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PLATANTHERA CHLORANTHA (CUSTER) RCHB. IN THE KOZINKA RIVER VALLEY (CENTRAL POMERANIA)

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Abstract

Field research was conducted in the years 2015-2018 in the Kozinka River valley in Central Pomerania. The purpose of the work was to characterize the stand of *Platanthera chlorantha*, a species protected by law and listed among species endangered with extinction in Gdańsk Pomerania, Western Pomerania and Greater Poland. The edaphic and phytocoenotic conditions in which greater butterfly-orchid found were determined. There were 25 phytosociological relevés taken with *P. chlorantha*, 12 of which were listed in the phytosociological table. In addition, biometric analysis was performed for selected morphological features of greater butterfly-orchid.

Key words: greater butterfly-orchidis, endangered species, edaphic and phytocoenotic conditions

INTRODUCTION

The species distribution of the greater butterfly-orchid – *Platanthera chlorantha* covers Europe (in the north, it reaches the vicinity of St. Petersburg), the Caucasus, Asia Minor and North Africa (Hultén and Fries 1986). In Poland, it occurs in dispersed stands almost all over the country, in the mountains found up to the lower subalpine forests zone (Zając and Zając 2001), more frequently seen in the south, especially in lower mountain locations and in the east (Szlachetko 2001).
It grows in shady forests, on brown soils, brown alluvial soils and rendzinas, with grains of clayey sands, medium clays or heavy clays. These are moist, eutrophic soils with a weakly acidic to alkaline pH (pH 5.5-7.7). It is also found on brown soils poor in nutrients or podzols with loose sand grains (Piękoś-Mirkowa and Mirek 2003). *Platanthera chlorantha* is most often a component of meso- and eutrophic communities of deciduous forests belonging to the order *Fagetalia sylvati-*

cae. It is encountered sporadically in the mixed coniferous forests *Quercoroboris-Pinetum* and on wet meadows in the order *Molinietalia* (Szlachetko 2001, Piękoś-Mirkowa and Mirek 2003). *Platanthera chlorantha* is becoming extinct in Western Pomerania, Greater Poland (Żukowski and Jackowiak 1995) and Gdańsk Pomerania (Markowski and Buliński 2004). It is listed in the red list of plants of Greater Poland (Jackowiak et al. 2007) and it is an item from the list of endangered, protected and rare species in Central Pomerania (Osadowski 2006).

The Kozinka is a left-bank tributary of the Słupia River, 2.5 km long which drains the moraine plateau north of Strzelinko. The source of the Kozinka is found at the old brick factory in Gałęzinowo; it flows in a deep valley, which is reached by ravines and gullies. At the mill in Zamełowo, the Kozinka flows through two ponds that once fed the mill. In 1819, 50 acres of land were purchased from the administrator of the grove forests of Gałęzinowo for the needs of the Słupsk city board. At that time, the area was cleaned up for the Sunday rest of the inhabitants (Pagel 1989). In 1931, the "Charlottental" recreational centre was established in the Kozinka Valley. The centre was managed by Bernard Körlin (Schultz and Wolter 2002). The Charlotta Valley is full of space, greenery and peace.

According to physico-geographical regionalization, the Kozinka River valley belongs to the mesoregion of the Sławieńska Plain (Kondracki 1994). According to the geobotanical division of Szafer (1972), the studied area lies within the boundaries of the Baltic Coastland, and according to Matuszkiewicz (1993), it is located in the South-Baltic Coastland, in Słupsk district. According to the classification of ATPOL code numbers, the Kozinka Valley is located in the square BA69 (Zając 1978).

The purpose of the work was to characterize the stand of *Platanthera chlorantha* occurring in the Kozinka River valley in Central Pomerania.

MATERIAL AND METHODS

Observations of the *Platanthera chlorantha* stand in the Kozinka River valley (Fig. 1) were conducted in 2015-2018. The stand of *Platanthera chlorantha* was first penetrated in May 2015, although this species was recorded here in 2010 (Truchan and Sobisz 2011). At that time, the area of *Platanthera chlorantha* prevalence was estimated, phytosociological relevés with it were taken and the specimens of this species were counted. The research site was visited again in spring and summer in subsequent years 2015-2018. In April and May, phytosociological relevés of the spring aspect were taken, and then of the summer aspect using the classic Braun-Blanquet method on the areas of 40-60 m^2 (Pawłowski 1972). The naming of vascular plants is given after Mirek et al. (2002), bryophyte nomenclature is in accordance with the list of Ochyra et al. (2003).

The soil analysis was performed in the soil laboratory of the District Chemical and Agricultural Station in Koszalin. Annually, soil samples were collected to study. The following soil properties were determined: pH – using potentiometric method in H_2O and 1 n HCl, total nitrogen – with Kjeldahl method, organic carbon – using Tiurin's method (Bednarek et al. 2005), total phosphorus – using the molybdate method (Nowosielski 1974). In addition, the content of organic matter in the tested substrate was determined.

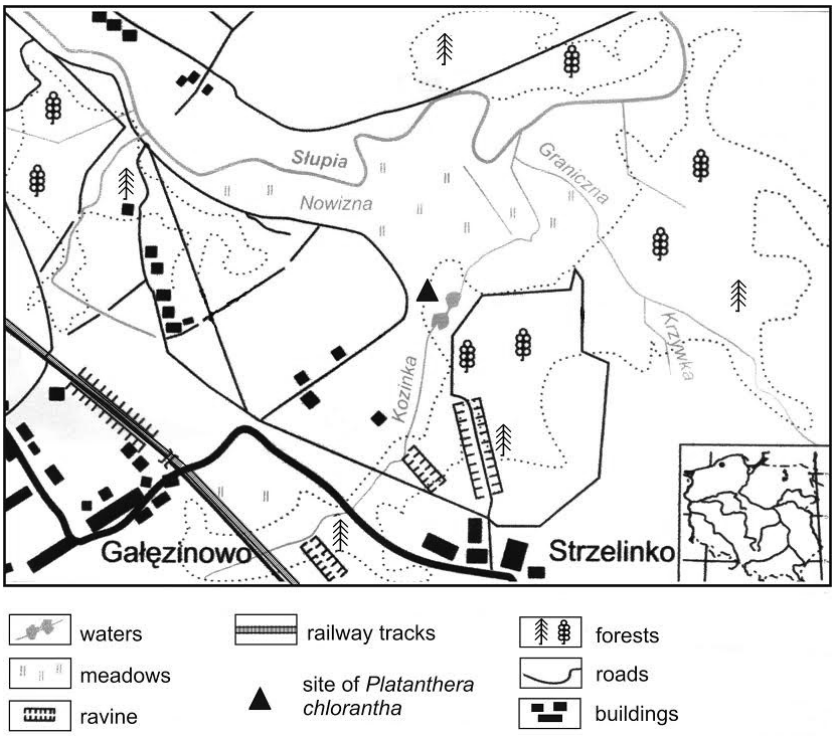

Fig. 1. Area of the study

In May 2018, due to the steady decline in the number of generative *Platanthera chlorantha* on this stand, all generative specimens (17 plants) were subjected to biometric measurements for the following traits: 1 – height, 2 – inflorescence length, 3 – number of flowers on the shoot, 4 – the length of the first basal leaf, 5 – the width of the first basal leaf at the widest point, 6 – the length of the second basal leaf, 7 – the width of the second basal leaf at the widest point. The measurements were made with an accuracy of 1 mm. Average values (X) were calculated for each feature, and minimum and maximum values were determined.

RESULTS AND DISCUSSION

Platanthera chlorantha in the Kozinka River valley is distributed over an area of 360 m^2. In 2015, 51 flowering plants and 42 sterile specimens were found. In 2016 there were 37 flowering and 46 sterile plants. In 2017, there were 30 specimens in the generative state and 37 sterile plants observed. In 2018, only 17 flowering plants and 29 in the sterile state were found.

In total, in the years 2015-2018, 25 phytosociological relevés were taken, 12 of which are presented in the table showing the phytosociological structure of plant community with *Platanthera chlorantha* (Table 1).

Table 1

Phytosociological structure of community with *Platanthera chlorantha* (Cluster) Rchb.

Successive number		1	2	3	4	5	6	7	8	9	10	11	12		
Date (day, month, year)		1.05. 2015	2.05. 2016	29.05 2016	27.05 2017	28.04. 2018	30.05 2018	10.06 2017	1.06. 2015	27.07. 2015	15.07. 2016	21.07 2017	25.07 2018		
Mechanical composition of a horizon of soil (0-20 cm)		pgm	org	pgm	org	pgm	pgm	org	pgm	pgm	pgm	org	pgm		
Crown density (%)	a	30	20	15	30	20	20	15	20	20	25	20	10		
	b	25	15	20	15	5	20	15	15	15	5	10	15		
Cover of plant layers (%)	c	80	75	40	70	45	80	70	60	75	55	45	60		
	d	20	30	5	5	15	15	5	5	20	5	35	5		
Area of relevé (m^2)		50	40	40	50	60	50	40	40	50	40	40	50		
Number of species in phytosociological relevé		37	36	32	38	36	34	34	27	33	30	32	28	S	D
I. ChCl. *Querco-Fagetea,* ChO. *Fagetalia sylvaticae*,* ChAll. *Alno-Ulmion,* ChAll. *Carpinion betuli*****															
**Platanthera chlorantha*		+.2	.	+.2	+.2	+	+.2	+	3.3	2.2	1.2	1.1	1.2	V	633
Anemone nemorosa		2.2	1.2	1.1	1.2	1.1	2.2	1.2	.	+	.	.	.	III	508
**Anemone ranunculoides*		1.1	+.2	+.2	1.1	.	1.2	1.1	.	.	.	.	.	III	183
**Lathyrus vernus*			1.1	+.2	1.1	+.2	1.2	+.2	+	.	.	.		III	158
**Ficaria verna*		.	1.1	+	.	+.2	+.2	+	.	.	.	.	.	III	75
***Chrysosplenium alternifolium*		.	.	.	.	+	+	+.2	.	.	.	.	.	II	25
**Fagus sylvatica*	a	2.2	.	1.1	1.1	1.2	1.2	1.2	1.1	1.1	+	1.1	1.2	V	529
	b	2.2	.	.	.	.	.	.	+	+	.	.	.	II	162
****Carpinus betulus*	a	+.2	2.2	1.1	1.1	.	1.2	1.2	1.2	1.2	1.2	1.1	1.2	V	529
	b	+	+	.	.	.	.	.	.	1.1	.	.	.	II	58
Aegopodium podagraria		+	+.2	.	+	+	1.2	.	1.1	2.2	2.2	.	2.2	V	554
Poa nemoralis		+.2	1.2	.	1.1	+.2	1.1	+.2	+	.	+	+.2	.	V	175
Acer platanoides	a	1.1	.	.	1.2	1.2	1.2	1.2	.	.	+	1.1	1.2	IV	300
	b	.	+	+	1.1	+	1.2	.	+.2	+	.	+	+	V	142
***Circaea lutetiana*			1.1	+	+.2	+	1.1	1.1	+.2	.	.	.	+.2	IV	167
**Atrichum undulatum*	d	2.2	.	.	.	2.2	.	.	.	1.2	.	1.1	1.2	III	417
****Stellaria holosteum*		1.1	.	1.1	1.1	.	.	+	1.1	1.1	.	+	.	III	225
**Galeobdolon luteum*		.	1.2	.	.	1.1	+	1.2	.	1.1	+	.	+.2	III	192
Corylus avellana	b	1.1	+	.	.	.	.	1.1	.	.	1.1	1.2		III	175
Epipactis helleborine		.	+	+	+.2	.	+	.	.	.	1.1	1.1	1.1	III	158
**Galium odoratum*		.	+.2	.	.	.	1.2	1.2	.	.	+	.	.	II	100
**Phyteuma spicatum*		.	+	.	.	.	+	1.1	.	.	.	.	.	II	58
***Plagiomnium undulatum*	d	.	+.2	.	.	.	.	1.2	.	.	.	+.2	.	II	58

**Pulmonaria obscura*		.	+.2	.	.	+	.	+	.	.	.	.	+	II	33
**Stachys sylvatica*		.	.	+	+.2	.	+	.	.	.	+	.	.	II	33
II. ChCl.ChO. *Epilobietea angustifolii, Atropetalia,* ChAll. *Sambuco-Salicion**															
**Sambucus nigra*	b	1.2	1.1	1.1	+	.	1.1	+	1.1	+.2	+	+	.	V	250
**Betula pendula* DAll.	a	.	1.2	+	1.1	1.1	+	.	.	.	+	.	.	III	150
**Populus tremula* DAll.	b	+	+	.	.	.	1.1	1.2	.	+	+.2	.	+	III	125
Fragaria vesca		1.2	.	+	1.1	+	.	+	.	+	.	+	.	III	125
**Sorbus aucuparia*	b	.	+	.	.	+	1.1	.	.	.	.	+	+	III	75
III. ChCl. *Rhamno-Prunetea, Prunetalia spinosae,* ChAll. *Pruno-Rubion fruticosi**															
Prunus spinosa	b	+	1.2	+	1.2	+	+	.	1.2	1.2	+	.	+.2	V	217
**Sarothamnus scoparius*		.	+.2	+	+	+	.	1.2	+	.	+	1.1	.	IV	133
Crataegus monogyna	b	+	.	+	+.2	1.1	.	1.1	+.2	.	+	+	.	IV	133
Crataegus laevigata	b	.	.	.	+	.	+	.	+	1.1	.	.	1.1	III	108
Rosa canina	b	.	.	.	+	+	.	.	+	+.2	.	.	1.1	III	75
IV. ChCl. *Molinio-Arrhenatheretea,* ChO. *Arrhenatheretalia*,* ChO. *Trifolio fragiferae-Agrostietalia stoloniferae*****															
**Achillea millefolium*		1.1	1.2	1.1	1.2	+	1.1	.	1.1	1.1	1.1	1.1	+	V	392
***Ranunculus repens*		1.1	+	1.2	+.2	.	.	1.2	1.2	.	.	.	+	III	192
Cerastium holosteoides		.	1.2	.	.	+	1.1	.	.	.	+.2	.	+	III	100
**Taraxacum officinale*		+	+.2	.	+	+	1.1	.	.	+	.	+	.	III	92
**Dactylis glomerata*		.	.	+	+	1.2	.	+.2	+	+.2	.	+	.	III	92
V. ChCl. *Artemisietea*															
Anthriscus sylvestris		+.2	1.1	+	1.1	+.2	.	1.2	+	+	+.2	.	+	V	183
Geum urbanum		+.2	+.2	1.2	.	.	+	+.2	.	+.2	+.2	.	+	IV	100
Glechoma hederacea		1.2	.	+	+.2	+	.	+	.	.	.	+	.	III	83
Urtica dioica		+	.	.	.	+	.	+	.	.	+	+	.	III	42
Alliaria petiolata		+	+	+	+	.	.	.	.				.	II	33
VI. Accompanying species															
Quercus robur	a	1.1	.	.	1.1	+	.	1.1	1.1	+.2	2.2	1.1	.	IV	445
	b	+	.	+		.	.	+						II	25
Equisetum sylvaticum		1.1	1.2	+.2	+.2	.	.	1.2	+.2	1.1	.	+.2	+	IV	208
Pinus sylvestris	a	+	.	.	1.1	.	1.1	.	1.1	1.1	+	+.2	+..2	IV	200
	b	.	+.2	1.2	.	+	+		.	.	.	.	.	II	67
Veronica chamaedrys		.	.	.	.	.	.	+			+	+	.	IV	167

Brachythecium rutabulum	d	1.2	.	+.2	1.2	.	2.2	.	1.2	2.2	.	1.2	.	III	467
Ajuga reptans		1.1	.	.	+.2	1.2	.	.	1.1	.	+	+.2	.	III	150
Athyrium filix-femina		+	+	.	+	+	.	.	+	+	.	1.2	.	III	92
Pohlia nutans	d	+	+	.	.	+.2	.	.	.	+.2	.	.	1.1	III	75
Oxalis acetosella		.	1.2	.	.	1.2	.	1.2	.	.	.	.	1.2	II	167
Amblystegium serpens	d	.	+.2	1.2	+	.	.	.	.	.	1.2	.	.	II	100
Convallaria majalis		+	.	.	.	+	1.2	.	.	+	.	.	.	II	67
Vaccinium myrtillus		+	.	.	.	.	+	.	.	.	+	.	1.2	II	67
Solidago virgaurea		.	.	.	.	+	.	+	.	.	.	+	.	II	25

Plant species occuring only in I degree of phytosociological stability:
I. ***Stellaria nemorum* 1(+.2), 12 (1.1); **Oxyrrhynchium hians* d 2 (1.2); *Fraxinus excelsior* b 9 (+.2)
IV. *Lysimachia nummularia* 3 (+); *Plantago lanceolata* 9 (+); *Rumex acetosa* 11(+)
V. *Artemisia vulgaris* 6 (+), 10 (+), *Melandrium album* 8 (+); *Geranium robertianum* 9 (+); *Rumex obtusifolius* 11 (+)
VI. *Plagiomnium affine* d 2 (1.2), 11 (2.2); *Deschampsia flexuosa* 4 (+); *Monotropa hypopitys* 10 (+), 12 (+); *Malus domestica* 11 (r)
Explanation: org – organic soil, pgm – heavy loamy sand, S – phytosociological stability, D – cover coefficient

Despite the undoubtedly anthropogenic origin of the greater butterfly-orchid stand in the Kozinka River valley, the nature and features of the habitat refer to the conditions of its natural distribution. Greater butterfly-orchid in its natural habitats occurs in fertile deciduous forests belonging to the order *Fagetalia sylvaticae* (Matuszkiewicz 2001). Similar habitat conditions characterize the area of *Platanthera chlorantha* distribution in the Kozinka River valley.
Among the plants found with *Platanthera chlorantha*, the taxa of the following syngenetic groups are noteworthy: *Fagetalia sylvaticae* and *Querco-Fagetea*. They constitute the largest group of plants co-exist with *Platanthera chlorantha*. Among 25 taxa from these syntaxonomic groups, high stability was achieved by: *Poa nemoralis* (V), *Aegopodium podagraria* (V), *Circaea lutetiana* (IV), *Epipactis helleborine* (III), *Galeobdolon luteum* (III) and *Stellaria holosteum* (III). In the moss layer, the presence of *Atrichum undulatum*, which occurred in the III degree of stability and with a relatively high coverage factor (D = 417), draws particular attention. The share of other mosses characteristic for both syntaxons *Plagiomnium undulatum* and *Oxyrrhynchium hians* is negligible. Among the plants of the spring aspect (Table 1, rel. 1-7), the most common are the geophytes: *Anemone nemorosa*, *A. ranunculoides*, *Lathyrus vernus* and *Ficaria verna.* In total, 69 taxa occurred in the community. In individual patches, 27 to 38 species were recorded (33 on average) The tree stand of the analysed patches consists of 13 species, among which the dominant role is played by *Fagus sylvatica*, *Carpinus betulus*, *Acer platanoides* and *Quercus robur*. The shrub layer is rich in species – but relatively weakly compact. It is represented by *Corylus avellana, Prunus spinosa* and *Rosa canina* and haws: *Crataegus monogyna* and *C. laevigata*. Most of the patches is dominated by *Acer platanoides*,

Populus tremula and *Sorbus aucuparia. Rhamno-Prunetea* species – plants of thermophilic conifer communities are represented in phytocoenoses by five species, the highest stability of which (V) is exhibited by *Prunus spinosa*. The presence of: *Anthriscus sylvestris*, *Taraxacum officinale* and *Urtica dioica* and the share of *Malus domestica* evidence the synanthropization of the analysed patches of the *Platanthera chlorantha* communities. A large group consists of 17 associated species, among which *Equisetum sylvaticum* and *Veronica chamaedrys* in 4th class of stability draw particular attention. The moss layer is built by four taxa, of which *Brachythecium rutabulum* occurred most frequently (3rd class of stability).
The tests of soil (Table 2) showed that it is acidic (from pH = 3.95 to pH = 4.65). The analysis of the individual years indicated that quite well supplied with nitrogen, and a small amount of organic matter indicates the mineral soil. The narrow C/N ratio indicates good soil efficiency and good quality of the habitat. The soil is sufficiently rich in phosphorus.

Table 2

Chemical characteristics of soil in the Kozinka River valley

Years of study	pH		Humus	C (%)	N (%)	P (%)	C/N	C/P	N/P
	H_2O	KCl							
2015	5.18	4.38	4.35	2.50	0.147	0.044	17.01	56.8	3.34
2016	5.11	4.34	4.56	2.95	0.151	0.038	19.53	77.6	3.97
2017	5.05	3.95	5.26	2.80	0.165	0.051	16.96	54.9	3.23
2018	5.21	4.65	5.15	2.70	0.148	0.049	18.12	55.1	3.02

Table 3 presents the results of biometric measures of 17 generative species of *Platanthera chlorantha* including both minimal and maximum values, and average values (X) of certain features.

Table 3

Selected morphological features of generative individuals of *Platanthera chlorantha* in the Kozinka River valley

Features	X	Min.	Max.
1. Height of plants (mm)	395.5	312.0	490.0
2. Length of the inflorescence (mm)	97.1	76.0	141.0
3. Number of flowers	13.0	9.0	17.0
4. Length of the first basal leaf (mm)	164.6	110.0	210.0
5. Width of the first basal leaf (mm)	43.6	24.0	72.0
6. Length of the second basal leaf (mm)	161.1	118.0	205.0
7. Width of the second basal leaf (mm)	41.8	26.0	70.0

The height of *Platanthera chlorantha* plants recorded in the Kozinka River valley (Table 3) is in the range of sizes given by Szafer et al. (1986), Szlachetko (2001), Piękoś-Mirkowa and Mirek (2003). The average height of the shoots is greater than those given by Więcław and Kurnicki (2016) from the area of the Dobrzany and Karniszewice Forest Inspectorates, but the maximum values of shoots recorded in these forest districts exceed those from the Kozinka River valley. The average length of the inflorescence is lower than the value given by Więcław and Kurnicki

(2016), with the minimum values being much smaller, and the maximum values much greater than those presented in the work. The average number of flowers on the shoot in the Kozinka River valley is similar to that reported by Więcław and Kurnicki (2016), but the minimum values presented by them are much smaller, and the maximum ones are much higher. The length of the leaf and the width of the leaf is in the range given by Więcław and Kurnicki (2016), the minimum and maximum values recorded by these authors significantly differ from those found in the Kozinka River valley.

Observations of the stand of *Platanthera chlorantha* in the Kozinka River valley in the years 2015-2018 confirm the systematic decline in the number of both generative and sterile specimens in the stand. Perhaps the reason for this is the tourist traffic in the recreational complex of the Charlotta Valley Resort & Spa, which directly borders with the described stand of the greater butterfly-orchid. Recently, the presence of European beaver *Castor fiber* has also been observed in this place, which may contribute to changing the water conditions of the habitats, and thus to the disappearance of many plant species. The stand will be still monitored.

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PLATANTHERA CHLORANTHA (CUSTER) RCHB. W DOLINIE RZEKI KOZINKI (POMORZE ŚRODKOWE)

Streszczenie

W pracy przedstawiono wyniki badań nad populacją *Platanthera chlorantha* (Custer) Rchb. w dolinie rzeki Kozinki na Pomorzu Środkowym. Badania prowadzono w sezonach wegetacyjnych lat 2015-2018. *Platanthera chlorantha* należy do gatunków wymierających na Pomorzu Zachodnim i w Wielkopolsce oraz na Pomorzu Gdańskim. Określono warunki edaficzne i fitocenotyczne, w jakich występuje podkolan zielonawy. Wykonano 25 zdjęć fitosocjologicznych z udziałem *P. chlorantha*, z czego 12 zestawiono w tabeli fitosocjologicznej. Przedstawiono wyni-

ki pomiarów biometrycznych 17 osobników generatywnych *P. chlorantha*, uwzględniające wartości minimalne i maksymalne oraz wartości średnie wybranych cech.