



## SEA CUCUMBER STOCK STATUS UPDATE IN NAFO SUBDIVISION 3PS

### Context

The status of Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps Sea Cucumber was last assessed in February 2017. The assessment concluded that given the uncertainties with this species on the St. Pierre Bank, there is no scientific basis for assessing the risk of any increase in harvest level and that sustainable exploitation rates are unknown. It was also noted that the Fisheries and Oceans Canada (DFO) September 2016 3Ps Sea Cucumber survey was incomplete; the entire southeast area was surveyed, but only 23% of the northwest area was surveyed, therefore the Sea Cucumber biomass index for the northwest area was considered inconclusive. In September 2017, the remainder of the northwest area was surveyed. The current stock assessment update was requested by Fisheries Management to provide the Minister with advice in order to inform decisions regarding any changes to the current Management Plan for conservation purposes.

The intent of this document is to update the stock assessment provided in February 2017 by providing analyses of data from the September 2017 DFO Sea Cucumber survey which completed sampling of the northwest area. Up-to-date commercial catch data for both areas are also included.

This Science Response Report results from the Science Response Process on January 18, 2018 of Subdivision 3Ps Sea Cucumber Status Update.

### Background

This document updates the 2016 NAFO Subdivision 3Ps Sea Cucumber stock assessment provided in February 2017 (DFO 2017) with new data. The additional data include the updated 2016 logbook data not available at the time of the 2017 Regional Peer Review (RPR), the 2017 logbook data available as of January 2018, and survey data from the 2017 DFO Sea Cucumber survey which completed the strata in the northwest fishing area that were not sampled during the 2016 DFO Sea Cucumber survey.

Stock status indicators for Sea Cucumber, *Cucumaria frondosa*, in Subdivision 3Ps in 2017 were evaluated based on trends in fishery and survey data. Fishery data include landings from purchase slips, and catch per unit effort (CPUE) from emerging fishery logbooks (2004-08) and commercial fishery logbooks (2009-17). Survey data were used to determine biomass and abundance indices from the emerging fishery surveys (2004-08) and the DFO Sea Cucumber surveys (2016 and 2017). Sea Cucumber biometric data and bycatch data collected during the DFO Sea Cucumber surveys (2016 and 2017) were also investigated. The exploitation rate index was calculated using landings from purchase slips and the biomass index from survey data.

### The Fishery

In 2003, a Sea Cucumber drag fishery, under the umbrella of the New Emerging Fisheries Policy, was established on the St. Pierre Bank with eight participants sharing a total allocation of 454 t. As part of the emerging fishery, the same eight harvesters entered into a five year Joint Project Agreement (JPA) with DFO, the Newfoundland and Labrador (NL) Department of Fisheries and Aquaculture (DFA), and Industry commencing in 2004. An exploratory fishery and resource assessment surveys were conducted annually over a five year period (2004-08) to gather sufficient data to delineate Sea Cucumber distribution, provide biomass estimates, and evaluate the potential of a commercial fishery. In 2012, the Sea Cucumber emerging fishery on the St. Pierre Bank formally transitioned to a commercial fishery.

There are two main Sea Cucumber fishing areas on the Canadian portion of the St. Pierre Bank, one northwest and one southeast of the French Economic Zone (Figure 1). The commercial fishery normally takes place between June and December and has focused primarily within the northern portion of the northwest area of the resource distribution. In 2010, as a result of consultation between DFO and Industry, the southeast area was closed to fishing and remained closed until 2017. Temporary permits were issued in 2017 to additional harvesters to allow fishing in the southeast area. Harvesters use a six foot modified Sea Urchin drag to catch Sea Cucumber on the St. Pierre Bank.

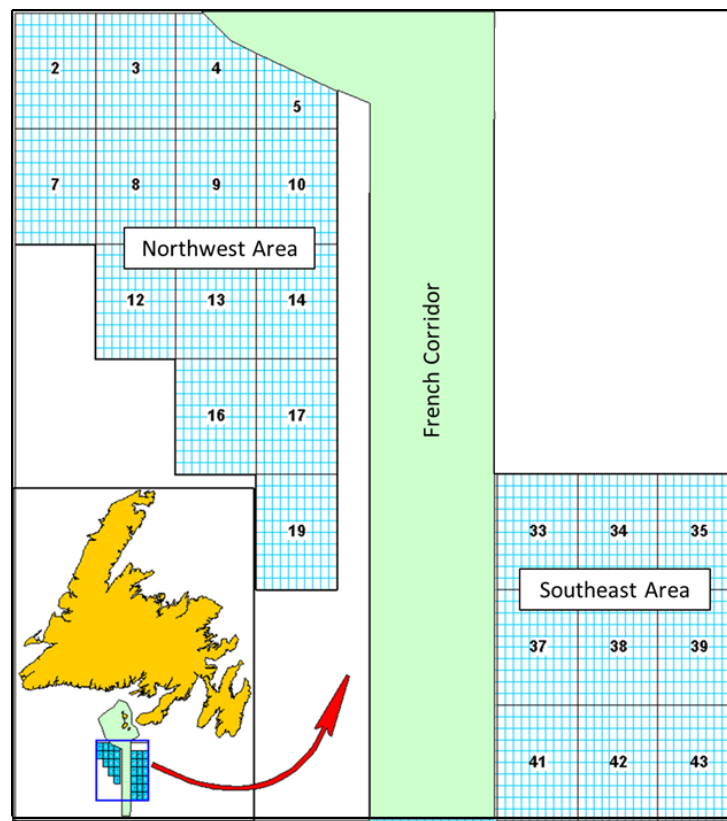


Figure 1. Map of the St. Pierre Bank showing the northwest and southeast Sea Cucumber fishing areas and the 23 strata used for the DFO Sea Cucumber surveys.

The Sea Cucumber total allowable catch (TAC) on the St. Pierre Bank gradually increased from 454 t in 2003 to 2,242 t in 2013. The TAC of 2,242 t for the northwest area has remained unchanged since 2013. A TAC of 3,773 t was set for the southeast area in 2017.

## Analysis and Response

### Fishery Data

#### Commercial Landings

Commercial landings averaged 460 t over the period of 2003 to 2006 and declined to 190 t in 2007 due to poor market conditions. The landings averaged approximately 820 t between 2009 and 2014, and then increased to take the full TAC of 2,242 t in 2015 and 2016. Fishing activity was exclusive to the northwest area during the 2009-16 time period. At the time of the RPR in February 2017, the preliminary landings for 2016 were 1,600 t; complete landings for 2016 are 2,261 t (Figure 2). The preliminary landings for 2017 for the northwest and southeast areas combined are 3,707 t.

#### Commercial Catch per Unit Effort (CPUE)

Commercial CPUE increased between 2003 and 2008 during the emerging fishery. As reported at the RPR in February 2017, the CPUE had remained relatively stable since 2009 and this remains unchanged with the inclusion of additional 2016 logbook data and preliminary 2017 logbook data (Figure 2). From 2009 to 2012, commercial fishing occurred only in strata 2, 7 and 8, and since 2013 it has occurred exclusively in strata 7 and 8 (with the exception of additional permits for the southeast area in 2017). Although fishing activity was exclusive to this small area, the CPUE has remained relatively stable (particularly for stratum 7) since completion of the emerging fishery in 2008 (Figure 3).

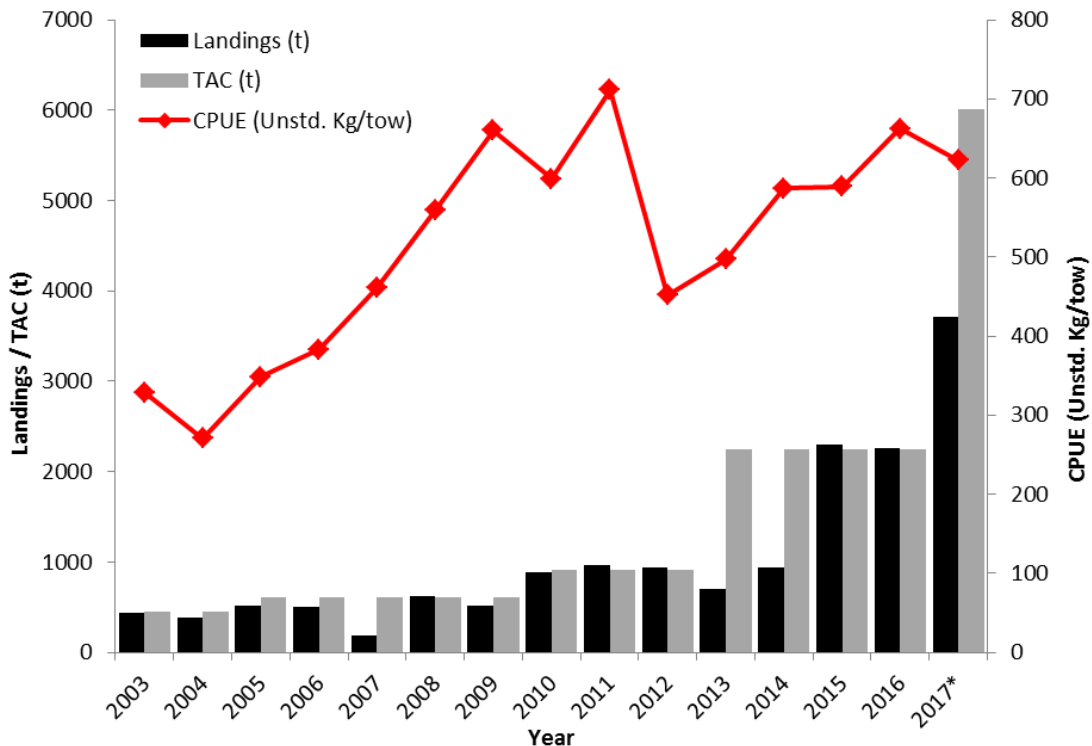


Figure 2. Trends in St. Pierre Bank Sea Cucumber landings, Total Allowable Catch (TAC) and commercial fishery CPUE from 2003 to 2017. Landings and TAC data are from purchase slips and CPUE data are from commercial fishery logbooks. \*The 2017 logbook data are preliminary as of January 2018. Fishing took place in both areas from 2003 to 2008 and 2017, and only the northwest area from 2009 to 2016. A TAC for temporary permits was established in the southeast area in 2017.

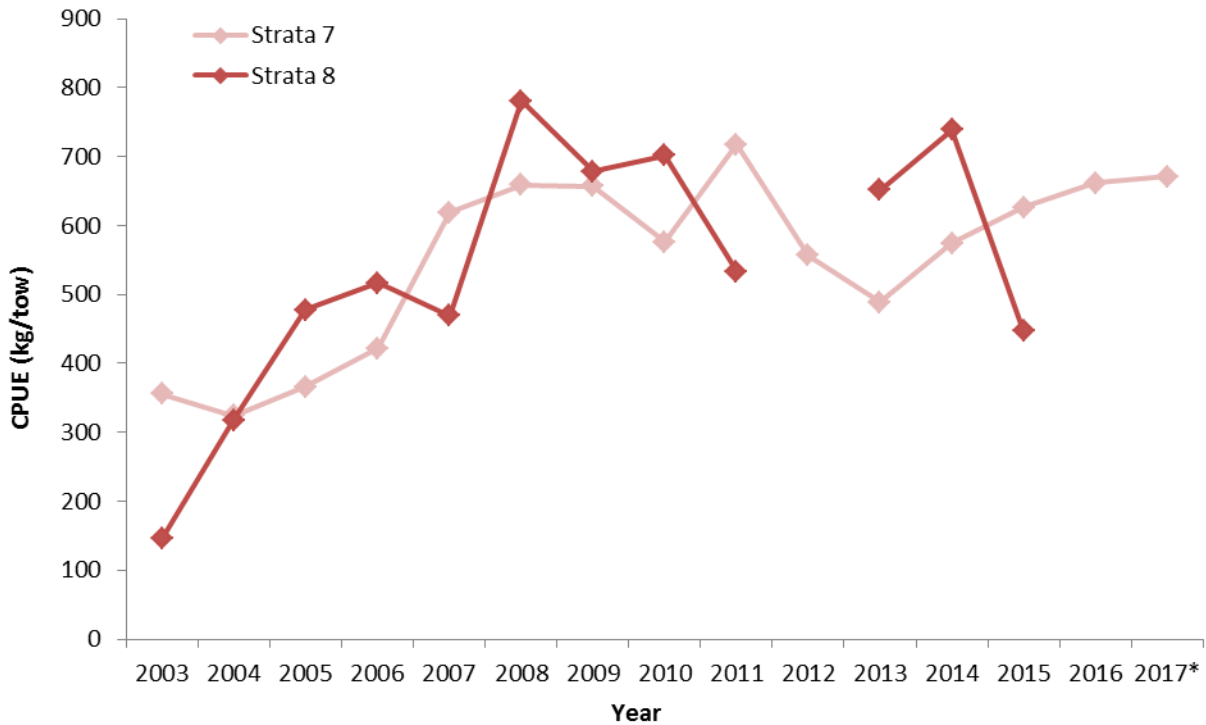


Figure 3. Commercial CPUE (kg/tow) from 2003 to 2017 in strata 7 and 8 in the northwest area from emerging and commercial fishery logbooks. \*The 2017 logbook data are preliminary as of January 2018.

## Survey Data

### CPUE, Biomass Index, and Abundance Index

During the emerging fishery surveys (2004-08) the CPUE (kg/tow) was consistently high in the entire southeast area, strata 2 and 7 of the northwest area, and to a lesser degree, strata 16 and 17 of the northwest area. These three sections of the St. Pierre Bank also had the highest CPUE during the 2016 and 2017 DFO Sea Cucumber surveys (Figure 4).

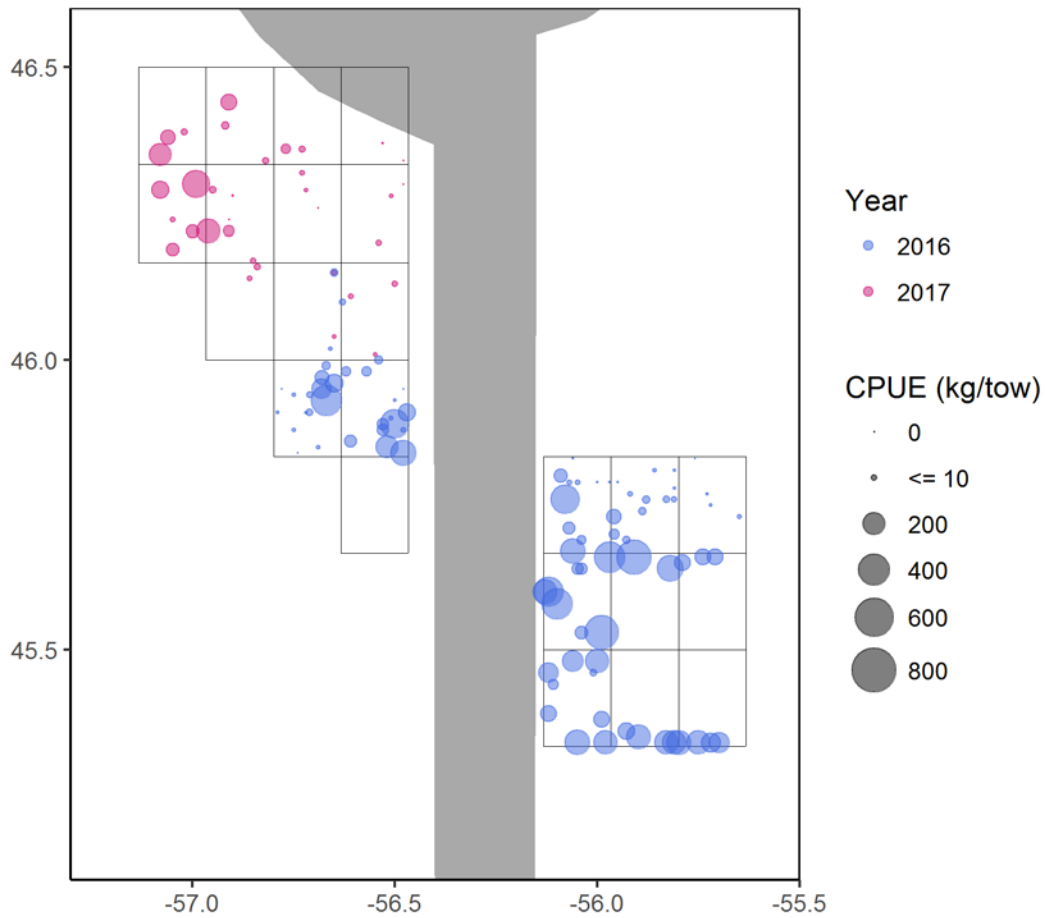


Figure 4. CPUE (kg/standardized tow) for the DFO Sea Cucumber surveys in 2016 and 2017 for the southeast and northwest Sea Cucumber areas on the St. Pierre Bank.

The biomass indices based on the emerging fishery surveys from 2004 to 2008 (excluding 2005) averaged 88.9 kt in the northwest area and 210 kt in the southeast area. The 2005 estimate is not considered reliable due to gear configuration issues. No Sea Cucumber surveys were completed during the 2009-15 period. In 2016, the Sea Cucumber survey biomass index was 187 kt in the southeast area, and could not be estimated for the northwest area as the 2016 DFO Sea Cucumber survey only covered 23% of the area. The biomass index for the 23% surveyed was 22.6 kt. The updated biomass index combining the data from the 2016 and 2017 DFO Sea Cucumber surveys for the northwest area is 67.6 kt. Both areas have slightly lower biomass index estimates than the 2004-08 averages (Figure 5).

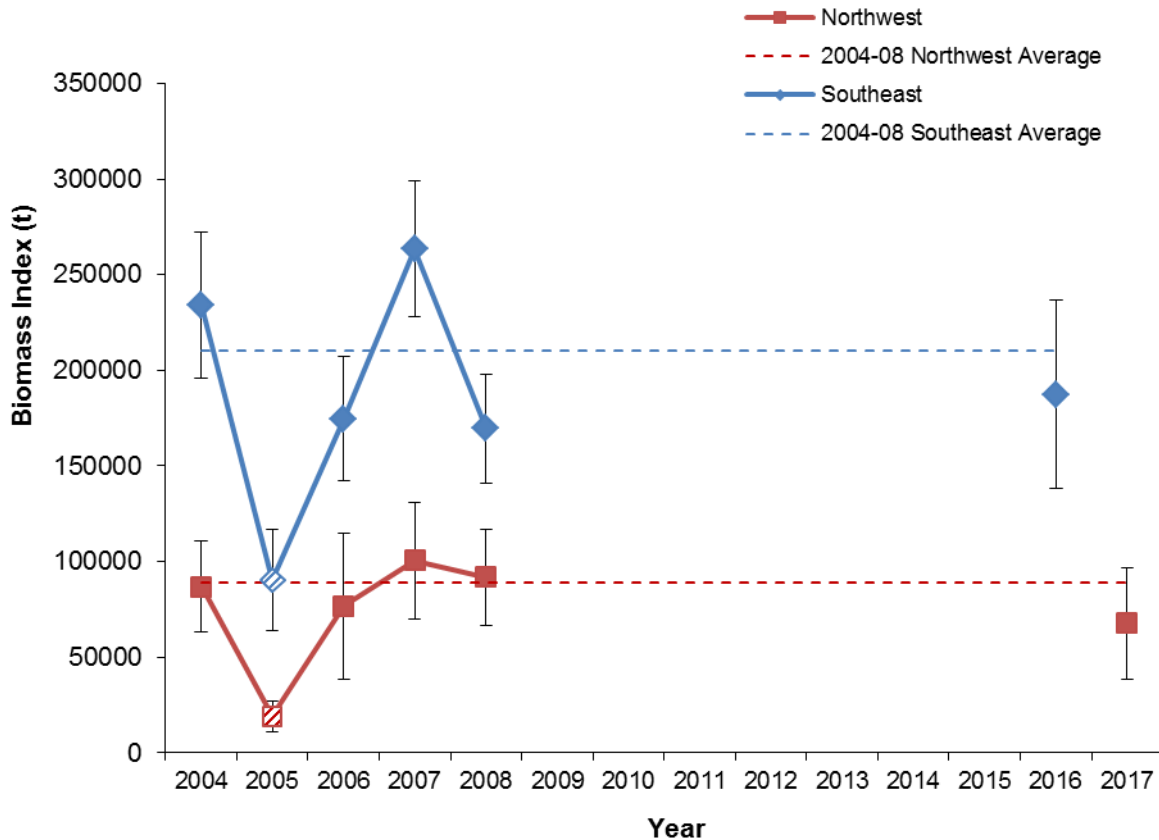


Figure 5. Annual biomass indices from 2004 to 2017 of Sea Cucumber in the southeast and northwest areas from STRAP analysis (error bars indicate 95% Confidence Intervals (CI)). The 2005 estimate is not considered reliable due to gear configuration issues. The 2004-08 average excludes 2005. The point for the northwest area in 2017 includes data from 2016 and 2017.

The abundance indices based on the emerging fishery surveys from 2004 to 2008 (excluding 2005), averaged 146 million Sea Cucumber in the northwest area and 557 million Sea Cucumber in the southeast area. In 2016, the abundance index for the southeast area was 748 million Sea Cucumber, and could not be estimated for the northwest area as the 2016 DFO Sea Cucumber survey only covered 23% of the area. The abundance index for the 23% surveyed was 65 million Sea Cucumber. The updated abundance index combining the results from the 2016 and 2017 Sea Cucumber surveys for the northwest area is 180 million Sea Cucumber. The Sea Cucumber abundance index, which includes both market size and undersized Sea Cucumber, is much higher in the southeast area than the northwest area. Both areas have abundance indices above the 2004-08 averages (Figure 6) and the abundance index for the southeast area in 2016 was the highest in the time series.

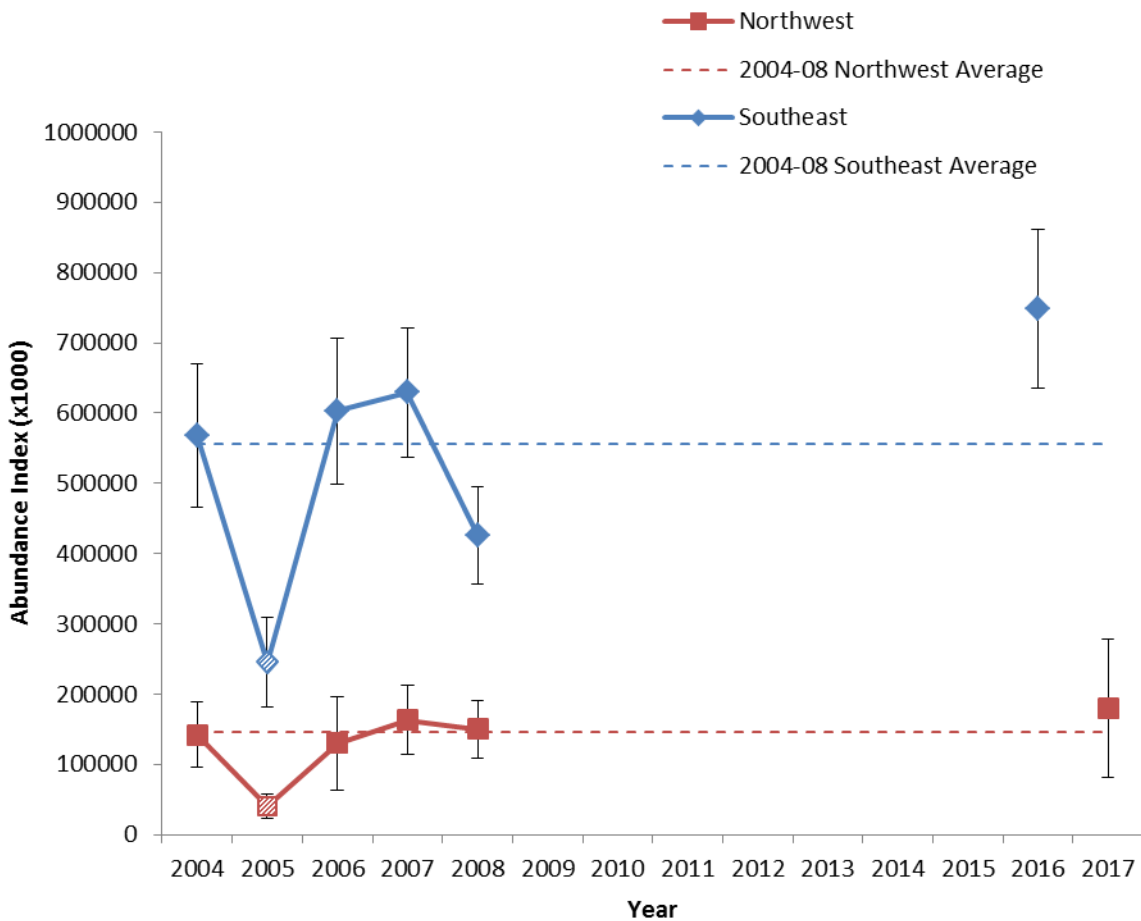


Figure 6. Annual abundance indices from 2004 to 2017 of Sea Cucumber in the southeast and northwest areas from STRAP analysis (error bars indicate 95% Confidence Intervals (CI)). The 2005 estimate is not considered reliable due to gear configuration issues. The 2004-08 average excludes 2005. The point for the northwest area in 2017 includes data from 2016 and 2017.

Survey gear efficiency is unknown, but believed to be less than one, therefore biomass and abundance indices obtained from the surveys are considered minimal indices. The biomass index is calculated from fresh wet weight of Sea Cucumber at time of capture with no adjustments for drainage or water absorption. The biomass and abundance indices are not absolute numbers and are intended as indicators of trends.

### Biometric Measures

During the 2016 and 2017 DFO Sea Cucumber surveys, up to 50 representative samples of Sea Cucumber were measured (length, weight, girth) from each tow. The analyses for the RPR in February 2017, using only 2016 Sea Cucumber survey data, indicated that the Sea Cucumber in the northwest area (23% of area sampled) are larger and heavier than those in the southeast area. The updated biometric data with additional measurements from the 2017 DFO Sea Cucumber survey indicate the same trend towards larger and heavier Sea Cucumber in the northwest area (Table 1; Figure 7).

Basic biometrics such as length, weight, and girth are difficult to obtain for Sea Cucumber due to the plasticity of their physical characteristics. Variability in these types of measurements is

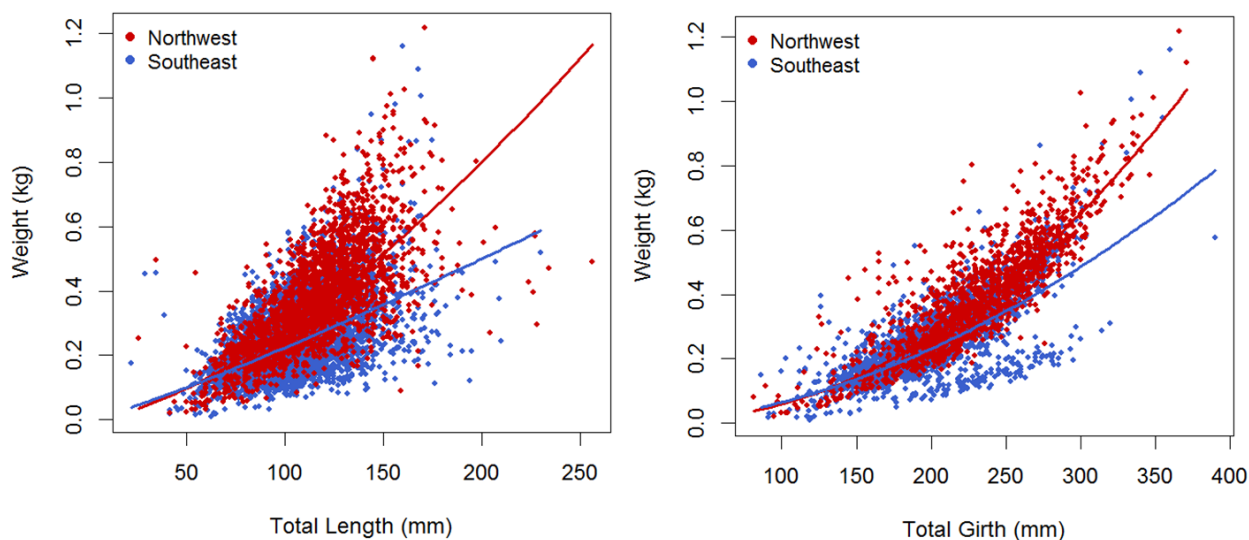


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inevitable as Sea Cucumber are comprised of 80-90% water and are able to expand or contract by absorbing or dispelling water, therefore caution should be used when interpreting biometric data.

*Table 1. Mean length (mm), weight (kg), and girth (mm) of Sea Cucumber sampled in the northwest (NW) and southeast (SE) areas during the DFO 2016 and 2017 Sea Cucumber surveys on the St. Pierre Bank. The number in brackets is the number of Sea Cucumber sampled.*

<b>Biometric</b>	<b>St. Pierre Bank</b>	<b>NW 2016</b>	<b>NW 2016 &amp; 2017</b>	<b>SE 2016</b>
Mean Length	108 (7,118)	113 (1,594)	116 (2,473)	104 (4,645)
Mean Weight	0.30 (7,090)	0.37 (1,586)	0.38 (2,465)	0.25 (4,625)
Mean Girth	214 (3,655)	229 (962)	229 (1,460)	204 (2,195)



*Figure 7. Weight-length (left panel) and weight-girth (right panel) model fits for the northwest and southeast areas based on the 2016 and 2017 DFO Sea Cucumber surveys.*

**Bycatch**

The most prominent bycatch species in the 2016 DFO Sea Cucumber survey were Sea Urchin (*Strongylocentrotus droebachiensis*) and Sand Dollar (*Echinarachnius parma*). With the addition of the 2017 DFO Sea Cucumber survey data, Sea Urchin and Sand Dollar remain the most prominent survey bycatch species on the St. Pierre Bank (Figure 8). Bycatch comprised 33% of the total catch by weight from the 2016 and 2017 DFO Sea Cucumber surveys.



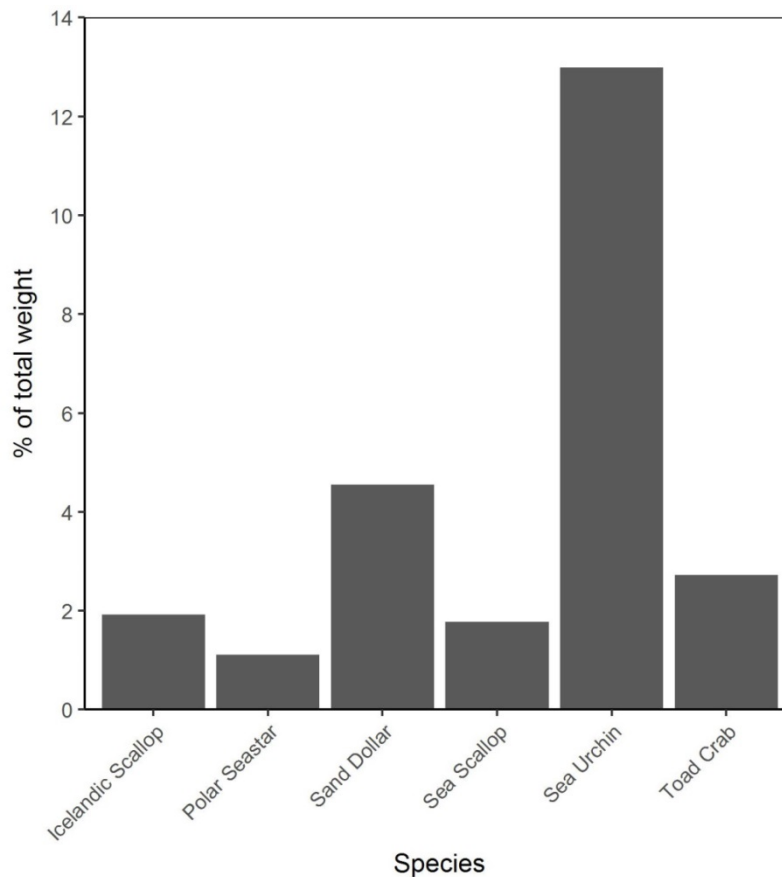


Figure 8. The percentage by weight (kg) of the most prominent bycatch species caught in the 2016 and 2017 DFO Sea Cucumber surveys on the St. Pierre Bank. Species which comprised at least 1% of the total catch by weight are displayed.

### Exploitation

Exploitation rate indices can be calculated provided there are survey biomass and commercial catch data from the same year. Exploitation rate indices could not be calculated for the northwest area for the RPR in February 2017 due to an incomplete survey, resulting in an incomplete biomass index. An exploitation rate index could not be calculated for the southeast area because it was closed to fishing. Combining the 2016 and 2017 DFO Sea Cucumber survey data for a more representative biomass estimate, the exploitation rate index for the northwest area of St. Pierre Bank in 2017 would have been 3.4%; however, the survey data are not from the same year. The exploitation rate index for the southeast area cannot be calculated as the fishing did not occur in the same year as the survey. The biomass index is not absolute, therefore neither is the exploitation rate index. Sustainable exploitation rates are unknown for Sea Cucumber on the St. Pierre Bank.

### Mortality

The natural mortality rate for Sea Cucumber on the St. Pierre Bank is unknown. Measures of fishing induced mortality and survival rate of Sea Cucumber returned to the water from directed or incidental fisheries is also unknown.

## Conclusions

This document provides an update of the NAFO Subdivision 3Ps Sea Cucumber stock status following completion of survey sampling in the northwest area that was not included in the 2017 RPR. Up-to-date fishery data are also included.

There is currently no Integrated Fishery Management Plan (IFMP) for Sea Cucumber on the St. Pierre Bank. Additionally, there are no established reference points by which to determine stock status in relation to a Precautionary Approach Framework. Fishery data (landings and commercial CPUE) and survey data (CPUE, biomass and abundance indices, and biometric measures) are used as indicators of stock status; however, sustainable levels are unknown. In most cases, current estimates are compared to the mean estimate from the 2004 to 2008 emerging fishery (excluding 2005), which represents the pre-commercial fishery Sea Cucumber stock status on the St. Pierre Bank. The indicators of stock status should be interpreted in terms of trends over time, not absolute values.

With the addition of up-to-date commercial fishery data, landings in the northwest area increased in 2015 and 2016 to take the full TAC, and increased in 2017 due to the issuance of new permits for the southeast area. Fishery CPUE for the northwest area has remained stable. With the completion of the survey for the northwest area in 2017, survey CPUE was highest in the same areas as during the emerging fishery surveys (2004-08). The biomass indices were slightly lower while the abundance indices were higher than the 2004-08 means in both the northwest and southeast areas. This could suggest that Sea Cucumber have decreased in size in both areas. Biometric measurements indicate Sea Cucumber in the northwest area are larger and heavier than those in the southeast area. The exploitation rate index for the northwest area, using 2016 and 2017 survey data, was 3.4% and no exploitation rate index could be calculated for the southeast area.

Caution should be taken when interpreting the indicators of stock status for the St. Pierre Bank Sea Cucumber due to sources of uncertainty. There is limited information on the life history of Sea Cucumber specific to the St. Pierre Bank; especially with respect to age at maturity, recruitment processes, reproductive rate, natural mortality, and the connectivity between the northwest and southeast areas. The consequences of the harvesting method and removals on ecosystem structure and function are unknown.

Interpretation of the trends in stock status indicators over time is limited due to large gaps in the time series. Since the completion of the emerging fishery surveys in 2008, the Sea Cucumber resource on the entirety of the St. Pierre Bank has been surveyed once; the southeast area in 2016 and northwest area partially in 2016 and completed in 2017. Increased frequency of surveys is necessary to address this issue.

Given the uncertainties with this species on the St. Pierre Bank, there is no scientific basis for assessing the risk of any increase in harvest level. Sustainable exploitation rates are unknown, and due to the slow growth rate of Sea Cucumber on the St. Pierre Bank, sustaining a relatively low exploitation rate could help maintain the biomass available to the fishery over a longer period of time.

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### Sources of information

DFO. 2017. An assessment of the Sea Cucumber (*Cucumaria frondosa*) resource on the St. Pierre Bank (NAFO Subdivision 3Ps) in 2016. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/029.

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