The unusual Ondinea, actually just another Australian water-lily of Nymphaea subg. Anecphya (Nymphaeaceae)

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Source: Willdenowia, 39(1) : 55-58

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.39.39104
The generic name *Ondinea* was created by Hartog in 1970 for a newly discovered and “remarkable” member of the *Nymphaeaceae* endemic to the Kimberley region of Western Australia. This monotypic genus was considered unusual in its sagittate, mostly submersed mature leaves, apetalous flowers with a protruding floral base and supposedly exarillate seeds. A close relationship of *Ondinea* to the genus *Nymphaea* L. was suggested by Hartog (1970) and has been reinforced by studies of several other authors (Kenneally & Schneider 1983; Müller 1970; Schneider 1983; Schneider & Ford 1978; Schneider & al. 1995; Williamson & Moseley 1989).

This genus was included in a phylogenetic study of the *Nymphaeaceae* by Les & al. (1999), who sampled one species per genus. However, until recently the phylogenetic position of *Ondinea* was not investigated using data from a broad sampling of water-lily species. In contrast, our analyses of the order *Nymphaeales* have used extensive data sets of chloroplast DNA (Borsch & al. 2007; Löhne & al. 2007) and a detailed study of *Nymphaea subg. Anechypa* (Casp.) Conard incorporated both chloroplast and nuclear DNA data (Löhne & al. 2008). The results of these studies provide high support for *Ondinea* as a derived lineage within the genus *Nymphaea*. In fact, *Ondinea* is nested within one of two subgroups of the Australian water-lilies (*N. subg. Anechypa* sensu lato). The subgenus has been divided into a small-seeded group, *N. subg. Confluentes* S. W. L. Jacobs, and a large-seeded group, *N. subg. Anechypa* sensu stricto, by Jacobs & Porter (2007). The nested position of *Ondinea* within the small-seeded group of *N. subg. Anechypa* sensu lato is supported from both nuclear and chloroplast DNA (Löhne & al. 2008).

Morphological comparisons with *Nymphaea* species provide additional evidence for this phylogenetic position of *Ondinea*. The report of a petaloid subspecies of *Ondinea* by Kenneally & Schneider (1983) erased one of the original distinctions between the two genera. The violet colouration of these petals, exceptional among basal angiosperms according to Endress (2001),
occurs elsewhere in *Nymphaeales* only in *N.* subg. *Anecphya* and subg. *Brachyceras* (Casp.) Conard. Additionally, these two subgenera share with *Ondinea*, alone among the *Nymphaeaceae*, the character state of partially fused carpels (see Schneider 1983: 375). According to Borsch & al. (2008) the eusyncarpous gynoecia with carpels less than 50% fused, common to these three groups, appears to be derived within the family (Fig. 1). The presence of stigmatic fluid also unites *Ondinea* with *Nymphaea*. Within *Nymphaea*, the very inconspicuous to almost absent carpellary appendages in *Ondinea* are most similar to those of *N.* subg. *Anecphya* (Borsch & al. 2008: see char. no. 48 & 50). Water-lilies have evolved several kinds of carpellary appendages probably in relation to specializations in floral biology, and their extreme reduction must have occurred in a common ancestor of *N.* subg. *Anecphya* and *Ondinea*.

Schneider & Ford (1983) found the seeds of *Ondinea* to be arillate, in contrast to the original report by Hartog (1970), and within *Nymphaeaceae* they most closely match those of *Nymphaea* in their overall morphology. The gain of an aril was hypothesized by Borsch & al. (2008) to have happened in conjunction with the adaptation of fruits developing under water (Fig. 1). When compared to seeds of various *Nymphaea* subgenera illustrated by Wiersema (1987) and Jacobs & Porter (2007), *Ondinea* seeds compare best, in their lon-

Fig. 1. Shifts in phenotypic characters during evolution of the core water-lilies (*Nymphaea, Euryale, Victoria, Ondinea*). – This figure shows a simplified tree based on the results of Borsch & al. (2008, see fig. 6 there), illustrating unambiguous character changes (regardless of using accelerated or delayed transformation settings) with unique shifts (apomorphies) displayed as black boxes and shifts that occurred more than once (homoplasies) shown as white boxes. Most features appearing on the branch to *Ondinea* are quantitative or homoplastic, and five character state changes were reconstructed to have happened since the evolution of the common ancestor of tropical *Nymphaea* species (incl. *Ondinea*).
gitudinally ridged glabrous surfaces, with those of ei-
ther N. subg. Lotos (DC.) Conard (usually ridged, 
usually without hairs). Earlier in the evolution of wa-
ter-lilies, testal hairs were gained in a common ancestor 
of the tropical subgenera of Nymphaeae including Ondi-
nea. The subsequent loss of testal hairs occurred in a 
common ancestor of Ondinea and the small-seeded 
group of N. subg. Aneocypha (Fig. 1). Thus, the position 
of Ondinea within the Australian radiation of Aneocypha 
species as inferred at the species level by nuclear and 
and plastid sequence data (Löhne & al. 2008) is also con-
formed by morphological evidence.

Ondinea has also been separated from Nymphaea by 
its predominately submersed sagittate mature foliage, but 
similar foliage characterizes N. oxyypeta Planch. of N. 
subg. Hydrocallis (Planch.) Conard and juvenile leaves of 
a number of Nymphaea species, being often associated 
with lotic environments (Wiersema 1987) such as are in-
habited by Ondinea. Indeed, juvenile sagittate leaves of 
N. hastifolia Domin, the species judged closest to 
Ondinea among those sampled in molecular studies 
(Löhne & al. 2008), are the basis for its specific epithet. A 
number of water-lily species of various lineages develop 
submerged leaves when light conditions become limiting, 
as with cultivated tropical taxa during the winter in the 
northern hemisphere (Borsch, Wiersema, Löhne, pers. 
obs.), indicating that shifts from floating to submerged 
leaves are easily possible and in some cases may be 
environmentally induced modifications. The floating 
leaves sometimes produced by Ondinea (Wilson 2009) 
are reminiscent of sagittate-leaved Nymphaea such as N. 
belophylla Trickett and N. potamophila Wiersema of N. 
subg. Hydrocallis (Wiersema 1987). The extreme re-
duction in floral size and floral organ number seen in 
Ondinea is also approached in some Nymphaeae; for ex-
ample, comparable numbers of flower parts were 
recently described for the small-flowered N. minuta K. C. 
Landon & al. (2006) of N. subg. Brachyceras. Ex-
trmely small flowers also occur in small plants of N. mi-
crantha (N. subg. Brachyceras) that arise from prolifer-
ating leaf buds.

Another character that was considered to separate 
Ondinea from Nymphaea is the former’s extremely 
long-projecting floral base. Schneider (1983) hypothe-
sized this feature to be an adaptation heightening the 
level of the stigmatic fluid, thereby improving pollina-
tion effectiveness. The overall analysis of floral charac-
ter evolution in water-lilies (Fig. 1; Borsch & al. 2008) 
indicates the prolongation of the floral base into a cen-
tral protrusion to have occurred in the common ancestor 
of the Nymphaeae clade, which includes Euryale-Victo-
ria and Ondinea. The tissue identity of this central pro-
trusion (i.e. axial tissue or receptacle) is, however, not 
fully understood; therefore the conservative term ‘flora-
al base’ is used (see char. 17 in Borsch & al. 2008).

The further prolongation in Ondinea is likely an adaptation 
influenced by the reduced stigmatic surface area of 
Ondinea and under strong selective pressures to im-
prove fertility. Thus, despite the seeming phenotypic 
distance of Ondinea from the other water-lilies, the 
only clearly autapomorphic character state change that 
remains is the shift from introrse to latrorse anthers 
(Fig. 1).

Whereas DNA sequence data from all three genomic 
compartments reveal Ondinea in a derived position, 
nested within Nymphaea subg. Aneocypha, with high sta-
tistical support (Borsch & al. 2007; Löhne & al. 2007, 
2008; Borsch & al. 2008), the situation is not as clear 
for the Euryale-Victoria clade. The latter has been 
found nested within Nymphaea based on combined 
plastid DNA sequence data (Löhne & al. 2007). Such a 
position has been confirmed with mitochondrial and es-
specially nuclear data but is still not well supported 
(Borsch & al. 2008). Ongoing work (Borsch, Löhne, 
Wiersema, work in progress) will be necessary to con-
firm whether the plastid tree of Löhne & al. (2007) 
resembles the organismic tree of core Nymphaeales. Thus, 
in contrast to Ondinea, nomenclatural adjustments for 
Euryale and Victoria would be premature at this time.

Given the above described evidence, it is no longer 
appropriate to treat Ondinea purpurea as a taxon distinct 
from Nymphaea. Due to the existence of the earlier 
name N. purpurea Rehnhlt & F. Henkel (in Henkel & al. 
1907) its specific epithet cannot be transferred to Nym-
phaea. We therefore validly publish the following new 
names to accommodate it within the water-lily genus:

Nymphaea ondinea Löhne, Wiersema & Borsch, nom. 
nov. = Ondinea purpurea Hartog in Blumea 18: 413. 
1970. – Holotype: Australia, Western Australia, Kim-
berley District, Kurunundalo [or Kurunundalu], 15.4. 
1968, W. Leutert 108 (CANB 171930; isotypes: CANB 
[5 sheets]).

Nymphaea ondinea subsp. petaloidea (Kenneally & E. 
L. Schneid.) Löhne, Wiersema & Borsch, comb. nov., = 
Ondinea purpurea subsp. petaloidea Kenneally & E. L. 
Schneid. in Nytsia 3: 362. 1983. – Holotype: Australia, 
Western Australia, Kimberley District, Mitchell Plate-
au, 21.1.1982, E. L. Schneider s.n. (PERTH; isotypes: 
CANB, K, NY, PERTH, TEX).

Nymphaea ondinea subsp. petaloidea is retained at the 
rank of subspecies because of its morphological distinc-
tions (Jacobs & Porter 2007) and, although slight, its 
geographical separation from the apetaloid subspecies.

Moreover, this study adds empirical data to the ongoing 
discussion of whether or not to accept paraphyletic taxa 
(Stevens 2006; Hörandl 2006; Albach 2008). One of the 
arguments advocated by those in favour of recognizing 
paraphyletic taxa (e.g., Hörandl 2006) is that all taxa
have to be recognizable by phenotypic characters. Morphologically deviating species within a genus, for example, can therefore be classified in their own, distinct genera. We argue that the question of “being different” strongly depends on the depth of investigation. The case described in this study shows how a few shifts of predominantly quantitative, and presumably highly adaptive, features can produce a very different phenotypic appearance (*Nymphaea ondinea*). More thorough investigation reveals apomorphies for successively deeper nodes, and allows for identification of the monophyletic taxon (*Nymphaea* including *Ondinea*) on morphological grounds. Similar arguments were provided by Albach (2008), who reclassified *Pseudolysimachion* Opiz into *Veronica L.* (*Plantaginaceae, Lamiales*) and explained that characters used to define *Pseudolysimachion* were strongly homoplastic. We believe that the case of *Ondinea* provides a further good example favouring a monophyly-based classification above the species level (such as genera and families) as stable, predictive and at the same time practical.

**Acknowledgements**

The authors wish to thank Surrey W. L. Jacobs (Royal Botanic Gardens, National Herbarium, Sydney) and C. Barre Helliquist (Massachusetts College of Liberal Arts, Department of Biology, North Adams) for long-standing collaboration in water-lily research, for providing plant material and for fruitful discussions on the status of *Ondinea*. We also thank the two reviewers for valuable comments on the manuscript.

**References**


Endress P. K. 2001: The flowers in extant basal angiosperms and inferences on ancestral flowers. – *Int. J. Pl. Sci.* 162: 1111-1140. [CrossRef]


Wilson, D. 2009: Images: *Ondinea* species. – Published at www.victoria-adventure.org/waterlilies/ondinea_species_images.html