



ASSESSMENT OF DIVISIONS 0B-3K NORTHERN SHRIMP

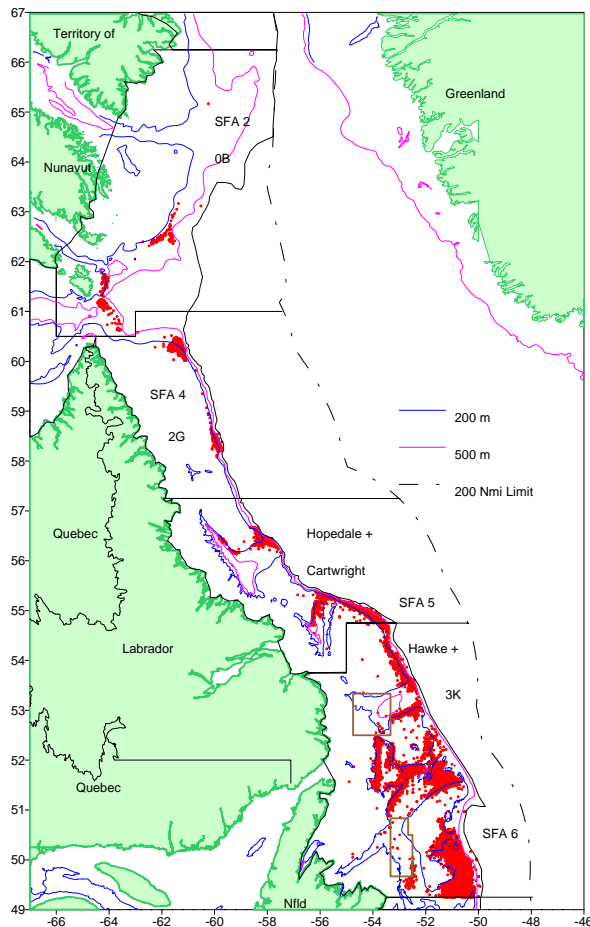
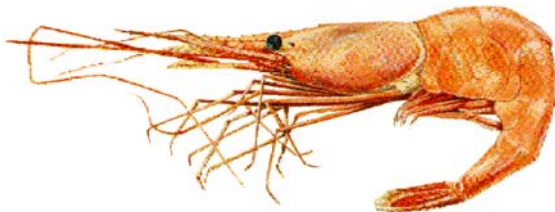


Figure 1. Map of northern shrimp fishing areas (SFA's) including the Hawke Channel and Funk Island Deep closed areas.

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

The 2003 TAC remained at the 2002 level in shrimp fishing area (SFA) 2 (Div. 0B), while increases were granted in SFA's 4 (Div. 2G), 5 (Hopedale + Cartwright Channels) and 6 (Hawke Channel + Div. 3K) (Fig. 1). Furthermore, in 2003 the fishing season was changed from a calendar year to a management year (Apr. 1, 2003 – Mar. 31, 2004). An interim quota of 20,229 t was set for Jan 1 – Mar. 31, 2004. Thus the 2003 – 2004 management year was 15 months in length and the total TAC within SFAs 2, and 4-6 was set at 140,531 t. Since then the management year for shrimp fishing areas 2 and 4-6 was 12 months in length (Apr. 1 – Mar. 31) and TACs returned to the 2003 level of 120,302 t.

A formal assessment of the resource was conducted during 2006; therefore, 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 trends in fishery catch per unit effort (CPUE) and fishing pattern. Also a fall multi-species research vessel (RV) bottom trawl survey series (1995 – 2005) provided information on distribution, abundance, biomass and recruitment indices, size and sex composition in the Div. 2J portion of SFA 5 and Hawke Channel + Div. 3K (SFA 6).
- The Northern Shrimp Research Foundation in partnership with the Department of Fisheries and Oceans conducted a shrimp based research survey into Divisions 2G (SFA 4) and 0B (SFA 2). This was the first of at least five consecutive annual surveys into these shrimp fishing areas.
- Catches were near the all-time high and resource status appears positive. However, uncertainties increase from south to north due to insufficient fishery independent data.

SFA 6 (Hawke Channel + Division 3K)

- Catches increased from 11,000 t in 1994 – 1996 to over 72,000 t by 2004 due mainly to increases in TAC. The TAC in the 2005 – 2006 management year remained unchanged and it is anticipated that the quota will be taken.
- Spatial distribution of the fishery expanded since the mid 90's and remained stable since 2000.
- The 2005 large (>500 t) vessel CPUE remained at a high level, while the small vessel (<65') CPUE increased significantly during 2004 and remained at that level in 2005.
- Biomass and abundance indices from fall multi-species surveys increased over the 1997 – 2001 period. Both indices decreased slightly during 2002; since then abundance remained at a high level while biomass increased to the highest recorded level.
- The 2003 year class appears weaker than average; however, strong residual female biomass is expected to maintain the fishery in the short-term.
- Medium-term recruitment appears positive from the presence of a stronger than average 2004 year class.
- The female stock index increased from an estimated 182,000 t (22 billion animals) in 1997 to 404,000 t (55 billion) in 2005.
- The resource continues to be distributed over a broad area and the exploitation rate index has remained low. Recent catches have had no observable impact on shrimp abundance and biomass.
- Current status remains positive.

SFA 5 (Hopedale and Cartwright Channels)

- Catches increased from 7500 t in 1994 – 1996 to 26,600 t by 2004 due mainly to increases in TAC. The TAC in the 2005 – 2006 management year remained unchanged and it is anticipated that the quota will be taken.
- Since 1996, CPUE has remained above the long-term average.

- Biomass and abundance indices from fall multi-species surveys have increased since 1998.
- 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 impact on shrimp abundance and biomass.
- Current status remains positive.

SFA 4 (Division 2G)

- Catches increased from 4000 t in 1994 to 11,000 t by 2004 due mainly to increases in TAC. The TAC in the 2005 – 2006 management year remained unchanged and it is anticipated that the quota will be taken.
- CPUE declined since 2001 to the long-term average in 2004 and 2005.
- Current status appears positive from fishery data but future prospects are unknown.

SFA 2 (Division 0B)

- Catches increased from 106 t in 1993 to 7500 t in 2005 due mainly to increases in TAC. The TAC in the 2005 – 2006 management year remained unchanged.
- CPUE has been relatively stable at a high level since 1998.
- Current status appears positive from fishery data but future prospects are unknown.

BACKGROUND

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 0B (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 to 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.

Catches from 1994 to 1996 ranged between 24,000 and 27,000 t in response to increased TAC's for several SFA's. Catches more than tripled to 94,000 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.

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 (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 – 2004 fishing season became 15 months in length. The 2004 – 2005 the fishing season was 12 months in duration and total allocations, within SFAs 2 and 4-6, equalled 120,302 t. This TAC was maintained throughout the 2005 – 2006 fiscal 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 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.

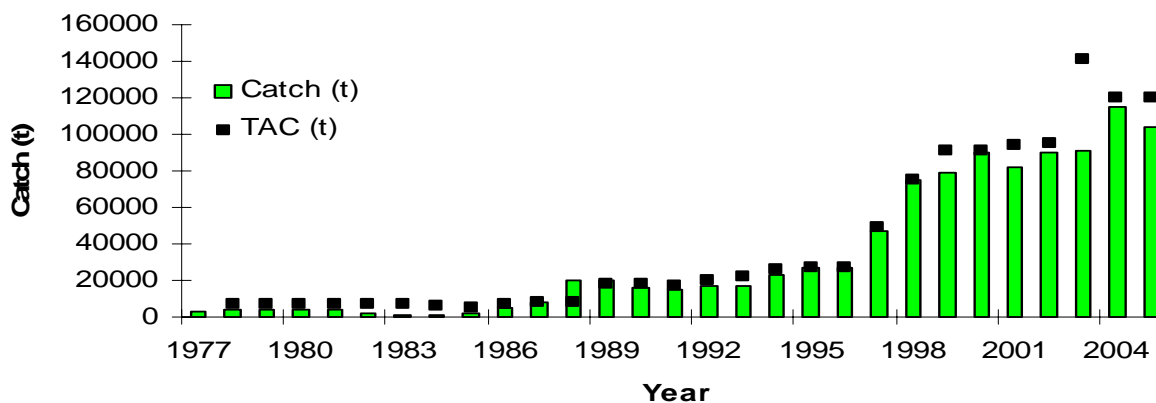


Figure 2. Historic northern shrimp catches (SFA's 2 and 4-6) and TAC's for the period 1977 – 2005 (2005 catches are preliminary).

ASSESSMENT

Resource status was evaluated based on trends in fishery CPUE, as well as, abundance, biomass and recruitment indices from surveys. Data were derived from autumn multi-species bottom trawl surveys in Divisions 2J3K, fishery data from logbooks and observer catch – effort data, as well as biological sampling data from multiple sources.

Autumn multi-species bottom trawl surveys provide indices of recruitment, total abundance, spawning stock biomass, and total biomass. Recruitment indices (abundance of animals with 11.5 – 16 mm carapace length) provide prospects of biomass two years later (males with carapace lengths => 17.5 mm and all females <22.5 mm). Exploitation rate indices were determined by comparing the catch to the lower 95% confidence interval for trawlable biomass for the previous year's survey. This index provides an upper bound for the exploitation rate for two reasons: survey catchability is less than one and the lower confidence limit substantially underestimates biomass. 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

Annual 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 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 fleet. TACs 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 fishing season January 1 – March 31, 2004 to facilitate an industry requested change in fishing season from January 1 – March 31. Thus the 2003 – 2004 fishing season was 15 months long and had an 85,585 t TAC. The 2004-2005 fishing season was 12 months and had a 77,932 t TAC. Approximately 72,000 t of shrimp were caught during the 2004 calendar year. The TAC in the 2005 – 2006 management year was maintained at the 2003 - 2004 level and it is anticipated that the quota will be taken.

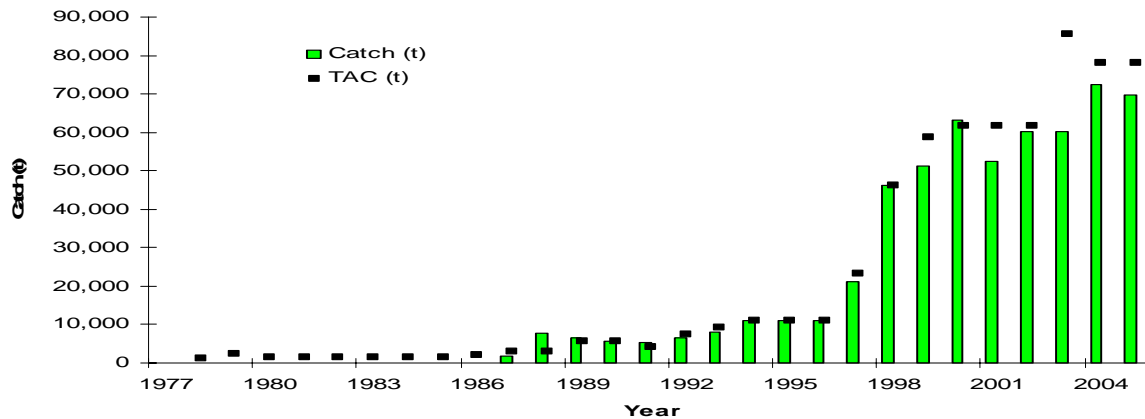


Figure 3. SFA 6 reported calendar year catches (t). Note that beginning in 2003, TAC's have been allocated by management year (Apr. 1 – Mar. 31.).

Abundance and biomass

The 2005 large (>500 t) vessel CPUE remained at a high level, while the small vessel (<65') CPUE increased significantly during 2004 and remained at that level in 2005 (Fig. 4).

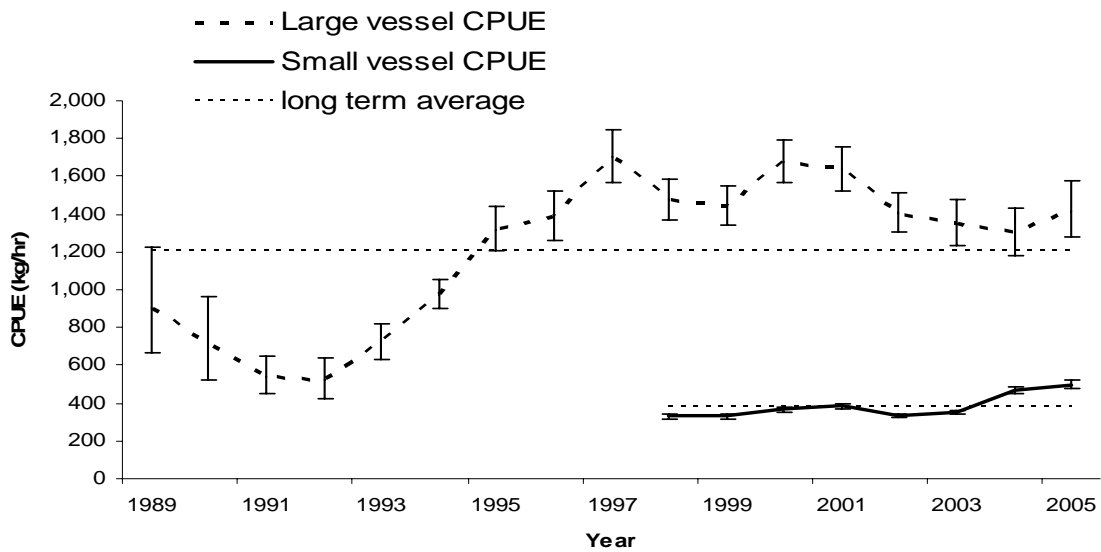


Figure 4. SFA 6 large and small vessel CPUE (error bars indicate 95% confidence intervals for CPUE).

Spatial distribution of the fishery expanded since the mid 90's and remained stable since 2000 (Fig. 5).

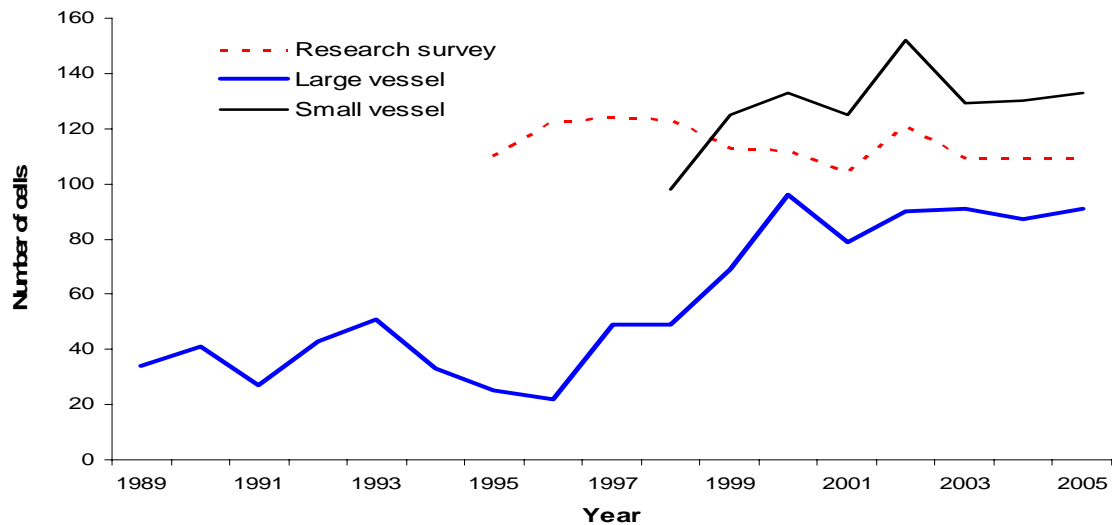


Figure 5. The area necessary to account for 95% of the research and commercial catches over the period 1989 – 2005.

Biomass and abundance indices from fall multi-species surveys increased over the 1997 – 2001 period. Both indices decreased slightly during 2002; since then abundance remained at a high level while biomass increased to the highest recorded level (Fig. 6). Most of the biomass is due to females. The female spawning stock biomass index increased from an estimated 182,000 t (22 billion animals) in 1997 to 404,000 t (55 billion) in 2005.

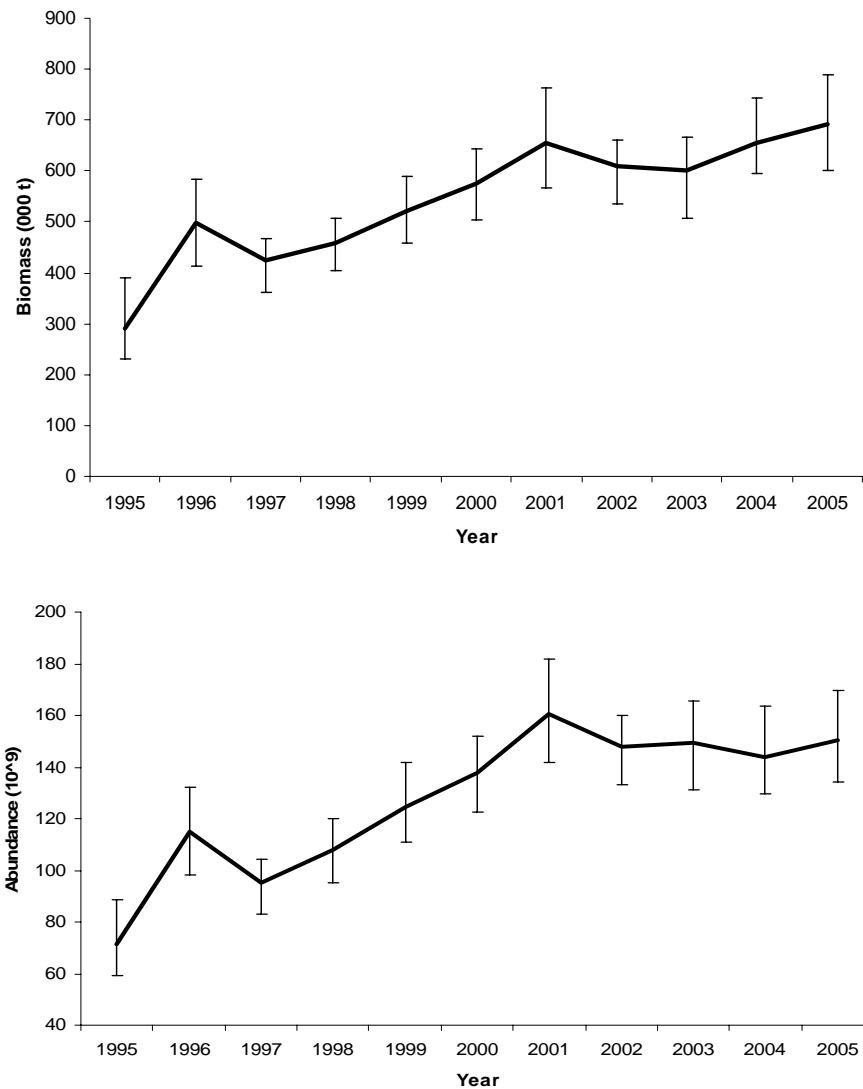


Figure 6. SFA 6 biomass and abundance indices (error bars indicate 95% confidence intervals for biomass or abundance).

Recruitment

Males within 11.5 mm – 16 mm carapace length, primarily age 2, are used as a recruitment index. The latest recruitment index, suggests that the 2003 year class is weaker than average (Fig. 7); however, strong residual female biomass is expected to maintain the fishery in the short-term (Fig. 8).

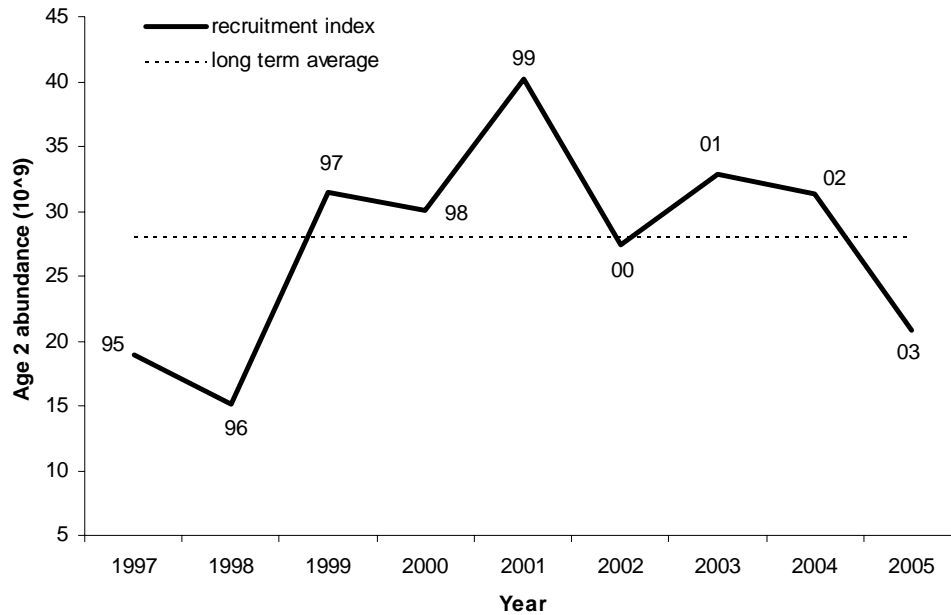


Figure 7. A recruitment index as determined from SFA 6 research survey, abundance of males with 11.5 – 16 mm carapace lengths (primarily age 2), over the period 1997 – 2005. (Numbers denote year classes).

Medium term recruitment appears positive from the presence of a stronger than average 2004 year class (Fig. 8).

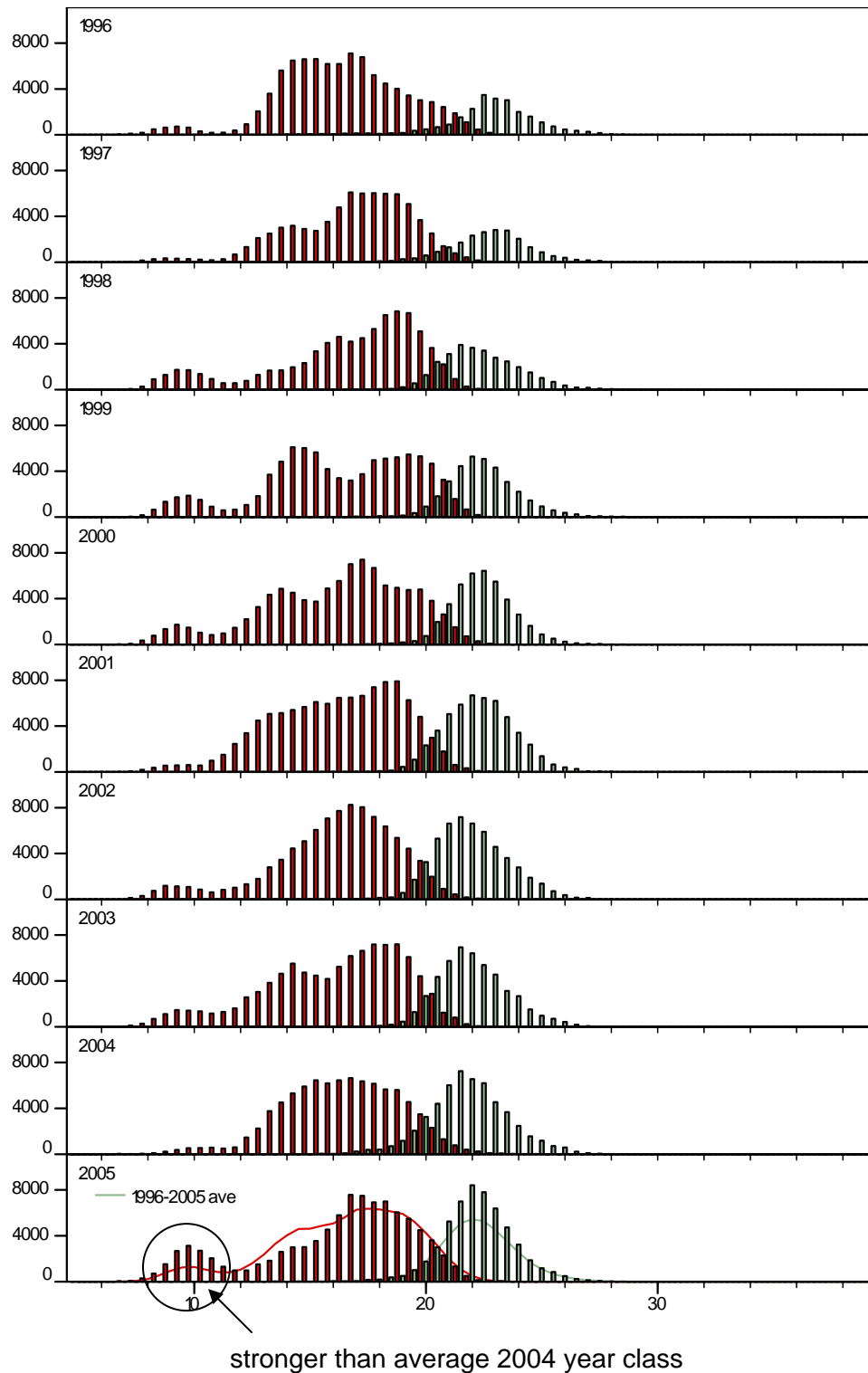


Figure 8. Abundance at length for northern shrimp within Hawke Channel + 3K (SFA 6) from autumn research bottom trawl survey data 1996 – 2005. The red bars are males while the green bars are females.

Mortality

The resource continues to be distributed over a broad area (Fig. 5) and the exploitation rate index has remained low (Fig. 9).

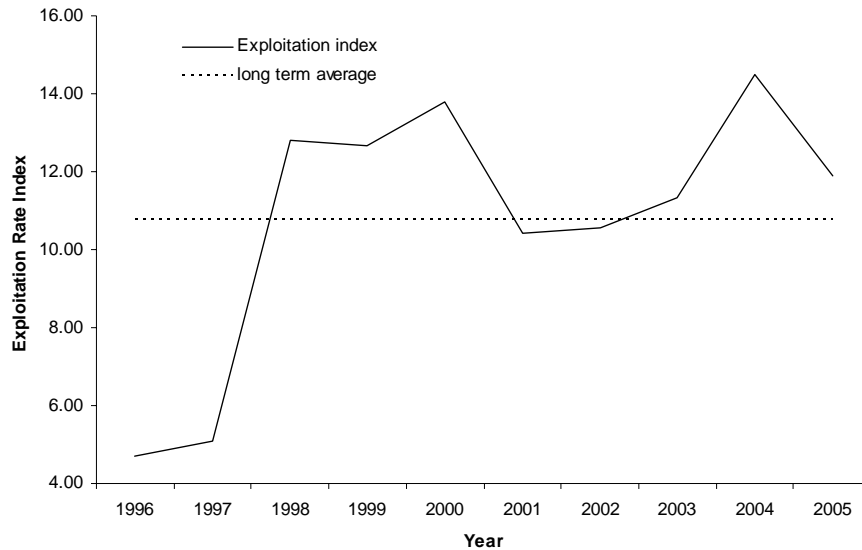


Figure 9. SFA 6 exploitation rate indices over the period 1996 – 2005 (total catch/ lower 95% confidence interval for previous year biomass).

SFA 5 (Hopedale and Cartwright Channels)Commercial Fishery

TACs 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 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 9787 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 and 2005 – 2006 seasons. TACs have been taken in most years. Approximately 27,000 t were taken during the 2004 calendar year and it is anticipated that the 2005 – 2006 quota will be taken (Fig. 10).

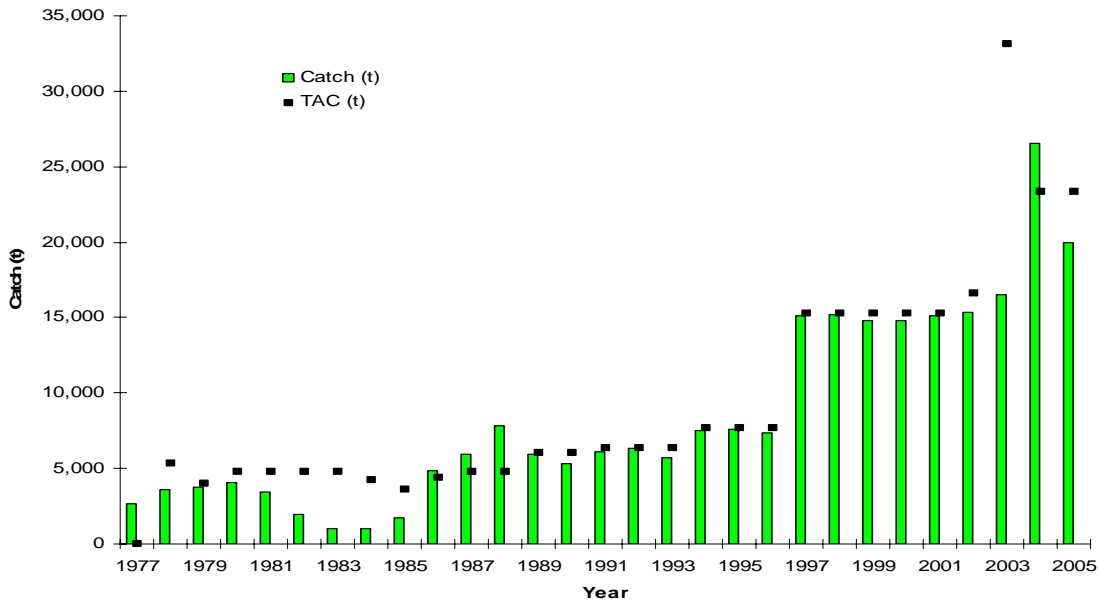


Figure 10. SFA 5 reported calendar year catches (t). Note that beginning in 2003, TAC's have been allocated by management year (Apr. 1 – Mar. 31).

Since 1996, CPUE has remained above the long-term average (Fig. 11).

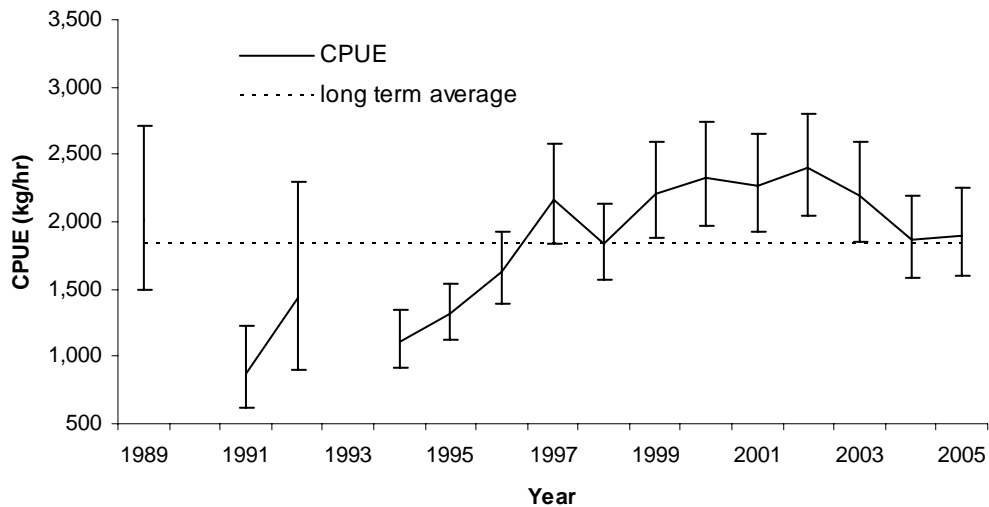


Figure 11. SFA 5 large vessel CPUE (error bars indicate 95% confidence intervals for point estimates).

Biomass and abundance from autumn multi-species surveys have increased since 1998 (Fig. 12). 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, SFA 5 was to be surveyed in its entirety during alternating years. However, the lower part of SFA 5 (Cartwright Channel) has been surveyed during all years since 1996. Trends in indices and biological characteristics from SFA 5 and Cartwright Channel were broadly consistent; therefore, indices from Cartwright Channel are used in this assessment as proxies for the entire of SFA 5.

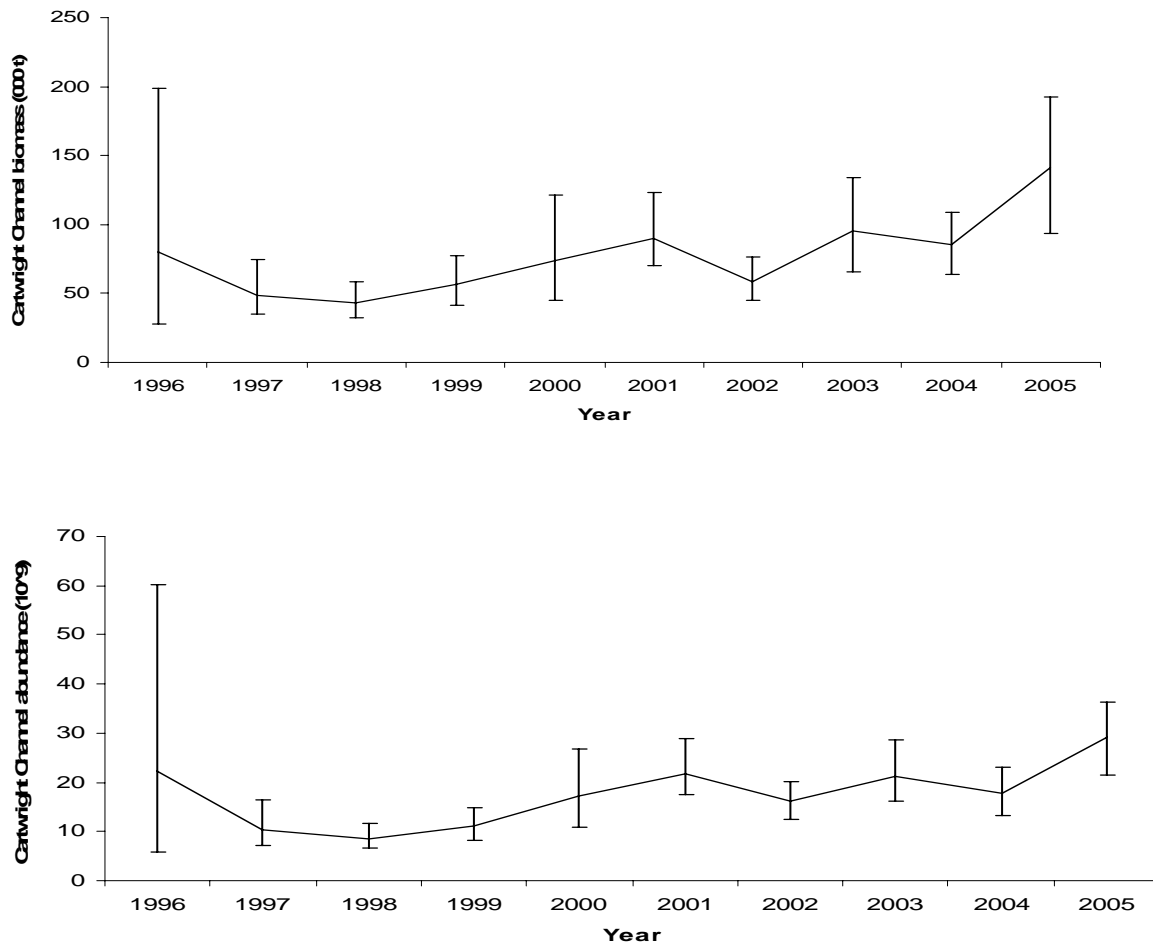


Figure 12. Biomass and abundance indices within Cartwright Channel (error bars indicate 95% confidence intervals for point estimates).

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

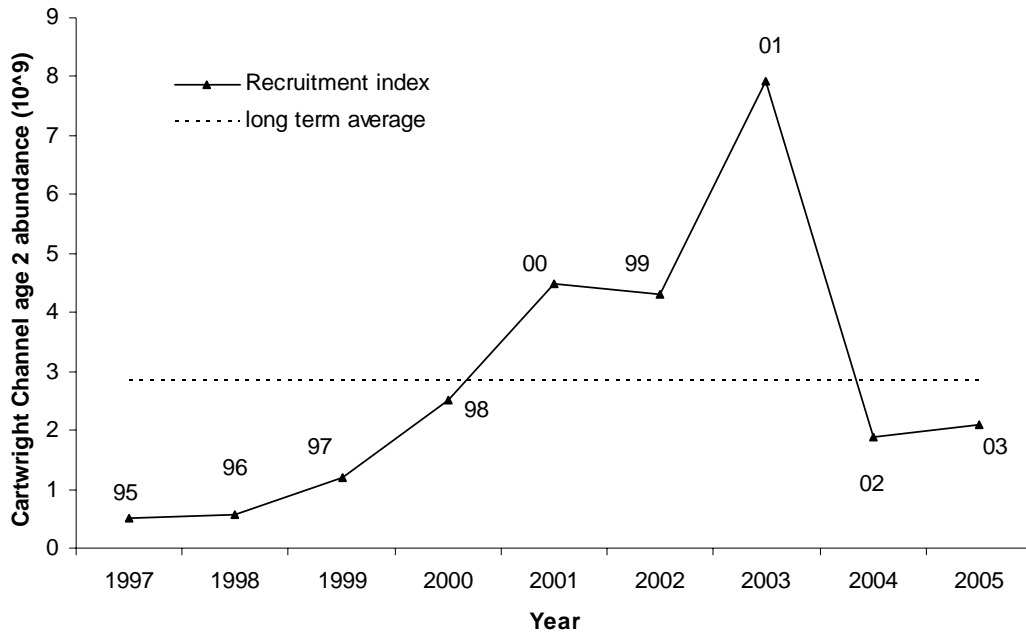


Figure 13. A recruitment index as determined from the Cartwright Channel research survey age 2 abundance (all males with 11.5 – 16 mm carapace lengths) over the period 1997 – 2005. (Numbers denote year classes).

The resource continues to be distributed over a broad area and the exploitation rate index has remained low (Fig. 14). Recent catches have had no observable impact on shrimp abundance and biomass.

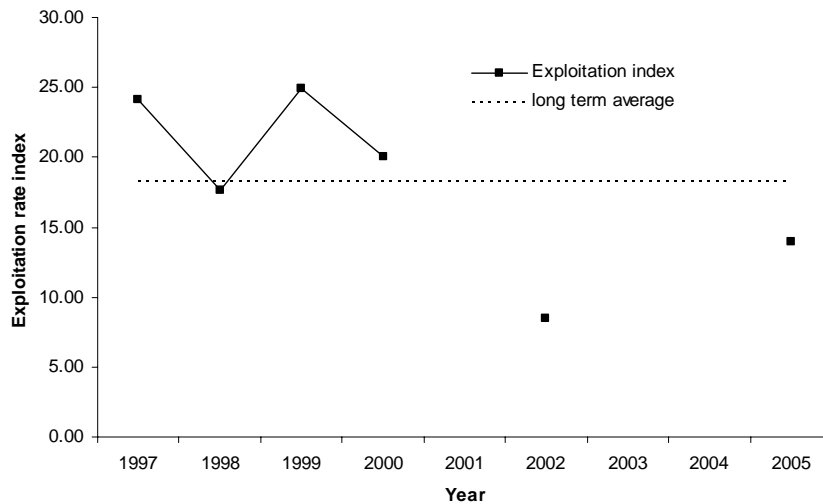


Figure 14. SFA 5 exploitation rate indices over the period 1996 – 2005 (total catch/ lower 95% confidence interval for previous year biomass).

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 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 and 2005 – 2006 seasons. Preliminary data indicate that ~11,000 t were taken during the 2004 calendar year and it is anticipated that the entire quota will be taken.

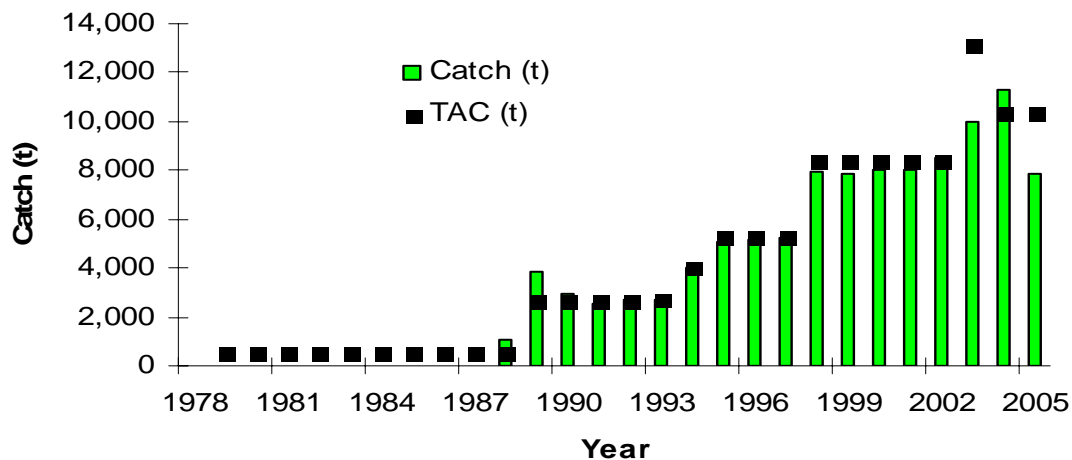


Figure 15. SFA 4 reported calendar year catches (t). Note that beginning in 2003, TAC's have been allocated by management year (Apr. 1 – Mar. 31.).

CPUE declined since 2001 to the long-term average in 2004 and 2005 (Fig. 16).

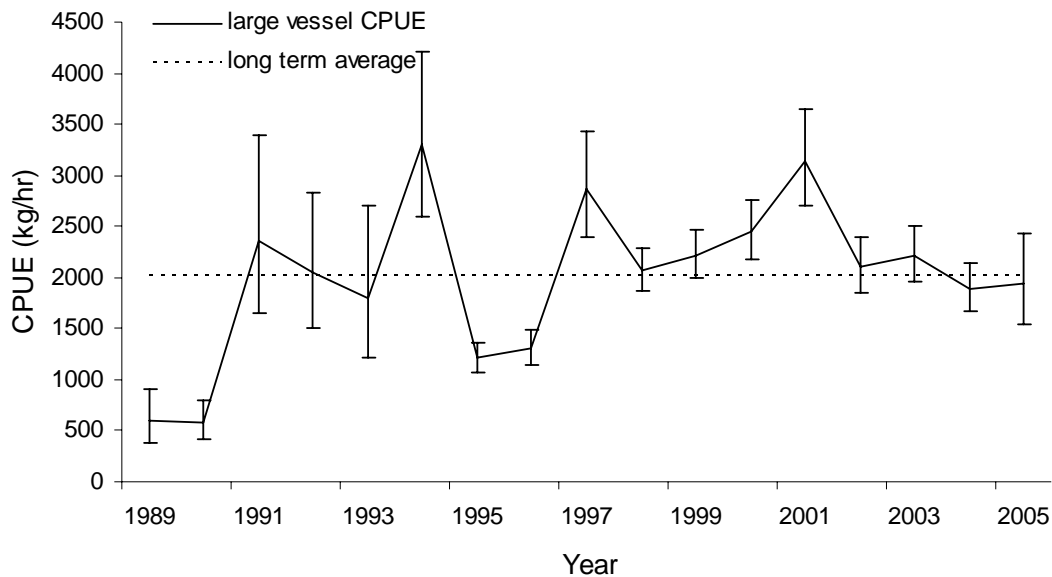


Figure 16. SFA 4 large vessel CPUE (error bars indicate 95% confidence intervals for point estimates).

Abundance and Biomass

It must be noted that the Northern Shrimp Research Foundation, in partnership with the Department of Fisheries and Oceans, conducted a shrimp based research survey in NAFO Division 2G during the summer of 2005. This survey is to be repeated over at least five consecutive summers. Once there is a time series, this source of data will be used as an aid in assessing northern shrimp resource status within SFA 4.

SFA 2 (NAFO Division 0B)

Commercial Fishery

Catches of *Pandalus borealis* in Div. 0B increased from about 2800 t in 1988 to 3000 t in 1989 but subsequently declined to 100 t in 1993. In 1994, catch remained below 500 t but increased substantially to about 3600 and 3200 t in 1995 and 1996, respectively. Catches increased to 6000 t in 2001, declined to 4800 t in 2004. Preliminary catch data indicate that the TAC of 6200 t was taken in 2005.

TAC's remained at 3500 t from 1989 to 1996 but were increased experimentally to 5250 t for 1997 and 1998. In 1999, an additional 3500 t were provided for the area north of 63° N as an incentive for the offshore fleet to return to grounds not fished extensively since 1995. However, only 105 t were reported from this area in 1999. In 2000, the additional 3500 t was not included in the quotas. The reported catch north of 63° N (237 t) was not counted against the TAC for the southern area (5353 t). Since 2001, a 3500 t exploratory quota was assigned to the area east of 63°W while the TAC west of 63°W was maintained at 5250 t.

In 2003 the fishing season changed to April 1 – March 31. The 2003 - 2004 fishing season was 12 months long and had an 8753 t TAC. This TAC and season was maintained through to the present. Preliminary data indicate that ~6000 t were taken during the 2005 calendar year (Fig. 17).

Recent catches for the species have been estimated, in part, from the mixed fishery data for *P. borealis/montagui* in the area east of Resolution Island but their accuracy is questionable. *Pandalus borealis* taken in the immediately adjacent areas of SFA's 3 and 4 were included in the catches reported for SFA 2.

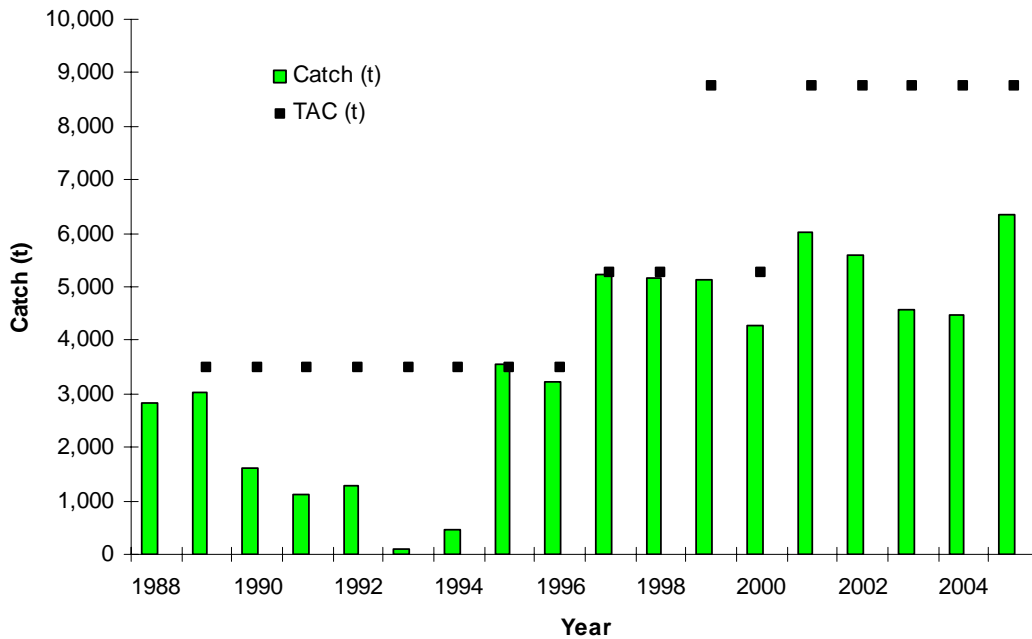


Figure 17. SFA 2 reported calendar year catches (t). Note that beginning in 2003, TAC's have been allocated by management year (Apr. 1 – Mar. 31).

CPUE has been relatively stable at a high level since 1998 (Fig. 18).

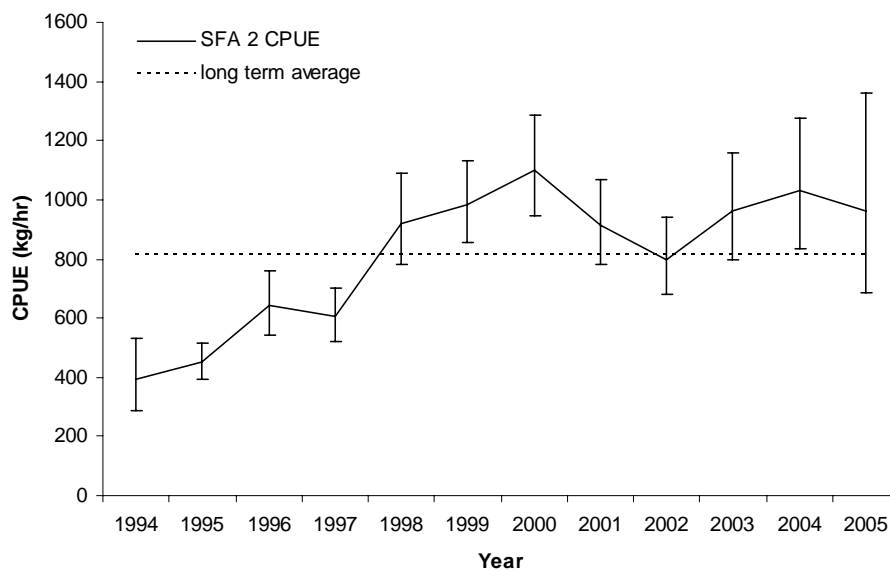


Figure 18. SFA 2 large vessel CPUE (error bars indicate 95% confidence intervals for point estimates).

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

It must be noted that the Northern Shrimp Research Foundation in partnership with the Department of Fisheries and Oceans conducted a shrimp based research survey in NAFO Division 0B during the summer of 2005. This survey is to be repeated over at least five consecutive summers. Once there is a time series, this source of data will be used as an aid in assessing northern shrimp resource status within SFA 2.

INDUSTRY PERSPECTIVES

Small vessel shrimp fleet perspective

In 2005 the inshore shrimp fleet landed almost 109 millions pounds of shrimp from Area 6, representing 93.8% of the available quota.

Industry is positive about Area 6 shrimp as numerous factors point to a healthy resource. Harvesters have experienced high catch rates and broad distribution of the resource throughout the Area. The size of shrimp has also increased, decreasing the count per pound.

In 2005 harvesters reported a lower incidence of shrimp affected by yellow liver, or blackberry.

Large vessel shrimp fleet perspective:

Conditions are similar to last year, with higher abundances in SFA 5.

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. The 2005 recruitment index (age 2 abundance) appears weaker than average; however, the strong residual female biomass is expected to maintain the fishery in the short-term. Medium-term recruitment appears positive from the presence of a stronger than average 2004 year class.

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.

SFA 5

Current status remains positive. Since 1996, CPUE has remained above the long-term average. Biomass and abundance indices from autumn multi-species surveys have increased since 1998. Recruitment in the short-term while uncertain appears average. Longer-term prospects are unknown. Female biomass is expected to be maintained over the short-term.

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

SFA 4

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

SFA 2

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

MANAGEMENT CONSIDERATIONS

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

SOURCES OF UNCERTAINTY

The implications of finishing the 2001 – 2005 autumn multi-species surveys later than usual are unknown.

A 400 Nm² area, within Hawke Channel, has been closed to gillnetting and trawling since September 2002. The closed area was increased to 2500 Nm² in July 2003 (Fig. 1). The larger area has traditionally been an important shrimp fishing area for the large vessels and therefore may have had an impact upon catch rates. The closure has had little impact upon the small vessel catch rates as most of their catches are taken from other parts of the SFA 6 management area.

During 2005, the Funk Island Deep box (Fig. 1) was closed to bottom trawling. This area had been an important shrimp fishing area for the small vessels and therefore may have had an impact upon catch rates. The closure has had little impact upon the large vessel catch rates as most of their catches are taken from other parts of the SFA 6 management area.

Lack of complete research surveys in SFA 5 introduces uncertainty into the assessment for this area.

Lacking sufficient research survey data, it was not possible to evaluate the impact of the 2005 fishery or contemplate future prospects in SFA's 2 and 4.

SOURCES OF INFORMATION

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