ON THE DISCOVERY OF A NEW LARGE CHAMELEON INHABITING THE LIMESTONE OUTCROPS OF WESTERN MADAGASCAR: *FURCIFER NICOSIAI* SP. NOV. (REPTILIA, CHAMAEOLEONIDAE)

INTRODUCTION - In a widely accepted revision of the family Chamaeleonidae (KLAVER & BÖHME, 1986), Malagasy taxa ascribed to the subfamily Chamaeleoninae have been grouped in two endemic genera: *Furcifer* Fitzinger, 1843 ("defined by the synapomorphic pedunculi and auriculae on the hemipenis apex") and *Calumma* Gray, 1865 (including all the remaining Malagasy species).

While *Calumma* species seem to be rather microthermic and restricted to rainforest habitats, most of the species ascribed to the genus *Furcifer* - which includes the largest known chameleon: *Furcifer oustaleti* (Mocquard, 1894) - inhabit areas characterized by marked dry season and deciduous vegetation types.

Several sources witness the occurrence of two *Furcifer* species within Tsingy de Bemaraha Massif and/or in the area of the nearby village of Antsalova: *Furcifer oustaleti* (BIVOUC, 1971; NICOLI & LANGRAND, 1989; HALLMANN et al., 1990; GLAW & VENCES, 1994; EMANUELI & JESU, 1995) and *Furcifer verrucosus* (Cuvier, 1829) (HALLMANN et al., 1990; EMANUELI & JESU, 1995). Further investigations, carried out on site by Acquario di Genova in 1995 and 1997, lead us to state that the *Furcifer verrucosus* population inhabiting Tsingy de Bemaraha must be considered a new species.

This paper deals with the formal description of this taxon, which joins the list of herpetofauna species apparently restricted to the biodiversity fortress of Tsingy de Bemaraha.

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MATERIALS AND METHODS - The fieldwork was carried out during the rainy season in February-March 1997 in two sites: the specimens ascribed to the new taxon were collected in the locality of Trano Passage, along the western slopes of the Antingy forest (18°43'S, 44°43'E; 120-130 m a.s.l.) in the period 2-14 March 1997; the comparative ones were collected in the dune spiny forest close to Anaka village (23°38'S, 43°39'E; 5-10 m a.s.l.) in the period 24-31 March 1997.

Both in the two study areas, the chameleons could be easily observed and collected during the day in activity on bushes and low trees; it was nevertheless easier to spot them at night, while roosting asleep on branches (Fig. 1).

After exposure to acetic ether, the died specimens were injected with 70% ethanol alcohol and preserved in the same solution. Hemipenis evagination was obtained through an ethanol alcohol injection near the base of retractor penis magnus muscle (caudal end of hemipenis pocket). For what regards hemipenis morphology, it has been followed the terminology proposed by Klaver & Böhme (1966).

The photographs accompanying the text were taken in the field by G. Schimmanti and R. Jesu. All the drawings of the external morphology of heads and hemipenes were made by F. Mattioli tracing pictures obtained from slides.

In the text, the following museum acronyms have been used: MNHN (Muséum national d’Histoire naturelle, Paris) and MSNG (Museo Civico di Storia Naturale “Giacomo Doria” di Genova).

**Furcifer nicosiai** sp. nov.

DIAGNOSIS - A large species which can be ascribed to the *Furcifer verrucosus* group (Glaw & Vences, 1994), named "group C" by Brygoo (1971), for the presence of a high parietal crest and the absence of rostral appendages. Besides this, the head shows separated canthi rostrailes, a poorly developed but evident gular crest and a markedly acute rostral profile. The body bears a complete ventral crest and a poorly developed dorsal crest extending from the nuchal region to the tail. The body scales are strongly heterogeneous. The female shows a significantly less developed parietal crest, a proportionally more developed gular crest and a dorsal crest - formed by a few sharp conical tubercles - which is evident only in the anterior third of the body.

![Female of Furcifer nicosiai sp. nov. roosting on a thin branch and giving support to a calling male of Heterochilus luteomarginatus (Andersson, 1910).](image1)

![Furcifer nicosiai sp. nov., MSNG 49094 (male holotype).](image2)


DESCRIPTION OF HOLOTYPE - Adult male in good state of preservation. Hemipenes fully everted. Head (Fig.6) without occipital lobes and rostral appendages. Parietal and orbital crest well developed; lateral crest poorly developed; absence of temporal crest. Canthi rostrales well developed and separated. Rostral profile markedly acute. Evident gular crest formed by 16 pointed conical tubercles. Large rounded scales (diameter longer than 2 mm) in parietal and temporal regions, between canthi rostrales and between orbital crests.

Body elongated and typically compressed. Poorly developed complete dorsal crest extending on tail; first 4-5 tubercles markedly sharp and conical. Evident ventral crest formed by pointed conical tubercles extending from end of gular region to pelvic region. Flanks and limbs sprinkled with many scattered flattened tubercles.

Hemipenis (Fig.8) clavate and capitulate with apex evidently bilobed. Truncus calyculate. Sulcal lips strongly divergent. Each lobe of the apex bears the following structures: 1) an evident pedunculus laterally curved with large pointed papillae at the sulcal distal surface, 2) a denticulate transverse auricula at the asulcal base of the pedunculus and 3) a large tuft of superimposed papillae at the asulcal base of the pedunculus. No median structures are present along the midline of the apex.

Coloration in vivo during breeding season (Fig.2): head, body and tail whitish with diffused brown marblings, shading into red lateroventrally and on

Fig. 3 Furcifer nicosaai sp. nov., MSNG-49653 (female paratype).

Fig. 4 Dense sub-humid forest of the Antsingy ("Tsingy de Bemaraha" Massif).
limbs; a large white stripe along flanks growing thinner towards tail; several dark cross bands laterodorsally on body and tail.

Coloration in preservative: almost uniformly greyish conserving the whitish stripe on flanks.

VARIATION - The only paratype (adult female MSNG 49653), as all the other females observed in the study area, is significantly smaller than the holotype and the other adult males observed. Table 1 shows measurements of the type specimens of Furcifer nicosiei. In comparison with the holotype, the paratype (Fig.7) shows a significantly less developed parietal crest, a proportionally more developed gular crest and a dorsal crest - formed by 8 sharp conical tubercles - which is evident only in the anterior third of the body.

Colour of paratype in vivo (Fig.3) extremely peculiar, including various shadings of light blue and violet, a pink stripe along flanks interrupted by a few bluish cross bands.

Coloration in preservative pale pink with fine dark reticulations.

DERIVATIO NOMINIS - Dedicated to Guido Nicosia, Ambassador of Italy in Madagascar, who made our expedition successful thanks to his continuous help and encouragement.

NATURAL HISTORY - This species was found only in the Antsiny forest in a wide range of habitats: dense sub-humid forest (Fig.4), dense dry forest with xerophytic vegetation on top of the sharp limestone blocks locally named “tsiny” (Fig.5), clearings covered with Pederia creepers and forest edges.

The occurrence of Furcifer nicosiei within these habitats was already reported by Emanuelli & Jesu (1995), who attributed the specimens belonging to this taxon to Furcifer verrucosus (Cuvier, 1829). With the apparent exception of the dense sub-humid forest, elsewhere this species is sympatric with Furcifer oustaleti (Mocquard, 1894), which is the only chameleon found in the savannah surrounding the Antsiny forest and in the cultivated areas in the proximity of Antsalova village. The majority of the specimens of Furcifer nicosiei observed were found in the night roosting on branches at height of 1-2 m from the ground; a few were sighted at much higher positions, up to 6 m. We witnessed the existence of illegal collecting activities of this species within the limits of the Strict Nature Reserve No 9 “Tsingy de Bemaraha”; these chameleons, named “verrucosus” or “pardalis d’Antsalova” currently find their way in the pet trade towards Europe and North America.

JUSTIFICATION OF THE NEW SPECIES - Furcifer nicosiei, as already stated in the diagnosis, can be ascribed to the Furcifer verrucosus group (Glaw & Vences, 1994), named “group C” by Brygoo (1971), for the presence of a high parietal crest and the absence of rostral appendages; nevertheless, it shows characters which easily allow to distinguish it from the two species currently included in this group. While a morphological comparison with Furcifer oustaleti immediately underlines the remarkable differences between the two taxa, Furcifer verrucosus is with no doubt the species most closely related to Furcifer nicosiei, at least as regards their external morphology. The main differences between these two taxa can be summarized as follows: the male of Furcifer nicosiei shows significantly smaller size, more acute rostral profile, a larger number of tubercles forming the dorsal crest (from the nape to the vent, less than
40 in Furicer verrucosus and 50-60 in Furicer nicosi) which are far less developed and pointed (the highest reaches 2 mm in the holotype of Furicer nicosi), but can exceed 4 mm in large specimens of Furicer verrucosus), more marked ventral crest; the female shows smaller size, far less developed parietal crest, occiput not pointed, dorsal crest formed by less than 10 scarcely developed pointed tubercles (the highest does not reach 2 mm in Furicer nicosi, but can exceed 3 mm in Furicer verrucosus), more developed ventral crest. Also the predominant grey-green coloration of both sexes of Furicer verrucosus has not much to share with the peculiar dimorphic colour just described in Furicer nicosi.

The two species show marked differences also for what regards their hemipenis structure (Figs 8, 9). The hemipenis structure of Furicer verrucosus, obtained from the specimen MSNG 49093 and from the literature (Bourrat & Brygoo, 1968; Brygoo & Domergue, 1970; Klaver & Bohme, 1986) can be described as follows:

Hemipenis clavate and capitulate with apex slightly bilobed. Truncus calyculate with an evident lamimate appearance due to the length and depth of calyces.

Sulcal lips divergent. Each lobe of the apex bears the following structures: 1) a stout curved pedunculus whose sulcal surface bears large pointed papillae, 2) a denticulate transverse auricula at the sulcal base of the pedunculus and 3) a single papilla at the sulcal base of the pedunculus. The only structure present along the midline of the apex is a small, denticulated ridge.

Then, the just described hemipenis differs from the one of the holotype of Furicer nicosi for the following features:

- truncus calyces are deep and give to the truncus a laminate appearance;
- sulcal lips are far less divergent;
- apex pedunculi are more pronounced and evidently curved towards the sulcal side;
- sulcal base of the pedunculus bears a single papilla, instead of a tuft of superimposed papillae;
- apex midline not smooth, but with a small, denticulated ridge sited between the two auriculae.

It must be underlined the remarkable affinity between the hemipenis structure of the holotype of Furicer nicosi and the one of Furicer pardalis (Cuvier, 1829), described in detail by Klaver & Bohme (1986).
CONSERVATION ASPECTS - *Furcifer nicosiati*, which probably shares a common ancestor with *Furcifer verrucosus*, might be a species endemic of Tsingy de Bemaraha Massif, as *Brookesia perarmata* (Angel, 1933) and *Brookesia exarata* Schimmenti & Jesu, 1996 are likely to be; on the other hand, it cannot be excluded its occurrence in other deciduous forests of western Madagascar, as the nearby forest of Tsimembo. Its apparent dependence from rather open habitats within the primary deciduous forest, makes *Furcifer nicosiati* a species extremely vulnerable to habitat modifications (it must be stressed that it represents the only species of the *Furcifer verrucosus* group not occurring in any kind of man-related vegetal associations). As already stated in the paragraph dealing with the natural history of *Furcifer nicosiati*, unknown numbers of specimens belonging to this species - as to species of the genera *Brookesia* and *Uroplatus* (Schimmenti & Jesu, 1997) - are illegally collected in the Tsingy in order to supply the pet trade. Since Malagasy legislation allows the commercial exploitation of only four species of the genus *Furcifer* - *F. lateralis* (Gray, 1831), *F. oustaleti*, *F. pardalis*, *F. verrucosus* - the ascertainment of the Antsingy taxon to a new species should prevent the commercial export of specimens belonging to it. It is however desirable that all kinds of illegal collecting of wildlife within the Strict Nature Reserve “Tsingy de Bemaraha” be effectively repressed by competent authorities.

![Image](image_url)

**Fig. 8** Hemipenis morphology of *Furcifer nicosiati* sp. nov., MSNG 49094, male holotype (vulcal view on the left, lateral view on the right).

![Image](image_url)

**Fig. 9** Hemipenis morphology of *Furcifer verrucosus verrucosus* (Cuvier, 1829), MSNG 49093 (vulcal view on the left, lateral view on the right).

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Table 1 - Measurements (in mm) of the type specimens of *Furcifer nicosiati* sp. nov. in comparison with three specimens - including the holotype - of *Furcifer verrucosus verrucosus* (Cuvier, 1829).
ACKNOWLEDGEMENTS

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A special and grateful thought goes to the memory of Ermanno Carbonne, at that time Honorary Consul of Madagascar in Genova, who recently disappeared.

REFERENCES


ABSTRACT

During fieldwork carried out in February-March 1997 in the Strict Nature Reserve No 9 “Tsingy de Bemaraha” (western Madagascar), a new species of chameleon (genus Fuscifer) was discovered on the western slopes of the Antsirabe forest. This species seems to be restricted to the Antsirabe forest, where it was observed in a wide range of habitats: dense subhumid forest, dense dry forest with xerophytic vegetation (top of the sharp limestone blocks locally named “tsingy”), clearings covered with Pederia creepers and forest edges. All these habitats, where Fuscifer nicosa sp. nov. is sympatric with Fuscifer ocellatus, belong to the large karstic complex of the “Tsingy de Bemaraha” Massif. Fuscifer nicosa is a large species which can be ascribed to the Fuscifer verrucosus group for the presence of a high parietal crest and the absence of nuchal appendages. Other features include: separated canthi rostralis, poorly developed basioccipital, evident gular crest, markedly acute rostral profile, complete ventral crest and poorly developed dorsal crest extending from the nuchal region to the tail. The external morphology and the sexual dimorphism make this new taxon very similar to Fuscifer verrucosus, from which it can be distinguished by: smaller size, different colour patterns and hemipenis ornamentation.

RIASSUNTO

Durante una spedizione condotta nel periodo febbraio-marzo 1997 nella Riserva Naturale Integrale No 9 “Tsingy de Bemaraha” (Madagascar ovest) è stata rilevata una nuova specie di camaleonte, ascrivibile al genere Fuscifer, sul versante occidentale della foresta dell’Antsirabe. La nuova specie sembra escludere definitivamente l’unicità di foresta stessa, all’interno della quale è stata osservata in una notevole varietà di habitat: foresta densa sub-humida, foresta densa arida costituita da predominanza di xerofite (sulle sommità dei blocchi di calcare appartenenti localmente denominati “tsingy”), aree esposte alla luce del genere Pederia e zone costituite da biroda della foresta. Tutt’altro che unici questi habitat, nei quali Fuscifer nicosa sp. nov. risulta simpatrico con Fuscifer ocellatus, appartengono all’imponente complesso karstico del Massiccio “Tsingy de Bemaraha”. Fuscifer nicosa è una specie di piccola taglia ascrivibile al gruppo Fuscifer verrucosus per la presenza di una cresta parietale molto sviluppata e per l’assenza di appendici rostrali. Fra gli altri caratteri vanno annoverati: canthi rostrali separati, cresta golare poco sviluppata ben evidente, profilo rostrale visibilmente acuto, cresta ventrale completa e cresta dorale poco sviluppata che si estende dalla regione nuchale alla coda. La morfologia esterna ed il dimorfismo sessuale rendono questo nuovo taxon molto simile a Fuscifer verrucosus, da cui si distingue per: taglia inferiore, colorazione differente ed ornamentazione degli empiomi.
Dans une expédition effectuée en février-mars 1997 dans la Réserve Naturelle Intégrale n°9 "Tsingy de Bemaraha" (Madagascar oriental) a été découverte une nouvelle espèce de caméléon, attribuable au genre Fascifer, sur le versant ouest de la forêt de l'Anstingy. La nouvelle espèce semble être exclusive à cette forêt, dans laquelle a été observée une conséquente variété d'habitat : forêt dense sub-humide, forêt dense sèche avec prédominence de xérophiles (sur le sommet des blocs calcaires aiguisés dénommés localement "tsingy"), clairières couverte de lianes du genre Pedernis et zones d'écotone sur le bord de la forêt. Tous ces habitats, dans lesquels Fascifer nicolai sp. nov. est syntonique avec Fascifer microlepis, appartiennent au imposant complexe karstique du massif "Tsingy de Bemaraha". Fascifer nicolai est une espèce de grande taille attribuable au groupe Fascifer verrucosus par la présence d'une crête pariétale très développée et par l'absence d'appendices rostraux. Parmi les autres caractères il faut mentionner : caudal rostrales séparés, crête palatale peu développée bien qu'évidente, profile rostral visiblement aigu, crête ventrale complète et crête dorsale peu développée qui s'étend de la région de la nuque à la queue. La morphologie externe et le dimorphisme sexuel rendent ce nouveau taxon très semblable à Fascifer verrucosus, duquel il se distingue par : une taille inférieure, une coloration différente, et une ornementation des hemipenes différente.