

Royal fern *Osmunda regalis* L. in isolated localities in the Łódź Province – a state of preservation

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ABSTRACT: The article presents the distribution, threats and the state of conservation of the royal fern in the Łódź Province. In addition, the structure and the spatial distribution of specimens (clumps) of three isolated populations of *Osmunda regalis* in Ugoda Barczewska, Mogilno and Podlubień are described based on research performed in years from 2006 to 2008.

ABSTRAKT: Artykuł przedstawia dane o rozmieszczeniu, zagrożeniach i formach ochrony *Osmunda regalis* L. w województwie Łódzkim. Scharakteryzowano również strukturę przestrzenną i dynamiczne przemiany populacji długosza królewskiego na trzech izolowanych stanowiskach: w Ugodzie Barczewskiej, Mogilnie i Podlubieniu w latach 2006–2008.

KEY WORDS: *Osmunda regalis*, fern, population size, central Poland, conservation

Introduction

The royal fern *Osmunda regalis* L. is a cosmopolitan species related to the oceanic climate. It occurs in Europe, North, Central and South America, Asia, Africa, Madagascar and the Mascarene Islands, but it is not found in Australia. In Poland, the royal fern reaches the eastern border of its distribution in Europe. Starting from 1946 this fern has been strictly protected by the law as a rare and endangered species. The main reasons for the decrease of the number of localities are changes in habitat conditions, namely the water drainage of the forest areas and shading by shrubs (Baryła, Pietras 1982; Michalik, Michalik 1997). Despite various forms of the protection of the royal fern in Poland, the species is declining (Baryła, Pietras 1982). In central part of the country it is vulnerable taxon (VU; Jakubowska-Gabara, Kucharski 1999).

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In the province of Łódź *Osmunda regalis* L. has been reported in 13 isolated localities which are given below as 1×1 km ATPOL grid squares (Zając 1978).

Mogilno – DD 9414 ATPOL grid square, in the Dobroń community, Pabianice district. The royal fern was found there in 1979 by biology students and by J.K. Kurowski and M. Mamiński (Kurowski, Mamiński 1982). In *Herbarium* collection there are three vouchers of *Osmunda regalis* from Mogilno: leg. J.K. Kurowski, M. Mamiński, 1979, No. 78838; leg. M. Mamiński, 1980, No. 99288 and leg. G. Ojrzyńska, 1981, No. 71586. This locality is also known as Pawlikowice (Ojrzyńska 1987). Since 2006 the population in Mogilno has been monitored.

Dobroń – DD 9510, Dobroń community, Pabianice district. Only a single clump of *Osmunda regalis* was discovered here in 1979 (Kurowski, Mamiński 1982). At present, this location is a part of the protected area “Dobroń” which is a nature-landscape complex and is located in the same forest complex as the described above Mogilno locality. Now, the royal fern at this locality is not present (Piechota 2007).

Ugoda Barczewska – DE 0024, Brzeźnio community, Sieradz district. The royal fern was found in the 1970s in a private forest by foresters from the Dąbrowa Wielka Forest District. In 1974 there were about 50 clumps present in the area of 500 m² (Kurowski 1975). The locality is documented in *Herbarium*: leg. J. K. Kurowski, 1974, No. 79062. Since 2006 the population in Ugoda Barczewska has been monitored.

Święte Ługi near Lubiec – DE 1344, Szczerców community, Bełchatów district. In 1973 only one specimen (one clump) of *Osmunda regalis* was documented there by a student, G. Sumorok. Next year, J. K. Kurowski found the second clump of the royal fern. The locality was documented in *Herbarium Universitatis Lodzianensis* (LOD abbreviation): leg. J. K. Kurowski, 1974, No. 79061. This locality is also known as Lubiec (Jakubowska-Gabara 2001). At present, this area is a part of the “Święte Ługi” ecological area and is situated in the Szczercowski Protected Landscape Area. The presence of the royal fern was not confirmed in Święte Ługi, despite the intensive search in years 2004–2006 (Chęciński 2006; Piechota 2007).

Osina – DE 2411, Kluki community, Bełchatów district. Few specimens were noted in 1982 by K. Czyżewska on the wet forest road and documented in *Herbarium*: leg. K. Czyżewska, 1982, No. 84408 (LOD, Jakubowska-Gabara 1989). The locality is also named as BOP which stands for the Bełchatów Industrial Area, near the Osina village (Jakubowska-Gabara 2001).

Podlubień – DE 2832, Sulejów community, Piotrków Trybunalski district. The locality was noted in 1970 and described by J.K. Kurowski (Kurowski

1973). The fronds of *O. regalis* were collected twice: *leg. J.K. Kurowski*, 1970, No. 79059 (LOD) and *leg. J.K. Kurowski*, 1972, No. 79060 (LOD). The locality is also described as Lubień (Jakubowska-Gabara 2001). Since 2006 the population of the royal fern in Podlubień has been monitored.

Kamień – DE 3412, Kleszczów community, Bełchatów district. It was found by J. Jakubowska-Gabara in 1982 (Jakubowska-Gabara 1989) and documented: *leg. J. Jakubowska-Gabara*, 1982, No. 84398 (LOD). The locality is also named as BOP, the Bełchatów Industrial Area, near the Kamień village (Jakubowska-Gabara 2001).

Żytno – DE 5634, Żytno community, Radomsko district. The fern was noted by W. Pisarek (Jakubowska-Gabara, Pisarek 1997; Jakubowska-Gabara 2001).

Orły near Wojków – **CD 9920**, **Przerycie** near Żuraw (also known as Pnerycie; Zając A., Zając M. 2001) – **CE 0910** and **Wielki Las** near Złoczew – **DE 1022**; these localities are located in the Błaszki community, Sieradz district. They were discovered by Pachulska-Rydel in 1994.

Węglewice – CE 1732, Galewice community, Wieruszów district. The royal fern was found there in the 1960s by the foresters J. Kozłowski and L. Szyfer. A plant community with *O. regalis* occurrence was described and characterized by Mowszowicz (1963). Since 1965 the population of this beautiful fern is protected in the nature reserve „Długosz Królewski w Węglewicach”. This reserve covers an area of 3.2 ha in divisions 189f and 188h (formerly 188c and 189d) of the Węglewice forest complex in the Foluszczyki Forest District. In 1963 there were reported 134 clumps of *O. regalis* (Mowszowicz 1963), but in 1996 only 38 mature and 12 juvenile specimens were found (Zenkteler 1999). To avoid the extinction of *Osmunda regalis* in this location, the population has been under permanent observation since 1988 and additionally it has been supported by reintroduction of new heterozygotic specimens (Zenkteler 2002).

Błota – CD 0910, Brąszewice community, Sieradz district. In 1966 212 clumps of *Osmunda regalis* were reported in the area of about 1 ha (division 130f in the Jażwiny Forest District; Mowszowicz 1966). This locality is located just outside of the border of the “Jażwiny” forest reserve, which was created in 1963. It is also known as Brąszewice (Zając, Zając 2001; Woziwoda 2006).

The royal fern is the endangered species because of the changes in habitat conditions and the natural succession of forests. The main subject of this research was to characterize populations of *Osmunda regalis* in three isolated localities in the province of Łódź. Results presented here may contribute to the effective conservation of the royal fern.

1. Materials and methods

The spatial structure and dynamics of three isolated populations of *Osmunda regalis* were studied in Ugoda Barczewska, Mogilno and Podlubień. The field investigations started in 2006. The studies were repeated in 2007 and in 2008, and they would be continued during next 7 years at the permanent plots. In each locality the number of specimens, their spatial distribution and condition, as well as the presence/absence of juvenile plants were examined once a year.

Due to the clonal plagiotropic growth of *O. regalis* rhizomes (Zenkteler 2000) and the difficulty to indicate the separate specimens within dense fronds, the clumps versus groups of clumps of the royal fern were distinguished. The clump consisted of several compound fronds, which grew from the vertical rootstalk. The adjacent clumps formed the group, which might contain one or more specimens.

The spatial distribution of clumps and groups was mapped. The fertile fronds and sterile photosynthetic leaves were counted and the fertile clumps were marked on the map. The leaf index, which is the ratio of fertile to sterile leaves, was counted for all clumps in all populations studied in every year, and given as an average in a population.

2. Results

The largest population of *Osmunda regalis* occurs in **Ugoda Barczewska**. There are 23 groups including 187 clumps of the royal fern. The groups are formed by various numbers of clumps – from 2 to 35 (Fig. 1). During three years of the studies, the number of groups has not change. In 2008 three clumps did not produce any leaves.

Significant differences in the leaf number were noted in individual clumps every year (Fig. 2). In addition, the number of fertile clumps and the number of fertile fronds in clump differed. In 2006 and 2007 only 13.4% of clumps produced fertile leaves. In 2008 the number of specimens forming leaves with numerous sporangia increased to 14.7%. The number of fertile and sterile leaves in population successively increased to 30 and 454 in 2006, 34 and 448 in 2007, and 41 and 439 in 2008, respectively. The increasing ratio of fertile leaves to all fronds has been permanently noted since 2006: 6.2%, 7.05% and, finally 8.54% in 2008.

In the **Mogilno** forest complex, 38 clumps of *Osmunda regalis* clustered in 7 groups in 2006. None of them formed the fertile leaves. During the following years of investigation, the increase of the clump number to 47 in 2007

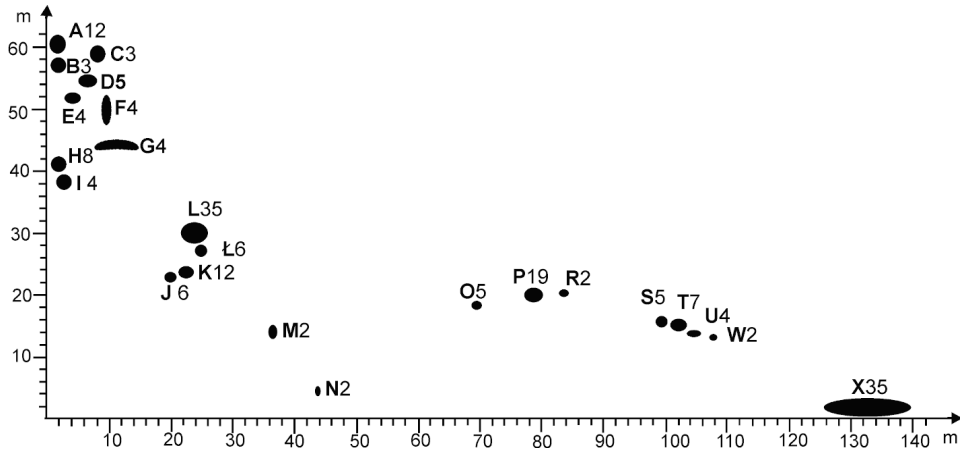


Fig. 1. Distribution of the royal fern *Osmunda regalis* L. in the Ugoda Barczewska locality; A12: A – a group number, 12 – the number of clumps in a group

Ryc.1. Rozmieszczenie długosza królewskiego *Osmunda regalis* L. w Ugodzie Barczewskiej; A12: A – numer zgrupowania, 12 – liczba kęp w zgrupowaniu

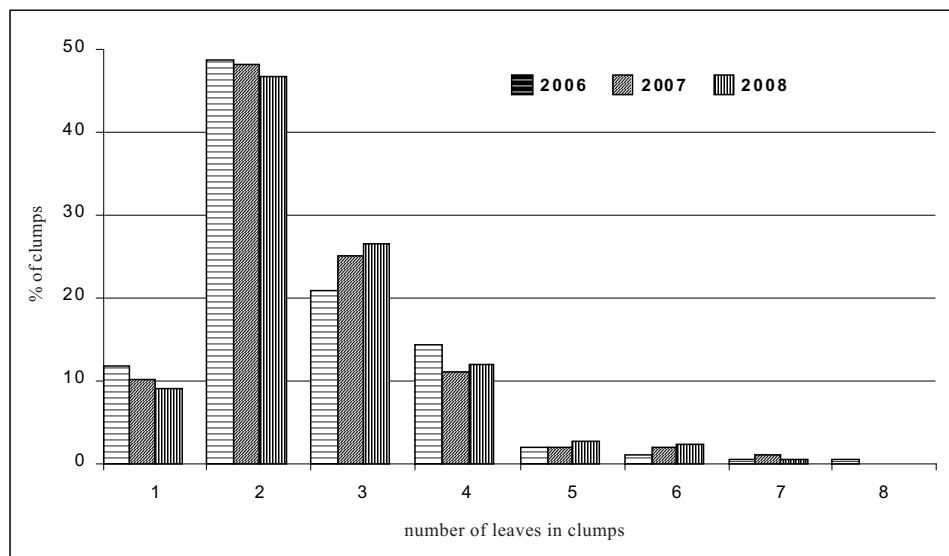


Fig. 2. Diversity of the frond number in clumps of the royal fern in years 2006–2008 in the Ugoda Barczewska locality

Ryc. 2. Zróżnicowanie liczby liści w kępach długosza królewskiego w latach 2006–2008 w Ugodzie Barczewskiej

and 2008 was observed (Fig. 3), but new rosettes grew from the existing root system of old plants. No juvenile specimen was discovered.

Number of fronds increased to 121 in 2007 and to 165 in 2008 (Fig. 4). Seven fertile leaves present in 4 clumps in 2007 and 12 in 9 clumps in 2008 were noticed.

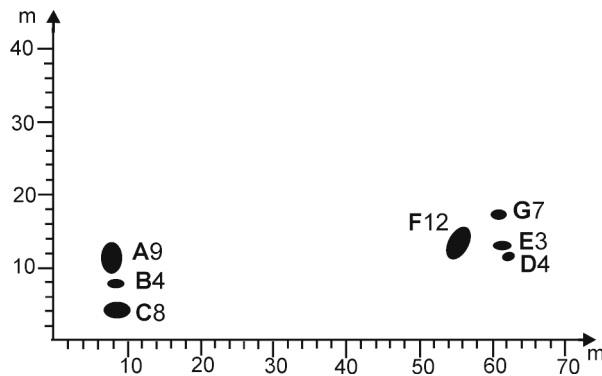


Fig. 3. Distribution of the royal fern *Osmunda regalis* L. in the Mogilno locality; A9: A – a group number, 9 – the number of clumps in a group

Ryc. 3. Rozmieszczenie długosza królewskiego *Osmunda regalis* L. w Mogilnie; A9: A – numer zgrupowania, 9 – liczba kęp w zgrupowaniu

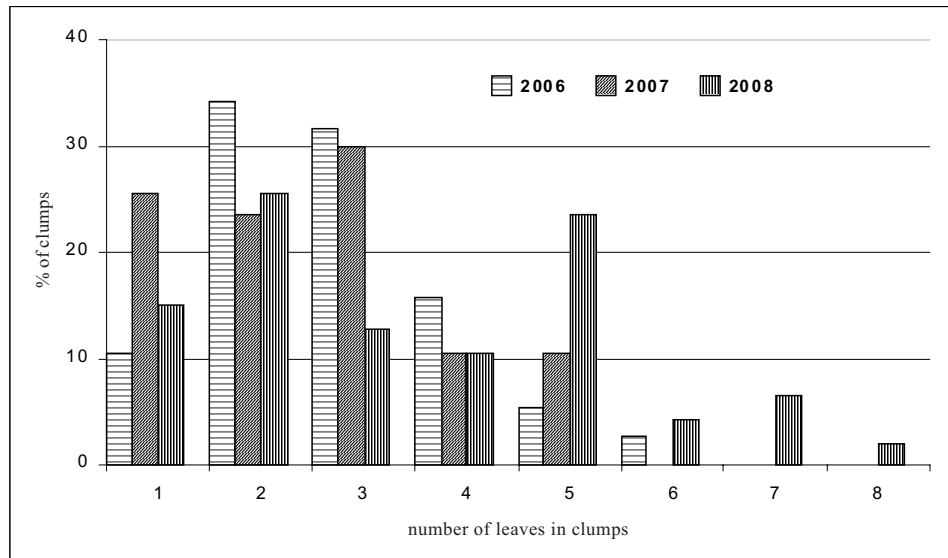


Fig. 4. The number of fronds in particular clumps of the royal fern in years 2006–2008 in the Ugoda Barczewska locality

Ryc. 4. Zróznicowanie liczby liści w kępach długosza królewskiego w latach 2006–2008 w Ugodzie Barczewskiej

The population of the royal fern in **Podlubień** includes 11 clumps distributed in two groups. During three years of studies the number of groups and specimens has not changed. The number of fertile fronds has fluctuated from 6 leaves in 4 clumps in 2006, 4 in 3 clumps in 2007 to 7 leaves in 5 clumps in 2008. The population is rather stable and it does not extend. No juvenile specimen was noted.

3. Discussion

The populations of *Osmunda regalis* in Ugoda Barczewska, Mogilno and Podlubień grow in small areas. There are private (Ugoda Barczewska) or governmental timber forests. It is necessary to preserve the ground water level and light conditions to protect the fern. The royal fern tolerates full insolation if it receives plenty of moisture, but preferably it grows in wet, swampy soils.

The all populations but the Ugoda Barczewska locality are represented by the small number of specimens, and they are spatially isolated. Their existence is highly jeopardized but not only because of the poor habitat conditions. One of the reasons for the decline of lowland populations of *Osmunda regalis* in Poland is the presence of the gene of the sporophytic lethality, which is expressed as a result of the intragametophytic selfing (Zenkteleter *et al.* 1997; Zenkteleter 1998, 1999). The high rate of the mortality of juvenile sporophytes, which probably occurs during colonization of open habitats, is responsible for the lack of the royal fern self-renovation in natural conditions (Zenkteleter *et al.* 1997; Zenkteleter 1998). The gene exchange between isolated populations may increase the heterozygosity of *O. regalis* (Zenkteleter 1999) and prevent the extinction of this species.

The populations in Mogilno and Podlubień are seriously threatened by human activity due to the growing tourist pressure. Tourist trails for walking, cycling or horse-riding run through or near to the localities of rare protected species endangering the plants. The frequent visits of people in these locations can result in the destruction of the ferns.

The establishment of the protected areas, e.g. nature reserves or stands for completing documentation in Ugoda Barczewska and Mogilno, is strongly suggested. Still existing, vital localities require special attention, and the permanent studies on populations are necessary to preserve *Osmunda regalis*.

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Długosz królewski *Osmunda regalis* L. na izolowanych stanowiskach w województwie łódzkim – stan zachowania

Na obszarze województwa łódzkiego odnotowano dotychczas 13 stanowisk długosza królewskiego *Osmunda regalis* L.: Mogilno (DD 9414), Dobroń (DD 9510), Ugoda Barczewska (DE 0024), Święte Ługi koło Lubca (DE 1344), Osina (DE 2411), Podlubień (DE 2832), Kamień (DE 3412), Żytno (DE 5634), Orły koło Wojkowa (CD 9920), Przerycie koło Żurawia (CE 0910), Wielki Las (DE 1022), Węglewice (CE 1732) i Błota (CD 0910). Zlokalizowane są one na gruntach państwowych lasów gospodarczych bądź lasów prywatnych.

W 2006 r. zinwentaryzowano populacje długosza królewskiego na pięciu stanowiskach: w Ugodzie Barczewskiej, Mogilnie, Dobroniu, Podlubieniu i Świętych Ługach. Wyniki badań porównano z danymi z lat osiemdziesiątych ubiegłego wieku (Kurowski, Mamiński 1982). Nie odnaleziono długosza na torfowisku w Świętych Ługach oraz na obszarze leśno-torfowiskowym „Dobroń”. W pozostałych uroczyskach odnotowano wzrost liczby okazów w porównaniu z danymi z 1982 r. Populacje w Ugodzie Barczewskiej, Podlubieniu oraz w Mogilnie objęto monitoringiem. Stwierdzono stałą liczebność kęp (ryc. 1, 3) oraz znaczne różnice w ilości wykształconych liści (ryc. 2, 4) i zarodnikowania paproci w poszczególnych obiektach w kolejnych latach badań.

Obecnie największymi potencjalnymi zagrożeniami dla *Osmunda regalis* są przekształcenia lokalnych warunków siedliskowych (obniżenie poziomu wód gruntowych, zmiana warunków świetlnych) oraz antropopresja związana z działalnością leśno-hodowlaną (przebudowa drzewostanów) i eko-turystyką (rowerowe i piesze ścieżki edukacyjne).