

**THE PROBLEM OF THE OCCURRENCE OF *NYMPHAEA CANDIDA* C. PRESL
IN THE OPOLE SILESIA**

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ABSTRACT: The paper presents the preliminary results of taxonomic investigations of *Nymphaea* genus in the Opole Silesia. The main aim of the research is to highlight the problem of the occurrence of *Nymphaea candida* in the region and to stimulate further studies on the chorology and taxonomic differentiation of the species. The 72 specimens of water lily were collected from 19 locations. To identify the species, 14 features were checked in the field on a fresh material. The majority of them were *N. candida* (56), eleven were assigned to *N. alba* and five were determined as intermediate ones. The authors conclude that further studies are needed, especially on a molecular level, to solve finally the problem of the occurrence of *N. candida* in the south-western Poland.

KEY WORDS: *Nymphaea candida*, distribution, ponds, water flora, endangered species

Introduction

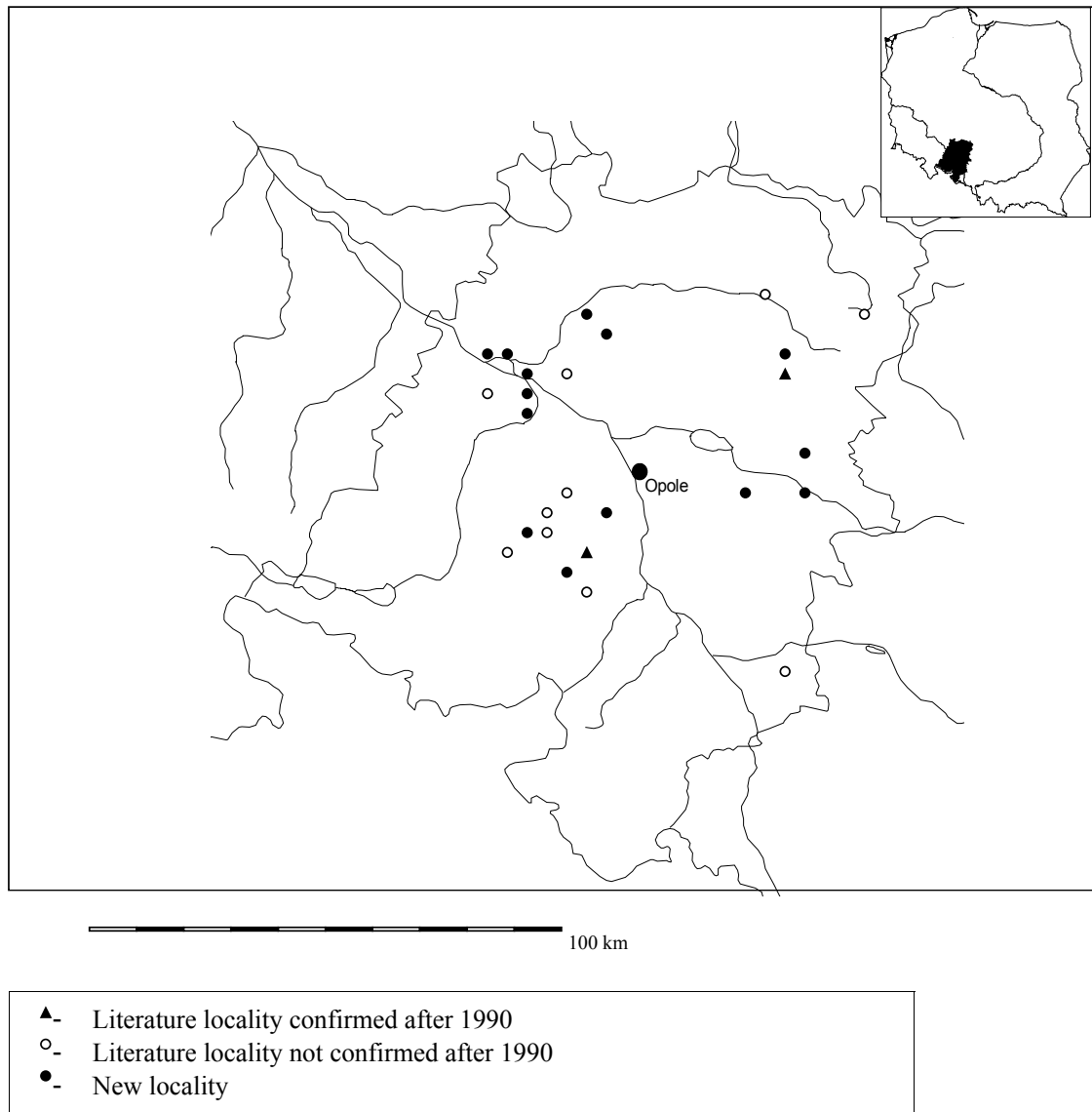
Nymphaea candida C. Presl is an Euro-Siberian element of water flora with the western range limit on the line of the Rhine (Meusel et al. 1965, Hulten & Fries 1986, Muntendam *et al.* 1996, Wayda 2000). There is still a great deal of confusion as to its southern limit. Wayda (2000) suggests that *N. candida* occurs only in the north-western Poland. However, the species has also been reported from Czech Republic (Hejný and Slavik 1997) and the southern regions of Germany (Benkert et al. 1996). According to the Tutin et al. (2002) and Muntendam et al. (1996) *N. candida* occurs also in eastern France, Switzerland, south west Romania, Austria, Hungary and former Yugoslavia.

Several times *Nymphaea candida* has been reported from the area of the Opole Silesia, SW Poland (Fig. 1). Schube (1903, 1906, 1908, 1910) gave several locations in the vicinity of Kluczbork, as well as in ponds in Szumirad, Borki Wielkie, Chróścice, Przysiecz, Tułowice Małe, Grodziec, Stara Kuźnia, Dobra, Buszyce, Jamki and Tułowice. Unfortunately, there is no herbarium documentation from these stations. After the second world war *Nymphaea candida* was noticed in Nowe Kolnie (Kuźniewski 1964).

This data has been questioned in the last few years (Wayda 2000) and, as a consequence, *N. candida* was not indicated within the Silesian area in the atlas of vascular plants of Poland (Zajac and Zajac 2001).

However, several times the authors have found the individuals of water lily, identified in the field as *N. candida* according to the botanical key of Rutkowski (1998) or Kubat (2002). Thus, the special investigation was undertaken to expand the knowledge about the distribution of water lilies in the region. One of the reasons for the reliability of evidence that *N. candida* occurs in the Silesia is the number of carpellary teeth in flowers and ovaries stated in the analyzed specimens. According to some researchers, this feature is very useful and could serve as the precise tool for distinguishing both species because the number of stigma rays hardly overlaps between them (*N. candida* 9-14, *N. alba* 15-25) (Muntendam et al. 1996). The individuals collected in the Opole Silesia usually had 8 or even 7 carpellary teeth in stigma.

Fig. 1 Temporary distribution map of *Nymphaea candida* C. Presl. in the Opole Silesia



So far, many varieties and subspecies of *N. alba* have been described (Glück 1924, Hegi 1965, Casper and Krausch 1981). One of them is *N. alba* var. *minor* DC., a starvation form which is considered as the smaller form of *N. alba* restricted to colder northern regions of Europe (Muntendam et al. 1996). *N. alba* var. *minor* has its eastern range limit far away from Poland (Oberdorfer 1994). Recently, this form has also been reported from the Opole Silesia (Spalek 2007), but with no taxonomical evidence and herbarium documentation. There is also possibility that *N. candida* is an extreme morphological form of *N. alba*, as suggested by Heukels and Van der Meijden (1990).

A differentiation between the two closely related species brings many confusions, thought both species have been extensively investigated (Glück 1924, Radics 1967, Casper and Krausch 1981, Muntendam et al. 1996, Jones and Clarke 1981, Neuhäusl and Tomsovic 1957). To solve the problem of chorology of *Nymphaea* species in the southern Poland further investigation is needed, including molecular and genetic approaches. The main aim of this study was to highlight the problem of the occurrence of *N. alba* and *N. candida* in the Opole Silesia and to stimulate further researches.

Materials and methods

Flowers, leaves and fruits of *Nymphaea* species were collected from 19 locations in the Opole Silesia in July and September 2007. The plants were collected during the warm days between 10 am. and 6 pm. The fresh material was identified in the field using the botanical key of Rutkowski (1998).

On the basis of the botanical keys of Rutkowski (1998), Kubát (2002), Oberdorfer (1994), Hejny and Slavik (1997), as well as regarding the research works of Muntendam et al. (1996) and Wayda (2000), following fourteen features were chosen to describe the specimens: a diameter of the stigma (1), a number of carpellary teeth (2), a position of the flower on water (3), a shape of the flower (4), a side view of the flowerbase (5), an underside view of the flowerbase (6), the stigma surface structure and colour (7, 8), a diameter of the flower (9) vertical/erect sepals (10), a colour of the underside leafblade (11), a nervation of the leafblade (12), a direction of the main nerves leafslips (13) and a proportion of the stigma to the width of the ovary (14). The collected material was stored in the herbarium of the Division of Plant Biology of the Opole University (OPUN).

Results

Altogether, 74 flowers, 79 leaves and 15 ovaries belonging to 72 specimens were collected. Most of them were identified in the field as *N. candida* (56). Only 11 were *N. alba*, according to Rutkowski's (1998) key. Five individuals were determined as the intermediate form. The characteristic of the collected individuals is given in the table 1.

Tab. 2. Mean values of countable features for the three differentiated taxa.

| | stigma diameter | number of | flower diameter |
|------------------------------------|------------------------|-------------------------|------------------------|
| | [mm] | carpellary teeth | [cm] |
| <i>N. candida</i> | 5.95 | 9.31 | 5.89 |
| <i>N. alba</i> x <i>N. candida</i> | 7.5 | 12.6 | 6.91 |
| <i>N. alba</i> | 13.4 | 16.1 | 11.2 |

Discussion and conclusions

Evidently, both species of water lily are closely related and many morphological features overlap without any distinct differences. However, the number of carpellary teeth seems to be a very useful characteristic feature for species recognition as it hardly overlaps between *N. alba* and *N. candida* (Muntendam et al. 1996).

Using the current botanical keys we come to the conclusion that, with no doubts, not only does *N. alba* occur in the Opole Silesia. The number of carpellary teeth, which should exceed 14 in case of *N. alba*, was very often below 10. The mean value for the examined specimens was 9.31 (from 7 to 12). Thus, all the individuals suited the range designated for *N. candida* by Muntendam et al. (1996), Wayda (2000), Rutkowski (1998) and others. Also the other countable features, like the diameter of the flowers (5.91 in average) or the proportion of the stigma diameter to the ovary one (mean value 0.6) evidently indicated *N. candida* (Tab. 2). Almost all plants had cup-shaped flowers, the square-shaped flowerbase (sometimes with a rough edge), the orange stigma, and the flower partially submerged in the water with erected sepals. Leaves were in the majority red or red-green with converging nerves of leafslips.

The results of the study revealed the considerable differentiation among *Nymphaea* species. Remarkable differences were found within some characteristics features, such as the stigma diameter (5.95 for *N. candida*, 7.5 for the intermediate form, and 13.4. for *N. alba*) and the number of carpellary teeth (respectively 9.31, 12.6, 16.1). At the same time, the flower diameters also differ significantly reaching 5.81 cm for *N. candida* and 11.2 cm for *N. alba* (Tab. 2).

The conducted preliminary study on the occurrence and taxonomical differentiation of *Nymphaea* genus is certainly the first step towards species recognition in the Opole region. We hope that our research prove that the current knowledge on the distribution of both *Nymphaea* species is far from the reality. Further chorological and taxonomical investigations should to be done also on the molecular level.

Table 1. Sampled specimens with their location and morphological characteristic.

| Location, organ | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-----------------|------|-----|-----|-----|-----|------|------|------|-----|-----|-----|-------|-----|------|------|
| Szumirad | 1* F | 4 | 8 | sub | cup | str | squ | dull | ora | 5.5 | ere | | | | |
| | L | | | | | | | | | | | red | pro | par | |
| | L | | | | | | | | | | | red | pro | par | |
| | 2* O | 4 | 7 | | | | | | | | | | | | 0.57 |
| F | 7 | 11 | sub | cup | str | squ | dull | ora | 6.5 | ere | | | | | |
| L | | | | | | | | | | | | red | pro | conv | |
| L | | | | | | | | | | | | red | pro | par | |
| Lasowice Ml. | 1* F | 4.5 | 11 | sub | cup | conc | squ | dull | ora | 6 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | conv | |
| | 2* F | 6 | 10 | sub | cup | str | squ | dull | ora | 7 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | conv | |
| 3* F | 7 | 9 | sub | cup | str | squ | dull | ora | 6.5 | ere | | | | | |
| L | | | | | | | | | | | | re/gr | pro | conv | |
| 4* F | 5 | 8 | sub | cup | str | squ | dull | ora | 6.5 | ere | | | | | |
| L | | | | | | | | | | | | re/gr | pro | conv | |
| Utrata | 1* F | 6 | 8 | sub | cup | conc | squ | dull | ora | 6.5 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | par | |
| | 2* F | 6 | 8 | sub | cup | conc | squ | dull | ora | 5.5 | ere | | | | |
| L | | | | | | | | | | | | red | pro | par | |

| Location, organ | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-------------------|-----|-----|-----|-----|------|------|------|------|-------|-------|------|-------|-------|------|------|
| Staw Łoża | 1** | F | 13 | 17 | on | star | str | roun | shin | yel | 12 | flat | | | |
| | | L | | | | | | | | | | | gre | pro | div |
| | 2** | F | 13 | 15 | on | star | str | roun | squ | yel | 10 | flat | | | |
| | | L | | | | | | | | | | | gre | pro | div |
| | 3** | F | 15 | 19 | on | star | str | roun | squ | yel | 11 | flat | | | |
| | | L | | | | | | | | | | | gre | pro | par |
| | 4** | F | 12 | 16 | on | star | str | roun | shin | yel | 10 | flat | | | |
| | | L | | | | | | | | | | | gre | pro | div |
| 5** | F | 11 | 16 | on | star | str | squ | shin | yel | 10 | flat | | | | |
| | L | | | | | | | | | | | gre | pro | div | |
| 6** | F | 17 | 19 | on | star | str | squ | shin | yel | 15.5 | flat | | | | |
| | L | | | | | | | | | | | gre | pro | div | |
| 7** | F | 13 | 15 | on | star | str | squ | shin | yel | 12.5 | flat | | | | |
| | L | | | | | | | | | | | gre | pro | div | |
| 8*** | F | 7 | 12 | on | star | str | squ | dull | or/ye | 5.5 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | par | |
| Przysiecz | 1* | F | 7.5 | 11 | sub | cup | str | squ | dull | or/ye | 8 | ere | | | |
| | | L | | | | | | | | | | | red | pro | par |
| | 2* | F | 5.5 | 11 | sub | cup | conc | squ | dull | ora | 4 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | par |
| 3* | F | 7 | 12 | sub | cup | str | squ | dull | ora | 7 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | conv | |
| 4* | F | 7 | 10 | sub | cup | conc | squ | dull | ora | - | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | par | |
| Staw Ławnik | 1** | F | 14 | 17 | on | star | str | squ | shin | yel | 11 | flat | | | |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | 2** | F | 15 | 15 | | | | | | | | | | | 0.88 |
| | | O | 13 | 15 | on | star | str | roun | shin | yel | 10 | flat | | | |
| | | L | | | | | | | | | | | re/gr | pro | div |
| 3** | F | 12 | 14 | on | star | str | roun | shin | yel | 11 | flat | | | | |
| | L | | | | | | | | | | | re/gr | pro | div | |
| 4* | F | 6 | 12 | sub | cup | conc | squ | dull | or/ye | 5 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | conv | |
| 5*** | F | 7 | 14 | on | star | str | squ | dull | yel | 7 | flat | | | | |
| Staw Nowokuznicki | 1* | F | 5.5 | 7 | sub | cup | str | squ | dull | or/ye | 7 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | 2* | F | 6 | 10 | sub | cup | conc | squ | dull | or/ye | 6 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | 3* | F | 4 | 8 | sub | cup | str | squ | dull | or/ye | 5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | 4* | F | 6.5 | 11 | sub | cup | str | squ | dull | or/ye | 6.5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | conv |
| | 5* | F | 6.5 | 12 | sub | cup | str | squ | dull | or/ye | 7 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | conv |
| | 6* | F | 6 | 8 | sub | cup | str | roun | dull | or/ye | 5.5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | conv |
| | 7* | F | 13 | 7 | sub | cup | str | squ | dull | or/ye | 5.5 | ere | | | |
| | L | | | | | | | | | | | re/gr | pro | par | |
| 8* | F | 6 | 9 | sub | cup | str | squ | dull | or/ye | 6 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | par | |
| 9* | F | 6 | 8 | sub | cup | str | squ | dull | or/ye | 6 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | conv | |
| 10* | F | 7.5 | 11 | sub | cup | str | roun | dull | or/ye | 7.5 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | par | |
| 11* | F | 5 | 10 | sub | cup | str | squ | dull | ora | 5 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | conv | |
| 12* | F | 6 | 9 | sub | cup | str | roun | dull | or/ye | 6 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | par | |
| 13* | F | 6 | 8 | sub | cup | str | squ | dull | or | 7.5 | ere | | | | |
| | L | | | | | | | | | | | re/gr | pro | par | |

| Location, organ | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-----------------|------|---|-----|----|-----|------|------|------|------|-------|-----|------|-------|-----|------|
| | 14* | F | 6 | 11 | sub | cup | str | squ | dull | ora | 7.5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | 15* | F | 5 | 8 | sub | cup | str | squ | dull | ora | 5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | conv |
| | 16* | F | 5 | 8 | sub | cup | str | squ | dull | ora | 4 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | conv |
| | 17* | F | 5 | 7 | sub | cup | str | roun | dull | ora | 5.5 | ere | | | |
| Krogólina | | L | | | | | | | | | | | re/gr | pro | par |
| | 1* | F | 6 | 12 | sub | cup | str | squ | dull | or/ye | 7.5 | ere | | | |
| | | F | 7 | 10 | sub | cup | str | squ | dull | or/ye | 7.5 | ere | | | |
| | 2*** | F | 10 | 14 | on | star | str | squ | dull | or/ye | 7 | flat | | | |
| | | F | 10 | 14 | on | star | str | squ | dull | or/ye | 7 | flat | | | |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | 1* | F | 6.5 | 8 | sub | cup | str | squ | dull | ora | 4.5 | ere | | | |
| Wron. | | L | | | | | | | | | | | re/gr | pro | conv |
| | | L | | | | | | | | | | | re/gr | pro | conv |
| Winna Góra | 1* | F | 5 | 8 | sub | cup | conc | squ | dull | ora | 4.5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | 2* | F | 4.5 | 8 | sub | cup | conc | squ | dull | or/ye | 4.5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | | L | | | | | | | | | | | re/gr | pro | par |
| | | L | | | | | | | | | | | re/gr | pro | par |
| Skorog. | 1* | F | 6.5 | 9 | sub | cup | str | squ | dull | or/ye | 5.5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | conv |
| | 2* | F | 6 | 8 | sub | cup | str | squ | dull | or/ye | 5.5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | conv |
| | | L | | | | | | | | | | | re/gr | pro | conv |
| SM | 1* | F | 5.5 | 10 | sub | cup | str | squ | dull | or/ye | 6.5 | ere | | | |
| | | L | | | | | | | | | | | re/gr | pro | conv |

Explanations: * - *Nymphaea candida*; ** - *N. alba*; *** - intermediate form; sub – partially submerged, cup – cup-shaped flower, star – star-shaped flower, str – straight flowerbase, conc – concavely curved flowerbas, squ – square flowerbase, roun – rounded flowerbase, dull – carpellary teeth dull, shin – carpellary teeth shiny, or – orange colour of a stigma, yel – yellow colour of a stigma, or/ye – orange/yellow colour of a stigma, ere – erect sepals, re/gr – partially red, partially green colour of the underside leafblade, pro – nervation pronounced, conv – direction of main leafslip nerves converging, par - direction of main leafslip nerves parallel, div - direction of main leafslip nerves diverging; Wiel. – Wielopole, Opole-Gr. – Opole – Groszowice, Stob. – Stobrawa, Pu. – Staw Pustelnik, Wron. – Wronin, Skorog. – Skorogoszcz, SM – Staniszcze Małe; F – flower, L – leaf, O – ovary.

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Streszczenie

*Problem występowania *Nymphaea candida* C. Presl na Śląsku Opolskim*

Publikacja przedstawia wstępne wyniki badań taksonomicznych i chorologicznych rodzaju *Nymphaea* na Śląsku Opolskim. Głównym celem pracy było podkreślenie niejasnej sytuacji chorologicznej *Nymphaea candida* na terenie województwa opolskiego i spowodowanie większego zainteresowania botaników problem jego ewentualnego występowania na terytorium Śląska. Badania wykazały, że spośród 72 okazów zebranych z 19 stanowisk na Opolszczyźnie aż 56 należało do *N. candida*. Jedynie 11 okazów zostało oznaczonych jako *N. alba*. Oznaczenia dokonano na podstawie dostępnych kluczy do oznaczania roślin naczyniowych oraz specjalistycznych publikacji, z których wybrano 14 cech morfologicznych pozwalających na kwalifikację taksonomiczną. Autorzy stwierdzają, że z całą pewnością na terenie województwa opolskiego występują także inne gatunki rodzaju *Nymphaea* niż tylko *N. alba*. Zakładając, że powszechnie stosowane klucze do oznaczania nie prowadzą do błędów, występowanie *N. candida* jest także bardzo prawdopodobne. Proponuje się, aby kontynuować badania taksonomiczne i chorologiczne rodzaju *Nymphaea* w południowo-zachodniej Polsce i wesprzeć je analizami na poziomie molekularnym