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Contributing to the knowledge of the distribution of the world's smallest angiosperms in the Amazon: first record of *Lemna minuta* Kunth (Araceae) in the state of Pará, Brazil

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ABSTRACT

Lemnoideae is a yet little known taxon in Brazil in taxonomic and distributive terms, given the few records for the country, especially in the Amazon region. Here, we present the first record of *Lemna minuta* Kunth for the state of Pará, providing a description of the species, its occurrence in Brazilian territory, and additional comments. This contributes to expanding the knowledge of the species' distribution in the Amazon.

KEYWORDS: aquatic macrophyte, Araceae, duckweed, taxonomy.

Contribuindo para o conhecimento da distribuição das menores angiospermas do mundo na Amazônia: primeiro registro de *Lemna minuta* Kunth (Araceae) no estado do Pará, Brasil

RESUMO

Lemnoideae é um táxon ainda pouco conhecido no Brasil, em termos taxonômicos e distributivos, dado os poucos registros para o país, principalmente na região amazônica. Neste trabalho, apresentamos o primeiro registro de *Lemna minuta* Kunth para o estado do Pará, fornecendo uma descrição da espécie, sua ocorrência em território brasileiro e comentários adicionais. Com isso, ampliamos o conhecimento sobre a distribuição da espécie na Amazônia.

PALAVRAS-CHAVE: Araceae, lentilha d'água, macrófita aquática, taxonomia.

Lemnoideae (formerly Lemnaceae) is currently inserted in the Araceae family, supported by phylogenetic data (Cusimano *et al*. 2011), a classification accepted by the Angiosperm Phylogeny Group (APG II 2003, APG IV 2016). Considered the smallest flowering plants ever recorded, this subfamily comprises 36 species distributed in five genera: *Landoltia* Les & D.J.Crawford (one sp.), *Lemna* L. (12 spp.), *Spirodela* Schleid. (two spp.), *Wolffia* Horkel ex Schleid (11 spp.), and *Wolffiella* Hegelm. (10 spp.) (Bog *et al*. 2020a).

The subfamily is widely distributed across the globe, except for the Arctic and Antarctic zones (Landolt 1992, Sree *et al*. 2016). In addition, the tropical and subtropical zones, specifically South America, represent the center of dispersion for Lemnoideae due to the presence of basal lineages in each group (Landolt 1986, Landolt 2015). Thus, this region plays an important role in maintaining diversity in this subfamily.

Brazil is a region with climate characteristics favorable for the occurrence of the Lemnoideae, which contributes to the diversity of the subfamily (Landolt 1999). However, the taxonomy and distribution of Lemnoideae is still little known in the country, likely due to the lack of collections and the low number of specialists (Pott and Cervi 1999, Pereira *et al*. 2016). In fact, Venezuela, a much smaller country, has a richness of 15 Lemnoideae species (Landolt *et al*. 2015), while Brazil with its much larger area and large number of aquatic environments records only 16 species: *Landoltia* (one species), *Lemna* (four species), *Spirodela* (one species), *Wolffia* (five species) and *Wolffiella* (five species) (Pott and Lourenço 2024 a,b,c,d,e).

Among the Lemnoideae, *Lemna* is the group with the greatest taxonomic richness, comprising 12 species (Sree *et al*. 2016, Bog *et al*. 2019, Bog *et al*. 2020b). These species are

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characterized by free-floating fronds that range from lanceolate to ovate and measure 1 to 15 mm in length, with each frond having a single root up to 15 cm long and flowers gathered in a spathe open on one side, containing one pistil and two 4-locular stamens (Landolt *et al*. 2015). Among the 12 species of *Lemna*, four are recorded in Brazil, where the greatest diversity is found in the southern region of the country (four species), followed by the northeast, central-west and southeast regions with three species each, and finally the north region with two species, according to Flora e Funga do Brasil (Pott and Lourenço 2024b).

The Legal Amazon has only 15 records referring to *Lemna*, distributed among the states of Amapá, Amazonas and Pará. These specimens are *L. valdiviana* Phil. (three specimens), *L. aequinoctialis* Welw. (five specimens) and *L. minuta* Kunth (one specimen), and six specimens identified only at the generic level. In Amazonas state, all species have been recorded; in Pará state, only *L. aequinoctialis*; and in Amapá state, only one specimen has been recorded but identified only at the generic level. The first records of these species in the biome are the specimens Ginzberger 571 (F-Seedplants), identified as *L. valdiviana*, collected in 1927; then, *L. aequinoctialis* was registered in 1975 under the voucher of *Prance et al. 23303* (NY); and *L. minuta* was recorded in *Prance et al. 23426* (INPA49441) and another deposited in NY (NY02711008), which refers to a collection carried out in 1975. All these specimens were registered only in the Amazonas state.

Lemna minuta has only its first record of occurrence in the Legal Amazon, under the proof Prance *et al. 23426* (INPA 49441; NY02711008), collected in 1975 and identified in 2007 by Vali J. Pott. The specimen was collected in the Marrahã Lake, on the banks of the Purus River, in the São Clemente Seringal, near Manaus, Amazonas, in May, which coincides with the dry season in the Amazon. Since then, no occurrence of the species has been recorded for the biome.

The first record of *Lemna* in Pará is from the specimen *Project Iara s.n.* (IAN164429; IAN164407) from 1996, collected in the region of Santarém; however, analyzing the material available on SpeciesLink, it was observed that the specimen has morphological characteristics better resembling representatives of other taxon rather than *Lemna*, such as larger size and more rounded shape of the fronds and a greater number of roots. Thus, the history of distribution of the genus in Pará is more recent, with the specimen *Bove 1507* (R), registered as *L. aequinoctialis* in 2005 in the municipality of São João do Araguaia, followed by *Mehlig 1535* (HBRA), with an inaccurate identification recording the taxon for the region of Bragança. Two decades later, *L. aequinoctialis* was recorded again, in *Mehlig 2028* (HBRA) for the same region of Bragança.

During fieldwork for the project "Use of aquatic macrophytes in the treatment of açaí effluent" (Soares et al. in prep.), we collected a species identified as *L. minuta*. After its identification, we realized that little information is available for this species in Brazilian Amazon and nobody had yet recorded it for the Pará state. Therefore, in this study we report this new record of one of the smallest angiosperms in the world, *L. minuta*, for the state of Pará, expanding its geographic distribution and contributing to increasing knowledge of Amazonian floristic diversity.

Specimens of *L. minuta* were collected in September 2022 from a stream intersected by a road passing through the village of Brasileira, located in the rural zone of Irituia, Pará state (1°52'24.6"S, 47°26'43.1"W). This period coincides with the dry season in the Amazon region. The stream had a slow water flow, and the species was dominant in the water body.

The specimens were georeferenced using the Geo Tracker program (version 5.3.0), with an accuracy of 3 meters, and collected in a plastic pot, containing water from the environment itself. Then, the individuals were taken to the Laboratório de Estudos Ambientais of the Universidade Federal Rural da Amazônia, campus Capitão Poço, where they were screened and identified with the aid of a stereomicroscope. The identification of the specimens was carried out following specialized literature (Pott and Cervi 1999; Landolt *et al*. 2015). The descriptions were made based on the fresh material visualized under a stereomicroscope, and measurements were taken using the ImageJ program (version 1.54d). The specimens were herborized in a single exsiccate and deposited in the HCP herbarium.

The distribution data for *Lemna minuta* were obtained from Pott and Lourenço (2024b). To create the species distribution map in Brazil, data from SpeciesLink (2024) were used. The distribution map was generated in QGIS (version 3.34.3) using cartographic basemaps provided by IBGE (2024). Information on the species' flowering and fruiting periods was extracted from the collection notes associated with materials available in SpeciesLink (2024).

Lemna minuta Kunth, Nov. Gen. Sp. ed. 4, 1:372. 1816. (Figure 1)

Floating aquatic herb. **Root** 1 per frond, 0.6–1.9 cm long. **Fronds** 1.5 – 2.3 x 1.1 – 2 mm, obovate to elliptical, flattened, slightly asymmetrical at the base, green, 1 to 2 times longer than wide; 2–3(4) tied-fronds; rare papillae in the midline on the adaxial surface of the frond; vein not evident. **Flowers** not seen. **Fruit** 0.3-0.6 mm long, ellipsoid, brown, indehiscent, ca. 6 dark longitudinal lines.

Material examined: Brazil, Pará: Irituia, Brasileira village, 1°52'24.6"S, 47°26'43.1"W, Creek on the side of the road, slow-flowing water, 6.IX.2022, *W. C. R. Soares 21*(HCP).

Figure 1. *Lemna minuta*. **A** – vegetative fronds; **B** – fertile fronds; **C** – details of the fruit.

Comments: *Lemna minuta* can be confused with *L. valdiviana* or *L. aequinoctialis* due to the great morphological simplicity of the group, with few distinctive characteristics between species. *Lemna aequinoctialis* can be easily distinguished from the others by the presence of three veins in the fronds, while *L. minuta* differs from *L. valdiviana* by rarely presenting a vein, when present it has one, inconspicuous and less than 1 mm long and having 2-3(-4) tied-fronds, while in *L. valdiviana* the vein is always present, conspicuous and greater than 1 mm in length, in addition to having 4(-10) tied-fronds (Pott and Cervi 1999; Pereira *et al.* 2015; Lourenço and Bove 2019; Pott and Lourenço 2024b; Table 1). *Lemna minuta* can be found co-occurring with the congener *L. aequinoctialis*, but also with other species of floating aquatic plants, such as *Pistia stratiotes* L. and *Salvinia* spp. in environments with anthropogenic impacts (Lourenço and Bove 2019).

Tabel 1. Vegetative traits for identification of *Lemna* species, based on Pott and Cervi (1999), Pereira et al. (2016), Lourenço and Bove (2019) and Pott and Lourenço (2024b).

Vegetative traits	*L. aequinoctialis*	*L. valdiviana*	*L. minuta*
Number of veins	Three	One	One
Presence of vein	Always present	Always present	Rarely present
Vein evidence	Conspicuous	Conspicuous	Inconspicuous
Frond symmetry	Asymmetrical	Asymmetrical	Symmetrical
Number of tied-fronds	1(2-4)	4(-10)	2-3(-4)

Geographic distribution: *Lemna minuta* is widely distributed in Brazil, where it is native but not endemic to that country. According to Pott and Lourenço (2024b), this species occurs in the northeast, southeast, central-west and south regions; however, the authors cite possible occurrences for the north region (Amazonas). The specimen *Prance et al. 23426* (INPA49441; NY02711008), collected in 1975 and identified in 2007 by V.J. Pott is the first record of this species in the north region and in the Brazilian Amazon. In Pará state, this is the first record of *L. minuta* and the second for the Brazilian Amazon (Figure 2).

Flowering and Fruiting data: Only four of the 142 specimens of *L. minuta* in SpeciesLink have records of flowering and three of flowering and fruiting, occurring between the months of March and August. These specimens were recorded for the states of Ceará, Pernambuco and Mato Grosso do Sul. The material of *L. minuta* from Amazonas [*Prance et al.* 23426 (INPA 49441; NY02711008)] does not present flowering or fruiting data, like most of the specimens in other states. However, the specimen occurring in Pará [*Soares 21* (HCP)] is the first to provide information on the fruiting of the species for the northern region and for Brazilian Amazon, with the fruits recorded in September, coinciding with the dry season in the biome.

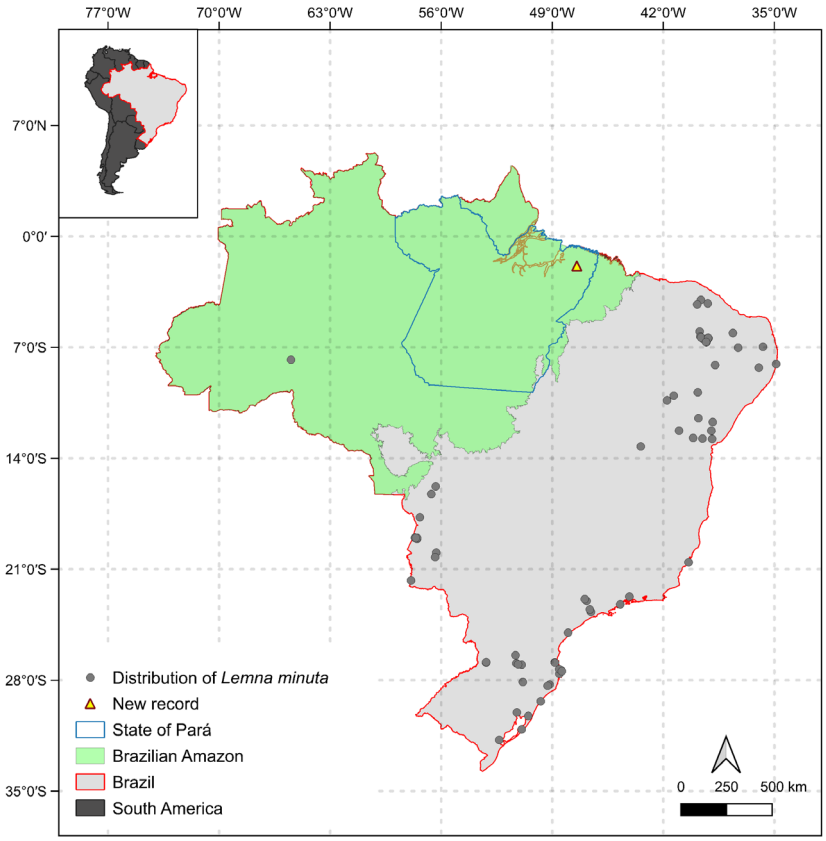

Figure 2. Distribution map of *Lemna minuta* in Brazil.

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