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THE IMPACT OF THE SPECIES *ELODEEA NUTTALLII* ON NATURAL AQUATIC HABITATS IN OLTENIA, ROMANIA

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Abstract

Elodea nuttallii (Planch.) H. St John is a native taxon from North America, which is increasingly widespread in Oltenia, in recent years. It has been known in the flora of Romania since 1993. At the European level, it is on the list of invasive species of interest for the EU. In Oltenia, it prefers aquatic habitats with stagnant or smoothly flowing water. However, it grows in very good conditions and in cloudy waters, where very little light penetrates, a fact that gave this species an advantage compared to the plants it coexists with, greatly reducing their number. Following the research carried out by us, we noticed that in some aquatic habitats in Oltenia this plant registers low dominance abundance indices, but in others it builds up monodominant plant communities or with very few other vascular species, which causes biodiversity to decrease in these places very much. Among the aquatic habitats affected by the presence of the species Elodea nuttallii we mention: 3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation and 3160 Natural dystrophic lakes and ponds.

Key words*: aquatic habitats, Elodea nuttallii, impact, Oltenia, Romania.*

INTRODUCTION

Although floristic and vegetation studies have been conducted since the end of the 19th century in this part of Romania, it cannot be stated that this research work on vascular flora and natural and semi-natural vegetation is completed at present. A strong evidence is provided by the research carried out by the botanists of the Craiova University Centre until 2006, regarding the aquatic flora and vegetation (Buia & Popescu, 1952; Păun, 1967; Păun & Popescu, 1969; Cârțu, 1972; Cârțu, 1976). To this date, no publication includes a study of the species analysed by us. After 2001, it appears in several scientific works, but only in the floristic list or in the composition of certain phytocoenoses belonging to other associations (Popescu et al., 2001; Costache, 2005; Costache, 2011; Răduțoiu, 2011).

Before discussing how climate change affects plant constrainers, it is necessary to take into account how the world's climate may affect the dynamics and population structure of plants, the micro-evolutionary processes and structure of plant communities, as well as crop yield and quality (Dima et al., 2023; Sălceanu et al., 2023; Sărățeanu et al., 2023). Furthermore, there will be crop relocation, diseases associated with changes in the atmospheric composition and global climate with economic consequences from crop loss and changes in host-pathogen relationship (Paraschivu et al., 2022; Paraschivu et al., 2023). The climate changes occurred during the last 25 years have triggered obvious changes in the floristic composition of the phytocoenoses of certain plant associations (Niculescu, 2016; 2023), favouring the spread of some adventitious species with invasive potential (e.g. *Elodea nuttallii*).

The analysis of the different natural and semi-natural habitats in Oltenia underlined the fact that the aquatic habitats are the ones that have registered the most noticeable changes in the floristic composition, in the framework of climate changes during recent years.

The allogeneic alien species have gained ground over native species (Lambdon et al., 2008), becoming invasive in certain habitats (Georgescu & Luchian, 2023; Costache et al., 2021). In these places, they produce major changes both in terms of phytoplankton and zooplankton, inducing significant damage in the economy of these areas (Paini et al., 2016).

In recent years, it has been noticed that *Elodeea nuttallii* (Planch.) H. St. John also settles in artificial, man-made aquatic habitats (Chytrý et al., 2009; Wang et al., 2019).

The changes in aquatic habitats are explained, on the one hand, by the actions of humans and domestic animals (Thiébaut, 2007; Fleming & Dibble, 2015), which enter these habitats where they leave their visible mark during the warm periods of the year; on the other hand, they are triggered by water fluctuations, which are increasingly frequent in recent years.
Elodea nuttallii (Planch.) H. St. John is an adventive species of EU interest, originating in North America (Figure 1).

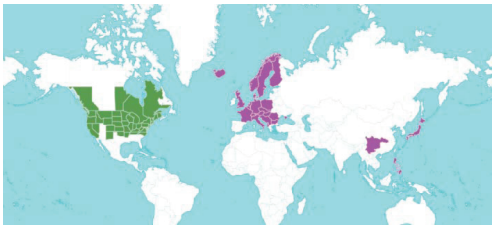

Figure 1. Distribution of the species *Elodea nuttallii* (POWO, 2023)

The presence of this species in the European flora dates back to 1939, when it was mentioned from Belgium. From Kempen and the Schelde river valley it is cited as a rare species (Van Rompaey & Delvosalle, 1979). Its presence in the flora of Romania dates back to 1997, from the Danube Delta (Ciocârlan et al., 1997). Over time, this species has been found to gradually replace *Elodea canadensis*, as the stems and branches of *Elodea nuttallii* grow much faster as compared to cu *E. canadensis*; moreover, *Elodea nuttallii* is a species with higher tolerance to low light (Simpson, 1990; Greulich & Trémolières, 2006).
Elodea nuttallii is a plant that tolerates the oligotrophic, as well as the eutrophic sites and even the polluted ones (Samecka-Cymerman & Kempers, 2003; Grinberga & Priede, 2010; Dodkins et al., 2012). Moreover, in recent years, it has been found that due to the increase in temperatures in southern Romania, this plant remains green even during the winter, favouring a faster entry into vegetation in the spring of the following year. This fact has serious consequences for the waters in which the species is present, because it occupies the entire water mass in a relatively short time (Kunii, 1984; Zehnsdorf et al., 2015). The specialized literature states that *Elodea nuttallii* grows well in dirtier, polluted waters, unlike *E. canadensis*, which is found in clear, clean and cold waters (Ciocârlan et al., 1997).

The main purpose of the present study is to show the impact of the invasion exerted by *Elodea nuttallii* within the plant communities where it settles in Oltenia. The authors accomplished that aim through the comparative analysis of unaffected habitats and of those where this species occupies the entire water table.

MATERIALS AND METHODS

Information on the chorology of this species in Oltenia was obtained from the specialised literature, various sources mentioning the species in the floristic inventory of the studied areas (Popescu et al., 2001; Costache, 2005; 2011; Răduțoiu, 2011). Valuable information was also obtained from the main herbaria of the country (Bucharest, Iași, Cluj-Napoca, and Craiova), as well as from the field trips conducted by the author in different areas of Oltenia.
By comparing the existing data in the specialized literature with the information collected from the field, the author was able to assess the impact triggered by the development of the species *Elodea nuttallii* on the aquatic habitats in which it is present.
The scientific plant names used in this material are in accordance with POWO (2023). The acronyms for the consulted herbariums are in accordance with the Index Herbariorum (Thiers 2022+): Iași ("Alexandru Ioan Cuza" University Herbarium - I), Cluj-Napoca ("Babeș-Bolyai" University Herbarium in Cluj-Napoca - CL), Bucharest (Herbarium of the Institute of Biology of the Romanian Academy - BUCA; Herbarium of the "D. Brândza" Botanical Garden in Bucharest - BUC), Craiova (Herbarium of the University of Craiova - CRA).
The distribution maps were achieved by using the RoBioAtlas program (2023), which displays the species distribution in correlation with the average annual precipitation and temperatures. On these maps, the points where this species is invasive are marked in red, while the green marks identify the places where it is present in the floristic composition of other plant associations, where it has low Abundance-Dominance indices.

RESULTS AND DISCUSSIONS

The areas where *Elodea nuttallii* is characterised by a significant development, inducing obvious

changes on these types of habitats in Oltenia, have been identified in several places in the counties of Gorj (e.g. Rovinari), Mehedinți (Lunca Banului), Olt (Gostavățu), and Dolj (Sadova, Bădoși, Ciupercenii Noi, Desa, Piscu Sadovei, and Ciupercenii Vechi). Furthermore, this taxon is present in several other places in Oltenia, without showing invasive potential. The comparative analysis involving the structure of the phytocoenoses of the association dominated by this plant attests to the existence of certain differences in terms of floristic composition and water quality.

The association edified by *Elodea nuttallii* was described for the first time in the field literature under the name of *Ceratophyllo demersi – Elodeetum nuttallii* Ciocârlan, Sârbu, Ștefan, Marian 1997 and it was included in the following coenotaxonomic system: *Potamogetonetea pectinati* Tx. et Prsg. 1942, *Potamogetonetalia pectinati* W. Koch 1926, *Potamogetonion lucentis* Rivas Martinez 1973 (Ciocârlan et al., 1997).

In the samplings presented by the authors of the work, from the Danube Delta, the presence of 14 taxa is noticed. The nomenclatural type of the association is represented by sampling number 3 (Ciocârlan et al., 1997).

Other phytocoenoses of this association, in which the presence of 18 taxa can be observed, are described from the Danube Delta Biosphere Reserve, more precisely from the area of Dranov and Belciug lakes (Ștefan et al., 2006). Moreover, 10 species from the floristic composition of this association are mentioned from Mărașu locality (Brăila county) (Sanda et al., 2005).

It is important to mention that the species *Elodea nuttallii* is known from few aquatic communities at the European level (Rodwell, 2000; Weekes et al., 2018).

Although the species analysed by us is present both in habitat 3150 - Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation, as well as in habitat 3260 - Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation, the invasive potential is manifested only in the habitat 3260. This is due to the fact that the water of the latter habitat has a slow and permanent flow, also being shallower than that of habitat 3150; this characteristic induces the near absence of the floating vegetation, thus favouring the development of submerged plants (Figure 2).

Figure 2. *Ceratophyllo demersi - Elodeetum nuttallii* (Ciocârlan et al., 1997) from the Jiu meadow, near Sadova settlement (original)

The analysis of the association table (Table 1) underlines the fact that the surveys carried out in different areas of Oltenia point to the very small number of species (3-4) with which it coexists. This is also reflected in the ichthyofauna of these areas, the number of fish species being greatly reduced. The conducted studies pointed out to the fact that those that still survive are small in size (Figure 3). In the end, there will be major disturbances at the level of the entire food chain.

Figure 3. Fish species from habitats where *Elodea nuttallii* este is invasive - Rovinari (Gorj county)

Chorology: In order to represent the distribution of the *Elodea nuttallii* species, we used the RoBioAtlas program, which enables correlations with average annual temperatures (Figure 4) and average annual precipitation quantities (Figure. 5).

Table 1. *Ceratophyllo demersi - Elodeetum nuttallii* Ciocârlan, Sârbu, Ștefan, Marian 1997

Proveniența releveurilor	1	2	3	4	5	6	7	8	9
Acoperirea vegetației (%))	90	85	90	90	85	90	90	85	90
Adâncimea apei (cm)	90	120	150	125	95	80	95	65	75
Suprafața (m^2)	5	4	4	25	30	12	10	4	4
Expoziția	-	-	-	-	-				
Elodea nuttallii	5	4	4	5	4	4	5	4	5
Ceratophyllum demersum	-	+	1	+	+	1	-	+	+
Potamion et Potametalia									
Potamogeton pectinatus	+	1	-	-	-	-	-	-	-
Potamogeton pusillus	-	-	+	-	-	+	-	+	
Potamogeton crispus	-	+	-	+	+	-	-	+	+
Potamogeton nodosus	-	-	+	+	+	-	+	+	+
Myriophyllum verticillatum	+	-	-	-	-	-	-	-	+
Ranunculus trichophyllus	+	+	-	-	+	+	-	+	-
Hydrocharition									
Hydrocharis morsus-ranae	-	-	-	-	-	+	-	+	-
Salvinia natans	-	+	-	-	-	+	-	+	+
Lemnion									
Lemna minor	+	+	+	+	+	-	-	+	+
Lemna trisulca	-	-	+	-	-	+	-	-	-
Azolla filiculoides	-	+	-	-	-	-	-	-	-
Nymphaeion									
Trapa natans	-	+	-	-	-	-	+	+	-
Nymphoides peltata	-	-	-	-	-	-	+	-	-
Phragimtetea australis									
Typha angustifolia	-	-	-	+	-	-	-	-	+
Sparganium erectum	-	-	-	+	-	-	-	+	+
Alisma plantago-aquatica	-	-	-	-	-	-	+	-	-

The provenance of the reliefs: 1. Lunca Banului (Mehedinți County) (13.06.2012); 2. Canal in the meadow of Olt next to the town of Gostavătu (Olt County) (01.06.2013); 3. Sadova - in the Jiului meadow (Dolj County) (12.10.2014); 4. The city of Bădoși, along a canal in the Jiului meadow (Dolj County) (30.05.2015); 5. Desa, along a channel near the Pietrile pond (Dolj County) (09.06.2015); 6. Ciupercenii Vechi - in Ciuperceni Pond (Dolj County) (09.06.2015); 7. The outskirts of Rovinari (județul Gorj) (26.08.2023); 8. Ciupercenii Noi (Dolj County) (16.07.2015); 9. Piscu Sadovei in Zăcătoarea Pond (14.09.2019).

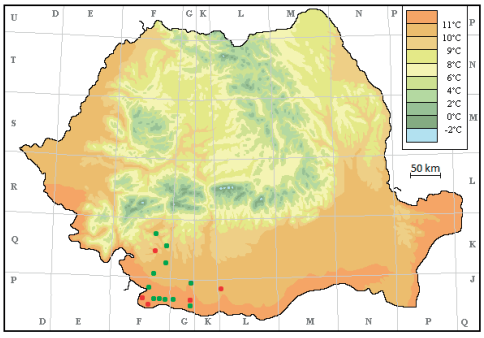

Figure 4. Distribution of the species *Elodea nuttallii* in Oltenia, in correlation with the average annual temperatures

The species analysed in the present paper was identified in the following settlements: Lunca Banului, in Debarcader Lake (Mehedinți County), Gostavățu (Olt County), Rovinari, Izvoarele, Ceplea and Bâlteni (Gorj County), as well as Bădoși - along a canal, Ciupercenii Noi, Desa - along a canal near the Pietrile pond, Sadova, Piscu Sadovei - in the Zăcătoarea pond, Ostroveni, on the outskirts of Calafat, Ciupercenii Vechi - Ciuperceni pond, Rast, Bistreț, Ghidici, Dunăreni, Grindeni, Hunia, Salcia, and Lișteava (Dolj).

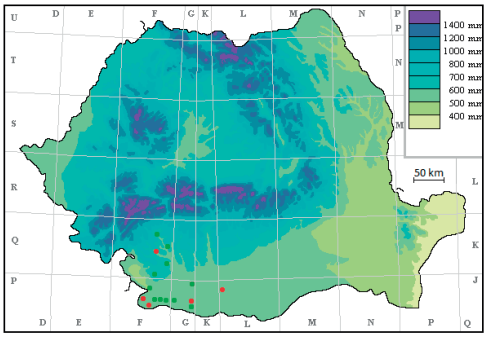

Figure 5. Distribution of the species *Elodea nuttallii* in Oltenia, in correlation with the average annual precipitation quantities

In addition, the presence of the species *Elodea nuttallii* in other areas from southern Oltenia enables us to state that the invasive potential of this plant will also become obvious in these places in the near future, the taxon being favoured by the zoo-anthropogenic factor (Figure 6) and by the climate changes of recent years.

Figure 6. The influence of the zoo-anthropogenic factor on the aquatic vegetation in southern Oltenia

CONCLUSIONS

Following the research carried out, we can state that the increasing dispersion of *Elodea nuttallii* species can be attributed to water pollution. The main factor that triggers changes in the floristic composition of aquatic habitats is the zoo-anthropogenic one. On the other hand, the decreasing water regime during recent years creates new favourable habitats for *Elodea nuttallii*.

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