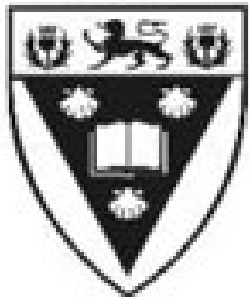


The impact of global climate change on the inshore marine ecosystem of the Prince Edward Islands

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ZOOLOGY & ENTOMOLOGY



Global climate change: Southern Ocean

Physical environment

- Warming of sea surface and midwater temperatures
- Decrease in sea-ice extent
- Melting/retreat of glaciers
- Shifts in position and intensity of the major oceanic frontal systems

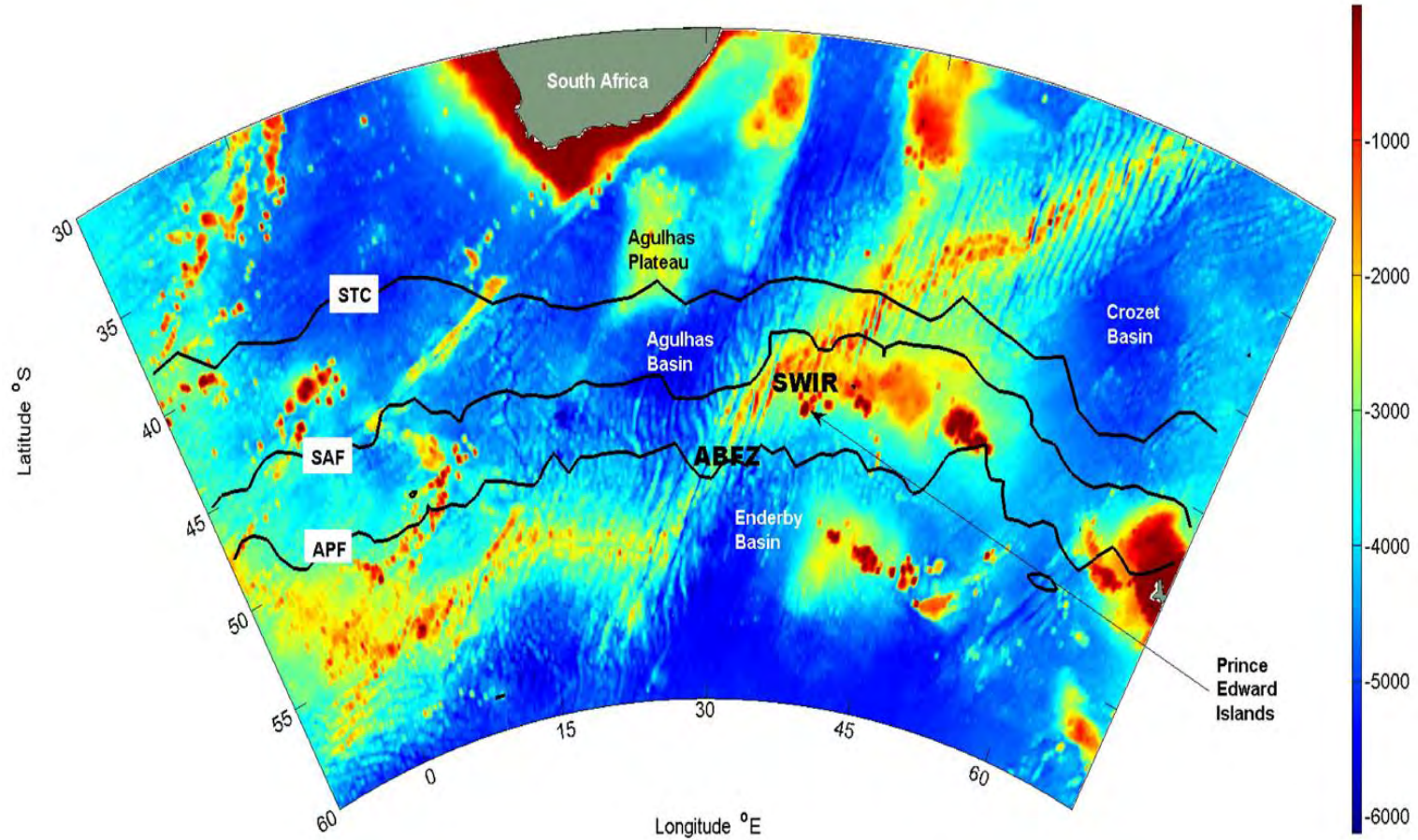
Global climate change: Southern Ocean

Biology

- Reduction in primary and secondary production rates.
- Loss of habitat (sea-ice).
- Range extension of warm water species southwards.

Major problem: absence of long-term data to assess the response of the biology to observed changes in the physical environment

Prince Edward Islands



Prince Edward Islands

- Seasonally home for up to five million breeding pairs of top predators including penguins, flying sea birds and seals.
- Top predators on the islands are either moulting or breeding- both of which are energetically expensive.
- Estimated that at peak of breeding season, top predators on the islands require 7000t of food daily to meet their energetic requirements



Food supply to islands:

Allochthonous sources:

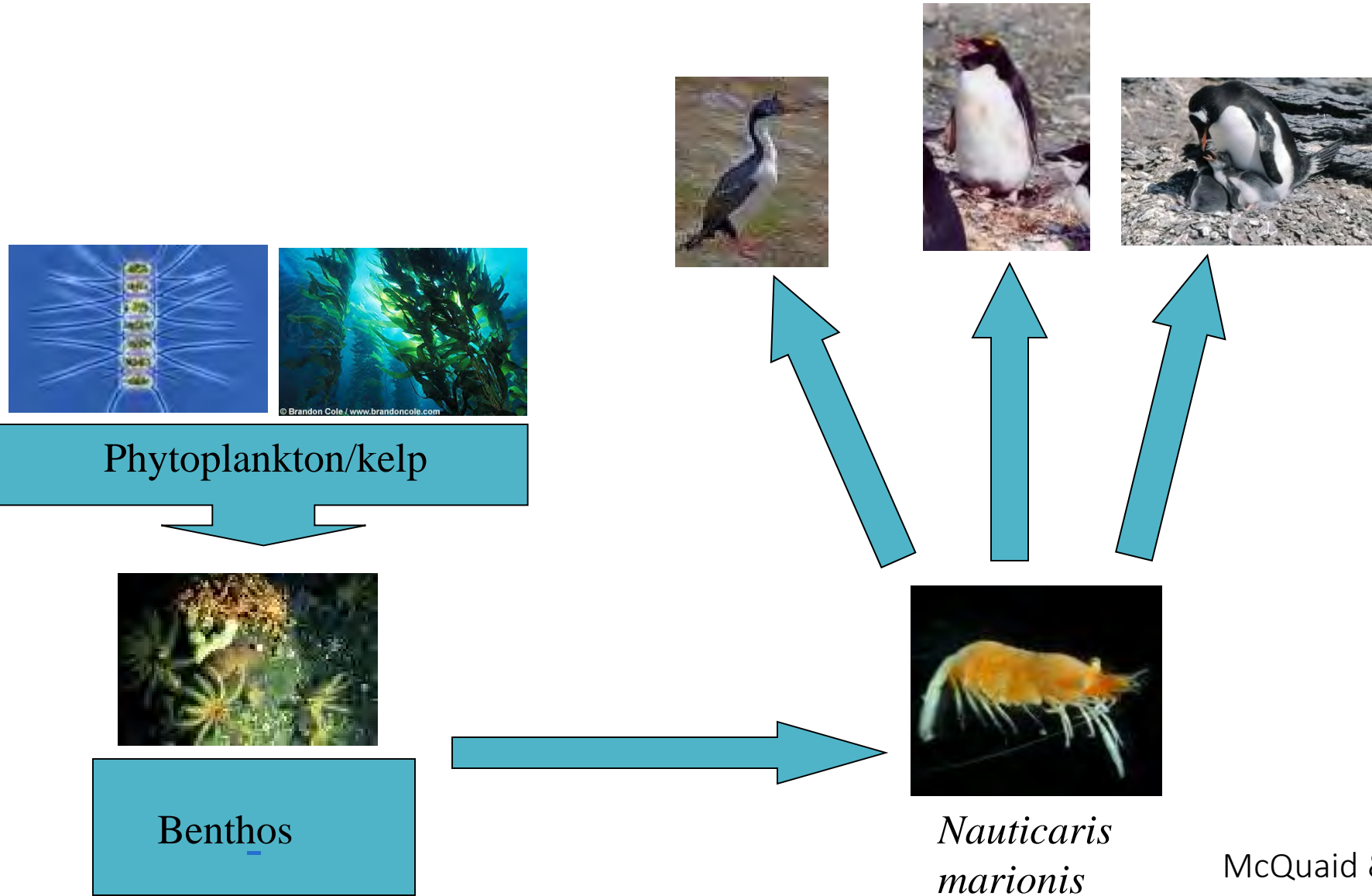
- Advection of zooplankton and nekton.
- Warm- and cold core eddies.

Autochthonous source:

- “Island mass effect”

Combined these sources are termed “*The Life support system of the Prince Edward Islands*”.

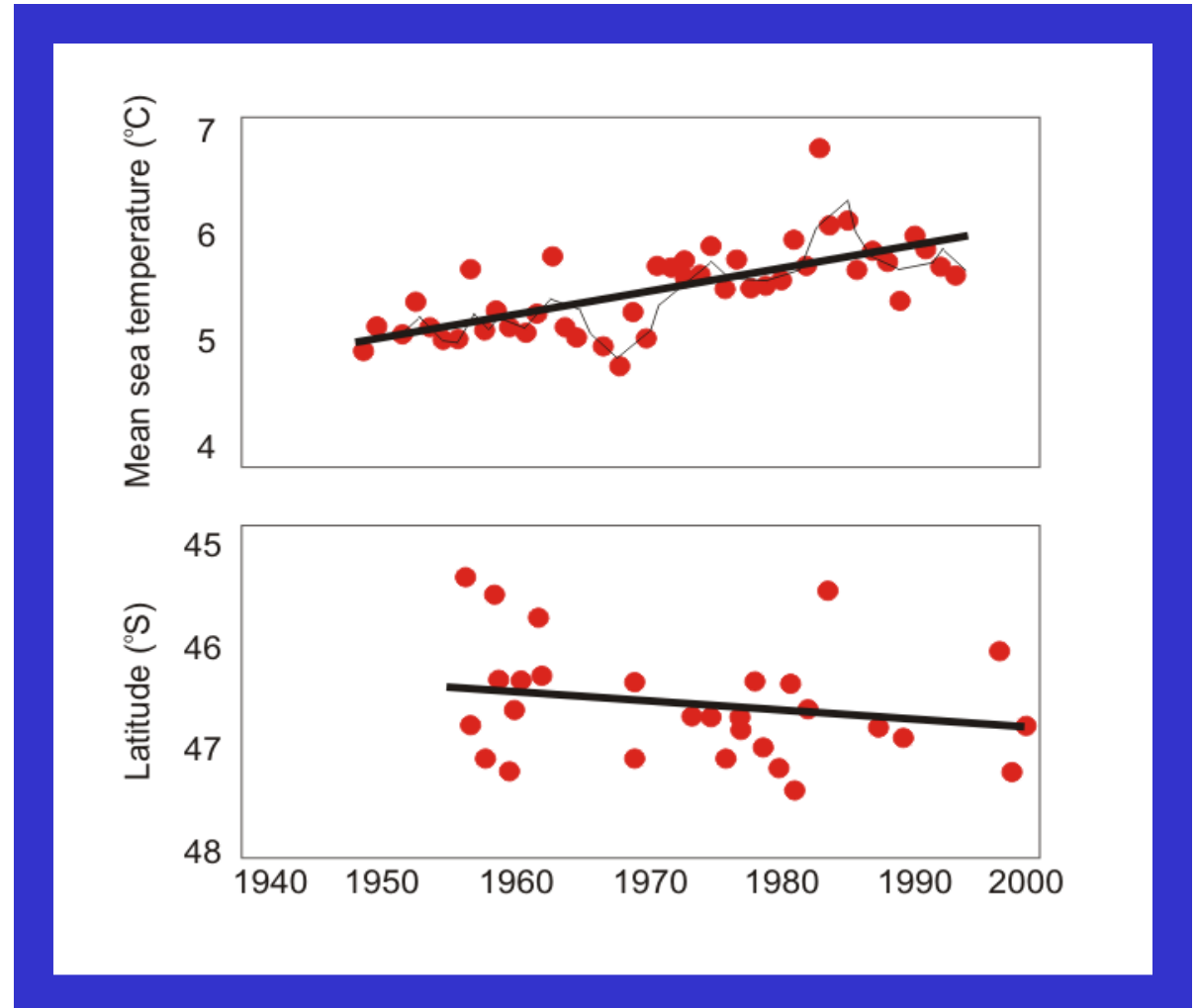
Inshore marine ecosystem



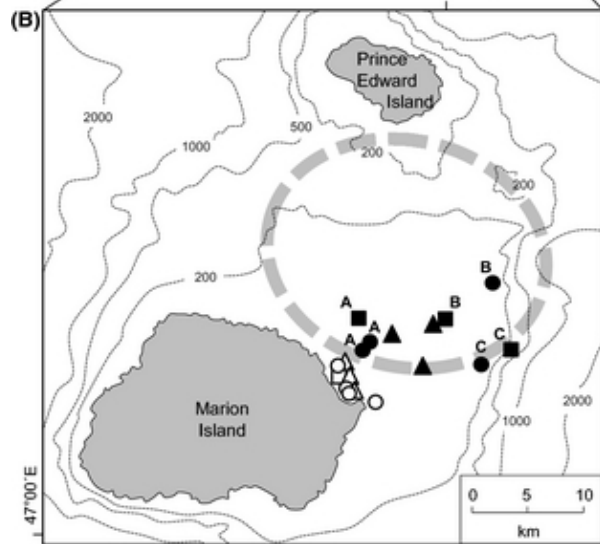
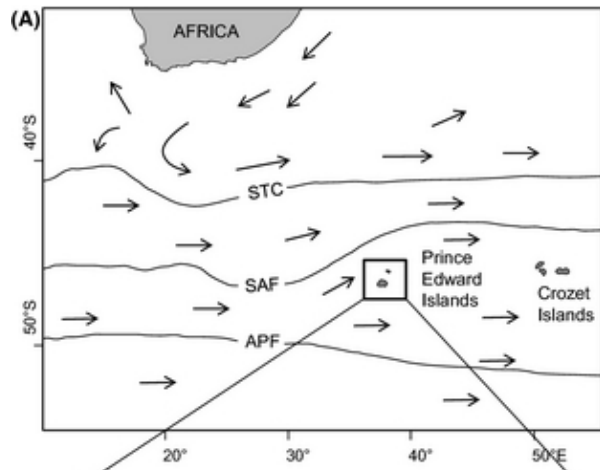
McQuaid & Froneman (2008)

Global climate change: Prince Edward Islands

- Changes in wind intensity/direction
- Warming of surface waters
- Southward migration of the SAF



Pakhomov et al. (2002)



- | | |
|---|---|
| ○ nearshore shrimp
(1984, 1985, 1987, 2000)* | ● inter-island shrimp
(1997 ^B , 1999 ^A , 2000 ^{AC})* |
| △ nearshore benthos
(1999)** | ▲ inter-island benthos
(1999)** |
| □ nearshore shrimp + benthos
(2009)*** | ■ inter-island shrimp + benthos
(2009 ^{ABC})*** |

Samples collected during:

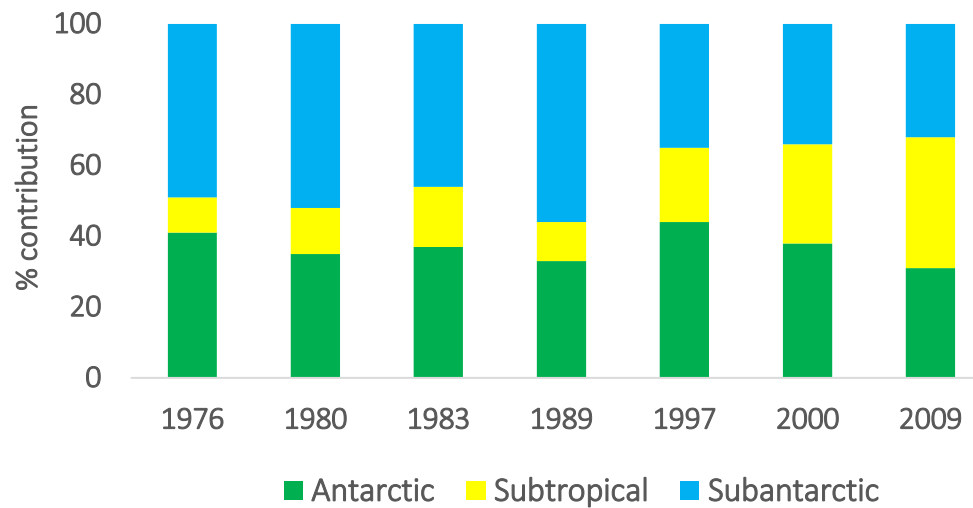
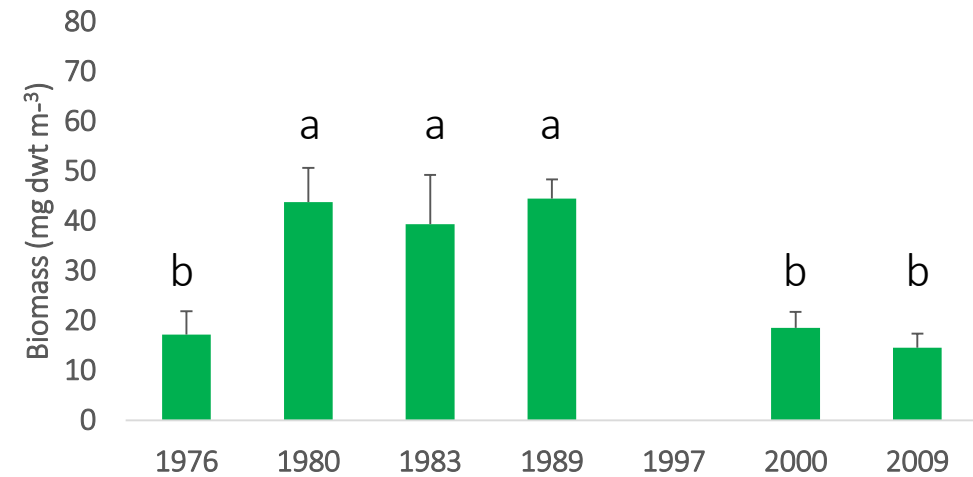
- Marion Offshore Ecosystem Study (MOES)
- Marion Island Oceanographic Study (MIOS I-V)
- Marion Offshore Ecosystem Variability Study (MOEVS I and II)
- Variability in Southern Ocean Ecosystems Study

Sampling of the zooplankton, benthos and hyperbenthos conducted in both the near-shore and inter-island region of the Prince Edward Islands:

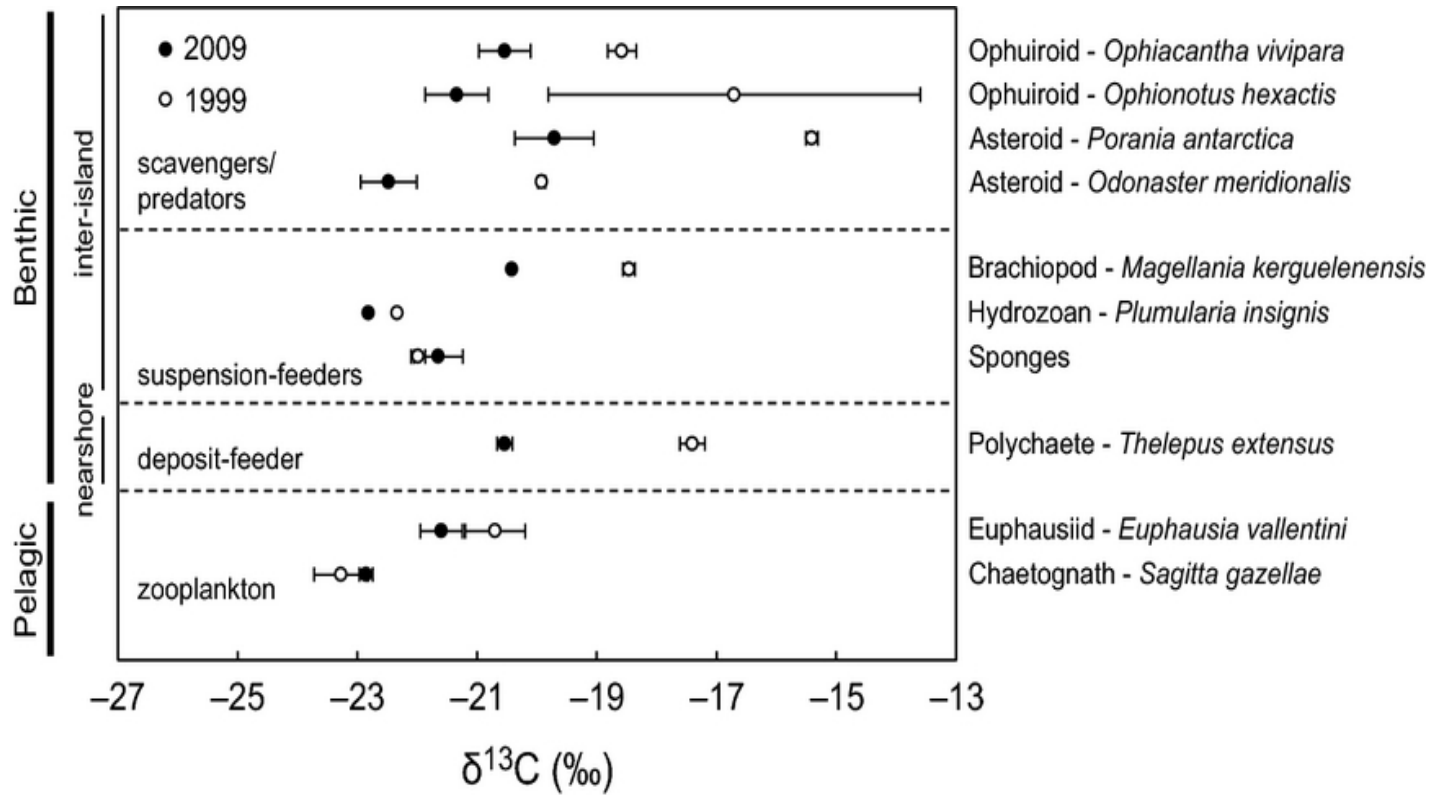
Allowed for assessment:

- Long-term changes in zooplankton community structure
- Changes food web dynamics – stable C and N isotopes

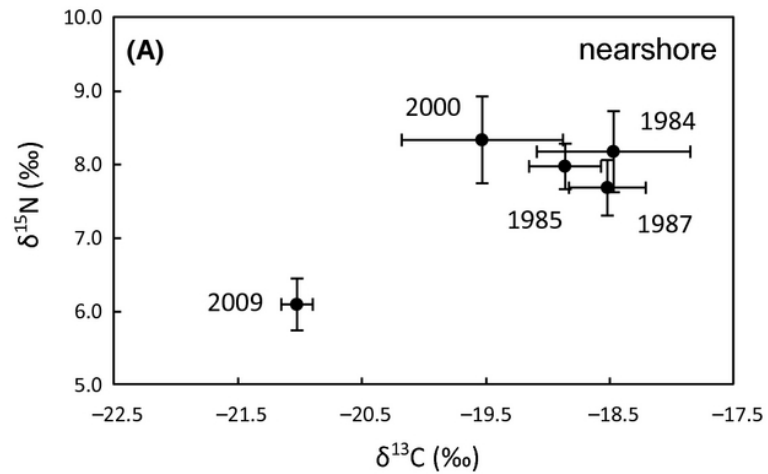
Zooplankton community



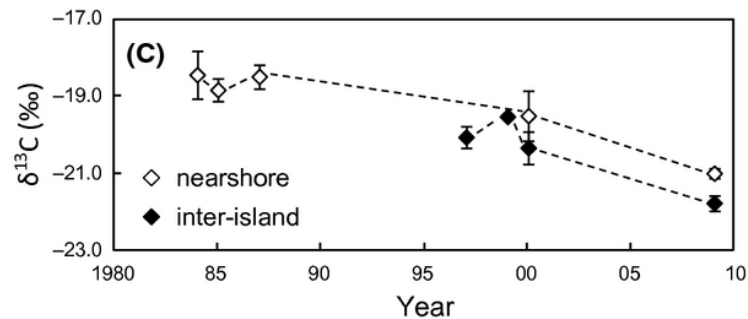
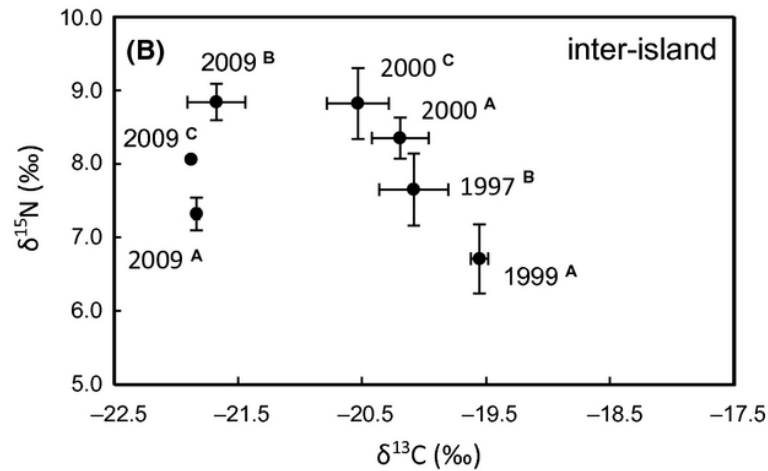
Benthic community

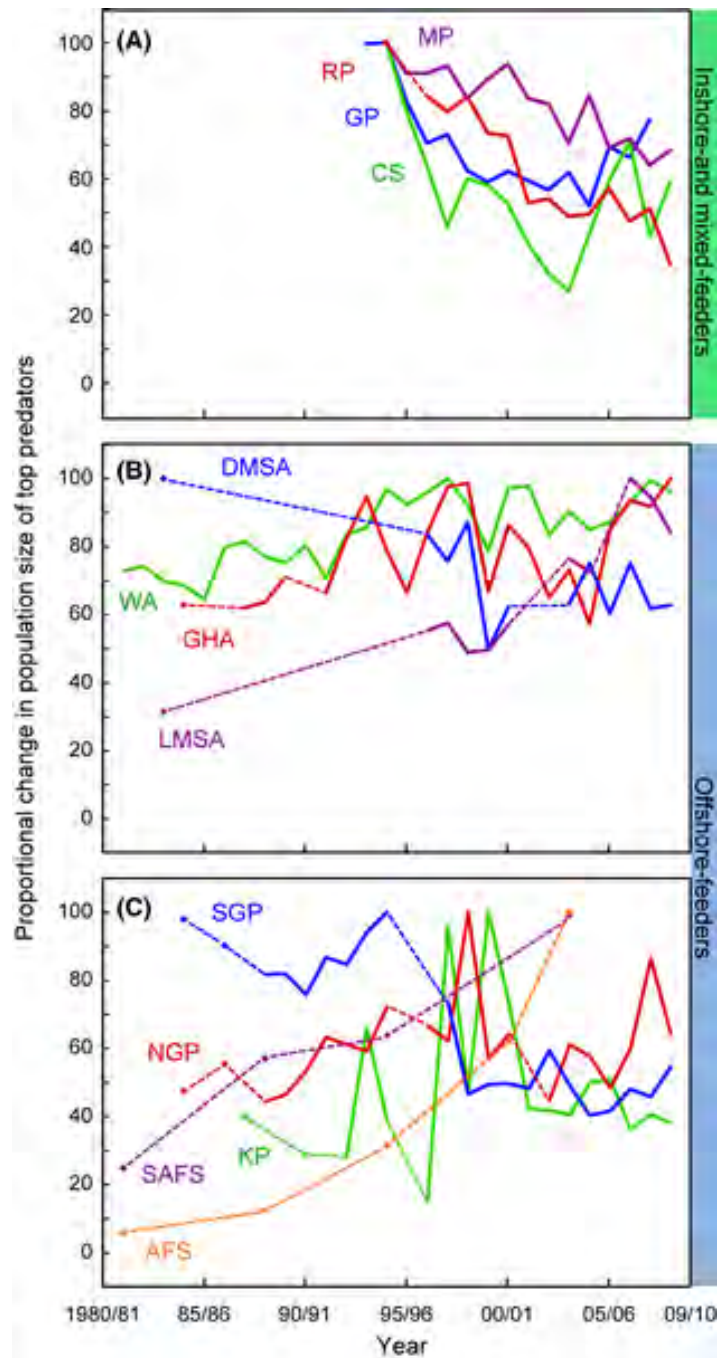


Depletion in carbon isotope ratio's of benthos- linked decreased frequency of “island mass effect”



Overall depletion in stable isotope ratios of *Nauticaris marionis* in the nearshore and interisland region of the Prince Edward Islands over the past three decades.





Overall decline in populations of inshore- and mixed feeders

With few exception, general increase in the populations of the offshore feeders

Conclusions:

Warming of waters within the Polar Frontal Zone associated with:

- Increased contribution of warm water species and decrease in total zooplankton biomass.
- Depletion in the carbon ratios of the benthos and hyperbenthos –linked to shift in diet (increased contribution of allochthonous carbon).
- Apparent declines in the population of top predators that feed within the immediate vicinity of the islands.

Knowledge gaps:

- No studies on the benthic community structure of the islands since mid-1980's.
- Only single study has been conducted on the population demographics of *Nauticaris marionis* in the vicinity of the islands.
- Biological invasions (??).