



First record of *Pilularia americana* A. Braun (Polypodiidae, Salviniiales, Marsileaceae) from Peru

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Abstract

The aquatic fern *Pilularia americana* A. Braun is known from several countries in South and North America. Here we provide a first report of this species for Peru, from 2 localities in the Ancash and Ayacucho regions (central Peru), which confirm its presence in the national flora.

Key words

Aquatic fern; high Andes; Peru.

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Introduction

Pilularia Linneo is a small fern genus of 3 or 6 species distributed in the Americas, Australia, Europe, and New Zealand (Kramer 1990). *Pilularia* belongs to a clade of aquatic heterosporous ferns (Pryer 1999). It is a monophyletic genus having phylogenetic affinities with *Regnellidium* Lindman; and together they form a sister relation to *Marsilea* Linneo within the monophyletic family Marsileaceae (Pryer 1999, PPG I 2016).

Pilularia is characterized by its inconspicuous size and shape that usually resembles that of sedges or other graminoid herbaceous aquatics. All species of this genus are morphologically similar, and original descriptions of key taxonomic features are still in need of further evaluation (Large and Braggins 1989). The work of Nagalingum et al. (2008) provided the needed evidence for

preliminary phylogenetic affinities within *Pilularia*; they recovered 2 strongly-supported lineages, one consisting of European taxa, and another including plants from North America, New Zealand and Australia. *Pilularia americana*, a species currently recognized in the Americas, is among this latter group. They also noted the need for additional sampling in Africa and South America to clarify species limits in *P. americana* and related species (Nagalingum et al. 2008).

Pilularia americana A. Braun has a wide range in continental tropical and temperate Americas. It is known in South America from Argentina (Arana 2016), southern Brazil (Prado et al. 2015, Windisch 2015), Colombia (Murillo et al. 2015), and Bolivia (Kessler 2014, Kessler and Smith 2017). Its presence in Peru's flora was expected (Tryon and Stolze 1994), and here we confirm its occurrence from 2 high Andean localities of central Peru.

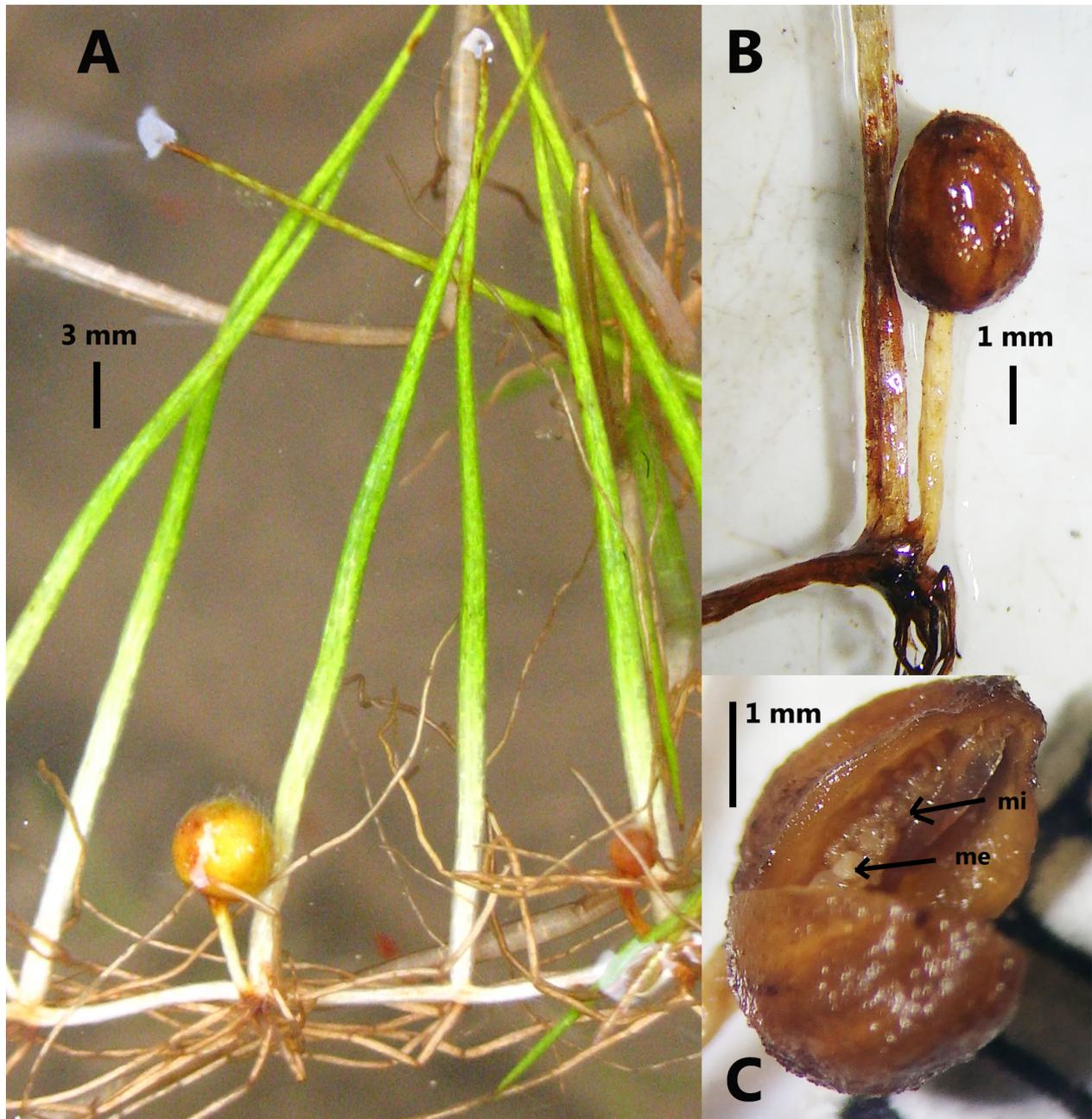


Figure 1. *Pilularia Americana*. **A.** Habit of plant collected in Ancash (M. Morales sn USM 300555). **B.** Sporocarp and pedicel. **C.** Longitudinal section of the sporocarp showing 2 locules. Arrows indicate a megasporangium (me) with a single megaspore, and a microsporangium (mi) with several microspores.

Methods

During revision of fern material at the herbarium of the Museo de Historia Natural of the Universidad Nacional Mayor de San Marcos (USM), Lima, Peru we identified 2 specimens as belonging to *Pilularia*. One specimen was collected as part of a study examining plant composition and ecology of high altitude wetlands in Ayacucho. All material was examined using a Bausch & Lomb stereomicroscope, and pictures were taken using a Nikon Coolpix S6500 camera. Living material was observed and photographed using a Canon Powershot A630 camera before being processed at the herbarium in Lima. We also examined type material kept at the Philadelphia (PH) and New York (NY) herbaria available through JSTOR-

Global Plants website. The morphological terminology follows that of Lellinger (2002). The map was generated using the software DIVA-GIS version 7.1.7.2 (Hijmans et al. 2005), showing altitudinal ranges and departmental administrative units.

Results

Pilularia americana A. Braun, Monatsberichte der Königlich-Preussische Akademie des Wissenschaft zu Berlin 435. 1863.

Type: USA, Arkansas, Fort Smith, Nuttall s.n. (holotype uncertain, probably PH-00031057; isotype NY-00149821). Figures 1A–C, 2.

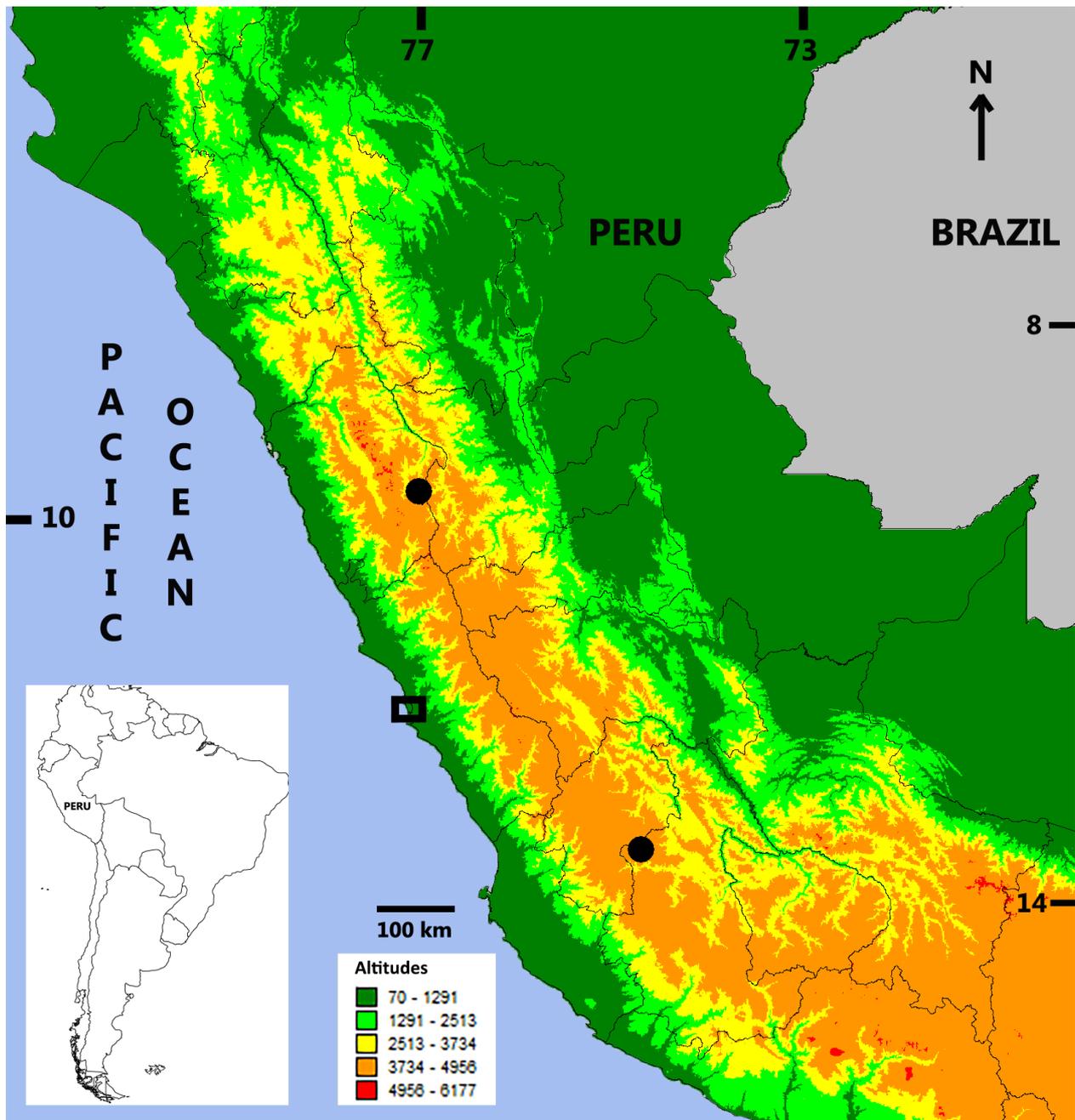


Figure 2. Geographic location of *Pilularia americana* sites (black circles) in Peru, and location of Lima, capital of Peru (hollow rectangle). Inset map of South America showing the location of Peru. In the main map, thin dark lines are departmental administrative units. Legend: altitude in meters, altitudinal ranges in color. Latitude and longitude in degrees.

New record/material examined. Peru. Ancash: Huari, San Marcos, alrededores del campamento minero Antamina ($09^{\circ}35'55.08''$ S, $077^{\circ}01'20.22''$ W), 4530 m, 4 May 2012, M. Morales s.n. (USM 300555). Ayacucho: Huamanga, Vinchos, Guitarrachayoc ($13^{\circ}23'43.99''$ S, $074^{\circ}41'14.01''$ W), 4593 m, 6 October 2016, M. Huaycha-Allca s.n. (USM 300554).

Identification. Aquatic, submerged or limnophytic, forming groups, usually fertile when less than a third of the proximal part of leaves is found submerged. Rhizome whitish when fresh, long-creeping, branched, with roots at the nodes, sometimes hairs in the youngest parts. Leaves

filiform, $1.3\text{--}9 \times 0.1\text{--}0.15$ cm, 1 central vein surrounded by aerenchyma. Pedicellate sporocarp born at the base of the leaf, in a lateral position, pedicels 0.2–0.37 cm long; sporocarp globose 0.2–0.25 cm wide, with 4 locules, each locule with both megasporangia and microsporangia, whitish elliptic megaspores, 437–468 μm in diameter; brownish globose microspores, 31–32 μm in diameter.

Discussion

Pilularia americana is known from North America (USA and Mexico) and South America (Argentina, Bolivia, Brazil, Chile, Colombia, Venezuela, and now

from Peru) (Mickel and Smith 2004). It has also been reported from South Africa (Roux 2002). In Peru, *P. americana* forms small mats along margins of shallow ponds at high elevations. It grows usually associated with *Crassula venezuelensis* (Steud.) M. Bywater & Wickens (Crassulaceae), *Callitriche heteropoda* Engelm. ex Hegelm. (Plantaginaceae), *Elodea* sp. (Hydrocharitaceae) and *Chara* sp. (Characeae). In both locales, it was a rare species, and it was collected during the dry season. Both locales are heavily affected by human activities, especially mining and other alterations to the surface hydrology.

Peru's fern flora is one of the most diverse in the Neotropics (Smith et al. 2005). Several new records or new species have been published as a result of extensive plant collecting during the last 15 years, mainly in humid montane forests. On the other hand, the finding of *Pilularia americana* at high elevations (4530–4590 m) also demonstrates that the country is still in need of a more detailed plant exploration in other kinds of environments, such as these high Andean localities.

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Authors' Contributions

BL, HB identified the specimens and wrote the manuscript; HB took photos of living material from Ancash deposited later at USM, BL took microphotographs; CC-B, EP-Q and MH-A collected samples, provided data, and reviewed manuscript.

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