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Three Maples (*Acer* L., Aceraceae Juss.) in the Republic of Mordovia, Russian Federation

Introduction

Genus *Acer* L. (Maple) includes a large number of species distributed worldwide, but especially in the northern hemisphere. Maples are deciduous trees from 12 m to 35 m in height, rarely evergreen or sometimes shrubs (Morselli, 1989). Classically this genus is considered belonging to the Aceraceae Juss. family (Dicotyledoneae) (Takhtajan, 1987; Cronquist, 1988; Cherepanov, 1995). However, in recent time many studies using pollen morphology (Müller, Leenhouts, 1976), biochemistry of plants (Umadevi, Daniel, 1991) and molecular sequence data (Gadek et al., 1996; Savolainen et al., 2000; APG III, 2009; Buerki et al., 2009) confirm inclusion of this genus into the Sapindaceae s. lato. There are up to 148 wild or cultivated *Acer* species widely distributed throughout North America, Eurasia and North Africa (Olson et al., 1974).

Republic of Mordovia is located in Central Russia. Its territory lies on the border of the forest and forest-steppe zones in Central Russia. Eastern part of the Republic of Mordovia covers the north-west of the Volga Upland, and its western part is located on the west of the Oka-Don Lowland. Therefore, high habitats diversity is observed within this area. Coniferous and mixed forests are distributed in the west and north-west Mordovia. Broad-leaved forests are located in the central and eastern parts of the region. Forest-steppe landscapes dominate in the east and south-east of Mordovia (Yamashkin, 1998, 2012).

Within Mordovia four maple species are known. *A. platanoides* L. is widely distributed species which inhabits plant communities of broad-leaved and mixed forests (Silaeva et al., 2010). *A. campestre* L. (Field maple) is vulnerable maple species which is on the north-eastern border of its range in the Republic of Mordovia (Utorova et al., 2014). It is known in six districts (Insar, Kadoshkino, Kovylkino, Kochkurovo,

and Ruzaevka district, as well as in neighborhoods of Saransk). *A. campestre* is included in the regional Red Data Book (*Resolution of the Government…*, 2015). *A. tataricum* L. (Tatarian maple) is species distributed in Mordovia sparsely, as well as in adjacent regions. It is known predominantly within floodplain broad-leaved forests from 13 districts of the Republic of Mordovia. There is a lack of data on the favorable environmental conditions for *A. tataricum* existing. *A. negundo* L. (Ash-leaved maple) is alien species known in all districts of Mordovia (Silaeva et al., 2010), as well as in all adjacent regions. This tree species is aggressive invasive plant included in the Black Data Book of Central Russia (Vinogradova et al., 2010). Better knowledge of ecology and biology of *A. negundo* is an important task in limiting its penetration into natural ecosystems within secondary range.

We aimed to investigate three maple species (*Acer campestre*, *A. tataricum*, *A. negundo*) in conditions of Central Russia on example of the Republic of Mordovia due to the lack of data on the ecology of these species in European part of Russia.

Material and methods

The field investigations were carried out following Aleksandrova (1964) and Khapugin et al. (2014). For *A. campestre* and *A. tataricum*, ecological conditions of habitats have been evaluated using the data on the ecological preferences of vascular plant species which grow with maples together. Distribution of plant species of the accompanying flora on the ecological groups in relation to water has been carried out according to the classification of Shennikov (1950) with separation of main groups (hygrophytes, mesophytes, xerophytes) and intermediate groups (hygromesophytes, mesohygrophytes, xeromesophytes, mesoxerophytes). Ecological scale proposed by Tsyganov (1983) has been used in distribution of plant species of the accompanying flora on the ecological groups in relation to the lighting/shading.

The field investigations of *A. campestre* populations were carried out in three locations of Kadoshkino district of Mordovia: Adashevo (53.925 N, 44.377 E), Latyshovka (53.961 N, 44.384 E) and Insar station (54.060 N, 44.310 E) in years 2013–2015 (Fig. 1). Within all locations, we established square plots (10×10 m) to investigate the accompanying flora and determine the forest's stand formula. Forest's stand formula has been determined as percent of individuals of forest stand in the canopy layer per 100 m^2 (area of one square plot). In Adashevo location and Insar station the total number of *A. campestre* individuals was counted. In Latyshovka we established close to each other 2 square plots (10×10 m) (Latyshovka 1 and Latyshovka 2) to investigate the number of 1-year-old *A. campestre* seedlings (seed reproduction). For this purpose, we established 10 study plots (1×1 m) within each of large (10×10 m) established plots. In Insar station we have counted number of age-bearing *A. campestre* individuals per 100 m^2.

The field investigations of *A. tataricum* populations were carried out in Bolshie Berezniki district of Mordovia (54.176 N, 46.181 E) in years 2014–2015 (Fig. 1). We established four square plots (10×10 m) in different habitats: floodplain meadow (plot 1), lime-pine forest (plot 2), floodplain broad-leaved forest (plot 3), and plant community with *A. negundo* dominance (plot 4). We investigated the number of *A. tataricum* individuals per established plot, composition of accompanying flora; forest stand formula was determined for each of studied plant communities. On the basis of the vascular flora of herb and shrub layers of studied plant communities, we calculated weighted mean (Diekmann, 2003) of environmental indicator values for several ecological factors (light, temperature, continentality, moisture, reaction pH, nutrient) according to Ellenberg et al. (2001). In this calculation, r_{ij} is the response of species *i* in sample plot *j*, and x_i is the indicator value of species *i*. Then, weighted mean of all values of those plant species presented in the plot was calculated to estimate the environmental indicator values for factors:

$$Weighted\ mean = \sum_{i=1}^{n} (r_{ij} * x_i) / \sum_{i=1}^{n} r_{ij}$$

The field investigation of *A. negundo* populations were carried out in Bolshie Berezniki district of Mordovia (54.176 N, 46.181 E) and on wasteland in Saransk (54.164 N, 45.150 E) in years 2014–2015 (Fig. 1). Within each of these localities, we

Fig. 1. Allocation of studied localities with *Acer* species in the Republic of Mordovia. Symbols: rhombs – localities with *Acer campestre* in Kadoshkino district: 1 – Insar station, 2 – Latyshovka, 3 – Adashevo; 4 (circle) – locality with *Acer tataricum* and *Acer negundo* populations in Bolshie Berezniki district; 5 (square) – locality with *Acer negundo* in Saransk

established 2 large square plots (5×5 m) to investigate the number of 1-year-old *A. negundo* seedlings (seed reproduction). For this purpose, we established 10 study plots (1×1 m) within each of large (25 m^2) established plots. The field investigations of *A. negundo* seed reproduction were carried out in established plot No. 4 for *A. tataricum* study (see above). The field investigations of *A. negundo* seed reproduction were carried out in the abandoned wasteland with ruderal vegetation in Saransk.

Statistical analysis was performed in MS Excel and PAST (Hammer et al., 2001).

Results and discussion

Acer campestre L. – Field maple

As the result of investigations, we found that number of *A. campestre* individuals per 1 plot in Adashevo widely varied from 8 to 115 different-age plants (240 in total). In Insar locality, this parameter was less variable – from 12 to 53 different-age individuals (163 in total). Mean values varied from 32.2 to 40 individuals per 1 established plot (Tab. 1).

Tab. 1. Number of *Acer campestre* individuals per 1 established plot

Parameter	Locality	
	Adashevo	Insar station
M	40.00	32.20
m	15.80	7.30
min	8.00	12.00
max	115.00	53.00

Note: M – mean value, m – error of the mean, min – minimal value, max – maximal value

Investigations of the number of *A. campestre* 1-year-old individuals in Latyshovka showed that this parameter varied from 8 (Latyshovka 1) to 31 (Latyshovka 2) individuals per 1 established plot (Tab. 2). In average the number of *A. campestre* 1-year-old individuals varied from 12 to 19.4.

Tab. 2. Number of 1-year-old individuals of *Acer campestre* per 1 established plot

Parameter	Locality	
	Latyshovka 1	Latyshovka 2
M	13.00	19.40
m	2.60	3.30
min	8.00	12.00
max	22.00	31.00

Note: M – mean value, m – error of the mean, min – minimal value, max – maximal value

However, seed reproduction is of little importance in maintaining of *A. campestre* populations in Mordovia since very few individuals of field maple reach the generative age (Utorova et al., 2014). This suggest with our results: only 11.7% (19 of 163) bearing-age individuals of *A. campestre* were found within established plots in the Insar station locality (Tab. 3).

Tab. 3. Characteristics of bearing-age individuals in *Acer campestre* population in the Insar locality

Number of plots	Number of bearing-age individuals (percentage of total number of individuals [%])	Average tree girth [cm]	Average tree diameter on the breast height [cm]
1	2 (5.10)	21.00	5.90
2	4 (10.50)	10.00	4.20
3	4 (33.30)	8.40	3.10
4	7 (13.20)	15.60	8.20
5	2 (9.50)	6.40	2.20

The lack of generative individuals in *A. campestre* populations is completely offset by an active vegetative propagation by root offsprings. As a result, the group arrangement of young individuals of *A. campestre* is observed around the parent individual (Fig. 2).

Ecological conditions of certain habitats with *A. campestre* could be assessed on the basis of ecological preferences of plant species of flora accompanying to this species. Table 4 includes data on the distribution of plant species of accompanying flora on ecological groups in relation of plants to water.

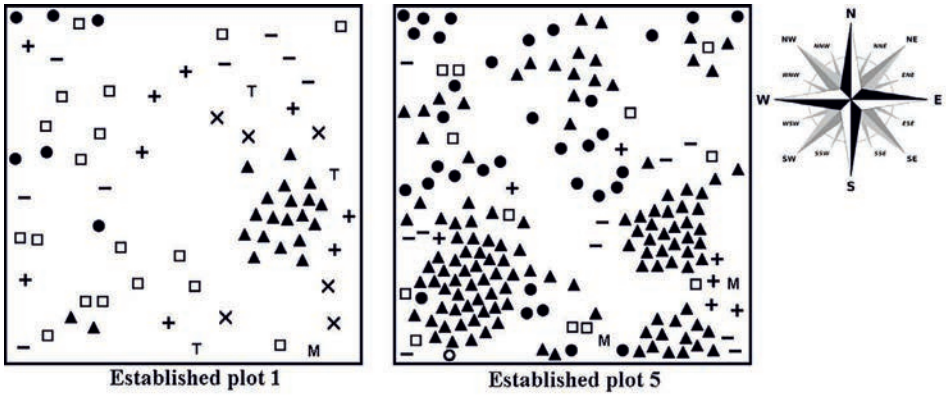

Fig. 2. Spatial arrangement of *Acer campestre* individuals amongst woody plant species at established plots 1 and 5. Symbols: ▲ – *Acer campestre*, ● – *Acer platanoides*, O – *Fraxinus excelsior* L., □ – *Tilia cordata* Mill., + – *Euonymus verrucosa* Scop., **M** – *Quercus robur* L., **T**– *Lonicera xylosteum* L., × – *Sorbus aucuparia* L., – – *Corylus avellana* L.

Table 4 shows that plant community with *A. campestre* has been formed in conditions of sufficient moisture. Such conditions are typical to the deciduous forests in the river valleys. As seen from table 4, mesophytes group includes the highest percentage of species (53.7%). Among them, there are *A. platanoides*, *Lathyrus vernus* (L.) Bernh., *Stellaria graminea* L. and others. Other ecological groups include less number of species.

Tab. 4. Ecological groups on the basis of relation of plants to water in plant community with *Acer campestre*

Ecological group	Number of species	Total number of species [%]
Mesophytes	36	53.70
Hygrophytes	9	13.40
Xeromesophytes	8	11.90
Mesohygrophytes	7	10.40
Mesoxerophytes	6	8.90
Hygrophytes	1	1.40
Total	67	100.00

Table 5 includes data on the distribution of plant species of the accompanying flora on the ecological groups in relation of plants to the lighting/shading. As seen in table 5, the group of shade-tolerant species dominates (65.6%). It includes such species as *Vicia sylvatica* L., *Milium effusum* L., *Lonicera xylosteum* L. and others. It indicates the significant shading in plant communities with *A. campestre*. However, group of light-demanding species includes 29.8% plants of the accompanying flora. Such situation is typical for deciduous forest exposed to anthropogenic pressure (Burova, Feklistov, 2007).

Tab. 5. Ecological groups of plants in relation to the lighting/shading in plant community with *Acer campestre*

Ecological group	Number of species	Total number of species [%]
Shade-tolerant	44	65.60
Light-demanding	20	29.80
Shade-demanding	3	4.40
Total	67	100.00

An ecological-coenotical characteristic of the flora, which is accompanying *A. campestre*, is presented in table 6 with distributing of plant species on several ecological-coenotical groups.

Tab. 6. Ecological-coenotical characteristics of the flora which is accompanying *Acer campestre* in the investigated plant communities

Ecological-coenotical group	Number of species	Total number of species [%]
Forest	43	63.80
Meadow	16	23.70
Weed	6	8.90
Forest swamp	2	2.80
Total	67	100.00

Species of forest group are predominant (63.8% of total species number) in the accompanying flora of investigated plant community with *A. campestre*. Among them, there are *Asarum europaeum* L., *Galium odoratum* (L.) Scop., *Platanthera bifolia* (L.) Rich. and others. Group of meadow species is located on the second place with 16 species (23.7%). Among them, there are *Campanula patula* L., *Stellaria graminea*, *Ranunculus acris* L. and others. Presence of meadow species indicates penetration of these plants through forest roads, cuttings, forest edges and clearings. They also contribute to the penetration weed plants (6 species; 8.9%) into the plant community with *A. campestre*. As a whole, the plant community with *A. campestre* is a typical broad-leaved forest, being under anthropogenic influence.

Acer tataricum L. – Tatarian maple

We investigated accompanying flora of each of 4 established plots in Bolshie Berezniki district. Established plot 1 was floodplain meadow plant community with high abundance of *Fragaria viridis* L. (19%), *Alopecurus pratensis* L. (8%), and *Carex praecox* Schreb. (6%). Established plot was located in lime-pine forest where *Urtica dioica* L. (5%), *Pteridium aquilinum* (L.) Kuhn. (4%), *Dryopteris carthusiana* (Vill.) H.P. Fuchs (3%), *Stellaria media* L. (3%) are dominant in herb layer; shrub layer was represented by *Rosa cinnamomea* L., *Euonymus verrucosa*, *Rubus idaeus* L., *Ribes nigrum* L. Established plot 3 was located in floodplain lime-oak forest with dominance of *Aegopodium podagraria* L. (7%), *Glechoma hederacea* L. (5%) in herb layer. Established plot 4 was located in floodplain plant community formed by invasive *A. negundo* representing about 80% of forest stand; *Urtica dioica* (15%) and *Glechoma hederacea* (7%) are dominant in herb layer; shrub layer is represented by *Padus avium* Mill. and *A. negundo*.

Vegetation projective cover varied from 35% (lime–oak) to 80% (floodplain meadow) (Tab. 7). However, the number of *A. tataricum* individuals was not determined by this parameter. The highest number of tatarian maple individuals was observed in floodplain lime–oak forest. Perhaps this can be explained by the fact that floodplain deciduous forest is a typical habitat for *A. tataricum*. The lowest number of tatarian maple individuals was found in floodplain forest with dominance of *A. negundo* (Tab. 7).

This invasive tree species is capable of forming multilevel plant communities with high density of the forest canopy oppressing native species (Kostina et al., 2016). Investigated plant community was probably formed in place of well-moistened forest edge or meadow. This is consistent with presence of meadow and forest edge species (*Filipendula vulgaris* Moench, *Rumex confertus* Willd.) and plants of deciduous forests (*Glechoma hederacea*, *Angelica sylvestris* L.) in this seminatural plant community.

Tab. 7. Characteristics of established plots with *Acer tataricum*

Parameter	Plots			
	1	2	3	4
Projective cover [%]	80.00	35.00	65.00	65.00
Number of *Acer tataricum* individuals per plot	32.00	28.00	38.00	26.00
Light	7.00	5.10	5.50	6.10
Temperature	5.70	5.30	5.20	5.50
Continentality	4.50	4.40	4.30	3.70
Moisture	5.00	5.70	5.50	6.40
Reaction	6.80	6.10	6.70	7.00
Nutrient	5.20	5.30	5.80	6.60
Forest stand composition [%]	–	70Ps20Tc10Qr+Ap	50Qr40Tc10Pt+Ul	80An20At+Ul+Qr

Note: An – *Acer negundo*, Ap – *Acer platanoides*, At – *Acer tataricum*, Ps – *Pinus sylvestris* L., Tc – *Tilia cordata*, Qr – *Quercus robur*, Pt – *Populus tremula* L., Ul – *Ulmus laevis* Pall

The analysis of the vascular flora of herb and shrub layers of studied plant communities was carried out according to Ellenberg et al. (2001). Detrended correspond-

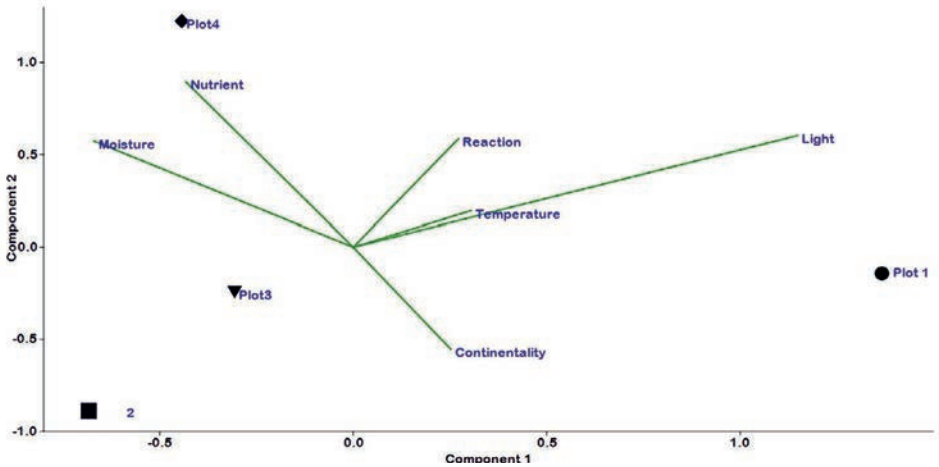

Fig. 3. Detrended correspondence analysis (DCA) ordination diagram of plots established in plant communities with *Acer tataricum*

ence analysis of total set of environmental indicator values (Fig. 3) shows that the lowest number of *A. tataricum* individuals were found in the most moist and shaded plant communities (established plots 2 and 4). Thus, the excessive moisture of habitat adversely affects the seed reproduction and development of *A. tataricum* seedlings, despite the fact that tatarian maple is a species of floodplain broadleaved forests. The highest number of *A. tataricum* individuals was found under conditions of sufficient light and moderate moisture (established plot 1). Thus, light and moisture are the most significant environmental factors for *A. tataricum* populations in the Republic of Mordovia.

We selected 25 *A. tataricum* samaras per each established plot to reveal its morphological characteristics. As it is seen from Table 8, samara of *A. tataricum* reached 3.7 cm in length and 0.9 cm in width as a mean.

Tab. 8. Characteristics of *Acer tataricum* samaras

Parameter	Length of samara [cm]	Width of samara [cm]
M	3.70	0.90
m	0.30	0.30
min	2.80	0.40
max	4.20	2.00

Note: M – mean value, m – error of the mean, min – minimal value, max – maximal value

We analysed ecological preferences of plant species of flora accompanying to *A. tataricum* to estimate ecological conditions of habitats with tatarian maple. Table 9 includes data on the distribution of plant species of accompanying flora of ecological groups in relation of plants to water. The mesophytes group dominates with 52 species (51.4%) which are typical for habitats with moderate moisture level. Among them, there are *Fragaria vesca*, *Alopecurus pratensis*, *Quercus robur* and others. Xeromesophytes (18.8% of total species number) are located on the second place. Most of them were found on the established plot 1 located in meadow habitat. Among them, there are *Festuca rubra* L., *Elymus* (=*Elytrigia*) *repens* (L.) Gould, *Bromus arvensis* L. and others. Plants confined to habitats with excessive moisture (hygrophytes, hygromesophytes) were presented by 14 species in sum. They include *Urtica dioica*, *Athyrium filix-femina* (L.) Roth, *Lysimachia nummularia* L., *L. vulgaris* L., *Filipendula ulmaria* (L.) Maxim. and others.

Table 10 includes data on the distribution of plant species of the accompanying flora of the ecological groups in relation of plants to the lighting/shading. As it is seen from table 10, both light-demanding and shade-tolerant groups contain approximately equal number of species. This is explained by the fact, that *A. tataricum* is capable to grow both in open, as well as in woodland habitats.

Tab. 9. Ecological groups on the basis of relation of plants to water in plant community with *Acer tataricum*

Ecological group	Number of species	Total number of species [%]
Mesophytes	52	51.40
Xeromesophytes	19	18.80
Mesohygrophytes	10	9.90
Hygrophytes	9	8.90
Hygromesophytes	5	4.90
Mesoxerophytes	5	4.90
Xerophytes	1	0.90
Total	101	100.00

Tab. 10. Ecological groups of plants in relation to the lighting/shading in plant community with *Acer tataricum*

Ecological group	Number of species	Total number of species [%]
Shade-tolerant	46	45.50
Light-demanding	45	44.50
Shade-demanding	10	9.90
Total	101	100.00

Tab. 11. Ecological-coenotical characteristics of the flora which is accompanying *Acer tataricum* in the investigated plant communities

Ecological-coenotical group	Number of species	Total number of species [%]
Forest	51	50.10
Meadow	24	23.40
Weed	15	14.70
Forest swamp	10	9.70
Steppe	1	0.90
Total	101	100.00

An ecological-coenotical characteristic of the flora accompanying *A. tataricum* is presented in table 11 with distribution of plant species on several ecological-coenotical groups. Forest group contains the highest number of species (50.1%). Among them, there are *Asarum europaeum*, *Galium odoratum*, *Platanthera bifolia*, *Rubus saxatilis* L., *Scrophularia nodosa* L. and others. Second place is occupied by group of meadow plants (24 species) that indicates ability of *A. tataricum* to grow in floodplain meadows. Among them, there are *Betonica officinalis* L., *Carex vulpina* L., *Agrostis capillaris* L. and others. The presence of weed species (14.7%) in accompanying flora indicates disturbance of habitats with tatarian maple. Among them, there are *Arctium lappa* L., *Taraxacum officinale* Wigg. s.l., *Polygonum convolvulus* L. and others. Thus,

A. tataricum populations are capable to grow in open, as well as in woodland habitats of floodplain including under anthropogenic pressure.

Acer negundo L. – Ash-leaved maple

Seed reproduction of *A. negundo* was determined within the established plot 4 to study *A. tataricum* populations (study plots 1, 2), as well as in Saransk at wasteland overgrown by ash-leaved maple (study plots 3, 4). Brief description of established plot in Bolshie Berezniki district of Mordovia was listed above in section about *A. tataricum*. Vegetation cover of wasteland in Saransk is presented by ruderal plant species. Among them, *Conyza* (=*Erigeron*) *canadensis* (L.) Cronquist, *Arctium lappa*, *Lactuca serriola* L., *Artemisia vulgaris* L., *Taraxacum officinale* are dominant.

As a result of investigations, we found that seed reproduction of *A. negundo* was significantly higher in seminatural plant community with dominance of its invasive species. Although there is no shading that inhibits *A. negundo* juveniles (Kostina et al., 2016), number of 1-year-old individuals of ash-leaved maple in Saransk was less in 1.7–2.6 time in comparison with habitat in Bolshie Berezniki district of Mordovia (Tab. 12). Probably, more dry conditions of wasteland in Saransk decrease the seed germination of *A. negundo* that is consistent with results of other researchers (Erfmeier et al., 2011; Lamarque et al., 2013).

Tab. 12. Number of 1-year-old individuals of *Acer negundo* per study plot in Saransk and in Bolshie Berezniki district of Mordovia

Parameter	Bolshie Berezniki district		Saransk	
	1	2	3	4
M	66.00	71.00	27.00	39.00
m	8.60	12.50	4.80	9.10
min	43.00	36.00	14.00	18.00
max	95.00	108.00	42.00	67.00

Note: M – mean value, m – error of the mean, min – minimal value, max – maximal value

Conclusions

Acer campestre populations have relatively low level of seed reproduction (13.0–19.4 of 1-year-old individuals per 100 m^2). Investigation of the number of generative individuals shows that only 11.7% of plants reach generative age. Active vegetative propagation of *A. campestre* suggests maintaining the field maple population on the north-eastern border of its range. As a result, group arrangement of *A. campestre* individuals is observed. Analysis of the accompanying flora indicates that *A. campestre* is confined to floodplain broadleaved forests and it capable to grow under moderate disturbance of habitats.

A. tataricum is capable to grow both in open (meadows, forest edges, banks of water bodies) and in woodland habitats in floodplains. Maintenance and development of *A. tataricum* populations are provided primarily by a sufficient amount of light and moisture. The shading, appearing under the canopy of some tree plants (e.g. *A. negundo* forest stand), has depressing effect on *A. tataricum* seedlings development. The analysis of the accompanying flora reflects the ecological-coenotical confinement of *A. tataricum* to plant communities of both forests and meadows in floodplains. Participation of weed species (14.7%) in accompanying flora indicates the ability of tatarian maple to develop in seminatural habitats.

Significantly smaller number of *A. negundo* seedlings (in 1.7–2.6 times) in the urban environment can indicate initial stage of ash-leaved maple invading in this habitat. In opposition, in seminatural plant community with *A. negundo* dominance, its seeds reproduction has a large level, probably due to indirect facilitation of the adult trees for the growth of its own seedlings by suppressing of native plants in this habitat. This is consistent with results of investigations of this phenomenon in relation to exactly *A. negundo* (Saccone et al., 2010), as well as other plant species (e.g. Siemann, Rogers, 2003).

Obtained results about interactions of several maple species (*A. tataricum* and *A. negundo*) show the relevance of these studies in relation to study of closely related tree species in conditions of their joint existence.

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Abstract

Genus *Acer* in the Republic of Mordovia is presented by four plant species: *Acer campestre* L., *A. negundo* L., *A. platanoides* L. and *A. tataricum* L. For *A. campestre* and *A. tataricum* we investigated accompanying flora composition and conducted its analysis; characteristics of populations were carried out. Seed reproduction of *A. negundo* was investigated in seminatural and anthropogenically disturbed habitats. Seed reproduction is of little importance for the maintenance of *A. campestre* populations on the north-eastern border of its range. This is offset by an active vegetative propagation by root offsprings. All in all, very few *A. campestre* individuals reach the generative age. *A. tataricum* is capable to grow in open, as well as in woodland habitats in floodplains. Sufficient light and moderate moisture are the most significant environmental factors for *A. tataricum* populations. Depressing of tatarian maple is observed under conditions of shading in plant community with *A. negundo* dominance. Analysis of the accompanying floras of *A. campestre* and *A. tataricum* show the coenotical confinement of these maple species. Seed reproduction of *A. negundo* was significantly higher in seminatural habitats with dominance of ash-leaved maple than it was in urban environment. Probably, this is a manifestation of indirect facilitation of the adult *A. negundo* tree canopy for the growth of its own seedlings by oppressing other plants (e.g. *A. tataricum* seedlings). Thus, we showed relevance for investigations of interactions between closely related tree species.

Key words: *Acer campestre*, *Acer negundo*, *Acer platanoides, Acer tataricum*, invasive species, population, rare species, Republic of Mordovia

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Trzy klony (*Acer* L., Aceraceae Juss.) w Republice Mordowii (Federacja Rosyjska)

Streszczenie

Rodzaj klon w Republice Mordowii reprezentowany jest przez cztery gatunki: *Acer campestre* L., *A. negundo* L., *A. platanoides* L. i *A. tataricum* L. Dla gatunków *A. campestre* i *A. tataricum* zbadano skład flory towarzyszącej oraz przeprowadzono charakterystykę populacji. Zbadano również reprodukcję nasion *A. negundo* w siedliskach półnaturalnych i antropogenicznie zaburzonych. Na północno-wschodniej granicy zasięgu występowania *A. campestre* reprodukcja nasion ma niewielkie znaczenie dla utrzymania jego populacji. Jest to równoważone przez aktywne rozmnażanie wegetatywne poprzez odrosty korzeniowe. Niewiele osobników *A. campestre* osiąga wiek generatywny. *A. tataricum* rozwija się, zarówno w miejscach otwartych, jak i w siedliskach leśnych, na obszarach zalewowych. Odpowiednie warunki świetlne i umiarkowana wilgotność są najbardziej istotnymi czynnikami środowiskowymi dla populacji *A. tataricum*. Nieprawidłowo rozwinięte osobniki klonu tatarskiego obserwowano w warunkach zacienienia, w zbiorowisku roślinnym z dominacją *A. negundo*. Analiza flory towarzyszącej *A. campestre* oraz *A. tataricum* pokazała cenotyczne uzależnienie tych gatunków. Reprodukcja nasion *A. negundo* była znacząco wyższa w półnaturalnych siedliskach z dominacją jesieniolistnych klonów, niż w środowisku miejskim.

Prawdopodobnie jest to przejaw niebezpośredniego ułatwiania wzrostu siewek *A. negundo* w starszych drzewostanach poprzez zdominowanie innych roślin (np. siewek *A. tataricum*). W ten sposób wykazano znaczenie interakcji pomiędzy blisko spokrewnionymi gatunkami drzew.

Słowa kluczowe: *Acer campestre*, *Acer negundo*, *Acer platanoides, Acer tataricum*, gatunki inwazyjne, populacja, gatunki rzadkie, Republika Mordowii

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At present he studies population ecology and biology of rare and endangered plant species in Central Russia. Also, recently he has carried out investigations of pyrogenic successions in forest ecosystems under conditions of southern boundary of the taiga zone. The results of his investigations are dedicated to biology and ecology of several rare and endangered plants. Additionally, he has investigated the biology and ecology of several alien invasive plants species.

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