Chapter 1

Introduction

1.1 Background

Fisheries and aquaculture play important role for people's life worldwide. They are sources of income, food supply and also traditional fishery products. Especially, Asia-Pacific is the main resources of fisheries and aquaculture. The persons engaged in fisheries and aquaculture production accounted for 87% of the total global and the top ten producer amount to 58% of the total global production (Longren *et al*., 2006). However, over fishing or using illegal gears, cause the decreasing of economic fish species whereas the catches of discards/bycatch or low value fish increase (Chesoh *et al*., 2008).

Discard/Bycatch

One concern about the state of world's fisheries is focused on non-target species in the catch that are discarded. Discards also include unmarketable, undersized or damaged fish of commercial fish species (Clucas, 1997). Many countries confront on this problem and attempt to overcome this silent discards issue. Discarding has impacts on the changing economic, sociological, environmental and biological factors. Especially important issues are impacts on the environment, which include increased mortality of target species, and alteration of food webs by supplying increased levels of food to scavenging organisms on the sea floor (Matsuoka, 2008)

Table 1.1 contains data from a Food and Agriculture Organization of The United Nations (FAO) publication on estimates of global discards in marine fisheries. A total of 27,012 million tons was estimated for 1994. In the Southeast Pacific, 2,602 million tons of discards (9.6% of catch) were found. In 2004, global discards were estimated to be 7.3 million tons, a discards rate of 8% of the catch discarded. In Thailand, Kelleher (2004) reported that the discards rate in the Gulf of Thailand was 1% of the catch discarded. Matsuoka (2008) estimated that discards were 0.4% of total catch, 27.8 million tons, as shown in table 1.2.

Nominal regions	*Discards (1000MT)*	*(%)*
Northwest Pacific	9,132	33.8
Northeast Atlantic	3,671	13.6
Central-west Pacific	2,777	10.3
Southeast Pacific	2,602	9.6
Central-west Atlantic	1,601	5.9
West Indian	1,471	5.4
Northeast Pacific	925	3.4
Southwest Atlantic	803	3.0
East Indian	802	3.0
Central-east Pacific	767	2.8
Others	2,461	9.1
Total	*27,012*	*100*

Table 1.1: Global and regional fishing discards estimated in 1994 from Alverson (Matsuoka, 2008)

Usually deep-water fisheries have high levels of discards and appear to be over-exploited. Most studies on discards have focused on species, quantities, discard rates and normally have been concerned with fishing ground, gear types used, fishing period, season and catch per unit effort (CPUE). (see for example Kennelly, 1999; Moranta *et al*., 2000; Rochet *et al*., 2002; Monteiro *et al*., 2001; Allain *et al*., 2003; Enever *et al*., 2007; and Goncalves *et al*., 2007).

Countries (Asia)	*Discards (1000MT)*	*(%)*
Cambodia	0.0	0.0
China	74.3	1.1
Indonesia	270.4	4.0
Japan	918.4	13.5
Korea	1.0	0.0
Malaysia	10.4	0.2
Myanmar	27.4	0.4
North Korea	1.1	0.0
Philippines	7.5	0.1
Thailand	27.8	0.4
Viet Nam	17.8	0.3
Others	5463.1	80.1
Total	*6819.2*	*100.0*

Table1.2: Estimation of global and national fishing discards, revised in 2005 from Kelleher (Matsuoka, 2008)

Low value/trash fish

In the Asia Pacific, the discards are mainly low value fish or trash fish (Simon *et al*., 2005). The proportion of low value/trash fish is increasing in these areas, a trend that is meeting the growing demand for these fish for livestock/aquaculture feeds (Lungren *et al*., 2006). The low value fish can be used for either human consumption or as animal feed (for both fish and livestock). They can be processed into fish meal/oil or directly fed to other fish. As human food, the fish may be consumed directly or further processed often using traditional methods of processing small fish.

Country	*Low value/ trash fish*	*% of catch*	*Dominant gear*	*Year of estimate*
Bangladesh	71,000	17	Gill nets (48%) Set bag nets (42%)	2001-02
China PR	5,316,000	38	Trawl	2001
India	271,000	10-20	Trawl	2003
Philippines	78,000	4	Trawl (41%) Danish seine (22%) Purse seine (12%)	2003
Thailand	765,000	31	Trawl	1999
Viet Nam	933,183	36	Trawl	2001

Table1.3: Estimated low value/trash fish production in Asia-Pacific (tones)

Table 1.3 presents a summary of the estimated amounts of low value/trash fish being caught in Asia-pacific regions. The percentage of low value/trash fish recorded in these countries ranged from 4 percent to 38 percent of the total marine capture landings. In Thailand, the low value/trash fish totaled 765,000 tonnes, being 31% of catch and always caught by trawl gear.

In addition, recent studies in South-East Asia indicated that 35% of trash fish were defined as low value marine fish (Kaewnern and Wangvoralak, 2005). Goncalves *et al*., (2008) studied the relationship of selectivity of the gear, depth, soak time, season and non-commercial invertebrates, and found that discards were 48% of the total catch in southern Portugal. Similarly, in Panay Gulf of Philippines it was found that discards comprised 25 non-commercial species (Cornelio *et al*., 2008). Stobutzki *et al*. (2005) reported that in Thailand 47 fish families identified in trash fish, the dominant families being Leiognathidae, Engrauidae, Mullidae, Syndontidae and

Apogonidae, which comprised 47.5% of trash fish by weight. Most of the 28 families of low value fish are also included in the trash fish.

In Songkhla province, 68% of low value fish go to fishmeal production in the local factories. This can be used in human consumption <5% and directly by aquaculture farms for sea bass and grouper 30% (Stobutzki *et al*., 2005).

Songkhla Lake

Songkhla Lake is the largest natural lagoon located in Southern Thailand. The Lake has played the important role both for recreation and food supply for inhabitants. It has a very unique characteristic. It is a 3-water ecosystem, with mixing of fresh water runoff and overland flow with saline water from the sea, causing salinity of Songkhla Lake water to vary, spatially and temporally (Office of Natural Resources and Environment Policy and Planning, 2005).

Songkhla Lake basins comprise the upper, middle and lower lakes. Thale Noi and Thale Luang are the upper lakes. The water ecosystem of Thale Noi is freshwater for all year and brackish water in Thale Luang, which is caused by saline water intrusion during the dry season. Also, the water ecosystem of Thale Sab (middle lake) is brackish but the density of salinity is higher than in Thale Luang. In Thale Sab Songkhla (lower lake), the density of salinity is the highest, because the water ecosystem is saline water due to this area being directly connected to the Gulf of Thailand.

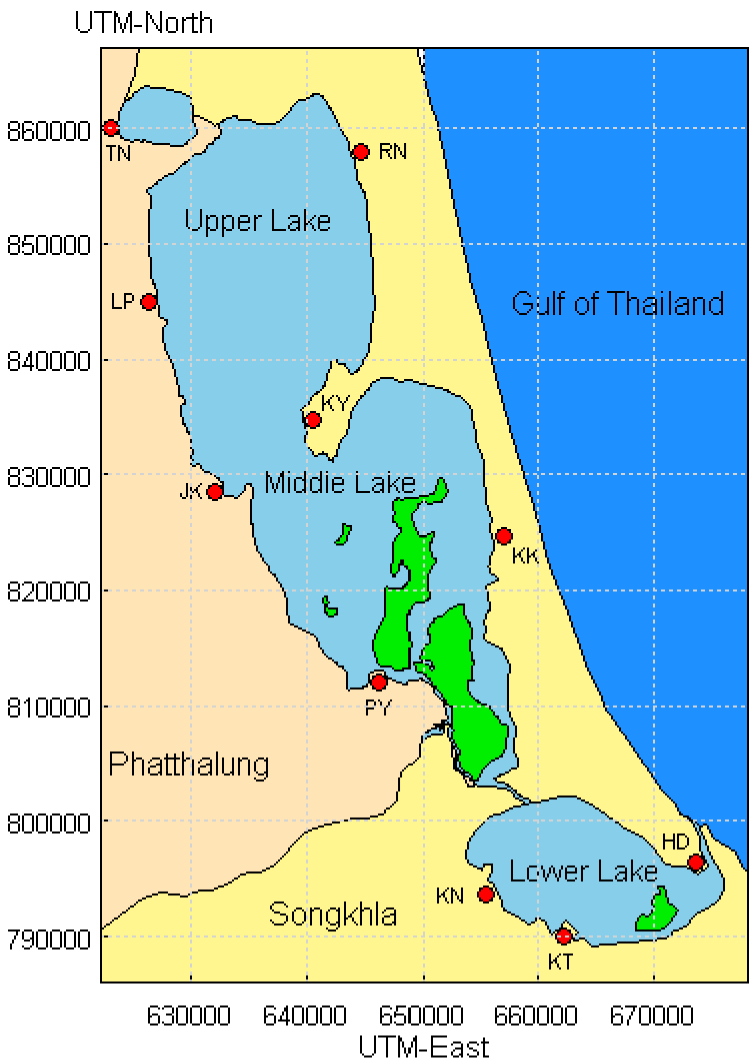

Figure 1.1: Songkhla Lake (Chesoh and Choonpradub, 2009)

In Songkhla Lake, the total catches during 1984-1986 and during 1994-1995 were 12,290 tons/year and 9,634 tons/year, respectively. In the latter period, 528; 5,745 and 3,361 tons/year were from Thale Noi, Thale Luang and Outer Lake, respectively (Office of Natural Resources and Environmental Policy and Planning, 2005). In 1985, the amount of fish landing was approximately 1,992.9 tons/year (Tookwinas *et al*., 1985). In 1996, Choonhapran *et al*. found that the resident fish constituted 30.77% of fish landing catch weight, the migrant fish 45.05% and the displacement fish 25.00%.

The quantity of aquaculture production has trended to be increased over time, especially, in Thailand (Khemakorn, 2005; Thongrod, 2005). At the same time, it is contributing to increasing fishing pressure on the already overexploited fish stocks (Simon, 2005). Besides, there is increasing capture of low value fish, indicating the deterioration of fishery resources in the Lake (Chesoh *et al*., 2008). Our study focuses on the low value fish.

1.2 Objectives

The objectives of our study are as follows.

1. To investigate both species and quantities of low value fish species based on the commercial fish landing around Songkhla Lake in 2003-2006.

2. To determine trends, seasonal patterns and develop statistical models of the quantity of various types of low value fish.

1.3 Literature Reviews

There have been several recent studies of discards and bycatch. These include papers by Kennelly (1999) about areas, depths, and times of high discard rates of scup, *Stenotomus chrysops*, during demersal fish trawling off the northeastern United States. The areas had different scup discard rates, based on sampling. Most areas recorded high discard rates across a range of depths. The highest scup discard rates were in November and December in some areas. The main discarded species was dogfish (672 pounds/hour), and the second was scup (319 pounds/hour).

Moranta *et al.* (2000) studied about fish catch composition of the deep-sea decapod crustacean fisheries in the Balearic Islands (western Mediterranean). 42% of the total catch was discarded. The discards proportion varied in each season, the discards being greater than landings in the spring, but in other seasons the landings were greater. The discards rates and discards species varied with depth. The first, second and third highest discard rates were upper, intermediate and lower depth (300 meters, 489 meters, 616 meters), respectively. The fish, crustacean and cephalopod species were greater biomass in the upper, intermediate and lower depth, respectively.

Rochet *et al.* (2002) analysed discards from the French trawler fleet in the Celtic Sea. This fleet consisted of benthic trawlers, Gadoid trawlers and *Nephrops* trawlers. The discards were an estimated 30,000 tons and the landing 63,000 tons. The discards were high for Gadoid trawlers and *Nephrops* trawlers. Benthic trawler discards were 60% for each of four species. Gadoid trawler discards were 50% for each of three species. *Nephrops* trawler discards were 60% for two species.

Allain *et al.* (2005) studied preliminary estimates of French deepwater fishery discards in the Northeast Atlantic Ocean. The discards were an estimated 17,500 tons in 1996-1997. Some of each of forty-three species were discarded. The mean discarding rate by haul was 48.5%. Discards species composition and discard quantities varied with depth. The mean discarding rates were 25.1%, 55.4% and 61.0% in the depths 800 metre, 1,000 metre and 1,200 metre, respectively.

Shiromoto *et al.* (2006) contributed a study on trash fish and discards of push net catch at Samuut Prakan in Thailand. The push net catch was divided into three categories: commercial fish, trash fish and discards by body length and weight of the species. The catches of discards, commercial fish and trash fish were 54%, 23% and 23%, respectively, of total weight. Almost 80% of the discards were crabs, *mainly Charybdis affinis,* and While Soapy, *Leiognathus* sp. In trash fish and discards, juveniles of commercial species were included. The discards ratio (=discards/landing) was 1.17. The discards rate [=discards/(landing+discards)] was 0.54.

Enever *et al.* (2007) investigated discarding in the English Channel, Western approaches, Celtic and Irish seas (ICES subarea VII). An estimated 186 million (72,000 tons) of fish and cephalopods were caught every year, of which 117 million (24,500 tons) were discarded. Beam trawlers contributed 58% to the total number of the discards generated (68.5 million fish, 12,500 tons). Otter trawlers were responsible for 35% (42 million fish, 9,000 tons). Discard levels were highest during winter (November-February) for Beam trawlers, while otter trawlers had highest discard levels during summer (May-July).

Stobutzki *et al*. (2005) conducted a study on the status of trash fish resources in coastal fisheries of Thailand and Malaysia. They found that of the 47 fish families identified in trash fish, the dominant families were Leiogathidae, Engraulidae, Mullidae, Synodontidae and Apogonidae, which comprised 47.5% of trash fish by weight. The low value fish comprised 28 families, most of which also occur in the trash fish in Thailand. In addition, in Songkhla, all of the trash fish and 68% of the low value fish go to fishmeal production in the local factories.

Khemakorn *et al*. (2005) studied the trash fish: the links between capture fisheries and aquaculture in Thailand. The main portions were Leiognathidae and Nemipteridae in trash fish and low value food fish, respectively. The quantity of aquaculture production has trended to be increased overtime while the trends of commercial landings catch of trash fish and low value food fish are slightly decreasing. During 1971-1991, the low value food fish production remained roughly constant at a level of

34,000-45,000 tonnes and decreased to be 28,099 tonnes in 1992. After 1993, the production fluctuated but showed the increasing trend. In addition, it was found that the price of low value food fish has increased continuously from 3.44 baht/kilograms in 1971 to be 18.31 baht/kilograms in 1995. Since then the price fluctuated but showed the increasing trend, last year showed 28.5 baht/kilograms.

Grainger *et al.* (2005) studied the production and utilization of trash fish in selected Chinese ports. The sampling survey have 7 kinds of fishing gears, pair trawlers, otter trawlers, beam trawlers for shrimp, drift gillnet, purse seiners, crab-cage and sail stow net. The catch of low value fish was 50,981.7 metric tons, 15.7% of total catch in October 2002 to May 2003 from 6 kind fishing gears, not included the sail stow net. The proportion of low value fish was highest in October 2002 and the lowest was in March 2003 for otter trawling. There was higher in March, April and May 2003 for pair trawling and it was slightly consistent for beam trawling for shrimp. For drift gill net, the highest proportion of low value fish occurred in September 2002 and the lowest in May 2003. The proportion was fluctuated and the highest occurred in March 2005, followed in January 2005 and the lowest was in September 2004 for sail stow net.

Komontree *et al*. (2006) studied the trends in marine fish catches at Pattani Fisher Port during 1999-2003. They found that a decreasing trend occurred in mackerel, other food fish, squid, shrimp and lobster. There was no detectable trend up or down in the trash fish and crab and an increased trend only in the scads. The seasonal effects on marine fish (mackerel, other food fish, squid, shrimp and lobster, but not for other invertebrates) were that they were at a minimum during the four months from December to March, and rose to a maximum in September and October.

Goncalves *et al*. (2007) conducted a study on discards from trammel nets in four southern European areas. The main reasons for discarding were (1) species of no or low commercial value, (2) commercial species that were damaged or spoiled, (3) undersized commercial species, and (4) species of commercial value but not caught in sufficient quantities to warrant sale. The discards were 79.7% of the total catch, containing137 species. Discards consisted mainly of *Trisopterus luscus, Scomber japonicus, Torpedo torpedo, Sardina pilchardus* and *Diplodus annularis*. S. *japonicus* and T. *torpedo* were species of no or low commercial value. There was a strong seasonal influence on the species composition and relative abundance of the discards. S. *japonicus* were more important in autumn-winter and T. *torpedo* were those mainly discarded in autumn.

A study of the discards of the Algarve (southern Portugal) crustacean trawl fishery from June 1998 to October 1999, conducted by Monteiro *et al.* (2007) revealed that most of the species had no or little commercial value and were almost always discarded to the sea (90%). A total of 91 species were identified, 47 vertebrates and 44 invertebrates corresponding to 65 families.

Cornelio *et al*. (2008) studied the catch composition and discards of a stationary liftnet fishery in Panay Gulf, Philippines, from December 2005 to March 2006. They found that the total of catch composition and discards included 83 species, belonging to 38 families of finfish, crustaceans, mollusks and annelids. 56 of these were commercial species whereas 27 other species had no commercial value. Almost all non-commercial species comprised the discards, but juveniles of nine commercial species were also noted among discards.