CHAPTER 4

Results

4.1 Physicochemical water parameters

Averages of physicochemical parameters were sampling and analyzed in Mae Ngat Somboonchol dam during June 2013 to May 2014. The results were showed the statistical significance between upstream and downstream sampling sites (Table 4.1).

The highest average air temperature was in sampling site 3 (SD3) 29.3 °C and the lowest average air temperature was 24.7 °C in sampling site 7 (SD7). However, Sampling site 7 (SD7) had the highest value of air temperature was 36.3 °C on June 2013 and also had the lowest value of air temperature, 18.2 °C. on March 2014. Air temperature was significantly different between all sampling sites, using ANOVA for analyzed. Sampling site 7 (SD7) and sampling site 3 (SD3) were totally different between the others sampling sites with, 24.7±4.96 °C and 29.3±2.65 °C respectively. While another sampling sites as SU1, SU2, SD4, SD5 and SD6 were not significantly different (Figure 4.1).

During year period from June 2013 to May 2014, used of ANOVA ($P<0.05$) statistical showed that there were significantly different in air temperature between June 2013 and December 2013 with 31.88 °C and 23.44 °C respectively. While the air temperature of the others months was nearly same value.

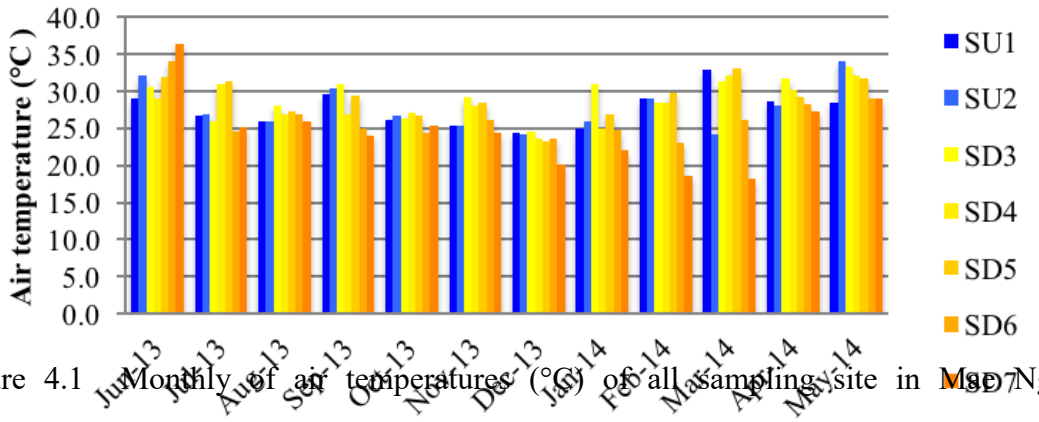

Figure 4.1 Monthly of air temperatures (°C) of all sampling site in Mae Ngat Somboonchol dam during June 2013 - May 2014.

Water temperature between all sampling sites were not significantly different, analyzed by ANOVA ($p<0.05$). The highest average water temperature was 29.7 C° on site 3 (SD3) and the lowest water temperature was 26.4 C° on site 1 (SU1), see figure 4.2. However, statistical analyzed by ANOVA ($p<0.05$) showed that water temperatures on January and February 2014 with 24.86±2.48 and 24.44±1.87, were different with June and July 2013 with 30.53±1.63 and 30.54±2.87, respectively.

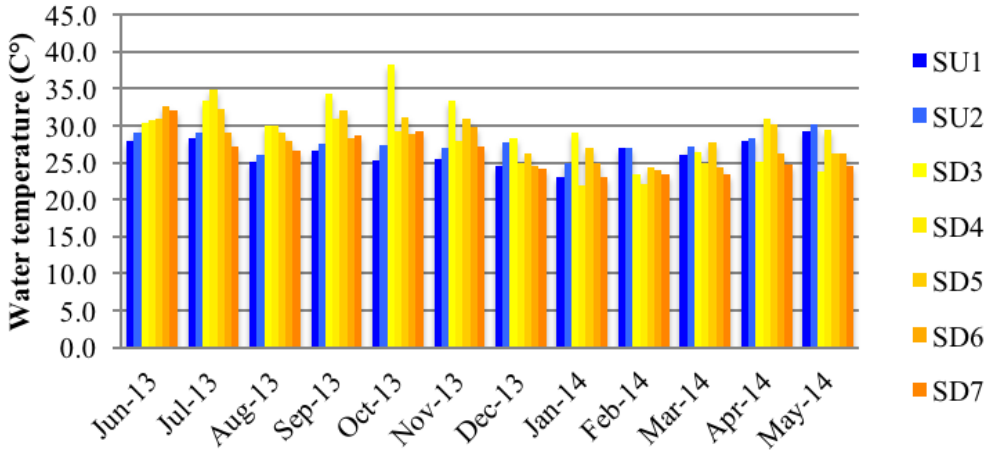

Figure 4.2 Monthly of water temperatures (°C) of all sampling site in Mae Ngat Somboonchol dam during June 2013 - May 2014.

Between all sampling sites, pH values were significantly different between upstream and downstream sites. The pH values on sampling site 3 (SD3) was higher than the others sampling sites (Figure. 4.3)

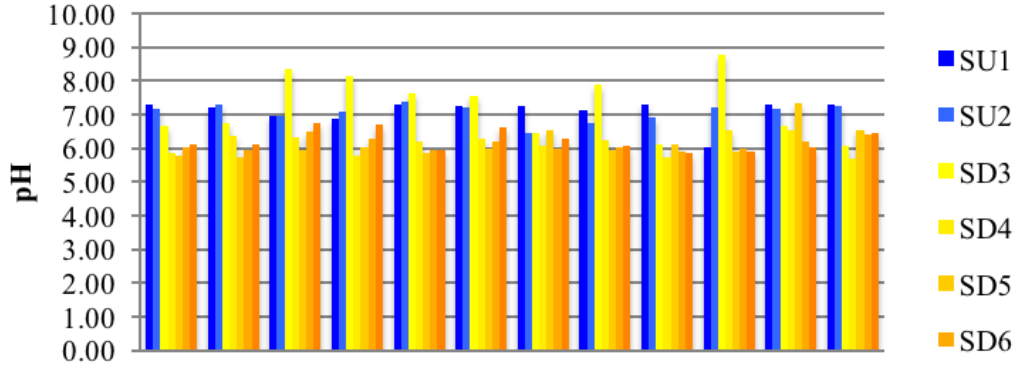

Figure 4.3 Monthly of pH of all sampling site in Mae Ngat Somboonchol dam during June 2013 - May 2014.

Total dissolved solid (TDS) and conductivity were totally significantly different between upstream and downstream sites showed in Figure 4.4.

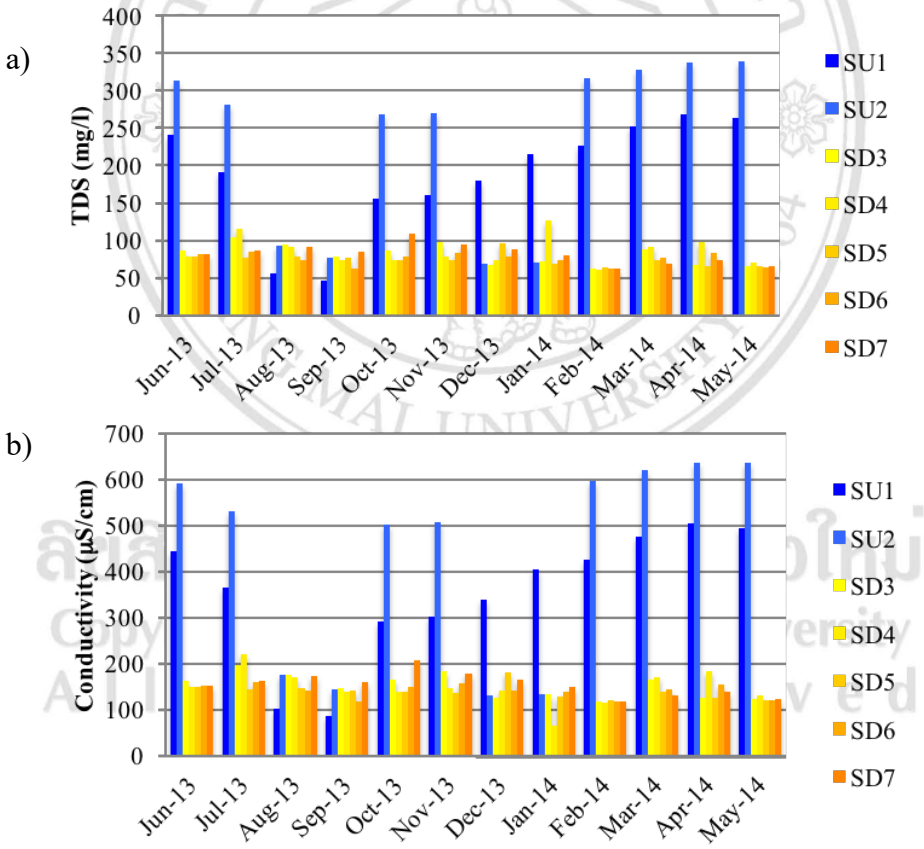

Figure 4.4 Monthly total dissolved solid (TDS: mg/l – bar graph) and conductivity: µS /cm – line graph) of all sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014. a) TDS and b) conductivity.

Dissolved oxygen (DO) and biochemical oxygen demand BOD_5 were showed in Figure 4.5, which BOD_5 were not significantly different between all sampling sites. DO values were significantly different and separated in 3 groups, upstream sites group (SU1 and SU2), downstream sites group (SD3, SD5, SD6 and SD7) and the last group was site 4 (SD4). On November 2013, BOD_5 values were higher than others months which effected from increased water depth in every sampling sites (Figure 4.6).

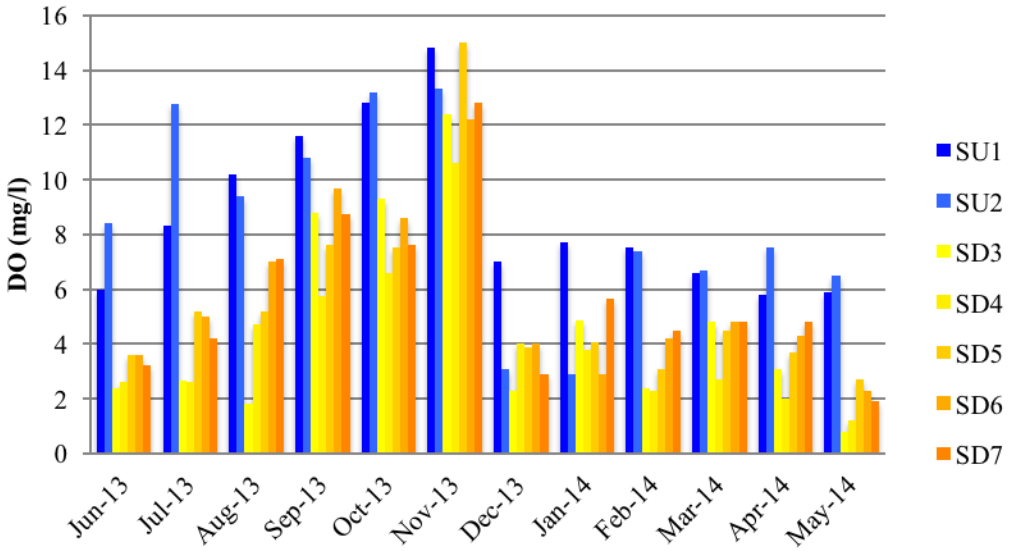

Figure 4.5 Monthly of DO (mg/l) of all sampling site in Mae Ngat Somboonchol dam during June 2013 - May 2014.

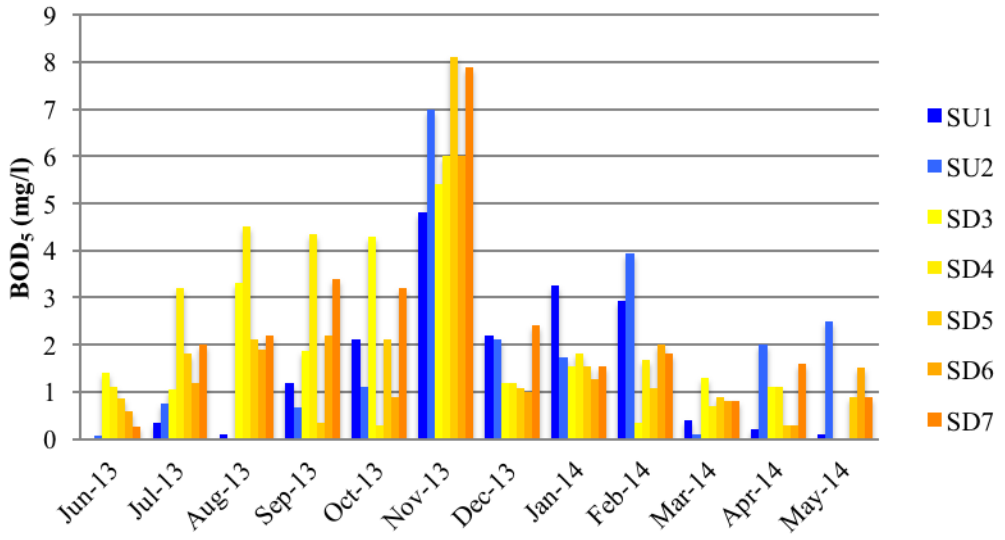

Figure 4.6 Monthly of BOD_5 (mg/l) of all sampling site in Mae Ngat Somboonchol dam during June 2013 - May 2014.

Monthly nutrients, ammonia nitrogen, nitrate nitrogen and ortho-phosphate were showed (Figure 4.7). Nitrate nitrogen and ortho-phosphate level were not significantly different between all sampling sites, except ammonia nitrate levels. Ammonia nitrate level was significantly different between all sampling sites and separated into 3 groups, group 1 was site 2 (SU2), group 2 were site 1(SU1), site 3 (SD3), site 5 to 7 (SD5, SD6 and SD7), and the last group was site 4 (SD4).

a)

b)

c)

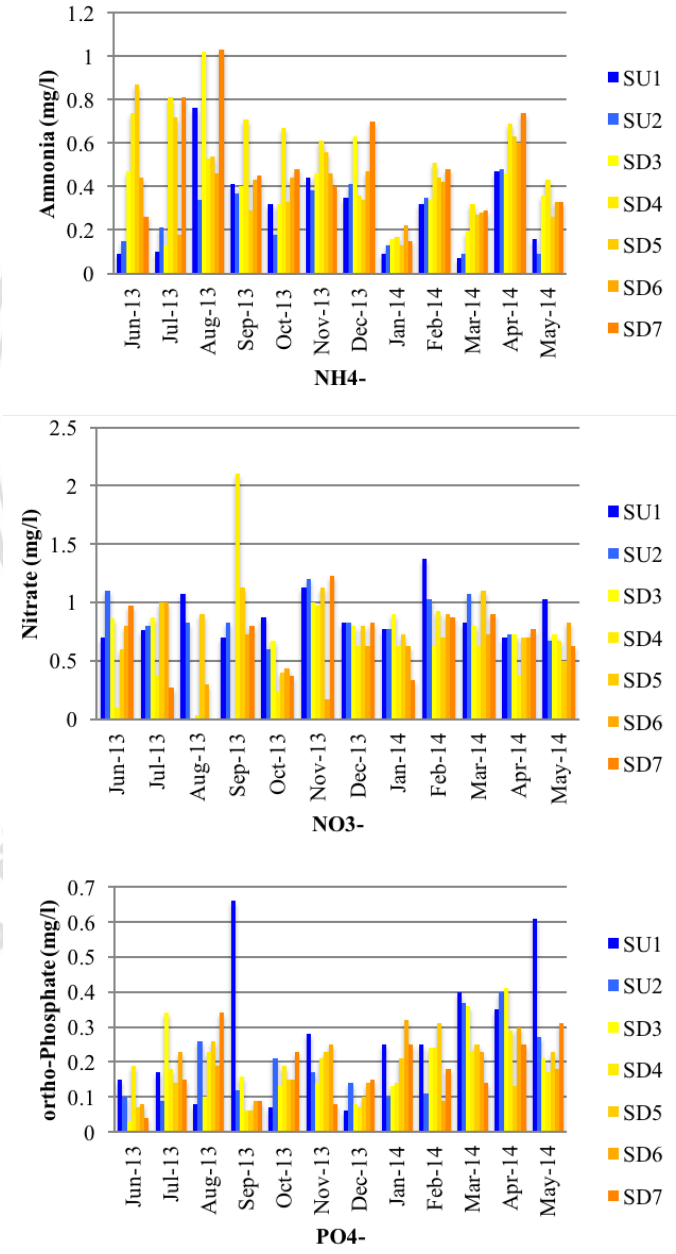

Figure 4.7 Monthly nutrients (mg/l) of sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014; a) ammonia nitrogen, b) nitrate nitrogen and c) ortho-phosphate.

Table 4.1 Average and standard deviation (one way ANOVA $p<0.05$) of Physicochemical parameters of sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014.

Water parameters	Site 1 (SU1)	Site 2 (SU2)	Site 3 (SD3)	Site 4 (SD4)	Site 5 (SD5)	Site 6 (SD6)	Site 7 (SD7)
Air temp (ºC)	27.6±2.43^{ab}	27.8±3.14^{ab}	29.3±2.65^{b}	28.4±2.66^{ab}	29.1±2.78^{b}	24.3±2.99^{ab}	24.7±4.96^{a}
Water temp (ºC)	26.4±1.80^{a}	27.6±1.39^{a}	29.7±4.57^{a}	28.2±3.90^{a}	29.0±2.63^{a}	27.2±2.64^{a}	26.2±2.81^{a}
TDS (mg/l)	188±74.47^{b}	230±115.53^{b}	81±13.92^{a}	86±19.41^{a}	74±8.54^{a}	75±8.01^{a}	82±13.67^{a}
Conductivity (µS /cm)	353±139.49^{b}	434±217.15^{b}	152±26.29^{a}	148±38.15^{a}	140±15.98^{a}	142±15.08^{a}	155±25.35^{a}
pH	7.10±0.36^{b}	7.08±0.26^{b}	7.26±0.91^{b}	6.13±0.30^{a}	6.14±0.45^{a}	6.12±0.19^{a}	6.24±0.32^{a}
DO (mg/l)	8.7±2.98^{c}	8.5±3.56^{c}	4.6±3.61^{ab}	4.1±2.59^{a}	5.5±3.37^{abc}	5.7±3.02^{abc}	5.7±3.00^{abc}
BOD_5 (mg/l)	1.5±1.57^{a}	1.8±2.00^{a}	1.9±1.61^{a}	2.2±1.90^{a}	1.8±2.08^{a}	1.6±1.48^{a}	2.3±1.98^{a}
Ammonia (mg/l)	0.30±0.20^{ab}	0.26±0.13^{a}	0.41±0.24^{ab}	0.55±0.19^{b}	0.45±0.21^{ab}	0.39±0.11^{ab}	0.51±0.25^{ab}
Nitrate (mg/l)	0.90±0.21^{a}	0.87±0.18^{a}	0.67±0.32^{a}	0.64±0.54^{a}	0.81±0.24^{a}	0.65±0.35^{a}	0.66±0.32^{a}
Ortho-phosphate (mg/l)	0.28±0.19^{a}	0.20±0.10^{a}	0.19±0.12^{a}	0.18±0.06^{a}	0.18±0.08^{a}	0.19±0.08^{a}	0.18±0.09^{a}

The dendrogram of cluster analysis based on the correlation of water parameter among all sampling sites in Mae Ngat Somboonchol dam from June 2013 – May 2014. (Figure 4.8)

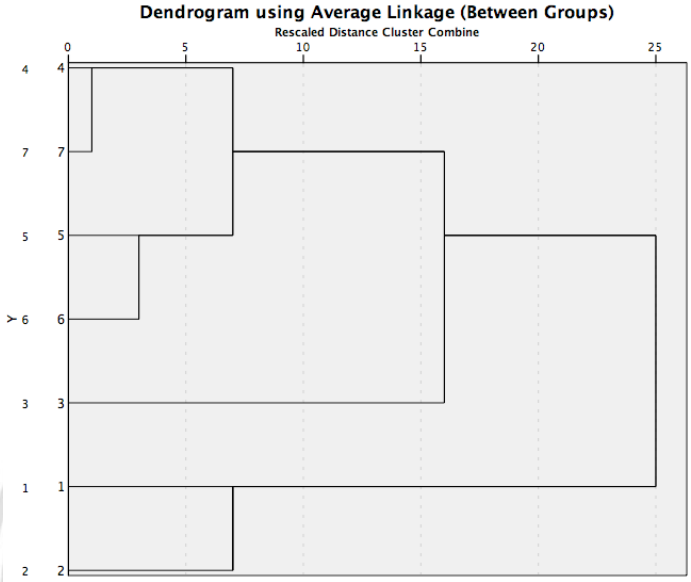

Figure 4.8 The dendrogram of cluster analysis based on the correlation of water parameter among all sampling sites in Mae Ngat Somboonchol dam from June 2013 – May 2014.

Trichoptera assemblages

Larvae of Trichoptera were collected by semiquantitative sampling method on Mae Ngat Somboonchol dam during June 2013 to May 2014. The totals number of Trichoptera larvae was 5,596 individuals include 15 families followed by Calamoceratidae, Dipseudopsidae, Ecnomidae, Glossosomatidae, Goeridae, Helicopsychidae, Hydropsychidae, Hydroptilidae, Lepidostomatidae, Leptoceridae, Odontoceridae, Philopotamatidae, Polycentropodidae, Psychomyiidae and Xiphoncentronidae. The most dominant family were Hydroptilidae with 1,689 individuals, Helicopsychidae with 1,604 individuals and Leptoceridae 1,300 individuals. The highest number of larvae occurrence was 1,032 individuals on March 2014 and found 804 individuals on April 2014. The lowest numbers were found 160 individuals on August 2013. Furthermore, site 1 (SU1) was the highest number of larvae occurrence between all sampling sites with 2,738 individuals and the lowest number was 36 individuals on site 4 (SD4).

On upstream sampling site 1 (SU1), the total numbers of Trichoptera larvae were 2,738 individuals included 15 families followed by Calamoceratidae, Dipseudopsidae, Ecnomidae, Glossosomatidae, Goeridae, Helicopsychidae, Hydropsychidae, Hydroptilidae, Lepidostomatidae, Leptoceridae, Odontoceridae, Philopotamatidae, Polycentropodidae, Psychomyiidae and Xiphoncentronidae. The highest numbers of larvae was family Hydroptilidae with 906 individuals (33.09%) and were found all year round. The second highest number of larvae was family Leptoceridae with 885 individuals (32.32%) and those were found almost year except June 2013. The third and fourth highest number of larvae was Helicopsychidae and Hydropsychidae with 404 (14.76%) and 335 individuals (12.24%) respectively; both of families were found every month except one month, which was August 2013 and September 2013 respectively (Figure 4.9). Larvae of Xiphoncentronidae was found only 1 individual (0.04%) on February 2014 and larvae of Psychomyiidae family was found only 3 individuals (0.11%) followed by 2 individuals on January 2014 and 1 individual on March 2014.

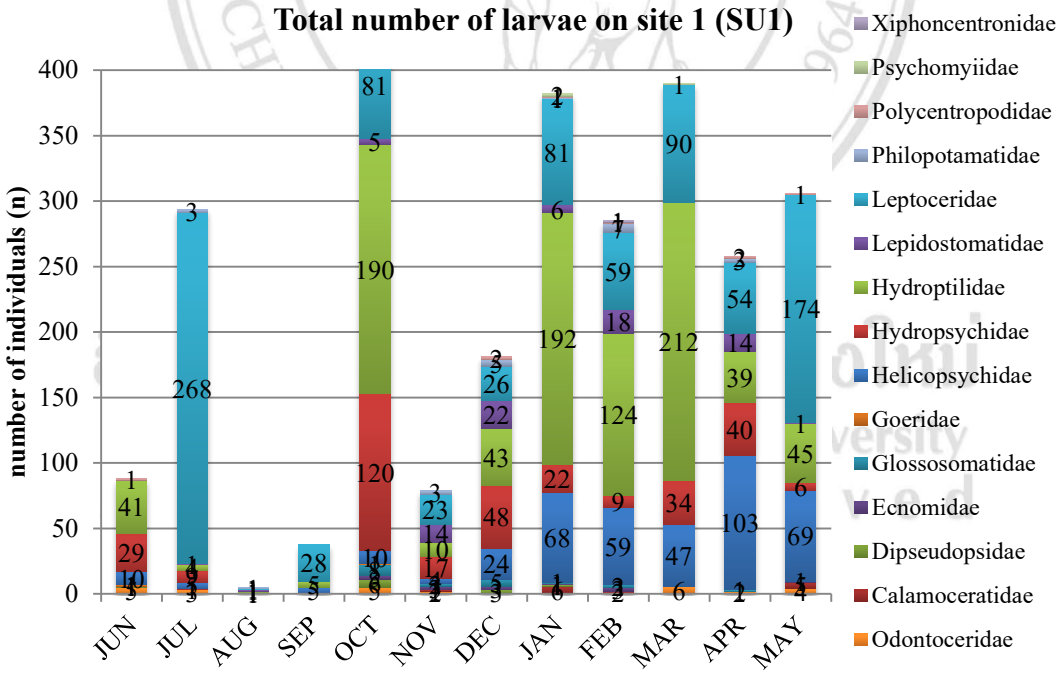

Figure 4.9 Numbers of individuals of larvae Trichoptera in SU1, Mae Ngat Somboonchol dam during June 2013 – May 2014.

On upstream sampling site 2 (SU2), the total numbers of Trichoptera larvae were 1,625 individuals included 14 families followed by Calamoceratidae, Dipseudopsidae, Ecnomidae, Glossosomatidae, Goeridae, Helicopsychidae, Hydropsychidae, Hydroptilidae, Lepidostomatidae, Leptoceridae, Odontoceridae, Philopotamatidae, Polycentropodidae and Psychomyiidae. The highest numbers of larvae was Hydropsychidae with 566 individuals (34.84%) and were found for 10 months except December 2013 and January 2014. Leptoceridae and Hydroptilidae were found 23.20% (n=377) and 18.95% (n=308) on this site for 10 months except December 2013 and January 2014. Hydroptilidae were unfound on October 2013, December 2013, January 2014, February 2014 and May 2014. Odontoceridae was found 15.26% (n=248) for 11 months except on January 2014 (Figure 4.10). Goeridae was found only 1 individual (0.06%) on October 2013.

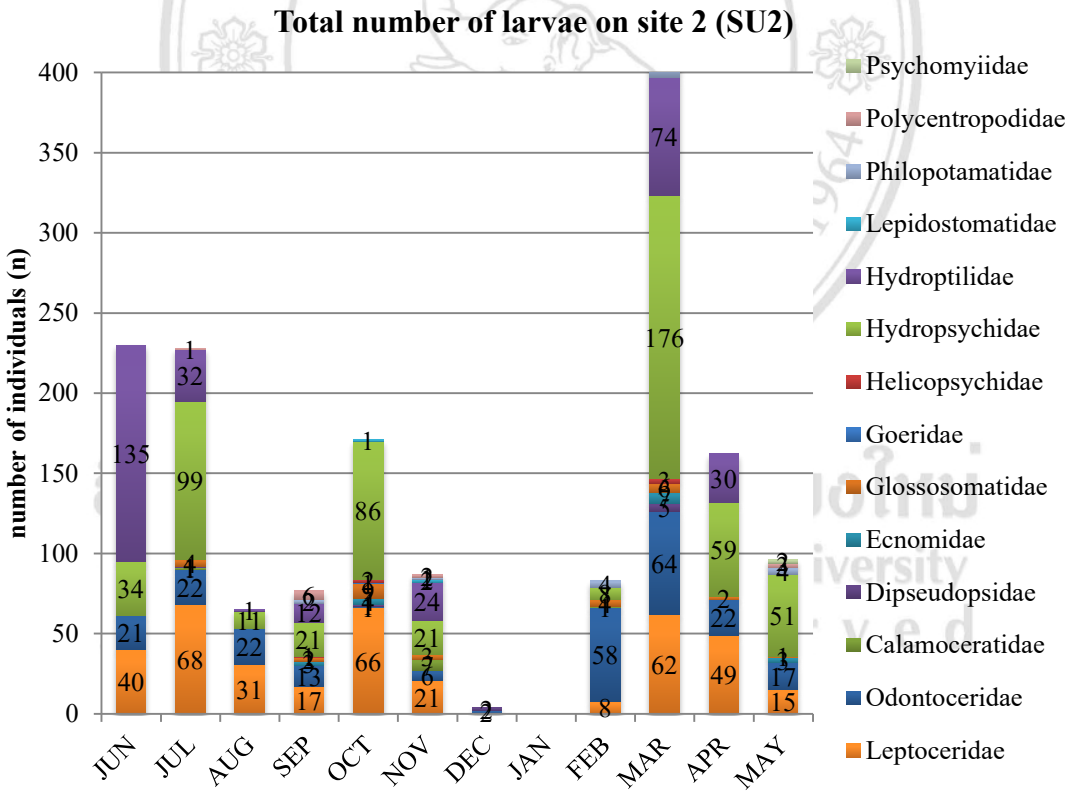

Figure 4.10 Numbers of individuals of larvae Trichoptera in SU2, Mae Ngat Somboonchol dam during June 2013 – May 2014.

On downstream sampling site 3 (SD3), the total numbers of Trichoptera larvae were 60 individuals included 2 families followed by 56 individuals (93.33%) of Hydropsychidae and 4 individuals (6.67%) of Leptoceridae, all of larvae were found only on August 2013 (Figure 4.11).

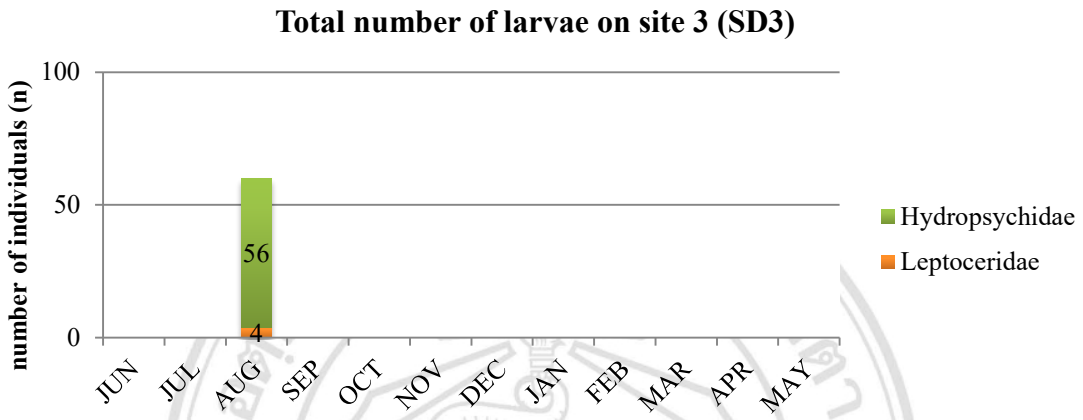

Figure 4.11 Numbers of individuals of larvae Trichoptera in SD3, Mae Ngat Somboonchol dam during June 2013 – May 2014.

On downstream sampling site 4 (SD4), the total numbers of Trichoptera larvae were found 36 individuals included 6 families followed by Hydropsychidae, Hydroptilidae, Leptoceridae, Odontoceridae, Philopotamatidae and Psychomyiidae. The highest numbers of larvae were Hydropsychidae found 14 individuals (38.89%), which found only on January 2014. Both of Hydroptilidae and Leptoceridae were found 9 individuals (25%) and found only 3 months, December 2013, January 2014 and March 2014 respectively. Psychomyiidae was found only 1 individual on January 2014 (Figure 4.12)

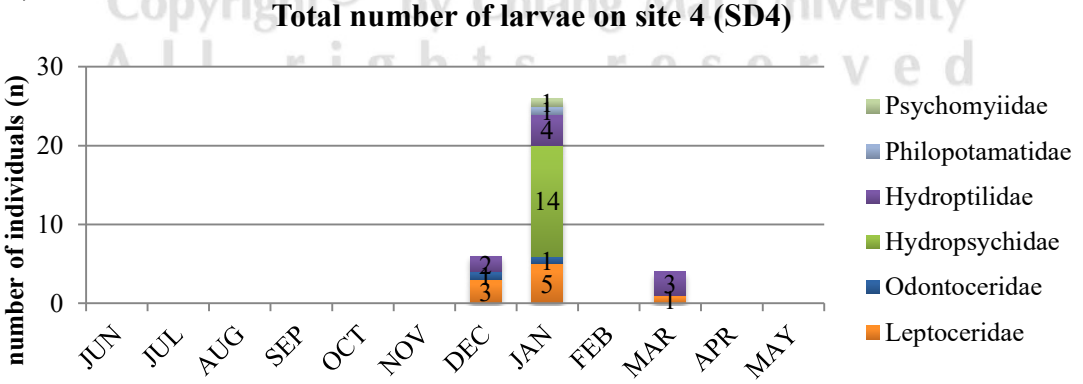

Figure 4.12 Numbers of individuals of larvae Trichoptera in SD4, Mae Ngat Somboonchol dam during June 2013 – May 2014.

On downstream sampling site 5 (SD5), the total numbers of Trichoptera larvae were 373 individuals included 8 families followed by Dipseudopsidae, Hydropsychidae, Hydroptilidae, Leptoceridae, Odontoceridae, Philopotamatidae, Polycentropodidae and Psychomyiidae. The highest numbers of larvae were Hydropsychidae with 349 individuals (93.57%) and those were found for 6 months. Leptoceridae was the second highest numbers of larvae with 13 individuals (3.49%) and found for 4 months. The others families were found between 1 to 4 individuals in a few months (Figure 4.13).

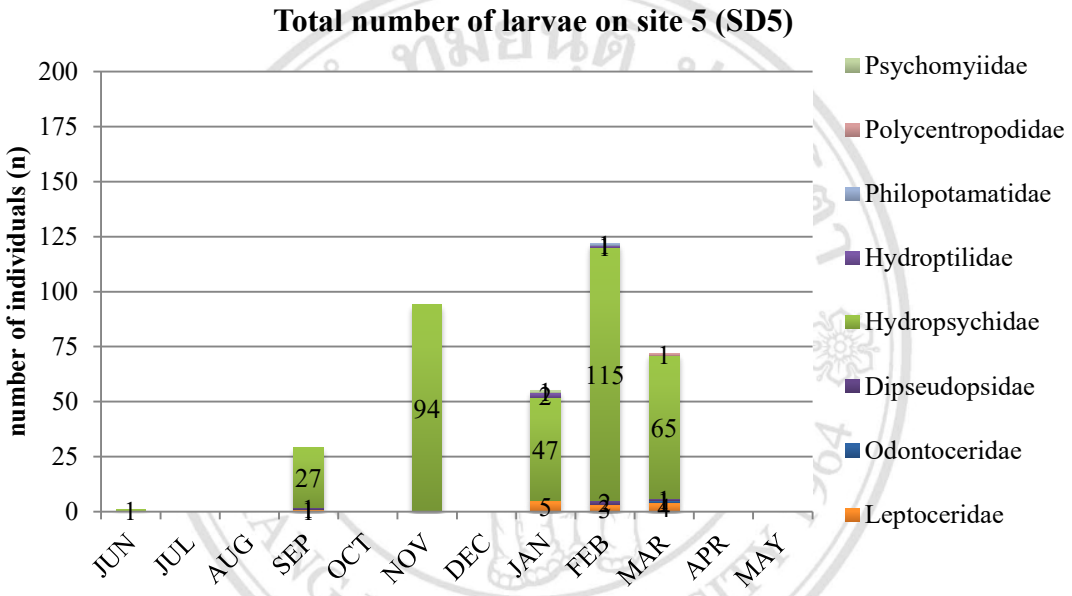

Figure 4.13 Numbers of individuals of larvae Trichoptera in SD5, Mae Ngat Somboonchol dam during June 2013 – May 2014.

On downstream sampling site 6 (SD6), the total numbers of Trichoptera larvae were 595 individuals included 6 families followed by Dipseudopsidae, Glossosomatidae, Hydropsychidae, Hydroptilidae, Leptoceridae and Psychomyiidae. The highest numbers of larvae were Hydroptilidae and Hydropsychidae with 284 (47.73%) and 297 individuals (49.92%), respectively. Both of families were found in rang between 3 to 5 months from January to June. Leptoceridae were found 10 individuals (1.68%) on January 2014 and May 2014. The others families were found between 1 to 2 individuals on a few months (Figure 4.14).

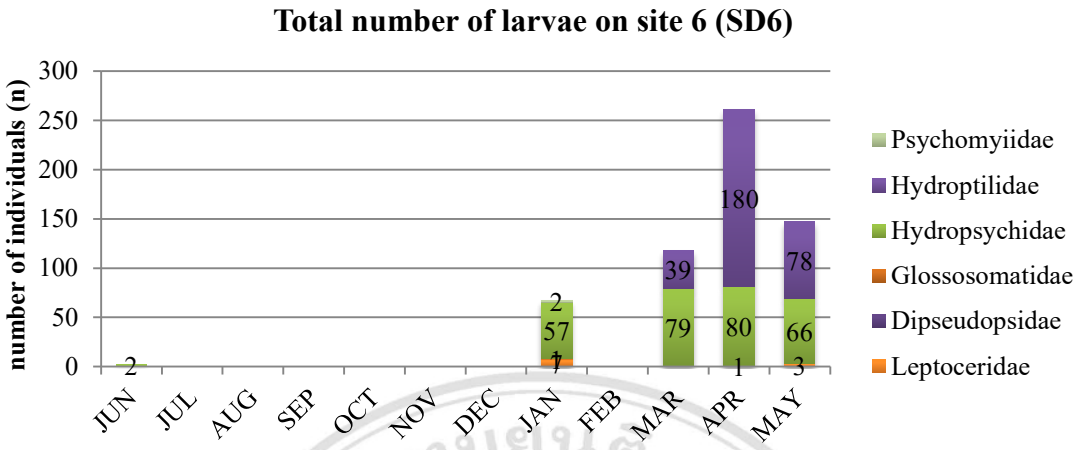

Figure 4.14 Numbers of individuals of larvae Trichoptera in SD6, Mae Ngat Somboonchol dam during June 2013 – May 2014.

On downstream sampling site 7 (SD7), the total numbers of Trichoptera larvae were found 169 individuals included 3 families followed by Dipseudopsidae, Hydroptilidae and Leptoceridae. Larvae of Hydroptilidae were found 166 individuals (98.22%) from 3 months, which were September 2013, March 2014 and April 2014. Larvae of Leptoceridae were found 2 individuals (1.18%) from July 2013 and September 2013. Lastly, larva of Dipseudopsidae was found only 1 individual (0.59%) on April 2014, showed in Figure 4.15.

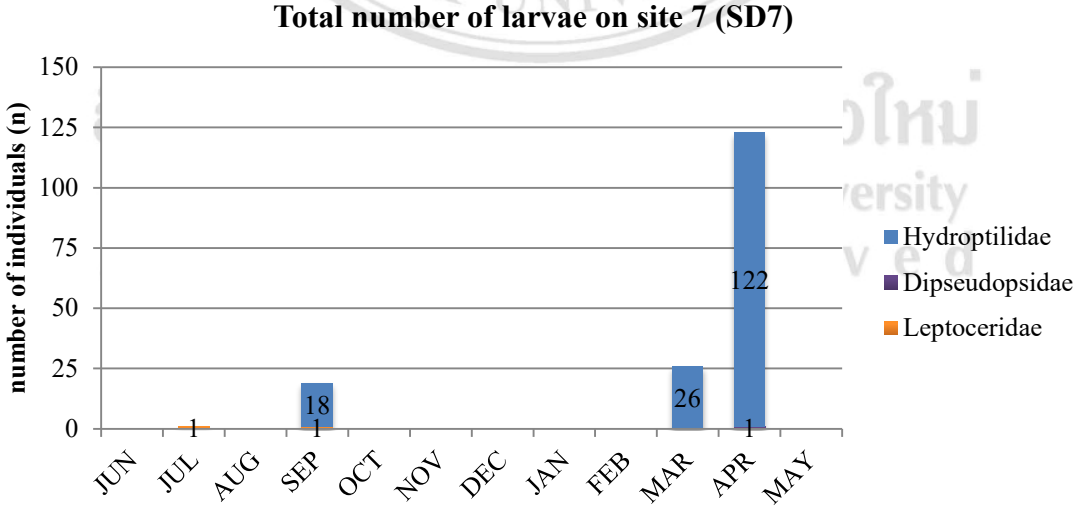

Figure 4.15 Numbers of individuals of larvae Trichoptera in SD7, Mae Ngat Somboonchol dam during June 2013 – May 2014.

A Trichoptera larvae diversity, Shannon's wiener index and evenness index, were compared between all sampling sites and showed (Table 4.2).

Table 4.2 Total number of larvae Trichoptera individuals, species richness, diversity index and evenness index in Mae Ngat Somboonchol dam during June 2013 – May 2014.

Sampling sites	**SU1**	**SU2**	**SD3**	**SD4**	**SD5**	**SD6**	**SD7**
Number of individuals	2,738	1,625	60	36	373	595	169
Family richness	15	14	2	6	8	6	3
H'	1.61	1.29	0.08	0.07	0.31	0.51	0.17
Evenness	0.14	0.17	0.81	0.26	0.15	0.21	0.38

The dendrogram showing the result from cluster analysis to compare the dissimilarity of larvae Trichoptera family between all sampling sites, based on abundance data for 15 Trichoptera families (Figure 4.16). At 5% similarity, 3 groups of Trichoptera were separated. The first group of larvae Trichoptera composition was on SU1. The second group of larvae Trichoptera composition was on SU2. The third group of larvae of Trichoptera composition was included SD3, SD4, SD5, SD6 and SD7.

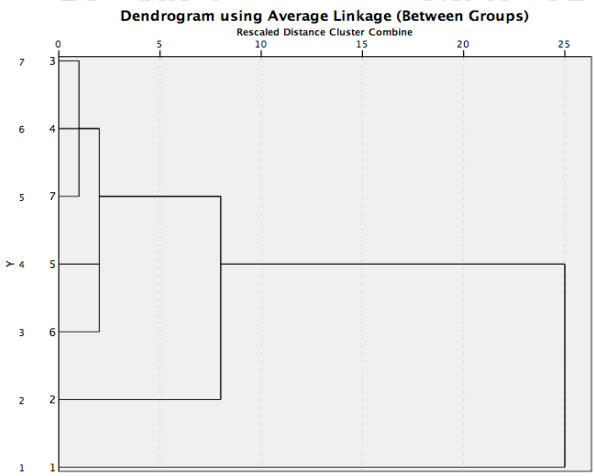

Figure 4.16 The dendrogram showing the result from cluster analysis to compare the dissimilarity of larvae Trichoptera family between all sampling sites, base on abundance data for 15 Trichoptera family.

Water depth and number of Trichoptera larvae individuals were compared among all sampling sites showed in Figure 4.17

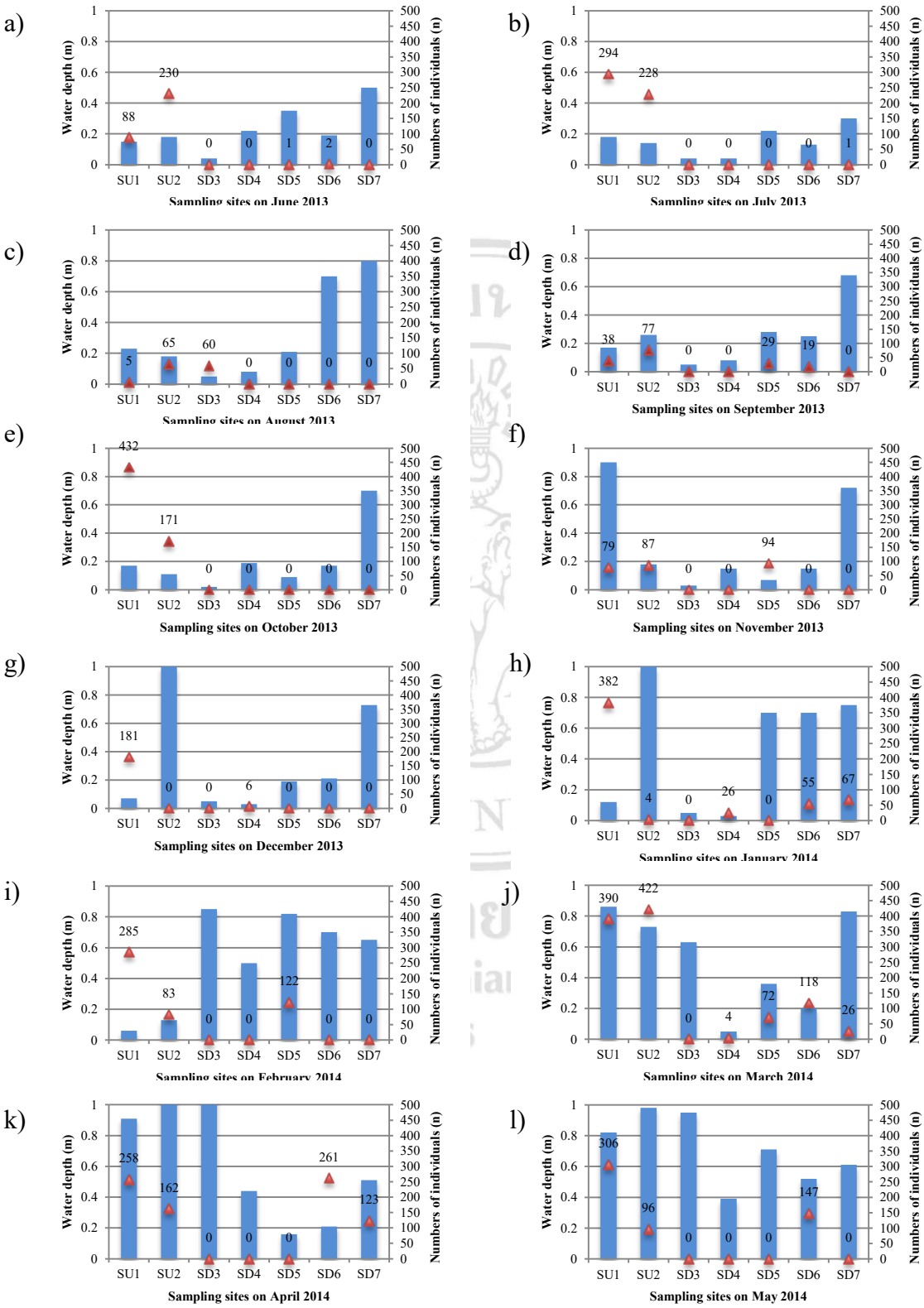

Figure 4.17 Number of larvae individuals (triangle graph) and water depth (bar graph) monthly during June 2013 – May 2014 in Mae Ngat Somboonchol dam; a) June 2013, b) July 2013, c) August 2013, c) September 2013, d) October 2013, e) November 2013, f) December 2013, g) January 2014, h) February 2014, i) March 2014, j) April 2014 and k) May 2014.

Adult Trichoptera were collected by light pan trap for 12 months during June 2013 to May 2014 at Mae Ngat Somboonchol dam, Chiang Mai Province. Seven sampling site were separated along upstream to downstream area. Total of 3,884 individuals of adult male Trichoptera were identified included 16 families followed by Brachycentridae, Calamoceratidae, Dipseudopsidae, Ecnomidae, Glossosomatidae, Goeridae, Helicopsychidae, Hydropsychidae, Hydroptilidae, Lepidostomatidae, Leptoceridae, Odontoceridae, Philopotamatidae, Polycentropodidae, Psychomyiidae and Xiphoncentronidae

After identified to species, Trichoptera composition were grouping in 3 groups from their appearance, upstream group which were found only in site 1 (SU1) and site 2 (SU2), downstream group which were found only in site 3 (SD3) to site 7 (SD7) and shared group which were found both upstream and downstream sites. The upstream species were 44 species following *Chimarra akkaorum, C. chiangmaiensis, C. helios, Kiasura peleg, Wormaldia nyctimon, Nyctiophylax zadox, Polycentropus admin, Psychomyia amphiaraos, P. lak, P. mento, Tinodes ragu, Proxiphocentron patrus, Ecnomus jojachin, E. venimar, Cheumatopsyche cacus, C. criseyde, Diplectona aurovittata, Hydromanicus eliakim, Hydropsyche camillus, H. clitumnus, H. formosana, H. harpagofalcata, Macrostemum fenestratum, M. hestia, Goera echo, G. matuilla, G. redsat, G. uniformis, Ceraclea hippodamia, Leptocerus dirghachuka, Oecetis asmada, Setodes brevicaudatus, S. endymion, S. isis, S. kybele, S.opora, S. orcus, S. thoneti, Trichosetodes anaksepuluh, Marilia mogtina, M. arope, Anisocentropus brevipennis, A. pan,* and *Ganonema fascipenne.* The dominant upstream species were *Cheumatopsyche chrysothemis* 13.12% (n=223), *Pseudoneureclipsis ramose* 10.76% (n=183), *C. globosa* 7.76% (n=132) and *Hydroptilia thuna* 7.76% (n=132).

Downstream species were 23 species followed by *Orthotrichia maendrica, Chimarra momma, Dipseudopsis bernardi, D. varians, Psychomyia kerynitia, P. sampati, Drepanocentron curmisagius, Ecnomus alkios, E. cincibilus, E. mammus, E. puro, E. votticius, Anthaloptera sexpunctata, Cheumatopsyche banksi, C. caieta, Ceraclea idaia, Oecetis kodros, O. meghadouta, O. misenos, O. tripunctata, Parasetodes respersella, Stodes okyrrhoe* and *S. opheltes.* The dominant downstream species were *Oecetis scutulata* 25.23% (n=541), *Setodes argentiguttatus* 20.15% (n=432), *Cheumatopsyche globosa* 12.50% (n=268) and *C. lucida* 9.14% (n=196).

And shared species were 30 species following *Agapetus halong, Hydroptilia* sp., *H. thuna, Pseudoneurpclipsis ramosa, Dipseudopsis robusitor, Amphisyche meridiana, Cheumatopsyche chrysothemis, C. copia, C. globosa, C. lucida, Macrostemum floridum, M. midas, Potamyia alleni, P. flavata, P. periboia, P. phaidra, Micrasema* sp., *Lepidostoma doligung, Leptocerus chiangmaiensis, L. posticus, Oecetis bengalica, O. biramosa, O. empusa, O. scutulata, Setodes argentiguttatus, S. sarapis, S. tcharurupa, S. fluvialis, Cochliophylax angusta* and *Marilia sumatrana.*

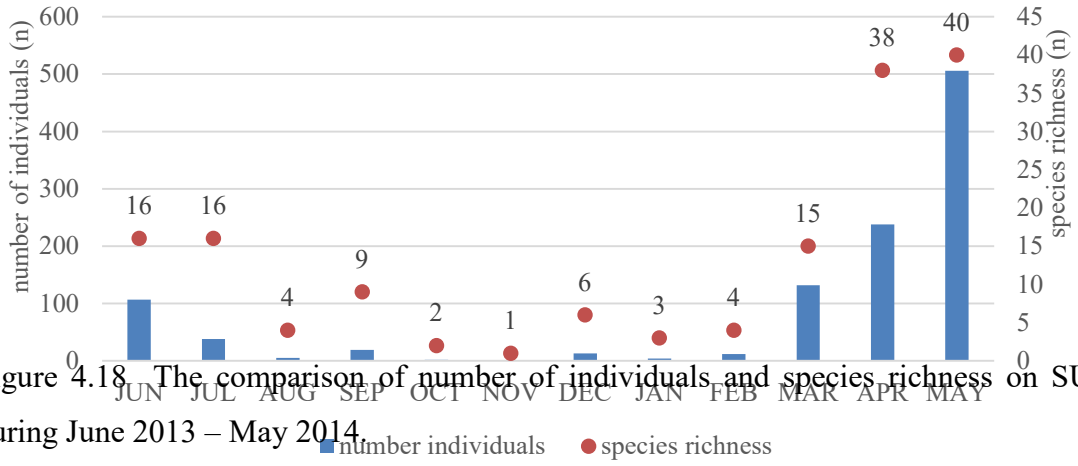

Figure 4.18 The comparison of number of individuals and species richness on SU1 during June 2013 – May 2014.

From upstream sampling sites, a total of 1,077 of adult male Trichoptera were identified in SU1 included 15 families and 66 species. The highest number of adult male Trichoptera was found 506 individuals on May 2014, the dominant species were *Pseudoneureclipsis ramosa* (n=161) and *Marilia sumatrana* (n=76). The lowest number of adult male Trichoptera was found 1 individual on November 2013, *Cheumatopsyche*

chrysothemis. The dominant species was *Pseudoneureclipsis ramosa* 15.6% (n=168) and *Cheumatopsyche chrysothemis* 15.13% (n=163), the others minor species were *Macrostemum hestia*, *Cheumatopsyche criseyde*, *Oecetis biramosa*, *Ganonema fascipenne*, *Psycomyia lak, Chimarra helios, Nyctiophylax zadox* and *Hydroptilia* sp., all specimens found only 1 individual (0.09%). The comparison of number of individuals and species richness on SU1 from June 2013 – May 2014 was showed in Figure 4.18

Total number of adult male Trichoptera in SU2 during June 2013 – May 2014 was 623 individuals included 14 families and 49 species. The highest number of adult male Trichoptera was found 352 individuals on April 2014, the dominant species were *Cheumatopsyche globosa* (n=93), *Oecetis scutulata* (n=43) and *Cheumatopsyche chrysothemis* (n=42). The lowest number of adult male Trichoptera were found 3 individuals on January 2014 followed by *Setodes argentiguttatus* (n=2) and *Hydroptilia thuna* (n=1). The dominant species were *Cheumatopsyche globosa* 15.09% (n=94) and *Hydroptilia thuna* 12.20% (n=76) found on SU2, the minor species were *Macrostemum fenestratum*, *Amphipsyche meridiana*, *Cheumatopsyche cacus, Hydropsyche clitumnus, Oecetis bengalica, Setodes thoneti, Leptocerus dirghachuka, Marilia mogtina, Psychomyia lak, P. amphiaraos* and *Micrasema* sp., all specimens found only 1 individual (0.16%). The comparison of number of individuals and species richnesson SU2 during June 2013 – May 2014 was showed in Figure 4.19

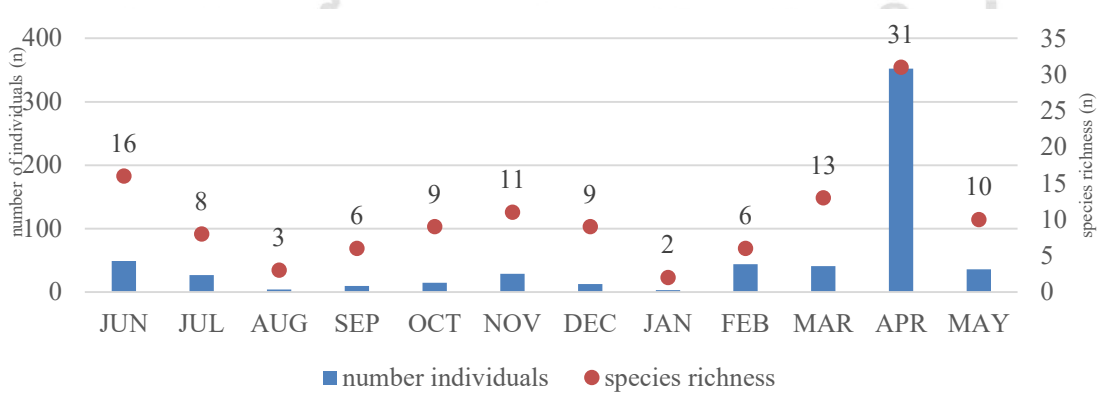

Figure 4.19 The comparison of number of individuals and species richness in SU2 during June 2013 – May 2014.

From downstream sampling sites, total number of adult male Trichoptera in SD3 during June 2013 – May 2014 was 678 individuals included 9 families and 26 species.

The highest number of adult male Trichoptera was 292 individuals found on April 2014, the dominant species were *Setodes argentiguttatus* (n=102), *Oecetis scutulata* (n=66) and *Cheumatopsyche globosa* (n=57). The lowest number of adult male Trichoptera was 6 individuals found on October 2013 followed by *Oecetis scutulata* (n=1), *Setodes argentiguttatus* (n=2) and *Ecnomus votticus* (n=3). The dominant species were *Oecetis scutulata* 29.05% (n=197) and *Setodes argentiguttatus* 28.32% (n=192), the minor species were *Setodes tcharurupa, Leptocerus chiangmaiensis, Chimarra momma and Cocholiophylax angusta*, all specimens found only 1 individual (0.15%). The comparison of number of individuals and species richness on SD3 during June 2013 – May 2014 was showed in Figure 4.20

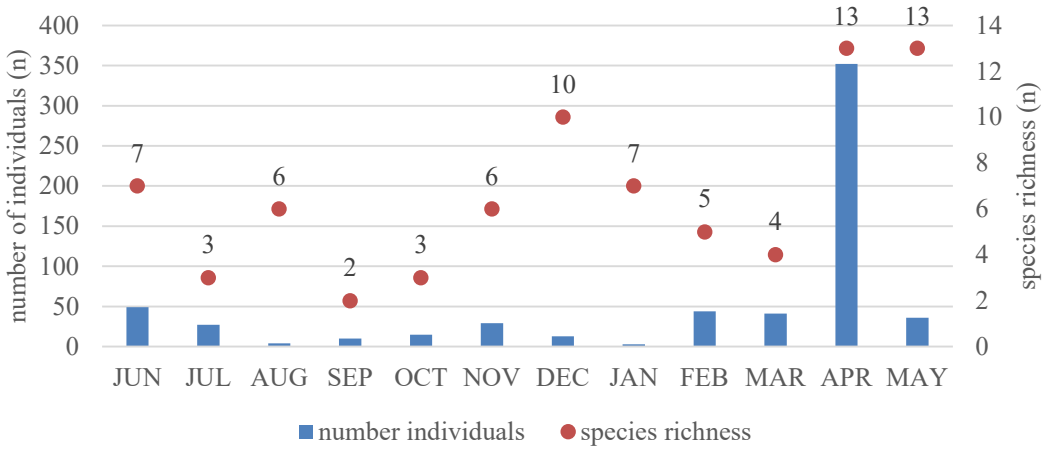

Figure 4.20 The comparison of number of individuals and species richness in SD3 during June 2013 – May 2014.

Total number of adult male Trichoptera in SD4 during June 2013 – May 2014 was 412 individuals included 9 families followed by 31 species. The highest number of adult male Trichoptera was 130 individuals found on April 2014, the dominant species were *Oecetis scutulata* (n=48). The lowest number of adult male Trichoptera were *Cheimatopsyche globosa* 1 individual found on October 2013 and *Agapetus halong* 1 individuals found on February 2014. The dominant species were *Oecetis scutulata* 25.97% (n=107), the minor species were *Macrostemum midas, Anthaloptera sexpunctata, Potamyia alleni, P. periboia, Agapetus halong* and *Cocholiophylax angusta*, all specimens found only 1 individual (0.15%). The comparison of number of individuals and species richness on SD4 during June 2013 – May 2014 was showed in Figure 4.21

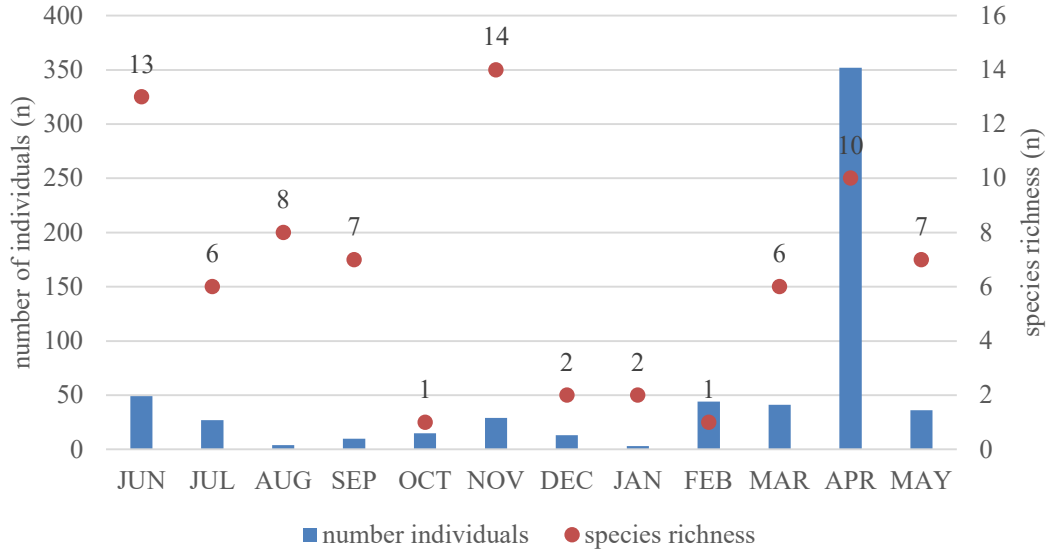

Figure 4.21 The comparison of number of individuals and species richness in SD4 during June 2013 – May 2014.

Total number of adult male Trichoptera in SD5 during June 2013 – May 2014 was 420 individuals included 8 families and 28 species. The highest number of adult male Trichoptera was 84 individuals found on July 2013, the dominant species were *Oecetis scutulata* (n=29) and *Setodes argentiguttatus* (n=66). The lowest number of adult male Trichoptera was 1 individual found on October 2013, which was *Cheumatopsyche globosa.* The dominant species on SD5 were *Setodes argentiguttatus* 29.05% (n=122) and *Oecetis scutulata* 27.14% (n=114), the minor species were *Potamyia flavata, P. periboia, Ceralea idaia, Oecetis tripunctata, Parasetodes respersella, Setodes sarapis* and *Agapetus halong*, all specimens found only 1 individual (0.24%). The comparison of number of individuals and species richness on SD5 during June 2013 – May 2014 was showed in Figure 4.22.

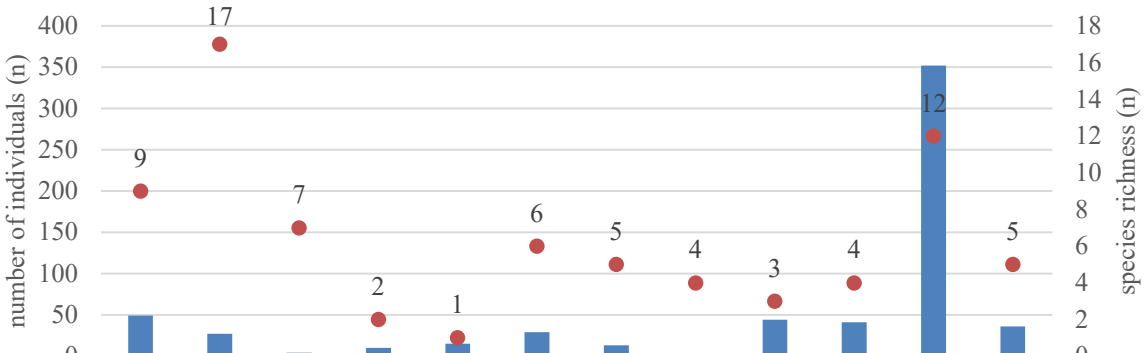

Figure 4.22 The comparison of number of individuals and species richness in SD5 during June 2013 – May 2014.

Total number of adult male Trichoptera in SD6 during June 2013 – May 2014 was 333 individuals included 9 families and 27 species. The highest number of adult male Trichoptera was 114 individuals found on December 2013, the dominant species were *Oecetis scutulata* (n=46) and *Setodes argentiguttatus* (n=34). The lowest number of adult male Trichoptera was 2 individuals found on October 2013, which was *Cheumatopsyche globosa.* The dominant species was *Oecetis scutulata* 29.73% (n=99), the minor species were *Oecetis meghadouta, Ecnomus cincibilus, Lepidostoma doligung* and *Drepanocentron curmisagius*, all specimens found only 1 individual (0.30%). The comparison of number of individuals and species richness on SD6 during June 2013 – May 2014 was showed in Figure 4.23.

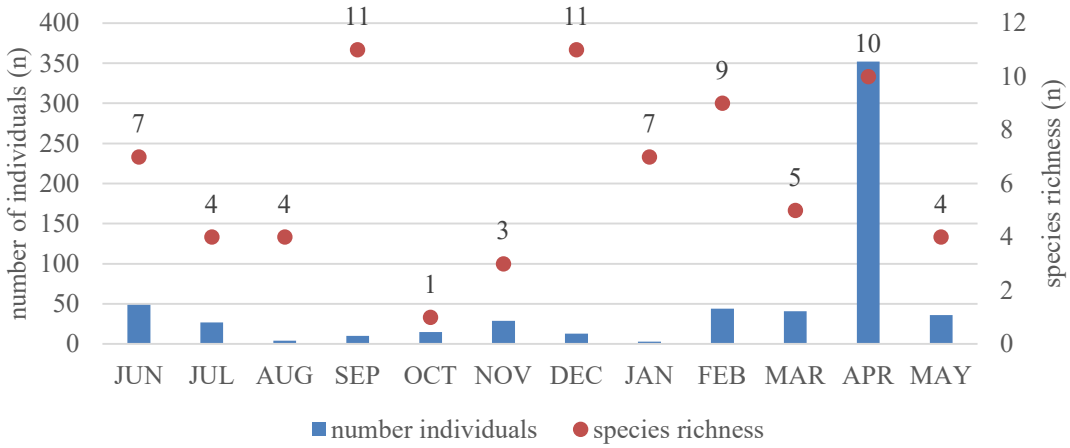

Figure 4.23 The comparison of number of individuals and species richness in SD6 during June 2013 – May 2014.

Total number of adult male Trichoptera in SD7 during June 2013 – May 2014 was 301 individuals included 7 families and 26 species. The highest number of adult

male Trichoptera was 98 individuals found on April 2014, the dominant species was *Cheumatopsyche lucida* (n=40). The lowest number of adult male Trichoptera was found on January 2014 with 2 individuals, *Cheumatopsyche copia* (n=1) and C. *globosa* (n=1). The dominant species were *Cheumatopsyche lucida* 21.26% (n=64) and *C. globosa* 17.61% (n=53), the minor species were *Potamyia phaidra, Oecetis biramosa, Psychomyia sampati* and *Micrasema* sp., all specimens found only 1 individual (0.33%). The comparison of number of individuals and species richness on SD7 during June 2013 – May 2014 was showed in Figure 4.24.

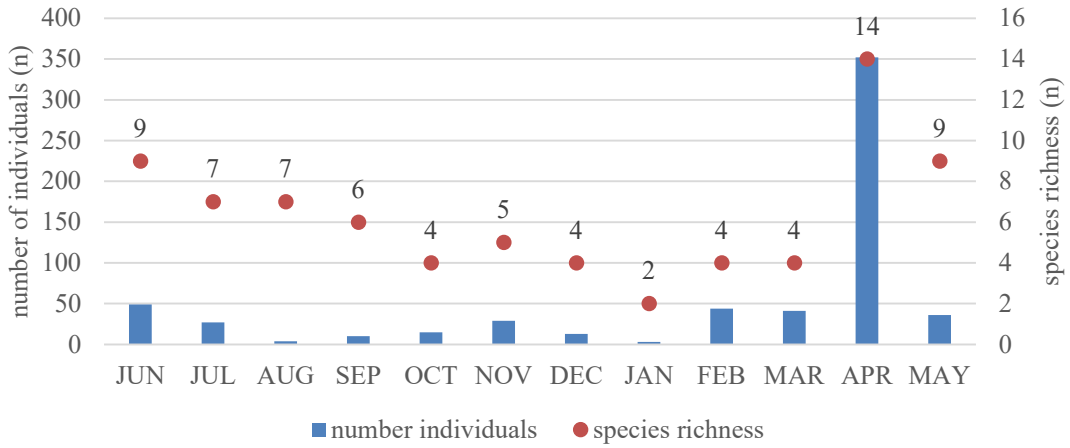

Figure 4.24 The comparison of number of individuals and species richness in SD7 during June 2013 – May 2014.

Among studied for year period, the appearance of dominant species, with the range between 399 to 600 individuals were *Oecetis scutulata* 15.74% (n=605), *Setodes argentiguttatus* 12.15% (n=467) and *Cheumatopsyche globosa* 10.41% (n=400), and the range between 199 to 400 individuals were *Hydroptilia thuna* 6.92% (n=266), *Cheumatopsyche lucida* 6.56% (n=252), *Cheumatopsyche chrysothemis* 4.32% (n=243) and *Pseudoneureclipsis ramosa* 5.18% (n=199). The appearance of minor species in all sampling sites among year were *Marcrostemum fenestratum* 0.08 % (n=3), *M. hestia* 0.03% (n=1), *Diplectona aurovttata* 0.05% (n=2), *Cheumatopsyche cacus* 0.03% (n=1), *Hydropsyche clitumnus* 0.03% (n=1), *Ceralea idaia* 0.03% (n=1), *C. hippodamia 0*.05% (n=2), Oecetis *asmada* 0.05% (n=2), *O. meghadouta* 0.03% (n=1), *O. kodros* 0.05% (n=2), *Parasetodes respersella* 0.08% (n=3), *Setodes opora* 0.05% (n=2), *S. orcus* 0.05% (n=2), *Dipseudopsis varians* 0.05% (n=2), *Anisocentropus pan* 0.08% (n=3), *Ganonema fascipenne* 0.03% (n=1), *Marilia mogtina* 0.08% (n=3), *M. arpoe* 0.08%

(n=3), *Psychomyia lak* 0.05 (n=2), *P. mento* 0.08% (n=3), *Tinodes ragu* 0.05% (n=2), *Chimarra momma* 0.03% (n=1), *C. helios* 0.03% (n=1), *Kisaura peleg* 0.05% (n=2), *Ecnomus cincibilus* 0.08% (n=3), *E. mammus* 0.05% (n=2), *E. venimar* 0.08% (n=3), *Nyctiophylax zadox* 0.03% (n=1), *Goera echo* 0.05% (n=2), *G. redsat* 0.05% (n=2), *G. matuilla* 0.08% (n=3), *Orthotrichia maendrica* 0.05% (n=2), *Drepanocentron curmisagius* 0.03% (n=1), *Proxiphocentron patrus* 0.05% (n=2) and *Micrasema* sp. 0.05% (n=2).

Monthly in species richness and abundance of Trichoptera individuals

Total monthly Trichoptera species richness between all sampling sites in Mae Ngat Somboonchol dam was showed in Figure 4.25. On April 2014, there were presented the highest species richness of Trichoptera with 61 species. Thirty-eight species were found in SU1 and 31 species were found in SU2, downstream sampling sites were less number of species (10-14 species). The lowest species richness was presented in October 2013 range from 1 to 9 species.

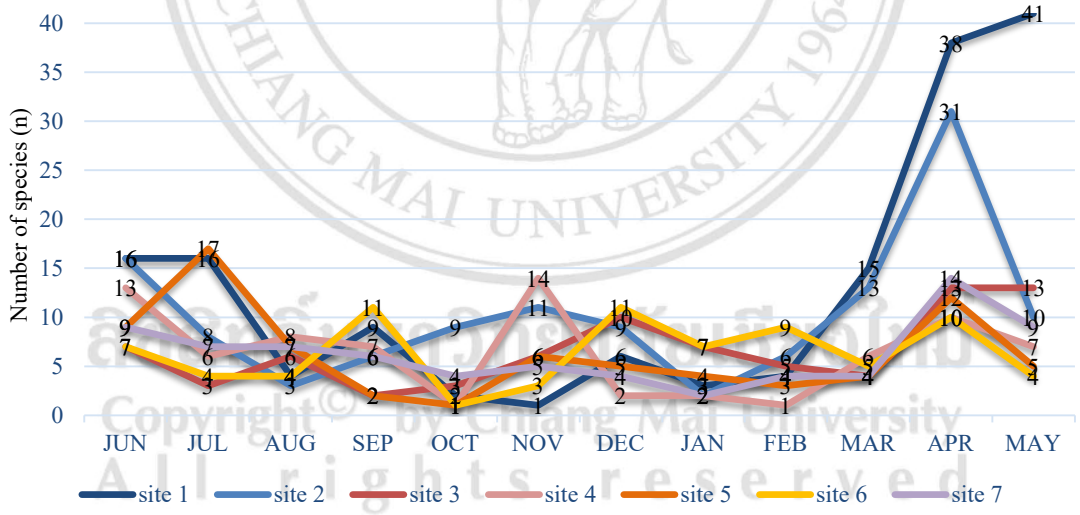

Figure 4.25 Monthly in species richness of Trichoptera between all sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014.

Total monthly adult male Trichoptera abundance between all sampling sites in Mae Ngat Somboonchol dam were showed in Figure 4.26. The highest abundance of adult male Trichoptera abundance were presented on April 2014 with 1,226 individuals. On April 2014, adult male Trichoptera were found 352 individuals in sampling site 2

(SU2), found 292 individuals in sampling site 3 (SD3) and found 238 individuals in sampling site 1 (SU1). The highest abundance of adult male Trichoptera was found in sampling site 1 (SU1) on May 2014 with 506 individuals. The lowest abundance of adult male Trichoptera was on October 2013 range between 1 to 15 individuals.

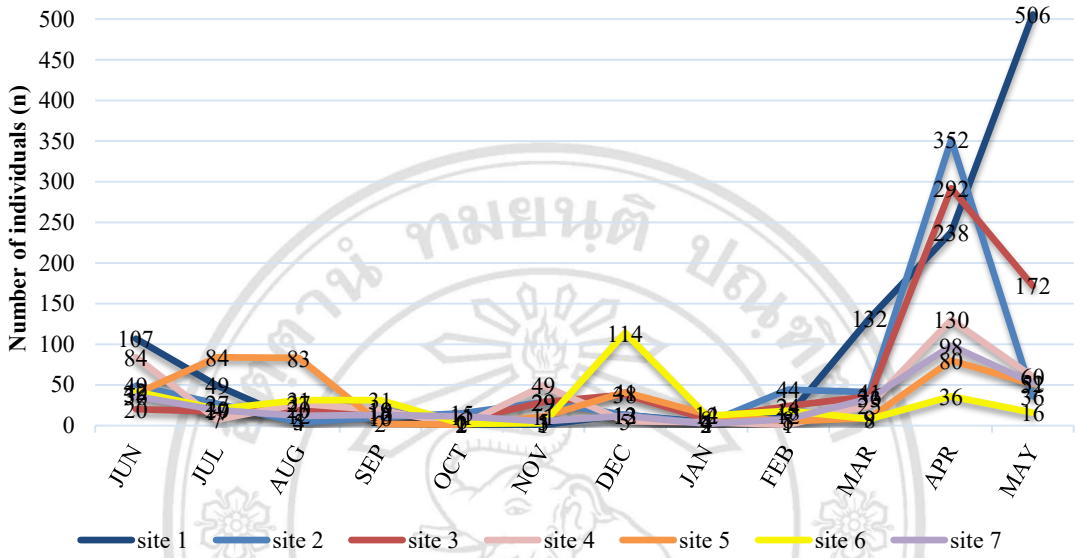

Figure 4.26 Monthly in abundance of adult male Trichoptera between all sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014.

Larvae and adult composition

The total number of individuals, species richness, diversity index (Shannon wiener index) and evenness of adult male Trichoptera were showed in Table 4.3.

Table 4.3 Total number of adult male Trichoptera individuals, species richness, diversity index and evenness index in Mae Ngat Somboonchol dam during June 2013 – May 2014.

Sampling sites	**SU1**	**SU2**	**SD3**	**SD4**	**SD5**	**SD6**	**SD7**
Total number	1,077	623	678	412	420	333	301
Species richness	66	49	26	31	28	27	26
H'	3.13	3.06	1.99	2.54	2.17	2.40	2.55
Evenness	0.31	0.32	0.24	0.24	0.29	0.37	0.37

Number of larvae and adult male individuals of Trichoptera were compared in family level between all sampling sites during year from June 2013 – May 2014. The

results on upstream sampling sites were represented. In SU1, Trichoptera larvae presented in 15 families and Hydropsychidae was found in every month. Compared with adult stage were presented in 11 months except in January 2014 (Table 4.4). In SU2, larvae presented in 14 families, Hydroptilidae was the dominant which was found every months and compared with adult stage were presented in 6 months, except July, September, November, December 2013, March and May 2014. There were 2 families which the larvae stage was presented without adult stage. Only adult of Brachycentridae were presented on July 2013 and May 2014. Xiphoncentronidae larvae was presented on February 2014 and missing adult stage among year (Table 4.5).

From downstream sampling sites, in SD3 Hydropsychidae and Leptoceridae larvae were presented on August 2013, while adult stage was found with 9 families, (Table 4.6). In SD4, six families of larvae stage were found in December 2013, January and March 2014. And nine families of adult stage were found (Table 4.7). In SD5, there were 8 families of larvae stage presented in this area; Hydropsychidae was the most dominant larvae represented in 6 months and adult were found in 8 families (Table 4.8).

In SD6, there were found total number of larvae families in 5 months followed by June 2013 (n=1), January 2014 (n=5), March 2014 (n=2), April 2014 (n=3) and May 2014 (n=3). And total number of adult families was 9 families; the most occurrence families were Hydropsychidae and Leptoceridae (Table 4.9). At the last sampling site SD7, there were 3 of larvae families of Trichoptera presented in 4 months followed by July 2013 (n=1), September 2013 (n=19), March 2014 (n=26) and April 2014 (n=123). And total number of adult stage was found in 7 families, the dominant family was Hydropsychidae (see Table 4.10).

Comparison with previous recorded

In this study, comparison of Trichoptera composition from previous data (Thapanya *et al*., 2013) was showed in Table 4.11. From Thapanya *et al*. (2013) studied, there were 4 sampling sites, which some were located in the same spot with recent study followed by site 1 and 2 from upstream (same spot with recent), site 3 on hydro electrical generator and site 4 under the main bridge (different spot on recent) and sampling period was 3 months on May, July and November 2009.

Fifty species were new found from the previous recorded by Thapanya *et al*. (2013), and eighteen species were missing following by *Cheumatopsyche dhanikari, C. chryseis, C. concava, Hydromanicus serubabel, Hydropsyche dolosa, H. pallipenne, Macrostemum dohrni, Leptocerus lanzenbergeri, Leptocerus suthepensis, Oecetis laodike, O. purucha, O. purusamedha, Mystacides elongate, Triaenodes menestheus, Paduniella semarangensis, Psychomyia kaiya, Kisaura sura* and *Pahamunaya jihmita.*

Table 4.4 Comparison of abundance and occurrence of larvae and adult stage of Trichoptera in sampling site 1 (SU1) on Mage Ngat Somboonchol dam during June 2013 – May 2014. (Note; total number of larvae individuals see in appendix II)

Family	Sampling site 1 (SU1)															
	Larvae		Adult													
	abundance	occurrence	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	abundance	occurrence
Brachycentridae	0	0													0	0
Calamoceratidae	15	5										1	5	4	10	3
Dipseudopsidae	11	4												2	2	1
Ecnomidae	14	6	3	5									1		9	3
Glossosomatidae	19	6							4					2	6	2
Goeridae	2	2		2	1	2							2	2	9	5
Helicopsychidae	404	11	1	2							1	1	2	4	11	6
Hydropsychidae	335	11	43	17	2	10	1	1	4		5	115	157	121	476	11
Hydroptilidae	906	12				3	1		1	1			22	29	57	6
Lepidostomatidae	82	9											2		2	1
Leptoceridae	885	11	58	5	2	2					2	2	27	91	189	8
Odontoceridae	27	7	2						1		4	11	7	77	102	6
Philopotamatidae	26	8		2		1			1	1			7	8	20	6
Polycentropodidae	8	6		5		1							5	162	173	4
Psychomyiidae	3	2							2			2	1	4	9	4
Xiphoncentronidae	1	1								2					2	1
Total individuals	2,738	-	107	38	5	19	2	1	13	4	12	132	238	506	1,077	-
Family richness	-	15	5	7	3	6	2	1	6	3	4	6	12	12	-	15

Table 4.5 Comparison of abundance and occurrence of larvae and adult stage of Trichoptera in sampling site 2 (SU2) on Mage Ngat Somboonchol dam during June 2013 – May 2014. (Note; total number of larvae individuals see in appendix II)

Family	Sampling site 2 (SU2)															
	Larvae		Adult													
	abundance	occurrence	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	abundance	occurrence
Brachycentridae	0	0		1										1	2	2
Calamoceratidae	9	3													0	0
Dipseudopsidae	9	4		2											2	1
Ecnomidae	17	4					2		1			2	3		8	4
Glossosomatidae	31	8					2	13					12		27	3
Goeridae	1	1				1			1						2	2
Helicopsychidae	6	3		1							1			1	3	3
Hydropsychidae	566	10	25	20	2	6	6	5	6		4	32	192	12	310	11
Hydroptilidae	308	7	6		2		1			1	35		31		76	6
Lepidostomatidae	3	2				1	1								2	2
Leptoceridae	377	10	14	3			1	4	2	2		7	96	4	133	9
Odontoceridae	248	11	4				1		1		2		6	12	26	6
Philopotamatidae	20	5				2	1	6	2				2		13	5
Polycentropodidae	26	5						1			2		10	4	17	4
Psychomyiidae	4	2												2	2	1
Xiphoncentronidae	0	0													0	0
Total individuals	1,625	-	49	27	4	10	15	29	13	3	44	41	352	36	623	-
Family richness	-	14	4	5	2	4	8	5	6	2	5	3	8	7	-	14

Table 4.6 Comparison of abundance and occurrence of larvae and adult stage of Trichoptera in sampling site 3 (SD3) on Mage Ngat Somboonchol dam during June 2013 – May 2014. (Note; total number of larvae individuals see in appendix II)

Family	Sampling site 3 (SD3)															
	Larvae		Adult													
	abundance	occurrence	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	abundance	occurrence
Brachycentridae	0	0													0	0
Calamoceratidae	0	0													0	0
Dipseudopsidae	0	0						1					1		2	2
Ecnomidae	0	0					3	1	7					2	13	4
Glossosomatidae	0	0													0	0
Goeridae	0	0													0	0
Helicopsychidae	0	0												1	1	1
Hydropsychidae	56	1	3		2			1	6	2	5	9	88	48	164	9
Hydroptilidae	0	0									11	13	16	9	49	4
Lepidostomatidae	0	0													0	0
Leptoceridae	4	1	16	17	18	16	3	26	25	5	8	14	183	112	443	12
Odontoceridae	0	0											3		3	1
Philopotamatidae	0	0	1												1	1
Polycentropodidae	0	0								1			1		2	2
Psychomyiidae	0	0													0	0
Xiphoncentronidae	0	0													0	0
Total individuals	60	-	20	17	20	16	6	29	38	8	24	36	292	172	678	-
Family richness	-	2	3	1	2	1	2	4	3	3	3	3	6	5	-	9

Table 4.7 Comparison of abundance and occurrence of larvae and adult stage of Trichoptera in sampling site 4 (SD4) on Mage Ngat Somboonchol dam during June 2013 – May 2014. (Note; total number of larvae individuals see in appendix II)

Family	Sampling site 4 (SD4)															
	Larvae		Adult													
	abundance	occurrence	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	abundance	occurrence
Brachycentridae	0	0													0	0
Calamoceratidae	0	0													0	0
Dipseudopsidae	0	0			2				3	3			3		11	4
Ecnomidae	0	0	4	1				5							10	3
Glossosomatidae	0	0									1				1	1
Goeridae	0	0													0	0
Helicopsychidae	0	0											1		1	1
Hydropsychidae	14	1	29	5	15	5	1	18		1		14	40	28	156	10
Hydroptilidae	9	3											7	7	14	2
Lepidostomatidae	0	0													0	0
Leptoceridae	9	3	40	1	10	14		26	2			11	79	25	208	9
Odontoceridae	2	2													0	0
Philopotamatidae	1	1													0	0
Polycentropodidae	0	0	3												3	1
Psychomyiidae	1	1	8												8	1
Xiphoncentronidae	0	0													0	0
Total individuals	36	-	84	7	27	19	1	49	5	4	1	25	130	60	412	-
Family richness	-	6	5	3	3	2	1	3	2	2	1	2	5	3	-	9

Table 4.8 Comparison of abundance and occurrence of larvae and adult stage of Trichoptera in sampling site 5 (SD5) on Mage Ngat Somboonchol dam during June 2013 – May 2014. (Note; total number of larvae individuals see in appendix II)

Family	Sampling site 5 (SD5)															
	Larvae		Adult													
	abundance	occurrence	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	abundance	occurrence
Brachycentridae	0	0													0	0
Calamoceratidae	0	0													0	0
Dipseudopsidae	4	3		5	4								3		12	3
Ecnomidae	0	0				1		1			2	1			5	4
Glossosomatidae	0	0											1		1	1
Goeridae	0	0													0	0
Helicopsychidae	0	0													0	0
Hydropsychidae	349	6	6	20	3		1	9		3	3		32	9	86	9
Hydroptilidae	3	2		3								6	9	16	34	4
Lepidostomatidae	0	0													0	0
Leptoceridae	13	4	33	52	76	1		1	41	11		2	31	26	274	10
Odontoceridae	1	1		2											2	1
Philopotamatidae	1	1													0	0
Polycentropodidae	1	1		2									4		6	2
Psychomyiidae	1	1													0	0
Xiphoncentronidae	0	0													0	0
Total individuals	373	-	39	84	83	2	1	11	41	14	5	9	80	51	420	-
Family richness	-	8	2	6	3	2	1	3	1	2	2	3	6	3	-	8

Table 4.9 Comparison of abundance and occurrence of larvae and adult stage of Trichoptera in sampling site 6 (SD6) on Mage Ngat Somboonchol dam during June 2013 – May 2014. (Note; total number of larvae individuals see in appendix II)

Family	Sampling site 6 (SD6)															
	Larvae		Adult													
	abundance	occurrence	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	abundance	occurrence
Brachycentridae	0	0													0	0
Calamoceratidae	0	0													0	0
Dipseudopsidae	1	1			1	1		1	4	2	1		1	2	13	8
Ecnomidae	0	0				3			3	3	1		3		13	5
Glossosomatidae	1	1													0	0
Goeridae	0	0													0	0
Helicopsychidae	0	0													0	0
Hydropsychidae	284	5	11	16	1	5	2	1	8	3	5	5	8	9	74	12
Hydroptilidae	297	3									2		19	4	25	3
Lepidostomatidae	0	0		1											1	1
Leptoceridae	10	2	31	3	29	22		1	94	4	6	3	4	1	198	11
Odontoceridae	0	0													0	0
Philopotamatidae	0	0													0	0
Polycentropodidae	0	0							5						5	1
Psychomyiidae	2	1									3				3	1
Xiphoncentronidae	0	0											1		1	1
Total individuals	595	-	42	20	31	31	2	3	114	12	18	8	36	16	333	-
Family richness	-	6	2	3	3	4	1	3	5	4	6	2	6	4	-	9

Table 4.10 Comparison of abundance and occurrence of larvae and adult stage of Trichoptera in sampling site 7 (SD7) on Mage Ngat Somboonchol dam during June 2013 – May 2014. (Note; total number of larvae individuals see in appendix II)

Family	Sampling site 7 (SD7)															
	Larvae		Adult													
	abundance	occurrence	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	abundance	occurrence
Brachycentridae	0	0													0	0
Calamoceratidae	0	0													0	0
Dipseudopsidae	1	1	2		5	1	4	1	7		4			4	28	8
Ecnomidae	0	0											8		8	1
Glossosomatidae	0	0													0	0
Goeridae	0	0													0	0
Helicopsychidae	0	0													0	0
Hydropsychidae	0	0	17	16	6	9	7	2	5	2	2	22	72	38	198	12
Hydroptilidae	166	3	3	3									12		18	3
Lepidostomatidae	0	0													0	0
Leptoceridae	2	2	14		1	3		2			2	11	6	8	47	8
Odontoceridae	0	0													0	0
Philopotamatidae	0	0													0	0
Polycentropodidae	0	0													0	0
Psychomyiidae	0	0												1	1	1
Xiphoncentronidae	0	0												1	1	1
Total individuals	169	-	36	19	12	13	11	5	12	2	8	33	98	52	301	-
Family richness	-	3	4	2	3	3	2	3	2	1	3	2	4	5	-	7

Table 4.11 Species occurrence and abundance of adult male Trichoptera in Mae Ngat Somboonchol, compared with previous data from Thapanya *et al*. (2013) Abun.; Abundance, Occur.; Occurrence

Family/species	Sampling sites (2013)							Abun. (n)	Occur. (month)	Sampling sites on 2009 (Thapanya *et al*., 2013)				Abun. (n)	Occur. (month)
	(SU1)	(SU2)	(SD3)	(SD4)	(SD5)	(SD6)	(SD7)			(SU1)	(SU2)	(SD3)	(SD5)		
Glossosomatidae															
Agapetus halong	✓	✓		✓	✓			35	7	✓				1	1
Hydroptilidae															
Hydroptilia sp	✓				✓		✓	5	3						
Hydroptilia thuna	✓	✓	✓	✓	✓	✓	✓	266	27						
Orthotrichia maendrica					✓			2	1						
Philopotamidae															
Chimarra akkaorum	✓	✓						18	6	✓	✓			4	2
Chimarra chiangmaiensis	✓	✓						6	5			✓		1	1
Chimarra helios	✓							1	1						
Chimarra momma			✓					1	1			✓		7	1
Kiasura peleg	✓							2	1						

Wormaldia nyctimon	✓	✓						6	2						

Table 4.11 (continued)

Family/species	Sampling sites (2013)							Abun. (n)	Occur. (month)	Sampling sites on 2009 (Thapanya *et al*., 2013)				Abun. (n)	Occur. (month)
	(SU1)	(SU2)	(SD3)	(SD4)	(SD5)	(SD6)	(SD7)			(SU1)	(SU2)	(SD3)	(SD5)		
Polycentropidae															
Nyctiophylax zadox	✓							1	1						
Polycentropus admin	✓	✓						6	4			✓		1	1
Pseudoneurpclipsis ramosa	✓	✓	✓	✓	✓	✓		199	13	✓	✓	✓		11	3
Dipseudopsidae															
Dipseudopsis bernardi				✓	✓		✓	8	5						
Dipseudopsis robusitor	✓	✓	✓	✓	✓	✓	✓	60	25		✓	✓		12	4
Dipseudopsis varians							✓	2	1				✓	1	1
Psychomyiidae															
Psychomyia amphiaraos	✓	✓						4	3		✓			1	1

Psychomyia kerynitia				✓				8	1						
Psychomyia lak	✓	✓						2	2	✓				1	1
Psychomyia mento	✓							3	2		✓	✓		9	3
Psychomyia sampati						✓	✓	4	2		✓			1	1
Tinodes ragu	✓							2	1	✓		✓		3	2

Table 4.11 (continued)

Family/species	Sampling sites (2013)							Abun. (n)	Occur. (month)	Sampling sites on 2009 (Thapanya *et al*., 2013)				Abun. (n)	Occur. (month)
	(SU1)	(SU2)	(SD3)	(SD4)	(SD5)	(SD6)	(SD7)			(SU1)	(SU2)	(SD3)	(SD5)		
Xiphocentronidae															
Drepanocentron curmisagius						✓		1	1						
Proxiphocentron patrus	✓							2	1						
Ecnomiidae															
Ecnomus alkios						✓	✓	4	3						
Ecnomus cincibilus				✓		✓		3	2						

Ecnomus jojachin	✓	✓						14	6	✓	✓	✓		14	5
Ecnomus mammus						✓		2	1			✓		1	1
Ecnomus puro			✓	✓	✓	✓	✓	23	12	✓	✓	✓	✓	23	7
Ecnomus venimar	✓							3	1						
Ecnomus votticius			✓	✓	✓	✓	✓	17	8			✓		1	1
Hydropsychidae															
Amphisyche meridiana		✓		✓	✓	✓	✓	68	14			✓	✓	8	2
Anthaloptera sexpunctata				✓			✓	5	3						
Cheumatopsyche banksi			✓	✓				7	5			✓	✓	55	3

Table 4.11 (continued)

Family/species	Sampling sites (2013)							Abun. (n)	Occur. (month)	Sampling sites on 2009 (Thapanya *et al*., 2013)				Abun. (n)	Occur. (month)
	(SU1)	(SU2)	(SD3)	(SD4)	(SD5)	(SD6)	(SD7)			(SU1)	(SU2)	(SD3)	(SD5)		
Cheumatopsyche cacus		✓						1	1						
Cheumatopsyche caieta			✓					2	1						

Cheumatopsyche chrysothemis	✓	✓	✓	✓			✓	243	21		✓			2	1
Cheumatopsyche copia	✓					✓	✓	6	4						
Cheumatopsyche criseyde	✓	✓						21	6	✓	✓	✓	✓	360	10
Cheumatopsyche globosa	✓	✓	✓	✓	✓	✓	✓	400	41						
Cheumatopsyche lucida	✓	✓	✓	✓	✓	✓	✓	252	47	✓	✓	✓	✓	126	9
Diplectona aurovittata	✓							2	1						
Hydromanicus eliakim	✓							2	2						
Hydropsyche camillus	✓	✓						98	11	✓	✓	✓		5	4
Hydropsyche clitumnus		✓						1	1						
Hydropsyche formosana	✓	✓						90	6						
Hydropsyche harpagofalcata	✓	✓						4	2						
Macrostemum fenestratum	✓	✓						3	4						
Macrostemum floridum	✓	✓	✓	✓	✓	✓	✓	61	21						

Table 4.11 (continued)

Family/species	Sampling sites (2013)							Abun. (n)	Occur. (month)	Sampling sites on 2009 (Thapanya *et al*., 2013)				Abun. (n)	Occur. (month)

	(SU1)	(SU2)	(SD3)	(SD4)	(SD5)	(SD6)	(SD7)			(SU1)	(SU2)	(SD3)	(SD5)		
Macrostemum hestia	✓							1	1						
Macrostemum midas	✓	✓		✓				36	10	✓	✓	✓		323	6
Potamyia alleni	✓	✓	✓	✓	✓	✓	✓	25	11			✓		1	1
Potamyia flavata	✓	✓	✓	✓	✓	✓	✓	91	25	✓	✓	✓	✓	9	5
Potamyia periboia	✓	✓		✓	✓			9	8						
Potamyia phaidra	✓	✓		✓			✓	36	9	✓		✓	✓	17	3
Brachycentridae															
Micrasema sp.		✓					✓	2	2						
Goeridae															
Goera echo	✓							2	1						
Goera matuilla	✓							3	2	✓		✓		2	2
Goera redsat	✓							2	1						
Goera uniformis	✓	✓						4	3	✓	✓	✓		9	4
Lepidostomatidae															

Lepidostoma doligung	✓	✓				✓		5	4		✓	✓		5	2

Table 4.11 (continued)

Family/species	Sampling sites (2013)							Abun. (n)	Occur. (month)	Sampling sites on 2009 (Thapanya *et al*., 2013)				Abun. (n)	Occur. (month)
	(SU1)	(SU2)	(SD3)	(SD4)	(SD5)	(SD6)	(SD7)			(SU1)	(SU2)	(SD3)	(SD5)		
Leptoceridae															
Ceraclea hippodamia		✓						2	1						
Ceraclea idaia					✓			1	1						
Leptocerus chiangmaiensis	✓		✓					4	2			✓	✓	2	2
Leptocerus dirghachuka	✓	✓						4	3	✓	✓	✓	✓	12	4
Leptocerus posticus		✓						4	2			✓	✓	2	4
Oecetis asmada	✓							2	1						
Oecetis bengalica		✓	✓	✓			✓	11	6	✓		✓	✓	27	3
Oecetis biramosa	✓		✓	✓	✓	✓	✓	17	8			✓		12	2
Oecetis empusa	✓	✓	✓	✓	✓	✓	✓	121	22	✓	✓	✓	✓	215	10

Oecetis kodros						✓		2	1						
Oecetis meghadouta						✓		1	1		✓	✓		3	2
Oecetis misenos					✓			4	1						
Oecetis scutulata	✓	✓	✓	✓	✓	✓	✓	605	49						
Oecetis tripunctata			✓	✓	✓		✓	17	7		✓	✓	✓	8	3

Table 4.11 (continued)

Family/species	Sampling sites (2013)							Abun. (n)	Occur. (month)	Sampling sites on 2009 (Thapanya *et al*., 2013)				Abun. (n)	Occur. (month)
	(SU1)	(SU2)	(SD3)	(SD4)	(SD5)	(SD6)	(SD7)			(SU1)	(SU2)	(SD3)	(SD5)		
Parasetodes respersella					✓	✓		3	2						
Setodes argentiguttatus	✓	✓	✓	✓	✓	✓	✓	467	38	✓	✓	✓	✓	27	6
Setodes brevicaudatus	✓	✓						9	4						
Setodes endymion	✓	✓						14	5	✓	✓	✓		51	5
Setodes fluvialis	✓	✓	✓	✓	✓	✓		64	15	✓	✓	✓	✓	202	7
Setodes isis	✓	✓						42	6	✓	✓	✓		20	3

Setodes kybele	✓	✓						11	4							
Setodes okyrrhoe				✓		✓		5	2							
Setodes opheltes			✓		✓			13	6							
Setodes opora	✓							2	1							
Setodes orcus		✓						2	2		✓	✓		2	2
Setodes sarapis	✓				✓			4	2	✓	✓	✓		5	3
Setodes tcharurupa	✓	✓	✓					33	9							
Setodes thoneti	✓	✓						23	5							
Trichosetodes anaksepuluh	✓							5	2							

Table 4.11 (continued)

Family/species	Sampling sites (2013)							Abun. (n)	Occur. (month)	Sampling sites on 2009 (Thapanya *et al*., 2013)				Abun. (n)	Occur. (month)
	(SU1)	(SU2)	(SD3)	(SD4)	(SD5)	(SD6)	(SD7)			(SU1)	(SU2)	(SD3)	(SD5)		
Helicopsychidae															
Cochliophylax angusta	✓	✓	✓	✓				16	11	✓				1	1
Odontoceridae															

Maarilia mogtina	✓	✓						3	3						
Marilia arope	✓							3	2		✓		✓	4	2
Marilia sumatrana	✓	✓	✓		✓			128	14	✓	✓	✓		10	3
Calamoceratidae															
Anisocentropus brevipennis	✓							6	3						
Anisocentropus pan	✓							3	2	✓				1	1
Ganonema fascipenne	✓							1	1	✓				1	1
Total 97 species								3,844	661					1,619	152

Compared average water width, depth and velocity between upstream and downstream sampling sites were showed in Figure 4.27 to 4.29. Average water width in upstream sites were between 0.1 to 4 m while in downstream sites were between 2.3 to 25 m. The channels in SD3 and SD7 were the widest channel between all sampling sites. Sampling site 4 (SD4) was the lowest value of water width with 2.38 m.

Average water depth in upstream and downstream sampling sites were compared, the average depth value was indistinct different, SU2 were the highest average depth value with 0.52 m on SU2 and SD7 was the highest depth value with 0.65 m. The lowest average depth value was 0.39 m on SU1 and the lowest depth value was 0.18 m on SD4.

Average water velocity were compared between all sampling sites, the average velocity in upstream sampling sites were range between 0.6 to 0.8 m/s and in downstream sites were between 0.03 to 1.25 m/s. The lowest average water current speed was 0.03 m/s on SD4 and the highest average water current speed was 1.25 m/s on SD3.

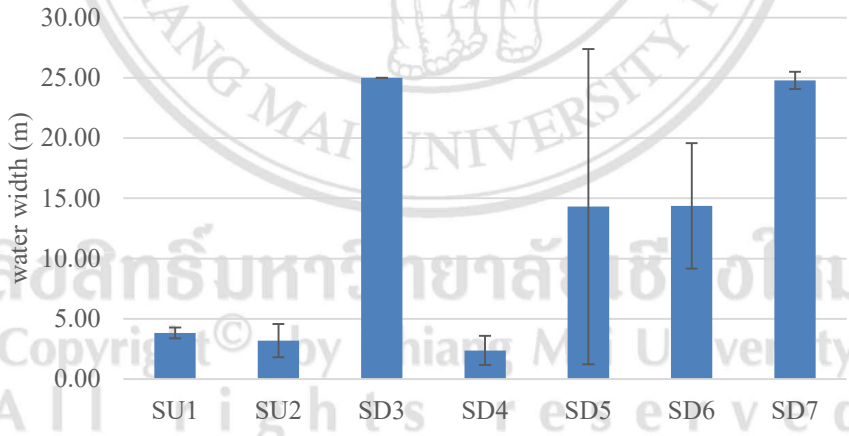

Figure 4.27 Bar graph of mean with standard deviation of water width (m) among all sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014.

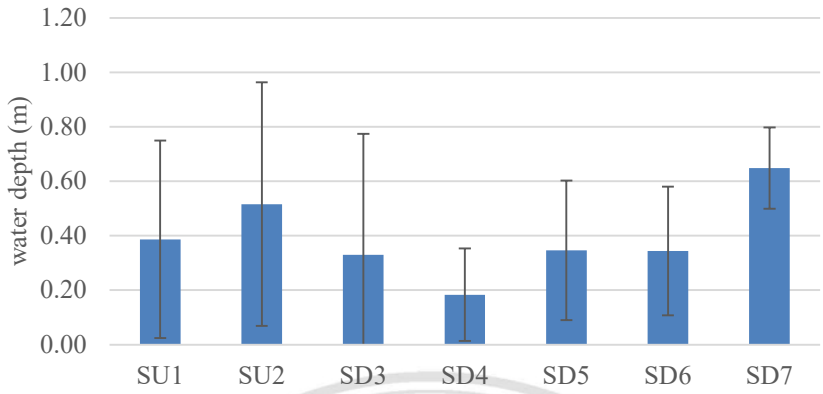

Figure 4.28 Bar graph of mean with standard deviation of water depth (m) among all sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014.

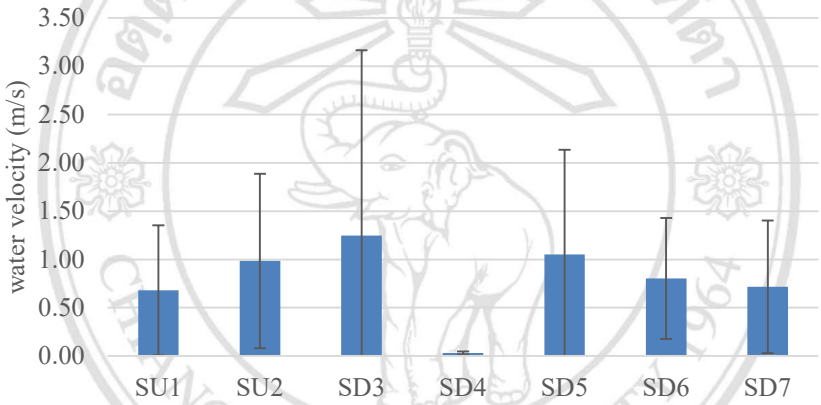

Figure 4.29 Bar graph of mean with standard deviation of water velocity (m/s) among all sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014.

Trichoptera assemblage from upstream to downstream

Total number of larvae's Trichoptera and the richness of families between upstream sampling sites and downstream sampling sites were compared. In upstream sampling sites, the number of larvae's Trichoptera was greatly high average range between 1,625 to 2,738 individuals. In downstream larvae composition was lower. The lowest number of larvae's Trichoptera individuals was 60 individuals on SD3 and the highest number of individuals was 595 on SD6. The richness of Trichoptera larvae's families was compared. In upstream sampling sites had the greatly high of diversity with 15 families, only 10 families were found on downstream sampling sites following by Dipseudopsidae, Glossosomatidae, Helicopsychidae, Hydropsychidae, Hydroptilidae, Leptoceridae, Odontoceridae, Philopotamatidae, Polycentropodidae and

Psychomyiidae. SD6 was the highest number of families of larvae's Trichoptera which were 8 families (Figure 4.30).

Adult male Trichoptera composition were compared between upstream and downstream sampling sites, more than 1,700 male Trichoptera individuals were found from upstream and more than 50 species were found which found 66 species from SU1 and found 49 species from SU2. Compared with downstream sampling sites, 2,144 individuals were found with 26 to 31 species were found among each sites (Figure 4.31).

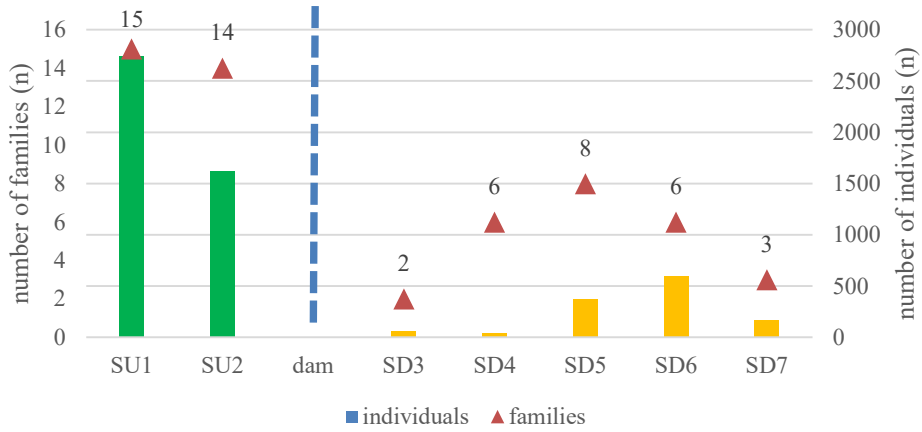

Figure 4.30 Comparison of average larvae family richness and number of individuals between upstream and downstream sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014.

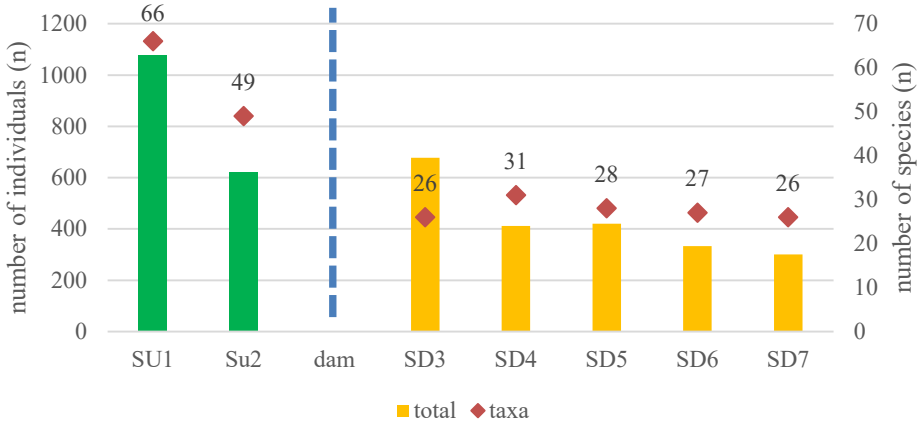

Figure 4.31 Comparison of average adult male of Trichoptera family richness and number of individuals between upstream and downstream sampling sites in Mae Ngat Somboonchol dam during June 2013 – May 2014.