CHAPTER 2

LITERATURE REVIEW

2.1 History of Phu Hin Rongkla National Park

Phu Hin Rongkla National Park has an area of 307 square kilometers. It lies in Dansai District, Loei Province and Nakhon Thai District, Phitsanulok Province. Phu Hin Rongkla is blessed with natural beauty and historical significance. Unfortunately, the fighting there during communist years did incalculable damage to the forest. The geological features of the landscape and the natural beauty in the area have been restored and protected after the communist insurgents lost (Forest Land Resources Division, 2002).

In February 1982, the National Park Division sent officials to survey the area and concluded that it had fantastic natural beauty, served as an important watershed, and had many historical points such as Lan Hin Taek and Lan Hin Pum. It was deemed on agreement that Phu Hin Rongkla held the significance of a national park. The Royal Forest Department proposed the park to the assembly on March 15, 1982. A decree made areas of Nakhon Thai District in Phitsanulok as well as Dansai District in Loei into a national park in 1986. Phu Hin Rongkla officially became Thailand's 48th national park (Forest Land Resources Division, 2002).

2.2 Geographical and Geological features of Phu Hin Rongkla National Park

The general topography of the park is steeply mountainous. The northern part of the park in Chaiburi District borders Laos. The Southern part of the park runs into Phetchabun Province. The mountain range includes the peaks of Phu Phangma, Phu Lomlo, Phu Hin Rongkla and Phu Man Khao, the highest point in the park at 1,820 meters above sea level. The second highest point is Phu Lomlo at 1,664 meters, and Phu Hin Rongkla stands at 1,614 meters. The park contains the headwaters of many streams, including Huay Nam Sai, Huay Ka Mun Noi, Huay Awn Singh, Huay Muad Kon, and Huay Luang Yai. Moreover geological features in the park provide the most interest for visitors (Forest Land Resources Division, 2002).

Phu Hin Rongkla's climate is similar to that of Phu Kra Dueng and Phu Luang national parks. Because of its high altitude, the park is cool all year round (temperatures do not rise much above 25^0C), especially, of course, in the cool season, when temperatures can occasionally drop to the freezing point (Forest Land Resources Division, 2002).

The park has mixed deciduous, dry dipterocarp, dry evergreen, and hill evergreen forests. The mixed deciduous forest tends to be spacious and open. The soil quality and moisture is low. Tree species commonly found include *Dipterocarpus obtusifolius, Shorea obtusa, Shorea siamensis* and *Dipterocarpus tuberculatus* (Forest Land Resources Division, 2002).

The dry evergreen forest has better and moister soil, particularly in higher elevations and along streams. Species include *Dipterocarpus alatus, Hopea ferrea, Hopea oborata, Anisoptera castata, Afzelia xylocarpa, Lagerstroemia calycatata,* *Dalbergia cochinchinensis, Dalbergia oliveri, Chukrasia venlatina*, bamboo and Bramble among others (Forest Land Resources Division, 2002).

Hill evergreen forests occur in cool higher elevations of 1,000 meters and above. Species tend to be softwoods. Important species include *Dacrydium elatum, Betula alnoides, Eugenia cumini, Anneslea fragrans, Podocarpus imbricatus and Pinus merksii, P. kasiya* (Forest Land Resources Division, 2002).

The flat areas on the tops of the mountain are sandy and support *Sphagnum recuryum*, algae and perennial plants such as *Burmannia disticha* and *Osbeckia chinensis*. In addition, many orchid species can be found in rocky areas, including *Lycopodium phlegmaria* and rhododendron. These flowers bloom between the rainy and cool seasons (Forest Land Resources Division, 2002).

In the past, Phu Hin Rongkla was covered in evergreen forest and a had large diversity of wildlife. But later, when the communists and government began fighting, the area turned into a battlefield. Much of the forest was damaged and much of the wildlife was killed or fled to safer areas. Remaining wildlife includes tigers, leopards, asiatic black bears, wild boar, fox, monkeys, leopard cats, wild hare and many bird species, such as doves, barbets, common flame back, asian barred owlet, brown hawk-owl, jungle fowl, bulbuls, and swallows (Forest Land Resources Division, 2002).

2.3 Spatial and temporal changes of insect communities

It is well known that ecological communities are spatially and temporally dynamic (Scott *et al*., 2000). Knowledge about the spatial and temporal scales of both habitat use and the functional significances of different adaptations is essential for an understanding of the population dynamics of invertebrate assemblages. This fundamental knowledge is not only interesting from an academic point of view, but is sorely lacking and needed in the field of restoration ecology. Many species are threatened due to degradation. Knowing what environmental conditions are important during the life cycle of these species is important in the design of restoration measures which aim to lift existing bottlenecks for threatened species (Verberk, *et al.,* 2005). In streams, spatial and temporal variability are essential considerations in the study of aquatic insects. Traditionally, these two sources of variability are treated separately, however they should be considered together because they occur concurrently in natural systems. In a stream, spatial and temporal variability can be considered from the habitat scale up to it's intersystem and from a day to year to year scale (Resh and Rosenberg, 1989). The survey of published literature by Resh and Rosenberg (1989) concluded that the spatial variation resulted from habitat heterogeneity relative to the size of benthic insects in streams. And, temporal variation resulted from fluctuations in environmental features, such as the discharge that occurs over a range from gradual to more rapid periods.

In the temperate and polar region, dispersal of adult insects from water bodies has a distinct seasonal basis. In Britain some of insects have two dispersal peaks. The first is in spring (April-May) and the second, which is much larger, occurs from the middle of June to the end of August. The temperature was thought to be the controlling factor. High wind and light levels may play a role on depressing flight (Williams and Feltmate, 1992). Glacial-fed streams, which experienced strong seasonal changes in water chemistry, reflected temporal changes as the influence from the source glacier. Macroinvertebrate biomass was two to three times higher in winter than in summer suggesting winter may be a more favorable period for these animals (Robinson *et al.,* 2001). And the spatial variation among the macroinvertebrate assemblages were attributed to environmental (temperature and discharge) stability (Johnson and Harp, 2005).

In the Asian tropics, the tendency of macroinvertebrate abundance to peak at the end of the dry season and decline during the wet season appears to be a general characteristic of perennial streams and rivers (Dudgeon, 1999). This was similar to the study in the Neotropical landscape of high invertebrate density during the dry season (Ramírez and Pringle, 2001), but the trend was not significant.

In Thailand, many studies (Prommi, 1999; Silalom, 2000; Thamsenanupap *et al*., 2002; Cheunbarn, 2003; Nawvong, 2004) focused on the spatial and temporal variability of Trichopatera. The studies on spatial and temporal change of Trichoptera were mainly separated into 2 categories; larvae and adults. The studies on Trichoptera larvae indicated the tendency of diversity and abundance peaked at the end of the dry season and the end of the wet season or before the cold-dry season. The tendency of diversity and abundance declined during the wet or rainy season. In the perennial stream, Huai Kaew Stream, diversity of Trichoptera was stable based on the stability of the stream. The distribution in each family depended on the type of habitat (Silalom, 2000). Nawvong (2004) reported that habitats preferable to the larvae were different depending on the seasons. It would seem the decreasing number of larvae during the wet season was in accordance with water discharge and chosen habitats, such as an unstable habitat of gravel was less preferable in the wet season but preferred the most in the dry season. The least preferable habitat was in the dry season with trailing roots and stream banks, the most preferable habitat was during the wet season. For adult Trichoptera studies, they showed slightly different results. For example, Thamsenanupap *et al.* (2003) and Prommi (1999) reported that species richness and species abundance of adult Trichoptera showed the highest peak in the hot-dry season to the early wet season (March-June) and the second peak was in the late wet season or before the cool-dry season (September to October). The species richness and abundance declined in the wet season and in the mid cold-dry season (July to August, November to December). The peak levels of adult caddisfly before the wet season would be explained by swarming and reproduction. The swarming and reproduction usually occur before the southeast monsoon, whereas oviposition and hatching extend well into the monsoon. During the rainy season, small larvae more easily escaped into boundary layers or interstitial spaces, and were less susceptible to being washed away or killed during monsoonal spates. (Thamsenanupap *et al.*, 2005). Contrarily, Nawvong (2004) showed the species diversity and abundance of adult caddisfly peaked in the middle of the wet and cool-dry seasons, because of the avoidance of harsh conditions of high water discharge and low air and water temperature. To avoid these disturbances, larvae would emerge to the terrestrial stage.

2.4 Relationship between Trichoptera and water quality

Long-term studies of macroinvertebrate assemblages in unregulated lotic environments have typically demonstrated a constancy of community structure over time. When dramatic changes in macroinvertebrate assemblages do occur, they are typically attributed to environmental variations or degradation within those streams (Johnson and Harp, 2005). The study of relationships between faunal assemblages and their environment is a central theme of community ecology. Whenever possible, the inherent spatial and temporal variation of both the environment and the faunal assemblage should be considered (Ramírez and Pringle, 2001). When using benthic macroinvertebrate communities for bioassessment, temporal variation may influence judgement as to whether or not a site is degraded. Aquatic invertebrates are involved in many different processes in riverine ecosystems (Wallace and Webster, 1996). The benthic macroinvertebrate community is widely used in bioassessment for a number of reasons, benthic macroinvertebrates are ubiquitous and diverse, allowing the detection of a variety of perturbations in a range of aquatic habitat. Macroinvertebrates also have relatively long life cycles compared to groups such as zooplankton and phytoplankton, making the temporal scale of the population response appropriated for pollution response (Rosenberg and Resh, 1993). The large spatial and temporal variation in community structure of the benthic macroinvertebrates was observed in both impaired and unimpaired sites.

The Trichoptera or caddisflies, one of the largest groups of aquatic insects, belong to the important groups suitable for the bioindication of water quality (Rosenberg and Resh, 1993). Adult Trichoptera specices richness is a potentially useful indicator of environmental conditions and general status of the ecosystem

(Sykora, 1997; Dohet, 1999; Chaibu, 2000). The longitudinal profiles of the stream caddisfly communities react to different environmental factors, diversity increases from the spring to the middle stream where it culminates. The disturbance of continual zonation of caddisflies by localities, environmental variables and caddisfly species demonstrate the determining influence of maximum temperatures, fine organic material and phosphorus (Lukas and Krno, 2003). The usual zonation of cadissfly species can be influenced by organic pollution (Dohet, 1999).

The study of Robert *et al.* (1999) in southwestern Ontario, Canada, reported better water quality in the same streams in winter relative to summer. No consistent pattern of seasonal difference was detected for the diversity indices or percentage dominant taxa.

In Thailand, many studies (Prommi, 1999; Luadee, 2003; Chaibu, 2000) indicated the individual insect, population and community correlated with water quality. For example, Prommi (1999) reported that the species richness and abundance of Odontoceridae and Polycentropodidae were related to several physico-chemical factors: BOD, Conductivity, total dissolved solids, water temperature and air temperature and nitrate-nitrogen. Chaibu (2000) suggested 13 pollution-tolerant and 11 sensitive species of caddisfly can be used as indicators to assess anthopogenic pollution in lowland rivers in tropical regions.