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RECORD OF *RANA CHLORONOTA* (GÜNTHER, 1875) (ANURA: RANIDAE) FROM MIZORAM, NORTH-EASTERN INDIA

Rana chloronota was originally described from Darjeeling, eastern India as *Polypedates chloronotus* Günther, 1875, and previously reported from India (Darjeeling and Assam), China (including Hong Kong), Lao People's Democratic Republic, Myanmar, Thailand and Vietnam (Bain et. al., 2003).

This note reports the occurrence of *Rana* chloronota in a forested area of Mizoram State, north-eastern India. Four adults (two males and two females) of the species were collected from the stream Herhse (23° 58'N; 92° 41'E; ca. 310 m asl) at Kawnpui, Kolasib District, Mizoram. The climate of the area is highly variable: summer is hot (up to 36°C) and wet, with relative humidity of 94%, whereas winter is cold (down to 13°C) and dry (relative humidity 32%). The average air temperature during the time of collection in the months of September 2003 and April 2006 was 23°C. Morphometric measurements were taken using dial caliper and ruler (in mm), the data shown in Table 1. One of the specimens (a male) was deposited at the Zoological Survey of India, Eastern Regional Station, Shillong (V/ A/ERS/706) to serve as voucher.

All specimens are green on the dorsum, with a row of large black spots on the middorsum. A prominent white streak is present on both sides of upper jaw. There is glandular fold originating from the posterior corner of eyes to the shoul-

 Table 1. Morphometric measurements (in mm) of adult

 Rana chloronota collected from Kolasib District, Mi

 zoram State, north-eastern India.

Measurements	adult f	emales	adult males		
	min	max	min	max	
Snout-vent length	78.46	101.36	46.8	48.81	
Head length	23.08	31.32	15.5	16.62	
Head width	26.24	35.52	17.66	18.20	
Snout length	12.51	18.48	7.28	8.32	
Length of tibia	50.52	71.80	31.42	34.6	

der, which is followed by a glandule. Tympanum is brown with a clear whitish circular rim. Head is broader than long, much depressed; snout rounded in dorsal view and the interorbital width is close to the diameter of eyes. Limbs have prominent brownish cross bands and the ventral part of the skin is cream-white and smooth.

Fingers are free, their relative length II < I < IV < III. Hind limbs are long, tibiotarsal articulation reaching beyond tip of snout; heels are strongly overlapping when hind limbs are folded at right angles to body; tibia almost five times as long as broad, webbing of feet up to disks, weak lateral fringes on I and V to terminal phalanges, webbing brown. Disks on fingers and toes greatly enlarged with ventral circummarginal grooves. Subarticular tubercles and inner metatarsal tubercle distinct, conical: outer metatarsal tubercle absent; relative length of toes IV > V > III > II > 1.

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DIET AND SIZE RECORDS FOR CROCODYLUS CATAPHRACTUS (CROCODYLIDAE) IN SOUTH-WESTERN GABON

In the course of a crocodile survey at Lake Divangui (01°56'28.4"'S, 9°59'19.9"E), in the Gamba Complex of Protected Areas (GCPA), Ogooué-Maritime Province, south-western Gabon, in the last week of June 2003, 19 Crocodylus cataphractus Cuvier, 1825 were captured, sexed and measured to the nearest cm (Table 1). Tails were checked for the correct number of caudal scutes in order to ensure that they were not truncated (only that of crocodile no. 19 was). Crocodiles were detected at night by spotlight via their eyeshine and captured by pole-snare from a motor boat. No C. cataphractus specimen was kept as voucher, but some of these Divangui specimens were illustrated on the front cover of the Crocodile Specialist Group Newsletter 23(1) (Barr, 2004) and in Anonymous (2003).

Sex ratio in our sample was in favour of males (68%). Ratio of tail L/total L in our sample varied for females between 0.40 and 0.47 (mean = 0.44; n = 6) and for males between 0.42 and 0.49 (mean = 0.44; n = 12). Five specimens (# 3, 8, 9, 10 and 11) were randomly selected for stomach flushing using the hose-Heimlich method. Specimens were held no longer than two hours between capture and stomach flushing. Following stomach flushing, specimens were released in the lake. Stomach contents are presented in Table 2.

The frequency of occurrence by prey class are: 100% for Osteichthyes (5/5 stomachs) and 40% for Insecta (2/5 stomachs). Considering the five stomachs as a data set, eight fish specimens and two insect specimens were counted. Fish thus represent 80% of the total number of prey items recorded and insects represent only 0.3% of the total prey mass (see Table 2). Although two insect orders are presently recorded, fish is most likely this species' staple diet. Accidental ingestion of the insects cannot be excluded in any of the two cases (as well as secondary ingestion, via fish stomach contents). Lake Divangui is the only locality in Gabon for which

 Table 1. Measurements and mass data for 19 Crocodylus cataphractus from Lake Divangui, south-western Gabon. Within each sex, specimens are arranged by increasing snout-vent length (SVL).

Crocodile #	Sex	SVL (cm)	Tail L (cm)	Mass (kg)
1	F	20	18	Not recorded
2	F	37	30	0.4
3	F	73	56	6.2
4	F	106	82	17.6
5	F	126	101	35.1
6	F	136	89	37.8
7	М	18	17	Not recorded
8	М	52	41	1.8
9	М	58	46	2.7
10	М	71	58	5.0
11	М	75	60	6.4
12	М	101	79	17.1
13	М	104	79	13.1
14	М	112	91	21.2
15	М	113	87	24.8
16	М	116	91	23.0
17	М	117	84	19.8
18	М	120	97	28.4
19	М	127	>83	28.8

dietry data for *C. cataphractus* were previously documented (Pauwels et al., 2003); only fishes, belonging to at least four species and four families were recorded.

Another observation on the diet of *Crocodylus cataphractus* was made in the GCPA. On 14 June 2003 at about 2100 h, on the Echira River close to its confluence with the Ngové River (near Akaka village), Edward Truter (pers. com.) observed a juvenile specimen lying in shallow water, mouth open, waiting for small alestiid fish to swim into its jaws and then snap.

 Table 2. Stomach contents from five Crocodylus cataphractus from Lake Divangui, south-western Gabon.

Crocodile #	Stomach contents and content mass (g)
3	Scales and bones of a large fish (5.6)
8	Two small headless fishes (0.1); 2 gastroliths (0.8 & 1.1)
9	Digested remains of two large fishes (17.5)
10	Elytra and remains of one aquatic Coleop- tera (0.1); bones of a fish (0.4)
11	Wings and body parts of a dragonfly (Odo- nata) (< 0.1); digested remains of two large fishes (15.1); a tree leaf (< 0.1) and five gastroliths ($< 0.1, 0.1, 0.4, 0.4, 0.5$)

No parasitic worms were detected in our Divangui samples. All gastroliths were composed of limonite.

Maximal diameters of the gastroliths found in crocodile # 8 were 10.8 and 13.6 mm. In crocodile # 11, maximal diameter of smallest and largest gastroliths were respectively 5.1 and 11.4 mm. In these two crocodiles, gastroliths represented respectively 0.1% and 0.02% of the crocodile mass. The absence of gastroliths in 60% of our sample, and the extremely small mass of the gastroliths compared to the whole crocodile's mass, indicate that they are unlikely to serve a hydrostatic function.

Global knowledge on the diet of this crocodile species is still poor and was synthesized by Pauwels et al. (2003). Additional data were later added by Eaton and Barr (2005) who recorded catfish (Clariidae) spines, unidentified fish scales and palm nuts in a single specimen's stomach in northern Congo Republic. Although fish obviously represent the main part of its diet, as supported by our new data, Insecta, Crustacea, Amphibia, Reptilia (aquatic snakes), Mammalia and Aves (water fowls) were also occasionally recorded (Pauwels et al., 2003; Waitkuwait, 1985).

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HEAD SCALATION IN NAJA SPUTATRIX BOIE, 1827– DISCUSSION ON THE PRESENCE OF A SMALL ACCESSORY SCALE

(with seven text-figures)

Cephalic scalation provides helpful characters for snake identification. A small accessory scale separates the preocular from the internasal in *Naja sputatrix*. Typically, scalation of the head



Figure 1. Head scalation of *Naja sputatrix* (MZB Oph 1853) from Sukabumi, West Java showing a small accessory scale (grey shading) directly adjacent to four other scales without touching supraocular (as = accessory scale, po = preocular, so = supraocular, n = nasal, in = internasal and pf = prefrontal)



Figure 2. Head scalation of *Naja sputatrix*, showing a small accessory scale (grey shading) directly adjacent to five other scales (as = accessory scale, so = supraocular, po = preocular, n = nasal, in = internasal and pf = prefrontal), all specimens with this pattern are from West Java (e.g. specimen MZB Oph 392, also shows two preoculars on one side) and Sulawesi (MZB Oph 394).

in this species shows seven upper labials, the 3rd and 4th touching the eye, the 3rd being enlarged and also in contact with the posterior nasal, and lower labials 8, between 4th and 5th there is usually a small triangular scale, the cuneate, on the margins of the mouth (Tweedie, 1983).

Naja sputatrix is a species endemic to Indonesia, found in Java (de Haas, 1941), Bali, Lombok, Alor (Wüster and Thorpe, 1989), Sumbawa, Komodo, Flores (Auffenberg, 1980) and Sulawesi (Kopstein, 1936). Its occurrence in Sulawesi is not confirmed (Wüster, 1996; Wüster in: David and Ineich, 1999). A character of head scalation of *Naja sputatrix* that shows an uncommon condition in all other Asiatic *Naja*, is the lack of contact between the preocular and the internasal. It is caused either by the presence of a small accessory scale or prefrontal-nasal contact (Wüster, 1996).

On the basis of a single specimen of *Naja sputatrix* from Makale, Sulawesi (MZB Oph 394), Kopstein (1936) described a small accessory



Figure 3. The common head scalation of *Naja sputatrix* from Java and the Lesser Sunda, without a small accessory scale showing separation of prefrontal from nasal caused by the preocular-internasal contact (so = supraocular, po = preocular, n = nasal, in = internasal and pf = prefrontal).



Figure 4. Head scalation of *Naja sputatrix*, showing direct contact of prefrontal and nasal and separation of preocular from internasal (in = internasal, pf = pre-fontal, po = preocular, so = supraocular).

scale that is smaller than preocular, and located between the internasal, the preocular, the supraocular, the prefrontal and the nasal. The differences between MZB Oph 394 and the Javan *Naja sputatrix* is the fact that in the Sulawesi specimen the internasal is separated from the preocular by a small accessory scale, whereas in the Javan specimens, the two scales are in contact (Kopstein, 1936). On the other hand, Wüster (1996) cited that the lack of contact between these two scales is common in *Naja sputatrix*, both from Java and the Lesser Sunda Islands. In most Javan specimens, the preocular was separated from the internasal by the presence of a small accessory scale, whereas in the specimens from the Lesser Sunda Islands, the separation is more commonly due to a contact between the prefrontal and the nasal (Wüster, 1996).

I examined 54 specimens of *Naja sputatrix* in Museum Zoologicum Bogoriense (MZB), including a single specimen (MZB Oph 394) from Makale–Sulawesi, 38 specimens from Java (west Java = 24, central Java = 2, east Java = 12) and 15 specimens from the Lesser Sunda Islands. The results based on the pattern of head



Figure 5. The four patterns of head scalation of *Naja sputatrix* and their distribution.

scalation with or without a small accessory scale revealed four different patterns of head scalation in *Naja sputatrix* that can be described as follows:

- Pattern 1: a small accessory scale directly adjacent to four other scales (prefrontal, preocular, nasal and internasal).
- Pattern 2: a small accessory scale directly adjacent to five other scales (supraocular, preocular, prefrontal, internasal and nasal)
- Pattern 3: without a small accessory scale, the internasal and the preocular are in contact, thus separating prefrontal from nasal.
- Pattern 4: without a small accessory scale, the internasal is separated from the preocular by a prefrontal-nasal contact.

Four patterns of head scalation in *Naja sputarix* are known, these distributed over many localities both in Java and the Lesser Sunda Islands (Fig. 5). The common characters in the head scalation of *Naja sputatrix* are the lack of a small accessory scale and a preocular-internasal contact (Pattern 3, Fig. 3). Based on the MZB specimens, pattern 3 was found in specimens from West Java, Central Java, East Java, Madura, Bali, Sumbawa, Flores and Rinca. This pattern was distributed in all population of *Naja sputatrix*, both from Java and the Lesser Sunda Islands. Wüster (1996) described Pattern 3 as common scalation of Asiatic cobras as shown in Fig. 6a.

The head scalation pattern (Fig. 6b) is often found in Javan *Naja sputatrix* (Wüster, 1996). The presence of a small accessory scale which, by its position separates the internasal from the preocular and is directly in contact with four other scales (preoccular, prefrontal, internasal and nasal), without contacting supraoccular (Fig. 1 and Fig. 6b) was hitherto unknown in *Naja sputatrix*. However, this pattern was found in a specimen (MZB Oph 1853) from Sukabumi, West Java.

Wüster (1996) considered the separation of the preocular from the internasal by a prefrontalnasal contact (pattern 4) (Fig. 4) to be common in specimens from the Lesser Sunda, but I found it in only four of 15 specimens from the Lesser Sundas, so it is probably atypical. However, this type of scalation is also seen in specimens from West Java, Central Java and East Java.

A single specimen of *Naja sputatrix* from Makale, Sulawesi (MZB Oph 394) that was re-

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Figure 6. Head scalation of Asiatic cobras. (a) The most common scalation in Asiatic cobras, showing contact between preocular and internasal. (b) Situation often found in Javanese *Naja sputatrix*, preocular and internasal separated by a small accessory scale (in black). It shows position of a small accessory scale that is directly adjacent to four other scales (preocular, internasal, nasal and prefrontal, without contacting supraocular (as = accessory scale, p = preocular, n = nasal, i = internasal, pf = prefrontal, so = supraocular). Modified from Bogert (1943) in Wüster (1996).

ported by Kopstein (1936) and considered by Wüster (1996) to be indistinguishable from Java specimens, has a small accessory scale separating the internasal from the preocular. This scale is directly adjacent to four other scales (prefrontal, preocular, internasal and nasal) without touching supraocular (Fig. 6b). I reexamined the presence and position of this small accessory scale in this specimen, and it is directly adjacent to five other scales (supraocular, preocular, internasal, prefrontal and nasal), so this small accessory scale is in contact with the supraocular, as shown in Fig. 7.

The accessory scale may also be defined as a loreal scale. The traditional practical definition of a loreal scale is one of several scales between the orbit and the nostril. This term is usually applied to a plate(s) lying between the nasal(s) and preocular(s). In some snakes, a



Figure 7. Head scalation of a single specimen of *Naja* sputatrix (MZB Oph 394) from Makale, Sulawesi, showing the position of a small accessory scale directly adjacent to five other scales (as = accessory scale, so = supraocular, po = preocular, n = nasal, in = internasal and pf = prefrontal).

single plate lies between the eye and the nasal ("preocular", if higher than long and "loreal" if longer than high; Peters in: Savage, 1972). Savage (1972) defined loreal as a plate or plates posterior to the nasal or postnasal and anterior to the orbit or preocular that separates the prefrontal from contact with the supralabials; when the loreal is absent (i.e., the suture fails to develop between the loreal and the prefrontal, or they are "fused") the prefrontal contacts one or more supralabial. Preocular is a plate or plates anterior to and bordering the orbit, that separates the prefrontal and/or loreal from orbit. Based on the definition above, the accessory scale in Naja sputatrix, is doubtfully defined as a loreal because the preocular is present and directly contacts the postnasal and separates the prefrontal from the supralabials.

A small accessory scale has been recorded only in specimens from west Java (including localities: Bogor, Jakarta, Sukabumi, Salak) and Makale Sulawesi (MZB Oph 394). Based on the multivariate analysis from morphological character of Naja sputatrix, Wüster and Thorpe (1989) noted tree groups; 1) the West Java population, 2) The Central & East Java, Bali, Lombok, Sumbawa population, and 3) The Komodo and Flores population. Furthermore, in considering only the presence of the small accessory scale, population from West Java includes all the four patterns described above, while other localities such as Central Java, East Java and the Lesser Sunda Islands belongs to two patterns.

The character of head scalation due to the presence of a small accessory scale is indirectly related to the adaptation process. In contrast, the coloration might be one of the factors that result from adaptation processes. The population in West Java has dominantly a blackish colour, and occupies humid and thick rainforest. In East Java and the Lesser Sunda Islands, some population have brighter colouration (e.g., silvery or brown) and occupies relatively open monsoon forests. The habitat type difference among localities separated by distance suggests a possible process of ecogenesis as current natural selection for environmental condition (Wüster et al., 1995). The current ecological condition in West Java had caused population of Naja sputarix to be taxonomically isolated from other localities (Wüster and Thorpe, 1989).

Kopstein (1936) noticed that on the basis of ventral, subcaudal and dorsal scale counts, Naja sputatrix from Sulawesi (MZB Oph 394) is morphologically more similar to the Naja population of the Lesser Sunda Islands. However, Wüster (1996) reexamined this single specimen (MZB Oph 394) and on the basis of morphological characters, it is indistinguishable from Java specimens. Wüster (1996) suggested that it may not originate from Sulawesi but it is closest to Java population. In this study, based on the presence and position of a small accessory scale (directly adjacent with five other scales: supraoccular, preoccular, internasal, prefrontal and nasal), I concur with Wüster that MZB Oph 394 is morphologically similar with those from West Java.

The populations of *Naja sputatrix* distributed in different localities in Java and the Lesser Sunda have different morphological characters. This information could be the base of more advanced research on the species taxonomy.

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OBSERVATIONS ON EGG-LAYING BY CALOTES ELLIOTI (GÜNTHER, 1864)

Calotes ellioti Günther, 1864 is a lizard endemic to the southern ranges of the Western Ghats of India, distributed in semi-evergreen and evergreen forests (Smith, 1943; Das, 2002). Existing information on its reproductive biology is limited: between 3-5 eggs, measuring 5 x 12 mm are laid in April (Das, 2002). This short communication presents observations of egg-laying in *C. ellioti*, made in a privately owned vanilla plantation in Candurra Division, Murugalli Estate, Anamalai Hills, Tamil Nadu, bordering Vazhachal Reserve forest in Kerala.

On 9 May 2006 at 1444 h, a female *Calotes elliotti* (SVL 61.6 mm; TL 172.5 mm) was observed digging a pit on barren soil. The pit (2 x 2 cm) was under a tree, 5 m from a path, at 845 m above msl, under contiguous canopy cover. The understorey has been cleared for planting *Erythrina indica*, which supports the vanilla plants. The lizard used both fore- and hind limbs to throw mud out of the pit, which was conical, gently curving downwards and was excavated till 1500 h. Between 1500 and 1504 h, four ovoid eggs, within an interval of ca. 1 min was produced. They were white in colour, leathery and oval, measured 13.3 x 7.75 mm; 12.7 x 7.77 mm; 13.25 x 8.00 mm and 12.45 x 7.15 mm.

The lizard arranged the eggs in the pit, licked them and settled them firmly in place by pounding them with the head. This continued till 1514 h. The lizard positioned its midbody at the centre and covered the pit primarily using the forelimbs to push the soil back into the pit. The soil was rather dry and the eggs were packed together closely, by pounding the mud with the snout. The forelimbs were also used for packing the mud. Once the pit was covered, mud in the area immediately around the nest was packed by scraping and collecting the soil from around the nest, with the jaw. The packing of the nest and the soil around the nest, into a firm neat surface continued till about 1556 h, or over half an hour. The process of egg laying and covering the pit took about 56 min. This included several minutes of rest several times during the process and once it stopped to feed on a passing insect. While I observed pit digging for about 15 min, the exact time taken for digging the pit could not be determined.

Usage of the snout to pack the nest has been reported in *Calotes grandisquamis* by Vijaya (1984). This may be a common method used by agamids for nest packing. *C. calotes* were observed to nest during May–June in Anaikatty Hills (Rathinasabapathy and Gupta, 1997). *C. versicolor* has been observed nesting between April–May (Singh et al., 1984). In *C. ellioti*, nesting continues to the second week of May and some gravid individuals were observed till the end of May. Along with observations of other gravid females and juveniles, this observation also substantiates that the human modified, privately owned vanilla plantation in Anamalai hills support reproducing populations of *C. ellioti*.

These observations were made while working on a project documenting the diversity of reptiles in various plantation types in Anamalai hills, Western Ghats. I thank the management and staff of M/S Parry Agro Industries Limited, Murugalli Estate, for support and Venky Muthiah and Murugappa Trust for funding and other support provided.

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WRESTLING FOR TERRITORIAL DEFENSE IN PHILAUTUS ANNANDALII

(with one text-figure)

Notes

Existence of territoriality is generally accepted when animals maintain some sort of spacing and in some manner exclude conspecifics from their immediate proximity (Bunnell, 1973). Spacing in anuran amphibians was first documented in Rana clamitans by Martof (1953) and territorial defense has been observed in Rana catesbeiana by Emlen (1968) and in the dendrobatid, Prostherapsis trinitatis by Sexton (1960). Whereas Emlen (1968) showed that territoriality in R. catesbeiana is associated with mating, Sexton (1960) presented evidence that in the dendrobatids, feeding was the primary basis for territoriality. Actual fighting which may be related to territorial defense has also been observed in other dendrobatid species, including Dendrobates granuliferus (see Goodman, 1971).

Territorial defense by frogs is accomplished through a continuum of behavioural patterns ranging from acoustic advertisements to overt aggression. Male *Eleutherodactylus coqui* call from exposed perches that are separated in space from their retreat sites. Aggressive behaviour exhibited by males in defense of nests includes calling, biting, blocking and wrestling (Townsend, 1989). Typical aggressive bouts consist of aggressive calling, followed by lunges toward the opponent with forward kicks of the legs and then by more bouts of aggressive calling. Persistent intruders are occasionally bitten during which time both frogs kicked each other with their rear legs (Stewart and Rand, 1991).

The agonistic behaviour exhibited by male *Dendrobates pumilio* in defense of territories was described by Duellman (1966) and Bunnell (1973). Typical interactions begin with distinctive aggressive calls and then escalate into prolonged display and wrestling matches. Display behaviour in this species includes orientation toward the opponent and elevation of the body in a "push up" posture (Duellman, 1966). Males distribute themselves uniformly at an inter-in-

dividual spacing of 2–3 m. They detect the intrusion of an aberrant call within at least 3 m of their calling site, as evidenced by changes in the rate and pattern of their own calling. As the distance of the intruding call crosses some threshold between 2–3 m, some degree of advance towards the source of the intruding call is initiated. The intensity of advance increases as the intruder approaches the calling site. The approach and modified calling may result in retreat of the intruder or less frequently result in fighting and wrestling bouts (Bunnell, 1973).

Casual observations were made while photographing Philautus annandalii at Mirik (26°53'146"N; 88°11'235"E; 1,408 m asl), Darjeeling District, northern West Bengal, eastern India. On 31 May 2006 at 2100 h, several males were found calling from a single site. One of the males approached another and soon both were entangled in a wrestling bout, which continued for 8 min, until the intruder left the occupant's calling area. About 35 min later, a female entered the occupant male's area and amplexus occurred. Fig. 1 shows aggressive calling and wrestling by two male P. annandalii. While fighting for territorial defense was previously known for Neotropical anurans, this appears to be the first record in an Oriental species of anuran amphibian.

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Figure 1. Wrestling for territorial defense in *Philautus annandalii* at Mirik (26°53'146"N; 88°11'235"E; 1,408 m asl), Darjeeling District, West Bengal, India.

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