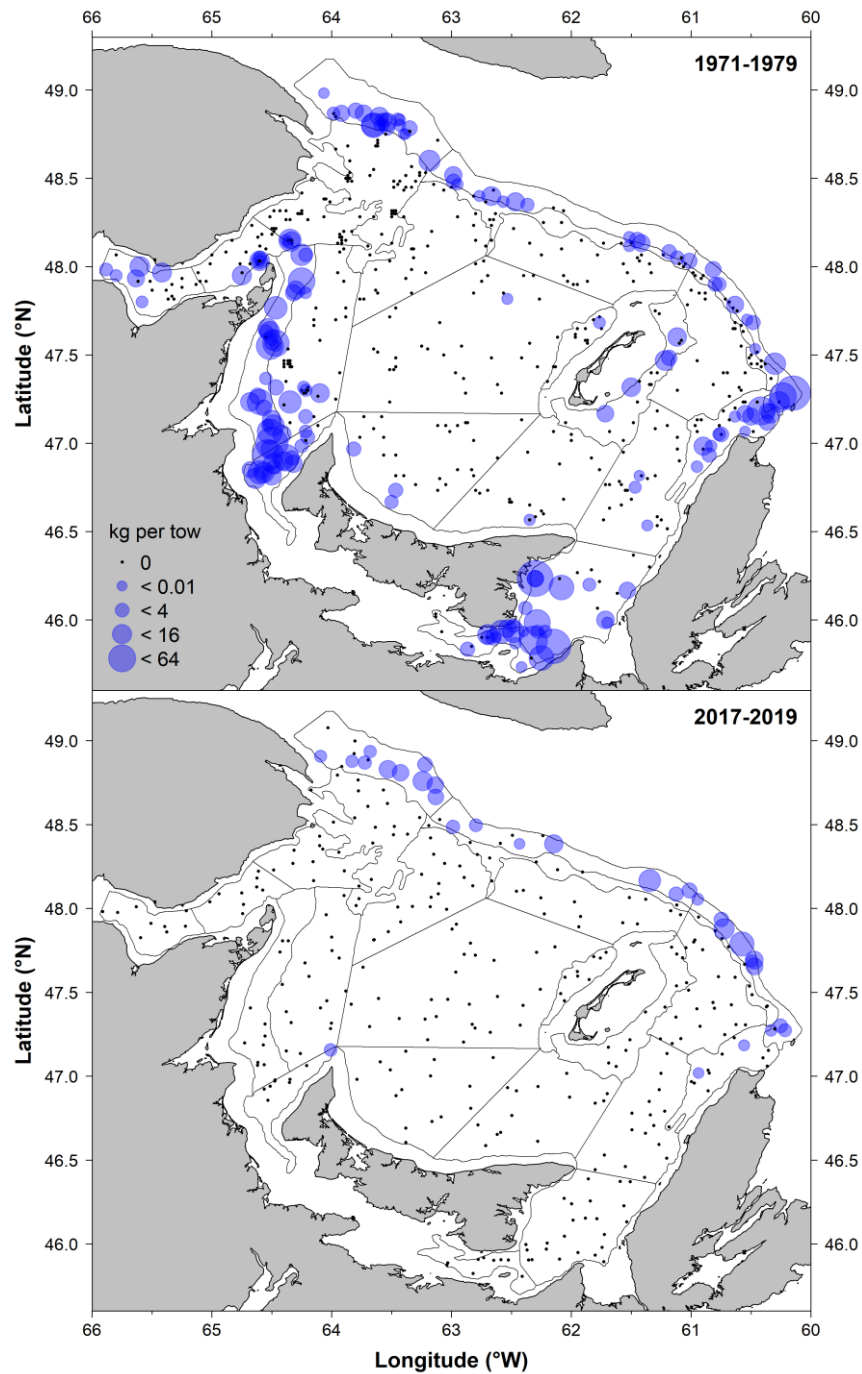


Figure 5. Spatial distribution of standardized commercial-sized (≥ 45 cm total length) White Hake biomass indices (kg per tow) from the September RV survey for 1971 to 1979 (upper panel) and for 2017 to 2019 (lower panel).



## Conclusions

The RV biomass index for commercial-sized ( $\geq 25$  cm total length) Winter Flounder in the southern Gulf of St. Lawrence indicates that there has been no improvement in status since its last assessment and the commercial biomass remains at or near record low level. The three-year (2017 to 2019) average value of the indicator is 0.64 kg per tow (Figure 2), well below the threshold value of 3.82 kg per tow. Analysis of the indicator shows the indicator's trigger value has not been reached. A stock re-assessment is not warranted and the previous advice for the fishery remains appropriate. The next assessment for Winter Flounder for the sGSL is scheduled for February 2022.

The RV biomass index for commercial-sized ( $\geq 30$  cm total length) Witch Flounder indicates that the stock status is following the projection from the last assessment. For Witch Flounder, the three-year (2017 to 2019) average value of the indicator is 8.65 kg per tow (Figure 3), and above the LRP equivalent value of 5.37 kg per tow. DFO (2017a) concluded that the Witch Flounder stock of NAFO Divs. 4RST was projected to increase in abundance with less than a 30% probability of being below the LRP by 2021. Since the index is above the threshold value, a stock re-assessment is not warranted and the previous advice for the fishery remains appropriate. The next full assessment for Witch Flounder for the GSL is scheduled for February 2022.

For White Hake, there has not been any improvement in the indices of abundance or distribution since the Recovery Potential Assessment (DFO 2016b). The three-year (2017 to 2019) average value of the biomass index for commercial-sized ( $\geq 45$  cm total length) White Hake is 0.46 kg per tow (Figure 4), only 44% of the proposed abundance target for recovery (1.06 kg per tow). There has not been a return to inshore waters of commercial-sized White Hake to the levels observed in the 1970s which was proposed as a distribution recovery target in the Recovery Potential Assessment (DFO 2016b). The majority of commercial-sized White Hake in September are distributed in the deep waters along the edge of the Laurentian Channel with few to any fish in shallower waters of the sGSL.

## Contributors

Name	Affiliation
Eliane Aubry	DFO Science Gulf Region
G��rald Chaput	DFO Science Gulf Region
Daniel Lapierre	DFO Fisheries Management Gulf Region
Jeffrey McFadden	DFO Science Gulf Region
Daniel Ricard (author)	DFO Science Gulf Region
Karen Robertson	DFO Science Gulf Region
Nicolas Rolland (author)	DFO Science Gulf Region
Doug Swain	DFO Science Gulf Region
Steve Trottier	DFO Fisheries Management Quebec Region
Fran��ois Turcotte	DFO Science Gulf Region

## Approved by

Doug Bliss  
Regional Director  
Science Branch, Gulf Region  
Fisheries and Oceans Canada  
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## Sources of information

This Science Response Report results from the Science Response Process of December 12 2019, on the update of indices of abundance to 2019 of Witch Flounder (NAFO Div. 4RST), Winter Flounder (NAFO Div. 4T) and White Hake (NAFO Div. 4T) assessed and managed by DFO Gulf Region. No other publications will be produced from this process.

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Gulf Region  
Fisheries and Oceans Canada  
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Telephone: 506-851-6253  
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*Aussi disponible en français :*

*MPO. 2020. Mise à jour des indices d'abondance jusqu'en 2019 pour les stocks de Plie Rouge de la Div. 4T de l'OPANO, de Plie Grise des Divs. 4RST de l'OPANO et de Merluche Blanche de la Div. 4T de l'OPANO. Secr. can. de consult. sci. du MPO, Rép. des Sci. 2020/008.*