

A revision of the endemic Sri Lankan agamid lizard genus *Ceratophora* Gray, 1835, with description of two new species

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Abstract

The horned lizards of the endemic Sri Lankan genus *Ceratophora* Gray, 1835, hitherto considered to be comprised of only three species (*Ceratophora stoddartii* Gray, 1835; *C. tennentii* Günther & Gray, 1861; and *C. aspera* Günther, 1864), are redescribed. Two new species are described: *Ceratophora erdeleni* sp. nov. is distinguished from all other *Ceratophora* by having the rostral appendage absent or rudimentary (8.7-17.3% of eye-to-nostril distance, if present). *Ceratophora karu* sp. nov. is distinguished from its congeners (except *C. tennentii* and *C. aspera*) by the rostral appendage being complex, comprising more scales than the rostral scale alone; it is distinguished from *C. tennentii* by the presence of prominent superciliary scales (absent in *C. tennentii*) and from *C. aspera* by the absence of a squamosal process and the presence of a prominent nuchal crest (vs. squamosal process present, nuchal crest feebly defined in *C. aspera*). All the species, except for *C. erdeleni* and *C. karu* (which share part of their ranges of distribution), are allopatric. While *C. aspera* is widely distributed in the lowland moist forests of Sri Lanka's south-western wet zone, all the other species of *Ceratophora* are restricted to areas of undisturbed cloud forest between 760 and 2200 m above sea level.

Introduction

The agamid lizard genus *Ceratophora* Gray, 1835, endemic to the island of Sri Lanka, was last reviewed by Taylor ('953), Deraniyagala (1953) and Wermuth (1967). These lizards are conspicuous because of their rhinoceros horn-like rostral appendages, lacking in all other agamid genera (the Indonesian genus *Harpesaurus* Boulenger, 1885 has a prolix rostral scale which however is retrorse). Taylor (*op. cit.*), Deraniyagala (*op. cit.*) and Wermuth (*op. cit.*) all recognised three species (with no synonyms): *Ceratophora stoddartii* Gray, 1835; *C. tennentii* Günther & Gray, 1861; and *C. aspera* Günther, 1864. All these species are not only endemic to Sri Lanka, but also restricted to relatively undisturbed, montane, forested parts of the island.

While investigating the distribution of amphibian species in Sri Lanka between 1993 and mid-1996 (Dutta & Manamendra-Arachchi, 1996), we looked also at the distribution of some of the island's lizard taxa (Manamendra-

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Arachchi & Liyanage, 1994), among them *Ceratophora*. This led to the collection of the three species referred to above, as well as representatives of two hitherto undescribed species of this genus which had previously been collected (but not investigated) by W. Erdelen, F.R. Senanayake and P.B. Karunaratne.

We describe here all five species of *Ceratophora* now known from Sri Lanka in the hope that this will lead to renewed interest in this unique group of lizards and the implementation of conservation measures that transcend mere protection. Several of the species are restricted to very small and diminishing ranges, surrounded by agricultural lands, and could face extinction in the short to medium term. The biology, ecology and conservation of these animals need urgent investigation and assessment if effective long-term measures are to be taken to ensure their survival. At the same time, the taxonomy of this group is in need of updating, all the species hitherto referred to the Agamidae in Sri Lanka having been described between 1758 and 1887, and recently published information being largely by way of informal observation (e.g. Ilangakoon, 1990).

Material and methods

Altitudes are given in metres above mean sea level. Abbreviations: F.R., forest reserve; s.d., standard deviation. Sex was determined by dissection and the presence of hemipenes.

Scale counts. Canthus rostralis: counted from the rostral scale or lateral scale at base the rostral appendage, along the scale row passing over the nostril to the posterior end of the superciliary ridge; supralabials: counted from the first anterior scale to that at the angle of gape, not including the median scale (when present); infralabials: counted from first scale posterior to mental, to angle of gape; midventrals: counted from first scale posterior to mental, to last scale anterior to cloaca; scales around mid-body are counted from the middle of the dorsal row, between axilla and groin, forwards and downwards along the scale row, across the venter and upwards and backwards along the scale row (this count is made unreliable by the unequal size of the lateral scales).

External measurements. AD, rostral appendage diameter (width of rostral appendage measured along the axis of the body); AG, distance between axilla and groin; AL, rostral appendage length; AW, rostral appendage width (horizontal width of base); ED, horizontal diameter of orbit; EN, distance between anteriormost point of orbit and middle of nostril; ES, snout length (distance between anteriormost point of orbit and tip of snout excluding appendage); FEL, femur length (distance between groin and knee); FL, finger length (distance between tip of claw and the nearest fork); HD, head depth (distance between top of head and ventral margin of mandible); HL, head length (distance between posterior edge of mandible and snout tip, excluding appendage); HW, head width (maximum width of head); IO, interorbital width (least distance between the upper margins of orbit); LAL, lower arm length (distance from elbow to wrist with both upper arm and palm flexed); NS, distance between middle of nostril and snout tip, excluding appendage; SA, distance between snout tip and axilla; SVL, snout-vent length (measured from tip of

snout, excluding appendage, to anterior margin of cloaca); SW, superciliary width (measured from bony edge of supraorbital to outer edge of superciliary ridge); TAL, tail length (measured from anterior margin of cloaca to tail tip); TBL, tibia length (distance between knee and heel with both tibia and tarsus flexed); TL, toe length (distance between tip of claw and nearest fork); UAL, upper arm length (distance between axilla and elbow).

The tongue was measured only in the specimen from each species from which a skull was prepared. Tongue length is the total length of the tongue; tongue width is the greatest width.

Skull measurements. CL, cranial length (greatest length of cranium); CD, cranium depth (greatest depth of cranium); CW, cranial width (greatest width of cranium); DM, mandible depth (greatest depth of mandible); FW, frontal width (least width of frontal); HFM, horizontal width of foramen magnum; LM, mandible length (greatest length of mandible); LUF, length of upper temporal fossa; PAW, parietal width (least distance between the upper margins of temporal fossae); POW, postfrontal width (distance between outer margins of postfrontal bones); PP, premaxilla-prefrontal length (distance between posterior edge of prefrontal and anterior edge of premaxilla); PW, prefrontal width (distance between outer margins of prefrontal); STL, stapes length (distance between free edge and edge of rim); TP, pre-temporal fossa length (distance between anterior edge of upper temporal fossa and anterior edge of premaxilla); WUE, width of upper temporal fossa. Measurements were taken from at least one prepared skull for each species.

Material. All material referred to originates from Sri Lanka, and is deposited in the following institutions: The Natural History Museum (London), BMNH; National Museum of Sri Lanka (Colombo), NMSL; Wildlife Heritage Trust of Sri Lanka (Colombo), WHT.

Taxonomic account

Ceratophora Gray, 1835

Ceratophora Gray, J.E. in Gray, J.E. & R. Hardwicke. 1835. Illustrations of Indian zoology, vol. 2, pl. 68, Fig. 2. Gender: feminine; type species: *C. stoddartii*.

Ceratophorus tennentii Günther, A.L.C.G. & J.E. Gray (in Tennent, 1861: Natural History of Ceylon, p. 281).

Note— The date of availability of the genus name *Ceratophora* and the species name *Ceratophora stoddartii*, from vol. 2, pl. 68 of Gray & Hardwicke's "Illustrations of Indian zoology" (which was issued in parts between 1830 and 1835) has been variously cited as 1834 and 1835 by different authors (e.g. Smith, 1935; Deraniyagala, 1953; Taylor, 1953). This confusion may be in part the result of the plates not having been issued in the same sequence in which they are numbered and bound (Dawson, 1946). Kinnear (1925) showed that the part containing plate 68 of volume 2 was not issued prior to 20 February 1835, so these names in fact became available only in 1835.

Diagnosis

Ceratophora is diagnosed from the other members of the Lyriocephalinae (Deraniyagala, 1953) by lacking the highly developed and bizarre canthus rostralis extending beyond the eye as a bony, terminally-pointed superciliary ridge (present in *Lyriocephalus* Merrem, 1820); and by lacking a dorsal crest, a prehensile tail, and having oviparous reproduction (dorsal crest and prehensile tail present, reproduction viviparous in *Cophotis ceylanica* Peters, 1861). It differs from all other Agamidae by the presence of a simple rostral appendage in the form of a modified rostral scale or a complex rostral appendage comprising several scales, sometimes together with postrostrals; the appendage is prominent in males (except in some male specimens of *Ceratophora erdeleni*). It also differs from other Agamidae by having a subdermal tympanum, by the gular fold and nuchal crest being absent or greatly reduced, and by having some of the lateral scales of the body greatly enlarged.

N.b. In the species descriptions, information relating to the holotype (where present) is presented in square brackets.

Ceratophora aspera (Günther, 1864) (Figures 1-12)

Ceratophora aspera Günther, A.L.C.G., 1864. Reptiles of British India: 131.

Syntypes. Male, 28.5 mm SVL, BMNH1946.8.30.52; female, 35.9 mm SVL, BMNH1946.8.30.51; Ceylon; H. Cuming.

Other material (all from Kottawa (Galle), alt. 60 m, (06°06'N, 80°20'E)). Female, 34.3 mm SVL, WHT1396; coll. C. Piyasiri, M. M. Bopage & M. M. Bahir, 29 IX 1996. Male, 33.6 mm SVL, WHT1400; coll. M. M. Bahir, M. De Silva & M. M. Bopage, 03 III 1996.

Diagnosis

Ceratophora aspera is distinguished from all other *Ceratophora* by the presence of a visible and palpable squamosal process (Fig. 1) (absent in all other *Ceratophora*).

Description

(See Table 1 for morphometric data.) Dorsal aspect of head suboval or subtriangular. Interorbital area deeply concave. Orbit rim prominent; supraorbital area elevated. Superciliary edge with a row of large, carinate, elevated, compressed and upwardly-directed scales, more elevated in males (a 20.7 mm SVL juvenile specimen, WHT1393, lacks these scales). An x-shaped dorsal ridge at rear of head; two short, lateral, longitudinal ridges from postorbital to middle of area between postorbital and neck. Rostral appendage present in mature individuals of both sexes, rarely absent in some females (WHT1355, WHT1381 and WHT1386), slender, covered with acuminate scales (appendage of 28.5 mm SVL syntype with 11 scales on its ventral surface); a ridged and pointed scale on top (Fig. 2). Superciliary scales smooth, carinate or ridged; second scale row from inner margin of both upper and lower eye-

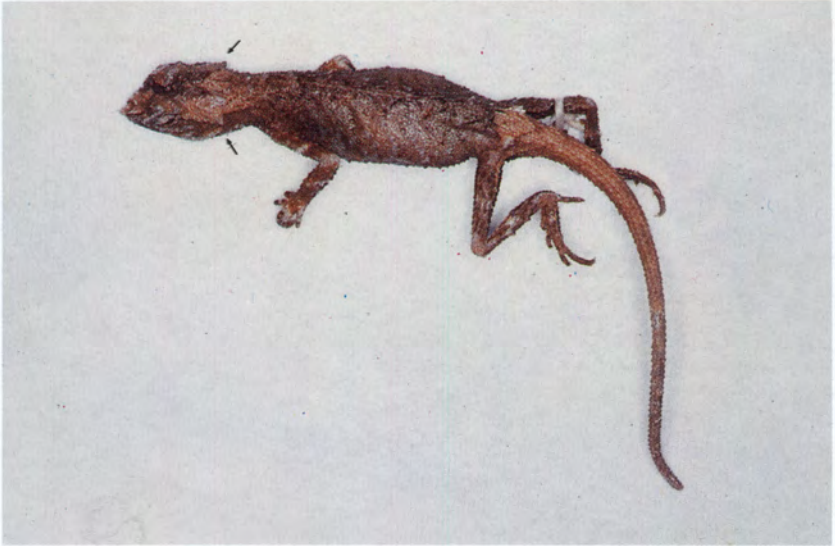


Figure 1. *Ceratophora aspera*, BMNH1946.8.30.51, syntype, female, 35.9 mm SVL, dorso-lateral aspect (arrow indicates squamosal process).



Figure 2. *Ceratophora aspera*, WHT1400, topotype, male, 33.6 mm SVL, lateral aspect of rostral appendage.

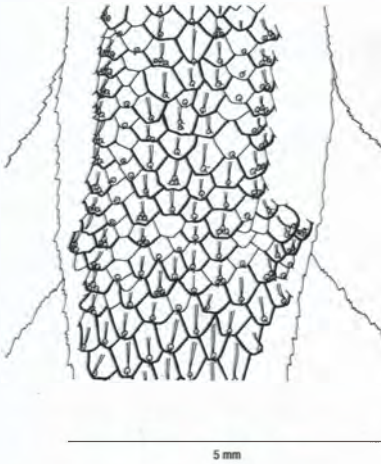


Figure 3. *Ceratophora aspera*, WHT1404, topotype, male, 33.6 mm SVL, dorsal scalation of posterior area of body.



Figure 4. *Ceratophora aspera*, WHT1392, topotype, male, 28.5 mm SVL, lateral aspect.



Figure 5. *Ceratophora aspera*, BMNH-1946.8.30.51, syntype, female, 35.9 mm SVL, dorsal sculation of posterior area of body (n.b.—sensory pores not shown).

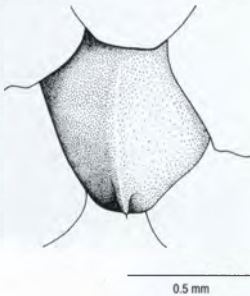


Figure 6. *Ceratophora aspera*, WHT1400, topotype, male, 33.6 mm SVL, mid-ventral scale.

lids with large, carinate scales. Cephalic scales irregular, subequal to mid-dorsals, strongly carinate (a few scales smooth), ridged or conical. Scales on snout more compressed. Canthus indistinct. Nostril rounded or oval, laterally or anterolaterally orientated. Nasal scale large, suboval, above second and third supralabials, touching supralabials or separated by a row of narrow scales. Nasals separated from one another by 8-13 scales. Supralabials 12-14; infralabials 9-12. First pair of supralabials touching each other anteriorly. Both labials carinate. Some cephalic scales, lateral scales of head (including supralabials and infralabials), rostral appendage and gular scales with 1-10 pores, each pore with a sensory seta. Tympanum subdermal. Two enlarged, conical and ridged scales at back of head in vicinity of squamosal process. Dorsinuchal crest feebly defined, on neck only, with 1-3 pointed and ridged scales. Mental subpentagonal or subhexagonal. Postmentals indistinct. Gular fold absent. Gular scales carinate, subequal to ventrals, oval, rhombic or triangular, arranged in regular series.

Head longer than wide (HW 61.0-66.7% of HL; HD 82.1-91.8% of HW; HL 28.9-29.5% of SVL). Eye diameter subequal to snout length (ED 96.8-119.4% of ES). Interorbital width greater than superciliary width (IO 115.8-146.7% of SW). Distance between nostril and snout less than distance between eye and nostril (NS 88.9-93.8% of EN). Length of rostral appendage less than distance between eye and nostril in females (AL 50.0-61.9% of EN), longer of males (AL 205.0-543.8% of EN). Appendage length 5.0-51.9% of head length in females; 48.8-88.8% in males.

Body slightly compressed. Five to eight rows of large, carinate scales dorsally in series from occiput to base of tail, with one or two rows of smaller scales between them (18 ex.) (Figs. 3 & 4); or one to five of the larger scales forming short, angular series across the mid-vertebral line, with their angles pointing backwards (42 ex.) (Figs. 1 & 5). Dorsal scales subequal to laterals, smooth or strongly carinate, ridged, serrated, conical, unequal, imbricate, some distinctly larger than the others. Dorsolateral area with clusters of 2-5 enlarged, ridged, conical and backward-pointing scales. Lateral scales smooth or carinate, smaller than ventrals, intermixed with a few large, carinate or conical scales, irregular, imbricate, mostly angled backwards, a few angled downwards or upwards. Ventral scales uniform, carinate, larger than lateral and dorsal scales (Figs. 6 & 7). Caudals carinate, subequal to subcaudals and ventrals. Subcaudals more markedly keeled than ventrals. Limbs with unequal, carinate scales, the scales of the forelimbs strongly carinate. Hind edge of thigh with three large, carinate scales. Digits covered dorsally and laterally with carinate scales. Most body and limb scales pored, each pore with a sensory seta. Subdigitals bicarinate. Subdigital squamation: first finger with 5-8, second finger with 6-10, third finger with 10-13, fourth finger with 11-14, fifth finger with 7-9 scales; first toe with 5-7, second toe with 6-8, third toe with 9-13, fourth toe with 14-17, fifth toe with 7-9 scales. Claws laterally compressed, curved, pointed, each claw with a tricarinate (rarely bicarinate) scale above, and another one below. Scales from mental to cloaca 77-92; around mid-body 46-62. Tail rounded. Distance between snout and axilla subequal to that between axilla and groin (SA 78.9-104.1% of AG; SA 39.6-44.2% of SVL). Distance between



Figure 7. *Ceratophora aspera*, BMNH1946.8.30.52, syntype, male, 28.5 mm SVL, lateral aspect.



Figure 8. *Ceratophora aspera*, WHT167, topotype, male, 32.7 mm SVL, lateral aspect.

axilla and groin 42.5-50.1% of SVL. Upper arm length subequal to lower arm length (UAL 96.8-113.6% of LAL). Fourth finger longest (FL IV 50.0-61.4% of LAL). Tibia length less than femur length (TBL 85.7-97.6% of FEL; FEL 24.8-28.0% of SVL). Fourth toe longest (TL IV 56.8-65.2% of TBL). Tail longer than SVL (TAL 118.1-144.3% of SVL). Digital formula: fingers, 4>3>2>5>1 (3 ex.) and 4>3>5>2>1 (1 ex.); toes, 4>3>5>2>1 (3 ex.) and 4>5>3>2>1 (1 ex.).

Measurements of 28.5 mm SVL syntype (in mm): AG, 12.1; AL, 4.1; AW, 1.0;



Figure 9. *Ceratophora aspera*, WHT1393, topotype, juvenile, 20.7 mm SVL, lateral aspect.

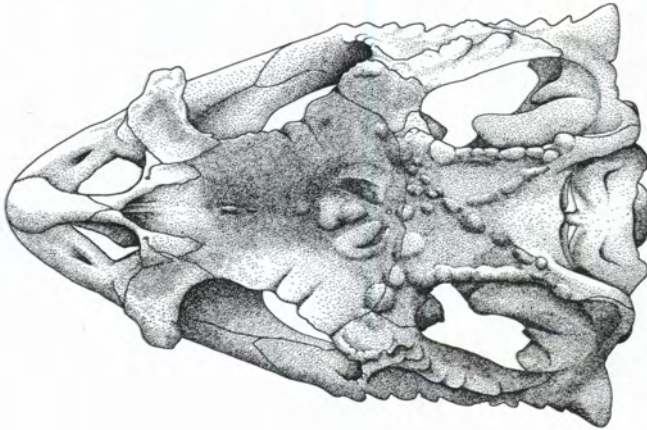


Figure 10. *Ceratophora aspera*, WHT1326, topotype, female, 36.5 mm SVL, dorsal aspect of cranium.

ED, 3.0; EN, 2.0; ES, 3.1; FEL, 7.7; FL I, 1.5; FL II, 2.0; FL III, 2.5; FL IV, 2.7; FL V, 1.8; HD, 4.6; HL, 8.4; HW, 5.6; IO, 2.2; LAL, 4.4; SA, 12.6; SVL, 28.5; SW, 1.5; TAL, 40.5; TBL, 6.6; TL I, 1.1; TL II, 1.5; TL III, 2.5; TL IV, 4.3; TL V, 2.4; UAL, 5.0.

Colour. In life, males dark brown (Fig. 8) or brick red both dorsally and laterally (Fig. 4), females similar to males or lighter and duller. Some individuals with about four diamond-shaped markings and black spots or longitudinal

Table 1. Measurements, expressed as percentages of head length, of the syntypes (2 ex., BMNH 1946.8.30.51-2, 28.5-35.9 mm SVL) and 2 topotypes (WHT1396, WHT1400, 34.3-33.6 mm SVL) of *Ceratophora aspera*.

	Range	Mean	s.d.
Axilla to groin (AG)	144.0 - 171.4	156.5	11.8
Eye diameter (ED)	33.3 - 38.4	36.3	2.3
Eye to nostril (EN)	16.3 - 23.8	19.6	3.2
Eye to snout (ES)	31.6 - 36.9	34.3	2.2
Femur length (FEL)	85.7 - 95.9	89.8	4.9
Finger length I (FLI)	13.3 - 17.9	15.2	2.0
Finger length II (FLII)	18.4 - 23.8	20.1	2.5
Finger length III (FLIII)	26.5 - 29.8	28.6	1.5
Finger length IV (FLIV)	29.5 - 33.7	31.5	2.0
Finger length V (FLV)	16.3 - 21.4	19.0	2.3
Head depth (HD)	51.4 - 56.6	54.5	2.2
Head width (HW)	61.0 - 66.7	62.6	2.7
Interorbital width (IO)	19.0 - 26.2	22.2	3.0
Lower arm length (LAL)	52.4 - 59.0	56.6	2.9
Snout to axilla (SA)	135.2 - 151.0	144.4	7.5
Snout to vent (SVL)	339.3 - 346.5	342.7	3.0
Superciliary width (SW)	14.3 - 19.4	16.7	2.4
Tail length (TAL)	403.8 - 494.9	450.0	45.2
Tibia length (TBL)	77.1 - 87.8	81.2	4.9
Toe length I (TLI)	13.1 - 16.2	14.4	1.6
Toe length II (TLII)	17.9 - 22.9	20.1	2.4
Toe length III (TLIII)	23.8 - 30.6	27.9	3.1
Toe length IV (TLIV)	43.8 - 51.2	48.9	3.5
Toe length V (TLV)	25.3 - 28.6	26.8	1.4
Upper arm length (UAL)	55.6 - 59.5	57.6	1.7

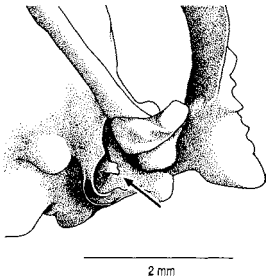


Figure 11. *Ceratophora aspera*, WHT-1326, topotype, female, 36.5 mm SVL, ventral aspect of cranium: left posterior corner (arrow indicates stapes).

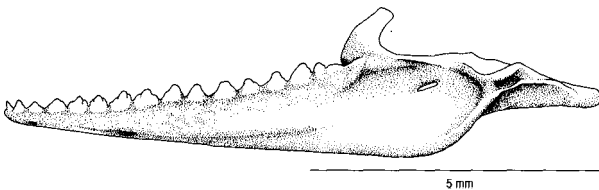


Figure 12. *Ceratophora aspera*, WHT1326, topotype, female, 36.5 mm SVL, labial aspect of left mandible.

lines on the dorsum, variable in intensity. Some mature males with yellow or yellowish-orange labials and gular spots (Fig. 4). Colour of juveniles similar to those of adults (Fig. 9).

In alcohol, dorsum, sides and venter dark brown to light brown (Figs. 1 & 7) with a lighter patch on the mid-dorsal area. Whitish, light-brown stripes on neck and dorsum. Venter with small, dark brown spots on a light brown background in some specimens.

Description of skull (paratype WHT1326, 36.5 mm SVL). Premaxilla with 2 and left mandible with a single pointed incisoroid; left maxilla and left mandible each with a single large, pointed caniniform; left maxilla and left mandible each with 13 triangular, laterally compressed molariforms. Frontal concave, its outer edge prominent, rugose (anteriorly smooth), its posterior margins elevated. Frontal deeply concave, with a prominent conical process at its centre. Outer edges of jugal, postfrontal and squamosal bones with distinct, retrorse serrae. A prominent squamosal process. Upper temporal fossa oval (WUF 54.8% of LUF; LUF 31.6% of CL), its inner margins elevated (Fig. 10). Parietal with two conical processes, with a forward-pointing "V"-shaped ridge in front. Stapes very short and bar-like (Fig. 11), smaller than horizontal width of foramen magnum (STL 25.0% of HFM). Mandible (Fig. 12) longer than cranium (CL 96.1% of LM); articular process absent. CD 44.9% of CL; CW 68.4% of CL; DM 23.5% of LM; FW 22.4% of CL; HFM 54.5% of PAW; PAW 22.4% of CL; POW 70.5% of TP; PP 84.7% of PW; PW 43.4% of CL; and TP 70.9% of CL.

Measurements of skull (in mm): CD, 4.4; CL, 9.8; CW 6.7; DM, 2.4; FW 2.2; HFM, 1.2; LM, 10.2; LUF, 3.1; PAW, 2.2; POW, 4.9; PP, 3.6; PW, 4.25; STL, 0.3; TP, 6.95; WUF, 1.7.

***Ceratophora erdeleni* sp. nov.**

(Figures 13-21)

Holotype. Male, 78.6 mm SVL, BMNH 1996.448, Morningside F.R. (near Rakwana), alt. 1060 m (06°24'N, 80°38'E), coll. D. Gabadage & S. Dharmasiri, 22 II 1996.

Paratypes. (All from type locality, except where stated). Male, 73.2 mm SVL, BMNH 1996.450; coll. M.M. Bahir & D. Gabadage, 07III1996. Female, 80.7 mm SVL, BMNH 1996.449; Male, 67.8 mm SVL, NMSL L/16-1; coll. D. Gabadage & M.M. Bahir, 07III1996. Male, 74.5 mm SVL, NMSL L/16-2; male, 75.2 mm SVL, WHT1328; male, 74.9 mm SVL, WHT2070; coll. M.M. Bahir, 31 III 1996. Male, 84.0 mm SVL, WHT2071; Silverkanda F.R. (Deniyaya), alt. 915 m (06°23' N, 80°37' E), coll. D. Gabadage, 31 III 1996.

Diagnosis

Ceratophora erdeleni is distinguished from all other *Ceratophora* by having only a rudimentary rostral appendage (restricted to rostral scale alone) (Fig. 13) or lacking such an appendage altogether in both sexes, the appendage length (AL) when present is 8.7-17.3% of distance between anteriormost point of orbit and middle of nostril (EN) (vs. 20.0-225.6% in both sexes of *C. stoddartii*, the species most closely related to it (Fig. 38)).

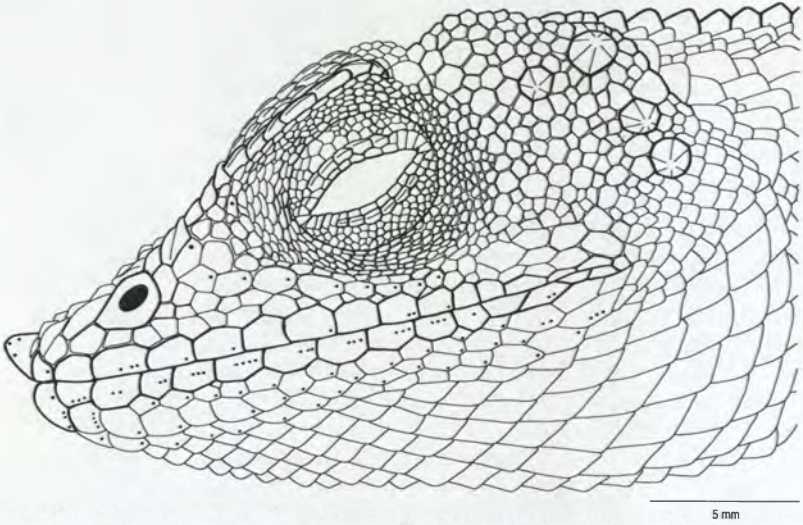


Figure 13. *Ceratophora erdeleni*, BMNH 1996.448, holotype, male, 78.6 mm SVL, scalation of lateral aspect of head.

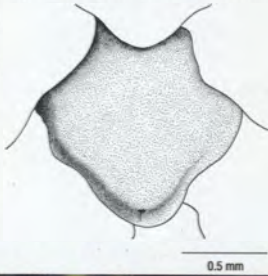


Figure 14. *Ceratophora erdeleni*, BMNH 1996.448, holotype, male, 78.6 mm SVL, mid-body ventral scale.



Figure 15. *Ceratophora erdeleni*, BMNH 1996.448, holotype, male, 78.6 mm SVL, lateral aspect.



Figure 16. *Ceratophora erdeleni*, WHT2071, paratype, male, 84.0 mm SVL, lateral aspect.

Description

(See Table 2 for morphometric data). Dorsal aspect of head oval [or triangular]; interorbital and area between snout tip and interorbital concave. Orbital rim prominent. Supraorbital ridge with a row of large, carinate scales. Temporal region with 3-6 [4] large, conical scales. Area between upper temporal fossae concave. A transverse ridge between the posterior margins of the orbits. Dorsal aspect of rostral appendage oval, the appendage surrounded by the first pair of supralabials and 3-5 [5] other scales. Cephalic scales irregular, some smaller than mid-dorsal scales, smooth or feebly carinate or conical. Canthus rostralis with 17-20 [18] smooth and strongly compressed scales; 4-6 [5] scales from rostral appendage to posterior margin of nasal; 12-15 [13] from nasal scale to rear of orbit, slightly concave in outline anterior to eye when viewed laterally. Nostril oval, anterolaterally orientated. Nasal scale large, horizontally oval, separated from rostral appendage by 2-3 [3] scales, over third [third and fourth] or fourth and fifth supralabials (nasal scale separated from supralabials by a row of scales); nasal scales separated from each other by 5-7 [6] scales. Superciliary scales carinate. Second row of scales from inner margins of both upper and lower eyelid large, carinate. Supralabials, 13-16 [15]; infralabials, 11-15 [14]. Some cephalic scales, supralabials, infralabials, rostral scale [or appendage] and gular area each with between 1 and 16 [1 and 10] pores, some pores with a sensory seta. Tympanum subdermal. A well-developed [or feebly-defined] dorsinuchal crest on neck only, with 15-22 [16] triangular scales. Mental subtriangular [or subhexagonal], its width and depth equal, in turn equal to the length of the rostral scale [or appendage], the mental somewhat wider in the female. One [or two] pairs of postmentals, smaller than mental: the first pair touching first and second infralabials and separated by [a hexagonal scale or] the mental itself; the second pair touching first to third [or second only]

Table 2. Measurements, expressed as percentages of head length, of the holotype (78.6 mm SVL, BMNH 1996.448); and 7 paratypes (73.2 mm SVL, BMNH 1996.450; 80.7 mm SVL, BMNH 1996.449; 67.8 mm SVL, NMSL L/16-1; 74.5 mm SVL, NMSL L/16-2; 75.2 mm SVL, WHT1328; 74.9 mm SVL, WHT2070; 84.0 mm SVL, WHT2071 of *Ceratophora erdeni*.

	Holotype	Range	Mean	s.d.
Axilla to groin (AG)	138.9	137.8 - 169.0	152.1	11.1
Eye diameter (ED)	34.2	31.8 - 36.3	34.7	1.4
Eye to nostril (EN)	20.2	18.9 - 21.0	20.0	0.7
Eye to snout (ES)	33.9	32.7 - 35.0	34.0	0.7
Femur length (FEL)	81.3	79.0 - 101.7	84.0	7.3
Finger length I (FLI)	18.7	17.6 - 20.2	19.0	1.0
Finger length II (FLII)	29.2	25.7 - 31.5	28.5	1.8
Finger length III (FLIII)	40.5	35.6 - 40.7	38.5	2.0
Finger length IV (FLIV)	41.6	38.1 - 42.2	40.0	1.4
Finger length V (FLV)	27.2	25.2 - 31.0	27.8	2.5
Head depth (HD)	56.0	50.0 - 61.7	57.2	3.9
Head width (HW)	68.5	55.9 - 68.5	60.6	5.1
Interorbital width (IO)	15.2	14.0 - 19.5	16.2	1.7
Lower arm length (LAL)	55.3	52.4 - 62.3	56.9	3.4
Nostril to snout (NS)	15.6	12.5 - 15.6	14.1	1.0
Snout to axilla (SA)	136.2	120.2 - 141.6	131.8	6.4
Snout to vent (SVL)	305.8	293.7 - 337.7	310.8	15.3
Superciliary width (SW)	14.4	14.4 - 16.5	15.1	0.8
Tail length (TAL)	511.7	490.6 - 566.8	529.9	24.8
Tibia length (TBL)	75.5	75.5 - 84.9	78.7	3.0
Toe length I (TLI)	17.9	17.1 - 21.7	18.4	1.4
Toe length II (TLII)	26.5	23.0 - 26.5	25.1	1.1
Toe length III (TLIII)	38.9	36.4 - 41.5	39.5	1.9
Toe length IV (TLIV)	61.9	60.6 - 63.2	61.8	0.8
Toe length V (TLV)	39.3	35.2 - 40.6	38.1	2.0
Upper arm length (UAL)	52.5	49.8 - 61.1	53.3	3.6

infralabials and separated by three scales. Gular fold poorly developed [or absent]. Gular scales smooth, larger than ventrals (except around the mental and mid-gular region), rhombic, set in regular series (Fig. 13).

Head longer than wide (HW 55.9-67.7% [68.5%] of HL; HD 89.5-104.2 [81.8%] of HW; HL 29.6-34.0% [32.7%] of SVL). Eye diameter subequal to [or greater than] snout length (ED 91.0-111.1% [101.1%] of ES). Superciliary width subequal to [less than] interorbital width (SW 75.0-116.1% [94.9%] of IO). Distance between nostril and tip of snout less than distance between eye and nostril (NS 62.0-80.4% [76.9%] of EN). Some mature males (WHT2071 and WHT1328) and the female lack a rostral appendage. When present, rostral appendage small, blunt, smooth; its length equal to depth of third supralabial, its lateral aspect triangular and its vertical aspect oval (AL 8.7-16.3 [17.3%] of EN; AW 40.0-66.7% [37.5%] of AD; AL 33.3-53.3% [56.3%] of AD for specimens having an appendage). Tongue short and thick, anteriorly nicked, the posterior half villose, its width 57.1% of its length (WHT1328).

Body subtriangular in section. Dorsal scales smaller than the larger of the lateral scales, smooth or feebly carinate, unequal, irregular imbricate. Some of



Figure 17. *Ceratophora erdeleni*, WHT2172, paratype, female, 76.7 mm SVL, lateral aspect.



Figure 18. *Ceratophora erdeleni*, WHT2176, paratype, juvenile, 44.0 mm SVL, lateral aspect.

the larger dorsal scales in the pelvic area form short, feebly-defined transverse rows, the scale angles pointing backwards (absent in WHT1328). Lateral scales larger, in seven [or eight] rows on left hand side, interspersed with smaller scales, irregular, mostly smooth, some scales feebly carinate, subimbricate, pointing upwards and backwards. Ventral scales uniform, smooth or feebly carinate, smaller than the larger lateral scales (Fig. 14). Caudals subequal to ventrals, smooth or feebly carinate. Subcaudals larger than ventrals (except

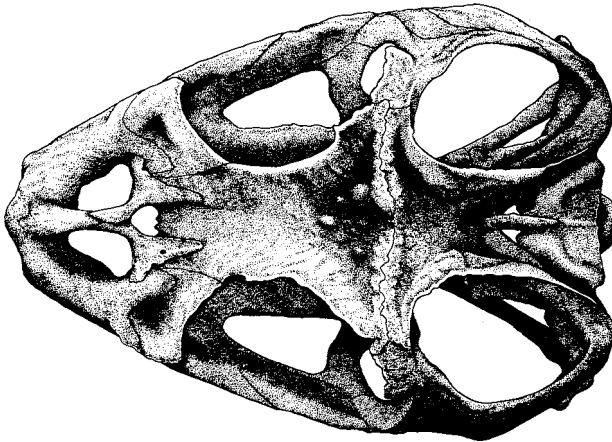


Figure 19. *Ceratophora erdeleni*, WHT1328, paratype, male, 75.2 mm SVL, dorsal aspect of cranium.

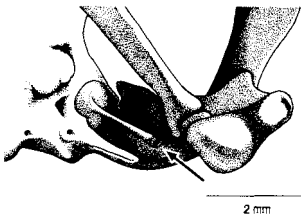


Figure 20. *Ceratophora erdeleni*, WHT1328, paratype, male, 75.2 mm SVL, ventral aspect of cranium of left posterior corner (arrow indicates stapes).

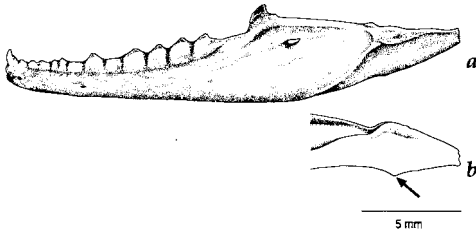


Figure 21. *Ceratophora erdeleni*, WHT1328, paratype, male, 75.2 mm SVL (a) labial aspect of left mandible (coronoid process and posterior articular damaged); and (b) ventral aspect of posterior end of left mandible (arrow indicates articular process).

for scales around cloaca), the anterior scales feebly carinate [or smooth] and the posterior ones strongly carinate. Limbs with unequal scales, dorsally mostly carinate a few being smooth, ventrally mostly smooth or only feebly carinate. Distal end of keels of scales on palm and foot elevated, acuminate. Digits covered dorsally and laterally with carinate or smooth triangular scales. Subdigitals bicarinate. Subdigital squamation as follows: first finger with 9-11 [10], second finger with 12-15 [13], third finger with 17-20 [17], fourth finger with 18-21 [19], fifth finger with 12-14 [13] scales; first toe with 8-9 [8], second toe with 11-14 [13], third toe with 17-20 [18], fourth toe with 24-28 [26], fifth toe with 14-16 [15] scales. Some dorsal, lateral, caudal, subcaudal and limb-scales, and all ventral scales each with a sensory pore at its posterior end, some pores with a

sensory seta. Digits and claws laterally compressed, the claws slightly curved, pointed, each claw between two scales, one above and one below. About 74-78 [77] scales between mental and cloaca, 44-65 [55] around mid-body. Tail slightly compressed. Distance between snout and axilla less than distance between axilla and groin (SA 75.3-93.7% [98.0%] of AG; SA 39.6-43.9% [44.5%] of SVL; AG 46.9-52.7% [45.4%] of SVL). Upper arm length less than lower arm length (UAL 88.4-99.3% [95.1%] of LAL). Fourth finger longest (FL IV 63.8-79.2% [75.4%] of LAL); third finger longest in specimens NMSL L/16-1 and WHT2070 (FL III 67.4% and 70.2% of LAL). Tibia length less than femur length (TBL 83.5-97.5% [92.8%] of FEL [TBL 24.7% of SVL]) except in female (FEL 101.7% of HL in female, vs. 79.0-83.9% in males); FEL 24.4-30.1% [26.6%] of SVL. Fourth toe longest (TL IV 74.4-80.6% [82.0%] of TBL). Tail longer than snout-vent length (TAL 160.7-184.4% [167.3%] of SVL). Digital formula: fingers, 4>3>2>5>1 (4 ex. including holotype), 4>3>5>2>1 (2 ex.) or 3>4>2>5>1 (2 ex.); toes, 4>5>3>2>1 (2 ex. including holotype) or 4>3>5>2>1 (6 ex.).

Measurements of holotype (in mm). AD, 1.6; AG, 35.7; AL, 0.9; AW, 0.6; ED, 8.8; EN, 5.2; ES, 8.7; FEL, 20.9; FL I, 4.8; FL II, 7.5; FL III, 10.4; FL IV, 10.7; FL V, 7.0; HD, 14.4; HL, 25.7; HW, 17.6; IO, 3.9; LAL, 14.2; NS, 4.0; SA, 35.0; SVL, 78.6; SW, 3.7; TAL, 131.5; TBL, 19.4; TL I, 4.6; TL II, 6.8; TL III, 10.0; TL IV, 15.9; TL V, 10.1; UAL, 13.5.

Colour. In life, mature individuals with a dorsal and lateral background colour of light brown (Fig. 15) to yellowish (Fig. 16) or brownish red (Fig. 17); about 17 broad, dark brown bands on body and tail separated by narrow, lighter interspaces. The larger lateral scales with lighter margins. Limbs with cross bars. Venter yellowish green. Juvenile (SVL 44.0 mm) greenish on both dorsum and sides (Fig. 18).

In alcohol, dorsally and laterally dark brown; head with light brown lateral patches. Larger lateral scales light brown; broad, dark brown bands on body and tail. Limbs with dark bands on their dorsal sides. Gular area and venter light brown to ashy brown.

Description of skull (paratype WHT1328, 75.2 mm SVL). Premaxilla with 3 and right mandible with a single pointed incisoroid; left maxilla with 2 and right mandible with a single large, pointed caniniform; left maxilla and right mandible each with 12 triangular, laterally compressed molariforms. Frontal concave, its outer edge smooth, concave, its anterior two-thirds smooth, the posterior third rugose, and the posterior margin elevated. Parietal bone deeply concave, smooth, deeply grooved centrally, its anterior edge with a prominent ridge. Upper temporal fossa oval (WUF 61.1% of LUF; LUF 35.5% of CL), its inner margin elevated (Fig. 19). Stapes bar-like (Fig. 20), slightly smaller than horizontal width of foramen magnum (STL 92.9% of HFM). Mandible (Fig. 21a) longer than cranium (CL 87.3% of LM), its posterior end with a feebly-defined articular process (Fig. 21b); CD 53.7% of CL, CW 71.4% of CL, FW 17.5% of CL, HFM 57.9% of PAW, PAW 19.2% of CL, POW 74.8% of TP, PP 84.8% of PW, PW 46.5% of CL and TP 76.4% of CL.

Measurements of skull (in mm), CD, 10.9; CL, 20.3; CW, 14.5; FW, 3.55; HFM, 2.26; LM, 23.25; LUF, 7.2; PAW, 3.9; POW, 11.6; PP, 8.0; PW, 9.43; STL, 2.1; TP, 15.5; WUF, 4.4.

Reproduction. Of two ovigerous females, BMNH 1996.449 contained four immature ova which were 6.2-6.5×6.7-7.1 mm; WHT2172 contained five mature ova which were 7.2-7.8×13.1-13.7 mm.

Etymology. The species name is a patronym honouring Walter Erdelen (University of Würzburg, Germany), who in the course of extensive work in Sri Lanka in the 1980s was responsible for inspiring renewed interest in the herpetofauna of this island.

Ceratophora karu sp. nov.

(Figures 22-32)

Holotype. Male, 31.1 mm SVL, BMNH 1996.445, Morningside F.R. (near Rakwana), alt. 1060 m (06°24'N, 80°38'E), coll. M.M. Bahir & D. Gabadage, 07 III 1996.

Paratypes (all from type locality). Male, 30.8 mm SVL, BMNH 1996.447; female, 33.7 mm SVL, BMNH 1996.446; male, 31.6 mm SVL, NMSL L/15-1; M.M. Bahir & D. Gabadage, 01 V 1996. Female, 30.2 mm SVL, NMSL L/15-2; M.M. Bahir & D. Gabadage, 14 VIII 1996. Male, 31.8 mm SVL, WHT2065; male, 31.0 mm SVL, WHT2066; D. Gabadage & S. Dharmasiri, 21 II 1996. Male, 30.8 mm SVL, WHT2067; female, 30.0 mm SVL, WHT2068; female, 30.0 mm SVL, WHT2069; M.M. Bahir & D. Gabadage, 07 III 1996.

Diagnosis

Ceratophora karu is distinguished from all other *Ceratophora* (except *C. tennentii* and *C. aspera*) by the rostral appendage being complex, comprising more scales than rostral scale alone (Fig. 22) (vs. rostral appendage restricted to rostral scale alone in *C. erdeleni* and *C. stoddartii*). It is distinguished from *C. tennentii* by the presence of prominent superciliary scales (vs. absent in *C. tennentii*) and from *C. aspera* by the absence of a palpable squamosal process (Fig. 30) (vs. squamosal process present (Fig. 10) in *C. aspera*).

Description

(See Table 3 for morphometric data). Dorsal aspect of head oval. Interorbital area deeply concave. Orbit rim prominent. Supraorbital area elevated, the supraorbital ridge with a row of large, carinate, ridged or conical scales. Superciliary ridge with strongly compressed antrorse scales, more elevated in males (Fig. 22) (a juvenile specimen (WHT2193, 23.4 mm SVL) lacks elevated supraorbital scales (Fig. 25)). A backward-pointing "V"-shaped ridge at rear of interorbital. Area between upper temporal fossae concave, the proximal ridges of the fossae elevated. Two short, lateral, longitudinal ridges from postorbital to mid-area between postorbital and neck. In females, rostral appendage absent (Fig. 28); rostral scale triangular in both lateral and frontal aspects, surrounded by first pair of supralabials and 5-6 scales. Superciliary scales smooth or carinate. Other cephalic scales irregular, some smaller than mid-dorsal scales, strongly carinate or smooth, sometimes conical. Scales on snout compressed. Nostril oval, laterally or anterolaterally orientated. Nasal scale large, suboval, above first and second, second, third, or both second and third supralabials.

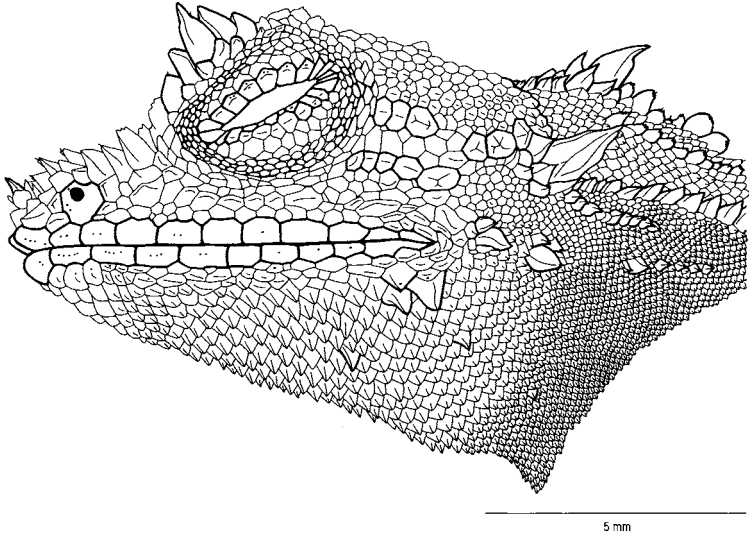


Figure 22. *Ceratophora karu*, BMNH 1996.445, holotype, male, 31.1 mm SVL, lateral scalation of head.

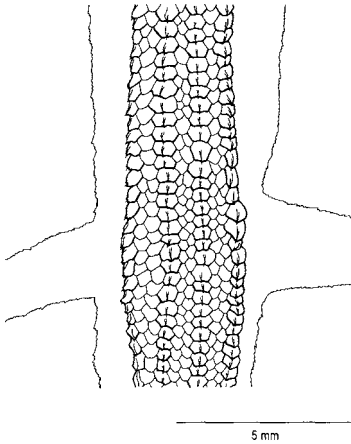


Figure 23. *Ceratophora karu*, BMNH 1996.445, holotype, male, 31.1 mm SVL, dorsal scalation above hind leg insertion.

Nasal touches supralabials or is separated from them by a row of narrow, oval scales. Nasals separated by 4-7 [6] scales between them. Second scale row from inner margin of lower eyelid and marginal scale row of upper eyelid with large, carinate scales. Supralabials 10-13 [11], infralabials 9-11 [9], the first pair of supralabials touching each other anteriorly. Some cephalic scales (including supralabials and infralabials), rostral appendage and gular scales with 1-6 pores, some pores with a sensory seta. Tympanum subdermal. A well-defined dorsinuchal crest on neck only, with 5-12 [13] subtriangular, pointed, rounded or ridged and conical scales (better defined in the male specimens,

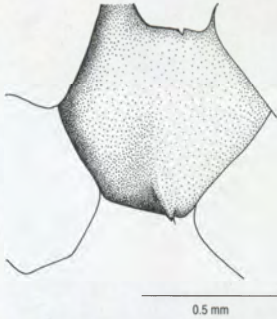


Figure 24. *Ceratophora karu*, BMNH 1996.445, holotype, male, 31.1 mm SVL, mid-body ventral scale.



Figure 25. *Ceratophora karu*, WHT2193, paratype, juvenile, 23.4 mm SVL, lateral aspect.

BMNH 1996.447 and NMSL L/15-1 (Figs. 26 & 27)). Mental subpentagonal, subhexagonal or "U"-shaped [its width equal to length of rostral appendage]. Postmentals, smaller than mental, the first pair of postmentals touching the first or first and second infralabials and separated by a scale or touching each other; the second pair touching first or both first and second infralabials and separated by 2-4 [2] scales. Gular fold absent. Gular scales carinate, smaller than ventrals, oval or triangular, arranged in regular series, intermixed with a few large, ridged or carinate scales.

Head longer than wide (HW 65.4-75.0% [69.6%] of HL; HD 75.7-86.8% [83.1%] of HW; HL 30.8-33.1% [32.8%] of SVL). Eye diameter greater than snout length (ED 103.0-124.1% [118.2%] of ES). Interorbital width less than superciliary width (IO 60.7-86.4% [75.0%] of SW). Nostril to snout distance subequal to that from eye to nostril (NS 83.3-106.7% [88.9%] of EN). Rostral appendage composed of triangular, smooth or feebly carinate scales, a laterally compressed, pointed scale on top. Length of rostral appendage less than eye to nostril dis-

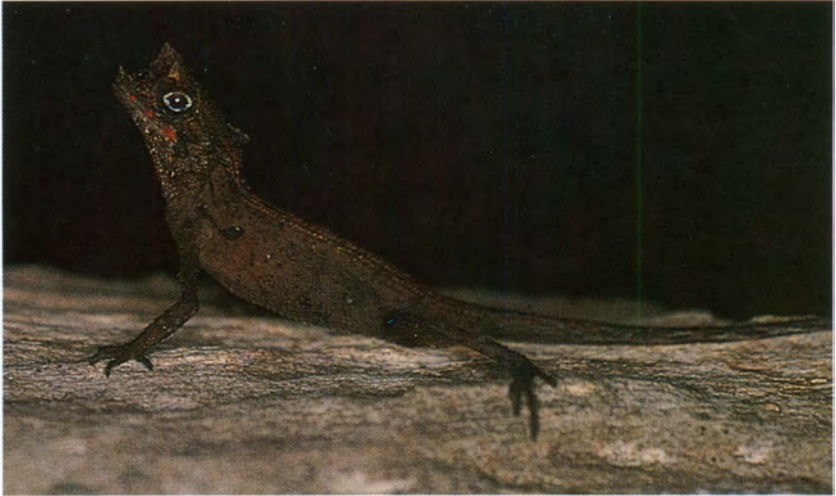


Figure 26. *Ceratophora karu*, BMNH 1996.447, paratype, male, 30.8 mm SVL, lateral aspect.



Figure 27. *Ceratophora karu*, NMSL L/15-1, paratype, male, 31.6 mm SVL, dorsolateral aspect.

tance (AL 66.7-93.8% [77.8%] of EN). Tongue short and thick, its width 51.7% of its length (WHT1325), anteriorly nicked, the posterior third villose.

Body subtriangular in section. Four or five [four] rows of large, carinate scales in dorsal series from occiput to base of tail, interspersed with one or two rows of smaller scales (Fig. 23) (4 ex., including holotype); or some of the larger scales forming short, angular series across the mid-vertebral line, with their angles pointing backwards (6 ex.) (Fig. 29). Dorsal scales larger than laterals, smooth or carinate, unequal, arranged in regular series, imbricate. Lateral scales



Figure 28. *Ceratophora karu*, WHT2192, paratype, female, 32.4 mm SVL.

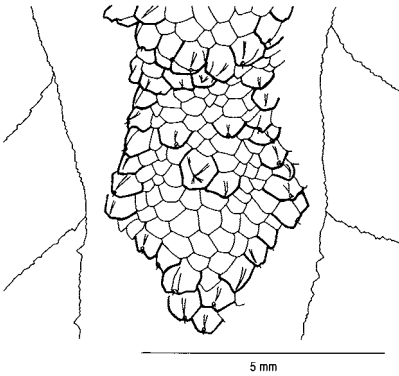


Figure 29. *Ceratophora karu*, WHT2067, paratype, male, 30.8 mm SVL, dorsal sculation above hind leg insertion.

smaller than dorsals and ventrals, intermixed with few large, carinate scales (sometimes smooth), irregular, subimbricate; most scales point upwards, a few backwards. Most body and limb scales and all ventral scales pored, each pore with a small sensory seta. Ventral scales uniform, carinate (Fig. 24), larger than laterals. Caudals subequal to mid-dorsals, a few smooth, but most carinate. Subcaudals subequal to ventrals (except scales around cloaca), strongly carinate. Limbs with unequal, carinate scales: those on forelimb strongly carinate; 1-4 [2] large carinate scales on hind side of thigh. Digits covered above and on sides with carinate scales. Subdigitals bicarinate. Subdigital squamation: first finger with 6-7 [7], second finger with 8-9 [8], third finger with 10-12 [8], fourth finger with 11-14 [11], fifth finger with 7-10 [7] scales; first toe with 5-6 [5], second toe with 6-10 [8], third toe with 9-12 [9], fourth toe with 14-17 [14], fifth toe with 8-10 [8] scales. Scale on claw tricarinate. Digits and claws laterally compressed; the claws slightly curved, pointed, each claw between two scales, one above and one below. Scales from mental to cloaca 70-87 [71]; around mid-

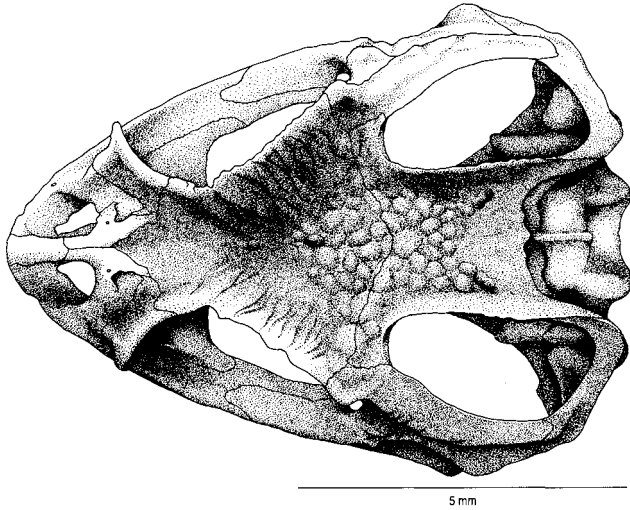


Figure 30. *Ceratophora karu*, WHT1325, paratype, female, 34.4 mm SVL, dorsal aspect of cranium.

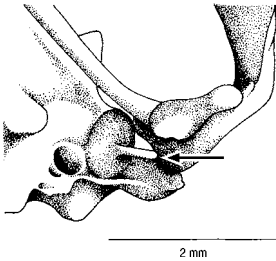
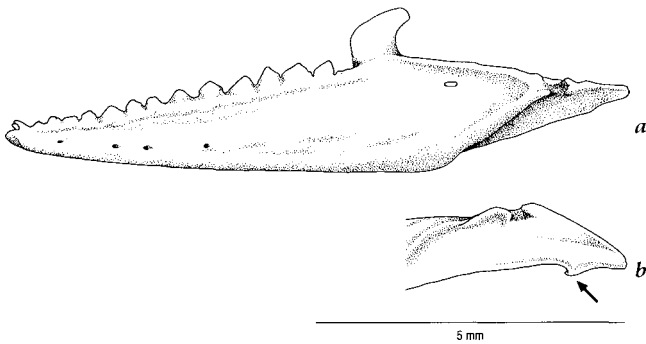


Figure 31. *Ceratophora karu*, WHT1325, paratype, female, 34.4 mm SVL, left posterior corner of ventral aspect of cranium (arrow indicates stapes).

Figure 32. *Ceratophora karu*, WHT1325, paratype, female, 34.4 mm SVL, (a) labial aspect of left mandible; and (b) ventral aspect of posterior end of left mandible (arrow indicates articular process).



body 58-70 [60]. Tail rounded in section. Distance between snout and axilla subequal to distance between axilla and groin (SA 86.8-119.4% [99.3%] of AG; SA 41.2-48.4% [43.1%] of SVL). Distance between axilla and groin 40.6-50.0% [43.4%] of SVL. Upper arm length subequal to lower arm length (UAL 101.7-130.0% [96.5%] of LAL), but both segments equal in two female specimens,

Table 3. Measurements, expressed as percentages of head length, of the holotype (31.1 mm SVL, BMNH 1996.445) and 9 paratypes (30.8 mm SVL, BMNH 1996.447; 33.7 mm SVL, BMNH 1996.446; 31.6 mm SVL, NMSL L/15-1; 30.2 mm SVL, NMSL L/15-2; 31.8 mm SVL, WHT2065; 31.0 mm SVL, WHT2066; 30.8 mm SVL, WHT2067; 30.0 mm SVL, WHT2068; 30.0 mm SVL, WHT2069) of *Ceratophora karu*.

	Holotype	Range	Mean	s.d.
Axilla to groin (AG)	132.4	124.0 - 158.9	146.0	11.3
Eye diameter (ED)	38.2	33.3 - 38.2	35.8	1.8
Eye to nostril (EN)	17.6	13.5 - 18.0	16.4	1.3
Eye to snout (ES)	32.4	29.2 - 34.6	32.2	1.5
Femur length (FEL)	76.5	76.5 - 91.0	81.9	5.0
Finger length I (FLI)	16.7	13.5 - 20.0	16.8	1.9
Finger length II (FLII)	19.6	19.2 - 26.0	22.6	2.3
Finger length III (FLIII)	28.4	26.0 - 32.6	30.1	2.1
Finger length IV (FLIV)	34.3	27.9 - 35.8	32.8	2.8
Finger length V (FLV)	19.6	15.4 - 23.5	20.1	2.2
Head depth (HD)	57.8	52.0 - 62.1	56.0	3.1
Head width (HW)	69.6	65.4 - 75.0	69.6	2.5
Interorbital width (IO)	20.6	15.3 - 22.0	18.8	2.1
Lower arm length (LAL)	55.9	41.7 - 60.0	53.5	5.6
Nostril to snout (NS)	15.7	13.5 - 16.8	15.4	0.9
Snout to axilla (SA)	131.4	124.5 - 148.1	137.3	7.3
Snout to vent (SVL)	304.9	302.0 - 324.2	310.2	6.9
Superciliary width (SW)	27.5	19.6 - 34.0	25.9	4.2
Tail length (TAL)	432.4	324.0 - 456.8	400.9	46.0
Tibia length (TBL)	68.6	68.6 - 80.0	73.0	4.0
Toe length I (TLI)	16.7	11.6 - 16.7	14.1	1.6
Toe length II (TLII)	19.6	17.9 - 23.4	20.3	1.9
Toe length III (TLIII)	28.4	26.3 - 32.0	29.5	2.0
Toe length IV (TLIV)	45.1	41.4 - 51.0	46.3	3.1
Toe length V (TLV)	25.5	21.2 - 28.0	24.7	1.8
Upper arm length (UAL)	53.9	50.0 - 63.2	56.2	4.4

BMNH 1996.446 and NMSL L/15-2. Fourth finger longest (FL IV 52.7-69.4% [61.4%] of LAL), but third finger longest in paratype WHT2069. Tibia length less than femur length (TBL 84.6-93.7% [89.7%] of FEL; FEL 24.7-28.9% [25.1%] of SVL). Fourth toe longest (TL IV 57.9-69.1% [65.7%] of TBL). Tail longer than SVL (TAL 103.7-141.6% [141.8%] of SVL). Digital formula: fingers, 4>3>2=5>1 (2 ex., including holotype); 4>3>2>5>1 (7 ex.), 3>4>2>5>1 (1 ex.); toes, 4>3>5>2>1.

Measurements of holotype (in mm): AG, 13.5; AL, 1.4; ED, 3.9; EN, 1.8; ES, 3.3; FEL, 7.8; FL I, 1.7; FL II, 2.0; FL III, 2.9; FL IV, 3.5; FL V, 2.0; HD, 5.9; HL, 10.2; HW, 7.1; IO, 2.1; LAL, 5.7; NS, 1.6; SA, 13.4; SVL, 31.1; SW, 2.8; TAL, 44.1; TBL, 7.0; TL I, 1.7; TL II, 2.0; TL III, 2.9; TL IV, 4.6; TL V, 2.6; UAL, 5.5.

Colour. In life, males are blackish dark brown above; laterally brown or olive green (Figs. 26 & 27), some scales on head and mid-dorsal area reddish yellow or chestnut colour, some specimens with bright orange-red patches on supralabials (Fig. 26). Gular area and venter buff or dirty white to yellowish

brown with small black patches. Mid-dorsal area of some specimens lighter brown than laterals, a few bright white scales being present on the gular area. A few black lines on sides of head and neck. Margins of eyelids and lower part of orbital rim whitish yellow in males, duller in females. Females generally lighter coloured than males (Fig. 28), and juveniles lighter-coloured than adults (Fig. 25).

In alcohol, dorsally, laterally and ventrally dark brown to light brown; mid-dorsal area lighter. Venter light brown; with large, dark brown patches in some specimens.

Description of skull (paratype WHT1325, 34.4 mm SVL). Premaxilla with 3 and left mandible with a single pointed incisoroid; left maxilla and left mandible each with a single large pointed caniniform; left maxilla and left mandible each with 13 triangular, laterally compressed molariforms. Frontal concave, with a conical process at its centre; its outer edge prominent, concave and rugose; its anterior half smooth, the posterior half rugose, and the posterior margins elevated. Upper temporal fossa oval (WUF 50.0% of LUF; LUF 36.1% of CL), its inner margins elevated (Fig. 30). Parietal with two conical processes at its middle. Stapes bar-like (Fig. 31), smaller than horizontal width of foramen magnum (STL 52.2% of HFM). Mandible (Fig. 32a) longer than cranium length (CL 94.2% of LM), its posterior end with an articular process (Fig. 32b). CD 51.0% of CL, CW 75.4% of CL, DM 26.5% of LM, FW 18.0% of CL, HFM 50.0% of PAW, PAW 24.4% of CL, POW 75.7% of TP, PP 87.8% of PW, PW 39.3% of CL and TP 72.2% of CL.

Measurements of skull (in mm): CD, 4.8; CL, 9.4; CW, 7.1; DM, 2.65; FW, 1.7; HFM, 1.15; LM, 10.0; LUF, 3.4; PAW, 2.3; POW, 5.15; PP, 3.25; PW, 3.7; STL, 0.6; TP, 6.8; WUF, 1.7.

Reproduction. One ovigerous female (BMNH 1996.446) contained two ova measuring 8.6×4.9 and 8.8×5.0 mm.

Etymology. The species name is a patronym commemorating the late Punchi Banda Karunaratne, mentor, guide and friend both to ourselves and so many other investigators of Sri Lanka's natural wealth, universally known to friends and colleagues simply as "Karu," which diminutive form we use here with respect and affection as a noun in apposition.

Ceratophora stoddartii Gray, 1835

(Figures 33-44)

Ceratophora stoddartii Gray, J.E. in Gray, J.E. & R. Hardwicke. 1835. Illustrations of Indian zoology, vol. 2, pl. 68, Fig. 2.

Holotype. Male, 67.8 mm SVL, BMNH1946.8.27.37; Ceylon; Stoddart.

Other material. Male, 75.5 mm SVL; juv., 30.0 mm SVL, WHT170; Nagrak Division, Nonpareil Estate (adjoining Horton Plains, alt. 2135 m), (06°46'N, 80°47'E), coll. K. M.-Arachchi, 4 II 1993. Female, 70.4 mm SVL, WHT209; Hakgala (near Nuwara Eliya), alt. 1830 m (06°55'N, 80°49'E), coll. K. M.-Arachchi, 28 XII 1993. Male, 85.6 mm SVL, WHT1170; Nagrak Division, Non-

pareil Estate (adjoining Horton Plains, alt. 2135 m), (06°46'N, 80°47'E), coll. M.M. Bahir & D. Gabadage, 26 III 1996. Male, 84.9 mm SVL, WHT1700; 02V1996; male, 79.5 mm SVL, WHT1327; male, 70.2 mm SVL, WHT1701; female, 78.7 mm SVL, WHT1702; female, 77.1 mm SVL, WHT1703; Namunukula Peak, alt. 1980 m (06°56'N, 81°07'E), coll. 18 IV 1996, M.M. Bahir & D. Gabadage.

Diagnosis

Ceratophora stoddartii is distinguished from all other *Ceratophora* by the presence of a prominent rostral appendage restricted to the rostral scale.

Description

(See Table 4 for morphometric data). Description based on the holotype (BMNH1946.8.27.37), three presumed topotypes (WHT170, WHT209 and WHT1170) and five examples from the disjunct population at Namunukula (WHT1327, WHT1700, WHT1701, WHT1702, WHT1703) for which counts and measurements are given in parantheses. Rostral appendage description includes data also from specimens listed under Supplementary Material.

Dorsal aspect of head oval or triangular. Nasal to interorbital region concave. Temporal region with 3-7 (4-7) large conical scales (Fig. 33 and 44). Orbit rim prominent. Supraorbital ridge with a row of large, carinate scales. Area between upper temporal fossae concave (Fig. 34). A transverse ridge across rear of interorbital. Rostral appendage pointed (absent in female topotype, WHT1703) surrounded by first pair of supralabials and 4-5 (4-7) other scales. Cephalic scales irregular, a few of them smaller than mid-dorsal scales, feebly carinate, smooth or conical. Canthus rostralis of 18-19 (18-22) smooth and strongly compressed scales, slightly concave in outline anterior to eye when viewed laterally 4-6 (3) scales from rostral appendage to posterior margin of nasal scale; 13-14 (15-19) scales from nasal scale to rear end of orbit). Nostril oval or rounded, anterolaterally or laterally orientated. Nasal scale large, its lateral aspect oval, separated from rostral by 2-3 (3) scales, over second to fourth supralabials (nasal scale touching supralabials or separated from them by a row of narrow scales); nasal scales separated from each other by 5 (5-6) scales. Superciliary scales carinate. Second row of scales from inner margin of both upper and lower eyelids of large, carinate scales. Supralabials, 13-14 (12-14); infralabials, 10-13 (10-12). Scales on head, rostral appendage, supralabials, infralabials and gular area with 1-11 (1-22) pores, most pores with a minute seta. Tympanum subdermal. A well-developed or feebly-defined dorsinuchal crest on neck only, with about 16-20 (16-22) triangular scales. Mental subhexagonal or elongate (five to seven-sided). One or three pairs of postmentals, smaller than mental, the first pair of postmentals touching first or first and second infralabials and separated by 1-2 scales or the mental itself; second pair of postmentals touching first and second or second infralabials and separated by 1-2 scales, the third pair separated by 3 scales touching third infralabials. Gular fold feebly defined. Gular scales smooth or feebly carinate, larger than ventrals, rhombic, arranged in regular series, smaller on mid-gular region and around mental.

Head longer than wide (HW 52.3-58.3% (53.6-60.7%) of HL; HD 90.8-112.0% (99.2-121.8%) of HW; HL 30.4-33.5% (30.9-33.6%) of SVL). Eye diameter subequal to snout length (ED 87.4-100.0% (102.4-120.5%) of ES). Superciliary width subequal to interorbital width (SW 84.1-105.6% (68.5-103.2%) of IO).

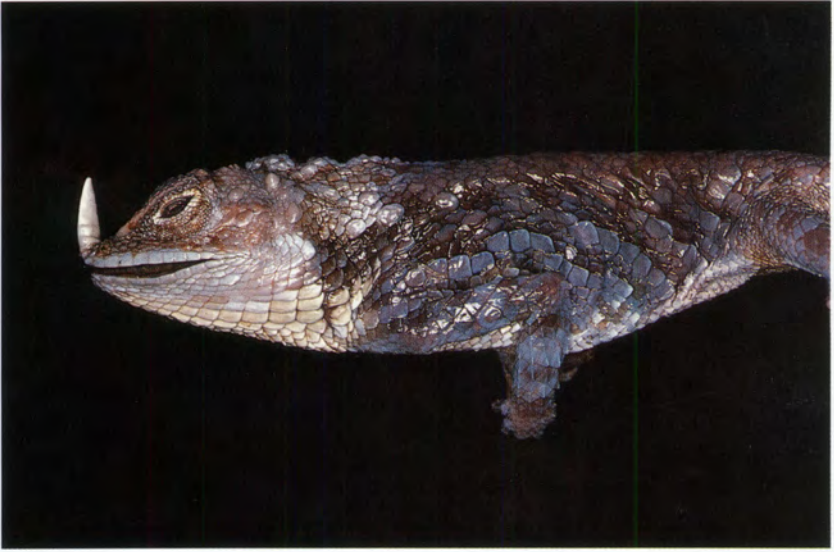


Figure 33. *Ceratophora stoddartii*, BMNH1946.8.27.37, holotype, male, 67.8 mm SVL, lateral aspect.



Figure 34. *Ceratophora stoddartii*, BMNH1946.8.27.37, holotype, male, 67.8 mm SVL, dorsal aspect of head.



Figure 35. *Ceratophora stoddartii*, WHT1170, topotype, male, 85.6 mm SVL, mid-body ventral scale.



Figure 36. (a) *Ceratophora stoddartii*, WHT170, topotype male from Horton Plains area, 75.5 mm SVL, lateral aspect; (b) *C. stoddartii*, WHT1700, male from Namunukula area, 84.9 mm SVL, lateral aspect.

Nostril to snout distance less than eye to nostril distance (NS 67.2-87.0% (69.2-85.7%) of EN) (not measured in holotype). Rostral appendage prominent in both sexes (and also in juveniles and subadults), long, pointed, the appendage more prominent in males (AL 117.6-225.6% (123.8-167.3%) of EN in the males; 20.0-88.9% (54.3%) of EN in the females). Tongue short and thick, its width



Figure 37. *Ceratophora stoddartii*, WHT1330, topotype, female, 60.0 mm SVL, dorsolateral aspect.

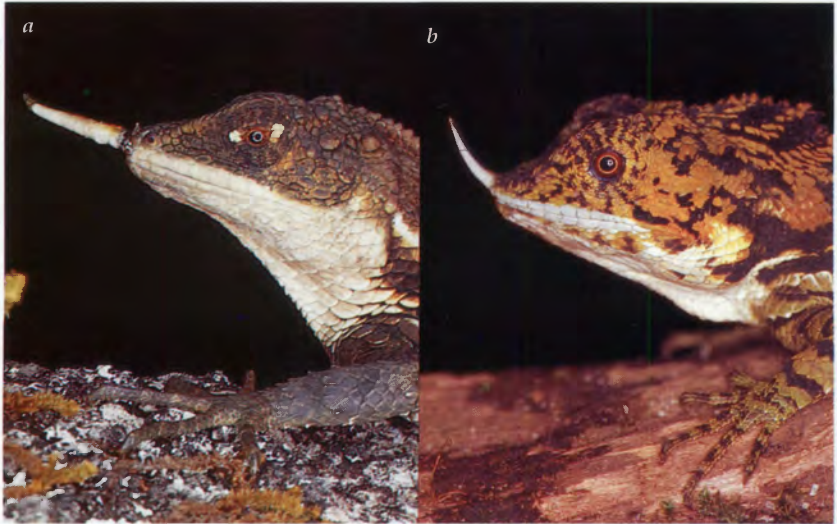


Figure 38. Lateral aspect of head of (a) *Ceratophora stoddartii*, WHT170, topotype male from Horton Plains area, 75.5 mm SVL, lateral aspect; (b) *C. stoddartii*, WHT1700, male from Namunukula area, 84.9 mm SVL, lateral aspect.

53.2% of its length in a single example (WHT1170), anteriorly nicked, the posterior half villose, the anterior half smooth.

Body subtriangular in section. Dorsal scales smaller than the larger lateral scales, smooth or feebly carinate, unequal, irregular, imbricate or prominent;



Figure 39. *Ceratophora stoddartii*, WHT170, topotype, juvenile, 30.0 mm SVL, lateral aspect.

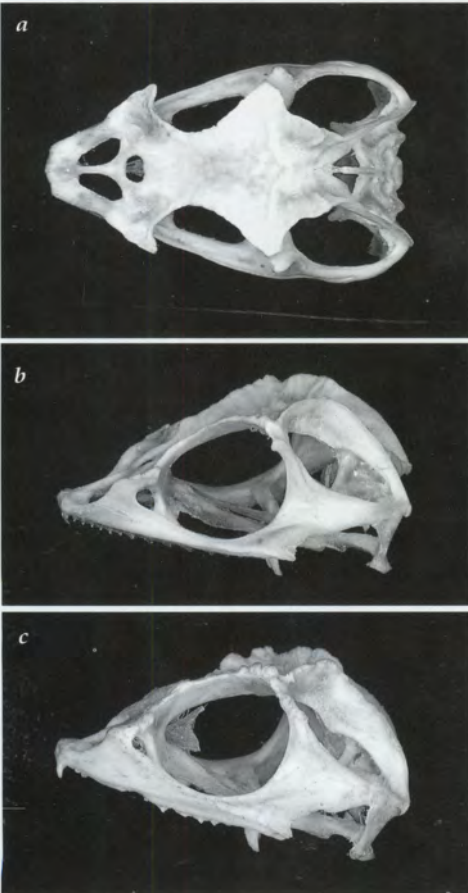


Figure 40. Cranium of *Ceratophora stoddartii*, WHT1170, from Central Hills, male 85.6 mm SVL (a) dorsal aspect, (b) lateral aspect; (c) WHT-1327, from Namunukula, male 79.5 mm SVL, lateral aspect.

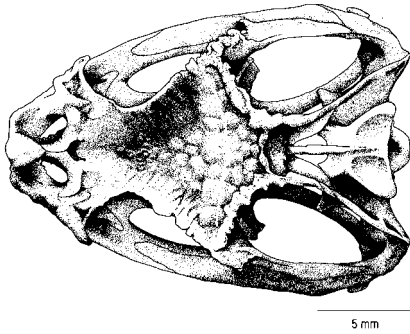


Figure 41. Cranium of *Ceratophora stoddartii*, WHT1327, from Namunukula, male 79.5 mm SVL, dorsal aspect.

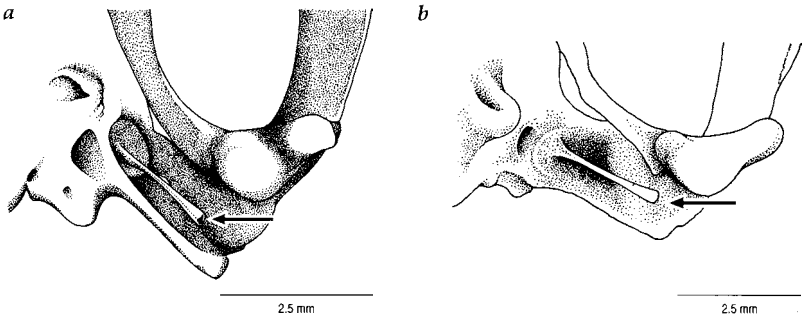


Figure 42. Ventral aspect of left posterior corner of cranium (arrow indicates stapes) of *Ceratophora stoddartii* from (a) Central Hills, WHT1170, male 85.6 mm SVL; and (b) Namunukula, WHT1327, male, 79.5 mm SVL.

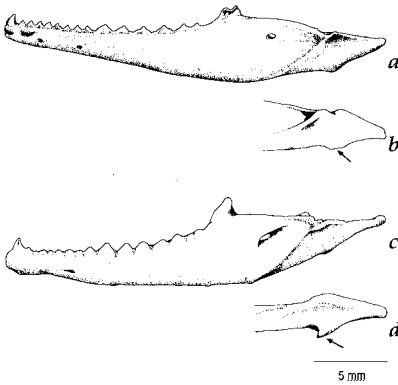


Figure 43. *Ceratophora stoddartii*, WHT1170, from Central Hills, male 85.6 mm (a) labial aspect of left mandible (coronoid process broken); and (b) ventral aspect of posterior end of left mandible; WHT1327, from Namunukula, male 79.5 mm SVL, (c) labial aspect of left mandible; and (d) ventral aspect of posterior end of left mandible (arrows indicate articular processes).

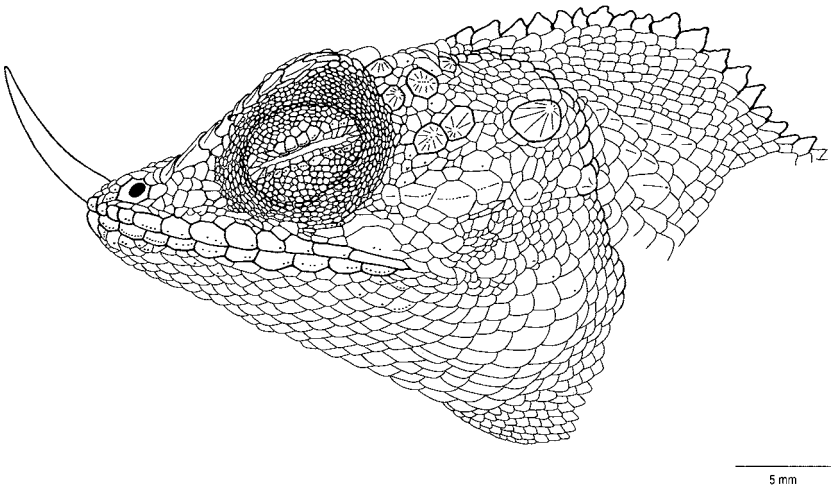


Figure 44. *Ceratophora stoddartii*, WHT1700, male from Namunukula, 84.9 mm SVL, lateral scalation of head.

some of the larger dorsal scales in the pelvic area form short, feebly defined transverse rows, the scale angles pointing backwards. Lateral scales larger, seven or eight rows on left side, interspersed with smaller scales, irregular, smooth, some feebly carinate, subimbricate, pointing upwards and backwards. Ventral scales uniform, smooth or feebly carinate, smaller than the larger of the laterals (Figure 35). Caudals subequal to ventrals, smooth or feebly carinate. Subcaudals larger than ventrals (except scales around cloaca), the more anterior scales smooth or feebly carinate, the posterior ones strongly carinate. Limbs with unequal scales, dorsally carinate (a few are smooth), ventrally smooth or only feebly carinate. Distal end of keels of scales on palm and foot elevated, acuminate. Digits covered both dorsally and laterally with carinate or smooth triangular scales. Some dorsal, lateral, caudal, subcaudal and limb scales each with a sensory pore at its posterior end, each pore with a sensory seta. Subdigitals wider, bicarinate. Subdigital squamation: first finger with 9-12 (9-11), second finger with 14-15 (13-15), third finger with 17-19 (15-22), fourth finger with 19-22 (17-21), fifth finger with 12-14 (12-14); first toe with 7-9 (7-9), second toe with 10-15 (10-13), third toe with 17-20 (14-21), fourth toe with 23-27 (21-28), fifth toe with 15-21 (13-17) scales. Digits and claws laterally compressed. Claws slightly curved, pointed, each claw between two scales, one above and one below. Scales in series from mental to cloaca 79-86 (76-96); around mid-body 47 (50-59). Tail slightly compressed. Distance from snout and axilla subequal to that from axilla to groin (SA 78.4-106.3% (83.1-100.5%) of AG; SA 41.2-47.2% (41.9-46.0%) of SVL; AG 44.2-52.6% (45.3-50.4%) of SVL). Upper arm length subequal to lower arm length (UAL 89.8-105.3% (92.2-99.3) of LAL).

Table 4. Measurements, expressed as percentages of head length, of the holotype (BMNH 1946.8.27.37, 67.8 mm SVL), and 3 topotypes (WHT170, WHT209, WHT1170, 70.4-85.6 mm SVL) of *Ceratophora stoddarti* from the central hills, and 5 examples from Namunukula (WHT1700, WHT1327, WHT1701, WHT1702, WHT1703, 70.2-84.9).

	Central Hills					Namunukula			
	Holotype	Range	Mean	s.d.		Range	Mean	s.d.	
Axilla to groin (AG)	145.6	138.7- 163.0	147.6	10.6		136.3- 162.2	148.5	11.7	
Eye diameter (ED)	34.5	32.1- 35.2	33.6	1.5		33.7- 39.5	35.2	2.4	
Eye to nostril (EN)	19.4	19.4- 20.3	20.0	0.4		18.0- 20.6	19.0	1.0	
Eye to snout (ES)	34.5	34.5- 38.3	36.4	1.7		32.4- 33.3	32.9	0.3	
Femur length (FEL)	90.8	74.4- 93.2	84.4	9.1		73.1- 84.3	79.5	4.2	
Finger length I (FLI)	22.3	16.7- 23.9	20.7	3.1		16.0- 20.7	18.6	1.8	
Finger length II (FLII)	33.0	30.3- 33.5	32.0	1.5		26.7- 30.2	28.1	1.4	
Finger length III (FLIII)	45.1	39.3- 45.1	42.5	2.4		32.8- 41.0	37.8	3.0	
Finger length IV (FLIV)	48.5	43.2- 48.5	44.7	2.5		33.6- 45.3	40.3	4.8	
Finger length V (FLV)	31.6	28.2- 31.6	29.7	1.4		23.3- 27.3	25.4	1.7	
Head depth (HD)	52.9	52.9- 58.5	55.1	2.5		55.0- 65.5	60.6	4.8	
Head width (HW)	58.3	52.3- 58.3	56.5	2.8		53.6- 60.7	57.1	3.1	
Interorbital width (IO)	17.5	17.5- 20.7	18.7	1.4		14.0- 21.3	17.7	2.9	
Lower arm length (LAL)	60.2	55.5- 60.2	57.7	2.0		54.5- 59.2	57.4	2.0	
Snout to axilla (SA)	140.8	127.8- 152.1	139.0	10.2		132.4- 140.3	135.5	3.2	
Snout to vent (SVL)	329.1	298.3- 329.1	315.0	13.7		297.8- 323.9	311.0	9.7	
Superciliary width (SW)	18.4	15.8- 18.4	17.1	1.4		13.5- 17.6	15.4	1.6	
Tail length (TAL)	662.6	591.6- 693.4	653.6	43.5		457.1- 600.0	533.1	56.8	
Tibia length (TBL)	78.6	72.7- 79.8	77.7	3.3		73.8- 79.7	76.5	2.3	
Toe length I (TLI)	17.0	17.0- 17.8	17.3	0.4		14.5- 19.8	16.5	2.5	
Toe length II (TLII)	27.7	25.1- 28.6	27.1	1.5		22.5- 29.0	26.1	2.7	
Toe length III (TLIII)	42.2	38.3- 44.4	41.3	2.6		33.8- 42.8	38.1	3.5	
Toe length IV (TLIV)	66.5	55.9- 66.5	61.9	4.4		51.3- 66.7	58.6	5.6	
Toe length V (TLV)	39.3	37.0- 42.9	40.5	2.9		32.8- 45.0	38.8	4.3	
Upper arm length (UAL)	61.2	52.3- 61.2	56.8	4.4		51.3- 55.8	54.4	1.8	

Fourth finger longest, sometimes equal to third finger (FL IV 74.3-80.6% (56.7-80.7%) of LAL). Tibia length subequal to femur length (TBL 85.3-100.9% (92.1-101.0) of FEL; FEL 24.0-28.9% (23.7-27.3%) of SVL). Fourth toe longest (TL IV 77.0-84.6% (68.5-83.6%) of TBL). Tail longer than snout-vent length (TAL 190.8-232.5% (141.1-194.3%) of SVL). Digital formula: fingers, 4>3>2>5>1 (3 ex. (4 ex., 3>4>2>5>1 in one ex.)) and 4=3>2>5>1 (1 ex.); toes, 4>3>5>2>1 (3 ex. (2 ex.)) and 4>5>3>2>1 (1 ex. (2 ex., 4>5=3>2>1 in one ex.)).

Measurements of holotype (in mm). AG, 30.0; AL, 7.4; AW, 2.3; ED, 7.1; EN, 4.0; ES, 7.1; FEL, 18.7; FL I, 4.6; FL II, 6.8; FL III, 9.3; FL IV, 10.0; FL V, 6.5; HD, 10.9; HL, 20.6; HW, 12.0; IO, 3.6; LAL, 12.4; SA, 29.0; SVL, 67.8; SW, 3.8; TAL, 136.5; TBL, 16.2; TL I, 3.5; TL II, 5.7; TL III, 8.7; TL IV, 13.7; TL V, 8.1; UAL, 12.6.

Colour. In life, background colour of dorsum and sides of mature individuals dark brownish-green (Figs. 36) or yellowish brown (Fig. 37); about 10-16 broad, dark brown bands on tail separated by narrow, lighter interspaces. Some of the larger lateral scales with lighter margins. Limbs with cross bars. Venter

light brownish-grey. Underside of appendage, gular area and thorax of mature males white or yellow (Fig. 38). Juvenile (SVL 30.0 mm) brown on both dorsum and sides; a narrow white stripe between eye and gape (Fig. 39). A young male (SVL 47.7 mm) with light green sides.

In alcohol, dorsally and laterally dark brown to ashy blue, both supralabials and infralabials light brown, chestnut or grey (Fig. 33). Gular and area around angle of mouth ashy brown to light brown. Neck black, with light brown stripes. The larger lateral scales light brown or ashy blue. Broad, dark brown bands on body and tail, indistinct, sometimes absent. Limbs with dark bands dorsally. Venter light brown to ashy brown.

Description of skull (WHT1170, 85.6 mm SVL, presumed topotype). Premaxilla with 3 and left mandible with a single pointed incisoroid; left maxilla with 2 and left mandible with a single large, pointed caniniform; left maxilla with 13 and left mandible with 14 triangular, laterally compressed molariforms. Frontal concave, its outer edge smooth, concave, its anterior three-fourths smooth, the posterior fourth rugose; posterior frontal margin elevated (Fig. 40a). Parietal bone deeply concave, smooth, its anterior area with two prominent ridges. Upper temporal fossa oval (WUF 50.0% of LUF; LUF 35.2% of CL), its inner margins elevated (Fig. 40b). Stapes bar-like (Fig. 42a), longer than horizontal width of foramen magnum (STL 128.6% of HFM). Mandible (Fig. 43a) longer than cranium (CL 87.5% of LM), its posterior end with a feebly-defined articular process (Fig. 43b). CD 49.2% of CL, CW 60.1% of CL, FW 18.9% of CL, HFM 53.2% of PAW, PAW 17.4% of CL, POW 74.7% of TP, PP 90.3% of PW, PW 45.3% of CL and TP 73.0% of CL.

Measurements of skull (in mm). CD, 11.2; CL, 22.75; CW, 13.7; DM, 5.5; FW 4.3; HFM, 2.1; LM, 26.0; LUF, 8.0; PAW, 3.95; POW, 12.4; PP, 9.3; PW, 10.3; STL, 2.7; TP, 16.6; WUF, 4.0.

Description of skull (WHT1327, 79.5 mm SVL, from Namunukula). Premaxilla with 3 and left mandible with a single pointed incisoroid; left maxilla and left mandible each with a single large, pointed caniniform; left maxilla and left mandible each with 13 triangular, laterally compressed molariforms. Frontal deeply concave, its outer edge concave, prominent, rugose; the posterior margins elevated (Fig. 40c). Parietal deeply concave, rugose, its anterior edge with a prominent, rugose ridge (Fig. 41), its middle with two deep grooves. Upper temporal fossa oval (WUF 47.6% of LUF; LUF 37.3% of CL), its inner margins elevated. Stapes bar-like (Fig. 42b), longer than horizontal width of foramen magnum (STL 128.6% of HFM). Mandible longer than cranium (CL 86.7% of LM) (Fig. 43c), its posterior end with a prominent articular process (Fig. 43d). CD 58.1% of CL, CW 67.4% of CL, DM 22.9% of LM, FW 20.8% of CL, HFM 56.8% of PAW, PAW 16.4% of CL, POW 78.9% of TP, PP 85.3% of PW, PW 45.2% of CL and TP 71.4% of CL.

Measurements of skull (in mm): CD, 13.1; CL, 22.55; CW 15.2; DM, 5.95; FW 4.7; HFM, 2.1; LM, 26.0; LUF, 8.4; PAW, 3.7; POW, 12.7; PP, 8.7; PW, 10.2; STL, 2.7; TP, 16.1; WUF, 4.0.

Reproduction. Two ovigerous females, WHT1339, each contained ten immature ova in the size range 4.4-5.6×5.7-6.5 mm; another, WHT1340, contained seven immature and six mature ova in the range 4.3-5.0×4.3-5.6 and 7.6-8.1×13.5-

14.5 mm respectively. A single ovigerous female (WHT1704) from the Namunukula series contained six ova measuring 7.5-8.0×13.6-14.1 mm.

***Ceratophora tennentii* Günther and Gray, in Tennent, 1861**
(Figures 45-52)

Ceratophora tennentii, Günther and Gray, in Tennent, J.E. 1861. Sketches of the natural history of Ceylon.

Syntypes (4 ex.), 88.5 mm SVL, BMNH1946.8.27.33; juv., 35.1 mm SVL, BMNH1946.8.27.34; juv., 28.4 mm SVL, BMNH1946.8.27.35; juv., 24.6 mm SVL, BMNH1946.8.27.36, SVL, Ceylon; H. Cuming.

Other material. Males, 2 ex. (59.1 mm SVL, WHT103A; 65.9 mm SVL, WHT103B; Laggala (Knuckles), alt. 1220 m, (07°33'N, 80°44'E), coll. K. M.-Arachchi & D. Gabadage, 16 X 1993); 4 ex. (male, 64.2 mm SVL, WHT114A; male, 62.8 mm SVL, WHT114B; female, 71.9 mm SVL, WHT114C; female, 68.2 mm SVL, WHT114D; Mousakanda-Gammaduwa (Knuckles), alt. 760 m, (07°34'N, 80°42'E), coll. K. M.-Arachchi & D. Gabadage, 23 X 1993). Male, 73.7 mm SVL, WHT1350; Midlands, between Rattota and Laggala (Knuckles), alt. 915 m, (07°31'N, 80°44'E), coll. M. M. Bahir & D. Gabadage, 03 IX 1996.

Diagnosis

Ceratophora tennentii is distinguished from all other *Ceratophora* by the complex, laterally compressed rostral appendage (Fig. 45) (vs. rostral appendage not laterally compressed in all other *Ceratophora*).

Description

(See Table 5 for morphometric data). Head oval in dorsal aspect. Interorbital and internasal region slightly concave. Temporal region with 3 or 5 large, conical scales. Orbit rim prominent. Supraorbital ridge with a row of large, carinate scales. Area between upper temporal fossae concave. Rostral append-

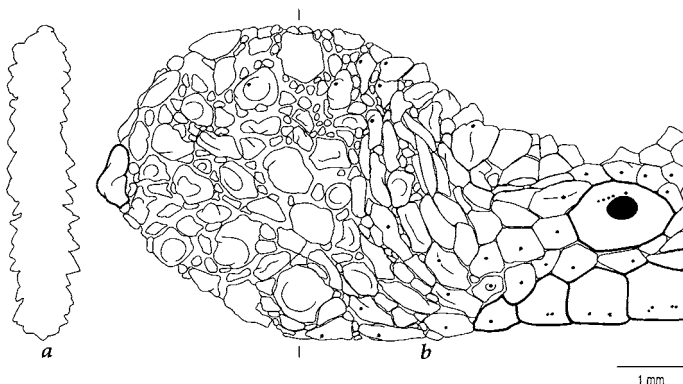


Figure 45. *Ceratophora tennentii*, WHT103A, topotype, male, 59.1 mm SVL, rostral appendage (a) mid-section; (b) lateral aspect.

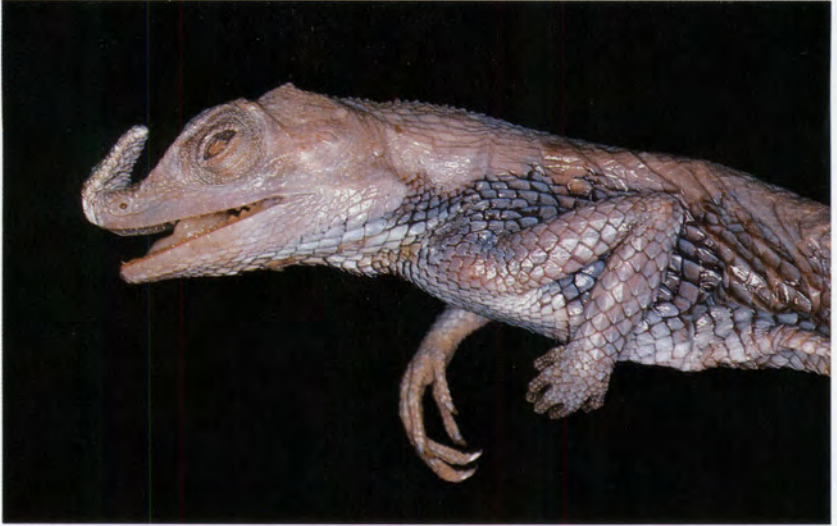


Figure 46. *Ceratophora tennentii*, BMNH1946.8.27.33, syntype, 88.5 mm SVL, lateral aspect.

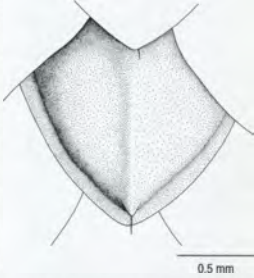


Figure 47. *Ceratophora tennentii*, WHT114D, topotype, female, 68.2 mm SVL, mid-ventral scale.

Figure 48. *Ceratophora tennentii*, WHT103A, topotype, male, 59.1 mm SVL, lateral aspect.





Figure 49. *Ceratophora tennentii*, WHT103C, topotype, juvenile, 23.6 mm SVL, lateral aspect.

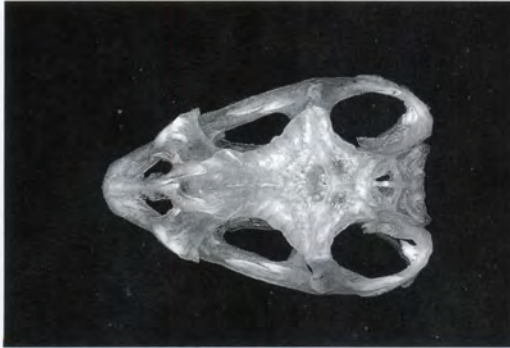


Figure 50. *Ceratophora tennentii*, WHT1350, topotype, male, 73.7 mm SVL, dorsal aspect of cranium.

age fleshy, laterally compressed, elliptical in lateral aspect, tipped with a bluntly conical scale, covered with scales and granules (Fig. 45). Cephalic scales irregular, some smaller than mid-dorsal scales, feebly carinate, conical or smooth. Canthal scales smooth and strongly compressed, canthus rostralis slightly concave in outline anterior to eye when viewed laterally. Nostril oval or rounded, anterolaterally orientated. Nasal scale large, horizontally oval, over second to fourth supralabials (either touching supralabials or separated from them by a row of narrow scales). Nasal scales separated by 7-11 scales. Superciliary scales carinate. Second row of scales from inner margin of both upper and lower eyelids with large, carinate scales. Supralabials 11-14, infralabials 10-13. Cephalic scales, rostral appendage, supralabials, infralabials and gular scales with 1-16 pores (those of syntypes not counted), each pore with a small sensory seta. Tympanum subdermal. Nuchal crest absent or only feebly defined, with

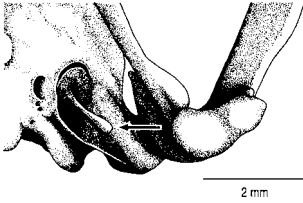
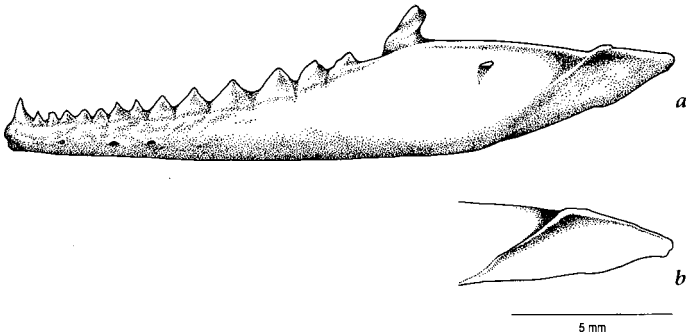


Figure 51. *Ceratophora tennentii*, WHT1350, topotype, male, 73.7mm SVL, ventral aspect of cranium of left posterior corner (arrow indicates stapes).

Figure 52. *Ceratophora tennentii*, WHT1350, topotype, male, 73.7 mm SVL, (a) labial aspect of left mandible; and (b) ventral aspect of posterior end of left mandible.



16-22 triangular or pointed scales. Mental six or seven-sided, one or two pairs of postmentals, smaller than mental, the first pair touching first or first and second infralabials and separated by 1-2 scales; the second pair touching first or second, or both first and second infralabials and separated by 2-4 scales. Gular fold absent. Gular scales smooth or carinate, larger than ventrals, rhombic, arranged in regular series, small on mid-gular area and around mental.

Head longer than wide (HW 54.4-63.9% of HL; HD 84.3-93.7% of HW; HL 29.0-32.8% of SVL). Eye diameter subequal to snout length (ED 92.2-114.7% of ES). Superciliary width subequal to interorbital width (SW 92.3-114.8% of IO). Distance from nostril to snout less than or equal to distance from eye to nostril (NS 73.3-100.0% of EN) (not measured in syntypes). Rostral appendage present in both sexes (also in juveniles and subadults), its length greater than distance from eye to nostril (AL 127.3-183.3% of EN). Tongue short and thick, its width 58.1% of its length (WHT1350, 73.7 mm SVL) anteriorly nicked, the posterior half villose.

Body subtriangular in section. Dorsal scales smaller than the larger of the lateral ones, smooth or feebly carinate, unequal, irregular, imbricate. Some specimens (WHT114D, WHT114E, WHT1352 and WHT1354) have the largest dorsal scales in the pelvic area forming short, transverse rows, the scale angles pointing backwards. Lateral scales larger. Axillary scales larger than other lateral scales (Fig. 46), smooth, a few feebly carinate, subimbricate, pointing upwards or backwards. Ventral scales uniform, strongly carinate, smaller than the larger of the lateral scales (Fig. 47). Caudal scales subequal to ventrals,

Table 5. Measurements, expressed as percentages of head length, of a syntype (BMNH 1946.8.27.33, 88.5 mm SVL) and 7 topotypes (WHT103A-B, WHT114A-D, WHT1350, 59.1-73.7 mm SVL) of *Ceratophora tennentii*.

	range	mean	s.d.
Axilla to groin (AG)	141.7 - 177.5	159.3	12.8
Eye diameter (ED)	33.2 - 39.3	36.8	2.3
Eye to nostril (EN)	17.8 - 21.8	20.3	1.3
Eye to snout (ES)	34.2 - 37.4	36.1	0.9
Femur length (FEL)	82.7 - 98.1	91.0	5.3
Finger length I (FLI)	18.9 - 23.0	20.2	1.4
Finger length II (FLII)	26.0 - 34.0	29.6	2.8
Finger length III (FLIII)	38.0 - 44.5	40.5	2.1
Finger length IV (FLIV)	39.8 - 46.1	41.8	2.0
Finger length V (FLV)	26.4 - 30.4	28.4	1.2
Head depth (HD)	49.2 - 58.2	52.5	3.1
Head width (HW)	54.4 - 63.9	59.0	3.2
Interorbital width (IO)	14.6 - 18.1	16.1	1.1
Lower arm length (LAL)	56.5 - 64.6	62.4	2.6
Snout to axilla (SA)	132.7 - 145.0	138.9	4.5
Snout to vent (SVL)	304.9 - 344.4	328.6	12.2
Superciliary width (SW)	14.9 - 18.3	16.3	1.1
Tail length (TAL)	538.9 - 657.6	592.2	35.0
Tibia length (TBL)	79.6 - 89.4	84.7	3.5
Toe length I (TLI)	15.7 - 20.9	18.0	1.8
Toe length II (TLII)	21.8 - 29.8	24.8	2.4
Toe length III (TLIII)	34.7 - 44.7	40.2	3.7
Toe length IV (TLIV)	56.9 - 71.2	65.3	4.6
Toe length V (TLV)	32.7 - 40.6	37.3	3.1
Upper arm length (UAL)	55.1 - 63.4	57.9	2.6

smooth or feebly carinate. Subcaudals subequal to ventrals, the anterior scales smooth or feebly carinate, the posterior ones strongly carinate. Limbs with unequal scales, carinate or smooth. Distal end of keels of scales on palm and foot elevated, acuminate. Digits covered dorsally and laterally with triangular carinate scales. Subdigitals wider than other digital scales, bicarinate. Subdigital squamation: first finger with 8-10, second finger with 12-15, third finger with 16-21, fourth finger with 17-21, fifth finger with 10-13 scales; first toe with 7-9, second toe with 10-13, third toe with 15-20, fourth toe with 23-30, fifth toe with 13-16 scales. Body and limb scales pored, each pore with a sensory seta, the seta longer in ventral scales (Fig. 47). Digits and claws laterally compressed. Claws slightly curved, pointed, each claw between two scales, one above and one below. Scales from mental to cloaca 72-83; round mid-body, 40-48. Tail moderately compressed. Distance between snout and axilla less than that between axilla and groin (SA 78.2-98.9% of AG; SA 40.3-44.7% of SVL; AG 45.2-52.8% of SVL). Upper arm length subequal to lower arm length (UAL 87.9-112.0% of LAL). Fourth finger longest or equal to third finger (FL IV 63.3-81.5% of LAL). Tibia length subequal to femur length (TBL 88.2-100.7% of FEL; FEL 25.9-29.6% of SVL). Fourth toe longest (TL IV 69.4-84.0% of TBL). Tail longer than snout-vent length (TAL 161.9-192.5% of SVL). Digital formula: fingers, 4>3>2>5>1 (5 ex.), 4>3>5>2>1 (1 ex.), 4=3>2>5>1 (1 ex.) and 4=3>5>2>1 (1 ex.); toes, 4>3>5>2>1 (7 ex.) and 4>5>3>2>1 (1 ex.).

Measurements of 88.5 mm SVL syntype (in mm): AG, 41.2; AL, 10.2; ED, 9.1; EN, 5.6; ES, 9.2; FEL, 25.2; FL I, 4.9; FL II, 8.5; FL III, 10.3; FL IV, 10.5; FL V, 7.1; HD, 13.4; HL, 25.7; HW, 14.3; IO, 4.1; LAL, 16.6; SA, 36.6; SVL, 88.5; SW, 3.9; TAL, 169.0; TBL, 22.5; TL I, 5.0; TL II, 6.5; TL III, 11.5; TL IV, 17.7; TL V, 10.0; UAL, 15.3.

Colour. In life, background colour of dorsum and sides of mature individuals reddish brown to olive green (Fig. 48); larger scales on sides more greenish. Area around the eye and sides of neck with black markings. About 10 broad, dark brown bands on tail separated by narrow, lighter interspaces. Venter whitish. Juvenile (SVL 23.6 mm) dark brown both dorsally and laterally (Fig. 49).

In alcohol, dorsally chestnut to olive brown, laterally dark brown or ashy blue (Fig. 46). Outer edges of larger lateral scales white. Supralabials and infralabials light brown or silvery light blue. Gular area ashy blue to dark brown. Venter ashy brown.

Description of skull (based on topotype WHT1350, 73.7 mm SVL). Premaxilla with 3 and left mandible with a single pointed incisoroids; left maxilla with 2 and left mandible with a single large pointed caniniform; left maxilla with 12 and left mandible with 13 triangular, laterally compressed molariforms. Frontal concave, its outer edge almost smooth, concave, its anterior fourth smooth, the posterior three-fourths rugose; posterior frontal margins elevated. Parietal bone deeply concave, smooth, with two prominent anterior ridges. Upper temporal fossa oval (WUF 70.6% of LUF; LUF 32.2% of CL); its inner margins elevated (Fig. 50). Stapes bar-like (Fig. 51), longer than horizontal width of foramen magnum (STL 152.6% of HFM). Mandible longer than cranium (CL 88.1% of LM) (Fig. 52a), its posterior end lacking an articular process (Fig. 52b). CD 48.9% of CL, CW 64.9% of CL, FW 19.2% of CL, HFM 65.5% of PAW, PAW 15.7% of CL, POW 73.3% of TP, PP 90.4% of PW, PW 44.9% of CL and TP 75.9% of CL.

Measurements of skull (in mm): CD, 9.05; CL, 18.5; CW, 12.0; DM, 4.7; FW 3.55; HFM, 1.9; LM, 21.0; LUF, 5.95; PAW, 2.9; POW, 10.3; PP, 7.5; PW, 8.3; STL, 2.9; TP, 14.05; WUF, 4.2.

Distribution and conservation

Figure 53 shows the distribution in Sri Lanka of each of the five species of *Ceratophora* we recognise here. Although we did not make formal population studies of the various taxa, we note that *C. aspera* and *C. stoddartii* have the largest ranges and also the highest frequency. *Ceratophora aspera* was recorded from the lowland (60-990 m altitude) dipterocarp forests of Sri Lanka's southwestern wet zone belt (annual rainfall in excess of 2500 mm), including the Sinharaja World Heritage Site. It is a slow-moving, purely ground dwelling species, and although it was not recorded from agricultural habitats, it was found also in secondary forests. Contrary to the estimate of Manamendra-Arachchi & Liyanage (1994), its population appears large and stable, and does not appear to be faced with any imminent threats.

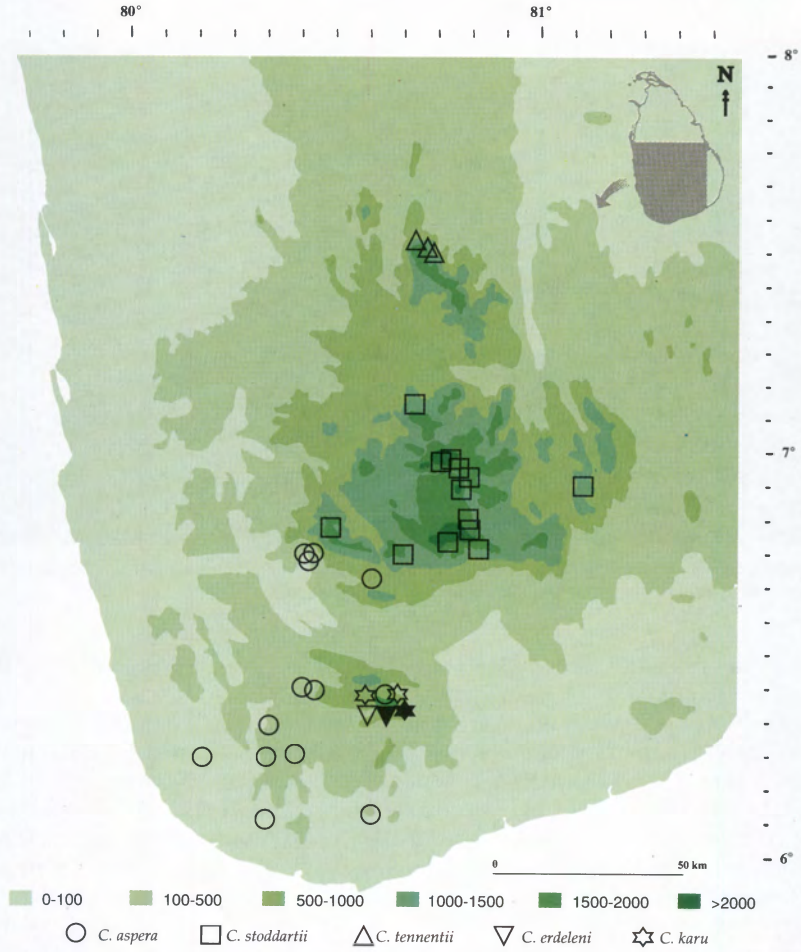


Figure 53. Distribution of *Ceratophora* species in Sri Lanka (solid symbols indicate type localities).

Although *Ceratophora stoddartii* also appears to have an extensive range, it is in fact restricted to such patches of cloud forest as remain in the higher elevations (1525-2200 m) of the Central Massif, mainly the Peak Wilderness, Horton Plains and adjacent protected areas. Available data suggest that *C. stoddartii*, a slow-moving subarbooreal species usually found on moss-covered tree trunks, has a significantly lower frequency than *C. aspera*. Clearly, the species now inhabits only a small portion of its former range, most of the lower elevations (under 1800 m) of the Central Massif having been cleared during the past century for the cultivation of tea (*Camellia*). The population of this species at Namunukula (06°56'N, 81°07'E; 1980 m altitude) appears to be a



Figure 54. Morningside Forest Reserve, the eastern sector of the Sinharaja World Heritage Site: habitat of *Ceratophora karu* and *Ceratophora erdeleni*.

marginal relict. It is restricted to a very small forest reserve of about 200 ha, the last remnant of a much larger montane cloud forest that has now given way entirely to tea plantations. Although they have similar rainfall and share a similar vegetation, the Namunukula highlands are separated from the highlands of the Central Massif (and the range of *C. stoddartii*) by the relatively dry lowlands of the Uva Valley, ca. 500 m altitude (Domrös, 1971; Werner, 1984).

Ceratophora tennentii is restricted to the Knuckles range of mountains, separated from the Central Massif by the lowlands (500 m) of the valley of the Mahaweli River. Also a slow-moving, arboreal, cloud-forest species, its was recorded at altitudes of approximately 760-1220 m. Most of the habitat of this species has now been underplanted with cardamom (*Elettaria cardamonium*), with its concomitant clearing of undergrowth, causing concern that forest regeneration will be impeded (Gurusinghe, 1988). The problem appears to have been recognised by the forest conservation authorities of Sri Lanka however, and we understand moves are afoot to return this unique region to its former status as an unexploited forest reserve.

All three species of *Ceratophora* described here as new occupy very small ranges of distribution, which is perhaps one reason for their having remained undiscovered for so long.

Ceratophora erdeleni and *C. karu* are the only two species of the genus that are sympatric even in part of their ranges. While both species were recorded from the eastern side of the Sinharaja World Heritage Site at Morningside F.R. near Rakwana (Fig. 54) (06°24'N, 80°38'E, alt. 1060 m), *C. erdeleni*, a slow-moving subarboreal species, was also recorded from Silverkanda near Deniyaya,

(06°23' N, 80°37' E, alt. 915 m), some 3.5 km from Morningside. *Ceratophora karu* however, the smallest species in this genus (<35 mm SVL), is known only from the Morningside F.R., the nearby Thangamalai Plains (6°24' N, 80°36' E, alt. 1070 m) and Gongala near Deniyaya (6°23' N, 80°39' E, alt. 1300 m): the natural vegetation in this area of submontane rain forest, replaced by tea, much of which has now been abandoned and replaced in turn by grassland, the primary habitat of this fast-moving, purely ground dwelling lizard. Much of the forest that does remain is now underplanted with cardamom. While our present data indicate that the range of distribution of these two species is very restricted, it is significant that they have survived major alterations in their habitats and recolonised recent secondary vegetation after the removal of tea.

Given the very small ranges of distribution of most of the species of *Ceratophora*, and the continuing fragmentation and degradation of these habitats, it is important that attempts be made to maintain viable captive populations in order to guard against possible catastrophic declines in natural populations as a result of events such as forest fires and prolonged droughts. It is also necessary that more detailed studies be made of the ecology and population biology of these species, about which very little is known at present. Given the very small ranges of distribution of some of the species, and the large but fragmented distribution of others, genetic studies should also be carried out to identify more accurately the composition of this fauna, thereby enabling a better quality of conservation management.

Discussion

All the genera presently included in the Lyriocephalinae Deraniyagala, 1953 (*Lyriocephalus* Merrem, 1820; *Cophotis* Peters, 1861; and *Ceratophora*) have a modified rostrum or rostral scale. Additionally, the premaxilla of the species in this group is completely enveloped by the maxilla. While we have not examined material of *Cophotis sumatrana* Hubrecht, 1872, the only species of this subfamily recorded outside of Sri Lanka, we are guided by Moody's (1980) conclusion that this taxon has in fact no place in *Cophotis*: he suggested it is more aligned with the Sundaic-Southeast Asian agamid genera *Harpesaurus* Boulenger, 1885 and *Pseudocalotes* Fitzinger, 1843 (*Harpesaurus* shares with *Cophotis* a prolix rostral scale which however is folded backwards). *Cophotis* sensu stricto is well separated from the other two lyriocephaline genera by being the only viviparous agamid (Moody *op. cit.*, observed weak placentation), and by having a dorsal crest and prehensile tail. The pronounced and bizarre development of the cranium of *Lyriocephalus* sets it apart from the other two genera of its subfamily.

Moody & Hutterer (1978) pointed out that the morphological characters Deraniyagala selected for defining the subfamily Lyriocephalinae are not unique to the included genera and in any case not considered sufficiently conservative for postulating a phylogenetic relationship. They found that among the 19 species of agamids up to that time karyotyped, the $2n=30$ karyotype and chromosomal arrangement of *Lyriocephalus* appeared unique. We are not aware of any subsequent karyotype studies in this group.

Despite applying a variety of analytical techniques across a wide range of

taxa however, Moody later (1980) suggested that *Ceratophora*, *Lyriocephalus* and *Cophotis* belong to a single, monophyletic group. Some of the species presently assigned to *Ceratophora* however, demonstrate significant differentiation from the others. Most remarkable among these is the highly-developed squamosal processes of *C. aspera* (its outer edge, and also those of the jugal and postfrontal, with distinct, pointed, retrorse serrae), terminating in a process both visible and palpable externally. *Ceratophora aspera* also differs from its congeners by lacking a knob or boss at the dorsoanterior corner of the postorbital.

All lyriocephaline species lack an external ear, the tympanum being covered by scales. Moody (*op. cit.*) observed additionally that although a stapes (columella) is present (Figs. 11, 20, 31, 42, 51), the columellar footplate and corresponding fenestra vestibularis become hypertrophied.

All the species of *Ceratophora* share a distinctive dorsal squamation by having one to several of the large dorsolateral scales forming short, angular series across the mid-vertebral line, with their angles pointing backwards. Some specimens of *C. aspera* and *C. karu* however, are distinguished by having more or less well-defined rows of large scales in series from the occiput to the base of tail with one or two rows of smaller scales between them (see Figs. 3 & 5 vs. Figs. 23 & 29). The occurrence of these variations throughout the ranges of each of these species, regardless of sex or size, deters us from assigning any taxonomic value to this character.

Ceratophora karu also shows an unusual behavioural trait in always holding its head well above the horizontal (Fig. 26), its supraoccipital being recessed to facilitate this (Fig. 30). *Ceratophora aspera* and *Lyriocephalus scutatus* are the only two lyriocephalines inhabiting lowland rain forest, the other species in this subfamily being restricted to montane cloud forests.

Taylor (1953: 1561-3), having examined six male specimens of *C. stoddartii* from "Ceylon" (no specific locality) felt that there were certain variations which he arranged in the form of a key provisionally diagnosing three taxa within the series examined. This key is based largely on the morphology of the rostral appendage and on the carinate nature of the scales, in addition to the height of the nuchal crest. All these characters appear more or less variable in the series examined by us, and none of them appears consistently in any population of this species.

As for the morphology of the rostral appendage in *Ceratophora stoddartii*, we note that some of the specimens show a somewhat compressed appendage while others have appendages with more rounded cross-sections. The transverse lines figured in the appendage of the iconotype of *C. stoddartii* (Gray, 1835: pl. 68, Fig. 2) however, could be an artefact caused by creasing of the appendage as a result of the specimen being placed head-down in the preserving jar; we also have a single specimen (WHT1682) which in life had a 'wrinkled' appendage, similar to that of the holotype.

We gave consideration to the possibility that the Namunukula population of *C. stoddartii* might in fact be distinct species. The articular process at the posterior end of the mandible, while present in all the Namunukula specimens, is also rarely present in those from the Central Highlands. Further, while the Namunukula examples have a head depth on average greater than those

of the Central Highlands, there is some overlap. We prefer therefore at this time to not assign any taxonomic value to these characters, and hope the question will be resolved through studies of molecular data we propose to undertake in the future.

Relationships

We recognise two informal groupings of within *Ceratophora*, as follows:

- (1) *C. tennentii*, *C. aspera* and *C. karu* have complex rostral appendages comprising several scales. The latter two species are the smallest members of the genus and are ground dwelling species with near-contiguous ranges of distribution, no overlap having been observed however, up to now. *Ceratophora aspera* however, differs from both *C. tennentii* and *C. karu* by its highly-developed squamosal process.
- (2) *C. stoddartii* and *C. erdeleni* appear to form a group of their own, it being possible that the Namunukula population of *C. stoddartii* in fact represents a distinct species within this group.

We have not investigated here relationships between *Ceratophora* and other agamid genera. Moody (1980) however, using principal component analysis hypothesised that *Ceratophora*, *Cophotis*, *Lyriocephalus* were, together with the Sundaic genus *Aphaniotis* Peters, 1864, a monophyletic group. Moody (*op. cit.*) suggested that the phylogenetic clustering of the members of the Lyriocephalinae (all endemic to Sri Lanka) with a Sundaic taxon supports the existence of a past vicariance track between Sri Lanka and Sumatra. Such vicariance could also explain the disjunct distribution of several other taxa which are present in the Sri Lanka–Western Ghats region and in the Sunda Region, but absent between them (see data in Jayaram, 1974; Das, 1996).

The function of the rostral appendage in *Ceratophora* is not well understood. Our field observations suggest that it is not obviously used in breeding or threat display. We did note however, that *C. tennentii* and *C. stoddartii* are able to move their appendages slowly through an angle of about 45° in the vertical plane, at the same time opening their mouths in a threat display, when threatened, for example by placing a finger a few cm in front of them. However, in a study of three species of the Central and South American iguanid genus *Anolis*, the males of which are equipped with an elongate, multi-scaled rostral proboscis, Williams (1979) suggested that the proboscis appeared to be primarily an intraspecific social signal increasing the virtual size of individuals. In *Anolis* as in *Ceratophora*, the proboscis is not present in all species, and it is uncertain whether it occurs in females (the material examined by Williams comprised only males). Further, in *Ceratophora*, the maximum size (SVL) of both 'horned' and 'unhorned' species is about the same (e.g. *C. stoddartii*, *C. erdeleni*). However, in an intraspecific context, the consistent presence, absence or (interspecific) relative size of the proboscis clearly has no relevance and Williams' inference becomes difficult to confirm or refute.

Key to species of the genus *Ceratophora*

1. Rostral appendage restricted to rostral scale alone 2
 Rostral appendage complex, comprising more scales
 than rostral scale alone 3
2. Rostral appendage absent or rudimentary in both sexes
 (8.7-17.3% of eye to nostril distance when present) *Ceratophora erdeleni*
 Rostral appendage prominent in males
 (117.6-225.6 of eye to nostril distance) *Ceratophora stoddartii*
3. Rostral appendage laterally compressed *Ceratophora tennentii*
 Rostral appendage not laterally compressed 4
4. A prominent squamosal process present *Ceratophora aspera*
 No squamosal process present *Ceratophora karu*

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Literature cited

- Das, I. 1996. Biogeography of the reptiles of South Asia. Krieger Publishing Co., Malabar, Florida. 87 pp., 16 pl.
- Dawson, W.R. 1946. On the history of Gray and Hardwicke's *Illustrations of Indian zoology*, and some biographical notes on General Hardwicke. *J. Soc. Bibl. Nat. Hist.*, 2(3): 55-69.
- Deraniyagala, P.E.P. 1953. A colored atlas of some vertebrates from Ceylon. Vol. II. Ceylon National Museums, Colombo. vii + captions to pls. + 35 pls. + 3 unpaginated pp. + 101 pp.

- Domrös, M. 1971. "Wet Zone" und "Dry Zone"—Möglichkeiten einer klimaökologischen Raumgliederung der Insel Ceylon. *Erdkundl. Wiss.*, 27: 205-232.
- Dutta, S.K. & K. Manamendra-Arachchi. 1996. The amphibian fauna of Sri Lanka. *Wildlife Heritage Trust of Sri Lanka*, Colombo. 232 pp.
- Eckart, H. 1925. Das Geruchsorgan einiger ceylonischer Eidechsen (Agamiden), pp. 1-48 in Plate, L. (Ed.), *Fauna et Anatomia ceylanica*, Band 2: Zoologische Ergebnisse einer Ceylon-Reise ausgeführt mit Unterstützung der Ritter-Stiftung 1913/14 von L. Plate. Gustav Fischer, Jena, 538 pp, 25 pls.
- Gray, J.E. & R. Hardwicke. 1830-35. *Illustrations of Indian zoology, chiefly selected from the collection of Major-General Hardwicke, F.R.S. Treuttel, Wurtz, Treuttel Jun. & Richter*, London. Vol. 1, pl. 1-100; vol. 2, pl. 1-102.
- Günther, A.L.C.G. 1864. *The reptiles of British India*. Hardwicke, London. xxvii+452 pp., 26 pl.
- Gurusinghe, P. de A. 1988. Cardamom cultivation in the Knuckles Range. Proc. preliminary workshop on the preparation of a conservation plan for the Knuckles range of forests. (Separate), 7 pp.
- Hubrecht, A.A.W. 1872. Contributions to the herpetology of Sumatra. *Notes Roy. Zool. Mus. Netherlands at Leyden*, 1: 243-245.
- Ilangakoon, A. 1990. Observations on the horned lizard, *Ceratophora stoddartii*. *Loris*, 19(1): 44-45.
- Jayaram, K.C. 1974. Ecology & Distribution of freshwater fishes, amphibia and reptiles; pp 517-584 in Mani, M.S. *Ecology and biogeography of India*, W. Junk, The Hague.
- Kinnear, N.B. 1925. The dates of publication of the plates of the birds in Gray and Hardwicke's 'Illustrations of Indian Zoology', with a short account of General Hardwicke. *The Ibis*, (12)1: 484-489.
- Manamendra-Arachchi, K. & S. Liyanage. 1994. Conservation of the agamid lizards of Sri Lanka with illustration of the extant species. *J. South Asian nat. Hist.*, 1: 77-96.
- Merrem, B. 1820. Versuch eines Systems der Amphibien.—Tentamen systematis Amphibiorum. Marburg, xv+189 pp., 1 pl.
- Moody, S.M. 1980. Phylogenetic and historical biogeographical relationships of the genera in the family Agamidae (Reptilia: Lacertilia). Unpubl. Ph.D. Dissertation, Univ. Michigan. 373 pp.
- Moody, S.M. & R. Hutterer. 1978. Karyotype of the agamid lizard *Lyriocephalus scutatus* (L., 1758), with a brief review of the chromosomes of the lizard family Agamidae. *Bonner Zoologische Beiträge*, 29: 165-170.
- Peters, W. 1861. Eine neue Gattung (sic) von Eidechsen, *Cophotis Ceylanica* aus Ceylon. *Monatsberichte der Königlichen Preussischen Akademie der Wissenschaften zu Berlin*, (1861 Dec.), 1103-1105.
- Smith, M. A. 1935. *The fauna of British India, including Ceylon and Burma: Reptilia and Amphibia*, vol. 2—Sauria. Taylor & Francis, London. xiii+440 pp., 1 pl.
- Taylor, E.H. 1953. A review of the lizards of Ceylon. *Univ. Kansas Sci. Bull.*, 35: 1525-1585.
- Tennent, J.E. 1861. *Sketches of the natural history of Ceylon with narratives and anecdotes illustrative of the habits and instincts of the Mammalia, birds, reptiles, fishes, insects &c. including a monograph of the elephant and a description of the modes of capturing and training it...* Longman, Green, Longman, and Roberts, London. xxi+500 pp.
- Wermuth, H. 1967. Liste der rezenten Amphibien und Reptilien. Agamidae. *Das Tierreich*, 86: i-xiv, 1-127.

- Werner, W.L. 1984. Die Höhen- und Nebelwälder auf der Insel Ceylon (Sri Lanka). Akad. d. Wiss. u. d. Literatur Mainz, — Steiner, Wiesbaden. Tropische und subtropische Pflanzenwelt, 46: 1-200 pp., 2 maps.
- Williams, E.E. 1979. South American anoles: the species groups. 2. The proboscis anoles (*Anolis laevis* group). *Breviora* (Mus. Comp. Zool.), 449: 1-18.

APPENDIX

Supplementary and comparative material

Supplementary material

Ceratophora aspera: male, 32.7 mm SVL, WHT167, Induruwa (Ratnapura). Male, 31.2 mm SVL, WHT178, Beraliyakele (nr. Elpitiya). Female, 38.5 mm SVL, WHT190, Silverkanda (Deniyaya). Female, 36.5 mm SVL, WHT1326, Dotalugala (Bambarabotuwa F.R.). Female, 34.4 mm SVL, WHT1366, Opata (Kannelia Forest). Juvenile, 23.5 mm SVL, WHT1367, Koskulana (nr. Panapola). Juvenile, 17.5 mm SVL, WHT1368, Kudawa (nr. Weddagala). Male, 29.6 mm SVL, WHT1369; juv., 22.4 mm SVL, WHT1380, Kannelia (Galle). Female, 36.1 mm, WHT1370; male, 32.6 mm SVL, WHT1371, Kottawa (Galle). Female, 32.5 mm SVL, WHT1399, Gilimale (Ratnapura). Female, 36.7 mm SVL, WHT1402, Haycock F.R. (Hiniduma). Female, 37.1 mm SVL, WHT1408, Napana Waterfall (nr. Induruwa), Ratnapura. Male, 31.8 mm SVL, WHT2170, Wiharakelle (nr. Kamburupitiya), Matara.

Ceratophora erdeleni (all from Morningside F.R., nr. Rakwana): juv., 43.9 mm SVL, WHT2171; female, 76.7 mm SVL, WHT2172; juv., 57.2 mm SVL, WHT2173; juv., 61.6 mm SVL, WHT2174; subadult, 67.0 mm SVL, WHT2175; juv., 44.0 mm SVL, WHT2176.

Ceratophora karu: subadult, 24.3 mm SVL, WHT2191; female, 34.4 mm SVL, WHT1325; female, 32.4 mm SVL, WHT2192; juv., 23.4 mm SVL, WHT2193, Morningside F.R. (nr. Rakwana). Juvenile, 23.9 mm SVL, WHT1381; juv., 20.7 mm SVL, WHT1382, Tangamale Plains (nr. Deniyaya). Juvenile, 24.0 mm SVL, WHT1383, Gongala (nr. Deniyaya).

Ceratophora stoddartii: juv., 48.5 mm SVL, WHT1329: Ganguletenna (nr. Appalakanda), Peak Wilderness. Male, 67.7 mm SVL, WHT1331, Haputale. Female, 67.5 mm SVL, WHT1335, Hakgala (nr. Nuwara Eliya). Female, 82.7 mm SVL, WHT1339, Maratenna (Balangoda). Male, 60.6 mm SVL, WHT1342, Pattipola. Juvenile, 46.2 mm SVL, WHT1348, Pidurutalagala (nr. Nuwara Eliya). Male, 66.3 mm SVL, WHT1349, Lover's Leap (nr. Nuwara Eliya). Male, 78.5 mm SVL, WHT1503, Ohiya. Female, 74.3 mm SVL, WHT1704, Namunukula Peak. Male, 71.5 mm SVL, WHT1681, Kotakitulakanda (nr. Somuraella Oya). Male, 62.4 mm SVL, WHT1682, Kandapola (nr. Sitaeliya). Male, 78.6 mm SVL, WHT1698; female, 64.3 mm SVL, WHT1699, Galaha (nr. Deltota).

Ceratophora tennentii: juv., 23.6 mm SVL, WHT103C; Laggala (Knuckles). Juvenile, 46.9 mm SVL, WHT114E; juv., 52.0 mm SVL, WHT114F, Mousakanda-Gammaduwa (Knuckles). Male, 61.9 mm SVL, WHT1351; female, 68.1 mm SVL, WHT1352; female, 80.0 mm SVL, WHT1353; juv., 33.4 mm SVL, WHT1354; female, 63.9 mm SVL, WHT1333, Midlands, between Rattota and Laggala (Knuckles).

Compative material

Cophotis ceylanica: female, 56.7 mm SVL, WHT177, Nagrak Division, Nonpareil Estate (adjoining Horton Plains).

Lyriocephalus scutatus: female, 115.7 mm SVL, WHT175, Koskulana (nr. Panapola).

Calotes versicolor: male, 94.6 mm SVL, WHT104, Laggala (Knuckles). Male, WHT105, 74.5 mm SVL, Pallegama (Knuckles). Juvenile, 48.7 mm SVL, WHT112; male, 93.5 mm SVL, WHT165, Mousakanda-Gammaduwa (Knuckles). Male, 98.0 mm SVL, WHT164A; female, 69.7 mm SVL, WHT166, Koskulana (nr. Panapola). Male, 119.0 mm SVL, WHT181; female, 92.3 mm SVL, WHT183, Puttalam. Female, 86.5 mm SVL, WHT184, Nagagamuwa (Puttalam). Female, 77.0 mm SVL, WHT185; female, 75.0 mm SVL, WHT186, Palavi (Puttalam). Female, 83.1 mm SVL, WHT189, Yatapatha (Lihinigala). Female, 83.6 mm SVL, WHT193, Attidiya-Bellanwila. Female, 71.6 mm SVL, WHT194, Nawalamulla (Migoda). Male, 125.3 mm SVL, WHT204, Bundala (Hambantota). Male, 101.0 mm SVL, WHT205, Siribopura (Hambantota). Female, 72.0 mm SVL, WHT208, Dombagaskanda (Ingiriya).

Calotes calotes: female, 101.5 mm SVL, WHT107, Induruwa (Ratnapura). Male, 85.8 mm SVL, WHT108A; male, 83.0 mm SVL, WHT108B, Laggala (Knuckles). Male, 107.4 mm SVL, WHT182, Puttalam. Male, 128.4 mm SVL, WHT187; male, 100.8 mm SVL, WHT188, Yatapatha (Lihinigala). Female, 99.8 mm SVL, WHT377, Udawalawe. Male, 114.2 mm SVL, WHT381A; juv., 49.2 mm SVL, WHT381B, Warnagalla (nr. Erathne).

Calotes liocephalus: female, 84.3 mm SVL, WHT106A; juv., 44.3 mm SVL, WHT106B; juv., 31.4 mm SVL, WHT106C, Mousakanda-Gammaduwa (Knuckles).

Calotes ceylonensis: male, 80.9 mm SVL, WHT1428, Rathugala (nr. Bulupitiya). Female, 74.5 mm SVL, WHT519, Minihagalkanda. Male, 72.7 mm SVL, WHT515, Pallegama (Knuckles). Female, 84.6 mm SVL, WHT511, Konketiya (between Kataragama and Buttala).

Calotes liolepis: female, 61.7 mm SVL, WHT176, Bogahawatta (Dimbula). Male, 81.7 mm SVL, WHT191, Peradeniya. Female, 74.2 mm SVL, WHT192, Batadombalena (nr. Kuruvita).

Calotes nigrilabris: male, 104.5 mm SVL, WHT173A; female, 80.9 mm SVL, WHT173B; female, 68.9 mm SVL, WHT173C; female, 78.5 mm SVL, WHT173D; female, 76.8 mm SVL, WHT380A; female, 79.1 mm SVL, WHT380B; male, 94.1 mm SVL, WHT380C, Nagrak Division, Nonpareil Estate (adjoining Horton Plains). Female, 78.2 mm SVL, WHT379, Kuda Oya (nr. Labugolla).

Sitana ponticeriana: female, 38.7 mm SVL, WHT111A; female, 42.5 mm SVL, WHT111B; female, 45.1 mm SVL, WHT111C; female, 38.9 mm SVL, WHT111D; male, 43.7 mm SVL, WHT111E, Nagagamuwa (Puttalam). Male, 41.5 mm SVL, WHT174A; male, 39.5 mm SVL, WHT174B; female, 43.9 mm SVL, WHT174C, Palavi (Puttalam). Female, 45.2 mm SVL, WHT195A; female, 45.2 mm SVL, WHT195B, Mahapalassa (nr. Kirinda). Juvenile, 20.2 mm SVL, WHT206A; juv., 20.0 mm SVL, WHT206B; juv., 20.8 mm SVL, WHT206C; female, 43.5 mm SVL, WHT206D; female, 45.2 mm SVL, WHT206E; male, 48.8 mm SVL, WHT206F; male, 49.5 mm SVL, WHT206G, Siribopura (Hambantota).

Otocryptis wiegmanni: female, 54.0 mm SVL, WHT109A; male, 68.3 mm SVL, WHT109B, Induruwa (Ratnapura). Male, 62.5 mm SVL, WHT113, Kitulgala. Female, 56.5 mm SVL, WHT168, Beraliyakele (nr. Elpitiya). Female, 58.2 mm SVL, WHT169A; juv., 29.1 mm SVL, WHT169B; juv., 21.3 mm SVL, WHT169C; male, 61.5 mm SVL, WHT171A; juv., 30.6 mm SVL, WHT171B, Silverkanda (nr. Deniyaya). Female, 55.6 mm SVL, WHT172A; male, 64.4 mm SVL, WHT172B; male, 41.2 mm SVL, WHT172C, Koskulana (nr. Panapola). Female, 53.1 mm SVL, WHT219, Dombagaskanda (Ingiriya).

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අංකවුස්සන් අයත් වන ශ්‍රී ලංකාවට ආවේණික *Ceratophora* ගුණ, 1835 ඝනකට මේ වනතෙක් ඇතුළුව තිබූයේ විරෂ්ඨ තුනක් පමණි. (*Ceratophora stoddartii* ගුණ, 1835: *C. tennentii* ගුණකර සහ ගුණ, 1861 සහ *C. aspera* ගුණකර, 1864). මෙම විරෂ්ඨ ගැන හැචන විස්තරයක්ද සමග නව විරෂ්ඨ දෙකක් විස්තර කිරීමද මෙම පර්යේෂණ පත්‍රිකාව මගින් සිදු කොට ඇත. එම විරෂ්ඨ වල විස්තර පහත දැක්වේ.

Ceratophora erdeleni නව විරෂ්ඨය. (රූප 13-21) (සිංහල නම :- අරධිලෙන්ගේ අංකවුස්සන්, ඉංග්‍රීසි නම :- Erdelen's Horned Lizard) මෙම විරෂ්ඨය අතහැර සියලුම *Ceratophora* විරෂ්ඨ වලින් වෙන් කොට හඳුනාගත හැක්කේ අග ක්ෂීණ වීම හෝ නැතිවීම මගිනි. අඟක් තිබෙනම එය ඇගේ සිට නාස් විවරය අතර දුර මෙන් 8.7-17.3x ක් වේ. හිස් කඩලේ වෙනස්කම් හැරුණු කොට අනෙකුත් බාහිර දේහ ලක්ෂණ අතින් බොහෝ දුරට *C. stoddartii* ට සමානකම් පෙන්වයි. මේ විරෂ්ඨයේ විරෂ්ඨ නාමය සඳහා *erdeleni* නම කොටු ඇත්තේ පැරණිම ජාතික උරග හා උඤ්චී විද්‍යාඥ මහාචාර්ය වෝල්ෆර්ට අරධිලෙන් මහතාට ගරු කිරීමක් වශයෙනි. ඔහු දැනට වසර කිහිපයක සිට ශ්‍රී ලංකාවේ පර්යේෂණ වල නිරත වුවද, මෙතම අප උරග සන්නති සංරක්ෂණය කිරීමෙහිලා කැප වූ විද්‍යාඥයෙකි.

Ceratophora karu නව විරෂ්ඨය. (රූප 22-32) (සිංහල නම :- කරාණාරත්තගේ අංකවුස්සන්, ඉංග්‍රීසි නම :- Karunaratne's Horned Lizard) මෙම විරෂ්ඨය අතහැර සියලුම *Ceratophora* විරෂ්ඨ වලින් (*C. aspera* හා *C. tennentii* හැර) වෙන් කොට හඳුනාගත හැක්කේ තුන්ඩි කොටුයෙන්ම පමණක් නොව තවත් කොටුද සමුහයකින් නිර්මිත සංකීර්ණ අඟක් තිබීමය. එමෙන්ම මෙම විරෂ්ඨය *C. tennentii* ගෙන් වෙන් කළ හැක්කේ ප්‍රමුඛ ඇති බැව් කොටුද දැරීමත් (ප්‍රමුඛ ඇතිබැව් කොටු *C. tennentii* ට නැත) හා *C. aspera* ගෙන් වෙන් කළ හැක්කේ ලේකාස්ථ ප්‍රකරය නොතිබීමත්, ප්‍රමුඛ අවටු ශිඛාවක් දැරීමත් (*C. aspera* ගේ ලේකාස්ථ ප්‍රකරය සහිත අතර අවටු ශිඛාව ඉතා සුළු වශයෙන් පමණක් ඇත) නිසාය. විරෂ්ඨ නාමය *karu* යනුවෙන් ගොදුරු ලද්දේ නැයි ගිය ප්‍රාචී බන්ඩා කරාණාරත්ත මහතා සිහිවීම පිණිසය. "කරු" යන සරල නාමයෙන් අප කවුරුන් දන්නා ඔහු ශ්‍රී ලංකාවේ ප්‍රසිද්ධ සිට විද්‍යාඥයෙක් මෙන්ම ස්වභාව විද්‍යාඥයෙකි. එමෙන්ම මෙහි කාර්තවීරු දෙදෙනාටම මේ සඳහා මග පෙන්වීම කළ මිතුරෙකි.

Ceratophora stoddartii ට අයත් නමුණුකුළු ගහනය නව විරෂ්ඨයක්ද ගන්නා අවි කාරුණු සොයමින් සිටින්නෙකු, නමුණුකුළු ගහනයේ නිදර්ශක වල ඇති ඉතා ප්‍රමුඛ සන්ධාන ප්‍රකරය මධ්‍ය කඳකර ගහනයේ නිදර්ශක වලද කලාතුරකින් හමුවේ. එමෙන්ම නමුණුකුළු ගහනයේ හිස් නැඹුරු ඉතා ඉහල අගයක් පෙන්වනමුත් එය මධ්‍ය කඳකර නිදර්ශක සමඟද ඉඳු හිට අභිපිචිත වේ. මෙම වෙනත් රූප විද්‍යාවේ ඇති 3.5 ක් දක්න නිරාකරණය කිරීමටත් නව වර්ධකරණ විද්‍යාත්මක තත්වයන් සොයා බැලීමටත් මේ ප්‍රජන විසඳීම සඳහා ගෞල විද්‍යාත්මක පර්යේෂණද ඉදිරියේදී සිදුකරනු ඇත.

Ceratophora ඝනකේ ව්‍යාප්තිය ශ්‍රී ලංකාවේ පහත් කලාපයට පමණක් සීමා වේ (රූපය 53). *Ceratophora aspera* පුළුල් ලෙස ව්‍යාප්ත වී ඇති විරෂ්ඨයකි. මුහුදු මට්ටමේ සිට මීටර 60-990 ක් අතර, වාර්ෂික වර්ෂාපතනය මිලි මීටර 2500 ඉක්මවන හෝ ඊට වැඩි වන වනාන්තර දරණ නිර්වනදිය හා බටහිර කලාප වල පැතිර ඇත. *Ceratophora stoddartii* මුහුදු මට්ටමේ සිට මීටර 1525-2200 අතර වූ මධ්‍යම කඳකරන අයත් වලකුළු වනාන්තර කලාප වලට සීමා වී ඇති අතර ශ්‍රී ජාද අඩවිය, හෝර්ටන් තැන්න හා ඒ ආශ්‍රිත රක්ෂිත කලාප මේ අතර විරෂ්ඨයන් සඳහන් කළ යුතුය. *Ceratophora tennentii* මුහුදු මට්ටමේ සිට මීටර 760-1220 ක් අතර වූ දුම්බර (නකල්ස්) කඳ වැටියේ පහත් ප්‍රදේශයන්ට සීමා වී ඇති අතර මෙම කලාපයේ යටි රෝපණය එන්සාල් (*Elettaria cardamomium*) වගාව සඳහා ඉවත් කිරීම මෙම විරෂ්ඨයේ ඉදිරි පැවැත්ම සඳහා තර්ජනයක් වී ඇති බව නොරහසකි. *Ceratophora erdeleni* සහ *C. karu* විරෂ්ඨ දෙක එකම ප්‍රදේශයෙන් හමුවන මේ ඝනකේ විරෂ්ඨ වේ. සිංහරාජ ලේක උරුම කලාපයේ නැගෙනහිරට වන්නට පිහිටි මෝරනියයිසි (උ.අ. 06° 24', නැ.ද. 80° 38') රක්ෂිත වනකේ (රූපය 54) මුහුදු මට්ටමේ සිට මීටර 1060 ක පමණ ප්‍රදේශයෙන් හමුවේ. *C. erdeleni* විරෂ්ඨය මීට අමතරව මෙම ප්‍රදේශයේ සිට කිලෝමීටර 3.5 ක් දුරකිසා දෙසට වන්නට වූ ගෞලවකන්ද (උ.අ. 06° 23', නැ.ද. 80° 37') ප්‍රදේශයේ මුහුදු මට්ටමේ සිට මීටර 915 ක් පමණ වූ කලාපයෙන් හමුවන අතර *C. karu* විරෂ්ඨයද ඉහත ව්‍යාප්තියට අමතරව ඊට ආසන්නව පිහිටි තංගමලේ තැන්නකන්ද (උ.අ. 06° 24', නැ.ද. 80° 36', මුහුදු මට්ටමේ සිට උස මීටර 1070) ගොගල (උ.අ. 06° 23', නැ.ද. 80° 39', මුහුදු මට්ටමේ සිට උස මීටර 1300) ප්‍රදේශයන්ද හමුවේ.