



Research article

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Cyrioctea (Araneae, Zodariidae) in Africa: temperate Gondwanaland relict, recent radiation, or both?

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Abstract. Two new species of the zodariid genus *Cyrioctea* Simon, 1889 are described: *C. sawadee* sp. nov. and *C. lotzi* sp. nov., both only known from males. The genus now contains seven Afrotropical species and this abundance is discussed in the context of its basal situation in the family and its apparent temperate Gondwanaland distribution, which implies a much greater age of the Zodariidae than presently accepted. Unlike most taxa with a temperate Gondwana distribution, *Cyrioctea* boasts a high number of species with small distribution areas. This points in the direction of a recent radiation initiated after a long period of stasis.

Keywords. Cyriocteinae, distribution area, complexity, identification key.

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Introduction

The spider genus *Cyrioctea* is remarkable in many ways. The spiders are characterized by a transverse row of, most often six, short but sturdy spines between the eye rows. These are assumed to constitute a burrowing device. *Cyrioctea* do indeed live under ground and females, that hardly ever emerge from their burrows, are very rarely collected. Although the position of the genus has been the subject of some debate, these spiders clearly belong to the Zodariidae (Jocqué 1991): they lack a serrula and are provided with long anterior lateral spinnerets. Since the claw teeth are positioned in the axis of the claw, they were considered as the sister group of all other Zodariidae, in which the claws are positioned on the side of the claw facing the other one. The first cladistic analysis of the family on genus level therefore used *Cyrioctea* as the outgroup. A recent unpublished cladistic analysis (Jocqué 2006) on morphological grounds with *Amaurobius* as outgroup (see Jocqué & Dippenaar 2007), finds *Cyrioctea* in the same position at the root of the Zodariidae, thus sister to all other genera in the family.

Because of its ancestral character it is not surprising to find the genus on three continents: Africa, South America and Australia (Platnick 1986; Platnick & Griffin 1988; Platnick & Jocqué 1992). This is a typical temperate Gondwanaland distribution with all the localities on the southern tip of the continents. On the other hand, the complexity of the male genitalia is startling. Moreover, the species appear to have

very small distribution areas, which is also puzzling as the Gondwanaland relicts have been assumed to be leftovers of old radiations with a large distribution.

The present paper describes two new species, gives an overview and a distribution map of African *Cyrioctea* species. A key to the males is provided.

Material and methods

All material is preserved in 70% ethanol. Specimens were observed and measured with a Leica M10 stereo microscope. Photographs were taken with a Leica MZ16 using the LAS automontage software. Drawings were carried out with a camera lucida on a WILD M5.

All measurements are in millimetres.

Abbreviations

ALE	=	Anterior Lateral Eyes
AME	=	Anterior Median Eyes
CA	=	Central apophysis
d	=	dorsal
DA	=	Distal apophysis
dw	=	distal whorl
DTA	=	Dorsal tibial apophysis
E	=	Embolus
F	=	Femur
MA	=	median apophysis
Mt	=	Metatarsus
NCA	=	National Collection of Arachnids, Pretoria (A. Dippenaar)
NMBA	=	National Museum Bloemfontein, Arachnids (L. Lotz)
P	=	Patella
PLE	=	Posterior Lateral Eyes
PME	=	Posterior Median Eyes
pl	=	prolateral
rl	=	retrolateral
RTA	=	retrolateral tibial apophysis
T	=	Tibia
v	=	ventral

Results

Taxonomic descriptions

Class Arachnida Cuvier, 1812
Order Araneae Clerck, 1757
Family Zodariidae Thorell, 1881
Subfamily Cyriocteinae Jocqué, 1991
Genus *Cyrioctea* Simon, 1889

Remarks

The genus *Cyrioctea* was described by Simon (1889), on a species from South America and redescribed in detail by Platnick (1986) and Jocqué (1991). *Cyrioctea* now contains 13 species of which five occur in

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South America, one in Australia (Platnick 2012) and seven in southern Africa. These African species are *C. griswoldorum* Platnick & Jocqué, 1992 (♂), *C. hirsuta* Platnick & Griffin, 1988 (♀), *C. lotzi* sp. nov. (♂), *C. marken* Platnick & Jocqué, 1992 (♂), *C. namibensis* Platnick & Griffin, 1988 (♂♀), *C. sawadee* sp. nov. (♂) and *C. whartoni* Platnick & Griffin, 1988 (♂♀).

Key to the males of African *Cyrioctea* (*C. hirsuta* only known from females)

- 1 Male palpal tibia with dorsal apophysis clearly separated from broad RTA which is provided with tooth on inferior margin2
- Male palpal tibia without dorsal apophysis; RTA without tooth on inferior margin3
- 2 Dorsal apophysis much shorter than RTA, which is roughly triangular and pointed; abdomen dark grey except for white spot above spinnerets*C. griswoldorum* Platnick & Jocqué, 1992
- Dorsal apophysis almost as long as RTA, which is roughly rectangular and broadly truncated; abdomen pale with dark pattern of central spot followed by transverse bands (Fig 1A)*C. sawadee* sp. nov.
- 3 RTA a single sharp, down-curved prong*C. namibensis* Platnick & Griffin, 1988
- RTA bifid4
- 4 Ventral tip of RTA longer than dorsal tip; distal tegular apophysis with narrow tip
.....*C. whartoni* Platnick & Griffin, 1988
- Ventral tip of RTA shorter than dorsal tip; distal tegular apophysis broadly truncated5
- 5 Ventral tip of RTA a tiny prong, much smaller than dorsal tip; median apophysis without median spur at base (Fig. 3E)*C. lotzi* sp. nov.
- Ventral tip of RTA not so small; median apophysis with median spur at base
.....*C. marken* Platnick & Jocqué, 1992

Cyrioctea sawadee sp. nov.

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Figs 1A-C, 2A-B, 3A-C, 4

Diagnosis

The male of *C. sawadee* sp. nov. can be recognized by the modified third leg with dense spination and very short tibia, and by the characters of the palp, of which the tooth on the ventral margin of the RTA is the most conspicuous. That character is shared with *C. griswoldorum*, which has a shorter dorsal tibial apophysis, the shape of the RTA is triangular rather than rectangular and the abdominal pattern consists of one pale spot on a dark background.

Etymology

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

Type material**Holotype**

SOUTH AFRICA: ♂, Western Cape Province, Sawadee, 32°20.316' S – 18° 49.405' E, Oct. 2007, pittrap, 359 m alt., Nortje E. & Kritzinger-Klopper (NCA).

Paratypes

2 ♂♂, same data as holotype.

Other material examined

None.

Description

Male (holotype, Fig. 1A-C)

MEASUREMENTS. Total length 4.32; carapace 2.14 long, 1.22 wide; TI+PI: 1.95.

COLOUR. Carapace brownish yellow with black fovea and dark margin; palp, chelicerae, mouthparts and sternum pale brown; legs yellow, femora suffused with dark grey; abdomen pale grey with dark pattern of central spot followed by four transverse bands; venter medium grey, darkened towards yellow spinnerets.

CEPHALOTHORAX. Clypeus centre devoid of setae but with dense cluster of inward curved thick setae on either side. Eye region with a row of six slightly curved spines (Figs 1B, 3A), on right side with one short thick extra seta. Chilum poorly developed, inconspicuous. Sternum subcircular, with rather long, thin, posterior extension.

EYES. AME: 0.04; ALE: 0.06; AME-AME: 0.08; AME-ALE: 0.01; PME: 0.06; PLE: 0.06; PME-PME: 0.05; PME-PL: 0.07. Clypeus 0.17 or 2.9 times width of ALE.



Fig. 1. – A-C. *Cyrioctea sawadee* sp. nov., ♂. A. Habitus, dorsal view. B. Carapace, dorsal view. C. Idem, ventral view. – D-F. *Cyrioctea lotzi* sp. nov., ♂. D. Habitus, dorsal view. E. Carapace, dorsal view. F. Idem, ventral view. (Scale bars: 2 mm).

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LEGS. Legs III modified, provided with numerous spines; femora slightly swollen, spineless, tibiae short, as long as patella.

SPINATION.

	F	P	T	Mt
I	d1	-	v2	d1-1v2
II	d1	-	rl1v2	v2
III	-	pl3rl1-2	pl1-1-1d2-15rl1-1v2	7dispdw6
IV	d1	pl2rl1	pld1-1-1rl1-1v2-2-2	8dispdw6

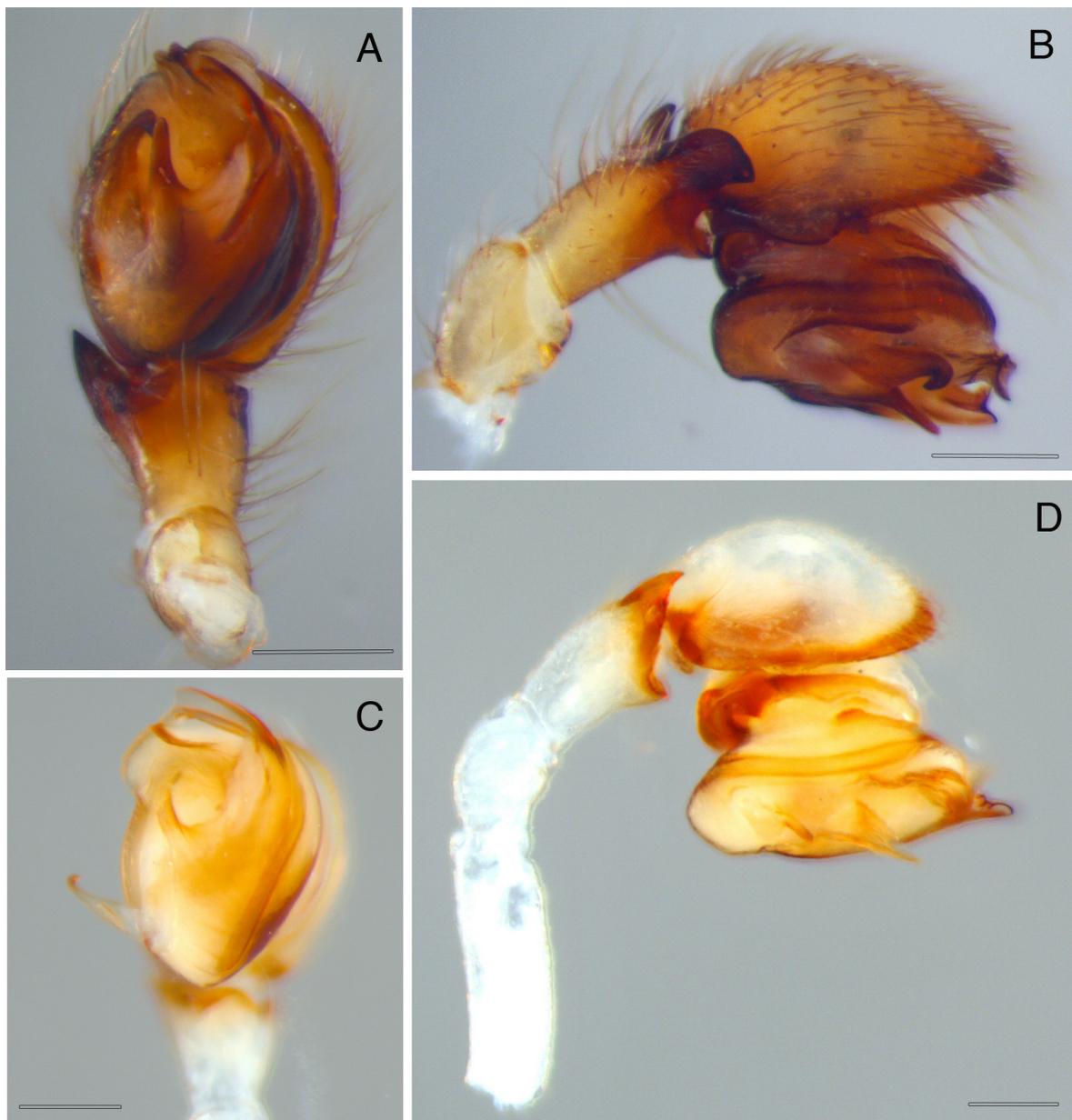


Fig. 2. – **A-B.** *Cyrioctea sawadee* sp. nov., ♂. **A.** Palp, ventral view. **B.** Idem, retrolateral view. – **C-D.** *Cyrioctea lotzi* sp. nov., ♂. **C.** Palp, ventral view. **D.** Idem, retrolateral view. (Scale bars: 200 µm).

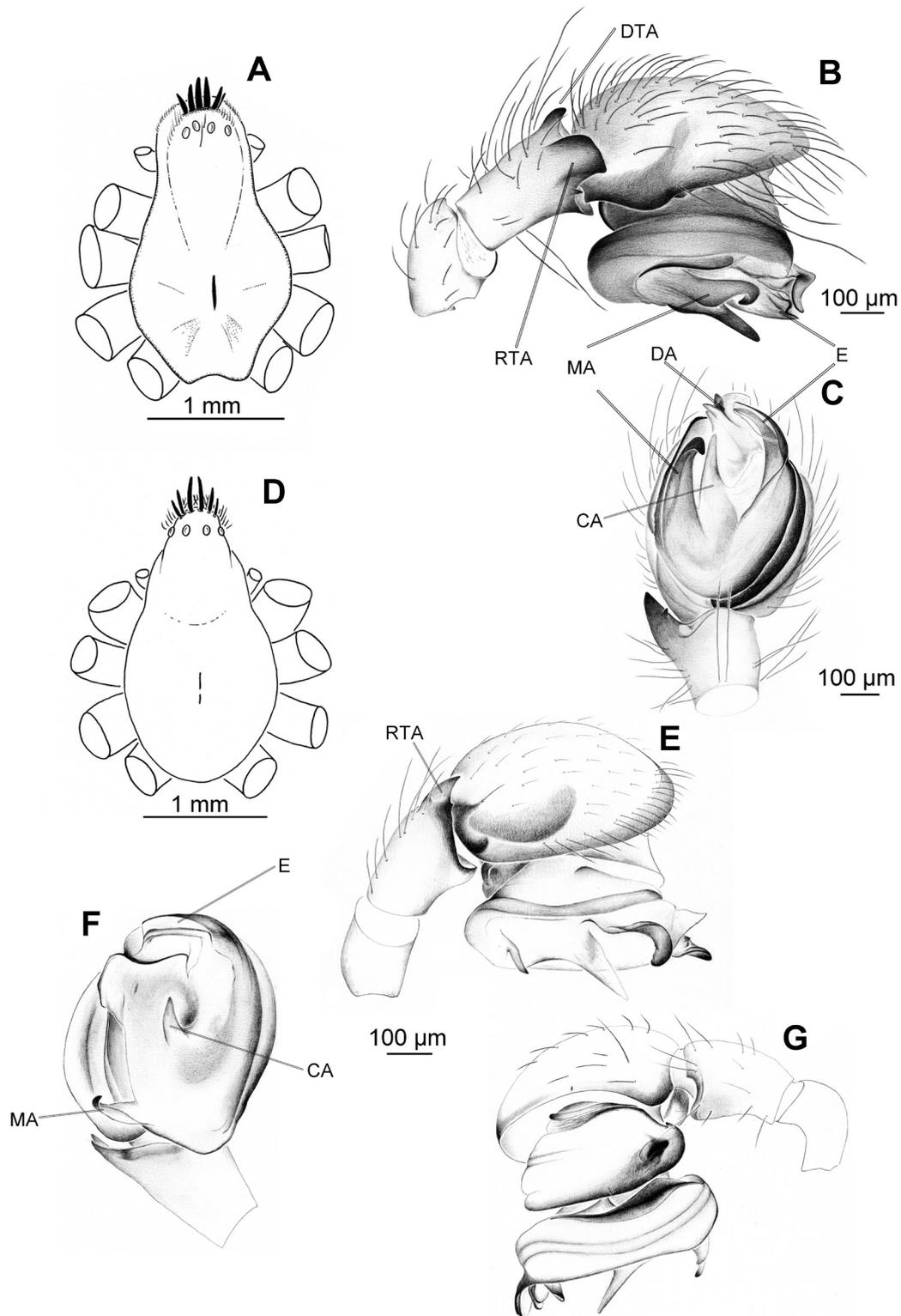


Fig. 3. – A-C. *Cyrioctea sawadee* sp. nov., ♂. **A.** Carapace, dorsal view. **B.** Palp, retrolateral view. **C.** Idem, ventral view. – D-G. *Cyrioctea lotzi* sp. nov., ♂. **D.** Carapace, dorsal view. **E.** Palp, retrolateral view. **F.** Idem, ventral view. **G.** Idem, proximal view. CA: central tegular apophysis; DA: distal tegular apophysis; DTA: dorsal tibial apophysis; E: embolus; MA: median apophysis; RTA: retrolateral tibial apophysis.

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MALE PALP. (Figs 2A-B, 3 B-C) Tibia with short, triangular dorsal apophysis; RTA broad with dorsal margin smoothly curved down, ventral margin straight, with small tooth at base; cymbium oval, with sclerotized rim, slightly bulging near RTA. Tegulum strongly bulging and complex; embolus prolateral, broad and with semitransparent proximal flange, smoothly curved outwards; median apophysis near retrolateral margin, curved downward, ventrally concave; central apophysis (CA) with digitiform sclerotized tip; distal apophysis (DA) with three short prongs.

Female

Unknown

Distribution

Only known from type locality in the Western Cape Province (Fig. 4).

Cyrioctea lotzi sp. nov.

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Figs 1D-F, 2C-D, 3D-G, 4

Diagnosis

The male of *C. lotzi* sp. nov. can be recognized by the pale abdomen with faint dorsal stripe, the strong spines on the first leg and the details of the male palp in which the RTA is adjacent to the dorsal apophysis.

Etymology

The species name is a patronym in honour of one of the collectors.

Type material

Holotype

SOUTH AFRICA: ♂, Free State, Deelfontein, 27°07' S – 26° 35' E, Aug.-Oct. 1986, preservation trap, Museum Staff (NMBA).

Paratypes

4 ♂♂, same data as holotype (1 ♂ in MRAC).

Other material examined

None.

Description

Male (holotype, Fig. 1D-F)

MEASUREMENTS. Total length 4.54; carapace 2.30 long, 1.31 wide; TI+PI: 2.40.

COLOUR. Carapace brownish yellow with black fovea and dark margin; palp, chelicerae, mouthparts, sternum and legs yellow; femora suffused with dark grey; abdomen pale grey with faint darker dorsal median stripe; venter and spinnerets pale.

CEPHALOTHORAX. Clypeus provided with dense cluster of short upturned thick setae. Eye region with a row of six slightly curved spines (Figs 1E, 3D). Chilum poorly developed, inconspicuous. Sternum oval; slightly wider than long with rather long, thin, sharp posterior extension.

EYES. AME: 0.06; ALE: 0.07; AME-AME: 0.13; AME-ALE: 0.0; PME: 0.09; PLE: 0.08; PME-PME: 0.08; PME-PLE: 0.06. Clypeus 0.16 or 2.2 times width of ALE.

LEGS. Legs I with numerous and strong but short spines; legs III with hair cover slightly denser than other legs.

SPINATION.

	F	P	T	Mt
I	d1	-	pl1-1-2rl1-1v1-1-1-1-1	v2-2
II	d1	-	pl1-1rl1-1-1v3	v2dw3
III	d1	pl3d1rl1	6dispv2	8dispdw6
IV	d1v1	rl1	pld1-1d1-1rl1-1-1v2-2-2	8dispdw6

MALE PALP. (Figs 2C-D, 3E-G) Tibia with short, triangular dorsolateral apophysis, adjacent to slightly shorter RTA; cymbium almost rounded, with sclerotized rim, thickened near RTA. Tegulum strongly bulging and complex: embolus distal, provided with transparent flange; median apophysis near posterior retrolateral margin; central apophysis triangular; distal part of tegulum a transverse ridge with sclerotized rim.

Female

Unknown.

Distribution

Only known from type locality in the Free State, South Africa (Fig. 4).

Discussion

Taxa with a temperate Gondwana distribution, also called an Austral distribution (Humphreys & Parenti 1999), found on the southern tip of the continents Australia, Africa and South America, sometimes including New Zealand and New Caledonia, have been considered to be relicts (e.g. Crisci *et al.* 1991; Robertson & Holzenthal 2005). This type of distribution is often synonymous with the presence of ancestral characters, which is also the case for *Cyrioctea*. Other examples are the ancestral Ratites, flightless birds (Bourdon *et al.* 2009), Pleurodira, primitive turtles (Sterli 2010) and beetles that are herbivorous on *Araucaria* (Sequeira & Farrel 2001). Some of these have been qualified as living fossils as they are at the base of old, large clades. Such groups, albeit rarely exhibiting a Gondwana-distribution, are most often very poor in species, e.g., *Tuatara* (Hay *et al.* 2010), *Platypus* (Groves 2005), Coelacanth (Forey 1998) etc. However, this phenomenon cannot be qualified as a rule since there are remarkable exceptions. The “primitive” spiders with segmented abdomen belonging to the family Liphistiidae are an excellent example of such an exception: the family is composed of 5 genera and contains not less than 85 species (Platnick 2012). And in spider families for which a detailed phylogenetic analysis is available, it is not the rule that basal genera are species poor. It might be so for *Lordhowea* Griswold, 2001 in Cyatholipidae (Griswold 2001) or *Pararchaea* Forster, 1955 in Pararchaeidae (Rix 2006), but in Theridiidae, for instance, the most basal genus is the speciose *Dipoena* Thorell, 1869 (Agnarsson 2004). Also in families like Linyphiidae (Miller & Hormiga 2004), Ctenidae (Silva 2003) and Thomisidae (Benjamin *et al.* 2008), the most basal genera are rich in species. Thus it is certainly not a general phenomenon that basal taxa of a large evolutionary line tend to be relicts in the sense that they are poor in species.

But also from the morphological point of view, certain characters and more precisely the genitalia of *Cyrioctea*, are puzzling. In the Zodariidae, the root of the large clades is very often occupied by species with very simple genitalia. A recurring pattern is the presence of a short, straight, spine-like embolus accompanied by a short and simple median apophysis and a simple RTA in the species near

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the root, evolving to a long embolus accompanied by intricate supporting structures and the addition of apophyses on the palpal patella and even the femur. Examples are *Diores namibia* Jocqué, 1991 for *Diores* with more than 50 species (Jocqué 1991), *Tenedos infrarmatus* Jocqué & Baert, 2002 at the base of a large clade containing the genera *Tenedos*, *Ishania*, *Epicratinus* and *Colima* (Jocqué & Baert 2005), *Procydrela procursor* Jocqué, 1999 at the base of the Cydrelineae (Jocqué 1999), and *Pentasteron simplex* Baehr & Jocqué, 2001 at the base of the very large *Asteron* complex in which more than 100 species have already been described (Baehr & Jocqué 2001).

In other families where a similar phenomenon is assumed to occur, the trend is often obscured by the creation of separate genera exactly on the basis of these additional structures on palpal patella and femur (e.g. Wang 2002). Data on the Zodariidae, one of the few families for which there is a combination of generic and species phylogenies, show that a somatic radiation precedes the genital one. But *Cyrioctea*, does not qualify. All the species have a complex bulbus with several tegular appendages. In several species, however, the palpal tibia shows a typical ancestral character with the presence of a dorsal apophysis, which may be the precursor of the retrolateral tibial apophysis (RTA). But the complexity of the bulbus is incoherent with the idea that *Cyrioctea* might be considered a living fossil dating back from the split-off of Gondwanaland. It might therefore be argued that a recent radiation has occurred, explaining the existence of closely related species with small distribution areas. Such a recent radiation

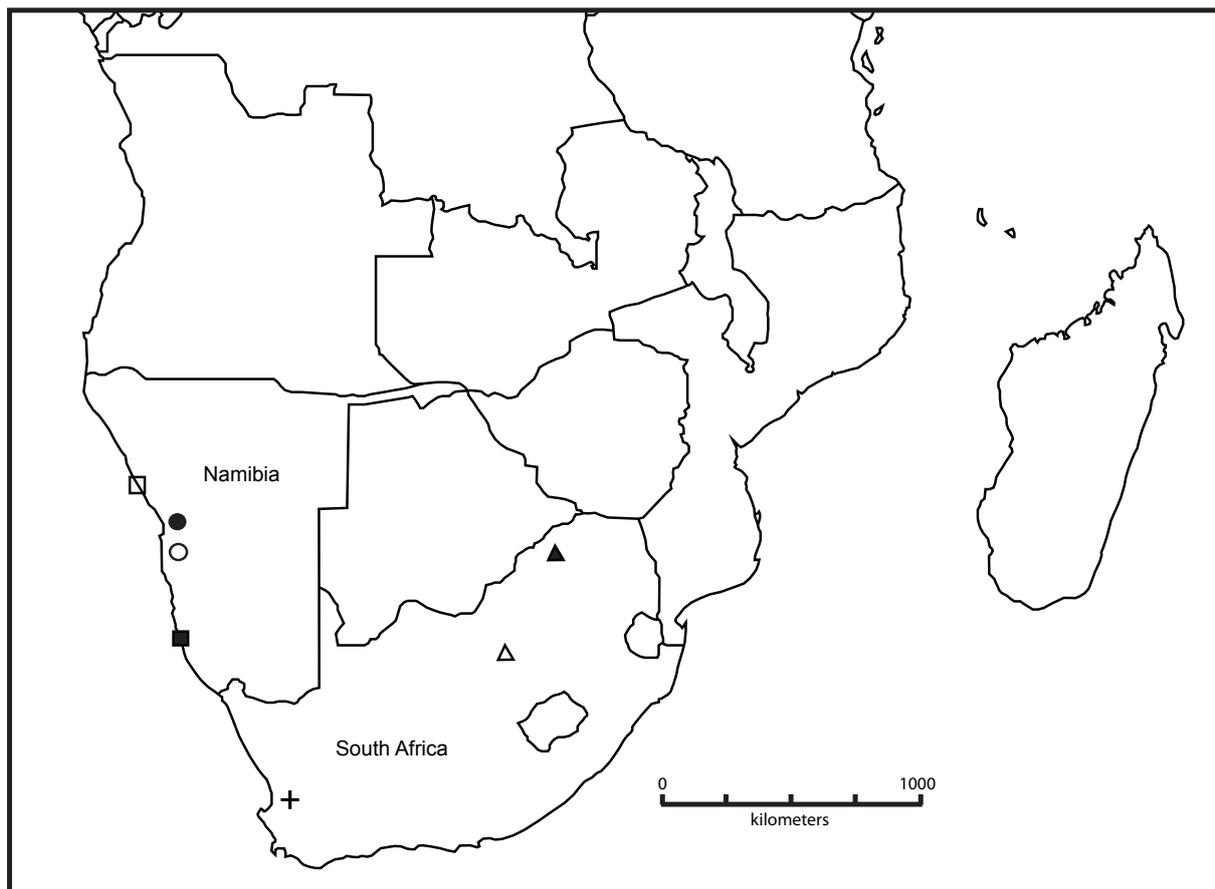


Fig. 4. Distribution of *Cyrioctea* species in Africa: (■) = *C. griswoldorum* Platnick & Jocqué, 1992; (□) = *C. hirsuta* Platnick & Griffin, 1988; (△) = *C. lotzi* sp. nov.; (▲) = *C. marken* Platnick & Jocqué, 1992; (●) = *C. namibensis* Platnick & Griffin, 1988; (+) = *C. sawadee* sp. nov.; (○) = *C. whartoni* Platnick & Griffin, 1988.

is known for the plants belonging to the Cycadales, considered a group of “living fossils” until recently (Nagalingum *et al.* 2011). Neither the Liphistiidae nor *Cyrioctea* have been subject to such a detailed analysis, but may well represent other examples of old taxa with a recent radiation. However, the most important consequence of *Cyrioctea*'s distribution is that the family is much older than what is proposed in Penney & Selden (2011). Following Miller *et al.* (2010a, 2010b), they consider Zodariidae the sister family of Penestomidae and conclude that the clade is not older than 30 ma. Since it must date back from before the split up of western Gondwanaland, its age must be pushed back to at least 100 ma (Pitman *et al.* 1993).

It is evident that only a detailed cladistic analysis including molecular data can corroborate the hypothesis that has been formulated here.

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