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The transformer species of the Ukrainian Polissya

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Abstract: The investigation results of the transformer species participation (*Echinocystis lobata* (Michx.) Torr. & A. Gray, *Heracleum sosnowskyi* Manden., *Impatiens glandulifera* Royle, *I. parviflora* DC., *Reynoutria japonica* Houtt., *Robinia pseudoacacia* L.) in different plant communities of the Ukrainian Polissya (Forest zone of Ukraine) are presented. All the above-mentioned species are strong edificators in the region that can significantly change important species composition parameters of communities and character of landscape.

Key words: alien plants, transformer species, Forest zone, Ukraine

1. Introduction

By the end of the 20th century, invasions of alien organisms, including plants, were widely realized as one of major global threats for biodiversity (Pyšek *et al*. 1995; Mooney & Cleland 2001; Reichard & White 2001; Kowarik 2002; Protopopova *et al.* 2002, 2003; Chornesky & Randall 2003; Davis 2003; Sax & Gaines 2003, etc.).

Ukrainian Polissya region (Forest zone of Ukraine) for a long time has been characterized by a low level of vegetation adventization, mostly due to its natural and climatic conditions: large percentage of the area covered with forests and wetlands, absence of large urban and industrial centers, relatively poorly developed transportation network, and other factors. Following major land reclamation conducted during the mid-20th century, the situation changed significantly. The urbanization and emergence of industrial centers over the last decades of the 20th century facilitated penetration of many species of alien plants, which currently tend to be spreading actively.

The alien fraction flora in the left-bank regions of Polissya is specific; the species composition is more diverse and alien species are generally more widespread. Here, the influence of the Forest-Steppe zone and eastern continental Eurasiatic regions is observed. Alien species prevail in the florogenetic spectrum of the Eastern Mediterranean and Irano-Turanian origin. The right-bank regions of Polissya have species of the Central European origin, including species connected with South European mountain areas, Western Mediterranean species, species from the Balkans and Caucasus region, as well as numerous mesophytes of the Northern American origin. The distribution of species on the territory of Polissya has been influenced by drainage reclamation with substantial changes caused in the aboriginal species composition and structure of natural ecosystems.

The most negative changes are caused by invasive species, especially transformers species (according to Richardson *et al*. (2000). These species changed phytocoenotic environment of plant communities (regime of soil and air moisture, biochemical composition of soil, light, etc.), its floristic composition and structure.

The aim of the presented work was to study the transformer species of plants in the Ukrainian Polissya region. The objectives of the study included: (*i*) defining the group of transformer species, (*ii*) reconstructing

the history of their cultivation or introduction and evaluating the current distribution and coenotic confinement of species.

2. Material and methods

The presented work continues the research direction we carried out on the regional level (Protopopova *et al*. 2009, 2010, 2012, 2014). The study is based on original data obtained through routine research in 2010-2014, the analysis of literature data and examination of the collections of the Herbaria of M. G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine (KW), Ivan Franko Lviv National University (LW), Taras Shevchenko Kiev National University (KWU), Taras Shevchenko Chernigiv National Pedagogical University (CHU), Lesya Ukrainka East-European National University (LUU) and Desniansko-Starogutsky National Nature Park (DSR). Comparative morphological and geographical methods were used in the present investigations. The nomenclature of species follows the Checklist of vascular plants of Ukraine (Mosyakin & Fedoronchuk 1999). The transformer groups were determined according to Richardson *et al*. (2000) as: "a subset of invasive plants which change the character, condition, form or nature of ecosystems over a substantial area relative to the extent of that ecosystem". The participation of the transformer species in the plant community was analyzed according to the Braun-Blanquet classification.

The dot maps of distribution of *Echinocystis lobata*, *Heracleum sosnowskyi*, *Impatiens glandulifera* and *Reynoutria japonica* in the region were prepared based on herbarium and field expedition data.

The satellite images from the RapidEye and WorldView-2 used in the paper for *Echinocystis lobata* were obtained during the "Avoidance of greenhouse gas emissions by restoration and sustainable management of peatlands in Ukraine" project, 2009-2012. (BMU-№: 09_III_009_UKR_K_Moor Renaturierung), executed by the Ukrainian Society for the Protection of Birds (USPB) in a partnership with the Institute for Community Development (ICDU), the Royal Society for the Protection of Birds (RSPB, UK) and the Michael Succow Foundation (Germany) with financial support from the Federal Ministry of Environment, Nature Conservation and Nuclear Safety (Germany) through KfW Entwicklungsbank within the International Initiative Government of Ukraine and Germany to reduce the negative effects of climate change. Based on their spectral characteristics, the areas that distinguish from the surrounding vegetation were highlighted on the satellite images and their geographical coordinates were determined. Using GPS, such areas were subjected to deciphering of plant communities; investigation of floristic composition determining trends of succession and photographing was also conducted.

3. The studied area

The Ukrainian Polissya is a physiographic province located in the south-west part of mixed forest zone, on the border with the forest-steppe zone. The Polissya region is characterised by a low relief, extensive hydrological system, wide, swampy river valleys, high groundwater level and prevalence of turf-podzol and swamp soils. The highest participation in plant cover of this region have pine and mixed forests, meadows and swamps. The area has also a high share of agricultural lands. It is occupied by different geological structures of Russian Platform. The west part of Ukrainian Polissya is situated on the northern part of Galytsko-Volynska depression, middle part – on the north-west part of the Ukrainian crystalline shield and its slope, and eastern part – in the Dnipro-Donetsk depression. Landscapes of these Polissyan areas are characterized by numerous landforms, such as: river valleys and outwash, moraine-outwash and moraine plains. These landforms prevail

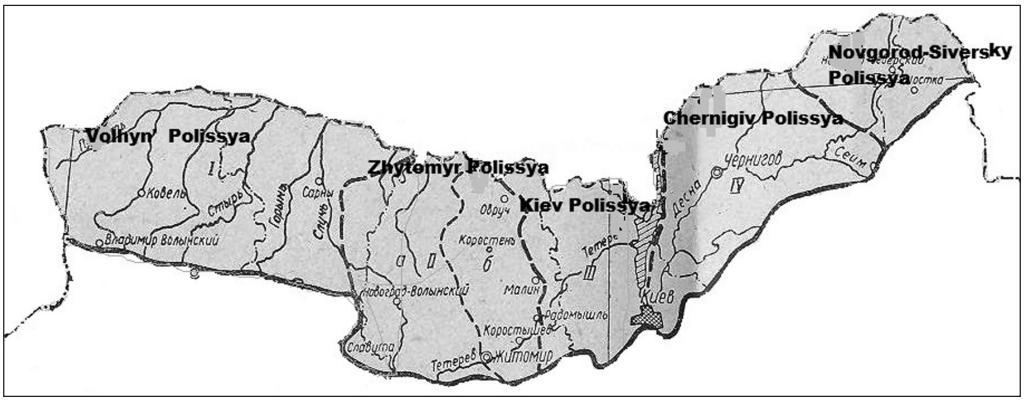

Fig. 1. Map of Ukrainian Polissya

in the modern relief of Polissya. The region has a temperate-continental climate with warm and humid summer and mild, cloudy winter, and it is divided into 5 botanical and geographical regions (Fig. 1).

Volynian Polissya is a flat undulating plain, located to the north of the Pripyat River valley. This region is characterized by numerous swamps, deposits of marl and chalk, turf-podzol soils and lakes of karst origin. Vegetation is dominated by broad-leaved pine forests.

Zhytomyr Polissya is located on the Ukrainian crystalline shield. It is distinguished by the significant development of denudation forms of relief, well-developed topographic features and small waterlogged areas. Its southern and central parts are located at the altitude of 200–250 m a.s.l., northern part – 150–200 m a.s.l., and Slovenchansko-Ovruchsky ridge – 315 m a.s.l. The region has numerous outputs of crystalline rocks and sand-dominated clay-sandy and sod-podzolic soils. In vegetation prevail oak-pine, birch-pine, pine, hornbeam-oak and oak forests with high species diversity.

Kiev Polissya occupies an area of the Middle Dnipro region, located on the Ukrainian crystalline shield in the Dnipro-Donetsk depression. Its topographic features are poorly developed and a high groundwater level promotes waterlogging. Among soils prevail turf-podzol soils, while vegetation is dominated by oak-pine and pine forests, as well as pine plantations. Meadows, swamps and shrubby vegetation are distributed along the region's river valley.

Chenigiv Polissya occupies an area located in the Dnipro-Donetsk depression. It is a low relief area – a moraine-outwash, slightly undulating plain with small loess islands, dissected by the Dnipro, Desna and Snow River valleys. The region is dominated by poor and medium turf-podzolic soils, occupied by mixed forests.

Novgorod-Siversky Polissya is an extreme eastern part of the Ukrainian Polissya. It occupies the northern part of south-western slope of the Voronezh crystalline massif. The climate is more continental than in other parts of the Ukrainian Polissya and the region has the lowest percentage of waterlogged areas. The specific features of this region are numerous chalk outputs and development of karst phenomena. The main types of forests are pine-mixed and oak-hornbeam forests. They are characterised by high species diversity.

The Polissya region of Ukraine occupies the southern part of Polissian Lowland of the East European Plain. The land area is approximately 113 thousand km² (19% of the territory of Ukraine). It is divided by the Dnipro River into the Right-bank Polissya (western part) and the Left-bank Polissya (eastern part). The Right-bank Polissya (Wolynian Polissya, Zhytomyr Polissya and Kiev Polissya) differs from the Left-bank Polissya (Chernigiv and Novgorod-Sivers'k Polissya) (Popov *et al.* 1968).

4. Results

Depending on the determined invasive potential of alien species, six transformers were defined and characterized in detail, which are common for both regions of Ukrainian Polissya: *Echinocystis lobata* (Michx.) Torr. & A. Gray, *Heracleum sosnowskyi* Manden., *Impatiens glandulifera* Royle, *I. parviflora* DC., *Reynoutria japonica* Houtt., *Robinia pseudoacacia* L. Among the determined transformers, the following types were identified: therophytes (3 species), phanerophyte (1), hemicryptophyte (1), and geophyte (1). All species are neophytes judging by their time of immigration, and ergasiophytes – by the way of introduction; four species were introduced into the region during the second half of the 20th cent., and two – by the end of 19th cent., but their active distribution and pervasion into natural ecosystems had begun at the end of the 20th cent. and was characterized by a relatively short period of naturalization. The participation of the transformer species in the anthropogenic, semi-natural and natural ecosystems and plant communities of Polissya and their influences on the aboriginal flora were analyzed.

Echinocystis lobata (Michx.) Torr. & A. Gray – species of the North American origin, which is common in the North-east of the United States (reaching Texas and Florida) and also the neighboring areas of Canada (49°-55°N) (Gleason & Cronquist 1991; Vinogradova *et al*. 2010), mostly along river banks, moist areas and floodplain shrubs.

Its transformative impact is caused by entwining bushes (highly ramified stem can reach the length of 4-6 m), therefore shading the area is significant as well as increasing its air humidity level, making other natural inhabitants of the area, especially photophilic ones, drop out of vegetation which causes significant depletion of phytodiversity of floodplain ecosystems.

Its high levels of seed production (one plant is able to produce 40-160 seeds), high germination rate – up to ~ 70 % (Vinogradova *et al*. 2010) promotes further spreading of the species and its rapid growth which, together with the simplicity of the conditions required for growth, leads to displacement of other species of the grass community.

The species was cultivated in Europe since the middle of the 19th century (Romania) and it was found growing wild in 1904. Then after 1923, it was also found in Ukraine (Dnister source) and in 1938 – in Transcarpathian region (Protopopova & Shevera 2014). In Polissya it is mainly found to be part of sparse tree and shrub communities growing on the relatively rich and moist soils (Fig. 2). It prefers natural and semi-natural riverside and flooded areas, and can be often found along river banks, ditches, shrub-willow thickets, along drainage channels, on drained eutrophic swamps

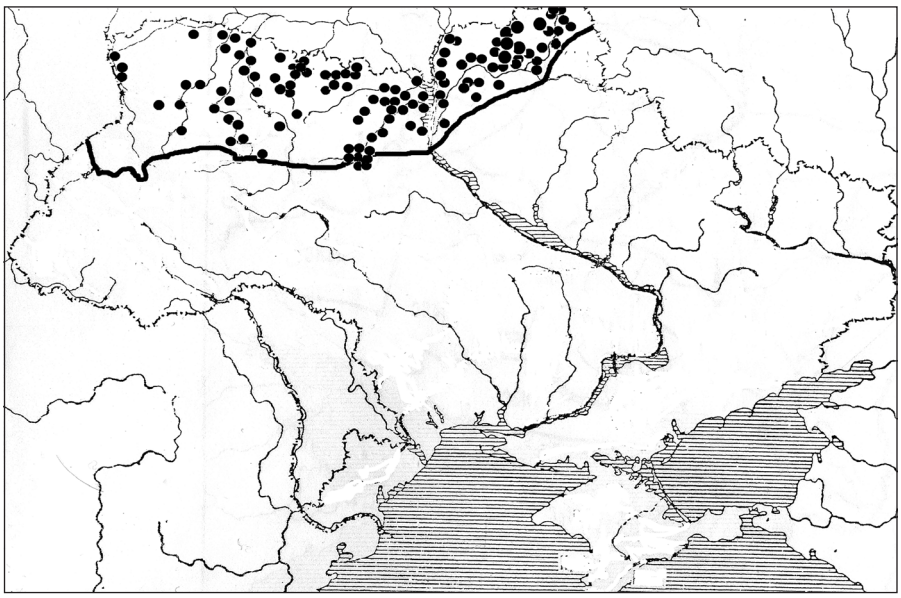

Fig. 2. Distribution of *Echinocystis lobata* in Ukrainian Polissya

and areas formed after peat extraction. The species is a component of *Alnetea glutinosae* and *Galio-Urticetea* plant communities (Lukash 2008).

As it was shown during the execution of the «Avoidance of greenhouse gas emissions by restoration and sustainable management of wetlands in Ukraine» Project, *E. lobata* formed dense thickets (projected coverage was 80-100%) on the studied wetland areas of Chernihiv Polissya (Romen and Udai wetlands, on the border with Forest-Steppe zone) which can be easily distinguished among other vegetation even with remote sensing on space images.

Fig. 3. Fragment of RapidEye satellite image of extensive Romen swamp, between the villages of Ponory, Korinetske and Lypove in the Talalayivsky District of Chernigiv Region (09.08. 2010), with participation of *Echinocystis lobata*. The pixel size – 5 × 5 m

The following fragments of satellite images of the wetlands are matched with the ground-level photos of the thickets. Figure 3 clearly shows that *E. lobata* occupies the narrow strip along the drainage channel (1 km length and 10-30 m width), covering the riparian vegetation and the shrub willows (Fig. 4).

Less frequently, it creates large thickets, 250-300 m in diameter, covering the old peat extraction areas after some reclamation. On the Udai wetland, *E. lobata* is spread mostly between the regular drainage channels on the old peat extraction spots forming nearly monospecies thickets, 20-150 m in diameter, with the projective coverage of 90-100 % (Figs. 5-6), suppressing all other species.

The distribution assessment of the species across the wetland showed that it hindered renaturalization of the wetland vegetation, created sustained plant communities with the succession different from the planned rehabilitation directions, quickly expanded onto new areas and - on the whole – created significant problems for rewetting.

On the left bank Polissya, the *E. lobata* was common in *Fraxino-Alnetum* (the frequency of occurrence was 10-15%), *Chelidonio-Robinietum* (1-5%), *Salicetum pentandro-cinereae* Passarge 1961 (30-40%).

Heracleum sosnowskyi Manden – the species of Caucasian origin; in its natural habitat, it grows in the middle and upper forest zones of mountains, mainly on the forest glades and edges (Mandenova 1951). In its secondary habitat during the initial stages of expansion, the species is spreading through open, mainly anthropogenic or semi-natural ecotopes: field edges, abandoned

Fig. 4. Thickets of *Echinocystis lobata* along the watercourse, as shown by the arrow in Fig. 3

places of culture, road sides, along the drainage channels, in the meadows, especially disturbed ones, around farms in ruderal ecotopes, in gullies and ravines, etc. Among the natural ecotopes during this period, it grows in floodplains. During the second period of expansion, this species appears under the forest canopy, creating dense thickness even in oak forests and spruce forests. Such situation now is observed in some localities in Belorussia (Laman *et al*. 2009), although it prefers better lighted areas. At the same time, the essential feature of this species is its high ability to continue enlarging the areas created during the previous period.

Its high germination ability (above 90%), early germination, high viability and rapid growth, high population density, early and stretched blooming periods, self-pollination, high content of biologically active substances (furanocoumarins), effective ways of seed dispersal etc. cause great negative impact on phytodiversity (Dalke & Chadin 2008).

The species had been cultivated in Russia since 1947 and was well known in Ukraine starting from 1960s-1970s in western and northern forested regions (Protopopova & Shevera 2014). The plant was grown in Polissya since 1960s as a silage crop at the Zhytomyr regional bee farm (Tokar 1975). Intensive distribution in the western regions of Ukraine including Polissya was observed in late 1980s – early 1990s (Fig. 7).

In Eastern Polissya, *H. sosnowskyi* was found along roadsides, highways, train tracks, abandoned cultural places, fallows, forested floodplains with mosaic vegetation, willow dominated areas, forests with tree canopy of low density, forest edges as a component of the *Artemisietea vulgaris* Lohm., Prsg. et R. Tx. in R. Tx. 1950, *Agropyretea repentis* Oberd., Th. Müll. et Görs in Oberd. et al. 1967 plant communities (Lukash 2008).

The situation is similar in the central part of Polissya. As for the Western Polissya, floodplain localities are prevailing (rivers Styr, Horyn', Ustia, Ikva), where thickets of considerable length (250-500 m) and width are formed.

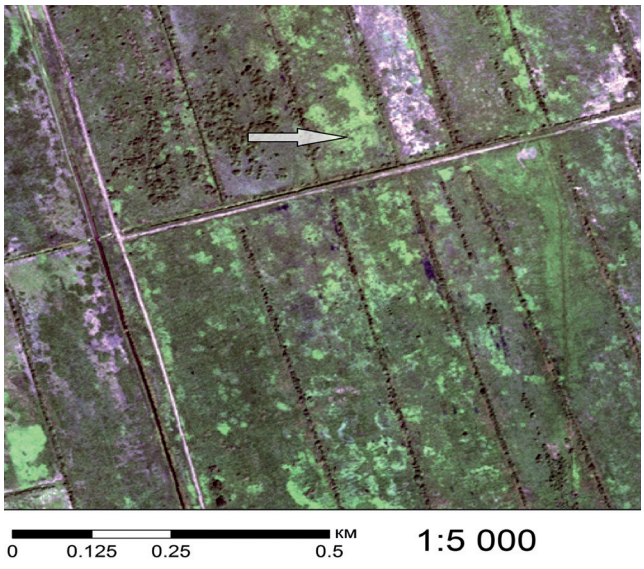

Fig. 5. Fragment of WorldView-2 (DigitalGlobe) of the satellite image of extensive Uday swamp, between the villages of Monasterysche and Korshaky in the Ichnya District of Chernigiv Region (02.08. 2010), with participation of *Echinocystis lobata*. The pixel size – 2 × 2 m

Fig. 6. Continuous thickets of *Echinocystis lobata* on the old peat extraction site, as shown by the arrow in Fig. 5

Sometimes *H. sosnowskyi* is already a component of the herb-dwarf-shrub layer of the dense hornbeam-oak forests, where its projective coverage can reach up to 80%. In the future, the number of such localities of this species in dense forests in the region is expected to be increasing.

H. mantegazzianum Sommier & Levier has a similar influence on the plant communities – another species of the Caucasian origin. Both species of *Heracleum* were often cultivated together in Polissya region, their wild populations tend to consist of plants of both species as well and, possibly, these species can give hybrids, since the plants now often show some signs not typical for their parental forms.

In forested and forest edge areas of Eastern Polissya, *H. mantegazzianum* displaces the following species from the grass level: *Calamagrostis epigeios* (L.)

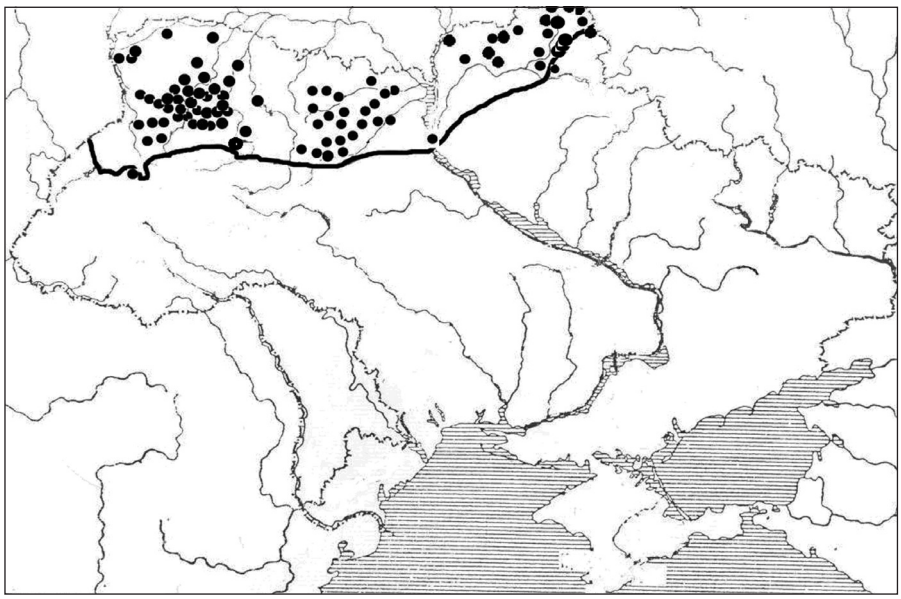

Fig. 7. Distribution of *Heracleum sosnowskyi* in Ukrainian Polissya

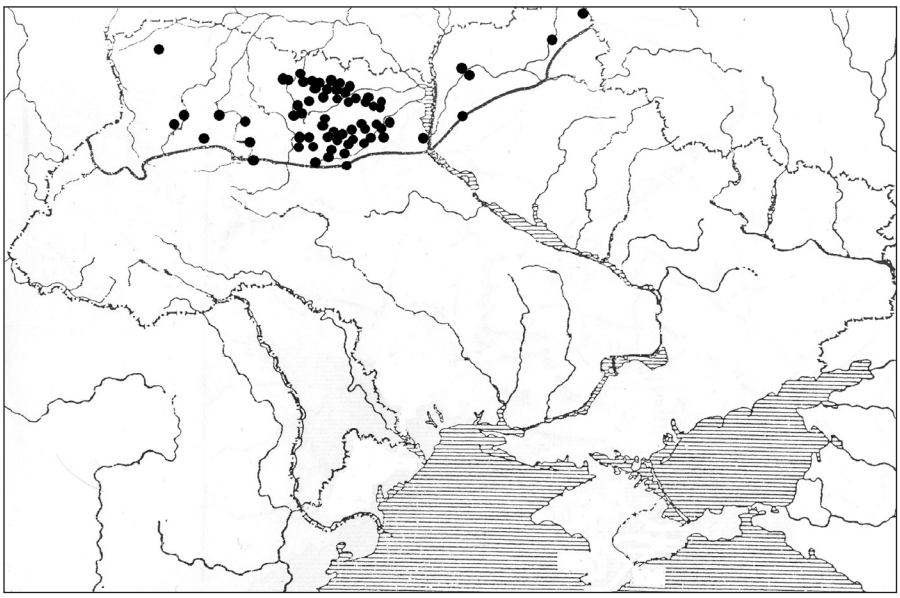

Fig. 8. Distribution of *Impatiens glandulifera* in Ukrainian Polissya

Roth, *Agrostis vinealis* Schreb., *Convallaria majalis* L., *Chamaerion angustifolium* (L.) Holub, *Gnaphalium sylvaticum* L., *Euphorbia cyparissias* L., *Galium verum* L., *Veronica spicata* L. etc.; and in the ruderalized psammophytic and meadow *Artemisietea vulgaris* and *Agropyretea repentis* communities, it displaces both the natural meadow species (e.g. *Festuca pratensis* Huds., *Dactylis glomerata* L.) and the synanthropic species (like *Elytrigia repens* (L.) Nevsks, *Melilotus albus* Medik., *Pastinaca sylvestris* Mill., *Daucus carota* L., etc.), and also alien species (*Lupinus polyphyllus* Lindl., *Cichorium intybus* L., *Centaurea diffusa* Lam., etc.), with the progective coverage reaching up to 95% in some places.

Less commonly, it inhibits grass communities formed within forest clearings, classified as *Epilobietea angustifolii* Tx. et Prsg. ex von Rochow 1951 and the transformed forest coenoses – *Calamagrostio arundinaceae-Pinetum* Shevchyk et V. Sl. 1996 (Lukash 2008).

Impatiens glandulifera Royle – the species of West-Himalayan origin (Beerling & Perrins 1993), is often located along river banks, field edges and undisturbed moist forests (Valentine 1971) at the altitude of 1800-4000 meters, and in Pakistan – up to 4300 m (Nasir 1980).

At its secondary area, one plant is able to produce from 500 to 2500 seeds, has wide range of habitats, yet prefers moist areas with rich soils and sparse grass coverage (Markov *et al*. 1997). Factors limiting the expansion of this species include moisture scarcity and low temperatures (Beerling & Perrins 1993). In Europe, the species tends to form thickets with 40, sometimes up to 70 plants/m^2, in Central Russia – 200-700 plants/m^2 (Wadsworth *et al*. 2000; Vinogradova *et. al*. 2010; Vinogradova & Kuklina 2012) that impede local flora development, suppressing not only grass species, but tree-species as well. As a result, instead of mixed grass associations, plant communities dominated by *I. glandulifera* are formed, for example the *Impatienti-Calystegium* com. association found in the Czech Republic (Vinogradova *et. al*. 2010).

In Europe (England), this species has been cultivated since 1838 and the first references of its cultivation in Ukraine go back to the 1930s, first wild plants were mentioned in 1938 in Osii and Han'kovytsia villages (Transcarpathian region) and in 1939 – in Mykhailivka vil. (Khmelnitsky region) (Protopopova & Shevera 2014). It was also cultivated in Polissya, including the Left-bank Polissya; wild forms found growing in 1980s. The species can sporadically spread in the region at present (Fig. 8).

In Polissya, the species can be found on river banks, tall grass eutrophic wetlands and swampy thickets, alder forests, forested floodplains of streams and rivers, moist forests with high and low density tree strand, on forest edges, along roadsides and near houses in ruderal ecotopes as a part of *Phragmito-Magnocaricetea* Klika in Klika et Novak 1941, *Mollinio-Arrhenatheretea* R. Tx. 1937, *Alnetea glutinosae* Br.-Bl. et R. Tx. 1943 ex Westhoff et al. 1946**,** *Bidentetea tripartiti* Tx., Lohm. et Prsg. in Tx. 1950 communities.

In some places, it occupies areas 2 km × 10-30 m (Lukash 2008). In black alder forests of Zhytomyr Polissya, the population density of *I. glandulifera* ranges from 10 to 40 plants/m^2 with the projective coverage between 50 and 100%. In open ruderal habitats, the

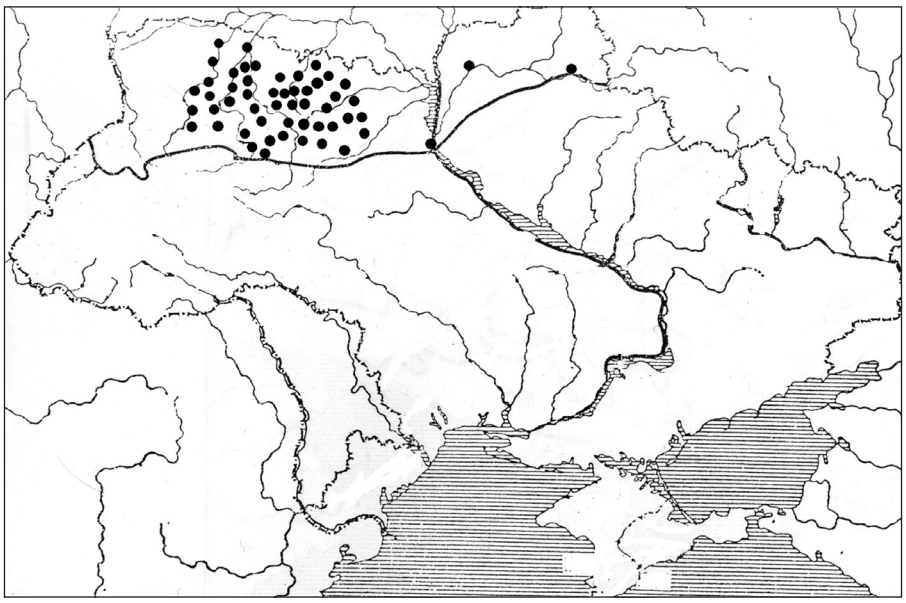

Fig. 9. Distribution of *Reynoutria japonica* in Ukrainian Polissya

population density is somewhat lower – 10-30 plants/m^2; however, the average plant is much taller – up to 2.3 m.

On the left bank Polissya, *I. glandulifera* was very rarely noted near settlements in *Carici elongatae-Alnetum* W. Koch. 1926 ex Tx. 1931 ass. cenoses.

Impatiens parviflora DC. – is a species of Central Asian origin (Nasir 1980; Beerling & Perrins 1993), natural inhabitant of the hazelnut-maple forests of Tien Shan and Pamir-Alai, where it growth in the grass layer with *Brachypodium sylvatica* (Huds) P. Beauv., *Poa nemoralis* L., *Geum urbanum* L. It prefers rich well-aerated soils but can also grow on relatively poor ones (Pobedimova 1949; Ovchinnikov 1971; Vinogradova *et al*. 2010; Protopopova *et al*. 2010). The species reproduces with seeds; is chasmogamous, or less frequently – cleistogamous; thus providing pollination independent of the presence of insect pollinators (Vinogradova *et al*. 2010).

As a secondary forest habitat, due to its high competitive ability and seed production (up to 10000 seeds per plant), early and long germination and fruiting periods (aprox. 3 months dissemination period), effective ways of seed dispersal (autho-mechanochorus), formation of great phytomass etc., it suppresses species of natural flora through altering light regimes, moisture and temperature, replaces the aboriginal *Impatiens noli-tangere* L., suppresses other species of grass layer of the deciduous and coniferous-deciduous forests. Thus, expansion of *I. parviflora* leads to transformation of vegetation.

In Europe (Switzerland), the plant had been cultivated since 1831, while in Ukraine – the cultivation was recorded in 1895 in Dubliany (Lviv region) and the species grew wild – in 1908 in Lviv and the Carpathians (Protopopova 1973; Protopopova & Shevera 2014).

In Polissya region, the species is registered in both low and high stand density forests, on forest edges, in younger forest plantations, forest nurseries, forest parks, disturbed natural forests and forest edges, as well as along roadsides, train tracks, ruderal areas, as part of the *Querco-Fagetea* Br.-Bl. et Vlieger in Vlieger 1937, *Galio-Urticetea* Passarge ex Kopecky 1969, *Robinietea* Jurko ex Hadač et Sofron 1980 plant communities (Orlov & Yakushenko 2005; Lukash 2008). The species, in the Kiev urban forest, is characterized by the following parameters, e.g.: constancy (100%), population density (29.2 plants/m^2) exceeding those of other species by 10 or more, and according to R. Burda (2012) the *I. parviflora* is a transformer of forest herbaceous cover. In forests of Kiev and vicinity, the species is characterized by high ecological and phenotypical variability, including population level. The relative intensity of lighting and soil moisture are main limited factors of the functioning of the species populations (Golivets 2014). In pine, pine-oak and hornbeam-oak forests of Zhytomyr Polissya, its population density varies from 20 to 70 plants/m² with the projective cover between 50 and 100%. On the left-bank Polissya, *I. parviflora* participates in the following plant communities: *Chelidonio-Robinietum* Hadač et Sofron 1963 (the frequency of occurrence is 25-30%), *Fraxino-Alnetum* W. Matuszkiewicz 1952 (10%), *Mercurialo perrenis-Quercetum roboris* Bulokhov et Solomeshch 2003 (2%), *Galeobdolono lutei-Carpinetum* Shevchik *et al*. 1996 em. Onyschenko et Sidenko 2002 and in the

secondary associations of *Lathyro nigri-Quercetum roboris* Bulokhov et Solomeshch 2003 (*Potentillo albae-Quercetum roboris* Bulokhov 1991), which are represented by oak- and pine-hazel forests, and in the ruderal communities and erosion-controling forest cultures of *Chelidonio-Robinietum* (30-40%) association.

Reynoutria japonica Houtt. is a species of the East Asian origin [Komarov & Grigor'ev 1936; Vinogradova *et al*. 2010] (southern Primorye of Far East and Sakhalin, Southern Kuriles, Japan, Korea, most of China, Taiwan). It can be found in China on mountain slopes, valleys and field edges; in Japan – it grows at altitudes of up to 1500 m above the sea level, is a pioneer species to cover volcanic deserts and open areas with bare ground. It creates huge phytomass which leads to changes of illumination regime, shading and later displacing phytophillous aboriginal plant species.

This species was introduced in Europe in 1825: originally brought from China by the London agricultural society, later seedings were mailed from Siebold in Leiden (Netherlands).

The data about the beginning of cultivation of the species in Ukraine is absent; in the wild state – the plants were recorded in 1929 in Rakhiv (Transcarpathian region) (Protopopova & Shevera, 2014) where they probably arrived from Romania.

In Polissya region, *R. japonica* grows on former places of cultivation, along roadsides, train tracks, forest edges, fallows, parks, cemeteries, forest edges. Active distribution of the species in Polissya regions was observed since 1990s (Fig. 9).

The species is a diagnostic species of the *Reynoutrietum japonicae* Görs et Müller in Görs 1975 and a component of several plant communities: *Artemisietea vulgaris* Lohm. et Prsg. & R. Tx. in R. Tx. 1950 em. Lohm. & al. 1962, *Galio-Urticetea* Passarge ex Kopecký, and also *Plantaginetea majoris* R. Tx. et Prsg. in R. Tx 1950, *Stellarietea media* R. Tx., Lohm. et Prsg., 1950 classes (Lukash 2008).

Robinia pseudoacacia L. – species of the North American origin, in its natural habitat (from Pennsylvania south to Georgia and west towards Iowa and Oklahoma), it grows in mixed forests of various broadleaf species (Gleason & Cronquist 1991).

Unpretentious to soils, it, however, prefers light, well-aerated soils, loamy or with admixture of lime. The plant is photophilous, drought- and frost-resistant (withstands up to -40° C). Its annual growth at young age is 1-1.2 m/year, starting from the age of 10 years – 25-50 cm/year and starting from the age 40 years – approx. 20 cm/year. The seed reproduction is less effective (seed viability is 90-100 %, with 10-20 % germination) than vegetative, seeds germinate quickly and the seedlings rapidly develop, which ensures their competitive ability. The species enriches soil with nitrogen, thus, suppressing growth of natural inhabitants which could not withstand high nitrogen levels and causing vast rooting of weeds, nitrophilous species instead, such as *Urtica dioica* L., *Cannabis sativa* L. etc.

The root system covers an area of 15 m^2, forms numerous shoots from roots which quickly develops creating tight undergrowth. When it prevails in the forest stands, it can cause a certain impact on the surface of the soil acting like a strong edificator. High levels of nitrogen released from fallen leaves in upper soil levels during certain vegetation periods and high illumination level provide a dominant position for the nitrophilous herbaceous plants (Protopopova *et. al*. 2014). There is also literature data about allelopathic impact of this species on aboriginal vegetation through the influence of some phenolic compounds and their derivatives in the soil (Vinogradova & Kuklina 2012).

In Europe (England), the species was cultivated since the 17th and in Ukraine – since the 18th century (Palimpsestov 1855), as for Polissya region – the exact date is unknown. According to Schmalhausen (1895), the plant was cultivated but without any specific guidelines and according to Flora of Ukrainian SSR (Visiulina 1954) – it was cultivated as common species throughout the whole country.

In Polissya region, the plant acts as a transformer species, mainly in pine forests. Seedlings of *R. pseudoacacia* tend to appear on recreational and grazing territories or in places of total tree felling, esp. where the moss-coverage is disturbed; they develop quickly and replace the undergrowth of *Pinus sylvestris* and suppress other forest species replacing them with weeds, *Chelidonium majus.* According to Lukash (2008), *R. pseudoacacia* forms such ecological-coenotic series in pine forests of Eastern Polissya: disturbed coenosis of *Peucedano-Pinetum* W. Matuszkiewicz 1962 with numerical juvenile instances of *R. pseudoacacia* → depleted coenosis of *Peucedano-Pinetum* with dense spinneys of *R. pseudoacacia* → transition cenoses between *Peucedano-Pinetum* and *Chelidonio-Robinietum* → typical *Chelidonio-Robinietum*.

On the left-bank Polissya, *R. pseudoacacia* is widely used for creation of forest cultures of shelterbelts on agricultural land sites and on cuttings of oak-pine and deciduous forests. It is a characteristic species of *Chelidonio-Robinietum* (the frequency of occurrence is 100%) (Panchenko 2013) and noted in *Mercurialo perrenis-Quercetum roboris* (the frequency of occurrence is 1%), *Querco roboris-Pinetum sylvestris* (W. Matuszkiewicz 1981) J. Matuszkiewicz 1988 (the frequency of occurrence is 1%), and *Agrostio vinealis-Salicion acutifoliae* Bulokhov 2005 (single individuals).

There are four more species changing the structure of plant communities of the region, but as they more or less occupy limited areas, we only consider them to be potential transformers: *Amelanchier spicata* (Lam.) K. Koch, *Quercus rubra* L., *Symphyotrichium novae-angliae* (L.) Nesom*, S. lanceolatum* (Willd.) Nesom.

In Polissya region, the *Amelanchier spicata* was known since 1980s, growing not far from areas of its cultivation, for example, in Korostyshiv, near the former manor and in Zhytomyr park. It creates under the tree canopy almost one-species bush thickets which are formed through vast growth, suppressing and gradually displacing aboriginal plants of pine forests (*Peucedano-Pinetum*) in Korostyshiv and Zhytomyr (Zhytomyr Region), near Sarny town, Sarny State Forestry, Kostyantynivske forestry unit (Rivne Region), where the area of thicket of the species is almost 3.0 ha, the height of undergrowth is 0.8-1.0, closeness – 0.6-1.0. Also several separate thickets of this species were found in Kiev Polissya – in Ivankiv distr. of Kiev Region. On the left-bank Polissya, e.g. Sumy Region, the species is characterized by sporadic distribution in some forest localities where it was previously cultivated. Birds and mammals are the main agents of distribution of plants. The species grows in *Lathyro nigri-Quercetum roboris*, *Cladonio-Pinetum* Juraszek 1927 and *Peucedano-Pinetum*, and also in artificial plantings on agricultural sites.

The species *Quercus rubra* was cultivated in Ukraine since 1970s, tested as tree species for plantation growing in Zhytomyr region. The experimental areas which were left behind became the center of the species' expansion on the surrounding forest territories. Such situation is observed in Zhytomyr State Forestry, Boguns'ke forestry unit. It roots on lit areas and light forests, forest clearings and also tight oak and pine-oak forests, creating high-density thickets and, then, spreading on the surrounding territory.

Unlike *Quercus robur* L., the abundant seed years of which have been noted in Ukrainian Polissya once every 8-10 years, *Q. rubra* is fruiting annually, forming thick undergrowth with nearly 100% coverage keeping herbaceous as well as tree species from growth. The species is a component of *Potentillo albae-Quercetum* Libbert 1933.

Our pilot research showed that *Symphyotrichium* Nees genus has a great transformer potentials in the region. Just like other species of this genus – *Symphyotrichium novae-angliae* and *S. lanceolatum* – was extensively cultivated throughout the region, thus often growing wild as well. The plant, with its long rhizomes, actively changes vegetation, creating one-species thick curtains, occupying large areas and threatening phytodiversity. Besides, it has a great seed productivity; seeds are anemochorous and can propagate on significant distances. The species is common along river banks, eutrophic bogs and different types of anthropogenic ecotopes, participating in the following plant communities: *Phragmito-Magnocaricetea*, *Artemisietea vulgaris* and *Agropyretea repentis.*

5. Conclusion

All species mentioned above are strong edificators in the Ukrainian Polissya region that can significantly change important parameters of environment, species composition of communities and character of landscape. Majority of these species is also invasive.

The transformer species are rarely presented in plant communities of *Vaccinio-Piceetea* Br.-Bl. 1939 class on pure sandy soil in the Region. They are most common in rich ecological conditions of deciduous and oak-pine forests places.

The species *Robinia pseudoacacia* and *Amelanchier spicata* grow in zonal pine forests, *Quercus rubra* – mainly in conifer-broadleaf forests, causing changes in plant successions. *Impatiens parviflora* misplaces *I. noli-tangere* – the aboriginal species of wet broadleaf forests. Most of the transformer species – *Echinocystis lobata*, *Impatiens glandulifera*, *Heracleum sosnowskyi*, *H. mantegazzianum*, *Symphyotrichium* species grow in natural plant communities, including riverbank willow thickets, alder forests and floodplain meadows, suppressing the aboriginal species and preventing initial plant communities from renovation. *Reynoutria japonica* forms monodominant communities in parks and disturbed forests near places of former cultivation.

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