LIMNOTEK
Perairan Darat Tropis di Indonesia
Limnotek.or.id

LIMNOTEK (2012) 19 (2) : 113 – 125

ECOLOGICAL ASSESSMENT OF LIMAU MANIS'S TORRENT FROGS, WEST SUMATRA

Hellen Kurniati

Pusat Penelitian Biologi-LIPI

e-mail: hkurniati@yahoo.com

Diterima redaksi : 10 Mei 2012, disetujui redaksi : 10 Oktober 2012

ABSTRAK

Suatu tinjauan ekologi katak-katak arus deras Sumatera dilakukan dari pertengahan Desember 2011 sampai pertengahan Januari 2012 di hutan hujan Manis Limau. Modifikasi metode transek digunakan untuk menentukan mikrohabitat yang disukai jenis-jenis katak di sepanjang aliran air Sungai Manis Limau yang deras. Sebanyak 15 jenis katak yang tercatat selama 15 hari sensus di dua baris transek (panjang total transek 600 meter) di sepanjang sungai, yang terdiri dari lima suku katak, yaitu Megophryidae, Microhylidae, Bufonidae, Dicroglossidae dan Ranidae. Di antara 15 jenis katak, sembilan jenis selalu hadir di dalam daerah transek, yaitu Phrynoidis aspera, Limnonectes blythii, L. kuhlii, Huia sumatrana, Hylarana chalconota, Odorrana hosii, H. parvaccola, H. picturata *dan* H. rufipes. *Berdasarkan hasil analisis regresi linier, jumlah individu katak sangat dipengaruhi oleh suhu air dan cenderung dipengaruhi oleh suhu udara. Jumlah jenis cenderung dipengaruhi oleh suhu air, namun sinar rembulan selama waktu sensus tidak berdampak pada jumlah jenis dan jumlah individu. Jumlah individu dari empat jenis, yaitu* H. rufipes, O. hosii, H. sumatrana *dan* P. aspera *yang hadir di sepanjang daerah transek secara nyata dipengaruhi oleh suhu air, namun kehadiran jenis* H. picturata *dan* O. hosii *sangat tergantung pada suhu air.*

Kata kunci: Ekologi, Sumatra, Limau Manis, katak perairan deras.

ABSTRACT

An ecological assessment of sumatran torrent frogs was conducted from mid December 2011-mid January 2012 in Limau Manis rain forest. A Modification of the transect method was used to determine the preferred microhabitat of frog species along the Limau Manis strong water stream. A total of 15 species of frogs were recorded during 15 days censuses at the two transect lines (total transect length was 600 meters) along the stream, which consisted of five frog families, including Megophryidae, Microhylidae, Bufonidae, Dicroglossidae and Ranidae. Among 15 frog species, nine species were always present at the transect area, including Phrynoidis aspera, Limnonectes blythii, L. kuhlii, Huia sumatrana, Hylarana chalconota, Odorrana hosii, H. parvaccola, H. picturata *and* H. rufipes. *Based on linear regression analyses, the number of individuals was significantly influenced by water temperature and tended to be influenced by air temperature. The number of species tended to be influenced by water temperature. The number of individuals of four species,* H. rufipes, O. hosii, H. sumatrana *and* P. aspera *that were present along the transect lines were significantly influenced by water temperature.*

Key words: Ecology, Sumatra, Limau Manis, torrent frogs.

INTRODUCTION

Habitat loss and fragmentation are among the most important threats to frog diversity in tropical rain forest areas, including the rain forest in Sumatra; dessication of microhabitats within natural forests or wetlands, as well as alterations of the flow of natural water courses, followed by the development of agriculture areas have drastic negative impacts on frog diversity in Kerinci Seblat National Park (Kurniati 2010). Two sites were selected to conduct an ecological assessment of Sumatran torrent frogs, Gunung Tujuh rain forest in Jambi Province and Limau Manis rain forest in West Sumatra Province; however, the frogs' habitat at Gunung Tujuh survey site was changed drastically; due to the increasing area of agriculture in this site, some frogs species were no longer found along the fast moving streams that were surveyed in 2005 (Kurniati 2008), they were *Huia sumatrana, Rhacophorus achantharrhena, Rh. angulirostris, Rh. bifasciatus, Rh. catamitus* and *Rh. poecilonotus*. Based on this observation, the rain forest habitat in Gunung Tujuh area had become less suitable for the life of frog communities over the last ten years, because agricultural land in June 2011 looked to be more extensive compared to agricultural land in 2005. The Limau Manis rain forest was chosen for ecological assessment of Sumatran torrent frogs because these forests have always been monitored by the management of Andalas University as a wildlife research site (Figure 1).

Adaptation of frog in the fast-flowing waters or torrent water is generally accompanied by the morphology of the frog itself. Usually the toes webbing are full up to the fingertips and the toe or hands usually widens to form a disc; this forms make the feet and hands can hold stony substrate. Additionally, body shape of torrent frogs are usually slim and have longer legs than a living terrestrial frog's legs, or some species have strong and muscular legs, because it should be able to withstand foot frog's body on any substrates.

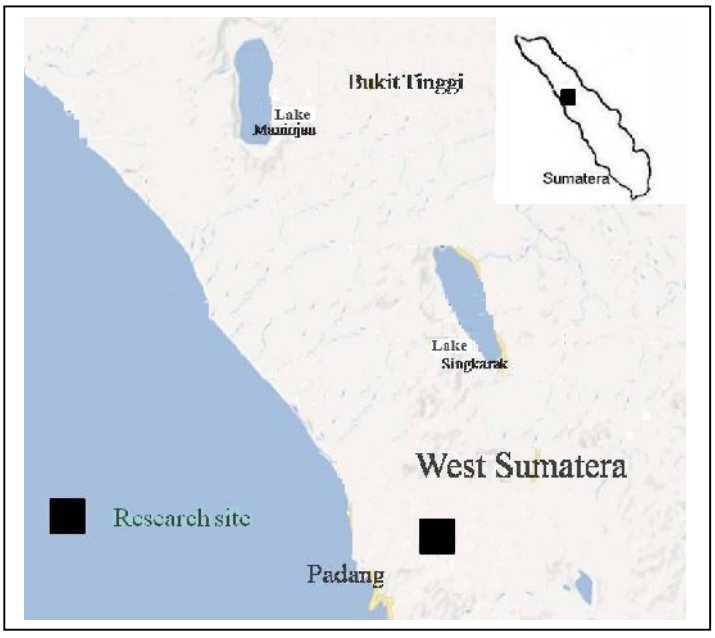


Figure 1. Limau Manis site that was surveyed for ecological assessment of sumatran torrent frogs in West Sumatra Province.

METHODOLOGY

Ecological assessment on sumatran torrent frogs was conducted in mid December 2011-mid January 2012 at Limau Manis rain forest. An ecological assessment was carried out inside Limau Manis rain forest, where a strong water stream was selected for this assessment. The strong water stream was located at coordinates S $00^0$54'43.8"; E $100^0$28'00.7"; elevation: 280 m above sea level (asl).

Limau Manis River is a gravel, shallow and fast water stream. High and low vegetation along the stream is quite dense. The width of the stream, where the transect line was set, was about five to 10 meters and depth of water was between 30-50 cm. The slope of stream bank was between 20-90 degrees.

A modification of the transect method (Jaeger, 1994) was used to determine the preferred microhabitat of frog species along the stream at Limau Manis rain forest. The transect method was carried out as follows:

a. Three hundred meters long of rope was numbered as many as 31 to indicate a distance of 10 meters of the length of each sub-transect. The beginning of the number in the first 10 meters is 1.
b. Rope was laid on one side of the stream by following the shape the stream. Rope was laid in the late afternoon so that the presence of amphibians in their microhabitat along the stream was back to normal condition at the time of the census in the evening.
c. The census was conducted by walking slowly along the stream edges (left and right), mid stream and 10 meters of forest floor outside the stream (left and right); the census was carried out between the hours of 20:00 to 24:00 p.m. at night. Head lamps with strong light were used to shine frog's eye; the strong light made the frog got temporarily blind and it would not jump, so the frog was easy to identify.
d. All of frogs that were found at first position such as distance from stream edge, height from the water or ground were recorded. Environmental data of air temperature and water temperature were recorded at each sub-transect (range 10 meters) to complete the environmental data that are likely to affect the presence of frogs in their microhabitat. The equipment that used to measure air temperature and water temperature was a digital thermometer, SATO brand model SK-2000 MC (accuracy of one digit behind the comma). All data were recorded on a data sheet (see Appendix 1).
e. Two transects lines were set at the stream; each transect was visited five times but not on consecutive nights.

Data analysis:

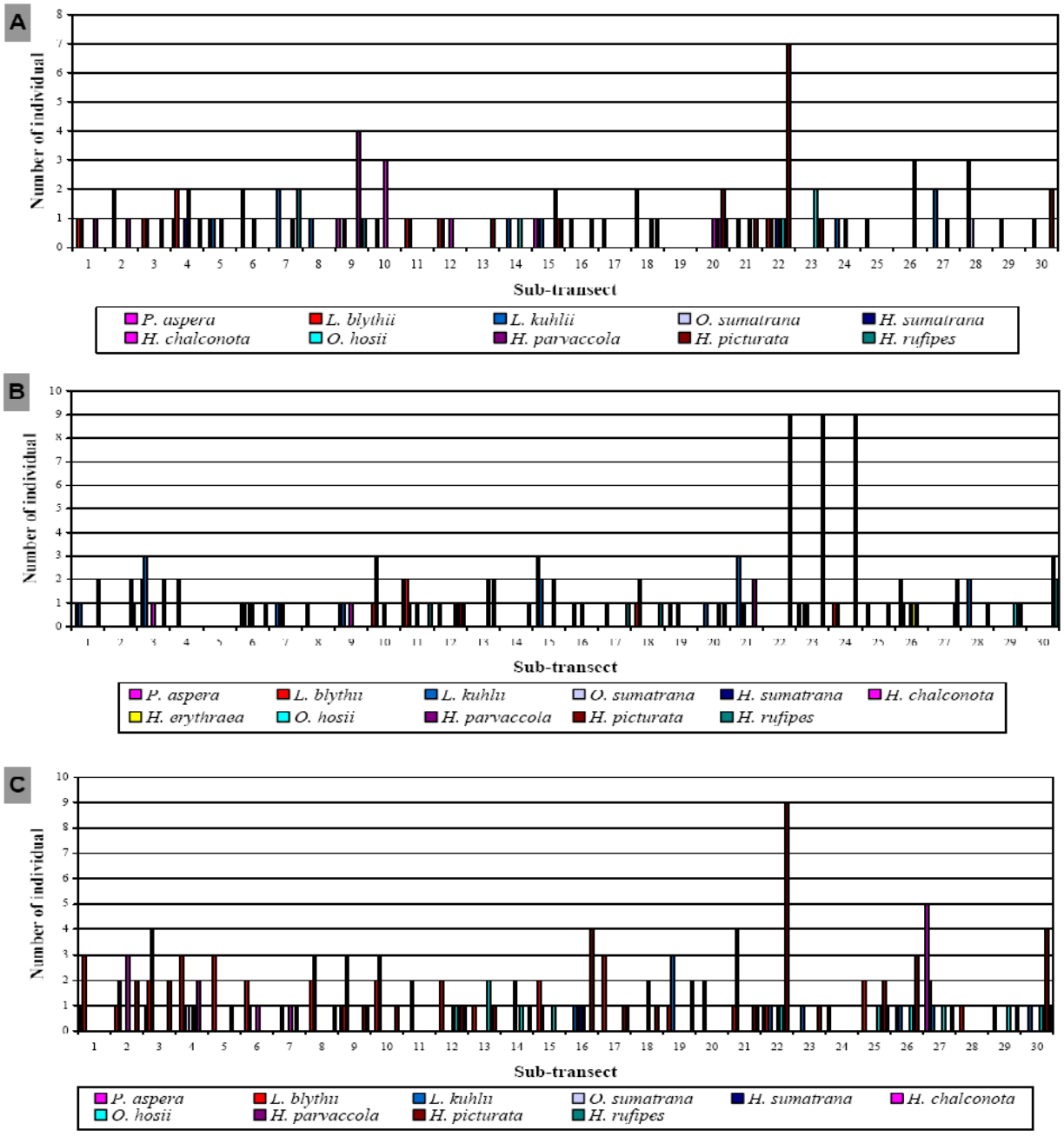
All data obtained were tested with the statistical program SPSS version 16.0. Regression linear analysis was used to test the effect of the dynamics of environmental parameters (air temperature, water temperature and percentage of moon shine) to the number of species and individuals; linear regression analysis was used to test the association of the presence of one species to another species in the two transects. The results of the analysis was significantly different at the 95% confidence level ($p \leq 0.05$).

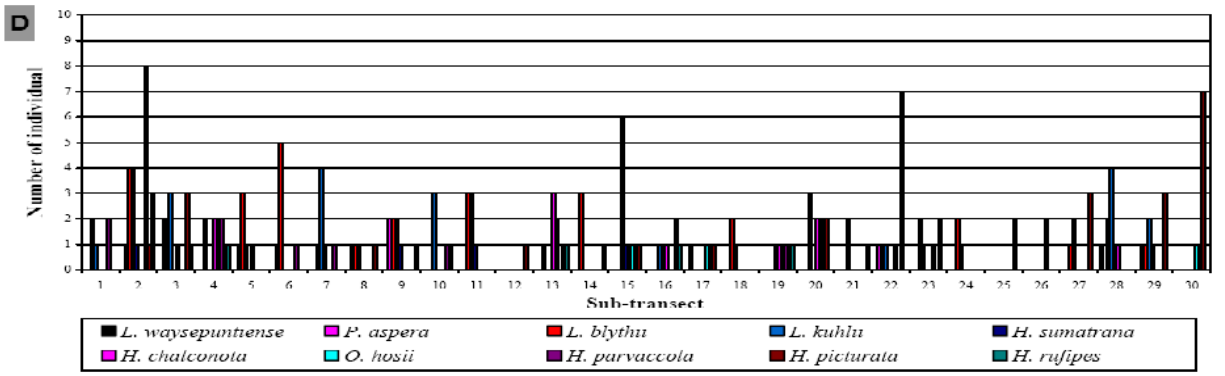
RESULTS AND DISCUSSION

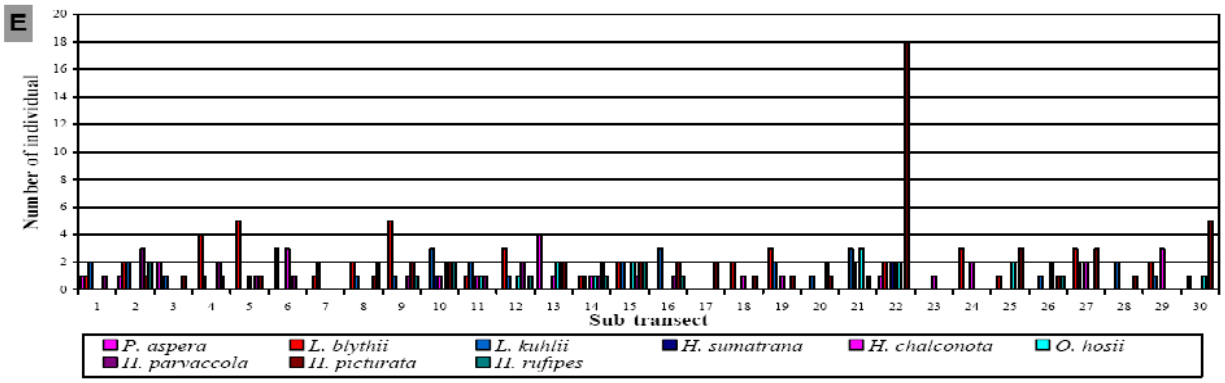
A. Transect lines (frogs' diversity and environment factors)

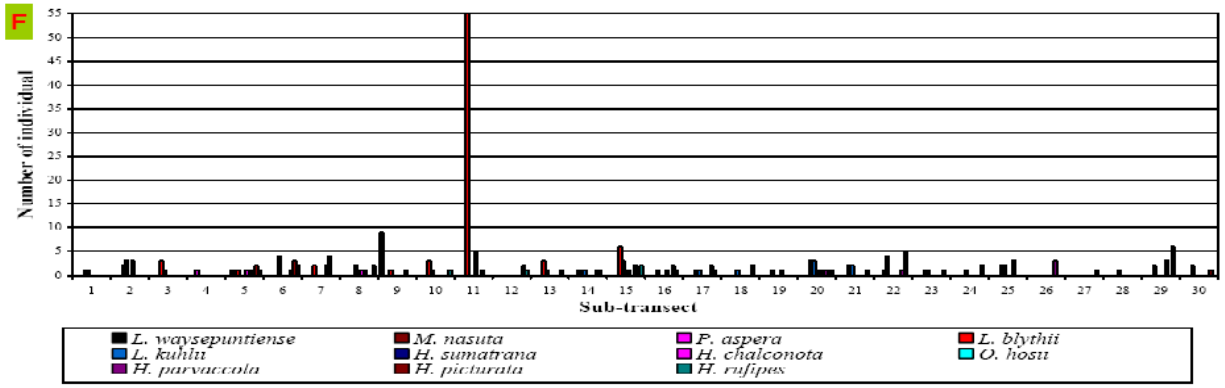
A total of 15 species of frog were recorded during 15 days censuses at the two transects lines (total transect length was 600 meter) in Limau Manis forest stream, which consisted of five frog families, included Megophryidae, Microhylidae, Bufonidae, Dicroglossidae and Ranidae. Megophryidae consisted of two species (*Leptobrachium waysepuntiense* and *Megophrys nasuta*); Microhylidae consisted of only one species (*Phrynella pulchra*); Bufonidae consisted of

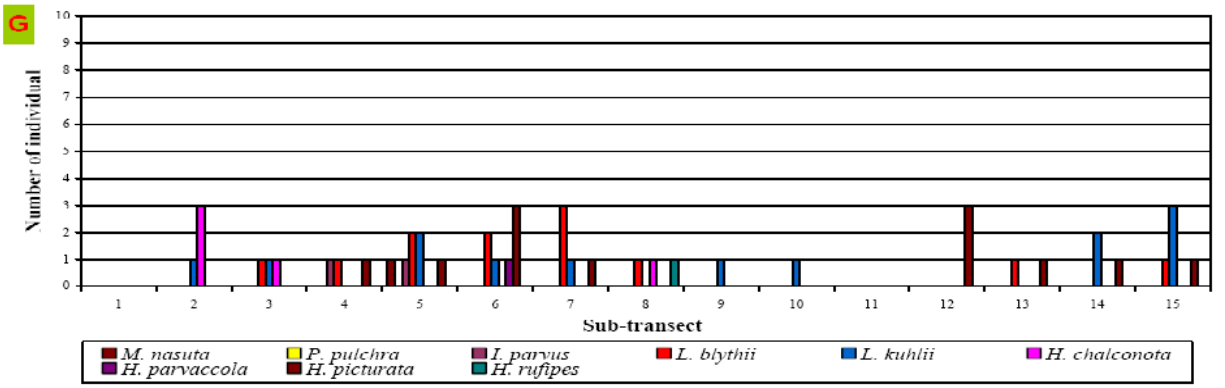
two species (*Phrynoidis aspera* and *Ingerophrynus parvus*); Dicroglossidae consisted of three species (*Limnonectes blythii*, *L. kuhlii* and *Occidozyga sumatrana*) and Ranidae consisted of seven species (*Huia sumatrana, Hylarana chalconota, H. erythraea, Odorrana hosii, H. parvaccola, H. picturata* and *H. rufipes*). Among 15 frog species, nine species always presented at the strong water stream of the transects area, included *P. asper, L. blythii, L. kuhlii, H. sumatrana, H. chalconota, O. hosii, H. parvaccola, H. picturata* and *H. rufipes*; however among these species, only *L. blythii* has near threatened status under IUCN category with decreasing population trend (Van Dijk & Iskandar 2004). Six species (*L. waysepuntiense, M. nasuta, P. pulchra, I. parvus, O. sumatrana* and *H. erythraea*) were incidentally present along the transects. Presence of all frogs species found at two line transects in the strong water stream are shown in Figure 2.




D
Number of individual
Sub-transect
L. waysepuntiense
P. aspera
L. blythii
L. kuhlii
H. sumatrana
H. chalconota
O. hosii
H. parvaccola
H. picturata
H. rufipes


E
Number of individual
Sub transect
P. aspera
L. blythii
L. kuhlii
H. sumatrana
H. chalconota
O. hosii
H. parvaccola
H. picturata
H. rufipes


F
Number of individual
Sub-transect
L. waysepuntiense
M. nasuta
P. aspera
L. blythii
L. kuhlii
H. sumatrana
H. chalconota
O. hosii
H. parvaccola
H. picturata
H. rufipes


G
Number of individual
Sub-transect
M. nasuta
P. pulchra
I. parvus
L. blythii
L. kuhlii
H. chalconota
H. parvaccola
H. picturata
H. rufipes

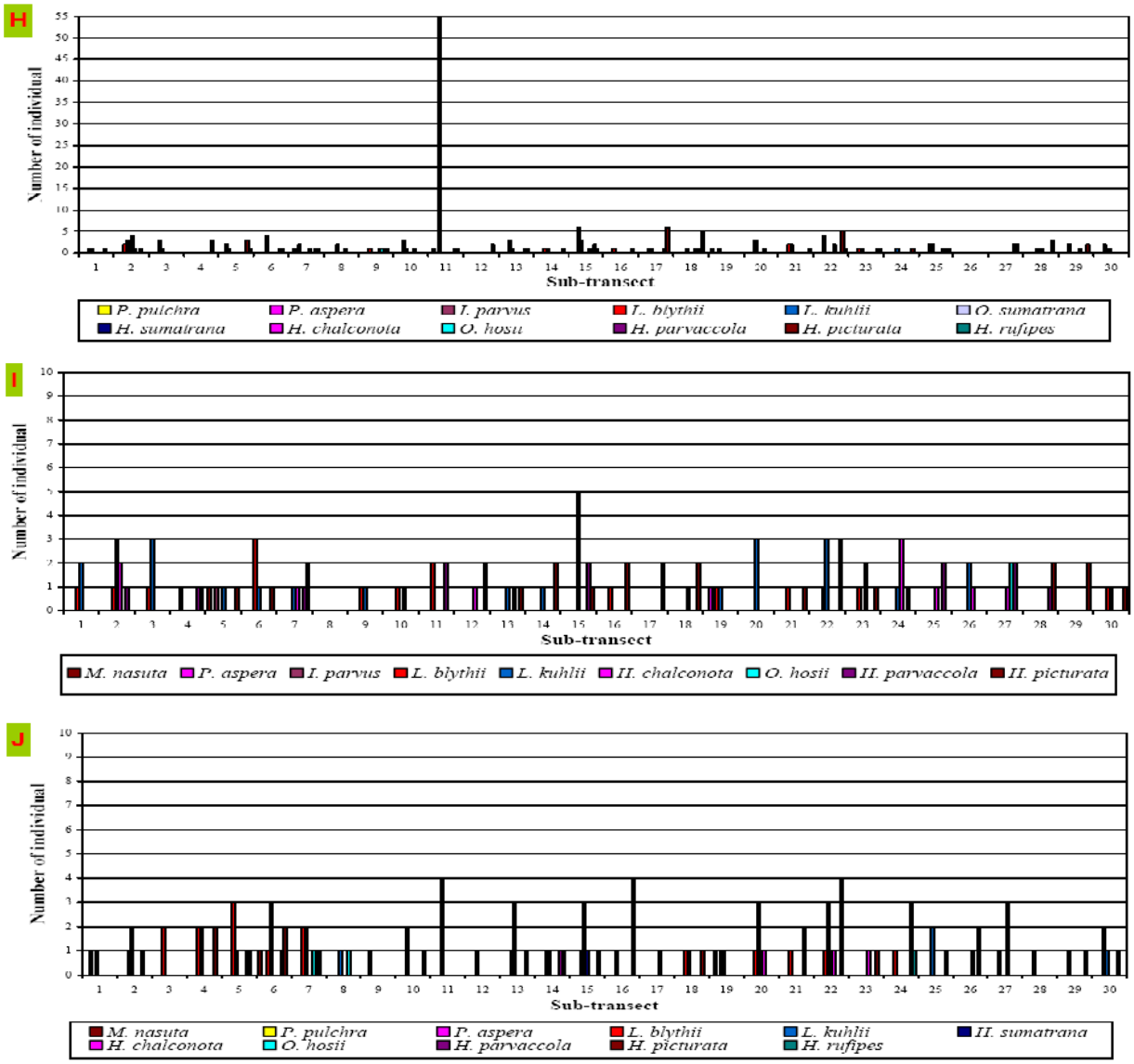


Figure 2. Presence of frogs found at two transects line. First transect (A, B, C, D, E) and second transect (F, G, H, I, J).

The number of frog species, which came to the transect location varied between 9-12 species as shown at Figure 2 (A-J). Transect length of second transect at second repetition (Figure 2-G) was 150 meter, because of heavy rain in the mid of census time. Dynamics of the species and individuals numbers with environmental factors along the two transects with five repetitions censuses are shown at Figure 3.

Based on linear regression analyses, number of individuals was significantly influenced by water temperature (R=0.15; P=0.014) and tended to be influenced by air temperature (R=0.11; P=0.06); species number tended to be influenced by water temperature (R=0.12; P=0.05); however moon shine during the census time had no impact on the number of the species and individuals number (see Table 1). This indicates that water temperature is a determining factor on the presence of individual frogs in this stream: an increase of water temperature caused a decrease on the number of frog individuals in this streamand there is a tendency of a positive relationship with air temperature.

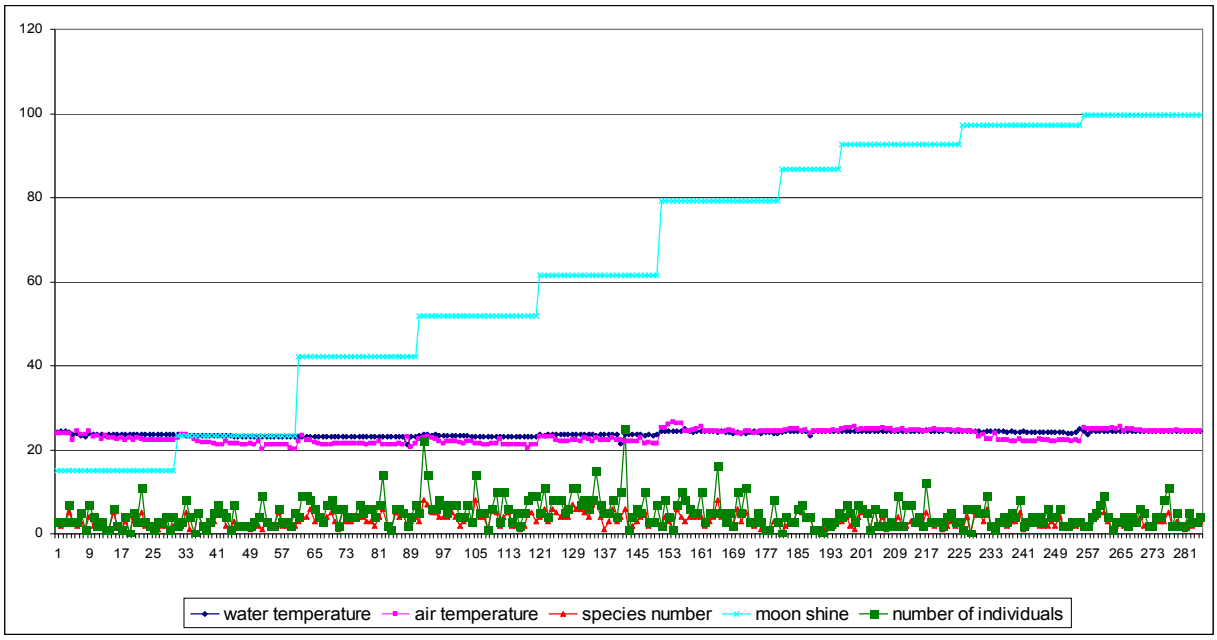


Figure 3. Dynamics graphs of species and individual number with three environmental factors along the two transects with five repetitions censuses. Y axis shows the number of species, number of individuals, the temperature and the percentage of the moon shine during the census times.

Table 1. Results of linear regression to determine the relationship of number of species and number of individuals in each sub-transect with environment factors. (**) Strong significant level at P<0.05; (*) There tends to associate. R: Pearson correlation.

Environment factors	Number of frog species	Number of individuals
Water temperature -Average: 23.8^{0}C -SD: 0.5^{0}C -Max: 25.1^{0}C -Min: 21.3^{0}C	R=0.12 P=0.05*	R=0.15 P=0.014**
Air temperature -Average: 23.1^{0}C -SD: 1.5^{0}C -Max: 26.5^{0}C -Min: 20.1^{0}C	R=0.08 P=0.16	R=0.11 P=0.06*
Moon shine 15.0%-99.5%	R=0.01 P=0.89	R=0.01 P=0.89

Water temperature also has positive impact on the dynamic of the number of species along the transects, increasing water temperature caused a decrease on species number. Table 2 showed that the number of individuals of four species (*H. rufipes, O. hosii, H. sumatrana* and *P. aspera*) that presented along the two transects were significantly influenced by water temperature, an increase in water temperature caused a reduction in the number of individuals of these species; and presence of individual *H. parvaccola* tended to be influenced by water temperature. There are two species (*H. picturata* and *O. hosii*) which are strongly dependent on air

temperature along the transects, an increase in air temperature caused reduction of their individual numbers; however presence of *H. parvaccola* and *H. rufipes* have tendency to depend on air temperature, increasing of air temperature caused reduction of their individual numbers.

Moonshine has no impact to the number of species and number of individual (see Table 1); however in more detail analysis (among nine species that always presented in the transects) (Table 2) showed that number of individual of *H. rufipes* and *O. hosii* were strongly influenced by moon shine; increasing of moon shine caused reduction of their individual numbers. Thethree environmental factors (water and air temperature and moon shine) have a significant influence on the presence of *O. hosii* and *H. rufipes*.

There are nine species of frogs, which are always present or almost always present on the transect lines, they are *L. blythii, L. kuhlii, H. picturata, H. parvaccola, H. chalconota, H. rufipes, O. hosii, H. sumatrana* and *P. aspear*. Based on linear regression analysis on the presence of nine species, there were some positive associations with each other (see Table 3). There were very strong positive associations between *H. rufipes* and *H. parvaccola* (R=0.27; P=0.000); between *H. sumatrana* and *H. picturata* (R=0.14; P=0.02) and between *O. hosii* and *H. picturata* (R=0.19; P=0.001); however associations between *P. aspera* and *L. kuhlii*, between *P. aspera* and *H. picturata* and between *H. sumatrana* and *H. parvaccola* tended to have positive associations with R=0.10 and P=0.09; and also between *P. aspera* and *H. rufipes* (R=0.12; P=0.05), between *O. hosii* and *H. sumatrana* (R=0.11; P=0.07). Strong positive associations occurred between individual *H. masonii* with *O. hosii* in a fast-moving stream at the foot hill of Mount Salak of West Java (Kurniati & Sumadijaya 2012).

Among the nine frogs species which were always present on the transect lines, *L. blythii, L. kuhlii* and *H. chalconota* were not affected by the dynamics of environment factors (water and air temperature and moon shine) (see Table 2); these three species also were not affected by the presence of other

Table 2. Results of linear regression to determine the relationship of individual number in each sub-transect and environment factors (water and air temperatures and moon shine) of nine frogs species which were always present at the transects. (**) Strong significant level at P<0.05; (*) There tends to associate. R: Pearson correlation.

Environment factors	*L. blythii*	*L. kuhlii*	*H. picturata*	*H. parvaccola*	*H. chalconota*	*H. rufipes*	*H. sumatrana*	*O. hosii*	*P. aspera*
Water temperature -Average: 23.8^{0}C -SD: 0.5^{0}C -Max: 25.1^{0}C -Min: 21.3^{0}C	R=0.05 P=0.41	R=0.04 P=0.55	R=0.07 P=0.21	R=0.10 P=0.08*	R=0.02 P=0.72	R=0.18 P=0.002**	R=0.15 P=0.01**	R=0.23 P=0.000**	R=0.13 P=0.031**
Air temperature -Average: 23.1^{0}C -SD: 1.5^{0}C -Max: 26.5^{0}C -Min: 20.1^{0}C	R=0.09 P=0.13	R=0.01 P=0.90	R=0.13 P=0.03**	R=0.10 P=0.08*	R=0.01 P=0.90	R=0.12 P=0.05*	R=0.08 P=0.19	R=0.21 P=0.000**	R=0.09 P=0.10
Moon shine 15.0%-99.5%	R=0.05 P=0.36	R=0.07 P=0.27	R=0.01 P=0.84	R=0.07 P=0.25	R=0.03 P=0.58	R=0.18 P=0.003**	R=0.06 P=0.32	R=0.16 P=0.006**	R=0.09 P=0.10

frogs species (Table 3). Independent behavior of *H. chalconota* was also found in *H. chalconota*'s populations that lived in fast-flowing streams at Mount Salak foot hill, West Java (Kurniati & Sumadijaya 2011).

The number of individual *L. blythii* can be so many in one night (55 individuals), as shown at sub-transect 11 of Figure 3 (F, H). The causes of this behavior of this species are not yet known.

1. Family Megophryidae

Leptobrachium waysepuntiense Hamidy & Matsui, 2010

This frog was recently described by Hamidy & Matsui (2010). The adult phase of this species is a terrestrial frog. Its froglet was encountered on leaf litter of stream bank. Habitat along the transect was strong-flowing water. Strong water streams are not the main habitat of adult *Leptobrachium* group, because this frog is a forest floor litter dweller (Inger & Stuebing 2005).

Table 3. Results of linear regression to determine the relationship of individual number in each sub-transect between two species among nine frogs species which were always present at the transects. (**) Strong significant level at P<0.05; (*) There tends to associate; R: Pearson correlation.

Frog species	*L. blythii*	*L. kuhlii*	*H. picturata*	*H. parvaccola*	*H. chalconota*	*H. rufipes*	*H. sumatrana*	*O. hosii*	*P. aspera*
L. blythii	0								
L. kuhlii	R=0.06 P=0.31	0							
H. picturata	R=0.06 P=0.29	R=0.04 P=0.51	0						
H. parvaccola	R=0.01 P=0.86	R=0.05 P=0.41	R=0.08 P=0.19	0					
H. chalconota	R=0.03 P=0.67	R=0.02 P=0.78	R=0.09 P=0.15	R=0.04 P=0.51	0				
H. rufipes	R=0.01 P=0.10	R=0.03 P=0.66	R=0.01 P=0.89	R=0.27 P=0.000**	R=0.01 P=0.88	0			
H. sumatrana	R=0.02 P=0.81	R=0.06 P=0.35	R=0.14 P=0.02**	R=0.10 P=0.09*	R=0.02 P=0.69	R=0.09 P=0.14	0		
O. hosii	R=0.05 P=0.45	R=0.07 P=0.25	R=0.19 P=0.001**	R=0.04 P=0.53	R=0.08 P=0.17	R=0.03 P=0.64	R=0.11 P=0.07*	0	
P. aspera	R=0.04 P=0.53	R=0.10 P=0.09*	R=0.10 P=0.09*	R=0.08 P=0.21	R=0.04 P=0.55	R=0.12 P=0.05*	R=0.04 P=0.53	R=0.08 P=0.19	0

B. Species accounts

Description of the 15 frog's species that were encountered during the surveys in Limau Manis strong water stream is given below:

Megophrys nasuta (Schlegel, 1858)

This species is a terrestrial frog. It was encountered along the strong water stream. Only one individual was found along 300 meters transect length. This frog was found sitting on the rock at the edge of the stream at about 20 cm height above the

water surface. This type of habitat along the transect was not the main habitat of *M. nasuta*, because this frog is a forest floor litter dweller (Inger & Stuebing 2005; Kurniati 2008). The presence of *M. nasuta* on the site was unusual. Probably it was carried away by the strong water from upstream.

2. Family Microhylidae

Phrynella pulchra Boulenger, 1887

This is an arboreal frog. This frog was found at tree hole up to one meters above the ground of second transect line. It can live up to 30 meters above the ground (Yaakob *et al.,* 2004); however at Upper Rupit River of Kerinci Seblat National Park, a female of *P. pulchra* was found on fallen tree on stream bank (Kurniati, 2008). This species can be recorded from its specific call that can explain which tree they stay; however it did not release any calls during the census period at Limau Manis strong water stream.

3. Family Bufonidae

Ingerophrynus parvus (Boulenger, 1887)

This is an aquatic frog; it inhabits streams in primary and regenerating rainforest, mainly in lowlands. It has not been found in open areas outside forest. It breeds in forest pools and slow-moving streams where the larvae also develop (Van Dijk & Iskandar, 2004). During census times in Limau Manis forest, the frogs were found three times at sub-transect 5 of second transect line where a temporary pool was there (Figure 3, G, H, I).

Phrynoidis aspera (Gravenhorst, 1829)

This is an aquatic frog, of which riparian area is its main habitat (Inger, 2009). In Sumatra it is apparently confined to the banks of rainforest streams and rivers throughout its life cycle, and has been recorded only from heavily forested areas (Inger *et al.,* 2004); however in Kerinci Seblat National Park, it has been observed along strong water stream in plantation areas (Kurniati, 2008). During the time of census in Limau Manis strong water stream, the frogs were often found sitting on rock surface located in the stream body. Average population density of *P. aspera* along 600 m transect line was 0.15 individual/10 meters.

4. Family Dicroglossidae

Limnonectes blythii (Boulenger, 1920)

This is an aquatic frog, however adults are usually found at stream bank. It inhabits gravelly and boulder streams in primary forest (Van Dijk & Iskandar, 2004). The frog is listed as Near Threatened because this species is in significant decline (but at a rate of less than 30% over ten years) because it is being over-harvested for food and because its habitat is shrinking, making the species close to qualifying for Vulnerable (Van Dijk & Iskandar, 2004); however, the population of this species in Kerinci Seblat National Park was locally variable, ranging from being fairly common to common (Kurniati, 2008). Based on the census in Limau Manis forest, the number of individuals *L. blythii* was varies between each census time. This frog could be very abundant in sub-transect, but could also be very low in number. Average population density of *L. blythii* along 600 meters transect line was 1.21 individual/10 meters.

Limnonectes kuhlii (Tschudi, 1838)

This is an aquatic frog. It is found in small, clear streams in evergreen forest in hilly areas. It breeds in small tributary streams and the larvae develop in quiet pools along these streams (Van Dijk *et al.,* 2004). Usually in Sumatra it was found in clear slow moving streams or standing water in primary rain forest of Kerinci Seblat National Park (Kurniati, 2008). However in Limau Manis forest, the frog was found very

common along strong water stream, included along the first and second transects lines. Average population density of *L. kuhlii* along 600 meters transect line was 1.08 individual/10 meters.

Occidozyga sumatrana (Peters, 1877)

This is an aquatic frog that usually inhabits temporary muddy pool in primary forest or in degraded forest. The frog is never found in high numbers in its suitable habitat, although it is not a rare species (Kurniati, 2008). It lives in lowland moist forest, where it is always close to water. It can survive in secondary forest, providing that it is not too seriously degraded (Iskandar & Mumpuni, 2004). It occasionally came to the transect lines in Limau Manis forest.

5. Family Ranidae

Huia sumatrana Yang, 1991

This is an aquatic frog that inhabits clean torrents and fast-moving streams in rain forest and open areas near the forest, sometimes it sits on herb leaf near fast-moving stream (Iskandar & Mumpuni, 2004; Kurniati, 2008). It occurs from 300 to more than 1200 meters asl (Mistar, 2003); however at Upper Rupit River of Kerinci Seblat National Park, it was found at elevation 150 meters asl (Kurniati, 2008). It was abundant in suitable habitat such as strong water stream in highland forest where the average air temperature around 20^0 Celsius (Kurniati, 2008). Average population density of *H. sumatrana* along 600 meters transect line was 0.11 individual/10 meters.

Hylarana chalconota (Schlegel, 1837)

This is a semi-arboreal frog; usually, it was seen on low vegetation around fishpond or small lowland forest streams (Kurniati 2008). It is generally common in lowland forest streams, and is less common but still present in highland areas (Van Dijk *et al.,* 2004). Average population density of *H. chalconota* along 600 meters transect line was 0.39 individual/10 meters.

Hylarana erythraea (Schlegel, 1837)

This is semi-aquatic frog. Usually, it occurred in paddy fields and freshwater swamps. It is characteristic of vegetated floodplain ponds and is also frequently associated with paddy fields (Diesmos *et al*., 2009). Fast-moving stream habitat was not a favorite habitat of *H. erythraea*; this frog presented in the first transect line just one individual and only one time at sub-transect 26, this was just a coincidence.

Hylarana parvaccola Inger, Stuart & Iskandar, 2009

This is semi-aquatic and semi-arboreal frog. This species was recently separated from *H. chalconota* group by Inger *et al.* (2009). Average population density of *H. parvaccola* along 600 meters transect line was 0.40 individual/10 meters.

Hylarana picturata Boulenger, 1920

This is an aquatic frog. It occurs in primary and slightly disturbed rainforests. Breeding takes place in small streams and the tadpoles live in quiet side pools and in accumulations of dead leaves in open pools (Inger *et al.,* 2004); however in Limau Manis strong water stream, the frog was found in congregation at stream bank of sub-transect 22 of the first transect line; microhabitat type was like a puddle of water where the water was not moving so fast, stony bottom and depth of water was about 50 cm. Average population density of *H. picturata* along 600 meters transect line was 1.13 individual/10 meters.

Hylarana rufipes Inger, Stuart & Iskandar, 2009

It is semi-aquatic and semi-arboreal frog. This species was recently separated from *H. chalconota* group by Inger *et al.* (2009). Average population density of *H.*

rufipes along 600 meters transect line was 0.25 individual/10 meters.

Odorrana hosii Boulenger, 1891

This is an aquatic frog. It is mainly associated with clear, swift-flowing boulder streams in evergreen primary rainforest in hilly areas, and is sometimes found in the forest at modest distances from streams. It is occasionally found in old secondary forest that has streams of the appropriate type (Van Dijk *et al*., 2004). Average population density of *O. hosii* along 600 meters transect line was 0.25 individual/10 meters.

CONCLUSIONS

An ecological assessment of Sumatran Torrent Frogs by using transect methodology in Limau Manis strong water river, West Sumatra can be concluded that:

1. Fifteen species of frogs were found in the strong water of Limau Manis River; however nine species were permanent settlers (*L. blythii, L. kuhlii, H. picturata, H. parvaccola, H. chalconota, H. rufipes, O. hosii, H. sumatrana* and *P. aspear*).
2. Water temperature has negative impact on the dynamic of the number of species along the transects, increasing water temperature caused a decrease on species number.
3. The presence of individuals *L. blythii, L. kuhlii* and *H. chalconota* were not affected by the dynamics of environment factors (water and air temperature and moon shine); these three species also were not affected by the presence of other frogs species.

ACKNOWLEDGEMENTS

Many thank were addressed to Prof. Rosichon Ubaidillah of LIPI who has supported this project in the process of administration. Acknowledgements are also given to Dr. Wilson Novarino of the University of Andalas who helped for the smoothly of this project in the field. Many thanks were also given to all of students that participated to work in the field. Finally many thanks were addressed to Dr. Arjan Boonman for his assistance in editing the English.

REFERENCES

Diesmos, A., A. Alcala, R. Brown, L. Afuang, G. Gee, J. Sukumaran, N. Yaakob, L.T. Ming, Y. Chuaynkern, K. Thirakhupt, I. Das, D. Iskandar, Mumpuni, R. Inger, R. Stuebing, P. Yambun & Makl, 2009, *Hylarana erythraea*, In: IUCN 2011. IUCN Red List of Threatened Species, Version 2011.2, <www.iucnredlist.org>, Downloaded on 13 April 2012.

Hamidy, A & M. Matsui, 2010, A New Species of Blue-eyed *Leptobrachium* (Anura: Megophryidae) from Sumatra, Indonesia, *Zootaxa,* 2395: 34–44.

Inger, R.F., B.L. Stuart & D.T. Iskandar, 2009, Systematics of a Widespread Southeast Asian Frog, *Rana chalconota* (Amphibia: Anura: Ranidae), *Zoological Journal of the Linnean Society,* 155: 123–147.

Inger, R., D. Iskandar & P.P. van Dijk, 2004, *Phrynoidis aspera*, In: IUCN 2011. IUCN Red List of Threatened Species, Version 2011.2, <www.iucnredlist.org>, Downloaded on 11 April 2012.

Inger, R, D. Iskandar, P.P. van Dijk & N. Yaakob, 2004, *Hylarana picturata*, In: IUCN 2011. IUCN Red List of Threatened Species, Version 2011.2, <www.iucnredlist.org>, Downloaded on 13 April 2012.

Inger, R.F., 2009, Contributions to the Natural History of Seven Species of Bornean Frogs, *Fieldiana Zoology,* (116): 1-25.

Inger, R.F. & R.B. Stuebing, 2005, *A Field Guide to the Frogs of Borneo*, Natural History Publication (Borneo), Kota Kinabalu.

Iskandar, D & Mumpuni, 2004, *Occidozyga sumatrana*, In: IUCN 2011. IUCN Red List of Threatened Species, Version 2011.2, <www.iucnredlist. org>, Downloaded on 12 April 2012.

Jaeger, R.G., 1994, Transect Sampling, In : Heyer, W.R., M.A. Donnely, R.W. McDiarmid, L.C. Hayek & M.S. Foster (editors), *Measuring and monitoring biological diversity, standard method for amphibians*, Pp. 103-107, Smithsonian Institution Press, Washington, 364 pp.

Kurniati, H., 2008, Biodiversity and Natural History of Amphibians and Reptiles in Kerinci Seblat National Park, Sumatra, Indonesia, LIPI-NEF-RSG Report, Research Center for Biology-LIPI, Cibinong, 100 pp.

Kurniati, H., 2010, Negative Impact of Forest Degradation to Herpetofauna Species Richness in Kerinci Seblat National Park, Sumatra, *Biological News,* 9 (6): 699-713.

Kurniati, H. & A. Sumadijaya, 2011, Mikrohabitat Kodok *Hylarana chalconota* pada Sungai Berarus Deras di Lahan Terdegradasi Kaki Gunung Salak**,** *Widyariset* (in press).

Kurniati, H. & A. Sumadijaya, 2012, Komunitas Kodok pada Lahan Terdegradasi, *Jurnal Biologi Indonesia*, 8 (2): 229-246..

Mistar, 2003**,** *Panduan Lapangan Amfibi Kawasan Ekosistem Leuser*, Gibbon Foundation-PILI-NGO Movement.

Van Dijk, P.P. & D. Iskandar, 2004, *Limnonectes blythii*, In: IUCN 2011. IUCN Red List of Threatened Species, Version 2011.2, <www.iucnredlist.org>, Downloaded on 28 March 2012.

Van Dijk, P.P., D. Iskandar & R. Inger , 2004, *Odorrana hosii*, In: IUCN 2011. IUCN Red List of Threatened Species, Version 2011.2, <www.iucnredlist.org>, Downloaded on 13 April 2012.

Van Dijk, P.P., D. Iskandar, R. Inger, M.W.N. Lau, Y. Datong, A. Ohler, L. Shunqing, S. Sengupta & S. Bordoloi, 2004, *Limnonectes kuhlii*, In: IUCN 2011. IUCN Red List of Threatened Species, Version 2011.2, <www.iucnredlist.org>, Downloaded on 11 April 2012.

Van Dijk, P.P., D. Iskandar, R. Inger & M. Kusrini, 2004, *Hylarana chalconota*, In: IUCN 2011. IUCN Red List of Threatened Species, Version 2011.2, <www.iucnredlist.org>, Downloaded on 12 April 2012.

Yaakob, N., D. Iskandar, L.T. Ming, Y. Chuaynkern & Mumpuni, 2004, *Phrynella pulchra*, In: IUCN 2011. IUCN Red List of Threatened Species, Version 2011.2, <www.iucnredlist.org>, Downloaded on 11 April 2012.