

ALIEN FLORA IN AMUR REGION (HISTORICAL PATTERN OF FORMATION AND RESEARCH)

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The article provides a brief analysis of alien flora in Amur Region, describes historical pattern of its formation and research. From 1855 to 2009 there were 217 species, 51 of which became completely extinct at different times, 32 species are only documented by records and 7 are still unidentified. At present the invasive flora in the region is represented by 127 species comprised in 94 genera and 27 families.

Key words: spread, naturalization, Amur region, invasive, plant.

Over the last two centuries due to scientific and technical progress, a great number of non-native species has been transported across major geographical barriers. [Richards et al., 2006]. Some scientists [Vinogradova, 1992; Sugiyama et al., 1997; Richards et al., 2006] assume that it is the phenotypic plasticity that helps aliens to occupy different niches.

Many recent studies [Vyunkova, 1985; Vynayev, 1979; Basargin, 1989; Boyko, 1989; Markelova, 1989; Vinogradova, 1992, 2002, 2004; Antonova, 1996; Ulyanova, 1998, 2003; Baranova, 2003; Heltman, 2003, 2006; Advantive flora..., 2004; Richardson et al., 2000; Pysek et al., 2002, 2003; Grice, 2004; Dehnen-Schmutz, 2004; Jian Liu et al., 2005; Lloret et al., 2005 etc.] attempt to analyze alien flora in different parts of the planet.

Diplomatic relations and economic integration (mainly involving such countries as PRC, DPRK) contribute to introduction of invasive species into Amur Region and the existence of human habitats promotes their further spread and naturalization.

In the text the following reductions are accepted: LE – Vascular Plants Herbarium of the Komarov Botanical Institute, Russian Academy of Sciences; MHA –

Herbarium of the Main Botanical Garden, Russian Academy of Sciences, VLA – Herbarium of the Institute of Biology and Soil Science, the Far East Branch of the Russian Academy of Sciences, WIR – Herbarium of cultivated plants and their wild relatives (including weeds) of N.I. Vavilov All-Russian Research Institute of Plant Industry, PRC- The People's Republic of China, DPRK – Democratic People's Republic of Korea.

The first reports on Amur environment were carefully completed by V.D. Poyarkov in 1643-1644 [quoted from Shulman, 1994]. But more intense attempts to somehow describe or analyze it were made just in the middle of the 19th century. In 1859 among the meadow flora Maak R.K. found *Hordeum jubatum* L. A bit later Maksimovich K.I. (1862) named among those *Taraxacum officinale* F.H.Wigg., *Sonchus brachyotus* DC., *Chenopodium album* L., *Artemisia vulgaris* L., *Kochia* Roth, *Axyris* L., a few of *Cannabis sativa* L., *Cuscuta* L., *Geum* L., *Siegesbeckia* L. This may be due to the fact that Chinese, Daur and Manchu people used to practice intense farming and were cultivating millet (*Setaria italica* (L.) P.Beauv.), barley (*Hordeum vulgare* L.), oat (*Avena sativa* L.), soybeans (*Soja*

hispida Moench.), tobacco (*Nicotiana tabacum* L.), kidney beans (*Phaseolus vulgaris* L.), celery cabbage (*Brassica chinensis*), radish (*Raphanus sativus* L.), pumpkin (*Cucurbita pepo* L.), cucumbers (*Cucumis sativus* L.), carrots (*Daucus carota* L.) and rice (*Oryza sativa* L.). In 1862 along with other factors that support invasiveness and cause changes in composition of the whole alien floras, Maksimovich K.I. (1862) named the influx of immigrants. While analyzing the distribution pattern of *Artemisia sieversiana* Willd, nettle, cannabis, hop and eschscholzia he explained that it could have been promoted by expanding colonization of the area by newcomers from the Central Chernozemic and Volga regions, Siberia and Ukraine after 1882 [Argudyaeva, 1999]. At the end of the 20th century flagrant deforestation and plowing resulted in a number of fundamental changes in microrelief, mesorelief and microclimate. And this might have been the period when some aliens were introduced into the region to establish themselves. At that time the research into invasive plants and their naturalization received little attention in the literature and most of them are now available from floristic and herbarium collections in LE, MHA, VLA, WIR.

Regarding the issue under consideration the beginning of the 20th century was more productive. In 1909 B.A. Fedchenko started describing plant community within the southern part of Zeysko-Bureinskaya plain. In 1906 using I.F. Kryukov's materials, he and O.A. Fedchenko published the list of local taxa that included such invasive species as *Artemisia vulgaris* L., *Tanacetum boreale* Fisch., *Linaria vulgaris* L., *Euphrasia hirtella* Jord. ex Reut., *Axyris amaranthoides* L., *Urtica dioica* L., *Hordeum vulgare* L., *Avena sativa* L. and some others.

After the Great October Revolution non-native flora studies in the region were mostly conducted in woods, meadows and wetlands. And their foremost agenda was to identify forage crops, medicinal and

poisonous plants. But this period is nevertheless important due to geobotanical studies of Zeysko-Bureinskaya plain.

Later, in 1931-1932, V.L. Komarov and E.N. Klobukova-Alisova edited two-volume "Keys to Far-Eastern plants" that tended to inventory all flora of the southern Far East and listed some weeds and invasive plants specific to Amur Region. In this regard considerable contribution was also made by I.K. Shishkin (1936), who attempted to classify pests and their distribution in Ussuri Krai and Amur Region. Thus, from 1855 to 1933 there were found 56 invasive species, 8 of which (*Briza maxima* L., *Lolium remotum* Schrank, *Persicaria linicola* (Sutulov) Nejukov, *Linum usitatissimum* L., *Nicandra physaloides* (L.) Gaertn. and others) finally became extinct. But the emergence of violated areas and rapid development of agriculture during the post-war period led to naturalization and distribution of most species.

In 1966 the group of authors [Vorobyov D.P., Voroshilov V.N. Gorovoy P.G. and Shreter A.I.] published "The key to invasive plants in Primorsky Krai and Amur Region which excluded any reports on their habitats. And Voroshilov (1966, 1982, and 1985) wrote about 131 species that can be relatively labeled as "aliens".

Since 1950 the composition of invasive species has been supplemented with 83 additional specimens (*Puccinellia distans* (Jacq.) Parl., *Vaccaria hispanica* (Vill.) Rauschert, *Lophanthus chinensis* (Rafin.) Benth., *Dracocephalum thymiflorum* L. and others), 12 of which were gathered just once.

Since 1964 Sadovoye and Dronovo villages farmlands sited in Tambovsky County (with Russian Research Institute for soya cultivation as an umbrella body) have been providing the major experimental base for studies related to the scale of invasiveness. In 1977 R.D. Chepelev's illustrated edition of "Weed vegetation in Amur Region" featured approximately 84 weeds found among cultivations.

The experimental summary “Vascular plants of the Soviet Far East” (1985-1996) gave more precise accounts of non-native flora for the region – 187 species. Later, V.M. Starchenko (2001) mentioned just 140 ones. This discordance might have generated from different interpretation of the terms “adventive species” and “invasion” which always leads to much confusion when it comes to identifying alien species.

The weeds which didn't occur after 1990 are *Agrostemma githago* L., *Camelina microcarpa* Andrz., *Hyosyamus niger* L., *Rhinanthus vernalis* (N. Zing.) Schischk. Et. Serg., *Sonchus brachyotus* DC., *S. oleraceus* L. Their potential extinction can be connected with their belonging to a certain cultivation or accidental introductions. For instance, in 2003 we picked up *Oxytropis oxyphylla* (Pall.) DC., *Euphorbia waldsteinii* (Sojak) Czer. [Aistova, 2004], *Elymus fibrosus* (Schrenk) Tzvel., *Sorghum saccharatum* (L.) Moench, which were introduced accidentally. The invasive plants which became incorporated within the resident flora are *Bidens frondosa* L., *Galinsoga parviflora* Cav., *Cyclachaena xanthiifolia* (Nutt.) Fresen, *Senecio viscosus* L. and others. Some of them were identified in 1960s-1970s.

First recorded in the region in 2001 *Cyclachaena xanthiifolia* has now spread towards its southern parts and occupies violated areas. And the factors that would deter this spread are non-existent. Another invasive *Berteroa incana* (L.) DC., first and just once gathered in 1975 (VLA) is at present increasingly invading roadsides and cultivated areas. Such considerable spread might be explained by bad weather conditions and partly by the fact that roadsides are reluctantly mowed.

Among invasive species that have also established themselves in segetal flora are *Bromopsis inermis* (Leys.) Holub., *Abutilon theophrasti* Medik., *Hibiscus trionum* L., *Helianthus rigidus* (Cass.) Desf., *Chenopodium album* L., *Amaranthus retroflexus* L. and others [Aistova, 2011]. In 2009-2010 in the city

of Blagoveshchensk and its environs, several populations of *Cuscuta campestris* Yunck. were detected. Up to now this species has occurred only sporadically on host plants, mainly on *Artemisia* L.

The group that deserves particular attention is the group of introduced species that can be referred to as “refugees”. A dazzling array of them occupies violated areas and “escapes from cultivating” using different dispersal vectors like wind, garbage, animals and humans. They are to be found sporadically on waste disposal sites, lawns, roadsides and riverbanks. Among them there are: *Calendula officinalis* L., *Malva sylvestris* L., *Physalis* L., *Solanum tuberosum* L., *S. lycopersicum* L., *Citrullus lanatus* (Thunb.) Matsumura & Nakai, *Cucumis melo* L., *Anethum graveolens* L., *Petroselinum crispum* (Mill.) Nyman ex A.W.Hill, *Cosmos bipinnatus* Cav., и другие. These species survive just one growing season and in most cases produce no reproductive offspring. For this reason, further spread requires reintroduction. “Refugees” is quite a large group of species supplemented annually with species supplied by global seed providers. But most of them are herbaceous plants. Among lawn grass on roadsides, sidewalks and violated areas such species as *Phleum phleoides* (L.) Karst., *Dactylis glomerata* L., *Poa supina* Schrad. and *Lolium perenne* L. can be spotted. From cultivated species there are: *Brassica napus* L., *Raphanus sativus* L., *Triticum aestivum* L., *Avena sativa* L., and *Hordeum vulgare* L. In gardens there can be medicinal and spicy plants. And they do not belong to indigenous flora and can be found on waste disposal sites, lawns, roadsides sometimes completely fitting into ruderal plant communities of multiple urbanized areas. The species currently used for gardening are: *Rosa rugosa* Thunb., *Prunus serrulata* Lindl., *Lonicera caprifolium* L., *Syringa vulgaris* L., *Micromeles alnifolia* (Siebold. Et Zucc.) Koehne, *Lotus corniculatus* L., *Celastrus orbiculata* Thunb., *Elaeagnus multiflora* Thunb. and some others. They occupy local habitat patches and without proper

care can live from a year up to several years.

Naturalization pattern of woody species can be illustrated using the species *Hippophaë rhamnoides* L. and *Acer negundo* L. The first has now flooded quarries, gives seeds and serves as a source of nutrition for birds and rodents. The second species from North America (its native land) follows the tendency “to escape from cultivation” and spreads on wastelands, in parks and roadsides. Decorative, unpretentious, fast-growing but less productive than all the rest far eastern species it spreads by seeds. The other introduced species used for landscaping in the region are: *Populus alba* L., *P. simonii* Carr., *Caragana arborescens* Lam., *Lonicera tatarica* L., *Forsythia europaea* L. and others.

From 1855 to 2009 in Amur Region there were recorded 217 species, 51 of which became extinct completely at different times, 32 species are only documented by records and 7 are still unidentified. At present the invasive flora in the region is represented by 127 species that constitute 94 genera and 27 families.

Deep insight into the local alien taxa has shown that the most abundant families are Asteraceae (26.19%), Poaceae (15.07%), Brassicaceae (7.14%), Fabaceae (9.52%). As for life-forms, they are represented by therophytes (64.0%) and hemicryptophytes (36.0%); the leading ecological group is mesophytes (63 species or 50.0%), and regarding the way of dispersal – xenophytes (91 species or 72.20%); naturalized plants constitute 65.08%. Vast geographical groups are formed by Eurasian (40.47%), American (11.88%) and circumboreal (12.70%) species [Aistova, 2009].

Thus, a more detailed analysis of alien flora and “refugees” in Amur Region, research into the character of their spread, naturalization, biology, mapping (dotting) and occurrence, along with search for phytophagous insects will make it possible to predict and deter the spread of invasive plants.

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