

NEW LOCALITY RECORDS OF *BIPALIUM KEWENSE* (PLATYHELMINTHES: TRICLADIDA: GEOPLANIDAE) IN CUBA

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ABSTRACT: The land planarian *Bipalium kewense* Moseley, 1878 (Tricladida: Geoplanidae) is thought to be native from Southeast Asia, but it has been introduced into about 50 countries, including most part of the Insular Caribbean. It was reported from Cuba in 2016, based on some specimens collected in the Guamuhaya Massif, in the central region of the country. Herein we report *B. kewense* from western Cuba and other localities in the Guamuhaya Massif, besides we comment on the previous records of the species in the country.

KEYWORDS: Exotic land planarian, Bipaliinae, distribution, Greater Antilles

RESUMEN: NUEVOS REGISTROS DE LOCALIDAD DE *BIPALIUM KEWENSE* MOSELEY, 1878 (PLATYHELMINTHES: TRICLADIDA: GEOPLANIDAE) EN CUBA. La planaria terrestre *Bipalium kewense* Moseley, 1878 (Tricladida: Geoplanidae) se cree que es originaria del sudeste de Asia, pero ha sido introducida en alrededor de 50 países, incluyendo la mayor parte del Caribe Insular. Fue registrada para Cuba en el año 2016, a partir de recolectas realizadas en el Macizo de Guamuhaya, en la región central del país. En este trabajo se reporta *B. kewense* para la región occidental de Cuba y otras localidades en el Macizo de Guamuhaya, además, se comenta sobre los registros previos de esta especie en el país.

PALABRAS CLAVE: Planaria terrestre exótica, Bipaliinae, distribución, Antillas Mayores

Land planarians (Platyhelminthes: Tricladida: Geoplanidae: Bipaliinae) have received very little attention in Cuba, with a few records since 1996 as the only available information on this group in the country (Reinés, 1996; Suárez, 2012; Alegre and Barba, 2014; Morffe *et al.*, 2016). The species *Bipalium kewense* Moseley, 1878 is believed to be native from Southeast Asia, but it currently has a cosmopolitan distribution: it has been introduced into about 50 countries, including most part of the Insular Caribbean (e.g., Winsor, 1983; Pérez-Gelabert, 2010; Justine *et al.*, 2014; Sanchez-García, 2014; Lago-Barcia *et al.*, 2015; Morffe *et al.*, 2016). It was reported from Cuba in 2016, based on some specimens collected at La Chispa and the path to Caburní River,

near Topes de Collantes, Guamuhaya Massif, in the central region of the country (Fig. 1; Morffe *et al.*, 2016). However, Reinés (1996) reports suggest that it has been also present in western and eastern Cuba since at least about 25 years earlier.

Bipalium kewense is a known predator of earthworms and terrestrial mollusks, therefore it is frequently found associated to earthworm cultures, gardens and plant nurseries (for reviews see Winsor, 1983; Winsor *et al.*, 2004; Morffe *et al.*, 2016). Its main non-natural dispersal mode has been by transport of exotic potted plants containing adults or cocoons in the soil (Winsor, 1983; Justine *et al.*, 2014; Lago-Barcia *et al.*, 2015; Morffe *et al.*, 2016). This species can be readily distinguished from other geoplanids by a combination of large size, color pattern (dorsal ground color pale ochre with five black to gray longitudinal stripes: one median, two sub-lateral and two marginal; median and marginal stripes with more or less well-defined margins, sub-lateral stripes fade with diffuse margins; with paired sub-lateral and marginal stripes fused at "neck" level forming an

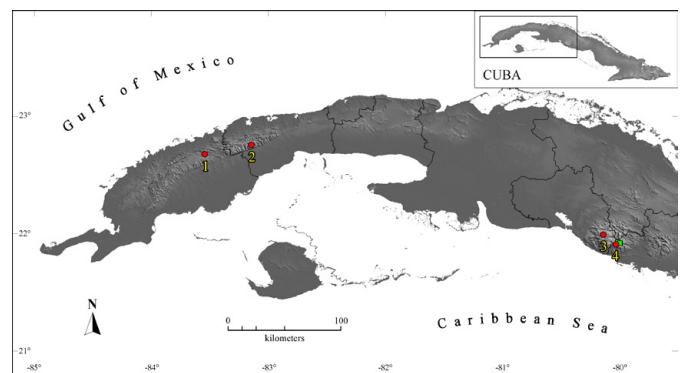


FIGURE 1. Map of central and western Cuba depicting the distribution of the exotic land planarian *Bipalium kewense*: previous records (green squares; Morffe *et al.* 2016) and new records (red dots): 1) Cayo Hueso, 2) Santa Cruz River canyon, 3) Pico San Juan, and 4) La Batata Cave.

FIGURA 1. Mapa de Cuba central y occidental con la distribución de la planaria terrestre exótica *Bipalium kewense*: registros previos (cuadros verdes; Morffe *et al.* 2016) y los nuevos registros (círculos rojos): 1) Cayo Hueso, 2) cañón del río Santa Cruz, 3) Pico San Juan y 4) Gruta La Batata.

incomplete collar interrupted dorsally by a small median gap), and the anterior end of the body expanded forming a characteristic semilunate head plate (Winsor, 1983; Morffe *et al.*, 2016). Following diagnosis by Winsor (1983), who stated that *B. kewense* can be distinguished from all other *Bipalium* species on the base of color and stripe pattern, besides other anatomical features, herein we report this species from several new localities in central and western Cuba based on visual and/or photographic records.

SPECIMENS OBSERVED (Fig. 1): PINAR DEL RÍO Province (new locality record): La Palma Municipality: Cayo Hueso (22°40'21", -83°33'07"; 150 m a.s.l.); 13 August 2009; under a slab in a house's backyard; one specimen observed and photographed by J. Torres and R. Marrero (Fig. 2A). ARTEMISA Province (new locality record): San Cristóbal Municipality: Santa Cruz River canyon (22°44'58", -83°08'59"; 180 m a.s.l.); 9 February 2018; under a rock in a house's backyard; one specimen observed and photographed by R. López-Silvero (Fig. 2B). CIENFUEGOS Province (new locality record): Cumanayagua Municipality: Pico San Juan, around the meteorological radar station (21°59'21", -80°08'51";

1,140 m a.s.l.); 22 February 2014; under a rock in secondary vegetation surrounded by mountain rainforest; one specimen observed and photographed by T. M. Rodríguez Cabrera, C. Martínez and R. Domínguez (Fig. 2C). SANCTI SPÍRITUS Province: Trinidad Municipality: La Batata Cave (new locality record; 21°54'24", -80°02'15"; 750 m a.s.l.); 11 February 2011; on the cave's wall; one specimen observed and photographed by R. López-Silvero and R. Montes (Fig. 2D).

The color and stripe pattern of the specimens reported herein was slightly variable, but fall within the range reported for *B. kewense* (Winsor, 1983). The exception is the specimen from the Santa Cruz River canyon (Fig. 2B), which had broad marginal stripes, of similar width to sub-lateral stripes, fade and with diffuse margins over most of its body length. This pattern coincides to some degree with *B. dubium*, but the latter has the sub-lateral stripes fused before the "neck", with black head plate and "neck" (Winsor, 1983). Until additional material from this locality is available and other diagnostic characters can be examined (e.g., anatomy of copulatory organs), we refer this record to *B.*



FIGURE 2. Specimens of the exotic land planarian *Bipalium kewense* photographed *in situ* in Cuba: A) Cayo Hueso, B) Santa Cruz River canyon, C) Pico San Juan (inset: detail of the anterior region of the body in dorsal view), and D) La Batata Cave. Photographs © J. Torres (A), R. López-Silvero (B, D) and R. Domínguez (C).

FIGURA 2. Especímenes de la planaria terrestre exótica *Bipalium kewense* fotografiados *in situ* en Cuba: A) Cayo Hueso, B) cañón del río Santa Cruz, C) Pico San Juan (cuadro interior: detalle de la región anterior del cuerpo en vista dorsal) y D) Gruta La Batata. Fotografías © J. Torres (A), R. López-Silvero (B, D) y R. Domínguez (C).

kewense, assuming that such a color pattern might be a variation not described by Winsor (1983). Also, in the specimen from Cayo Hueso (Fig. 2A) the sub-lateral stripes were very fade, particularly on the anterior half of the body, but Winsor (1983) already noted that sub-lateral stripes in this species “sometimes exhibit considerable variation even on a single specimen.” The color pattern around the “neck” and head plate seems to be the most diagnostic external feature of *B. kewense* (Winsor, 1983).

The records of *B. kewense* in western Cuba, over 300 km from the previous ones (Morffe *et al.* 2016), suggest that the species either might had been more widely distributed than previously thought or it has been spreading rapidly. As a matter of fact, Reinés (1996) recorded land planarians referred to the genus *Bipalium* in earthworm cultures from western and eastern Cuba, without giving a precise locality. Reinés (1996) also mentioned that the material examined by her was collected between 1981 and 1992, therefore the presence of *Bipalium* in Cuba may be tracked back to the 1980's at the most. The later would not be surprising since *B. kewense* was reported from the Greater Antillean region, specifically from Jamaica, as early as the late 19th century (Cockerell, 1897).

The specimen of *B. kewense* from La Batata Cave (Fig. 2D) was observed in February 2011, more than three years earlier than those reported by Morffe *et al.* (2016) from other

two localities around Topes de Collantes in October 2014. Topes de Collantes is a touristic place with a great movement of people and goods year round, thus, it is not surprising that probably *B. kewense* had arrived to this area with some cargo of potted plants or of humus from earthworm cultures as occurs in other parts of the world (Winsor, 1983; Justine *et al.*, 2014; Lago-Barcia *et al.*, 2015). Also, this species apparently is able to reproduce both sexually and asexually by fission (Winsor, 1983), therefore, the introduction of a single individual or a fragment may be sufficient to originate a new population.

Most of the *B. kewense* specimens were found associated to disturbed areas (Fig. 3), which coincides with previous records in Cuba (Morffe *et al.* 2016) and other countries outside its native range (e.g., Winsor, 1983; Álvarez-Presas *et al.*, 2014; Justine *et al.*, 2014; Sánchez-García 2014). The exception might be Pico San Juan, which is an Ecological Reserve currently far from human settlements, but populated several decades ago, with a road that ends at the meteorological radar station and remaining patches of secondary vegetation (Fig. 3C). However, Winsor (1983) mentioned that in its native range *B. kewense* inhabits highlands (1,300–2,000 m a.s.l.) with cold sub-tropical climate and rainforest, which coincides with the environmental conditions around Pico San Juan (i.e., predominant elevations above 1,000 m with mountain rainforest). This constitutes the highest elevation at which this species has been reported in Cuba.



Figure 3. Some habitats where the exotic land planarian *Bipalium kewense* has been found in Cuba: A) near Cayo Hueso, B) Santa Cruz River canyon, C) Pico San Juan, and D) La Batata Cave. Photographs © R. Marrero (A) and T. M. Rodríguez-Cabrera (B, C, D).

Figura 3. Algunos hábitats donde se encontró la planaria terrestre exótica *Bipalium kewense* en Cuba: A) cerca de Cayo Hueso, B) cañón del río Santa Cruz, C) Pico San Juan y D) Gruta La Batata. Fotografías © R. Marrero (A) y T. M. Rodríguez-Cabrera (B, C, D).

The potential negative impact of *B. kewense* on the native biota of Cuba is unknown. In Cuba there are 46 different earthworm species reported, nearly 40% endemic (Rodríguez, 1993; Cabrera *et al.* 2017), and it is well known that earthworms play an important role in the physical properties of the soil and in the nutrients dynamic (e.g., Lavelle *et al.*, 1992; Blanchart *et al.*, 1991; Rodríguez, 2000; Jiménez *et al.*, 2003). It is possible that large densities of this land planarian may affect native earthworm populations, breaking the equilibrium of natural ecosystems starting at the soil level. Moreover, Cuba harbors one the richest faunas of terrestrial mollusks of the world, with about 1,400 species, of which about 96% are endemic and some have very restricted geographical ranges (Espinosa and Ortea, 2009; Hidalgo-Gato *et al.*, 2016; Hernández *et al.*, 2017). Since *B. kewense* is known to prey also on terrestrial gastropods (Winsor *et al.*, 2004), many of the most threatened Cuban endemic species may be vulnerable to this exotic predator. It is necessary to keep studying this land planarian in Cuba in order to detect in time any possible deleterious effect on natural ecosystems, so environmental authorities can provide the most appropriate management.

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REFERENCES

- Alegre, A. and R. Barba. 2014. Estado de conservación de *Jimenezziella decui*, una especie cavernícola de Cuba (Opiliones: Laniatores). *Revista Ibérica de Aracnología* 25: 43-57.
- Álvarez-Presas, M., E. Mateos, A. Tudó, H. D. Jones and M. Riutort. 2014. Diversity of introduced terrestrial flatworms in the Iberian Peninsula: a cautionary tale. *PeerJ* 2: e430.
- Blanchart, E., P. Lavelle and A. V. Spain. 1991. Effect of two species of tropical earthworms (Oligochaeta: Eudriliidae) on the size distribution of aggregates in an African soil. *Revue d'Ecologie et de Biologie du Sol* (France), 26: 417-425.
- Cabrera Dávila, G., A. A. Socarrás, E. Gutiérrez Cubría, T. Tcherva, C. A. Martínez-Muñoz and A. Lozada Piña. 2017. Fauna del suelo. Pp. 254-283. In: *Diversidad biológica de Cuba: métodos de inventario, monitoreo y colecciones biológicas* (C. A. Mancina and D. D. Cruz, Eds.). Editorial AMA, La Habana. 502 pp.
- Cockerell, T. D. A. 1897. *Bipalium kewense*. *American Naturalist* 31: 155.
- Espinosa, J. and J. Ortea. 2009. *Moluscos terrestres de Cuba*. UPC Print, Vaasa, Finland, 191 pp.
- Hernández Quinta, M., L. Álvarez-Lajonchere Ponce de León, D. Martínez Borrego, D. Maceira Filguera, A. Fernández Velázquez and J. Espinosa Sáez. 2017. Moluscos terrestres y dulceacuícolas. Pp. 168-195. In: *Diversidad Biológica de Cuba: métodos de inventario, monitoreo y colecciones biológicas* (C.A. Mancina and D.D. Cruz, Eds.). Editorial AMA, La Habana. 502 pp.
- Hidalgo-Gato González, M. M., J. Espinosa Sáez and R. Rodríguez-León Merino (Eds.). 2016. *Libro Rojo de Invertebrados Terrestres de Cuba*. Editorial Academia, La Habana. 244 pp.
- Jiménez, J. J., T. Decaëns, R. J. Thomas and P. Lavelle. 2003. La macrofauna del suelo: Un recurso natural aprovechable pero poco conocido. Pp. 1-17. In: *El arado natural: las comunidades de macroinvertebrados del suelo en las sabanas neotropicales de Colombia* (J. J. Jiménez Jaén and R. J. Thomas, Eds.). Centro Internacional de Agricultura Tropical (CIAT), Cali.
- Justine, J. L., L. Winsor, D. Gey, P. Gros and J. Thévenot. 2014. The invasive New Guinea flatworm *Platydemus manokwari* in France, the first record for Europe: time for action is now. *PeerJ* 2: e297.
- Lago-Barcia, D., F. A. Fernández-Álvarez, L. Negrete, F. Brusa, C. Damborenea, C. Grande and C. Noreña. 2015. Morphology and DNA barcodes reveal the presence of the non-native land planarian *Obama marmorata* (Platyhelminthes: Geoplanidae) in Europe. *Invertebrate Systematics* 29: 12-22.
- Lavelle, P., A.V. Spain, E. Blanchart, A. Martin and S. Martin. 1992. The impact of soil fauna on the properties of soils in the humid tropics. Pp. 157-185. In: *Myths and Science of Soil of the Tropics* (P.A. Sánchez and R. Lal, Eds.). Soil Science of America, Madison.
- Morffe, J., N. García, B. J. Adams and K. Hasegawa. 2016. First record of the land planarian *Bipalium kewense* Moseley, 1878 (Tricladida: Geoplanidae: Bipaliinae) from Cuba. *BioInvasions Records* 5: 127-132.
- Pérez-Gelabert, D. 2010. Primera cita de la planaria terrestre cosmopolita *Bipalium kewense* Moseley, 1878 (Turbellaria: Tricladida: Terricola) para la República Dominicana. *Novitates Caribaea* 3: 81-82.
- Rodríguez Aragonés, C. 1993. Listado preliminar de las lombrices de tierra (Annelida: Oligochaeta) de Cuba. *Poeyana* 443: 1-9.
- Rodríguez Aragonés, C. 2000. Comunidad de lombrices de tierra (Annelida: Oligochaeta) en ecosistemas con diferentes grados de perturbación. *Revista Biología* 14: 147-155.
- Reinés, M. M. 1996. Nuevos registros de turbelarios terrestres para Cuba. *Revista Biología* 10: 3-8.
- Sánchez-García, I. 2014. Cuatro planarias terrestres exóticas nuevas para Andalucía. *Revista de la Sociedad Gaditana de Historia Natural* 8: 15-20.
- Suárez Torres, A. 2012. Depredación de moluscos cubanos por una planaria terrestre de la familia Rhynchodemidae. *CartaCuba*, 4: 13-14.
- Winsor, L. 1983. A revision of the Cosmopolitan land planarian *Bipalium kewense* Moseley, 1878 (Turbellaria: Tricladida: Terricola). *Zoological Journal of the Linnean Society* 79: 61-100.
- Winsor, L., P. M. Johns and G. M. Barker. 2004. Terrestrial planarians (Platyhelminthes: Tricladida: Terricola) predaceous on terrestrial gastropods. Pp. 227-278. In: *Natural enemies of terrestrial mollusks* (G. M. Barker, Ed.). CAB International, London.