

**A NEW STAND AND THE CURRENT STATUS  
OF THE *NUPHAR PUMILA* POPULATION  
IN WARMIŃSKO-MAZURSKIE PROVINCE**

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**Key words:** endangered species, glacial epoch survivor, protected areas, forest lake.

**Abstract**

During a floristic study conducted in 2003 in the “Beaver Refuge on the Pasłęka River” reserve (Olsztyn Lakeland, north-eastern Poland), a new stand was found of *Nuphar pumila* (Timm) DC (a rare species in Poland, one of the glacial epoch survivors) in a humic and forested closed water body within Warmińsko-Mazurskie Province. The aim of the study, conducted in 2013 and presented in this paper, was to confirm the presence of the stand, and to determine the current conservation status of the *N. pumila* population. In 2003, the occurrence of *N. pumila* in the southern bay of the lake was found to be only one stand. The study conducted in 2013 confirmed the presence of the species in question in a lake (regionally known as Jeziorko Leśne). In addition, a distinct extension of the range of *N. pumila* compared to the status in 2003 was observed; currently, the species is found in several dozen stands. As in previous years, *N. pumila* grew on the bottom of the water body to a depth of approx. 70–90 cm, and developed mainly submerged leaves. It covered the largest areas in the north-eastern part of the lake.

**NOWE STANOWISKO I AKTUALNY STAN ZACHOWANIA POPULACJI  
*NUPHAR PUMILA* W WOJEWÓDZTWIE WARMIŃSKO-MAZURSKIM**

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**Słowa kluczowe:** gatunek zagrożony wyginięciem, relikw glacialny, obszary chronione, śródlądne jezioro.

**Abstrakt**

Podczas badań florystycznych prowadzonych w 2003 r. w Rezerwacie przyrody „Ostoja bobrów na rzece Pasłęce” (Pojezierze Olsztyńskie, północno-wschodnia Polska) w humusowym, śródlądowym, bezodpływowym zbiorniku stwierdzono nowe stanowisko *Nuphar pumila* (Timm) DC (rzadkiego w Polsce gatunku należącego do relikwów glacialnych) w granicach województwa warmińsko-mazurskiego. Celem badań przedstawionych w pracy (przeprowadzonych w roku 2013) było potwierdzenie tego stanowiska oraz określenie aktualnego stanu zachowania populacji *N. pumila*. W 2003 r. stwierdzono występowanie *N. pumila* w południowej zatoce opisywanego zbiornika tylko na jednym stanowisku. W badaniach z 2013 r. potwierdzono obecność tego gatunku w jeziorze (regionalna nazwa Jezioro Leśne) na południe od Gamerek Wielkich. Stwierdzono również wyraźne rozprzestrzenianie się zasięgu *N. pumila*, w porównaniu ze stanem z roku 2003 – w 2013 r. występował on na kilkudziesięciu stanowiskach. Podobnie jak w latach ubiegłych grzał drobny porost dno zbiornika do głębokości około 70–90 cm, wytwarzając głównie liście zanurzone. Największe powierzchnie zajmował w północno-wschodniej części jeziora.

**Introduction**

*Nuphar pumila* (Timm) DC, syn. *N. pumilum* (Timm) DC, is a member of the *Nymphaeaceae* family. *N. pumila* is found in northern, central and western Europe (where it is endangered), in Siberia, in eastern Asia, and in the central-eastern part of North America. Since 1983, the species has been under strict protection in Poland (Journal of Laws 2014, item 1409), and, according to the Polish Red Data Book of Plants, is classified as an endangered species. Given that the species is critically endangered in Germany and Czech Republic, endangered in Belarus, rare in Lithuania, and no longer found in Kaliningrad Oblast, it is also listed in the European Red List of Vascular Plants (KŁOSOWSKI 2014). *N. pumila* is a perennial plant with a rather long (20–70 cm) rhizome and ovate floating leaves that are morphologically similar to the leaves of *N. lutea* (L.) Sibith. & Sm., but much smaller, as well as submerged leaves,

which are cordate or orbicular in shape. The characteristic feature of *N. pumila* is a pistil topped with a flat stigma disc, with 8–12 radiated lines reaching the clearly dentate edge, and a fruit that is usually curved in the upper part (KŁOSOWSKI and KŁOSOWSKI 2012, KŁOSOWSKI 2014). It grows in meso- to oligotrophic and dystrophic ponds and lakes with cool water of low hardness, on a peaty and slimy organic substratum (KRASKA et al. 2006, KŁOSOWSKI and KŁOSOWSKI 2012, KŁOSOWSKI 2014). *N. pumila* is a component of aquatic plant communities classified as the alliance *Nymphaeion* Oberd. 1957. Most often, it forms phytocoenoses of the association *Nupharetum pumili* Oberd. 1957, in combination with the following species: *Potamogeton natans* L., *Nymphaea alba* L. and *Myriophyllum spicatum* L., in which it is a dominant species. In Poland, *N. pumila* primarily grows within the Lakeland Belt, mainly in the Suwałki Lakeland and Pomorskie Lakeland (ZAJĄC and ZAJĄC 2001, KŁOSOWSKI and KŁOSOWSKI 2012, MATUSZKIEWICZ 2014, KŁOSOWSKI 2014).

During the floristic study conducted in 2003 in the “Beaver Refuge on the Pasłęka River” reserve, the collaborators found a new stand of *Nuphar pumila* (Timm) DC within Warmińsko-Mazurskie Province.

The aim of the study, conducted in 2013 and presented in this paper, was to confirm the presence of the stand and to determine the current conservation status of the *N. pumila* population.

## Material and Methods

### Study area

The floristic study was focused on a small, forested, closed water body (regionally known as Jeziorko Leśne), which is situated in north-eastern Poland, in the Olsztyn Lakeland, (PUWG 1992: 575127, 664519) – Figure 1. The lake is located at a height of 82.4 m.a.s.l., with an actual area of 2.34 ha, length of 260 m, and width of 150 m. The deepest spot found in the lake was a depth of 2.5 m. In the south-western part, a periodic outlet is situated, allowing outflow to the Pasłęka River. The immediate surroundings of the lake are forests. The southern shores of the lake are covered with a 90-year-old mixed marshy coniferous forest, parts of the western shore by a more than 100-year-old mixed fresh coniferous forest, and the north-eastern shore by a 110-year-old mixed fresh forest.

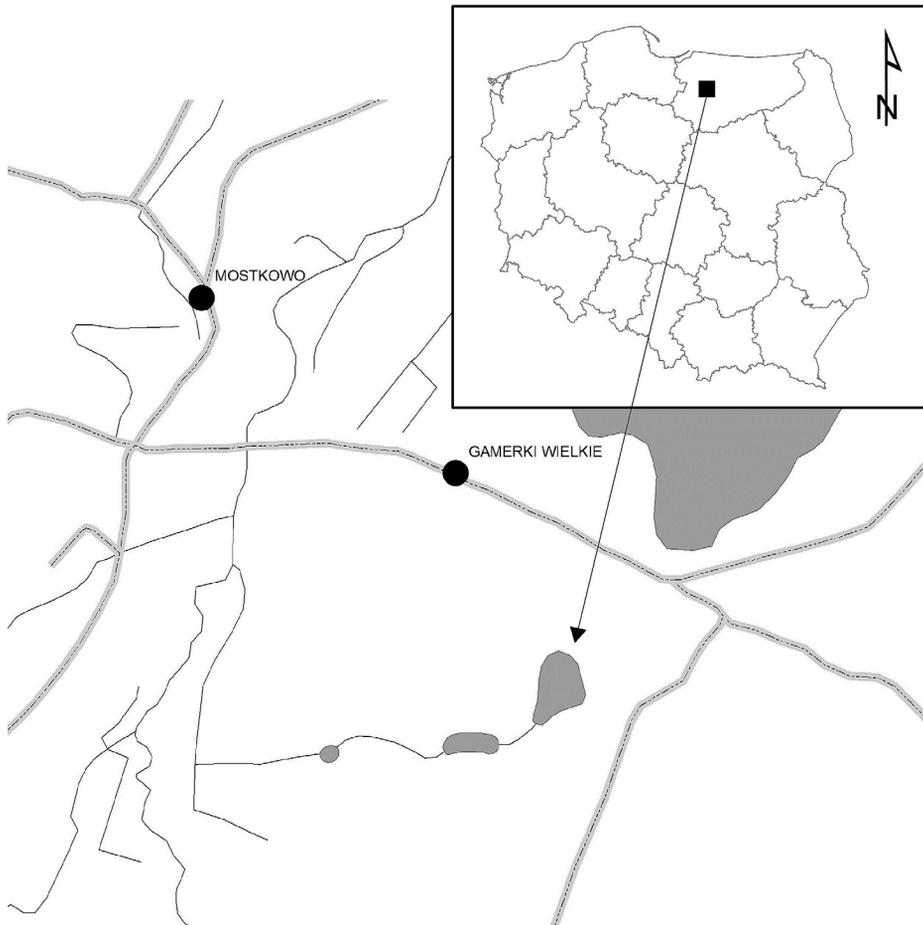


Fig. 1. The location of study site

### Sampling and data collection

The field study was conducted with the use of a boat, an anchor for sampling macrophytes, and a Garmin eTrex Vista GPS satellite receiver. Geographical positions were determined for the stands of individual plant communities and stands of the small yellow pond-lily. The range of occurrence of individual species and communities was determined using ArcMAP 9.3.1. software. The performed floristic analyses were based on the commonly used method of phytosociological relevés (BRAUN-BLANQUET 1951). Based on the characteristic species, individual plant communities ranked as an association were identified (HERBICH 2004, MATUSZKIEWICZ 2014). The paper presents

protected species in accordance with the classification of the Regulation of the Minister of the Environment (Journal of Laws 2014, item 1409). The nomenclature of vascular plant species is presented in accordance with MIREK et al. (2002). Using a Combo pH & EC tester (Hanna Instruments), the pH, temperature and conductivity of water were measured. Water transparency was determined using a Secchi disc.

## Results and Discussion

According to literature data, in north-eastern Poland, *N. pumila* is currently present in only five known stands found in the Suwałki Lakeland (Okliny Lake near Okliny, Poblędzie Lake near Skajzgiry, Wersle Lake near Wersle, Dziadówek Lake near Dzierwany, and Jegliniszki Lake near Soliny), and in Serwent Lake in the Olsztyn Lakeland (ZAJĄC and ZAJĄC 2001, SZYMKIEWICZ 2011, DZIEDZIC et al. 2012, KŁOSOWSKI 2014). The stands of *N. pumila*, unconfirmed after 1990, include, *inter alia*: Prosno in the commune of Morąg, Morańskie Łąki, Gamerki Wielkie in the commune of Jonkowo, Małdyty near Morąg, Dywity near Olsztyn, Jonkowo near Olsztyn, Kiemno swamp near Purda, Smolajny in the commune of Dobre Miasto, Rudzienickie Lasy near Hawa, Czarne Lake near Ostróda, Kierzlińskie Lake, and Lisunie Lake near Mikołajki (DZIEDZIC 2001, KŁOSOWSKI 2014). Jeziorko Leśne is therefore the second stand of *N. pumila* confirmed after 1990 and situated in Olsztyn Lakeland.

In 2003, the occurrence of *N. pumila* was found in the southern bay of the presented lake in only one stand. The study conducted in 2013 have confirmed the presence of this species in Jeziorko Leśne. In addition, a visible spread of the range of *N. pumila* compared to the status as of 2003 was observed, as this species was found in several dozen stands. Its largest coverage is in the north-eastern part of the lake (Figure 2, Table 1 – relevé no 6). As in previous years, *N. pumila* grew on the bottom of the water body to a depth of approx. 80 cm. Some 90% of individuals developed only submerged leaves. The floating leaves (intensely bitten by insects), flowers and fruits were only found occasionally (Figure 3). In Serwent Lake, the situation was opposite. *N. pumila* developed mostly floating leaves, while submerged leaves accounted for approx. 20% of the total. *N. pumila* individuals growing in Serwent Lake developed more flowers and fruits compared to those growing in Jeziorko Leśne. In addition, reduced insect pressure was observed (own data, unpublished).

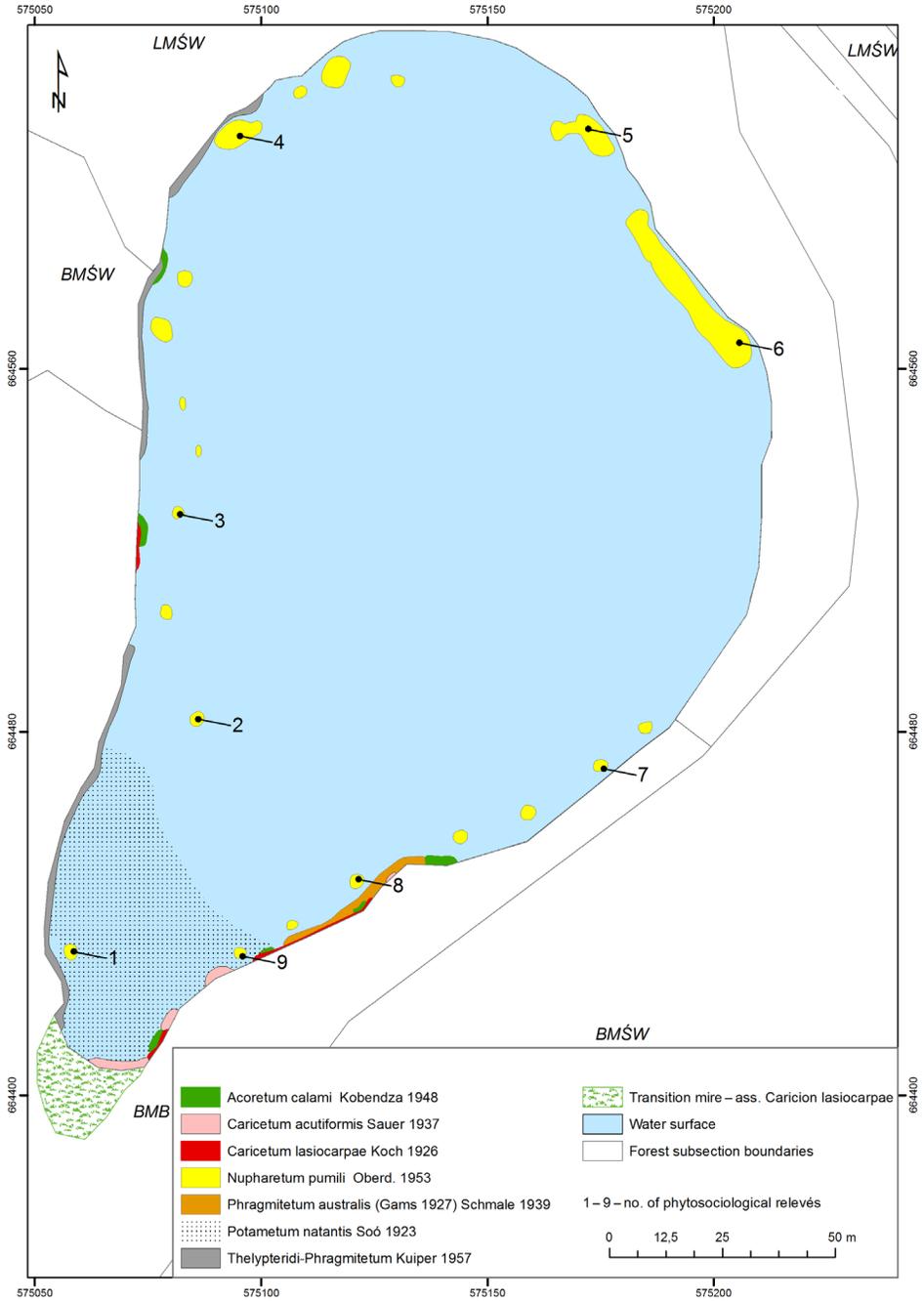


Fig. 2. Map of actual vegetation of Jezioro Leśne

Table 1

Association *Nupharetum pumili* Oberd. 1953

No. of relevé	1	2	3	4	5	6	7	8	9	10
Date	20.08.2013									6.08.2003
Forest division	Kudypy									
Forest district	Bobry									
Forest section	350i									
Cover of herb layer [%]	90	20	40	70	20	20	30	30	100	20
The area of record [m <sup>2</sup> ]	20	40	20	20	20	20	20	20	20	20
The number of species	3	2	1	1	1	1	1	1	2	2
<i>Nuphar pumila</i>	2	2	3	4	2	2	3	3	2	2
<i>Potamogeton natans</i>	3	+	·	·	·	·	·	·	4	1
<i>Nymphaea alba</i>	1	·	·	·	·	·	·	·	·	·

Source: Herbich et al. 2003 (unpublished) for data of the 2003, own study for data of the 2013



Fig. 3. *Nuphar pumila* – leaves, flower and fruit (Jeziorko Leśne, 20 August, 2013; photo by P. Dynowski)

The characteristics of individual plant associations found in the lake under study in 2013 are presented in detail below.

### The aquatic plant communities

1. Association *Nupharetum pumili* Oberd. 1953. On the national level, this is a rather rare community, poor from a floristic point of view, with a boreal type of range and probable relict nature (KŁOSOWSKI et al. 1996, MATUSZ-

KIEWICZ 2014). *N. pumila*, which is a characteristic species for the association, grows along the south-eastern, western, and northern shores to a depth of 1.6 m. Patches of this association were scattered, and their area was approx. 10–20 m<sup>2</sup>. Near the eastern shore, over a distance of approx. 100 m, no phytocoenoses of the association concerned were found (near a small beach with a pier) – Figure 2). *N. pumila* mostly forms single-species phytocoenoses with different areas. In only the southern bay were found two small patches of the association *Nupharetum pumili* adjacent to a dense patch of the broad-leaved pondweed association *Potametum natantis* (Table 1).

2. Association *Potametum natans* Soó 1923. A characteristic species for this association is *Potamogeton natans*, which forms a single patch of the association in the southern bay (Figure 2). Within the phytocoenosis with the dominant *P. natans*, *Nymphaea alba* and *N. pumila* grew in separate stands, and in shallower spots, near the shore, moss *Fontinalis antipyretica* grew.

### The rush communities

1. Association *Phragmitetum australis* (Gams 1927) Schmale 1939. A poorly developed, narrow, discontinuous strip of reed bed is formed of *Phragmites australis* and *Acorus calamus*. Phytocoenoses of the association *Phragmitetum australis* were recorded at a 40 m-long section of the south-eastern shore (Figure 2). As regards the species forming the reed bed, in addition to the dominant *Phragmites australis*, also *Carex acutiformis*, *Acorus calamus* and *Carex lasiocarpa* were recorded.

2. Association *Acoretum calami* Kobendza 1948. Small phytocoenoses with the dominant *Acorus calamus* were found in several scattered stands near the south-eastern and western shores (Figure 2). In the patches of calamus rushes, in addition to the dominant species, the occurrence of *Phragmites australis*, *Carex pseudocyperus*, *Carex lasiocarpa*, *Carex acutiformis*, *Cicuta virosa*, *Bidens connata* and *Phalaris arundinacea* was recorded.

3. Association *Thelypteridi-Phragmitetum* Kuiper 1957. The phytocoenosis is determined by the presence of *Thelypteris palustris* and the rush species. Along the entire western shore (with several metre-long gaps), patches of this association with a width of 3–5 m had developed (Figure 2). In the formation of the community, in addition to *Thelypteris palustris*, *Typha latifolia* was playing a significant role as well. As regards rush species, the occurrence of *Equisetum fluviatile*, *Carex rostrata*, *Carex pseudocyperus*, *Peucedanum palustre* and *Lycopus europaeus* was observed. They were accompanied by *Comarum palustre*, *Solanum dulcamara* and *Juncus conglomeratus*. Near the western shore, phytocoenoses of this association develop in the form of a strip with a width of 1.5–3 m, which are significantly poorer in species. In addition to

*Thelypteris palustris* and *Typha latifolia*, *Acorus calamus*, *Carex pseudocyperus* and *Scutellaria galericulata* were recorded. In certain locations, they were accompanied by *Juncus conglomeratus*.

4. Association *Caricetum acutiformis* Sauer 1937. A characteristic species for the association is *Carex acutiformis*. Along the shores of the lake, the occurrence of four small patches of the association, with a width of 1–3 m and a length of 2–5 m, were found (Figure 2). Phytocoenoses of this association develop near the south-eastern shore, and are accompanied by reed and calamus rushes. In addition to *Carex acutiformis*, patches of this association are formed by *Acorus calamus*, *Cicuta virosa*, *Peucedanum palustre* and *Phalaris arundinacea*.

### The marsh-sedge peat bogs and morasses communities

1. Association *Caricetum lasiocarpae* Koch 1926. A characteristic species for this association is *Carex lasiocarpa*. Phytocoenoses of this association were found in three stands (Figure 2). The largest patch, with a length of 30 m and a width of 0.5 m, develops along the outer limits of the high rushes, near the south-eastern shore. Patches of the association, with the dominant *Carex lasiocarpa*, develop with the participation of species penetrating from adjacent communities. In certain locations, it was accompanied by *Phragmites australis*, *Acorus calamus* and *Carex limosa*. The other two small patches with lengths of 2 m and 5 m developed along the calamus rushes.

#### Community with *Eriophorum angustifolium*, a characteristic species of the *Scheuchzerio-Caricetea* *nigrae* class

Near the shore of the southern bay, at the outer limits of a patch of the association *Thelypteridi-Phragmitetum*, a community developed with the dominant *Eriophorum angustifolium*, which covers part of the shore to a length of 60 m and width of 10–12 m. With its species composition, it is similar to phytocoenoses of transitional peat bogs. *Eriophorum angustifolium* was accompanied by *Equisetum fluviatile*, *Peucedanum palustre*, *Thelypteris palustris*, *Typha latifolia*, *Cicuta virosa*, *Carex rostrata*, *Carex pseudocyperus*, *Alisma plantago-aquatica* and *Lycopus europaeus*. In addition, *Comarum palustre*, *Bidens cernua*, *Salix cinerea*, *Salix aurita* and *Vaccinium myrtillus* also occurred there. The community concerned develops near a mixed coniferous forest, in a highly hydrated habitat with *Sphagnum* spp.

In the tree stand that forms the immediate surroundings of the water body, *Pinus sylvestris* is dominant. In the layer of trees, *Betula pendula*, *Carpinus betulus*, *Fagus sylvatica*, *Quercus robur*, *Quercus rubra*, *Alnus glutinosa*, *Populus tremula*, *Sorbus aucuparia*, *Picea abies* and a sapling *Acer platanoides* were found. As regards shrubs and dwarf shrubs, *Frangula alnus*, *Vaccinium myrtillus* and *Vaccinium vitis-idaea* were recorded. In the group of herbaceous plant species, the occurrence of *Lysimachia thyrsiflora*, *Scutellaria galericulata*, *Peucedanum palustre*, *Carex nigra*, *Carex lasiocarpa*, *Trientalis europaea*, *Juncus conglomeratus* and *Maianthemum bifolium* was found.

As mentioned earlier, *N. pumila* grows in lakes, ponds and oxbow lakes. This species is characterised by wide ecological amplitude as regards the fertility of the habitat. It grows in oligotrophic, humotrophic (dystrophic) and eutrophic waters, and *N. pumila* has the biggest chance for survival in water bodies with humotrophic (dystrophic) characteristics, not being subject to rapid succession changes (KŁOSOWSKI 2014).

Jeziorko Leśne is characterised by the following parameters: temperature of 17.3°C; pH of 6.5; conductivity of 180 µS/cm (75 ppm); water transparency of 65 cm. In addition, the lack of submerged vegetation other than *N. pumila*, *N. alba*, *F. antipyretica* and *P. natans* was recorded (despite the average depth of approx. 1 m). Therefore, presented lake may be preliminarily classified as humic, forest, small lake.

The data obtained by the authors concerning the phytocoenoses of *Nupharetum pumili* in the new stand coincide with data presented for the phytocoenoses of *Nupharetum pumili* from north-eastern Poland (KŁOSOWSKI et al. 1996, 2011, JABŁOŃSKA and KŁOSOWSKI 2012). However, a detailed study of the physicochemical properties of the water and sediments must be conducted in the future.

According to the information included in the Polish Red Data Book of Plants, in Poland, the most serious risk to the presented species is an increase in water hardness, which contributes to the more intense development of other plants forming communities of the *Potametea* class, e.g., *Potamogeton natans*, and in particular *Nuphar lutea*, which is one of the strongest competitors to *N. pumila* (KŁOSOWSKI 2014). At all stands where both of those species occurred, the formation of an increasing number of hybrids (*N. x intermedia*), and the gradual domination of *N. lutea* were recorded. This process has been observed in such places as Serwent Lake (SZYMKIEWICZ 2011, DZIEDZIC et al. 2012), Okilny Lake, or an astatic water body near Nożyk (KŁOSOWSKI 2014). This issue has also been noticed in other parts of the world, e.g., in the lakes Kämmoosteich and Lac de Lussy in Switzerland (KOZŁOWSKI and EGGENBERG 2005), and in the Podilskyi Reserve in Ukraine (DIDUKH et al. 2010). On the other hand, in Japan, natural hybridisation occurring between *N. pumila* and *N. japonica* has been observed (SHIGA and KADONO 2007).

The literature suggests that all lakes with stands of *N. pumila* should be turned into reserves (as a form of protection actions). In other stands of this species, maintaining low water hardness must be pursued (KŁOSOWSKI 2014). The lake described in this paper is situated within the “Beaver Refuge on the Pasłęka River” reserve, Natura 2000 site PLB 280002 Dolina Pasłęki, the Special Protection Area Dolina Pasłęki (PL.ZIPOP.1393.OCHK.370). Given its natural values, during the preparation of the plan of protective measures it was proposed that the lake, along with the immediate surroundings, should be incorporated into the Natura 2000 SITE PLH 280006 Rzeką Pasłęka.

In 2003, only a single phytocoenosis of the small yellow pond-lily was found (Table 1, relevé no 10). In 2013, it turned out that the small yellow pond-lily spread along the shores. Therefore, if the habitat conditions in the lake do not change, the conservation status of the *N. pumila* population will not be at risk. A potential threat to this site is a possible decrease in the water level (which can be controlled by making the valve downstream), forestry clearance and increased supply of humus compounds.

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