New records of invasive hammerhead flatworms (Platyhelminthes, Geoplanidae, Bipaliinae) from Mexico using a citizen science platform, with an identification key to the species found in North America

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Abstract
We present new records of the invasive hammerhead flatworms Bipalium kewense Moseley, 1878 and Bipalium vagum Jones & Sterrer, 2005 (Platyhelminthes, Geoplanidae, Bipaliinae) from several states in Mexico based on iNaturalist and two vouched specimens. This represents for Mexico the first review of distribution records of this group and highlights the importance of citizen science in monitoring the distribution of these ecologically important invasive predators. Methods for the collection and preservation of hammerhead flatworms, as well as an identification key, are proposed.

Keywords
Bipalium kewense, Bipalium vagum, Continenticola, Diversibipalium, Terricola, Tricladida

Introduction
Among the many taxa that comprise the phylum Platyhelminthes (flatworms), only one family, Geoplanidae Stimpson, 1857, has been able to truly colonize terrestrial ecosystems (Winsor et al. 1998). This family of free-living carnivores, commonly known as land planarians or terrestrial flatworms, is currently divided into five subfamilies, of which Bipaliinae Stimpson, 1857 is easily distinguished from the others by the presence of a greatly widened and conspicuous head (Fig. 1), earning them the common name of hammerhead flatworms.
Hammerhead flatworms are native to the island of Madagascar as well as Southeast Asia, from India to Japan and including Indonesia and the Philippines (Ogren and Kawakatsu 1987). However, several species have been accidentally introduced to several countries around the globe (Fig. 2), where they are considered invasive (Álvarez-Presas et al. 2014). Hammerhead flatworms are important predators of soft-bodied soil fauna, particularly earthworms and gastropods (Ducey et al. 1999, 2007), although they have been observed attempting predation upon tiny vertebrates such as Brahminy Blind Snake, Indotyphlops braminus (Daudin, 1803) (Serpentes, Typhlopidae) (Mizuno and Kojima 2017). They constitute a threat to the native soil fauna wherever they are introduced (Okochi et al. 2010; Justine et al. 2018).

Four genera of hammerhead flatworms are recognized: Bipalium Stimpson, 1857, Humbertium Ogren & Sluys, 2001, and Novibipalium Kawakatsu, Ogren & Froehlich, 1998, three natural genera which are differentiated by their genitalia as determined by histological examination (Kawakatsu et al. 1998, 2002; Ogren and Sluys 2001), and Diversibipalium Kawakatsu, Ogren, Froehlich & Sasaki, 2002, a collective genus for the currently unclassifiable hammerhead flatworms from which sufficient information on their genitalia is lacking (Kawakatsu et al. 2002). Five species of two genera are recorded as introduced invaders in North America, all of which can be differentiated by the shape of the head, size, color, and stripe pattern: Bipalium adventitium Hyman, 1943; Bipalium kewense Moseley, 1878; Bipalium pennsylvanicum Ogren, 1987; Bipalium vagum Jones & Sterrer, 2005; and Diversibipalium multilineatum (Makino & Shirasawa, 1983).

While there are multiple records of hammerhead flatworms for Canada (Winsor 1983; Justine et al. 2019), the USA (Hyman 1943; Ogren 1981, 1984, 1987; Winsor 1983; Ball and Sluys 1990; Ogren and Sheldon 1991; Ducey and Noce 1998), some Caribbean islands (Winsor 1983; Morffe et al. 2016; Justine et al. 2018; Reínés-Álvarez 1996; Rodriguez-Cabrera and Torres 2019), as well as other regions of the world (Baptista et al. 2010; Du Bois-Reymond 1953; Filella-Subirà 1983; Justine et al. 2018, 2022; Sánchez-García 2014; Negrete et al. 2012; Okochi et al. 2010; Wu et al. 2005), there is almost no information on this subfamily in Mexico. We were unable to find more than a single formal record for the country (Winsor 1983).

**Methods**

**Collection, recording and fixation of terrestrial flatworms.** We followed the methodology described by Winsor (1998). Upon finding a specimen either resting under rocks, wood, or debris, or active at night...
(especially during rainy and foggy weather), we placed it, individually, in a clean container (centrifuge tubes, test tubes, etc.) with some moist leaf litter or moss, and kept it in a cool, dark place. We then transported it to the workstation and placed it in a Petri dish filled to the brim with tap water and photographed it in a distended state. Following this, we drained the water and added a weak ethanol solution (~5%). This caused somewhat violent contractions in the specimen but anesthetized it in 10–20 min. After the specimen ceased movement and no longer reacted to stimuli, we carefully straightened it and photographed it (dorsally and ventrally) in this relaxed state.

Following the anesthetization process, we drained the weak ethanol solution and added “Winsor fixative” to the brim. This solution is hereby named after researcher Leigh Winsor, who proposed this modification of Tyler’s fixative to fix terrestrial flatworms (Winsor 1998). It consists of 1-part commercial formaldehyde (37–40%) and 9-parts tap water, adding 20 g of anhydrous calcium chloride and 2 g of either cobalt chloride or cobalt nitrate for each liter of solution. If this solution is not available, carefully pouring boiling water on the living specimen and then placing it in commercial 70–96% ethanol or 8–10% commercial formaldehyde can be done instead. After the fixing media was added, the lid was placed on the Petri dish. The specimens are extremely fragile at this stage; therefore, care must be given in moving the Petri dish as little as possible, at least for the first 48 hours. The specimen is then left in the medium for at least a week, two if possible, refilling it when necessary. The specimens can be stored in Winsor’s fixative at ambient temperature almost indefinitely but should not be stored in 8–10% commercial formaldehyde alone for more than 48 hours, as in our experience, it turns the specimens very hard and brittle. After fixation, the specimen was carefully washed in tap water and placed in 70% ethanol for long-term storage. Other histological techniques are explored in Winsor and Sluys (2018).

Correctly labeling of specimens is critical and must be done on water-resistant paper, with the data written with a pencil or solvent-resistant ink. It is important to add georeferenced locality data, date of collection, the collector’s name, the fixing media, and codes for the photographs taken. The label must be inside the vial with the specimen, never on the outside. After specimens are properly prepared, photographed both dorsally and ventrally, and labeled, they should be deposited in museums or university collections, preferably those with collections of soil invertebrates or that have experts working on terrestrial flatworms.

The two physical vouchers were deposited in the Entomology Laboratory of the Facultad de Ciencias Forestales (FCF) of the Universidad Autónoma de Nuevo León (UANL) under the codes GEOPL001 and GEOPL002.

Records from iNaturalist. Records in this citizen science app were reviewed manually, searching for phylum Platyhelminthes, family Geoplanidae, subfamily Bipaliinae, as well as the genera *Bipalium*, *Humbertium*, *Novibipalium*, and *Diversibipalium*; the searches were limited to Mexico, including its islands. Those with obscured locality data were excluded from this study. A database was created using the 269 records found (190 for *Bipalium kewense* and 79 for *Bipalium vagum*). The determination of the species was corroborated using original and subsequent descriptions (Hyman 1943; Makino and Shirasawa 1983; Winsor 1983; Ogren 1987; Ball and Sluys 1990; Jones and Sterrer 2005; Justine et al. 2018; Wallace and Winsor 2020), from which an artificial identification key that employs external charac-

Figure 3. New records in Mexico for *Bipalium kewense* (red triangles) and *Bipalium vagum* (blue stars). Map made using SimpleMappr (Shorthouse 2010).
ters was also created. The complete link (https://www.inaturalist.org/observations/) for each iNaturalist observation is abbreviated with the symbol # in the records list. The maps showing the records of the species were made using the website SimpleMappr (Shorthouse 2010).

Results

*Bipalium kewense* Moseley, 1878

Figures 1B, 2–4

**Material examined.** MEXICO – Tamaulipas • Reserva de la Biosfera “El Cielo”, gardens of the Centro Interpretativo Ecológico (CIE), of Gomez Farias; 23.0066, −099.1684; 819 m alt.; 5.VII.2020; Manuel de Luna and Roberto García-Barrios leg.; active on a rainy night (around 02:00), fixed in Winsor’s fixative (specimen was already dead before fixation), GEOPL001.

**iNaturalist records.** MEXICO – Baja California • El Sauzal, Ensenada; 31.8989, −116.6995; 14 m alt.; 30.V.2020, oscar jimenez obs.; #47845508 • Chiapas • San Cristóbal de las Casas; 16.7171, −092.6444; 2117 m alt.; 21.VII.2014; juarez120190 obs.; #795463 • Tabachulpa, 14.9237, −092.4081; 23 m alt.; 31.X.2021; villanuevagr obs.; #99900322 • Tuxtla Gutiérrez; 16.7544, −093.0592; 663 m alt.; 27.IX.2020; jmnelendez obs.; #62072398 • Barrio de Fátima, San Cristóbal de las Casas; 16.7248, −092.6504; 2142 m alt.; 12.VII.2019; laurenzarae obs.; #29225588 • San Cristóbal de las Casas; 16.1717, −092.6444; 2114 m alt.; 21.VII.2014; juarez120190 obs.; #795463 • Hueguétlan; 15.0154, −092.4358; 27 m alt.; 21.VII.2014; giezianthony obs.; #17223154. CIUDAD DE MÉXICO • Mayorazgo de los Gigantes, Ciudad López Mateos; 19.5746, −099.2218; 2275 m alt.; 25.VIII.2021; carolinaestradaogutierrez obs.; #92470151 • 10 de Mayo; 19.4342, −099.1208; 2258 m alt.; 6.IX.2021; pabloevd obs.; #93900285 • Tlapalpan; 19.2790, −099.2114; 2535 m alt.; 2.V.2013; annemir dl obs.; #438193 • Viveros de Coyoacán, Coyoacán; 19.3536, −099.1715; 2259m. a.s.l.; 4.VII.2014; leticiamercadogaribay obs.; #793937 • cerca de Avenida Unión, Tlalpan; 19.3029, −099.2201; 2435 m alt.; 8.VII.2015; criss org.; #1767872 • Parque Ecológico Experimental, Coyoacán; 19.3176, −099.1726; 2269 m alt.; 8.X.2015; martznatalia obs.; #2406091 • Copiloc el Alto, Coyoacán; 19.3318, −099.1753; 2268 m alt.; 8.V.2017; alondrafal obs.; #6549611 • Calle Cerro de la Mano, Coyoacán; 19.3385, −099.1726; 2263 m alt.; 8.VII.2015; jainz obs.; #7107593 • Parque Nacional Bosque de Pedregal, Tlapalpan; 19.2872, −099.1964; 2413 m alt.; 25.II.2018; jlius2503 obs.; #10013991 • Ciudad Universitaria, Coyoacán; 19.3189, −099.1728; 2270 m alt.; 23.V.2018; jorch66 obs.; #12798800 • Av. Universidad, Coyoacán, 19.3364, −099.1875; 2288 m alt.; 19.VI.2018; m00ncaddy obs.; #13589318 • Plaza de las Vizcaínas, Cuauhtémoc; 19.4276, −099.1407; 2235 m alt.; 6.VIII.2018; mon43 obs.; #15173450 • Viveros de Coyoacán, Coyoacán; 19.3539, −099.1704; 2258 m alt.; 22.I.2012; paulmartinez2 obs.; #16862128 • Plaza de las Vizcaínas, Cuauhtémoc; 19.4277, −099.1405; 2237 m alt.; 25.IX.2018; yanly obs.; #16915820 • Calle Hortensia, Álvaro Obregón; 19.3566, −099.1833; 2271 m alt.; 9.XI.2018; deni etxe obs.; #18308124 • Coyoacán; 19.3250, −099.1794; 2271 m alt.; 20.XI.2018; anakenarmartnezhara obs.; #19235601 • Avenida año de Juárez, Xochimilco; 19.2604, −099.0299; 2250 m alt.; 5.XI.2018; educadoreang obs.; #20806119 • Calle Saye 6-C, Tlapalpan; 19.2978, −099.2301; 2501 m alt.; 25.IV.2019; priscila27 obs.; #23072725 • Santa Fe, Álvaro Obregón; 19.3684, −099.2641; 2542 m alt.; 7.VII.2019; lorena28 obs.; #30734776 • Bosque de Chapultepec, Miguel Hidalgo; 19.4175, −099.1836; 2258 m alt.; 16.VIII.2019; g1rt4b obs.; #30943319 • Calle Cerro de la Mano 38, Coyoacán; 19.3385, −099.1726; 2263 m alt.; 25.VIII.2019; jainz obs.; #31505081 • Del Carmen, Coyoacán; 19.3551, −099.1701; 2259 m alt.; 26.X.2019; joegr org.; #35060716 • Coyoacán; 19.3166, −099.1953; 2329 m alt.; 23.1.2020; gisell.15 obs.; #38029338 • San Andrés Ahuayucan, Xochimilco; 19.2237, −099.1044; 2427 m alt.; 21.XI.2020; alejandro.fb obs.; #78639522 • Ajusco, Coyoacán; 19.3218, −099.1614; 2280 m alt.; 14.IV.2021; joancarloso obs.; #74149041 • Ciudad Universitaria, Coyoacán; 19.3203, −099.1728; 2272 m alt.; 15.XI.2017; dani mg obs.; #67741299 • Atizapán de Zaragoza; 19.5605, −099.2457; 2289 m alt.; 6.XII.2020; Oswaldo Maldonado Flores obs.; #66220766 • Parque Nacional Bosque de Pedregal, Tlapalpan; 19.2875, −099.2100; 2476, a.s.l.; 1.X.2020; dani mg obs.; #61449108 • La Draga, Tlapalpan; 19.2819, −099.0421; 2241 m alt.; 23.VIII.2020; joegr org.; #57497509 • Condo minios del Bosque, Tlapalpan; 19.2960, −099.1890; 2304 m alt.; 21.VIII.2020; davidcruz82, #54458163 • Amp. Cuchilla Tepecimilpa, Tlapalpan; 19.2692, −099.1926; 2691 m alt.; 29.V.2020; leonday_jlda obs.; #40996897 • Amp.

**Figure 4.** Dorsal aspect of the head and neck of *Bipalium kewense*, diagnostic of the species. Specimen GEOPL001, post fixation.
A very long species, up to 80 cm. Head laterally expanded into a semilunate headplate with recurved lappets. Dorsal ground color light brown; head with the same color of the dorsum or slightly darker. Dorsum with five longitudinal black to dark-gray or dark-brown stripes, median, paired lateral and paired marginal. Median stripe black, narrow, and well-marked; it starts behind neck and broadens over pharyngeal area. Lateral stripes lighter, broader, and with diffuse margins. Marginal stripes narrow, dark, and well-marked. Lateral and marginal stripes of each side unite behind neck to form an incomplete collar (Figs. 1B, 4). Ventral surface light-ochre, with white creeping sole distinct, ridged, and delineated by paired, narrow, diffuse grayish, longitudinal stripes which extend from the ventral portion of the collar to the posterior end; collar interrupted on each side of creeping sole (Winsor 1983; Justine et al. 2018).

**Distribution in Mexico.** Recorded from Baja California, Chiapas, Ciudad de México, Coahuila, Colima, Durango, Estado de México, Guanajuato, Hidalgo, Jalisco, Michoacán, Morelos, Nayarit, Nuevo León, Oaxaca, Puebla, Querétaro, San Luis Potosí, Tamaulipas, Tlaxcala, Veracruz, and Zacatecas.

*Bipalium vagum* Jones & Sterrer, 2005

**Material examined.** MEXICO – Tamaulipas • Reserva de la Biosfera “El Cielo”, gardens of the Centro Interpretativo Ecológico CIE, Gomez Farias; 23.0066, −099.1684; 819 m alt.; 5.VII.2020; Manuel de Luna and Roberto García-Barrios leg.; active on a rainy night (around 00:00), fixed in Winsor’s fixative, GEOPL002.

*iNaturalist records.** MEXICO – Campeche • cerca de “Alacranes”, Calakmul; 17.9317, −089.2264, 69 m alt.; 16.XII.2020; Maricruz_juarez1 obs.; #74080154 • Tenabo; 19.9632, −090.2046; 16 m alt.; 27.VII.2021; carloskumijangos obs.; #8890341 • San Antonio Bobolá, Campeche; 19.7705, −090.4189; 21 m alt.; 13.IX.2021;

![Figure 5. Dorsal aspect of the head and neck of *Bipalium vagum*, diagnostic of the species. Specimen GEOPL002, prior to anesthesia.](image)
Bipalium kewense has been previously reported from Mexico by Winsor (1983), but the locality in the country was unspecified. The specimen on which this is based is in the Zoologisches Institut and Zoologisches Museum der Universität Hamburg (Hamburg, Germany) with the voucher number V10734. The data are “Mexico, in garden under old [indecipherable] Dr. Dampf [or Dampf] and Rob. Muller. xi. 1928” (L. Winsor pers. comm.; specimen not examined by us). Therefore, we provide for the first time records of this species for 22 Mexican states.

Bipalium vagum has never been formally recorded for Mexico, so the records presented here are the first for the country and for 17 states.

The distribution patterns of both species correspond to the predictions made by Fourcade et al. (2022), who also used iNaturalist records. No hammerhead flatworms were recorded from the states of Aguascalientes, Baja California Sur, Chihuahua, or Sonora.

The iNaturalist platform has been recognized as a valuable tool for contributing to the knowledge of species’ distributions (Chandler et al. 2017; Alzate-Cano and Hurtado-Pimienta, 2021). Given that hammerhead flatworm species recorded in North America can be confidently identified by photographs alone (when diagnostic features are visible), this citizen science app is appropriate to monitor their distribution on the continent, as it has been done previously for invasive (Hiller and Haelewa 2019; Werenkraut et al. 2020) and endangered (Roux et al. 2019) species. However, although citizen science can be a very helpful tool, it cannot replace museum collections, and for this reason we decided to describe our collection and fixation techniques here.

Finally, we emphasize the need to study the genital structure of mature specimens of Diversibipalium multilineatum to properly assign it to one of the three
“natural” genera. Since many introduced land planarians reproduce only asexually outside of their place of origin or preferred climate, not developing sex organs, molecular studies can also help characterize a species and its phylogenetic position (Justine et al. 2018, 2022).

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Author’s Contributions

Conceptualization: ML. Data curation: RGB, ML, PV. Formal analysis: ML, PV, RGB. Investigation: PV, ML, RGB. Methodology: ML. Resources: PB. Validation: PB. Visualization: PB. Writing – original draft: ML. Writing – review and editing: PB.

References

Álvarez-Presas M, Mateos E, Tudó Á, Jones H, Riutort M (2014) Diversity of introduced terrestrial flatworms in the Iberian Peninsula: a cautionary tale. PeerJ 2: e430. https://doi.org/10.7717/peerj.430
Alzate-Cano JD, Hurtado-Pimiento EA (2021) Tipulodes annae Pryzybylowicz, 2003 (Lepidoptera, Erebidae): rediscovery in the wild and citizen science. Check List 17: 1255–1259. https://doi.org/10.15560/17.5.1255
Ball JR, Shuys R (1990) Turbellaria: Tricladiida: Terricola In: Dindal DL (Ed.) Soil biology guide. John Wiley & Sons, New York, USA, 137–153.
Baptista V dos A, Leal-Zanchet AM (2010) Inventario de planárias terrestres (Platyhelminthes, Tricladida) em remanescentes de Floresta Estacional Decidual do Sul do Brasil. Biotota Neotropica 10: 247–252.
Chandler M, See L, Copas K, Bonde AM, López BC, Danielsen F, Alzate-Cano JD, Hurtado-Pimiènta EA (2021) Tipulodes annae Pryzybylowicz, 2003 (Lepidoptera, Erebidae): rediscovery in the wild and citizen science. Check List 17: 1255–1259. https://doi.org/10.15560/17.5.1255
Ducey PK, Messere M, Lapoint K, Noce S (1999) Lumbrecid prey and potential herpetofaunal predators of the invading terrestrial flatworm Bipalium adventitium (Turbellaria: Tricladiida: Terricola). American Midland Naturalist 140: 301–314. https://doi.org/10.1674/0003-0031(1999)140[0301:fpapdp]2.0.co;2
Ducey PK, Noce S (1998) Successful invasion of New York state by the terrestrial flatworm, Bipalium adventitium. Northeastern Naturalist 5: 199–206. https://doi.org/10.2307/3858619
Filella-Subirà E (1983) Nota sobre la presència de la planària terrestre Bipalium kewense Moseley, 1978 a Catalunya. Butlletí de la Institució Catalana d’Història Natural 49: 151.
Fourcade Y, Winsor L, Justine JL (2022) Hammerhead worms everywhere? Modelling the invasion of bipalian flatworms in a changing climate. Diversity and Distributions 28: 844–858. https://doi.org/10.1111/ddi.13489
Hiller T, Haelewaters D (2019) A case of silent invasion: citizen science confirms the presence of Harmonia axyridis (Coleoptera, Coccinellidae) in Central America. PLoS ONE 14: e0220082: 1–16. https://doi.org/10.1371/journal.pone.0220082
Hymen LH (1943) Endemic and exotic land planarians in the United States with a discussion of necessary changes of names in the Rhynhchodemidae. American Museum Novitates 1241: 1–21.
Jones HD, Sterrer W (2005) Terrestrial planarians (Platyhelminthinae, with three new species) and nemertines in Bermuda. Zootaxa 1001: 31–58. https://doi.org/10.11646/zootaxa.1001.1.3
Justine J-L, Théry T, Gey D, Winsor L (2019) First record of the invasive flatworm bipalium adventitium (Platyhelminthidae, Geoplanidae) in Canada. Zootaxa 4656: 591–595. https://doi.org/10.11646/zootaxa.4656.3.13
Justine J-L, Gastineau R, Gros P, Gey D, Ruzzzier E, Charles L, Winsor L (2022) Hammerhead flatworms (Platyhelminthidae, Geoplanidae, Bipaliana): mitochondrial genomes and description of two new species from France, Italy, and Mayotte. PeerJ 10:12725: 1–55. https://doi.org/10.7717/peerj.12725
Justine J-L, Winsor L, Gey D, Gros P, Thévenot J (2018) Gigant worms chez moi! Hammerhead flatworms (Platyhelminthidae, Geoplanidae, Bipaliana spp., Diversibipalium spp.) in metropolitan France and overseas French territories. PeerJ 6:6472: 1–45. https://doi.org/10.7717/peerj.6472
Kawakatsu M, Ogren RE, Froehlich EM (1998) The taxonomic revision of several homonyms in the genus Bipalium, family Bipalianidae (Turbellaria, Seriata, Tricladida, Terricola). Bulletin of Fuji Women’s College 36: 83–93.
Kawatsus M, Ogren RE, Froehlich EM, Takai M, Sasaki G-Y (2002) Miscellaneous papers on turbellarians. Bulletin of Fuji Women’s College 40: 157–177.
Makino N, Shirasawa Y (1983) 東京周辺の長大,細長型二新種,有稼業コウガイビルにおける形態および生態学的比較と新種名[Morphological and ecological comparison with two new species of elongated-slower land planarians have several stripes and their new scientific names]. Bulletin of Tokyo Medical College 9: 69–83 [in Japanese].
Mizuno T, Kojima Y (2017) Indotyphlops braminus (Brahminy blindsnake) Predation. Herpetological Review 48: 451.
Morff J, García N, Adams BJ, Hasegawa K (2016) First record of the land planarian Bipalium kewense Moseley, 1878 (Tricladiida: Geoplanidae) from Cuba. BioInvasions Records 5(5): 127–132. https://doi.org/10.3391/bir.2016.5.3.01
Negrete L, Brusa F, Damborenea C (2012) A new species of Geoplanina (Platyhelminthes: Tricladiida: Geoplanidae) from the Western Amazon basin with comments on the land planarian fauna from Peru. Zootaxa 3358: 55–67. https://doi.org/10.11646/zootaxa.3358.1.3
Ogren RE (1981) Land planarians in Pennsylvania. Proceedings of the Pennsylvania Academy of Science 55: 52–56.
Ogren RE (1984) Exotic land planarians of the genus Bipalium (Platyhelminthes: Tricladiida) from Pennsylvania and the Academy of Natural Sciences, Philadelphia. Proceedings of the Philadelphia Academy of Science 58: 193–201.
Ogren RE (1987) Description of a new three-lined land planarian of the genus Bipalium (Tricladiida: Terricola) from Pennsylvania, U.S.A. Transactions of the American Microscopical Society 106: 21–30.
Ogren RE, Kawakatsu M (1987) Index to the species of the genus Bipalium (Turbellaria, Tricladida, Terricola). Bulletin of Fuji Women’s College 25: 79–119.
Ogren RE, Sheldon JK (1991) Ecological observations on the land pla-
narian Bipalium pennsylvanicum Ogren, with references to phe-
nology, reproduction, growth rate and food niche. Journal of the
Pennsylvania Academy of Science 65: 3–9.
Ogren RE, Sluys R (2001) The genus Humbertium gen. nov., a new
taxon of the land planarian family Bipaliidae (Tricladidae, Ter-
ricola). Belgian Journal of Zoology (Supplement 1) 131: 201–204.
Okochi I, Sato H, Ohbayashi T (2010) The cause of mollusk decline on
the Ogasawara Islands. In: Kawakami K, Okochi I. (Ed). Restor-
ing the oceanic island ecosystem: impact and management of in-
vasive alien species in the Bonin Islands. Springer Japan, Tokyo,
Japan, 15–25.
Rodríguez-Cabrera TM, Torres J (2019) New locality records of Bi-
palium kewense (Platyhelminthes: Tricladida: Geoplanidae) in
Cuba. Poeyana 508: 38–41.
Reinés-Álvarez MM (1996) Nuevo registro de turbelarios terrestres
para Cuba. Revista Biología 10: 3–8.
Roux JM de, Noguera-Urbano EA, Ramirez-Chavez HE (2019) The
vulnerable Colombian weasel Mustela felipei (Carnivora): new re-
cord from Colombia and a review of its distribution in protected
areas. Therya 10: 207–210. https://doi.org/10.12933/therya-19-776
Sánchez-García I (2014) Cuatro planarias terrestres exóticas nuevas
para Andalucía. Revista de la Sociedad Gaditana de Historia Nat-
ural 8: 15–20.
Shorthouse, DP (2010) SimpleMappr, an online tool to produce pub-
lication-quality point maps, https://www.simplemappr.net/. Ac-
cessed on: 2021-01-01.
Wallace RD, Winsor L (2020) Hammerhead worms Bipalium spp. &
Diversibipalium multilineatum. Center for Invasive Species and
Ecosystem Health, University of Georgia, Athens, USA, 1 p.
https://bugwoodcloud.org/resource/files/18410.pdf. Accessed on:
2022-5-21.
Werenkraut V, Baudino F, Roy HE (2020) Citizen science reveals the
distribution of the invasive Harlequin ladybird (Harmonia axy-
ridis Pallas) in Argentina. Biological Invasions 22: 2915–2921.
https://doi.org/10.1007/s10530-020-02312-7
Winsor L (1983) A revision of the cosmopolitan land planarian Bip-
palium kewense Moseley, 1878 (Turbellaria: Tricladida: Terricola).
Zoological Journal of the Linnean Society 79: 61–100.
Winsor L (1998) Collection, handling, fixation, histological and stor-
age procedures for taxonomic studies of terrestrial flatworms
(Tricladida: Terricola). Pedobiologia 42: 405–411.
Winsor L, Johns PM, Yeates GW (1998) Introduction, and ecological
and systematic background, to the Terricola (Tricladida). Pedo-
biologia 42: 389–404.
Winsor L, Sluys R (2018) Basic histological techniques for planarians.
In: Rink JC (Ed). Planarian Regeneration: Methods and Protocols.
Humana Press, New York, USA, 285–351.
Wu SW, Kawakatsu M, Lue KY, Lee JD, Tsai CL, Lin HH, Sluys R,
Sasaki GY (2005) A preliminary study on land planarians on Tai-
wan. Endemic Species Research 7: 23–40.