



## ASSESSMENT OF NORTHERN SHRIMP (*Pandalus borealis*) IN SFA 0, 2, 3 AND STRIPED SHRIMP (*Pandalus montagui*) IN SFA 2, 3 AND 4 WEST OF 63°W



Top: Northern Shrimp (*Pandalus borealis*)  
Bottom: Striped Shrimp (*Pandalus montagui*)

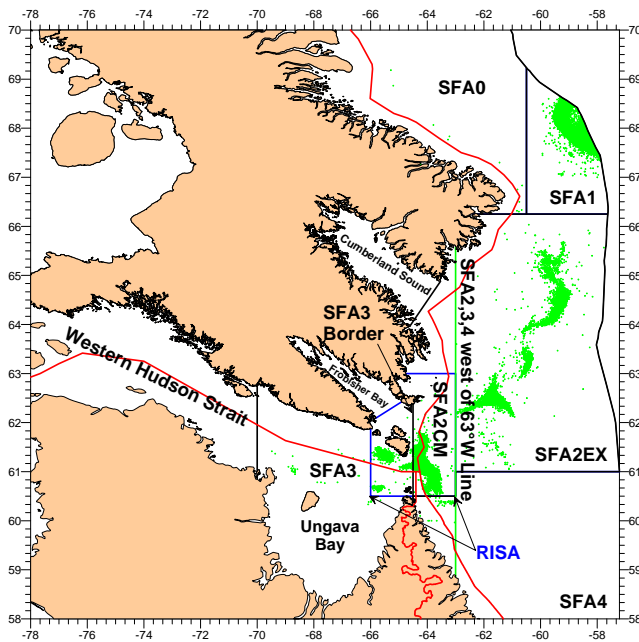


Figure 1. Map of Shrimp Fishing Areas and survey study areas in Hudson Strait and Ungava Bay, Davis Strait and Baffin Bay. Points are fishing locations from 1985-2009. Land claim boundaries are marked in red.

### Context :

Fisheries and Oceans Canada (DFO) Fisheries and Aquaculture Management (FAM) has requested Science advice on the status of shrimp resources in the waters adjacent to Nunavut. The shrimp fishing areas (SFAs) being considered include SFAs 0, 2, 3 and 4 west of 63°W (Fig. 1). SFA 1 is assessed by the North Atlantic Fisheries Organization and will not be discussed here.

A series of fishery-independent surveys and fishery data formed the basis of the current assessment. Surveys were conducted in five study areas (Fig. 1); SFA 0, SFA 2EX (SFA 2 east of 63°W), the Resolution Island study area (RISA: 66°W-63°W and 60°30'N-63°N), SFA 3 (west of RISA) and western Hudson Strait (WHS: 70°W-78°W). Observer catch data corresponds to management areas SFA 0, SFA 2EX, SFA 2CM, SFA 3 and SFA 4 west of 63°W.

Two species of shrimp, northern shrimp (*Pandalus borealis*) and striped shrimp (*P. montagui*), occur in these areas. Northern shrimp is the dominant species in SFAs 0 and 2EX. Striped shrimp is the dominant species in SFA 3. Both species are highly mixed and interspersed in RISA.

Past management of the fishery has involved Total Allowable Catch (TAC) allocations for subareas of the SFAs under various exploratory and commercial licences. TACs were set without fishery-independent survey data from these areas.

This assessment follows the framework developed in 2007 for northern shrimp off Labrador and the northeastern coast of Newfoundland (DFO 2007). Both species were last assessed in 2008 (DFO 2008). Assessments are planned every two years.

## SUMMARY

- *Pandalus borealis* was assessed in management areas SFA 0, SFA 2 (SFA 2EX and SFA 2CM), SFA 3 (SFA 3 and RISA west survey areas) and western Hudson Strait (WHS).
- *Pandalus montagui* was assessed in management area SFA 2, 3, 4 west of 63°W (SFA 2CM, SFA 3 and SFA 4 west of 63°W).
- Since the 2008 assessment, four research surveys: 2008 DFO survey of SFA 0, 2009 DFO survey of SFA 3 and western Hudson Strait, the 2008 and 2009 Northern Shrimp Research Foundation (NSRF)-DFO surveys of SFA 2EX and RISA provide the fishery-independent data for this assessment.
- Production (survey biomass and fishery data) and fishery exploitation rate indices are used to assess the resources.

### **SFA 0 – *P. borealis***

#### Fishery

- No fishery in recent years.

#### Biomass

- Resource status is based on two surveys conducted in 2006 and 2008.
- Fishable biomass index was 750 t (2006) and 1,100 t (2008).
- Female spawning stock biomass index was 580 t (2006) and 800 t (2008).

#### Recruitment

- Recruitment is uncertain.

#### Mortality

- Competitive TAC of 500 t could result in a potential exploitation rate index of 40%-70% based on the observed biomass. A lower TAC is recommended.

#### Current Outlook and Future Prospects

- Future prospects for a fishery are limited.
- There are no plans for future surveys in this area.

### **SFA 2 (SFA 2EX and SFA 2CM combined)– *P. borealis***

#### Fishery

- CPUE varied without trend at a high level from 2000 to 2008/09, increasing in 2009/10.

#### Biomass

- Resource status is based on fishery data and a four year survey series starting in 2006.
- Fishable biomass index increased from 33,000 t in 2006 to 78,000 t in 2009.
- Female spawning stock biomass index increased from 17,000 t in 2006 to 39,000 t in 2009.

#### Recruitment

- Recruitment is uncertain.

Mortality

- The observed exploitation rate index has declined from a 2006/07 high of 18% to 7% in 2009/10. The four-year mean was 13%.
- Potential exploitation rate index based on total TAC has declined from a high of 27% in 2006/07 to 11% in 2009/10 with a mean of 20%.
- SFA 2 comprises an exploratory area (SFA 2EX) with low exploitation rate index and a commercial area (SFA 2CM).

Current Outlook and Future Prospects

- Survey biomass indices have been increasing since 2006/07.
- Female spawning stock biomass is currently in the healthy zone, well above the provisional Upper Stock Reference.
- Transferring 1,200 t of *P. borealis* quota from SFA 2CM to SFA 2EX would reduce fishing pressure on SFA 2CM without exceeding an exploitation rate index of about 15% of the observed biomass.

**SFA 3 (including RISA-W survey area) – *P. borealis***Fishery

- There is no directed *P. borealis* fishery in this area.

Biomass

## SFA3 west of RISA

- Resource status is based on two survey years, 2007 and 2009.
- Fishable biomass index for the two years was 14,600 t (2007) and 15,500 t (2009).
- Female spawning stock biomass index was 3,200 t (2007) and 3,800 t (2009).

## RISA-W

- Resource status is based on two survey years, 2008 and 2009.
- Fishable biomass index for the two years was 3,700 t (2008) and 606 t (2009).
- Female spawning stock biomass index was 2,250 t (2008) and 200 t (2009).

Recruitment

- Recruitment is uncertain.

Current Outlook and Future Prospects

- Prospects are uncertain due to limited data.

**SFA 2, 3, 4 west of 63° management area – *P. montagui***Fishery

- CPUE has varied without trend since 2000 at a high level.

Biomass

- Resource status is based on fishery data and four years of survey data in SFA 2, SFA 4 using the Campelen trawl starting in 2006 and two surveys in SFA 3 east of 66°W using the Cosmos trawl in 2007 and 2009.
- Fishable biomass index for the area between 63°W to 66°W had an overall mean of 12,900 t.
- Fishable biomass index for the SFA 3 area was 48,400 t (2007) and 46,700 t (2009).

- Female spawning stock biomass index for area between 63°W to 66°W had an overall mean of 9,500 t.
- Female spawning stock biomass index for the SFA 3 area was 16,700 t (2007) and 18,000 t (2009).

#### Recruitment

- Recruitment is uncertain.

#### Mortality

- The observed exploitation rate index for 2008/09 and 2009/10 was low at 4%.
- The potential exploitation rate index varied between 28% and 47% based on the total TAC (6,300 t) for all *P. montagui* for 2008/09 and 2009/10.

#### Current Outlook and Future Prospects

- Female spawning stock biomass is currently in the healthy zone, well above the provisional Upper Stock Reference for the area between 63°W to 66°W.

### **Western Hudson Strait - *P. borealis* and *P. montagui***

#### Fishery

- There has never been a fishery in this area.

#### Biomass

- Resource status is based on one survey in 2009.
- Fishable biomass index was 175 t for *P. borealis*, 3,800 t *P. montagui*.
- Female spawning stock biomass 7 t for *P. borealis* and 1,200 t *P. montagui*.

#### Current Outlook and Future Prospects

- Outlook for a fishery in this area is poor.

## **BACKGROUND**

### **Species Biology**

Northern shrimp (*P. borealis*) are found in the Northwest Atlantic from Baffin Bay to the Gulf of Maine, and striped shrimp (*P. montagui*) are found from Davis Strait south to the Bay of Fundy. Both species have preferred depth and temperature distributions. In the north, *P. montagui* prefer cooler water (-1 to 2°C) which tend to occur in shallower depths than *P. borealis* (0 to 4°C). The main density for *P. borealis* tends to occur at 300-600 m while *P. montagui* occur mainly in 200-400 m. Northern shrimp have been found associated with sediment high in organic content. Striped shrimp adults prefer harder bottoms and are found on sand, mud, gravel and rocks.

Both species of shrimp are protandric hermaphrodites, functioning as males early in their lives then changing sex and reproducing as females for the remainder of their lives. Females usually produce eggs once a year in the late summer-fall and carry them, attached to their abdomen, through the winter until the spring, when they hatch. Newly hatched shrimp spend three to four months as pelagic larvae. At the end of this period they move to the bottom and take up the life

style of the adults. Shrimp ageing in the north is uncertain but shrimp are thought to live five to eight years. Growth rates and maturation are likely slower in northern populations. Both species migrate into the water column during the night. The migration consists mainly of males and smaller females. Shrimp are opportunistic feeders on or near the sea floor and in the water column.

*Pandalus* shrimp are important forage species for fishes and marine mammals.

## **Fishery**

The fishery is managed by Total Allowable Catch (TAC). Access to the fishery is limited to 17 offshore license holders and to special quota allocations to Nunavut managed by the Nunavut Wildlife Management Board (NWMB) to be fished within the Nunavut Settlement Area (NSA). The NWMB sub-allocates their quota to Hunters and Trappers Organizations (HTO) and other Nunavut organizations such as the Baffin Fisheries Coalition. New access to the fishery has been capped but Nunavut HTOs charter vessels on a royalty basis to fish their quota. All fishing to date has been conducted by large vessels (>500 t) with 100% observer coverage.

Fishing gear consists of single and more recently twin shrimp trawls requiring a minimum codend mesh size of 40 mm and Nordmøre separator grate (maximum 28 mm bar spacing). Since 2003, the management year has been April 1 to March 31. The fishing season is limited by the extent of sea ice, and is conducted between May and December in most years.

*P. borealis* has been the main commercial species throughout the history of the shrimp fishery in this area. Directed *P. montagui* fishing does occur but the majority of this species is taken as by-catch in the directed *P. borealis* fishery.

The fishery began in the late 1970s in SFA 1. Exploratory fishing expanded into northern SFA 2 and then to areas southeast of Resolution Island in Hudson Strait. In the mid-1990s, the fishery moved southeast of Resolution Island in SFA 2, where the main fishery remains to date. In recent years, no fishing has occurred in SFA 0, or the area of SFA 3 west of RISA. Over the last eight years the distribution of fishing effort has remained unchanged.

By-catch taken over the history of the fishery is summarized in Siferd (2010).

## **ASSESSMENT**

This is an assessment of both *P. borealis* and *P. montagui*. These two species have overlapping distributions, especially in RISA, resulting in an overlap of their fisheries. The total removal, both directed catch and by-catch, of each species is considered in the assessment (Siferd in prep.).

Prior to the 2008 assessment, resource status could only be evaluated on the basis of trends in fishery CPUE and observer sampling. Fishery independent bottom trawl research surveys have been completed in SFA 0, SFA 2EX, RISA and SFA 3. In addition, for this assessment a survey of western Hudson Strait (west of SFA 3) was conducted to examine the western distribution of the population. These surveys allowed the estimation of abundance, biomass and recruitment indices for all SFAs in the assessment. Depending on the area, the number of surveys range from one to five years. Therefore for some areas, the time series is not long enough to draw definitive conclusions as yet. In SFAs 2 and 3, plans are in place to continue surveys. There are no further plans to survey SFA 0 and western Hudson Strait.

The assessment follows the framework established by DFO (2007) where possible. Fishery data and fishable and female spawning stock biomass (SSB) indices form the basis of the assessment. Fishable biomass refers to that portion of the survey catch with a carapace length greater than 17 mm and therefore includes both males and females. SSB refers to the female portion of the survey catch regardless of size. The recruitment index, which is the abundance of the population from 11.5 to 17 mm carapace length, was reviewed. An acceptable methodology to calculate total instantaneous mortality (Z) has not been found and therefore was not included as part of the assessment in these areas. Since surveys were conducted in the middle of the fishing season, exploitation rate indices were calculated based on catch divided by the fishable biomass index from the same year. TACs in these areas were not based on fishery independent biomass data when they were set so the assessment also considered the potential exploitation if the entire TAC was taken. Bootstrapped 95% confidence intervals have been included for each of the indices.

For this assessment, population status was evaluated within the Precautionary Approach (PA) framework (DFO 2006) against provisional limit reference points (LRP) developed for shrimp (DFO 2009a) for each management area. Proxies for the LRPs were based on geometric mean of available SSB. The provisional Lower Limit Reference (LRP) is 30% and Upper Stock Reference (USR) 80% of the mean.

SFA 0 and SFA 3 study areas were surveyed with a Cosmos trawl, whereas all other areas were surveyed with a Campelen trawl. Following the 2008 assessment, the mathematical model for determining swept area of the Cosmos trawl resulted in a smaller, more accurate swept area estimate than used previously. The new method was applied to all DFO surveys conducted with the Cosmos trawl including those assessed in 2008. This resulted in a higher biomass than was reported in the 2008 assessment.

Strong tidal currents up to five knots in Hudson Strait could result in quick shifts in shrimp biomass. This is an added complication when interpreting the data.

## **SFA 0 – *P. borealis***

### Fishery

No commercial fishing has occurred in SFA 0 in recent years.

### Biomass

The assessment of SFA 0 is based on two DFO surveys<sup>1</sup> conducted in late August-early September 2006 and October in 2008. *P. borealis* was the only commercial shrimp caught. Most *P. borealis* were found in the southern half of the study area with occasional *P. borealis* recorded north of 70°N. The fishable biomass index was 750 t (2006) and 1,100 t (2008). Most *P. borealis* were caught in the 400-600 m depth range in both years. The total area within this depth range combined with the species' preferred temperature (available habitat), limits the commercial potential in SFA 0. SSB index was 580 t (2006) and 800 t (2008). Individual size was larger than observed in other SFAs.

### Recruitment

Very few individuals in either survey were found with carapace lengths less than 17 mm; therefore, the recruitment in this area is uncertain.

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<sup>1</sup> All DFO surveys are funded in partnership with the Government of Nunavut, Nunavut Wildlife Management Board, Baffin Fisheries Coalition, Nunavut Tunngavik Inc., and Makivik Corp.

### Mortality

Competitive TAC of 500 t, if fully taken, would result in an exploitation rate index of 40% (2008) to 70% (2006) based on the observed biomass.

### Current Outlook and Future Prospects

With only two surveys, no biomass trends can be determined and current status remains uncertain. However, both surveys indicate very low total biomass of shrimp in this area. The area is not currently fished and based on the observed biomass, future prospects for a fishery are limited. As a result, no future surveys are planned at this time.

## **SFA 2 (SFA 2EX and SFA 2CM combined)– *P. borealis***

### Fishery

SFA 2 is divided at 63°W forming two management areas, SFA 2EX (exploratory) to the east and SFA 2CM (commercial) to the west, each having an assigned TAC. Most fishing has occurred in SFA 2CM since 1994.

Some exploratory sets are taken in SFA 2EX annually, but from the low in 2003/04 catches have fluctuated around a mean of 350 t to 2008/09 with a sharp increase to 974 t in 2009/10 (Fig. 2a). CPUE in this area has varied without trend at a moderate level from 1999 to 2008/09 with a sharp increase in 2009/10 (Fig. 3a). Observer records for the 2009/10 management year are incomplete, only containing 2/3 of the catch reported in the Canadian Atlantic Quota Report (CAQR). CPUE may change once all observer data are included.

In SFA 2CM, total catches (directed and by-catch) of *P. borealis* were stable at about 5,500 t per year, slightly above the TAC (Fig. 2b) from 2001 to 2007/08, with a slight decrease over the last two years. CAQR is reporting 4,400 t as of March 2010 so it is unlikely that the entire TAC will be taken for 2009/10.

CPUE trends in SFA 2CM and SFA 2 combined varied without trend at a high level from 2000 to 2008/09, increasing in 2009/10 (Fig. 3b, c). Industry indicated that the reduction in catch (2008/09 and 2009/10) (Fig. 2b, c) was the result of commercial/operational factors rather than resource availability.

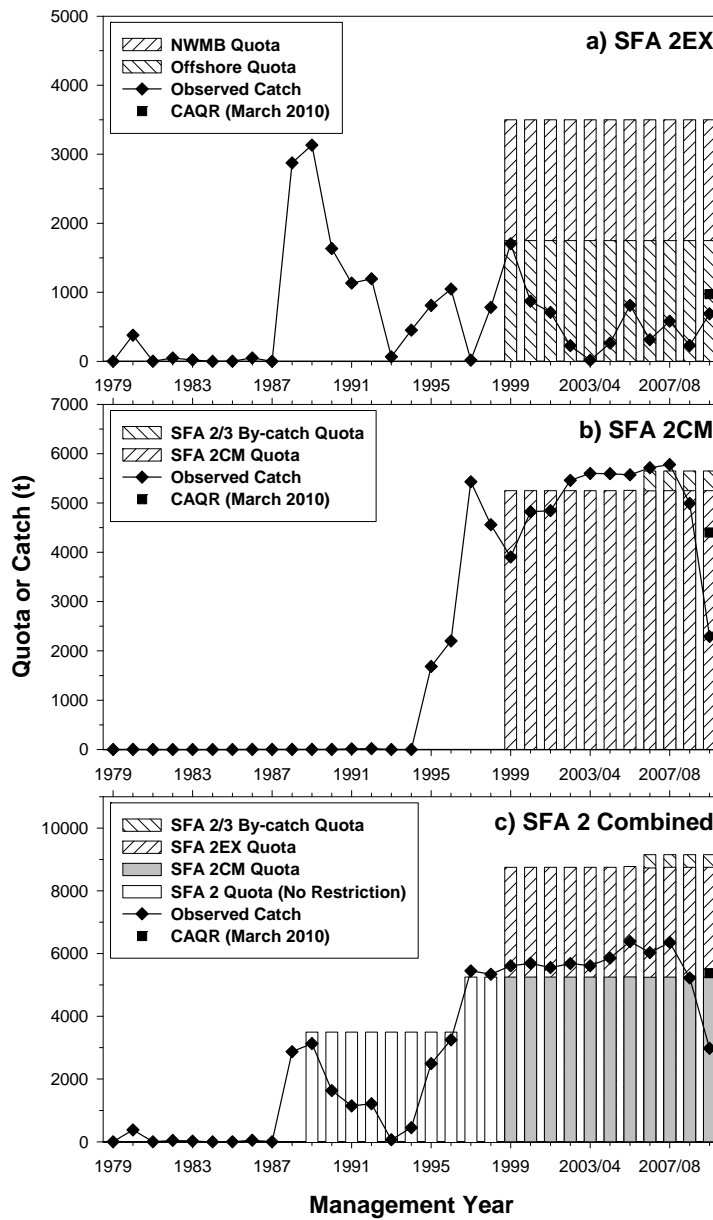


Figure 2. TAC, from the addition of assigned quotas, and historical catch as recorded by the observer program for a) SFA 2EX, b) SFA 2CM and c) SFA 2 combined. Observed catch records are incomplete for 2009/10 but CAQR (March 2010) reports 974 t. CAQR should be the total catch in 2009/10 as SFA 2 is generally not fished past December.



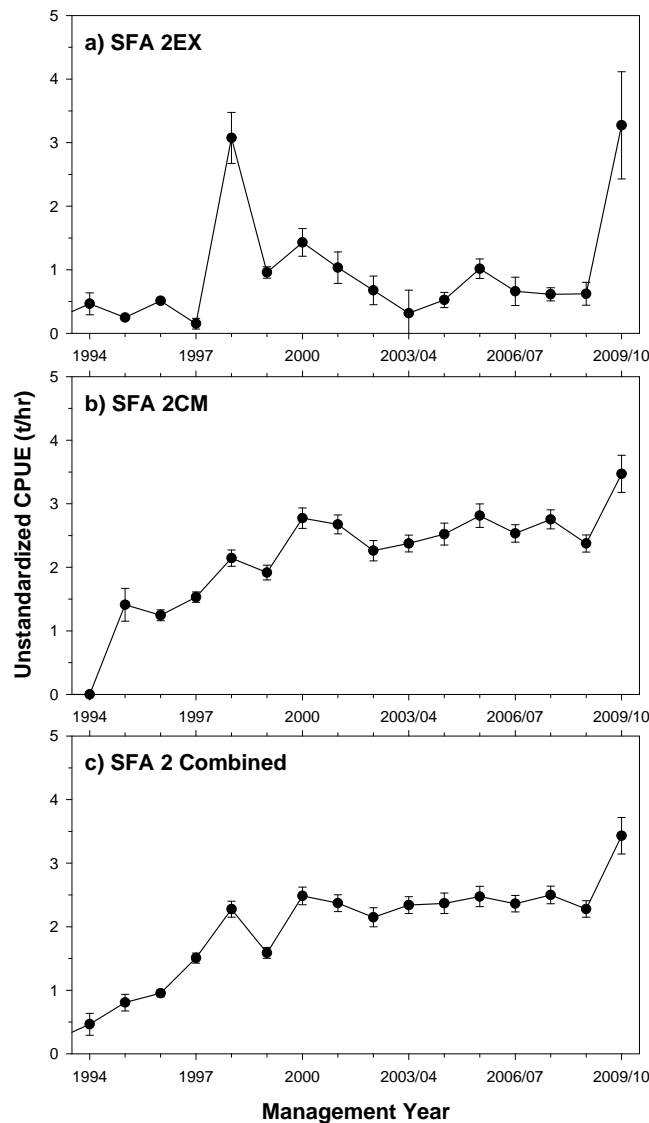


Figure 3. Unstandardized CPUE indices in a) SFA 2EX, b) SFA 2CM and c) SFA 2 combined. Observer records for 2009/10 season are incomplete.

**Biomass**

RISA was divided in half to allow biomass to be estimated for SFA 2CM (RISA-E) which could be added to SFA 2EX for an estimate of SFA 2 as a whole (DFO 2009b). SFA 2EX has five years of survey data, SFA 2CM has four years so there are four years of survey data for SFA 2 as a whole beginning in 2006.

In SFA 2EX, the fishable biomass index increased from 23,000 t in 2006 to 36,000 t in 2008 and 2009. The SSB index ranged from a low of 10,000 t in 2006 to 23,000 t in 2007.

In SFA 2CM, fishable biomass index increased from 11,000 t in 2008 to 42,000 t in 2009. The SSB index ranged from a low of 6,000 in 2008 to 22,000 in 2009.

In SFA 2, fishable biomass index increased from 33,000 t in 2006 to 78,000 t in 2009 (Fig. 4a). SSB index increased from 17,000 t in 2006 to 39,000 t in 2009 (Fig. 4b).

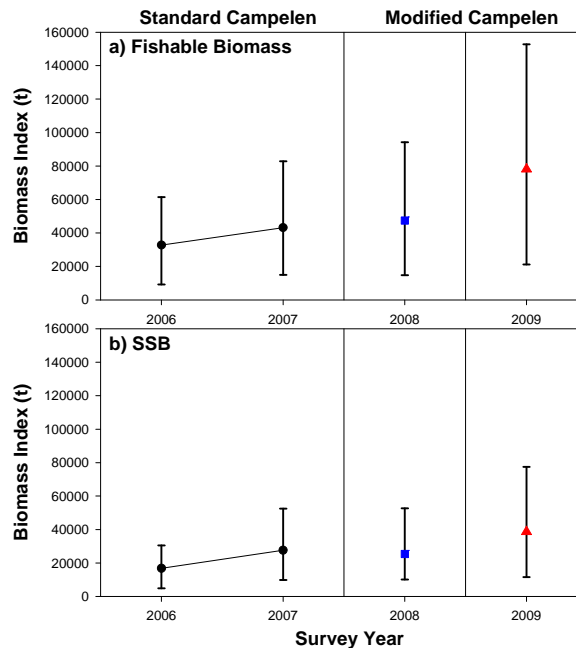


Figure 4. SFA 2 a) fishable biomass and b) SSB indices for the four common survey years 2006-2009. The modified Campelen was used in SFA 2CM (RISA-E), the standard in SFA 2EX in 2008. The modified was used in both areas in 2009.

### Recruitment

Recruitment is uncertain. Currently, there is no recruitment index for this area but work continues to develop one.

### Mortality

In SFA 2, the observed exploitation rate index has declined from a 2006/07 high of 18% to 7% in 2009/10 (Fig. 5a). The four-year mean was 13%. The potential exploitation rate index based on total TAC has declined from a high of 27% in 2006/07 to 11% in 2009/10 with a mean of 20% (Fig. 5b). The exploratory area (SFA 2EX) has a low exploitation rate index of 2% but a higher potential rate of 11% (i.e., if all TAC is taken). In comparison, the commercial area (SFA 2CM) has an exploitation rate index of 33% in 2008/09 and 10% in 2009/10 and potential exploitation rate indices of 37% in 2008/09 and 13% in 2009/10.

### Current Outlook and Future Prospects

For SFA 2, survey biomass indices have been increasing since 2006/07. SSB is currently in the healthy zone, well above the provisional USR (Fig. 6). Trends in biomass are positive and CPUE appears stable in recent years. Future prospects appear positive for SFA 2.

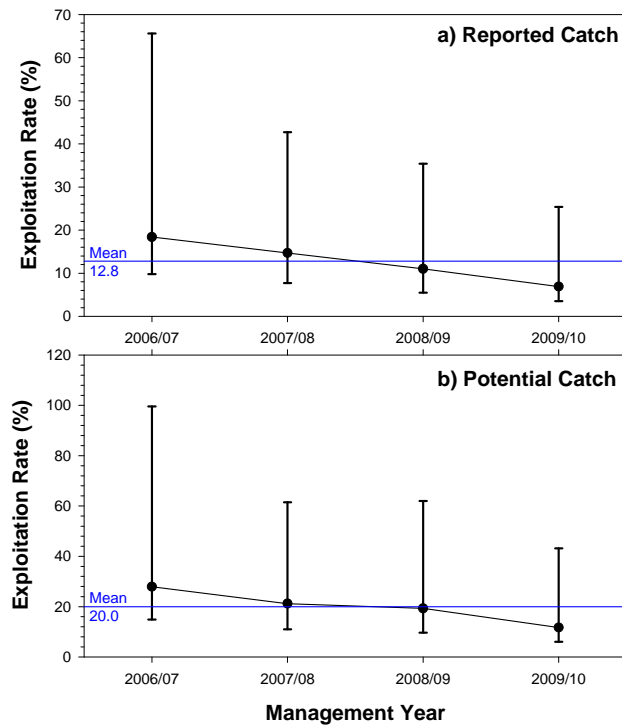


Figure 5. Exploitation rate index based on observed catch for 2006-2008 and CAQR reported catch in 2009/10 for the whole of SFA 2. Observer records are incomplete for the 2009/10 season.

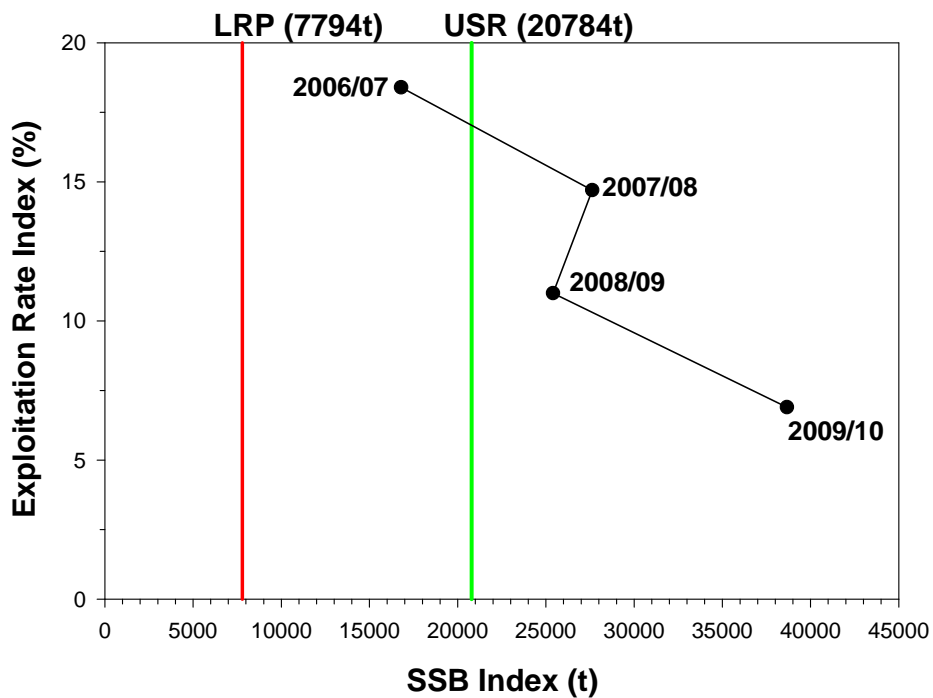


Figure 6. SFA 2 precautionary approach framework with provisional limit reference points and trajectory of exploitation rate index vs SSB.

In SFA 2EX, all indices indicate a stable population with low actual exploitation and a potential exploitation of less than 15%. The SFA 2CM sub-area has exhibited relatively high exploitation rates with a mean of 22% for 2008/09 and 2009/10. Transferring 1,200 t of *P. borealis* quota from SFA 2CM to SFA 2EX would reduce fishing pressure on SFA 2CM without exceeding an exploitation rate index of 15% of the observed biomass assuming that biomass levels remain the same as observed in 2009. Transferring quota from SFA 2EX to SFA 2CM would increase the already high exploitation rate indices in that area.

### **SFA 3 (including RISA-W survey area) – *P. borealis***

#### Fishery

There is no directed commercial fishery for *P. borealis* in the SFA 3 area.

#### Biomass

The assessment of SFA 3 is based on two DFO surveys conducted in October 2007 and 2009 in SFA 3 west of RISA-W using the Cosmos trawl and four NSRF-DFO surveys in August 2006-2009 using the Campelen trawl in RISA-W. Beginning in 2008, a modified Campelen trawl was used in RISA-W, resulting in better spatial coverage thereby increasing confidence in the 2008 and 2009 survey results.

The fishable biomass index in SFA 3 west of RISA-W was 14,600 t (2007) and 15,500 t (2009). In RISA-W, the fishable biomass index was 3700 t (2008) and 606 t (2009). The SSB index in SFA 3 west of RISA-W was 3200 t (2007) and 3800 t (2009). In RISA-W, the SSB index was 2250 t (2008) and 200 t (2009).

#### Recruitment

The recruitment index in the SFA 3 west of RISA-W increased from 700 to 900 million between 2007 and 2009 and increased from 2 to 12 million in RISA-W from 2008 to 2009. Recruitment is uncertain in these areas. However, the proportion of 11.5 mm to 17 mm shrimp in SFA3 is higher than seen in other northern SFAs.

#### Mortality

In recent years there has been no *P. borealis* exploitation in SFA 3 although there is a 400 t by-catch quota for *P. borealis* in the directed *P. montagui* fishery.

#### Current Outlook and Future Prospects

The majority of *P. borealis* was found in Hudson Strait north of Akpatok Island. This SFA is dominated by *P. montagui* with *P. borealis* comprising 25% of the total *Pandalus* biomass. With two surveys in each study area, no resource trends can be determined. The use of two different gears in surveying the SFA further limits our ability to provide advice. Solutions are being investigated. The fishable biomass index of at least 15,000 t would suggest there is potential for a *P. borealis* fishery in this area. However, there is a large proportion of smaller individuals and a mix of species in this area.

### **SFA 2, 3, 4 west of 63° management area – *P. montagui***

Resource status is based on fishery data and four years of survey data in SFA 2 and SFA 4 using the Campelen trawl starting in 2006 and two surveys in SFA 3 east of 66°W using the Cosmos trawl in 2007 and 2009.

### Fishery

The majority of *P. montagui* catch is taken as by-catch in the directed fishery for *P. borealis*. The vast majority of *P. montagui* comes from SFA 2CM south of 63°N (i.e., RISA-E). There are quotas for directed *P. montagui* fisheries within the NSA in SFAs 2 and 3 but have generally not been taken. Catch is taken between 63°W and 64°30'W with small amounts just over the border in SFA 3 with none taken further west than 66°W in recent years. Catch has declined from a high of 4,200 t in 2000 to a low of 438 t in 2009/10 (Fig. 7). This decline is thought to be more a reflection of the industry's increased ability to find cleaner catches of *P. borealis* than of declining biomass of *P. montagui*. This is supported by the observation that CPUE has varied without trend at a high level during the same time period (Fig. 8).

### Biomass

Biomass for common years can not be combined because of area specific differences in trawls, vessels used and survey timing. Since the NSRF-DFO survey covers the entire fishery area, it was used as the basis to assess this resource. SFA 3 biomass was not combined with that from the other area but is presented to represent biomass outside of the main fishing area. The fishable biomass index between 63°W and 66°W was 22,500 t (2008) and 13,500 t (2009) (Fig. 9). Confidence in the biomass estimates from the 2006 and 2007 NSRF-DFO surveys is low because of incomplete spatial coverage. The fishable biomass index for the SFA 3 survey area was 48,000 t (2007) and 47,000 t (2009). The SSB index between 63°W and 66°W was 19,000 t (2008) 11,000 t (2009). The SSB index for the SFA 3 survey area was 17,000 t (2007) and 18,000 t (2009).

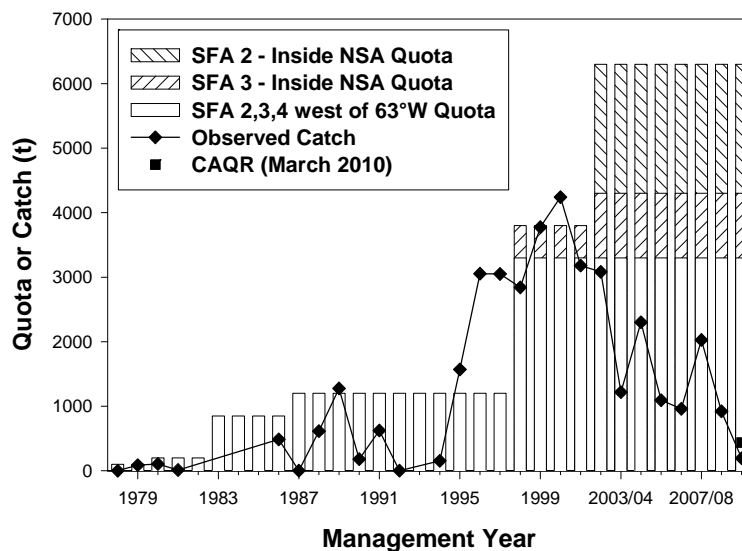


Figure 7. SFA 2, 3, 4 west of 63°W Quota Area cumulative quotas and historic catch. Observed catch records are incomplete for 2009/10 but CAQR (March 2010) reports 438 t. CAQR should be the total catch in 2009/10 as the area is generally not fished past December.

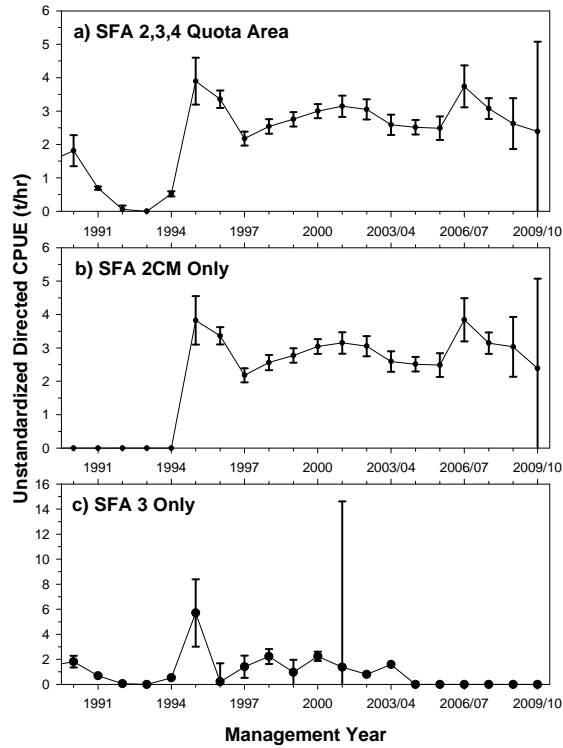


Figure 8: Unstandardized CPUE indices for directed *P. montagui* fishing in the a) SFA 2, 3, 4 Quota Area, b) SFA 2CM and c) SFA 3 with 95% confidence interval. Observer records for 2009/10 season are incomplete.

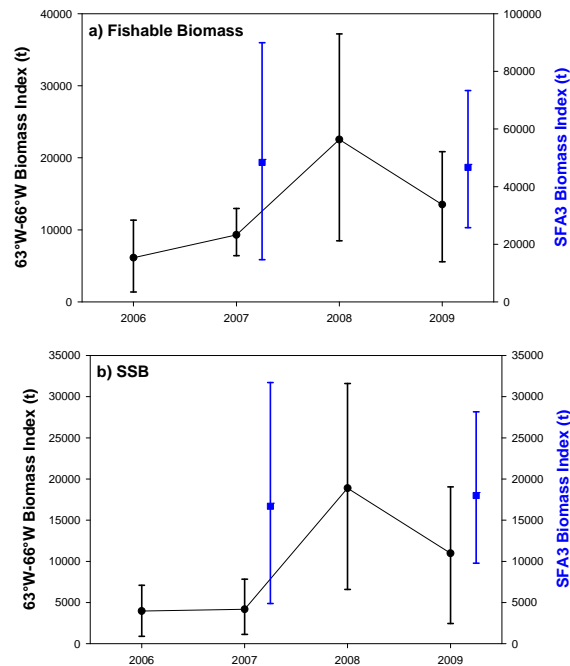


Figure 9: a) Fishable biomass and b) SSB indices for the 63°W-66°W area and the two years of DFO surveys in the SFA 3 survey area.

### Recruitment

Recruitment is uncertain. Currently, there is no recruitment index for this area but work continues to develop one.

### Mortality

Catch can only be related to biomass observed in the area of 63°W to 66°W as this is where the fishery occurs. The exploitation rate index for the last two years was low at about 4% (Fig. 10a). If the cumulative quotas were taken in the area of 63°W to 66°W this would result in a much higher exploitation rate index of 28% (2008/09) and 47% (2009/10) (Fig. 10b).

### Current Outlook and Future Prospects

The SSB in the area between 63°W and 66°W is currently in the healthy zone, well above the provisional USR (Fig. 11). There is some concern that the potential exploitation rate index would be high if the entire TAC was taken from within the area between 63°W and 66°W. However, the additional biomass in SFA 3 west of this area somewhat lessens the concern. This highlights the need for rationalization of quotas and boundaries.

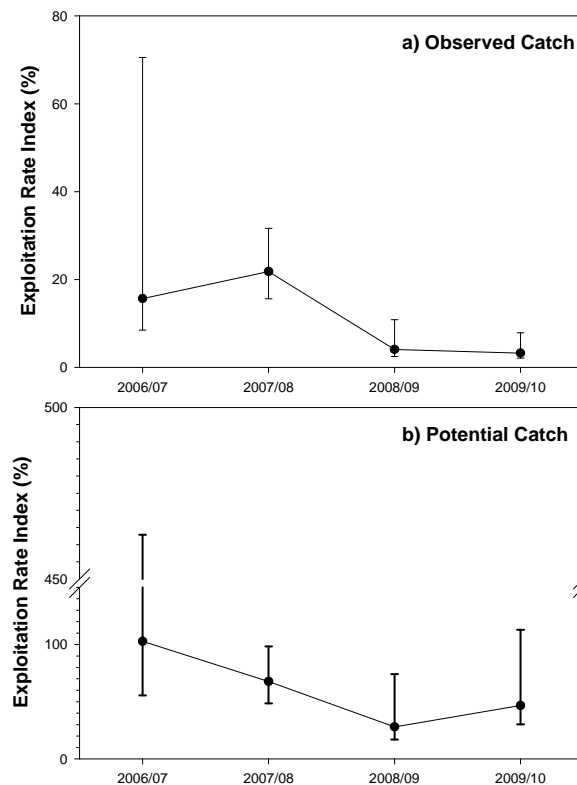


Figure 10. Exploitation rate index based on a) observed catch for 2006-2008 and b) potential catch should the entire TAC be taken in SFA 2, 3, 4 between 63°W and 66°W. Observer records are incomplete for the 2009/10 season.

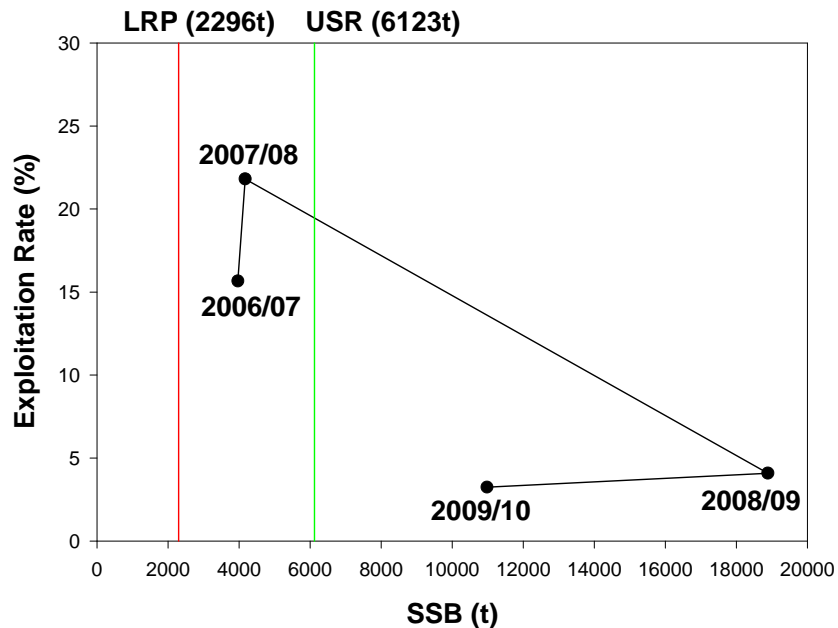


Figure 11. SFA 2, 3, 4, 63°-66°W precautionary approach framework with provisional limit reference points and trajectory of exploitation rate index vs SSB.

## Western Hudson Strait - *P. borealis* and *P. montagui*

### Fishery

This is not a commercial fishing area under the Atlantic Fisheries Regulations. The area has never been fished.

### Biomass

The assessment of this area is based on a single DFO survey conducted in October 2009. *P. borealis* and *P. montagui* both occur in this area. The fishable biomass index for *P. borealis* was 175 t and for *P. montagui* was 3,800 t. The *P. borealis* biomass consisted mainly of males with an SSB of only 7 t. Approximately one third of the *P. montagui* biomass was females with an SSB of 1,230 t. The highest density of both species occurred in the far eastern portion of the survey area near SFA 3.

### Recruitment

Recruitment is unknown.

### Mortality

There is no fishing mortality.

### Current Outlook and Future Prospects

The resource is currently unexploited. Based on the survey biomass estimates and limited suitable habitat, the prospect for a fishery in this area is very poor.



## **Sources of Uncertainty**

Hudson Strait is a highly dynamic system with strong tidal currents and mixing. Shrimp could be transported great distances in a relatively short period of time. This could result in populations shifting rapidly among the small management areas.

Fisheries independent surveys are conducted annually or biennially depending on the survey area. If there is seasonality in the distribution of shrimp and/or the catchability of the shrimp in the trawl, this could affect the assessment.

Trawls used in the surveys have catchability less than one but the exact value is unknown. Therefore, estimates produced from the surveys are minimum observed rather than absolute levels. Catch is known; however, the total fishery induced mortality is unknown (landed catch plus incidental mortality from trawling). Exploitation rates are relative indices rather than absolute.

Modifications were made to the Campelen trawl which resulted in better spatial coverage in 2008 and 2009 within RISA. This provided increased confidence in the results from these two years. However, there are still only two years of complete surveys. Continued use of this modified trawl should allow better evaluation of future resource trends.

Surveys from 2006-2008 were all conducted at the height of the spring tide, while the 2009 survey was conducted at a neap tide. Experimental work done by DFO in 2007 in the Resolution Island area suggests that results may be affected by the tidal cycle. With the new standard gear for the northern study areas, this effect will be minimized by conducting the survey during neap tides as was done in 2009.

In RISA, fishery trends (CPUE) may not reflect resource abundance. The location of fishing sets is affected by the distribution of the two species and their different market values. Since 1999, the land claim borders changed the location of the fishery.

## **INDUSTRY PERSPECTIVES**

### **Offshore Shrimp Sector**

The offshore shrimp sector observes that resource conditions observed in SFA 2 continue to be positive.

## **CONCLUSIONS AND ADVICE**

### **SFA 0 – *P. borealis***

While no commercial fishing occurs in SFA 0 it does have an assigned competitive 500 t TAC. This TAC was intended to provide fishers the opportunity to investigate the potential for shrimp fishing in the area. The current status is uncertain. The competitive TAC if taken would result in a very high exploitation rate index (40-70%). It is recommended that the TAC be lowered. This would still leave a small competitive TAC for exploration in the area but would reduce potential harm if fully taken.

**SFA 2 (SFA 2EX and SFA 2CM combined)– *P. borealis***

The current status of this resource is considered healthy based on the provisional limit reference points. Fishing pressure in SFA 2CM is higher than in the SFA 2EX. Reducing the fishing effort in SFA 2CM by moving quota to SFA 2EX would be positive for the SFA 2 resource as a whole without increasing the overall TAC for SFA 2. Transferring up to 1,200 t should result in an exploitation rate index of less than 15% in SFA 2EX assuming that biomass levels remain the same as observed in 2009. Transferring quota from SFA 2EX to SFA 2CM would increase the already high exploitation rate index in that area.

**SFA 3 (including RISA west survey area) – *P. borealis***

The current status of this resource is considered uncertain because the assessment is based on only two years of survey data in each of the sub-areas, complicated by use of different survey trawls. There is no TAC for directed *P. borealis* fishing. The fishable biomass index of at least 15,000 t would suggest there is potential for a *P. borealis* fishery in this area.

**SFA 2, 3, 4 west of 63° management area – *P. montagu***

The current status of this resource is considered healthy based on the provisional limit reference points within the area 63°W-66°W. Although the actual exploitation rate index appears to be low due to limited directed fishing, the high potential exploitation rate index in the area is of some concern.

**Western Hudson Strait - *P. borealis* and *P. montagu***

The objective of the 2009 survey in this area was to define the extent of the two *Pandalus* species to the west of SFA 3. Results suggest that the boundary at 70°W for SFA 3 adequately defines the western limit of the resource. Surveys west of the SFA 3 border would add little information to the assessment; therefore no future surveys are being considered.

**MANAGEMENT CONSIDERATIONS**

This is an extremely complex region with multiple management areas and overlapping quotas that can be fished across management units with the added complication of two highly intermixed species overlying three adjacent land claim areas (Nunavut Settlement Area, Nunavik Marine Region and Nunatsiavut Zone). This makes the assessment difficult.

The overlap of quotas in the northern SFAs result in TAC levels which would lead to very high exploitation rate indices if fished to their full extent. This continues to be a concern.

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