



## A new species of *Geoplana* (Platyhelminthes: Tricladida: Geoplanidae) from the Western Amazon Basin with comments on the land planarian fauna from Peru

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### Abstract

*Geoplana excelentissima* sp. nov. is described from the east centre of Peru. This new species is very long (165 mm), broad and flat. The dorsal surface is black with five white stripes, and two marginal pinkish stripes with a blue inner surface. A unique combination of external and internal characters (*e. g.* the copulatory apparatus) is present in the new species. *Geoplana regia* and *Geoplana matuta*, species known from Brazil, have some affinities with respect to the copulatory apparatus. Additionally, we provide a list of all Geoplanidae species already described for Peru with new information on the distribution of some species through the revision of the Fundación Miguel Lillo Collection (Argentina).

**Key words:** *Geoplana excelentissima* sp. nov., *Geoplana regia*, *Geoplana matuta*, Geoplaninae, Peruvian Amazon

### Introduction

Land planarians of Peru are very little known compared to the knowledge obtained on other areas of the Neotropical Region with a great biodiversity, such as southeastern Brazil. The knowledge of this group in Peru was mainly obtained from expeditions carried out by Dr. Wolfgang K. Weyrauch. He collected numerous specimens of land planarians, most of these in the mid-twentieth century. Most of this material was described by du Bois-Reymond Marcus (1951, 1953, 1957, 1958). Other species from Peru, collected by the Yale Peruvian Expedition in 1911, were described by Hyman (1955). The rest of the known species belong to other contributions (Meixner 1906; de Beauchamp 1939). Recently a new species from southern Peru was reported (Negrete *et al.* 2010), which increases to 34 the species described for this country.

Most of the land planarian species of Peru (~60%) belong to *Geoplana* Stimpson, 1857. This genus comprises some hundred species of Neotropical flatworms that have been additionally described from Argentina, Brazil, Chile, Colombia, Paraguay, Trinidad and Tobago, and Uruguay. Among the main features of *Geoplana* are the creeping ciliated sole broader than a third of body width, strong cutaneous longitudinal muscles, parenchymatic longitudinal musculature weak or absent, dorsal testes, penis papilla present and female canal entering to genital atrium dorsally (Ogren & Kawakatsu 1990).

In this paper, we describe a new species of the genus *Geoplana* from the Yuruá River Basin, western Peru. This basin rises in the department of Ucayali in Peru and runs into Brazilian territory. The Yuruá river is a tributary to the Solimões river (Brazil) in the Amazon Basin (Carvalho *et al.* 2009). This work has been conducted in the frame of Research Projects that have involved an inventory of vertebrate and invertebrate fauna in the Peruvian Amazon. It has included the study of the turbellarian diversity (Damborenea *et al.* 2005, 2011; Noreña *et al.* 2006 a, b). Also, we provide a brief revision of the diversity of Peruvian land planarians and we give new data about distribution of some species by means a revision of scientific collections.

## Material and methods

The new species was collected in August 2008 in the Department of Ucayali, Peru (09° 30.999' S; 72° 47.891' W), near Quebrada Boca Piedras, Breu (242 masl). The area has suffered low anthropogenic impact, so communities of organisms can be considered pristine (Damborenea *et al.* 2011). It was found under a hollow palm tree trunk. It was observed and photographed *in vivo*. The specimen was fixed in 10% formaldehyde and kept in 70% ethanol. Then it was sectioned in fragments corresponding to different regions: anterior end, pre-pharynx, pharynx and copulatory apparatus. These fragments were dehydrated and included in paraplast. Thin serial, frontal, transversal and sagittal cuts (10–12 µm) of the different regions of the body were performed. The histological preparations were stained with Masson's trichrome method (Romeis 1989). The internal structures were reconstructed from the study of serial sections, and diagnostic characters were recognized to carry out the description of the species.

The ratio of height of cutaneous musculature to height of body (cutaneous muscular index, CMI) was calculated according to Froehlich C. G. (1955). The holotype was deposited in the Invertebrate Collection at Museo de La Plata (MLP), Argentina.

On the other hand, we have done a bibliographic compilation of the land planarians from Peru and a revision of scientific collection of Fundación Miguel Lillo (FML), Tucumán (Argentina), which has specimens deposited from Weyrauch's expeditions.

## Abbreviations used in figures

bmc, bulbar muscular coat; cml, cutaneous muscle layers; co, common glandular ovovitelline duct; di, dorsal insertion of the pharynx; ed, efferent duct; ej, ejaculatory duct; fa, female genital atrium; fp, folds of the pharynx; g, gonopore; i, intestine; ma, male genital atrium; mo, mouth; od, ovovitelline duct; oe, oesophagus; pg, prostatic glands; ph, pharyngeal pouch; pp, penis papilla; pv, prostatic vesicle; sg, shell glands; t, testes; v, vagina; vi, ventral insertion of the pharynx; vit, vitellaria.

## Systematic account

### Order Tricladida Lang, 1884

### Suborder Continenticola Carranza, Littlewood, Clough, Ruiz-Trillo, Bagnuà & Riutort, 1998

### Superfamily Geoplanoidea Stimpson, 1857

### Family Geoplanidae Stimpson, 1857

### Subfamily Geoplaninae Stimpson, 1857

### Genus *Geoplana* Stimpson, 1857

### *Geoplana excelentissima* sp. nov.

**Study material.** Holotype MLP 6535. C. Damborenea & F. Brusa col. Anterior region: horizontal sections on 40 slides (12 µm thick). Pre-pharyngeal region: transversal sections on 15 slides (10 µm thick). Pharynx: sagittal sections on 70 slides (12 µm thick). Copulatory apparatus: sagittal sections on 85 slides (12 µm thick).

**Diagnosis.** Body large, broad and flat (length: 165 mm, maximum width: 16 mm, maximum height: 2.5 mm); dorsal surface black with a white median strip, two paramedian white stripes, two lateral white stripes, and two marginal pinkish stripes with a blue inner surface; eyes initially marginal and uniserial encircling the anterior tip, backwards becoming dorsal and pluriserial with clear halos along the black lateral bands; intrabulbar prostatic vesicle with folded walls; penis papilla traversed by a straight and eccentric ejaculatory duct; female atrium wide and folded.

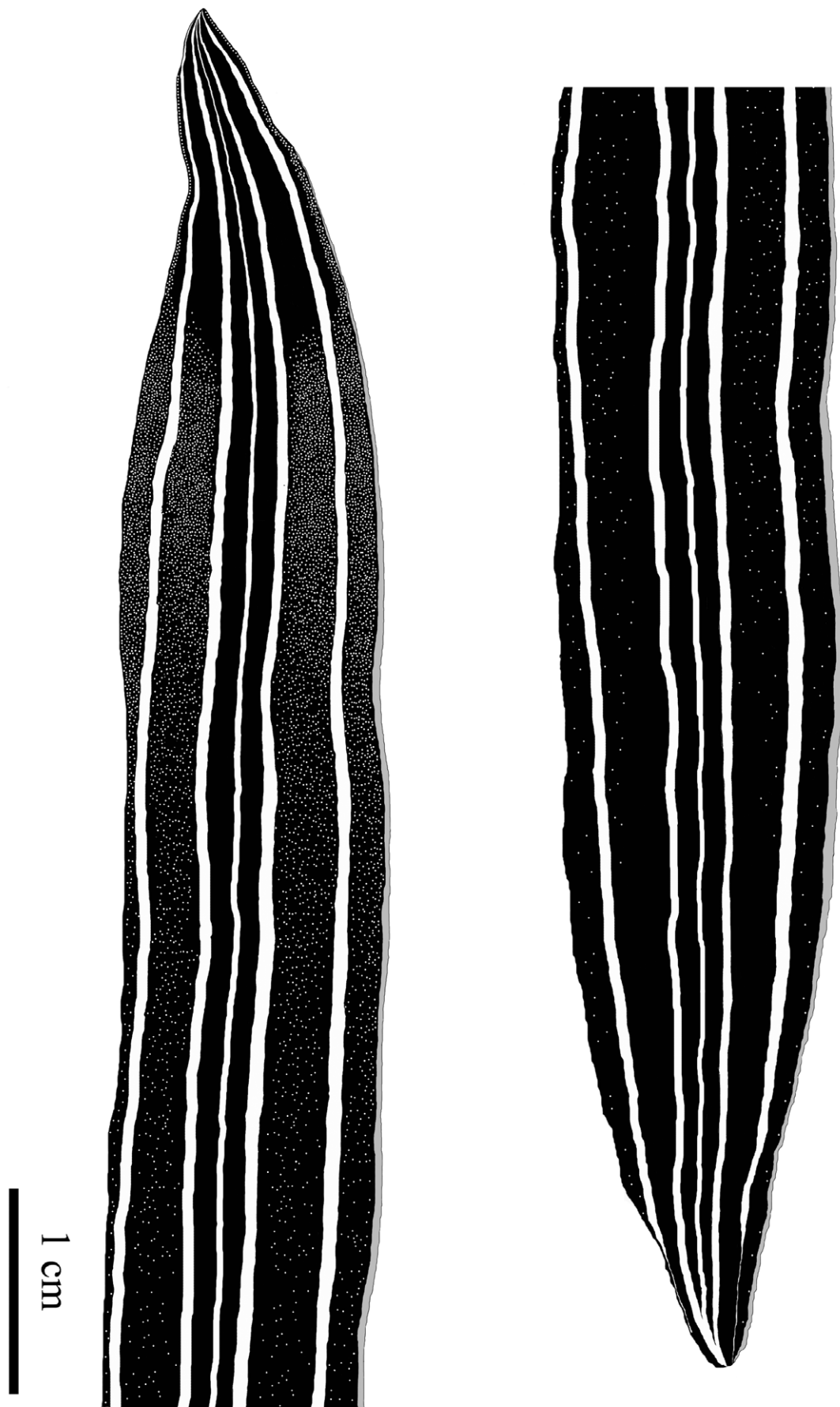
**Type locality.** Tropical rainforest near Quebrada Boca Piedras (09° 30.999' S; 72° 47.891' W) at 242 masl, in Department of Ucayali, Peru.

**Etymology.** The species is devoted to Eveline du Bois-Reymond Marcus, eminent turbellariologist, who carried out the greatest contribution on the diversity of land planarians of Peru. The specific name refers to the way in which Ernesto Marcus, her husband, referred to her at the beginning of his works on turbellarians ("*minha Esposa, Excelentíssima Snra. D. Eveline du Bois-Reymond Marcus*").

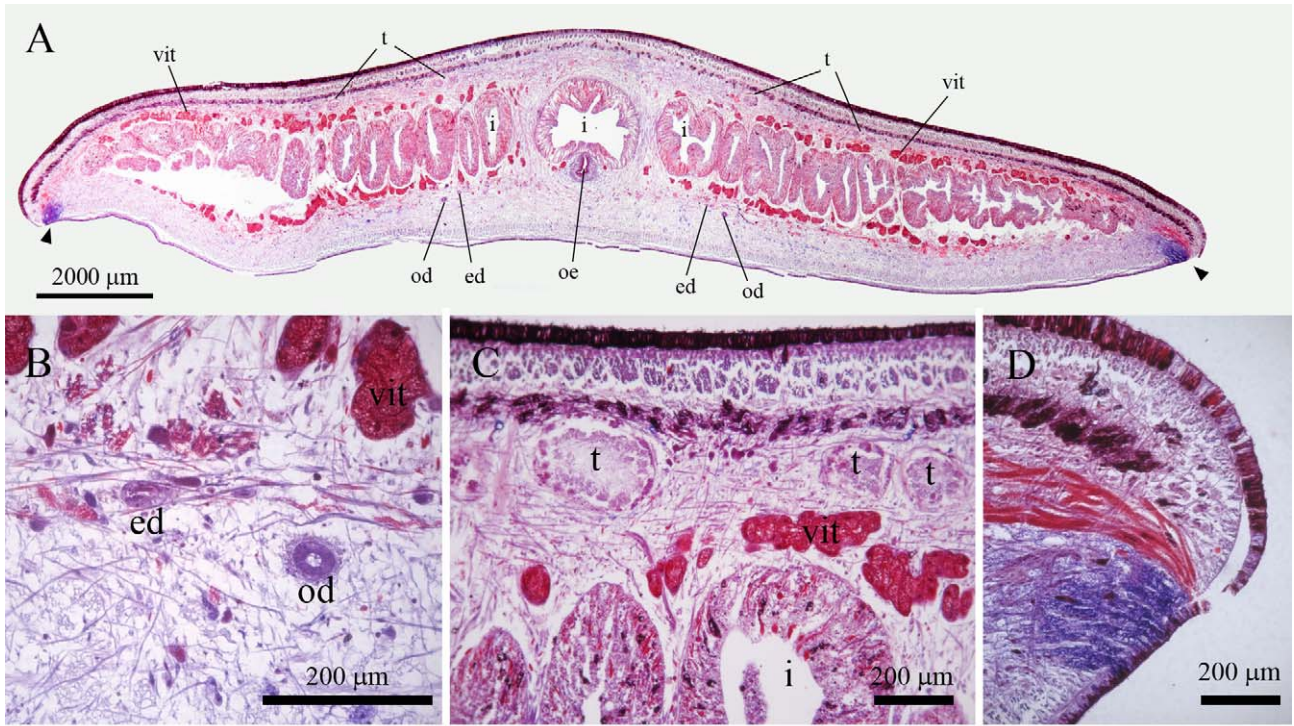
**Description. External features.** The body of the land planarian is broad and flat, with the anterior end pointed and posterior end blunt. When crawling, the specimen reached 165 mm in maximum length, and 16 mm in width at pharynx level. After fixation, the flatworm is 149 mm long and 14 mm wide (9.4% width: length ratio). Maximum height is 2.5 mm at pre-pharyngeal level. Mouth and gonopore are located at 77.5 mm (52%) and 93 mm (62.4%) respectively, from the anterior end.



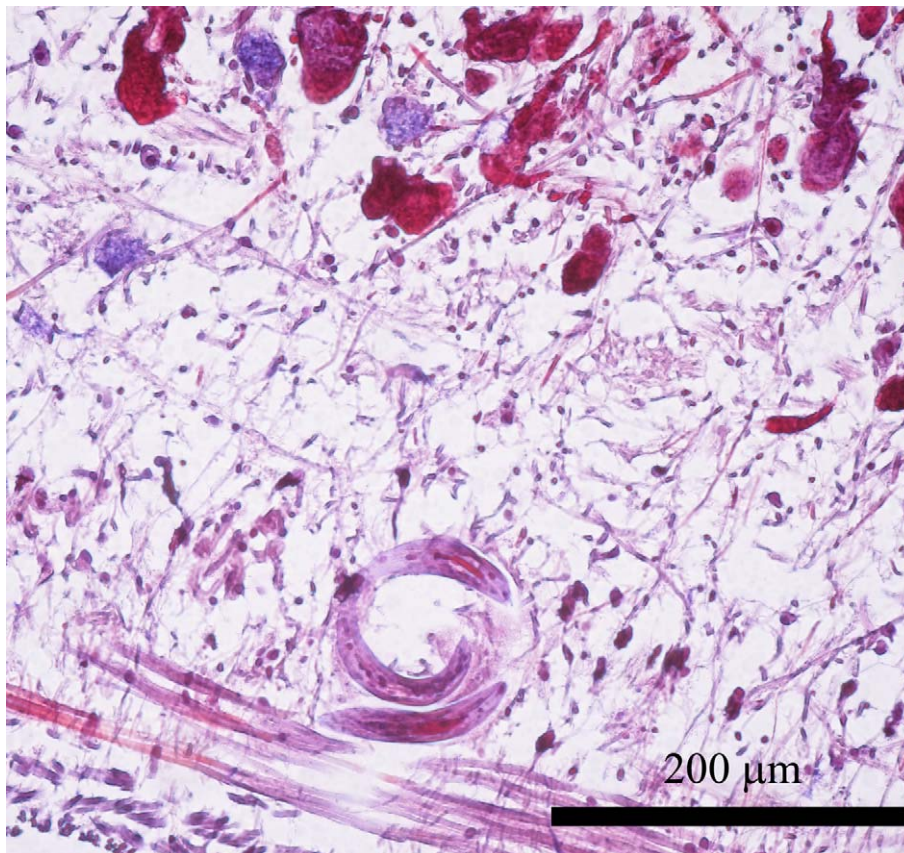
**FIGURE 1.** *Geoplana excelentissima* sp. nov. External view of a living specimen. A, Dorsal view. B, Ventral view. The anterior end is on the left.



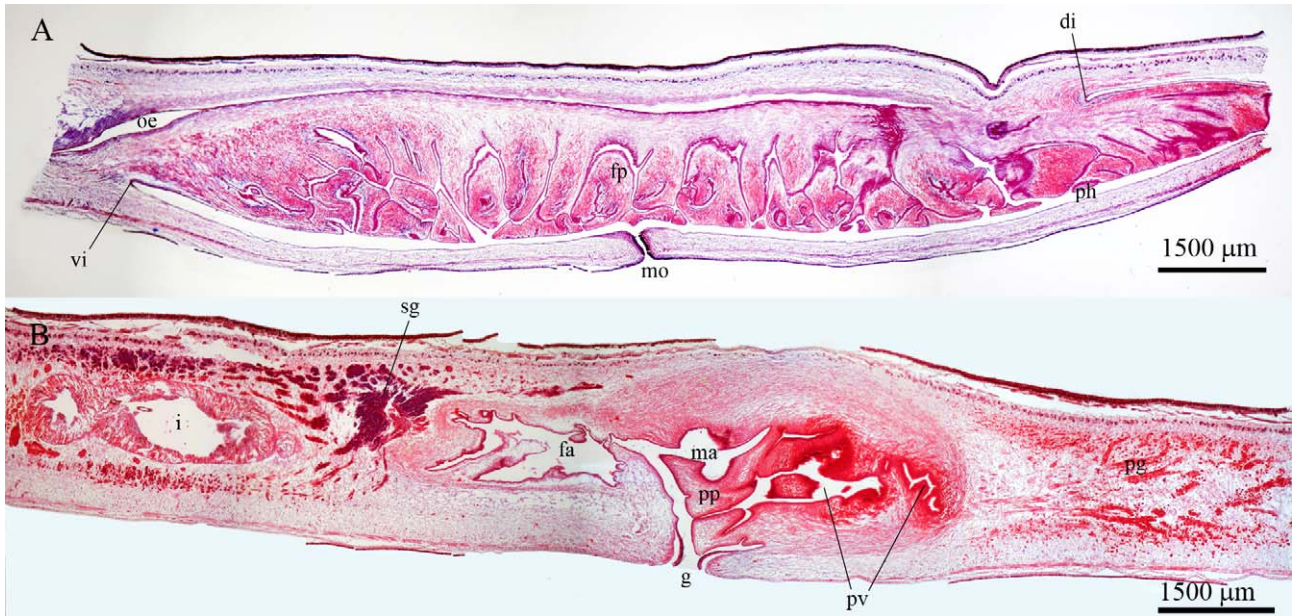
**FIGURE 2.** *Geoplana excelentissima* sp. nov. Schematic drawing of the colour pattern and eyes of anterior (left) and posterior (right) body regions, in dorsal view from preserved specimen.



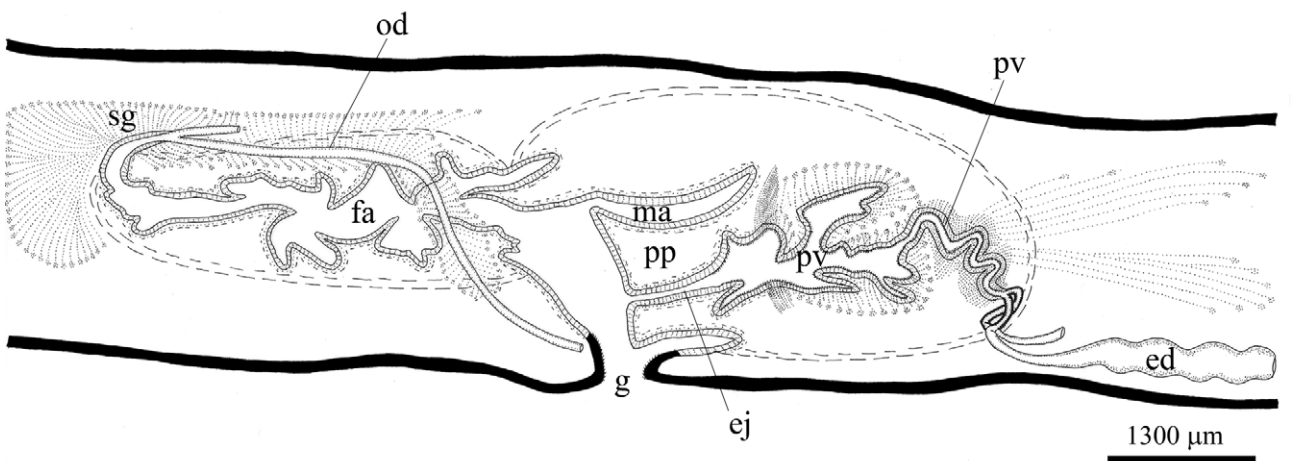
**FIGURE 3.** *Geoplana excelentissima* sp. nov. A, Transversal section of the pre-pharyngeal region. Arrow heads show the glandular margin. B, Detail of the ventral side showing the oviduct and the efferent duct. C, Detail of the testes in the dorsal side. D, Detail of the glandular margin.



**FIGURE 4.** *Geoplana excelentissima* sp. nov. A nematode larva below the ventral cutaneous musculature.



**FIGURE 5.** *Geoplana excelentissima* sp. nov. A, Sagittal section of the pharynx (anterior end to the left). B, Sagittal section of the copulatory apparatus (anterior end to the right).



**FIGURE 6.** *Geoplana excelentissima* sp. nov. Sagittal reconstruction of the copulatory apparatus (anterior end to the right).

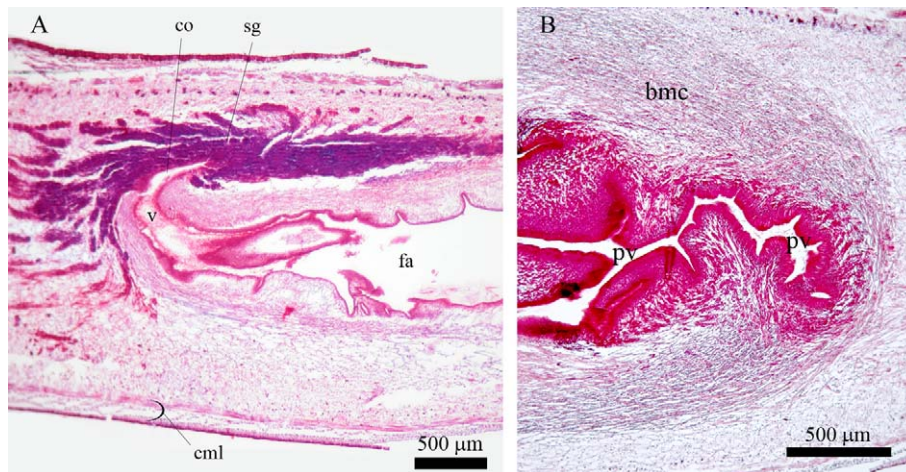
The dorsal side is black, with five white stripes, one thin median, two thicker paramedian and two lateral ones with the same width as the last ones. The margins of the body are pink. The dark colour defines five bands: one black median band (crossed by the median stripe), two black lateral bands (separated by the paramedian stripes) and two marginal bands (separated from the lateral bands by the lateral stripes). The marginal bands have a dark blue pigment toward the outer surface of the body, contacting with the pinkish margin (Fig. 1A). Near the posterior tip the lateral stripes become very thin. The ventral surface is light orange-brownish, with a clearer midline. A very thin pinkish pigment is present in the margins of the ventral surface (Fig. 1B).

The eyes are initially marginal and uniserial encircling the anterior tip, on the blue surface. Between 6-8 mm from the anterior end, they are biserial and between 8-14 mm tri-tetra serial. Posteriorly, the eyes become pluriserial. Beyond 18 mm they are dorsal on the black lateral bands of the body. At 50 mm, on the pre-pharyngeal region, the eyes are less numerous. At the level of the pharynx they are more isolated, and posterior to the copulatory apparatus the eyes become scattered along the marginal bands to reach the posterior tip (Fig. 2).

**Epidermis, secretions and musculature at pre-pharyngeal region.** The dorsal epidermis is 25 µm high and ventrally it is 27.5 µm high. The creeping sole reaches the glandular margin and it covers the entire ventral surface of the body. Rhabditogen cell bodies are below the cutaneous musculature. Their secretions open onto the whole epidermal surface.

In the dorsum and in the body margins rhabditogen secretion is abundant, and ventrally it occupies only the apical region of the epidermal cells. Below the rhabditogen cell bodies, in the parenchyma there are glandular secretions both cyanophil and erythrophil, the latter more abundant. Their secretions open principally at the dorsal surface. The glandular margin is composed of two types of secretory cells, cyanophil and erythrophil, and some rhabditogen cells (Fig. 3A, D).

The cutaneous musculature is formed by the three layers typical of the Geoplaninae: an external circular layer, a diagonal layer, and an internal longitudinal layer which is arranged in bundles (Fig. 3C). In the pre-pharyngeal region, circular and diagonal layers have both dorsally and ventrally similar thickness, 5-7.5  $\mu\text{m}$  and 25-30  $\mu\text{m}$  thick, respectively. The thickness of the longitudinal layer is approximately three times higher than the diagonal one, being 75-87.5  $\mu\text{m}$  and 90-102.5  $\mu\text{m}$  thick in the dorsal and ventral surface, respectively. Cutaneous muscular index (CMI) ranges between 9.1% and 10.5%.



**FIGURE 7.** *Geoplana excelentissima* sp. nov. A, Female reproductive system, detail of the vagina opening into the female atrium. B, Male reproductive system showing the structure of the prostatic vesicle.

The parenchymatic muscle fibres are arranged in three layers: (1) a dorsal layer with decussated fibres (75-112.5  $\mu\text{m}$  thick) located under the dorsal submuscular peripheral nerve net; (2) a well developed supra-intestinal transverse layer (200-225  $\mu\text{m}$  thick); and (3) a sub-intestinal transverse layer (125-150  $\mu\text{m}$  thick). Numerous oblique and dorso-ventral fibres run among the intestinal branches, and extend to the body margins.

A lot of nematode larvae were observed in the parenchyma of the ventral surface of the body, both in the pre-pharyngeal region and in the copulatory apparatus. Also, the larvae are located within the cutaneous musculature (Fig. 4).

**Digestive system.** The mouth is located in the middle of the pharyngeal pouch. The pharynx, collar type, is 15.9 mm long (~10% of body length) and strongly folded (Fig. 5A).

The dorsal insertion is situated in the posterior third. The pharynx presents very abundant glandular erythrophil secretion and cyanophil in a less quantity; this secretion is abundant in the folds and at the level of the insertions. The external epithelium is cubic and ciliated (erythrophil), with three muscular layers; an external longitudinal one (5  $\mu\text{m}$  thick), a circular one (15  $\mu\text{m}$  thick) and a longitudinal one (5  $\mu\text{m}$  thick). The internal epithelium is cubic ciliated (erythrophil) with a thick layer of longitudinal muscular fibres, with some circular fibres intermingled (135-150  $\mu\text{m}$  thick). The oesophagus is extremely long (13.2 mm) and dorsal to the pharynx (oesophagus:pharynx ratio, 83%). It has a ciliated cubic epithelium with a strong longitudinal musculature (100-125  $\mu\text{m}$  thick).

**Male reproductive system.** The testes are rounded and located beneath the rhabditogen glands and the dorsal parenchymatic musculature, interrupting the continuity of the supra-intestinal parenchymatic muscle fibres (Fig. 3C). The testes are placed on 5 rows on both sides of the body; they are mature and charged with spermatozoa (Fig. 3A, C). The relationship between the height of the testes and the height of the body varies between 7.4% and 7.8%.

The efferent ducts are internal and slightly dorsal to the ovovitelline ducts. They are inside the sub-intestinal parenchymatic muscular layer (Fig. 3A, B). The epithelium of the efferent ducts is cubic and ciliated. Behind the pharynx the efferent ducts run latero-ventrally, they are broadened and charged with spermatozoa. They reach the

proximity of the penis bulb and give on to tubular intrabulbar paired projections of the prostatic vesicle. These projections, which are the first portion of the prostatic vesicle, ascend slightly towards the sagittal plane. They present a ciliated cylindrical epithelium with a fine erythrophil secretion. The paired projections open into a sinuous unpaired ascending portion (1.1 mm long). The unpaired prostatic vesicle, with circular (15  $\mu\text{m}$  thick) and longitudinal muscle layers (2.5  $\mu\text{m}$  thick), continues as an expanded and irregular chamber (1.5 mm long) with folded walls (Figs. 6, 7B). The epithelium is cylindrical, glandular and ciliated. It receives abundant erythrophil secretions, which is finer in its distal portion. Outside the penis bulb there are glands whose erythrophil secretion reaches the prostatic vesicle (Figs. 5B, 6). The ejaculatory duct, whose epithelium is cylindrical, is a straight canal that goes through the penis papilla eccentrically. The cylindrical papilla is 1 mm long, blunt with a cylindrical epithelium. It occupies almost the whole male atrium (1.25 mm long). The atrium has an inner circular muscle layer and an outer longitudinal one (10  $\mu\text{m}$  each). The musculature of the penis bulb is strong and compact, being formed by fibres arranged in different directions.

**Female reproductive system.** The ovaries were not observed in the slides of the anterior part of the body, but the rest of the female reproductive system is fully developed (Figs. 5B, 7). The ovovitelline ducts are placed below the sub-intestinal parenchymatic muscular layer. The vitelline glands, placed dorsal and ventrally to the intestinal branches, give on to the oviducts along their run (Fig. 3A-C). Behind the gonopore the ovovitelline ducts rise towards the sagittal plane. These ascending portions get scarce secretion from shell glands. As they ascend, they receive more secretion and in their final portion they are horizontal, receiving a great quantity of secretion (Figs. 5B, 6, 7A). They join, forming a short glandular common ovovitelline duct just before they empty dorsally into a short vagina (250  $\mu\text{m}$  long).

The epithelium of the glandular common duct is cubic and ciliated, while the vagina has a cylindrical non ciliated epithelium. The vagina is crescent-shaped and it opens dorsally in the atrium (Fig. 7A). A muscular coat formed by circular (50  $\mu\text{m}$  thick) and longitudinal fibres (75  $\mu\text{m}$  thick) encircle the vagina and the atrium. The female atrium (4.25 mm long) has folded walls (Figs. 5B, 6, 7A), with a cubic non ciliated epithelium apically erythrophil.

## Systematic discussion

The species here described presents the characteristics of the genus *Geoplana*: presence of a penis papilla, testes dorsal to the intestine, and the vagina entering the female atrium dorsally. Besides, the subepidermal longitudinal muscular layer is strong and organized in bundles, and the longitudinal parenchymatic musculature is absent.

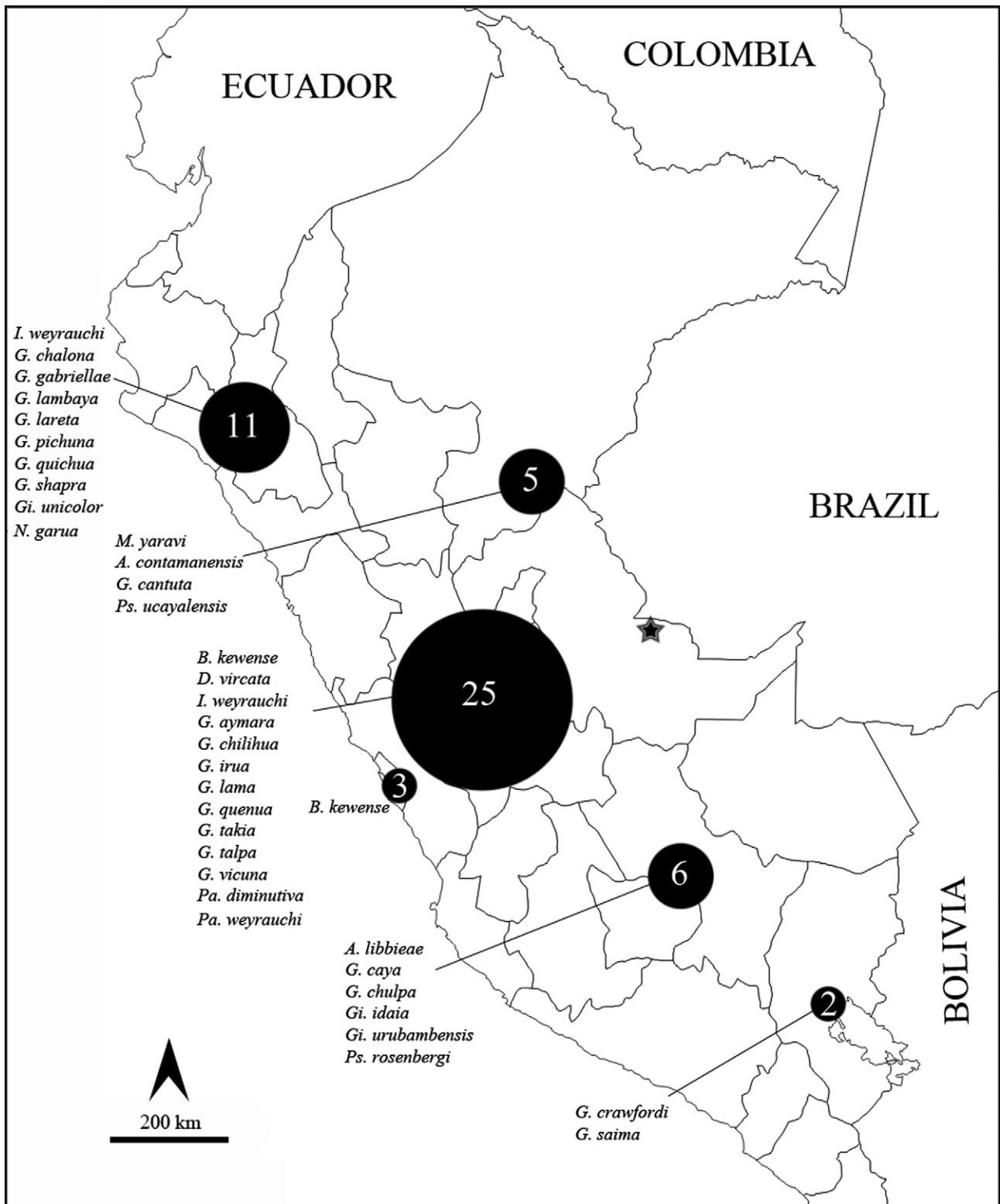
Among almost 100 species of *Geoplana* distributed in the Neotropical Region, some show a dorsal colour pattern with stripes. None of them presents a colour pattern of *Geoplana excelentissima* sp. nov.; that is, five white longitudinal stripes on a black background with a dark blue pigment toward the outer surface of the body, contacting with the pinkish margins. The new species was compared with species of *Pseudogeoplana* Ogren & Kawakatsu, 1990. This genus is a collective group to temporarily assign Neotropical land planarian species of which internal morphology is unknown. No species of *Pseudogeoplana* with a colour pattern with longitudinal bands resembles *G. excelentissima* sp. nov.

Moreover, the new species presents unique internal characteristics. The male reproductive system is characterized by the presence of a prostatic vesicle with two regions: a proximal paired one and a distal unpaired one. The distal portion is large, with folded walls. It also presents a short and irregular penis papilla which occupies almost all the male atrium. The species with comparable characteristics to *G. excelentissima* sp. nov. are *Geoplana regia* Froehlich E. M. 1955 and *Geoplana matuta* Froehlich E. M. 1955 whose known distribution are restricted to Araquara (type locality) in São Paulo and Teresópolis (type locality) in Rio de Janeiro respectively, Brazil.

However, *G. regia* has five longitudinal dark bands on an ocher background. Its male reproductive system presents efferent ducts that enter ventrally to the penis bulb; they bent slightly forward and they join in small diverticula of the prostatic vesicle. The unpaired prostatic vesicle runs tortuously before opening into the ejaculatory duct (Froehlich E. M. 1955). In the new species the efferent ducts have a similar run but they do not enter the penis bulb, but they join into paired intrabulbar projections of the prostatic vesicle. The paired projections open into a sinuous unpaired ascending portion, continuing as an expanded and irregular chamber with folded walls, absent in *G. regia*. The female reproductive system of *G. excelentissima* sp. nov. is similar to that of *G. regia*, since both present a large



female atrium with folded walls. In both species the ovovitelline ducts ascend posteriorly to the gonopore but in *G. regia* the distal portions tend to go forward before joining in the common glandular duct. In *G. excelentissima* sp. nov., the ovovitelline ducts, after ascending, curve backwards to join in the common glandular duct. In spite of the mentioned similarities, *G. regia* has been described from a mature specimen 25 mm long.



**FIGURE 8.** Records of land planarians from Peru. The black dots indicate areas with records and the relative size (and numbers inside them) indicates the number of localities cited for a given region. The species are listed for each region. The star indicates the type locality of *G. excelentissima*.

**TABLE 1.** Distribution of species of Geoplanidae in Peru. The known distribution is mentioned and the new information of distribution obtained from the material deposited in the Fundación Miguel Lillo (FML, Argentina) is added. The number of specimens (in brackets) and the authorities who identified the FML material are included. The altitude (masl) of the localities is given when known.

Subfamily	Species	Localities (masl)	Department	References
Bipaliinae	<i>Bipalium kewense</i> Moseley, 1878	La Molina, near Lima (250 m)	Lima	dB-R Marcus (1953)
		Oxapampa (1,700 m)	Pasco	dB-R Marcus (1953)
		Lima	Lima	FML (11), Marcus det.
		San Isidro, Lima	Lima	FML (4), Weyrauch det.
		Hacienda Naranjal, valley of the Chanchamayo river	Junín	FML (7), Weyrauch det.
		Villarica, near Oxapampa (1,500 m)	Pasco	FML (2), Weyrauch det.
Rhynchodermiinae	<i>Dolichoplana vircata</i> dB-R Marcus, 1957	Chanchamayo valley (800 m)	Junín	dB-R Marcus (1957)
Microplaniinae	<i>Incapora weyrauchi</i> dB-R Marcus, 1953	Tarmatambo, near Tarma (3,400 m)	Junín	dB-R Marcus (1953)
		Santa Rosa on the Chinchipe river (1,600 m)	Cajamarca	dB-R Marcus (1957)
		Quebrada Casaracra, near Oroya (3,800 m)	Junín	dB-R Marcus (1957)
		Casaracra river, near Oroya (3,900 m)	Junín	dB-R Marcus (1957)
		Hacienda Maraynioc, east of Tarma (3,500 m)	Junín	FML (10), dB-R Marcus det.
		Shicsha, Tarma river (2,650 m)	Junín	FML (1), Weyrauch det.
Microplaniinae	<i>Microplana yaravi</i> dB-R Marcus, 1957	Cordillera Azul (1,600 m)	Ucayali	dB-R Marcus (1957)
Geoplaninae	<i>Amaga contamanensis</i> (Hyman, 1955)	Contamana, Ucayali river (3,000 m)	Loreto	Hyman (1955)
Geoplaninae	<i>Amaga libbieae</i> (dB-R Marcus, 1958)	Tuicochchaca (2,000 m)	Cusco	dB-R Marcus (1958)
Geoplaninae	<i>Geoplana aymara</i> dB-R Marcus, 1951	Tarmatambo, near Tarma (3,400 m)	Junín	dB-R Marcus (1951)
		Tarma river, Campanillago, near Palca (2,600 m)	Junín	FML (1), Weyrauch det.
		Carpapata, Tarma river (2,400 m)	Junín	FML (1), Weyrauch det.
		5 Km from Huasahuasi, near Carpapata, Tarma river	Junín	FML (1), Weyrauch det.
Geoplaninae	<i>Geoplana cantuta</i> dB-R Marcus, 1951	Cordillera Azul, Fundo Sinchono (1,600 m)	Ucayali	dB-R Marcus (1951)
		Sierra del Divisor (1,650 m)	Ucayali	FML (1), Weyrauch det.
Geoplaninae	<i>Geoplana caya</i> dB-R Marcus, 1951	Sahuayaco, Urubamba valley (800 m)	Cusco	dB-R Marcus (1951)
Geoplaninae	<i>Geoplana chalonga</i> dB-R Marcus, 1951	Contumazá (2,850 m), SW of Cajamarca	Cajamarca	dB-R Marcus (1951)
Geoplaninae	<i>Geoplana chilihua</i> dB-R Marcus, 1958	Chanchamayo river, Hacienda Maraynioc, east of Tarma (3,500 m)	Junín	dB-R Marcus (1958); FML (1), dB-R Marcus det.
Geoplaninae	<i>Geoplana chulpa</i> dB-R Marcus, 1951	Ollantaytambo, Urubamba valley	Cusco	dB-R Marcus (1951)
Geoplaninae	<i>Geoplana crawfordi</i> de Beauchamp, 1939	Capachica	Puno	de Beauchamp (1939)
Geoplaninae	<i>Geoplana excelentissima</i> sp. nov.	Near Quebrada Boca Piedras, Breu (242 m)	Ucayali	This paper
Geoplaninae	<i>Geoplana gabriellae</i> dB-R Marcus, 1951	Cordillera Cumulca (3,600 m), between Cajamarca and Celendin	Cajamarca	dB-R Marcus (1951)
Geoplaninae	<i>Geoplana irua</i> dB-R Marcus, 1958	Hacienda Naranjal, valley of the Chanchamayo river (950 m)	Junín	dB-R Marcus (1958)

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**TABLE 1.** (continued)

Subfamily	Species	Localities (masl)	Department	References
Geoplaninae	<i>Geoplana lama</i> dB-R Marcus, 1957	Tschaidicancha, between Huánuco and Tingo María (2,500 m)	Huánuco	dB-R Marcus (1957); FML (1), dB-R Marcus det.
		Panao, near Huánuco (2,700 m)	Huánuco	FML (1), dB-R-Marcus det.
Geoplaninae	<i>Geoplana lambaya</i> dB-R Marcus, 1958	Hacienda Yanasara, east of Huamachúco, Chusgon river (2,300 m)	La Libertad	dB-R Marcus (1958)
Geoplaninae	<i>Geoplana lareta</i> dB-R Marcus, 1958	Near Chiclayo, Llama and Chota (2,100-3,000)	Cajamarca	dB-R Marcus (1958)
		Macheipungo, near Bambamarca (3,000 m)	Cajamarca	FML (4), dB-R Marcus det.
Geoplaninae	<i>Geoplana pichuna</i> dB-R Marcus, 1951	Hacienda Chaquil, near Cajamarca (3,150 m)	Cajamarca	dB-R Marcus (1951)
Geoplaninae	<i>Geoplana quenua</i> dB-R Marcus, 1958	The Chanchamayo river, Hacienda Maraynioc, east of Tarma (3,500 m)	Junín	dB-R Marcus (1958); FML (1), dB-R Marcus det.
Geoplaninae	<i>Geoplana quichua</i> dB-R Marcus, 1951	Contumazá, SW of Cajamarca (2,850 m)	Cajamarca	dB-R Marcus (1951)
Geoplaninae	<i>Geoplana saima</i> dB-R Marcus, 1951	Puno on Titicaca lake (3,900 m)	Puno	dB-R Marcus (1951)
Geoplaninae	<i>Geoplana shapra</i> dB-R Marcus, 1957	Cajabamba, SE of Cajamarca (2,800 m)	Cajamarca	dB-R Marcus (1957)
Geoplaninae	<i>Geoplana takia</i> dB-R Marcus, 1951	Huacapistana on Tarma river (1,800 m)	Junín	dB-R Marcus (1951)
		Pichita Caluga (1,700 m)	Junín	FML (1), Weyrauch det.
Geoplaninae	<i>Geoplana talpa</i> dB-R Marcus, 1951	Huailahuichán on Tarma river, near Palca (2,900 m)	Junín	dB-R Marcus (1951)
Geoplaninae	<i>Geoplana vicuna</i> dB-R Marcus, 1957	Between Cerro de Pasco and Rafael (3,800 m)	Pasco	dB-R Marcus (1957)
Geoplaninae	<i>Gigantea idaia</i> (dB-R Marcus, 1951)	Puna over Abancay (4,000 m)	Apurímac	dB-R Marcus (1951)
Geoplaninae	<i>Gigantea unicolor</i> (Hyman, 1955)	Lucma (2,100 m)	La Libertad	Hyman (1955)
Geoplaninae	<i>Gigantea urubambensis</i> Negrete <i>et. al.</i> 2010	Near Camisea, Urubamba valley (400 m)	Cusco	Negrete <i>et al.</i> (2010)
Geoplaninae	<i>Notogynaphallia garua</i> (dB-R Marcus, 1951)	Contumazá, SW of Cajamarca (2,850 m)	Cajamarca	dB-R Marcus (1951)
Geoplaninae	<i>Pasipha diminutiva</i> (Hyman, 1955)	Charapa river	Huánuco	Hyman (1955)
Geoplaninae	<i>Pasipha weyrauchi</i> (dB-R Marcus, 1951)	Huacapistana on Tarma river (1,800 m)	Junín	dB-R Marcus (1951)
		Villarica, near Oxapampa (1,500 m)	Pasco	FML (1), Weyrauch det.
Geoplaninae	<i>Pseudogeoplana rosenbergi</i> (Meixner, 1906)	Santo Domingo (1,980 m)	Cusco	Meixner (1906)
Geoplaninae	<i>Pseudogeoplana ucayalensis</i> (Hyman, 1955)	Contamana, Ucayali river (300 m)	Loreto	Hyman (1955)

Otherwise, *G. matuta* resembles the species here described in possessing the end of the intrabulbar efferent ducts rising like an “S”, an also ascending intrabulbar and folded prostatic vesicle, which receives erythrophil secretion from extrabulbar glands. Froehlich (1955) describes an intrabulbar ejaculatory duct, large and highly folded, receiving erythrophil secretion. This structure is similar to the second portion of the prostatic vesicle of *G. excelentissima*. Both species have a penis papilla that occupies all the male atrium, and a large female atrium. The latter has no folded walls in *G. matuta*. Besides, the ovovitelline ducts rise posteriorly to the gonopore, similar to *G. excelentissima*, but they join in a long common glandular duct. Despite these similarities in the copulatory apparatus, *G. matuta* has an almost uniform colour pattern without stripes or bands.

## Planarian diversity from Peru

In the fauna of land flatworms of Peru, the four subfamilies of Geoplanidae are represented: Rhynchodeminae, with one species of *Dolichoplana* Moseley, 1877; Microplaninae, one *Incapora* du Bois-Reymond Marcus, 1953 and other *Microplana* Vejdovsky, 1889 species; Geoplaninae with 31 species belonging to six genera –*Amaga* Ogren & Kawakatsu, 1990, *Geoplana*, *Gigantea* Ogren & Kawakatsu, 1990, *Notogynaphallia* Ogren & Kawakatsu, 1990, *Pasipha* Ogren & Kawakatsu, 1990 and *Pseudogeoplana* Ogren & Kawakatsu, 1990– and Bipaliinae with the cosmopolitan species *Bipalium kewense* Moseley, 1878 (Table 1, Figure 8).

The knowledge of land planarians in Peru is mainly of species from highlands, most of them living between 1,600 and 3,600 masl. Almost all the species described or cited are from the Los Andes Mountain Range. Most of the species known (13) are from the centre of Peru, and from the north of the country, in the surroundings of Cajamarca (10). They are less known from the surroundings of Cusco, Titicaca Lake and Ucayali Valley south of Loreto (Table 1, Figure 8). The central region of Peru besides being the richest region of the country is the area with the greatest number of records. This could be related to the proximity of big cities with research centres, and/or specific areas of expeditions, which distorts the known distribution of species, as with the turbellarians in general.

The FML collection (Argentina) holds land planarians conserved *in toto* (ethanol) with different conditions of conservation. These species were identified by E. Du Bois-Reymond Marcus, W. Weyrauch and E. Marcus (Table 1). The revision of the collection has made it possible to know new localities for ten species of Geoplanidae already described from Peru (Table 1, Figure 8), which were collected by Dr. Weyrauch. For two species their distribution is increased to two new departments: *B. kewense* in Junín and *Pasipha weyrauchi* (du Bois-Reymond Marcus, 1951) in Pasco.

All species of Peru, except *B. kewense*, have been recorded exclusively for this country, particularly in highlands. Peru is the second South American country with a high diversity of land planarians. Although the number of known species for Peru (35) represents only about 20% of the known species in Brazil (~ 170 *sensu* Carbayo *et al.* 2009) –biodiversity hotspot of land planarians (Sluys 1999)– the real number of species is expected to be much greater because of the existence of different environments for the colonization of these species.

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