

APPENDICES

APPENDIX A

NUMBER OF SPECIES AND ABUNDANCE OF ANURANS AND ENVIRONMENTAL VARIABLES

Table A.1 Environmental factors among elevations at the Huai Chang Tai stream from November 2012 to October 2013.

Environmental Factors	Unit	Property	Group of factor	550 msl		700 msl		900 msl		1100 msl	
				mean	SD	mean	SD	mean	SD	mean	SD
max air temp *	°C	continuous	climate	33.6	3.3	33.8	2.9	27.6	4.3	27.0	3.7
min air temp	°C	continuous	climate	19.3	3.6	18.9	3.6	18.5	2.5	18.8	2.1
mean air temp *	°C	continuous	climate	26.5	2.6	26.4	2.5	23.1	2.8	22.9	2.6
stream width **	m	continuous	stream characteristics	3.39	0.81	4.44	0.68	3.49	0.97	1.92	0.86
stream depth **	m	continuous	stream characteristics	0.35	0.10	0.43	0.07	0.38	0.10	0.20	0.07
stream volume**	m ³	continuous	stream characteristics	61.53	30.82	96.17	26.89	70.33	38.89	21.64	19.02
stream flow	m/s	continuous	stream characteristics	0.29	0.15	0.27	0.13	0.28	0.11	0.31	0.12
water pH**	-	continuous	abiotic	7.46	0.21	7.69	0.30	7.61	0.21	7.57	0.21
water temp **	°C	continuous	abiotic	21.6	1.5	20.9	1.6	19.9	1.3	19.1	1.2
soil temp **	°C	continuous	abiotic	23.0	1.4	22.2	1.5	21.1	1.3	20.3	1.2
soil relative humidity	-	continuous	abiotic	2.7	0.7	2.8	0.7	2.5	0.7	2.5	0.6
soil pH	-	continuous	abiotic	6.6	0.1	6.7	0.1	6.7	0.1	6.7	0.1
air temp *	°C	continuous	climate	24.0	1.7	23.3	1.8	22.1	1.6	21.1	1.5
relative humidity	%	percentage	climate	86.7	9.8	86.9	9.0	89.2	7.8	89.1	8.2
canopy cover *	%	percentage	plant	85.8	5.9	90.6	4.2	93.8	2.2	95.4	2.8

*one-way ANOVA, $p \leq 0.05$, **Kruskal-Wallis test, $p \leq 0.05$

Table A.1 Environmental factors among elevations at the Huai Chang Tai stream from November 2012 to October 2013.

Environmental Factors	Unit	Property	Group of factor	550 msl		700 msl		900 msl		1100 msl	
				mean	SD	mean	SD	mean	SD	mean	SD
vegetation at ground level *	stems/50m ²	continuous	plant	61.4	8.1	80.4	29.9	64.1	15.2	54.5	11.9
vegetation at 1 m *	stems/50m ²	continuous	plant	12.9	7.4	20.2	6.5	20.1	8.3	19.6	9.2
vegetation at 2 m *	stems/50m ²	continuous	plant	3.3	0.8	4.9	1.0	3.8	1.7	4.9	1.9
vegetation above 2 m*	stems/50m ²	continuous	plant	7.2	0.7	12.7	1.9	14.9	1.4	13.4	1.8
waterfall	degree(°)	continuous	abiotic	12	0	20	0	25	0	23	0
mean rainfall	mm	continuous	climate	135.40	140.40	138.91	97.66	138.91	97.66	138.91	97.66
min rainfall **	mm	continuous	climate	2.71	1.95	0.38	0.34	0.38	0.34	0.38	0.34
max rainfall	mm	continuous	climate	26.36	20.16	37.45	27.17	37.45	27.17	37.45	27.17

*one-way ANOVA, $p \leq 0.05$, **Kruskal-Wallis test, $p \leq 0.05$

Table A.2 Number of observed frogs, species distribution, each species' snout-vent length (SVL; mean±SD; cm; followed by ranges in parentheses) and biomass (mean±SD; g) across elevations in the Huai Chang Tai stream from November 2012 to October 2013; Elev = elevation, T = total number of observed frogs at each elevation, IUCN = IUCN status, in parentheses after the scientific name is the species abbreviation (taxonomic nomenclature from Frost, 2013; IUCN status as of 2013). SVL and biomass were calculated from number of observed frogs across elevations in one year shown in [] and (), respectively.

Family/Species	Elev	N	D	J	F	M	A	M	J	J	A	S	O	T	SVL	biomass	IUCN
Dicroglossidae																	
<i>Limnometes blythii</i> (Boulenger, 1920) (LB) •	550	1				3	1		1		1	1	1	9	9.9±1.7 (6.9-10.8)	126.46 (1)	NT
	700														[5]		
	900																
	1100																
<i>L. doriae</i> (Boulenger, 1887) (LD) •	550														3.3±0.2 (3.1-3.5)	2.83 (1)	DD
	700														[4]		
	900																
	1100							1	2		1			4			
<i>L. gyldenstolpei</i> (Andersson, 1916) (LG) †	550			1	2	2	24	3	10	2	6	1		51	5.0±0.7 (4.1-6.9)	17.78±1.58 (2)	LC
	700			1	1	4	14	2	2					24			
	900														[24]		
	1100																
<i>L. limborgi</i> (Sclater, 1892) (LL) •	550						1							1	2.7±0.7 (1.5-3.8)	4.65±0.83 (8)	DD
	700																
	900					1	1							2	[23]		
	1100					1	9	2	3	2		4	3	24			

Table A.2 (continued) (* *O. livida* can define sex due to distinct difference in size and presence of vocal sac (M = Male, F = Female))

Family/Species	Elev	N	D	J	F	M	A	M	J	J	A	S	O	T	SVL	biomass	IUCN
Dicroglossidae																	
<i>Limnonectes taylori</i>	550	14	12	8	11	10	18	34	40	22	12	18	8	207	6.6±1.5	61.25±22.04	LC
(Matsui, Panha, Khonsue,	700	14	12	12	11	23	30	46	26	26	14	14	10	238	(3.4-11.3)	(10)	
and Kuraishi, 2010) (LT) ‡‡	900	15	20	16	20	34	71	70	43	29	12	14	9	353	[410]		
	1100	14	9	12	15	24	26	37	37	30	22	20	13	259			
Ranidae																	
<i>Hylarana cubitalis</i>	550			1								1	1	3	7.5±1.4	49.82±8.36	LC
(Smith, 1917) (HC) ○	700			3	3				1				1	8	(4.3-9.3)	(4)	
	900	1							2	1	1	1		6	[14]		
	1100																
<i>H. nigrovittata</i>	550	11	15	30	29	12	23	14	8	4	3	4	3	156	4.6±0.6	12.08±3.89	LC
(Blyth, 1856) (HN) ○○	700		1	5	4	3	6	5	2					26	(3-5.8)	(6)	
	900														[67]		
	1100																
<i>Odorrana livida</i>	550	3		1	4			2	3	5		2	6	26	M5.2±0.8	M18.73±8.93	DD
(Blyth, 1856) (OL) ††	700	10	14	8	14	15	29	35	33	12	14	12	8	204	(3.7-6.9)	(6)*	
	900	5	5	5	4	5	11	5	3	6	7	11	9	76	F9.5±1.0	F98.05±15.11	
	1100								1				1	2	(7.5-12)	(10)*	
<i>O. nasica</i>	550														[76]*		LC
(Boulenger, 1903) (ON) •	700														4.9	11.06	
	900														[1]	(1)	
	1100												1	1			

Table A.2 (continued)

Family/Species	Elev	N	D	J	F	M	A	M	J	J	A	S	O	T	SVL	biomass	IUCN
Megophryidae																	
<i>Brachytarsophrys carinense</i> (Boulenger, 1889) (BC) •	550									7	4			11	12.1±1.1	180.38±15.22	LC
	700	4	1		1					7	1			14	(10-14)	(10)	
	900	4	1	1						4	2			12	[22]		
	1100									1		1		2			
<i>Leptobrachium smithi</i> (Matsui, Nabhitabhata, and Panha, 1999) (LS) ••	550						10		1			1		12	5±1.4	22.6	LC
	700			3		1	19		2					25	(3.2-7.1)	(1)	
	900														[17]		
	1100																
<i>Leptolalax pelodytoides</i> (Boulenger, 1893) (LP) ‡	550	21	21	16	10	4	48	17	21	43	14	16	39	270	2.9±0.5	2±0.45	LC
	700	8	13	14	15	5	40	3	4	18	11	19	80	230	(2-5.5)	(10)	
	900	2	4	11	3	4	3	9	11	5	6	4	3	65	[242]		
	1100		1	1	1	1				1		1		6			
<i>Xenophrys major</i> (Boulenger, 1908) (XM) ○	550														6.7±1.0	20.42±1.61	LC
	700														(5.5-8.8)	(8)	
	900														[10]		
	1100	1							2				9	12			
<i>X. parva</i> (Boulenger, 1893) (XP) •	550														5.8±0.6	21.06±3.52	LC
	700														(4.5-6.8)	(10)	
	900									3	1			4	[17]		
	1100							2	1	2	1	3	5	14			

Table A.2 (continued) (** *M. fissipes*' SVL and biomass data from Thammachoti *et al.*, 2009)

Family/Species	Elev	N	D	J	F	M	A	M	J	J	A	S	O	T	SVL	biomass	IUCN
Bufonidae																	
<i>Ingerophrynus parvus</i>	550				7	4	3	5	4	2	1		2	28	3.6±0.3	4.71±0.53	LC
(Boulenger, 1887) (IP) §	700														(3.1-4.2)	(2)	
	900														[18]		
	1100																
Rhacophoridae																	
<i>Polypedates leucomystax</i>	550														5.0±0.8	8.7	LC
(Gravenhorst, 1829) (PL) Δ	700					1	2							3	(4-5.5)	(1)	
	900														[3]		
	1100																
<i>Raorchestes parvulus</i>	550														2.1±0.2	2.2±1.56	LC
(Boulenger, 1893) (RP) ◻◻	700														(1.8-2.4)	(2)	
	900														[4]		
	1100						3						1	4			
<i>Rhacophorus bipunctatus</i>	550			1										1	4.5±1.4	2.43	LC
(Ahl, 1927) (RB) ◻	700														(3.6-5.5)	(1)	
	900			1										1	[2]		
	1100																
Microhylidae																	
<i>Microhyla fissipes</i>	550														2.5±0.2**	1.72±0.41**	LC
(Boulenger, 1884) (MF) §§	700						2							2	(2.3-2.7)	(10)	
	900														[10]		
	1100																

Table A.2 (continued)

Family/Species	Elev	N	D	J	F	M	A	M	J	J	A	S	O	T	SVL	biomass	IUCN
Microhylidae																	
<i>M. heymonsi</i>	550						1							1	2.0	1.28±0.61	LC
(Vogt, 1911) (MH) §§○○	700						1							1	[1]	(2)	
	900																
	1100																
<i>M. pulchra</i>	550														2.0	2.7	LC
(Hallowell, 1861) (MP) §§	700						1							1	[1]	(1)	
	900																
	1100																
Total		128	129	151	155	157	397	292	263	232	134	149	212	2399			

Breeding sites are designated as; • = forest stream, •• = forest streams with little current, ○ = swift-flowing streams, ○○ = slow-flowing streams, † = flowing stream, ‡ = clear swift-flowing sand gravel streams, †† = presumably breeds in the streams, ‡‡ = flowing-water with rocky bottoms & quiet pools along these streams, § = mainly in lowlands forest pools and slow-moving streams, §§ = temporary rain pools, ponds, paddy fields and other bodies of still water, △ = rain pools and standing water in streams in forest. Foam nests are created on tree branches overhanging shallow moving water, Δ = foam nests are attached at the branch or rock over the rain puddles or ponds, △△ = presumably laid away from water in damp vegetation axils and have direct development (Chan-ard, 1987; IUCN, 2013; Simchareon and Duangchantrasiri, 2002).

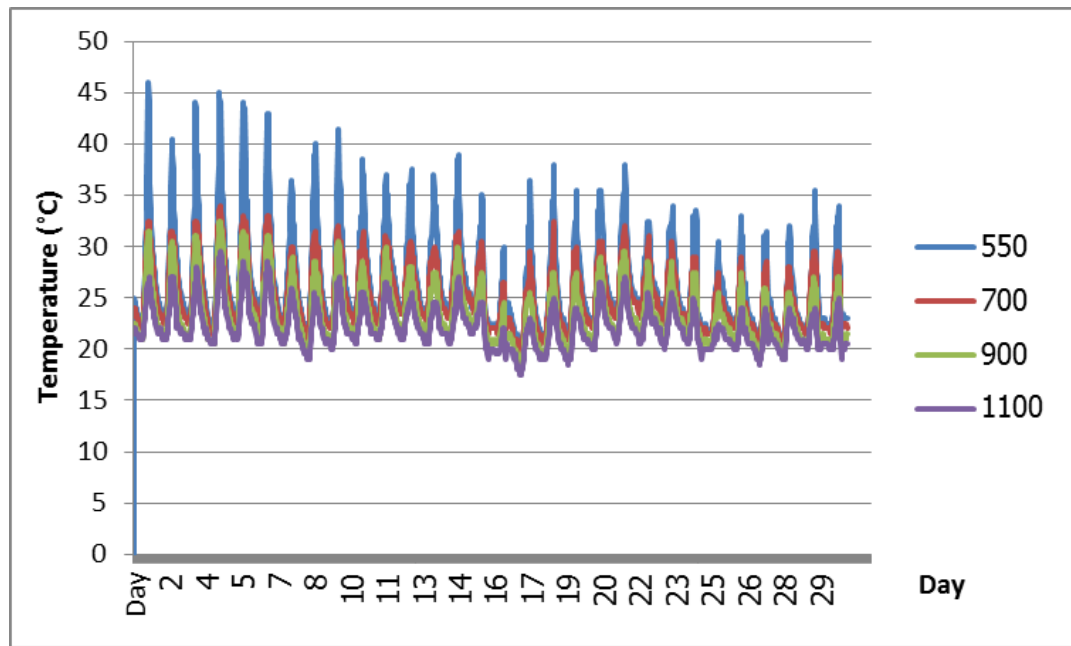


Figure A.1 Air temperature (24 hrs. data) along the stream transects at each elevation during April 2013.

APPENDIX B

PHOTOGRAPHS OF ANURAN FOUND IN THIS STUDY

(Photographs by Pichani Saengtharatip unless stated otherwise)



Limnonectes blythii

กบหูด



Limnonectes doriae

กบดอร์เรีย



Limnonectes gyldenstolpei

กบหงอน



Limnonectes limborgi

กบกา



Courtesy of Thaneer Dawrueng

Limnonectes taylori

กบหัวเขเตอร์



Hylarana cubitalis

กบหูดำ



Hylarana nigrovittata

กบอ่องเล็ก



Odorrana livida

กบชะง่อนผาตะนาวศรี



Odorrana nasica

กบเวียดนาม



Brachytarsophrys carinense

อิงกรายข้างแถบ



Leptobrachium smithi

อิงกรายลายเลอะ



Leptolalax pelodytoides

อิงกรายหนังปุ่ม



Xenophrys major
อึ่งกรายห้วยใหญ่



Xenophrys parva
อึ่งกรายห้วยเล็ก



Courtesy of Thane Dawrueng

Ingerophrynus parvus
คางคกแคระ



Polypedates leucomystax
ปาดบ้าน



Raorchestes parvulus
ปาดแคระป่า



Rhacophorus bipunctatus
ปาดดินเหลืองเหนือ



Microhyla fissipes
อึ่งน้ำเต้า



Microhyla heymonsi
อึ่งข้างดำ



Microhyla pulchra
อึ่งขาคำ

APPENDIX C

ANALYTICAL METHODS

C.1 Agarose gel electrophoresis

Agarose gel electrophoresis was used to determine the quality of extracted genomic DNA and PCR products. Agarose gel was prepared by dissolving agarose in 0.5x Tris-acetate EDTA (TAE) buffer to get a final concentration of 1.5% (w/v). Agarose was melted and 3 μL of nucleic acid staining solution was added. Then, agarose solution was poured into a casting chamber with a comb. After the agarose gel was solidified, a comb was removed carefully. Agarose gel was put in an electrophoresis chamber. 0.5x TAE was added into an electrophoresis chamber to cover the gel. Five volumes of genomic DNA or PCR product were loaded to a well of agarose gel. The 1 kb DNA ladder Gene Ruler (Fermentas) was used as a reference for PCR product. Lambda DNA cut with EcoRI+Hind III marker (0.04 $\mu\text{g}/\mu\text{L}$) was used as a reference for genomic DNA. Electrophoresis was performed at 80 volts, 400 mA for 40 minutes. The DNA samples were illustrated under a UV transilluminator.