

## Abstract

The West Antarctic Peninsula region and the area in its vicinity, which includes King George Island and Admiralty Bay, are recognized as the region on Earth with the most rapid climate change. There is a rapid increase in average surface temperature and a reduction in the extent and duration of ice cover. One of the consequences of these processes is a decrease in the cell size of organisms forming the phytoplankton community, which will consequently negatively affect populations of key planktonic crustaceans, Antarctic krill and copepods, as small cryptophytes are not their preferred food. In Admiralty Bay, diatoms, the main food of copepods, were found to have declined from 44% to less than 5% of the phytoplankton at the turn of the 20th century. The reconfiguration of the trophic web could have a huge impact on populations of higher-order consumers, including pinnipeds and penguins. In the King George Island region, the average air temperature has increased by 1.2°C between 1948 and 2011. In addition, rapid melting of glaciers is taking place, with a number of negative phenomena associated with it. For example, by the Potter Cove between 2003 and 2012, a significant amount of mineral suspension from glacial flows caused very high mortality of *Euphausia superba* individuals.

Free-living, planktivorous Copepoda, are one of the most important components of the Southern Ocean zooplankton and play a key role in pelagic trophic webs. The main factors determining the life cycle and development of copepods in high latitudes are water temperature and food availability. Species most abundant and widespread in Southern Ocean waters include *Calanoides acutus*; *Calanus propinquus*; *Metridia gerlachei* and *Rhincalanus gigas*. Considering the changes observed over the last few decades in phytoplankton communities constituting the food base for Copepoda, it cannot be excluded that the described processes may cause visible changes in the populations of key copepods over a longer period of time. Four Copepoda species, representing different levels of flexibility in life-history strategies and food preferences - from omnivorous (*M. gerlachei*), through predominant omnivory and predation (*C. propinquus*), to less (*R. gigas*) or more strict (*C. acutus*) herbivory - were selected for the study that is the subject of this dissertation. Work on the diet of dominant Copepods using gut content analysis has only examined populations from the eastern shores of the Weddell Sea. In addition, these works did not cover a period longer than one year, so feeding behavior was not considered in the context of changes occurring in pelagic ecosystems. Data on long-term changes in copepod food composition are lacking.

There is also relatively little work documenting the food content of Antarctic Copepods, including photographs taken using scanning electron microscopy.

The purpose of this study is to verify the hypothesis that there are long-term changes in the functioning of Admiralty Bay Copepods based on 15 years of observations, with a particular focus on feeding. To verify the hypothesis, the following research tasks were set:

- to analyze the long-term variability of basic aspects of Copepod functioning, such as abundance and age structure,
- conducting biometric studies on specimens of four copepod species,
- analysis of digestive tract condition of Copepoda over the entire study period,
- analysis of qualitative composition of gut contents of copepods in time.

To accomplish the research tasks, plankton material from the central part of Admiralty Bay was analyzed from four study periods - 1994/95, 2003/04, 2008/09 and 2015. It should be noted that the material from 2015, due to frequent failures of floating equipment, is fragmentary. However, it was decided to use it in this study as it is some of the most recent plankton data from Admiralty Bay.

The analyses conducted allowed to identify changes in the functioning of the Copepoda studied over nearly 15 years. Changes in such aspects as abundance, body length and feeding behavior of individuals were manifested to different degrees depending on the species. There were no significant differences in the age structure of the population between seasons or between study periods when compared to the results of previous studies from Admiralty Bay and Bransfield Strait. *Metridia gerlachei* maintained abundance values similar to those previously recorded during all study periods. *Calanoides acutus*, *Calanus propinquus* and *Rhincalanus gigas* generally had higher abundance values.

Older individuals of *M. gerlachei* showed a decrease in mean body length over time. For *C. acutus*, an increase in length was found for individuals in the CIV stage, while for *R. gigas* and *C. propinquus*, an increase was found for CV individuals and females. Of the three factors analyzed - water temperature, salinity and number of day in the year, water temperature has the greatest influence on the body length of the Copepods studied. The results obtained allow to assume that in the future it can be expected that the mean body length of adult *M. gerlachei* individuals will decrease, while increasing in *R. gigas* and *C. propinquus*. In the case of *C. acutus* females, the mean body length will be fairly even over time.

Based on the analysis of feeding parameters during the different study periods, there were long-term changes in the feeding behavior of Copepoda. Among all species, except *C. propinquus*, there was a significant decrease in the proportion of individuals with food in guts

during successive study periods. It was also shown that the mean length of the fecal pellet of the copepods studied was most influenced by food type and water temperature. Moreover, the relative length of the fecal pellet of Copepoda was found to decrease during successive study periods. The food composition of the studied copepods in the 1994/1995 period, especially in terms of the elements dominating the diet, is similar to the results obtained in earlier works from the Antarctic Peninsula and Southern Ocean region. In the subsequent periods, a marked depletion in diet composition was observed for *M. gerlachei*, *R. gigas* and *C. acutus*. Among *C. propinquus*, the highest number of food types was recorded in 2003/04. Over the years, an increasing proportion of amorphous matter was found in the diet of the copepods studied. The presence of benthic diatoms and sponge spicules in the diet of three of the four studied species may indicate a deliberate supplementation of the diet with benthic organic matter as a "replacement" strategy in changing environmental conditions. The fact that copepods feed on spicules is noteworthy as it has not been reported before. Nearly 15 years of research indicate symptomatic changes in the feeding of Copepoda, and the neritic nature of Admiralty Bay, located in the vicinity of glaciers and streams constantly supplying suspended matter, may be considered as the cause. It may be assumed that in the long term this factor will have a negative impact on populations of filter-feeding organisms.