SYSTEMATICS AND PHYLOGENY

A taxonomic revision of *Lemna* sect. *Uninerves* (Lemnaceae)

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Abstract *Lemna* sect. *Uninerves* Hegelm. consists of three species, *Lemna minuta* Kunth (synonym *L. minuscula*), *L. valdiviana* Phil. and *L. yungensis* Landolt. *Lemna yungensis* was discovered growing on rocks in the Yungas in Bolivia by E. Landolt and was described just 20 years ago. In the original description, Landolt reported that this species is closely related to *L. valdiviana* and that it is difficult to distinguish the three species on a morphological basis. Therefore, the taxonomic position and status of *L. yungensis* remained controversial. Here, we carried out a detailed taxonomic study, integrating approaches that include quantitative morphometry, metabolomic profiling by matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF-MS) as well as molecular genetic analysis using amplified fragment length polymorphism (AFLP), and barcoding of plastidic sequences. We also investigated genome sizes of clones of the three species. Whereas *L. minuta* can easily be differentiated from *L. valdiviana* and *L. yungensis*, it was not possible to distinguish *L. valdiviana* from *L. yungensis* with any of the methods used. These data imply that *L. yungensis* is identical to *L. valdiviana*. Thus, the name *L. yungensis* should be synonymised with the name *L. valdiviana*, since this is the older name.

Keywords AFLP; barcoding; duckweed; *Lemna yungensis*; MALDI-TOF-MS

Supporting Information may be found online in the Supporting Information section at the end of the article.

■ INTRODUCTION

The genus *Lemna* L. was initially divided into five sections by Landolt (1986); however, this structure was later corrected by reducing the number of sections to four because the *L.* sect. *Hydrophylla* Dumort. (*Lemna trisulca* L.) turned out to be a part of *L.* sect. *Lemna* (Les & al., 2002). The *Lemna* sections, *Lemna*, *Alatae* Hegelm., *Biformes* Landolt, and *Uninerves* Hegelm., represent well-supported monophyletic clades (Les & al., 2002). *Lemna* sect. *Uninerves* includes three species: *L. minuta* Kunth, *L. valdiviana* Phil., and, since 1998 (Landolt, 1998), *L. yungensis* Landolt. *Lemna valdiviana*, which is restricted to warm temperate, subtropical and tropical regions of North and South America (Landolt, 1986), was first described by Rudolph Amandus Philippi (14 September 1808–23 July 1904) honouring the main place of his work, Valdivia, Chile (Philippi, 1864). The taxonomic separation of *L. valdiviana* from its sister species *L. minuta* was reviewed by Reveal (1990) and Crawford & al. (1996). *Lemna minuta*, a species originally distributed throughout the temperate zones and in the mountains of North and South America (Landolt, 1986), but invasive in Europe (e.g., Ceschin & al., 2016a, 2018; Kirjakov & Velichkova, 2016; Paolacci & al., 2018a,b), was already described in *Nova genera et species plantarum* by Karl Sigismund Kunth (Humboldt & al., 1815: 371–372) and was referred to as *L. minuscula* Herter for many years (Landolt, 1986) until Reveal (1990) showed that *L. minuta* is the older, i.e., legitimate name for this species. After investigating 25 clones of *L. minuta* and 26 clones of *L. valdiviana*, Crawford & al. (1996) called the two species sisters because they could only be distinguished, with difficulty, on a morphological basis. Even Elias Landolt, world-renowned Lemnaceae-expert and co-author of Crawford & al. (1996), confessed great problems in distinguishing these two species. It was also Landolt, who established the endemic species *L. yungensis*,

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