MACROPHYTE FLORA AND VEGETATION OF LAKE RIČU

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Lake Riču is a unique freshwater ecosystem of international importance situated in the very south-east of Latvia on the state border between Latvia and Belarus and being under state protection since 1977 in Latvia (Silene Nature Park, Natura 2000 place) and since 1979 in Belarus (Riči Hydrological Reserve). Its area is 12.88 km^2 and it is the 12th largest and the 3rd deepest lake of Latvia (51.9 m). The lake is characterized by a very complicated configuration with many peninsulas and bays, a very wide littoral (50 – 300 m) with predominantly mineral sediments as well as by a remarkable water quality with the transparency reaching 5 – 6 m even during the summer period and thus creating very favourable conditions for the development of diverse aquatic vegetation. Because of these qualities, the lake harbours a unique biota characterized by the presence of many relict species from the Glacial and Postglacial (Boreal) periods and represented by crustaceans – *Limnocalamus macrurus*, *Mysis relicta*, *Pallasea quadrispinosa*, *Pontoporeia affinis* as well as by vascular plants – *Isoetes lacustris*, *Najas flexilis*, *Nuphar pumila*.

The article gives also a review of the history of botanical investigations in Lake Riču started by the Baltic German botanist Theophil Bienert (1833 – 1873) in 1860. The investigations of the macrophyte flora and vegetation of the whole Latvian (northern) part of the lake (5.89 km^2) by the author were started in 1989 – 1990 and completed in 2007. The study revealed that Lake Riču maintains an unusually rich macrophyte flora of altogether 69 species represented by 9 charophyte, 8 bryophyte and 52 vascular plant species among them. The richest family is *Potamogetonaceae* represented by altogether 13 pondweed species that makes up more than two thirds of the Latvian pondweed flora (16 species). Besides the mentioned relicts, macrophyte flora is characterized by 9 other rare and endangered species: charophytes – *Chara filiformis*, *Ch. strigosa*, bryophytes – *Fontinalis hypnoides*, *Platyhypnidium riparioides*, vascular plants – *Callitriche hermaphroditica*, *Potamogeton acutifolius*, *P. pusillus*, *P. rutilus* and *Scolochloa festucacea*. The vegetation of Lake Riču is described according to the dominating species.

Key words: macrophytes, vascular plants, flora, vegetation, lakes, Latvia.

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Introduction

Latvia is a country rich in lakes because its territory is crossed by the Baltic Lake District (Sleinis 1936). Before World War II the total number of lakes larger than 1 ha made up 2980 and their total area constituted 1.64% of the territory of Latvia (Ozoliņš 1932, Slaucītājs 1936). In addition to that, there was also a considerable number of lakes smaller than 1 ha (at least some

hundreds), so that the total number of natural lakes at that time definitely exceeded 3000. In course of last 70 years the number of lakes has considerably decreased because rather many of them have been drained or have overgrown naturally. Recent inventories provide data about 2084 Latvian lakes with the area larger than 1 ha that constitute 1.5% of the territory of Latvia (Glazačeva 2004). The actual number of natural lakes is definitely considerably higher because there are a lot of lakes which are smaller than 1 ha. For example, the last inventory mentions 195 lakes for Daugavpils District and 252 ones for Krāslava District, i.e., altogether 447 lakes larger than 1 ha (Glazačeva 2004). A more accurate survey of all the lakes including those smaller than 1 ha shows that the actual number of natural lakes in both districts is much higher – 256 of them in Daugavpils District and 325 of them in Krāslava District, i.e., altogether 581 natural lake (Suško 2008a). The difference between both surveys makes up altogether 134 lakes or 23% of the actual number of natural lakes in these two districts. This example allows us to judge that the actual number of natural lakes in Latvia should be at least 2500 because there are altogether 26 districts in the country.

South-east Latvia (South-east Geobotanical Region) is the richest region in lakes in the country. There are about 950 lakes with the area larger than 1 ha here, i.e., more than 800 in Latgale Highlands (the central and northern part of the region) and about 144 in Augšzeme Highlands (the southern part of the region) (Āboltiņš 1995, Suško 1995). Taking into account all the lakes (including those smaller than 1 ha), the total number of lakes in this region certainly exceeds 1000 because the total number of all natural lakes in Augšzeme Highlands (the Ilūkste Lakeland) is about 200 and it is definitely between 900 and 1000 in Latgale Highlands (Suško 1995). That means that almost a half of all Latvian lakes are situated in the south-east part of the country. Such a plenty of lakes supports a very diverse and rich macrophyte flora and vegetation represented by many rare and endangered species (Suško 2008a).

Material and Methods

Study area

Lake Riču is situated in the very south-east part of Latvia on the state border between Latvia and Belarus, 17 km to the SE of Daugavpils (Latvia), 17 km to the NWW of Braslau (Belarus) as well as 3 km to the NE of the state border with Lithuania (Fig. 1). At the same time, it is located in the southernmost part of the South-eastern Geobotanical Region characterized by the warmest summers in the country with the sum of active temperatures reaching 2100 – 2150°C here (Rutkis 1960, Āboltiņš 1994, Pūriņš 1975, Табака 1982). It is a unique freshwater ecosystem of international importance being under state protection since 1977 in Latvia (Nature Park Silene – Natura 2000 place) and since 1979 in Belarus (Riči Hydrological Reserve).

Lake Riču is the twelfth largest lake of Latvia as well as the largest one of the Ilūkste Lakeland (comprising about 200 lakes of the Augšzeme Highlands and the adjacent territory). It belongs to the catchment area of River Daugava (Zachodniaja Dzvina in Belarus) and lies 146.2 m above the sea level (Daugavas …1972, Leinerte 1992a, 1992b, Suško 1992a, 1994a, 1994b, 1994c, 1995, 1999, 2008b, Tidriķis 1997, Якушко 1988, Шидловский 1989). Geographically, it stretches from 26° 39’ 31.1” E (the west end, Latvia) to 26° 45’ 11.3” E (the east end, Latvia) and from 55° 43’ 16.5” N (the north end, Latvia) to 55° 40’ 9.9” N (the south end, Belarus).

The total area of the lake is 12.88 km^2 comprising 12.83 km^2 of water area as well as the territory of 4 small islands with the total area 5.1 ha (*Fig. 2*). The northern part of the lake with the total area 5.89 km^2 (5.88 km^2 of water area as well as one and a half islands with the total area 1.2 ha) belongs to Latvia while the southern part with the total area 6.99 km^2 (6.95 km^2 of water area as well as two and a half islands with the total area 3.9 ha) to Belarus. Lake Riču is the third deepest lake in Latvia and the second deepest in Belarus with the maximum depth reaching 51.9 m (Якушко

1988, Шидловский 1989, Tidriķis 1997, Suško 2008a, 2008b). It is also the third biggest lake in Latvia judging by the water volume that reaches 131.5 million m^3 and the fifth deepest in Latvia according to the mean depth reaching 10.2 m. The maximum length of the lake is 6.23 km and the maximum width – 3.80 km. The total length of the shoreline is 33.4 km and 52.4% of it or 17.5 km are lying in Latvia and 47.6% or 15.9 km in Belarus.

The catchment area of Lake Riču occupies the territory of 130 km^2 with 78% (101 km^2) of it lying in Latvia and 22% (29 km^2) in Belarus. A half of its predominantly hilly landscape is covered by agricultural land, about 35% by forests and 15% by lakes (Daugavas … 1972, Якушко 1988). There are altogether 22 lakes in the catchment area of Lake Riču with 15 of them located in Latvia, two of them (Lake Riču, Lake Beļānu) lying on the state border between Latvia and Belarus and 5 small ones situated very close to the state border in Belarus. Total area of these lakes occupies 19.763 km^2 and 62.2% of it (1228.4 ha) are situated in Latvia and 37.8% (747.9 ha) in Belarus. The main inflow of the lake is River Silica that flows into its north-eastern bay from the nearby Lake Sila (Latvia) and there are about 10 other small brooks or ditches flowing into the lake (*Fig. 2*). The only one outflow is River Ryčanka that flows out from the south bay of the lake near Mikalajuncy in Belarus. Because of the great water volume Lake Riču has a rather small value of the specific catchment area as well as a

Fig. 1. Location of Lake Riču.

rather long period of water turnover that takes, on average, 3.8 years. Owing to all favourable conditions, Lake Riču could preserve in mesotrophic state until the middle of the 20th century. A rather considerable inflow of biogenic substances from 5 recreation centres built in 1980s at the northern and eastern shores of the lake (some of them have preserved until today) as well as a rather big number of holidaymakers determined at that time the gradual switch of the lake from mesotrophic to eutrophic state. Today only the central part of the lake can be characterized as slightly eutrophic while its western and south-eastern parts are obviously eutrophic (Leinerte 1988, 1992a, Poikane et al. 2001, Glazačeva 2004, Suško 2008b). As compared to early 1990-ies, the eutrophication level in many peripheral parts of the lake has obviously increased. Besides the negative anthropogenic impact it may also be favoured by the warming up of the climate. Nevertheless, the water quality of the lake is remarkable and its transparency during summer usually varies between 4 and 6 meters. The colour of the water is yellowish green (20^o – 30^o mg Pt/l, corresponds to the colour standard no. 15 of the Forel – Ule scale) and its pH is about 8.0 on the surface and 7.0 at the bottom of the lake (Jakuško 1988, Poikane et al. 2001).

The remote location of the lake and its comparatively little transformed catchment area with rather many forests and small population as well as its particular geological, limnological and morphometric features (great depth, very pronounced groundwater seepage) have favoured the preservation of a remarkable water quality that preserves all the year round. Thanks to these conditions many endangered and relict northern species have preserved in the lake since the Glacial and Postglacial (Boreal) periods, e.g., oxyphilous, cryophilous and stenothermous zoobenthos crustaceans – *Limnocalamus macrurus*, *Mysis relicta*, *Pallasea*

quadrispinosa and *Pontoporeia affinis* as well as aquatic macrophytes – *Isoetes lacustris*, *Najas flexilis*, *Nuphar pumila* (Якушко 1988, Шидловский 1989, Красная ... 2006, Suško 1999, 2008b). There are also many other rare and endangered macrophyte species growing in the lake, e.g., water mosses *Fontinalis hypnoides* and *Platyhypnidium riparioides* as well as vascular plants – *Callitriche hermaphroditica*, *Potamogeton acutifolius*, *Potamogeton pusillus*, *Potamogeton rutilus* and *Scolochloa festucacea*. In 1991 also Pond Turtle *Emys orbicularis* was observed in the eastern part of the Lake Riču (Pupiņš, Škute 1992). Belorussian limnologists have discovered a unique formation of iron-manganese ores at the depth of 8 – 15 m in the sublittoral of Lake Riču where 3 – 5 mm thick iron-manganese laminae of 9 – 12 cm diameter are to be found up to the depth of 20 meters. Such process of formation of ores is known just from several of altogether 10000 Belorussian lakes (Якушко 1988).

Lake Riču has a very complicated configuration with many peninsulas as well as smaller or bigger bays and it is characterized mostly by a wide (50 – 300 m), shallow littoral that occupies approximately half of the water area (Fig. 2).

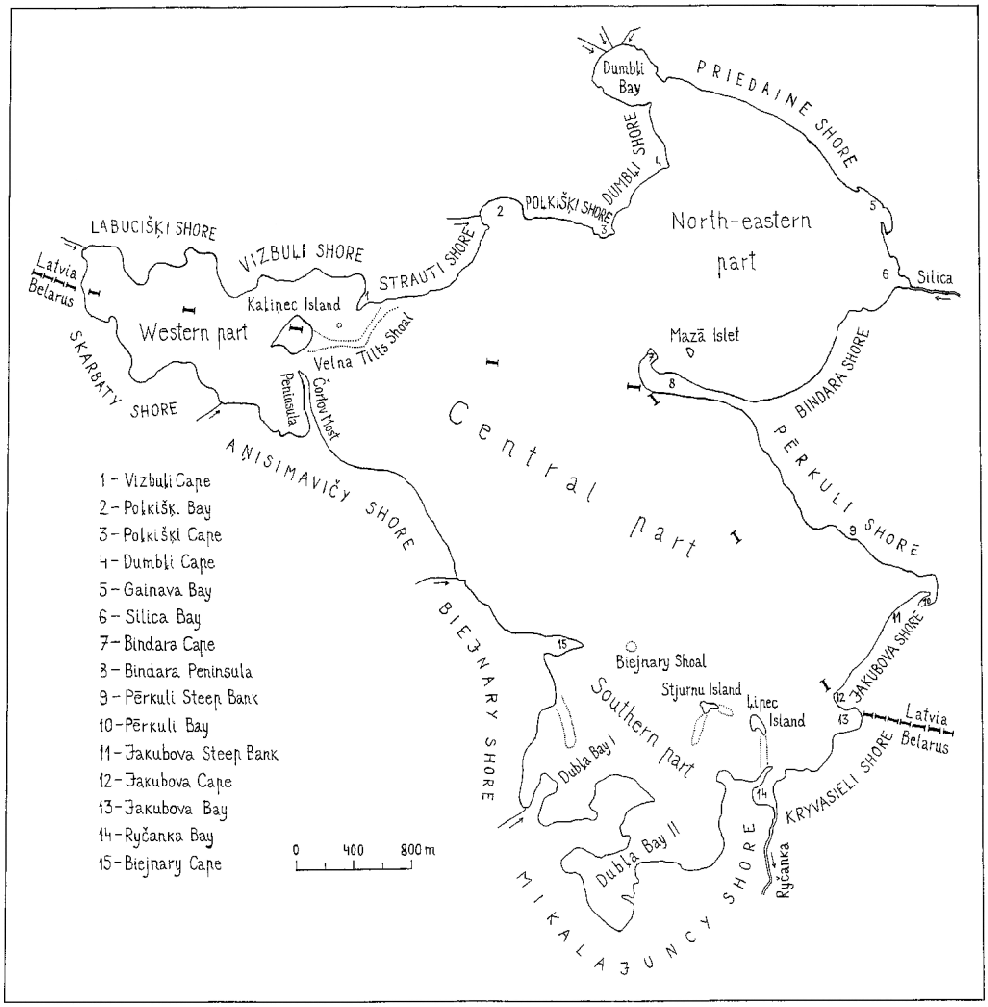

Fig. 2. Lake Riču and its parts.

Sediments in the littoral are mostly represented by sand, gravel, pebbles or small stones. In 50% of its area Lake Riču is deeper than 8 m, in 35% the depth reaches 2 – 8 m and in 15% – 0 – 2 m (Якушко 1*988*). It means that from one side there is a very wide sublittoral and profundal and from the other side a very wide (50 – 300 m, on average) littoral in the lake. The littoral zone actually occupies approximately a half of the lake water area thus creating very favourable conditions for the development of diverse aquatic vegetation. According to O. F. Jakushko, macrophyte vegetation extends to the depth of 9 meters (Якушко 1*988*). Along the shoreline there is a more or less pronounced belt of emergent vegetation that becomes absent only near abrasion shores. Continuous belts of emergent vegetation are to be found mostly in shallow bays. The most characteristic species of this belt is *Phragmites australis* which is growing up to the depth of 2.5 m. Vegetation of floating-leaved macrophytes is to be found exclusively in different (more or less open or closed) bays. At the depth of 2.5 to 4.5 meters mostly different pondweed and charophyte species occur. At a depth of 6 to 9 meters where there is less light aquatic bryophytes, mainly *Fontinalis antipyretica*, are to be found.

Lake Riču can be divided into 4 different parts (Fig. 2). The western part stretches from the west end of the lake at the state border between Latvia and Belarus eastwards to the Kaļiņec Island on the state border, the Čortov Most Peninsula near Aņisimavičy in Belarus and the Velna Tilts Shoal in Latvia. The north-eastern part of the lake embraces its more shallow north-eastern bay in Latvia to the east of the line between the Bindara Cape at the north end of the Bindara Peninsula and the Poļkišķi Cape at the opposite north shore of the lake. It includes the Mazā Islet as well as two smaller bays – the Silica Bay and the Dumbļi Bay that are almost the only places at the lake surrounded by quagmires and fens (in Latvian part of the lake very short stretches of quagmires are to be found also at the western shores of the Pērkuli Bay and the Poļkišķi Bay). The southern part of the lake also embraces its more shallow southern part in Belarus and its border stretches from the Jakubova Cape at the state border near Jakubova in the east westwards along the northern side of the Biejnary Shoal as far as the Biejnary Cape in the west including both Belorussian islands (Stjurnu Island and Ļipec Island), the Ryčanka Bay as well as two bays near Mikalajuncy (Dubļa Bay I, Dubļa Bay II). Nevertheless, the greatest area of the lake is taken by its open and deep central part embracing the territory of Latvia and Belarus and stretching from the Čortov Most Peninsula near Aņisimavičy, the Kaļiņec Island and the Velna Tilts Shoal in the west, the Poļkiški Shore in the north to the south-east along the southern shore of the Bindara Peninsula as far as the Jakubova Shore (Latvia) in the east. There are also two small bays in the central part of the lake – the Poļkišķi Bay in its northern part and the Pērkuli Bay in its SEE part.

Methods

The littoral of the lake was surveyed by boat along the whole stretch of the Latvian shoreline that extends to the length of 17.5 km. The survey was performed in course of 4 days – started on August 31 from the Jakubova Cape at the state border in the SE part of the lake and completed on September 2 – 4, 2007 at the state border near Labucišķi at the west end of the lake. Macrophytes were detected by the help of a macrophyte hook, a rake and a diving mask. Distribution of rare and endangered species was mapped as well as the littoral border drawn on the map of the lake (scale 1:10000) according to the distribution of macrophytes. Macrophyte vegetation was described according to the dominating species. The water transparency was measured with the Secchi disc and its colour was characterized using colour standards of the classical Forel – Ule colour scale in half of the Secchi depth. Also, some morphometric data of the lake (catchment area, land use of the catchment area, number and area of lakes in the catchment area, area of islands, length and width of the lake, length of the shoreline, geographical coordinates) were specified according to the latest available topographical maps. Names were given

to the different parts of the lake taking into account the local conditions as well as the historical toponyms at shores of the lake.

The nomenclature of the species follows H. Schubert, I. Blindow, W. Krause and E. Zviedre (Schubert & Blindow 2003, Krause 2007, Zviedre 2008) for charophytes, M. O. Hill and co-authors (Hill et. al. 2006) for bryophytes (mosses) and Ģ. Gavrilova and V. Šulcs as well as N. Priedītis (Gavrilova & Šulcs 1999, Priedītis 2003) for vascular plants.

History of botanical investigations

The first botanical findings in Lake Riču date as far back as 1860 when the Baltic German botanist (also pharmacist and entomologist) Theophil Bienert (1833 – 1873) visited the vicinity of Ilgas at the south-east shore of Lake Riču and found here *Scolochloa festucacea* (Bienert 1861, Lehmann 1895, Suško 2008b). Today the species is known in Ilūkste Lakeland just from 3 lakes situated rather close to each other – Lake Riču, Lake Sila and Lake Skirnas (Suško & Bambe 2002). It is not exactly known whether T. Bienert found the species in Lake Riču or in Lake Sila – both lakes are situated in a close vicinity of Ilgas but judging by the local conditions I am inclined to think that most evidently it could have been Lake Riču.

The next botanical records from Lake Riču were made just a century later and refer to the period of 1959 – 1962 (1980) when several students of the Daugavpils Pedagogic Institute (today Daugavpils University) – A. Jaško, V. Karlsberga, H. Landsberga and others collected several macrophyte species in the lake, namely, *Potamogeton filiformis*, *P. natans*, *P. lucens*, *P. perfoliatus* as well as *Elodea canadensis*. In 1961 (on July 2) lecturer E. Ozoliņa collected 3 pondweed species in the eastern part of the lake – *Potamogeton filiformis*, *P. x nitens* and *P. x zizii*. Today these herbaria are kept at the Daugavpils University.

The first comprehensive investigations of macrophyte flora of Lake Riču were carried out in 1979 and 1980 by botanists Ģetrūde Kļaviņa (Gavrilova) and Laima Tabaka (1924 – 2000) who registered altogether 33 vascular plant species in the lake (Table 1) (Эглите & Клявиня 1982). The published records of *Potamogeton alpinus* and *P. berchtoldii* do not refer actually to Lake Riču but to River Silica in its stretch approximately half a kilometre upstream its mouth into the lake (Gavrilova 2008, pers. comm.).

The next comprehensive investigations were performed 10 years later by the author in 1989 (June 5 – 6, July 4 – 5) and 1990 (July 10 – 11) when a fragmentary survey by boat was made throughout the largest part of Lake Riču. As compared to the previous investigations, this survey took into consideration also charophytes and aquatic bryophytes of the lake. On June 5, 1989 the eastern side of the central part of Lake Riču along the Jakubova Shore was explored, while on June 6 the surroundings of the north end of the Bindara Peninsula and the Mazā Islet westwards along the north shore of the lake as far as the Velna Tilts Shoal and Kaļiņec Island were surveyed. In this time first aquatic bryophytes of the lake were explored. On July 4, 1989 the survey was started at the west end of the Bindara Peninsula and continued along the north shore of the lake westwards to its west end near the state border. In this time, *Isoetes lacustris* was discovered for the first time in Lake Riču and in the Ilūkste Lakeland as well (Suško 1991). On July 5, 1989 the north-eastern part of the lake was explored. On July 10 – 11, 1990 a two-day expedition was made through the largest part of the whole lake (including the Belorussian part). It was started from the Jakubova Cape at the state border in the SE part of the lake, continued to the outlet of River Ryčanka through the shoals around the Belorussian islands Ļipec and Stjurnu westwards to the Biejnary Cape, then further on along the southern shore of the lake as far as the Čortov Most Peninsula near Aņisimaviču in Belarus and around Kaļiņec Island, then along the northern shore of the lake eastwards through the Velna Tilts Shoal to the north-eastern part of the lake (including the Dumbļi Bay at its NNW side) and concluded from the northern shore southwards at the north shore of the Bindara

Peninsula. In this time, for the first time charophytes of the lake were explored in its Belorussian part on shoals near Ļipec Island and Stjurnu Island as well as some toponyms of the lake recorded from the local villagers at Mikalajuncy in Belarus (Suško 1994a). As a result of this survey, altogether 3 charophyte, 3 bryophyte and 34 vascular plant species were recorded in the lake (Table 1). As compared to the results of the previous investigations carried out in 1979 – 1980 by Ģ. Kļaviņa and L. Tabaka, 6 new macrophyte species were recorded for the first time in flora of the lake – *Acorus calamus*, *Eleocharis uniglumis*, *Isoetes lacustris*, *Myriophyllum verticillatum*, *Potamogeton friesii* and *P. praelongus*.

In 1998 hydrobiologists Sandra Poikāne and Vita Līcīte made limnological investigations of Lake Riču within the pilot programme of "The Synoptic Monitoring of Latvian lakes" and report about 7 macrophyte species found in the lake – *Fontinalis antipyretica*, *Nuphar lutea*, *Phragmites australis*, *Potamogeton lucens*, *P. natans*, *Scirpus lacustris* and *Utricularia vulgaris* (Poikane et al. 2001).

In 2001 botanist Egita Zviedre visited Lake Riču within "The Synoptic monitoring of Latvian lakes" and recorded 8 macrophyte species here – *Equisetum fluviatile*, *Myriophyllum spicatum*, *Nuphar lutea*, *Phragmites australis*, *Potamogeton gramineus*, *P. lucens*, *P. perfoliatus* and *Typha latifolia* (E. Zviedre 2008, pers. comm.). She continued her investigations in 2002 and 2004 and found altogether 7 charophyte species in the lake – *Chara aspera*, *Ch. contraria*, *Ch. globularis*, *Ch. filiformis*, *Ch. rudis*, *Ch. tomentosa* and *Nitellopsis obtusa* (*Zviedre 2002*, *2003*, *2005a*, *2005b*, *www.imuzejs.lv*). Four species – *Ch. contraria*, *Ch. globularis*, *Ch. filiformis* and *Nitellopsis obtusa* were recorded for the first time in the lake.

In 2006 Belorussian botanists A. N. Skuratovitch and D. V. Dubovik (the Institute of the Experimental Botany of the Academy of Sciences of Belarus) made short investigations in Lake Riču and recorded *Isoetes lacustris* in Belorussian part of the lake (Красная ... 2006, A. Skuratovitch 2008, pers. comm.)

In the summer of 2007 botanist of the Daugavpils University Pēteris Evarts-Bunders found a very rare and endangered relict macrophyte species *Najas flexilis* for the first time in Lake Riču. He recorded also *Potamogeton gramineus* and *P. perfoliatus* in the lake (P. Evarts-Bunders 2008, pers. comm.).

A complete and detailed survey of the Latvian part of the lake was made by the author on August 31 and September 2 – 4, 2007 considerably improving the knowledge of macrophyte species composition, vegetation and distribution of rare and endangered macrophyte species of the lake. Altogether, 9 charophyte, 8 bryophyte and 52 vascular plant species were found in the littoral of the lake. In this survey 6 rare and endangered macrophyte species were found for the first time in the lake – bryophytes *Fontinalis hypnoides* and *Platyhypnidium riparioides* as well as vascular plants – *Callitriche hermaphroditica*, *Potamogeton acutifolius*, *P. pusillus* and *P. rutilus*. Besides that, 8 other more or less common macrophyte species were recorded for the first time in the lake – *Alisma plantago-aquatica*, *Carex rostrata*, *Naumburgia thyrsiflora*, *Potamogeton obtusifolius*, *Sparganium microcarpum*, *S. minimum*, *S. oocarpum* and *Spirodela polyrhiza*.

Results

The aquatic macrophyte flora of Lake Riču is unusually rich. Altogether, 69 macrophyte species were found in the littoral of the lake with 9 charophyte species from 3 genera and 3 families (*Chara aspera*, *Ch. contraria*, *Ch. filiformis*, *Ch. globularis*, *Ch. rudis*, *Ch. strigosa*, *Ch. tomentosa*, *Nitella flexilis*, *Nitellopsis obtusa*), 8 bryophyte species from 4 genera and 3 families (*Drepanocladus aduncus*, *D. longifolius*, *D. polygamus*, *D. sendtneri*, *Fontinalis antipyretica*, *F. hypnoides*, *Platyhypnidium riparioides*, *Scorpidium scorpioides*) as well as

Table 1. Results of the investigation of macrophyte flora of Lake Rièu by Ì. Kïavièa and L. Tabaka in 1979 – 1980 and by U. Suðko in 1989 – 1990 (rare and endangered species in bold)

Investigations by Ģ. Kļaviņa and L. Tabaka in 1979 – 1980 (*Эглите & Клявиня 1982*)	Investigations by U. Suško in 1989 – 1990
Charophytes *Charophyta*	
-	*Chara aspera*
	Chara rudis
	Chara tomentosa
	3 species
Bryophytes *Bryophyta*	
-	*Drepanocladus sendtneri*
	Fontinalis antipyretica
	Scorpidium scorpioides
	3 species
Vascular plants *Tracheophyta*	
-	*Acorus calamus*
Batrachium circinatum	*Batrachium circinatum*
Butomus umbellatus	-
Ceratophyllum demersum	-
Eleocharis acicularis	*Eleocharis acicularis*
Eleocharis palustris	*Eleocharis palustris*
-	*Eleocharis uniglumis*
Elodea canadensis	*Elodea canadensis*
Equisetum fluviatile	*Equisetum fluviatile*
Glyceria maxima	*Glyceria maxima*
Hydrocharis morsus-ranae	-
-	***Isoetes lacustris***
Lemna minor	-
Lemna trisulca	*Lemna trisulca*
Myriophyllum spicatum	*Myriophyllum spicatum*
-	*Myriophyllum verticillatum*
Nuphar lutea	*Nuphar lutea*
Nuphar pumila	***Nuphar pumila***
Nymphaea candida	*Nymphaea candida*
-	*Phragmites australis*
Polygonum amphibium	*Polygonum amphibium*
Potamogeton compressus	*Potamogeton compressus*
Potamogeton filiformis	*Potamogeton filiformis*
-	*Potamogeton friesii*
Potamogeton gramineus	*Potamogeton gramineus*
Potamogeton lucens	*Potamogeton lucens*
Potamogeton natans	*Potamogeton natans*
Potamogeton pectinatus	*Potamogeton pectinatus*
Potamogeton perfoliatus	*Potamogeton perfoliatus*
-	*Potamogeton praelongus*
Ranunculus lingua	-
Ranunculus reptans	*Ranunculus reptans*
Sagittaria sagittifolia	*Sagittaria sagittifolia*
Scirpus lacustris	*Scirpus lacustris*
Scolochloa festucacea	***Scolochloa festucacea***
Sparganium emersum	*Sparganium emersum*
Sparganium erectum	-
Stratiotes aloides	*Stratiotes aloides*
Typha angustifolia	*Typha angustifolia*
Utricularia vulgaris	*Utricularia vulgaris*
33 species	**34 species**

Table 2. The structure of macrophyte flora of Lake Riču (results of investigations of 2007)

Family	Number of species	Number of genera	Represented genera
Charophytes			
Nitellaceae	1	1	*Nitella*
Nitellopsidaceae	1	1	*Nitellopsis*
Characeae	7	1	*Chara*
3	9	3	
Bryophytes			
Amblystegiaceae	5	2	*Drepanocladus*, *Scorpidium*
Brachytheciaceae	1	1	*Platyhypnidium*
Fontinalaceae	2	1	*Fontinalis*
3	8	4	
Vascular plants			
Potamogetonaceae	13	1	*Potamogeton*
Cyperaceae	4	3	*Carex, Eleocharis, Scirpus*
Nymphaeaceae	4	2	*Nuphar, Nymphaea*
Sparganiaceae	4	1	*Sparganium*
Gramineae	3	3	*Glyceria, Phragmites*, *Scolochloa*
Hydrocharitaceae	3	3	*Elodea*, *Hydrocharis*, *Stratiotes*
Lemnaceae	3	2	*Lemna*, *Spirodela*
Ranunculaceae	3	2	*Batrachium*, *Ranunculus*
Alismataceae	2	2	*Alisma*, *Sagittaria*
Haloragaceae	2	1	*Myriophyllum*
Araceae	1	1	*Acorus*
Butomaceae	1	1	*Butomus*
Callitrichaceae	1	1	*Callitriche*
Ceratophyllaceae	1	1	*Ceratophyllum*
Equisetaceae	1	1	*Equisetum*
Isoetaceae	1	1	*Isoetes*
Lentibulariaceae	1	1	*Utricularia*
Najadaceae	1	1	*Najas*
Polygonaceae	1	1	*Polygonum*
Primulaceae	1	1	*Naumburgia*
Typhaceae	1	1	*Typha*
21	52	31	

52 vascular plant species from 31 genus and 21 family among them (Tables 2, 3).

The richest family of the vascular plants is *Potamogetonaceae* with 13 species – *Potamogeton acutifolius*, *P. compressus*, *P. filiformis*, *P. friesii*, *P. gramineus*, *P. lucens*, *P. natans*, *P. obtusifolius*, *P. pectinatus*, *P. perfoliatus*, *P. praelongus*, *P. pusillus* and *P. rutilus* (*Table 2*). With the exception of just 3 species (*Potamogeton alpinus*, *P. berchtoldii* and *P. trichoides*) it makes up almost the whole of the pondweed flora of Latvia. Other richest families are *Cyperaceae* (4 species, 3 genera), *Nymphaeaceae* (4 species, 2 genera), *Sparganiaceae* (4 species, 1 genus), *Gramineae* (3 species, 3 genera), *Hydrocharitaceae* (3 species, 3 genera), *Lemnaceae* (3 species, 2 genera), *Ranunculaceae* (3 species, 2 genera), *Alismataceae* (2 species, 2 genera) and *Haloragaceae* (2 species, 1 genus). Other 11 families (*Araceae*, *Butomaceae*, *Callitrichaceae*, *Ceratophyllaceae*, *Equisetaceae*, *Isoetaceae*, *Lentibulariaceae*, *Najadaceae*, *Polygonaceae*, *Primulaceae*, *Typhaceae*) are represented by 1 species/genus each. The presence and status of *Eleocharis uniglumis* (Link) Schult. in flora of the lake should be clarified in future investigations.

The macrophyte vegetation of the lake is also rich and diverse. Usually, there is a mixed belt of emergent and submerged macrophytes stretching along the shore (the depth 0 – 2.5 m) and towards the depth (deeper than 2.5 m) gradually turning into the belt of submerged macrophytes. At some places (near abrasion shores) the belt of emergent macrophytes is completely lacking. The floating-leaved macrophytes are considerably rare and grow almost exclusively in muddy bays and other wind-sheltered places.

The emerged vegetation is represented by altogether 17 vascular plant species (Table 3). It is dominated mostly by *Phragmites australis* which usually forms a rather sparse and fragmented belt of different width although there are many stretches without any emerged vegetation in the littoral. Rather often it is accompanied by *Scirpus lacustris* which is to be found in much smaller quantities and only occasionally forms rather small stands. Rather rarely one can find also small groups of *Scolochloa festucacea* (altogether 17 localities), rarely – *Eleocharis palustris* (about 7 places), *Sagittaria sagittifolia* (about 6 places), *Typha angustifolia* (6 places, mainly in overgrowing bays), *Equisetum fluviatile* (6 places), *Carex rostrata* (5 places, overgrowing and muddy bays), very rarely – *Glyceria maxima* (3 places, small muddy bays), *Sparganium erectum* (3 places, muddy bays), *Acorus calamus* (3 places, small muddy bays), *Alisma plantago-aquatica* (2 places, muddy bays), *Ranunculus lingua* (2 places, small muddy bays), *Butomus umbellatus* (2 places, muddy bays), *Sparganium emersum* (emergent form in 1 place, small muddy bay) and *Naumburgia thyrsiflora* (1 place, small muddy bay).

The floating-leaved vegetation comprises altogether 11 vascular plant species (*Table 3*). It is dominated mainly by *Nuphar lutea* (8 places) and, to a smaller extent, also by *Potamogeton natans* (6 places). Rarely these species are accompanied by *Nuphar pumila* (10 places). Very rarely one can also find *Polygonum amphibium* (small groups in 4 places), *Hydrocharis morsus-ranae* (4 places, muddy bays), *Nymphaea candida* (2 places, muddy bays), *Sparganium emersum f. fluitans* (2 places, muddy bays), *Lemna minor* (2 places, muddy bays), *Nymphaea alba* (1 place, small sandy bay), *Spirodela polyrhiza* (1 places, muddy bay) and *Sparganium minimum* (1 place, muddy bay).

The submerged vegetation is represented by altogether 40 macrophyte species among which there are 25 vascular plant species, 8 bryophyte species as well as 9 charophyte species (*Table 3*). It is dominated mainly by *Potamogeton lucens* and, to a smaller extent, by *P. gramineus*, *P. filiformis* as well as by *Eleocharis acicularis*, *Chara aspera*, *Ch. rudis*, *Ch. tomentosa* and *Ch. filiformis*. Rather rarely these species are accompanied by *Elodea canadensis* (at least in 9 places), *Myriophyllum spicatum* (8 places), *Potamogeton perfoliatus* (at least in 6 places), *Najas flexilis* (at least in 11 places) and *Fontinalis antipyretica* (at least in 7 places). Rare species of submerged macrophytes are *Callitriche hermaphroditica* (at least in 10 places), *Ranunculus reptans* (at least in 4 places), *Batrachium circinatum* (5 places, mainly muddy bays), *Stratiotes aloides* (5 places, muddy bays), *Lemna trisulca* (5 places, muddy and sheltered bays), *Potamogeton praelongus* (4 places, muddy and sheltered bays), *P. compressus* (3 places, muddy and sheltered bays), *P. acutifolius* (3 places, muddy and sheltered bays), *P. rutilus* (3 places, muddy and sheltered bays), *P. pusillus* (at least in 6 places), *Chara strigosa* (at least in 3 places, muddy and sheltered bays), *Nitella flexilis* (at least in 3 places), *Fontinalis hypnoides* (at least in 3 places) and *Utricularia vulgaris* (at least in 2 places). Very rare submerged macrophytes are *Potamogeton pectinatus* (2 places), *Ceratophyllum demersum* (2 places), *Potamogeton friesii* (2 places), *P. obtusifolius* (2 places, muddy and sheltered bays), *Isoetes lacustris* (2 places, sparsely), *Drepanocladus sendtneri* (2 places), *Nitellopsis obtusa* (at least in 3 places), *Myriophyllum verticillatum* (1 place, muddy bay), *Drepanocladus aduncus* (1 place), *Drepanocladus longifolius* (1 place), *Drepanocladus polygamus* (1 place), *Platyhypnidium riparioides* (1 place), *Chara*

Table 3. The composition of macrophyte flora, frequency and distribution of species in Lake Riču (rare and endangered species in bold)

Macrophyte species	Frequency and distribution of the species
Charophytes (9 species)	
Chara aspera Willd.	quite often, usually forming stands on sand or gravel in shallows and deeper parts of the littoral, found mainly in the central part of the lake, also in the NE part of the lake
Chara contraria A. Braun ex Kütz.	rarely, on muddy mineral ground on a small rounded rush shoal at the NE side of the Kaļiņec Island in the W part of the lake, possible also in other places
***Chara filiformis* Hertzsch**	rather often, usually forming stands of different size on sand or gravel mainly in the central part, in smaller amounts also in NE part of the lake
Chara globularis Thuill.	rarely, on muddy mineral ground on a small rounded rush shoal at the NE side of the Kaļiņec Island in the W part of the lake, possible also in other places
Chara rudis A. Braun	quite often, usually forming stands of different size on sand or gravel mainly in the central part, in smaller amounts also in the NE part of the lake
***Chara strigosa* A. Braun**	very rarely, on muddy ground in wind-sheltered bays, found altogether in 3 places (the N side of the mouth of the Dumbļi Bay and in a small bay between the W end of the Bindara Peninsula and the Mazā Islet as well as at the Bindara Shore of the NE part of the lake)
Chara tomentosa L.	quite often, usually forming stands of different size on sand or gravel mainly in the central part, in smaller amounts also in the NE part of the lake
Nitella flexilis (L.) C. Agardh	rarely, usually small groups or stands on muddy or muddy mineral ground in deeper parts of the littoral, found so far in 3 places (the Poļkišķi Shore at the N side and the Jakubova Shore at the SEE side of the central part, also around the Mazā Islet in the NE part of the lake), possible also in other places
Nitellopsis obtusa (Desv. in. Loisel.) J. Groves	rarely, found so far in 3 places (on muddy mineral ground on a small rounded rush shoal at the NE side of the Kaļiņec Island in the W part of the lake, the Poļkišķi Shore at the N side of the central part, also the E shore of the Mazā Islet in the NE part of the lake), possible also in other places
Bryophytes (8 species)	
Drepanocladus aduncus (Hedw.) Warnst.	very rarely, on muddy mineral or mineral (sandy) ground at a depth of 60 – 150 cm in open parts of littoral, so far found in 2 places (the Jakubova Shore at the SEE side of the central part, on a small rounded rush shoal at the NE side of the Kaļiņec Island in the W part of the lake), possible also in other places
Drepanocladus longifolius (Mitt.) Broth. et Par.	very rarely, on gravel and sand at a depth 100 – 120 cm in open parts of the littoral, so far found only at the Poļkišķi Shore at the N side of the central part, possible also in other places
Drepanocladus polygamus (B.S.G.) Hedenaes	very rarely, on sandy ground at a depth of 130 cm, so far found only at the SE side of the NE part of the lake, possible also in other places
Drepanocladus sendtneri (Schimp. ex H. Muell.) Warnst.	rarely, on mineral (sand or gravel) and muddy sediments at a depth of 60 – 200 cm in open parts of the littoral, so far found only in 3 places (the Poļkišķi Shore at the N side and the Jakubova Shore at the SEE side of the central part, also on a small rounded rush shoal at the NE side of the Kaļiņec Island in the W part of the lake), possible also in other places
Fontinalis antipyretica Hedw.	rather rarely, on muddy, muddy mineral and mineral ground at a depth of 100 – 200 cm, found so far in 7 places (the Pērkuli Bay and the Jakubova Shore at the SEE side as well as the Poļkišķi Shore at the N side of the central part, the N side of the Bindara Peninsula, the Bindara Shore and the Silica Bay of the NE part of the lake, also in the W part of the lake), possible also in other places
***Fontinalis hypnoides* Hartm.**	very rarely, on mineral sediments (sand, gravel and stones) at a depth of 100 – 120 cm in open parts of the littoral, so far found only in 3 places (the Poļkišķi Shore at the N side and the Jakubova Shore at the SEE side of the central part, the W shore of the Mazā Islet in the NE part of the lake), possible also in other places
***Platyhypnidium riparioides* (Hedw.) Dix.**	very rarely, on sandy ground at a depth of 100 – 120 cm in open part of the littoral, so far found only in 1 place (the N part of the Jakubova Shore at the SEE side of the central part of the lake), possible also in other places
Scorpidium scorpioides (Hedw.) Limpr.	very rarely, on mineral (sand or gravel) ground at a depth of 100 – 120 cm in open part of the littoral, so far found only in 1 place (the Poļkišķi Shore at the N side of the central part of the lake)

Table 3 (continued)

Vascular plants (52 species)	
Acorus calamus L.	very rarely, small groups on mineral sediments in eutrophic conditions at bathing-places, found altogether in 3 places (the Pērkuli Bay at the SEE side and the Poļkišķi Bay at the N side of the central part and also in the W part of the lake)
Alisma plantago-aquatica L.	very rarely, small groups on muddy ground, found altogether in 2 places (the Pērkuli Bay at the SEE side of the central part and the Dumbļi Bay in the NE part of the lake)
Batrachium circinatum (Sibth.) Spach	rarely, usually small stands on muddy mineral and muddy ground in wind-sheltered and eutrophic bays, found altogether in 5 places (the Pērkuli Bay at the SEE side and the W side of the Poļkišķi Bay at the N side of the central part, the Dumbļi Bay in the NE part, the Bindara Shore of the NE part of the lake, also in the W part of the lake)
Butomus umbellatus L.	very rarely, small groups on muddy sediments in wind-sheltered and eutrophic bays, found altogether in 2 places (the Poļkišķi Bay at the N side of the central part and the Dumbļi Bay in the NE part of the lake)
***Callitriche hermaphroditica* L.**	rarely, usually in small quantity (rarely groups or small stands, e. g., at the N shore of the Mazā Islet) among other submerged macrophytes at a depth of 130 – 150 cm on mineral ground in open parts of the littoral, found altogether in 10 places *in situ* (the W side of the Pērkuli Steep Bank, the Jakubova Shore at the SEE side of the central part, the W and N shore of the Mazā Islet, the N shore of the Bindara Peninsula, 4 places at the Bindara Shore of the NE part, the Silica Bay in the NE part, also 1 place in the W part of the lake) as well as in 4 places washed ashore (the Pērkuli Bay at the SEE side and Poļkišķi Bay at the N side of the central part, the NE shore of the Bindara Cape and at the mouth of River Silica in the NE part of the lake),
Carex rostrata Stokes	rarely, found in small quantities as an accompanying species or occasionally forming small stands in wind-sheltered and more eutrophic places (most often small bays) on muddy sediments, found altogether in 5 places (the Pērkuli Bay at the SEE side and Poļkišķi Bay at the N side of the central part, the Silica Bay and the Dumbļi Bay in the NE part of the lake and also in the W part of the lake)
Ceratophyllum demersum L.	very rarely, in small quantity in wind-sheltered places and eutrophic places, found altogether in 2 places (the Pērkuli Bay at the SEE side of the central part as well as on a small rounded rush shoal at the NE side of the Kaļiņec Island in the W part of the lake), possible also in other places
Eleocharis acicularis (L.) Roem. et Schult.	not rarely, on sand or gravel in shallows and deeper parts of the littoral, found mainly in the central part of the lake, in smaller amounts also in the W and NE parts of the lake
Eleocharis palustris (L.) Roem. et Schult.	rarely, usually accompanying species and only rarely forming small stands, found altogether in 7 places (the S side of the Bindara Peninsula, the Pērkuli Bay at the SEE side and the Poļkišķi Shore at the N side of the central part, near the Mazā Islet, between the Mazā Islet and the Silica Bay and the Priedaine Shore of the NE part of the lake as well as in the W part of the lake)
Elodea canadensis Michx.	rather rarely, small groups or stands on mineral, muddy mineral or muddy ground, found altogether in different quantity in 9 places (the S side of the Bindara Peninsula, the Pērkuli Bay at the SEE side and the Poļkišķi Shore at the N side of the central part, the Bindara Shore, the Priedaine Shore and the Dumbļi Bay as well as at the Dumbļi Shore of the NE part of the lake, also in the W part of the lake and especially at its W end)
Equisetum fluviatile L.	rarely, found in small quantities as an accompanying species or occasionally forming small stands in wind-sheltered and more eutrophic places (most often small bays) on muddy sediments, found altogether in 6 places (the S side of the Bindara Peninsula, the Pērkuli Bay at the SEE side and the Poļkišķi Shore at the N side of the central part, 2 places in the NE part of the lake – at the Mazā Islet and in the Dumbļi Bay, also in the W part of the lake)
Glyceria maxima (Hartm.) Holmb.	very rarely, small groups or stands on muddy sediments, found altogether in 3 places (the Pērkuli Bay at the SEE side of the central part, the Silica Bay in the NE part of the lake and the W part of the lake)
Hydrocharis morsus-ranae L.	very rarely, small groups on muddy sediments at the quagmire in wind-sheltered and eutrophic bays, found altogether in 4 places (the Pērkuli Bay at the SEE side and the Poļkišķi Bay at the N side of the central part, the mouth of River Silica and the Dumbļi Bay in the NE part of the lake)

Table 3 (continued)

***Isoetes lacustris* L.**	very rarely, an accompanying species in small groups on sandy ground at a depth of 120 – 140 cm in open parts of the littoral as well as in sparse reed stands, found altogether in 2 places (growing at the N side of the Priedaine Shore in the NE part of the lake and washed ashore at the W side of the Pērkuli Steep Bank in the central part of the lake), recently extinct on a small rounded rush shoal at the NE side of the Kaļiņec Island in the W part of the lake (last time recorded in 1989), possible also in other places
Lemna minor L.	very rarely, in small quantities in wind-sheltered and eutrophic bays, found altogether in 2 places (the mouth of River Silica, the Dumbļi Bay and the area around its mouth at the quagmire in the NE part of the lake)
Lemna trisulca L.	rarely, usually in small quantity in wind-sheltered and eutrophic bays, found altogether in 5 places (the Pērkuli Bay at the SEE side and the W side of the Poļkišķi Bay at the N side of the central part, the N shore of the Bindara Peninsula near the Mazā Islet and the mouth of River Silica in the NE part as well as in the W part of the lake)
Myriophyllum spicatum L.	rather rarely, groups or stands on mineral, muddy mineral or muddy ground, found altogether in 8 places (the Pērkuli Bay at the SEE side and the Poļkišķi Bay at the N side of the central part, the N shore of the Bindara Peninsula at the Mazā Islet, the Bindara Shore of the NE part of the lake, the Silica Bay, the Priedaine Shore, the Dumbļi Bay and the Dumbļi Shore in the NE part of the lake, also in the W part of the lake)
Myriophyllum verticillatum L.	very rarely, small group on muddy sediments in a wind-sheltered and eutrophic bay at the mouth of River Silica in the NE part of the lake
***Najas flexilis* (Willd.) Rostk. et W.L.E. Schmidt**	rather rarely, small scattered groups on mineral (sand, gravel and stones) ground at a depth of 40 – 200 cm in open parts of the littoral, also groups on muddy ground at a depth of 160 cm (at the SE shore of the Mazā Islet), found at least in 11 places (the S side of the Bindara Peninsula, the Jakubova Shore at the SEE side and the Poļkišķi Shore at the N side as well as at a small cape at the mouth of the Pērkuli Bay in the central part, the W, the N and SE shores of the Mazā Islet, the Bindara Shore of the NE part of the lake), possible also in other places
Naumburgia thyrsiflora (L.) Rchb.	very rarely, small group on muddy sediments in wind-sheltered and eutrophic bays, found altogether in 1 place (the Pērkuli Bay at the SEE side of the central part of the lake)
Nuphar lutea (L.) Sm.	rarely, on muddy sediments mostly in wind-sheltered and eutrophic bays, found altogether in 8 places (the S side of the Bindara Peninsula, the Pērkuli Bay at the SEE side and the Poļkišķi Bay at the N side of the central part, the N side of the Bindara Peninsula, the Silica Bay, the Dumbļi Bay and the area around its mouth, also the Dumbļi Shore of the NE part of the lake as well as in the W part of the lake)
***Nuphar pumila* (Timm) DC.**	rarely, smaller or larger groups or stands mostly on muddy sediments (rarely on sand) mainly in wind-sheltered and eutrophic bays, found altogether in 10 places (the Bindara Shore of the NE part of the lake, the Silica Bay, the Dumbļi Bay and the area around its mouth, also at the Dumbļi Shore of the NE part of the lake as well as 5 places in the W part of the lake)
Nymphaea alba L.	very rarely, one sparse stand on sand found in a wind-sheltered and shallow Gainava Bay to the NNW of the mouth of River Silica in the NE part of the lake
Nymphaea candida C. Presl	very rarely, small groups on muddy sediments in wind-sheltered and eutrophic bays, found altogether in 2 places (the mouth of River Silica as well as the Dumbļi Bay and area around its mouth in the NE part of the lake)
Phragmites australis (Cav.) Trin. ex Steud.	very often, usually forming comparatively sparse stands of different width in all parts of the lake (both on mineral and organic sediments)
Polygonum amphibium L.	very rarely, separate stands on muddy sediments or sand mostly in wind-sheltered and eutrophic bays, found altogether in 4 places (the S side of the E part of the Bindara Peninsula in the central part of the lake, the N side of the Bindara Peninsula and the Silica Bay in the NE part of the lake as well as in the W part of the lake)
***Potamogeton acutifolius* Link**	very rarely, small groups on mineral (sandy) and muddy sediments (at the quagmire) at a depth of 30 – 140 cm usually in wind-sheltered and eutrophic bays, found altogether in 3 places (the Dumbļi Bay and the SE shore of the NE part as well as in the W part of the lake)
Potamogeton compressus L.	very rarely, small groups on muddy mineral and muddy sediments at a depth of 50 – 120 cm usually in wind-sheltered and eutrophic bays, found altogether in 3 places (the N shore of the Bindara Peninsula at the Mazā Islet, the W side of the Poļkišķi Bay at the N side of the central part as well as in the W part of the lake)

Table 3 (continued)

Potamogeton filiformis Pers.	not rarely, on sand or gravel in shallows and deeper parts of the littoral, found mainly in the central part of the lake, in smaller amounts also at the Bindara Shore of the NE part of the lake
Potamogeton friesii Rupr.	very rarely, in small quantity in wind-sheltered parts of the littoral, found altogether in 2 places (growing at the N shore of the Bindara Peninsula at the Mazā Islet in the NE part and washed ashore at the Pērkuli Bay at the SEE side of the central part of the lake)
Potamogeton gramineus L.	not rarely, on sand or gravel in shallows and deeper parts of the littoral, found mainly in the central part of the lake, in smaller amounts also at the Bindara Shore of the NE part of the lake
Potamogeton lucens L.	rather often, on mineral and organic sediments usually in the deepest part of the littoral, found in all parts of the lake
Potamogeton natans L.	rarely, on muddy sediments mostly in wind-sheltered and eutrophic bays, found altogether in 6 places (the S side of the Bindara Peninsula, the Poļkišķi Bay at the N side of the central part, the N side of the Bindara Peninsula, the Silica Bay, the Dumbļi Bay and area around its mouth, also the Dumbļi Shore of the NE part of the lake)
Potamogeton obtusifolius Mert. et W.D.J. Koch	very rarely, small stands on muddy sediments in wind-sheltered and eutrophic bays, found altogether in 2 places (the Dumbļi Bay and the mouth of River Silica in the NE part of the lake)
Potamogeton pectinatus L.	very rarely, small groups on soft mineral (sandy) and muddy sediments at a depth of 20 – 150 cm, found altogether in 2 places (the N part of the Jakubova Shore at the mouth of the Pērkuli Bay at the SEE side as well as the Poļkišķi Shore at the N side of the central part of the lake)
Potamogeton perfoliatus L.	rather rarely, groups or stands on mineral and muddy ground, found altogether in 6 places (the Pērkuli Bay at the SEE side and the Poļkišķi Bay at the N side of the central part, the N shore of the Bindara Peninsula at the Mazā Islet, the Dumbļi Bay as well as the Priedaine Shore of the NE part, also in the W part of the lake)
Potamogeton praelongus Wulfen	rarely, usually small groups on muddy sediments in wind-sheltered and eutrophic bays, found altogether in 4 places (the W side of the Poļkišķi Bay at the N side of the central part, the N shore of the Bindara Peninsula at the Mazā Islet and at the mouth of River Silica in the NE part, also in the W part of the lake)
***Potamogeton pusillus* L.**	rarely, small scanty groups on mineral (sandy and stony) sediments at a depth of 20 – 200 cm, found altogether in 6 places (3 places at the Jakubova Shore at the SEE side of the central part, at the N shore of the Mazā Islet and 2 places at the Bindara Shore of the NE part of the lake)
***Potamogeton rutilus* Wolfg.**	very rarely, small groups on mineral or muddy sediments in wind-sheltered and eutrophic bays, found altogether in 3 places (the N shore at the E part of the Bindara Peninsula and in the Dumbļi Bay in the NE part as well as in the W part of the lake)
Ranunculus lingua L.	very rarely, small groups on muddy sediments in wind-sheltered and eutrophic small bays, found altogether in 2 places (the Pērkuli Bay at the SEE side and the Poļkišķi Bay at the N side of the central part of the lake)
Ranunculus reptans L.	rarely, usually in small quantity as an accompanying species on sandy ground in the littoral or occasionally forming small stands on sand in the shallows of the littoral, found so far in 4 places (the S shore of the Bindara Peninsula and the Poļkišķi Bay at the N side of the central part, the Priedaine Shore as well as the Bindara Shore of the NE part of the lake), possible also in other places
Sagittaria sagittifolia L.	rarely, usually in small quantities as an accompanying species or occasionally forming small stands in wind-sheltered and more eutrophic places (most often small bays), found altogether in 6 places (the Pērkuli Bay at the SEE side and the Poļkišķi Bay at the N side of the central part, 3 places in the NE part of the lake – near the Mazā Islet, the Silica Bay and the Dumbļi Bay)
Scirpus lacustris L.	rather often, an accompanying species in reed stands (in much smaller amounts) and occasionally forming rather small stands (both on mineral and organic sediments)
***Scolochloa festucacea* (Willd.) Link**	rather rarely, forming small stands on mineral and muddy sediments, found altogether in 17 places (the W end of the Bindara Peninsula, the W side of the Pērkuli Steep Bank, the Pērkuli Bay at the SEE side of the central part, the S side of the Mazā Islet, the Silica Bay, the N side of the mouth of the Dumbļi Bay and the Dumbļi Shore of the NE part of the lake as well as 10 places in the W part of the lake from the Velna Tilts Shoal as far as the W end of the lake)
Sparganium emersum Rehmann	emergent form – very rarely, small group on muddy sediments, found just in 1 place (the Silica Bay in the NE part of the lake), floating-leaved form – very rarely, small groups on muddy sediments, found altogether in 2 places (the Poļkišķi Bay at the N side of the central part and in the W part of the lake)

Table 3 (continued)

Sparganium erectum L.	very rarely, small groups on muddy sediments, found altogether in 3 places (the Silica Bay and the Dumbļi Bay in the NE part and a small bay in the W part of the lake)
Sparganium minimum Wallr.	very rarely, found on muddy sediments at the quagmire in the Dumbļi Bay in the NE part of the lake
Sparganium oocarpum (Čelak.) Fritsch	very rarely, two small groups on muddy sediments, found just in 1 place at the W shore of the Dumbļi Bay in the NE part of the lake
Spirodela polyrhiza (L.) Schleid.	very rarely, a vital population found in a wind-sheltered and eutrophic bay at the mouth of River Silica in the NE part of the lake
Stratiotes aloides L.	rarely, usually small groups in wind-sheltered and eutrophic bays, found altogether in 5 places (the Pērkuli Bay at the SEE side and the W side of the Poļkišķi Bay at the N side of the central part, the mouth of River Silica and the Dumbļi Bay in the NE part as well as in the W part of the lake)
Typha angustifolia L.	rarely, usually forming smaller or larger stands in wind-sheltered places (most often bays) on muddy sediments, found altogether in 6 places (the Pērkuli Bay at the SEE side and the Poļkišķi Bay at the N side of the central part, 4 places in the NE part of the lake – near the Mazā Islet, between the Mazā Islet and the Silica Bay, the Silica Bay and most of all in the Dumbļi Bay)
Utricularia vulgaris L.	very rarely, found in small quantity altogether in 2 places (the Jakubova Shore and the Pērkuli Bay at the SEE side of the central part), possible also in other places

contraria (so far in 1 place, distribution insufficiently investigated) and *Chara globularis* (so far in 1 place).

Macrophyte flora of Lake Riču is very rich in rare and endangered plant species which are represented by 8 vascular plant species – *Callitriche hermaphroditica*, *Isoetes lacustris*, *Najas flexilis*, *Nuphar pumila*, *Potamogeton acutifolius*, *P. pusillus*, *P. rutilus* and *Scolochloa festucacea*, 2 bryophyte species – *Fontinalis hypnoides* and *Platyhypnidium riparioides* as well as by 2 charophyte species – *Chara filiformis* and *Ch. strigosa*. The lake is especially valuable as one of the altogether 10 known localities of *Najas flexilis* in Latvia (2 of them have become extinct in the 2nd half of the 20th century) being the richest one among them.

Lake Riču also represents a protected European habitat „Natural eutrophic lakes with *Magnopotamion* of *Hydrocharition* type vegetation (code 3150)" as well as 3 protected habitat types of Latvian importance – „Lakes with *Najas* stands", „Lakes with *Nuphar pumila* stands" and "Lakes with dominating mineral ground in the littoral".

Conclusions

Despite the protection status of the lake, the eutrophication level has risen during the last 20 years, especially in the peripheral parts of the lake and its western part in particular. Because of that, the former locality of *Isoetes lacustris* discovered in 1989 has become extinct. In order to preserve the unique ecosystem of Lake Riču it is necessary to constantly monitor the ecological state of the lake and to reduce the negative impacts arising from anthropogenic influence on lake and its catchment area. In this respect, recreational activities on the lake and its shores should be restricted and the impact from the existing facilities on the lake ecosystem should be regularly monitored. Possible scientific cooperation between Latvian and Belorussian parts for the better protection and research of Lake Riču would be very welcome in future.

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