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# An urban fern refugium: Municipal Ecological Reserve of Avellaneda (Eco Área) (Buenos Aires, Argentina)

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**Key words**

Buenos Aires
diversity
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ruderal

**Abstract** The riparian forest is one of the most diverse environments of the La Plata River plains. It is represented by patches of humid forests, which are a valuable source of ecosystem services and have recreational and educational potential. However, the riparian forest has undergone constant modification, worsened by private real-estate developments and a lack of government regulation. Among the reserves that protect the riparian forest, the Municipal Ecological Reserve of Avellaneda is the closest to the southern limit of the Autonomous City of Buenos Aires. Although there are around 300 species of wild fauna and flora informally registered in the area, there are only a few studies published about its biodiversity. In this work, the diversity of thirteen native and exotic ferns in the core area (Eco Área) of the reserve is characterized, the origin of the species is also evaluated and comparisons are made with other nearby protected areas. The Eco Área of the Reserve plays an important role as part of the urban reserve corridor of the La Plata River plains and constitutes a refuge for both native and exotic ruderal species. The present work represents the basis for future studies about the population dynamics and the colonization strategies of the ferns.

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## INTRODUCTION

The origin and conservation of humid forests and gallery forests associated with the La Plata River estuary on the border of Argentina and Uruguay have received considerable attention from researchers for decades. Historically, the fragments of marginal forest located in towns in the north of Buenos Aires province (Argentina), such as Punta Lara, Hudson and Martín García island, were considered as remnants of an ecosystem degraded by human activity (Cabrera & Dawson 1944, Cabrera 1949, Montaldo 2000, Barbetti 2008). In contrast, based on historical records and palaeoclimatic and geomorphological data, some authors hypothesized a recent origin of these plant communities, dating back to the end of the 19th century (Deschamps & Tonni 2007, Guerrero et al. 2018c). In this sense, the humid forest communities distributed on the banks of the La Plata River belong to early stages of ecological succession, and during the last century there has been an increase in the specific richness due to the introduction of exotic species in urbanized areas. This colonization process would have been favoured by the fluvial dispersion throughout the La Plata River basin and by modifications in the temperature and rainfall regimes of the region that determined changes in the dispersion barriers (Guerrero 2014, Guerrero & Agnolin 2016).

Regardless of their origin, the humid forest communities of La Plata River plains represent important corridors of biodiversity (Giraudo & Arzamendia 2004), they are a valuable source of environmental services and have an important recreational and educational value. However, at present these places are almost entirely occupied by cities or used for agricultural activities.

The riparian forest and its associated wetlands have had constant modifications, accelerated by private real-estate developments and a lack of government regulation (Zuleta et al. 2012, Aguirre Pacheco 2019). The transformation of natural environments not only generates loss of biodiversity and natural and cultural heritage, but also an intellectual and moral impoverishment of society whose consequences cannot be foreseen. This has motivated the community itself to consider a priority to protect, as urban reserves, areas with high levels of biodiversity that are disconnected from each other and vulnerable to anthropogenic impact (Chebez et al. 2012).

The Municipal Ecological Reserve of Avellaneda located in Sarandí city, to the south of the Autonomous City of Buenos Aires, is one of the areas destined to protect the riverside forests of the La Plata River. It was created in 2015 (Ordinance No. 26862/2015) and covers 145 ha, in which industrial activities are prohibited and only sustainable agriculture developed by residents of the area is allowed. Later, in 2018, a core area called Eco Área was established, which aims to restore and preserve the ecosystem (Fig. 1).

According to the traditional phytogeographic scheme of Cabrera & Willink (1973) the Eco Área belongs to Pampeano Oriental District of the Pampeana Province. However, in a

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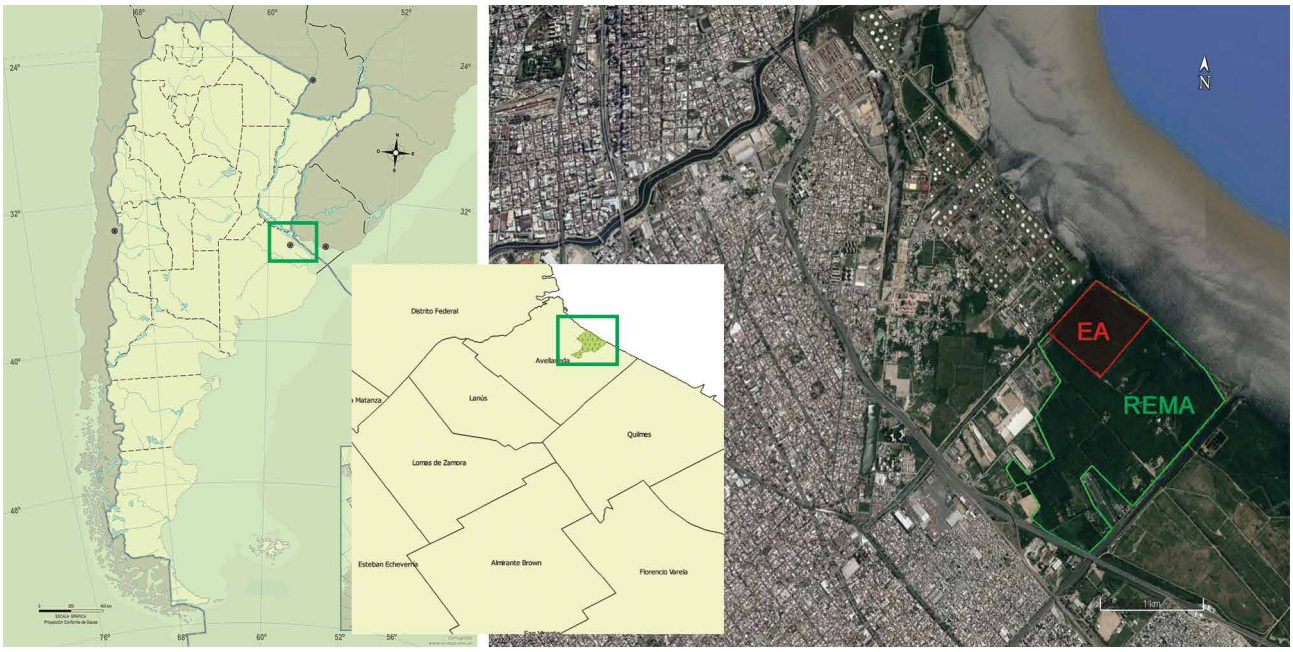


**Fig 1** Study area. MERA = Municipal Ecological Reserve of Avellaneda, EA = Eco Área.

recent biogeographic study based on climbing plants and epiphytes, Guerrero et al. (2018b) suggested that the area could be recognized as a unit of the Paranaense province. Different plant communities are identified within the reserve: reed beds and grasslands dominated by *Schoenoplectus californicus* (C.A.Mey.) Soják, *Sagittaria montevidensis* Cham. & Schltdl., *Typha latifolia* L. growing on the banks of the La Plata River; portions of forests dominated by *Erythrina crista-galli* L., accompanied by marsh species such as *Zizaniopsis bonariensis* (Balansa & Poitr.) Speg., *Panicum grumosum* Nees, and *Iris pseudacorus* L.; mixed forests dominated by *Salix humboldtiana* Willd. growing up next to other native species such as *Ocotea acutifolia* (Nees) Mez, *Terminalia australis* Cambess., *Pouteria salicifolia* (Spreng.) Radlk., *Tessaria integrifolia* Ruiz & Pav. and *Myrceugenia glaucescens* (Cambess.) D.Legrand & Kausel of which the herbaceous layer is represented by annual or perennial grasses (Cabrera & Zardini 1978).

Although there are around 300 species of flora and fauna in the area (Muson pers. comm.), there are only two studies published so far: one about *Opiliones* (Daddy longlegs; Guerrero 2019) and the other dealing with lichen (García in press.) communities. This scarce knowledge of the biological diversity in the reserve contrasts significantly with the effort carried out by researchers in neighboring areas of Avellaneda and Quilmes districts to learn about the communities of birds (Godoy et al. 2012), opiliones (Guerrero 2013, Guerrero et al. 2013), amphibians and reptiles (Lerzo et al. 2019) and epiphytic and climbing plants (Dosil Hiriart et al. 2018).

The fern diversity associated with the La Plata River banks has been studied as part of local (Capurro 1961) and provincial floras (Cabrera 1968). Recently, floristic studies have been carried out in other reserves along the La Plata River coast, near to Municipal Ecological Reserve of Avellaneda (Giudice et al. 2011, Guerrero et al. in prep). Likewise, the distribution and development of some species that grow in the area has been analysed (Ramos Giacosa et al. 2014, 2017, Luna et al. 2016, 2017, Gorrer et al. 2018, Berrueta et al. 2021).

The objective of this work is to characterize the diversity of ferns in the Eco Área of Municipal Ecological Reserve of Avellaneda, evaluate its origin (native or exotic), and establish comparisons with other protected areas located on the banks of the La Plata River. A dichotomous key is presented to distinguish the species and comments related to their habit, the environment where they grow and distribution in the country are given.

This work is part of a more comprehensive study that aims to provide information that contributes to generate tools for the conservation of urban reserves and the evaluation of connectivity between riparian forest patches. Likewise, it is intended to contribute to the appreciation that protected areas have for the conservation of plant species in one of the most populated provinces of the Argentina (INDEC 2010).

## MATERIAL AND METHODS

The Eco Área of the Municipal Ecological Reserve of Avellaneda includes 45 ha on the coast of the La Plata River, delimited by the Sarandí canal to the northwest and the Santo Domingo canal to the southeast (S34°39'51.6" W58°18'56.0") (Fig. 1, 2).

Surveys were carried out from 2018 to 2020 following the 'Fast walking' method ('Caminhamento rápido') (Filgueiras et al. 1994), with adjustments according to the type of environment. It consists of, at least, three walks in a straight line for each type of environment identified, verifying the species viewed, until no new species are found or after the expiration of a time limit (Walter & Guarino 2006). During the walks, attention was focused, both on the understory and on the standing tree branches, with the aim of also identifying epiphytic species.

The specimens were collected and processed under standard techniques, and vouchers were deposited in BA (Argentine Museum of Natural Sciences 'Bernardino Rivadavia'), and LP (Museum of La Plata). They were photographed in the field and the localities georeferenced.

The classification proposed in PPG I (2016) was followed. In addition, for the identification of specimens and development of the key, the Argentine Republic Vascular Flora (Ponce & Arana 2016) and local floras of the Buenos Aires province (Cabrera 1968, Cabrera & Zardini 1978, Giudice et al. 2011) were consulted.

Some taxa were found in sterile, juvenile stages or only represented by the gametophytic generation. In order to corroborate their taxonomic identification, they were collected in resealable bags and their development was completed *in vitro*. Young gametophytes and sporophytes were sown in soil arranged in


**Fig 2** Plant communities and habitats of Municipal Ecological Reserve of Avellaneda. a. Main access trail; b. low flow stream; c–d. flooded understorey: c. *Cyclosorus interruptus*, d. *Iris pseudacorus*; e. mixed forest; f. scrubs, reed beds and grasslands of La Plata River margin. — Photos: a, c–d by Agustina Yañez; b, e–f by Soledad Weigel.

plastic containers and kept in the greenhouse of the Faculty of Ciencias Naturales y Museo from National University of La Plata, until they reached sufficient maturity to observe the diagnostic characters that allowed their identification.

## RESULTS

Thirteen species belonging to 13 genera and 8 families were found growing in the Eco Área of the Municipal Ecological Reserve of Avellaneda. Most were terrestrial (10), one aquatic (*Salvinia biloba* Raddi), and two epiphytic: *Microgramma mortoniana* de la Sota and *Pleopeltis minima* (Bory) J.Prado & R.Y.Hirai; both growing on *Erythrina crista-galli*.

Most of the species were found in isolated populations within the reserve (in one sector), except *Cyclosorus interruptus* (Willd.) H.Ito, *Christella dentata* (Forssk.) Brownsey & Jermy, *Pteris tremula* R.Br., *Adiantum raddianum* C.Presl and *Gastoniella chaerophylla* (Desv.) Li Bing Zhang & Liang Zhang, which were observed in different sectors.

## KEY TO THE FERN SPECIES OF MUNICIPAL ECOLOGICAL RESERVE (ECO ÁREA)

1. Plants aquatic . . . . . *Salvinia biloba*
1. Plans terrestrial or epiphytic . . . . . 2
2. Plants epiphytic . . . . . 3
2. Plants terrestrial . . . . . 4
3. Rhizomes without clathrate scales; immature sori uncovered . . . . . *Microgramma mortoniana*
3. Rhizomes with clathrate scales; immature sori covered by peltate scales . . . . . *Pleopeltis minima*

4. Leaves reduced and fused into a sheath, eusporangia aggregated in terminal clusters (strobili) . . . . . *Equisetum giganteum*
4. Leaves not reduced, leptosporangia borne on the abaxial face of the euphylls . . . . . 5
5. Sporangia grouped in elongated sori or cenosori, or, if orbicular, born on reflexed margin of the lamina . . . . . 6
5. Sporangia grouped in circular or elongated sori, sometimes confluent at maturity . . . . . 9
6. Rhizomes inconspicuous, erect, hairy (not scaly); sori without indusia . . . . . *Gastoniella chaerophylla*
6. Rhizomes conspicuous, erect, oblique, or short-creeping, scaly; sori with indusia . . . . . 7
7. Lamina 1-pinnate; petioles scaly throughout; sori medial . . . . . *Blechnum auriculatum*
7. Lamina 2–4-pinnate-pinnatifid; petioles not scaly or with basal scales; sori marginal or submarginal . . . . . 8
8. Lamina ovate; pinnules (2nd order segments) flabellate; petioles lustrous, black, brittle; sori borne on reflexed lamina margin . . . . . *Adiantum raddianum*
8. Lamina lanceolate; pinnules (2nd order segments) linear-lanceolate and divided; petiole stramineous to brown, flexible; marginal cenosori continuous along lamina margin . . . . . *Pteris tremula*
9. Rachis and/or costae hairy, never scaly . . . . . 10
9. Rachis and/or costae scaly . . . . . 11
10. Rhizome erect to short creeping, covered by linear to triangular-lanceolate scales; laminae with 2–4 pairs of reduced basal pinnae . . . . . *Christella dentata*
10. Rhizome long-creeping, glabrous; basal pinnae not or weakly reduced . . . . . *Cyclosorus interruptus*
11. Lamina 2- or 3-pinnate . . . . . *Rumohra adiantiformis*
11. Lamina 1-pinnate . . . . . 12
12. Rhizome short, ascending; pinnae stalked, 4–14 by 1.2–5 cm; venation areolate; sporangia protected by circular, peltate indusium . . . . . *Cyrtomium falcatum*
12. Rhizome long-creeping, stoloniferous; pinnae sessile, 1–3.3 by 0.3–0.9 cm; venation free, furcate; sporangia protected by lunulate indusium . . . *Nephrolepis cordifolia*

### *BLECHNACEAE*

***Blechnum auriculatum*** Cav.

Origin — Native. Distributed in Argentina, Brazil and Uruguay. In Argentina, it is registered for the northwest, northeast and centre of the country, and it would represent evidence of the floristic connection between southern Brazil and the low mountains of Buenos Aires (Arana et al. 2013).

Habitat & Ecology — Terrestrial. Grows in a wide variety of habitats, from mountainous, dry environments with stony soils to subtropical forests or riparian forests with humid and shady soils.

Location within the reserve — This species grows in the elevated understory of mixed forests, which never floods, together with *Rumohra adiantiformis* and *Adiantum raddianum*. These substrate conditions were not observed in any other part of the reserve. Likewise, the soil remains covered all year round by the dry leaves of a *Magnolia grandiflora* L. individual. Remains of old buildings were observed in that sector.

Observations — Although it is located in a single area within the reserve, it forms a dense population.

Illustration and morphological description reference — Ramos Giacosa (2016).

*Studied specimens*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 486* (BA), 18-IX-2018; *Yañez et al. 491* (BA), 31-V-2019.

### *DRYOPTERIDACEAE*

***Rumohra adiantiformis*** (G.Forst.) Ching — Fig. 3a

Origin — Native. It is widely distributed in tropical and subtropical regions of the Paleotropics and Neotropics. In Argentina, it is present in the northeast, central and south provinces.

Habitat & Ecology — Terrestrial.

Location within the reserve — A small population was found growing in the understory of mixed forests (see *Blechnum auriculatum*).

Illustration and morphological description reference — Ponce & Arana (2016).

*Studied specimens*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), Y*añez et al. 479* (BA), 18-IX-2018; *Yañez et al. 569* (BA), 22-XII-2020.

### *EQUISETACEAE*

***Equisetum giganteum*** L.

Origin — Native. It is widely distributed in Central and South America and, particularly, in Argentina, where it is reported for all provinces.

Habitat & Ecology — Terrestrial, marsh species. It grows in flooded soils, near bodies of water such as stream banks or ditches. Generally in areas exposed to direct sunlight.

Location within the reserve — This species was found forming a dense population near a watercourse in the northern limit of the Eco-area, where it borders a deforested area destined to livestock.

Illustration and morphological description reference — Arana (2016).

*Studied specimen*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 483* (BA, LP), 18-IX-2018.

### *NEPHROLEPIDACEAE*

***Nephrolepis cordifolia*** (L.) C.Presl — Fig. 3b

Origin — Exotic to southern South America, naturalized in Argentina (Yañez et al. 2020). It is a native species from Africa, Southeast Asia, Malesia, Australia, New Zealand, Pacific Islands, and probably Caribbean countries and northern South America.

Habitat & Ecology — Terrestrial.

Location within the reserve — It forms a dense population in exposed understory areas.

Observations — The population is growing associated with rubble of old buildings that belonged to the ancient inhabitants of the area. In this sense, its presence in the area could be related to its ornamental use in a domestic environment. Later it is possible that *N. cordifolia* has colonized the surrounding area thanks to its fast-growing rhizomes and the origin of new individuals through the formation of typical tubers of the species.

Illustration and morphological description reference — Arana (2016).

*Studied specimen*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 478* (BA, LP), 18-IX-2018.


**Fig 3** Ferns from Eco Área of Municipal Ecological Reserve. a. *Rumohra adiantiformis*; b. *Nephrolepis cordifolia*; c. *Adiantum raddianum*; d. *Gastoniella chaerophylla*; e. *Pteris tremula*; f. *Microgramma mortoniana*; g. *Pleopeltis minima*; h. *Cyrtomium falcatum*; i. *Cyclosorus interruptus* (a: *Yañez et al. 479*; b: *Yañez et al. 478*; c: *Yañez et al. 570*; d: *Yañez et al. 567*; e: *Yañez et al. 489*; f: *Yañez et al. 481*; g: *Yañez et al. 484*; h: *Yañez et al. 482*; i: *Yañez et al. 477*; all BA). — Photos by Agustina Yañez.

### *PTERIDACEAE*

***Adiantum raddianum*** C.Presl — Fig. 3c

Origin — Native. Widely distributed in tropical America from Mexico to Paraguay and Uruguay. In Argentina, it is distributed in the northwest, northeast and central provinces.

Habitat & Ecology — Terrestrial.

Location within the reserve — Mixed forest understory (see *Blechnum auriculatum*). It has also been found growing in flooded soil along the banks of a stream, next to *Gastoniella chaerophylla* populations and under dense *Equisetum giganteum* populations.

Observations — During the *in vitro* culture carried out to obtain fertile specimens of *G. chaerophylla*, gametophytes of *A. raddianum* were observed growing from the substrate collected in the field. This highlights the importance of natural spore banks present in the soil of protected areas as reservoirs of biodiversity and potential tools for the conservation of native species (Berrueta et al. 2021).

Illustration and morphological description reference — Giudice (2016)

*Studied specimens*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 480* (BA), 18-IX-2018; *Yañez et al. 487* (BA), 31-V-2019; *Yañez et al. 570* (BA), 22-XII-2020.

***Gastoniella chaerophylla*** (Desv.) Li Bing Zhang & Liang Zhang — Fig. 3d

Origin — Native. Neotropical species, widely distributed in Mexico, Central America, and southern South America. In Argentina it is cited for the Northwest (Jujuy), Center (Córdoba, Santa Fe and Buenos Aires) and Northeast.

Habitat & Ecology — Terrestrial.

Location within the reserve — It was found growing in humid and shady environments on the edge of temporary ponds and low flow streams. During the collections carried out in 2020, new and numerous populations were found growing under the tourists walkways.

Observations — Only young gametophytes and sporophytes, a few centimetres long were found during 2018 and 2019. They were cultivated *in vitro* until obtaining mature sporophytes with fertile fronds. Later, in the trips carried out during 2020, fertile populations were found in the field.

Illustration and morphological description reference — Arana (2016).

*Studied specimen*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 567* (BA), 22-XII-2020.

***Pteris tremula*** R.Br. — Fig. 3e

Origin — Exotic. Native to Australia, New Zealand and Fiji, widely naturalized in the Northern Hemisphere countries and registered as an invasive weed in South Africa (Baard & Kraaij 2014). In Argentina, it is distributed in coastal areas of the La Plata River (Buenos Aires). It was recently classified as naturalized by Arana et al. (2020).

Habitat & Ecology — Terrestrial.

Location within the reserve — Edge of the main road and near the park ranger's house and on the edges and under the tourist walkways, in dense populations.

Observations — Throughout the successive annual trips carried out, a striking growth of the populations of this species was observed. While in 2018 only one sterile population was observed on the side of the main road, during 2019 new fertile populations were found and in 2020, the species was found colonizing large sectors under the tourist walkway. A phenological analysis of the population found would be necessary to understand its reproductive strategies and the potential effect of this exotic species on native flora.

Illustration and morphological description reference — Kramer & McCarthy (1998).

*Studied specimens*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 476* (BA), 18-IX-2018; *Yañez et al. 489* (BA, LP), 31-V-2019.

### *POLYPODIACEAE*

***Microgramma mortoniana*** de la Sota — Fig. 3f

Origin — Native. Mainly found in southern South America, where it is distributed in Uruguay, Paraguay and Brazil. In Argentina it is associated with humid forests in the northeast (Corrientes and Misiones), northwest (Jujuy, Salta and Tucumán) and in riparian forests in Buenos Aires.

Habitat & Ecology — Epiphyte. It can grow under different conditions of solar radiation and on different substrates such as living trees, fallen trunks from the understory, supporting structures of woody origin or, occasionally, walls of old buildings (García & Rosato 2011). Plasticity for the colonization of different substrates could be related to the presence of vegetative reproduction buds associated with gametophytes (Gorrer et al. 2018).

Location within the reserve — It was found growing on *Erythrina crista-galli*, always exposed to direct sunlight.

Observations — It could be identified from its dimorphic to hemidimorphic fronds, ovate lamina scales with a markedly ciliate margin and rhizome scales with a slightly ciliate margin.

Illustration and morphological description reference — Cacharani & Martínez (2016).

*Studied specimens*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 481* (BA), 18-IX-2018; *Yañez et al. 571* (BA, LP), 22-XII-2020.

***Pleopeltis minima*** (Bory) J.Prado & R.Y.Hirai — Fig. 3g

Origin — Native. Distributed in Argentina, astern of Bolivia, southern Brazil, Paraguay and Uruguay. In Argentina, it is widely distributed in the northwestern, northeastern and central provinces.

Habitat & Ecology — Epiphyte.

Location within the reserve — It forms dense populations on the trunks of *Erythrina crista-galli*.

Observations — Guerrero & Cellini (2017) suggested that this species is in geographical expansion towards the south of the Buenos Aires province, and this would coincide with the changes in temperature and rainfall the region went through during the 20th century.

Illustration and morphological description reference — Cacharani & Martínez (2016).

*Studied specimen*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 484* (BA, LP), 18-IX-2018.

***Cyrtomium falcatum*** (L.f.) C.Presl — Fig. 3h

Origin — Exotic, introduced for ornamental purposes. Native to China, Japan and South Korea.

Habitat & Ecology — Terrestrial, it is occasionally epipetric and growing on walls.

Location within the reserve — A single population of this species was found growing in a shady area of the understory.

Observations — Due to its exotic origin, its traditional use as an ornamental species (Yañez et al. 2020), and its growing close to *Nephrolepis cordifolia*, make it likely that the origin of

this species in the area could also be linked to the anthropogenic use of the reserve area prior to its foundation. Previous work has recorded its potential to colonize new habitats and displace native species (Robinson 2009).

Illustration and morphological description reference — Zhang & Barrington (2013).

*Studied specimen*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 482* (BA, LP), 18-IX-2018.

### *SALVINIACEAE*

***Salvinia biloba*** Raddi

Origin — Native. It is distributed along the Plata basin in Argentina, southern Brazil, Paraguay and Uruguay. In Argentina, it grows in northeastern provinces.

Habitat & Ecology — Aquatic, floating. It forms large populations that cover reservoirs, artificial and natural lakes and channels.

Location within the reserve — It was found in small populations, growing in a temporary pond next to the park rangers' house.

Observations — Years prior to starting the present study, the temporary presence of unidentified specimens of *Salvinia* had been observed growing in bodies of stagnant or low-flow water found within the Eco Área (García pers. obs.). However, during the trips made in 2018 and 2019 these populations were not found, as well as any other species of aquatic fern. Recently, during 2020, a population was recorded in a flooded area where the invasive species *Iris pseudacorus* was removed.

Illustration and morphological description reference — Arana (2016).

*Studied specimen*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 568* (BA), 22-XII-2020.

### *THELYPTERIDACEAE*

***Christella dentata*** (Forssk.) Brownsey & Jermy

Origin — Exotic, naturalized. It has a palaeotropical origin, naturally distributed in Africa, Asia, Australia and the Pacific Islands. Later it was introduced and naturalized in the Americas, where it is widely distributed from the US to southern South America. In Argentina, it is widely cited for Tucumán, and the northeast and central provinces of the country.

Habitat & Ecology — Terrestrial, grows very frequently in exposed habitats and is a colonizing species in disturbed areas such as forest clearings, roadsides or lands where vegetation was removed. It is occasionally epiphyte or epipetric and grows on walls.

Location within the reserve — Edge of roads and under tourist walkways.

Observations — Previous work highlights that this species can cause the displacement of populations of native species (Tejero-Díez & Torres-Díaz 2012).

Illustration and morphological description reference — Ponce (2016).

*Studied specimens*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 485* (BA, LP), 18-IX-2018; *Yañez et al. 488*, *Yañez et al. 499* (BA, LP), 31-V-2019.

***Cyclosorus interruptus*** (Willd.) H.Ito — Fig. 3i

Origin — Native. It is a cosmopolitan species, widely distributed in the Americas from the southern US, northern Mexico and Central America to Bolivia, Paraguay and Uruguay. In Argentina, it is widely distributed in the Northwest, Center and Northeast.

Habitat & Ecology — Terrestrial, marsh species. It forms dense populations at the edge of low flow streams, in flooded soil.

Location within the reserve — Grows both in exposed places, next to *Iris pseudacorus*, and in the shady undergrowth, next to temporary streams that run through the reserve.

Observations — As was mentioned for *Gastoniella chaerophylla* and *Pteris tremula*, during the collections carried out in 2020, new populations of this species were found growing on the edges of the tourist walkways.

Illustration and morphological description reference — Ponce (2016).

*Studied specimens*. Argentina, Buenos Aires, Mun. Avellaneda, Reserva Ecológica Municipal de Avellaneda (Eco Área), *Yañez et al. 477* (BA, LP), 18-IX-2018; *Yañez et al. 492* (BA), 31-V-2019.

## DISCUSSION AND CONCLUSIONS

The Municipal Ecological Reserve of Avellaneda is one of the smallest among the reserves that protect the riparian forest of the La Plata River plains. However, with only 45 ha, the Eco Área has about half of the number of fern species found in other larger protected areas, such as the Punta Lara Integral Natural Reserve (6000 ha – 27 species), Isla Martín García Provincial Natural Reserve (170 ha – 30 species) and Municipal Reserve 'Selva Marginal Quilmeña' (150 ha – 20 species) (Giudice et al. 2011, Arana et al. 2020, Guerrero pers. comm.). Other authors reached similar results when studying the specific richness of lichens in the mentioned protected areas. While 43 species were recorded in the Municipal Ecological Reserve of Avellaneda, the species found in Isla Martín García Provincial Natural Reserve and Punta Lara Integral Natural Reserve are only 50 and 52, respectively (García & Rosato 2013, 2015, García in press). This highlights the unique potential of the Eco Área for the conservation of local flora. In relation to the fauna diversity of the area, the only published article registered two species of *Opiliones* (Guerrero 2019). However, since the authors did not specifically study the Eco Área, but rather that the samplings were carried out in the non-intangible zone of the Municipal Ecological Reserve of Avellaneda, comparisons with other protected areas are not possible.

Among the protected areas mentioned, the Municipal Ecological Reserve of Avellaneda is the closest to the southern limit of the Autonomous City of Buenos Aires, and this is reflected in the influence that the urban habitat has on the nature of the fern species found. In this sense, five of the 13 taxa found in the Eco Área, *Christella dentate, Cyrtomium falcatum, Microgramma mortoniana*, *Nephrolepis cordifolia* and *Pteris tremula* are frequently called 'ruderal' because they are associated with disturbed environments. Except for *Microgramma mortoniana*, these ruderal taxa are exotic, although in most cases they naturally form sustainable populations over time, being considered as naturalized species.

Regarding the native species that grow in the study area, in all cases they were also found growing in the riparian reserves of the La Plata River mentioned above. This highlights the relevance of maintaining biodiversity corridors between urban reserves that can function as refuges in heavily developed areas. The present work represents the basis for future comparative studies between the population dynamics of exotic, naturalized and native species and the colonization strategies they adopt within the area. Likewise, the changes registered over the years in terms of the colonization of new areas within the reserve by *Cyclosorus interruptus*, *Gastoniella chaerophylla* and *Pteris*

*tremula*, show a successional process that accompanies the actions to protect biodiversity that are being carried out. In this sense, the Eco Área has an optimal setting to study the recovery of the environment. Likewise, the finding of *Adiantum raddianum* spores in the substrate used for *in vitro* cultures during this work highlights the importance of studying in detail the soil spore bank and its role in the recolonization of the habitat by native species.

Finally, despite the fact that aquatic ferns, species of *Azolla* Lam., *Marsilea* L. and *Salvinia* Ség., are frequent in the La Plata River basin, during the successive collections only an apparently temporary small population of *Salvinia biloba* was found. It is probable that the intermittent appearance of *Salvinia* is associated with periods of flooding of the La Plata River margins. Recently, the movement on natural rafts constituted by *Eichhornia crassipes* (Mart.) Solms, a species present within the Eco Área, was indicated as a form of dispersal for species such as *Salvinia biloba* and *S. minima* Baker (Guerrero et al. 2018a). Likewise, the removal of dense patches of *Iris pseudacorus* could have generated appropriate conditions for the settlement of the species. In this sense, the Eco Área constitutes an ideal setting to study, in the long term, the mechanisms of permanent establishment of aquatic species.

Knowledge of the richness, diversity and dynamics of the ecosystem protected by the Eco Área in particular, and by the Municipal Ecological Reserve of Avellaneda in general, is essential to continue generating conservation tools and nurturing the positive assessment that the residents of the area have of it.

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