



## Research note

# The blue land planarian *Caenoplana coerulea*, an invader in Argentina

## La planaria terrestre azul *Caenoplana coerulea*, un invasor en Argentina

Lisandro Héctor Luis-Negrete<sup>1</sup>, Francisco Brusa<sup>1\*</sup> and Leigh Winsor<sup>2</sup>

<sup>1</sup>CONICET. División Zoología Invertebrados, Facultad de Ciencias Naturales y Museo, Paseo del Bosque s/n. 1900. UNLP. La Plata, Argentina.

<sup>2</sup>School of Marine and Tropical Biology, c/- People and Equity Directorate, James Cook University, Townsville, Queensland 4811, Australia.

\*Correspondent: fbrusa@fcnym.unlp.edu.ar

**Abstract.** The blue land planarian *Caenoplana coerulea* is reported from Argentina (Buenos Aires province). We found *C. coerulea* in the east central region of Argentina in anthropic environments. The specimens that we found have the characteristic of the species found in others regions; that is, a bluish dorsal surface with a yellow mid-dorsal stripe and eyes forming a single row around the anterior tip, clustered laterally. This is the first record of this species from the Neotropical Region, and together with *Bipalium kewense* are the only 2 species of exotic terrestrial planarians so far recorded in Argentina.

Key words: land flatworm, *Caenoplana coerulea*, *Bipalium kewense*, invasive species, Neotropical Region.

**Resumen.** La planaria terrestre azul *Caenoplana coerulea* se registra para el centro este de Argentina (provincia de Buenos Aires), en ambientes antropizados. Los ejemplares encontrados presentan las características de la especie registrada en otras regiones, con una superficie dorsal azulada y una hilera medio dorsal amarilla, y ojos formando una hilera alrededor del extremo anterior, agrupados lateralmente. Es la primera vez que se cita dicha especie en la Región Neotropical, y junto a *Bipalium kewense* son las únicas planarias terrestres exóticas registradas en Argentina.

Palabras clave: planaria terrestre, *Caenoplana coerulea*, *Bipalium kewense*, especie invasora, Región Neotropical.

The blue land planarian *Caenoplana coerulea* Moseley, 1877 is native to eastern Australia. As a result of human activities it has been introduced to New Zealand, the United States, the United Kingdom, Norfolk Island (Australia), and France (Ogren, 1989; Winsor, 1998; Winsor et al., 2004) (Fig. 1). This species is commonly encountered in Australian suburban gardens, but also in hothouses, horticultural areas, and flower shops in the countries where it has been accidentally introduced.

Externally, *C. coerulea* is characterized by a dorsal dark blue ground-colour with a thin median dorsal stripe. The ground colour can vary from Prussian blue through to cerulean blue (which gives rise to the name of the species) to dark olive green. One of us (LW) has observed that in Australia, some specimens of *C. coerulea* found in open woodland lack the blue pigment and the specimens appear a pale brown to purple colour (cf. *Australopacifica purpurea* (Dendy, 1894)), and that the dark green pigmentation seen in some specimens appears to be due to the age-related accumulation of epidermal melanin. The median dorsal

stripe can vary in colour from a pale yellow to cream and white colour (Moseley, 1877; Winsor, 1979). The anterior tip is reddish-orange to pinkish and may be even pale white. The eyes extend in single row around the anterior tip, cluster anterolaterally, and continue posteriorly in a staggered submarginal row, but do not extend dorsally. Some of these characteristics tend to disappear when the worms are fixed, resulting in uniformly bluish-coloured specimens.

The blue-green ground colour of *C. coerulea* is also present in *Caenoplana spenceri* (Dendy, 1890) and *Australopacifica walhalla* (Dendy, 1891) although the latter 2 species lack a pale median dorsal stripe. *Caenoplana coerulea* has superficial external similarities to *A. purpurea*, *Artioposthia garveyi* (Dendy, 1901), and *Pasipha caeruleonigra* (Riester, 1938). Hyman (1943) described *Geoplana vaga* based on a preserved specimen that was sent to her from Pasadena, California (USA). Subsequently, Ogren (1989) proposed to assign *G. vaga* as *Caenoplana coerulea vaga* (Hyman, 1943) for all those specimens probably introduced into United States and considered *Caenoplana coerulea coerulea* Moseley, 1877



**Figure 1.** World distribution of *Caenoplana coerulea* based on Ogren (1989), Winsor (1998), and Winsor et al. (2004). In detail, locality where *C. coerulea* was collected in Argentina (Buenos Aires province).

as a subspecies native to the Australian region. However, Ogren's subspecies are not generally accepted and *G. vaga* is relegated to a synonym of *C. coerulea*. *Caenoplana coerulea* belongs to an Australian species complex that shares the pale dorsal median stripe and blue-green ground colour, but differ slightly in other external features, and more so in its internal anatomy.

In this contribution we report the presence of *C. coerulea* for the first time in the Neotropical Region of Argentina.

Specimens of *C. coerulea* were manually collected in the city of La Plata, east of Buenos Aires, Argentina (34° 55' S; 57° 57' W) (Fig. 1). Six specimens were found. The first 2 worms were collected in March and May 2008 (35 and 50 mm length *in vivo*), during the afternoon under flower-pots in a flower shop; 3 specimens (38, 57, and 62 mm length *in vivo*) were found between October 2008 and April 2009, crawling in the open during the early morning in the courtyard of a house; and the last 1 (72 mm length *in vivo*) was found under a flower-pot in another flower shop (July 2009). The places where the specimens were found had the same environmental characteristics as those in La Plata.

The planarians were brought to the laboratory, the external morphology and colour pattern noted, and the specimens photographed *in vivo*. Subsequently, the flatworms were killed with boiling water, fixed with 10% formaldehyde solution, and stored in 70% ethanol. Tissue

blocks of the body taken for histological studies were dehydrated in an ascending ethanol series, and embedded in Paraplast plastic polymer wax m.p. 56°C. Sagittal serial sections (6–8 µm) of the middle and posterior regions, and transverse sections (10 µm) of the pre-pharyngeal and anterior regions were stained with haematoxylin-eosin. Voucher specimens were lodged in the Helminthological Collection of La Plata Museum MLP6139-6144.

The specimens found in Argentina agree with the description of *C. coerulea* given by Fletcher and Hamilton (1888), having a bluish dorsal surface, becoming paler laterally and extending ventrally with the mid ventral surface very diffuse light blue. The mid-dorsal stripe is yellow, and the anterior tip an orange to brick colour (Fig. 2). The eyes form a single row around the anterior tip, cluster laterally, but do not extend dorsally. A conspicuous pale, pitted sensorial zone in the outer ventral region passes around the anterior tip (Winsor, 1979) (Fig. 2).

Unfortunately, none of the specimens found was sexually mature as the gonopore was not present in any of them. The immaturity of the specimens was confirmed on sectioning as the reproductive system was not observed in serial histological sections. One specimen had sperm in the testes, situated ventrally to the branches of the intestine, and anterior to the pharynx, suggesting that the species might be protandrous.

Some species of Caenoplaninae present external similarities with the specimens we studied. *Caenoplana*



**Figure 2.** Photograph of live specimen in dorsal view. Scale bar: 1 cm. View in detail of the pale sensorial zone (arrow) below the row of eyes.

*spenceri* has a greenish blue almost black colour, and the eyes are placed at the anterior and posterior ends of the body, while in the Argentine specimens they can only be seen at the anterior end. Other species that are similar in external morphology to *C. coerulea*, *A. purpurea* and *A. walhallae*, regrouped within the collective

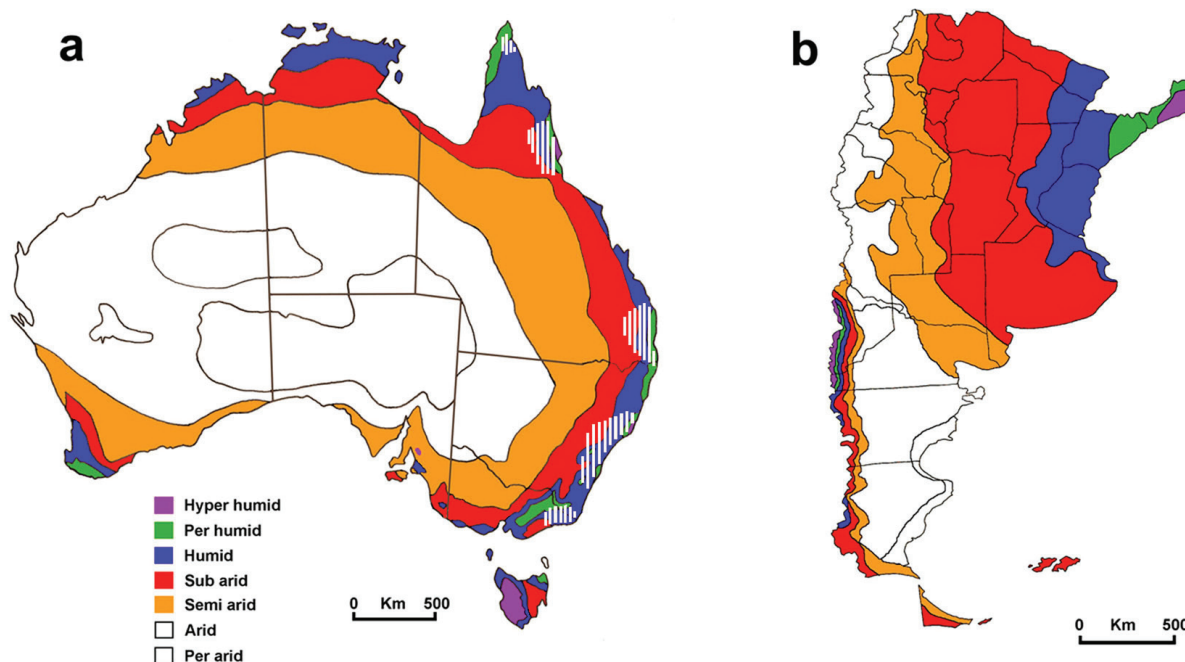
*Australopacifica* (Ogren and Kawakatsu, 1991). Even though the dorsal colour in both species is similar to *C. coerulea*, they lack the characteristic anterior pitted sensorial zone, which does appear in the specimens studied here (Fig. 2).

Apart from its diet, very little is known of the ecology and the potential impact of *C. coerulea* outside its native range. The species feeds on isopods, diplopods, earwigs (Dermaptera) (Olewine, 1972), and snails (Barnwell, 1978). Terrace and Baker (1994) found that *C. coerulea* fed upon the introduced black Portuguese millipede *Ommatoiulus moreleti* (Lucas, 1860), a pest species in southern Australia, and also fed on a native millipede species, terrestrial isopods, and earwigs. The blue planarians from La Plata were found together with millipedes, slaters (terrestrial isopods), the introduced snail *Helix aspersa* Müller, 1774, native snails, slugs, *Bipalium kewense* Moseley, 1878, and native land planarians, but *C. coerulea* was not observed feeding on the other soil fauna.

Records of exotic land planarians in Argentina have been known since the mid-twentieth century, specifically in the northwest (Tucumán), with the discovery of *B.*

*kewense* (du Bois-Reymond Marcus, 1953). Recently, this cosmopolitan species has been found in domestic households in Buenos Aires and wild environments in Misiones (northeastern Argentina). Thus, *C. coerulea* represents the second record of a land planarian introduced in this country. It is probable that the accidental introduction of individuals or cocoons of *C. coerulea* was the result of the importation and subsequent sale of potted plants with ornamental or commercial purposes.

Terrestrial flatworms are primarily restricted in their environment by the availability of moisture. In Australia, their distribution may best be explained in terms of moisture regions defined by Gentilli (1972) (Fig. 3 a). Terrestrial flatworms are largely confined to areas with hyper-humid, per-humid, humid, and sub-arid climate types, with a few species around the margins of the semi-arid climate regions in southeastern Australia. Distributional studies undertaken on some southern element species (e.g. *C. spenceri* and *Fletchamia quinquelineata* (Fletcher and Hamilton, 1888)) show that there is a strong correlation between their distribution and the thermal zones of the Bassian (Kosciuskan) and Eyrean zoogeographic subregions, which can also be regarded as moisture zones (Winsor, 1977, 1998). Soil moisture status has been advanced as a contributing factor in the success in Europe of *Arthurdendyus triangulatus* (Dendy, 1895), a New Zealand vermivorous species regarded as a serious agricultural pest (Fraser and Boag, 1998). Comparison



**Figure 3 a.** Moisture regions of Australia (modified from Gentili, 1972); white bars showing the distribution of *C. coerulea*. **b.** Regions of Argentina divided by average annual rainfall (modified from S.N.I.H., 2001).

of the distribution of flatworms to areas of differing soil moisture deficits may be worthy of further investigation (Fraser and Boag, 1998).

We do not know when this exotic species arrived to Argentina and if has been successfully established in urban habitats. At present, there is no indication of its impacts on the native soil fauna. Nevertheless, the moist temperate climate of the northeast of the Buenos Aires province (La Plata: average annual temperature: 16.2°C; annual rainfall: 1 040 mm) (Hurtado et al., 2006) provides weather conditions similar to those of eastern Australia (Parramatta, type locality of *C. coerulea*: average annual temperature: 17°C; annual rainfall: 1 016 mm) (Commonwealth of Australia 2009) since both regions are approximately at the same latitude. The climatic similarities between Argentina and Australia (Fig. 3 a-b) coupled with the broad food preferences of *C. coerulea* may facilitate the establishment and possible expansion of the species' distribution in Argentina, corroborated by the survival of the species in glasshouses in the United Kingdom (Jones, 1988) and its expansion in the United States (Ogren, 1989, 2001).

For these reasons it is important to continue to monitor the occurrence and spread of *C. coerulea* in Argentina, to try and prevent the spread of the species into native

habitats, and also to attempt to prevent future introductions of exotic land planarians.

We are grateful to Hugo Merlo for the collection of some specimens. This work was partially supported by CONICET (Consejo Nacional de Investigaciones Científicas y Técnicas), Argentina.

#### Literature cited

- Barnwell, G. M. 1978. *Geoplana vaga*: a sexually-reproducing terrestrial planarian in San Antonio. *Southwestern Naturalist* 23:151-152.
- Commonwealth of Australia, Bureau of Meteorology, Australian Government. 2009. Online: <<http://www.bom.gov.au/>>. Last access: 20.II.2009.
- du Bois-Reymond Marcus, E. 1953. Some South American Triclad. *Anais da Academia Brasileira de Ciencias* 25:65-78.
- Fletcher, J. J. and A. G. Hamilton. 1888. Notes on Australian land planarians with descriptions of some new species. Part I. *Proceedings of the Linnean Society of New South Wales* 2:349-374.
- Fraser, P. M. and B. Boag. 1998. The distribution of lumbricid earthworm communities in relation to flatworms: a comparison

- between New Zealand and Europe. *Pedobiologia* 42:542-553.
- Gentili, J. 1972. *Australian Climate Patterns*. Nelson, Melbourne. 285 p.
- Hurtado, M. A., J. E. Jiménez and M. G. Cabral. 2006. Análisis ambiental del partido de La Plata: Aportes al ordenamiento territorial. Consejo Federal de Inversiones, Argentina. 134 p.
- Hyman, L. H. 1943. Endemic and exotic land planarians in the United States with a discussion of necessary changes of names in the Rhynchodemidae. *American Museum Novitates* 1241:1-21.
- Jones, H. D. 1988. The status and distribution of British terrestrial planarians. *Fortschritte der Zoologie* 36:511-516.
- Moseley, H. N. 1877. Notes on the structure of several forms of land planarians, with a description of two new genera and several new species, and a list of all species at present known. *Quarterly Journal of Microscopical Science* 17:273-292.
- Ogren, R. E. 1989. Redescription and a new name for the blue land planarian *Geoplana vaga* Hyman now considered conspecific with *Caenoplana coerulea* Moseley from Australia (Turbellaria: Tricladida: Geoplanidae). *Journal Pennsylvania Academy of Sciences* 63:135-142.
- Ogren, R. E. 2001. The Blue Planarian: A New Locality. [http://course.wilkes.edu/REOgren/discuss/msgReader\\$22?d=6&m=8&mode=topic&y=2005](http://course.wilkes.edu/REOgren/discuss/msgReader$22?d=6&m=8&mode=topic&y=2005). Last access: 9.IV.2009.
- Ogren, R. E. and M. Kawakatsu. 1991. Index to the species of the family Geoplanidae (Turbellaria, Tricladida, Terricola) Part II: Caenoplaninae and Pelmatoplaninae. *The Bulletin of Fuji Women's College* 29, Ser II: 25-102.
- Olewine, D. A. 1972. Further observations in Georgia on the land planarian, *Bipalium kewense* and *Geoplana vaga* (Turbellaria: Tricladida: Terricola). *Association of Southeastern Biologists Bulletin* 19:88.
- S.N.I.H. 2001. Sistema Nacional de Información Hídrica. <<http://www.hidricosargentina.gov.ar/Mapaprecip.html>>. Last access: 7.XII.2009
- Terrace, T. E. and G. H. Baker. 1994. The blue land planarian, *Caenoplana coerulea* Moseley (Tricladida: Geoplanidae), a predator of *Ommatoiulus moreleti* (Lucas) (Diplopoda: Julidae) in southern Australia. *Australian Journal of Entomology* 33:371-372.
- Winsor, L. 1977. Terrestrial planarians and nemerteans of the Otway Region. *Proceedings of the Royal Society of Victorian Museum* 89:137-146.
- Winsor, L. 1979. Land planarians (Tricladida: Terricola) of the Royal Botanic Gardens, Melbourne, Victoria. *Victorian Naturalist* 96:155-161.
- Winsor, L. 1998. The Australian terrestrial flatworm fauna (Tricladida: Terricola). *Pedobiologia* 42:457-463.
- Winsor, L., P. M. Johns and G. M. Barker. 2004. Terrestrial planarians (Platyhelminthes: Tricladida: Terricola) predaceous on terrestrial gastropods. *In* *Natural Enemies of Terrestrial Molluscs*, G. M. Barker (ed.). CAB International, London. p. 227-278.

