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# Dynamics of the range of *Cytisus scoparius* (L.) Link (*Fabaceae*) in Eastern Europe (Ukraine and Belarus)

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**Abstract.** Regularities of dynamics of geographical didstribution of Scotch broom (*Cytisus scoparius* (L.) Link., Fabaceae) in the East European plain (Ukraine, Belorus) over the past 200 years are established. This species absent in floristic reports of XIX century, so for at that time it was not the component of native flora of this region. It was a cultivated species in forestries for wild animals forage. From places of cultivation *C. scoparius* was penetrated to natural ecosystems, occupying the niches in outskirts of forest massives, forest openings, forest cultivated coenoses, in ecotons between forests and ploughed fields, along forest rouds and paths. The rate of migration of *C. scoparius* increase in XX century and especially in XXI century in connections with getting warmer of climate and intensive anthropogenic change of environment (wood felling on a mass scale, absence of treatnunt on a vast places of ploughed fields, presents of many open pits and dumps of rocks, where *C. scoparius* found suitable habitats). Strong frost and drought are slow down, but do not stop migrating of *C. scoparius* in East. Inclution *C. scoparius* in Red Date Book of former Soviet Union was mistakenly.

**Keywords:** Scotch broom area, geographical distribution, habitat, community, adventive species, invasion, Ukraine.

## 1. Introduction

At the beginning of new millennium the tendency of global climate change, which are called global warming, is becoming more pronounced. Living organisms react sensitively for such changes, which is manifested at the populations, species and ecosystem levels. Given this, the urgent task of modern ecology is development scientific bases of biological diversity protection in condition of global warning. Special attention deserve to the species, which expand their ranges. Study of it modern state may be the basis for monitoring of the populations.

Scotch broom – *Cytisus scoparius* (L.) Link (*Sarothamnus scoparius* (L.) Wimm. ex W.D.J.Koch) is include to such species. This European species is adventive in Northern and Southern America (United States, Brazil, and Chile), Asia (India, Japan), Southern Africa, Australia and New Zealand where it intensively occupied new places (Williams, 1981; Potter et al., 2009; Rosenmeier et al., 2013). The expansion of its range occurs also in Northern-Western Europe (Dania and Norway). The rapid Northern range expansion of *C. scoparius* in the recent century was driven by human introduction, so far as, scotch broom can be classified as alien in Norway and Dania (Brandes et al., 2019).

Controversial and understudies is a situation with *C. scoparius* near eastern limit of it range in Eastern Europe (Ukrainian and Belarus). In Red Date Book of former USSR *Cytisus scoparius* was considered as a rare species of the flora of Eastern Europe and was included in Red Data Book of the former USSR (Kuvajev (eds.), 1978). However, other authors (Kleopov, 1990) attributed it to the invasive species of Eastern Europe. For establishment the origin and modern state of populations of this species on the eastern limits of the area, we studied its geographical distribution and habitats in historical aspect from the beginning of floristic investigation up to now in Ukraine and Belarus.

## 2. Material and methods

Dynamics of area of *Cytisus scoparius* in Ukraine was studied by analyzing the geographical distribution and habitats in historical aspect and in current conditions. Field researches were carried out in the 1989–2021 years. Phytocenotic investigation and description of communities with *C. scoparius* carried out by the method adopted in Eastern Europe (Rabotnov, 1983). Results of field research, analysis of phytocenotic and floristic works for last two hundred years, herbaria materials of herbarium of Ukraine, Belarus, Russian Federation (CHER, CBR (KBZ), KFTA, KW, KWHA, KWU, KWHU, LE, LECB, LW, LWS, MHA, MSK, MW, UU, Rivne Regional Museum (RUU) and electronic database Plantarium (PLN) are used.

## 3. Results and Discussion

*Cytisus scoparius* is subatlantic element of the flora of Europe (Walter & Straka, 1970). Its natural range is occupied the space from Ireland to Belarus and Ukraine, from South Scandinavia to South of the Iberian, Apennine and Balkan peninsulas (Meusel et al., 1965; Hegi, 1975; Hultin & Fries, 1986). The question about the eastern boundary of the area of this species is open to discussion. According to Czeczott (1926), it runs along the Vistula River. Meusel et al. (1965) point out that natural area of *C. scoparius* are covered largest part of Poland, excluding Lublin Upland and Mazowian Lowland. Kozlovskaya and Parfenov (1972) believe that the eastern boundary of range of species approximately coincided with the state border between Poland and Belarus, Poland and Ukraine. In east of it are known some local habitats of species. Zieliński (1975) pointed out that the eastern limit of the area of this species cannot be established due to the fact that in many cases identification natural or artificial origin of *C. scoparius* growth is impossible.

Consider more details the features of geographical distribution of *C. scoparius* in Ukraine and in Belarus in historical aspect.

### 3.1 Dynamics of *Cytisus scoparius* range within Ukraine

In the floristic works of XIX – early XX centuries, dedicated to the flora of Ukraine, Polissya and the Carpathians (Besser, 1822; Rogovych, 1869; Montrezor, 1886; Paczoski, 1897; Pax, 1908) there are absent information about geographical distribution of *C. scoparius* in Ukraine. Only in Schmalhausen's work (1886) is an indication that this species was collected by A. Andrzejowski surroundings of Rokytne in Kyiv region. In his book „Flora Ukrainy" (1889), A. Andrzejowski leads the genus *Sarothamnus* without species name. Obviously, during time of A. Andrzejowski, the plants of this specious may be cultivated in the surroundings of Rokytne town.

In the herbarium of the M.G. Kholodny Institute of Botany NAS of Ukraine is preserved specimen of *C. scoparius*, collected by V. Montrezor in Yalta in 1882. Whereas this species does not grow naturally in Crimea Mountains, its herbarium specimen could be collected only from cultivated plants.

In Lviv herbariums (LW, LWS) store were collected specimens of the 19 century from the Lviv and its surroundings (historical districts and environs – Bryukhovychi, Holosko, Lychakiv, Pogulyanka) (Łobarzewski, 1855, LWS; Dzieduszycki, 1875, LWS; Błocki, 1888 , LW) and on the territory of Lviv region – around of the village Telezhyntsi (Mostyska district) (Druszll, 1899, LW), in the outskirts of the Brody (Ciesielski, 1877, LW) and village Markopil (modern Brody dist.) (Shauer, 1876, LWS); and modern Ternopil region – in surroundings with Bilche-Zolote (Borshchiv dist.) (Błocki, 1888, LW) and Ratyschi (Zboriwskyi dist.) (Shauer, 1885, LW). Analysis of the data, is contained on the labels of these specimens, according to the condition of habitats of *C. scoparius*, showed that it grown in Galicia (Western Ukraine) on the edges of forests, the clearing, the forest plantations along forest roads and trails, ecotones between forests and fields.

Valuable information on the label accompanying the specimen was collected by B. Dzieduszycki (1875, LWS), indicating that *C. scoparius* was grown for fodder for animals. Obviously, for this purpose the plants was introduced to Galicia by B. Dzieduszycki and other landowners and grown in their private forests. From this place it spread to nearby territories on Podillia and on the Male Polissya, occupying ecological niches in the field of human abuse of forest ecosystems.

In 19 century *C. scoparius* was rare plant not only in Ukraine but in neighboring territories of Poland. Szubert (1827) gave this species only for vicinity of Góra Kalvaria, where it grew on the site of a felled forest. Searches it in vicinity of Warsaw were unsuccessful. According to the data presented in the article of Krzyżanowski (1883) the centers

of its natural growth are placed mainly in the western and northern parts of country, near Częstochowa and Złoty Potok (Silesia), Szczecin (Pomerania). Nearest localities to Ukraine was near the town Góra Kalvaria (Mazovia). Based on the values of *C. scoparius* as higly-dekorative, honey, medicinal, fodder and soil fixing plant, the author of cited article is recommended it to widely implementation in culture.

Thus, analysis of literatures and herbarium data of XIX century are shown that in Ukraine, and nearby territories of Poland *C. scoparius* not growing wildly, but only was implemented in the culture. This process was continued in the early twentieth century. This situation changed after 1910, when this plant began to be actively planted by landowners in their hunting grounds for feeding wild animals.

N.A. Troitzki (1916) wrote that *C. scoparius* is cultivated in some forests in Volhynian Polissya. He indicated three localities in vicinity of Sarny, Zbuzh and Stepan villages (Rivne region) and does not excluded anthropogenic origin of these habitats. J. Panek (1939) firsted discovered *C. scoparius* in Volhynian Upland, where was a significant population in vicinity of Rivne town and surrounding villages, where it occurred often on the margins of pine and mixed forests.

In the work, dedicated to Atlantic element of flora of Poland (including Western Ukraine), H. Czeczott (1926) noted that the eastern boundary of the area of *C scoparius* runs along the Vistula and outside from it (in the Carpathians and on the Podillia) distribution of this species is depend on human activities related to introduction of plants.

In generalized work about the plant's horology, issued at that time in Ukraine, *C. scoparius* was attributed to run wild plants (Barbarych, 1955; Kleopov, 1990). Herbarium data are supplementing the picture of geographical distribution of *C. scoparius* in Ukraine in the first half of the XX century. Herbarium labels confirm that process of cultivating of *C. scoparius* was continued. Thus, the specimen of *C. scoparius* from village Antoniny (now Khmelnytsky region) (Kucheriava, 1932, KW) is accompanied by a label with information about cultivation of *C. scoparius* in forests as food for hares. From place of cultivation it has spread to nearby areas in the Carpathian Mountains, in Volhynian-Podolian Upland, on Polissya lowlands and reached the Dnieper Upland (Cherkasy region, surroundings of Talne town) (Kosets & Syvoholovko, 1936, KW) (Fig. 1).


**Figure 1.** Distribution of *Cytisus scoparius* on the eastern border of the range until 1900

In the second half of the XX century *C. scoparius* play more and more significant role in plant cover of Western Ukraine. The eastern boundary of its area reach Chernigiv region. It was found its thickets in Mrynsk forestry and Krasnyanske forestry on Desna river valley (Slobodian, 1967) (Fig. 2).

Slobodian (1967) found *C. scoparius* localities in Ukrainian Carpathians between the villages Zelene and Bystrytsia Nadvirna in Ivano-Frankivsk region, where it was sown on the edges of the road. In 60–80 years of the last century this species was widely spread in the foothills of the Carpathians – in surroundings Chernivzi, in Hlyboka, Storozhinets, Vyzhnytsia in Bukovyna and Uzhgorod, Mukachevo and Khust districts in Transcarpathia (Kostevych, 1972; Badei, 1988).

In recent decades *C. scoparius* accuppied lowland part of Transcarpathia in Mukachivskij, Irshavskij and Uzgorodskij districts. It grows along all automobile rouds in Transkarpathian lowland (Felbaba-Klushina et al., 2021). It widely spread in Ukrainian Polisia from the the Polish-Ukrainian border to Chernihiv and in forestep from East Podillia to Dnieper Upland.

Modern eastern limit of *C. scoparius* In Ukraine is in the Left-Bank of Polissya through the cities Chernihiv – Nizhyn – Nosivka (Chernihiv region) to Right-Bank Polissya, where it turns west to Polisskyi district of Kyiv region, then goes south on the administrative border between Kyiv and Zhytomyr regions and then on the river Ros through the settlements Radomyshl in Zhytomyr region, Bila Zerkva and Rokytne in Kyiv region to the Smila of Cherkasy region, then turns west and runs through Gaysyn, Tulchyn and Tomashpil district of Vinnitsia region and reaches Yampil (Fig. 3, Table 1).

There are differences in character of geographical distribution of *C. scoparius* on Polissya lowland and on Volhynian-Podolian Upland. Available information about locations of *C. scoparius* in Polissya does not fully reflect the picture of modern geographical distribution of the species in this region. Obviously, there are much more localities than registered by researchers. The species has become so widespread in Polissya in recent years that fixed by botanists in every corner on the Right Bank of Polissya. According to the significant similarity of geographical conditions of the various parts of the region and the large number of ecotopes suitable


**Figure 2.** Distribution of *Cytisus scoparius* on the eastern border of the range until 1950

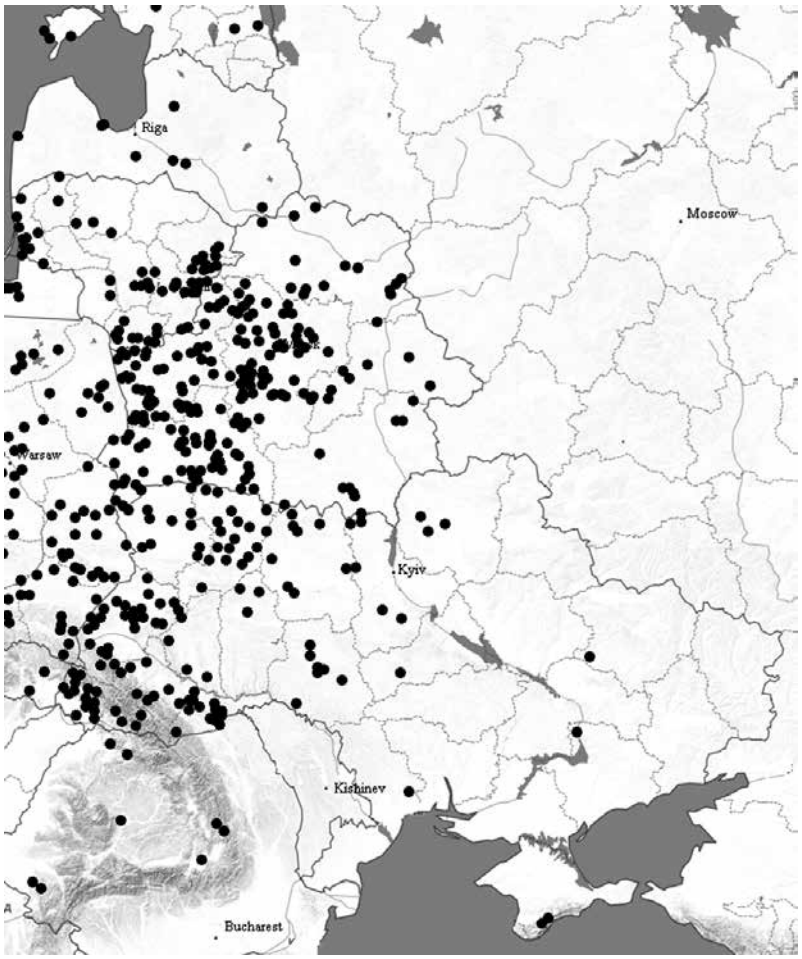


**Figure 3.** Modern distribution of *Cytisus scoparius* on the eastern border of the range

**Table 1.** Chronological and territorial distribution of *Cytisus scoparius* in Eastern Europe (Ukraine and Belarus)

| Period/Number of habitats | Belarus | Ukraine | Summ |
|---|---|---|---|
| Until 1900 | 4 | 11 | 15 |
| 1901–1950 | 4 | 18 | 22 |
| 1951–2021 | 170 | 98 | 268 |
| Total | 178 | 127 | 305 |

to growth and development of *C. scoparius*, it is logically to assume that in those parts of Polisia where recent years have not performed botanical expedition it will be as common as on well-studied areas of its participation. In Volhynian-Podolian Upland *C. scoparius* occurs much less frequently.

### 3.2 Dynamics of *Cytisus scoparius* range within Belarus

The first literary references to the growth of C. *scoparius* in Belarus are contained in the work of Gilibert (1781), which is actually one of the first floristic works concerning Belarus. Here the author indicates that he saw it in Lithuania on the outskirts of Brest (now Belarus). Then for the presence of the species in the outskirts of Terespol, located on the left bank of the river Western Bug near Brest, mentioned by E. Eichwald (Eichwald, 1830). Currently, this city belongs to the territory of Poland. J. Brincken (1828) pointed out the growth of *C. scoparius* in Belovezhska Pushcha at about the same time. In 1850, its presence here was also confirmed by E. Lindemann (Lindemann, 1850). However, already in the 1880s. C. *scoparius* in Belovezhska Pushcha is not found by Polish botanists (Błonski et al., 1888). According to

a number of floristic works, it can be established that from the second half of the 50s. 19th century *C. scoparius* began to be cultivated in botanical gardens and parks in Belarus. So, in 1850 it is grown in the botanical garden in the town of Gorki, Mogilev region, in 1890 in the Borisovshchina park of the Khoiniki district of the Gomel region, and in 1915 in the botanical garden in the village Big. Lettsy of the Vitebsk region (Index, 1915).

J.K. Paczoski, who conducted floristic research at the end of the 19th century, believed that *C. scoparius* does not occur in the wild in the Grodno province (Paczoski, 1897), since it does not grow everywhere even in neighboring Poland. He did not cite a single independently identified location of the species, but only references to its findings by previous researchers. Therefore, it can be said with great confidence that until the beginning of the 20th century, the species, within Belarus, *C. scoparius* was extremely rare.

In the work of Polyanskaya (1931), devoted to the study of the flora of the eastern part of Belarus, indicates that the species was found in the 1920s. in eight localities it is noted that this fact is interesting as an example of the rapid naturalization of the species: "in Belarus this plant was planted in the forests by landowners for winter feeding of hares and quickly became wild, as a result of which it is now found in forests far from habitation in an undoubtedly wild state". Novikov (1933) mentions that the species does not occur in the wild, but has long and successfully naturalized throughout Belarus.

Thus, Wodzinska (1911) mentions the presence of the species in the hunting grounds of the Radziwill princes near the village of Bobovnya of the Kopyl district in 1911. Then after 20s of XX century, a number of publications appear about the presence of this species near former estates and in forest dachas in various regions of Belarus (Tessendorff, 1922; Polyanskaya, 1931; Prachin, 1928). Among the stock materials of the herbarium of the Institute of Experimental Botany of the National Academy of Sciences of Belarus (MSK) there are also herbarium specimens indicating on the labels the specific facts of the cultivation of the species, these are: "Lepel district, the Kraytsy-Perekhodtsy road, along the road, sown in 1929", as well as "Luninetsky district, pine forest, planted, 1950".

By the 70s XX century *C. scoparius* naturalized in Belarus so well that Kozlovskaya (1970) writes about it as the species growing in the southern and central parts of Belarus to the north up to the line of the village of Mikhalishki, Ostrovets district-Oshmyany-Logoisk-Berezinsky reserve-Orsha district (village Ratsevo and Klyukovka). The author writes "in a number of places this plant was planted artificially, and then settled; in most cases, its natural growth pattern is undeniable". This comment later served as a pretext for an ambiguous interpretation of the nature of the species growth in the republic. Soon, this thesis was strengthened in the monograph by Kozlovskaya and Parfenov (1972), where *C. scoparius* was attributed to the aboriginal component of the flora of Belarus as an Atlantic-European element, and its distribution was compared with the area of *Arnica montana* L. in Belarus. Outside of the range of this species outlined by them, isolated points were indicated (in the vicinity of the cities of Orsha, Mogilev and in the Berezinsky reserve), where it was assumed that they were artificial origin. However, it is known that even in Belovezhska Pushcha (in the extreme west of the country), approximately in the same period, the species was actively cultivated for feeding ungulates, in some places it became wild (Nikolaeva & Zefirov, 1971).

After the 70s in the XX century, there was a further progressive spread of the species (Table 1). At this time, it is quite often used for biotechnical activities in the forests of many forestry enterprises of the country. In places, in snowless and frosty winters, it freezes heavily, but then recovers rather quickly. A sharp outbreak in the number of *Sarothamnus scoparius* occurred in the late 1990s – early 2000s, when the winters in Belarus became warmer. For example, in vicinity of the village Selyakhi, Brest region in 1986, according to the diary records of G.V. Vynaev, the species was rare, now it is quite abundant here, and its bushes often reach 2 m in height.

### 3.3 Habitats of *Cytisus scoparius* in Earsten Europe

*Cytisus scoparius* have wide phytocenological amplitude. It is confined to well-lit pioneer, mesophilic, acidophilus ecotypes. In Atlantic Europe, it grows on forest edges and clearings, along roadsides and trails, screes mountain roads, heather moor and in scrub uncultivated fields (Quere et al…, 2009. In Central Europe *C. scoparius* confined to oak forests on acid soils *(Quercion roboris-petraea)*, birch-oak forest communities *Ulici-Sarothamnion*, to the plantation of pine, laid on the sand dunes and the heather moor with domination of *Calluna vulgaris* (Hegi, 1974; Walter et Straka, 1970; Ellenberg & Leuchmann, 2010).

In the foothills of the Carpathians *C. scoparius* forms dense thickets. Its communities represented by association *Sarothamnetum varioherbosum*. Participation of edificator is 90–95% in maine vegetable layer (Badei, 1988).

In Transcarpathian lowland it grows in secondary meadow in former arable lands and in ruderal ecotops. Occasionally *C. scoparius* is penetrated in natural forests in Mukachivskiy district. There some continually thickets of *C. scoparius* in Transcarpathian to 200 $m^2$ by place, mourned near villages Obava in Mukachevskij district and in Nysznia Martynka in Irshavskij district (Felbaba-Klushina et al., 2021).

In Ukrainian Polissya, *C. scoparius* is a part component of the forest communities rocky-oak woods *Quercetum (petraea) majanthemosum* and pine forests *Pinetum convallarioso – hylocomiosum* (Melnik, 1989; Melnik et al., 2009). Participate of *C. scoparius* in these communities are generally not large. Its projective cover is less than 1%. Only in forest clearings it can form dense thickets, with 100% projective cover, that we observed near village Lushtsi in Novograd Volynski district of Zhytomyr region.

In recent years, intensive expansion of *C. scoparius* in forest plantations take place in Western Pollisia. In the upper pach of interfluver Gorin – Sluch this species grows in forest plantation on two sandy manes created system of dunes. These manes stretching for 10 kilometers from north to south from the village Berezhky (Dubrovytskyi district) near village Lyubykovychi (Sarny district, Rivne region), parallel to the railway and highway Rivne-Pinsk. Sand dunes were planted by pine cultures 50–60- years ago. Now there is Pine forest (*Pinetum (sylvestris) – Vaccinium (myrtilli) – hylocomiosum*) massive. Average diameter of trees – 35 cm, the average height – 21 m. *Frangula alnus* Mill., *Sambucus racemosa* L., *Sorbus aucuparia* L., and *Cytisus scoparius* formed in brushwood. Presented of undergrowth *Pinus sylvestris* L. and *Quercus robur* L. Grass-shrub layer rich floral, sparse. Projective cover is 60%. *Vaccinium myrtillus* L. is dominant of this layer. *Asparagus officinalis* L., *Betonica officinalis* L., *Calamagrostis epigeios* (L.) Roth, *Chimaphila umbellata* (L.) Natt., *Dactylis glomerata* L., *Dianthus arenarius* subsp. *pseudoserotinus* (Błocki) Tutin, *Eremogone saxatilis* (L.) Ikonn., *Euphorbia cyparissias* L., *Gypsophilla paniculata* L., *Pilosella officinarum* F.Schultz & Sch.Bip., *Hypericum perforatum* L., *Jurinea cyanoides* (L.) Rchb., *Linaria genistifolia* (L.) Mill., *Silene eugeniae* Kleopow, *Peucedanum oreoselinum* (L.) Moench, *Poa annua* L., *Polypodium vulgare* L., *Pteridium aquilinum* (L.) Kuhn, *Pyrola rotundifolia* L., *Rumex acetosella* L., *Scrophullaria nodosa* L., *Hylotelephium decumbens* (Lucé) V.V.Byalt, *Thymus serpyllum* L., *Veronica officinalis* L. are components of this laer. Moss layer formed *Pleurozium schreberi* Mitten. *Cytisus scoparius* often occurs along the margins of forest plantations.

There is invasion of *C. scoparius* on abandoned and noncultivated fields and on the piles of rocks in last years. In the surrounding forest areas of noncultivated fields emerging generation of young pine forests. Such ecotops is a new ecological niche for *C. scoparius* on Polissya region. Along the way Berestovets – Korchyk (Kostopil district Rivne region), 1 km from Berestovets on abandoned farmland formed young ages pine forest. The maximum age of the trees is 20 years. Together with *Pinus sylvestris* growth *Betula pendula* Roth and young 1–3 year *Quercus robur.* Among the trees are some thickets bushes of *Cytisus scoparius*, projective cover is 60%. Poorly grass layer formed by *Berteroa incana* (L.) DC., *Helichrysum arenarium* (L.) Moench, *Hypericum perforatum, Jasione montana* L., *Knautia avensis* (L.) Coult., *Stennactis annua* (L.) Cass. Moss layer formed *Pleurozium schreberi*.

Often *Cytisus scoparius* grows on both sides of forest roads and trails. On the forest road Kostopil – Piskiv (Rivne region), which runs through the hornbeam-oak-pine forest, *C. scoparius* occupies a narrow strip between the road and the forest. Besides it, there are some young trees *Alnus glutinosa* (L.) Gaertn., *Betula pendula, Fraxinus excelsior* L., *Salix aurita* L. and shrubs *Rubus idaeus* L. In emerging grass cover are isolated individuals *Ajuga reptans* L., *Chamaenerion angustifolium* (L.) Scop., *Daucus carota* L., *Erigeron canadensis* L., *Hypericum perforatum, Impatiens parviflora* DC., *Fragaria vesca* L., *Leontodon autumnalis* L., *Stenactis annua, Trifolium medium* L., *Urtica dioica* L. *Cytisus scoparius* growing as separate individuals or small clumps in the most of it area.

*Cytisus scoparius* is a typical components of heather moor of Polissya (plant communities with domination of *Calluna vulgaris*), which are resulting from human activities (deforestation and burning bushes). Unlike heather moor of Western Europe, which is a type of vegetation, heather moor of Polissya is only a stage demutation of forest vegetation. With time on their site restored forests. Heather moor of Polissya is presents on military grounds in Rivne region in Kostopil district. *C. scoparius* is codominant of plant communities. The timber stand was represented by single young distant from one another tree *Betula pendula, Pinus sylvestris, Pyrus communis* L. In the shrub layer is dominated *Cytisus scoparius*, projective coverage reaches 60%. There are also *Crataegus monogyna* Jacq., *Rosa canina* L. in this layer. *Calluna vulgaris* (L.) Hull is dominant of herb layer, projective cover is 50–80% also includes *Achillea millefolium* L., *Astragalus glycyphyllos* L., *Briza media* L., *Carlina biebersteinii* Bernh. ex Hornem., *Centaurea scabiosa* L., *Galium verum* L., *Hypericum perforatum, Jasione montana, Knautia arvensis, Potentilla argentea* L., *Thymus serpyllum, Vaccinium myrtillus* and rare included in the Red Date Book of Ukraine (2009) species *Daphne cneorum* L. are component of this layer. Moss was formed by *Pleurozium schreberi*.

Close to the described are conditions of habitats of *Cytisus scoparius* on meadows in military training ground in the northern outskirts of the Volodymyr-Volynskyi (Volynien region). In 20–30 years of XX century this territory was belonged to the Polish landowners (colonists) who actively planted groves around the landfill. J. Paczoski (1888) did not mention *C. scoparius* in the Vladimir-Volynsky area. Obviously, after landowners, *C. scoparius* left the culture, ran wild, active multiply and become codominant of plant communities. Besides *C. scoparius*, in the rarefied tree and shrub layer of military training ground, single and compact groups are grown *Populus tremula* L., *Pinus sylvestris, Betula pendula, Pyrus communis, Crataegus monogyna, Prunus spinosa* L., *Rosa canina, Genista germanica* L., *Chamaecytisus ruthenicus*

(Fisch. ex Wołoszcz.) Klásková, *Cerasus mahaleb* (L.) Mill. Floral rich herbaceous layer was formed by *Agrimonia eupatoria* L., *Anemone sylvestris* L., *Allium oleraceum* L., *Anthyllis vulneraria* L., *Arabidopsis thaliana* (L.) Heynh., *Astragalus glycyphyllos, Briza media, Calamagrostis epigeios, Calluna vulgaris, Carex hirta* L., *C. humilis* Leyss., *Carlina biebersteinii, Centaurea scabiosa, Clematis recta* L., *Coronilla varia* L., *Digitalis grandiflora* Mill., *Equisetum arvense* L., *Euphorbia cyparissias, Festuca pratensis* Huds., *Fragaria viridis* Duchesne, *Galium verum, Holcus mollis* L., *Hypericum perforatum, Jasione montana, Knautia arvensis, Lavatera thuringiaca* L., *Linaria vulgaris* L., *Lotus corniculatus* L., *Medicago lupulina* L., *Myosotis stricta* Link ex Roem. & Schult., *Orobanche lutea* Baumg., *Pilosella officinarum, Plantago media* L., *Plathantera bifolia* (L.) Rich., *Potentilla argentea, Ranunculus acris* L., *Silene latifolia* Poir., *Thymus pulegioides* L., *Trifolium medium, T. pratense* Horv., *Vicia cracca* L., *Viola arvensis* Murray.

As already mentioned, in recent years, have been observed the intensive migration of *Cytisus scoparius* in careers and piles of rocks. It is widely spread in basalt quarries in the Yanova Dolyna in the village Basaltove Kostopil district Rivne region. Especially significant is the participation of this species in quarries No. 2 and No. 3. These quarries are piles of brown clay, which opened in the supergene volcanic tuffs. Due to the upwelling groundwater, part of the quarries flooded with water. Owing to good fertile moist substrate promotes, vegetation form intensively in these dumps. The basis of the tree layer, condensed in some places, in others is diluted, creating different ages generation of *Pinus sylvestris* (from 1 to 30 years old). *Fraxinus excelsior, Robinia pseudoacacia* L., *Populus nigra* L., *P. tremula, Salix alba* L. are component of this layer. Well developed, spreading shrubs of *C. scoparius*, up to 2 meters, are occupied space free from trees. Projective cover is 60–80%. The structure of the shrub layer also formed by *Genista tinctoria* L., *Salix cinerea* L., *S. aurita, S. myrsinifollia* Salisb. Grass cover is sparse, not entire, fragmented. Projective cover is about 20%. It consists by *Achillea millefolium, Anthemis tinctoria* L., *Betonica officinalis* L., *Carlina biebersteiniana, Coronilla varia, Daucus carota, Oenothera biennis* L., *Eryngium planum* L., *Euphorbia seguieriana* Neck., *Equisetum arvense, Galium verum, Galeopsis speciosa* Mill., *Lotus corniculatus, Lythrum salicaria* L., *Melilotus albus* Medik., *M. officinalis* (L.) Pall., *Nonea pulla* (L.) DC., *Origanum vulgare* L., *Pimpinella saxifraga* L., *Ranunculus acris, Saponaria officinalis* L., *Silene dichotoma* Ehrh., *Solanum nigrum* L., *Tussilago farfara* L., *Trifolium medium* and rare species *Equisetum ramosissimum* Desf.

In Podolian Upland we have seen large dense overgrown of *Cytisus scoparius* along the railway near the station Mostytska (Lviv region), and infrequent shrubs on the beech forest edge outskirts Zolotyi Potik in Buchach district, Ternopil region. Old-growth beech forest is located at elevation in relief. In addition to *Fagus sylvatica* L., the forest stand includes single trees of *Acer pseudoplatanus* L. Undergrowth formed by *Fagus sylvatica, Acer campestre* L., *A. pseudoplatanus* L., *Fraxinus excelsior*. In the shrub layer occasionally occurs *Daphne mezereum* L., *Euonymus verrucosa* Scop. Grass formed *Galium odoratum* (L.) Scop., *Aegopodium podagraria* L., *Atropa belladonna* L., *Aposeris foetida* (L.) Cass. ex Less., *Euphorbia amygdaloides* L., *Laserpitium latifolium* L., *Lunaria rediviva* L., *Paris quadrifolia* L., *Salvia glutinosa* L. *Cytisus scoparius* occasionally occurs along the margins of the forests.

In Belarus most often, C. *scoparius* grows on forest edges, along roads, forest clearings, in clearings, glades, former clearings, among forest cultures in pine forests of the mossy, heather and blueberry types, pine-oak bracken forests, derived from them dry birch and spruce stands, forest belts. Often it acts as a dominant and coedifier of forest and forest phytocenoses.

Since the end of the XIX century to the beginning of the XXI century has been an increase in air temperature, in extratropical latitudes 0.8°C. In the mid-70s of the last century in the Northern Hemisphere is warming with greater intensity than in previous years and continues to these days. In some decades of the last century increase the global temperature averages 0.046°C, and from 70s doubled (Lipinsky et al., 2003).

Climatic changes have contributed to the migration subatlantic species *S. scoparios* to the east, where it found appropriate ecotops in anthropogenically disturbed ecosystems, an area which is growing in East Europe. Intensive deforestation of ever-increasing pace in the past decade, the decommissioning of the former collective farm fields at the end of last and the beginning of this millennium, the large number of pits and piles of rocks – all this leads to the formation of a large number of anthropogenically-disturbed ecotopes conducive to growth and development of *C. scoparius* and expanding its area eastward.

Experience of growing of *C. scoparius* at the M.M. Gryshko National Botanical Garden Ukrainian Academy of Science and our observations in nature, intensive spread of *C. scoparius* east prevent severe winter frosts and summer drought. In the botanical garden plants of *C. scoparius* were plan in the autumn of 2007 on phytogeographical area "Forest of plain part of Ukraine." Strong cold winter of 2007–2008 led to the death every of fourth of plants. Survived plants well blossomed and fruited. However, severe drought in mid-summer in 2008 led to the death of half of the plants. Strong cold winter frosts of 2008–2009 caused the extinction new adult plants. Survived only a new generation of plants, which grown from seeds collected in 2008.

After a harsh winter in nature there is blackening of the stems of *C. scoparius* and their extinction, but in the next growing season is regeneration of a large part of the

population. This phenomenon is seen in the vicinity of the station Mostyska in Lviv region in 2010–2011. Obviously, severe winter frosts and summer drought is somewhat slow, but not stop the migration of *C. scoparius* to the east. In Western Belarus and Polissya lowland in Ukraine this migration occurs on a broad front anthropogenically disturbed ecosystems different ecotopes, but on the Volhynian – Podolian Upland mostly in river valleys. This difference apparently associated with different rates of moisture of both regions (Lipinsky et al., 2003). Polissya lowland region is more humid than the Volhynian – Podolian Upland, so its climate more favorable to growth and development of subatlantic species *C. scoparius*.

So far as, the analysis of the geographical distribution of *C. scoparius*, from beginning of floristic research in East Europe Ukraine (XIX century) to present day and conditions of habitat of this species indicates that it is alien plant kenofit of East Europe. Its participation is significant in anthropogenically-derived ecotopes (in fallow, rock dumps, heather moor, continental meadows, along roads and trails) and little in forest communities.

Including of *C. scoparius* in the Red Data Book of the former Soviet Union (Kuvajev, 1978) and its inclusion in the list of rare plants of Polissya (Smyk, 1989) was a mistake.

## 4. Conclusions

Analysis of geographical distribution and conditions of habitats of *Cytisus scoparius* (L.) Link. (Fabaceae) in historical aspect give grounds to refute the point of view about *C. scoparius* as a rare autochtonous species of the flora of Eastern Europe. This species is alien species, kenofit and ergasiofit of East-European flora. Including *C. scoparius* in Red Date Book of former Soviet Union was mistake.

Date of floristic works of XVIII – XIX centuries testify that *C. scoparius* was rare in Eastern Europe in that time and penetrated from culture into nature.

From places of cultivation C. scoparius entered in the nearby ecosystems where it found on ecological niche on the edge of forests, forest glades in the forest cultivated cenoses, along roads and trails and in ecotones between forest and field lands.

The rate of invasion of *C. scoparius* and its eastward migration increased significantly in seconde half of XX and in XXI centuries, with connection of global warming and intensive anthropogenic changes in the environment: deforestation, the growth areas of follow land, large number of quarries and damps where *C. scoparius* fond favorable condition for habitats.

Including of *C. scoparius* in the Red Data Book of the former Soviet Union was a mistake.

As a sensitive indicator of the worming *C. scoparius* can be convenient model for monitoring of the vegetation change due to climate changes (Melnik & Baransky, 2018).

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