

CONTRIBUTION TO THE SNAKE FAUNA OF THE SULU ARCHIPELAGO,
WITH THE DESCRIPTION OF A NEW SUBSPECIES OF
DENDRELAPHIS CAUDOLINEATUS (GRAY, 1834)

MAREN GAULKE

Muhliusstrasse 84, 24103 Kiel, Germany

On the islands of Bongao, Sanga Sanga, Siasi, Sibutu, and Tawitawi (all in the Sulu Archipelago) a total of 18 species/subspecies of land snakes were recorded. The observations on the different islands resulted in many new distribution records, 19 of which are published here for the first time: five for Bongao, four for Sanga Sanga, four for Siasi, and six for Tawitawi. One of the snakes (*Boiga drapiezii drapiezii* Boie, 1827) was not known before from the Philippines and the endemic subspecies *Dendrelaphis caudolineatus flavescens* nov. subsp. is described. The Sulu Archipelago shelters several endemic species/subspecies (e.g. *Maticora intestinalis suluensis* [Steindachner, 1891], *Oligodon meyerinkii* [Steindachner, 1891]). Other members of its land snake fauna are widely distributed on Borneo but occur nowhere else in the Philippines (*B. d. drapiezii*, *Sibynophis geminatus geminatus* Boie, 1827), while some are only known from the Philippines (*Elaphe erythrura erythrura* [Duméril, Bibron & Duméril, 1854], *Chrysopelea paradisi paradisi* Boie, 1826).

INTRODUCTION

Knowledge of the fauna of the Sulu Archipelago, one of the most remote areas of the Philippines, is still fragmentary. The herpetological records are based mainly on the investigations of E.H. Taylor, who obtained small collections of reptiles from several of the Sulu Islands some 70 years ago. This material resulted in range extensions for several species, and the description of other new species and subspecies (Taylor, 1918a,b, 1919, 1922a,b,c, 1923). "Reptiles of Sulu Archipelago" (Taylor, 1918a), lists 13 species of snakes for the Sulu Archipelago, with the highest number of records from the Bubuan/Tapaan group (five species, including the sea snake *Laticauda colubrina*). Only on Jolo, the largest island of the Archipelago (345 square miles), was a significant increase in the snake fauna inventory made. While Taylor (1918a) recorded only *Python reticulatus* for Jolo, he found several more species in the following years (Taylor, 1918b, 1919, 1922a,b,c, 1923). Leviton (1963) lists 13 land snake species for this island. On the other islands none or very few further records have been made. Even for Tawitawi, the second largest island (229 square miles), only two species of land snakes are listed in Leviton (1963).

Recent observations on the distribution of land snakes on some islands of the Sulu Archipelago are given here, contributing considerably to their fragmentary snake lists. A new endemic subspecies of *Dendrelaphis caudolineatus* (Gray, 1834) is described. The dispersal routes of the listed snakes are discussed, emphasizing the special position which this island group holds as a transitional zone between Borneo and the Philippines.

MATERIAL AND METHODS

During three excursions to the Sulu Archipelago in 1990, 1991, and 1992 the following islands were visited: Bongao, Sanga Sanga, Siasi, Sibutu, and Tawitawi (Fig. 1). The time spent on each of these islands varied between almost three weeks on Sibutu, and less than a week on Siasi. Therefore the number of species which were detected on each island is correlated to the observation time, not the actual number of species present. Records are mainly based on sightings. If possible, specimens were caught for closer examination and photographic records. A few specimens were preserved, including dead or badly injured ones brought by inhabitants, and those which could not be identified in the field. Observations on habitat, relative abundance, and behaviour were recorded. The field investigations were supplemented by examination of material from the herpetological collection of the "Forschungsinstitut und Naturmuseum Senckenberg" (SMF). Additional material for Tawitawi, collected by the Noona-Dan expedition from Denmark, which visited the island in 1961, was examined in the Zoological Museum in Copenhagen, Denmark (ZMUC).

RESULTS

The species recorded are listed below, and their previously known and newly determined distribution within the Philippines is given. New island records are marked with an asterisk, and all the Sulu Islands are italicised. A species' occurrence on Borneo is mentioned, but its distribution elsewhere in Asia is not given since this is of little importance for the discussion of the direct zoogeographical relation of the Sulu Archipelago.

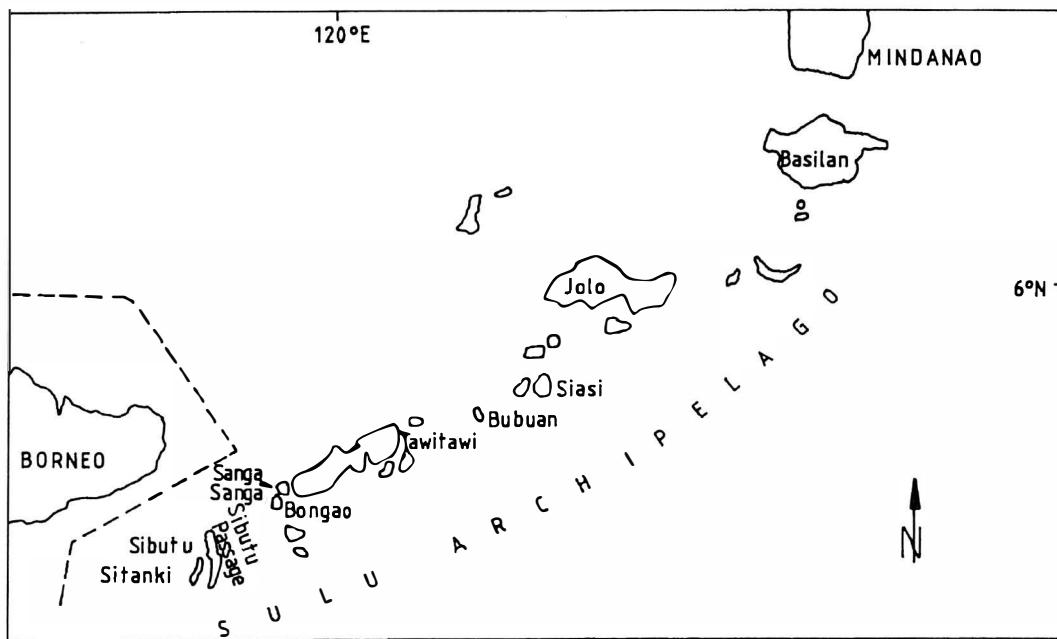


FIG. 1. Sulu Archipelago, generalized map of the study area.

A list of the visited islands and their known land snake fauna, determined from the previous and new records, is added as Appendix I.

SPECIES LIST:

Python reticulatus (Schneider, 1801).

Range: Basilan, Bohol, *Bongao**, Cebu, *Jolo*, Leyte, Luzon, Mindanao, Mindoro, Negros, Palawan, Panay, Polillo, Samar, *Siasi**, *Sibutu*, *Tawitawi*. Borneo.

Remarks: The reticulated python is widespread in the Sulu Archipelago, and will certainly be found on several more islands. It is not restricted to a special habitat. On Sibutu an adult specimen was observed in a cave at the coastline, and on Tawitawi a juvenile was seen in secondary forest. On Bongao and Siasi pythons were kept as pets by villagers, who had caught them near their homes. However, I was informed by inhabitants that the populations are decreasing because of continued hunting for its skin.

Ahaetulla prasina suluensis Gaulke, 1994.

Range: *Bongao*, *Sanga Sanga*, *Siasi*, *Sibutu*, *Tawitawi*.
Material: SMF 74298-9, 74844-5, 74870-2, 75059-60, 75231.

Remarks: This recently described subspecies of the Malaysian vine snake is one of the most common snakes on all of the visited islands. Like the other subspecies, this diurnal, arboreal snake inhabits primary and secondary forest, bushland and bamboo forest. It was observed several times at night sleeping on riverside trees. It was seldom found on the ground, e.g. if crossing a trail.

Malaysian vine snakes were reported from the Sulu Archipelago previously, including the nominate race

A. p. prasina (Boie, 1827) from Sibutu (in Gaulke, 1994, transferred to *A. p. suluensis*), and the Philippine subspecies *A. p. preocularis* (Taylor, 1922) from Jolo (in Leviton 1963).

Boiga cynodon (Boie, 1827).

Range: Basilan, Culion, Dinagat, Leyte, Luzon, Mindanao, Palawan, Polillo, *Sibutu*, *Tawitawi**. Borneo.

Material: SMF 74304, ZMUC R63877.

Remarks: This large, nocturnal and aboreal cat snake is reported from Sibutu (Gaulke, in press). Examination of the Noona-Dan expedition material has also revealed a specimen from Tawitawi (ZMUC R63877). In spite of its wide distribution in Southeast Asia, the poorly known dog-toothed cat snake, seems to be confined to primary forest. Since deforestation is almost complete on the islands of the Sulu Archipelago, it must be considered as endangered in the region.

Boiga drapiezii drapiezii (Boie, 1827).

Range: *Tawitawi**. Borneo.

Material: ZMUC R631170.

Remarks: The Noona-Dan expedition material contains a juvenile Boiga from Tawitawi (ZMUC R631170), whose head and neck are unfortunately badly battered. The determinable features are as follows: About 255 ventrals, 140 subcaudals, and 19 midbody scale rows. Dorsal colour light brown with 67 dark transverse bars across the back, not extending onto the belly. Inconspicuous lighter blotches on border between dorsals and ventrals. Tail lighter than back, without dark bands, but 20 whitish blotches both sides along border of ventrals. Belly slightly lighter than

back, heavily powdered with darker speckles, dark stripes along the edges.

The closely related forms *Boiga angulata* (Peters, 1861), *Boiga d. drapiezii* and *B. d. schultzei* Taylor, 1923 are distinguished from each other by head scalation, and therefore the identity of the Tawitawi specimen cannot be determined by this feature. Mindanao is the nearest locality from which the rare *B. angulata* is known, while on Borneo, which is much closer to Tawitawi, *B. d. drapiezii* occurs. On Palawan, which like the Tawitawi group is geographically and zoogeographically very close to Borneo, but geographically separated from the Sulu Archipelago, another subspecies of *B. drapiezii* occurs (*B. d. schultzei*). The relations between the three forms, especially the specific status of Philippine *B. angulata*, are still under discussion (see Leviton, 1970). Because of the close faunistic relation between Tawitawi and Borneo, the complete geographic separation from Palawan, and the wide separation between Tawitawi and Mindanao, the snake from Tawitawi almost certainly belongs to the nominate form, which is the most widespread and common of the three forms. This determination is strongly supported by an unpublished determination key (pers. com. J. B. Rasmussen/Copenhagen, 1993; key system based on Kroon). *B. angulata* and *B. d. schultzei* have unstriped bellies, while *B. d. drapiezii* has a pair of dark stripes on the belly. These stripes are present in the specimen under discussion.

This record adds another species to the Philippine herpetofauna.

Chrysopelea paradisi paradisi Boie 1826.

Range: Sibutu. Borneo.

Material: 74300-3.

Remarks: Although in most publications they are just named as *C. paradisi*, all other known records of the paradise tree snake from the Philippines, refer to the Philippine subspecies *C. p. variabilis* Mertens, 1960. The nominate form was only recently detected on Sibutu (Gaulke, in press). This diurnal, arboreal snake is rather common in the forest and coconut plantations on Sibutu.

Chrysopelea paradisi variabilis Mertens 1960.

Range: Balabac, Bantayan, Banton, Basilan, Bongao*, Bubuan, Camiguin, Cebu, Dinagat, Jolo, Kalotkot, Leyte, Luzon, Marongas, Medis, Mindanao, Mindoro, Negros, Palawan, Polillo, Samar, Sanga Sanga*, Sibuyan, Siquijor, Tawitawi*.

Material: SMF 74779, 75175, ZMUC R63880.

Remarks: The distribution of this widespread Philippine form was extended to three more islands of the Sulu Archipelago, and it will certainly be found on several more in the future. Like the nominate form, it inhabits forests and coconut plantations. On Sanga Sanga one specimen was found basking on a fence just 1 metre above ground.

Dendrelaphis caudolineatus caudolineatus (Gray, 1834).

Range: Balabac, Busuanga, Candaraman, Palawan, Sibutu. Borneo.

Material: SMF 74296-7, 74375.

Remarks: The range of this snake in the Philippines is confined to the Palawan province and the westernmost island group of the Sulu Archipelago, where it was recently discovered (Gaulke, in press). This diurnal snake is relatively common on Sibutu. It was mostly observed climbing on bushes and trees in the forest and shrublands, and seldom seen on the ground.

Dendrelaphis caudolineatus flavescens nov. subsp.

Range: Bongao*, (Bubuan), Sanga Sanga*, Tawitawi*. The island in parenthesis is a distribution record for *D. modestus* Boulenger, 1894 (now *D. c. modestus*) given by Taylor (1922a). As the discussion will show, it belongs to the newly described subspecies.

Holotype: SMF 74846, female, Sanga Sanga, Sulu Archipelago, Philippines.

Paratypes: SMF 75174 (Sanga Sanga), SMF 75173 (Bongao), ZMUC R60763 (Tawitawi).

Diagnosis: *Dendrelaphis caudolineatus flavescens* is characterized as follows: No hint of black stripes on back, sides of head, or underside of tail; a very conspicuous, broad, metallic orange-yellow band extends from both sides of the neck along the anterior part of the body; eyes large; ground dwelling.

Derivatio nominis: *flavescens* because of the yellowish band.

Description of holotype: The elongate head is distinct from body. Rostral wider than high, pointed behind, visible from above. Internasals as broad as long. Large prefrontals, wider than deep, longer than internasals. Frontal as long as its distance from end of snout, widening anteriorly. Supraoculars as long as frontal, widening posteriorly. Parietals longer than frontal, longer than wide. Nasal completely divided into a smaller anterior and a larger posterior part. One loreal, much longer than high. One big preocular and two postoculars, the superior larger and the inferior in contact with anterior temporals. Temporals on right side 1+2+2, left 2+2+2, increasing in size posteriorly. Nine upper labials, numbers 5 and 6 entering orbit. The seventh upper labial is positioned below the orbit, but is excluded from it because the 6th is much prolonged posteriorly at its upper part (Fig. 2). Nine lower labials right, 10 left, the first 5 touching anterior chin shields. Diameter of eye greater than its distance from nostril, pupil round. 15 scale rows around neck, 13 around midbody, and 11 before tail. The median scale row is slightly enlarged. There are 178 ventrals, a divided anal, and 103 paired subcaudals. Snout-vent length 930 mm, tail-length 33 mm. Colour in life: Back dark olive brown, head and anterior part of body slightly darker than rest. Dorsal scales with darker edges. Supralabials yellowish, with brown borders between

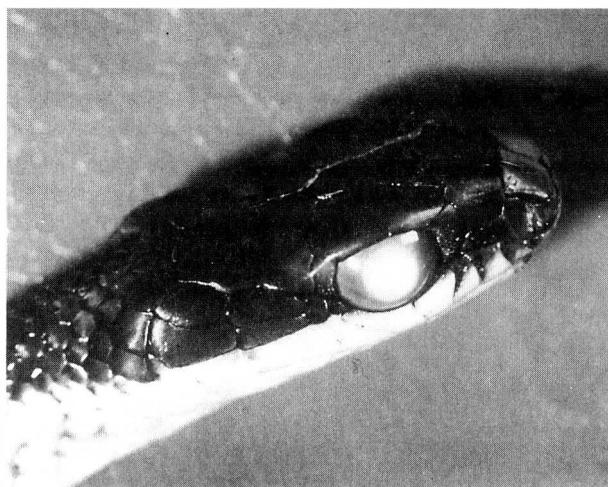


FIG. 2. Portrait of *Dendrelaphis caudolineatus flavesiensis* nov. ssp. (SMF 74846). Notice the lack of a black ocular stripe and the big eye.

the first four. A broad metallic orange-yellow band extends from behind the head about 9 cm backwards, to the 32nd ventral. This band covers the lowest three dorsal scale rows anteriorly, and reduces to two scale rows posteriorly. The ventral side is greenish yellow. *Colour in alcohol:* The metallic orange-yellow stripe fades quickly in alcohol; however, it remains visible as a lighter band. The greenish yellow tinge of the ventral side becomes a dirty greyish white.

Variation: There is no significant difference between the four specimens at hand. The juvenile (ZMUC R60763) has the same colouration as the adults, and also lacks completely any dark stripes. For measurements and scale counts see Table 1.

Discussion: Taylor (1922a) assigns an unstriped olive brown form of *Dendrelaphis*, which he detected on Palawan, Mindoro, Negros, and Sulu (Bubuan), to *D. modestus*. He considered it to be sympatric with *D. caudolineatus* on Palawan, and with *D. terrificus* (Peters, 1872) on Mindoro and Negros. Meise & Hennig (1932) regard these three forms as subspecies of *Dendrophis* (= *Dendrelaphis*) *caudolineatus*, therefore excluding a sympatric occurrence. They considered Taylor's (1922a) Philippine *D. modestus* to be only a colour variant of *D. c. terrificus*, especially as they do not have the higher ventral counts typical for *D. c. modestus*. Leviton (1968), who differentiates *D. c. terrificus* into two subspecies (the northern *D. c. luzonensis* Leviton, 1968 and the southern *D. c. terrificus*), agrees with Meise & Hennig (1932) in the evaluation of the unstriped Philippine *Dendrelaphis*. He regarded it as a colour variation of *D. c. terrificus* and, more seldom, of his newly described *D. c. luzonensis*. Leviton (1968) mentions that this colour variety lacks dorsal stripes, but has a well developed black stripe along the middle of the ventral surface of the tail.

The examination of three *D. c. modestus* from the SMF collection (SMF 18637-9, from Batjan) showed that they have a well developed black ocular stripe (as all described subspecies of *D. caudolineatus*), and at least the indication of a stripe along the underside of the tail.

Taylor (1922a) recognized a difference in the unstriped *Dendrelaphis* between the Sulu Archipelago and the rest of its Philippine distribution. He writes (1922a:173): "The greatest variation found in the Philippine specimens of this species (meaning *D. modestus*) occurs in one from Bubuan Island, Sulu Archipelago. An orange stripe is present in life behind the eye, continuing some distance on the neck. This stripe is formed by a wash colour over the greenish ground colour and disappears largely in alcohol. The eye is larger, its diameter greater than distance from eye to nostril.....". This stripe should not be confused with the yellowish lateral band considered by Meise & Hennig (1932) as a distinguishing feature for *D. caudolineatus* in general. This is a small, non-metallic stripe, sharply bordered by two black stripes, which runs the entire body length, and does not occur in the new subspecies.

	SMF 74846	SMF 75174	SMF 75173	ZMUC R60763
SVL(mm)	93.0	72.0	80.0	31.6
TL(mm)	33.0	26.5	26.3	11.7
Ventrals	178	171	172	171
Subcaudals	103	108	95 (Tm)	104
Supralabials	9/9	9/9	9/9	9/9
Supralabials entering eye	56	56	56	56
Sublabials	9/10	10/10	10/10	10/10
Preoculars	1	1	1	1
Postoculars	2	2	3	2
Loreals	1	1	1	1
Temporals	122/222	222/222	222/222	222/222
Scale rows:				
neck	15	17	17	15
midbody	13	13	13	13
tail	11	11	13	11

TABLE 1. Measurements and scale counts of *Dendrelaphis caudolineatus flavesiensis* nov. ssp. (Tm, tip missing.)

The broad metallic orange band, and the complete lack of black stripes not only on the back but also on the underside of the tail and the headsides, clearly separates the new subspecies from all other forms of *D. caudolineatus*, including the unstriped varieties of *D. c. terrificus* and *D. c. luzonensis*. It does not occur sympatrically with other forms of *D. caudolineatus*.

Differences from closest forms: From *D. c. modestus* the new form differs in having larger eyes, no hint of a black stripe under the tail, no ocular stripe, and lower ventral and subcaudal counts. From *D. c. terrificus* it differs in the lack of black stripes on the body, head and underside of tail, and it is bulkier in appearance. *Range:* The new subspecies is only known from the western part of the Sulu Archipelago (Bongao, Bubuan, Sanga Sanga, Tawitawi). Its range is separated by the Sibutu Passage from the nominate form, which is widespread on Sibutu. Since no *D. caudolineatus* is known yet from the Jolo group, its exact range to the northeast remains open. The Philippine *D. c. terrificus* occurs on Basilan and Mindanao. The occurrence of *D. c. terrificus* on Sitanki (Sibutu group) (a juvenile snake, Leviton, 1963) must seriously be doubted. Either it is an accidentally introduced specimen, as assumed by Leviton (1963), or it is a not yet completely marked, or abnormally marked specimen of the nominate form, which is abundant on the nearby island of Sibutu.

Observations: It is not a rare snake. In all, 10 specimens were sighted, but as it is a very fast snake, few were caught. All sighted snakes agreed in their colouration, showing no hint of black stripes on their back or head, but having a conspicuous yellowish band on the sides. Besides the difference in colouration, there is presumably an ecological difference from other subspecies. While all other forms are mainly arboreal, climbing in trees and bushes, all sighted specimens of *D. c. flavescens* were observed on the floor of primary and secondary forest. One snake was basking on a small trail leading up to Bongao Peak. When disturbed, it reared like a cobra, displaying its beautiful orangish neck sides. It is assumed that these markings may have a warning function.

One specimen on Tawitawi was observed hunting for locusts between stones and rotten logs in the forest. It caught several grasshoppers before being disturbed, and then quickly disappeared into the undergrowth. Another specimen was seen crawling over leaf litter, and SMF 75173 was found run over by a car on the street in front of Bongao Hill. It was the only one seen outside the forest.

SMF 75174 was kept alive in a terrarium for about 12 months. It behaved very calmly, feeding on live geckos. Locusts and mice were not taken. One morning it was found dead; the reason is unknown.

Dendrelaphis pictus pictus (Gmelin, 1789).

Range: Bohol, Bongao*, Busuanga, Cagayan Sulu, Cebu, Culion, Guimaras, Jolo, Lapac, Luzon,

Mindanao, Mindoro, Negros, Palawan, Panay, Polillo, Samar, Siargao. Borneo.

Material: SMF 74780-3.

Remarks: Considering the wide distribution of this snake and its high abundance on many Philippine Islands, it is surprising that it is known from comparatively few of the Sulu Islands. This climbing and ground dwelling snake is found in cultivated areas, and along forest edges and riversides.

Elaphe erythrura erythrura (Duméril, Bibron & Duméril, 1854).

Range: Bohol, Camiguin, Dinagat, Jolo, Mindanao, Pacijan, Polillo, Ponson, Poro, Samar, Siasi*.

Remarks: Only one specimen of this large, diurnal, ground dwelling snake was sighted on Siasi. However, it normally is not a rare snake, inhabiting forested as well as cultivated areas.

Elaphe erythrura philippina Griffin, 1909.

Range: Balabac, Bongao, Busuanga, Culion, Palawan, Sanga Sanga*, Sibutu, Tawitawi*.

Material: SMF 74305-6, 74784, 74847.

Remarks: This subspecies is confined to the westernmost islands of the Philippines (Palawan Province and Tawitawi group), close to Borneo. Therefore it can be expected that it will be detected on Sabah in future, from where it most probably originated, as already assumed by Leviton (1963). It occupies the same habitats as the nominate form, and is relatively common.

Gonyosoma oxycephala (Boie, 1827).

Range: Balabac, Bohol, Bongao*, Dinagat, Lubang, Luzon, Mindoro, Negros, Palawan. Borneo.

Material: One snake from Bongao, kept alive at the "Forschungsinstitut Senckenberg."

Remarks: This snake was not previously recorded from the Sulu Archipelago, not even from the Mindanao region. However, it can be expected on several more of the islands. Even though this arboreal snake is very large, and looks very conspicuous in captivity, it is seldom found in the Philippines. This is probably due to its habitat in the tree canopies, where it is well camouflaged with its bright green colouration.

Oligodon meyerinkii (Steindachner, 1891).

Range: Bongao, Jolo, Papahag, Sibutu, Tawitawi.

Material: SMF 19213, 74281-2, 74791, 75057-8.

Remarks: This kukri snake is one of the few snake species confined to the Sulu Archipelago, being distributed on the Tawitawi and Jolo groups. No range extention was recorded, but its presence on Bongao, Sibutu, and Tawitawi was confirmed. The specimens from Sibutu show no external morphological differences to the striped kukri snake (*O. octolineatus* [Schneider, 1801]), which is widely distributed in Malaysia and Indonesia, including Borneo. For discussion see Leviton (1962) and Gaulke (1993b).

These small, ground dwelling and burrowing snakes are not rare in their habitat. However, since they are confined to the forest floor, they must be considered as endangered, together with the rapidly vanishing forest.

Sibynophis geminatus geminatus Boie, 1827.

Range: Tawitawi. Borneo.

Material: SMF 74249.

Remarks: Only one specimen of this species was found in the Philippines previously (Gaulke, 1993a). It came from a still undisturbed forest in the vicinity of Languyan/Tawitawi, where it was found at a river bank. Not much is known about this small, obviously rare and secretive snake, and it is not surprising that it has escaped detection on the Philippines for so long. However, as other regions of the Philippines are explored much more intensively, it can be assumed that it is confined to the Sulu Archipelago, or even the Tawitawi group in the Philippines. Its relation to the polyodont snake found on Palawan province (*S. bivittatus* [Boulenger, 1894]) is discussed in Gaulke (1993).

Xenopeltis unicolor Reinwardt, 1827.

Range: Balabac, Bongao, Jolo, Palawan, Sanga Sanga*. Borneo.

Material: SMF 75222.

Remarks: On Sanga Sanga a burned specimen was found in a dried and burned mangrove swamp near the coastline. On Bongao Peak a sunbeam snake was observed swallowing an *O. meyerinkii*, lying half-buried under the leaf litter of the forest floor.

Observations in other regions show that they also live under coconut debris and in village gardens.

Maticora intestinalis suluensis (Steindachner, 1891).

Range: Jolo, Siasi*.

Material: SMF 74873.

Remarks: According to present knowledge this subspecies of the banded Malaysian coral snake is confined to the Jolo and Tapul group in the Sulu Archipelago. It seems to be a very rare snake. On Siasi, from where it was not known before, one specimen was found under leaf litter at the forest edge. This small, burrowing snake is one of two dangerously poisonous snakes known from the Sulu Archipelago.

Tropidolaemus wagleri (Boie, 1827).

Range: Balabac, Basilan, Calamianes, Dinagat, Jolo, Leyte, Luzon, Mindanao, Negros, Palawan, Samar, Siasi*, Sibutu, Tawitawi*. Borneo.

Material: SMF 74283-5, 74307-8, 74874-6, 74901.

Remarks: Until recently (Gaulke, in press), Wagler's pit viper was unknown from the Tawitawi group, but is now found to be a rather common snake on Sibutu and Tawitawi. It will certainly be found on other islands as well. The highest abundance of this nocturnal and ar-

boreal snake was observed on Siasi (Tapul group), where it appeared to be the most common snake. It inhabits forests as well as fruit (e.g. mango trees) plantations and bamboo forest. During the daytime it rests motionless on a branch, and therefore is easily overlooked. The stomach of one big specimen from Siasi contained two large rats. These poisonous but not aggressive snakes are beneficial to men.

Rhamphotyphlops suluensis (Taylor, 1918).

Range: Basilan, Bubuan, Sibutu.

Remarks: The recent record of this poorly known blind snake from Sibutu (Gaulke, in press) extends its range from Basilan throughout the Sulu Archipelago. However, it remains known from very few places. It is a relatively large, arboreal blind snake. During the night it was observed actively climbing across branches. It was not rare on Sibutu. However, like all species which are confined to forests, its continued existence is highly endangered by deforestation.

DISCUSSION OF DISPERSAL ROUTES

The islands of the Sulu Archipelago lie on a high submarine shelf (that is about 50 m below sea level), extending from Zamboanga province (western Mindanao) southwards. Between Bongao and Sibutu there is an abrupt drop to a depth of about 300 m. This Sibutu Passage (see Fig. 1) seems to be geologically young, having formed after the mid-Pleistocene (Voss, 1974). This island chain has probably formed a continuous land connection between Borneo and the Philippines during the height of the Pleistocene glaciations (Brown & Alcala, 1970; Dickerson, 1928; Inger, 1954; Leviton, 1963; Wang & Wang, 1990). Of the two former land connections between Borneo and the Philippines, Palawan in the north and the Sulu Archipelago in the south, the latter is generally considered as the more important entryway for herptiles (e.g. Brown & Alcala, 1970; Inger, 1954; Leviton, 1963).

Leviton (1963) divides the land snakes of the Philippines into five districts. The Sulu Islands (district four) are a transitional region between Borneo and the Philippines, with elements of the Philippine fauna migrating southwest towards Borneo, and Bornean elements migrating northeast towards the Philippines. According to him, the small size of the Sulu Islands and the periodic inundation of many of them is responsible for the scarcity of snakes. As the new investigations show, these islands shelter a richer snake fauna than expected by Leviton (1963). Therefore we now have better evidence to demonstrate the role which this island group holds as a former entryway to the Philippines, and as a present transitional zone between both regions.

Fig. 3 shows the recent distribution of the listed snakes. Even though no new investigations took place on Jolo, this island is included, because it is the biggest

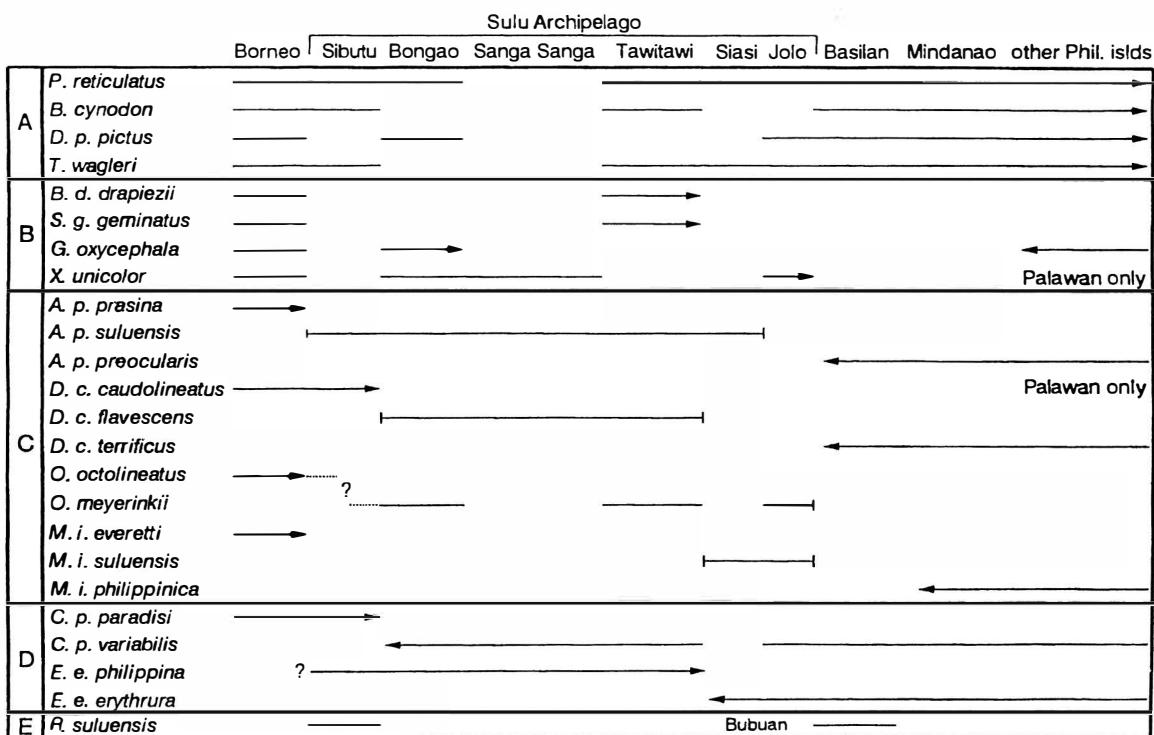


FIG. 3. Distribution and dispersal routes of the observed snakes. Lines indicate the known range, arrows the direction of migration.

A: This group includes species/subspecies which are widespread on Borneo and the Philippines, and occur on the Sulu Archipelago. None of these snakes originate in the Philippines. Therefore it can be concluded that the Sulu Islands functioned as a migration route from Borneo to the Philippines.

B: This group includes Bornean species/subspecies, which are found on the Sulu Archipelago, but to our present knowledge neither on Basilan nor on Mindanao. *Sibynophis* and *Xenopeltis* have presumably never dispersed to the more eastern islands of the Philippines, since they are known only from the Sulu Archipelago and Palawan. A close relative of *B. drapiezii*, *B. angulata*, inhabits several Philippine Islands. It can be assumed that its progenitor reached the Philippines via the Sulu bridge, and the recent population of *B. drapiezii* on Tawitawi attributes to a more recent immigration from Borneo. As long as *G. oxycephala* is not recorded on Mindanao, it is more likely that it has occupied the Philippines via Palawan.

C: This group includes snakes which are endemic to the Sulu Archipelago. The nearest Bornean and Philippine relatives are also figured.

D: This group includes two species, which are represented on the Sulu Archipelago by two different subspecies. One subspecies came from Borneo, the other from the Philippines.

E: *R. suluensis* has a scattered distribution on the Sulu Archipelago and Basilan. Its closest relative, *R. olivacea* (Gray, 1845) is known from Borneo and the Philippines. It is possible that the dispersal of this blind snake took place via the Sulu route, and the population of this area became isolated later on, developing into a new species.

island of the Sulu Archipelago, and its snake fauna is fairly well known. The arrows indicate the direction from which the represented species presumably occupied the Sulu Islands.

As shown in Fig. 3, the Sulu Archipelago cannot be considered as a closed faunistic unit at present. In general the Bornean influence is stronger than the Philippine one, with two Bornean forms being known from nowhere else within the Philippines (*B. d. drapiezii* and *S. g. geminatus*). However, there are several gradations. While the snake fauna of Sibutu is closest to Borneo (*C. p. paradisi* and *D. c. caudolineatus*), the Philippine influence becomes stronger on the rest of the Tawitawi group (*C. p.*

variabilis), and adds another Philippine element on Siasi (Tapul group, *E. e. erythrura*). However, even on Sibutu a typical Sulu element (*A. p. suluensis* can be found, with more endemic forms on the rest of the islands (*D. c. flavescens*, *O. meyerinkii* and *M. i. suluensis*). At present, with even the few remaining forests on these small islands quickly vanishing, a change in the snake fauna will take place. While some of the specialized forest dwellers (e.g. *O. meyerinkii*, *R. suluensis*, *D. c. flavescens* and *M. i. suluensis*), including most of the endemic forms, will have little chance of survival, other more opportunistic ones like *D. p. pictus*, *E. erythrura*, or *T. wagleri* will continue their dispersal.

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REFERENCES

- Brown, W. C. & Alcala, A. C. (1970). The zoogeography of the herpetofauna of the Philippine Islands, a fringing archipelago. *Proc. Cal. Acad. Sci.*, fourth series, **38**, 105-130.
- Dickerson, R. S. (1928). Distribution of life in the Philippines. *Phil. Bur. Sci.* **21**, 1-322.
- Gaulke, M. (1993a). First record of the polyodont snake *Sibynophis geminatus geminatus* (Boie, 1826) from the Philippines, with a discussion of *Sibynophis bivittatus* (Boulenger, 1894). *Herp. J.* **3**, 151-152.
- Gaulke, M. (1993b). Zur Taxonomie und Biologie von *Oligodon meyerinkii* (Steindachner, 1981). *Sauria* **3**, 3-6.
- Gaulke, M. (1994). Eine neue Unterart des Malaysischen Baumschnüfflers, *Ahaetulla prasina suluensis* n. subsp.. *Senckenbergiana biologica* **73**, 45-47.
- Gaulke, M. (in press). Die Herpetofauna von Sibutu-Island (Philippinen), unter Berücksichtigung zoogeographischer und ökologischer Aspekte. *Senckenbergiana biologica*.
- Inger, R. F. (1954). Systematics and zoogeography of Philippine amphibia. *Fieldiana Zoology* **33**, 183-531.
- Leviton, A. E. (1962). Contributions to a review of Philippine snakes, 1 - The snakes of the genus *Oligodon*. *Phil. J. Sci.* **91**, 459-484.
- Leviton, A. E. (1963). Remarks on the zoogeography of Philippine terrestrial snakes. *Proc. Cal. Acad. Sci.*, fourth series, **31**, 369-416.
- Leviton, A. E. (1968). Contributions to a review of Philippine snakes, XII - The Philippine snakes of the genus *Dendrelaphis*. *Phil. J. Sci.* **97**, 371-394.
- Leviton, A. E. (1970). Contributions to a review of Philippine snakes, 11 - The snakes of the genus *Boiga*. *Phil. J. Sci.* **97**, 291-314.
- Meise, W. & Hennig, W. (1932): Die Schlangengattung *Dendrophis*. *Zoologischer Anzeiger* **99**, 273-297.
- Taylor, E. H. (1918a). Reptiles of Sulu Archipelago. *Phil. J. Sci.* **13**, 233-269.
- Taylor, E. H. (1918b). Two new species of the genus *Holarchus* with descriptions of other Philippine species. *Phil. J. Sci.* **13**, 359-369.
- Taylor, E. H. (1919). New or rare Philippine reptiles. *Phil. J. Sci.* **14**, 105-123.
- Taylor, E. H. (1922a). The snakes of the Philippine Islands. *Phil. J. Sci.* **16**, 1-312.
- Taylor, E. H. (1922b). Additions to the herpetological fauna of the Philippine Islands, 1. *Phil. J. Sci.* **21**, 161-206.
- Taylor, E. H. (1922c). Additions to the herpetological fauna of the Philippine Islands, 2. *Phil. J. Sci.* **21**, 257-303.
- Taylor, E. H. (1923). Additions to the herpetological fauna of the Philippine Islands, 3. *Phil. J. Sci.* **22**, 515-557.
- Voss, F. (1974). Geology and geomorphology of the Sulu Archipelago. *Z. Geomorph. N. F.* **18**, 389-406.
- Wang, L. & P. Wang (1990). Late Quaternary paleoceanography of the South China Sea: glacial-interglacial contrasts on an enclosed basin. *Paleoceanography* **5**, 77-90.

APPENDIX I
ISLAND LISTS (COMPILED FROM NEW AND PREVIOUS RECORDS)

BONGAO ISLAND

Bongao is a small island in the south of the Tawitawi group. Only little forest remains on the upper part of Bongao Peak (330 m). Observations took place on Bongao Peak, and in the shrub and bushlands around the city of Bongao.

Python reticulatus

Ahaetulla prasina suluensis

Chrysopela paradisi variabilis

Dendrelaphis caudolineatus flavescens

Dendrelaphis pictus pictus

Elaphe erythrura philippina

Gonyosoma oxycephala

Oligodon meyerinkii

Psammodynastes pulverulentus

Xenopeltis unicolor

Rhamphotyphlops braminus

Two of the snakes listed, *P. pulverulentus* and *R. braminus*, were not observed during the recent expeditions.

SANGA SANGA ISLAND

This island is situated between Bongao and Tawitawi. Observations were made in the partly forested area near Boloboc, and along the trail from the airport to the forest (through agricultural areas and bushlands).

Ahaetulla prasina suluensis

Dendrelaphis caudolineatus flavescens

Chrysopela paradisi variabilis

Elaphe erythrura philippina

Xenopeltis unicolor

No snakes were reported from here previously.

SIASI ISLAND

This small island belongs to the Tapul group, situated between the Tawitawi and Jolo groups. The last tiny forest can be found on Siasi summit. Observations were made around this area.

*Python reticulatus**Ahaetulla prasina suluensis**Elaphe erythrura erythrura**Maticora intestinalis suluensis**Tropidolaemus wagleri*

No snakes were reported from here previously.

SIBUTU ISLAND

This small island is separated from the Tawitawi group by the Sibutu Passage. It lies 29 km off the coast of Sabah/Borneo. Observations were made in the forest around Kaban Kaban, and on the small Sibutu Peak (165 m).

*Python reticulatus**Ahaetulla prasina suluensis**Boiga cynodon**Chrysopela paradisi paradisi**Dendrelaphis caudolineatus caudolineatus**Elaphe erythrura philippina**Oligodon meyerinkii**Tropidolaemus wagleri**Rhamphotyphlops suluensis*

The herpetofauna of Sibutu, including the snakes listed above, is published in Gaulke (in press).

TAWITAWI ISLAND

This is the second largest island of the Sulu-Archipelago (229 square miles), and still holds several forested areas. Observations were made in the forest of Langyan, Magsaggaw, and Tarawakan.

*Python reticulatus**Ahaetulla prasina suluensis**Boiga cynodon**Boiga drapiezii drapiezii**Chrysopela paradisi variabilis**Dendrelaphis caudolineatus flavescens**Elaphe erythrura philippina**Oligodon meyerinkii**Sibynophis geminatus geminatus**Tropidolaemus wagleri*

Only two species are reported in Leviton (1963), both of which could be observed in the recent investigations.

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