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## **Native dendroflora of Western Kazakhstan at introduction in the Mangistau desert**

The article is devoted to the study of the indigenous dendroflora of Western Kazakhstan and its introduction into the desert conditions of Mangistau. The flora of the Mangistau region includes 770 species of higher spore and vascular plants belonging to 333 genera and 73 families. In Atyrau region, 899 species of higher vascular plants have been recorded, associated with 351 genera and 85 families. Indigenous woody plants comprise 7.8 % of the total flora in the Atyrau region and 16.7 % in the Mangistau region, indicating their low representation in the vegetation cover. The status of natural populations of six woody fruit and berry species has been studied: *Crataegus ambigua*, *Crataegus altaica*, *Rosa laxa*, *Rosa iliensis*, *Ribes aureum*, and *Lonicera tatarica*. The selection of representatives of the indigenous dendroflora of Western Kazakhstan has begun for the formation of a collection, which includes 14 species, four of which are rare and endangered, listed in the Red Book of Kazakhstan. It analyzes indigenous woody plants, their nutritional, medicinal, and ecological functions, as well as their potential for ecosystem restoration and ensuring food security.

*Keywords:* aboriginal dendroflora, Western Kazakhstan, Mangistau, Atyrau, flora, population, introduction.

### *Introduction*

The conservation and sustainable use of biodiversity is an important objective of biological science, promoting the introduction of sustainable species for introduction, food security and ecosystem restoration [1]. Plant resources, in particular wild and cultivated plants, play a key role in national security.

Western Kazakhstan, characterized by a climate ranging from semi-desert to desert, exhibits significant floristic diversity, which emphasizes its desert character [1]. The Mangistau and Atyrau regions are distinguished by dendroflora adapted to arid conditions, however, remain insufficiently studied.

Desert conditions of Western Kazakhstan, characterized by harsh climate and deficit of water resources, create difficult conditions for the growth of woody plants. The diversity of relief, soil mosaic and harsh climate form unique natural complexes, contributing to the spread of tolerant non-traditional woody plants.

This determines the adaptation of local dendroflora to extreme environmental conditions. However, introduction of native tree species can significantly improve the ecological situation and contribute to the restoration of natural resources.

Taking into account the climatic diversity of Western Kazakhstan, in Mangyshlak experimental botanical garden the study of natural populations and organized introduction of promising non-traditional woody plants, the brief results of which are presented in this article.

### *Experimental*

The main objects of the study are floristic diversity of plants of Mangistau and Atyrau oblasts. Expedition trips were conducted according to the route-reconnaissance method [2-3], with the establishment of semi-stationary key sites for studying the diversity of fruit and berry plants. Herbarium, vegetative and seed materials will be collected during field studies.

Optimization of growing conditions of planting material was carried out in the open (at the nursery) and closed (in the greenhouse) ground. Observations of phenological phases, growth and development dynamics will be carried out according to the methodological guidelines for botanical gardens of Kazakhstan [4] and forest nurseries [5].

### *Results and Discussion*

Selection of economically valuable plants in natural conditions and enrichment of cultural flora of any region should be made not only by cultivated plants, but also by species represented in the natural flora. Nat-

ural flora has a significant prospect of use as a source of plants resistant to local climatic conditions, having decorative, medicinal, food, honey-bearing, ameliorative properties.

The extra arid conditions of Western Kazakhstan, especially in the Mangistau and Atyrau regions, contributed to the formation of a diverse relief and unique vegetation cover [6–9].

The flora of Mangistau region includes 770 species of higher spore and vascular plants belonging to 333 genera and 73 families. The most numerous families by the number of species are Amaranthaceae (114) and Asteraceae (101), which indicates the arid conditions of the region and the presence of significant areas of saline or saline areas.

Brassicaceae (74), Poaceae (69) and Fabaceae (59), which are adapted to dry and desert conditions and play the role of edifiers of steppe and desert flora, are also the three leaders in the number of species. Multi-species families including 15 or more species include Apiaceae (16), Polygonaceae (23), Scrophulariaceae (24), Caryophyllaceae (28) and Boraginaceae (36). The structure of families is conditioned by the location of the territory on the border of the Boreal and Old Mediterranean subkingdoms of the Holarctic Kingdom. High ranks of the families Amaranthaceae and Boraginaceae are characteristic of the Turanian flora, and a large number of species of the families Asteraceae, Poaceae and Fabaceae indicates the influence of the Mediterranean flora. The presence of Caryophyllaceae, Ranunculaceae, Brassicaceae and Lamiaceae indicates the boreal features of the flora of the region.

In Atyrau region 899 species of higher vascular plants belonging to 351 genera and 85 families were recorded. Ten leading families (Asteraceae, Amaranthaceae, Poaceae, Brassicaceae, Fabaceae, Caryophyllaceae, Polygonaceae, Boraginaceae, Scrophulariaceae, Lamiaceae) comprise 596 species, which is 66.2 % of the total number, and 214 genera (60.9 % of the total number of genera of the flora). Among the most numerous families are Asteraceae (134 species), Amaranthaceae (106), Poaceae (75), Brassicaceae (66) and Fabaceae (57 species), characteristic of the floras of the Iran-Turan sub-region of the Saharan-Gobi region.

Analysis of the flora of Mangistau and Atyrau oblasts revealed a significant number of species with potential for practical application, among which the diversity of ornamental plants stands out, represented by 215 and 135 species, respectively. Most of the species belong to herbaceous perennials. In ornamental landscaping of tree and shrub species *Amygdalus nana*, *Lonicera tatarica*, *Juniperus sabina*, *Rosa laxa*, *Salix triandra*, *Salix alba*, *Spiraea hypericifolia*, *Clematis orientalis*, *Caragana grandiflora* are used.

In terms of size, the group of plants used for economic purposes is made up of melliferous species, which account for more than 10 % of the total number of species. Here the most valuable are plants from the families *Salicaceae* (*Salix pentandra*, *Salix triandra*, *Salix alba*); *Rosaceae* (*Rosa laxa*, *Spiraea hypericifolia*, *Crataegus altaica*), *Fabaceae* (*Astragalus ammodendron*), as well as good mellifers are *Nitraria schoberi*, *Halimodendron halodendron*.

The group of food plants includes 129 species in Mangistau oblast and 70 species in Atyrau oblast from the total number of flora. Fruit and berry woody species make up a smaller part of this group. Food woody plants account for 7.8 % in Atyrau oblast and 16.7 % in Mangistau oblast, indicating a low proportion. These include: *Lonicera tatarica*, *Ribes aureum*, *Crataegus ambigua*, *Crataegus altaica*, *Malus baccata*, *Malus sieversii*, *Rosa laxa*, *Rosa canina*, *Rubus caesius*, *Prunus spinosa* (Table).

Analysis of distribution of fruit and berry crops by families showed that the most numerous is the family Rosaceae, which includes 8 species from 6 genera in Atyrau oblast and 8 species from 5 genera in Mangistau oblast. The second place is occupied by three families containing 2 species from 1 genus (Nitrariaceae, Elaeagnaceae, Moraceae), with the family Moraceae occurring only in Mangistau oblast. Other families (Caprifoliaceae, Grossulariaceae, Peganaceae, Solanaceae) are represented by 1 genus and species.

Table

List of wild fruit plants of Atyrau and Mangistau oblasts

Family	Rod	View	Life form	Environmental Group	Gathering place
<i>Atyrau region</i>					
<i>Caprifoliaceae</i>	<i>Lonicera</i> L.	<i>L. tatarica</i> L.	Shrub	Mesophyte	Imankara Mountains, Yellowtau Mountains, Maikungam Sands

## Continuation of Table

Family	Rod	View	Life form	Environmental Group	Gathering place
<i>Elaeagnaceae</i>	<i>Elaeagnus</i> L.	<i>E. angustifolia</i> L.	Shrub or low tree	Xerophyte	Ural River floodplain near Sary-Togai, Makhanbet villages Sands of Naryn Zhangyr River floodplain Uter River floodplain Taisongan Sands Zimovka Aksai (vicinity of Ushterek settlement)
		<i>E. oxycarpa</i> Schlecht.	Wood	Xerophyte	Ural River floodplain near Sary-Togai, Makhanbet, Eltai villages
<i>Grossulariaceae</i>	<i>Ribes</i> L.	<i>R. aureum</i> Pursh	Shrub	Mesophyte	
<i>Nitrariaceae</i>	<i>Nitraria</i> L.	<i>N. schoberi</i> L.	Shrub	Xerophyte	
		<i>sibirica</i> Pall.	Shrub	Xerophyte	
<i>Peganaceae</i>	<i>Malococarpus</i>	<i>crithmifolius</i> (Retz.) C.A. Mey	Shrub	Xerophyte	
<i>Rosaceae</i>	<i>Cerasus</i> L.	<i>C. fruticosa</i> Pall.	Shrub	Mesophyte	
	<i>Crataegus</i> L.	<i>C. altaica</i> Lge.	A small tree	Xeromesophyte	Zheltau Mountains
	<i>Malus</i> Mill.	<i>M. baccata</i> (L.) Borkh.	Wood	mesophyte	
		<i>M. sieversii</i> (Ledeb.) M. Roem	Wood	mesophyte	
	<i>Prunus</i> L.	<i>P. spinosa</i> L.	Shrub	Mesophyte	
	<i>Rosa</i> L.	<i>R. canina</i> L.	Shrub	Mesophyte	
		<i>R. laxa</i> Retz.	Shrub	Mesophyte	The Inderbor Mountains
	<i>Rubus</i> L.	<i>R. caesius</i> L.	Shrub	Mesophyte	
	<i>Amygdalus</i>	<i>Amygdalus nana</i>	Shrub	Xeromesophyte	
<i>Mangistau region</i>					
<i>Caprifoliaceae</i>	<i>Lonicera</i> L.	<i>L. tatarica</i> L.	Shrub	Mesophyte	Kolenkeli Mountains Zheltau Mountains
<i>Elaeagnaceae</i>	<i>Elaeagnus</i> L.	<i>E. angustifolia</i> L.	Shrub or low tree	Xerophyte	Western Karatau Tubkaragan Peninsula
		<i>E. oxycarpa</i> Schlecht.	Wood	Xerophyte	Tubkaragan Peninsula
<i>Grossulariaceae</i>	<i>Ribes</i> L.	<i>R. aureum</i> Pursh	Shrub	Mesophyte	Western Karatau Southern Aktau
<i>Moraceae</i>	<i>Morus</i> L.	<i>M. alba</i> L.	Wood	Xeromesophyte	Tubkaragan Peninsula
		<i>nigra</i> L.	Wood	Xeromesophyte	Tubkaragan Peninsula
<i>Nitrariaceae</i>	<i>Nitraria</i> L.	<i>N. schoberi</i> L.	Shrub	Xerophyte	Karagie Depression, Tubkaragan Peninsula,
		<i>sibirica</i> Pall.	Shrub	Xerophyte	Caspian coast
<i>Peganaceae</i>	<i>Malococarpus</i>	<i>crithmifolius</i> (Retz.) C.A. Mey	Shrub	Xerophyte	Caspian Sea coast, Tubkaragan Peninsula, Western Karatau, Eastern Karatau,
<i>Rosaceae</i>	<i>Crataegus</i> L.	<i>C. ambigua</i> C.A. Mey.	Shrub or tree	xeromesophyte	Tubkaragan Peninsula, Western Karatau, Eastern Karatau, Northern Aktau Mountains
		<i>C. altaica</i> Lge.	A small tree	Xeromesophyte	Zheltau Mountains

## Continuation of Table

Family	Rod	View	Life form	Environmental Group	Gathering place
<i>Rosaceae</i>	<i>Rubus</i> L.	<i>R. caesius</i> L.	Shrub	Mesophyte	Tubkaragan Peninsula, Southern Aktau Mountains, Western Karatau,

Comparative analysis of the ecological spectrum of fruit and berry plants has shown that in both regions a significant proportion of mesophytes are mesophytes. Distribution of species by ecological groups is as follows: in Mangistau — 7 mesophytes, 6 xeromesophytes and 5 xerophytes; in Atyrau — 9 mesophytes, 1 xeromesophyte and 5 xerophytes.

Extremely arid conditions, poor soils, high salinity and high summer temperatures favor the distribution of xeromesophytes, which require certain moisture conditions, in coastal zones, floodplains, stony and clay soils, knobby sands and mountainous areas [10-11].

The current status of natural populations of six tree fruit species was investigated: *Crataegus ambigua*, *Crataegus altaica*, *Rosa laxa*, *Rosa iliensis*, *Ribes aureum* and *Lonicera tatarica*.

*Crataegus altaica* is found in the Zheltau Mountains, located on the border of Atyrau and Mangistau oblasts. This species is concentrated mainly in the lower part of the mountain on stony slopes, with dense thickets observed on the northern slopes of Zheltau. Here *Crataegus altaica* forms herb-shrub-bush-bogwort communities covering areas of 500–600 m<sup>2</sup>, mainly in the lower parts of gorges and along their bottoms, on stony and loamy soils. The vegetation cover is characterized by diversity with projective coverage of 50–65 %. The main species of the community are *Crataegus altaica*, *Lonicera tatarica* and *Rosa laxa*, as well as various perennials. Structurally, the community is divided into three tiers: woody (200–600 cm high), represented by *C. altaica*; shrubs and bushes. *altaica*; shrub (120–200 cm), including *Rhamnus sintenesii*, *Lonicera tatarica*, *Spiraea hypericifolia*, *Rosa laxa*, and *Atraphaxi sreplicata*; and herbaceous (up to 70 cm) with such species as *Centaurea adpressa*, *Marrubium vulgare*, *Nepeta cataria*, *Ephedra distachya*, *Agropyron desertorum*, *Achillea nobilis*, and others.

*Crataegus ambigua* is endemic to Western Kazakhstan and a rare endangered species, included in the Red Data Book of Kazakhstan [12] and the Catalog of Rare Species of Mangystau Oblast [13]. In a number of works, the name *Crataegus ambigua* (doubtful hawthorn) is retained for the Mangyshlak hawthorn [14–16], when other authors [17] recognize it as an independent species *Crataegus transcaspica* (Transcaspien hawthorn).

In the natural flora of Mangistau, *C. ambigua* is found in the gorges of oases of the Karatau Mountains and the Tyubkaragan Peninsula. Here, on steep stony slopes with bedrock outcrops, wormwood-shrub communities with petrophytic perennials (*Centaurea squarrosa*, *Cousinia onopordioides*, *Lagochilus acutilobus*, *Verbascum songaricum*), shrubs (*Rhamnus sintenesii*, *Caragana grandiflora*, *Atraphaxis replicata*) and semishrub *Convolvulu sfruticosus* develop. Mesophytic thickets (*Carex diluta*, *Mentha longifolia*, *Phragmites australis*, *Plantago lanceolata*) grow along the bottom of the gorge near springs, and *Achnatherum splendens* grows on saline soils near springs, with projective coverage of 60–65 %. In gorges, *C. ambigua* forms hawthorn-joster-grass communities found in the lower parts of gorges and along stream beds. These communities are structured into three tiers: woody (up to 300 cm, with *C. ambigua*), shrubby (up to 300 cm, with *C. ambigua*), shrub (120–200 cm, with *Rhamnus sintenesii*, young hawthorns and *Caragana grandiflora*), and herbaceous (up to 70 cm), represented by *Centaurea squarrosa*, *Teucrium polium*, *Prangos odontalgica*, *Gallium humifusum*, *Mentha longifolia*, *Marrubium vulgare*, *Nepeta cataria*, *Crambe edentula*, *Ephedra distachya*, *Plantago lanceolata*, *Veronica amoena*, *Cynanchum sibiricum*, *Scandix stellata*, *Stellari amedia*, *Barbarea arcuata*, *Polygonum aviculare*, *Erodium cicutarium*, *Lamium amplexicaule*, *Verbascum songaricum*, and rarely occurring *Ziziphora tenuior*.

*Lonicera tatarica* was found in the Kolenkeli Mountains of Mangistau Oblast and the Zheltau Mountains of Atyrau Oblast. Distribution and tier structure of communities with participation of Tatar honeysuckle is similar to communities formed by *Crataegus altaica* and described above. Honeysuckle communities are located on stony plains punctuated by gorges. In the Kolenkeli Mountains, *Lonicera tatarica* grows on the upper parts of gentle slopes in sparse groups, occupying patches of 12×3.5 m, 8×3 m, 4×2 m, and 2.5×5 m in size. It forms small thickets in the composition of gurganic-wormwood and boyalycheid-solanaceous com-

munities (*Lonicera tatarica* — *Artemisia gurganica* — *Salsola arbusculiformis*). The vegetation here is typically mountain-desert, with low species diversity and total projective cover of 40–45 %. Two tiers are distinguished in the community: upper shrubby (120–220 cm) and herbaceous (60–80 cm). The shrub layer is represented by middle-aged, young and old shrubs of honeysuckle and tavolga. The herbaceous tier includes *Cichorium intybus*, *Agropyron fragile*, *Ephedra distachya*, *Descurainia sophia*, *Lepidium latifolium*, *Poa bulbosa*, *Tanacetum santolina*, *Stipa lessingiana*, *Achillea nobilis* and others. On stony peaks there are wormwoods, including *Artemisia gurganica*, *A. lerchiana* and shrub *Salsola arbusculiformis*, with herbs (*Ephedra aurantiaca*, *Agropyron desertorum*, *Tulipa biflora*, *Tulipa schrenkii*, *Melandrium viscosum*, *Goldbachia pendula*, etc.). Due to the steep relief and remoteness of slopes, the vegetation here is not used for grazing.

*Rosa laxa* is found on the Western Karatau Ridge in the Akmysh and Kogez Gorges, in the Zheltau Mountains (Sarbulak Gorge) of Mangistau Oblast, and in the Zheltau and Inder Mountains of Atyrau Oblast. In the Akmysh Gorge *Rosa laxa* is part of the hawthorn-herbaceous community (*Crataegus ambigua* — *Herba varia*), confined to rocky scree of the lower part of slopes. Three tiers are distinguished in the community: woody (up to 4.5 m), formed by adults of the doubtful hawthorn (*Crataegus ambigua*) and common apricot (*Armeniaca vulgaris*); shrubby (up to 160 cm), including *Rhamnus sintenisii*, *Rosa laxa*, *Convolvulus fruticosus*, *Atraphaxis replicata*, *Caragana grandiflora*, young hawthorn plants; and herbaceous tier (up to 60 cm), including *Mentha longifolia*, *Teucrium polium*, *Artemisia austriaca*, *Meristotropis triphylla*, *Lagochilus acutilobus* and other species.

In the Kogez Gorge *Rosa laxa* participates in the hawthorn-joster-herbaceous community (*Crataegus ambigua* — *Rhamnus sintenisii* — *Herba varia*), characteristic of the mountain desert. Three tiers were also identified here: Woody (up to 5–5.5 m), represented by white willow, single specimens of Sievers apple and common apricot, and adult hawthorns; shrubby (up to 200 cm), including thickets of *Rhamnus sintenisii*, *Caragana grandiflora*, *Rosa iliensis*, *Prunus spinosa*; and herbaceous tier (up to 70 cm) with such species as *Nepeta cataria*, *Cichorium intybus*, *Teucrium polium*, *Inula britannica*, *Artemisia austriaca*, *Melilotus albus*, *Scandix stellata*, *Stellaria media*, *Chorisporea tenella*, *Camelina sylvestris* and others. In both Akmysh and Kogez gorges, *Rosa laxa* vitality is good, plants flower abundantly, although fruiting is average, with no signs of damage or disease. Renewal from root shoots is also observed.

In Atyrau oblast *Rosa laxa* forms small thickets in the Zheltau Mountains, being a part of a shrubby herbaceous community (*Atraphaxis spinosa* + *Rosa laxa* — *Herba varia*). The community is located on stony scree in the middle part of the gorge slopes, where *Atraphaxis spinosa* dominates with *Rosa laxa* co-dominant. The vegetation consists of two tiers: the upper shrubby tier (80–120 cm) is represented by individuals of *Atraphaxis spinosa* and *Rosa laxa*, and the second herbaceous tier (20–50 cm) includes *Centaurea squarrosa*, *Echinops ritro*, *Silene suffrutescens*, *Malacocarpus critmifolium* and other species. In the Zheltau Mountains, rose hips show poor fruiting, but the general condition of plants is assessed as satisfactory.

In the Inderbora mountains, *Rosa laxa* forms large thickets in deep cavities, forming a briar-herbaceous community with a diverse vegetation cover. Two tiers are distinguished in these communities: Upper shrubby (100–200 cm), represented by *Spiraea hypericifolia*, *Rubus caesius* and *Rosa laxa*, and lower herbaceous (30–70 cm), consisting of *Nepeta cataria*, *Marrubium vulgare*, *Verbascum songaricum*, *Potentilla pedata*, *Plantago salsa*, *Lavatera thuringiaca*, *Lactuca serriola*, *Artemisia lercheana*, *Ephedra lamotolepis*, *Agropyron fragile*, *Poa bulbosa*, *Euphorbia seguieriana*, *Allium sabulosum*, *Kochia prostrata* and other species. The rosehip population is characterized by good condition and the presence of a significant number of young fruit-bearing individuals, as well as the absence of pests and damage.

*Rosa iliensis* Chrshan is a rare, endangered and narrowly endemic species. In the natural environment it lives in the Ili River valley, preferring floodplain tugai and moisture-loving conditions.

In Mangistau it occurs in Western Karatau, in the stream valley and on stony slopes of the Kogez Gorge, being a part of hawthorn-herbaceous community (*Crataegus ambigua* — *Herba varia*), forming a shrubby tier. The height of a single shrub reaches 2.5 m, the curly branches can grow up to 7 m, clinging to nearby trees. Individual shrubs vary in size from 5 to 8 m long and 3–4 m wide. Plants are well-branched, dense and abundantly fruiting; fruits are smooth, globular, black, 5–6 mm in diameter.

*Ribes aureum* Rursh. was recorded in the Karaturan Gorge of the Southern Aktau Range and in the Kogez Gorge of the Western Karatau Range. In the Karaturan gorge, golden currant grows in a silk-grass community (*Morus alba* — *Herba varia*), where *Morus alba* dominates and *Artemisia lessingiana* is a co-dominant. The vegetation is distributed in three tiers: tree (up to 5 m high), shrub (120–150 cm) and herb (up to 50–60 cm). The woody tier is represented by *Morus alba*, the shrubby tier by *Rhamnus sintenisii*,

*Atraphaxis replicata* and *Ribes aureum*. The herbaceous tier is characterized by a diversity of species including *Artemisia lessingiana*, *Agropyron fragile*, *Medicago caerulea*, *Potentilla supina*, *Eremopyron bonaepartis*, *Poa bulbosa*, *Alhagi pseudalhagi*, *Malacocarpus critmifolium*, *Ephedra distachya*, *Echinops ritro*, *Nepeta cataria*, *Haplophyllum obtusifolium* and *Schumannia karelinii*. *Ribes aureum* occurs sporadically in this community, the plants are of medium maturity and in good condition, but most of the trees are non-bearing. Root regeneration was identified during the survey.

In Mangyshlak Experimental Botanical Garden the selection of representatives of indigenous dendroflora of Western Kazakhstan for the formation of the collection was started. It includes 15 species of tree and shrub plants collected in natural conditions, among which 7 rare and endangered species included in the Red Book of Kazakhstan and the Catalog of rare species of Mangystau region. Phenological observations and primary biometric measurements were made. The following is a brief characterization of introducers:

Doubtful hawthorn (*Crataegus ambigua* C.A. Mey. Ex A.Beck.). It is a shrub or small tree up to 3-4 m high with a broadly round crown, belonging to mesoxerophytes. The trunk is gray, strongly gaunt and branched; young shoots are grayish-yellow in color. Spines are stout, 1-1.5 cm long. Leaves are leathery, green above, lighter below, with 7 lobes and toothed edges, 4-5 cm long and 3-4 cm wide, petiole 1.5-2 cm long. The plant flowers and fruits abundantly. Flowers are white, five-petaled, 1.5 cm in diameter, with 15 stamens and one pistil. Grown from seeds collected in the natural flora of Mangistau. Flowering begins in the third decade of April and lasts until mid-May. Fruits are purplish-red, fleshy, juicy, globular, 12-14 mm in diameter, with 1-2 seeds (seed length 8-9 mm, width 4-5 mm, ribbed, elliptical shape), ripening in October. Propagated by seeds; the most effective is the fall sowing of freshly harvested seeds. It has high winter hardiness and drought resistance. It has potential for use in medicine, ornamental horticulture, beekeeping and food industry.

White silkworm (*Morus alba* L.) is a 15-20 m tall tree belonging to mesoxerophytes. Branches are grayish-brown, young ones are downy; buds are broadly ovate, about 6 mm long. Leaves are 6-15 cm long and 4-10 cm wide, ovate or oblong-ovate, may be entire or more often pinnately 2-5-lobed, roundly urban-toothed along the margin. The plant was brought from the natural flora of Mangistau (Tyubkaragan peninsula). The height of a 5-year-old specimen is 1.2 m, average growth is 27 cm. Growth rate is medium, with high winter hardiness and drought resistance. Flowering occurs in the second half of April to the first decade of May, fruiting — in the third decade of June. Fruits are 1-2.5 cm long, greenish-white, pink or purplish-black, very juicy and sweet. The species has prospects for use in ornamental horticulture and food industry.

Sievers' apple-tree (*Malus sieversii* (Ledeb.) M.Roem) is a tree belonging to xeromesophytes. The apple-tree specimens were attracted to the culture by live plants from the Ural River floodplain. The apple-tree starts vegetation in the first decade of March, leaf budding is recorded from the second decade of March to the middle of April. Young specimens have not reached the generative period yet. The condition of plants in the collection is satisfactory, height up to 1.5 m. The species has prospects as a food, ornamental and melliferous plant, as well as a scion for cultivated varieties of apple trees.

*Populus diversifolia* (*Populus diversifolia* Schrenk) — small trees belonging to xerophytes. Plants were attracted by live specimens and cuttings from Ustyurt Reserve (Mangistau oblast). Vegetation begins in the first decade of March, leaf unfolding occurs in the middle of March, and the end of their growth — in the third decade of July. Budding was recorded in early April, flowering — from mid to late April. Fruit formation was not recorded. The height of plants reaches 1.2-1.8 m, the condition in culture is very good. The species has prospects of application for landscaping of the region and as a phytomeliorative plant.

The prickly plum or sloe (*Prunus spinosa* L.) is a small tree or shrub belonging to mesoxerophytes. Plants were attracted from the Ural River valley. The beginning of vegetation is observed in the second decade of March, and leaf budding and growth occurs from mid-March to the second half of April. The attracted specimens are young, they have not entered the generative period. The condition of the plants is very good, with a height of up to 80 cm. Tern has prospects as a food, ornamental, ameliorative and melliferous plant.

Steppe almond (*Amygdalus nana* L.) is a low-growing shrub belonging to mesoxerophytes. It is grown from seeds. Vegetation begins in the second decade of March, full leaf budding is completed by the end of March; budding occurs in late March, and flowering — in the first and second decades of April. Fruit setting has not been recorded in culture. Under botanical garden conditions, plants reach a height of 30-35 cm and are in good condition. The species has potential for use in ornamental and melliferous purposes.

Rosehip loose (*Rosa laxa* Retz.) is a tall shrub, reaching 2.5 m, belongs to mesoxerophytes. Old branches are brown, young branches are brown-greenish. Spines up to 7 mm long are located in pairs under the leaves, they are curved and slightly flattened. Leaves are about 7 cm long and consist of 5-9 oval leaflets,

glabrous on both sides, gray-green in color with simple toothed edges. The plant was brought from the vicinity of Lake Inder (Atyrau region). Vegetation begins in the first decade of March, leaf budding is observed from mid-March to early May. Budding is observed in the first half of May, flowering — from the middle to the end of May, fruiting — from the end of May, fruit ripening occurs in late September. The plant is characterized by high winter hardiness and drought resistance, the average growth during the growing season is 21 cm. In culture stable, the condition is very good. Promising for ornamental and medicinal use Iliya rosehip (*Rosa iliensis* Chrshan) is a low, densely branched shrub with thin, zigzag branches; it belongs to xeromesophytes. Branches are covered with powerful hook-shaped spines up to 7 mm long. Leaves are 8 cm long and consist of 7-8 oval-elliptic leaflets with acuminate apex, simply toothed margins and are green-blue above and gray-green below. The plant is brought from seed. It blooms from early May to the end of the first decade of June. Flowers form loose semi-umbrellas, corollas white or slightly pinkish, 3 cm in diameter. Fruits are black, globular, ripening in late September. The species is close to Begger's briar, differing only in black fruits. It has high winter hardiness and drought resistance, the average growth is 12 cm. It is promising for ornamental and melliferous use; it is found in nature in the Ili River valley.

Dog rosehip (*Rosa canina* L.) is a large shrub up to 3-4 m high and with a base diameter up to 4 cm, belonging to xeromesophytes. Old shoots are gray-brownish-brown, thick and arcuately curved. Young shoots have a red upper part and green lower part, with sparse sickle-shaped spines up to 1 cm long. Leaves are up to 12 cm long and consist of 5-7 broadly oval, pointed at the apex. Inflorescences are semi-umbrellas containing up to 12 flowers, more often 3-4, with bright pink corollas up to 6 cm in diameter. The plant is grown from seeds and blooms from the second decade of April to mid-May. The fruits are oval, smooth, dark maroon, ripen in late September and are used medicinally. The plant is propagated by seeds and gives abundant self-seeding, the average annual growth during the growing season is 24 cm. It is characterized by high decorative value, both in the period of flowering and fruiting. Dog rose is a common rootstock for garden roses, providing unpretentiousness, winter hardiness and resistance to diseases. It has prospects as an ornamental, medicinal and melliferous plant.

*Spiraea hypericifolia* L. is a low shrub belonging to xerophytes. It was brought into culture by cuttings and young specimens from steppe areas of Atyrau and northern part of Mangistau oblast. The beginning of vegetation is observed in the first decade of March, leaf budding is fixed from the middle to the end of March. At the moment, plants have not reached generative state, which did not allow to record budding and flowering. The condition of plants is satisfactory, height is 40-50 cm. This species has prospects of application in ornamental and honey-bearing horticulture.

Golden currant (*Ribes aureum* Pursh.) is a shrub belonging to xeromesophytes. It is attracted by living plants from the Ural River floodplain. The beginning of vegetation falls on the middle of March, leaf budding was recorded from the second half of March to the third decade of April. Budding begins in the middle of April, flowering — from the second half of April to the end of April. Fruiting is abundant, from late April to mid-June. Growth of shoots is completed in mid-April. The condition in culture is very good, the height of plants is 120-140 cm. The species has prospects as an ornamental, ameliorative and food plant.

Malacocarпуситтмифолиус (Retz.) C.A. Mey.) is a shrub with whitish bark, belonging to xeromesophytes. It is a rare relict species. It was brought into culture by seedlings from the natural flora of Mangistau. Height reaches 1.5 m, bush diameter — 2.95 m, average growth — 16 cm. Vegetation begins in the first decade of April, flowering occurs from the second decade of May to the end of August, fruiting — from the second half of June to the third decade of September. Both fully ripe and unripe fruits can occur on one specimen. Winter resistance and drought tolerance are high. It is well propagated by seeds. The species has prospects as an ornamental and food plant.

*Nitraria schoberi* L. is a 1-2 m high shrub with whitish-gray bark, spreading-branched, with prickly twigs at the ends, belonging to xerophytes. Seedlings from the natural flora of Mangistau were attracted to the botanical garden and planted in the form of a clump. Height reaches 1.3-2 m, bush diameter — 5.95 m, growth varies from 21 to 58 cm. The growth rate is high. Vegetation begins from the first decade of April, flowering — from the second decade of May to the second decade of June, fruiting — from the second decade of June to the end of July. It has high winter hardiness and drought resistance, well propagated by seeds. The species has prospects as an ornamental, food and medicinal plant.

Gester sintenisii (*Rhamnus sintenisii* Rech. fil.) is a strongly branched thorny shrub belonging to xerophytes. Living plants from the natural flora of Mangistau were attracted to the botanical garden. Height reaches 1.1-2 m, bush diameter — 4.5 m, average growth is 15-20 cm. The growth rate is average. Vegetation begins in the second decade of March, flowering — from the first decade of May to the third decade of

May, fruits ripen in June–July. It has high winter hardiness and drought resistance, and is propagated by seeds. The species has prospects as an ornamental and medicinal plant.

Blue raspberry or blackberry (*Rubus caesium* L.) is a thorny climbing shrub belonging to mesophytes. Plants were attracted from the gorges of Tyubkargan peninsula in Mangistau oblast. The beginning of vegetation falls on the second decade of March, leaf budding is recorded from mid-March to mid-April. Budding begins in early May, flowering — from the first decade of May to mid-August. Fruiting is abundant and prolonged, from the end of May to the end of August. The height of shoots in culture reaches 120–140 cm, the condition is good. The plant has prospects as a melliferous and food plant.

### Conclusion

Aboriginal dendroflora of Western Kazakhstan is an important resource for introduction in desert conditions of Mangistau. Despite the natural limiting factors of the desert zone, all the species under consideration are well adapted and can be used as fruit and berry plants. Proper use of these plants can significantly improve the ecological situation in the region, contributing to the restoration of the natural balance and sustainable development of local communities.

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## Батыс Қазақстанның аборигенді дендрофлорасын Маңғыстаудың шөліне интродукциялау

Мақала Батыс Қазақстанның аборигенді дендрофлорасын зерттеуге және оны Маңғыстаудың шөлді жағдайларына интродукциялауға арналған. Маңғыстау облысының флорасы 333 тұқымдас пен 73 туысқа жататын жоғары споралы және тамырлы өсімдіктердің 770 түрін қамтиды. Атырау облысында 351 тұқымдас пен 85 тұқымдасқа жататын жоғары тамырлы өсімдіктердің 899 түрі тіркелген. Аборигенді ағаш өсімдіктері Атырау облысында жалпы флораның 7,8%-ын; Маңғыстау облысында 16,7%-ды құрайды, бұл олардың өсімдік жамылғысындағы үлесінің төмендігін көрсетеді. *Crataegus ambigua*, *Crataegus altaica*, *Rosa laxa*, *Rosa iliensis*, *Ribes aureum* және *Lonicera tatarica* секілді алты ағаш жеміс-жидек түрлерінің табиғи популяцияларының жағдайы зерттелді. Батыс Қазақстанның дендрофлорасының өкілдерін жинау жұмыстары басталды, оның құрамына 15 түр, соның ішінде Қазақстанның және Маңғыстау облысының Қызыл кітабына енгізілген 7 сирек және жойылып бара жатқан түрлер бар. Аборигенді ағаш өсімдіктерінің азықтық, дәрілік және экологиялық функциялары, сондай-ақ экожүйелерді қалпына келтіру мен азық-түлік қауіпсіздігін қамтамасыз ету мақсатында қолдану перспективалары талданды.

*Кілт сөздер:* табиғи өсімдіктер дүниесі, Батыс Қазақстан, Маңғыстау, Атырау, өсімдіктер әлемі, популяциясы, интродукциясы.

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## Аборигенная дендрофлора Западного Казахстана при интродукции в пустыне Мангистау

Статья посвящена исследованию аборигенной дендрофлоры Западного Казахстана и её интродукции в пустынные условия Мангистау. Флора Мангистауской области включает 770 видов высших споровых и сосудистых растений, принадлежащих к 333 родам и 73 семействам. В Атырауской области зафиксировано 899 видов высших сосудистых растений, относящихся к 351 роду и 85 семействам. Аборигенные древесные растения составляют 7,8 % от общего числа флоры в Атырауской области и 16,7 % в Мангистауской области, что указывает на их низкую долю в растительном покрове. Изучено состояние природных популяций шести древесных плодово-ягодных видов: *Crataegus ambigua*, *Crataegus altaica*, *Rosa laxa*, *Rosa iliensis*, *Ribes aureum* и *Lonicera tatarica*. Начат отбор представителей аборигенной дендрофлоры Западного Казахстана для формирования коллекции, в которую включены 15 видов, в том числе 7 редких и исчезающих, занесённых в Красную книгу Казахстана и Мангистауской области. Анализируются аборигенные древесные растения, их пищевые, лекарственные и экологические функции, а также перспективы использования для восстановления экосистем и обеспечения продовольственной безопасности.

*Ключевые слова:* природная флора, Западный Казахстан, Мангистау, Атырау, флора, популяция, интродукция.

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