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The Snakes of the Lesser Sunda Islands (Nusa Tenggara), Indonesia

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Abstract From the existing literature and data from museum specimens an overview is presented of all currently known terrestrial and semi-aquatic snakes of the Lesser Sunda Islands, in the Wallacean area of Indonesia. In total, twenty-nine species are known to inhabit the area. Of these eight are endemic to the area: *Boiga hoeseli*, *Coelognathus subradiatus*, *Dendrelaphis inornatus*, *Stegonotus florensis*, *Cylindrophis opisthorhodus, Broghammerus timoriensis*, *Liasis mackloti* and *Typhlops schmutzi*. Insular endemism is only found at the subspecific level, including *Liasis mackloti dunni* (Wetar), *Liasis mackloti savuensis* (Sawu), *Ramphotyphlops polygrammicus brongersmai* (Sumba), *Ramphotyphlops polygrammicus elberti* (Lombok) and *Ramphotyphlops polygrammicus florensis* (Flores). Such endemism may be due to the relatively young geological age of the Lesser Sunda Islands and that the snake fauna is still underestimated. Taxonomy of the genus *Cylindrophis,* the species *Coelognathus subradiatus*, *Dendrelaphis inornatus*, *Cryptelytrops insularis*, and the five subspecies of *Ramphotyphlops polygrammicus* need to be reviewed. Ecological studies are urgently required to establish if the species *Broghammerus timoriensis* and *Liasis mackloti savuensis* are endangered and which conservation measures should be taken.

Abstrak Telah dilakukan pengamatan ulang dari kepustakaan yang ada, data dari databank Western Australian Museum, maupun koleksi museum. Hasil tersebut dirangkum dalam suatu tinjauan mengenai semua jenis ular yang hidup di darat maupun di air-tawar dari daerah Nusa Tenggara sebagai bagian dari daerah Wallacea. Jumlah jenis yang dapat dipastikan berjumlah dua puluh sembilan jenis, dan delapan di antaranya merupakan jenis yang endemik, yaitu *Boiga hoeseli*, *Coelognathus subradiatus*, *Dendrelaphis inornatus*, *Stegonotus florensis*, *Cylindrophis opisthorhodus, Broghammerus timoriensis*, *Liasis mackloti* dan *Typhlops schmutzi.* Jenis endemic dalam daerah pulau hanya meliputi anak jenis*: Liasis mackloti dunni* (Wetar), *Liasis mackloti savuensis* (Sawu), *Ramphotyphlops polygrammicus brongersmai* (Sumba), *Ramphotyphlops polygrammicus elberti* (Lombok) dan *Ramphotyphlops polygrammicus florensis* (Flores). Hal ini diperkirakan merupakan konsekuensi langsung dari sejarah geologi yang relatif singkat namun dapat juga disebabkan karena kekayaan jenis ular kurang dipelajari dengan lebih seksama. Kedudukan sistematik dari *Coelognathus subradiatus*, *Dendrelaphis inornatus, Cylindrophis boulengeri*, *C. opisthorhodus*, dan ke-lima subspecies *Ramphotyphlops polygrammicus* serta *Cryptelytrops insularis* perlu ditinjau kembali. Jenis-jenis yang diperkirakan terancam dan perlu perlindungan adalah jenis-jenis piton *Broghammerus timoriensis* dan *Liasis mackloti savuensis.* Penelitian ekologi perlu segara dilakukan untuk menentukan apakah jenis-jenis tersebut perlu perlindungan, dan juga tindakan konservasi yang mana bisa diambil.

Keywords Ophidia, serpents, Lesser Sunda Islands, Nusa Tenggara, Indonesia, Timor-Leste, checklist, distribution

1. Introduction

Indonesia is a country on an archipelago in tropical Southeast Asia with over 240 millions inhabitants as of January 2010 (Indonesian Central Bureau of Statistics, 2010), which consists of approximately 17,000 islands scattered around the equator between Peninsular Malaysia and Australia. It is one of the two countries in the world with ecosystems possessing the highest degree of biodiversity (Mittermeier *et al*., 1999). Its habitats and species are threatened by increasing demands of natural resources from a growing population, resulting in habitat destruction and species overexploitation by hunting and trading.

Indonesia is suspected to host the worldwide highest numbers of amphibian and reptile species. According to the Indonesian Biodiversity Action Plan 16% of the world's amphibian and reptiles occur in this country (BAPPENAS, 1993). However, in view of the alarming rate of deforestation and the low level of knowledge of its herpetofauna, much additional

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research is urgently required to collect information on which to base conservation measures. This is particularly acute in those parts of Indonesia where island areas are small and, as a consequence, extension of natural vegetation and absolute numbers of individuals for most of the species are already low. This applies for instance to eastern Indonesia, e.g., the Lesser Sunda Islands and the Moluccas (Iskandar and Erdelen, 2006).

The Lesser Sunda Islands, or Nusa Tenggara, is a chain of small islands ("stepping stones") between Bali and the Australo-Papuan region (Figure 1). This area belongs to the territory of the State of Indonesia, except for the sovereign state of Timor-Leste, located in the eastern part of Timor and on some islands nearby. This region is quite different from the other parts of Indonesia. The climate is drier and more seasonal, resulting in a different flora and fauna. Biogeographically, the area is very interesting because the fauna is a mixture of western and eastern elements. Many endemic or rare species inhabit the Lesser Sunda Islands and our picture of the fauna, including the herpetofauna, is still incomplete.

It is commonly known that the Komodo Dragon (*Varanus komodoensis*), the largest lizard in the world, is endemic to the area. However, three non-marine turtles that are less well known are present: *Chelodina mccordi*, *Cuora amboinensis* and *Pelodiscus sinensis* (Kuchling *et al*., 2007; Samedi and Iskandar, 2000; Shepherd and Ibarrondo, 2005). Interestingly, some amphibian species, such as *Oreophryne jeffersoniana* and *Kaloula baleata* from Komodo are able to overcome the problem of surviving the long dry season by aestivating (Auffenberg, 1980).

Most islands of the Lesser Sunda Islands group are very young geologically (1–15 million years old) and have never been connected to landmasses. This means that their flora and fauna began to evolve on independently. The islands can be classified into three types: 1) Young volcanic (oceanic) islands. Examples: Lombok, Sumbawa, Komodo, Flores, Solor, Adonara, Lomblen, Pantar, Alor and Wetar; 2) Nonvolcanic (oceanic) islands. Examples: Sawu, Roti and Semau; 3) Continental islands broken off from the Australian continental crust. Examples: Timor and Sumba.

Volcanoes are present on several islands. Almost half the area is mountainous with steep slopes: 59% of Lombok and Sumbawa, and 45% of the islands between Sumbawa and Wetar. Sumba is a level exception.

The most extensive vegetation types present are moist primary lowland and submontane forest, and forest on limestone rock. The forests are divided in relatively small patches, highly scattered over the islands. Remnants of monsoon forests (dry or moist deciduous forests, dry evergreen forests and thorn forests) are also present.

Wet zones with an annual rainfall of 100 mm or less during 0–4 months and dry zones with an annual rainfall of 100 mm or less during 9–12 months are spread over each island. Northwest monsoon winds bring from December to March a monthly rainfall of 200–400 mm at maximum. From April to September dry southeast tradewinds blow, bringing 0–100 mm rain per month. They are strongest and coolest in July and August, and

Figure 1 Map of the Lesser Sunda Islands

are intermediate from October to November. Diurnal temperatures are maximum at noon and decrease gradually to a minimum just before next day's sunrise. Maximum temperatures (35–38°C) usually occur during October and November and minimum (13–15°C) during July or August. Fluctuations in daily temperature are less in the wet season (December to March; 7–9°C) than in the dry season (July to August; 13°C) (Monk *et al*., 1997).

Based on faunal observations in the Indo-Australian archipelago, three biogeographic lines have been defined: Wallace's Line, Weber's Line and Lydekker's Line (Whitten *et al*., 1987) (Figure 2). The Malay Peninsula and the Greater Sunda Islands (Sumatra, Borneo and Java) as well as Bali belong to the former Sunda shelf, which is presently inundated in part. New Guinea and Australia were parts of the former Sahul shelf. Wallace's Line delimits the eastern boundary of the Asian fauna. Lydekker's Line delimits the western boundary of the Australian fauna. Both these lines effectively follow the 180–200 m depth contours of the Sunda and Sahul shelves. The area between the two lines, including Sulawesi, the Moluccas and the Lesser Sunda Islands has been nominated as a separate region, called Wallacea. This area has always been isolated. As a result a unique fauna developed, which is not a transition between the faunas of the two shelves, although a number of Papuan species reach their western limit in Wallacea and a number of Asian species reach their eastern limit here (Whitten *et al*., 1987).

The concordance in distribution has been examined for the snake species *Coelognathus subradiatus*, *Psammodynastes pulverulentus*, *Lycodon capucinus*, *Cryptelytrops insularis*, *Dendrelaphis inornatus* and *Dendrelaphis pictus* over the Lesser Sunda Islands of Lombok, Flores, Lomblen, Alor, Sumba and Wetar (How *et al*., 1996a, 1996b). It appeared that the populations of these snakes on Flores and Lomblen are more similar to one another than they are to conspecific populations on the adjacent islands to the east (Alor) or west (Lombok, Sumba). The data of this study show that the populations on islands, which were joined through land bridges during the Pleistocene, when sea le-vels were approximately 120 m lower than present (Flores and Lomblen), are more similar than those on islands, which remained isolated at that time by sea barriers (Lombok, Sumba, Alor). How and Kitchener (1997) calculated the geographic similarities of all land and fresh water snakes present on 36 Indonesian islands. They found two main groups: 1) the Greater Sunda Islands, the Lesser Sunda Islands, Sulawesi and the Banggai and Sula archipelagos, which have principally Asian snake genera and species, and 2) the islands of northern and southern Maluku, New Guinea and adjacent islands and Australia, which have principally Australo-Papuan genera and species. The major division in snake faunas appeared to be between the islands of Maluku in the east and Sulawesi and the Lesser Sunda Islands in the west, with the islands of the Banggai and Sula archipelagos linked to the former. Therefore the major boundary in the snake fauna of Indonesia is not Wallace's Line but Weber's Line. Within the Lesser Sunda Islands, Alor and Wetar had snake faunas more similar to Sawu, Roti, Semau and Timor on the Outer Banda Arc, than to the more westerly Sunda Islands Sumbawa and Moyo and the Inner Banda Arc Islands of Komodo, Flores, Lomblen and Pantar. Sumba was more closely linked to the Inner Banda Arc Islands Flores and Pantar than to any of the Outer Banda Arc Islands. Holloway (2003) reanalysed How and Kitchener's data, thereby nesting the snake faunas of smaller islands into those of larger ones, where possible. The faunas of Moyo and Pantar could be included into Sumba, and those of Komodo, Sumba and Lomblen into Flores. Sawu was included into Roti, Roti into Wetar and Wetar into Timor. Subsequently the data of Alor, Sumbawa, Flores, Lombok, Semau and Timor were analysed. The results agreed for the greater part with those of How and Kitchener but there were also differences. The snake fauna of Lombok was for instance more strongly associated with those of the Lesser Sunda Islands than with the Greater Sunda Islands Java, Sumatra and Borneo.

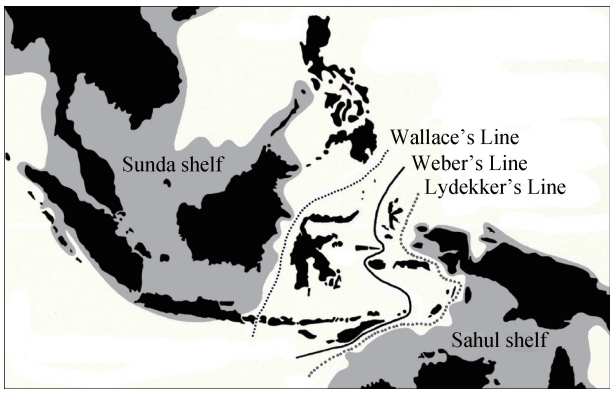

Figure 2 Biogeographic lines in the Indo-Australian archipelago

2. Material and Methods

All records of the Lesser Sunda Islands' terrestrial and semi-aquatic snake species in the scientific literature from 1837 up to and including December 2010, data collected during systematic surveys of the area by joint Western Australian Museum-Museum Zoologicum Bogoriense expeditions from 1987 to 1994, and data from museum specimens collected by the author, were reviewed and

stored in a database. A checklist of the snakes certainly inhabiting the area was prepared. The checklist data had to come from at least one, preferably two, independent and reliable sources. Sea snakes are not included.

The area covered consists of the Indonesian administrative province West Nusa Tenggara (enclosing the islands Lombok, Sumbawa and Moyo), the province East Nusa Tenggara (enclosing the islands Komodo, Padar, Rinca, Flores, Ende, Solor, Adonara, Lomblen, Pantar, Alor, Sumba, Sawu, Roti, Semau and West Timor), and the area of the independent state Timor-Leste (the eastern part of Timor). Bali is excluded because it lies west of Wallace's Line. The easternmost island Wetar is part of the Indonesian province the Moluccas. Nevertheless it is included, because its snake fauna belongs biogeographically to the area (How and Kitchener, 1997).

This paper precedes an illustrated field guide of the snakes of the Lesser Sunda Islands (In press).

3. Results

The checklist, containing 29 species, is presented in Table 1. In Table 2 the distribution of species over the islands is given. The occurrence of *Boiga hoeseli* on Rinca is a new record for this species (P. Hien, pers. comm.).

4. Discussion

Although the Lesser Sunda Islands have been surveyed for many years, the picture we now have of the snake fauna is an underestimate. There are still islands and places on islands that need to be explored and it is very likely that new species will be discovered. For example, recently a snake occurring on several of the Lesser Sunda Islands, so far referred to as *Boiga cynodon*, has proven to be a new species: *Boiga hoeseli* Ramadhan, Iskandar and Subasri, 2010.

In order to understand the particular characteristics of the snakes of the Lesser Sunda Islands, how they arrived there and how they evolved, many factors have to be taken into account, most importantly the geologic history, sea level changes, climatic shifts, habitat changes and human activities. It is difficult to determine the influence of these factors, for instance because of the complex tectonic history of the area with islands emerging and submerging and the occurrence of violent volcanic activities. It is also difficult to look further back than the Last Glacial Maximum in the late Pleistocene, about 20,000 years ago (Monk *et al*., 1997). The Lesser Sunda Islands, with the exception of Timor, are usually regarded as the products of subduction along the Banda Arc and of Neogene volcanism. However, the western Lesser Sunda Islands may have been built on Australian continental rocks (Michaux, 2010). Timor is composed of an Australian continental fragment and Asian material which gathered 2.4 Mya (Richardson and Blundell, 1996).

According to the equilibrium theory of island biogeography of MacArthur and Wilson (1969), the number of species (species richness) on islands is dependent on island size and the distance from a large land mass, ac-ting as a source of colonizing species. Smaller islands, far from a mainland source have fewer species than larger islands, close to it. However, this relationship is coarse. Other factors, such as isolation, topography, climatic zones, history of connection to other areas and history of volcanic emergence also play a role (Holloway, 2003). The theory also predicts that the islands in a chain stretc-hing from a larger land mass ("stepping stones") are a filter for the spread of populations. Each successive island, with larger distance from the mainland, is expected to contain fewer species. The latter effect has indeed been shown for the entire group of reptiles in the Lesser Sunda Islands from Bali in the west to the Aru Islands in the east. Sumba, Sawu, Roti, Semau and Timor are not included (Whittaker and Fernández-Palacios, 2007). The islands act in fact as a two-way filter. Species coming from the Asian as well as from the Australian-Papuan side are filtered.

The checklist (Table 1) indicates that there are 29 species of land and semi-aquatic snakes in the Lesser Sunda Islands. Species numbers for the larger islands are: Lombok 18, Sumbawa 16, Flores 18, Sumba 12 and Timor 14 (Table 2). These numbers are much lower than those of larger islands in the archipelago. This is in agreement with the theory. Sumatra, Borneo and Sulawesi for instance have respectively 134, 133 and 52 land and semi-aquatic snake species (Teynié *et al*., 2010; De Lang and Vogel, 2005; Stuebing and Inger, 1999).

Also according to the theory, two factors influence the occurrence of endemic species on an island: poor dispersal from a mainland leads to a high number of endemic species, and the longer island species have been isolated, the higher the taxonomic level of endemism. In the Lesser Sunda Islands snake fauna insular endemism occurs currently only at the subspecific level. Five islands have one endemic subspecies each: Lombok with *R. polygrammicus elberti*, Sumba with *Ramphotyphlops polygrammicus brongersmai*, Flores with *R. polygrammicus florensis*, Sawu with *Liasis mackloti savuensis* and Wetar with *Liasis mackloti dunni*. This is clearly a low level of endemism. The explanation for this is probably that the Lesser

Table 1 Checklist of the snakes of the Lesser Sunda Islands

Family Subfamily	Species	Endemics
Acrochordidae	*Acrochordus granulatus* (Schneider, 1799)	
Colubridae Colubrinae	*Ahaetulla prasina prasina* (Boie, 1827)	
	Boiga hoeseli Ramadhan, Iskandar and Subasri, 2010	E
	Coelognathus subradiatus (Schlegel, 1837)	E
	Dendrelaphis inornatus inornatus Boulenger, 1897	E
	Dendrelaphis inornatus timorensis Smith, 1927	E
	Dendrelaphis pictus (Gmelin, 1789)	
	Gonyosoma oxycephalum (Boie, 1827)	
	Lycodon capucinus Boie, 1827	
	Lycodon subcinctus subcinctus Boie, 1827	
	Oligodon bitorquatus Boie, 1827	
	Psammodynastes pulverulentus pulverulentus (Boie, 1827)	
	Sibynophis geminatus (Boie, 1826)	
	Stegonotus florensis (De Rooij, 1917)	E
Cylindrophiidae	*Cylindrophis boulengeri* Roux, 1911	
	Cylindrophis opisthorhodus Boulenger, 1897	E
Elapidae Elapinae	*Naja sputatrix* Boie, 1827	
Homalopsidae	*Cantoria violacea* Girard, 1857	
	Cerberus rynchops (Schneider, 1799)	
	Fordonia leucobalia (Schlegel, 1837)	
Pareatidae	*Pareas carinatus carinatus* Wagler, 1830	
Pythonidae	*Broghammerus reticulatus reticulatus* (Schneider, 1801)	
	Broghammerus timoriensis (Peters, 1876)	E
	Liasis mackloti dunni Stull, 1932	E – Wetar
	Liasis mackloti mackloti Dumeril and Bibron, 1844	E
	Liasis mackloti savuensis Brongersma, 1956	E -Sawu
	Python bivittatus bivittatus Kuhl, 1820	
Typhlopidae	*Ramphotyphlops braminus* (Daudin, 1803)	
	Ramphotyphlops polygrammicus brongersmai (Mertens, 1929)	E – Sumba
	Ramphotyphlops polygrammicus elberti (Roux, 1911)	E – Lombok
	Ramphotyphlops polygrammicus florensis (Boulenger, 1897)	E – Flores
	Ramphotyphlops polygrammicus polygrammicus (Schlegel, 1839)	
	Ramphotyphlops polygrammicus undecimlineatus (Mertens, 1927)	
	Typhlops schmutzi Auffenberg, 1980	E
Viperidae Crotalinae	*Cryptelytrops insularis* (Kramer, 1977)	
Viperidae Viperinae	*Daboia siamensis* (Smith, 1917)	

This list contains the species of terrestrial and semi-aquatic snakes, known to inhabit the Lesser Sunda Islands up to and including December 2010. Doubtful records as well as Sea Snakes are excluded..
Species endemic to the Lesser Sunda Islands are marked: E; island endemics are marked: E - island name.

Sunda Islands are geologically young with a relatively short duration of isolation and a restricted amount of time for the development of endemic species. We also have to realize that our picture of the snake fauna of these islands is not complete yet and that they have not been extensively studied using modern tools, such as genetic analysis and morphometrics. Therefore, endemism is probably underestimated.

Endemic to the region are eight species: *Boiga hoeseli*, *Coelognathus subradiatus*, *Dendrelaphis inornatus*, *Stegonotus florensis*, *Cylindrophis opisthorhodus*, *Broghammerus timoriensis*, *Liasis mackloti* and *Typhlops schmutzi*.

Other characteristics of snakes on islands are a smaller or greater size than that of their relatives on the mainland. Large species on the mainland tend to dwarfism on islands and small mainland species to gigantism on islands. This is possibly related to prey. Snakes on islands encounter larger or smaller preys than on the mainland (Boback, 2003; Boback and Guyer, 2003). The Lesser Sunda Islands data show two examples of dwarfism. *Liasis mackloti savuensis* from Sawu is significantly smaller than *L. mackloti mackloti* found on much larger islands. *Naja sputatrix* specimens from the area seem considerably smaller than those from Java.

The taxonomy of species in several genera is uncertain

Table 2 Distribution of the snake species of the Lesser Sunda Islands

	Lombok	Sumbawa	Moyo	Komodo	Padar	Rinca	Flores	Ende	Solor	Adonara	Lomblen	Pantar	Alor	Sumba	Sawu	Roti	Semau	West Timor	Timor-Leste	Wetar
Acrochordidae																				
Acrochordus granulatus				X			X											X	X	
Colubridae – Colubrinae																				
Ahaetulla prasina prasina	X	X																		
Boiga hoeseli	X	X		X		X	X						X	X						
Coelognathus subradiatus	X	X		X		X	X	X		X	X		X	X		X	X	X	X	X
Dendrelaphis inornatus inornatus		X	X	X	X	X	X				X			X	X					
Dendrelaphis inornatus timorensis												X	X			X	X	X	X	X
Dendrelaphis pictus	X																			
Gonyosoma oxycephalum	X																			
Lycodon capucinus	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Lycodon subcinctus subcinctus	X	X					X						X	X					X	
Oligodon bitorquatus		X																		
Psammodynastes p. pulverulentus	X	X		X	X	X	X				X		X	X						
Sibynophis geminatus	X																			
Stegonotus florensis							X							X						
Cylindrophiidae																				
Cylindrophis boulengeri																		X	X	X
Cylindrophis opisthorhodus	X	X		X			X													
Elapidae – Elapinae																				
Naja sputatrix	X	X		X		X	X				X		X							
Homalopsidae																				
Cantoria violacea																			X	
Cerberus rynchops	X	X		X		X	X				X			X	X	X		X	X	X
Fordonia leucobalia																		X		
Pareatidae																				
Pareas carinatus carinatus	X																			
Pythonidae																				
Broghammerus r. reticulatus	X	X					X					X	X	X				X	X	
Broghammerus timoriensis	X						X		X	X	X	X								
Liasis mackloti dunni																				X
Liasis mackloti mackloti													X			X	X	X	X	
Liasis mackloti savuensis															X					
Python bivittatus bivittatus		X																		
Typhlopidae																				
Ramphotyphlops braminus	X	X		X			X				X			X				X		
R. polygrammicus brongersmai														X						
R. polygrammicus elberti	X																			
R. polygrammicus florensis							X													
R. polygrammicus polygrammicus																		X	X	
R. polygrammicus undecimlineatus		X	X	X																
Typhlops schmutzi				X			X													
Viperidae – Crotalinae																				
Cryptelytrops insularis	X	X		X	X	X	X			X	X	X	X	X		X	X	X	X	X
Viperidae –Viperinae																				
Daboia siamensis				X		X	X	X	X?	X?	X									
Species total	18	16	3	14	4	9	18	3	2?	5?	10	5	10	12	4	6	5	12	12	7

X = Present; X? = Presence to be confirmed

and needs to be reviewed. The endemic Lesser Sundas Rat Snake (*Coelognathus subradiatus*) and Lesser Sundas Bronzeback (*Dendrelaphis inornatus*) are species complexes (R. How, pers. comm.). The morphological differences between the Pipe Snakes *Cylindrophis boulengeri* and *C. opisthorhodus* are small and it is possible that they are in fact subspecies of one species (Iskandar, 1998). Indonesian cobras of Sumbawa are morphologically different from those of Komodo and Flores (Wüster and Thorpe, 1989). The morphological differences among the five subspecies of *Ramphotyphlops polygrammicus* (*brongersmai, elberti, florensis, polygrammicus* and *undecimlineatus*) are so small, that we might be dealing here with one species. The White-lipped Island Pit Viper (*Cryptelytrops insularis*) from Wetar is morphologically different from those on the other islands of the Lesser Sundas (How *et al*., 1996b).

An interesting phenomenon of large variation of the dorsal colour was observed in the populations of two snake species. The specimens of the White-lipped Island Pit Viper (*Cryptelytrops insularis*) are bright green, yellow-green, leaf-green, olive, aqua-blue or yellow (Figures 3–5). Green forms of this species seem to be present on all islands. They are at least found on the islands of Lombok, Komodo, Rinca, Flores, Alor, Sumba, Roti, Timor and Wetar. The aqua-blue form seems to be restricted to Komodo. The yellow form was only found on Timor and Wetar. Individuals of the Indonesian Cobra (*Naja sputatrix*) were encountered in the colours light to dark brown, olive-yellow or greyish (Figures 6–8). Brownish forms were found on Lombok and Alor. The olive-yellow form was seen on Rinca and Flores. The greyish form was encountered on Rinca. So, it seems that there is one basic green colour form of *Cryptelytrops insularis,* but that other colour forms of this species and of *Naja sputatrix* have evolved on specific islands. More research is needed to determine the exact spread of these colour forms over the islands and the reasons for the occurrence of this phenomenon.

The most threatened taxa in need of conservation seem to be two pythons, both included in CITES Appendix II. The endemic Lesser Sundas Python (*Broghammerus timoriensis*), which is also included in the Indonesian Endangered Species List, seems to be rare (Yuwono, 1998). Habitat loss is probably the most important factor influencing the population size of the Sawu Python (*Liasis mackloti savuensis*) (Ibarrondo, 2006). Ecological studies are urgently required to establish if and to what extent these two species are endangered and which conservation measures could be taken.

5. Conclusions

1. Twenty-nine species of snakes are currently known to inhabit the Lesser Sunda Islands. Eight species are endemic to the area; insular endemism exists only at subspecies level for two subspecies of *Liasis mackloti* and three subspecies of *Ramphotyphlops polygrammicus*. Almost all snakes are from Asian origin. Only two species are from Australian-Papuan origin: *Liasis mackloti* and *Ramphotyphlops polygrammicus*.
2. The taxonomy of the genus *Cylindrophis*, the spe-

Figure 3 *Cryptelytrops insularis* from Komodo (Photo by P. Hien)

Figure 4 *Cryptelytrops insularis* from Komodo (Photo by P. Hien)

Figure 5 *Cryptelytrops insularis* from Timor-Leste (Photo by C. Trainor)

Figure 6 *Naja sputatrix* from Lombok (Photo by J.L. McKay)

Figure 7 *Naja sputatrix* from Rinca (Photo by P. Hien)

Figure 8 *Naja sputatrix* from Flores (Photo by M. Auliya)

cies *Coelognathus subradiatus*, *Dendrelaphis inornatus*, *Cryptelytrops insularis*, and the five subspecies of *Ramphotyphlops polygrammicus* needs to be reviewed.

3. The species *Cryptelytrops insularis* and *Naja sputarix* are found in different colour forms. More research is needed to determine the exact spread of these forms over the islands and the reasons for the occurrence of this phenomenon.

4. Ecological studies are urgently required to establish if the species *Broghammerus timoriensis* and *Liasis mackloti savuensis* are endangered and which conservation measures could be taken.

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