



CONSERVATION OF HERPETOFAUNA IN BANTIMURUNG BULUSARAUNG NATIONAL PARK, SOUTH SULAWESI, INDONESIA



By:

M. Irfansyah Lubis, Wempy Endarwin, Septiantina D. Riendriasari,
Suwardiansah, Adininggar U. Ul-Hasanah, Feri Irawan, Hadijah Aziz K., and
Akmal Malawi



Conservation Leadership Programme

CONSERVATION OF HERPETOFAUNA
IN BANTIMURUNG BULUSARAUNG
NATIONAL PARK, SOUTH SULAWESI,
INDONESIA

Final Report
2008

By:

M. Irfansyah Lubis, Wempy Endarwin, Septiantina D.
Riendriasari, Suwardiansah, Adininggar U. Ul-Hasanah,
Feri Irawan, Hadijah Aziz K., and Akmal Malawi

Departemen Konservasi Sumberdaya Hutan
Fakultas Kehutanan Institut Pertanian Bogor
Bogor Indonesia 16000
Tel : +62 - 251 - 621 947
Fax: +62 - 251 - 621 947
Email: lubizt@yahoo.com (team leader)

Executive Summary

Sulawesi is an island with complex geological and geographical history, thus resulting in a complex array in biodiversity. Bantimurung Bulusaraung National Park (BabulNP) was gazetted in 2004 to protect the region's biodiversity and karst ecosystem. However, the park's herpetofauna is almost unknown. This project consists of three programs: herpetofauna survey in BabulNP, herpetofauna conservation education to local schools, and herpetofauna training for locals and was conducted from July to September 2007. Based on the survey conducted in six sites in the park, we recorded 12 amphibian and 25 reptile species. Five of those species (*Bufo celebensis*, *Rana celebensis*, *Rhacophorus monticola*, *Sphenomorphus tropidonotus*, and *Calamaria muelleri*) are endemic to Sulawesi. Two species of the genus *Oreophryne* are still unidentified. We visited six schools around the park for our herpetofauna conservation education program. The Herpetofauna Observation Training was held over four days with 17 participants from BabulNP staff, local NGOs, school teachers, and Hasanuddin University students.

Acknowledgements

This project would not have been possible without the contribution of many persons. We would like to express our gratitude to BP Conservation Leadership Programme for providing funding. Many thanks go to CLP managers (Maina, Marianne, Robyn) for their assistance throughout this project. Idea Wild provided books for identification. We also would like to thank Pak Darsono (Head of Bantimurung NP), Pak Iskandar, Pak Dedi, Pak Abdul Rajab, Pak Muhaiyyang, Pak Burhanuddin, Pak Hidayat, Pak Chairil (Bantimurung Bulusaraung National Park); Dr. Ir. Amran Achmad and Kelompok Pandu Alam dan Lingkungan Fakultas Kehutanan (Hasanuddin University); Our Guides: Pak RT, Pado, Tuo, Pak Tua; Forest rangers: Pak Amir Sorong, Pak Haro, Pak Khairul, Sidek, Pak Rasyid; Puang Aji (Head of Samaenre Village) and Adi (Cakar) and his family for their hospitality. Our heartfelt thanks are given to Mirza D. Kusri, PhD for her advice before and during the project, especially for her guidance during rough times. We are also grateful for the help and assistance of Dr. Rineko Soekmadi (Head of Department of Forest Resource & Ecotourism) and Arzyana Sunkar, PhD (Advisor for Himakova). Neneng Sholihat, S.hut helped during the training, and for this we are grateful.

CONTENTS

Executive Summary	i
Acknowledgements	ii
CONTENTS.....	iii
INTRODUCTION.....	1
A. Background	1
B. Aims and Objectives	1
METHODS	2
A. Project Site and Time	2
B. Data Collection	6
C. Data Analysis.....	7
RESULTS	8
A. Microclimate	8
B. Herpetofauna of Bantimurung Bulusaraung National Park.....	8
C. Relative Abundance.....	12
D. Parental Care in <i>Limnonectes modestus</i>	13
E. Conservation Status and Issues.....	14
F. Difficulties and Setbacks	16
OTHER PROJECT COMPONENTS.....	17
A. Local Participation	17
B. Herpetofauna Conservation Education and Public Awareness	17
C. Herpetofauna Training for Various Related Stakeholders.....	18
CONCLUSION AND RECOMMENDATIONS.....	21
A. Conclusion.....	21
B. Recommendations.....	21
THE TEAM.....	22
LITERATURE CITED.....	25
APPENDIX.....	28

LIST OF FIGURES

1. Map of Bantimurung Bulusaraung National Park (BabulNP), South Sulawesi	2
2. Aquatic and terrestrial habitats in Bontosiri	3
3. River during dry season and terrestrial habitat in Kappang	4
4. Aquatic and terrestrial habitat in Pattunuang	4
5. Terrestrial and aquatic habitats in Leang-leang	5
6. Terrestrial and aquatic habitats in Tompobulu	5
7. Aquatic and terrestrial habitats in Leang Lonrong	6
8. Various methods employed to catch arboreal lizards	7
9. Suwardiansyah photographs an <i>Ahaetulla prasina</i> before releasing the snake	7
10. Species accumulation curve for herpetofauna in BabulNP	10
11. Relative abundance of herpetofauna in BabulNP	12
12. Egg deposition and nest guarding displayed by <i>L. modestus</i>	13
13. Preserved <i>Draco sp.</i> from Bantimurung Nature Recreation Park as souvenirs	15
14. Vandalism in Pattunuang and solid rubbish along river in Bantimurung Nature Recreation Park	15
15. Paved road cutting through BabulNP	16
16. Herpetofauna conservation education program at local schools	18
17. Participants of the Herpetofauna Observation Training in BabulNP	19
18. Cover of training module developed by team and Dr. Mirza D. Kusri	19
19. Herpetofauna training activities	20
20. Souvenirs produced by the team	21
21. Team members	24

LIST OF TABLES

1. Microclimate conditions in six survey sites in BaBulNP	8
2. Herpetofauna species of BabulNP	8
3. Herpetofauna species based on habitat types	11

INTRODUCTION

A. Background

Herpetofauna, or reptiles and amphibians, are regarded as the less appealing of the animal kingdom when compared to mammals and birds. Reptiles are often feared, due to the misconception surrounding their fearsome appearance or fatal venom. On the other hand, amphibians in particular are often labeled as bio-indicator, or animals that behave as an environmental gauge due to their sensitivity to changes in their habitat. Their permeable skin absorbs gases and liquids from the surrounding air and water, including pollutants (Stebbins & Cohen 1997).

Sulawesi is a large equatorial island in the Indonesia Archipelago lying between Borneo and the Moluccas islands. Its complex geological origins and geographical position have resulted in a distinctive mixture of Australasian and Asian flora and fauna elements, with high levels of endemism across all vertebrate groups (Whitten et al., 2002; Evans et al., 2003). More than 115 reptile and 40 frogs have been recorded from the island to date, many of which are endemic (Iskandar & Tjan, 1996). Although rich in endemic diversity, little study has been done on the herpetofauna of the island, and even less has been published (Iskandar & Tjan, 1996; Gillespie et. al, 2005; dan Gillespie & Howard, 2006). This lack of information and knowledge is a setback in the conservation of herpetofauna, especially because it is still difficult to identify the species from the area.

Bantimurung Bulusaraung National Park (BabulNP) in South Sulawesi is a recently gazetted park which achieved its status in October 2004 based on Decree of the Minister of Forestry No. 398/Menhut/II/2004. The park is known for its unique karst ecosystem and butterfly diversity. The park's herpetofauna, however, is practically unexplored.

B. Aims and Objectives

The aims of the project are to collect data on the herpetofauna species of BabulNP, and to introduce the herpetofauna diversity of the area to locals, national park staff, and local NGOs.

The objectives of the project are the following:

1. To collect baseline data on herpetofauna species diversity in BabulNP;
2. To promote herpetofauna diversity and conservation through public awareness campaign, using data obtained from the study;

3. To contribute towards the training of local guides through in-class and field training; and
4. To develop and strengthen the network between BabulNP, local university and community, and local NGOs.

METHODS

A. Project Site and Time

BabulNP is located in South Sulawesi, near the southernmost tip of the island's southern "arm". The park covers an area of approximately 43,750 Ha. It lies between latitudes 04°43'10"S to 05°07'12"S, and longitudes 119°34'11"E to 119°55'13"E, within two administrative borders, Maros and Pangkep Regencies in South Sulawesi.

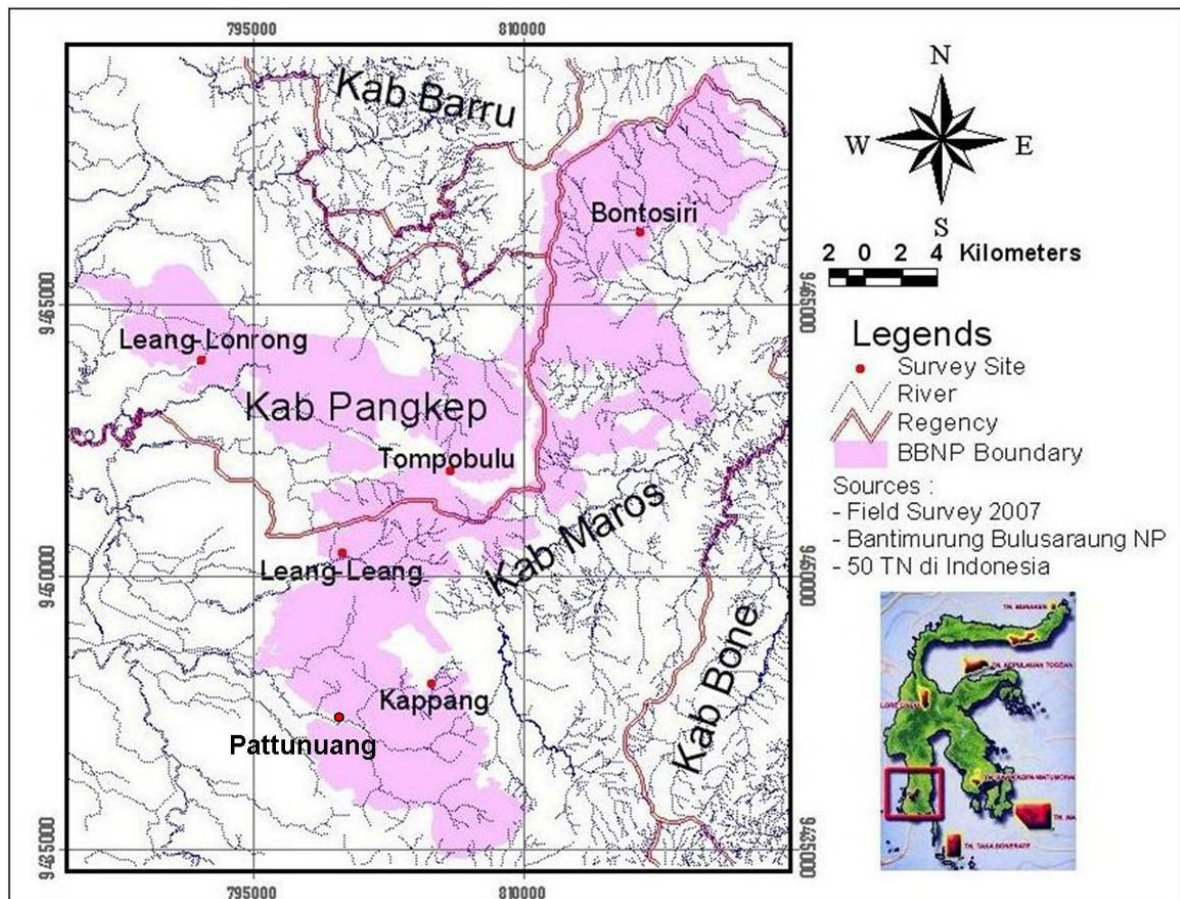


Figure 1. Map of Bantimuring Bulusaraung National Park (BabulNP), South Sulawesi.

The project was conducted from July to September 2007. Six sites were surveyed on July 13 to August 2 and August 14 - 21 2007. We visited 6 schools for the Herpetofauna Conservation Education from August 7 - 11, and the Herpetofauna Training was held on August 30 to September 2, 2007.

Most of the topography of BabulNP consists of mountainous areas (40%), located in the northern and center of the park. It is characterized by its steep highlands and cliffs. The highest peak in BabulNP is the summit of Bulusaraung at 1,300 m asl. The remaining areas of the park consist of hilly areas (25%) to flat lands (35%). According to Schmidt and Ferguson, the park's climate is classified as having type C with average temperature of 28-30°C. Wind speed averages 3 knots but may reach up to 20 knots. Rainy season lasts from November to April while dry season occurs from July to September.

Based on our preliminary survey on April 2007, we selected six sites within the park representing forest (Bontosiri, Pattunuang, and Tompobulu) and non-forest (Kappang, Leang-leang and Leang Lonrong) habitats. Forest habitats were generally undisturbed areas. Non-forests were habitats that have been altered by humans, including rice fields and human settlements.

Bontosiri (Lat -4.79814 S, Long 119.8525 E; 550-650 m asl)

Located in the eastern side of the national park, Bontosiri is the name of a village located on the border of the park. Most of the land is planted with Kemiri *Aleurites moluccana* long before the park was established. Survey was focused in the forested areas and around the waterfall. Bontosiri is relatively steep, and the river was difficult to work with. Therefore, we surveyed the aquatic herpetofauna along a seasonal stream. We surveyed this site from July 13 to 17, 2008.



Figure 2. Aquatic (left) and terrestrial (right) habitats in Bontosiri.

Kappang (Lat -5.02454 S, Long 119.7497 E; 300 m asl)

Kappang is the only site outside of the national park. Kappang is located south of BabulNP. The river in the area was dry at the time of the survey; therefore we surveyed aquatic species along water holes. Terrestrial species were surveyed in surrounding rice fields and plantations. This site was surveyed on July 18 to 21, 2008.



Figure 3. River during dry season (left) and terrestrial habitat (right) in Kappang.

Pattunuang (Lat -4.79814 S, Long 119.7046 E; 1685 mdpl)

Pattunuang is a tourist attraction within the park area. It consists of a pristine river surrounded by steep cliffs along both sides. The site also offers a camping ground for visitors. Survey was focused along the river and the surrounding karst area. We surveyed Pattunuang for four days from July 23 to 26, 2008.



Figure 4. Aquatic (left) and terrestrial (right) habitats in Pattunuang.

Leang-leang (Lat -4.95944 S, Long 119.7046 E; 200 mdpl)

Leang-leang is a transition from a forest ecosystem to cultivated land. Forest vegetation grows in the steep slopes, while the flatter areas are planted with Teak or other cultivated plants by villagers. We surveyed the plantations as well as Panaikang River. Leang-leang is located on the southern part of BabulNP, and was surveyed from July 31 to August 3, 2008.



Figure 5. Terrestrial (left) and aquatic (right) habitats in Leang-leang.

Tompobulu (Lat -4.918 S, Long 119.7579 E; 500-550 mdpl)

Tompobulu is located in Pangkep Regency, while the previous sites are located in Maros Regency. Tompobulu is the trail which leads to Bulusaraung Mountain. The area is planted with Aren (*Arenga pinnata*) that locals use to produce sugar and ballo, an alcoholic drink. Survey was focused on the on the upstream of the river because the downstream river had dried due to the season. We conducted our survey in Tompobulu from August 14 to 17, 2008.



Figure 6. Terrestrial (left) and aquatic (right) habitats in Tompobulu.

Leang Lonrong (Lat -4.86293 S, Long 119.6339 E; 50 mdpl)

Leang Lonrong has started to be developed as a tourism site. Leang, meaning cave, signifies the large river that starts inside a cave. The site is a transition of locals' plantations and steep karst cliffs. The area is dominated by secondary vegetation, undergrowth, and Teak. The Leang Lonrong River is a large river system, and is used by a large cement industry in the area. We visited Leang Lonrong from August 18 to 21, 2008.



Figure 7. Aquatic (left) and terrestrial (right) habitats in Leang Lonrong.

B. Data Collection

Herpetofauna data was collected using methods modified from Heyer (1994). Visual encounter survey (VES) was conducted in 400 m stream transects and using time-search in terrestrial habitats in each of the six sites. For the stream transects, we surveyed reptiles and amphibians by walking down the stream and searching along the banks. Time-searches were done by randomly walking the forest for two hours.

We sampled herpetofauna in the mornings (approximately 9:00 a.m. to 12:00 p.m., depending on weather) and nights (7:00 p.m. to 11:00 p.m.) with three repetitions each. Searches were done throughout the transects and forest but we focused on possible hideouts or nests such as along the river banks, understory vegetation, among leaf litter, fallen logs, and tree branches.

All observed specimens were captured by hand if possible. At times we had to climb trees to catch small arboreal lizards, but when that was not possible, we used a slingshot instead. Those that escaped or were not possible to capture were noted. We also employed other methods to help catch quick and sensitive animals, especially terrestrial skinks. We set up glue traps using rat glue on possible skink basking sites, such as fallen logs and rocks. The glue traps eventually lose their adhesiveness after several days or after rainfall.



Figure 8. Various methods employed to catch arboreal lizards. A local guide skillfully climbs a tree (left) and Hadijah tries her aim at a *Draco spp.*

Specimens captured were then collected to be identified and measured. Information recorded for each individual included species, sex (if possible), snout-vent-length (SVL), tail length (for reptiles), weight, morphological abnormalities, as well as location and time of capture. Specimens were photographed before released back in their habitat.



Figure 9. Suwardiansyah photographs an *Ahaetulla prasina* before releasing the snake.

In addition to herpetofauna data, we also collected habitat data, including weather, air and water temperature, and relative humidity. We also measured physical characteristics of the streams. Habitat disturbances and land use were visually observed and noted.

C. Data Analysis

Analysis was divided into two parts. First, herpetofauna specimens were identified based on van Kampen (1923) and de Rooij (1915), as well as by comparing with specimens from the Museum Zoologicum Bogoriense (MZB). Most were able to be identified, except for

two species. Data was then analyzed descriptively to calculate species diversity and abundance at each site.

RESULTS

A. Microclimate

In general, microclimate in Bantimurung Bulusaraung was hot and dry. Temperatures ranged from 19°C to 27.5°C. Bontosiri had different microclimate compared to other survey sites. During the survey, Bontosiri experienced heavy rains almost daily, and therefore the site was wetter than the others. On the other hand, Kappang was hot and dry. The river was completely dry during the survey.

Table 1. Microclimate conditions in six survey sites in BaBulNP.

Location	Elevation (mdpl)	Air Temp. (°C)		Water Temp. (°C)		RH (%)	
		Day	Night	Day	Night	Day	Night
Bontosiri	550-650	22-23.5	21-22	21.5-22	21.8-22	91-92	82-91
Kappang	300	24.5-31.5	22-24	na	na	54-75	75-91
Pattunuang	-	22.5-28	21-24	24.5-25.5	24.5-26	77-84	82-91
Leang-leang	200	25-33.5	21.5-25	23.5-26.7	23-25	51-68	73-91
Tompobulu	500-550	19-29.5	19.2-23	20.5-22	20.7-21.5	63-75	68-82
Leang Lonrong	50	27.5-33.5	25.5-27	24.7-25	19.9-24.8	53-70	61-92

Notes: Water temperature is not available for Kappang because the stream was dry during time of survey.

B. Herpetofauna of Bantimurung Bulusaraung National Park

In total, we recorded 37 herpetofauna species, consisting of 12 amphibian species (from four families) and 25 reptile species (from eight families). Two Microhylids have not been identified (*Oreophryne sp.1* and *Oreophryne sp.2*).

Compared to other studies of the area, Iskandar dan Tjan (1996) recorded more than 115 reptile and 40 amphibian species in Sulawesi. These numbers are not unlikely to increase due to new findings of new species. Gillespie *et al.* (2005) recorded 74 herpetofauna species in the islands off of Southeast Sulawesi.

Table 2. Herpetofauna species of BabulNP.

Species	Forested Habitat			Non Forested Habitat		
	Btsr	Ptng	Tmbl	Kppg	Lean	Lelo
1	2	3	4	5	6	7
AMPHIBIA						
Bufonidae						
<i>Bufo celebensis</i> ^e	•	•	•	•		
<i>Bufo melanostictus</i>					•	•

	1	2	3	4	5	6	7
Microhylidae							
<i>Oreophryne</i> sp. 1		•					
<i>Oreophryne</i> sp. 2		•		•			•
Ranidae							
<i>Fejervarya cancrivora</i>				•	•	•	•
<i>Limnonectes grunniens</i>		•		•			
<i>Limnonectes modestus</i> ^e		•					
<i>Occidozyga laevis</i>			•	•			
<i>Rana celebensis</i> ^e		•	•	•			
<i>Rana erythraea</i>						•	•
Rhacophoridae							
<i>Polypedates leucomystax</i>				•	•	•	
<i>Rhacophorus monticola</i> ^e		•		•			
REPTILIA							
Agamidae							
<i>Draco walkeri</i>			•	•	•	•	•
<i>Hydrosaurus amboinensis</i>			•				
Gekkonidae							
<i>Cyrtodactylus jellesmae</i>		•	•	•		•	
<i>Gehyra mutilata</i>						•	
<i>Hemidactylus frenatus</i>				•		•	
Scincidae							
<i>Eutropis multifasciata</i>					•		•
<i>Eutropis rudis</i>			•	•	•	•	•
<i>Lamprolepis smaragdinum</i>			•			•	
<i>Sphenomorphus tropidonotus</i> ^e			•				
<i>Sphenomorphus variegatus</i>		•	•	•	•	•	•
<i>Tropidophorus grayi</i>							•
Varanidae							
<i>Varanus salvator</i>							•
Colubridae							
<i>Ahaetulla prasina</i>				•	•		•
<i>Boiga dendrophila</i> ^o			•				
<i>Calamaria muelleri</i> ^{eo}			•				
<i>Dendrelaphis pictus</i>			•	•	•		•
<i>Elaphe erythrura</i> ^o			•				
<i>Enhydris plumbea</i>			•			•	•
<i>Oligodon waandersi</i> ^o							•
<i>Psammodynastes pulverulentus</i>		•		•			
<i>Xenochrophis trianguligera</i>			•	•			
Crotalidae							
<i>Tropidolaemus wagleri</i>			•				
Cylindrophiiidae							
<i>Cylindrophis melanotus</i> ^{SP}		•					
Pythonidae							
<i>Python reticulatus</i> ^{SP}			•				

	1	2	3	4	5	6	7
Typhlopidae							
<i>Ramphotyphlops braminus</i>					•		
TOTAL		11	18	17	10	12	14

Notes: Btsr: Bontosiri, Ptng: Pattunuang, Tmbl: Tompobulu, Kppg: Kappang, Lean: Leang-leang, Lelo: Leang Lonrong, e: endemic to Sulawesi, o: recorded outside of survey time and transect, p: recorded during preliminary survey.

In BaBulNP, students from Bogor Agricultural University recorded six amphibian and 17 reptile species from Pattunuang and Bantimuring Nature Recreation Parks (Himakova 2007). The three species that were recorded by the Himakova team which we did not find were *Fejervarya limnocharis* (Ranidae), *Boiga irregularis* (Colubridae), and *Rhabdophis chrysargoides* (Colubridae). This may be due to the greater search effort exerted by their team, therefore they were able to find more species.

As many as five species or 13.51% are endemic to Sulawesi (*Bufo celebensis*, *Rana celebensis*, *Rhacophorus monticola*, *Sphenomorphus tropidonotus*, and *Calamaria muelleri*), all of which were found in undisturbed habitats. The rest of the species recorded have greater distribution, ranging to western part of Indonesia and even to Southeast Asia.

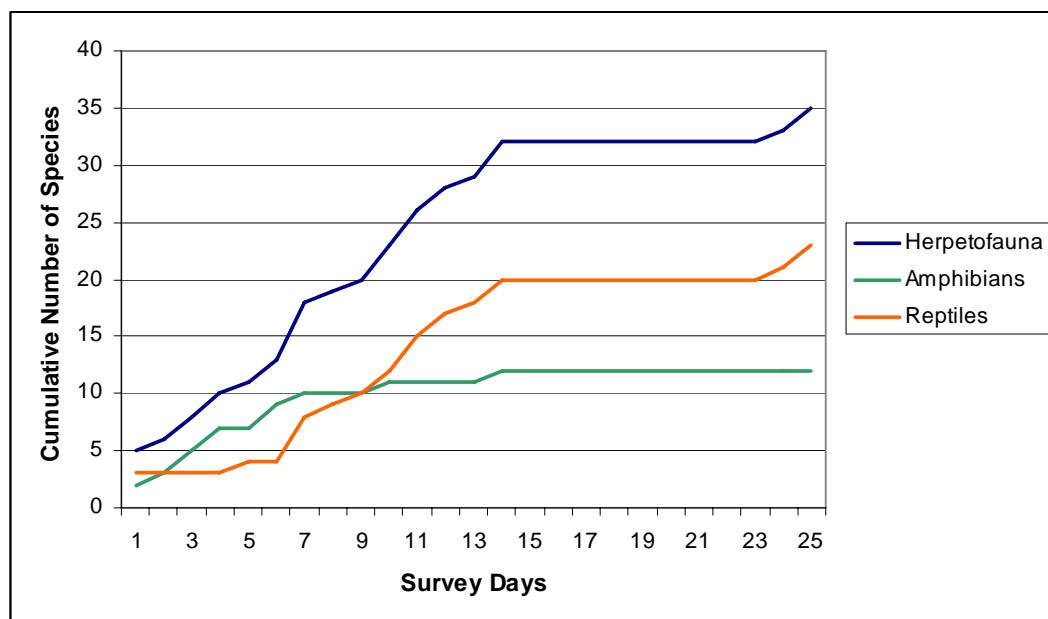


Figure 10. Species accumulation curve for herpetofauna in BabulNP (not including two species recorded in preliminary survey).

Species accumulation curve (Fig. 10) show the number of new species recorded each day during the survey. This curve does not include the two species, *Cylindrophis melanotus* and *Python reticulatus*, recorded during the preliminary survey on April 2007. As shown in the table, the curve for amphibians reached a plateau on the fifteenth day of survey. On the other hand, the number of reptile species recorded during the last two days of survey increased. Reptiles cover a more diverse microhabitat and are more difficult to

find compared to amphibians. With additional days of survey, it is not impossible to find even more reptiles in BabulNP.

Based on habitat types, as shown in Table 3 below, more herpetofauna species were recorded only in forested habitats (16 species) compared to those recorded only in non-forested habitats (8 species) or both habitat types (13 species).

Amphibians that are only found in forested habitats are those that are dependent on clear streams or shrubs and trees only found in relatively undisturbed forests. *Limnonectes spp.*, *Occidozyga laevis* and *Rana celebensis* are dependent on clear rushing streams of pristine forests. *Oreophryne sp. 1* and *Rhacophorus monticola* live among forest trees and shrubs. The two species can live far from water, and therefore need the moisture provided by the humidity in the air and leaf litter, provided by the canopy cover in forests (Ul-Hasanah 2006). Those that are only found in non-forested habitats are species amphibians that are associated with human habitations and are sometimes found in forest edges, but not within the forest itself (Iskandar 1998). Highly adaptable species were recorded in both habitat types.

Table 3. Herpetofauna species based on habitat types.

Taxa	Forested	Both	Non-forested
Amphibia	<i>Oreophryne sp. 1</i>	<i>Bufo celebensis</i>	<i>Bufo melanostictus</i>
	<i>Limnonectes grunniens</i>	<i>Oreophryne sp. 2</i>	<i>Rana erythraea</i>
	<i>Limnonectes modestus</i>	<i>Fejervarya cancrivora</i>	
	<i>Occidozyga laevis</i>	<i>Polypedates leucomystax</i>	
	<i>Rana celebensis</i>		
	<i>Rhacophorus monticola</i>		
Reptilia	<i>Hydrosaurus amboinensis</i>	<i>Draco walkeri</i>	<i>Oligodon waandersi</i>
	<i>Boiga dendrophila</i>	<i>Ahaetulla prasina</i>	<i>Gehyra mutilata</i>
	<i>Calamaria muelleri</i>	<i>Dendrelaphis pictus</i>	<i>Eutropis multifasciata</i>
	<i>Elaphe erythrura</i>	<i>Enhydris plumbea</i>	<i>Tropidophorus grayi</i>
	<i>Psammodynastes pulverulentus</i>	<i>Cyrtodactylus jellesmae</i>	<i>Ramphotyphlops braminus</i>
	<i>Xenochrophis trianguligera</i>	<i>Hemidactylus frenatus</i>	<i>Varanus salvator</i>
	<i>Tropidolaemus wagleri</i>	<i>Eutropis rudis</i>	
	<i>Cylindrophis melanotus</i>	<i>Lamprolepis smaragdinum</i>	
	<i>Python reticulatus</i>	<i>Sphenomorphus variegatus</i>	
	<i>Sphenomorphus tropidonotus</i>		
Total	16	13	8

Similar to amphibians, reptiles recorded only in forested habitats are those dependent on clear streams (*Hydrosaurus amboinensis*) or trees, whether arboreal (*Boiga dendrophila*, *Psammodynastes pulverulentus*, or *Tropidolaemus wagleri*) or fossorial (*Calamaria muelleri*, *Cylindrophis melanotus*). Fossorial species are found under loose soil or leaf litter. On the other hand, species only found in non-forested areas are those associated with human habitation (*Gehyra mutilata*, *Eutropis multifasciata*). *Oligodon waandersi* is not limited to disturbed habitats. One individual was recorded inside a cave in Leang Lonrong. Our

observation could not determine whether the species is a cave-dwelling species or whether the encounter was incidental.

C. Relative Abundance

We collected 504 reptiles and amphibians over 25 survey days, consisting of 264 amphibians and 240 reptiles. For amphibians, the most abundant species were *Rana celebensis* and *Fejervarya cancrivora* (see Fig. 11). The most abundant reptile species were *Eutropis rudis* and *Sphenomorphus variegatus*. *Rana celebensis* was recorded in forested as well as non-forested habitats, including riverbanks, forests, and near water bodies. *Fejervarya cancrivora* is a common species that inhabits rice fields, swamps, and other habitats closely associated with humans (Berry 1975, Iskandar 1998).

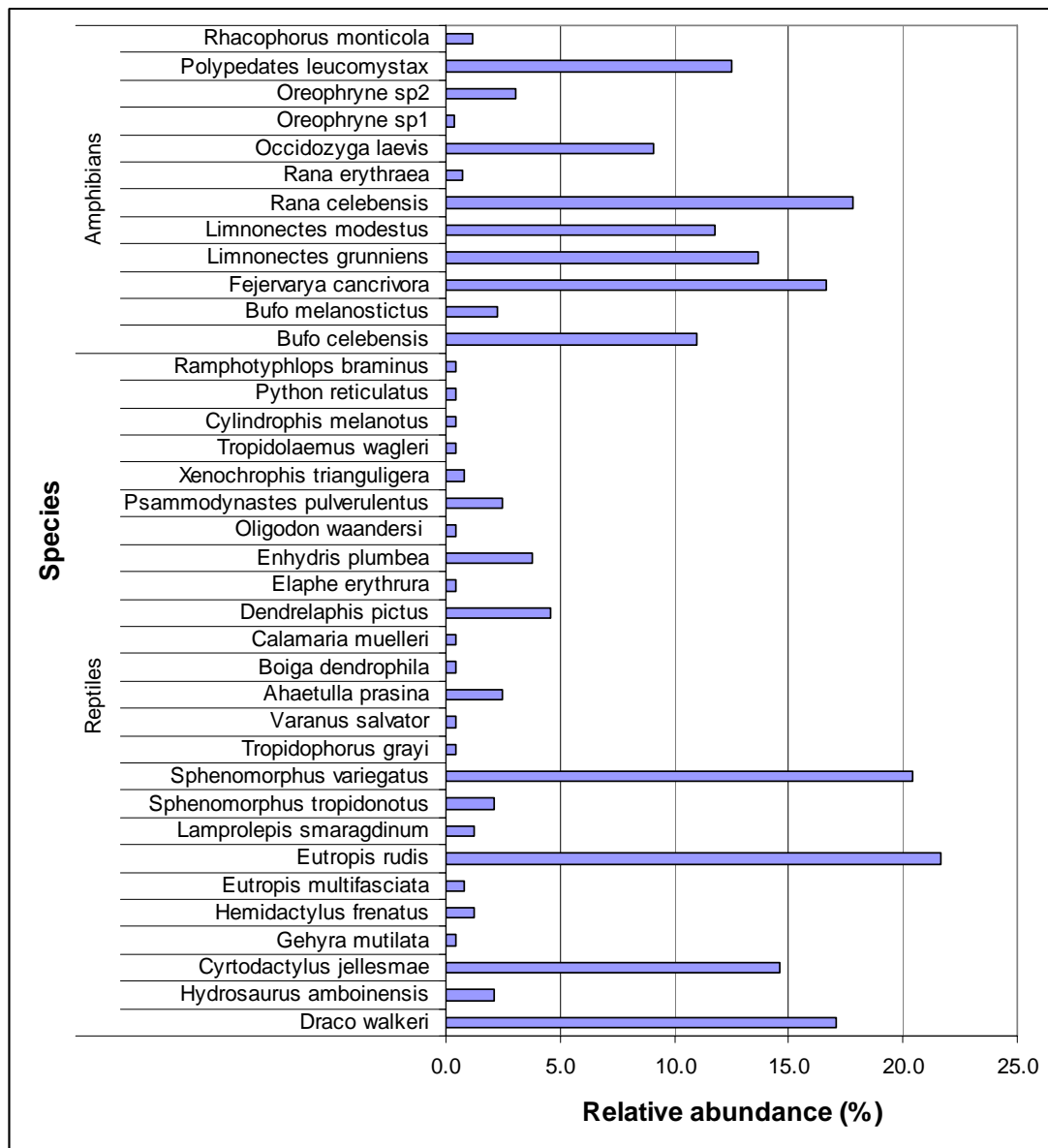


Figure 11. Relative abundance of herpetofauna in BabulNP.

D. Parental Care in *Limnonectes modestus*

In Bontosiri, we observed a small stream-dwelling Ranid, *Limnonectes modestus*, displaying unique parental care of nest guarding. Parental care in anurans occurs although it is uncommon, and anurans display a wide variety of modes of parental care (Stebbins and Cohen 1997). We recorded a total of 31 individuals and 9 nests in seven observations. *L. modestus* displays paternal care, in which males guard the nests during the day as well as nighttime.



Figure 12. Egg deposition and nest guarding displayed by *L. modestus*. Eggs are laid on surface of leaves or moss-covered rocks above stream (left), and a male is seen guarding two clutches of eggs.

Egg clutches were observed on the surface leaves of Bello-bello seedlings along the stream as well as mossy surface of rocks. Bello-bello leaves are smooth and oval shaped, therefore providing excellent surface for egg deposition. All nests are located above a small stream with slow current (0.23 m/s), therefore when tadpoles fall into the water immediately after they hatch. Water depth during time of survey ranged from 10 to 20 cm with average width of 1 to 2 m.

We observed up to two clutches of eggs on a single leaf, with an average of 21 per clutch. Multiple clutches consist of eggs at different growth stages and had only one frog guarding the nest, suggesting that *L. modestus* possibly returns to the same leaf to lay its eggs.

E. Conservation Status and Issues

From all the 37 species recorded, only *Hydrosaurus amboinensis* is nationally protected under the Government Regulation Act No. 7 of 1999. This regulation prohibits all utilization of the species, including hunting and trade, except with special permission from the Ministry of Forestry.

Based on international conservation status, *Varanus salvator* is listed in CITES Appendix II, in which international trade of the species is allowed under strict monitoring and regulations. Based on IUCN Red List of Endangered Species, one amphibian species is listed as Near Threatened (*Rhacophorus monticola*) because its current population does not qualify to be included in any of the more threatened category, but may be so in the near future. In addition, nine amphibian species are categorized as Least Concern due to their wide distribution and abundant populations (*Bufo celebensis*, *B. melanostictus*, *Fejervarya limnocharis*, *Limnonectes grunniens*, *L. modestus*, *Occidozyga laevis*, *Rana celebensis*, *R. erythraea*, and *Polypedates leucomystax*), and the rest are not listed. None of the reptiles recorded are listed in the Red List. These non-listings may indicate that populations of those species are not experiencing any declines or threats, but most likely it is because there is insufficient information.

Although already a conservation area, anthropogenic threats to herpetofauna species still occur within and surrounding the park. One form of species harvest is common in Bantimurung Nature Recreation Park, where vendors sell preserved *Draco sp.* – possibly *D. walkeri* – as souvenirs around the park's main entrance. Each specimen is placed on a piece of cardboard or wood and covered with a thin piece of clear plastic. The specimens are labeled as *D. volans*, a similar species also occurring in Sulawesi. Each specimen is sold for IDR 5,000 to 7,500. Some vendors sell the specimens for up to IDR 50,000 per pair, though they are willing to bargain with potential buyers. Although the species itself are not protected under international or national legislation, all species inside national parks are protected under National Law No. 5 of 1990 concerning Conservation of Natural Biological Resources and its Ecosystems.

Park officials have prohibited the hunting of the species, but the trade continues with locals claiming that the lizards are from areas outside the park. This form of utilization needs further study of the lizard's population in the area and intensity of its harvest.



Figure 13. Preserved *Draco* sp. from Bantimurung Nature Recreation Park sold as souvenirs.

Another potential threat is the negative impacts caused by visitors to Bantimurung and Pattunuang Nature Recreation Parks. Bantimurung's main attraction is its waterfall and river which include swimming areas for visitors. Unregulated bathing activities result in soap and detergents flowing downstream from the waterfall, along with solid rubbish such as food and drinks packaging that have washed up downstream. Stream pollutants pose a major threat especially to aquatic amphibians living along the stream, such as *Fejervarya cancrivora*. In Pattunuang, litter and vandalism is a greater problem.



Figure 14. Vandalism in Pattunuang (left) and solid rubbish along river in Bantimurung Nature Recreation Park (right).

Another cause of conservation concern is the paved road that cuts through Karaenta Forest in the southern portion of the park. This road connects Maros and Bone Regencies and was constructed before the establishment of the park. An impact of the road can be

seen in the garbage dump located near Karaenta Forest. The dump is a pollutant source that can be harmful to the area's herpetofauna and other wildlife. In addition, the road provides unguarded access to the national park which provides an advantage to would-be poachers or loggers.

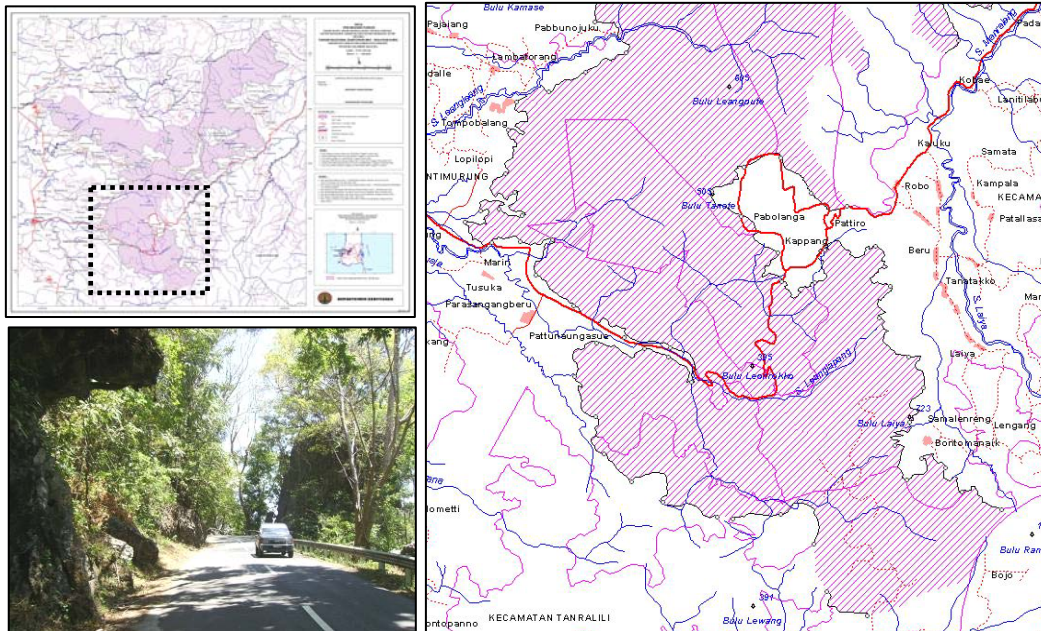


Figure 15. Paved road cutting through BabulNP. Clockwise from top left: BabulNP, with dashed square enlarged; southern portion of BabulNP (shaded) split into two by road (red line); paved road cutting through the national park. Map source: Bantimurung Bulusaraung National Park 2004.

Around the national park are several limestone mines. Occurring adjacent to the park, the mines gradually degrade wildlife habitats. Although they are currently conducted outside the park, mining activities will alter the karst cliffs around the park. One study shows that one mining company's activities have already altered the water cycle and therefore the hydrological functions of the park (Subchan 2008).

F. Difficulties and Setbacks

We came across several weather related setbacks that forced us to spend an extra day or two on the field. In Kappang, the river was completely dry, and therefore we had to compensate by changing our aquatic site to a nearby spring instead.

The team also experienced internal issues in which the previous team leader, Anisa Fitri, resigned from her position. The position was replaced by M. Irfansyah Lubis. This change did not affect much of the continuation of the project.

OTHER PROJECT COMPONENTS

A. Local Participation

The main team consisted of students and graduates from Bogor Agricultural University. The team members are or were active members of the Herpetofauna Interest Group (KPH-HIMAKOVA IPB). They have previously done surveys in Java, Sumatra and Kalimantan. This project gave them the opportunity to survey the Wallacea region, as well as basic skills such as organizing a project, communicating with various levels of government officials and the community, and all the while adapting to a whole different culture and environment.

The team also included two additional members from Hasanuddin University, Makassar. The two members, a Forestry graduate and a student, are not new to biodiversity surveys, but have never done herpetofauna studies before. They have extensive knowledge of the area. Through the survey, they learned a whole new taxon, herpetofauna survey methods, to handling live reptiles.

During the field survey, the team also involved locals by employing local guides. Guides came from all members of society, including head of sub-village, farmer, and young villagers. Guides camped along during the whole time of survey, except if they lived close enough to walk home everyday. Guides were chosen by recommendations from park officers or rangers.

B. Herpetofauna Conservation Education and Public Awareness

We visited six schools around the national park from August 7 to 11, 2008. The schools consisted of three elementary schools (SD Inpres 26 Bantimurung, SDN Pakalu, SD Inpres 15 Mallawa), two middle schools (SMPN 2 Mallawa and SMPN 1 Bantimurung), and one high school (SMUN 1 Bantimurung).

During each visit, we showed a 20 minute presentation to introduce the students to the life of herpetofauna and showed slides of herpetofauna species from our survey in BabulNP. We then asked the students questions related to the presentation. Those who answered questions correctly were given stickers or pins that the team made before for the program. The presentation and discussion sessions lasted for two hours. A total of 246 students participated in our program.

There were mixed responses from the students, from scared, excited, and enthusiastic. However, they became attentive and were very interested. They were satisfied with the

material, because it was different to their everyday lessons. In addition to students, the school teachers also responded positively to the presentation.



Figure 16. Herpetofauna conservation education program at local schools. Clockwise from top left: team member gives a presentation on the reptiles and amphibians around us; students participate in games; the team with teacher and students from SMA I Bantimurung.

C. Herpetofauna Training for Various Related Stakeholders

The Herpetofauna Observation Training took place on August 30 to September 2, 2007 in Sanggar Kegiatan Belajar (SKB) Bantimurung Nature Recreation Park, located near Bantimurung Nature Recreation Park. A total of 17 participants took part in the training. Participants included BabulNP staff, local NGOs, school teachers, and students from Hasanuddin University. The training was a joint project with Dr. Mirza D. Kusri from Bogor Agricultural University and partly funded by Whitley Fund for Nature.



Figure17. Participants of the Herpetofauna Identification Training in BabulNP

The training consisted of in-class presentations as well as field survey to implement the in-class theories. In-class materials covered topics on Introduction to Herpetofauna; Bio-Ecology of Reptiles and Amphibians; Frog Identification; Snakes, Lizards, and Turtle Identification; Survey Methods for Herpetofauna; Preservation Methods; Data Analysis; and Herpetofauna Conservation in Indonesia, all of which were compiled for the participants. Speakers included Dr. Mirza D. Kusriani from Bogor Agricultural University and team members.

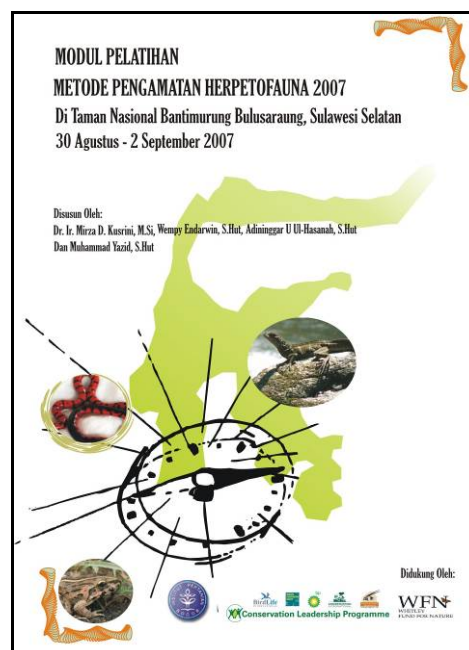


Figure 18. Cover of training module developed by team and Dr. Mirza D. Kusriani.

Training participants got a chance to survey the herpetofauna in Bantimurung Nature Recreation Park. Participants were divided into four groups and searched for reptiles during the day and surveyed nocturnal herps at night.

Participants practiced observation using several methods, which are transecting along streams, quadrant, and timed-search. The observation itself proved to be a challenge. One of the plots was quite a walking distance from SKB, and one stream was heavily

littered and was home to little herpetofauna diversity. However, that did not diminish the participants' enthusiasm. Each group collected specimens for identification purposes which the groups released immediately the next day.

After all in-class materials and survey, participants worked in small groups to make a short report of the results of their observations. By doing so, participants learned to put together what the theories and practical they have learned.



Figure 19. Herpetofauna training activities. Clockwise from top left: greetings from Dr. Mirza D. Kusrini from Bogor Agricultural Institute and Pak Dedy from BabulNP; participants listen to in-class presentation; nocturnal field survey; Lubis helps participants identify a frog; a team weighs one of their specimens; participants present result of their group's observations.

In addition to presentations for Herpetofauna Conservation Education and Training and training module, the team also designed stickers, pins, and bookmarks to give to training participants, schools, and students.



Figure 20. Souvenirs produced by the team (not in actual size). Clockwise from top left: bookmark depicting herpetofauna species of BabulNP; bookmark with the BabulNP landscape; sticker; and pin with herpetofauna species and their names.

CONCLUSION

A. Conclusion

A total of 37 herpetofauna species were recorded six sites in BabulNP, five of which are endemic to Sulawesi. We completed our herpetofauna conservation education in six schools around the park, including three elementary schools, two middle schools, and one high school. A representative from each school was invited to our herpetofauna identification training. Other participants included BabulNP staff, local NGOs, school teachers, and Hasanuddin University students.

B. Recommendations

Further study. There is a need for further study in protected species, such as *Hydrosaurus amboinensis*, as well as endemic species such as *Bufo celebensis*, *Rana celebensis*, *Rhacophorus*

monticola, *Sphenomorphus tropidonotus*, and *Calamaria muelleri*. Further study is also needed of the unique bio-ecology of *Limnonectes modestus*, especially that of its parental care.

Collection and trade survey. Further study is also needed for species that are collected for trade, such as *Draco spp.* and several skink species. Intensity and frequency of harvest, species collected, as well as whether the reptiles are sold outside of the Bantimurung area (Maros Regency) is still unknown. By collecting such information, the impact of the trade can be assessed.

Herpetofauna field guide. Currently there is no field guide available for herpetofauna species in Sulawesi, except for snakes. Field guide would provide great assistance for conducting surveys, but more importantly encourage scientists learn more about the herpetofauna of Sulawesi and increase the public's interest.

Networking. Networking needs to be established between BabulNP and local university and NGOs to study herpetofauna of BabulNP. Local academic and environmental institutions have the resources, access, and longevity to conduct continuous studies of herpetofauna in BabulNP.

Public awareness. Public awareness is especially important to introduce and change the public's negative perception of herpetofauna, especially reptiles. It is a common practice for Indonesians to kill snakes at first sight. If this sense of fear can be replaced with respect for the species, there will be a better chance of seeing fewer snakes as roadkills. In addition, if the public – especially locals around BabulNP – have a sense of pride of the herpetofauna diversity in BabulNP, they will be compelled to protect the species, and protect the area as well.

The team

M. Irfansyah Lubis, 23 yr., is the leader of the team. He oversees all components of the project. In addition, he is also the logistics officer. Lubis has participated in herpetofauna surveys in Kalimantan, West Java, and Lampung. He is a member of Herpetofauna Interest Group (Kelompok Pemerhati Herpetofauna or KPH HIMAKOVA) since 2005 and was the group's president in 2006. He is an active volunteer for the Amphibian and Reptile Conservation Working Group (Kelompok Kerja Konservasi Amfibi dan Reptil or K3AR), taking part in amphibian surveys, training and conservation education. Currently, this forestry student at Bogor Agricultural University (BAU) is studying frog distribution in Gede Pangrango National Park, West Java using GIS and Remote Sensing for his undergraduate thesis. Lubis replaced Anisa Fitri who resigned as a team leader.

Septiantina Dyah Riendriasari, 24 yr., is the team secretary and treasurer. Her meticulous record-keeping skills make this 2007 BAU graduate the right person for this job. Ririn's experience includes herpetofauna survey in Betung Kerihun National Park, West Kalimantan as well as an active volunteer with K3AR. With the working group, she focuses on conservation education for schoolchildren at the kindergarten through high school level.

Wempy Enderwin, 25 yr., is the team's field coordinator. Prior to this project, he was involved in another BP-funded study on the amphibians of Gede Pangrango National Park. As a member of KPH HIMAKOVA, he has participated in an environmental conservation study in Lampung, where he later returned to study reptile diversity for his undergraduate thesis. He also has traveled to East Nusa Tenggara to study longneck turtles. Though now working on several amphibian projects, his main interest is reptiles.

Adininggar U. Ul-Hasanah, 26 yr., is a team member and training coordinator. She graduated from Department of Forest Resource Conservation and Ecotourism of BAU in 2006. She has gotten down and dirty from Lampung to West Java, East Nusa Tenggara, Papua and New South Wales to survey amphibians and reptiles, including studying amphibian diversity in Bukit Barisan Selatan National Park, Lampung for her undergraduate thesis.

Suwardiansyah, 23 yr., is the specimen manager of the team. Dian is responsible for all herpetofauna specimens and data collected during the survey. He has surveyed herps in West Java, including those in Pancoran Mas, Depok for his final paper. Also a member of K3AR, Dian has participated in amphibian conservation education in schools around Gede Pangrango National Park. This is Dian's first survey outside of Java.

Hadijah Azis Karim, 26 yr., better known as DJ, is one of two of the project's local counterparts. This Hasanuddin University graduate is currently a teacher's assistant at the university. DJ has numerous survey experiences all over Sulawesi and North Maluku. Her main interest is ornithology, with her undergraduate thesis on the Green Peafowl in Baluran National Park, East Java. In this project, DJ is one of the team member and public relations officer.

Akmal Mallawi, 23 yr., is the second half of the project's local counterpart and the youngest member of the team. He is a student of Hasanuddin University and majoring in Forest Management. Akmal has taken part in environmental impact assessment in PT INCO, South Sulawesi. Akmal is a newcomer to herpetology, with this project being his first in this discipline.

Feri Irawan, 23 yr., is a senior at BAU. Feri is the team's graphic designer, creating publications and merchandise for the project's conservation education program and

training. His ongoing undergraduate research is on the habitat preference of *Polypedates leucomystax* tadpoles. As a volunteer of K3AR, he has been involved in the group's work in amphibian conservation and education.



Figure 21. Team members (from left to right): Akmal Malawi, Suwardiansyah, Feri Irawan, Hadijah Azis Karim, Adininggar U. U-Hasanah, Septiantina Dyah Riendriasari, M. Irfansyah Lubis, Wempy Endarwin.

LITERATURE CITED

- Bennett, D. 1999. Expedition field techniques reptiles and amphibians. Expedition Advisory Centre. London.
- Berry, P.Y. 1975. The Amphibian Fauna of Peninsular Malaysia. Tropical Press. Kuala Lumpur.
- [CITES] Convention on the International Trade in Endangered Species of Wild Fauna and Flora. www.cites.org/ Accessed on October 17, 2007.
- de Lang, Ruud, & Gernot Vogel. 2005. The Snakes of Sulawesi. Chimaira. Frankfurt.
- de Rooij, N. 1915. The Reptiles of The Indo-Australian Archipelago, Lacertilia. Chelonia, Emydosauria. Volume I. E J Brill Ltd. Leiden.
- _____. 1917. The Reptiles of The Indo-Australian Archipelago, Ophidia. Volume II. E J Brill Ltd. Leiden.
- Duellman WE and L Trueb. 1994. Biology of Amphibians. Johns Hopkins. Baltimore.
- Ehmann, Harald. 1993. Family Colubridae. In C.J. Glasby, G.J.B. Ross and P.L. Beesley (eds.) Fauna of Australia: Volume 2A (Amphibia and Reptilia). Australian Government Publishing Service. Canberra.
- Endarwin, Wempy. 2006. Keanekaragaman Jenis Reptil dan Biologi *Cyrtodactylus cf fumosus* di Taman Nasional Bukit Barisan Selatan Lampung-Bengkulu. Unpublished undergraduate thesis. Bogor: Departemen Konservasi Sumberdaya Hutan, Fakultas Kehutanan, Institut Pertanian Bogor. Bogor.
- Evans, B.J., J. Supriatna, N. Andayani, M.I. Setiadi, D.C. Cannatella and D.J. Menick. 2003. Monkeys and toads define areas of endemism on Sulawesi. *Evolution* 57: 1436–1443.
- Gillespie, G., S. Howard, D. Lockie, M. Scroggie and Boeady. 2005. Herpetofaunal richness and community structure of offshore islands of Sulawesi, Indonesia. *Biotropica* 37(2): 279-290.
- Gillespie, G.R. and S. Howard. 2006. Photographic guide to the frogs and reptiles of Sulawesi. Draft. Wildlife Conservation and Science, Victoria Zoo. Victoria.
- [Himakova] Himpunan Mahasiswa Konservasi Sumberdaya Hutan dan Ekowisata. 2007. Eksplorasi Flora Fauna Ekosistem Karst dan Budaya Masyarakat Lokal Bagi Pengembangan Ekowisata di Taman Nasional Bantimurung Bulusaraung, Provinsi Sulawesi Selatan, Agustus 2007. Unpublished report. Himpunan Mahasiswa Konservasi Sumberdaya Hutan dan Ekowisata. Bogor.

- Heyer, W.R., M.A. Donnely, R.W. McDiarmid, L.C. Hayek and M.S. Foster (eds.). 1994. Measuring and monitoring biological diversity: Standard methods for amphibians. Smithsonian Institution Press. Washington.
- Iskandar, D.T. and K.N. Tjan. 1996. The amphibians and reptiles of Sulawesi, with notes on the distribution and chromosomal number frogs. *In* D.J. Kitchener and A. Suyanto (eds). Proceeding of the First International Conference on Eastern Indonesian-Australian Vertebrate Fauna, Manado, Indonesia, pp. 39 - 46.
- Iskandar DT. 1998. Amfibi Jawa dan Bali – Seri Panduan Lapangan. Puslitbang LIPI. Bogor.
- [IUCN] International Union for Conservation of Nature and Natural Resources. 2006. www.iucnredlist.org Accessed on October 17, 2007.
- Kuch, U., A. Gumprecht and C. Melaun. 2007. A New Species of Temple Pitviper (*Tropidolaemus* Wagler, 1830) from Sulawesi, Indonesia (Squamata: Viperidae: Crotalinae). *Zootaxa* 1446: 1-20.
- Lim, K.K.P. 1992. A Guide to the Amphibians and Reptiles of Singapore. Singapore Science Center. Singapore.
- Manthey, U. and W. Grossman. 1997. Amphibien & reptilien Súdostasiens. Natur und TierVerlag. Múnster.
- McGuire, J.A., R.M. Brown, Mumpuni, A. Riyanto, N. Andayani. 2007. The Flying Lizards of the *Draco lineatus* group (Squamata: Iguania: Agamidae): A Taxonomic Revision with Descriptions of Two New Species. *Herpetological Monographs* 21: 179-212.
- Mori, A. and T. Hikida. 1993. Natural History Observations of the Flying Lizard, *Draco volans sumatranus* (Agamidae, Squamata) from Sarawak, Malaysia. *Raffles Bulletin of Zoology* 41 (1): 83-94.
- Soehartono, T. and A. Mardiasuti. 2002. CITES Implementation in Indonesia. Nagao Natural Environment Foundation. Jakarta.
- Stebbins, R.C. and N.W. Cohen. 1997. A natural history of amphibians. Princeton University Press. New Jersey.
- Stuebing, Robert. 1994. A New Species of *Cylindrophis* (Serpentes: Cylindrophiiidae) from Sarawak, Western Borneo. *Raffles Bulletin of Zoology* 42 (4): 967-973.
- Subchan, Moehd. 2008. Study of Marble Quarry in Karst of Bulusaraung Protection Forest, South Sulawesi. Unpublished undergraduate thesis. Bogor: Departemen Konservasi Sumberdaya Hutan, Fakultas Kehutanan, Institut Pertanian Bogor. Bogor.
- Tweedy, M. W. F. 1983. The Snakes of Malaya. Third edition. Singapore National Printers Ltd. Singapore.

- Ul-Hasanah, Adininggar Ulfa. 2006. Amphibian Diversity in Bukit Barisan Selatan National Park, Lampung-Bengkulu. Unpublished undergraduate thesis. Bogor: Departemen Konservasi Sumberdaya Hutan, Fakultas Kehutanan, Institut Pertanian Bogor. Bogor.
- van Kampen, P.N. 1923. The amphibia of the Indo-Australian Archipelago. E.J. Brill. Leiden.
- Voris, H.K., and D.R. Karns. 1996. Habitat Utilization, Movements, and Activity Patterns of *Enhydryis plumbea* (Serpentes: Homalopsinae) in a Rice Paddy Wetland in Borneo. *Herpetological Natural History* 4 (2): 111-126.
- Whitten, A.J., M. Mustafa and G.S. Henderson. 2002. The ecology of Sulawesi. Periplus Editions. Hong Kong.
- Witten, Geoffrey J. 1993. Family Agamidae. In C.J. Glasby, G.J.B. Ross and P.L. Beesley (eds.) Fauna of Australia: Volume 2A (Amphibia and Reptilia). Australian Government Publishing Service. Canberra.

APPENDIX. HERPETOFAUNA SPECIES DESCRIPTION

I. Amphibia

Bufonidae

Bufonids, or true toads, in general are stout-bodied Anurans covered in warty skin. Live in a variety of habitats, from the pristine streams of primary forests to disturbed habitats around human settlements. Unlike most other frogs, Bufonids lay their eggs in strings in water bodies. Bufonids are naturally found worldwide except in the Poles, New Guinea, Madagascar, Australia and New Zealand (unless introduced). In Indonesia, Bufonids are naturally found from Sumatra to Sulawesi and Lombok. However, introduced populations are now found as far west as Papua.

1. *Bufo celebensis* Schlegel, 1867



Common name: Celebes toad.

Medium-sized toad, large paratoid glands located above the tympanums (ear drums). Color rusty to dark brown with black speckles on warts. Toes half-webbed for adaptation in semi-aquatic habitat. Endemic from Sulawesi. Recorded in Pattunuang and Tompobulu.

2. *Bufo melanostictus* Schneider, 1799



Local name: Asian toad.

Medium to large-sized toad. Skin yellow to rust-colored to brown. Skin covered with small to medium bumps or warts with black tips. Species is easily identified with black ridge along snout and above eyes. Often found in human settlements or altered habitats. Terrestrial to semi-aquatic in nature. Wide natural and introduced distribution including Java, Sumatra, Irian, to China and India. Recorded in Kappang and Leang-leang.

Microhylidae

Just as their name suggest, members of the family have small heads and mouths. Microhylids are small to medium-sized. They are usually found among leaf litter or shrubs in forests. Members of the family are found in South America, Southeast Asia and Australia. In Indonesia, they are found all over the country.

3. *Oreophryne sp. 1*



Common name: -

Small frog with rounded snout. Body cream in color with dark and white speckles. Belly pale white. Eyes large. Toes with large disks. Disks on front legs larger than those of *Oreophryne sp.2*. Only one individual was recorded in Bontosiri at elevation of 550 to 650 m asl near a waterfall.

4. *Oreophryne sp. 2*



Common name: -

Small frog, smaller than *Oreophryne sp.1*. Color light to dark brown with darker specks. Belly light colored. Base of thighs of hind legs reddish. Lives in moist, forested areas. Usually found among leaf litter or soil, or on leaves of shrubs. Species was recorded in Bontosiri, Tompobulu and inside a cave in Leang Lonrong.

Ranidae

Ranidae, or true frogs, is a highly diverse family. Members range in sizes, colors, and habitats. Ranids in general are slim-bodied frogs with large eyes. Most are aquatic, while some are terrestrial in nature. Larger Ranids are sold for consumption. Ranidae is distributed all over the world.

5. *Fejervarya cancrivora* Boie, 1835



Common name: Crab-eating frog, rice field frog.

Medium to large-sized frog. Color reddish brown to dark brown with darker markings which provide excellent camouflage with surroundings. Vertebral stripe may or may not be present. Hind legs half webbed to adapt to semi-aquatic lifestyle. Found in rice fields and even brackish water. Harvested for human consumption. In BabulNP, the species was

recorded in Tompobulu, Kappang, Leang-leang and Leang longrong.

6. *Limnonectes grunniens* Latreille, 1801



Common name: -

Large-sized aquatic frog. Dark brown skin with fine tubercles camouflages it in mud. Large species from the genus are often sold for consumption. Males with enlarged heads and “fangs” on the lower jaw. Only one individual was recorded in Bontosiri, while found to be abundant in Tompobulu.

7. *Limnonectes modestus* Boulenger, 1882



Common name: -

Small-sized frogs. Body grayish brown with darker markings. Dorsal with longitudinal folds. Belly light creamy gray. Legs with dark bars. Only recorded along small streams in Tompobulu, where *L. modestus* were observed guarding clutches of eggs that were laid on leaves along the stream.

8. *Occidozyga laevis* Gunther, 1858



Common name: Puddle frog.

Small to medium-sized frog. Snout short and rounded. Color varies from cream, dark brown, to almost black dorsal. Eyes large, legs short and stout. Recorded in Pattunuang and Tompobulu around streams.

9. *Rana celebensis* Schlegel, 1872



Common name: Celebes frog.

Medium to large-sized frog. Body slender with long, pointed snout. Eye and tympanum large. Color varies from greenish brown to dark yellowish green above and lighter below. Sides dark, thighs with dark bars. Recorded not far from streams in Bontosiri, Pattanuang and Tompobulu. Endemic from Sulawesi.

10. *Rana erythraea* Schlegel, 1837



Common name: Common greenback, rice paddy frog. Medium-sized frog with slender body and pointed snout. Limbs long and slender. Body yellowish green, belly light yellowish cream. Easily identified by ivory-colored dorsolateral lines. Often found in ponds, lakes and rice fields. Recorded in Leang lonrong and Leang-leang.

Rhacophoridae

This family of South Asian tree-frogs includes some very colorful members. They are characterized by their large eyes and large disks on the tips of their toes. Rhacophorids are arboreal, living in shrubs to trees up to 10 meters high. Some Rhacophorus species are sold for pets.

11. *Polypedates leucomystax* Gravenhorst, 1829



Common name: Common tree frog, four-lined tree frog. A large tree frog with colors ranging from cream, grayish brown, brown, to reddish brown, some with dark dorsal stripes. Skin on the head is fused with the skull. Highly adaptable species, common near settlements as well as in secondary forests. Recorded in Kappang, Leang-leang and Tompobulu.

12. *Rhacophorus monticola* Boulenger, 1896



Common name: -

Small tree frog with various colors, from yellow with brown markings to yellowish green with green spots and yellow belly. Body slim, snout long and pointed. Usually found perching on shrubs in moist forests. Recorded in Bontosiri and Tompobulu.

II. Reptilia

Agamidae

Agamids, also called dragons, are small to medium-sized lizards. Head is compressed. Body is covered in irregular scales. Agamids are able to make their skin darken to absorb heat more rapidly or when males are defending their territories. Most Agamids are

arboreal, except for *Hydrosaurus* spp., and most are active during the day (diurnal). Members of the genus are distributed all over tropical and sub-tropical Asia, Australia and Africa (except for Madagascar), and throughout Indonesia.

13. *Draco walkeri* Boulenger, 1891



Common name: Walker's flying lizard.

The genus is easily identified by its patagium, or "wings" of extended skin over elongated ribs. Completely arboreal, moving from tree to tree by gliding through the air. Dorsal grayish green with dark and greenish bands. Patagium black. Often found basking on tree trunks. Males with gular sac which is displayed to attract females. Widespread in South and Central Sulawesi. Recorded in Kappang, Leang lonrong and Leang-leang.

14. *Hydrosaurus amboinensis* Schlosser, 1768



Common name: Sailfin Lizard, East Indian Water Lizard.

A unique Agamid, due to its large size and aquatic lifestyle. Color dark greenish brown, with light thin bands on back and tail. Scales on base of tail raised, forming a "sail". Toes long with skin flaps on each side of toes of hind legs. Often found basking on large rocks

along river banks. Diurnal in nature. Recorded in Pattunuang.

Gekkonidae

Gekkonidae is a family consisting of geckos. Body is covered by small, often smooth scales. Skin is loose and easily tears. Geckos have large, depressed heads with large eyes with narrow vertical pupils. Gekkonids are known to be able to regenerate tail. Nocturnal and arboreal in nature. Widely distributed throughout the globe, in human habitations as well as primary forests.

15. *Cyrtodactylus jellesmae* Boulenger, 1897



Common name: Kabaena bow-fingered gecko.

Small to medium-sized forest gecko. Back covered with small tubercles. Color varies, from dark grayish brown to light gray above and light creamy color below. Often with darker markings on back. Detaches tail when feeling threatened. Found on tree trunks, and smaller individuals are found on leaves of shrubs in forested areas. Recorded in Tompobulu, Pattanuang and Leang-leang.

16. *Gehyra mutilata* Wiegmann, 1834



Common name: Common four-clawed gecko.

Small-sized gecko. Color varies from grayish to dark brown with dark dusting. Belly light. Tip of toes with expanded pads to enable it to cling onto surfaces. Often found in human habitations. Only recorded in Leang-leang.

17. *Hemidactylus frenatus* Schlegel, 1836



Common name: Common house gecko.

Small-sized gecko. Color brownish gray, pale creamy white to brown above. Sometimes with darker spots. Belly whitish. Tail flattened. Often found in human habitations. Recorded in Leang-leang and Tompobulu.

Scincidae

Skinks are small to medium-sized terrestrial lizards, although some are arboreal. Head almost as wide as body, slightly depressed. Easily identified by shiny scales. Tympanum distinct. Limbs short. Skinks are generally diurnal. They are swift and easily release tails when feeling threatened.

18. *Eutropis multifasciata* Kuhl, 1820



Common name: Many-lined sun skink.

Body large and head short. Dorsal scales golden brown, sometimes with three to five longitudinal lines. Sides are darker than back, belly lighter brown. Often found basking on road sides or small stones. Recorded in Leang lonrong and

Kappang.

19. *Eutropis rudis* Boulenger, 1887



Common name: Rough mabuya

Very similar in morphology and behavior to *E. multifasciata*. Differs in that *E. rudis* has keeled scales on the underside of fingers, while *E. multifasciata* does not. Recorded in all survey sites except

Bontosiri.

20. *Lamprolepis smaragdinum* Lesson, 1830



Common name: Emerald skink.

Medium-sized skink. Color bright green, dark between the scales. Belly yellowish. Snout long and pointed. Tail long, up to twice head and body length. Diurnal and arboreal in nature. Recorded in Pattunuang and Leang-leang.

21. *Sphenomorphus tropidonotus* Boulenger, 1897



Common name: -

Small skink. Snout short and rounded. Color dark brown with yellow interconnected spots that form stripes and darker markings. Tail long. Only recorded in Pattunuang.

22. *Sphenomorphus variegatus* Peters, 1867



Common name: -

Small-sized terrestrial skink. Dorsal brown with dark spots or markings, sides dark brown with lighter spots. Tail long. Abundant in all six survey sites.

23. *Tropidophorus grayi* Gunther, 1861



Common name: Gray's keeled skink

Unique skink with sharply keeled scales. Medium-sized skink with slender body and short limbs. Tympanum large. Dorsal dark brown with lighter bands or spots. Belly yellowish. One specimen was recorded in Bontosiri.

Varanidae

Varanids, or monitor lizards, is a genus that includes the largest lizard, the Komodo dragon. All monitor lizards have large bodies with long necks, sharp claws and long, strong tails. Even though the genus is easily identified, species identification is more difficult. Varanids are mostly terrestrial, some are semi-aquatic, and juveniles are more arboreal.

24. *Varanus salvator* Laurenti, 1786

Common name: Asian water monitor

A large species with long head and neck, large body, and long tail. Color varies from dark gray with light spots to uniform dull gray. Common throughout Asia, including Indonesia. A semi-aquatic species, it lives near water bodies. Recorded in Leang lonrong, along the rocky river.

Colubridae

Colubridae is a diverse group of snakes with many members. Most are non-venomous, but several species have fangs located on the back of the upper jaw. Colubrids are medium-sized snakes. Head is slightly distinct from neck. Habitat varies from aquatic, arboreal, fossorial to terrestrial.

25. *Ahaetulla prasina* Boie, 1827



Common name: Oriental whip snake.

Genus is easily identified by long, slender body, long head, and sharply pointed snout. Color bright green above, belly yellowish. Color provides camouflage among trees. Arboreal and diurnal, often found at night sleeping on tree branches. Common in secondary forests or near human settlements.

Recorded in Kappang, Leang lonrong and Tompobulu.

26. *Boiga dendrophila* Boie, 1827



Common name: Mangrove cat-snake.

Genus is characterized by head that is distinct from neck and large eyes. The species is easily identified by black color with narrow yellow bands, and yellow lips with dark bars. Inhabits forested areas, often near water. Widely distributed in Indonesia. Recorded outside of transect in Pattunuang.

27. *Calamaria muelleri* Boulenger, 1896



Common name: Mueller's reed snake.

Small snake, head not distinct from neck. Light orange band on neck. Body dark grayish brown. Dark, narrow longitudinal line present below tail. Eyes round and small, body cylindrical. Genus is fossorial. One individual was recorded outside of survey transect and time in Pattunuang.

28. *Dendrelaphis pictus* Gmelin, 1789



Common name: Common bronzeback, Indonesian bronzeback.

Body bronze, sides dark. Belly yellow. Eyes large and round. Arboreal and diurnal, often found at night sleeping on tree branches. Common in secondary forests and near human settlements. Recorded in Pattunuang, Tompobulu, Kappang and Leang lonrong.

29. *Elaphe erythrura* Griffin, 1911



Common name: Philippine rat snake.

Large snake. Body uniform dark gray, head slightly lighter. Terrestrial and diurnal. Inhabits primary as well as secondary forests. One individual was recorded in Pattunuang. The species is feared by locals, who call it “ular hitam” or “black snake”, possibly mistaking it for the similar and highly venomous cobra.

30. *Enhydris plumbea* Boie, 1827



Common name: Plumbeous water snake, Rice paddy snake.

Medium-sized snake with short, stout body. Body uniform dark grayish brown. Dorsal with black spots that form a vertebral line. Eyes small and upward-pointing, suitable for a highly aquatic lifestyle. Inhabits muddy rivers, including rice

fields. Recorded in Pattunuang, Leang lonrong and Leang-leang.

31. *Oligodon waandersi* Bleeker, 1860



Common name: Bleeker’s kukri snake.

Body long and moderate. Head not distinct from neck. Body dull grayish brown with light bands bordered with black spots. Scales smooth. Eyes small and round. Recorded outside of survey time and transect in a cave in Leang lonrong.

32. *Psammodynastes pulverulentus* Boie, 1827



Common name: Common mock viper.

Head elongated with unmistakable dark symmetrical markings above. Body long and slender. Body dark grayish brown to reddish brown with light bands bordered with dark. Semi-arboreal in nature, found in shrubs or near streams. Recorded in Bontosiri and Tompobulu.

33. *Xenochropis trianguligera* Boie 1827



Common name: Triangle keelback

Medium-sized slender snake. Easily identified by its coloration. Dorsal dark greenish brown, forming triangles pointing down at the sides. Sides with orange and white. Scales keeled. A semi-aquatic snake, it is found near water bodies. Recorded in Tompobulu and Pattunuang.

Crotalidae

Crotalids are vipers are medium-sized snakes with short and stout bodies. Like other vipers, Crotalids have triangular head and are highly venomous. Fangs are located in the front part of its upper jaw and folds when the snake closes its mouth. Crotalids differ from other vipers with the pair of heat sensors located above its lips. Crotalids are nocturnal snakes. Depending on reference, Crotalidae is sometimes treated as a subfamily of Viperidae.

34. *Tropidolaemus wagleri* Wagler, 1830



Common name: Wagler's pit viper, Temple pitviper.

A striking species, its color is highly variable. Dorsal is green with white spots to brown with green bands. Head is distinctly triangular. White and light brown or green line extends at side of face. Arboreal in nature. Highly venomous. One specimen was recorded in Pattunuang.

Cylindrophiidae

Small snakes. Cylindrophiids are semi-fossorial snakes that live under leaf litter or loose soil. Head not distinct from neck, eyes small. Sometimes called two-headed snake because its tail is short and similar to its head.

35. *Cylindrophis melanotus* Wagler, 1830



Common name: Black pipe snake

Moderately slender snake. Head small and not distinct from neck. Dorsal dark purplish black. Belly bright red with broken dark bands. Will upturn itself to reveal bright underside when threatened. Recorded in Bontosiri during preliminary survey.

Pythonidae

Large constricting snakes, with some of the world's longest snakes. Pythons are easily recognized by their guitar-shaped heads and heat pits located above the lips. Their unique patterns make pythons sought after as pets, and skin is used as materials for wallets, boots, and other products. Although non-venomous, pythons can cause painful bite due to their sharp hooked teeth.

36. *Python reticulatus* Schneider, 1801



Common name: Reticulated python.

One of the most recognized snakes. Reticulated pythons are strong, large snakes. Head distinct from neck. Body with distinctive brown, cream and black patterns. Head light brown with black line along the middle. One specimen was recorded in Pattunuang during preliminary survey.

Typhlopidae

Small snakes that are more similar to worms than snakes. Blind snakes are fossorial, living underground. Head not distinct from neck. Eyes small and covered by scales, a characteristic that contributes to its name. Scales are small and uniform.

37. *Ramphotyphlops braminus* Daudin, 1803



Common name: Brahminy blind snake, Flowerpot snake.

Small snake. Body uniform dark grayish brown. Body slender with short tail. End of tail with small hooked scale. Fossorial in nature. One individual was recorded in Kappang.