

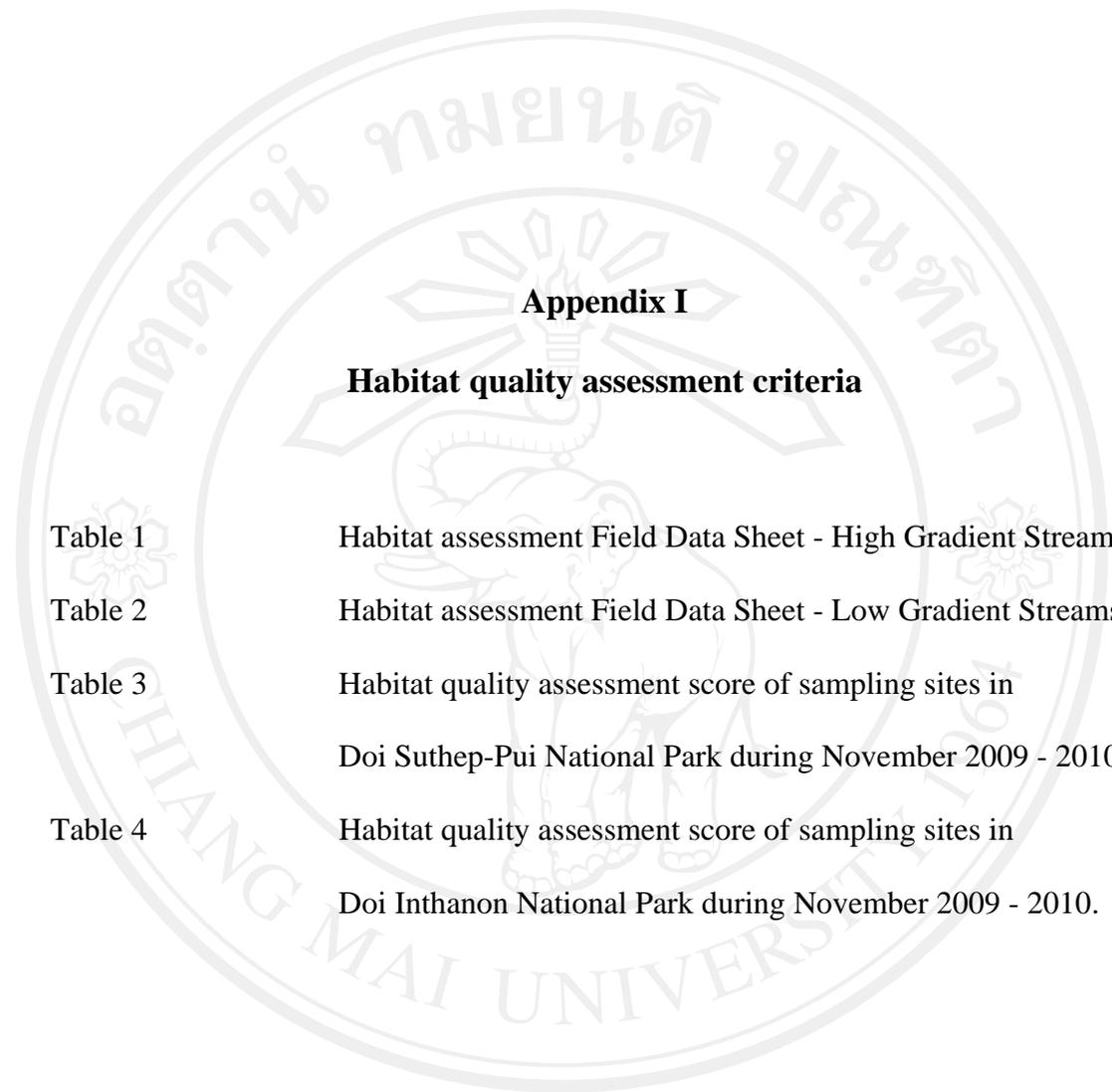


APPENDICES

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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The logo of Chiang Mai University is a large, faint watermark in the background. It features a central emblem with a crown and a figure, surrounded by Thai text and the English name 'CHIANG MAI UNIVERSITY'.

Appendix I

Habitat quality assessment criteria

Table 1	Habitat assessment Field Data Sheet - High Gradient Streams
Table 2	Habitat assessment Field Data Sheet - Low Gradient Streams
Table 3	Habitat quality assessment score of sampling sites in Doi Suthep-Pui National Park during November 2009 - 2010.
Table 4	Habitat quality assessment score of sampling sites in Doi Inthanon National Park during November 2009 - 2010.

Table 1 Habitat assessment Field Data Sheet - High Gradient Streams (Barbour *et al.*, 1999)

Habitat parameters	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available	Greater than 70% of substrate favorable for epifaunal colonization and fish cover, mix of snags, sub-merged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e. logs/ snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale)	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25 - 50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is <0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little of no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constructions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed	Water fills >75% of the available channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Table 1 continued

Habitat parameters	Condition Category																				
	Optimal					Suboptimal					Marginal					Poor					
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. Instreams where riffles are continuous, placement of boulder or other large, natural obstruction is important.					Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.					Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.					Generally all flat water or shallow riffles; poor habitats; distance between riffles divided by the width of the stream is a ratio of >25.					
	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent of minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosion scars.					
Left bank	10	9				8	7	6			5	4	3			2	1	0			
Right bank	10	9				8	7	6			5	4	3			2	1	0			
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation has been removed to 5 centimeters or less in average stubble height.					
Left bank	10	9				8	7	6			5	4	3			2	1	0			
Right bank	10	9				8	7	6			5	4	3			2	1	0			
10. Riparian Vegetation Zone (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.					Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.					Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.					Width of riparian zone < 6 meters; little or no riparian vegetation due to human activities.					
Left bank	10	9				8	7	6			5	4	3			2	1	0			
Right bank	10	9				8	7	6			5	4	3			2	1	0			

Total Score _____

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Table 2 Habitat assessment Field Data Sheet - Low Gradient Streams (Barbour *et al.*, 1999)

Habitat parameters	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available	Greater than 50% of substrate favorable for epifaunal colonization and fish cover, mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay, mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the sediment deposition.	Some new increase in bar formation, mostly from gravel, and or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, and or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelization and disrupted. Instream habitat greatly altered or removed entirely.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3. to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Table 2 continued

Habitat parameters	Condition Category											
	Optimal		Suboptimal			Marginal			Poor			
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.		Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.			Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing 60-100% of bank has erosional scars.			
Left bank	10	9	8	7	6	5	4	3	2	1	0	
Right bank	10	9	8	7	6	5	4	3	2	1	0	
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream	More than 90 % of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative or mowing minimal or not evident almost all plant allowed to grow naturally.		70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disrupting of streambank vegetation is very high; vegetative has been removed to 5 centimeters or less in average stubble height.			
Left bank	10	9	8	7	6	5	4	3	2	1	0	
Right bank	10	9	8	7	6	5	4	3	2	1	0	
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impact zone.		Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.			
Left bank	10	9	8	7	6	5	4	3	2	1	0	
Right bank	10	9	8	7	6	5	4	3	2	1	0	

Total Score _____

Table 3 Habitat quality assessment score of sampling sites in Doi Suthep-Pui National Park during November 2009 - 2010.

	PP	PL	Mon_U	Mon_L	PNG
1. Substrate variety	18	18	18	15	20
2. Embeddedness	10	12	15	12	18
3. Velocity/depth regime	10	18	19	12	19
4. Sediment deposition	5	10	15	10	15
5. Channel flow status	10	12	15	15	18
6. Channel alteration	15	10	15	15	18
7. Frequency of riffles	10	15	18	12	15
8. Bank stability	16	6	18	13	10
9. Vegetative protection	18	14	15	14	15
10. Riparian vegetation zone width	20	18	15	16	18

Table 4 Habitat quality assessment score of sampling sites in Doi Inthanon National Park during November 2009 - 2010.

	KMP_U	KMP_L	SRB	SRT	WCRT	MK
1. Substrate variety	20	20	18	15	17	15
2. Embeddedness	20	20	20	17	15	15
3. Velocity/depth regime	18	20	20	20	20	20
4. Sediment deposition	18	20	15	15	18	15
5. Channel flow status	20	20	18	20	20	20
6. Channel alteration	20	20	18	20	20	20
7. Frequency of riffles	18	18	18	20	20	16
8. Bank stability	20	18	12	19	18	13
9. Vegetative protection	20	20	10	20	17	15
10. Riparian vegetation zone width	19	20	12	20	17	14

Appendix II

Monthly physico-chemical parameters of sampling sites in Doi Suthep-Pui and Doi Inthanon National Parks

Table 1	Monthly physicochemical parameters of water at Pu Ping water supply during November 2009 - November 2010.
Table 2	Monthly physicochemical parameters of water at Pa Lad during November 2009 - November 2010.
Table 3	Monthly physicochemical parameters of water at Montatarn upper during November 2009 - November 2010.
Table 4	Monthly physicochemical parameters of water at Montatarn lower during November 2009 - November 2010.
Table 5	Monthly physicochemical parameters of water at Pa Ngerb during November 2009 - November 2010.
Table 6	Monthly physicochemical parameters of water at Keaw Mae Pan upper during November 2009 - November 2010.
Table 7	Monthly physicochemical parameters of water at Keaw Mae Pan lower during November 2009 - November 2010.
Table 8	Monthly physicochemical parameters of water at Siribhum during November 2009 - November 2010.
Table 9	Monthly physicochemical parameters of water at Siritarn during November 2009 - November 2010.
Table 10	Monthly physicochemical parameters of water at Wachiratarn during November 2009 - November 2010.
Table 11	Monthly physicochemical parameters of water at Mae Klang Sob Ab during November 2009 - November 2010.

Table 1 Monthly physicochemical parameters of water at Pu Ping water supply during November 2009 - November 2010.

	13-Nov-09	2-Dec-09	12-Feb-10	26-Mar-10	24-Apr-10	30-May-10	22-Jun-10	8-Jul-10	20-Aug-10	26-Sep-10	21-Oct-10	16-Nov-10
Discharge (m3/s)	0.0136	0.00515	0.00654	0.00316	0.00246	0.00212	0.00855	0.01925	0.08414	0.20678	0.27715	0.05228
			0.00475	0.00842	0.00637	0.0022		0.01291	0.08544	0.18833	0.23407	0.06437
Avg.	0.0136	0.00515	0.005645	0.00579	0.004415	0.00216	0.00855	0.01608	0.08479	0.197555	0.25561	0.058325
Air temperature (°C)	21	20.5	20	23	26.5	23	24	25.5	23	23	19	23
Water temperature (°C)	19	17	18	20.5	22	22	22	22	21	22	20	20
pH	5.33	6.73	6.22	6.11	5.73	5.49	6.53	6.05	6.24	6.15	6.51	6.35
TDS (mg/l)	20.2	16.5	18.6	19.4	16.2	17.9	19.8	20.4	22.7	13.9	20.9	18.8
Conductivity	38.2	31.1	35.3	36.7	31	34.2	37.2	38.2	43.4	26.2	39	35.3
DO	7.3	8	8.2	8.8	8.1	7.3	7.5	8.4	6.9	7.4	7.2	7.56
	7.3	8.4	8.2	8.9	7.8	7.3	7.8	8.3	7.4	7.4	7.3	7.58
			8.4	9.1	7.5	7.5	8.2	8.2	7.3	7.1	7.4	7.3
			8.6	9.6	8.1	7.4	8.2	8.3	7.5	7.1	7.5	7.36
Avg.	7.3	8.2	8.35	9.1	7.875	7.375	7.925	8.3	7.275	7.25	7.35	7.45
BOD	1.545	0.77	1.95	2.45	2.325	0.675	1.175	1.025	0.225	0.575	0.725	0.285
Ammonia (mg/l)	2.4	0.03	0.02	0.11	0.26	0.18	0.11	0.09	0.06	0.08	0.1	0.06
Nitrate (mg/l)	1	1.7	1.1	0.7	1.2	1.2	1.1	1	1.1	1.1	1.3	1.3
Ortho-phosphorus (mg/l)	0.12	0.07	0.11	1.1	0.14	0.32	0.1	0.16	0.33	0.24	0.59	0.21
Turbidity	5	4	12	11	5	17	6	3	3	15	16	6
Dominant substrate	bedrock, sand											
% shade in stream	90	90	100	95	90	85	70	70	70	70	70	70
% of riparian tree coverage:												
Left	100	100	100	95	100	100	100	100	100	100	100	100
Right	100	100	100	95	100	100	100	100	100	100	100	100

Note:

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Table 2 Monthly physicochemical parameters of water at Pa Lad during November 2009 - November 2010.

	13-Nov-09	3-Dec-09	12-Feb-10	26-Mar-10	25-Apr-10	30-May-10	22-Jun-10	8-Jul-10	20-Aug-10	26-Sep-10	21-Oct-10	16-Nov-10
Discharge (m ³ /s)	0.0665	0.02883	0.00349	0.001223	0.00102	0.00025	0.00755	0.01024	0.11213	0.41151	0.28164	0.04899
	0.02743	0.02249	0.0033		0.00122	0.00027	0.013803	0.01951		0.30669	0.3017	0.0308
Avg.	0.046965	0.02566	0.003395	0.001223	0.00112	0.00026	0.010677	0.014875	0.11213	0.3591	0.29167	0.039895
Air temperature (°C)	23.5	19	24	28	28.5	28.5	28	26	26	27	21	21.5
Water temperature (°C)	21	18	28.5	22	22	24.5	24.5	24.5	23	24	21	21
pH	5.54	7.22	6.73	6.91	6.47	5.68	7.39	6.31	6.68	6.83	6.85	6.7
TDS (mg/l)	59	61	87	114	176	113	92	95	59	41.6	35.2	43.8
Conductivity	112	115	163	214	328	212	174	178	111	78.4	66.2	82.2
DO	6	8	8.4	6.5	7.4	6.5	8.2	8.3	7.4	7.5	7.5	7.2
	6.4	8.4	8.7	6.7	7.6	6.3	8.2	8.5	7.4	7.7	7.6	7.2
			8.4	8.4	7.6	5.9	8.1	8.3	7.6	7.6	7.3	7.6
			8.2	8.4	7.5	5.5	8.1	8.4	7.4	7.6	7.3	7.7
Avg.	6.20	8.20	8.43	7.50	7.53	6.05	8.15	8.38	7.45	7.60	7.43	7.43
BOD	0.50	0.09	2.48	1.38	1.95	4.10	4.83	1.55	1.28	1.15	2.20	1.32
Ammonia (mg/l)	0.18	0.05	0.02	0.19	0.5	0.21	0.21	0.12	0.12	0.14	0.29	0.02
Nitrate (mg/l)	1.7	3	1	1	2.5	0.8	1.9	1.8	1.8	1.6	1.8	2.1
Ortho-phosphorus (mg/l)	0.26	0.36	0.07	0.6	0.39	0.41	0.35	0.6	0.55	0.33	0.77	0.44
Turbidity	4	9	7	15	13	1	7	3	7	15	30	10
Dominant substrate	bedrock, gravel	bedrock, gravel	bedrock, gravel, sand									
% shade in stream	80	50	80	70	70	50	50	50	50	50	50	50
% of riparian tree coverage:												
Left	70	60	60	50	80	80	80	80	80	80	80	80
Right	80	100	100	100	100	70	70	70	70	70	70	70

Note: 25-Apr-10 water in the channel dried out during sampling
 21-Oct-10 was rain in the night of light trap

Table 3 Monthly physicochemical parameters of water at Montatarn upper during November 2009 - November 2010.

	13-Nov-09	2-Dec-09	12-Feb-10	26-Mar-10	24-Apr-10	30-May-10	22-Jun-10	8-Jul-10	20-Aug-10	27-Sep-10	21-Oct-10	16-Nov-10
Discharge (m3/s)	0.09432	0.09321	0.03094	0.01876	0.00374	0.01842	0.10743	0.03779	0.2811	0.24275	0.84468	0.07327
	0.0484	0.0795		0.03541	0.011	0.0156	0.04028	0.04781	0.34009	0.34445	0.832	0.10139
Avg.	0.07136	0.086355	0.03094	0.027085	0.00737	0.01701	0.073855	0.0428	0.310595	0.2936	0.83834	0.08733
Air temperature (°C)	23	20	28.5	26.5	25	24	26	26	27	24.5	21	21
Water temperature (°C)	20.5	18	18	22	22	24	24.5	24.5	24	23.5	21	21
pH	6.1	6.34	5.74	5.87	5.77	5.42	6.71	6.49	7.01	6.49	6.33	6.16
TDS (mg/l)	13.5	11	11.6	16.5	22.6	17.6	18.9	18	15.4	15.9	11.3	12.6
Conductivity	25.3	21.1	21.8	30.8	41.7	33	35.8	33.7	34	29.1	21.3	24.2
DO	7.1	8.6	8.5	8.4	7.8	7	7.9	8.5	7.2	6.6	7.6	7.5
	7.3	8.6	8.5	8	6.8	7	8	8.4	7.5	6.7	7.3	9.96
			8.8	8.3	6.9	6.9	8	8.2	6.7	6.6	7.4	8.4
			8.8	8.3	7.1	6.6	8	8.3	7	6.5	7.3	8.44
Avg.	7.2	8.6	8.65	8.25	7.15	6.875	7.975	8.35	7.1	6.6	7.4	8.575
BOD	0.6	0.43	2.35	2.83	6.6	1.03	0.98	1.93	0.43	0.525	0.75	1.14
Ammonia (mg/l)	0.3	0.13	0.08	0.17	0.57	0.22	0.3	0.23	0.17	0.1	0.17	0.06
Nitrate (mg/l)	1	1.1	1.1	1.1	1.4	0.8	1	1.3	1.1	1.2	1.4	1.2
Ortho-phosphorus (mg/l)	0.1	0.08	0.27	0.31	0.2	0.21	0.23	0.38	0.23	0.33	0.61	0.26
Turbidity	6	7	5	15	22	11	18	13	8	17	27	9
Dominant substrate	cobble, bedrock	cobble, bedrock	cobble bedrock									
% shade in stream	70	30	70	50	50	80	50	50	50	50	50	50
% of riparian tree coverage:												
Left	70	100	100	70	80	80	80	100	100	50	70	70
Right	70	50	70	60	60	50	50	50	50	100	100	100

Note: 24 Apr-10 shower rain

Table 4 Monthly physicochemical parameters of water at Montatarn lower during November 2009 - November 2010.

	13-Nov-09	2-Dec-09	12-Feb-10	26-Mar-10	24-Apr-10	30-May-10	22-Jun-10	8-Jul-10	20-Aug-10	27-Sep-10	21-Oct-10	16-Nov-10
Discharge (m3/s)	0.07898	0.04953	0.19486	0.01971	0.04243	0.0051	0.08835	0.04746	0.34813	0.29191	0.83114	0.1161
	0.23577	0.0779	0.19866	0.08753	0.00443	0.07425	0.07351	0.07045	0.29445	0.11822	0.77912	
Avg.	0.157375	0.063715	0.19676	0.05362	0.02343	0.039675	0.08093	0.058955	0.32129	0.205065	0.80513	0.1161
Air temperature (°C)	23.5	20	23.5	28	25	25	26	26	27	24.5	21.5	21
Water temperature (°C)	21	18	18	22	22.5	24.5	24.5	25	24	23.5	21	20.8
pH	6.04	6.55	6.31	6.8	5.96	5.97	6.81	6.48	6.15	6.44	6.15	6.2
TDS (mg/l)	13.6	11.1	11.7	18.5	19.5	17.9	16.5	17.3	13.1	13.4	10.9	13.3
Conductivity	25.6	20.8	22.2	37	36.3	33.8	31.2	32.4	24.7	25.3	20.9	26
DO	7.5	10.7	9	9	8.4	8	7.3	8.1	6.9	6.8	7.3	7.3
	7.7	9.6	8.8	9	8.4	7.7	7.4	8.3	7.1	6.6	7.4	7.4
		10.3	8.8	6.5	7.9	8.1	7.2	8	7.3	6.4	7.4	8
			8.9	6.6	7.6	7.9	7.5	8	7.3	6.3	8.1	7.6
Avg.	7.6	10.2	8.875	7.775	8.075	7.925	7.35	8.1	7.15	6.525	7.55	7.575
BOD	0.95	1.7	2.05	0.8	2.325	1.375	0.2	1.575	0.6	0.125	0.975	6.075
Ammonia (mg/l)	0.23	0.06	0	0.15	0.33	0.21	0.36	0.22	0.16	0.14	0.17	0.08
Nitrate (mg/l)	1.2	1.1	1.1	0.9	1.1	1.1	1.2	1	1.3	1.1	1.2	1
Ortho-phosphorus (mg/l)	0.12	0.08	0.08	0.35	0.12	0.16	0.09	0.41	0.26	0.27	0.65	0.34
Turbidity	10	9	13	18	11	10	20	13	9	11	25	11
Dominant substrate	sand, bedrock	sand bedrock										
% shade in stream	60	40	70	50	20	30	10	30	30	30	30	30
% of riparian tree coverage:												
Left	70	100	100	100	100	100	100	100	100	100	100	100
Right	50	80	50	70	50	30	50	60	60	60	60	60

Note: 30-May-10 rain

Table 5 Monthly physicochemical parameters of water at Pa Ngerb during November 2009 - November 2010.

	13-Nov-09	2-Dec-09	12-Feb-10	26-Mar-10	24-Apr-10	30-May-10	22-Jun-10	8-Jul-10	20-Aug-10	26-Sep-10	21-Oct-10	16-Nov-10
Discharge (m3/s)	0.1524	0.311	0.15812	0.01118	0.00962	0.0101	0.21198	0.04778	0.36958	0.50528	0.9641	0.20645
	0.07864	0.24554	0.06755	0.02483		0.0137	0.12806	0.04631	0.37909	0.30669	1.09483	
Avg.	0.11552	0.27827	0.112835	0.018005	0.00962	0.0119	0.17002	0.047045	0.374335	0.405985	1.029465	0.20645
Air temperature (°C)	24.5	22	23	31	35	25	28.5	27.5	25	30	22	21
Water temperature (°C)	21	18.5	17	23	27	26	25.5	26	22.5	25	21	20.5
pH	6.23	6.51	6.12	5.91	5.8	5.4	6.3	6.16	6.04	6.32	6.22	5.85
TDS (mg/l)	15	11.9	13	21.8	24.5	26.6	19.4	20.2	13.9	15.7	12.2	13.4
Conductivity	28.4	21.7	24.5	41	46	50.3	39.3	38	26	29.6	22.8	25.2
DO	7.2	8	8.9	6.4	5	6.1	7.1	7.6	7	6.1	7.3	7.72
	7.2	8.5	9	5.9	6.4	6.2	7.2	7.3	7.3	6.4	7.1	7.7
			9.1	7.8	6.9	5.9	7	7.4	7.5	6.9	7	8.1
			9.1	7.6	6.9	6.3	7.5	7.5	7.6	6.8	7	7.7
Avg.	7.20	8.25	9.03	6.93	6.30	6.13	7.20	7.45	7.35	6.55	7.10	7.81
BOD	0.25	0.18	2.00	1.05	0.90	1.28	1.55	1.13	0.48	0.23	1.03	1.11
Ammonia (mg/l)	0.24	0.09	0	0.19	0.36	0.21	0.59	0.33	0.19	0.13	0.27	0.07
Nitrate (mg/l)	1.4	1.1	2.4	0.7	1.1	0.9	0.8	1	1.1	1	1.2	0.7
Ortho-phosphorus (mg/l)	0.23	0.06	0.4	1.1	0.16	0.27	0.11	0.39	0.33	0.38	0.18	0.34
Turbidity	8	9	7	12	9	11	23	15	13	17	49	10
Dominant substrate	cobble, gravel, boulder											
% shade in stream	90	80	90	90	80	70	90	90	90	90	90	90
% of riparian tree coverage:												
Left	70	80	90	90	50	70	80	80	80	80	80	80
Right	80	80	90	90	70	80	80	80	80	80	80	80

Note:

Table 6 Monthly physicochemical parameters of water at Kaew Mae Pan upper during November 2009 - November 2010.

	15-Nov-09	6-Feb-10	18-Mar-10	27-Apr-10	3-Jun-10	25-Jun-10	12-Jul-10	23-Aug-10	19-Sep-10	23-Oct-10	16-Nov-10
Discharge (m3/s)	ND	0.01691	0.09854	0.02213	0.00927	0.07731	0.01599	0.61238	0.054941	0.227186	1.03313
				0.01599	0.0198		0.014267	0.55019		0.189052	0.68544
Avg.		0.01691	0.09854	0.01906	0.014535	0.07731	0.015129	0.581285	0.054941	0.208119	0.859285
Air temperature (°C)	19	16	18	19.5	20	17.5	16	19	15.5	16	14.5
Water temperature (°C)	13.5	10	13	15.5	15.5	12	15	15	15	9	12.5
pH	4.6	3.1	4.92	5.24	4.11	4.72	5.17	5.38	5.63	4.28	5.66
TDS (mg/l)	0.4	7.5	2.3	2.6	4.1	3.7	2.9	2.3	2.2	1.4	2.3
Conductivity	0.6	14.2	4.2	4.9	7.6	6.9	5.4	4	4.1	2.7	3.8
DO1	7.9	9.2	9.5	8.9	8.4	8.1	8	7.4	7.6	7.1	8.3
	7.8	8.9	9.1	8.9	7.6	7.9	7.7	7.4	7.6	7.2	8.24
		9.1	9.2	8.7	8	7.6	8	7	7.6	7.1	8.46
		9.5	9.1	8.5	8	7.7	7.5	7.2	7.4	7.1	8.6
Avg.	7.85	9.18	9.23	8.75	8.00	7.83	7.80	7.25	7.55	7.13	8.40
BOD	0.45	4.28	3.76	0.30	1.10	0.48	1.83	0.95	0.70	0.27	0.80
Ammonia (mg/l)	0.22	0.42	0.25	0.29	0.19	0.14	0.19	0	0.05	0.13	0.11
Nitrate (mg/l)	1.4	0.9	1.3	1.1	1.2	1.3	1.3	1.3	1	1.2	1.1
Ortho-phosphorus (mg/l)	0.07	0.01	0.05	0.08	0.03	0.29	0.14	0.08	0.13	0.11	0.1
Turbidity	6	6	5	4	5	7	5	5	2	6	3
Dominant substrate	boulder, sand										
% shade in stream	100	100	100	90	90	100	100	100	100	100	100
% of riparian tree coverage:											
Left	100	100	100	100	100	100	100	100	100	100	100
Right	100	100	100	100	100	100	100	100	100	100	100

Note:

ND - non detectable

มอส ก้อนหิน กิ่งไม้ ท่อนซุง หญ้า ปกคลุมลำธารกว่า 80-90 เปอร์เซ็นต์

Table 7 Monthly physicochemical parameters of water at Kaew Mae Pan lower during November 2009 - November 2010.

	14-Nov-09	6-Feb-10	19-Mar-10	27-Apr-10	3-Jun-10	25-Jun-10	12-Jul-10	23-Aug-10	19-Sep-10	23-Oct-10	13-Nov-10
Discharge (m3/s)	ND	0.05789	0.09669	0.01196	0.01152	0.14941	0.25551	0.88675	1.41748	0.289558	0.88346
		0.05286	0.09323	0.02484	0.01694	0.04653	0.14793	0.54981		0.138925	1.09585
Avg.		0.055375	0.09496	0.0184	0.01423	0.09797	0.20172	0.71828	1.41748	0.214242	0.989655
Air temperature (°C)	16	14.5	14	19	18.5	17	18	19	18	14.5	13.5
Water temperature (°C)	13	10	12	15	16	15	15	15	15	14.5	12.5
pH	4.5	4.08	4.9	4.78	4.02	4.91	5.07	5.18	5.43	4.6	5.99
TDS (mg/l)	0.8	3.3	3.7	13.8	4.7	4.5	2.7	3	2	2	5.4
Conductivity	1.6	6.2	6.8	26.1	8.8	8.4	5.1	5.6	3.8	4	10.1
DO1	7.3	8.8	9.4	8.5	7.9	7.8	8.5	7.2	6.4	7	7.6
	7.5	9	9.3	8.3	8.1	7.9	8.3	7	7.5	7	7.5
		8.9	9.2	8.4	7.2	7.9	8.7	6.9	7.4	7.2	7.6
		8.9	9.7	7.7	8.4	7.8	8.6	7.1	7.4	7.3	7.7
Avg.	7.4	8.9	9.4	8.225	7.9	7.85	8.525	7.05	7.175	7.125	7.6
BOD	0.4	4.025	4.3	0.575	3.35	0.675	2.275	0.225	1.3	0.3	0.185
Ammonia (mg/l)	0.22	0.46	0.04	0.17	0.06	0.17	0.15	0.04	0.05	0.12	0.09
Nitrate (mg/l)	1.4	1.1	1.1	0.9	1	1.2	1	1.2	1	1.5	1.3
Ortho-phosphorus (mg/l)	0.1	0.01	0.05	0.05	0.05	0.13	0.07	0.16	0.2	0.06	0.09
Turbidity	5	6	4	5	6	5	6	5	8	4	4
Dominant substrate	boulder, sand, bedrock										
% shade in stream	90	100	100	100	100	100	100	100	100	100	100
% of riparian tree coverage:											
Left	100	100	100	100	100	100	100	100	100	100	100
Right	100	100	100	100	100	100	100	100	100	100	100

Note: ND - non detectable

Table 8 Monthly physicochemical parameters of water at Siribhum during November 2009 - November 2010.

	15-Nov-09	6-Feb-10	18-Mar-10	27-Apr-10	3-Jun-10	25-Jun-10	12-Jul-10	23-Aug-10	19-Sep-10	23-Oct-10	16-Nov-10
Discharge (m3/s)	0.48157	0.31524	0.1959	0.09012	0.11518	0.22907	0.22279	0.44931	nd	2.02845	1.00886
	0.57182	0.13027	0.13092	0.05015	0.09869	0.20787	0.3803	0.60053		2.3466	1.42329
Avg.	0.526695	0.222755	0.16341	0.070135	0.106935	0.21847	0.301545	0.52492	nd	2.187525	1.216075
Air temperature (°C)	20	23	18.5	22	22.5	20	24	20	19	18	17
Water temperature (°C)	17	12	17	11	20.5	20	20.5	19	18	17.5	16
pH	5.97	6.23	6.34	6.75	6.66	6.24	6.81	6.32	5.76	5.4	6.01
TDS (mg/l)	9.1	18.9	33.6	28	28.2	17.9	42.2	9.3	7.2	4.6	7.4
Conductivity	17.3	35.6	42.3	52.6	53.2	34	22.5	21	13.4	8.6	13.8
DO1	7.9	8.9	11.8	8.4	8	8.1	7.8	7.7	7.3	7.1	7.7
	7.7	9	8.4	8	8.2	8.2	7.8	7.4	7.4	7.3	7.7
		8.3	9	8.5	8.3	8.1	7.6	7.2	7.3	7.5	7.7
Avg.	7.8	8.675	9.6	8.35	8.225	8.15	7.675	7.4	7.35	7.25	7.7
BOD	0.45	4.825	3.475	0.075	1.725	0.725	2.175	1.45	0.225	0.375	0.25
Ammonia (mg/l)	0.28	0.41	0.04	0.11	0.1	0.12	0.13	0.02	0.09	0.15	0.11
Nitrate (mg/l)	1	1.1	1.1	1	1	1.3	0.6	1.1	1.1	0.9	1.2
Ortho-phosphorus (mg/l)	0.09	0.01	0.09	0.11	0.05	0.18	0.41	0.19	0.16	0.1	0.35
Turbidity	12	4	6	7	6	8	7	9	3	8	4
Dominant substrate	boulder, cobble										
% shade in stream	20	30	50	50	70	80	80	80	80	80	80
% of riparian tree coverage:											
Left	100	70	50	80	80	80	80	80	80	80	80
Right	70	70	50	70	80	80	80	80	80	80	80

Note: ND - non detectable พื้นที่ข้าง ๆ ลำธารถูกเปลี่ยนเป็นสวนดอกไม้ แต่ยังมีต้นไม้ใหญ่อยู่

Table 9 Monthly physicochemical parameters of water at Siritarn during November 2009 - November 2010.

	15-Nov-09	7-Feb-10	19-Mar-10	27-Apr-10	3-Jun-10	25-Jun-10	11-Jul-10	23-Aug-10	19-Sep-10	23-Oct-10	13-Nov-10
Discharge (m3/s)	11.57476	2.16	7.81177	1.01389	0.92996	2.8467	4.26705	7.65332	ND	ND	4.41121
								3.92018			7.33324
Avg.	11.57476	2.16	7.81177	1.01389	0.92996	2.8467	4.26705	11.5735	0	0	11.74445
Air temperature (°C)	20.5	24.5	20.5	26	25.5	27	28	24.5	22.5	22	22
Water temperature (°C)	18.5	16	18.5	23	25	24.5	25.5	23.5	22.5	20.5	18.5
pH	6.64	6.83	6.78	7.35	6.57	7.15	7.17	6.68	6.48	5.83	6.66
TDS (mg/l)	19.1	30.3	33.2	47.6	43	33.4	65.2	25.4	20.4	13.9	19.4
Conductivity	35.6	57.5	62.5	89.6	81.5	62.8	34.7	47.7	38.4	26.4	36.6
DO1	8.1	9.5	9.6	8.5	7.3	8.6	8.8	7.7	8.3	7.3	7.7
	8.4	8.9	9.2	8.5	7.8	8.6	8.7	7.4	8.3	7.4	8.1
		9.6	9.3	8.7	7.9	8.3	8.5	7.2	8.6	7.4	8
		9.4	9.6	8.2	7.2	8.5	9.1	7.6	8.4	7.8	7.4
Avg.	8.25	9.35	9.425	8.475	7.55	8.5	8.775	7.475	8.4	7.475	7.8
BOD	0.925	4.675	2.45	0.4	2.875	1.2	2.95	0.95	1.125	0.75	0.55
Ammonia (mg/l)	0.23	0.44	0.2	0.18	0.08	0.22	0.13	0.05	0.15	0.13	0.07
Nitrate (mg/l)	1	1.2	1.2	1.2	1.3	1.1	1.1	1.3	1	1.4	1.4
Ortho-phosphorus (mg/l)	0.16	0.05	0.1	0.11	0.1	0.32	0.32	0.36	0.2	0.13	0.21
Turbidity	9	7	11	10	15	46	20	11	8	14	6
Dominant substrate	bedrock	bedrock	bedrock	bedrock	bedrock	bedrock	bedrock	bedrock	bedrock	bedrock	bedrock
% shade in stream	40	20	30	0	0	20	20	20	20	20	20
% of riparian tree coverage:											
Left	100	100	100	100	90	100	100	100	100	100	100
Right	100	100	100	100	100	100	100	100	100	100	100

Note: ND - non detectable
 19 Mar 10 rain in the night before water sampled
 23 Aug 10 bank-full flooded

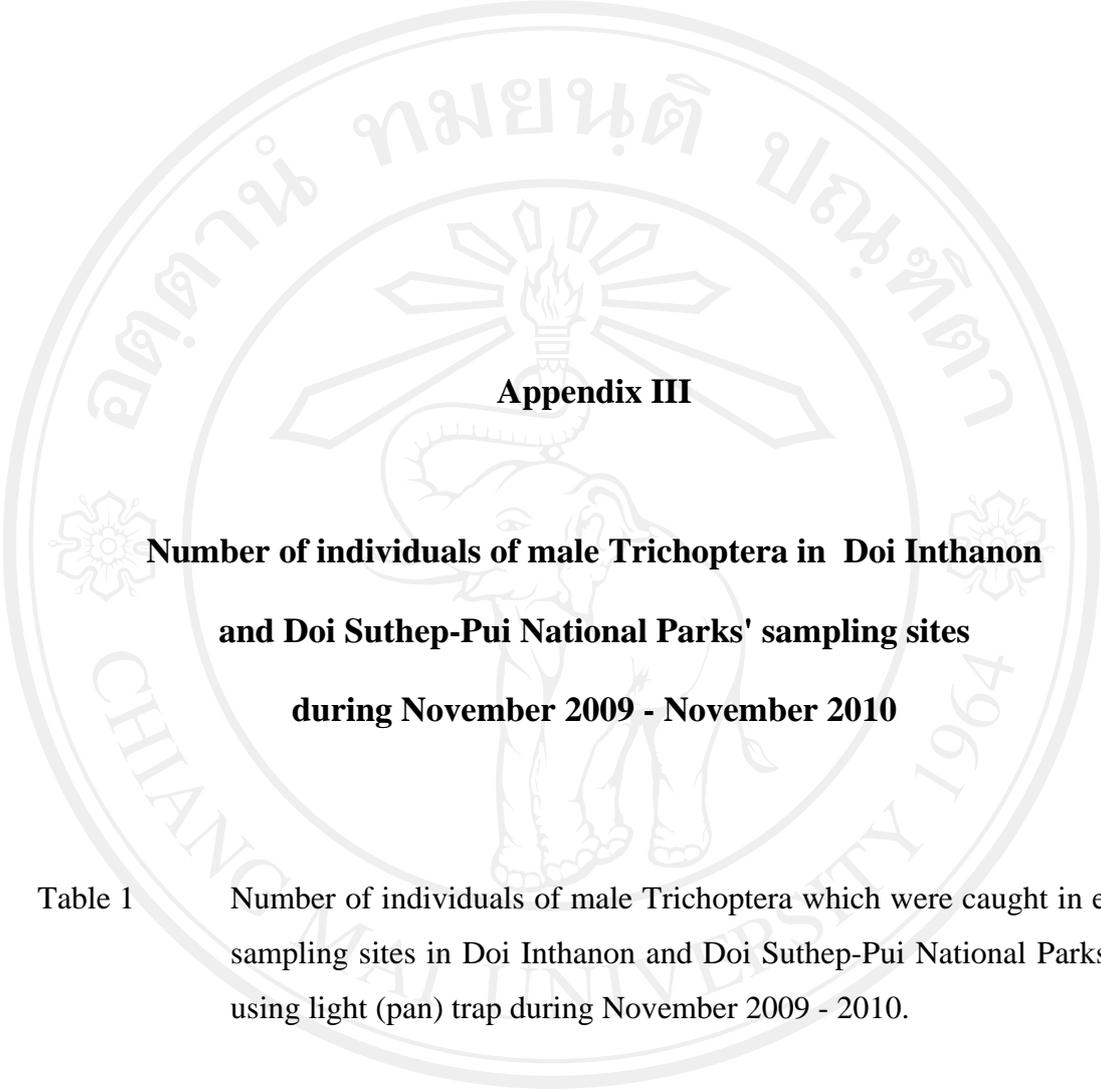
Table 10 Monthly physicochemical parameters of water at Wachiratarn during November 2009 - November 2010.

	15-Nov-09	6-Feb-10	19-Mar-10	27-Apr-10	3-Jun-10	5-Jun-10	11-Jul-10	23-Aug-10	19-Sep-10	23-Oct-10	13-Nov-10
Discharge (m3/s)	1.028192	1.00938	1.68981	1.23919	0.51441	1.54497	1.51021	4.89562	9.98799	24.00605	6.14166
	1.545417			0.63346		1.41381		3.84794	18.31467		4.33808
Avg.	1.2868045	1.00938	1.68981	0.936325	0.51441	1.47939	1.51021	4.37178	14.15133	24.00605	5.23987
Air temperature (°C)	22	22	23.5	25	26.5	28.5	28	25	25	22	21
Water temperature (°C)	20.5	16.3	20	23	25.5	24.5	24	23	23	21.5	19
pH	6.15	6.81	6.55	7.33	7.09	7.32	7.06	6.72	6.73	6.04	6.5
TDS (mg/l)	18.5	29.9	33	46.1	39.1	33.2	65.7	24.9	20.4	15.3	20.4
Conductivity	34.8	56.2	62.3	86.8	73.6	62.7	35	46.5	38.4	28.8	38.3
DO1	7.9	8	9.2	8.5	7.5	8.6	9	7.6	7.6	6.9	7.3
	8.1	8.4	9.1	8.1	8	9.1	9	7.7	7.7	7.2	7.5
		9.3	8	8.7	7.7	8.5	9.5	7.7	7.9	7	7.5
		8.3	9.9	8.5	7.7	8.5	9.4	7.9	7.9	7.4	7.5
Avg.	8	8.5	9.05	8.45	7.725	8.675	9.225	7.666667	7.775	7.125	7.45
BOD	0.95	4	4.625	0.175	1.725	0.9	3.075	0.541667	0.9	0.4	0.05
Ammonia (mg/l)	0.25	0.44	0.19	0.14	0.06	0.2	0.15	0.02	0.16	0.17	0.1
Nitrate (mg/l)	1.6	1.3	1.2	1.3	1.2	1.4	0.9	1.3	1.2	1.4	1.3
Ortho-phosphorus (mg/l)	0.08	0.05	0.04	0.12	0.13	0.21	0.33	0.3	0.29	0.11	0.25
Turbidity	15	12	12	15	18	21	17	13	9	21	7
Dominant substrate	bedrock, boulder										
% shade in stream	40	70	50	30	50	60	60	60	60	60	60
% of riparian tree coverage:											
Left	100	100	100	100	100	100	100	100	100	100	100
Right	20	70	80	80	50	80	80	80	80	80	80
Note: ND - non detectable	13 Nov 10	flooded evidence									

Table 11 Monthly physicochemical parameters of water at Mae Klang-Sob Ab during November 2009 - November 2010.

	15-Nov-09	6-Feb-10	19-Mar-10	27-Apr-10	3-Jun-10	5-Jun-10	11-Jul-10	23-Aug-10	19-Sep-10	23-Oct-10	13-Nov-10
Discharge (m3/s)	1.67961	1.79445	2.25142	1.25222	1.56257	1.4541	1.16382	4.76881	6.91172	18.44949	2.79603
				1.10177		1.46611	1.68987	4.23846	2.09684	18.85287	5.25712
Avg.	1.67961	1.79445	2.25142	1.176995	1.56257	1.460105	1.426845	4.503635	4.50428	18.65118	4.026575
Air temperature (°C)	27	27.5	26.5	24	28	32	30	30	30	25	27
Water temperature (°C)	20	17	21	24	26.5	26	26	25	25.5	22.5	22
pH	6.42	6.72	6.66	7.24	6.62	6.95	7.07	6.38	5.7	6.1	6.21
TDS (mg/l)	18.9	30.3	26.8	43.9	37.6	31.1	36.1	23.6	21.1	16.8	18.4
Conductivity	36	56.8	50.3	82.7	70.8	59.8	67.6	43.9	41	31.6	36.1
DO1	7.7	8.7	9.9	8	7.1	7.7	8.5	7.6	6.9	6.5	7.2
	6.7	8.7	9.9	8.1	7.2	7.9	8.2	7.6	7.2	7	7.2
		9.1	9.9	8.6	7	7.7	8.4	7.2	6.7	6.4	7.7
		9.5	9.2	7.9	7	7.8	8.2	7	6.9	6.7	7.8
Avg.	7.2	9	9.725	8.15	7.075	7.775	8.325	7.35	6.925	6.65	7.475
BOD	0.033	3.625	6.658	0.625	1.825	1.1	1.35	1.05	1.175	0	0.975
Ammonia (mg/l)	0.26	0.45	0.1	0.17	0.11	2.65	0.14	0.07	0.19	0.24	0.15
Nitrate (mg/l)	0.8	1.2	1.1	1.3	1.2	1.4	1.2	1.3	1.2	1.4	1
Ortho-phosphorus (mg/l)	0.14	0.1	0.03	0.1	0.07	0.18	0.26	0.28	0.44	0.35	0.26
Turbidity	13	17	21	17	27	19	21	12	15	21	8
Dominant substrate	boulder, sand										
% shade in stream	40	20	30	30	0	10	10	10	10	10	10
% of riparian tree coverage:											
Left	100	90	90	90	100	100	100	100	100	100	100
Right	20	30	40	50	50	20	20	20	20	10	20

Note: ฝั่งขวาเป็นหญ้าและดอนทราย
23 Oct 10 flooded evident, right bank coverage was destroyed



Appendix III

**Number of individuals of male Trichoptera in Doi Inthanon
and Doi Suthep-Pui National Parks' sampling sites
during November 2009 - November 2010**

Table 1 Number of individuals of male Trichoptera which were caught in each sampling sites in Doi Inthanon and Doi Suthep-Pui National Parks by using light (pan) trap during November 2009 - 2010.

Table 1 Number of individuals of male Trichoptera which were caught in each sampling sites in Doi Inthanon National Park (KMP upper: Keaw Mae Pan upper; KMP lower: Keaw Mae Pan lower; SRB: Siribhum; SRT: Siritarn; WCRT: Wachiratarn, and MK: Mae Klang Sob Ab) and Doi Suthep-Pui National Park (PP: Pu Ping water supply; PL: Pa Lad; Mon upper: Montatarn upper; Mon lower: Montatarn lower and PNG: Pa Ngerb) by using light (pan) trap during November 2009 - 2010.

Family Species	KMP upper	KMP lower	SRB	SRT	WCRT	MK	PP	PL	Mon upper	Mon lower	PNG
Rhyacophilidae											
<i>Himalopsyche acharai</i>	5	2	8	2					7	2	1
<i>Rhyacophila bicolor doiangka</i>	1										
<i>Rhyacophila blenda</i>	5	2									
<i>Rhyacophila curvata</i>				1	2		12	18	18	24	3
<i>Rhyacophila falita</i>	5	22	2								
<i>Rhyacophila inaequalis</i>											1
<i>Rhyacophila malayana</i>	5	4	8		2		1		4		
<i>Rhyacophila manna</i>		1					2	1			
<i>Rhyacophila mayestril</i>		1									
<i>Rhyacophila murhu</i>		1									
<i>Rhyacophila pemba</i>				1							
<i>Rhyacophila petersorum</i>		4	3	9	9		4	10	33	8	1
<i>Rhyacophila scissa</i>		13	5					1	6	5	
<i>Rhyacophila scissoides</i>							3		1	2	
<i>Rhyacophila smithi</i>	2										
<i>Rhyacophila suthepensis</i>								2			
<i>Rhyacophila uncata</i>	1										
<i>Rhyacophila verugia</i>	2										
<i>Rhyacophila xayide</i>		1									
Glossosomatidae											
<i>Agapetus atuus</i>						98					
<i>Agapetus cenomarus</i>						14					
<i>Agapetus dangorum</i>						1					
<i>Agapetus halong</i>						518		1		1	14
<i>Agapetus voccus</i>			1	1							
<i>Glossosoma jentumar</i>			1								
<i>Glossosoma malayanum</i>			1								
<i>Paduniella akkad</i>						14					
<i>Poeciloptila briatec</i>						31					
Hydroptilidae											

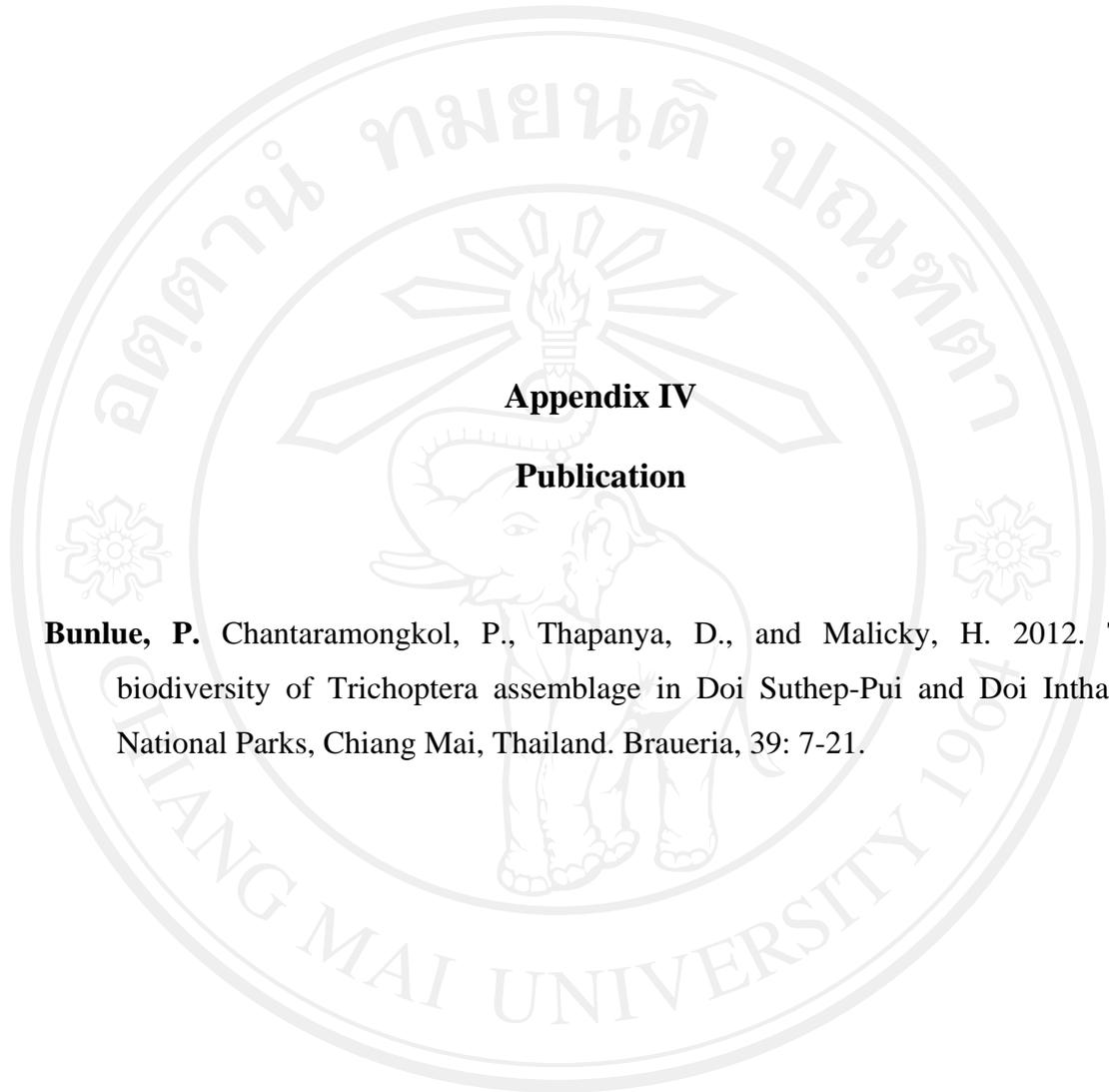
Family Species	KMP upper	KMP lower	SRB	SRT	WCRT	MK	PP	PL	Mon upper	Mon lower	PNG
<i>Gunungiella segsafiazga</i>								1			
<i>Kisaura cina</i>			2								
<i>Kisaura consagia</i>		21	1	3	3	42	1	20	4	2	6
<i>Kisaura laban</i>		1									
<i>Kisaura longispina</i>	39	48	11								
<i>Kisaura sura</i>					1		21	3	1		
<i>Wormaldia relictia</i>	1	1									
<i>Wormaldia serata</i>		1									
Polycentropodidae											
<i>Nyctiophylax Chiangmaiensis</i>				1			1	16	13	5	1
<i>Plectronemia arphachad</i>	5	1									
<i>Polyplectropus admin</i>								4	1		8
<i>Polyplectropus aiolos</i>						14					
<i>Polyplectropus menna</i>							1			2	
<i>Pseudoneureclipsis asa</i>									2		1
<i>Pseudoneureclipsis methusalah</i>						14					
<i>Pseudoneureclipsis philemon</i>						14					
<i>Pseudoneureclipsis uma</i>					4						1
<i>Pseudoneureclipsis usia</i>							1		1		21
Psychomyiidae											
<i>Lype atria</i>								1			
<i>Paduniella Semarangensis</i>		1			1	36					
<i>Paduniella wangtakraiensis</i>								1			
<i>Psychomyia arthit</i>					21	64					
<i>Psychomyia benyagai</i>			2			70					
<i>Psychomyia chompu</i>				3	8	1					
<i>Psychomyia inthorachit</i>						42					
<i>Psychomyia kaiya</i>						185					
<i>Psychomyia kerynitia</i>									2	1	
<i>Psychomyia kiskinda</i>						1			3		
<i>Psychomyia lak</i>						290					
<i>Psychomyia monto</i>						12				1	5
<i>Tinodes cincibilus</i>			10								
<i>Tinodes mahalat</i>									1		
<i>Tinodes mogetius</i>			3								
Xiphocentronidae											
<i>Abaria guatila</i>										1	1
<i>Drepanocentron curmisagius</i>							5	4			6
<i>Drepanocentron jabal</i>								2			

Family Species	KMP upper	KMP lower	SRB	SRT	WCRT	MK	PP	PL	Mon upper	Mon lower	PNG
<i>Drepanocentron vercaius</i>							2				
<i>Melanotrichia attia</i>			2								
Ecnomidae											
<i>Ecnomus suadrus</i>										1	
<i>Ecnomus venimar</i>								2			2
Arctopsychidae											
<i>Arctopsyche hynreck</i>		1	29								
<i>Arctopsyche variabilis</i>	4	1									
<i>Parapsyche intawitichajanon</i>	1										
Hydropsychidae											
<i>Cheumatopsyche admetos</i>							7				
<i>Cheumatopsyche carna</i>						378					
<i>Cheumatopsyche ceres</i>			2								
<i>Cheumatopsyche charites</i>			1	71	1392	8199					
<i>Cheumatopsyche chrysothemis</i>						28					1
<i>Cheumatopsyche cocles</i>			1					48	26	26	
<i>Cheumatopsyche copia</i>			2	206	1500	886				1	
<i>Cheumatopsyche criseyde</i>			1	22	70	669					
<i>Cheumatopsyche globosa</i>						380					1
<i>Cheumatopsyche jaekam</i>						14					
<i>Diplectrone aurovittata</i>	41	8	15			42		12	10	9	7
<i>Diplectrone burha</i>		3									
<i>Diplectrone eurydike</i>			1	4	5			7	1	1	1
<i>Diplectrone harpyia</i>	31	2	2				1				
<i>Diplectrone hermione</i>							9	1	1	1	
<i>Diplectrone joannisi</i>			1				16	1	1		
<i>Hydromanicus abiud</i>					1		10	6	2	1	3
<i>Hydromanicus adonis</i>							6	16	2		
<i>Hydromanicus eldaa</i>							1		2		
<i>Hydromanicus eliakim</i>	4	8	15								
<i>Hydromanicus inferior</i>		1	57	153	132	123		6	7	3	18
<i>Hydromanicus klanklini</i>							3	19	5	5	1
<i>Hydromanicus luctuosus</i>			30				3		12	10	
<i>Hydromanicus punctosalis</i>			20						1	1	
<i>Hydromanicus scotosius</i>			1								
<i>Hydromanicus sealthiel</i>							6		1		
<i>Hydromanicus serubabel</i>								61	10	22	18
<i>Hydropsyche arcturus</i>									1	3	
<i>Hydropsyche askalaphos</i>			2	35	118	17					

Family Species	KMP upper	KMP lower	SRB	SRT	WCRT	MK	PP	PL	Mon upper	Mon lower	PNG
Goeridae											
<i>Goera atiugo</i>			13								
<i>Goera matuilla</i>											2
<i>Goera redsat</i>					20	4					
<i>Goera redsomar</i>				1		86					3
<i>Goera unica</i>					1	2					
<i>Larcasia lannaensis</i>									1	1	
Uenoidea											
<i>Uenoa ketura</i>	1										
Lepidostomatidae											
<i>Lepidostoma abruptum</i>									1	1	
<i>Lepidostoma aprilius</i>	3										
<i>Lepidostoma brueckmanni</i>			14	5	1		1				
<i>Lepidostoma daidalion</i>						14			1	2	
<i>Lepidostoma doligung</i>						28				1	4
<i>Lepidostoma fischeri</i>			5								
<i>Lepidostoma inthanon</i>	60	19									
<i>Lepidostoma martius</i>				1	1		1			1	1
<i>Lepidostoma moulmia</i>				1			25	10	1	2	
<i>Lepidostoma pratetaiensis</i>							1			1	4
<i>Lepidostoma pseudoabruptum</i>									1		1
<i>Lepidostoma septembrius</i>							1				
<i>Lepidostoma taungya</i>							4	1			
<i>Lepidostoma varithi</i>	3										
<i>Paraphlegopteryx angkangensis</i>	2										
<i>Paraphlegopteryx malickyi</i>	1	5									
Leptoceridae											
<i>Adicella evadne</i>			23				1	3			1
<i>Adicella kanake</i>			3								2
<i>Adicella larentia</i>							1				
<i>Ceraclaea globosa</i>						25					
<i>Leptocerus hylaios</i>						4					
<i>Leptocerus inthanonensis</i>						1					1
<i>Leptocerus protesilaos</i>						2					
<i>Leptocerus skamendrios</i>						14					
<i>Leptocerus suthepensis</i>											1
<i>Mystacides elongata</i>				1							
<i>Oecetis iros</i>						14					

Family Species	KMP upper	KMP lower	SRB	SRT	WCRT	MK	PP	PL	Mon upper	Mon lower	PNG
<i>Oecetis miletos</i>											1
<i>Oecetis pretakalpa</i>						1					
<i>Oecetis purusamedha</i>					4	1					
<i>Oecetis raghava</i>											2
<i>Oecetis tripunctata</i>					4				1		6
<i>Parasetodes respersella</i>						2					
<i>Setodes abhirakta</i>					1			4	6	16	
<i>Setodes argentiguttatus</i>						1					
<i>Setodes endymion</i>						14			1		
<i>Setodes isis</i>						28					1
<i>Setodes kerkopos</i>			1						2	1	
<i>Setodes lailaps</i>		2									
<i>Setodes likymnios</i>						84					
<i>Setodes mefitis</i>						8					
<i>Setodes megaira</i>						14					
<i>Setodes menestratos</i>			2	4	14	1					
<i>Setodes menestratos</i>						24					
<i>Setodes menoikeus</i>					4	126					
<i>Setodes mercurius</i>					4	1					
<i>Setodes metis</i>				5	96	29					
<i>Setodes neleus</i>											1
<i>Setodes periklymenos</i>						28					
<i>Setodes sarapis</i>											1
<i>Setodes tcharurupa</i>					1	371					225
<i>Triaenodes pentheus</i>				1							
<i>Trichosetodes anaksepuluh</i>						14					
Odontoceridae											
<i>Inthanopsyche trimeresuri</i>	9		10								
<i>Lannapsyche chantaramongkolae</i>			1					1			
<i>Marilia aerope</i>				2	68	62					
<i>Marilia mogtiana</i>				2	11	5					4
<i>Marilia sumatrana</i>			2	1					3		1
<i>Psilotreta abudeb</i>			2								
<i>Psilotreta baureo</i>			2	3	3		1				
<i>Psilotreta quin</i>						1					
Calamoceratidae											
<i>Anisocentropus brevipennis</i>											1
<i>Anisocentropus diana</i>							1				
<i>Anisocentropus janus</i>									3	5	7

Family <i>Species</i>	KMP upper	KMP lower	SRB	SRT	WCRT	MK	PP	PL	Mon upper	Mon lower	PNG
<i>Anisocentropus pan</i>				1			1	4			3
<i>Anisocentropus pandora</i>	1										
<i>Anisocentropus salsus</i>			2								
<i>Ganonema dracula</i>			4								
<i>Ganonema extensum</i>									3	1	
<i>Ganonema fuscipenne</i>				2		1					3
Molannidae											
<i>Molannodes alticola</i>		1									
<i>Molannodes lirr</i>									1	3	
<i>Molannodes magdiel</i>											1
<i>Mollannodes nimrod</i>	1										
Total	<u>295</u>	<u>232</u>	<u>615</u>	<u>773</u>	<u>4100</u>	<u>14720</u>	<u>237</u>	<u>581</u>	<u>330</u>	<u>291</u>	<u>644</u>



Appendix IV

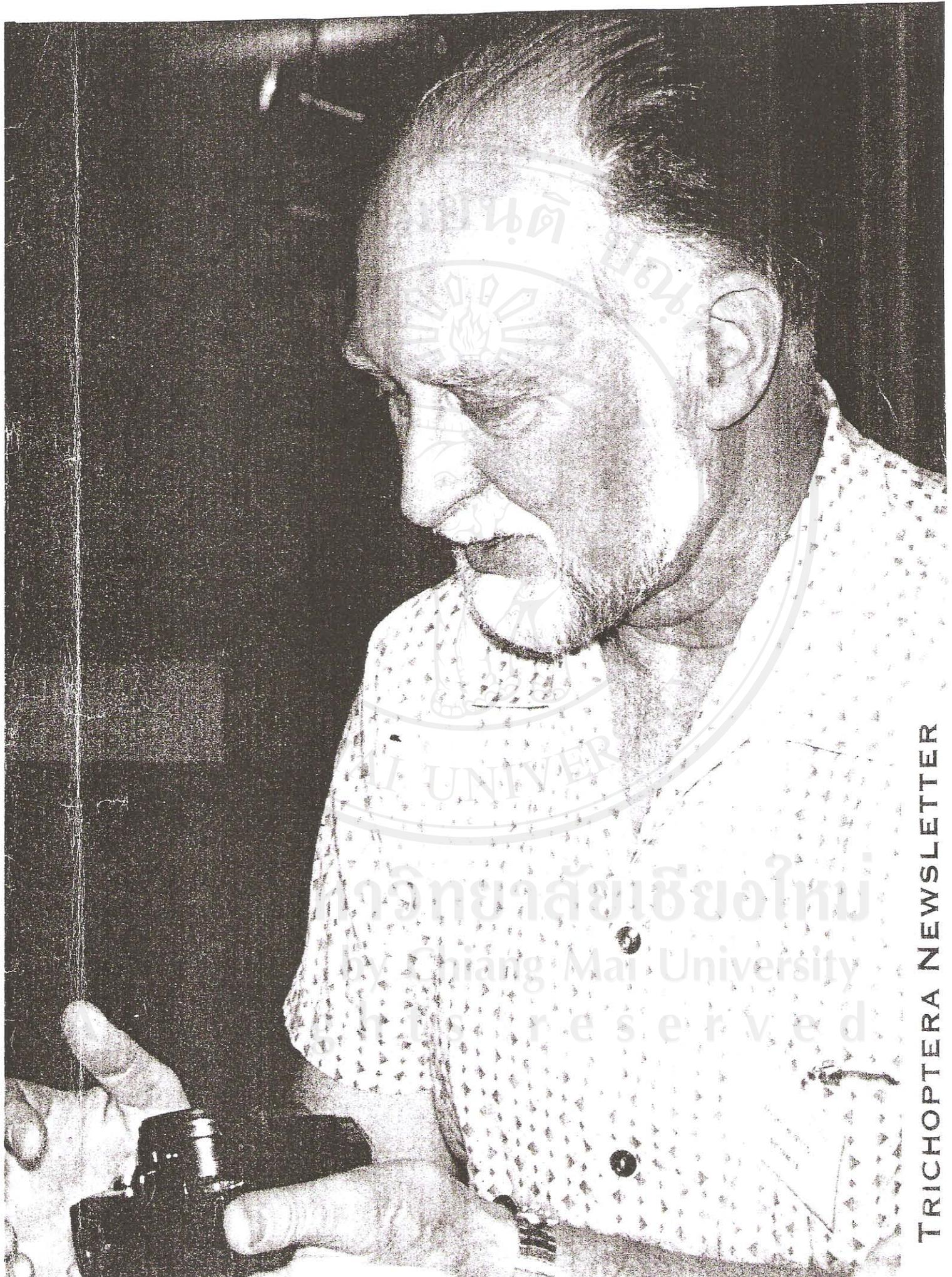
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The biodiversity of Trichoptera assemblage in Doi Suthep-Pui and Doi Inthanon National Parks, Chiang Mai, Thailand

Pensri BUNLUE, Pomtip CHANTARAMONGKOL, Decha THAPANYA & Hans MALICKY

Abstract

The Trichoptera in Doi Suthep-Pui and Doi Inthanon National Park (NP) was studied using light traps during 2009-2010. The study sites included five sites in Doi Suthep-Pui NP (i.e., Pu Ping water supply, Montatarn_upper, Montatarn_lower, Pa Lad, and Pa Ngerb at 1,171, 746, 693, 686 and 461 m asl, respectively) and six sites in Doi Inthanon NP (i.e., Kaew Mae Pan_upper, Kaew Mae Pan_lower, Siribhum, Siritarn, Wachiratarn, and Mae Klang at 2,070, 2,051, 1,380, 890, 750, and 630 m asl respectively). A total of 4339 male Trichoptera representing 195 species (122 identified species in Doi Suthep-Pui and 114 identified species in Doi Inthanon) were collected in 87 light traps during the study period. Trichoptera data from previous light trap studies at Doi Suthep-Pui NP and Doi Inthanon NP (PROMMI (1999) and THAMSENANUPAP (2005)) were combined with those from the present study to create a comprehensive Trichoptera database thus allowing for comparison and evaluation of species diversity, distribution, and abundance over time. The present database contains 23,702 individuals (males) belonging to 23 families and representing a total of 319 species recorded at Doi Suthep-Pui and Doi Inthanon NPs. Establishment of this initial Trichoptera database will serve as a data repository for future expansion to other locations throughout Thailand, and will allow for the evaluation of best research practices, and the long-term assessment of the conservation status of species and habitats.

Introduction

Freshwater ecosystems, particularly lotic ecosystems (streams and rivers), are an essential resource for the survival of many living organisms including human beings. Although lotic ecosystems represent a minute fraction of the Earth's water storage, they play a significant role in supporting a wealth of biodiversity and interdependent biosystems. As with virtually all ecosystems on earth, lotic ones are facing increasing pressure primarily from anthropogenic threats. The primary threats that have been reported include overexploitation, watershed degradation, flow modification, instream habitat alteration, non-native species invasion, pollution, and global climate change (ALLEN & FLECKER, 1993, DUDGEON & al. 2006, STRAYER & DUDGEON, 2010).

Among the many animal species found in riverine ecosystems around the world, Trichoptera in particular, represent taxa of crucial importance to the functional and structural makeup of these ecosystems. They are great in species richness and abundance. Their special role in the riverine ecosystem ecology has attracted considerable study by biologists which is well-documented by the research on taxonomy, biology and ecology in many regions, especially temperate zones. Some species show particular sensitivity to

environmental changes, while others demonstrate considerable tolerance. They have also shown the ability to adapt to and thrive in a variety of instream habitats (VINSON & HAWKINS, 1998). As such, Trichoptera serve as important bioindicators in studies of lotic ecosystems (NÓGRÁDI & UHERKOVICH, 1999; MALICKY, 2010).

To-date, 1000 species of Trichoptera have been identified throughout Thailand (MALICKY, 2010), beginning with the first Trichoptera study in 1987 at the Doi Suthep-Pui National Park (NP) (MALICKY & CHANTARAMONGKOL, 1987). The research on Trichoptera in Thailand not only involves taxonomic evaluation, but also includes increasing work on their ecology, biology and biomonitoring (SOMPONG & CHANTARAMONGKOL, 1999; THANI & CHANTARAMONGKOL, 1999; CHAIBU & al., 2002; THAMSENANUPAP & al., 2005). Among the many sites where Trichoptera have been found, Doi Suthep-Pui NP and Doi Inthanon NP have been key research areas due to their species diversity and extraordinary environment. Most of the Trichoptera type specimens come from these two areas (MALICKY, 2010).

Overnight light trap collecting by PROMMI (1999) in Doi Suthep-Pui NP from 1998-1999 resulted in the identification of 153 different Trichoptera species along the NP's Huay Kaew stream (at 4 sampling sites with elevation differences), and the Huay Koo Kaew and Pa Lad streams. In 2002-2003, light trap collecting by THAMSENANUPAP (2005) revealed 93 different species from the Montatarn and Sai Yoi waterfalls in Doi Suthep-Pui NP, and 186 different species from the Huai Sai Lüang, Mae Pan Noi, Siribhum and Mae Klang streams in Doi Inthanon NP.

Additionally, THAPANYA & al. (2004) published a review of several Trichoptera studies that used various collecting methods and reported a total of 199 different species that were found in Doi Suthep NP and 249 different species found in Doi Inthanon NP including the altitudinal range and phenology. He concluded that the total number of species found in both national parks was 345; this represents about 34.5% of all the identified species in Thailand (MALICKY, 2010).

With respect to the conservation status of Trichoptera, as the result of their vulnerability to changes in habitat and water quality, IUCN has listed 4 species of caddisflies as extinct (IUCN, 2010). In Hungary, Trichoptera species have been categorized into 6 groups (unknown, extinct, endangered, vulnerable, presumed vulnerable, and not threatened) and eleven threatened trichoptera species are legally protected (NÓGRÁDI & UHERKOVICH, 1999). Further, SCHMERA (2001, 2002, 2003 and 2004) developed a procedure to categorise the conservation status of Trichoptera species and their habitat using a calculation based on their rarity, abundance and occurrence, collected by light traps.

The purpose of the present study was to provide current data on the status of Trichoptera (collected using light traps) in Doi Suthep-Pui and Doi Inthanon NPs and to construct a Trichoptera database that will facilitate the comparison and evaluation of species diversity, distribution, abundance and rarity status at both NPs over time. Establishment of this initial Trichoptera database will serve as a data repository for future

expansion to other locations throughout Thailand, and will allow for the evaluation of best research practices, and the long-term assessment of the conservation status of species and habitats.

Methods

Mae Klang-Sob Aeb is a wide stream (about 10-13 m in width). The water surface has full exposure, and the predominant substrate is boulders. Wachiratarn and Siritarn are turbulent waterfalls, with a high amount of discharge throughout the year and a dominant substrate of bedrock. Siribhum has a variety of microhabitats such as bedrock, boulder and gravel and the area along the stream has been modified as a tourist attraction. Kaew Mae Parn_lower and upper reaches have dense riparian forest, water temperature less than 15°C throughout the year, and a predominate substrate of rock, gravel and organic materials. Pa Ngerb stream reach has a variety of microhabitats in which gravel and rock are predominant. Montatarn_upper and lower waterfalls are tourist areas, and the streambed has been modified and disturbed. The predominant substrate is bedrock, gravel and sand. Pa Lad has bedrock and gravel as the predominant substrate. During the hot dry season, part of the stream dried out for few days. On Pu Ping water supply, the stream reach has been regulated by a permanent dam. The predominant substrate includes bedrock and sand.

Study sites. The study sites were located in Doi Suthep-Pui and Doi Inthanon National Park, Chiang Mai Province, Thailand (Figure 1). The study site locations included:

Doi Inthanon NP		Doi Suthep-Pui NP	
1. Mae Klang-Sop Ab (MK; 630 m asl)	18° 31' 47" N 98° 36' 34" E	1. Pa Ngerb (PNG; 461 m asl)	18° 48' 47" N 98° 56' 18" E
2. Wachiratarn (WCRT; 750 m asl)	18° 32' 30" N 98° 35' 57" E	2. Montatarn_lower (Mon_lower; 693 m asl)	18° 49' 00" N 98° 55' 24" E
3. Siritarn (SRT; 890 m asl)	18° 32' 36" N 98° 34' 47" E	3. Montatarn_upper (Mon_upper; 746 m asl)	18° 49' 02" N 98° 55' 24" E
4. Siribhum (SRB; 1,380 m asl)	18° 33' 11" N 98° 34' 33" E	4. Pa Lad (PL; 686 m asl)	18° 47' 02" N 98° 55' 24" E
5. Kaew Mae Parn_Lower (KMP_lower; 2,051 m asl)	18° 32' 47" N 98° 30' 58" E	5. Pu Ping water supply (PP; 1,171 m asl)	18° 48' 19" N 98° 54' 28" E
6. Kaew Mae Parn_Upper (KMP_upper; 2,074 m asl)	18° 32' 37" N 98° 28' 34" E		

Insect collecting was conducted from November 2009 through November 2010 using light traps (pan traps) which consisted of a black light lamp, 12N11 rechargeable battery and plastic pan (measuring 33 x 33 x 14 cm) filled to one third full with a water and detergent mixture. The traps were set up overnight (just before sunset till sunrise) at each site. A total of 87 light trap collecting sessions were conducted over the study period with 45 light traps set up in the 5 sites in Doi Suthep-Pui NP and 42 light traps in the 6 locations in Doi Inthanon NP (Table 1). The male Trichoptera fauna were identified using the illustrated key from the "Atlas of Southeast Asian Trichoptera" (MALICKY, 2010). The specimens from this study were deposited as a reference collection at the Environmental Monitoring: Aquatic Insect Research Unit, Biology Department, Faculty of Science, Chiang Mai University.

In order to construct a comprehensive database for Trichoptera, abundance data from PROMMI (1999) and THAMSENANUPAP (2005) were included with those from the present study. This provided for a more complete evaluation of species richness and abundance and allowed for comparison with the current study. The expected Trichoptera biodiversity was estimated using EstimateS 8.2 (COLWELL, 2009). Random sampling in each area was used for calculations such as species accumulation predictor (Chao 1), abundance coverage estimator (ACE), and raw observed species (Sobs). Cluster analyses of the abundance data from the study sites in each NP, were assessed using MVSP - MultiVariate Statistical Package 3.1 (KOVACH, 1999). A dendrogram was constructed to illustrate the similarity of the assemblages using Simpson's Coefficient and the UPGMA method. Simpson's Coefficient is defined by the following:

$$I = a/[a + \min(b, c)]$$

a = number of species that were found in both assemblages

b = number of species that were found only in assemblage 1

c = number of species that were found only in assemblage 2

Results

A total of 4339 male Trichoptera representing 194 different species (122 identified species in Doi Suthep-Pui NP and 113 identified species in Doi Inthanon NP with 41 shared species (species repeats) between the two NPs) were collected during the current study (see Table 2). Of the 122 species identified in Doi Suthep-Pui NP, only 83 (or 40% of the total identified species in Doi Suthep-Pui NP) showed overlap with species identified in previous studies (PROMMI, 1999; THAMSENANUPAP, 2005). Of the 113 species identified in Doi Inthanon NP, only 76 (35% of the total identified species in Doi Inthanon NP) were also identified in previous studies (THAMSENANUPAP, 2005) (Table 2).

The Trichoptera database (composed of data from the current study and that from PROMMI, (1999) and

THAMSEANUPAP (2005)) contained information on a total of 23,702 male Trichoptera belonging to 23 families (a total of 28 families have been identified throughout Thailand) and representing a total of 319 different species in the Doi Suthep-Pui and Doi Inthanon NPs combined (See Table 2). There were 89 species identified with only 1-2 specimens per species (rare), 169 species with 3 - 100 specimens per species (common), 61 species with 101-1,000 specimens per species (abundant), and 4 species with >1,000 specimens per species (e.g. *Chimarra suthepensis* CHANTARAMONGKOL & MALICKY, 1998 and *Cheumatopsyche cocles* MALICKY & CHANTARAMONGKOL, 1997 which were mostly found in Doi Suthep-Pui NP and *Paduniella semarangensis* ULMER, 1913 and *Ugandatrachia maliwan* MALICKY & CHANTARAMONGKOL, 1991 which are only found in Doi Inthanon NP).

Only 14 species of caddisflies were found in the highest study sites (2050 and 2071 m asl) during the 2009-2010 collections (number in the parentheses represent number of individuals): *Rhyacophila bicolor doiangka* MALICKY 1999 (1), *Rhyacophila blenda* MALICKY & CHANTARAMONGKOL 1993 (5), *Rhyacophila falita* ROSS 1956 (5), and *Rhyacophila murhu* MALICKY & CHANTARAMONGKOL 1989 (4) (Family Rhyacophilidae), *Chimarra inthanonensis* CHANTARAMONGKOL & MALICKY 1989 (2), *Dolophilodes torrentis* KIMMINS 1955 (36), and *Wormaldia serrata* KIMMINS 1955 (1) (Family Philopotamidae), *Arctopsyche variabilis* SCHMID 1968 (4) (Family Arctopsychidae), *Nothopsyche muqua* MALICKY & CHANTARAMONGKOL 1989 (1) and *Moropsyche gerolan* MALICKY & CHANTARAMONGKOL 1991 (2) (Family Limnephilidae), *Lepidostoma inthanon* MALICKY & CHANTARAMONGKOL 1994 (52), *Lepidostoma varithi* MALICKY & CHANTARAMONGKOL 1994 (1), *Paraphlegopteryx angkangensis* WEAVER 1999 (2) and *Paraphlegopteryx malickyi* WEAVER 1999 (4) (Family Lepidostomatidae).

The grouped similarity of sites based on species composition and their abundance was revealed by UPGMA with Simpson's coefficient. In Doi Suthep-Pui, the data showed that four groups likely relate to habitat features (stream and waterfall+stream) (Figure 3) and in Doi Inthanon, four groups were represented by distinctive elevation differences (figure 4).

The accretion species curve for Doi Suthep-Pui showed the asymptote graph of $y = 30.943\ln(x) + 21.086$, $R^2 = 0.9976$. For Doi Inthanon, the curve showed a rising trend graph where $y = 22.48 \ln(x) - 33.067$, $R^2 = 0.8768$.

Discussion

Over the past two decades of study on the Trichoptera fauna of Thailand mainly concentrates in northern areas, about 1000 species have been recorded (MALICKY, 2010). The current study, together with those by PROMMI, (1999) and THAMSEANUPAP (2005), have identified a total of 319 species in both Doi Suthep-Pui and Doi Inthanon NPs. These species, collected by light trap, account for approximately 32% of the Trichoptera fauna found in Thailand. Given the high diversity of

Trichoptera in these two NPs, there is considerable likelihood for the discovery of more new species in other areas of Thailand (MALICKY & PROMMI, 2006).

Based on the review of the accretion species curve for Doi Suthep-Pui, the curve had reached asymptote, although most of sites were located only on one side of the mountain. Meanwhile, the accretion species curve for Doi Inthanon showed that more collecting should be conducted to reveal the complete biodiversity of the area.

Doi Inthanon NP is remarkable for its biodiversity and a well-known tourist attraction due to the impressive and unique forest. In particular, the high elevation streams support an unique habitat with year round cold water temperatures and dense, moist riparian forests. This ecosystem is also home to potentially rare species such as *Nothopsyche muqua* MALICKY & CHANTARAMONGKOL 1989. This species has only been found in Doi Inthanon, at 1200-1300 m asl (MALICKY & CHANTARAMONGKOL, 1993) and during the current study in Keaw Mae Pan_upper (one specimen was identified at 2071 m asl). These are the only reports of this species in Thailand. Similarly, during the current study, *Eubasilissa maclachlani* WHITE 1862, the largest caddis species in Thailand, was found in Siribhum (1380 m asl) and in Keaw Mae Pan_lower (2050 m asl). From a conservation standpoint, these rare species may serve a useful role as candidate flagship species (see GUINEY & OBERHAUSER, 2008) helping to generate public awareness and appreciation of the need for habitat conservation of critical lotic ecosystems.

To date, establishment of the Trichoptera database (composed of data from the current study and that from PROMMI (1999) and THAMSEANUPAP (2005)) has provided a more comprehensive understanding of the distribution, occurrence and abundance of species in Doi Suthep-Pui and Doi Inthanon NPs. This database has allowed for comparison of species composition both geographically and temporally. It also has demonstrated the need for additional and continuous updating of information so as to ensure adequate evaluation of Trichoptera and associated habitats. Establishment of this initial database will serve as a data repository for future expansion to other areas throughout Thailand, and will allow for the evaluation of best research practices, the application of Trichoptera as bioindicators for water and habitat quality, and the long-term assessment of the conservation status of the species and their habitats.

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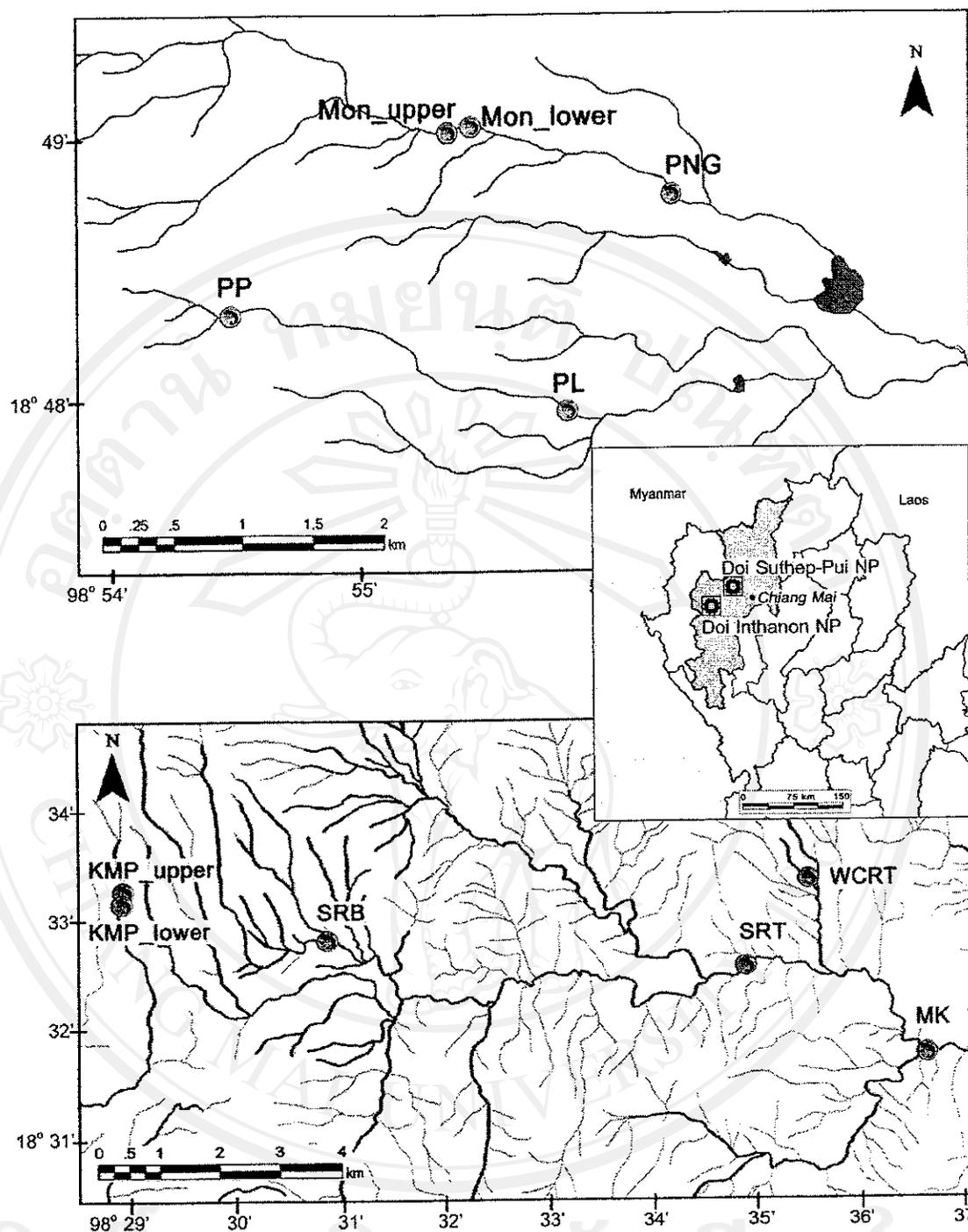


Figure 1 : Location of the collecting sites in Doi Suthep-Pui NP (top) and Doi Inthanon NP (below) during 2009 - 2010.

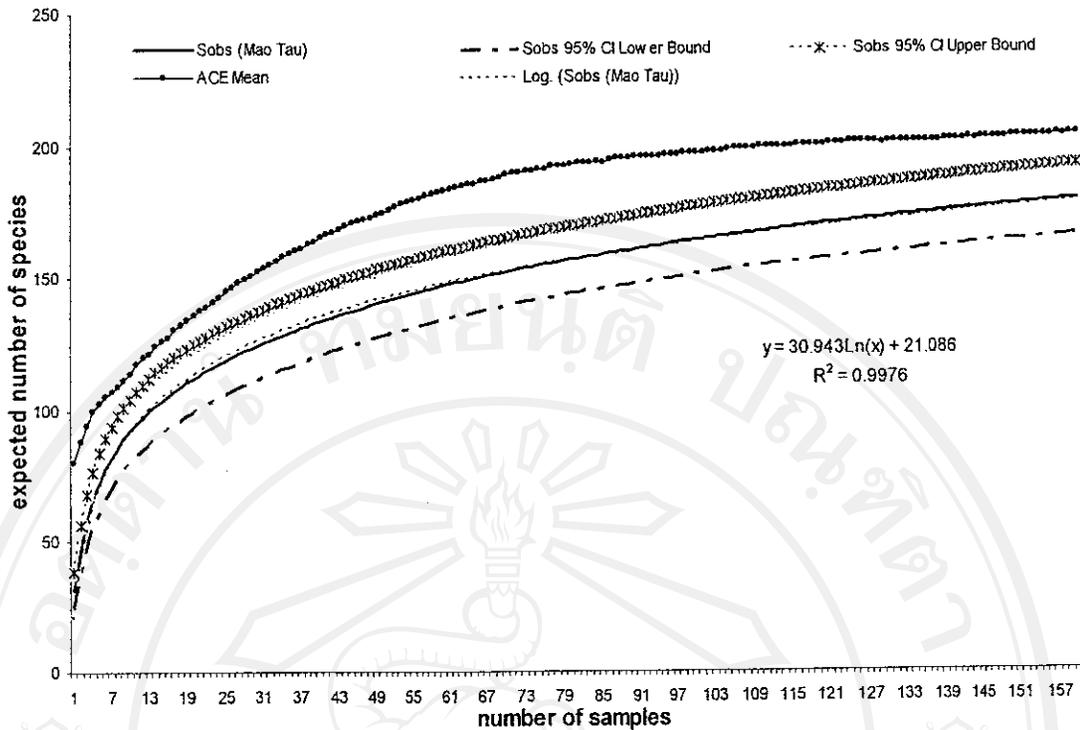


Figure 2 : Species accumulation curve for all sites in Doi Suthep-Pui N P [combined data from Prommi (1999), Thamsenanupap (2005) and Bunlue et al. (current study)]. The solid lines show the observed species (Sobs) and the dash lines show the corresponding 95% confidence bounds.

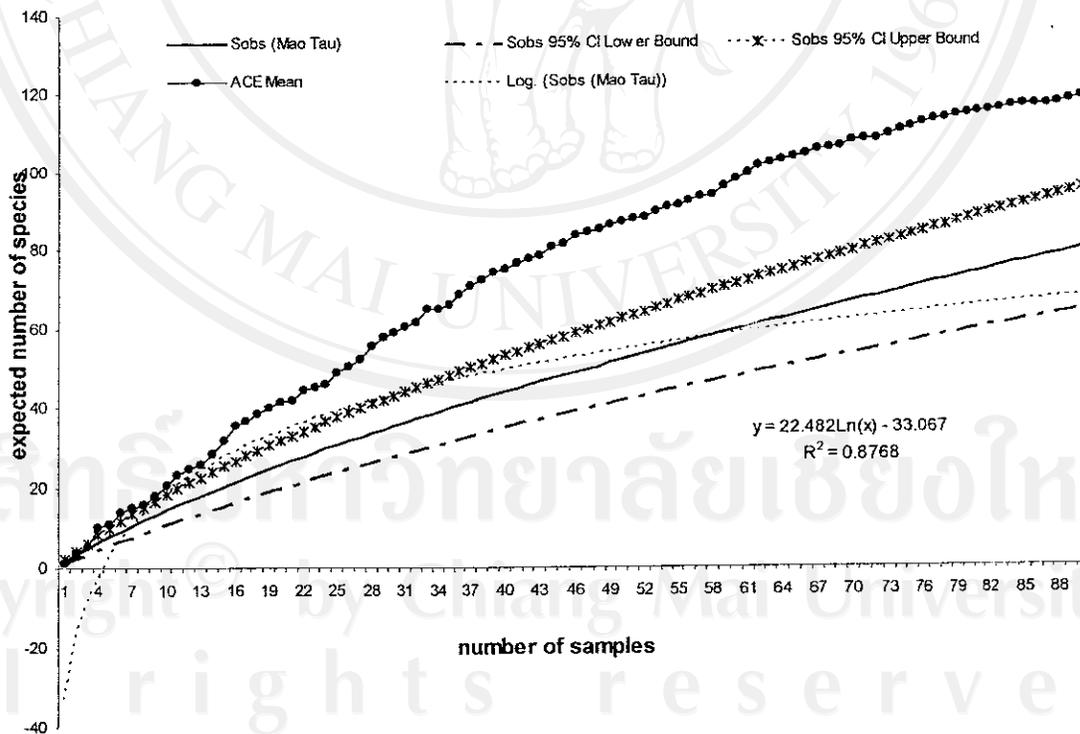


Figure 3: Species accumulation curve, all sites in Doi Inthanon NP [combined data from Thamsenanupap (2005) and Bunlue et al. (current study)]. The solid lines show the observed species (Sobs) and the dash lines show the corresponding 95% confidence bounds.

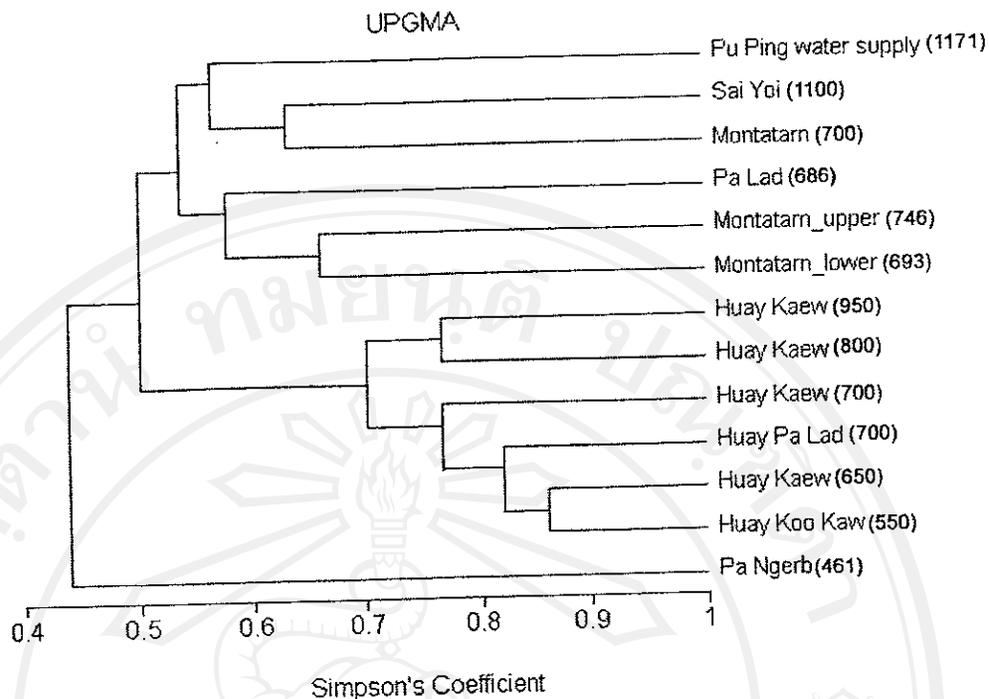


Figure 4: Cluster analysis (UPGMA and Simpson's coefficient) of sites in Doi Suthep-Pui NP. based on abundance data of adult trichoptera from Prommi (1999), Thamsenanupap (2005) and Bunlue et al. (current study). Numbers in the parentheses indicate elevation (m asl).

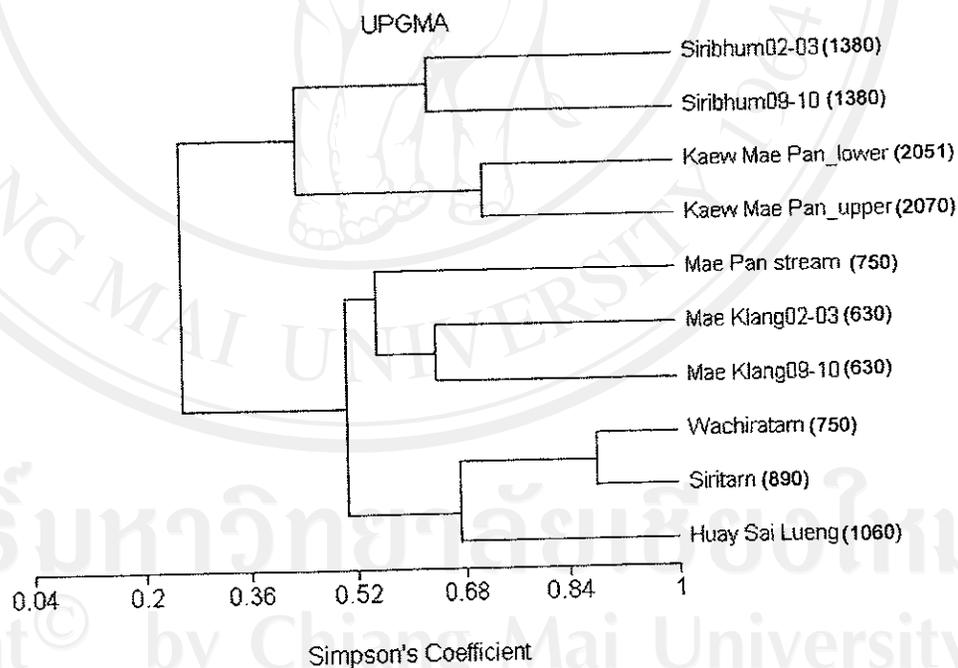


Figure 5: Cluster analysis (UPGMA and Simpson's coefficient) of sites in Doi Inthanon NP. based on abundance data of adult trichoptera from Thamsenanupap (2005) and Bunlue et al. (current study). Number in the parentheses indicate elevation (m asl).

Table 1 Summary of species richness and abundance at Doi Suthep-Pui and Doi Inthanon NPs

<u>Study Site</u>	<u>Elevation (m asl)</u>	<u>Habitat Type</u>	<u># Light Trap Collecting</u>	<u>#Species</u>	<u>#Individuals (males)</u>
Doi Suthep-Pui NP.					
2009-2010 (Bunlue <i>et al.</i> , current study)					
Pa Ngerb	461	stream	9	60	532
Montatarn_lower	693	waterfall+stream	9	57	273
Montatarn_upper	746	waterfall+stream	9	55	268
Pa Lad	686	waterfall+stream	9	43	478
Pu Ping water supply	1,171	waterfall+stream	9	45	207
Total			45	(122)	1,758
2002-2003 (Thamsenanupap, 2005)					
Montatarn	700	waterfall+stream	12	68	938
Sai Yoi	1,100	waterfall +stream	12	67	1,356
Total			24	(93)	2,294
1998-1999 (Prommi, 1999))					
Huay Koo Kaw	550	stream	16	64	568
Huay Pa Lad	700	stream	16	65	1,143
Huay Kaew	650	stream	16	93	1,867
Huay Kaew	700	stream	16	92	1,712
Huay Kaew	800	stream	16	76	1,429
Huay Kaew	950	stream	16	81	1,659
Total			96	(153)	8,378
Doi Inthanon NP.					
2009 - 2010 (Bunlue <i>et al.</i> , current study)					
Mae Klang	630	stream	7	42	884
Wachiratarn	750	waterfall+stream	7	39	702
Siritarn	890	waterfall+stream	7	24	237
Siribhum	1,380	waterfall+stream	7	51	498
Kaew Mae Pan_lower	2,051	stream	7	20	145
Kaew Mae Pan_upper	2,070	stream	7	23	115
Total			42	(113)	2,581
2002-2003 (Thamsenanupap, 2005)					
Mae Klang	630	stream	12	71	3,700
Mae Pan Noi	750	stream	12	78	898
Huay Sai Lueng	1,060	waterfall+stream	12	99	1,939
Siribhum	1,380	waterfall+stream	12	79	2,154
Total			48	(186)	8,732
Grand Total			255	(319)	23,702

Note: Species numbers in parentheses () indicate the total number of different species identified at each NP by each study. Species repeats among locations are not reflected in the totals. The grand total () represents the total number of different species identified by all studies in both NPs combined.

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Poster presentation

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