

Short Communication:
First record of the Genus *Calamaria* (Squamata: Colubridae:
Calamariinae) from Karimunjawa Island, Indonesia:
Morphology and systematic

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Manuscript received: 17 January 2018. Revision accepted: 26 April 2018.

Abstract. Sidik I, Subasli DR, Sumitro SB, Widodo N, Kurniawan N. 2018. Short Communication: First record of the Genus *Calamaria* (Squamata: Colubridae: Calamariinae) from Karimunjawa Island, Indonesia: Morphology and systematic. *Biodiversitas* 19: 912-917. We present the first record of the Genus *Calamaria* from Karimunjawa Island, Central Java, Indonesia based on an unfathomable single specimen collected in the coastal forest of Legon Moto. Morphological characters analysis revealed the specimen as *Calamaria melanota*. This finding unravels the extent of the species distribution which was previously thought to be restricted in Borneo, representing the southernmost record of this species. The examined specimen is described in detail and meticulously compared with other *Calamaria* species such as *C. battersbyi*, *C. borneensis*, *C. linnaei*. Our study highlights several characteristic differences between the specimen and the holotype of *C. melanota*.

Keywords: Biogeography, *Calamaria*, morphology, snake, systematic

INTRODUCTION

Indonesia is a fascinating archipelagic country that has been known for its species diversity of Genus *Calamaria* in the Oriental zone (Inger and Voris 2001). Reports show that more than half the total numbers of *Calamaria* in the world are present in Indonesia (Iskandar et al. 2012). Currently, there are 41 species of *Calamaria* in Indonesia from the total 61 species, placing Indonesia as the region with the highest *Calamaria* species number worldwide (Uetz and Hallermann 2016). *Calamaria* were found in the western to eastern part of Indonesia from Sumatra (16 species), Simeulue (2), Nias (3), Siberut (1), Riau Islands (1), Bangka (2), Belitung (2), Java (10), Bali (1), Borneo included of Kalimantan, Sarawak and Sabah (22), Natuna Islands (1), Sulawesi (8) and the surrounding islands of Banggai (1) and Buton (2), and to Seram (1) in Moluccas (Iskandar and Colijn 2002).

There are several *Calamaria* species endemic to certain locations in Indonesia. In Sumatra, there are 9 endemic species such as *C. abstrusa*, *C. alidae*, *C. crassa*, *C. doederleini*, *C. eiselti*, *C. forcarti*, *C. lautensis*, *C. margaritophora*, and *C. ulmeri*. In Borneo there are 6 endemic species namely, *C. battersbyi*, *C. grabowskyi*, *C. gracillima*, *C. griswoldi*, *C. lumholtzi*, and *C. rebentischi* (Inger and Marx 1965). Although, the number of endemic species of *Calamaria* in Borneo is not as many as that in Sumatra, Borneo has been home to the largest numbers of *Calamaria* of all other distribution areas. In Sulawesi and

the surrounding small islands, there are 10 species, *C. acutirostris*, *C. apraeocularis*, *C. curta*, *C. muelleri*, *C. banggaiensis*, *C. boesemani*, *C. brongersmai*, *C. butonensis*, *C. longirostris*, and *C. nuchalis* which are almost all endemic to Sulawesi (Howard and Gillespie 2007; Koch et al. 2009). In Seram island, there has been found 1 endemic species, i.e., *C. ceramensis* from Honitetu (Rooij 1917). Meanwhile, there has been none endemic *Calamaria* species originated from Java.

The specimen of *Calamaria* found in the Karimunjawa was identified as *C. melanota* or commonly known as Kapuas reed snake. This species was previously recorded in Kapuas and Barito Rivers, in the southern part of the Schwanner Mountains in Central Kalimantan and Sarawak (Iskandar et al. 2012). Marx and Inger (1955) also mentioned that the distribution of *C. melanota* is only found in Borneo. Karimunjawa Island with an area of 71.2 square kilometers is an island in the Islands of Karimunjawa located in the Java Sea and administratively belongs to the province of Central Java, Indonesia (Susanto et al. 2014). The islands were formed from a carbonate arch in the edge of the topographical Sundaland during the Pleiocene Epoch about 5.3-1.6 million years ago (Smyth et al. 2008). Although the island has been known as a tourism destination, many locations in the island have not been explored scientifically. The research on the diversity of herpetofauna of Karimunjawa is rare and the information about it is still lacking. The important papers ever published about the island are an inventory of amphibian

and reptiles based on specimens collected by Delsman in 1920, Dammerman in 1926, Lieftinck in 1930 and Hoogerwerf between 1954 to 1955 (Mertens 1956; 1959); and the abundance of herpetofauna populations (Subasli 2004). However, the extent of diversity in the island still remains unknown. It is most likely that there are still many *Calamaria* species have not been discovered in the isolated islands around the mainland. Therefore, this interesting findings can help in understanding the existence of *Calamaria* species in Karimunjawa.

MATERIALS AND METHODS

Study area

The study was conducted between April and May 2004 on the coastal forest of Legon Moto in the eastern corner of the Karimunjawa Island. The topography comprises of hilly forests with an altitude of 0 – 300 meters above sea level. The forest is an uninhabited area which can only be reached by sea travel. The vegetation of Legon Moto is dominated by mangrove fan palms (*Licuala spinosa*), leguminous trees (Caesalpiniaceae), woody climbing shrubs (Annonaceae), euphorbias and evergreen shrubs or small trees (*Aglaia* spp.) (Figure 1).

Karimunjawa Island is a part of the Karimunjawa Islands which is located in the Java Sea at 5°40' 39"-5°55' 00" latitude and 110°05' 57"-110°31' 15 " longitude. The location is within the administrative region of Jepara District, the Province of Central Java, Indonesia and situated about 60 nautical miles north of Semarang, the capital city of Central Java, Indonesia (Figure 2).



Figure 1. Coastal forest of Legon Moto in the Karimunjawa Island, Java Sea, Indonesia which discovery habitat of *C. melanota* (Photograph by Dadang R. Subasli)

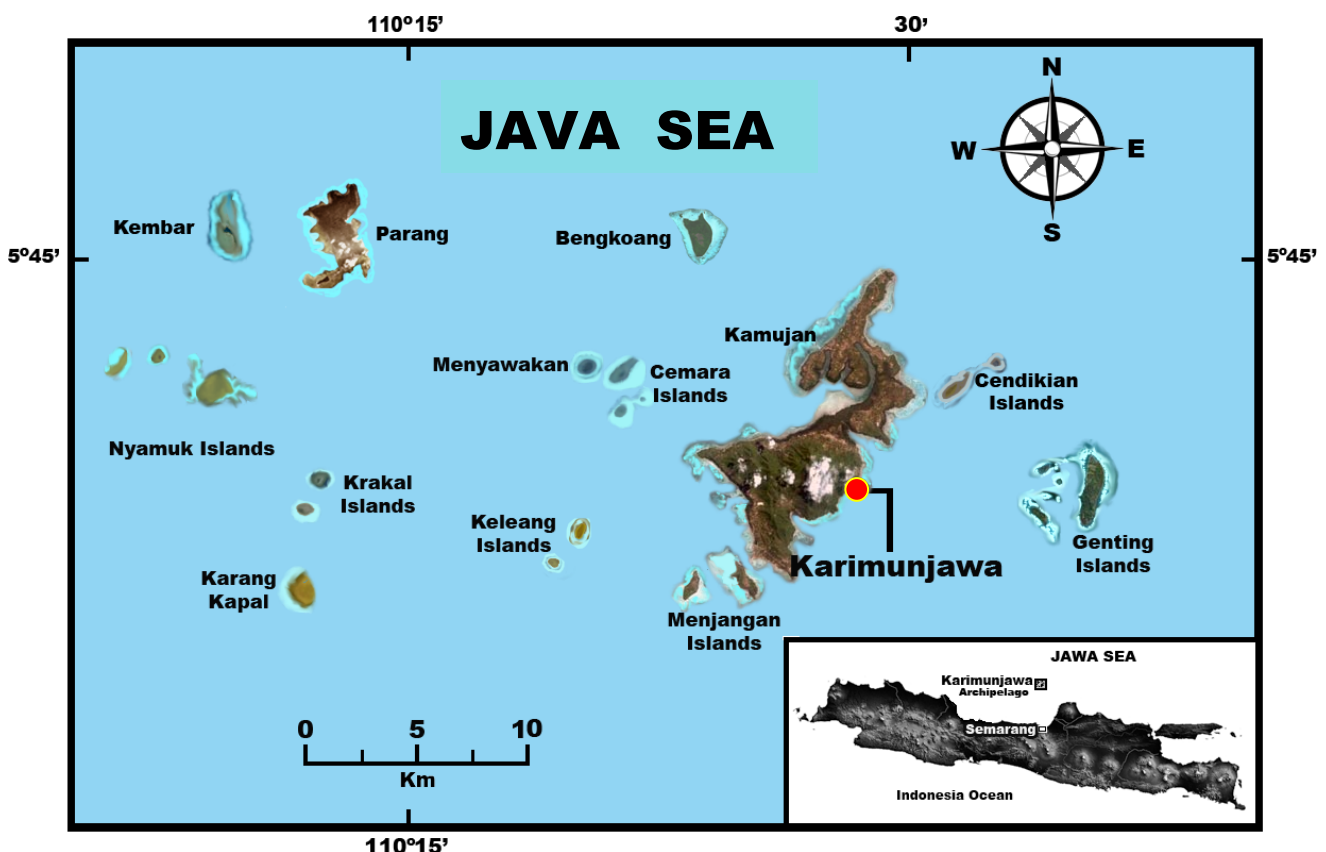


Figure 2. Map of Karimunjawa on the Karimunjawa Islands located in the Java Sea, north of Java, Indonesia

Morphological data

This paper describes the pholidosis of a single specimen of snake found in Karimunjawa as indicated by its characters. The specimen has been deposited as an unidentified specimen in the herpetology collection of the Museum Zoologicum Bogoriense (MZB) in Cibinong, Indonesia for more than ten years. Since the specimen is too small to be observed by naked eyes, then the morphometric data of the head scales are observed and analyzed by using Leica M60 modular stereo microscope and documented with a digital camera Nikon D80 and Tamron 60mm macro lens. The measurement of body and tail length was done by an electronic digital caliper to the nearest 0.01 mm. The morphological characteristics of the specimen were compared with the holotypes of *C. melanota* (RMNH.RENA 37), *C. linnaei* (RMNH.RENA 27) and *C. battersbyi* (BMNH 96.2.17.13), and the original description of *C. borneensis* was examined by the authentic literature.

The following abbreviations are commonly used to indicate morphological characters for comparing species of *Calamaria*. **Body:** ToL: total body and tail length, measured from the snout to the tip of the tail; TaL / ToL: the ratio of tail to total length. The head of a snake is the most important thing than any other part of its body. The three main parts analyzed in this study were the upperside (dorsum), the underside (ventrum) and the lateral side.

Dorsum: Rpf: the length of the rostral seen from above to the prefrontal suture; Pff: the distance from the prefrontal suture to the longest frontal; Fsu: the distance from the frontal to the supraocular; FP: the longest distance from the frontal to the parietal suture; PPf: the longest distance from the parietal suture to the prefrontal; Par: shields and scales that surround the paraparietal. **Ventrum:** M – ACS: mental being in contact to the anterior chin shield or not; IL: the number and size of infralabial; IL – ACS: the number of infralabials touching to the anterior chin shield; ACS – PCS: size comparison between the anterior chin shield and the posterior chin shield; G: the number of gular; V: ventral scales on the body; SC: subcaudal scales on the tail.

Lateral: NPto: the distance from the nasal to the postocular; Pro: the presence of preocular; Pro-Pto: height comparison between preocular and postocular; Pto: the form and size of the postocular; Pro & Pto – Eye: height of both preocular and postocular compared to the eye diameter; EM: eye-to-mouth distance: comparison between the diameter of eye with the distance from the bottom of the eye to the lower part of the supralabial; SL: the number and dimensional size of the supralabial; SLE: the number of supralabials in contact with the eyes. The sex of the snake is identified by its lower tail after the anal scales revealed by dissecting the underside of the tail.

Institutional acronyms as follows: MZB = Museum Zoologicum Bogoriense, Zoology Division, Research Center for Biology, Indonesian Institute of Sciences, Cibinong, Bogor, Indonesia; RMNH.RENA = Rijksmuseum van Natuurlijke Historie, Reptiles and Amphibians, Leiden, The Netherlands (now Naturalis Biodiversity Center); BMNH = British Museum of Natural

History (now known as Natural History Museum), London, United Kingdom.

RESULTS AND DISCUSSION

Specimen description

A single snake specimen of *Calamaria* has been collected in the Legon Moto coastal forest, Karimunjawa Island, Central Java. The specimen was found at 5°51'25.3" S, 110°27'56.8" E, 2 meters above sea level and about 6 meters from the shoreline when the sea water recedes. The specimen was found under leaf litters in moist soil with fine white sand without coral remains. The specimen was a juvenile female collected by DRS on 26 April 2004 and labeled as MZB.Ophi.3129 (field number DRS202).

The body of the specimen (Figure 3) is cylindrical, with smooth scales without apical pits and with a snout-vent length of 104 mm. The habitus is vermiform. The head is not distinct from the neck. This genus of *Calamaria* is distinguished from all other snakes by 13 rows of dorsal scales throughout the body. In the underside of the body, ventral scales are dark in color on the anterior and lightly creamy on the posterior and those scales are divided by two transversal lines. The number of ventral scales is 155. The anal plate is single, broadened, and uniformly pale in color without any spots. The tail length is 8 mm, a moderately short tail and posteriorly tapered in half to the tip. The subcaudal scales are 16 which are divided into two rows with a fine dark line in the middle of the division. Dorsal scales are reduced to 4 rows on the tail. The position of the reduction on the tail can be located by counting the number of subcaudals from tip of tail forward. The eight maxilla teeth in specimen *Calamaria* from Karimunjawa Island which has been modified to prey on earthworms.

The following is the description of the dorsum portion of the head (Figure 4.A). The rostral is higher rather than wide, visible from above, shorter, i.e., about three quarters the length of the prefrontal suture. Prefrontal: the suture is shorter than that of the frontal one; in contact with the first and second supralabials. Frontal: hexagonal in shape; the anterior is blunter while the posterior is more pointy; about three and a half times the width of the supraocular; the longest frontal length is shorter than that of the parietal suture. The parietal is one and a half times the length of the prefrontal. The para parietal is surrounded by 6 shields and scales.

The following is the description of the ventral of the head (Figure 4.B). The mental is triangular, the stabbed is in contact with the anterior chin shields (ACS), and the first pair of infralabials are prevented from being in contact with each other by the mental. There are 5 infralabials, the first three scales touching the ACS; the half portion of the third and the whole fourth of the infralabial are usually in contact with the posterior chin shield (PCS), the fifth infralabial is in contact with the fourth supralabial. Anterior chin shields are larger than posterior and meet in the midline. Less than half of the posterior chin shields meet in the midline. There are 3 gulars in the midline between the posterior chin shields and the first ventral.



Figure 3. The upper side (A) and under side (B) body of *C. melanota* (MZB.Ophi.3129) from the Karimunjawa Island, north of Java, Indonesia. The first three scale rows and ventral scales show the characteristics of this species (Photographs by Irvan Sidik).

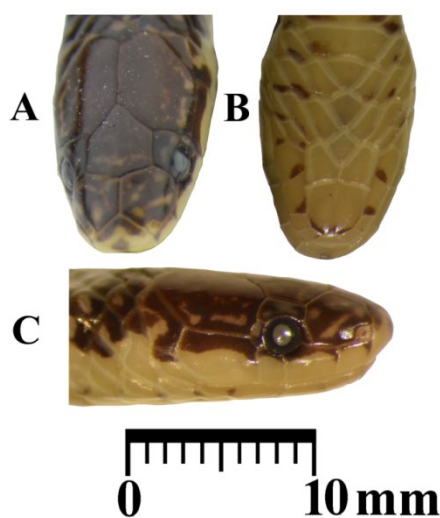


Figure 4. The scalation detail of the dorsum (A), ventrum (B) and lateral (C) of the head of *C. melanota* (MZB.Ophi.3129) from the Karimunjawa Island, north of Java, Indonesia (Photographs by Irvan Sidik).

The following is the description of the lateral surface of the head (Figure 4.C). The nasal is smaller than the postocular. The preocular is present and smaller than the postocular. The postocular has a saddle or elliptical orbit form. Both oculars are not as high as the eye. Eyes are bigger than the eye-mouth distance. There are 4 supralabials, the first is longer than the third scales; the second and the third one is entering the eyes and have a size of a third or less than half the length of the second one; the fourth is the longest scale than any other supralabial.

The following are the descriptions of the specimen upon coloration in ethanol preservative. The body showed dark brown color with each scale exhibiting a light spot at the posterior tip. The scales at the first three rows have wider bright areas than those at the rows above. The dorsum area of the head shows dark brown color with scattered indistinct lighter spots at the prefrontal, anterior of frontal, outer edges of the supraocular and parietal. The

anterior of the para parietal is dark brown and posteriorly bright. Meanwhile, the middle of the rostral and area bordering to the prefrontal exhibit a darker coloration. The upper half of the postocular part bordering the parietal is brighter. The first, second and third supralabial have wider bright area compared with that of the fourth one. The underside of the head is light creamy in color with varying amounts of small dark spots on the boundary of the anterior chin shield with the mental, and the first infralabial, and at the front edge of the third, fourth or fifth infralabial. The upperside of the tail is brown in color similar to that of the body. The subcaudals show similar one as the ventrals with a dark streak in the midline. This description is reminiscent of the original characters previously described for *C. benjaminsi* by Edeling (1864). The original description of *C. benjaminsi* which is similar to *C. melanota* by Inger and Marx (1965) mentions that the conspicuous pattern of dark and light streak in the ventral scales is the characteristic of *C. melanota*. Comparing the specimen with this previous species descriptions assured us that the karimunjawa specimen is *C. melanota*.

Taxonomic status

The following nomenclature is the historical taxonomy of *C. melanota*. In 1862, Jan first introduced *C. linnaei* var. *melanota* with several other species as its variants: *C. linnaei* var. *bilineata*, *C. linnaei* var. *contaminata*, *C. linnaei* var. *gastrogramma*, *C. linnaei* var. *rhomboidea*, and *C. linnaei* var. *transversalis*. The original statements from his paper “*Enumerazione Sistematica Delle Specie d' Ofidi del Gruppo Calamaridae*”, unfortunately, did not provide a detailed explanation on how to distinguish one variant of *C. linnaei* from the others. The identification for classification only mentioned three striking characters including four numbers of supralabial, mental touching the infralabial, and on the basis of delicate teeth. Meanwhile, other characters that distinguish between species have been described by Schlegel (1837) and Dumeril et al. (1854).

Edeling (1864), on the other hand, has described two new species of *Calamaria* collected by Mr. Benjamins, an army physician in Martapura, southeast Kalimantan which subsequently named as *C. benjaminsi* and *C. martapurensis*. In 1865, Jan also published a book “*Iconographie générale des ophidiens*” which includes images contrasting *C. linnaei* and its varieties based on their color pattern. Twenty-five years later Boulenger (1894) reviewed *C. linnaei* var. *melanota* through anatomical evidence and separated it from *C. linnaei* variants. On the basis of the characteristics from the variant of *C. linnaei* by Jan's iconography, differences in numbers of the modified maxillary teeth, number of subcaudals and the width of frontal is the same size as its length, then Boulenger (1894) raised the taxonomical status of *C. linnaei* var. *melanota* into a distinct species as *C. melanota*. The remaining species variants are still incorporated as the variant of *C. linnaei* species.

Because of their similar morphological characteristics, Inger and Marx (1965) classified *C. benjaminsi* as synonymous to *C. melanota* and *C. electa*, a species described by Barbour (1927) that is originated from Pasir

(East Kalimantan). Another species, *C. martapurensis*, previously described by Edeling is also considered synonymous to *C. schlegeli schlegeli*. Since Jan was the first person who used the characteristics of *C. melanota* as the variants of *C. linnaei*, the applied scientific name for the species is *C. melanota* Jan (1862) (Boulenger 1894).

Comparisons

The pholidotic patterns were applied to compare the morphology of *C. melanota* from Karimunjawa from those of other related *Calamaria* species in Borneo and Java. Some of the similar characters are not presented in the summary (Table 1). All the species examined have the same number of 13 rows dorsal scales; hexagonal form of frontal; smaller nasal size compared to that of the postocular; the height of the preocular and postocular are lower than the eyes level; the prefrontal scales touched the 1st and 2nd supralabial; 6 shields and scales surrounding the para parietal; 2nd and 3rd supralabials are in contact with the eyes; the mental is in contact with the anterior chin shield; the anterior chin shield and the posterior chin shield meet in the midline. Specimen from Karimunjawa that was identified as *C. melanota* appeared to be most closely related to *C. battersbyi*, exhibiting the following characteristics: the eyes are larger than the eye-to-mouth distance, having four supralabials, the same number of modified maxillary teeth, and preocular is present. However, the specimen also showed similar morphological characteristics to *C. linnaei* for example in terms of the number of low ventral scale (< 166), and the thick short, blunt tail. Overall, the morphological pattern of the specimen is geographically concordant with those of *C. melanota* from Borneo.

The dorsal color pattern of *C. melanota* from Karimunjawa is dark brown, and each scales has a light spot at its posterior tip, readily distinguished from other species such as *C. battersbyi* from Borneo which has

brownish dorsum and yellowish dorsal scales with brown margins (Inger and Marx 1965). *C. borneensis* is known to have dark grayish brown scales with fine dark reticulation or scattered dark pattern (Bleeker 1860). *C. linnaei* has dark brown or black to light sandy brown color, and its dorsal scales are characterized by dark network or small isolated black spots scattered all over its body (Boulenger 1894).

The lower surface of the body and the underside of the tail also show a various color pattern with conspicuous difference. Ventral scales of *C. melanota* from Karimunjawa are composed of two transversed dark and light lines; the underside of the tail is same as the ventral. *C. battersbyi* possess ventral scales with dark stippling across the anterior, and yellow across the posterior. Meanwhile, the underside of the tail of *C. battersbyi* shows a dark streak in the midline. The original description of *C. battersbyi* by Inger and Marx (1965) does not provide any means for distinguishing the color pattern in the ventral portion in detail. *C. borneensis* has ventrals dark stripe along the adjacent edges. The underside of the tail is black and yellow checkered with varying amount of dark pigment. *C. linnaei* has whitish or cream-colored ventrals with varying amounts of dark pigment in the outer margins, few black squares, or completely black-checkered appearance; the underside of the tail is uniformly cream-colored or has varying intensity of black.

Furthermore, the morphological comparisons of some specimens from Borneo generally show similarities. However, in certain characters, there are differences between the specimens, for example on dorsal scales of the tail. In *C. borneensis*, the dorsal scales on tail are reduced by 2nd to 11th of subcaudals and *C. linnaei* by 2nd to 10th of subcaudals. Considering the specimen we obtained in Karimunjawa Island, the distribution pattern of *C. melanota* is broader than previously thought, i.e., the species has limited distribution only in Borneo.

Table 1. Diagnostic characters to distinguish between the Karimunjawa, north of Java, Indonesia specimen with *C. battersbyi*, *C. borneensis*, and *C. linnaei*. Morphometrics of the body in mm and meristic data in units of scale. M = male; F = female.

Characters	Karimunjawa	<i>C. battersbyi</i>	<i>C. borneensis</i>	<i>C. linnaei</i>
Morphometric				
Total length	112	92	135-374	91-396
Ratio tail to total length	0.073	0.065	0.061-0.133	0.029-0.113
Rostral	Higher than wide	Broader than high	Higher than wide	Higher than wide
Rostral to prefrontal	¾ length	½ length	¾ length	Equal length
Frontal to supraocular	3½ times width	1⅓ times width	2 times width	1⅓-2 times width
Frontal to parietal	¾ length	¾ length	¾ length	Shorter to equal length
Parietal to prefrontal	1½ length	1½ length	1½ length	Longer about 1½ length
Preocular to postocular	Shorter	Equal	Shorter	Equal
Diameter eye to eye-mouth distance	Larger	Larger	Equal	Equal to slightly greater
Meristic				
Supralabial	4	4	4	4
Infralabial	5	5	4	5
Infralabial to ACS	1 st , 2 nd , 3 rd	1 st , 2 nd , 3 rd	1 st , 2 nd	1 st , 2 nd , 3 rd
Gular	3	3	3 (rarely 2)	3
Ventrals	155 (F)	171 (M)	126-169 (M); 159-192 (F)	130-149 (M); 148-166 (F)
Subcaudals	16 (F)	16 (M)	20-26 (M); 13-21 (F)	15-22 (M); 7-13 (F)
Tail reduction	4 th	4 th	2 nd to 11 th	2 nd to 10 th
Maxillary teeth	8 modified	8 modified	8 or 9 modified	10 modified

Pholidosis has always been an intriguing feature for herpetologists interested in an enigmatic reed snake. Regardless of its adaptive potential, the scaling characters provide information about the species evolutionary history and often used in the taxonomy of *Calamaria*. Therefore, the characteristics and keys for species identification are also based on or at least include information about the pholidosis of *Calamaria* which is generally described by Dumeril et al. (1854), Boulenger (1894), and Inger and Marx (1965). Similarly, pholidosis feature is the key to identify various species of *Calamaria* in Vietnam (Darevsky and Orlov 1992; Ziegler et al. 2008), Sulawesi and Moluccas (Koch et al. 2009). The formation of geological history also amplifies the existence of the evidence in various morphological characters as a result of species evolutionary processes. We assume that these intrinsic factors play an important role in generating species diversity within this genus.

This species is present in Karimunjawa, yet it is known to be absent in Java. Thus, it remains a question whether this species might be found in Java. The Karimunjawa was a part of the expansion of the paleogeography of Sundaland's ancient formation on the Late Jurassic about 161.2 to 145.5 Ma (Hall 2013). At that time, the east border of the Great Sunda shelf was between Kalimantan and Java. Furthermore, Zahirovic et al. (2016) mention that the physio-geography of the Sundaland spanned southward from the eastern periphery of the complex Meratus Mountains in Southern Kalimantan to the eastern Java. Therefore, the Islands of Karimunjawa has been a part of the Sundaland massive plain since ancient time. Historically, from the point of view of taxonomic status, *C. melanota* has been a complex species. Hence, the knowledge of its existence in Karimunjawa provides valuable information on its distribution that can explain the biogeographical pattern of this species in Sundaland.

ACKNOWLEDGEMENTS

The field research was funded by *Proyek Inventarisasi dan Karakterisasi Sumberdaya Hayati* in 2004, from the Research Center for Biology, Indonesian Institute of Sciences Cibinong, Bogor, Indonesia with a purpose to provide information and evaluation of biodiversity in Indonesia.

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