CHOROLOGY OF *AMORPHA FRUTICOSA* IN THE DANUBE DELTA

M. DOROFTEI[1]

In this paper a comprehensive review of the relevant field data is provided, with the purpose to determine the state of knowledge regarding the distribution of *Amorpha fruticosa* in the Danube Delta.

Key words: the Danube Delta, *Amorpha*, chorology.

INTRODUCTION

On the territory of Romania, the studied species mainly settle at present on the inferior course of the Danube, its tributaries, and within the Danube Delta.

The climate conditions in the Danube Delta resemble those of the origin area the invasive species *Amorpha fruticosa* comes from (Binggeli, 1996). The main characteristic of the Danube Delta is the acute lack of rainfall, an aspect that is reflected in a tendency of spontaneous salinization of the hot sandy soils and the meadow's flooding during spring.

Amorpha fruticosa is frequently found within wetlands, on channels and ponds' banks, and sometimes in riparian forests (Fargione, 2005) or in unvegetated or sparsely vegetated shores, water-fringing reed beds and tall helophytes (Anastasiu, P., 2007).

MATERIAL AND METHODS

The aim of presenting the research methods of the species *Amorpha fruticosa* is to highlight some ecological characteristics of the species, the distribution and its way to spread within the territory of the Danube Delta.

For this aim, five study areas have been chosen (annex), different in terms of the soil conditions, the hydrologic regime and profile, and the vegetation structure: Pardina Depression; Caraorman Dunes; Şontea – Fortuna Depression; the lake complex Matiţa – Merhei and the Fishing Arrangement Dunăvăţ.

The field trips have systematically been accomplished depending on the vegetation period in order to observe various stages of the species *Amorpha*

[1] Danube Delta National Institute, Tulcea, Babadag, Str. 165, 820112, e-mail: doroftei@indd.tim.ro

fruticosa in distinct ecologic stations. The vegetation surveys (50 m^2) have been made in the areas where the invasive species *Amorpha fruticosa* is present.

The counting and recording is made on sections of a specific length in order to compute the linear density and to see the way it varies along the entire transect (annex).

To examine the distribution of *Amorpha fruticosa* as accurate as possible, the aero-photographic mapping method was established. The purpose of this method is to obtain first summary information on the variability of the vegetation, the recurrence in specific habitats and on the local conditions.

The necessary basic materials for recognition are the maps database of the DDNI such as topographic maps, the satellite images from different years and seasons, altitude scale map, soil salinity map (Munteanu, 1996) and the vegetation map (Hanganu, 2002). The proper working mode is realized by the separation of the vegetation types (reed beds, sand dunes and forest areas) on satellite images. In each territory, at least one route is chosen that has to include all the landscape forms which are characteristic to the Danube Delta more than once. The route can be limited to a restricted key surface, but it has to include all the landscape forms.

RESULTS AND DISCUSSION

The field observations show that the species *Amorpha fruticosa* is particularly spread sub spontaneous in riparian forests, in the banks area, along the channels and lesser on the banks of the lakes.

Pardina Depression – the abundance of *Amorpha fruticosa* is as follows: along the banks of the Tătaru Channel and the Chilia Branch the abundance is of 3 with 37.5% of the surface being covered by the ligneous vegetation; along the banks of the Gotca Channel the abundance is of 2 with 17.5% of the surface being covered by the ligneous vegetation.

The abundance also continues to decrease towards south reaching up to 1 with 5.5% of the surface covered with ligneous vegetation along the banks along Ceamurlia Channel and Pardina Channel.

Regarding the altitude, the banks range between 1 and 2 m Nm, the agricultural precinct Pardina shows in general levels below 0 m Nm.

Caraorman Dunes – The presence of *Amorpha fruticosa* species is more prominent in the fluvial delta of the channel, the abundance of *Amorpha fruticosa* species is 3 – 37. 5%. This aspect may be due to the fact that the area presents a low drainage, characteristic of this type of Delta and ligneous vegetation which

offers it conditions of semi-shadow. Then the species appears scattered (1 – 5.5%) in the sandy part (transition phytocenoses) where the vegetation is mainly on sand soil, being often solitary and with reduced dimensions. Near Caraorman locality, *Amorpha fruticosa* is distributed fragmentarily on the canals' protection dam without showing impressive dimensions. With regard to altitude, the banks of the channel Crişan – Caraorman range are included between 1 and 2 m continuing to rise in the northern part towards the dunes interior up to 2–3 m.

Şontea – Fortuna Depression. In comparison with the other studied areas, the complex presents a diversity of vegetation, soils and higher altitude. The vegetation inside the depression is mainly formed of reed beds and grasslands, while along the channels it is generally formed of floodable natural forests. The exception from this description is represented by the areal between Gârla Păpădia, Dunărea Veche and Sulina Branch, which is mainly planted forest vegetation. The drainage is low on the entire surface of the complex, a factor that is beneficial for the development of the species. The abundance of *Amorpha fruticosa* species is as follows: along the Şontea channels (near Băclăneşti Lake, in the intersection point of Sireasa Channel with Mila 35 Channel, Stipoc as well as in the second line of vegetation, Şontea Nouă and on the left bank, Draghilea confluence with Şontea - Iulia) the abundance is 4 (62.5%); along the channels Draghilea at platform, Sireasa 1-2 km towards the Roşu bridge, Sireasa Veche the area of Cotețe Lake, Crânjeală, Olguța in the area Ligheanca – Mila 23 the abundance is 3 (37.5%); along the Trofilca Channel, Candura Channel – only at the channel's entrance Draghilea beside Lung Lake, Şontea beside Nebunu Lake, Războinița – the abundance is 2 (17.5%).

Matița– Merhei Complex. The complex is characterized by the presence of numerous lakes which occupy almost the entire centre of the depression. The dominant vegetation within the complex consists of reed associations (70%). From the point of view of altitude, the depression shows the lowest in the central part a range between 0 and 1 m, while in the southern and western part values between 1 and 2 m are determined. The drainage on the entire surface of the depression is slow. The salinity is very low as in the rest of lacustrine complexes that belong to the fluvial Delta. The abundance of *Amorpha fruticosa* is as follows: Dunărea Veche Branch – the abundance is of 3 (37, 5%); along the channels Bogdaproste parallel to Miazăzi Lake, the linking channel with Răducu Lake – the abundance is 2 (17.5%); Lopatna Channel parallel to the lakes Trei Iezere, Matița – the abundance is 1 (5.5%).

The fishing arrangement Dunavăț. Within this area, the reed vegetation also prevails, except along the channels the vegetation is formed of floodable

natural forests. The drainage is slow in spite of being changed within almost the entire area. Regarding the altitude, the arrangement is included between 0 and 1 m, rarely 2 m. The abundance of *Amorpha fruticosa* is as follows: Along the channels Mustaca, Cocoş, Dunăvăţ and Dranov – the abundance is 4 (62.5%); Along the channels Lejai, Tărâţa and Crasnicol – the abundance is de 3 (37.5%); Along the channels Lipovenilor, Belciug, Perişor and the belt channel – the abundance is 2 (17.5%).

The distribution of Amorpha fruticosa within other areas than the studied ones. The Popina fish pond (ponds 21–22) on the belt channel between Letea Dunes and the arrangement; Sfiştofca; Sulina branch, within the areas with ligneous plants, usually in the second line of vegetation; Litcov Channel – in clumps of a few dozens of specimens along the channel (more abundant within the areas of linking channels with the lakes Gorgovăţ, Potcoava, Cuibul cu Lebede and Isac); Perivolovca Channel – the species has a reduced presence (more frequent in the southern part of Sfântu-Gheorghe branch – Taranova channel; Candura channel (at Scăunele) – Durnoi boundary stone (Nebunu); the islet neighboring Erenciuc channel; Cioban Gârlă channel; Dunărea Veche both knots of "*the big M*", Sfântul Gheorghe channel; Chilia channel, Periteaşca at the end of the channel; the area of the littoral cordon; Popina Island; Sahalin Island – a few amorpha specimens of reduced dimensions (max. 50 cm) present in *Convolvuletum persici* (Borza 1931 n.n) Burduja 1968; Erenciuc Channel, few specimens on the channel's edge under willows; Lupilor Dunes, the area of channel 5 – few specimens; Portiţa – within the resort, a few planted specimens of higher dimensions, on the beach, within the strictly protected area, rare specimens of reduced dimensions (max. 50 cm); on the linking channel between Sfântu – Gheorghe branch and Melea at the fishery – a few specimens 2–3 m high; Gura Dranovului – high specimens forming a grove; Iancina area, at Bisericuţa – a few specimens of reduced dimensions; Leahova Channel (on stone); Gura Dunăvăţului; Tudor Vladimirescu area – in poplar plantations; Pătlăgeanca; Cernovca branch; Caraorman Dunes, the amorpha specimens (1–2 m) are present in the area of inner dunes.

The following main plant communities (Doniţă, 2005) within the studied areas are presented where the presence of *Amorpha fruticosa* is significant:

- *Artemisietum arenariae* Popescu et Sanda 1977 vegetation cover of 70% where *Amorpha fruticosa* has a frequency of + and an average cover percent of 0.5%
- *Bassietum sedoidis* (Ubrizsy 1949) Soo 1964 vegetation cover of 70% where *Amorpha fruticosa* has a frequency of + an average cover percent of 0.5%;
- *Cynodonto – Poetum angustifoliae* (Rapaics 1926) Soo 1957 vegetation cover of 60% where *Amorpha fruticosa* has a frequency of 1 and an average cover percent of 5.5%;

- *Hordeetum murini* Libbert 1923 emend.Pass. 1964 vegetation cover of 70% where *Amorpha fruticosa* has a frequency on Braun – Blanquet scale of + an average cover percent of 0.5%;
- *Scirpo-Phragmitetum* W.Koch 1926 vegetation cover of 100% where *Amorpha fruticosa* has a frequency from + to 1 and an average cover percent from 0.5% to 5.5%;
- *Thelyptero – Phragmitetum* Ştefan *et al.* 1995 vegetation cover of 100% where *Amorpha fruticosa* has a frequency of + and an average cover percent of 0.5%;
- *Typhetum angustifoliae* (All.1922) Pign. 1934 vegetation cover of 100 % where *Amorpha fruticosa* has a frequency of + and an average cover percent of 0.5%;
- S*alicetum albae – fragilis* Issler 1926 em. Soo 1957 vegetation cover of 90 % where *Amorpha fruticosa* has a frequency of 2 and an average cover percent of 17.5%;
- S*alicetum albae – fragilis* Issler 1926 em. Soo 1957 vegetation cover of 70 % where *Amorpha fruticosa* has a frequency of 3 and an average cover percent of 37.5%;
- *Calamagrostio-Salicetum cinereae* Soo et Zolyomi (1934) 1955 vegetation cover of 70% where *Amorpha fruticosa fruticosa* has a frequency of 3 and an average cover percent of 37.5%;
- *Salicetum triandrae* Malciut 1929 vegetation cover of 80 - 90% where *Amorpha fruticosa* has a frequency of 3 and an average cover percent of 37.5%;
- *Salicetum triandrae* Malciut 1929; subas. *amorphosum fruticosae* Borza 1954 vegetation cover of 70% where *Amorpha fruticosa* has a frequency of 4 and an average cover percent of 62.5%;

The invasive species *Amorpha fruticosa* has been identified with a higher frequency in phytocenoses of ligneous species such as : S*alicetum albae– fragilis, Calamagrostio-Salicetum cinereae, Salicetum triandrae, Salicetum triandrae* subas. a*morphosum fruticosae* only in phytocenoses of herbaceous species such as: *Scirpo-Phragmitetum, Typhetum angustifoliae, Artemisietum arenariae, Hordetum murini, Bassietum sedoidis, Cynodonto – Poetum angustifoliae, Thelyptero – Phragmitetum.*

With regard to distribution, it may be mentioned that the species has been identified within almost any areas, ecologic conditions and vegetation type, but the difference is made by the species frequency and dimensions.

CONCLUSIONS

After obtaining a general view about the chorology of *Amorpha fruticosa* in the Danube Delta we can confirm that the species is abundant on canal levees in semi-shade riparian vegetation. Under light and good drainage conditions it was observed that the species grows slowly. The cumulated locations have to express a general image of the distribution of the species *Amorpha fruticosa* in the Danube Delta. The existent data will be compared with other areas where the invasive species does not exist in order to identify certain vectors of distribution and spreading.

Regarding the comparison of the *Amorpha fruticosa* ecological status in all five studied areas we can assess that it has a higher abundance in fluvial than in fluvial-maritime Delta areas; the differences between these sectors consist in the drainage, salinity, soil and vegetation type. Mentioning the habitat factors of distribution we can emphasize that the most important factor is the density and type of vegetation correlated with human interventions. Under these conditions, the seeds number, the root system and multiple stems are just secondary factors of spreading which vary from an area to another.

Acknowledgements. This paper is a fragment result of a three years research project financed by the Ministry of Education and Research – National Authority for Scientific Research. The author thanks Jenică Hanganu PhD and Beate Mittmann PhD for useful discussions during the project and Prof. dr. Ştefan Nicolae for sustaining the elaboration of this paper. The research support of Mihai Marinov jr. in the fieldtrips is gratefully acknowledged.

REFERENCES

1. Anastasiu Paulina, *et al.*, 2007, A preliminary study on the neophytes of wetlands in Romania, Rabitsch, W., F. Essl & F. Klingenstein (Eds.): Biological Invasions – from Ecology to Conservation. *NEOBIOTA* 7 : 181-192.
2. Binggeli, P., 1996, A taxonomic, biogeographical and ecological overview of invasive woody species. *Journal of Vegetation Science*, 7, 121–124.
3. Doniţă N., Popescu A., Păucă-Comănescu Mihaela, Mihăilescu Simona, Biriş I.-A., 2005, *Habitatele din România*, Editura Tehnică Silvică, Bucureşti, 442 pp.
4. Fargione JE, Tilman D., 2005, Diversity decreases invasion via both sampling and complementary effects. *Ecology Letters*, 8: 604–611.
5. Hanganu J., Dubyna D., Zhmud E., Grigoraş I., Menke U., Drost H., Ştefan N., Sârbu I., 2002, *Vegetation of the Biosphere Reserve Danube Delta – with Transboundary Vegetation Map on a 1:150000 scale*. The Netherlands, Lelystad, ISBN 9036954797.
6. Munteanu I., Curelariu Gh., 1996, *Thematic map of the Danube Delta – soil salinity 1:175000 scale*, The Netherlands, Lelystad.

ANNEX

Table 1

Values of species in the vegetal surveys

Abundance-dominant scale (AD)	The species covering interval	The average covering percent of the species
+	0.1-1%	0.5%
1	1-10%	5.5%
2	10-25%	17.5%
3	25-50%	37.5%
4	50-75%	62.5%

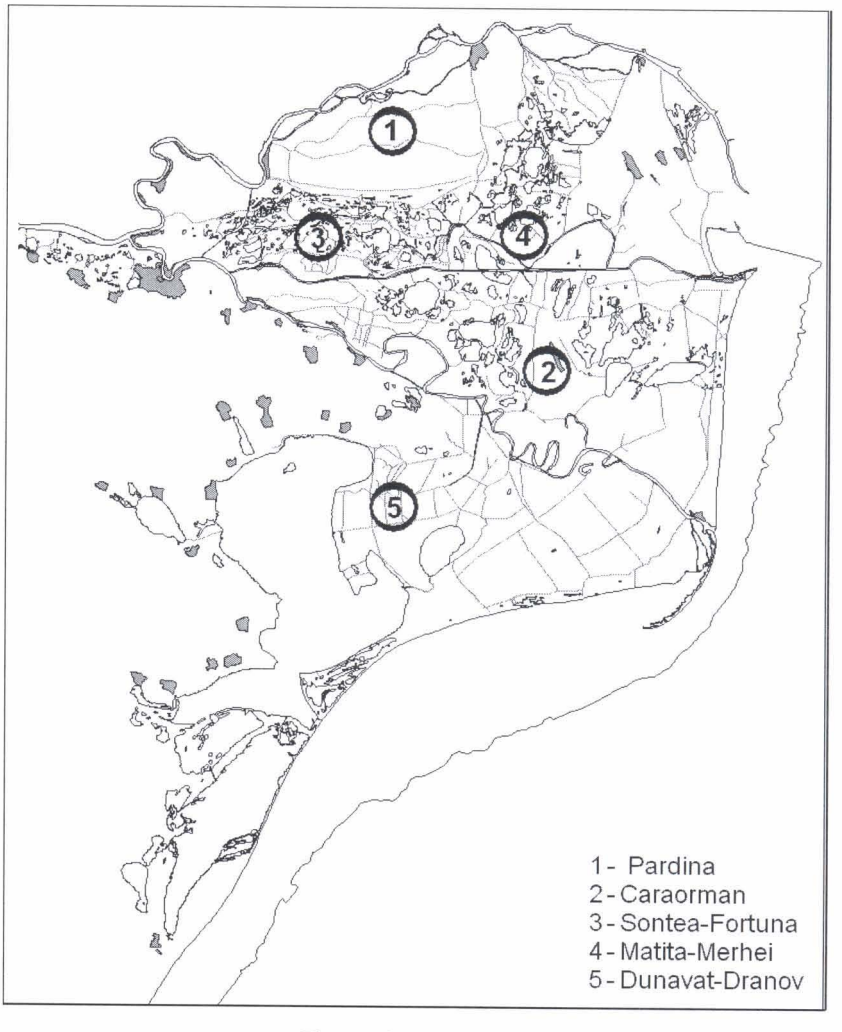

Fig. 1. The study areas.