

# The status of *Acleotrema* Johnston & Tiegs, 1922 and *Heteroplectanum* Rakotofiringa, Oliver & Lambert, 1987 (Monogenoidea: Diplectanidae), with the redescription of *Acleotrema* *girellae* Johnston & Tiegs, 1922

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**Abstract** *Acleotrema* Johnston & Tiegs, 1922 is resurrected and its diagnosis amended. *A. girellae* Johnston & Tiegs, 1922 is redescribed based on the lectotype from the Australian Museum (Sydney, Australia). *A. kyphosi* Yamaguti, 1968 is considered a junior synonym of *A. girellae*. *Heteroplectanum* Rakotofiringa, Oliver & Lambert, 1987 is considered a junior synonym of *Acleotrema*. The nine species of the latter genus are transferred to *Acleotrema* as: *A. diplobulbus* (Yamaguti, 1968) n. comb., *A. nenue* (Yamaguti, 1968) n. comb., *A. spiculare* (Yamaguti, 1968) n. comb., *A. yamagutii* (Oliver, 1983) n. comb., *A. nenuoides* (Rakotofiringa, Oliver & Lambert,

1987) n. comb., *A. parastromatei* (Rakotofiringa, Oliver & Lambert, 1987) n. comb., *A. serrulopenis* (Rakotofiringa, Oliver & Lambert, 1987) n. comb., *A. tamatavense* (Rakotofiringa, Oliver & Lambert, 1987) n. comb. and *A. oliveri* (León-Règagnon, Pérez-Ponce de León & Garcia-Prieto, 1997) n. comb. An historical account of the species of *Acleotrema* is presented.

## Introduction

*Acleotrema* Johnston & Tiegs, 1922 was proposed by Johnston and Tiegs (1922) to accommodate their new species, *A. girellae* Johnston & Tiegs, 1922, from the gills of *Girella tricuspidata* (Quoy & Gaimard) (Perciformes: Kyphosidae) collected off Caloundra, southeast of Queensland, Australia. The genus was characterised by possessing a haptor armed with four anchors, 14 hooks and 15 rows of modified scales (rodlets), a thin-walled vagina thin-walled, a male copulatory organ surrounded by a muscular sac, and both reproductive organs communicating with a chitinous cavity. Price (1937) considered *Acleotrema* a junior synonym of *Diplectanum* Diesing, 1858, based on the presence of squamodiscs. However, Yamaguti (1963) accepted *Acleotrema* as a valid genus. Yamaguti (1968) described *A. kyphosi* Yamaguti, 1968 [the types are listed as *Diplectanum* in USNPC] from the gills of *Kyphosus cinerascens* (Forsskål) collected off

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Hawaii and suggested that Johnston and Tiegs (1922) misinterpreted some of the reproductive structures of *A. girellae*. Young (1972) reported '*A. gibsoni* Johnston & Tiegs, 1922' from *G. tricuspidata* and '*A. heronensis* Young, 1969' from *K. cinerascens* and *K. waigiensis* Quoy & Gaimard (= *K. gibsoni*) collected off Queensland, Australia. However, Oliver (1987) considered the designation of '*A. gibsoni*' a typographical error and that the species reported by Young (1972) represented *Diplectanum girellae* (Johnston & Tiegs, 1922) and also considered '*A. heronensis*' a *nomen nudum*, since Young (1969) did not describe any species of *Acleotrema* [the 'types' of *heronensis* are listed as *A. kyphosi* in the USNPC]. Rakotofiringa, Oliver, and Lambert (1987) proposed *Heteroplectanum* Rakotofiringa, Oliver & Lambert, 1987 to receive *H. diplobulbus* (Yamaguti, 1968), *H. nenuoides* Rakotofiringa, Oliver & Lambert, 1987 (type-species), *H. nenu* (Yamaguti, 1968), *H. parastromatei* Rakotofiringa, Oliver & Lambert, 1987, *H. serrulopenis* Rakotofiringa, Oliver & Lambert, 1987 and *H. tamatavense* Rakotofiringa, Oliver & Lambert, 1987. These species are characterised by possessing squamodiscs with divergent rows of dumbbell-shaped rodlets, with the two most internal rows in a 'V'-shape. Oliver (1987) transferred *D. spiculare* Yamaguti, 1968 and *D. yamagutii* Oliver, 1983 to *Heteroplectanum*. León-Règagnon, Pérez-Ponce de León, and García-Prieto (1997) reported *H. nenu* and *H. kyphosi* (Yamaguti, 1968), and described *H. oliveri* León-Règagnon, Pérez-Ponce de León & García-Prieto, 1997 from the gills of *K. elegans* (Peters) collected in Chamela Bay, Mexico.

This study presents arguments to resurrect *Acleotrema* and to consider *Heteroplectanum* its junior synonym. A list of valid species and new combinations is presented.

## Materials and methods

Type-material and vouchers of the following species were examined: 4 paratypes, *Acleotrema kyphosi* Yamaguti, 1968, United States National Parasite Collection (USNPC), USA, no. 63150; 6 vouchers, *A. kyphosi*, Queensland Museum (QM), Australia, no. GL 13643–13648; vouchers, *Acleotrema* sp., QM no. GL 13649–13657; voucher, *Diplectanum diplobulbus* Yamaguti,

1968, USNPC no. 63663.02; paratype, *D. kyphosi* Yamaguti, 1968, USNPC no. 63663.02; holotype, *D. spiculare* Yamaguti, 1968, USNPC no. 63663.02; syntype, *D. yamagutii* Oliver, 1983, USNPC no. 63663.02; paratype, *Heteroplectanum nenuoides* Rakotofiringa, Oliver & Lambert, 1987, Muséum national d'Histoire naturelle (MNHN), Paris, France, no. 59 HC-i 102; paratypes, *H. oliveri* León-Règagnon, Pérez-Ponce de León & García-Prieto, 1997, USNPC no. 84878; paratypes, *H. parastromatei* Rakotofiringa, Oliver & Lambert, 1987, MNHN no. 61 HC-i 104–105; holotype of *H. serrulopenis* Rakotofiringa, Oliver & Lambert, 1987, MNHN no. 62 HC-i 106–107; and voucher, *H. tamatavense* Rakotofiringa, Oliver & Lambert, 1987, MNHN no. 59 HC-i 102. One specimen of *Acleotrema girellae* deposited at the Australian Museum (AM), Australia, no. W885 is designated here as the lectotype.

The measurements, all in micrometres, were made according to the procedures of Mizelle and Klucka (1953) except for the measurements of the male copulatory organ that are represented by: (1) the diameter of the proximal bulbous portion (sac); and (2) its length and width. The dimensions of organs and other structures represent the greatest measurement in dorsoventral view; lengths of curved or bent structures (anchors, bars, male copulatory organ) represent straight line distances between extreme ends. The average measurements are followed by the range and number of specimens measured (n) in parentheses. Illustrations were prepared with aid of camera lucida attached to a phase-contrast or differential interference contrast (DIC) microscope.

## **Polyonchoinea** Bychowsky, 1937

### **Dactylogyridea** Bychowsky, 1937

#### **Diplectanidae** Monticelli, 1903

#### ***Acleotrema* Johnston & Tiegs, 1922**

Syn. *Heteroplectanum* Rakotofiringa, Oliver & Lambert, 1987 (new synonymy)

#### *Amended diagnosis*

Body slightly flattened dorso-ventrally, divided into cephalic region, trunk, peduncle, haptor.

**Table 1** List of species of *Acleotrema*, host species and host family

Species	Host	Family
<i>Acleotrema girellae</i> Johnston & Tieg, 1922	<i>Girella tricuspidata</i> (Quoy & Gaimard) <i>Kyphosus elegans</i> (Peters)	Kyphosidae Kyphosidae
<i>A. diplobulbus</i> Yamaguti, 1968	<i>K. cinerascens</i> (Forsskål)	Kyphosidae
<i>A. nenuoides</i> (Rakotofringa, Oliver & Lambert, 1987) n. comb.	<i>K. cinerascens</i> (Forsskål)	Kyphosidae
<i>A. nenu</i> (Yamaguti, 1968) n. comb.	<i>Rhabdosargus sarba</i> (Forsskål)	Sparidae
	<i>Polyamblyodon gibbosum</i> (Pellegrin)	Sparidae
	<i>K. elegans</i>	Kyphosidae
	<i>K. cinerascens</i>	Kyphosidae
<i>A. oliveri</i> (León-Règagnon, Pérez-Ponce de León & Garcia Prieto, 1997) n. comb.	<i>K. elegans</i>	Kyphosidae
	<i>K. sectator</i> (Linnaeus)	Kyphosidae
	<i>K. vaigiensis</i> (Quoy & Gaimard)	Kyphosidae
<i>A. parastromatei</i> (Rakotofringa, Oliver & Lambert, 1987) n. comb.	<i>Parastromateus niger</i> (Bloch)	Carangidae
<i>A. serrulopenis</i> (Rakotofringa, Oliver & Lambert, 1987) n. comb.	<i>R sarba</i>	Sparidae
	<i>P. gibbosum</i>	Sparidae
<i>A. spiculare</i> (Yamaguti, 1968) n. comb.	<i>K. cinerascens</i>	Kyphosidae
<i>A. tamatavense</i> (Rakotofringa, Oliver & Lambert, 1987) n. comb.	<i>P. gibbosum</i>	Sparidae
<i>A. yamagutii</i> (Oliver, 1983) n. comb.	<i>K. cinerascens</i>	Kyphosidae

Tegument scaled. Two terminal and 2 bilateral cephalic lobes. Head organs present; cephalic glands at level of pharynx. Eye-spots 2 pairs. Mouth subterminal; pharynx muscular, glandular; oesophagus short; intestinal caeca non-confluent, lacking diverticula. Genital pore mid-ventral; genital atrium sclerotised. Gonads intercaecal, tandem. Testis dorso-posterior to germarium. Vas deferens intercaecal; seminal vesicle a sigmoid dilatation of vas deferens. Male copulatory organ comprising 2 nested tubes surrounded by slightly sclerotised sac; male copulatory organ anterior to genital pore; accessory piece absent. Vagina sinistral. Seminal receptacle immediately anterior to germarium. Vitelline follicles extend throughout trunk, except in regions of major reproductive organs. Haptor with 3 bars, 1 mid-ventral and 2 latero-dorsal; 2 pairs of anchors; ventral and dorsal squamodiscs with articulated rodlets forming divergent rows; internal rows 'V'-shaped; 7 pairs of similar hooks (5 ventral, 2 dorsal). Parasitic on gills of perciform fishes.

*Type-species:* *A. girellae* Johnston & Tieg, 1922 from *Girella tricuspidata* (Quoy & Gaimard) (Perciformes: Kyphosidae).

*Other species:* Table 1.

#### Remarks

Price (1937) considered *Acleotrema* a junior synonym of *Diplectanum*, based on the following characteristics: (1) squamodiscs consisting of concentric rings of thorns similar to scales; (2) great hooks (=anchors) on haptor supported by three transverse bars; and (3) vagina present or absent. However, species of *Acleotrema* share unique features and can be distinguished from other diplectanids (including species of *Diplectanum*) by having: (1) squamodiscs with articulated rodlets forming divergent rows, and with the internal rows in a 'V'-shape; (2) a male copulatory organ surrounded by a slightly-sclerotised sac; and (3) a heavily sclerotised genital atrium.

Rakotofringa et al. (1987) proposed *Heteroplectanum* for diplectanids with squamodiscs consisting of divergent rows of dumbbell-shaped rodlets, with the two more internal rows in a 'V'-shape. However, all species of *Acleotrema* share this feature and possess a relatively uniform male copulatory organ morphology that is fundamentally similar to that of *Heteroplectanum*. Species previously allocated to *Acleotrema* and *Heteroplectanum* are, thus, congeneric. *Acleotrema* has temporal priority and, consequently,

*Heteroplectanum* must be suppressed and considered its subjective junior synonym. Hence, the species of that latter genus are hereby transferred to *Acleotrema* as *A. diplobulbus* (Yamaguti, 1968) n. comb., *A. nenu* (Yamaguti, 1968) n. comb., *A. spiculare* (Yamaguti, 1968) n. comb., *A. yamagutii* (Oliver, 1983) n. comb., *A. nenuoides* (Rakotofiringa, Oliver & Lambert, 1987) n. comb., *A. parastromatei* (Rakotofiringa, Oliver & Lambert, 1987) n. comb., *A. serrulopenis* (Rakotofiringa, Oliver & Lambert, 1987) n. comb., *A. tamatavense* (Rakotofiringa, Oliver & Lambert, 1987) n. comb. and *A. oliveri* (León-Règagnon, Pérez-Ponce de León & Garcia-Prieto, 1997) n. comb.

The microscope slide containing the type-specimens of *A. nenuoides* from the gills of *Rhabdosargus sarba* (Forsskål) from Tamatave, Madagascar (MNHN no. 59 HC-i 102) also includes a specimen of *A. tamatavense*, easily identified by the morphology of the haptor and the male copulatory organ.

The analysis of specimens of *Acleotrema* sp. from the gills of *Kyphosus vaigiensis* (Quoy & Gaimard) from off Green Island, Queensland, Australia (QM no. GL 13653–13657) and *K. sectator* (Linnaeus) off Tortugas, Mexico (QM no. 13650 and 13652), both deposited by P.C. Young, and the type-specimens of *A. oliveri* (USNPC 84878) indicates that they are conspecific, based on the morphology of the male copulatory organ and the similarity of their hosts. These specimens have the anterior portion of the internal tube of the male copulatory organ armed with spines. However, due to the poor condition of Young's specimens, the elongate sac associated with the male copulatory organ could not be observed. This species is apparently specific to members of the Kyphosidae having been found on three species of *Kyphosus* (see Table 1). The specimens collected off Mexico and Australia did not significantly differ morphometrically, extending distribution of *A. oliveri* to Australia.

The slides containing specimens identified as *Acleotrema* sp., a parasite of *Kyphosus sectator* from off Mexico (QM no. GL 13649 and 13651), appears to represent specimens of *A. diplobulbus*. However, we could not confidently confirm the

specific and generic status of this material, because the specimens are not adequate for a detailed study of their morphology.

Kritsky and Boeger (1989) assumed that the presence of the vas deferens looping the right intestinal caecum is symplesiomorphic for the Diplectanidae. Indeed, this feature has been described for several species (Bychowsky & Nagibina, 1977; Domingues, 2004; Kritsky & Thatcher, 1984; Kritsky, Jiménez-Ruiz, & Sey, 2000; Yamaguti, 1968; Zambrano, 1997). This proposal is supported by the sharing of this character with the other familial taxa of the Dactylogyrinea. The presence of an intercaecal vas deferens in *Acleotrema* suggests that this feature may represent a potentially informative character (synapomorphy) within the family.

#### ***Acleotrema girellae* Johnston & Tiegs, 1922**

Syns *Diplectanum girellae* (Johnston & Tiegs, 1922) Price, 1937; *A. gibsoni* Young, 1972 (*nomen nudum*); *A. heronensis* Young, 1970 (*nomen nudum*); *A. kyphosi* Yamaguti, 1968 (new synonymy)

*Type-host*: *Girella tricuspidata* (Quoy & Gaimard) (Perciformes: Kyphosidae).

*Type-locality*: Off Caloundra, southeast of Queensland, Australia.

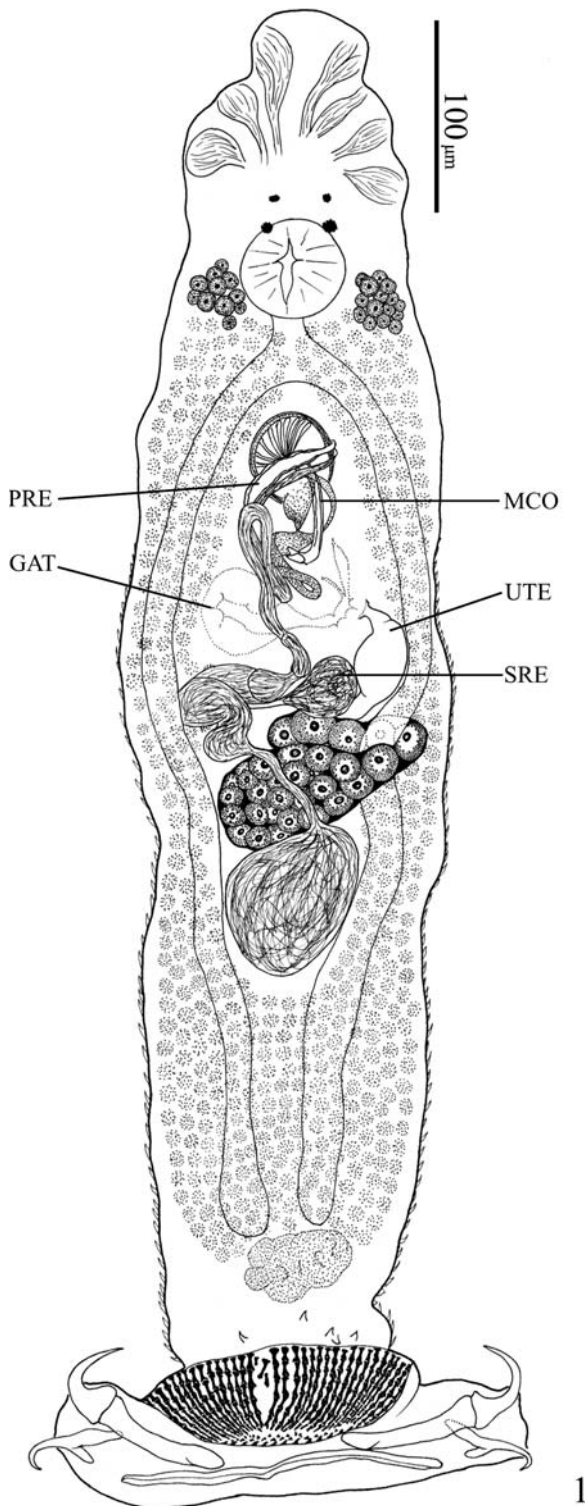
*Other hosts and localities*: *Kyphosus cinerascens* (Forsskål) from off Hawaii; *K. cinerascens* from off Heron Island, Queensland, Australia; *K. elegans* (Peters) from Chamela Bay, Jalisco, Mexico; *K. vaigiensis* Quoy & Gaimard from off Heron Island, Queensland, Australia.

*Site*: Gills.

*Material examined*: Lectotype, AM no. W885; vouchers, USNPC no. 63663.02; USNPC no. 63149–63151; QM no. GL 13643–13648.

#### Redescription (Figs. 1–7)

[Based on the lectotype]. Body fusiform 605 long, 119 wide, at level of germarium. Tegumental scales, with acute anterior margins, directed anteriorly; extend from peduncle to level of genital atrium. Cephalic lobes well developed; head organs conspicuous, 3 pairs; cephalic glands, unicellular, bilateral to pharynx. Two pairs of eye-spots, equidistant; granules elongate-oval;



**Fig. 1** *Acleotrema girellae*. Lectotype (dorsal view). Abbreviations: GAT, genital atrium; MCO, male copulatory organ; PRE, prostatic reservoir; SRE, seminal receptacle; UTE, uterus

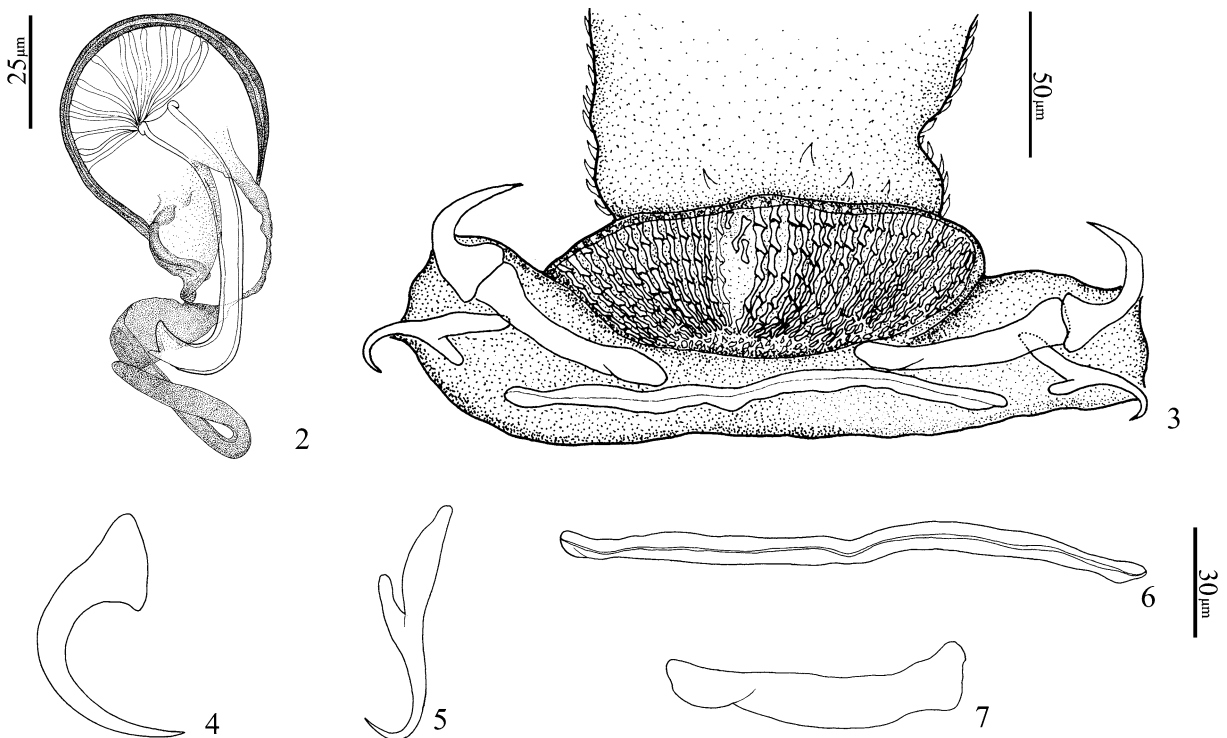
accessory granules common in cephalic area. Pharynx oval, 34 in diameter; oesophagus short. Haptor laterally expanded, 61 long, 180 wide. Squamodiscs oval 93 long, 34 wide; each formed by approximately 38 divergent rows of dumbbell-shaped rodlets. Ventral anchor 42 long, with base 5 wide; elongate deep root twice as long as superficial root; shaft slightly curved and continuous with point. Dorsal anchor 37 long, base 16 wide; shaft and point evenly curved. Ventral bar 118 long, with mid-ventral longitudinal groove, tapered ends. Dorsal bars, similar; each bar 50 long; internal ends expanded. Hooks not observed. Male copulatory organ tubular, 64 long, 5 wide; recurved distal end bifid. Proximal portion of male copulatory organ surrounded by sclerotised sac with radial musculature associated with base of male copulatory organ; distal portion of sac with elongate ventral sclerotised process, directed towards genital atrium; sac 34 in diameter. Testis 65 long, 50 wide; vas deferens sinuous. Prostatic reservoir fusiform, muscular, parallel to seminal vesicle. Germarium 85 long, 30 wide; oötype not observed. Vaginal aperture not observed; vaginal channel narrow, not sclerotised, opens into pyriform seminal receptacle. Uterus sinistral, parallel to left intestinal caecum. Genital atrium wide, heavily sclerotised. Vitelline follicles dense. Eggs not observed.

#### Remarks

*Acleotrema girellae* differs from its congeners by having: (1) a tubular male copulatory organ with the distal extremity recurved and bifid; and (2) a sclerotised sac with radial musculature involving the proximal portion of male copulatory organ.

The presence of two pairs of unicellular glands in the haptor described by Johnston and Tiegs (1922) from *A. girellae* could not be confirmed. Furthermore, these authors described only 15 juxtaposed rows of dumbbell-shaped rodlets for each squamodisc. During the evaluation of the lectotype, we detected 38 rows of rodlets for each squamodisc. However, the margins of the squamodiscs were bent, hindering the determination of the total number of rows.

We also detected misinterpretations in the morphological description of the reproductive or-



**Figs. 2–7** Sclerotised structures of *Acleotrema girellae*. 2. Male copulatory organ (dorsal view). 3. Dorsal view of haptor showing dorsal squamodisc. 4. Dorsal anchor. 5.

Ventral anchor. 6. Ventral bar. 7. Dorsal bar. *Scale-bars:* 2,4,5,7, 25 µm; 3, 50 µm; 6, 30 µm

gans and associated structures. Johnston and Tieg (1922) mistook the vagina for the uterus and erroneously identified the prostatic reservoir as the uterus (Fig. 1). They also indicated, in their illustration of the genital organs of an adult worm (plate XIV, illustration 29), the abbreviation ‘go’ as one of the female genital openings, close to the sac of male copulatory organ. However, examination of the lectotype suggests that Johnston and Tieg (1922) confused the distal area of the prostatic reservoir with this structure. We could not observe the vaginal opening, since the single available specimen was mounted dorsally.

Comparison of the paratypes and other specimens of *A. kyphosi* with the lectotype of *A. girellae* confirms that these specimens are conspecific. Yamaguti (1968) distinguished *A. kyphosi* from the other species based on the presence of tooth-like projections at the borders of the genital atrium. However, upon study of the slide (USNPC no. 63663.02) bearing the paratypes, this apparent

diagnostic feature could not be observed, suggesting the existence of intraspecific variation. The study of paratypes and vouchers of *A. kyphosi* confirms the bifid condition of the distal portion of the male copulatory organ. The drawing of the male copulatory organ given by and the morphology described by Yamaguti (1968) clearly show that this author confused the distal portion of the male copulatory organ with the distal portion of the sac, which is projected over the male copulatory organ (plate XXIV, illustration 97B). The size and form of the remaining sclerotised structures are not significantly different. *A. kyphosi* is, thus, considered a junior synonym of *A. girellae*.

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