Modern Distribution and Ecological-phytocenotic Features of 
*Platanthera chlorantha* (Cust.) Rchb. in the Republic of Adygea

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**Abstract**

During the monitoring of rare plant species in the Maykop region of the Republic of Adygea, known and discovered new locations of *P. chlorantha* were confirmed, for which the height above sea level and geographical coordinates were determined. The identification of the species to a certain range of altitudes above sea level and types of phytocenoses was revealed. Ongenetic states, ontogenetic structure and intraspecific variability of *P. chlorantha* were studied in populations.

**Key words:** locations, populations, ongenetic states, ontogenetic structure, intraspecific variability.

**Introduction**

In connection with the growing negative impact of human activity on the environment, the problem of preserving the biodiversity of the planet becomes especially acute. One of the most vulnerable components of plant communities are species of the Orchidaceae Juss. Family, which is associated primarily with their bioecological features: highly specialized entomophilia; undifferentiated embryo; the lack of spare substances in the seed, which contributes to the long-term formation of the protocorm and makes it dependent on mycorrhizal fungi; low competitiveness; narrow ecological amplitude and high sensitivity to anthropogenic influences. The listed features of orchids cause their rarity in natural habitats. The most rare and endangered species in the territory of Adygea are listed in the Red Book of the Republic of Adygea (2012). Careful study of geographical distribution, ecology and taxonomy is the first step towards the organization of the protection of species (Ivanov & Kovaleva 2005).

Genus *Platanthera* Rich. family Orchidaceae Juss. includes 124 species of perennial grasses found in North America, North Africa, Europe, South-West and Asia Minor, in the Caucasus, in the Carpathians and Crimea (Averyanov 2000). In the Russian Federation there are nine species of the genus: *P. oligantha* Turcz., *P. sachalinensis* F. Schmidt, *P. bifolia* (L.) Rich., *P. metabifolia* F. Maek., *P. chlorantha* (Cust.) Rchb., *P. densa* Freyn, *P. tipuloides* (L. f.) Lindl., *P. mandarinorum* Rchb. f. var. *cornu-bovis* (Nevski) K. Inoue, *P. ophryoides* F. Schmidt. Many of the Russian species of the genus, growing in temperate latitudes, are mainly studied at the population-ontogenetic level (Vakhrameeva et al. 2014; Efimov 2006;
Khomutovsky 2012; Perebora 2015). However, the issues of distribution and biocology of individual representatives require further study. Such studies are relevant for the Republic of Adygea.

The Republic of Adygea is located in the central part of the North-West Caucasus in the basins of the Kuban, Laba, Belaya, Pshish and Psekups rivers. Adygea occupies a unique geographical position, which determines the presence on its territory of several geographical zones and vertical vegetation zones, significant landscape, phytocenotic and floristic diversity, as well as a high level of endemism and relictism of flora. About a third of the territory is occupied by specially protected natural territories, 14% of the land is classified as a UNESCO World Natural Heritage Site "Western Caucasus".

In Adygea, the Orchid family is represented by 33 species from 18 genera. The Red Book of the Republic (2012) includes 25 species from 12 genera. At least 12 species of orchids are found in areas of intensive economic and recreational activities in connection with the development of a network of tourist zones in the mountainous part of the republic and active construction. In addition, the high decoration and medicinal properties of the plants of the family make them the object of blanks, which causes significant damage to natural populations. Increasing anthropogenic impact leads to a decrease in the number of local populations of orchids, and creates threats to their survival.

Materials and methods

Studies included an analysis of literary sources and herbarium collections of the Caucasus State Natural Biosphere Reserve them. H.G. Shaposhnikov (CSR), Adyghe State University (MAY) and the National Museum of the Republic. The collection of factual material was carried out in 2017-2019 years during route reconnaissance surveys of the territory in combination with semi-stationary observations.

In the study of the species, a population-based approach was used, based on the classical works of T.A. Rabotnov, A.A. Uranov and their followers, with some clarifications recommended for orchids (Vakhrameeva et al. 1987) and rare species (Program and methodology ... 1986). Ontogenetic states are distinguished on the basis of qualitative and quantitative morphological features of plants. Studied living and fixed in 75% ethanol material. The intraspecific variability of the morphological features of the generative and vegetative organs of plants was studied by the method of S.A. Mamaev (1975). The measure of variability was the coefficient of variation (Cv, %). The recommendations of Yu.A. Zlobin et al. (2013) were used to assess the state of species populations.

Results

According to literary data, the genus Platanthera is presented in Adygea by two species: *P. bifolia* and *P. chlorantha* (Red Book of the Republic of Adygea 2012). We have confirmed known and found new locations of only one species – *P. chlorantha*. The locations of *P. bifolia* for three years of field observations were not found. The redefinition of herbarium specimens also showed that in the studied herbariums there are no collections of *P. bifolia* in the territory of Adygea.

*P. chlorantha* is a sympodially growing herbaceous perennial plant with annually renewed oblong-ovoid tuberoid with a thin awl-shaped ending, with two (rarely three) almost opposite basal and 2-3 (5) stem leaves. Bottom leaves obovate, narrowed to base at short petiole. The stem reaches a height of 30-65 cm, bears a loose apical multi-flowered spike 11-35 cm long, with greenish flowers (15-35 pieces) with a very faint odor. The middle lobe of the outer circle of the perianth is rounded-heart-shaped, the lateral ones are ovate. The lip is narrow-lanceolate, at the base without tubercles above the midrib; the spur is directed downwards or horizontally, noticeably S-shaped curved and at the end of the club-shaped thickened, 1.5–2 times longer than the ovary (fig. 1). Stickers are rounded. Boot with a wide connection box and spaced, dispersed flows at the bottom (the distance between them is up to 1.5 mm above, down to 4 mm below).

*P. chlorantha* is found on the territory of the republic at altitudes from 220 m (near the city of Maykop) to 1760 m (Pshekish mountain). Ecologically, *P. chlorantha* is mesotrophe and mesophyte, in phytocenotic it is margant and silvant. Sciogeliofit, occurs under the canopy of oak, oak-hornbeam, oak-beech, beech-hornbeam, beech-fir and fir-beech, fir and fir-pine forests, on their edges and in clarified areas (fig. 2).
In the *Platanthera chlorantha* populations, the following ontogenetic states of individuals are distinguished: juvenile, immature, virginal and generative. The juvenile plant (j) has one narrow-lanceolate leaf with 2–4 veins up to 5–6 cm long, the immature (im) has one lance-elliptic leaf with 6–8 veins up to 8–13 cm long. For virginous individuals (v) there are two elliptical or oblong-ovate leaves with 10–12 veins, for generative (g) - 2 (less often 3) leaves with 10-16 veins. Counting of seedlings was not carried out, as they lead an underground way of life. Senile individuals not identified.

The number and ontogenetic structure of *P. chlorantha* populations in different locations differ (fig. 3).

For example, in 2018 the number and structure of populations were: in the vicinity of Maykop 24 individuals (5j:6im:5v:8g), Krasnoktyabrsky settl. nearabouts 16 individuals (2j:7v:7g), Karmir-Asth nearabouts 13 individuals (1j:2v:10g), Dagestanskaya settl. nearabouts 9 individuals (1im:1v:7g), Shuntuk nearabouts 9 individuals (1im:2v:6g), Sevastopolskaya settl. nearabouts 7 individuals (1im:1v:5g), lvl. Taiwan 15 (3j:1im: 5v:6g), Koryto m. 11 (1im:3v:7g).

All studied populations of the species are isolated and small, their condition is pessimal. Most populations are normal, incomplete, developmental with right-sided spectra with a maximum on a group of generative individuals. A significant predominance of generative individuals in the ontogenetic spectrum suggests that in populations, due to various reasons, including anthropogenic, there is an irregular renewal, which can serve as a basis for maintaining the rarity status of the species in the new edition of the Red Book of the Adygea Republic.

The variability of almost all *P. chlorantha* morphoparameters is high (fig. 4).
Figure 2. High-altitude distribution *P. chlorantha*.

Figure 3. Ontogenetic structure of populations *P. chlorantha*: 1 – Maykop nearabouts; 2 – Krasnooktyabrsky settl. nearabouts; 3 – Karmir-Asth nearabouts; 4 – Dagestanskaya settl. nearabouts; 5 – Shuntuk nearabouts; 6 – Sevastopolskaya settl. nearabouts; 7 – lvl. Taiwan; 8 – Koryto m.
Figure 4. Variability *P. chlorantha*: 1 – height; 2 – length of inflorescence; 3 – the length of the bottom sheet; 4 – the width of the bottom sheet; 5 – number of stem leaves; 6 – the length of the lower bract; 7 – the width of the lower bract; 8 – number of flowers; 9 – spur length of bottom flower; 10 – length of the ovary; 11 – the length of the lip; 12 – the width of the lip.

Only two parameters have a low level of variability – the length of the lower basal leaf (Cv = 13 %) and the length of the ovary of the lower flower (Cv = 15 %); five parameters – the average level of variability (plant height – 19 %, length of the lower bract – 22 %, number of flowers – 22 %, lip length of the lower flower – 23 %, lip width of the lower flower – 18%); four parameters – increased (inflorescence length – 29 %, bottom leaf width – 26 %, number of stem leaves – 26 %, width of the lower bract – 27 %); one parameter is very high (the length of the spur of the lower flower is 130 %). The most stable signs of the species should be considered the length of the lower basal leaf (Cv = 13 %) and the length of the ovary of the lower flower (Cv = 15 %). The length of the spur of the lower flower is subject to the strongest variation (Cv = 130 %).

Discussion

*Platanthera chlorantha* is a Euro-Asia Minor non-moral species with a declining number with a general distribution in Europe, the Caucasus, South-West Asia and North Africa (Efimov 2006). The species is included in the European Red List of Vascular Plants (Bilz et al. 2011) and CITES Annex (2017), listed in the Red Books of 25 regions of Russia (Vakhrameeva et al. 2014). In the Red Book of the Republic of Adygea *P. chlorantha* is listed with the rarity status category 2, a vulnerable species.
P. chlorantha has a diploid set of chromosomes equal to 42. In populations of P. chlorantha, individuals with 2n = 54 and 56 are also found, which may indicate aneuploid changes in the karyotype (Red Book of Krasnodar Region 2017).

When studying the morphological features of the species, our main attention was paid to the structure of the anther, as in describing the genus L.K. Richard (1817) assigned him the scientific name Platanthera from the Greek words "platys" – wide and "anther" – boot, since the plant had a wide boot. In the “Flora of the USSR” (Flora of the USSR 1935) this is indicated by S.A. Nevsky, who conducted the taxonomic treatment of the genus. On page 652, he writes: "... Richard by P. bifolia meant what is now called P. chlorantha."

A number of researchers of a related P. chlorantha species, P. bifolia (Dressler 1993; Boberg & Ågren 2009), believe that the length of the spur correlates positively with the length of the proboscis of local pollinators, others believe that it is associated with the type of habitat and environmental conditions (soil properties, shading) (Bateman & Sexton 2008). Our observations show that in P. chlorantha the length of the spur depends primarily on the illumination of the habitat: the higher the illumination, the shorter the length of the spur.

The species prefers moderately moist, well-aerated soils, from slightly acidic to neutral (Vakhrameeva & Zagulsky 1995; Vakhrameeva et al. 2014). Our data indicate that the plant grows in a wide range of soil moisture and aeration. According to E.A. Perebora (2015), when ecological-phytocenotic conditions change (drought, waterlogging, anthropogenic impact) in the populations of P. chlorantha, the total number of individuals decreases, the share of ontogenetic groups changes in the ontogenetic spectrum: generative individuals become vegetative, decreases the proportion of juvenile and immature individuals. M.G. Vakhrameeva (2015) believes that if it is damaged by pests, drought, weakening after the first flowering, plants can become secondary dormant, which most often lasts one year, less often 2-3 years. In our opinion, after flowering, plants under unfavorable conditions can turn into a temporarily non-flowering state, and not return to a vegetative (virginal) state, and not only after the first flowering.

P. chlorantha – entomophilous (pollinated by nocturnal and twilight butterflies), anemochore, propagated by seeds, mycosymbiont. Within two to four years, the seedling leads an underground lifestyle, a real leaf appears in the third or fifth year, flowering occurs in the eighth (11th) year. It blossoms in the republic in May-June, bears fruits in June-July.

In the study of the ontogenetic structure of P. chlorantha populations, the data obtained from the senile group are similar to the results of other researchers of species of the genus (Perebora 2011; Khomutovsky 2012).

Conclusion

It can be argued with high probability that only P. chlorantha is distributed in the territory of the Republic of Adygea of the genus Platanthera. The species is rarely found in small normal, incomplete populations with a predominance of generative individuals on both dry and over-wetted soils. The variability of most morphoparameters of the species is high, which is consistent with its high altitude distribution and high phytocenotic and ecological plasticity. The limiting factors are: the natural rarity of the species, due to complex reproductive biology, the lack of vegetative renewal of populations, invasion of alien species, the economic use of the territory, the intensification of recreation and mass tourism. The main way to maintain the stability of the natural populations of the species is to maintain the status of rarity in the new edition of the Red Book of the Republic of Adygea.

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