Characteristics of the coenopopulation *Platanthera bifolia* (L.) Rich. in conditions of different nature management modes

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Abstract. The paper considers ecological-phytocoenotic, structural-populational characteristics of *Platanthera bifolia* (L.) Rich. in phytocoenoses in conditions of different nature management modes in the Kirov region. Two coenopopulations (CP 1, CP 2) in green moss pine forests and one coenopopulation (CP 3) in a spruce-birch poly-herb forest were considered. As a result of vegetation analysis with the use of D.N. Tsyganov phytoindication scales, it was found out that in the green moss pine forests the growth of *Platanthera bifolia* is being restricted by lack of light and soil moistening, while in the poly-herb forest the conditions are more optimal for the species. The coenopopulations under research are numerous; two periods and seven states are distinguished in the ontogenesis. The ontogenetic specter is normal, full-member (green moss pine forests) and not full-member (due to lack of plantlets) in a spruce-birch poly-herb forest. A high share of plants in the pregenerative period (90.6%) in CP 3 suggests successive reproduction in conditions of dynamic succession processes which took place after natural damage of the community. The coenopopulations considered are steady; they are capable of self-maintaining, still. The nature management modes analysis showed relative resistance of the species to natural factors and anthropogenic ipact.

1 Introduction

Nowadays they pay more and more attention to global warming, as well as to the nature changes caused by it. Warming is taking place in such rapid leaps that plants have no time “to get adjusted” to the altering environmental conditions. The northern border of the boreal forests is extending, biome conditions are changing, and, consequently, composition and structure of taiga phytocoenoses are transforming. Many representatives of the family Orchidaceae are met in tropical regions, in mid-latitudes their flora is much more scarce. In the Northern hemisphere less than 5.0% of the total species wealth of Orchidaceae grow. The most of northern orchids are rare and vulnerable species, as a result of their ecological-biological properties and ecological-coenotic requirements.

The Kirov region is situated in the north-east of European Russia, in the taiga zone. On the territory of the region 28 species of Orchidaceae were found, 82.0% of them are

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included in the regional Red Book. And rare species diversity provides stable functioning of ecosystems. Thus it is important to have a full picture of Orchidaceae's resistance to various natural and anthropogenic factors. Wild-growing Orchidaceae are being thoroughly researched: they are being studied with the use of populational and molecular methods; the specific features of their biology, biomorphology, and ecology are being investigated.

Platanthera bifolia (L.) Rich. is spread in the Eurasian area and it can boast ample adaptive capability. In the European part of Russia this species is spread from the Kaliningrad region to the Ural, in the north – from the Kola Peninsula, the Arkhangelsk and Vologda regions, in the south – to the Belgorod, Rostov, and Volgograd regions, it is also met in the Asian part and in the Caucasus. In the Kirov region the species is included into the list of rare and vulnerable species which need to be controlled and observed on the territory. Thus researching adaptive capability of the coenopopulations (CP) *Platanthera bifolia* in conditions of different nature management modes, in changing ecological conditions is necessary for keeping, reproduction, and remediation of the species.

2 Material and Methods

From 2018 to 2024 two CPs of *Platanthera bifolia* were investigated on the territory of the natural sanctuary "Medvedskiy Bor" (the Nolinsk district, the Kirov region) and one CP – in the vicinity of Kirov. The CP 1 and CP 2 grow in green-moss pine forests in different areas with controlled forest exploitation of the natural sanctuary. This zone is used as an experimental ground. Any controlled forestry activity is fulfilled there in accordance with the Forest Land Use Plan for this territory; the plan was worked out taking into account scientific recommendations on forming optimal conditions for keeping and remediation of natural objects. The CP 3 grows in a spruce-birch poly-herbal forest which is being formed at the site of windfall timber.

At the site of the CPs growing geobotanic description of vegetation communities was made in accordance with the standard methods. The biotope conditions were assessed by means of amplitude scales of D. N. Tsyganov according to the lists of the species found out. On the basis of scale gradation according to the method of L.A. Zhukova the potential (PEV) and realized (REV) ecological valences, as well as the coefficient of ecological efficiency ($K_{ec.eff.}$), were calculated.

The CPs were researched with the use of the program and method of researching rare species, without digging out plants. An individual plant, a individual, was considered a unit at studying the ontogenetic structure of a CP. In stating age-specific (ontogenetic) states standard methods were used. In all the plants found such biometric parameters as shoot length, inflorescence length, the number of flowers in the inflorescence, the number of leaves of median formation, the length and breadth of each leaf, the number of nerves on leaves were stated. Dynamic processes in the CPs were assessed by means of regeneration and replacement indices. The type of CP was stated according to "delta-omega" classification on the basis of age index (Δ) and efficiency index (ω).

3 Results and Discussion

3.1 Phytocoenotic characteristics of habitats

The CP 1 *Platanthera bifolia* under research grows in a green-moss pine forest in Medvedskiy Bor, its crown density is 0.5. The wood stand consists of *Pinus sylvestris* L. aged from 50 to 120 years, the height of the trees varies from 20 to 25 m, the stem diameter varies from 32.5 to 37.6 cm. The composition is 5C5C. The undergrowth includes *Pinus*

sylvestris, *Picea* × *fennica* (Regel) Kom., *Betula pubescens* Ehrh., *Quercus robur* L. In the bush mat *Juniperus communis* L., *Sorbus aucuparia* L., *Chamaecytisus ruthenicus* (Fisch. Ex Woloszcz.) Klask., *Rhamnus cathartica* L., *Viburnum opulus* L. are met. The degree of closure is 25.0%.

The grass-subshrub layer with the common projective cover of 55.0% includes 26 species. *Vaccinium vitis-idaea* L., (35.0%) dominates, the cover of other species is less spacious – *Calamagrostis epigeios* (L.) Roth (5.0%), *Calamagrostis arundinacea* (L.) Roth (3.0%), *Fragaria vesca* L. (4.0%), *Polygonatum odoratum* (Mill.) Druce (2.0%), *Pulsatilla patens* (L.) Mill. (2.0%). The other species are represented just by singular plants: on the whole, their cover accounts for 4.0%. The common projective cover of the moss-lichen story is 90.0%. Such species as *Pleurozium schreberi* (Bird.) Mitt. (60.0%) and *Dicranum scoparium* Hedw. (20.0%) pevail; *Hylocomium splendens* (Hedw.) Bruch et al. (5.0%), *Cladonia rangiferina* (L.) F. H. Wigg. (3.0%) and *Cladonia arbuscula* (Wallr.) Flot. (2.0%) are also represented there.

The CP 2 also grows in a green-moss pine forest in the Medvedskiy Bor, its crown density is 0.5. The wood stand consists of *Pinus sylvestris* 16.0–18.5 m high, the stem diameter is 29.0–45.5 cm. The undergrowth includes *Pinus sylvestris*, *Picea* × *fennica*, *Betula pubescens*. The degree of closure of the bush mat is 10.0%; it includes *Juniperus communis*, *Sorbus aucuparia*, *Chamaecytisus ruthenicus*.

The grass-subshrub layer is thin (the common projective cover is 40.0%) and not rich – 24 species of higher vascular plants. *Vaccinium vitis-idaea* (20.0%) dominates, the projective cover of other plants is less – *Calamagrostis epigeios* and *Convallaria majalis* L. (5.0%), *Calamagrostis arundinacea* (2.0%), *Pulsatilla patens* (2.0%), *Antennaria dioica* (L.) Gaertn. (1.0%). The rest of the species are represented just by singular plants. In the moss-lichen layer with the common projective cover of 95.0% *Pleurozium schreberi* (60.0%) and *Dicranum scoparium* (25.0%) prevail. *Cladonia arbuscula* (5.0%), *Cladonia rangiferina* (5.0%) were also met, *Hylocomium splendens* is represented by single plants.

The CP 3 is situated in the northern part of Kirov, in a tree belt area near the highway, in the place of windfall timber. The spruce-birch poly-herbal forest's woodstand composition is 6Б4Е: it consists of *Betula pubescens*, *Picea abies* (L.) H. Karst., *Populus tremula* L. The projective cover is 0.6. The undergrowth includes *Quercus robur*, *Betula pubescens*, *Pinus sylvestris*, *Picea abies*. In the underbrush there are *Salix* sp., *Rosa majalis* Herrm., *Sorbus aucuparia*, *Frangula alnus* Mill., *Padus avium* L., *Ribes nigrum* L., *Viburnum opulus* L., *Amelanchier canadensis* (L.) Medik.

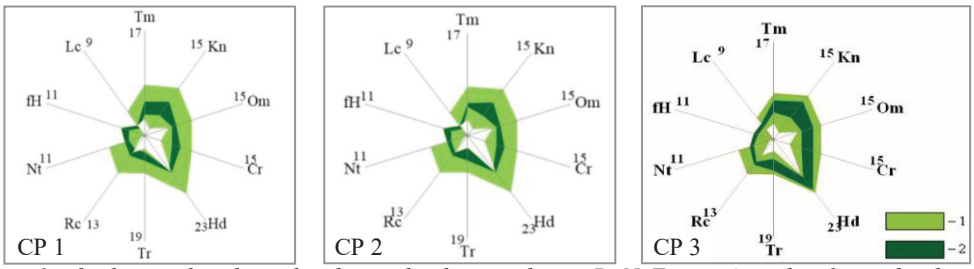
The grass-subshrub story consists of 46 species. There *Equisetum sylvaticum* L. (20.0%) and *Angelica sylvestris* L. (15.0%) prevail, the cover of other species is less: *Vaccinium myrtillus* L. (10.0%), *Cirsium heterophyllum* (L.) Hill (10.0%), *Asarum europaeum* L. (5.0%), *Geum rivale* L. (5.0%), *Calamagrostis canescens* (Weber) Roth (3.0%), *Agrostis stolonifera* L. (3.0%) et al. The common projective cover of this story is 90.0%.

3.2 Ecological Niche

Processing geobotanic descriptions showed the following biotope conditions in green-moss pine forests with *Platanthera bifolia*: as for soil moistening regime (Hd), the realized range agree with the intermediate ones, between dry- and mid-steppe soils, as for salt regime (Tr), – lean ones, as for soil acidity (Rc), – very acid, as for nitrogen resources (Nt),– poor, as for periodical soil moistening (fH), – with slightly variable soil moistening, as for light-shadow scale (Lc), – shadowy forests. In a spruce-birch poly-herbal forest with *Platanthera bifolia* soil conditions are characterized according to: moisture regime – between humid- and wet-forest-meadow, salt regime – quite rich, acidity – between sub-acidic and neutral, nitrogen resources – poor, periodical soil moistening – with slightly variable soil moistening. The

realized ecological position, as for light-shadow scale, suggests growing in conditions of light forests.

The fundamental ecological niche amplitude of *Platanthera bifolia* is broader, as compared with conditions of biotopes of green-moss pine forests, as well as with those of a spruce-birch poly-herb forest (Figure 1). As for the most factors, the realized ecological niches are situated within the fundamental one and occupy the central position, i. e. the plants grow under quite favorable conditions. The maximal efficiency of using the ecological space, as for the CP 1 and CP 2, is characteristic of the climate continentality factor (Kn): they take $^1/_3$ potential ecological niche. As for soil moistening, salt regime, and ombro-climatic aridity-humidity factors (Om), the CP 3 occupies more than a half of the potential ecological niche. As for the factors of nitrogen resources and soil acidity, the least degree of efficient use of ecological potential of all the three CPs under research is shown. Same could be said about the soil moistening and light-shadow factors for the CP 1 and CP 2, as well as about the thermoclimatic factor (Tm) for the CP 2.



1 – fundamental ecological niche amplitude according to D. N. Tsyanov's scales; 2 – realized ecological niche amplitude; CP 1, CP 2, CP 3 – coenopopulations 1, 2, 3; scales – Tm – thermoclimatic; Kn – climate continentality; Om – aridity-humidity ombro-climatic; Cr – cryo-climatic; Hd – soil moistening; Tr – salt regime; Rc – soil acidity; Nt – nitrogen resources; fH – periodical soil moistening; Lc – light-shadow regime

Fig. 1. *Platanthera bifolia* ecological niche amplitude.

Efficiency of ecological space use by the CP 1 and CP 2, which grow in green-moss pine forests in the Medvedskiy Bor, was assessed. It was stated that the least coefficient of *Platanthera bifolia* concerns the following factors: nitrogen resources (11.23% and 11.11%, accordingly), ombro-climatic aridity-humidity factor (13.04% and 15.22%, accordingly), soil moistening (13.33% – the both CPs). A bit higher the ecological efficiency coefficient of the CP 1 concerns such scales as a thermoclimatic scale – 32.07% (at the same time, in the CP 2 it accounts only for 11.32%) and climate continentality scale (31.4%). On the whole, all the indices are less than 50.0%, which suggests low efficiency of environmental space use in the communities (Table 1).

In a spruce-birch poly-herb forest (CP 3) the lowest ecological efficiency coefficient is characteristic of such factors as nitrogen resources (11.11%) and soil acidity (12.96%). To the fullest extent the ecological potencies are acquired for the following factors: soil moistening (56.66%), ombro-climatic aridity-humidity factor (43.48%), and salt regime (43.24%). These indices are slightly realized in phytocoenoses of green-moss pine forests (CP 1, CP 2).

Table 1. Characteristics of the ecological niche of the researched *Platanthera bifolia* coenopopulations.

No.	Ecological scale	PEV	A_{min}–A_{max}			REV			$K_{ec.\ eff.}$ (%)		
			CP 1	CP 2	CP 3	CP 1	CP 2	CP 3	CP 1	CP 2	CP 3
1	Tm	0.53	5–8	7–8	7–10	0.17	0.06	0.17	32.07	11.32	32.08
2	Kn	0.86	6–10	6–10	7–12	0.27	0.27	0.33	31.40	31.40	38.83
3	Om	0.46	7–8	7–8	7–10	0.06	0.07	0.20	13.04	15.22	43.48
4	Cr	0.60	7–9	7–9	7–10	0.13	0.13	0.20	22.33	22.33	33.33
5	Hd	0.30	10–11	10–11	12–16	0.04	0.04	0.17	13.33	13.33	56.66
6	Tr	0.37	4–6	3–6	5–8	0.11	0.16	0.16	28.38	43.24	43.24
7	Nt	0.81	4–5	4–5	5–6	0.09	0.09	0.09	11.23	11.11	11.11
8	Rc	0.54	4–6	5–6	7–8	0.16	0.07	0.07	28.70	12.96	12.96
9	Lc	0.55	2–3	2–3	4–5	0.11	0.11	0.11	20.36	20.0	20.0
10	fH	–	4–6	7–8	4–5	0.18	–	0.09	–	–	–

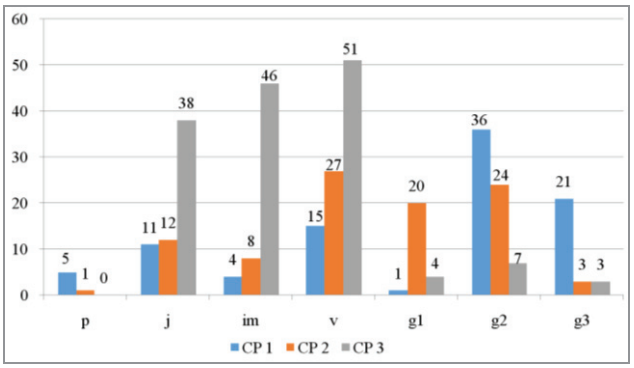
Note. The scales interpretation is the same as in the Figure 1; CP 1, CP 2, CP 3 – coenopopulations 1, 2, 3; PEV – the potential ecological valence; REV – the realized ecological valence; $K_{ec.\ eff.}$ – the coefficient of ecological efficiency.

Putting together efficiency of ecological space inhabiting by all the CPs, it was found out that the CP 3 lives nowadays in favorable conditions and occupies the biggest part of the environmental niche. Development of the CPs is limited by the amount of nitrogen resources in soil and soil acidity.

3.3 Ontogenetic structure of the coenopopulations

In *Platanthera bifolia* ontogenesis two age periods (pregenerative and generative) and seven ontogenetic states: plantlets (p), juvenile (j), immature (im), virginile (v), young generative (g_1), mature generative (g_2), old generative (g_3) are distinguished.

The CP 1 is numerous, plants in generative period prevail there (62.4%), the share of mature generative ones is 38.7%, of young generative – 1.1%, of old generative – 22.6% (Figure 2). In the pregenerative period virginile (16.1%) and juvenile (11.8%) plants prevail; plantlets and the immature plants are significantly fewer (5.4% and 4.3%, accordingly). The common type of the structure is 5:11:4:15:1:36:21 (p, j, im, v, g_1, g_2, g_3).



CP 1, CP 2, CP 3 – coenopopulations 1, 2, 3.

Fig. 2. The ontogenetic structure of *Platanthera bifolia* coenopopulations under research: OX direction – ontogenetic state; OY direction – number of plants (units).

Low percent of the pregenerative period plants suggests poor seed regeneration. This issue could be caused by high soil acidity and low soil moistening. Predominance of

generative plants suggests maturity of the CP 1. The ontogenetic structure is normal, right-sided, full-member, single-top.

The CP 2 is also numerous; in the ontogenetic structure the ratio of pregenerative period plants to generative period plants is almost equal: 50.5% and 49.5%, accordingly. The common type of the structure is 1:12:8:27:20:24:3 (p, j, im, v, g_1, g_2, g_3). Among generative plants the share of mature plants and young plants is about similar (25.3% and 21.2% accordingly); the share of the old is rather small (3.6%). In the population structure young vegetative pregenerative plants prevail – 28.4%, the share of plantlets is 1.1%, of the juvenile ones is 12.6%, and of the immature ones is 8.4% (Figure 2). On the whole, the ontogenetic structure is normal, full-member, double-top, with virginile and mature generative plants prevailing.

The CP 3 is numerous; pregenerative period plants prevail there – 90.6%. Such a high index suggests successful seed regeneration, despite lack of plantlets. The share of juvenile plants is 25.5%, of the immature ones is 30.9%, and of the virginile ones is 34.2%. The generative period plants account for just 9.4%, the share of the mature is 4.7%, of the young is 2.7%, of the old is 2.0%. Low percent of the generative period plants suggests young age of the CP 3. The ontogenetic structure is normal, left-sided, not full-member (due to lack of plantlets), single-top. The common type of the structure is 38:46:51:4:7:3 (j, im, v, g_1, g_2, g_3).

According to L. A. Zukova's classification, CP 1 is a declining one ($I_з < 1$). The regeneration index ($I_в$) is equal to the replacement index ($I_з$), they are 0.5, i. e. there is only one offspring to each two generative plants. Such a low index suggests either seed regeneration declining or the pregenerative plants being in the state of secondary dormancy. According to "Δ–ω" classification, CP 1 is a transient one (Δ=0.39; ω=0.66), close to the mature one: the generative period plants 1.7 times dominate over the generative period ones in number.

Potential ecological valence PEV also suggests high degree of allocation to low variability habitats, first of all, to low soil variability habitats. According to the scale of soil moistening, the species is a steno-valence one (PEV=0.30). According to the scale of soil salt regime, it is a hemistenovalence one (PEV=0.37).

In the CP 2 the regeneration index and the replacement index are equal: one generative plant to one offspring. It is young (Δ=0.25, ω=0.59) and if conditions do not change it can last long, as in this CP regeneration processes prevail over aging processes.

Thus, the state of *Platanthera bifolia* CP 1 and CP 2 situated in green-moss pine forests is quite satisfactory. The CP 1 grows in conditions of higher opacity; underwood cover density is 25.0% there. The CP 2 is situated on a more open area, in the "window" on the slope of the western exposure. Difference in environmental conditions is also proved by the morphometric characteristics of the plants: in the CP 1 *Platanthera bifolia* plants are bigger.

The CP 3, as well as the CP 2, is young (Δ=0.11, ω=0.3): pregenerative plants 10.6 times prevail; in total, the share of vegetative plants is 90.6%. The regeneration index and the replacement index are equal, they are 9.64, i. e. over nine offsprings for one generative plant. Such high indices show successful seed regeneration of *Platanthera bifolia* in a spruce-birch poly-herb forest. Evidently, the plants grow in conditions close to optimal ones, the size of their environmental niche suggests the same. High percentage of pregenerative plants per unit area also proves that. In the area where the CP 3 grows windfall happened not long ago, now it has "windows" with quite optimal conditions for the species. Still, in course of demutational succession, interspecies competition of wild gasses has already increased, illumination is getting worse, which is probably the reason for lack of plantlets.

3.4 Size polyvariety

Platanthera bifolia in the ontogenetic states of plantlets, the juvenile, and the immature have one leaf of medium formation. Plantlets are found only in coenopopulations situated in green-moss pine forests, with leaves which are 4.0 cm long and up to 0.8 cm broad. Juvenile and immature plants in a spruce-birch poly-herb forest (CP 3) have leaves which are 1/5 longer and 5.0 times less in breadth than those in green-moss pine forests (Table 2). Juvenile plants in green-moss pine forests have narrow lance-shaped leaves which are 0.3–11.6 cm long and 3.0–13.0 cm broad. In a spruce-birch poly-herb forest their leaves are 14.3 cm long and 0.3–2.5 cm broad. Immature plants have broad lance-shaped leaves, in pine forests they are 3.0–13.0 cm long and 1.4–3.0 cm broad, while in a spruce-birch poly-herb forest they are up to 14.3 cm long and 0.3–2.5 cm.

Table 2. Morphometric parameters of *Platanthera bifolia* individuals in the CP 1, CP 2, CP 3 ($x_m \pm x$).

Onto-genetic state		Shoot length, cm	Length of the 1st leaf, cm	Breadth of the 1st leaf, cm	Length of the 2nd leaf, cm	Breadth of the 2nd leaf, cm	Inflores-cence length, cm	Number of flowers
p	CP 1	–	3.5±0.2	0.3±0.1	–	–	–	–
	CP 2	–	–	–	–	–	–	–
	CP 3	–	–	–	–	–	–	–
j	CP 1	–	6.1±0.5	1.7±3.3	–	–	–	–
	CP 2	–	6.5±0.4	0.8±0.5	–	–	–	–
	CP 3	–	8.1±0.5	0.9±0.6	–	–	–	–
im	CP 1	–	10.1±1.1	2.4±0.2	–	–	–	–
	CP 2	–	8.6±0.5	2.0±0.6	–	–	–	–
	CP 3	–	14.6±0.4	3.1±0.8	–	–	–	–
v	CP 1	–	8.2±0.7	2.3±0.9	7.9±1.9	2.1±0.5	–	–
	CP 2	–	7.6±0.4	1.6±0.6	7.1±1.7	1.5±0.3	–	–
	CP 3	–	16.5±0.3	3.7±0.9	16.0±2.2	3.6±1.0	–	–
g_1	CP 1	–	–	–	–	–	–	–
	CP 2	27.1±2.5	7.9±1.9	2.1±0.3	6.4±1.3	1.6±0.2	6.2±1.6	11.3±1.2
	CP 3	41.0±1.4	13.6±0.2	3.8±0.2	12.7±0.4	2.9±0.1	7.4±1.1	10.0±1.7
g_2	CP 1	42.9±1.2	10.4±1.8	2.7±0.4	10.1±0.8	2.6±0.3	12.7±1.3	15.9±1.2
	CP 2	34.8±2.3	8.8±2.1	2.4±0.4	8.4±1.3	2.1±0.3	9.0±1.6	13.8±1.4
	CP 3	45.5±1.8	14.1±1.6	3.9±0.4	13.1±0.7	3.4±0.4	10.5±1.2	14.7±0.5
g_3	CP 1	52.7±1.6	12.4±1.5	3.6±0.6	12.2±0.8	3.8±1.5	17.1±1.9	21.2±1.6
	CP 2	48.7±3.4	9.6±2.0	3.7±0.2	8.3±1.4	2.7±0.4	13.9±1.3	16.7±1.4
	CP 3	56.0±3.0	16.3±1.1	4.6±0.7	15.5±1.0	4.4±0.3	11.8±1.3	20.3±0.7

Note. P, j, im, v, g_1, g_2, g_3 – ontogenetic states; CP 1, CP 2, CP 3 – coenopopulations 1, 2, 3.

Virginile plants have two leaves of medium formation, the lower one is oblong-ovoid, the upper one is broad lance-shaped. Like leaves of the previous ontogenetic states, plants of the CP 3 have leaves which are 3 times longer and 3 times narrower, as compared with plants in green-moss pine forests. In the CP 1 and CP 2 plants have the first leaf from 3.0 to 16.0 cm long and 0.8 to 3.5 cm broad, their second leaf is from 3.0 to 15.0 cm long and 0.5 to 3.3 cm broad. In spruce-birch poly-herb forest plants the lower leaf is from 8.5 to 21.8 cm long and from 1.5 to 5.9 cm broad; the second leaf is 5.3–21.5 cm long and 1.2–3.3 cm broad. Broader leaves of the plants in green-moss pine forests, probably, are caused by more shadowy conditions due to restricted forestry activity characteristic of protection regime.

In a spruce-birch poly-herb forest generative plants are stronger according to all the criteria, but their inflorescences are shorter and the number of flowers is less, as compared with the coenopopulations in green-moss pine forests.

The lower leaf of young generative plans, as well as the one of virginile plants, is oblong-ovoid, while the upper one is broad lance-shaped. In green-moss pine forests, the lower leaf is 5.6–12.5 cm long and 1.0–3.0 cm broad; the upper leaf is 0.5–10.2 cm long and 0.8–2.9 cm broad. The inflorescence length is 1.3–11.5 cm, the number of flowers is from 6 to 16. In a spruce-birch poly-herb forest, the lower leaves are 13.3–17.0 cm long and 3.4–4.0 cm broad; the upper leaves are 12.2–14.5 cm long and 2.6–3.6 cm broad. The inflorescence length is 6.0–11.0 cm, the number of flowers is from 4 to 14.

Mature generative plants have developed broad lance-shaped laminas. In green-moss pine forests, the lower leaf is 5.5–27.0 cm long and 1.1–3.6 cm broad; the upper leaf is 5.3–12.5 cm long and 1.1–4.0 cm broad. The inflorescence length is 1.7–22.5 cm; the number of flowers is from 1 to 22. In a spruce-birch poly-herb forest, the lower leaves are 12.0–16.4 cm long and 3.2–5.0 cm broad; the upper leaves are 11.8–15.65 cm long and 2.1–4.5 cm broad. The inflorescence length is 8.1–14.3 cm, the number of flowers is from 13 to 18.

Old generative plants also have lance-shaped laminas. In green-moss pine forests, the lower leaf is 8.2–15.5 cm long and 2.0–5.2 cm broad; the upper leaf is 6.6–15.0 cm long and 2.1–6.3 cm broad. The inflorescence length is 1.3–11.5 cm, the number of flowers varies from 6 to 16. In a spruce-birch poly-herb forest, the lower leaves are 15.0–17.3 cm long and 4.2–6.0 cm broad; the upper leaves are 13.1–16.1 cm long and 3.9–5.1 cm broad. The inflorescence length is 11.8–15.1 cm; the number of flowers varies from 20 to 22. It is noted that in more shadowy conditions of green-moss pine forests and with a restricted number of insect-pollinators, plants form more flowers (Table 2).

4 Conclusion

The results of researching *Platanthera bifolia* CPs in conditions of regulated forestry in the natural sanctuary “Medvedskiy Bor”, as well as in the tree belt area near the highway, have lead to the following conclusions.

- During the field research we characterized the habitats of *Platanthera bifolia* in the south taiga in the Kirov region. They differ in the degree of anthropogenic load and in the association type. All the CPs under research are stable, the CP 2 and CP 3 are capable of self-maintenance, still their state requires control.
- Two periods and seven stages are distinguished in the individual development of *Platanthera bifolia*. The maximum of the CP 1 ontogenetic structure is characteristic of generative period plants: in total the share of mature and old plants is 61.3%. In the CP 2 the correlation is the following: one pregenerative plant per one generative plant, which suggests similarity in number between the pregenerative and generative periods. In the CP 3 in conditions of the middle of the south taiga juvenile, immature and virginal plants prevail, the local maximum is characteristic of virginile plants. On the whole, it proves intensive seed regeneration of the CP 3.

The ontogenetic structure of the *Platanthera bifolia* CPs under research in the region is normal, full-member in green-moss pine trees and not full-member in a spruce-birch poly-herb forest. In the CP 1 and the CP 2 mature generative plants dominate (38.7% and 25.3%, accordingly), which is typical for the region, while in the CP 3 viginile plants prevail (34.2%). High share of pregenerative period plants (90.6%) in the CP 3 suggests active regeneration of the CP in conditions of active succession processes after natural disturbance of the community.

- Comparative assessment of three habitats of *Platanthera bifolia* in central-southern parts of the region showed difference in the moistening degree, light regime, nitrogen resources and soil acidity, as well as in the protection regime.

As for the biotope conditions, a spruce-birch poly-herb forest is the most favorable habitat for the species due to windfall timber and presence of "windows". Habitats of the Medvedskiy Bor are less favourable, as in conditions of the protection regime in green-moss pine forests shadowing increases.

- In accordance with ecological and biological specific features of *Platanthera bifolia,* we offer a set of measures to be taken in order to preserve the species on the territory of the Kirov region. They are as follows: preserving natural habitats by means of rational nature management, monitoring the state of the CPs, holding events which contribute to increasing the level of ecological education of the population.

The contemporary world is oriented to preserving a high degree of the vegetation cover biodiversity to the maximum. Thus it is necessary to reconsider the strategy and the tactics of nature management, to combine biodiversity preserving with using it reasonably. Lack of human activity on the territory of the natural sanctuary "Medvedskiy Bor" can be dangerous to rare and vulnerable species. Nowadays replacement of pine forests by the zonal type forests has led to decrease of light access in biotopes, as well as to appearing and prevailing of boreal species in the underbrush and grass-subshrub layer. *Platanthera bifolia* is a species with broad ecological amplitude. Still, over the period of research the number of plants in the CP 1 has decreased, which was caused not only by the natural factors, but also by the change of conditions in the phytocoenosis. In the CP 3 the conditions are more favorable, as long as the plants grow on a well-lit place with the minimal interspecies competition. Nowadays the CP 3 growing on the territory without any regulated protection is flourishing; it is forming on the naturally damaged habitat.

Platanthera bifolia is characterized by a low degree of competitive ability and complex consortive connections, as well as by constrained propagation, as soil fungi which are myco- and rhyzo-developers are needed for seedlings emergence. This naturally vulnerable species, even if small in number, could successfully survive for a long time without taking any special protective measures in case the conditions in the habitat are stable enough.

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