Roczniki Akademii Rolniczej w Poznaniu CCCLXXXIX

Botanika – Steciana

14, 2010, 101-105

www.up.poznan.pl/steciana

ISSN 1896-1908

POPULATION OF *LISTERA OVATA* (L.) R. BR. (ORCHIDACEAE) IN THE SOUTH-WESTERN PART OF POZNAŃ (FORMER ECOLOGICAL USELAND "KOPANINA II") – RESULTS OF MONITORING IN THE YEARS 1997-2009

Magdalena Kluza-Wieloch, Irmina Maciejewska-Rutkowska

M. Kluza-Wieloch, Department of Botany, Poznań University of Life Sciences, Wojska Polskiego 71 C, 60-625 Poznań, Poland, e-mail: kluza@up.poznan.pl
I. Maciejewska-Rutkowska, Fundamentals of Forestry Department of Natural, Poznań University of Life Sciences, Wojska Polskiego 71 D, 60-625 Poznań, Poland, e-mail: irminamr@up.poznan.pl

(Received: March 22, 2010. Accepted: April 23, 2010)

ABSTRACT. Monitoring of population of *Listera ovata* within the former ecological useland "Kopanina II" (south-western part of Poznań) was carried out in the years 1997-2009. The changes in numerical force of orchid population, including participation of vegetative and generative specimens and variation of morphological traits of plants were investigated. Plant community with *L. ovata* was also analysed. The investigated population of orchid was a component of alluvial forest *Fraxino-Alnetum*. In the first years of observations this population was in good form and domination of specimens in generative phase and with average height was testified to it. In the last years of monitoring its condition got worse as a result of devastation of its site, by building machines and cutting of some maples in tree-stand. Additionally, expansion of some arborescent species may also threaten population existence in feature.

KEY WORDS*: Listera ovata*, population structure, variation, Poznań

INTRODUCTION

Listera ovata (L.) R. Br. (Orchidaceae) has a wide, Eurasian range. In Asia it naturally grows in western Siberia, Caucasus, Altai and Himalaya. In Europe it is relatively often met, with the exception of northern Scandinavia, Hungarian Lowland and Iberian Peninsula, where its sites are not numerous. In Poland this plant belongs to the most common species of native orchid, especially in the southern and western parts of country. It usually grows in wet, calcareous meadows, transitional and lowland bogs, alder swamps, alluvial and oak-hornbeam forests, as well as in beech and beech-fir forests. Sporadically it is also a component of xerotermic oak forests, dry pine forests and alpine associations of high herbs and grasses (Szlachetko and Skakuj 1996, Atlas... 2001, Piękoś-Mirkowa and Mirek 2003).

As the other members of Orchidaceae family, *L. ovata* is under law protection in Poland (Rozporządzenie... 2004). Zarzycki et al. (2002) numbered it among group of vascular plants showing tendency to disappear of their sites and appearance of new ones during the last decades. With regard to rarity of this species in the Wielkopolska region this orchid was added to local "red list", as a species subjected to extinction (Żukowski and Jackowiak 1995). According to Jackowiak (1993) there had been 10 sites of *L. ovata* in evidence within Poznań up to the 90's of last century, including four historical localities of this plant. However, elaboration of the cited author did not include a site of *L. ovata* from south-western part of Poznań, within contemporary ecological useland "Kopanina II".

This site was found during the floristic investigations within former ecological uselands "Kopanina I" and "Kopanina II" (Kluza and Maciejewska 1998, Król et al. 1998, Kluza et al. 1999, Kluza and Maciejewska 1999). Henceforth, this local population of *L. ovata* had been monitored. The goal of the current work was to sum up long-term investigations (1997-2009) on the changes of population structure and its area, resulting from a strong anthropopressure.

METHODS

Object

Population of *L. ovata* occupies south-western hillside of basin, being remains of clay excavation, nearby brickyard, beside the Mieleszyńska Street (former ecological useland "Kopanina II", in the south-western part of Poznań). It grows in dispersion on the area of about 100 m^2. This orchid is a component of high herbs, being part of the remains of alluvial forest *Fraxino-Alnetum*. Specimens of *L. ovata* most often fill a gap among trees, however individual ones may also be found in strongly shaded sites, in immediate surroundings of trees.

Methods

Since 1997 to 2009, with the exception of 2005-2008, monitoring of *L. ovata* population was carried out from the beginning of orchid vegetation till the end of it. Each year number of specimens, including participation of generative and vegetative ones was determined. The height of plants was measured every season of observation, too. Besides, since 1998 the length of inflorescences was measured and number of flowers per inflorescence was counted. Additionally, phenological stages of orchids were observed.

The received data allowed to count basic statistical characteristics (Kala 1996). Arithmetic mean, median, variance, standard deviation and variation coefficient were calculated and minimal and maximal values were determined for at least 25 plants per every year of observations.

Two phytosociological records were carried out to investigate species composition and association structure with *L. ovata*. The species terminology following Mirek et al. (2002) was applied and classification of plant communities following Matuszkiewicz (2006) was used.

RESULTS

The investigated population of *L. ovata* grew on the mineral soil, formed from clay. Practically all specimens of orchid appeared in the constantly wet sites, often seasonally flooded. Together with common *L. ovata* 40 other species of vascular plants were noted. They composed small phytocenosis of alluvial forest *Fraxino-Alnetum* (*Querco-Fagetea* class), with two characteristic species of this syntaxon: *Solanum dulcamara* (+.2) and *Lycopus europaeus* (+.2). Besides, characteristic species of *Alno-Ulmion* alliance: *Ribes spicatum* (1.3) and *Festuca gigantea* (+) as well as characteristic species of *Querco-Fagetea* class: *Acer platanoides* (2.3), *Fraxinus excelsior* (2.1) and *Tilia cordata* (2.1) were observed. Plants related to *Molinio-Arrhenatheretea* class [*Deschampsia caespitosa* (3.1), *Dactylis glomerata* (2.1), *Poa trivialis* (2.1), *Avenula pubescens* (1.2), *Geum rivale* (1.2), *Lysimachia nummularia* (1.1), *Lathyrus pratensis* (+.2), *Galium mollugo* (+.2), *Ranunculus repens* (+.2), *Carex cuprina* (+), *Taraxacum officinale* (+)] and *Artemisietea vulgaris* class [*Rubus caesius* (3.1), *Chelidonium majus* (3.1), *Epilobium hirsutum* (2.3), *Urtica dioica* (2.1), *Geum urbanum* (2.1), *Galium aparine* (1.1), *Myosoton aquaticum* (+.2), *Cirsium arvense* (r)] were the most often met. Then species of rushes [*Phragmitetea* class: *Phalaris arundinacea* (2.3) and *Phragmites australis* (1.1)], clearing sites [*Epilobietea angustifolii* class: *Sambucus nigra* (2.2), *Populus tremula* (2.3) and *Eupatorium cannabinum* (+.2)] and species of the genus *Salix* [*S. cinerea* (1.2) – *Alnetea glutinosae* class; *S. purpurea* (2.1) and *S. alba* (2.2) – *Salicetea purpureae* class] were of significant importance too. Additionally, *Equisetum pratense* (1.1), *Poa angustifolia* (+.3), *Crataegus laevigata* (+), *Dryopteris carthusiana* (+), *Cerasus avium* (r) and *Vicia angustifolia* (r) were noted within the investigated area.

In the first years of observations *L. ovata* population occupied an area of about 100 m^2 and in the last year of monitoring its range diminished to about 10 m^2. During the whole period of observations on average 142 specimens of orchid were found, including 97 blooming ones. Population of orchid was the most numerous in 1997 (more than 500 individuals) and the least of all in last year (2009 – 23 ones; Table 1). Decrease of numerical force of orchid population had been observed since 1990, when part of area with *L. ovata* was devastated by heavy building machines, used in modernization of nearby brickyard. Besides, often burning of adjacent meadows in springtime caused destruction of herb layer in alluvial forest, including juvenile specimens of *L. ovata*.

Table 1. Numerical force of population of *Listera ovata* within former ecological useland "Kopanina II" during the period of monitoring (1997-2009)

Year of investigation	Number of specimens		
	generative	vegetative	together
1997	282	233	515
1998	300	79	379
1999	60	2	62
2000	118	3	121
2001	37	11	48
2002	26	12	38
2003	25	0	25
2004	26	41	67
2009	0	23	23

During the whole period of monitoring predominance of plants in generative stage was observed (on average 68.4% specimens of population). Together with decrease of numerical force of population, number of blooming plants had reduced, too. Though almost all specimens of *L. ovata* bloomed in the years 1999-2000, there was no orchid in juvenile stage in 2003. However, in the last year of observations all the noted plants were in juvenile phase (Table 1).

Usually the beginning of vegetation of *L. ovata* fell in mid-April and finished in mid-July. In the phase of fullness of blooming (2nd mid-May), during the whole time of investigations, average high of stems was 51.5 cm (with minimum 11.0 cm and maximum 84.0 cm). In 1999 population of orchid had got maximum value of this trait, and in 1997 – minimum value. Median analysis showed plants 52.5 cm high were most often met. On the other hand comparative analysis of standard deviation and variance revealed predominance of specimens with the height nearing arithmetic mean. Hence, the distribution of this trait was normal in population, but at the same time it was characterised by a relatively large variation, amounting to 20%. With respect to height the most similar plants were noted in 2002, and the most diverse ones in 1997 (Table 2).

On average the length of inflorescence was 19.4 cm (with range 8.0-34.0 cm) – 37.7% of whole length of stem. Median of this trait was 19.7 cm. The longest inflorescences were observed in 1999 and the shortest ones

Table 2. Statistical characteristics of investigated traits of *Listera ovata* during the period of monitoring (1997-2009)

Years	Average mean	Min.	Max.	Median	Variance	Standard deviation	Variation coefficient (%)
Height of plant (cm)							
1997	28.4	11	55	28.5	69.7	8.4	29.6
1998	59.8	17	84	60.5	158.7	12.6	21.1
1999	63.1	31	83	65.0	139.1	11.8	18.7
2000	53.2	34	71	55.0	81.5	9.0	16.9
2001	53.0	31	74	55.5	108.3	10.4	19.6
2002	55.4	43	70	54.5	71.8	8.5	15.3
2003	52.4	36	67	54.0	77.2	8.8	16.8
2004	47.2	27	66	47.0	97.3	9.9	21.0
Length of inflorescence (cm)							
1998	22.0	12	34	22.0	32.2	5.7	25.9
1999	22.3	9	34	22.5	37.5	6.1	27.4
2000	21.0	9	30	21.0	19.5	4.4	21.0
2001	16.9	7	23	17.0	15.2	3.9	23.1
2002	19.6	13	26	19.5	12.6	3.5	17.9
2003	17.6	8	23	20.0	17.1	4.1	23.3
2004	16.1	9	23	16.0	15.5	3.9	24.2
Number of flowers							
1998	37.2	13	63	40.0	108.8	10.4	28.0
1999	36.7	15	66	35.5	123.3	11.1	30.2
2000	33.7	9	48	33.5	73.2	8.6	25.5
2001	27.6	9	41	27.5	61.9	7.9	28.6
2002	28.8	15	43	29.5	49.2	7.0	24.3
2003	30.5	19	43	31.0	38.1	6.2	20.3
2004	24.2	15	35	23.5	32.2	5.7	23.6

in 2009. This trait was more variable than the length of stems. The most strongly variation of it revealed in 1999. On the other hand the length of inflorescence was the most equalized in 2002 (Table 2).

On average single inflorescence consisted of 31.2 flowers (with minimum value nine and maximum 66). Median analysis showed plants with 31-32 flowers per inflorescence were the most common. This trait was the most variable from among all the investigated ones. Number of flowers per inflorescence was the most diverse in 1999 (more than 30%) and the most constant in 2003 (Table 2).

DISCUSSION

Usually particular populations of *L. ovata* consist of several specimens, only sporadically several dozen (Piękoś-Mirkowa and Mirek 2003). At the beginning of monitoring Poznań population numbered more than 500 orchids. Unfortunately meadow burning in the springtime and first of all devastation of its area by building machines and felling maple-trees, causing rise in groundwater level, influenced significant regression of this population.

Total changes of site conditions, in particular changes of land irrigation are the most important threat for existence of orchid species (Kowalewska 1995). Then those plants are subjected to intraspecific competition and they are often not able to win with the other more expansive vascular species. Hence in numerous revisions they have not been observed again on their former sites, however, these places are not subjected to any forms of anthropopressure (Wells and Willems 1991, Bednorz and Golis 2001, Wyrzykiewicz-Raszewska 2001, 2002).

In balanced plant communities many years' population dynamics of perennial plants characterises inconsiderable fluctuations of numerical force or progressive direction changes (Falińska 1996). Given species has better growth conditions, where life cycle of its specimens proceeds faster and maximal participation of flowering plants is an indicator of this phenomena (Rabotnov 1950). At currently observed population it revealed only through the first years of monitoring. On the other hand Vakhrameeva and Tatarenko (1998) state participation of generative plants significantly increases in disturbed systems. Just only generative specimens determine a preservation of reproductive potential, with regard to fructification, as well as maximal power

of forming runners (Symonides 1974). According to Snagovska (1966) prevalence of specimens with medium height evidences optimal site conditions. A large number of flowers per plant also testifies to good form of a given population (Szlachetko and Skakuj 1996).

In the recent years investigations on orchid populations have referred to estimate their resources and learn their ecology. Falińska (1990) considers the ability of population changes of its numerical force to be a significant feature, reflecting living conditions. Poor site conditions may be a reason of poor growth of plants. Such an occurrence was noted at *L. ovata* population from Poznań in recent years of monitoring. If specimens with medium height predominate in population, it testifies to its stabilization.

Characterised population of *L. ovata* grows in plant community, formed on the area of remains of former clay excavation, as a result of secondary succession. Thus it is a new population, though genetically connected with the other populations of species in the valley of Junikowski stream. Jackowiak and Celka (1997) noticed the possibilities of maintenance, but also appearance and survival of new populations of vulnerable species even in urban agglomeration. According to Adamowski and Conti (1991) open area or disturbance of soil conditions are even conductive to orchid expansion.

Among others, two isolated population of *L. ovata* were described from the Biebrzański National Park (Przydyba 2003). It was noted on average 36.7 and 33.6 flowers per inflorescence for those populations. Population from Poznań formed similar number of flowers in inflorescences, however site deterioration in last years of observations, affected reduction of length of inflorescences and number of flowers per raceme.

In population survey of different species of orchids variation of individual traits, as plant height, length of inflorescence, number of flowers and leaves are usually analysed (Antkowiak and Pankros 2000, Bednorz and Golis 2000, Wyrzykiewicz-Raszewska 2001). In current work the range of variation of those traits at population of *L. ovata* from Poznań was similar in comparison to data cited in literature.

CONCLUSIONS

During the investigations significant reduction in numerical force of population of *L. ovata* from "Kopanina II" was noted. Compared to the first year of observations, in the recent year number of specimens decreased more than 20 times. Simultaneously participation of juvenile specimens increased in population.

For the whole period of monitoring progressive reduction of plant size, length of inflorescences and number of flowers per raceme was observed.

Number of flowers per inflorescence was the most variable trait. The other investigated traits were characterised by 20% variation.

Strong anthropopressure seems to be a main reason of regression of *L. ovata* population from Poznań. Hence the analysed population of orchid does requires immediate protection against further devastation of its area. In addition, expansion of woody plants, as *Rubus caesius* or species of genus *Salix* may also negatively influence on population existence in future.

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For citation: Kluza-Wieloch M., Maciejewska-Rutkowska I. (2010): Population of *Listera ovata* (L.) R. Br. (Orchidaceae) in the south-western part of Poznań (former ecological useland "Kopanina II") – results of monitoring in the years 1997-2009. Rocz. AR Pozn. 389, Bot.-Stec. 14: 101-105.