CHAPTER 1

INTRODUCTION

At present, water quality is a significant concern worldwide. The surface water resource is a very essential resource in terms of the humans, animals, aquatic flora and fauna that all depend on it, as well as in terms of numerous other important applications and functions such as for navigation, agriculture, etc. A healthy environment is one in which the water quality supports a rich and varied community of organisms and protects public health (Adekoyeni and Salako, 2012; Afejuwon and Adelakun, 2012). Surface water monitoring is essential for aquatic resource management, and flood forecasting (Haque, 2008).

Water is a very important natural resource, not only for the lives of the humans and animals that consume it, but it is also highly useful in a variety of other purposes. Water is needed in household, agricultural, industrial, recreational, fishery and environmental activities. Virtually all of these human activities require clean water. However, freshwater stock makes up about only 2.5% of the earth's total water content and most of it is frozen in glaciers and ice caps. Only a limited amount of unfrozen freshwater is found as groundwater, with only a small fraction being present above the ground or in the air. Water demand already exceeds the supply in many parts of the world; therefore, thoughtful management of water is essential and the period of time applied to our handling of the water resource needs to be extended throughout the world.

Thailand is a developing country with increasing economic growth. Some industrial and agricultural activities are expanding, and these significantly affect the water quality by the waste that is discharged into the water, which may consist of organic, inorganic nitrogen and phosphorus compounds. The sewage disposal, as well as the discharges from industries that are not equipped with proper effluent treatment facilities, have been released into the river and this has had a negative influence on the properties of the water. Moreover, fertilizers and pesticides that are used on the surrounding cultivable lands are washed out through surface runoff, which also degrade the water quality of the river.

The Wang River is the main river of northern Thailand, it is one of the tributaries of the Chao Phraya River which is the most significant river of Thailand. The Wang River originates from the Phi Pan Nam Range in Wiang Pa Pao District, Chiang Rai Province, flows through most of areas of Lampang Province and combines with the Ping River at Tak Province; with a total length of about 460 kilometers. There are two large irrigation projects located on this river, including the Kew Lom Dam built in 1968 and the Kew Kor Ma Dam constructed in 2005. Presently, the Wang River is facing various problems such as water pollution in urban and agricultural areas, water shortages during the dry season and flooding during the rainy season; as a result of increases in populations and expansions of residential communities. Therefore, environmental changes and the effects of human activities may also significantly affect organisms which live in this river as well, such as in terms of the diversity and species composition during each season.

Diatoms are the most diverse group of algae in rivers and streams (Leland and Porter, 2000), and they belong in the Division Bacillariophyta. Diatoms are unicellular and eukaryotic microorganisms. Single cells of diatoms are 5-500 µm in diameter and cell walls are constructed of silicon dioxide (SiO_2). Diatoms have a special cell structure comprised of frustules. The frustules are composed of bivalves which are similar to a petri-dish. The shape of the diatoms could be separated as being symmetrical and asymmetrical. The valve structure is called the striae and includes a range of little pores of punctae and longitudinal valves called raphe. The color of the diatoms is yellow-brown. These characteristics are major the characterizations that are used in their identification (Round *et al.*, 1990: John *et al.*, 2002).

Diatoms are appropriate indicators of the environmental completeness of lotic ecosystems because they are regularly present in most streams and represent the primary food source for many invertebrates and some juvenile aquatic animals that reside in these systems (Lowe and Pan 1996, Stevenson and Pan 1999). Their value as bioindicators has been determined for a long time, and diatom analysis is still done for the reconstruction of the paleo-environment and for water quality or environmental health assessments. Their usefulness is due to the rapid and accurate response of the diatom community structure to shifting conditions (Stoermer & Smol, 1999). In addition, diatoms are

convenient monitors of sensitivity and tolerance to environmental variables and optima along environmental gradients, such as pH values, oxygen requirements, BOD, trophic state and others and have been empirically acquired for many species (Van Dam *et al.*, 1994). Moreover, the identification of diatoms is based on the morphological features of their frustules, which are made of silicon dioxide. This arranges an opportunity to prepare permanent reference slides of diatom assemblages under different environmental conditions for use in water condition assessments. Many diatomists have applied various benthic diatom assemblages to determine the environmental conditions in streams including in terms of discharge and hydraulic fluctuations (Duncan and Blinn 1989, Biggs and Hicky 1994, Benenati *et al*. 1998), light (Duncan and Blinn 1989, Hardwick *et al*. 1992), temperature (Squires *et al*. 1979, Blinn *et al*. 1989), salinity (Blinn and Bailey 2001), nutrients (Patrick, 1977). Benthic diatoms live in a wide range of aquatic habitats and can sustain life under a range of parameters such as pH, high concentrations of alkalinity, as well as nutrient and organic and inorganic contaminations. Each species of benthic diatom is usually strictly responsive to specific ecological conditions. As a result, they are accepted as environmental indicators. The used of diatoms as indicators of water quality has had a long history. Diatoms continue to be useful and play a role as major components of water quality assessment programs, such as in the National Water Quality Assessment Program of the U.S. Geological Survey (Wehr and Sheath, 2003) and the Biodiversity Research and Training Program (BRT) in Thailand.

Nowadays, benthic diatoms have been used and widely applied as indicators of water quality in Europe, America and Asia. They react directly and rapidly to environmental changes, as well as to the physical and chemical factors of the water properties. This reaction can change the species and it has been found that species-specific diatoms are sensitive to environmental factors, such as pH, DO, BOD, alkalinity and some nutrients.

There have been some previous studies which have focused on the benthic diatom index in Thailand, such as the Mae Sa Benthic Diatoms Index for the Mae Sa Stream (Pekthong, 2002), the Ping and Nan Benthic Diatoms Index for Ping and Nan Rivers (Kunpradid, 2005), the Mekong Diatom Index for use in specific parts of Thailand

(Suphan, 2009), the Thailand Benthic Diatom Index acquired from the main rivers in 6 regions of Thailand (Leelahakriengkrai, 2011) and the Yom Diatom Index for the Yom River (Yana, 2014). However, the applications of these indexes have only been reported in running water and through the collected data during specific periods in each season.

In this study, benthic diatom samples and the physico-chemical properties of each study site will be collected every month for a year, both from the main rivers and the reservoirs (standing water), and all of this data will be assessed for the purpose of studying the species composition and the response of the benthic diatoms during each season. The results of this study will clearly show the total number of diatom species in the Wang River, the differences between diatom species in lotic and lentic ecosystems, the responsiveness of benthic diatoms and could then be used to assess water quality in lotic ecosystems in a more precise application. Moreover, this study will allow us to know about the distribution of benthic diatoms during different seasons and their different classifications of water quality. Consequently, the result of this study could be used to establish a benthic diatom index for the Wang River and this index will be used as bio-monitors for the classification of water quality with greater accuracy.

Research Objectives

1. To investigate the diversity of benthic diatoms in the Wang River, both in terms of the running and standing water.

2. To study the water quality of the Wang River, which has an affect on the species composition of benthic diatoms.

3. To study the relationship between the changes in the species composition of benthic diatoms and other relevant environmental factors in order to work toward the establishment of a water quality index.