

Northern Shrimp (*Pandalus borealis*)

Div. 0B to 3K

Background

Northern or pink shrimp (*Pandalus borealis*) are found in the Northwest Atlantic from Davis Strait to the Gulf of Maine, usually in areas where the ocean floor is soft and muddy and where temperatures near the bottom range from about 2 to 6°C. These conditions occur throughout the Newfoundland and Labrador offshore area within a depth range of roughly 150 - 600 m, thus providing a vast area of suitable habitat. The species is the primary cold-water shrimp resource in the north Atlantic.

These shrimp are protandrous hermaphrodites. They first mature as males, mate as males for one to several years and then change sex to spend the rest of their lives as mature females. They are known to live for more than 8 years in some areas. Some northern populations exhibit slower rates of growth and maturation but greater longevity results in larger maximum size.

During the daytime, northern shrimp rest and feed on or near the ocean floor. At night, substantial numbers migrate vertically into the water column, feeding on zooplankton. They are important prey for many species such as Atlantic cod, Greenland and Atlantic halibut, skates, wolffish, snow crab and harp seals.

Status of the resource for each shrimp fishing area (SFA) (Fig. 1) is determined by monitoring performance of the fishery within and between years, distribution of fishing effort and the size/sex composition of the catches. Also, research vessel (RV) trawl surveys since 1995 provide data on stock size and structure for some areas. Using both sources of information, inferences can be made on state of spawning stock (female abundance),

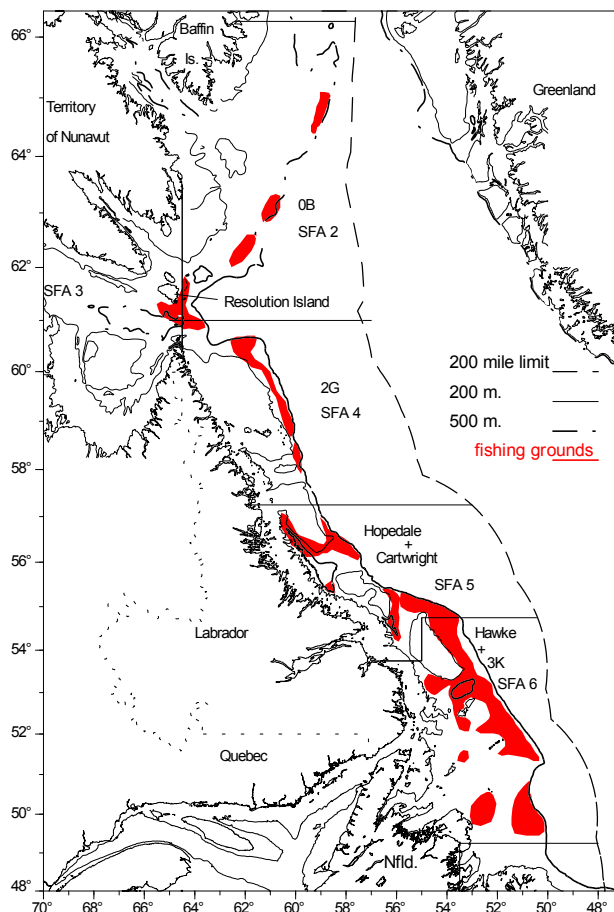


Figure 1: Shrimp fishing areas (SFAs).

potential for future recruitment to the fishery (male abundance) and an index of exploitation (ratio of commercial catch to lower 95% confidence interval of biomass index from the previous year's RV survey, expressed as a percent).

TAC's for the 2002 fishery remained at 2001 levels, for SFA's 2 (Div. 0B), 4 (Div. 2G), 5 (Hopedale and Cartwright Channels) and 6 (Hawke Channel + Div. 3K).

The assessment conducted in May, 2003 compared the 2002 fishery and research survey data to those of previous years to determine if significant changes in stock status have occurred.

Summary

- Resource status was evaluated based on trends in fishery catch per unit of effort (CPUE), fishing pattern and size/ sex composition of commercial catch. A fall multispecies research vessel (RV) bottom trawl survey series (1995 - 2002) provided information on distribution, abundance and biomass indices, size and sex composition of shrimp in Cartwright Channel and Hawke Channel + Div. 3K.
- In general, landings are at an all time high in all shrimp fishing areas (SFA's) and resource status appears positive. However, uncertainties increase from south to north due to lack of fishery independent data from the more northern areas. The mean size of females has declined in each SFA.

SFA 6 (Hawke Channel + Div. 3K)

- Landings in 2002 totaled ~ 60,000 t, remaining near the all time high (TAC = 61,632 t).
- Biomass and abundance indices from RV surveys increased over the 1997 – 2001 period, remaining high in 2002. Large (>500 t) and small vessel CPUEs were below 2000 and 2001 values but remained near average. The resource continues to be distributed over a broad area.
- The mean size of females in the fishery has been declining since 1992.

- The female component should be maintained over the next 2 - 3 years, as relatively strong 1998 and 1999 year classes change sex.
- Since 1998 the exploitation rate index has remained stable at a low level. Recent catches have had no observable impact on shrimp abundance and biomass.
- Current status remains positive.

SFA 5 (Hopedale and Cartwright Channels)

- Landings in 2002 totaled ~ 15,000 t, remaining near the all time high (TAC = 15,300 t).
- The 2001 RV survey biomass and abundance indices for Hopedale Channel were substantially higher than those observed over the 1997 – 1999 period. The 2002 survey covered only Cartwright Channel where biomass and abundance indices have remained stable since 1996. The resource continues to be distributed over a broad area and commercial catch rates have stabilized since 1999, at a high level.
- The mean size of females in the fishery has declined since 1993 but has remained stable at a smaller size since 2000.
- The female component should be maintained over the next 2 - 3 years, as relatively strong 1998 and 1999 year classes change sex, based upon 2001 survey results.

- Recent catches have had no observable impact on shrimp abundance and biomass.
- Current status remains positive.

SFA 4 (Div. 2G)

- Landings in 2002 totaled ~ 8000 t, remaining near the all time high (TAC = 8008 t).
- No RV surveys have been conducted in this area since 1999. Therefore, there is no recent fishery independent data or exploitation rate index.
- Fishery CPUE has fluctuated around the long-term mean over the past 10 years.
- The mean size of females in the fishery declined since 1993, but has stabilized at a smaller size since 1998.
- Current status appears positive from the fishery data, but the lack of recent research survey data creates uncertainty.

SFA 2 (Div. 0B)

- Landings in 2002 totaled ~ 5600 t, remaining near the all time high (TAC = 8750 t).
- Research surveys for shrimp have never been conducted in this area. Therefore, there are no fishery independent data or exploitation rate index.

- Fishery CPUE has been stable at a high level since 1998. However, it may not be reflective of stock status due to fishing constraints associated with the overlapping distributions of *Pandalus borealis* and *P. montagui*.

- The mean size of females in the fishery has declined since 1993.
- Current status remains uncertain.

SFA 6 (Hawke Channel + Div. 3K)

Commercial Fishery

Catches increased from about 1800 t in 1987 to more than 7800 t in 1988 and ranged between 5500 and 8000 t from 1989 to 1993. The TAC for SFA 6 in the 1994 - 1996 Management Plan was set at 11,050 t annually and catches were approximately 11,000 t in each of those years. The TAC for 1997, the first year of the 1997 - 1999 plan, was raised to 23,100 t as a first step toward increasing the exploitation of an abundant resource. Most of the increase was reserved for development of the small vessel fleet. The catch in 1997 was approximately 21,200 t, of which about 6100 t was caught by the small vessel fleet.

Despite the large increase in catch, relative exploitation in 1997 remained low and the TAC for 1998 was further increased (100%) to 46,200 t. Catches totaled ~ 46,300 t with the expanding small vessel fleet taking ~ 30,000 t.

The 1999 TAC was increased (27%) to 58,632 t. Due to operational problems,

small vessels failed to take 7400 t of their 41,000 t allocation, whereas large vessels took all of their 17,600 t allocation.

In 2000, the TAC was increased by 5% to 61,632 t. Catches totaled ~63,300 t ;~20,600 t by large vessels and ~42,700 t by small vessels.

The 2001 TAC remained at 61,632 t. Large vessels took ~19,900 t, whereas small vessels took ~ 32,700 t. Due to market constraints small vessels did not take their entire allocation.

The 2002 TAC remained at 61,632 t. Preliminary data indicate that large vessels caught their entire 20,102 t allocation. Small vessels failed to catch 1700 t of their 41,529 t allocation due to market constraints, as in the previous year (Fig. 2).

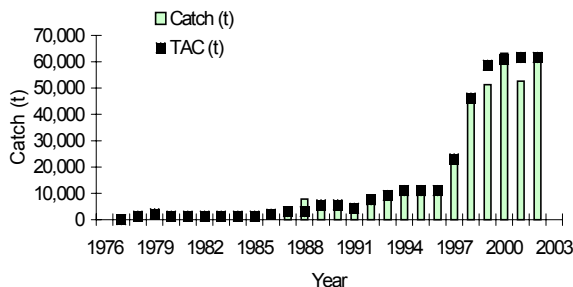


Figure 2: SFA 6 catch and TAC.

Resource Status

Large vessel catch rates increased throughout 1992 - 1995 and have since fluctuated at a high level (bars indicate 95% confidence intervals around point estimates; Fig. 3).

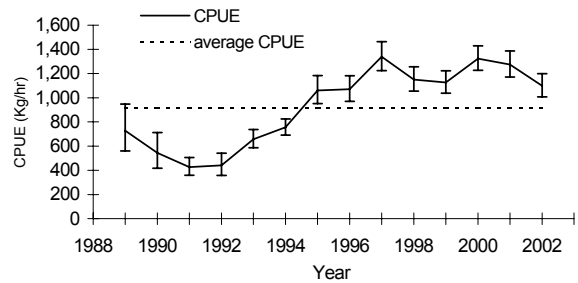


Figure 3: SFA 6 large vessel CPUE.

Small vessel catch rates have fluctuated around the mean throughout the limited time series (Fig. 4).

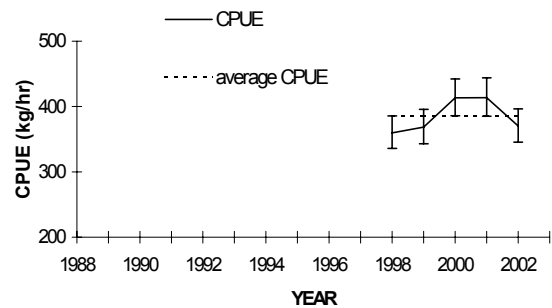


Figure 4: SFA 6 small vessel CPUE.

Research vessel survey biomass and abundance indices have shown an increase from 1997 - 2001 and changed little in 2002 (Fig. 5). The biomass and abundance of males is expected to be maintained over the next 1-2 years by the strong 1999 year class currently represented by 15 – 17 mm males. The female component should also be maintained over the next 2 - 3 years as large males change sex (15 - 19 mm; 1998 and 1999 year classes).

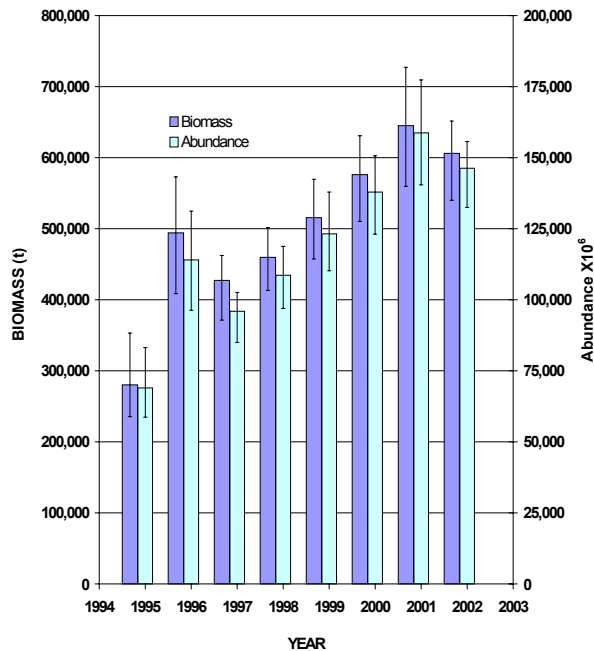


Figure 5: SFA 6 *P. borealis* biomass and abundance indices.

The exploitation rate index (ratio of commercial catch to lower 95% confidence interval of biomass index from the previous year's RV survey, expressed as a percent) has been less than 15% over the past several years. Since catchability of shrimp by the RV trawl is believed to be <1 exploitation rates have likely been lower than 15%.

The mean size of females in the fishery has been declining since 1992. It is believed that reduced individual fecundity associated with this decrease has a minimal impact upon total egg production, as biomass/ abundance indices are currently near historically high levels.

Sources of Uncertainty

The effects of finishing the 2002 fall RV survey a month later than usual are unknown.

Outlook

The resource in this area remains healthy with high biomass and abundance of both sexes. Recruitment is expected to be maintained over the next 2 –3 years.

Management Considerations

Removals at the current catch level will not likely increase the exploitation rate appreciably.

SFA 5 (Hopedale and Cartwright Channels)

Commercial Fishery

Catches in Hopedale and Cartwright Channels increased from about 2700 t in 1977 to 4100 t in 1980, declined to 1000 t in 1983 and 1984, increased again to 7800 t in 1988 and then stabilized at approximately 6000 t during 1989 - 1993. The TAC for the 1994 - 1996 management plan, which combined the two channels as a single management area, was increased to 7650 t and catches increased, averaging 7500 t during that period. The TAC for the 1997 - 1999 plan was doubled to 15,300 t and catches of approximately 15,000 t were taken each year. This TAC was maintained throughout the 2000 – 2002 plan with approximately 15,000 t taken each year (Fig. 6).

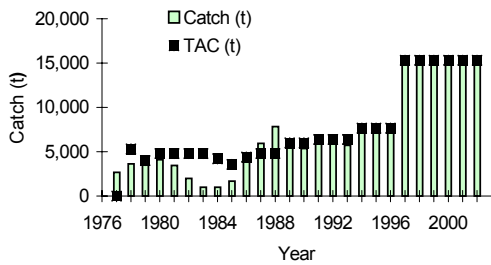


Figure 6: SFA 5 catch and TAC.

Resource Status

Commercial CPUE was stable from the mid 1980's to the early 1990's and has since increased, reflecting an overall increase in the resource during the past decade (Fig. 7).

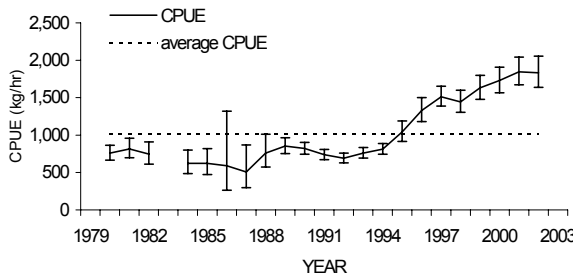


Figure 7: SFA 5 large vessel CPUE.

The 2001 RV survey biomass and abundance indices for Hopedale Channel were substantially higher than those observed over the 1997 – 1999 period. The 2002 survey covered only Cartwright Channel, where biomass and abundance indices have remained stable since 1996.

Based upon 2001 RV survey results, the female component should be maintained, over the next 2 - 3 years, as relatively strong 1998 and 1999 year classes change sex. Low catchability of

small males and no RV survey in 2002 preclude inferences about recruitment. Exploitation rate indices were less than 25% between 1997 and 2000.

The northern portion of SFA 5 was not surveyed in 2000. Therefore, it was not possible to determine an exploitation rate index in 2001. Due to the increase in biomass observed in 2001, the exploitation rate index decreased to 8% in 2002. Since catchability of shrimp by the RV trawl is believed to be <1 exploitation rates have likely been lower than this.

The mean size of females in the fishery has declined since 1993 but has remained stable at a smaller size since 2000. It is believed that individual fecundity associated with this decrease has minimal impact upon total egg production, as 2001 biomass/abundance indices were substantially higher than those observed over the 1997 – 1999 period.

Sources of Uncertainty

The lack of RV survey coverage into the northern portion of SFA 5 (Div. 2H) during 2002 creates uncertainty. The effects of conducting the 2001 and 2002 RV surveys later than usual are unknown.

Outlook

The current status of the northern shrimp resource in the Hopedale and Cartwright Channels appears positive from the 2001 RV survey and 2002 fishery data. Based upon 2001 RV survey results, the female component should be maintained, over the next 2 - 3 years, as relatively strong 1998 and 1999

year classes change sex. However, longer term recruitment is unknown.

Management Considerations

Removals at the current catch level will not likely increase the exploitation rate appreciably.

SFA 4 (NAFO Division 2G)

Commercial Fishery

Catches increased from 1083 t in 1988 to 3842 t in 1989 and remained within the 2500 - 3000 t range up to and including 1993. The 1994 catch increased to 3982 t with an increase in TAC (46%) to 4000 t in the first year of the 1994 - 1996 Management Plan. A second TAC increase (30%) to 5200 t for 1995 and 1996 resulted in catches of about 5100 t in both years. The TAC of 5200 t was maintained for 1997 and catch was estimated at 5217 t.

In 1998 the TAC was increased (60%) to 8320 t, of which 2184 t was allocated to the area south of 60°N to promote spatial expansion of the fishery. Catches from 1998 to 2002 were reported to be about 8000 t each year (Fig. 8).

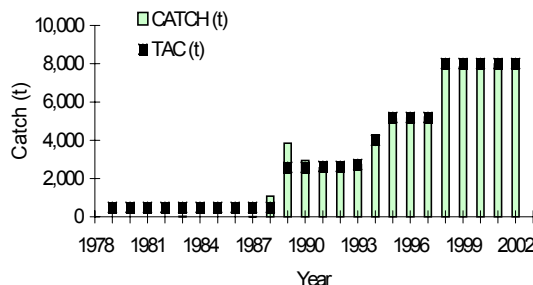


Figure 8: SFA 4 catch and TAC.

Resource Status

Commercial CPUE has fluctuated around the long term mean over the past 10 years (Fig. 9).

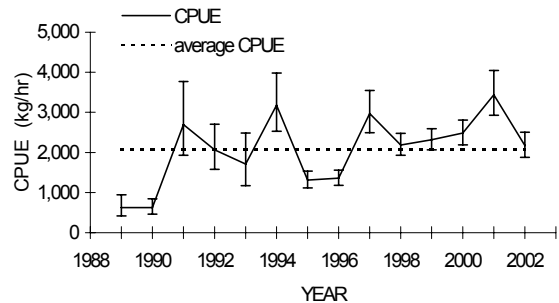


Figure 9: SFA 4 large vessel CPUE.

The meansize of females in the fishery declined since 1993, but has stabilized at a smaller size since 1998. There has been no survey in SFA 4 since 1999. Therefore, the reduction in mean female size and associated individual fecundity has an unknown impact upon total egg production.

Sources of Uncertainty

Current status is uncertain because no surveys have been conducted in SFA 4 since fall 1999, precluding evaluation of stock size and relative level of exploitation. Prospects are uncertain due to lack of a recruitment index.

Outlook

Current status appears positive from the fishery data, but lack of a RV survey creates uncertainty. Because there is no RV survey, an exploitation rate index could not be estimated and recruitment prospects are unknown.

Management Considerations

Lacking RV surveys, it was not possible to evaluate the impact of the 2002 fishery.

SFA 2 (NAFO Division 0B)

Commercial Fishery

Catches increased from about 2800 t in 1988 (with no TAC) to 3000 t in 1989. The **TAC** was set at 3500 t during 1989 – 1996. Catches declined to 100 t in 1993 remained below 500 t in 1994 but increased substantially to about 3600 and 3200 t in 1995 and 1996, respectively. The TAC was increased (50%) to 5250 t for 1997 and 1998 and the full TAC was taken during each year. In 1999, an additional 3500 t allocation was provided for the area north of 63°N as an incentive for the large vessel fleet to return to grounds not fished extensively since 1995. However, only 105 t were taken from this area in 1999. In 2000, the TAC returned to 5250 t with a catch of ~4200 t. An additional 237 t was taken north of 63°N in an exploratory fishery.

In 2001, the TAC was returned to the 1999 level (8750 t) with 3500 t allocated to the area east of 63°W. During 2001, 5400 t was caught near Resolution Island while 400 t were taken east of 63°W. The TAC was maintained during 2002. Preliminary data suggest that ~ 5500 t was taken in the area near Resolution Island, while only 64 t was taken east of 63°W (Fig. 10).

Recent catches of northern shrimp have been estimated, in part, from the mixed *P. borealis*/ *P. montagui* fishery data for

the area east of Resolution Island. Therefore, the accuracy is questionable. *Pandalus borealis* taken in SFA's 3 and 4, immediately adjacent to Resolution Island, were included in the catches reported for SFA 2.

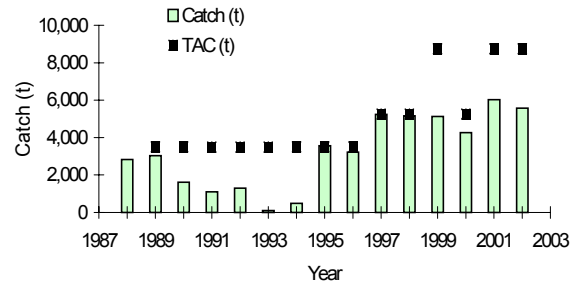


Figure 10: SFA 2 catch and TAC.

Resource Status

Shrimp concentrations in the northeast are elusive, as reflected by the low catch in recent years from the areas north of 63°N and east of 63°W. Concentrations immediately east of Resolution Island have persisted since 1995.

Commercial CPUE has been stable at a high level since 1998 (Fig. 11).

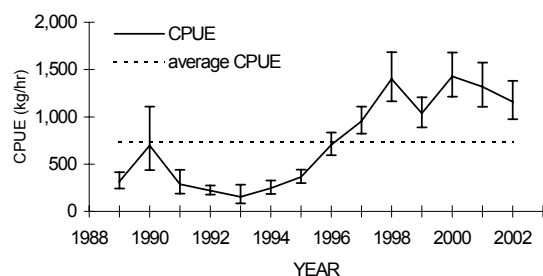


Figure 11: SFA 2 large vessel CPUE.

However, this may not be reflective of stock status due to fishing constraints associated with the overlapping distributions of *Pandalus borealis* and *P. montagui*.

Research vessel surveys of shrimp have never been conducted in SFA 2.

The mean size of females in the fishery declined since 1993. The reduction in mean female size and associated individual fecundity has an unknown impact upon total egg production.

Sources of Uncertainty

The distribution and population structure are unknown.

The mixed fishery for *Pandalus borealis* and *P. montagui* confounds the assessment and the lack of knowledge on the distribution and abundance and biomass of both species will persist in the absence of a time series of RV surveys. Neither exploitation rate nor recruitment indices could be estimated because there are no fishery independent data.

Outlook

Although commercial CPUE appears positive, the current status of this resource remains uncertain and prospects remain unknown.

Management Considerations

In the absence of RV surveys, it is not possible to evaluate the impact of the fishery.

Industry Perspective

The northern shrimp fishery has expanded rapidly since 1997 and now accounts for a major portion of the landed value of fish product in Newfoundland and Labrador. The fishery continues to develop and opportunities exist for further expansion in the north (2GH, 0B). Industry has expressed in the past its disappointment about the Department of Fisheries and Oceans decision to reduce the frequency of research surveys in Division 2H to every second year and to discontinue surveys entirely in Division 2G. Industry continues to view this approach as a limitation on the development of the northern shrimp fishery that results in lost economic opportunity for its participants. The restoration of scientific surveys in the north is a necessary measure to ensure the development and conservation of northern fisheries.

Other Considerations

The abundance of known fish predators (e.g. cod, redfish, skate, and American plaice) remains low in the offshore. However, snow crab, a known predator of shrimp, are abundant. The harp seal population has increased, but its importance as a predator is unknown.

A direct relationship exists between area of ice coverage and CPUE 6 years later. This implies that ice coverage, or other aspects of a cold oceanographic regime, early in the life cycle, promotes subsequent recruitment. Ice coverage has been light and the oceanographic regime warm during 1996 – 2001,

suggesting that recruitment and CPUE may decline in the near future.

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References

Colbourne, E. 2003. Oceanographic conditions in NAFO Subdivisions 3Pn and 3Ps during 2002 with comparisons to the previous year and the long-term (1971-2000) average. CSAS Res. Doc. 2003/001.

Colbourne, E. 2003. Physical Oceanographic conditions on the Newfoundland and Labrador Shelves during 2001. CSAS Res. Doc. 2003/020.

DFO, 2002. Northern Shrimp (*Pandalus borealis*) – Div. 0B to 3K. DFO Science Stock Status Report C2-05 (2002).

Orr, D., D.G. Parsons, P.J. Veitch, and D.J. Sullivan. 2003. Northern shrimp (*Pandalus borealis*) off Baffin Island, Labrador and northeastern Newfoundland. CSAS Res. Doc. 2003/50.

Parsons, D.G., E. B. Colbourne. 2000. Forecasting Fishery Performance for Northern Shrimp (*Pandalus borealis*) on the Labrador Shelf (NAFO Divisions 2HJ). J. Northw. Atl. Fish. Sci., Vol 27: 1-9.

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