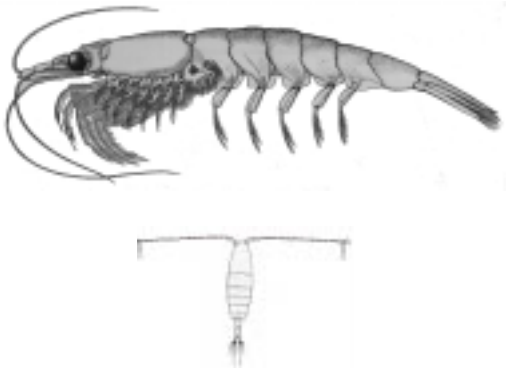

State of phytoplankton, zooplankton and krill on the Scotian Shelf in 1996

Background

Zooplankton range in size from smaller than 1 mm (e.g. copepods) to about 4 cm (krill). They are eaten by all species of fish at some time in the fishes life cycle. There is evidence that the abundance of some species of zooplankton can influence recruitment and growth of fish such as cod, herring and capelin. The most important copepods to fish are ***Calanus finmarchicus*** *and* ***Pseudocalanus spp.****;* ***Meganyctiphanes norvegica*** *is the most important krill species. The eggs and young of zooplankton are eaten by the youngest stages of fish and as the fish grow they feed on larger zooplankton. Many fish species also feed heavily on the adult krill.*

Temperature can have a large influence on production of zooplankton and can cause large seasonal, yearly and multi-year changes in zooplankton population size. Zooplankton are sampled with a variety of nets, multifrequency acoustics and optical instruments in the area twice a year. These data are used to monitor long-term changes in the levels of zooplankton species. Zooplankton abundance between 1961 and 1994 were measured with the Continuous Plankton Recorder (CPR) and trends are examined.

Long-Term Plankton Trends

The Continuous Plankton Recorder (CPR) is an instrument that collects phytoplankton and zooplankton on a long slowly moving continuous ribbon of silk while being towed from commercial ships. The position on the silk corresponds to the location of different sampling stations. Historical CPR data were analyzed to detect differences in indices of phytoplankton and zooplankton abundance for different years between the eastern and western halves of the Scotian Shelf. All CPR data, from 1961 to 1994, were grouped into eastern or western Shelf regions, and the two regions compared over time. The phytoplankton greenness index (a measure of the amount of chlorophyll on the silk) was significantly higher in both regions of the shelf between 1991-1994 than during 1961-1975. The index of abundance of krill was higher on the eastern shelf during 1961 to 1975 than during 1991 to 1994. There was no significant difference between 1961-75 and 1991-94 in the krill index for the western shelf. Data were not collected between 1975 and 1991.

Conditions in 1996

The Halifax and Louisbourg lines were sampled during the spring and fall of 1996 using conventional plankton nets and

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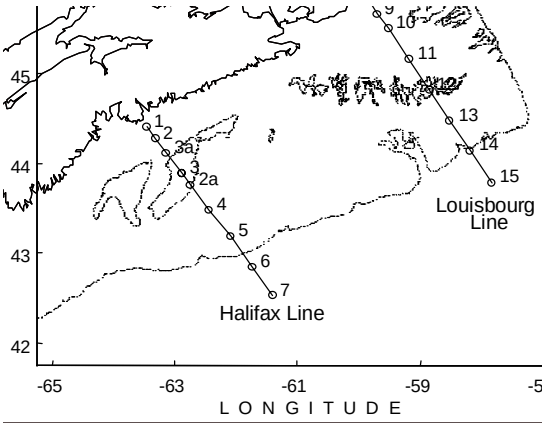
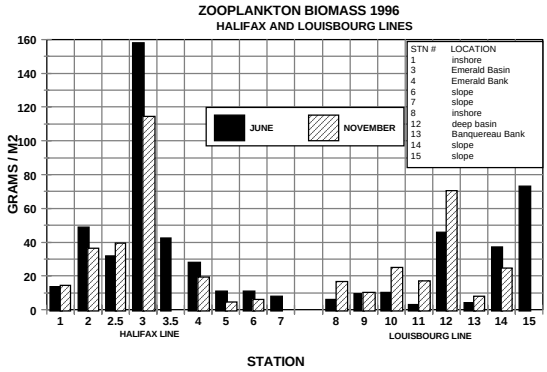
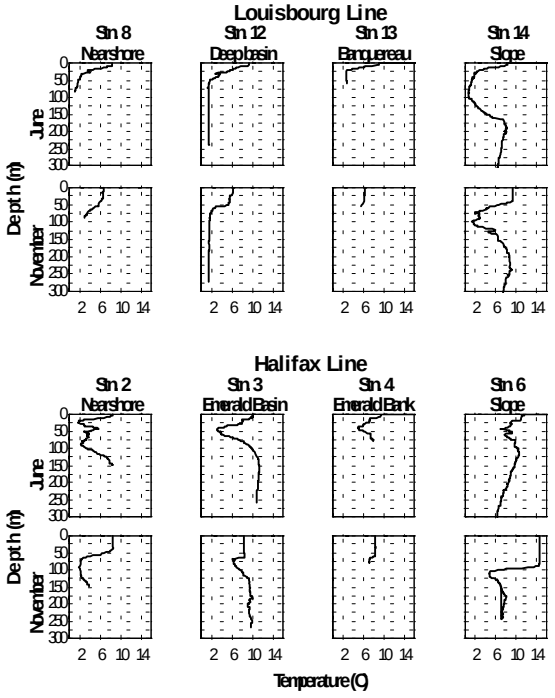
multifrequency acoustics (Sameoto and Herman 1990).



The **mean zooplankton biomass** values on the Halifax Line stations (1 to 5) in June were significantly higher than those on the Louisbourg Line. There was no significant difference between the November means. A comparison between Banquereau and Emerald banks (stations 13 and 4) showed Emerald Bank had a higher biomass in both months. The same pattern was found for the deep basin (station 12), and the Emerald Basin (station 3).



Temperature profiles are shown below for selected stations on the two transects for comparison. During June, the temperature profiles in the top 50 m on both transects were similar, but below 50 m, the water was significantly warmer on the Halifax line. The deep basin station 12 and Emerald Basin station 3 showed the most extreme contrast in temperature. Station 12 had temperatures <2 C° below 50 m in June and November, whereas the coldest water in Emerald Basin was about 3 C° in June. These data show that **zooplankton** living in the top 50 m on the two transects would be exposed to similar temperature regimes between June and November. Animals that vertically migrated between day and night from deep water into the upper 50 m would spend about half of their life in colder water on the Louisbourg transect than would animals on the Halifax transect and therefore would likely have slower growth rates.

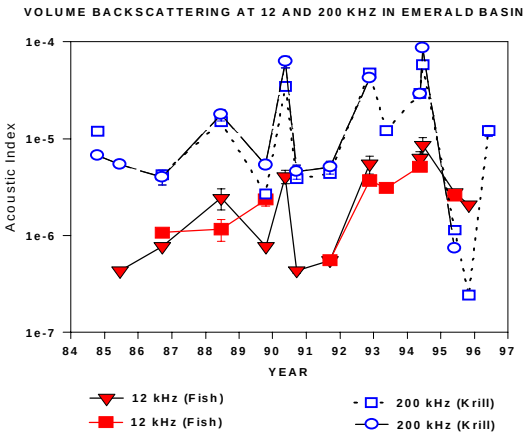


Acoustic data are good indicators of changes in krill abundance both across the shelf and between different months of the year. The levels of acoustic backscattering at 200 kHz were higher in 1996 than those of 1995. The krill acoustic index on the Louisbourg line indicated a biomass five times lower than that on the Halifax line. The pelagic fish index, primarily silver hake and sandlance, was not measured in June, 1996. There was little evidence of significant numbers of pelagic fish larvae and / or juveniles.

Krill and Pelagic Fish Trends in Emerald Basin 1984-1996

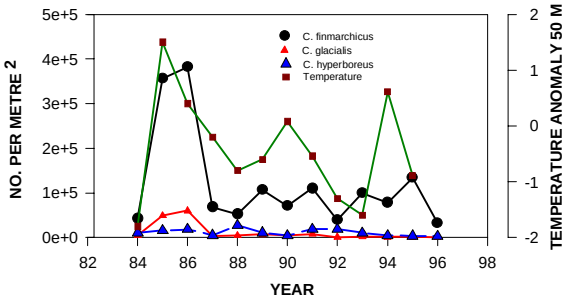
Acoustic data indicate a close relationship between the fish and krill in Emerald Basin. These data collected over the last decade have shown a close relationship between backscattering at 12 and 200 kHz. The 12 kHz frequency data reflects the concentrations of pelagic fish in the basin and the 200 kHz frequency data provides an accurate estimate of the krill concentrations. The relationship between these two frequencies over the years 1985 to 1995 showed a significant positive correlation. Both frequencies showed a general increase between 1985 and 1994 followed by a significant decrease in 1995.

Silver hake and redfish, the two dominant pelagic species, feed primarily on krill in the Basin (Waldon, 1988). In June 1996, there was a large increase in the levels of the 200 kHz backscattering, indicating the krill stocks had increased from the low values seen in 1995. Data at 12 kHz were not collected in June, 1996.



Zooplankton trends in Emerald Basin, 1984-1996

The copepod *C. finmarchicus* accumulates in Emerald Basin during the summer and fall and remains in the deep water until the breeding season in the late winter and early spring. It is believed that the size of the fall population of *C. finmarchicus* in the Basin is a good indicator of the size of the previous spring and summer's population on the Scotian Shelf (Sameoto and Herman 1990). The *C. finmarchicus* population declined between 1995 and 1996 to reach the historical low levels observed in 1984 and 1992. *C. glacialis* and C. *hyperboreus* (both Arctic species) had very low concentrations in the Basin in 1996. The temperature anomaly at 50 m in June and the numbers of *C. finmarchicus* appeared to be related, showing that as the temperature increased there was generally an increase in the size of *C. finmarchicus* population.



Outlook

The eastern shelf has been influenced by abnormally cold bottom temperatures in recent years and it is possible that this cold water has effected the size of the krill population in the area. Long-term time series data show that the levels of krill in the eastern region were lower in the 1990s than in the period between 1961 to 1975 when bottom temperatures were warmer.

The Emerald Basin *Calanus finmarchicus* data indicated that since 1987, population levels have been stable but much lower than in 1985 and 1986. Zooplankton samples and the acoustic index showed there was a gradual increase in both krill and fish populations in the Basin between 1984 and 1994 followed by a steep decline in their population size in 1995. The krill abundance increased in 1996 to levels observed between 1984 and 1994. The causes for the large fluctuations during 1994 and 1996 are not known.

It is postulated that if the bottom temperatures on the eastern shelf remain cold (i.e. in the range of 1 C°), *C. finmarchicus* populations and possibly krill populations will remain low in the eastern region. Krill populations on the western half of the shelf are near their long term average.

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