ENVIRONMENTAL CHANGES
AND BIOLOGICAL ASSESSMENT IV

Editors:
Petr Kočárek
Vítězslav Plášek
Kateřina Malachová
Šárka Cimalová
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Editors: RNDr. Petr Kočárek, Ph.D.; RNDr. Vítězslav Plášek, Ph.D.;
         Doc. RNDr. Kateřina Malachová, CSc.; Mgr. Šárka Cimalová

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Influence of an alien element on taxonomic composition of steppe and forest-steppe flora in Altai region (Russia)

Dmitry ZOLOTOV

Abstract: In this paper the alien element influence on taxonomic composition of steppe and forest-steppe flora of Altai Region (Russia) is considered. The Barnaulka river basin is taken as a case study. The study made it apparent that the enrichment of steppe and forest-steppe flora by alien species results not only in the increase of total number of species, genera and families, but also in the change of relationship among them.

Key words: alien element, taxonomic composition, elementary regional flora, anthropogenic influence, anthropogenically transformed flora.

Introduction

In 1995–2007, the flora of higher vascular plants in the Barnaulka river basin (Zolotov, Silantyeva 2000; Zolotov 2001, 2002, 2005) located on the Priobskoye plateau, Altai Region (167996 km²) was studied. The modern Barnaulka river basin occupies the area of 5720 km² and stretches for about 240 km from the south-west to the north-east. The basin appeared in Holocene at the terraced channel of an ancient flow, its most intensive formation fell on Pleistocene. Steppe and forest-steppe vegetation predominates on erosive terraces, while pine forests - on the bottom of the ancient flow channel. Such a diversity of landscapes and vegetation is representative for Altai plains and the site under study making the Barnaulka river basin suitable for studying flora composition and anthropogenic influence as well as for working out measures on natural flora conservation.

Methods

To study the flora of Barnaulka river basin and differential species (Yurtsev 1983) distribution for revealing the elementary regional or specific flora as basic units of floristic regionalization, i.e. division into districts (Yurtsev 1987), the floristic method for studying total territorial aggregate of plant species from the whole spectrum of ecotypes present nearby the specific geographical point (Yurtsev 1975) was used. Owing to this method, five elementary regional floras that geographically correspond to 5 floristic districts were revealed, i.e. F1–F5 (table 1). Floristic districts of the Barnaulka river basin alternate from the south-west to the north-east; as this takes place, a number of forest ones increases, while steppe species (note: the both were partially used as differential species for setting the floristic borders) decreases. It is common knowledge that due to the anthropogenic pressure, flora could be enriched by alien plant species. The investigation by Silantyeva (2006) served as a basis for this study. Silantyeva (2006) specifies 1886 native and 300 alien species (archaeophytes and neophytes) of higher vascular plants found in Altai Region; of 2186 species, alien plants make up 13.7 %. For division of flora into the native species and alien ones, Silantyeva (2006) used practically all available floristic, geobotanical and paleobotanical data on Altai Region. In this paper, the data obtained by Silantyeva were compared with the ones received in the Barnaulka river basin.

<table>
<thead>
<tr>
<th>Flora</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone</td>
<td>Steppe</td>
<td>Forest-steppe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subzone</td>
<td>Droughty steppe</td>
<td>Temperate-droughty steppe</td>
<td>Southern forest-steppe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area, km²</td>
<td>1704</td>
<td>1145</td>
<td>834</td>
<td>967</td>
<td>1070</td>
</tr>
</tbody>
</table>

Tab. 1: Zonal and area characteristics of the floristic districts in the Barnaulka river basin.
Results

According to our data, the native flora of the Barnaulka river basin (BB) numbers 853 species from 372 genera and 99 families (table 2).

Tab. 2: Basic taxonomic parameters of the native flora of the Barnaulka river basin

<table>
<thead>
<tr>
<th>Flora</th>
<th>Number</th>
<th>Average number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>species</td>
<td>genera</td>
</tr>
<tr>
<td>BB:</td>
<td>853</td>
<td>372</td>
</tr>
<tr>
<td>F1</td>
<td>552</td>
<td>279</td>
</tr>
<tr>
<td>F2</td>
<td>543</td>
<td>272</td>
</tr>
<tr>
<td>F3</td>
<td>508</td>
<td>266</td>
</tr>
<tr>
<td>F4</td>
<td>542</td>
<td>288</td>
</tr>
<tr>
<td>F5</td>
<td>717</td>
<td>339</td>
</tr>
</tbody>
</table>

The alien element of the Barnaulka river basin flora numbers 128 species from 92 genera and 36 families (table 3).

Tab. 3: Basic taxonomic parameters of the alien element in flora of the Barnaulka river basin

<table>
<thead>
<tr>
<th>Flora</th>
<th>Number</th>
<th>Average number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>species</td>
<td>genera</td>
</tr>
<tr>
<td>BB:</td>
<td>128</td>
<td>92</td>
</tr>
<tr>
<td>F1</td>
<td>42</td>
<td>39</td>
</tr>
<tr>
<td>F2</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>F3</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>F4</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>F5</td>
<td>120</td>
<td>89</td>
</tr>
</tbody>
</table>

The check-list of alien species in the flora of the Barnaulka river basin is the following:
- Ranunculaceae: Leptopyrum fusiformis (L.) Rehb.;
- Fumariaceae: Fumaria schleicheri Soj.-Will.;
- Portulacaceae: Portulaca oleracea L.;
- Caryophyllaceae: Agrostemma githago L., Psammophiliella muralis (L.) Ikon., Saponaria officinalis L., Silene dichotoma Ehrh., Stellaria media (L.) Vill.;
- Chenopodiaceae: Atriplex hortensis L., A. patula L., A. sagittata Borkh., Chenopodium botrys L., Ch. novopokrovskianum (Aellen) Uotila, Ch. suecicum J.Murr., Ch. urbicum L.;
- Polygonaceae: Fagopyrum esculentum Moench, Fallopia convolvulus (L.) A.Löve, Polygonum aviculare L., P. propinquum Ledeb.;
- Violaceae: Viola arvensis Murr., V. tricolor L., V. × wittrockiana Gams ex Hegi; Salicaceae: Salix ledebouriana Trautv.;
- Cucurbitaceae: Echinocystis lobata (Michx.) Torr. et A.Gray;
- Malvaceae: Malva mauritiana L., M. moheleviensis Downar;
- Ulmaceae: Ulmus laevis Pall.;
- Cannabinaeae: Cannabis sativa L.;
- Urticaceae: Urtica urens L.;
- Grossulariaceae: Ribes aureum Pursh.;
- Rosaceae: Fragaria moschatula Duch., F. virginiana Duch., Malus baccata (L.) Borkh., Potentilla norvegica L.;
- Onagraceae: Epilobium adenocaulon Hausskn.;
- Oenothera biennis L., O. rubricaulis Klebahn, O. villosa Thunb.;
- Aceraceae: Acer negundo L.;
- Linaceae: Gray. Linum usitatissimum L.;
- Elaeagnaceae: Elaeagnus angustifolia L.;
- Apiales Lindl.: Anethum graveolens L., Conium maculatum L.;
- Valerianaceae: Valeriana officinalis L.;
- Rubiaceae: Galium mollugo L., G. vaillantii DC.;
- Cuscutaceae: Cuscuta epithymum Weath.;
- Hydrophyllaceae: Phacelia tanacetifolia Benth.;
- Boraginaceae: Borago officinalis L., Buglossoides arvensis (L.) Johnst., Echium vulgare L., Symphytum officinale L.;
- Scrophulariaceae: Veronica verna L.;
- Plantaginaceae: Plantago lanceolata L.;


In elementary regional floras of the Barnaulka river basin the portion of alien plants in number of species varies from 4.1% to 14.3% depending on the size of traffic centers (settlements) located within the corresponding floristic districts.

The anthropogenically influenced flora in the Barnaulka river basin unites 981 native and alien species of higher vascular plants from 426 genera and 106 families (table 4). When compared to the native flora, the anthropogenically influenced flora shows the disturbance in basic relationships among the parameters of taxonomic richness: numbers of species, genera and families.

Tab. 4: Basic taxonomic parameters of the anthropogenically influenced flora in the Barnaulka river basin

<table>
<thead>
<tr>
<th>Flora</th>
<th>Number</th>
<th>Average number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>species</td>
<td>genera</td>
</tr>
<tr>
<td>BB:</td>
<td>981</td>
<td>426</td>
</tr>
<tr>
<td>F1</td>
<td>594</td>
<td>300</td>
</tr>
<tr>
<td>F2</td>
<td>566</td>
<td>288</td>
</tr>
<tr>
<td>F3</td>
<td>537</td>
<td>283</td>
</tr>
<tr>
<td>F4</td>
<td>574</td>
<td>308</td>
</tr>
<tr>
<td>F5</td>
<td>837</td>
<td>392</td>
</tr>
</tbody>
</table>

Hence, the average number of species in a genus remains constant because the occurrence of new alien species is compensated by the occurrence of new alien genera. The spectrum of 9 genera leading in abundance of the alien element in flora of the Barnaulka river basin is as follows: Centaurea – 5, Chenopodium – 4, Amaranthus – 4, Sisymbrium – 4, Atriplex – 3, Viola – 3, Brassica – 3, Oenothera – 3, Setaria – 3. The share of 10 largest genera of the alien element spectrum includes 34 species or 26.6% of alien species quantity in the flora of the Barnaulka river basin.

The average number of species in a family increases dramatically from 8.6 in the native flora up to 9.2 in the anthropogenically influenced one. This is because the alien species belong mainly to leading families of native flora. The spectrum of 13 families leading
in specific abundance of the alien element of the basin flora appears as follows: Asteraceae – 25, Brassicaceae – 17, Poaceae – 14, Chenopodiaceae – 7, Fabaceae – 6, Solanaceae – 5, Caryophyllaceae – 5, Amaranthaceae – 4, Polygonaceae – 4, Rosaceae – 4, Onagraceae – 4, Boraginaceae – 4, Violaceae – 3. It is necessary to note that 10 largest families of the spectrum unite 91 species or 71.1 % of species quantity of the BB flora alien element.

The average number of genera in the family demonstrates less growth: from 3.8 in the native flora up to 4.0 in the anthropogenically influenced one. This parameter varies because alien species exceed alien families in number essentially. The spectrum of families leading in generic abundance of the alien element in the flora of the Barnaulka river basin looks as follows: Asteraceae – 19, Brassicaceae – 10, Poaceae – 9, Caryophyllaceae – 5, Solanaceae – 5, Fabaceae – 4, Boraginaceae – 4, Polygonaceae – 3, Rosaceae – 3, Apiaceae – 2, Chenopodiaceae – 2, Onagraceae – 2. The share of 10 largest families of the spectrum includes 64 genera or 69.6 % of genera quantity of the alien element in the flora of the Barnaulka river basin.

Conclusion

In conclusion it is necessary to emphasize that while studying anthropogenically influenced flora it is extremely important to divide the set of species into native and alien ones. The native flora composition reflects the history of its natural formation, zonal position and landscape features of the territory. The alien element composition and anthropogenically influenced flora shows the role of human activity in flora formation, the degree and character of this influence. Such a differential approach to the analysis allows us to gain a more penetrating insight into flora genesis, its relationship with the landscape structure of the territory and processes of anthropogenic impact. Besides, it promotes the development of floristic division into districts and the strategy of native flora preservation.

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References

Dmitry Zolotov

Institute for Water and Environmental Problems, Siberian Branch of the Russian Academy of Sciences,
1, Molodezhnaya St., Barnaul, 656038, Altai Region, Russia;
E-mail: zolotov@iwep.asu.ru; dao-poetry@ya.ru