# CHAPTER VI DISCUSSION

## A. PHYSICO-CHEMICAL PROPERTIES

The alkalinity and conductivity were much higher in the dry season than in rainy season.The alkalinity of water is controlled by the sum of the titration bases. It is mostly taken as an indication of the concentrations of carbonate, bicarbonate and hydroxide ions, but may include concentrations from borate, phosphate, silicates and other basic compounds. Waters of low alkalinity( < 24 mg/l as $CaCO_3$ ), have a low buffering capacity and can, therefore, be susceptible to alteration in pH (Chapman, 1992). All the measurements of alkalinity from all the sites were higher than 24 mg/l.Therefore alkalinity is unlikely to change much during the year.

pH is an important variable in water quality assessment as it influences many biological and chemical process within a water body, and all processes associated with water supply and treatment. The natural acid-base balance of a water body can be affected by industrial effluents and atmospheric deposition of acid-forming substances. Changes in pH values can indicate the presence of certain effluents, particularly when continuously measured and recorded, together with the conductivity of the water body. Diel variations in pH can be caused by the photosynthesis and respiration cycles of algae in eutrophic waters. The pH values of most natural waters are between 6.0 and 8.5(Chapman, 1992); the lower values containing high organic contents, and higher values in eutrophic waters, groundwater brines and salt lakes. The measurements of pH in this study in two seasons ranged from 6.8 to 8.1 indicating the natural condition.

Oxygen is essential to all forms of aquatic life, including those organisms responsible for the self-purification process in natural waters. In fresh-waters dissolved oxygen(DO) at sea level ranges from 15 mg/l at 0°C to 8 mg/l at 25°C (Chapman,1992).

Determination of DO concentrations is a fundamental part of a water quality assessment since oxygen is involved in, or influences, nearly all chemical and biological processes within water bodies.

From Tables 1 and 2, DO increased in the rainy season at all running waters sites, except those on the sewage canal. Waste discharges containing high organic matter and nutrients can lead to decreases in DO concentrations as a result of the increased microbial activity(respiration) occurring during the degradation of the organic matter. In the dry season at sites SC2, SC3, the DO contents were 0 and 0.3 mg/l respectively. The functioning and survival of biological communities are affected if the concentration falls below 5 mg/l(Chapman,1992), and below 2 mg/l may lead to the death of most fish. Therefore, at the sewage canal the DO concentration indicates the highly polluted water.

Ammonia-nitrogen occurs naturally in water bodies arising from the breakdown of nitrogenous organic and inorganic matters in soil and water, excretion by biota, reduction of the nitrogen gas in water by microorganisms and from gas exchange with the atmosphere. It is also discharged into water bodies by some industrial processes. Higher concentrations could be an indication of organic pollution, such as from domestic sewage, a component of municipal or community waste in SC sites. On the other hand, the unpolluted waters contain small amounts of ammonia and ammonia compounds, usually less than 0.1 mg/l as nitrogen. Total ammonia concentrations measured in surface waters are typically less than 0.2 mg/l N but may reach 2-3 mg/l N.(Chapman,1992).Natural seasonal fluctuations also occur as a result of the death and decay of aquatic organisms,particularly phytoplankton and bacteria in nutritionally rich waters(Chapman,1992).

In this study ammonium concentrations at most sites except three on the sewage canal were less than 0.2 mg/l.The concentration of ammonium in the rainy season was higher than in the dry season in some sites, but not for SC and IC sites. This situation may be caused by natural seasonal fluctuation.

The nitrate ion ($NO_3^-$) is the common form of combined nitrogen found in natural waters. It may be biochemically reduced to nitrite($NO_2^-$) by denitrification processes, usually under anaerobic conditions. The nitrite ion is rapidly oxidised to nitrate. Natural sources of nitrate to surface waters include igneous rocks, land drainage and plant and animal debris. Seasonal fluctuations in nitrate occur with aquatic plant growth and decay, as they are essential nutrients for aquatic plants. When influence caused by man's activities, surface waters normally contain nitrate concentrations up to 5 mg/l $NO_3$-N, but often less than 1 mg/l $NO_3$-N. Levels in excess of 5 mg/l $NO_3$-N usually indicate pollution by human or animal waste,or fertilizers run-off. In cases of extreme pollution, concentrations may reach 200 mg/l $NO_3$-N(Chapman, 1992). . In some areas, large increases in nitrate concentrations over 20 or 30 years have been related to increased fertilizer applications.( Hagebro *et al*, 1983; Roberts and March, 1987).Concentrations of nitrate found in this study were less than 1 mg/l except at one site, and lower in the rainy season. Site S1 in the dry season had 1.10 mg/l $NO_3$-N, This may be due to the use of inorganic nitrate fertilizers in the surrounding area.

Phosphorus is an essential nutrient for living organisms and exists in water bodies as both dissolved and particulate species. It is generally the limiting nutrient for algal growth and, therefore, controls the primary productivity of a water body.

Phosphorus is rarely found in high concentrations in freshwaters as it is actively taken up by plants. As a result there can be considerable seasonal fluctuations in concentrations in surface waters. In most natural surface waters, phosphorus ranges from 0.005 to 0.020 mg/l $PO_4$-P. Concentrations as low as 0.001 mg/l $PO_4$-P may be found in some pristine waters and as high as 200 mg/l $PO_4$-P in some enclosed saline waters (Chapman,1992).As phosphorus is an essential component of the biological cycle in water bodies, it is often included in basic water quality surveys or background monitoring programmes. High concentrations of phosphates can indicate the presence of pollution and are largely responsible for eutrophic conditions.

The concentrations of phosphate in the dry and the rainy seasons at the sewage canal sites(SC1, SC2 and SC3) were higher than those at the other sites.This is probably the result of the addition of phosphate from detergents to the sewage flowing into the canal.

The biochemical oxygen demand(BOD) is an approximate measure of the amount of biochemically degradable organic matter present in a water sample. The BOD measurements are usually lower than chemical oxygen demand(COD) measurements. Unpolluted waters typically have BOD values of 2 mg/l $O_2$ or less, whereas those receiving wastewaters may have values up to 10 mg/l $O_2$ or more, particularly near to the point of wastewater discharge. Raw sewage has a BOD of about 600 mg/l $O_2$. In the sewage canal in the dry season, the values measured

439, 444 and 419 mg/l in SC1, SC2 and SC3 respectively. These values indicate the highly polluted water at all sewage canal.

The other sites had BOD values less than 10 mg/l in both dry season and rainy season. These values of BOD indicate the higher water quality than the sewage canal sites. From these results, it can be said that BOD in urban runoff at sewage canal sites is much higher than in the runoff from the other sites.

The cluster analysis of physico-chemical parameters clearly indicates that the sewage canal sites with highly polluted water were separated from the other sites by their physico-chemical properties. The cluster analysis was able to identify the difference between the sewage canal sites and the others in both dry season and rainy season.It is clear that the distinctive characters of sewage canal sites as opposed to other sites can be investigated by these analysis processes.

The water quality of different running water were classified in Water Classes 1-5. The Ping River and stream sites were classified in WCs 1-3. The Ping River has a large amount of water even when contaminated from organic loading e.g. site P3 is affected by the sewage outfall upstream. But the water quality still tends to be good due to the large amount of water discharge, and the distance of the distance more than 10 km between SC3 and P3. The sewage was diluted from highly polluted water to the higher quality.

The stream site S1 is situated in the botanical garden and it has less impact from human activity. Stream site S2, S3 may be affected by the surrounding area but the number of families found those sites indicates the potential of self purification on the water quality.

The irrigation canal sites are situated near the urban and agricultur areas, these affect to the water quality. The water at these sites was classified in WCs2-5.

The Mae Kha sewage canal is the canal receiving the organic loading from urban area. The oxygen concentration was very low relative to the others and only some annelids can survive in this canal. The physico-chemical properties indicated the highly polluted water. Therefore, this canal was classified in WC5.

## B. BIOLOGICAL RESULTS

### 1. MACROINVERTEBRATES COLLECTED

In running water in temperate climates, and particularly markedly in small streams, there is a very clear sequence of seasonal events in the invertebrate benthos. Many species appear and disappear from collections made at intervals throughout the year as one species after another completes its development. There is very limited knowledge of life histories of the freshwater invertebrates in the tropical, In view of the limited range of temperature and light conditions it may be that reproduction and growth are continuous, with all stages present at all times.In this study it was found that the number of families in the dry season was higher than in the rainy season at nearly all sites(Table3). The highest number of families found was present in stream sites, whereas the lowest number of families was present in the sewage canal sites, and in urbanized areas. The water quality and food supply affect the abundance of macroinvertebrates as do other factors such as current speed, substratum,etc.

In this study no species was found at sites IC1 and IC2 in the rainy season (Table 3) due to the inefficiency of the sampling method. The Ekman grab was used for collecting the samples at the bottom of the irrigation canal. At that time the water flowed with quite high speed and washed the sediment away. Therefore by this sampling technique no specimen was collected.This is related to Sannarm's study in Northern Thailand 1993, she found that both seasonal and depth-related factors were having an effect on the occurrence of families.

Oxygen is rarely a factor in the ecology of invertebrates in clear rivers, because it hardly ever drops to low levels. In polluted waters, on the other hand, lack of oxygen can be of very great importance. It was shown above that the sewage canal sites have very low oxygen.Only animals which can tolerate e.g. the anelid Tubificidae, can survive. In this study thousands of Tubificidae was found in a small area at sampling site SC1 in both rainy season and dry season, but they were not found at sites SC2 and SC3. The sewage outfall site SC3 is almost without oxygen, so it is difficult to live, and hardly any macroinvertebrates were found.

The number of families declined in the rainy season. The highest number of families found was in S1(reference site)with more than fifty percent of the total number(Table 3). The reduction of families found was caused by many factors.These factors have been used by various authors (e.g. Ricker, 1934; Berg et at., 1948 )as a basis for the classification of streams and rivers, or for reaches of them, and these classifications give a fairly clear indication, for a given region, of the species which are likely to occur in particular places.

Obviously many of these factors are interrelated. Current, for example, very largely controls the substratum.This situation will be discussed in the next section concerned with habitat assessment.

## C. HABITAT ASSESSMENT

### 1. THE SCORE OF HABITAT ASSESSMENT

The highest column total score of habitat assessment was found at stream site S2. This indicated that the good quality of the habitat for macroinvertebrates. The highest number of families was found at site S2 in the dry season, whereas, in the rainy season the highest column total score was found at the same site S2, but the highest number of families found was at reference site S1. At that time, road construction at site S2 caused the habitat degradation, soil erosion increased the turbidity of the stream and some riparian vegetation was also destroyed. Because of the turbidity increase the light penetration to the attached algae was reduced, and this affected the food supply for the macroinvertebrates. The above factors influenced the community structure of the macroinvertebrates. Chapman and Demory(1963) reported that the availability of food is an obvious factor controlling the occurrence and abundance of species. Generally speaking, species occur, or are common, only where their food is readily available, but it should not be forgotten that few running water invertebrates are very specialized in their diets. For instance, many insects can eat either algae scraped from stones, or detritus, and diet may change somewhat with season according to the availability of algae.

## 2. PHYSICAL CHARACTERIZATION

The results show that there are the increasing values of stream depth, width and velocity as the number of macroinvertebrate families decreases. The velocity is the especially important factor influencing the community structure of macroinvertebrates, as well as the distribution of substrate types. The result in this study are related to the results of Rajapakdee(1992). She found that water current and differences in substrate types may have an effect on the number of species present.

## 3.THE HABITAT ORIENTATION OF THE MACROINVERTEBRATES FOUND ( THE STREAM SITE S2 )

The reduction of number of families at stream site S2 may be caused by seasonal changes and habitat degradation. These factors influence the macroinvertebrate community. This indicates the ecological condition follows the Rapid Bioassessment Protocol (Plafkin, 1989). Habitat is the principal determinant of biological potential. The next section gives more information.

## 4.THE HABITAT QUALITY AND BIOLOGICAL CONDITION

Figure 29 indicates the relationships which have been found between biological condition and habitat quality. Figure 28 the curve for the dry season approximates to curve II in Figure 29. This situation shows that stream sites S1 and S2 have the excellent habitat supporting the biological condition. And S3 has partially supporting habitat quality biological condition. In the rainy season, the curve approximates to curve III in Figure 29. This situation results from seasonal changes and the habitat degradation. Another reson could be the effect of leaching of the organic matter from the surrounding area.

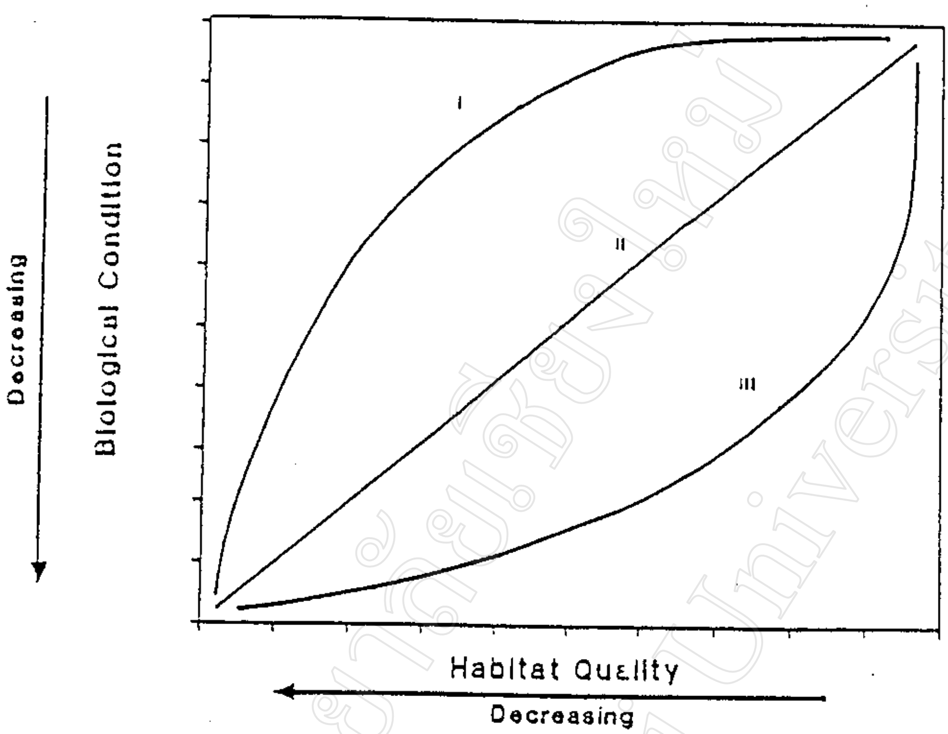


**Figure 29.** Relationship of Habitat Quality and Biological Condition in the Context of Water Quality.

Curve I indicate nutrient enrichment effect the biological condition and habitat quality

Curve II general relationship of biological condition and habitat quality

Curve III organic pollution or toxicants will adversely affect biological condition regardless of the quality of the habitat.