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Plant balls from a Pomeranian lake, their invertebrate and microplastic components

by

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Abstract

Two balls with similar diameters (approximately 11–12 cm) were found on the bottom of Lake Białe (Kashubian Lake District) at depths of 4 m and 7 m. The structures were made of tightly-packed plant remains represented mainly by decaying leaves of *Larix* sp. The balls were colonised by invertebrates (Tubificinae, Hirudinea, Isopoda, and insect larvae). They also contained pollutants, namely microplastics in blue, white, red, and black colours with a length from 500 to 1000 µm. Four other balls had been earlier reported by another diver in the same lake. According to a report of the local press, similar balls have also been found in Lake Bobęcińskie (Bytowskie Lake District). This article aims to record the first appearance of larch balls in this area.

Key words: larch ball, lake ball, macrophytes, microplastics

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1. Introduction

Unusual spherical or oval shaped structures of plant material are called sea balls or lake balls, depending on their place of development. Their other names include moss, posidonia, and larch balls, referring to the particular main material of which they are composed. They are encountered in lakes, seas, and rivers around the globe (McAtee 1925, Golubić 1961, Nakazawa 1974, Cannon 1979, Gerbeaux & Ward 1986, Olson et al. 2005, Kumar 2014). In European lakes they were so far been reported in Austria, Croatia and Finland (Morton 1953, Golubić 1961, Luther 1979).

The balls have a diameter from approximately 2 to 20 cm. The genesis of the balls is probably related to water movement (wave action, high and low tides) that creates round structures by rolling plant remains (Ganong 1905). They have also been successfully produced in artificial conditions. Nakazawa & Abe (1973) used filamentous algae for this purpose (*Cladophora sauter*, *C. minima*). Cannon (1979) used plants from genera *Posidonia* and *Thalassia*. In both cases, the authors placed the substrate in dishes with forced rotating water movement.

The balls were discussed by Aristotle and Theophrastus. They were used for caulking the seams of ship hulls and as material for securing clay amphoras during marine transport. In modern times, due to their properties (resistance to mould and fire), they are used in production of insulation material under the commercial name NeptuThen (Bellincampi 2016). This indicates mass occurrence of the balls in some places, especially near the sea.

The environmental importance of the balls is related to their colonisation by various invertebrates (Schlosser et al. 1983), and the content of various anthropogenic artefacts (Sanchez-Vidal et al. 2021).

The objective of this article is to describe the structure of the balls found in Lake Białe. A description of the artefacts and invertebrates contained in the balls was also provided.

2. Materials and methods

2.1. Study area

Lake Białe is located in the Kashubian Lake District, near the village of Grzybno (54° 22' 38.502'' N; 18° 11'40.542'' E). A belt of alders (*Alnus glutinosa*) grows along the shoreline. The lake catchment area is under agricultural use. In the southern and eastern part of the catchment, the lake is adjacent to a forest approximately 100–300 m from the shore. It covers an 11-hectare stand of larch (*Larix decidua*) with trees aged 55–64 (MBDL) (Mobile Forest Data Bank) application. The remaining forested areas are dominated by spruce *Picea abies* (60%), pine *Pinus sylvestris*, and beech *Fagus sylvatica* (20%).

The lake has a surface area of 54.6 ha, and maximum depth of 38 m (Fig. 1). The lake basin is round, with a strongly elongated and shallow bay only in its western part. The remaining part of the bottom shows steep slopes, particularly in the southern part of the lake. In terms of productivity, the lake is mesotrophic. Secchi depth in summer reaches approximately 4.5 m (own data, unpublished).

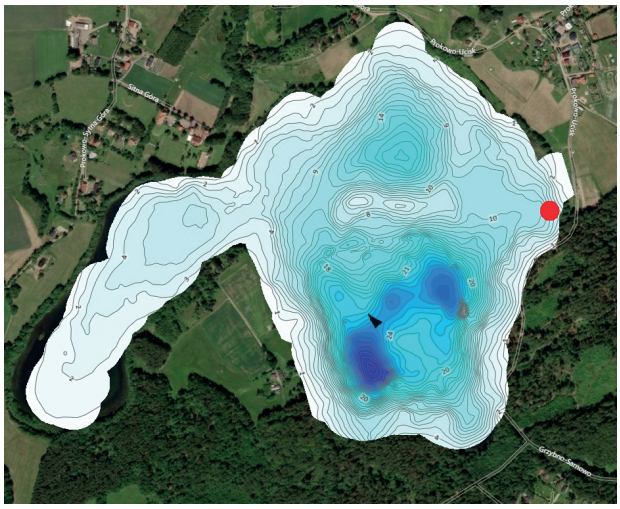

Figure 1

Bathymetric plan of Lake Białe (source: Cmap Genesis Social Map). The red dot denotes the place where balls were found.

2.2. Sampling and analyses

The research was conducted by SCUBA diving, dozens of times in the period 2021–2022. The found balls were placed in a net with 20 µm mesh under water. At the laboratory, they were rinsed with a strong stream of water to wash out the invertebrates, and filtered through a net with 300 µm mesh. Then, for the purpose of isolating microplastics, the water was filtered again through a chrome-molybdenum net with 25 µm mesh with the maintenance of hygiene to avoid secondary contamination of the sample.

On 19.07.2021, the floristic composition of the lake was investigated from a boat. A total of 9 transects perpendicular to the shoreline were designated. Plant samples were collected randomly from the transects every several meters by means of a grapnel, and relative share of particular species was

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visually estimated. Data regarding the tree species composition in the lake catchment were obtained from the MBDL.

3. Results and discussion

Submerged vegetation in Lake Białe grew up to a depth of 6 m. It was dominated by *Elodea canadensis* and *Ceratophyllum demersum* growing in many places around the lake. The north-western shore also featured some patches of *Chara* sp. and *Myriophyllum spicatum*. The latter species was also abundant at the southern and south-eastern shore. The emergent vegetation in the form of a single species patch of *Equisetum* sp. with an area of several hundred square metres occurred only at the eastern shore.

Two lake balls were found on 21.06.2021 and 8.01.2022 at a depth of 4 and 7 m at the northern shore. They were suspended several centimetres above the bottom. They therefore showed positive buoyancy, and moved under the influence of forced water movement. The bottom in this part of the lake is characterised by a relatively steep slope (Fig. 1). The sediment is muddy, devoid of vegetation, and at a depth between 2 and 10 m it is covered with a layer of decaying tree leaves (mainly alder) with a thickness of several dozen centimetres. The sediments in the shallower zone are sandy. Previously, one ball had been retrieved from the lake by Jarosław Kur, and three others had been observed by him under water (oral information, 17.05.2021). Several balls had also been found in much larger Lake Bobęcińskie (524 ha) in the Bytowski District, Pomerania (Jarosław Kur, oral information, 09.01.2022).

The balls found in Lake Białe were composed of strongly compacted decaying needle leaves of *Larix* sp. (Figs. 2, 3). They also contained no identifiable remains of aquatic plants. The average length of the leaves varied from 26.9 mm ± 5.19 mm SD (standard deviation) to 28.1 mm ± 3.9 mm SD (n = 10). The leaves may have been blown by the wind from the larch stand on the southern side of the lake. Balls made of the same material were also found in the Austrian Lake Hallstatt (Morton 1953).

The material of which the balls are made may vary, depending on local availability. Most often, these are remains of aquatic plants, e.g., *Ruppia maritima* (McAtee 1925, Olson et al. 2005), *Potamogeton pectinatus* (Golubić, 1961), mosses *Fontinalis antiperitica* and *Drepanocladus tenuinervis* (Luther 1979), or *Posidonia oceanica* (Sanchez-Vidal et al. 2021). Other additional components can be, e.g., sticks, feathers, fragments of the shells of crustaceans, stones, and calcium concretions (Golubić 1961).

The balls were colonised by nine invertebrate taxa typical of the littoral (Kornijów et al. 2005, Kornijów et al. 2016): Hirudinea (*Erpobdella* sp., *Glossiphonia heteroclita*), Tubificinae, Naidinae, Ephemeroptera, Heleidae, Chironomidae (*Polypedilum* gr. *nubeculosum, Tanytarsus* sp.), and Isopoda (*Asellus aquaticus*). The fauna was dominated by Ephemeroptera (60%) and Tubificinae. A similar composition of the invertebrates, also suggesting a near-shore origin of the ball, was found by Schloesser et al. (1983) in Lake Michigan.

Attention has recently been paid to the content of artefacts such as microplastics (O'Malley 2021, Sanchez-Vidal et al. 2021). Microplastics also occurred in the balls we found. These were red, black, and white microplastics with a length from 500 to 1000 µm (Fig. 4). Plastic particles smaller than 5 mm were from the fragmentation or degradation of large plastic items (Barnes et al. 2009, Jambeck et al. 2015), as well as from direct production of microscopic particles contained,

Figure 2

Lake ball found in Lake Białe on 21.06.2021. To the left, the ball in its entirety, to the right, cut in half.

Figure 3

Larch leaves taken out of plant balls (left) and collected from the ground around trees (right).

e.g., in granules of cosmetics and microfibres from clothing (Browne et al. 2011, Napper & Thompson 2016).

The balls are periodically discharged from the seas to the shores in vast amounts, where together with pollutants they are taken further ashore with the wind, which potentially may have great importance in cleaning the bottom of water bodies (Sanchez-Vidal et al. 2021). In places where balls are often found, they can be used as a tool to assess the degree of plastic pollution in aquatic ecosystems (Sanchez-Vidal et al. 2021).

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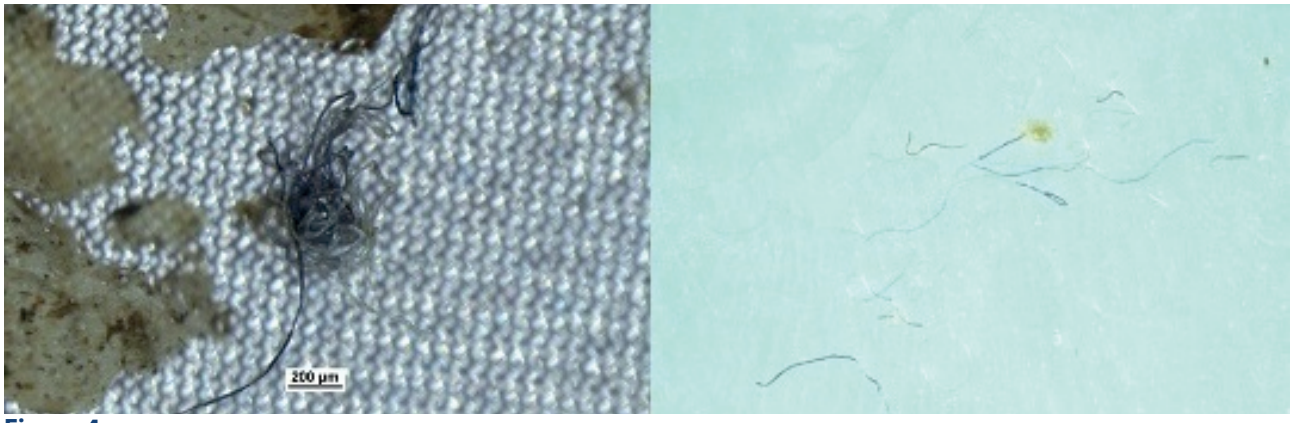

Figure 4

Microplastic fibres extracted from the lake ball.

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