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Trichoptera (Caddisflies) Diversity, New Records, and Species' Relationship to Water Quality Parameters in Lower Phuket Mountain Range, Thailand

Solomon Boga Valdon[1;] Pongsak Laudee2
[1]Faculty of Science and Industrial Technology, Prince of Songkla University,
[2]Faculty of Innovative Agriculture and Fishery Establishment Project,
Prince of Songkla University, Surat Thani Campus, Muang District, Surat Thani Province, Thailand 84100

Abstract:- A survey on the occurrence of caddisflies, distribution, and abundance was carried out in four protected areas of Khlong Saeng Wildlife Sanctuary, and Khlong Phanom, Kaengkrung, Khao Sok National Parks in Surat Thani Province, southern Thailand. These are areas found in the west of Surat Thani province that hold the Lower Phuket mountains, an off-shoot range linked to the great Tenasserim Hills called the Indo-Malayan Mountain system. The streams of Khlong Phanom, Khlong Yan, Khlong Sok, and Khlong Saeng tributaries of the Phum Duang River were used for this investigation. The largest water source of River Tapi is Phum Duang, which drains the wetlands of the Tapi River. This study was conducted in March-December 2019. samples were collected once in the dry season and twice during the rainy season, giving a sum of three collections during the research. The results revealed that two hundred and one (201) species were caught and identified, this falls into fifty-one (51) genera, and eighteen (18) families. Families Ecnomidae, Philopotamidae, Hydropsychidae, and Leptoceridae are extensive and constitute about sixty percent (60%) of the insects sampled. *Cheumatopsyche contexta* ULMER 1951[*], *Cheumatopsyche opposita* BANKS 1931[*], and *Polymorphanisus scutellatus* BANKS 1939[*], were the new records observed. Water quality variables were correlated to some species, and the analysis revealed that some species demonstrated negative and positive responses to various water parameters.

Keywords:- *National Parks, Occurrence, Tributaries, New Records.*

I. INTRODUCTION

Aquatic insects are important components of aquatic ecosystems worldwide, living in terrestrial habitats close to water sources. In contrast, their immature stages, or juveniles referred to as aquatic macroinvertebrates, spend their lifetime in water as benthos. Three orders of aquatic insect groups: Trichoptera, Ephemeroptera, and Plecoptera are substantially exploited in the study of aquatic environmental conditions. However, Trichoptera (Caddisflies) seems more suitable in the distribution, diversity, and ecology of the streams, lakes, and rivers they inhabit. They belong to the holometabolous insect group. The diversity of Trichoptera fauna in tropical countries is very extensive, particularly in the Oriental region (Melnitsky et al. 2019). Morse et al. (2019) reported that caddisfly distribution varies across the Biogeographical regions globally, they added that the Oriental region has the largest number and diversity, while the East Palearctic has the lowest. In addition. they showed that more than 5,854 instant species were described in the Oriental region alone. Literature has also shown that there has been an increase in the study of Trichoptera in this region in the last decade, adding more than 3,000 species to the knowledge of science in the same period (Laudee et al. 2020). Thailand is located within the Oriental region where great biodiversity exists of both flora and fauna Laudee and Prommi (2011), however, revealed that the study of Trichoptera in the south of Thailand was at the lowest level. Caddisflies are considerably distributed in Thailand and are probably the most largely studied order of aquatic insects in Southeast Asia (khamrak and Prommi, 2020). The study of Trichoptera in Thailand is high but more concentrated in Doi Inthanon and Doi Suthep-Pui National Parks, north of the country than other parts (Bunlue et al. 2012, Thapanya et al. 2004). Trichopteran immature stages make up a [large number of macroinvertebrates in freshwater bodies with varying responses to aquatic environmental conditions. They are used as biomonitoring tools/indicators to evaluate the water parameters of their habitats. The large quantities and diversities of Caddisflies larvae in streams and rivers indicate that the water is good quality. Extensive use of Trichoptera juveniles has been possible because larvae of different species vary in the manner in which they respond to various water conditions (Holzenthal, 2017). The result of this research is used to compare the distribution and diversity pattern of Trichoptera in the Lower range lowlands of the Tenasserim Mountain system in the south to those of the Upper range in the north. There exist altitudinal differences between the species observed in the research area and those of the biologically diverse areas of Doi Inthanon and Doi Suthep-Pui (400-2300m) altitude. The most abundant species in the lowland forest areas consist of the members of the families Leptoceridae and Hydropsychidae (Prommi & Thani 2014, Laudee & Prommi, 2011, Prommi et al. 2014) whereas the abundant species of the Upper range are members of

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Hydropsychidae and Philopotamidae families (Thapanya et al. 2004).

II. MATERIALS AND METHODS

To investigate the presence of Trichoptera along the Phum Duang River, a study was carried out in March-December 2019. Five sampling locations were selected along each tributary of the Khlong Saeng, Khlong Yang, Khao Sok, and Khlong Phanom streams, giving a total of twenty locations. Sampling was conducted thrice (3x), twice in the wet season, and once in during the hot season. Specimens were gathered by the use of a UV-pan light trap (15W fluorescents, and 12X DC batteries), it involves placing a fluorescent tube on a plastic container containing some water with a small quantity of detergent, and set along the stream at every sample location (table. I) and kept throughout the night. Specimens gathered were conserved in 70% alcohol and conveyed to the laboratory where they were divided into groups. The posterior part of the male abdomen was removed in the process, soaked in 10% potassium hydroxide (KOH) solution, and boiled for 30-60^{o}C minutes. The structure was observed under a stereomicroscope and to compare with Malicky's (2010) structures of Trichoptera in Southeast Asia, the specimen would therefore be identified as a species. A detailed description of the classical pattern of distribution and abundance of species in this study was based on Thapanya et al. 2004 methods. Pearson's Correlation Analysis method analyzed the relationship of water quality parameters to some species.

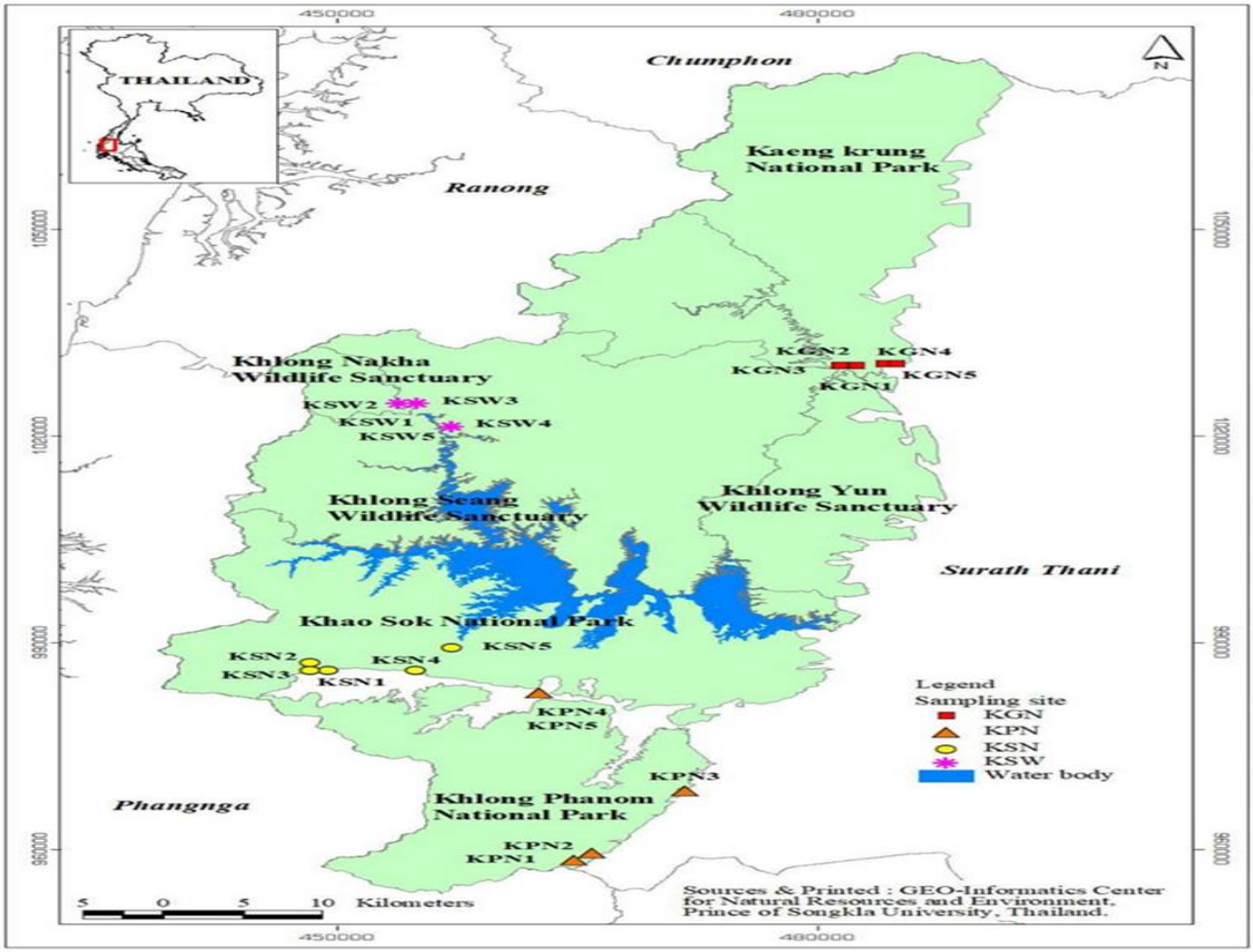

Fig. 1: The Study Area Map

Table 1: Sample Locations at Khlong Saeng Wildlife Sanctuary Kaengkrung National Parks and Khao Sok, Khlong Phanom

Site Codes	Site Names	Coordinates	Altitude (m)	Substrates
KSW5	Khlong Saeng Khlong Saeng Wildlife	9º14ʾ15ʺ N 98º35ʾ82ʺ E	102m	Sand, clay, boulder, and bedrock.
KSW4	Khlong Saeng Khlong Saeng Wildlife	9º14ʾ15ʺ N 98º35ʾ89ʺ E	99m	Sand, cobble, boulder bedrock.
KSW3	Khlong Saeng	9º15ʾ68ʺ N	85m	Sand, clay, and boulder

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	Khlong Saeng Wildlife	98°35'38" E		
KSW2	Khlong Saeng Khlong Saeng Wildlife	9°15'87" N 98°35'02" E	90m	Sand, gravel and boulder.
KSW1	Khlong Saeng Khlong Saeng Wildlife	9°15'79" N 98°34'98" E	102m	Sand and gravel
KGN5	Khlong Yan Kaengkrung National Park	9°18'59" N 98°51'90" E	61m	Sand, gravel, cobble, boulder.
KGN4	Khlong Yan Kaengkrung National Park	9°18'82" N 98°51'57" E	60m	Sand, gravel, and bedrock.
KGN3	Khlong Yan Kaengkrung National Park	9°19'17" N 98°50'04" E	90m	Sand, and gravel.
KGN2	Khlong Yan Kaengkrung National Park	9°19'22" N 98°49'90" E	59m	Sand, gravel, and boulder.
KGN1	Khlong Yan Kaengkrung National Park	9°19'18" N 98°49'98" E	62m	Sand, gravel and cobble.
KSN5	Khlong Sok Khao Sok National Park	8°56'44" N 98°35'87" E	35m	Sand, and gravel.
KSN4	Khlong Sok Khao Sok National Park	8°54'83" N 98°34°76" E	56m	Sand, and gravel.
KSN3	Khlong Sok Khao Sok National Park	8°54'65" N 98°31'63" E	49m	Sand, gravel, and cobble.
KSN2	Khlong Sok Khao Sok National Park	8°54'91" N 98°31'62" E	65m	Sand, gravel, and cobble.
KSN1	Klong Sok Khao Sok National Park	8°55'07" N 98°31'68" E	97m	Sand, gravel, and cobble.
KPN5	Khlong Phanom Khlong Phanom National Park	8°52'91" N 98°39'30" E	55m	Sand, and gravel.
KPN4	Khlong Phanom Khlong Phanom National Park	8°52'90" N 98°39'29" E	94m	Sand, and gravel,
KPN3	Khlong Phanom Khlong Phanom National Park	8°45'28" N 98°44'57" E	65m	Sand, and gravel.
KPN2	Khlong Phanom Khlong Phanom National Park	8°41'02" N 98°41'10" E	128m	Sand gravel, cobble, boulder, cobble.
KPN1	Khlong Phanom Khlong Phanom National Park	8°40'00" N 98°41'01" E	140m	Sand gravel, cobble, boulder, and bedrock.

Table 2: Trichoptera Species Diversity in Phum Duang Tributaries

Family	**KSW**	**KGN**	**KSN**	**KPN**	**L&P**	**PT**	**Abund.**	**Dist.**
Brachycentridae								
Micrasema fortiso M&C 1992	1	-	-	-	+	+		
Calamoceratidae								
Ganonema fuscipenne ALBARDA 1881	-	3	6	4	+	+	p	m
Anisocentropus brevipennis ULMER 1906	-	3	-	2	+	+	c	m
A. pan M&C 1994	1	3	3	-		+	p	m
Dipseudopsidae								
Hyalopsyche winkleri ULMER 1930	-	-	2	-				
D. doehleri ULMER 1929	-	4	-	-			p	
D. varians ULMER 1929	-	-	6	2	+	+	p	m
D. robustior ULMER1929	88	-	2	5	+		c	m
D. benardi NAVAS 1930	-	-	8	4	+		p	m
Dipseudopsis nebulosa ALBARDA 1881	97	16	1	13		+	a	m
Ecnomidae								
Ecnomus pseudotenellus ULMER 1930	-	1	2	-		+	p	m
E. vebinus M&C 1993	-	3	-	-		+	p	
E. neri M&C 1993	25	38	4	44		+	a	m
E. puro M&C 1993	30	106	28	181	+	+	a	m
E. uttu M&C 1993	1	4	1	15		+	c	m
E. robustior ULMER 1951	-	1	1	-		+		
E. penjabi SCHMID 1961	-	-	4	-		+	p	

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E. battu MALICKY 1993	-	-	10	7		+	p	m
E. digitatus MOSELY 1932	-	-	1	-				
E. anakagung MALICKY 1995	-	3	-	-				
E. volovicus M&C 1993	-	21	48	10	+	+	c	m
E. totiio M&C 1993	21	6	78	112	+	+	a	m
E. thamyris MALICKY & PROMMI 2006	-	1	-	-		+		
E. stentor MALICKY & PROMMI 2006	-	135	27	22		+	a	m
E. talenoi M&C 1993	-	3	-	-		+	p	
E. plaiwat M&C 1993	-	-	3	-		+		
E. jojachin M&C 1993	-	8	1	-		+	p	m
Glossosomatidae								
Agapetus halong OLAH 1998	3	-	-	-			p	

Table 3: Trichoptera Species Diversity in Phum Duang Tributaries (Continued)

Family	KSW	KGN	KSN	KPN	L&P	PT	Abund.	Dist.
Goeridae								
G. ateduna M&C 1992	-	-	-	3		+	p	
G. matuila M&C 1992	-	1	-	8			p	m
Goera uniformis BANKS 1931	24	11	14	62	+	+	a	m
G. echo MALICKY & THANI 2000	-	-	-	3		+	p	
G. redsomar M&C 1992	1	-	-	-				
Gastrocentrides sumatranus ULMER 1930	15	12	189	53			a	m
G. redsat M&C 1992	-	-	5	-		+	p	
Helicopsychidae								
H. anaksaku MALICKY 1995	-	1	-	1				m
H. angusta ULMER 1951	2	17	1	33			c	m
Helicopsyche lata ULMER 1951	-	-	1	-				
H. martynovi MOSELY 1939	1	-	-	2			p	m
Hydropsychidae								
Diplectrona dulitensis KIMMINS 1955	4	-	26	1		+	c	m
M. floridum NAVAS 1929	12	112	11	5	+	+	a	m
P. unipunctus BANKS 1939	-	-	1	-				
Macrostemum fenestratum ALBARDA 1887	-	-	28	-		+		
M. dohrni ULMER 1905	-	1	1	-	+	+		m
D. hermione M&C 2002	-	-	3	-		+	p	
Polymorphanisus astictus NAVAS 1923	2	-	-	-		+		
D. gombak OLAH 1993	7	9	49	7	+	+	c	m
M. midas M&C 1998	5	-	-	1		+	p	m
M. dione M&C 1998	-	-	19	-	+		p	
H. serubabel M&C 1993	1	-	2	1		+	p	m
Pseudoleptonema quinquefasciatum MARTYNOV1935	11	6	-	16		+	c	m
H. inferior C&M 1995	1	3	4	14	+	+	c	m
P. scutellatus BANKS 1939 *	-	1	-	-				
Amphipsyche gratiosa NAVAS 1922	16	255	-	20			a	m
Hydromanicus unicolor ULMER 1951	2	-	-	-				
H. abiud M&C 1993	1	-	2	-		+	p	m
Potamyia flavata BANKS 1934	3	8	1	12	+	+	c	m

Table 4: Trichoptera Species Diversity in Phum Duang Tributaries (Continued)

Family	KSW	KGN	KSN	KPN	L&P	PT	Abund.	Dist.
P. phaidra M&C 1997	14	16	5	6	+	+	c	m
P. alleni M&C 1997	-	1	6	-	+		p	m
P. chaos MALICKY & THANI 2000	26	5	-	4		+	c	m
Cheumatopsyche lucida ULMER 1907	3	18	283	36			a	m
C. globosa ULMER 1910	-	2	-	-		+		
C. opposita BANKS 1931*	-	-	17	4			c	m
C. dubitans MOSELY 1942	75	-	-	1		+	c	m

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C. contexta ULMER 1951*	-	145	1	33			a	m
C. dhanikari MALICKY 1979	29	6	15	25			c	m
C. trilari M&C 1997	6	4	13	4		+	c	m
C. copia M&C 1997	13	-	-	16	+	+	c	m
C. chryseis M&C 1997	-	3	-	124		+	c	m
C. chrysothemis M&C 1997	9	186	8	126		+	a	m
C. charites M&C 1997	227	434	675	217	+	+	a	m
C. tramota M&C 1997	9	-	-	-	+	+	p	
C. cocles M&Y 1997	-	-	-	2				
C. theophane MALICKY & PROMMI 2006	-	6	-	42		+	c	m
Hydropsyche formosana ULMER 1911	19	1	-	1			c	m
H. appendicularis MARTYNOV 1931	-	-	1	-				
H. camillus M&C 2000	18	8	-	5	+	+	c	m
H. brontes M&C 2000	11	-	3	-	+	+	p	m
H. atropos M&C 2000	3	-	-	-		+	p	
Hydroptilidae								
H. venus M&C 2007	-	2	-	-				
H. roma M&C 2007	3	6	3	-			p	m
Ugandatrichia hairanga OLAH 1989	1	-	-	-		+		
H. rumpun WELLS & HUSMAN 1992	-	4	4	3			p	m
H. thuna OLAH 1989	1	-	-	2	+			m
H. portumus M&C 2007	4	1	4	-	+		p	m
H. verticordia M&C 2007	-	4	-	-			p	
H. tethys M&C 2007	-	2	-	-				
Hydroptila gaya OLAH 1989	-	1	-	-				
H. sabit WELLS & HUSMAN 1992	4	11	-	5			c	m

Table 5: Trichoptera Species Diversity in Phum Duang Tributaries (Continued)

Family	KSW	KGN	KSN	KPN	L&P	PT	Abund.	Dist.
Oxyethira bogambara SCHMID 1958	-	2	-	3			p	m
Scelotrichia tatius M&C 2007	-	-	-	1				
Chryotrichia tydeus M&C 2007	-	2	-	-				
C. zoroastres M&C 2007	-	4	-	-			p	
Orthotrichia bencana OLAH 1989	-	-	1	-				
O. maendrica ULMER 1951	-	4	-	3				m
Lepidostomatidae								
Lepidostoma doligung MALICKY 1979	-	-	1	-		+		
Lepidostoma schwendingeri M&C 1994	1	-	3	-		+	p	m
L. pseudabrutum M&C 1994	-	-	2	-				
Leptoceridae								
Oecetis tripunctata FABRICIUS 1793	2	94	15	55	+	+	a	m
O. hemerobioides MACLACHLAN 1866	-	3	1	-		+	p	m
O. jacobsoni ULMER 1930	1	-	-	-	+			
O. biramosa MARTYNOV 1936	2	-	-	11	+		p	m
O. scutulata MARTYNOV 1936	-	-	10	-			p	
O. asmada MALICKY 1979	-	4	2	-	+	+	p	m
O. raghava SCHMID 1995	-	-	3	-			p	
O. devakiputra SCHMID 1995	-	1	-	-				
O. empusa MALICKY & CHAIBU 2000	4	3	-	-	+		p	m
O. lotis MALICKY & THAPANYA 2004	10	35	57	109	+	+	a	m
O. kyanippos MALICKY &SOMPONG 2005	-	1	17	-		+	p	m
O. laodike MALICKY & CHEUNBARN 2005	-	1	3	1	+		p	m
O. hyperion MALICKY2005	-	-	1	-		+		
O. numitor MALICKY 2005	-	-	6	-			p	
O. momos MALICKY 2005	-	-	-	1		+		
O. meleagros MALICKY & THANI 2005	1	-	-	-	+			

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O. ladon MALICKY & LAUDEE 2005	-	4	-	-			p	
Adicella evadine SCHMID 1994	-	1	3	-		+	p	m

Table 6: Trichoptera Species Diversity in Phum Duang Tributaries (Continued)

Family	KSW	KGN	KSN	KPN	L&P	PT	Abund.	Dist.
C. hersilia MALICKY & CHANGTHONG 2002	-	7	-	18	+		c	m
C. harpalyke MALICKY & CHANGTHONG 2002	-	1	-	-	+			
Cereclea idaia MALICKY & CHAIBU 2002	-	1	24	7	+		c	m
C. iuno M&C 2003	-	-	-	1				
Poecilopsyche gyges M&C 2002	1	-	-	-				
Tagalopsyche brunnea ULMER 1905	-	1	-	-		+		
Triaenodes pellectus ULMER 1908	-	1	1	6		+	p	m
C. iambe MALICKY & PROMMI 2002	-	-	-	3			p	
T. dursa SCHMID 1965	-	1	-	-		+		
T. narkissos MALICKY 2005	2	-	-	-		+		
Trichosetodes pales MALICKY & CHAIBU 2006	1	80	331	261	+		a	m
Parasetodes respersella RAMBUR 1842	-	2	7	3	+		p	m
Leptocerus amoenus ULMER 1951	-	1	-	-		+		
L. dirghachuka GORDON & SCHMID 1987	36	15	24	35	+	+	a	m
L. Tursiops MALICKY 1979	-	4	5	-		+	p	m
L. lampunensis M&C 1991	-	13	17	47	+		c	m
L. chiangmaiensis M&C 1991	8	-	-	-			p	
L. inthanonensis M&C 1991	-	-	1	-	+	+		
L. Masik MALICKY 1995	2	1	29	10			c	m
L. posticoides MALICKY 1995	1	-	-	-		+		
L. faunus M&C *2002*	-	1	-	-		+		
L. skamandrios MALICKY & PROMMI 2006	-	-	2	-	+	+		
Setodes fluvialis KIMMINS 1963	-	1	-	2			p	m
S. gangaya GORDON & SCHMID 1987	20	-	21	55	+		c	m
S. akrura GORDON & SCHMID 1987	4	-	-	-			p	
S. thoneti M&C 2006	7	-	7	-	+		p	m
S. iulus M&C 2006	12	1	5	16			c	m
S. kybele M&C 2006	86	6	514	362			a	m
S. opora M&C 2006	-	-	217	2		+	a	m

Table 7: Trichoptera Species Diversity in Phum Duang Tributaries (Continued)

Family	KSW	KGN	KSN	KPN	L&P	PT	Abund.	Dist.
S. minotauros M&C 2006	86	680	-	277		+	a	m
S. neleus M&C 2006	83	4	73	13		+	a	m
S. leto M&C 2006	-	-	23	-			c	
S. larva M&C 2006	1	295	60	107			c	m
S. melpomene M&C 2006	-	-	6	-			c	
S. okyrrhoe M&C 2006	-	1	546	6			a	m
S. isis MALICKY & NAWVONG 2006	-	1	-	-	+	+		
S. lertpongsombatae LAUDEE & MALICKY 2018	-	-	1	-				
Philopotamidae								
C. horok MALICKY 1989	1	1	2	-			p	m
C. argax MALICKY 1989	13	139	76	1	+		a	m
C. chiangmaiensis C&M 1989	1	153	-	9	+		a	m
C. shanorum C&M 1989	-	-	1	-				
C. bimbltona MALICKY 1979	17	-	62	1	+	+	c	

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C. khamuorum C&M 1989	-	3	-	1		+	p	m
C. monorum C&M 1989	2	7	12	9	+	+	c	m
C. spinifera KIMMINS 1957	4	-	-	1	+	+	p	m
C. thaiorum C&M 1989	-	-	2	2			p	m
C. yskal MALICKY 1989	2	4	14	-		+	p	m
C. pipake M&C 1993	-	5	5	11		+	c	m
C. atnia M&C 1993	-	-	1	-		+		
C. rama M&C 1993	-	-	1	-		+		
C. akkaorum C&M 1989	-	-	2	-		+		
C. toga M&C 1993	12	-	-	-			p	
C. vibena M&C 1993	2	-	-	-				
C. ravanna M&C 1993	1	-	-	-		+		
C. okuihorum MEY 1998	136	122	59	113			a	m
Gunungiella fimfafiazga M&C 1993	-	-	1	-	+	+		
Kisaura peleg MALICKY & LAUDEE 2009	1	-	-	-				
Polycentropodidae								
Pseudoneureclipsis ramosa ULMER 1913	1	66	109	301			a	m
N. salma M&C 1993	-	-	2	-				
Polyplectropus matthatha M&C 1993	7	-	1	-		+	p	m
Nyctiophylax khaosokensis M&C 1993	19	30	2	5		+	c	m

Table 8: Trichoptera Species Diversity in Phum Duang Tributaries (Continued)

Family	KSW	KGN	KSN	KPN	L&P	PT	Abund.	Dist.
P. tramot M&C 1993	1	90	-	1		+	c	m
P. uma M&C 1993	1	3	1	3		+	p	m
P. enos M&C 1993	-	-	-	1		+		
P. cincinatus M&C 2000	-	-	-	2				
P. chrysippus MALICKY & SOMPONG 2000	3	6	7	8		+	c	m
P. magog M&C 2009	-	-	-	1				
Pahamunaya jihmita SCHMID & DENNING 1979	-	5	-	-			p	
Paduniella semarangensis ULMER 1913	1	3	-	6	+	+	p	m
P. hatyaiensis M&C 1993	-	-	6	8			p	m
P. phuketiella	-	-	-	3			p	
P. yeratel	1	-	-	-				
Psychomyia thienemanni ULMER 1951	92	165	303	203	+	+	a	m
P. indra M&C 1993	269	-	-	-	+	+	a	
P. amphiaraos M&C 1997	50	1	19	205		+	a	m
P. pinsuwane LAUDEE & MALICKY 2018	-	13	-	-			p	
P. sinon MALICKY & PROMMI 2006	33	18	249	86		+	a	m
Tinodes ragu M&C 1993	-	4	2	3		+	p	m
T. mahalat M&C 2009	-	-	3	-			p	
Lype atnia M&C 1993	2	2	1	7		+	p	m
Odontoceratidae								
Marilia sumatrana ULMER 1951	-	3	5	2	+	+	p	m
Rhyacophilidae								
Rhyachophila noeibia M&C 1993	2	-	1	-		+	p	m
Stenopsychidae								
Stenopsyche siamensis MARTYNOV 1931	1	-	1	-	+	+		m
Xiphocentronidae								
***Melanotrichia samaconius* M&C 1992**	-	-	-	2		+		

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Remark: KSW = Khlong Saeng Wildlife Sanctuary, KGN = Kaengkrung National Park, KPN = Khlong Phanom National Park KSN = Khao Sok National Park, L&P = Laudee and M&C = Malicky and Chantaramongkol, C&M = Chantaramongkol and Malicky, MH = Hans Malicky, Prommi, PT = Prommi Taeng-On, Abund. = Abundance, Dist. = Distribution, a = abundant, more than 100 specimens were found, c = common, 20-100 specimens were found in the sample p = 3-20 specimens found in the sample, m = species found in other sites and neighboring countries.

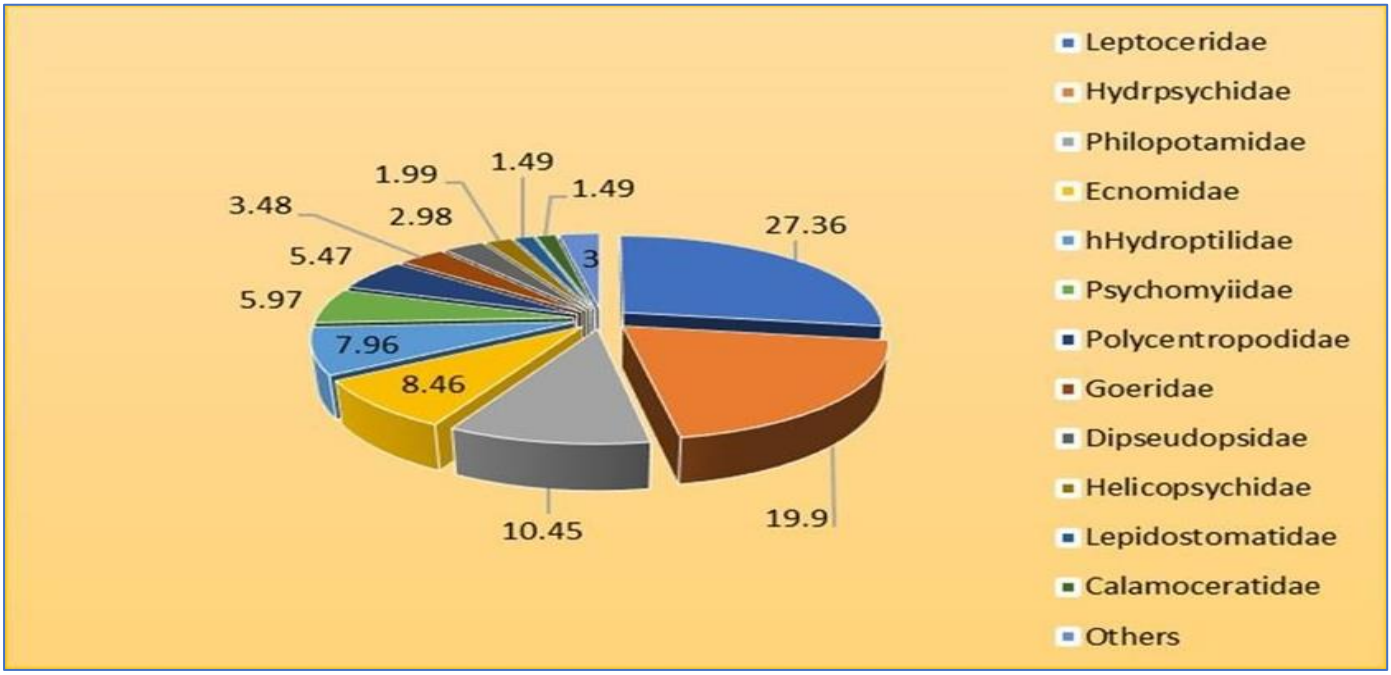

Fig 2: Pie chat describing the Percentages of Species in Each of the Twelve Families and Others (Brachycentridae, Rhyacophilidae, Glossosomitidae, Stenopsychidae Odontoceridae Xiphocentronidae)

III. DISCUSSION

A. Diversity, New Records, and Mode Distribution

The results of the analysis showed that a total of two hundred and one species (201) were caught and identified. This falls into fifty-one (51) genera, and eighteen families (18). The result further revealed that the Philopotamidae, Ecnomidae, Leptoceridae, and Hydropsychidae families, were the most extensive and constituted about sixty percent (60%) of the total individual insects sampled. In terms of species, the Leptoceridae family had fifty-five (55) species, the family Philopotamidae had twenty-one species (21), the Hydropsychidae family recorded forty (40) species, and the Ecnomidae family found seventeen (17) species. In the family Hydroptilidae sixteen (16) species were observed, twelve (12) species were found in the family Psychomyiidae, and for the Polycentropodidae family eleven (11) species were recorded, the Goeridae family found seven (7) species, Helicopsychidae recorded four (4) species, the Dipseudopsidae family found six (6) species. Calamoceratidae and Lepidostomatidae found three (3) species each. The Brachycentridae, Glossosomatidae, Stenopsychidae, Rhyacophilidae, Odontoceridae, and Xiphocentronidae families, found one (1), species each.

The study also found *Cheumatopsyche contexta* ULMER 1951*, *Cheumatopsyche opposita* BANKS 1931*, and *Polymorphanisus scutellatus* BANKS 1939*, as new records *P. scutellatus* BANKS 1939* of Subfamily Macronematinae, were described and reported by Malicky, in 1998 from Sabah (Malaysia). They were also observed in Borneo, Java, and Sumatra (Malicky, 2010), Lombok, Bali, Java (Indonesia), and Malicky et al. 2014. *C. opposita* BANKS 1931* belongs to the Subfamily Hydropsychinae, described and reported by Malicky, in 2013 in Malaysia (peninsular). They were reported from Peninsular (Malaysia) and Sumatra (Malicky, 2010). *C. contexta* ULMER 1951* Subfamily Hydropsychinae was also found. They have been reported from Borneo, Java, and, Sumatra (Malicky, 2010). The new records were enlisted to the Trichopteran list of Thailand.

The focal point of diversity discussion is more or less the integration of information on the diversities of results obtained in this research compared to the records presented in the Upper Phuket mountains in the north, and those of the remaining parts of the country. From the reports of Prommi et al. 2014, it showed Hydropsychidae family recorded the largest number of species after the Leptoceridae family in the study conducted north of Thailand. This agrees with Thapanya et al. 2013 in the studies on adult caddisfly assemblages from northern Thailand. Nevertheless, the report of Laudee and Prommi (2011) revealed that the highest population of species observed was in the family Hydropsychidae, in the research carried out around the Tapi River, in the south of Thailand. more so, Prommi and Thani (2014) recorded the greatest diversity of individuals in the Hydropsychidae family in the studies carried out in the central part of the country. Likewise, Maneechan and Prommi (2015) observed the largest species recorded in the family

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Hydropsychidae in a study performed in the west of Thailand. According to the kind of habitat, the mode of distribution of *Cheumatopsyche lucida* was observed to be habitat-specific to gravel, sand, boulders, and bedrock as reported in the studies carried out in Phayao Province, north of Thailand (Nuntakwang et al. 2014). However, the spread of *Cheumatopsyche lucida* in this work adhered not to any preference for habitat peculiarity but the mentioned species were found in all the sampling locations despite variations in habitat specifically with regards to bedrock and boulder flow bed formations.

The preceding literature above indicated that the family Hydropsychidae and the family Leptoceridae appeared to be the most extensive and possibly the most widespread taxonomic genera within the Oriental area Muray-Stocker et al. (2020), with the tendency to overlap. The observations from this work aligned with the mode of diversity distribution of Trichoptera abundance in the Oriental zone and even on the far side. surprisingly many studies beyond this range reported a similar pattern of dispersal as observed in some countries within the same biogeographical zone as can be seen in the research of Mey and Freitag (2020), which revealed that the Leptoceridae family recorded the greatest number of individuals from the result of work reported in the Philippines, Palawan central. The findings of Armitage et al. (2003) agreed with the mode of dispersal of caddisflies in Southeast Asia with Family Hydropsychidae dominating in the diversity of species according to a report from Vietnam.

The pertinent information on Trichoptera dispersal throughout Southeast Asia or in the Oriental zone is the Atlas for Southeast Asian Trichoptera by Malicky (2010), which confirmed that members of the Hydropsychidae and Leptoceridae families contain the greatest number of species of Trichoptera fauna in this region. Therefore, a need to compare this mode of spread to the biologically diverse areas of Doi Inthanon and Doi Suthep-Pui National Parks which opposed this pattern of dispersal due to differences in altitude. Considering Malicky (2010), most supported by Morse (2019), is used to explain the mode of Trichoptera dispersal in Thailand and other Southeast Asian countries for this purpose, some families and species were randomly selected. From the accounts of this work, all the Families of Brachycentridae, Stenopsychidae, Glossosomatidae, Odontoceridae, Rhyacophilidae, and Xiphocentronidae had one species, but every one of them got several other species representatives at the biologically diverse areas (Bunlue et al. 2012; Malicky 2010; Thapanya et al. 2004). It demonstrated that various species in the mentioned families preferred high altitudes. Nevertheless, *Rhyacophila noebia* of the Rhyacophilidae family is a rare species, native to Thailand, but has never been observed at Doi Inthanon and Doi Suthep-Pui elevations suggesting to prefer living in forest lowlands. The remaining species were found at 2300 – 400m elevations (Thapanya et al. 2004). In Family Stenopsychidae, *Stenopsyche siamensis* is a single species largely dispersed than any other in this genus. They were observed many times in Doi Inthanon (200-2300m) and once in Doi Suthep-Pui (400-1200m) elevations (Thapanya et al. 2004). In the Brachycentridae family, *Micrasema fortiso* happens to be a scares species, indigenous to Thailand, are reported in Doi Inthanon 1200-1300m and Doi Suthep-Pui 400m (Thapanya et al. 2004). Presently many other members are found in Vietnam, Borneo countries, and Thailand (Malickay, 2010). *Melanotrachia samaconius* is an extensively distributed species in the family Xiphocentronidae, found in Doi Inthanon (500-600m) elevation, but the remaining members are indigenous to one or two countries in the Southeast Asian region (Malicky, 2010). *Marilia sumatrana* in Family Odontoceridae is a common species, widely dispersed in Southeast Asia, they were observed one time in Doi Inthanon 400m (Thapanya et al. 2004) and several times in Doi Suthep-Pui (600m). The remaining family members are restricted to Laos, Vietnam, and Thailand (Malicky, 2010). Further to the forgoing, species in Stenopsychidae, Rhyacophilidae, and Glossosomatidae families were reported at (400-2300m) elevations, which proved they prefer high elevations but for species in Families Brachycentridae, Odontoceridae, and Xiphocentronidae were observed between 400-900m elevations, indicating that species of these families are comfortable in average elevations lower than 1500m above Sea level (Thapanya et al. 2004). *Oecetis tripunctata*, in Family Leptoceridae, is an extensively dispersed species in Southeast Asia, Malicky (2010), it was observed once in Doi Inthanon, at 1000m altitude as a rare species but has never been found at Doi Suthep-Pui, Thapanya et al. (2004), it could be because it likes forest lowlands. This study revealed that it was found in every sampling site and at all times and, therefore, exhibited a year-round life cycle. *Cheumatopsyche lucida* Family Hydropsychidae is another highly dispersed species in the Oriental zone but has never been observed in biologically diverse areas of Doi Inthanon and Doi-Suthep-Pui Thapanya et al. (2004), this proof that it prefers forest areas, of low-elevations and demonstrated a year-round life cycle in this study.

In conclusion, the result of the study showed that about half of the species observed, were reported before by Prommi (2007). There exist similar individuals to the study of Laudee and Prommi (2011) in a work conducted around the River Tapi. Additionally, the study emphasizes the distribution of Trichoptera fauna in Thailand based on their ecological niches. This indicated that some caddisfly species were found in high elevations, and are referred to as Mountain species such as those found at the biologically diverse spots of Doi Inthanon and Doi-Suthep-Pui high altitudes (Thapanya et al. 2004). Some species prefer low ranges and forest areas where rivers are found, and the species found in rivers are referred to as Potamon species (laudee and Prommi, 2011). Other species confined to freshwater streams and lakes and are referred to as Rhitom species Prommi (2007). Most of the species found in this study belong to the group of Rhitom species.

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Table 9: Correlation of some species to water quality parameters.

Species	Temperature	pH	Electrical Conductivity	Water Velocity
Diplectrona gombak	.547*	.556*		
Macrostemum floridum				.610**
Amphipsyche gratiosa				.621**
Dipseudopsis nebulosi		.500*		
Cheumatopsyche charites				.487*
Setodes minotauros			.474*	
Setodes neleus	-565**			
Setodes larva	.547*			.474*

The result presented the above-revealed species' responses to water characteristics, such as *Setodes larva* and *Diplectrona gombak* which demonstrated an average positive correlation with water state of heat. This does not agree with the observations of Prommi and Thamsenanupap, (2015), who reported that some *Hydropsyche* spp. and *Macrostemum fenestratum* associated negatively with the water state of heat. Nevertheless, *Setodes neleus* demonstrated a high negative correlation with the water state of heat. This could be inferred that *S. neleus* requires a lower water state of heat. *Dipseudopsis nebulosa* and *Diplectrona gombak* correlated relatively to pH conditions in their habitats, this is a fact that they preferred neutral Potential Hydrogen (pH) levels. It supported Prommi and Thamsenanupap's (2015) observations, which revealed that Diplectrona spp. displayed a minimal positive relationship with potential Hydrogen. More so, the report of Prommi and Thani (2014) showed that some Trichopteran species associated positively with water state of heat, water potential Hydrogen, and ionic conductors in their habitat, in central Thailand. *Setodes minotauros* showed a moderate positive correlation to ionic conductors in their habitat, which suggests that the larvae demonstrated a high affinity to aquatic environments with appropriate ionic conduction. *Macrostemum floridum* and *Amphipsyche gratiosa* displayed a very high positive relationship to fast-following freshwater streams, implying a preference for fast-following stream waters or streams with high speed, whereas, *Cheumatopsyche charites* and *S. larva* displayed a moderate positive correlation to water velocity. Payakka and Prommi (2014), reported that aquatic insect diversity of immature stages associated differently to water environmental parameters such as dissolved oxygen and alkalinity. Generally, it could be concluded that the relationship between water quality parameters and the diversity of caddisfly juveniles in the various locations demonstrated both positive and negative responses of immature stages to environmental conditions. This study revealed that Trichopteran larvae prefer optimum environmental factors such as Dissolved Oxygen, Temperature, pH, Electrical Conductivity, Water velocity, etc. for optimum growth and succession in any given aquatic environment.

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