Elodea nuttallii (Planchon) St. John – a competitive hydrophyte in the Romanian Danube river corridors

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Introduction

The longest reach of the Danube River borders, or crosses the Romanian territory, respectively. The composition and distribution of aquatic vegetation is specific for the diversity of the channel types in the Danube River corridor. Increased eutrophication stimulates the development of some well-adapted cormophytes (Sârbu 2006). Therefore, special attention was given to the two *Elodea* species found in the Romanian flora: *Elodea canadensis* Michx., a long-established hydrophyte (Poplavskaia 1948) and *Elodea nuttallii* (Planchon) St. John, an adventive species (Ciocârlan et al. 1998), which is very competitive in eutrophic conditions.

Methods

This study was carried out in Romania, between 2002-2004 in all the Romanian Danube river corridors: main channel (1346 km), river branches (951 km) and in ten Danube Delta channels (186 km). It was part of the international project "Macrophyte Inventory Danube – Corridor and Catchment" (www.midcc.at) funded by the Austrian Federal Ministry of Education, Science and Culture. The field assessment of aquatic macrophytes was based on the methodology developed by Kohler (Kohler et al. 1971, Kohler 1978, Kohler and Janauer 1995; contiguous survey units, 5-level estimator scale: 1 – rare, 2 – occasional, 3 – frequent, 4 – abundant, 5 – very abundant), in accordance with the European Standard EN 14184 (2003), which is also relevant for the EU Water Framework Directive.

Diversity and abundance of aquatic plant species is displayed in diagrams: Distribution Diagrams, Relative Plant Mass (RPM) and Average Distribution of species (MMT/O/d). Structural analyses of the stem and assimilatory pigments assessment were carried out also. In stem cross section analysis Congo red & cryzoidine were used to staining the cellulose (in red color). Assimilatory pigments were analyzed spectrophotometrically (chlorophyll a λ = 662 nm, chlorophyll b λ = 644 nm, carotenoide pigments λ = 440 nm).

Results

Elodea nuttallii was recorded in the Danube River main channel, except river km 252-177 (left-side), in the 5 river branches (Borcea, Măcin, Chilia, Sulina, Sf. Gheorghe) and in 50% of the assessed smaller channels in the delta. *E. canadensis* was found only in one oxbow located along the Danube river main channel, between river km 930-794. Regarding the metrics Relative Plant Mass and Average Distribution, *E. nuttallii* was assessed as "frequent" in the narrow channels in the Danube Delta (Fig. 1, Fig. 2) and in the river branches (Fig. 3, Fig. 4) and as "occasional" in the Danube river main channel (Fig. 5, Fig. 6). The mean value of the total assimilatory pigments was 14.75 mg g^{-1} dry weight, with a range of the mean values of 9.0-19.40 mg g^{-1} dry weight. This values are higher than to those recorded for *E. canadensis* (12.42 mg g^{-1} dry weight; ranges of the mean values of 9.10-14.80 mg g^{-1} dry weight) and closer to those of *Ceratophyllum demersum* (Sârbu et al. 1999). *E. nuttallii* has a thicker, more compact and stronger stem than *E. canadensis* (Fig. 7, Fig. 8). The aerenchyma

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consists almost of one row of canals (Fig. 8). The cortex cells, the parenchyma cells from the central cylinder and also the epidermis cells develop thick cellulose walls, which provide a support for the stem, without restraining growth (Fig. 9, Fig. 10).

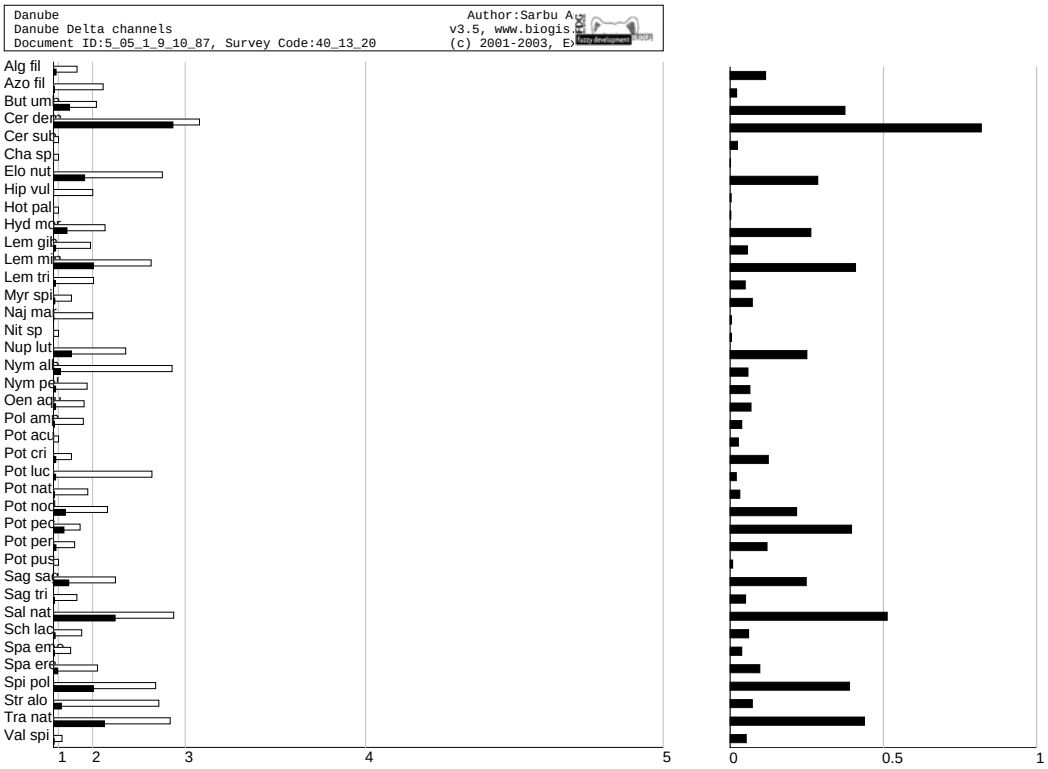

Figure 1. Average distribution of species (MMT/O/d) – Danube Delta channels

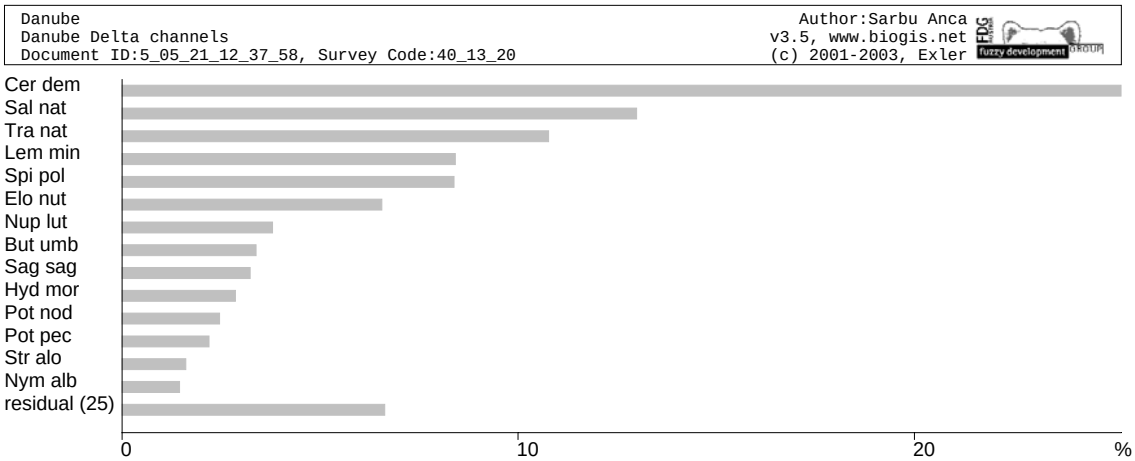

Figure 2. Relative Plant Mass (RPM) – Danube Delta channels

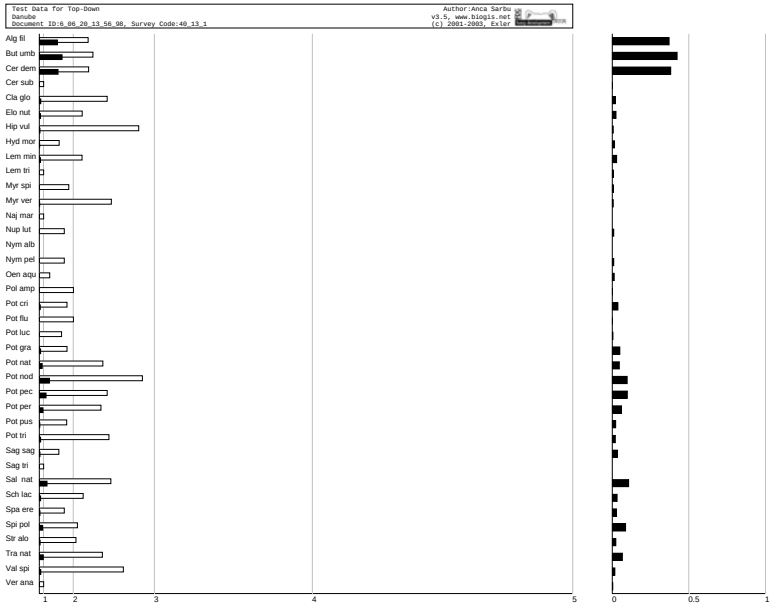

Figure 3. Average distribution of species (MMT/O/d) – Danube river branches

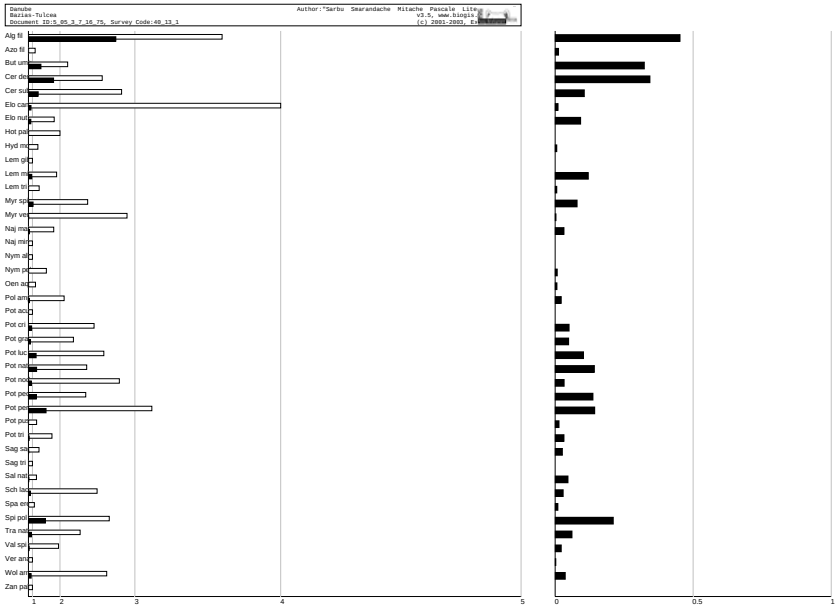

Figure 5. Average distribution of species (MMT/O/d) – Danube river main channel

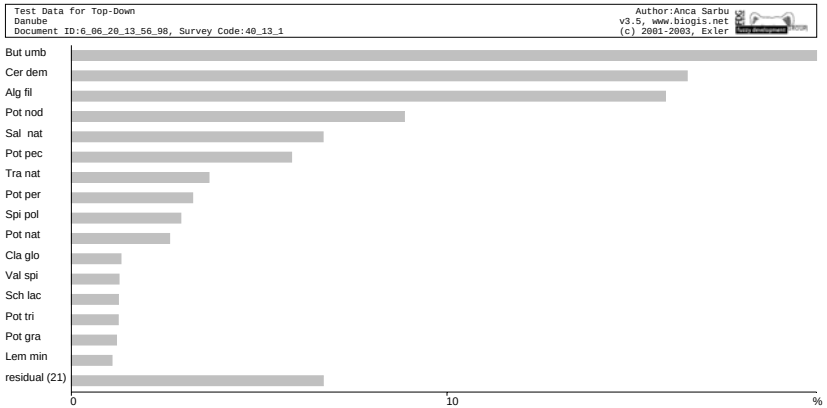

Figure 4. Relative Plant Mass (RPM) – Danube river branches

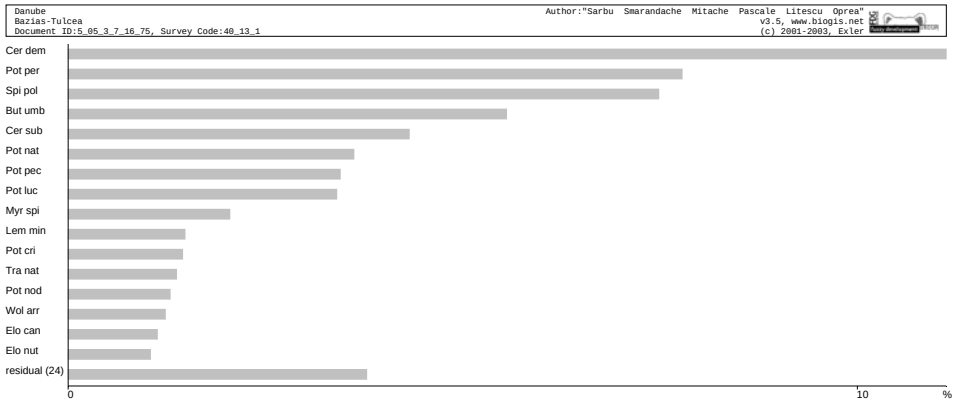

Figure 6. Relative Plant Mass (RPM) – Danube river main channel

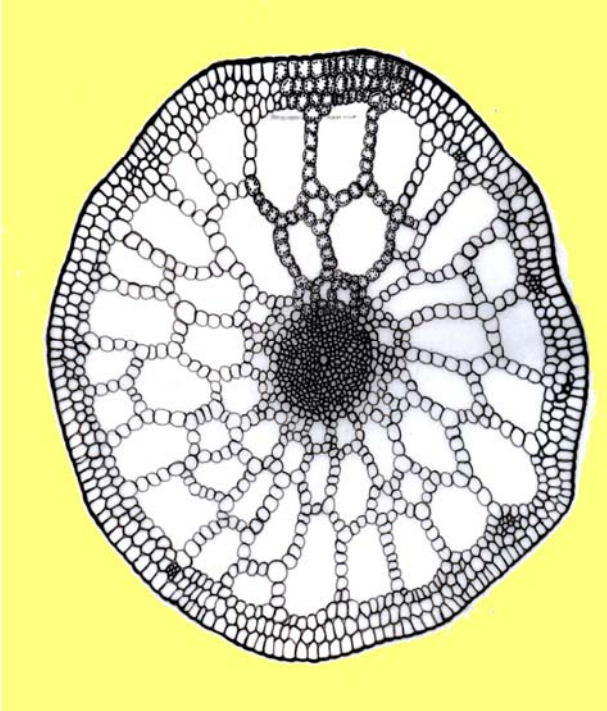

Figure 7. *E. canadensis* – stem, cross section (Poplavskaia 1948)

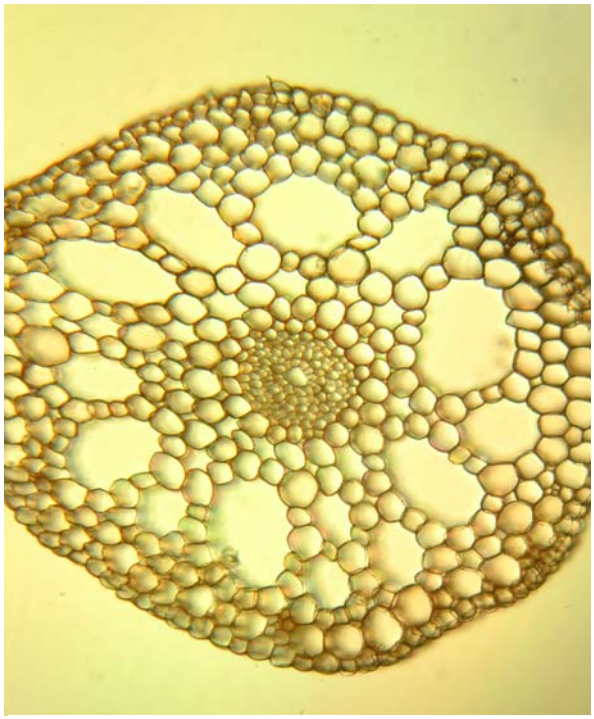

Figure 8. *E. nuttallii* – stem, cross section (Oc 12,5x; Ob 10; Amp. 12,5)

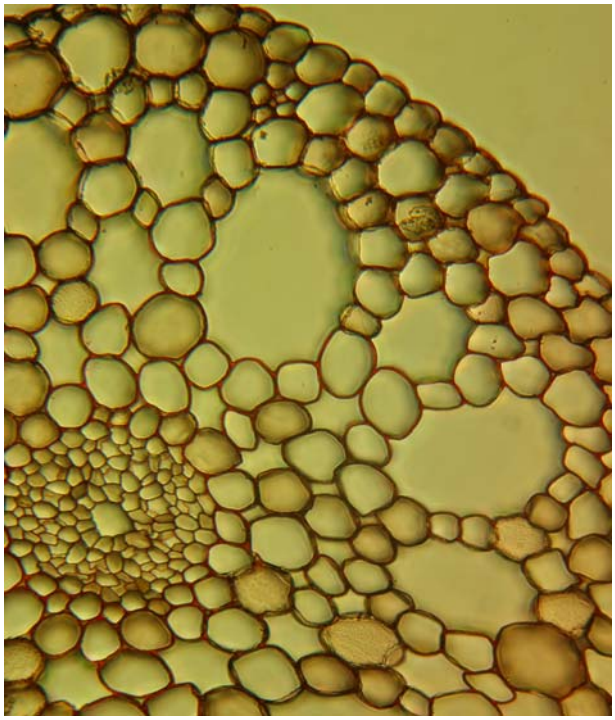

Figure 9. *E. nuttallii* – stem, cross section, detail of the cortex and central cylinder (Oc 12,5x; Ob 10; Amp. 16)

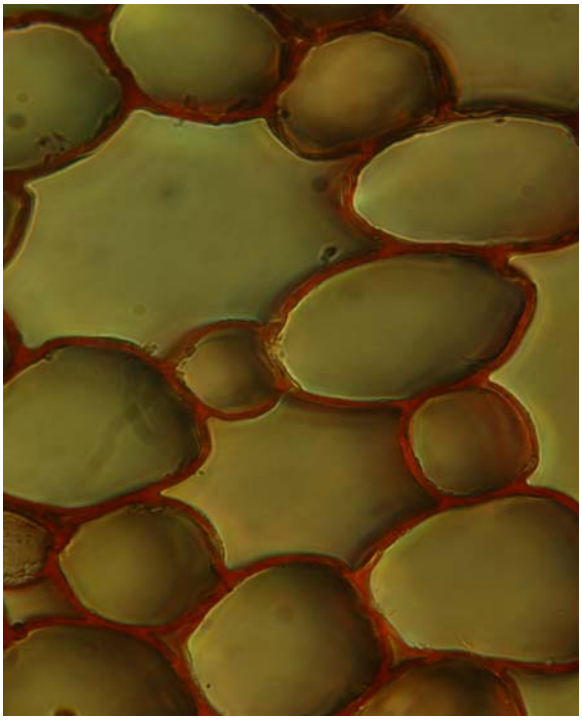

Figure 10. *E. nuttallii* – stem, cross section, detail of the cortical cells (Oc 12,5x; Ob 10; Amp. 25)

Disscusion

First nominated for the Danube Delta in 1998, *Elodea nuttallii* was found between 2002-2004 in the majority of the Romanian Danube river corridors: in 90% of the main channel, 100% of the river branches and 50% of the assessed delta channels, but it was nowhere dominant. In the delta channels this species, evaluated as "frequent", realized the most significant RPM value (7%), but placed under the dominance values. In the Danube river arms it was "frequent" and in the river main channel it was "occasional", but the RPM values were very low ('residual'). This position can be related to its short period of presence in the Romanian Danube River reach. Anyhow, the existing information (Sârbu 1999) associated with the results of the present study confirm the replacement of *E. canadensis* with *E. nuttallii* in the last 5 years, at least in two channels (Old Danube and Magearu) from the Danube Delta. Some physiological and structural characteristics support the hypothesis on the rapid increase in the *E. nuttallii* population: (i) higher content of assimilatory pigments, which ensure its significant success in the competition for light, (ii) the presence of a stem strengthened by the features of its cell walls, which allows for efficient vertical growth, (iii) the capacity to form a high number of "winterbuds" from which young plants will start to develop in spring. It is therefore of no surprise that it could effectively out-compete *E. canadensis*.

Summary

E. nuttallii, a short-time adventive species in Romania, became a non-negligible element of the aquatic plant communities of Romania. Its physiological and structural features offer a significant advantage in the interspecific competition.

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