

Morphology of wintering shoots of a rare species *Exochorda serratifolia* S. Moore in Primorsky Krai

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Abstract. The paper studies the morphology of winter shoots of the rare species *Exochorda serratifolia* S. Moore (Rosaceae Juss.) included in the Red Book of Primorsky Krai (Russian Federation) in the natural population (Khankaisky district of Primorsky Krai) and in culture (the arboretum of the Mountain Taiga Station of the Far Eastern Branch of the Russian Academy of Sciences) during 2020-2021. The studied morphological features (linear dimensions of the stem, buds and leaf scars, the number of metamers, bud scales, etc.) vary slightly. A number of morphological characteristics of the buds of *Exochorda serratifolia* – polyscaly, type of budding, the presence of a waxy coating are adaptive features to temperate continental climatic conditions. The obtained data on the morphology of overwintering shoots of *Exochorda serratifolia* can be used as additional diagnostic features for identification of the plant in a leafless state.

1 Introduction

Exochorda Lindl. (pearlbush) is a small genus of the family Rosaceae Juss., whose range covers East and Central Asia [1, 2].

Up to 5 species were differentiated in the genus, subsequently the number of species was reduced to 3 [3]. However, there are studies indicating a close similarity of different species, which can be considered subspecies of the same species *Exochorda racemosa* (Lindl.) Rehder [1].

Plants of the genus are mainly used as ornamental plants [4, 5]; they have been cultivated in Russia since 1883 [6]. The chemical composition of the aboveground organs of *Exochorda* is studied [7, 8].

The area of *E. serratifolia* S. Moore covers East Asia, where it grows in Northeast China [9], on the Korean Peninsula [10, 11] and in Primorsky Krai (Russian Federation).

In China, the species occurs in the provinces Hebei and Liaoning, where it grows along the slopes of hills, river banks, and also in the undergrowth of Mongolian oak forests [2, 11]. On the Korean Peninsula, *Exochorda serratifolia* is considered a rare species, and its

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population structure and biological and ecological features are currently being studied [12, 13, 14].

In Primorsky Krai, the species is located in the north-east of its area, locally recorded only in the Khanka region, in the vicinity of the villages Dvoryanka and Komissarovo [15, 16]. It grows on gravelly and rocky sites of the southern and southwestern slopes of uplands [17]. *Exochorda serratifolia* is assigned to North Korean floristic elements, to the group of ultranemoral [18] and subtropical [19] plants. It is a relic of the warm and dry Eopleistocene [20].

Due to the rare occurrence, the species is included in the Red Data Book of Primorsky Krai in the VU (vulnerable) status [21]. As ornamental species it's recommended for landscaping in the south of Primorye [22]. It should be noted that, compared with *Exochorda giraldii* and *E. rasemosa*, the Far Eastern species *E. serratifolia* is much less common in botanical gardens and arboreturns in Russia. Thus, in the territory of the Far East, it is found in the collections of the Botanical Garden-Institute (Vladivostok), its Amur branch (Blagoveshchensk), and in the arboretum of the Mountain Taiga Station, where it is represented by single specimens.

The aim of this work is to identify the morphological features of the shoots of *Exochorda serratifolia* in the winter period of plants of the natural population and in culture in the arboretum of the Mountain Taiga Station of the Far Eastern Branch of the Russian Academy of Sciences.

2 Materials and methods

The morphology of winter shoots of *Exochorda serratifolia* was studied during 2019-2021 in the Khanka district (vicinities of the village of Komissarovo, 44°59'24" N, 131°47'05" E) and the Ussuri urban district (the arboretum of the Mountain Taiga Station of the Far East Branch of the Russian Academy of Sciences, 43°42'00" N, 132°09'00" E) (Figure 1).



Fig. 1. Collection sites.

The morphological description was carried out according to the criteria identified in the relevant methodological works [23, 24, 25]. To determine the morphometric parameters, 10 shoots of each plant were taken. Considering that the shoots vary significantly in their length (from 5 to 52 cm) and the number of metameres (from 2-3 in short shoots to 40-45 in elongated shoots that arose from dormant buds), shoots of approximately the same length (about 9 cm) were taken for the study. When processing the data, the methods of mathematical statistics [26] were used.

3 Results and discussion

The natural population of *Exochorda serratifolia* in the vicinity of the village Komissarovo cover 2 ha. on south-west slope of hill at its base. Plants form groups of 5-10 specimens, reach 1.2-1.7 m in height and 1.1-2.7 cm in diameter at the base of the trunk.

In the arboretum of the Mountain-Taiga Station there are 12 specimens of *Exochorda serratifolia*, which were brought in 2007 [27, 28] and 2020 from Khanka district of Primorsky Krai.

In the arboretum, the species is represented by shrubs 150 and 260 cm in height with a relatively small number (1-9) of the main axes which diameter vary from 1.5 to 3 cm. The trunk bark is dirty gray, longitudinally cracking and flaking.

3.1 General shoot morphology

Average data on the general morphology of the shoot are presented in Table 1.

Table 1. Average shoot morphometric parameters of *Exochorda serratifolia*.

Place	Shoot length, sm	Diameter at stem apex, sm	Diameter at stem base, sm	Number of metameres	Length of internode, sm
Arboretum of Mountain-Taiga Station	7.05±1.41	0.27±0.01	0.31±0.02	7.6±0.49	1.2±0.11
Khanka district	10.07±0.75	0.25±0.01	0.3±0.01	8.3±0.63	1.5±0.23

In *Exochorda serratifolia*, both in the natural population and in culture, a large number of dried annual shoots are observed, the apical bud is often absent. The diameter of the stem at the base and at the top, the number of metameres, and the average length of the internode are approximately the same in plants of the natural population and the arboretum.

The change in the length of the internodes from the base of the shoot to the apex generally corresponds to the course of growth: there are 2-3 very short internodes at the base, 1-2 short ones at the apex, and the longest internode in the middle part. The uppermost elongated internode somewhat widens in the upper part compared to its middle part. The uppermost 2-3 internodes are very short, usually 0.05-0.1 cm long. The length of internodes in the middle part of the shoot are approximately the same for all species – 2.5-3 cm.

The shape of the cross section is round, at the top of the stem often oval. The stems are slightly tapered. The ratio of the diameter of the stem base to the diameter of its top is 1.14 in arboretum plants and 1.2 in plants of the natural population. The stems are smooth, glabrous, brown or light brown, whitish due to the presence of epidermis, longitudinally cracking and exfoliating.

The lenticels are slightly convex, oval (up to 0.12 cm long and 0.06 cm wide) or rounded (0.05-0.07 cm in diameter), less often lenticular (up to 0.12 cm long and 0.07 cm wide), with longitudinal central cracking. The stems are completed, the core is white, rounded or oval in

outline, the ratio of the diameter of the core to the diameter of the stem is 0.3. Bud arrangement is alternate. Lower 2-3 nodes without buds. From the middle and lateral sides of the leaf scars, more or less pronounced ridges extend downward, made the stem a slight ribbing.

3.2 Bud morphology

Data on the morphometric parameters of the buds are presented in Table 2.

Table 2. Average morphometric parameters of lateral buds of *Exochorda serratifolia*.

Place	Bud length, sm	Bud width, sm	Number of outer bud scales	Total number of bud scales
Arboretum of Mountain-Taiga Station	0.37±0.04	0.20±0.01	8-9	13
Khanka district	0.31±0.02	0.19±0.001	8-9	13

Buds are alternate, solitary (Figure 2), sessile, often separated from the stem, lateral cone-shaped, flattened, terminal bud is cone-shaped or cylindrical-cone-shaped. In most cases, lateral buds adjoin the upper side of the leaf scar, however, on elongated shoots formed by dormant buds (rarely in ordinary shoots), they are located at a certain distance (0.25-0.3 cm) from it. The size of the buds correlates with the size of the shoots. Lateral buds up to 0.45 cm long and 0.26 cm wide. The terminal buds are usually slightly larger than the lateral ones, up to 0.6 cm long and 0.35 cm wide. In the longitudinal section, buds are triangular, in the transverse section they are rounded (terminal) or oval (lateral buds). The apex of buds is acute.



Fig. 2. Shoot node of *Exochorda serratifolia* (arboretum of Mountain-Taiga Station).

External bud scales 8-9. The total number of bud scales is 13. The outer scales are brown or dark brown, with a lighter base, glabrous, smooth, and shiny on the outer and inner sides. In the upper part of the scales there is often a wax coating, the top of the scales is often with

a keel and a small "beak" up to 0.03 cm in length. The outermost bud scales with a thickened base.

The coloration of the scales in the studied species changes in a similar way: the inner scales become paler, only the top of the scales remains brown, the middle part acquires a reddish tint, and the base is greenish. The innermost scales are pale reddish green. Outer scales (2-3 pairs) opposite, inner semi-encompassing, innermost almost enclosing.

3.3 Leaf scar morphology

Leaf scar rounded-obversely triangular (Fig. 2), with a concave upper side, rarely semilunar, up to 0.29 cm wide and 0.08 cm wide, on a small leaf pad, the surface is light brown, often dark brown, almost black, grainy. Leaf scars are often almost horizontal and therefore poorly visible visually.

There are 3 leaf traces, in the form of stumps, located closer to the upper border of the leaf scar.

The edge of the leaf pad protrudes above the surface of the leaf scar. In the lower part of the leaf scar, on the lower side, it is bordered by a brown or dark brown stripe, while a variety of colors of this stripe is observed – there may be a lighter part above, a darker one below, or there is a solid brown stripe.

4 Conclusions

An analysis of the morphometric parameters of winter shoots of *Exochorda serratifolia* plants of the natural population and those growing in the arboretum of the Gornotaiga Station showed that they vary slightly. Such characteristics of *Exochorda serratifolia* buds as multiscaly, semi-enclosing aestivation and the presence of a wax coating are adaptive features to temperate continental climatic conditions. The obtained data on the morphology of overwintering shoots of *Exochorda serratifolia* can be used as additional diagnostic features for identification of *Exochorda serratifolia* in a leafless state.

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