

Spatial distribution and structure of benthic communities in Herve and Cardozo Coves (Admiralty Bay, King George Island, South Shetlands, Antarctica)



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Introduction

In the last 50 years a significant climatic shift was observed along Antarctic Peninsula (e.g. glacial retreat, temperature rise). Many maritime glaciers have dramatically retreated in the last decades exposing new habitats for benthic organisms and changing environmental conditions by increased sedimentation and freshening events associated with glacial melting. Such changes may have significant impact on the structure and diversity of benthic communities.

Aim

The aim of this project was to describe distribution patterns of macrozoobenthos in two differing coves formed by retreating glaciers, correlating them with the data on glacial retreat.

Methods

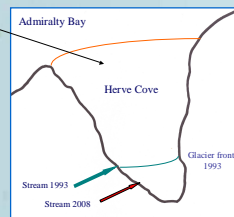
Underwater photographic documentation of epimacrozoobenthos was carried out in Cardozo (quantitative study, 3 transects, ca 390 photos from depths 5, 10, 15, 20, 25 and 30 m) and Herve Coves (qualitative study, 8 transects, ca 700 photos) during austral summers 2007-2008 and 2009-2010. Observations of bottom morphology and sediment type were done by SCUBA divers.



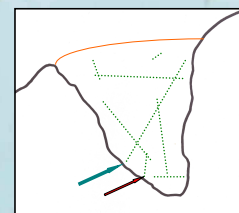
The location of phototransects in Cardozo Cove



Part of Admiralty Bay with Cardozo and Herve Coves



Herve Cove and the location of phototransects



Admiralty Bay is a fjord-like inlet in the southern coast of King George Island (South Shetlands). Cardozo and Herve Coves are two of the many inlets, coves and lagoons forming parts of its complicated shoreline. Both are formed by retreating glaciers, but they differ in area, depth, glacial input and isolation from main waters of Admiralty Bay.

Cardozo Cove is a large (ca 1.2 km²), deep (<150 m) and open cove. Since 1956 glacier retreated by ca 250 m (Birkenmajer 2002). Two of our transects (glacier and middle cove) were freed from ice during that time.

Herve Cove is a small (ca 0.14 km²) and shallow (<30 m) lagoon partly isolated by underwater ridge (2 m depth). In 1993 its benthic communities were found to be strongly influenced by glacial freshwater input and sedimentation (Siciński *et al.* 1996). Since then, glacier retreated ca 150 m (cove area increased by 15%), and glacial input significantly decreased.

Results

Cardozo Cove supported more diverse macrofauna (35 species in comparison to 16 in Herve Cove).

Significant differences in the structure of benthic communities from different parts of Cardozo Cove were observed. In the areas adjacent to the glacier front and in the middle part of the cove benthic communities at depths of 20 – 30 m were dominated by ascidians (*Molgula pedunculata*, *Cnemidocarpa verrucosa*) and sea urchins *Stereochinus neumayeri*. Sporadically, crinoids *Promachocrinus kerguelensis* were observed.

Benthic communities in the outer part of Cardozo Cove adjacent to Admiralty Bay were dominated by echinoderms (sea urchins *S. neumayeri*, crinoids *P. kerguelensis* and brittle stars *Ophionotus victoriae*). Sea anemones (*Urticina antarctica*, *Isotelia antarctica*) and a few small sponges were also observed.

Number of species increased from 18 (in the glacier front area) to 28 (outer cove).

Sea anemones *Edwardsia* sp. and bivalves *Y. eightsi* - numerous in Herve Cove - were absent in Cardozo Cove. Gastropods *N. concinna* and sea stars *O. validus* were observed in Cardozo Cove in significant numbers at depths 5 – 15 m.

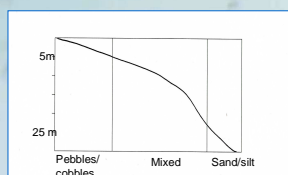
Since 1993 macrofauna of **Herve Cove** was enriched by species previously unknown or incidental there such as isopods *Glyptonotus antarcticus*, sea urchins *Stereochinus neumayeri*, sea stars *Odontaster validus* and limpets *Nacella concinna*.

The benthic communities of Herve Cove at depths of 23 – 16 m were dominated by bivalves (*Laternula elliptica* and *Yoldia eightsi*) and amphipods (mainly *Cheirimedon femoratus*), at depths of 16 – 5 m by sea anemones *Edwardsia* sp., and at depths of 5 – 0 m by limpets *N. concinna*.

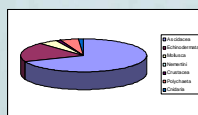
The ice-free zone exposed since 1993 was colonized mostly by bivalves *Y. eightsi* and *L. elliptica*.

Areas previously overgrown with sea anemones, *Edwardsia* sp., were significantly increased, covering most of the cove. Small clumps of macroalgae (*Ascoseira* sp.) were for the first time observed in several locations. A dense layer of *L. elliptica* shells was noted near the old stream estuary, where living bivalve were observed in 1993 - remains of a local die-off, caused probably by an event of massive silting or freshening.

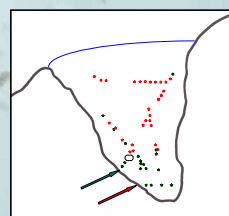
Cardozo Cove



Depth profile of shallow coastal area of Cardozo Cove (glacier & middle cove)



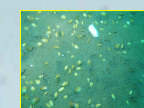
At depth 30 m benthic communities under the glacier's front and in middle part of Cardozo Cove are dominated by ascidians (58 ind/m²).



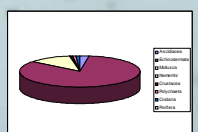
The distribution of bivalves and sea anemones in Herve Cove

Herve Cove

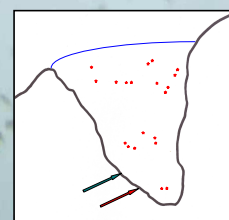
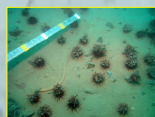
- Dense populations of *Edwardsia* sp.
- Dense populations of *Yoldia eightsi* and *Laternula elliptica*.
- Local die-off of *L. elliptica*



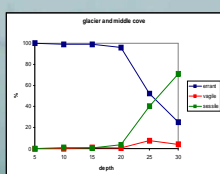
Depth profile of shallow coastal area of Cardozo Cove (outer cove)



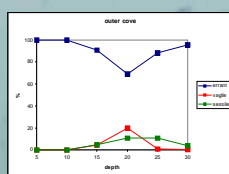
At depth of 30 m benthic communities in the outer cove are dominated by echinoderms (43 ind/m²).



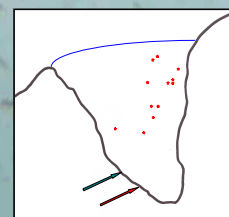
The distribution of sea stars *Odontaster validus* in Herve Cove in 2008. In 1993 only single specimen was found near the underwater ridge.



At depth of 30 m benthic communities under the glacier's front and in the middle part of Cardozo Cove are dominated by sessile forms.



At depth of 30 m benthic communities in the outer cove are dominated by errant forms.



The distribution of isopods *Glyptonotus antarcticus* in Herve Cove in 2008. In 1993 this species was absent inside the cove.



Conclusions

Analysis of data showed significant changes in the density, diversity and species composition of benthic communities in both coves. Different paths of colonization and faunal succession were observed.

Since 1993 glacial input in Herve Cove decreased, opening the lagoon for species migrating (by pelagic larvae) from the rich benthic communities of Admiralty Bay. First macrobenthic predators (isopods and sea stars) came into Herve Cove. Future changes in community structure are expected.

In Cardozo Cove both glacier and middle cove transects were characterized by a vertical zonation of benthic communities typical for the Antarctic (errant forms in shallow waters, sessile filterators at depths >20 m). New ice-free areas were colonized by *M. pedunculata*, a typical Antarctic pioneer species quickly responding to habitat changes. Lack of sessile species observed in outer cove at depths >20 m may have been caused by biological (sea stars predation and sea urchins grazing) or physical (ice phenomena) factors.

Future research

Sediment cores for pigment analysis were collected in both coves with the aim of estimating food base available for benthic invertebrates.

Future photographic documentation of macrobenthos in both coves is planned with the aim to describe colonization processes and formation of communities in such evolving habitats.

Collected data will be used in long-term monitoring and mapping changes in benthic communities under environmental stress

Acknowledgments

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