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Host relationships and geographic distribution of species of *Acanthobothrium* Blanchard, 1848 (Onchoproteocephalidea, Onchobothriidae) in elasmobranchs: a metadata analysis

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Abstract

Species of *Acanthobothrium* have been documented as parasites of the spiral intestine of elasmobranchs. Results of a metadata analysis indicate that 114 species of elasmobranchs have been reported as hosts of 200 species of *Acanthobothrium*. The metadata analysis revealed that 3.7% of species of sharks and 14.9% of species of rays that have been reported as hosts to date; some species are parasitized by more than one species of *Acanthobothrium*. This work provides a Category designation, as proposed by Ghoshroy and Caira (2001), for each species of *Acanthobothrium*. These Category designations are a tool to facilitate comparisons among members of *Acanthobothrium* for descriptions of new species in the future.

Keywords

Biodiversity, Elasmobranchii, Eucestoda, geographic distribution, rays, sharks

Introduction

According to Last et al. (2016b), there are 34 families comprised of 516 valid species of sharks and 26 families that include 633 valid species of rays. Since that publication, six new species of sharks and rays were described by: Yokota and Carvalho (2017) (two species of rays), Vaz and Carvalho (2018) (one species of shark), Rutledge (2019) (one species of ray), Grace et al. (2019) (one species of shark) and Concha et al. (2019) (one species of ray). This brought the current number of recognized species to 517 species of sharks and 637 species of rays.

Elasmobranchs (sharks, skates and rays) are host to a great variety of parasites in nature, particularly helminths. *Acanthobothrium* Blanchard, 1848 (Onchoproteocephalidea) is the most diverse genus that has been reported as parasite of the spiral intestine of elasmobranchs (Caira and Jensen 2017). At the present time, 201 species of *Acanthobothrium* are considered to be valid (Maleki et al. 2013; Caira and Jensen 2017; Rodríguez-Ibarra et al. 2018; Franzese and Ivanov 2018; Maleki et al. 2019; Zaragoza-Tapia et al. 2019, 2020). The genus consists of species that exclusively parasitize elasmobranchs as adults and, in many cases, individual species are thought to parasitize only a single species of elasmobranch (Caira 2011; Caira and Jensen 2017). Therefore, the genus *Acanthobothrium* is an excellent model for future studies of host-parasite co-speciation.

The main goal of this work is to provide a revised checklist based on a metadata analysis of the host relationships of members of *Acanthobothrium* and their geographic distribution based on records that have been generated from different parts of the world. The checklist focuses on the 201 valid species of *Acanthobothrium* and reports correlated with the genera and species of elasmobranchs, and includes the geographical distribution of each.

The number of species of *Acanthobothrium* continues to grow and there are still regions of the world without a single report of this genus (see Figure 1). For some time, the process of distinguishing new species of *Acanthobothrium* from existing species has become more and more unwieldy because of the large number of species. As an identification tool, Ghoshroy and Caira (2001) developed a categorical method for identifying species for initial comparisons. Therefore, in order to provide an update to this method, categorical designations are provided in the present checklist for each species of *Acanthobothrium* in the manner proposed by Ghoshroy and Caira (2001). The categories are based on and obtained from the combination of four quantitative characters: total length of the worm; the number of proglottids comprising the strobila; the number of testes per proglottid; and symmetry of the ovarian lobes. This categorical designation allows parasitologists working with this genus to postulate a group of similar species, those of the same category designation, for comparison of a new species or to aid in the preliminary identification of known species. As an additional aid, in the checklist the accession number, if known, of type specimens of each species is provided.

Materials and methods

The checklist, updated until March 2020, was based on bibliographical information from two sources of information: 1. a compilation of the records of species of *Acanthobothrium* as originally described, complemented by information gathered from Global Cestode Database (Caira et al. 2019) and from recent compilation studies (e.g., Ghoshroy and Caira 2001; Campbell and Beveridge 2002; Fyler and Caira 2006; Caira and Jensen 2017); and 2. information for the distribution and taxonomy of elasmobranchs that integrated a bibliographical search using different databases of literature published to date (e.g., Del Moral-Flores et al. 2015; Last et al. 2016b; Merlo-Serna and García-Prieto 2016; Alves et al. 2017) and data from FishBase (Froese and Pauly 2019).

In the checklist, the species of *Acanthobothrium* are arranged in alphabetical order. The scientific names and geographic distribution of elasmobranchs have been updated based on Last et al. (2016a, 2016b), Amaral et al. (2018) and Froese and Pauly (2019). The regional classification scheme of the geographic distribution of the hosts is according to Last et al. (2016b) with additional information from Froese and Pauly (2019). The following abbreviations are used for biogeographic regions (see Figure 1):

ARC Arctic Ocean;
ECA Eastern Central Atlantic;
ECP Eastern Central Pacific;
EIO Eastern Indian Ocean;
ENA Eastern North Atlantic;
ENP Eastern North Pacific;
ESA Eastern South Atlantic;
ESP Eastern South Pacific;
MED Mediterranean Sea;
NIO Northern Indian Ocean;
SOC Southern (Antarctic) Ocean;
WCA Western Central Atlantic;
WCP Western Central Pacific;
WIO Western Indian Ocean;
WNA Western North Atlantic;
WNP Western North Pacific;
WSA Western South Atlantic;
WSP Western South Pacific.

Information for each species of *Acanthobothrium* presented herein includes the name of the species, authority (original description referenced in the literature cited), abbreviation of the name of the collection where specimens are deposited and the accession numbers of the specimens, followed by the status of the specimens (holotype, paratype, neotype, syntype or voucher). The acronym "NR" was used for data that are not reported in the original source. Localities (type or/and additional localities) were given and referenced in the literature cited. A Category designation was supplied for all species using the categorical method proposed by Ghoshroy and Caira (2001).

The categorical method was developed as a system of grouping species of *Acanthobothrium* based on the combination of four qualitative characters: the total length of worms- ≤ 15 mm = S (short) or > 15 mm = L (long); the number of proglottids comprising the strobila- ≤ 50 = F (few) or > 50 = M (many); the number of testes per proglottid- ≤ 80 = F (few) or > 80 = M (many); and symmetry of the ovarian lobes- symmetrical = S or asymmetrical = A. Of the possible combinations the following 10

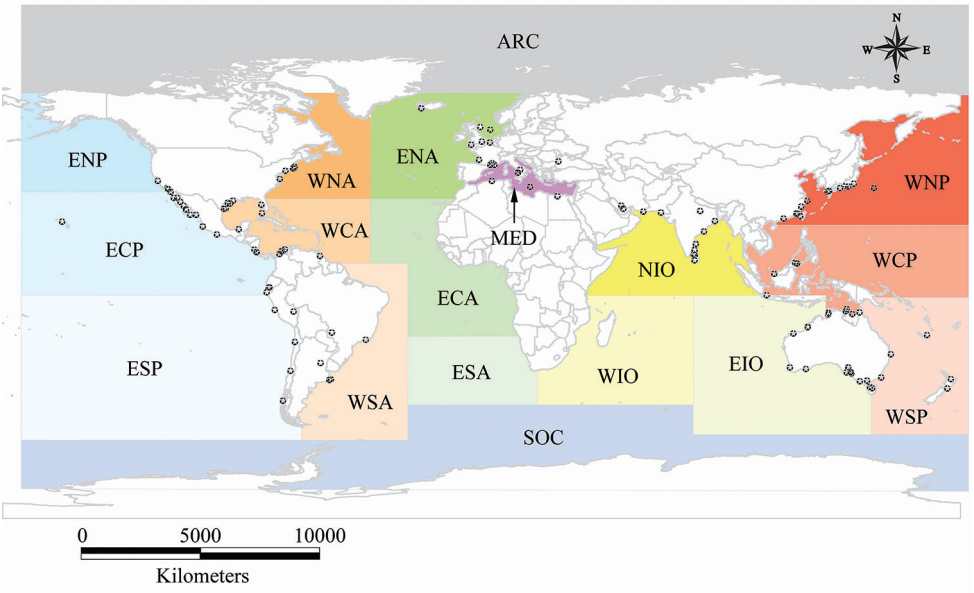

Figure 1. Type localities of species of *Acanthobothrium* reported worldwide and the biogeographic regions (Last et al. 2016b) of the geographic distribution of their hosts (see Table 1).

categories currently are recognized and coded as follows: 1 = SFFS; 2 = SFFA; 3 = LMMA; 4 = LMMS; 5 = LMFS; 6 = LMFA; 7 = LFFA; 8 = SMFS; 9 = LFFS; 10 = SMMS. This method limited the number of necessary comparisons required in the description between known species with new species assigned to the same Category. For this work, the categories and characteristics were used as in Ghoshroy and Caira (2001) and Fyler and Caira (2006) but the character values are as given in the original descriptions or as supplemented by the most recent taxonomic publications. In the Category designation, the type species is identified by number for this classification; the symbol "–" was used for the additional reports of species with additional hosts and/or localities.

For specimens deposited in a formal collection, acronyms are as follows:

AMS Australian Museum, Sydney;

CH-MHNJP Colecciones Helmintológicas del Museo de Historia Natural "Javier Prado" y del Instituto de Medicina Tropical "Daniel. A. Carrión", Universidad Mayor de San Marcos, Perú;

CHE Colección de Helmintos, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo, Pachuca, México;

CHIOC Coleção Helmintológica do Instituto Oswaldo Cruz, Rio de Janeiro, Brazil;

CNHE Colección Nacional de Helmintos del Instituto de Biología, Universidad Nacional Autónoma de México, México;

DMNZ	Dominion Musem (=National Museum), New Zealand;
DZAUW	Department of Zoology, Andhra University, Waltair, India;
DZCJ	Department of Zoology, Bipin Bihari, P. G. College, Jhansi, India;
HWML	University of Nebraska State Museum, Harold W. Manter Laboratory, Division of Parasitology, Lincoln, Nebraska, United States;
IPCAS	Institute of Parasitology, Academy of Sciences of the Czech Republic, České Budějovice, Czech Republic;
IPMB	Institut Penyelidikan Marin Borneo (Borneo Marine Research Institute), Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia;
LRP	Lawrence R. Penner Parasitology Collection, Helminthological Collection, University of Connecticut, Storrs, Connecticut, United States;
MACN-Pa	Museo Argentino de Ciencias Naturales, Colección Parasitológica, Buenos Aires, Argentina;
MEPN	Museum of the Escuela Politecnica Nacional, Quito, Ecuador;
MHNLS	Museo de Historia Natural La Salle, Caracas, Venezuela;
MHNP	Museo de Historia Natural, Lima, Peru;
MLP	Museo de Ciencias Naturales de La Plata, Departamento de Zoología Invertebrados (Parasitología), Argentina;
MNHG	Museum of Natural History, Geneva, Switzerland;
MNHN	Muséum National d'Histoire Naturelle, Paris;
MNHNC	Museo Nacional de Historia Natural de Chile;
MPM	Meguro Parasitology Museum, Tokyo, Japan;
MZUM (P)	Muzium Zoologi, Universiti Malaya, Kuala Lumpur, Malaysia;
MZUSP	Museu de Zoologia da Universidade de São Paulo, Brazil;
NHMUK	The Natural History Museum, London;
NMNS	National Museum of Natural Science, Taichung, Taiwan;
PRLXU	Parasitology Research Laboratory, Xiamen University, China;
QM	Queensland Museum, Brisbane, Queensland, Australia;
SAM AHC	South Australian Museum, Adelaide, Australia;
SBC	Sarawak Biodiversity Center, Kuching, Sarawak, Malaysia;
SPUK	School of Parasitology, Department of Zoology, University of Karachi, Pakistan;
SYSU	School of Life Sciences, Sun Yat-sen University;
UAA	Department of Zoology, University of Allahabad, Allahabad, India;
USNPC	United States National Parasite Collection, Beltsville, Maryland, United States;
ZCUOK	Zoological Collection, University of Kurdistan, Sanandaj, Iran;
ZIMC	Collection of the Zoological Survey of India, Indian Museum, Calcutta and the Collection of the Department of Zoology, the University of Allahabad, India;
ZMB	Natural History Museum Berlin, Germany;
ZUTC	Collection of the Zoological Museum, University of Tehran, Tehran, Iran.

Table 1. Species of *Acanthobothrium* reported from the different species of elasmobranchs of the world. Abbreviations: Gd = Geographical distribution; Ht = Holotype; Nt = Neotype; Pt = Paratype; Va = Voucher; Loc = Locality; Sou = Source; Cd = Category designation; * = Additional host; † = Additional locality; ‡ = Category designation obtained from Ghoshroy and Caira (2001); § = Category designation obtained from Fyler and Caira (2006); ¶ = Category designation obtained in this study from original descriptions; ** = Host identification requiring confirmation.

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. adlardi Campbell & Beveridge, 2002	SAM AHC 28210	SAM AHC 22723, 22724	*Pristiophorus cirratus* (Latham, 1794)	EIO, WSP	Port Stanvac, South Australia	Campbell and Beveridge (2002)	4§
A. aetiobatidis (Shipley, 1900) Southwell, 1925	NR	NR	*Aetobatus narinari*** (Euphrasen, 1790)	WSA, WCA, WNA, ECA	Lifu, Loyalty Islands	Shipley (1900),Southwell (1925), Baer and Euzet (1962),Goldstein (1967)	6§
A. amazonensis Mayes, Brooks & Thorson, 1978	USNPC 74806	USNPC 74807; HWML 20562	*Potamotrygon circularis* German, 1913	WSA	Itacuari River, Brazil	Mayes et al. (1978)	5‡
A. americanum Campbell, 1969	USNPC 71355	USNPC 71356	*Hypanus americanus* (Hildebrand & Schroeder, 1928)	WSA, WCA, WNA	Chesapeake Bay, Virginia, USA	Campbell (1969)	6‡
A. americanum†	NR	NR	*Hypanus americanus*	WSA, WCA, WNA	Isla Margarita, Venezuela	Mayes and Brooks (1981)	–
A. angelae Campbell & Beveridge, 2002	SAM AHC 22661	SAM AHC 22709, 22712	*Hypnos monopterygius* (Shaw, 1795)	EIO, WSP	Yarraville Shoals, South Australia	Campbell and Beveridge (2002)	5§
A. annapinkiensis Carvajal & Goldstein, 1971	MNHNC 20.003	NR	*Zearaja chilensis* (Guichenot, 1848)	ESP, WSA,	Anna Pink Bay, Chile	Carvajal-G. and Goldstein (1971)	2‡
A. arlenae Campbell & Beveridge, 2002	SAM AHC 28225	SAM AHC 28226	*Aetobatus narinari***	WSA, WCA, WNA, ECA	Fog Bay, Timor Sea, North Australia	Campbell and Beveridge (2002)	6§
A. asnihae Fyler & Caira, 2006	MZUM (P) 142	USNPC 96413; LRP 3809-3812, LRP 3814 (including cross sections and SEM specimens); MZUM (P) 143–144; IPMB 77.14.04	*Urogymnus polylepis* (Bleeker, 1852)	NIO, WCP	Off Kampung Abai, Kinabatangan River, Sabah, Malaysia	Fyler and Caira (2006)	1§
A. asrinae Maleki, Malek & Palm, 2015	ZUTC 1325	ZUTC 1326; ZMB E.7569; SEM voucher ZUTC 1327	*Rhynchobatus* cf. *djiddensis*** (Forsskå, 1775)	WIO, NIO	Persian Gulf, Iran	Maleki et al. (2015)	**1¶**

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. atahualpai Marques, Brooks & Barringa, 1997	MEPN 3029	MNHG 22098; CNHE 3029	*Gymnura afuerae* (Hildebrand, 1946)	ECP, ESP	Puerto Bolivar, Provincia de El Oro, Ecuador	Marques et al. (1997a)	1‡
A. australis Robinson, 1965	AMS	AMS	*Squalus megalops* (Macleay, 1881)	ENA, MED, ECA, ESA, WIO, EIO, WSP	Eden, New South Wales, Australia	Robinson (1965)	3§
A. australis†	NR	SAM AHC 22696	*Squalus megalops*	ENA, MED, ECA, ESA, WIO, EIO, WSP	Beachport, South Australia	Campbell and Beveridge (2002)	–
A. bajaensis Appy & Dailey, 1973	USNPC 72567	USNPC 72568	*Heterodontus francisci* (Girard, 1855)	ECP, ESP	San Quintin Bay, Baja California, Mexico	Appy and Dailey (1973)	4‡
A. bajaensis†	NR	NR	*Heterodontus francisci*	ECP, ESP	Newport Bay, California, USA	Appy and Dailey (1973)	–
A. bartonae Campbell & Beveridge, 2002	SAM AHC 28235	NR	*Rhynchobatus djiddensis***	WIO, NIO	Broome, Western Australia	Campbell and Beveridge (2002)	1§
A. batailloni Euzet, 1955	NR	NR	*Myliobatis aquila* (Linnaeus, 1758)	ENA, MED, ECA, ESA, WIO	Mediterranean Sea, Gulfe du Lion	Euzet (1955)	7(2)‡
*A. batailloni**†	NR	MNHNC 20015	*Myliobatis chilensis*** Philippi, 1892	ESP	Antofagasta, Chile	Carvajal-G. and Jeges-G. (1980)	–
*A. batailloni**†	NR	NR	*Myliobatis chilensis***	ESP	Coquimbo, Chile	Carvajal-G. and Jeges-G. (1980)	–
*A. batailloni**†	NR	NR	*Myliobatis chilensis***	ESP	Trujillo, Peru	Escalante-A. (1986)	–
A. benedenii (Lönnberg, 1889)	NR	NR	*Raja clavata* Linnaeus, 1758	ENA, MED, ECA, ESA, WIO	Mediterranean Sea	Lönnberg (1889)	**2¶**

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
*A. benedenii**†	NR	NR	*Pteroplatytrygon violacea*** (Bonaparte, 1832)	ENP, ECP, ESP, WSA, WCA, WNA, ENA, MED, ECA, ESA, WIO, NIO, EIO, WSP, WCP, WNP	Naples, Italy	Baer (1948)	–
*A. benedenii**†	NR	NR	*Torpedo marmorata*** Risso, 1810	ENA, MED, ECA, ESA	Casablanca, Marruecos	Euzet (1952), Euzet (1959)	–
A. bengalense Baer & Euzet, 1962	NR	NR	*Pastinachus sephen* (Forsskål, 1775)	NIO	Nagapattinam, India	Baer and Euzet (1962)	4§
A. blairi Campbell & Beveridge, 2002	SAM AHC 28211	SAM AHC 28212	*Dipturus whitleyi* (Iredale, 1938)	EIO, WSP	Stanley, Tasmania	Campbell and Beveridge (2002)	3§
A. blairi†	NR	NR	*Dipturus whitleyi*	EIO, WSP	Spencer Gulf, South Australia	Campbell and Beveridge (2002)	–
A. bobconniorum Fyler & Caira, 2010	QM G232499	QM G232500–G232501; USNPC 104278; LRP 7583–7585; cross sections of one paratype worm and voucher LRP 7586, 7588, 7589, SEM LRP 7587–7590	*Rhynchobatus laevis*** (Bloch & Schneider, 1801)	NIO, WNP	Gove Harbor, Gulf of Carpentaria, Northern Territory, Australia	Fyler and Caira (2010)	**2¶**
A. brachyacanthum Riser, 1955	USNPC 37418	NR	*Raja stellulata* (Gilbert, 1915)	ENP, ECP	Monterey Bay, California, USA	Riser (1955)	2‡
*A. brachyacanthum**	NR	NR	*Beringraja binoculata*** (Gilbert, 1855)	ENP, ECP	Monterey Bay, California, USA	Riser (1955)	–
A. brayi Campbell & Beveridge, 2002	SAM AHC 22670	SAM AHC 22730	*Sutorectus tentaculatus* (Peters, 1864)	EIO, WSP	Eastern Shoal, South Australia	Campbell and Beveridge (2002)	2§
A. brevissime Linton, 1909	USNPC 9008	NR	*Hypanus say* (Lesueur, 1817)	WSA, WCA, WNA	Dry Tortugas, Florida, USA	Linton (1908), Goldstein (1964)	2‡

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
*A. brevissime**†	NR	NR	*Raja eglanteria* Bosc, 1800	WCA, WNA	Gulf of Mexico, Chesapeake Bay, Virginia, USA	Campbell (1969)	–
*A. brevissime**†	NR	USNPC 71349, 71350	*Hypanus americanus*	WSA, WCA, WNA	Gulf of Mexico, Chesapeake Bay, Virginia, USA	Campbell (1969)	–
*A. brevissime**†	NR	CH-MHNJP 727	*Myliobatis peruvianus*** Garman, 1913	ESP	Lima, Peru	Tantaleán-Vidaurre (1991)	–
A. brevissime†	USNPC 9008	USNPC 60178 (neotype)	*Hypanus say*	WSA, WCA, WNA	Gulf of Mexico, Chesapeake Bay, Virginia, USA	Campbell (1969), Vardo-Zalik and Campbell (2011)	–
A. bullardi Ghoshroy & Caira, 2001	CNHE 4045	CNHE 4046–4047; LRP 2060–2062; USNPC 90466–90468	*Hypanus dipterurus* (Jordan & Gilbert, 1880)	ECP	Bahía de Los Angeles, Gulf of California, Mexico	Ghoshroy and Caira (2001)	2‡
A. bullardi†	NR	NR	*Hypanus dipterurus*	ECP	Puertecitos, Gulf of California, Mexico	Ghoshroy and Caira (2001)	–
A. bullardi†	NR	NR	*Hypanus dipterurus*	ECP	Santa Rosalia, Gulf of California, Mexico	Ghoshroy and Caira (2001)	–
A. cairae Vardo-Zalik & Campbell, 2011	USNPC 103801	USNPC 103802–103814	*Bathytoshia centroura* (Mitchill, 1815)	WSA, WCA, WNA	Narragansett Bay off Sakonnet Point, Rhode Island, USA	Vardo-Zalik and Campbell (2011)	**3¶**
A. campbelli Marques, Brooks & Monks, 1995	MNHG 20014	MNHG 20015–20016; HWML 38546; CNHE 3033	*Urotrygon chilensis* (Günther, 1872)	ECP, ESP	Costa de Pajaros, Puntarenas, Costa Rica	Marques et al. (1995)	2‡
*A. campbelli**†	NR	MEPN 3033	*Hypanus longus* (Garman, 1880)	ECP	Puerto Huatulco, Provincia de El Oro, Ecuador	Marques et al. (1997a)	–
A. cannoni Campbell & Beveridge, 2002	SAM AHC 28236	SAM AHC 28237	*Himantura uarnak* (Gmelin, 1789)	WIO, NIO, EIO, WCP	Fog Bay, Timor Sea, North Australia	Campbell and Beveridge (2002)	4§
A. cartagenensis Brooks & Mayes, 1980	USNPC 75159	NR	*Urobatis jamaicensis* (Cuvier, 1816)	WCA, WNA	Cartagena, Colombia	Brooks and Mayes (1980)	**1¶**

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. cartagenensis†	NR	CNHE 9706; HWML 101020; CHE P00061	*Urobatis jamaicensis*	WCA, WNA	Ría Lagartos, Yucatán, Quintana Roo	Monks et al. (2015)	–
A. cartagenensis†	NR	CNHE 9706; HWML 101020; CHE P00061	*Urobatis jamaicensis*	WCA, WNA	Isla Contoy, Quintana Roo	Monks et al. (2015)	–
A. cartagenensis†	NR	CNHE 9706; HWML 101020; CHE P00061	*Urobatis jamaicensis*	WCA, WNA	Isla Cozumel, El Paso de los Cedros, Quintana Roo	Monks et al. (2015)	–
A. cartagenensis†	NR	CNHE 9706; HWML 101020; CHE P00061	*Urobatis jamaicensis*	WCA, WNA	Xcalak, Quintana Roo	Monks et al. (2015)	–
A. cestraciontis (Yamaguti, 1934)	NR	NR	*Heterodontus japonicus* Miklouho-Maclay & Macleay, 1884	WNP, WCP	Pacific Ocean, Japan	Yamaguti (1934)	4§
A. cestraciontis†	NR	NR	*Sphyraena japonica*** (Bloch &Schneider, 1801)	?	Pacific Ocean, Japan	Goldstein (1967)	–
A. chabahariense Maleki, Malek & Rastgoo, 2018	ZCUOK 100	ZCUOK 101– 112 and (SME specimen) ZCUOK 113	*Pastinachus* cf. *sephen***	NIO	Chabahar coasts, the coast of the Gulf of Oman, Iran	Maleki et al. (2018)	**1¶**
A. chengi Cornford, 1974	USNPC 72958	USNPC 72959	*Bathytoshia lata* (Garman, 1880)	ECP, ENA, MED, ECA, WIO, NIO, EIO, WSP, WCP, WNP	Oahu, Hawaii	Cornford (1974)	3§
A. chilensis Rego, Vincente & Herrera, 1968	CHIOC 30.308 a-c	NR	*Sarda chiliensis*** (Cuvier, 1832)	?	Paita, Piúra, Peru	Rêgo et al. (1968)	3‡
A. chisholmae Campbell & Beveridge, 2002	SAM AHC 28223	SAM AHC 28224	*Pastinachus sephen***	NIO	Nickol Bay, Western Australia	Campbell and Beveridge (2002)	2§
A. cimari Marques, Brooks & Monks, 1995	MNHG 20017	MNHG 20018–20020; HWML 38547	*Hypanus longus*	ECP	Punta Morales, Puntarenas Province, Costa Rica	Marques et al. (1995)	2‡
A. clarkeae Campbell & Beveridge, 2002	SAM AHC 28349	SAM AHC 28350	*Urolophus paucimaculatus* Dixon, 1969	EIO, WSP	Queenscliff, Victoria, Australia	Campbell and Beveridge (2002)	1§

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
*A. clarkeae**†	NR	SAM AHC 28243, 28244	*Urolophus cruciatus* (Lacepède, 1804)	EIO, WSP	Devonport, Tasmania	Campbell and Beveridge (2002)	–
*A. clarkeae**†	NR	SAM AHC 28208	*Urolophus expansus* McCulloch, 1916	EIO	Beachport, South Australia	Campbell and Beveridge (2002)	–
A. cleofanus Monks, Brooks & Lonce de Leon, 1996	CNHE 2670	CNHE 2671; MNHG 38576; HWML 38576.	*Hypanus longus*	ECP	Chamela Bay, Jalisco, Mexico	(Monks et al. 1996)	3‡
A. colombianum Brooks & Mayes, 1980	USNPC 75160	USNPC 75161	*Aetobatus narinari*	WSA, WCA, WNA, ECA	Cartagena, Colombia	Brooks and Mayes (1980)	9‡
A. confusum Baer & Euzet, 1962	NR	NR	*Neotrygon kuhlii*** (Müller & Henle, 1841)	WSP	Indian Ocean, Sri Lanka	Baer and Euzet (1962)	5§
A. coquimbensis Carvajal & Jeges, 1980	MNHNC 20016	NR	*Myliobatis chilensis*	ESP	Antofagasta, Chile	Carvajal-G. and Jeges-G. (1980)	2‡
A. coquimbensis†	NR	NR	*Myliobatis chilensis*	ESP	Coquimbo, Chile	Carvajal-G. and Jeges-G. (1980)	–
A. coronatum (Rudolphi, 1819), Blanchard, 1848	NR	NR	*Dipturus batis* (Linnaeus, 1758)	ENA	Mediterranean Sea, Italy	Rudolphi (1819), Baer (1948)	4§
*A. coronatum**	NR	NR	*Scyliorhinus stellaris* (Linnaeus, 1758)	ENA, MED, ECA	Mediterranean Sea, Italy	Rudolphi (1819), Baer (1948)	–
*A. coronatum**	NR	NR	*Torpedo marmorata*	ENA, MED, ECA, ESA	Mediterranean Sea, Italy	Rudolphi (1819), Baer (1948)	–
*A. coronatum**	NR	NR	*Torpedo torpedo* (Linnaeus, 1758)	ENA, MED, ECA	Mediterranean Sea, Italy	Rudolphi (1819), Baer (1948)	–
*A. coronatum**	NR	NR	*Dasyatis pastinaca* (Linnaeus, 1758)	ENA, MED, ECA	Mediterranean Sea, Italy	Rudolphi (1819), Baer (1948)	–
*A. coronatum**†	NR	NR	*Hemitrygon akajei*** (Müller & Henle, 1841)	WNP	Nakatsu, West Japan	Yoshida (1917)	–
*A. coronatum**†	NR	NR	*Aetobatus narinari***	WSA, WCA, WNA, ECA	Batavia, Java, Indonesia	MacCallum (1921)	–
*A. coronatum**†	NR	NR	*Scyliorhinus stellaris*	ENA, MED, ECA	Sète, France	Euzet (1959)	–
*A. coronatum**†	NR	NR	*Scyliorhinus stellaris*	ENA, MED, ECA	Concarneau, France	Euzet (1959)	–
*A. coronatum**†	NR	NR	*Mustelus mustelus* (Linnaeus, 1758)	ENA, MED, ECA, ESA	Naples, Italy	Euzet (1959)	–

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
*A. coronatum**†	NR	NR	*Scyliorhinus stellaris*	ENA, MED, ECA	Cardigan Bay, UK	Rees and Williams (1965)	–
*A. coronatum**	NR	NR	*Carcharodon carcharias* (Linnaeus, 1758)	MED	Mediterranean Sea	Goldstein (1967)	–
*A. coronatum**†	NR	MNHG 40003, 40009	*Scyliorhinus canicula* (Linnaeus, 1758)	ENA, MED, ECA	Naples, Italy	Euzet (1959), Vardo-Zalik and Campbell (2011)	–
A. costarricense Marques, Brooks & Monks, 1995	MNHG 20008	MNHG 20009–20010; HWML 38544; CNHE 3034	*Hypanus longus*	ECP	Punta Morales, Puntarenas Province, Costa Rica	Marques et al. (1995)	2‡
A. costarricense†	NR	MEPN 3034	*Hypanus longus*	ECP	Puerto Huatulco, Provincia de El Oro, Ecuador	Marques et al. (1997a)	–
A. crassicolle Wedl, 1855	NR	MNHG 40014 88/77	*Dasyatis pastinaca*	ENA, MED, ECA	Arcacho, Gironde, France	Dollfus (1926), Baer (1948), Goldstein (1967)	3§
A. cribbi Campbell & Beveridge, 2002	SAM AHC 28251	SAM AHC 28252	*Gymnura australis* (Ramsay & Ogilby, 1886)	EIO, WSP, WCP	Gulf of Carpentaria, Northern Territory, Australia	Campbell and Beveridge (2002)	4§
A. dasi Ghoshroy & Caira, 2001	CNHE 4043	CNHE 4044; HWML 15549–15551; LRP 2051–2054; USNPC 90463–90465	*Hypanus dipterurus*	ECP	Puertecitos, Gulf of California, Mexico	Ghoshroy and Caira (2001)	2‡
A. dasybati Yamaguti, 1934	NR	NR	*Hemitrygon akajei*	WNP	Tarumi, Kobe, Japan	Yamaguti (1934)	4§
*A. dasybati**†	NR	NR	*Okamejei kenojei*** (Müller & Henle, 1841)	WNP	Maisaka, Japan	Yamaguti (1952)	–
*A. dasybati**†	NR	NR	*Urolophus* sp.** (*U. fuscus*?)	?	Hamazima, Mie, Japan	Yamaguti (1952)	–
A. dighaensis Srivastava & Capoor, 1980	UAA	NR	*Pateobatis uarnacoides* (Bleeker, 1852)	NIO, WCP	Digha, Orissa, India	Srivastav and Capoor (1980)	4§
A. dollyae Caira & Burge, 2001	CNHE 4169	CNHE 4170; LRP 2097–2101; USNPC 90837–90839	*Diplobatis ommata* (Jordan and Gilbert, 1890)	ECP	Bahía de Los Angeles, Gulf of California, Mexico	Caira and Burge (2001)	**1¶**

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. dollyae†	NR	NR	*Diplobatis ommata*	ECP	Isla San Esteban, Gulf of California, Mexico	Caira and Burge (2001)	–
A. dollyae†	NR	NR	*Diplobatis ommata*	ECP	Punta Arena, Gulf of California, Mexico	Caira and Burge (2001)	–
A. dujardini van Beneden, 1850	NR	NR	*Raja clavata*	ENA, MED, ECA, ESA, WIO	English Channel,Belgium	van Beneden (1850), Goldstein (1967)	2§
A. dujardini	NR	NR	*Raja clavata*	ENA, MED, ECA, ESA, WIO	English Channel, Belgium	Williams (1969)	–
*A. dujardini**†	NR	NR	*Raja brachyura*** Lafont, 1871	ENA, MED, ECA	Roscoff, France	Euzet (1959)	–
*A. dujardini**†	NR	NR	*Raja montagui*** Fowler, 1910	ENA, MED	British Isles	Williams (1960)	–
A. dysbiotos (MacCallum, 1921) Williams, 1969	NR	NR	*Aetobatus narinari***	WSA, WCA, WNA, ECA	Batavia, Java, Indonesia	MacCallum (1921), Williams (1969)	4§
A. edmondsi Campbell & Beveridge, 2002	SAM AHC 28205	SAM AHC 28206, 22704	*Parascyllium ferrugineum* McCulloch, 1911	EIO, WSP	Port Stanvac, South Australia	Campbell and Beveridge (2002)	5§
A. edmondsi†	NR	NR	*Parascyllium ferrugineum*	EIO, WSP	Holdfast Bay, South Australia	Campbell and Beveridge (2002)	–
A. edmondsi†	NR	NR	*Parascyllium ferrugineum*	EIO, WSP	Esperance, Western Australia	Campbell and Beveridge (2002)	–
A. edwardsi Williams, 1969	NR	NR	*Leucoraja fullonica* (Linnaeus, 1758)	ENA, MED, ARC	West coast of Britain, United Kingdom	Williams (1969)	2§
A. electricolum Brooks & Mayes, 1978	USNPC 74728	USNPC 74729	*Narcine brasiliensis* (Olfers, 1831)	WSA	Caribbean Sea, near Cartagena, Colombia	Brooks and Mayes (1978)	9‡
A. elongatum Subhapradha, 1955	NR	NR	*Rhynchobatus djiddensis*	WIO, NIO	Madras Coast, India	Subhapradha (1955)	4¶

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. etini Fyler & Caira, 2006	MZUM (P) 145	USNPC 96414–96415; LRP 3815-3824 (including cross sections and SEM specimens); MZUM (P) 146; IPMB 77.14.05	*Urogymnus polylepis*	NIO, WCP	Off Kampung Abai, Kinabatangan River, Sabah, Malaysia	Fyler and Caira (2006)	8§
A. filicolle (Zschokke, 1888) Yamaguti, 1959	NR	NR	*Torpedo marmorata*	ENA, MED, ECA, ESA	Mediterranean Sea	Zschokke (1888), Yamaguti (1959b)	**1(8)¶**
*A. filicolle**	NR	NR	*Torpedo torpedo*	ENA, MED, ECA	Mediterranean Sea	Williams (1969)	–
A. floridensis Goldstein, 1964	USNPC 60025	NR	*Raja eglanteria*	WCA, WNA	Gulf of Mexico and Coast of Massachusetts	Goldstein (1964)	8(10)‡
A. floridensis†*	NR	USNPC 103848–103850	*Raja texana* Chandler, 1921	WCA	Gulf of Mexico	Vardo-Zalik and Campbell (2011)	–
A. floridensis†	NR	NR	*Raja eglanteria*	WCA, WNA	Gulf of Mexico, Chesapeake Bay, Virginia, USA, USA	Campbell (1969)	–
A. fogeli Goldstein, 1964	USNPC 60024	NR	*Gymnura micrura* (Bloch & Schneider, 1801)	WSA, WCA, WNA, ECA	Northeastern Gulf of Mexico, Florida	Goldstein (1964)	1‡
A. fogeli†	NR	NR	*Gymnura micrura*	WSA, WCA, WNA, ECA	Isla Margarita, Venezuela	Mayes and Brooks (1981)	–
A. foulki Reyda & Caira, 2006	MZUM (P) 168(h)	USNPC 97463–97464; LRP 3850–3853 (including cross sections and SEM specimens); MZUM (P) 169(p)–171(p); IPMB 77.08.14	*Pateobatis uarnacoides*	NIO, WCP	Off Kampung Tetabuan, Sabah, Malaysia	Reyda and Caira (2006)	**1¶**
A. franus Marques, Centritto & Stewart, 1997	CNHE 3139	USNPC 87374; CHIOC 33754a, b; CNHE 3140	*Narcine entemedor* Jordan & Starks, 1895	ECP	Cuajiniquil Beach, Gulf of Santa Helena, Guanacaste, Costa Rica	Marques et al. (1997b)	5(8)‡

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. fylerae Maleki, Malek & Palm, 2015	ZUTC 1319	ZUTC 1320–1323; ZMB E.7568; SEM voucher ZUTC 1324	*Rhynchobatus* cf. *djiddensis***	WIO, NIO	Gulf of Oman, Iran	Maleki et al. (2015)	**1¶**
A. gasseri Campbell & Beveridge, 2002	SAM AHC 28217	SAM AHC 28218	*Pastinachus sephen***	NIO	Nickol Bay, Western Australia	Campbell and Beveridge (2002)	3§
A. gibsoni Campbell & Beveridge, 2002	SAM AHC 28239	NR	*Rhynchobatus djiddensis***	WIO, NIO	Fog Bay, Timor Sea, North Australia	Campbell and Beveridge (2002)	3§
A. giganticum Sanaka, Lakshmi & Hanumantharao, 1993	NR	NR	*Gymnura micrura***	WSA, WCA, WNA, ECA	Waltair coast, India	Sanaka et al. (1993)	5§
A. gloveri Campbell & Beveridge, 2002	SAM AHC 22600	SAM AHC 22715	*Trygonorrhina fasciata* Müller & Henle, 1841	WSP	Goolwa, South Australia	Campbell and Beveridge (2002)	2§
A. gnomus Reyda & Caira, 2006	MZUM (P) 172(h)	USNPC 97465–97466; LRP 3854–3859 (includes cross sections and SEM specimens); MZUM (P) 173(p)–175(p); IPMB 77.08.15	*Pateobatis uarnacoides*	NIO, WCP	Off Kampung Tetabuan, Sabah, Malaysia	Reyda and Caira (2006)	**1¶**
A. goldsteini Appy & Dailey, 1973	USNPC 72569	USNPC 72570	*Platyrhinoidis triseriata* (Jordan & Gilbert, 1880)	ENP, ECP	Seal Beach, California, USA	Appy and Dailey (1973)	5(9)‡
A. gonzalesmugaburoi Severino & Sarmiento, 1979	CH-MHNJP 340	CH-MHNJP 341, 341a, 341b	*Myliobatis peruvianus*	ESP	Callao, Lima, Peru	Severino and Sarmiento (1979)	**7(6)¶**
A. gracile Yamaguti, 1952	NR	NR	*Narke japonica* (Temminck & Schlegel, 1850)	WNP	Tokushima, Japan	Yamaguti (1952)	3§
A. grandiceps Yamaguti, 1952	MPM 22638	NR	*Telatrygon zugei* (Müller & Henle, 1841)	WCP, WNP	East China Sea, Japan	Yamaguti (1952), Yang et al. (2016)	4§
*A. grandiceps**	NR	NR	*Hemitrygon akajei*	WNP	East China Sea, Japan	Yamaguti (1952)	–
A. guanghaiense Yang, Sun, Zhi, Iwaki, Reyda & Yang, 2016	MPM 21229	MPM 21230; SYSU 20140818-1-4	*Hemitrygon akajei*	WNP	Off Guanghai Port, Taishan, Guangdong Province, China	Yang et al. (2016)	**2¶**

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. halehae Maleki, Malek & Palm, 2019	ZCUOK 127	ZCUOK 128–130; ZUTC Platy. 1342–1343, 1 SEM voucher ZUTC Platy. 1344	*Gymnura* cf. *poecilura*** (Shaw, 1804)	NIO, EIO, WCP, WNP	Chabahar coast, Gulf of Oman, Iran	Maleki et al. (2019)	**1¶**
A. hanumantharaoi Rao, 1977	NR	NR	*Aetomylaeus nichofii* (Bloch & Schneider, 1801)	NIO, EIO, WCP, WNP	Waltair coast, Benegal Bay, India	Rao (1977)	4§
A. herdmani Southwell, 1912	NR	NR	*Neotrygon kuhlii***	WSP	Ceylon Pearl Bank, Sri Lanka	Southwell (1912), Southwell (1925), Southwell (1930)	**3¶**
A. heterodonti Drummond, 1937	NR	NR	*Heterodontus portusjacksoni* (Meyer, 1793)	EIO, WSP	Lady Julia Perey Island, Victoria, Australia	Drummond (1937)	4§
A. heterodonti†	NR	SAM AHC 22595, 22597, 15744	*Heterodontus portusjacksoni*	EIO, WSP	Derwent Estuary, Hobart, Tasmania	Campbell and Beveridge (2002)	–
A. heterodonti†	NR	NR	*Heterodontus portusjacksoni*	EIO, WSP	Bunbury, Western Australia	Campbell and Beveridge (2002)	–
A. himanturi Brooks, 1977	USNPC 73963	USNPC 73964; HWML 20260	*Styracura schmardae* (Werner, 1904)	WCA	Caribbean Sea, La Cienaga, Magdalena, Colombia	Brooks (1977)	1‡
A. hispidum Riser, 1955	USNPC 37416	NR	*Tetronarce californica* (Ayres, 1855)	ENP, ECP, WNP	Monterey Bay, California, USA	Riser (1955)	5‡
A. holorhini Alexander, 1953	USNPC 47853	USNPC 47854	*Myliobatis californicus* Grill, 1865	ENP, ECP	Long Beach Harbor, California, USA	Alexander (1953)	3‡
*A. holorhini**†	NR	CHIMTDC 542	*Myliobatis chilensis*	ESP	Callao, Peru	Rodriguez and Tantaleán-Vidaurre (1980)	–
A. hypanus Zaragoza-Tapia, Pulido-Flores & Monks, 2020	CNHE 11255	CNHE 11256; HWML 216261	*Hypanus longus*	ECP	La Puntilla, Mazatlán, Sinaloa, Mexico	Zaragoza-Tapia et al. (2020)	**2¶**

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. hypermekkolpos Fyler & Caira, 2010	QM G232506	QM G232507; USNPC 104280; LRP 7591, hologenophores LRP 7592–7593	*Rhynchobatus laevis***	NIO, WNP	Gove Harbor, Gulf of Carpentaria, Northern Territory, Australia	Fyler and Caira (2010)	**1¶**
A. icelandicum Manger, 1972	NR	NR	*Dipturus batis*	ENA	Faxa Bay, Western coasts Iceland	Manger (1972)	3§
A. ijimai Yoshida, 1917	NR	MPM 22639	*Hemitrygon akajei*	WNP	Tokyo, Japan	Yoshida (1917), Williams (1969),Yang et al. (2016)	4§
A. ijimai†	NR	NR	*Hemitrygon akajei*	WNP	East China Sea, Japan	Yamaguti (1952)	–
A. inbiorium Marques, Centritto & Stewart, 1997	CNHE 3137	USNPC 87373; CHIOC 33753a, b; CNHE 3138	*Narcine entemedor*	ECP	Cuajiniquil Beach, Gulf of Santa Helena, Guanacaste, Costa Rica	Marques et al. (1997b)	5‡
A. incognita (MacCallum, 1921) Wardle & McLeod, 1952	NR	NR	*Dasyatis pastinaca*	ENA, MED, ECA	New York Aquarium	MacCallum (1921), Southwell (1925), Williams (1969)	**?¶**
A. indicum (Subhapradha, 1955)	NR	NR	*Narcine brasiliensis***	WSA	Madras Coast, India	Subhapradha (1955), Williams (1969)	5§
A. intermedium Perrenoud, 1931	NR	NR	*Dasyatis pastinaca***	ENA, MED, ECA	Tauranga, New Zealand	Perrenoud (1931)	4§
A. jalalii Maleki, Malek & Palm, 2013	ZUTC 1291	ZUTC 1292–1295), SEM voucher ZUTC 1296); IPCAS C–639); ZMB E.7559	*Pastinachus* cf. *sephen***	NIO	Gulf of Oman, Iran	Maleki et al. (2013)	**1¶**
A. jamesi Maleki, Malek & Palm, 2015	ZUTC 1328	ZMB E.7570; SEM voucher ZUTC 1329.	*Rhynchobatus* cf. *djiddensis***	WIO, NIO	Persian Gulf, Iran	Maleki et al. (2015)	**1¶**
A. janineae Maleki, Malek & Palm, 2015	ZUTC 1311	ZUTC 1312–1316; ZMB E.7566; SEM vouchers ZUTC 1317–1318	*Rhynchobatus* cf. *djiddensis***	WIO, NIO	Gulf of Oman, Iran	Maleki et al. (2015)	**1¶**

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. jeanneae Fyler & Caira, 2010	QM G232502	QM G232503–G232505; USNPC 104279; LRP 7573–7575, cross sections of one paratype worm and voucher LRP 7580–7582, SEM LRP 7576–7578, hologenophore LRP 7579	*Rhynchobatus laevis***	NIO, WNP	Gove Harbor, Gulf of Carpentaria, Northern Territory, Australia	Fyler and Caira (2010)	**1¶**
A. jonesi Campbell & Beveridge, 2002	SAM AHC 28227	SAM AHC 28228	*Dasyatis* sp.**	?	Cape Ford, North Australia	Campbell and Beveridge (2002)	6§
A. karachiense Bilqees, 1980	NR	SPUK 2000 (syntype)	*Mustelus manazo* Bleeker, 1855	NIO, WCP, WNP	Karachi Coast, Pakistan	Bilqees (1980)	4§
A. kurdistanense Maleki, Malek & Palm, 2019	ZCUOK 122	ZCUOK 123–127; ZUTC Platy. 1336–1340, 1 SEM voucher ZUTC Platy. 1341	*Gymnura* cf. *poecilura***	NIO, EIO, WCP, WNP	Chabahar coast, Gulf of Oman, Iran	Maleki et al. (2019)	**1¶**
A. larsoni Reyda & Caira, 2006	MZUM (P) 176(h)	USNPC 97467–97468; LRP 3860–3865 (including cross sections and SEM specimens); MZUM (P) 177(p)–180(p); IPMB 77.08.16	*Pateobatis uarnacoides*	NIO, WCP	Off Kampung Tetabuan, Sabah, Malaysia	Reyda and Caira (2006)	**1¶**
A. lasti Campbell & Beveridge, 2002	SAM AHC 28247	SAM AHC 28248	*Rhynchobatus djiddensis***	WIO, NIO	Broome, Western Australia	Campbell and Beveridge (2002)	2§
A. latum Yamaguti, 1952	MPM 22637	NR	*Hemitrygon akajei*	WNP	Sea of Ariake, Kyusyu, Japan	Yamaguti (1952), Yang et al. (2016)	4§
A. laurenbrownae Campbell & Beveridge, 2002	SAM AHC 28215	SAM AHC 28216	*Pastinachus sephen*	NIO	Nickol Bay, Western Australia	Campbell and Beveridge (2002)	1§
A. lentiginosum Vardo-Zalik & Campbell, 2011	USNPC 103815	USNPC 103816–103819	*Pseudobatos lentiginosus* (Garman, 1880)	WCA, WNA	Gulf of Mexico	Vardo-Zalik and Campbell (2011)	**1¶**

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. lepidum Reyda & Caira, 2006	MZUM (P) 181(h)	USNPC 97469; LRP 3866–3868 (including cross sections and SEM specimens); MZUM (P) 182(p)–183(p); IPMB 77.08.17	*Pateobatis uarnacoides*	NIO, WCP	Off Kampung Tetabuan, Sabah, Malaysia	Reyda and Caira (2006)	**1¶**
A. lilium Baer & Euzet, 1962	NR	NR	*Dasyatis* sp.**	?	Ceylon Pearl Bank, Sri Lanka	Baer and Euzet (1962)	2§
A. lineatum Campbell, 1969	USNPC 71353	USNPC 71354	*Hypanus americanus*	WSA, WCA, WNA	Chesapeake Bay, Virginia, USA	Campbell (1969)	1‡
A. lintoni Goldstein, Henson & Schlicht, 1968	USNPC 62938	USNPC 62939	*Narcine brasiliensis***	WSA	Gulf of Mexico, Texas, USA	Goldstein et al. (1969)	1(8,9,5)‡
A. lintoni†	NR	USNPC 74851	*Narcine brasiliensis***	WSA	Gulf of Mexico, Florida, USA	Goldstein et al. (1969)	–
A. longipedunculata Meheswari, Sanaka, Lakshmi & Rao, 1985	NR	NR	*Himantura uarnak*	WIO, NIO, EIO, WCP	Waltair coast, India	Maheswari et al. (1985)	6§
A. lusarmientoi Severino & Verano, 1980	CH-MHNJP 342	CH-MHNJP 343, 343a	*Sympterygia brevicaudata* (Cope, 1877)	ECP, ESP	Callao, Lima, Peru	Severino and Verano (1980)	**7¶**
A. macracanthum Southwell, 1925	NR	NR	*Urogymnus* sp.**	?	Madras Coast, India	Southwell (1925)	6§
A. macrocephalum Wang & Yang, 2001	MPM 21231	NR	*Hemitrygon akajei*	WNP	Xiamen, Fujiari, China	Wang and Yang (2001), Yang et al. (2016)	4§
A. macrocephalum†	MPM 21231	MPM 21232; SYSU 20140620-1-7	*Hemitrygon akajei*	WNP	Off Guanghai Port, Guangdong, China	Yang et al. (2016)	–
A. macrocephalum†	NR	NR	*Hemitrygon akajei*	WNP	Sanya Fishing Port, Sanya, Hainan, China	Yang et al. (2016)	–
A. maculatum Riser, 1955	USNPC 37417	NR	*Myliobatis californicus*	ENP, ECP	Monterey Bay, California, USA	Riser (1955)	6(3)‡

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. magnum Euzet, 1959	NR	NR	*Pteroplatytrygon violacea*	ENP, ECP, ESP, WSA, WCA, WNA, ENA, MED, ECA, ESA, WIO, NIO, EIO, WSP, WCP, WNP	Mediterranean Sea, France	Euzet (1959)	4§
A. makranense Maleki, Malek & Palm, 2019	ZCUOK 130	ZCUOK 131–135; ZUTC Platy. 1345–1350, 1 SEM voucher ZCUOK 139, 1 SEM voucher ZUTC Platy. 1350	*Gymnura* cf. *poecilura***	NIO, EIO, WCP, WNP	Chabahar coast, Gulf of Oman, Iran	Maleki et al. (2019)	**1¶**
A. manteri Hassan, 1983	IHAHE S1051/A	IHAHE S1051/B	*Pastinachus sephen***	NIO	Mediterranean Sea, Egypt	Hassan (1983)	5§
A. margieae Fyler, 2011	NMNS 6356–001	NMNS 6356–002, 6356–003, 6356–004, 6356–005, 6356–006, 6356–007; LRP 7468–7477; USNPC 103274	*Orectolobus japonicus* Regan, 1906	WNP, WCP	Off Penghu Island, East China Sea, Magong, Taiwan	Fyler (2011)	**8¶**
A. marplatensis Ivanov & Campbell, 1998	MLP 4025	MLP 4026; USNMPC 87475; NHMUK 1998.2.10.1-2	*Atlantoraja castelnaui* (Miranda Ribeiro, 1907)	WSA	Mar del Plata, Buenos Aires, Argentina	Ivanov and Campbell (1998)	1‡
A. marquesi Rodríguez-Ibarra, Pulido-Flores, Violante-González & Monks, 2018	CNHE 10554	CNHE 10555, 10556; HWML 139377–139384; CHE P00061–P00063	*Aetobatus* cf. *narinari***	WSA, WCA, WNA, ECA	Laguna de Términos, Ciudad del Carmen, Campeche, Mexico	Rodríguez-Ibarra et al. (2018)	**3¶**
A. marquesi†	NR	NR	*Aetobatus* cf. *narinari***	WSA, WCA, WNA, ECA	Champotón, Campeche, Mexico	Rodríguez-Ibarra et al. (2018)	–
A. martini Campbell & Beveridge, 2002	SAM AHC 28213	SAM AHC 28214	*Myliobatis tenuicaudatus* Hector, 1877	EIO, WSP	Bunbury, Western Australia	Campbell and Beveridge (2002)	1§

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. maryanskii Caira & Burge, 2001	CNHE 4171	CNHE 4172; LRP 2012, 2013; USNPC 90840, 90841	*Diplobatis ommata*	ECP	Loreto, Gulfo of California, Mexico	Caira and Burge (2001)	**5¶**
A. marymichaelorum Twohig, Caira & Fyler, 2008	MZUM(P) 699(H)	MZUM(P) 700(P)–702(P); SBC P–00028; USNPC 100700; LRP 4162–4164 (whole mount), 4167–4168 (cross sections)	*Brevitrygon walga* (Müller & Henle, 1841)	NIO	Off Sematan, Sarawak, Malaysia	Twohig et al. (2008)	**1¶**
A. marymichaelorum	NR	NR	*Brevitrygon walga*	NIO	Off Mukah, Sarawak, Malaysia.	Twohig et al. (2008)	–
A. masnihae Fyler & Caira, 2006	MZUM (P) 147	USNPC 96416–96417; LRP 3825-3835 (including cross sections and SEM specimens); MZUM (P) 148; IPMB 77.14.06	*Urogymnus polylepis*	NIO, WCP	Kampung Abai, Kinabatangan River, Sabah, Malaysia	Fyler and Caira (2006)	2§
A. mathiasi Euzet, 1959	NR	NR	*Mustelus mustelus*	ENA, MED, ECA, ESA	Sète, France	Euzet (1959)	1§
*A. mathiasi**	NR	NR	*Mustelus canis* (Mitchill, 1815)	WNA, WCA, WSA	Sète, France	Euzet (1959)	–
A. matttaylori Fyler & Caira, 2010	QM G232508	Hologenophore USNPC 104281	*Rhynchobatus laevis***	NIO, WNP	Gove Harbor, Gulf of Carpentaria, Northern Territory, Australia	Fyler and Caira (2010)	**4¶**
A. micracantha Yamaguti, 1952	NR	MPM 22635, 22636	*Hemitrygon akajei*	WNP	Nagasaki, East China Sea, Japan	Yamaguti (1952), Yang et al. (2016)	4§
*A. micracantha**	NR	NR	*Gymnura micrura***	WSA, WCA, WNA, ECA	Nagasaki, East China Sea, Japan	Yamaguti (1952)	–
*A. micracantha**	NR	NR	*Telatrygon zugei*	WCP, WNP	Nagasaki, East China Sea, Japan	Yamaguti (1952)	–
A. microcephalum Alexander, 1953	USNPC 47852	NR	*Myliobatis californicus*	ENP, ECP	Long Beach Harbor, California, USA	Alexander (1953)	4‡

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. minus Tazerouti, Kechemir-Issad & Euzet, 2009	MNHN HEL 76, Th 180	MNHN HEL 77, Th 181, HEL 78, Th 182, HEL 79, Th 183; NHMUK 2009.2.10.1-2	*Raja asterias* Delaroche, 1809	ENA, MED	Cap Djinet, Algérie	Tazerouti et al. (2009)	**2¶**
A. minus†	NR	NR	*Raja asterias*	ENA, MED	Zemmouri El Bahri, Algérie	Tazerouti et al. (2009)	–
A. minus†	NR	NR	*Raja asterias*	ENA, MED	Bouharoun, Algérie	Tazerouti et al. (2009)	–
A. minusculus Marques, Brooks & Barriga, 1997	MEPN 3030	MNHG 22099; HWML 39178, CNHE 3030	*Urobatis tumbesensis* (Chirichigno F. & McEachran, 1979)	ECP	Puerto Hualtaco, Provincia de El Oro, Ecuador	Marques et al. (1997a)	1‡
A. monksi Marques, Brooks & Barriga, 1997	MEPN 3031	MNHG 22100; HWML 39179; CNHE 3031	*Aetobatus narinari***	WSA, WCA, WNA, ECA	Puerto Jelí, Provincia de El Oro, Ecuador	Marques et al. (1997a)	1‡
A. mooreae Campbell & Beveridge, 2002	SAM AHC 28209	SAM AHC 22665, 22718, 28265	*Trygonorrhina fasciata*	WSP	Northhaven, South Australia	Campbell and Beveridge (2002)	2§
A. mujibi Bilqees, 1980	NR	SPUK 2001 (syntype)	*Mustelus manazo*	NIO, WCP, WNP	Karachi Coast, Pakistan	Bilqees (1980)	**?¶**
A. musculosum (Baer, 1948) Yamaguti, 1959	NR	NR	*Pteroplatytrygon violacea*	ENP, ECP, ESP, WSA, WCA, WNA, ENA, MED, ECA, ESA, WIO, NIO, EIO, WSP, WCP, WNP	New Zealand	Baer (1948), Euzet (1959), Yamaguti (1959a),Williams (1969)	4§
A. myliomaculata Srivastav, Shweta & Noopur, 1995	DZCJ	NR	*Aetomylaeus maculatus* (Gray, 1834)	NIO, WCP, WNP	Madras Coast, India	Srivastav et al. (1995)	4§

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. nanogravidum Zschoche, Caira & Fyler, 2011	QM G232166	QM G232167–G23217, cross sections QM G232171, G23217; USNPC 104103); LRP 7480–7483, cross sections LRP 7486–7491, SEM LRP 7484–7485), egg mounts LRP 7492–7493	*Pastinachus ater* (Macleay, 1883)	WIO, NIO, EIO, WSP, WCP	Gulf of Carpentaria off Weipa, Queensland, Australia.	Zschoche et al. (2011)	**1¶**
A. nicoyaense Brooks & McCorquodale, 1995	USNPC 84477	USNPC 84388; MNHG 18255	*Aetobatus narinari***	WSA, WCA, WNA, ECA	Punta Morales, Golfo de Nicoya, Costa Rica	Brooks and McCorquodale (1995)	1‡
A. ningdense Yang, Sun, Zhi, Iwaki, Reyda & Yang, 2016	MPM 21226	MPM 21227, 21228; SYSU 20121113-1-3, 20141002-1-27	*Hemitrygon akajei*	WNP	Fuhai aquatic market, Ningde, Fujian Province, China	Yang et al. (2016)	**4¶**
A. ningdense†	NR	NR	*Hemitrygon akajei*	WNP	Off Wanjichi aquatic wholesale market, Taizhou, Zhejiang Province, China	Yang et al. (2016)	–
A. ningdense†	NR	NR	*Hemitrygon akajei*	WNP	8th Seafood Market, Xiamen, Fujian Province, China	Yang et al. (2016)	–
A. ningdense†	NR	NR	*Hemitrygon akajei*	WNP	Guanghai Port, Taishan, Guangdong Province, China	Yang et al. (2016)	–
A. ningdense†	NR	NR	*Hemitrygon akajei*	WNP	Sanya Fishing Port, Sanya, Hainan Province, China	Yang et al. (2016)	–
A. obuncus Marques, Brooks & Barriga, 1997	MEPN 3032	MNHG 22101; HWML 39180; CNHE 3032, 3167	*Hypanus longus*	ECP	Puerto Hualtaco, Provincia de El Oro, Ecuador	Marques et al. (1997a)	6‡

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. ocallaghani Campbell & Beveridge, 2002	SAM AHC 28202	SAM AHC 28203	*Aptychotrema vincentiana* (Haacke, 1885	EIO	Musgrave Shoal, South Australia	Campbell and Beveridge (2002)	2§
A. oceanharvestae Fyler, Caira & Jensen, 2009	QM 231345	QM G231346–G231347; USNPC 101957–101958; LRP 4317–4318; cross sections QM 231349, QM G231348; SEM LRP 4319–4320, 4327–4328, hologenophores LRP 4321, LRP 4322	*Urogymnus acanthobothrium* Last, White & Kyne, 2016	WSP, WCP	Arafura Sea, east of Wessel Islands, Northern Territory, Australia.	Fyler et al. (2009), Caira and Jensen (2017)	**1¶**
A. odonoghuei Campbell & Beveridge, 2002	SAM AHC 22699	SAM AHC 22699	*Urolophus expansus*	EIO	Holdfast Bay, South Australia	Campbell and Beveridge (2002)	1§
*A. odonoghuei**†	NR	NR	*Urolophus lobatus* McKay, 1966	EIO	Esperance, Western Australia	Campbell and Beveridge (2002)	–
A. olseni Dailey & Mudry, 1968	USNPC 71216	NR	*Pseudobatos productus* (Ayres, 1854)	ENP, ECP	Newport Beach, California, USA	Dailey and Mudry (1968)	2‡
*A. olseni**†	NR	NR	*Pseudobatos planiceps* (Garman, 1880)	ECP, ESP	Lima, Chorrillos, Peru	Iannacone et al. (2011)	–
*A. olseni**†	NR	NR	*Urobatis halleri* (Cooper, 1863)	ENP, ECP	Anaheim Bay, California, USA	Appy and Dailey (1973)	–
*A. olseni**†	NR	NR	*Urobatis halleri*	ENP, ECP	Puerto Peñasco, Sonora, Mexico	Friggens and Brown (2005)	–
A. omanense Maleki, Malek & Palm, 2019	ZCUOK 117	ZCUOK 118–122; ZUTC Platy. 1330–1334, 1 SEM voucher ZUTC Platy. 1335	*Gymnura* cf. *poecilura***	NIO, EIO, WCP, WNP	Chabahar coast, Gulf of Oman, Iran	Maleki et al. (2019)	**1¶**
*A. omanense**	NR	NR	*Gymnura* cf. *poecilura*	NIO, EIO, WCP, WNP	Bandar Abbas, Persian Gulf, Iran	Maleki et al. (2019)	–
A. parviuncinatum Young, 1954	USNPC 49095	NR	*Urobatis halleri*	ENP, ECP	San Diego Bays, California, USA	Young (1954)	8‡

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
*A. parviuncinatum**	NR	NR	*Gymnura marmorata* (Cooper, 1864)	ECP	San Diego Bays, California, USA	Young (1954)	–
A. parviuncinatum†	NR	NR	*Urobatis halleri*	ENP, ECP	Puerto Peñasco, Sonora, Mexico	Friggens and Brown (2005)	–
A. parvum Manger, 1972	NR	NR	*Dipturus batis*	ENA	Faxa Bay, Western coasts Iceland	Manger (1972)	6§
A. paulum Linton, 1890	NR	USNPC 07683, 35882, 71351, 71352.	*Bathytoshia centroura*	WSA, WCA, WNA	Woods Hole, Massachusetts, USA	Linton (1890), Vardo-Zalik and Campbell (2011)	1(8,9,5)‡
*A. paulum**†	NR	NR	*Raja eglanteria*	WCA, WNA	Chesapeake Bay, Virginia, USA	Campbell (1969)	–
*A. paulum**†	NR	NR	*Hypanus americanus*	WSA, WCA, WNA	Chesapeake Bay, Virginia, USA	Campbell (1969)	–
A. pearsoni Williams, 1962	NR	NR	*Orectolobus maculatus* (Bonnaterre, 1788)	EIO, WSP	Hastings Point NSW, Australia	Williams (1962),Campbell and Beveridge (2002)	1§
A. persicum Maleki, Malek & Palm, 2019	ZCUOK 135	ZCUOK 136–137; ZUTC Platy. 1351–1352, 1 SEM voucher ZCUOK 142, 1 SEM voucher ZUTC Platy. 1353	*Gymnura* cf. *poecilura***	NIO, EIO, WCP, WNP	Bandar Abbas, Persian Gulf, Iran	Maleki et al. (2019)	**1¶**
A. peruviense Reyda, 2008	USNPC 99945	USNPC 99946; LRP 4108–4111 (including whole mounts and SEM specimens); MZUSP 6393a–6393b; MHNP 2335	*Potamotrygon motoro* (Müller & Henle, 1841)	WSA, WCA	Madre de Dios River at Boca Manu, Madre de Dios Department, Peru	Reyda (2008)	**1(8)¶**
A. pichelinae Campbell & Beveridge, 2002	SAM AHC 28229	SAM AHC 28230	*Myliobatis tenuicaudatus*	EIO, WSP	Devonport, Tasmania	Campbell and Beveridge (2002)	4§
A. pichelinae†	NR	NR	*Myliobatis tenuicaudatus*	EIO, WSP	Bunbury, Western Australia	Campbell and Beveridge (2002)	–

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. pintanensis Wang, 1984	NR	NR	*Neotrygon kuhlii***	WSP	Fujian Province, China	Wang (1984)	**4¶**
A. polytesticularis Wang & Yang, 2001	PRLXU	NR	*Squalus* sp.**	?	Xiamen, Fujiari, China	Wang and Yang (2001)	4§
A. ponticum Léon-Borcea, 1934	NR	NR	*Raja clavata*	ENA, MED, ECA, ESA, WIO	Agigéa, Black Sea	Léon-Borcéa (1934)	**?¶**
*A. ponticum**	NR	NR	*Dasyatis pastinaca*	ENA, MED, ECA	Agigéa, Black Sea	Léon-Borcéa (1935)	–
A. popi Fyler, Caira & Jensen, 2009	QM G231350	QM G231351–G231352; USNPC 101959–101960; LRP 4323–4324; cross sections QM G231353; SEM LRP 4329–4330, 4325–4326, hologenophores LRP 4331, 4332	*Urogymnus acanthobothrium*	WSP, WCP	Arafura Sea, east of Wessel Islands, Northern Territory, Australia.	Fyler et al. (2009), Caira and Jensen (2017)	**2¶**
A. ppdeleoni Zaragoza-Tapia, Pulido-Flores & Monks, 2020	CNHE 11253	CNHE 11254; HWML 216260	*Hypanus dipterurus*	ECP	Bahía de Chamela, Jalisco, Mexico	Zaragoza-Tapia et al. (2020)	**2¶**
A. psammobati Carvajal & Goldstein, 1969	USNPC 71357	USNPC 71358	*Psammobatis scobina* (Philippi, 1857)	ESP	South Pacific Ocean, between Papudo and Talcahuano, Chile	Carvajal-G. and Goldstein (1969)	5‡
*A. psammobati**†	NR	CH-MHNJP 342a, 342b	*Sympterygia brevicaudata*	ECP, ESP	Callao, Lima, Peru	Tantaleán-Vidaurre (1991)	–
A. puertecitense Caira & Zahner, 2001	CNHE 4175	CNHE 4176; USNPC 90843; LRP 2105–2106	*Heterodontus francisci*	ECP, ESP	Puertecitos, Gulf of California, Mexico	Caira and Zahner (2001)	**4¶**
A. puntarenasense Marques, Brooks & Monks, 1995	MNHG 20005	MNHG 20006–20007; HWML 38543, CNHE 4176.	*Hypanus longus*	ECP	Punta Morales, Puntarenas Province, Costa Rica	Marques et al. (1995)	2‡
A. quadripartitum Williams, 1968	NR	NR	*Leucoraja naevus* (Müller & Henle, 1841)	ENA, MED, ECA	North Sea, off Aberdeen	Williams (1968)	2§

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. quinonesi Mayes, Brooks & Thorson, 1978	USNPC 74804	USNPC 74805; HWML 74806	*Potamotrygon magdalenae* (Duméril, 1865)	WCA	Magdalena River, Cienaga Jobo, vicinity of San Cristobal, Bolivar, Colombia	Mayes et al. (1978)	5‡
*A. quinonesi**†	NR	NR	*Potamotrygon yepezi* Castex & Castello, 1970	WCA	Lake Maracaibo area near El Congo and Represa de Tule, Rio Cachiri, Zulia, Venezuela	Brooks et al. (1981)	–
A. rajaebatis (Rudolphi, 1810) Euzet, 1959	NR	NR	*Dipturus batis***	ENA	Mediterranean Sea	Rudolphi (1810)	5§
*A. rajaebatis**†	NR	NR	*Dipturus oxyrinchus* (Linnaeus, 1758)	ENA, MED, ECA	Sète, France	Euzet (1959)	–
*A. rajaebatis**†	NR	NR	*Rostroraja alba* (Lacepède, 1803)	ENA, MED, ECA, ESA, WIO	Sète, France	Euzet (1959)	–
*A. rajaebatis**†	NR	NR	*Rostroraja alba*	ENA, MED, ECA, ESA, WIO	Lacépède, France	Euzet (1959)	–
A. rajaebatis†	NR	NR	*Dipturus batis***	ENA	Sète, France	Euzet (1959)	–
A. rajaebatis†	NR	NR	*Dipturus batis***	ENA	Roscoff, France	Euzet (1959)	–
A. rajivi Ghoshroy & Caira, 2001	CNHE 4038	CNHE 4039; HWML 15552; LRP 2055–2056; USNPC 90461	*Hypanus dipterurus*	ECP	Puertecitos, Gulf of California, Mexico	Ghoshroy and Caira (2001)	2‡
A. ramiroi Ivanov, 2005	MACN-Pa 412/1-4	USNPC 92521	*Potamotrygon motoro*	WSA, WCA	Río Colastiné, Santa Fé, Argentina	Ivanov (2005)	**4¶**
A. ramiroi†	NR	NR	*Potamotrygon motoro*	WSA, WCA	Río Coronda, Santa Fé, Argentina	Ivanov (2005)	–
A. regoi Brooks, Mayes & Thorson, 1981	USNPC 75709	USNPC 75710; HWML 21012, 21013	*Potamotrygon hystrix* (Müller & Henle, 1841)	WSA	Orinoco River Delta, Orinoco River near Los Castillos, Venezuela	Brooks et al. (1981)	5‡

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
*A. regoi**†	NR	NR	*Potamotrygon falkneri* Castex & Maciel, 1963	WSA	Paraná River, Brazil	Lacerda et al. (2008)	–
*A. regoi**†	NR	NR	*Potamotrygon motoro*	WSA, WCA	Paraná River, Brazil	Lacerda et al. (2008)	–
A. rhinobati Alexander, 1953	USNPC 47858	USNPC 47859	*Pseudobatos productus*	ENP, ECP	Santa Monica Harbor, California, USA	Alexander (1953)	9(5)‡
A. rhinobati†	NR	NR	*Pseudobatos productus*	ENP, ECP	Ocean Park Pier, California, USA	Alexander (1953)	–
A. robertsoni Campbell & Beveridge, 2002	SAM AHC 28197	SAM AHC 22590, 22591, 22592, 22667, 22714	*Trygonorrhina fasciata*	WSP	Middleton, South Australia	Campbell and Beveridge (2002)	3§
*A. robertsoni**†	NR	SAM AHC 28257	*Pristiophorus cirratus*	EIO, WSP	Port Stanvac, South Australia	Campbell and Beveridge (2002)	–
*A. robertsoni**†	NR	NR	*Aptychotrema vincentiana*	EIO	North Haven, South Australia	Campbell and Beveridge (2002)	–
*A. robertsoni**†	NR	NR	*Aptychotrema vincentiana*	EIO	Goolwa, South Australia	Campbell and Beveridge (2002)	–
*A. robertsoni**†	NR	NR	*Dentiraja cerva* (Whitley, 1939)	EIO, WSP	Port Stanvac, South Australia	Campbell and Beveridge (2002)	–
*A. robertsoni**†	NR	NR	*Dentiraja cerva*	EIO, WSP	Holdfast Bay, South Australia	Campbell and Beveridge (2002)	–
*A. robertsoni**†	NR	SAM AHC 28260	*Urolophus bucculentus* Macleay, 1884	EIO, WSP	Rapid Head, South Australia	Campbell and Beveridge (2002)	–
*A. robertsoni**†	NR	SAM AHC 22699	*Urolophus expansus*	EIO	Holdfast Bay, South Australia	Campbell and Beveridge (2002)	–
*A. robertsoni**†	NR	SAM AHC 28256	*Urolophus lobatus*	EIO	Esperance, Western Australia	Campbell and Beveridge (2002)	–
A. robertsoni†	NR	NR	*Trygonorrhina fasciata*	WSP	Outer Harbour, South Australia	Campbell and Beveridge (2002)	–
A. robertsoni†	NR	NR	*Trygonorrhina fasciata*	WSP	North Haven, South Australia	Campbell and Beveridge (2002)	–
A. robertsoni†	NR	NR	*Trygonorrhina fasciata*	WSP	Port Stanvac, South Australia	Campbell and Beveridge (2002)	–
A. robertsoni†	NR	NR	*Trygonorrhina fasciata*	WSP	Goolwa, South Australia	Campbell and Beveridge (2002)	–

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. robertsoni†	NR	NR	*Trygonorrhina fasciata*	WSP	Port Vincent, South Australia	Campbell and Beveridge (2002)	–
A. robertsoni†	NR	NR	*Trygonorrhina fasciata*	WSP	Queenscliff, Victoria, Australia	Campbell and Beveridge (2002)	–
A. robustum Alexander, 1953	USNPC 47856	USNPC 47857	*Pseudobatos productus*	ENP, ECP	Long Beach Harbor, California, USA	Alexander (1953)	4‡
*A. robustum**†	NR	NR	*Pseudobatos planiceps*	ECP, ESP	Trujillo, Peru	Escalante-A. (1986)	–
A. rodmani Fyler, Caira & Jensen, 2009	QM G231354	QM G231355–G231357; USNPC 101961–101963; LRP 4333–4335; cross sections QM G231359 G231358); cross sections LRP 4564–4569, 4563), longitudinal sections 4560–4562, 4559, SEM LRP 4336–4339, hologenophores LRP 4340, 4341	*Urogymnus acanthobothrium*	WSP, WCP	Arafura Sea, east of Wessel Islands, Northern Territory, Australia.	Fyler et al. (2009), Caira and Jensen (2017)	**6¶**
A. rohdei Campbell & Beveridge, 2002	SAM AHC 28233	SAM AHC 28234	*Urolophus lobatus*	EIO	Esperance, Western Australia	Campbell and Beveridge (2002)	1§
A. romanowi Fyler, Caira & Jensen, 2009	QM G231360	QM G231361–231363; USNPC 101964–101966; LRP 4342–4344; cross sections QM G231365, G231364); cross sections LRP 4351–4356, SEM LRP 4345–4348, hologenophores LRP 4350, 4349.	*Urogymnus acanthobothrium*	WSP, WCP	Arafura Sea, east of Wessel Islands, Northern Territory, Australia.	Fyler et al. (2009), Caira and Jensen (2017)	**1¶**
A. rotundum Subhapradha, 1955	NR	NR	*Rhynchobatus djiddensis*	WIO, NIO	Madras Coast, India	Subhapradha (1955)	**4¶**

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. royi Caira & Burge, 2001	CNHE 4173	CNHE 4174; LRP 2104; USNPC 90842	*Diplobatis ommata*	ECP	Punta Arena, Gulf of California, Mexico	Caira and Burge (2001)	**1¶**
A. royi†	NR	NR	*Diplobatis ommata*	ECP	Loreto, Gulfo of California, Mexico	Caira and Burge (2001)	–
A. rubrum Bilqees, 1980	NR	SPUK 2002 (syntype)	*Mustelus manazo*	NIO, WCP, WNP	Karachi Coast, Pakistan	Bilqees (1980)	6§
A. saliki Fyler & Caira, 2006	MZUM (P) 149	USNPC 96418–96419; LRP 3836-3843 (including cross sections and SEM specimens); MZUM (P) 150; IPMB 77.14.07	*Urogymnus polylepis*	NIO, WCP	Off Kampung Abai, Kinabatangan River, Sabah, Malaysia	Fyler and Caira (2006)	1§
A. santarosaliense Caira & Zahner, 2001	CNHE 4177	CNHE 4178; USNPC 90844; LRP 2107	*Heterodontus mexicanus* Taylor & Castro-Aguirre, 1972	ECP, ESP	Santa Rosalia, Gulf of California, Mexico	Caira and Zahner (2001)	**3¶**
A. satyanarayanaraoi Sanaka, Vijaya Lakshmi & Hanumantha Rao, 1993	DZAUW	NR	*Glaucostegus granulatus* (Cuvier, 1829)	NIO	Waltair coast, India	Sanaka et al. (1993)	4§
A. schalli Vardo-Zalik & Campbell, 2011	USNPC 103820	USNPC 103821–103826	*Mustelus canis*	WNA, WCA, WSA	Gulf of Mexico	Vardo-Zalik and Campbell (2011)	**1¶**
*A. schalli**	NR	NR	*Mustelus norrisi* Springer, 1939	WNA, WCA, WSA	Gulf of Mexico	Vardo-Zalik and Campbell (2011)	–
A. semnovesiculum Verma, 1928	ZIMC	NR	*Pastinachus sephen*	NIO	Allahabad (Ganges and Jumna), India	Verma (1928)	2§
A. semnovesiculum†	NR	NR	*Pastinachus sephen***	NIO	Fog Bay, Timor Sea, North Australia	Campbell and Beveridge (2002)	–
A. semnovesiculum†	NR	NR	*Pastinachus sephen***	NIO	Nickol Bay, Western Australia	Campbell and Beveridge (2002)	–
A. septentrionale Baer & Euzet, 1962	NR	NR	*Dipturus batis*	ENA	Atlantic, Nort Sea	Baer and Euzet (1962), Baer (1948), Euzet (1959)	3§
*A. septentrionale**	NR	NR	*Dipturus oxyrinchus*	ENA, MED, ECA	Atlantic, Nort Sea	Williams (1969)	–

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. sinaloaensis Zaragoza-Tapia, Pulido-Flores & Monks, 2020	CNHE 11257	CNHE 11258; HWML 216262	*Hypanus longus*	ECP	La Puntilla, Mazatlán, Sinaloa, Mexico	Zaragoza-Tapia et al. (2020)	**2¶**
A. soberoni Ghoshroy & Caira, 2001	CNHE 4040	CNHE 4041–4042; HWML 15548; LRP 2057–2059; USNPC 90462	*Hypanus dipterurus*	ECP	Puertecitos, Gulf of California, Mexico	Ghoshroy and Caira (2001)	6‡
A. soberoni†	NR	NR	*Hypanus dipterurus*	ECP	Bahía de Los Angeles, Gulf of California, Mexico	Ghoshroy and Caira (2001)	–
A. soniae Zaragoza-Tapia, Pulido-Flores, Violante-Gonzalez & Monks, 2019	CNHE 11136	CNHE 11137; HWML 139978; CHE P00081	*Narcine entemedor*	ECP	Bahía de Acapulco, Playa Las Hamacas, Guerrero, Mexico	Zaragoza-Tapia et al. (2019)	**2¶**
A. southwelli Subhapradha, 1955	NR	NR	*Rhinobatos schlegelii*** Müller & Henle, 1841	WNP	Madras Coast, India	Subhapradha (1955)	1§
A. sphaera Maleki, Malek & Palm, 2013	ZUTC 1298	ZUTC 1299–1307), SEM vouchers ZUTC 1308–1309; IPCAS C–641; ZMB E7560	*Pastinachus* cf. *sephen***	NIO	Persian Gulf, Iran	Maleki et al. (2013)	**2¶**
A. stefaniae Franzese & Ivanov, 2018	MACN-Pa 624	MACN-Pa 625/1–6, 626/1–3, 627/1, 628/1–2; IPCAS C-786; LRP 9403–9410	*Discopyge tschudii* Heckel, 1846	ESP, WSA	Coastal waters off Mar Chiquita City, Buenos Aires Province	Franzese and Ivanov (2018)	**1¶**
A. stefaniae†	NR	NR	*Discopyge tschudii*	ESP, WSA	Coastal waters off Villa Gesell, Argentina	Franzese and Ivanov (2018)	–
A. stefaniae†	NR	NR	*Discopyge tschudii*	ESP, WSA	Off San Clemente del Tuyú, Argentina	Franzese and Ivanov (2018)	–
A. stefaniae†	NR	NR	*Discopyge tschudii*	ESP, WSA	Off Camarones, Argentina	Franzese and Ivanov (2018)	–
A. stevensi Campbell & Beveridge, 2002	SAM AHC 28198	SAM AHC 28199	*Trygonorrhina fasciata*	WSP	Marion Bay, South Australia	Campbell and Beveridge (2002)	2§

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. stevensi†	NR	NR	*Trygonorrhina fasciata*	WSP	Goolwa, South Australia	Campbell and Beveridge (2002)	–
A. stevensi†	NR	NR	*Trygonorrhina fasciata*	WSP	Coorong, Australia	Campbell and Beveridge (2002)	–
A. tasajerasi Brooks, 1977	USNPC 73961	USNPC 73962; HWML 20261	*Styracura schmardae*	WCA	Caribbean Sea, La Cienaga, Magdalena, Colombia	Brooks (1977)	2‡
*A. tasajerasi**†	NR	NR	*Hypanus guttatus* (Bloch & Schneider, 1801)	WSA, WCA	Lake Maracaibo, Venezuela	Mayes and Brooks (1981)	–
A. terezae Rego & Dias, 1976	CHIOC 31.215c	CHIO 10.847, 10.994, 31.412a-b, 31.215a-b	*Potamotrygon motoro*	WSA, WCA	Rio Salobra, Mato Grosso, Brazil	Rêgo and Luna Dias (1976)	4‡
A. tetabuanense Reyda & Caira, 2006	MZUM (P) 184(h)	USNPC 97470–97471; LRP 3869–3873 (including cross sections and SEM specimens); MZUM (P) 185(p)–186(p); IPMB 77.08.18	*Pateobatis uarnacoides*	NIO, WCP	Off Kampung Tetabuan, Sabah, Malaysia	Reyda and Caira (2006)	**2¶**
A. thomasae Campbell & Beveridge, 2002	SAM AHC 28201	SAM AHC 22676	*Aptychotrema vincentiana*	EIO	Musgrave Shoal, South Australia	Campbell and Beveridge (2002)	2§
A. thomasae†	NR	NR	*Aptychotrema vincentiana*	EIO	Cowell, Australia	Campbell and Beveridge (2002)	–
A. tortum (Linton, 1916) Baer & Euzet, 1962	NR	NR	*Aetobatus narinari*	WSA, WCA, WNA, ECA	Woods Hole, Massachusetts, USA	Linton (1916)	3‡
A. tortum†	NR	NR	*Aetobatus narinari*	WSA, WCA, WNA, ECA	Caimare Chico, Gulf of Venezuela	Mayes and Brooks (1981)	–
A. tortum†	NR	USNPC 70494	*Aetobatus narinari*	WSA, WCA, WNA, ECA	Cape Haze Marine Laboratory, Sarasota, Florida.	Campbell (1970)	–
A. triacis Yamaguti, 1952	NR	NR	*Triakis scyllium* Müller & Henle, 1839	WNP	Hamazima, Mie, Japan	Yamaguti (1952)	**4¶**
A. tripartitum Williams, 1969	NR	NR	*Raja microocellata* Montagu, 1818	ENA, ECA	English Channel, Plymouth	Williams (1969)	2§

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. ulmeri Vardo-Zalik & Campbell, 2011	USNPC 103830	USNPC 103831–103837, 103839, 103842, 103846	*Raja texana*	WCA	Gulf of Mexico	Vardo-Zalik and Campbell (2011)	**1¶**
A. unilateralis Alexander, 1953	USNPC 47855	NR	*Myliobatis californicus*	ENP, ECP	Long Beach Harbor, California, USA	Alexander (1953)	7(2)‡
A. urogymni (Hornell, 1912) Southwell, 1925	NR	NR	*Urogymnus asperrimus* (Bloch & Schneider, 1801)	ECA, WIO, NIO, EIO, WSP, WCP, WNP	Gulf of Mannar, India	Hornell (1912), Southwell (1925)	**?¶**
A. urolophi Schmidt, 1973	USNPC 72284	USNPC 72284	*Trygonoptera testacea* Müller & Henle, 1841	WSP	Glenelg Beach near Adelaide, South Australia	Schmidt (1973)	1§
*A. urolophi**†	NR	NR	*Urolophus paucimaculatus*	EIO, WSP	Devonport, Tasmania	Campbell and Beveridge (2002)	–
A. urotrygoni Brooks & Mayes, 1980	USNPC 75162	USNPC 75163; HWML 20917	*Urobatis venezuelae* Schultz, 1949	WCA	Cartagena, Colombia	Brooks and Mayes (1980)	2‡
*A. urotrygoni**†	NR	NR	*Hypanus guttatus*	WSA, WCA	Lake Maracaibo, Venezuela	Mayes and Brooks (1981)	–
*A. urotrygoni**†	NR	NR	*Hypanus guttatus*	WSA, WCA	Isla Margarita, Venezuela	Mayes and Brooks (1981)	–
A. vargasi Marques, Brooks & Monks, 1995	MNHG 20011	MNHG 20012–20013; HWML 38545	*Hypanus longus*	ECP	Punta Morales, Puntarenas Province, Costa Rica	Marques et al. (1995)	2‡
A. vidali Zaragoza-Tapia, Pulido-Flores, Violante-Gonzalez & Monks, 2019	CNHE 11134	CNHE 11135; HWML 139979-139981; CHE P00082	*Narcine entemedor*	ECP	Bahía de Acapulco, Playa Las Hamacas, Guerrero, Mexico	Zaragoza-Tapia et al. (2019)	**6¶**
A. walkeri Campbell & Beveridge, 2002	SAM AHC 28219	SAM AHC 28220	*Pastinachus sephen***	NIO	Nickol Bay, Western Australia	Campbell and Beveridge (2002)	2§
A. waltairensis Uma Maheswari, Sanaka, Vijaya Lakshmi & Hanumantha Rao, 1987	NR	NR	*Himantura uarnak*	WIO, NIO, EIO, WCP	Waltair coast, India	Maheswari et al. (1987)	3§
A. wedli Robinson, 1959	NR	DMNZ 194b,c,d, 195–197 (syntype)	*Zearaja nasuta* (Müller & Henle, 1841)	WSP	Petone Beach, New Zealand	Robinson (1959)	4§

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. wedli†	NR	NR	*Zearaja nasuta*	WSP	Portobello, Otago Harbour, New Zealand	Robinson (1959)	–
A. wedli†	NR	NR	*Zearaja nasuta*	WSP	South Island, off Lyttelton, New Zealand	Campbell and Beveridge (2002)	–
A. westi Vardo-Zalik & Campbell, 2011	USNPC 103841	USNPC 103838, 103840, 103843–103845, 103847	*Raja texana*	WCA	Gulf of Mexico	Vardo-Zalik and Campbell (2011)	**1¶**
A. woodsholei Baer, 1948	NR	MNHG 40028 (syntype)	*Bathytoshia centroura*	WSA, WCA, WNA	Woods Hole, Massachusetts, USA	Baer (1948), Vardo-Zalik and Campbell (2011)	2(7)‡
A. woodsholei†	NR	NR	*Bathytoshia centroura*	WSA, WCA, WNA	Western North Atlantic	Goldstein (1964)	–
A. xiamenensis Yang & Lin, 1994	NR	NR	*Rhynchobatus djiddensis***	WIO, NIO	Xiamen, South Fujian, China	Yang (1994)	5§
A. zainali Fyler & Caira, 2006	MZUM (P) 151	USNPC 96420–96422; LRP 3844-3849 (including cross sections and SEM specimens); MZUM (P) 152–153; IPMB 77.14.08	*Urogymnus polylepis*	NIO, WCP	Off Kampung Abai, Kinabatangan River, Sabah, Malaysia	Fyler and Caira (2006)	1§
A. zapterycum Ostrowski de Nuñez, 1971	MACN-Pa 214/1	NR	*Zapteryx brevirostris* (Müller & Henle, 1841)	WSA	Mar del Plata, Buenos Aires, Argentina	Ostrowski de Núñez (1971)	2‡
A. zapterycum†	NR	MACN-Pa 214/1-2, 214/4–5, 629/1, 630/1–3, 631/1–4, 632/1–4; IPCAS C-787; LRP 9411–9417	*Zapteryx brevirostris*	WSA	Coastal waters off Villa Gessel, Argentina	Franzese and Ivanov (2018)	–
A. zapterycum†	NR	NR	*Zapteryx brevirostris*	WSA	La Lucila del Mar, Argentina	Franzese and Ivanov (2018)	–
A. zapterycum†	NR	NR	*Zapteryx brevirostris*	WSA	Puerto Quequén, Argentina	Franzese and Ivanov (2018)	–

Species of *Acanthobothrium*	Ht	Nt, Pt or Va	Species of Host	Gd	Loc	Sou	Cd
A. zapterycum†	NR	NR	*Zapteryx brevirostris*	WSA	Puerto Pirámides, Argentina	Franzese and Ivanov (2018)	–
A. zimmeri Fyler, Caira & Jensen, 2009	QM G231366	QM G231367–G231369; USNPC 101967–101969; LRP 4357–5358; cross sections QM G231371, G231370); cross sections LRP 4364–4366, SEM LRP 4359–4361, hologenophores LRP 4363, 4362	*Urogymnus acanthobothrium*	WSP, WCP	Arafura Sea, east of Wessel Islands, Northern Territory, Australia.	Fyler et al. (2009), Caira and Jensen (2017)	**1¶**
A. zschokkei Baer, 1948	MHNG 88/39	NR	Torpille (common name)**	?	Naples, Italy	Baer (1948)	6§
*A. zschokkei**†	NR	NR	*Torpedo marmorata*	ENA, MED, ECA, ESA	Adriatic Sea, Mediterranean Sea	Goldstein (1967)	–
*A. zschokkei**†	NR	NR	*Torpedo torpedo*	ENA, MED, ECA	Sète, France	Euzet (1959)	–
*A. zschokkei**†	NR	NR	*Torpedo torpedo*	ENA, MED, ECA	Adriatic Sea, Mediterranean Sea	Goldstein (1967)	–

Results

The information obtained from the metadata analysis (Table 1) is comprised of 336 reports of the 201 valid species of *Acanthobothrium*. The list includes the type host of each species, type locality, and additional hosts and/or localities. Five of the elasmobranchs that were reported as hosts of *Acanthobothrium* were only identified to genus and four others are reported as "cf." (= similar to) (see Table 1).

The type localities where species of *Acanthobothrium* have been reported is shown in Figure 1. The currently known diversity of sharks comprises 517 species (34 families); of these, 19 species of sharks (eight families) have been reported to be parasitized by species of *Acanthobothrium* (Fig. 2). Eighteen of the 201 valid species have been described from sharks. The families of sharks that have the highest number of reports are Orectolobidae (three different species of *Acanthobothrium*), Heterodontidae (five species) and Triakidae (six species) (Fig. 2B). In contrast, currently known diversity of rays comprises 637 species (26 families); of these, 95 species (18 families) have been reported to be parasitized by species of *Acanthobothrium* (Fig. 3). Of the 201 valid species of *Acanthobothrium*, 182 have been described from rays. The families of rays that have the highest number of reports are Rajidae (20 species of *Acanthobothrium*) and Dasyatidae (70 species) (Fig. 3B).

Species of *Acanthobothrium* are not evenly grouped in the different categories. In Category 1 there are 55 species, 44 in Category 2, 19 in Category 3, 37 in Category 4, 17 in Category 5, 14 in Category 6, four in Category 7, four in Category 8, and three in Category 9. Although there is a Category 10, species in that category also are in grouped with those in Category 8 because their characteristics are thought to fall into both categories (Table 1). The categories of four species of *Acanthobothrium* were classified as unknown ("?") because the original descriptions do not have sufficient information for assignment in one of the ten categories (Table 1).

Discussion

Currently, 517 species of sharks have been described worldwide with 3.7% (19 of the 517 species) have been reported as hosts for species of *Acanthobothrium* (Fig. 2C). In contrast, 637 species of rays have been described with 14.9% (95 of the 637 species) have been reported as hosts for species of *Acanthobothrium* (Fig. 3C). Estimates of cestode diversity in elasmobranchs discussed by Caira (2011) assumes that the fauna of cestodes of a species of elasmobranchs does not vary substantially across in its distribution. Knowledge of life cycles are essential in understanding the distribution of species of *Acanthobothrium*; however, for this study it is assumed that the distribution of adults of these parasites normally is limited to that of its normal definitive host. Thus, it is hypothesized that the limits of the distribution of the host limits the species of its parasites to the same biogeographic regions proposed for the distribution of elasmobranchs by Last et al. (2016b). It is recognized that an infected elasmobranch

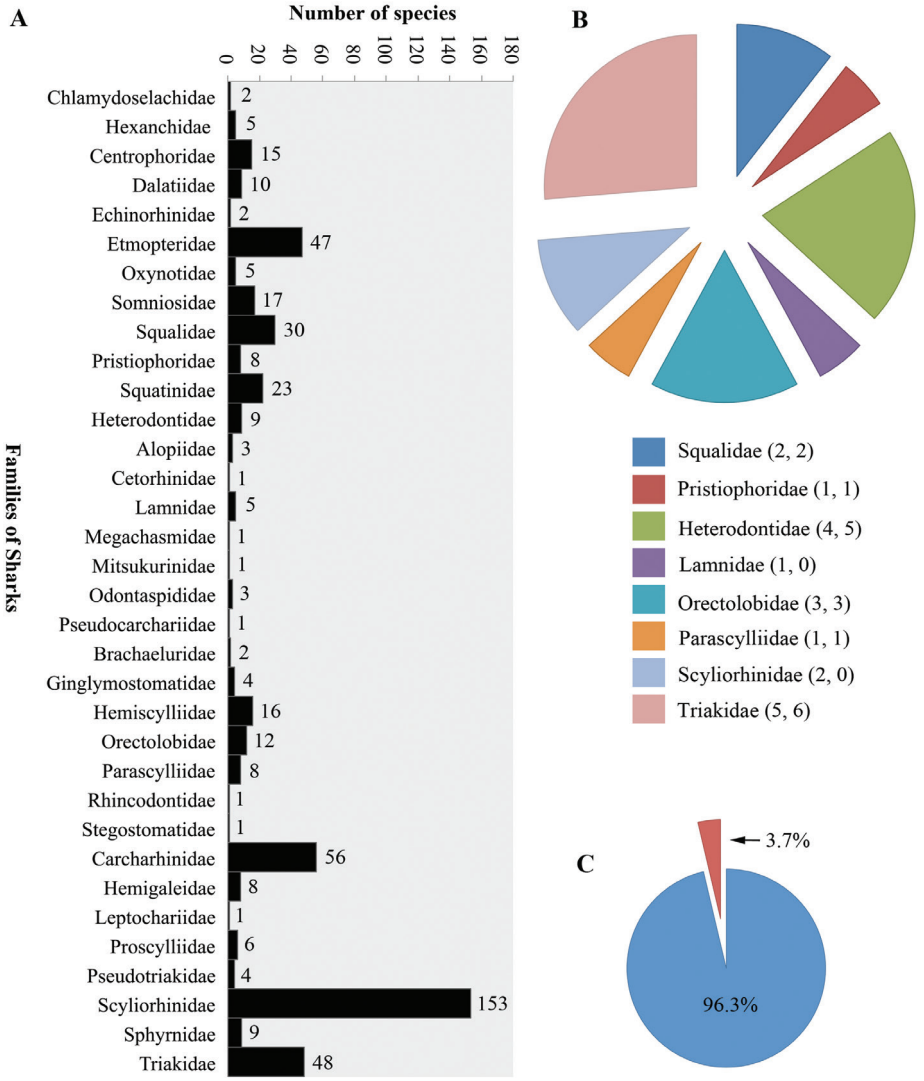

Figure 2. Families of sharks: **A** number of species of sharks per family **B** number of species of sharks parasitized by species of *Acanthobothrium*. Note: The first number within parentheses corresponds to the number of species of shark that have been reported as hosts of *Acanthobothrium* and the second is the number of species that have been described from that Family **C** percentage of species of shark reported to be parasitized within the total number of families of sharks- note: Red color = parasitized; Blue color = not parasitized.

could move outside of the region where it has been designated, but until an extension to its distribution has been reported, it must be assumed that the normal distribution for each species of parasite also is that same designated region. The information in the table will be subject to future research, not forgetting that there is a lack of knowledge of the life cycle of the species of *Acanthobothrium*; a partial life cycle of a single species

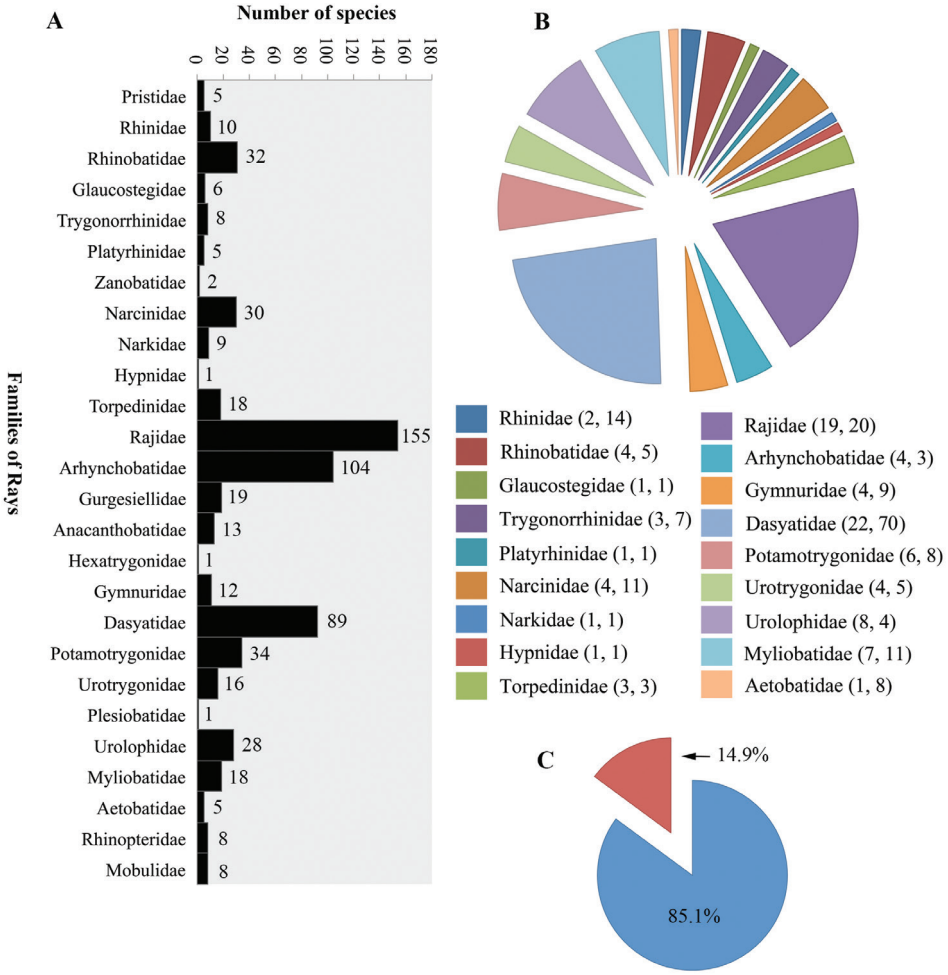

Figure 3. Families of rays: **A** number of species of rays per family **B** number of species of rays parasitized by species of *Acanthobothrium*. Note: The first number within parentheses corresponds to the number of species of ray that have been reported as hosts of *Acanthobothrium* and the second is the number of species that have been described from that Family **C** percentage of species of rays reported to be parasitized within the total number of families of rays- note: Red color = parasitized; Blue color = not parasitized.

has been reported (Holland and Wilson 2009). Publication of molecular sequences for more species will provide new discoveries in this subject.

The information in the Figures 1 and 4 indicates that there is an absence of reports from several regions of the world, such as ECA, ESA, WIO, ARC, and SOC. According to the percentages of species of elasmobranchs that have been reported as hosts of species of *Acanthobothrium*, we can infer that there are still many new species of *Acanthobothrium* to be discovered. In the GenBank database records, molecular sequences

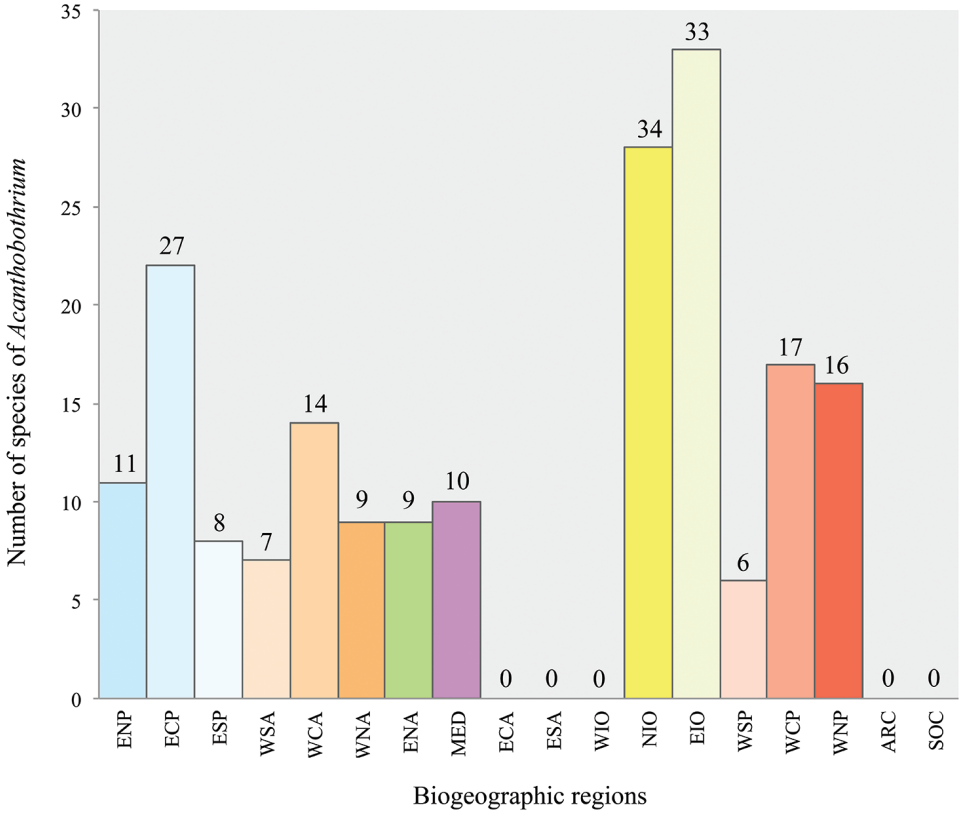

Figure 4. Number of species of *Acanthobothrium* reported from elasmobranchs in each biogeographic region (Last et al. 2016b).

of only 16 of the 201 species of *Acanthobothrium* have been reported. However, more molecular information about species of *Acanthobothrium* is required for future analyzes, both for identification and life cycle studies; these would provide more solid information for delimiting distributions.

In Table 1, *Acanthobothrium chilensis* Rêgo, Vicente & Herrera, 1968, was included for reference, although it was described from a fish, *Sarda chiliensis* (Cuvier, 1832) (Perciformes: Scombridae) (see Rêgo et al. 1968). Extensive recent studies of this species of fish (Chero et al. 2016; Luque et al. 2016) failed to report *A. chilensis*; there is only the report by Rêgo et al. (1968). The report of the host for this species of *Acanthobothrium* likely is an accidental infection and not a normal host.

According to Fyler et al. (2009) and Franzese and Ivanov (2018), species of *Acanthobothrium* appear to exhibit oioxenous specificity for their elasmobranch hosts. In the present metadata analysis, for species exclusively in elasmobranchs, 83% of the species of *Acanthobothrium* show remarkable host specificity for their definitive host, and thus, should be considered to be an oioxenous species. In contrast, 34 of the 200

species (17%) of *Acanthobothrium* have been reported in more than one species of elasmobranch (Table 1). However, with the metadata analysis of the distribution of the hosts and the reports of the species of *Acanthobothrium*, 45 of the type specimens of *Acanthobothrium* require confirmation of the host (Table 1) because some appear to be problematic identifications and other hosts were reported as "cf." or only as an unidentified member of a particular genus In addition, there are reports of species of *Acanthobothrium* that suggest misidentification of the parasites; these should reevaluated in future studies. To mention obvious cases, *A. batailloni* has been reported from the Mediterranean Sea and from the Pacific coast of Peru and Chile and *A. brevissime* has been reported from the Gulf of Mexico and the Pacific coast of Peru.

The categorical method developed by Ghoshroy and Caira (2001) was proposed in order to delimit the number of taxonomic comparisons when describing new species. Using the method of Ghoshroy and Caira (2001), which focused only on species from the Americas, Fyler and Caira (2006) later applied the same methodology to biodiversity data for species from other regions; those works are augmented by this study. Of the 201 known species of *Acanthobothrium*, 13 have been classified in more than one category (see category designations in Table 1) because some characteristics of those species overlap with those of more than one category (see descriptions found in Zschokke 1888; Linton 1890; Baer 1948; Alexander 1953; Euzet 1955; Riser 1955; Yamaguti 1959; Goldstein 1964; Williams 1969; Goldstein et al. 1969; Appy and Dailey 1973; Severino and Sarmiento 1979; Marques et al. 1997; Reyda 2008). This does not decrease the usefulness of the categorical method as a tool for the initial stages in identification.

Having more information, such as molecular sequences, could solve some problems in identification, such as the two cases mentioned above. A species of *Acanthobothrium* that has been assigned to more than one category suggests that the categories still need some refining, or it is an example of cryptic species that cannot be distinguished without molecular information. However, molecular information cannot replace morphological descriptions of species. One reason is the lack of material for sequencing of the vast majority of already-known species. Morphology also augments molecular data in studies of the phylogeny of platyhelminths (Zamparo et al. 2001; Littlewood 2008). A complete phylogenetic hypothesis based on total evidence (morphological and molecular data) such as that of Littlewood (2008) for any major group of cestodes is still distant. Until that time, a categorical method provides the easiest and most direct method for selection of a group of species similar to a new species of *Acanthobothrium*. This updated database includes the category designation for each species described to date will be an important tool for the future taxonomic studies.

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References

Alexander CG (1953) Five new species of *Acanthobothrium* (Cestoda: Tetraphyllidea) from southern California rays. Journal of Parasitology 39: 481–486. https://doi.org/10.2307/3273847

Alves PV, de Chambrier A, Scholz T, Luque JL (2017) Annotated checklist of fish cestodes from South America. ZooKeys 650: 1–205. https://doi.org/10.3897/zookeys.650.10982

Amaral CRL, Pereira F, Silva DA, Amorim A, de Carvalho EF (2018) The mitogenomic phylogeny of the Elasmobranchii (Chondrichthyes). Mitochondrial DNA A DNA Mapp Seq Anal 29: 867–878. https://doi.org/10.1080/24701394.2017.1376052

Appy RG, Dailey MD (1973) Two new species of *Acanthobothrium* (Cestoda: Tetraphyllidea) from elasmobranchs of the eastern Pacific. Journal of Parasitology 59: 817–820. https://doi.org/10.2307/3278414

Baer JG (1948) Contributions a l'étude des cestodes de sélaciens I-IV. Bulletin de la Société des Sciences Naturelles de Neuchâtel 71: 63–122.

Baer JG, Euzet L (1962) Revision critique des Cestodes Tétraphyllides décrits par T. Southwell (1ere Partie). Extrait du Bulletin de la Société neuchâteloise des Sciences naturelles 85: 143–172.

Bilqees FM (1980) Three new species of *Acanthobothrium* Van Beneden (Cestoda: Tetraphyllidea: Onchobothriidae) in *Myrmillo manazo* (blk.) of Karachi coast. Pakistan Journal of Zoology 12: 239–246.

Brooks DR (1977) Six new species of tetraphyllidean cestodes, including a new genus, from a marine stingray *Himantura schmardae* (Werner, 1904) from Colombia. Proceedings of the Helminthological Society of Washington 44: 51–59.

Brooks DR, Mayes MA (1978) *Acanthobothrium electricolum* sp. n. and *A. lintoni* Goldstein, Henson, and Schlicht, 1969 (Cestoda: Tetraphyllidea) from *Narcine brasiliensis* (Olfers) (Chondrichthyes: Torpedinidae) in Colombia. Journal of Parasitology 64: 617–619. https://doi.org/10.2307/3279945

Brooks DR, Mayes MA (1980) Cestodes in four species of euryhaline stingrays from Colombia. Proceedings of the Helminthological Society of Washington 47: 22–29.

Brooks DR, Mayes MA, Thorson TB (1981) Systematic review of cestodes infecting freshwater stingrays (Chondrichthyes: Potamotrygonidae) including four new species from Venezuela. Proceedings of the Helminthological Society of Washington 48: 43–64.

Brooks DR, McCorquodale S (1995) *Acanthobothrium nicoyaense* n. sp. (Eucestoda: Tetraphyllidea: Onchobothriidae) in *Aetobatus narinari* (Euphrasen) (Chondrichthyes: Myliobatiformes: Myliobatidae) from the Gulf of Nicoya, Costa Rica. Journal of Parasitology 81: 244–246. https://doi.org/10.2307/3283927

Caira JN (2011) Synergy advances parasite taxonomy and systematics: an example from elasmobranch tapeworms. Parasitology 138: 1675–1687. https://doi.org/10.1017/S0031182011000643

Caira JN, Burge AN (2001) Three new species of *Acanthobothrium* (Cestoda: Tetraphyllidea) from the ocellated electric ray, *Diplobatis ommata*, in the Gulf of California, Mexico. Comparative Parasitology 68: 52–65.

Caira JN, Jensen K, Barbeau E (2019) Global Cestode Database. http://tapewormdb.uconn.edu/

Caira JN, Jensen K, Ivanov VA (2017) Onchoproteocephalidea II. In: Caira JN, Jensen K (Eds) Planetary biodiversity inventory (2008–2017): tapeworms from vertebrate bowels of the earth Special Publication, Natural History Museum, The University of Kansas Lawrence, Kansas, 290–315.

Caira JN, Zahner SD (2001) Two new species of *Acanthobothrium* Beneden, 1849 (Tetraphyllidea: Onchobothriidae) from horn sharks in the Gulf of California, Mexico. Systematic Parasitology 50: 219–229. https://doi.org/10.1023/A:1012241913722

Campbell RA (1969) New species of *Acanthobothrium* (Cestoda: Tetraphyllidea) from Chesapeake Bay, Virginia. Journal of Parasitology 55: 559–570. https://doi.org/10.2307/3277298

Campbell RA (1970) Notes on tetraphyllidean cestodes from the Atlantic Coast of North America, with descriptions of two new species. Journal of Parasitology 56: 498–508. https://doi.org/10.2307/3277613

Campbell RA, Beveridge I (2002) The genus *Acanthobothrium* (Cestoda: Tetraphyllidea: Onchobothriidae) parastic in Australian elasmobranch fishes. Invertebrate Systematics 16: 273–344. https://doi.org/10.1071/IT01004

Carvajal-G. J, Goldstein RJ (1969) *Acanthobothrium psammobati* n. sp. (Cestoda: Tetraphyllidea: Onchobothriidae) from the skate, *Psammobatis scobina* (Chondrichthyes: Rajidae) from Chile. Zoologischer Anzeiger 182: 432–435.

Carvajal-G. J, Goldstein RJ (1971) *Acanthobothrium annapinkiensis* n. sp. (Cestoda: Tetraphyllidea: Onchobothriidae) from the skate, *Raja chilensis* (Chondrichthyes: Rajidae) from Chile. Zoologischer Anzeiger 186: 158–162.

Carvajal-G. J, Jeges-G. J (1980) Cestodos parásitos de *Myliobatis chilensis* Phillipi (Pisces: Myliobatidae), con la descripción de una nueva especie de *Acanthobothrium*. Anales del Centro de Ciencias del Mar y Limnología 7: 51–56.

Chero J, Sáez G, Iannacone J, Cruces C, Alvariño L, Luque J (2016) Ecología comunitaria de metazoos parásitos del bonito *Sarda chiliensis* Cuvier, 1832 (Perciformes: Scombridae) de la Costa Peruana. Revista de Investigaciones Veterinarias del Perú 27: 539–555. https://doi.org/10.15381/rivep.v27i3.12008

Concha FJ, Caira JN, Ebert DA, Pompert JHW (2019) Redescription and taxonomic status of *Dipturus chilensis* (Guichenot, 1848), and description of *Dipturus lamillai* sp. nov. (Rajiformes: Rajidae), a new species of long-snout skate from the Falkland Islands 4590: 501–524. https://doi.org/10.11646/zootaxa.4590.5.1

Cornford EM (1974) Two tetraphyllidean cestodes from Hawaiian stingrays. Journal of Parasitology 60: 942–948. https://doi.org/10.2307/3278520

Dailey MD, Mudry DR (1968) Two new species of cestodes from California rays. Journal of Parasitology 54: 1141–1143. https://doi.org/10.2307/3276979

Del Moral-Flores LF, Morrone JJ, Alcocer-Durand J, Espinosa-Pérez H, Pérez-Ponce de León G (2015) Lista patrón de los tiburones, rayas y quimeras (Chondrichthyes, Elasmobranchii, Holocephali) de México. Arxius de Miscel·lània Zoològica 13: 47–163. https://doi.org/10.32800/amz.2015.13.0047

Dollfus RP (1926) Sur *Acanthobothrium crassicolle* K. Wedl 1855. Bulletin Société Zool France 51: 464–470.

Drummond FH (1937) Cestoda. Lady Julia Percy Island. Reports of the expedition of the McCoy Society for Field Investigations and Research. Proceedings of the Royal Society of Victoria 49: 401–404.

Escalante-A. H (1986) Cestodes de elasmobranquios de la costa peruana. Revista de Ciencias Universidad Nacional Mayor de San Marcos 74: 70–74.

Euzet L (1952) Cestodes tétraphyllides de la côte Atlantique du Maroc et de Mauritanie. (Collection resemblée par R. Ph. Dollfus). Comptes Rendus de la Société des Sciences Naturelles de Maroc 5: 91–96.

Euzet L (1955) Quelques cestodes de *Myliobatis aquila* L. Receuil des Travaux des Laboratoires de Botanique, Géologie et Zoologie de la Faculté des Sciences de l' Université de Montpellier Série Zoologie 1: 18–27.

Euzet L (1959) Recherches sur les Cestodes Tétraphyllides des Sélaciens de côtes de France. Docteur ès Sciences Naturelles, Montpellier, France: University of Montpellier.

Franzese S, Ivanov VA (2018) Hyperapolytic species of *Acanthobothrium* (Cestoda: Onchoproteocephalidea) from batoids off Argentina. Parasitology International 67: 431–443. https://doi.org/10.1016/j.parint.2018.04.001

Froese R, Pauly D (2019) FishBase. Version (08/2019). World Wide Web electronic. http://www.fishbase.org

Friggens MM, Brown JH (2005) Niche partitioning in the cestode communities of two elasmobranchs. Oikos 108: 76–84. https://doi.org/10.1111/j.0030-1299.2005.13275.x

Fyler CA (2011) An extremely hyperapolytic *Acanthobothrium* species (Cestoda: Tetraphyllidea) from the Japanese wobbegong, *Orectolobus japonicus* (Elasmobranchii: Orectolobiformes) in Taiwan. Comparative Parasitology 78: 4–14. https://doi.org/10.1654/4454.1

Fyler CA, Caira JN (2006) Five new species of *Acanthobothrium* (Tetraphyllidea: Onchobothriidae) from the freshwater stingray *Himantura chaophraya* (Batoidea: Dasyatidae) in Malaysian Borneo. Journal of Parasitology 92: 105–125. https://doi.org/10.1645/GE-3522.1

Fyler CA, Caira JN (2010) Phylogenetic status of four new species of *Acanthobothrium* (Cestoda : Tetraphyllidea) parasitic on the wedgefish *Rhynchobatus laevis* (Elasmobranchii : Rhynchobatidae): implications for interpreting host associations. Invertebrate Systematics 24: 419–433. https://doi.org/10.1071/IS10034

Fyler CA, Caira JN, Jensen K (2009) Five new species of *Acanthobothrium* (Cestoda: Tetraphyllidea) from an unusual species of *Himantura* (Rajiformes: Dasyatidae) from northern Australia. Folia Parasitologica 56: 107–128. https://doi.org/10.14411/fp.2009.016

Ghoshroy S, Caira JN (2001) Four new species of *Acanthobothrium* (Cestoda: Tetraphyllidea) from the whiptail stingray *Dasyatis brevis* in the Gulf of California, Mexico. Journal of Parasitology 87: 354–372. https://doi.org/10.1645/0022-3395(2001)087[0354:FNSOAC]2.0.CO;2

Goldstein RJ (1964) Species of *Acanthobothrium* (Cestoda: Tetraphyllidea) from the Gulf of Mexico. Journal of Parasitology 50: 656–661. https://doi.org/10.2307/3276123

Goldstein RJ (1967) The genus *Acanthobothrium* van Benden, 1849 (Cestoda: Tetraphyllidea). Journal of Parasitology 53: 455–483. https://doi.org/10.2307/3276705

Goldstein RJ, Henson RN, Schlicht FG (1969) *Acanthobothrium lintoni* sp. n. (Cestoda: Tetraphyllidea) from the electric ray, *Narcine brasiliensis* (Olfers) in the Gulf of Mexico. Zoologischer Anzeiger 181: 435–438.

Grace MA, Doosey MH, Denton JSS, Naylor GJP, Bart HLJ, Maisey JG (2019) A new Western North Atlantic Ocean kitefin shark (Squaliformes: Dalatiidae) from the Gulf of Mexico. 2019 4619: 109–120. https://doi.org/10.11646/zootaxa.4619.1.4

Hassan S (1983) *Acanthobothrium manteri* sp. n. a tetraphyllidean cestode (Onchobothriidae) from *Dasyatis sephen*. Journal of the Egyptian Society of Parasitology 13: 75–80.

Holland ND, Wilson NG (2009) Molecular Identification of Larvae of a Tetraphyllidean Tapeworm (Platyhelminthes: Eucestoda) in a Razor Clam as an Alternative Intermediate Host in the Life Cycle of *Acanthobothrium brevissime*. Journal of Parasitology 95: 1215–1217. https://doi.org/10.1645/GE-1946.1

Hornell J (1912) XVIII. New cestodes from Indian fishes. Records of the Indian Museum 7: 197–204. [110 plates] https://doi.org/10.5962/bhl.part.28231

Iannacone J, Avila-Peltroche J, Rojas-Perea S, Salas-Sierralta M, Neira-Cruzado K, Palomares-Torres R, Valdivia-Alarcón S, Pacheco-Silva A, Benvenutto-Vargas V, Ferrario-Bazalar V (2011) Dinámica poblacional de los parásitos metazoos del Pez Guitarra del pacífico *Rhinobatos planiceps* (Batoidea: Rajiformes) de la zona costera marina de Lima, Perú. Neotropical Helminthology 5: 265–278.

Ivanov VA (2005) A new species of *Acanthobothrium* (Cestoda: Tetraphyllidea: Onchobothriidae) from the ocellate river stingray, *Potamotrygon motoro* (Chondrichthyes: Potamotrygonidae), in Argentina. Journal of Parasitology 91: 390–396. https://doi.org/10.1645/GE-354R1

Ivanov VA, Campbell RA (1998) A new species of *Acanthobothrium* van Beneden, 1849 (Cestoda: Tetraphyllidea) from *Rioraja castelnaui* (Chondrichthyes: Rajoidei) in coastal waters of Argentina. Systematic Parasitology 40: 203–212. https://doi.org/10.1023/A:1006049404646

Lacerda ACF, Takemoto RM, Pavanelli GC (2008) Digenea, Nematoda, Cestoda, and Acanthocephala, parasites in Potamotrygonidae (Chondrichthyes) from the upper Paraná River floodplain, states of Paraná and Mato Grosso do Sul, Brazil. Check List 4: 115–122. https://doi.org/10.15560/4.2.115

Last PR, Naylor GJP, Manjali-Matsumoto BM (2016a) A revised classification of the family Dasyatidae (Chondrichthyes: Myliobatiformes) based on new morphological and molecular insights. Zootaxa 4139: 345–368. https://doi.org/10.11646/zootaxa.4139.3.2

Last PR, White WT, de Carvalho MR, Séret B, Stehman MFW, Naylor GJP, McEachran JD (2016b) Rays of the World. Comstock Publishing Associates, a division of Cornell University Press; Clayton South VIC, Australia: CSIRO Publishing, Ithaca, New York, 790 pp.

Léon-Borcéa L (1934) Note préliminaire sur les cestodes de elasmobranchs ou sélaciens de la mer noire. Annales scientifiques de l'Université de Jassy 19: 345–369.

Léon-Borcéa L (1935) Novelle note sur *Acanthobothrium ponticum* L. Borcéa (n. sp.). Annales scientifiques de l'Université de Jassy 20: 480–481.

Linton E (1890) Notes on Entozoa of marine fishes of New England, with descriptions of several new species. Part II. Annual Report of the Commissioner of Fish and Fisheries for 1887. Washington, D.C., 719–899. https://doi.org/10.5962/bhl.title.995

Linton E (1908) IX. Helminth fauna of the Dry Tortugas. I. Cestodes. Papers from the Tortugas Laboratory. Carnegie Institucion of Washington, Washington, D.C., 157–190.

Linton E (1916) Notes on two cestodes from the spotted stingray. Journal of Parasitology 3: 34–38. https://doi.org/10.2307/3270745

Littlewood DTJ (2008) Platyhelminth systematics and the emergence of new characters. Parasite 15: 333–341. https://doi.org/10.1051/parasite/2008153333

Lönnberg E (1889) Bidrag till Kanendomen om i Sverge förs Kommande Cestoder. Bihang till Kongl Svanska vetenskaps-akademiens Handlingar 14: 1–69.

Luque JL, Cruces C, Chero J, Paschoal F, Alves PV, Da Silva AC, Sanchez L, Iannacone J (2016) Checklist of Metazoan parasites of fishes from Peru. Neotropical Helminthology 10: 301–375.

MacCallum GA (1921) Studies in helminthology. Zoopathologica 1: 137–284.

Maheswari JU, Lakshmi CV, Rao KH (1985) Studies on a new species of *Acanthobothrium* from *Dasyatis uarnak* (forskal) from Waltair coast. Rivista de Parassitologia 2: 39–44.

Maheswari JU, Sanaka S, Lakshmi CV, Rao KH (1987) *Acanthobothrium waltairensis* n. sp. (Cestoda: Tetraphyllidea) parasite of *Dasyatis uarnak* (Pisces: Condrichtehyes) from India. Revista Ibérica de Parasitología 47: 33–36.

Maleki L, Malek M, Palm HW (2013) Two new species of *Acanthobothrium* (Tetraphyllidea: Onchobothriidae) from *Pastinachus* cf. *sephen* (Myliobatiformes: Dasyatidae) from the Persian Gulf and Gulf of Oman. Folia Parasitologica 60: 448–456. https://doi.org/10.14411/fp.2013.048

Maleki L, Malek M, Palm HW (2015) Four new species of *Acanthobothrium* van Beneden, 1850 (Cestoda: Onchoproteocephalidea) from the guitarfish, *Rhynchobatus* cf. *djiddensis* (Elasmobranchii: Rhynchobatidae), from the Persian Gulf and Gulf of Oman. Folia Parasitologica 62: 012 (011–015). https://doi.org/10.14411/fp.2015.012

Maleki L, Malek M, Palm HW (2019) Five new species of *Acanthobothrium* (Cestoda: Onchoproteocephalidea) from the long-tailed butterfly ray, *Gymnura* cf. *poecilura* (Elasmobranchii: Gymnuridae), from the Persian Gulf and Gulf of Oman. Zootaxa 4609: 289–307. https://doi.org/10.11646/zootaxa.4609.2.5

Maleki L, Malek M, Rastgoo A (2018) *Acanthobothrium chabahariensis* n. sp. (Cestoda: Onchoproteocephalidea) in the cowtail stingray *Pastinachus* cf. *sephen* (Myliobatiformes: Dasyatidae) from the Gulf of Oman, Iran. Journal of Genetic Resources 4: 114–121.

Manger BR (1972) Some cestode parasites of the elasmobranchs *Raja batis* and *Squalus acanthias* from Iceland. Bulletin of the British Museum of Natural History (Zoology) 24: 161–181.

Marques F, Brooks DR, Barriga R (1997a) Six species of *Acanthobothrium* (Eucestoda: Tetraphyllidea) in stingrays (Chondrichthyes: Rajiformes: Myliobatoidei) from Ecuador. Journal of Parasitology 83: 475–484. https://doi.org/10.2307/3284414

Marques F, Brooks DR, Monks S (1995) Five new species of *Acanthobothrium* van Beneden, 1849 (Eucestoda: Tetraphyllidea: Onchobothriidae) in stingrays from the Gulf of Nicoya, Costa Rica. Journal of Parasitology 81: 942–951. https://doi.org/10.2307/3284046

Marques F, Centritto R, Stewart AS (1997b) Two new species of *Acanthobothrium* in *Narcine entemedor* (Rajiformes: Narcinidae) from the Northwest Coast of Guanacaste Peninsula, Costa Rica. Journal of Parasitology 83: 927–931. https://doi.org/10.2307/3284291

Mayes MA, Brooks DR (1981) Cestode Parasites of Some Venezuelan Stingrays. Proccedings of the Biological Society of Washington 93: 1230–1238.

Mayes MA, Brooks DR, Thorson TB (1978) Two new species of *Acanthobothrium* Van Beneden 1849 (Cestoda: Tetraphyllidea) from freshwater stingrays in South Americana. Journal of Parasitology 64: 838–841. https://doi.org/10.2307/3279513

Merlo-Serna AI, Garcia-Prieto L (2016) A checklist of helminth parasites of Elasmobranchii in Mexico. ZooKeys 2016(563): 73–128. https://doi.org/10.3897/zookeys.563.6067

Monks S, Brooks DR, Pérez-Ponce de León G (1996) A new species of *Acanthobothrium* Van Beneden, 1849 (Eucestoda: Tetraphyllidea: Onchobothriidae) in *Dasyatis longus* Garman (Chondrichthyes: Myliobatiformes: Dasyatididae) from Chamela Bay, Jalisco, Mexico. Journal of Parasitology 82: 484–488. https://doi.org/10.2307/3284090

Monks S, Pulido-Flores G, Lara-Sánchez M (2015) Distribution extension of *Acanthobothrium cartagenensis* Brooks & Mayes, 1980 (Tetraphyllidea: Onchobothriidae) in *Urobatis jamaicensis* (Cuvier, 1816) (Myliobatiformes: Urotrygonidae) from Quintana Roo, México. Check List 11: 1–3. https://doi.org/10.15560/11.4.1707

Ostrowski de Núñez M (1971) Estudios preliminares sobre la fauna parasitaria de algunos elasmobranquios del litoral bonaerense, Mar del Plata, Argentina. I. Cestodes y trematodes de *Psammobatis microps* (Günther) and *Zapteryx brevirostris* (Müller and Henle). Physis 30: 425–446.

Perrenoud N (1931) Recherches anatomiques et histologiques sur quelques cestodes de sélaciens. Revue Suisse de Zoologie 38: 469–555. https://doi.org/10.5962/bhl.part.117651

Rao V (1977) *Acanthobothrium humantharaoi* sp. n. (Cestoda: Tetraphyllidea, Oncobothriidae) from the nieuhof 's eagle ray, *Myliobatus nieuhofii* (Bloch and Schneider) of Waltair coast, Bay of Bengal. Rivista di Parassitologia 38: 277–283.

Rees G, Williams HH (1965) The functional morphology of the scolex and the genetalia of *Acanthobothrium coronotum* (Rud.) (Cestoda: Tetraphyllidea). Parasitology 55: 617–651. https://doi.org/10.1017/S0031182000086212

Rêgo AA, Luna Dias AP (1976) Estudos de cestóides de peixes do Brasil. 3. Nota: cestóides de raias fluviais Paratrygonidae. Revista Brasileira de Biologia 36: 941–956.

Rêgo AA, Vicente JJ, Herrera NI (1968) Sôbre dois novos parásitos de peixe da costa do Peru (Cestoda, Tetraphyllidea). Memorias do Instituto Oswaldo Cruz 66: 145–149. https://doi.org/10.1590/S0074-02761968000200002

Reyda FB (2008) Intestinal helminths of freshwater stingrays in southeastern Peru, and a new genus and two new species of cestode. Journal of Parasitology 94: 684–699. https://doi.org/10.1645/GE-1230.1

Reyda FB, Caira JN (2006) Five New Species of *Acanthobothrium* (Cestoda: Tetraphyllidea) from *Himantura uarnacoides* (Myliobatiformes: Dasyatidae) in Malaysian Borneo. Comparative Parasitology 73: 49–71. https://doi.org/10.1654/4194.1

Riser NW (1955) Studies on cestode parasites of sharks and skates. Journal of the Tennessee Academy of Science 30: 265–311.

Robinson ES (1959) Some new cestodes from New Zealand marine fishes. Transactions of the Royal Society of New Zealand 86: 381–392.

Robinson ES (1965) Cestoda (Tetraphyllidea and Trypanorhyncha) from marine fishes of New South Wales. Records of the Australian Museum 26: 341–348. https://doi.org/10.3853/j.0067-1975.26.1965.683

Rodriguez TJ, Tantaleán-Vidaurre M (1980) Estudio sobre helmintos de peces elasmobranquios de la costa Peruana. 1. Nuevos registros de Tetraphyllideos. Boletin Peruano de Parasitologia 2: 71–75.

Rodríguez-Ibarra E, Pulido- Flores G, Violante González J, Monks S (2018) A new species of *Acanthobothrium* (Eucestoda: Onchobothriidae) in *Aetobatus* cf. *narinari* (Myliobatidae) from Campeche, México. Revista Brasileira de Parasitologia Veterinária 27: 66–73. https://doi.org/10.1590/s1984-29612018009

Rudolphi CA (1810) Entozoorum, sive *Vermium intestinalium* historia naturalis. Treuttel et Würtz, 386 pp.

Rudolphi CA (1819) Entozoorum synopsis, cui accedunt mantissa duplex et indices locupletissimi. Humboldt-Universität, Rücker, 811 pp. https://doi.org/10.5962/bhl.title.9157

Rutledge KM (2019) A New Guitarfish of the Genus Pseudobatos (Batoidea: Rhinobatidae) with Key to the Guitarfishes of the Gulf of California. Copeia 107: 451–463. https://doi.org/10.1643/CI-18-166

Sanaka S, Vijaya Lakshmi C, Hanumantha Rao K (1993) Description of the new species *Acanthobothrium satyanarayanaraoi* from *Rhinobatus granulatus* from Waltair Coast, India. Boletin Chileno de Parasitologia 48: 15–17.

Sanaka S, Vijaya Lakshmi C, Hanumantha Rao K (1993) Description of the New species *Acanthobothrium giganticum* from *Gymnura micrura* from Waltair Coast. Rivista di Parassitologia 54: 15–17.

Schmidt GD (1973) *Acanthobothrium urolophi* sp. n., a tetraphyllidean cestode (Onchobothriidae) from an Australian stingaree. Proceedings of the Helminthological Society of Washington 40: 91–93.

Severino LR, Sarmiento BI (1979) Neuva especie del genero *Acanthobothrium* Van Benedem [sic] 1849; Cestode: Tetraphyllidea de *Myliobatis peruvianus* Garman 1913. Revista de Ciencias Universidad Nacional Mayor de San Marcos 71: 38–43.

Severino LR, Verano MR (1980) *Acanthobothrium lusarmientoi* n. sp. (Cestoda: Tetraphyllidea: Onchobothriidae) [de] Psammobatis caudispina Hildebrand, 1941 (Chondrichtyes: Rajidae) de Peru. Revista de Ciencias Universidad Nacional Mayor de San Marcos 72: 21–27.

Shipley AE (1900) A description of the Entozoa collected by Dr Willey during his sojourn in the Western Pacific (Ed. A. Wiley, Cambridge University Press, UK.). Zoological Results 5: 531–568.

Southwell T (1912) A description of ten new species of cestode parasites from marine fishes of Ceylon, with notes on other cestodes from the same region. Colombo, Ceylon, Printed, London, 259–278.

Southwell T (1925) A monograph on the Tetraphyllidea with notes on related cestodes (Liverpool University Press, UK.). Memoirs of the Liverpool School of Tropical Medicine (New Series) 2: 1–368.

Southwell T (1930) Cestoda. Taylor and Francis, London, , 250–251.

Srivastav AK, Capoor VN (1980) On *Acanthobothrium dighaensis* sp. n. (Onchobothriidae Braun, 1900) from *Trygon marginatus*. Helminthologia 17: 165–170.

Srivastav AK, Lohia S, Mathur N (1995) *Acanthobothrium myliomaculata* sp. nov. (Onchobohriidae, Cestoda) from the *Myliobates maculata* from Madras (India). Flora and Fauna 1: 43–45.

Subhapradha CK (1955) Cestode parasites of fishes of Madras coast. Indian Journal of Helminthology 7: 41–132.

Tantaleán-Vidaurre M (1991) Nuevos helmintos parasitos en peces elasmobranquio de la costa peruana. Boletin de Lima 73: 25–28.

Tazerouti F, Kechemir-Issad N, Euzet L (2009) *Acanthobothrium minus* n. sp. (Tetraphyllidea: Onchobotriidae) parasite de *Raja asterias* (Elasmobranchii : Rajidae) en Méditerranée. Parasite 16: 203–207.

Twohig ME, Caira JN, Fyler CA (2008) Two new cestode species from the dwarf whipray, *Himantura walga* (Batoidea: Dasyatidae), from Borneo, with comments on site and mode of attachment. Journal of Parasitology 94: 1118–1127. https://doi.org/10.1645/GE-1475.1

van Beneden PJ (1850) Recherches sur la faune littorale de Belgique. Les vers cestoides, considérés sous le rapport physiologique, embryogénique et zooclassique. Mémoires de l'Academie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique 25: 1–204. https://doi.org/10.5962/bhl.title.47103

Vardo-Zalik AM, Campbell RA (2011) Five new species of *Acanthobothrium* van Beneden, 1849 (Cestoda: Tetraphyllidea) in elasmobranchs from the northwest Atlantic and Gulf of Mexico with the first records from smooth-hound sharks and guitarfish. Zootaxa 2828: 41–64. https://doi.org/10.11646/zootaxa.2838.1.3

Vaz DFB, Carvalho MRd (2018) New Species of Squatina (Squatiniformes: Squatinidae) from Brazil, with Comments on the Taxonomy of Angel Sharks from the Central and Northwestern Atlantic. Copeia 106: 144–160. https://doi.org/10.1643/CI-17-606

Verma S-C (1928) Some Cestodes from Indian fishes including four new species of Tetraphyllidea and revised keys to the genera *Acanthobothrium* and *Gangesia*. Allahabad University Studies 4: 119–176.

Wang P-Q (1984) Notes on some cestodes of fishes in Fujian province, with a list of fish cestodes recorded from China. Wuyi Science Journal 4: 71–83.

Wang Y-H, Yang W-C (2001) Two New Species of *Acanthobothrium* from Marine Fishes in Xiaroen, Fujian, China (Cestoda: Tetraphyllidea: Onchobothridae). Journal of Xiamen University (Natural Science) 40: 943–948.

Williams HH (1960) A list of parasitic worms, including 22 new records, from marine fishes caught off the British Isles. Annals and Magazine of Natural History 2: 705–715. https://doi.org/10.1080/00222935908655756

Williams HH (1962) *Acanthobothrium* sp. nov. (Cestoda: Tetraphyllidea) and a comment on the order Biporophyllaeidea. Parasitology 52: 67–76. https://doi.org/10.1017/S0031182000024008

Williams HH (1968) *Acanthobothrium quadripartitum* sp. nov. (Cestoda: Tetraphyllidea) from *Raja naevus* in the North Sea and English Channel. Parasitology 58: 105–110. https://doi.org/10.1017/S0031182000073467

Williams HH (1969) The genus *Acanthobothrium* van Beneden 1849 (Cestoda: Tetraphyllidea). Nytt Magasin for Zoologi 17: 1–56.

Yamaguti S (1934) Studies on the helminth fauna of Japan. Part 4. Cestodes of fishes. Japanese Journal of Zoology 6: 1–112.

Yamaguti S (1952) Studies on the helminth fauna of Japan. Part 49. Cestodes of fishes, II. Acta Medica Okayama 8: 1–97.

Yamaguti S (1959a) The cestodes of vertebrates. Wiley Interscience Publications, New York.

Yamaguti S (1959b) Systema Helminthum: Cestoda. Wiley Interscience Publications, New York, 860 pp.

Yang C, Sun Y, Zhi T, Iwaki T, Reyda FB, Yang T (2016) Two new and one redescribed species of *Acanthobothrium* (Cestoda: Onchoproteocephalidea: Onchobothriidae) from *Dasyatis akajei* (Myliobatiformes: Dasyatidae) in the China Sea. Zootaxa 4169: 286–300. https://doi.org/10.11646/zootaxa.4169.2.3

Yang WLY (1994) Two New Species of *Acanthobothrium* Cestodes (Tetraphyllidea: Onchobothriidae) from Saltwater Fishes in Xiamen.South Fujian.China. Journal of Xiamen University (Natural Science) 33: 532–536.

Yokota L, Carvalho MRd (2017) Taxonomic and morphological revision of butterfly rays of the *Gymnura micrura* (Bloch & Schneider 1801) species complex, with the description of two new species (Myliobatiformes: Gymnuridae). 2017 4332: 1–74. https://doi.org/10.11646/zootaxa.4332.1.1

Yoshida S (1917) Some cestodes from Japanese selachians including five new species. Parasitology 9: 560–592. https://doi.org/10.1017/S003118200000620X

Young RT (1954) Cestodes of sharks and rays in Southern California. Proceedings of the Helminthological Society of Washington 21: 106–112.

Zamparo D, Brooks DR, Hoberg EP, McLennan DA (2001) Phylogenetic analysis of the Rhabdocoela (Platyhelminthes) with emphasis on the Neodermata and their relatives. Zoologica Scripta 30: 59–77. https://doi.org/10.1046/j.1463-6409.2001.00050.x

Zaragoza-Tapia F, Pulido-Flores G, Violante-González J, Monks S (2019) Two new species of *Acanthobothrium* Blanchard, 1848 (Onchobothriidae) in *Narcine entemedor* Jordan & Starks, 1895 (Narcinidae) from Acapulco, Guerrero, Mexico. ZooKeys 852: 1–21. https://doi.org/10.3897/zookeys.852.28964

Zaragoza-Tapia F, Pulido-Flores G, Monks S (2020) Three new species of *Acanthobothrium* Blanchard, 1848 (Cestoda: Onchoproteocephalidea) in Stingrays (Dasyatidae) from the Pacific coast in Mexico. Zootaxa 4766 (1): 139–172. https://doi.org/10.11646/zootaxa.4766.1.8

Zschoche M, Caira JN, Fyler CA (2011) A new species of *Acanthobothrium* van Beneden, 1850 (Tetraphyllidea: Onchobothriidae) from *Pastinachus atrus* (Macleay) (Batoidea: Dasyatidae) in Australian waters, with a reassessment of the host associations of *Acanthobothrium* spp. parasitising *Pastinachus* spp. Systematic Parasitology 78: 109–118. https://doi.org/10.1007/s11230-010-9279-2

Zschokke F (1888) Recherches sur la structure anatomique et histologique des Cestodes. Institut national genevois.

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New cheiracanthiid spiders from Xishuangbanna rainforest, southwestern China (Araneae, Cheiracanthiidae)

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Abstract

Four new species of the genus *Cheiracanthium* C.L. Koch, 1839 from Xishuangbanna, Yunnan Province, China are described: *C. daofeng* Yu & Li, **sp. nov.** (♂♀), *C. duanbi* Yu & Li, **sp. nov.** (♂♀), *C. gou* Yu & Li, **sp. nov.** (♂), and *C. wuquan* Yu & Li, **sp. nov.** (♀). In addition, *Sinocanthium* Yu & Li, **gen. nov.,** is described with the type species *S. shuangqiu* Yu & Li, **sp. nov.** A key to cheiracanthiid genera distributed in East and Southeast Asia is provided.

Keywords

key to genera, new genus, new species, Oriental Region, taxonomy

Introduction

Cheiracanthiidae Wagner, 1887 is a relatively large spider family with twelve genera and 354 valid species distributed worldwide, except for the Polar Regions (WSC 2020). The Cheiracanthiidae fauna of China is presently known by 42 described spe-

cies, all of them belonging to *Cheiracanthium* C.L. Koch, 1839 sensu lato (Li 2020). The global diversity of this family remains insufficiently studied, and several new species have been described recently (Lotz 2015; Marusik and Fomichev 2016; Zhang et al. 2018; Li and Zhang 2019). The current paper reports new Cheiracanthiidae taxa from Xishuangbanna.

Xishuangbanna, which lies between 21°08'–22°36'N and 99°56'–101°50'E, is in southwestern China and shares a border with Myanmar in the southwest and Laos in the southeast. Xishuangbanna is a biodiversity hotspot, and a large number of new taxa across a wide variety of spider families have been discovered in this region recently (Li 2020). Seven *Cheiracanthium* species were reported from Xishuangbanna before the current study. They are *C. exquestitum* Zhang & Zhu, 1993, *C. falcatum* Chen, Huang, Chen & Wang, 2006, *C. insigne* O. Pickard-Cambridge, 1874, *C. insulanum* (Thorell, 1878), *C. ningmingense* Zhang & Yin, 1999, *C. taiwanicum* Chen, Huang, Chen & Wang, 2006, and *C. unicum* Bösenberg & Strand, 1906.

During the examination of spiders collected from 2006 to the present in Xishuangbanna Tropical Botanical Garden in Menglun Town, four species recognized as new to science are described here and are temporarily placed in *Cheiracanthium* sensu lato. The fifth species is not readily assignable to any of the existing genera; thus, we established a new genus to accommodate it. Detailed morphological descriptions and diagnoses of the new taxa are given. The body and the copulatory organs are photographed and illustrated for each species. An identification key to cheiracanthiid genera occurring in East and Southeast Asia is provided.

Materials and methods

Specimens were collected by fogging, pitfall trapping, and hand collecting from the canopy, tree trunks, and leaf litter in the tropical rainforest in Xishuangbanna Tropical Botanical Garden and preserved in 75 or 95% ethanol. All type specimens are deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS) in Beijing, China (curator: Jun Chen).

Specimens were examined using a LEICA M205C and an Olympus SZX7 stereomicroscope. Further details were studied under a CX41 compound microscope. Male and female copulatory organs were examined and illustrated after dissection. Left male palps are illustrated, unless otherwise indicated (photos of the right palp were horizontally mirrored in the figures to allow easier comparison with other species). Epigynes were removed and cleared in lactic acid or warm 10% potassium hydroxide (KOH) solution. Some vulvae were imaged after being embedded in Arabic gum. Images were captured with a Canon EOS 70D digital camera mounted on an Olympus CX41 compound microscope and assembled using Helicon Focus 6.80 image stacking software. All measurements were obtained using an Olympus SZX7 stereomicroscope and are

given in millimetres. Eye diameters are taken from the widest distance. The total body length does not include chelicerae or spinnerets. Leg lengths are given as total length (femur, patella + tibia, metatarsus, tarsus). Most of the terminology in the text and figure legends follows Lotz (2015) and Zhang et al. (2018), and some follows Marusik and Fomichev (2016) and Morano and Bonal (2016). Abbreviations used in the text and figures are as follows:

A	atrium	**FD**	fertilisation duct
AAM	atrial anterior margin	**LL**	total length of leg I
AER	anterior eye row	**LL/CL**	leg I / carapace length
AL	abdomen length	**MA**	median apophysis
ALE	anterior lateral eyes	**MOQ**	median ocular quadrangle
AME	anterior median eyes	**MOQA**	MOQ anterior width
AME–AME	distance between AMEs	**MOQP**	MOQ posterior width
AME–ALE	distance between AME and ALE	**OAL**	ocular area length
		OAW	ocular area width
APM	atrial posterior margin	**PER**	posterior eye row
AW	abdomen width	**PLE**	posterior lateral eyes
C	conductor	**PME**	posterior median eyes
CD	copulatory duct	**PME–PME**	distance between PMEs
CF	cymbial fold	**PME–PLE**	distance between PME and PLE
CI	carapace index		
CL	carapace length	**PMT**	promarginal teeth
CL/CW	carapace length / carapace width	**PTA**	prolateral tibial apophysis
		R	receptacle
CLL	clypeal length	**RMT**	retromarginal teeth
CO	copulatory opening	**RTA**	retrolateral tibial apophysis
CS	cymbial spur		
CW	carapace width	**STL**	sternum length
DTA	dorsal tibial apophysis	**STW**	sternum width
E	embolus	**TL**	total body length
EB	embolic base		

A DNA barcode was also obtained for species delimitation and matching of different sexes. A partial fragment of the mitochondrial cytochrome oxidase subunit I (CO1) gene was amplified and sequenced using the primers LCOI1490 (5'-GGTCAACAAATCATAAAGATATTG-3') and HCOI2198 (5'-TAAACTTCAGGGTGACCAAAAAAT-3'). For additional information on extraction, amplification, and sequencing procedures, see Morano and Bonal (2016). All sequences were analysed using BLAST and are deposited in GenBank. The accession numbers are provided in Table 1.

Table 1. Voucher specimen information.

Species	Voucher code	Sex	GenBank accession number	Sequence length
C. daofeng sp. nov.	YHCH010	♂	MT449426	664bp
	YHCH021	♀	MT478102	665bp
C. duanbi sp. nov.	YHCH030	♂	MT478103	665bp
	YHCH029	♀	MT478104	665bp
C. gou sp. nov.	YHCH016	♂	MT477871	665bp
C. wuquan sp. nov.	YHCH020	♀	MT477870	664bp
S. shuangqiu sp. nov.	YHCH011	♀	MT478105	665bp

Taxonomy

Family Cheiracanthiidae Wagner, 1887

Key to cheiracanthiid genera occurring in East and Southeast Asia (females)

1 Trochanters not notched; epigynal atrium absent or reduced (Deeleman-Reinhold 2001: 251, fig. 335)..... ***Calamoneta***

– Trochanters notched (Deeleman-Reinhold 2001: 64, fig. 94); epigynal atrium present (Figs 2A, 2B, 4A, 4B, 6C, 6D, 6F, 11C, 11D, 11F; Deeleman-Reinhold 2001: 241, fig. 305; 247, figs 323, 328) **2**

2 Small-sized spiders (less than 4 mm) ..... ***Summacanthium***

– Medium to large-sized spiders, usually larger than 4 mm (Figs 2G, 2H, 4G, 4H, 6A, 6B, 11A, 11B)..... **3**

3 Fragile cheiracanthiids with a slender body and greenish colour (Deeleman-Reinhold 2001: 247, figs 321, 322), carapace flattened (Deeleman-Reinhold 2001: 247, fig. 321), venter of abdomen with colour pattern (Deeleman-Reinhold 2001: 247, fig. 322), trochanters shallowly notched, metatarsus and tarsus I flexible, with pseudosegments..... ***Calamopus***

– Yellow or brownish spider, sometimes with reddish or dark brown head, carapace not flattened, abdomen ventrally without distinct colour pattern (Figs 2G, H, 4G, H, 6A, B, 11A, B), trochanters are deeply notched, metatarsus and tarsus I inflexible, without pseudosegments..... **4**

4 Copulatory ducts absent; atrium located anteriorly, with delimited margin posteriorly (Fig. 11C–G) ..... ***Sinocanthium* gen. nov.**

– Copulatory ducts distinct, with variable shapes, lengths and courses; atrium located posteriorly or centrally, usually rebordered anteriorly and laterally (Figs 2A–D, 4A–D, 6C–G) ..... ***Cheiracanthium* sensu lato**

Key to cheiracanthiid genera occurring in East and Southeast Asia (males)

1 Trochanters not notched; cymbium without spur (Deeleman-Reinhold 2001: 251, figs 333, 334)..... ***Calamoneta***

– Trochanters notched (Deeleman-Reinhold 2001:64, fig. 94); cymbial spur present (Figs 7–9; Deeleman-Reinhold 2001: 241, figs 303, 304; 243, figs 310, 311; 246, figs 315, 316; 247, fig. 327)..... **2**

2 Small-sized spiders (less than 4 mm); abdomen ventrally with a scape-shaped bulge, bulge laterally with chitinized pits (Deeleman-Reinhold 2001: 241, figs 301, 302; 243, figs 307, 308) ..... ***Summacanthium***

– Medium- to large-sized spiders, usually larger than 4 mm; abdomen unmodified (Figs 2E, 2F, 4E, 4F) **3**

3 Fragile cheiracanthiids with a slender body and greenish colour (Deeleman-Reinhold 2001: 246, fig. 312; 247, figs 319, 320), carapace flattened (Deeleman-Reinhold 2001: 247, fig. 318), venter of abdomen with colour pattern (Deeleman-Reinhold 2001: 247, fig. 320), trochanters notched shallowly, metatarsus and tarsus I flexible with pseudosegments; cymbial spur reflexed near the base, directed alongside the dorsal cymbium, directed apically alongside the dorsal cymbium (Deeleman-Reinhold 2001: 246, figs 315, 316; 247, 327) ..... ***Calamopus***

– Yellow or brownish spider, sometimes with reddish or dark brown head, carapace not flattened, abdomen ventrally without distinct colour pattern (Figs 2E, F, 4E, F, 5D–F), trochanters are deeply notched, metatarsus and tarsus I inflexible without pseudosegments; cymbial spur not flexed at base, pointing in variable directions ..... ***Cheiracanthium* sensu lato**

Comments. The debate on the group's limits and internal structure of this family remains open (Deeleman-Reinhold 2001), and there is much dispute about the family placement of Neotropical genera (i.e. *Eutichurus* Simon, 1897) (Marusik and Fomichev 2016). Within Cheiracanthiidae, four genera from East and Southeast Asia can be considered most closely related to the type genus *Cheiracanthium.*

Genus *Cheiracanthium* C.L. Koch, 1839

Chiracanthops Mello-Leitão 1942 (*Cheiracanthium* is considered a senior synonym of *Chiracanthops*, Bonaldo and Brescovit 1992: 732).

Cheiracanthium C.L. Koch 1839: 9 (type species: *Aranea punctoria* Villers, 1789); Simon 1897: 87; Simon 1932: 895; Petrunkevitch 1933: 53; Reimoser 1937: 71; Edwards 1958: 368; Lehtinen 1967: 291; Dondale and Redner 1982: 17; Roberts 1985: 88; Sterghiu 1985: 100; Yaginuma 1986: 177; Chikuni 1989: 122; Paik 1990: 3; Wolf 1991: 233; Bonaldo and Brescovit 1992: 731; Deeleman-Reinhold 2001: 224; Lotz 2007a: 4; 2007b: 148; 2011: 23; 2014: 303; 2015: 322; Li and Lin 2016: 78.

Helebiona Benoit, 1977: 80 (type species: *H. wilma* Benoit, 1977); Lotz, 2007a: 66.

Type species. *Aranea punctoria* Villers, 1789, type locality: Europe.

Comments. The genus *Cheiracanthium* currently includes 215 extant species that are widespread in the Old World and represent 61% of the total number of Cheiracanthiidae species (WSC 2020). However, the genus remains inadequately studied because: (1) almost half of the species are known from a single sex or juveniles (37

from males, 59 from females, two from juveniles), and in some cases, the adults are apparently mismatched, or conspecific male and females have been described as separate species (Dankittipakul and Beccaloni 2012; WSC 2020); (2) original descriptions are rather brief and lack illustrations or the illustrations are inadequate (Zhang et al. 2018); (3) the diversity of this genus is still insufficiently known (Zhang et al. 2018). Although several major taxonomic studies on a regional scale have been conducted, e.g., Edwards (1958) for the US, Wolf (1991) for Central Europe, Bonaldo and Brescovit (1992) for the Neotropical Region, Lotz (2007a, b, 2011, 2014, 2015) for the Afrotropical Region, Deeleman-Reinhold (2001) for Southeast Asia, the genus *Cheiracanthium* has been widely considered paraphyletic (Wunderlich 2012; Marusik and Fomichev 2016). We agree with Bayer (2014) regarding the need of an extensive, large-scale review of the genus. Consequently, the present study follows the WSC (2020) and temporarily places the four new species in *Cheiracanthium* sensu lato.

Cheiracanthium daofeng Yu & Li, sp. nov.

http://zoobank.org/148233AF-5A6E-42EC-B4ED-B3E7258631DD
Figures 1, 2, 7A, 8A, 9A, 10A–C

Holotype. ♂ (IZCAS-Ar 34741), China, Yunnan Province, Xishuangbanna, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, seasonal tropical primary rainforest, 21°54.725'N, 101°13.261'E, elevation ca. 734 m, 8.VIII.2007, Guo Zheng leg. Paratype: 1♀ (IZCAS-Ar 34742), same data as holotype.

Other material examined. China, Yunnan Province, Xishuangbanna, Mengla County, Menglun Town, 1♂ (YHCH010), Baka Village, 21°57.703'N, 101°12.062'E, elevation ca. 736 m, 5.VIII.2012, Guo Zheng leg.; 1♀ (YHCH021), Bubang Village, monsoon forest, 21°36.827'N, 101°34.847'E, elevation ca. 690 m, 12.VIII.2012, Guo Zheng leg.

Etymology. The specific name is derived from the Chinese pinyin 'dāo fēng', which means 'blade point', referring to the narrow, sharp conductor which is shaped like a blade; noun in apposition.

Diagnosis. Males of the new species can be easily distinguished from the congeners by the blade-shaped pointed conductor with a sharp tip and by the embolar tip extending to the apex of the cymbium (Figs 1A–C, 7A, 8A, 10A–C) (the conductor and the embolar tip are relatively short and do not extend to the cymbial tip in almost all other *Cheiracanthium* species, such as *C. duanbi* sp. nov. and *C. gou* sp. nov.; Figs 3A–C, 5A–C, 7B, C, 8B, C, 10D–I). The females are similar to those of *C. taiwanicum* (Chen and Huang 2012: 25, fig. 7E, F) in having a similar habitus, an eyebrow-shaped atrial anterior margin, and coiled copulatory ducts but differ in the following: (1) the receptacles are kidney-shaped (Fig. 2C, D) (vs. globular in *C. taiwanicum*), and (2) having different numbers of copulatory duct coils (four coils in *C. daofeng* sp. nov., vs. six coils in *C. taiwanicum*) (Fig. 2C, D).

Description. Male. Holotype (Figs 2E, F): TL 4.95; CL 2.15, CW 1.74, CI (CL/CW) 1.24; AL 2.80, AW 1.34. Carapace pale brown, with pair of brown lateral bands extending from behind PME and PLE, almost reaching posterior margin, fused, forming a U-shaped patch. Eyes: AER slightly recurved, PER slightly wider than AER, almost straight in dorsal view. All eyes dark with black rings. Eye sizes and interdistances: OAL 0.37, OAW 0.99; AME 0.12, ALE 0.14, PME 0.11, PLE 0.13; AME–AME 0.07, AME–ALE 0.10, PME–PME 0.17, PME–PLE 0.27; MOQA 0.37, MOQP 0.45, CLL 0.05. Chelicerae protruding and coloured as carapace, with a small basal condyle, three teeth on promargin and three on retromargin. Sternum pale brown, STL 1.04, STW 0.91. Labium and endites coloured as carapace. Legs pale yellow, without distinct markings. Leg measurements: I 21.08 (5.36, 6.70, 6.72, 2.30), II 11.50 (3.11, 3.83, 3.66, 0.91), III 8.58 (2.35, 2.57, 2.85, 0.82), IV 12.28 (3.24 3.76, 4.27, 1.02); LL/CL 9.80. Abdomen lanceolate, dorsally yellowish white, dorsum with indistinct heart-shaped mark, two pairs of inconspicuous muscle depressions, scattered numerous white pigmented spots; venter yellowish white without distinct pattern.

Palp (Figs 1A–C, 7A, 8A, 9A, 10A–C). Tibia with two apophyses: a retrolateral one that is relatively long and sclerotized, ca. 1/3 of palpal tibia length, with a more-or-less finger-like apex; a very minute, tooth-shaped dorsal apophysis; cymbial spur two times shorter than tibia, beak-shaped; cymbial fold strongly developed and conspicuous in ventral and retrolateral views for approximately 2/3 of cymbium length; tip of cymbium long, ca. 1/2 of cymbium length. Tegulum oval, 1.6 times longer than wide; median apophysis long and filamentous, more than 1/2 of tegulum length, with a curved tip resembling a sickle in ventral view; embolus filiform, originating on the retrolateral flank (approximately 1 o'clock on tegulum), surrounding base and ending at conductor apex, its tip curved behind conductor and extending to apex of cymbium; conductor large, shaped like a blade point, base wide, gradually tapering toward apex.

Female. Distinctly larger and darker than male. Paratype (Fig. 2G, H) measured: TL 6.32; CL 2.40, CW 1.67, CI (CL/CW) 1.44; AL 3.92, AW 2.42. Eye diameters and interdistances: OAL 0.41, OAW 1.07; AME 0.11, ALE 0.13, PME 0.12, PLE 0.13; AME–AME 0.09, AME–ALE 0.15, PME–PME 0.19, PME–PLE 0.22; MOQA 0.39, MOQP 0.46, CLL 0.08. PMT: RMT = 3:3. STL 1.20, STW 1.06. Legs yellowish white, without distinct markings. Leg measurements: I 21.08 (5.36, 6.70, 6.72, 2.30), II 11.50 (3.11, 3.83, 3.66, 0.91), III 8.58 (2.35, 2.57, 2.85, 0.82), IV 12.28 (3.24 3.76, 4.27, 1.02); LL/CL 9.80.

Epigyne (Figs 2A–D). Atrium ca. two times wider than long, atrial anterior margin eyebrow-shaped and heavily sclerotized, posterior and lateral margins inconspicuous; receptacles are faintly visible through epigynal plate in ventral view; two copulatory openings, large and conjoined, located at posterior portion of epigynal plate; transparent copulatory ducts coiled, forming four entwined loops (including three ascending coils and one descending coil); receptacle reniform, separated by diameter of receptacle.

Distribution. Known only from the type locality, Xishuangbanna, Yunnan, China.

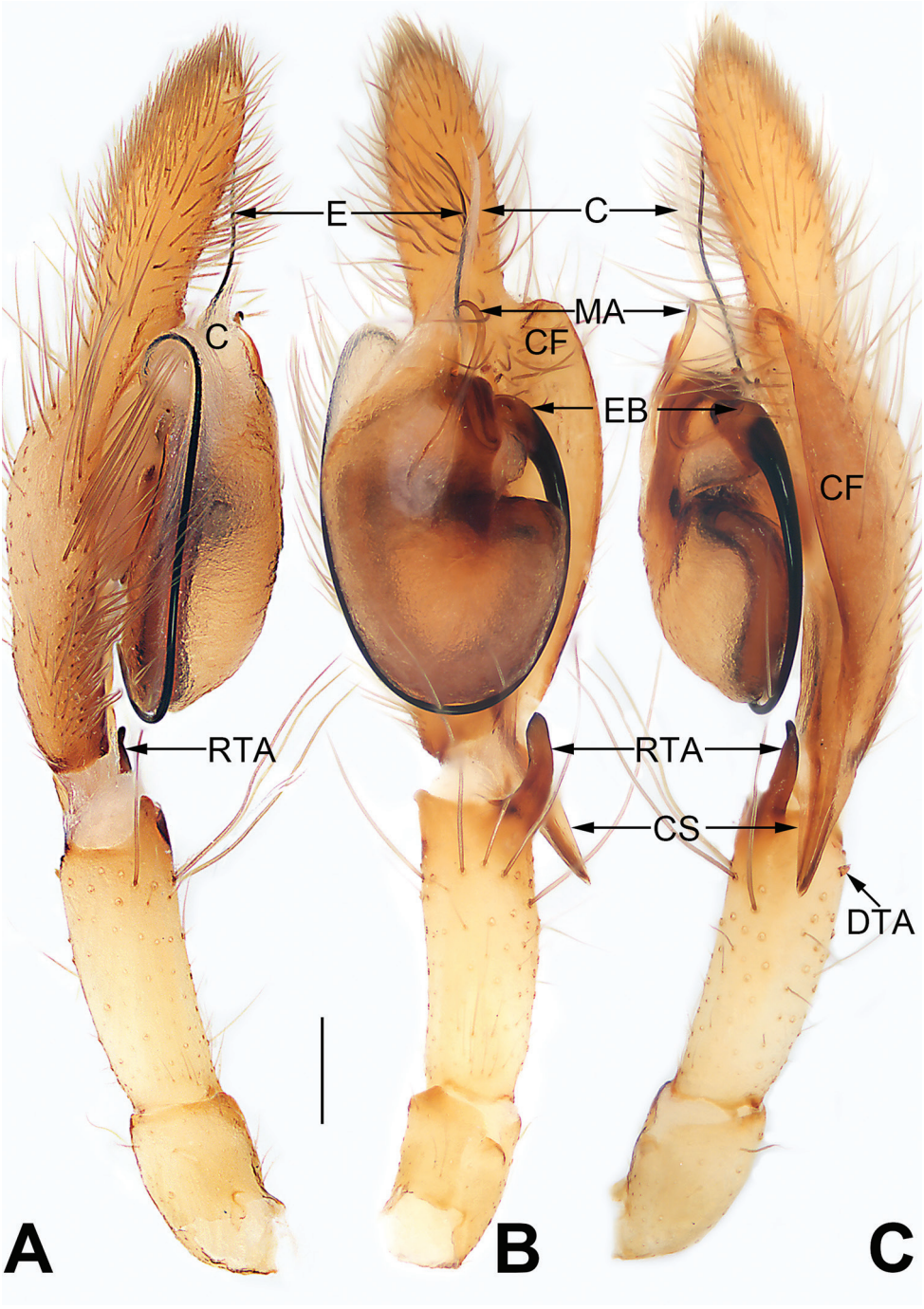

Figure 1. Palp of *Cheiracanthium daofeng* sp. nov., male holotype. **A** Prolateral view **B** ventral view **C** retrolateral view. Abbreviations: C = conductor; CF = cymbial fold; CS = cymbial spur; DTA = dorsal tibial apophysis; E = embolus; EB = embolic base; MA = median apophysis; RTA = retrolateral tibial apophysis. Scale bar: 0.2 mm.

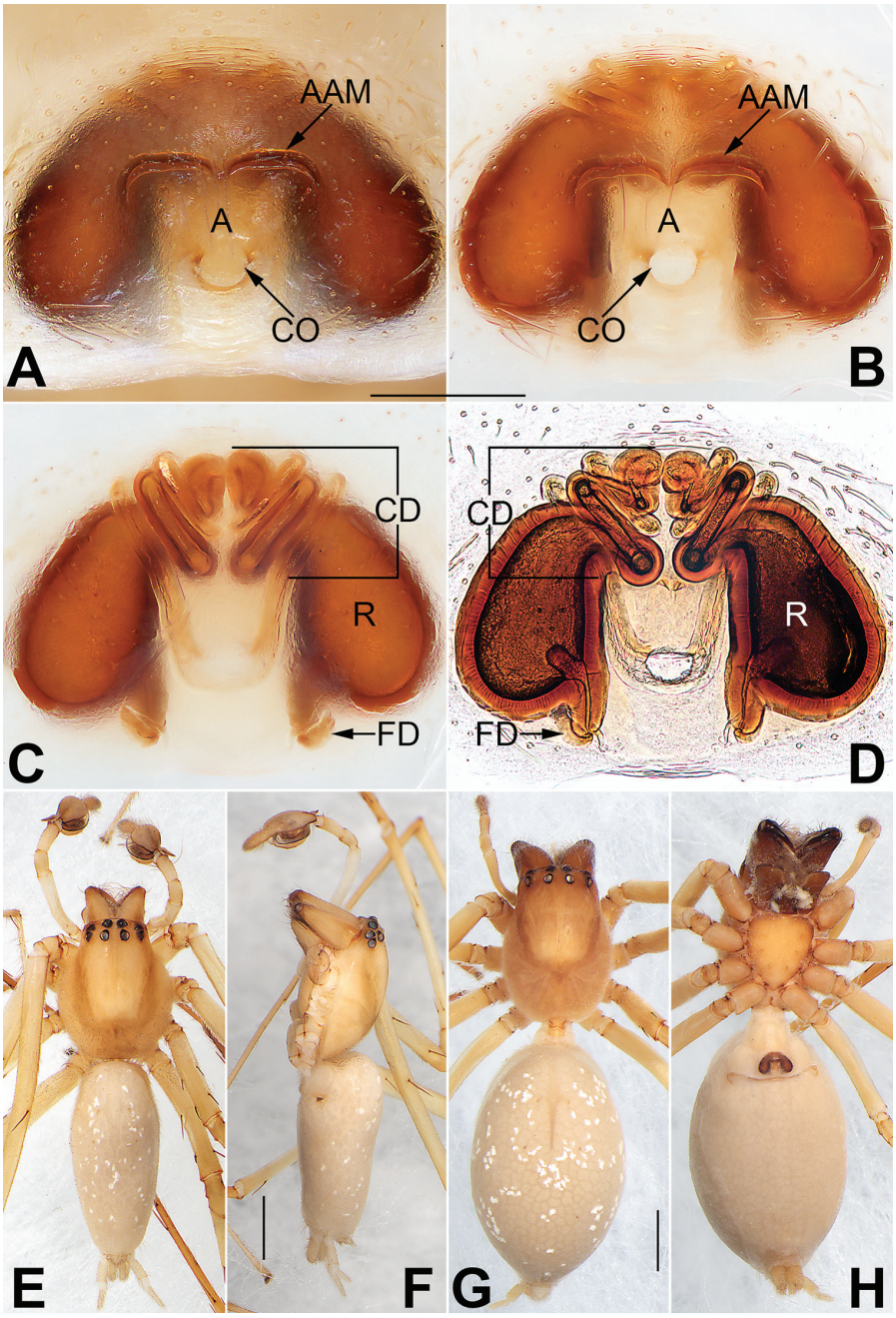

Figure 2. *Cheiracanthium daofeng* sp. nov., female paratype and male holotype. **A** Epigyne, intact, ventral view **B** epigyne, cleared, ventral view **C** vulva, cleared, dorsal view **D** vulva, cleared and embedded in Arabic gum, dorsal view **E** male habitus, dorsal view **F** male habitus, lateral view **G** female habitus, dorsal view **H** female habitus, ventral view. Abbreviations: A = atrium; AAM = atrial anterior margin; CD = copulatory duct; CO = copulatory opening; FD = fertilization duct; R = receptacle. Scale bars: 0.2 mm (**A–D**); 1 mm (**E–H**).

***Cheiracanthium duanbi* Yu & Li, sp. nov.**
http://zoobank.org/0BC67D41-E295-4A3E-B8DB-BB84448A7B9C
Figures 3, 4, 7B, 8B, 9B, 10D–F

Holotype. ♂ (IZCAS-Ar 34743, YHCH030), China, Yunnan Province, Xishuangbanna, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, G213 roadside, *Anogeissus acuminata* plantation, 21°53.748'N, 101°17.084'E, elevation ca. 620 m, 1.V.2019, Zhigang Chen leg. Paratype: 1♀ (IZCAS-Ar 34744, YHCH029), Xishuangbanna Tropical Botanical Garden, 21°54.007'N, 101°16.395'E, elevation ca. 620 m, 10.V.2019, Zilong Bai leg.

Etymology. The specific name is derived from the Chinese pinyin 'duǎn bì', which means 'short dagger', and refers to the dagger-shaped retrolateral tibial apophysis; noun in apposition.

Diagnosis. The male of *C. duanbi* sp. nov. can be distinguished from all other *Cheiracanthium* species, except *C. exquestitum* (Zhang and Yin 1999: 287, figs 8, 9), by having a distally wide cymbial spur, a spine-like median apophysis, and a beak-shaped conductor but can be distinguished from *C. exquestitum* by having: (1) the distal tip of the cymbial spur partly membranous and not forked (Figs 3A–C, 7B, 8B); with a sclerotized and forked apex in *C. exquestitum*; (2) the retrolateral tibial apophysis erect, like a short dagger, in retrolateral view (Figs 3C, 8B), instead of sinuate and hook-shaped as in *C. exquestitum*; (3) the median apophysis shorter (Figs 3B, C, 7B, 8B, 10D–F). The females are similar to those of *C. exquestitum* (Zhang and Yin 1999: 287, figs 10, 11), *C. rehobothense* Strand, 1915 (Bayer 2014: 29, figs 8a–c, 9a, b), *C. gratum* Kulczyński, 1897 (Merkens and Wunderlich 2000: 42, figs 6–9), and *C. fulvotestaceum* Simon, 1878 (Hänggi and Stäubli 2012: 64, fig. 5) by the general shape of the atrium and vulva but can be distinguished by the copulatory ducts having three turns (vs. copulatory ducts with four turns in *C. exquestitum*, with two turns in *C. rehobothense* and *C. gratum*) and by the larger atrium (lateral margin of atrium close to the receptacle in *C. duanbi* sp. nov. vs. distant from the receptacle in *C. fulvotestaceum*).

Description. Male. Holotype (Figs 4E, F): TL 7.68; CL 3.64, CW 2.83, CI (CL/CW) 1.29; AL 4.01, AW 1.99. Carapace white, uniformly coloured, without any pattern. Eyes: in dorsal view, both anterior and posterior eye rows recurved, PER slightly wider than AER. All eyes dark, on tubercles. Eye sizes and interdistances: OAL 0.41, OAW 1.27; AME 0.18, ALE 0.20, PME 0.17, PLE 0.12; AME–AME 0.15, AME–ALE 0.22, PME–PME 0.28, PME–PLE 0.32; MOQA 0.51, MOQP 0.56, CLL 0.04. Chelicerae robust and coloured as carapace, both margins with two teeth. Sternum yellowish white, STL 1.87, STW 1.41. Labium and endites coloured as carapace. Legs white with greyish metatarsi and tarsi. Leg measurements: I 29.59 (7.23, 9.39, 9.69, 2.28), II 21.05 (5.77, 6.86, 6.58, 1.84), III 15.11 (3.81, 4.86, 5.08, 1.35), IV 20.96 (5.31, 6.81, 7.07, 1.77); LL/CL 8.13. Abdomen lanceolate, dorsally grey, lighter anteriorly, darker posteriorly; dorsum with a lengthwise white heart mark, 1/3 of opisthosoma length; venter greyish without any pattern.

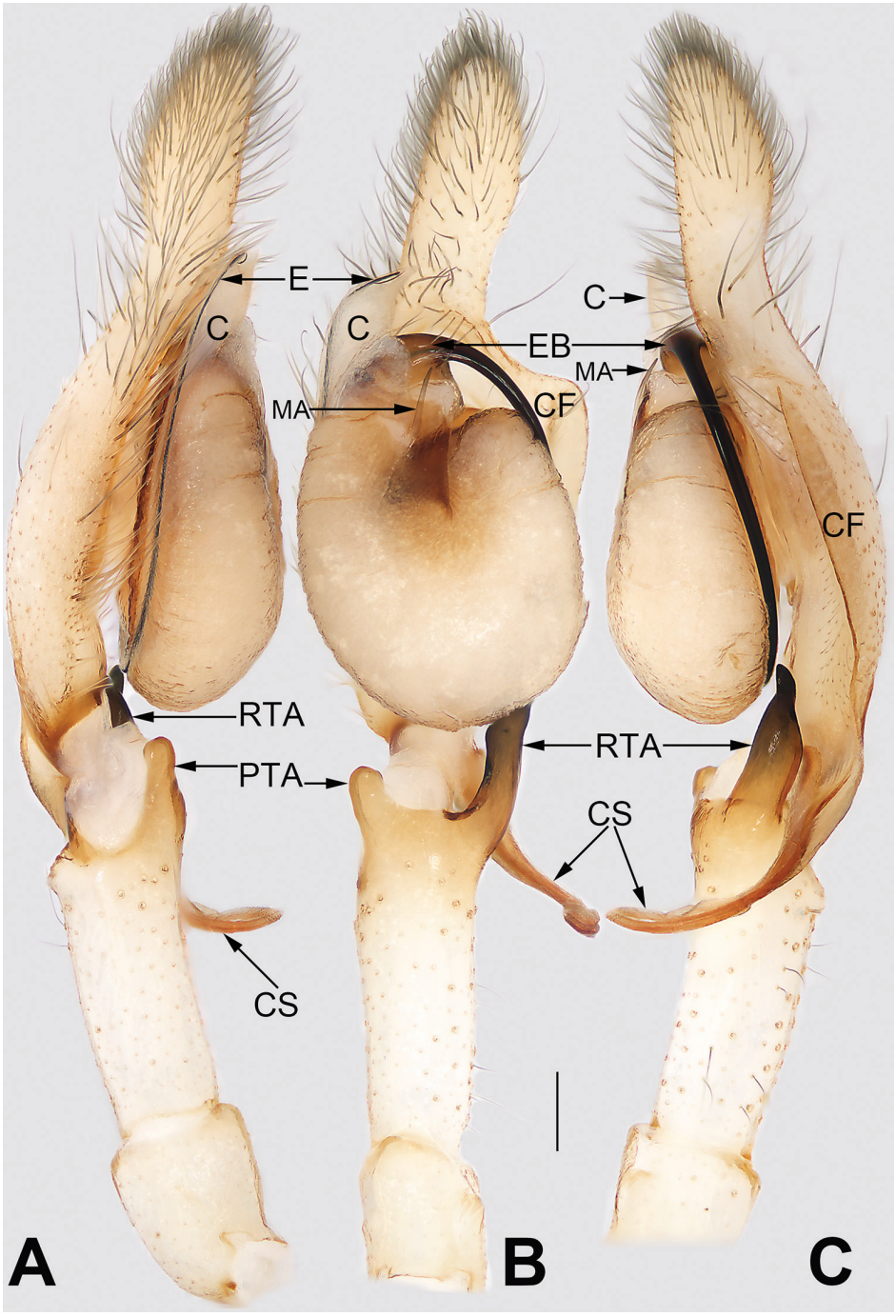

Figure 3. Palp of *Cheiracanthium daofeng* sp. nov., male holotype. **A** Prolateral view **B** ventral view **C** retrolateral view. Abbreviations: C = conductor; CF = cymbial fold; CS = cymbial spur; E = embolus; EB = embolic base; MA = median apophysis; PTA = prolateral apophysis; RTA = retrolateral tibial apophysis. Scale bars: 0.2 mm.

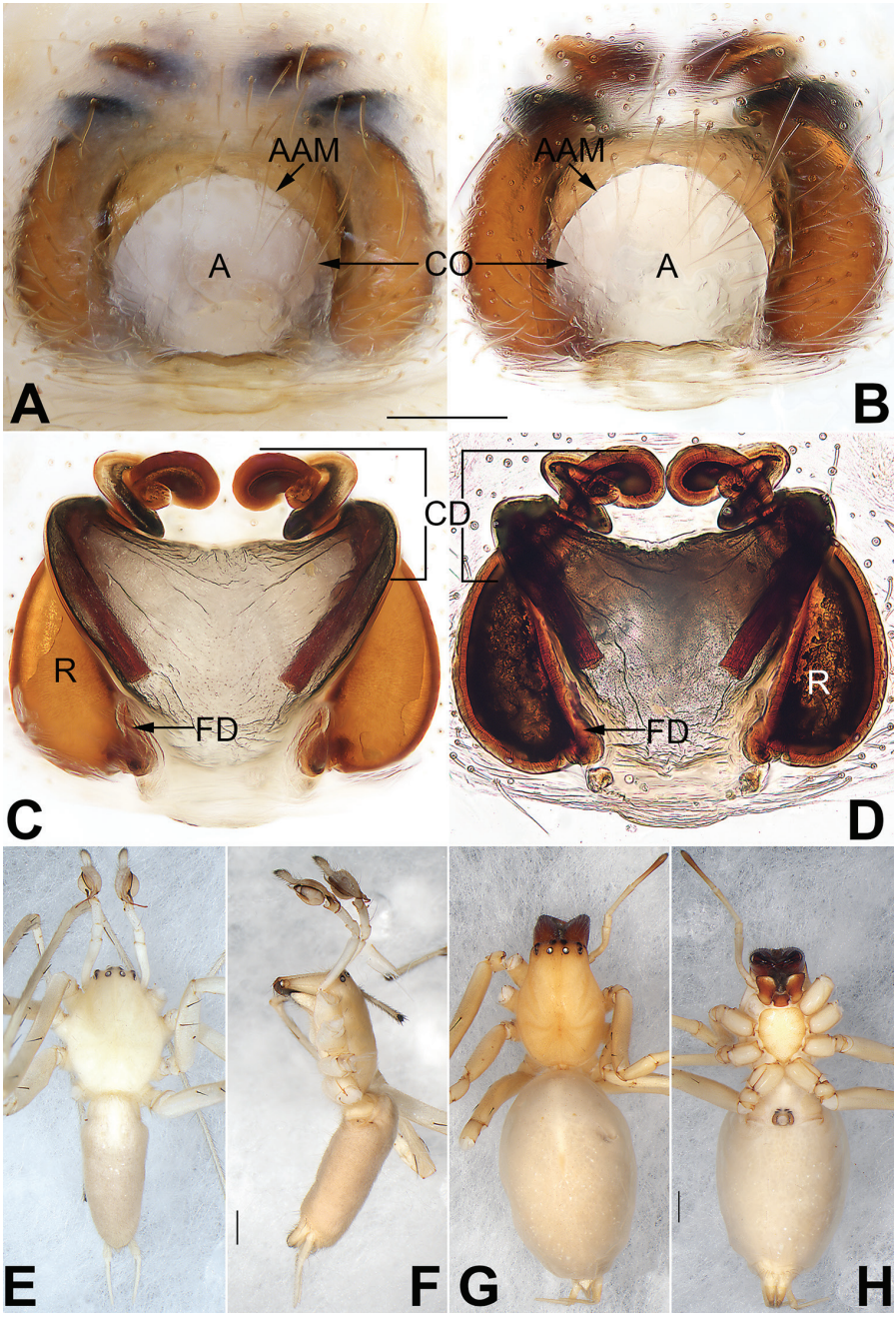

Figure 4. *Cheiracanthium duanbi* sp. nov., female paratype and male holotype. **A** epigyne, intact, ventral view **B** epigyne, cleared, ventral view **C** vulva, cleared, dorsal view **D** vulva, cleared and embedded in Arabic gum, dorsal view **E** male habitus, dorsal view **F** male habitus, lateral view **G** female habitus, dorsal view **H** female habitus, ventral view. Abbreviations: A = atrium; AAM = atrial anterior margin; CD = copulatory duct; CO = copulatory opening; FD = fertilization duct; R = receptacle. Scale bars: 0.2 mm (**A–D**); 1 mm (**E–H**).

Palp (Figs 3A–C, 7B, 8B, 9B, 10D–F). Tibia relatively long, ca. 2/3 of cymbium length, with two apophyses: a short and sclerotized retrolateral one, ca. 1/2 of palpal tibia length, with wide base and narrow apex, dagger-shaped; and a small, round, thumb-like prolateral apophysis; cymbial spur approximately as long as tibia, distal tip wide and partly membranous; cymbial fold well-developed and clearly visible in ventral and retrolateral views for ca. 1/2 length of cymbium; tip of cymbium long, ca. 1/2 of cymbium length. Tegulum oval, 1.4 times longer than wide, surface wrinkled; median apophysis small and hyaline, spine-like; embolus filiform, arising at approximately 12 o'clock position, terminating at approximately 11 o'clock position, tip covered by conductor; conductor short, wide, beak-shaped, base covering embolic base, tip covering embolar apex.

Female. Distinctly larger and darker than male. Paratype (Figs 4G, H): TL 10.32; CL 3.64, CW 2.79, CI (CL/CW) 1.30; AL 6.69, AW 4.20. Eye diameters and interdistances: OAL 53, OAW 1.46; AME 0.21, ALE 0.23, PME 0.18, PLE 0.17; AME–AME 0.12, AME–ALE 0.31, PME–PME 0.37, PME–PLE 0.41; MOQA 0.55, MOQP 0.74, CLL 0.06. PMT: RMT = 2:3. STL 1.79, STW 1.50. Legs yellowish brown, without distinct markings. Leg measurements: I 20.68 (5.27, 7.07, 6.06, 2.28), II 14.99 (4.25, 5.33, 4.00, 1.42), III 10.55 (2.91, 3.47, 2.97, 1.21), IV – (3.86, –, –, –); LL/CL 5.68.

Epigyne (Fig. 4A–D). Atrium large, located at posterior portion of epigynal plate, with delimited margin anteriorly and laterally, length is almost equivalent to width; receptacles and copulatory ducts prominent through epigynal plate in ventral view; two copulatory openings located at basolateral atrial borders; transparent copulatory ducts coiled, with three turns (including two ascending coils and one descending coil); receptacles elongated and pyriform, ca. two times longer than wide, separated by 1.5 diameters.

Distribution. Known only from the type locality, Xishuangbanna, Yunnan, China.

***Cheiracanthium gou* Yu & Li, sp. nov.**

http://zoobank.org/BC42EBA3-7A0D-44FE-9274-5E5EB8FDB88D

Figures 5, 7C, 8C, 9C, 10G–I

Holotype. ♂ (IZCAS-Ar 34746, YHCH016), China, Yunnan Province, Xishuangbanna, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, 48 km landmark in the reserve, seasonal rainforest, 21°58.704'N, 101°19.748'E, elevation ca. 1088 m, 12.VIII.2011, Guo Zheng leg.

Etymology. The specific name is derived from the Chinese pinyin 'gōu', which means 'hook', and refers to the curved distal tip of the cymbial spur which is shaped like a hook; noun in apposition.

Diagnosis. Males of this new species can be easily distinguished from all other *Cheiracanthium* species by the structure of the palp. The retrolateral tibial apophysis consists of a thin distal half and a wide basal half. The cymbial spur is partly membranous proximally and sclerotized distally with the distal tip blunt and thick, hook-

shaped (Figs 5A–C, 7C, 8C, 9C). By contrast, in almost all known *Cheiracanthium* species, the retrolateral tibial apophysis and the cymbial spur cannot be easily divided into two parts, and the distal tip of the cymbial spur is usually sharply pointed, such as in *C. daofeng* sp. nov. and *C. duanbi* sp. nov. (Figs 1A–C, 3A–C, 7A, B, 8A, B, 9A, B).

Description. Male. Holotype (Fig. 6D–F): TL –; CL 3.63, CW 2.83, CI (CL/CW) 1.28; AL –, AW –. Carapace pale yellow, uniformly coloured, without distinct pattern; cephalic region inconspicuously raised, cervical groove and radial grooves distinct, tegument smooth, clothed with short, fine hairs. Eyes: in dorsal view, both anterior and posterior eye rows recurved, PER slightly wider than AER. All eyes dark, on tubercles. Eye sizes and interdistances: OAL 0.49, OAW 1.32; AME 0.22, ALE 0.20, PME 0.17, PLE 0.18; AME–AME 0.17, AME–ALE 0.18, PME–PME 0.22, PME–PLE 0.28; MOQA 0.53, MOQP 0.58, CLL 0.09. Chelicerae with three teeth on promargin and three on retromargin, with long red fangs. Sternum pale yellow, STL 1.67, STW 1.32. Labium and endites orange. Legs distinctly long, yellowish white, with brown metatarsi and tarsi, without distinct markings. Leg measurements: I 32.75 (8.38, 1.062, 11.29, 2.46), II – (5.32, –, –, –), III missing, IV 22.07 (6.4, 6.34, 7.72, 1.61); LL/CL 9.02. Abdomen missing.

Palp (Figs 5A–C, 7C, 8C, 9C, 10G–I). Tibia with two apophyses: long and sclerotized retrolateral apophysis, ca. 1/3 of palpal tibia length, with thin distal half and wide basal half; and a short, thin, stalk-like dorsal apophysis; cymbial spur short, ca. 1/3 of cymbium length, partly membranous proximally, heavily sclerotized distally, distal tip curved and blunt; cymbial fold poorly developed and indistinct in ventral and retrolateral views for ca. 1/2 the length of cymbium; tip of cymbium long, ca. 1/2 of cymbium length. Bulb elongated, 1.5 times longer than wide; median apophysis long and hyaline, more than 1/2 of tegulum length, with wide base, thin middle part, and hook-shaped tip; embolus originates at ca. 1 o'clock position, surrounds base, and ends atop conductor at distal end of tegulum; conductor short, thick, membranous.

Female. Unknown.

Comments. According to the WSC (2020), a total of ten *Cheiracanthium* species from China are known only from females: *C. approximatum* O. P.-Cambridge, 1885, *C. escaladae* Barrion et al., 2013, *C. fujianense* Gong, 1983, *C. hypocyrtum* Zhang & Zhu, 1993, *C. liuyangense* Xie et al., 1996, *C. olliforme* Zhang & Zhu, 1993, *C. potanini* Schenkel, 1963, *C. solidum* Zhang et al., 1993, *C. sphaericum* Zhang et al., 1993, and *C. longtailen* Xu, 1993. Among them, *C. escaladae* is supposedly a *Clubiona* species based on epigyne morphology, *C. approximatum* and *C. potanini* are doubtful or invalid species because of the poor original illustrations and descriptions, *C. liuyangense* may be a synonym of *C. taegense* Paik, 1990, and *C. longtailen* is considered a junior synonym of *C. pichoni* Schenkel, 1963. The remaining five species can be tentatively considered valid species. In addition, *C. spectabile* (Thorell, 1887) from Myanmar is known by the male but is not illustrated. We cannot rule out the possibility that the above six species are conspecific to *C. gou* sp. nov.

Distribution. Known only from the type locality, Xishuangbanna, Yunnan, China.

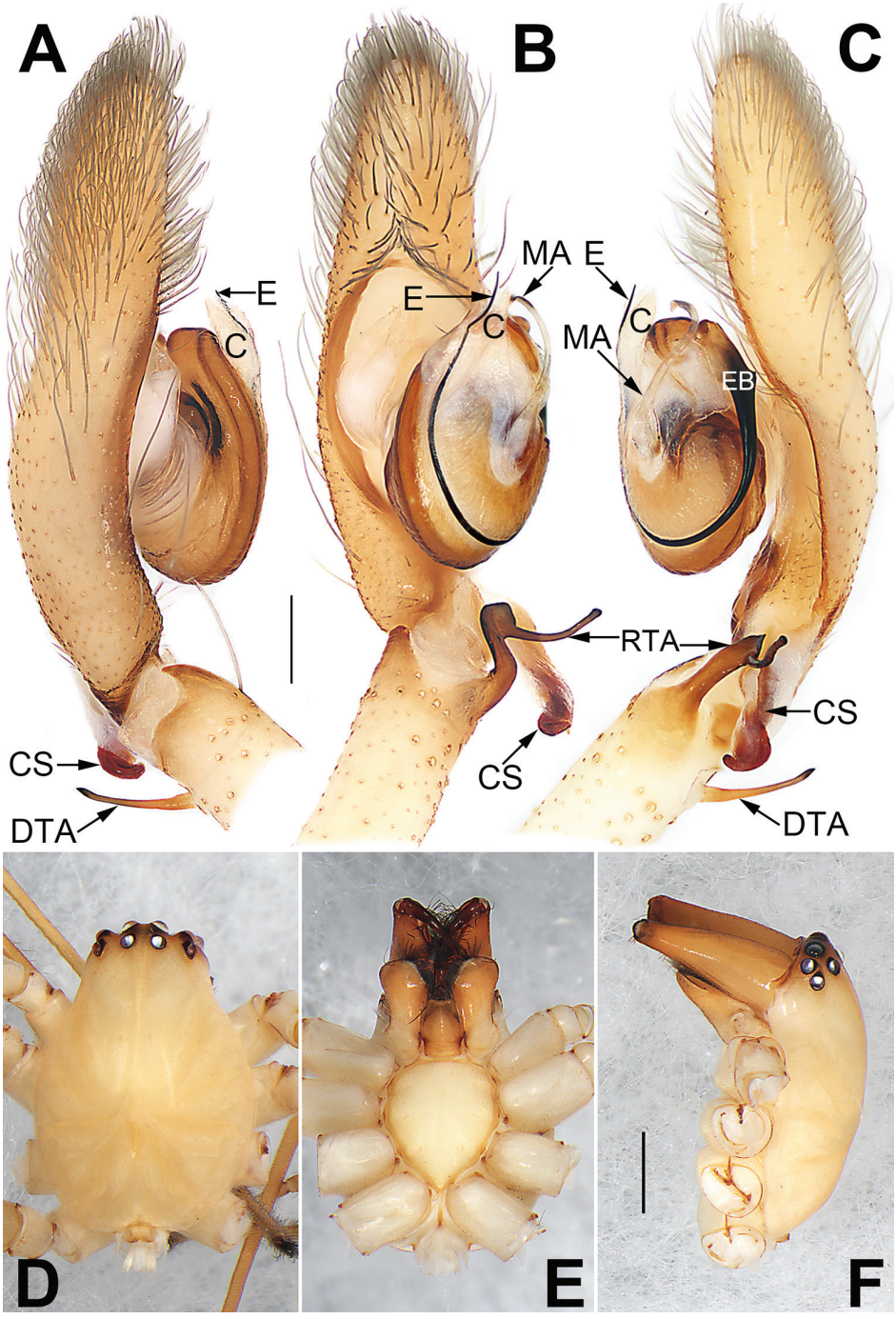

Figure 5. *Cheiracanthium gou* sp. nov., male holotype. **A** Flipped right palp, prolateral view **B** left palp, ventral view **C** left palp, retrolateral view **D** habitus, dorsal view **E** habitus, ventral view **F** habitus, lateral view. Abbreviations: C = conductor; CS = cymbial spur; DTA = dorsal tibial apophysis; E = embolus; EB = embolic base; MA = median apophysis; RTA = retrolateral tibial apophysis. Scale bars: 0.2 mm (**A–C**); 1 mm (**D–F**).

***Cheiracanthium wuquan* Yu & Li, sp. nov.**
http://zoobank.org/6BEB7F25-F29A-47A9-BFAB-E5D11EDECC36
Figure 6

Holotype. ♀ (IZCAS-Ar 34747, YHCH020), China, Yunnan Province, Xishuangbanna, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, 48 km landmark in the reserve, seasonal rainforest; 21°58.704'N, 101°19.748'E, elevation ca. 1088 m, 12.VIII.2011, Guo Zheng leg.

Etymology. The specific name is derived from the Chinese pinyin 'wǔ quān', which means 'five loops', and refers to the coiled copulatory ducts, forming five entwined coils; noun in apposition.

Diagnosis. The female of the new species is similar to those of *C. japonicum* Bösenberg & Strand, 1906 (Zhu and Zhang 2011: 341, fig. 246A, B), *C. simaoense* Zhang & Yin, 1999 (Zhang and Yin 1999: 286, figs 6, 7), *C. turiae* Strand, 1917 (Deeleman-Reinhold 2001: 234, figs 292, 293), and *C. virescens* (Sundevall, 1833) (Zhu and Zhang 2011: 346, fig. 250A, B) by the general shape of the atrium and receptacles and the coiling of the copulatory duct around the distal part of the receptacle. The new species can be easily distinguished by the different number of copulatory duct coils (copulatory ducts with five turns in *C. wuquan* sp. nov. vs. three turns in *C. simaoense* and *C. virescens* and four turns in *C. japonicum* and *C. turiae*) (Figs 6C–G).

Description. Female. Holotype (Fig. 6A, B): TL 6.85; CL 2.69, CW 2.42, CI (CL/CW) 1.11; AL 4.15, AW 2.78. Carapace yellowish orange except yellowish brown ocular area, without distinct pattern; cervical groove and radial grooves indistinct. Eyes: both anterior and posterior eye rows almost straight in dorsal view, PER slightly wider than AER. All eyes dark, with black rings. Eye sizes and interdistances: OAL 0.37, OAW 1.10; AME 0.15, ALE 0.11, PME 0.14, PLE 0.14; AME–AME 0.20, AME–ALE 0.23, PME–PME 0.30, PME–PLE 0.33; MOQA 0.46, MOQP 0.57, CLL 0.04. Chelicerae robust and brownish red, with long, red wine-coloured fangs, with three teeth on promargin and two on retromargin. Sternum pale yellow, STL 1.35, STW 1.12. Labium and endites light orange. Legs yellowish white with brown metatarsi and tarsi, without distinct markings. Leg measurements: I 9.38 (2.54,3.35, 2.73, 0.77), II 7.83 (2.00, 2.88, 2.23, 0.72), III 5.78 (1.64, 1.86, 1.65, 0.62), IV 7.96 (2.41, 2.43, 2.42, 0.70); LL/CL 3.49. Abdomen oval, uniformly grey, dorsum with two pairs of conspicuous muscle depressions; venter medially with two longitudinal dotted lines.

Epigyne (Figs 6C–G). Atrium large, slightly wider than long, located at posterior portion of epigynal plate, with arched anterior hood and indistinct posterior margin; two copulatory openings, large and contiguous, located at basolateral atrial borders; receptacles and copulatory ducts conspicuous through epigynal plate in ventral view; transparent copulatory ducts coiled, with five ascending turns, connecting receptacle anteriorly; receptacles elongated and separated by 1.5 diameters, pear shaped, ducts coil around distal part.

Male. Unknown.

Comments. Due to the large and long, ovoid receptacles and the slender copulatory duct encircling the anterior part of the receptacles, we justifiably place *C. wuquan*

sp. nov. in *Cheiracanthium* sensu stricto. Until now, five *Cheiracanthium* species from China are known from males only: *C. antungense* Chen & Huang, 2012, *C. echinulatum* Zhang, Zhang & Yu, 2018, *C. gobi* Schmidt & Barensteiner, 2000, *C. ningmingense* Zhang & Yin, 1999, and *C. chayuense* Li & Zhang, 2019 (WSC 2020). Based on the palpal structure, with the exception of *C. ningmingense*, the other four species do not belong to *Cheiracanthium* sensu stricto (Wunderlich 2012). *C. ningmingense* is presently known from Ningming county in Guangxi (type locality), Shimen county in Hunan, and Xishuangbanna in Yunnan. However, *C. ningmingense* maybe a junior synonym of one known species.

Distribution. Known only from the type locality, Xishuangbanna, Yunnan, China.

***Sinocanthium* Yu & Li, gen. nov.**

http://zoobank.org/E11D612A-3AC7-4F35-BCAD-D0B2EAD27FCF

Type species. *Sinocanthium shuangqiu* Yu & Li, sp. nov.

Etymology. The generic name is derived from its similarity to *Cheiracanthium* and the Latin adjective Sino- for Chinese referring to the distribution region of the genus. The gender is neuter.

Diagnosis. *Sinocanthium* gen. nov. resembles *Cheiracanthium* by the similar habitus (Figs 11A, B, 4G, H, 6A, B) but is consistently separable by the shape of the epigyne. *Sinocanthium* gen. nov., as in most *Cheiracanthium* species, has a yellow body, a wide cephalic part, long legs, subequal eyes, and parallel eye rows of equal width occupying the greater width of the head. It can be distinguished from *Cheiracanthium* sensu lato by the absence of copulatory ducts (Fig. 11E, G) (vs. copulatory ducts with variable lengths but distinct in all *Cheiracanthium* species, including *C. daofeng* sp. nov., *C. duanbi* sp. nov., and *C. wuquan* sp. nov. (Figs 2C, D, 4C, D, 6E, G), and by the atrium located anteriorly with a rebordered posterior margin (Figs 11C, D, F) (vs. atrium located anteriorly or centrally, atrial hood located anteriorly in *Cheiracanthium*).

Description. Same as for the species.

Composition. Type species only.

Comments. Based on the original figures and text descriptions of the epigynes, *Cheiracanthium* sensu lato can be further divided into at least four or five different taxa (Wunderlich 2012). The morphology of the epigyne exhibits very high diversity. However, all *Cheiracanthium* species related to the generotype have copulatory ducts, even though the shapes, lengths, and courses of the copulatory ducts are variable. Despite the variable shapes, the atria of the different taxa are located posteriorly or centrally and are usually rebordered anteriorly and laterally. Obviously, *Sinocanthium shuangqiu* sp. nov. cannot be placed in *Cheiracanthium* sensu lato because of the peculiar structure of the epigyne, so we described a new genus to accommodate it. Although we examined only one female of *S. shuangqiu* sp. nov., our specimen is strikingly different from all *Cheiracanthium* species: The atrium is located anteriorly, the atrial posterior margin is rebordered, and copulatory ducts are absent, supporting our decision.

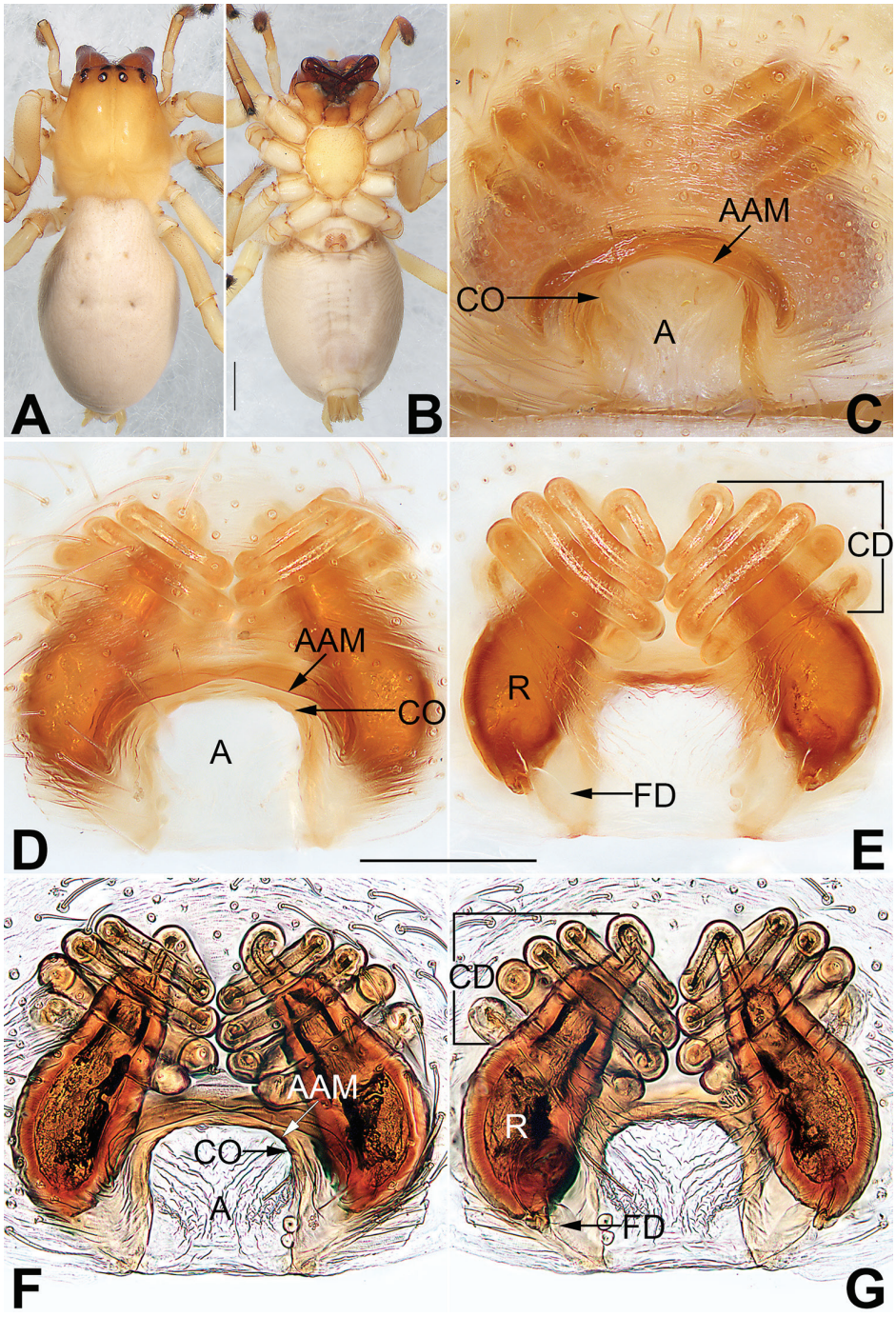

Figure 6. *Cheiracanthium wuquan* sp. nov., female holotype. **A** Habitus, dorsal view **B** habitus, ventral view **C** epigyne, intact, ventral view **D** epigyne, cleared, ventral view **E** vulva, cleared, dorsal view **F** epigyne, cleared and embedded in Arabic gum, ventral view **G** vulva, cleared and embedded in Arabic gum, dorsal view. Abbreviations: A = atrium; AAM = atrial anterior margin; CD = copulatory duct; CO = copulatory opening; FD = fertilization duct; R = receptacle. Scale bars: 1 mm (**A, B**); 0.2 mm (**C–G**).

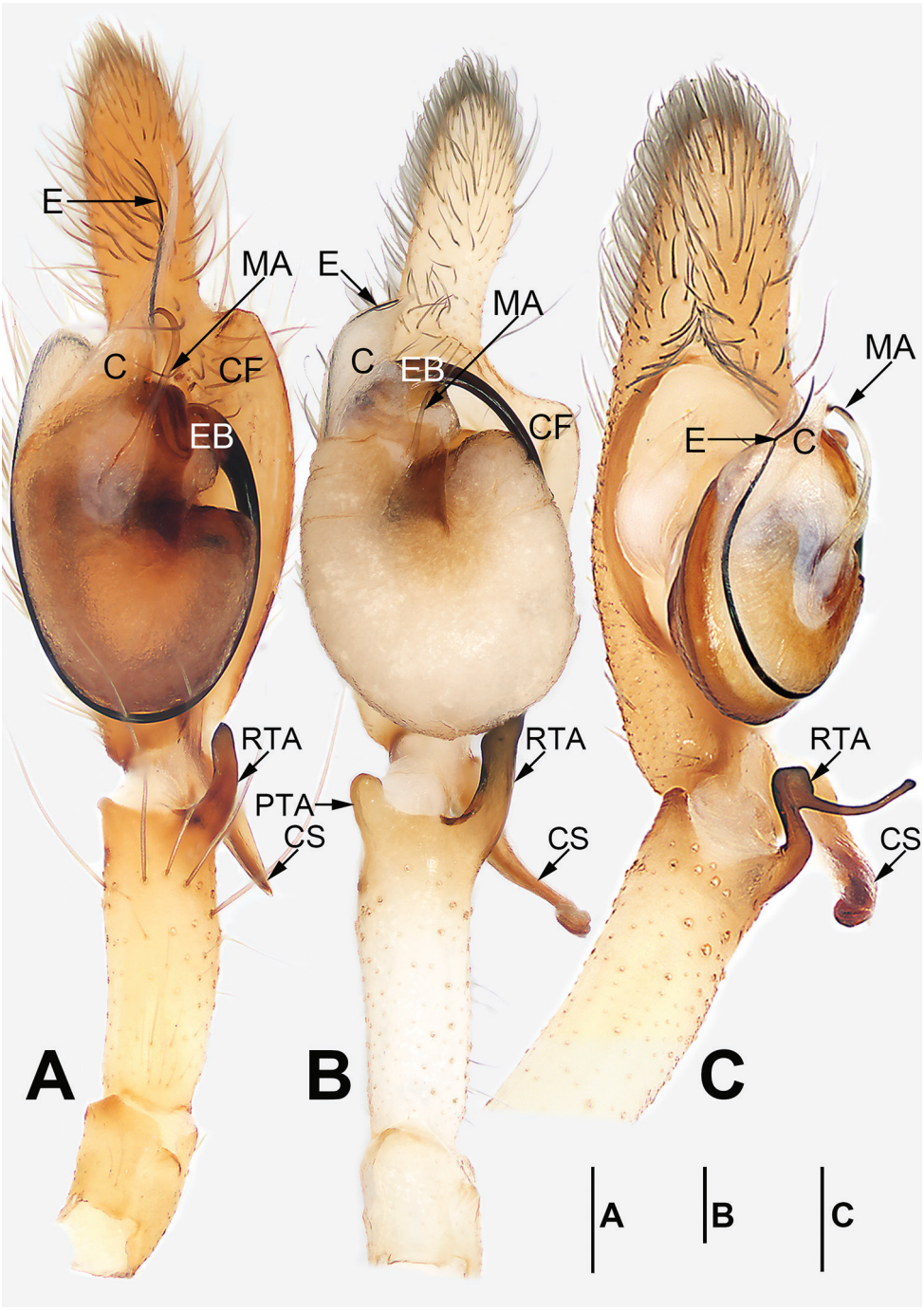

Figure 7. *Cheiracanthium* spp., left palp, ventral view. **A** *C. daofeng* sp. nov., male holotype **B** *C. duanbi* sp. nov., male holotype **C** *C. gou* sp. nov., male holotype. Abbreviations: C = conductor; CF = cymbial fold; CS = cymbial spur; E = embolus; EB = embolic base; MA = median apophysis; RTA = prolateral tibial apophysis; RTA = retrolateral tibial apophysis. Scale bars: 0.2 mm.

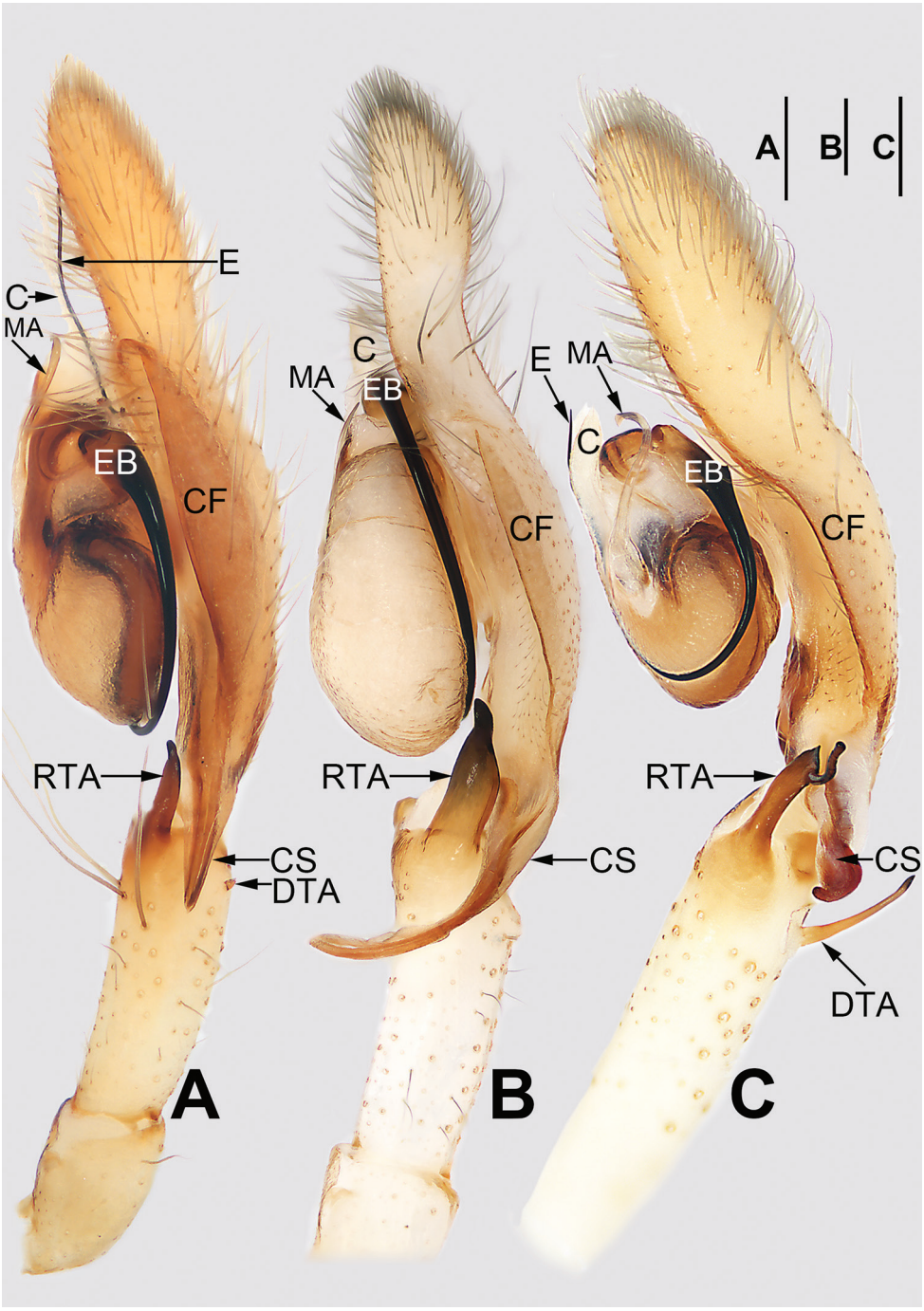

Figure 8. *Cheiracanthium* spp., left palp, retrolateral view. **A** *C. daofeng* sp. nov., male holotype **B** *C. duanbi* sp. nov., male holotype **C** *C. gou* sp. nov., male holotype. Abbreviations: C = conductor; CF = cymbial fold; CS = cymbial spur; DTA = dorsal tibial apophysis; E = embolus; EB = embolic base; MA = median apophysis; RTA = retrolateral tibial apophysis. Scale bars: 0.2 mm.

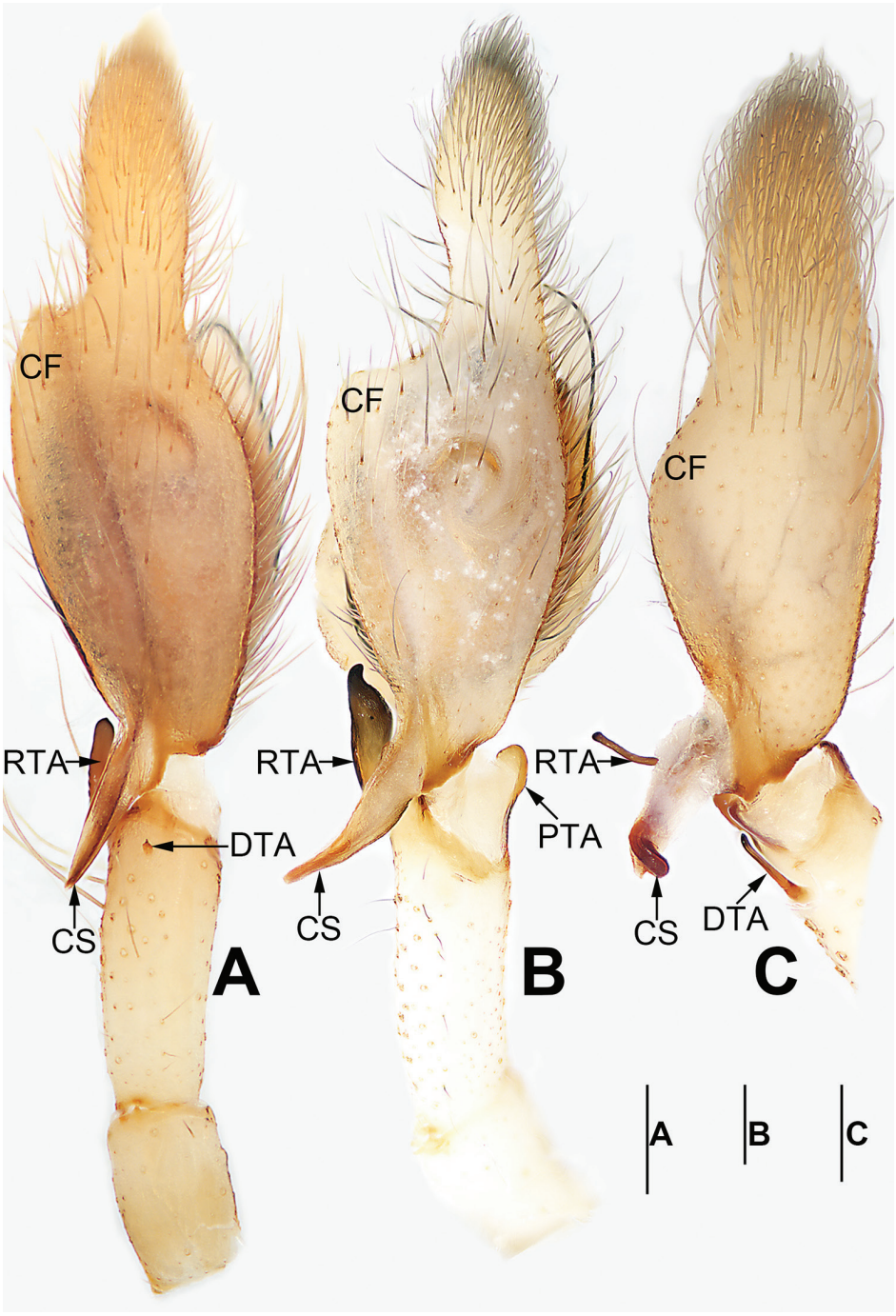

Figure 9. *Cheiracanthium* spp., left palp, dorsal view. **A** *C. daofeng* sp. nov., male holotype **B** *C. duanbi* sp. nov., male holotype **C** *C. gou* sp. nov., male holotype. Abbreviations: CF = cymbial fold; CS = cymbial spur; DTA = dorsal tibial apophysis; PTA = prolateral tibial apophysis; RTA = retrolateral tibial apophysis. Scale bars: 0.2 mm.

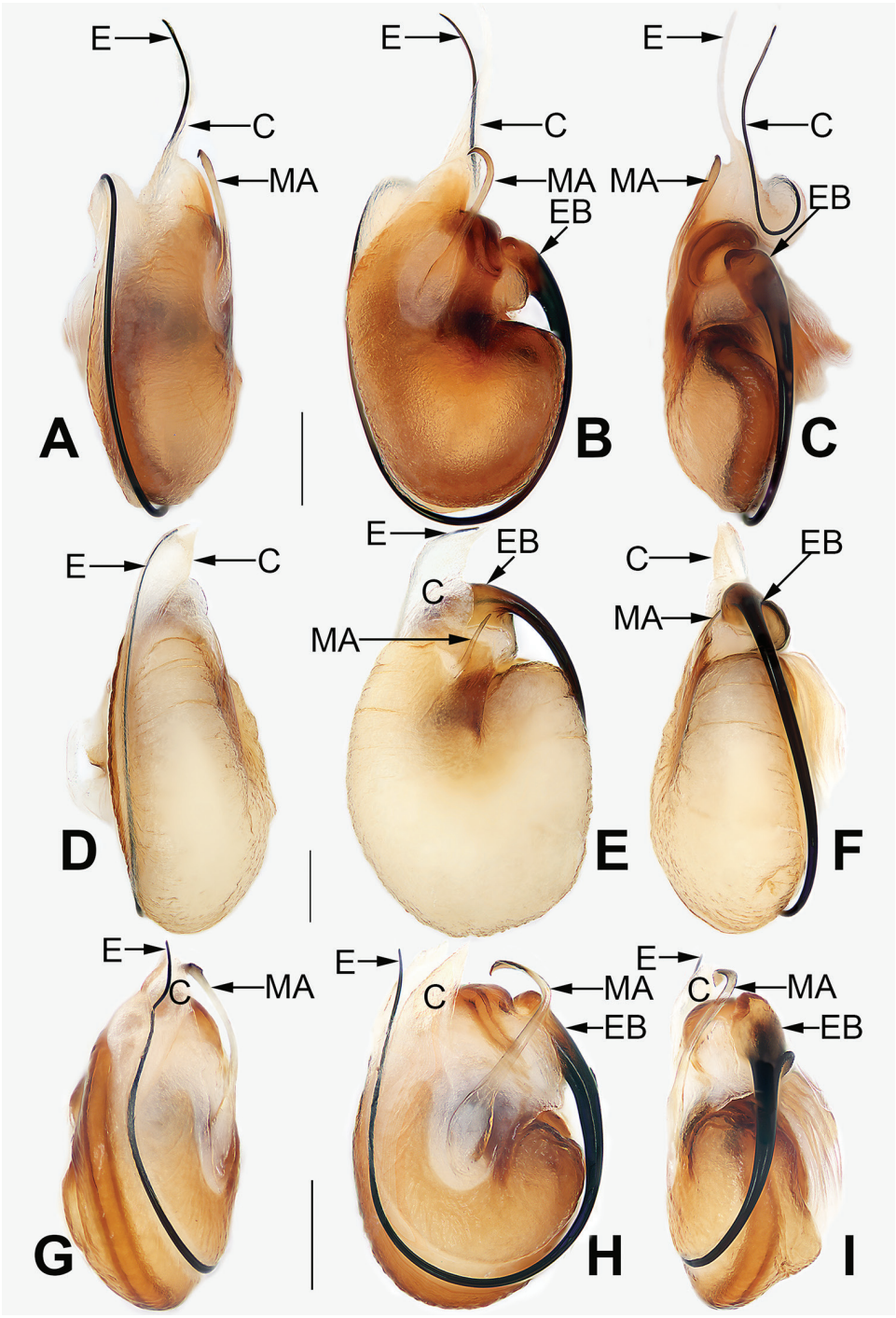

Figure 10. *Cheiracanthium* spp., left bulb, prolateral view (**A, D, G**), ventral view (**B, E, H**), retrolateral view (**C, F, I**).**A–C** *C. daofeng* sp. nov. **D–F** *C. duanbi* sp. nov. **G–I** *C. gou* sp. nov. Abbreviations: C = conductor; E = embolus; EB = embolic base; MA = median apophysis. Scale bars: 0.2 mm.

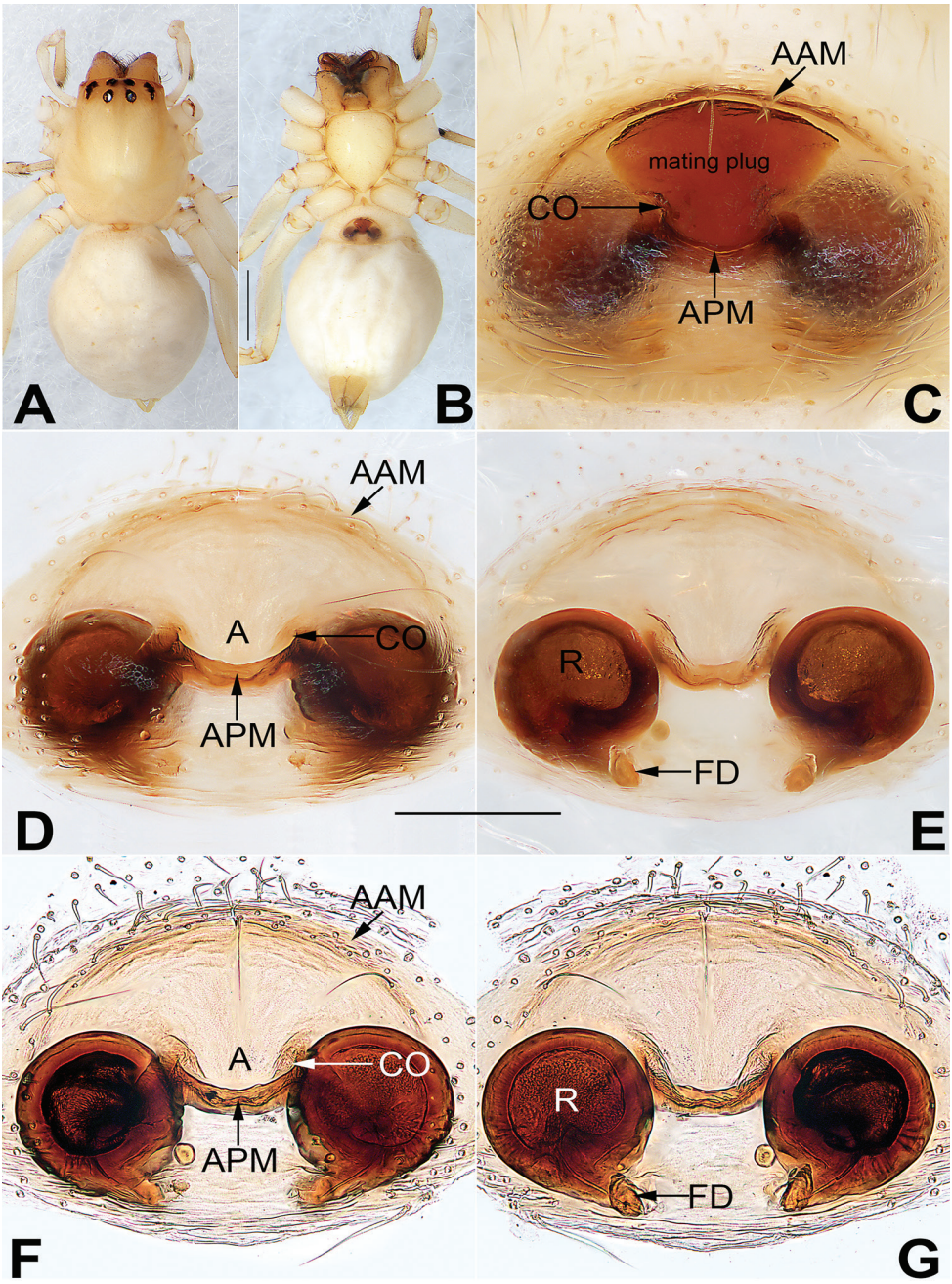

Figure 11. *Sinocanthium shuangqiu* sp. nov., female holotype. **A** habitus, dorsal view **B** habitus, ventral view **C** epigyne, intact, ventral view **D** epigyne, cleared, ventral view **E** vulva, cleared, dorsal view **F** epigyne, cleared and embedded in Arabic gum, ventral view **G** vulva, cleared and embedded in Arabic gum, dorsal view. Abbreviations: A = atrium; AAM = atrial anterior margin; APM = atrial posterior margin; CO = copulatory opening; FD = fertilization duct; R = receptacle. Scale bars: 1 mm (**A, B**); 0.2 mm (**C–G**).

***Sinocanthium shuangqiu* Yu & Li, sp. nov.**
http://zoobank.org/C9C8FB70-E418-4B37-8EBF-EA5533BE4373
Figure 11

Holotype. ♀ (IZCAS-Ar 34745, YHCH011), China, Yunnan Province, Xishuangbanna, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, 48 km landmark in the reserve, seasonal rainforest; 21°58.704'N, 101°19.748'E, elevation ca. 1088 m, 12.VIII.2011, Guo Zheng leg.

Etymology. The specific name is derived from the Chinese pinyin 'shuāng qiú ', which means 'double ball', and refers to the two bulb-shaped receptacles; noun in apposition.

Diagnosis. The new species is easily distinguished from other cheiracanthiids by the epigyne, which has a fan-shaped fovea that is rebordered posteriorly and by the absence of copulatory ducts.

Description. Female. Holotype (Fig. 11A, B): TL 5.02; CL 2.13, CW 1.71, CI (CL/CW) 1.25; AL 2.89, AW 2.06. Carapace pale yellow, ocular area brown, a pair of brown lateral bands originating from behind PME and PLE, almost reaching posterior half of carapace. Eyes: AER almost straight, PER wider than AER and slightly procurved in dorsal view. All eyes dark, with black rings. Eye sizes and interdistances: OAL 0.51, OAW 0.93; AME 0.16, ALE 0.16, PME 0.17, PLE 0.13; AME–AME 0.21, AME–ALE 0.26, PME–PME 0.28, PME–PLE 0.34; MOQA 0.49, MOQP 0.58, CLL 0.11. Chelicerae with orange base, fangs red wine-coloured, both margins without teeth. Sternum yellowish, STL 1.17, STW 0.94. Labium and endites coloured as ocular area. Legs yellowish white, without any markings. Leg measurements: I and II missing, III – (–, 1.56, 1.36, 0.57), IV 8.02 (2.35, 2.59, 2.37, 0.71). Abdomen (Fig. 11A, B) oval, dorsally yellowish white, dorsum with two pairs of inconspicuous muscle depressions; venter white with no distinct pattern.

Epigyne (Fig. 11C–G). Atrium large and fan-shaped, located anteriorly on epigynal plate, margin delimited, atrial anterior margin long and indistinct, posterior margin heavily sclerotized; atrium ca. two times wider than long, blocked by mating plug before cleaning; receptacles clearly visible through the tegument in ventral view; copulatory openings small, located at basolateral atrial borders; receptacles perfectly round, separated by 0.8 diameters.

Male. Unknown.

Distribution. Known only from the type locality, Xishuangbanna, Yunnan, China.

Acknowledgements

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References

Bayer S (2014) Miscellaneous notes on European and African *Cheiracanthium* species (Araneae: Miturgidae). Arachnologische Mitteilungen 47: 19–34. https://doi.org/10.5431/aramit4704

Benoit PLG (1977) La faune terrestre de l'Ile de Sainte-Hélène, quatrième partie, 3. Arachnida: 3. Araneae, 9. Fam. Clubionidae. Annales du Musée royal de l'Afrique central, Série Zoologie, 220: 64–81.

Bonaldo AB, Brescovit AD (1992) As aranhas do gênero *Cheiracanthium* C.L. Koch, 1839 na região neotropical (Araneae, Clubionidae). Revista Brasileira de Entomologia 36: 731–740.

Chen SH, Huang WJ (2012) Miturgidae (Arachnida: Araneae). In: Chen SH, Huang WJ (Eds) The spider fauna of Taiwan. Araneae. Miturgidae, Anyphaenidae, Clubionidae. National Taiwan Normal University, Taipei, 5–30, 101–102, 114–125.

Chikuni Y (1989) Pictorial Encyclopedia of spiders in Japan. Kaisei-sha Publishing, Tokyo, 310 pp.

Dankittipakul P, Beccaloni J (2012) Validation and new synonymies proposed for *Cheiracanthium* species from south and southeast Asia (Araneae, Clubionidae). Zootaxa 3510: 77–86. https://doi.org/10.11646/zootaxa.3510.1.5

Deeleman-Reinhold CL (2001) Forest spiders of South East Asia: With a Revision of the Sac and Ground Spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae). Brill, Leiden, 591 pp.

Dondale CD, Redner JH (1982) The insects and arachnids of Canada. Part 9. The sac spiders of Canada and Alaska. Araneae: Clubionidae and Anyphaenidae. Research Branch Agriculture Canada, Ottawa, Publication 1724, 194 pp.

Edwards RJ (1958) The spider subfamily Clubioninae of the United States, Canada and Alaska (Araneae: Clubionidae). Bulletin of the Museum of Comparative Zoology 118: 365–436.

Hänggi A, Stäubli A (2012) Nachträge zum "Katalog der schweizerischen Spinnen" 4. Neunachweise von 2002 bis 2011. Arachnologische Mitteilungen 44: 59–76. https://doi.org/10.5431/aramit4410

Koch CL (1839) Die Arachniden. Sechster Band, Nürnberg, 156 pp

Li S (2020) Spider taxonomy for an advanced China. Zoological Systematics 45(2): 73–77.

Li S, Lin YC (2016) Species Catalogue of China. Volume 2. Animals. Invertebrates (I), Arachnida: Araneae. Science Press, Beijing, 549 pp.

Li ZY, Zhang F (2019) Two new species of *Cheiracanthium* C. L. Koch, 1839 (Araneae, Cheiracanthiidae) from Xizang, China. Acta Arachnologica Sinica 28(2): 87–95.

Lotz LN (2007a) The genus *Cheiracanthium* (Araneae: Miturgidae) in the Afrotropical region. 1. Revision of known species. Navorsinge van die Nasionale Museum Bloemfontein 23: 1–76.

Lotz LN (2007b) The genus *Cheiracanthium* (Araneae: Miturgidae) in the Afrotropical region. 2. Description of new species. Navorsinge van die Nasionale Museum Bloemfontein 23: 145–184.

Lotz LN (2011) The genus *Cheiracanthium* (Araneae: Miturgidae) in the Afrotropical region. 3. Description of four new species. Navorsinge van die Nasionale Museum Bloemfontein 27: 21–36.

Lotz LN (2014) New species of *Cheiracanthium* (Araneae: Eutichuridae) from Madagascar and the Comoros Islands. Zootaxa 3857(3): 301–332. https://doi.org/10.11646/zootaxa.3857.3.1

Lotz LN (2015) New species of the spider genus *Cheiracanthium* from continental Africa (Araneae: Eutichuridae). Zootaxa 3973(2): 321–336. https://doi.org/10.11646/zootaxa.3973.2.7

Marusik YM, Fomichev AA (2016) A new species of *Cheiracanthium* (Araneae: Cheiracanthiidae) from Mongolia. Indian Journal of Arachnology 5(1–2): 79–83.

Merkens S, Wunderlich J (2000) Zwei für Deutschland neue Spinnenarten (Araneae): Enoplognatha serratosignata (L. Koch) (Theridiidae) und *Cheiracanthium gratum* Kulczyński (Clubionidae). Arachnologische Mitteilungen 19: 41–48. https://doi.org/10.5431/aramit1906

Morano E, Bonal R (2016) *Cheiracanthium ilicis* sp. n. (Araneae, Eutichuridae), a novel spider species associated with Holm Oaks (*Quercus ilex*). ZooKeys 601: 21–39. https://doi.org/10.3897/zookeys.601.8241

Paik KY (1990) Korean spiders of the genus Cheiracanthium (Araneae: Clubionidae). Korean Arachnology 6: 1–30.

Petrunkevitch A (1933) An inquiry into the natural classification of spiders, based on a study of their internal anatomy. Transactions of the Connecticut Academy of Arts and Sciences 31: 299–389.

Reimoser E (1937) Beitrag zur Spinnenfauna von Erythreae. Memorie della Società Entomologica Italiana 16: 16–24.

Roberts MJ (1985) The spiders of Great Britain and Ireland, Volume 1: Atypidae to Theridiosomatidae. Harley Books, Colchester, England, 229 pp.

Simon E (1897) Description d'Arachnides nouveaux. Annales de la Société Entomologique de Belgique 41: 8–17.

Simon E (1932) Les Arachnides de France. Tome VI. Synopsis générale et Catalogue des espèces françaises de l'ordre des Araneae. Paris, 773–978.

Sterghiu C (1985) Fam. Clubionidae. In: Fauna Republicii Socialiste România: Arachnida. Academia Republicii Socialiste România, Bucharest 5: 1–165.

Wolf A (1991) *Cheiracanthium*. In: Heimer S, Nentwig W (Eds) Spinnen Mitteleuropas. Ein Bestimmungsbuch. Verlag Paul Parey, Berlin, 543 pp.

WSC (2020) World Spider Catalog. Version 21.0. Natural History Museum Bern. http://wsc.nmbe.ch [accessed on 15 April 2020]

Wunderlich J (2012) Few rare and a new species of spiders (Araneae) from Portugal, with resurrection of the genus *Chiracanthops* Mello-Leitao 1942 (Clubionidae: Eutichurinae). Beiträge zur Araneologie 8: 183–191.

Yaginuma T (1986) Spiders of Japan in colour. Hoikusha Publishing, Osaka, 305 pp

Zhang JS, Zhang GR, Yu H (2018) Four species of spider genus *Cheiracanthium* C. L. Koch, 1839 (Araneae, Eutichuridae) from Jinggang Mountains, Jiangxi Province, China. ZooKeys 762: 33–45. https://doi.org/10.3897/zookeys.762.23786

Zhang YJ, Yin CM (1999) Two new species of the genus *Cheiracanthium* from China with notes on male spiders of two species (Araneae: Clubionidae). Acta Zootaxonomica Sinica 24: 285–290.

Zhu MS, Zhang BS (2011) Spider Fauna of Henan: Arachnida: Araneae. Science Press, Beijing, 558 pp.

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RESEARCH ARTICLE

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Eight new species of the spider genus *Pimoa* (Araneae, Pimoidae) from Tibet, China

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Abstract

Eight new species of the spider genus *Pimoa* Chamberlin & Ivie, 1943 are described from Tibet, China: *P. cona* Zhang & Li, **sp. nov.** (♂♀), *P. duiba* Zhang & Li, **sp. nov.** (♂♀), *P. lemenba* Zhang & Li, **sp. nov.** (♀), *P. mainling* Zhang & Li, **sp. nov.** (♂♀), *P. nyingchi* Zhang & Li, **sp. nov.** (♂♀), *P. rongxar* Zhang & Li, **sp. nov.** (♂♀), *P. samyai* Zhang & Li, **sp. nov.** (♂♀), and *P. yadong* Zhang & Li, **sp. nov.** (♂♀). The DNA barcodes of the eight new species are documented.

Keywords

Asia, description, diagnosis, taxonomy

Introduction

The spider family Pimoidae Wunderlich, 1986 contains 45 species in four genera: *Nanoa* Hormiga, Buckle & Scharff, 2005, *Pimoa* Chamberlin & Ivie, 1943, *Putaoa* Hormiga & Tu, 2008, and *Weintrauboa* Hormiga, 2003 (Li 2020). *Pimoa*, with the type species *Pimoa hespera* (Gertsch & Ivie, 1936) described from the USA, is the most species-rich genus in Pimoidae, with 33 described species prior to the current study. The genus is distributed on the west coast of the USA from Washington to California, the western Mediterranean (Alps and Cantabrian Mountains), and Asia (Himalaya to Beijing) (Mammola et al. 2016; Zhang and Li 2019; WSC 2020). Nine species are already known from China:

Pimoa anatolica Hormiga, 1994, *P. binchuanensis* Zhang & Li, 2019, and *P. lihengae* Griswold, Long & Hormiga, 1999 from Yunnan Province; *P. lata* Xu & Li, 2009, *P. reniformis* Xu & Li, 2007, *P. trifurcata* Xu & Li, 2007, and *P. wanglangensis* Yuan, Zhao & Zhang, 2019 from Sichuan Province; *P. clavata* Xu & Li, 2007 from caves in the city of Beijing; and *P. xinjianensis* Zhang & Li, 2019 from three caves in Hunan Province (Griswold et al. 1999; Hormiga 1994a; Xu and Li 2007; Xu and Li 2009; Yuan et al. 2019; Zhang and Li 2019). In the present paper, eight new pimoids from Tibet, China are described.

Materials and methods

Specimens were examined with a LEICA M205C stereomicroscope. Images were captured with an Olympus C7070 wide zoom digital camera (7.1 megapixels) mounted on an Olympus SZX12 dissecting microscope and assembled using Helicon Focus 3.10.3 image stacking software (Khmelik et al. 2006). Epigynes and male palps were examined after dissection from the spiders' bodies. The left palps were illustrated unless otherwise noted. Epigynes were removed and treated in a warmed 10% potassium hydroxide (KOH) solution.

All measurements were obtained using a LEICA M205C stereomicroscope and are given in millimeters. We put legs and the body of the spider on the objective table of stereomicroscope and measured the length by a ruler in the eyepiece. Eye sizes were measured as the maximum diameter from either dorsal or frontal views. Leg measurements are shown as total length (femur, patella + tibia, metatarsus, tarsus). The terminology used in the text and the figure legends follows Hormiga (1994a). Distribution maps were generated using ArcView GIS (ESRI) software.

Abbreviations used in this paper and in the figure legends:

ALE	anterior lateral eye;
AME	anterior median eye;
AME-ALE	distance between **AME** and **ALE**;
AME-AME	distance between **AMEs**;
AS	alveolar sclerite;
C	conductor;
CDP	cymbial denticulate process;
CO	copulatory opening;
DP	dorsal plate of the epigyne;
E	embolus;
FD	fertilization duct;
MA	median apophysis;
P	paracymbium;
PCS	pimoid cymbial sclerite;
PEP	pimoid embolic process;
PLE	posterior lateral eye;

Table 1. Voucher specimen information.

Species	GenBank accession number	Sequence length	Collection locality
Pimoa cona sp. nov.	MT373707	654bp	Cona, Lhoka, Tibet, China
Pimoa duiba sp. nov.	MT373708	654bp	Duopozhang and Aza, Lhoka, Tibet, China
Pimoa lemenba sp. nov.	MT373706	654bp	Cona, Lhoka, Tibet, China
Pimoa mainling sp. nov.	MT373710	654bp	Mainling, Nyingchi, Tibet, China
Pimoa nyingchi sp. nov.	MT373713	654bp	Lulang, Nyingchi, Tibet, China
Pimoa rongxar sp. nov.	MT373712	654bp	Dinggyê, Shigatse, Tibet, China
Pimoa samyai sp. nov.	MT373711	654bp	Samyai Town, Lhoka, Tibet, China
Pimoa yadong sp. nov.	MT373709	654bp	Yadong, Shigatse, Tibet, China

All specimens (including molecular vouchers) are deposited in the Institute of Zoology, Chinese Academy of Sciences (**IZCAS**), Beijing, China.

PME posterior median eye;
PME-PLE distance between **PME** and **PLE**;
PME-PME distance between **PMEs**;
S spermatheca;
T tegulum;
VP ventral plate of epigyne.

DNA barcodes were obtained for the eight new species by amplifying and sequencing a partial fragment of the mitochondrial gene cytochrome oxidase subunit I (COI) using primers LCO1490-oono (5'-CWACAAAYCATARRGATATTGG-3') (Folmer et al. 1994; Miller et al. 2010) and HCO2198-zz (5'-TAAACTTCCAGGTGACCAAAAAATCA-3') (Folmer et al. 1994; Zhao and Li 2017). For additional information on extraction, amplification, and sequencing procedures, see Wang et al. (2008). All sequences were checked for validity using BLAST and are deposited in GenBank. The accession numbers are provided in Table 1.

Taxonomy

Family Pimoidae Wunderlich, 1986

Genus *Pimoa* Chamberlin & Ivie, 1943

Pimoa: Chamberlin and Ivie 1943: 9; Hormiga 1994a: 4; Hormiga and Lew 2014: 1; Mammola et al. 2016: 1.

Type species. *Labulla hespera* Gertsch & Ivie, 1936, from California, USA.

Diagnosis and description. See Chamberlin and Ivie 1943; Gertsch and Ivie 1936; Griswold et al. 1998; Hormiga 1994a; Hormiga 1994b.

***Pimoa cona* Zhang & Li, sp. nov.**
http://zoobank.org/B51D64B4-BBFD-4B42-AE2D-648926292E2E
Figures 1, 2, 16

Type material. ***Holotype:*** ♂ (IZCAS-Ar40310), China, Tibet, Lhoka, Cona County, Senmuzha Scenic Area, 27.83°N, 91.73°E, elevation ca. 2845 m, 10.VIII.2018, X. Zhang and J. Liu leg. ***Paratypes:*** 1♂2♀ (IZCAS-Ar40311-40313), same data as holotype; 1♂1♀ (IZCAS-Ar40314-40315), Cona County, Yelang Valley, 27.87°N, 91.81°E, elevation ca. 3379 m, 13.VIII.2018, X. Zhang and J. Liu leg.

Etymology. The specific name is a noun in apposition taken from the type locality.

Diagnosis. The male of *Pimoa cona* sp. nov. resembles *P. nematoides* Hormiga, 1994 (see Hormiga 1994a: 71, figs 285–289) and *P. sinuosa* Hormiga, 1994 (see Hormiga 1994a: 67, figs 256–265) but can be distinguished by the large pimoid cymbial sclerite that is subdistally wide and distally pointed (Fig. 1B, vs. small and distally curved in *P. nematoides*; vs. slender and distally blunt in *P. sinuosa*); distinguished from *P. nematoides* by the long tibia, ca. 1/2 of the cymbial length (Fig. 1A–C, vs. short tibia, ca. 1/3 of cymbial length); distinguished from *P. sinuosa* by an embolus that begins at the 2:00 o'clock position (Fig. 1B, vs. an embolus that begins at the 5:30 o'clock position). The female of *P. cona* resembles *P. sinuosa* (see Hormiga 1994a: 67, figs 266–284)

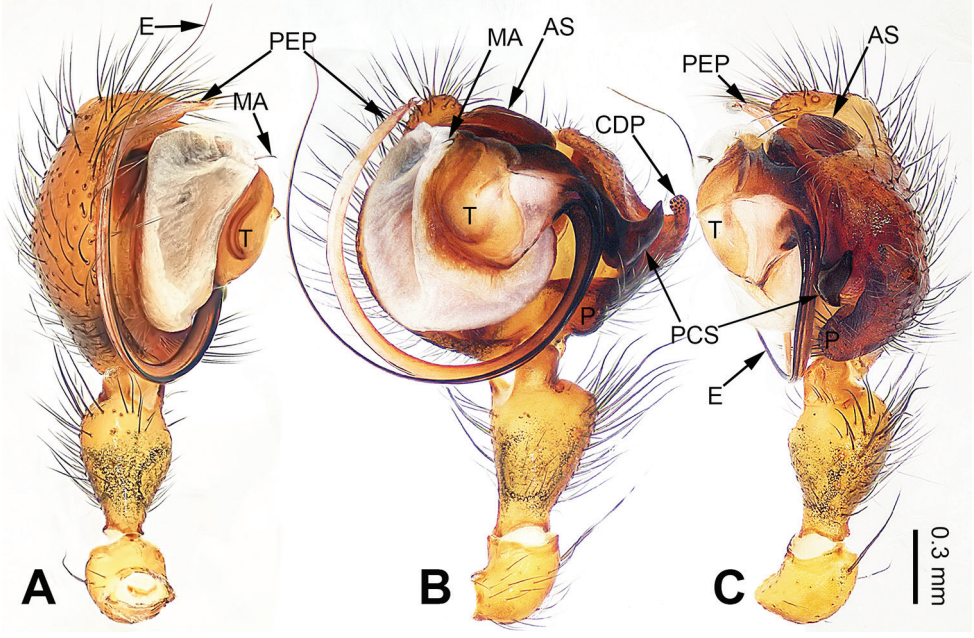

Figure 1. Left palp of *Pimoa cona* sp. nov., holotype **A** prolateral view **B** ventral view **C** retrolateral view. Abbreviations: AS = alveolar sclerite; CDP = cymbial denticulate process; E = embolus; MA = median apophysis; P = paracymbium; PCS = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum. Scale bar: equal for **A–C**.

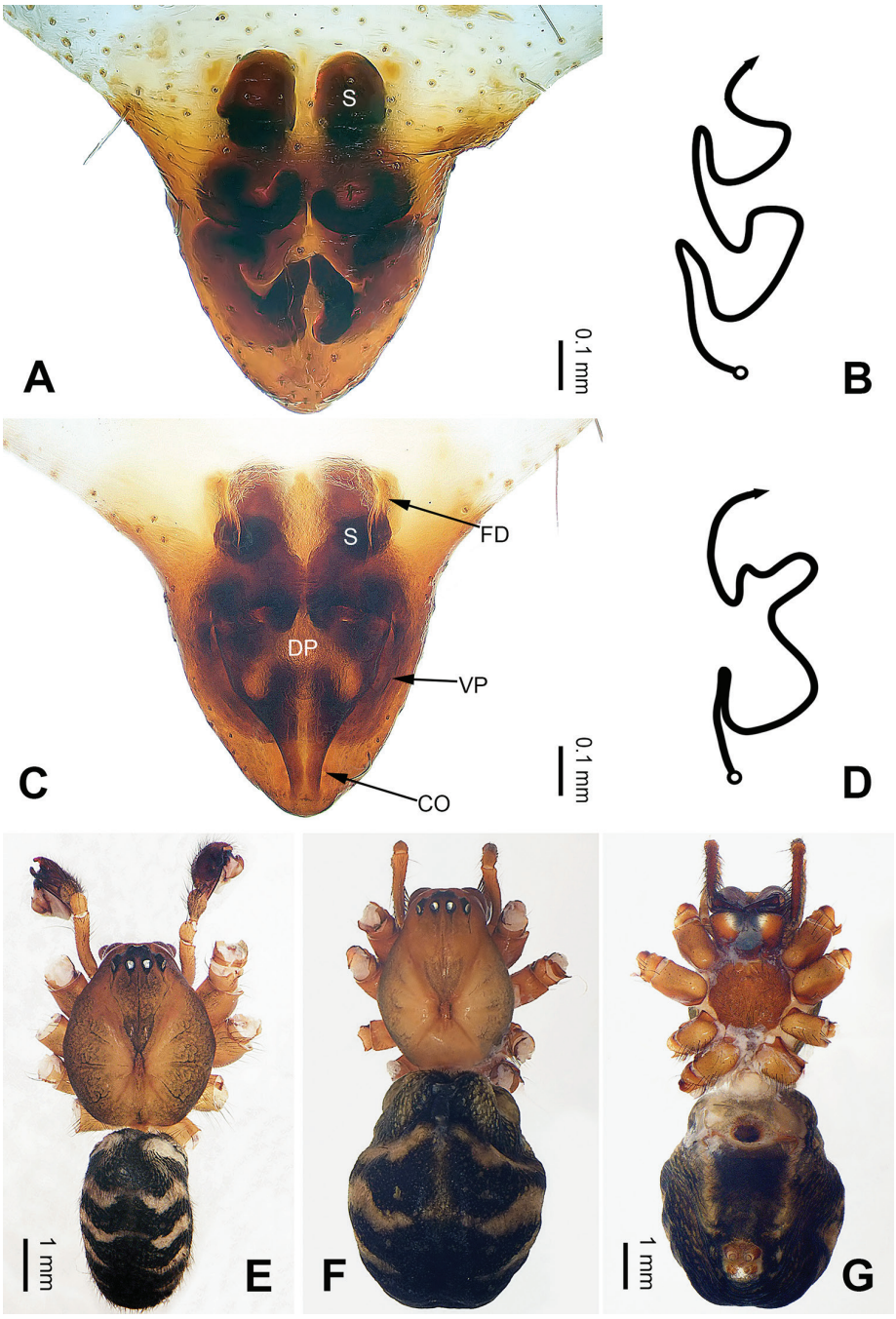

Figure 2. Epigyne and habitus of *Pimoa cona* sp. nov., female paratype and male holotype **A** epigyne, ventral view **B** schematic course of internal duct system, ventral view **C** vulva, dorsal view **D** schematic course of internal duct system, dorsal view **E** male habitus, dorsal view **F** female habitus, dorsal view **G** female habitus, ventral view. Abbreviations: CO = copulatory opening; DP = dorsal plate of the epigyne; FD = fertilization duct; S = spermatheca; VP = ventral plate of epigyne. Scale bars: equal for **F** and **G**.

but can be distinguished by the pair of oval spermathecae (Fig. 2A, vs. subtriangular spermathecae) and by the subdistally narrow dorsal plate (Fig. 2C, vs. subdistally wide).

Description. Male (**holotype**): Total length 7.24. Carapace 3.59 long, 2.95 wide. Abdomen 3.65 long, 2.18 wide. Eye sizes and interdistances: AME 0.18, ALE 0.20, PME 0.19, PLE 0.17; AME-AME 0.14, AME-ALE 0.17, PME-PME 0.16, PME-PLE 0.18. Leg measurements: I: 33.34 (9.36, 10.19, 9.94, 3.85); II: 32.52 (9.25, 10.13, 9.87, 3.27); III: 20.92 (6.16, 6.36, 6.35, 2.05); IV: – (7.95, –, –, –). Habitus as in Fig. 2E. Carapace brownish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse chevron bands. Legs brownish with black annulations, especially distinct on legs III and IV. Palp (Fig. 1A–C): patella short, ca. 1/2 of tibial length, with one retrolateral macroseta; tibia long, ca. 1/2 of cymbial length, with several macrosetae and a dorsal process; paracymbium short, ca. 1/3 of cymbial length, finger-shaped; pimoid cymbial sclerite large, subdistally wide and distally sharp, ca. 1/2 of cymbial length; cymbial denticulate process short and distally pointed, with more than 15 cuspules; median apophysis slender; conductor indistinct; pimoid embolic process with two short and sharp branches distally; embolus long and thin, longer than pimoid embolic process, beginning at the 2:00 o'clock position; embolic tooth absent.

Female (**paratype**): Total length 9.62. Carapace 3.72 long, 3.01 wide. Abdomen 5.90 long, 4.10 wide. Eye sizes and interdistances: AME 0.18, ALE 0.22, PME 0.19, PLE 0.21; AME-AME 0.14, AME-ALE 0.21, PME-PME 0.17, PME-PLE 0.20. Leg measurements: I: 27.83 (7.76, 9.17, 7.82, 3.08); II: 24.80 (6.79, 8.20, 6.99, 2.82); III: 17.56 (5.38, 5.51, 4.81, 1.86); IV: 22.31 (6.73, 7.37, 5.90, 2.31). Habitus as in Fig. 2F, G. Carapace brownish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse chevron bands and a short vertical band medially. Legs brownish with black annulations, especially distinct on legs III and IV. Epigyne (Fig. 2A–D): triangular; ventral plate broad, length subequal to width; dorsal plate narrow, with a blunt point; copulatory openings distinct; spermathecae oval, separated by ca. 1/3 width of spermatheca; fertilization ducts membranous, anteriorly oriented.

Distribution. Known only from the type locality, Tibet, China (Fig. 16).

***Pimoa duiba* Zhang & Li, sp. nov.**

http://zoobank.org/2A93ED2B-AFAE-4EB6-B1BE-ACB9752BBF9D

Figures 3, 4, 16

Type material. ***Holotype:*** ♂ (IZCAS-Ar40316), China, Tibet, Lhoka, Duopozhang Town, Duiba Village, 29.37°N, 91.70°E, elevation ca. 4095 m, 14.VIII.2019, X. Zhang, Z. Bai and J. Liu leg. ***Paratypes:*** 1♀ (IZCAS-Ar40317), same data as holotype; 1♀ (IZCAS-Ar40318), Lhoka, Aza Town, Beside the stream behind Zonggongbu Cave, 29.37°N, 91.32°E, elevation ca. 4537 m, 29.VIII.2018, X. Zhang and J. Liu leg.

Etymology. The specific name is a noun in apposition taken from the type locality.

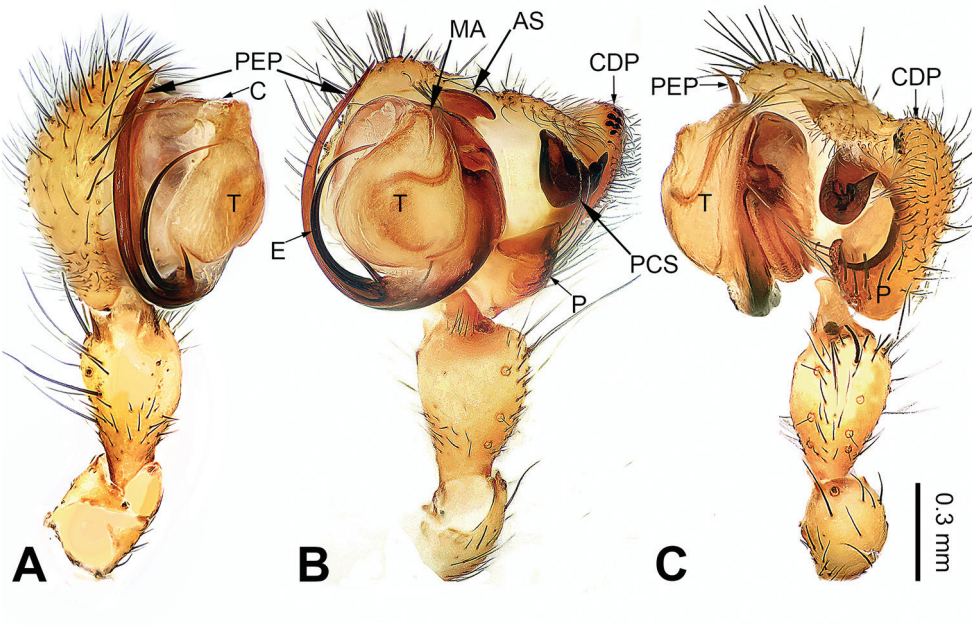

Figure 3. Left palp of *Pimoa duiba* sp. nov., holotype **A** prolateral view **B** ventral view **C** retrolateral view. Abbreviations: AS = alveolar sclerite; C = conductor; CDP = cymbial denticulate process; E = embolus; MA = median apophysis; P = paracymbium; PCS = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum. Scale bar: equal for **A–C**.

Diagnosis. The male of *Pimoa duiba* sp. nov. resembles *P. samyai* sp. nov. (Fig. 12A–C) and *P. trifurcata* (see Xu and Li 2007: 496, figs 48–54) but can be distinguished by the short and distally blunt cymbial denticulate process (Fig. 3B, vs. relatively long and distally narrow in *P. samyai* and *P. trifurcata*); distinguished from *P. samyai* by the nearly V-shaped pimoid cymbial sclerite (Fig. 3B, vs. nearly L-shaped); distinguished from *P. trifurcata* by the pimoid embolic process without a trifurcate apex (Fig. 3A–C, vs. with a trifurcate apex). The female of *P. duiba* also resembles *P. samyai* sp. nov. (Fig. 13A–D) and *P. trifurcata* (see Xu and Li 2007: 496, figs 55–61) but can be distinguished by the short distance between the spermathecae (Fig. 4A, vs. separated by ca. 1/2 the width of a spermatheca in *P. samyai* and *P. trifurcata*); distinguished from *P. samyai* by having a spermatheca that is wider than long (Fig. 4A, vs. longer than wide); distinguished from *P. trifurcata* by the medially narrow dorsal plate (Fig. 4C, vs. medially relatively wide).

Description. Male (**holotype**): Total length 5.26. Carapace 2.18 long, 1.86 wide. Abdomen 3.08 long, 1.73 wide. Eye sizes and interdistances: AME 0.12, ALE 0.13, PME 0.12, PLE 0.12; AME-AME 0.07, AME-ALE 0.11, PME-PME 0.10, PME-PLE 0.14. Leg measurements: I: 23.84 (6.60, 7.95, 6.73, 2.56); II: 21.79 (5.90, 7.24, 6.34, 2.31); III: 16.16 (4.62, 5.45, 4.49, 1.60); IV: 19.41 (5.51, 6.15, 5.83, 1.92). Promargin of chelicerae with three teeth, retromargin with two teeth. Habitus as in

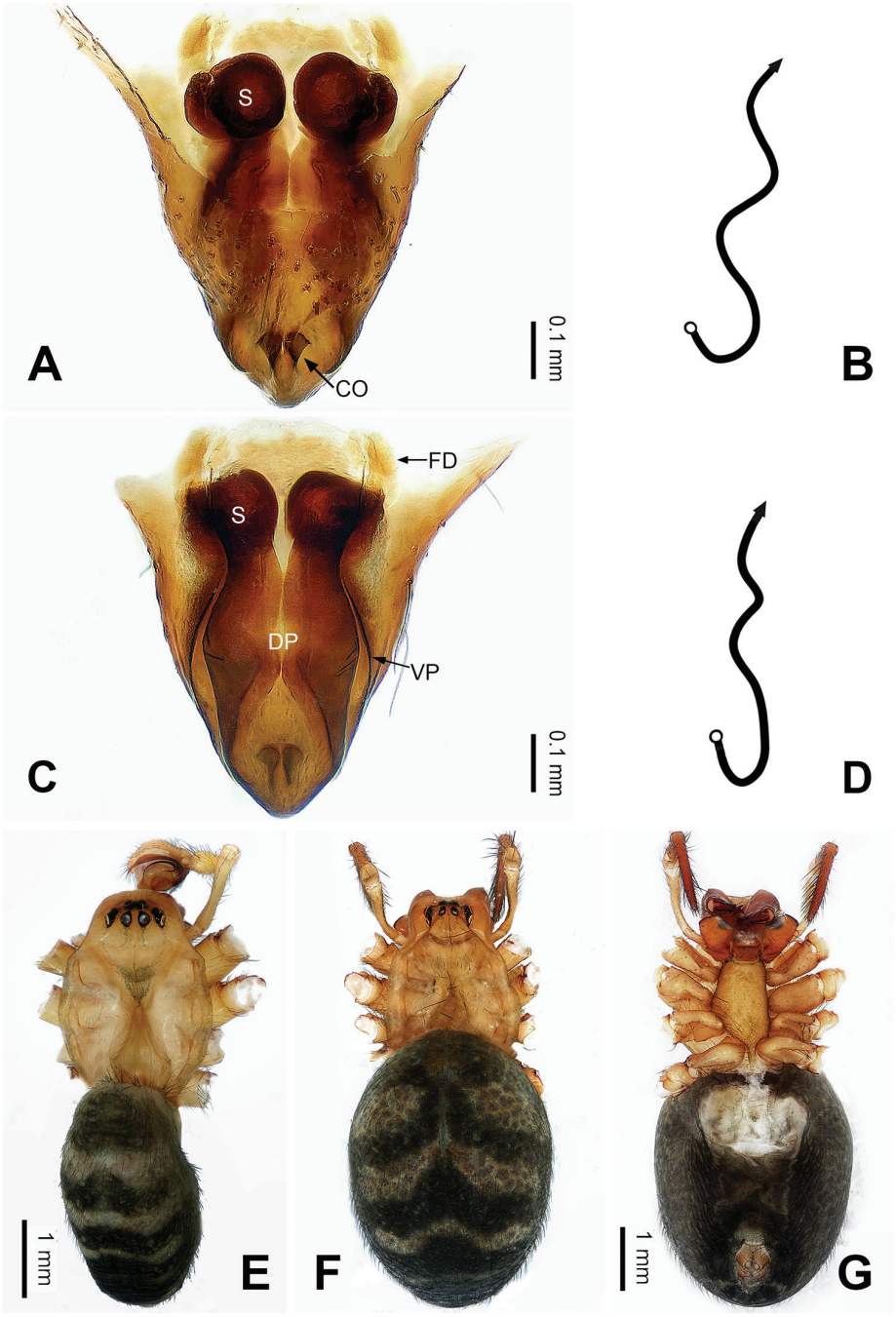

Figure 4. Epigyne and habitus of *Pimoa duiba* sp. nov., female paratype and male holotype **A** epigyne, ventral view **B** schematic course of internal duct system, ventral view **C** vulva, dorsal view **D** schematic course of internal duct system, dorsal view **E** male habitus, dorsal view **F** female habitus, dorsal view **G** female habitus, ventral view. Abbreviations: CO = copulatory opening; DP = dorsal plate of the epigyne; FD = fertilization duct; S = spermatheca; VP = ventral plate of epigyne. Scale bars: equal for **F** and **G**.

Fig. 4E. Carapace yellowish with slightly darker lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse chevron bands. Legs brownish without black annulations. Palp (Fig. 3A–C): patella short, ca. 1/2 of tibial length, with a single retrolateral macroseta; tibia long, ca. 1/2 of cymbial length, with several macrosetae and a dorsal process; paracymbium short, ca. 1/3 of cymbial length, hook-shaped; pimoid cymbial sclerite nearly V-shaped, ca. 1/3 of cymbial length; cymbial denticulate process short and distally blunt, with more than five cuspules; median apophysis slender; conductor distinct; pimoid embolic process distally pointed, longer than embolus; embolus beginning at the 7:00 o'clock position, with short slender spine proximally; embolic tooth absent.

Female (**paratype**): Total length 6.85. Carapace 2.56 long, 2.11 wide. Abdomen 4.29 long, 3.27 wide. Eye sizes and interdistances: AME 0.12, ALE 0.16, PME 0.10, PLE 0.15; AME-AME 0.09, AME-ALE 0.15, PME-PME 0.09, PME-PLE 0.17. Leg measurements: I: 21.47 (6.15, 6.73, 6.03, 2.56); II: 19.55 (5.38, 6.67, 5.38, 2.12); III: 15.20 (4.62, 4.81, 4.10, 1.67); IV: 19.23 (5.51, 6.22, 5.45, 2.05). Promargin of chelicerae with three teeth, retromargin with two teeth. Habitus as in Fig. 4F, G. Carapace brownish with slightly darker lateral margins; thoracic fovea and radial grooves indistinct; sternum brownish. Abdomen black with yellowish transverse chevron bands. Legs brownish without black annulations. Epigyne (Fig. 4A–D): triangular; ventral plate broad, length subequal to width; dorsal plate longer than wide, nearly tongue-shaped; copulatory openings distinct; spermathecae nearly round with short distance between them; fertilization ducts yellowish, anteriorly oriented.

Distribution. Known only from the type locality, Tibet, China (Fig. 16).

***Pimoa lemenba* Zhang & Li, sp. nov.**

http://zoobank.org/643BA218-A6BB-4CC1-AEA5-60CD91E84F5D

Figures 5, 16

Type material. ***Holotype:*** ♀ (IZCAS-Ar40319), China, Tibet, Lhoka, Cona County, Lemenba Town, 17–20 km section from Lewang Bridge to Liulian Highway, 27.80°N, 91.77°E, elevation ca. 3706 m, 5.VI.2016, J. Wu leg.

Etymology. The specific name is a noun in apposition taken from the type locality.

Diagnosis. The species resembles *Pimoa sinuosa* Hormiga, 1994 (see Hormiga 1994a: 67, figs 266–284) but can be distinguished by the pair of round spermathecae which are close together (Fig. 5A, vs. separated by ca. 1/2 the width of a spermatheca), by the medially wide dorsal plate (Fig. 5C, vs. medially relatively narrow), and by the abdomen with the vertical band not extending to the distal part (Fig. 5E, vs. vertical band absent).

Description. Female (**holotype**): Total length 8.59. Carapace 3.40 long, 2.88 wide. Abdomen 5.19 long, 3.46 wide. Eye sizes and interdistances: AME 0.17, ALE 0.20, PME 0.19, PLE 0.18; AME-AME 0.10, AME-ALE 0.19, PME-PME 0.14, PME-PLE 0.22. Leg measurements: I: – (7.12, –, –, –); II: – (6.47, –, –, –); III: missing; IV: missing. Habitus as in Fig. 5E–G. Carapace yellowish with black lat-

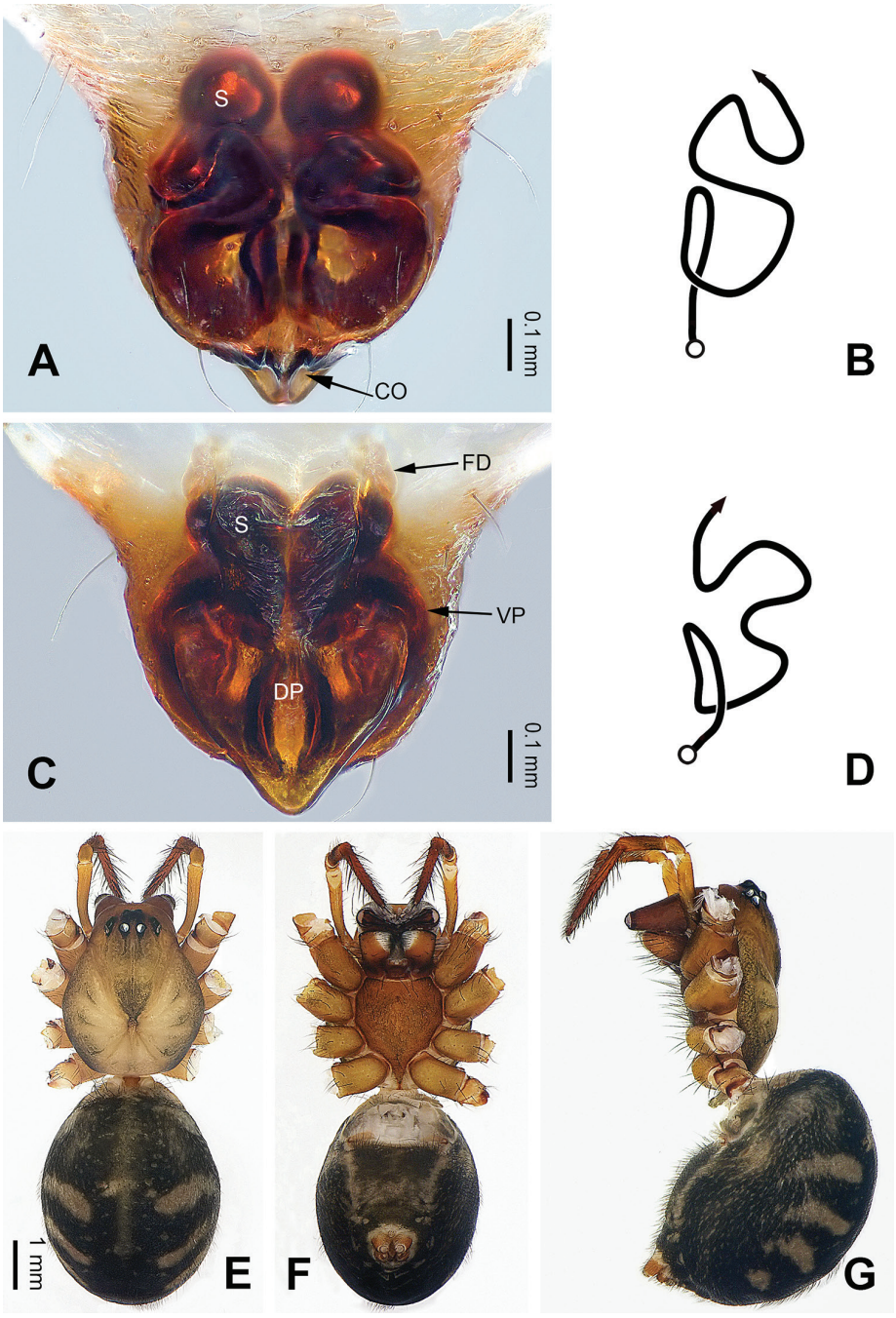

Figure 5. Epigyne and habitus of *Pimoa lemenba* sp. nov., female holotype **A** epigyne, ventral view **B** schematic course of internal duct system, ventral view **C** vulva, dorsal view **D** schematic course of internal duct system, dorsal view **E** female habitus, dorsal view **F** female habitus, ventral view **G** female habitus, lateral view. Abbreviations: CO = copulatory opening; DP = dorsal plate of the epigyne; FD = fertilization duct; S = spermatheca; VP = ventral plate of epigyne. Scale bars: equal for **E–G**.

eral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse bands and a vertical band not extending to distal part. Legs brownish with black annulations. Epigyne (Fig. 5A–D): ventral and dorsal plates broad, length subequal to width; copulatory openings distinct; spermathecae round, close to each other; fertilization ducts crystalline, anteriorly oriented.

Male: unknown.

Distribution. Known only from the type locality, Tibet, China (Fig. 16).

Pimoa mainling Zhang & Li, sp. nov.

http://zoobank.org/75899015-5478-4F26-AB92-E96010E8185D
Figures 6, 7, 16

Type material. ***Holotype:*** ♂ (IZCAS-Ar40320), China, Tibet, Nyingchi, Mainling County, along the way from Zhagonggou Scenic Area to Ganlu Cave, 29.16°N, 94.23°E, elevation ca. 3440 m, 27.VIII.2018, X. Zhang and J. Liu leg. ***Paratypes:*** 2♀ (IZCAS-Ar40321-Ar40322), same data as holotype.

Etymology. The specific name is a noun in apposition taken from the type locality.

Diagnosis. The male of *Pimoa mainling* sp. nov. resembles *P. binchuanensis* (see Zhang and Li 2019: 3, figs 1, 2) but can be distinguished by the distally curved and nearly hook-shaped pimoid cymbial sclerite (Fig. 6B, vs. medially curved and nearly

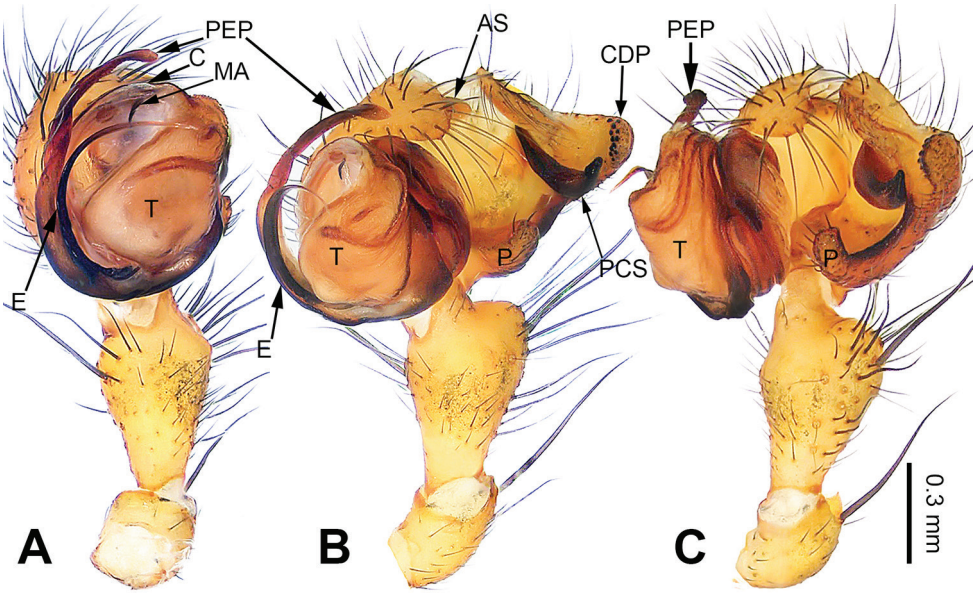

Figure 6. Left palp of *Pimoa mainling* sp. nov., holotype **A** prolateral view **B** ventral view **C** retrolateral view. Abbreviations: AS = alveolar sclerite; C = conductor; CDP = cymbial denticulate process; E = embolus; MA = median apophysis; P = paracymbium; PCS = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum. Scale bar: equal for **A–C**.

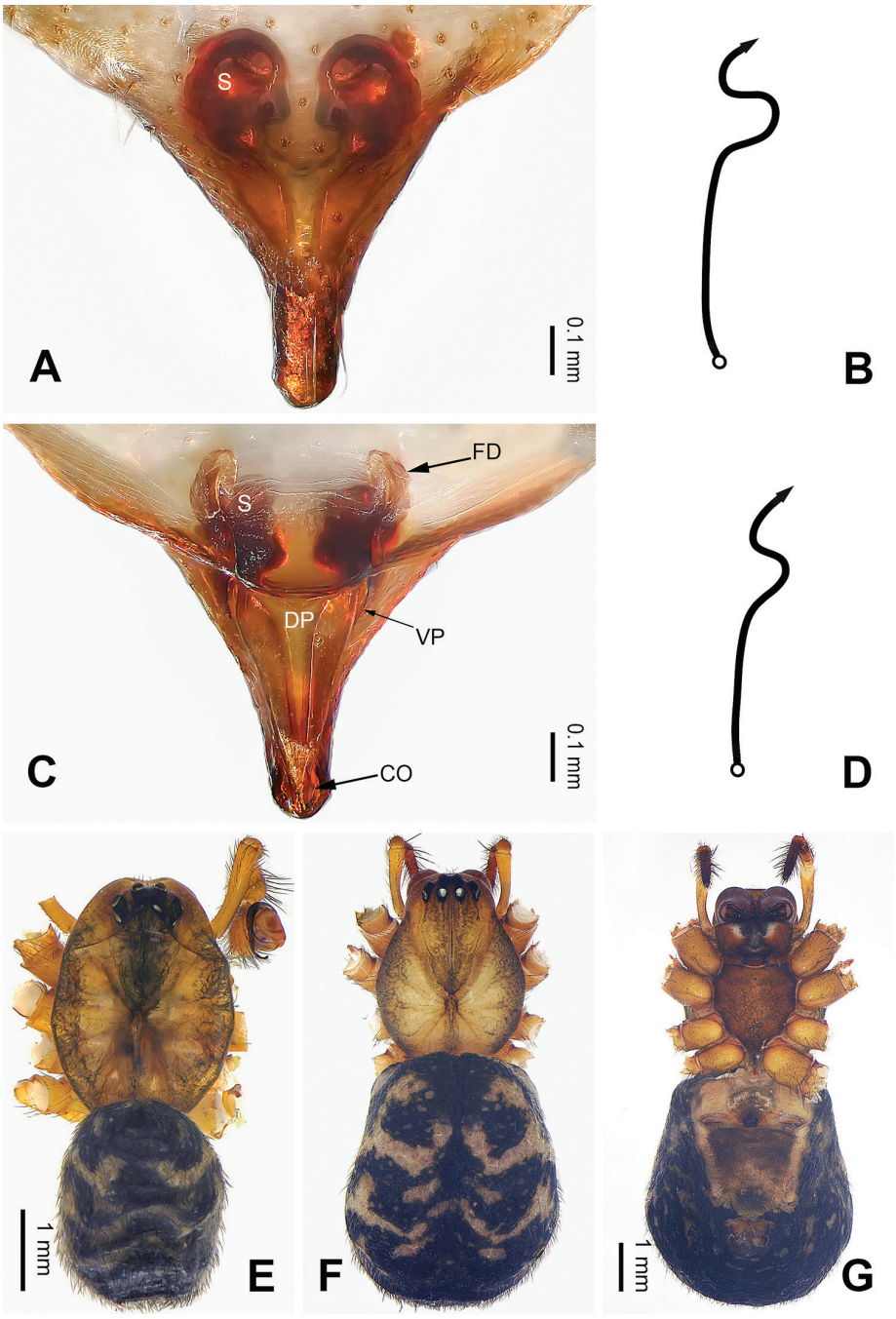

Figure 7. Epigyne and habitus of *Pimoa mainling* sp. nov., female paratype and male holotype **A** epigyne, ventral view **B** schematic course of internal duct system, ventral view **C** vulva, dorsal view **D** schematic course of internal duct system, dorsal view **E** male habitus, dorsal view **F** female habitus, dorsal view **G** female habitus, ventral view. Abbreviations: CO = copulatory opening; DP = dorsal plate of the epigyne; FD = fertilization duct; S = spermatheca; VP = ventral plate of epigyne. Scale bars: equal for **F** and **G**.

U-shaped). The male of *P. mainling* also resembles *P. crispa* Hormiga, 1994 (see Hormiga 1994a: 63, figs 233–238; Hormiga 1994b: fig 1A, B) but can be distinguished by a distally narrow cymbial denticulate process with few cuspules (Fig. 6B, vs. distally wide cymbial denticulate process with many cuspules). The female of *P. mainling* resembles *P. crispa* Hormiga, 1994 (see Hormiga 1994a: 63, figs 239–247) but can be distinguished by the distance between the pair of spermathecae which is ca. 1/3 the width of a spermatheca (Fig. 7A, vs. shorter distance between spermathecae) and by the funnel-shaped epigyne, which is distally straight and long (Fig. 7A–D, vs. triangular epigyne).

Description. Male (**holotype**): Total length 5.06. Carapace 2.56 long, 2.18 wide. Abdomen 2.50 long, 2.05 wide. Eye sizes and interdistances: AME 0.16, ALE 0.17, PME 0.13, PLE 0.17; AME-AME 0.13, AME-ALE 0.17, PME-PME 0.10, PME-PLE 0.16. Leg measurements: I: 25.38 (6.99, 8.40, 7.49, 2.50); II: – (5.90, –, –, –); III: 13.52 (4.17, 4.23, 3.65, 1.47); IV: 16.79 (5.19, 5.38, 4.55, 1.67). Habitus as in Fig. 7E. Carapace brownish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse chevron bands. Legs brownish with black annulations, especially distinct on legs III and IV. Palp (Fig. 6A–C): patella short, ca. 1/3 of tibial length, with one retrolateral macroseta; tibia almost the same length as cymbium, with several macrosetae and a dorsal process; paracymbium short, ca. 1/3 of cymbial length, hook-shaped; pimoid cymbial sclerite distally curved, ca. 1/2 of cymbial length; cymbial denticulate process short, distally narrow and blunt, with more than ten cuspules; median apophysis slender; conductor distinct; pimoid embolic process long, slightly wider distally; embolus beginning at the 7:30 o'clock position; embolic tooth absent.

Female (**paratype**): Total length 8.78. Carapace 3.40 long, 3.01 wide. Abdomen 5.38 long, 4.55 wide. Eye sizes and interdistances: AME 0.17, ALE 0.19, PME 0.19, PLE 0.20; AME-AME 0.15, AME-ALE 0.17, PME-PME 0.17, PME-PLE 0.21. Leg measurements: I: 21.22 (6.15, 7.37, 5.58, 2.12); II: 18.33 (5.32, 6.22, 4.74, 2.05); III: 13.14 (4.17, 4.10, 3.40, 1.47); IV: – (5.06, 5.51, 4.42, –). Habitus as in Fig. 7F, G. Carapace yellowish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse chevron bands. Legs brownish with distinct black annulations on all legs. Epigyne (Fig. 7A–D): funnel-shaped; ventral and dorsal plates narrow; copulatory openings distinct; spermathecae nearly oval, separated by ca. 1/3 width of spermatheca; fertilization ducts membranous, anteriorly oriented.

Distribution. Known only from the type locality, Tibet, China (Fig. 16).

***Pimoa nyingchi* Zhang & Li, sp. nov.**

http://zoobank.org/AA082852-47BB-4A5B-AF4D-78E06176DDC6

Figures 8, 9, 16

Type material. ***Holotype:*** ♂ (IZCAS-Ar40323), China, Tibet, Nyingchi, near Lunang Town, 29.94°N, 94.80°E, elevation ca. 2615 m, 25.VIII.2018, X. Zhang and J.

Liu leg. ***Paratypes:*** 1♂2♀ (IZCAS-Ar40324-Ar40326), same data as holotype; 2♂2♀ (IZCAS-Ar40327-Ar40330), Nyingchi, Near Sejila Pass, 29.56°N, 94.57°E, elevation ca. 3764 m, 26.VIII.2018, X. Zhang and J. Liu leg.

Etymology. The specific name is a noun in apposition taken from the type locality.

Diagnosis. The male of *Pimoa nyingchi* sp. nov. resembles *P. reniformis* (see Xu and Li 2007: 493, figs 36–41) but can be distinguished by the long, distally flat and wide pimoid cymbial sclerite (Fig. 8B, vs. narrow and distally curved) and by the relatively large and wide paracymbium (Fig. 8B, C, vs. small and narrow). The female of *P. nyingchi* also resembles *P. reniformis* (see Xu and Li 2007: 493, figs 42–47) but can be distinguished by a pair of small, oval spermathecae (Fig. 9C, vs. large and kidney-shaped) and by the broad dorsal plate (Fig. 9C, vs. narrow dorsal plate).

Description. Male (**holotype**): Total length 7.05. Carapace 3.59 long, 3.01 wide. Abdomen 3.46 long, 2.44 wide. Eye sizes and interdistances: AME 0.17, ALE 0.17, PME 0.18, PLE 0.16; AME-AME 0.14, AME-ALE 0.16, PME-PME 0.15, PME-PLE 0.18. Leg measurements: I: 28.08 (7.63, 8.91, 8.01, 3.53); II: 16.92 (5.89, 5.26, 3.78, 1.99); III: 16.73 (5.00, 5.19, 4.62, 1.92); IV: 14.10 (5.45, 4.23, 2.95, 1.47). Habitus as in Fig. 9E. Carapace yellowish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse bands. Legs brownish with distinct black annulations on all legs. Palp (Fig. 8A–C): patella short, almost the same length as tibia, with one retrolateral macroseta; tibia short, ca. 1/3 of cymbial length, with several macrosetae and a dorsal process; paracymbium short, ca. 1/3 of cymbial length, hook-shaped; pimoid cymbial sclerite long, distally

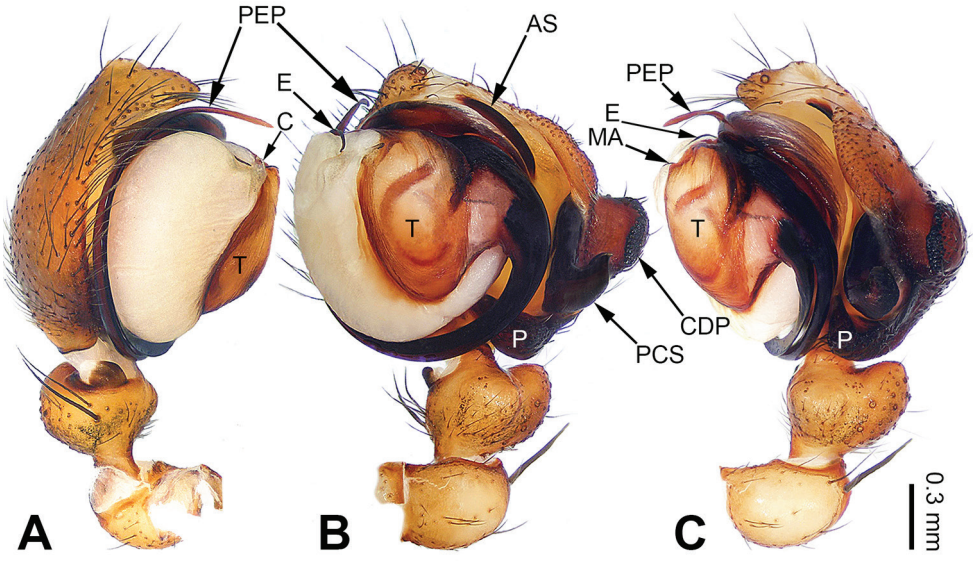

Figure 8. Left palp of *Pimoa nyingchi* sp. nov., holotype **A** prolateral view **B** ventral view **C** retrolateral view. Abbreviations: AS = alveolar sclerite; C = conductor; CDP = cymbial denticulate process; E = embolus; MA = median apophysis; P = paracymbium; PCS = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum. Scale bar: equal for **A–C.**

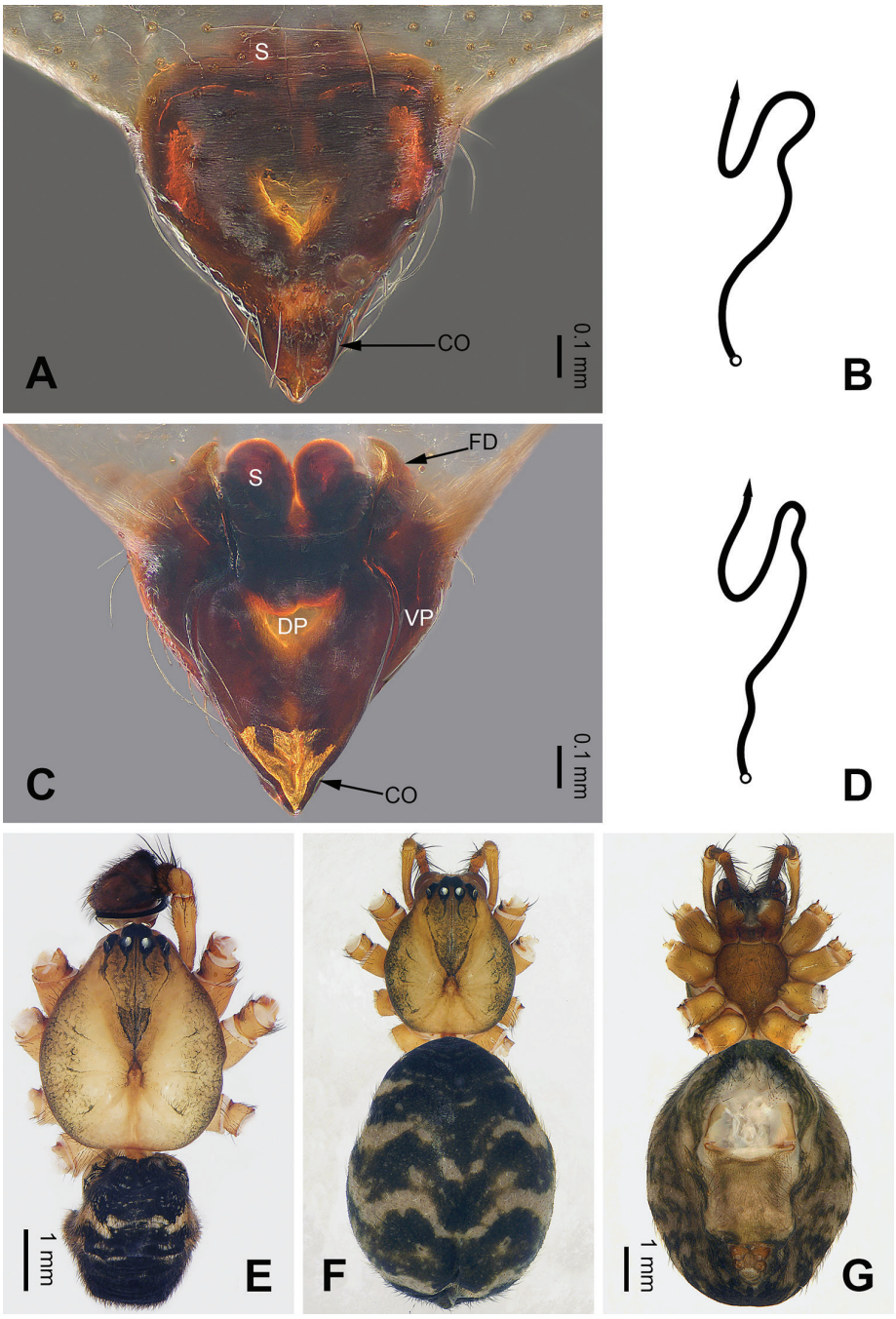

Figure 9. Epigyne and habitus of *Pimoa nyingchi* sp. nov., female paratype and male holotype **A** epigyne, ventral view **B** schematic course of internal duct system, ventral view **C** vulva, dorsal view **D** schematic course of internal duct system, dorsal view **E** male habitus, dorsal view **F** female habitus, dorsal view **G** female habitus, ventral view. Abbreviations: CO = copulatory opening; DP = dorsal plate of the epigyne; FD = fertilization duct; S = spermatheca; VP = ventral plate of epigyne. Scale bars: equal for **F** and **G**.

flat and wide, ca. 1/2 of cymbial length; cymbial denticulate process short, distally wide and bent inward, with more than 20 cuspules; median apophysis slender; conductor distinct; pimoid embolic process almost the same length as embolus; embolus beginning at the 3:00 o'clock position; embolic tooth absent.

Female (**paratype**): Total length 9.49. Carapace 3.27 long, 2.88 wide. Abdomen 6.22 long, 4.68 wide. Eye sizes and interdistances: AME 0.19, ALE 0.20, PME 0.19, PLE 0.20; AME-AME 0.14, AME-ALE 0.12, PME-PME 0.15, PME-PLE 0.17. Leg measurements: I: 20.76 (6.09, 6.79, 5.38, 2.50); II: 17.49 (5.06, 5.89, 4.68, 1.86); III: – (3.97, –, –, –); IV: 16.34 (5.06, 5.58, 4.42, 1.28). Habitus as in Fig. 9F, G. Carapace yellowish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse chevron bands. Legs brownish with distinct black annulations on all legs. Epigyne (Fig. 9A–D): triangular; ventral plate broad, length subequal to width; dorsal plate wide medially and pointed distally; copulatory openings indistinct; spermathecae oval, close to each other; fertilization ducts laterally oriented.

Distribution. Known only from the type locality, Tibet, China (Fig. 16).

Pimoa rongxar Zhang & Li, sp. nov.

http://zoobank.org/F5A97419-F64D-4B8C-ACFD-D88831A6CABA
Figures 10, 11, 16

Type material. ***Holotype:*** ♂ (IZCAS-Ar40331), China, Tibet, Shigatse, Dinggyê County, Rongxar Town, Woods by the river, 28.07°N, 86.37°E , elevation ca. 3520 m, 29.VII.2018, X. Zhang and J. Liu leg. ***Paratype:*** 1♀ (IZCAS-Ar40332), same data as holotype.

Etymology. The specific name is a noun in apposition taken from the type locality.

Diagnosis. The male of *Pimoa rongxar* sp. nov. resembles *P. reniformis* (see Xu and Li 2007: 493, figs 36–41) and *P. thaleri* Trotta, 2009 (see Trotta 2009: 1404, fig. 1) but can be distinguished by the large, long and subdistally wide pimoid cymbial sclerite (Fig. 10B, vs. small and narrow in *P. reniformis*; vs. short and medially wide in *P. thaleri*); distinguished from *P. reniformis* by the long palpal tibia, ca. 1/2 of the cymbial length (Fig. 10A–C, vs. palpal tibia short, ca. 1/3 of the cymbial length); distinguished from *P. thaleri* by the pimoid embolic process which is longer than the embolus (Fig. 10B, vs. a pimoid embolic process that is almost the same length as the embolus). The female of *P. rongxar* resembles *P. indiscreta* Hormiga, 1994 (see Hormiga 1994a: 66, figs 248–255) but can be distinguished by a pair of nearly round spermathecae (Fig. 11A, vs. nearly oval) and by the laterally oriented pair of fertilization ducts (Fig. 11A–D, vs. medially oriented fertilization ducts).

Description. Male (**holotype**): Total length 3.97. Carapace 2.50 long, 1.92 wide. Abdomen 1.47 long, 1.86 wide. Eye sizes and interdistances: AME 0.12, ALE 0.14, PME 0.16, PLE 0.14; AME-AME 0.14, AME-ALE 0.15, PME-PME 0.11, PME-PLE 0.11. Leg measurements: I: 19.23 (5.26, 6.22, 5.19, 2.56); II: 16.79 (4.55, 5.38, 4.62, 2.24); III: 11.48 (3.27, 3.46, 3.21, 1.54); IV: 14.16 (3.97, 4.55, 4.04, 1.60). Habi-

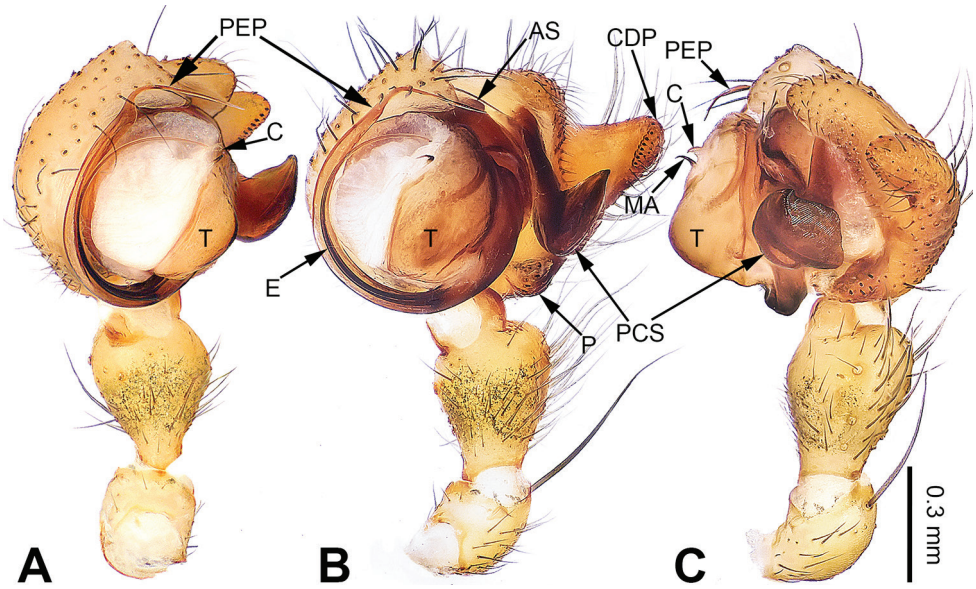

Figure 10. Left palp of *Pimoa rongxar* sp. nov., holotype **A** prolateral view **B** ventral view **C** retrolateral view. Abbreviations: AS = alveolar sclerite; C = conductor; CDP = cymbial denticulate process; E = embolus; MA = median apophysis; P = paracymbium; PCS = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum. Scale bar: equal for **A–C**.

tus as in Fig. 11E. Carapace brownish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen dark gray. Legs brownish with distinct black annulations on all legs. Palp (Fig. 10A–C): patella short, ca. 1/2 of tibial length, with a single retrolateral macroseta; tibia long, ca. 1/2 of cymbial length, with several macrosetae and a dorsal process; paracymbium short, ca. 1/3 of cymbial length; pimoid cymbial sclerite large, long and subdistally wide, slightly shorter than cymbial length; cymbial denticulate process short, distally narrow, with more than ten cuspules; median apophysis slender; conductor distinct; pimoid embolic process longer than embolus, abruptly narrowing; embolus beginning at the 5:30 o'clock position; embolic tooth absent.

Female (**paratype**): Total length 7.63. Carapace 3.78 long, 2.95 wide. Abdomen 3.85 long, 2.63 wide. Eye sizes and interdistances: AME 0.17, ALE 0.20, PME 0.18, PLE 0.17; AME-AME 0.13, AME-ALE 0.17, PME-PME 0.18, PME-PLE 0.21. Leg measurements: I: 24.29 (6.67, 8.14, 6.60, 2.88); II: 22.50 (6.35, 7.44, 6.15, 2.56); III: 17.38 (5.19, 5.58, 4.62, 1.99); IV: 20.77 (6.15, 6.86, 5.58, 2.18). Habitus as in Fig. 11F, G. Carapace yellowish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen yellowish with black marks. Legs yellowish with distinct black annulations on all legs. Epigyne (Fig. 11A–D): triangular; ventral plate broad, length subequal to width; dorsal plate narrow, longer than wide; copulatory openings distinct; spermathecae nearly round, separated by ca. 1/4 width of spermatheca; fertilization ducts yellowish, laterally oriented.

Distribution. Known only from the type locality, Tibet, China (Fig. 16).

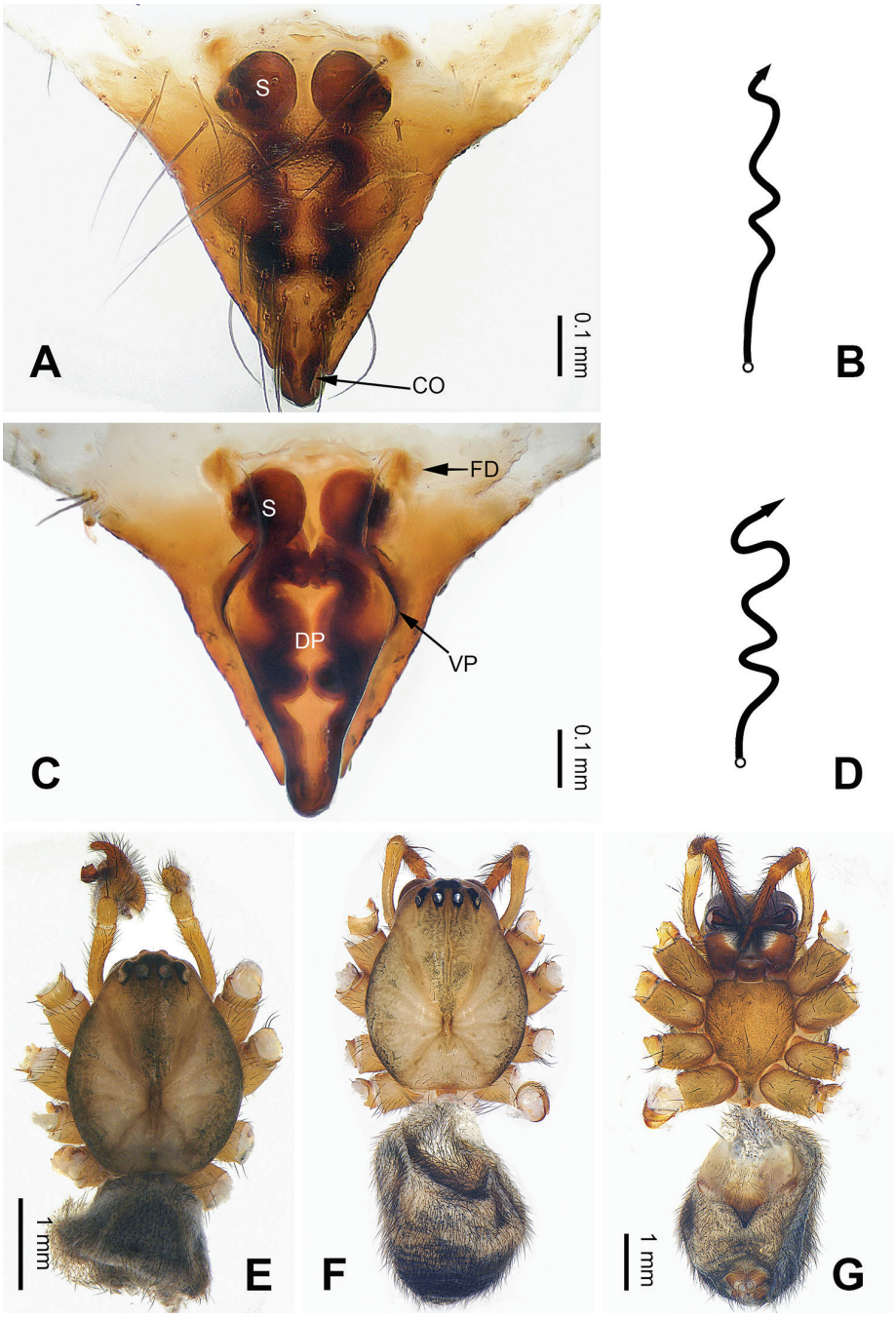

Figure 11. Epigyne and habitus of *Pimoa rongxar* sp. nov., female paratype and male holotype **A** epigyne, ventral view **B** schematic course of internal duct system, ventral view **C** vulva, dorsal view **D** schematic course of internal duct system, dorsal view **E** male habitus, dorsal view **F** female habitus, dorsal view **G** female habitus, ventral view. Abbreviations: CO = copulatory opening; DP = dorsal plate of the epigyne; FD = fertilization duct; S = spermatheca; VP = ventral plate of epigyne. Scale bars: equal for **F** and **G**.

***Pimoa samyai* Zhang & Li, sp. nov.**
http://zoobank.org/F6AADDC6-7CDA-4DD3-B406-D028D22913A0
Figures 12, 13, 16

Type material. ***Holotype*:** ♂ (IZCAS-Ar40333), China, Tibet, Lhoka, Samyai Town, along the way to Qingpu Practice Cave, 29.38°N, 91.55°E, elevation ca. 4231 m, 15.VIII.2018, X. Zhang and J. Liu leg. ***Paratypes*:** 1♂1♀ (IZCAS-Ar40334-Ar40335), same data as holotype; 2♀ (IZCAS-Ar40336-Ar40337), Lhoka, Aza Town, along the way to Zonggongbu Cave, 29.37°N, 91.32°E, elevation ca. 4389 m, 14.VIII.2018, X. Zhang and J. Liu leg.

Etymology. The specific name is a noun in apposition taken from the type locality.

Diagnosis. The male of *Pimoa samyai* sp. nov. resembles *P. binchuanensis* (see Zhang and Li 2019: 3, figs 1, 2) and *P. crispa* Hormiga, 1994 (see Hormiga 1994a: 63, figs 233–238; Hormiga 1994b: fig. 1A, B) but can be distinguished by the short and distally narrow cymbial denticulate process (Fig. 12B, vs. long and distally wide in *P. binchuanensis*; vs. distally wide in *P. crispa*); distinguished from *P. binchuanensis* by the nearly L-shaped pimoid cymbial sclerite (Fig. 12B, vs. nearly U-shaped); distinguished from *P. crispa* by a palpal tibia that is ca. 1/2 of the cymbial length (Fig. 12A–C, vs. tibia almost the same length as cymbium). The female of *P. samyai* resembles *P. crispa* Hormiga, 1994 (see Hormiga 1994a: 63, figs 239–247) and *P. indiscreta* Hormiga, 1994 (see Hormiga 1994a: 66, figs 248–255) but can be distinguished by the distance between the pair of

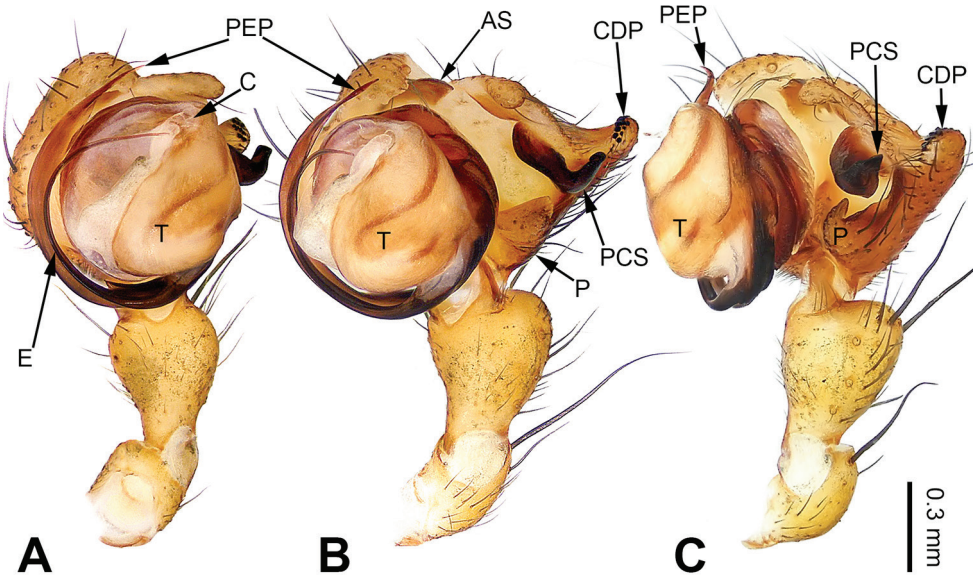

Figure 12. Left palp of *Pimoa samyai* sp. nov., holotype **A** prolateral view **B** ventral view **C** retrolateral view. Abbreviations: AS = alveolar sclerite; C = conductor; CDP = cymbial denticulate process; E = embolus; P = paracymbium; PCS = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum. Scale bar: equal for **A–C**.

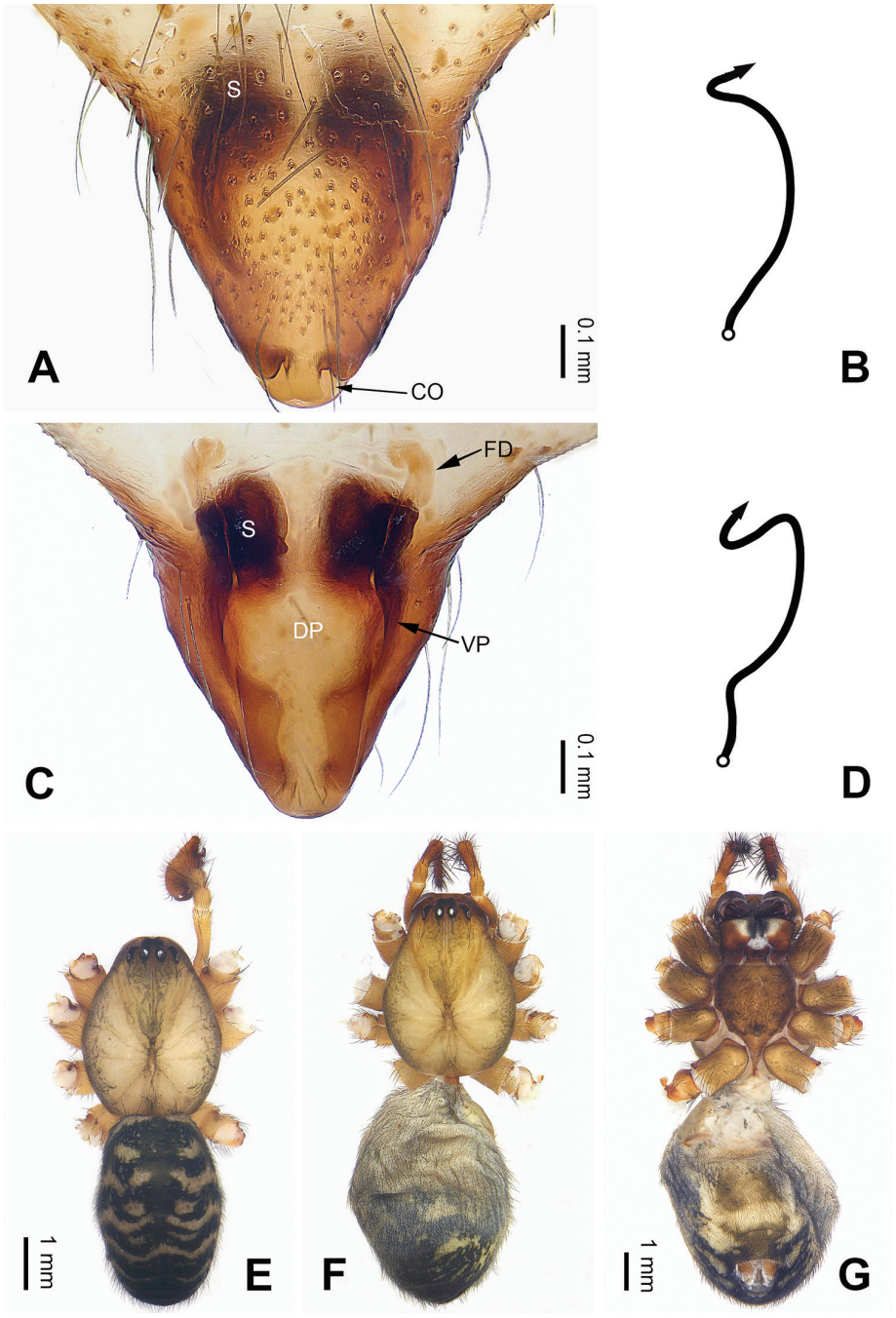

Figure 13. Epigyne and habitus of *Pimoa samyai* sp. nov., female paratype and male holotype **A** epigyne, ventral view **B** schematic course of internal duct system, ventral view **C** vulva, dorsal view **D** schematic course of internal duct system, dorsal view **E** male habitus, dorsal view **F** female habitus, dorsal view **G** female habitus, ventral view. Abbreviations: CO = copulatory opening; DP = dorsal plate of the epigyne; FD = fertilization duct; S = spermatheca; VP = ventral plate of epigyne. Scale bars: equal for **F** and **G**.

spermathecae which is ca. 1/2 the width of a spermatheca (Fig. 13C, vs. separated by ca. 1/4 the width of a spermatheca in *P. crispa* and *P. indiscreta*) and by the distally wide dorsal plate (Fig. 13C, vs. distally narrow in *P. crispa* and *P. indiscreta*).

Description. Male (**holotype**): Total length 6.92. Carapace 3.33 long, 2.63 wide. Abdomen 3.59 long, 2.31 wide. Eye sizes and interdistances: AME 0.16, ALE 0.17, PME 0.15, PLE 0.16; AME-AME 0.14, AME-ALE 0.14, PME-PME 0.16, PME-PLE 0.19. Leg measurements: I: 31.92 (8.85, 10.06, 9.74, 3.27); II: 31.40 (8.33, 9.94, 9.99, 3.14); III: 19.81 (5.83, 6.03, 5.96, 1.99); IV: 25.77 (7.31, 8.27, 7.88, 2.31). Habitus as in Fig. 13E. Carapace yellowish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse chevron bands. Legs brownish with black annulations, especially distinct on legs III and IV. Palp (Fig. 12A–C): patella short, ca. 1/2 of tibial length, with one retrolateral macroseta; tibia long, ca. 1/2 of cymbial length, with several macrosetae and a dorsal process; paracymbium short, ca. 1/3 of cymbial length, hook-shaped; pimoid cymbial sclerite nearly L-shaped, ca. 1/2 of cymbial length; cymbial denticulate process short and distally narrow, with more than ten cuspules; median apophysis indistinct; conductor distinct; pimoid embolic process pointed distally, longer than embolus; embolus beginning at the 5:30 o'clock position; embolic tooth absent.

Female (**paratype**): Total length 10.51. Carapace 4.81 long, 3.46 wide. Abdomen 5.70 long, 4.42 wide. Eye sizes and interdistances: AME 0.20, ALE 0.20, PME 0.19, PLE 0.19; AME-AME 0.16, AME-ALE 0.17, PME-PME 0.17, PME-PLE 0.23. Leg measurements: I: 31.73 (8.91, 10.51, 9.04, 3.27); II: 28.59 (7.95, 9.49, 8.14, 3.01); III: 20.19 (5.83, 6.54, 5.83, 1.99); IV: 26.85 (7.88, 8.97, 7.50, 2.50). Habitus as in Fig. 13F, G. Carapace yellowish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen yellowish with black parts. Legs brownish with distinct black annulations on all legs. Epigyne (Fig. 13A–D): triangular; ventral plate broad, length subequal to width; dorsal plate longer than wide, nearly tongue-shaped; copulatory openings distinct; spermathecae nearly oval, separated by ca. 1/2 width of spermatheca; fertilization ducts anteriorly oriented.

Distribution. Known only from the type locality, Tibet, China (Fig. 16).

***Pimoa yadong* Zhang & Li, sp. nov.**

http://zoobank.org/4ED45938-95D8-43C3-B000-AAC071D0258E

Figures 14–16

Type material. ***Holotype:*** ♂ (IZCAS-Ar40338), China, Tibet, Shigatse, Yadong County, along the way to the Qing Dynasty Customs Site, 27.42°N, 88.92°E, elevation ca. 2953 m, 6.VIII.2018, X. Zhang and J. Liu leg. ***Paratype:*** 1♀ (IZCAS-Ar40339), same data as holotype.

Etymology. The specific name is a noun in apposition taken from the type locality.

Diagnosis. The male of *Pimoa yadong* sp. nov. resembles *P. nematoides* Hormiga, 1994 (see Hormiga 1994a: 71, figs 285–289) and *P. sinuosa* Hormiga, 1994 (see Hor-

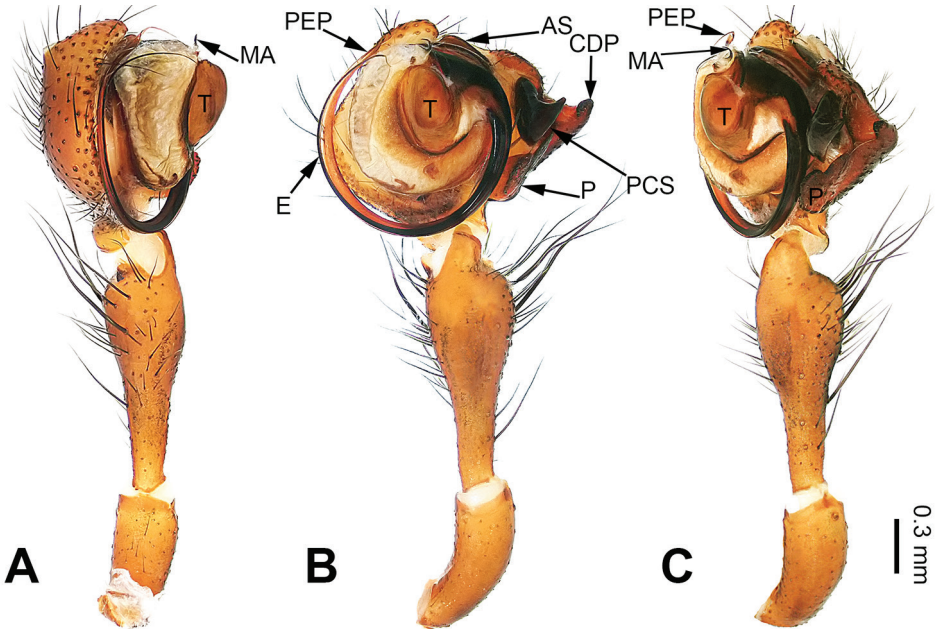

Figure 14. Left palp of *Pimoa yadong* sp. nov., holotype **A** prolateral view **B** ventral view **C** retrolateral view. Abbreviations: AS = alveolar sclerite; CDP = cymbial denticulate process; E = embolus; MA = median apophysis; P = paracymbium; PCS = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum. Scale bar: equal for **A–C**.

miga 1994a: 67, figs 256–265) but can be distinguished by the wide and subtriangular pimoid cymbial sclerite (Fig. 14B, vs. proximally wide, distally narrow and curved in *P. nematoides*; vs. slender and distally blunt and curved in *P. sinuosa*), by the long palpal tibia, ca. 2 times longer than the cymbium (Fig. 14A–C, vs. short tibia, ca. 1/3 of cymbial length in *P. nematoides* and *P. sinuosa*). The female of *P. yadong* resembles *P. sinuosa* (see Hormiga 1994a: 67, figs 266–284) and *P. cona* sp. nov. (Fig. 2) but can be distinguished by a pair of nearly round spermathecae that are almost touching one another (Fig. 15A, vs. elliptic and separated spermathecae in *P. cona*; vs. subtriangular and separated spermathecae in *P. sinuosa*) and by the dorsal plate which extends beyond the ventral plate (Fig. 15C, vs. a dorsal plate shorter than the ventral plate in *P. nematoides* and *P. sinuosa*).

Description. Male (**holotype**): Total length 8.46. Carapace 4.04 long, 3.27 wide. Abdomen 4.42 long, 2.95 wide. Eye sizes and interdistances: AME 0.21, ALE 0.19, PME 0.18, PLE 0.20; AME-AME 0.13, AME-ALE 0.18, PME-PME 0.17, PME-PLE 0.19. Leg measurements: I: – (11.60, –, –, –); II: – (10.13, –, –, –); III: 24.42 (7.18, 7.56, 7.18, 2.50); IV: – (8.91, 9.94, 9.04, –). Habitus as in Fig. 15E. Carapace yellowish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with slightly yellowish transverse bands. Legs brownish with black annulations, especially distinct on legs III and IV. Palp (Fig. 14A–C):

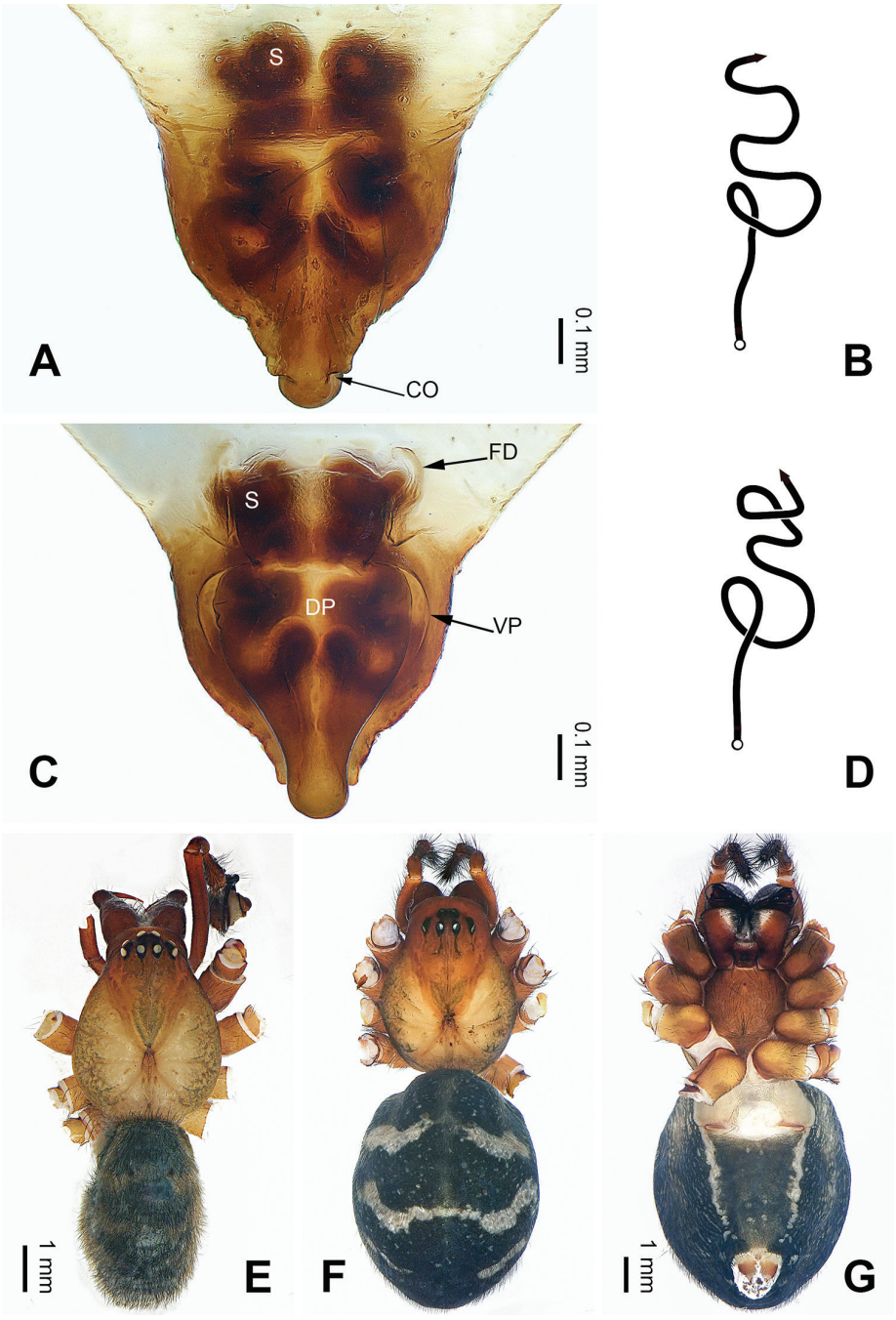

Figure 15. Epigyne and habitus of *Pimoa yadong* sp. nov., female paratype and male holotype **A** epigyne, ventral view **B** schematic course of internal duct system, ventral view **C** vulva, dorsal view **D** schematic course of internal duct system, dorsal view **E** male habitus, dorsal view **F** female habitus, dorsal view **G** female habitus, ventral view. Abbreviations: CO = copulatory opening; DP = dorsal plate of the epigyne; FD = fertilization duct; S = spermatheca; VP = ventral plate of epigyne. Scale bars: equal for **F** and **G**.

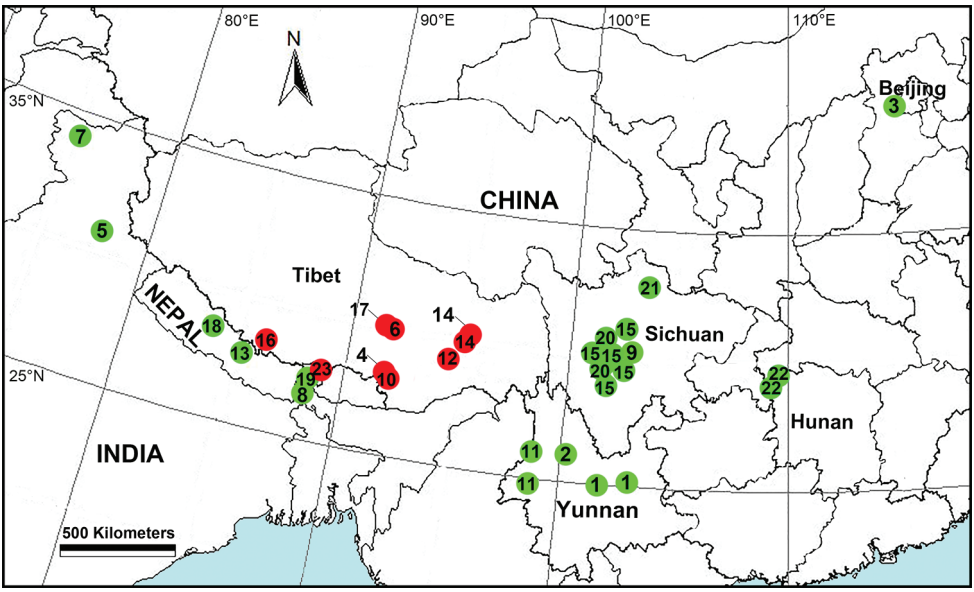

Figure 16. Distribution of *Pimoa* species from Asia. Red dots represent new species, green dots represent previously described species. **1** *P. anatolica* **2** *P. binchuanensis* **3** *P. clavata* **4** *P. cona* sp. nov. **5** *P. crispa* **6** *P. duiba* sp. nov. **7** *P. gandhii* **8** *P. indiscreta* **9** *P. lata* **10** *P. lemenba* sp. nov. **11** *P. lihengae* **12** *P. mainling* sp. nov. **13** *P. nematoides* **14** *P. nyingchi* sp. nov. **15** *P. reniformis* **16** *P. rongxar* sp. nov. **17** *P. samyai* sp. nov. **18** *P. sinuosa* **19** *P. thaleri* **20** *P. trifurcata* **21** *P. wanglangensis* **22** *P. xinjianensis* **23** *P. yadong* sp. nov.

patella long, ca. 1/2 of tibial length; tibia long, ca. 2 times longer than cymbium, with several macrosetae and a dorsal process; paracymbium short, ca. 1/3 of cymbial length; pimoid cymbial sclerite wide and subtriangular, ca. 1/3 of cymbial length; cymbial denticulate process short and distally pointed, with more than five cuspules; median apophysis slender; conductor indistinct; pimoid embolic process pointed distally, almost the same length as embolus; embolus beginning at the 2:00 o'clock position; embolic tooth absent.

Female (**paratype**): Total length 11.86. Carapace 4.55 long, 3.85 wide. Abdomen 7.31 long, 5.38 wide. Eye sizes and interdistances: AME 0.19, ALE 0.22, PME 0.21, PLE 0.22; AME-AME 0.19, AME-ALE 0.26, PME-PME 0.24, PME-PLE 0.28. Leg measurements: I: 43.08 (11.60, 14.04, 12.82, 4.62); II: 34.30 (10.58, 8.91, 11.09, 3.72); III: 24.30 (7.44, 7.69, 6.86, 2.31); IV: – (9.42, –, –, –). Habitus as in Fig. 15F–G. Carapace yellowish with black lateral margins; thoracic fovea and radial grooves distinct; sternum brownish. Abdomen black with yellowish transverse chevron bands and vertical band not extending to the distal part. Legs brownish with black annulations, especially distinct on legs III and IV. Epigyne (Fig. 15A–D): subtriangular; ventral plate broad, length subequal to width; dorsal plate narrowing distally, extending beyond the ventral plate; copulatory openings distinct; spermathecae round, close to each other; fertilization ducts laterally oriented.

Distribution. Known only from the type locality, Tibet, China (Fig. 16).

Discussion

As a relict group, pimoids are ideal organisms for biogeographic study (Wang et al. 2008). Wang et al. (2008) estimated the divergence time of the North American and Asian species of *Pimoa* was approximately 110 Ma, and suggested that the discontinuous distribution was probably a consequence of the break-up of Laurasia. Mammola et al. (2016) inferred that European pimoids probably originated in the alpine region as a result of range contractions following dramatic climatic changes in the Alps after the mid Miocene.

Based on our spider collections in the last years, we have found that many *Pimoa* species have colonized in the southern region of the Tibetan Plateau. This study describes eight new species, yielding a total of 17 *Pimoa* species from China. However, this is only the tip of the iceberg of Chinese *Pimoa* species, and more new species will be reported with further collections. Phylogeographic analysis of Pimoidae from China will be conducted when the majority of *Pimoa* species appear to be recorded.

Acknowledgments

We are deeply grateful to Dimitar Dimitrov (Bergen, Norway), Gustavo Hormiga (Washington D.C., USA), and Daniele Polotow (Campinas, Brazil) for providing constructive comments during the review process. Sarah Crews kindly checked the language. This study was supported by the National Natural Science Foundation of China to Shuqiang Li (NSFC-31530067).

References

Chamberlin RV, Ivie W (1943) New genera and species of North American linyphiid spiders. Bulletin of the University of Utah 33(10): 1–39.

Folmer O, Black M, Hoeh W, Lutz R, Vrijenhoek R (1994) DNA primers for amplification of mitochondrial cytochrome oxidase subunit I from diverse metazoan invertebrates. Molecular Marine Biology and Biotechnology 3(5): 294–299.

Gertsch WJ, Ivie W (1936) Descriptions of new American spiders. American Museum Novitates 858: 1–25.

Griswold CE, Coddington JA, Hormiga G, Scharff N (1998) Phylogeny of the orb-web building spiders (Araneae, Orbiculariae: Deinopoidea, Araneoidea). Zoological Journal of the Linnean Society 123: 1–99. https://doi.org/10.1111/j.1096-3642.1998.tb01290.x

Griswold CE, Long CL, Hormiga G (1999) A new spider of the genus *Pimoa* from Gaoligong Mountains, Yunnan, China (Araneae, Araneoidea, Pimoidae). Acta Botanica Yunnanica, Supplement 11: 91–97.

Hormiga G (1994a) A revision and cladistic analysis of the spider family Pimoidae (Araneoidea: Araneae). Smithsonian Contributions to Zoology 549: 1–104. https://doi.org/10.5479/si.00810282.549

Hormiga G (1994b) Cladistics and the comparative morphology of linyphiid spiders and their relatives (Araneae, Araneoidea, Linyphiidae). Zoological Journal of the Linnean Society 111: 1–71. https://doi.org/10.1111/j.1096-3642.1994.tb01491.x

Hormiga G, Lew S (2014) A new American species of the spider genus *Pimoa* (Araneae, Pimoidae). Zootaxa 3827(1): 95–100. https://doi.org/10.11646/zootaxa.3827.1.9

Khmelik VV, Kozub D, Glazunov A (2006) Helicon Focus. Version 3.10.3. http://www.heliconsoft.com/ heliconfocus.html [accessed 9 March 2020]

Li S (2020) Spider taxonomy for an advanced China. Zoological Systematics 45(2): 73–77.

Mammola S, Hormiga G, Arnedo MA, Isaia M (2016) Unexpected diversity in the relictual European spiders of the genus *Pimoa* (Araneae: Pimoidae). Invertebrate Systematics 30(6): 566–587. https://doi.org/10.1071/IS16017

Miller JA, Carmichael A, Ramirez MJ, Spagna JC, Haddad CR, Řezáč M, Johannesen J, Král J, Wang XP, Griswold CE (2010) Phylogeny of entelegyne spiders: affinities of the family Penestomidae (new rank), generic phylogeny of Eresidae, and asymmetric rates of change in spinning organ evolution (Araneae, Araneoidea, Entelegynae). Molecular Phylogenetics and Evolution 55: 786–804. https://doi.org/10.1016/j.ympev.2010.02.021

Trotta A (2009) *Pimoa thaleri*, a new species of the genus *Pimoa* Chamberlin & Ivie, 1943 from India (Araneae: Pimoidae). Contributions to Natural History 12: 1403–1407.

Wang Q, Li S, Wang R, Paquin P (2008) Phylogeographic analysis of Pimoidae (Arachnida: Araneae) inferred from mitochondrial cytochrome c oxidase subunit I and nuclear 28S rRNA gene regions. Journal of Zoological Systematics & Evolutionary Research 46(2): 96–104. https://doi.org/10.1111/j.1439-0469.2007.00441.x

WSC (2020) World Spider Catalog. Version 21.0. Natural History Museum Bern. http://wsc.nmbe.ch [accessed 14 March 2020]

Xu X, Li S (2007) Taxonomic study of the spider family Pimoidae (Arachnida: Araneae) from China. Zoological Studies 46: 483–502.

Xu X, Li S (2009) Three new pimoid spiders from Sichuan Province, China (Araneae: Pimoidae). Zootaxa 2298: 55–63. https://doi.org/10.11646/zootaxa.2298.1.4

Yuan L, Zhao L, Zhang Z (2019) Preliminary study on the spider diversity of the Wanglang National Nature Reserve. Acta Arachnologica Sinica 28(1): 7–36.

Zhang X, Li S (2019) On three species of the spider genus *Pimoa* (Araneae, Pimoidae) from China. ZooKeys 855: 1–13. https://doi.org/10.3897/zookeys.855.33501

Zhao Z, Li S (2017) Extinction vs. rapid radiation: the juxtaposed evolutionary histories of coelotine spiders support the Eocene-Oligocene Orogenesis of the Tibetan Plateau. Systematic Biology 66(6): 988–1006. https://doi.org/10.1093/sysbio/syx042

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RESEARCH ARTICLE

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Two new and one newly recorded species of *Thelcticopis* Karsch, 1884 (Araneae, Sparassidae) from China

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Abstract

Two new species of the genus *Thelcticopis* Karsch, 1884, *T. dahanensis* Zhu & Zhong, **sp. nov.** (♂) and *T. unciformis* Zhu & Zhong, **sp. nov.** (♂), are described and figured from Taiwan Island. *Thelcticopis severa* (L. Koch, 1875) is recorded from Guangdong and Fujian provinces for the first time. So far, *Thelcticopis*, including four species from China, is mainly distributed in the tropical or subtropical areas of China (Hainan, Taiwan, Yunnan, Guangdong, Fujian).

Keywords

biodiversity, huntsman spiders, Taiwan, taxonomy

Introduction

Sparianthinae Simon, 1887 is a subfamily of Sparassidae Bertau, 1872, including 15 genera and 91 described species. The genera included *Decaphora* Franganillo, 1931, *Defectrix* Petrunkevitch, 1925, *Extraordinarius* Rheims, 2019, *Pleorotus* Simon, 1898, *Pseudosparianthis*, *Rhacocnemis* Simon, 1897, *Sagellula* Strand, 1942, *Sampaiosia* Mello-Leitão, 1930, *Sparianthis*, *Stasina*, *Stipax* Simon, 1898, *Strandiellum* Kolosváry, 1934, *Thelcticopis* Karsch, 1884, *Thomasettia* Hirst, 1911, and *Uaiuara* Rheims, 2013

(Rheims and Alayón 2016; Rheims 2019; World Spider Catalog 2020). These are distributed in Latin and South America, Africa, Asia, and Australia. This subfamily can be separated from other sparassid subfamilies by the presence of small retromarginal teeth on the chelicerae, a trilobate membrane with a reduced or inconspicuous median lobe, and male palps bearing a median apophysis (Rheims 2019). Sparianthinae is represented in China by the genera *Sagellula* and *Thelcticopis* (World Spider Catalog 2020).

Thelcticopis was proposed by Karsch (1884) as a new name for *Themeropis* L. Kock, 1875, preoccupied by a coleopteran beetle (*Themeropis* Pascoe, 1874). The genus was originally proposed by L. Koch (1875) to include the type species, *T. severa* L. Koch, 1875, described based on a female from China. Years later, Jäger (2005) synonymized *Seramba* Thorell, 1887 with *Thelcticopis* Karsch, 1884, and pointed out that probably the two African species, *Thelcticopis humilithorax* (Simon, 1910) and *T. truculenta* Karsch, 1884, did not belong to *Thelcticopis*. Nevertheless, he kept both species in the genus until a more thorough revision, as discussed in later regional revisions (Jäger 2005; Jäger and Kunz 2005). Currently, *Thelcticopis* includes 48 described species distributed mainly in East, South and Southeast Asia, South and Western Pacific (World Spider Catalog 2020). Two species are reported from China, *T. severa* and *T. zhengi* Liu, Li & Jäger, 2010. While studying new materials collected in Taiwan Island, two new *Thelcticopis* species were recognized and described in the present paper. In addition, we provide new records and photographs of *T. severa*.

Materials and methods

Specimens were examined and measured with a Leica M205C stereomicroscope. Positions of the tegular appendages are given according to clock positions, based on the left palp in ventral view. Male palps were examined after dissection and detachment from the spiders' bodies, the epigyna were examined and illustrated after dissection. All photographs were captured with an Olympus C7070 wide zoom digital camera (7.1 megapixels) mounted on an Olympus SZX12 dissecting microscope, and assembled using Helicon Focus 3.10.3 image stacking software. Photographic images were then edited using Adobe Photoshop. Left palps are depicted unless otherwise stated. All specimens are deposited in Centre for Behavioural Ecology and Evolution, College of Life Sciences, Hubei University, Wuhan, China (CBEE).

Leg measurements are shown as: total length (femur, patella, tibia, metatarsus, tarsus). Number of spines is listed for each segment in the following order: prolateral, dorsal, retrolateral, ventral (in femora and patellae ventral spines are absent and fourth digit is omitted in the spination formula). Abbreviations follow Zhong et al. (2017, 2018, 2019):

ALE anterior lateral eyes;
AME anterior median eyes;
AW anterior width of prosoma;
C conductor;
CH clypeus height;
dRTA dorsal branch of RTA;
E embolus;
FD fertilization duct;

FE	femur;
TA	tegular apophysis;
MS	middle septum;
Mt	metatarsus;
OL	opisthosoma length;
OW	opisthosoma width;
Pa	patella;
PL	prosoma length;
PLE	posterior lateral eyes;
PME	posterior median eyes;
Pp	palpus;
PW	prosoma width;
RTA	retrolateral tibial apophysis;
S	spermatheca;
SP	spermophore;
Ta	tarsus;
Ti	tibia. I, II, III, IV–legs I to IV;
vRTA	ventral branch of RTA.

Taxonomy

Family Sparassidae Bertkau, 1872
Subfamily Sparianthinae Simon, 1897

Genus *Thelcticopis* Karsch, 1884

Type species. *Thelcticopis severa* (L. Koch, 1875).

Diagnosis. The subfamily Sparianthinae is represented in China by two genera: *Sagellula* Strand, 1942 and *Thelcticopis* Karsch, 1884. However, most species of both genera have been poorly described so far, and the monophyly of these genera is also debatable as *Sagellula xizangensis* (Hu, 2001) may be wrongly placed (Jäger and Yin 2001). Therefore, we just provide a diagnosis between the Chinese *Thelcticopis* and *Sagellula* (only *S. xizangensis*) species in the current paper. The Chinese *Thelcticopis* species are most similar to *S. xizangensis* in having spoon-shaped tegular apophysis in the male palp and median septum in the epigynum (Hu 2001; fig. 187. 1–4), but can be distinguished from the latter by the following characters: 1, tibia of male palp stout, about 1/3 cymbium length in *Thelcticopis*, but normal, less than 1/2 cymbium length in *S. xizangensis*; 2, retrolateral tibial apophysis complicated, branched in most *Thelcticopis* species, but simple in *S. xizangensis*; 3, spermatheca significantly irregular in most *Thelcticopis* species, but globular in *S. xizangensis*; 4, anterior median eye larger than other eyes in *Thelcticopis*, but posterior lateral eyes obviously largest in *S. xizangensis*.

Distribution. Asia and Pacific zoogeographic regions.

***Thelcticopis dahanensis* Zhu & Zhong, sp. nov.**
http://zoobank.org/B362CCBC-E054-4FA1-B293-07693E07E439
Figures 1, 5

Type materials. ***Holotype.*** ♂ (CBEE), China, Taiwan Island, Pingdong County, Mt. Dahan, 22.41N, 120.74E, 29.VI.2013, J. Liu leg. ***Paratypes*** (CBEE): ♂, same data as holotype.

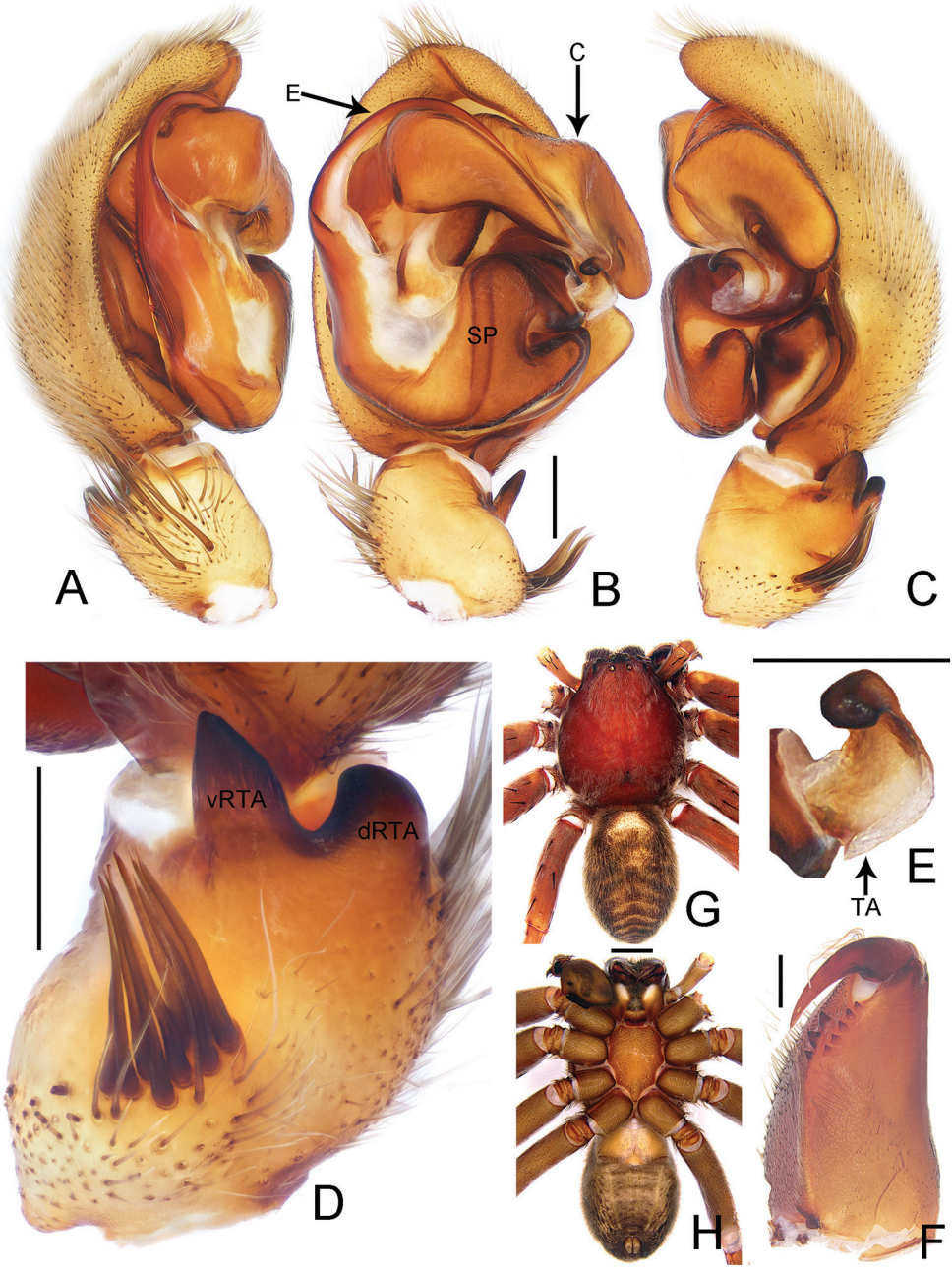

Figure 1. *Thelcticopis dahanensis* Zhu & Zhong, sp. nov., holotype male **A–C** palp, left **D** left male palpal tibia **E** tegular apophysis **F** cheliceral dentition **G, H** male habitus (**A** prolateral view; **B, E, F, H** ventral view; **C, D** retrolateral view; **G** dorsal view). Abbreviations: C–conductor, dRTA–dorsal branch of RTA, E–embolus, TA–tegular apophysis, SP–spermophore, vRTA–ventral branch of RTA. Scale bars: 0.5 mm (**A–F**); 5 mm (**G, H**).

Etymology. The specific name is a noun in apposition taken from the type locality.

Diagnosis. The male of this new species resembles those of other Chinese *Thelcticopis* species (*T. severa*, *T. unciformis* sp. nov. and *T. zhengi*) in having stout tibia, broad cymbium and spoon-shaped tegular apophysis, but can be separated from *T. severa* by RTA arising distally from tibia, branched (arising proximally, not branched in *T. severa*); from *T. unciformis* sp. nov. by the developed conductor with two branches distally, dorsal branch extending beyond ventral one (dorsal branch not extending beyond ventral one in *T. unciformis* sp. nov.), from *T. zhengi* by the long embolus with filiform end, visible in ventral view (but short, with blunt end, covered by a large tegular apophysis in *T. zhengi*) (Fig. 1A–E).

Description. Male. PL 6.1, PW 5.3, AW 2.8, OL 6.0, OW 3.1. Eyes: AME 0.25, ALE 0.21, PME 0.18, PLE 0.20, AME–AME 0.25, AME–ALE 0.34, PME–PME 0.58, PME–PLE 0.69, AME–PME 0.36, ALE–PLE 0.34, CH AME 0.16, CH ALE 0.14. Spination: Palp: 131, 101, 0002; Fe: I–II 323, III 322, IV 321; Pa: I–IV 000; Ti: I–II 212 10, III–IV 2126; Mt: I–II 1012, III 3032, IV 3034. Measurements of palp and legs: Palp 7.5 (2.2, 0.8, 1.3, –, 3.2), I 20.6 (5.6, 2.8, 5.6, 5.3, 1.3), II 18.7 (5.1, 2.7, 5.0, 4.7, 1.2), III 15.5 (4.6, 2.3, 3.9, 3.7, 1.0), IV 19.7 (5.8, 2.2, 4.8, 5.7, 1.2). Leg formula: I-IV-II-III. Cheliceral furrow with three anterior and five posterior teeth, without denticles (Fig. 1F). Dorsal prosoma reddish brown, posterior margins dark, with shallow fovea and radial furrows. Chelicerae deep reddish brown. Sternum yellowish brown, with margin deep brown. Gnathocoxae and labium deep yellowish brown, with white distal lips. Legs deep reddish to yellowish brown, covered by short spines. Dorsal opisthosoma with irregular patches and distinct median chevrons in posterior half. Ventral opisthosoma with patches especially in lateral half (Fig. 1G, H).

Palp as in diagnosis. Cymbium approximately two times longer than tibia in ventral view. Conductor arising from tegulum in the 11-o'clock-position. Appendage of median apophysis finger-shaped in ventral view. Sperm duct almost straight in ventral view. vRTA with tip pointed and dRTA blunt in retrolateral view. Palpal tibia retrolaterally with distinct bunch of nine setae (Fig. 1A–E).

Female. Unknown.

Distribution. Known only from the type locality (Fig. 5).

Thelcticopis severa (L. Koch, 1875)

Figures 2, 3, 5

Themeropis severa L. Koch, 1875: 699, pl. 60, fig. 1 (♀).
Thelcticopis severa Simon, 1897: 72 (transferred from *Themeropis*).

Remarks. See the World Spider Catalogue for the full list of references.

Material examined. 2♂, 1♀ (CBEE), China, Hainan Island, Wuzhishan National Reserve, 18.89N, 109.69E, 29.VI.2013, F.X. Liu leg.; 2♂, 1♀ (CBEE), China, Shenzhen

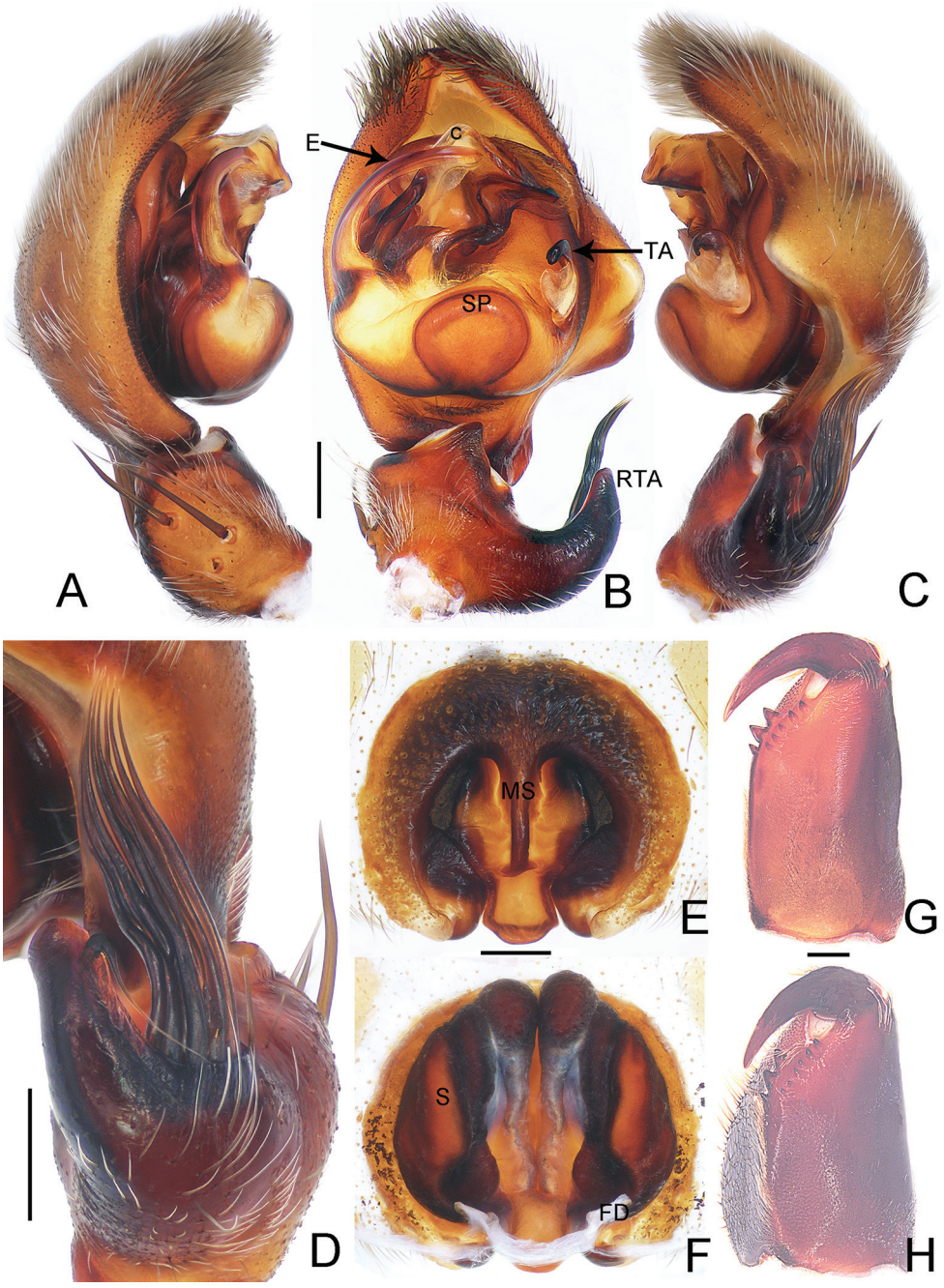

Figure 2. *Thelcticopis severa* (L. Koch, 1875) **A–C** palp, left **D** left male palpal tibia **E** epigyne **F** vulva **G, H** cheliceral dentition (**A** prolateral view; **B, E, G, H** ventral view; **C, D** retrolateral view; **F** dorsal view; **G** male; **H** female). Abbreviations: C–conductor, E–embolus, FD–fertilization duct, MS–middle septum, RTA–retrolateral tibial apophysis, S–Spermatheca, SP–spermophore, TA–tegular apophysis. Scale bars: 0.5 mm

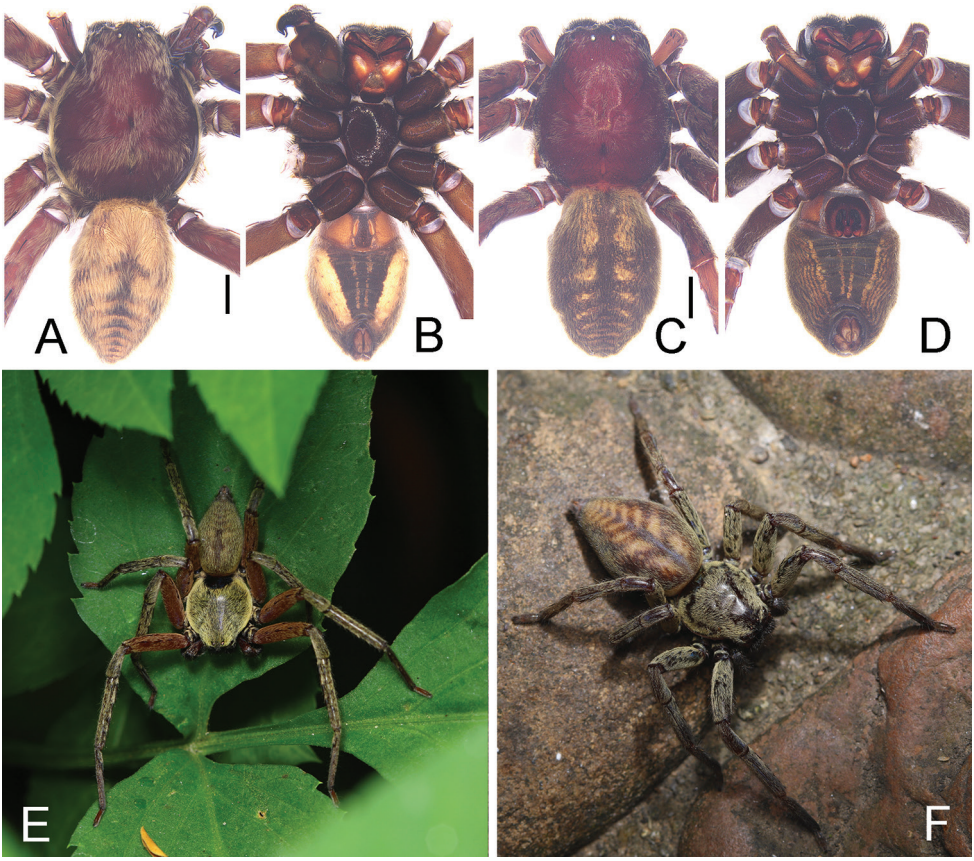

Figure 3. A–D habitus of *Thelcticopis severa* (L. Koch, 1875) **A** male, dorsal **B** male, ventral **C** female, dorsal **D** female, ventral **E, F** photographs of living *Thelcticopis severa* (L. Koch, 1875) from Bijiashan park **E** male **F** female. Photographs by Qianle Lu. Scale bars: 5 mm.

City, Bijiashan Park, 22.56N, 114.08E, 26.VII.2018, Q.L. Lu leg; 2♂ (CBEE), China, Fujian Province, Wuyishan National Reserve, 27.58N, 117.48E, 25.VIII.2019, Y. Zhong leg.

Diagnosis. Males of this species can be distinguished from males of other *Thelcticopis* species by its unique bases of RTA with seven or eight stiff setae, long and standing in line (almost the same length as dRTA) and tip of RTA with one stiff seta bending backwards in retrolateral view (Fig. 2A–D). Females are similar to those of *Thelcticopis picta* (Thorell, 1887) in having median septum somewhat heart-shaped with a tongue-like posterior structure pointing in the direction of the epigastric furrow (Jäger 2005: figs 1–7), but distinguished from the latter by the following characters: anterior part of the median septum with a longitudinal ridge (absent in *T. picta*); ends of internal duct system inconspicuous in dorsal view (visible in *T. picta*) (Fig. 2A–F).

Description. See Hu and Ru (1988) and Yin et al. (2012).

Distribution. China (Guangdong, new province record; Guangxi; Hainan; Fujian, new province record; Hongkong; Hunan; Taiwan; Yunnan; Zhejiang); Korea; Japan; Laos (Fig. 5).

***Thelcticopis unciformis* Zhu & Zhong, sp. nov.**
http://zoobank.org/A2035161-2D57-493D-8E14-5E12A5357C52
Figures 4, 5

Type materials. ***Holotype.*** ♂ (CBEE), China, Taiwan Island, Taipei City, Mt. Yangming, 25.17N, 121.53E, 5.VII.2013, J. Liu leg. ***Paratypes*** (CBEE): ♂, same data as holotype.

Etymology. The specific name is derived from Latin adjective *unciformis*, *-is*, *-e*, meaning hooked and referring to the embolus being curved.

Diagnosis. The male of *T. unciformis* resembles that of *T. dahanensis* (Fig. 1A–D) by the embolus arising from the tegulum at the 8:30 to 9-o'clock position, embolus tip slender; tibia with retrolateral setae, RTA arising distally from the tibia. However, it

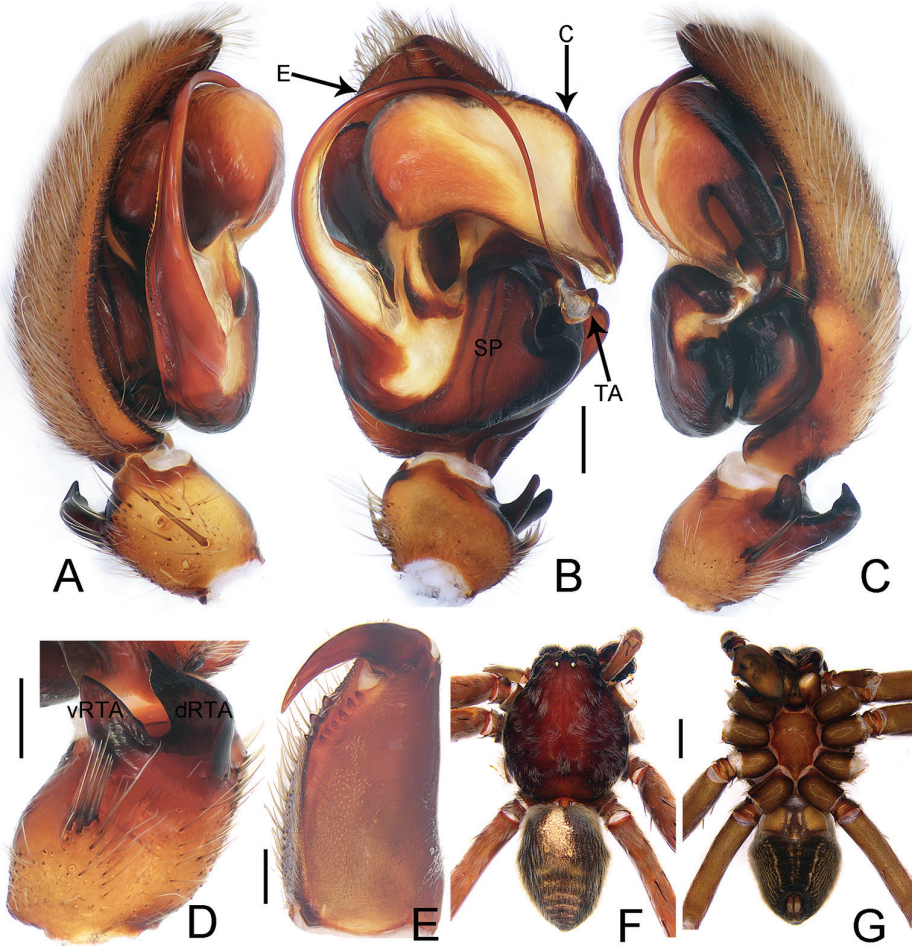

Figure 4. *Thelcticopis unciformis* Zhu & Zhong, sp. nov., holotype male **A–C** palp, left **D** left male palpal tibia **E** cheliceral dentition **F, G** male habitus (**A** prolateral view; **B, E, G** ventral view; **C, D** retrolateral view; **F** dorsal view). Abbreviations: C–conductor, dRTA–dorsal branch of RTA, E–embolus, TA–tegular apophysis, SP–spermophor, vRTA–ventral branch of RTA. Scale bars: 0.5 mm (**A–E**); 5 mm (**F, G**).

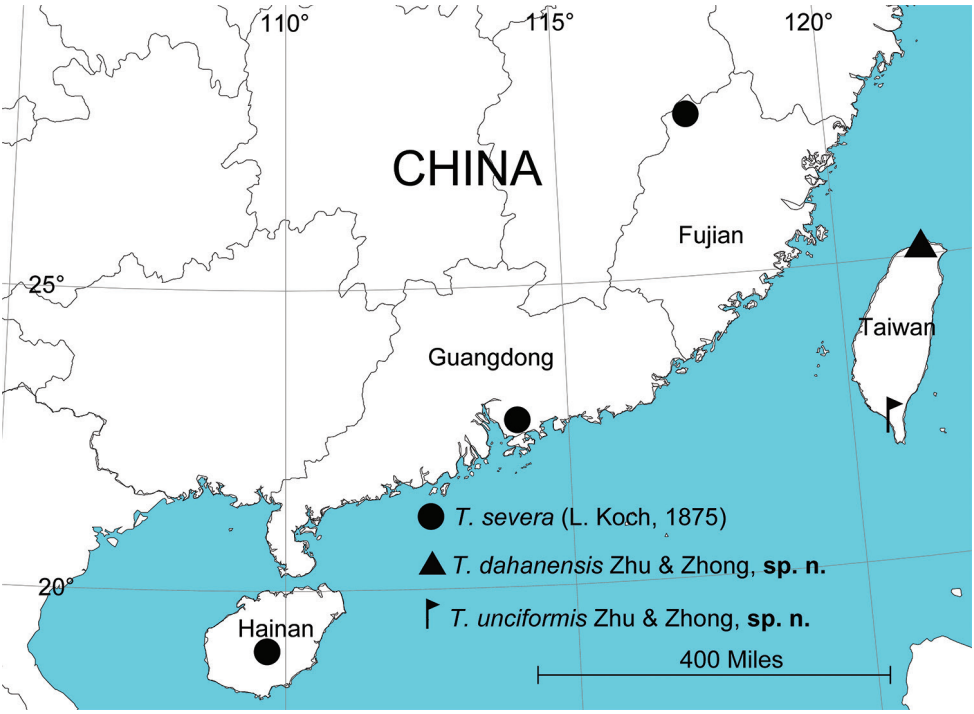

Figure 5. Collection localities of three *Thelcticopis* species from China.

can be distinguished by the embolus tip extending beyond the conductor (not so in *T. dahanensis*); dRTA tip pointed in retrolateral view (blunt in *T. dahanensis*) (Fig. 4A–D).

Description. Male. PL 7.5, PW 6.0, AW 3.3, OL 7.1, OW 4.0. Eyes: AME 0.39, ALE 0.30, PME 0.21, PLE 0.27, AME–AME 0.21, AME–ALE 0.35, PME–PME 0.58, PME–PLE 0.77, AME–PME 0.33, ALE–PLE 0.32, CH AME 0.15, CH ALE 0.12. Spination: Palp: 131, 101, 0002; Fe: I–III 323, IV 321; Pa: I–IV 000; Ti: I–II 212(10), III 2026, IV 2226; Mt: I–II 1012, III 1014, IV 3034. Measurements of palp and legs: Palp 7.3 (2.0, 0.8, 1.2, –, 3.3), I 22.9 (6.2, 3.1, 6.3, 5.8, 1.5), II 21.3 (6.1, 2.9, 5.7, 5.2, 1.4), III 17.6 (5.4, 2.6, 4.2, 4.1, 1.3), IV 22.4 (6.8, 2.4, 5.6, 6.1, 1.5). Leg formula: I-IV-II-III. Cheliceral furrow with three anterior and six posterior teeth, without denticles (Fig. 5C). Dorsal prosoma deep reddish brown, posterior margins dark, with shallow fovea and radial furrows. Chelicerae deep reddish brown. Sternum yellowish to reddish brown, with margin reddish brown. Gnathocoxae deep yellowish brown, with white distal lips. Labium deep reddish brown. Legs deep yellowish brown, covered by short spines. Dorsal opisthosoma with irregular patches and distinct median chevrons in posterior half. Ventral opisthosoma yellowish brown, with larger and black hairs (Fig. 4F, G).

Palp as in diagnosis. Cymbium about three times longer than tibia in ventral view. Conductor arising from tegulum in an 11-o'clock-position. Median apophysis spoon-shaped and bifid in ventral view. Sperm duct slightly curved in ventral view. vRTA and

dRTA with pointed tips in retrolateral view. Palpal tibia retrolaterally directed with distinct bunch of six setae (Fig. 4A–D).

Female. Unknown.

Distribution. Known only from the type locality (Fig. 5).

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References

Bertkau P (1872) Über die Respirationsorgane der Araneen. Archiv für Naturgeschichte 38: 208–233.

Hu JL, Ru YC (1988) On two species of Heteropodidae (Araneae) from Guangxi Zhuang Autonomous Region, China. Journal of Shadong University 23: 92–98. [in Chinese]

Hu JL (2001) Spiders in Qinghai-Tibet Plateau of China. Henan Science and Technology Publishing House, 658 pp. [in Chinese]

Jäger P, Yin CM (2001) Sparassidae in China. 1. Revised list of known species with new transfers, new synonymies and type designations (Arachnida: Araneae). Acta Arachnologica 50: 123–134. https://doi.org/10.2476/asjaa.50.123

Jäger P, Kunz D (2005) An illustrated key to genera of African huntsman spiders (Arachnida, Araneae, Sparassidae). Senckenbergiana Biologica 85: 163–213.

Jäger P (2005) *Seramba* Thorell 1887 is a synonym of *Thelcticopis* Karsch 1884 (Arachnida, Araneae, Sparassidae, Sparianthinae). Senckenbergiana Biologica 85: 57–59.

Järvi TH (1914) Das Vaginalsystem der Sparassiden. II. Spezieller Teil. Annales Academiae Scientiarum Fennicae (A) 4: 118–235.

Karsch F (1884) Arachnoidea. In: Greeff R (Ed.) Die Fauna der Guinea-Inseln S.-Thomé und Rolas. Sitzungsberichte der Gesellschaft zur Beförderung der Gesamten Naturwissenschaften zu Marburg 2: 60–68. [79 pp.]

Koch L (1875) Die Arachniden Australiens. Nürnberg 1: 577–740.

Liu J, Li SQ, Jäger P (2010) Huntsman spiders (Araneae: Sparassidae) from Xishuangbanna rainforest, China. Zootaxa 2508: 56–64. https://doi.org/10.11646/zootaxa.2508.1.4

Rheims CA, Alayón G (2016) *Neostasina* gen. nov., a new genus of huntsman spiders from the Neotropical region (Araneae, Sparassidae, Sparianthinae). Zootaxa 4079: 301–344. https://doi.org/10.11646/zootaxa.4079.3.1

Rheims CA (2019) *Extraordinarius* gen. nov., a new genus of Sparianthinae spiders (Araneae: Sparassidae) from southeastern Brazil. Zootaxa 4674: 83–99. https://doi.org/10.11646/zootaxa.4674.1.4

Simon E (1897) Histoire Naturelle des Araignées. Deuxième édition, tome second. Roret, Paris, 192 pp.

WSC (2020) World Spider Catalog, version 20.0. Natural History Museum, Bern. https://doi.org/10.24436/2 [2020-2-01]

Yin CM, Peng XJ, Yan HM, Bao YH, Xu X, Tang G, Zhou QS, Liu P (2012) Fauna Hunan: Araneae in Hunan, China. Hunan Science and Technology Press, Changsha, 1590 pp. [in Chinese]

Zhong Y, Cao XW, Liu J (2017) Six *Sinopoda* species (Araneae: Sparassidae) from Fujian and Yunnan Provinces in China. Zootaxa 4227: 151–172. https://doi.org/10.11646/zootaxa.4227.2.1

Zhong Y, Jäger P, Chen J, Liu J (2018) Taxonomic review of the *Sinopoda okinawana*-group (Araneae: Sparassidae) in China. Zootaxa 4388: 328–346. https://doi.org/10.11646/zootaxa.4388.3.2

Zhong Y, Lin YJ, Liu J (2019) First description of the male of *Barylestis saaristoi* Jäger, 2008 (Araneae, Sparassidae) from China. ZooKeys 832: 153–160. https://doi.org/10.3897/zookeys.832.32569

ZooKeys 940: 117–159 (2020)
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RESEARCH ARTICLE

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Revision of Taiwanese species of *Atrachya* Chevrolat, 1836 (Coleoptera, Chrysomelidae, Galerucinae): descriptions of three new genera, two new species, and designations of three new synonyms

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Abstract

The genus *Atrachya* Chevrolat is redefined based on study of the type species *A. menetriesii* (Faldermann, 1835). All Taiwanese species of *Atrachya* are transferred to three new genera: *A. hirashimai* Kimoto, 1976 and *A. nitidissima* (Chûjô, 1935) are transferred to *Neochya* **gen. nov.**; *A. mediofasciata* Kimoto, 1976 is transferred to *Tsouchya* **gen. nov.**; *A. unifasciata* Takizawa, 1978 is transferred to *Chinochya* **gen. nov**. Two species are described: *N. chengi* **sp. nov.** and *N. tsoui* **sp. nov.** *Atrachya bicoloripennis* (Chûjô, 1938) and *A. saramao* (Chûjô, 1962) are regarded as synonyms of *N. nitidissima* (Chûjô, 1935) **comb. nov.**, and *Monolepta tsoui* Lee, 2009 is synonymized with *T. mediofasciata* (Kimoto, 1976) **comb. nov.** *Monolepta sublata* Gressitt & Kimoto, 1963 is redescribed and transferred to *Chinochya* **gen. nov.** Taiwanese records of *Monolepta sublata* are based on misidentifications and represent specimens of *C. unifasciata*. Variablity of adult color patterns is discussed.

Keywords

Chinochya, leaf beetles, *Neochya*, new genus, taxonomic revision, *Tsouchya*

Introduction

The genus *Atrachya* Chevrolat, 1836 is attributed to "Monoleptites" *sensu* Wilcox (1973) having elongate metatarsomere I. Twenty-seven species of *Atrachya* were docu-

mented by Nie et al. (2017). Besides *Atrachya*, *Paleosepharia* Laboissière, 1936 and *Monolepta* Chevrolat, 1836 are members of this group recorded from Taiwan. Chûjô (1935) described the first species as *Luperodes nitidissimus* from Taiwan. Later, he described two additional species, *L. bicoloripennis* Chûjô, 1938 and *L. saramao* Chûjô, 1962. Kimoto (1969) transferred these Taiwanese species of *Luperodes* to *Atrachya* and described a fourth species, *A. hirashimai* and later, a fifth, *A. mediofasciata* Kimoto, 1976. The last, sixth species, was described as *A. unifasciata* by Takizawa (1978).

Diagnostic characters of the genus *Atrachya* were discussed (Wagner and Bieneck 2017) based on *Cnecodes bisignatus* Motschulsky, 1858. However, one important character, the sexually dimorphic elytral impression, does not occur in any Taiwanese species. This paper redefines the genus *Atrachya* based on the type species, *A. menetriesii* (Faldermann, 1835). The taxonomic status of the Taiwanese species of *Atrachya* is reevaluated, and their identities reviewed. In addition, Kimoto (1976) recorded *Monolepta sublata* from Taiwan, which is extremely similar to *A. unifasciata* Takizawa, 1978. These two species are compared to clarify their taxonomic status.

The Taiwan Chrysomelid Research Team (TCRT) has been inventorying chrysomelid fauna since 2005. Adults of the taxa covered in this paper were collected by sweeping host plants, species of *Celastrus* and *Euonymus* (Celastraceae) (Fig. 1). More than 600 specimens were collected using this method in addition to loaned specimens, providing an adequate sample set for assessing species diversity of the group.

Materials and methods

The abdomens of adults were separated from the bodies and boiled in 10% KOH solution, followed by washing in distilled water to clear and soften genitalia. The genitalia were then dissected from the abdomen, mounted on slides in glycerin, and studied and drawn using a Leica M165 stereomicroscope. A Nikon ECLIPSE 50i microscope was used for detailed examination.

At least two pairs from each species were examined to delimit variability of diagnostic characters. For species collected from more than one locality, at least one pair from each locality was examined. Length was measured from the anterior margin of the eye to the elytral apex, and width at the greatest width of the elytra. Descriptions are all based on adult specimens.

Specimens were available for study and deposited in the following institutions:

BPBM Bernice P. Bishop Museum, Hawaii, USA [James Boone];
CAS California Academy of Sciences, California, USA [David H. Kavanaugh];
KMNH Kitakyushu Museum of Natural History and Human History, Kitakyushu, Japan [Yûsuke Minoshima];
KUEC Faculty of Agriculture, Kyushu University, Fukuoka, Japan [Osamu Tadauchi];
NMNS National Museum of Natural Science, Taichung, Taiwan [Jing-Fu Tsai];

OMNH The Osaka Museum of Natural History, Osaka, Japan [Shigehiko Shiyake];
SDEI Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany [Mei-Ling Chan, Jing-Fu Tsai];
SEHU Systematic Entomology, The Hokkaido University Museum, Sapporo, Japan [Masahiro Ôhara];
TARI Taiwan Agricultural Research Institute, Taichung, Taiwan.

Exact label data are cited for all type specimens of previously described species; a double slash (//) divides the data on different labels and a single slash (/) divides the

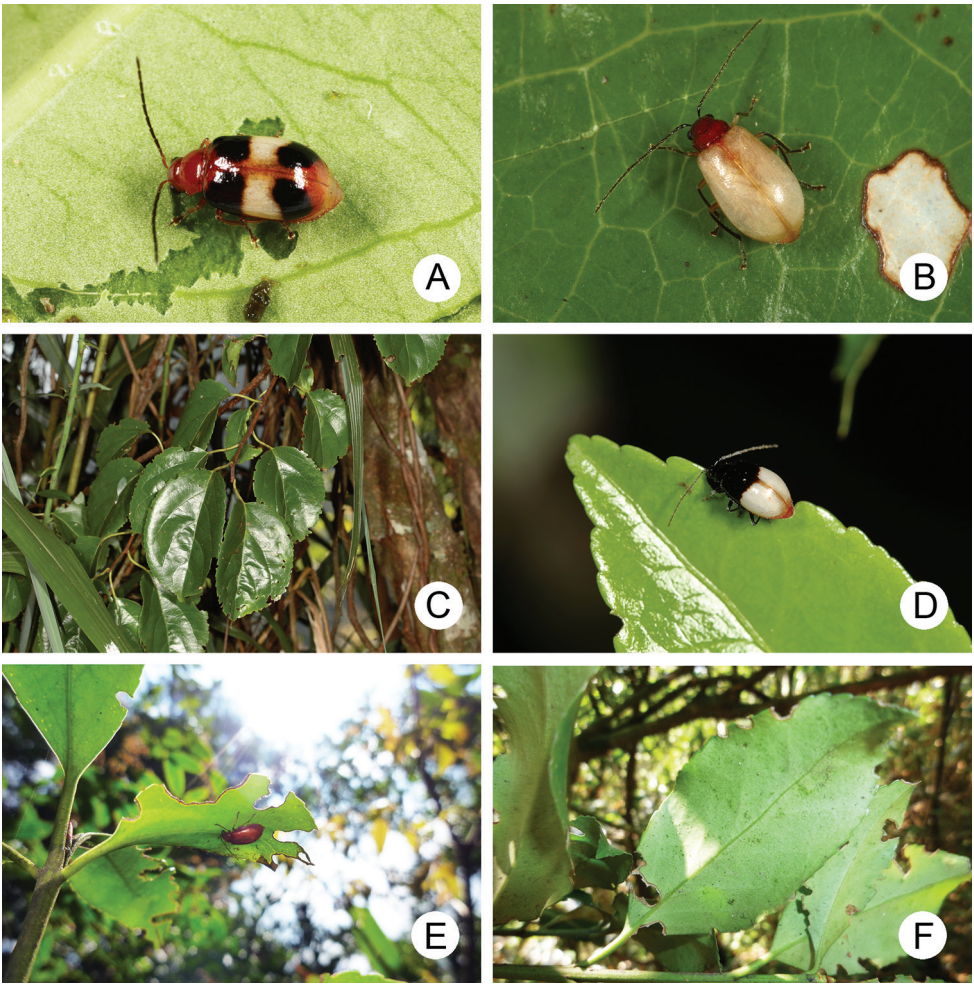

Figure 1. Habitat photographs **A** adult of *Neochya chengi* sp. nov. feeding on leaves of *Celastrus hindsii* **B** adult of *N. hirashimai* **C** *Celastrus kusanoi*, food plant for *Neochya* species **D** adult of *N. nitidissima* feeding on leaves of *Euonymus spraguei* **E** adult of *N. tsoui* resting on underside of leaves of *Euonymus spraguei* **F** *Euonymus spraguei*, food plant for *Neochya* species.

data in different rows. Other comments and remarks are in square brackets: [p] – preceding data are printed, [h] – preceding data are handwritten, [w] – white label, [y] – yellow label, [r] – red label, [b] – blue label.

Taxonomy

Atrachya Chevrolat, 1836

Atrachya Chevrolat, 1836: 401 (type species: *Galleruca menetriesii* Faldermann, 1835, by monotypy).

Iphidea Baly, 1865: 127 (type species: *Iphidea discrepens* Baly, 1865, by original designation) (= *Galleruca menetriesii* Faldermann, 1835. Synonymized by Gressitt and Kimoto (1963)).

Cnecodes Motschulsky, 1858: 99 (type species: *Cnecodes bisignatus* Motschulsky, 1858, by Weise (1892)) (= *Chrysomela bimaculata* Hornested, 1788. Synonymized by Weise (1892)). Synonymized by Wagner and Bieneck (2012).

Examined specimens of *Atrachya menetriesii* (Faldermann, 1835). Japan. Hiroshima: 1♂ (TARI), Mihara-shi, Yahata-cho, Honjo, 28.VI.2013, leg. H. Suenaga; Hokkaido: 1♂ (TARI), Sapporo-shi, Minami-ku, Kannonzawa, 26.VII.2011, leg. H. Suenaga; Okayama: 1♀ (TARI), Maniwa-shi, Hiruzen, Kamitokuyama, 7.VII.2007, leg. H. Suenaga; 1♀ (TARI), Maniwa-shi, Hiruzen, Utsumi-toge, 20.VII.2013, leg. H. Suenaga; Tokushima: 1♀ (TARI), Minokoshi, Tsurugisan, Miyoshi-shi, 22.VII.2007, leg. S. Sejima; Tottori: 1♂ (TARI), Hoki-cho, Iwatate, Masunizu-kogen, 20.VII.2013, leg. H. Suenaga.

Remarks. *Atrachya* is a distinct genus similar to *Paleosepharia* Laboissière (redefined based on type species by Rizki et al. (2016) and Taiwanese species by Lee (2018)) in possessing elongate antennomere III that is much longer than antennomere II (Fig. 3A, B) (both antennomeres subequal in length in *Monolepta*), the presence of a subscutellar impression or groove on the elytra in males (Fig. 2A–C) (absent in those of *Monolepta*). In addition, females of *Atrachya* share some genitalic characters with *Paleosepharia*, including only one pair of bursal sclerites (Fig. 3H), similar shapes of spermatheca (Fig. 3I) and gonocoxae (Fig. 3G). However, members of *Atrachya* differ from those of *Paleosepharia* in having uniform tarsomere I of front legs (sexual dimorphic tarsomere I of front legs in *Paleosepharia*), almost straight apex of penis in lateral view (Fig. 3D) (dorsally curved apex of penis in lateral view in *Paleosepharia*), deeply incised tectum with strong apical hooks (Fig. 3C) (apical tapering tectum or weakly incised tectum without apical hooks in *Paleosepharia*).

Included species. Excluding Taiwanese species, 21 species in the African, Palaearctic, and Oriental regions (Nie et al. 2017). Taxonomic status of species should be reevaluated (see below).

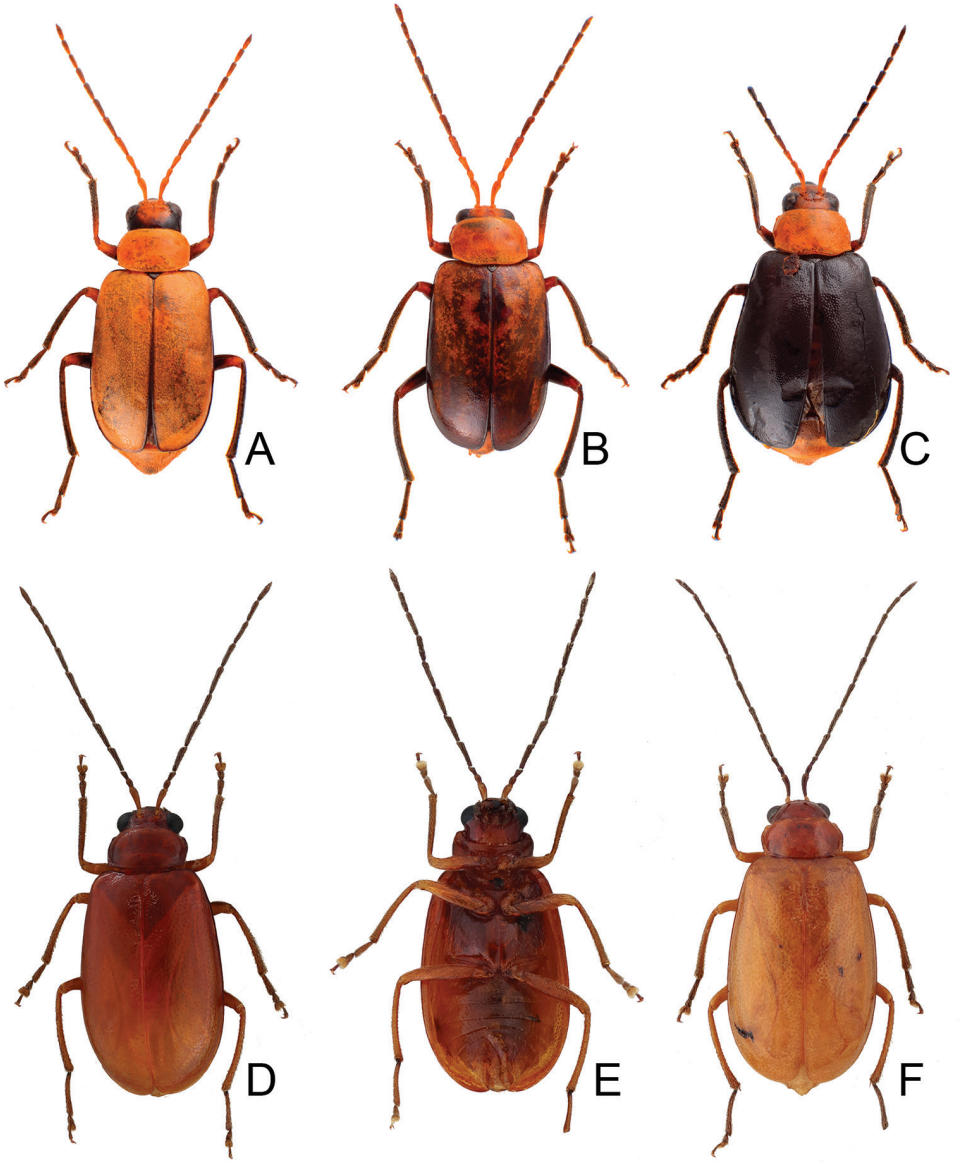

Figure 2. Habitus of *Atrachya menetriesii* and *Neochya tsoui* **A** *A. menetresii*, male, dorsal view **B** same, male, color variation **C** same, female, dorsal view **D** *N. tsoui*, male, dorsal view **E** same, ventral view **F** same, female, dorsal view.

***Neochya* gen. nov.**
http://zoobank.org/A10C4F16-751F-4EC1-B4F0-655AA94D9208

Type species. *Atrachya hirashimai* Kimoto, 1969

Description. ***Coloration*****:** extremely variable but without metallic color. Body length 4.6–7.0 mm.

Head**.** Labrum trapezoidal, transverse, with six pores in transverse row bearing pale setae, anterior margin medially depressed. Anterior part of head very short, almost impunctate and glabrous, several setae on anterior margin of clypeus and anterofrontal ridge. Interantennal space broad, 1.5–2.6× as wide as diameter of antennal insertion. Frontal tubercles transverse, subtriangular, slightly elevated, glabrous. Vertex smooth and glabrous. Antennae slender, covered with dense setae, antennomere II as long as antennomere III; similar in both sexes.

Pronotum 1.75–2.00 times as broad as long, lateral margins slightly rounded, basally narrowed. Disc covered with dense, coarse punctures, moderately or strongly convex, with lateral depressions, except *N. chengi* sp. nov. and *N. nitidissima*. Anterior margin lacking marginal bead, lateral and posterior margins with marginal bead. Anterior and posterior margins without setae, lateral margins with two pairs of setae near base and apex respectively. Anterior angles moderately swollen, rectangular, posterior angles obtuse angulate, all angles with setigerous pore bearing long pale seta.

Scutellum subtriangular, impunctate, glabrous, with rounded apex.

Elytra ca 1.35–1.68 times as long as wide, almost glabrous (with indistinct, sparse, short, pale setae on humeri, lateral margins and apical slopes), parallel sided, except *N. nitidissima* (Fig. 9, broader in middle), covered with densely confused punctures. Humeral calli well developed. Epipleura broad at base, gradually narrowed from basal 1/3, abbreviated near apex (Fig. 19D). Macropterous.

Ventral surface sparsely covered with fine punctures and pale setae. Anterior coxal cavities widely open (Fig. 18D). Prosternal process not visible between procoxae. Abdomen simple, posterior margin of last ventrite with two long incisions in males.

Legs slender**.** All tibiae with one apical spine, the longest spine on metatibia. Protarsomeres I not modified in males. Metatarsomeres I much longer than pro- and mesotarsomeres I, much longer than II and III combined. Claws appendiculate.

Penis broad, with one pair of small lateral processes near apex (Figs 8C–E, 10C–E, 12C–E) (except *N. chengi* sp. nov. (Fig. 5C–E)); tectum broad, apical margin truncate; internal sac with only one type of endophallic spiculae (median endophallic spiculae).

Gonocoxae (Figs 5F, 8F, 10F, 12F) slender, tightly conjunct medially; each gonocoxa with eight setae from near apex to apical 1/6, subapically widened, apex narrowly rounded, base bifurcate. Ventrite VIII (Figs 5G, 8G, 10G, 12G) weakly sclerotized except apex, with several short and long setae at apex, and several long setae at sides, spiculum elongate. Spermathecal receptaculum (Figs 5H, 8H, 10H, 12H) as slender as pump, apically tapering; pump slender and curved; sclerotized spermathecal duct extremely elongate, but base wide, followed by short slender tube with inflated areas. Bursal sclerites reduced.

Diagnosis. *Neochya* gen. nov. differs from *Atrachya* Chevrolat and *Monolepta* Chevrolat in the following combination of characters: antennomere II subequal to III in length (antennomere II much shorter than III in *Atrachya* (Fig. 3A, B)); widely open prothoracic coxal cavities (Fig. 18D) (closed prothoracic coxal cavities in Taiwanese species of *Monolepta*, Fig. 18C); absence of subscutellar impression on the

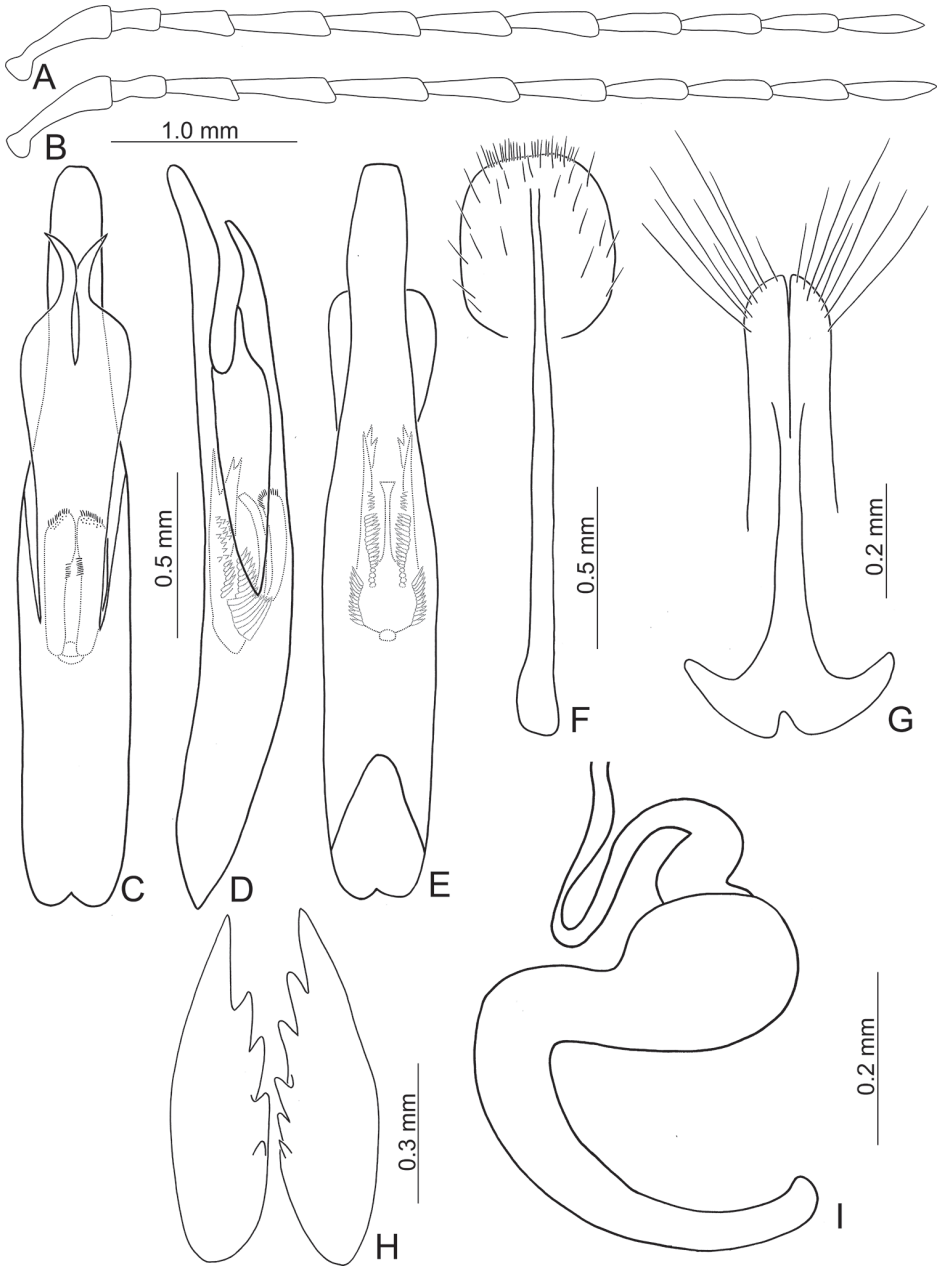

Figure 3. Diagnostic characters of *Atrachya menetriesii* **A** antenna, male **B** antenna, female **C** aedeagus, dorsal view **D** aedeagus, lateral view **E** aedeagus, ventral view **F** abdominal ventrite VIII **G** gonocoxae **H** bursal sclerites **I** spermatheca.

elytra in males (presence of subscutellar impression on the elytra of *Atrachya*); penis with tectum broad and apical margin truncate (Figs 5C, 8C, 10C, 12C) (tectum elongate with apex deeply bifurcate in *Atrachya* (Fig. 3C)), only one type of endophal-

lic spiculae (Figs 5C–E, 8C–E, 10C–E, 12C–E) (three types of endophallic spiculae in *Monolepta*); gonocoxae slender and subapically broadened (Figs 5F, 8F, 10F, 12F) (gonocoxae broad and parallel-sided in *Atrachya* (Fig. 3F)), spermathecae with slender receptaculum as pump (Figs 5H, 8H, 10H, 12H) (greatly swollen receptaculum in *Atrachya* (Fig. 3I)), with apex acute (without acute apex in *Atrachya*); reduced bursal sclerites (well-developed bursal sclerites in *Atrachya* (one pair (Fig. 3H)) and *Monolepta* (two pairs); ventrite VIII with few lateral setae (Figs 5G, 8G, 10G, 12G) (dense lateral setae in *Atrachya* (Fig. 3F)).

Etymology. Composed from new and *Atrachya* to indicate that this is a new genus similar to *Atrachya*.

Included species. *Neochya chengi* sp. nov., *N. hirashimai* (Kimoto), comb. nov., *N. nitidissima* (Chûjô) comb. nov., and *N. tsoui* sp. nov.

Neochya chengi sp. nov.

http://zoobank.org/8B7C01A7-66F1-42AB-B0FD-48833F2D5D96
Figures 4, 5

Types (*N* = 49). ***Holotype*** ♂ (TARI): Taiwan. **Pingtung**: Tahanshan (大漢山), 30.III.2015, leg. I.-L. Lee. ***Paratypes.*** 3♂♂ (TARI), same locality, 7.II.2008, leg. M.-H. Tsau (= Tsou); 1♀ (TARI), same locality, 6.II.2008, leg. S.-F. Yu; 1♀ (TARI), same locality, 6.II.2008, leg. M.-H. Tsou; 1♀ (TARI), same locality, 3.III.2008, leg. C.-F. Lee; 3♂♂, 2♀♀ (TARI), same locality, 22.I.2009, leg. M.-H. Tsou; 1♂, 2♀♀ (TARI), same locality, 24.I.2009, leg. M.-H. Tsou; 1♂, 2♀♀ (TARI), same locality, 21.III.2009, leg. M.-H. Tsou; 2♂♂, 1♀ (TARI), same locality, 5.IV.2009, leg. C.-F. Lee; 1♂, 1♀ (TARI), 15.II.2010, leg. M.-H. Tsou; 1♀ (TARI), same locality, 6.I.2012, leg. Y.-T. Chung; 1♀ (TARI), Chunri (春日), 5.IV.2015, leg. J.-C. Chen; 1♀ (TARI), Kenting (墾丁), 23.VIII.2016, leg. Y.-T. Chung; 2♀♀ (TARI), Lilungshan (里龍山), 10.XI.2009, leg. J.-C. Chen; 1♀ (TARI), same locality, 23.XII.2009, leg. J.-C. Chen; 1♂ (TARI), same locality, 2.III.2012, leg. J.-C. Chen; 2♂♂ (TARI), Nanjenhu (南仁湖), 31.III.2011, leg. J.-C. Chen; 1♂, 2♀♀ (TARI), Shouka (壽卡), 5.II.2008, leg. S.-F. Yu; **Hsinchu**: 1♀ (TARI), Lupi (魯壁), 20.VII.2008, leg. S.-F. Yu; 1♂ (TARI), same locality, 10.III.2009, leg. H. Lee; **Taitung**: 1♀ (TARI), Imalintao (依麻林道), 4.II.2008, leg. M.-H. Tsou; **Yunlin**: 1♂, 11♀♀ (TARI), Chiananyunfeng (嘉南雲峰), 29.IX.2013, leg. W.-C. Liao.

Description. ***Length*** 4.2–5.2 mm, width 2.3–3.0 mm. ***General color*** reddish brown (Fig. 4A–C); antennae blackish brown except two basal antennomeres reddish brown. ***Antennae*** (Fig. 5A) filiform in males, ratio of length of antennomeres I to XI 1.0 : 0.4 : 0.4 : 0.9 : 1.0 : 1.0 : 1.1 : 0.9 : 0.9 : 0.8 : 1.0; ratio of length to width from antennomere I to XI 4.7 : 1.9 : 2.2 : 4.5 : 5.0 : 5.3 : 5.3 : 4.8 : 4.6 : 4.1 : 5.5; a little slender in females, ratio of length of antennomeres I to XI (Fig. 5B) 1.0 : 0.4 : 0.4 : 1.0 : 1.0 : 1.0 : 1.0 : 0.9 : 0.8 : 0.7 : 0.9; ratio of length to width from antennomere I to XI 3.6 : 1.9 : 2.4 : 5.3 : 5.8 : 5.8 : 5.4 : 4.8 : 4.9 : 4.7 : 5.1. ***Pronotum*** 1.73–1.76 times wider than long; lateral margins slightly rounded and basally narrowed, basal margin

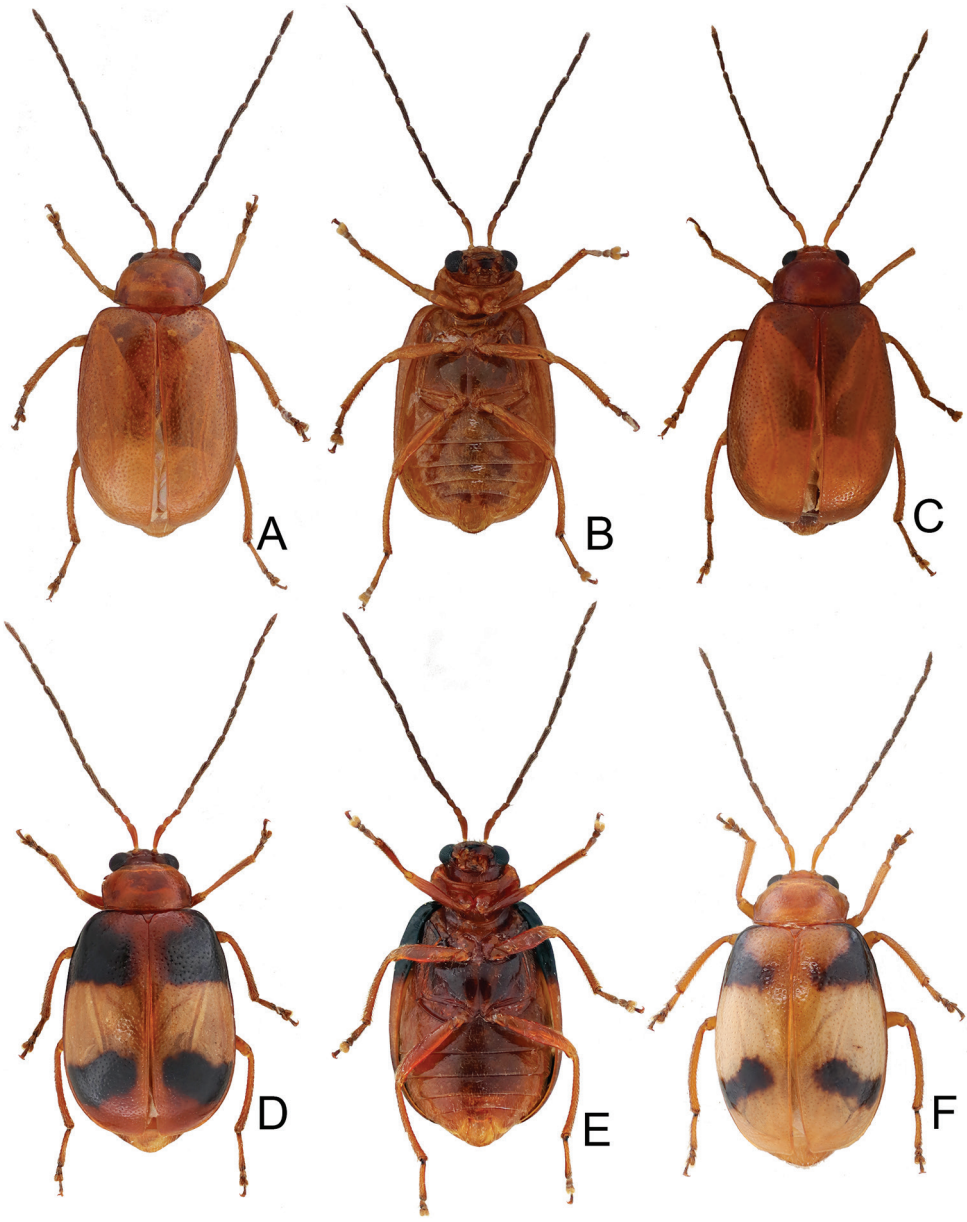

Figure 4. Habitus of *Neochya chengi* sp. nov. **A** male, dorsal view **B** same, color variation **C** female, dorsal view **D** male, from Tahanshan (大漢山), dorsal view **E** same, ventral view **F** female, from Kenting (墾丁), dorsal view.

slightly rounded, apical margin slightly concave; disc with dense coarse punctures, without lateral depressions. ***Elytra*** 1.33–1.42 times longer than wide; parallel sided; disc slightly convex, with dense, coarse punctures; apex truncate. ***Penis*** (Fig. 5C–E)

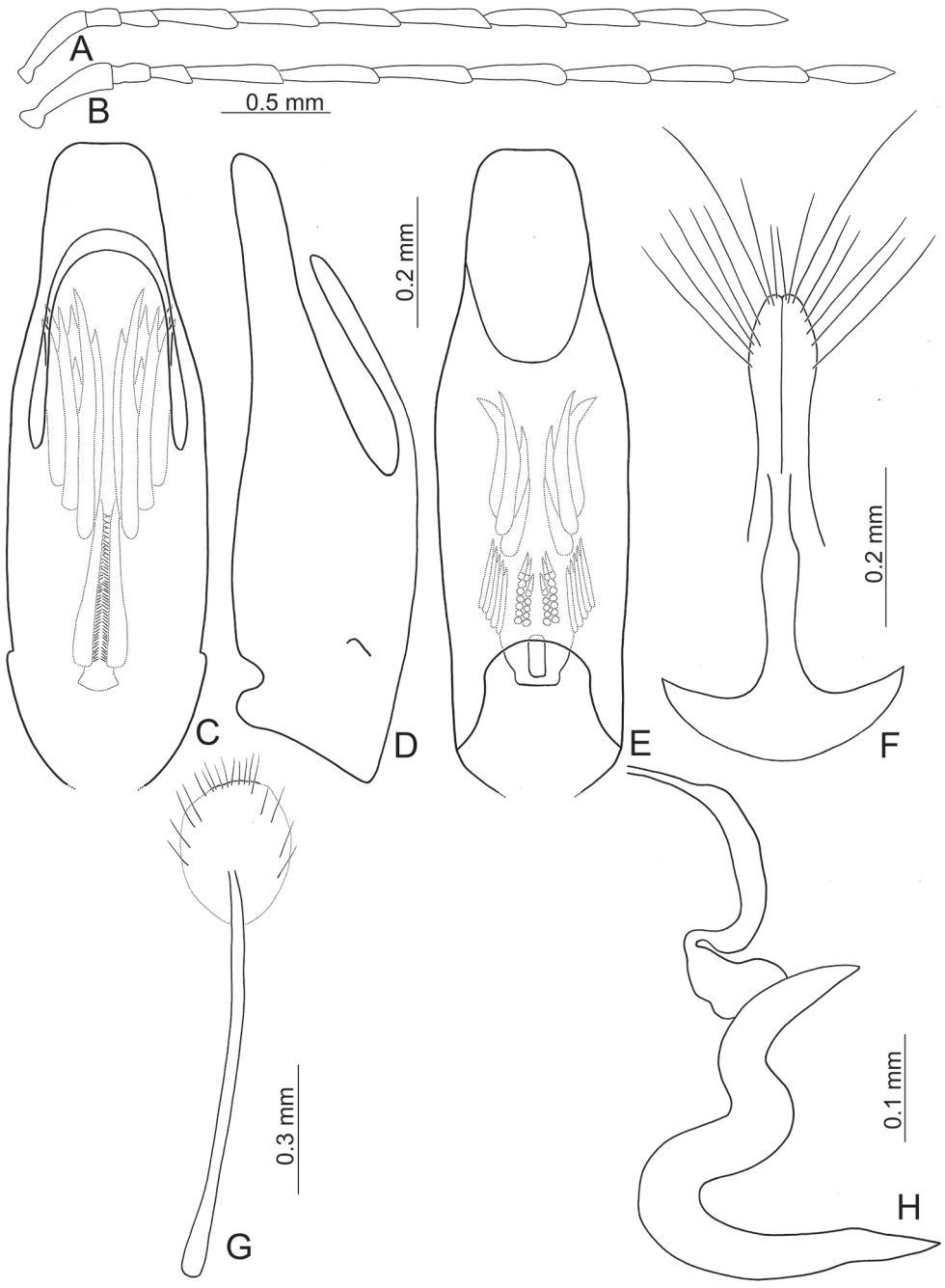

Figure 5. Diagnostic characters of *Neochya chengi* sp. nov. **A** antenna, male **B** antenna, female **C** aedeagus, dorsal view **D** aedeagus, lateral view **E** aedeagus, ventral view **F** gonocoxae **G** abdominal ventrite VIII **H** spermatheca.

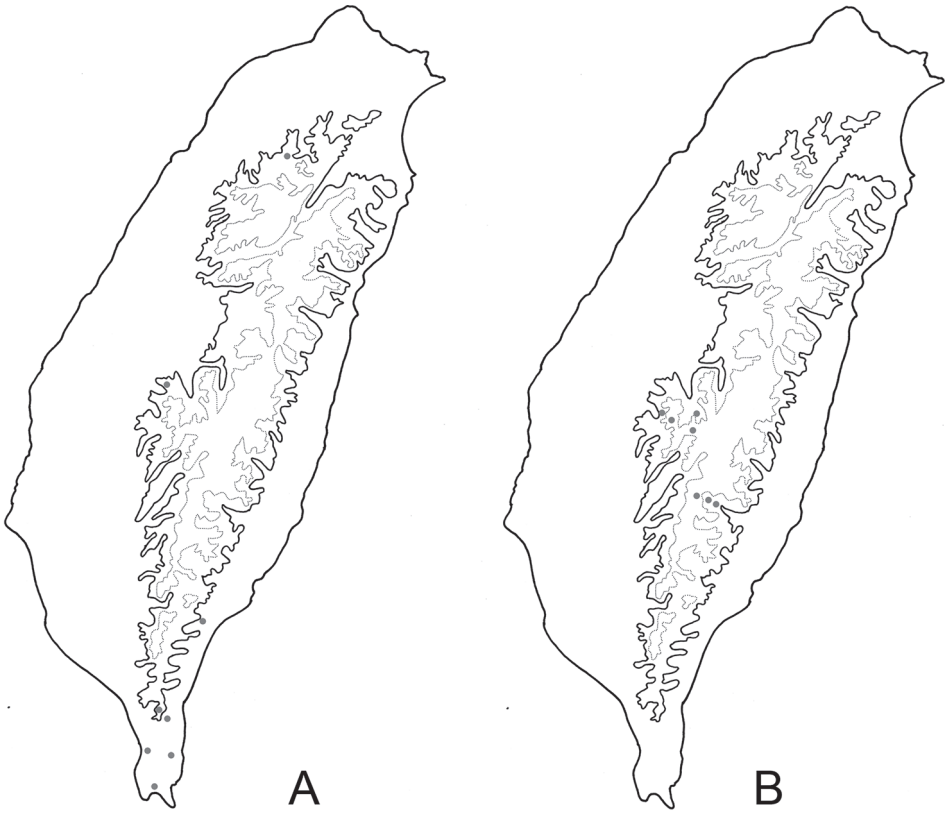

Figure 6. Distribution map of *Neochya* species, solid line: 1000 m, broken line: 2000 m **A** *N. chengi* sp. nov. **B** *N. hirashimai*.

wide, ca. 3.5 times longer than wide; lateral margins parallel from base to middle, then slightly narrowed towards apex, apex broadly rounded; tectum broad from apical 1/6 to middle, apex truncate; slightly and curved at apical 1/3 in lateral view; ventral surface with membranous area from apex to apical 1/3. Endophallic spiculae complex with median endophallic spiculae composed of seven pairs of hooked spiculae, and ventral endophallic spiculae composed of four pairs of hooked spiculae; with one pair of longitudinal rows of hair-like setae and one pair of longitudinal double rows of small stout setae near base. ***Gonocoxae*** (Fig. 5F) slender, tightly conjunct from apex to apical 1/3; each gonocoxa with eight setae from apical 1/6 to apex, subapically widened, apex truncate. ***Ventrite*** VIII (Fig. 5G) weakly sclerotized except apex, with several long setae at apex, and several long setae at sides, spiculum elongate. ***Spermathecal receptaculum*** (Fig. 5H) as slender as pump, apically tapering; pump slender and curved; sclerotized spermathecal duct extremely elongate, but base extremely wide, followed by very short slender tube, then followed with inflated areas. Bursal sclerites reduced.

Variation. Most of specimens from Tahanshan have a distinct color pattern on elytra (Fig. 4D, E): with two pairs of transverse, wide black bands, running from lateral margins, abbreviated before suture, anterior pair near base, posterior pair at apical 1/3 an oblique; with one transverse, broad white band at middle. One specimen from Kenting has much narrower black bands on the elytra (Fig. 4F).

Diagnosis. *Neochya chengi* sp. nov. is similar to *N. nitidissima* (Chûjô) in having wide elytra, truncate elytral apices and reduced lateral depressions on the pronotum (Figs 4, 9) (narrow elytra, rounded elytra apices and with lateral depression on the pronotum in others (Figs 2D–F, 7) but it differs from *N. nitidissima* in paralle sided elytra and having coarse punctures on pronotum and elytra (Fig. 4) (rounded elytra and reduced punctures on pronotum and fine punctures on elytra in *N. nitidissima* (Fig. 9)), and parallel sided elytra (rounded elytra in *N. nitidissima*). In addition, males of both species are separated from others with smooth margin of tectum of the penis (Figs 5C, 10C) (serrate margin of tectum (Figs 8C, 12C), but males of *N. chengi* differs from those of *N. nitidissima* with absence of small rounded process on lateral margin of the penis (Fig. 5C–E) (with small rounded process on lateral margin of the penis in *N. nitidissima* (Fig. 10C–E)

Food plants. Celastraceae: *Celastrus hindsii* Benth (Fig. 1A), *C. kusanoi* Hayata.

Etymology. It is named after Mr. Hsing-Tzung Cheng who was a member of the TCRT and an editor for a series of the books entitled "The Chrysomelidae of Taiwan". The gender is feminine.

Distribution. Widespread but scattered in Taiwan (Fig. 6A).

Neochya hirashimai **(Kimoto), comb. nov.**
Figures 7, 8

Atrachya hirashimai Kimoto, 1969: 54; Kimoto 1989: 257.

Types. ***Holotype*** ♂ (KUEC): "(Taiwan) / Alishan, 2300m / Chiayi Hisen [p, w] // 9 [h].IV.1965 / Y. Hirashima [p, w] // Japan –U. S. / Co-op. Sci. / Programme [p, y] // Atrachya / hirashimai / Kimoto, n. sp. [h, w] // HOLOTYPE [p, r]. ***Paratypes*****:** 1♂ (KMNH), same data as holotype but with "PARATOPOTYPE [p, b]"; 1♂ (KMNH): "(Taiwan) / Fenchihu (奮起湖), 1400 m / Chiayi Hsien [p, w] // 12[h].IV.1965 / T. Shirôzu [p, w] // Japan –U. S. / Co-op. Sci. / Programme [p, y] // Atrachya / hirashimai / Kimoto, n. sp. [h, w] // PARATYPE [p, b]".

Other material (*N* = 81). Chiayi: 4♂♂, 4♀♀ (TARI), Alishan (阿里山), 12.V.2011, leg. C.-F. Lee; 2♂♂, 1♀ (TARI), Shihshan catchwater, 23.XI.2013, leg. W.-C. Liao; 3♂♂, 3♀♀ (TARI), same locality, 21.I.2017, leg. W.-C. Liao; **Nantou:** 1♀ (TARI), Tatachia (塔塔加), 15–22.IV.2007, leg. C.-S. Tung; 1♀ (TARI), same locality, 9.VI.2009, leg. C.-F. Lee; 9♂♂, 3♀♀ (TARI), same locality, 30.X.2009, leg. C.-F. Lee; 2♂♂ (TARI), same locality, 29–30.XII.2009, leg. H. Lee, M.-H. Tsou, H. Lee; 8♂♂, 6♀♀ (TARI), same locality, 27.IV.2010, leg. C.-F. Lee; 5♂♂, 6♀♀

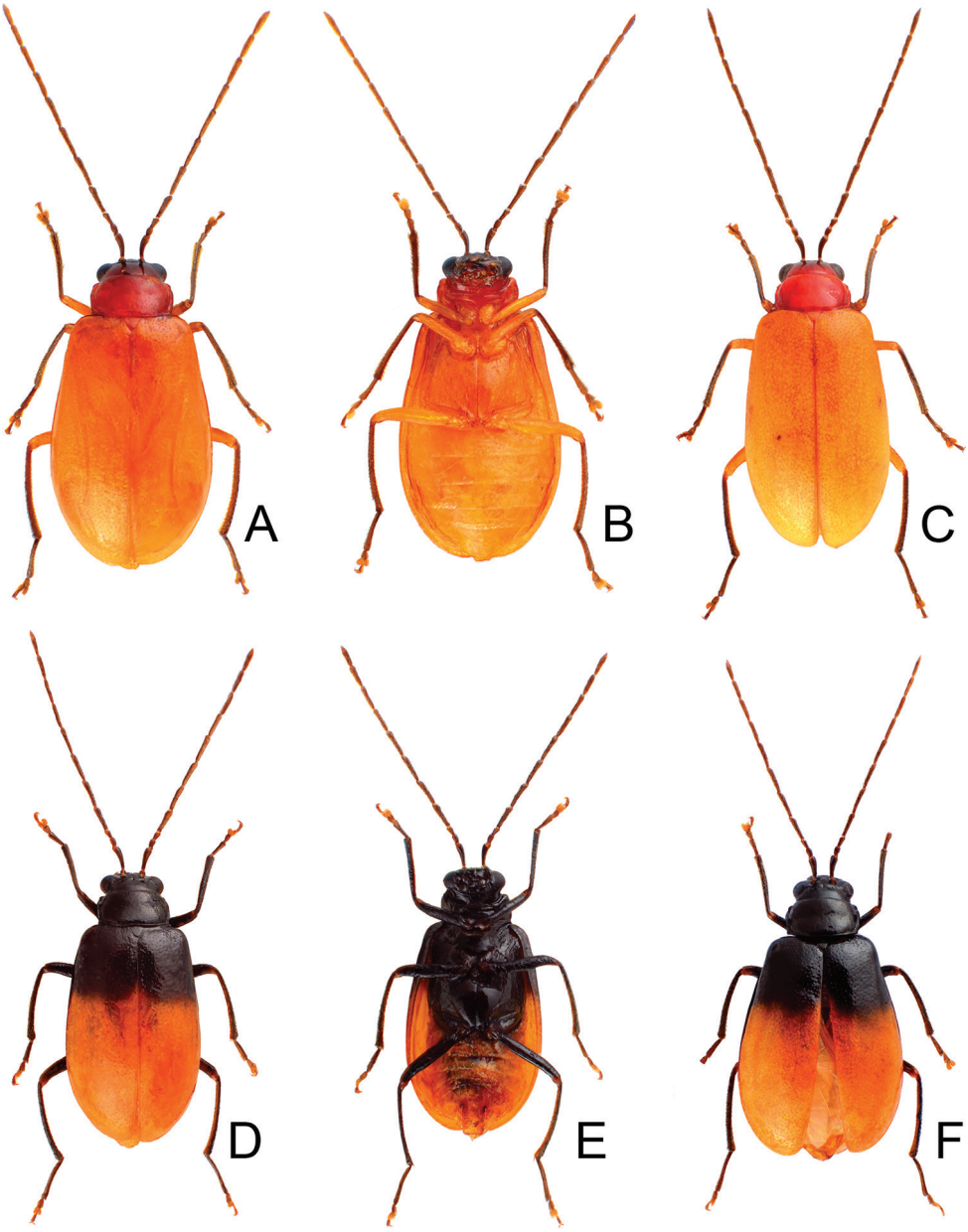

Figure 7. Habitus of and *Neochya hirashimai* **A** male, from Tatachia (塔塔加), dorsal view **B** same, ventral view **C** female, from Tatachia (塔塔加), dorsal view **D** male, from Liyuan (栗園), dorsal view **E** same, ventral view **F** female, from Liyuan (栗園), dorsal view.

(TARI), same locality, 16–17.V.2010, leg. C.-F. Lee & M.-H. Tsou; 2♂♂, 4♀♀ (TARI), same locality, 8–9.V.2011, leg. C.-F. Lee & M-H. Tsou; 1♀ (TARI), Tungpu (東埔), 8.V.2015, leg. J.-C. Chen; **Taitung**: 2♂♂, 1♀ (TARI), Hsiangyang (向陽),

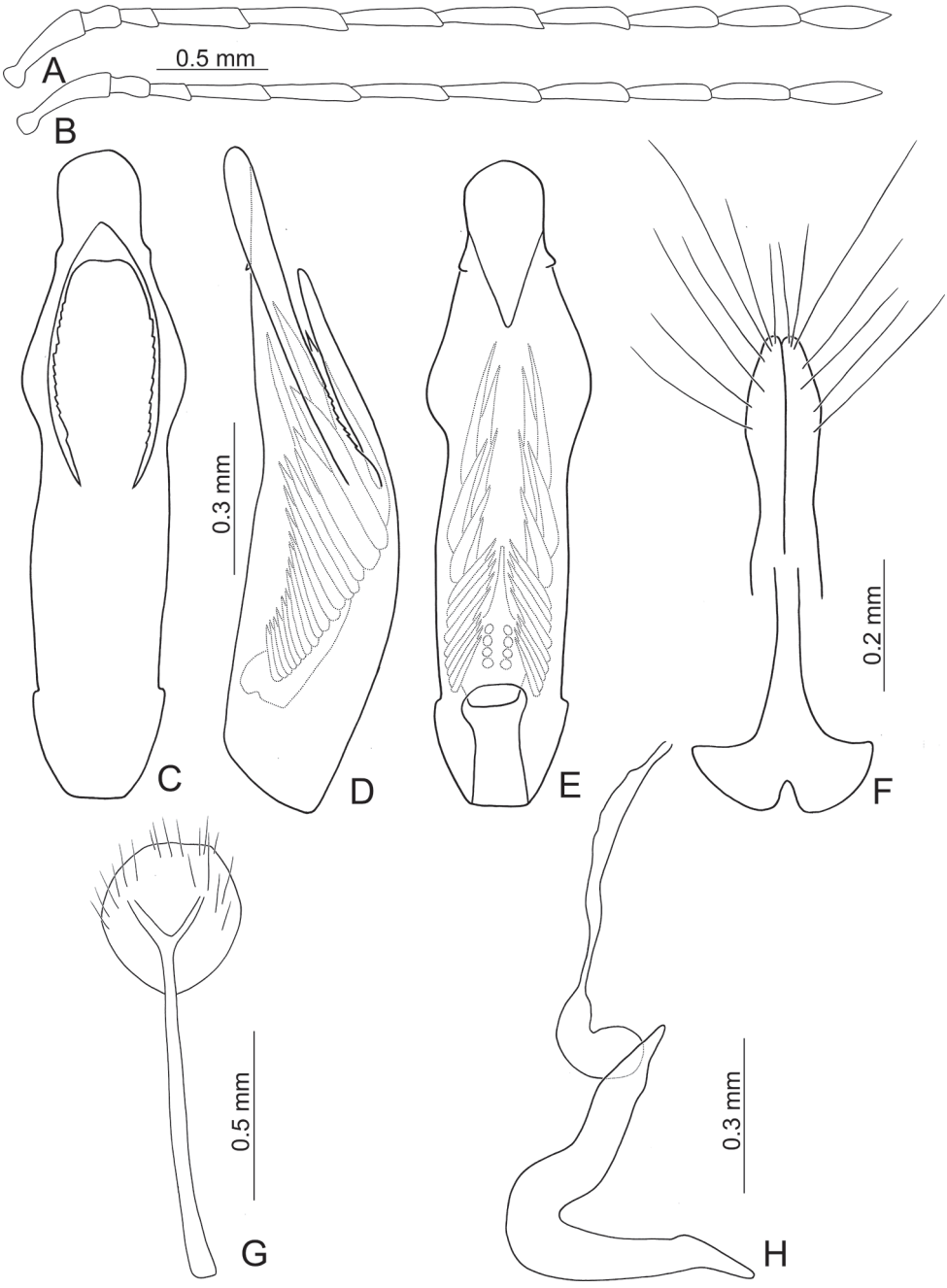

Figure 8. Diagnostic characters of *Neochya hirashimai* **A** antenna, male **B** antenna, female **C** aedeagus, dorsal view **D** aedeagus, lateral view **E** aedeagus, ventral view **F** gonocoxae **G** abdominal ventrite VIII **H** spermatheca.

5.IV.2012, leg. J.-C. Chen; 1♀ (TARI), same locality, 3.VII.2014, leg. J.-C. Chen; 4♂♂, 4♀♀ (TARI), Liyuan (栗園), 23.V.2011, leg. C.-F. Lee; 1♂, 3♀♀ (TARI), Motien (摩天), 19.VI.2011, leg. C.-F. Lee.

Redescription. ***Length*** 5.1–6.2 mm, width 2.4–3.1 mm. ***General colo***r yellowish brown (Fig. 7A–C); prothorax and head reddish brown, but anterior portion of head darker; antennae, tibiae, and tarsi black. ***Antennae*** (Fig. 8A) filiform in males, ratio of length of antennomeres I to XI 1.0 : 0.4 : 0.4 : 1.0 : 1.1 : 1.1 : 1.1 : 1.0 : 1.0 : 0.9 : 1.0; ratio of length to width from antennomere I to XI 3.6 : 1.7 : 1.8 : 4.5 : 5.1 : 5.3 : 5.3 : 4.7 : 4.5 : 4.1 : 4.4; slender in females, ratio of length of antennomeres I to XI (Fig. 8B) 1.0 : 0.4 : 0.4 : 0.8 : 1.0 : 0.9 : 1.0 : 0.8 : 0.8 : 0.8 : 0.9; ratio of length to width from antennomere I to XI 4.2 : 2.0 : 2.4 : 4.7 : 5.7 : 5.5 : 5.7 : 5.1 : 5.2 : 5.2 : 3.9. ***Pronotum*** 1.92–2.00 times wider than long; lateral margins straight and basally narrowed, basal margin slightly rounded, apical margin slightly concave; disc with dense coarse punctures, with lateral depressions. ***Elytra*** 1.57–1.68 times longer than wide; lateral margins widest at apical 1/3; disc slightly convex, with dense, coarse punctures; apex rounded. ***Penis*** (Fig. 8C–E) wide, ca. 4.0 times longer than wide; lateral margins parallel from base to middle, then strongly broadened, widest at apical 1/3; apex broadly rounded; tectum elongate from apical 1/6 to middle, lateral margins slightly rounded and toothed, apex truncate but medially depressed; weakly curved in middle in lateral view; ventral surface with membranous area from apex to apical 1/4; with one small rounded process on lateral margin at apical 1/6. Endophallic spiculae complex, with five or six pairs of hooked spiculae; with one pair of longitudinal rows of hair-like setae and small rounded sclerites near base. ***Gonocoxae*** (Fig. 8F) slender, tightly conjunct from apex to middle; each gonocoxa with eight setae from apical 1/6 to apex, subapically widened, apex narrowly rounded, base shallowly bifurcate. ***Ventrite*** VIII (Fig. 8G) weakly sclerotized except apex, with several long setae at apex, and several long setae at sides, spiculum elongate. ***Spermathecal receptaculum*** (Fig. 8H) as slender as pump, apically tapering; pump slender and curved; sclerotized spermathecal duct extremely elongate, but base extremely wide, followed by slender tube, then with inflated areas. Bursal sclerites reduced.

Variation. A distinct color pattern occurs in beetles from the east part of South Cross-Island Highway (南橫公路): general color black; but apical 3/4 of elytra and abdomen yellowish brown (Fig. 7C–E).

Diagnosis. *Neochya hirashimai* (Kimoto) is similar to *N. tsoui* sp. nov. in having slender elytra and lateral depressions on the pronotum (Figs 2D–F, 7) (wide elytra and lacking lateral depressions on the prnotum in others (Figs 4, 9), but differs from *N. tsoui* sp. nov. in having reddish brown pronotum and yellowish brown elytra, or black pronotum, black basal half and yellowish brown apical half of elytra (Fig. 7) (reddish brown pronotum and elytra in *N. tsoui* sp. nov. (Fig. 2D–F)). In addition, males of both species are separated from others with serrate margin of tectum of the penis (Figs 8C, 12C) (smooth margin of tectum (Figs 5C, 10C), but males of *N. hirashimai*

differs from those of *N. tsoui* with the penis widest at middle (Fig. 8C, E) (penis widest at apical 2/5 in *N. nitidissima* (Fig. 12C, E).

Food plants. Celastraceae: *Celastrus kusanoi* Hayata (Fig. 1B, C), *C. punctatus* Thunb.

Distribution. Restricted to several places in central Taiwan. Two color patterns are separated in the eastern and western parts of the range (Fig. 6B).

***Neochya nitidissima* (Chûjô, 1935), comb. nov.**
Figures 9, 10

Luperodes nitidissimus Chûjô, 1935: 161; Chûjô 1962: 228.
Atrachya nitidissimus: Kimoto, 1966: 30 (additional records); Kimoto 1969: 55(additional records).
Luperodes bicoloripennis Chûjô, 1938: 138; Chûjô 1962: 227 (redescription). syn. nov.
Atrachya bicoloripennis: Kimoto, 1969: 55: (additional records); Kimoto 1986: 58 (additional records); Kimoto 1987: 190 (additional records).
Atrachya bicolor [sic!]: Kimoto, 1989: 257 (additional records).
Luperodes saramao Chûjô, 1962: 230. syn. nov.
Atrachya saramao: Kimoto, 1989: 257 (additional records).

Types. *Luperodes nitidissimus*. ***Holotype*** ♀ (SDEI): "Kankau (Koshun = 恆春) / Formosa / H. Sauter V. 1912 [p, w] // Luperodes / nitidissimus / Chûjô [h] / DET. M. CHUJO [b, w] // Holotype [p, w, red letters]". ***Paratypes.*** 1♀ (TARI): "Formosa / Koshun, 1918 / IV 25–V 28 / J. Sonan, [p, w] // Allotype [h, w, red letters] // Luperodes / nitidissimus / Chûjô [h] / DET. M. CHUJO [b, w] // 2966 [p, w]"; 1♀ (TARI): "Formosa / Koshun, 1918 / IV 25–V 28 / J. Sonan, [p, w] // Paratype [h, w, red letters] // Luperodes / nitidissimus / Chûjô [h] / DET. M. CHUJO [b, w] // 2967 [p, w]".

Luperodes bicoloripennis. ***Lectotype*** ♂ (TARI, here designated): "Arisan (阿里山) / FORMOSA/ 24–25.V.1933 / Col. M. CHUJO [p, w] // CO / Type [p, w, circular label with yellow letters] // Luperodes / bicoloripennis / Chûjô [h] / DET. M. CHUJO [b, w] // 1383 [p, w]". ***Paralectotypes*:** 1♀ (TARI), same data as holotype but with "1382"; 1♂ (TARI): "Arisan [h] / FORMOSA [p] / 22.X.1931 [h] / COL. M. CHUJO [p, w] // CO / Type [p, w, circular label with yellow letters] // Luperodes / bicoloripennis / Chûjô [h] / DET. M. CHUJO [b, w] // 1381 [p, w]"; 1♀ (TARI), same but with "1373"; 1♂ (SDEI): "Arisan / FORMOSA / 24–25.V.1933 / COL. M. CHUJO [p, w] // Luperodes / bicoloripennis / Chûjô [h] / DET. M. CHUJO [b, w] // Syntypus [p, r]" 1♀ (SDEI), same but with "25.V.1933 [p]"; 1 (TARI, sex undetermined, abdomen lost): "ARISAN / XII.1915 [h] / Coll. M. Maki [p, w] // CO / Type [p, w, circular label with yellow letters] // Luperodes / bicoloripennis / Chûjô [h] / DET. M. CHUJO [b, w] // 1493 [p, w]"; 1♂ (TARI): "Formosa / Musha (霧社), 1919 / V 18–VI 15. / T. Okuni, [p, w] // CO / Type [p, w, circular label with yellow letters] // Luperodes / bicoloripennis / Chûjô [h] / DET. M. CHUJO [b, w] // 2587 [p, w]"; 1♀ (TARI), same but with "1492". One specimen (♀, TARI) bearing type

label: "Jujiro (十字路, in Chiayi) / 26-IV 1931 / Col. T. Shiraki [p, w] // CO / Type [p, w, circular label with yellow letters] // Luperodes / bicoloripennis / Chûjô [h] / DET. M. CHUJO [b, w] // 1494 [p, w]". It cannot be included in the type series since the data did not appear in the original description (Chûjô 1938).

Luperodes saramao. ***Holotype*** ♂ (KUEC): "13 VIII 1936 / Mururoahu (給里洛山 =見晴山) / --- Kussya (庫霞 = 大同) / TAIHEIZAN (太平山) [p, pink label] // Luperodes / saramao / Chûjô [h, w] // Holotype [h, r]".

Other material. Form A (*N* = 84). Chiayi: 1♂, 1♀ (TARI), Alishan (阿里山), 12.V.2011, leg. C.-F. Lee; 1♀ (TARI), same locality, 29.V.2016, leg. B.-X. Guo; 5♂♂, 1♀ (TARI), Shihshan channel (石山引水道), 23.XI.2013, leg. W.-C. Liao; 1♂, 2♀♀ (TARI), same locality, 21.I.2017, leg. W.-C. Liao; 8♂♂, 8♀♀ (TARI), Tzuchung (自忠), 21.IX.2009, leg. C.-F. Lee; **Kaohsiung**: 1♂ (TARI), Tienchih (天池), 17.V.2015, leg. B.-X. Guo; **Nantou**: 2♂♂ (TARI), Fenghuangshan (鳳凰山), 10.V.2010, leg. Y.-T. Wang; 2♂♂ (TARI), Hsitou (溪頭), 6.V.2009, leg. C.-F. Lee; 1♂ (NMNS), Shanlinchi (杉林溪), 10.V.1990, leg. C.-C. Chiang; 2♀♀ (NMNS), same locality, 19.V.1991, leg. C.-C. Chiang; 2♂♂, 3♀♀ (TARI), Tatachia (塔塔加), 9.VI.2009, leg. C.-F. Lee; 1♂, 1♀ (TARI), same locality, 21.VII.2009, leg. S.-F. Yu; 1♂, 1♀ (TARI), same locality, 21.IX.2009, leg. C.-F. Lee; 2♂♂ (TARI), same locality, 29.X.2009, leg. H. Lee; 1♂, 1♀ (TARI), same locality, 30.X.2009, leg. C.-F. Lee; 1♂, 2♀♀ (TARI), same locality, 17.XI.2009, leg. C.-F. Lee; 2♀♀ (TARI), same locality, 29.XII.2009, leg. M.-H. Tsou; 4♂♂, 4♀♀ (TARI), same locality, 17.XI.2009, leg. C.-F. Lee; 3♂♂ (TARI), same locality, 27.IV.2010, leg. C.-F. Lee; 1♂, 1♀ (TARI), same locality, 17.V.2010, leg. M.-H. Tsou; 2♂♂ (TARI), same locality, 13.VII.2014, leg. W.-C. Liao; **Taichung**: 1♂ (TARI), Anmashan (鞍馬山), 6–9.VII.1979, leg. L.-Y. Chou; 1♂ (TARI), same locality, 18.X.2008, leg. H. Lee; 2♂♂ (TARI), same locality, 15.X.2009, leg. J.-C. Chen; 1♀ (TARI), same locality, 7.VI.2010, leg. C.-F. Lee.

Form B (*N* = 255). Hsinchu: 1♀ (TARI), Kuanwu (觀霧), 30.IV.2009, leg. Y.-F. Hsu; 1♀ (TARI), same locality, 19.VIII.2009, leg. Y.-F. Hsu; 1♂ (TARI), same locality, 5.XI.2009, leg. H. Lee; 27♂♂, 7♀♀ (TARI), same locality, 30.IV.–1.V.2010, leg. C.-F. Lee & M.-H. Tsou; 1♂ (TARI), 3.VI.2011, leg. S.-F. Yu; 1♂ (TARI), Talulintao (大鹿林道), 17.II.2008, leg. M.-H. Tsou; 1♀ (TARI), same locality, 25.III.2009, leg. Y.-L. Lin; 2♂♂, 1♀ (TARI), same locality, 23.VI.2016, leg. Y.-L. Lin; **Hualien**: 2♂♂, 2♀♀ (TARI), Tayuling (大禹嶺), 2.VI.2016, leg. Y.-T. Chung; **Miaoli**: 1♂, 1♀ (TARI), Hsuehchien (雪見), 7.VI.2013, leg. W.-B. Yeh; 4♂♂ (TARI), Leshan (樂山), 14.VIII.2010, leg. H.-J. Chen; **Nantou**: 5♂♂, 3♀♀ (TARI), Huakung (華岡), 12.–13.IX.2010, leg. C.-F. Lee; 1♂ (TARI), same locality, 17.VI.2016, leg. J.-C. Chen; 1♂ (TARI), Lienhuachi (連華池), 23.–26.V.1980, leg. K.-S. Lin & B.-H. Chen; 3♂♂, 2♀♀ (TARI), Meifeng (梅峰), 10.V.1979, leg. K.-C. Chou; 2♂♂, 4♀♀ (TARI), same locality, 20.–22.VI.1979, leg. K.-S. Lin & B.-H. Chen; 1♂ (TARI), same locality, 23.V.–3.VI.1979; 1♀ (TARI), same locality, 18.VII.1979, leg. K.-C. Chou; 1♀ (TARI), same locality, 2.–12.X.1979; 1♂ (TARI), same locality, 24.X.1979, leg. K.-C. Chou; 1♂, 1♀ (TARI), same locality, 2.–4.VI.1980, leg. L.-Y. Chou & C.-C. Chen; 1♂, 1♀ (TARI), same locality, 5.–8.VI.1980, leg. C.-C. Chen; 2♂♂, 4♀♀

(TARI), same locality, 8.VI.1980, leg. K.-S. Lin & B.-H. Chen; 1♀ (TARI), same locality, 9.–16.VI.1980, leg. K.-S. Lin & B.-H. Chen; 6♂♂, 3♀♀ (TARI), same locality, 22.V.1982, leg. L.-Y. Chou; 3♂♂, 2♀♀ (TARI), same locality, 4.–7.X.1982, leg. K.-C. Chou; 1♂, 1♀ (TARI), same locality, 19–21.IV.1983, leg. K.-C. Chou & S.-P. Huang; 1♀ (TARI), same locality, 30.VII.1983, leg. L.-Y. Chou; 1♀ (TARI), same locality, 8.-11.V.1984, leg. K.-C. Chou & C.-C. Pan; 1♂ (TARI), same locality, 23.VII.1984, leg. K.-S. Lin; 1♀ (NMNS), same locality, 3.-15.X.1990, leg. C. K. Starr; 2♂♂ (NMNS), same locality, 27.II.1992, leg. Y.-C. Shiau; 1♀ (NMNS), same locality, 6.VIII.–11.IX.2001, leg. C.-S. Lin & W.-T. Yang; 5♀♀ (NMNS), same locality, 15.IV.–7.V.2003, leg. C.-S. Lin & W.-T. Yang; 2♀♀ (NMNS), same locality, 7.V.–11.VI.2003, leg. C.-S. Lin & W.-T. Yang; 1♂ (NMNS), same locality, 4.XI.–15.XII.2003, leg. C.-S. Lin & W.-T. Wang; 1♀ (NMNS), same locality, 6.IV.–11.V.2004, leg. C.-S. Lin & W.-T. Yang; 1♀ (NMNS), same locality, 5.X.–16.XI.2004, leg. C.-S. Lin & W.-T. Yang; 1♀ (NMNS), same locality, 12.IV.3.V.2005, leg. C.-S. Lin & W.-T. Yang; 1♀ (NMNS), same locality, 20.II.2009, leg. M.-L. Chan; 1♀ (TARI), same locality, 18.V.2009, leg. M.-H. Tsou; 2♀♀ (TARI), same locality, 15.IX.2009, leg. H. Lee; 2♀♀ (TARI), same locality, 15.IX.2009, leg. S.-F. Yu; 1♀ (TARI), same locality, 17.VI.2010, leg. C.-F. Lee; 2♂♂, 3♀♀ (TARI), same locality, 20.IV.2011, leg. C.-F. Lee; 1♂ (TARI), same locality, 30.V.2011, leg. M.-H. Tsou; 25♂♂, 18♀♀ (TARI), Peitungyanshan (北東眼山), 16.IX.2013, leg. F.-S. Huang; 2♀♀ (TARI), same locality, 28.III.2014, leg. F.-S. Huang; 3♂♂ (TARI), same locality, 14.IV.2014, leg. C.-F. Lee; 1♀ (NMNS), Piluchi (碧綠溪), 4.XII.1991, leg. Y.-C. Shiau; 1♂ (NMNS), same locality, 15.–31.III.1998, leg. M.-M. Yang; 3♂♂, 3♀♀ (TARI), Sungkang (松崗), 15.-17.VIII.1984, leg. K.-C. Chou; 1♂ (TARI), same locality, 18.IV.2015, leg. B.-X. Guo; 1♂, 1♀ (TARI), same locality, 10.IV.2016, leg. Y.-T. Chung; 1♂ (TARI), same locality, 2.VI.2016, leg. B.-X. Guo; 1♂, 3♀♀ (TARI), Tsuifeng (翠峰), IV.1984, leg. K.-S. Lin & K.-C. Chou; 1♂ (NMNS), Tunyuan (屯原), 29.IV.1992, leg. W.-T. Yang; 4♂♂, 1♀ (TARI), same locality, 18.X.2011, leg. J.-C. Chen; 1♂ (TARI), same locality, 30.IV.2017, leg. Y.-F. Hsu; 1♂ (NMNS), Yuanfeng (鳶峰), 5.VII.–2.VIII.2005, leg. C.-S. Lin & W.-T. Yang; **Taichung**: 9♂♂, 9♀♀ (TARI), Anmashan (鞍馬山), 6.–9.VII.1979, leg. L.-Y. Chou; 1♀ (NMNS), same locality, 1.V.1990, leg. C.-C. Chiang; 2♂♂ (NMNS), same locality, 3.V.1992, leg. C.-Y. Li; 1♂, 1♀ (NMNS), 22.IV.1998, leg. M.-M. Yang & H.-T. Chan; 1♀ (TARI), same locality, 16.VII.2007, leg. M.-H. Tsou; 1♀ (TARI), same locality, 7.VI.2010, leg. C.-F. Lee; 1♂ (TARI), same locality, 23.VII.2011, leg. J.-C. Chen; 9♂♂, 10♀♀ (TARI), Fushoushan (福壽山), 3.V.2016, leg. J.-C. Chen; 1♀ (NMNS), Nanhushi (南湖溪), 10.–11.VI.1988, leg. K.-W. Huang; 1♂ (TARI), Pilu (畢祿), 22.IV.2015, leg. C.-F. Lee; 1♀ (TARI), Wuleng (武陵), 27.–29.VI.1979, leg. K.-S. Lin & L.-Y. Chou; 1♂ (TARI), same locality, 6.IV.2014, leg. J.-C. Chen; 1♂ (TARI), same locality, 15.VIII.2014, leg. M.-H. Tsou.

Form C (*N* = 85). Hsinchu: 1♂ (TARI), Sumakusu (司馬庫斯), 26.IX.2009, leg. H.-J. Chen; **Hualien:** 1♀ (TARI), Kuanyuan (關原), 7.V.2006, leg. Y.-F. Hsu; 1♀ (TARI), same locality, 2.VII.2008, leg. M.-H. Tsou; 1♂, 2♀♀ (TARI), same locality, 2.VI.2016, leg. Y.-T. Chung & B.-X. Guo; 1♂ (NMNS), Kuanyun (觀雲), 13.V.2005,

leg. J.-H. Chen; 1♂ (TARI), same locality, 19.VI.2010, leg. W.-P. Chan; 1♀ (TARI), Pilu (碧綠), 9.VII.2009, leg. C.-F. Lee; 1♀ (TARI), same locality, 10.IV.2014, leg. C.-F. Lee; 1♂ (TARI), same locality, 13.VI.2014, leg. C.-F. Lee; 1♀ (TARI), same locality, 23.IV.2015, leg. C.-F. Lee; 1♂ (TARI), same locality, 14.V.2015, leg. J.-C. Chen; 1♂, 1♀ (TARI), same locality, 7.VII.2015, leg. C.-F. Lee; 1♀ (TARI), same locality, 22.VII.2015, leg. U. Ong; 1♂, 2♀♀ (TARI), Sungyuan (松苑), 19.V.2018, leg. H.-F. Lu; 1♂ (TARI), Tayuling (大禹嶺), 6.–9.IX.1983, leg. L.-Y. Chou & K.-C. Chou; **Kaohsiung**: 2♀♀ (TARI), Chungchihkuan (中之關), 16.IV.2012, leg. L.-P. Hsu; 1♀ (TARI), same locality, 12.X.-6.XII.2012, leg. L.-P. Hsu; 1♂, 1♀ (TARI), same locality, 31.VII.2015, leg. C.-F. Lee; 1♂ (TARI), Tengchih (藤枝), 2.–5.VI.2008, leg. C.-F. Lee; 1♀ (TARI), same locality, 7.–10.XI.2008, leg. C.-T. Yao; 1♀ (TARI), same locality, 6.II.2009, leg. S.-F. Yu; 1♀ (TARI), same locality, 23.III.2009, leg. H. Lee; 1♀ (TARI), 26.V.2009, leg. C.-F. Lee; 1♀ (TARI), same locality, 6.VIII.2013, leg. B.-X. Guo; 1♀ (TARI), same locality, 8.III.2014, leg. W.-C. Liao; 3♂♂, 3♀♀ (NMNS), Tona (多納), 28.IV.1998, leg. M.-L. Chan; 1♀ (TARI), same locality, 2.VIII.2017, leg. B.-X. Guo; **Miaoli**: 1♂ (TARI), Hsuehchien (雪見), 12.III.2013, leg. W.-B. Yeh; 2♂♂ (TARI), same locality, 7.VI.2013, leg. W.-B. Yeh; 2♀♀ (NMNS), Taian (泰安), 19.XII.1989, leg. K.-W. Huang; **Nantou**: 1♂, Tunyuan (屯原), 12.VII.2014, leg. J.-C. Chen; **Pingtung**: 1♂ (TARI), Peitawushan (北大武山), 22.IX.2012, leg. J.-C. Chen; 1♂ (TARI), same locality, 25.VI.2018, leg. Y.-T. Chung; 1♀ (TARI), Tahanshan (大漢山), 20.VII.2007, leg. C.-F. Lee; 3♂♂, 8♀♀ (TARI), same locality, 6.II.2008, leg. M.-H. Tsou & S.-F. Yu; 3♂♂ (TARI), same locality, 3.III.2008, leg. C.-F. Lee; 1♀ (TARI), same locality, 4.VII.2008, leg. M.-H. Tsou; 3♂♂, 1♀ (TARI), same locality, 22.I.2009, leg. S.-F. Yu; 1♀ (TARI), same locality, 24.I.2009, leg. M.-H. Tsou; 1♂, 2♀♀ (TARI), same locality, 5.IV.2009, leg. C.-F. Lee; 1♀ (TARI), same locality, 26.XI.2009, leg. J.-C. Chen; 1♀ (TARI), 15.II.2010, leg. M.-H. Tsou; 1♂ (TARI), same locality, 14.IV.2011, leg. J.-C. Chen; 1♀ (TARI), same locality, 14.XII.2011, leg. J.-C. Chen; 1♀ (TARI), same locality, 19.XI.2012, leg. J.-C. Chen; 1♀ (TARI), same locality, 26.III.2013, leg. C.-F. Lee; 1♀ (TARI), same locality, 3.IV.2013, leg. Y.-T. Chung; 3♂♂ (TARI), same locality, 17.III.2014, leg. Y.-T. Chung & J.-C. Chen; 1♂ (TARI), same locality, 2.III.2015, leg. Y.-T. Chung; 1♀ (TARI), same locality, 24.III.2017, leg. Y.-T. Chung; **Taichung**: 1♂ (TARI), Pilu (畢祿), 18.VI.2010, leg. C.-F. Lee; 1♂ (TARI), same locality, 2.VI.2016, leg. J.-C. Chen.

Form D (*N* = 44). Chiayi: 4♂♂, 1♀ (TARI), Laichitashan (來吉塔山), 19.III.2009, leg. H. Lee; **Hsinchu**: 1♂, 1♀ (TARI), Leetungshan (李棟山), 15.III.2009, leg. S.-F. Yu; 4♂♂, 1♀ (TARI), same locality, 27.X.2009, leg. S.-F. Yu; 1♀ (TARI), Mamei (馬美), 4.V.2008, leg. S.-F. Yu; 1♀ (TARI), Taikang trial (泰崗林道), 8.IX.2013, leg. Y.-L. Lin; **Ilan:** 1♀ (TARI), Suyuan (思源), 15.IV.2009, leg. M.-H. Tsou; 1♀ (TARI), same locality, 9.VI.2009, leg. S.-F. Yu; 2♀♀ (TARI), same locality, 12.IX.2010, leg. M.-H. Tsou; 1♂, 1♀ (TARI), same locality, 11.VIII.2014, leg. H. Lee & J.-C. Chen; 1♂ (TARI), same locality, 30.VII.2015, leg. H. Lee; 1♀ (TARI), Taipingshan (太平山), 13.VI.2007, leg. Y.-C. Chang; **Pingtung:** 1♀ (TARI), Kenting (墾丁), 23.VIII.2016, leg. Y.-T. Chung; **Tainan:** 1♂ (TARI), Kantoushan (崁頭

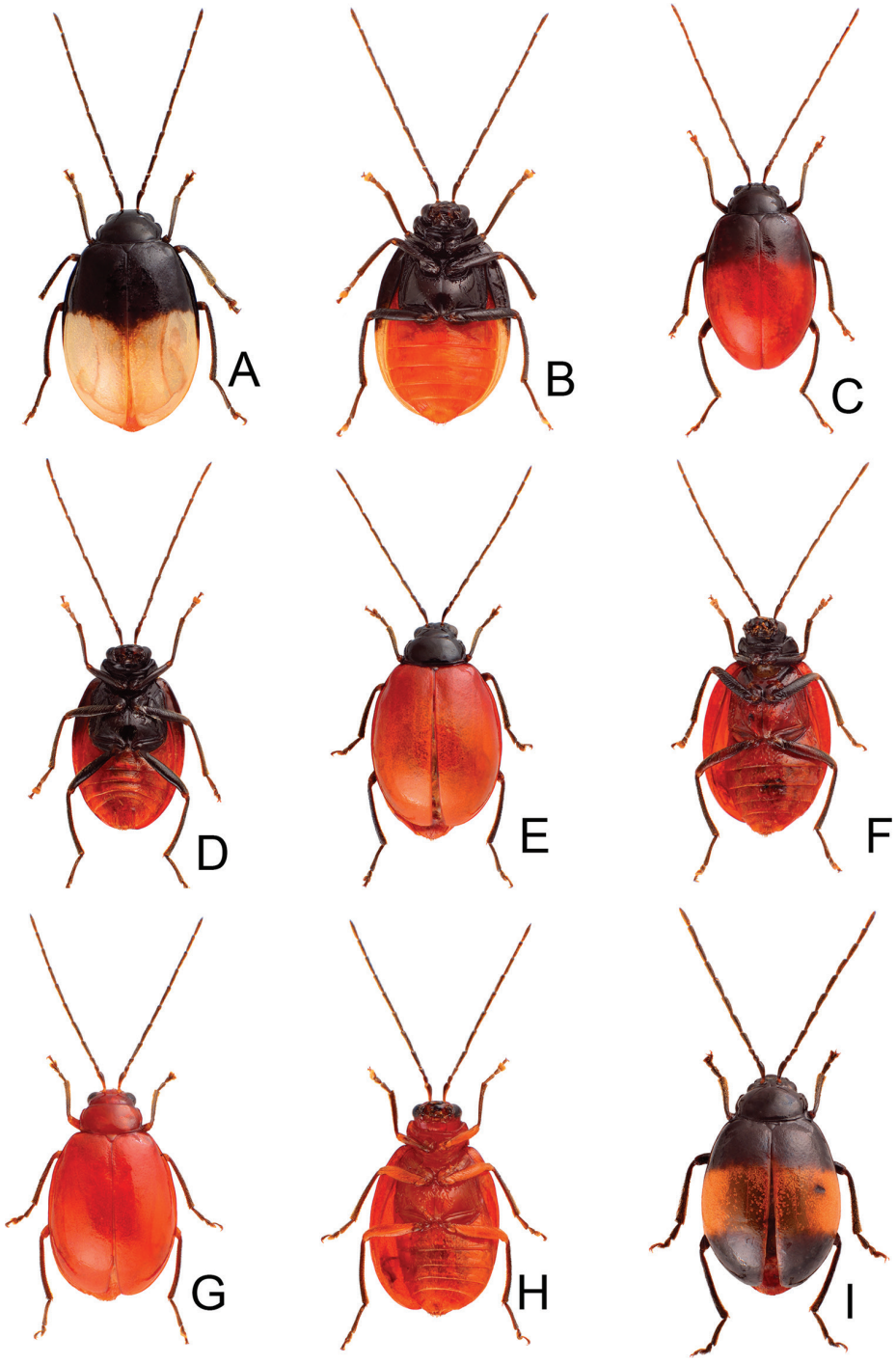

Figure 9. Habitus of *Neochya nitidissima* **A** form A, female, from Alishan (阿里山), dorsal view **B** same, ventral view **C** form B, male, from Kuanwu (觀霧), dorsal view **D** same, ventral view **E** form C, female, from Pilu (碧綠), dorsal view **F** same, ventral view **G** form D, female, from Taikang trial (泰崗林道), dorsal view **H** same, ventral view **I** form E, male, from Peitawushan (北大武山), dorsal view.

山), 17.VI.2012, leg. W.-C. Liao; 1♂, 1♀ (TARI), Meiling (梅嶺), 28.XII.2008, leg. U. Ong; **Taipei**: 1♂, 1♀ (TARI), Fushan (福山), 19.VI.2007, leg. M.-H. Tsou; 1♂ (TARI), Houtung (侯硐), 25.V.2009, leg. J.-C. Chen; **Taoyuan**: 1♂ (TARI), Lalashan (拉拉山), 7.VIII.2008, leg. H.-J. Chen; 1♂, 1♀ (TARI), same locality, 30.X.2008, leg. S.-F. Yu; 2♂♂, 2♀♀ (TARI), same locality, 8.III.2009, leg. S.-F. Yu; 1♂, 1♀ (TARI), same locality, 2.IV.2009, leg. C.-F. Lee & H.-J. Chen; 4♂♂, 1♀ (TARI), same locality, 14.V.2009, leg. C.-F. Lee; **Yunlin**: 1♀ (TARI), Shihpishan (石壁山), 26.IV.2015, leg. W.-C. Liao.

Form E (*N* = 1). Pingtung: 1♂ (TARI), Peitawushan (北大武山), 25.VI.2018, leg. Y.-T. Chung.

Redescription. ***Length*** 5.6–7.0 mm, width 2.9–3.8 mm. ***General color*** extremely variable, with five distinct color patterns (see variation). ***Antennae*** (Fig. 10A) filiform in males, ratio of length of antennomeres I to XI 1.0 : 0.4 : 0.4 : 1.0 : 1.1 : 1.1 : 1.1 : 1.0 : 1.1 : 0.9 : 1.0; ratio of length to width from antennomere I to XI 3.6 : 1.6 : 1.8 : 4.1 : 5.0 : 5.3 : 5.9 : 5.1 : 5.9 : 5.2 : 5.4; similar in females, ratio of length of antennomeres I to XI (Fig. 10B) 1.0 : 0.4 : 0.4 : 1.0 : 1.1 : 1.0 : 1.1 : 1.0 : 1.0 : 0.9 : 1.0; ratio of length to width from antennomere I to XI 3.6 : 1.8 : 2.1 : 4.5 : 5.3 : 5.2 : 5.4 : 5.5 : 5.5 : 5.0 : 5.8. ***Pronotum*** 1.90–1.94 times wider than long; lateral margins slightly rounded, basal margin slightly rounded, apical margin slightly concave; disc with dense minute punctures, but without lateral depressions. ***Elytra*** 1.36–1.40 times longer than wide; lateral margins rounded, widest at middle; disc moderately convex, with dense, minute punctures; apex truncate. ***Penis*** (Fig. 10C–E) wide, ca. 3.8 times longer than wide; lateral margins rounded, widest at basal 1/3; apex broadly rounded; tectum elongate from apical 1/6 to middle, parallel-sided, apex broadly rounded; slightly and apically curved in lateral view; ventral surface with membranous area from apex to apical 1/4; with one small rounded process on lateral margin at apical 1/4. Endophallic spiculae complex with six or seven pairs of hooked spiculae (visible in dorsal view), one additional pair of hooked spiculae near middle with four or five ventral branches; with one pair of longitudinal rows of hair-like setae and small rounded sclerites near base. ***Gonocoxae*** (Fig. 10F) slender, tightly conjunct from apical 1/6 to middle; each gonocoxa with eight setae from apical 1/6 to apex, subapically widened, apex narrowly rounded, base deeply bifurcate. ***Ventrite*** VIII (Fig. 10G) weakly sclerotized except apex, with several short and long setae at apex, and several long setae at sides, spiculum elongate. ***Spermathecal receptaculum*** (Fig. 10H) as slender as pump, apically tapering; pump slender and curved; sclerotized spermathecal duct extremely elongate, but base wide, followed by slender tube, then with inflated areas. Bursal sclerites reduced.

Variation. Color pattern divided into four forms. Form A (Fig. 9A, B) (described as one form of *Atrachya bicoloripennis*): general color black; but apical 2/3 white, abdomen reddish brown. Form B (Fig. 9C, D): similar to form A, but white area replaced with red (described as another form of *A. bicoloripennis*). Form C (Fig. 9E, F) (described as *A. saramao*): similar to form B, but elytra entirely reddish brown, meso-and metathoracic ventrites reddish brown; some individuals have paler femora and antennae. Form D (Fig. 9G, H) (described as typical form of *A. nitidissima*): body color

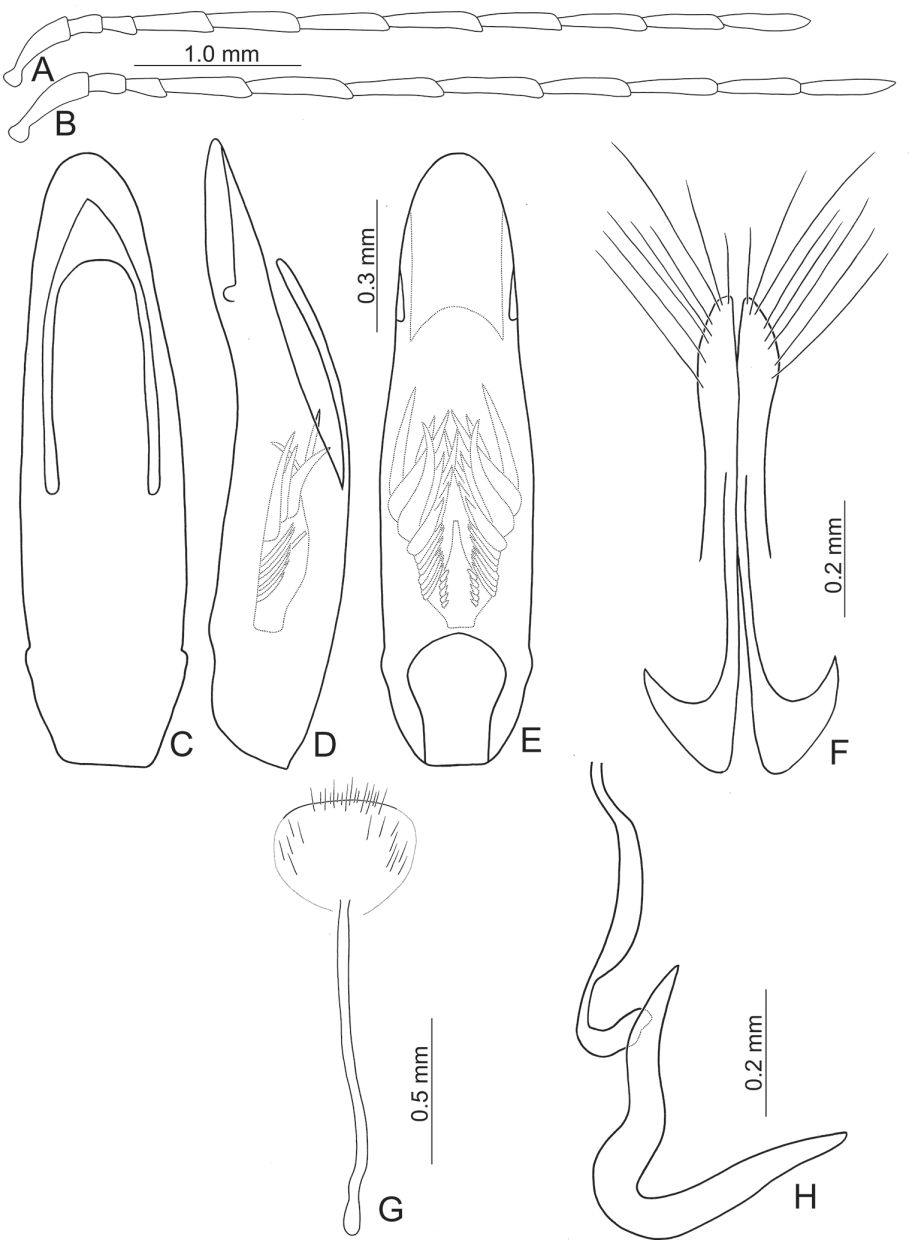

Figure 10. Diagnostic characters of *Neochya nitidissima* **A** antenna, male **B** antenna, female **C** aedeagus, dorsal view **D** aedeagus, lateral view **E** aedeagus, ventral view **F** gonocoxae **G** abdominal ventrite VIII **H** spermatheca.

reddish brown, but antennae, tibiae, and tarsi darker. Form E (Fig. 9I): similar to form A, but apical 1/3 of elytra black.

Diagnosis. *Neochya nitidissima* (Chûjô) is similar to *N. chengi* sp. nov. in having wide elytra, truncate elytral apices and reduced lateral depressions on the pronotum

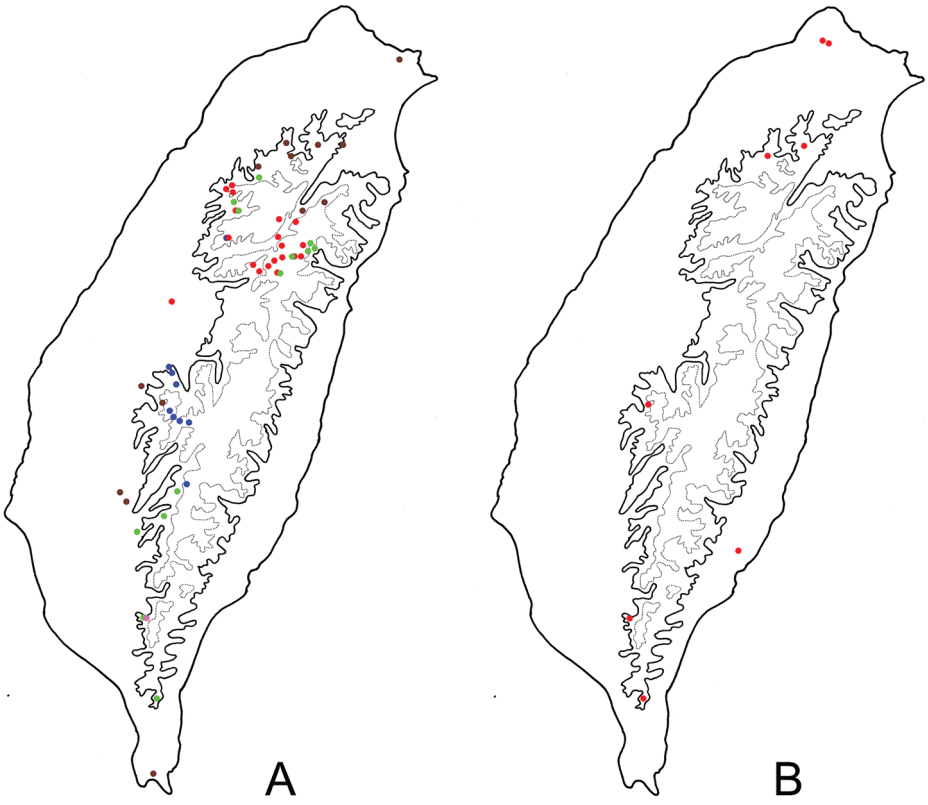

Figure 11. Distribution map of *Neochya* species, solid line: 1000 m, broken line: 2000 m **A** *N. nitidissima* Blue Dots = Form A, red dots = form B, green dots = form C, gray dots = form D, pink dots = form E **B** *N. tsoui* sp. nov.

(Figs 4, 9) (narrow elytra, rounded elytra apices and with lateral depression on the pronotum in others (Figs 2D–F, 7) but differs from *N. chengi* sp. nov. in rounded elytra and having reduced punctures on the pronotum and fine punctures on the elytra (Fig. 9) (parallel sided elytra and coarse punctures on pronotum and elytra in *N. chengi* sp. nov. (Fig. 3)). In addition, males of both species are separated from others with smooth margin of tectum of the penis (Figs 5C, 10C) (serrate margin of tectum (Figs 8C, 12C), but males of *N. nitidissima* differs from those of *N. chengi* with small rounded process on lateral margin of the penis (Fig. 10C–E) (lacking small rounded process on lateral margin of the penis in *N. nitidissima* (Fig. 5C–E). *Atrachya bicoloripennis* (Forms A and B: Fig. 9A–E) and *A. saramao* (Form C: Fig. 9E, F) have distinct color patterns which are different from typical form *N. nitidissima* (Form D: (Fig. 9G, H)). All of they are synonyms with no doubt based on examination of the penis.

Remarks. The holotype of *Luperodes nitidissimus* was described as a male (Chûjô 1935), but it is actually a female.

Food plants. Celastraceae: *Celastrus kusanoi* Hayata, *C. hindsii* Benth., *Euonymus spraguei* Hayata (Fig. 1D).

Distribution. Widespread in Taiwan. Most individuals with different color patterns can be separated based on distributions (Fig. 11A) except for the single form E. Members of form A occur at high elevation (> 2000 m) in south Taiwan, including Chiayi, south Nantou, and Kaohsiung counties. Those of form B also occur at high elevation (> 2000 m) but in central Taiwan, including Hsinchu, Miaoli, north and central Nantou, Taichung and Hualien counties. Those of form C occur at middle elevations (1000–2000 m) in central and south and east Taiwan, including Hsinchu, Miaoli, Taichung, Nantou, Kaohsiung, Pingtung, and Hualien counties. Those of form D occur at middle elevations (1000–2000 m) in north Taiwan, including Taipei, Taoyuan, Hsinchu, and Ilan counties, as well as lowlands (< 1000 m) in central and south Taiwan, including Yulin, Tainan, and Pingtung counties. Coexistence of two different color patterns was observed in some areas, such forms A and B at Anmashan (鞍馬山); forms B and C at Hsuehchien (雪見), Tayuling (大禹嶺), and Tunyuan (屯原); forms C and E at Peitawushan (北大武山).

***Neochya tsoui* sp. nov.**

http://zoobank.org/53CBEF0B-44C9-4F4F-8912-FAE75CD2BD85

Figures 2D–F, 12

Types (*N* = 49). ***Holotype*** ♂ (TARI), Taiwan. **Chiayi**: Laichitashan (來吉塔山), 19.III.2009, leg. H. Lee. ***Paratypes.*** 3♂♂, 4♀♀ (TARI), same data as holotype; **Hsinchu**: 1♂ (TARI), Lupi (魯壁), 3.II.2009, leg. H. Lee; 3♂♂, 3♀♀ (TARI), same locality, 10.III.2009, S.-F. Yu; 1♂, 1♀ (TARI), same locality, 18.IV.2009, leg. M.-H. Tsou; 1♂ (TARI), same locality, 12.VII.2009, leg. M.-H. Tsou; 3♂♂, 6♀♀ (TARI), same locality, 25.II.2010, leg. S.-F. Yu; Taipei: 1♂, 1♀ (TARI), same locality, 13.III.2011, leg. M.-H. Tsou; 3♂♂, 3♀♀ (TARI), same locality, 20.III.2011, leg. M.-H. Tsou; 1♀ (TARI), same but with "leg. S.-F. Yu"; **Pingtung**: 1♀ (TARI), Peitawushan (北大武山), 21.IX.2012, leg. J.-C. Chen; 1♀ (TARI), Tahanshan (大漢山), 22.II.2007, leg. S.-F. Yu; 1♀ (TARI), same locality, 19.VIII.2011, leg. J.-C. Chen; 4♀♀ (TARI), same locality, 2.IX.2011, leg. J.-C. Chen; 1♀ (TARI), same locality, 31.III.2012, leg. W.-C. Liao; 1♀ (TARI), same locality, 9.VI.2013, leg. Y.-T. Chung; **Taipei**: 1♂ (TARI), Fengkueitsui (風櫃嘴), 26.VII.2007, leg. M.-H. Tsou; 1♂ (TARI), Yangmingshan (陽明山), 10.III.2007, leg. M.-H. Tsou; Taitung: 1♀ (TARI), Tulanshan (都蘭山), 20.IX.2017, B.-X. Guo; **Taoyuan**: 1♂ (TARI), Lalashan (拉拉山), 14.V.2009, leg. C.-F. Lee.

Description. ***Length*** 4.6–5.5 mm, width 2.1–3.0 mm. ***General color*** reddish brown or yellowish brown (Fig. 2D–F); but antennae, tibiae, and tarsi darker. ***Antennae*** (Fig. 12A) filiform in males, ratio of length of antennomeres I to XI 1.0 : 0.4 : 0.4 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 0.9 : 0.8 : 0.9; ratio of length to width from antennomere I to XI 3.6 : 1.7 : 1.8 : 4.5 : 5.1 : 5.3 : 5.3 : 4.7 : 4.5 : 4.1 : 4.4; a little slender in females, ratio of length of antennomeres I to XI (Fig. 12B) 1.0 : 0.4 : 0.4 : 0.9 :

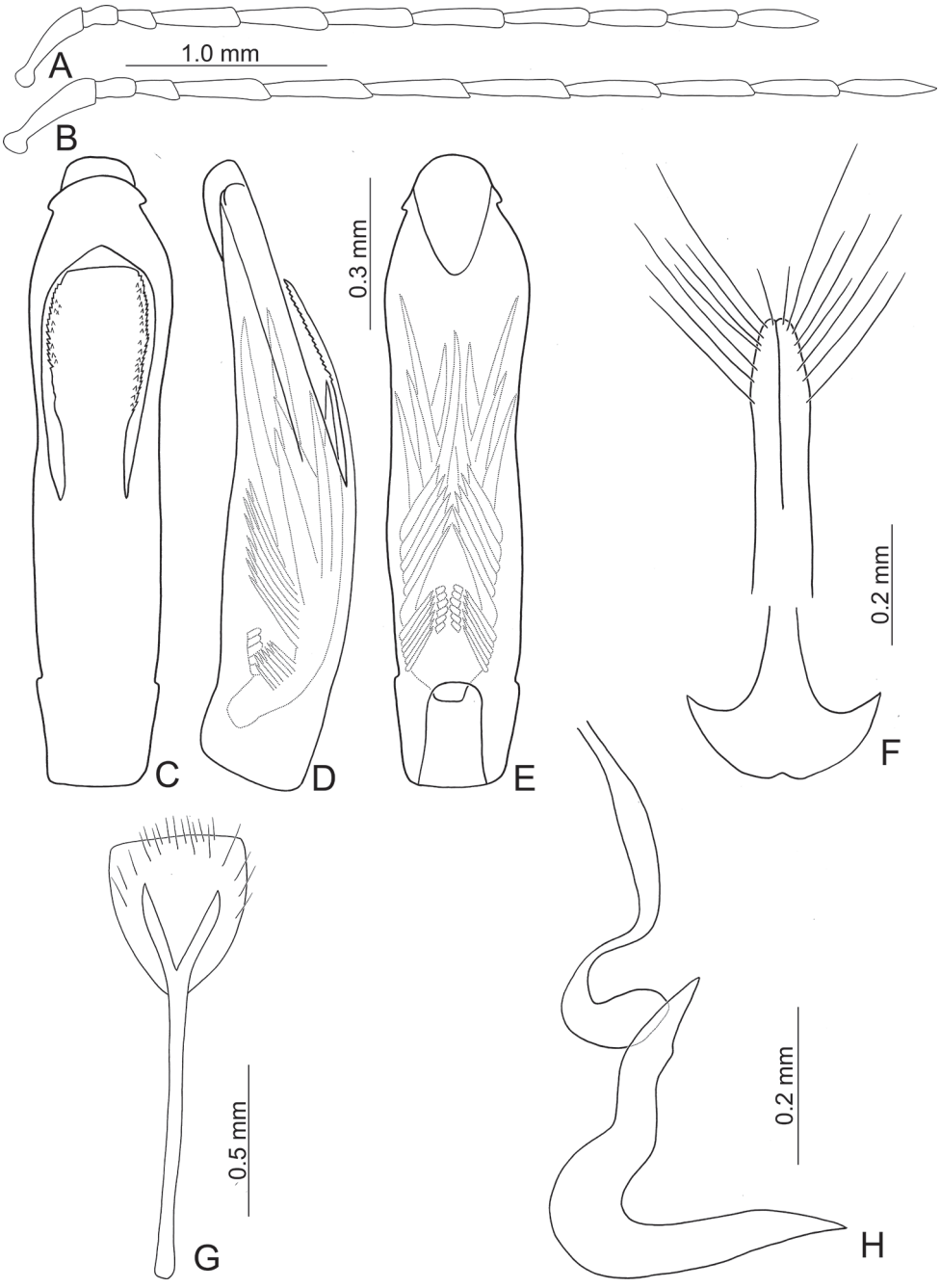

Figure 12. Diagnostic characters of *Neochya tsoui* sp. nov. **A** antenna, male **B** antenna, female **C** aedeagus, dorsal view **D** aedeagus, lateral view **E** aedeagus, ventral view **F** gonocoxae **G** abdominal ventrite VIII **H** spermatheca.

1.0 : 1.0 : 1.0 : 0.9 : 0.9 : 0.8 : 0.9; ratio of length to width from antennomere I to XI 3.8 : 2.0 : 2.3 : 4.5 : 5.1 : 5.8 : 6.4 : 6.1 : 6.1 : 5.6 : 5.5. ***Pronotum*** 1.75–2.00 times wider than long; lateral margins rounded and basally narrowed, basal margin slightly rounded, apical margin slightly concave; disc with dense coarse punctures, with lateral depressions. ***Elytra*** 1.51–1.65 times longer than wide; lateral margins widest at apical 1/3; disc slightly convex, with dense, coarse punctures; apex rounded. ***Penis*** (Fig. 12C–E) wide, ca. 4.5 times longer than wide; lateral margins parallel from base to apical 2/5, then moderately broadened, widest at apical 1/5; apex broadly rounded; apical area weakly sclerotized; tectum elongate from apical 1/5 to middle, lateral margins slightly rounded and toothed, apex truncate; slightly curved in lateral view; ventral surface with membranous area from apex to apical 1/5; with one small rounded process inside lateral margin near apex. Endophallic spiculae complex with five or six pairs of hooked spiculae, with one pair of longitudinal rows of hair-like setae and small rounded sclerites near base. ***Gonocoxae*** (Fig. 12F) slender, tightly conjunct from apex to middle; each gonocoxa with eight setae from apical 1/6 to apex, subapically widened, apex truncate, base shallowly bifurcate. ***Ventrite*** VIII (Fig. 12G) weakly sclerotized except apex, with several long setae at apex, and several long setae at sides, short setae along apical margin, spiculum elongate. ***Spermathecal receptaculum*** (Fig. 12H) as slender as pump, apically tapering; pump slender and curved; sclerotized spermathecal duct extremely elongate, but base extremely wide, followed by slender tube, then with inflated areas. Bursal sclerites reduced.

Diagnosis. *Neochya tsoui* sp. nov. is similar to *N. hirashimai* (Kimoto) in having slender elytra and lateral depressions on the pronotum (Figs 2D–F, 7) (wide elytra and lacking lateral depressions on the pronotum in others (Figs 4, 9), but differs from *N. hirashimai* in having reddish brown pronotum and elytra (reddish brown pronotum and yellowish brown elytra, or black pronotum, black basal half and yellowish brown apical half of elytra in *N. hirashimai*). In addition, males of both species are separated from others with serrate margin of tectum of the penis (Figs 8C, 12C) (smooth margin of tectum (Figs 5C, 10C), but males of *N. tsoui* differs from those of *N. hirashimai* with the penis widest at apical 2/5 (Fig. 12C, E) (penis widest at middle in *N. nitidissima* (Fig. 8C, E).

Food plants. Celastraceae: *Euonymus japonicus* Thunb., *E. spraguei* Hayata (Fig. 1E, F).

Etymology. This new species is dedicated to Mei-Hua Tsou, a member of TCRT and the first to collect this new species.

Distribution. Widespread but scattered in Taiwan (Fig. 11B).

Tsouchya gen. nov.

http://zoobank.org/3DBEF74D-9D2E-40E4-BA4A-50325FBB8E01

Type species. *Atrachya mediofasciata* Kimoto, 1976.

Description. Color extremely variable (Fig. 13) but without metallic color (see remarks of *Tsouchya mediofasciata*). Body length 4.5–6.0 mm.

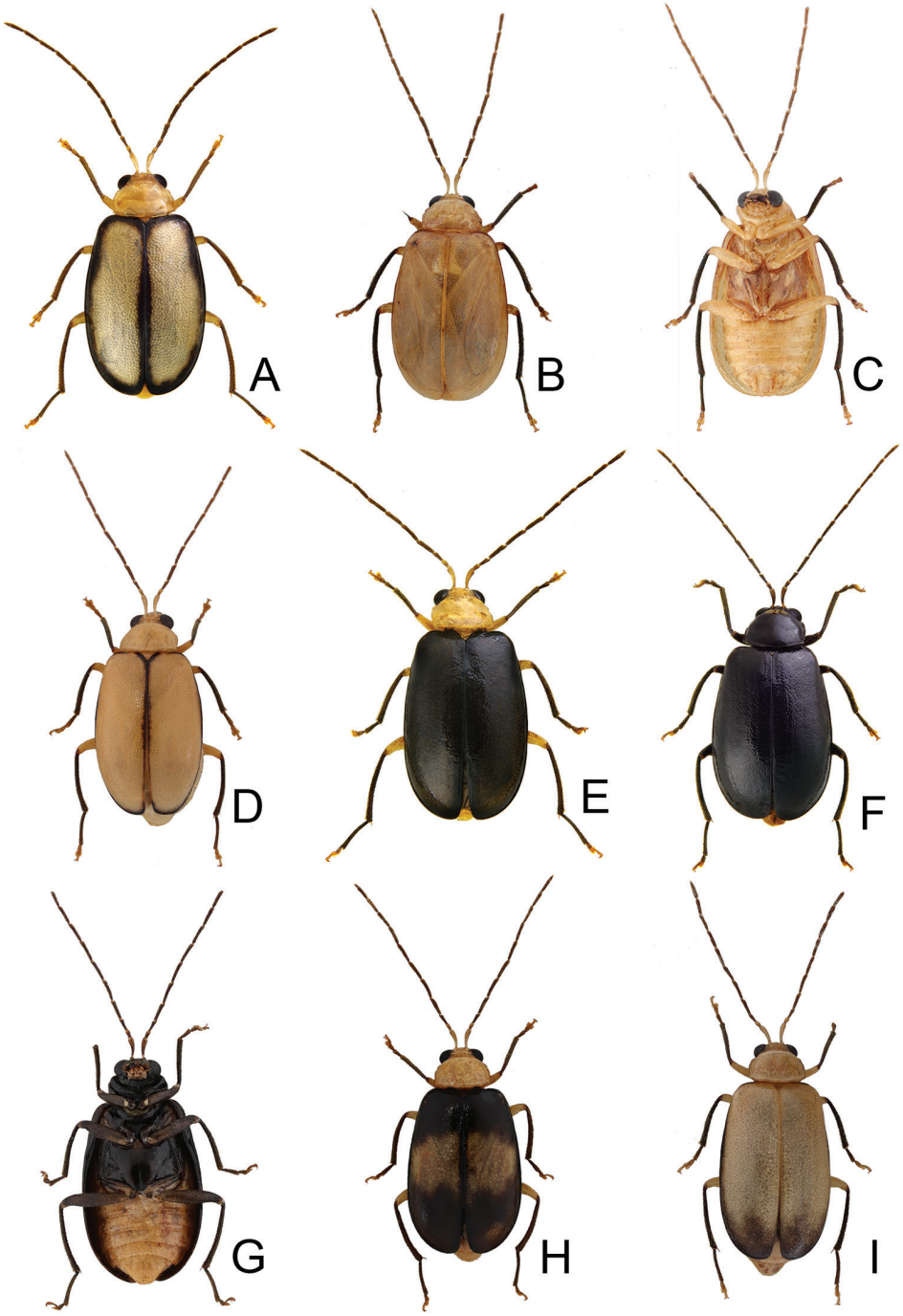

Figure 13. Habitus of *Tsouchya mediofasciata* **A** female, from Shihshan trail (石山林道), dorsal view **B** male, from Lilungshan (里龍山), dorsal view **C** same, ventral view **D** female, from Lilungshan (里龍山), dorsal view view **E** male, from Shihshan trail (石山林道), dorsal view **F** female, from Shihshan trail (石山林道), dorsal view **G** same, dorsal view **H** male, from Talu trail (大鹿林道), dorsal view **I** female, from Meifeng (梅峰), dorsal view.

Head. Labrum trapezoidal, transverse, with six pores in transverse row bearing pale seta, anterior margin truncate. Anterior part of head short, almost impunctate and glabrous, four setae on anterior margin of clypeus and several setae along anterior margin of anterofrontal ridge. Interantennal space narrow, 1.0–1.2× as wide as diameter of antennal insertion. Frontal tubercles transverse, slightly reduced, glabrous. Vertex smooth and glabrous. Antennae slender, covered with dense setae, antennomere II much shorter than antennomere III (0.61–0.68× as long as III); similar in both sexes (Fig. 14A, B).

Pronotum 1.52–1.56 times as broad as long, lateral margins straight, basally narrowed. Disc covered with dense coarse punctures, moderately convex. Posterior half of disc with wide shallow transverse impression. Anterior margin lacking marginal bead, lateral and posterior margins with marginal bead. Anterior and posterior margins without setae, lateral margins with two pairs of setae near base and apex, respectively. Anterior angles moderately swollen, rectangular, posterior angles obtuse angulate, all angles with setigerous pores bearing long pale setae.

Scutellum subtriangular, impunctate, glabrous, with rounded apex.

Elytra 1.55–1.61 times as long as wide, almost glabrous (with indistinct, sparse, short, pale setae on humeri, lateral margins and apical slopes), parallel-sided, densely covered with coarse confused punctures. Humeral calli well developed. Epipleura broad at base, strongly narrowed at basal 1/3, abbreviated from apical 1/3 to apex. Macropterous.

Ventral surface sparsely covered with fine punctures and pale setae. Anterior coxal cavities closed (Fig. 18F). Prosternal process not visible between procoxae. Abdomen simple, posterior margin of last ventrite with two long incisions in males.

Legs slender. All tibiae with one apical spine, the longest spine on metatibia. Protarsomeres I not modified in males. Metatarsomeres I much longer than pro- and mesotarsomeres I, much longer than II and III combined. Claws appendiculate.

Penis (Fig. 14C–E) broad, without lateral processes; tectum elongate, apical margin truncate, with one pair of apically tapering sclerites articulated with lateral margins; internal sac with two types of endophallic spiculae (median and apical endophallic spiculae); with one rounded sclerite projecting from ventral surface.

Gonocoxae (Fig. 14G) slender, tightly conjunct medially; each gonocoxa with eight setae from near apex to apical 1/6, subapically widened, apex narrowly rounded. Ventrite VIII (Fig. 14F) weakly sclerotized except apex, with several short and long setae at apex, and several long setae at sides, spiculum elongate. Spermathecal receptaculum (Fig. 14I) strongly swollen; pump slender and curved; sclerotized spermathecal duct extremely elongate, but base wide, followed by short slender tube, then with inflated areas. Bursal sclerites (Fig. 14H) paired, circular, with three or four teeth at one side.

Diagnosis. *Tsouchya* gen. nov. differs from *Neochya* gen. nov., *Monolepta* Chevrolat and *Atrachya* Chevrolat based on the following combination of characters: antennomere II much short than III in length (Fig. 14A, B) (antennomere II subequal to III in *Neochya* gen. nov. (Figs 5A, B, 8A, B, 10A, B, 12A, B) and *Monolepta*); closed prothoracic coxal cavities (Fig. 18F) (open prothoracic coxal cavities in *Atrachya*

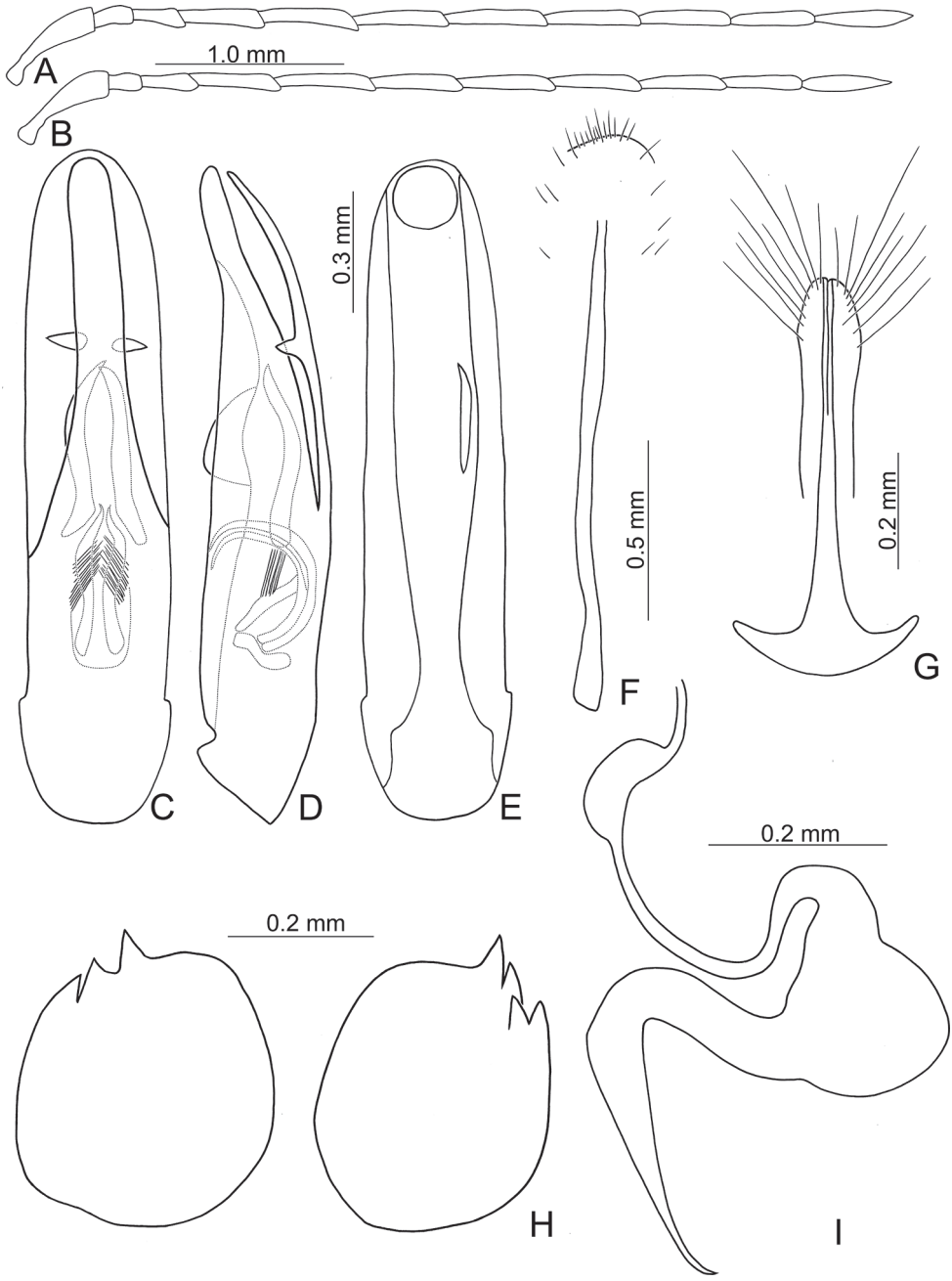

Figure 14. Diagnostic characters of *Tsouchya mediofasciata* **A** antenna, male **B** antenna, female **C** aedeagus, dorsal view **D** aedeagus, lateral view **E** aedeagus, ventral view **F** abdominal ventrite VIII **G** gonocoxae **H** bursal sclerites **I** spermatheca.

(Fig. 18A) and *Neochya* gen. nov. (Fig. 18D)); absence of subscutellar impression on the elytra in males (presence of subscutellar impression on the elytra in those of *Atrachya*); penis without lateral processes near apex (Fig. 14C–E) (with lateral processes in *Neochya* gen. nov. (Figs 8C–E, 10C–E, 12C–E); tectum broad and with apical margin truncate (Fig. 14C) (tectum elongate with apex deeply bifurcate in *Atrachya* (Fig. 3C)), with one pair of lateral sclerites (Fig. 14C) (lacking lateral sclerites in others); two types of endophallic spiculae (Fig. 14C) (only one type of endophallic spiculae in *Neochya* gen. nov. (Figs 5C–E, 8C–E, 10C–E, 12C–E; three types of endophallic spiculae in *Monolepta*); spermatheca with strongly swollen receptaculum (Fig. 14I) (slender receptaculum in *Neochya* gen. nov. (Figs 5H, 8H, 10H, 12H)), without acute apex (with acute apex in *Neochya* gen. nov.); one pair of bursal sclerites (Fig. 14H) (two pairs of bursal sclerites in *Monolepta*; reduced in *Neochya* gen. nov.), circular and flattened (slender in others); ventrite VIII with few setae at sides (dense setae at sides in *Atrachya* (Fig. 3F)).

Etymology. Composed from Tsou and *Atrachya* to honor Mei-Hua Tsou, who is a member of TCRT (Taiwan Chrysomelid Research Team) and made great contributions to inventorying the chrysomelid fauna in Taiwan. The gender is feminine.

Included species. *Tsouchya mediofasciata* (Kimoto), comb. nov.

Tsouchya mediofasciata (Kimoto, 1976), comb. nov.

Atrachya mediofasciata Kimoto, 1976: 6; Kimoto 1989: 257 (additional records); Kimoto 1991: 15 (additional records).

Monolepta tsoui Lee, 2009: 23. syn. nov.

Monolepta bicavipennis: Kimoto, 1969: 50 (Taiwan). non *Monolepta bicavipennis* Chen, 1942.

Types. *Atrachy mediofasciata*. ***Holotype*** ♂ (OMNH): "[Taiwan] / Meifeng (梅峰) / Nantou Hsien [h, w] // 26.VI.1971 / Y. Miyatake [h, w] // Atrachya / mediofasciata / Kimoto, n. sp. [h, w] // HOLOTYPE [p, r] // (Redg. O.M.N.H.) [p, w]". ***Paratypes***: 1♀ (KMNH): "(Taiwan) / Fenchihu (奮起湖), 1400m / Chiayi Hsien [p, w] // 7[h].vii.1965 / Y. Kurosawa [p, w] // Japan-U. S. / Co-op. Sci / Programme [p, y] // PARATYPE [p, b] // Atrachya / mediofasciata / Kimoto, n. sp. [h, w]"; 1♀ (KMNH): "(Taiwan) / Alishan (阿里山), 2300m / Chiayi Hsien [p, w] // 6[h].vii.1965 / Y. Kurosawa [p, w] // Japan-U. S. / Co-op. Sci / Programme [p, y] // PARATYPE [p, b] // Atrachya / mediofasciata / Kimoto, n. sp. [h, w]".

Other material. Kaohsiung: 1♂, 2♀♀ (KMNH), Shik Shan (石山), near Liu Kui (六龜), 9.VIII.1986, leg. K. Baba; **Nantou**: 1♂ (KMNH), Chun Yan (春陽), 7.X.1986, leg. K. Baba; 1♂ (NMNS), Juiyenhsi (瑞岩溪) Station, 29–30.VIII.2009, leg. H.-H. Liang; 1♂ (NMNS), same but with "12.VII.2007"; **Taichung**: 1♀ (NMNS), Tasheishan (大雪山) Forest Road 32km, 16.VIII.2008, leg. Liang, Chen, & Fu; 2♀♀ (BPBM), Hassenzan (= Pahsienshan, 八仙山), 23.VI.1934, leg. J. L. Gressitt, both specimens were identified as *Monolepta bicavipennis* Chen (Kimoto 1969).

Remarks. This species is described in detail as *Monolepta tsoui* by Lee (2009). Color patterns of this species are extremely variable. Typical individuals have a yellowish brown body, with wide black bands along the lateral margins and suture of elytra (Fig. 13A), blackish brown antennae, except two basal antennomeres, tibiae, tarsi, metasternum, metepisternum, and epimera yellowish brown. Some have a more yellowish body color (Fig. 13B, C) but with blackish brown antenna, tibiae, and tarsi as typical form. Different degrees of variation exist between both forms, such as slender back stripes along the margin of the elytra (Fig. 13D). Some are similar to the typical form, but the elytra are entirely black (Fig. 13E). Some are entirely black except the yellowish brown abdomen (Fig. 13F, G). In addition, two color patterns have not been studied previously. One is similar to the typical form but with the elytra black except one transverse white band (Fig. 13H). It was described as *Atrachya mediofasciata*. The other is also similar to the typical form but the elytra black apically (Fig. 13I). In addition, two specimens misidentified as *Monolepta bicavipennis* have a characteristic color pattern: yellowish brown body but head and prothrax blackish brown, tibiae darker.

***Chinochya* gen. nov.**
http://zoobank.org/F1F08437-3300-4C41-B900-C765AA4E77E3

Type species. *Monolepta sublata* Gressitt & Kimoto, 1963.

Description. ***Coloration*** (Fig. 15): Head, prothorax, and abdomen yellowish brown; antennae black except two basal antennomeres yellowish brown; meso- and metathoracic ventrites black; front legs yellowish brown, but tibia and tarsi darkened; middle and hind legs black; elytra black with one transverse, broad white band at middle. Body length 4.9–6.3 mm.

Head. Labrum trapezoidal, transverse, with six pores in transverse row bearing pale setae, anterior margin truncate. Anterior part of head short, almost impunctate and glabrous, four setae on anterior margin of clypeus and several setae along anterior margin of anterofrontal ridge. Interantennal space narrow, 0.8–0.9× as wide as diameter of antennal insertion. Frontal tubercles transverse, slightly reduced, glabrous. Vertex smooth and glabrous. Antennae slender, covered with dense setae, antennomere II subequal to III in length; similar in both sexes.

Pronotum 1.62–1.69 times as broad as long, lateral margins rounded, basally narrowed. Disc covered with dense, fine punctures, moderately convex, without transverse impression. Anterior margin lacking marginal bead, lateral and posterior margins with marginal bead. Anterior and posterior margins without setae, lateral margins with two pairs of setae near base and apex, respectively. Anterior angles moderately swollen, rectangular, posterior angles obtuse angulate, all angles with setigerous pores bearing long pale setae.

Scutellum subtriangular, impunctate, glabrous, with rounded apex.

Elytra 1.37–1.61 times as long as wide, almost glabrous (with indistinct, sparse, short, pale setae on humeri, lateral margins and apical slopes), parallel-sided, densely covered with coarse, confused punctures. Humeral calli well developed. Epipleura

broad at base, strongly narrowed at basal 1/3, abbreviated from apical 1/3 to apex. Macropterous.

Ventral surface sparsely covered with fine punctures and pale setae. Anterior coxal cavities almost closed (Fig. 18B). Prosternal process not visible between procoxae. Abdomen simple, posterior margin of last ventrite with two long incisions in males.

***Legs slender*.** All tibiae with one apical spine, the longest spine on metatibia. Protarsomeres I swollen in males (Figs 16J, K, 17J, K). Metatarsomeres I much longer than pro- and mesotarsomeres I, much longer than II and III combined. Claws appendiculate.

Penis (Figs 16C–E, 17C–E) broad, without lateral processes; tectum elongate, apical margin truncate; internal sac with two types of endophallic spiculae (median and lateral endophallic spiculae).

Gonocoxae (Figs 16G, 17G) slender, tightly conjunct medially; each gonocoxa with nine or ten setae from near apex to apex, subapically widened, apex oblique truncate. Ventrite VIII (Figs 16F, 17F) well sclerotized except apex, with several short and long setae at apex, and dense long setae at sides, spiculum elongate. Spermathecal receptaculum (Figs 16L, 17L) strongly swollen, with one erect sclerite; pump slender and curved; sclerotized spermathecal duct extremely elongate, but base wide, followed by short slender tube, then with inflated areas. Bursal sclerites (Figs 15H, I, 16H, I) with two pairs of well-developed bursal sclerites.

Diagnosis. *Chinochya* gen. nov. differs from *Tsouchya* gen. nov., *Neochya* gen. nov., *Atrachya* Chevrolat, and *Monolepta* Chevrolat based on the following combination of characters: antennomere II subequal to III in length (Figs 16A, B, 17A, B) (antennomere II much shorter III in *Tsouchya* gen. nov. (Fig. 14A, B) and *Atrachya* (Fig. 3A, B)); almost closed prothoracic coxal cavities (Fig. 18B) (completely closed prothoracic coxal cavities in *Tsouchya* gen. nov. (Fig. 18F) and Taiwanese species of *Monolepta* (Fig. 18C), widely open prothoracic coxal cavities in *Atrachya* (Fig. 18A) and *Neochya* (Fig. 18D)); absence of subscutellar impression on the elytra in males (presence of subscutellar impression on the elytra in those of *Atrachya*); tarsomere I of front legs swollen in males (Figs 16J, K, 17J, K) (not modified in males of other genera); penis without lateral processes near apex (Figs 16C–E, 17C–E) (with lateral processes in *Neochya* gen. nov. (Figs 8C–E, 10C–E, 12C–E)); tectum broad and with apical margin truncate (Figs 16C, 17C) (tectum elongate with apex deeply bifurcate in *Atrachya* (Fig. 3C)), without pair of lateral sclerites (with one pair of lateral sclerites in *Tsouchya* gen. nov. (Fig. 14C)); presence of median and lateral endophallic spiculae (Figs 16C, E, 17C, E) (median and apical endophallic spiculae in *Tsouchya* gen. nov. (Fig. 14C, D); only one type of endophallic spiculae in *Neochya* gen. nov. (Figs 5C–E, 8C–E, 10C–E, 12C–E); three types of endophallic spiculae in *Monolepta*); spermatheca with strongly swollen receptaculum (Fig. 16L, 17L) (slender receptaculum in *Neochya* gen. nov. (Figs 5H, 8H, 10H, 12H)), not apically tapering (apically tapering in *Neochya* gen. nov.), with one erect sclerite (no erect sclerites in others); ventrite VIII in females with dense long setae and well sclerotized (Figs 16F, 17F) (with few setae and weakly sclerotized in others); two pairs of well-developed bursal sclerites (Figs 16H, I, 17H, I)

(one pair of bursal sclerites in *Tsouchya* gen. nov. (Fig. 14H) and *Atrachya* (Fig. 3H); reduced in *Neochya* gen. nov.); nine or ten setae on each gonocoxa, some of them small (Figs 16G, 17G) (seven or eight setae on each gonocoxa, all long in others).

Etymology. Composed from China and *Atrachya* to indicate the locality of the type species. The gender is feminine.

Included species. *Chinochya sublata* (Gressitt & Kimoto) comb. nov. and *C. unifasciata* (Takizawa) comb. nov.

***Chinochya sublata* (Gressitt & Kimoto, 1963), comb. nov.**
Figures 15A–C, 16

Monolepta sublata Gressitt & Kimoto, 1963: 635.

Types. ***Paratype***: 1♀ (CAS): "Szechuan, China / NE. of Motauchi / Wanhsien, IX [p] 27 [h] 48 / 4200–4800 ft. [p, w] // Gresitt & / Djou Collrs. [p, w] // NO. 28 [p, w] // PARATYPE [P] ♀ / Monolepta / sublata [h] / Gressitt & Kimoto [p, y]".

Other material. China. Fujian: 1♀ (KMNH), Chungan, Lower Kuatun, 16.X.1941, leg. T. C. Maa; 2♂♂ (TARI), Jiuxianshan (九仙山), 21.VI.2014, leg. Y.-T. Chung; 13♂♂ (TARI), same locality, 12–17.VI.2015, leg. Y.-T. Chung; Yunnan: 3♂♂, 1♀ (TARI), Heinitang (黑泥塘), 6–9.IX.2017, leg. Y.-T. Wang; 3♂♂, 1♀ (TARI), Houqiao (猴橋), 12.VII.2016, leg. Y.-T. Wang; 1♀ (TARI), same locality, 5.IX.2018, leg. C.-C. Chen; 2♂♂ (TARI), Yunfengshan (雲峰山), 11.VII.2016, leg. Y.-T. Wang.

Description. ***Length*** 5.3–6.3 mm, width 3.1–3.7 mm. ***Head, prothorax, and abdomen*** yellowish brown; antennae black except two basal antennomeres yellowish brown; meso- and metathoracic ventrites black; front legs yellowish brown, but tibia and tarsi darkened; middle and hind legs black; elytra black with one transverse, broad white band at middle (Fig. 15A–C). ***Antennae*** (Fig. 16A) filiform in males, ratio of length of antennomeres I to XI 1.0 : 0.4 : 0.5 : 1.1 : 1.0 : 0.9 : 0.9 : 0.8 : 0.9 : 0.7 : 0.9; ratio of length to width from antennomere I to XI 3.8 : 1.6 : 2.0 : 4.0 : 3.6 : 3.5 : 3.3 : 3.2 : 4.0 : 4.0 : 4.3; similar in females, ratio of length of antennomeres I to XI (Fig. 16B) 1.0 : 0.4 : 0.4 : 0.8 : 0.9 : 0.8 : 0.8 : 0.8 : 0.7 : 0.7 : 0.9; ratio of length to width from antennomere I to XI 3.5 : 1.9 : 2.1 : 3.8 : 3.9 : 3.6 : 3.4 : 3.5 : 3.4 : 3.4 : 4.2. ***Pronotum*** 1.67–1.69 times wider than long; lateral margins rounded and apically narrowed, basal margin slightly rounded but slightly depressed at middle, apical margin truncate; disc with dense, fine punctures, without lateral depressions. ***Elytra*** 1.37–1.42 times longer than wide; parallel-sided; disc moderately convex, with dense, fine punctures; apex truncate. Tarsomere I of front legs swollen in males (Fig. 16J), but not modified in females (Fig. 16K). ***Penis*** (Fig. 16C–E) wide, ca. 4.5 times longer than wide; lateral margins parallel from base to apical 2/5, then basally narrowed, apex broadly rounded; with transverse and longitudinal, strongly sclerotized area near apex, intersecting at middle; tectum weakly sclerotized, elongate from apical 1/10 to

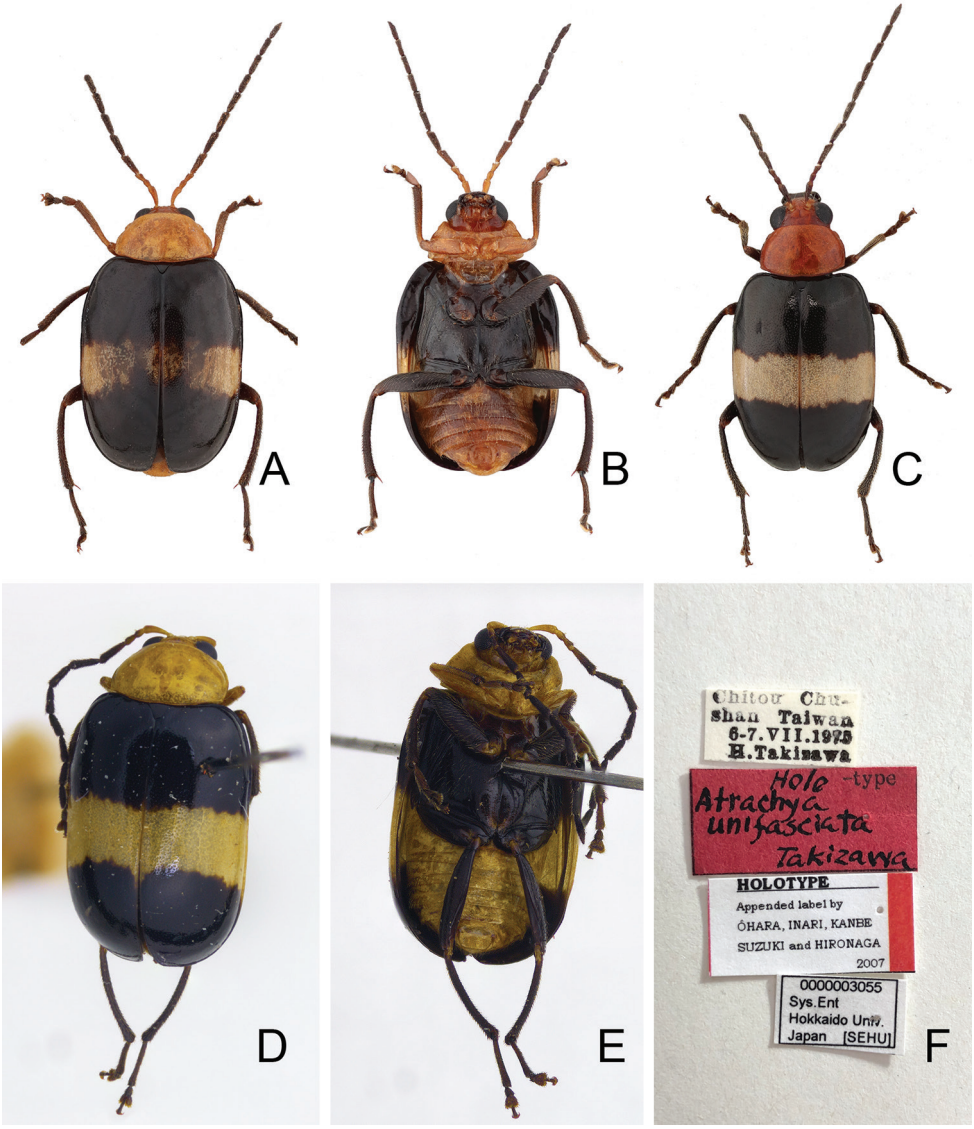

Figure 15. Habitus of *Chinochya sublata* and *C. unifasciata* **A** *C. sublata*, male, dorsal view **B** same, ventral view **C** same, female, dorsal view **D** *C. unifasciata*, holotype, dorsal view **E** same, ventral view **F** *C. unifasciata*, holotype, labels.

basal 2/5, apex rounded; basally broadened in lateral view; ventral surface with broad groove from apex to middle. Endophallic spiculae complex: median endophallic spiculae composed of three pairs of different shapes, one pair elongate and with acute apices near middle, another pair hook-like between inner and outer pairs, the last pair bifurcate at middle; lateral endophallic spiculae composed of transverse row of hook-like, larger setae ventrally located, small setae dorsally located. ***Gonocoxae*** (Fig. 16G)

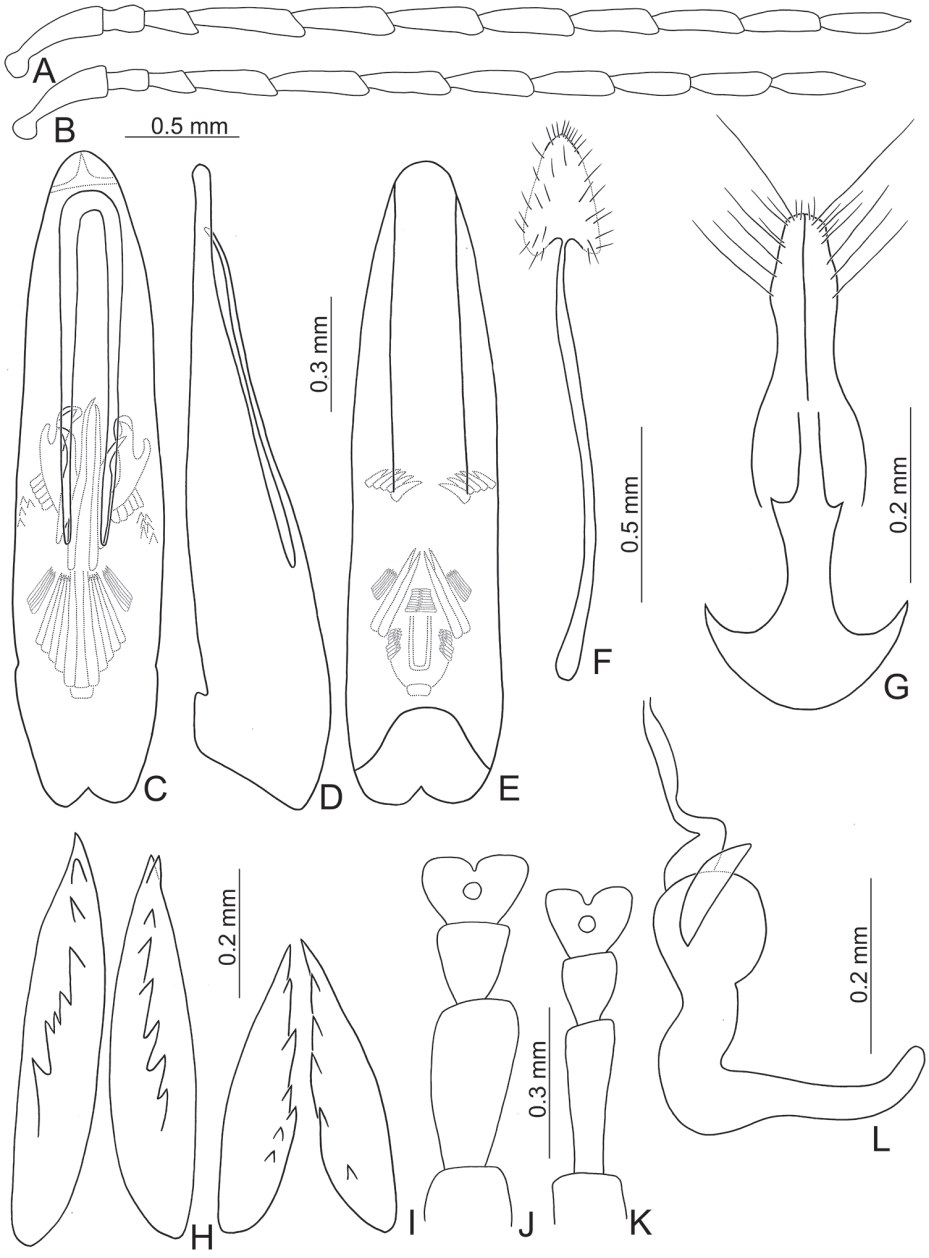

Figure 16. Diagnostic characters of *Chinochya sublata* **A** antenna, male **B** antenna, female **C** aedeagus, dorsal view **D** aedeagus, lateral view **E** aedeagus, ventral view **F** abdominal ventrite VIII **G** gonocoxae **H** dorsal bursal sclerites **I** ventral bursal sclerites **J** protarsi, male **K** protari, female **L** spermatheca.

slender, tightly conjunct from apex to apical 2/5; each gonocoxa with ten setae from apical 1/5 to apex, some setae very small; subapically widened; apex oblique truncate. ***Ventrite*** VIII (Fig. 16F) strongly sclerotized except apex, with a number of long setae

at sides, short setae along apical margin, spiculum elongate. ***Spermathecal receptaculum*** (Fig. 16L) strongly swollen, with one transverse, erect sclerite; pump slender and curved; sclerotized spermathecal duct extremely elongate, but base extremely wide, followed by short slender tube, then with inflated areas. Bursal sclerites paired and well developed, dorsal bursal sclerites larger (Fig. 16H), with one longitudinal row of eight stout setae; ventral bursal sclerites smaller (Fig. 16I), with one longitudinal row of seven or eight small denticles.

Diagnosis. *Chinochya sublata* is similar to *C. unifasciata*. They cannot be separated based on their external morphology, however, *C. sublata* (Fig. 16C–E) differs from *C. unifasciata* (Fig. 17C–E) in genitalic characters as follow: median endophallic spiculae composed of three different pairs of sclerites (only two pairs of sclerites in *C. unifasciata*); lateral endophallic spiculae transversely arranged (longitudinally arranged in *C. unifasciata*); ventral bursa sclerite with seven or eight small denticles (13 or 14 small denticles in *C. unifasciata*).

Remarks. Males are here described for the first time. Types on which the original description was based are all females (Gressitt and Kimoto 1963)

Distribution. South China (Fujian, Sichuan, Yunnan).

***Chinochya unifasciata* (Takizawa, 1978), comb. nov.**
Figures 15D–F, 17

Atrachya unifasciata Takizawa, 1978: 132.
Monolepta sublata: Kimoto, 1976: 6 (Taiwan). non *Monolepta sublata* Gressitt & Kimoto, 1963

Types. ***Holotype*** ♂ (SEHU) (Fig. 15D–F): "Chitou (溪頭) Chu- / shan Taiwan / 6–7. VII.1975 / H. Takizawa [p, w] // Holo [h] -type [p] / Atrachya / unifasciata / Takizawa [h, r] // **HOLOTYPE** / Appended label by ÔHARA, IMRAI, KANBE / SUZUKI and HIRONAGA / 2007 [p, w, with red band along right margin] // 0000003055 / Sys. Ent / Hokkaido Univ. / Japan [SEHU] [p, w]".

Other material. Taiwan. **Hsinchu**: 1♂ (TARI), Talu trail (大鹿林道), 24.VI.2009, leg. Y.-F. Hsu; **Maioli**: 2♂♂ (TARI), Hsuehchien (雪見), 7.VI.2013, leg. W.-B. Yeh; **Kaohsiung**: 2♂♂ (TARI), Chungchihkuan (中之觀), 3.VII.2009, leg. S.-F. Yu & M.-H. Tsou; **Taitung**: 1♀ (TARI), Liyuan (栗園), 19.VI.2013, leg. B.-X. Guo.

Description. ***Length*** 4.9–5.8 mm, width 2.6–3.0 mm. ***Head, prothorax, and abdomen*** yellowish brown; antennae black except two basal antennomeres yellowish brown; meso- and metathoracic ventrites black; front legs yellowish brown, but tibiae and tarsi darker; middle and hind legs black; elytra black with one transverse, broad, white band at middle (Fig. 15D, E). ***Antennae*** (Fig. 16A) filiform in males, ratio of length of antennomeres I to XI 1.0 : 0.4 : 0.4 : 0.9 : 0.9 : 0.9 : 0.9 : 0.8 : 0.8 : 0.7 : 0.9; ratio of length to width from antennomere I to XI 3.8 : 1.8 : 2.0 : 3.9 : 3.4 : 3.5 : 3.6 : 3.4 : 3.6 : 3.3 : 3.5; similar in females, ratio of length of antennomeres I to XI (Fig. 17B) 1.0 : 0.4 : 0.5 : 1.0 : 1.0 : 0.9 : 0.9 : 0.9 : 0.8 : 0.8 : 0.9; ratio of length to

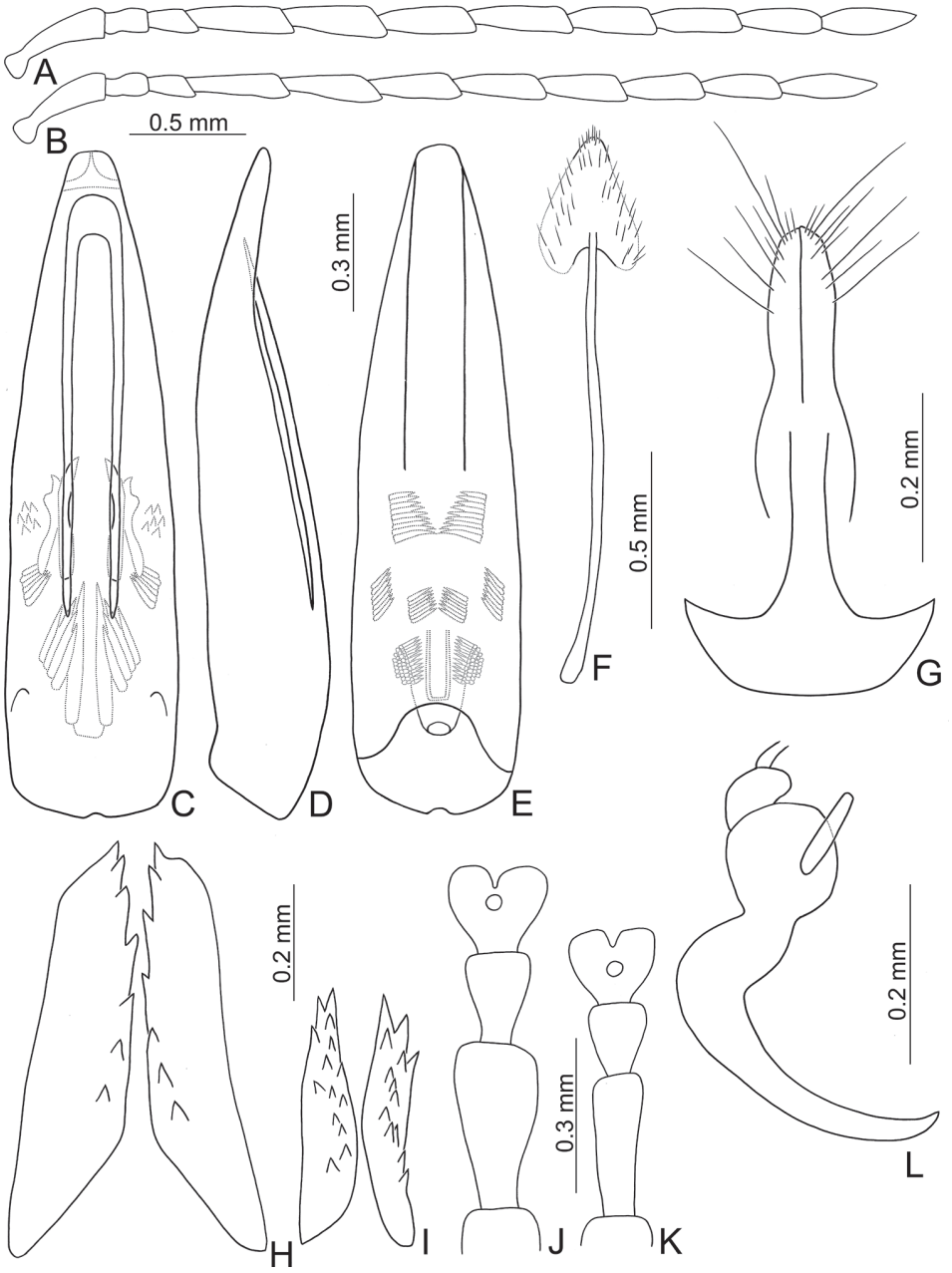

Figure 17. Diagnostic characters of *Chinochya unifasciata* **A** antenna, male **B** antenna, female **C** aedeagus, dorsal view **D** aedeagus, lateral view **E** aedeagus, ventral view **F** abdominal ventrite VIII **G** gonocoxae **H** dorsal bursal sclerites **I** ventral bursal sclerites **J** protarsi, male **K** protari, female **L** spermatheca.

width from antennomere I to XI 3.8 : 1.8 : 2.1 : 4.2 : 3.6 : 3.3 : 3.6 : 3.4 : 3.3 : 3.4 : 4.2. ***Pronotum*** 1.62–1.67 times wider than long; lateral margins rounded and apically narrowed, basal margin slightly rounded but slightly depressed at middle, apical

margin truncate; disc with dense fine punctures, without lateral depressions. ***Elytra*** 1.51–1.61 times longer than wide; parallel-sided; disc moderately convex, with dense, fine punctures; apex truncate. Tarsomeres I of front legs swollen in males (Fig. 17J), but not modified in females (Fig. 17K). ***Penis*** (Fig. 17C–E) wide, ca. 4.0 times longer than wide; lateral margins parallel from base to apical 2/5, then basally narrowed, apex broadly rounded; with transverse and longitudinal, strongly sclerotized area near apex, intersecting at middle; tectum weakly sclerotized, elongate from apical 1/8 to basal 1/3, apex rounded; basally broadened in lateral view; ventral surface with broad groove from apex to middle. Endophallic spiculae complex: median endophallic spiculae composed with two pairs of different shapes, one pair elongate and with acute apices near middle, outer pair hook-like; lateral endophallic spiculae composed of longitudinal row of hook-like, larger setae ventrally located, small setae dorsally located. ***Gonocoxae*** (Fig. 17G) slender, tightly conjunct from apex to apical 2/5; each gonocoxa with nine setae from apical 1/5 to apex, some setae smaller, subapically widened, apex obliquely truncate. ***Ventrite*** VIII (Fig. 17F) strongly sclerotized except apex, with a number of long setae at sides, short setae along apical margin, spiculum elongate. S***permathecal receptaculum*** (Fig. 17L) strongly swollen, with one transverse, erect sclerite; pump slender and curved; sclerotized spermathecal duct short (broken), but base extremely wide. Bursal sclerites well developed, dorsal bursal sclerites larger (Fig. 17H), with one longitudinal row of seven stout setae; the ventral bursal sclerites smaller (Fig. 17I), with one longitudinal row of 13 or 14 small denticles.

Diagnosis. *Chinochya unifasciata* is similar to *C. sublata*. They cannot be separated based on their external morphology, however, *C. unifasciata* (Fig. 17C–E) differs from *C. sublata* (Fig. 16C–E) based on genitalic characters as follow: median endophallic spiculae composed of two pairs of sclerites (three different pairs of sclerites in *C. sublata*); lateral endophallic spiculae longitudinally arranged (transversely arranged in *C. sublata*); ventral bursa sclerite with 13 or 14 small denticles (seven or eight small denticles in *C. sublata*).

Distribution. Widespread but scattered in Taiwan.

Key to genera of Monoleptites with elongate metatarsomere I and species of *Neochya* gen. nov. in Taiwan

1	Subscutellar groove on the elytra present in males	***Paleosepharia*** **Laboissière**
–	Subscutellar groove on the elytra absent in males	**2**
2	Tarsomere I of front legs swollen in males (Fig. 16J, K; 17J, K)	***Chinochya*** **gen. nov.**
–	Tarsomere I not modified in males	**3**
3	Antennomere III longer than II	***Tsouchya*** **gen. nov.**
–	Antennomere III subequal or smaller than II	**4**
4	Prothoracic coxal cavities closed (Fig. 18C)	***Monolepta*** **Chevrolat**
–	Prothoracic coxal cavities open (Fig. 18D)	***Neochya*** **gen. nov. 5**

5 Elytra slender (Figs 2D–F, 4), 1.5–1.7× longer than wide, with apices rounded **6**

– Elytra wide (Figs 4, 9), 1.3–1.4× longer than wide, with apices truncate..... **7**

6 Pronotum and elytra reddish brown (Fig. 2D–F) ..... ***N. tsoui* sp. nov.**

– Pronotum reddish brown and elytra yellowish brown; or pronotum black and elytra with basal half black and apical half yellowish brown (Fig. 7) .... ***N. hirashimai* (Kimoto)**

7 Elytra parallel sided; punctures on pronotum and elytra coarse..... ..... ***N. chengi* sp. nov.**

– Elytra with lateral margins rounded; punctures on pronotum reduced and punctures on elytra fine ..... ***N. nitidissima* (Chûjô)**

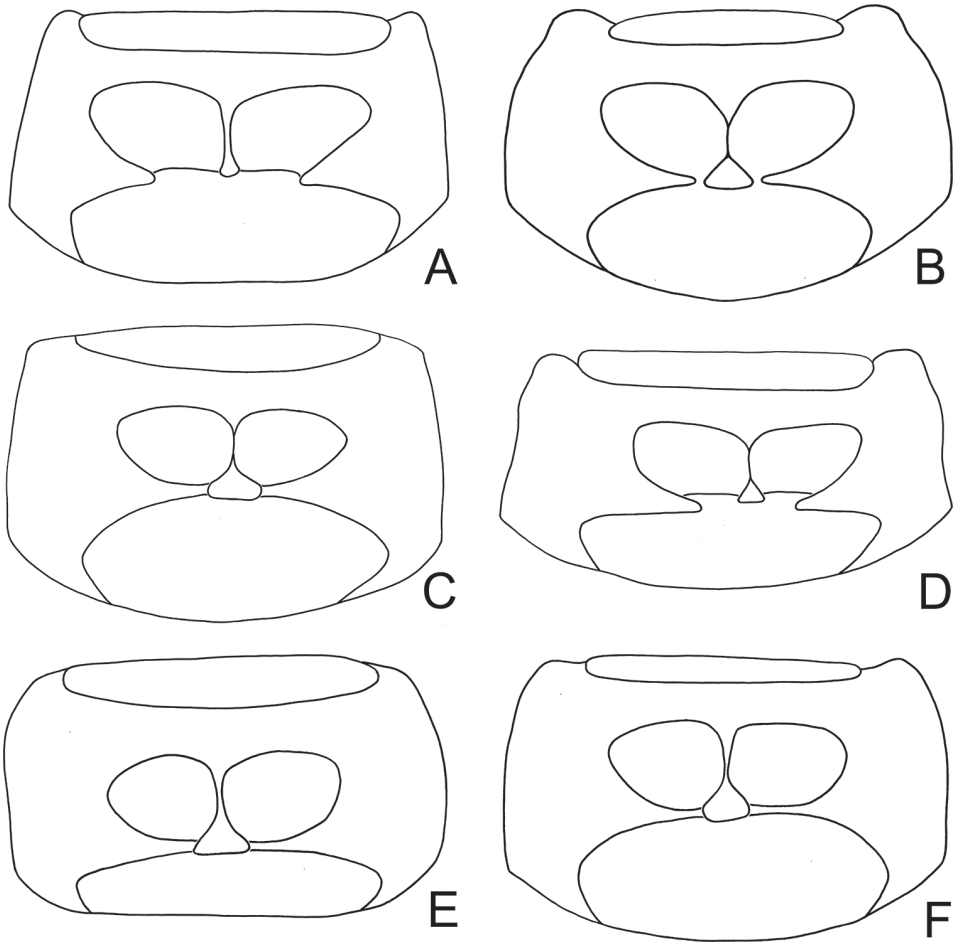

Figure 18. Prothorax, ventral view **A** *Atrachya menetriesii* **B** *Chinochya unifasciata* **C** *Monolepta gracilipes* **D** *Neochya nitidissima* **E** *Paleosepharia formosana* **F** *Tsouchya mediofasciata*.

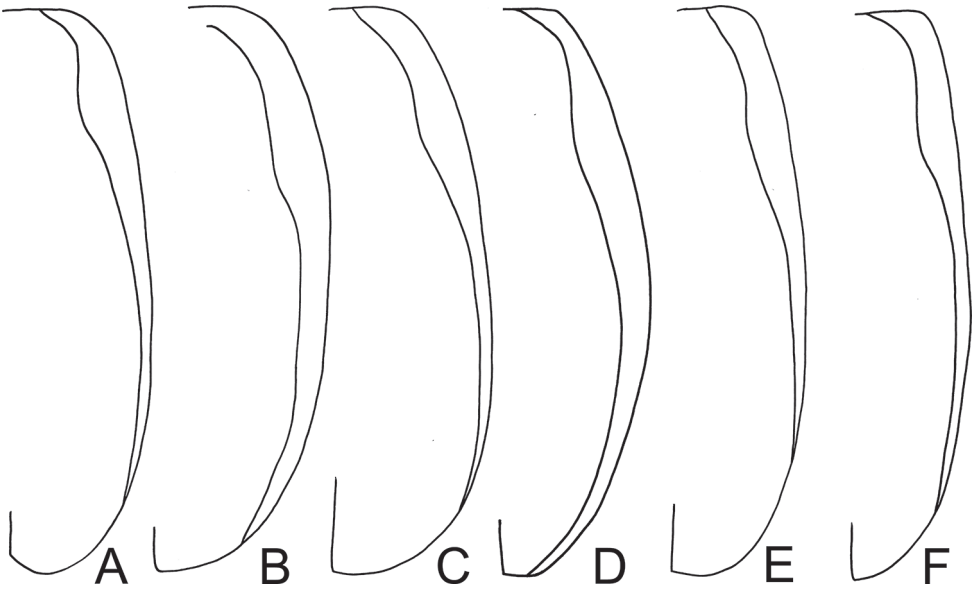

Figure 19. Elytron, ventral view **A** *Atrachya menetriesii* **B** *Chinochya unifasciata* **C** *Monolepta gracilipes* **D** *Neochya nitidissima* **E** *Paleosepharia formosana* **F** *Tsouchya mediofasciata.*

Discussion

A number of genera of Monoleptites in Sundaland with elongate metatarsomeres I were reevaluated and redefined recently, together with new genera, including *Arcastes* Baly, 1865 (Hazmi and Wagner 2010c), *Luperodes* Motschulsky, 1858 (Wagner and Bieneck 2012), *Neolepta* Jacoby, 1884 (Hazmi and Wagner 2013), *Ochralea* Clark, 1865 (Hazmi and Wagner 2010a), *Orthoneolepta* Hazmi & Wagner, 2013, *Paraneolepta* Hazmi & Wagner, 2013, *Rubrarcastes* Hazmi & Wagner, 2010a. This high supraspecific diversity occurs in both Oriental and African regions (Wagner 2007). However, no endemic genera were known in the eastern Palaearctic region, which includes Taiwan. The present study revealed that high supraspecific diversity may also occur in this area when more species of *Monolepta* and *Atrachya* are studied in detail. In addition, a number of genera appear in mainland China, Vietnam, Laos, and Thailand, including *Macrima* Baly, 1878, *Pseudosepharia* Laboissière, 1936, and *Desbordelepta* Nguyen & Gómez-Zurita, 2017. They are awaiting redescription and comprehensive revision.

Reliable diagnostic characters for the supraspecific taxonomy of Monoleptites with elongate metatarsomeres I have been limited. Color patterns are useful for most Oriental genera, but not diagnostic for east Palaearctic genera. This character in most species of *Neochya* and *Tsouchya* is variable, and in *N. nitidissima* and *T. mediofasciata* it is extremely variable. Although color patterns of *Chinochya* species are similar, some species of *Monolepta* share these patterns, including *M. leechi* Jacoby, 1890 and *M. maana* Gressitt & Kimoto, 1963.

Prothoracic coxal cavities have been used for diagnosis of genera within this group of Monoleptites. This character was evaluated in *Atrachya menetriesii*, all species of *Neochya*, *Chinochya*, *Tsouchya*, Taiwanese species of *Paleosepharia*, and *Monolepta*. It can be separated into three states: widely open for *Atrachya* (Fig. 18A) and *Neochya* (Fig. 18D), almost closed for *Chinochya* (Fig. 18B), completely closed for *Monolepta* (Fig. 18C), *Paleosepharia* (Fig. 18E), and *Tsouchya* (Fig. 18F).

Elytral epipleurae of *Paleosepharia* (Fig. 19C) are abbreviated before the middle and this has been considered diagnostic (e.g., Lee 2018). However, interpreting subtle differences in character states is difficult when comparing it in other related genera (Fig. 19). It is not diagnostic for distinguishing *Paleosepharia* from others. In addition, few female genitalic characters have been used as diagnostic characters. Spermathecae are poorly illustrated, and abdominal ventrites VIII and gonocoxae were usually ignored in most papers. This study supports the use of these characters as diagnostic provided that descriptions are supported by good quality illustrations.

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References

Baly JS (1865) Descriptions of new genera and species of Galerucidae. The Entomologist's Monthly Magazine 2: 127–128.

Chevrolat LAA (1836) [new taxa]. In: Dejean PFAM (Ed.) Catalogue des Coléoptères de la Collection de M. le Comte Dejean. Deuxième edition. Livraison 5. Méquignon-Marvis Père et Fils, Paris, 361–442.

Chûjô M (1935) H. Sauter's Formosa-Ausbeute: Subfamily Galerucinae (Coleoptera: Chrysomelidae). Arbeiten über Morphologische und Taxonomische Entomologie aus Berlin-Dahlem 2: 160–174.

Chûjô M (1938) H. Sauter's Formosa-Collection: subfamily Galerucinae (Coleoptera: Chrysomelidae). Arbeiten über Morphologische und Taxonomische Entomologie aus Berlin-Dahlem 5: 135–152.

Chûjô M (1962) A taxonomic study on the Chrysomelidae (Insecta: Coleoptera) from Formosa Part XI. Subfamily Galerucinae. The Philippine Journal of Science 91: 1–239.

Faldermann F (1835) Coleopterorum ab illustrissimo Bungio in China boreali, Mongolia, et Mantibus Altacis collectorum, nec non ab ill. Turczaninoffio et Stchukino e provincial Irkutsk missorum illustrations. Mémoires présentés à l'Académie Impériale des Sciences de Staint-Pétersburg (6) Sciences Mathématiques, Physiques et Naturelles 2: 337–464.

Gressitt JL, Kimoto S (1963) The Chrysomelidae (Coleopt.) of China and Korea Part 2. Pacific Insects Monograph 1B: 301–1026.

Hazmi IR, Wagner T (2010a) Revalidation and revision of *Ochralea* Clark, 1865 (Coleoptera: Chrysomelidae: Galerucinae) from the oriental region. Zootaxa 2530: 47–59. https://doi.org/10.11646/zootaxa.2530.1.5

Hazmi IR, Wagner T (2010b) *Rubrarcastes* gen. nov., a new group of Oriental galerucine leaf beetles (Coleoptera: Chrysomelidae, Galerucinae). Entomologische Zeitschrift, Stuttgart 120: 85–88.

Hazmi IR, Wagner T (2010c) Revision of *Arcastes* Baly, 1865 from the Oriental region (Coleoptera, Chrysomelidae, Galerucinae). ZooKeys 42: 79–99. https://doi.org/10.3897/zookeys.42.336

Hazmi IR, Wagner T (2013) Revision of *Neolepta* Jacoby, 1884 and related galerucines from the oriental region, including descriptions of two new genera (Coleoptera: Chrysomelidae: Galerucinae). The Raffles Bulletin of Zoology 61: 73–95.

Hornstedt CF (1788) Beschreibung neuer Blattkäferarten. Schriften der Gesellschaft Naturforschender Freunden zu Berlin 8 [1787]: 1–8.

Kimoto S (1966) A list of the chrysomelid specimens of Taiwan preserved in the Zoological Museum, Berlin. Esakia 5: 21–38.

Kimoto S (1969) Motes on the Chrysomelidae from Taiwan II. Esakia 7: 1–68.

Kimoto S (1976) Notes on the Chrysomelidae from Taiwan, VIII. The Entomological Review of Japan 29: 1–9.

Kimoto S (1986) The Chrysomelidae (Insecta: Coleoptera) collected by the Nagoya University Scientific Expedition to Taiwan in 1984. Kurume University Journal 35: 53–62.

Kimoto S (1987) The Chrysomelidae (Insecta: Coleoptera) collected by the Nagoya University Scientific Expedition to Taiwan in 1986. Kurume University Journal 36: 183–194.

Kimoto S (1989) The Taiwanese Chrysomelidae (Insecta: Coleoptera) collected by Dr. Kintaro Baba, on the occasion of his entomological survey in 1983 and 1986. Kurume University Journal 38: 237–272.

Kimoto S (1991) The Taiwanese Chrysomelidae (Insecta: Coleoptera) collected by Dr. Kintaro Baba, on the occasion of his entomological survey in 1987, 1988 and 1989. Kurume University Journal 40: 1–27.

Lee C-F (2009) A taxonomic revision of *Monolepta pallidula* species group in Taiwan (Coleoptera: Chrysomelidae: Galerucinae). Zootaxa 2070: 15–27. https://doi.org/10.11646/zootaxa.2170.1.2

Lee C-F (2018) The genus *Paleosepharia* Laboissière, 1936 in Taiwan: review and nomenclatural changes (Coleoptera, Chrysomelidae, Galerucinae). ZooKeys 744: 19–41. https://doi.org/10.3897/zookeys.744.22970

Motschulsky V (1858) Insects des Indes orientales 1:1ère Serie. Études Entomologiques 7: 20–122.

Nie RE, Bezděk J, Yang XK (2017) How many genera and species of Galerucinae s. str. do we know? Updated statistics (Coleoptera, Chrysomelidae). ZooKeys 720: 91–102. [supplementary file] https://doi.org/10.3897/zookeys.720.13517

Rizki A, Hazmi IR, Wagner T, Idris AB (2016) Redescription of *Paleosepharia trunctata* Laboissiére, 1936, type species of the genus *Paleosepharis* Laboissiére, 1936 (Coleoptera: Chrysomelidae: Galerucinae). The Coleopterists Bulletin 70: 395–398. https://doi.org/10.1649/0010-065X-70.2.395

Takizawa H (1978) Notes on Taiwanese Chrysomelidae, I. Kontyû 46: 123–134.

Wagner T (2007) *Monolepta* Chevrolat, 1837 the most speciose galerucine taxon: redescription of the type species *Monolepta bioculata* (Fabricius, 1781) and key to related genera from (Chrysomelidae, Coleoptera). Journal of Natural History 41: 81–100. https://doi.org/10.1080/00222930601127384

Wagner T, Bieneck S (2012) Galerucine type material described by Victor Motschulsky in 1858 and 1866 from the Zoological Museum Moscow (Coleoptera: Chrysomelidae, Galerucinae). Entomologische Zeitschrift, Stuttgart 122: 205–216.

Weise J (1892) Chrysomeliden and Coccinelliden von der Insel Nias, nebst Bemerkungen über andere, meist südostasiatische Arten. Deutsche Entomologische Zeitschrift 1892: 385–400. https://doi.org/10.1002/mmnd.48018920128

Wilcox JA (1973) Chrysomelidae: Galerucinae (Luperini: Luperina). In: Wilcox JA (Ed.) Coleopterorum Catalogus Supplementa. Pars 78(3), Second edition. W Junk, 's-Gravenhage, 433–664.