CHAPTER 1

INTRODUCTION

Lotic Ecosystems and their importance

Lotic ecosystems (riverine or running water ecosystem; rivers and streams) contain a small proportion of the stored water on the earth, and are crucial for the survival of all living organisms, especially humankind. We depend on these ecosystems for our health (drinking water and sanitization), waterway transportation, waste removal, and as a source of renewable energy (Giller and Malmqvist, 2002).

The unique characteristics of lotic ecosystems, which distinguish them from other freshwater ecosystems, are 1) a water flow in one direction, from upstream to downstream, which creates a dynamic whereby upstream areas influence downstream reaches 2) the morphology of the channel bank and substrate beds are dynamic due to the action of the flow, thus the geomorphology of the bank and streambed is continually changing overtime. Lotic ecosystems have multidimensional relationships. There is a longitudinal dimension; from headwater, streams to the mouth of river, and a lateral dimension; instream waters relating with the watershed, and also the relationship of the channel and underground water. The functions of lotic ecosystems (e.g. self purification, decomposition, respiration and primary productivity) results from the spatio-temporal heterogeneity in biotic and abiotic factors. Lotic ecosystems also hold a vast number of fauna and flora diversity (Palmer and Poff, 1997; Ward, 1998).

There are many hypotheses that have aimed at unifying the patterns of heterogeneity over environmental gradients, for example '*River Continuum Concept*' (Vennote *et al.*, 1980). Generally each stream or river systems is unique, and will have its own specific characteristics due to the geomorphology of the catchment and land use patterns. Living organisms have evolved and adapted for long periods of time to occupy specific instream habitats. Theoretically, each river or stream contains a high level of endemism of both habitats and organisms (Giller and Malmqvist, 2002).

Threats of lotic ecosystem

Human population growth has lead to the over consumption of natural resources and, as a result, we have seriously altered our own environment. Historically, as a result of development pressures, lotic ecosystem structures and functions have been severely degraded. Ultimately, the adverse impacts of our growth will create challenges for the future of human life on this planet. Over the years that lotic ecosystems have faced deterioration, many species have now been wiped out. According to the Convention on Biological Diversity (UN-CBD), lotic ecosystems face the greatest rate of biodiversity loss, especially in tropical zones which are defined as biodiversity hotspots (Revenga and Kura, 2003). In the past thirty years, it has been reported throughout the world that lotic ecosystems have been severely threatened by overexploitation, water pollution, flow modification, physical degradation of instream habitats, and invasion by exotic species (Chantaramongkol, 1983; Allan and Flecker, 1993; Malmqvist and Rundle, 2002; Dudgeon, 2000; Dudgeon, 2002; Dudgeon, 2003; Dudgeon *et al.*, 2006;). Recent research has focused on the impacts of climate change on lotic ecosystems such as prediction of how rising water temperature will effect on upland stream macroinvertebrates (e.g. Durance and Ormerod, 2007). The structures, functions and biodiversity of lotic ecosystems are threatened not only by individual factors, but also by synergistic factors. Finally, although lotic ecosystems are somewhat resilient, and have attributes which allow for self-purification, they are also require sufficient time to recover from adverse impacts, such as pollution (Giller and Malmqvist, 2002).

Lotic ecosystem conservation

Regarding the importance of lotic ecosystems for human health, and the threats that exist for lotic ecosystems, effort should therefore be focused towards maintaining the ecosystem structure, function and biodiversity of lotic ecosystems. Fundamentally, diversity leads to complex interactions in the system. These complex interactions create resilience in the ecosystem, allowing ecosystems to face disturbances and remain as functional ecosystems. Unfortunately, a strong understanding of freshwater biology and ecology in developing countries, such as those in tropical Asia, does not yet exist, when compared to temperate regions. The knowledge of biodiversity in lotic ecosystems is still incomplete and the up to date national or regional inventories is lacking (Dudgeon 2000, 2002 and 2003). This lack of knowledge has constrained any understanding of what species have disappeared from lotic ecosystems and also how degraded ecosystems may be restored.

Northern Thailand consists mainly of mountainous areas, containing numerous headwaters and streams, and which feed the river systems that support many lives along the downstream systems, including humans (for instance Chao Praya River system). The region holds a great genetic, species, and ecosystem diversity, and both terrestrial and freshwater ecosystems. Like many parts of the country, expansion of community settlement has created pressure on natural habitats, and forest and riverine ecosystems have been affected significantly. Unfortunately, knowledge of our lotic ecosystems, such as fauna and flora, is still limited. Management and conservation plans should be approached differently for areas based on longitudinal zonation, due to the spatial and temporal heterogeneity of physiochemical properties and biological components.

Why Trichoptera?

Trichoptera (Class Insecta, Order Trichoptera, common name: caddisfly) are holometabolous insects. Larvae of Trichoptera inhabit truly submerged water, while adults emerge and live in the terrestrial environment. The adaptation and evolutionary success of Trichoptera is a result of the diversity of larvae which occupy a wide range of freshwater ecosystem habitats, in particular lotic ecosystems (Mackay and Wiggins, 1979). Due to their high abundance and diversity, Trichoptera are key functional components and crucial participants in aquatic food webs. Some groups are particularly sensitive to environmental perturbations, while some groups are insensitive. This attribute provides sufficient information for assessing and monitoring ecosystem health. Moreover, Trichoptera behavior has attracted biologists to study their taxonomy, biology and ecology, providing a wealth of literature, particularly in temperate countries (Holzenthal *et al.*, 2007; de Moor and Ivanov, 2008).

In Thailand, there has been excellent research conducted by Professor Dr. Hans Malicky and Assoc. Professor Dr. Porntip Chantaramongkol along with graduated students. These studies have identified and classified more than 1,000 species belonging to 105 genera and 28 families (Malicky, 2010). Since 2009, the 'Trichoptera World Checklist' has recorded 13,574 valid, extent species in 609 genera of 47 families (available as online database) (Morse, 2011). Biological and ecological studies have been conducted as well as taxonomic research, which has indicated that Trichopteran fauna is valuable as a bioindicator or biomonitor due to their great diversity and abundance in lotic ecosystems. The many observations showed Trichoptera is a major component of the instream community composition and reflect changing habitat and water quality.

Presently, the knowledge of Thailand's Trichopteran fauna is scattered. There is a need to construct a database in order to provide knowledge on the entire spectrum of Thai Trichopteran fauna, for instance, the geographical distribution, ecological properties and biological attributes. The database would serve the purpose of assessing and monitoring the health and biodiversity status of lotic ecosystems. Furthermore, the conservation of running water resources using Trichoptera as a flagship species is possible. Zoning of stream and river biotopes longitudinally using Trichoptera species composition will provide the information which could influence management in each of the zones. Moreover, by adding further information to the database, we will benefit the future research of Trichoptera and lotic ecosystems in Thailand.

OBJECTIVES

1. construct the Thai Trichoptera database.
2. compare the community composition and ecological diversity of adult Trichoptera among the habitats or biotopes change longitudinally from headwater to lower reach.
3. compare the community composition, diversity and abundance of adult Trichoptera with prior data to reveal the temporal changes.
4. evaluate the rarity index based on Trichoptera species to determine conservation status of the lotic ecosystem.