


First record of *Landoltia punctata* (Araceae, Lemnoideae) in Amazonia

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ABSTRACT

Landoltia punctata is a species of duckweed originating from India, but has been recorded in all continents, except Antarctica. It is of economic interest, being used in phytoremediation, but mainly due to its high invasive potential. Here we report the first record of this species in the Amazon region, both expanding its known distribution and raising awareness about the potential losses of biodiversity that may occur in the kind of environment where the species was registered. Future studies should focus on the competitive potential and population control of *L. punctata* in the region.

KEYWORDS: biological invasion, species distribution, duckweed, freshwater environment, aquatic macrophyte

Primeiro registro de *Landoltia punctata* (Araceae, Lemnoideae) na Amazônia

RESUMO

Landoltia punctata é uma espécie de lentilha-d'água originária da Índia, mas que atualmente tem registro em todos os continentes, à exceção da Antártida. A espécie tem interesse econômico, sendo usada em fitorremediação, mas principalmente por seu grande potencial invasor biológico. Aqui reportamos o primeiro registro dessa espécie para a região Amazônica, ampliando sua distribuição conhecida e chamar a atenção para a potencial perda da biodiversidade no tipo de ambiente em que a espécie foi registrada. Estudos futuros deveriam focar no potencial competitivo e controle populacional de *L. punctata* na região.

PALAVRAS-CHAVE: invasão biológica, distribuição de espécies, lentilha-d'água, ambiente de água doce, macrófita aquática

Landoltia punctata (G.Mey.) Les & D.J.Crawford (family Araceae, subfamily Lemnoideae) is the only species in the monospecific genus *Landoltia* Les & D.J.Crawford. This floating aquatic herb, known popularly as duckweed (like other Lemnoideae), was formerly included in the Lemnaceae family, which was incorporated into the Araceae family by APG (1998). Although its holotype was described with botanic material from India, the species was later recorded in Oceania, Africa, and the Americas, including Brazil (Les and Crawford 1999; Les et al. 2002; GBIF 2023; Flora e Funga do Brasil 2023). Despite its broad distribution, there is no notable geographical variation in morphology (see Pott 2002; Valkenburg and Pot 2008; Al-Mayah and Al-Saadi 2013; Hassemmer et al. 2015; Pereira et al. 2016; Lourenço and Bove 2019; Lee et al. 2020). This worldwide distribution is probably a reflection of dispersion through ornithochory (Les et al. 2003), but also can occur by

humans that may have introduced the species in different parts of the world (Pyšek et al. 2020).

This species, as some other Lemnoideae, has an invasive potential, and was found in remote places such as islands (Otto and Verloove 2016). Considering it is an invasive species, it is important to track its introduction to new sites, in order to monitor its dispersion and potentially harmful effects, especially through competitive exclusion of native species (Gallardo et al. 2016). To date there are no reports on specific native species harmed by the overgrowth of *L. punctata*, despite it having one of the fastest growths among angiosperms, that causes shading of the water surface and impairs the growth of other aquatic macrophytes, especially submerged species (Appenroth et al. 2015; Wang et al. 2021). On the other hand, *L. punctata* also possesses an interesting potential for phytoremediation (Anjos et al. 2019; Braga et al. 2021), use

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for animal feed (Mohedano et al. 2012), and even conversion of residual waters into biofuel (Miranda et al. 2020).

In Brazil, the subfamily Lemnoideae is represented by five genera and 18 species (CRIA 2023). The distribution of *L. punctata* in Brazil is concentrated in the Cerrado, Caatinga and Atlantic Forest biomes, where most of the records have been made. Records from other South American countries are also outside of the limits of the *strictu sensu* Amazon biome. Andrade-Pereira and Cuddington (2024) showed the rapid expansion of the species and warn of the possibility that, with the increase in temperatures across the globe due to climate change, *L. punctata* may reach places where it has not yet been recorded. The species has been shown to have a hibernation strategy between layers of ice (Ziegler et al. 2023), resistance to Diquat, the herbicide used to control duckweed (Koschnick et al. 2006), and even to the ingestion by ducks (Andrade-Pereira and Cuddington 2024), demonstrating a high potential for invasion and being difficult to control. Here we report the first record of *L. punctata* in the Amazon biome.

Landoltia punctata was recorded in the city of Belém, Pará state, Brazil (3000-3300 mm annual rainfall, 36.1 °C average annual maximum temperature; Pará 2023), at the campus

of Universidade Federal do Pará (UFPA) (1°27'58.34"S, 48°26'48.55"W) (Figure 1). The campus is located in a very urbanized part of the city, on the margins of the Guamá River and contains some fragments of floodplain forest, which extends to the Utinga Camillo Vianna State Park. The plants were initially found in a small permanent pond (formed by rainfall and tidal influence of the river) (Figure 2a). We surveyed the campus area and the presence of the species was not detected in other nearby ponds. During a subsequent survey six months later, we found the species in at least five other ponds, as well as in a nearby culvert. Capybaras (*Hydrochoerus hydrochaeris* L. 1766) present at the campus were observed carrying *L. punctata* attached to their fur (Figure 2b), which possibly facilitated the dispersal of the plants from the initial pond to other ponds, indicating that the species may have entered the sewage system. Currently, the species has been documented in six small water bodies (Figure 1b), ranging from a 1.5-m-wide culvert that periodically dries up to 35-m-wide pools with depths exceeding 2 m.

The collected material has been identified as *L. punctata* using the Flora e Funga do Brasil (2023) identification key and confirmed with specialist Vali Pott and Alba Lucia Lins.

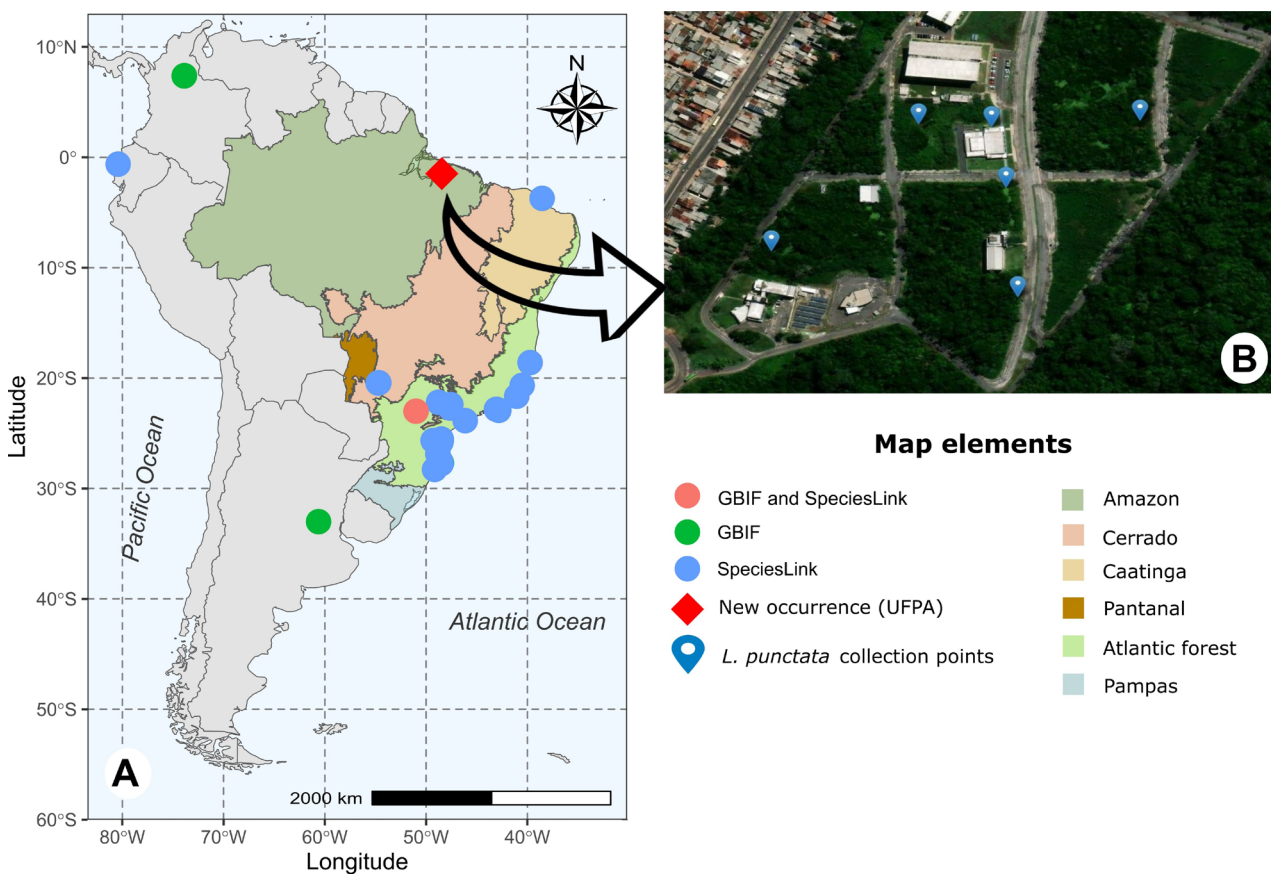


Figure 1. Location of the site where *Landoltia punctata* was recorded (red symbol) in Belém, state of Pará, in the Brazilian Amazon (area in darker green) (A) and distribution of the six ponds where the specimens were found at the campus of Universidade Federal do Pará (UFPA) (B).



Figure 2. First pond where *Landoltia punctata* was recorded at the campus of UFPA (A) and image of a capybara with dozens of *Landoltia punctata* units adhered to the body (B).

Landoltia punctata (G.Mey.) Les & D.J.Crawford

(Figure 3)

Description: Forms floating fronds next to the water column, obovate to elliptical, green with margins at times reddish or purplish (Figure 3a); abaxial surface varying between green, brown, and purple (Figure 3b); ability to inflate; slight asymmetry; presence of 2-6 fronds per individual measuring 0.2-0.9 cm x 0.1-0.3 cm; ribs imperceptible to the naked eye (Figure 3c); occasional presence of papillae and a somewhat prominent central rib. Roots 2-5 per frond, 0.7-2.5 cm long, cylindrical, and green; root cap pointy 0.1 to 0.3 mm length, slightly curvilinear, green to brownish (Figure 3d). Sparse, yellow flowers, occur inside the fronds, composed of an anther and stigma, 0.1-0.2 mm. No individuals with fruits were found.

Examined material: Ten adult individuals. Brazil. Pará: Belém: Universidade Federal do Pará- UFPA, water pond located next to the fourth gate, partially shaded; 04 Jun 2022, G.S. Cabral & R.L.M. Sousa 121. The material is deposited in the herbarium of Museu Paraense Emílio Goeldi (MPEG), Belém (Pará) (MG246309).

This is the first record in the Amazon biome. Database records (GBIF; SpeciesLink) confirm its presence in South America, but species lists on macrophytes (Moura Júnior et al. 2015; Córdova et al. 2022; Flora e Funga do Brasil 2023) did not record *L. punctata* in the Amazon.

Although the local has anthropic influence, the introduction and development of duckweed were apparently unintentional, as access to the areas is not easy, and Lemnoideae are not widely targeted in the aquarium trade. Another unlikely possibility is that *L. punctata* arrived via the Guamá River. The most likely explanation is, in fact, dispersal by ornithochory, as described by Les et al. (2003).

The present record is important for several reasons. We contribute to the basic knowledge about the species and update its current distribution in Brazil. Furthermore, early detection of a potentially invasive species is the best way to develop efficient strategies to deal with it, before uncontrolled propagation occurs, and higher costs are required for its control (Fares et al. 2020; Machado et al. 2020). The species is relevant in the context of invasion ecology, as it is of easy and fast dissemination (Andrade-Pereira and Cuddington 2024) and its potentially harmful interaction with native species of the highly biodiverse Amazon biome is completely unknown. This shows the need for observational and experimental studies on the competitive ability of *L. punctata* relative to Amazonian macrophytes (Antonelli et al. 2018; Pyšek et al. 2020). It is noteworthy that the UFPA campus harbors a natural population of *Lemna aequinoctialis* Welw. Given their ecological similarity, *L. aequinoctialis* and *L. punctata*

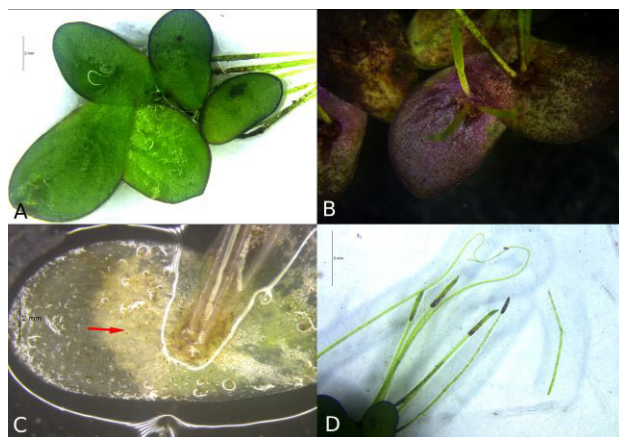


Figure 3. General aspect of *Landoltia punctata* (A); abaxial surface, detailing the aerenchyma and the insertion of the roots into the fronds (B); clarified aspect, with prominent venation (C); roots and root cap (D).

may compete for resources. Although no record of ecological exclusion behavior has been documented for *L. punctata*, other Lemnoideae have exhibited this behavior, such as *Lemna minuta* Kunth (Paolacci et al. 2018). Assuming the species has already established itself locally, future research should focus on its ecology and competitive success with native and other invasive species in the region, given the difficulty in eliminating it.

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