

DISTRIBUTION AND POPULATION SIZE OF THE THREATENED FEN ORCHID  
*LIPARIS LOESELII* (L.) RICH. IN THE LITHUANIAN LAKE DISTRICT (NE POLAND)

PAWEŁ PAWLIKOWSKI

P. Pawlikowski, Department of Plant Ecology and Environmental Conservation, University of Warsaw,  
Al. Ujazdowskie 4, 00-478 Warszawa, Poland, e-mail: p.pawlikowski@uw.edu.pl

(Received: June 3, 2008. Accepted: September 15, 2008)

**ABSTRACT.** Fifty-five localities of *Liparis loeselii*, hosting populations of ca. 15 000 individuals, were recorded in the rich fens of the Lithuanian Lake District (north-easternmost Poland) during the field survey in 2003-2008. Among them were 39 populations discovered for the first time. Sixteen sites of the species known from the literature and unpublished (including herbarium) sources were not confirmed during the survey, three of them being definitely extinct. *Liparis loeselii* was distributed unevenly within the area studied, with the main aggregation of localities in the Sejny Lakeland and the Wigry National Park and its vicinity. Small populations (less than 100 individuals) predominated, but there were also 14 populations consisting of more than 100 individuals, as well as one very large population in the lower Rospuda river valley (exceeding 5000 individuals). The biggest Rospuda population, along with five neighbouring smaller ones, consisted of more than 10 000 individuals. The Lithuanian Lake District seems to be an area of general importance for the conservation of *L. loeselii* in Poland and Europe. The species is threatened, first of all, due to mires overgrowing with shrubs, and requires conservation measures as well as establishing nature reserves in the places of its occurrence.

**KEY WORDS:** *Liparis loeselii*, Orchidaceae, threatened species, distribution, ATPOL, population size, conservation status, Habitat Directive, Rospuda valley, Lithuanian Lake District, Poland

## INTRODUCTION

*Liparis loeselii* (L.) Rich. is a greenish or green-yellowish, two-leaved perennial 6-20(25) cm high (MOORE 1980, PROCHÁZKA and VELÍSEK 1983). This amphiatlantic species is generally restricted to temperate (mainly warm temperate) zone and mountain regions southwards (HULTÉN and FRIES 1986). Its distribution in Poland used to cover most of the territory excluding mountain areas (ZAJĄC and ZAJĄC 2001). It is a calciphilous, light-demanding species, growing in ground water fed mires (rich fens) (PROCHÁZKA and VELÍSEK 1983, WHEELER et AL. 1998). In Poland, it is usually found in mires with brown moss-small sedge vegetation. It grows less frequently in calcitolerant *Sphagnum*-dominated phytocoenoses (KUCHARSKI 2001, PAWLIKOWSKI 2004).

In Europe, due to land reclamation (e.g. drainage), land use intensification and succession processes in abandoned meadows, the species has decreased considerably and is regarded as threatened throughout the continent (e.g. INGELÖG et AL. 1993, WHEELER et AL. 1998, PROCHÁZKA and POTŮČEK 1999, KUCHARSKI 2001, TASENKEVICH 2002, KULL and HUTCHINGS 2005). Central European countries share a particular responsibility for the conservation of *L. loeselii*, since this territory is

the main area of the species distribution world-wide. At the same time, *L. loeselii* has been given “endangered” species status in Central Europe (EN category). Poland and France are the only Central European countries, where *L. loeselii* is considered vulnerable (VU category, in contrast to other countries in this part of Europe, where it is either endangered or critically endangered – EN or CR category) (SCHNITTLER and GÜNTHER 1999). The species is protected by Berne Convention (CONVENTION... 1979) and is listed in Annexes II and IV of the European directive 92/43/EEC (COUNCIL DIRECTIVE... 1992).

In Poland *L. loeselii* has lost more than half of its known localities. Moreover, several dozens of localities have not been confirmed. Probably most of these localities do not exist any longer (KUCHARSKI 2001, PAWLIKOWSKI 2004). In all the regional lists published, the species is considered endangered, critically endangered or extinct. Several numerous and vital populations were reported in the Lithuanian Lake District in the north-easternmost part of the country in the 1970s and 80s (SOKOŁOWSKI 1978, 1989, 1990). This area is considered to be the most important region for the species in Poland (PAWLIKOWSKI 2004). Nevertheless, there is no clear evidence of that and the number of localities and the population size remains unknown.

The aim of this study is to determine the distribution and population size of *L. loeselii* in the Lithuanian Lake District and assess the role the area studied plays in the conservation of the species. Reliable data on the species status are needed in order to undertake conservation measures.

METHODS

Literature and herbaria surveys were carried out to reveal all the historical data on the species occurrences in the Polish part of the Lithuanian Lake District region (according to KONDRACKI 2002). The literature and herbarium localities were the subject of field investigations. Suitable habitats within the area studied were checked in order to find new sites. For all the localities confirmed or discovered, the number of individuals was counted (where possible) or estimated. Several hitherto unpublished observations of other botanists were included in the data set obtained.

Every locality was assigned an appropriate ATPOL grid square (ZAJĄC and ZAJĄC 2001). Apart from the 10 km × 10 km squares, smaller 5 km × 5 km quarters (one-fourth of the big square) were applied. For example,

letter “A” denotes north-west quarter, letter “B” denotes north-east quarter and so on. In cases when several local populations existed within one bigger locality, they were treated as one locality (unless they were located in different ATPOL squares).

RESULTS

List of localities

ATPOL grid square codes are given in **bold**. Numbers in [brackets] refer to site numbers on the map (Fig. 1). Explanations of abbreviations: PKPR – Romincka Forest Scenic Park; SPK – Suwałki Scenic Park; WPN – Wigry National Park; ! – confirmed sites; ? – unconfirmed sites; EX – sites extinct due to habitat destruction; (number in brackets) – year of observation. Population size is presented using intervals: [1] 1-3, [2] 4-10, [3] 11-25, [4] 26-100, [5] 101-250, [6] 251-1000, [7] more than 1000 individuals.

**FA86B** [1] PKPR: “Żytkiejska Struga” reserve, fen south of the Żytkiejska Struga river (! 2005: 1).

**FA88B** [2] Szeszupa river valley, fen Rudawki in a valley reaching the main river valley near Potopy village (! 2003, 2006, 2008: 5).

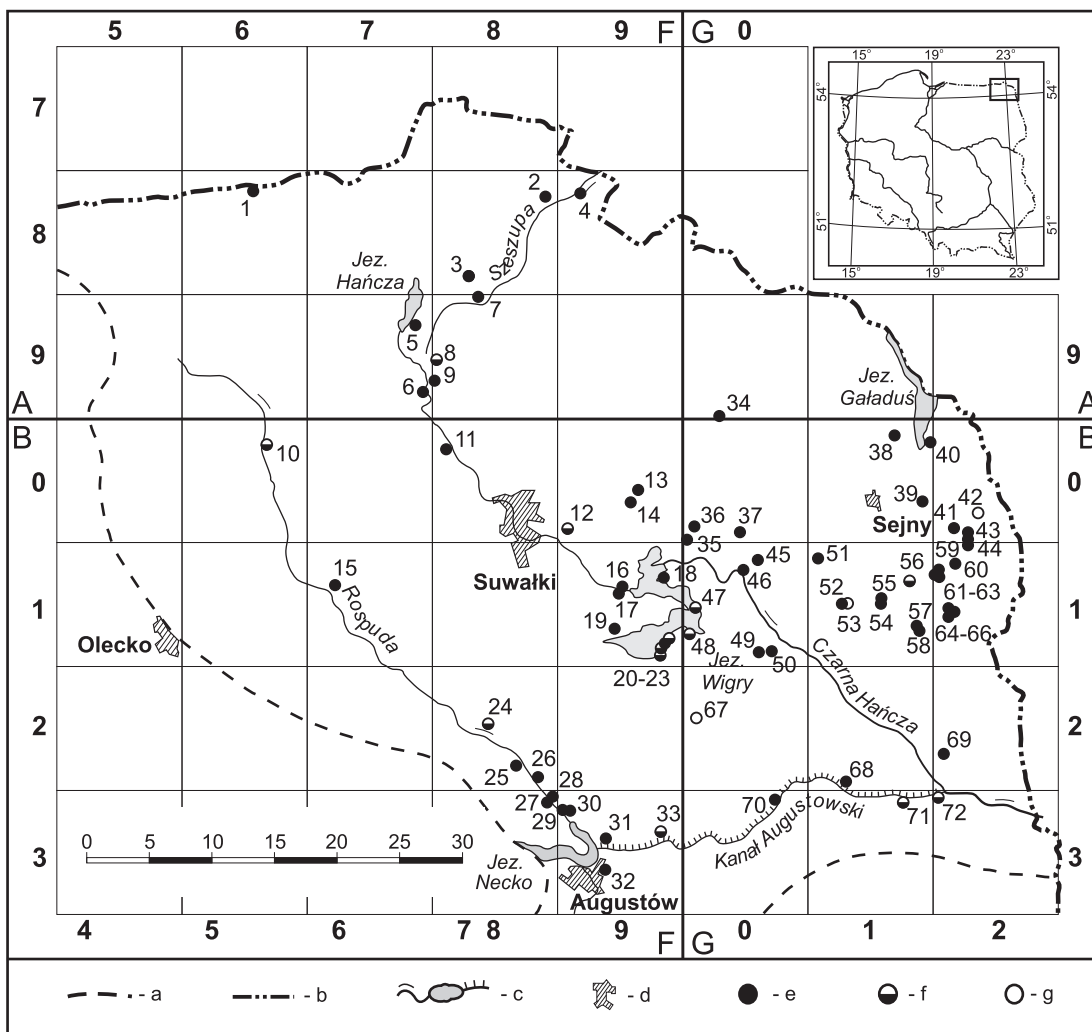


FIG. 1. Distribution of *Liparis loeselii* in the Polish part of the Lithuanian Lake District. a – border of the Lithuanian Lake District region; b – state border; c – waters; d – towns, e – confirmed localities; f – unconfirmed localities, probably extinct; g – extinct localities

- FA88C** [3] SPK: fen adjacent to Purwin (Purwinek) Lake (BIL: *leg.* A.W. Sokołowski 1980, KAWECKA 1991, ! 2002-2003: 4, 2007: 2).
- FA89A** [4] Szeszupa river valley, fen adjacent to Poszeszupie village near the east edge of the valley (! 2003, 2008: 3).
- FA97B** [5] SPK: fen east of Bocznial Lake (! 2004: 1, PAWLIKOWSKI 2008).
- FA97D** [6] Czarna Hańcza river valley, fen west of the river, east of the Stara Pawłówka village (F. Jarzombkowski 2008 unpubl.: 1).
- FA98A** [7] SPK: fen south of Kojle Lake, in a valley of a small rivulet (! 2006: 1, PAWLIKOWSKI 2008).
- FA98C** [8] fen adjacent to Linówek Lake (SOKOŁOWSKI 1973, BIL: *leg.* A. Kawecka 1969). The map in an article by SOKOŁOWSKI (1973) shows an erroneous location. ? (2004, 2006).
- FA98C** [9] Czarna Hańcza river valley, fen east of the river, between Malesowizna and Rutka villages (F. Jarzombkowski 2008 unpubl.: 1).
- FB06B** [10] Rospuda river valley, 2 km south of Filipów (K. Brzezińska 2002 unpubl.: 1). ? (2003, 2007).
- FB08A** [11] Czarna Hańcza river valley, spring and fen complex between Osowa and Potasznia villages, west of the river (! 2003-2004, 2006: 5).
- FB09C** [12] fen bordering the south-west part of Krzywe Lake, near Mała Huta settlement (BIL: *leg.* A.W. Sokołowski 1976). ? (2007).
- FB09D** [13] WPN: Wiatrołuża (Kaletnik) river valley, fen south of Czarny Mostek on both sides of the river (BIL: *leg.* A.W. Sokołowski 1981, SOKOŁOWSKI 1990, JUTRZENKA-TRZEBIATOWSKI et AL. 2002, ! 2003-2005, 2008: 6).
- FB09D** [14] WPN: fen bordering the north part of Białe Piertańskie Lake (SOKOŁOWSKI 1988(1990), ! 2004: 4).
- FB17A** [15] Rospuda river valley, "Bagno Parchacz" fen near Stara Kamionka village (! 2003-2004: 4).
- FB19A** [16] WPN: Czarna Hańcza river valley west of Wigry Lake, fen north of the river (Z. Dajdok 2007 unpubl.: 2).
- FB19A** [17] WPN: Czarna Hańcza river valley west of Wigry Lake, fen south of the river (SOKOŁOWSKI 1990, ! 2003: 1).
- FB19B** [18] WPN: fen on Rosochaty Róg peninsula (JUTRZENKA-TRZEBIATOWSKI et AL. 2002, M. Romański 2003-2004 unpubl.: 4).
- FB19C** [19] WPN: fen bordering the west part of Muliczne Lake (! 2004: 1).
- FB19D** [20] WPN: fen bordering the north-east part of Kruszyn (Krusznik) Lake (BIL: *leg.* A.W. Sokołowski 1982, SOKOŁOWSKI 1990). ? (2007).
- FB19D** [21] WPN: Jurkowy Róg peninsula, fen between Kruszyn (Krusznik) Lake and Wigry Lake (JUTRZENKA-TRZEBIATOWSKI and SZAREJKO 2001, JUTRZENKA-TRZEBIATOWSKI et AL. 2002, ! 2004, 2006-2007: 6).
- FB19D** [22] WPN: fen between Czarne Lake and Wigry Lake, 1 km north of Bryzgiel village (SOKOŁOWSKI 1990, JUTRZENKA-TRZEBIATOWSKI and SZAREJKO 2001, JUTRZENKA-TRZEBIATOWSKI et AL. 2002). ? (2003-2004, 2007).
- FB19D** [23] WPN: fen between Czarne Lake and Wigry Lake, 0.5 km north of Bryzgiel village (BIL: *leg.* A.W. Sokołowski 1982, SOKOŁOWSKI 1990). ? (2004).
- FB28A** [24] fen bordering the north part of Jałowo Lake, near Rospuda river valley (SOKOŁOWSKI 1989). ? (2007, 2008).
- FB28D** [25] fen in a valley of a small rivulet joining Rospuda river valley south of Młynisko, east of Jabłońskie village (BIL: *leg.* A.W. Sokołowski 1986, SOKOŁOWSKI 1989, ! 2003: 3).
- FB28D** [26] Rospuda river valley, fen east of the river, west of Szczeberka village (SOKOŁOWSKI 1989, ! 2002-2007: 6).
- FB38B** [27] Rospuda river valley, fen west of the river (! 2004-2005, 2007, 2008: 6).
- FB38B** [28] Rospuda river valley, fen east of the Rospuda river, north of the Blizna river (BIL: *leg.* A.W. Sokołowski 1986, SOKOŁOWSKI 1989, ! 2003-2008: 7; estimated number of individuals exceeded 5000).
- FB39A** [29] Rospuda river valley, fen south of the Blizna river and west of the Kozia Szyja hill (BIL: *leg.* A.W. Sokołowski 1987, ! 2003, 2007, 2008: 7).
- FB39A** [30] Rospuda river valley, forested mire east of the Rospuda river, south of the Blizna river and east of the Kozia Szyja hill (! 2008: 1).
- FB39A** [31] "Kobyła Biel" fen bordering the north-west part of Białe Augustowskie Lake (LUDERA 1932, KRAM: *leg.* F. Ludera 1933, TYSZKOWSKI 1992, 1993, ! 2004-2006: 4).
- FB39C** [32] fen adjacent to allotment gardens in Augustów, near "Szosa do Sejn" road (! 2006: 3).
- FB39B** [33] fen adjacent to a small forest lake near Przewięź settlement (BIL: *leg.* A.W. Sokołowski 1977). ? (2004, 2007).
- GA90C** [34] fen 1.5 km south of Stare Boksze village, near Czarna river valley (! 2004: 1).
- GB00C** [35] fen on peninsula bordering the north part of Dowcień Lake near Wigry Lake (BIL: *leg.* A.W. Sokołowski 1981, SOKOŁOWSKI 1990). ? (2003, 2006-2007).
- GB00C** [36] fen bordering the south-west part of Żubrowo Lake (! 2002-2003, 2006: 4).
- GB00C** [37] fen bordering the north-west part of Gremzdy Lake (! 2004-2005: 3).
- GB01B** [38] fen bordering the north-west part of Druce Lake (! 2006: 1).
- GB01D** [39] fen bordering the north part of Zdaniszki Lake (near Poćkuny village) (! 2005: 1).
- GB01B** [40] fen bordering the west part of Dusajtis Lake (near Dusznicia village) (! 2004: 3).
- GB02C** [41] fen bordering the east part of Gajlik Lake (KŁOSOWSKI and TOMASZEWICZ 1979, JABŁOŃSKA 2005, ! 1999-2006: 4).
- GB02C** [42] fen bordering the south part of Pilwie Lake (KŁOSOWSKI and TOMASZEWICZ 1979). EX (2002, 2006).
- GB02C** [43] Kunisianka river valley, fen in Berźniki (Berzniki, Berźniki) village (! 2004-2007: 4).
- GB02C** [44] Kunisianka river valley, fen between Berźniki (Berzniki, Berźniki) village and Iłgiel Lake, near Małe Leszkowo (! 2005, 2007: 5).
- GB10B** [45] fen bordering the south-west part of Gremzdy Lake (! 2004: 3).
- GB10A** [46] Czarna Hańcza river valley, fen adjacent to Buda Ruska village (! 2008: 2).
- GB10C** [47] WPN: Węgał site, Łapa peninsula bordering the east part of Wigry Lake (TYSZKOWSKI 1993,

- JUTRZENKA-TRZEBIATOWSKI and SZAREJKO 2001). ? (2003-2004, 2006-2007).
- GB10C** [48] WPN: fen adjacent to a small lake south of Krzyżacka Bay of Wigry Lake, near Czerwony Krzyż village (SOKOŁOWSKI 1990). ? (2007)
- GB10D** [49] fen west of Sarnetki (Sernetki) village (! 2003-2005: 5).
- GB10D** [50] Czarna Hańcza river valley, fen east of Sarnetki (Sernetki) village (K. Brzezińska 2001 unpubl., 2003-2005: 4).
- GB11A** [51] fen bordering the south part of a small lake in Daniłowce (! 2004-2005: 1).
- GB11A** [52] fen bordering the south-west part of Gieret (Hiret) Lake (WA: *leg.* H. Werblan-Jakubiec 1975, MAZUR et AL. 1978). EX (2006).
- GB11A** [53] fen in a small valley joining the south-west part of Gieret (Hiret) Lake (! 2006: 3).
- GB11B** [54] fen bordering the north-west part of Pomorze Lake (! 2004-2005: 5).
- GB11B** [55] Marycha river valley, fen near Alekszejówka village (S. Kłosowski 1998 unpubl., ! 1999-2000, 2002-2007: 5).
- GB11B** [56] fen bordering the north part of Dowcień (Dautenis) Lake near Pomorze Lake (WA: *leg.* B. Sudnik 1975, MAZUR et AL. 1978). ? (2003, 2005).
- GB11D** [57] fen bordering the south-west part of Wiłkokuk Lake (BIL: *leg.* J. Żurawski 1974, *leg.* A.W. Sokołowski 1974, 1982, WA: *leg.* J. Popławska 1975, SOKOŁOWSKI 1978, KŁOSOWSKI and TOMASZEWICZ 1979, TYSZKOWSKI 1993, ! 2004-2006: 5).
- GB11D** [58] fen 0.5 km south-west of the southernmost part of Wiłkokuk Lake (! 2004: 2).
- GB12A** [59] fen bordering the north part of Hgielk Lake (! 2003, 2005-2006: 2).
- GB12A** [60] Kunisianka river valley, between Hgielk Lake and Kunis Lake, fen east of the river (! 2004-2005, 2007: 4).
- GB12A** [61] Kunisianka river valley, between Kunis Lake and Pomorze Lake, fen north of the river (! 2003: 2).
- GB12A** [62] fen bordering the north-west part of Kunis Lake, several local populations were observed (! 2003: 4).
- GB12A** [63] fen bordering the south-west part of Kunis Lake, two local populations were observed on both sides of the Kunisianka river (! 2002-2005: 4).
- GB12C** [64] fen "Wielka Bagna" bordering the east part of Seklis Lake (! 2003: 3).
- GB12C** [65] fen "Mielubagno" bordering the north-east part of Zelwa Lake (! 2004: 2).
- GB12C** [66] fen between Zelwa Lake and Seklis Lake (KŁOSOWSKI and TOMASZEWICZ 1979, ! 2003-2005: 4).
- GB20A** [67] fen between Blizienko Lake and Kopanica Lake (SAROSIEK et AL. 1995). EX (2007).
- GB21C** [68] "Borsuki" fen in a valley of a small rivulet joining Augustowski Canal north-east of Paniewo lock, north of the Canal (! 2005: 2).
- GB22C** [69] fen bordering the north part of Krajwelanek (Krejwelanek) Lake (KŁOSOWSKI and TOMASZEWICZ 1979, TYSZKOWSKI 1995 b, ! 2003-2004: 5).
- GB30B** [70] fen in a small valley reaching the Augustowski Canal valley, between Żyliny settlement (near Sucha Rzeczka village) and Żydowskie set-

tlement (near Płaska village) (TYSZKOWSKI 1995 a, ! 2006: 2).

**GB31B** [71] Augustowski Canal valley, fen adjacent to Jazy settlement west of Mikaszówka village (BIL: *leg.* A.W. Sokołowski 1962, BIL: *leg.* J. Żurawski 1963, SOKOŁOWSKI 1965, BIL: *leg.* M. Petrowicz 1974). ? (2002-2003, 2007).

**GB32A** [72] Augustowski Canal valley, fen adjacent to Rygol village (BIL: *leg.* J. Żurawski 1974). ? (2007).

The survey revealed the presence of *L. loeselii* at 55 localities. 16 populations that were previously known from the literature have been confirmed, and 39 new ones have been discovered. Three localities are definitely extinct, and 14 have not been confirmed (most of them are probably extinct). In the Polish part of the Lithuanian Lake District, the number of localities of the species recorded so far is estimated at 72. The distribution of the species in the area studied as well as the status of localities are presented in Figure 1.

Most of the localities are concentrated in the easternmost part of the area studied: in the Sejny Lakeland area and in the Wigry National Park and its vicinity. Smaller groups of populations are known from the Rospuda river valley, Czarna Hańcza river valley and from areas along the Augustowski Canal and Szeszupa river valley. Apart from these areas, the other localities are scattered. It is hardly present in the western part of the region studied.

Small populations of *L. loeselii* (less than 100 individuals) predominate, comprising nearly 3/4 of the total number of populations. As many as 40% of the localities host very small populations (less than 10 individuals). Larger populations (with more than 100 individuals) account for 25% of the total population number. Only six populations (11%) are numerous (exceeding 250 individuals). They are present in the lower Rospuda valley and in the Wigry National Park only. It is difficult to estimate the size of the biggest populations in the lower Rospuda river valley, since it covers unevenly an area of about 50 hectares. Nevertheless, on the basis of six-year observations (2003-2008) it can be stated beyond any doubt that the number of individuals in the neighbouring populations in Rospuda river valley (populations 25-30) exceeds 10 000 individuals. This is twice as much as all the other populations investigated taken together (nearly 4000 individuals at 49 localities). The biggest population (in the area studied), east of the river in the main complex of the Rospuda mire, consists of more than 5000 individuals.

## DISCUSSION

Recent papers providing data on the population size of *L. loeselii* at the Polish localities usually report rather small numbers – from several to several dozens of individuals per population (NOWAK et AL. 2000, ANDRZEJEWSKI et AL. 2002, BEDNORZ 2006, BZDON and CIOSEK 2006, MICHAŁOWSKA and RYMON-LIPIŃSKA 2006, PISARCZYK 2006, PRAJS and ANTKOWIAK 2008, SZCZEPAŃSKI 2008). Bigger populations, consisting of several hundreds of individuals, have been documented



only occasionally (MICHALCZUK and STACHYRA 2003, SZCZEPAŃSKI 2008). A single more numerous population has been reported from a man-made habitat – a sand pit in Dąbrowa Górnicza in southern Poland (more than 1000 individuals – R. Bula, A. Henel, A. Czyłok, J. Parusel and W. Bąba 2006 unpubl., cited after PISARCZYK 2006). The high number of individuals in the area studied (more than 2000), with at least 14 populations exceeding 100 individuals, indicates that the Polish part of the Lithuanian Lake District hosts the majority of the Polish resources of the species (although small populations predominate here and the high population size is affected mainly by the abundant Rospuda site).

The number of current *L. loeselii* localities known from the Lithuanian Lake District is surprisingly high in comparison with the adjacent Warmia and Masuria region, which shared similar geological (glacial) history and are geomorphologically similar to the area investigated in the present study (KONDRACKI 2002). From among more than 50 localities recorded in Warmia and Masuria region (former East Prussia territory) by German botanists in the 19th and at the beginning of the 20th century (ABROMEIT et AL. 1931-1940), only about a dozen were confirmed after World War II, and a similar number of new sites were discovered (see KUCHARSKI 2001, SZCZEPAŃSKI 2008). At the same time, the area of the Warmia and Masuria region is much bigger than the area of the Lithuanian Lake District within Polish borders. The reason for the striking difference in the number of localities between these two regions is probably historical and relates to the fact that Masuria and Warmia territory was intensively managed and drained before and after World War II, whereas in the Lithuanian Lake District traditional extensive land management practices continued until very recently.

In the part of Belarus adjacent to Poland, *L. loeselii* has not been recorded since the 19th century (SHVETS 2005). By contrast, a few dozen localities of the species are known from the adjacent, main part of the Lithuanian Lake District within Lithuanian borders. It is the species main area of distribution in Lithuania (GUDŽINSKAS 2001). Thus, the Polish part of the Lithuanian Lake District together with the adjacent part of Lithuania should be considered an area of general importance for the conservation of *L. loeselii* in Europe. Special efforts should be made to ensure that the borderline concentration of viable populations of the species is protected against human impact.

In order to protect the species, conservation measures should be undertaken (mowing, removing of shrubs, restoring proper hydrological conditions and creating regeneration niches – WHEELER et AL. 1998, PAWLIKOWSKI 2004), and nature reserves established that would protect the best preserved populations of the species. At present, only seven confirmed populations of the species are situated within the borders of the protected areas (six populations in the Wigry National Park and one in “Żytkiejmska Struga” nature reserve). Among the areas that should be designated as nature reserves are:

- fens in the lower Rospuda river valley (populations 25-30),

- a fen complex bordering the south-west side of Wilkokuk Lake (populations 57 and 58),
- fens adjacent to Sernetki village (populations 49 and 50),
- fen adjacent to Pomorze Lake and a nearby fen in Marycha river valley near Alekszejówka (populations 54 and 55),
- fens adjacent to Kunis Lake (populations 62 and 63).

The distribution of *L. loeselii* in the Lithuanian Lake District was poorly documented until now. The present field survey doubled the recorded number of localities of the species in the area studied. The area seems to host the majority of Polish population of *L. loeselii* (see KUCHARSKI 2001, PAWLIKOWSKI 2004, as well as more recent papers of PISARCZYK 2006 and SZCZEPAŃSKI 2008). Thus it is a key area for the conservation of the species in Poland, considering both the number of individuals and the number of populations.

#### Acknowledgements

I would like to thank Prof. Stanisław Kłosowski for providing his unpublished information on the location of mires in the Lithuanian Lake District and help during the field surveys (along with Filip Jarzombkowski and Michał Kazimierzuk). I am indebted to Prof. Adam Zajac for providing me with the ATPOL database information, as well as Dr. Zygmunt Dajdok, Filip Jarzombkowski, Kamila Brzezińska and Maciej Romański for making their unpublished data available to me. I am also grateful to the Curators and Staff of the Polish herbaria for providing access to herbarium collections and Marek Fiedor for his help in preparing the map. The study was supported in part by the Ministry of Science and Higher Education (former State Committee for Scientific Research), through Faculty of Biology, Warsaw University intramural grants: BW 1601/5, BW 1636/40 and BW 1680/43.

#### REFERENCES

- ABROMEIT J., NEUHOFF W., STEFFEN H. (1931-1940): Flora von Ost- und Westpreußen 2. Kommissionverlag Gräfe und Unzer, Königsberg.
- ANDRZEJEWSKI H., KUROWSKI J.K., WITOSŁAWSKI P. (2002): Nowe stanowisko lipiennika Loesela w środkowej Polsce. *Chrońmy Przyr. Ojcz.* 58, 6: 70-73.
- BEDNORZ L. (2003): Population dynamics of *Liparis loeselii* (L.) L.C. Rich. in the nature reserve ‘Mielno’ – some results from a 8 year study. *EJPAU* 6, Biol. 2. URL: <http://www.ejpau.media.pl/series/volume6/issue2/biology/art-06.html>
- BZDON G., CIOSEK M. (2006): Fen orchid *Liparis loeselii* (L.) Rich. in abandoned gravel-pit in Dąbrówka Stany near Siedlce (Poland). *Biodiv. Res. Conserv.* 1-2: 193-195.
- CONVENTION on the Conservation of European Wildlife and Natural Habitats. Bern, 19.09.1979. – European Treaty Series 104.
- COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora. *Official Journal of European Communities* OJ L 206, 22.07.1992.

- GUDŽINSKAS Z. (2001): Diversity, state, and protection of *Orchidaceae* species in Lithuania. *J. Eur. Orch.* 33, 1: 415-441.
- HULTÉN E., FRIES M. (1986): Atlas of North European vascular plants. North of the Tropic of cancer. Vol. 1. Koeltz Scientific Books, Königstein.
- INGELÖG T., ANDERSSON R., TJERNBERG M. (1993): Red Data Book of the Baltic Region. 1. List of threatened vascular plants and vertebrates. Swedish Threatened Species Unit, Uppsala.
- JABŁOŃSKA E. (2005): Flora roślin naczyniowych i mszaków torfowiska nad jeziorem Gajlik na Pojezierzu Sejneńskim. *Fragm. Florist. Geobot. Polonica* 12, 1: 67-81
- JUTRZENKA-TRZEBIATOWSKI A., SZAREJKO T. (2001): Zespół *Caricetum buxbaumii* w Wigierskim Parku Narodowym. *Fragm. Florist. Geobot. Polonica* 8: 149-171.
- JUTRZENKA-TRZEBIATOWSKI A., SZAREJKO T., DZIEDZIC J. (2002): Walory florystyczne wybranych obiektów badań geobotanicznych Wigierskiego Parku Narodowego. *Acta Bot. Warm. Masur.* 2: 63-92.
- KAWECKA A. (1991): Rośliny chronione, rzadkie i zagrożone w Suwalskim Parku Krajobrazowym i na terenach przyległych. *Parki Nar. Rez. Przyr.* 10, 3-4: 93-109.
- KŁOSOWSKI S., TOMASZEWICZ H. (1979): Rzadkie i interesujące rośliny z Pojezierza Suwalskiego. *Fragm. Florist. Geobot.* 25: 371-375.
- KONDRACKI J. (2002): Geografia regionalna Polski. Wydawnictwo Naukowe PWN, Warszawa.
- KUCHARSKI L. (2001): *Liparis loeselii* (L.) Rich. In: Polska czerwona księga roślin. Eds R. Kaźmierczakowa, Z. Zarzycki. Instytut Botaniki im. W. Szafera PAN, Instytut Ochrony Przyrody PAN, Kraków: 574-575.
- KULL T., HUTCHINGS M.J. (2005): A comparative analysis of decline in the distribution ranges of orchid species in Estonia and the United Kingdom. *Biol. Cons.* 129, 1: 31-39.
- LUDERA F. (1932): Roślinność torfowiska nad jeziorem Białem w Augustowskim. *Ochr. Przyr.* 12: 149-150.
- MAZUR W., SUDNIK-WÓJCIKOWSKA B., WERBLAN-JAKUBIEC H. (1978): Flora okolic Gib (Pojezierze Sejneńskie). *Fragm. Florist. Geobot.* 24, 2: 225-257.
- MICHALCZUK W., STACHYRA P. (2003): Nowe stanowiska lipiennika Loesela *Liparis loeselii* na Zamojszczyźnie. *Chrońmy Przyr. Ojcz.* 59, 3: 122-125.
- MICHAŁOWSKA A., RYMON-LIPIŃSKA J. (2006): Nowe stanowisko *Liparis loeselii* (L.) Rich. w Wielkopolsce. *Chrońmy Przyr. Ojcz.* 62, 6: 41-44.
- MOORE D.M. (1980): *Liparis* L.C.M. Richard. In: Flora Europaea 5. Alismataceae to Orchidaceae. Eds T.G. Tutin, V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters, D.A. Webb. Cambridge University Press, Cambridge: 350.
- NOWAK A., NOWAK S., SPAŁEK K. (2000): Nowe stanowisko lipiennika Loesela *Liparis loeselii* na Śląsku Opolskim. *Chrońmy Przyr. Ojcz.* 56, 4: 79-83.
- PAWLIKOWSKI P. (2004): *Liparis loeselii* (L.) Rich. Lipiennik Loesela. In: Gatunki roślin. Poradniki ochrony siedlisk i gatunków Natura 2000 podręcznik metodyczny. Vol. 9. Eds B. Sudnik-Wójcikowska, H. Werblan-Jakubiec. Ministerstwo Środowiska, Warszawa: 150-154.
- PAWLIKOWSKI P. (2008): Nowe stanowiska zagrożonych gatunków torfowiskowych roślin naczyniowych i mchów w Suwalskim Parku Krajobrazowym i jego otulinie. *Fragm. Florist. Geobot. Polonica* 15, 1: 43-50.
- PISARCZYK E. (2006): Nowe stanowisko lipiennika Loesela *Liparis loeselii* (L.) Rich. na terenie Krakowa na tle rozmieszczenia gatunku w południowo-wschodniej Polsce. *Chrońmy Przyr. Ojcz.* 62: 40-54.
- PRAJS B., ANTKOWIAK B. (2008): Nowe stanowiska *Liparis loeselii* (L.) Rich. i *Cypripedium calceolus* L. w dolinie Kulawy (Zaborski Park Krajobrazowy). *Chrońmy Przyr. Ojcz.* 64, 2: 77-86.
- PROCHÁZKA F., POTŮČEK O. (1999): *Liparis loeselii* (L.) L.C. Rich. Hlízovec Loeselův. In: Červená kniha ohrožených a vzácných druhů rostlin a živočichů ČR a SR. Eds J. Čerovský, V. Feráková, J. Holub, Š. Maglocký, F. Procházka. Příroda a.s., Bratislava: 230.
- PROCHÁZKA F., VELÍSEK V. (1983): Orchideje naší přírody. Československé Akademie Véd, Praha.
- SAROSIEK J., KOSZELA M., KRUKOWSKA-ZDANOWICZ J. (1995): Charakterystyka populacji lipiennika Loesela *Liparis loeselii* (L.) L.C. Rich. z Kopanicy w Puszczy Augustowskiej. *Acta Univ. Wratisl. 1717, Pr. Bot.* 63: 113-124.
- SCHNITTLER M., GÜNTHER K.-F. (1999): Central European vascular plant requiring priority conservation measures – an analysis from national Red Lists and distribution maps. *Biodiv. Conserv.* 8: 891-925.
- SHVETS I.V. (2005): Losiyak Lëzelya. *Liparis loeselii* (L.) Rich. In: Krasnaya Kniga Respubliki Belarus'. Rasteniya. Eds G.P. Pashkov, L.V. Kalenda, V.N. Logvin, A.M. Petrikov. 'Belaruskaya Entsykłapedyya' imeni Petrusya Brovki, Minsk: 235-236.
- SOKOŁOWSKI A.W. (1965): Notatki florystyczne z Puszczy Augustowskiej. *Fragm. Florist. Geobot.* 11, 1: 23-26.
- SOKOŁOWSKI A.W. (1973): Rośliny naczyniowe Suwalskiego Parku Krajobrazowego. *Pr. Białost. Tow. Nauk.* 19: 85-101.
- SOKOŁOWSKI A.W. (1978): Projektowany rezerwat Wiłkokuk w Puszczy Augustowskiej. *Chrońmy Przyr. Ojcz.* 34, 1: 60-65.
- SOKOŁOWSKI A.W. (1989): Flora roślin naczyniowych rezerwatu Rospuda w Puszczy Augustowskiej. *Parki Nar. Rez. Przyr.* 9, 1 (1988): 33-43.
- SOKOŁOWSKI A.W. (1990): Flora roślin naczyniowych Wigierskiego Parku Narodowego. *Parki Nar. Rez. Przyr.* 9, 4 (1988): 5-84.
- SZCZEPAŃSKI M. (2008): Lipiennik Loesela i sierpowiec błyszczący w RDLP Olsztyn. *Przegl. Przyr.* 19, 3-4 (in press).
- TASENKEVICH L. (2002): Red list of vascular plants of the Carpathian mountains. State Museum of Natural History, National Academy of Sciences of Ukraine, Carpathian Ecoregion Initiative, Lviv.
- TYSZKOWSKI M. (1992): Godne ochrony torfowisko nad jeziorem Białym koło Augustowa. *Chrońmy Przyr. Ojcz.* 48, 6: 68-72.
- TYSZKOWSKI M. (1993): *Eleocharitetum quinqueflorae* Lüdi 1921 – the initial plant association of calcare-

- ous fens in Poland. *Fragm. Florist. Geobot.* 38, 2: 621-626.
- TYSZKOWSKI M. (1995 a): Wątlík błotny *Hammarbya paludosa* w Puszczy Augustowskiej. *Chrońmy Przyr. Ojcz.* 51, 4: 79-83.
- TYSZKOWSKI M. (1995 b): Interesujące torfowisko nad jeziorem Krejwelanek w Puszczy Augustowskiej. *Chrońmy Przyr. Ojcz.* 51, 6: 79-83.
- WHEELER B.D., LAMBLEY P.W., GEESON J. (1998): *Liparis loeselii* (L.) Rich. in eastern England: constraints on distribution and population development. *Bot. J. Linn. Soc.* 126, 1-2: 141-158.
- ZAJĄC A., ZAJĄC M. (2001): Distribution atlas of vascular plants in Poland. Laboratory of Computer Chorology, Institute of Botany, Jagiellonian University, Kraków.
- For citation: Pawlikowski P. (2008): Distribution and population size of the threatened fen orchid *Liparis loeselii* (L.) Rich. in the Lithuanian Lake District (NE Poland). *Rocz. AR Pozn.* 387, Bot.-Stec. 12: 53-59.