

CHAPTER 3 MATERIALS AND METHODS

3.1 Field study

The observation of dragonflies and damselflies was conducted at Doi Suthep-Pui National Park, Chiang Mai province from June 2009 to December 2010. The collection sites consist of 11 altitude sites ranging from 400-1,400 meters and distribute throughout the accessible aquatic resources of the park (Table 1). These sites are Mae Sa waterfall, Huay Kaew waterfall, Huay Rai reservoir, Tad Mok waterfall, Sri Sangwan waterfall, Mon Tha Than waterfall, Pha Lad stream, Mok Fa waterfall, Sai Yoi waterfall, Pau Pau waterfall, and a pond near the Bhubing Palace (Fig. 7). The recording was taken twice a month for 18 months. Museum and recorded specimens will be labeled with locality and date for taxonomical and data analyses.

3.2 Data analyses

The degree of species diversity for each site was determined by using the Shannon-Weaver Index (H') (Magurran, 2004). This indicates the degree of species composition per unit area. The higher value of H' , the greater the diversity and supposedly the cleaner the environment (Wahizatul-Afzan *et al.*, 2006).

$$H' = -\sum [(n_i/N) \ln(n_i/N)]$$

Where; H' = Shannon-Weaver Index

N = Total individuals of population recorded

n_i = Total individuals belonging to the i species

The abundance of the species per unit area or number of species in a sample was calculated using the Richness Index (R).

$$R = S - 1/\ln(N)$$

Where; R = Richness Index

S = Total of species

N = Total of individuals recorded

Homogeneity or pattern of distribution of species in relation to other species in a sample per unit area was measured by Evenness Index (E). The less value of E means the higher variation in communities between each species.

$$E = H' / H'_{\max}$$

Where; E = Evenness Index

H' = Shannon-Weaver Index

H'_{\max} = Diversity index observed to a maximum diversity

3.3 Classification and identification

The odonate species seen were photographed and identified by using scientific papers and books, viz. Asahina (1993), Hämäläinen and Pinratana (1999), Orr (2003, 2005), and Tang *et al.* (2010). The classification and nomenclature were based on The Catalogue of Life database (van Tol, 2010). Some identifications were confirmed by Dr. Matti Hämäläinen, University of Helsinki. Photographs of characteristic features for identification of each species were made from museum specimens.

3.4 Making pictorial keys

Characteristic features used in identification of each species were made from photographs and museum specimens. The museum specimens were studied a 100x microscope. Only adult specimens were used to construct a pictorial key. The key to families, genera, and species were compiled separately with texts and pictures. The keys to families, genera and species primarily follows those in Fraser (1933, 1934, 1936), Orr (2003, 2005), and Tang *et al.* (2010). Making pictorial keys were conducted in laboratory room at Division of Entomology, Department of Entomology and Plant Pathology, Faculty of Agriculture, Chiang Mai University.

Table 1 Description of study sites in the Doi Suthep-Pui National Park, Chiang Mai Province.





Site	Latitude, Longitude	Altitude (m)	Description	Image of site
1 Mae Sa waterfall	18° 54' N, 98° 53' E	400	Mountain stream with cascades and surrounded by grasses and trees.	
2 Huay Kaew waterfall	18° 48' N, 98° 56' E	402	Open mountain stream with many cascades and seepages.	
3 Huay Rai reservoir	18° 46' N, 98° 52' E	424	Reservoir fed by small mountain stream. Open site surrounded by grasses and trees.	
4 Tad Mok waterfall	18° 57' N, 98° 51' E	540	Mountain stream along the forest. Streamlets above the waterfall are close to terrace paddy fields.	

Table 1 Description of study sites in the Doi Suthep-Pui National Park, Chiang Mai (continued).






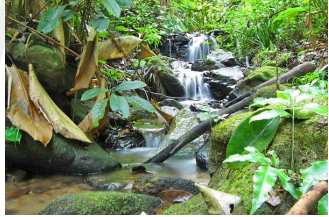

Site	Latitude, Longitude	Altitude (m)	Description	Image of site
5 Sri Sangwan waterfall	18° 47' N, 98° 51' E	639	Partly-shaded stream along the forest. Fast-running water current.	
6 Mon Tha Than waterfall	18° 49' N, 98° 55' E	715	Partly-shaded stream with many seepages and cascades in good forest.	
7 Pha Lad stream	18° 47' N, 98° 55' E	753	Small and slow stream along the forest. Site partly exposed to the sun.	
8 Mok Fa waterfall	19° 06' N, 98° 46' E	889	Partly shaded stream forest. Water current is fast.	

Table 1 Description of study sites in the Doi Suthep-Pui National Park, Chiang Mai (continued).

Site	Latitude, Longitude	Altitude (m)	Description	Image of site
9 Sai Yoi waterfall	18° 49' N, 98° 55' E	992	Partly-shaded stream along the good pristine forest.	
10 Pau Pau waterfall	18° 48' N, 98° 54' E	1,194	Include downstream and upstream. Small and slow-running stream. Partly disturbed by water flow upstream. Water surface mostly covered with trees.	
11 Pond near the Bhubing Palace	18° 48' N, 98° 53' E	1,383	Small man-made ponds surrounded by grasses and shrubs.	

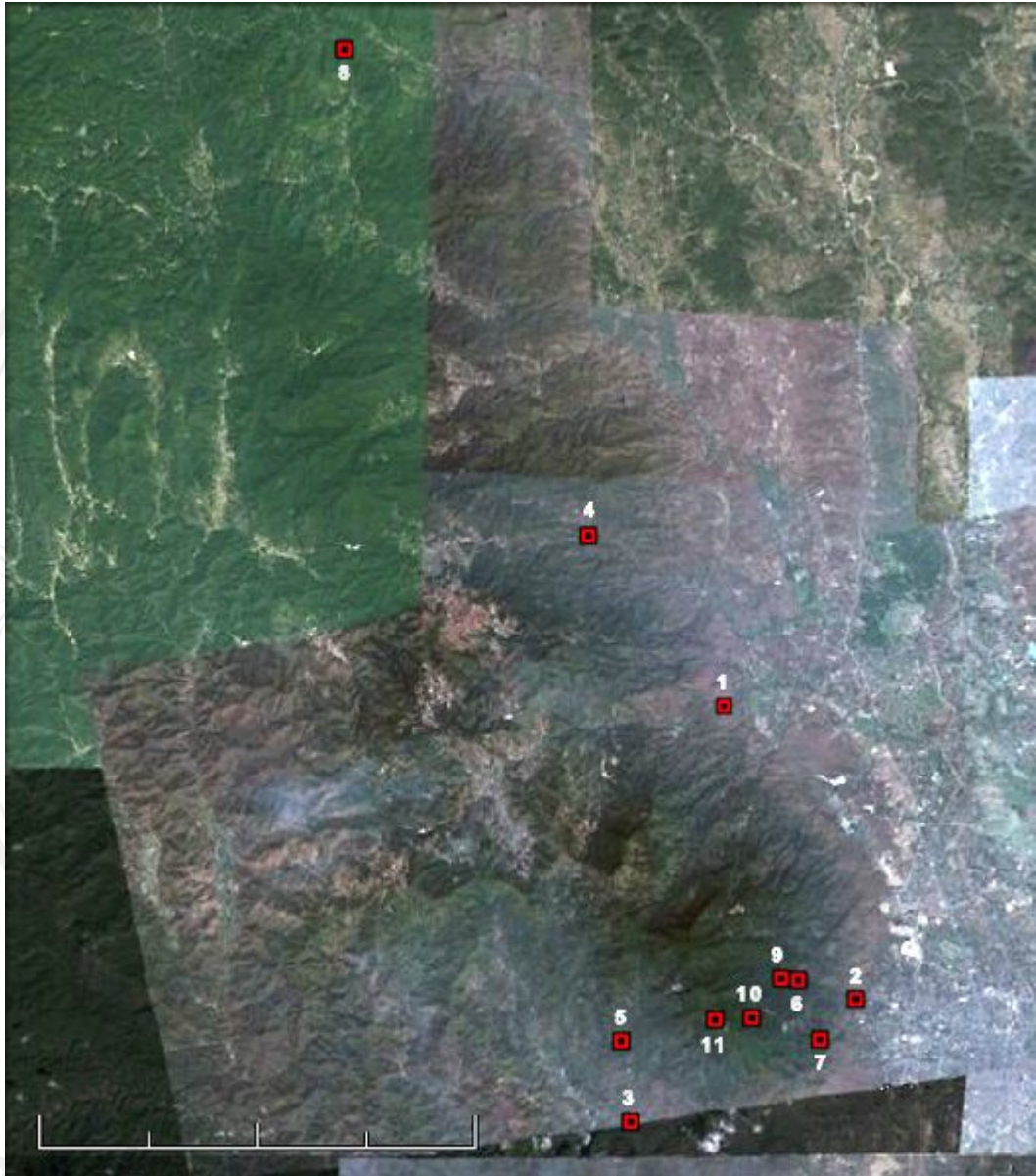


Fig. 7 Map of Doi Suthep-Pui National Park, Chiang Mai, showing location of study sites:

1, Mae Sa waterfall; 2, Huay Kaew waterfall; 3, Haui Rai reservoir; 4, Tad Mok waterfall; 5, Sri Sangwan waterfall; 6, Mon Tha Than waterfall; 7, Pha Lad stream; 8, Mok Fa waterfall; 9, Sai Yoi waterfall; 10, Pau Pau waterfall; 11, Pong near the Bhubing Palace.