



## ASSESSMENT OF DIVISIONS 2G-3K NORTHERN SHRIMP

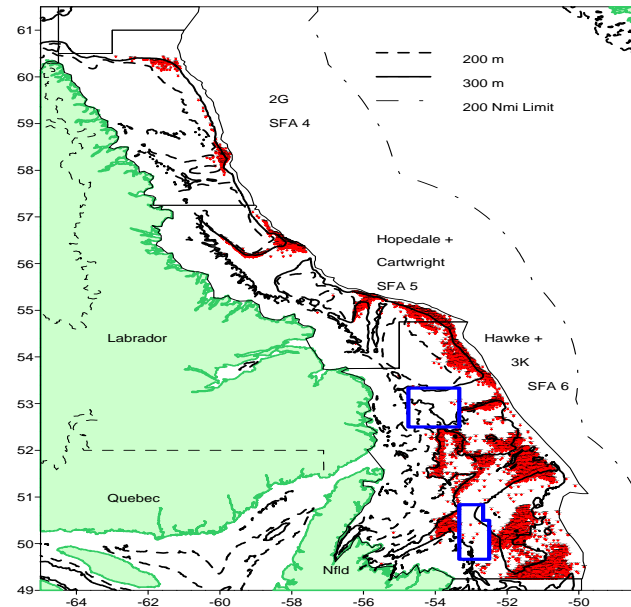


Figure 1. Map of northern shrimp fishing areas (SFAs) including the Hawke Channel and Funk Island Deep closed areas. The Funk Island Deep closed area is mandatory for small vessels and voluntary for large vessels. The red crosses indicate large and small vessel fishing positions during 2007

### Context

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 1°C 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. Most of the fishable biomass is female.

The shrimp are thought to begin to recruit to the fishery at age three, but may not be fully recruited until much later.

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 halibut, skates, wolffish, snow crab and harp seals.

The fishery for northern shrimp off the coast of Labrador began in the mid 1970's, primarily in the Hopedale and Cartwright (SFA 5) Channels. It expanded north and south through the 1980's. Catches increased from 23,000 t in 1994 to 111,000 t in 2004/05 and have changed little since. The

*management year for shrimp fishing areas 4-6 changed from a calendar year to April 1–March 31 in 2003. Since then, TACs remained at 112,000 t.*

*This resource is assessed on a biannual schedule and was last assessed in March 2006. An assessment framework workshop was held during May 2007 with the objective of determining the appropriate indices to use in the assessment, providing short term predictions of trends in future stock size and developing a precautionary approach to northern shrimp management, with clear limit reference points. The framework meeting was not able to propose limit reference points.*

*A formal assessment of the resource was conducted during March 6-8, and 12-13, 2008. The assessment made use of fishery data from observer and logbook datasets when estimating catch rate indices and indices of fishery aggregation. Bottom trawl surveys provided indices of recruitment, spawning stock biomass, fishable biomass and exploitation rate.*

*This report provides a summary of key results of the assessment, a narrative describing the fishery with an expanded discussion of resource status and outlook.*

## SUMMARY

- Resource status was updated based on a Fisheries and Oceans Canada (DFO) fall multi-species research vessel (RV) bottom trawl survey series (1996-2007), which provided information on distribution, abundance, biomass, recruitment, size, and sex composition in the Div. 2J portion of SFA 5 and Hawke Channel + Div. 3K (SFA 6). Trends in stock size were also inferred from fishery catch per unit effort (CPUE) and fishing patterns.
- The Northern Shrimp Research Foundation (NSRF) in partnership with DFO conducted annual shrimp based research surveys in Division 2G (SFA 4) during 2005-2007.
- Catches were near the all-time high and resource status appears positive. However, uncertainties increase from south to north due to less fishery independent data.

## **SFA 6 (Hawke Channel + Division 3K)**

- Catches increased from 11,000 t in 1994-1996 to over 78,000 t by 2004/05 due mainly to increases in TAC. The TAC in the 2007/08 management year was 79,000 t and it is anticipated that the TAC will be taken.
- Spatial distribution of the fishery changed little over recent years.
- The large (>500 t) vessel CPUE remained at a high level since 1995 while the small vessel (<100 ft) CPUE has increased significantly since 2003.
- Biomass indices (total, fishable and female) from fall multi-species surveys have generally increased since 1997.
- Recruitment indices in 2006 and 2007 were the highest in the time series.
- Recruitment and female biomass are expected to support the fishery over the next four years.

- The resource continues to be distributed over a broad area and, over the past two years, exploitation rate indices were about 11% of survey fishable biomass. Recent catches have had no observable impact on the resource.
- Current status remains positive. At the current TAC the 2008/09 exploitation rate index is expected to be 11-15%. Any modest change in TAC is expected to have a proportional change in the exploitation rate index.

### **SFA 5 (Hopedale and Cartwright Channels)**

- Catches increased from 7500 t in 1994-1996 to 23,000 t in 2004/05 due mainly to increases in TAC. The TAC in the 2007/08 management year is 23,600 t and it is anticipated that the TAC will be taken.
- Since 1996, CPUE has fluctuated above the long-term average.
- Surveys of the whole of SFA 5 were completed in only three (2001, 2004, 2006) of the last eight years.
- Survey indices (total, fishable and female) after 2000 have been somewhat higher than before 2000.
- Recruitment in the short-term, while uncertain, appears average. Longer-term prospects are unknown.
- The resource continues to be distributed over a broad area while the 2006/07 exploitation rate index was 15%. Recent catches have had no observable impact on the resource.
- Current status remains positive.

### **SFA 4 (Division 2G)**

- Catches increased from 4000 t in 1994 to 10,000 t by 2004/05 due mainly to increases in TAC. The TAC is 10,300 t in the 2007/08 management year and it is anticipated that the TAC will be taken.
- Since 2002 CPUE has varied about the long-term average.
- The NRSF-DFO research survey fishable biomass index has ranged between 66,000 t and 119,000 t since 2005.
- Recruitment trends are unknown.
- Exploitation rate indices ranged between 8% and 15% during 2005-2007.
- Current status appears positive from fishery catch rate indices and survey exploitation rate indices.

## BACKGROUND

The fishery for northern shrimp off the coast of Labrador began in the mid 1970's, primarily in the Hopedale and Cartwright (SFA 5) Channels (Fig. 1). Annual catches (Fig. 2) increased steadily from less than 2700 t in 1977 to about 4100 t in 1981 but subsequently declined to 1000 t in 1983 and 1984 due to poor markets and high operating costs. Economic conditions improved thereafter, and catches from SFA's 5 and 6 increased to about 7800 t in 1987. In 1988, fishing effort became more widespread as vessels ventured into Division 2G (SFA 4) where both catch rate and size of shrimp proved to be very attractive to the industry. Additional commercial concentrations of shrimp were located within SFA 6 in a small area east of St. Anthony Basin and in the Funk Island Deep. Catches in both 1988 and 1989 approached 17,000 t and remained in the 14,000-20,000 t range from 1990 to 1993. Exploratory fisheries along the slope of the shelf in SFA's 4, 5 and 6 in 1992 and 1993 revealed commercial concentrations of shrimp in those areas, as well.

Catches from 1994 to 1996 ranged between 24,000 t and 25,000 t in response to increased TAC's for several SFA's. Catches more than tripled to 91,000 t in 2000, mainly due to progressive increases in TAC within SFA 6 where the resource was considered to be healthy and exploitation low. The increases after 1996 were primarily reserved for the development of a small vessel (< 100 ft) fleet which has since grown to include more than 300 vessels.

In 2003, TAC's increased by 25,000 t and included a 3625 t allocation to fund northern shrimp research in SFA's 2 and 4. During that year industry was granted a change in management year from a calendar (Jan 1 – Dec. 31) year to a fiscal (Apr. 1 – Mar. 31) year. To facilitate this change, an additional 20,229 t interim quota was allocated to the large vessel fleet and the 2003/04 management period became 15 months in length. The 2004/05 management year was 12 months in duration and total allocations, within SFAs 4-6, equalled 111,552 t. This TAC was maintained throughout to the 2007/08 management year.

All northern shrimp fisheries in eastern Canada are subject to the Atlantic Fisheries Regulations regarding territorial waters, bycatches, discarding, vessel logs, etc. The regulations for shrimp refer to the minimum mesh size of 40 mm and no fishing is permitted in any defined area, after it has been closed. Also, to minimize bycatch of non-target species, large and small vessels must use sorting grates with a maximum bar spacing of 28 mm and 22 mm respectively. Observers are required on all trips by the large vessel fleet and a target of 10% coverage has been established for the small vessel fleet.

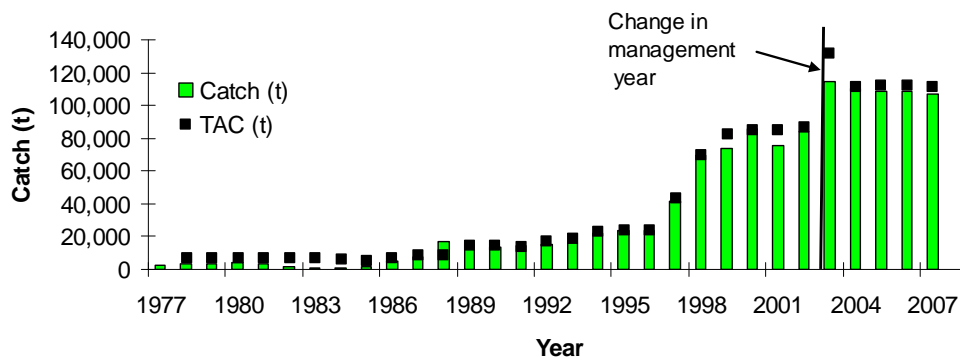


Figure 2. Historic northern shrimp catches (SFA's 4-6) and TAC's for the period 1977-2008 (2007/08 catches are preliminary). In 2003, the management year changed from Jan. 1 – Dec. 31 to Apr. 1– Mar. 31.

## ASSESSMENT

Resource status was evaluated based on trends in fishery CPUE, indices derived from DFO autumn multi-species bottom trawl surveys in Divisions 2HJ3K, a joint NSRF-DFO summer shrimp-based survey in Division 2G, fishery data from logbooks and observer catch – effort, as well as biological sampling from multiple sources.

The bottom trawl surveys provide indices of recruitment, total abundance, spawning stock biomass, and total biomass. Recruitment indices (abundance of males with 11.5 - 16 mm carapace length, primarily age 2) provide prospects of biomass two years later. Exploitation rate indices were determined by comparing the catch to the survey fishable biomass index (catch/ previous year autumn fishable biomass index for SFA's 5 and 6; catch/ current year summer fishable biomass index for SFA 4). The fishable biomass is defined as the weight of all males with a carapace length  $\Rightarrow$  17 mm plus the weight of all females. These indices provide an upper bound for exploitation rates because survey catchability is less than one. Research survey indices are for offshore strata only as they were consistently sampled over the time series and include the majority of the resource.

### **SFA 6 (Hawke Channel + Division 3K)**

#### Commercial Fishery:

**TAC's** were set at 11,050 t annually in the 1994 – 1996 Management Plan and increased to 23,100 t in 1997 as a first step towards increasing the exploitation of an abundant resource within the 1997 – 1999 Plan (Fig. 3). Most of the increase was reserved for development of the small vessel fleet. TACs more than doubled between 1997 and 1999, increased slightly to 2002 and further increased, by 26%, to 77,932 t in 2003. An additional interim quota of 7653 t was set for the fishing season January 1 – March 31, 2004 to facilitate an industry requested change in fishing season from April 1 – March 31. Thus the 2003/04 management period was 15 months long and had an 85,585 t TAC. The 2004/05 management year was 12 months, had a 77,932 t TAC, and approximately 77,800 t were caught. The 2004/05 TAC was maintained through to 2007/08 management year and it is anticipated that the quota will be taken in 2007/08.

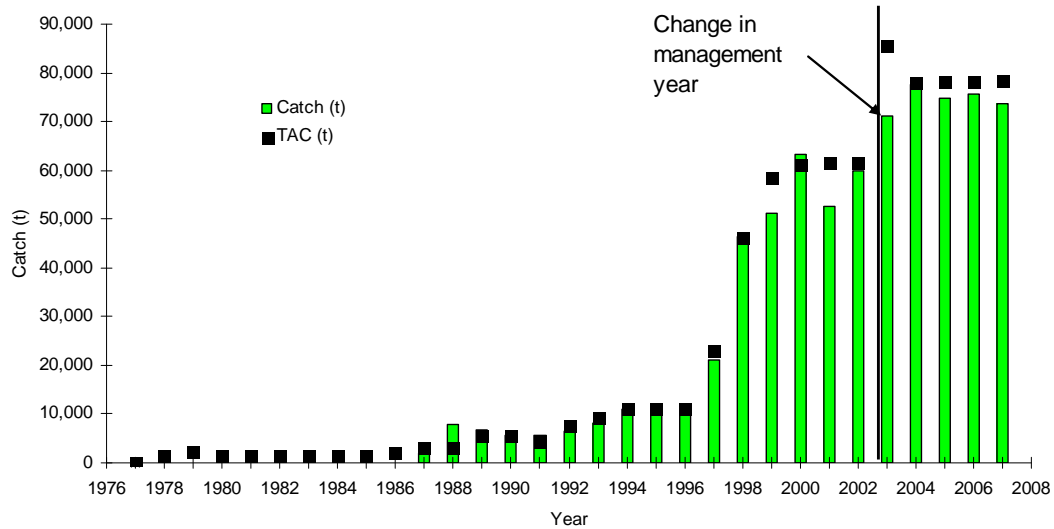


Figure 3. SFA 6 catches (t). In 2003, the management year changed from Jan. 1 – Dec. 31 to Apr. 1 – Mar. 31.

**Biomass**

Large (>500 t) vessel CPUE remained at a high level since 1995, while the small vessel (<100 ft) CPUE increased significantly since 2003 (Fig. 4).

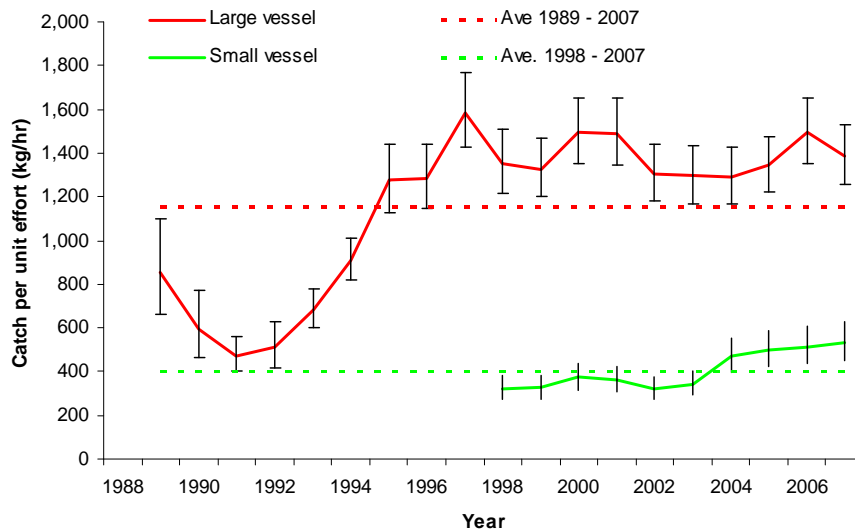


Figure 4. SFA 6 large and small vessel CPUE (error bars indicate 95% confidence intervals).

Percent total area within SFA 6 necessary for the large (>500 t) vessel fleet to obtain 95% of their catch has increased from 2 – 6% over the period 1988 – 2007. A similar index for the small vessel fleet increased from 11 – 20% between 1998 and 2007 while the DFO survey index remained at 10 – 15% over the same time period (Fig. 5). These indices provide a measure of fishery aggregation meant to aid in the interpretation of catch rates. Spatial distribution of the fishery changed since 1996.

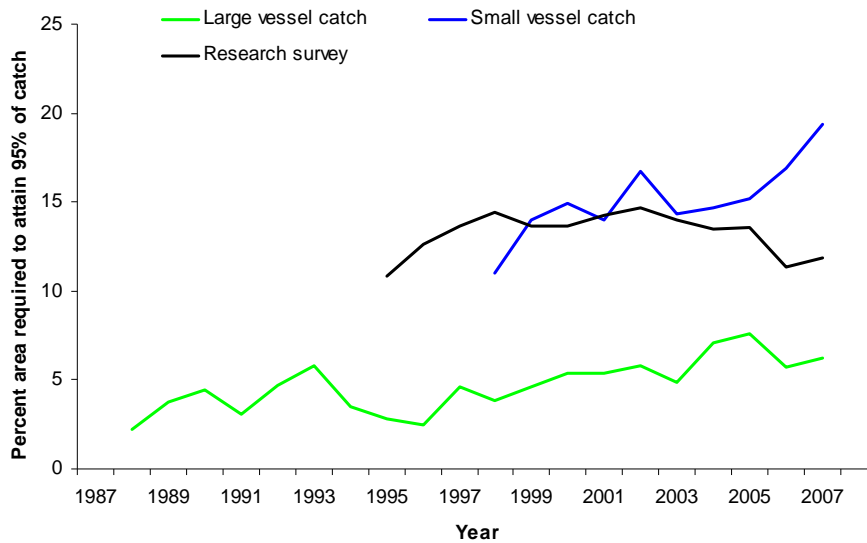


Figure 5. Percent of the total area available within SFA 6 necessary to account for 95% of the research and commercial catches over the period 1989–2007.

**Biomass** indices from fall multi-species surveys have generally increased since 1997. The female spawning stock biomass (SSB) index increased from an estimated 182,000 t in 1997 to 462,000 t in 2006, decreasing slightly to 441,000 t in 2007 (Fig 6). Fishable and female spawning stock biomass indices have remained above the long term mean since 2003.

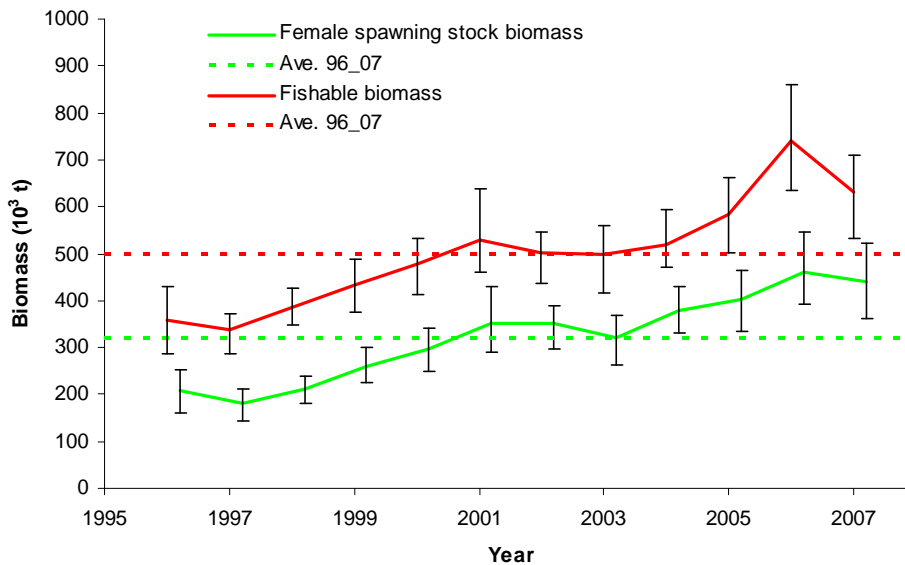


Figure 6. SFA 6 biomass indices (error bars indicate 95% confidence intervals).

Recruitment

Recruitment has fluctuating about the mean between 1996 and 2005. The 2006 and 2007 recruitment indices were the highest in the time series.

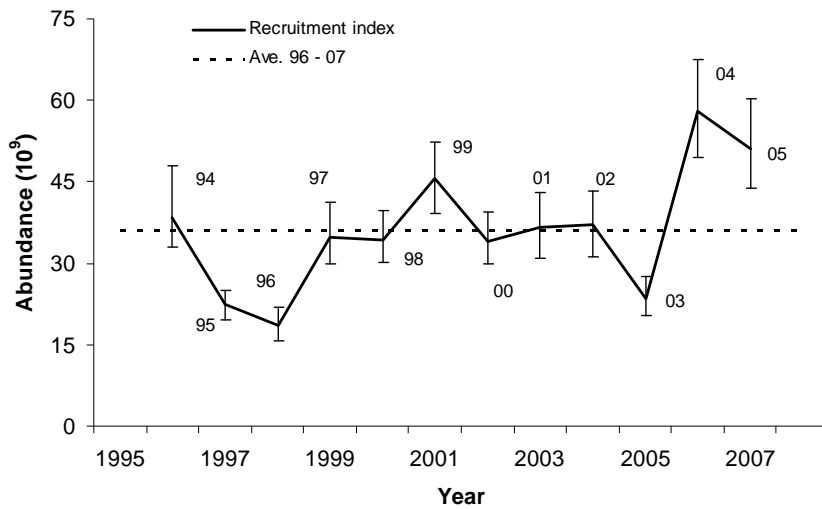


Figure 7. SFA 6 recruitment indices (error bars indicate 95% confidence intervals; numbers denote year classes).

**Mortality**

The exploitation rate index has decreased over the past four year and was almost 11% in 2007 (Fig 8). Recent catches have had no observable negative impact on the resource.

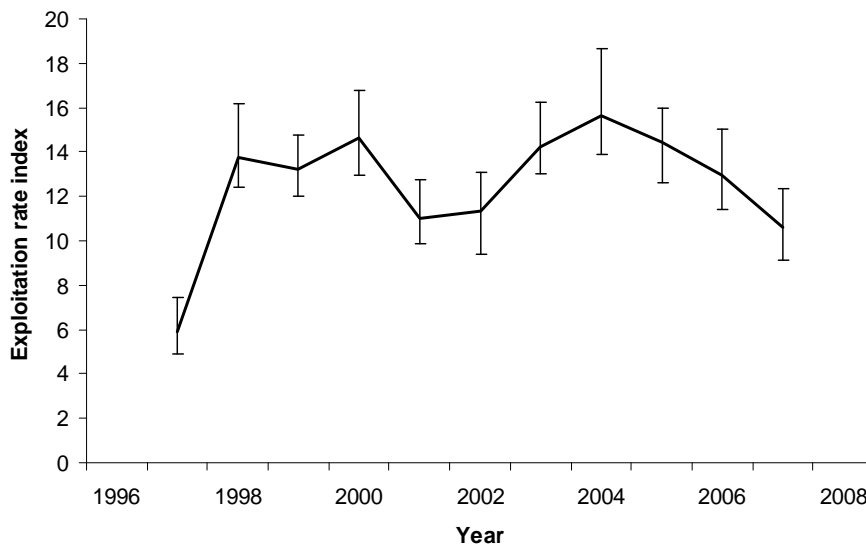


Figure 8. SFA 6 exploitation rate indices (total catch/ fishable biomass index from the previous year; error bars indicate 95% confidence intervals).

Current status remains positive. The resource continues to be distributed over a broad area as inferred from the spatial distribution of commercial effort and surveys catches (Figs. 1 and 5). Biomass and abundance indices from fall multi-species surveys have generally increased since 1997. Recruitment and female biomass are expected to support the fishery over the next four years. At the current TAC the 2008/09 exploitation rate index is expected to be 11-15% (based on 2007/08 TAC and 2007/08 fishable biomass



confidence intervals). Any modest change in TAC is expected to have a proportional change in the exploitation rate index.

### SFA 5 (Hopedale and Cartwright Channels)

#### Commercial Fishery

TAC's doubled from 7650 t during 1994 - 1996 to 15,300 t over the 1997-2002 period. In 2003, the TAC increased 52% to 23,300 t. In 2003, the management year changed to April 1 – March 31, and an additional interim quota of 9,787 t was set for the period January 1 – March 31, 2004. Thus the 2003/04 management period was 15 months long and had a 33,084 t TAC. The 2003/04 management year TAC (23,300 t) was maintained through to 2007/08. TACs have been taken in most years. Approximately 23,000 t were taken during the 2007 calendar year and it is anticipated that the remaining 300 t of the 2007/08 management year quota will be taken (Fig. 9).

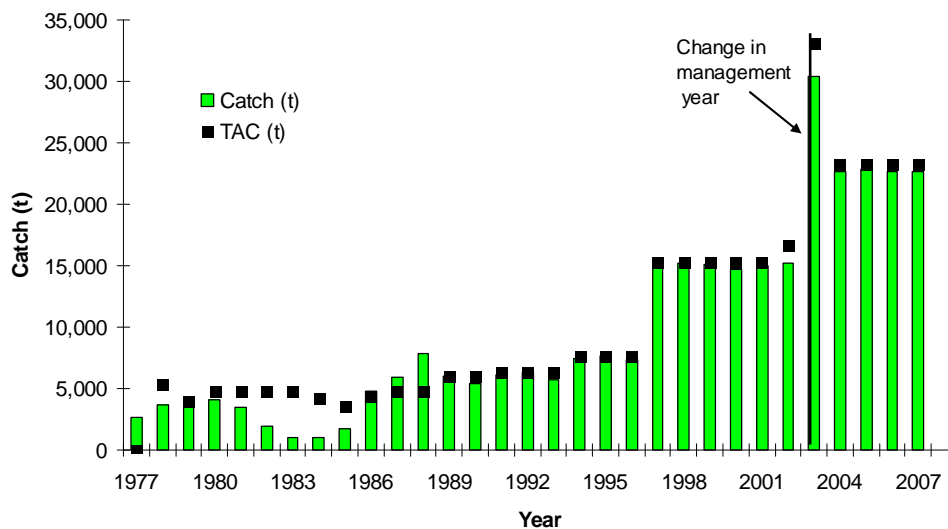


Figure 9. SFA 5 catches (t). In 2003, the management year changed from Jan. 1 – Dec. 31 to Apr. 1 – Mar. 31.

Since 1996, CPUE has fluctuated above the long-term average and is approximately double the pre-1996 CPUE (Fig. 10).

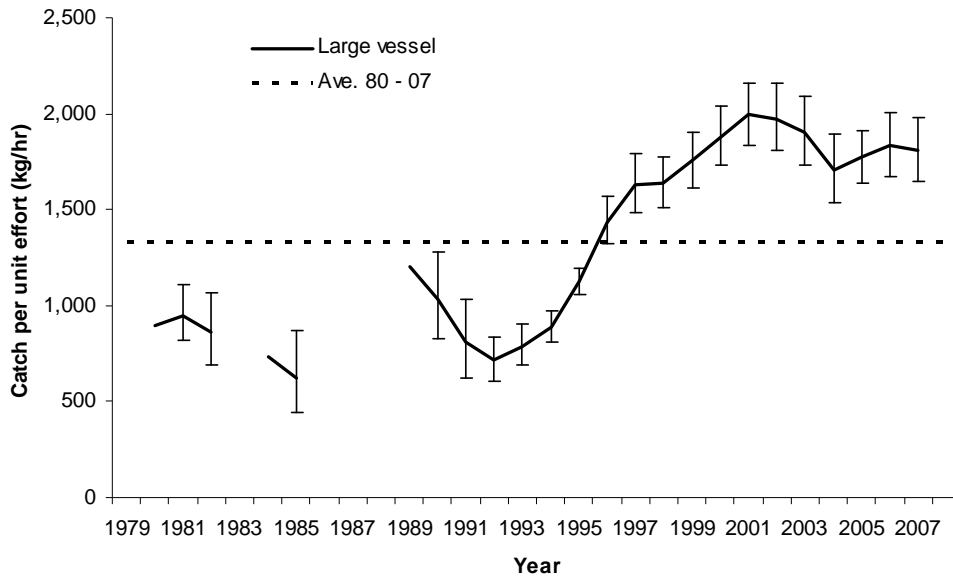


Figure 10. SFA 5 large vessel CPUE (error bars indicate 95% confidence intervals).

Percent total area within SFA 5 necessary for the large (>500 t) vessel fleet to obtain 95% of their catch has increased from 2 – 11% over the period 1980 – 2007 (Fig. 11). The fact that the CPUE has been fluctuating above the long term mean while area fished has been increasing provides an indication that the resource is healthy.

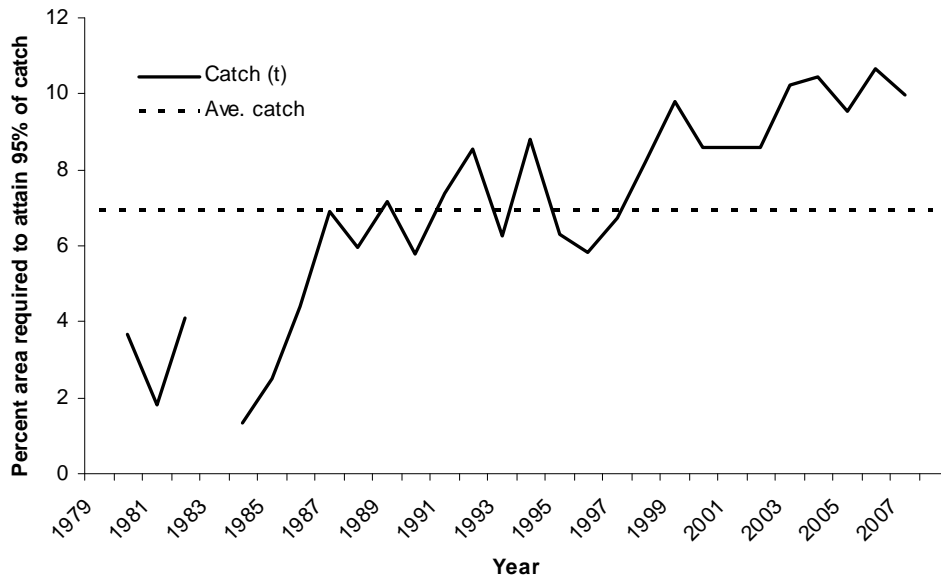


Figure 11. Percent of the total area available within SFA 5 necessary to account for 95% of large commercial catches over the period 1980 – 2007.

Note that annual autumn multi-species surveys were conducted in the northern part of SFA 5 (NAFO Division 2H) between 1996 and 1999. Since then, surveys of the whole of SFA 5 were completed in only three (01, 04, 06) of the last eight years. However, the

southern portion of SFA 5 (i.e., 2J) has been surveyed during all years since 1996. In the years that all of SFA5 has been surveyed, trends in indices and biological characteristics for the entire area and the 2J portion were broadly consistent.

Survey biomass indices (fishable and female) after 2000 have been somewhat higher than before 2000 (Fig. 12).

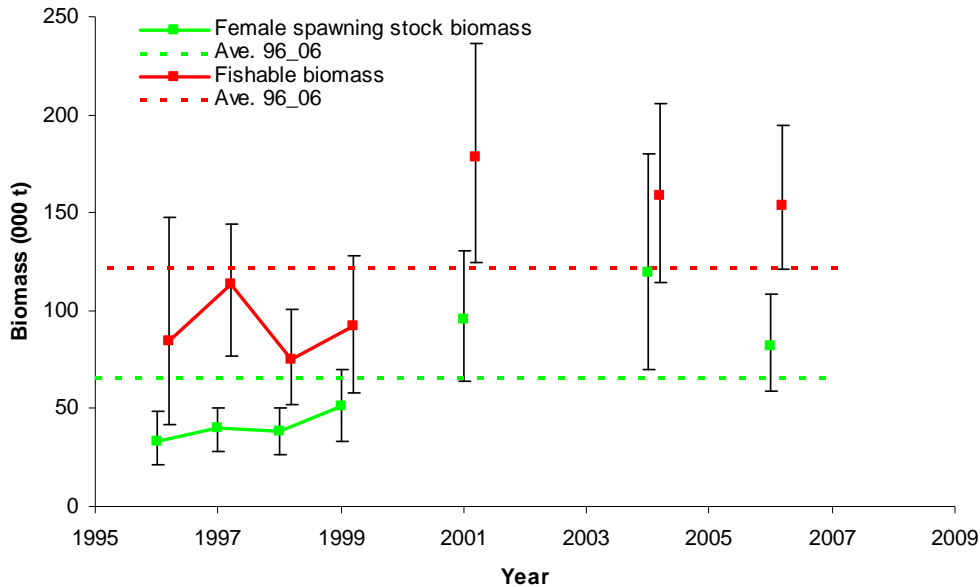


Figure 12. Biomass indices within the entire of SFA 5 (error bars indicate 95% confidence intervals).

Recruitment in the short-term, while uncertain, appears average (Fig. 13). Longer term prospects are unknown.

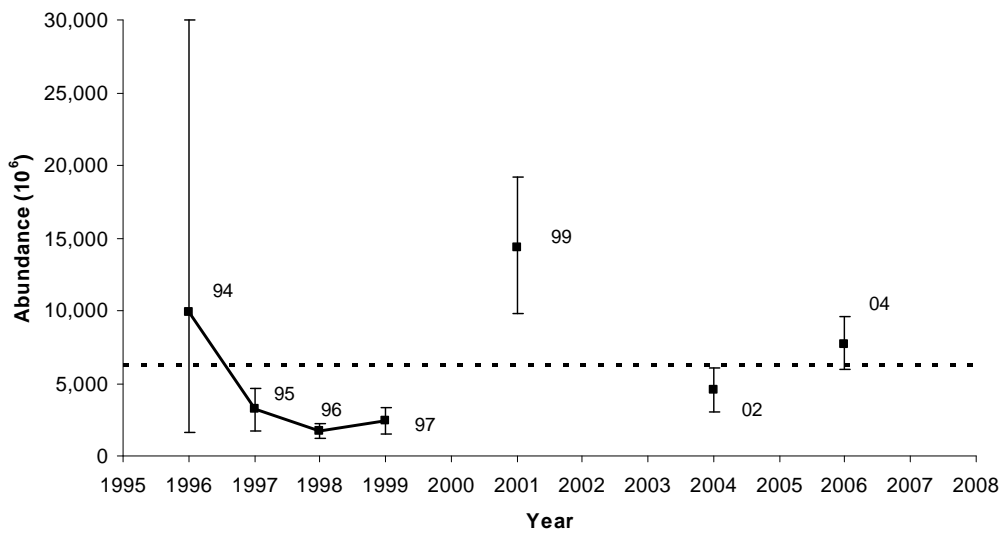


Figure 13. SFA 5 recruitment indices (error bars indicate 95% confidence intervals; numbers denote year classes).

The exploitation rate index has remained near the long-term average of 15% (Fig. 14). Recent catches have had no observable negative impact on shrimp abundance and biomass.

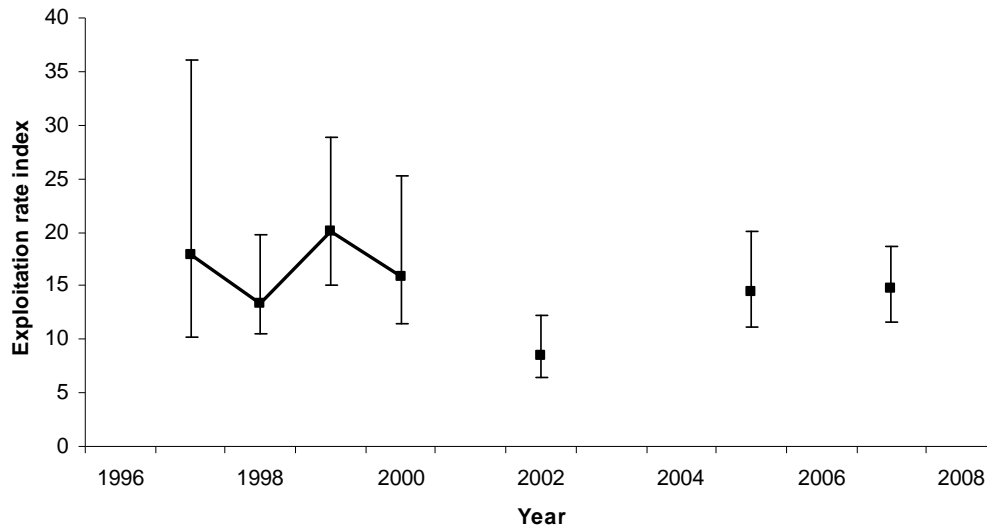


Figure 14. SFA 5 exploitation rate indices over the period 1996 – 2007 (total catch/ fishable biomass index from the previous year; error bars indicate 95% confidence intervals).

Current status remains positive. The resource continues to be distributed over a broad area (Figs. 1 and 11). Survey indices after 2000 are somewhat higher than before 2000. Recruitment in the short-term, while uncertain, appears average. Longer-term prospects are unknown.

## **SFA 4 (NAFO Division 2G)**

### Commercial Fishery

**TAC's** increased from 2580 t in 1989 to 5200 t in 1995 and 8320 t in 1998 (Fig. 15). The 1998 TAC allocated 2184 t to the area south of 60°N to promote spatial expansion of the fishery. The 2003 TAC was increased to 10,320 t. In 2003 the management year changed to April 1 – March 31, and an additional interim quota of 2802 t was set for the period January 1 – March 31, 2004. Thus the 2003/04 management period was 15 months and had a 13,122 t TAC. The 2003/04 management year TAC (10,320 t) was maintained through to 2007/08. Preliminary data indicate that ~10,000 t were taken during the 2007 calendar year and it is anticipated that the entire quota will be taken in the 2007/08 management year.

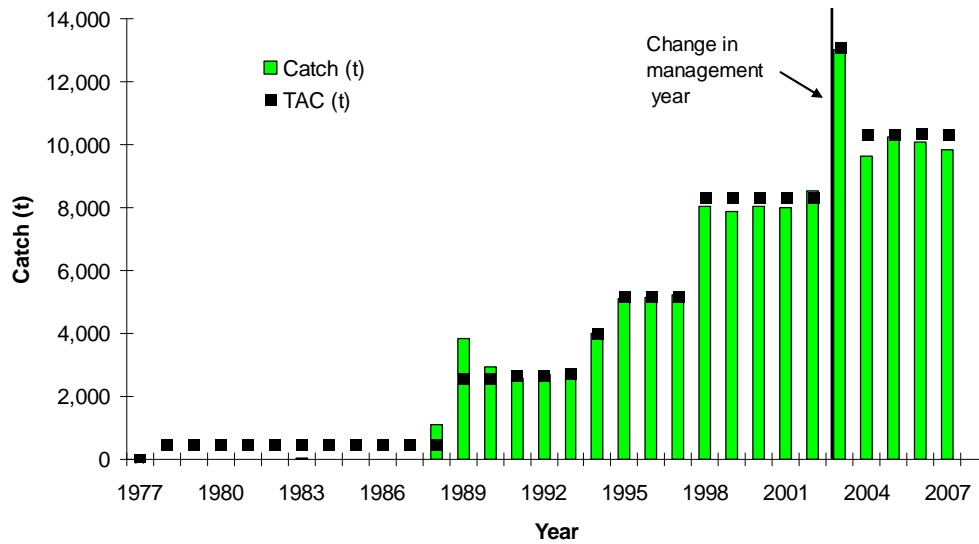


Figure 15. SFA 4 catches (t). In 2003, the management year changed from Jan. 1 – Dec. 31 to Apr. 1 – Mar. 31.

Biomass

Since 2002 CPUE has varied along the long-term average (Fig. 16).

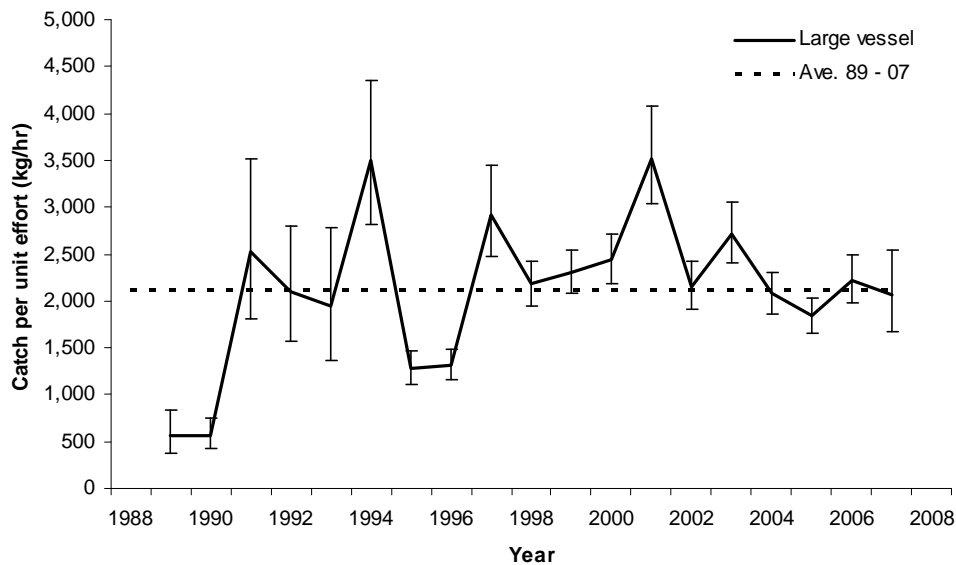


Figure 16. SFA 4 large vessel CPUE (error bars indicate 95% confidence intervals).

Percent total area within SFA 4 necessary for the large (>500 t) vessel fleet to obtain 95% of their catch has increased from 1 – 6% over the period 1980 – 2007 and has generally been showing an upward trend since 1997 (Fig. 17) indicating an expansion of the fishery.

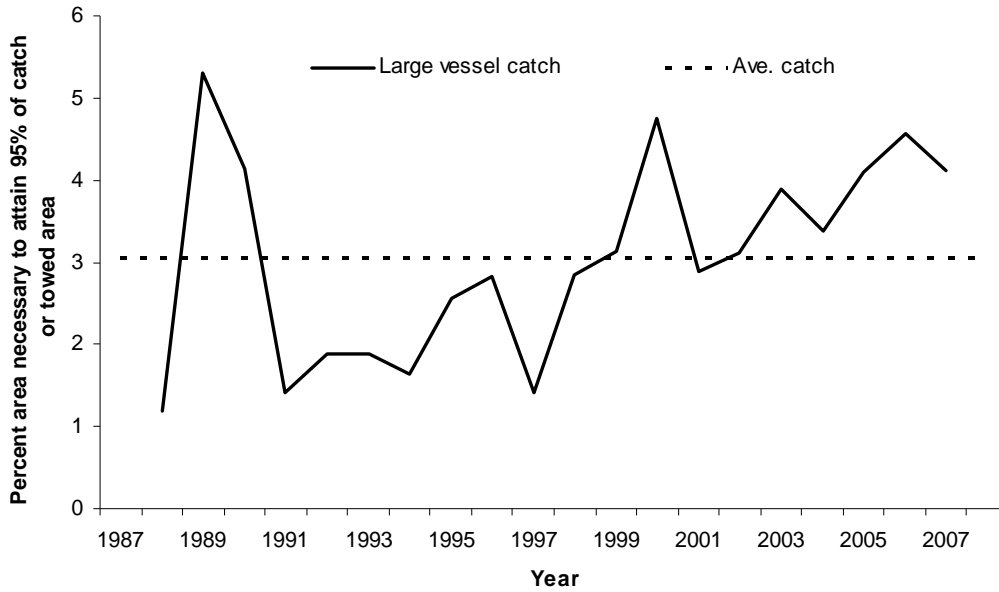


Figure 17. Percent of the total area available within SFA 4 necessary to account for 95% of large commercial catches over the period 1988 – 2007.

The fishable biomass and abundance indices from the joint NSRF–DFO research survey in SFA 4 (NAFO Division 2G) increased from 66,000 to 119,000 t during 2005 – 2007 (Fig 18).

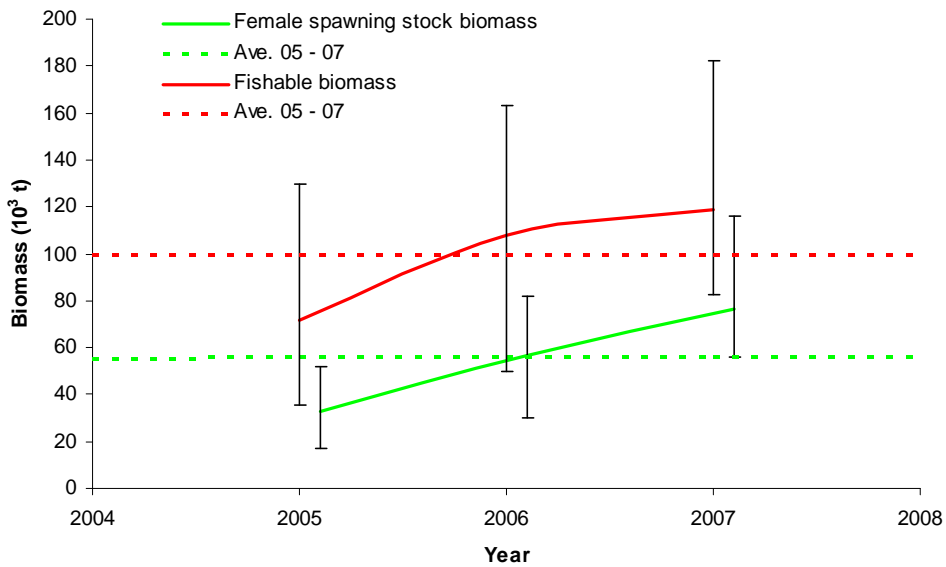


Figure 18. SFA 4 biomass indices (error bars indicate 95% confidence intervals).

Recruitment indices ranged between 1.0 and 2.3 billion animals over the short survey time series (Fig. 19). Recruitment trends are unknown because the time series is too short.

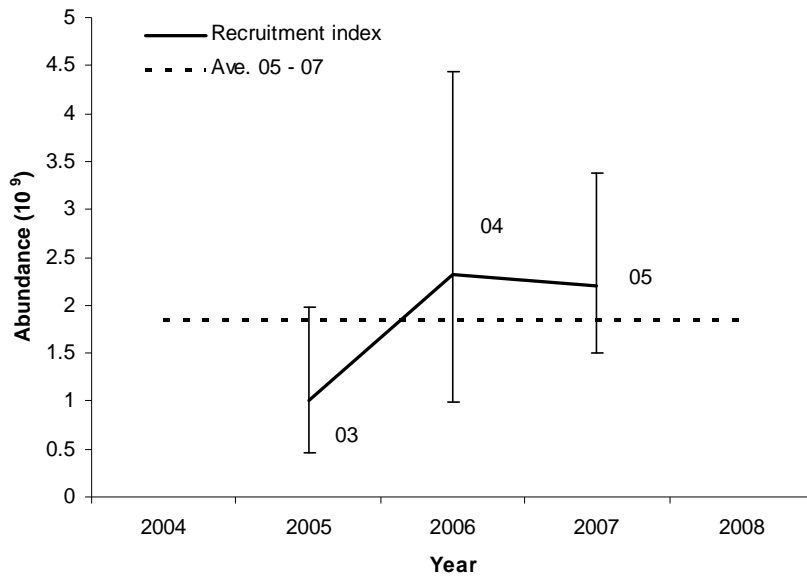


Figure 19. SFA 4 recruitment index (error bars indicate 95% confidence intervals; numbers denote year classes).

Exploitation rate indices ranged between 8 and 15% during 2005 – 2007 (Fig. 20). These exploitation rate indices are based on catch divided by same year biomass estimates. This is different than the procedure used in SFA’s 5 and 6 because the NSRF-DFO survey in SFA 4 occurs in July, which is the middle of the management year. Exploitation rate indices for SFA’s 5 and 6 are based on catch divided by the previous year’s biomass estimates because the DFO surveys are closer to the end of the management year.

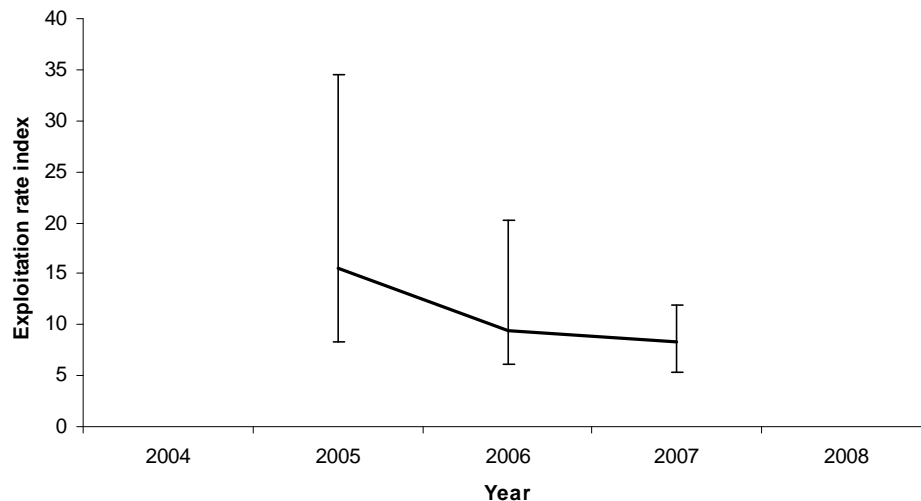


Figure 20. SFA 4 exploitation rate indices. (total catch/ fishable biomass index from the same year; error bars indicate 95% confidence intervals).

Current status appears positive from fishery catch rate indices and survey exploitation rate indices. The fishable biomass index has ranged between 66,000 and 119,000 t. Recruitment trends are unknown.

## **Industry Perspectives:**

### **Small vessel shrimp fleet perspective:**

In 2007, the inshore fleet landed approximately 115 million pounds of shrimp from SFA 6, which was 99% of the allocation available to the fleet. The shrimp fishing in SFA 6 by this fleet is conducted over a broad area. Harvesters experienced an increase in catch rates over the previous year and also an increase in the size of shrimp. The exploitation rate continues to be low and the fishery does not show any impact on the resource. The outlook for the future is positive within a healthy resource.

### **Large vessel shrimp fleet perspective:**

#### SFAs 5 and 6

In SFA 5 catch rates remain consistent, with the resource distributed over a broad area. Smaller size shrimp similar to that seen in SFA 6 were observed. SFA 6 catch rates also remained consistent. Considerable level of very small young recruits observed in some areas.

#### SFA 4

Catches rates remain good and there is no concern at this time regarding abundance. Based on general knowledge, it is believe that the resource is healthy. Notable presence of smaller size shrimp may be related to the recruitment of young males.

## **Sources of Uncertainty**

Various methods were explored to determine shrimp mortality rates; however, further work must be completed before mortality estimates become available.

Lack of complete research surveys in SFA 5 is a substantial source of uncertainty for this area.

The joint NSRF-DFO survey into SFA 4 is only three years in length, therefore it is difficult to assess trends in stock size.

The shortness of the survey time series, lack of dynamic range and lack of stock-recruit relationship within these data, as well as modest catches in relation to biomass indices resulted in failed attempts at modeling stock dynamics. The assessments are based upon evaluating various indices of stock conditions. There is no risk analysis for this resource because of the lack of limit reference points.

Area closures in good shrimp fishing areas may affect catch rate models as indicators of stock size.



## CONCLUSIONS AND ADVICE

### **SFA 6**

Current status remains positive. Large (>500 t) vessel CPUE remained at a high level since 1995 while the small (<100 ft) vessel CPUE has increased since 2003. The resource in this area remains healthy with biomass indices generally increasing since 1997. Recruitment indices in 2006 and 2007 were the highest in the time series. Recruitment and female biomass are expected to support the present fishery over the next four years. Recent catches have had no observable negative impact on shrimp abundance and biomass.

The resource continues to be distributed over a broad area and the exploitation rate index has remained low over the history of the autumn multi-species research survey. At the current TAC the 2008/09 exploitation rate index is expected to be 11-15% (based on 2007/08 TAC and 2007/08 fishable biomass confidence intervals). Any modest change in TAC is expected to have a proportional change in exploitation rate index.

### **SFA 5**

Current status remains positive. Since 1996, CPUE has fluctuated above the long-term average. While surveys of the entire SFA 5 were completed in only three (01, 04, 06) of the last eight years, survey biomass indices (fishable and female) after 2000 have been somewhat higher than before 2000.

Recruitment in the short-term while uncertain appears average. Longer-term prospects are unknown.

The resource continues to be distributed over a broad area and the exploitation rate index has remained low. Recent catches have had no observable negative impact on shrimp abundance and biomass.

### **SFA 4**

Current status appears positive from fishery catch rate indices and survey exploitation rate indices. The fishable biomass index derived from the NSRF-DFO research survey has ranged between 66,000 and 119,000 t since 2005, while exploitation rate indices decreased from 15 to 8%. Recruitment trends are unknown.

## MANAGEMENT CONSIDERATIONS

The fishery has had no observable negative impact upon the resource in shrimp fishing areas 5 and 6.

In SFA 6, the 2007 post season DFO survey can be used to forecast the 2008 exploitation rates for TAC options. The range in 2008 exploitation rate indices provided in this document (11-15%) was based on a status quo TAC option. However, any modest change in TAC's is expected to have a proportional change in the exploitation rate index in SFA 6. This was not possible for SFA's 4 and 5 because there was no 2007 post season survey in SFA 5 while the

SFA 4 survey was mid season. Over all SFA's, present TACs have been low relative to biomass size.

It is believed that, under current catch levels, any substantial change in stock dynamics will be determined by environmental shifts and not due to the fishery.

An assessment framework workshop was held during May 2007 with the objective of determining the appropriate indices to use in the assessment, providing short term predictions of trends in future stock size, and developing a precautionary approach to northern shrimp management, with clear limit reference points. The framework meeting was not able to propose limit reference points. Without limit reference points it is not possible to predict what level of catch will cause serious harm. The performance reports appended to this report were also developed in the assessment framework workshop and summarize stock status within SFAs 4-6.

However the resource is healthy and it is felt that current biomass levels are well above any precautionary limit reference points.

## **SOURCES OF INFORMATION**

DFO, 2006. Northern Shrimp (*Pandalus borealis*) – Div. 0B to 3K. DFO Can. Sci. Advis. Sec. Stock Advisory Report 2006/007.

DFO, 2007. Assessment framework for Northern shrimp (*Pandalus borealis*) off Labrador and the northeastern coast of Newfoundland; 28-30 may 2007. DFO. Can. Sci. Advis. Sec. Proceed. Ser. 2007/034.

Orr, D. P. J. Veitch and D. J. Sullivan. 2008. Northern shrimp (*Pandalus borealis*) off Labrador and northeastern Newfoundland. DFO Can. Sci. Advis. Sec. Res. Doc. *In prep.*

**APPENDIX 1:** Performance report for Northern Shrimp (*Pandalus borealis*) – Hawke Channel + 3K (SFA 6)

Index	Observation	Interpretation
<b>Production</b>		
Survey fishable biomass	Fishable biomass indices from fall multi-species surveys have generally increased since 1997.	Healthy resource
Survey female biomass	Female biomass indices from fall multi-species surveys have generally increased since 1997.	Healthy resource
Large vessel CPUE	The large (>500 t) vessel CPUE remained at a high level since 1995.	Healthy, broadly distributed resource.
Small vessel CPUE	The small vessel (<100 ft) CPUE has increased significantly since 2003.	Healthy, broadly distributed resource.
<b>Recruitment</b>		
Recruitment index (11.5 – 16 mm C.L. males)	Recruitment indices in 2006 and 2007 were the highest in the time series.	Recruitment and female biomass expected to support fishery over next four years.
<b>Fishery</b>		
Exploitation rate index	Over the past two years, the exploitation rate indices were about 11% of survey fishable biomass. Recent catches have had no observable impact on the resource.	Low exploitation
Z	Not available	
Industry Perspectives	Able to harvest TAC; fish over a broad area, good catch rates; shrimp size variable depending upon area fished; belief that resource is healthy.	Healthy resource

<b>Stock Status</b>		Evaluation
Current Outlook	Remains positive; survey indices have generally increased since 1997; no observed impact from fishery; resource distributed over a broad area.	positive
Future Prospects	Recruitment and female biomass expected to support fishery over next four years; at the current TAC, the 2008/09 exploitation rate index is expected to be 11 - 15%. Any modest change in TAC expected to have a proportionate change in exploitation rate index.	positive

Status Definitions	
	Concern for Current Status or Prospect
	Intermediate
	Positive Evaluation
	Uncertainty of interpretation

**APPENDIX 2:** Performance report for Northern Shrimp (*Pandalus borealis*) – Hopedale + Cartwright Channels (SFA 5)

Index	Observation	Interpretation
<b>Production</b>		
Survey fishable biomass	Somewhat higher after 2000 than before 2000.	Resource appears healthy; however, incomplete surveys in 5 of the last 8 years creates uncertainty.
Survey female biomass	Somewhat higher after 2000 than before 2000.	Resource appears healthy; however, incomplete surveys in 5 of the last 8 years creates uncertainty.
Large vessel CPUE	Since 1996, CPUE has fluctuated above the long-term average.	Healthy resource distributed over a broad area.

**Recruitment**

Recruitment index (11 – 16.5 mm C.L. males)	Recruitment in the short-term, while uncertain, appears average. Longer-term prospects are unknown.	Recruitment uncertain.
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**Fishery**

Exploitation rate index	The 2006/07 exploitation rate index was 15%. Recent catches have had no observable impact on the resource.	Low exploitation.
Z	Not available	
Industry Perspectives	Catch rates remain consistent; resource distributed over broad area; smaller size shrimp similar to that seen in SFA 6.	Healthy resource

**Stock Status**

Stock Status		Evaluation
Current Outlook	Current status remains positive; survey indices higher after 2000; no observed impact from fishery; resource distributed over broad area.	positive
Future Prospects	Recruitment in the short-term appears average. Due to incomplete survey in 5 out of 8 most recent years, there is uncertainty in recruitment and residual female biomass indices.	Uncertainty of interpretation

Status Definitions	
	Concern for Current Status or Prospect
	Intermediate
	Positive Evaluation
	Uncertainty of interpretation

**APPENDIX 3:** Performance report for Northern Shrimp (*Pandalus borealis*) – Division 2G (SFA 4)

Index	Observation	Interpretation
<b>Production</b>		
Survey fishable biomass	Fishable biomass index has ranged between 66,000 and 119,000 t.	Time series too short to infer trend.
Survey female biomass	Female biomass index has ranged between 33,000 and 76,000 t.	Time series too short to infer trend.
Large vessel CPUE	Since 2002 CPUE has varied along the long -term average.	Healthy resource; fishery able to maintain CPUE over broad area.
<b>Recruitment</b>		
Recruitment index (11 – 16.5 mm C.L. males)	Recruitment trends are unknown.	Not available
<b>Fishery</b>		
Exploitation rate index	Exploitation rate indices ranged between 8 and 15% during 2005 - 2007.	Low exploitation
Z	Not available	
Industry Perspectives	Catches rates remain good; no concern regarding abundance. Based on general knowledge, it is believe that the resource is healthy. Notable presence of smaller size shrimp may be related to the recruitment of young males.	Healthy resource

<b>Stock Status</b>		Evaluation
Current Outlook	Current status appears positive from fishery catch rate indices and survey exploitation rate indices.	positive
Future Prospects	Recruitment prospects are unknown and the survey time series is only three years in length.	Uncertainty of interpretation.

Status Definitions	
	Concern for Current Status or Prospect
	Intermediate
	Positive Evaluation
	Uncertainty of interpretation

**FOR MORE INFORMATION**

Contact: Dave Orr  
Fisheries and Oceans Canada  
P.O. Box 5667  
St. John's, NL A1C 5X1  
Tel: (709) 772-7343  
Fax: (709) 772-4105  
E-mail: [david.orr@dfo-mpo.gc.ca](mailto:david.orr@dfo-mpo.gc.ca)

This report is available from the:

Centre for Science Advice  
Newfoundland and Labrador Region  
Fisheries and Oceans Canada  
PO Box 5667  
St. John's, NL  
A1C 5X1

Telephone: (709) 772-2302/8892

Fax: (709) 772-6100

E-Mail: [Dale.E.Richards@dfo-mpo.gc.ca](mailto:Dale.E.Richards@dfo-mpo.gc.ca)

Internet address: [www.dfo-mpo.gc.ca/csas](http://www.dfo-mpo.gc.ca/csas)

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