

# A new species of *Triaenops* (Mammalia, Chiroptera, Hipposideridae) from Aldabra Atoll, Picard Island (Seychelles)

**Steven M. GOODMAN**

Field Museum of Natural History,  
1400 South Lake Shore Drive, Chicago, Illinois 60605 (USA)  
and Vahatra, BP 3972, Antananarivo (101) (Madagascar)  
sgoodman@fieldmuseum.org

**Julie RANIVO**

Université d'Antananarivo, Département de Biologie animale,  
BP 906, Antananarivo (101) (Madagascar)  
and Vahatra, BP 3972, Antananarivo (101) (Madagascar)  
ranivo.julie@voila.fr

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## ABSTRACT

The bat genus *Triaenops* Dobson, 1871, of the family Hipposideridae is broadly distributed in Africa, portions of the Middle East, and islands in the western Indian Ocean. Three species of *Triaenops* are restricted to Madagascar (*T. rufus*, *T. auritus* and *T. furculus*) and the latter is also known from the western Seychelles Islands. After comparisons of specimens previously referred to *T. furculus* from Aldabra Atoll to recent series of this species group obtained on Madagascar, it is clear that the former represents a species new to science, which is described herein as *T. pauliani* n. sp. from Picard Island. *Triaenops pauliani* n. sp., which is within the *T. furculus/auritus* group, differs from other congeneric species based on external, cranial, and dental measurements and characteristics, as well as the shape of the trident noseleaves. Previous records of *T. pauliani* n. sp. on Cosmoledo Atoll in the western Seychelles are called into question and these specimens are presumed to be from Picard Island, Aldabra Atoll.

## KEY WORDS

Mammalia,  
Chiroptera,  
Hipposideridae,  
*Triaenops pauliani* n. sp.,  
Aldabra,  
Picard Island,  
new species.

## RÉSUMÉ

Une nouvelle espèce de *Triaenops* (Mammalia, Chiroptera, Hipposideridae) de l'atoll d'Aldabra, île Picard (Seychelles).

Les chauves-souris du genre *Triaenops* Dobson, 1871, de la famille des Hipposideridae, sont largement distribuées en Afrique, dans certaines parties du Moyen-Orient et sur les îles de l'ouest de l'océan Indien. Trois espèces de *Triaenops* ont une distribution limitée à Madagascar (*T. rufus*, *T. auritus* et *T. furculus*), cette dernière étant aussi connue des îles occidentales des Seychelles. Après examen des spécimens précédemment attribués à *T. furculus* qui avaient été récoltés dans l'atoll d'Aldabra, en comparaison avec une série récemment obtenue de Madagascar, il apparaît nettement que les premiers se rapportent à une espèce nouvelle pour la science, qui est décrite ici en tant que *T. pauliani* n. sp. en provenance de l'île Picard. *Triaenops pauliani* n. sp., qui appartient au groupe *T. furculus/auritus* diffère des autres espèces congénériques par certaines mesures et caractéristiques externes, crâniennes et dentaires, telles que l'appendice nasal en forme de feuilles à trois dents. Des données antérieures de la présence de *T. pauliani* n. sp. sur l'atoll de Cosmoledo à l'ouest des Seychelles sont remises en question ici et ces spécimens sont présumés provenir de l'île Picard, de l'atoll d'Aldabra.

## MOTS CLÉS

Mammalia,  
Chiroptera,  
Hipposideridae,  
*Triaenops pauliani* n. sp.,  
Aldabra,  
île Picard,  
espèce nouvelle.

## INTRODUCTION

Until recently, little research had been conducted on the microchiropteran bats of the western Indian Ocean islands, several taxa are poorly known and specimen material is limited. Contemporary field inventories on Madagascar have resulted in new reference collections that allow detailed examination of patterns of geographic variation, including differentiation of intra- and interspecific variations in several western Indian Ocean bat species. As a result of these field and museum investigations, several species new to science have been discovered on Madagascar (e.g., Goodman & Cardiff 2004; Goodman *et al.* 2005, 2006a, b, 2007a, b; Bates *et al.* 2006).

Amongst this new Malagasy material is a series of microchiropteran bats of the hipposiderid genus *Triaenops* Dobson, 1871, for which few specimens were previously available (e.g., Peterson *et al.* 1995). On the basis of these new specimens, obtained from different portions of Madagascar, morphological studies reveal that three different taxa occur on the island: *T. rufus* Milne-Edwards, 1881, with a broad

distribution across the dry portions of the island and into the humid northeast; *T. furculus* Trouessart, 1906, found in the dry central west to the extreme south; and *T. auritus* Grandidier, 1912, known from dry forest regions of the north (Ranivo & Goodman 2006; Fig. 1). The latter two forms, which form a species-group, are differentiated based on size, cranial and dental parameters, noseleaf shape, and pelage coloration. Molecular research conducted with tissue samples of many of the same individuals as the morphological study corroborated the conclusions of three different species occurring on Madagascar (Russell *et al.* 2007), as well as *T. furculus* and *T. auritus* being each others closest living relatives and that *T. rufus* is more closely related to *T. persicus* Dobson, 1871, of Africa and the Middle East, although these latter two forms are specifically distinct.

As noted by several authors, specimens referred to *T. furculus* have been obtained on the Aldabra and Cosmoledo Atolls (e.g., Hill 1971, 1982; Racey & Nicoll 1984; Simmons 2005), the furthest west of the islands in the Seychelles Archipelago and the latter atoll is slightly less than 500 km to the north-

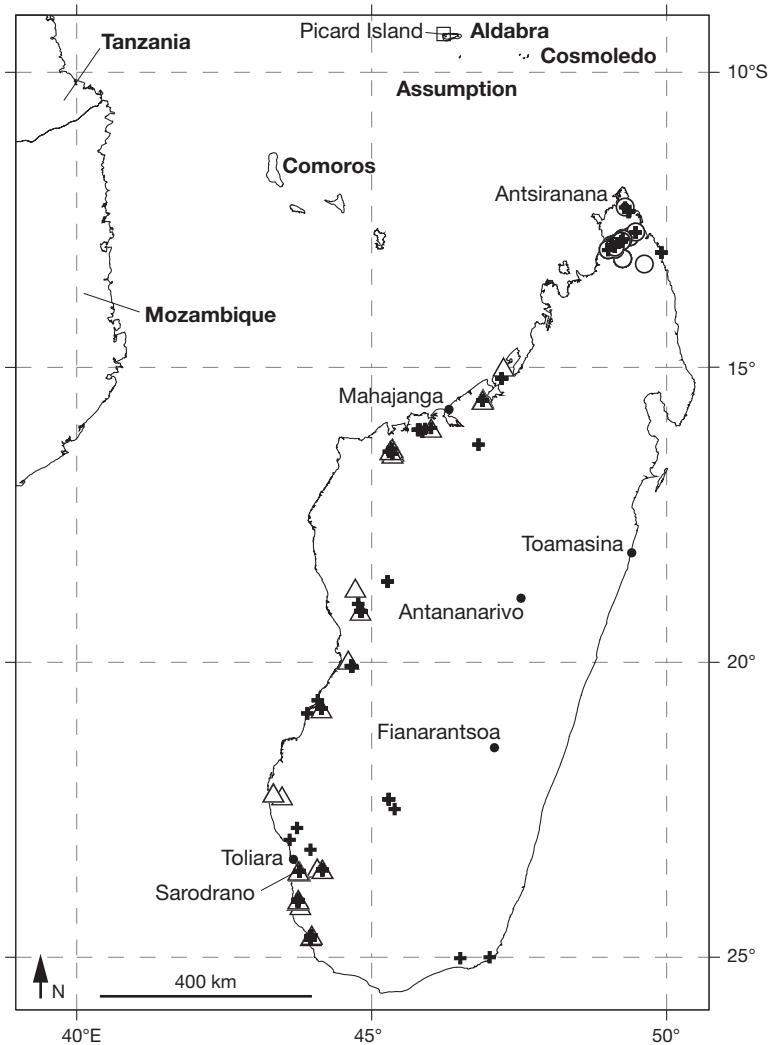


FIG. 1. — Map of the islands of the western Seychelles Archipelago (Aldabra, Cosmoledo, and Assumption), Madagascar, and the east African coast showing the distribution of the different *Triaenops* species occurring across the western Indian Ocean. O, *T. auritus* G. Grandidier, 1912; Δ, *T. furculus* Trouessart, 1906; +, *T. rufus* A. Milne-Edwards, 1881; □, *T. pauliani* n. sp. Note that Aldabra is to the northwest of the northern tip of Madagascar and these two zones form an almost equidistant triangle with the Comoro Islands.

west of the northern tip of Madagascar (Fig. 1). The specific status of these animals has never been properly examined, at least in part due to a lack of comparative material of *Triaenops* from Madagascar. Given the recent collections made of members of this genus on that island, we are now able to address the question of the specific identification of *Triaenops* occurring in the western Seychelles.

#### RECORDS OF *TRIAENOPS* IN THE ALDABRA ATOLL GROUP

The Natural History Museum in London (formerly known as The British Museum (Natural History) (BMNH)) holds three specimens of *Triaenops* in its collections from the western Seychelles Archipelago. Two of these specimens (BMNH 13.2.18.1 and

13.2.18.2) are reported to have been obtained from the Cosmoledo Atoll, to the east of the Aldabra Atoll, by J. C. F. Fryer, but this locality information is called into question (see Discussion). The third specimen (BMNH 78.185) was obtained on the Aldabra Atoll, Picard Island (also known as West Island), by J. J. Whitelaw on 4 May 1977 and near the Aldabra Research Station (Brandis 2004; Hutson 2004). Further, an additional two specimens held by the Cambridge University Museum of Zoology (CUMZ E5609.A and E5609.B) were taken by J. C. F. Fryer and bear the same information on the collection locality as his two specimens in the BMNH. Finally, a sixth specimen was obtained in a house on Picard Island on 9 April 2004, which is held by the Field Museum of Natural History, Chicago (FMNH 185795). There is also an observation of this species on Aldabra in 1992, but further details are lacking (Hutson 2004).

## SPECIMENS AND MEASUREMENTS

In order to understand patterns of morphological variation amongst specimens referred to *Triaenops furculus* from the western Seychelles, we have compared all available known specimens from this region, which are rather limited, to series of *Triaenops* from Madagascar and elsewhere. Comparisons are confined to adult specimens and we have used a subset of the measurement data for Malagasy *Triaenops* presented in Ranivo & Goodman (2006), with a few recalculations. As members of this genus show some sexual dimorphism in certain characteristics, we have presented measurements separately of males and females.

Given that all of the specimens previously referred to *T. furculus* from the Seychelles are preserved in fluid, and that no original external measurement data were taken by the collectors before their fixation, we have relied on external measurements taken by SMG directly from the cadavers. External measurements, all taken with a dial calipers, include: total length, tail length, hindfoot length (excluding claws), ear length, forearm length, external noseleaf length, and central noseleaf length. The first two measurements were taken with an accuracy

of 1 mm and the balance to 0.1 mm. All of the above external measurements for the Malagasy specimens of *Triaenops*, with the exclusion of those concerning the noseleaf, were made from recently dispatched individuals before their preservation in formalin. Given that little shrinkage occurs with fluid preservation, we consider these different styles of measurements comparable.

Six cranial or mandible and four dental measurements were made using a digital caliper, accurate to the nearest 0.1 mm:

- anterior palatal width (C<sup>1</sup>-C<sup>1</sup>): taken across the outer alveolar borders of the canines;
- complete cranial tooththrow (I<sup>1</sup>-M<sup>3</sup>): length from anterior alveolar border of incisors to posterior alveolar border of M<sup>3</sup>;
- greatest skull length (GSKL): from posteriormost part of occipital to anteriormost point of upper incisors;
- greatest zygomatic breadth (ZYGO): width taken across zygomatic arches at the widest point;
- interorbital breadth (IOB): dorsal width at most constricted part of skull;
- mandible length (MAND): from posteriormost portion of the condyles to anteriormost point of upper incisors;
- mastoid breadth (MAST): maximum width of skull across mastoid processes;
- molar tooththrow length (MOLS): length of upper post canine molariform teeth, excluding the reduced PM<sup>1</sup>;
- palatal length (PAL): from posterior border of hard palate to anterior edge of premaxillary bone;
- posterior palatal width (M<sup>3</sup>-M<sup>3</sup>): taken across the outer alveolar borders of the third molars.

## SYSTEMATICS

### Genus *Triaenops* Dobson, 1871

#### REMARKS

As explained in the diagnosis below, within the Malagasy and African/Middle East species of the genus *Triaenops* there are two distinct types of noseleaves that clearly distinguish two different groups in this genus (Hill 1982). In this respect

the material from the western Seychelles is referable to the *T. auritus/furculus* group, rather than to the *T. rufus/persicus* group. Thus, in making our detailed evaluations we have used specimens of *T. furculus* and *T. auritus* from near their type localities, which are, respectively, extreme southwestern Madagascar in the general vicinity of Sarodrano and the Ankarana region near Antsiranana (see Ranivo & Goodman 2006; Fig. 1).

On the basis of our comparisons of the western Seychelles material of *Triaenops* to specimens of this genus from Madagascar, as well as Africa and the Middle East, animals from the former locality possess unique morphological characters and certain measurements fall outside of the range of any previously named species of *Triaenops*. Given these differences, we consider the western Seychelles material to be new to science.

*Triaenops pauliani* n. sp.  
(Figs 2; 3; Tables 1; 2)

**HOLOTYPE.** — Adult ♂, date not specified, J. C. F. Fryer coll. (BMNH 13.2.18.1). Based on the itinerary of the Percy Sladen Trust Expedition to the Seychelles, Fryer was in the western Seychelles (Astove, Cosmoledo, Assumption, and Aldabra) from 13.IX.1908 to 24.I.1909 (Gardiner *et al.* 1910).

The specimen was presumably preserved in formalin and subsequently transferred into alcohol. The skull was extracted and cleaned. The cadaver is generally in a good state of preservation, as is the skull, with the exception of the right pterygoid plate that has been damaged and largely broken. A hole has been drilled into the back of the cranium for the insertion of a thread used to attach a specimen tag and the mandible.

**PARATYPES.** — Aldabra Atoll, Picard Island, c. 09°24'S, 46°12'E, 13.IX.1908–24.I.1909, J. C. F. Fryer coll., fluid preserved specimen with skull removed, dorsal portion of cranium missing, upper tooththrows complete, complete mandible, 1 adult ♀ (BMNH 13.2.18.2). — Same data, fluid preserved specimen, 1 adult ♀ (CUMZ E5609.A); 1 adult ♂ (CUMZ E5609.B). — Aldabra Atoll, Picard Island, Aldabra Station, 09°24'04.4"S, 46°12'21.4"E, 5 m, 4.V.1977, J. J. Whitelaw coll., fluid preserved specimen with skull *in situ*, 1 adult ♀ (BMNH 78.185). — Aldabra Atoll, Picard Island, Aldabra Station, 09°24'04.4"S, 46°12'21.4"E, 9.IV.2004, U. Samedi coll., fluid preserved specimen with skull removed, 1 sub-adult ♂ (FMNH 185795).

**ETYMOLOGY.** — The name *pauliani* is a patronym after the late Prof. Renaud Paulian, who conducted extensive research in the western Indian Ocean islands and was responsible for a major synthesis of the biogeography of Madagascar and neighbouring islands (Paulian 1961). Previously Tate (1941: 3) used the name "*Triaenops furinea* Trouessart" for the species on Aldabra. To our knowledge Trouessart never named the form occurring on Aldabra; the use of "*furinea*" is presumably a misreading of the name *furcula* and is considered a *nomen nudum* (Hayman & Hill 1971: 30; Hill 1982).

**TYPE LOCALITY.** — Aldabra Atoll, Picard Island, c. 09°24'S, 46°12'E (Fig. 1) (see Discussion for precision of holotype locality).

**DISTRIBUTION.** — *Triaenops pauliani* n. sp. is currently known only from the western portion of the Seychelles Archipelago, specifically the Aldabra Atoll, Picard Island. Previous records of this taxon on the Cosmoledo Atoll are called into question (see Discussion). The nearest landmass to the Aldabra Atoll is Assumption Island, 27 km to the south.

**HABITAT.** — No precise information is available on the site where the holotype and several of the paratypes were collected. Picard Island, the only known site where this species is clearly documented from, is in the northwestern portion of the Aldabra Atoll, which is divided into four different islands. The Aldabra Research Station is located on Picard Island, has been the focal point of faunistic studies on the atoll, and is in close proximity to an abandoned settlement. One of the specimens (FMNH 185795) was obtained in a house within the research station complex, where it was presumably attracted after sunset to insects flying around an electric light (Samedi pers. comm.). The islands making up the Aldabra Atoll complex are uplifted fringing coral reefs that rise a few meters above sea level and Stoddart *et al.* (1971) have described their geomorphology in detail. The climate is semi-arid with the rainy season falling between November and April and summer maximum temperatures average 32°C and winter minimum temperatures average 22°C – in general, the local climatic regime is similar to Antsiranana in northern Madagascar (Farrow 1971).

The terrestrial vegetation of Picard Island is relatively intact, composed of several different formations (Stoddart & Wright 1967): mixed scrub – a variable formation in the floristic sense and often with some introduced plants near the settlement; *Pemphis* thicket – dominated by *P. acidula*; psammophilic communities – a dwarf plant community found close to the shore or at edge of cliffs; man-induced vegetation – principally coconut plantations, *Casuarina* thickets and woodlands, and other non-native vegetation.

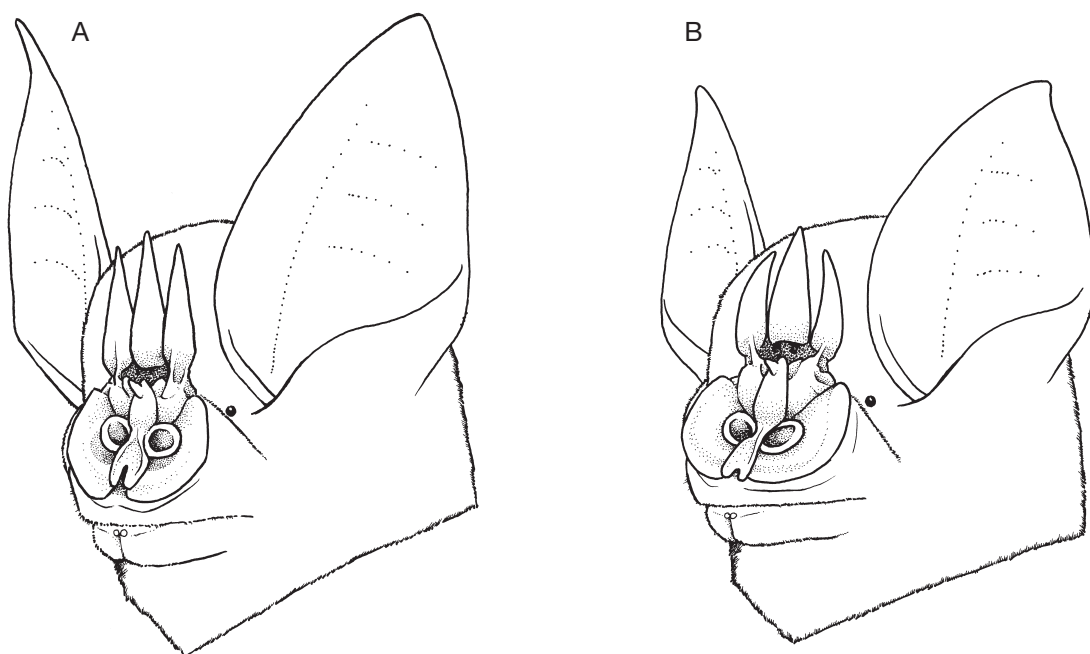


FIG. 2. — Drawings of the heads and facial discs: **A**, adult *Triaenops furculus* Trouessart, 1906 (FMNH 173243); **B**, *T. pauliani* n. sp. (BMNH 78.185). The shape of the lance-like noseleaves and the disc horseshoe are notably different between these two species.

MEASUREMENTS. — Measurements taken directly from the fluid preserved holotype.

External (approximate): total length 55 mm, tail length 18 mm, hindfoot length 5.8 mm, ear length 15.3 mm, forearm length 43.7 mm, external noseleaf length 3.8 mm, central noseleaf length 3.7 mm.

Skull and teeth: GSKL 17.1 mm, ZYGO 8.7 mm, IOB 2.3 mm, MAST 8.3 mm, PAL 4.4 mm, MAND 11.1 mm, I<sup>1</sup>-M<sup>3</sup> 6.9 mm, MOLS 4.4 mm, C<sup>1</sup>-C<sup>1</sup> 4.2 mm, and M<sup>3</sup>-M<sup>3</sup> 6.1 mm (Table 2).

DIAGNOSIS. — Distinctive cranial and external characteristics, including the dental formula 1/2-1/1-2/2-3/3, inflated rostrum, wide plated zygoma, thickened premaxilla, and distinct trident noseleaf, clearly identify the Picard Island animals as members of the genus *Triaenops* (Hill 1982; Koopman 1994). The noseleaf structure of the western Seychelles specimens, with three elongated tridents, nearly the same length, places this animal within the *T. furculus/auritus* species group, as compared to the *T. rufus/persicus* group where the outer noseleaves are shorter than the internal one and distinctly different (Hill 1982). *Triaenops pauliani* n. sp. is distinguished from *T. furculus* and *T. auritus* on the basis of slightly concave and less elongated outer noseleaf lancets (Fig. 2); diminutive general body size, including a distinctly

shorter ear length (14.5-15.4 mm); and a less inflated rostral swelling (Fig. 3).

#### DESCRIPTION

Within the Malagasy species of *Triaenops*, there are two distinct types of noseleaves. Specimens referable to *T. rufus* have the central lancet of the trident noseleaf as an elongated spear-like structure and the two outer lancets are distinctly shorter than the central lancet and notably concave (Peterson *et al.* 1995: 83). The trident structure in *T. persicus* of Africa and the Middle East (Hill 1982: 179), the only other previously recognized species in this genus living outside Madagascar (Simmons 2005), is similar to *T. rufus*. These two animals are each other's closest living relatives (Russell *et al.* 2007). In contrast, individuals referable to *T. auritus* and *T. furculus* have a more elongated central lancet than in *T. rufus* and the two outer projections of the trident are distinctly lance-shaped and almost equal in length to the central lancet (Peterson *et al.* 1995: 80). Based on these characters, *T. pauliani* n. sp.



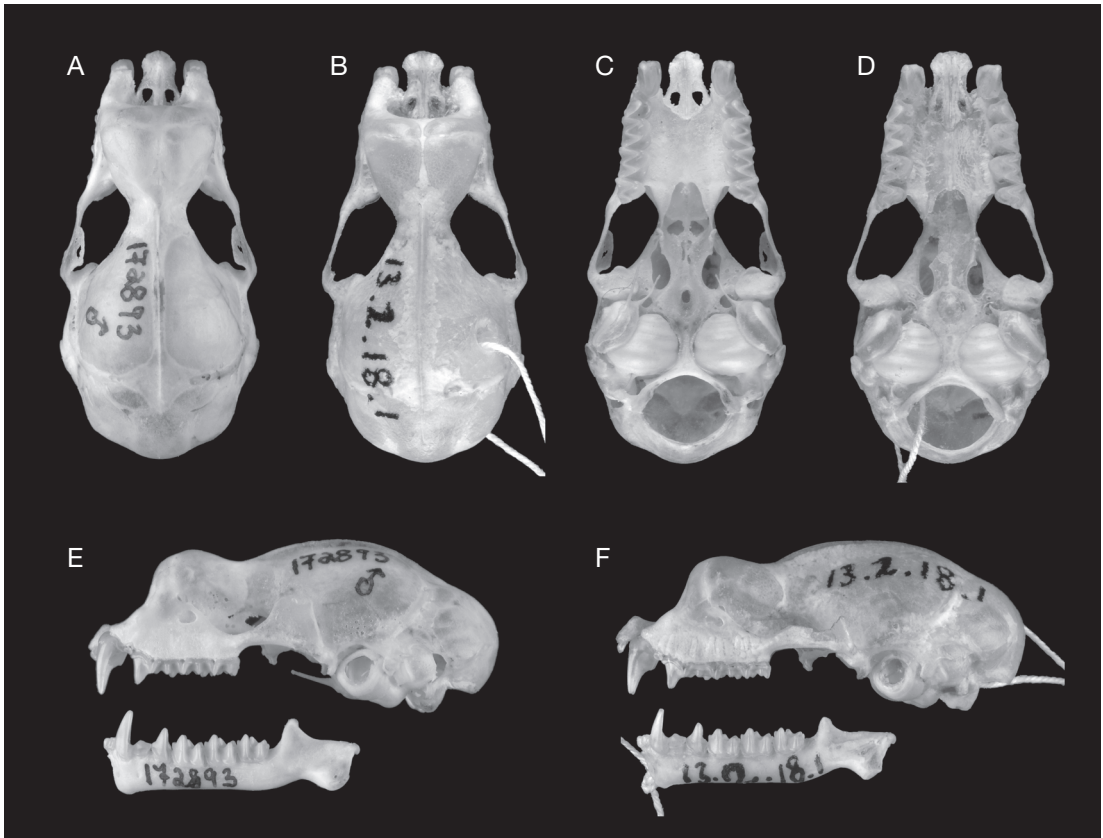


FIG. 3. — Dorsal (A, B), ventral (C, D), and lateral (E, F) views of adult crania and mandibles of *Triaenops* Dobson, 1871: A, C, E, *T. furculus* Trouessart, 1906, FMNH 172893 (greatest skull length 17.3 mm) from near Sarodrano, the type locality of this species; B, D, F, holotype of *T. pauliani* n. sp., BMNH 13.2.18.1 (greatest skull length 17.1 mm) taken on Picard Island, Aldabra Atoll. Photos: John Weinstein (FMNH image No. Z94447\_10d).

is a member of the Malagasy *T. auritus/furculus* group.

The noseleaves of *T. pauliani* n. sp. are shorter than those in individuals of *T. auritus* or *T. furculus*, with, for example, the central noseleaf in male *T. furculus* measuring on average 5.3 mm ( $n = 15$ ), in male *T. auritus* 4.9 mm ( $n = 15$ ), and in five adult individuals of *T. pauliani* n. sp. 3.4 mm (♀), 3.7 mm (♂), 3.7 mm (♀), 4.0 mm (♀), and 4.0 mm (♂). Further, in *T. pauliani* n. sp. the external lancets are shorter than the internal lancet, and the outer margins of the external lancets are distinctly arch-shaped (Fig. 2), while in members of the *T. auritus/furculus* group the external lancets are distinctly spear-shaped and the difference in length of the

external and internal lancets is less marked. In the hand, these characters readily distinguish *T. pauliani* n. sp. from these other two species.

Finer details of the noseleaf structure of *T. pauliani* n. sp. are difficult to discern from BMNH 13.2.18.1 and 13.2.18.2, in part associated with the fact the skulls have been extracted and the considerable period since their original preservation rendering some of the structures flaccid. However, in BMNH 78.185 and CUMZ E5609.A and E5609.B the skull remains in each respective specimen and the horseshoe of the noseleaf is notably broader than in typical specimens of the *T. auritus/furculus* group and distinctly more rounded along the lateral margin (Fig. 2). Further, the anteriormost portion of the

TABLE 1. — External measurements of adult *Triaenops furculus* Trouessart, 1906 and *T. auritus* Grandidier, 1912 from the vicinity of their type localities (Sarodrano and Antsiranana, respectively) and specimens of *T. pauliani* n. sp. Measurements presented as mean  $\pm$  standard deviation, minimum and maximum measurements, and number of specimens.

	Tail length	Hindfoot length	Ear length	Forearm length	External noseleaf length	Central noseleaf length
<b><i>T. furculus</i></b>						
♂♂	22.5 $\pm$ 1.97 19.0-25.0 n=6	6.8 $\pm$ 0.41 6.0-7.0 n=6	18.7 $\pm$ 0.52 18.0-19.0 n=6	44.0 $\pm$ 0.63 43.0-45.0 n=6	4.7 $\pm$ 0.49 3.5-5.4 n=15	5.3 $\pm$ 0.42 4.4-5.9 n=15
♀♀	23.5 $\pm$ 1.29 22.0-25.0 n=4	7.5 $\pm$ 0.58 7.0-8.0 n=4	18.3 $\pm$ 0.50 18.0-19.0 n=4	46.3 $\pm$ 0.96 45.0-47.0 n=4	4.9 $\pm$ 0.55 4.1-5.5 n=8	5.5 $\pm$ 0.57 4.6-6.3 n=8
<b><i>T. auritus</i></b>						
♂♂	22.2 $\pm$ 1.42 19.0-25.0 n=17	7.4 $\pm$ 0.73 6.0-9.0 n=16	17.9 $\pm$ 0.93 16.0-19.0 n=17	46.4 $\pm$ 1.51 43.9-50.0 n=17	4.3 $\pm$ 0.30 3.6-4.8 n=13	4.9 $\pm$ 0.36 4.3-5.4 n=15
♀♀	24.0 $\pm$ 1.57 22.0-28.0 n=36	7.7 $\pm$ 0.61 7.0-9.0 n=36	18.9 $\pm$ 1.12 15.0-20.0 n=36	48.8 $\pm$ 1.35 46.0-51.0 n=36	4.6 $\pm$ 0.42 3.9-5.4 n=32	5.4 $\pm$ 0.37 4.6-6.2 n=34
<b><i>T. pauliani</i> n. sp.</b>						
Adults						
BMNH 13.2.18.1, ♂ (holotype)	18	5.8	15.3	43.7	3.8	3.7
BMNH 13.2.18.2, ♀	17	6.0	14.9	43.1	3.8	3.7
BMNH 78.185, ♀	20	6.0	14.5	45.1	3.6	3.4
CUMZ E5609.A, ♀	21	6.2	15.4	44.6	3.8	4.0
CUMZ E5609.B, ♂	18	5.7	14.6	41.4	3.8	4.0
Summary statistics for adults of <i>T. pauliani</i> n. sp.	18.8 $\pm$ 1.64 17-21 n=5	5.9 $\pm$ 0.19 5.7-6.2 n=5	14.9 $\pm$ 0.40 14.5-15.4 n=5	43.6 $\pm$ 1.44 41.4-45.1 n=5	3.7 $\pm$ 0.09 3.6-3.8 n=5	3.8 $\pm$ 0.25 3.4-4.0 n=5
Subadult						
FMNH 185795, ♂	18	5.5	14.0	44.0	3.8	3.6

secondary horseshoe in *T. furculus* is notably more indented than in *T. pauliani* n. sp.

Other external characteristics separate *T. pauliani* n. sp. from members of the *T. auritus/furculus* group. In the latter species complex, most external measurements are larger than in *T. pauliani* n. sp. including, for example, ear length (Table 1), which on average in males of *T. furculus* is 18.7 mm (n = 6), in males of *T. auritus* is 17.9 mm (n = 17), and in five individuals of *T. pauliani* n. sp. is 14.5 mm (♀), 14.6 mm (♂), 14.9 mm (♀), 15.3 mm (♂), and 15.4 mm (♀). Further, the hindfoot lengths of *T. pauliani* n. sp. in the males are 5.7 mm and 5.8 mm and in three females 6.0 mm, 6.0 mm, and 6.2 mm, as compared to the average measurements in males and females (respectively) in *T. furculus* of 6.8 mm (n = 6) and 7.5 mm (n = 4) and in *T. auritus* of 7.4 mm (n = 16) and 7.7 mm (n = 36). The only

datum on body mass of *T. pauliani* n. sp. is from the male specimen obtained by Whitelaw in 1977 (BMNH 78.185), which weighed 6.5 g (Brandis 2004); this falls within the range of *T. furculus* from Madagascar (Ranivo & Goodman 2006).

One of the distinguishing characters separating adult specimens of *T. auritus* and *T. furculus* is the pelage coloration. In adult specimens of the former species the fur is generally reddish-gold, while that of *T. furculus* is brownish-gray or occasionally light yellowish-gray; in both species the dorsum is darker and more saturated with colour than the ventrum (Ranivo & Goodman 2006 and unpubl. data). The four specimens of *T. pauliani* n. sp. collected by Fryer (BMNH 13.2.18.1 and 13.2.18.2, CUMZ E5609.A and E5609.B) have been stored in alcohol for close to 90 years and it is presumed that the pelage pigmentation has changed dramatically from



TABLE 2. — Cranial and dental measurements (see text for acronyms definitions) of adult *Triaeops furculus* Trouessart, 1906 and *T. auritus* Grandidier, 1912 from the vicinity of their type localities (Sardrano and Antsiranana, respectively) and adult specimens of *T. pauliani* n. sp. Measurements presented as mean  $\pm$  standard deviation, minimum and maximum measurements, and number of specimens.

	GSKL	ZYGO	IOB	MAST	PAL	MAND	I <sup>1</sup> -M <sup>3</sup>	MOLS	C <sup>1</sup> -C <sup>1</sup>	M <sup>3</sup> -M <sup>3</sup>
<b><i>T. furculus</i></b>										
♂♂	16.6 $\pm$ 0.25	8.5 $\pm$ 0.22	2.3 $\pm$ 0.15	8.5 $\pm$ 0.08	4.8 $\pm$ 0.15	10.8 $\pm$ 0.19	6.2 $\pm$ 0.10	4.6 $\pm$ 0.11	4.4 $\pm$ 0.28	6.2 $\pm$ 0.13
	16.2-16.9	8.1-8.8	2.0-2.5	8.4-8.6	4.5-5.0	10.5-11.1	6.0-6.3	4.5-4.8	3.9-4.5	5.9-6.3
	n=8	n=8	n=9	n=8	n=8	n=9	n=9	n=9	n=8	n=8
♀♀	17.3 $\pm$ 0.15	8.6 $\pm$ 0.18	2.3 $\pm$ 0.08	8.7 $\pm$ 0.10	5.0 $\pm$ 0.15	11.0 $\pm$ 0.08	6.3 $\pm$ 0.13	4.8 $\pm$ 0.10	4.5 $\pm$ 0.10	6.3 $\pm$ 0.11
	17.1-17.5	8.5-8.9	2.3-2.5	8.6-8.9	4.8-5.2	11.0-11.2	6.1-6.4	4.6-4.9	4.4-4.6	6.2-6.5
	n=7	n=7	n=7	n=6	n=7	n=7	n=7	n=7	n=7	n=7
<b><i>T. auritus</i></b>										
♂♂	17.3 $\pm$ 0.44	8.7 $\pm$ 0.15	2.3 $\pm$ 0.06	8.7 $\pm$ 0.11	5.0 $\pm$ 0.17	11.2 $\pm$ 0.19	6.4 $\pm$ 0.11	4.8 $\pm$ 0.14	4.5 $\pm$ 0.09	6.3 $\pm$ 0.15
	16.8-18.1	8.5-8.9	2.2-2.4	8.4-8.8	4.8-5.5	10.8-11.5	6.1-6.5	4.5-5.0	4.3-4.7	6.0-6.6
	n=16	n=17	n=17	n=16	n=17	n=17	n=17	n=17	n=17	n=17
♀♀	17.8 $\pm$ 0.44	8.8 $\pm$ 0.19	2.4 $\pm$ 0.09	8.9 $\pm$ 0.14	5.2 $\pm$ 0.18	11.5 $\pm$ 0.20	6.5 $\pm$ 0.11	4.9 $\pm$ 0.15	4.6 $\pm$ 0.12	6.4 $\pm$ 0.14
	17.2-18.8	8.4-9.3	2.3-2.7	8.6-9.2	4.9-5.7	11.2-11.9	6.3-6.8	4.5-5.2	4.3-4.8	6.2-6.7
	n=35	n=36	n=36	n=36	n=36	n=36	n=36	n=36	n=36	n=36
<b><i>T. pauliani</i> n. sp.</b>										
BMNH	17.1	8.7	2.3	8.3	4.4	11.1	6.9	4.4	4.2	6.1
13.2.18.1, ♂ (holotype)										
BMNH	—	—	—	—	—	11.1	7.0	4.4	—	—
13.2.18.2, ♀										

their original natural colour. In contrast, BMNH 78.185, an adult male, and FMNH 185795, a sub-adult male, were collected and preserved over the past 30 years and presumably display a more natural pelage coloration. In BMNH 78.185, the dorsum is brownish-gray and the ventrum mouse gray, typical of adult *T. furculus* and in FMNH 185795 the pelage is a light gray, typical of sub-adult *T. furculus*.

The cranial measurements of *T. pauliani* n. sp. are similar to those of *T. auritus* and *T. furculus* and fall within the range of size variation of these latter two taxa (Table 2). The same point holds in general for different dental measurements, although there is an elongation of the anterior portion of the upper toothrows in *T. pauliani* n. sp., with the I<sup>1</sup>-M<sup>3</sup> measurements (6.9 [♂], 7.0 [♀] mm) falling outside the range for *T. furculus* (6.0-6.4 mm, sexes combined, n = 16) and *T. auritus* (6.1-6.8 mm, sexes combined, n = 53). In contrast, the molar toothrows are generally shorter in *T. pauliani* n. sp. (4.4 mm [♂], 4.4 mm [♀]) than in *T. furculus* (4.5-4.9 mm, sexes combined, n = 16) or *T. auritus* (4.5-5.2, sexes combined, n = 53).

The morphology of the crania of *T. pauliani* n. sp. and *T. auritus* and *T. furculus* are similar to one another (Fig. 3). One consistent difference, based on the limited number of cranial specimens available of *T. pauliani* n. sp., is that in this taxon the rostral area is less inflated, particularly the nasal compartments, than in individuals of *T. auritus* and *T. furculus*. When seen in side view, the inflated rostrum in *T. pauliani* n. sp. does not rise to the level of the braincase, while in *T. auritus* and *T. furculus* the swelling is at a level equal or surpassing the braincase. In both *T. auritus* and *T. furculus* the rostral depression is more prominent than in *T. pauliani* n. sp. Further, the sagittal crest terminates anterior to the interorbital constriction in *T. pauliani* n. sp., and generally posterior to the constriction in *T. auritus* and *T. furculus*.

## DISCUSSION

### HOLOTYPE LOCALITY

The locality and collector inscribed in the BMNH register for specimens 13.2.18.1 and 13.2.18.2 are

“Cosmoledo Id., nr Aldabra... received in exchange from Cambridge Museum. Collected by J. G. F. Fryer, Esq.”. The same information is also associated with these specimens in the original catalog in the CUMZ (Ray Symmonds, *in litt.*), as well as the two additional specimens in the original series (CUMZ E5609.A and E5609.B). Cosmoledo is composed of several different islands and is located approximately 115 km to the east of the eastern edge of the Aldabra group. In his accounts of the Percy Sladen Trust Expedition to the Seychelles, during which these four specimens (BMNH 13.2.18.1, 13.2.18.2 and CUMZ E5609.A and E5609.B) were collected, Fryer (1911: 417) noted: “*Triaenops furcula* Trouessart, was not uncommon on Picard near the settlement.” In the description of animals obtained on Cosmoledo by Fryer, nothing is mentioned about bats and we assume that the *Triaenops* specimens were not collected there. Hence, the exact locality where these specimens were collected is called into question. We have not been able to locate an original field catalog of J. G. F. Fryer.

Another important point in trying to find out on which island the four Fryer specimens were collected is one of suitable habitat for day roosts of *Triaenops*. In Madagascar, *T. furculus* often uses different types of caves and rock overhangs, including coastal sea caves (Peterson *et al.* 1995; Ranivo & Goodman 2006). On the various islands of the Aldabra Atoll, the coastal coralline limestone fringe or land-rim is extensive, as well as a very particular formation of metamorphosed coral derived rock known as “champignon” (Fryer 1911). In both of these formations, there are a myriad of potential roosting sites for rock-shelter-dwelling bats. In comparison, while most of the islands in the Cosmoledo group are raised atolls, the fringing land-rim and rock islands have been broken by erosion (Fryer 1911). Hence, sea caves are rare and there is little habitat for *Triaenops* day roost sites on this atoll. This information provides some further inference that the Fryer specimens are not from the Cosmoledo group, but rather from the Aldabra group.

During the night of 17-18 December 2005 SMG installed nets to capture bats near the abandoned settlement on Menai Island (09°42'35.9"S, 47°30'28.4"E) in the Cosmoledo group. Three

mist nets of 12 m in length were installed from sunset to sunrise and no individual of *Triaenops* was captured. Further, a significant portion of the western coastal zone of this island was searched in vain for sea caves. No elevated land features occur on the island that might serve as day roost sites for *Triaenops*. On the basis of these various points and subsequent bat research conducted in the outer islands of the Seychelles (e.g., Hutson 2004), we conclude that there is no clear evidence for the occurrence of *Triaenops* in the Cosmoledo group and all verifiable records to date of this genus in the western Seychelles are from the Aldabra group, specifically Picard Island. We assume a clerical error occurred during the cataloging of the Fryer specimens at the CUMZ, and that the material is from the Aldabra Atoll, rather than Cosmoledo Atoll. Hence, we restrict the type locality of *T. pauliani* n. sp. to Picard Island.

#### BIOGEOGRAPHY

Three species of *Triaenops* are recognized on Madagascar (Ranivo & Goodman 2006; Russell *et al.* 2007). Most records of *T. auritus* are from caves and restricted to the far northern end of the island (Fig. 1), particularly in the region with exposed karstic limestone. *Triaenops furculus* has a non-overlapping distribution with *T. auritus*, which is its closest relative, and is known across the remaining dry portions of western, southwestern, and southern Madagascar (Fig. 1). *Triaenops furculus* has been recorded in a variety of habitats including caves, shallow sea caves, rock overhangs, under bridges, and large road drainage pipes. The third taxon, *T. rufus*, is morphologically distinct from the *furculus/auritus* group, with a different shaped skull and noseleaf (Peterson *et al.* 1995; Ranivo & Goodman 2006), and the sister species to *T. persicus* of Africa and portions of the Middle East. Thus, there have been either two separate colonizations of *Triaenops* on Madagascar or this group evolved and speciated on Madagascar and subsequently colonized continental portions of the Old World. On the basis of numerous characters, *T. pauliani* n. sp. is a member of the *furculus* group.

As the westernmost island complex in the Seychelles Archipelago, Aldabra Atoll is about 480 km

to the northeast of the northern tip of Madagascar and closer to the African Continent (Fig. 1), this is approximately the same distance between the western coast of Madagascar and the eastern coast of Africa. Further, the Comoro Islands forms a nearly equidistant triangle between Aldabra and Madagascar. Given that members of the *furculus* group are restricted to Madagascar and Aldabra Atoll, it is presumed that these animals speciated on islands in the western Indian Ocean. In late 2006 and early 2007, extensive bat surveys were conducted on all four major islands forming the Comoro Archipelago (Grande Comore, Mohéli, Anjouan, and Mayotte), including appropriate cave habitat for day roost sites, and no evidence of the genus *Trienops* was found (Goodman & Ruedi unpublished).

Aldabra Atoll only rises to 8 m a.s.l. and all of the currently existing exposed landmass would have been underwater during the Quaternary, which clearly indicates that Madagascar would have been the colonization source of animals that speciated into *T. pauliani* n. sp. The question of the level of genetic differentiation between *T. pauliani* n. sp. and members of the *T. furculus/auritus* species group will be fascinating to answer once tissue samples of the former are available. Given the known details of periods of inundation of Aldabra, such research will provide interesting insight in the evolution of this group and rates of speciation.

#### CONSERVATION STATUS

Information on the status of *Trienops pauliani* n. sp. on Picard Island is incomplete. When Fryer (1911: 417) visited the island, he noted that this species "was not uncommon (...) near the settlement". During the subsequent 90 years, we are only aware of three subsequent records of this species on Picard Island, a site of considerable research activity over several decades in part associated with the Aldabra Research Station (Stoddart 1984).

There are sea caves on the island, most of which are difficult to access. On 14 December 2005, the western portion of Picard Island was explored by SMG, including some sea caves and interior pits in the coral limestone base rock, and no bat day roost site was located. During the period of this visit, local

researchers and rangers working for the Seychelles Island Foundation associated with the research station were unaware of any microchiropteran roost site on the island or anywhere on the atoll. During the nights of 13 and 14 December 2005, SMG accrued 60 net hours (five, 12 m nets installed for 12 hours each) near the Aldabra Research Station and the nearby abandoned settlement. No bat was captured and no microchiropteran was observed.

Based on current information, it would appear that *T. pauliani* n. sp. is endemic to the Aldabra Atoll, specifically Picard Island, and all verifiable records are from the vicinity of the abandoned settlement and research station. Little research on microchiropteran bats has been conducted on the other islands of the atoll (see Hutson 2004), and this species might have a broader distribution than currently recognized. Further field research needs to be conducted on the distribution of *T. pauliani* n. sp., but given this animal's extremely limited distribution and apparent rareness it is of considerable conservation concern. The recognition of the Aldabra *Trienops* as a separate taxon from *T. furculus*, renders the latter as an endemic species to Madagascar.

The Aldabra Atoll was named as Réserve spéciale by the Seychelles Government in 1971 and subsequently as a UNESCO World Heritage Site in 1982. It is one of the last remaining intact large atoll ecosystems in the world and is well protected under the management of the Seychelles Island Foundation. The atoll holds a notable number of endemic and unique organisms, including a population of about 100 000 Aldabran giant tortoises (*Dipsosaurus dorsalis* Gray, 1831; see Bourn *et al.* 1999), an endemic fruit bat (*Pteropus aldabrensis* True, 1893), several bird species (e.g., *Dryolimnas aldabranus* (Gunther, 1879), *Dicrurus aldabranus* Ridgway, 1893, *Nesillas aldabranus* Benson & Penny, 1968), as well as a range of plants. The description of *T. pauliani* n. sp. adds another animal to the list of the unique biota of the island. The Republic of the Seychelles has an additional endemic microchiropteran bat species, *Coleura seychellensis* Peters, 1868, which is of considerable conservation concern because of apparent extensive population reductions and its limited range; this species is

currently classified as critically endangered (Hutson *et al.* 2001). The situation with *T. pauliani* n. sp. maybe equally precarious and should be the subject of field investigations in the near future.

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