

**Stock Status Update  
Assessment of Northern Shrimp  
Off Newfoundland and Labrador**

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## STOCK STATUS UPDATE

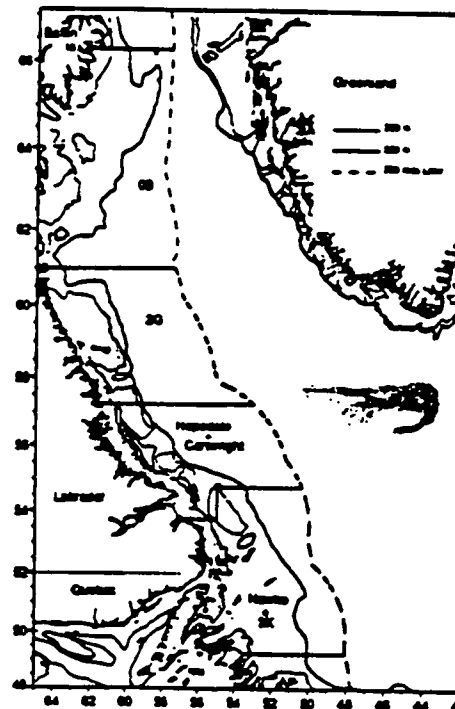
ASSESSMENT OF  
NORTHERN SHRIMP OFF  
NEWFOUNDLAND AND LABRADOR**Background**

Northern or pink shrimp (*Pandalus borealis*) are found in the Northwest Atlantic from Davis Strait, south to the Gulf of Maine. They live in areas where the ocean floor is soft and muddy and where bottom temperatures range from about 2 to 6° C. These conditions occur throughout the Newfoundland-Labrador region within a depth range of approximately 200 - 600 m, providing a vast area of suitable habitat. The species is the primary cold-water shrimp resource in the north Atlantic.

Northern shrimp are protandric hermaphrodites. That is to say, they first mature as males, function as males from one to several years and then change sex to spend the rest of their lives as females. They are known to live for more than 8 years in some areas. Populations in the northern part of the range exhibit slower rates of growth and maturation but increased longevity results in larger maximum size.

During the day, these shrimp spend much of the time resting and feeding on or near the ocean floor. At night, a substantial proportion migrate vertically into the water column, feeding on a variety of zooplankton. They are prey for many species including Atlantic cod, Greenland and Atlantic halibut, skates, wolf fish and even harp seals.

Status of the resource in each shrimp fishing area (SFA) is determined by monitoring fishery performance within and between years, distribution of the fishing effort, and the size/age/sex composition of the shrimp catches. This information enables inferences to be made on the state of the spawning biomass (i.e. female abundance) and the potential for future recruitment to the fishery (i.e. male abundance).

**The Fishery**

The shrimp fishery on the east coast of Canada began in the mid 1960's in the Gulf of St. Lawrence but it was not until the mid 1970's that an exploratory fishery developed off the east coast of Newfoundland and Labrador. During the late 1970's and early 1980's, the fishery occurred primarily in the Hopedale and Cartwright Channels and in Davis Strait (Div. 0A). Annual catches increased to about 9000 tons in 1981 but then declined to only 3000 tons in 1984. Since then, however, catches have steadily increased, the 1995 catch of approximately 30,000 tons being the highest recorded. This increase was due to continued high abundance in traditionally fished areas and the discovery of fishing grounds in Divisions 0B, 2G, 2J and 3K.

About 12 large, offshore trawlers are currently fishing the 17 northern shrimp licences. These vessels use small-meshed otter trawls which are often fitted with sorting grates to avoid by-catch while retaining the shrimp. Most of the catch is processed on board as either cooked or frozen product. The smallest or "industrial" shrimp is frozen in bulk for processing on shore.

The total allowable catch (TAC) for each fishing area is divided by 17, representing each participant's enterprise allocation (EA). The preferred species, for which most of the TAC's apply, is *Pandalus borealis*. Striped shrimp (*P. montagui*) occur at times as by-catch and, in Hudson Strait-Ungava Bay (SFA 3), represent the target species. The fishery requires 100% observer coverage to monitor activity and conduct sampling of the catches.

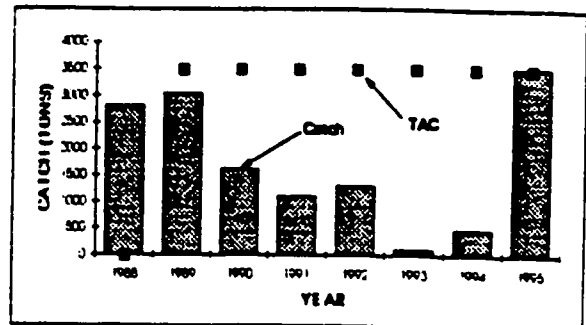
For the first ten years, this was primarily a summer-fall fishery but, since the late 1980's, has become a year-round operation.

## NAFO DIVISION 0B (SFA 2)

### FISHERY DATA

#### Catch and effort

The northern shrimp fishery in Division 0B began in October, 1988. Catches increased from 2800 tons that year to 3039 tons in 1989 but subsequently declined to 106 tons in 1993. Catches increased again to 476 tons in 1994 and 3510 tons in 1995. TAC's have remained at 3500 tons since first implemented in 1989.



TAC's for 1989 and 1990 were applied to a May 1 - April 30 fishing season and to the calendar year, thereafter.

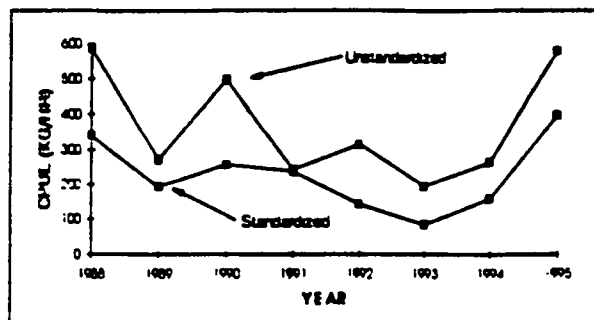
The 1995 catch estimate is preliminary and likely inflated by the inclusion of catches of the striped shrimp, *P. montagui*, from the area east of Resolution Island. Catches of this species possibly exceeded 2500 tons in 1995 due to an apparent eastward shift in distribution from Hudson Strait (SFA 3).

Effort roughly doubled from 1988 to 1989 but then decreased up to 1993. There was a substantial increase in effort from 1993 to 1995. In 1988, the fishery occurred north of 64° N with occasional tows near 66° N. Effort in 1989 was concentrated between 64° and 65° N but extended as far south as 62° N. More effort was distributed south of 64° N in subsequent years. The areas fished in 1995 reflected the targeting of *P. montagui* east of Resolution Island and a return to northern grounds near 65° 30' N.

#### Catch per unit effort (CPUE)

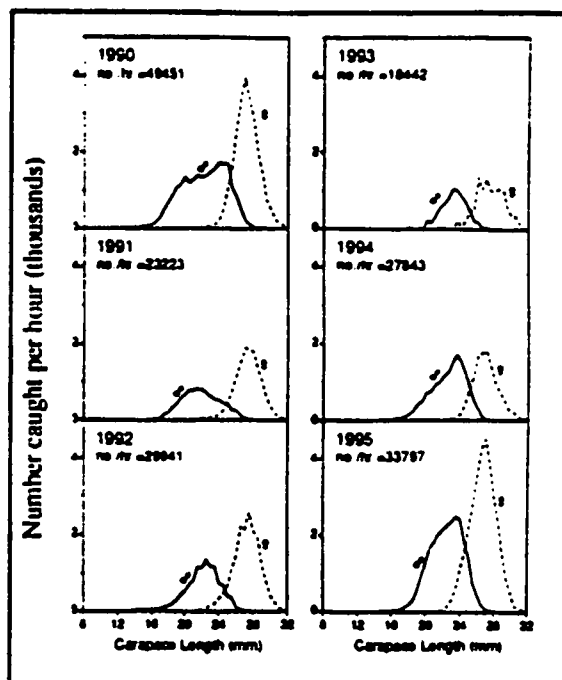
Annual CPUE's decreased from 585 kg/hr in 1988 to 271 in 1989 and increased to 497 in 1990. Catch rates decreased during 1991 - 1994 to the 200-300 kg/hr range but increased to 579 kg/hr in 1995. The data were analyzed

to account for variation due to year and vessel effects. The model showed that the standardized, 1995 catch rate of 395 kg/hr was higher than those in five of the previous six years and similar to the 1988 estimate. Both series showed an overall declining trend to 1993 and an increase, thereafter.



**Size composition**

Catches in most years were composed primarily of large, female shrimp with an average length of about 27 mm carapace length (CL). Occurrence of higher proportions of the male component (<25 mm) after 1988 was coincident with the southward shift in fishing effort. In 1994, catches comprised both large males (23 - 24 mm) and females whereas, in 1995, the female component was dominant.



**RESOURCE STATUS/PERSPECTIVES**

This area is difficult to fish due to the presence of ice and the apparent sudden shifts in water masses that are believed by fishermen to affect shrimp distribution. They have observed that shrimp concentrations throughout the area are elusive. This contrasts the situation in several southern locations where areas of high concentration support substantial levels of effort and CPUE, and persist from year to year.

The status of this resource remains uncertain. The CPUE and sampling data are not considered to be reliable indices of stock conditions. The fluctuations in both catch and catch rates are more likely a reflection of the degree of difficulty in locating concentrations of shrimp than they are indicators of significant changes in the resource abundance. High catch

rates still occur sporadically throughout the fishing area and, in 1995, were frequently encountered in the southwest, just east of Resolution Island as a *P. borealis/montagui* mixture.

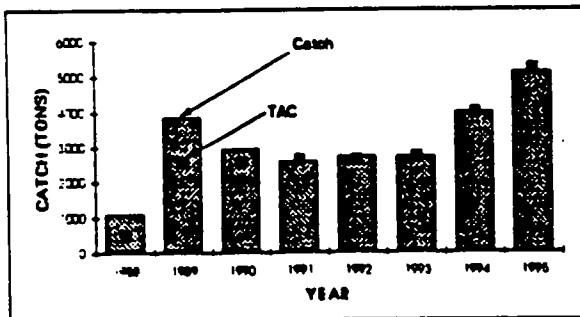
There is no basis on which to advise a change in the Management Plan which set the TAC for 1996 at 3500 tons. This level was established in 1989 as a precautionary level in an exploratory area and is still considered in this context.

NAFO DIVISION 2G (SFA 4)

FISHERY DATA

Catch and effort

Only incidental catch and effort were reported from Division 2G before 1988. Catches increased from 1083 tons in 1988 to 3842 tons in 1989 and remained within the 2500 - 3000 ton range up to 1993. The 1994 catch increased to 3982 tons with an increase in TAC to 4000 tons in the first year of the 1994 - 1996 Management Plan. A second, planned increase in the TAC, to 5200 tons in 1995, resulted in a catch of 5104 tons.

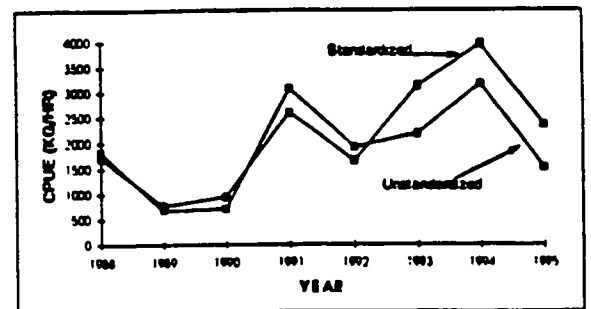


TACs for 1988 to 1990, inclusive, were applied to a May 1 - April 30 fishing season and to the calendar year, thereafter.

Fishing effort increased from 1988 to 1989, decreased to 1991 and remained relatively stable up to 1994 before increasing again in 1995. From 1988 to 1990, the fishery occurred throughout the area which, during that period, was split into two management zones, north and south of 60° N. The 1991 - 1993 Management Plan combined the two zones and, since then, effort has concentrated in the north. Some substantial by-catches of *P. montagui* were encountered in 1995, primarily in shallower water.

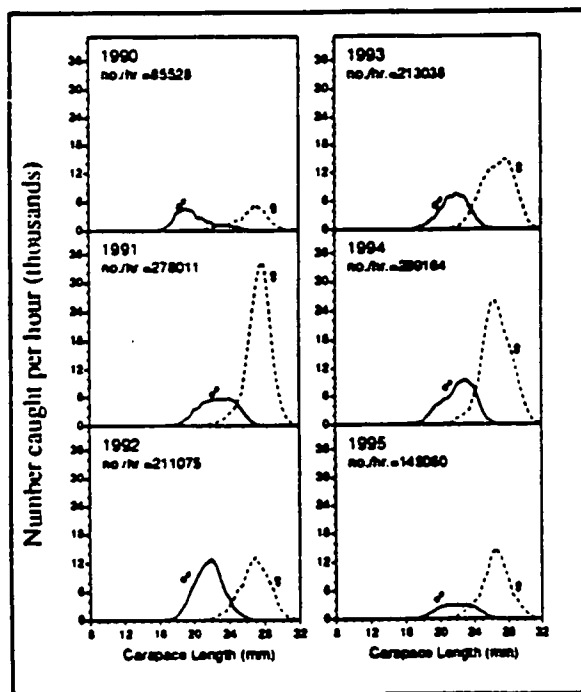
Catch per unit effort (CPUE)

The area is noted for producing high catch rates of large shrimp, especially north of 60° N. Annual CPUE's declined from 1823 kg/hr in 1988 to about 700 in 1989 and 1990. In 1991, the catch rate increased to more than 3000 kg/hr as fishing effort concentrated in the northern grounds. High CPUE's in the range of 2000 to 3000 kg/hr were maintained up to 1994. The 1995 catch rate declined to 1500 kg/hr. The CPUE data were analyzed to account for variation due to year, month and vessel effects. The model showed that the annual, standardized catch rate for 1995 was only lower than the 1994 rate and higher than the 1989, 1990 and 1992 estimates. Both series showed an overall increase from 1989 to 1994, followed by a decrease in 1995.



### Size composition

Size distributions were variable between years. High proportions of male shrimp (< 25 mm CL) and overall lower catch rates in 1989 and 1990 reflect the fishing activity south of 60° N in those years. Larger, female shrimp dominated in 1991 when effort shifted to the northern grounds. The female component continued to support high CPUE's in both 1994 and 1995.



### RESOURCE STATUS/ PERSPECTIVES

The continued occurrence of high densities of large, female shrimp in the northern grounds indicates that a healthy spawning biomass is being maintained. Most of the fishing effort likely will concentrate in that area, with little or no activity south of 60° N. The lower catch rate in 1995, although of some concern, still

compares favourably with those of most other years. There was also a relatively low proportion of male shrimp in 1995 which, when considered with the lower catch rate, could result in some reduction in recruitment to the female component in the short term.

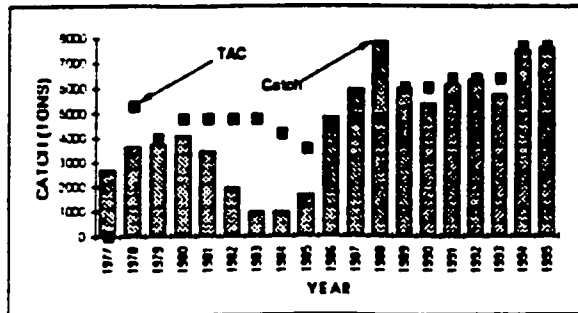
In 1994, it was suggested that the TAC be increased experimentally from 2700 tons to about 5000 tons. Industry chose to implement the proposed increase over two years - an initial increase to 4000 tons in 1994, the first year of the multi-year management plan, and a further increase to 5200 tons in 1995. There is no biological reason to change the TAC from the 1995 level. The effects on the resource should be closely monitored.

### HOPEDALE & CARTWRIGHT CHANNELS (SFA 5)

#### FISHERY DATA

##### Catch and effort

The northern shrimp fishery in Hopedale and Cartwright Channels began in 1977, following exploratory fishing in the previous two years. Catches increased from about 2700 tons in 1977 to 4100 tons in 1980, declined to 1000 tons in 1983 and 1984, increased again to 7800 tons in 1988 and then stabilized at roughly 6000 tons during the 1989 - 1993 period. The TAC's for the 1994 - 1996 Management Plan, which combined the two channels as a single management area, were increased by 20% to 7650 tons annually and catches subsequently increased to 7499 tons in 1994 and 7616 tons in 1995.



TACs for 1987 to 1990, inclusive, were applied to a May 1 - April 30 fishing season and to the calendar year before and after.

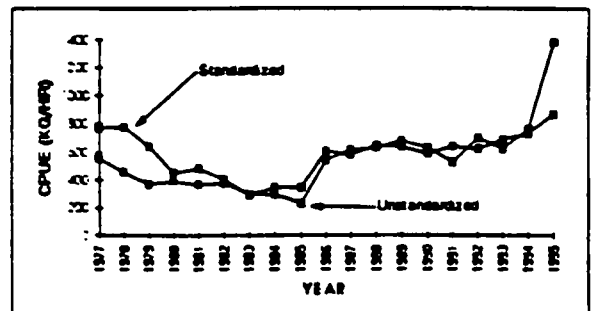
Since the implementation of the plan in 1994, the proportion of the annual catch taken near Cartwright Channel, in the south, has increased from about 25% during the 1991 - 1993 period to 42% in 1994 and 78% in 1995.

Fishing effort showed approximately the same trends over time as catch. In recent years, however, effort has either stabilized or decreased while catches have increased slightly. Traditionally, effort has concentrated in four main areas: northern, eastern and southern Hopedale Channel and Cartwright Channel. In the 1990's, however, more effort was reported from the slopes of the shelf - north and east of Cartwright Channel. In both 1994 and especially 1995, substantial effort occurred on the eastern slope during winter and spring. The same fishing pattern emerged in early 1996.

Historically, a summer - fall fishery, in 1995 and 1996 it has become mainly a winter - spring operation.

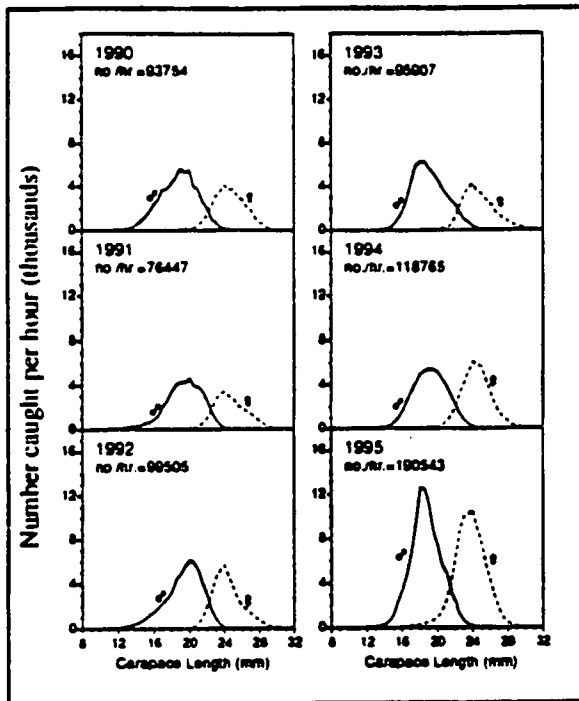
### Catch per unit effort (CPUE)

Annual CPUE's declined from 552 kg/hr in 1977 to 230 in 1985, increased in 1986 and stabilized around a mean level of 615 kg/hr during the 1986 - 1993 period. Catch rates increased, thereafter, to 757 kg/hr in 1994 and 1385 kg/hr in 1995. The CPUE data were analyzed to account for variation due to year, month, vessel and area effects. The standardized 1995 catch rate of 867 kg/hr was the highest in the time series and was significantly higher than the estimates in all but the first three years of the fishery. Both series show approximately the same trend: a decline to the mid 1980's, a large increase in 1986 followed by stability to the early 1990's and an increase since then.



### Size composition

Sampling data from 1988 to 1995 showed a component of females at 24 - 25 mm CL occurring each year. Recruitment of males between 16 and 23 mm (ages 4, 5 and 6) has been consistent from year to year and males have contributed substantially to the catch in numbers.



**RESOURCE STATUS/PERSPECTIVES**

The northern shrimp resource in the Hopedale and Cartwright Channels remains healthy with commercial catch rates stable over the late 1980's and increasing in recent years. No declining trend in the proportions or catch rates of female shrimp has emerged and the 1994 and 1995 data suggest that year classes produced in the late 1980's and early 1990's will maintain high catch rates for the next few years.

Preliminary data from daily vessel hauls show that the 1996 fishery performed well from January to March, with monthly catch rates exceeding those for the same months in 1995.

The impact of past fishing, although not yet quantified, appears minimal. Given the current,

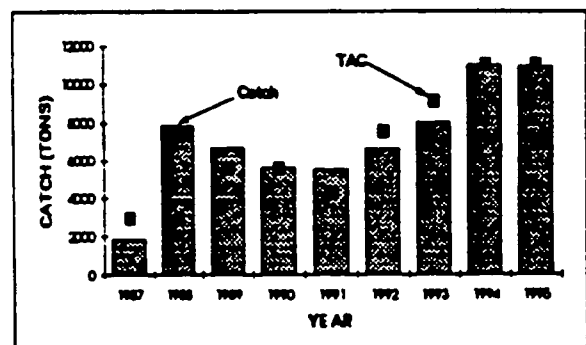
positive view of the status of the resource, no reduction in the TAC is required for the final year of the 1994 - 1996 Management Plan.

**HAWKE CHANNEL + DIV. 3K (SFA 6)**

**FISHERY DATA**

**Catch and effort**

The shrimp fishery in Hawke Channel + Div. 3K essentially began in 1987 when 1845 tons were caught. Previously, only a few tons had been reported from Hawke Channel in some years. Catches increased to more than 7800 tons in 1988 and ranged between 5500 and 8000 tons from 1989 to 1993, inclusive. The annual TAC for the 1994 - 1996 Management Plan was set at 11,050 tons (20% more than the 1993 TAC) to include Hawke Channel, St. Anthony Basin, east St. Anthony, Funk Island Deep as well as three exploratory areas on the seaward slope of the shelf. Catches increased to 10,978 tons in 1994 and 10,914 tons in 1995.



TACs for 1987 to 1990, inclusive, were applied to a May 1 - April 30 fishing season and to the calendar year, thereafter.

Fishing effort declined from 1989 to 1992, stabilized or increased slightly to 1994 and

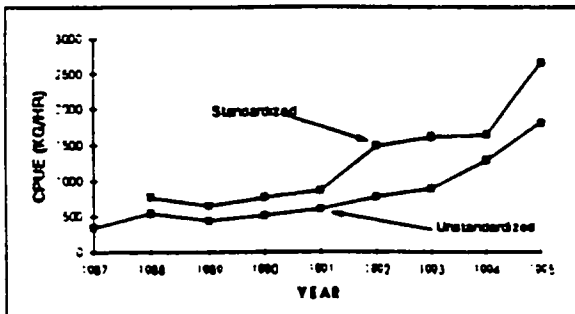


declined noticeably from 1994 to 1995. A displacement of fishing effort to the east occurred after 1991 due to several factors: the establishment of exploratory areas on the shelf slope in 1992 and 1993, the discovery of concentrations of shrimp in these areas, the occurrence of ice in winter and spring each year and the flexibility to fish recent TAC's anywhere within the large management area.

The fishery occurs, primarily, during the first five months of the year.

**Catch per unit effort (CPUE)**

Annual CPUE's decreased from 536 kg/hr in 1988 to 432 in 1989 and increased steadily thereafter to 1816 kg/hr in 1995. The data also were analyzed to account for variation due to year, month, vessel and area effects. Standardized values revealed approximately the same overall increasing trend as the unstandardized series. However, the 1992 to 1994 standardized rates were relatively stable whereas the unstandardized data indicated a continual increase.

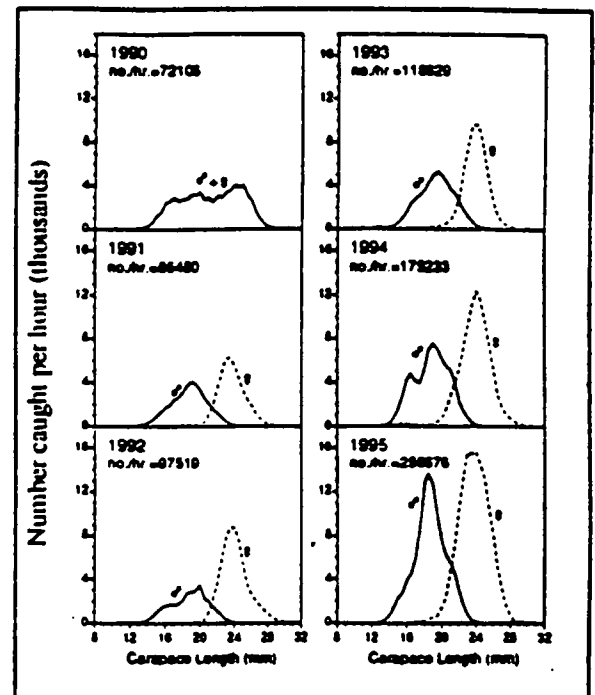


Despite the high catches from Hawke Channel in 1994 and 1995 compared to previous years, catch rates from that area alone continued to increase. The 1996 fishery, to date, also has

concentrated in the Hawke Channel area and catch rates for the January - April period remained high, at the 1995 level.

**Size composition**

Length frequencies from 1988 to 1995 showed dominance of the female component around 24 mm CL in most years. The relatively strong size group at 16.5 mm in 1994 (the 1991 year class) dominated the male component at 18.5 mm in 1995. The 1992 year class also appears to be relatively strong at 16 mm in 1995.



**RESEARCH SURVEY DATA**

The fall/winter multi-species research survey of 1995/96 was conducted using a small-meshed Campelen shrimp trawl and provided excellent data on distribution and density of

shrimp within the survey area (Div. 2J3KLNO). Shrimp were widely distributed and abundant throughout Hawke Channel + Div. 3K with catches over much of the area exceeding 50 kg per 15 minute tow.

### RESOURCE STATUS/PERSPECTIVES

The northern shrimp resource in Hawke Channel + Div. 3K remains healthy and catch rate data suggest that abundance has increased in recent years. The eastward displacement of the fishery after 1991 and the concentration of effort near Hawke Channel are more a reflection of the flexibility in the choice of fishing area than a change in shrimp distribution. Areas to the west, although fished less intensively after 1992, continue to produce high catch rates. The proportion of female shrimp in the commercial catches remains high and the substantial proportions and catch rates of male shrimp evident since 1993 suggest continued good recruitment. Furthermore, the 1995/96 research survey demonstrated that shrimp were very abundant throughout the management area.

Given the evidence for high abundance, a healthy spawning biomass and prospects for good recruitment to the fishery in the short term, no reduction in the TAC is required for the final year of the 1994 - 1996 Management Plan.

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### For More Information

#### Research Documents:

Parsons, D.G. and P.J. Veitch. 1996. Regional, interim review of the status of northern shrimp (*Pandalus borealis*) resources in areas off Newfoundland and Labrador (Divisions 0B to 3K). DFO Atlantic Fisheries Research Document 96/16.

Parsons, D.G., P.J. Veitch and D.W. Kulka. 1996. The fishery for *Pandalus montagui* in the Hudson Strait/Ungava Bay area, 1979 - 1995. DFO Atlantic Fisheries Research Document 96/17.

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