SHALLOW-WATER MARINE BENTHIC ECOSYSTEMS OF THE SOUTHERN SPITSBERGEN

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SUMMARY

A preliminary selection of main shallow-water marine benthic ecosystems is proposed for two regions of the southern Spitsbergen (Svalbard), Arctic Ocean. The selection is based on immediate SCUBA-diving observations and samplings on bottom organisms. Four benthic communities are briefly described for the fiord conditions of the Bellsund region (western Spitsbergen), four ecosystems are recorded for the open-sea region to the south of the Edgeøya Island (eastern Spitsbergen).

KEY WORDS

Arctic - Spitsbergen - benthic ecosystems - SCUBA-diving methods

INTRODUCTION

During 1991 and 1992 summer Arctic seasons marine benthic ecosystems were studied using SCUBA-diving method. Czech diving teams participated international expeditions initialized within regular workshops of the Coordinative Committee of the European Arctic Ecological Research at Hel, Poland. The former campaign was situated to Calypsobyen (Bellsund region, western Spitsbergen), a temporary station of the Polish expedition of Maria Curie-Sklodowska University of Lublin (Ďuriš, 1992a,b). The next year, the Czech-Polish research group operated around the Bölscheøya, a small island of the Tusenøyane Archipelago, south of the Edgeøya, eastern Spitsbergen (Weslawski et al., 1992; Ďuriš, 1993a,b). Bellsund provides true fiord conditions of the western Spitsbergen with its warmer North Atlantic marine waters but is also highly supported by fresh waters and silty sediment from glaciers discharge, while the Bölscheøya is surrounded by the open sea and washed by the cold Arctic current.

A comparison of the two very different regions allows us to contribute to the knowledge on a distribution and character of benthic ecosystems on both hard and soft bottoms down to 45 m deep. Although the collected material is determining now, data from immediate diving observations on marine habitats make us possible to select several marine habitats.

METHODS

A SCUBA-diving method was used for immediate observations, for qualitative and quantitative collecting on benthic biota, and for making underwater photo of benthic organisms and communities. In 1991, a qualitative collections were taken by hands or a hand net, quantitative samples were made by a net and a frame 0.5x0.5 m, forwarded by underwater photo of each sampled area.

During the 1992 campaign, a modified benthometer with a rounded frame limiting area of 0.5 m^2 was used for quantitative samplings, as well as underwater photo with a scaled frame (Ďuriš, 1993b).

Immediate underwater observations and notices to the photos were put down to a white plastic card.

RESULTS

Bellsund region:

1. Seaweed belt

Depth - 2-10(12) m.

Bottom - stones, sandy patches.

Plant cover - continuous cover of seaweeds *Alaria esculenta, Laminaria* spp. Uncovered spots occupied with filamentous, brown algae *Desmarestia* sp., red algae *Polysiphonia* sp. and green algae *Ulva* sp.

Dominant invertebrate forms - crab *Hyas araneus,* hermit crab *Pagurus pubescens,* gastropods *Neptunea* spp.

Associated fauna - sponges, hydroids and bryozoans on stones and rhizoids, mysid crustaceans *Mysis occulta,* amphipods *Caprella septentrionalis,* sedentary polychaetes *Spirorbis* sp., gastropod molluscs *Neptunea angulata, Neptune*a sp.

Remarks - Very rich biotope of a continuous cover of seaweeds. Lower frontier is distinct on slopes and lies 9 and 12 m deep (Fig. 1 - localities 3,4,7,8). At large flat shelves (Fig.1 - localities 1,2,9) the cover forms a network of seaweeds covering stony reefs, and sandy fields - the last occupied with colonies of small sedentarian polychaetes with deeply brownish-red fan of a filter apparatus. A single large walrus was met underwater at the locality 2, 11 July, 1991 (Ďuriš, 1992b).

2. Sublittoral slope

Depth - 10-45 m.

Bottom - strong slope 30-40°, gravel with sand and clay, scattered small stones.

Plant cover - filamentous green algae *Cladophora,* local areas of fine red, brown and green algae.

Dominant invertebrate forms - sand actinians *Edwardsia* sp., juvenile crabs *Hyas araneus.* Lover part - sea urchin *Strongylocentrotus droebachiensis.*

Associated fauna - barnacles *Balanus balanus,* hermit crabs *Pagurus pubescens,* shrimps *Eualus gaimardii gibba, Sclerocrangon boreas,* cyclopterid fish *Eumicrotremus spinosus,* sea stars *Urasterias lincki, Pterias* sp., *Lophaster furciger, Leptasterias groenlandica.*

Remarks - Wide variation of sessile as well as movable animal forms were present (Fig.1 - loc. 3). Very numerous small, up-to-one-year old crabs *Hyas araneus* were observed on the slope covered by filamentous green algae *Cladophora* sp. 15-30 m deep (Ďuriš, 1992a).

3. Sheltered shallow-water inlets.

Depth - 10-25 m.

Bottom - flat, sandy-clay.

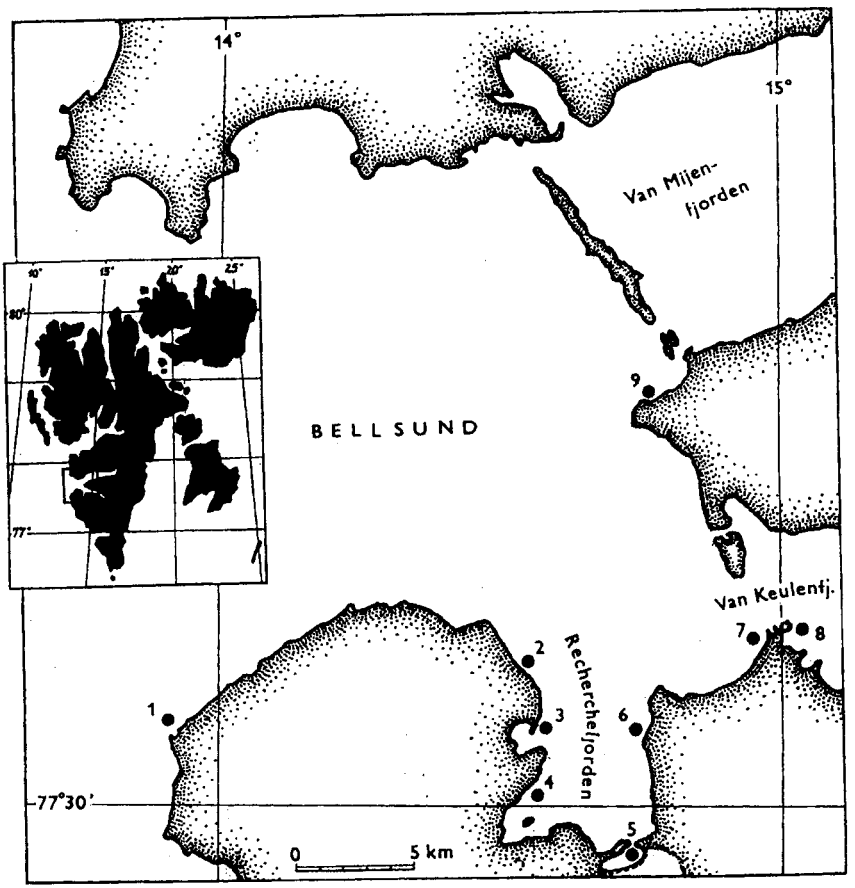

Fig. 2. Western Spitsbergen - Bellsund. Location of investigated area: 1 - Tomtvika, 2 - Calypsobyen, 3 - off Josephbukta, 4 - Vestervagen, 5 - fresh-water lagoon under Recherche Glacier, 6 - eastern Recherchefjorden, 7 - Malbukta, 8 - Van Keulenfjorden, 9 - Van Mijenfjorden

Plant cover - 10-15 m fine algae *Polysiphonia, Phyllophora, Desmarestia, Dictyosiphon* sp., deeper - almost absent.

Dominant invertebrate forms - large actinians cf. *Hormathia* sp. and *Tealia felina.*

Associated fauna - On algae - shrimps *Lebbeus polaris, Spirontocaris spinus, S. phippsi, Eualus gaimardii gibba,* large shrimps *Sclerocrangon boreas* on soft bottom. Large nemertinean worms digging into substrate. High quantity of shrimp and hermit crab postlarvae. Large soft sponges, barnacles *Balanus balanus.*

Remarks - High abundance of hippolytid shrimp and hermit crab postlarvae showed their preference of sheltered inlets with depths of 10-25 m (Fig.1 - localities 4,8). Sandy bottom with gravel and shallow depths under the seaweed belt allow to develope of fine tallomed and filamentous green, red and brown algae used as a shelter by crustacean juveniles and adults. On the other hand, slow currents allow higher sedimentation of finest silty mineral particles of a glacier origin. It, as well as

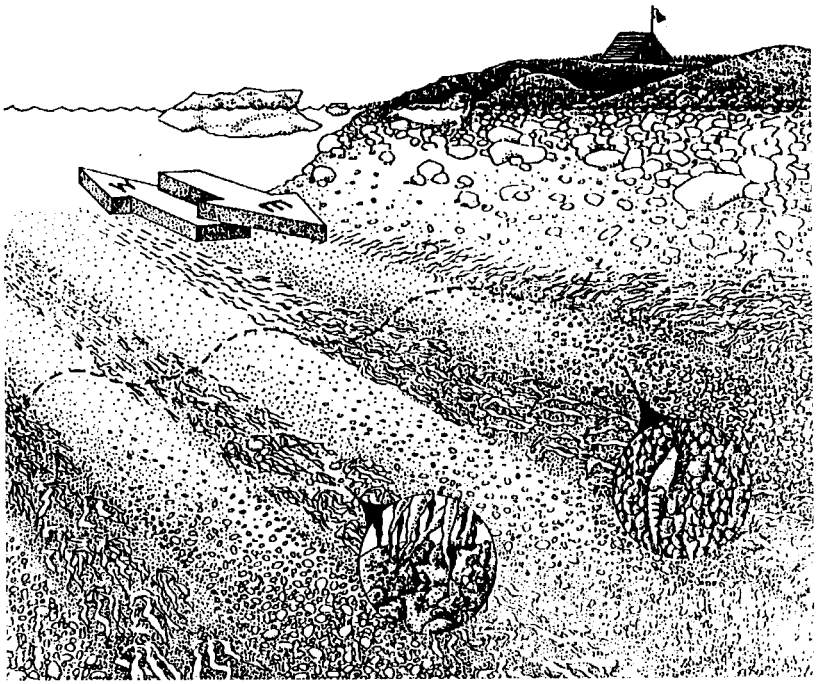

Fig. 1. Simplified impression view of benthic fauna biotop at Bölscheøya Island. Arrows indicate tidal currents (after Weslawski et al., 1992, changed)

anchoring stones, and transferred there by strong tidal currents from neighbouring "seaweed channels" (No. 6). The fauna usually associated with the latter biotop is mostly absent there. Seaweeds, transported to new channels, are incorporated to their typical biotop, or are drifted to deeper areas (under 30 m) with coditions insufficient for them (tanatocoenosis ?). Broken talloms are drifted to open sea or thrown up to the coast by waves.

DISCUSSION

The SCUBA-diving observations, together with the bottom-grab sampling and dredging on marine benthic organisms, showed good distribution of dominant plant and animal forms within investigated areas. The main shallow-water ecosystem, the dense seaweed belt, occupies the depths of 5 to 10-12 m in the fiords of the southwestern Spitsbergen, while the same laminarian fields cover flat bottoms surrounding the Bölscheøya Island (the southeastern Spitsbergen) on deeper waters, down to 25 m. It is probably caused by a different clearness of the sea water, which is rather muddy of fine mineral particles originated from discharged glaciers in western fiords. On the other hand, rich coastal and bottom geomorphological forms and hydrological conditions support a development various ecosystems of more sheltered areas in the western fiords, while open sea (southeastern) conditions lead to higher uniformity of marine habitats. A drifting ice and strong tidal currents are also important factors affecting the shallow-water communities at exposed areas.

Sheltered shallow-water inlets inside western fiords, with fine-talomed algae on the bottom, are frequently used by juvenile crustacean forms for their development. Dying planktonic organisms provide benthic animals with additional food resources in such areas. It leads to an occurrence of rich benthic communities, which could be preserved by local authorities as important natural areas. On the other hand, sheltered shallow-water inlet may be easy exposed and disturbed by increasing shipping, local industry, wastes from settlements, and marine tourism.

Very different conditions were observed in the southeastern area. Strong currents represent here a main hydrological factor affecting biocenoses - the coastal ones by drifting ices, the deeper ones - by drifting of unattached organisms. Much important are the observations on the seaweed "pseudobiotops" (see No. 8). Mass drifting of large seaweeds together with their stones ("anchors") and creating new, false, temporary seaweed covers at the deserted areas may lead to erroneous conclusions on the distribution and extension of the true seaweed communities. Only diver observations, or close examination of samples on the presence or absence of the usually associated fauna, may provide exact information on the state of the habitat.

Together with the main aim of our studies directed to the knowledge on marine benthic communities, we were able to evaluate problems and advantages of a using SCUBA-divers in Arctic ecology research of the sea. It is great advantage for the researcher to have possibility to see the marine communities by his eyes, in the natural conditions. Divings allowed us to see the animals undisturbed, but also to observe rare animals and various forms that can easily avoid any standard "eye-less" sampling apparatus used from a boat. The diver can choose an optimal sampling site and operate sampling mechanisms (Skarlato et al., 1964; Weslawski et al.,1992; Ďuriš, 1993b). An underwater photography, recently widely used for qualitative (Siferd, Welch, 1992), as well as for quantitative (Lundälv, 1971; Rørslett et al., 1978), analyses, allowes to increase an efficiency of the diving methods.

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