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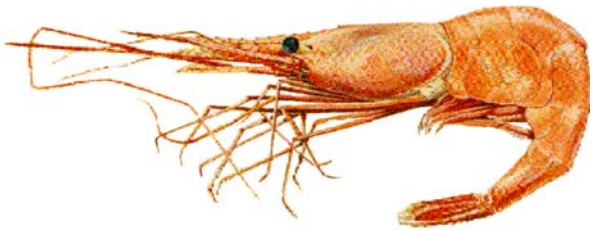
Newfoundland and Labrador Region
Canadian Science Advisory Secretariat
Science Advisory Report 2005/025

STOCK ASSESSMENT REPORT ON DIVISIONS 0B-3K NORTHERN SHRIMP



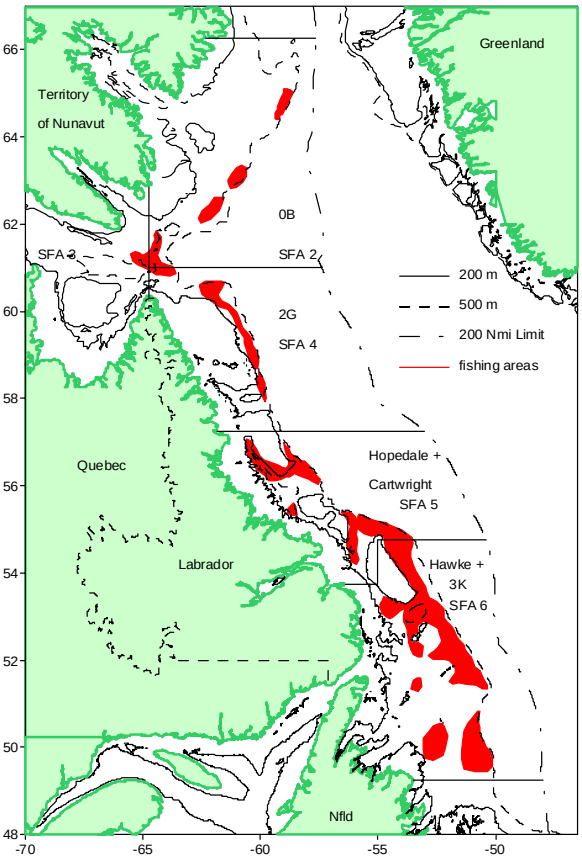


Figure 1: Map of northern shrimp fishing areas (SFA's).

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 to 6^{0}C. A vast area of suitable habitat exists throughout the Newfoundland and Labrador offshore area within a depth range of roughly 150-600 m. The species represents 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. Some northern populations exhibit relatively slow rates of growth and maturation but greater longevity (>8 years), resulting 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 halibut, skates, wolffish, snow crab and harp seals.

During 2003, the fishing season changed from January 1 – December 31 to April 1 – March 31 within SFA's 2-6. This change in season and the 2003 TAC's were maintained during 2004 - 2005.

This report provides an update of resource status in 2004. A full assessment was not conducted.

SUMMARY

- Resource status was updated based on trends in fishery catch per unit effort (CPUE) and fishing patterns. Also, a fall multi-species bottom trawl survey series (1995-2004) provided information on distribution, abundance and biomass indices, size and sex composition in the Hopedale – Cartwright Channels (SFA 5) and Hawke Channel + Division 3K (SFA 6).

- Catches in 2004 reached an all-time high and resource status appears positive. However, uncertainties increase from south to north due to lack of fishery independent data.

SFA 6 (Hawke Channel + Division 3K)

- Catches in 2004 totaled ~ 73,500 t, the all-time high.

- The 2004 large (>500 t) vessel CPUE remained above the long-term average, while the small vessel (< 65') CPUE increased significantly in 2004.

- Biomass and abundance indices from fall multi-species surveys increased over the 1997-2001 period and have since remained at a high level.

- The resource continues to be distributed over a broad area and the exploitation rate index has remained below 15%. Recent catches have had no observable impact on shrimp abundance and biomass.

- Current status remains positive.

SFA 5 (Hopedale and Cartwright Channels)

- Catches in 2004 totaled ~ 26,000 t, the all-time high.

- CPUE has remained above the long-term average since 1996.

- There are no trends in the biomass and abundance indices.

- Current status appears positive from the fall multi-species surveys and fishery data.

SFA 4 (Division 2G)

- Catches in 2004 totaled ~ 11,000 t, the all-time high.

- CPUE declined since 2001 to the long-term average in 2004.

- Current status appears positive from fishery data but future prospects are uncertain.

SFA 2 (Division 0B)

- Due to changes in areas fished and the mixture of *P. borealis* with *P. montagui*, CPUE does not reflect stock status. Therefore the status of the resource in SFA 2 was not updated.

DESCRIPTION OF THE ISSUE

Fishery

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 3000 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 Divisions OB (SFA 2) and 2G (SFA 4), where both catch rates and sizes 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 20,000 t and remained in the 15,000-17,000 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.

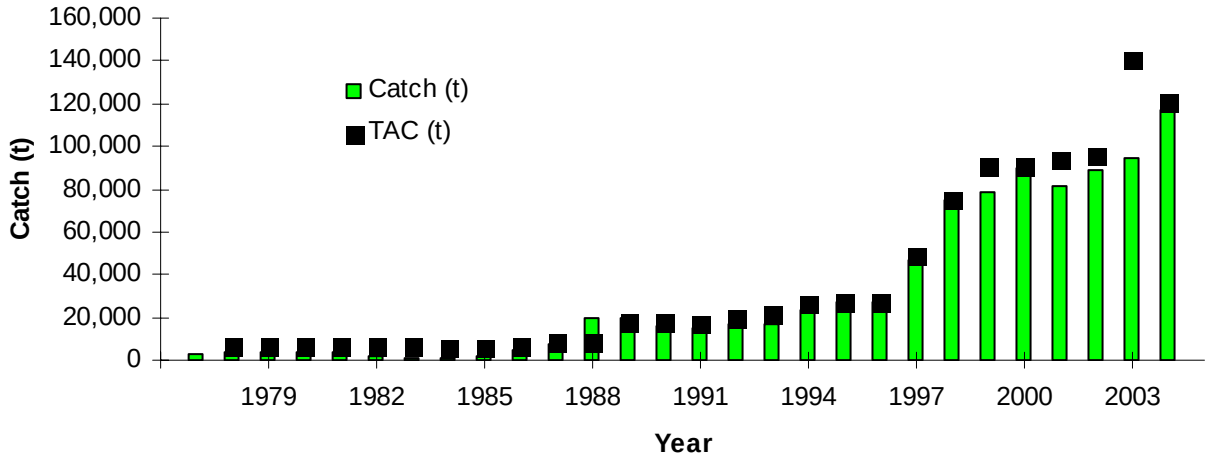


Figure 2: Historic northern shrimp catches (SFA's 2 and 4-6) and TAC's for the period 1977–2004.

Catches from 1994 to 1996 ranged between 23,000 t and 27,000 t in response to increased TAC's for several SFA's. Catches more than tripled to more than 90,000 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 (< 65') fleet which has since grown to include more than 300 vessels. TAC's increased to 95,000 t between 2000 and 2002.

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 fishing season from a calendar (January 1 - December 31) year to a fiscal (April 1 – March 31) year. To facilitate this change, an additional 20,000 t interim quota was allocated to the large vessel fleet

and the 2003 – 2004 fishing season was effectively (Jan. 2003 – Mar. 2004) 15 months. The 2004 – 2005 fishing season was 12 months and the TAC was set at the 2003 – 2004 fiscal year level, 120,000 tons.

All northern shrimp fisheries in eastern Canada are subject to the Atlantic Fisheries Regulations regarding territorial waters, bycatches, discarding, vessel logs, etc. Stipulations specifically for shrimp refer to the minimum mesh size of 40 mm and that 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.

ASSESSMENT

SFA 6 (Hawke Channel + Division 3K)

Commercial Fishery

Annual TAC's were set at 11,050 t in the 1994-1996 Management Plan and increased to 23,100 t in 1997 as a first step toward 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 (< 65') fishery. TAC's more than doubled between 1997 and 1999, increased slightly to 2002, and further increased, by 23%, to 77,932 t in 2003. An additional interim quota of 7653 t was set for the period January 1 – March 31, 2004 to facilitate an industry requested change in fishing season from January 1 – December 31 to April 1 – March 31,. Thus the 2003 – 2004 fishing season was 15 months long and had a 85,585 t TAC. The 2004-2005 fishing season was 12 months and had a 77,932 t TAC.

TAC's have been reached in most years; however, due to market constraints, small vessels have not always taken their entire allocations.

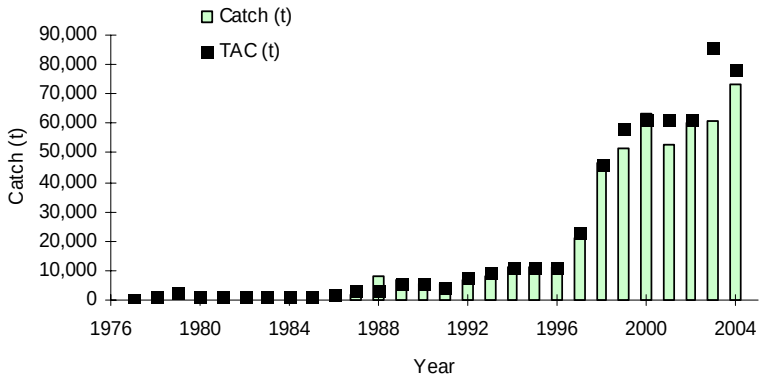


Figure 3: SFA 6 reported calendar year catches (t). Note that beginning in 2003, TAC's have been allocated by management year (Apr. 1 – Mar. 31).

Resource Status

Large vessel catch rates increased throughout 1990-1997 and have since fluctuated above the long-term average while the small vessel CPUE index increased significantly in 2004 (Fig. 4).

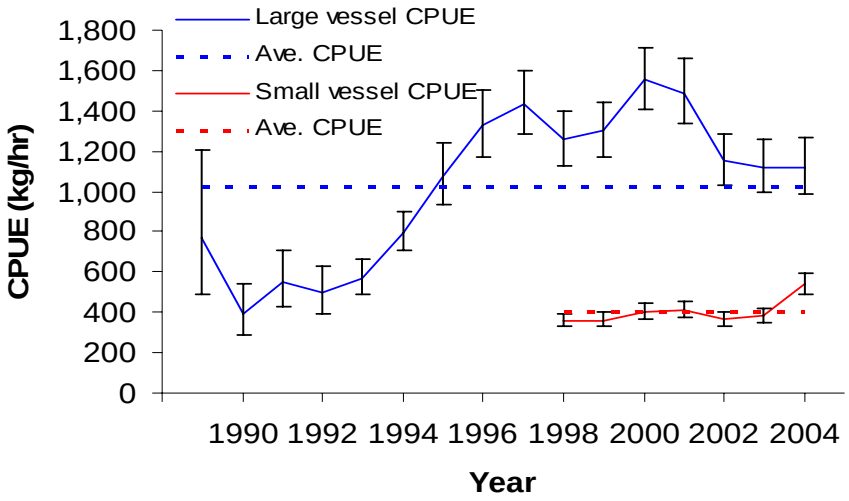


Figure 4: SFA 6 large and small vessel CPUE (error bars indicate 95% confidence intervals for point estimates).

Fall multi-species survey biomass and abundance indices increased over the 1997-2001 period and have since remained at a high level (Fig. 5).

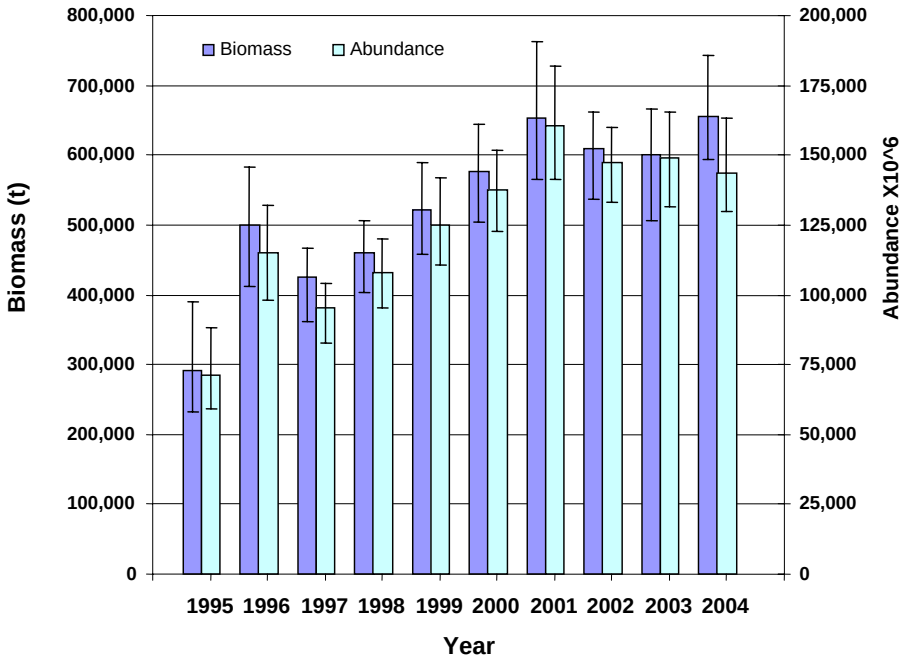


Figure 5: SFA 6 biomass and abundance indices (error bars indicate 95% confidence intervals for point estimates).

The 2000 and 2001 year classes are expected to be mostly female during 2005 and 2006 respectively. These year classes and the high residual female biomass should maintain the female component over the short term.

The **exploitation rate index** (ratio of commercial catch to lower 95% confidence interval of biomass index from the previous year's fall multi-species survey, expressed as a percent) has been less than 15% over the past several years. Catchability of shrimp by the survey trawl is assumed to be <1, therefore, actual exploitation rates have been lower. Recent catches have had no observable impact on shrimp abundance and biomass.

Sources of Uncertainty

The implications of finishing the 2002-2004 fall multi-species surveys later than usual are unknown.

A 400 Nm^2 area, within Hawke Channel, has been closed to gillnetting and trawling since September 2002. The closed area was increased to 2500 Nm^2 in July 2003. The larger area has traditionally been an important shrimp fishing area for the large vessels. The closure has had little impact upon the small vessel catch rates as most of their catches are taken from other parts of the management area.

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 (Fig. 6) and were taken in most years. The TAC increased 52% to 23,300 t in 2003 and included a 2500 t allocation for northern shrimp science research. (In 2003 the fishing season 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 2003-2004 fishing season was 15 months long and had a 33,087 t TAC.) The 2003-2004 fiscal year TAC (23,300 t) was maintained for the 2004 – 2005 season. Approximately 26,000 t of shrimp were caught during the 2004 calendar year.

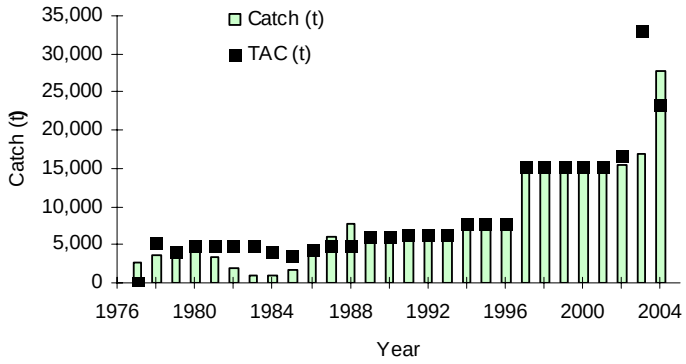


Figure 6: SFA 5 reported calendar year catches (t). Note that beginning in 2003, TAC's have been allocated by management year (April 1 – March 31).

Resource Status

Commercial CPUE has remained above the long-term average since 1996 (Fig. 7).

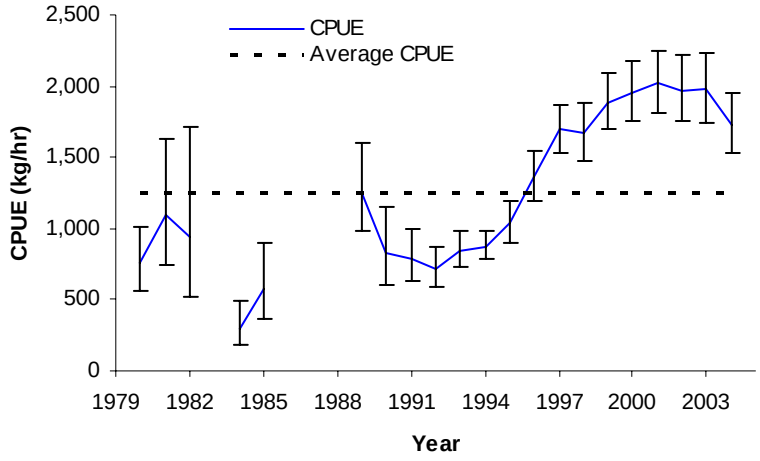


Figure 7: SFA 5 large vessel CPUE (error bars indicate 95% confidence intervals for point estimates).

There are no trends in the **biomass and abundance indices**, from fall multi-species surveys (Fig. 8). Note that annual fall multi-species surveys were conducted in the northern part of SFA 5 (NAFO Division 2H) between 1996 and 1999. Since then, SFA 5 was to be surveyed in its entirety during alternating years. However, due to operational difficulties, SFA 5 could not be surveyed during 2003. Instead it was surveyed during 2004.

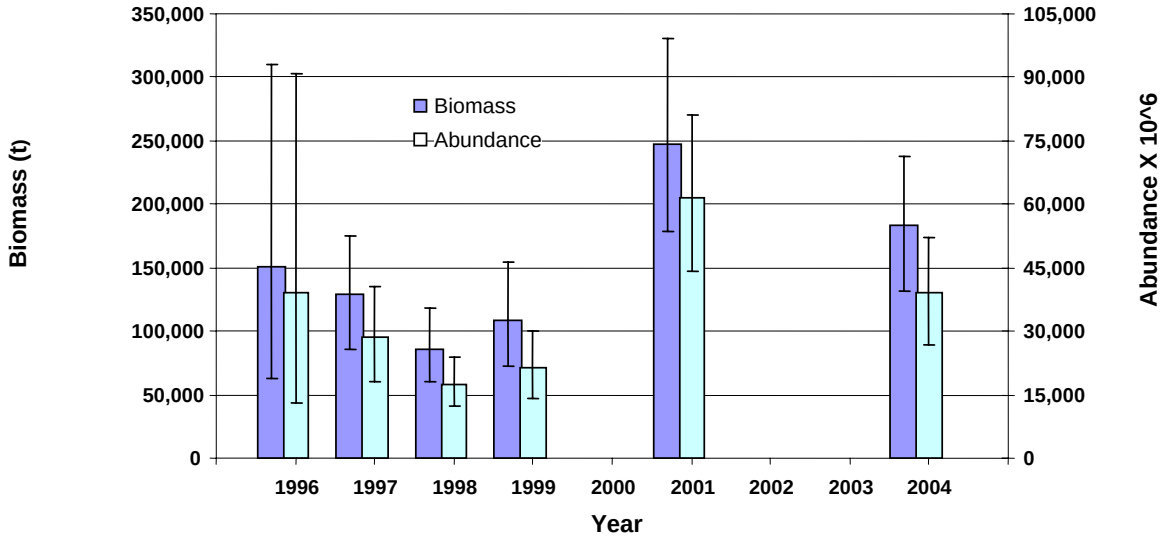


Figure 8: Biomass and abundance indices in SFA 5 (error bars indicate 95% confidence intervals for point estimates).

The 2000 and 2001 year classes are expected to become mostly female during 2005 and 2006 respectively. These year classes and the high residual female biomass should maintain the female component over the short term.

It was not possible to estimate an exploitation rate index since SFA 5 was not surveyed in it's entirety during 2003.

Sources of Uncertainty

The implications of finishing the 2001-2004 fall multi-species surveys later than usual 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. 9). 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 and included an 1125 t allocation for northern shrimp science research. (In 2003 the fishing season 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 2003-2004 fishing season was 15 months long and had a 13,122 t TAC.) The 2003-2004 (April 1 – March 31) TAC (10,320 t) was maintained for the 2004-2005 season. Preliminary data indicate that catches were ~11,000 t in the 2004 calendar year.

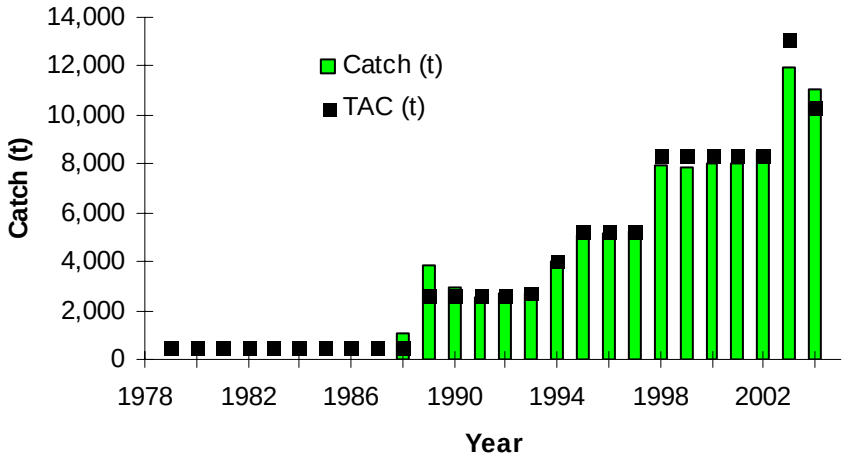


Figure 9: SFA 4 reported calendar year catches (t). Note that beginning in 2003, TAC's have been allocated by management year (April 1 – March 31).

Resource Status

CPUE declined since 2001 to the long-term average in 2004 (Fig. 10).

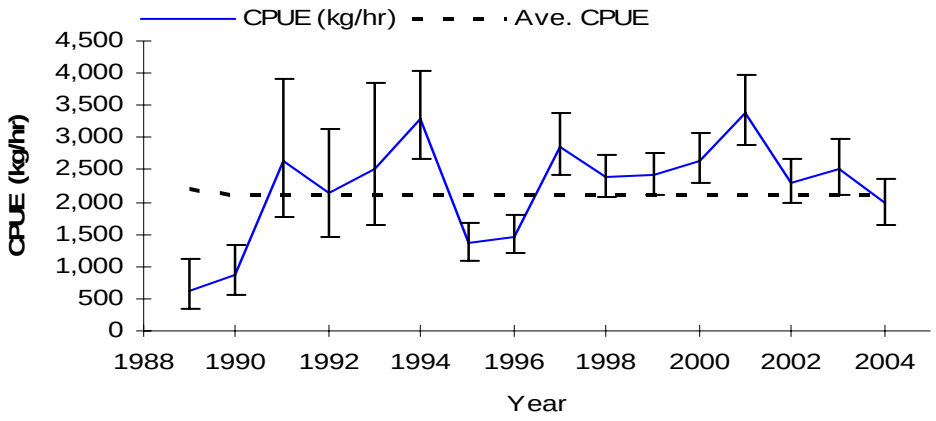


Figure 10: SFA 4 large vessel CPUE (error bars indicate 95% confidence intervals for point estimates).

Sources of Uncertainty

The lack of surveys since 1999 introduces uncertainty with respect to stock size, exploitation and recruitment.

SFA 2 (NAFO Division 0B)

Due to changes in areas fished and the mixture of *P. borealis* with *P. montagui*, CPUE does not reflect stock status. Therefore the status of the resource in SFA 2 was not updated.

ADDITIONAL STAKEHOLDER PERSPECTIVES

Industry Perspective: General

Changing environmental conditions such as warming water temperatures remain a concern as it relates to what impact it may be having on the resource. Capelin and herring have been observed in significant quantities as far north as SFA 1. In terms of the basic food chain, the presence of small pelagics may not be of concern at present, but if the levels remain or increase it may become a problem in the future if groundfish follow the return of capelin or herring.

Conservative harvesting rates are being employed as a general management strategy; however, the general view is that unknown environmental factors will dictate the timing and rate of any future decline.

Industry Perspective: SFA 5 and SFA 6

Northern parts of SFA 5 are generally better for shrimp size than the more southerly parts of the area, and SFA 6 is a concern overall. Knowledge of shrimp abundance in the traditional shrimp areas of the Hawke Channel was preempted in 2004 as a result of the area being closed to the shrimp fishery. Therefore, additional efforts were directed towards non-traditional areas in the continuing search for larger shrimp; there was some 'leveling off' of diminishing size in these areas. Catch rates remained good throughout these areas for the most part. In January 2005, vessels reported a "huge abundance" of very small shrimp - pinheads, baby shrimp and krill in SFA 6.

Industry Perspective: SFA 4

This area provides greater variability of catch rates within any given trip, with no significant overall change or concern regarding abundance. Shrimp appear to be distributed over most of the slope and this area appears to be a candidate for a TAC increase. The big concern with this area is the drastic reduction in size compared to just a few years ago. Larger size shrimp are very difficult to find, however, the increase in presence of smaller shrimp may be attributed to increased effort in a small area.

Industry Perspective: SFA 2

This is probably the most stable of all areas for catch rate, having best overall size of shrimp. While there has not been a large influx of recruits into the population, there are indications that average size may be declining.

CONCLUSIONS AND ADVICE

SFA 6

Current status remains positive. The resource in this area remains healthy with high biomass and abundance of both sexes. Recent catches have had no observable impact on shrimp abundance and biomass. Female biomass is expected to be maintained over the next two years.

SFA 5

Current status appears positive from fall multi-species surveys and fishery data. Female biomass is expected to be maintained over the short term.

SFA 4

Current status appears positive from fishery data, but future prospects are uncertain.

SFA 2

The status of the resource in SFA 2 was not updated.

MANAGEMENT CONSIDERATIONS

Removals at the current catch levels will not likely increase the exploitation rate appreciably within SFA's 5 and 6.

Lacking research surveys, it was not possible to evaluate the impact of the 2004 fishery or contemplate future prospects in SFA's 2 and 4.

SOURCES OF INFORMATION

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