Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
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ASSESSMENT OF NORTHERN SHRIMP (*Pandalus borealis*) AND STRIPED SHRIMP (*Pandalus montagui*) IN SHRIMP FISHING AREAS 0, 2 AND 3

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

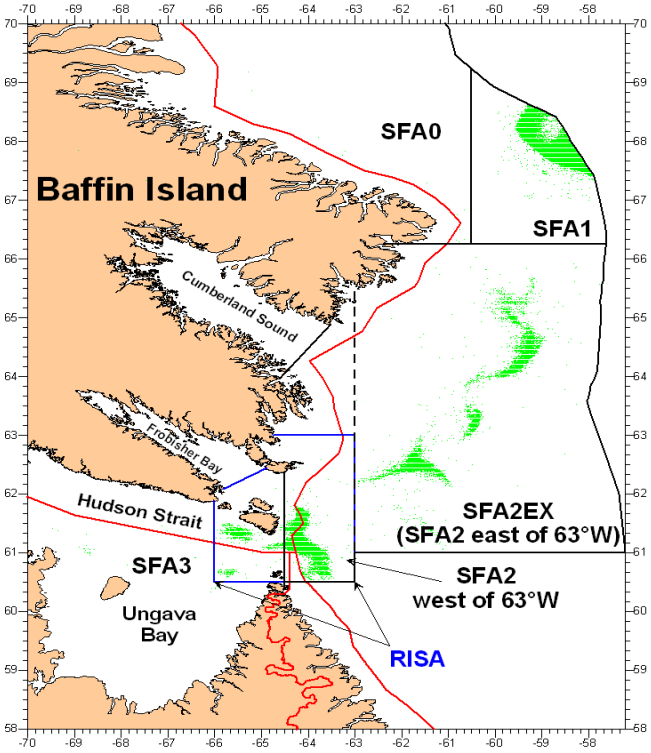

Figure 1: Map of Shrimp Fishing Areas and survey study areas in eastern Hudson Strait and Ungava Bay, Davis Strait and Baffin Bay. Points are fishing locations from 1985-2007.

Context :

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

The assessment is based on four study areas; SFA0, SFA2EX (SFA2 east of 63°W), the Resolution Island study area (RISA: 66°W-63°W and 60°30'N-63°N) and SFA3 (west of RISA). RISA encloses the main fishing area near Resolution Island. Study areas correspond with current management and fishing areas.

*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 SFA3. 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.

A series of fishery-independent surveys were undertaken to form the basis of the current assessment. RISA and SFA2EX are surveyed annually. SFA0 and SFA3 are surveyed biennially.

This assessment follows the framework developed in 2007 for northern shrimp off Labrador and the northeastern coast of Newfoundland (DFO 2007). P. borealis *was last assessed in 2006 (DFO 2006),* P. montagui *in 2003 (Orr* et al. *2003). Assessments are planned every two years*.

SUMMARY

- The areas being assessed are SFA0, the Resolution Island Study Area (RISA) which is SFA2 west of 63°W and SFA3 east of 66°W, SFA2EX which is SFA2 east of 63°W, and SFA3 west of 66°W.

- Three research surveys: 2006 DFO survey of SFA0, 2007 DFO survey of SFA3 and the 2005-2007 Northern Shrimp Research Foundation/DFO surveys of SFA2EX 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 stocks.

- The approach taken for the SFAs 0, 2 and 3 follows the framework developed for SFAs 5 and 6 (DFO 2007) to the extent possible.

- The group was unable to demonstrate there would be an improvement in future scientific advice in support of Fisheries and Aquaculture Management by changing the management areas.

SFA0 – *P. borealis*

- Resource status is based on a single survey conducted in 2006.

Production
- Survey fishable biomass index is 600 t (2006).
- Survey female biomass index is 460 t (2006).

Recruitment
- Recruitment is uncertain.

Fishery
- No fishery in recent years.

Stock Status/Current Outlook/Future Prospects
- Current status and future prospects are uncertain.
- There are plans for another survey in 2008.

SFA2EX (SFA2 east of 63°W) – *P. borealis*

- Resource status is based on fishery data and a three year survey series beginning in 2005.

Production
- Survey fishable biomass indices varied between 23,000 and 34,000 t.
- Survey female biomass indices varied between 10,000 and 23,000 t.
- Large vessel CPUE has varied without trend since 2000.

Fishery
- Exploitation rate index range for 2005/06 to 2007/08 is 2% to 3%.

Stock Status/Current Outlook/Future Prospects
- Current stock status and future prospects are uncertain.

RISA – *P. borealis*

- Resource status is based on fishery data and a two year survey series starting in 2006.

Production
- Survey fishable biomass indices were 13,000 t (2006) and 9,000 t (2007).
- Survey female biomass indices were 9,000 t (2006) and 5,000 t (2007).
- CPUE has varied without trend since 2000.

Recruitment
- Recruitment is uncertain.

Fishery
- The average exploitation rate index for 2006/07 to 2007/08 is 48%. It is based on biomass estimates which are more uncertain than in other study areas.
- Stock has supported the fishery since 2000 as CPUE and landings (directed and bycatch) have varied without trend during this period and the area fished has remained the same.

Stock Status/ Current Outlook/Future Prospects
- Stock status appears stable since 2000 from fishery data.
- Future prospects are uncertain.

RISA – *P. montagui*

- Resource status is based on fishery data and a two year survey series starting in 2006.

Production
- Survey fishable biomass indices were unchanged at 8,000 t (2006 and 2007).
- Survey female biomass indices were 7,000 t (2006) and 3,500 t (2007).
- CPUE has varied without trend since 2000 but increased significantly in 2006/07.

Recruitment
- Recruitment is uncertain.

Fishery
- Total annual catch (directed and bycatch) of *P. montagui* has decreased since 2000 primarily based on reduced effort.
- The average exploitation rate index for 2006/07 to 2007/08 is 22%. It is based on biomass estimates which are more uncertain than in other study areas.

Stock Status/ Current Outlook/Future Prospects
- Stock status and future prospects are uncertain.

SFA3 (west of 66°W)– *P. borealis*

- Resource status is based on single survey in 2007 and no fishery data.

Production
- Survey fishable biomass index is 13,000 t (2007).
- Survey female biomass index is 3,000 t (2007).

Recruitment
- Recruitment is uncertain.

Fishery
- No fishery in recent years.

Stock Status/ Current Outlook/Future Prospects
- Current status and future prospects are uncertain.

SFA3 (west of 66°W)–*P. montagui*

- Resource status is based on single survey in 2007 and no fishery data.

Production
- Survey fishable biomass index is 48,000 t (2007).
- Survey female biomass index is 17,000 t (2007).

Recruitment
- Recruitment is uncertain.

Fishery
- No fishery in recent years.

Stock Status/Current Outlook/Future Prospects
- Current status and future prospects are uncertain.

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 temperatures (-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 300-600m while *P. montagui* occur mainly in 200-400m. Striped shrimp adults are found on sand, mud, gravel and rocks but seem to show a preference for harder bottoms. Northern shrimp have been found associated with sediment high in organic content.

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 3 to 4 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 5 to 8 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 food for demersal fish and Arctic 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 bycatch in the directed *P. borealis* fishery.

The fishery in the north began in the late 1970s in SFA1. Exploratory fishing expanded into northern SFA2 and then to areas southeast of Resolution Island in Hudson Strait. Subsequently the fishery moved southeast of Resolution Island in SFA2 in the mid-1990s where the main fishery remains to date. In recent years, no fishing has occurred in SFA0, or the area of SFA3 west of RISA. Over the last six years the distribution of fishing effort has remained unchanged.

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 the fishery for each species. The total removal, both directed catch and bycatch, of each species is considered in the assessment.

In the past, resource status could only be evaluated on the basis of trends in fishery CPUE and observer sampling. Recently, fishery independent bottom trawl research surveys have been completed in SFA0, SFA2EX, RISA and SFA3. These surveys allowed the estimation of abundance, biomass and recruitment indices for all SFAs in the assessment. However, while

the time series is not long enough to draw definitive conclusions as yet, survey plans are in place to allow continuation of the surveys over the next few years.

The assessment follows the framework established by DFO (2007) where possible. Total, fishable and female spawning stock survey biomass indices form the basis of the assessment. Fishable biomass refers to that portion of the survey catch with a carapace length 17 mm or greater and therefore includes both males and females. Female spawning stock biomass (SSB) refers to the female portion of the survey catch regardless of size. Recruitment indices, which are the abundance of the population less than 17 mm carapace length, were reviewed. An acceptable methodology to calculate total instantaneous mortality (Z) has not been found and therefore was not included as part of the assessment. Since the surveys conducted in these SFAs occur in about the middle of the fishing season, exploitation rates were calculated based on catch divided by fishable biomass index in 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.

SFA0 – *P. borealis*

Commercial Fishery

No commercial fishing occurs in SFA0.

Abundance and Biomass

The assessment of SFA0 is based on a single DFO survey[1] in late August-early September 2006 where *P. borealis* was the only commercial shrimp collected. Most *P. borealis* were found in the southern half of the study area. Only two sets with *P. borealis* were recorded north of 70°N. The fishable biomass index was 600 t. The preferred depth range of *P. borealis* was 300-600 m. The total area within this depth range combined with the species' preferred temperature, limits the population potential in SFA0 (Fig. 2). SSB index was 460 t. Individual size was larger than observed in other SFAs.

Recruitment

Only seven individuals were recorded in the survey having a carapace length less than 17 mm; therefore, the recruitment in the area is uncertain.

Stock Trends and Current Status

With only a single survey estimate, no stock trends can be determined and current status is uncertain. While no commercial fishing occurs in SFA0 it does have an assigned competitive TAC of 500 t. This TAC was intended to provide fishers the opportunity to investigate the potential for shrimp fishing in the area. Based on the 2006 survey results (600 t fishable biomass index), prospects appear poor. A second research survey is planned for 2008.

[1] 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.

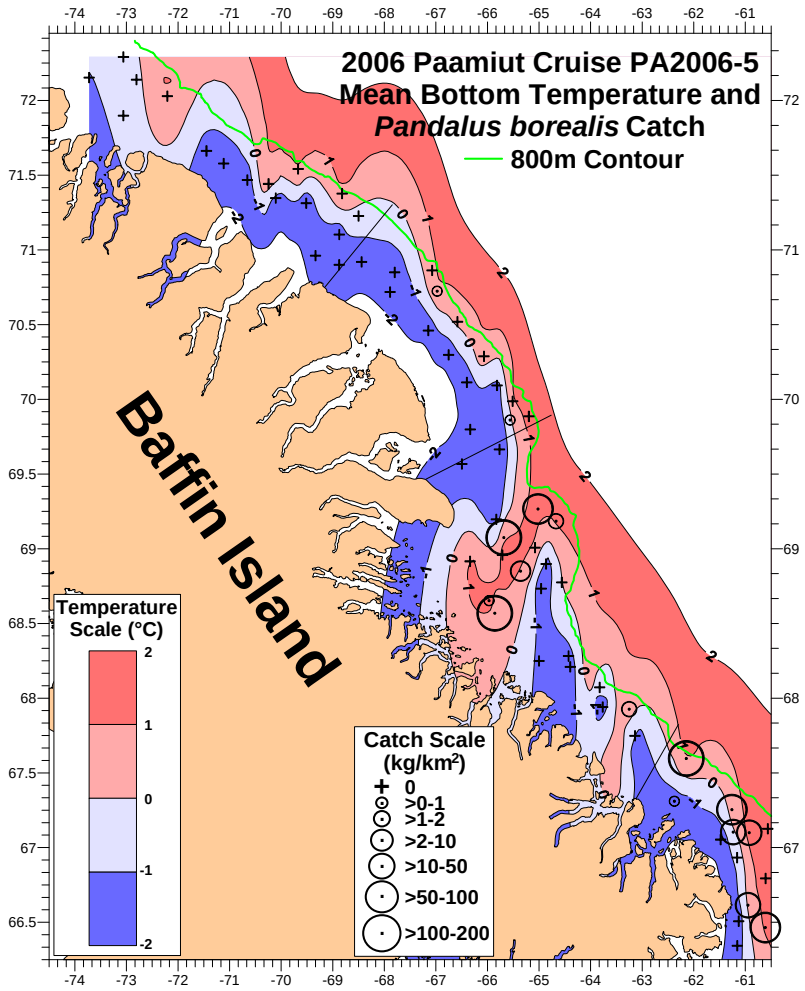

Figure 2: Mean bottom temperatures recorded during the survey of SFA0 overlain with standardized catches of P. borealis*.*

SFA2EX (SFA2 east of 63°W) – *P. borealis*

Commercial Fishery

The fishery in SFA2EX was assessed from 1999 to the present after the current management area was established and the current quotas were set. Some exploratory sets are taken in SFA2EX annually but there has been a significant reduction in catch from 1,700 t in 1999 to a few hundred tonnes in 2006/07 (Fig. 3). Relatively low CPUE combined with the economics of the shrimp industry has resulted in the reduced total catch in the area.

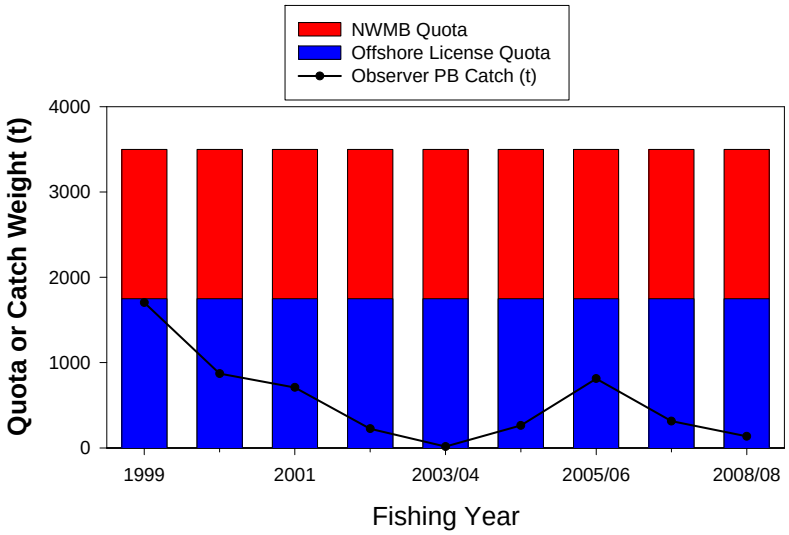

Figure 3: Total catch of P. borealis (PB) *from SFA2EX recorded by observers relative to quota. Note 2007/08 observer data is incomplete.*

Abundance and Biomass

Although the fishery observer data began in 1989, only data from 1999 to the present are shown here to coincide with the quota area. CPUE has varied without trend (Fig. 4) and is about half the observed rate in RISA (Fig. 8).

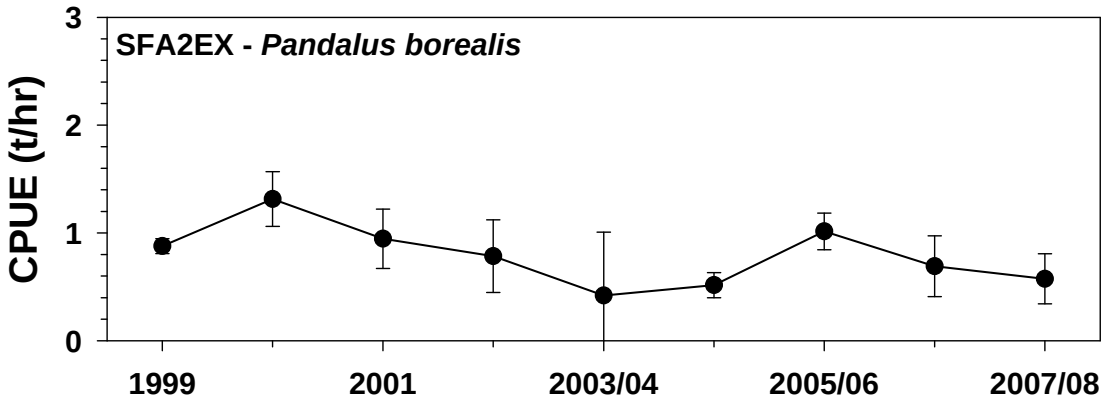

Figure 4: Unstandardized CPUE index for directed P. borealis *fishing in SFA2EX. Error bars are 95% confidence intervals. 2007/08 data is incomplete.*

The Northern Shrimp Research Foundation (NSRF) in partnership with DFO conducted three surveys in 2005-2007. Fishable biomass indices varied between 23,000 and 34,000 t. SSB indices varied between 10,000 and 23,000 t. No trends are evident in the data. The highest densities were seen in 300-400 m depth range with much lesser amounts observed in the 200-300 m and 400-500 m depth ranges which also corresponds to the preferred temperature of 1-3°C for the species.

Recruitment

Recruitment is uncertain. The trawl has lower selectivity for shrimp below 17 mm resulting in increased uncertainty in the recruitment index estimated from the codend catch. Juvenile

shrimp net sampling indicates that shrimp below 17 mm do occur in the area but are not being effectively sampled by the NRSF-DFO survey trawl codend.

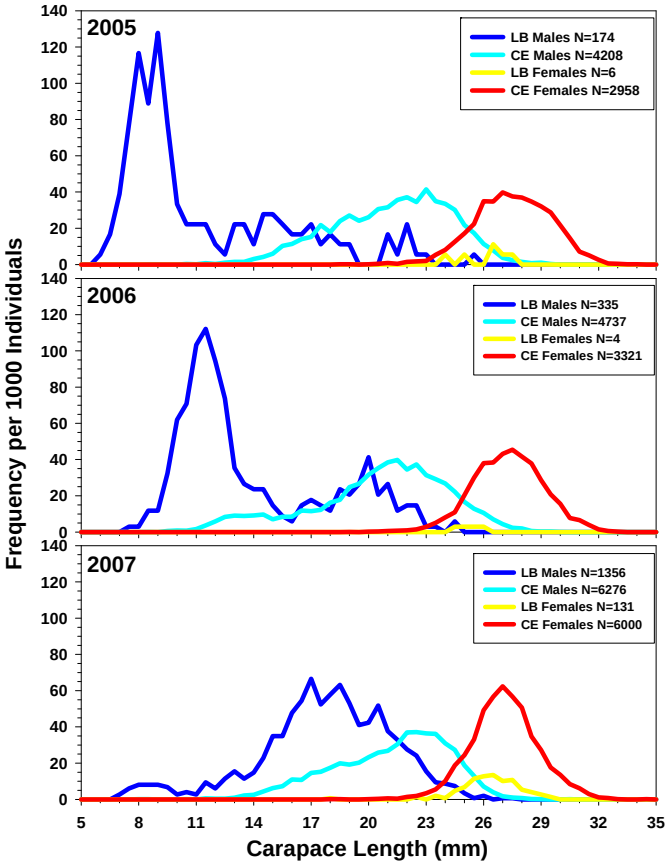

Figure 5: Overall length frequency of male and female P. borealis *in SFA2EX as captured in the codend (CE) and juvenile shrimp net (LB).*

Exploitation Rate

The exploitation rate index for 2005/06 to 2007/08 ranged from 2 to 3% (Fig. 6).

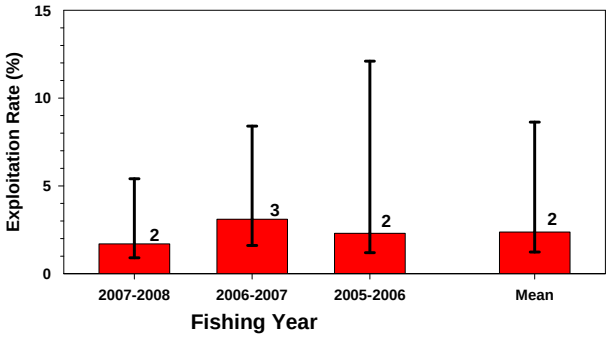

Figure 6: Exploitation rate index of P. borealis *in SFA2EX based on the reported catch in Canadian Atlantic Quota Report and the fishable biomass estimate of the NSRF-DFO surveys. Error bars are bootstrapped 95% confidence ranges.*

Stock Trends and Current Status

Stock status and future prospects are uncertain in SFA2EX because of the short time series of the surveys (3 years).

SFA2EX (SFA2 east of 63°W) – *P. montagui*

P. montagui does occur in the area but their fishable biomass index ranged from 0.4 to 12 t over the three surveys. These are low levels. The species will continue to be monitored in the area.

RISA – *P. borealis*

Commercial Fishery

Total catches (directed plus bycatch) of *P. borealis* were stable at about 5,300 t per year and slightly above the TAC (Fig. 7) since 2001. The low value in 2007/08 is a result of incomplete observer records. It is anticipated that the TAC will again be taken in 2007/08.

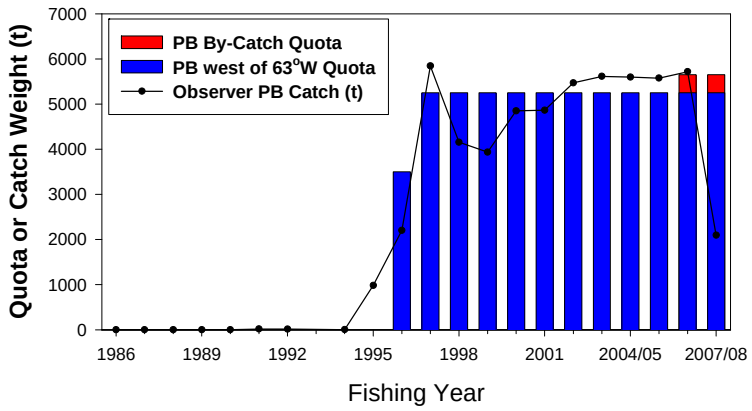

Figure 7: The total catch of P. borealis (PB) *from RISA recorded by observers relative to quota. Note 2007/08 observer data are incomplete.*

Abundance and Biomass

CPUE varied without trend since 2000 (Fig. 8).

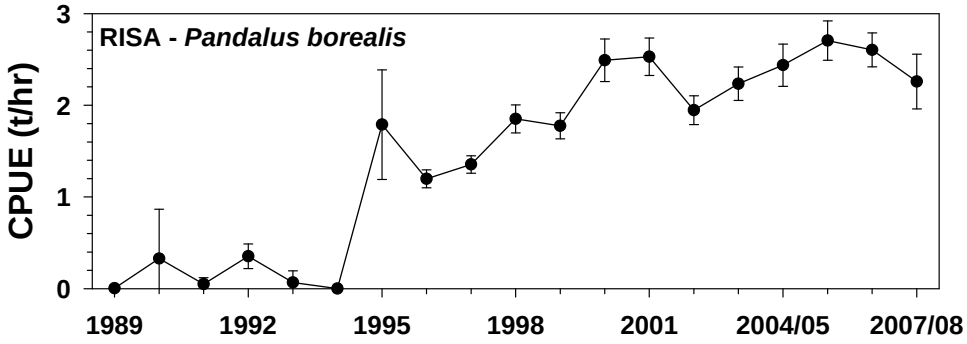

Figure 8: Unstandardized CPUE index for directed P. borealis *fishing in RISA. Error bars are 95% confidence intervals. 2007/08 data is incomplete.*

NSRF-DFO conducted two surveys in 2006 and 2007. Fishable biomass indices decreased from 13,000 t in 2006 to 9,000 t in 2007. SSB index also decreased from 9,000 t in 2006 to 5,000 t in 2007. *P. borealis* densities were highest in the 300-400 m depth range. The largest catches were found east of Resolution Island. Both of these factors correspond to warmer bottom temperatures in the area.

Recruitment

The trawl has lower selectivity for shrimp below 17 mm resulting in increased uncertainty in the recruitment index estimated from the codend catch (Fig. 10). Low catches also occur in the juvenile shrimp sampling in RISA. Recruitment prospects are uncertain.

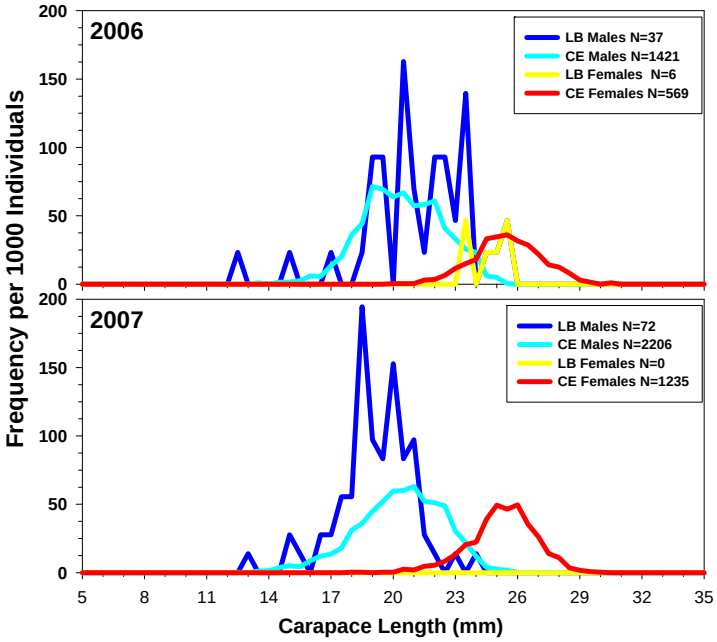

Figure 9: Overall length frequency of male and female P. borealis *in RISA as captured in the codend (CE) and juvenile shrimp net (LB).*

Exploitation Rate

The mean exploitation rate index for 2006/07 and 2007/08 was 48%, which is approximately four times higher than seen in southern SFAs where the full TAC is taken (Fig. 10). Uncertainty in the biomass estimates in RISA may have contributed to the high exploitation rate. A more detailed explanation of this is given in the Sources of Uncertainty section.

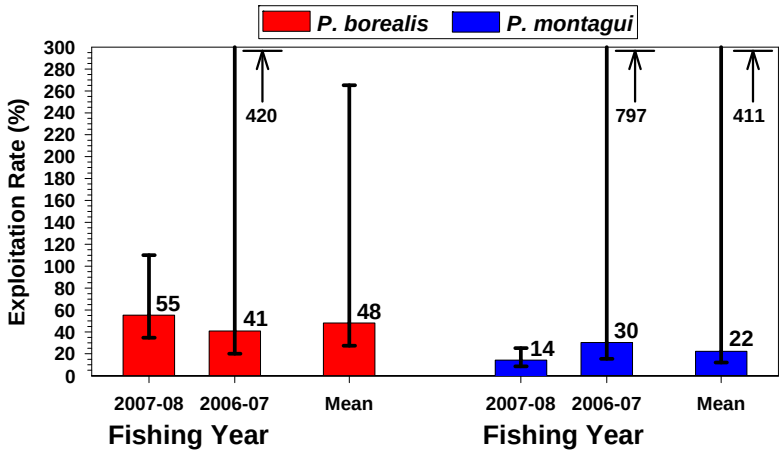

Figure 10: Exploitation indices of P. borealis *and* P. montagui *based on fishery catch reported to the Canadian Atlantic Quota Report for RISA.*

Stock Trends and Current Status

Stock status appears stable since 2000 based on the fishery data. The stock has maintained the *P. borealis* fishery over that time period. Future prospects for the fishery in this area remain uncertain because of uncertainty in recruitment.

RISA – *P. montagui*

Commercial Fishery

Total catches (directed and bycatch) of *P. montagui* have dropped from about 4,000 t in 1999 to less than 1,000 t in 2006/07 (Fig. 11). The cause of the decline is uncertain.

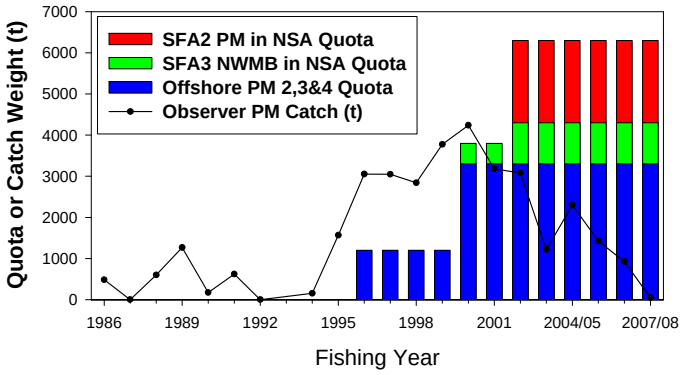

Figure 11: The total catch of P. montagui (PM) *from RISA recorded by observers relative to quota. Note 2007/08 observer data are incomplete.*

Abundance and Biomass

CPUE varied without trend from 1997 through 2005/06 but was significantly higher in 2006/07 (Fig. 12). The spike may be a result of renewed directed fishing for *P. montagui* within the NSA. The area had not been fished for several years but the creation of the *P. borealis* bycatch quota made this fishery viable again.

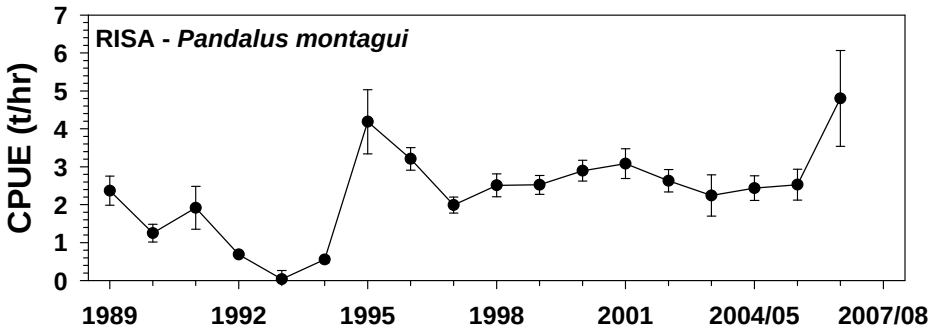

Figure 12: Unstandardized CPUE index for directed P. montagui *fishing in RISA. Error bars are 95% confidence intervals. 2007/08 data is incomplete.*

Fishable biomass indices from NSRF-DFO surveys were unchanged from 8,000 t over the two years. The SSB index, however, fell from 7,000 t in 2006 to 3,500 t in 2007 indicating an increase in smaller males in the population. The highest densities of *P. montagui* shifted from 300-400m in 2006 to 200-300m in 2007, consistent with the increase in males (i.e. smaller shrimp – shallower water).

Recruitment

Recruitment is uncertain in the RISA area because of the very short time series. However, there was a dramatic increase in the <17 mm component of the *P. montagui* population from 2006 to 2007 (Fig. 13).

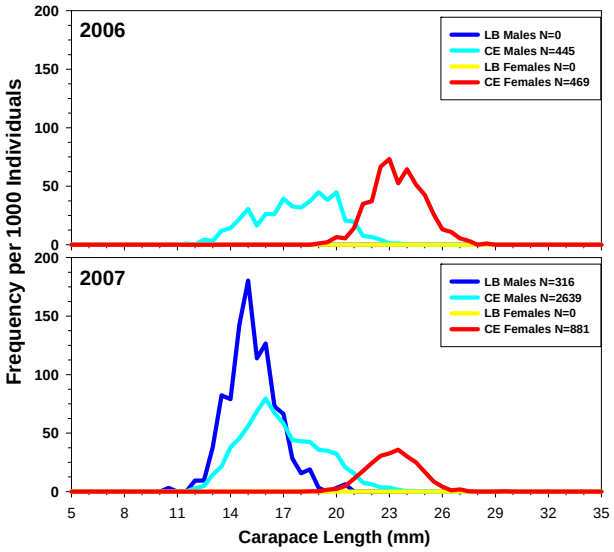

Figure 13: Overall length frequency of male and female P. montagui *in RISA as captured in the codend (CE) and juvenile shrimp net (LB).*

Exploitation Rate

The average exploitation rate index of the fishery for 2006/07 to 2007/08 was 22% (Fig. 10).

Stock Trends and Current Status
Stock status is uncertain due to the short time series and uncertainty in the survey data. Future prospects for the fishery are uncertain.

SFA3 (west of 66°W) – *P. borealis*

Commercial Fishery
No fishery has been conducted in the area in recent years.

Abundance and Biomass
A survey conducted by DFO in October of 2007 is the only source of data available to this assessment. The fishable biomass index was 13,000 t. The SSB index was 3,000 t. The highest observed densities were found in 400-600 m depths. The majority of *P. borealis* was found in Hudson Strait north of Akpatok Island.

Recruitment
Recruitment is uncertain in the area but the proportion of <17 mm shrimp in the survey catches in 2007 was higher than seen in other northern SFAs.

Stock Trends and Current Status
The current status is uncertain because there is only one survey estimate and no fishery data available.

SFA3 (west of 66°W) – *P. montagui*

Commercial Fishery
No fishery has been conducted in the area in recent years.

Abundance and Biomass
Fishable biomass index was 48,000 t out of a total index of 67,000 t. SSB index was 17,000 t. The highest densities of *P. montagui* were in the 200-300 m depth range, slightly shallower than *P. borealis* in the same area, which corresponds to slightly cooler water temperatures.

Recruitment
Recruitment is uncertain in the area but the proportion of <17 mm shrimp in the survey catches in SFA3 in 2007 was higher than seen in other northern SFAs.

Stock Trends and Current Status
The current status is uncertain because there is only one survey estimate and no associated fishery data available.

Sources of Uncertainty

The fishery independent survey data are currently the best data available although they are based on very short time series of up to three years. The short time series greatly increases the uncertainty in our ability to determine trends in the data. Trends in indices over a longer time period can only be detected if the surveys continue on the planned schedule which should result in improved advice in the future.

Fishery independent surveys are conducted once a year. If there is seasonality in the distribution of shrimp and/or the catchability of the shrimp in the trawl this could affect the assessment.

Catchability of the trawls used in the surveys is unknown but thought to be less than one; that is, the stock size indices are partial estimates. Therefore, the survey exploitation rate indices are greater than the stock exploitation rates.

RISA is currently the most important area in terms of total shrimp caught in the north. The high exploitation indices in RISA, especially for *P. borealis*, are a concern. Discussion at the meeting focused on the uncertainty in the biomass index. It was suggested the efficiency of the trawl may be significantly different in RISA as compared to the two other study areas conducted by the same ship and trawl. If a low biomass index was the result, this would inflate the exploitation rate index. No changes in TACs are recommended because of uncertainties surrounding the biomass indices, and also because CPUE has been stable since 2000.

Potential causes for the low biomass estimate in RISA could result from the following:

1. Incomplete surveys in both years. Only 34 valid sets out of the 55 assigned sets were taken in 2006, partially because the trawl monitoring equipment produced poor results and the inability to find trawlable bottom in some parts of the study area. In 2007, 47 out of the 59 locations assigned were completed. A change in trawl monitoring equipment improved the success rate in 2007 but it was still an incomplete survey;
2. In 2007, changes were made in the protocol for determining successful sets during the cruise. As a result, sets which in previous years would have been repeated were considered valid and may have affected the total catch thereby lowering the biomass estimates;
3. Experimental work done by DFO in 2007 in the Resolution Island area suggests the results of the full survey may be further compromised by the ability to fish at certain times of the lunar cycle which produced extremely strong currents. The survey needs to be re-examined taking into account tidal cycle to determine how much effect this may have had on the survey results. This cannot be undertaken in time to be included in this assessment but will be reported in future assessments; and
4. Insufficient number of sets in the study area.

These sources of uncertainty are recognized and mitigation measures will be implemented in the design of the 2008 survey of RISA.

In RISA, fishery data (CPUE) may not reflect stock size. The fishery does not sample the stock randomly. 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 and could also affect CPUE.

INDUSTRY PERSPECTIVES

SFA1

Temporal and spatial availability of the biomass in the Canadian zone was more sporadic than in previous years. When the resource is in the Canadian zone, catch rates can be reasonably good, but average CPUE is declining significantly. Total effort in the area is declining as a result.

SFA2
Abundance appears similar to previous years. Average size has diminished somewhat. Shell condition is less predictable by time and location.

SFA3
Abundance of *P. montagui* was good throughout the NSA (including SFA2), though the resource appears to have some seasonal movement in the late fall, mixing with *P. borealis* near SFA2.

CONCLUSIONS AND ADVICE

SFA0 – *P. borealis*
The current status of this stock is considered uncertain. The single survey resulted in a low biomass index (600 t) for the SFA. The area with suitable depth and temperature range for *P. borealis* is limited. The TAC of 500 t in this area is not currently being fished. There are plans to survey this area again in 2008.

SFA2EX (SFA2 east of 63°W) – *P. borealis*
The current stock status and future prospects for this area are uncertain. The results are based on both fishery data and three annual surveys beginning in 2005. There has been little fishing effort in the past six years resulting in a low exploitation rate index of about 2%. The index would average 12% over the same time period if the entire TAC was taken.

RISA – *P. borealis*
The stock in this area has supported the fishery since 2000. Based on fishery data, stock status appears stable since 2000. Future prospects are uncertain.

RISA – *P. montagui*
The current stock status and future prospects are uncertain. The average exploitation rate index for 2006/07 to 2007/08 is 22% based on biomass estimates which are more uncertain than in other study areas.

SFA3 (west of 66°W) – *P. borealis*
The current status of this stock is considered uncertain because the assessment is based on a single survey. There is no active fishery currently being conducted in the area and there is no TAC for *P. borealis*. The fishable biomass index of 13,000 t would suggest there is potential for a directed *P. borealis* fishery in this area.

SFA3 (west of 66°W) – *P. montagui*
The current status of this stock is considered uncertain because the assessment is based on a single survey. There is no active fishery currently being conducted in this area.

MANAGEMENT CONSIDERATIONS

Quota has increased in SFA2EX and RISA over time without the benefit of fishery independent survey biomass data on which to base the levels. SFA2EX is a management zone with area specific TACs. SFA2 west of 63°W, and SFA3 however have numerous TACs that accumulate in RISA because the fleet prefers to fish in this area. This assessment is the first examination of

the effects of these accumulated TACs on the potential exploitation rate index if the entire TAC was caught.

In SFA2EX, the potential exploitation rate index averaged 12% over the 2005-2007 period (Fig. 14). This approximates the mid-range of exploitation rate indices seen in southern SFAs.

In RISA, the potential exploitation rate index for *P. borealis* averaged 52%, *P. montagui* 79% (Fig. 15). These levels are several times higher than observed in the south. Quota for *P. montagui* could be fished west of RISA but this is not where current fishing effort occurs. Uncertainty in the biomass estimates in RISA may have contributed to the relatively high exploitation rate index. A more detailed explanation of this is given in the Sources of Uncertainty section.

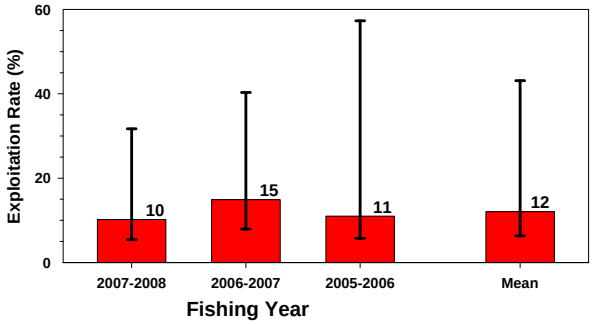

Figure 14: Potential exploitation rate index of P. borealis *assuming the entire TAC in SFA2EX was taken.*

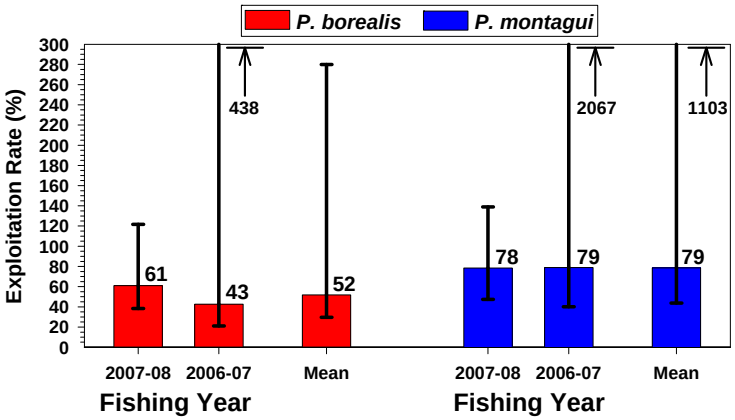

Figure 15: Potential exploitation rate index of P. borealis *and* P. montagui *assuming the entire quota was taken in RISA.*

Boundaries in the Resolution Island area were considered during the meeting. Science can provide advice based on the survey study areas regardless of the SFA borders.

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