Zootaxa 4450 (2): 297–300
http://www.mapress.com/j/zt/

Correspondence

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4450.2.10
http://zoobank.org/urn:lsid:zoobank.org:pub:5C61218B-4D9D-47D4-AE26-C341F3D1702C

First report of the land planarian *Endeavouria septemlineata* (Hyman, 1939) (Platyhelminthes, Tricladida, Continenticola, Geoplanidae) in French Polynesia

JEAN-LOU JUSTINE[1,5], THOMAS LEMARCIS[2], JUSTIN GERLACH[3] & LEIGH WINSOR[4]

[1]*Institut Systématique Évolution Biodiversité (ISYEB), Muséum National d'Histoire Naturelle, CNRS, Sorbonne Université, EPHE, 57 rue Cuvier, CP 51, 75005 Paris, France*
[2]*Service de Systématique Moléculaire, UMS 2700, Muséum National d'Histoire Naturelle, 57 rue Cuvier, CP 26, 75005 Paris, France*
[3]*133 Cherry Hinton Road, Cambridge CB1 7BX, United Kingdom*
[4]*College of Science and Engineering, James Cook University, Townsville, Australia*
[5]*Corresponding author. E-mail: justine@mnhn.fr*

Summary. We report the presence of the land planarian *Endeavouria septemlineata* from Tahiti, French Polynesia, on the basis of a single specimen collected in 2017. Identification of the species was ascertained by external and internal morphology and DNA COI sequence. The finding is of importance for conservation, since this species is a predator of soil animals.

Résumé. Nous rapportons la présence du Plathelminthe terrestre *Endeavouria septemlineata* à Tahiti, Polynésie française, sur la base d'un spécimen récolté en 2017. L'identification de l'espèce a été confirmée par morphologie externe et interne et séquence d'ADN (COI). La découverte est importante pour la conservation, car cette espèce est un prédateur des animaux du sol.

Alien species are considered one of the major threats to biodiversity, especially in islands which harbour endemic species (Lowe *et al.*, 2000). Several land planarians invading islands in the South Pacific have been reported, including *Platydemus manokwari* (Justine *et al.*, 2015) and *Bipalium kewense* (Justine *et al.*, 2018).

The land planarian *Endeavouria septemlineata* (Hyman, 1939) Ogren & Kawakatsu, 1991 was first described from the mountainous regions on the island of Oahu, Hawaii (Hyman, 1939); it has been found in the Cook Islands (FAO-SAPA, 2002) and recently in Brazil (Carbayo *et al.*, 2008). This species is a well-known predator of terrestrial molluscs: Winsor *et al.* (2004) compiled a list of more than 9 species of molluscan prey from earlier references. Boll *et al.*, (2015) studied the behaviour of the species both in the field (in Brazil) and in the laboratory. *Endeavouria septemlineata* showed a gregarious behaviour and fed on woodlice, millipedes, earwigs and gastropods; in the laboratory, specimens often displayed more of a scavenging than a predating behaviour (Boll *et al.*, 2015). In view of this information, the species should be considered a threat for the biodiversity of the soil fauna, either as a predator of native fauna or as a competitor of native scavengers.

We report here that *E. septemlineata* has now been found in Tahiti, French Polynesia. The species was positively identified through morphological and molecular analysis, with 100% similarity of DNA (COI gene) with specimens from Brazil.

A single specimen of *E. septemlineata* was photographed in the field (Figure 1A) and collected by one of us (JG) on Mt Marau, Tahiti, in a high altitude hygrophylic forest, in a ravine dominated by native plants surrounding habitat highly invaded by invasive plants on 3 August 2017 (Gerlach, 2017). The specimen was shipped to LW for morphological examination and was registered as LW1833; a small part of the body, preserved in absolute ethanol, was sent to JLJ for molecular analysis, and registered in the collections of the Muséum National d'Histoire Naturelle, Paris, France, under number MNHN JL311. The specimen sent for morphological examination was in two parts as a section of the body had been removed for molecular analysis: an anterior portion measuring 3 mm long, showing a single row of large eyes antero-laterally that do not contour the tip, and a posterior portion 8.5 mm long, with the mouth 4.5 mm and gonopore 3 mm from the posterior end. The dorsal markings (Figure 1B) comprise seven dark stripes on a cream ground colour: a fine dark median longitudinal stripe, separated from paired dark broad stripes by an equal width of ground colour.

Accepted by W. Sterrer: 15 May 2018; published: 24 Jul. 2018

External to these are paired fine greyish marginal stripes with diffuse margins, then separated by an equal width of ground colour paired dark sub-marginal stripes. The ventral markings (Figure 1C) consist of coarse dark mottling, more intense laterally, over the creeping sole that occupies some 50% of the ventral surface. The external morphology and histology of the copulatory organs of the Mt Marau specimen correspond closely with the original description of *E. septemlineata* (Hyman, 1939) in particular the presence of an intrapenial papilla, and the proximal and distal chambers of the seminal vesicle; the penis papilla occupied most of the common genital atrium. The external and internal morphology of the specimen of *E. septemlineata* from Mt Marau was also close to those of specimens from Hawaii confirmed histologically by LW as *E. septemlineata* (LW1521 Anini, Kauai, Hawaii and LW1522 Niumalu, Kauai, Hawaii).

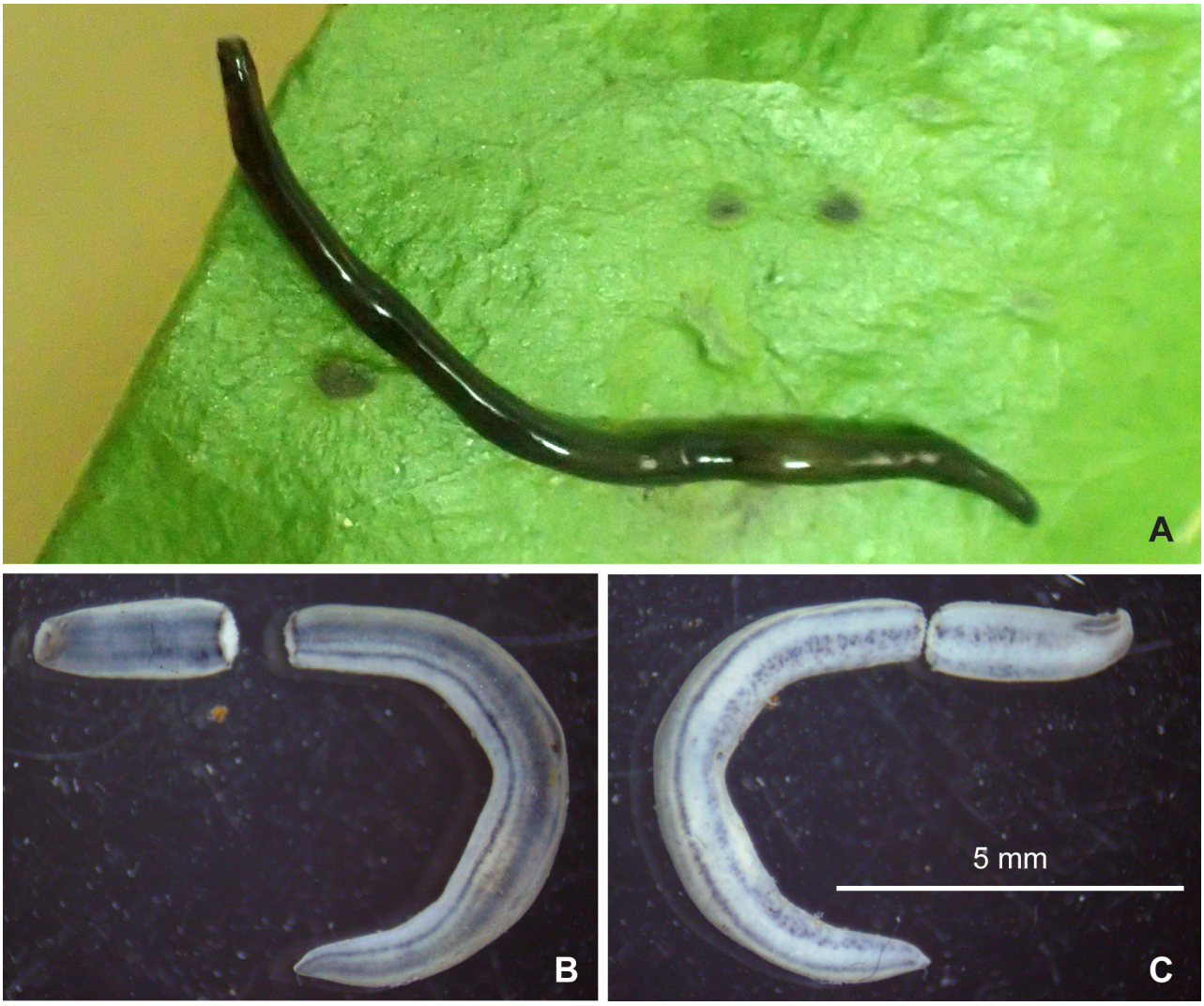

FIGURE 1. *Endeavouria septemlineata* from Mt Marau, Tahiti. A, live photograph in the field. B, C, preserved specimen; B, dorsal aspect, C, ventral aspect. Scale in C valid for B and C; no scale for A.

Genomic DNA was extracted using the QIAamp DNA Mini Kit (Qiagen). The protocol for obtaining sequences was the same as in Justine *et al.* (2018). Briefly, fragments of the COI gene were amplified with the primers BarS (forward 5′-GTTATGCCTGTAATGATTG-3′) (Álvarez-Presas *et al.*, 2011) and COIR (reverse 5′-CCWGTYARMCCHCCWAYAGTAAA-3′) (Lázaro *et al.*, 2009), following Mateos *et al.*, (2013) and with the primers JB3 (=COI-ASmit1) (forward 5′-TTTTTTGGGCATCCTGAGGTTTAT-3′) and JB4.5 (=COI-ASmit2) (reverse 5′-TAAAGAAAGAACATAATGAAAATG-3′) (Bowles *et al.* 1995; Littlewood *et al.* 1997). PCR products were purified and sequenced in both directions on a 3730xl DNA Analyzer 96-capillary sequencer (Applied Biosystems). Results of both analyses were concatenated to obtain a COI sequence of 862 bp in length. The sequence was edited using CodonCode Aligner software (CodonCode Corporation, Dedham, MA, USA), compared to the GenBank database content using BLAST and deposited in GenBank under accession number MH572010. MEGA7 (Kumar *et al.*, 2016) was used to estimate genetic distances.

Our new sequence was compared to two partial sequences of COI of *E. septemlineata* deposited in GenBank, KC608222 and KC608233, both from Brazil. These sequences are shorter and there were a total of 304 positions in the final dataset. Distances (kimura-2 parameter) with KC608233 was 0%, and distance with KC608222 was 1%; in contrast, distance with other land planarians such as *P. manokwari* (KR349581) or *Parakontikia ventrolineata* (KR349587) were respectively 19.4% and 17.3%.

We thus consider, based on both morphology and molecules, that the specimen found in Tahiti is identified without doubt as *E. septemlineata.*

This finding might have important consequences for the conservation of native soil fauna in the island of Tahiti, including species of partulid snails, which are highly diverse and comprise many endemic species in the Pacific islands, of which many are now extinct (Cowie, 1992; Gerlach, 2017). Since land planarians are generally transferred with plants and soil, it is likely that *E. septemlineata* is also present in other islands of the Society Islands (French Polynesia) and possibly in other islands in the Pacific. A survey is necessary to confirm this hypothesis, and major research programs are needed (Meyer *et al.*, 2018).

References

Álvarez-Presas, M., Carbayo, F., Rozas, J. & Riutort, M. (2011) Land planarians (Platyhelminthes) as a model organism for fine-scale phylogeographic studies: understanding patterns of biodiversity in the Brazilian Atlantic Forest hotspot. *Journal of Evolutionary Biology*, 24, 887–896.
https://doi.org/10.1111/j.1420-9101.2010.02220.x

Boll, P.K., Rossi, I., Amaral, S.V. & Leal-Zanchet, A. (2015) A taste for exotic food: Neotropical land planarians feeding on an invasive flatworm. *PeerJ*, 3, e1307.
https://doi.org/10.7717/peerj.1307

Bowles, J., Blair, D. & McManus, D.P. (1995) A molecular phylogeny of the human schistosomes. *Molecular Phylogenetics and Evolution*, 4, 103–109.
https://doi.org/10.1006/mpev.1995.1011

Carbayo, F., Pedroni, J. & Froehlich, E.M. (2008) Colonization and extinction of land planarians (Platyhelminthes, Tricladida) in a Brazilian Atlantic Forest regrowth remnant. *Biological Invasions*, 10, 1131–1134.
https://doi.org/10.1007/s10530-007-9190-1

Cowie, R.H. (1992) Evolution and extinction of Partulidae, endemic Pacific island land snails. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 335, 167–191.
https://doi.org/10.1098/rstb.1992.0017

FAO-SAPA (2002) Bio-control: flatworms and nemertean worms collected and identified from Cook Islands, Niue, Tonga and Vanuatu. *SAPA Newsletter*, 6, 3.

Gerlach, J. (2017) Partula survival in 2017, a survey of the Society islands. Published by the author, (29pp). Available from: https://islandbiodiversity.com/ (accessed 10 November 2017)

Hyman, L. H. (1939) Land planarians from the Hawaiian Islands. *Archives de Zoologie Expérimentale et Générale*, 80, 116–124.

Justine, J.-L., Winsor, L., Barrière, P., Fanai, C., Gey, D., Han, A.W.K., La Quay-Velazquez, G., Lee, B.P.Y.-H., Lefevre, J.-M., Meyer, J.-Y., Philippart, D., Robinson, D.G., Thévenot, J. & Tsatsia, F. (2015) The invasive land planarian *Platydemus manokwari* (Platyhelminthes, Geoplanidae): records from six new localities, including the first in the USA. *PeerJ*, 3, e1037.
https://doi.org/10.7717/peerj.1037

Justine, J.-L., Winsor, L., Gey, D., Gros, P. & Thévenot, J. (2018) Giant worms *chez moi*! Hammerhead flatworms (Platyhelminthes, Geoplanidae, *Bipalium* spp., *Diversibipalium* spp.) in metropolitan France and overseas French territories. *PeerJ*, 6, e4672.
https://doi.org/10.7717/peerj.4672

Kumar, S., Stecher, G. & Tamura, K. (2016) MEGA7: Molecular Evolutionary Genetics Analysis version 7.0 for bigger datasets. *Molecular Biology and Evolution*, 33, 1870–1874.
https://doi.org/10.1093/molbev/msw054

Lázaro, E.M., Sluys, R., Pala, M., Stocchino, G.A., Baguñà, J. & Riutort, M. (2009) Molecular barcoding and phylogeography of sexual and asexual freshwater planarians of the genus *Dugesia* in the Western Mediterranean (Platyhelminthes, Tricladida, Dugesiidae). *Molecular Phylogenetics and Evolution*, 52, 835–845.
https://doi.org/10.1016/j.ympev.2009.04.022

Littlewood, D.T.J., Rohde, K. & Clough, K.A. (1997) Parasite speciation within or between host species? - Phylogenetic evidence from site-specific polystome monogeneans. *International Journal for Parasitology*, 27, 1289–1297.
https://doi.org/10.1016/S0020-7519(97)00086-6

Lowe, S., Browne, M., Boudjelas, S. & De Poorter, M. (2000) *100 of the World's Worst Invasive Alien Species. A selection from the Global Invasive Species Database.* Published by The Invasive Species Specialist Group (ISSG) a specialist group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN), Gland, 12 pp. [first published as special lift-out in Aliens 12, December 2000, updated and reprinted version: November 2004]

Mateos, E., Tudó, A., Álvarez-Presas, M. & Riutort, M. (2013) Planàries terrestres exòtiques a la Garrotxa. *Annals de la Delegació de la Garrotxa de la Institució Catalana d'Història Natural*, 6, 67–73.

Meyer, J.-Y., Strasberg, D., Vidal, É., Jourdan, H., Delnatte, C. & Muller, S. (2018) Quelle stratégie de recherche pour une meilleure

conservation de la biodiversité terrestre dans les îles tropicales ultramarines françaises ? *Naturae*, 2, 15–26.
Winsor, L., Johns, P.M. & Barker, G.M. (2004) Terrestrial planarians (Platyhelminthes: Tricladida: Terricola) predaceous on terrestrial gastropods. *In*: Barker, G.M. (Ed.), *Natural enemies of terrestrial molluscs*. CAB International, Oxfordshire, pp. 227–278. https://doi.org/10.1079/9780851993195.0227