



## ECOLOGICAL AND BIOLOGICAL FEATURES OF *CYPRIPEDIUM* AT KATON-KARAGAY STATE NATIONAL NATURAL PARK

Yuri A. Kotukhov, Alevtina N. Danilova\*, Olga A. Anufriyeva, Abdrakhman N. Suleimenov, Aidar A. Sumbambayev and Serik A. Kubentaev

Altai Botanical Garden, Ridder, Republic of Kazakhstan

### Annotation

The article presents the results of studying the ecological and biological features of three species of the genus *Cypripedium*: *Cypripedium calceolus* L. *Cypripedium macranthon* Sw. and *Cypripedium ventricosum* Sw. on the territory of Katon - Karagay State National Natural Park. It was established that in natural coenopopulations of species, similarities were found in ecological parameters, differences in phytocenotic structure, age spectrum, morphometric indicators, methods of reproduction.

**Key words:** *Cypripedium calceolus* L. *Cypripedium macranthon* Sw. and *Cypripedium ventricosum* Sw., coenopopulation, phytocenosis, individual, escape, age structure.

### Introduction

Protection and preservation of rare and endangered plant species in general, and species of the family Orchidaceae (Juss.) in particular, is impossible without the development of specific conservation strategies, the main core of which is the study of the biology of the studied species and the knowledge of their life strategies at the population and organism levels (Suyundukov, 2014).

Orchids are one of the rarest and most vulnerable groups of plants. Due to the increasing anthropogenic load and complex life cycle, Orchidaceae family species are currently very popular objects among angiosperms for a wide variety of studies in the field of biology and ecology. Being mostly rare or diminishing in the number of plants, representatives of this family are studied from the point of view of population dynamics and the overall dynamics of the number of species, and work is being carried out on mapping of species in different regions. The threat of extinction of a number of species in nature stimulates cultivation works *in vitro* and reintroduction. A prominent place in studies of orchids is the study of their systematics and taxonomy, as well as the study of morphological features, geographical distribution, phytocenotic confinement.

Orchids are fairly well protected by international conventions: IUCN-1997z Red List, European habitats;

\*Author for correspondence:

Appendix I; valid from 5 March 1998. At the state level in Kazakhstan, out of 27 species growing on the territory of the Republic, 8 are listed in the Red Book (Red Book, 2014). The category of rare orchid species in the flora of Kazakhstan includes species of the genus *Cypripedium*: *Cypripedium calceolus* L. *Cypripedium macranthon* Sw. and *Cypripedium ventricosum* Sw.

*Cypripedium calceolus* L. is a rhizomatous summer green plant. Forest mesophyte, mesohygrophyte. Dwells in sparse small-leaved (*Betula pendula* Roth, *Populus tremula* L.) and mixed (*Betula pendula* Roth, *Picea obovata* Ledeb.) Forests; sphagnum swamps, forest glades, in marshy dark coniferous forests. The species is characterized by confinement to the valleys of large rivers and low-lying sphagnum bogs overgrown with sparse birch-spruce forests in well-drained areas of valley landscapes. The species is common in Eurasia and North America. In Kazakhstan, it is very rare Katon –Karagay along the banks of the Sarymsak river (Krylov, 1929), in the valley of the Irtysh river, Semipalatinsk pine forest (Kuznetsov, Pavlov, 1958); on the Kokchetav Upland (Karamysheva, Rachkovskaya, 1973), as well as new habitats of the species in the Southern Altai (Kotukhov, Danilova, Anufriyeva, 2009).

*Cypripedium macranthon* Sw. - rhizomatous summer green plant, Eurasian boreal-forest species with an extensive range. Distributed in some regions of the

European part of Russia, in southern and middle Siberia, in the Far East. The northern boundary of the range passes in Yakutia, in the south it reaches Tibet and the Himalayas (Sobolevskaya, 1984). Rare and shrinking species within the entire range. In Kazakhstan, it is found limited, only on the Kokchetav Upland (Kuznetsov, NM, Pavlov, 1958, and in Altai: the valley of the Bukhtarma River, in the area of the Zyryanovsk mine; near the village of Katon-Karagai along the Sarymsak River (Krylov PN, 1929; Kotukhov *et al.*, 2009).

*Cypripedium ventricosum* Sw. - perennial summer green plant, mesophyte. It is believed that *Cypripedium ventricosum* Sw. is a hybrid between *Cypripedium macranthos* Sw. and *C. calceolus* L. (Moskalyuk, 2007). In Kazakhstan, the species is found very limitedly, according to clarified young, thin-stemmed birch trees (Kotuhov and others, 2009 )

Starting from 2018, within the framework of the grant project No. Å05133868 “Study of the distribution and current state of populations of species of the Orchid family of Kazakhstan Altai and their primary introduction in the Altai Botanical Garden,” work continued on the study of these species. Orchidaceae.

The purpose of the study is to study the ecological and biological features of species of the genus *Cypripedium* in the flora of the Katon-Karagai State National Natural Park.

### Materials and research methods

Research subjects: *Cypripedium calceolus* L., *S. macranthos* and *C. ventricosum* Sw. in natural habitats in the territory of Katon -Karagay State National Natural Park of the East Kazakhstan region.

The territory of the national park is a mountainous country with numerous ridges. The main waterway is the Bukhtarma River. The climate is sharply continental, with large fluctuations in temperature, both by the seasons of the year and during the day. Precipitation is unevenly distributed, the largest amount falls in summer (June-July), the minimum is in January-February. The annual precipitation is 432 mm, the average annual air temperature is +1.6°C, with an absolute maximum of +34°C and an absolute minimum of -44°C Average soil freezing is from 47 to 100 cm. Steady snow cover usually forms in early November and is destroyed in early to mid-April. Within the park are four high-rise zones: nival, tundra-meadow, mining and forestry, mining and forest-steppe-meadow that include all specific landscapes of the region (Krykbaeva, 2008).

Ecological - biological research with the description of plant communities with the participation of *Cypripedium calceolus* was carried out in a young sparse birch forest in the mountain-forest zone;

*Cypripedium macranthos*-in the composition of the birch-willow forest; *C. ventricosum*-in a thin-walled birch forest. To determine the species composition of plants in phytocenoses with orchid participation, the academic works “Flora of Kazakhstan”, 1956-1964, “Flora of Siberia”, 1987 were used. The nomenclature of species is given according to S.K. Cherepanova (1995). Population studies, including ecological-phytocenotic characteristics of populations, age composition, viability of coenopopulations and individuals, were carried out according to the methodological guidelines of V.N. Golubeva, E.F. Molchanov (1978), according to the methodological developments of L.V. Denisova L.V., Nikitina S.V., L.B. Charcoal (1986).

### Results and its discussion

In the national park, the species studied are rare, of which *Cypripedium calceolus* and *Cypripedium macranthos* are included in the Red Book of Kazakhstan and, accordingly, have a rarity category-III, a rare species with a declining number and II, a very rare species (Red Book of Kazakhstan, 2014). For the flora of Kazakhstan *C. ventricosum* Sw. given for the first time.

The coenopopulation of *Cypripedium calceolus* in the composition of young sparse birch forests occupies a plot of 400 m<sup>2</sup>, the relief of which is moderately hilly, illuminated and blown by the winds. Soils are friable, meadow, acidic (pH = 5.2), easily drained, as the underlying layer is made of rolled pebbles. The geographical position of the coenopopulation is determined by the coordinates N 49°11'08", E 85° 30'59", height 1046 m above sea level. M

The main forest tree is *Betula pendula* Roth, less common are *Picea obovata* Ledeb., *Salix rorida* Laksch., *S. pentandra* L. The shrub layer is not pronounced. Grass is well developed, dominated by *Carex macroura* Meinsh, projective cover 60-80%. The species richness of the phytocenosis is very limited, on average, represented by 15-20 species (*Bistorta major* SF Gray, *Saussurea parviflora* (Poir.) DC., *Thalictrum minus* L., *Calamagrostis epigeios* (L.) Roth, *Veronica longifolia* L., *Dactylis glomerata* L., more dense, composed of *Equisetum sylvaticum* L., *E. ramosissimum* Desf., *Vicia sepium* L., *Ligularia glauca* (L.) O. Hoffm., *Ranunculus acris* L., *Lathyrus pratensis* L., *Lupinaster pentaphyllus* Moench, *Hieracium umbellatum* L., *Cypripedium macranthos* Sw., *C. calceolus* L., *Primula macrocalyx* Bunge, *Rubus saxatilis* L., *Scutellaria altaica* Fisch. Ex Sweet, *Carex macroura* Meinsh., *Melica nutans* L., *Fragaria vesca* L.). The total projective cover varies from 35-52%.

*Cypripedium calceolus* is found in small loose groups separated from each other. The demographic structure

of the population is formed by juvenile, adult vegetative, young generative, aging generative. Senile individuals are not marked. The age spectrum is left-sided, as a percentage of 62.2% of juveniles, 24.2% of vegetative individuals and 13.6% of generative ones. In young individuals, 1-2 generative shoots are formed, in adults - 4-7. As a rule, one flower is formed on the shoot, single - two each. The percentage of fruiting is very low-7.7%. Seeds in the middle of October in the bulk are taken out of the population due to good air flow through the site. The species propagates and settles with seeds, which linger on the unevenness of the plot and *Carex macroura* Meinsh. Sods, which promotes the formation of clusters of uneven-age individuals and testifies to the effectiveness of seed reproduction.

*Cypripedium macranthon*'s cenopopulation as part of a birch-willow forest occupies an area of 1200 m<sup>2</sup>. The geographical position is determined by the coordinates N 49° 11'31", E 85° 44'42", height 415 m above sea level. The soils in the habitats of the species are loose, meadow-peaty, acidic (pH = 5.2), significantly enriched in organic matter. The upper soil layer is weakly pronounced, the underlying layer consists of run-in pebbles and river silt.

Plant cover edificators are *Betula pendula* Roth, *Salix viminalis* L., *S. pyrolifolia* Ledeb., From low shrubs *Lonicera pallasii* Ledeb., From grassy *Bistorta major* S.F. Gray, *Angelica sylvestris* L. The woody layer is formed by *Betula pendula* Roth, *Salix viminalis* L., *S. pyrolifolia* Ledeb. Crown closure is relatively high - 07-08. The tier of tall shrubs is formed by *Salix caprea* L., *Crataegus chlorocarpa* Lenné et C. Koch, rarer *Betula microphylla* Bunge, *Padus avium* Mill., *Salix pentandra* L., *S. cinerea* L., *Hippophaë rhamnoides* L. Of the low-growing shrubs, *Lonicera pallasii* Ledeb., more rarely *Rosa acicularis* Lindl., *Atragene sibirica* L., *Pentaphylloides fruticosa* (L.) Schwarz.

Grass is mown, projective cover fluctuates at the level of 30-45%. The structure and abundance are determined by the dominant species: *Equisetum pratense* Ehrh., *Rubus saxatilis* L., *Carex songorica* Kar. et Kir., in places *Phragmites australis* (Cav.) Trin. ex Steud., *Tussilago farfara* L., *Bistorta major* S.F. Gray, *Saussurea parviflora* (Poir.) DC. Subdominant species in the first tier are forest high-grass species: *Filipendula ulmaria* (L.) Maxim., *Thalictrum minus* L., *Serratula coronata* L., *Senecio jacobaea* L., *Veronica longifolia* L., *Calamagrostis epigeios* (L.) Roth, *Dactylis glomerata* L., *Sanguisorba officinalis* L., *Aconitum volubile* Pall. ex Koelle, *Poa sibirica* Roshev., *Polygonatum sibiricum* Delaroche, *Artemisia vulgaris* L.; in the second tier – and *Equisetum sylvaticum* L., *Hieracium umbellatum* L., *Galium boreale* L., *Vicia cracca* L., *Lathyrus pratensis* L., *Ranunculus acris* L., *Geranium pratense*; in the third tier, *Cypripedium macranthon* Sw., *Angelica*

*sylvestris* L. *Trifolium pratense* L., *Lupinaster pentaphyllus* Moench, *Potentilla anserina* L., *Geum rivale* L., *Melica nutans* L., *Adonis sibirica* Patr. ex Ledeb., *Cerastium pauciflorum* Stev. ex Ser., *Orchis militaris* L., *Dactylorhiza traunsteineri* (Saut.) Soó, *D. fuchsii* (Druce) Soó, *D. longifolia* (L. Neum.) Aver., *Scutellaria altaica* Fisch. ex Sweet, *C. ventricosum* Sw., *C. calceolus* L., *Primula macrocalyx* Bunge.

*Cypripedium macranthon* Sw. on the area it is placed by friable groups from 3-15 or single isolated individuals. Plants *Cypripedium macranthon* Sw. well developed, form multi-stemmed sod., consisting of generative and vegetative shoots in a ratio of 3.2: 1.9. On a generative shoot, the height of which varies between 25-35 cm, usually one flower is formed. We found some turfs, where 20% of peduncles had 2 flowers each.

Calculation of the participation of different age groups (in percent) showed that the pregenerative age states in total amounted to 43.0%, uneven-age generative plants - 54.3%, senile ones - 0.7%. The ratio of vegetative and generative in the studied coenopopulation is 1: 1.3, which indicates a stable age spectrum. Cenopopulation normal type progressive, not affected by the influence of anthropogenic factors.

Individuals of *C. ventricosum* as part of a thin-walled birch forest were found on an area of 700 m<sup>2</sup> Location coordinates: 49° 11'02"N, 85° 30'53" E.d., 907 m above sea level m. The section is a flat-flat, with small depressions, where in spring there is a stagnation of thawed snow. Soils are loose, acidic (pH = 5.2). The soil layer is weak, 20-30 cm thick. The underlying layer is composed of rolled pebbles and river sludge.

In the plant community, the dominant forest forming species is *Betula pendula* Roth with crowns 03-04. Less commonly in the tree stand are noted *Salix caprea* L., *S. pyrolifolia* Ledeb. The shrub layer is not pronounced, *Rosa acicularis* Lindl., *Spiraea media* Franz Schmidt, *Lonicera pallasii* Ledeb. Their share in the coating accounts for not more than 0.7-1%. Grass cover is well formed, represented mainly by mesophilic species with a total projective cover of 70%. The structure and appearance of the phytocenosis determines the dominance of three types: *Carex macroura* Meinsh., *Rubus saxatilis* L., *Bistorta major* S.F. Gray, rarely *Melica nutans* L., which account for about 30-45%. In the formation of phytocenosis also participate in the first tier: *Calamagrostis epigeios* (L.) Roth, *Saussurea parviflora* (Poir.) DC., *Pleurospermum uralense* Hoffm., *Bistorta major* S.F. Gray, *Crepis lyrata* (L.) Froel., *Artemisia vulgaris* L., *Ligularia glauca* (L.) O. Hoffm; in the second tier: *Vicia sepium* L., *Trifolium pratense* L., *Poa pratensis* L., *Carex macroura* Meinsh., *Cerastium pauciflorum* Stev. ex Ser., *Galium boreale*

L., *Lupinaster pentaphyllus* Moench., *Hieracium umbellatum* L., *Cypripedium macranthon* Sw., *Adonis sibirica* Patr. ex Ledeb., *Lathyrus pratensis* L., *Scutellaria altaica* Fisch. ex Sweet, *Equisetum pratense* Ehrh., *Tussilago farfara* L., *Carum carvi* L., *Primula macrocalyx* Bunge, *Fragaria viridis* (Duch.) Weston.

Population *Cypripedium ventricosum* Sw. consists of multi-stemmed generative specimens placed in mosaic, loose groups of 3-4 pieces. in each.

Together *Cypripedium ventricosum* *Cypripedium* grows at a considerable distance in the population *mactanthon* and *Cypripedium calceolus*.

*Cypripedium ventricosum* Sw. well-developed, form from 17 to 30 single, rarely two-flowered generative shoots in height from 30 to 35 cm. One individual produces from 21 to 39 flowers. The formation of fruits (boxes) is relatively low - at the level of 14.4-17.9% per individual. The formation of underdeveloped curved capsules, in which the normally formed achenes are completely absent, is observed. It has been established that the species in the coenopopulation multiplies only vegetatively, forming multi-stem sod. In the second half of the summer, usually in August, there is a strong defeat of plants with diseases, as a result of their vital activity, already in the first decade of September, the above-ground mass of plants dries out.

Fruit-in late August, the boxes in the mass are revealed in the first decade of October. In normally developed boxes formed seeds are formed.

According to the age structure, the population of *C. ventricosum* is mature, incomplete, since it is formed only by uneven generative individuals.

### Conclusion

1. Individuals of *Cypripedium calceolus* in the composition of young sparse birch grow on sour, slightly sodded, well-aerated soils. In the structure of phytocenosis, they are located in isolated loose groups. Individuals form multi-stemmed sods with low generativeness. Due to the predominance of pregenerative individuals in the age groups, the coenopopulation is young, left-handed, incomplete, of the normal type, capable of self-maintenance by the seed method, which indicates the effectiveness of seed multiplication.
2. Individuals of *Cypripedium macranthon* in the composition of birch-willow forest grow on sour, weakly sodded, richly humified soils, located dispersed, form multi-stemmed sods, are also found in single individuals, characterized by high generativeness. The coenopopulation has a stable age spectrum, is a normal type, progressive, capable of self-maintenance by the seed method.
3. Individuals of *C. ventricosum* in the composition of a thin-walled birch forest are mosaically mosaicated, with high generative rates, but with low fruit formation. The absence of pregenerative ontogenetic groups in the age spectrum of coenopopulation indicates its transitional character from stable, formed by uneven generative individuals, to aging. Self-maintenance of coenopopulation occurs due to active vegetative propagation, as evidenced by the formation of large multi-stem sod.

The habitat of the coenopopulation is characterized by a moderate grassy cover, with poorly developed acidic soil.

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