

SUBFOSSIL SEEDS OF *Stratiotes aloides* L. IN NORTHERN AND CENTRAL POLAND

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Abstract

Fructification of *Stratiotes aloides* L. is very rarely recorded at present. In general, there are only one sex representatives in each lake basin, which simply makes generative reproduction difficult. The subfossil seeds of *Stratiotes aloides* have been found in five localities of biogenic accumulation in northern and central Poland.

Key words: *Stratiotes aloides*, subfossil seeds, paleoecology, Holocene

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INTRODUCTION

Stratiotes aloides L. is a species belonging to the Eurosiberian element, whose area of occurrence is at present limited (Palamarew 1979). It is a stenothermal plant (Samuelsson 1934, Burga, Perret 1998, Bennike, Hoek 1999). It occupies mainly eutrophic slow-flowing or standing waters – strongly shallowed lakes, oxbow lakes and ponds. It grows immersed in water, rooted in the substrate or as a floating plant (Kornatowski 1976, 1979). It creates compact plant communities within the littoral zone thus contributing to its further shallowing. It is commonly found in Poland except the mountains (Zajac, Zajac 2001).

This is a perennial plant with a short, thick rhizome and numerous stolons. Leaves of *Stratiotes aloides* L. are linear with characteristic thorns on the edges. The seeds are elongated, cylindrical in outline, hooked at the base. Elongated nodules in oblong rows and delicate foveolae can be seen on the surface of the seeds as well as a clearly visible rib running along its axis.

The fructifications of *Stratiotes aloides* L. are currently very rarely observed in nature (Cook, Urmi-König 1983, Smolders *et al.* 1995). In one water body usually only representatives of one sex are found, which makes generative reproduction difficult (Mowszowicz 1973).

In Poland there were reports on cases of generative reproduction of *Stratiotes aloides* L. in the 1930s near Gdańsk and in the ditch draining water from the meadow among the oxbow lakes of the Dniestr River near Mariampol (Małdalski 1938), and several years ago they were also observed in Wielkopolski National Park (Żukowski *et al.* 1995).

Stratiotes seeds have been known in Eurasia since the Oligocene (Mai 1995). Numerous findings from the Tertiary and Quaternary sediments gave a possibility to distinguish between several extinct species and to study changes in their

morphological structure (Kirchheimer 1957, Dorofeev 1963, Palamarew 1979, Velichkevich 1982). Besides the seeds in biogenic sediments it is also thorns of the edges of leaves that are found (Bennike, Hoek 1999).

The postglacial history of fructification of *Stratiotes aloides* is rather mysterious, because in spite of its frequent contribution to the covering of water bodies its seeds are very rarely found in Holocene lake sediments (Cook, Urmi-König 1983, Bennike, Hoek 1999, Tobolski 2000). So far in Poland they have been reported only by Polcyn (2003) from Wielkopolska, from the layers of biogenic sediments dated to the period between the 12th and 15th century. There were more frequent reports from the sediments of older Interglacials. Polish fossil seeds of *Stratiotes aloides* found in the Eemian interglacial sediments were reported from the sites in: Dzbanki Kościuszkowskie (Velichkevich *et al.* 2005), Góra Kalwaria (Sobolewska 1961), Szelaż (Środoń 1956), Szwałcaria (Borówko-Dłużakowa 1975), Tarzymiechy (Środoń 1954), Władysławów (Tobolski 1991), and those from the Mazovian Interglacial sediments were found in Ciechanki Krzesimowskie (Brem 1953), and Surniki (Sobolewska 1956).

RESULTS

During the research on lake and peatbog changes (Gałka 2007a, b, Gałka, Onuch 2007) in five biogenic accumulation reservoirs located in Tuchola Forest National Park, Świecie Land and in Giecz (Fig. 1) fossil seeds of *Stratiotes aloides* were found among numerous plant remains. Plant subfossils were extracted from sediments retrieved using an Instorf drill, and rinsed on the sieves (size 0.25 mm and 0.5 mm).

Altogether 12 seeds were found (of which four were damaged), and several dozen leaf-margin spines of *Stratiotes aloides* were identified (Figs 2, 3).

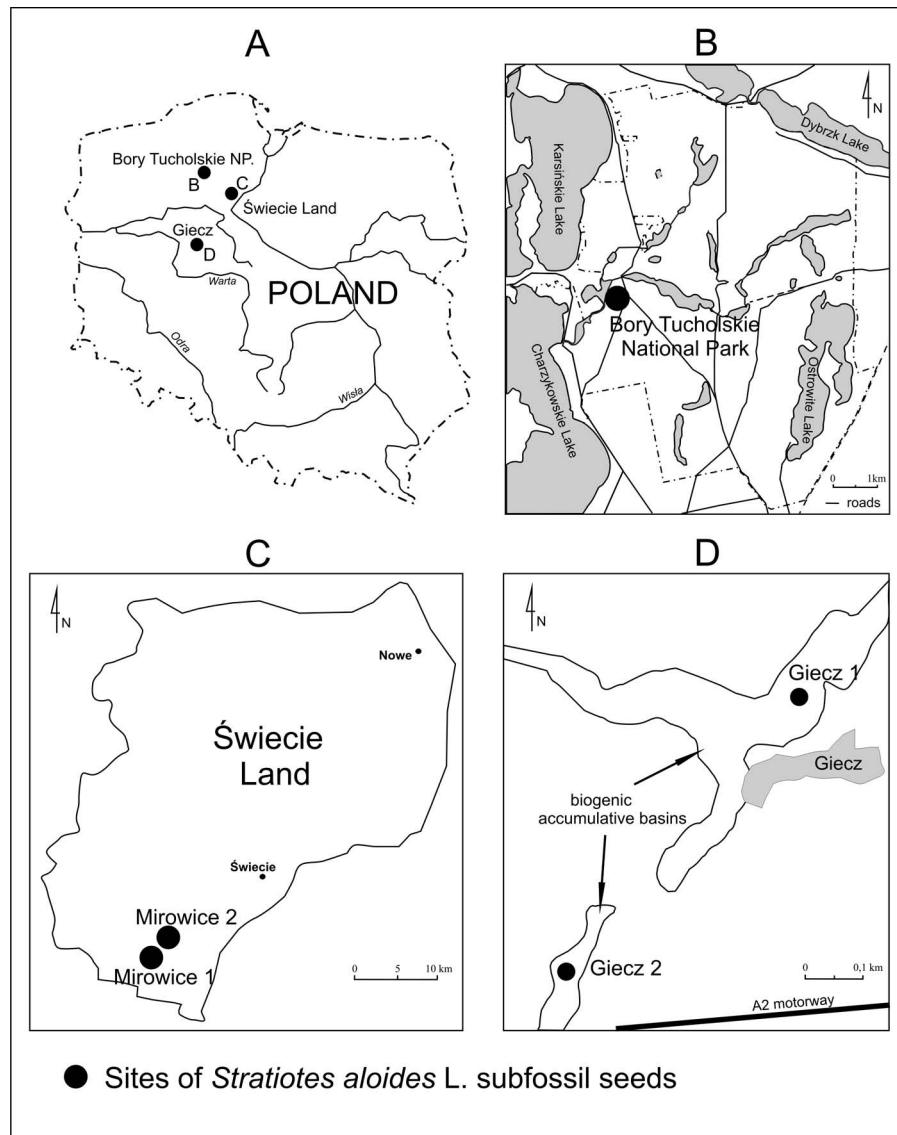


Fig. 1. The sites of occurrence of subfossil seeds of *Stratiotes aloides* L. analysed in the present study.

Site in Tuchola Forest National Park (Fig. 1B)

In the neighbourhood of the east shore of Lake Skrzyńka a damaged seed in the detritus gyttja layer was found at the depth of 295–290 cm. No *Stratiotes aloides* thorns were found. In that layer fossil remains of the following plant taxa were found: *Najas marina* L., *Typha* sp., *Thelypteris palustris* SCHOTT, *Carex pseudocyperus* L., *C. acutiformis* EHRN., *Alnus glutinosa* (L.) GAERTN. and *Betula pubescens* EHRN.

Mirowice 1 Site in Świecie Land (Fig. 1C)

In the layer of fine detritus gyttja with silt changing upwards into coarse detritus gyttja eight seeds were found at the depth of 120–80 cm (Fig. 2a–f). Two of them were damaged. The measurements of the others are given in Table 1. Numerous *Stratiotes aloides* thorns were found. In the same layer remains of other aquatic and reed plants were identified, such as: *Najas marina* L., *Lemna trisulca* L., *Lemna minor* L.,

Table 1
Dimensions of *Stratiotes aloides* L. seeds found in the present study

Site	Length (mm)	Width (mm)
Mirowice 1	9.5	3.1
Mirowice 1	9.4	3.0
Mirowice 1	9.7	2.7
Mirowice 1	8.6	2.5
Mirowice 1	8.3	2.8
Mirowice 1	7.5	2.2
Mirowice 2	7.5	2.2
Giecz 2	7.8	2.4

Ceratophyllum demersum L. S. STR, *Potamogeton crispus* L., *P. gramineus* L., *P. obtusifolius* MERT. & W.D.J. KOCH, *P. natans* L. and others.

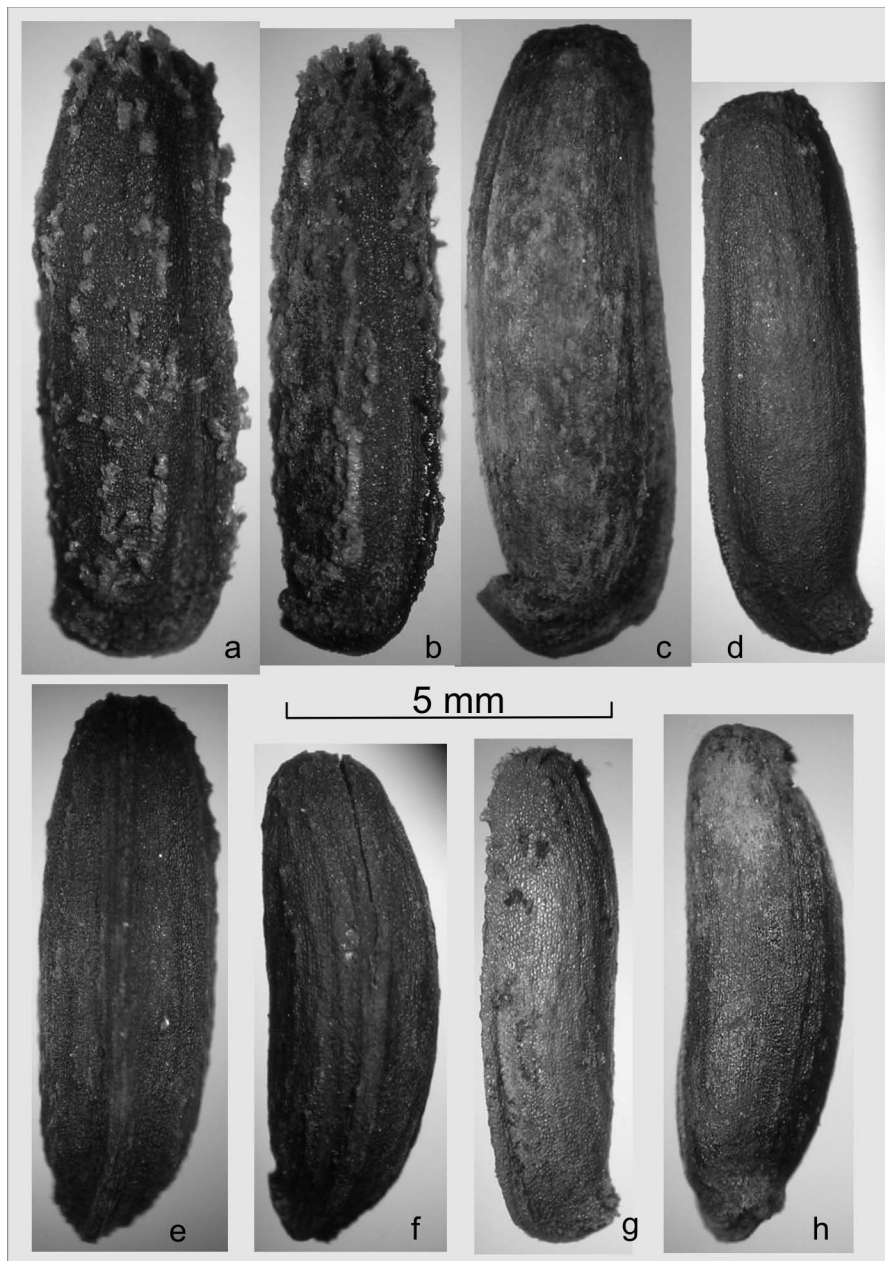


Fig. 2. *Stratiotes aloides* L. seeds. Mirowice 1 (a–f), Mirowice 2 (g), Giecz 2 (h).

Mirowice 2 Site in Świecie Land (Fig. 1C)

In this site (between the villages of Mirowice and Wałdowo) one seed in the layer of coarse detritus gyttja was found at the depth of 240–245 cm and thorns at the depth of 200–245 cm. They were accompanied by numerous remains of aquatic plants, such as *Potamogeton natans* L., *Ceratophyllum demersum* L. S. STR, *Nymphaea alba* L., *Nuphar lutea* (L.) SIBTH. & SM., *Lemna minor* L.

Giecz 1 Site, Central Wielkopolska (Fig. 1D)

There is a large biogenic accumulation reservoir in the neighbourhood of the hill fort of Giecz. In its north-western part one damaged seed in the detritus-calcareous gyttja layer was found at the depth of 74 cm.

Giecz 2 Site, Central Wielkopolska (Fig. 1D)

A strongly transformed peat bog developed on lake sediments is situated southwest of the hill fort in Giecz. In the detritus-calcareous gyttja, at the depth of 30 cm one *Stratiotes aloides* was found (Fig. 2h) together with numerous *Chara* sp. oospores and *Batrachium* sp. fruit.

Results of measurements of *Stratiotes aloides* seeds found in this research are shown in Table 1. They are within the limits of variability of *Stratiotes aloides* L. fossil seeds (6.6–9.7 x 2.1–2.7 mm) from the interglacial floras of Central and Eastern Europe (Velichkevich, Zastawniak 2006).

On the basis of palynological analysis the sediments with the *Stratiotes aloides* seeds from Tuchola Forest National Park are dated to the subboreal period (K. Tobolski, unpublished data). All the seeds from the reservoir in Miro-

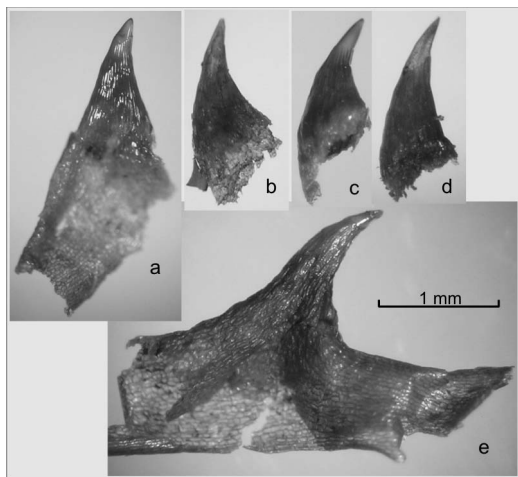


Fig. 3. Fossil leaf-margin spines of *Stratiotes aloides* L. Mirowice 1 (a–d), Mirowice 2 (e).

wice 1 are of the same age, and the layer where they were found was estimated to the subboreal period (J. Maj, unpublished data). However, the seed from Giecz (Giecz 1 Site) is dated to the late Middle Ages (Milecka, Tobolski 2007).

CONCLUSIONS

The fructification of *Stratiotes aloides* L. in central Poland in the Holocene period was not as rare as it has been supposed. This fact is proved by five new sites where fossil seeds of this plant were found. However, it is a fact that in the Eemian interglacial and Mazovian interglacial sediments *Stratiotes aloides* L. fossil seeds are more common. Disproportion between the number of sites with *Stratiotes aloides* L. fossil seeds from the Pleistocene and Holocene periods is particularly noticeable if we consider the number of sites from which the sediments were analysed for the content of macrofossils. The limitation of seed production by this plant in the Holocene is clear. However, it is difficult to account for this phenomenon. It might be attributed to the climatic conditions in this interglacial or history of *Stratiotes aloides* L. species itself. The dependence between the fructification of *Stratiotes aloides* L. and thermal conditions can be noticed when analysing fossil distribution of *Stratiotes aloides* L. in the sediments of the Eemian interglacial. In fact, *Stratiotes aloides* L. seeds occur in biogenic sediment accompanied by the macrofossils of plants with high thermal requirements (Tobolski 1991).

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