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PHYTOBENTHOS OF HULLO BAY AND FRESH WATERS CONNECTED (VORMSI ISLAND, BALTIC SEA)

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Abstract. Detail investigations of macrophytobenthos in Vormsi Island waters (Hullo Bay, Lake Prestviik, a creek, and Suur Spring) have not been made for a long time. We found that in Hullo Bay the dominant species were *Cladophora glomerata*, *Fucus vesiculosus*, and *Rhizoclonium riparium*. There were some species which were found both in the sea and the creek. These were *Potamogeton perfoliatus*, *Myriophyllum spicatum*, and *Cladophora glomerata*. *Littorella uniflora* was previously discovered in Estonia only once, in 1935, on Saaremaa Island. The bottom of Lake Prestviik is covered by *Chara polyachanta*, and no other species were recognized there. The Suur Spring is inhabited mainly by *Rhizoclonium hieroglyphicum* with wet weight more than 3000 g/m^2.

Key words: the Baltic Sea, Vormsi Island, macrophytobenthos.

INTRODUCTION

Vormsi Island belongs to the West-Estonian Archipelago, with the area of 95.7 km^2, being the fourth largest island in it. This territory is a part of the West-Estonian Archipelago Biosphere Reserve established in 1990.

The studies of macrophytobenthos of shallow waters in near-coastal region and inner water bodies of Vormsi Island have not been conducted for a long time. This paper is an attempt to evaluate the current status of benthic macroalgal flora of the southern coast of Vormsi and some inner water bodies. These data can also be used as a baseline for long-term biodiversity monitoring program, because Hullo Bay with its islets belongs to the Rumpo Peninsula Botanical Reserve.

STUDY AREA

Hullo Bay is situated on the southern coast of Vormsi Island, and it is separated from Haapsalu Bay by the Rumpo Peninsula and from the open sea on the western side by a couple of islets and the Suuremõisa Näsi Peninsula. The central and northern parts of the bay have mostly soft sandy and muddy bottoms. A stony bottom was observed near the islets and in the southern part of the bay. Numerous single erratic boulders of different sizes are situated between the islets and near the top of the Rumpo Peninsula. The salinity of seawater in the bay was 5.0—6.1‰.

The narrow Vae Stream that flows into Hullo Bay starts from Lake Prestviik and is about 1 km long and 1.5 m wide. The bottom of the stream is mostly muddy except for the section close to Lake Prestviik, where the bottom is stony.

Lake Prestviik has an area of 36.6 ha, and the depth is mostly less than 0.5 m. The bottom is composed of a thick layer of mud, and it is covered by vegetation all over.

The Suur Spring is connected with the lake by a short creek. The spring forms a circle with the area of 1 ha, and is about 1.5 m deep in the middle. The water is rich in nutrients (mainly nitrates); its temperature is about 8 °C during summer.

MATERIAL AND METHODS

The field collection for the present study was made at 62 stations from June till September, 1992. Sampling sites are shown on the map (Fig. 1.). In shallow water up to the depth of 0.5 m, samples were collected by hand within a special metallic frame with a surface area of 0.25 m^2; other samples were taken by mechanical tools from boat. Samples were taken from the water edge to a depth of 3 m and fixed in 4% formalin solution in sea water.

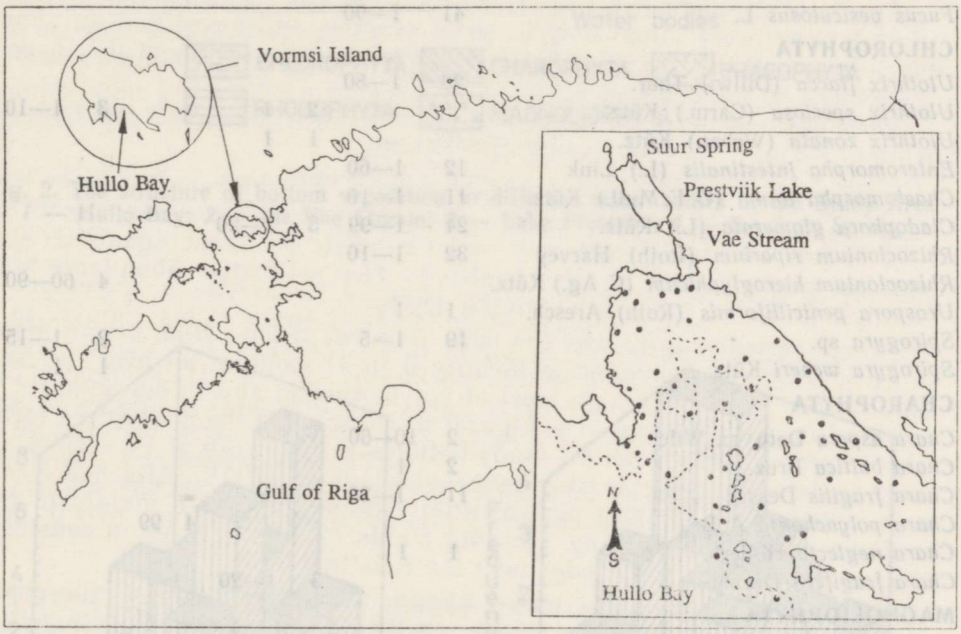

Fig. 1. Location of sampling stations in the Study Area.

RESULTS AND DISCUSSION

The investigated flora of macrophytobenthos consists of 6 taxa of red algae, 5 species of brown algae, 11 species of green algae, 6 species of charophytes, and 13 species of phanerogams identified in the samples collected in the study area. Table contains the list of species discovered in the study area with the number of findings and amplitude of their abundance in samples. Close examination of field material showed that the species composition and the structure of bottom vegetation in different water bodies differs a lot (Fig. 2.).

List of macrophytobenthos species found in the waters of Vormsi Island
(fr — number of findings, ab — abundance)

Taxa	Hullo Bay		Vae Stream		Lake Prestviik		Suur Spring	
	fr	ab	fr	ab	fr	ab	fr	ab
RHODOPHYTA								
Asterocytis ramosa (Thwaites in Harvey) Goby ex Scmitz	7	1						
Furcellaria lumbricalis (Hudson) Lamour	1	1						
Ceramium tenuicorne (Kütz.) Waern	29	1—80						
Ceramium rubrum (Huds.) C. Ag.	3	1						
Polysiphonia nigrescens (Hudson) Grev.	18	1—40						
Polysiphonia violacea (Roth.) Grev.	2	1						
PHAEOPHYTA								
Dictyosiphon foeniculaceus (Huds.) Grev.	7	1—50						
Pilayella littoralis (L.) Kjellm.	38	1—80						
Ectocarpus siliculosus (Dillw.) Lyngb.	17	1—45						
Sphacelaria arctica Harvey	4	1—20						
Fucus vesiculosus L.	41	1—90						
CHLOROPHYTA								
Ulothrix flacca (Dillw.) Thur.	28	1—80						
Ulothrix speciosa (Carm.) Kütz.			2	1			3	1—10
Ulothrix zonata (Weber.) Kütz.			1	1				
Enteromorpha intestinalis (L.) Link	12	1—60						
Chaetomorpha linum (O. F. Mull.) Kütz.	11	1—10						
Cladophora glomerata (L.) Kütz.	24	1—99	5	1—20				
Rhizoclonium riparium (Roth) Harvey	32	1—10						
Rhizoclonium hieroglyphicum (C. Ag.) Kütz.							4	60—90
Urospora penicilliformis (Roth) Aresch.	1	1						
Spirogyra sp.	19	1—5					2	1—15
Spirogyra weberi Kütz.							1	1
CHAROPHYTA								
Chara aspera Deth. ex Wild.	2	10—60						
Chara baltica Bruz.	2	1						
Chara fragilis Desv.	11	1—30						
Chara polyachanta A. Br.					4	99		
Chara neglecta Hollerb.	1	1						
Chara fragifera Durieu			3	1—20				
MAGNOLIOPHYTA								
Elodea canadensis Rich.			3	1—20				
Equisetum fluviatile L. em Ehrh.			2	20				
Equisetum palustre L.			1	20				
Littorella uniflora (L.) Asch.			1	15				
Myriophyllum spicatum L.	10	1—70	2	1—20				
Myriophyllum verticillatum L.			1	20				
Potamogeton pectinatus L.	32	1—80						
Potamogeton perfoliatus L.	9	1—50	2	5—20				
Potamogeton alpinus L.			2	1				
Ranunculus baudotii Godr.	4	1—20						
Zostera marina L.	2	1						

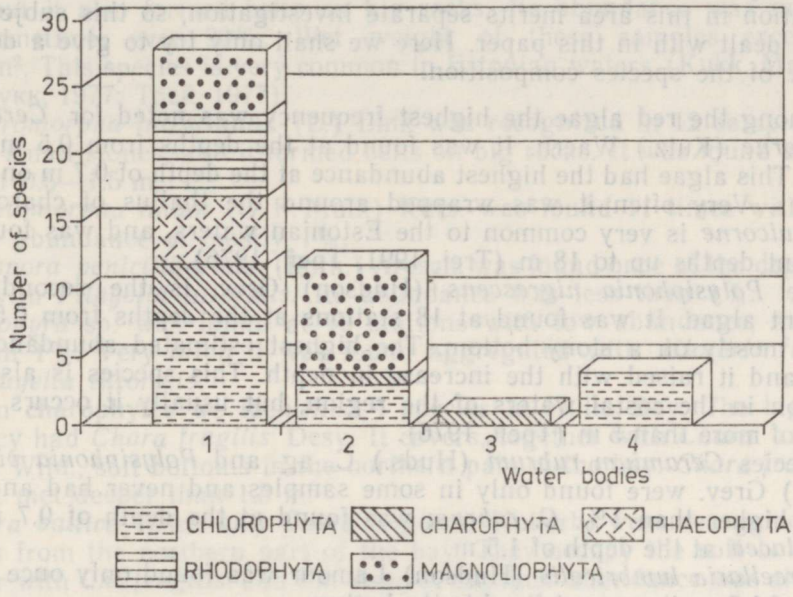

Fig. 2. The structure of bottom vegetation in different water bodies of the Study Area. *1* — Hullo Bay; *2* — the Vae Stream; *3* — Lake Prestviik; *4* — the Suur Spring.

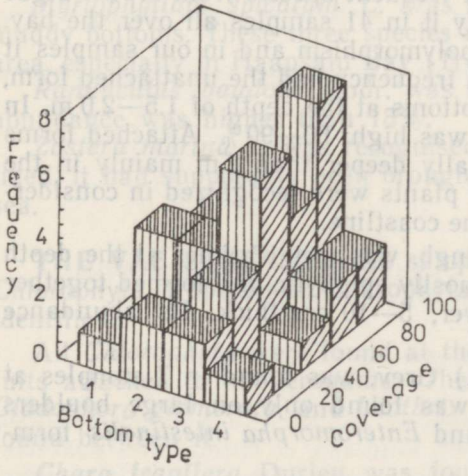

Fig. 3. The relationship of bottom type and the distribution of machrophytobenthos' coverage in Hullo Bay.
1 — mud; *2* — muddy sand; *3* — sand; *4* — stones.

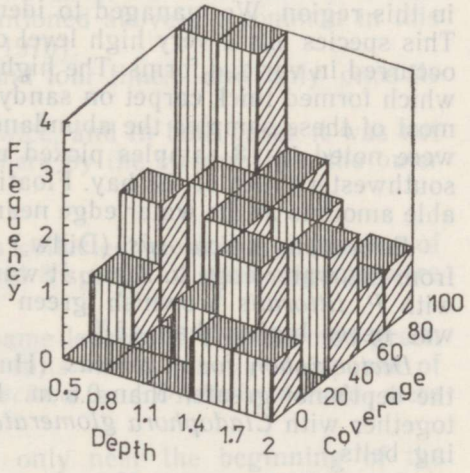

Fig. 4. The relationship of habitat depth (meters) and the distribution of macrophytobenthos' coverage in Hullo Bay.

HULLO BAY. The distribution of bottom vegetation in Hullo Bay has a certain regularity and is caused by definite environmental factors; for example, the coverage of the bottom by vegetation (% of covered bottom) depends directly on the depth and the bottom composition (Figs. 3 and 4). The analyses of the structure and distribution of communities of bottom vegetation in this area merits separate investigation, so this subject will not be dealt with in this paper. Here we shall only try to give a detailed picture of the species composition.

Among the **red** algae the highest frequency was noted for *Ceramium tenuicorne* (Kutz.) Waern. It was found at the depths from 0.5 m up to 2.8 m. This algae had the highest abundance at the depth of 0.7 m on sandy bottoms. Very often it was wrapped around the thallus of charophyta. *C. tenuicorne* is very common to the Estonian waters, and was found on different depths up to 18 m (Trei, 1991; Трей, 1976).

The *Polysiphonia nigrescens* (Hudson) Grev. is the second more frequent algae. It was found at 18 stations at the depths from 0.5 m to 2.8 m mostly on a stony bottom. The highest estimated abundance was 40%, and it raised with the increase in depth. This species is also very common in the costal waters of the region, but usually it occurs at the depth of more than 5 m (Трей, 1976).

Species *Ceramium rubrum* (Huds.) C. ag. and *Polysiphonia violacea* (Roth.) Grev. were found only in some samples and never had an abundance higher than 1%. *C. rubrum* was found at the depth of 0.7 m and *P. violacea* at the depth of 1.5 m.

Furcellaria lumbricalis (Hudson) Lamour was found only once at the depth of 1.5 m, it was not fixed to the bottom.

Brown algae were represented by 5 species. The highest frequency had *Pilayella littoralis* (L.) Kjellm. It was found at 38 stations from the water edge to 3 m, and recognized both as an epiphyte on phanerogams on soft bottoms, also attached to the boulders. The estimated abundance was mainly high and it increased with the depth.

Fucus vesiculosus L. was the most frequent species from brown algae in this region. We managed to identify it in 41 samples all over the bay. This species has a very high level of polymorphism and in our samples it occurred in various forms. The highest frequency had the unattached form, which formed thick carpet on sandy bottoms at the depth of 1.5—2.0 m. In most of these samples the abundance was high: 60—90%. Attached forms were noted in 18 samples picked usually deeper than 2 m mainly in the southwestern part of the bay. Floating plants were recognized in considerable amounts at the water edge near the coastline.

Ectocarpus siliculosus (Dillw.) Lyngb. was met 17 times at the depth from the water edge to 2.0 m. It was mostly epiphytic and formed together with *P. littoralis* brownish green layer, 5—10 cm thick. Its abundance was never higher than 45%.

Dictyosiphon foeniculaceus (Huds.) Grev, was found in 7 samples at the depth not greater than 0.5 m. It was found only on large boulders together with *Cladophora glomerata* and *Enteromorpha intestinalis* forming belts.

Sphacellaria arctica Harvey was identified 4 times at the depth of 0.5—2.8 m. Its abundance was higher than 1% at the depth of more than 1.5 m. This species grows on stony bottoms.

Green algae was the most numerous group of the algae in this region. Highest frequency had *Rhizoclonium riparium* (Roth) Harvey. It was found all over observed aquatory, but its abundance was not greater than 10%.

Ulothrix flacca (Dillw.) Thur. occurred at 28 stations. Its abundance was mostly less than 5%, but in one case, at the depth of 0.5 m, it covered stones with thick slimy layer.

Cladophora glomerata (L.) Kutz. was found in 24 samples at the depth from the water edge to 2.8 m. It grew like epiphyte on other plants and algae, but it also formed belts on big rocks. Its abundance was mostly high, sometimes even 99%. Wet weight of these samples exceeded 2000 g/m^2. This species is very common in Estonian waters (Kukk, Martin, 1992; Кукк, 1977; Трей, 1977).

Enteromorpha intestinalis (L.) Link was recognized in 12 samples. It covered small stones, and it formed belts on big rocks. It was found at the depth of 0.5—1.5 m.

Chaetomorpha linum (O. F. Mull.) Kutz. was found 11 times with the average abundance of mostly 1%.

Urospora penicilliformis (Roth.) Aresch. was found once at the depth of 1.5 m with *Pilayella littoralis*. Its abundance was less than 1%.

Spirogyra sp. was found at 19 stations with low abundance, mostly less than 1%. Very often it was found aggregated with *Ulothrix flacca* and *Pilayella littoralis*.

From **charophytes** we identified 4 species in Hullo Bay. The highest frequency had *Chara fragilis* Desv. It covers, together with *Chara aspera* Deth ex Wild., soft bottoms in the northern part of the bay. *Chara fragilis* was not met deeper than 1.5 m.

Chara baltica Bruz. and *Chara neglecta* Hollerb. were recognized in samples from the northern part of the bay. They occupy the soft bottoms together with *Ch. fragilis* and *Ch. aspera*, but their abundance was always low.

In Hullo Bay we discovered 5 species of **phanerogams**. The highest frequency had *Potamogeton pectinatus* L. It was identified in 32 samples all over the bay, mainly on soft bottoms. Its abundance decreased with the depth.

Potamogeton perfoliatus L. was found almost in the same places as *P. pectinatus*, but it seems to prefer more shallow water.

Myriophyllum spicatum L. was found at 10 stations, mostly on soft muddy bottoms. These three species mentioned above are common in this area, especially in Haapsalu Bay (Trei, 1970).

Ranunculus baudotii Godr. was found four times, and only once its abundance was higher than 15%.

Zostera marina L. was recognised twice, and in both cases it was not fixed, it had supposedly been brought there by the stream from the outer sea.

THE VAE STREAM. From samples collected in stream 3 species of Chlorophyta, 1 species of Charophyta and 8 species of phanerogams were identified.

All *Chlorophyta* were found at the same locations. They formed green tufts attached to phanerogams. These tufts were mainly composed of *Cladophora glomerata*, and *Ulothrix speciosa* and *Ulothrix zonata* were found between it.

Chara fragifera Durieu was found only near the beginning of the stream at more lighted locations.

Some of the phanerogam species collected from the stream were the same as in the bay. These were *Potamogeton perfoliatus* and *Myriophyllum spicatum*. There were some species found only in this area, such as *Equisetum fluviatile* L. em Ehrh., *Equisetum palustre* L., *Myriophyllum verticillatum* L., and *Potamogeton alpinus* L. *Elodea canadensis* Rich. was of special interest as it is quite common in mainland Estonia water bodies

but was earlier not found on Vormsi Island, and *Littorella uniflora* (L.) Asch. which was earlier recorded only on Saaremaa in 1931 (Lellep, 1973).

LAKE PRESTVIIK. The whole bottom of Lake Prestviik is covered with *Chara polyachanta* A. Br. It grows on a thick layer of mud and is strongly incrusted with lime.

THE SUUR SPRING. The bottom of the spring is composed of thin sand and mud. During summer time the central, deeper part of it is filled with bright green filaments of *Rhizoclonium hieroglyphicum* (C. Ag.) Kütz. mixed with *Spirogyra* sp.

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HULLO LAHE JA SELLE VESIKONNA FÜTOBENTOS (VORMSI SAAR, LÄÄNEMERI)

Georg MARTIN

Vormsi saare vete makrofütobentost ei ole uuritud viimase 50 aasta jooksul. Käesoleva uurimise käigus tehti kindlaks, et Hullo lahes domineerivad liigid: *Cladophora glomerata*, *Fucus vesiculosus* ja *Rhizoclonium riparium*. Selliseid liike nagu *Potamogeton perfoliatus*, *Myriophyllum spicatum* ja *Cladophora glomerata* leiti nii soolasest Hullo lahe veest kui ka Prestviigi järvest välja voolavast ojast. Ojast leitud *Littorella uniflora* on Eesti jaoks haruldane õistaim ning varem teada ainult mõnest leiukohast Saaremaa läänerannikul. Prestviigi järve mudane põhi on kaetud *Chara polyachanta* ühtlase paksu kihiga. Suurallika fütobentose moodustab põhiliselt *Rhizoclonium hieroglyphicum*, mille biomass ulatub 3000 g/m^2.

ФИТОБЕНТОС ЗАЛИВА ХУЛЛО И ЕГО ВОДОСБОРА (ОСТРОВ ВОРМСИ, БАЛТИЙСКОЕ МОРЕ)

Георг МАРТИН

Исследования макрофитобентоса вод о-ва Вормси не проводились долгое время. Нами было определено, что доминирующими видами в этом регионе являются *Cladophora glomerata, Fucus vesiculosus, Rhizoclonium riparium.* Такие виды как *Potamogeton perfoliatus, Myriophyllum spicatum, Cladophora glomerata* были обнаружены как в море, так и в ручье. Вид *Littorella uniflora* ранее был найден только на ограниченной территории на о-ве Сааремаа. Дно озера Преставиик покрыто массивным слоем *Chara polyachanta.* Большой Родник населен в основном видом *Rhizoclonium hieroglyphicum,* биомасса которого достигает 3000 г/м².