First record of the Blue Forest Lizard, *Calotes mystaceus* Duméril & Bibron, 1837 (Reptilia: Agamidae) from Ubon Ratchathani Province, Thailand, with a review of literature on the biology and distribution of the species in Thailand

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Abstract: In this paper, we record the Blue Forest Lizard, *Calotes mystaceus* Duméril & Bibron, 1837 (Reptilia: Agamidae) from Ubon Ratchathani Province, Thailand, for the first time. Its habitat at Ubon is described. Papers concerning its taxonomy, biology and distribution in Thailand are reviewed.

Key words: *Calotes mystaceus,* Agamidae, distribution, biology, review of literature, Ubon Ratchathani, Thailand.

Introduction

The Blue Forest Lizard, *Calotes mystaceus* Duméril & Bibron, 1837 (Reptilia: Agamidae) is a spectacular coloured lizard recorded from Thailand (e.g. Flower, 1899; Smith, 1915a,b; Taylor, 1934, 1963; Soderberg, 1967; Inger & Colwell, 1977; Pauwels *et al*., 2003, 2009; Pearson & Beletsky, 2008; Das, 2015; Zug, 2011; Chan-Ard *et al*., 2015; Thai National Parks, 2018; Wikipedia, 2018), Vietnam (e.g. Bobrov, 1993; Das, 2015 2012; Chan-Ard *et al*., 2015; Pham *et al*., 2018; Wikipedia, 2018), Myanmar (e.g. Stoliczka, 1870; Flower, 1899; Zug *et al*., 1998; Zug, 2011; Das, 2015; Chan-Ard *et al.,* 2015; Wikipedia, 2018), Laos (e.g. Das, 2015; Chan-Ard *et al*., 2015; Wikipedia, 2018), Cambodia (e.g. Flower, 1899; Grismer *et al.,* 2008a,b; Das, 2015; Hartmann *et al*., 2013; Stuart & Emmett, 2006; Stuart *et al.,* 2006; Zug, 2011; Chan-Ard *et al*., 2015; Wikipedia, 2018), Malaysia (e.g. Das, 2015), China (e.g. Smith, 1921; Das, 2010; Bain & Hurley, 2011; Thai National Parks, 2018), India (e.g. Stoliczka, 1870; Annandale, 1904; Venugopal, 2010; Das, 1996, 2015; Das & Das, 2017; Chan-Ard *et al.,* 2015; Wikipedia, 2018) and Sri Lanka (e.g. Flower, 1899; N.B. this record may be erroneous). In this review, all of the literature available to us on *C. mystaceus* pertaining to Thailand has been reviewed for the first time. Overall, since its discovery almost 200 years ago, very little has been written about the species' biology and behaviour, and scientific literature usually fails to refer to the works of others.

Observations

During the morning of 23 March 2018 [0821 hrs, Thailand time], one of us (AS) observed a single specimen of *Calotes mystaceus* Duméril & Bibron, 1837 (Reptilia: Agamidae) moving about on concrete and soil near her home near the city of Ubon Ratchathani (Ubon), Ubon Ratchathani Province, north-eastern Thailand. No observations on feeding or any other specialized behaviour was noted. The lizard was allowed to travel through the patio area to protective vegetation undisturbed. The habitat here is long established farmland with various crops such as rice (*Oryza sativa* L., Poaceae), guava (*Psidium guajava* L., Myrtaceae), coconut (*Cocos nucifera* L., Arecaceae), banana (*Musa x paradisiaca* L., Musaceae), rhambutan (*Nephelium lappaceum* L., Sapindaceae), durian (*Durio zibethinus* L., Malvaceae), cassava (*Manihot esculenta* Crantz, Euphorbiaceae) and there are also many weed species. The foliage of these crop plants, small trees and weeds is likely to be important cover for this lizard as it forages on insects in this farmland habitat and on the margins.

Discussion

This appears to be the first published record of *C. mystaceus* from Ubon Ratchathani, the most easterly or north-easterly province of Thailand, although some authors (e.g. Taylor & Elbel, 1958;

Pearson & Beletsky, 2008; Chan-Ard *et al.*, 2015) noted that the species is found throughout continental Thailand. In addition, Thai National Parks (2018) to date, have not listed the species from Ubon Ratchathani Province. [Aranya Sommung informs me (TJH) that this species is often common in the Ubon district and nearby Sisaket Province during summer, despite the related *Calotes versicolor* also being common in the area and more readily observed].

Stoliczka (1870) appears to have been one of the first authors to comment on the bright blue coloration (with often black/red markings) of the male during the breeding season. 45 years later, Smith (1915a) also recorded the phenomenon but did not refer to Stoliczka's (1870) earlier observations. However, Smith's (1915a) account is very interesting especially regarding defense of the males:

"The courtship, which has continued until the eggs were laid, was much the same as that described for C. *versicolor,* (Robinson, *P. Z. 8.* p. 858, 1899) and consisted for the most part in absurd bowings and noddings of the head. This was commenced by the male, and was usually, after a short time, responded to by the female. The pair invariably faced each other on these occasions, arching their backs and puffing out their throats to the full extent. The vivid hues assumed by the male (and slightly so by the female) during this performance, transformed him into a truly gorgeous creature. The head and fore-part of the body became of a light electric blue (sometimes green) colour, the gular pouch dark purple, whilst the pale stripe which borders the upper lip, and passes on to the shoulder, turned almost white, and stood out in strong contrast to its surroundings. They were first observed *in copula* on May 9th, and after that were frequently seen together. On June 21st, I observed the female busy with the earth in the flower pot in the cage. She did not like being watched, and ceased operations as soon as she saw me, but by hiding behind a door I was enabled to observe the rest of the proceedings. 'l'he eggs had been already laid, and she was then engaged in covering them up, raking the earth over them with her fore-paws and hammering it down with her nose. The male, perched on a branch above, watched the performance with great interest, and I was surprised to see him, in the midst of it all, suddenly race down to his mate and engage her. She, finally, completed her task, smoothing the earth completely over at the spot, so that no traces were left to show that anything had been clone there. I never saw her near the spot again, and she appeared to take no further interest in her progeny. The eggs were placed about 2 inches deep in the earth, and had the usual soft, white parchment-like covering. They were 7 in number, 15 to 18 x 10 to 11 mm. in size. The first young one appeared on Aug. 20th, and measured from snout to vent 26 mm., tail 48 mm. in length. 'l'hey had the usual drab colours of their parents. The colour changes in these specimens, I found, were not brought about by sexual excitement only. Fear would produce exactly the same effect. This could be demonstrated by putting a snake into their cage. Their attitude then was that of being fascinated and unable to escape. They invariably faced the snake, bowing to it and nodding their heads exactly as when courting. The crest was strongly erected, the gular pouch fully distended, and the colours would gradually become more vivid until they were almost as intense as during sexual excitement." [Smith, 1915a: 256-257].

Flower (1899) noted that he had received two specimens of *C. mystaceus* from Chantaboon [= Chanthaburi, Chanthaburi Province, Thailand] but did not provide any biological data on the species. [This important paper has been overlooked by most subsequent workers on SE Asian herpetofauna].

Smith (1915a) noted that the lizard was widely distributed throughout Thailand (as Siam) but its southerly range was at Hua Hin (Hua Hin Province) but was not found in Bangkok or the surrounding areas of the capital.

Smith (1915b) noted that the species was found in the Sai Yok district (cited as Sai Yoke), [Kanchanaburi Province] during Jan-March 1914 during the expedition with K.G. Gairdner.

Taylor (1934) recorded the species from Chiang Mai [Chiang Mai Province](fide Taylor, 1963) but we have not been able to review this paper because of its unavailability. [This paper has been overlooked by most subsequent workers on SE Asian herpetofauna].

Taylor & Elbel (1958), recorded the species from Lam Phaya village, Nakhon Pathom district (Nakhon Pathom Province), Boekprai village, Bangpon district (Ratchaburi Province- incorrectly cited as Rat Buri Province), Non Khun village, Phukhieo district (Chaiyaphum Province) as well as Nakhon Si Thammarat Province. Taylor & Elbel (1958) noted the species was widespread in continental Thailand but not in the southern peninisula with Malaysia. This was also what Smith (1915a) stated concerning its distribution in Thailand.

Taylor (1963) recorded the species from the following provinces in Thailand: Loei, Chiang Mai, Nong Khai, Udon Thani, Saraburi (as Sara Buri), Khon Kaen, Phetchaburi (as Phet Buri), Nakhon Pathom (as Fathom), Ratchaburi (as Rat Buri) and Chaiyaphum.

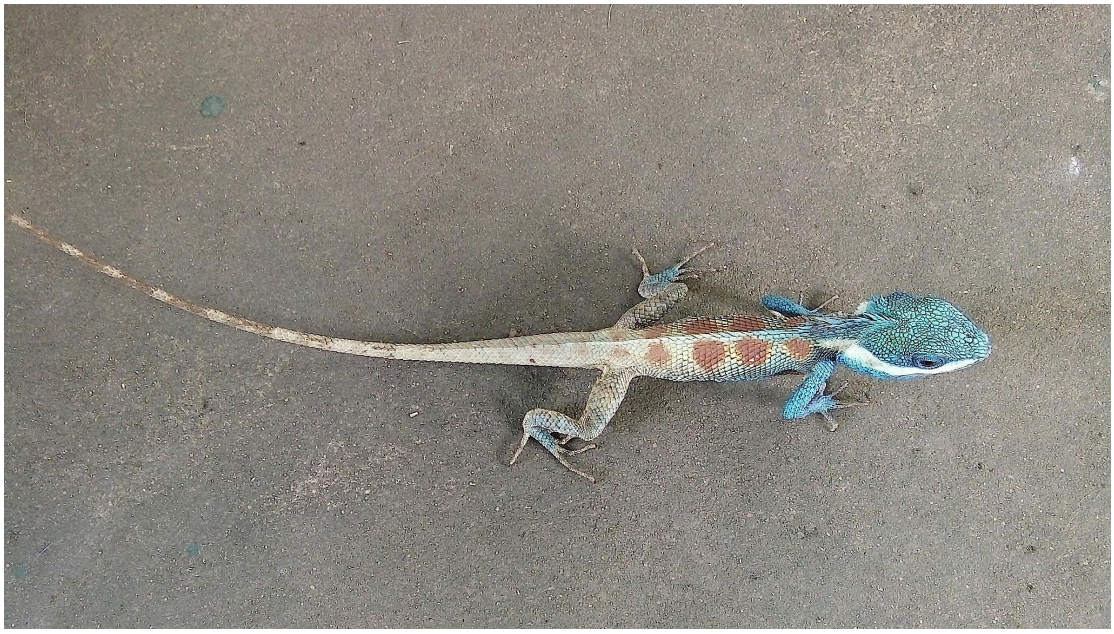

Fig. 1. Dorsal view of the male of *Calotes mystaceus* Duméril & Bibron, 1837 (Agamidae) wandering around a dwelling on concrete near Ubon Ratchathani, Ubon Ratchathani Province, Thailand. 23 March 2018. (Photograph: A. Sommung).

Soderberg (1967) recorded two preserved specimens of the species from Thaichai Teak Plantation, Sukhothai Province, and noted *C. mystaceus* was a predator of the Teak Bee-hole Borer (*Xyleutes ceramicus* Walker, 1865-Lepidoptera; incorrectly cited as *Xyleutes cerambicus*).

Pantawutana *et al.* (1969) recorded the species from Red Cross Horse Farm, Bang Phra, Chonburi, (as Cholburi) in southeast Thailand. (N.B. This paper seems to have been overlooked and not cited by any subsequent authors of *C. mystaceus*). These authors noted: "22 individuals captured; 2 preserved as specimens. Frequent. This lizard is larger (15 weights average 30 grams and range from 9 to 68 grams) and less numerous than the above, although certain adults can be seen daily at their stations on mango [*Mangifera indica* L., trunks. Habits and occurrence are like the foregoing; Viz. The habitat of the fleet-footed, wide-ranging immatures is on and about bushes, grass, vines, and fences, whereas the relatively few mature individuals are stationed upon the shady trunks of trees. There they advertise their territory by striking changes of color. Each mango tree probably harbors a pair".

Inger & Colwell (1977) recorded the species as common in deciduous forest of the Sakaerat research station (Nakhon Ratchasima Province) but less so in evergreen forest and agricultural land

(see also Zug, 2011, who utilises their data in a Table). Most of the specimens of *C. mystaceus* were collected on trees/saplings less than 3 metres in height, while some specimens were collected from seedlings and grass as well as from tree stumps (Inger & Colwell, 1977).

Pauwels *et al.* (2003) noted that several adults were observed in Ban Salakern, Ban Lat District, Phetchaburi Province during March-April 1998 on mango trees (*Mangifera indica* L., Anacardiaceae) in a garden during the afternoon; probably due to shyness and its arboreal habits, they rarely encountered the species. In a follow-up paper, Pauwels *et al.* (2009) recorded the species from the Witthaya School, Ban Lat, Ban Lat District, on 14 May 2006, representing a population living on the school campus and a new locality record; these authors noted that *C. mystaeus* is known only from two localities within this province (viz. Phetchaburi).

Fig. 2. Lateral view of the same male of *Calotes mystaceus* (Agamidae) wandering around a dwelling on concrete near Ubon Ratchathani, Ubon Ratchathani Province, Thailand. 23 March 2018. (Photograph: A. Sommung).

Pearson & Beletsky (2008) in a brief overview of the plant and animal life of Thailand, noted that *C. mystaceus* inhabited monsoon, evergreen and deciduous forests and rural areas with trees, mainly in lowlands; lizards are active by day, usually on tree trunks but occasionally on the ground.

Chan-Ard *et al.* (2015) noted *C. mystaceus* was found throughout continental Thailand southward to Prachup Khiri Khan Province. Chan-Ard *et al.* (2015) noted that the species is highly arboreal, occurring in dense foliage providing shade; a mature individual may occupy a tree trunk patrolling up and down and around the trunk, chasing away intruders. Adults feed mostly on insects found inhabiting trunks and branches of the host trees Chan-Ard *et al.,* 2015). Females lays eggs in soft soil where they are guarded (Chan-Ard *et al.,* 2015).

Das (2015) noted that the species inhabits evergreen forests at mid latitudes as well as parks and gardens in the lowlands and submontane forests at elevations of 180-1500 metres above sea level; individuals are active on high tree trunks and diet consists of insects. The egg clutches number 7 eggs and the incubation period is 60-70 days (Das, 2015; Das & Das, 2017).

Currin (2016) recently recorded the species from Kaeng Krachan National Park (Phetchaburi and Prachuap Khiri Khan Provinces, Thailand). He noted a specimen on a tree trunk near a campsite near the park headquarters in secondary forest.

Fig. 3. Male specimen from another area of Thailand (not specified)(from Wikipedia, 2018).

Amber *et al.* (2017) recorded the species from the Sakaerat Biosphere Reserve (SBR), located in Nakhon Ratchasima Province, in northeastern Thailand during September and November 2016. When they handled one specimen, the blue coloration became more apparent after it twitched but did not flee. Two juvenile specimens were also observed during November 2016; in the station headquarters parking area on a tree (*Shorea obtusa* Roth, Dipterocarpaceae) surrounded by a one metre radius ring of bare soil and woody shrubs (*Phyllanthus emblica* L., Euphorbiaceae/ Phyllanthaceae; *Wrightia tomentosa* Roem. & Schult, Apocynaceae); when approached within 1–2 metres, the smaller juvenile (Snout-Vent Length - SVL - ca. 3.0 cm) fled towards the brush without changing color, while the larger juvenile (SVL ca. 6.0 cm) displayed dark red spots on its dorsum; this individual also fled further up the tree in short bursts of about 0.5 metres, visibly pausing twice (Amber *et al.*, 2017). During both pauses the animal jerked its head straight backwards 2–3 times. Amber *et al.* (2017) finally summarized their observations thusly: "Individuals in all life stages appeared to first rely on cryptic defense, but upon approach differed in defensive tactics. The smaller juvenile, most vulnerable to predation, quickly fled. The larger juvenile may have used bright red spots and head jerks in an attempt to deter a predator, whereas the adults initially changed color and stood their ground. Our observations suggest that *C. mystaceus* undergo an ontogenetic shift in defensive strategies, with older individuals utilizing color change. However, it is also possible that the color change associated with our approach was an artifact of increased hormone levels (e.g. testosterone) due to the approach".

Saijuntha *et al.* (2017) undertook genetic studies on various populations of the species throughout Thailand (42 in total - but they did not list these). These authors recognized two lineages for the

species in Thailand (see Saijuntha *et al.*, 2017; Fig.2), and as such the specimen from Ubon falls into Lineage 1.

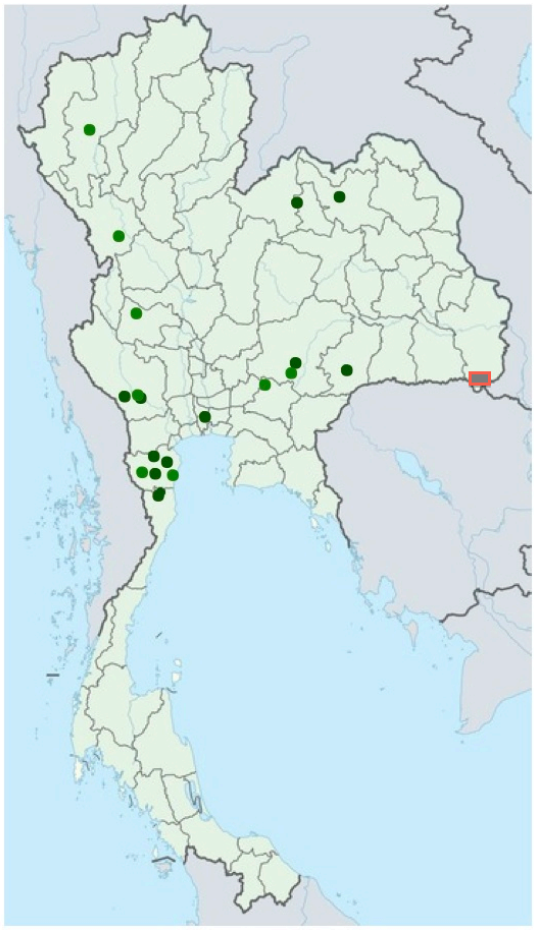

Fig. 4. Map of presently known distribution of *Calotes mystaceus* in Thailand (from Thai National Parks, 2018); our record from Ubon Ratchathani is shown as a red rectangle.

Within this paper have provided a summary and review of the biological and distributional data of *C. mystaceus* from scientific papers/books which have been available to us. [Taylor (1934), a paper cited rarely and not seen by us, should be reviewed for earlier research on Thailand reptiles]. There will be no doubt other obscure publications/reports which mention *C. mystaceus* in Thailand but which we were not able to review. However, we feel that most of the mainstream scientific literature has been reviewed together for the first time and hope that this paper will be useful as a basis for further studies on this lizard species.

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