

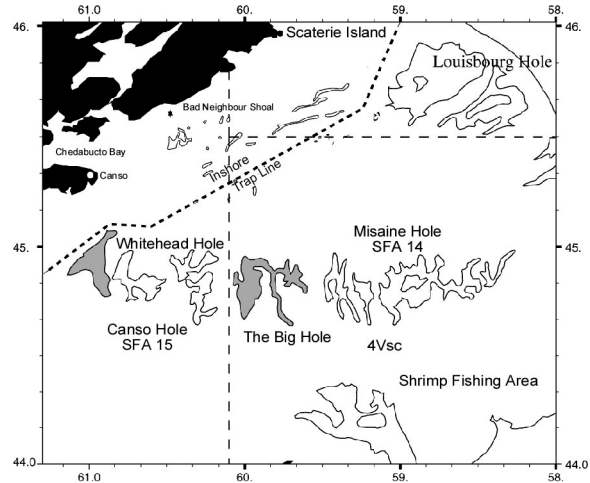
Northern Shrimp on the Eastern Scotian Shelf (SFA 13-15)

Background

The northern or pink shrimp, *Pandalus borealis*, is the only shrimp species of commercial importance in the Maritimes Region. Shrimp are crustaceans, and have a hard outer shell which they must periodically shed (molt) in order to grow. The females produce eggs once a year in the late summer- fall and carry them, attached to their abdomen, through the winter until the spring, when they hatch. Consequently, shrimp bear eggs, or are "ovigerous" for about 8 months of the year. Newly hatched shrimp spend 3 to 4 months as pelagic larvae, feeding near the surface. At the end of this period they move to the bottom and take up the life style of the adults. On the Scotian Shelf, the northern shrimp first matures as a male, at 3 years of age, and at age 4 it changes sex, to spend another 1 to 2 years as a female.

Shrimp concentrate in deep holes on the eastern Scotian Shelf, but nearshore concentrations along coastlines closest to the offshore populations have recently been discovered. They prefer temperatures of 2 to 6 °C, and a soft, muddy bottom with a high organic content.

The shrimp fishery on the Scotian Shelf concentrates during summer in Shrimp Fishing Areas (SFAs) 13-15, also called the Louisbourg, Misaine and Canso holes, respectively. The shrimp are fished with otter trawls having a 40 mm mesh size throughout. The main management tools are limits on the number of licenses and size of vessels used, minimum mesh size, use of a Nordmøre separator grate, and a Total Allowable Catch (TAC). The fleet is divided into two sectors, a midshore sector consisting of vessels 65-100' LOA based in New Brunswick on the Gulf of St. Lawrence side, and an inshore sector consisting of vessels <65' LOA based on the Atlantic coast of Nova Scotia. A trap fishery, currently consisting of 10 active licenses, has recently developed in Chedebucto Bay. Three vessels are currently engaged in an experimental trap fishery in Mahone Bay on the South Shore.



Summary

- The fishery continues to catch the TAC and stay within the 65 count (numbers per pound).
- The amount of the total TAC taken from the inshore decreased to about 28% in 2000. Overall, there has been a tendency for effort to concentrate in smaller areas in recent years.
- The age/length composition of the catch continues to show a progressive narrowing of the size distribution.
- Commercial catch rates (CPUE) continued to increase in 2000, however the DFO-industry trawl survey index decreased, mainly due to a large decrease in the lightly fished SFA 13. CPUEs also decreased in SFA 13.
- The trawl survey indicates that the 1997 and 1998 year-classes are about average. The weak 1996 year-class is more likely to have been caused by the high incidence of egg mortality that year than by overfishing.

- The spawning stock (females) remains high.
- Exploitation in 2000 increased to about 17%, from 13% in 1999. The latter was about average for the period 1995-99.
- The percentage of the total catch taken during the August-April ovigerous period increased from about 30% prior to 1999 to 41% in 1999 and 48% in 2000.
- Temperatures continue to increase on the eastern Scotian Shelf; groundfish predator abundance, and presumably shrimp natural mortality, remains low.
- The resource remains high but there are initial signs of a downturn. There should be no increase in the TAC in 2001 and consideration should be given to a slight reduction.

The Fishery

The introduction of the Nordmøre grate in 1991 reduced groundfish bycatches to negligible levels and allowed the shrimp fishery to expand to its full potential. In 1996, the inshore (23 vessels <65’ LOA) component of the trawler fleet moved from individual quotas (IQs) to individual transferable quotas (ITQs), while the midshore (6 vessels 65-100’ LOA) moved from a competitive fishery to IQs. Since 1998, all vessels have been under ITQs. Temporary mobile licenses were introduced in 1998 as part of a co-management agreement to take advantage of increasing stock sizes and TACs, while facilitating effort reduction in the event of the rapid downturn often seen in shrimp fisheries.

The fishery continues to take the TAC without difficulty. It has been caught every

year since individual SFA quotas were combined into a single TAC in 1994.

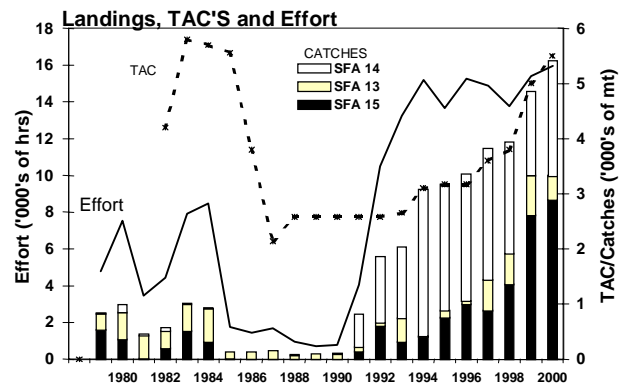
The trap fishery in SFA 15 continued at about the same level as in previous years, however there has been a steady decline in the catch rates in the northern part of the Bay. The reason for this is unclear although available information suggests it is not due to inshore fishing by trawlers. The Mahone Bay fishery continued at about previous levels in 2000.

The **temporal pattern** of the fishery changed in 1999-2000 as TACs increased and fishers took longer to catch their quota. The amount of the catch taken during the egg-bearing period (August-April) has increased from about 30% prior to 1999 to 41% in 1999 and 48% in 2000. This could impact on the reproductive capacity of the population, since there is less escapement of ovigerous females.

Landings (000s mt)

Year	1994	1995	1996	1997	1998	1999	2000 ¹
TAC	3.1	3.2	3.2	3.6	3.8	5.0	5.5
Landings	3.1	3.2	3.4	3.8	3.9	5.0	5.5

¹Landings to December 1, 2000.



The **spatial pattern** of the fishery has changed considerably since 1993. Prior to 1999, most of the effort and catch was in the Misaine Hole (SFA 14), while fishing in other areas varied between years. In 1998, the trawler fleet fished inshore in SFA 15 for

the first time, taking 20% of the TAC near the Bad Neighbour Shoal. This amount rose to 44% of the catch in 1999, but decreased to an estimated 28% in 2000. There appears to have been a tendency for effort to concentrate in smaller areas since 1998, particularly in SFA 14 where there has been less effort east of the Big Hole. These changes could result from changes in the distribution of the resource and/or fishing practices and complicate interpretation of the CPUE series.

The **age/length composition** of the catch continues to show a progressive narrowing of the shrimp size distribution. The decrease in the number of smaller animals can be attributed to the increased use of square meshed codends beginning in 1996. A decrease in the proportion of very large shrimp may be due to the fishery having caught up accumulated older and larger animals in the population. The latter could impact on population reproductive capacity, since fecundity is directly related to size.

Counts (numbers of shrimp per pound) data provided by industry show no trend since 1994. Fishers are apparently having no difficulties staying below the 65 count limit to obtain maximum landed value.

Resource Status

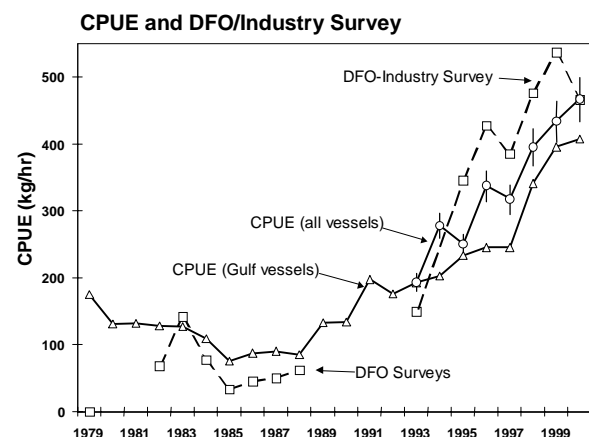
Assessments are based on two commercial catch rate (CPUE) indices (Gulf vessels only 1978-2000, and all vessels 1993-2000) obtained from trawler logbooks, samples from commercial trawl and trap catches (since 1995), a DFO shrimp survey (1982-88), a DFO-industry shrimp survey (since 1995), an experimental recruitment survey initiated in 1999, and logs from the experimental trap fishery.

The two commercial **CPUE** indices (all and Gulf based vessels) continue to show an

increasing trend, being the highest in 2000 for both series. The increased inshore effort and tendency for fishing to concentrate in smaller areas since 1998 may be relevant when evaluating this result, especially since the DFO-industry survey showed a decrease in 2000.

The **DFO-industry survey** index for 2000 decreased largely due to a decrease in catches in the relatively lightly fished SFA 13. Commercial CPUEs also decreased in this area.

The **age composition** in 2000 displayed four relatively strong peaks. Year-class splitting due to slow growth associated with high densities appears to have occurred three times since 1995, most recently with the 1995 year-class. Not all shrimp from this strong year-class changed sex in 1999. A portion was "held back" and re-enforced the male component of the weak 1996 year-class. Consequently, **recruitment of males** in 2000 was about average. Survey population estimates suggest that the **recruitment of juveniles** i.e. shrimp belonging to the 1997 and 1998 year-classes, is about average. Consequently, the weak 1996 year-class is more likely to have been caused by the high incidence of egg mortality that year than by overfishing.



Size-specific **exploitation**, based on minimum population estimates at length from surveys and commercial catch at length, increased in 2000, with females exploited at about 20% and males at 10-20%. Overall exploitation based on catch weight and the survey biomass was estimated to be about 17% in 2000, up from 13% (average since 1995).

The **spawning stock** (female population) remains high.

Regarding **ecosystem considerations**; feeding studies have shown that shrimp are important prey for many groundfish species. Significant negative correlations between shrimp and cod, redfish, plaice, and turbot

abundance have been demonstrated from the Gulf of Maine to the Newfoundland Shelf. With many groundfish stocks at low levels on the eastern Scotian Shelf, **natural mortality** is probably below the long-term average.

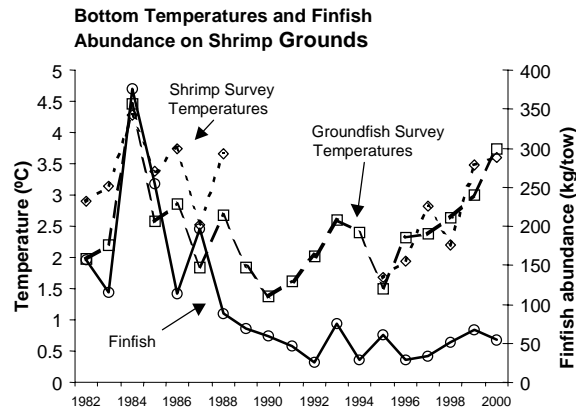
The table below summarizes the resource status indicators since the beginning of the DFO-industry survey series. When there is no concern on resource status, the indicator is given a score of 1 (green). When the indicator suggests some concern or uncertainty on status, the score is 0 (yellow). When the indicator suggests serious cause for concern, the score is negative one (red).

Traffic Light Scores: -1=red, 0=yellow, 1=green	1995	1996	1997	1998	1999	2000
FISHERY DATA						
CPUE/hr	1	1	1	1	1	1
Spatial pattern	1	1	1	0	0	0
Temporal pattern	1	1	1	1	1	0
Age/length composition	1	1	1	1	0	0
Industry counts	1	1	1	1	1	1
SURVEY DATA						
Biomass/abundance index	1	1	1	1	1	0
Spatial pattern	1	1	1	1	1	1
Age composition	1	1	1	1	0	1
Recruitment (juveniles)	1	1	1	0	-1	1
Recruitment (males)	1	1	1	1	1	1
Spawning stock (females)	1	1	1	1	1	1
Exploitation rate	1	1	1	1	1	0
OTHER DATA						
Predation (cod stock)	1	1	1	1	1	1
Temperature	1	1	1	0	0	0
TOTAL SCORE	14	14	14	11	8	8

The overall score across all indicators suggests that the stock is still high and healthy, but the first signs of a downturn are evident.

On the Scotian Shelf, northern shrimp are near their southern limit of distribution and population increases may be associated with

colder **water temperatures** during the early 1990's. There appears to have been a warming trend since 1995. Capelin, an important cold water indicator species, has also decreased since that time, suggesting that a regime shift may be occurring to one less favourable for shrimp.



Outlook

The continued strength of the 1995 year-class should carry the 2001 fishery at about the same level as in 2000. However, since a relatively large portion of the catch is male, the performance of the fishery will partially depend on the strength of the 1997 year-class, which appears to be only of about average size, and the survival of the 1995 year-class as females. Some declines in catch rates should be expected as this strong year-class completes its life cycle beginning in 2001.

Thus, the resource remains high but there are initial signs of a downturn. There should be no increase in the TAC in 2001 and consideration should be given to a slight reduction.

Management action beyond 2001 depends partly on the strength of the 1998 year-class, which cannot be determined at this time. A regime shift to a period of lower recruitment may partially be addressed by increasing escapement of egg bearing females to maintain production i.e. lower TACs. A recruitment survey which determines year-class strength 2-3 years in advance is under development to allow longer term forecasting and planning.

Preliminary results suggest that the inshore area may be an important nursery area for

shrimp. This possibility should be investigated further.

For more Information

Contact: Mr. Peter Koeller
Invertebrate Fisheries Division
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, N.S., B2Y 4A2

Tel: (902) 426-5379

Fax: (902) 426-1862

E-Mail:

koellerp@mar.dfo-mpo.gc.ca

References

- Koeller, P., M. Covey, and M. King. 2001. The Scotian Shelf shrimp (*Pandalus borealis*) fishery in 2000. DFO Atlantic Fisheries Research Document 2001/003.
- Koeller, P. (in press). Relative importance of environmental and ecological factors to the management of the northern shrimp (*Pandalus borealis*) fishery on the Scotian Shelf. J. Northwest Atl. Fish.

This report is available from the:
Maritimes Provinces
Regional Advisory Process
Department of Fisheries and Oceans
P.O. Box 1006, Stn. B203
Dartmouth, Nova Scotia
Canada B2Y 4A2
Phone number: 902-426-7070
e-mail address: myrav@mar.dfo-mpo.gc.ca

Internet address: www.dfo-mpo.gc.ca/csas
ISSN: 1480-4913

*La version française est disponible à
l'adresse ci-dessus.*



Correct citation for this publication:

DFO, 2000. Northern shrimp on the eastern
Scotian Shelf. DFO Sci. Stock Status
Report C3-15 (2000).