

NATURALIZATION OF ADVENTIVE PLANTS IN MAGADAN REGION

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Institute of Biological Problems of the North (IBPN) FEB RAS,
Magadan 685000; lysenkodm@ibpn.ru

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The results of the study on naturalization of adventive plants in Magadan region are given. The list of adventive flora of the region consists of 292 species and includes 22 pseudoaboriginals. Ergasiophygophytes include 42% of ephemerophytes, 34% of colonophytes, 16% of epocophytes and 8% of agriophytes. Xenophytes consist of 15% of ephemerophytes, 40% of colonophytes, 26% of epocophytes and 19% of agriophytes. Unintentionally introduced species have greater potential to naturalization. Pseudoaboriginal xenophytes have greater part of epocophytes than other xenophytes. Sixteen percent of adventive species spread to natural ecotopes.

Key words: adventive plants, naturalization, introduction, pseudoaboriginals, ergasiophygophytes, xenophytes, ephemerophytes, colonophytes, epocophytes, agriophytes, Magadan region.

Magadan region is situated in the North-East of Asia 66°20'–58°51' of North latitude and 144°43'–163°27' of East longitude. It borders on Chukotka and Kamchatsky region in the east and on Yakutia (Sakha) Republic and Khabarovsk region in the west. The region is washed by the Sea of Okhotsk in the south.

Magadan region is located in the climate zone of tundra and forest-tundra, where average January temperature is below –32°C and summer lasts for two months [Klyukin, 1970]. The dominating types of vegetation are open larch stands, mountain dwarf pine thickets and high-mountain stony deserts [Reutt, 1970].

Absence of railroad and regular car communication service make Magadan region isolated from other regions of Russia. Fundamental development of the region started at the end of 1930s. Since 1990s sharp population decrease has begun. Population density of Magadan region is now less than 0.5 man per 1km² and tends to decrease.

First newly arrived people in the basin of the Kolyma River were Russian cossacks from the squadron of Mikhail

Stadukhin. They founded Verkhnekolymyskaya fortress (present-day Verkhne-Kolymsk village, Yakutia) in the outlet of the Yasachnaya River in 1645. At the end of XVIII century first Yakut migrants appeared in the basin of the Kolyma. In the XIXth century both newly-come and native populations maintained commercial connection with American and Japan merchants. First registered example of vegetable-growing occurred on the territory of Seimchan in 1894 according to the present-day map of Magadan Region. By the beginning of the XXth century Yakuts of Seimchan cultivated potatoes and cabbage. First state farm was organized in Seimchan in 1931.

These were formation conditions of the adventive flora of the Magadan Region.

During field season of 2004–2009 we studied adventive flora of Magadan Region. About 4000 sheets of herbarium were collected, besides, collections of herbarium stored in IBPN FEB RAS (MAG) were reviewed. According to the obtained data we made a checklist of the adventive plants of Magadan Region [Lysenko, 2006, 2008] with indication of

naturalization degree for each species. The classification of naturalization degree is presented according to principles, stated by F.G. Schroeder in 1969 [Dorogostayskaya, 1972]. The list consisting of 292 species includes also those species which were found just once in Magadan Region. In study of naturalization all plant communities of inhabited and abandoned settlements, communities of desolate and cultivated fields and territories of the state farms were considered to be anthropogenic. Ecotopes with undisturbed or faintly disturbed by human vegetation cover (pebbles, sand drifts and silts over the riverbanks, sea pebbles, flood plain forests and meadows etc.) were considered to be natural.

Adventive flora of the region consists of unintentionally introduced species (xenophytes) and species which were brought to the region intentionally as seed grain or food and medicinal herbs, growing or remaining on anthropogenic ecotopes without human intention (ergasiophygophytes). Examples of ergasiophygophytes of Magadan Region are the *Hordeum vulgare*, growing on landfills from the seeds brought into the region as a food, and the *Papaver croceum*, cultivated in the region as an ornamental plant, self-sowing in ruderal ecotopes. Species which were brought to the region by mixed types of introduction are considered to be xeno-ergasiophygophytes. These are *Arctopoa subfastigiata*, *Chelidonium majus*, *Chenopodium*

foliosum, *Elytrigia repens*, *Heracleum sibiricum* and *Leucanthemum vulgare*.

A special group of adventive plants consisting of 22 species are pseudoaboriginals. According to the classical definition these are the species with the natural habitat bordering on the floristic region of the analyzed territory, but being in conditions of anthropogenic transformation they extend their habitat over the explored territory using anthropogenic ecotopes [Babkina, 2008]. Examples of such pseudoaboriginals are *Senecio pseudoarnica*, that is a species of the Sea of Okhotsk coast cultivated in continental parts of the region and running wild, and *Leymus mollis*, brought into some Kolyma settlements from the coast of the Sea of Okhotsk. However, considerable amount of such species were introduced not from the neighboring floristic areas within Magadan Region considering their rare occurrence here, but from other regions. Examples of such species are *Aegopodium alpestre*, found in Magadan Park, *Artemisia dracuncululus*, from the surroundings of Susuman and *Artemisia tanacetifolia*, from the surroundings of Sokol Settlement. In our work we included pseudoaboriginals into adventive flora and sorted according to type of introduction to xenophytes (19 species) and ergasiophygophytes (3 species).

Quantitative ratio of the species according to introducing type and degree of naturalization is presented in Table.

Table. The groups of adventive species by type of introduction and naturalization degree

	Ephemerophytes	Colono-phytes	Epoeco-phytes	Agriophytes	Total
Ergasiophygophytes (including pseudoaboriginals)	32 (0)	26 (1)	12 (2)	6 (0)	76 (3)
Xenophytes (including pseudoaboriginals)	31 (0)	84 (6)	55 (9)	40 (4)	210 (19)
Xeno-ergasiophygophytes	1	3	1	1	6
Total (including pseudoaboriginals)	64	113	68	47	292 (22)

Ephemerophytes make up 42% of the total amount of ergasiophygophytes. As a rule, these are food plants (*Coriandrum sativum*, *Malus comminus*, *Lycopersicon esculentum*, *Carthamus tinctorius* etc.), forage plants (*Cannabis sativa*), medicinal herbs (*Anethum graveolens*, *Linum usitatissimum*, *Matricaria recutita*) and some cultivated flowers (*Calendula officinalis*, *Eschscholzia californica*) growing on landfills and rarer among ruined buildings and alongside roads from rejected seeds or plant parts. Such plants do not complete their life cycle and every year they grow from again introduced seeds. According to our observations seeds of these plants persist in soil for a long time, and such species can be found in their introducing places at least 10 years after cessation of anthropogenic influence, for example, over ruins of a storehouse. Among these, a *Hordeum distichon* can be mentioned. Ergasiophygophytes-ephemerophytes come to 11% of total amount of adventive species.

Colonophytes form 34% of total number of ergasiophygophytes. These are irregularly seeding, predominantly cloning feral lawn plants (*Lolium perenne*, *Schedonorus pratensis*, *Dactylis glomerata* etc.), more rarely they are forage crops (*Vicia sativa*) growing alongside the roads and on anthropogenic meadows. Besides, among them there are food plants (*Allium ramosum*, *Acetosa pratensis*, *Rheum undulatum* etc.) and rarely ornamental plants (*Delphinium × cultorum*, *Malus baccata*), growing in the desolated courtyards or persisting in their previous planting places for a long time. Ergasiophygophytes-colonophytes amount to 9% of the total number of adventive species. Among ergasiophygophytes-colonophytes there is a pseudoaboriginal *Anemonidium dichotomum*, the species from the Sea of Okhotsk coast founded in Susuman on the desolate vegetable garden, where probably it had been cultivated as the ornamental plant.

Epoecophytes amount to 16% of total quantity of ergasiophygophytes. These are normally seeding in the climatic conditions

of Magadan Region lawn and forage crops, which are widespread on different anthropogenic ecotopes (*Trifolium pratense*, *Phleum pratense*, *Bromopsis inermis*), more rarely they are ornamental (*Aquilegia × cultorum*) and food (*Allium fistulosum*) plants. Ergasiophygophytes-epoecophytes make up 4% of total number of adventive species. There are two pseudoaboriginals among ergasiophygophytes-epoecophytes: the mentioned above *Senecio pseudoarnica* and *Allium schoenoprasum*, which is present in aboriginal flora, but comes to anthropogenic ecotopes (anthropogenic meadows, landfills, roadsides, desolate vegetable gardens) only by running wild from varietal cultivated plants.

Agriophytes amount to 8% of the total quantity of ergasiophygophytes. These are ornamental plants (*Tripleurospermum hookeri* and *T. subpolare*) running wild on the seacoast meadows and pebbles, forage crops (*Trifolium repens*, *Elymus sibiricus*) growing on river pebbles, lawn plant (*Poa supina*) naturalizing on the edges of forest and forage and lawn crop (*Alopecurus arundinaceus*) growing on wet floodplain meadows. Ergasiophygophytes-agriophytes amount to 2% of the total number of adventive species.

Ephemerophytes form 15% of the total number of xenophytes. These are once found casual plants of dumps (*Solanum nigrum*, *Bidens cernua*, *Ambrosia artemisiifolia* etc.), weeds of cultivated fields (*Agrostemma githago*, *Commelina communis*, *Centaurea cyanus*), and the weeds of roadsides (*Chenopodium vachellii*, *Camelina microcarpa*, *Vaccaria hispanica*). Rarely, they are weeds of lawns (*Axyris amaranthoides*, *Agropyron cristatum*), fallow lands (*Chorispora tenella*, *Myosotis arvensis*) and ruins of state farms (*Phalaris minor*, *Rumex obtusifolius*). As a rule, they are annuals occurring on the territories subjected to intensive anthropogenic influence. Ephemerophytes-xenophytes amount to 11% of the total number of adventive species.

Colonophytes make up 40% of the total number of xenophytes. These are weeds of fields, desolated over 10 years ago (*Nonea rossica*, *Astragalus uliginosus*, *Euphorbia waldsteinii*), and weeds of roadsides (*Centaurea scabiosa*, *Plantago urvillei*, *Saussurea amara*). Rarely these are weeds of lawns (*Centaurea jacea*, *Thalictrum lucidum*, *Berteroa incana*), landfills (*Urtica dioica*), fields and vegetable gardens (*Fagopyrum tataricum*). As a rule, they are predominantly cloning perennials persistent for many years just in the places of their introduction. More rarely they are irregularly seeding annuals (*Avena fatua*, *Persicaria scabra*, *Leptopyrum fumarioides*). Xenophytes-colonophytes form 29% of the total amount of adventive species. There are 6 pseudoaboriginals among xenophytes-colonophytes. These are weeds of roadsides, species of the Sea of Okhotsk coast, which were introduced into the Kolyma areas of the region (*Arctopoa eminens* and *Angelica gmelinii*) and besides species of continental part of the region, introduced into the Sea of Okhotsk coast predominantly from other regions of Russia, the weeds of fallows (*Veronica longifolia*), roadsides (*Galium densiflorum*) and lawns (*Achillea asiatica*, *Aegopodium alpinum*).

Epoecophytes make up 26% of total amount of xenophytes. These are the most common weeds of roadsides, fallows, waste grounds and anthropogenic meadows (*Lepidium densiflorum*, *Potentilla anserina*, *Rhinanthus aestivalis*), fields and vegetable gardens (*Erodium cicutarium*, *Amsinckia micrantha*, *Lamium amplexicaule*). Usually these species are not restricted to one anthropogenic ecotope. Xenophytes-epoecophytes amount to 19% of total quantity of adventive species. There are 9 pseudoaboriginals among xenophytes-epoecophytes. These are the mentioned above *Artemisia dracuncululus*, *A. tanacetifolia* and *Leymus mollis*, and *Lappula consanguinea*, *L. heteracantha*, *Potentilla sanguisorba*, *Plantago depressa* introduced into the southern part of the region, and besides the species of the Sea of Okhotsk coast spread

over continental part of the region, namely *Ptarmica camtschatica* and *Epilobium affine*.

Agriophytes form 19% of the total amount of xenophytes. These are annuals or biennials (*Dimorphostemon pectinatus*, *Potentilla norvegica*, *Artemisia jacutica*), more rarely perennials (*Linaria vulgaris*, *Achillea setacea*), spreading from anthropogenic ecotopes to river pebbles, rarely to floodplain meadows (*Plantago major*), osier-beds (*Rhinanthus vernalis*, *Ptarmica acuminata*), slide-rocks (*Crepis tectorum*) and rookeries (*Lepidotheca suaveolens*). Xenophytes-agriophytes amount to 14% of total quantity of xenophytes. There are 4 pseudoaboriginals among xenophytes-agriophytes. These are introduced from the Sea of Okhotsk coast into the continental part of the region and naturalized on river pebbles plants (*Carex cryptocarpa*, *Potentilla fragiformis*), on glades (*Carex gmelinii*), and also introduced from the continental part of the region into the coast of the Sea of Okhotsk and naturalized on the slide-rocks *Galium ruthenicum*.

Xeno-ergasiophygophytes amount to 1% of the total quantity of adventive plants. These are ephemerophyte *Chenopodium foliosum* – the weed of landfills, vegetable gardens and flowerbeds, colonophytes *Arctopoa subfastigiata*, *Chelidonium majus*, *Leucanthemum vulgare*, epoecophyte *Heracleum sibiricum* (plants of lawns and roadsides) and agriophyte *Elytrigia repens*.

According to the Table, the species unintentionally introduced into the region have greater potential of naturalization. Content of colonophytes is approximately equal among all naturalization groups including pseudoaboriginals by type of introduction and varies within 30–40%. In general, pseudoaboriginals-xenophytes spread to natural ecotopes as frequently as xenophytes, however, they naturalize more frequently on anthropogenic ecotopes. On the whole, 16% of adventive species spread to natural ecotopes. Thus, only 15 agriophytes (approximately 3% of adventive flora) were found in Vyatsko-

Kamskoye interfluves [Tuganayev, Puzyryov, 1988]. However, there is no species replacing aboriginal species in natural ecotopes among 47 agriophytes typical for Magadan Region.

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