THE BIODIVERSITY OF THE AMPHIBIANS AND REPTILES OF THE INDO-AUSTRALIAN ARCHIPELAGO: ASSESSEMENT FOR FUTURE STUDIES AND CONSERVATION

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Abstract. - Approximately 55% of the valid taxon names have been changed since the works of de Rooij (1915, 1917) and van Kampen (1923). The number of Indo-Australian herpetofauna is now about 468 amphibians, 381 snakes, 405 lizards, 33 turtles and six crocodilian species not including species now in the process of being described. This figure is about 120% of the initial number in 1911-1923. Most of the additional records are the result of very fast progress in taxonomic research, principally outside Indonesia, such as in Sarawak and Sabah and East New Guinea. The increase in number of species is remarkable in the family Microhylidae. Otherwise, new species discoveries either in amphibians or reptiles are evident in certain genera only. Judging from the progress outside the Indonesian areas, about 1000 amphibians and about the same number of lizards could be expected within the next 25 years, but there will be no remarkable changes in the number of species of snakes and turtles. Increase in the number of species is expected principally in the four large islands, New Guinea, Borneo, Sumatra and Sulawesi. The disappearances of several species during the last ten years without clear causes have been noted, signalling that future studies are urgently needed.

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INTRODUCTION

The only milestones about Indonesian Amphibians and Reptiles are the books of van Kampen (1923) and de Rooij (1915, 1917). Subsequently, no comparable work regarding the whole Indo-Australian Archipelago has been published ever since. Although several books or revisions appeared, especially from the Philippines (Taylor, 1921; Inger, 1954, Brown & Alcala, 1976); Borneo (Inger, 1966, Inger and Stuebing, 1992); Thailand (Taylor, 1962, 1963), New Guinea (Tyler, 1968, Zweifel, 1972, Greer, 1974, Menzies, 1976, Allison, 1982, 1993), Peninsular Malaysia (Berry, 1978) and Singapore (Lim & Lim, 1990), all these revisions are restricted to much smaller regions. This region is essentially too important to be neglected. To assess its species richness, presented here is a rough estimate of the status of Indonesian amphibian and reptiles along with my predictions about them in the future. These data are important to bring forward in order to assess the real situation of Indonesian herpetofauna.

MATERIAL AND METHODS

In order to give a clearer view about the total number of Indonesian herpetofauna, I used the books: The Reptiles of the Indo-Australian Archipelago vol I, II by de Rooij (1915, 1917) and The Amphibians of the Indo-Australian Archipelago by van Kampen (1923) as principal databases for further comparison. Data for the present situation have been extracted from other sources, specially those dealing with Southeast Asian herpetofauna. Unfortunately, it is impossible to distinguish the herpetofauna between Kalimantan and North Borneo (Sabah, Sarawak and Brunei) or between Irian Jaya and Papua New Guinea because a species is usually not restricted by political boundaries, except for some endemic species which have restricted distribution. The use of current political boundaries is inappropriate and not followed in this study because, most studies were carried out in the regions outside Indonesia, and most species from both islands were described from non-Indonesian localities. I had no choice than to include Sabah, Sarawak, Brunei, Palau, Papua New Guinea, Solomon and Bougainville in this study and follow de Rooij, (1915, 1917) and van Kampen (1923) to make the comparison possible. Although it is possible to present the evaluations based on the localities, the data obtained from such an approach are found to be worse because, there are few records pertaining only to the Indonesian part. To obtain a clearer view, Indonesia is divided into seven political boundaries: Sumatra, Java, Borneo, Lesser Sunda, Sulawesi, Maluku and New Guinea. I considered Borneo and New Guinea, each as a single entity. Herpetofauna from a number of small islands such as Mentawai island, Riau and Bangka-Belitung were calculated as Sumatran fauna; Palawan, Karimata and Natuna as Bornean fauna, Solomon and Bougainville as New Guinean fauna. To assess the prospective compositions of each region, I calculated the increase of present situation of Bornean and New Guinean fauna as well as other regions. To calculate the change in each genera, I considered only the species described before 1917-1923 to represent the past situation and compared the changes based on present records. Only valid numbers of species are counted. For example, I calculated that Sulawesi has 29 frogs, although Iskandar & Tjan (1994) reported 40 species, because 11 species have yet to be named. On the other hand, Stuebing (1991, 1994) recognized 151 snakes from Borneo. my record is 157 species, because I included some satellite islands such as Natuna, Miangas and Palawan as a part of Bornean fauna.

RESULTS

In the study of mammals, most species have already been described and the problem lies in the status of the subspecies. The dramatic change usually applies in the supraspecific level. Only 55 of the 495 mammalian species (11%) of the region (excluding New Guinea) were described after 1923, most of them belong to insectivores, rodents and bats. Only 16 of the 181 genera (9%) were described within the last 75 years (Corbet & Hill, 1992). The systematic situation of amphibians and reptiles are completely different compared to the mammals. There is a high increase in the number of species everywhere, but more pronounced in Borneo and New Guinea. The Bornean records resulted mainly from the work of Inger (1966). In New Guinea, several herpetologist have been responsible for the incredible increase of species of amphibian and reptiles (Tyler, 1968; Zweifel, 1972; Greer, 1976; Menzies, 1976 to cite only some of the major articles)

Table 1. The approximative number of herpetofaunal families, genera and species in the past and at present:

	AMPHIBIANS			LIZARDS			SNAKES			TURTLES			CROCODILES		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
FAMILIES	6	2	8	9	7	2	7	5	11	7	6	2	1	1	0
PRESENT Σ FAMILIES		10			9			16			8			1	
GENERA	46	25	36	42	30	37	84	49	51	20	11	15	2	2	0
PRESENT Σ GENERA		61			67			100			26			2	
SPECIES	215	181	285	267	240	167	318	262	111	35	11	19	4	3	3
PRESENT Σ SPECIES		469			407			373			30			6	

A: number of taxa recognized in the past; **B**: number of taxa still recognized at present; **C**: Number of additional or changed-status taxa.

Table 2. The approximative number of species of amphibians, lizards, snakes, turtles and crocodiles in each geographic area in the past and at present:

	AMPHIBIANS		LIZARDS		SNAKES		TURTLES		CROCODILES		TOTAL	
ISLAND	PAST	NOW	PAST	NOW	PAST	NOW	PAST	NOW	PAST	NOW	PAST	NOW
SUMATRA	61	88	70	74	129	152	17	20	1	3	278	334
JAVA	38	39	43	42	109	105	13	12	2	2	205	197
BORNEO	85	141	93	113	143	157	18	20	2	4	341	431
SULAWESI	22	28	44	45	63	74	6	9	1	2	136	154
NUSA TENGGARA	20	25	24	46	39	52	7	7	1	1	91	128
MALUKU	12	21	47	70	49	57	6	7	1	2	115	159
NEW GUINEA	85	206	115	229	79	132	15	15	1	2	295	582
TOTAL	215	469	267	405	318	381	35	30	4	6	839	1279

There is a considerable change in the number of families, subfamilies and genera. I count that there is 22-57% increase in families, genera and species or even higher (86-126%) if we subtract the number of invalid species. A total of 36 families is recognized by de Rooij and van Kampen, 21 among them are still recognized and now 44 families are considered here as valid (22-109% increase). There are 189 genera in the past, only 112 of them are still used and now 253 genera are considered here as valid (34-126% increase). A number of 839 species is recorded in the past, 711 among them are still in use and now 1279 species are considered here to occur in the Indo-Australian region (52-80 % increase) (Table 1).

A) Amphibians

According to van Kampen, this region has 6 families. Only two familial names (or three if Pelodryadidae is considered as a subfamily of Hylidae) are still used today.

Table 3. Changes in Familial or subfamilial names of IndoAustralian Amphibians and Reptiles during the last 75 years:

Caeciliidae ⇒ Epicriidae	Brevicipitidae ⇒ Microhylidae
Pelobatidae ⇒ Megophryidae ⇒ (+ Lymnodynastidae)	Brevicipitinae ⇒ Microhylinae ⇒ Asterophryninae
Cystignathidae ⇒ Myobatrachidae ⇒ Lymnodynastidae	Genyophryninae ⇒ Genyophryninae ⇒ Asterophryninae
Hylidae ⇒ Pelodryadidae	Ranidae (part) ⇒ Rhacophoridae
Geckonidae ⇒ Gekkonidae	Helodermatidae ⇒ Lanthanotidae
Testudinidae (part) ⇒ Batagurinae/ daeI	
Iysiidae ⇒ Anomochilidae ⇒ Cylindrophiidae	Hydrophiinae ⇒ Laticaudidae ⇒ Hydrophiidae
Acrochordinae ⇒ Acrochordidae	Dipsadomorphinae ⇒ Boiginae
Boidae (part) ⇒ Pythonidae	Homalopsinae ⇒ Homalopsinae/dae
Colubrinae (part) ⇒ Xenoderminae ⇒ Natricinae/dae ⇒ Calamariinae, etc.	Elapinae ⇒ Elapidae Viperidae (part) ⇒ Crotalidae Amblycephalidae ⇒ Dipsadinae/dae

Table 4. The major changes in number of species in certain families.

FAMILIES	CHANGE	AFFINITIES	FAMILIES	CHANGE	AFFINITIES
Bufonidae	24 ⇒ 38	asiatic	Scincidae	125 ⇒ 254	asiatic-papuan
Megophryidae	7 ⇒ 16	asiatic	Varanidae	14 ⇒ 20	asiatic-papuan
Microhylidae	43 ⇒ 150	asiatic papuan	Typhlopidae	15 ⇒ 22	asiatic-papuan
Ranidae	54 ⇒ 123	mainly asiatic	Cylindrophiidae	5 ⇒ 14	asiatic
Rhacophoridae	30 ⇒ 38	asiatic	Crotalidae	8 ⇒ 14	Asiatic
Pelodryadidae	31 ⇒ 79	papuan	Elapidae	23 ⇒ 37	Asiatic-papuan
Epicriidae	2 ⇒ 14	asiatic	Hydrophiidae	23 ⇒ 46	Asiatic-papuan
Agamidae	70 ⇒ 62	asiatic -papuan			

At present, eleven families are here considered as valid (Table 3). However, only one family (Bombinatoridae, distinct apart from Discoglossidae) is really new for the region after the discovery of the genus *Barbourula* in Busuanga island and subsequently found to occur in Palawan (Brown and Alcala,1976) and Borneo. The change in number of families is not simply a matter of splitting, but more likely based by considering new evidences to arrange each family in a more appropriate way (phyllogenetically).

From the 61 genera, 29 genera have more than 5 species, only 18 genera have moderate to high increase in number of species. A total of 12 genera has little increase, but nine of them were totally new for the region. To this category belong small genera with less than five species, so are another 20 small genera that have no increase in species (Table 4).

Table 5. Selected genera with changes of more than five species.

GENERA	CHANGES	AFFINITIES	GENERA	CHANGES	AFFINITIES
Epicriidae			**Ranidae**		
(Ichtyophis)	1 ⇒ 11	asiatic	*Amolops*	2 ⇒ 12	asiatic
Bufonidae			*Limnonectes*	8 ⇒ 23	mainly asiatic
Ansonia	3 ⇒ 11	asiatic	*Batrachylodes*	2 ⇒ 8	papuan
Microhylidae			*Platymantis*	5 ⇒ 23	asiatic-papuan
Kalophrynus	3 ⇒ 9	asiatic	**Scincidae**		
Microhyla	6 ⇒ 12	asiatic	*Lipinia*	0(3) ⇒ 15	*asiatic-papuan*
Barygenys	0 ⇒ 7	papuan	*Carlia*	0 ⇒ 13	papuan
Callulops	5 ⇒ 13	papuan	*Cryptoblepharus*	0(1) ⇒ 14	*papuan*
Xenobatrachus	7 ⇒ 17	papuan	*Emoia*	0(17) ⇒ 51	*papuan*
Xenorhina	1 ⇒ 6	papuan	*Sphenomorphus*	0 ⇒ 197	papuan
Cophixalus	5 ⇒ 19	papuan	*Tribolonotus*	2 ⇒ 7	*papuan*
Copiula	1 ⇒ 5	papuan	*Lygosoma***	112 ⇒ 3	asiatic
Oreophryne	13 ⇒ 23	papuan	**Varanidae**		
Sphenophryne	9 ⇒ 14	papuan	*Varanus*	14 ⇒ 20	asiatic-papuan
Rhacophoridae			**Gekkonidae**		
Rhacophorus	14 ⇒ 21	asiatic	*Gonydactylus*	13 ⇒ 23	asiatic papuan
*Philautus**	7 ⇒ 9	asiatic	*Lepidodactylus*	5 ⇒ 14	asiatic papuan
Pelodyadidae			**Agamidae**		
Litoria	44 ⇒ 60	papuan	*Draco****	26 ⇒ 13	asiatic
Nyctimystes	2 ⇒ 23	papuan			

Note: * *Philautus* has been included because of the high number of undescribed species. ** In *Lygosoma* there is a change in the generic concept. *** *Draco* has reduced number of species.

There are remarkable changes in the number of genera and species in the family Microhylidae, but in other families the changes are confined principally on one or two genera. Twelve genera have an increase of more that five species (Table 5). The number of Indo-Australian amphibians is now about 468 species, a two fold increase, if we eliminate the number of species now considered as synonymous (20 species) compared to the records of van Kampen (254 species). I predict over 500 species will be known from the Indo-Australian Archipelago within one or two years, because about 50 species are now in the process of being described (Table 1 and 2). For comparison, the amphibian species of the Philippine Islands (Palawan excluded), after the initial work of Taylor (1921), showed an increase from 47 (+19 synonyms) to 76 species (55% increase), but the turtle records remain stable.

B) Lizards

There are not many changes in lizard families. In contrast, there is a remarkable

change in the number of species, especially in the family Scincidae and to a lesser extent in the family Agamidae, Varanidae and Gekkonidae (Table 4 and 5). In the family Scincidae, the major change does not only involve the generic concept of *Lygosoma* (1 genus became 13 genera in the Indo-Australian Archipelago alone according to the present generic concept), but also in the number of species. This fact is responsible for the high increase in number of species. Except for the change in spelling (Geckonidae), there is only one change in lizard family name, Helodermatidae (for *Lanthanotus*) become Lanthanotidae or even Varanidae. I count 42 genera of lizards recognized by de Rooij. Twelve genera are not used anymore and 37 genera were added, 7 of them are completely new. This gives a total of 67 recognized genera for the region (Table 1 and 2).

C) Snakes

Remarkable change is evident in the number of snake families. The changes are still in an unstable condition compared to other herpetofauna families. It is still impossible to say how many families exist in Indo-Australian snakes. If de Rooij recognized only seven families, the number of families could be 12 to 20 depending on the adopted classification.

There is a moderate increase in number of genera, but the generic name changes are remarkable. Many old generic names were resurrected from synonymy. A considerable number of generic names have been changed in that senior synonyms became the valid name, and the better known names are not used anymore. I calculated that de Rooij recognized 86 genera. At present, 37 genera are not used anymore, leaving 49 genera, including different composition of two genera (*Xenochrophis* and *Enhydris*). A number of 45 genera was added. This figure gives a total of 94 genera now recognized to inhabit the Indo-Australian region. There are only two genera with marked increase in species. *Calamaria* has 18 new species and *Stegonotus* has an increase of 7 species. In other genera, there are some marked increases, but they were generally caused by the transfer from one genus to other genera. The number of species rose from 318 species to 387 species (Table 1 and 2).

D) Turtles and Crocodiles.

One turtle family, Chelydridae has been removed from the region, because the record is based on a South American species. Otherwise there is a change in the familial concept of Testudinidae - Emydidae - Bataguridae. Four generic names are changed in the family Trionychidae, Testudinidae and Bataguridae. In addition, four species from four different genera have been placed in four other distinct genera, so that all these genera are now monospecific. Previously, *Emydura* had seven species, five of them have been omitted from the New Guinean list and one other species has been transferred to the genus *Elseya*. The same situation applies to the genus *Trionyx*, so that there are now two other genera after the genus had been suppressed. Numbers of species are reduced in the families Trionychidae and Chelyidae (Table 1 and 2).

In Crocodiles, there is only a change in spelling for the crocodile family (from Crocodilidae to Crocodylidae). Although about five cryptic species have been reported, they are still unnamed.

DATA ANALYSIS

A. Pattern

Splitting is evident in cosmopolitan genera such as *Rana* in amphibians and *Lygosoma* in lizards or *Tropidonotus* in snakes. These three genera also contribute to the high increase in number of genera not only in this region, but perhaps to other regions as well.

As already noted above, New Guinea and Borneo have a very high increase in number of species (Table 2 and 6). There is of course a considerable bias because of the size of these two regions compared to other regions. Maluku and Nusa Tenggara have a relative high increase in percentage compared to Sumatra but actually, there are more findings in Borneo, New Guinea and even Sumatra (Iskandar, 1988, updated to present) compared to those two regions. Geographical increase is in concordance with the previous state of knowledge. The fauna of North Borneo and East New Guinea were constantly studied. These two areas were responsible for the high increase in these two islands, not only in the number of new species, but also in the number of genera. The Indonesian parts are relatively untouched for the last 75 years. If someone has to give a list of species or genera for the Indonesian part only, this region appears to be relatively poor. Each time we go to a certain "known" region, the species reported from that area were often not found anymore, but a number of new species appeared. There is of course a dramatic change caused by human activities, but the species lists are incomplete for most Indonesian regions without exception, even from Java.

B. Biodiversity and Forest Reductions

Judging from the facts that (1) the high increase of species from the regions outside Indonesia and (2) there are a lot of undescribed species everywhere each time we go to the field, a detailed inventory is a must for Indonesia. This is especially since huge forest areas are cut every second in Sumatra, Borneo, Sulawesi, Maluku and Irian Jaya. It is impossible to work in such areas before the process of deforestation. Many species (known and unknown) are reduced at an incredible rate and cannot be estimated. The export of frog legs for human consumption puts the Indonesian herpetofauna in another problem. Firstly, this group of species is in a chaotic situation. The species is usually assigned to *Limnonectes macrodon*. However, many of the frog legs originate from West Sumatra, for which *Limnonectes blythi* is the more appropriate name. To this species I also assign the giant frogs of Sumatra and Malaysia. For at least 10 years, the frogs were collected from the wild around Harau valley, West Sumatra. For the last 5 years, the people of Harau valley have been unable to supply sufficient frog legs to fulfill the demand and the species was then harvested from West Riau. Apparently, over-collecting is the main cause of the population decline in West Sumatra. The difficulty in identifying the species of exported frogs is alarming. Sumatra has about four large undescribed species, and the situation is the same in other large islands. On the other hand, the true *Limnonectes macrodon* appears to be extinct. Our observation showed that all specimens at the MZB and ITB do not conform to the *R. macrodon* type, but more appropriately to a small *R. blythi* type. Only one specimen without exact locality (bought from the market) is present in the ITB collection. The main cause for the

Table 6. Number of species in the amphibians and reptiles families of the Indo-Australian Archipelago.

FAMILY:	Sumatra	Java	Borneo	Nusa Tenggara	Sulawesi	Maluku	New Guinea	Total
Epicriidae	6	3	5	0	0	0	0	14
Bombinatoridae	0	0	2	0	0	0	0	2
Bufonidae	15	6	31	3	3	0	1	38
Megophryidae	3	2	15	0	0	0	0	16
Myobatrachidae	0	0	0	0	0	1	4	4
Limnodynastidae	0	0	0	0	0	0	4	4
Microhylidae	15	4	22	5	5	7	103	150
Ranidae	30	15	42	11	16	9	19	123
Rhacophoridae	19	7	24	1	4	0	0	38
Pelodryadidae	0	1?	0	1	0	8	75	79
Pipidae	0	1	0	0	0	0	0	1
Gekkonidae	18	10	30	15	11	15	36	74
Pygopodidae	0	0	0	0	0	1	2	2
Agamidae	30	11	27	4	8	10	17	62
Lanthanotidae	0	0	1	0	0	0	0	1
Anguidae	1	0	1	0	0	0	0	2
Varanidae	4	3	4	4	3	3?	8	19
Lacertidae	1	1	1	0	0	0	0	1
Scincidae	19	16	45	22	22	43	165	242
Dibamidae	1	1	4	1	1	1	1	4
Typhlopidae	4	5	6	3	4	3	14	22
Acrochordidae	2	2	2	1	1	1	2	3
Anomochiliidae	1	–	2	–	–	–	–	2
Cylindrophiidae	2	1	3	3	3	1	0	14
Boidae	0	0	0	0	1	1	2	2
Pythoniidae	3	2	3	3	2	2	8	14
Xenopeltidae	1	1	1	1	1	–	–	1
Colubridae+Natricinae	74	40	76	14	30	18	38	163
Xenoderminae	1	1	2	–	–	–	–	2
Homalopsinae+Boiginae	22	17	21	6	12	6	8	35
Dipsadidae	5	3	6	1	–	–	–	7
Elapidae	8	8	7	3	4	2	29	37
Hydrophiidae	14	15	15	10	12	20	26	46
Laticaudidae	2	3	2	3	3	3	3	4
Crotalidae	10	4	7	2	1	–	–	14
Viperidae	0	1	0	1	0	0	0	1
Testudinidae	1	0	1	0	1	1	0	2
Chelyidae	0	0	0	1	0	0	6	6
Cheloniidae	4	4	4	5	4	4	5	5
Bataguridae	10	5	10	1	1(+1)	1	1	11
Emydidae	0	(1)	0	0	0	0	0	(1)
Trionychidae	4	3	4	1	1	0	1	5
Dermochelyidae	1	1	1	1	1	1	1	1
Carettochelyidae	0	0	0	0	0	0	1	1
Crocodylidae	3	2	4	1	2?	2?	2	6
TOTAL	**334**	**197**	**431**	**128**	**154**	**159**	**582**	**1279**

Table 7. Generic names which are still used at present in the Indo-Australian region

Ichtyophis	*Oreophryne*	*Asterophrys*	*Kaloula*	*Staurois*
Bufo	*Callulops*	*Copiula*	*Microhyla*	*Batrachylodes*
Psudobufo	*Phrynella*	*Choerophryne*	*Genyophryne*	*Rhacophorus*
Aphantophryne	*Xenobatrachus*	*Hylophorbus*	*Rana*	*Philautus*
Discophina	*Xenorhina*	*Cophixalus*	*Ceratobatrachus*	*Nyctixalus*
Sphenophryne				
Aphaniotis	*Harpesaurus*	*Ophisaurus*	*Hemiphyllodactylus*	*Lygosoma*
Calotes	*Liolepis*	*Dibamus*	*Lepidodactylus*	*Tiliqua*
Chlamydosaurus	*Lophocalotes*	*Aeluroscalabotes*	*Ptychozoon*	*Tribolonotus*
Cophotis	*Phoxophrys*	*Gehyra*	*Lanthanotus*	*Tropidophorus*
Draco	*Physignatus*	*Hemidactylus*	*Lialis*	*Varanus*
Typhlops	*Liasis*	*Python*	*Cylindrophis*	*Xenopeltis*
Acrochordus	*Xenodermus*	*Stoliczkaia*	*Anoplohydrus*	*Iguanognathus*
Opisthotropis	*(Xenochrophis)*	*Pseudoxenodon*	*Dendrelaphis*	*Zaocys*
Macropisthodon	*Xenelaphis*	*Gonyophis*	*Lycodon*	*Lepturophis*
Stegonotus	*Dryocalamus*	*Tetralepis*	*Oligodon*	*Elapoides*
Hydrablabes	*Oreocalamus*	*Idiopholis*	*Calamorhabdium*	*Calamaria*
Homalopsis	*Cerberus*	*Fordonia*	*Cantoria*	*Myron*
Psamodynastes	*Dryophiops*	*Enhydrina*	*Thalassophis*	*Hydrophis*
Bungarus	*Naja*	*Calliophis*	*Glyphodon*	*Toxicocalamus*
Pseudechis	*Micropechis*	*Acanthophis*	*(Enhydris)*	
Carettochelys	*Caretta*	*Chelonia*	*Dermochelys*	*Batagur*
Callagur	*Cyclemys*	*Geoemyda*	*Notochelys*	*Orlitia*
Doganis	*Pelochelys*	*Chelodina*	*Emydura*	*Tomistoma*
Amphibians: 26	**Lizards: 25**	**Snakes: 50**	**Turtles: 15**	**Crocodiles: 1**

Table 8. Generic names which were not used anymore in the Indo-Australian region.

Nesobia	*Crinia*	*Colpoglossus*	*Microbatrachus*	*Oreobatrachus*
Megalophrys	*Hyla*	*Calligutus*	*Oxydactyla*	*Oxyglossus*
Batrachopsis	*Nyctimantis*	*Liophryne*	*Gastrophryne*	*Simomantis*
Phanerotis	*Nectophryne*	*Calophrynus*	*Pomatops*	*Cornufer*
Ranaster				
Acanthosaura	*Japalura*	*Gymnodactylus*	*Mimetozoon*	*Ablepharus*
Diporophora	*Lophura*	*Gonatodes*	*Tachydromus*	*Mabuia*
Gonyocephalus	*Gecko*			
Nardoa	*Chondropython*	*Enygrus*	*Anomalochilus*	*Chersydrus*
Polyodontophis	*Dendrophis*	*Tropidonotus*	*Zamenis*	*Coluber*
Simotes	*Ablabes*	*Agrophis*	*Rhabdophidium*	*Brachyorrhos*
Hypsirhina	*Hispites*	*Dipsadomorphus*	*Dryophis*	*Dipsadoides*
Platurus	*Aipysurus*	*Hydrus*	*Microcepha-lophis*	*Doliophis*
Ultrocalamus	*Apistocala-mus*	*Pseudapistocala-mus*	*Psedelaps*	*Diemenia*
Haplopeltura	*Amblycephalus*	*Agkistrodon*		
Bellia	*Testudo*	*Trionyx*	*Lachesis*	*Damonia*
Amphibians: 21	**Lizards: 12**	**Snakes: 33**	**Turtles: 5**	**Crocodiles: 1**

Table 9. Generic names added in The Indo-Australian region during the last 70 years.

(Lechriodus)	*(Ansonia)*	*(Micryletta)*	*(Leptolalax)*	*(Nyctixalus)*
(Lymnodynastes)	*(Leptophryne)*	*(Gastrophrynoides)*	*(Occidozyga)*	*(Theloderma)*
(Ranidella)	*(Pelophryne)*	*(Chaperina)*	*(Amolops)*	*Barbourula*
Mixophyes	*(Pedostibes)*	*(Metaphrynella)*	*(Fejervarya)*	*Caudacaecilia*
Uperoleia	*(Barygenys)*	*(Megophrys)*	*(Ingerana)*	*Hoplobatrachus*
(Litoria)	*(Calluella)*	*(Leptobrachium)*	*(Limnonectes)*	*Pherohapsis*
(Nyctimystes)	*(Kalophrynus)*	*(Leptobrachella)*	*(Polypedates)*	*Xenopus*
(Agama)	*(Gekko)*	*(Apterygodon)*	*(Lipinia)*	*Brachymeles*
(Bronchocoela)	*(Cnemaspis)*	*(Carlia)*	*(Lobulia)*	*Corucia*
(Diporipora)	*(Gonydactylus)*	*(Cryptoblepharus)*	*(Mabuya)*	*Egernia*
(Gonocephalus)	*(Nactus)*	*(Dasamyia)*	*(Papuascincus)*	*Fojia*
(Hydrosaurus)	*(Cosymbotus)*	*(Dasia)*	*(Prasinohaema)*	*Geomyersia*
(Hypsilurus)		*(Emoia)*	*(Scincella)*	*Lygisaurus*
(Lophognathus)	*(Takydromus)*	*(Eugongylus)*	*(Sphenomorphus)*	*Oedura*
(Pseudocalotes)		*(Lamprolepis)*		
(Aepyurus)	*(Calloselasma)*	*(Laticauda)*	*(Parapistocalamus)*	*(Tropidolaemus)*
(Ahaetulla)	*(Candoia)*	*(Leiopython)*	*(Pelamis)*	*Internatus*
(Amphiesma)	*(Demansia)*	*(Liopeltis)*	*(Ptyas)*	*Heurnia*
(Anomochilus)	*(Disteira)*	*(Maticora)*	*(Ramphotyphlops)*	*Hydrelaps*
(Aplopeltura)	*(Elaphe)*	*(Megaerophis)*	*(Rhabdion)*	*Etheridgeum*
(Apodora)	*(Emydocephalus)*	*(Morelia)*	*(Rhabdophis)*	*Pseudonaja*
(Aspidomorphus)	*(Ephalophis)*	*(Oxyuranus)*	*(Sibynophis)*	*Salomonelaps*
(Bitia)	*(Kerilia)*	*(Ophiophagus)*	*(Styporhynchus)*	*Unechis*
(Boiga)	*(Kolpophis)*	*(Ovophis)*	*(Thalassophina)*	*(Daboia)*
(Brachyura)	*(Lapemis)*	*(Parahydrophis)*	*(Trimeresurus)*	
(Malayemys)	*(Cuora)*	*(Indotestudo)*	*(Pelodiscus)*	*Natator*
(Siebenrockiella)	*(Elseya)*	*(Eretmochelys)*	*Hieremys*	*Chitra*
(Heosemys)	*(Manouria)*	*(Amyda)*	*Lepidochelys*	*Trachemys*
Amphibians: 34	**Lizards:37**	**Snakes: 59**	**Turtles: 15**	**Crocodiles: 0**

Generic names in parenthesis refers to species within that genera were recognized before.

disappearance of this species is unknown. Another example is *Leptophryne cruentata*. This endemic species is still known to be abundant around 1962 (Liem, 1962). I have collected this species in 1978 from the Southern slopes of Mt. Pangerango-Gedeh. I tried to collect this species in 1984, but could not find a single specimen. The last specimen was seen near the summit in 1993-1994. The cause of the decline is unknown. Although I report here some examples, these facts remained a problem, because there is no hard evidence to tell about the past situation.

C. Introduced species

A number of amphibians and reptiles were imported as well as exported. Some of them have already been noticed in the wild, such as the red cheeked turtle *Trachemys scripta elegans*. The importation of *Iguana*, *Anaconda*, bullfrog (*Rana catesbeiana*) might be alarming within the next 20 year period.

Table 10. Changes in generic names of Indo-australian amphibians and reptiles:

Ichtyophis (part)	⇒	*Caudacaecilia*		⇒	*Limnonectes*		⇒	*Eugongylus*		⇒	*Xenochrophis*
Nesobia	⇒	*Leptobrachella*		⇒	*Fejervarya*		⇒	*Lamprolepis*		⇒	*Styporhynchus*
Megalophrys	⇒	*Megophrys*	*Staurois* (part)	⇒	*Amolops*		⇒	*Lipinia*	*Zamenis*	⇒	*Ptyas*
	⇒	*Leptobrachium*	*Simomantis*	⇒	*Staurois*		⇒	*Lobulia*	*Coluber*	⇒	*Elaphe*
	⇒	*Leptolalax*	*Discodeles*	⇒	*Discodeles*		⇒	*Lygisaurus*	*Simotes*	⇒	*Oligodon*
Batrachopsis	⇒	*Lechriodus*	*Cornufer*	⇒	*Platymantis*		⇒	*Papuascincus*	*Ablabes*	⇒	*Liopeltis*
(Pelobatidae)	⇒	(Lymnodynastidae)	*Rhacophorus* (part)	⇒	*Polypedates*		⇒	*Prasinohaema*	*Agrophis*	⇒	*Pseudorhabdion*
Phanerotis	⇒	*Lechriodus*		⇒	*Theloderma*		⇒	*Scincella*	*Rhabdophidium*	⇒	*Rhabdion*
Ranaster	⇒	*Lymnodynastes*	*Philautus* (part)	⇒	*Nyctixalus*		⇒	*Sphenomorphus*	*Brachyorrhos*	⇒	*Brachyura*
Crinia	⇒	*Ranidella*	*Nyctixalus* (part)	⇒	*Philautus*	*Crocodilus*	⇒	*Crocodylus*	*Hypsirhina*	⇒	*Enhydris*
Nyctimantis	⇒	*Nyctimystes*	*Acanthosaura*	⇒	*Agama*	*Damonia*	⇒	*Malayemys*	*Hispites*	⇒	*Bitia*
Hyla	⇒	*Litoria*	*Calotes* (part)	⇒	*Bronchocoela*	*Bellia*	⇒	*Siebenrockiella*	*Dipsadomorphus*	⇒	*Boiga*
Nectophryne	⇒	*Pedostibes*		⇒	*Pseudocalotes*	*Geoemyda* (part)	⇒	*Heosemys*	*Dryophis*	⇒	*Ahaetulla*
	⇒	*Pelophryne*	*Diporophora*	⇒	*Diporipora*	*Cyclemys* (part)	⇒	*Cuora*	*Dipsadoides*	⇒	*Boiga*
	⇒	*Leptophryne*	*Gonyocephalus*	⇒	*Gonocephalus*	*Testudo*	⇒	*Indotestudo*	*Platurus*	⇒	*Laticauda*
Bufo (part)	⇒	*Ansonia*		⇒	*Hypsilurus*		⇒	*Manouria*	*Aipysurus*	⇒	*Aepyurus*
	⇒	*Leptophryne*	*Japalura*	⇒	*Phoxophrys*	*Chelonia* (part)	⇒	*Eretmochelys*	*Hydrus*	⇒	*Pelamis*
Discophina	⇒	*Calluella*	*Lophura*	⇒	*Hydrosaurus*	*Emydura* (part)	⇒	*Elseya*	*Hydrophis (part)*	⇒	*Disteira*
Colpoglossus	⇒	*Calluella*	*Physignathus* (part)	⇒	*Lophognathus*	*Trionyx*	⇒	*Amyda*		⇒	*Ephalophis*
Calliglutus	⇒	*Calluella*	*Gonatodes*	⇒	*Cnemaspis*		⇒	*Pelodiscus*		⇒	*Parahydrophis*
Calophrynus	⇒	*Kalophrynus*	*Hemidactylus* (part)	⇒	*Cosymbotus*	*Typhlops (part)*	⇒	*Ramphotyphlops*		⇒	*Hydrelaps*
Phrynella (part)	⇒	*Metaphrynella*	*Mimetozoon*	⇒	*Cosymbotus*	*Nardoa*	⇒	*Bothrochilus*	*Microcephalophis*	⇒	*Hydrophis*
Kaloula (part)	⇒	*Metaphrynella*	*Gecko*	⇒	*Gekko*	*Liasis (part)*	⇒	*Leiopython*	*Enhydris*	⇒	*Lapemis*
Microhyla (part)	⇒	*Kalophrynus*		⇒	*Lepidodactylus*		⇒	*Morelia*	*Doliophis*	⇒	*Maticora*
	⇒	*Mycriletta*		⇒	*Ptychozoon*		⇒	*Apodora*	*Ultrocalamus*	⇒	*Toxicocalamus*
Oreophryne (part)	⇒	*Cophixalus*	*Gymnodactylus*	⇒	*Gonydactylus*	*Python (part)*	⇒	*Morelia*	*Apistocalamus*	⇒	*Toxicocalamus*
Microbatrachus	⇒	*Sphenophryne*		⇒	*Nactus*	*Chondropython*	⇒	*Morelia*	*Pseudapistocalamus*	⇒	*Toxicocalamus*
Liophryne	⇒	*Sphenophryne*	*Lepidodactylus* (part)	⇒	*Hemiphyllodactylus*	*Enygrus*	⇒	*Candoia*	*Pseudelaps*	⇒	*Aspidomorphus*
Oxydactyla	⇒	*Sphenophryne*	*Mabuia*	⇒	*Mabuya*	*Anomalochilus*	⇒	*Anomochilus*	*Diemenia*	⇒	*Demansia*
Callulops (part)	⇒	*Phrynomantis*		⇒	*Dasamyia*	*Chersydrus*	⇒	*Acrochordus*	*Pseudechis(part)*	⇒	*Oxyuranus*
Copiula (part)	⇒	*Choerophryne*	*Tachydromus*	⇒	*Takydromus*	*Xenochrophis*	⇒	*Amphiesma*	*Haplopeltura*	⇒	*Aplopeltura*
Hylophorbus (part)	⇒	*Phrynomantis*	*Ablepharus*	⇒	*Cryptoblepharus*	*Polyodontophis*	⇒	*Sibynophis*	*Amblycephalus*	⇒	*Pareas*
Aphantophryne(part)	⇒	*Cophixalus*	*Lygosoma* (part)	⇒	*Apterygodon*	*Dendrophis*	⇒	*Dendrelaphis*	*Agkistrodon*	⇒	*Calloselasma*
Pomatops	⇒	*Phrynomantis*		⇒	*Carlia*	*Tropidonotus*	⇒	*Amphiesma*	*Lachesis*	⇒	*Trimeresurus*
Rana (part)	⇒	*Amolops*		⇒	*Dasia*		⇒	*Rhabdophis*		⇒	*Tropidolaemus*
	⇒	*Ingerana*		⇒	*Emoia*		⇒	*Tropidonophis*		⇒	*Ovophis*

D. Prospects of new species

About three new species have been found each year between 1924 to 1994 from regions outside Indonesia. These facts are good indicators that there will be an equal number of new taxa found within the Indonesian borders. Another fact is that so few persons have been working in Indonesian region during the last 70 years. Many increases have been based on the work of a single person (such as Inger, Zweifel, Taylor, Brown, Tyler, Menzies). They are responsible for the finding of many new species. Many other findings that appeared sporadically are usually based on old collections. Judging from the increase of species in general and in taking account of the progress uniquely made in Indonesia, the herpetological fauna faces a big problem. Although we used a 70 years time span, researches were principally performed in the neighbouring countries of Indonesia. The increase of more than 486 species (either new species or new records) was made during the last two or three decades alone. Considering these facts, a projection of 800-1000 species in this region is largely plausible. Details of changes could be consulted in Tables 6-10.

CONCLUSIONS

A) More research in Indonesia is needed. Inventory or describing new species itself does not solved the problem. The kind of research that is badly needed must basically be holistic in approach. Ecological or phylogenetical works are preferred, either based on morphology, genetics or all. At this point, I would like to thank Prof. Robert Inger who organized of the Sabah Workshop on Amphibians who already took some action to standardize methods in studying amphibians and reptiles in South-east Asia.

B) Cases such as extinction or declining population cannot be solved with direct action, if there is no data base to measure the change.

C) There are too few specialists to handle the whole of Indonesia. At present I can only mention less than 10 persons who are partially engaged with the study of amphibians and reptiles.

LITERATURE CITED

Allison, A., 1982. Distribution and ecology of New Guinean lizards. In: J. L. Gressit (ed.), *Biogeography and Ecology of New Guinea*. Dr. W. Junk., The Hague. Pp. 803-813.

Allison, A., 1993. Biodiversity and conservation of the fishes, amphibians and reptiles of Papua New Guinea. In: Beehler (ed.), *Papua New Guinea conservation needs assessement*. Vol **2**., Chapter VI. Department of Environment and Conservation, Government of Papua New Guinea, Boroko. Pp. 158-225.

Berry, P. Y., 1978. *The Amphibian fauna of Peninsular Malaysia*. Tropical Press, K. L. 130 pp.

Brown, W. C. & A. C. Alcala, 1976 The biogeography of the Philipinne Islands, a fringing archipelago. *Proceedings of the California Academy of Sciences*, **4**(38): 105-130.

Corbet, G. B. & J. E. Hill, 1992. *The mammals of the Indo-Malayan region*. Oxford University Press. 488 pp.

Greer, E. E. jr., 1994. The generic relationships of the scincid lizard genus *Leiolopisma* and its relatives. *Australian Journal of Zoology, Supplementary Series*, **31**: 1-67

Inger, R. F., 1954. Systematics and zoogeography of Philippine Amphibia. *Fieldiana (Zoology)*, **34**: 389-424.

Inger, R. F., 1966. The systematics and zoogeography of the Amphibia of Borneo. *Fieldiana (Zoology)*, **52**: 1-402.

Inger, R. F. & H. Marx, 1965. The systematics and evolution of the Oriental colubrid snakes of the genus *Calamaria*.. *Fieldiana (Zoology)*, **49**: 1-304.

Inger, R. F. & R. Stuebing, 1992. *Frogs of Sabah*. Sabah Parks Publication No. 10. Sabah Parks Trustees, Kota Kinabalu. 132 pp.

Iskandar, D. T., 1988. The Amphibian constitution at three regions of Sumatra: Up-to-date checklist and zoogeographical account. *First Congress on Oriental Amphibians*. Paris. Pp 12 .

Iskandar, D. T. & K. N. Tjan, 1996. The amphibians and reptiles of Sulawesi: with notes on the chromosomal number of frogs and its distribution. *Proceedings of the First International Conference on Eastern Indonesian Vertebrates*. Manado. Pp. 39-46.

van Kampen, P. N., 1923. *The Amphibians of the Indo-Australian Archipelago*. E. J. Brill, Leiden. 384 pp.

Lim, K. K. P. & F. L. K. Lim, 1990. *A guide to the amphibians and reptiles of Singapore*. Singapore Science Centre. 160 pp.

Menzies, J. I., 1976. *Handbook of common New Guinea Frogs*. Handbook 1. Wau Ecology Institute, Wau. 82 pp.

de Rooij, N., 1915. *The Reptiles of the Indo-Australian Archipelago. Vol I. Lacertilia, Chelonia, Emydosauria*. E. J. Brill, Leiden. 384 pp.

de Rooij, N., 1917. *The Reptiles of the Indo-Australian Archipelago. Vol II. Ophidia*. E. J. Brill, Leiden. 334 pp.

Stuebing, R. B., 1991. Annotated checklist of snakes from Borneo. *The Raffles Bulletin of Zoology*, **41**: 261-293.

Stuebing, R. B., 1994. Annotated checklist of snakes from Borneo. *The Raffles Bulletin of Zoology*, **43**: 261-293.

Taylor, E. H., 1921. *Amphibians and Turtles of the Philippine Islands*. Bureau of Sciences, Manila. 193 pp.

Taylor, E. H., 1962. The amphibian fauna of Thailand. *University of Kansas Science Bulletin*, **43**: 265-599.

Taylor, E. H., 1963. The lizard fauna of Thailand. *University of Kansas Science Bulletin*, **44**: 687-1077.

Tyler, M. J., 1968. Papuan hylid frogs of the genus *Hyla*. *Zoologische Verhandelingen*, Leiden: **96**: 1-203.

Zweifel, R. G., 1972. Results of the Archbold expedition. No. 97. A revision of the frog subfamily Asterophryiinae family Microhylidae. *Bulletin of the American Museum of Natural History*, **148**: 411-546.

Zweifel, R. G. & M. J. Tyler, 1982. Amphibia of New Guinea. In: J. L. Gressit (ed.), *Biogeography and Ecology of New Guinea*. Dr. W. Junk, The Hague. Pp. 759-801.