Diatom distribution in superficial sediments of northern part of the Curonian Lagoon

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The superficial sediment samples taken in the northern part of the Curonian Lagoon were studied for diatom species composition. On the basis of these studies the diatom complexes characteristic of some bottom areas in the northern part of the Curonian Lagoon were identified. Comparison of diatom species composition in sediments and in the Curonian Lagoon phytoplankton showed the influence on diatom complexes formation in sediments produced by water flows, features of bottom relief, inflows of marine water from the Baltic Sea through the Klaipėda strait and inputs of fresh water from the continent. The obtained data and their comparison imply that formation of diatom complexes in the sediments of the northern part of Curonian Lagoon is predetermined mostly by the bottom relief and water flows.

Keywords: Curonian Lagoon, diatom, superficial sediments

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INTRODUCTION

The Curonian Lagoon phytoplankton in composed of various microalgae, among which a considerable part belongs to diatoms (*Bacilariophyceae*). Diatoms take the second place according to the number of identified species in the Curonian Lagoon phytoplankton (30% of the total species composition; Уселите, 1959; Оленина, 1997) after the *Chlorophyceae* species of algae.

Due to abundance and variability of species structural features of cell wall and good preservation in sediments, diatoms can be investigated not only in water phytoplankton but also in superficial bottom sediments. The diatoms assembled in the superficial sediment layer reflect some recent physical and chemical properties of the water body. The dead diatom cell wall accumulations in sediments are suggestive of the recent living conditions of diatom cells and their distribution in the water body, *i.e.*, it is possible to tell where they lived (in plankton, on the bottom, or grew on various other surfaces in the water) and determine an approximate water salinity. Thus, the diatom complex of superficial bottom sediments is more abundant than that of live phytoplankton. The diatom complex of sediments represents the sum of diatom species composition of a few seasons. Moreover, sediments accumulate not only the planktonic diatoms, but also the ones that used to live on the bottom and other surfaces. The diatom complex development in superficial sediments takes its course under the influence of the whole of natural processes taking place in the water basin, such as water flows, lithological composition of sediments, impact of zooplankton (feeding on phytoplankton) and endurance of cell walls.

MATERIALS AND METHODS

In 1998, the Division of Marine Sedimentology from the Institute of Geography carried out field works in the northern part of the Curonian Lagoon and collected samples of superficial bottom sediments. Eighteen sediment samples (from the 0–5 cm layer) were selected for diatom analysis. The selected samples were composed of fine sediment fractions (expecting greater concentrations of diatoms).

The selected samples were distributed in the profile along the Curonian Spit. In a few places this profile is perpendicularly intersected by short smaller profiles (Fig. 1). This provided a possibility to determine the diatom species composition of the Curonian Lagoon along the spit and continental coast, also across the lagoon in some places.

For separation of the sand fraction, the sandy superficial bottom sediment samples were sieved using a sieve with perforations 0.125 mm in diameter. The further laboratory preparation of superficial bottom sediment samples employed the methods explicitly described in literature (Battarbe, 1986; Miller, Florin, 1989; Диатомовый анализ, 1947). Following the common practice of the preparation of the first samples, the heavy liquid was used to separation diatoms from sediments. It was later observed that the sediments contained very great quantities of diatoms and the extra concentration of diatoms was unnecessary. For this reason the final slides were prodused by collection of sediments into test-tubes immediately after silting.

The microscop analysis for taxonomic description of species was performed with the aid of a Leica microscope (immersion objective 100, ocular 10). In the central part of each slide 500 diatoms were counted or the whole slide was examined when the number of diatoms was small. The diatoms were identified to species or to genesis when there occurred difficulties in identifying species.

For description and ecological characteristics of species, a few main diatom guidebooks were referred to (Intercalibration and distribution of diatom species in the Baltic Sea, 1993–1998; Диатомовый анализ, 1949; Давыдова, 1985). All diatom species were divided into two ecological groups: 1) according to the life-form – planktonic, bottom and epiphytic; 2) according to the water salinity – brackish (mezohalobous – salinity 30–0.2‰) and freshwater (indifferent – diatoms living mostly in fresh water, halophilous – diatoms which reproduce more intensively when there is a slight increase in water salinity) diatoms. With the help of these groups we determined the approximate water depth in the northern part of the Curonian Lagoon and salinity depending on the marine water inflows through the Klaipėda strait.

COMPARISON OF SPECIES COMPOSITION OF PHYTOPLANKTON AND BOTTOM SEDIMENT DIATOMS

Curonian Lagoon is an intermediate link between the continental inflowing rivers (the Nemunas being the main one) and the Baltic Sea. For this reason the microorganisms inhabiting the lagoon are affected by multitude of factors predetermining their diversity and distribution patterns. The Curonian Lagoon phytoplankton has been the object of studies since the beginning of the 20th century. A lot of data are available on its composition and quantity, impact zone of fresh and marine water, and the lagoon eutrophication level which in the last few decades was ever more closely related with the implications of human economic activity (Schmidt-Reis, 1940; Касперовичене, 1990; Носкова, 1971; Оленина, 1997; Уселите, 1959; Янкевичус и др., 1988; Янкавичуте и др., 1987, 1988; Янкавичуте, 1990). According to Červinskas (1957), the annual renovation of the Curonian Lagoon water occurs approximately 3–4 times. The stable lagoon water flow into the sea is supplemented by a sophisticated system of flows within the lagoon itself, which depends on the bottom relief, synoptic seasonal conditions, and marine water inflows (Репечка и др., 1980). For this reason, in S. Ūselytė's (1959) opinion, the Curonian Lagoon provides no favorable conditions for the development of specific and stable phytoplankton. She assumes that the lagoon phytoplankton is composed by species input of rivers, and only a few of them under favorable conditions become abundantly distributed in the lagoon. Notwithstanding the mentioned assumption, the Curonian Lagoon phytoplankton has been subjected to investigation more than once in the last 60 years, revealing that the species composition of diatoms has differences and similarities (Table).

The spring proportion of diatoms in the Curonian Lagoon phytoplankton makes 50–90% (Уселите, 1959). In summer and autumn they cease to be dominant, yet their autumn proportion in the phytoplankton is somewhat higher than in summer. This is mainly accounted for by water temperature, bearing in mind that diatoms reproduce at lower temperatures than other kinds of Curonian Lagoon micro algae. The spatial boundaries of lagoon water surface are highly variable. For this reason it is rather difficult to distinguish different zones according to phytoplankton composition in different regions of water salinity (Оленина, 1997). Nevertheless, long-term phytoplankton investigation data have made it possible for researchers to distinguish certain parts of the lagoon, including the northern part, affected by marine water which extends from the strait up to Juodkrantė. J. Kasperovičienė (1990) analyzed diatoms in the phytoplankton of the northern part of the lagoon (up to Juodkrantė) in 6 selected points distributed approximately in the middle part of the lagoon. I. Olenina (1997) studied the general composition of the lagoon phytoplankton and on the

Table. **Dominating diatom species in phytoplankton of the northern part of Curonian Lagoon according to different authors and different years of investigation**
Lentelė. **Šiaurinės Kuršių marių dalies diatomėjos, vyraujančios fitoplanktone įvairiais sezonais (skirtingų autorių ir tyrimų metų duomenys)**

	Authors and year of investigation				
	H. Schmidt-Reis 1927, 1929, 1932, 1936 ir S. Ūselytė 1951, 1954–57 (1959)	S. Ūselytė, 1951, 1954–57 (1959)	J. Kasperovičienė, 1982–87 (1990)	I. Olenina, 1980–96 (1997)	G. Jankavičiūtė, 1974–75, 1986–87 (1990)
Diatom species	*Melosira islandica* ssp. *helvetica*	*Asterionella formosa*	*Stephanodiscus hantzschii*	*Aulacoseira islandica*	*Asterionella formosa*
	M. binderana	*Cyclotella comta*	*S. minutulus*	*Diatoma tenuis*	*A. gracillima*
	M. granulata	*Melosira* sp.	*Diatoma elongatum*	*Stephanodiscus hantzschii*	*Chaetoceros wighamii*
	Fragilaria brevistriata	*Fragilaria* sp.	*Aulacoseira granulata*	*Sceletonema costatum*	*Cyclotella kuetzingiana*
	F. lapponica		*A. islandica* ssp. *helvetica*	*Fragilaria virescens*	*Cymatopleura solea*
	F. crotonensis		*Stephanodiscus rotula*	*Sceletonema subsalsum*	*Coscinodiscus lacustris*
	F. construens		*Fragilaria inflata* var. *istvanfyi*		*Diatoma elongatum*
	Cyclotella striata		*Sceletonema costatum*		*Fragilaria construens* var. *venter*
	C. comta		*Actinocyclus kuetzingii*		
	Stephanodiscus rotula		*Thalassiosira bramaputrae*		*F. crotonensis*
	S. hantzschii		*Fragilaria construens* var. *venter*		*Melosira binderana*
	Synedra berolinensis		*F. brevistriata*		*M. granulata*
	S. ulna				*M. islandica*
	S. acus				*Nitzschia acicularis*
	Asterionella formosa				*Synedra acus*
	Gyrosigma attenuatum				*Stephanodiscus astrea*
	G. strigile				*St. hantzschii*
	Cymatopleura elliptica				
	C. solea				
	Surirella robusta				
	S. biseriata				
	Lyngbya limnetica				

grounds of their variations distinguished the northern part of the Curonian Lagoon, which includes the area of 20–22 km from the Klaipėda Strait to Juodkrantė (in this part of the lagoon there are 5 observation stations).

The author of the present article has analysed the diatom species composition in 18 samples of superficial bottom sediments, most of which were taken from the western side of the northern part of the Curonian Lagoon (Fig. 1). The common conclusion of researchers who studied the composition of the lagoon phytoplankton is to the effect that planktonic diatoms are the dominant ones. One of the most widespread in 1951–1957 species mentioned by S. Ūselytė (1959) was *Asterionella formosa*. In 1980–1996 (Касперовичене, 1990; Оленина, 1997; Янкавичуте, 1990) this species made the smaller part of plankton, most widespread being *Stephanodiscus hantzschii*. This diatom along with *Diatoma tenuis* is referred to in literature as the most abundant in eutrophic water basins (Глезер и др., 1974, 1988; Петрова, 1990; Янкавичуте, 1990). The content of freshwater planktonic diatom *Stephanodiscus hantzschii* in superficial bottom sediments examined by the author of the present work was small (about 2% of the total amount of diatoms, Fig. 4). The planktonic diatom *Stephanodiscus rotula* et var. *minutulus*, which in 1982–1987 was mentioned among the dominant species in plankton (Касперовичене, 1990), today is not one of the dominant, comprising from a few to 14%, whereas *Diatoma elongatum* was found only in a few samples as solitary diatoms. The dominant freshwater species in the phytoplankton investigated by the mentioned authors and superficial bottom sediments investigated by the author of the present article are *Aulacoseira islandica* et var. *helvetica*, *A. granulata*, *Fragilaria* sp. (Table).

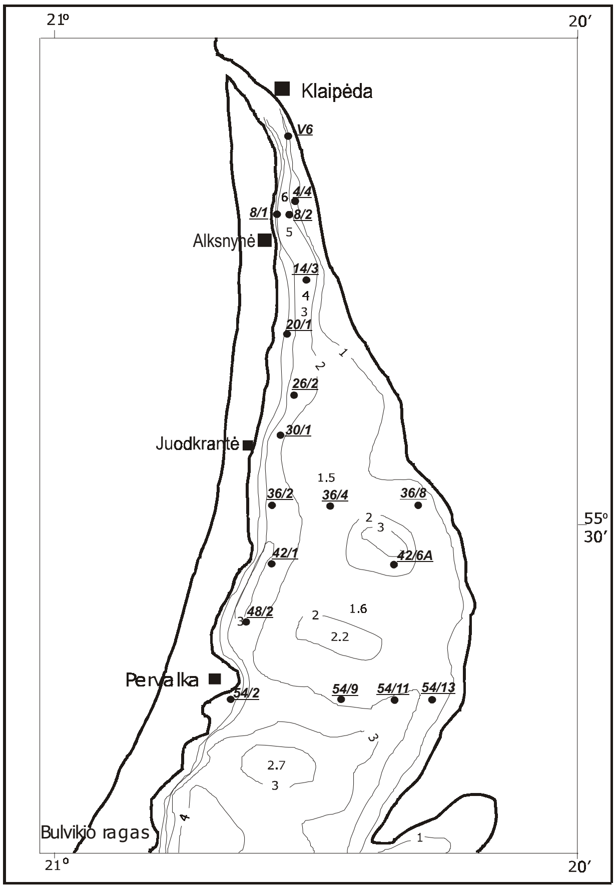

Fig. 1. Bathymetry map of the northern part of Curonian Lagoon (according to Červinskas, 1955) and location of the superficial bottom sediment samples studied
1 pav. Šiaurinės Kuršių marių dalies batimetrinis žemėlapis (pagal Červinską, 1955). Analizuotų paviršinių dugno nuosėdų pavyzdžių išsidėstymas

Diatoms tolerant to saline water become more widespread in the lagoon plankton in summer when the input of fresh water is smaller but marine water invades deeper into the lagoon. The following species may be mentioned among the widespread ones: *Sceletonema costatum*, *S. subsalsum*, *Actinocyclus kuetzingii*, *Thalassiosira bramaputrae* (Касперовичене, 1990; Оленина, 1997). The superficial bottom sediments were predominated by *Actinocyclus normanii* (up to 50% in some samples), *Thalassiosira lacustris* being also rather frequent (Fig. 4).

The mentioned differences between the diatom species composition in phytoplankton and bottom sediments are apparently predetermined by a few reasons. The sampling sites of phytoplankton and bottom sediments do not coincide, whereas the composition of lagoon plankton is apparently rather variable and of local character. Some species inhabit very narrow areas with specific ecological conditions. Therefore, it is natural that they are found in bottom sediments distributed over small areas. The freshwater bottom diatom *Navicula scutelloides* may serve as an example. In the bottom sediments of the eastern part of the lagoon it is found in abundance (up to 80%), whereas in other samples it occurs as solitary cases. This species is altogether absent in phytoplankton composition, despite that commonly plankton contains many species of this group which accumulate in plankton as a result of water hydrodynamics.

As is pointed out in literary sources (Давыдова, 1985), some species of diatoms (with thin and fragile cell walls) dissolve while sinking to the bottom or degrade in bottom sediments, because they lack resistance. Probably, the diatoms from the *Aulacoseira* sp., *Actinocyclus* sp., *Fragilaria* sp. are more resistant, accounting for their accumulation in bottom sediments in greater abundance.

The mezohalobous *Actinocyclus normanii* may be mentioned as one of the dominant species in bottom sediments. It is found in greater abundance in the Panerija Depression where the influence of marine water is greater than in other parts of the lagoon. Probably the lagoon plankton is not the only source of this species. Part of it might have been transported from the sea. By different kinds of analysis it was determined that the strait dredging accounts for 12–15% or even 20–25% of extra water from the Baltic Sea (Кирлис и др., 1987; Gailiušis ir kt. 1996). Marine water is first of all dispersed along the western side of the lagoon, what accounts for the higher accumulation values of the brackish diatom *Actinocyclus normanii*, the greater resistance of its cell wall to surroundings, being probably the second reason.

The diatom species composition of the Curonian Lagoon phytoplankton and bottom sediments implies that diatom complexes in sediments depend not only on the species inhabiting phytoplankton, but also on the lagoon bottom relief and the system of water flows.

INFLUENCE OF BOTTOM RELIEF ON THE FORMATION OF DIATOM COMPLEXES IN SEDIMENTS

The Curonian Lagoon is a semi-closed water basin which is separated from the Baltic Sea by the Curonian Spit and the Klaipėda Strait. These barriers limit the inflows of marine water, which are stronger only in the northern part of the lagoon. Marine water invasions are usually felt up to the latitude of Juodkrantė and Pervalka. In recent years marine water has been sometimes recorded at Nida as a result of the Klaipėda Strait dredging and favorable meteorological conditions (Žaromskis, 1996). The input of marine water into the northern part of the lagoon is facilitated by the bottom relief. In this part of the lagoon two forms of relief can be distinguished. One of them is represented by a rather large plateau in the eastern sector, which is slightly inclined in the western direction. The dominant depth is 2 m. Between Juodkrantė and Pervalka the plateau surface has two depressions where the depth exceeds 2 m. This form of relief has been generated by accumulation of coarse fractions of river sediments. The vital activity of biocenoses in this sector also plays an important role. The width of the plateau is from 2 km to 8–10 km. It narrows in the Klaipėda Strait area where the Kiaulės Nugara bank has developed. At a low water level this bank emerges as an isle. The Panerija Depression is the second distinct form of relief in the northern part of the lagoon. It extends along the Curonian Spit. The plateau and the depression are separated by a 2 m isobath. The isobath is situated about 2 km from the Ventės Ragas cape and stretches towards the Šventelė mire. Further in the north it makes a sudden turn to the west. At Juodkrantė the isobath comes close to the Curonian Spit, leaving a territory of about 1.5 km wide stretching along the spit to the submarine Panerija Depression with steep slopes. North of Juodkrantė the 2 m isobath moves away from the spit to the east and extends through the middle of the strait towards the Kiaulės Nugara bank. At this bank the width of depression is only 0.2–0.3 km, the depth from 2–3 m to 5–7 m (Fig. 1). The depression abounds in narrow troughs along the spit, which are separated by small elevations of morainic surface. The Panerija Depression is the main form of relief where water circulation between the Baltic Sea and the Curonian Lagoon takes place. It is through the Panerija Depression that marine water inflows the lagoon (under favorable conditions), as the eastern part of the lagoon is more shallow than the western sector (Гуделис, 1959; Репечка и др., 1980).

Analysis of diatom investigation data for the superficial bottom sediments of the northern part of the lagoon suggests an assumption that bottom relief is one of the main factors predetermining the accumulation differences of diatom species. The nar-

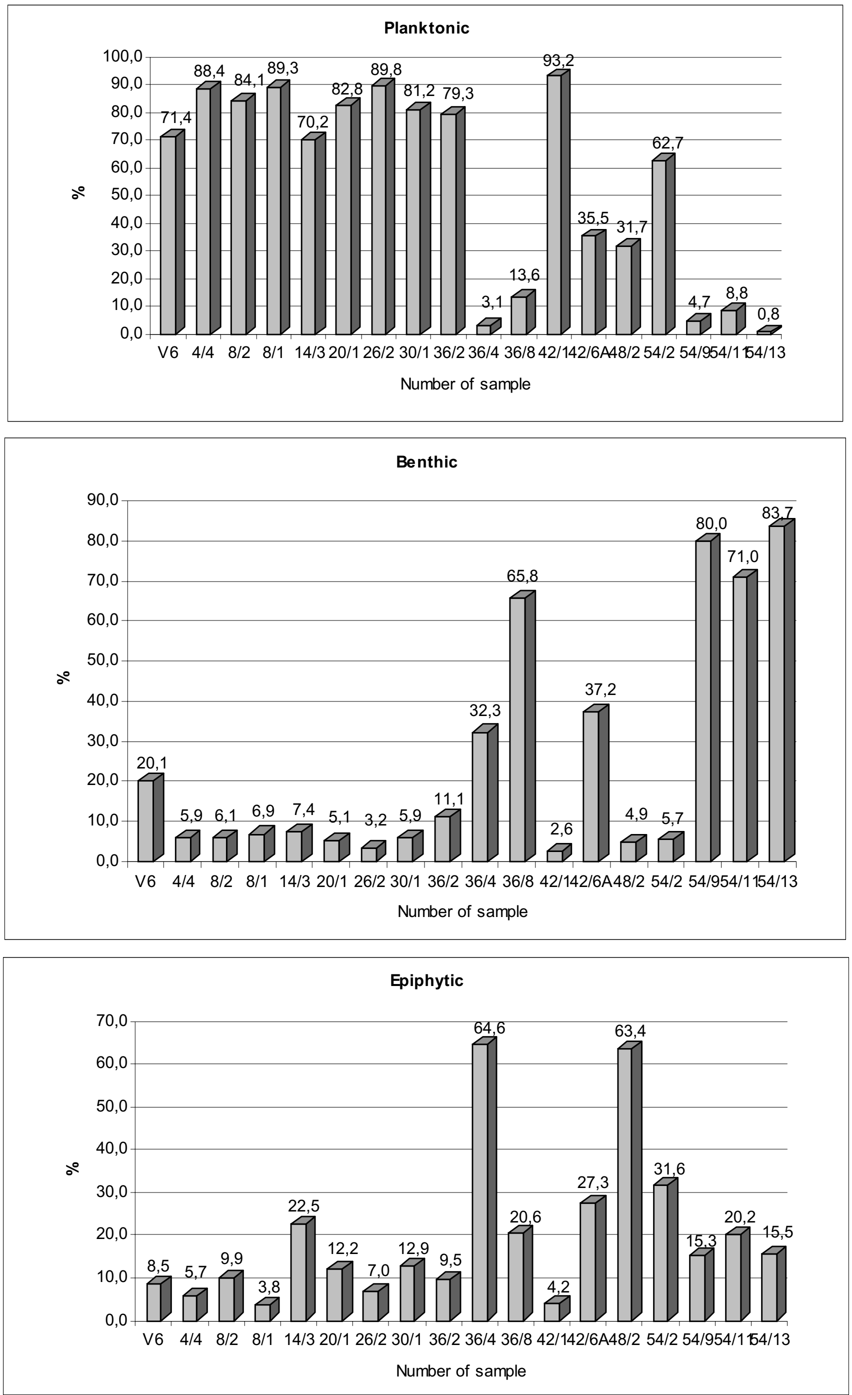

Fig. 2. Diatom composition in the superficial bottom sediment samples according to life-form

2 pav. Diatomėjų sudėtis paviršinių dugno nuosėdų pavyzdžiuose pagal jų paplitimo vietą vandens baseine

row but rather deep Panerija Depression stretching along the coast is the assemblage zone of planktonic diatom species. The investigated superficial sediments in the western part of lagoon (st. 4/4, 8/1, 14/3, 20/1, 26/2, 30/1, 36/2, 42/1, 54/2) contain 70–93% of planktonic diatoms from the total sum of diatoms, whereas in the eastern part (st. 36/8, 54/9, 54/11, 54/13) only from 1 to 14% (Fig. 2). In st. 42/6A, which is also situated in the eastern part of study area, the proportion of planktonic diatoms is 35%. This value is somewhat higher than in other eastern stations, what probably can be explained by the fact that sediments were sampled from a smaller depression with the depth more than 3 m (Fig. 1). This instance may serve as a proof that deeper lagoon areas (Panerija Depression and depressions in the eastern part of the lagoon) are assemblage zones of planktonic diatoms, whereas the more shallow areas (plateau in the eastern part of the lagoon where the depth does not exceed 2 m) are predominated by benthic diatoms. According to the life-form of the diatom group contained in bottom sediments, the northern part of the Curonian Lagoon can be divided into two areas: 1) the narrower and deeper western area along the spit coast, including the Panerija Depression, and 2) the wider and shallower eastern part coinciding with the shallow eastern part of the Curonian Lagoon.

According to A. Willer's (1931) data, the long-term water salinity of the Curonian Lagoon is very low, yet it may reach 5.2‰. In I. Olenina's (1997) work there is an indication that the lagoon water salinity may vary from 0 to 6.8‰. The northern part of the Curonian Lagoon is the area where the influence of marine water is obvious. Approaching the lagoon mouth the long-term salinity value becomes higher.

According to the data of long-term investigations, the main route of marine water invasions into the lagoon extends along the western coast. This is predetermined by greater depths in the mentioned area and by the fact that the spit shelters the lagoon

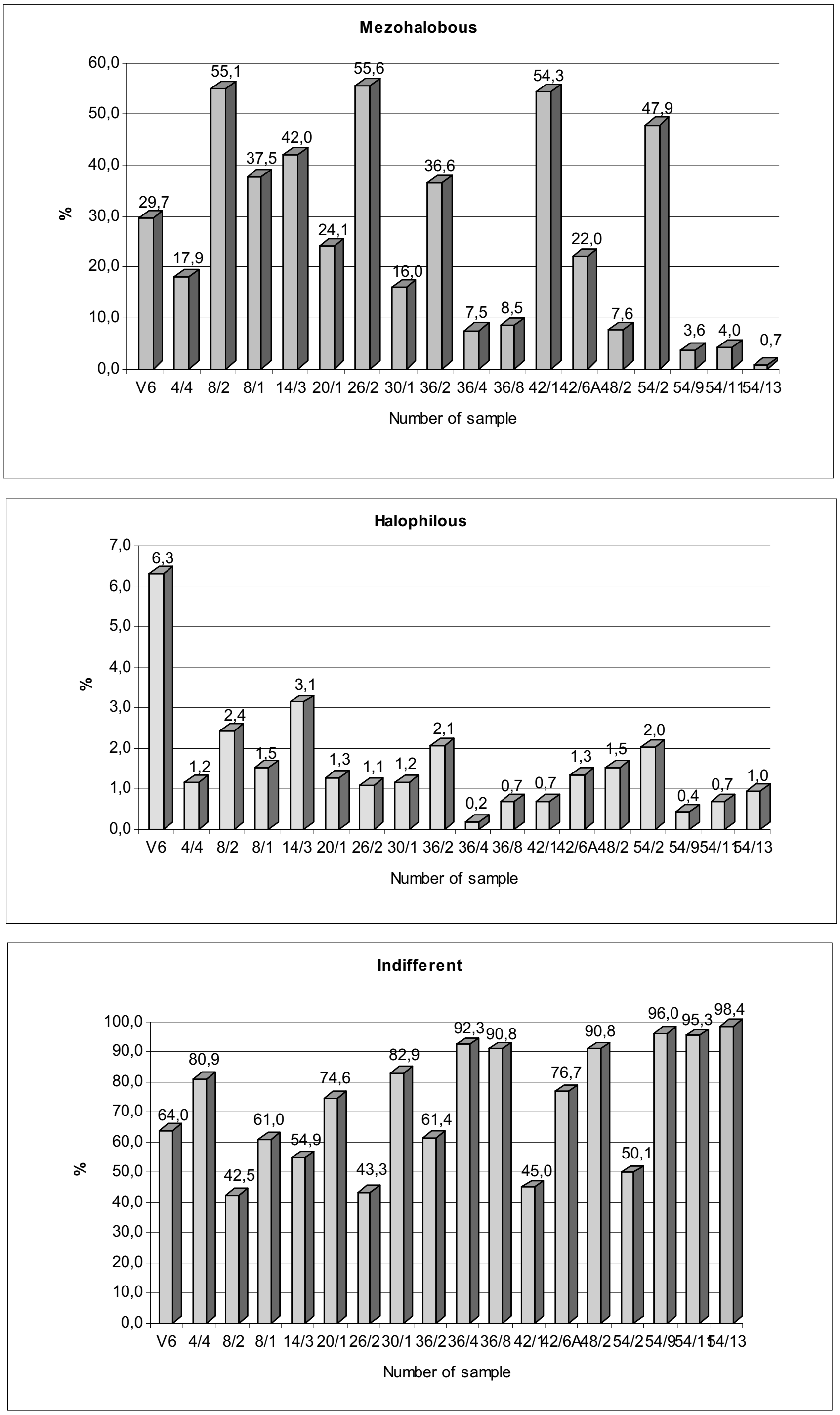

Fig. 3. Diatom composition in the superficial bottom sediment samples according to water salinity

3 pav. Diatomėjų sudėtis paviršinių dugno nuosėdų pavyzdžiuose pagal vandens druskingumą

from the western winds. The dominant W and SW winds push the excess of fresh water from the northern part of the lagoon into the sea along the eastern coast (Червинскас, 1959; Žaromskis, 1996). The diatom complexes of superficial bottom sediments in the northern part of the lagoon are predominated by indifferent species, what allows to attribute the lagoon water to the fresh water category (Fig. 3). Though mesohalobous diatoms in the sediments of the northern part of the Curonian Lagoon yield in content (1–55% of the total sum) to freshwater diatoms, their content variations mirror the differences (through negligible) in water salinity. In stations 8/2, 8/1, 14/3, 26/2, 36/2, 42/1, 54/2 mesohalobous diatoms make up 38–55%. All these sediment samples were taken from the western part of the Curonian Lagoon from the depth of 3 m and more. In the samples taken from the eastern part of the area (st. 36/4, 36/8, 54/9, 54/11, 54/13) mesohalobous diatoms account for 1–8% (Fig. 3). The mentioned stations are distributed in the shallow plateau of the northern part of the lagoon, the depth of sampling was 2 m or less (Fig. 1). The species composition and distribution of diatoms in superficial bottom sediments of the northern part of the Curonian Lagoon are in a rather good correlation with the mentioned bottom relief influence on the mechanism of marine water inflow into the lagoon. Commonly the marine water invades the lagoon along its western coast when dominate salt streams from the sea. In this part of the lagoon the water salinity is apparently somewhat higher than in the eastern near shore. Persistence of higher salinity values in the rather deep Panerija Depression is responsible for a greater distribution of mesohalobous planktonic diatoms (some of them come from the sea) whose cell walls settle down on the bottom. The outflow of fresh water prevailed in the more shallow eastern part of the area, what accounts for higher concentrations of freshwater bottom diatoms in the sediments. The implications of diatom species composition in the superficial sediments of the northern part of the Curonian Lagoon are that bottom relief is a very important factor in the formation of diatom complexes in sediments.

INFLUENCE OF WATER FLOWS ON THE DIATOM COMPLEXES FORMATION IN SEDIMENTS

The water flows in the northern part of the Curonian Lagoon are dependent not on the strong fresh water input from the Nemunas, but also on marine water invasions. This part of the lagoon is predominated by fresh water outflow, which becomes particulary strong in spring when the lagoon receives huge amounts of spring flood water.

The system of flows and currents changes when the marine water invades the lagoon. Such changes often occur in summer when the terrestrial water inputs are minimal but the marine water level is slightly higher, and in autumn when the frequency of storm set-up-induced sea water level oscillations increase. In two seasons there occur favorable conditions for water outflows into the sea. Based on salinity measurements and data on European smelt migration, A. Willer (Willer, 1933) was the first to compile a general lagoon water circulation scheme under conditions of salty water invasion. Following this pattern, an inflow of salty water occurs at the western coast and an outflow of fresh water at the eastern coast of the lagoon. The formation of these flows is affected by bottom relief features. The bottom in the northern part of the lagoon is composed of small elevations and a lowering extending across the lagoon. Such elevations are situated at the Bulvikio Ragas cope, Pervalka, Juodkrantė and Alksnynė. Above these elevations the flow velocity increases and above the lowering decreases. The high water level in the lagoon and the low hydraulic conductivity of the Klaipėda strait may induce the formation of a cyclic system of currents. In H. Schmidt-Reis opinion, the water surging through transversal lowering from the Panerija Depression into the eastern (shallower) part of the lagoon acts as the main impulse for this formations (Žaromskis, 1996).

As was already mentioned, most of the sampling stations are distributed in the western nearshore of the Curonian Lagoon – in the region of the Panerija Depression (Fig. 1). At stations 8/1, 14/3, 20/1, 26/2, 30/1, 36/2, 42/1, 48/2, 54/2 the depth is about 2.5 m (from 2.7 m to 5.2 m). The sediments are composed of fine-grained aleurite mud or aleurite-pelite mud. It was expected that diatom complexes in all mentioned samples would be similar as were the sampled sediments. The grouping of diatoms according to the degree of tolerance to salinity revealed that in many samples from the western stations mesohalobous species accounted for 54% of the total diatom sum. Yet, samples from three stations (20/1, 30/1 and 48/2) stood out for a considerably lower proportion of mesohalobous diatoms – 16% on the average (from 7.6 to 24%, Fig. 3). Apparently the formation of diatom complexes in the northern part of the lagoon is influenced by currents. The cyclic currents facilitate fresh and marine water mixing in some areas of the Panerija Depression, resulting in the fall of salinity values and a wider distribution of freshwater species. For this reason, some samples taken close to the spit contain higher concentrations of freshwater diatoms.

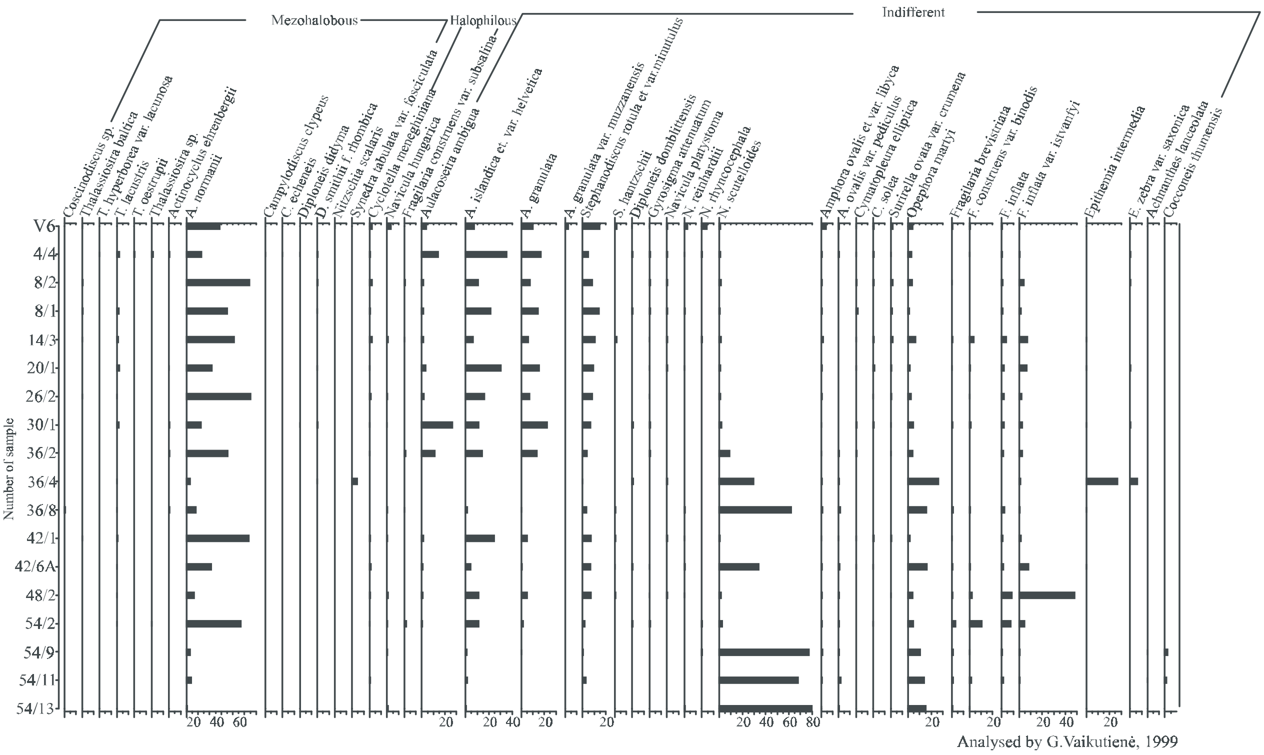

Fig. 4. Characteristic diatom species in the superficial bottom sediment samples in the northern part of the Curonian Lagoon

4 pav. Vyraujančios diatomėjos paviršinių dugno nuosėdų pavyzdžiuose šiaurinėje Kuršių marių dalyje

The second probable reason is that the currents mixing salty and fresh water also mix micro algae. The higher number of freshwater species in samples from stations 20/1, 30/1 and 48/2 (than in other stations of the western near shore) does not necessarily mean that freshwater diatoms are more widespread in these areas. They might have been carried from the eastern nearshore of the lagoon. In samples 20/1 and 30/1 the dominant freshwater planktonic species are *Aulacoseira islandica* et var. *helvetica*, *A. granulata, Stephanodiscus rotula* and in sample 48/2 *Fragilaria inflata* var. *istvanfyi* (Fig. 4). The second mentioned reason is more probable, because sample 48/2 contained many epiphytic species which are not characteristic of sediments from the Panerija Depression, but are found in more shallow areas. If the currents in the western nearshore slightly reduced the salinity value, all samples would probably be predominated by planktonic species, because in deeper areas the species of epiphytic and bottom diatoms are commonly scarce. In the case under consideration the cyclic currents in the northern part of the lagoon apparently mix the water and microorganisms or even the superficial bottom sediments, what accounts for accumulation in the Panerija Depression of not only inhabiting diatoms, but also diatoms transported from the eastern (more shallow) part of the lagoon.

IMPACT OF MARINE WATER INFLOW ON THE FORMATION OF DIATOM COMPLEXES IN SEDIMENTS

The Curonian Lagoon water salinity is very low. However, according to the level of mineralization the Curonian Lagoon is divided into two parts: the southern and the central part, on the one hand, where water mineralization is low, and the northern part where mineralization is higher due to marine water invasion (Юревичус, 1959). The inflows of marine water into the northern part of the lagoon vary by seasons. As was already mentioned, the inputs of marine water are greatest in summer and autumn and smaller in spring. The dispersion of marine water in the northern part of the lagoon depends not only on the synoptic situation or river input, but also on the bottom relief. Under favorable conditions marine water fills not only the depression, but also the whole northern part of the lagoon.

We can see from diatom complexes in the superficial sediments that such conditions occur infrequently, because the number of brackish diatoms in the sediments is rather small and diverse (Fig. 3). When it happens, marine water fills the whole northern part of the lagoon for a short time span, and brackish diatom species have no time to spread and accumulate in sediments. The content of diatoms in the superficial bottom sediments of the northern part of the lagoon is a rather reliable reflection of the lasting impact of marine water, *i.e.*, higher salinity water stays longer in the Panerija Depression, whereas in the eastern, shallow part of the lagoon the value of mineralization is lower.

Among brackish diatom species contained in samples 8/1, 8/2, 26/2, 36/2, 42/1, 54/2 there prevail *Actinocyclus normanii* (up to 50%) and in samples from eastern stations their proportion is smaller (Fig. 4). The mentioned diatom was attributed to the group of mesohalobous, but it can be found in water with different salinity. Therefore *Actinocyclus normanii* was found in greater or smaller amounts in all samples. In samples from the eastern stations (36/4, 36/8, 54/9, 54/11, 54/13) the content of this diatom is small – only 5%. It is possible that *Actinocyclus normanii* exists in deep areas of brackish water, but it can be carried to fresh shallow areas by currents.

The studied northern part of the Curonian Lagoon may be subdivided into two parts: the northern (with higher water salinity) and the southern (with lower water salinity). Despite that the variations of species composition are not so prominent as in the western and eastern nearshore of the lagoon, they are identifiable. Station 48/2 at Pervalka may be taken as a separating boundary (Fig. 3). North of point 48/2 the total number of brackish diatoms is higher than in the stations southward (54/2, 54/9, 54/11, 54/13). At the western neatshore of the study area the greatest amount of brackish diatoms makes about 55%. In station 54/2 their portion is 48%. Even at the eastern nearshore of the lagoon north of station 48/2 samples in points 36/4, 36/8 contain 9% of mesohalobous. South of the mentioned station samples 54/9, 54/11, 54/13 contain only 0.7–4% of brackish diatoms (Fig.). Water salinity has an influence on diatom complexes formation in sediments. However, the phytoplankton composition in the lagoon is determined by the features of bottom relief and specific hydrodynamic regime provided by them.

CONCLUSIONS

Some diatom species in phytoplankton inhabit very narrow areas with specific ecological conditions. Naturally, they occur in bottom sediments in very small areas. Methods of investigating phytoplankton and bottom sediments were different, so this may be a reason for differences in diatom complexes.

The accumulation of diatoms in sediments is strongly influenced by the bottom relief of the northern part of the Curonian Lagoon: the deeper areas are inhabited by greater amounts of planktonic diatoms, whereas the shallower areas are predominated by shallow water benthic and epiphytic diatoms.

Hydrodynamic conditions play a very important role in the development of diatom complexes – the currents mix up the water and microorganisms (or even the superficial bottom sediments). For this reasons sediments of the Panerija Depression contain in abundance not only the local brackish planktonic diatoms, but also the diatoms transported from the more shallow eastern part of the lagoon.

The water salinity in the northern part of the Curonian Lagoon depends on the input of marine and fresh water. For this reason the values of lagoon water salinity are unstable and provide no time for the development of specific phytoplankton. Consequently, the accumulation of diatoms in sediments is to a greater extent affected by water currents.

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Giedrė Vaikutienė

DIATOMĖJŲ PASISKIRSTYMAS PAVIRŠINĖSE DUGNO NUOSĖDOSE ŠIAURINĖJE KURŠIŲ MARIŲ DALYJE

S a n t r a u k a

Paviršiniame nuosėdų sluoksnyje susikaupusios diatomėjos atspindi netolimos praeities vandens baseino fizines bei chemines sąlygas (dažniausiai nusakomas vandens gylis ir apytikris druskingumas). Kuršių marios yra tarpinė grandis tarp įtekančių upių iš žemyno (pagrindinė – Nemunas) ir Baltijos jūros, todėl jose gyvenančius mikroorganizmus veikia daug skirtingų gamtinių procesų.

Straipsnio autorė išanalizavo 18 paviršinių nuosėdų pavyzdžių ir apibūdino diatomėjų rūšinę sudėtį. Kuršių marių fitoplanktoną pastaruosius keliasdešimt metų tyrinėjo kiti autoriai (Каспepовичене, 1990; Носкова, 1971; Оленина, 1997; Уселите, 1959; Янкевичус и др., 1988; Янкавичуте и др., 1987, 1988; Янкавичуте, 1990). Palyginus fitoplanktone esančių diatomėjų rūšinę sudėtį su nustatytomis paviršinėse dugno nuosėdose, aptikta nemažai skirtumų ir tik kelios gėlavandenės rūšys – *Stephanodiscus rotula* et var. *minutulus*, *Aulacoseira islandica*, *A. granulata*, *Fragilaria* sp. buvo surastos abiem atvejais. Skirtumai rūšinėje sudėtyje galimi dėl to, kad nesutampa fitoplanktono ir nuosėdų tyrimo taškai, skiriasi diatomėjų kiautelio tvirtumas, buvo naudojamos įvairios tyrimų metodikos.

Šiaurinėje Kuršių marių dalyje išsiskiria dvi ryškios dugno reljefo formos – gilesnis Panerijos duburys (išilgai Kuršių nerijos) ir seklesnis plato rytiniame marių pakraštyje. Atlikti tyrimai rodo, kad dugno reljefas turi didelę įtaką diatomėjų paplitimui ir susikaupimui nuosėdose. Panerijos duburyje daugiau rasta planktoninių diatomėjų, o seklesniame rytiniame marių pakraštyje vyrauja gėlavandenės dugno ir apaugimo rūšys.

Dėl dugno reljefo ypatumo jūrinis vanduo iš Baltijos jūros per Klaipėdos sąsiaurį pirmiausiai patenka į šiaurinės Kuršių marių dalies gilesnį Panerijos duburį, kuriame padidėja vandens druskingumas. Čia nuosėdose randama daugiau mezohalobinių planktoninių rūšių diatomėjų, kurių dalis gali būti atnešama iš jūros. Rytiniame, seklesniame, marių pakraštyje dėl įtekančių upių vandens druskingumas mažesnis, todėl nuosėdose vyrauja gėlavandenės dugno ir apaugimo diatomėjos.

Kai kuriuose nuosėdų pavyzdžiuose iš gilesnės marių dalies buvo randama gėlavandenių apaugimo ir dugno diatomėjų, būdingų seklesniam rytiniam marių pakraščiui. Taip gali būti dėl to, kad srovės sumaišo ne tik vandenį, bet ir vandenyje esančius mikroorganizmus.

Гедре Вайкутене

РАСПРЕДЕЛЕНИЕ ДИАТОМОВЫХ ВОДОРОСЛЕЙ В ПОВЕРХНОСТНОМ СЛОЕ ДОННЫХ ОСАДКОВ СЕВЕРНОЙ ЧАСТИ КУРШСКОГО ЗАЛИВА

Р е з ю м е

Диатомовые водоросли в поверхностном слое донных осадков северной части Куршского залива отражают физико-химические особенности водного бассейна (приблизительную глубину и соленость), существовавшего в прошлом. Куршский залив – промежуточное звено между впадающими реками (главная – Нямунас) и Балтийским морем. Поэтому распределение микроорганизмов в донных осадках обусловливается несколькими факторами.

Автором настоящей статьи проанализировано 18 проб поверхностного слоя донных осадков (до 5 см) из северной части Куршского залива. За последние десятилетия фитопланктон залива исследовали несколько авторов (Касперовичене, 1990; Носкова, 1971; Оленина, 1997; Уселите, 1959; Янкевичус и др., 1988; Янкавичуте и др., 1987, 1988; Янкавичуте, 1990). В результате сопоставления видового состава диатомей фитопланктона и поверхностного слоя донных осадков установлены довольно большие различия и лишь несколько видов были преобладающими и в фито-

планктоне, и в донных осадках – *Stephanodiscus rotula* et var. *minutulus, Aulacoseira islandica, A. granulata, Fragilaria* sp. Различия видового состава могут быть обусловлены: 1) несовпадением точек исследований фитопланктона и донных осадков, 2) разностью устойчивости диатомового панцыря разных видов, а также различиями методики микроскопического анализа.

В северной части Куршского залива преобладают следующие формы рельефа: сравнительно глубокая прикосовая ложбина, вытянутая вдоль Куршской косы, и широкое плато, расположенное на восточной части залива, глубиной до 2 м. Исследования показали, что рельеф дна оказывает достаточно большое влияние на распределение и скопление в осадках диатомовых водорослей. В районе прикосовой ложбины преобладают планктонные виды, а на территории плато в осадках скопились диатомовые из обрастаний и донные виды.

Рельеф дна предопределяет течения морской воды через Клайпедский пролив из Балтийского моря в первую очередь на прикосовую ложбину. Здесь обнаружено довольно большое количество мезогалобов планктона в осадках, часть которых, возможно, принесена с моря. На восточном побережье залива соленость воды ниже из-за влияния впадающих рек. Здесь преобладают пресноводные виды диатомей.

В некоторых пробах из более глубоких участков обнаружено довольно большое количество пресноводных диатомей, характерных для восточного мелководного побережья залива. Причиной этого явления могут быть течения, которые смешивают воду и обитающие в ней микроорганизмы.