690. NYMPHAEA THERMARUM
Nymphaeaceae

Plant in Peril, 34

Eberhard Fischer and Carlos Magdalena Rodriguez

Summary. *Nymphaea thermarum* Eb. Fisch. is described and illustrated. Its history, distribution, cultivation, propagation and conservation status are discussed.

The waterlilies of the genus *Nymphaea* L. (Nymphaeaceae), are among the most beautiful of aquatic plants. The genus, which consists of c. 45–50 species, has a cosmopolitan distribution with well-known ornamental species from the Northern Hemisphere such as *Nymphaea alba* L. and *Nymphaea tetragona* Georgi. Important taxa from Africa are *Nymphaea lotus* L. and *Nymphaea caerulea* Savigny. However, African species are actually far from well-known and only few modern regional treatments are available (e.g. Verdcourt, 1989). A modern phylogeny of the genus was published by Borsch *et al.* (2007), which showed that there are three evolutionary lineages in *Nymphaea.* One lineage comprises the plants from temperate regions (subgenus *Nymphaea*) which is sister to the two remaining lineages. The second clade consists of the subgenera *Hydrocallis* and *Lotos*, and the third clade of subgenera *Anecyphya*, *Brachyceras* and the former genus *Ondinea*, now included in *Nymphaea* subgenus *Anecyphya*, (see Löhne *et al.*, 2009).

During research on the vegetation of the Albertine Rift in Rwanda in 1987, the first author (EF) came across a very small water-lily growing in one hot spring called Mashyuza, at 1100 m in the Bugarama plain. Herbarium specimens and also living plants were collected and it became soon apparent that a new species of *Nymphaea* was at hand that was subsequently described, in 1988, as *Nymphaea thermarum* (Fischer, 1988). The species was later successfully cultivated in the greenhouses of the Botanical Garden at Mainz University. The most striking characters were the small size that did not change in cultivation even though the plant was grown in cold water, and the white colour of the petals. All other African waterlilies have either bluish to violet (e.g. *Nymphaea heudelotii* Planch.) or white-cream to pink (e.g. *Nymphaea lotus*) and rarely yellow petals (*Nymphaea sulphurea*

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Gilg). Finally the species proved to be the smallest of all waterlilies. Molecular studies (Borsch *et al.*, 2007) show that *Nymphaea thermarum* belongs to subgenus *Brachyceras* and forms a clade with other African waterlilies (e.g. *Nymphaea heudelotii*).

At the type and only known locality the plant was growing completely emerged and only the rhizome was covered by water at a temperature of c. 36°C. After the discovery of this strange endemic species all hot springs in the Albertine Rift from Lake Albert (D.R. Congo/Uganda) to Lake Edward (D.R. Congo/Uganda), Lake Kivu (D.R. Congo/Rwanda) and Lake Tanganyika (D.R. Congo/Burundi/Tanzania) were visited between 1988 and 2005 to search for *Nymphaea thermarum*. However, no other population was detected and the species appears to be a local endemic of Rwanda.

In 2000 the original population was destroyed due to a canalization of the stream below the waterfalls. The plant, however, survived along the stream at a few places as well as in rice and sweet potato fields. In 2009 the course of the stream was moved and led into a new bed to be used for washing. Thus the habitat of *Nymphaea thermarum* dried out and the plant disappeared completely. Today *N. thermarum* is considered to be extinct in the wild. However, the locality can easily be rehabilitated to provide suitable conditions for this waterlily again.

Meanwhile the species was also cultivated in the Botanical Gardens of the University of Bonn where the plant grew successfully but did not propagate. But, at least, it survived in cultivation. Field observation showed numerous seedlings established around a mother plant, and experience in cultivation confirms that this species is self-pollinated. A plant from Bonn was successfully propagated in the Royal Botanic Gardens, Kew, (see below), in 2011, so it is intended to start a reintroduction project, with the cooperation of the University of Koblenz, the Botanical Gardens of Bonn and Mainz, the Royal Botanic Gardens Kew and the Rwanda Development Board.

Cultivation. At Kew, this species is easily cultivated in the tropical glasshouses. Air temperature is kept at a minimum of 18°C (night min.) and programmed to aim for 25°C during the day (vents open at 25.5°C). The air humidity is kept above 70% at all times. Shading is avoided and supplementary lighting is often used over the winter period. Provided that the glasshouse is kept at the right

temperatures, the water does not need to be heated. The species has grown perfectly well between 22–32°C.

Nymphaea thermarum is cultivated in 23 cm plastic pots filled with fine grade loam. Despite the fact that cultivation in larger or smaller pots is possible, smaller pots would slow down the growth of adult plants. The pots are then placed in a watertight container filled with water up to the level of the loam contained in the pot. As the water evaporates slowly but constantly the tank should be refilled every one or two days. It is important not to allow the water level to rise much higher than the compost level. To avoid build up of algae, aquatic snails of the genera *Physa* or *Planorbis* should be placed in the container as they constantly eat the algae but leave the lilies untouched.

Repotting the specimens every two months ensures fast healthy growth and prolific flowering. When repotting, the rootball should be knocked out of the pot and washed thoroughly, leaving the roots completely free of loam. Then, an appropriate container should be chosen (wider than the rosette of leaves but deep enough to accommodate the root system). Ideally the loam should be dry and fine grade since wet loam is much more difficult to handle. To avoid the loss of loam through the pot's drainage holes, place a 2–3 cm layer of multipurpose or peat based compost at the bottom of the pot. It is important to position the plant in the middle of the pot and to keep the plant buried at the same level as it was in its previous pot. If the plant is held with all the leaves facing upwards, with one hand and then the rhizome is placed at the right level, the other hand can be used to fill the pot with dry loam. After repotting, pot is then placed in the tank of water. The waterlevel will need to be readjusted after a few minutes once the dry loam has taken up water.

In common with other waterlilies, *Nymphaea thermarum* is a greedy feeder. At Kew, small pellets of sheep manure are pushed into the loam with the aid of tweezers, about 2–4 cm down into the compost. One or two pellets every 10 days result in dark green, fast-growing plants. So far the species has been almost pest free but it is a magnet to western flower thrips (*Frankliniella* sp.). These tend to go for the flower, but when the flower fades, the insects thrive on the leaves where they feed, spoiling the pad's cuticles. Removal of the flower on its last day of blooming (if seed is not needed) helps, as does a daily high pressure shower of water strong enough to detach the insects

without stirring up the compost too much. However, if the problem gets out of control the application of a specific pesticide is necessary. Despite not being recorded (yet) it is quite likely that aphids would be happy to start colonies on this species since this is the case for all the species of *Nymphaea* I have grown.

Propagation. So far, vegetative propagation of this species appears to be near impossible as the plants do not seem to produce any offsets, and so far, unlike many other species of tropical *Nymphaea*, do not seem to form tubers. So far, sexual reproduction seems to be only the way to increase this species. Like many other species of African *Nymphaea*, *N. thermarum* is self-pollinated, though cross-pollination of individuals can be attempted by introducing pollen-loaded anthers (easily plucked out with the aid of small tweezers) from a second or third day flower onto the stigmatic secretion of the stigmatic disk of a first day flower. After the end of the flowering cycle, the flower will bend towards to the damp compost and if the plant is properly grown, a fruit will form. After 3–5 weeks the fruit disintegrates leaving behind numerous seeds. Since the water is kept at the same level as the compost, the seeds do not float and disperse as other waterlily species.

The seeds can be picked up and placed in a flask with some water. The seed arils degrade in the next 48 hours and can be separated from the seeds. The seeds are then kept in clean water at a temperature of 25°C. Germination occurs within 10 days and a filiform leaf develops. Before the first hastate leaf unfurls the seedlings should be planted out. Small scale trials have shown that the best way of raising them is in large pans (30 cm diameter, 10 cm deep) and in groups, rather than as single plants. The pan is filled with the same compost as is used for adult plants and placed in a water-tight container with *Physa* or *Planorbis* snails. Once the loam is totally rehydrated the seedlings are planted using tweezers. Holding the seedling by the seed, the plantlets are carefully 'fished out' of the flask where they germinated and pushed into the compost to a depth of 1 or 2 mm. They should be placed 3 cm apart in such a way that the filiform leaf lies on its side so that it touches the wet compost but is still exposed to the light. The first few leaves are similar to the submerged juvenile leaves found on all *Nymphaea* species, but very soon the first pad-like leaf appears and the plants start developing more quickly. When the seedlings begin to

be congested and the rosettes are large enough to handle, they should be pricked out individually as described in the cultivation section. With luck the plants will flower 2–3 months after planting.

All known species of *Nymphaea* subgenus *Brachyceras* seem to have seed that tolerates drying out and it is unlikely that *N. thermarum* is an exception. Trials are currently under way to confirm this. Seeds have also been stored in Kew's millennium seed bank and trials post desiccation and refrigeration at subzero temperatures will start soon.

Nymphaea thermarum Eb. Fisch., Feddes Repert. 99: 388 (1988). **Type:** Rwanda, hot springs S of Nyakabuye, April 25, 1987, *Fischer* 170/87 (holotype MJG, isotype BUTARE).

Description. *Small plant* with short rhizome up to 1–2 (−5) cm long. *Leaves* orbicular to suborbicular, glabrous, rounded, lobes with nearly parallel margins or overlapping, petiole up to 4–6 (–8) cm long, lamina 2.5–3.2 (–5) cm in diameter. *Pedicel* 1.5–3 cm long, recurved in fruit. *Flowers* up to 2 cm in diameter. *Sepals* 4, greenish, 1.7–1.8 × 0.6–0.7 cm, lanceolate, rounded at apex, with 9–11 veins. *Petals* 6–8, white, 1.5–1.6 × 0.4 cm, linear-lanceolate, obtuse to rounded at apex. *Stamens* up to 16, with sterile rounded apex formed by the connective up to 0.1 cm long, outer stamens 0.9–1 cm long, inner stamens 0.5–0.6 cm long; *anthers* up to 0.4 cm long in outer and 0.15–0.2 cm long in inner stamens; filaments up to 0.5–0.6 cm long. *Ovary* eusyncarpous with 7–9 carpels fused at base, up to 0.4–0.75 cm long; *stigma* 0.2 × 0.1 cm, thickened. *Fruit* up to 1.2–1.5 cm in diameter.

Distribution. Restricted to Rwanda where the species is known only from one locality at the hot springs of Mashyuza between Bugarama and Nyakabuye at 1100 m a.s.l. (S02°34′99.8″ E29°00′90.8″). It is considered as a narrow Albertine Rift endemic not known outside Rwanda.

Flowering time. In the wild and in cultivation the species flowers all through the year as the habitat is not influenced by the dry seasons.

Habitat. *Nymphaea thermarum* originally grew at the base of a small waterfall (Fig. 1) originating by sinter formation (mainly based on *Chara)* in very shallow water and almost emerged above the surface. The water is highly calcareous and has an average temperature of 36°C where *Nymphaea thermarum* was growing. Accompanying species were *Cyperus* sp., *Eleocharis* sp., *Berula erecta*, *Ammania auriculata*, and *Chara* sp.

Etymology. The specific epithet refers to the habitat in hot springs.

Conservation status. Extinct in the wild (EX).

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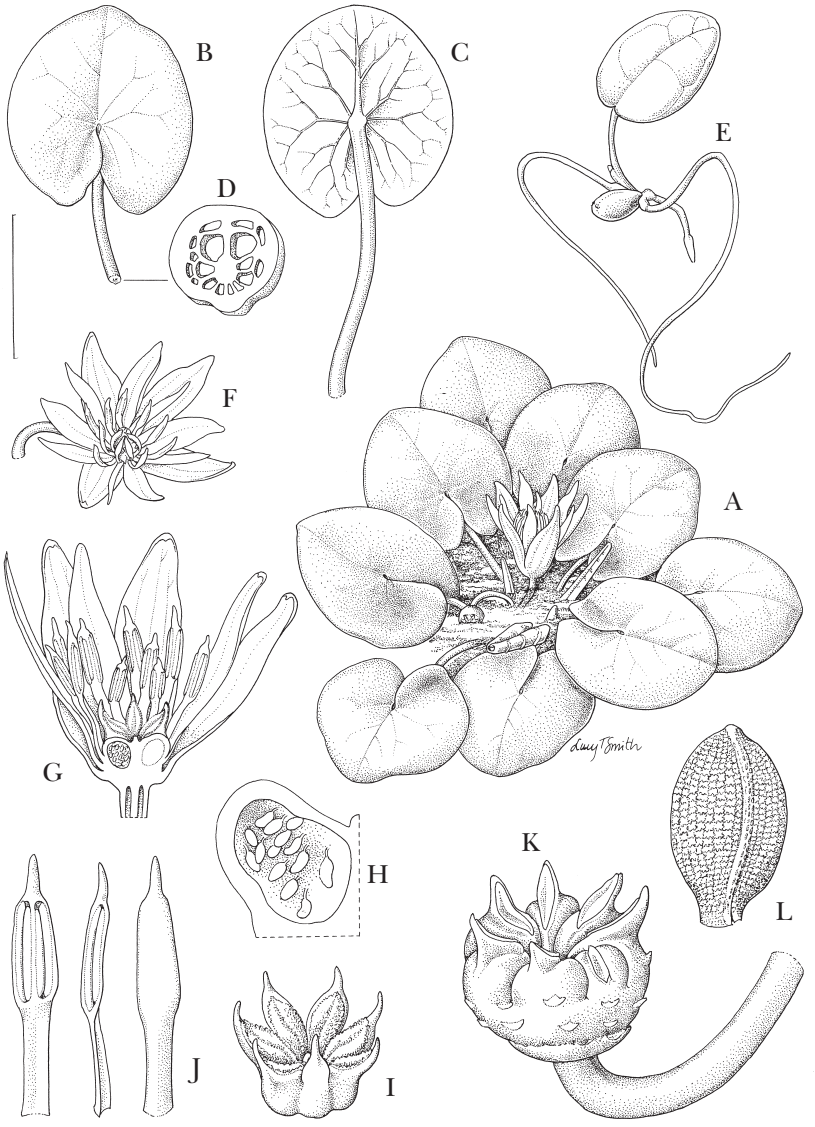
Fig. 1. Habitat of *Nymphaea thermarum* at the foot of a waterfall below a hot spring, Rwanda, Mashyuza, May 1987. Photograph: E. Fischer.

Fig. 2. Habitat of *Nymphaea thermarum*, on the margins of taller vegetation, below a hot spring, with leaves of sweet potato and *Ammania auriculata*: Rwanda, Mashyuza, September 2005. Photograph: E. Fischer.



Nymphaea thermarum. A, habit, × ¾; B, leaf, upper surface, ×1; C, leaf, lower surface, ×1; D, c/s petiole, ×11; E, seedling, ×6; F, flower, ×1; G, l/s flower. ×2; H, ovary locule, ×10; I, ovary, ×4; J, anther, three views, ×4; K, fruit, ×4; L, seed, ×18; scale bar: A = 2.5 cm; B, C, F = 2 cm; D = 1.8 mm; E = 3.3 mm; G = 1 cm; H = 2 mm; I, J, K = 5 mm; L = 0.75 mm. Drawn by Lucy T. Smith from plants cultivated at Kew.

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