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SNAKES OF JAVA WITH SPECIAL REFERENCE TO EAST JAVA PROVINCE*

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The name of Java conjures mystery and romance. This wonderful tropical island, albeit the most densely populated in the world, with 800 people/km², lies a few degrees south of the equator. During a spell of four years working on rice storage problems in Indonesia I had the opportunity to survey the snake species of East Java. As many of Java's snakes are threatened by industrial pollution, the extensive use and over-use of pesticides, loss of habitat and over-collecting for skins, it seemed a good idea to attempt an inventory of species before many disappear. The snakes of West Java are relatively well known from the works of the Dutch colonial herpetologists, in particular, De Rooij, De Haas and Kopstein. However, Central and East Java have attracted rather less attention, the latter being of some interest as it has a more seasonal climate and would therefore be expected to show some faunal variations.

Java lics at the southern reaches of the zoogeographical region called Sundaland which includes the Malay Peninsular and the islands of Sumatra and Borneo. The boundary between Sundaland and continental Asia is at the Isthmus of Kra in peninsular Thailand (Fig. 1). Many Sundaland snakes are endemic while others also have extensive distributions in continental Asia. East Java is well supplied with species of both types which, despite the increasing pressure of the human population, may be encountered in a wide range of habitats. These include the surrounding sea and associated estuaries, mud banks and mangrove swamps, lowland fish ponds, paddy fields, savannah and both natural and cultivated forests. The geography of the province is organised in three broad east-west bands. In the north there are alluvial plains and foothills



Figure 1 - Map of Java and surrounding territory

where all natural forest has been felled and in parts is replaced by large teak plantations. Centrally, the province has a spine of volcanoes (Fig. 2) rising to a little more than 3500 metres, which offer cool environments in forest, agricultural land and, at the highest elevations, exposed habitats with little cover. The volcanic peaks are separated by extensive, gently sloping lowlands. Small areas of seasonal monsoon forest remain, especially in the extreme northeast of the province in the Baluran Volcano Nature Reserve; sub-montane/montane forest can be found around the Ijen complex, and the southern slopes of the Tengger complex have the best examples of montane forest in East Java. Finally, in the south there are dissected plateaux, almost all of which lie below 500m, where little forest remains except in nature reserves such as Meru Betiri (Fig. 2) which still has extensive lowland rain forest, mangrove, lowland swamp and beach forest.

Field collecting in East Java presented some problems as except for common paddy field species most 'interesting' snakes appear to be secretive, localised, nocturnal or all three. My first taste of Javanese snakes came from daily travel to work along an 8km stretch of motorway on the western edge of Surabaya City. This afforded an opportunity to collect the traffic victims from the night before and sometimes live specimens. However, to obtain a reasonable sample from the province as a whole, it was essential to develop a network of collectors in a range of different habitats. This was, at least in theory, not going to be too difficult as there is a substantial trade in snakes.

My first attempts to recruit collectors involved a deal with the Chinese owner of a snakerestaurant. The restaurant served fried cobra meat as well as blood and bile mixed with brandy as a cure for all sorts of diseases. After the necessary polite formalities, a meal of fried cobra meat and whole fried eggs dipped in chilli sauce, I became the owner's chauffeur on trips to pick up his snakes from local suppliers. The introductions gained from this were useful but tended to be with dealers whose interest was in supplying cobras for restaurants and other large species for skins. I eventually abandoned this approach after one long day of visits which involved returning home with exactly 101 ill-secured Spitting Cobras in the back of my car.



* A check list of Fast Java species with locality records is available from the author on request.

Figure 2 - Physical features and climatic zones of East Java

My next step in building the network was with the aid of a local pawang (magic man). His forte was the cure of snakebite and on the side he ran a dance troupe called the Cobra Putih (White Cobra). He actually really liked snakes despite the fact that some of the dance antics can hardly have been beneficial to them. On my first visit to his house I spotted, in a dimly lit corner, a small snake in a bottle half filled with water. I asked him where it had come from and he explained that it was from the caldera of the famous volcano, Bromo, and had been captured at night during an animist ceremony in which bronze effigies are cast into the crater. The snake was later identified as East Java endemic Tetralepis frustorferi, a species confined to high altitude and known from only a few specimens in the Netherlands. As a local celebrity and Javanese speaker, the pawang was able to arrange all sorts of introductions and we soon had a group of collectors, mostly woodsmen and farmers, who would collect especially for us. They were given a small reward for each species captured which was increased if the snake was undamaged. No reward was given for repeat species and a special reward given for anything unusual. The collectors generally proved skilled at snake catching and most of their captures showed no signs of harm and could be released. Careful records were kept of capture sites and associated altitudes. A sample of most species caught was deposited at the Ecology Centre (Pusat Lingkungan Hidup), Trawas, East Java and in certain cases also the British Museum (Natural History).

NEW DISTRIBUTION RECORDS AND OTHER OBSERVATIONS

During the survey 49 species of snake were collected, of which eleven were apparently new records of East Java (Table 1). It is rather strange that a number of common species, particularly *Acrochordus javanicus, Enhydris cnhydris, Cerebus rynchops, Naja sputatrix* and *Trimeresurus albolabris* seem to have avoided earlier detection. Below are notes on some of the new records and other species. This is followed by a wider consideration of the distribution and the future of Javanese species.

The Burmese Python (Python molurus bivittatus)

This species is relatively common in lowland areas of East Java although neither De Rooij (1917) nor the Bogor Museum of Zoology have records of it from this province. Local snake collectors say that this species is not common in West Java and that most specimens encountered for sale there may well have originated in East Java. These pythons were very prone to bite even when captive from birth.

P. molurus bivittatus is the dark race of the Indian python and is found in S. China, Java and Sulawesi. P. molurus molurus and this sub-species may interbreed and produce offspring of intermediate form (Townson, 1980).

Collared Snake (Sibynophis geminatus)

This gentle and attractive species is found in East Java at altitudes of over 1000m and may well be widespread at this altitude although current records are only from the Tengger Mountains. It would seem that in Java *S. geminatus* may sometimes have a series of black bars or spots within the light dorso-lateral streaks that run the length of the body (De Rooij, 1917). Kopstein collected specimens with bars from both East and West Java. I have observed only two specimens in East Java and also one from Bali, and none had this character.

It has been suggested that *S. geminatus* and *Sibynophis melanocephalus* are one and the same species (De Haas, 1950) although Tweedie (1983) suggested that the species are distinct and that both may be found in Java. However, in more recent correspondence he considered that *S. melanocephalus* may not be a Javanese species. The status of these two needs clarification.

Shiny Mountain Snake (Elapoides fuscus)

This small dark brown snake, confined to Java and Sumatra, is typically found at high elevation. In this survey only a single specimen was collected, at 1200m. In one habitat in the highlands of West Java (900-1200m), with very high humidity and frequent rain, it was the most frequently captured snake with some 800 specimens taken in the course of a year (De Haas, 1941). While

TABLE 1

The Geographical Distribution of Javanese Snakes

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		Java	Limit of	
	East	Central	West	Distribution
TYPHLOPHIDAE				
Ramphotyphlops braminus	x+	x	x	C. Asia
Ramphotyphlops lineatus	x(1)	x	x	C. Asia
Typhlops ater	x(2)	-	x(2)	C. Asia
Typhlops bisubocularis	-	-	x	Sundaland
BOIDAE				
Python molurus	x*	-	x(3)	C. Asia
Python reticulatus	x+	x	x	C. Asia
ANILIIDAE				
Cylindrophis rufus	x+	х	х	C. Asia
XENOPELTIDAE				
Xenopeltis unicolor	x+	х	x	C. Asia
ACHROCHORDIDAE				
Acrochordus granulatus	x+	x	х	C. Asia
Acrochordus javanicus	X*	-	х	C. Asia
COLUBRIDAE				
Colubrinae				
Sibynophis geminatus	x+	х	х	Sundaland
Elapoides fuscus	x+	х	x	Sundaland
Lycodon capucinus	x+	х	х	C. Asia
Lycodon subcinctus	x+	х	х	C. Asia
Oligodon bitorquatus	x+	х	х	Sundaland
Oligodon octolineatus	x*	-	х	Sundaland
Oligodon propinquus	?	?	?	Sundaland
Oligodon purpurascens	х	-	x(3)	Sundaland
Liopeltis baliodirus	x+	х	х	(C. Asia)
Liopeltis longicauda	-	-	х	Sundaland
Liopeltis tricolor	х	-	x	(C. Asia)
Tetralepis fruhstorferi	x*	-	-	Sundaland
Calamaria bicolor	?	?	?	Sundaland
Calamaria javanica	?	?	?	Sundaland
Calamaria lateralis	?	?	?	Sundaland
Calamaria leucogaster	?	?	?	Sundaland
Calamaria linnaei	x+	х	х	Sundaland
Calamaria lowi	?	?	?	Sundaland
Calamaria lumbricoidea	-	х	х	C. Asia
Calamaria modesta	X*	х	х	Sundaland
Calamaria schlegeli	х	х	х	Sundaland
Calamaria virgulata	-	-	х	Sundaland

* A key to symbols is given at the end of the table.

Pareas carinatus	x+	х	х	C. Asia
Pareas laevis	-	x(4)	x	Sundaland
Aplopeltura boa	X+	-	x	(C. Asia)
Xenodermus javanicus	-	х	х	(C. Asia)
Boiga cynodon	x+	х	x	C. Asia
Boiga dendrophila	x*	х	х	C. Asia
Boiga drapiezii	-	-	x	(C. Asia)
Boiga jaspidea		-	x(5,6)	(C. Asia)
Boiga multimaculata	x+	х	x	C. Asia
Boiga nigriceps	x*	-	x	(C. Asia)
Psammodynastes pictus	?	?	?(8)	Sundaland
Psammodynastes pulverulentus	x	х	x	C. Asia
Psammophis condanarus	x(9)		-	C. Asia
Chrysopelea paradisi	x+	-	x	C. Asia
Ahaetulla mycterizans	x+	х	x	(C. Asia)
Ahaetulla prasina	x+	x	x	C. Asia
Dryophiops rubescens	x	-	x(3)	Sundaland
Dendralaphis formosus	x	x	x	Sundaland
Dendralaphis pictus	x+	x	x	C. Asia
Gonvosoma oxycephala	х	x	x	C. Asia
Elaphe flavolineata	x+	x	x	(C. Asia)
Elaphe radiata	x+	х	x	C. Asia
Ptyas korros	x+	x	х	C. Asia
Ptvas mucosus	x+	x	x	C. Asia
Zaocvs carinatus	x*	-	x	C. Asia
Xenalaphis hexagonotus	_	-	x	C. Asia
Homolpsinae				
Enhydris alternans	-	-	x(7)	Sundaland
Enhydris enhydris	x*	х	x	C. Asia
Enhydris plumbea	x+	х	х	C. Asia
Homolopsis buccata	x+	х	x	C. Asia
Cerebus rynchops	x*	х	x	C. Asia
Fordonia leucobalia	-	x	х	C. Asia
Notrigingo				
Rhabdonbis chrysprooides	-		×.	Sundaland
Rhabdophis chrysargus	v ±	v	~	C Asia
Rhabdophis un ysaigus	A	X	~	C. Asia
Maaranisthadan shadamalaa	2	2	2	(C. Asia)
Praudovenodon inornatus	:	2	: .	(C. Asia) Sundaland
Venechrophic picestor	: 	1	-	C Asia
Xenochrophis vittatua	X ⁺	X	X	C. Asia Sundaland
Sinopotrix triangulizona	X ⁺	X	X	
	X	Х	X	(C. Asia)
ELAPIDAE				
Bungarus candidus	x+	х	х	C. Asia
Bungarus fasciatus	x+	х	х	C.Asia
Bungarus javanicus	x	2	x	Sundaland
Bungarus flaviceps		?	1	C. Asia
Ivaja sputatrix Ophiophagus hacrach	X*	x	x	Sundaland
Opinopilagus ilalillall	A	^	A	C. Asid



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Plate 1. Collared Snake, Sibynophis geminatus, is found in East Java at altitudes over 1000m. The species may sometimes have black bars or spots in the orange dorso-lateral streaks.



Plate 2. The presence of Russell's Viper, Vipera russelli siamensis, in Java was only confirmed in the 1930's. Its distribution in Java is limited to a few sites on the western edge of Surabaya City.



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Plate 3. Malayan Pit Viper, Callosellasma rhodostoma (juvenile), this species is common in the dry forested areas in the north west of East Java.



Plate 4. White-lipped Pit Viper, *Trimeresurus albolabris*, is a very common cause of snakebite in lowland East Java, victims appear to be bitten only at night.

Matic	ora bivirgata	х	-	x(5)	Sundaland
Matic	ora intestinalis	x+	х	x	Sundaland
VIPER	RIDAE				
Calloselasma rhodostoma Trimeresurus albolabris Trimeresurus puniceus Vipera russelli		x+	-	x x x	C. Asia C. Asia Sundaland C. Asia
		x* x+	x x		
		x	Species present		
-	Species yet not found				
?	Species recorded but with no precise locality New distribution record for East Java				
*					

+ Species reconfirmed during this survey

(C. Asia) A Sundaland species, extending only a short distance into continental Asia

1)	Bogor Museum, Indonesia	6)	Kopstein (1929)
2)	Brongersma (1934)	7)	Gyi Ko Ko (1970)
3)	Kopstein (1930)	8)	Rasmussen (1975)
4)	Jong de (1930)	9)	Mertens (1957b)
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5) Haas de (1941)

in another habitat with a similar altitude, but seasonally dry climate, the species was relatively scarce. East Java habitats with dense populations of this species have not yet been encountered; they may be generally too dry.

Javanese Kukri Snake (Oligodon bitorquatus)

This species is fairly common at 400-1000m and has been found as high as 1600m. It is probably endemic to Java. The most westerly record is from Panaitan Island just off the coast of Java (Mertens, 1957a). An old record from the eastern island of Ambon reported in De Rooij (1917) may well be in error.

This snake has a seemingly gentle disposition but if handled may eventually grasp some flesh in its mouth and drag its blade like teeth back through the skin, making a series of parallel razor cuts up to a centimetre long. This action is very slow and deliberate and gives the impression that the snake is using its teeth like a can-opener.

Fruhstorfer's Mountain Snake (Tetralepis fruhstorferi)

This species is endemic to East Java and occurs only at high altitude, almost certainly no lower than 1000m. All records to date have been from the Tengger Mts and apparently from the drier western side (Fig. 2); it apparently has a preference for a cool, seasonal climate. These conditions occur in a few other East Java localities (Fig. 2) so it is possible that, in due course, a wider distribution may be recorded. The species may be quite common in the Bromo caldera since three expatriates, visiting the area on separate occasions during daylight, reported seeing snakes that would fit the description of this species – slow moving, small and pinkish-brown.

Javanese Reed Snake (Calamaria linnaei)

This species is abundant at and above 700m. Most specimens taken in this study had white bellies patched with black quadrangles. However, two out of seventeen specimens had red bellies. Van Hoesel (1959) considered that red bellies were the norm while Inger and Marx (1965) make no mention of this character. Another species, *Calamaria modesta* was identified by Dr Colin McCarthy from a single damaged specimen; this was the first East Java record for this species.

Specimens of *C. linnaei* could be maintained for some weeks in captivity in upland areas but if brought down to sea level either with no precautions or in an insulated box, to a drier hotter climate, they died within 24 hours. It would seem that they are very prone to the stress inflicted by travel and/or climatic change.

Indo-Chinese Rat Snake (Ptyas korros)

P. korros is extremely common in a wide variety of habitats throughout East Java. This species is considered normally to have either two or three loreal scales in Malaya (Tweedie, 1983), the Asian region (Smith, 1943) and Java (De Rooij, 1917). However, in half of the East Java specimens examined there was only a single loreal, all others had two.

Oriental Rat Snake (Ptyas mucosus)

This common speies is prized by snake collectors for its skin. It is apparently much less common in West Java and there seems to be only a single record from Sumatra. This would seem to be a good example of a continental Asian species that thrives in East Java.

Red-necked Keelback (Rhabdophis subminiatus)

R. subminiatus is rarely encountered on coastal plains but may be quite common in wooded areas up to at least 500m and in West Java is common at 700-1200m (De Haas, 1941). This is the only species of keelback known to be dangerously poisonous to man. There is one documented record of serious poisoning by a specimen apparently originating from Thailand. I have also met a somewhat eccentric butterfly collector, Scipio Pariwono, from Bogor (West Java), who had been hospitalised after a bite from this species. He had photographed both the snake and his symptoms, which included very widespread bruising.

Checkered Keelback (Xenochrophis piscator melanozostus)

This species is very common in lowland areas throughout East Java. The subspecies X. piscator melanozostus, probably found only in Java and Sumatra, is dimorphic having either 5 (4 on the neck) rows of black spots or stripes running the whole or part of the length of the body. The two forms are equally common and may have bright red flanks. Three other subspecies, which occur elsewhere, have only spots (Smith, 1943).

Striped Keelback (Xenochrophis vittatus)

The Striped Keelback is very common in paddy fields and gardens. Until recently it was only recorded from Java and Sumatra but it now appears to have found its way to Singapore, possibly through the pet trade. A snake dealer in West Java, who exports this species under the name 'SE Asian Garter Snake', has maintained large numbers together and noticed them to be very prone to density dependent mortality.

Indo-Chinese Sand Snake (Psammophis condanarus indochinensis)

There is only one record of this species from Indonesia (Mertens, 1957b). The specimen in question was a road traffic victim in Gresik, an area with a particularly dry climate. Elsewhere it is found in Thailand and Burma at elevations up to 2000m (Smith, 1943). In view of the fact that only one specimen has ever been collected, Liong (1958) suggested that it may have been introduced accidentally by trade. If the species was/is genuinely established in East Java then it may share the same unusual, discontinuous distribution shown by *Vipera russelli siamensis* (see below). In 1991, I could find no local snake collectors who recognised this species; a likely and as yet largely unchecked habitat for *P. condanarus* are the foothills and associated teak forests in the north west of the province.

Russell's Viper (Viper russelli siamensis)

Only during the 1930s was it confirmed that V. russelli occurred in Java (Neuhaus, 1935). Recent detailed study of the population systematics of V. russelli by Wüster et al. (1991) has shown Javanese specimens to be typical of the Burma/Thailand population, V. russelli siamensis, and distinct from V. russelli limitis found in the Lesser Sunda Islands eg. Flores, Komodo. The V. russelli population in Java appears to be confined to two sites west of Surabaya City. Reports from farmers and snake catchers suggest that it may also be encountered in the dry teak plantations around Gresik and Bojonogoro although there may be some confusion with *Calloselasma rhodostoma*. During three years I obtained six records of V. russelli, all specimens killed by cars on the motorway running close to a military cemetery (Kembang Kuning). It is quite possible that a nearby wooded area, preserved because it houses an ammunition dump, provides the necessary cover in an otherwise heavily cultivated area. Specimens were only ever collected in July or August, which is in the middle of the dry season and about three months to the onset of the rains. It would seem probable that mating occurs at this time of the year, especially as in one instance specimens were taken as a pair.

It is believed that the current distribution of V. russelli (and probably P. condanarus) has resulted from climate change in the recent past. As sea levels fell during the ice ages the sea floor (Sunda shelf) became a plain stretching from Thailand to eastern Sumatra and Java. This plain incorporated a corridor, with a seasonally dry climate, along which species favoured by these conditions might spread (Morley and Flenley, 1987). Subsequent rises in sea levels and the return of a more humid climate to several areas probably eliminated these species from all but those places retaining a seasonal climate, such as East Java (Wüster et al. 1992). However, the very limited distribution of V. russelli in Java, to just a few areas close to Surabaya rather than more widely in the dry northern coastal strip, is still unexplained. The same phenomenon is noticed elsewhere, as in continental Asia its distribution is said to be capricious (Smith, 1943).

Malayan Pit Viper (Calloselasma rhodostoma)

C. rhodostoma appears to prefer dry forested areas and is locally quite common, especially in the north west of the province although there are records from other locations up to 1600m. Tweedie (1983) suggested that C. rhodostoma prefers a climate with a distinct wet and dry season, so that East Java would appear to be a particularly suitable place although its distribution within the province is clearly very patchy.

White-lipped Pit Viper (Trimeresurus albolabris)

This species is very common in lowland areas and is often encountered in Surabaya gardens. During the day time snake collectors handle this viper with no precaution although they say that at night time it must be treated with respect. The pawang who accompanied me collecting and who specialised in the magic treatment of snakebite said that this species was the most common source of bites in and around Surabaya and that most people bitten would come to him, rather than go to hospital for fear that the afflicted part might be amputated. He claimed a 100% success rate in cure suggesting that the venom of this species is of rather low toxicity. In West Java, De Haas (1941) found this species to be very common in coffee and tea plantations at 700-1200m but bites to be very rare. Presumably, this is because plantation workers are generally not exposed to this species at night time.

Another species *Trimeresurus puniceus*, the Flat-nosed Pit Viper, occurs in East Java but has only been found at altitudes above 1500m. This species has been referred to as a 'hill variety' of *T. albolabris* (De Haas, 1941) despite great differences in the shape of the head and colour pattern.

Javanese Krait (Bungarus javanicus)

This species was first recorded from Cirebon in West Java and is said to be confined to the north coast of the island. Two specimens received by the Bogor Museum of Zoology were taken from a traditional medicine man in Surabaya. I have never met East Javanese who knew it and so conclude that the species is probably rather uncommon.

King Cobra (Ophiophagus hannah)

Specimens of this species are frequently on display in snake restaurants and are for sale at £30-£40. Judging by the numbers that I have seen it must still be fairly common, at least locally. In East Java, I have been informed that most specimens come from the forested slopes around Mt Semeru in the Tengger Mts.

Southern Spitting Cobra (Naja sputatrix)

This species has provisionally been re-established from the sub-species Naja naja sputatrix (Wüster and Thorpe, 1989) and is restricted to Java and the Lesser Sunda Islands. Further study is required to clarify its relationship with cobras in Sulawesi.

In East Java this is one of the most common snakes. In West Java, De Haas (1941) considers that it probably does not reach elevations above 700m; a similar limit would seem to obtain in East Java. Colour variation is considerable and with some geographical trends. Specimens from Malang and eastward, as far as Lumajang (see Fig. 2), tend to be black or dark brown. Further east they become lighter in colour and in and around Banyuwangi whitish specimens are common. Freshly captured specimens will readily spit venom but after a short while in captivity are generally reluctant to do so. When spitting, the venom stream breaks up soon after discharge to produce a spray rather than the accurate jet of venom typical of the African 'spitters'.

DISTRIBUTION OF JAVANESE SNAKES

Snake distribution between the provinces of Java and an indication of those species also found in continental Asia is given on Table 1; most records come from Brongersma (1929) or Tweedie (1983); others are referred to in Table 1. As long ago as 1929, Dammerman noted that the fauna of Java was not as rich as that in other areas of Sundaland and that the number of species declines from west to east. Data gathered on snakes since 1929 have not changed this view (Table 2). Other areas of Sundaland still have more species, mostly *Calamaria* and rarer montane forms, and East Java has 12% and Central Java has 30% fewer records than West Java. Perhaps records from the Central province would receive a boost from more intensive study.

TABLE 2

Geographical location	Number of Species	Source
Sumatra Borneo Malaya Java	131 133 117 84	De Haas (1950) Haile (1958) Tweedie (1983)
	Java Provinces West Central East 71 49 62	

Numbers of snake species recorded in the component areas of Sundaland

Of the 84 recorded land snakes of Java, half are species that occur only in Sundaland and half are also well established in continental Asia. East Java is well supplied with species typical of continental Asia. It would appear likely that two, *Ptyas mucosus* and *Python molurus*, are probably more abundant in East Java than elsewhere on the island and that two other species, *Vipera russelli* and *Psammophis condanarus*, are found only in this province and are probably confined to very restricted localities.

It is interesting to note that many species recorded as common in lowland habitats in Malaya by Tweedie (1983) appear to be confined to the middle of higher zones in East, and to some extent also West Java. Specific examples are Maticora bivirgata, Maticora intestinalis, Pareas carinatus, Psammodynastes pulverulentus, Rhabdophis chrysargus, Lycodon subcinctus and Sinonatrix trianguligera. This may result from the virtual absence of evergreen lowland forest and a generally less favourable lowland climate where competition from species more tolerant of the prolonged dry season confines the others to higher ground. It is also possible that some species may be recorded from lower altitude, once the moister forested areas that still remain, in particular those adjacent to the south coast, have been more thoroughly investigated. Table 3 shows the altitude ranges of species found in East Java according to their limits of distribution in continental Asia or Sundaland. To prepare this table an assessment was made of the likely altitude ranges of those species for which sufficient data exist (60). It is clear that in East Java the majority of species limited to Sundaland occur on higher ground with 33% not found below 1000m (Table 3). Continental Asian species appear to be far more tolerant of hotter drier conditions as they are better represented in the lower and middle elevations and have 35% of species able to exist over the widest altitude range, sea-level to above 1000m. Only a single Sundaland species, X, vittatus, is this versatile. However, despite this trend two of the species believed to be endemic to Java, Tetralepis fruhstorferi and Bungarus javanicus are also apparently restricted to areas with a seasonal climate, B. javanicus to the north coast and T. fruhstorferi to an area of the Tengger Mountains. It is assumed that they have evolved to occupy an environment with a seasonal climate and that their limited range is a reflection of this.

TABLE 3

Numbers of East Java snake species (%) found at various altitude ranges reflecting the limit of species distribution to Sundaland or continental Asia

	Distribution limit				
Altitude range	Sundaland		C	C. Asia	
Only above 1000m	8	(33)	0	(0)	
500m to above 1000m	9	(37)	7	(19)	
Sea level to above 1000m	1	(4)	14	(39)	
Sea level to 1000m	4	(17)	6	(17)	
Sea level to 500m	2	(8)	9	(25)	

THE FUTURE FOR THE SNAKES OF EAST JAVA

The need to conserve snakes in Java is not widely recognised despite the ever increasing threat of Java's industrialisation and burgeoning human population. However, although it may have to be accepted that, outside park areas, many of the more sensitive species may in the long term be doomed, there is still much that could be done to help maintain the diversity of the snake species that can survive the onslaught of intensive agriculture. The Indonesian public have no access to even simple literature on their native species; there are apparently no organisations actively promoting the well being of Javanese reptiles at large and there are no programmes, unlike say in Thailand, to educate farmers about the advantages of protecting rodent predators. Over the last few years farmers have become increasingly aware of rodent damage to their crops, yet to date there has been no effort to educate people in rural areas that this problem would be greatly reduced if they were to avoid the indiscriminate killing of those harmless snakes which eat rodents. Instead, they are encouraged to pay for rodenticides which they can ill afford and which are at best only partially effective. Further, the trade in skins flourishes. The first steps in the conservation of these creatures must be through education. The dissemination of cheap and simple but attractive literature would be of great benefit. So also would assistance to the Deaprtment of Agriculture so that it can mount simple farmer education programmes.

Over many years huge numbers of certain species, particularly cobras (*N. sputatrix*) and rat snakes (*Ptyas* spp), have been collected and killed for their skins but these species seem very robust and it is likely that while there is sufficient food and suitable habitat there is no immediate danger to their survival. However, special conservation measures are needed for several species. The pythons *P. reticulatus* and *P. molurus bivittatus* and the King Cobra (*O. hannah*) are very vulnerable as their high value in trade means that even when numbers have seriously declined the search for them will be relentless. In more immediate danger is *V. russelli siamensis* which is confined to small areas west of Surabaya and which may be lost as Surabaya expands. Fortunately, one site that it occupies, a wooded ammunition dump (Kembang Kuning), could easily be preserved and with it a species that is one of the clues to Java's geological past. The endemic *T. fruhstorferi* is also a species of special interest occuring in a limited area which fortunately includes the Luat Pasir Tengger Nature Reserve (3800 ha) and the Bromo Tengger Semeru National Park (53200 ha). It is important to establish the current status of the species over its small range and, if necessary, to implement measures to secure its future.



Plate 5. Javanese Kukri Snake, Oligodon bitorquatus, is probably endemic to Java and in the eastern province is common at 400-1000m.



Plate 6. Frustorfer's Mountain Snake, *Tetralepis frustorferi*, is endemic to East Java and has so far only been recorded from the drier western side of the Tengger Mountains, at altitudes well above 1000m.



Plate 7. Red-knecked Keelback, *Rhabdophis subminiatus*, is common in wooded areas at altitudes up to 500m. Humans bitten by this species may suffer serious symptoms.



Plate 8. Checkered Keelback, Xenochrophis piscator melanozostus, is a common paddy field species and this particular subspecies has as striped and spotted form.



Plate 9. Striped Keelback, Xenochrophis vittatus, sometimes known as the 'SE Asian Garter Snake' is a very common species found at sea-level up to at least 1000m.



Plate 10. Flat-nosed Pit Viper Trimeresurus puniceus, is relatively uncommon and occurs at high altitude in East Java.



Plate 11. A light coloured specimen of Southern Spitting Cobra, *Naja sputatrix*, from Banyuwangi, East Java. This species ejects a diffuse spray of venom rather than accurate jets.



Plate 12. Southern Spitting Cobras, *Naja sputatrix*, showing the range of colour variation encountered in East Java, from black to light brown. Within East Java specimens tend to be lighter coloured from the more easterly locations.

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