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FROGS OF GEDE PANGRANGO: A FOLLOW-UP PROJECT FOR THE CONSERVATION OF FROGS IN WEST JAVA INDONESIA

BOOK 1: MAIN REPORT

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Cover photographs:

Front cover: The bleeding toad *Leptophryne cruentata* from Cibeureum, Gede Pangrango Mountain. (Photo: Mirza D. Kusrini)

Photo credits:
Anisa Fitri: Fig 2-2 below right (p. 14), Fig 2-8 (p. 26), Fig 3-4 (p. 36),Fig 5-1 (p. 51), Fig 5-3 top (p. 53), Fig 6-3 (p. 65)
Wempy Endarwin: Fig 2-2 top right & below left (p. 14), Fig 2-10 (p. 28), Fig 3-8 middle & below (p. 41), Fig 4-3 (p. 46)
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Executive Summary

Monitoring of Mount Gede Pangrango National Park's amphibian was carried out from December 2006 to April 2007. We found 18 species of frogs from six families. Although the number of species was the same as result of 2004/2005 survey, species composition differed slighty. We found species that was not found during 2004/2005 such as *Microhyla palmipes.* In addition, we also recorded a caecilian from Bodogol, *Ichthyophis hypocyaneus,* in January 2007. Compared to 2004/2005 monitoring, the number of *L. cruentata* (endemic, CR) in two locations appears to increase. However, the opening of access to one of the main waterfalls in Cibeureum which serves as the habitat of this species is a cause for concern. We also conducted biology studies of *L. cruentata* from specimens deposited in Museum. The bleeding toad appears to specializing in ants for their diet and females have around 300 eggs.

To assess the occurrence *Batrachocytrium dendrobatidis*, a fungus implicated as one of the causes of global amphibian population decline, we conducted PCR diagnostic assays of 147 samples from 13 species of frogs of Gede Pangrango National Park. Five samples showed positive infection. Samples of *Rhacophorus javanus, Rana chalconota* and *Leptobrachium hasseltii* showed high levels of infection, while one sample of *Limnonectes microdiscus* showed a low level of infection. The result for *Leptophryne cruentata* with only 1 positive reaction is at a very low level, and therefore doubtful. This is the first record of Bd in Indonesia.

Amphibian conservation awareness program was conducted to schools around the vicinity of Mount Gede Pangrango National Park. The two-hour outreach program was carried out in six schools for schoolchildren grades four through six. We also organized a teacher training program where teachers from participated schools learned about the bio-ecology of amphibian and conservation efforts that they can implement in their teaching program.

During the project, team member also presented result of this study to various seminars, abroad or in local. Using part of BP funding and additional funding from other organization (IUCN-ASG, CI, IRATA), we also organized a two-day seminar on Indonesian Herpetology in May.

To increase the number of local researcher, we conducted two types of training on amphibian ecology and research methodology. The basic training was conducted in Bodogol from March 15-19 2007 and the second training was conducted in May 2007 with our international counterpart Dr. Jodi L. Rowley as the main trainer.

We recommend that population monitoring should be conducted regularly, with emphasize on forest specialist species. More research on the ecology and behaviour of *L. cruentata* is needed as well as revisiting their historical distribution to assess current distribution. We also recommend the park management to protect its main habitat in the third waterfall of Cibeureum. Studies on chytrid dynamics, pathogen-host interactions and effects of chytrid on population persistence should also be prioritized, in addition to conducting more assessment on the presence of Bd to other highland regions in Java.

PROJECT FACT SHEET

Project Name
Frogs of Gede-Pangrango: A Follow-Up Proposal for the Conservation of Frogs in West Java Indonesia

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Balai Taman Nasional Gede Pangrango
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Chapter 1
INTRODUCTION

Despite their diversity, amphibians in South-East Asia typically received little attention, especially in Indonesia. Mount Gede Pangrango National Park or Taman Nasional Gede Pangrango (TNGP) ranges from 1,400 to 3,400 m above sea level, and one of the last remaining pristine habitats in West Java. Although the size of natural habitat remaining in West Java is small, it harbours diverse wildlife, mostly living inside the national park or other protected areas (Wikramanayake *et al*., 2002). Mount Gede Pangrango National Park is popular for hiking, with an estimate of around 30,000 visitors climb the summit annually (Whitten *et al*., 1996). While visitor pressure is high, it also provides opportunities for raising amphibian conservation awareness to the general public.

In 2004, a survey to collect data on frog diversity in this area recorded eighteen species of frogs. From this survey, the number of the endemic frog *Leptophryne cruentata* was very low compared with survey by Liem during 1960's (Liem, 1971). There is a possibility that *L. cruentata* is declining, therefore there is a need to conduct more research to ensure conservation of this species. To provide on-going assessment of the population of frogs escpecially *L. cruentata*, regular monitoring of frog population of these sites must be continued on an annual basis and more research is needed on its ecology.

The Frogs of Gede Pangrango Project aims to increase awareness of frog research and conservation, extending research based on the first year's result. The objectives of the second year program are to:

1) continue annual monitoring of frog population at TNGP in order to extend data on the distribution and ecology of frogs, especially *L. cruentata*, which appears to have low population numbers. To assess the possibility of chytridiomycosis infection in Indonesia, we also conduct *Batrachocytrium dendrobatidis* (Bd) assessment from selected specimens,
2) carry out frog conservation education to primary schools, enhancing frog conservation awareness to the general public by developing, and
3) enhance research capabilities of local young scientists by training.

The result of this project is presented in this Book-1: Main Report. The main body of this main report is constituted in five chapters: chapters 2, 3, 4, 5, and 6. Chapter 2 provides result of amphibian monitoring in TNGP. Chapter 3 is a preliminary account of *L. cruentata* in Mount Gede Pangrango National Park with detailed biological study using museum specimens, while Chapter 4 provides the result of Bd assessment. Chapter 5 records our conservation education effort in schools including teacher training. Chapter 6 provides report of our training program given to local young herpetologist and in chapter 7 we summarize the results and recommendations for further studies.

Beside this main book, we also include two books which contain additional information and outcome of this project. Book-2 provides *Photographic Identification Guide for West-Java Amphibians* in Bahasa Indonesia. This is a draft that we are considering for publication later on, but at the moment is already used by our team and also by training participants. Book-3 provides power point notes of our training.

Chapter 2

THE AMPHIBIANS OF MOUNT GEDE PANGRANGO NATIONAL PARK

M. D. Kusrini, W. Endarwin, M. Yazid, A. U. Ul-Hasanah, N. Sholihat, and B. Darmawan

I. INTRODUCTION

Mount Gede Pangrango National Park or Taman Nasional Gede Pangrango (TNGP) in West Java province was established in March 1980. It evolved from several reserves in Indonesia, the original Cibodas Nature Reserve (established in 1889) covering 240 ha and later extended to include Cimungkat Nature Reserve, Situgunung Recreational Park, and Mount Gede Pangrango Nature Reserve. In 2003, by the decree from the Ministry of Forestry Number 174/Kpts-II/2003, the park was extended from 15,196 ha to 21,975 ha. The park itself is situated between longitudes 106°51'-107°02'E and latitudes 6°41-6°51'S. Administratively, it is shared between the Regencies of Bogor, Cianjur and Sukabumi.

The Gede-Pangrango Mountain has fascinated explorers and researchers since nearly two decades ago. Explorations were made by famous explorers such as F.W. Junghuhn (1839-1861), J.E. Teysmann (1839), A.R. Wallace (1861), S.H. Koorders (1890), M. Treub (1891) and W.M. van Leeuen (1911). The national park is mostly famous for its tropical plants and avian biology (Dammermann 1929; van Leeuwen 1929; Hoogerwerf 1949; Meijer 1959; van Steenis 1972; Yamada 1975; Werner 1986). However, there is a lack of amphibian survey in this area. Data on amphibians were mostly based on accounts made by Liem (1974) and afterward no report on the amphibian fauna until 2005. Here we present the account of amphibian community in Mount Gede Pangrango National Park and compare it with previous result made by Liem (2004) and Kusrini *et al*. (2005).

II. METHODS

Study Area

Monitoring was conducted in ten locations that are grouped into two sites: the Cibodas Trail and Non-Cibodas Trail. The Cibodas Trail mainly consists of locations previously surveyed either by Liem during his survey in 1961-1964 or by our team in 2003/2004. However, for 2006/2007 survey we omitted Rarahan village and Cibodas Botanical Garden and instead added another location: Ciwalen. The selection of habitat was non-random, based on several criteria: accessibility, representative range of elevation character, types of habitat and possibility of detecting amphibian species. Locations were selected to compare with Liem's previous results.

The Cibodas Trail consists of: 1) Ciwalen (1361-1420 m asl); 2) Telaga Biru (1571 m asl); 3) Curug Cibeureum (1685 m asl); 4) Rawa Denok (1699-1795 m asl); 5) Lebak Saat (2250 – 2500 m asl); and 6) Alun-alun Surya Kencana (2748 m asl). The Non-Cibodas trail consists of: 1) Bodogol (703-814 m asl); 2)

Selabintana (1186 m asl); 3) Megamendung (900-1000 m asl); and Situgunung (1000-1050 m asl). Figure 2-1 shows the map of Mount Gede Pangrango National Park. Below we describe each specific location.

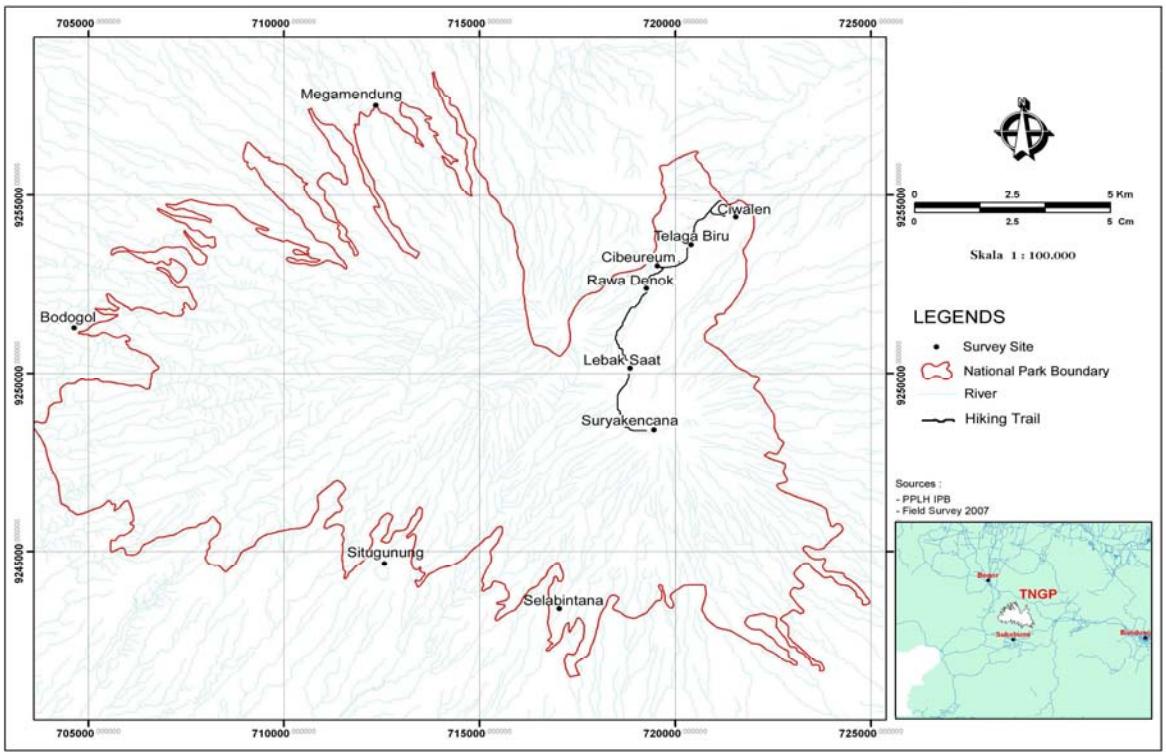

Fig. 2-1. Map of Mount Gede Pangrango National Park and our survey sites.

CIBODAS TRAIL

Rarahan (1258 m asl); Village/agriculture; 06º43.781'S, 107º00.472'E.

Surveys were focused in Cikundul River, irrigation ditch and terrestrial areas between vegetable farms. Rarahan is a village adjacent to the Cibodas Botanical Garden. Most of the landscape is rural housing, villas, and vegetable and ornamental plants farms. No rice fields are found in this area.

Cibodas Botanical Garden (1361-1420 m asl); Lower montane/submontane forest; 06º44.368'S, 107º00,682'E.

The Cibodas Botanical Garden (125 ha) is the second oldest botanical garden in Indonesia (built in 1852) after Bogor Botanical Garden (built in 1817). Mean temperature is 18°C, RH 90% and annual rainfall is 3380 mm. It is only 100 km from Jakarta (an approximatelythree-hour drive). TNGP shares a border with the botanical garden. Although most plants are planted, a small portion of lower montane forest still exists. Surveys were made in pools, streams and terrestrial areas around the botanical garden. We sampled 12 pools in the garden with various sizes and microhabitats. Survey in stream was made in Cibogo Stream. This stream is characterized by swift current, rocky substrate and, in some areas, dense vegetation cover. Terrestrial surveys were conducted in areas between pools, combining grassy area to shrubs, encountering small irrigation or puddle along the way.

Ciwalen (1450-1500 m asl); Lower montane/submontane forest; 06°44'40.64"S, 107°0'16.01"E. Ciwalen is located in the boundary between Mount Gede Pangrango National Park and Cibodas Botanical Garden. Surveys were conducted in three locations: terrestrial habitat along the Ciwalen Interpretation Trail and two stream habitats. Stream habitat consisted of two tracks: the first track was located near interpretation trail and even intersected this trail, while the second track was located in the Ciwalen Waterfall. Both streams flow into Cibodas Botanical Garden. The forested area consists of dense natural vegetation; however, the surrounding forest near the waterfall is opened for the benefit of tourism.

Telaga Biru (1571 m asl); A transition zone between submontane to montane forest; 06º44,909'S, 106º59,644'E. Telaga Biru lies in the middle of the trail from Cibodas to Curug Cibeureum, around 40 minutes from Cibodas. The name Telaga Biru literary means "The Blue Lake". The name implies the colour of the lake, which is mostly bluish and caused by the presence of algae. It is a popular place for hikers to take a rest in the area before commencing the journey. Previously, a wooden trail looped around half the lake for people to enjoy the scenery. However, the loop trail is now broken and unused. Survey focused in small creek along the trail of Cibodas and terrestrial areas around the lake.

Curug Cibeureum Waterfall and Rawa Gajonggong (1685 m asl); Montane forest; 06º45.232'S, 106º59.177'E. The place is a very popular destination for local hikers because of its relatively easy terrain. It is located at only an hour hike from the park gate at Cibodas (2,6 km). The Cibeureum Waterfall is actually a complex of three waterfalls in this area with heights around 50 to 75 m: Cibeureum, Cikundul, and Cidendeng. Rawa Gajonggong or Gajonggong Swamp lies between the trails from Telaga Biru to Curug Cibeureum. Survey focused on stream adjacent to the Cibeureum Waterfall and the swamp (Gajonggong) around the forested area. It is a creek of $\pm$ 3-4m wide with rocky substrates.

Rawa Denok (1699-1795 m asl); Montane forest; 06º45.580'S, 106º59.026'E. Although Rawa means swamp, nowadays no swamp could be found in this place. However, it has a rocky stream. The colors of the rocks are yellowish caused by the presence of sulphur coming from the crater. Surveys were conducted in the fast flowing stream (width $\pm$ 4-6 m) with rocky substrate and in adjacent terrestrial habitat. The area also had small waterfall ($\pm$ 2-3 m). Probably has high sulphur compound, rock yellowish in color. It also has steep forest gradient.

Lebak Saat (2250-2500 m asl); Transition from montane to subalpine forest; 06º46'23.00"S, 106º58'07.01"E. Lebak Saat lies between Rawa Denok and Kandang Badak, situated at approximately 8 km from Cibodas. Kandang Badak (literally means Rhino home) itself is the fork between the routes to Gunung Gede and Gunung Pangrango summit. It has a very steep gradient. Although Lebak also means swamp, we found no water during the survey.

Alun-alun Surya Kencana (2748 m asl); Subalpine forest; 06º47.728'S, 06º59.143'E. A valley situated around 11 km from Cibodas, or a six-hour hike. To reach this valley, we must first reach the summit of Mount Gede (ten km from Cibodas, 2958 m asl), and then pass the volcanic crater. It is about 20 m from the summit and adjacent to crater. The valley is famous for its grassland meadow with low herbaceous plant notably the everlasting "edelweiss" flower from the family Asteraceae (*Anaphalis javanica, A. longifolia* and *A. maxima*). Survey focused on terrestrial area around the edelweiss meadow and a small creek which only contain water during rainy season.

NON-CIBODAS TRAIL

All of Non-cibodas trail locations were previously managed by Perum Perhutani (Plantation Estates) before joining the Mount Gede Pangrango National Park management. Therefore most of the vegetation are plantation plants such as *Pinus merkusii* and *Agathis* sp.

Fig. 2-2. Clockwise from Top left: Forest of Kandang Badak near Surya kencana (>2,000 m asl); Selabintana; Forest of Cibeureum; The valley of Surya Kencana.

Bodogol (703-814 m); 06º46.214'S, 106º51.095'E. The location was also managed for conservation education by the consortium of Conservation International, Pelangi and TNGP. Bodogol has the only canopy trail in this national park. Surveys were conducted in Cikaweni Stream and in terrestrial area around the stream. Cikaweni Stream had substrate of gravel and rocks. The trail to Cikaweni Stream is very steep. Bodogol is a habitat for leopards, which mainly roam the area during the night in search of prey.

Selabintana; (1186 m); 06º50.460'S, 106º57.842'E. Most of the area is steep; the only flat area is reserved for camping ground. A big camping ground was developed in Selabintana. Stream surveyed is 5.2-11.3 m wide with depth of 5-42 cm, mostly fast flowing water with rock and gravel substrate. Most of the stream is shaded.

Situgunung; (100-1050 m asl); 06°49'57.15"S, 106°55'27.03"E. Survey was conducted between the Situgunung Natural Recreation Area and Curug Sawer Waterfall. Vegetation in the area consists of mixed-vegetation between plantation vegetation on Situgunung NRA and secondary forest in Curug Sawer. We

surveyed two different streams; one in Situgunung NRA and another which is the outflow of Curug Sawer Waterfall.

Megamendung; (900-100 m asl); 06°42'48.68"S, 106°55'14.76"E. Survey was carried out in the new Camping Ground of Bolang and Curug Beret Waterfall managed by the national park. The vegetation also consisted of mixed forest type: plantation and secondary forest. The main vegetation are pine, umbrella tree (*Maesopsis eminii*) and Powderpuff (*Calliandra calothyrsus*), as well as other vegetation such as rattan and bamboo. Along the stream, the vegetation mainly consisted of *tepus* (*Amomum* sp), *kecubung* (*Datura sp*.) and bamboo.

Data collection

Data on the presence and absence of amphibians were derived from frog surveys. The occurrence of a species were determined by finding adults or larvae, or, if possible, by male vocalization. During survey we actively searched areas within forest floor, leaf litter, fallen logs, water bodies, and surrounding vegetation. Methods for surveying frogs are mostly taken from Heyer *et al*. (1994), mostly using the Visual Encounter Survey modified for stream transect and timed-search for terrestrial habitat. Total effort for 2007 survey is shown on table 2-1.

Table 2-1. Total effort during frog survey at Mount Gede Pangrango National Park, 2006/2007

Location	Habitat	Number of surveyor	Total Effort (hour:minutes)
Ciwalen	Aquatic	2	28:14
Ciwalen	Terrestrial	2	30:46
Telaga Biru	Aquatic	3	19:28
Telaga Biru	Terrestrial	2	21:10
Cibeureum	Aquatic	5	28:40
Cibeureum	Terrestrial	5	31:20
Rawa denok	Aquatic	3	19:51
Rawa denok	Terrestrial	3	16:30
Lebak saat	Aquatic	2	5:00
Lebak saat	Terrestrial	2	10:44
Suryakencana	Aquatic	2	8:00
Suryakencana	Terrestrial	2	16:30
Bodogol	Aquatic	5	46:25
Bodogol	Terrestrial	5	61:00
Megamendung	Aquatic	3	21:27
Megamendung	Terrestrial	3	26:24
Situ Gunung	Aquatic	5	27:38
Situ Gunung	Terrestrial	5	26:10
Selabintana	Aquatic	3	21:48
Selabintana	Terrestrial	3	20:00

We measured weight and snout vent length (SVL) of each frog captured. The measurements were conducted in the location of capture. No restraining tool was used; frogs were usually easily handled with hands. Although no chytridiomycosis has been reported in Indonesia, we used standard procedure to avoid the spreading of disease. The hygiene protocol followed the procedure made by the NSW Parks & Wildlife Service (2001) and JCU (Speare *et al*., 2004). We also recorded sex (if possible), microhabitat, position along transects, and the behavior of each individual, along with measurements of environmental conditions (water, air and substrate temperatures, and humidity) at the time of capture. Frogs were released after examination at the point of capture, except for a small number which were caught and preserved as voucher specimens, especially for species which have not been found before. Voucher specimens are stored in Muzeum Zoologicum Bogoriense. Frog species were identified using several books such as Inger (1966), Berry (1975), Liem (1971) and Iskandar (1988). Names recorded were those used by Iskandar & Colijn (2000).

Stream frogs were surveyed during night, four days in a row during each sampling period except in Cibeureum where sampling was only done for 3 nights due severe storm. Surveys were carried out once for each location. In streams, we used a 200-400 m transect, depending on the location. Data were collected by walking down the transect line and counting all frogs seen on either side of the line. Stream frogs were surveyed in ten locations, including the small creek at Telaga Biru. Terrestrial habitat (sometimes including seepage or water bodies inside forested area) was explored using timed-search method mostly to search ground-dwelling frogs and tree frogs. Timed-search was carried out by randomly walking through the forest by two investigators and searching for frogs for a total of two hours.

We characterized habitats into nine groups belonging to two types of ecosystems (aquatic and terrestrial ecosystems). Although a national park, all locations experience human activity such as camping and hiking in different degrees of impact. The habitat groups are as follows: H1 = minimally disturbed stream (rarely used by people but sometimes hikers use it for water supply), H2 = moderately disturbed streams (mostly used by hikers, apparent litters but nearby vegetation are still dense), H3 = disturbed streams (usually near villages or camping ground. The streams are heavily used for washing and cleaning; apparent litter in the area; vegetation cover is minimal), H4 =natural pond, marsh or temporary wetland within forested area; H5 = artificial pond or artificial channel; H6 = minimally disturbed forest; H7 = moderately disturbed forest; H8 = plantations & farmland; and H9 = villages.

Data analysis

We used SPSS 14.0 and MINITAB 13.20 statistical softwares for data analyses. We constructed checklist of amphibian of Mount Gede Pangrango National Park and compared result for the Cibodas Trail with result from Liem (1974) and our survey in 2005. We also constructed species accumulation curve for species obtained during each periodic survey (usually between 3-4 days in a location), thus omitting species obtained outside sampling time but described in this report. Community and habitat similarity was examined for both 2004/2005 data (Kusrini *et al*. 2005) and 2006/2007 data by single linkage cluster analysis and developed into a dendogram.

To estimate amphibian richness in, we used Jackknife's assessment: $\hat{S} = s + \left(\frac{n-1}{n}\right)^k$ where

$\hat{S}$ = Jackknife estimate of species richness
s=Observed total number of species present in *n* quadrates
n=Total number of quadrates sampled

k=Number of unique species

To obtain confidence limits for the jackknife estimator as follows;

$\text{Var}(\hat{S}) = \left(\frac{n-1}{n}\right)\left[\sum_{j=1}^{s}(j^2.f_j) - \frac{k^2}{n}\right]$ Where

$\text{Var}(\hat{S})$ = Jackknife estimator of species richness

Using number of unique species *j* (j = 1, 2, 3, ..,s) we estimated 95% confidence limit:

$$\hat{S} \pm t_{\alpha}.\sqrt{\text{var}(\hat{S})}$$

III. RESULTS

A. Microclimate

The temperature in location varied, ranging from 10 – 23°C at night. The temperature was lower in higher altitude. In general, Bodogol is warmer than the rest of the locations. The humidity in all locations was high, ranging from 43- 100%. Table 2-2 illustrates the range of air and water temperatures and relative humidities (RH) during sampling.

Table 2-2. Range of nighttime air and water temperatures and RH in all locations (19.00 – 24.00).

Location	Date	Air temp. (Range °C)	Water temp. (Range °C)	Relative Humidity (%)
Megamendung	9-14/11 06	18.0-21.0	19.0-19.7	100
Ciwalen	17-21/01 07	16.0-19.2	17.1-18.5	89-100
Telaga Biru	31/12 06-02/01 07	10.0-17.5	15.2-17.0	43-100
Cibeureum	30/12 06-01/01 07	14.0-16.0	15.0-16.5	89-100
Rawa Denok	28-31/03 07	14.0-16.0	18.0-19.5	89-100
Lebak Saat	2-4/04 07	12.9-14.5	12.5-13.0	88-89
Alun-alun Suryakencana	25-27/12 06	10.0-12.1	12.0-13.9	100
Selabintana	22-17/11 06	16.0-20.5	16.9-21.0	91-100
Bodogol	8-12/11 06	20.0-22.9	21.0-22.5	91-100
Situgunung	13-16/02 07	16.0-20.0	17.0-18.5	89-100

B. The amphibians of Mount Gunung Gede Pangrango National Park

In total we found 959 individual of 18 species of frogs from six families (Table 2-3). The 18 species found in this study only represents approximately half of species present in Java (Iskandar, 1998). Although the number of species is the same as result of 2004/2005 survey, species composition differs. We found species that was not found during 2004/2005 such as *Microhyla palmipes.* In addition, we also recorded a caecilian from Bodogol, *Ichthyophis hypocyaneus* in January 2007. Considering species found by Liem, total amphibian species in TNGP is 23 species (Table 2-3). The jackknife estimate of species richness for the ten study sites (including Rarahan villages and Cibodas botanical garden) combined is 21.8 or ≅ 22, standard deviation 1.80 with 95% confidence limit 17.8 to 25.9 or 18 to 26 species.

Species accumulation curve shows how many new species were added during each episodic survey (Fig. 2-3) for each method. Fig. 2-3 shows that sampling had reached a plateau after the 12th episodic survey. High increase occured during survey episodes 1-7 which took place during first year monitoring program, while afterwards there was a lower increase.

Table 2-3. Total amphibians found in each location in Mount Gede Pangrango National Park during 2006/2007 survey.

Species	Non-Cibodas Trail				Cibodas Trail				
	Bodogol	Mega-mendung	Sela-bintana	Situ gunung	Ciwalen	Telaga Biru	Cibeu-reum	Rawa Denok	Grand Total
Bufo asper	18	8		1					27
Bufo melanostictus	5								5
Leptophryne borbonica	35								35
Leptophryne cruentata							20	33	53
Huia masonii	9	17	45	38	2	1	16	16	144
Limnonectes kuhlii	28	32	15	47	26		9	16	173
Limnonectes macrodon	12								12
Limnonectes microdiscus	2	3	7	7	9	6			34
Rana chalconota	5	3		2	55	4			69
Rana hosii	4	7	64	64	21				160
Leptobrachium hasseltii	12	15	4	15	5				51
Megophrys montana				1	6	2	4	3	16
Microhyla achatina	6					1			7
Microhyla palmipes					11	5			16
Philautus aurifasciatus		1	9		13	14	11	4	52
Polypedates leucomystax	1								1
Rhacophorus javanus	1		32	1	4	14	29	4	85
Rhacophorus reinwardtii	15					3			18
Ichthyophis hypocyaneus	1								
	154	86	176	176	152	50	74	77	959
	15	8	7	10	10	9	6	6	

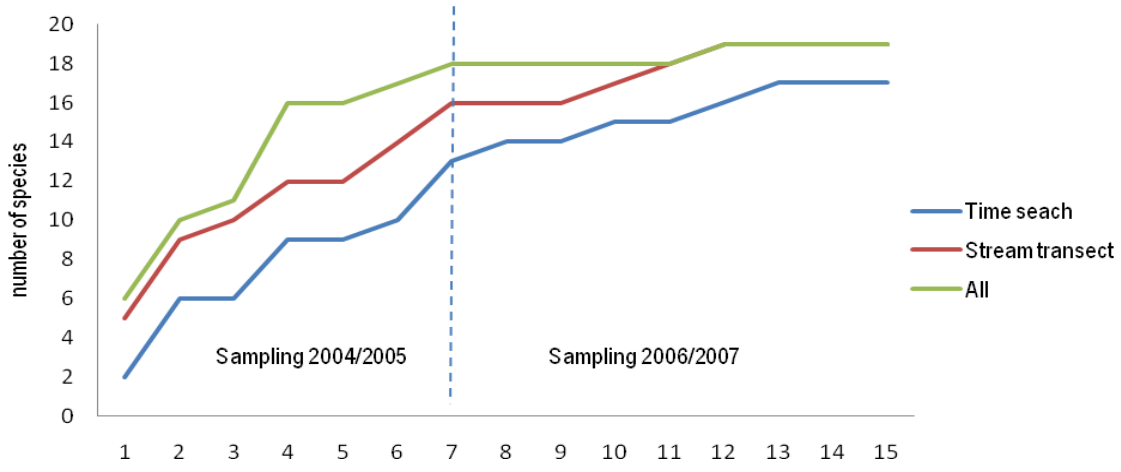

Fig. 2-3. Species accumulation curve for timed-search method, stream transect and both methods. We omitted data of *I. hypocyaneaus* from this curve. Sampling episodes 1-7 took place in 2004/2005; while sampling episodes 8-15 took place in 2006/2007.

Table 2-4. Total amphibian diversity in Mount Gede Pangrango National Park (Indonesia) and comparison of species composition during three times survey. Liem' survey took place during 1961-1964. Survey 2004/2005 and 2006/2007 conducted by the BP team.

Family	Species	Liem' survey 1964	Survey 2005	Survey 2007
Bufonidae	*Bufo asper*	+	+	+
	Bufo melanostictus	+	+	+
	Bufo bipocartus	+	-	-
	Leptophryne borbonica	-	+	+
	Leptophryne cruentata	+	+	+
Ranidae	*Fejervarya limnocharis*	+	+	-
	Fejervarya cancrivora	+	-	-
	Huia masonii	+	+	+
	Limnonectes kuhlii	+	+	+
	Limnonectes macrodon	-	+	+
	Limnonectes microdiscus	+	+	+
	Rana chalconota	+	+	+
	Rana hosii	-	+	+
	Rana nicobariensis	+	-	-
Megophryidae	*Megophrys montana*	+	+	+
	Leptobrachium hasseltii	+	+	+
Microhylidae	*Microhyla achatina*	+	+	+
	Microhyla palmipes	+	-	+
Rhacoporidae	*Philautus aurifasciatus*	+	+	+
	Polypedates leucomystax	+	+	+
	Rhacophorus javanus	+	+	+
	Rhacophorus reinwardtii	+	+	+
Ichtyophiidae	*Ichthyophis hypocyaneus*	-	-	+

Note:
- Species not found by Liem's survey but found at least once by BPCP team
- Species found by Liem's survey but not found by both BPCP team

Comparisons were made between amphibians of Mount Gede Pangrango with two other mountains nearby (Mount Halimun and Mount Salak; Table 2-4). Species recorded in TNGP were almost the same as the number of species recorded in Mount Halimun and higher than those of Mount Salak. The total 28 species is almost 3/4 of amphibian found in Java (Iskandar, 1998). Compared with other countries, the number of species recorded in West Java mountain area is low (28 species), as opposed to 34 species recorded in Cardamom Mountain in Cambodia (Ohler *et al.,* 2002) and 36 species in the Mount Muong Cha and Mount Tay Con Linh II in Vietnam (Bain & Truong, 2004).

Table 2-5. Comparison of amphibian richness in three mountains of West Java, Indonesia.

Family	Species	Mt. Gede Pangrango[a]	Mt Halimun[b]	Mt. Salak[c]
Ichtyophiidae (caecilian)	*Ichthyophis hypocyaneus*	+	-	-
Bufonidae	*Bufo asper*	+	+	+
	Bufo melanostictus	+	+	+
	Bufo bipocartus	+	+	+
	Leptophryne borbononica	+	+	+
	Leptophryne cruentata	+	+	-
Rhacophoridae	*Nyxticalus margaritifer*	-?	+	-
	Polypedates leucomystax	+	+	+
	Rhacophorus javanus	+	+	+
	Rhacophorus reinwardtii	+	+	+
	Philautus aurifasciatus	+	+	+
	Philautus vittiger	-	-	+
	Philautus pallidipes	-	+	-
Ranidae	*Huia masonii*	+	+	+
	Rana chalconota	+	+	+
	Rana hosii	+	+	+
	Rana nicobariensis	+	+	+
	Rana erythraea	-	+	-
	Fejervarya cancrivora	+	-	-
	Fejervarya limnocharis	+	+	-
	Limnonectes kuhlii	+	+	+
	Limnonectes macrodon	+	+	+
	Limnonectes microdiscus	+	+	+
	Occidozyga laevis	-	+	-
Megophryidae	*Megophrys montana*	+	+	+
	Leptobrachium haseltii	+	+	+
Microhylidae	*Microhyla achatina*	+	+	+
	Microhyla palmipes	+	-	-
	TOTAL SPECIES	24	24	19

a. Data is based on survey conducted by Liem (1974); Kusrini et al. (2005) and this report. There is anecdotal report of *N. margaritifer* in TNGP but no specimens are available
b. Data taken from Mumpuni (2002). The occurrence of *L. cruentata* in Halimun is based on Kurniati (2003)
c. Data taken from Kusrini *et al*. (2006)

C. Relative Abundance

With the apparent declines of frog populations elsewhere in the world, it is important to have historical information on distribution and abundance of frogs in TNGP. The information is necessary to assess the nature and extent of declines, if any. Although Liem reported the distribution, unfortunately he did not explicitly mention the abundance of frogs in his survey. However, in his paper he mentioned the number of specimens examined. Considering that in the 1960's researcher usually captured all frogs sighted and turn it into museum's collection, a comparison of relative abundance can be made for frogs from the Cibodas Trail. Figure 2-3 shows the comparison of frogs found in the Cibodas Trail.

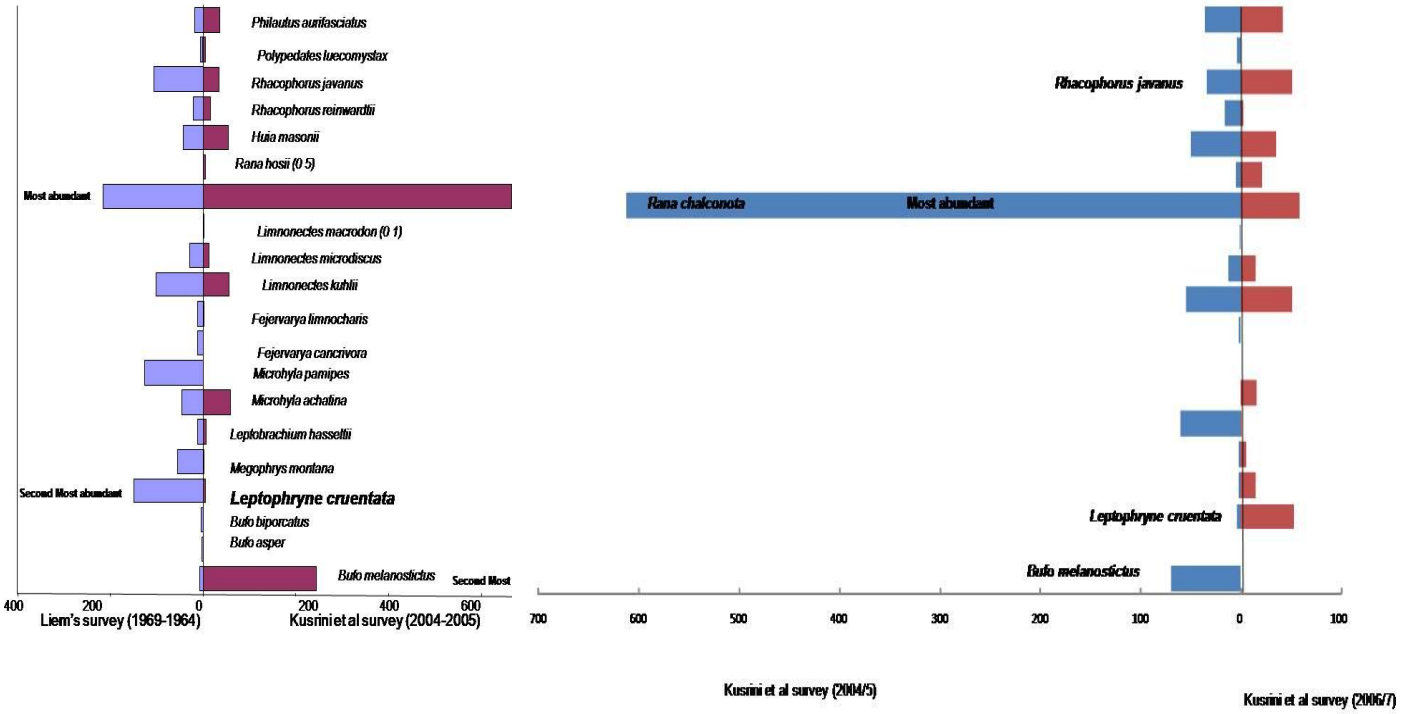

Figure 2-4. Comparison of relative abundances of frogs in the Cibodas Trail of TNGP. (Left) Comparison between Liem (1974) and Kusrini *et al*. (2005). (Right) Comparison between 2004/2005 and 2006/2007 surveys. Species in the right graph are listed in the same order as the left graph.

Five species with highest number of individuals caught during Liem's survey were *R. chalconota, L. cruentata, M. palmipes, R. javanus* and *L. kuhlii.* During the 2004/2005 survey, the five most abundant species were *R. chalconota, B. melanostictus, M. achatina, L. kuhlii* and *H. masonii* while during 2006/2007 they were *R. javanus, L. cruentata, H. masonii, P. aurifasciatus* and *L. kuhlii*. The high numbers of individuals caught appear to correlate with the higher incidents of occurrence in survey locations. *H. masonii, R. javanus, P. aurifasciatus, L. kuhlii, R. chalconota, L. microdiscus, L. hasseltii, M. achatina* are species with high detectability (Fig. 2-5)

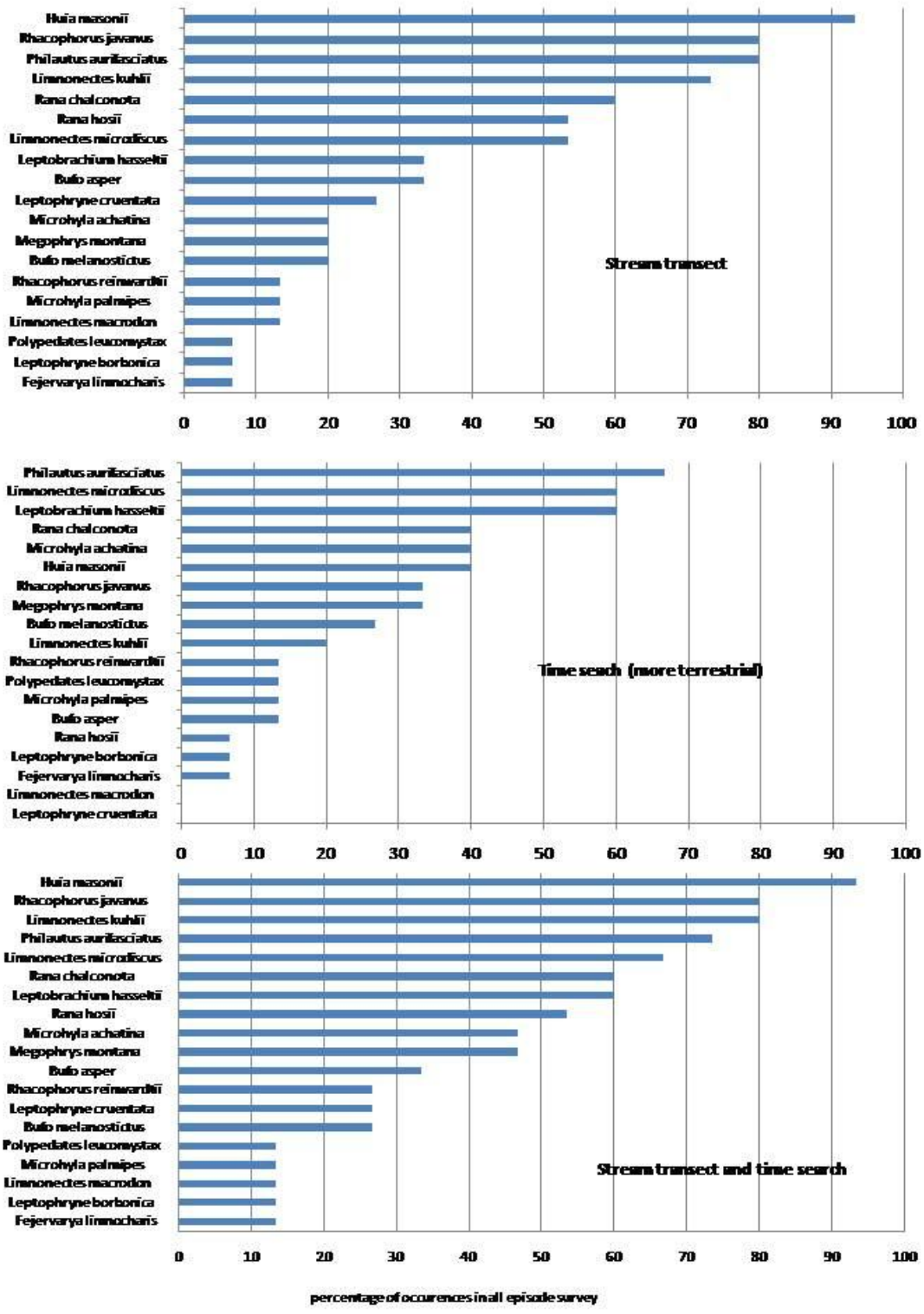

Fig. 2-5. Frequencies of occurrence of anurans within the Mount Gede Pangrango National Park for 2004/2005 and 2006/2007 data using stream transect survey and timed-search methods.

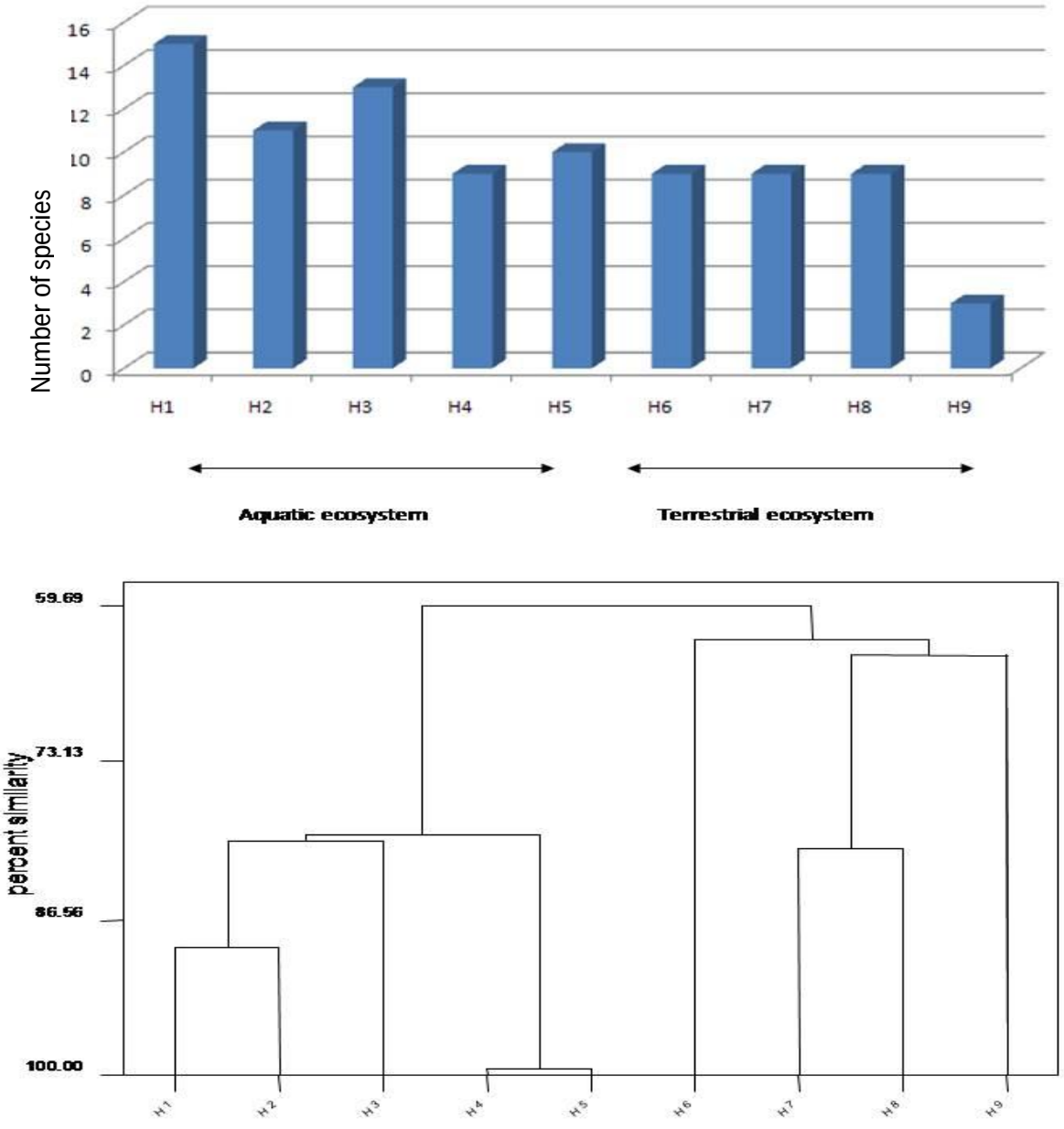

Fig. 2-6. Number of species in each habitat types (top) and comparison of habitat types according to the dominance of the particular anuran species in Mount Gede Pangrango National Park for 2004/2005 and 2006/2007 data using stream transect survey and timed-search methods. Habitat abbreviations are detailed in methodology section.

D. Community structure and distribution of anuran in Mount Gede Pangrango

Cluster analysis highlighted the influence of habitat on community organization (Fig. 2-6). The greatest Euclidean distance (i.e. the greatest difference in community indices) was between aquatic ecosystem and terrestrial ecosystem. Species richness was higher in aquatic ecosystem compared to terrestrial ecosystem (Fig. 2-6). Highest diversity in aquatic ecosystem and terrestrial ecosystem occured in minimally-disturbed streams and forested areas, respectively. Comparison between habitats showed that higher similarities in aquatic ecosystem occured between artificial and natural pond, minimally-disturbed streams and moderately-disturbed streams, while on terrestrial habitat the similarities occurred between moderately disturbed forests and plantations (Fig 2-6). Lowest diversity occured in artificial habitat within human settlements.

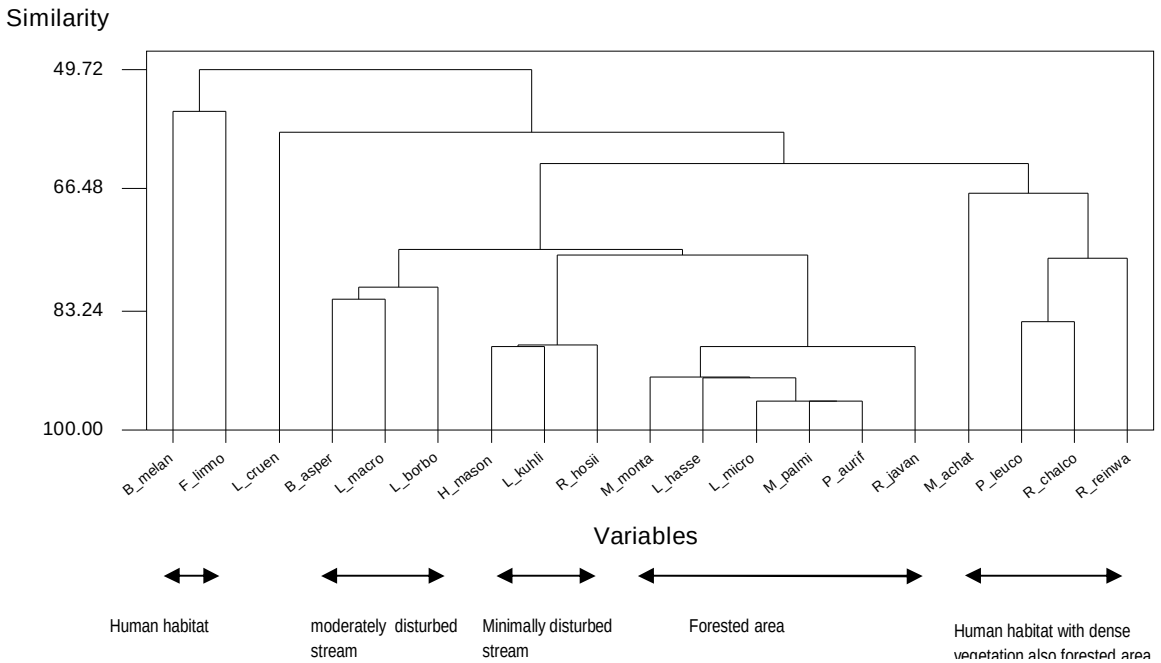

Fig. 2-7. Anuran community comparison according to habitat types in Mount Gede Pangrango National Park for 2004/2005 and 2006/2007 data using stream transect survey and timed-search methods. Species abbreviation is as follows: *B. melanostictus, F. limnocharis, L. cruentata, B. asper, L. macrodon, L. borbonica, H. masonii, L. kuhlii, R. hosii, M. montana, L. hasseltii, L. microdiscus, M. palmipes, P. aurifasciatus, R. javanus, M. achatina, P. leucomystax, R. chalconota, R. reiwardtii*.

This survey also confirms Liem's result that vegetation and water bodies play a major role in the distribution of frogs in Mount Gede Pangrango National Park. Species like *Bufo melanostictus, F. limnocharis* and *Polypedates leucomystax* occured primarily in the non-forest area, being typically found in human induced habitat of low vegetation cover. However, the species may be distributed to forest edges adjacent to human habitat. They were not found in the minimally diturbed forested area. *M. achatina, P. leucomystax, R. chalconota and R. reiwardtii* can be found in human habitat surrounded with dense vegetation and containing waterbody (such as park, garden, etc.). These species might spread to forested area. During breeding, these species could be easily seen near artificial ponds or other temporary pools (table 2-5).

Treefrogs such as *P. leucomystax* and *R. reiwardtii* usually mate in trees near this type of pool. Females will lay eggs in a foam nest while male fertilize the eggs. During our survey in Bodogol, we encountered females "attacked" by pirate males other than its mate trying to fertilize the eggs (Fig. 2-8). Six species of mostly terrestrial and arboreal species were only found in forested areas. Although its adult form might be distributed widely inside the forest, tadpoles of *L. hasseltii* and *M. montana* were usually found in streams inside forested area. The minute treefrog *P. aurifasciatus* was distributed quite far from water bodies, since it does not have tadpole stage thus it does not need water during its development (Iskandar, 1998). *L. cruentata* showed a distinct habitat, occuring only in high-altitude forested area, mostly near fast-flowing streams and its tadpoles usually aggregate in slow moving portions of streams (Fig. 2-7 and table 2-5).

Table 2-6. Ecological data for amphibians of Mount Gede Pangrango National Park.

	Edge forest	Forest pool	Forest seepage	Forest fast flowing stream	Forest slow moving stream	Forest floor far from water body	Stream side forest floor	Stream side forest floor and shrubs up to 1.5 m	Stream side forest floor and shrubs >1.5 m	Stream side trees more than 1.5 m
BUFONIDAE										
Bufo asper	-	-	-	C, M, F	M, F	F	M, F, C	M, F, C	M	-
Bufo melanostictus	M, F	-	A	-	-	M, F	-	-	-	-
Leptophryne borbonica	-	-	-	-	M, F	-	M, C	M, C	-	-
Leptophryne cruentata	-	-	-	M, F	T	-	M, F	M, F	F	-
MEGOPHRYDAE										
Leptobrachium hasseltii	M, F	-	M	-	T	M, F, C	J	J	-	-
Megophrys montana	-	-	-	T	T	M, F, C	M, J	M	-	-
RANIDAE										
Huia masonii	-	-	-	T, M, F, C	M, F, T	-	M, F, C	M, F, C	F	-
Limnonectes kuhlii	-	-	-	M, F	M, F, T	-	M, F	J	-	-
Limnonectes macrodon	-	-	-	-	F, J	-	F, J	J	-	-
Limnonectes microdiscus	M	M, F	M	-	M, F	M, C	F, M, J	F	-	-
Rana chalconota	-	M, F, T	-		M, F, C	-	M, F	M, F, C	M, F, C	-
Rana hosii	-	-	-	M, F, C	M, F, C, T	-	M, F, C	M, F, C	M	-
MICROHYLIDAE										
Microhyla achatina	M, F	M, F	M, F, C, T	-	-	M	-	-	-	-
Microhyla palmipes	-	A	-	-	-	M	A	-	M	-
RHACOPHORIDAE										
Philautus aurifasciatus	-	M	-	-	-	M, F	-	M, C	M, C	M,
Polypedates leucomystax	C, M	M, F	-	-	-	M	-	-	-	-
Rhacophorus javanus	-	M, F, T	T	-	T	-	-	M, F	M, F, C	M, F, C, E
Rhacophorus reinwardtii	M, F,E	M, F, T	T	-	-	-	-	M, F, C	-	-
ICHTYOPHIIDAE										
Ichthyophis hypocyaneus	F	-	-	-	-	F	-	-	-	-

Note: C = male calling; M = Male; F = Female; T = Tadpole; J = Juvenile; A = Adult, sex unknown

Number of species tends to lower as elevation increases. Similar trends were also shown in Vietnam (Bain & Truong, 2004). In Liem's survey, the highest altitude where frogs were recorded was in Lebak Saat. No frogs were found in Lebak Saat (~2200m asl) or Alun-Alun Surya Kencana (~2700 m asl) during our 2004/2005 and 2006/2007 survey, thus the highest elevation at which frogs were recorded was in Rawa

Denok (~ 1800 m asl). The differences of this finding were probably due to differences in habitat condition between Liem's survey and our survey. Figure 2-9 shows the distribution of frogs according to elevation

Fig. 2-8. Three male *R. reiwardtii* tried to fertilize eggs from a single female in Bodogol, Mount Gede Pangrango National Park .

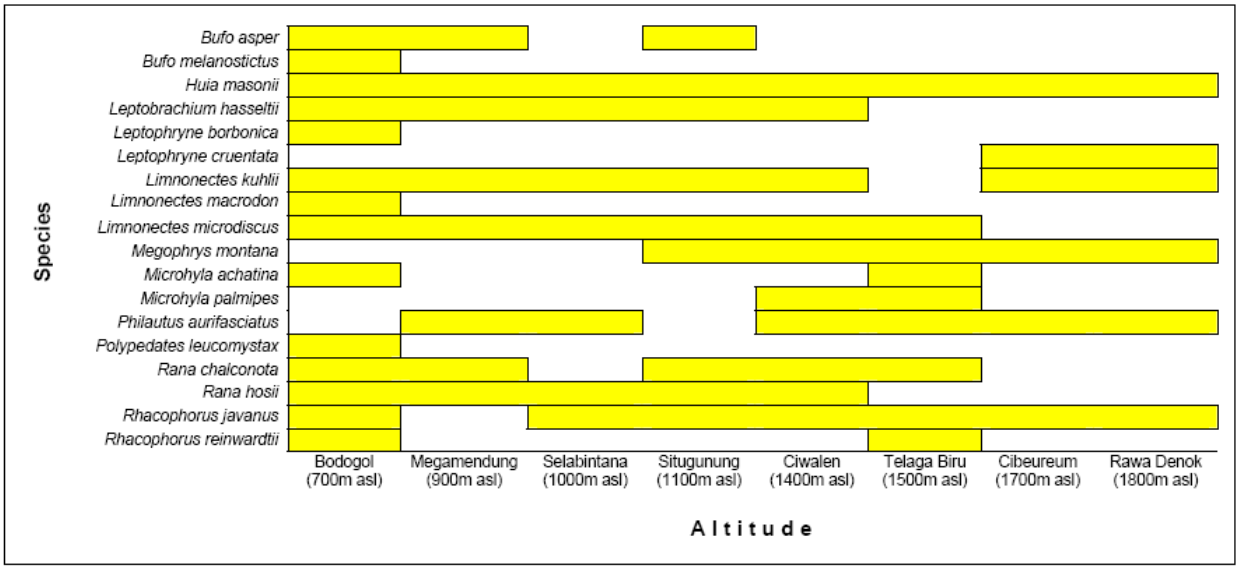

Fig. 2-9. Anuran distribution in Mount Gede Pangrango National Park according to elevation.

IV. DISCUSSIONS

Based on our two-year sampling, we had obtained sufficient record of amphibians in the area and we are confident that the most common species have been sampled. Species composition differed due to several reasons: 1) change of habitat, 2) differences in survey locations and 3) differences in sampling methods and effort. For instance, during Liem's survey, most of the Rarahan landscape consists of ricefields and vegetable gardens. Nearly 40 years later the ricefields have been transformed into villas. There are still few vegetable gardens and additional ornamental plants garden. This alteration caused rice field frogs such as *Fejervarya limnocharis* and *F. cancrivora* to be less abundant than before. Our survey in 2004 did not find Rawa Gajonggong, which probably the reason why we missed *Microhyla palmipes,* a frog according to Liem's account was restricted to Rawa Gajonggong. Liem only visited the Cibodas Trail and he used opportunistic method, in which he walked along the trail of Cibodas to find frogs for several days at a time. In his research note he mentioned that survey was conducted in 1961-1962 and more intensive surveys in August 1963, March and May 1964.

Based on 2004 result, the highest diversity of frogs in the Cibodas Trail was found in Cibodas Botanical Garden (13 species compared with Liem's eight species), thus confirming the Botancial Garden as transitional zone between non-forested area and forested area. In forested area, higher diversity occurs in Ciwalen (10 species). Omitting Cibodas Botanical Garden data, highest diversity in Cibodas Trail occurs in Ciwalen. Highest diversity of amphibian in non-Cibodas Trail occured in Bodogol. All non-Cibodas Trail were located within forested areas of the Perum Perhutani Forest Production Unit, with vegetation mostly composed of plantation timber such as *Calliandra calothyrsus, Pinus merkusii* and *Agathis dammara*. However, the area adjacent to the Bodogol stream is more densely forested than the others; the vegetation is mostly composed of natural forest mixed with plantation timber, and undergrowth such as *Brugmansia suaveolens*, *Ficus sp., Altingia excelsa, Achasma megalochilos*, *Selaginela plana*, *Artocarpus heterophyllus*, *Melastoma malabathricum*, *Acacia* sp., *Daemonorops rubra* and bamboo (*Bambusa* sp.). Higher diversity in these three locations (Cibodas Botanical Garden, Ciwalen, and Bodogol) showed the importance of forest edge for amphibian community structure.

In the Cibodas Trail, two species of endemic frogs were found: *Leptophryne cruentata* and *Rhacophorus javanus*. The distribution of *L. cruentata* is more limited compared to that of *R. javanus*. The first species is only found in Cibeureum and Rawa Denok of the Cibodas Trail, while the latter is distributed more widely not only in Mount Gede Pangrango NP (seven out of 10 locations surveyed) but also in Java (Iskandar, 1998). The endemic Javan Treefrog, *R. javanus*, is found widespread in forested area of Cibodas Trail up to Rawa Denok and in non-Cibodas Trail except for Megamendung. The species is more abundant than *L. cruentata*. The number of *L. cruentata* found in the 2006/2007 survey was higher than that of the 2004/2005 survey. One of the reasons of the higher number of *L. cruentata* recorded during 2006/2007 survey was probably due to the finding of its main habitat in the Cibeureum Waterfall.

Noted finding from Bodogol is the endemic caecilian *Ichthyophis hypocyaneus* in January 22, 2007 by Pepen, a National Park Officer. The female *I. hypocyaneus* (SVL 25.8 cm, tail 0.5 cm, weight 10 g; Fig. 2-10) is the first record of caecilian in Mount Gede Pangrango National Park. The original description of *Ichthyophis hypocyaneus* Boie, 1827 was based on specimen from Banten (previously part of West Java province; Iskandar, 1998)). Afterwards there have been no other published records of Ichthyophis in Java, which lead to questions regarding the existence of caecilians in Java. This record of *I. hypocyaneus* in Bodogol proves that Ichthyophis is in fact not extinct from Java.

Fig. 2-10. *Ichthyophis hypocyaneus* Boie, 1827. Specimen from Bodogol.

Six species were found in non-Cibodas Trail but not in the Cibodas Trail. Species not found in Cibodas Trail were *B. asper, B.melanostictus, L. borbonica, L. macrodon, P. leucomystax* and *I. hypocyaneus.* The difference was not only due to elevation but also on the ecology of each species. *B.melanostictus, L. macrodon, P. leucomystax are* widespread and thrive in human induced habitat (Iskandar, 1998). *Bufo asper* are usually found in canopied portion of streams while *L. borbonica* are usually found in streams in forested area. There is not much data on the ecology of *I. hypocyaneus*. However, the caecilian seems to be found in lowland rather than highland areas.

Huia masonii and *Limnonectes kuhlii* appear widespread and relatively abundant in all streams, both in non-Cibodas as well as Cibodas Trail. *H. masonii* was one of the most abundant species in the streams. Adult male *H. masonii* were usually seen perching on leaves, or branches of plants along riverbanks. Females were rarely seen, except when amplexing with males in the stream. *L. kuhlii* were usually found perched in rocks or rocky stream.

V. Conservation Issues and Management Implications

Since this amphibian monitoring in Mt.Mount Gede Pangrango appear to be the only one information available for West Javan amphibian species, data from this survey can act as a guideline for management of amphibians in West Java.There are at least two species of concern because of their limited distribution and low numbers: *I. hypocyaneus* and *L. cruentata*. Both species must be carefully considered when proposing any habitat-disturbing activities. So far, *I. hypocyaenus* has only been found in Bodogol. However, there is no data on the ecology and population of this species. There is a need for more research on this species to manage its habitat properly. Long-term monitoring should be encouraged in this national park. Intensive monitoring at population level should be conducted for rare species and selected species with high detectability such as *H. masonii, R. javanus, P. aurifasciatus, L. kuhlii, L. microdiscus,* and *L. hasseltii.*

In 1998, Iskandar mentioned in his book that *L. cruentata* is absent from Cibeureum. Looking at our 2004/2005 data, it appears that there is a declining trend in *L. cruentata* population. However, our 2007 survey showed that the number *L. cruentata* is relatively higher in this area. It is clear that amphibian population fluctuates as stated by several scientists working with data from other locations (Pechman *et al.* 1991; Pechman and Wilbur 1994; Marsh 2001). To analyse the population decline, there is a need for long-term monitoring program that is regrettably unavailable for any species in Mount Gede pangrango National Park. Therefore we are not certain that the low number of *L. cruentata* during 2004/2005 reflects the declining state. However, due to its limited distribution more conservation measures need to be focused on this species.

There are several potential threats for frogs in Mount Gede Pangrango National Park. Anthropogenic threats in form of habitat modification are minor. However, due to its popularity as hiking trail, parts of forest inside the recreational zone have been modified by the National Park Office. For instance, the waterfall area of Ciwalen is one of the recent areas opened by the management for recreation. Human visitation in the national park could act as potential threat. Every year thousands of visitors visit Curug Cibeureum or hike to the summit of Mount Gede. It is estimated that around 30,000 visitors climb the summit annually (Whitten *et al*., 1996) The pressure is quite high, which prompted the park management to close hiking permit to the summit for several months in a year, mostly during heavy rainy seasons. The threats from human visitation include trampling of bottom substrate which probably acts as nesting sites, and most importantly pollution, mostly in form of solid waste such as plastics and empty tin cans. During our survey, we found a lot of rubbish near Telaga Biru and Curug Cibeureum. The use of the third Cibeureum Waterfall for recreation should be minimized since the highest number of *L. cruentata* was recorded aggregating in this location.

Other threats that could possibly affect frogs are diseases. Chytridiomycosis, a skin disease caused by *Batrachochycium dendrobatidis* (Bd) or known as the chytrid fungus, has been implicated as the cause of frog declines in Australia, New Zealand, Central American countries and elsewhere (Berger *et al*., 1998; Berger *et al*., 1999). Our assessment found Bd in four species of frogs from the Cibodas Trail (see chapter 4). Therefore, threats from this disease could not be ignored.

There are several implications arising from this study:

a) that regular monitoring of frog population of these sites must be continued on an annual basis to provide an on-going assessment of the populations of frogs, especially *L. cruentata*,

b) that intensive monitoring of *L. cruentata* in known sites must be carried out along with more research on its ecology,

c) minimizing public access to known habitat of *L. cruentata*,

d) revise the endangered species list and propose *L. cruentata* in protected status, and

e) launch public education campaigns and increase public participations.

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Chapter 3

PRELIMINARY STUDY ON THE DISTRIBUTION AND BIOLOGY OF THE BLEEDING TOAD, *Leptophryne cruentata* Tschudi, 1838

M. D. Kusrini, M. Yazid, A. U. Ul-Hasanah and A. Hamidy

I. INTRODUCTION

Leptophryne cruentata or the bleeding toad is an endemic frog from the mountainous area of West Java. The toad was found in abundance in Cibodas Trail - Mount Gede Pangrango National Park during the 1960's and the second most abundant frog encountered after *Rana chalconota* (Liem 1971). Recent surveys found the number has declined sharply in contrast to other species. Iskandar (1998) even reported that this frog already disappeared from Cibodas. However, survey found 2005 found four individuals (Kusrini *et al*., 2005) and later on more than 15 individuals were found in aggregation within a waterfall in Cibereum (this report).

The toad is now listed in IUCN as Critically Endangered (2004 and 2006). On October 2006, a proposal to the Government of Indonesia for inclusion of *L. cruentata* as a protected species was logged to LIPI (Indonesian Institute of Science) as the Indonesian scientific authority (Kusrini 2006) and during the National Workshop in November the same year the proposal was approved along with nine other species of reptiles to be added as Indonesian protected species. Law status of all new species proposed as protected species is now pending waiting for the Indonesian President' approval (signature). By this approval, *L. cruentata* will be the first amphibian species in Indonesia acknowledged with a protected status.

Although the recent main population of this frog is found mostly in protected areas, the population decline showed that other factors such as visitor disturbances, volcanic activities and diseases might play a crucial role. To date, no information on its bio-ecology (i.e. breeding behaviour, number of clutch, home range) is available, including its historical distribution. Using specimens stored from Museum Zoologicum Bogoriense (MZB), we described the historical distribution of *L. cruentata* and presented results of a preliminary study to determine the number of eggs and diet of *L. cruentata*. In addition, we described the morphological differences between *L. cruentata* and its sibling *L. borbonica* which is more widely distributed.

II. METHODS

We examined 185 specimens of *L. cruentata* stored at MZB and noted the date of collection, collector name, location and sex. Based on available data, we then assemblage historical distribution of this toad. Ten females and eleven males were further dissected to analyze reproduction (for female) and stomach contents. We measured the SVL of the selected frogs and then removed the stomach contents and examined prey items. We measured niche breadth of each sex using Levin's standardize niche breath and Pianka Measure of Niche Overlap (Krebs 1999).

Levin's standardize niche breadth:

$$B = \frac{1}{\sum p_j^2}, \qquad B_A = \frac{B-1}{n-1}$$

B = Levins' measure of niche breadth

p_j = Proportion of individuals found in or using resource state j, or fraction of items in the diet that are of food category j (estimated by N_j / Y) ($\sum p_j = 1.0$)

N_j = Number of individuals found in or using resource state j

$Y = \sum N_j$ = Total number of individuals sampled

B_A = Levins' standardized niche breadth

B = Levins' measure of niche breadth

n = Number of possible resource states

Niche Overlap between sex:

$$O_{jk} = \frac{\sum_i^n p_{ij}\, p_{ik}}{\sqrt{\sum_i^n p_{ij}^2 \sum_i^n p_{ik}^2}}$$

where

O_{jk} = Pianka's measure of niche overlap between species j and species k

p_{ij} = Proportion resource i is of the total resources used by species j

p_{ik} = Proportion resource i is of the total resources used by species k

n = Total number of resources states

All specimen dissected were taken between January - April 1964 by Liem or Soemadikarta from Cibeureum. The number of eggs and size of maturity of females were estimated by the presence of oviductal eggs. The effect of female size on clutch size was tested by Linear regression. The minimum size at maturity is considered as the SVL of the smallest reproductive female. We also noted the morphological appearances of *L. cruentata* and differences to its sympatric relative, *L. borbonica* based on specimens examined during field work.

III. RESULTS AND DISCUSSIONS

3.1 Historical Distribution

The oldest specimen stored in MZB is a male specimen (MZB Amp 1545) collected by M.A. Lieptink in June 1932 from South Cisarua, Gedeh. The distribution of *L. cruentata* in Indonesia is restricted to three mountains in West Java province: Mount Gede, Mount Salak and Mount Halimun (Fig. 3-1). Specimens in MZB contained more male than female which was probably biased by the catchability of each sex (Fig. 3-2).

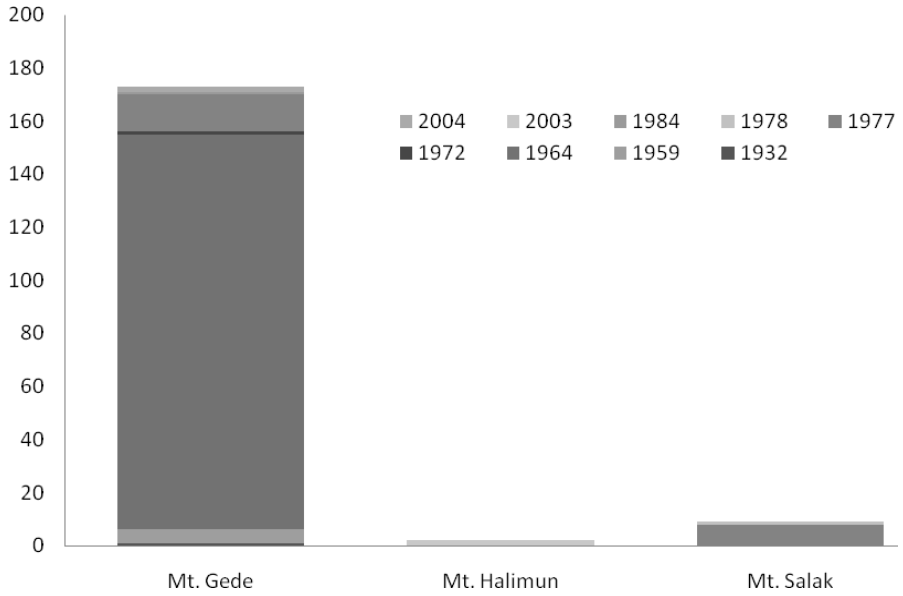

Figure 3-1. Distribution of *L. cruetata* in Indonesia.

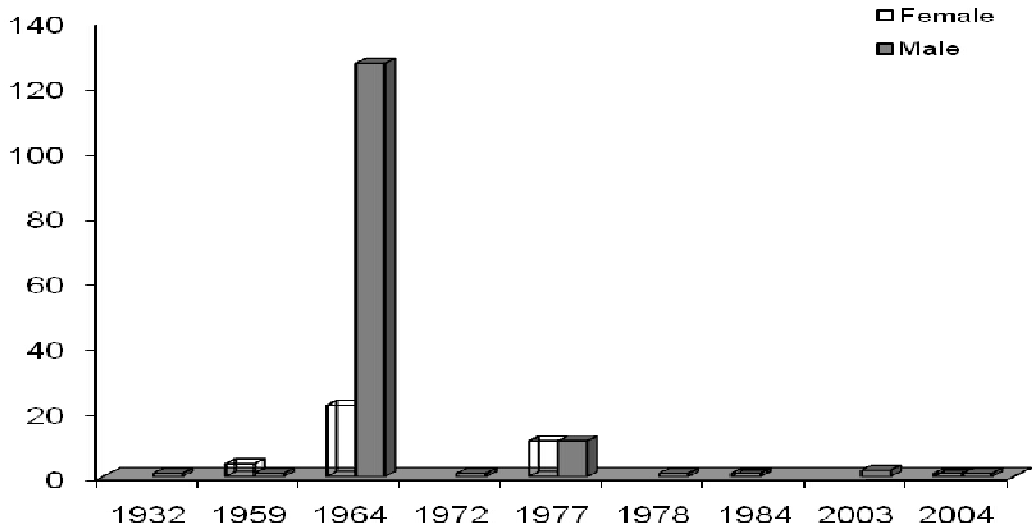

Figure 3-2. Specimens *L. cruetata* based on sex.

Information regarding exact locations of specimen collection is sketchy. The main distribution of *L. cruentata* in Mount Gede based on specimens was in Cibeureum, Rawa Denok and Lebak Saat. A small

number were taken from Cipelang, Perbawati and Selabintana. The distribution in Mount Salak is in Sagaranten and Ciapus whilst the new distribution in Mount Halimun was found in Cikeris (Kurniati, 2005). Nowadays, population is confirmed only for one location (Mount Gede) in two relatively small areas (Cibeureum and Rawa Denok). Two surveys conducted by BP team in 2004/2005 and 2006/2007 failed to find any population in Lebak Saat. The possibility that populations are quite small and isolated raises concern about its continued existence. Since monitoring is almost non-existent, the disappearance of *L. cruentata* from the majority of its historical distribution is entirely unclear. The populations in Mount Salak and Mount Halimun need to be re-surveyed and verified before establishing the status as disappeared.

3.2 Population Status in Mount Gede

There is no long-term monitoring of this species – as well for other species – in Mount Gede Pangrango. Number of specimens stored in MZB before 2004 is variable, however it might reflect population status (Fig. 3-3). Survey conducted by Liem (1971) showed high numbers of this species, but afterward, anecdotal report (Iskandar, 1998) stated the low number of this species. Survey by BP team in 2004/2005 showed low number of *L. cruentata*. However, another survey conducted on December 2006-January 2007 did not only find more *L. cruentata* but also a waterfall that we believe serves as core habitat for this species. Until now, records of *L.cruentata* only refer to finding them in the stream that flows out of the waterfalls. During 2006/2007 BP team found 15 *L. cruentata* well hidden in moss-covered rock crevices in a third waterfall in Cibereum in daytime (Fig. 3-4). This is the highest number of *L. cruentata* found in a single day. We also found several *L. cruentata* tadpoles in a small pool-like compound at the base of this waterfall. Unfortunately, the waterfall was recently opened by the National Park office as part of their Recreation Area, since all the waterfalls of Cibereum is popular with nature trekkers. Therefore, there is an urgent need to establish its home range to guarantee the protection of its habitat.

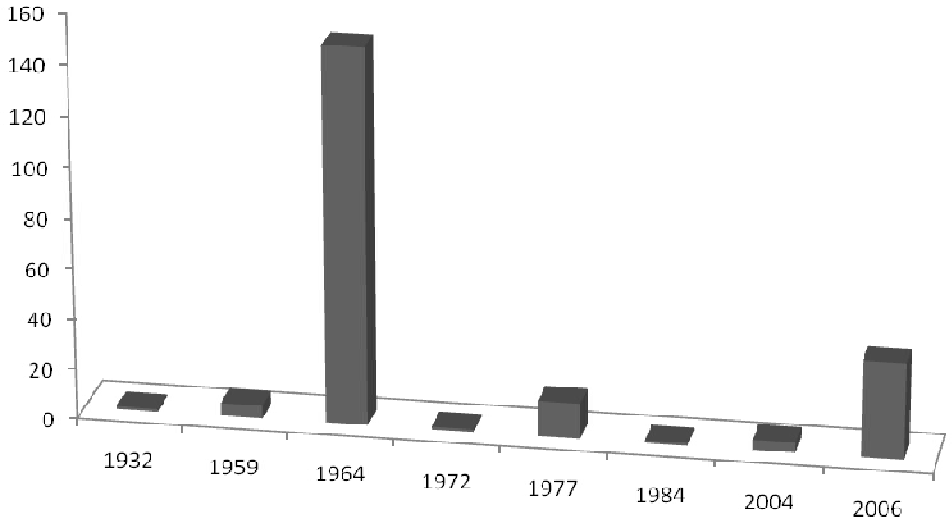

Fig. 3-3. Number of specimen collected from Mount Gede. Data for 2006 is based on survey conducted by the team (see chapter 2). No specimens were taken in 2006.

Fig. 3.4. The third waterfall of Cibeureum, that was recently opened by the National Park Office for a Recreation Area and is suspected as main habitat for the remaining *L. cruentata* population in Cibeureum.

3.3. Number of Clutch and Diet

All female specimens examined had eggs with uniform size, suggesting that the toad releases all eggs in a single clutch. Mature ovum measured approximately 1 to 1.3 mm in diameter. One female showed immature ova. The average number of eggs was 318.1 ± 59.9 (n = 10). The smallest female with mature ova had SVL of 32.00 mm. There is no correlation between number of eggs and snout vent length (R = 351, N = 10, P = 0.320). Number of *L. cruentata* eggs is relatively fewer than *L. borbonica*. The latter species is able to have up to 1,200 eggs in one clutch (Kusrini, unpublished data). There is no data on whether females release all eggs at the same time or able to oviposit more than once in a single season. There is a need to do more research to confirm if the number of eggs deposited correlate to the number of ovarian egg counts.

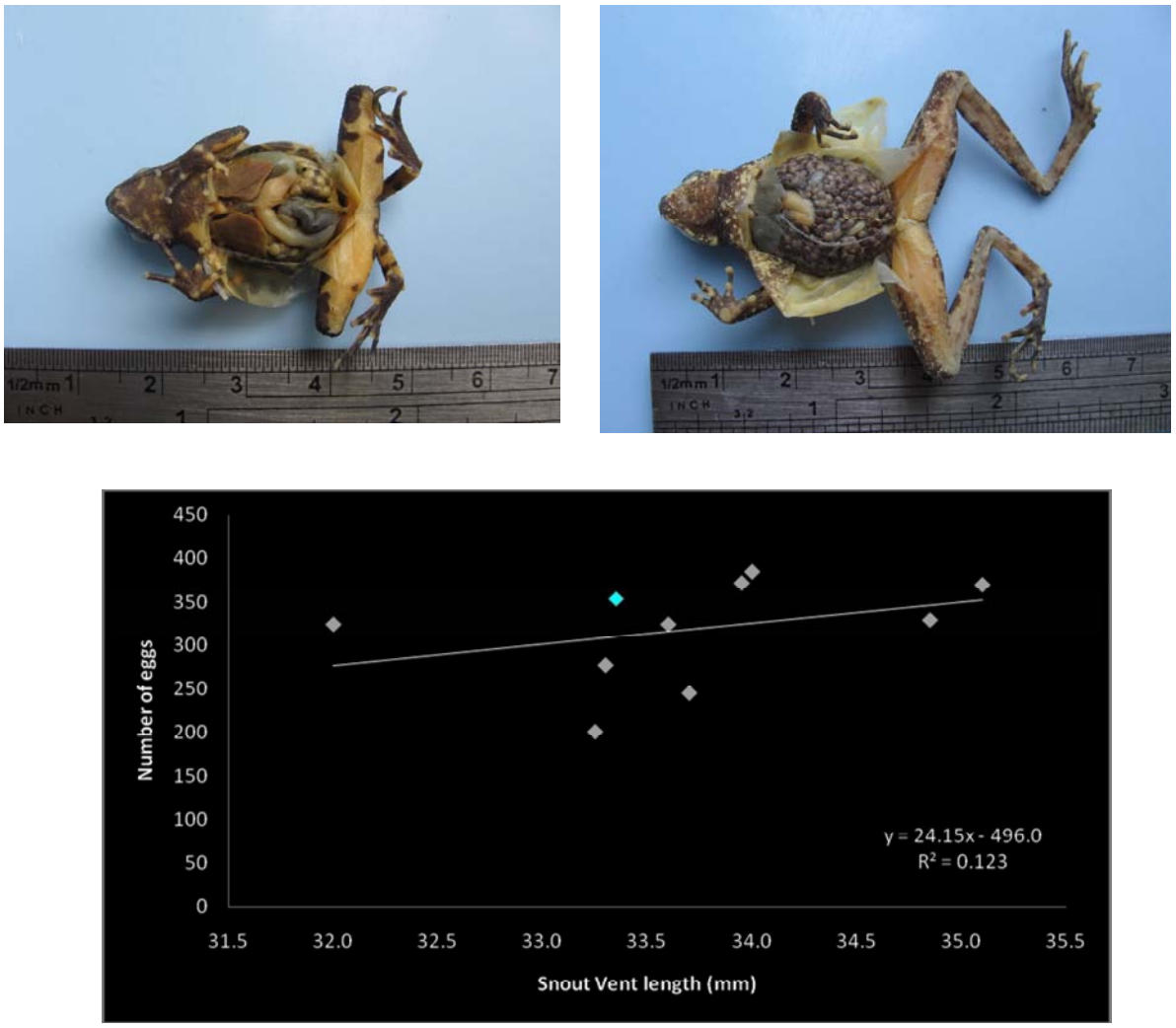

Fig. 3.5. Top left: Female *L. cruentata* with mature ove. Top right: Female *L. borbonica* from Bukit Barisan Selatan National Park in Sumatera full with eggs. Below: Relationship between number of eggs and length of female *L. cruentata*. Red dot refers to female with immature ova.

Food habit information has been documented for several species occurring in West Java as well in Cibodas, i.e *Microhyla achatina, Rana chalconota, Rana erythraena, Occidozyga lima, Fejervarya limnocharis* and *F. cancrivora* (Atmowidjojo and Boeadi, 1988; Mumpuni *et al*., 1990; Erftemeijer and Boeadi, 1991; Nurmainis, 2000). However there is no information of the food habits of the Bleeding Toad. The diet of *L. cruentata* showed specilized diet as reflected in the high number of ants in their diet and their narrow niche breadth (male 0.316, female 0.188). We identified 106 prey items (Table 3-1) consisting mostly of Hymenoptera (ants, 60.38%), followed by Coleoptera (7.55%), Orthoptera (6.60%), Diptera (6.60%), Lepidoptera (4.72%), Hemiptera (1.89%), Collembola (1.89%), and Isopoda (0.94%). We also found other materials in the stomach consisting of plant materials and soil (total 8.49%). Only one male showed empty stomach. We also recovered parasitic worms inside the digestive tract from most of the individuals, which we have yet to identify.

The specialized feeding of ants of *L. cruentata* is nearly identical as *M. achatina* and *M. heymonsii* in Cibodas (Mumpuni *et al*., 1990; Erftemeijer and Boeadi, 1991), which showed that *L. cruentata* forage to terrestrial habitats in search of food. Females tend to eat more items than males (Fig. 3-6), although prey selection is mostly similar as shown in their high niche overlap (0.964). These findings suggest that prey availability around frog habitat is very important to regulate food items of *L. cruentata*. However, we do not know whether food choice is influenced by prey availabity or depended on season. Thus, we recommend further research on the feeding habit of this species. Research can be conducted using stomach flushing methods (Patto 1998) to avoid unnecessary killing.

Table 3-1. Food items consumed by the Bleeding Toad, *Leptophryne cruentata*.

Prey Taxon			**M (n=10)**	**F (n=9)**	Freq
Arachnida			0	1	0.943
Insecta	Collembola		2	0	1.887
	Coleoptera		2	5	
	Coleoptera	(Curculionidae)	1	0	7.547
	Diptera		2	3	
	Diptera	(Sciaridae)	1	1	6.604
	Hemiptera		1	0	
	Hemiptera	(Reduviidae)	0	1	1.887
	Hymenoptera		4	2	
	Hymenoptera	(Formicidae)	13	4	
	Hymenoptera	(Formicidae – Cardiocondyla)	0	1	
	Hymenoptera	(Formicidae- Paratrechina)	0	6	
	Hymenoptera	(Formicidae- Pheidole)	3	30	
	Hymenoptera	Ichneumonidae	0	1	60.377
	Lepidoptera (larva)		0	5	4.717
	Orthoptera		0	6	
	Orthoptera	Blattidae	0	1	6.604
Malacostraca	Isopoda		0	1	0.943
Other	Plant material		3	3	
	Soil		2	1	8.491
			34	**72**	**100**

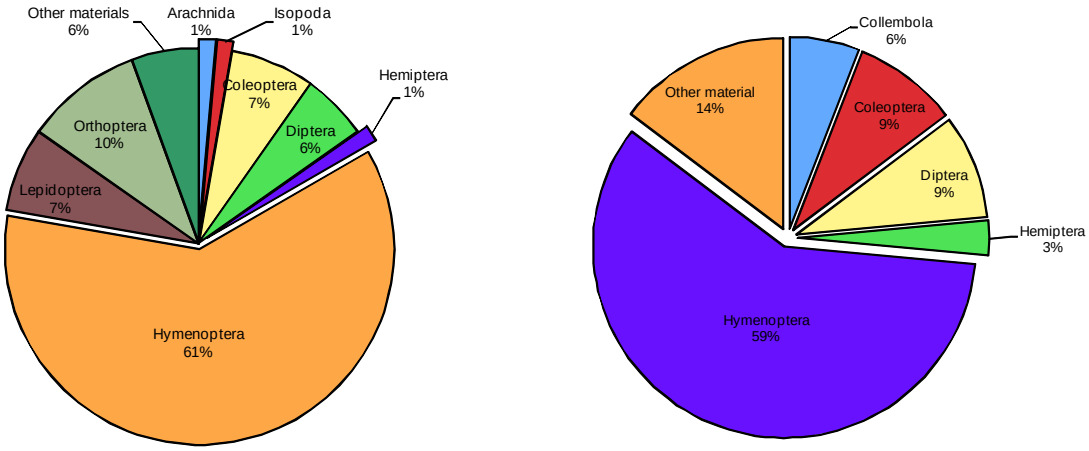

Fig 3.6. Left: Stomach content of female *L. cruentata* (N=9). Right: Stomach content of male *L. cruentata* (N=9).

Fig 3.7. Left: Hymenoptera or ant (Formicidae: Pheidole sp.), main diet of *L. cruentata*. Right: Parasite of *L. cruentata*.

3.4 Morphological differences between *L. cruentata* and *L. borbonica*

L. cruentata and *L. borbonica* were found in different locations. While the distribution of the first species is nowadays confined to Mount Gede Pangrango, *L. borbonica* is also found in Mount Halimun and Salak, as well as Sumatra and Kalimantan (Iskandar, 1998). In total, we measured 75 frogs from Mount Gede Pangrango which consisted of 34 male *L. borbonica*, 13 males and 28 female *L. cruentata*. For males, there is a significance difference among species in SVL ($F_{1,47}$=55.465; P < 0.0001) and mass ($F_{1,47}$=28.561; P < 0.0001). Table 3-2 summarizes the SVL and mass of both species.

Mean SVL of adult female and male *L. cruentata* were 32.58 and 24.97 mm, while mean mass were 3.63 and 1.56 g, respectively. Females were significantly longer ($F_{1,39}$ = 111.41, P < 0.0001) and heavier ($F_{1,39}$ = 136.15, P < 0.0001) than males.

Table 3-2. SVL and mass of *L. cruentata* and *L. borbonica* from Mount Gede Pangrango National Park.

Species			N	Mean±SD	Minimum	Maximum
L. cruentata	SVL (mm)	Male	13	24.97±1.14	23.72	27.42
		Female	28	32.85±2.56	24.14	37.54
		Total	41	30.35±4.31	23.72	37.54
	Mass (g)	Male	13	1.56±0.16	1.30	1.90
		Female	28	3.63±0.62	2.00	4.60
		Total	41	2.97±1.10	1.30	4.60
L. borbonica	SVL (mm)	Male	34	22.23±1.13	20.00	24.82
	Mass (g)	Male	34	1.13±0.28	0.76	1.80

L. borbonica and *L. cruentata* each has distinctive patterns, more notable is the hour-glass shaped of *L. borbonica* and the red-yellow streaks of *L. cruentata*. However, the reddish-yellow streaks of L. *cruentata* are sometimes indistinct which causes difficulties in differentiating the species, especially for novice herpetologists. Iskandar (1998) described the main differences between *L. cruentata* and *L. borbonica* is on the webbing of the toes. *L. cruentata* has more extensive webbing which reaches the last subarticular tubercle, while *L. borbonica*'s webbing does not reach the last subarticular tubercle. However, there is also an easier way to differentiate the species by looking at the tympanum. *L. borbonica* has a distinct tympanum behind its eyes while *L. cruentata* does not have visible tympanum (Fig.3-7).

Fig.3-8. Differences between *Leptophryne cruentata* and *Leptophryne borbonica*
Top-left: *L. cruentata*; **Top-right :** *L. borbonica*
Middle-left: Lateral view of head of *L. cruentata*; **Middle-right :** Lateral view of head of *L. borbonica* with tympanum highly visible
Bottom-left: Foot webbing of *L. cruentata*; **Bottom-right :** Foot webbing of *L. borbonica*

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Chapter 4

CHYTRIDIOMYCOSIS IN AMPHIBIANS OF MOUNT GEDE PANGRANGO NATIONAL PARK

M. D. Kusrini, L. Skerratt and W. Endarwin

I. INTRODUCTION

Batrachochytrium dendrobatidis (Bd) is the pathogen responsible for the amphibian disease chytridiomycosis, an emerging infectious disease thought to be responsible for declines and extinctions of amphibian populations around the world (Berger *et al*., 1998; Berger *et al*., 1999). To date, Bd has been identified in amphibian populations on all continents where they exist, except for Asia. It seems likely that this reflects a lack of data rather than the absence of Bd.

Western Java contains at least 25 native amphibian species, including a number that are endangered, near threatened or vulnerable. The climate of the region, particularly at high elevation sites, is highly favorable for Bd. For instance, the temperature in Mount Gede Pangrango National Park and Mount Halimun and Salak in West Java is typically between 13.5–28°C diurnally, with a relative humidity of 63–100% - well within the optimal conditions for Bd. Subsequently, models predicting the global distribution of Bd based on environmental variables have predicted that the montane forests of Java and Sumatra are highly favorable for Bd (Ron, 2005). In addition, Indonesia has introduced the bullfrog *Rana catesbeiana* in 1982 as part of an Indonesian government program to increase frog leg exports (Susanto, 1989), representing a potential source of introducing Bd into Indonesia. *R. catesbeiana*, a species often infected with Bd in South American frog farms (Mazzoni *et al*. 2003) is also a potential carrier of the pathogen, being able to transmit the disease to more susceptible amphibian species without succumbing to the infection itself (Daszak *et al.,* 2004). These factors make Indonesia and West Java in particular, an ideal location to conduct a systematic survey for Bd in the Asian region.

There have been two previous attempts to determine whether Bd occurs in Indonesia, all carried out as part of a PhD study during 2001-2004 (Kusrini, 2005). These surveys used skin histology to assess samples of toe clips of three edible frogs (*Fejervarya limnocharis-iskandari* complex, *F. cancrivora* and *Limnonectes macrodon* – see table 4-1) taken mostly from rice fields and adjacent areas in West Java. Bd was not detected in any of these samples. Further samples from eight frog species taken from five other locations were also not infected with Bd (Kusrini, unpublished data – table 4-2).

The fact that Bd was not detected in the two species of edible frogs inhabiting rice fields (*F. limnocharis-iskandari* complex and *F. cancrivora*) is not surprising, considering the properties of rice fields and the susceptibility of Bd to dessication. Most rice fields in Indonesia occur in lowland areas and experience periodic dry conditions that can last for more than a month, potentially eliminating Bd from the environment. It is likely that species at higher elevations in association with more permanent water may be at greater risk. One such species is *Leptophryne cruentata* (IUCN, 2004; Kusrini, *et al*., 2005), an endemic frog from West Java that appears to have undergone a dramatic population decline, the cause of which is unknown. *L. cruentata* occurs only on Mount Pangrango, Mount Gede and Curug Luhur in West Java, between 1000-2000 m asl, and breeds in very slow-moving, intermittent streams. The species is presently listed as

Critically Endangered. As Bd is known to be responsible for similar enigmatic declines in other parts of the world, efforts should be made in order to determine if Bd is present in *L. cruentata* and other sympatric species in the area.

Table 4-1. Species assessed for chytridiomycosis using phalanx histology examination. Specimens of *F. limnocharis-iskandari* complex and *F. cancrivora* were taken from rice fields in five locations: Caringin, Situgede, Ciptarasa, Panguyangan, Cisaat. *Limnonectes macrodon* samples were taken from two locations: Cilember and Ciapus. Assessor: Mirza D. Kusrini – JCU (Kusrini, 2005)

Species	N	Result
Fejervarya limnocharis-iskandari complex	103	Negative
Fejervarya cancrivora	35	Negative
Limnonectes macrodon	46	Negative
Grand Total	184	Negative

Table 4-2. Species assessed for chytridiomycosis using phalanx histology examination. Specimens were taken from five locations in West Java: Caringin, Ciapus, Cilember, Chevron Geothermal, Mount Walat during 2003-2004. Assessor: Diana Mendez from Rick Speare lab – JCU (Kusrini, unpublished result)

Spesies	N	Result
Bufo asper	14	Negative
Bufo melanostictus	9	Negative
Fejervarya limnocharis-iskandari complex	1	Negative
Huia masonii	29	Negative, 1 Negative suspicious from Chevron geothermal
Limnonectes kuhlii	12	Negative
Limnonectes macrodon	6	Negative
Megophrys montana	1	Negative
Fejervarya cancrivora	1	Negative
Rana chalconota	10	Negative
Rana hosii	27	Negative, 2 negative suspicious from Chevron Geothermal
Rhacophorus javanus	3	Negative
Grand Total	113	111 Negative, 3 negative suspicious

II. OBJECTIVE

The objective of this research is to assess the occurrence Bd in the frogs of Mount Gede Pangrango National Park (or Taman Nasional Gede Pangrango/TNGP).

III. METHODS

Survey was conducted from December 2006 to March 2007, in the Cibodas Trail of Mount Gede Pangrango National Park and an additional site in Bodogol. The survey was conducted in conjunction with amphibian monitoring at the national park (see Chapter-2). A total of 147 swabs were collected from 13 species of frogs, with more emphasis on *L. cruentata.* The number of frogs swabbed is only a small fraction of the total number of frogs encountered during the survey (Table 4-3).

Table 4-3. Number of individuals swabbed for each species in Mount Gede Pangrango National Park.

Species	Total individual found in field	Total swabbed
Huia masonii	144	10
Leptobrachium hasseltii	51	5
Leptophryne borbonica	35	10
Leptophryne cruentata	53	41
Limnonectes kuhlii	173	10
Limnonectes microdiscus	34	10
Megophrys montana	16	10
Microhyla achatina	7	1
Microhyla palmipes	16	10
Philautus aurifasciatus	52	12
Rana chalconota	69	8
Rana hosii	160	10
Rhacophorus javanus	85	10

Each frog was captured by hand, with a new pair of disposable plastic bags covering the hands in order to avoid cross-contamination between individuals (Fig. 4-1). We followed the hygiene protocol set out by Speare *et al*. (2004) and Wellington and Haering (2001). Information including locality, weather, sex of the individual, time, altitude and habitat type of the collected samples were recorded. We swabbed the posterior ventral surfaces of the lower abdomen, thighs, and all hands and feet of individual frogs twice. In addition, every time we encountered tadpoles at each survey site we examined the keratinized mouthparts of the tadpoles according to Obendorf (2005). The mouthpart of tadpole that had shown abnormalities in the anterior and posterior keratinized jaw sheaths were swabbed repeatedly for chytrid assessment. Care was taken to avoid repeatedly sampling the same individual.

Figure 4-1. *Leptophryne cruentata* swabbed for analyses.

All frogs analysed were released in their sampling location respectively, except for a tadpole of *Leptobrachium hasseltii* which has

shown oral deformities which was euthanized and fixed using 70% ethanol. Swab samples were then transported to Australia and entered the country via a permit issued by AQIS to the Amphibian Diseases Ecology Group (Permit No. 200520790). We then grouped the samples from the same species and location into 71 batches containing up to three samples for diagnostic test. Diagnostic PCR tests for *Batrachochytrium dendrobatidis* infection were performed for each batch by ADEC, using the Taqman RT-PCR primers and probe described by Boyle *et al*. (2004). Batches containing positive result were re-tested again to check for individuality. Each sample was tested in triplicate with concentration calculated by Corbett RotorGene software. Where only one or two wells are positive, the result is considered indeterminate. Results were verified by Dr. Stephen Garland from ADEC.

IV. RESULTS AND DISCUSSION

Five species has shown positive Bd result: *Rhacophorus javanus, Rana chalconota, Leptobrachium hasseltii, Limnonectes microdiscus* and *Leptophryne cruentata* (Table 4-4). Almost all of the infected specimens except for *Limnonectes microdiscus* were taken from aquatic habitats (streams and swamps) within the Cibodas Trail of Mount Gede Pangrango National Park (Fig. 4-2). Although taken from terrestrial habitat, samples of *L. microdiscus* were collected near stream. The main stream in Mount Gede Pangrango National Park flows from the top of the mountain and branches into Cibeureum, Telaga Biru and Ciwalen.

Table 4-4. Species infected with *Batrachochytrium dendrobatidis*.

JCU ID Number	Location	Species	Sex	SVL (mm)	Mass (g)	Zoospore equivalents per sample	Number of wells	Date collected
7082320	Telaga Biru	*Rhacophorus javanus*	Male	41.66	7.15	385	3	1 Jan 2007
7082305	Telaga Biru	*Rana chalconota*	Juvenile	42.6	2.5	72	3	1 Jan 2007
7082737	Ciwalen	*Leptobrachium hasseltii*	Tadpole	-	-	22	3	17 jan 2007
7082714	Ciwalen	*Limnonectes microdiscus*	Juvenile	19.62	0.75	3	3	17 jan 2007
07082130	Cibeureum	*Leptophryne cruentata*	Juvenille	23.72	1.3	≤ 1	1	31 Dec 2006

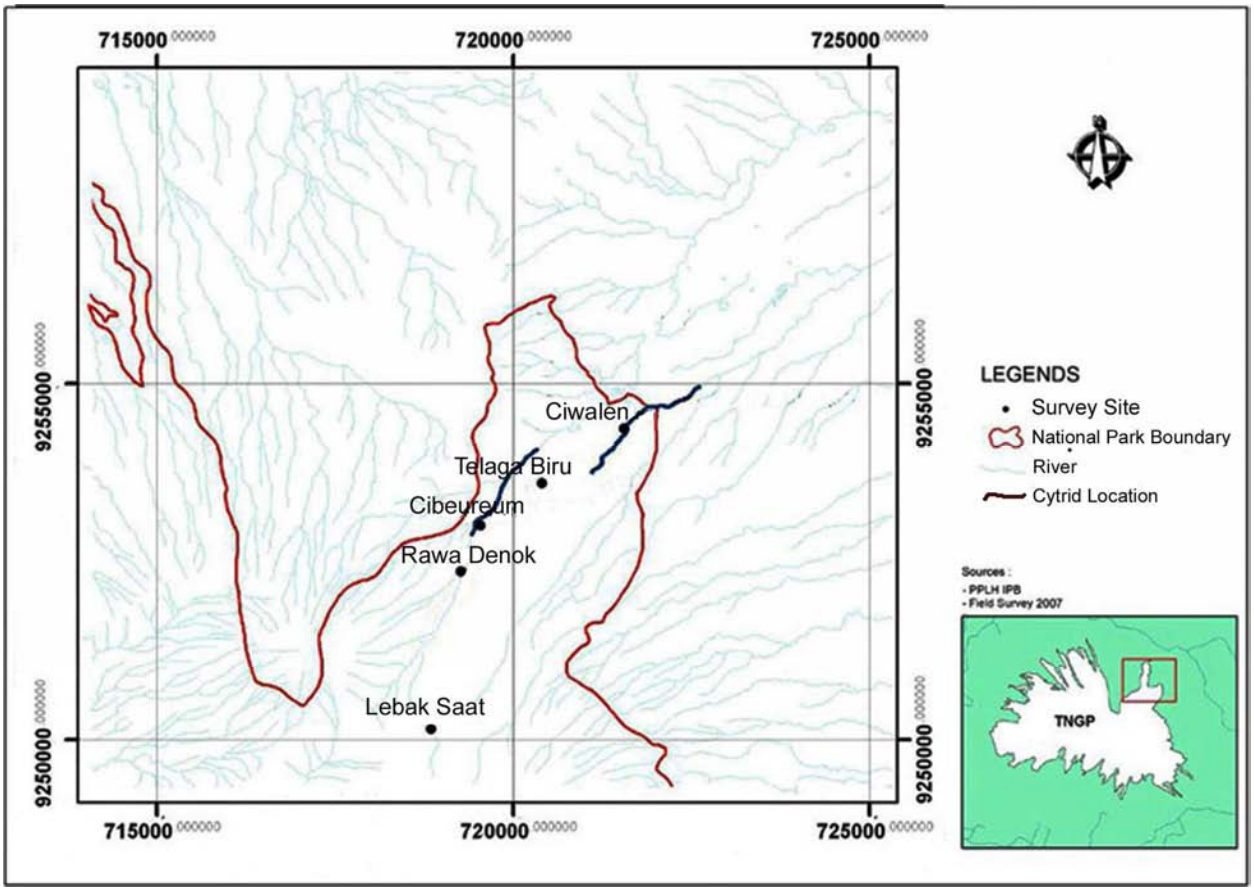
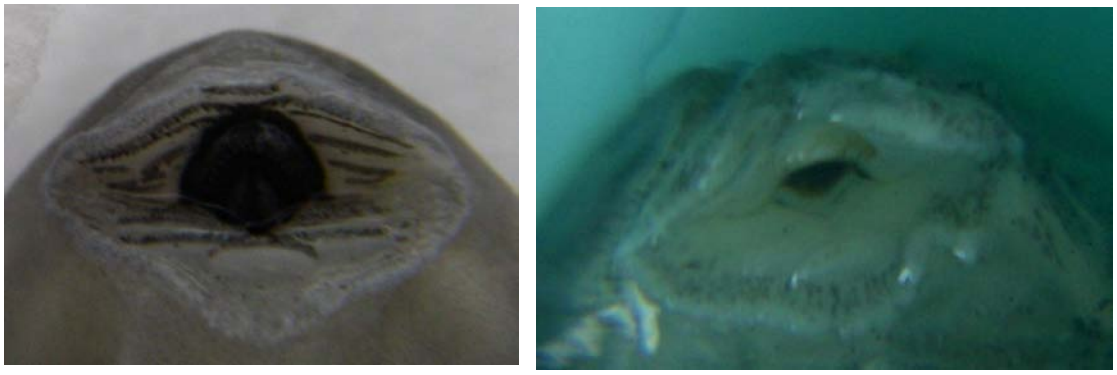


Fig.4-2. Sampling locations at Cibodas Trail, Mount Gede Pangrango National Park. Ciwalen: 06°44'40.64"S, 107°0'16.01"E; Telaga Biru: 06º44.909'S, 106º59.644'E; Cibeureum: 06º45.232'S, 106º59.177'E

Samples of *Rhacophorus javanus, Rana chaconota* and *Leptobrachium hasseltii* are clearly positive with Bd. *Rhacophorus javanus* is a treefrog species endemic to Java. This species was usually found 1-2 m above the ground, usually near streams, sitting and calling from leaves and branches. Although not a true treefrog, *Rana chalconota* was usually found sitting on branches or leaves near water. The specimens of Rana chalconota were captured while sitting quietly on leaves, around 20 cm above water. No frogs have shown evidence of abnormal posture or behavior, symptom typical of chytridiomycosis (Berger *et al*., 1999). *Leptobrachium hasseltii* is the only tadpole that upon examination showed distinct abnormalities in the mouthpart (Fig. 4-2). Adult *L. hasseltii* are terrestrial and usually found in abundance among leaf-litter. The tadpoles are quite large (SVL up to 73 mm) and could continue as tadpoles without metamorphosing for long time (Iskandar, 1998).

There are three positive amplifications for *Limnonectes microdiscus* but the level of infection is low. The result for *Leptophryne cruentata* with only one positive reaction is at a very low level, and therefore doubtful. Both results for *L. microdiscus* and *L. cruentata* is right at the limit of detection. However, because of this low level of infection there are several considerations to be taken before confirming this result as proof of chytrid infection, e.g. contamination during sample collection and pre-sampling contact with an infected frog.



Fig, 4-3. Left: A normal jaw of *L. hasselti* tadpole with keratinized mouthpart. Right: Specimen of *L hasseltii* tadpole taken from Ciwalen (Mount Gede Pangrango National Park) showing no keratinized mouthpart.

Three of the frog species infected with chytrid (*R. chalconota, L. hasseltii* and *L. microdiscus*) are distributed widely in Indonesia. Two others, *R. javanus* and *L. cruentata*, are endemic. There are no reports on the decline of population of any species except for *L. cruentata* (Kusrini *et al*. 2005). However, recent survey found higher numbers of *L. cruentata* in Mount Gede Pangrango National Park (see chapters 2 and 3).

Results confirm the presence of *Batrachochytrium dendrobatidis* in Indonesian frog species. We recommend that histological examination of *L. hasseltii* tadpole specimens are conducted. This result shows that distribution of *B. dendrobatidis* has finally reached Asia, a continent where data of Bd distribution was previously absent. There is a need to conduct further sampling for Bd especially in the mountainous area of West Java such as Mount Halimun and Mount Salak, as well as other parts of Indonesia. Sampling should not only be limited to skin swabbing but also toe clips or skin shedding for histological analysis.

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Chapter 5

AMPHIBIAN CONSERVATION EDUCATION, SEMINAR AND MEDIA EXPOSURE

M. D. Kusrini, N. Sholihat, W. Endarwin, M. Yazid, A. U. Ul-Hasanah and B. Darmawan

I. INTRODUCTION

For the last five years, our group has been developing an amphibian conservation awareness program to increase the understanding of frog conservation among the general public through conservation education and research. Amphibian conservation education was mostly projected to schoolchildren through school visits, on-site frog learning (frog camp) for older students and teacher training programs. With assistance from conservation funding institutions (Wildlife Trust, Rufford Foundation and more recently Whitley Fund of Nature), more than 1,000 schoolchildren from 40 schools in Bogor and Jakarta from grades 3 to 11 has been involved in this program.

In 2006 with funding from BP Conservation programme, we extended amphibian conservation awareness program to school around Mount Gede Pangrango National Park. Mount Gede Pangrango has a diverse amphibian community including the endangered Bleeding Toad *Leptophryne cruentata* and the caecilian *Ichthyophis javanus* (chapter 2). Six schools in the vicinity of the park were targeted. One way to increase the number of schoolchildren learning biodiversity conservation is through the teachers. Thus, for each school that participated in this program, we invited one to two teachers to participate in our teacher-training program to broaden their knowledge. Here we report the progress of the amphibian conservation awareness program.

II. CONSERVATION EDUCATION

A two-hour outreach program has been conducted on December 2006 to schoolchildren in grades 4 through 6 using slideshow programs that we developed. The slideshows showed the diversity of frogs in Indonesia, especially species found in Mount Gede Pangrango National Park, basic information of their habitat and life as well as conservation issues. After each outreach session, we opened up discussion and played games. We gave incentives such as books, t-shirts, pencils, pins, bookmarks with amphibian themes for children who participated in discussion and games. In each school, we gave a book on amphibian and our poster about the diversity of frogs for their library.

Table 5-1. Name of schools participating in conservation education program.

Schools	Number of children given presentation to	Grades
Cimacan 1	52	4 through 6
Cimacan 2	56	5 and 6
Cimacan 3	45	5 and 6
Cigombong 1	49	5
Cigombong 2	45	4 and 5
Cigombong 3	50	4 through 6

Fig. 5-1. Top right clockwise: Mirza D. Kusrini giving one of the teachers a frog souvenir for the school. M. Yazid presenting the life of frogs to the children. Team and schoolchildren from SD Cimacan 1 posing together after the presentation. Giving a poster as a gift for a student who participated in one of the games.

We developed and published leaflet of Mount Gede Pangrango anuran diversity in two languages (Bahasa Indonesia and English). They were distributed through the national park management, and the rest were distributed during our conservation education activities. We also developed amphibian bookmarks which portrayed notable species of Mount Gede Pangrango such as *L. cruentata, H. masonii, L. hasseltii* and *R. reiwardtii*. Figures 5-2 and 5-3 show the bookmarks and leaflet.

Fig. 5-2. Bookmarks portraying the anurans of Mount Gede Pangrango National Park.

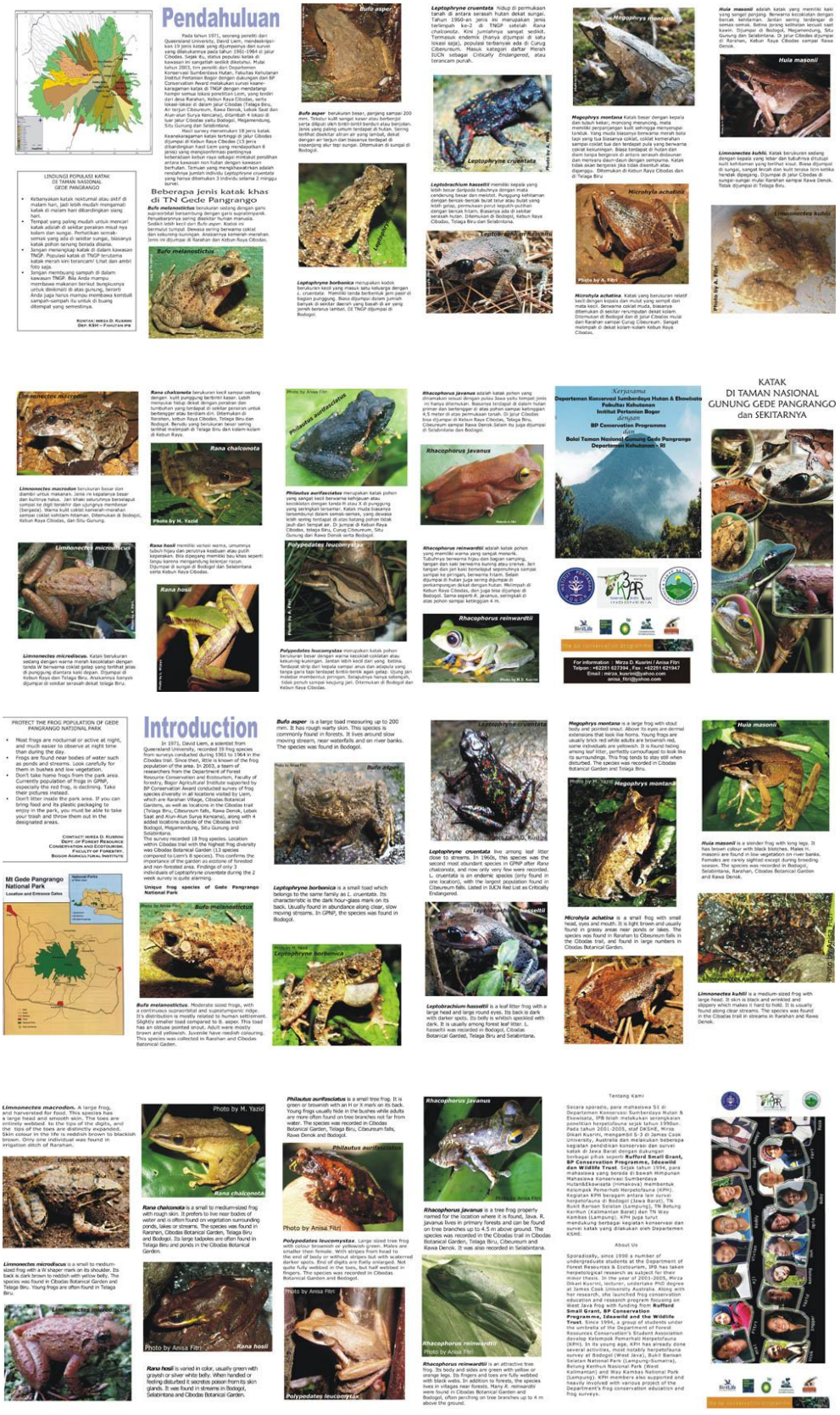

Fig. 5-3. Leaflet in two langunges illustrating the anurans of Mount Gede Pangrango National Park.

The teacher training program was conducted for three days and two nights (Friday, September 8, 2006 to Sunday, September 10, 2006) in Situ Gunung, one of our survey sites (Fig. 5-4). The program consisted of in-class instructional lectures and practical activities in an outdoor setting. The three-day training syllabus covered topics such as the global amphibian decline, biology of amphibians, amphibian conservation and how to implement frog conservation information into teaching (Table 5-2). The aim of this program was to enhance educators' knowledge and preparation in teaching and develop supplementary curricula with frogs as the main theme. Eighteen teachers from 17 schools (Table 5-3) participated in this training. Funding for teacher training from schools around Mount Gede Pangrango National Park was taken from BP project, while teachers from other schools participated in the training with funding from Rufford Booster Program. All teachers were able to attend this training free of charge, and we also supplemented a fraction of their transportation cost from their scool to the meeting point (IPB campus in Bogor).

Fig. 5-4. Top Left: Wempy Endarwin showing participants how to find frogs during nighttime frogging activity. Top Right: A teacher trying to identify a frog species using an identification guide. Below Right: Class lecture in the hall. Below Left: Group picture taken before leaving the training location.

Table 5-2. Three-day training syllabus

Day/Date	Activity	Location	Presenter	Time
Friday 8-Sep-2006	Registration Opening ceremony Break Lecture 1: Frog survey methods Lecture 2: Species identification Lunch break Depart to Situ gunung Arrival and break Practical: Frogging activities Sleep	IPB campus in Baranang Siang, Bogor Situ Gunung	 Anisa Fitri M. Yazid 	07:30 - 08:00 08:00 - 08:30 08:30 - 08:45 08:45 - 10:00 10:00 - 11:30 11:30 - 13:00 13:00 - 16:00 16:00 - 19:30 19:30 - 23:00 23:00
Saturday 9-Sep-06	Breakfast Lecture 3 : Bio-ecology of amphibian Lecture 4 : Declining Amphibian Population Break Lecture 4 : Preservation: what to do and not to do Lunch break Lecture 6 : Developing teaching program Surveying eggs and tadpoles Break Practical: example of teaching activity by measuring the length of frog jumps Developing program Sleep	Situ Gunung Lecture Hall 	 Mirza D. Kusrini Mirza D. Kusrini Wempy Endarwin Mirza D. Kusrini Mirza D. Kusrini teacher 	06:30 - 07:30 07:30 - 09:00 09:00 - 10:30 10:30 - 10:45 10:45 - 12:30 12:30 - 13:30 13:30 - 14:30 14:30 - 17:00 17:00 - 19:30 19:30 - 20:30 20:30 - finish
Sunday 10-Sep-06	Breakfast Developing program Program presentation by each group Closing ceremony Lunch break and preparation for departure Departure	Situ Gunung Lecture Hall 	 Teacher Teacher 	06:30 - 07:30 07:30 - 09:00 09:00 - 11:00 11:00 - 12:00 12:00 - 13:00 13:00

Table 5-3. Name of participants in teacher-training program conducted in September 2006. Note: [a] refers to teacher participating in the training with funding from BP project.

No.	Name	School
1.	Sutikna Tri Wardaya, S. Pd	SMAN 10 Bogor
2.	Noorlailah Sahlan, S. Pd	SMAN 1 Ciputat
3.	Ade Guntur	SDN Jayagiri[a]
4.	Engkus Kusmana, S. Pd	SMU Al-Azhar
5.	Dedy Rustandi, ST	SDN Rarahan[a]
6.	Sri Kasmiwati, S. Pd	SDN Cimacan I[a]
7.	Ahmad Jaenudin Gozali, S. Pd	SDN Babakan Darmaga 1
8.	Sii Fani Febriyani	SDN Babakan Darmaga 1
9.	Hj. Lilis Kustriani, S. Pd	SDN Gunung Gede
10.	Susi Kristanina, S. Pd	SMAN 29 Jakarta
11.	Lina Herlina, S . Pd	SDN Cimacan III[a]
12.	Euis Yuyun Komariah	SDN Cimacan II[a]
13.	Komariah	SDN Darmaga 3
14.	Tresa Gusia Afitasari, S. Pd	SMU BBS
15.	Wiwin Kholilah, S. P	SDN Insan Kamil
16.	Susiana	SDN Giri Mukti[a]
17.	Lilis Lisnawati, Amd. Pd.	SDN Insan Kamil
18.	Dra. Pantiyani	SMAN 34 Jakarta

III. SEMINAR

During the project, Mirza D. Kusrini presented results of this project in several national seminars (table 5-4). The seminars were mostly conducted in formal setting, however we also conducted informal session. Presentations focused on amphibian ecology and conservation, particularly related to species found in Mount Gede Pangrango National Park

On June 2006, Anisa Fitri, previous member of the project (2004/2005) had attended the Society of Conservation Biology (SCB) Annual International Meeting in San Jose, California, USA through invitation from BP Conservation Programme (Fig 5-5). Anisa participated in the poster session, bringing with her two posters titled Love *Thy Frogs: Increasing Awareness through Frog Conservation Education in Indonesia* which highlight this program and *The Status of Frogs in The Mount Gede Pangrango National Park, West Java, Indonesia* which depict the frog monitoring program in Mount Gede Pangrango.

Fig. 5-5. Anisa Fitri at the SCB meeting in 2006

On May 26 and 27, 2007, we conducted Indonesian Herpetology Seminar held in Bogor. Funding for this seminar was provided by Indonesian Reptile Amphibian Trader Association (IRATA), IUCN Amphibian Specialist Group as well as BP Conservation programme thorugh our Frogs of Gede Pangrango project. No less than 70 people from all over Indonesia attended this seminar. One of the seminar's resolutions was the development of the Indonesian Herpetological Society. Report of this seminar including abstracts of each presentation has been distributed to various stakeholders.

Table 5-4. List of seminars attended by Mirza D. Kusrini and title of presentation

Date	Name of Seminar	Title of presentation	Organising committe	Location
22 /11/ 2006	Seminar Sehari Herpetofauna dan mamalia Air	KONSERVASI AMFIBI DI INDONESIA: PERMASALAHAN GLOBAL DAN TANTANGAN (*Amphibian conservation in Indonesia: global problems and challenges)*	Departemen MSP – Faculty of Fisheries IPB	Darmaga Campus
30 /11/ 2006	Seminar informal TNGP	EKOLOGI DAN KONSERVASI KATAK DI TAMAN NASIONAL GUNUNG GEDE PANGRANGO (*Ecology and conservation of frogs of Gede Pangrango)*	Mt. Gede pangrango National Park	Cibodas
30 /01/ 2007	Seminar Serangga Nasional 2007	KATAK DAN SERANGGA: SIAPA MAKAN SIAPA? (*Frog and Insects: who eats whom?)*	Departemen Proteksi Tanaman IPB	Darmaga Campus
27/ 05/ 2007	Seminar Herpetologi Indonesia 2007	KEKAYAAN JENIS DAN STATUS POPULASI AMFIBI DI TAMAN NASIONAL GEDE PANGRANGO DAN TAMAN NASIONAL HALIMUN SALAK – JAWA BARAT (*Species richness and population status of amphibian in Mt. Gede Pangrango and Mt. Halimun Salak – West Java*)	BP Conservation Program, IRATA and CI and IUCN/Amphibian specialist group	Bogor
28 /06/ 2007	Seminar Sehari keanekaragaman hayati ditengah perubahan iklim: tantangan masa depan Indonesia	PERUBAHAN IKLIM TERHADAP KEHIDUPAN SATWA (*Climate change and wildlife*)	KEHATI	Kemang Hotel, Jakarta

IV. MEDIA EXPOSURE

TRANS-7: Asal-usul

Part of our research was aired in Trans-7, a national TV on March 20007. The interview with Mirza D. Kusrini was held at our lab in Faculty of Forestry, Bogor Agricultural University on January 23, 2007 and a segment of field work was shoot at Cilember, West Java on January 25.

Koran TEMPO

A two-page report of our project in Mount Gede Pangrango emphasizeing on *Leptophryne cruentata* was published in KORAN TEMPO, a national newspaper on Thursday, July 19, 2007 (p. A12-A13; Fig. 5-6).

Fig. 5-6. Clipping from Koran TEMPO

Chapter 6
TRAINING

M. D. Kusrini, N. Sholihat, W. Endarwin, M. Yazid, A. U. Ul-Hasanah, and J. Rowley

I. INTRODUCTION

A general observation showed that amphibian research is unpopular to Indonesian university students or researchers compared to other wildlife research such as birds and mammals. There are several reasons for this, such as (1) the fact that frogs are mostly active at night, the consequence that researchers must also be nocturnal; (2) identification books for Indonesian species are rare; (3) methodologies are relatively unknown; (4) not enough literature, what is available are in foreign languages; (5) authorities/researchers are not known or easy to contact, and (6) negative perceptions in which frogs are depicted as slimy and even sometimes dangerous and unfriendly.

To increase the number of Indonesian amphibian researcher, since 2002 we have conducted one- to five-day trainings on amphibian ecology and research methodology to various stakeholders such as NGOs, universities and national parks. Although this kind of training are available abroad, it not affordable to most Indonesian scientists. The main aspect of this program is the development of Indonesian herpetologist and to provide them the education to improve the conservation of Indonesian herpetofauna, especially amphibians.

In the context of this project, the focus of this activity was to provide clear guidance to participants enrolled in the training program. The training progressed as planned and facilitated communication and exchange in the fields of amphibian biology and ecology amongst students and researchers. Two types of training were conducted for this project: 1) five-day survey methods training, and 2) advanced training on radio-telemetry and frog call anaylsis.

II. AMPHIBIAN RESEARCH METHODOLOGY TRAINING

The training consisted of class lectures and four nighttime frog surveys on the field. Nineteen participants from five universities (Gadjah Mada University - Yogyakarta, University of Tirtayasa – Banten, University of Lampung – Sumatra, Muslim University of Syarif Hidayatullah – Jakarta, Biotrop – Institut Pertanian Bogor) and non-government and government employees attended the training in Bodogol, one of our research locations (see table 6-1 for list of participants).

Fig. 6-1. Top: Participants learning to conduct frog sampling using transect in the stream (left) and quadrats (right). Below: Participants and trainers posing together after night survey (left); participants (right)

This training introduced participants to the diversity, natural history, status, and conservation of Indonesian frogs. Participants learned basic identification, problems, threats to the diversity of Indonesian frog and conservation measures, as well as basic research methodology. During the training participants learned basic identification and applied methods taken mostly from Heyer *et al*. (Standard Methods for Amphibian Survey) such as transect methods, quadrats, timed-search and visual encounter survey. Practicals were conducted for four nights, in which each night each group used a different type of method to conduct frog survey. Participants also learned to make a simple species accumulation curve and see the difference between each method. Although Indonesian amphibian species differs among island, the training has provided the participants the know-how to develop frog research in their own location.

Table 6-1. List of participants attending the introductory training in Bodogol, 2007.

No.	Name	Address
1	Achmad Fanani Muharromi	Universitas Gadjah Mada
2	Haruhi Takahashi	Universitas Gadjah Mada
3	Jessica Dalila	Universitas Tirtayasa
4	Broto Raharjo	Biotrop
5	Guring Briegel Mandegani	Universitas Gadjah Mada
6	Chomsum Hadi Kurniawan	Universitas Gadjah Mada
7	Suhartono Amrullah	Universitas Islam Negeri Syarif Hidayatullah
8	Wahyu Tri Laksono	LIPI
10	Ariyanti Mariam Biarti	Universitas Gadjah Mada
11	Yogi Rizaldi	Universitas Lampung
12	Ayi Rustiadi	Gede Pangrango National Park Management
13	Iin Rajudin	Universitas Tirtayasa
14	Yan A. Zulfikar	Universitas Tirtayasa
15	Didi Supardi (Abo)	Volunteer Eagle - TNGP
16	Supian	Volunteer - TNGP
17	Ae Setiawan	Gede Pangrango National Park Management
18	Pepen	Gede Pangrango National Park Management
19	Arif Ma'mun	Volunteer Eagle - TNGP

Table 6-2. Time schedule for Introductory Training in Bodogol, March 15–19, 2007.

Activity	Place	Time	Presenter/organizer
Thursday, 15 March 2007			
Registration	Rafflesia Room	07:00 - 08:00	-
Opening		08:00 - 08:30	Dr. Rinekso Soekmadi
Depart to Bodogol		08:30 - 11:30	-
Arrive in Bodogol	PPKAB	11:30	-
Lunch break		11:30 - 13:00	-
Lecture 1: Survey method I		13:00 - 14:00	Anisa Fitri
Lecture 2: Frog identification techniques		14:00 - 16:00	M. Yazid & Wempy Endarwin
Break		16:00 - 16:30	

Introduction to field condition		16:30 - 17:30	Anisa Fitri
Break and dinner		17:30 - 19:30	
Grouping and equipment preparation		19:00 - 20:00	Uun
Frog survey		20:00 - 23:00	Group
Species identification & frog measurement		23:00 - 24:00	Uun
Sleep		24:00 -	Dian
Friday, 16 March 2007			
Breakfast	PPKAB	06:30 - 08:00	Neneng
Returning frog to point of capture		08:00 - 08:30	Uun
Lecture 3: Making specimen and preservation		09:00 - 09:45	Adininggar U. Ul-hasanah
Morning Break		09.45 – 10.00	
Practical 1: Preservation		10.00 – 11.00	Adininggar U. Ul-hasanah
Lunch break and Friday Prayer		11:00 - 14:00	
Lecture 4: Global Amphibian population decline		14:00 - 15:30	Mirza D. Kusrini
Lecture 5: Frog photography techniques		15:30 - 17:00	Anisa Fitri
Break and dinner		18:00 - 19:30	Dadi
Frog survey		20:00 - 23:00	Group
Species identification & frog measurement		23:00 - 24:00	Yazid
Sleep		24:00 -	
Saturday, 18 March 2007			
Breakfast	PPKAB	06:30 - 08:00	Feri
Returning frog to point of capture		08:00 - 09:00	Dadi
Lecture 6: Survey method II		09:00 - 10:15	Mirza D. Kusrini
Break		10:15 - 10:30	Dadi
Lecture 7: Biology and ecology of amphibian		10:30 - 12:00	Mirza Dikari Kusrini
Lunch break		12:00 - 13:30	Dadi
Lecture 8: Data analysis		13:30 - 16:00	Mirza Dikari Kusrini
Afternoon break		16:00 - 16:30	Feri
Equipment preparation		16:00 - 17:00	Uun
Break and dinner		17:00 - 19:30	Feri
Change of location		19:30 – 20:00	Uun
Frog survey		20:00 - 23:00	Group

Species identification & frog measurement		23:00 - 24:00	Uun
Sleep		24:00 -	
Sunday, 18 March 2007			
Breakfast	PPKAB	06:30 - 07:30	Feri
Returning frog to point of capture		07:30 - 08:30	Uun
Lecture 9: Caecilian		08.30 – 09.30	Amir Hamidy
Lecture 9: Frog diversity in Indonesia		09:30 - 12:00	Neneng
1. Java & Sulawesi			Anisa Fitri
2. Betung Kerihun National Park, kalimantan			M. Yazid
3. South Sumatera			Adininggar U. Ul-hasanah
Lunch break		12:00 - 13:30	Dian
Making report explanation		13:30 - 14:30	Anisa Fitri
Reporting I		14:30 - 16:00	Yazid
Equipment preparation		16:30 - 17:30	Dadi
Break and dinner		17:30 - 19:30	Feri
Change of location		19:30 – 20:00	Dadi
Frog survey		20:00 - 23:00	Dadi
Species identification & frog measurement		23:00 - 24:00.	Group
Sleep		24:00 -	Yazid
Monday, 19 March 2007			
Breakfast	PPKAB	07:00 - 08:30	Dian
Reporting		08:30 - 10:00	Yazid
Group presentation and discussion		10:00 - 12:00	Uun
Lunch break and preparation to depart		12:00 - 14:00	Dian
Departure			Dadi

III. ADVANCED TRAINING ON RADIO-TELEMETRY AND FROG CALL ANAYLSIS

This second training was conducted on May 2007, which also consisted of class lecture and practical. This is a more advanced training given in English (translated if needed) by our international collaborator from James Cook University (Australia). Twenty-five people participated in this training, half of which were students and lecturers from the Department of Forest Resources Conservation (DKSH), Faculty of Forestry IPB (Table 6-3). The training focused on the aspect of population surveying, using frog call and radio-tracking methods. Participants learned the basic of frog call and radio-tracking survey, how to set up

equipment, performing preliminary experiments in the laboratory, fieldwork and data analysing using special software (see time schedule on Table 6-4).

Table 6-3. Participants of advanced research techniques for amphibian biologist workshop.

No	Name	Organization
1	Mirza Dikari Kusrini	DKSHE, Faculty of forestry IPB
2	Yeni A. Mulyani	DKSHE, Faculty of forestry IPB
3	Amir Hamidy	LIPI
4	Rury Eprilurahman	Faculty of Biology, University of Gadjah Mada, Yogyakarta
5	Anhar Harahap	JICA
6	Anisa Fitri	DKSHE, Faculty of forestry IPB
7	Adininggar Ul-Hasanah	DKSHE, Faculty of forestry IPB
8	Wempy Endarwin	DKSHE, Faculty of forestry IPB
9	Neneng Sholihat	DKSHE, Faculty of forestry IPB
10	M. Yazid	DKSHE, Faculty of forestry IPB
11	Septiantina Dyah Riendriasari	DKSHE, Faculty of forestry IPB
12	Suwardiansyah	DKSHE, Faculty of forestry IPB
13	Boby Darmawan	DKSHE, Faculty of forestry IPB
14	M. Irfansyah Lubis	DKSHE, Faculty of forestry IPB
15	Feri Irawan	DKSHE, Faculty of forestry IPB
16	Rima L. Mikrimah	DKSHE, Faculty of forestry IPB
17	Bachtiar Santri Aji	JICA
18	Nuryani Widagti	Faculty of Biology, University of Indonesia
19	Umilaela	Faculty of Biology, Institut Teknologi Bandung
20	Dian Oktaviani	Faculty of Biology, University of Indonesia
21	Lanjar Wijanarti	DKSHE, Faculty of forestry IPB
22	Rahayu Oktaviani	DKSHE, Faculty of forestry IPB
23	Azhari Purbatrapsila	DKSHE, Faculty of forestry IPB
24	R. Yosi Zainal Muhammad	DKSHE, Faculty of forestry IPB
25	Najmi Firdaus	Faculty of Biology, University of Tirta Yasa, Banten

Figure 6-2. Top: Feri Irawan "lending" his voice for call analysis. Below: Jodi Rowley showing how to attach transmitter to a frog.

Figure 6-3. Top: Night frogging at the campus. Below: Jodi Rowley and the participants posing together.

Table 6-4. Advanced research techniques for amphibian biologist workshop shedule.

Day-1, Friday, 18th May 2007		
Time	Topic	Presenter
13.30-14.15	GENERAL INTRODUCATION & Non-telemetry tracking	Mirza D. Kusrini & Neneng Sholihat (in Bahasa Indonesia)
14.15-15.00	RADIO-TELEMETRY TECHNIQUES FOR FROGS (in English) - topics: transmitter mass and shape, internal or external transmitter, resolving confusing directional signals, error/bias introduced by radiotelemetry, possibility of radiotelemetry effect on amphibian behavior or physiology, safety concern and other	Jodi Rowley
15.00-15.45	Practical 1: attaching transmitter to frogs	
15.45-16.15	Break & Ashar shalat	
16.15-17.45	Practical 2: finding stationary frog model using telemetry (1/2 hour per group)	Jodi Rowley
19.30- finish	Practical 3: Recording frog calls in the field (night)	Jodi Rowley & MDK
Day-2, Saturday May 19th 2007		
8.00-8.45	WILDLIFE TELEMETRY	Anhar (in Indonesia)
8.45-10.45	Practical 3 continued: radio-tracking frogs (morning)	Jodi Rowley
10.45-11.00	Morning break	
11.00-11.45	CASE STUDY (Jodi's PhD using radio telemetry)	Jodi Rowley
11.45-12.45	Radio-telemetry data analysis	Jodi Rowley
12.45-13.45	Lunch & Dhuhur prayer	
13.45-14.30	Introduction to frog acoustic (theory): How they perceive and produce sound, the advantage of call, does female calls?, type of call (advertisement, aggressive, etc), call preference in mate selection, calling behavior, acoustic competition, etc	Jodi Rowley
14.30-15.15	Sound recording: introduction, definition of terms and theoretical concepts characteristic of the bioacoustics, selection and use of analog and digital recorders (cassettes, digital tape, walkman minidisk, Hi Minidisk), microphones, parabolas, recording techniques,	Jodi Rowley
15.15-15.45	Break & Ashar prayer	
15.45-16.30	Analyzing frog call (Part 1) • Describing frog call • Specialized software for digitalize and making sonograms	Jodi Rowley
16.30-18.00	Analyzing frog call (Part 2) • Elaboration and interpretation of the graphic representation of the sound (sonograms and spectrograms)	Jodi Rowley
19.30-finish	General discussions & Closing	MDK & Jodi Rowley

Chapter 7
CONCLUSIONS & RECOMMEDATIONS

M. D. Kusrini

The project had progressed as planned and in some cases surpassed expected results based from the original proposal. The field survey had produced more data on the diversity not only anurans of Mount Gede Pangrango but also other amphibian species. From this study, we can conclude that Mount Gede Pangrango National Park supports a diverse amphibian life, incuding endemic species. This project was able to report the occurrence of cryptic species such as the cecillian *Ichthyophis hypocyaneus* and collected preliminary data on the population and biology of a red-listed species, the Bleeding Toad *L. cruentata*. Study on disease (e.g chytridiomycosis) is not on the original proposal but developed after much discussion and encouragements from various experts. The finding of *Batrachochytrium dendobatridis* in Mount Gede Pangrango's frogs is alarming since most of the infected species (except for *R. chalconota*) are either endemic or forest-specialist. Although there is no definite evidence of amphibian population decline in Mount Gede Pangrango, further studies are needed to provide information on the effect of Bd to its host.

The frog conservation education had been running since 2002 with support not only from BP Conservation Programme but also from Rufford Foundation, The Wildlife Trust, and Whitley Foundation of Nature. So far 36 schools has participated in this program with more than 1,500 students given outreach and more than 30 teachers attending the teacher training. Although we could not measure direct impact of this program, we believe that this program has been successful in showing children the diversity of frogs in the region and opening their eyes on conservation issues related to frog survival, and hopefully will someday increase their interest on conservation especially related to frog conservation.

This project has become an important component in the development of conservation biology science for Indonesian students. Since 2000, a special section concerning amphibian and reptilian studies was inserted into various courses offered to undergraduate students of the Faculty of Forestry, such as in subject of wildlife research methodologies and wildlife ecology. The project has included several students as volunteers which in turns has increased their interest in amphibian research. There has been an increase of undergraduate students interested in amphibians, as shown by the number of students who selected frog research as their minor projects for their undergraduate thesis (Fig. 5). The student has also re-activated their herpetofauna groups and since 2004 has started doing expeditions during summer breaks to various national parks in Indonesia (Bukit Barisan Selatan NP in 2004, Betung Kerihun NP in 2005 and Way Kambas NP in 2006). In 2007 the students' herpetofauna group had even achieved a BP Conservation Award for their work on herpetofauna conservation in Sulawesi.

The award that we received from this project has enabled us to train other students/young scientist/amphibian enthusiats from other universities in amphibian research and provides means for promising young herpetologist to meet and exchange experience during our Indonesian Herpetologist Seminar in May 2007. We have seen some positive output from alumnus of the first training. For instance, Dwi Susanto from University of Indonesia did a research of frog diversity around his campus as his thesis objective. Kurniawan, lecturer from University of Brawijaya is now pursuing his Master's degree in amphibian biology in Japan, while Rury, a lecturer from Gadjah Mada University (Yogyakarta) is now

focusing on tadpole studies. We believe that the project acts as vehicle for promising Indonesian herpetologist to move forward as natural scientists and conservation biologists alongside other researchers from other countries.

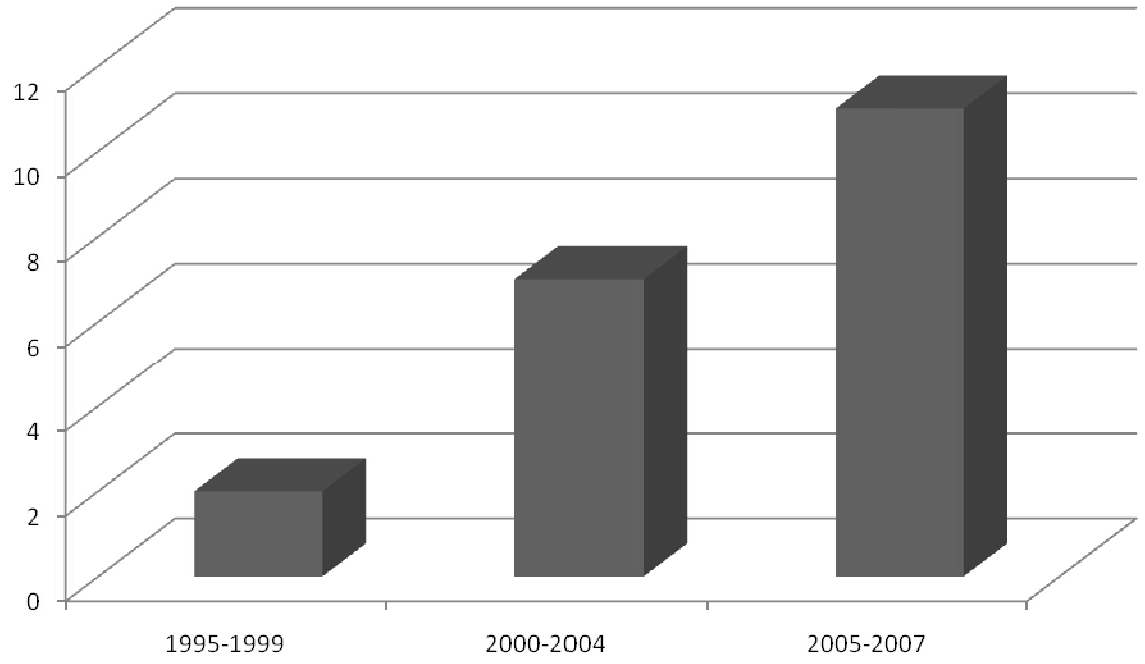

Fig. 7-1. Number of students of Department of Forest Resource Conservation & Ecotourism, Faculty of Forestry, Bogor Agricultural University who selected frog research for their Bsc or Master's research. Note: 2005-2007 data includes students who were still in final research stages and development of proposal.

On the basis of this study, we recommend the following actions regarding the conservation of amphibians of Mount Gede Pangrango National Park:

1. Population monitoring and survey should be conducted regularly. The project had provided basic survey data and therefore can be used for further monitoring. Monitoring multiple species would probably be expensive, thus monitoring could be focused on selected species. We recommend long-term monitoring at population level for forest specialist species such as *L. cruentata*, *H. masonii, R. javanus, P. aurifasciatus, L. kuhlii, L. microdiscus,* and *L. hasseltii.* Monitoring should be conducted at least every two years. Additional survey should also be conducted to assess the population of the caecilian *I. hypocyaenus.*
2. The preliminary result of *L. cruentata* study showed that this species chooses a specialized habitat. The finding of a group of this species in such habitat means that there is a need to ensure the quality of the habitat. Even though Mount Gede Pangrango is a protected area, the finding of this species in a recreation zone (Cibeureum) indicates that there is a need to modify the recreation zone to protect the species from human activities. Therefore, we highly recommend that the park management to restrict human activities around Cibeureum waterfalls and close all access to the third waterfall.
3. Since *L. cruentata* is highly endemic and had been assumed to undergo a population decline, more research needs to be conducted. It is well noted that many populations experience natural fluctuations caused by ecological interactions and climate condition, therefore a continued study is needed to assess the health of the population. Research should focus on the habitat characteristics and habitat

use, breeding ecology and behavior. Radio-tracking study would be valuable to gather data on habitat use and ecology. Although it might be expensive, data obtained would be invaluable and difficult to obtain in any other way. We also need to conduct survey on the historically occupied localities of *L. cruentata*. Those sites need to be revisited to determine presence or absence of the target species and to examine general trends in its distribution.

4. Our data showed that the anuran community in Mount Gede Pangrango has been exposed to Bd. Therefore, studies on chytrid dynamics, pathogen-host interactions and effects of chytrid on population persistence should be prioritized. There is also a need to conduct more assessment on the presence of Bd to other highland regions in Java. Park management should alert researchers if there is any evindence of large kills of anuran in their region.

To increase amphibian conservation and research effort, we recommend to:

1. Continue outreach program to schoolchildren and teacher-training program. There is also a need to develop and distribute more educational materials on frog conservation, and
2. Continue networking effort and training of local herpetologists. Activities include developing materials to aid people working on frog research and conducting informal/formal meetings between herpetologists to share news of their activities.

Distribution list

Jodi L. Rowley
Conservation International – Cambodia

Ross A. Alford
James Cook University – Australia

Lee Skerratt
James Cook University – Australia

Simon N. Stuart
Conservation International

Jeanne McKay
IUNC – Amphibian Specialist Group

Noviar Andayani
Wildlife Conservation Society – Indonesia program

Jatna Supriatna
Conservation International – Indonesia program

Lidia Ahmad
BP Indonesia

Rinekso Soekmadi
Fakultas Kehutanan – Institut Pertanian Bogor (Indonesia)

Damayanti Buchori
Yayasan Kehati – Indonesia

Shinta Puspitasari
Yayasan Peduli Konservasi Alam – Indonesia

Ani Mardiastuti
Traffic – Indonesia

Tonny Soehartono
Direktorat Jenderal PHKA

Amir Hamidy
Museum Zoologicum Bogoriense

Mumpuni
Museum Zoologicum Bogoriense

Hellen Kurniati
Museum Zoologicum Bogoriense

Djoko T. Iskandar
FMIPA - Institut Teknologi Bandung

Stephen Richards
South Australia Museum - Australia

Robyn Dalzen
BP Conservation Programme – USA

Marianne Carter
BP Conservation Programme - England

List of useful websites

Conservation leadership Programme
http://conservation.bp.com/

Global Amphibian Assessment
http://www.globalamphibians.org/

IUCN Amphibian Specialist Group
http://www.amphibians.org/

James Cook University Amphibian Disease Homepage
www.jcu.edu.au/school/phtm/PHTM/frogs/ampdis.htm

ABOUT THE TEAM

MIRZA DIKARI KUSRINI, Ph.D (James Cook University), MSi (IPB), Ir. (IPB); 42 yrs. Herpetologist, currently lecturer at Bogor Agricultural University (Faculty of Forestry). Mirza got her PhD from James Cook University on 2006 on her research on the sustainability of frog leg trade of Indonesia. Her work on frog research and conservation education is supported by several organizations such as the Indonesian Reptiles and Amphibian Trader Association, BP Conservation Award, Ideawild, Rufford Foundation, Wildlife Trust, and Whitley Fund of Nature. Her most memorable experience during the project is when she and her team got caught up in the middle of storm in Cibeureum.

WEMPY ENDARWIN, SHut. (IPB) 24 yrs. The "General Manager" of this project, Wempy graduated from IPB as bachelor of forestry in 2005 with his thesis on reptile diversity in the Bukit Barisan National park in South Sumatra. He is actively involved in herpetofauna research project, such as herpetofauna survey in Bukit Barisan National Park in South Sumatra (2003), frog survey in Mount Gede Pangrango National Park and Mount Salak, West Java (2004-2006), *Chelodina mccordi* survey in Roti Island *(2004).* This year, Wempy is also involved with other BP funded project in Bantimurung Bulusaraung National Park, Sulawesi.

MUHAMMAD YAZID, SHut (IPB), 23 yrs. Yazid graduated from IPB as bachelor of forestry in 2005 with his project on the breeding behavior of the green treefrog *Rhacophorus reinwardtii.* Yazid was the president of the Herpetofauna Interest Group, a part of Forestry Students Association in 2004/2005. He is actively involved in herpetofauna research project, such as herpetofauna survey in Bukit Barisan National Park in South Sumatra (2003), frog survey in Mount Gede Pangrango National Park and Mount Salak, West Java (2004-2006), herpetofauna survey in Betung Kerihun National Park in West Kalimantan (2005) and herpetofauna survey in Bantimurung Bulusaraung National Park (2007). This year, Yazid received amphibian seed grant from IUCN/amphibian specialist group for his work analyzing the habitat of *Leptophryne cruentata* in Mount Gede Pangrango.

NENENG SHOLIHAT,SHut (IPB), 23 yrs. As the treasurer and administrator of this project, Neneng handled all the financial and administrative work of this project including contacting schools, administering workshops, etc. She recently graduated from IPB as bachelor of forestry this September with her project on the movement of the Brown Treefrog *Polypedates leucomystax*. She is actively involved in herpetofauna research project, such as herpetofauna survey in Bukit Barisan National Park in South Sumatra (2003), frog survey in Mount Gede Pangrango National Park and Mt. Salak, West Java (2004-2006), herpetofauna survey in Betung Kerihun National Park in West Kalimantan (2005) .

ADININGGAR ULFA UL-HASANAH, 25 yrs, SHut (IPB). Inggar graduated from IPB as bachelor of forestry in 2005 with her project on amphibian diversity in Bukit Barisan National Park in South Sumatra. Well-known for her ability to sit and wait while listening for frog calls (no matter there were lots of leeches around), Inggar was also actively involved in our herpetofauna research project. In 2006 Inggar received an award from Earthwatch to participate on a two-week field study with Michael Mahony's amphibian project (University of Newcastle) in Australia. This year, Inggar is also involved with other BP funded project in Bantimurung Bulusaraung National Park, Sulawesi.

BOBY DARMAWAN, 22 yrs, currently a student at the Faculty of Forestry IPB. A very skillful driver, he is also actively involved in our herpetofauna research project. The most memorable experience of this year's survey was when the car that he drove flipped over on the way down from the Bodogol Research Station. Luckily, he was alright and quickly survived the shock of this ordeal and managed to bring the team back and forth to other locations. This year, Boby received amphibian seed grant from IUCN/amphibian specialist group for his work on the amphibian diversity in Jambi, Sumatra (part of his project to obtain the degree of Bachelor of forestry).