ISSN 2075-1117, Russian Journal of Biological Invasions, 2015, Vol. 6, No. 3, pp. 202–221. © Pleiades Publishing, Ltd., 2015.
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# Expansions of Plant Species to the Flora of Vladimir Oblast (Russia) in the Last Decade. Second Report

**A. P. Seregin**

*Moscow State University, Moscow, 119991 Russia*

*e-mail: botanik.seregin@gmail.com*

Received January 20, 2014

Abstract—The second report reviews naturalization and expansion of ten vascular plant species in Vladimir oblast (Russia) in the last decade. All records of *Acer tataricum* L., *Amelanchier* × *spicata* (Lam.) K. Koch, *Bidens frondosa* L., *Cuscuta campestris* Yuncker, *Galinsoga quadriradiata* Ruiz et Pav., *Nuttallanthus canadensis* (L.) D.A. Sutton, *Poa supina* Schrad., *Rosa villosa* L., *Rumex stenophyllus* Ledeb., and *Zizania palustris* L. since the first record until the end of 2013 are summarized. Series of grid maps for each species (dated 2007, 2011, and 2013), frequency of occurrence, ecological preferences, earlier reports from neighboring regions, and probable invasion routes are discussed. The data on further four-year expansion (2010–2013) are presented for ten species characterized in the first report: *Epilobium tetragonum* L., *Hypochoeris radicata* L., *Ambrosia trifida* L., *Erigeron* × *huelsenii* Vatke (*E. droebachiensis* auct.), *Aronia mitschurinii* A.K. Skvortsov et Maitul., *Trifolium fragiferum* L., *Phragmites altissimus* (Benth.) Mabille, *Schedonorus arundinaceus* (Schreb.) Dumort., *Vicia villosa* Roth, and *Galega orientalis* Lam.

*Keywords:* flora, Vladimir oblast, alien plant species, naturalization, invasion

**DOI:** 10.1134/S2075111715030066

## INTRODUCTION

Four years ago, I published a report on the details of rapid expansion in Vladimir oblast of 10 vascular plant species since the first record until the end of 2009 (Seregin, 2010). These expansions took place during the 10–15 years that preceded the publication of this paper during the work on the grid mapping of Vladimir oblast flora. Four years later, I am ready to review information on other ten species that have rapidly expanded across the region over the period of my research, as well as to provide data on the later expansions of those species mentioned in the first report. Plant species expanded exclusively along railways and never detected away from them are omitted. Examples of such species which were regularly recorded on the regional railways over the past 10–15 years are *Collomia linearis* Nutt., *Eragrostis minor* Host, *Artemisia dubia* Wall. ex Besser, *Chaenorhinum minus* (L.) Lange, *Senecio dubitabilis* C. Jeffrey et Y.L. Chen, etc.

As before, I have to admit that a majority of florists, after the publication of the first records of newly discovered plants, lose any interest in these species, considering them as fairly common. By the time of the publication of the next regional checklist or flora, recently discovered alien can become common or may remain a rarity. Thus, the process of expansion of a new species often is left beyond the routine floristic studies. Also, an expanding species at this time may not yet be recognized in the neighboring regions and this creates a significant bias in distribution data on alien plant species, even in adjacent regions.

In this paper, I would like to highlight the dynamics of the records of some species of Vladimir oblast flora, starting with the first one, and the details of their expansions. A similar scenario for these species can also be observed in other areas within the Middle Russia; however, I do not have comparable published data from other regions, especially from Nizhny Novgorod, Ryazan, and Yaroslavl oblasts. On the other hand, there are new high-quality reviews on alien species of Ivanovo, Tver, and Moscow oblasts with some observations on the dynamics of individual species (Borisova, 2007; Notov, 2009; Mayorov et al., 2013). I deliberately do not perform a comparison of naturalization data of species given below with other regions and countries owing to different field recording methods and incomparable climatic conditions.

## MATERIALS AND METHODS

Since 1999, I have been working on the grid mapping of Vladimir oblast flora. The region (29 074 km$^2$) was divided into 339 grid cells with the linear dimensions of 5′ in latitude and 10′ in longitude (ca. 9.2 × 10.4 km). Thus, the area of trapezoid cells (in the text also called "squares") slightly increases toward the south, ranging from 94.7 km$^2$ in the north of the oblast up to 98.2 km$^2$ in the south.

Typically, at least one complete floristic description was made in each of the 339 grid squares in the period from late May to late September. Prior to the field work, I outlined a route using topographical maps and satellite images of the grid square covering the highest possible diversity of habitats. Usually a floristic description of a single grid square takes one day (6–9 h, sometimes up to 12 h). I used the printed spreadsheet in a field notebook with a list of the 680 most common plants, which is about a half of the oblast flora. Rarer plants were placed at the end of the list; unclear or interesting species were collected.

I transferred the data obtained within the field season to the distributional database of Vladimir oblast plant species in October–November annually. This database, supplemented by all available data from the literature and herbarium collections, was used to produce maps in the recently published *Flora of Vladimir Oblast* (Seregin, 2012). At the time of map production for the *Flora* in November 2011, it contained 118231 records (in other words, the maps are based on ca. 118000 entries).

In 2012–2013, the grid mapping of Vladimir oblast flora was continued. Field data for the past two years contain important information on increasing number of localities of some plant species. In the following analysis, 123 052 individual records were used (on average 363 species per grid square).

By the beginning of 2013, the flora of Vladimir oblast included 1384 species of vascular plants (Seregin, 2014).[1] Distribution maps published below (Figs. 1, 2) are based on my personal observations, collections and all available references on the oblast flora. The relative number of grid squares with species records was calculated as a proportion from the number of studied squares (209 squares were studied by me by the end of 2007, 294 by the end of 2009, 337 by the end of 2011, and 339 by the end of 2013). Studied herbarium specimens for each species are arranged here in the chronological order; the indexes of the grid squares following Seregin (2012) are cited after the district name.

In 2002, we performed a grid mapping of the flora of the Meshchera National Park, located in Gus-Khrustalny District. We used a grid with cells that were four times smaller ("small squares")—2.5′ × 5′ , or ca. 24 km$^2$ each (Seregin, 2004). In 2012, I repeated this study for precise quantitative recording of the dynamics of species within "small squares" (Seregin, 2013). Data obtained in the Central Meshchera Lowlands in 2012 are widely employed below.

[1] According to the results of the field season of 2013, another five species should be added to this list: *Astragalus falcatus* Lam., *Lunaria rediviva* L., *Cirsium* × *hybridum* W.D.J. Koch ex DC. (Seregin, in press), *Digitalis purpurea* L., *Geranium phaeum* L. (Seregin, unpublished).

## RESULTS AND DISCUSSION

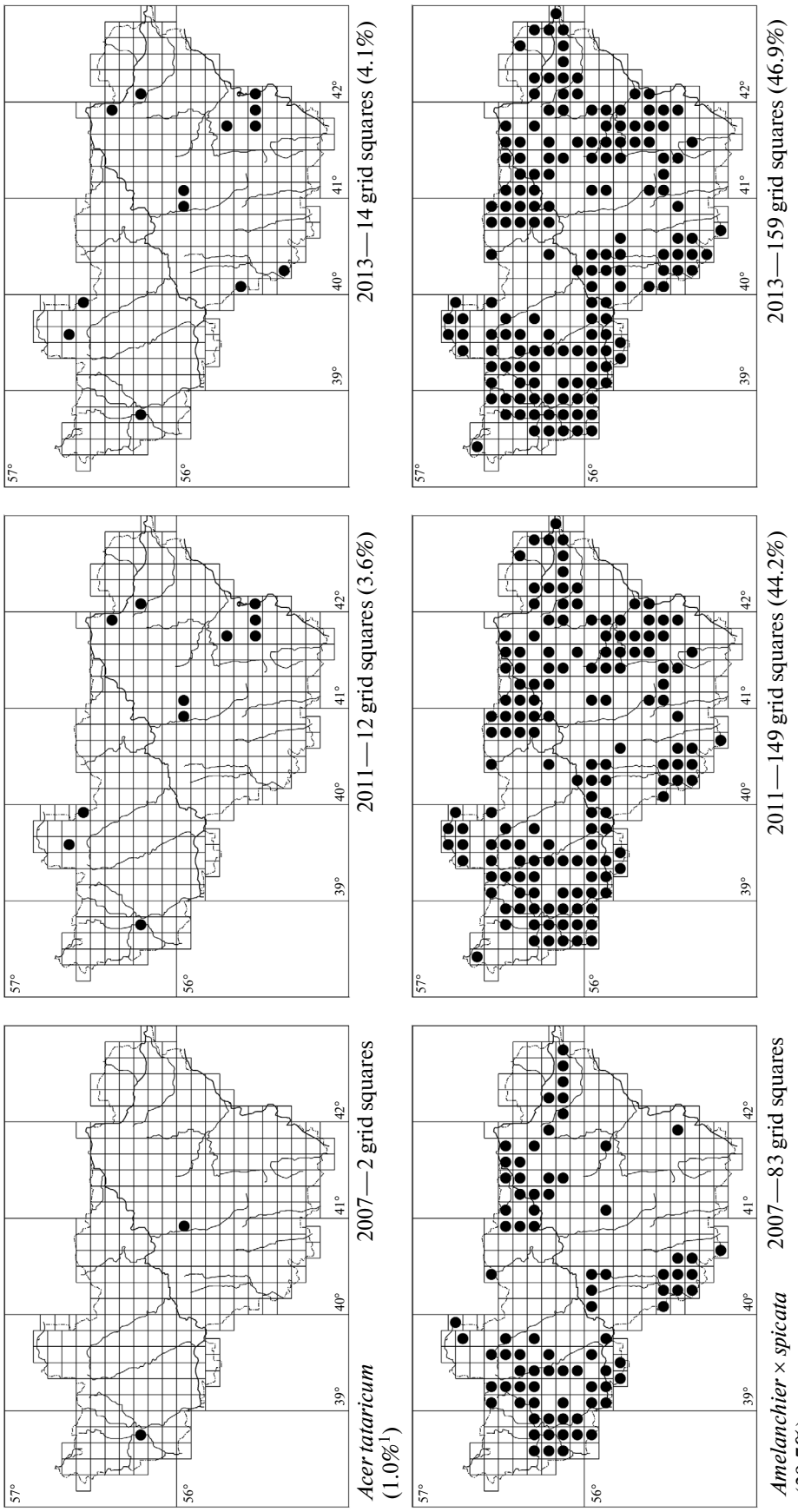
For the second report, I have selected the following recently discovered alien plant species widely naturalized in the region (the dates and the authors of the first records in Vladimir oblast are given in brackets): *Acer tataricum* L. (2004, A.P. Seregin); *Amelanchier* × *spicata* (Lam.) K. Koch (first casual record at the beginning of the 1900s, N.A. Kazanskii; second record in 1995, I.V. Vakhromeev); *Bidens frondosa* L. (1997, A.P. Seregin); *Cuscuta campestris* Yuncker (2003, A.P. Seregin); *Galinsoga quadriradiata* Ruiz et Pav. (1995, I.V. Vakhromeev); *Nuttallanthus canadensis* (L.) D.A. Sutton (1995, V.N. Tikhomirov et al.); *Poa supina* Schrad. (2011, A.P. Seregin); *Rosa villosa* L. (first casual record at the beginning of the 1910s, N.A. Kazanskii; second record in 2009, A.P. Seregin); *Rumex stenophyllus* Ledeb. (2002, A.P. Seregin); *Zizania palustris* L. (mid-1990s, M.P. Shilov et al.) (Fig. 1).

### *Acer tataricum L.*

Specimens studied: (1) Sudogodsky District, L14, Muromtsevo, Aug. 7, 2004, A. Seregin (hereinafter, A.S.), no. 2212 (MW); (2) Kirzhachsky District, Z3, railway platform "138 km", Aug. 27, 2006, A.S., no. 2822 (MW, MHA); (3) Vyaznikovsky District, Z23, Vyazniki station, Aug. 30, 2008, A.S., no. 3743 (MW); (4) Yuriev-Polsky District, G11, Maloluchinskoye, May 31, 2009, A.S., no. 3856 (MW); (5) Muromsky District, P13, Dmitrieva Sloboda, July 22, 2009, A.S., no. 4128 (MW); (6) Melenkovsky District, R11, Kondakovo station, Aug. 19, 2009, A.S., no. 4340 (MW); (7) Vyaznikovsky District, E22, Zarechnyi, July 5, 2010, A.S., no. 4540 (MW); (8) Sudogodsky District, L15, Tyurmerovka, Aug. 3, 2010, A.S., no. 4702 (MW); (9) Gus-Khrustalny District, T1, Tyurvishchi, Aug. 7, 2012, A.S., no. 5562 (MW); (10) Gus-Khrustalny District, P1, Tasinsky Bor, holiday village "Enthusiast", Sept. 13, 2012, A.S., no. 5696 (MW).

For the first time, Tatarian maple was found outside the places of cultivation in 2004 in Muromtsevo near the town of Sudogda (Seregin, 2007). Since the first record was made near a large old arboretum, I thought this to be a rare casual. Two years later, several trees were noted on the slope of embankment of the busy railway in Kirzhachsky District (Seregin, 2007).

According to the results of special observations, this species is rapidly spreading in roadside tree belt areas, settlements, and experimental forest plantations (near Tyurmerovka). *Acer tataricum* produces viable seeds and has successfully naturalized in light birch forest belts. Also, it was detected along embankments of railways, in settlements, and in roadside ditches. The largest populations were recorded in forest belts along the main railways near Murom and Vyazniki. Near Zarechnyi in Vyaznikovsky District, along the highway to Mstera, I noted the penetration of the species in shrubbery in the floodplain of the Tara River.




*Acer tataricum* (1.0%[1])

*Amelanchier* × *spicata* (39.7%)

**Fig. 1.** Progress in the number of known grid records of some species of Vladimir oblast flora: data to the end of 2007 (published for the first time), to the end of 2011 (according to Seregin, 2012), and to the end of 2013 (published for the first time).
[1] Proportion of grid squares where species was recorded from the number of examined squares: 209 squares to the end of 2007, 337 to the end of 2011, and 339 to the end of 2013.

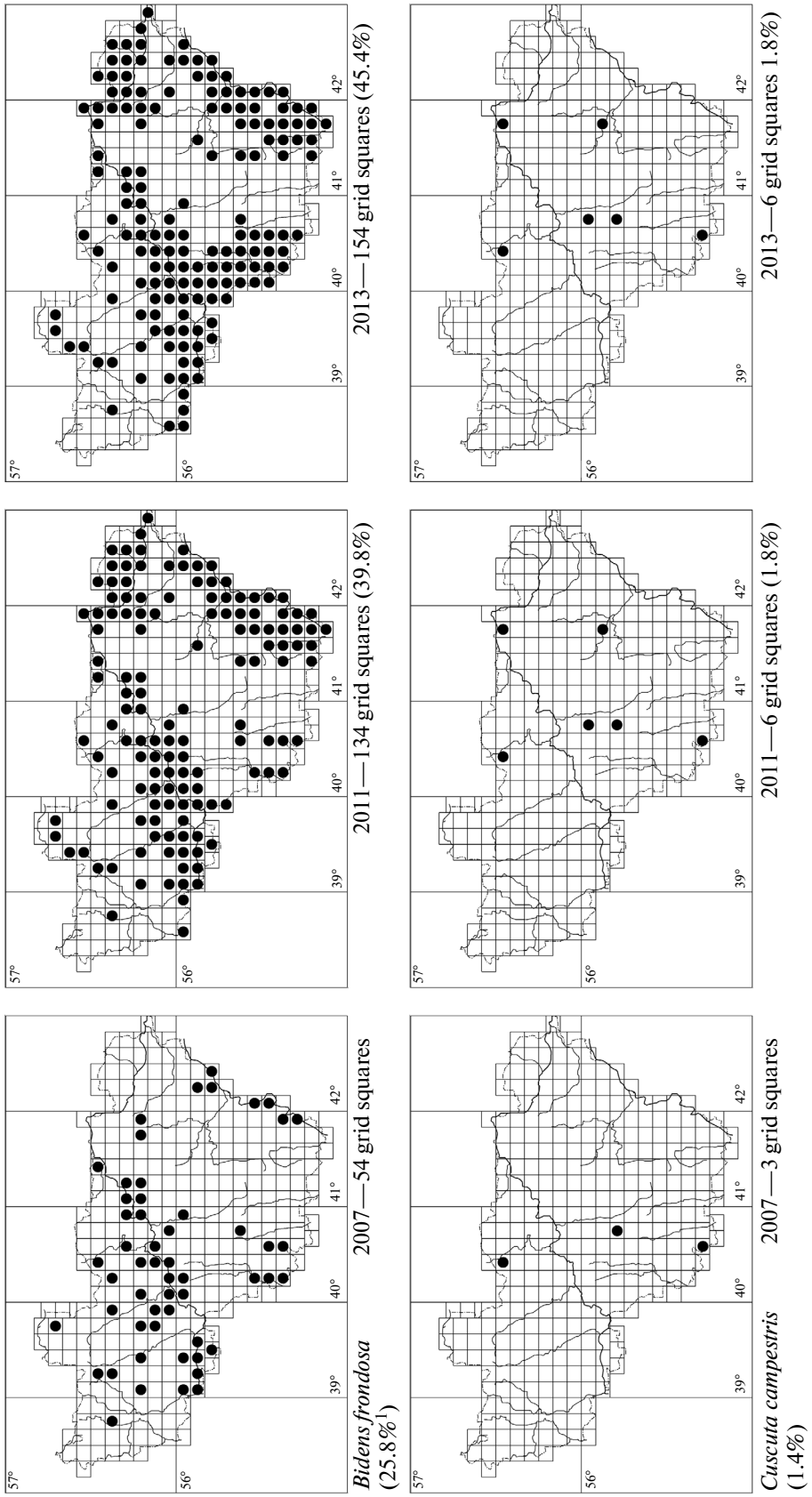

57°
56°
39°
40°
41°
42°
2013—154 grid squares (45.4%)
2013—6 grid squares 1.8%)
2011—134 grid squares (39.8%)
2011—6 grid squares (1.8%)
2007—54 grid squares
2007—3 grid squares
*Bidens frondosa* (25.8%[1])
*Cuscuta campestris* (1.4%)

**Fig. 1.** Contd.

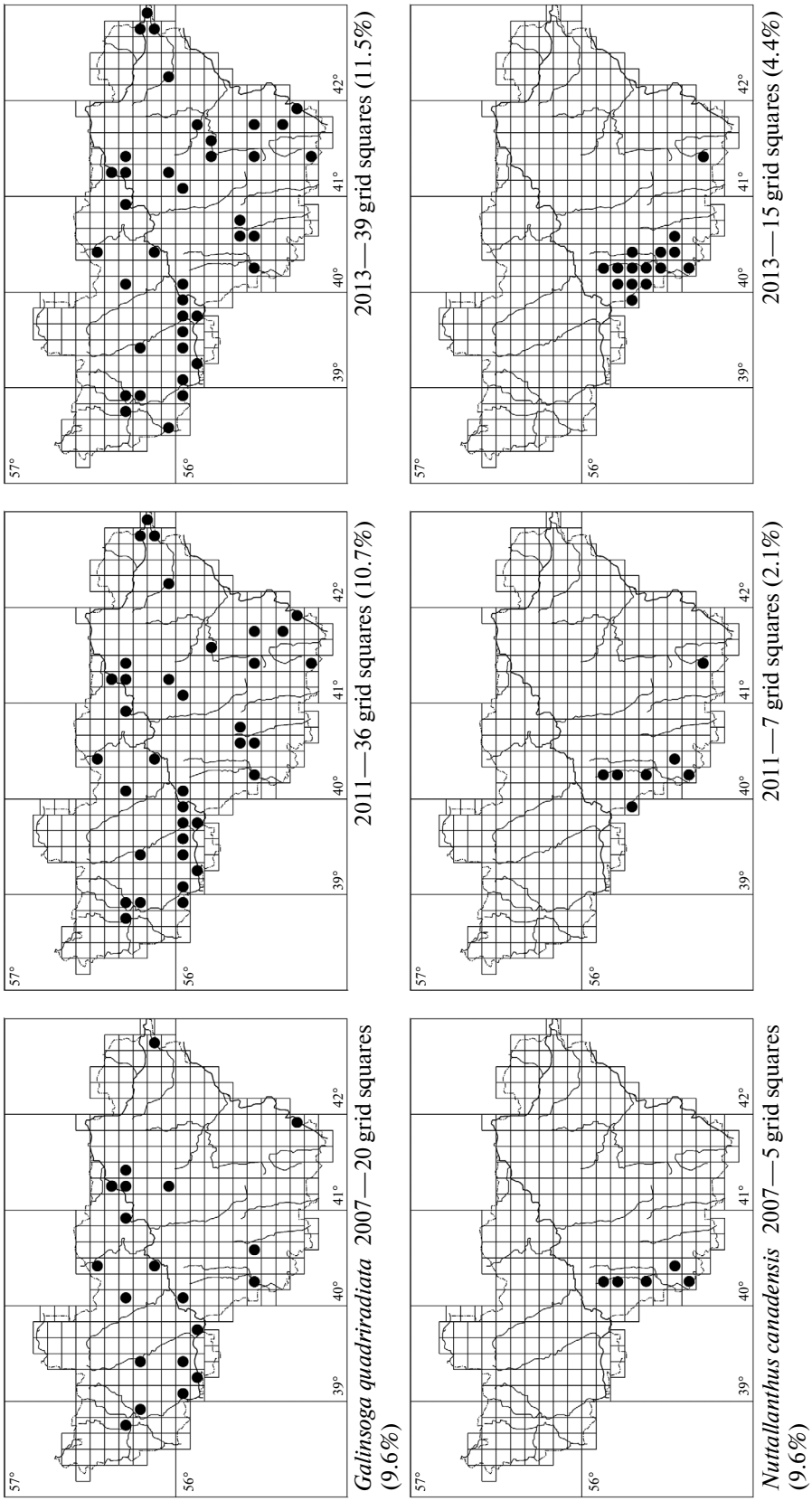

57°
56°
39°
40°
41°
42°
2013—39 grid squares (11.5%)
2013—15 grid squares (4.4%)
2011—36 grid squares (10.7%)
2011—7 grid squares (2.1%)
Galinsoga quadriradiata 2007—20 grid squares (9.6%)
Nuttallanthus canadensis 2007—5 grid squares (9.6%)

**Fig. 1.** Contd.

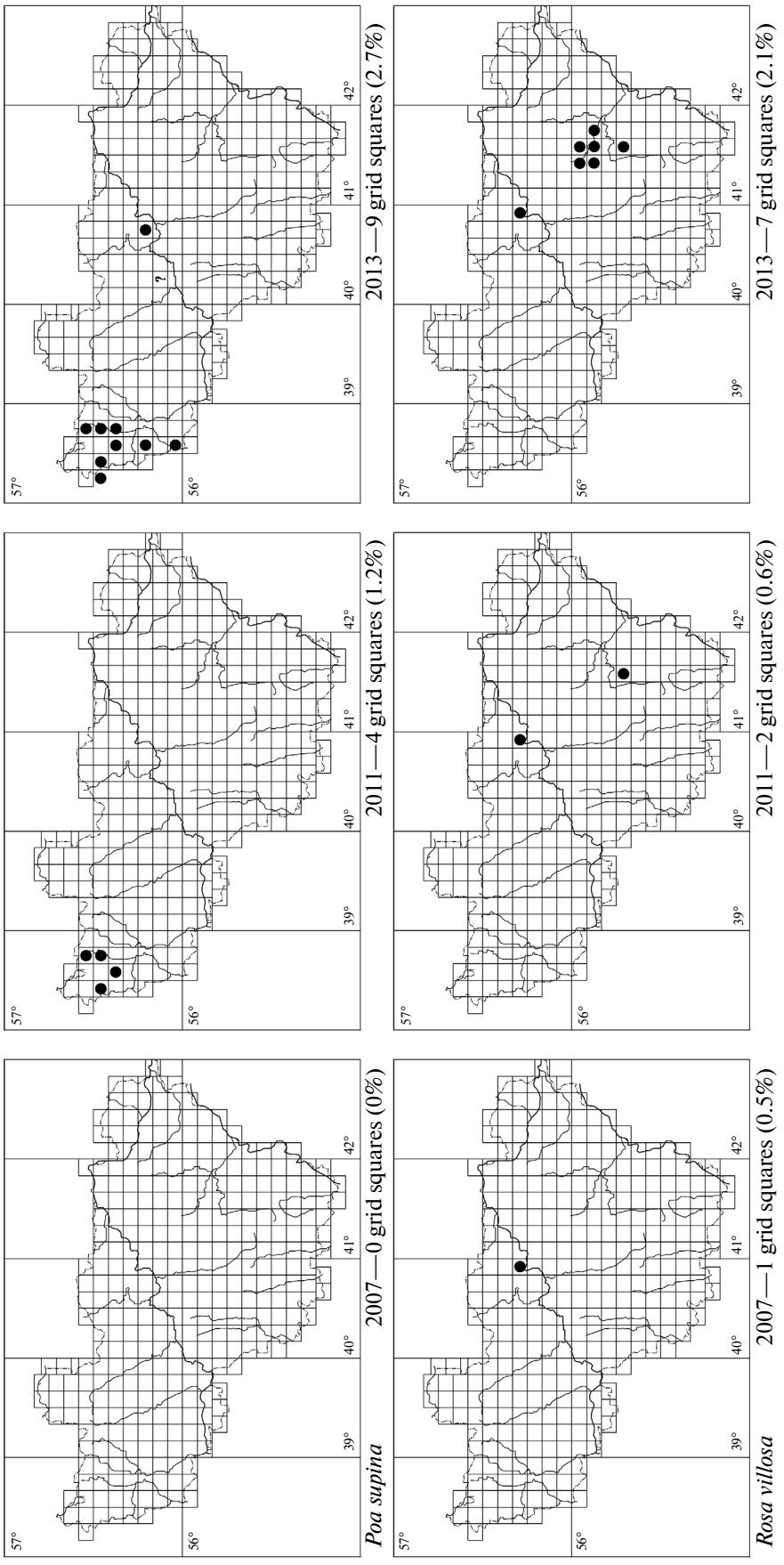

Poa supina
2007—0 grid squares (0%)
2011—4 grid squares (1.2%)
2013—9 grid squares (2.7%)
Rosa villosa
2007—1 grid squares (0.5%)
2011—2 grid squares (0.6%)
2013—7 grid squares (2.1%)
57°
56°
39°
40°
41°
42°
?

**Fig. 1.** Contd.

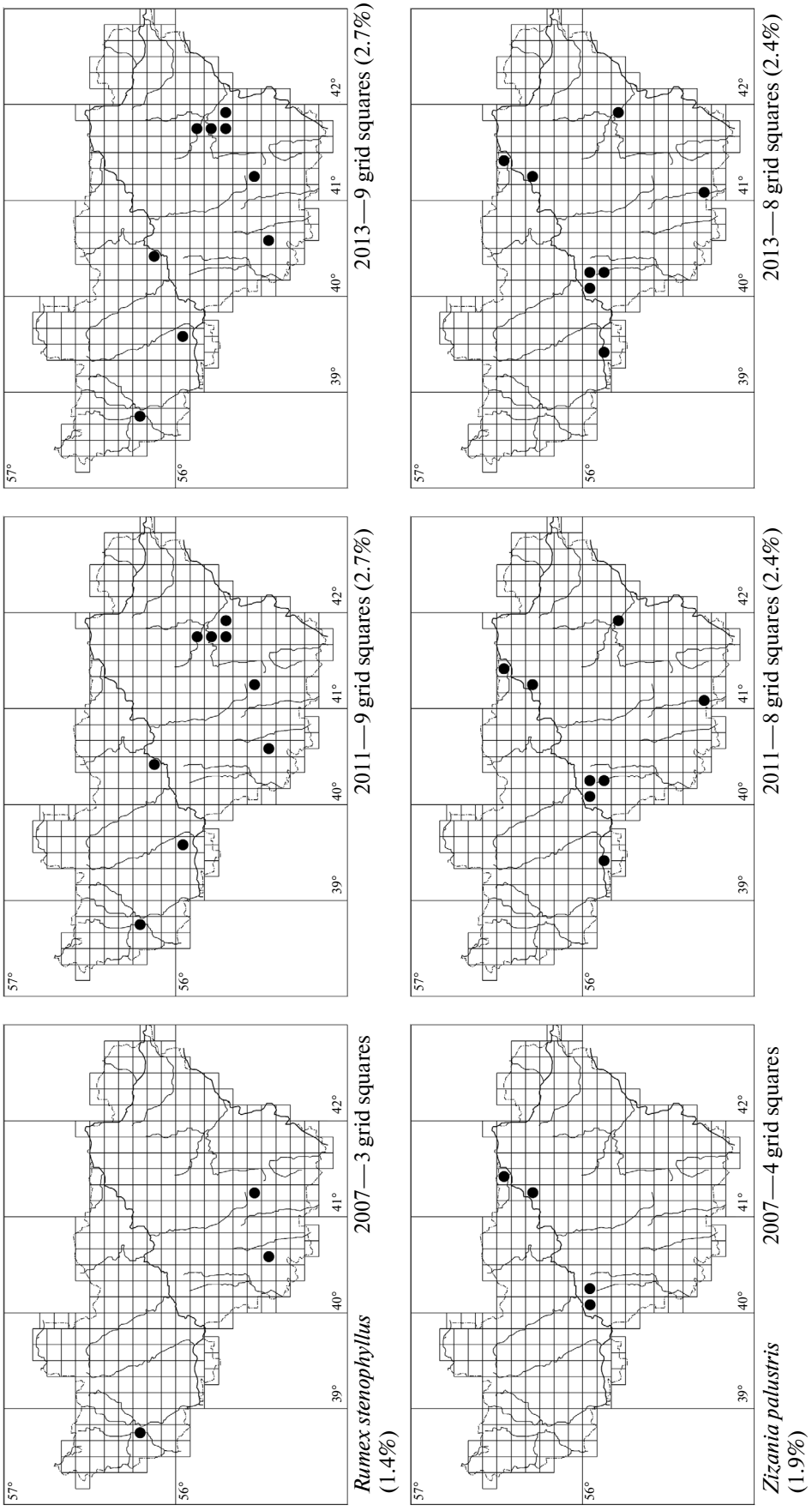

2013—9 grid squares (2.7%)
2011—9 grid squares (2.7%)
2013—8 grid squares (2.4%)
2011—8 grid squares (2.4%)
2007—3 grid squares
Rumex stenophyllus (1.4%)
2007—4 grid squares
Zizania palustris (1.9%)
57°
56°
39°
40°
41°
42°

**Fig. 1.** Contd.

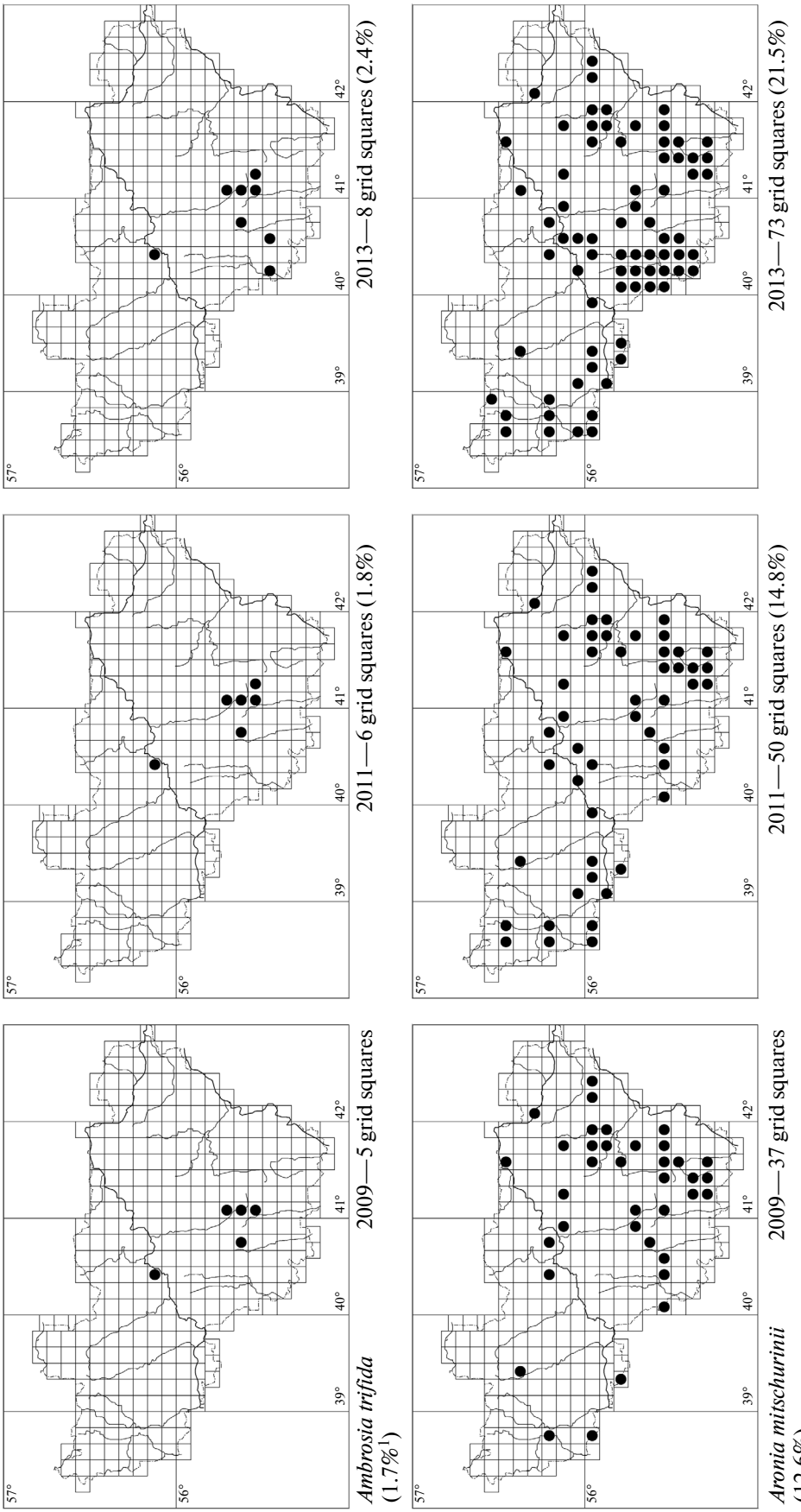



**Fig. 2.** Progress in the number of known localities of the species discussed earlier by Seregin (2010): the data to the end of 2009 (according to Seregin, 2010), to the end of 2011 (according to Seregin, 2012), and to the end of 2013 (published for the first time).

[1] Proportion of grid squares where the species was recorded from the number of examined squares: 294 grid squares to the end of 2009, 337 to the end of 2011, and 339 to the end of 2013.

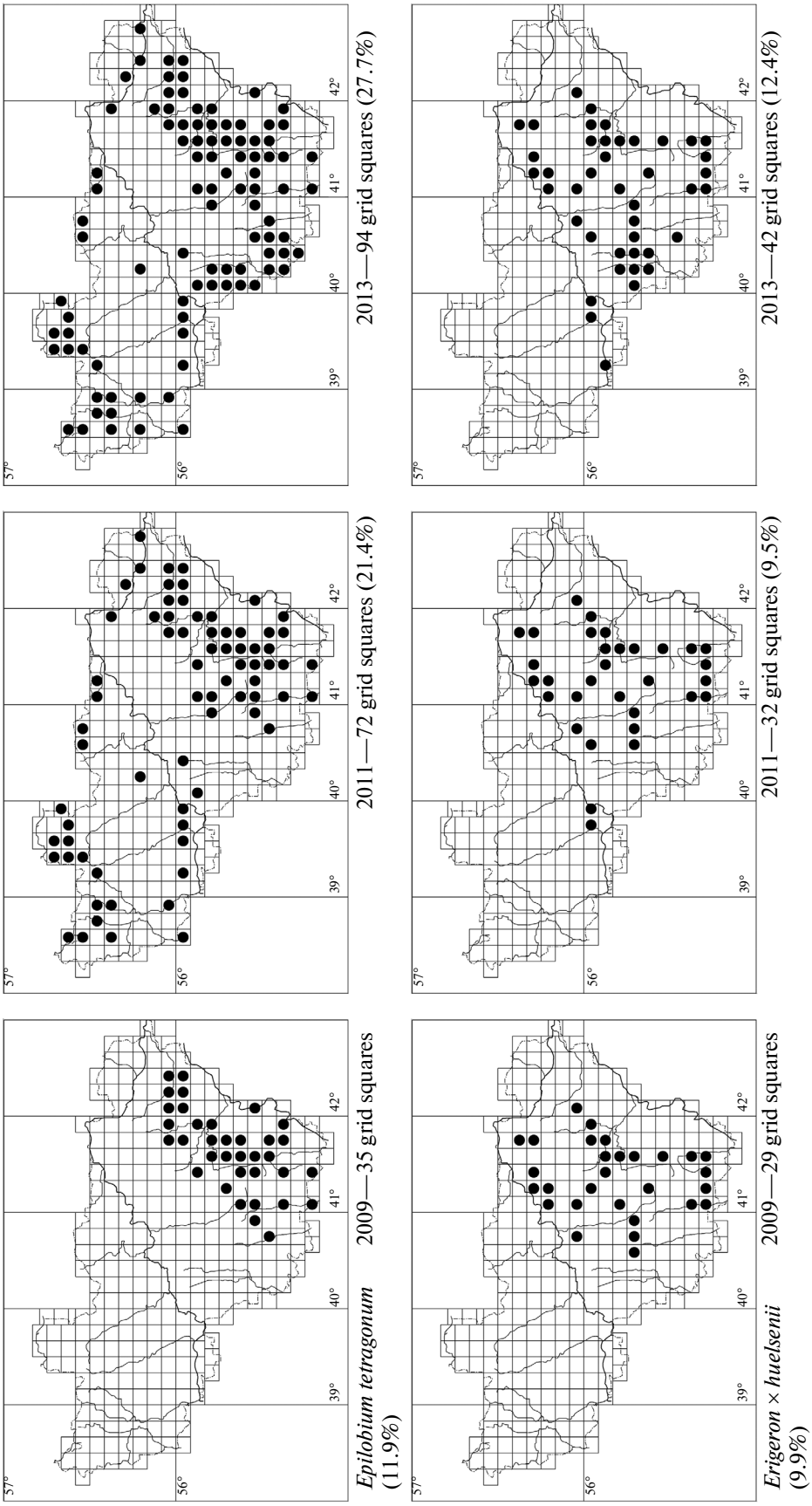

2013—94 grid squares (27.7%)
2013—42 grid squares (12.4%)
2011—72 grid squares (21.4%)
2011—32 grid squares (9.5%)
2009—35 grid squares
Epilobium tetragonum (11.9%)
2009—29 grid squares
Erigeron × huelsenii (9.9%)
57°
56°
39°
40°
41°
42°

**Fig. 2.** Contd.

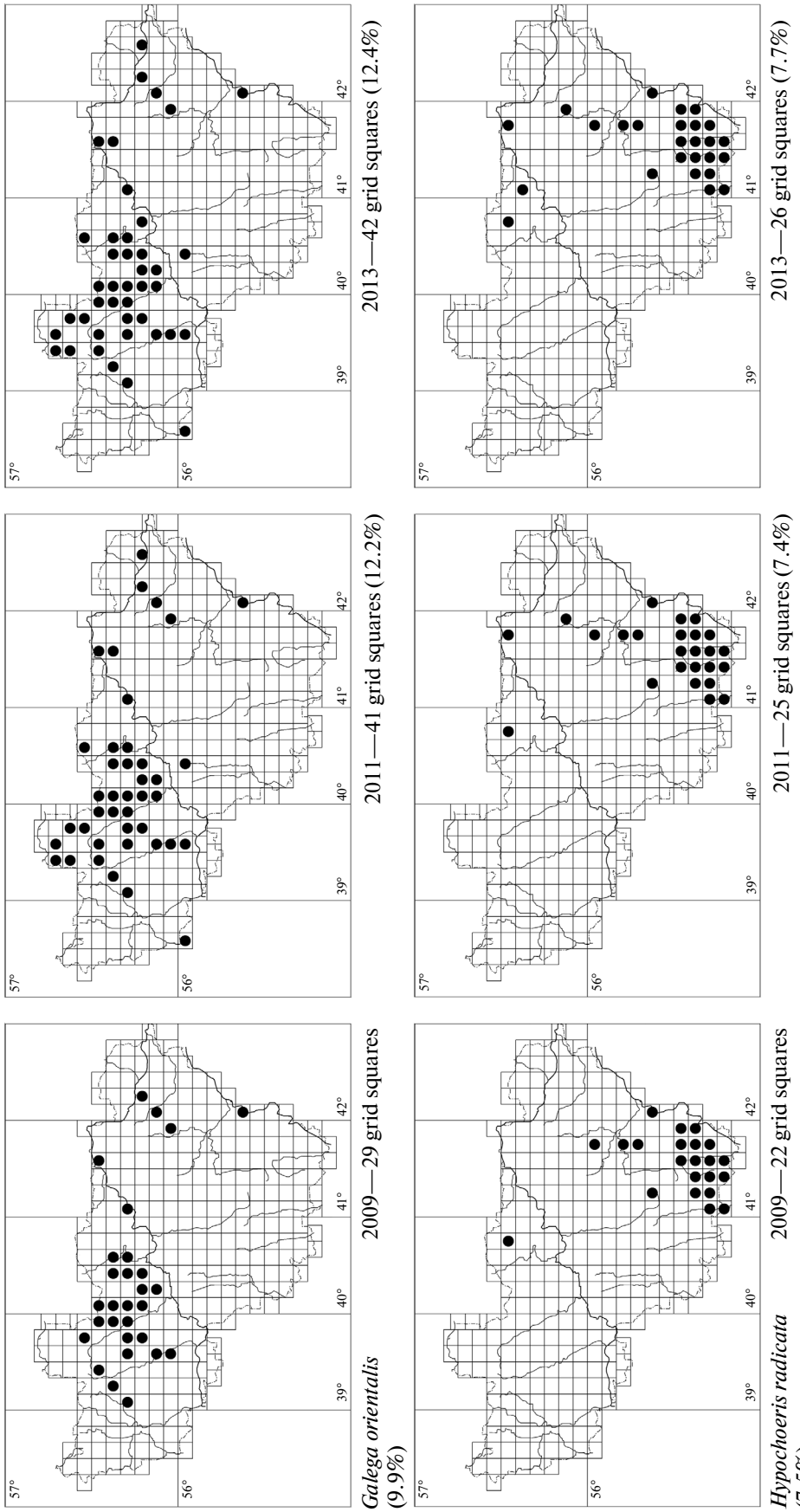

Galega orientalis (9.9%)
2009—29 grid squares
2011—41 grid squares (12.2%)
2013—42 grid squares (12.4%)
Hypochoeris radicata (7.5%)
2009—22 grid squares
2011—25 grid squares (7.4%)
2013—26 grid squares (7.7%)
57°
56°
39°
40°
41°
42°

**Fig. 2.** Contd.

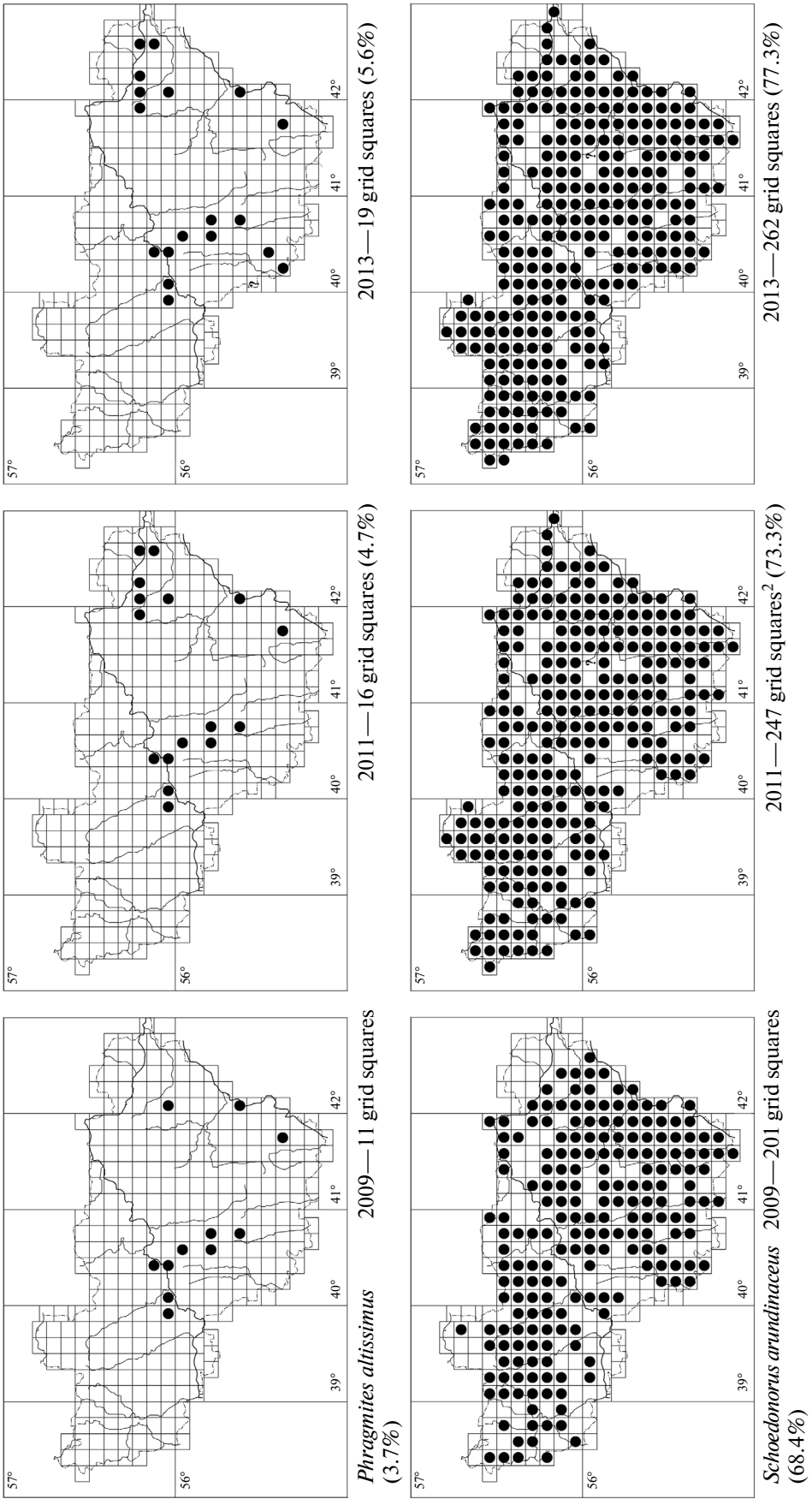



**Fig. 2.** Contd.

[2] In *Flora* (Seregin, 2012), 260 grid squares were indicated by mistake.

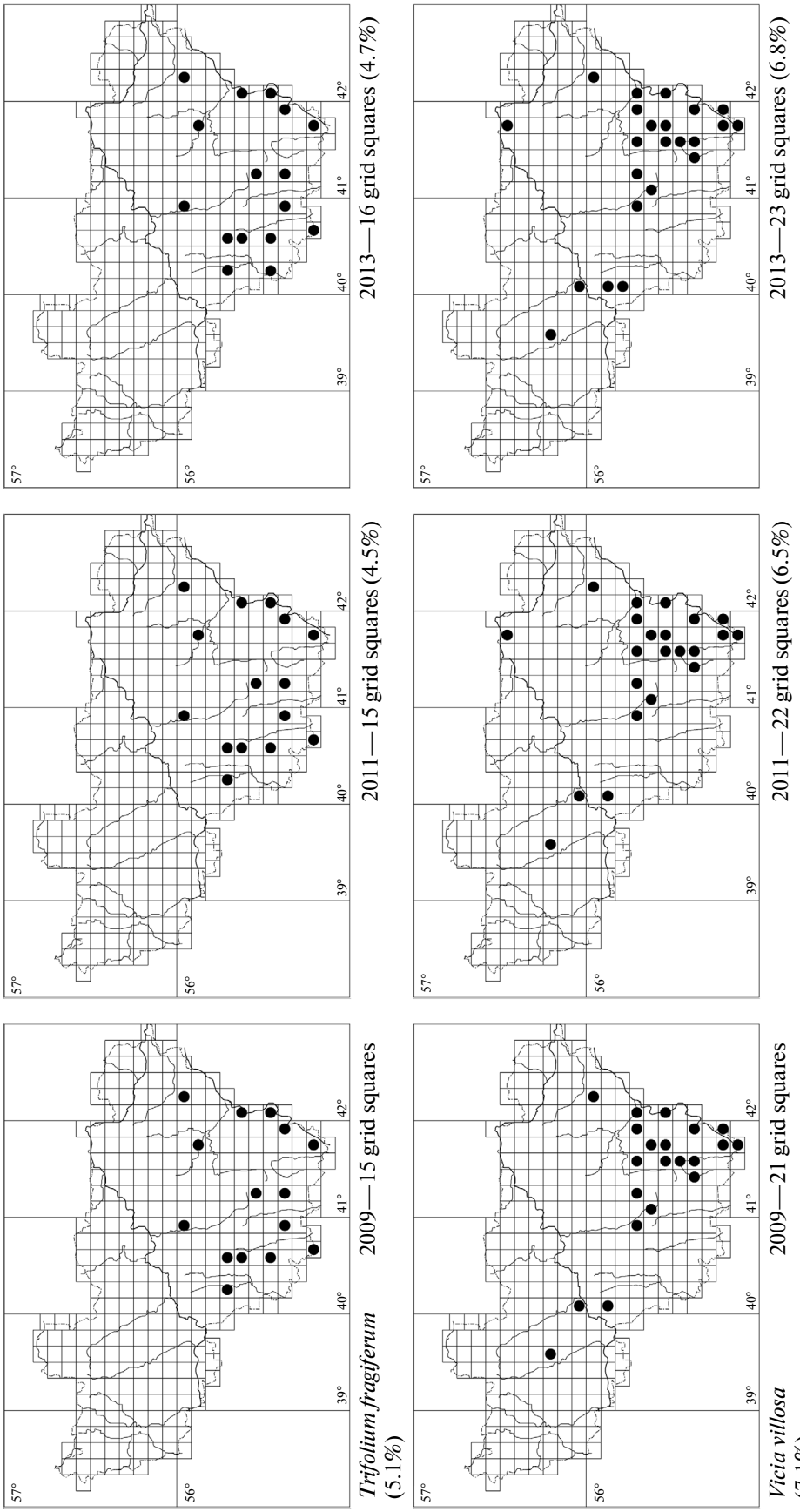

Trifolium fragiferum (5.1%)
2009—15 grid squares
2011—15 grid squares (4.5%)
2013—16 grid squares (4.7%)
Vicia villosa (7.1%)
2009—21 grid squares
2011—22 grid squares (6.5%)
2013—23 grid squares (6.8%)
57°
56°
39°
40°
41°
42°

**Fig. 2.** Contd.

In the Meshchera National Park, the species was found at two localities in 2012. In one case ("Enthusiast" holiday village), I clearly detected that the mass self-production of the species and its invasion began from a garden culture; in another case (Tyurvishchi), I failed to identify the initial source of seeds (Seregin, 2013).

In total, the species was recorded by the end of 2013 from 14 grid squares (4.1%) in the six municipal districts of the oblast (Yuriev-Polsky, Vyaznikovsky, Kirzhachsky, Sudogodsky, Muromsky, and Gus-Khrustalny). The long-distance dispersal of the species and its further expansion in the region is certainly possible.

In Moscow oblast, successful reproduction of the species was detected in old manor parks (Mayorov et al., 2013); in Tver oblast, it was recorded in a manor park and two localities along railways (Notov, 2009: "the active formation of seedlings and expansion along the bed of the railway were detected").

*Amelanchier × spicata (Lam.) K. Koch*

Specimens studied: (1) Kameshkovsky District, E17, Novki-2 station, Aug. 19, 2000, A.S., no. 552 (MW); (2) Petushinsky District, L3, Pokrov, Aug. 1, 2001, A.S., M. Shilov, no. 758 (MW); (3) Gus-Khrustalny District, S2, Mezinovsky, June 10, 2002, A.S., I. Privalova, no. 1210 (MW); (4) Gus-Khrustalny District, S3, Okatovo station, Aug. 25, 2002, A.S., no. 1833 (MW); (5) Kovrovsky District, D20, Klyazminsky Gorodok, July 8, 2006, A.S., no. 2586 (MW); (6) Kovrovsky District, D21, Kariki, May 18, 2007, A.S., no. 2995 (MW); (7) Petushinsky District, M3, Lake Ershevik, June 26, 2007, V. Vinogradov (MW); (8) Yuriev-Polsky District, G9, Khvoynyi, Aug. 23, 2007, A.S., no. 3373 (MW); (9) Kirzhachsky District, K1, Melezhi, June 5, 2008, A.S., no. 3518 (MW); (10) Kameshkovsky District, Z15, Nesterkovo, May 27, 2012, A.S., no. 5200 (MW); (11) Gus-Khrustalny District, S2, Mezinovsky, July 14, 2012, A.S., no. 5276 (MW); (12) Gus-Khrustalny District, R1, Cherusti station—Struya platform, July 16, 2012, A.S., no. 5330 (MW); (13) Selivanovsky District, M17, Krasnaya Gorbatka, Aug. 3, 2013, A.S., no. 5822 (MW).

For the first time, the species was reported in the wild in Vladimir oblast from Patakino (Kazanskii, 1904, sub nom. *A. vulgaris* Moench)—this was one of the first casual records of the species in Central Russia (cf. Vinogradova et al., 2009). However, the species naturalized much later. Up to the 1980s, junberry was not known to the south of the Klyazma River in Vladimir oblast (Opredelitel'..., 1986), but in the mid-1990s it became a dominant species at some localities (I.V. Vakhromeev, personal communication).

In recent years, the stabilization of the number of grid squares where the species is known has occurred. At the end of 2007, the species was known in 40.2% of the studied squares, by the end of 2011 in 44.2%, and by the end of 2013 in 46.9%. Thus, the expansion of junberry is close to completion (its active phase stopped in the early 2000s). This statement could be supported by the fact that the species was recorded in 2002 in 26% of the studied "small squares" in the Meshchera National Park vs. 30% in 2012 (Seregin, 2004, 2013).

Junberry is widely cultivated in Middle Russia as a berry crop. It is easily spread by birds and successfully naturalized. Usually it grows in herbaceous pine forests and close to housing. Also, it forms dense stands on limestone outcrops. On the other hand, it is sometimes detected on roadsides and railway embankments and as a weed on rough ground in populated areas. At the moment, the area of *A. spicata* expansion in the region can be divided into two sectors (see map). The western sector occupies the Meshchera Lowlands, Klin-Dmitrov Ridge, the northwest of Opolye, and the terraces of the Klyazma River above Vladimir. The eastern sector includes Nerl District, Oka-Tsna Ridge, Lower Oka District, and Frolishcheva Lowland. These two sectors are separated by the narrow strip of Opolye, Sudogda Upland, and the eastern edge of the Meshchera Lowlands, where the species is rare.

*Bidens frondosa L.*

Specimens studied: (1) Sobinsky District, K11, Vladimir City detour road, Aug. 4, 2000, A.S., no. 434 (MW); (2) Vladimir, I13, the Klyazma River, Aug. 5, 2000, A.S., no. 450 (MW); (3) Petushinsky District, L3, Pokrov, Aug. 1, 2001, A.S., M. Shilov, no. 742 (MW); (4) Gus-Khrustalny District, S1, Tasino, Aug. 8, 2002, A.S., no. 1669 (MW); (5) Kovrovsky District, J18, Pervomaysky, Sept. 1, 2003, A.S., no. 1988 (MW); (6) Suzdalsky District, D13, Suzdal, Sept. 3, 2003, A.S., no. 2000 (MW); (7) Muromsky District, S12, Panfilovo, Sept. 10, 2006, A.S., Yu. Kokoshnikova, and O. Miroshnik, no. 2898 (MW); (8) Kirzhachsky District, Z5, Vlasevo, Aug. 25, 2007, A.S., A. Khokhlov, no. 3383 (MW); (9) Sobinsky District, M6, Shepeli, Aug. 6, 2008, A.S., no. 3715 (MW); (10) Vyaznikovsky District, J26, Pochayka locality, the Lukh River, Sept. 25, 2010, A.S., S. Dudov, no. 4830 (MW); (11) Sudogodsky District, N13, Kostenets, Aug. 4, 2013, A.S., no. 5832 (MW).

In the City of Moscow, this plant was first recorded in 1976; in Moscow oblast, it was found three years later (Skvortsov, 1982; Makarov and Ignatov, 1983; Mayorov et al., 2013). In the 1980s, it quickly expanded along the rivers near Moscow (Ignatov et al., 1988), and in the 1990s, it reached Vladimir oblast. It was detected there in 1997 on the banks of the Klyazma River near Vladimir (Seregin, 1998). The history of the early stage of the species expansion in European Russia was described by Glazkova (2005).

During the first years after its penetration into the oblast, *B. frondosa* quickly expanded throughout the

river valleys, and for some time, it had a valley type of regional distribution—along the Oka, Klyazma, and some other major rivers (Seregin, 2012). I found this picture of valley distribution of the species in 2002 in the Meshchera National Park: "In the lower course of the Buzha River, shores of Lake Svyatoe, rarely in the secondary habitats. The species was recorded only in the southern part of the national park" (Seregin, 2004).

In the last seven or eight years mainly along roads and settlements, *B. frondosa* expanded in interfluves in Vladimir oblast (Seregin, 2012). This process *continues* even now: by the end of 2011, the species was observed in 134 grid squares (39.8%), and by the end of 2013, it was recorded in 154 squares (45.4%).

At the moment, *B. frondosa* has almost completely expanded over the territory of the Central Meshchera Lowlands, penetrating through suitable habitats (forest roads, valleys of rivers and streams) to the most distant areas of the lowlands. On the basis of the expansion rate and rapid growth of grid records, *B. frondosa* (11% of the studied grid squares in 2002 vs. 76% in 2012), in my opinion, is the most successful alien species in the flora of the Meshchera National Park over the ten-year period (Seregin, 2013). However, owing to the lack of suitable habitats, the species is still almost absent in the axial part of Oka-Tsna Ridge.

For Vladimir oblast, Papchenkov (2011) recorded hybrids like *B.* × *garumnae* Jeanj. et Debray (=*B. frondosa* × *B. tripartita*, including back hybrids with *B. frondosa*) and *B. frondosa* × *B. radiata*. I am not sure that the variability of *Bidens* is a result of the hybridization, although the reality of the *B. frondosa* × *B. radiata* hybrid seems to be confirmed (Vinogradova et al., 2013).

### *Cuscuta campestris Yuncker*

Specimens studied: (1) Suzdalsky District, D13, Suzdal, Sept. 3, 2003, A.S., no. 2023 (MW); (2) Gus-Khrustalny District, U2, Velikodvorsky, July 22, 2006, A.S., I. Privalova, no. 2715 (MW); (3) Selivanovsky District, M17, platform "47 km" of Murom–Kovrov railway, Aug. 22, 2009, A.S., no. 4372 (MW); (4) Kovrovsky District, D21, Kuvezino, July 18, 2011, A.S., no. 5062 (MW).

For the first time, the species was recorded from Vladimir oblast in 2003 (Seregin, 2006). *Cuscuta campestris* is associated mainly with highway areas; once it was found along a railway and on a village street. It was carried by motor transport from southern regions of European Russia. In the neighboring Ryazan oblast, large populations were observed in the floodplain of the Oka River (Opredelitel'..., 1987; MW), but *C. campestris* did not penetrate later into Vladimir oblast via the Oka valley. In some localities, it disappeared fast, but in my opinion, this was due to the constant disturbance of its habitats, rather than an inability to survive successfully for several seasons in the same place. For example, in Tver oblast in a single site of invasion, *C. campestris* remained for three years (Notov, 2009).

This noxious weed was detected in Vladimir oblast on *Polygonum* aggr. *aviculare*, *Erigeron canadensis*, etc. In total, it was detected in six grid squares (1.8%) in five municipal districts of the oblast (Suzdalsky, Kovrovsky, Sudogodsky, Gus-Khrustalny, and Selivanovsky). In the Moscow region, *C. campestris* was known by casual records since the late 1940s (Mayorov et al., 2013).

### *Galinsoga quadriradiata Ruiz et Pav. (G. ciliata (Raf.) S.F. Blake)*

Specimens studied: (1) Petushinsky District, L3, Pokrov, Aug. 1, 2001, A.S., M. Shilov, no. 748 (MW); (2) Gus-Khrustalny District, R2, Tasino, Aug. 8, 2002, A.S., no. 1683 (MW); (3) Kovrovsky District, J19, Kovrov, Aug. 29, 2003, A.S., no. 1941 (MW); (4) Gus-Khrustalny District, R4, Nechayevskaya, July 31, 2004, A.S., no. 2161 (MW); (5) Aleksandrovsky District, J4, Starovo, Aug. 24, 2006, A.S., no. 2776 (MW); (6) Petushinsky District, L7, Peksha, Aug. 20, 2011, A.S., no. 5072 (MW).

The species was already known in the City of Moscow upon collections of 1922–1923 (Mayorov et al., 2013), but it penetrated into Vladimir region much later. For instance, it was not recorded for the region in the Opredelitel'... (1987), although by this time in the Moscow Meshchera the species was "fairly widely distributed, especially in the vicinity of Moscow". For the first time, *G. quadriradiata* was recorded in Vladimir oblast in 1995 on lawns and roadsides in the City of Kovrov (Vakhromeev, 2000), and it was considered to be very rare for some time (Vakhromeev, 2002) despite the fact that in the early 2000s the species began to occur regularly in cities (on lawns and in flowerbeds) and near suburban holiday villages.

By the end of 2007, this plant was recorded in 8.6% of the studied grid squares, by the end of 2011 in 10.7%, and by the end of 2013 in 11.5%. At the moment, it is reported from almost all districts (except Yuriev-Polsky, Vyaznikovsky, and Muromsky). It grows as a weed in gardens and flower beds, as well as on urban lawns, on landfills, and in vegetable gardens and trash heaps on the outskirts of suburban settlements.

It is interesting to compare the ten-year dynamics of two species of *Galinsoga* known in Vladimir region (*G. parviflora* and *G. quadriradiata*) within the Central Meshchera Lowlands (2002 vs. 2012). Both species were collected in the national park in 2002 once each, and they were also recorded in weedy places at Nechayevskaya station two years later. Despite the fact that *G. parviflora* was collected for the first time in Vladimir oblast in 1974, and *G. quadriradiata* only in 1995, both plants expanded throughout the region almost simultaneously. By the end of 2011, *G. parvi-*

*flora* was found in 16.3% of grid squares, and *G. quadriradiata* in 10.7% (Seregin, 2012). However, some changes took place in 10 years with distribution of *Galinsoga* in the Central Meshchera: in 2012, *G. parviflora* was recorded in a majority of the studied settlements (26% of grid squares), while *G. quadriradiata* was found only once—it still exists at Nechayevskaya station (Seregin, 2013).

Thus, one can see now a stabilization in number of *G. quadriradiata* localities, while *G. parviflora*, which has existed in the area for at least 40 years, continues to expand and its occurrences are more frequent. Interestingly, *G. quadriradiata* occurs much more frequently than *G. parviflora* in the more urbanized Moscow region, especially on "fertile and fresh soils" (Mayorov et al., 2013); in Tver oblast, *G. quadriradiata* also dominates (Notov, 2009).

### *Nuttallanthus canadensis (L.) D.A. Sutton (=Linaria canadensis (L.) Dum. Cours.)*

Specimens studied: (1) Gus-Khrustalny District, T1, Tyurvishchi, June 12, 1995, V. Tikhomirov, A. Sukhorukov, and E. Mironov, no. 14863 (MW); (2) Gus-Khrustalny District, S2, Chaslitsy, June 18, 1995, A. Devyatov, S. Polevova, no. 14864 (MW); (3) Gus-Khrustalny District, N6, Bolshiye Ostrova, July 4, 2002, A.S., I. Privalova, nos. 1339–1341 (MW, MHA); (4) Sobinsky District, M8, Anfimikha, July 5, 2002, A.S., I. Privalova, no. 1355 (MW, MHA); (5) Sobinsky District, M8, Aserkhovo, the Buzha River, Aug. 4, 2011, A.S., no. 5014 (MW); (6) Melenkovsky District, U7, Sokolye, Volkovskoye peat bog, Sept. 2, 2009, A.S., no. 4398 (MW, LE); (7) Gus-Khrustalny District, S3, Kurlovo, July 22, 2012, A.S., no. 5403 (MW); (8) Gus-Khrustalny District, R3, Mezinovskiye peat mining, Aug. 1, 2012, A.S., A. Vozbrannaya, no. 5504 (MW); (9) Sobinsky District, N5, an isthmus between Baksheyevskiye and Ostrovskiye peat minings, Aug. 10, 2012, A.S., no. 5571 (MW).

A good example of a documented history of recent invasions in Vladimir oblast is the gradual expansion of Canadian toadflax on formerly mined (and now abandoned) peatlands. This species has been known in the peatlands near Moscow at least since 1894 (Petunnikov, 1900; Mayorov et al., 2013), but until the second half of the 20th century, it remained a very rare plant. Active development of the vast peatlands was favorable for wide expansion of the species in the east of the Moscow Meshchera (Opredelitel'..., 1987), from where it arrived to Vladimir oblast. Here, the species was recorded for the first time in 1995 at two sites in the Meshchera National Park by students of the Moscow State University during summer field practice (Tikhomirov, 1997). In 2002, we found it in the north of the national park on Ostrovskoye peat bog in another two "small squares" and obtained data on its presence on Garinsky peat bog (Seregin, 2004). Even then, it was clear that species was expanding along the bare sand of forest roads adjacent to the peatlands. By the end of 2011, seven "large squares" where *N. canadensis* was recorded were known in Vladimir oblast (in three municipal districts) (Seregin, 2012).

In 2012, during the repeated grid mapping of the Central Meshchera, the species was recorded in 23% of "small squares" (compared to 9% in 2002). In the northern part of the park, it was found in all squares adjacent to Ostrovskoye and Baksheevskoye peat bogs. Now habitats of Canadian toadflax are not as much peatlands as sandy forest roads and firebreaks.

Thus, the species is known in 15 grid squares within three districts (most likely, the species will be also recorded in Petushinsky and Sudogdsky Districts). All localities are situated within the Meshchera Lowlands. The species also can be found in Ryazan oblast where it is still unknown, as the nearest known localities are situated within 5 km from its borders.

In the City of Moscow, it is confined to fresh urban lawns covered with peat mixtures (Mayorov et al., 2013; observations of the author). In Vladimir oblast, it is strictly confined to the former sites of peat mining and the adjacent forest roads.

### *Poa supina Schrad. (=Ochlopoa supina (Schrad.) H. Scholz et Valdés)*

Specimens studied: (1) Aleksandrovsky District, G4, Balakirevo, May 25, 2011, A.S., P. Kołodziej, no. 4912 (MW, LE); (2) Aleksandrovsky District, G4, Ryuminskoye, May 25, 2011, A.S., P. Kołodziej, no. 4923 (MW, LE); (3) Aleksandrovsky District, E2, Strunino, July 20, 2011, A.S., no. 4940 (MW); (4) Aleksandrovsky District, D1, [Verkhnie] Dvoriki, Sept. 10, 2011, A.S., L. Abramova, no. 5109 (MW); (5) Kameshkovsky District, Z15, Karyakinskaya railway platform, May 27, 2012, A.S., no. 5204 (MW); (6) Aleksandrovsky District, E3, Aleksandrov, Aug. 7, 2013, A.S., no. 5844 (MW); (7) Aleksandrovsky District, Z2, Zhuklino, Sept. 8, 2013, A.S., no. 5886 (MW); (8) Kirzhachsky District, K1, Ratkovo, Sept. 9, 2013, A.S., no. 5898 (MW).

Being abundant in the Moscow region, this plant was first recognized in Vladimir flora only in 2011; in the same year, we found mass distribution of the species in the west of Aleksandrovsky District (within the Klin-Dmitrov Ridge) on the border with Moscow oblast (Seregin, 2012). Today the creeping meadow-grass is known from 9 grid squares (2.7%). Outside Aleksandrovsky District, *P. supina* was found twice: in the Left Bank Meshchera (Kirzhachsky District) and on the loamy right bank of the Nerl River (Kameshkovsky District).[2]

The main habitats of *P. supina* are trails and rarely used ground roads in the spruce and deciduous forests;

[2] Probably, this species was also recorded in the Druzhba forest park near Vladimir in 2011.

it is much less common in the field roads and village streets on heavy clay soils. Due to vegetative reproduction, it forms extensive clones that cover narrow clearings and forest roads with a uniform green carpet especially near the old holiday settlements.

According to Mayorov et al. (2013), in the neighboring localities near the City of Moscow, the species was first discovered in 1891 and after that quickly spread throughout Moscow oblast (Skvortsov, 1973), mainly along forest roads and trails in the spruce forests. Keeping in mind the species abundance in Vladimir oblast, I could assume that early 2000s is not the first decade of existence of *P. supina* here. Most probably, it was overlooked due to short period of blooming. However, the species is easily recognizable in a vegetative state, especially in the specific ecotopes. Definitely, new records will follow in the western districts of the oblast (Aleksandrovsky, Kirzhachsky, Kolchuginsky, and Petushinsky).

In Tver oblast, the species is considered to be very rare (Notov, 2009); it still has not been found in Yaroslavl and Ivanovo oblasts (cf. Alekseev in Maevskii, 2006, and subsequent publications on the flora of these regions), despite its undoubted occurrence there.

### *Rosa villosa L.*

Specimens studied: (1) Selivanovsky District, O11, 5 km from Malyshevo to Krasnaya Gorbatka, Aug. 7, 2009, A.S., no. 4274 (MW); (2) Kameshkovsky District, J16, Patakino, July 28, 2013, A.S., no. 5744 (MW); (3) Selivanovsky District, M15, Skalovo, Spasskoye locality, July 29, 2013, A.S., nos. 5759, 5760 (MW); (4) Selivanovsky District, L17, Rastovets locality, July 31, 2013, A.S., no. 5785 (MW); (5) Selivanovsky District, L18, Matveyevka, Aug. 2, 2013, A.S., no. 5802 (MW).

In Vladimir oblast, this species was first recorded a long time ago (Kazanskii, 1912): "In the overgrowth of the abandoned park near Kizhany in several places with fruits. Since that park existed 50 years ago, the presence of these plants to date shows their extreme ability to survive." In 2009, 100 years later, one bush was found in Selivanovsky District on the roadside. Two casual records did not provide a ground to believe that *R. villosa* can naturalize in Vladimir oblast (Seregin, 2012), but the field data of 2013 completely changed my views on degree of its naturalization.

First, I was able to confirm the record of the species in Kameshkovsky District. Two bushes 0.6–0.7 m high were found in the broadleaf forest in the upper part of the steep valley slope of the Klyazma River in the old manor park near Patakino (today it is the Patakinskaya Grove nature sanctuary). This location is just a couple of kilometers away from the place where *R. villosa* was found by N.A. Kazanskii. It became clear that the species could successfully exist in the old manor parks for at least a century.

Then *R. villosa* was discovered in the Kolp River valley (tributary of the Ushna River) in Selivanovsky District. It forms stable populations in the fallow lands near the former and current settlements, as well as on meadow slopes of the Kolp River valley. All large shrubberies are located in areas with a close bedding of carbonic limestones of the axial zone of the Oka-Tsna Ridge, entrenched by the Kolp River. From these habitats, it expanded along forest roads and highways to the surrounding area, including the locality where the single bush was found in 2009.

The nearest native locations of the species are associated with carbonates of the Central Russian Upland (Tula, Moscow, and Ryazan oblasts). Most probably, the locations along the Kolp River are the result of the species introduction as a traditional decorative culture of front gardens. Later, it successfully spread in suitable habitats without human care. The argument in favor of the introductory origin of the Kolp population is the fact that the species grows in meadow areas that are entirely resulted from the economic development of the area. The Kolp River valley, starting with the studies of Shilov (1995), was the subject of intense study by Vladimir botanists performed in order to create the Kolp Reserve. Unexplainably, there were no data on occurrence of *R. villosa* here before now.

Thus, today one can see the complete naturalization and the continuing expansion of the species in the Kolp River basin. The species is known in at least seven grid squares (2.1%) in two municipalities of Vladimir oblast. Its further expansion in the region will be limited to the area in which the Oka-Tsna Ridge is entrenched by the river valleys, primarily by the Ushna River and the Tara River.

In Moscow region, it is considered to be a rare alien plant, and the evidence of its naturalization here is absent (Mayorov et al., 2013); in Tver oblast, an active seed expansion of the species from the old manor parks was detected (Notov, 2009).

### *Rumex stenophyllus Ledeb.*

Specimens studied: (1) Gus-Khrustalny District, S3, 7 km east from the Torfoprodukt station, railway, Aug. 5, 2002, A.S., no. 1612 (MW); (2) Kirzhachsky District, Z3, Bel'kovo station, railway, Aug. 27, 2006, A.S., no. 2828 (MW); (3) Selivanovsky District, N15, Novlyanka, railway, July 30, 2009, A.S., no. 4192 (MW); (4) Muromsky District, O12, 27 km mark of Murom–Kovrov railway, Aug. 9, 2009, A.S., no. 4289 (MW); (5) Muromsky District, O13, 19 km mark of Murom–Kovrov railway, Aug. 9, 2009, A.S., no. 4297 (MW); (6) Selivanovsky District, M17, 46 km mark of Murom–Kovrov railway, Aug. 22, 2009, A.S., no. 4371 (MW); (7) Vladimir, I12, 2 km mark of Tuma railway, July 30, 2011, A.S., no. 5007 (MW); (8) Petushinsky District, L6, highway M-7, Yuchmer junction, Aug. 22, 2011, A.S., no. 5090 (MW).

The species was first recorded in Vladimir oblast in 2002 at two sites along the Kazan railway (Seregin, 2003). In 2009, it was abundant on the bed of the Kovrov–Murom railway (especially a lot between Selivanovo station and "10 km" platform), although the plants were depressed. However, this did not affect the successful seed production (Seregin, 2012). In 2011, the plant was first recorded far from the railways—along the M-7 highway.

In the Moscow region, the species was first recorded in 1934 and, with few exceptions, preferred railways and urban lawns (Mayorov et al., 2013). In Tver oblast, it is also considered to be a "railway plant", and in places of invasion, it does not survive for a long time (Notov, 2009).

The widespread use of salt for the treatment of highways during recent winters led to the penetration of some southern plants along the main highways into Vladimir oblast. For example, almost all recent localities of *Trifolium campestre* and *Puccinellia distans* are associated with salted roadsides. In the last few years, along the highways of southern direction, such halotolerant plants as *Bolboschoenus maritimus*, *B. planiculmis*, *Eleocharis uniglumis*, *Pulicaria vulgaris*, *Trifolium fragiferum*, and *Lythrum virgatum* were recorded. *Rumex stenophyllus* is also a species of similar ecology.

In total, *R. stenophyllus* is known at the end of 2013 in nine grid squares (2.7%) in six municipal districts. It was recorded on four railway branches (Kovrov–Murom, Kazan, Moscow Detour, and Tuma railways) and a highway. In spite of the active treatment of railways with herbicides, there definitely will be new records of the species.

### *Zizania palustris L.*

Specimens studied: (1) Muromsky District, N16, Molotitsy, Aug. 13, 2009, A.S., no. 4306 (MW); (2) Gus-Khrustalny District, U5, Talanovo, Sept. 4, 2009, A.S., no. 4408 (MW); (3) Petushinsky District, M3, Klyazminsky, Aug. 25, 2010, A.S., no. 4760 (MW); (4) Sobinsky District, M8, Aserkhovo, Aug. 4, 2011, A.S., no. 5013 (MW).

This North American alien was cultivated in hunting grounds as a fodder plant for waterfowl. Around Moscow, it has been known since 1959 (Mayorov et al., 2013). The species was mentioned for Vladimir oblast in Opredelitel'... (1986), but with no precise indications or herbarium collections cited. The first accurate information from the group of researchers headed by M.P. Shilov for Lakes Isikhra and Suekhra pertains to 1998 (Pavlovskaya et al., 1998; Koptseva et al., 1998).

Vakhromeev (2001) discovered *Zizania* in two places in Kovrovsky District. Later on, he described the distribution of this plant in Vladimir oblast on the basis of these records as follows: "All districts. Vigorously spreading plant. A frequent species" (Vakhromeev, 2002). However, he hastened to declare that *Zizania* is a "frequent" plant. As for two years ago (Seregin, 2012), we have to state that the rate of expansion of *Z. palustris* is low, and in most areas of Vladimir oblast, it is still unknown. It was found in the shallows of ponds, reservoirs, lakes, and flooded fields of former peat mining. Surprisingly, the plant has yet to be found in any (!) watered peat mining fields in the Meshchera National Park despite the availability of suitable habitats. Thus, when the species is introduced into a water body, it probably with great difficulty inhabits the neighboring areas.

In total, the species is known in eight grid squares (2.4%) within five municipal districts (Kovrovsky, Petushinsky, Sobinsky, Gus-Khrustalny, and Muromsky). In each square, the species was detected only in one water body with the exception of the square M8 (Sobinsky District), where *Z. palustris* was found on the shores of several flooded peat fields to the south of Aserkhovo.

Recently, for some reasons, in the Russian literature, *Z. palustris* was synonymized with *Z. aquatica* (Alekseev in Maevskii, 2006; Notov, 2009; Mayorov et al., 2013). These two Linnaean species from the New World in North American floras were always treated separately, and I have no reason to combine them in *Z. aquatica* s. l. in Middle Russia.

In Moscow oblast, a similar *Z. latifolia* (Griseb.) Turcz. ex Stapf is more widely distributed than *Z. palustris* (Mayorov et al., 2013), but in Vladimir oblast, it still has not been recorded. In Tver oblast, *Z. latifolia* also naturalized much more successfully and there is some evidence on complete loss of *Z. palustris* from some localities, since "in former plantations the species often was outcompeted by other aquatic plants" (Notov, 2009).

## DISCUSSION OF THE DYNAMICS OF SPECIES REVIEWED IN THE FIRST REPORT (SEREGIN, 2010)

In the first report on the latest expansions (Seregin, 2010), I reviewed the dynamics of the following species since the first record within Vladimir oblast: *Epilobium tetragonum* L., *Hypochoeris radicata* L., *Ambrosia trifida* L., *Erigeron huelsenii* Vatke (*E. droebachiensis* auct.), *Aronia mitschurinii* A.K. Skvortsov et Maitul., *Trifolium fragiferum* L., *Phragmites altissimus* (Benth.) Mabille, *Schedonorus arundinaceus* (Schreb.) Dumort. (*Festuca arundinacea* Schreb.), *Vicia villosa* Roth, *Galega orientalis* Lam.

For each plant, I compiled the grid map of distribution based upon data of the end of 2009. In *Flora* (Seregin, 2012), grid maps for these species were supplemented with records of 2010 and 2011. Now, we also have the data for the next two-year period (2012–2013). Thus, I have compiled a series of three grid maps for each species showing the expansion of these plants over the last four years (Fig. 2).

All floristic descriptions of grid squares in 2012–2013 repeated the former ones, and therefore I can confidently state that the species for which the number of grid records at the end of 2011 and 2013 is almost the same have so far completed the "extensive" period of their expansion in the oblast. For instance, *Hypochoeris radicata*, *Trifolium fragiferum*, *Vicia villosa*, and *Galega orientalis* were newly recorded only in one or two grid squares in the past two years. Their populations in Vladimir oblast are now stabilized. On the contrary, I observed further expansions of *Epilobium tetragonum*, *Aronia mitschurinii*, *Phragmites altissimus*, and *Schoedonorus arundinaceus* throughout the region, but in each case they had various intensity.

Thus, amazing rapid invasion of *Epilobium tetragonum* continued on fallow fields and disturbed meadows. Probably, I failed to pinpoint the exact time of penetration of *E. tetragonum* in Vladimir oblast, but the progress in the number of new grid records is impressive. Now this plant, first recorded in the oblast only in 2006, is already known in 27.7% of grid squares! In the Meshchera National Park, *E. tetragonum* was found in 2012 in 36% of "small squares". It is most amazing that, it still remains unrecognized in some neighboring areas or in old fashion is considered to be a rare species of fens.

*Aronia mitschurinii* is another example of an actively expanding species. It should be noted that, due to the fact that the Russian breeder I.V. Michurin used American chokeberry and common mountain ash to produce this species (Skvortsov and Maytulina, 1982; Skvortsov et al., 1983; Leonard, 2011), Sennikov and Phipps (2013) proposed to assign this plant to the nothogenus ×*Sorbaronia*. This avichorous species was first recorded in wild in Vladimir oblast in 2002, in a single place in the Meshchera National Park (Seregin, 2003, 2004). In 2012, *A. mitschurinii* was already recorded in the Central Meshchera in 43% of grid squares (Seregin, 2013). It grows in damp and marshy pine forests, in overgrown peatlands and fallow lands, and along the banks of water bodies, although it still remains close to housing and roads. *Aronia mitschurinii* well grows on acid substrates, thereby successfully expanding throughout the Meshchera Lowlands.

*Phragmites altissimus* was detected in a small number of new localities across Vladimir oblast. Although an increasing rate of new records remains stable, the dispersal of diaspores (i.e. fragments of stems or rhizomes) cannot promote rapid mass invasion. This species has only vegetative propagation, gradually spreading in the sites of initial establishment. Shvetsov et al. (2007) suggested several ways of the species dispersal into Central Russia from the south. The most constant source of rhizomes, in my opinion, is "mats" of cane used for the transportation of melons from the Lower Volga region, but it is certainly not the only way. In the Meshchera National Park, *P. altissimus* was found in 2012 in four localities—two times along highways, once near the railway, and once near the stockyards in Demidovo. Guards of the national park reported that in the latter locality the cane occupied the former silo bunker. In the 1970s–1980s, the Meshchera livestock was not provided with adequate fodder supply. In this regard, the brigades of Vladimir countrymen went for grass mowing in the Volga–Akhtuba floodplain. This green mass then was stored for silage. Now the Demidovo population of the "Astrakhan cane" is represented by one clone covering an extensive area of about 1500 $m^2$ (Seregin, 2013).

New records of *Schedonorus arundinaceus* are continued—almost all of them are confined to the squares visited in the late 1990s to early 2000s. On the basis of the expansion rate and the explosive growth of the grid records, the species was regarded as "the most successful invasive species in the flora of Vladimir oblast" (Seregin, 2010), and now it is known in 77.3% of grid squares. It is interesting that according to the number of grid records it is the leader among the alien species (xenophytes) of the "new wave", second only to such "old" aliens as *Erigeron canadensis* L., *Juncus tenuis* Willd., *Matricaria discoidea* DC., *Epilobium adenocaulon* Hausskn., and *Lupinus polyphyllus* Lindl. (Seregin, 2014).

*Erigeron* × *huelsenii*, which I previously treated under the name *E. droebachiensis* auct. (Seregin, 2005, 2010), is not an enigmatic endemic of Fennoscandia, but the hybrid of local *E. acris* and alien *E. canadensis*. However, despite the widespread distribution of both parental species in Europe, this hybridogenic taxon is considered to be rare. Thus, it was reported for Great Britain (Stace, 1997), Belgium (Verloove, 2014), Germany (Prasse et al., 2001), and a number of Russian regions (Seregin, 2005; etc.). Thereby, the "expansion" of this hybrid cannot be discussed, because most often it is produced *de novo* in sites where both parents occur. British authors, for example, consider hybrids of local and alien species as elements of local flora (e.g., Stace, 2010). Often, the species is represented by a single individual; however, *E.* × *huelsenii* produces fertile seeds in Vladimir oblast, and sometimes forms large progressive populations. In the Meshchera National Park in 2002, the species was not known, whereas in 2012 it was discovered in ten squares (13%) (Seregin, 2013).

A dangerous noxious weed *Ambrosia trifida* was recorded in 2010–2013 in another three squares and again in Gus-Khrustalny District (Seregin, 2012, 2013). Thus, we have to admit that a large maternal population of the species (probably the one that is located in the City of Gus-Khrustalny), despite the activities undertaken for its eradication (Nagornyi, 2010), continues to exist and gives rise to new populations. For instance, small populations of *A. trifida* were found in 2012 near municipal garbage bins in Kurlovo and on the edge of a village street in Mokroye.

## CONCLUSIONS

Almost all abovementioned species were first discovered in Moscow or nearby Moscow and penetrated to Vladimir oblast later. The main reason for this is a more intense economic development of the Moscow region, and only partly the absence of a continuous floristic observations in Vladimir oblast in the past. This is supported by the fact that these ten species spread mainly within the Oka-Klyazma interfluve—the area which was actively studied until the mid-1980s by the Meshchera expedition of the Moscow State University supervised by V.N. Tikhomirov. In the *Manual for the Identification of Meshchera Plants* (Opredelitel'..., 1986, 1987), published as a result of these studies, none of the abovementioned species were reported from Vladimir oblast. For the more developed eastern part of Moscow oblast, this reference includes the following records: *Amelanchier* × *spicata*, *Bidens frondosa*, *Cuscuta campestris*, *Galinsoga quadriradiata*, *Nuttallanthus canadensis*, *Poa supina*, *Rumex stenophyllus*, *Zizania palustris*.

The scale of the expansion of the abovementioned species within Vladimir oblast varies significantly. On the basis of current distribution, dynamics of new records, and environmental preferences of species, we can make a cautious forecast on the further expansion of these species in the very near future.

In Vladimir oblast, the obvious examples of limited expansions are the invasions of *Nuttallanthus canadensis* and *Rosa villosa*. Both species have a clear environmental confinement to dystrophic substrates (peat, bare sand) and calcareous soils, respectively; therefore, these species have a limited distribution in Middle Russia. However, in places where these species meet suitable soil conditions, they perfectly naturalize. Their further expansion will occur only within the similar landscapes, but the "island" character of suitable habitats objectively will not contribute to it. On similar reasons, wide expansion of *Zizania palustris* may occur in a distant future.

New records of *Rumex stenophyllus* and *Cuscuta campestris* will be continued on the edges of the main highways (and partly along railways). *Galinsoga quadriradiata* will expand more "uniformly" throughout the region near the settlements, but its wide expansion is limited to landscapes of the "Meshchera" type with poor sandy soils.

The number of *Amelanchier* × *spicata* records is unlikely to increase significantly, as figures show the stabilization in the number of known localities. Another species which escapes from cultivation is *Acer tataricum*, it rarely goes away from places of cultivation, and therefore its dispersal is likely to be limited. Low activity of the species is also reported in the neighboring Moscow region (Mayorov et al., 2013).

Following *Schedonorus arundinaceus*, *Bidens frondosa* can expand almost everywhere in Vladimir region. In any case, the flywheel of its expansion continues to unfold, and it could outcompete the native *B. tripartita*, one of the 100 most common species of the region.

Finally, *Poa supina* is already an apparently widespread in forests in the west of the region, especially near suburban villages and towns. The further identification of its localities will demonstrate the real picture of its expansion. However, casual records in other parts of the region will follow.

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*Translated by V. Mittova*