# CHAPTER 5

# DISCUSSION

## 5.1 Coastal land use

Coastal land use was the major activity that directly modifies the environment of mangrove canals at Trat Bay. According to the visual interpretation of LAND SAT-TM image in 1987, 1992 and 1997, 10 classes of land use in 7 sub districts of Trat Bay were compared. Particularly the land use along both sides of the study sites was clearly different.

Bangphra Canal, which was covered with the medium density of mangrove, without shrimp farming on both sides and its structure was in natural condition, had the best environment for living of fish when comparing with Thaprik and Thaleuan Canal. At Thaprik Canal, although its structure was in natural condition but almost all area on both sides was covered with shrimp farm, which was converted from mangrove.

The effect from the effluence of sediment and chemical substances from shrimp farming into the canal caused the water in Thaprik Canal had the highest turbidity in dry season when comparing with Bangphra and Thaleuan Canal. Besides, the concentration of surface $NO_3^-$ was found the most at station 3 (upstream) of Thaprik Canals. It was 123.3 μg $NO_3$-N /l in wet season and 140.7 μg $NO_3$-N /l in dry season. The highest concentration of bottom $PO_4^{3-}$, 12.5 μg/l, was also found at station 3 of Thaprik Canal in wet season.

In accordance with the study of Patanaponpaiboon et al. (1994), the highest concentration of $NO_3^-$ and $PO_4^{3-}$ was found at Thaprik Canal when comparing with Trat River and Chao Island at Trat Bay. The concentration of $NO_3^-$ at Thaprik Canal was 32.6 μg $NO_3$-N /l at downstream in wet season and 121.6 μg $NO_3$-N /l at upstream in dry season. At the same time, the concentration of $PO_4^{3-}$ was 52.0 μg/l at downstream in dry season, however, it was found less than 0.95 μg/l throughout the canal in wet season. From the result, they noticed that the highest concentration of $NO_3^-$ and $PO_4^{3-}$ in Thaprik Canal was probably due to the high water drainage that consisting of nitrogen source from shrimp farms on both sides.

Unlike Bangphra and Thaprik Canal, the most area on the both sides of Thaleun Canal was covered with the abundant mangrove and without the shrimp farming. However, its structure was not in natural condition, installing with the water gate at the inner part of the canal.

## 5.2 Fish abundance related to the environment

All 111 species from 47 families of fish were found throughout the study period. Fish collected by push net, 94 species, were greater than by drift gill net which could catch 25 specie. This showed that push net, active gear, has more efficiency for catching various aquatic animals than drift gill net, which is a passive gear fit for catching of certain pelagic aquatic fish.

Of all 109 species collected had been identified into species level. One species of genus *Rastrelliger* caught was rather young considered from the standard length. It was not over 10 centimetres and its morphological characters did not fully develop which might cause inaccurate identification (Suthakorn, 1986). Another species of Gobiidae caught family could not be identified because there was not enough data to determine its species level.

The maximum fish species were carnivore (69.4 %) and almost all found in mangrove canals were in juvenile stage. It was due to the fact that mangrove is a good nursery site, which can provide fish for two main reasons, the abundance of food supply and the shelter for young fish (Odum and Heald, 1975).

At the same time, the abundance of fish species found from 3 canals reflected their association with the coastal land use on both sides and the structure of the canals. Bangphra Canal, which runs through the natural recovery mangrove without shrimp farming on both sides and its structure is in natural condition, had the most proper characteristic when comparing with Thaprik and Thaleuan Canal in terms of species composition and species diversity of fish found.

The maximum species number of fish, 95 species, was found from Banphra Canal. In addition, Bangphra Canal showed the highest species diversity of fish found in each season when considered from the index value of species diversity. The more species diversity, the more index value of species diversity. From the result, species diversity index value of fish found from Bangphra Canal was 2.54 in wet season and 3.10 in dry season. From the statistical analysis, the

highest total weight of fish caught by drift gill net was 13.48 kg from Bangphra Canal. At the same time, the highest CPUE by drift gill net was 0.12 kg/hr. However, total weight of fish caught by push net of 3 canal was similar.

Seventy- five fish species were found in both seasons from Thaprik Canal, which runs through the area of mangrove destruction and shrimp farming area, while 80 species were found from Thaleuan Canal. Species diversity of fish found from Thaprik and Thaleuan Canal was lower than from Bangphra Canal when considered from the lower index value of species diversity of fish found from Thaprik and Thaleuan Canal. In addition, total weight of fish caught by drift gill net from Thaprik was lower, 9.47 kg, while the lowest was from Thaleuan, 6.45 kg. As well as the CPUE by drift gill net from Thaprik was lower, 0.09 kg/hr., while the lowest was from Thaleuan, 0.06 kg/hr.

From the results, even through along both sides of Thaleuan Canal were covered with the abundant natural mangrove but the structure of the canal was not in natural condition with the water gate installing at inner part. The water gate would be closed in dry season to prevent the freshwater on land from mixing with estuarine water in the canal and would be opened in wet season to discharge the freshwater into the canal.

The opening in wet season of water gate might affect to the distribution of fish species that could not adapt to the sudden change of water and brought about the lowest species number found, 39 species, in wet season at Thaleuan Canal. According to the species number of fish found from 3 canals, it showed that *Chelon subviridis*, *Gerres filamentosus* and *Gerres poieti* were found throughout Bangphra and Thaprik Canal in wet and dry season. At the same time, these 3 species were also found throughout Thaleuan Canal in dry season. However, they were found only at the mouth and midstream but not found at inner part of Thaleuan Canal in wet season. This might due to these 3 species affected from the opening of the water gate at inner part of the canal in the same season.

The species of fish found also depended on the environment of mangrove canals such as *Oxygaster anomalura* and *Toxotes chatareus*. Rainboth (1996) reported that *Oxygaster anomalura* preferred to live at surface of river with fertile forest canopy and its favourite food was exogenous insects and chironomid larvae. In this study, *Oxygaster anomalura* was found in wet season at the

mouth of Bangphra and the midstream of Thaleuan Canal that were covered with high density of mangrove but it was not found from Thaprik where had lowest area of mangrove on the both sides.

*Toxotes chatareus* which preferred to live in shaded area with overhanging of vegetation (Rainboth, 1996), was found throughout Bangphra Canal and at midstream and upstream of Thaleuan Canal but was not found from Thaprik Canal which had lowest shadow due to the mangrove destruction on both sides.

From the correlation coefficient and regression analysis, it showed that species number of fish had relationship with surface and bottom salinity, surface pH, bottom DO, the concentration of surface $PO_4^{3-}$ and zooplankton volume.

Surface and bottom salinity of 3 canals was similar in wet season with range of 0.0-5.3 ppt. All 62 species found in wet season were freshwater and estuarine fish. Many species of freshwater fish found were in family of Cyprinidae while the major species of estuarine fish were in family of Hemiramphidae, Chandidae, Eleotridae and Gobiidae.

In dry season, the water throughout 3 canals became saltier and Thaleuan Canal which its inner part was obstructed by water gate had the highest salinity, between 28.0-33.0 ppt. At the same time, number of fish species was found greater in dry season than in wet season. All 80 species found in dry season were estuarine and brackish fish in major family of Mugilidae, Lutjanidae, Engraulidae, Clupeidae, Carangidae, Gobiidae and Siganidae while freshwater fish were not found. The different groups of fish found from the study sites in both seasons resulting from the changing of salinity in those canals related to the distribution of fish species and their salinity preference.

According to the relationship of fish with pH and DO concentration, Dash (1994) stated that pH could be a factor to determinate on the distribution of aquatic organism. Furthermore, the discharge of wastewater from many activities on land into the water sources would change the pH of water and affected directly to fish and other aquatic organism. At the same time, Howell and Simpson (1994) indicated that species number of fish and overall total catch per tow showed a clear decline in abundance when declined bottom DO.

Bierman et al. (1994) explained that DO concentrations appeared very sensitive to changes in underwater light attenuation. Many causes of decrease in DO concentration were more oxidation of carbonaceous material in the water column, phytoplankton respiration and oxygen demand of sedimental organism and etc.

However, in this study, surface pH and bottom DO of water in all canals were in normal condition and had no negative effect on fish. The surface pH range was 6.56-7.09 in wet season and 7.41-7.80 in dry season. The pH value of 3 canals was lower in wet season than in dry season because it was influenced by the rainfall and river runoff from the land. At the same time, the condition of water was alkaline in dry season resulting from the concentration of $HCO_3^-$ and $CO_3^{2-}$ in marine water.

The bottom DO range was 4.97-6.00 mg/l in wet season and 4.00-4.97 mg/l in dry season. Referring to the description of Jobling (1995) and Smithsonian Institution (1998), the suitable pH range for aquatic lives was 5.0-9.0. Chapman (1986) and Howell and Simpson (1994) indicated that the critical DO concentration for metabolism of most fish species were below 2-3 mg/l.

Meanwhile, the concentration of surface $PO_4^{3-}$ of 3 canals was not different with range of 1.2-12.5 μg/l in wet season and 2.9-28.3 μg/l in dry season. In addition, the volume of zooplankton of 3 canals was not different. However, the frequency of zooplankton groups found from 3 canals was different. The most frequency found of euphausid, calanoid, cyclopoid and harpacticoid copepod, the positive indicator in the fishery sources as the food source of the other aquatic animals, was from Bangphra Canal.

As well as the most frequency found of medusae and ctenophore, the negative indicator in the fishery source as the predator of the other zooplankton groups and the fish larvae, was from Bamgphra Canal. However, mysid and stomatopod were not found from Bangphra Canal while fish egg, euphasid (*Pseudoeuphausia latifrons*) and stomatopod were not found from Thaleuan Canal. These results might due to the error of sampling.

The volume of zooplankton sampling from the study sites was greater in dry season than in wet season and in accordance with the study of Quansim (1973), Goswami and Selvakumar

(1977) and Khaosirikul (1979). They concluded that the abundance of zooplankton decreased in low salinity and high turbid water in wet season and it was found maximum in dry season when the salinity of water increased. Jermolajev (1958) explained that the high turbid water in wet season limited the growth rate of phytoplankton and bring about food shortage for zooplankton.

Cladoceran and gastropod were found greater in wet season than in dry season. Meanwhile, lucifer, cirripede nauplii, medusae, were found higher in dry season than in wet season. Polychate and harpacticoid copepod were found only in wet season while chaetognath, siphonophore, ctenophore and brittle star larvae were found only in dry season. In accordance with the study on zooplankton in the Tha Chin estuary of Teeratecha (1981), cladoceran, gastropod and polychate were found greater at the stations that had lower salinity, in wet season.

In addition, chaetognath, siphonophore and ctenophore were found greater at the stations, which had higher salinity, in dry season. Ackefors (1971) stated that cladoceran was usually an important group in freshwater. In contrast, chaetognath, ctenophore and brittle star larvae were the common marine groups (Wear, 1965; Goswami and Selvakumar, 1977 and Wongrat, 1995).

As same as the volume of zooplankton, the concentration of chlorophyll a, which was used for indicating the abundance of primary producer (phytoplankton) in the water source, of 3 canals was not different in both seasons. It was not rich with the range of 1.24-4.79 $mg/m^3$ in wet season and 2.08-6.32 $mg/m^3$ in dry season. Basing on the description of Marshall and Peters (1989), the high abundant water source would have the concentration of chlorophyll a more than 12 $mg/m^3$.

## 5.3 The distribution of fish in mangrove canals

The species number of fish found from 3 canals were greater during spring tide and at night than during neap tide and the day. In accordance with the study of Humphries, Potter and Loneragan (1992), they concluded that species number of teleoste in the shallow of Wilson Inlet mangrove in Australian estuary were greater at night than during the day. Dolar, Alcala and Nuique (1991) found that more mangrove fish of the North Bais Bay, Philippines, were caught at night than during the day.

Monkolprasit (1983) indicated that many groups of mangrove fish found from Klong Wan were the tidal visitor, such as sciaenid, baracuda, half-beak, carangid and etc, that moved into the mangrove at high tide to feed on the juvenile fish and invertebrate. Leh and Sasekumar (1991) found that mangrove creeks in Selangor, Malaysia, appeared to be an important feeding ground for engraulid, clupeid and carangid.

As well as the study on species composition of fish in estuaries elsewhere in Thailand and other parts of the world, species number of fish were found maximum at station 1 (the mouth) and the lowest at station 3 (upstream) of each canal. The abundance of fish at the mouth but declined at midstream and upstream of the mangrove canals is due to the mouth of the canals commonly contains various organisms aquatic animals need (Odum, 1971).

The value of species diversity index of 3 stations in each canal sometimes did not related with the species number of fish found. From the results, total species number of fish was found the most at the mouth (Station 1) of 3 canals in both seasons. However, the index value of species diversity was lower at the mouth of Bangphra Canal in each season and at the mouth of Thaprik and Thaleuan Canal in wet season.

These meant that the most species number of fish found from the mouth of the canals could not be used for indicating that place was proper for living of fish in term of ecological aspect if it had low value of species diversity index. The value of species diversity index behaves inversely to the dominance index, the more diversity of species the lower dominance of species.

For example, in wet season, though the mouth of each canal had the highest species number of fish but has low species diversity of fish because of the high dominant species that could be estimated from the value of dominance index. High value of dominance index at the mouth of canals showed that a few species of fish found had more numbers of individuals than other species. It concluded that number of individuals per species of fish found from the mouth of Bangphra Canal in each season and from Thaprik and Thaleuan Canal in wet season was in improper proportion, only a few species were rich or dominant while the rest were low in number of individuals.

According to the value of similarity index of fish, the index value of fish species of Bangphra:Thaprik:Thaleuan was the lowest. It was 0.443 in wet season and 0.524 in dry season. These meant that the number of the same species found from all canals was not many. In addition, in each season, the lowest value of Bangphra:Thaprik and the highest value of Thaprik:Thaleuan showed that the number of the same species found from both Bangphra and Thaprik Canal was lower than the number of the same species found from both Thaprik and Thaleuan Canal.

At Bangphra and Thaleuan Canal, the most same species found was at station 1 and station 2 of each canal in wet season while the most same species found in dry season was at station2 and station 3 of both canals. At Thaprik Canal, the greatest same species found was at station 1 and station 2 in each season. At the same time, the same species found from station 1: station2: station 3 of each canal was the lowest in each season.

The different species found, comparing among stations in each canal, depended on environmental parameters, particularly the salinity of water in each station. Besides, it also depended on the different ability of fish species to migrate into the canals up to the upstream. In wet season, the water throughout the canals became fresh water. This limited the migration of brackish fish into station 3 (upstream).

Therefore, more fish found at station 3 were freshwater fish and different from the fish found at station 1 and station 2, of which more estuarine fish were found. In dry season, the water in each canal was quite brackish water and allowed various fish species to swim into station 2 and station 3. This showed that the same species was found the greatest at station 2:station 3 of Bangphra and Thaprik Canal.

## 5.4 Coastal fisherfolks

The lifestyle of coastal fisherfolks in 7 sub-district of Trat Bay had not change from the past. The 40.6 % of coastal fisherfolks had been still poor and 52.7 % of households lived together in a large family comprising 4-5 persons per family while 30.8 % had more than five persons per family. More than half of them (57.1 %) learnt to be fishermen from their ancestors. Their income by fishing depended on various factors, fishing gears, the abundance of coastal aquatic animals, the environmental variation of Trat Bay and also the luck.

The fishing gears that could catch many of aquatic animals were push net and trawl and were preferred by 27.5 % of fisherfolks across the 7 sub-districts. These fisherfolks earned from fishing more than 10,000 baht a month while 40.6 % of fisherfolks, whose fishing gears used were such as crab net, drift gill nets and fish and crab trap had lower incomes between 1,000 to 5,000 baht per month.

The lower income of those latter groups brought about the poor to their families but could not brake their attention to preserve the aquatic animals for their further generations by using the conserve fishing gears. They indicated that although push net and trawl had higher efficiency but also destroyed many young aquatic animals in their fishing sources.

Ingsrisawang and Sungthong (1989) reported that push net was found along the coast of Trat Bay. At the same time, the fishing by using crap trap was decreased due to the decline of coastal crab affecting from the change of crab's habitat and the convert of mangrove area into shrimp farms along the coastal line.

Referring to the opinion of fisherfolks, 96 % pointed out that aquatic animals in term of number of individual were decreased from the past. The deterioration of aquatic animals of Trat bay was not only due to the fishing by trawl and push net but also due to various factors such as the increasing of fisherfolks, the wastewater discharge from coastal shrimp farms into the canals and the deterioration of coastal mangrove. Meanwhile, 93 % pointed out that mangrove condition around Trat Bay at present was poorer than the past resulting from two main causes, shrimp farming and woodcutting.