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A new species of *Coryphophylax* Fitzinger in: Steindachner, 1867 (Sauria: Iguania: Agamidae) from the Andaman Islands, India

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Abstract

The systematic position of the agamid genus *Coryphophylax* (Squamata: Agamidae) is given as monotypic and endemic to the Andaman and Nicobar Islands in the Bay of Bengal, India. After having surveyed intensively in thirteen different Islands and examined several individuals in the Andamans group of islands, we describe a second species of *Coryphophylax* from the lowland rainforests of the South Andaman Island. *Coryphophylax brevicaudus* **sp. nov.** is differentiated from its congener, *C. subcristatus* (Blyth, "1860" 1861) by its smaller size, relatively shorter tail, presence of nuchal and dorsal crests in both sexes, midbody scale row counts and colour pattern. The new species lives in sympatry with *C. subcristatus*. The taxonomic history and systematic status of the genus *Coryphophylax* are discussed, and the need for continued surveys in the Islands is emphasized.

सार /Abstract (*translation in Hindi*)

खाड़ी द्वीपीय छिपकली (Bay Island lizard), जो जननेन्द्रियरहित प्राणी जाति *कोरिफोफाइलेक्स* (स्क्वामाटा:एगेमिडे) के अन्तर्गत आती है, उसकी व्यवस्थित स्थिति एकक्षेत्रिय प्राणी के रूप में दी गई है और यह भारत में बंगाल की खाड़ी में अण्डमान एवं निकोबार द्वीपसमूह तक ही सीमित है। अण्डमान समूह के द्वीपसमूह में से तेरह विभिन्न द्वीपसमूहों का गहन रूप से सर्वेक्षण करने और अनेकों प्राणियों की जांच करने के पश्चात् हम *कोरिफोफाइलेक्स* की दूसरी प्रजाति का वर्णन करते हैं, जो दक्षिण अण्डमान दीपसमूह के निचली भूमि वाले वर्षा वनों से प्राप्त हुई है। *कोरिफोफाइलेक्स ब्रेविकॉडस* स्वी. नावे. अपने जैसे ही दूसरी प्रजाति *सी. सब्काइस्टेटस* (ब्लाइथ, '1860', 1881) से भिन्न है क्योंकि उसका आकार छोटा है व तुलनात्मक रूप से पूंछ भी छोटी है। इसके नर व मादा, दोनों लिंगों के प्राणियों में गर्दन के पिछले भाग एवं पृश्ठ भाग में कलगियाँ पाई जाती है। इनके षरीर के मध्य भाग में स्केल पंक्ति काउण्ट्स एवं रंग पद्वति भी अपने जैसी दूसरी प्रजाति से भिन्न होती है। यह नई प्रजाति, दूसरी प्रजाति *सी. सब्काइस्टेटस* से सामंजस्य बनाकर रहती है। *कोरिफोफाइलेक्स* प्रजाति के वर्गीकरण इतिहास एवं व्यवस्थित स्थिति पर विचार विमर्ष किया गया है, एवं द्वीपसमूह में सर्वेक्षणों की आवष्कता पर जोर दिया गया है।

Key words: Squamata, Iguania, Agamidae, *Coryphophylax brevicaudus* **sp. nov.,** Andaman Islands, India

Introduction

The agamid genus *Coryphophylax* Fitzinger *in*: Steindachner, 1867 is currently considered monotypic and endemic to the Andaman and Nicobar group of islands (Welch *et al*., 1990; Barts & Wilms, 1997; Manthey, 2011), with the sole representative, *Coryphophylax subcristatus* (Blyth, "1860" 1861). It was originally described as *Tiaris subcristata*, based on a series of specimens with data suggestive of their collection from "Port Blair," in the Andaman Islands (Fig. 1). This species is distributed across the Andaman and Nicobar Islands, except on the island

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of Great Nicobar (Vijayakumar, 2003; pers. obs.), the southernmost island in the archipelago. Where it occurs, *C. subcristatus* is abundant and constitutes a major component of the lizard biomass in the rainforest (pers. obs.). Das (1999) suggested that *C. subcristatus* might be a species complex. Two other species names assigned to *Coryphophylax* are available, described in the late Nineteenth Century, *Coryphophylax maximiliani* Fitzinger *in*: Steindachner, 1867 and *Tiaris humei* Stoliczka, 1873, both from islands in the Nicobar group. These are currently considered junior subjective synonyms of *Coryphophylax subcristatus* (Blyth, "1860" 1861).

Andaman and Nicobar Islands are a group of 556 islands, islets and rocks in the Bay of Bengal (Fig. 1) (Anonymous, 2007). These islands are part of a submerged mountain chain, a continuation of the Arakan Yomas of Myanmar and extending to the Mentawei Islands near Sumatra, Indonesia (Rodolfo, 1969; Das, 1999). This island group is divided in two by a deep (over 1000 m) channel, known as Ten Degree Channel, named after the latitude at which it is located. Andaman Islands are situated to the north of Ten Degree Channel while Nicobar Islands are to the south of it. Andaman Islands consists of 532 islands with a total land area of 8249 km^2, most of which are in close proximity to each other and separated by very shallow sea such that during Pleistocene sea level fluctuations, they would have constituted a single large island. The major large islands in this group are North Andaman, Middle Andaman, Baratang, South Andaman and Little Andaman. Ritchie's Archipelago, including Havelock, Neil and several other islands is situated to the east if these islands, and is separated by shallow sea. Nicobar Islands consists of 24 islands with total land area of 1962 km^2, in three sub groups: a northern group, a central or Nancowry group and a southern group consisting of Great Nicobar and nearby small islands. These island groups are separated by channels reaching depths of up to 200 m. Das (1999) showed that the herpetofauna of Andaman Islands showed Indo-Chinese affinities while that of Nicobar Islands showed Indo-Malayan affinities, particularly towards Sumatra. Thus, the Ten Degree Channel is a zoogeographical barrier for herpetofauna in these islands, with very few non-marine/non-estuarine species occurring on both sides of it.

During a biodiversity survey of the herpetofauna of Mount Harriet National Park (Fig. 1), near Port Blair, South Andaman Island, India, in 2010, we identified a distinct population of *Coryphophylax* that exists in sympatry with *C. subcristatus*. It is diagnosable from the name-bearing population by its colouration, smaller body size, relative body proportions and scale counts. In this communication, we describe this population as a new species.

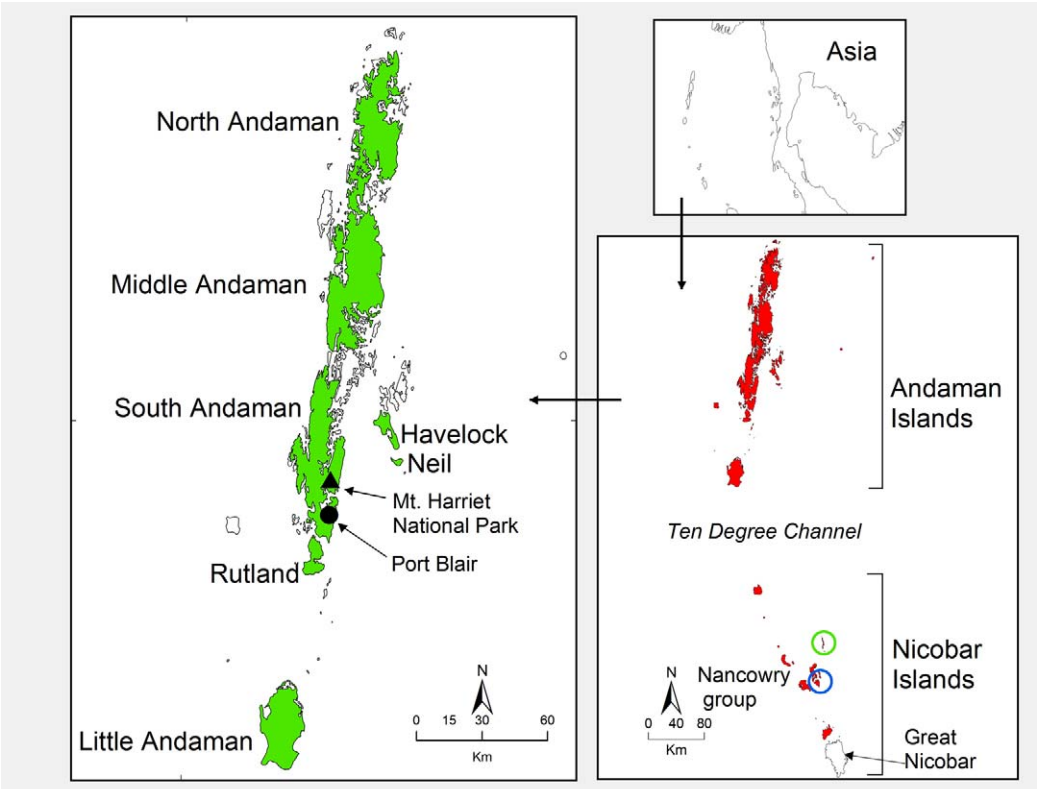

FIGURE 1. Andaman and Nicobar Islands. The type locality of *Coryphophylax brevicaudus* **sp. nov.** is indicated by a dark triangle, while the presumed type locality of *C. subcristatus* is indicated by a dark circle. The islands in which *C. brevicaudus* was recorded are shaded grey. The type localities of the two synonyms of *C. subcristatus*, namely *C. maximiliani* and *Tiaris humei* in the Nicobar Islands are indicated by blue and green circles respectively.

Material and methods

Specimens from the type series were hand-collected or noose trapped, fixed in formalin for 24 hours and subsequently placed in 70% ethanol for long-term storage. We made comparisons based on live and preserved specimens. Sex was determined by everting the hemipenes of adult males. For preserved specimens, sex determination was done prior to euthanasia. The following measurements were taken: snout-vent length (SVL, from tip of snout to vent), tail length (TaL, from posterior border of cloacal opening to tip of tail), tail width (TaW) and tail height (TaH) at tail base, weight (W), head length (HL, from snout tip to posterior border of tympanum), head width (HW, at temporal region), head depth (HD, at a point behind orbit), snout length (SL, from snout tip to anterior border of orbit), orbit diameter (OD, distance between anterior and posterior margins of orbit), tympanum diameter (TD, greatest diameter of tympanum), torso length (TrL, from arm pit to groin), torso height (TrH, at half torso length), torso width (TrW, at half torso length), forelimb length (FLL, from armpit to tip of longest digit), hindlimb length (HLL, from groin to tip of fourth toe), upper arm length (Hum, distance from the armpit to elbow), forearm length (Rad, distance from elbow to wrist), finger lengths (F1, F2, F3, F4, F5), thigh length (Fem, distance from groin to knee), shin length (Tib, distance from knee to ankle), toe lengths (T1, T2, T3, T4, T5), number of lamellae under third finger, number of lamellae under fourth toe, number of supralabials (left/right), number of infralabials (left/right), number of canthals (number of scales along the canthus rostralis from behind nasal to anterior border of orbit), number of supraorbitals, number of postmentals and number of scales around the body. All linear measurements were taken with a Mitutoyo™ Dial Vernier Caliper to the nearest 0.01 mm, except the measurements TaL, FLL and HLL, which were measured to the nearest mm. Measurements were taken of individuals with original tails. Body weights of live animals were measured using a Pesola™ spring balance (to nearest 0.1g). Three counts of mid-body scale rows were made and the mode used, on account of small, and sometimes irregular, nature of scales.

Eighteen live individuals (nine males and nine females) of the new species were examined and compared with 18 individuals (11 males and seven females) of *Coryphophylax subcristatus* from the South Andaman Island. The small sample size of sexes resulted from the elimination of the individuals that we considered juveniles or sub-adults. From live individuals, the following measurements were taken: SVL, TaL, W, SL, OD, TD, HL, HW, HD, TrL, FLL and HLL. A Discriminant Function Analysis (DFA) was used to test the group membership of each individual based on morphometric data collected from live individuals. All measurements, except body weight, were used in the analysis. We did not use body weight (W) in this analysis as it is likely to fluctuate rapidly, depending upon whether the lizard had fed or not, or whether the females were gravid or not, prior to capture. All body size measurements were expressed as a fraction of SVL, while SVL itself was used as such as a measure of absolute size. Prior to analyses, we checked for allometry in these measures using Pearson's correlation, but none of the variables showed significant relationships. Based on mean SVL for males and females of each species, we calculated a sexual size dimorphism score (SSD) (Gibbons & Lovich, 1990; Shine, 1994) for each male. This was used as an additional character for males. Thus, the final set of characters used was SVL (in mm), TaL/SVL, HL/SVL, HW/SVL, HD/SVL, SL/SVL, OD/SVL, TD/SVL, TrL/SVL, FLL/SVL, HLL/SVL and SSD (for males). Prior to analysis, all variables were square root transformed. Separate analyses were performed for males and females. Prior probabilities were set as equal for the two groups, and independent variables were added simultaneously. Significance of Wilk's lambda was evaluated at $\alpha = 0.05$. Analyses were performed with SPSS 15.0. (Norussis, 2005). Additionally, SVL, TaL and W were recorded from 158 individuals of *C. subcristatus* from Andaman and Nicobar Islands, including the type localities of the two synonyms of *C. subcristatus*.

Museum abbreviations used: ZRC—Zoological Reference Collection, Raffles Museum of Biodiversity Research, National University of Singapore, Singapore, ZSI—Zoological Survey of India, Kolkata, NMW—Museum of Natural History, Vienna. The types are deposited in the collection of Zoological Survey of India, Kolkata.

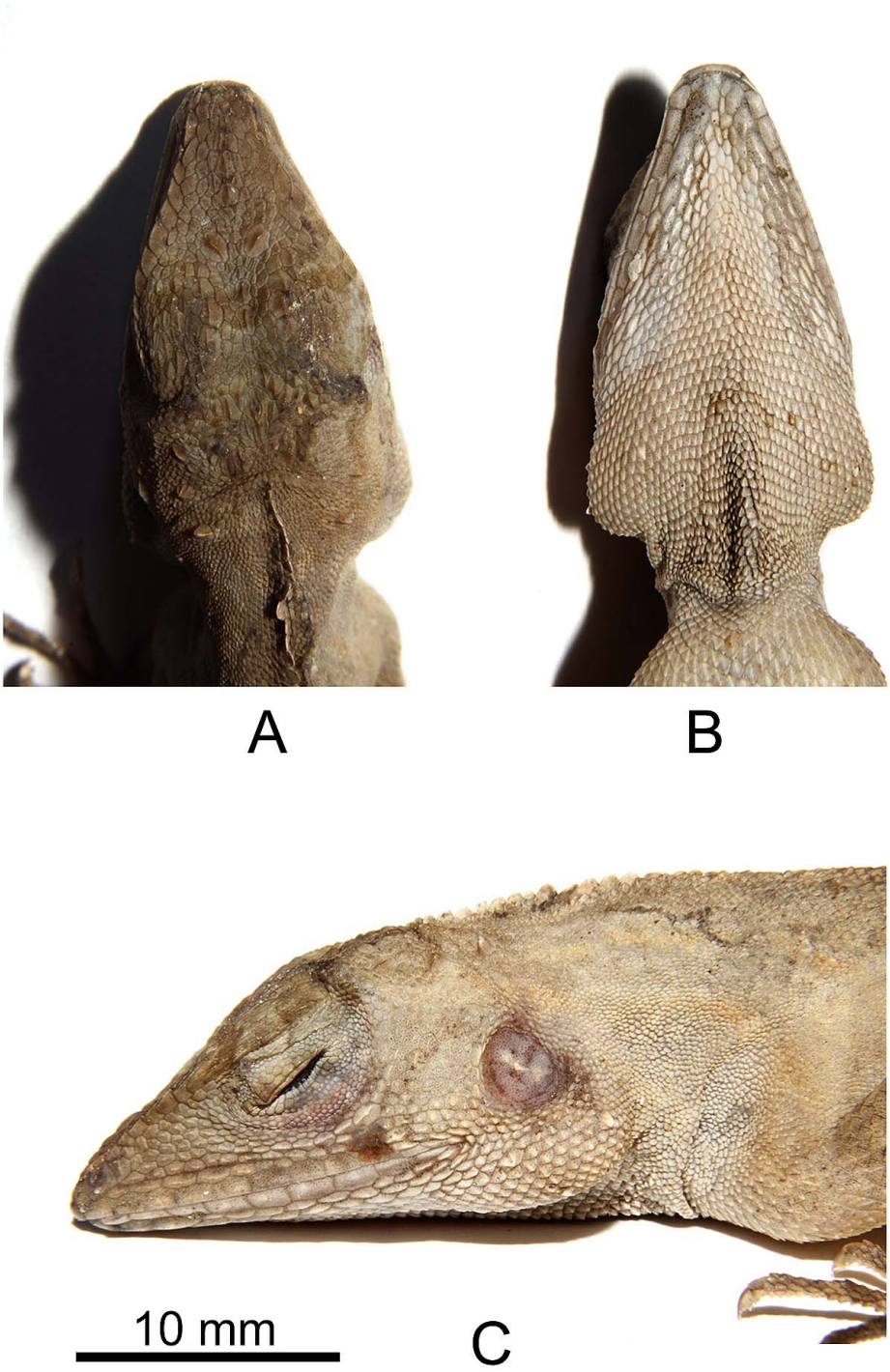

FIGURE 2. Dorsal (A), ventral (B) and lateral (C) views of head of the holotype of *Coryphophylax brevicaudus* **sp. nov**.

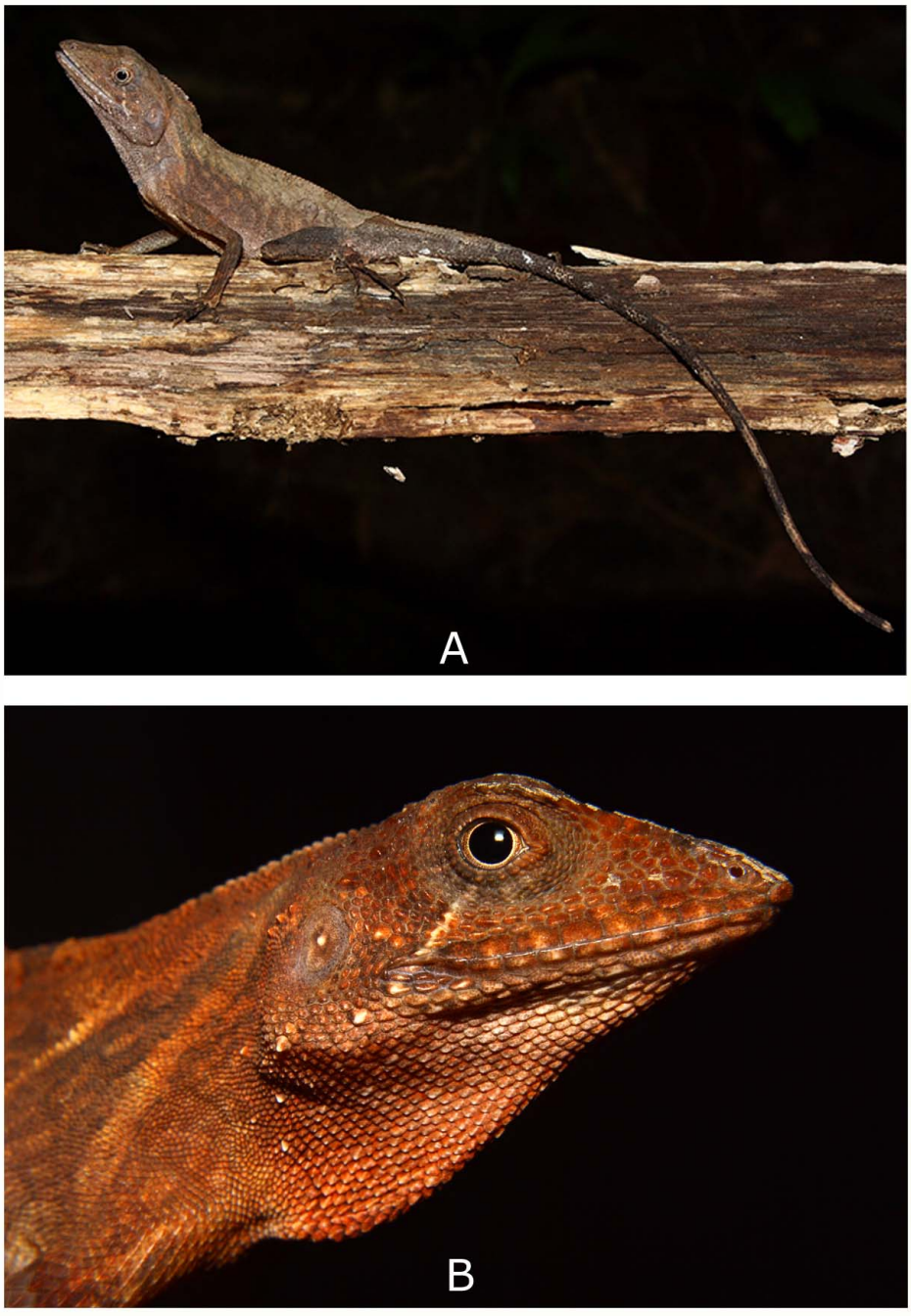

FIGURE 3. *Coryphophylax brevicaudus* **sp. nov.**, A) holotype (ZSIC 25962), adult male in life B) adult female showing the orange-red gular pouch, and the yellowish-white line from orbit to the corner of the mouth.

Taxonomy

***Coryphophylax brevicaudus* sp. nov.**
(Fig. 2–6, Table 1–3)

Holotype: ZSIC 25962, Adult male, Mount Harriet National Park, georeferenced latitude E 11.710579°, longitude N 92.735944°, South Andaman Island, Bay of Bengal, India, ca. 290 m asl. (Fig. 1). Collected by Harikrishnan S. and S. R. Chandramouli on 21 December 2010.

Paratypes: ZSIC 25963 (female), ZSIC 25964 (male), paratopotypes. Collected by S. Harikrishnan and S. R. Chandramouli on 25 June 2010.

Diagnosis: We allocate the new species to the genus *Coryphophylax* for showing the following suite of morphological characters: exposed tympanum, femoral pores absent, no lateral dermal expansions on body, absence of postorbital spines and lack of cephalic or nuchal spines.

The new species bears resemblance to several Asian genera of agamids, including the Malayan *Aphaniotis* Peters, 1864 and *Gonocephalus* Kaup, 1825 and the south Asian *Otocryptis* Wagler, 1830, but whether this is a result of phylogeny or convergent evolution warrants a phylogenetic study of the Southeast Asian agamids. *Aphaniotis* can be distinguished morphologically from *Coryphophylax* in having a concealed tympanum, while *Gonocephalus* includes species with distinct cephalic and/or nuchal spines. *Otocryptis* can be separated from *Coryphophylax* in showing a concealed tympanum.

Coryphophylax brevicaudus **sp. nov.** is diagnosed by: small adult size (mean SVL 57.97 mm); a relatively short tail (mean TaL/SVL = 1.93); tail narrows abruptly from base after cloacal opening; mid-body scale count range 110–121; males and females show a nearly uninterrupted flap of skin with small conical spines forming nuchal and dorsal crests; adult colouration reddish-brown or greyish-brown, with or without dark brown markings; presence of a thin yellowish white subocular stripe.

Description of holotype: adult male, SVL 63.60 mm. Morphometric data are summarized in Table 1. Head elongate (HW/HL ratio 0.61), maximum height less than maximum width; snout pointed; rostral broader than high; nostrils in upper half of single nasal shield, which is separated from rostral by a single scale; nasal in contact with first supralabial; supralabials 11/11; infralabials 11/11; mental shield narrower than rostral; two postmentals; anterior infralabials bordered on the inside by a row of enlarged scales; genials weakly keeled; scales on gular pouch strongly keeled, slightly smaller than genials; scales on top of snout small and smooth except median row, where there are three keeled scales; two enlarged, keeled scales, separated from each other by two small scales follow this row, each of ca. x 4 as large as adjacent snout scales; supraorbital scales keeled; six canthals along sharp canthus-rostralis, followed by eight compressed supraciliaries; orbit diameter 74% of distance between anterior border of orbit and snout tip; tympanum exposed, its greatest diameter 44% horizontal diameter of orbit; enlarged keeled scale between tympanum and orbit; one row of enlarged scales along dorsal inner border of orbit; a cluster of enlarged, elongated and keeled scales present just anterior to occiput, among which middle scale is largest; three enlarged spinous scales arranged in a line on both sides of occiput, separated from each other by 5–6 scales; nuchal crest begins at a point at the same level as the scale in the middle of this series; posterior region of jaws swollen, with three small spinous scales near angle of jaws.

Nuchal and dorsal crests low but well developed, composed of an erect flap of skin upon which are numerous conical compressed scales; skin flap continuous from nuchal to dorsal region, with a small region above shoulder, where conical compressed scales are lacking; dorsal crest continues to tail base; a weak antehumeral fold extending across throat; body scales minute, strongly keeled and intermixed with numerous enlarged spine-like scales; two parallel rows of enlarged spinous scales, separated from each other by a few scales on either side of vertebral region, the first of these separated from dorsal crest by ca. three scale rows, the second separated from first by 5–6 scale rows; 121 rows of scales around middle of body; scales on dorsum oriented postero-dorsally, while lateral ones oriented postero-ventrally; ventral scales with sharp keels and larger than laterals, genials and gular scales.

Limbs slender and covered with strongly keeled scales; scales under thighs weakly keeled; length of hindlimb ca. 92% SVL; relative length of fingers 4=3>5>2>1; relative lengths of toes 4>3>5>2>1; fifth toe longer than fourth finger; 19 subdigital lamellae under third finger; 26 subdigital lamellae under fourth toe; subdigital lamellae with sharp keels, bicarinate; tail slender, tapering abruptly posterior to cloaca; scales on dorsal and ventral surface of tail with sharp keels; tail length 124 mm, or 195% SVL.

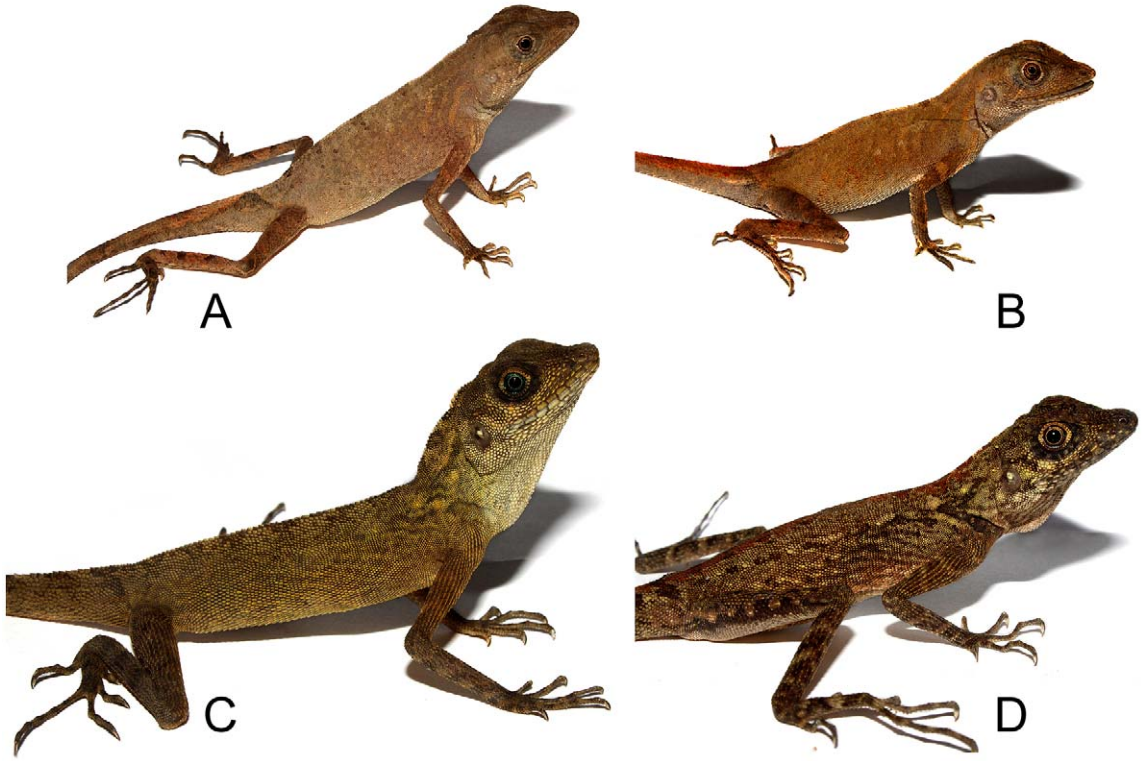

FIGURE 4. Clockwise from top left: *Coryphophylax brevicaudus* **sp. nov.** (A) male and (B) female compared with *Coryphophylax subcristatus* (C) male and (D) female, showing the differences in colour and general body shape. Female *Coryphophylax subcristatus* shows a different colour-pattern compared to the male of that species, whereas female *Coryphophylax brevicaudus* **sp. nov.** is more similar to the male of that species

In life (Fig. 3A), dorsum greyish-brown, lighter on vertebral region, with four dark brown vertebral spots; flanks darker brown; head greyish-brown, with a cream-coloured line from behind and below orbit to angle of mouth; infralabials grey; underside of chin greyish-white; gular pouch grey; light orange reticulations on sides of neck and anterior body; ventrals light yellowish-brown; limbs dark brown, banded with lighter brown; posterior part of fourth toe and foot dark brown, contrasting sharply with light brown of rest of foot; tail dark brown on sides basally, dark colour of both sides meeting dorsally at tail base of the tail, and separate lighter brown colour of tail dorsum from light brown of body dorsum; distally, tail banded alternatively with dark and light brown.

Description of paratypes: The two paratypes agree with the holotype in general morphology, scalation and colour, except for differences in mid-body scale count, which are 117 and 110, respectively. ZSIC 25963 also shows two enlarged scales on temporal region. ZSIC 25963 shows 11/10 (left/right) supralabials and 9/9 infralabials, while ZSIC 25964 shows 10/11 supralabials and 11/11 infralabials. ZSIC 25963 has 17 lamellae under the third finger and 28 lamellae under the fourth toe. ZSIC 25964 has 18 lamellae under the third finger and 27 lamellae under the fourth toe. In life, ZSIC 25963 had orange-red gular pouch, and body dorsum was a more intense shade of reddish-brown (Fig. 3B). Morphometric data on holotype and the paratypes are summarized in Table 1.

TABLE 1. Morphometrics of the type series of *Coryphophylax brevicaudus* **sp. nov.** All measurements are expressed in millimeters. The abbreviations are: SVL—snout-vent length, TaL—tail length, TaH—tail height, TaW—tail width, HL—head length, HW—head width, HD—head depth, SL—snout length, JL—jaw length, OD—orbit diameter, TD—tympanum diameter, TrL—torso length, TrW—torso width, TrH—torso height, HuL—upper arm length, Rad—forearm length, F1–F5—length of fingers 1–5, Fem—thigh length, Tib—shin length, T1–5—length of toes 1–5.

	ZSIC 25962 (Holotype)	ZSIC 25963 (Paratype)	ZSIC 25964 (Paratype)
Male/Female	Male	Female	Male
SVL	63.6	55.45	63.72
TaL	124	117	119
TaH	6.7	4.86	7.3
TaW	5.98	4.4	5
HL	19.3	16.19	18.33
HW	11.67	9.5	10.86
HD	9.91	8.93	9.57
SL	8.58	6.62	8.01
JL	20.74	17.3	19.67
OD	6.31	6.09	6.44
TD	2.78	2.19	2.75
TrL	26	25	29.19
TrW	13	12.35	11.26
TrH	12.95	11.14	10.59
Hum	15.18	12.63	14.39
Rad	13.2	11.2	12.9
F 1	2.46	2.72	2.4
F 2	4.48	4.61	3.35
F 3	7.6	6.69	6.91
F 4	7.76	6.95	6.91
F 5	4.8	3.57	4.87
Fem	19.15	14.93	18.67
Tib	20.65	17.79	19.71
T 1	3.48	2.14	2.78
T 2	4.67	4.17	4.07
T 3	9.05	7.1	8.17
T 4	13.98	13.83	12.8
T 5	7.88	6.55	7.15

Comparison with congener: For morphometric comparison using Discriminant Function Analysis, only live specimens from the Andaman Islands (type locality of both named species under the genus) have been used (see Appendix 2). For comparison of SVL, TaL, and meristic data, 158 live individuals from across the range of *C. subcristatus* in Andaman and Nicobar Islands are also used. Meristic characters are compared with museum specimens from both Andaman Islands and Nicobar Islands (Car Nicobar, Nancowry and Tillanchong) (See Appendix 3).

The most apparent difference between *C. brevicaudus* **sp. nov.** and its congener is the difference in adult body size. *C. brevicaudus* **sp. nov.** adults are smaller than *C. subcristatus* (mean SVL 57.97±5.92 mm [n = 18] vs. 77.05±12.63 mm [n = 158], respectively). *C. brevicaudus* **sp. nov.** has a relatively shorter tail than *C. subcristatus* (mean TaL/SVL = 1.93 ±0.10 vs. 2.42±0.17, respectively). In *C. brevicaudus* **sp. nov.**, tail narrows abruptly from base after cloacal opening, while in *C. subcristatus* tail is relatively muscular at base and gradually narrows to tip.

This difference is assumed to be due to the relatively greater arboreal habits of *C. subcristatus*, which uses tail as a support while perching vertically on tree trunks. The known mid-body scale count in *C. subcristatus* is 85–100, while the mid-body scale count in *C. brevicaudus* **sp. nov.** is 110–121. Sexual size dimorphism (SSD) scores are different for the two species, with *C. subcristatus* having a higher average SSD score (0.21) compared to *C. brevicaudus* **sp. nov.** (0.14). In *C. brevicaudus* **sp. nov.**, both male and female have an uninterrupted flap of skin with small conical spines forming nuchal and dorsal crests. In *C. subcristatus*, nuchal crest is considerably higher than dorsal crest in males, with a diastema above shoulder. Additionally, there is considerable variation in crest structure in *C. subcristatus*, primarily in relative length of spines on nuchal and dorsal crests, with some populations exhibiting elongated backward curving spines on nuchal crest. Our observations indicate that the degree of development of the nuchal and dorsal crest in *C. subcristatus* is correlated with body size and larger individuals tend to have better developed crest. *Coryphophylax maximiliani* Fitzinger *in* Steindachner, 1867 and *Tiaris humei* Stoliczka, 1873 were described based on specimens with such enlarged nuchal and dorsal crests (Steindachner, 1867, Plate II-6; Annandale, 1904). The new species is not conspecific with either of these, as indicated by its much smaller size, greater number of scales around the body and lack of backward curving conical spines on nuchal and dorsal crests. Females of *C. subcristatus* have a low nuchal crest, while dorsal crest is absent or barely indicated in large females.

Adults of *C. brevicaudus* **sp. nov.** are reddish-brown or greyish-brown, while in *C. subcristatus* the adult body dorsum vary from greenish-brown, to reddish-brown to dark brown (Fig. 4). Adult males of *C. brevicaudus* **sp. nov.** are reddish-brown or greyish-brown, with faint dark reticulations. Adult males of *C. subcristatus* are greenish-brown or brown, sometimes with black and yellow reticulations, especially on the anterior body. Many individuals of *C. subcristatus* have a thin pale line running parallel to the dorsal crest on flanks of body, a pattern unknown in *C. brevicaudus* **sp. nov.** A white or yellowish-white line starts at the lower posterior portion of the orbit and passes to the corner of the mouth in almost all individuals of *C. brevicaudus* **sp. nov.**, while this pale line is absent in *C. subcristatus*. Regardless of the colour of the rest of the tail, the basal dorsal region of the tail in *C. brevicaudus* **sp. nov.** is light brown, yellowish-brown, or orange, bordered by dark brown or black, while this marking is absent in *C. subcristatus*. Female *C. brevicaudus* **sp. nov**. are similar in appearance to the males, while female *C. subcristatus* have a different colour pattern from that of male *C. subcristatus*, being greyish-brown or yellowish-brown with black blotches and reticulations on the body (Fig. 4). In female *C. subcristatus*, the vertebral region is typically spotted with dark brown, and in some individuals, a dark reddish-brown vertebral stripe is present. Sub adult and juvenile *C. subcristatus* resemble the females in colour and pattern. Juveniles of *C. brevicaudus* **sp. nov.** are similar in colour to the adults except for the presence of a distinct light vertebral stripe, with five dark brown or black diamond-shaped vertebral spots, which fade in adults. The gular pouch is well developed in both males and females of *C. brevicaudus* **sp. nov.**, and becomes orange-red during the breeding season. Though previous authors have described the gular pouch of the male *C. subcristatus* as "reticulated with yellow, red and black" (e.g., Stoliczka, 1873), all males we have seen in the Andaman Islands had gular sacs that were primarily yellow or white, with little black or red reticulations. Many populations of this species from the Nicobar Islands show black and yellow reticulations or spots on the gular pouch. The gular pouch in the female is less developed in *C. subcristatus*.

Morphometric data from 36 live individuals (after removal of juveniles and sub adults) were used in a Discriminant Function Analysis, grouped into two (*C. brevicaudus* **sp. nov.** and *C. subcristatus*). Twelve variables were used in the analysis. For males, the group means were significantly different for SVL, TaL/SVL, HL/SVL, HW/SVL, HD/SVL, SL/SVL, OD/SVL and SSD (Tables 2a–2b). In the case of females SVL, TaL/SVL, HL/SVL, HW/SVL, HD/SVL and SL/SVL were significantly different. For both males and females, among the significant variables, maximum difference in mean value was in TaL/SVL while OD/SVL had the least difference (Table 2a & 2b). For both males and females, only one canonical discriminant function was used in the analysis. In the case of males, for the first canonical discriminant function, the eigenvalue was 1696.07, canonical correlation was 1 and Wilk's lambda was 0.001, and significant at $P < 0.001$. In the case of females, for the first canonical discriminant function, the eigenvalue was 38.77, canonical correlation was 0.99 and Wilk's lambda was 0.025, and significant ($P< 0.001$) The first canonical discriminant function explained 100% of variance in both cases. The Chi-square value for Wilk's lambda was significant in both cases (Chi-square = 89.24, df = 12 and Chi-square = 31.31, df = 12, for males and females respectively, $P< 0.001$). In the classification, prior probabilities were set at 0.5 for each group. All individuals (100% of original group cases) were correctly classified in their respective groups. The discriminant function scores for the two species are shown in Figure 5 & 6.

TABLE 2a. Test of equality of group means for males of *Coryphophylax brevicaudus* **sp. nov**. The significance of *F* statistic is assessed against α = 0.05. Wilk's lambda shows that all variables except TD/SVL, FLL/SVL and HLL/SVL contributed significantly to the difference in means, with SVL and Tal/SVL contributing the most. Abbreviations are the same as in Table 1, with the addition of the following: FLL—forelimb length, HLL—hindlimb length, SSD—sexual size dimorphism score.

Variable	Wilk's Lambda	F	df1	df2	P
SVL	0.177	83.686*	1	18	< 0.001
TaL/SVL	0.169	88.360*	1	18	< 0.001
HL/SVL	0.699	7.751*	1	18	0.012
HW/SVL	0.673	8.761*	1	18	0.008
HD/SVL	0.765	5.544*	1	18	0.030
SL/SVL	0.530	15.949*	1	18	0.001
OD/SVL	0.577	13.219*	1	18	0.002
TD/SVL	0.962	0.712	1	18	0.410
TrL/SVL	0.793	4.702*	1	18	0.044
FLL/SVL	0.896	2.085	1	18	0.166
HLL/SVL	0.946	1.025	1	18	0.325
SSD	0.735	6.495*	1	18	0.020

* Represents significance at α = 0.05

TABLE 2b. Test of equality of group means for females of *Coryphophylax brevicaudus* **sp. nov**. The significance of *F* statistic is assessed against α = 0.05. The first six variables contributed significantly to the difference in means, with Tal/SVL and HL/SVL contributing the most. Wilk's lambda shows that the contribution from SVL is much less compared to that for males. Abbreviations are the same as in Table 1, with the addition of the following: FLL—forelimb length, HLL—hindlimb length.

Variable	Wilk's Lambda	F	df1	df2	P
SVL	0.637	7.988*	1	14	0.013
TaL/SVL	0.283	35.537*	1	14	< 0.001
HL/SVL	0.345	26.587*	1	14	<0.001
HW/SVL	0.465	16.135*	1	14	0.001
HD/SVL	0.439	17.883*	1	14	0.001
SL/SVL	0.558	11.107*	1	14	0.005
OD/SVL	0.756	4.515	1	14	0.052
TD/SVL	0.830	2.868	1	14	0.112
TrL/SVL	0.993	0.099	1	14	0.757
FLL/SVL	0.991	0.1301	1	14	0.723
HLL/SVL	0.973	0.394	1	14	0.540

* Represents significance at α = 0.05

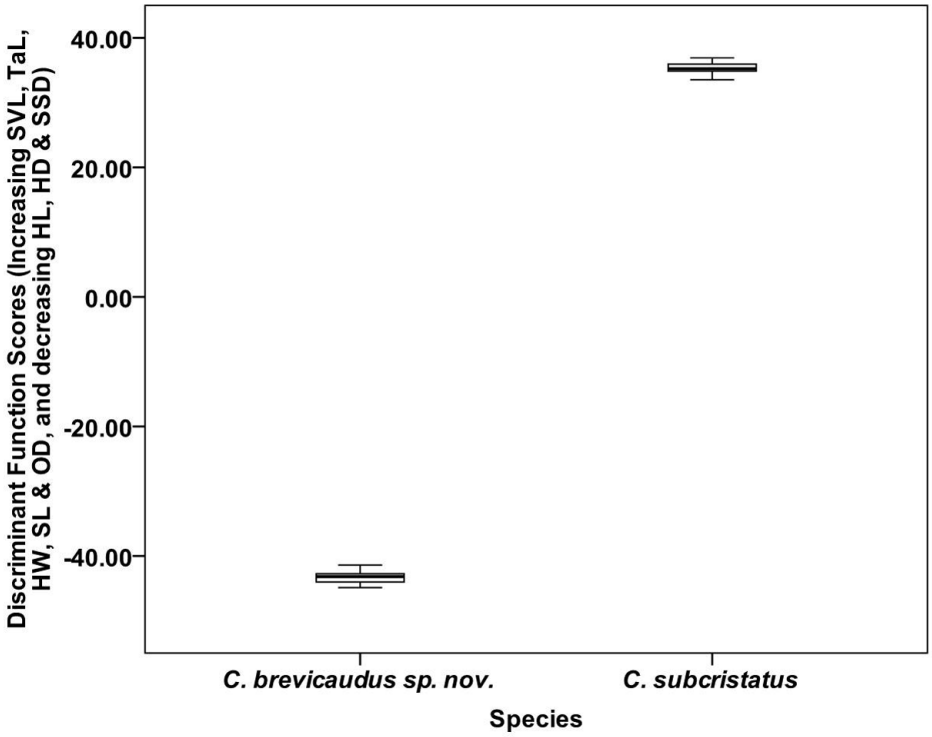

FIGURE 5. Box plot of discriminant function scores for males of *Coryphophylax brevicaudus* **sp. nov**. and *Coryphophylax subcristatus*.

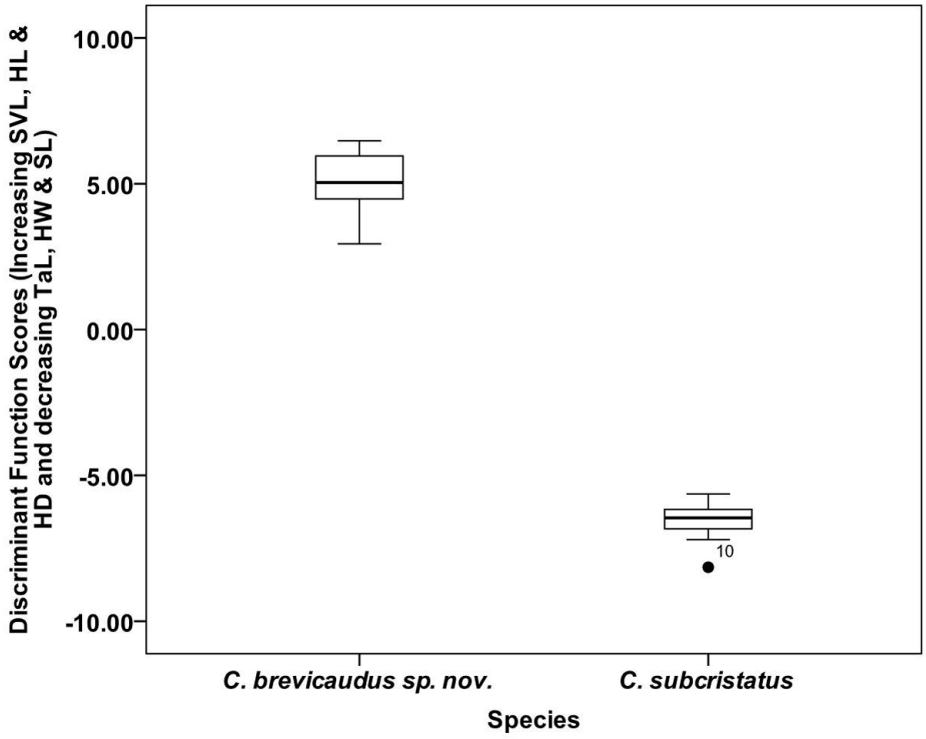

FIGURE 6. Box plot of discriminant function scores for females of *Coryphophylax brevicaudus* **sp. nov**. and *Coryphophylax subcristatus*.

Etymology: The specific epithet refers to the short tail in the new species.

Suggested Common Name: We suggest "Short-tailed Bay Island forest lizard" as a common English name for this new species. We also suggest the use of the name "Short-crested Bay Island forest lizard" for *Coryphophylax subcristatus*, a translation of its species nomen.

Natural History: The natural vegetation of the type locality is composed of four major types: Andaman tropical evergreen forest, giant evergreen forest, southern hilltop tropical evergreen forest and semi-evergreen forest (Champion & Seth, 1968). *Coryphophylax brevicaudus* **sp. nov.** is semi-arboreal to terrestrial in habits, and so far has been recorded only in evergreen and semi-evergreen forests. Individuals were seen perching on low bushes and twigs or on leaf-litter. They occur syntopically in the same habitat as *C. subcristatus*, but tend to prefer lower and thinner perches than *C. subcristatus*, and are not as abundant as *C. subcristatus*. Additionally, *C. subcristatus* shows caudal autotomy and regeneration (Smith, 1935; personal observations) but we have not recorded this in *C. brevicaudus* **sp. nov.**

Distribution: *Coryphophylax brevicaudus* **sp. nov.** is known only from the Andaman group of islands, specifically from the islands of South Andaman, Rutland, Alexandria, Little Andaman, Middle Andaman, North Andaman, Tarmugli, Havelock and Neil (Fig. 1). The altitudinal distribution is from 20–350 m asl. In all islands surveyed, it was only recorded from primary evergreen and semi-evergreen forests. It is likely that the species occurs in more islands in the Andaman archipelago. We have conducted surveys in fifteen Nicobar Islands, but this species was not recorded in any of the islands in this group. As with several other endemic herpetofauna, the Ten Degree Channel appears to be a barrier for dispersal of this species into the Nicobar Islands.

Discussion

In Blyth's ("1860" 1861) original description of *Tiaris subcristata*, there is no explicit mention of a type locality, but statement that the species was "common in Port Blair" (in the South Andaman Island). Since no other localities were mentioned, this may be taken as evidence for a type locality. The type specimens were accessioned in the Museum of the Asiatic Society of Bengal collection at Calcutta, which, eventually, was part of the erstwhile Indian Museum collection. During the writing of 'Fauna of British India' volume on squamate reptiles, Smith (1935:163) had Indian material mailed to him from Calcutta, but the types of Blyth were declared 'lost', inferring that Smith did not examine them personally. Subsequently, Das *et al*. (1998) found the series of specimens in the collection of Zoological Survey of India, the inheritors of the zoological material of the Indian Museum, ZSI 5192 and ZSI 5199–5202, that bears evidence of being the lost types of *Tiaris subcristata*. Later, Fitzinger (1867) described *Coryphophylax maximiliani*, as the only representative of the genus *Corphophylax*, from the Nancowry group of islands in the Nicobars, based on material obtained during the voyage of the Austrian sail frigate, SMS Novara, between the years 1857–1859, popularly referred to as the Novara Expedition (Gans, 1955). These specimens are in the collection of the Museum of Natural History, Vienna (NMW 20976.1–9 and NMW 20983.2–3). The third and last species nomen associated with the genus *Coryphophylax*, is *Tiaris humei* Stoliczka (1873) based on two specimens by Ferdinand Stoliczka from Tillinchang (current name: Tillanchong, in Nicobar Islands). According to the original description, *T. humei* differed from the other species in possessing higher nuchal and dorsal crests composed of well-developed spines, large size and the presence of enlarged scales on the dorsal surface of thighs. The description of *T. humei* made no mention of *Coryphophylax maximiliani* and compared the new species to *T. subcristata*. We infer that Stoliczka was probably unaware of the description of *C. maximiliani*. The characters F. Stoliczka used for erecting *Tiaris humei* were body size, enlarged scales on thigh and prominence of nuchal and dorsal crests. They were insufficient to separate *T. humei* from *Coryphophylax maximiliani*. Boulenger (1885, 1890) considered both *subcristatus* and *humei* as valid species, albeit not under their original genera, and transferred them to the genus *Gonocephalus* Kaup, 1825. Later, Annandale (1909), after examining a large number of specimens from different islands, concluded that all three names could be referred to a single species, and synonymized *Tiaris humei* Stoliczka, 1873 and *Coryphophylax maximiliani* Fitzinger *in* Steindachner, 1867 under *Tiaris subcristata* Blyth, "1860" 1861 but accepted Boulenger's generic allocation to '*Gonyocephalus*' [sic for *Gonocephalus* Kaup, 1825]. Hora (1926) followed Annandale's opinion and suggested that Stoliczka had erected *Tiaris humei* based on two exceptionally large specimens. Smith (1935) followed the opinion of these last two workers, and considered *G. subcristatus* (Blyth, "1860" 1861) to be the sole representative of the genus from the

Andaman and Nicobar Islands. This allocation was accepted by subsequent workers (e.g., Biswas, 1984; Biswas & Sanyal, 1977; 1980).

Moody (1980), in his unpublished thesis, redefined the contents of the genus *Gonocephalus* based on morphology and resurrected the genus '*Coryophophylax*' [sic for *Coryphophylax* Fitzinger, 1867] for the species *Gonocephalus subcristatus*. However, the genus *Coryphophylax* continues to be largely undefined based on morphological characters, and some authors have pointed out the uncertain nature of the generic status (see Stuart-Fox and Owens, 2003). Pending the inclusion of *Coryphophylax* in wider phylogenetic context, we adopt a conservative position and follow Moody's (1980) opinion in considering the genus valid.

Das (1999) expressed the opinion that *C. subcristatus* as currently understood, might be a species complex. The description of *C. brevicaudus* **sp. nov.** validates this opinion. Preliminary observations suggest that the new species lives in sympatry with *C. subcristatus* by partitioning the niche along multiple axes. For example, body size difference may allow the two species to utilize prey items of different sizes. There also seems to be fine microhabitat partitioning between the species, with *C. subcristatus* choosing on average higher and broader perches than *C. brevicaudus* **sp. nov.**, but these warrant further behavioural studies. Another important character that may allow the coexistence of the two congeners is the difference in colour of the gular pouch, used for signaling in many species of lizards (e.g. Nicholson *et al*., 2007). There is little information on the ecology of the two species to enable us to understand the significance of this difference. An interesting question here would be whether the two species are a result of sympatric or allopatric speciation. The islands in the Andaman group are currently separated from each other by shallow seas, such that during glacial maxima, they probably represented a single large island. If allopatric speciation occurred, one possibility is that one of these species evolved on mountaintops, and later colonized the rest of the islands. There is also a possibility of two independent colonisations from mainland Southeast Asia, which could make the genus *Coryphophylax* paraphyletic. The Nicobar Islands are separated from the Andaman Islands by a deep (> 120 m) channel, such that they remained isolated even during the glacial maxima. The only species of *Coryphophylax* known from Nicobar Islands is *C. subcristatus* barring its two synonyms: *Tiaris humei* and *Coryphophylax maximiliani*. We have conducted surveys in a majority of the islands that constitute the Nicobar archipelago, but have not come across individuals of *C. brevicaudus* **sp. nov.**, suggesting that this new species is endemic to the Andaman Islands. The affinities of species belonging to the genus *Coryphophylax* warrants further investigation.

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APPENDIX 1. Specimens examined.

Aphaniotis acutirostris Modigliani, 1889

ZRC 2.314–15, Pulau Siberut, Mentawai, Sumatra, Indonesia ; ZRC 2.316–18, Pulau Sipura, Mentawai, Indonesia.

Aphaniotis fusca (Peters, 1864)

ZRC 2.319, Kampung Prah, Perak, Malaysia; ZRC 2.4919, Kepong, Selangor, Malaysia ; ZRC 2.5542–43, Pulau Natuna Besar,Indonesia.

Aphaniotis ornata (Lidth de Jeude, 1893)

ZRC 2.959. Kiau, Gunung Kinabalu, Sabah, Malaysia.

Coryphophylax subcristatus (Blyth, "1860" 1861)

ZSI 5041–2 (syntype of *Tiaris humei*, from "Tillinchang"), ZSI5192, ZSI 5199, ZSI 5200, ZSI 5201, ZSI 5202 (syntypes of *Tiaris subcristata* from "the vicinity of Port Blair), ZSI 20865 (2 specimens), ZSI 20867 (3 specimens) Nicobar Islands, Car Nicobar; ZSI 20868 Nicobar Islands, Car Nicobar; ZSI 20866 (2 specimens) Nicobar Islands, Car Nicobar; ZSI 20869 (4 specimens) Nicobar Islands, Car Nicobar; ZSI 3874/SK03NC-5 Nancowry; ZSI 3874/NCA7 Nancowry; ZSI3874/ NCA8 Nancowry; ZSI3874/NC11 Nancowry; ZRC 2.4614, South Andaman Island, Shoal Bay; ZRC 2.4615–16, South Andaman Island, Madhuban; ZRC 2.4698–4701, North Andaman Island, Saddle Peak; ZRC 2.937, Andaman Islands, North Passage Island; ZRC 2.5175, Little Andaman Island; ZRC 2.1909, Nicobar Islands, Katchal; ZRC 2.927, Nicobar Islands, Tillangchong Island.

NMW 20976.1–9 Nicobars, 1857-59, Novara Expedition; NMW 20983.2–3 Nicobars, 1857-59, Novara Expedition (photographs examined)

Coryphophylax brevicaudus sp. nov.

ZSIC 25963, ZSIC 25964, ZSIC 25962 (Mt. Harriet National Park, South Andaman Island)

Gonocephalus bellii (Duméril & Bibron, 1837)

ZRC 2.883–84, Bukit Larut, Perak, Malaysia (ZRC 2.883–884) ; ZRC 2.886, Ulu Liang, Pahang, Malaysia.

Otocryptis beddomii Boulenger, 1885

ZSI 15733 (syntype),'Sivagherry Ghat' (Tamil Nadu, India).