First record of overlap between two species of *Pinguicula* in the Andean Patagonian forest

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Abstract: In Argentina there are two species of carnivorous plants of the genus *Pinguicula*, *P. antarctica*, and *P. australandina*. These species, also present in Chile, have a distribution in Argentina limited to the Andean Patagonian Forest ecoregion, which ranges from southern Neuquén to Tierra del Fuego and Isla de los Estados. To date, no cases of overlap between these two *Pinguicula* species have been reported. Knowing the distribution of species is a key component to understanding their ecology and conservation. The study of the carnivorous plants of Argentina contributes to increase the knowledge of the native flora.

Introduction

The *Pinguicula* species of Argentina are perennial herbs that grow as rosettes attached to the ground that rarely exceed 3.5 cm in diameter. The upper side of the leaves are covered with glands that produce a mucilaginous secretion. Small insects get stuck in the mucilage and are degraded by enzymes secreted by the referred glands. The absorbed nutrients are important sources of nitrogen for these plants (Dawson 1973). In autumn-winter they spend several months under the snow with the same type of leaves, being homophilic species, unlike others in the genus. In summer they develop one or more inflorescences consisting of a single flower through which they reproduce sexually. At first glance the two species appear similar, but if different characters of the inflorescence are punctually compared, the morphological distinction is achieved. These two *Pinguicula* grow in the Andean Patagonian Forest ("*Bosque Andino Patagónico*") ecoregion, but in very different environments. The habitat of *P. antarctica* corresponds to the peat bogs of the Patagonian rainforest (temperate rainforest) with reported sightings in Chubut, Santa Cruz, Tierra del Fuego, and Isla de los Estados (Dawson 1973). The plants occur from sea level to elevations of approximately 1000 m above sea level. The associated floristic set is Subantarctic (Lampard *et al*. 2016).

Pinguicula australandina has been determined to occur at elevations of 1400 to 2300 m above sea level, mainly in alpine pastures between 36° and 41° South latitude both for Argentina and Chile, in the former the reported sightings place populations in Neuquén and Río Negro (Lampard *et al*. 2016). A particularly interesting population of *P. australandina* has been sighted in a specific location in Puerto Blest (Río Negro) (Figs. 1 & 2), a habitat similar to the description of the ecosystem preferred by *P. antarctica*, growing on sphagnum peat moss and close to 790 m above sea level (Brion *et al*. 1988).

Methodology

In January 2020, within the framework of the "Carnívoras Argentina" project, an investigation was carried out in the Nahuel Huapi National Park in order to compare distinct populations of *P.*

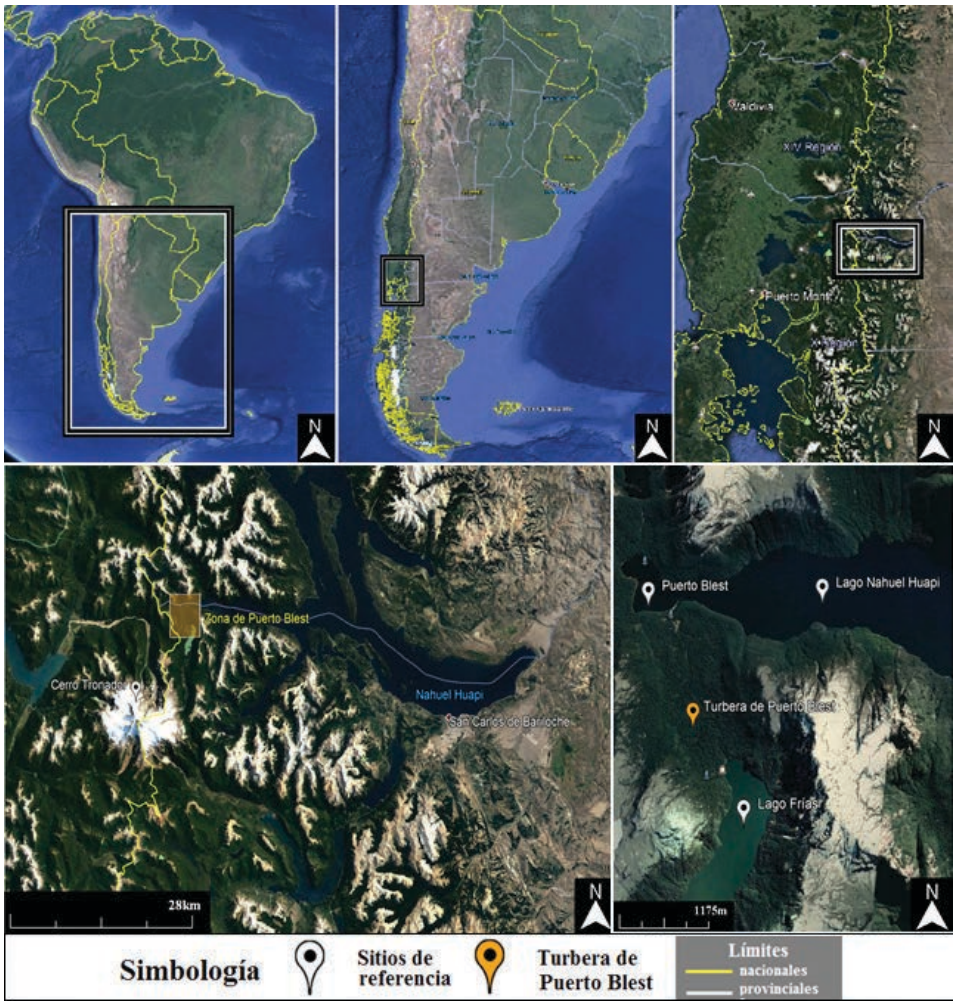


Figure 1: Location of the Puerto Blest peat bog. Satellite images taken from Google Earth. Image date according to satellite data: 10/17/2019.

australandina that exhibited morphological differences in their native habitat and determine if these differences prevailed in *ex-situ* cultivation (under the same growing conditions). Three previously known locations were surveyed, two of which were located in hills near the City of San Carlos de Bariloche over 1600 m above sea level, in high Andean pastures. The other location corresponds to the peat bog present in the Puerto Blest area. In this publication we will refer exclusively to the findings at this location. The survey method was *in-situ* photography, making measurements of the plants and recording the captures of invertebrates with macro photos. At the same time, with the permission of the National Parks Administration (Research Authorization - DRPN - No. 1676), live material was collected. With the collected material, two herbarium specimens were prepared.

With the photographic material generated *in-situ* and the collection of specimens, we proceed to review the specific bibliography with botanical description of the *Pinguicula* known in Argentina

Figure 2: Puerto Blest peat bog at 790 m above sea level. Photo taken 01/07/2020.

using the most recent works on the genus, viz. *Pinguicula* of Latin America, Vol. 2 (Lampard *et al*. 2016) and the review Revision of *Pinguicula* (Lentibulariaceae) in Chile and Argentina (Gluch 2017a,b).

In Puerto Blest, the meteorological, soil, and consequently ecosystem characteristics differ greatly from other sectors of the Nahuel Huapi National Park, giving rise to the Valdivian Forest.

Results

The presence of *P. australandina* in Puerto Blest is at least a strange fact, considering the floristic composition and the environment where the other known populations grow in the Cerros de Río Negro in the Nahuel Huapi National Park (Roccia 2018). Despite these environmental differences, the *P. australandina* population from Puerto Blest did not present great differences with the other populations observed (beyond those differences in color, typical of the varying light conditions) (Fig. 3). However, it was noted that the *P. australandina* population in Puerto Blest was more advanced in terms of fruit and seed development, possibly due to being approximately 790 m above sea level,

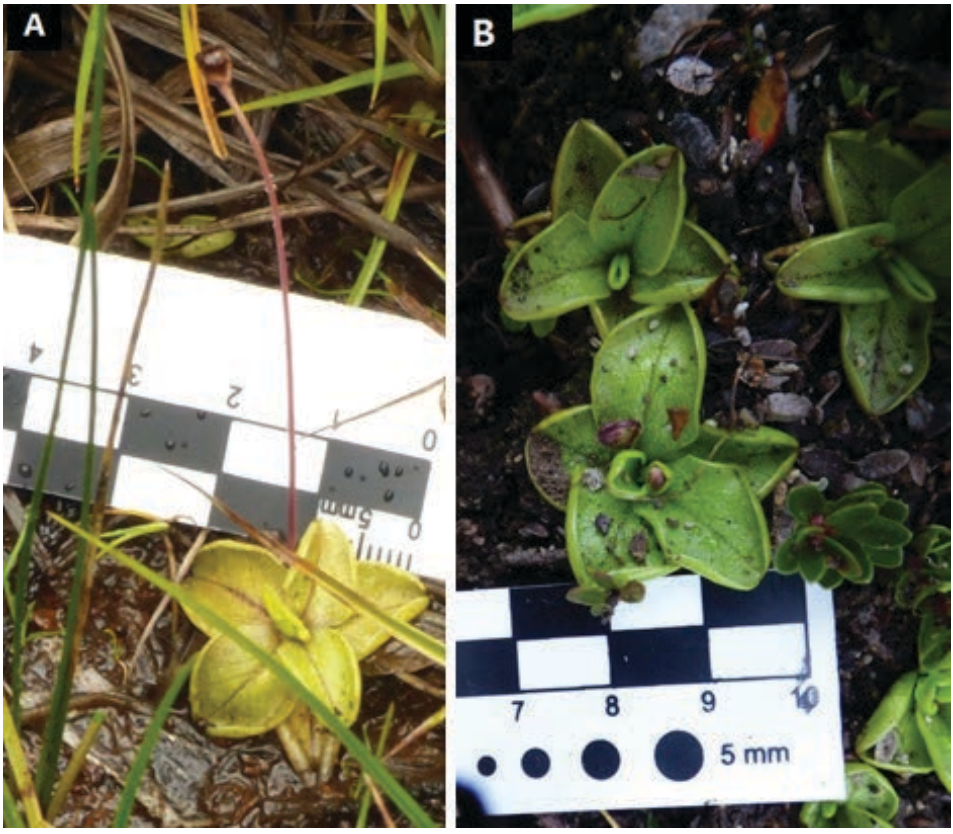


Figure 3: (A) *Pinguicula australandina* in Puerto Blest. Photo taken 01/07/2020. (B) Same species in a meltwater stream at 1600 m above sea level on a hill near San Carlos de Bariloche. Photo taken 01/05/2020.

while the populations that were above 1600 m above sea level were in a less developed flowering stage at the same time of the year (personal observations making comparisons in the flowering stages in an altitude gradient for the same hill).

In the survey and detailed observation in different sectors of the peat bog, where access was only possible thanks to the explicit permission of the Administration of National Parks within the framework of the proposed investigation (DRPN - N° 1676), *Pinguicula* with very different morphology were found, with widely involute leaves and longer floral scapes (Fig. 4).

Discussion

When carrying out the morphological comparison between the different Puerto Blest specimens, we consider the possibility that the *Pinguicula* with very involute leaves corresponds to *Pinguicula antarctica*.

P. antarctica and *P. australandina* are species that can appear to be very similar. Faced with different environmental conditions, the leaves can be more or less involute and their colors can vary from yellowish green to reddish (personal observations). These differences even occur in the same species

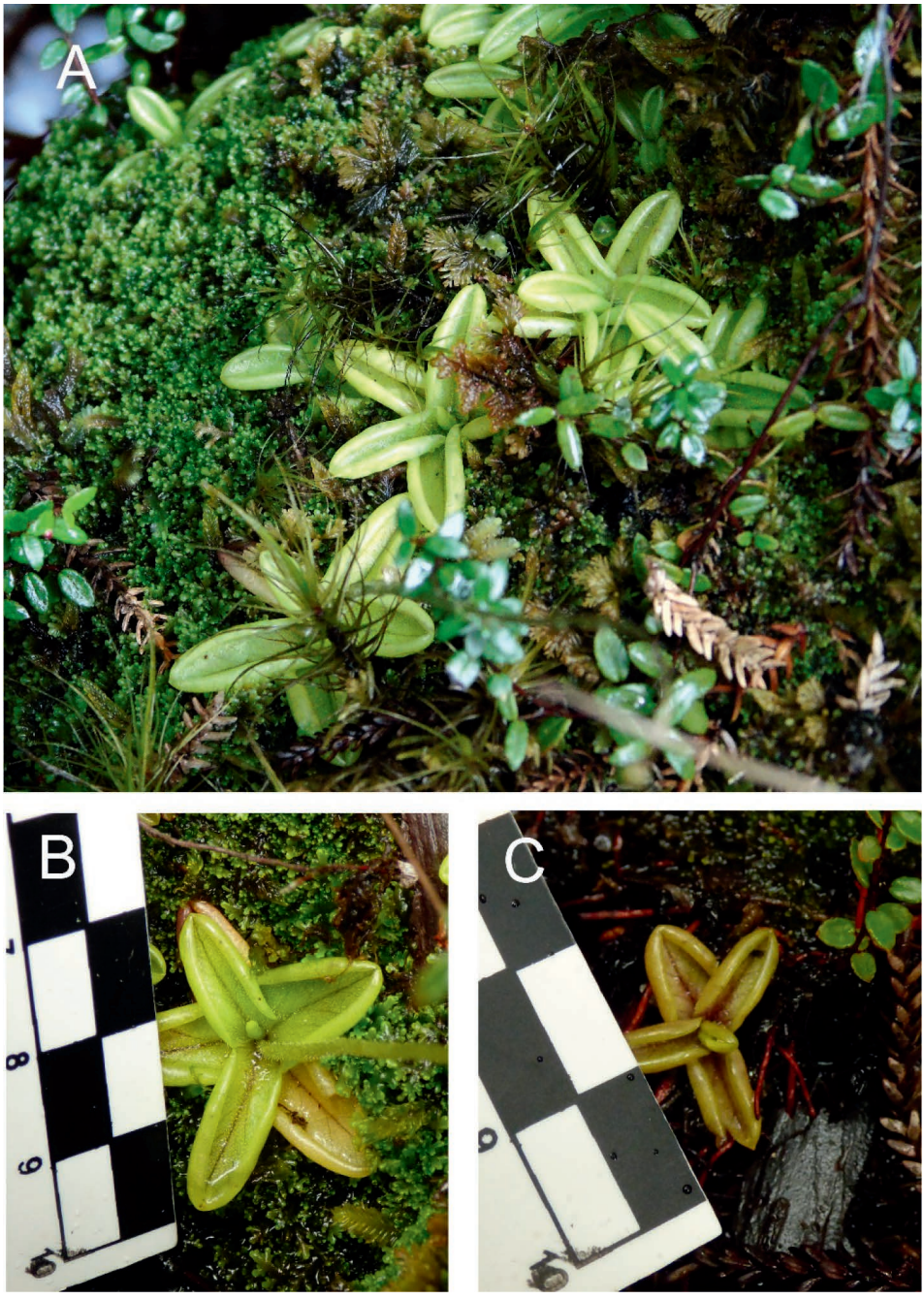


Figure 4: Several specimens of the *Pinguicula* with very involute leaves in Puerto Blest. (A) Group growing on moss and logs. (B) Adult specimen with developed floral scape. (C) Smallest specimen. Photos taken on 01/07/2020

Table 1. Adaptation of Gluch 2017a,b. * White corolla *P. australandina* has been observed. ** Differences in fruit shape were described by Gluch in personal communications.

Comparison reference	Organ	*P. australandina*	*P. antarctica*
#1	Length of floral scape	2-5 cm long.	4.5-20 cm long.
#2	Spur	2-3 mm conical and with pointed end. Solid green or yellow.	1-1.5 mm. shaped like a sack. With parallel violet lines.
#3	Corolla's shape	Sub-isolobada. The 2 petals of the upper lip are sub-equal to the 3 of the lower lip.	Bilaviated. The 2 petals on the upper lip are considerably shorter than the 3 on the lower lip, almost half.
#4	Presence of glands in floral scape	The entire scape moderately covered with glandular hairs.	Almost glabrous in the upper part of the stem, the presence of glandular hairs increases towards the base.
#5	Corolla's color	Pink, white*, lilac or purple	White
#6	Palate's location	Below the middle lobe inside the tube	At the base of the middle lobe of the lower lip.
#7	Fruit shape**	Globular or ovoid.	Elongated, slightly cylindrical, with a flat edge

under different environmental conditions (Aranoa 2018) which could lead to confusion. However, the differences that ensure the determination for these species are found in the floral organs.

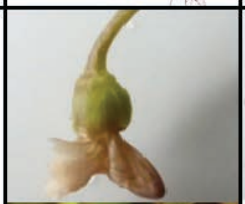
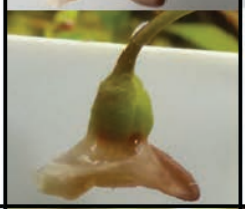
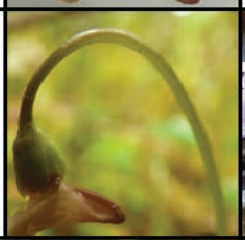
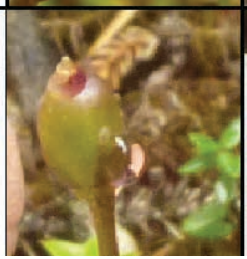
In addition to the morphological differences compared in Table 2, photos provided by the Puerto Blest tourist guides were reviewed to complement this comparative analysis. In this photographic review, a flower of *P. antarctica* is found in good condition in that locality (Fig. 5), thus confirming the presence of both species in the same location.

In consultation with other specialists of the genus *Pinguicula* from Latin America (Fernando Rivadavia and Oliver Gluch), the question was raised about another record of overlap between these two *Pinguicula* species. In Rodriguez *et al*. (2008) both species were recorded, but *P. australandina* in the Baker River Basin and *P. antarctica* in the Pascua River Basin, in Chile. Both basins have marked differences in location (Sandoval *et al*. 2016), not being a registered case of habitat overlap.

Conclusion

In January 2020, *P. antarctica* was found in the Puerto Blest bog. This is the most northern record for this species in Argentina, expanding its known distribution to Tierra del Fuego and Isla de los Estados, Santa Cruz, Chubut, and Río Negro. At the same time, in the present study, *P. antarctica* and *P. australandina* were found in an area of less than 400 m^2 in the Puerto Blest bog (Fig. 6), being the first record of an overlap between *P. antarctica* and *P. australandina*.

Table 2. Visual comparison between the floral characters of the Pinguiculas. All photos correspond to the Puerto Blest peat bog, except for #2 Spur and #4 Presence of glands in floral scape on *P. australandina* (# refers to Table 1).

Comparison reference	*P.antarctica*	*P.australandina*	Discussion
#1 Length of floral scape			*P.australandina* exhibits a scape between 2-5cm long (8). *P.antarctica*'s can greatly exceed this length, as evidenced by photographs and herbal material. On-site photos taken in Puerto Blest on 01/07/2020.
#2 Spur	 	 	The inflorescences found were in an advanced flowering stage.The spur's sack-shape is clear in *P.antarctica*, even when comparing with an old corolla of *P.australandina* which keeps its sharp conical shape.
#4 Presence of glands in floral scape			*P.australandina* is moderately covered with glandular hairs in the top of scape, but *P.antarctica* is almost glabrous.
#7 Fruit shape			The fruits of the two species are slightly different.

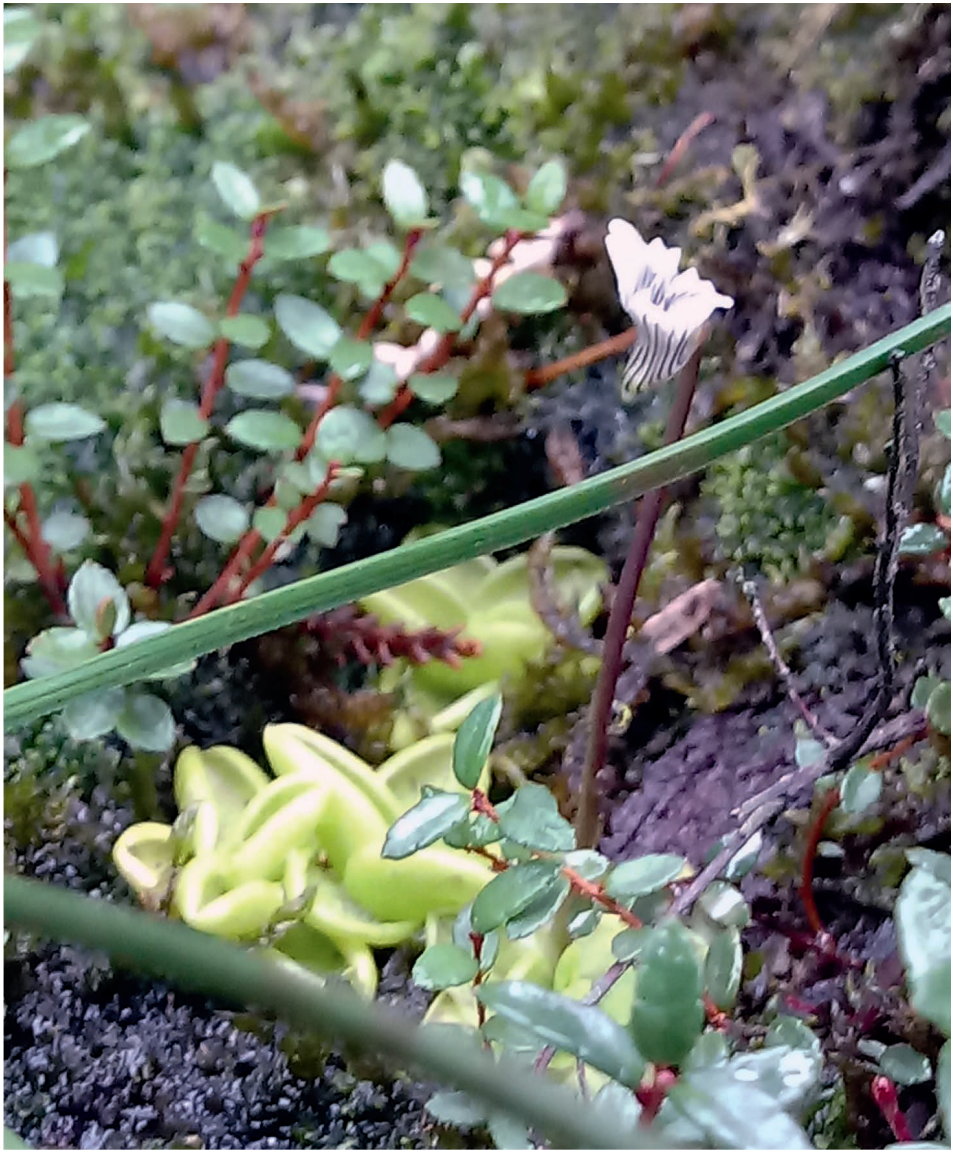


Figure 5: *Pinguicula antarctica* in flower in the bog of Puerto Blest. Maria Fernanda Tazzin.

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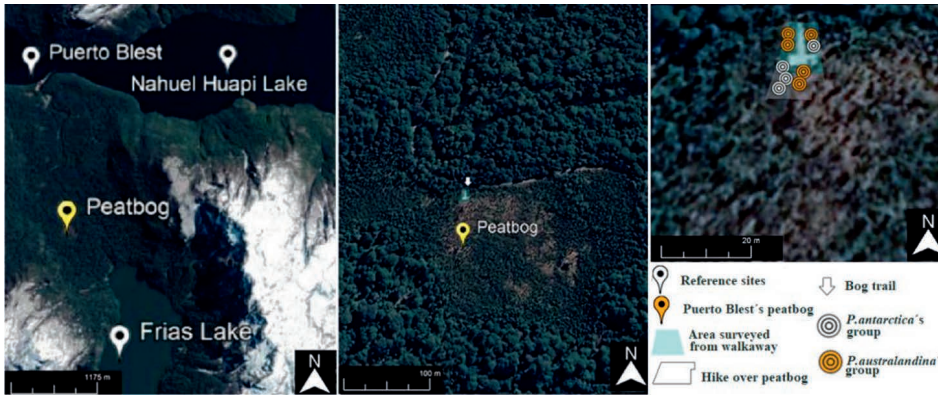

Figure 6: Spatial distribution of *P. antarctica* and *P. australandina* found in the study area.

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