Chapter 1

Introduction

1.1 Background

Fishing Industry in Thailand

The sea fishing industry has been a major component of Thailand's economy for many years, and it is thus essential that sustainable practices are maintained. The Gulf of Thailand and the Andaman Sea and their extensions into surrounding seas and oceans provide a rich source of seafood, but sustainable fishing policies cannot be developed without scientific planning and relevant guidelines. Historical data provide the basic ingredients for developing reliable forecasts, which are in turn essential to planning. Table 1.1 shows the total fish catches in thousands of tons for the top ten fishing countries in the world in the last year of the twentieth century, together with their populations and fishing productivity in tons caught per thousand residents (Department of Fisheries, 2000a). China is number one in both population and catch. The quantity is 16987.3 thousand tons, with catch per population is 12.1 ton per thousand residents. Thailand is ninth in the quantity of the catch. With population 64.9 million and fish catch 2923.6 thousand tons, Thailand's annual catch per person in 2000 was 45 kilograms.

In terms of the total quantity of fish production, Thailand makes the top ten countries in the world, but its productivity in terms of its population, though greater than neighbours Japan and Indonesia, was vastly exceeded by the two leading South American countries (Peru and Chile), and by Norway. While a major factor in the fishing productivity of a country is the extent of its coastline, and the greatest producers in terms of catch per

population, Norway, Peru and Chile, all have extensive sea coastlines with relatively small interior areas. In contrast, only the southern area of Thailand, with at most one third of the country's population, has a sea coastline, as Figure 1.1 shows.

Country	Catch (Ktons) in year 2000	Population (millions)	Catch per thousand residents
China	16,987.3	1,398.8	12.1
Peru	10,658.6	27.5	387.6
Japan	4,989.4	127.3	39.2
USA	4,745.3	293.0	16.2
Chile	4,300.2	15.8	272.2
Indonesia	4,140.0	238.5	17.4
Russia	3,973.5	143.8	27.6
India	3,594.4	1,065.1	3.4
Thailand	2,923.6	64.9	45.0
Norway	2,703.4	4.6	591.6

Table 1.1: Top ten fish-catching countries of the world, 2000

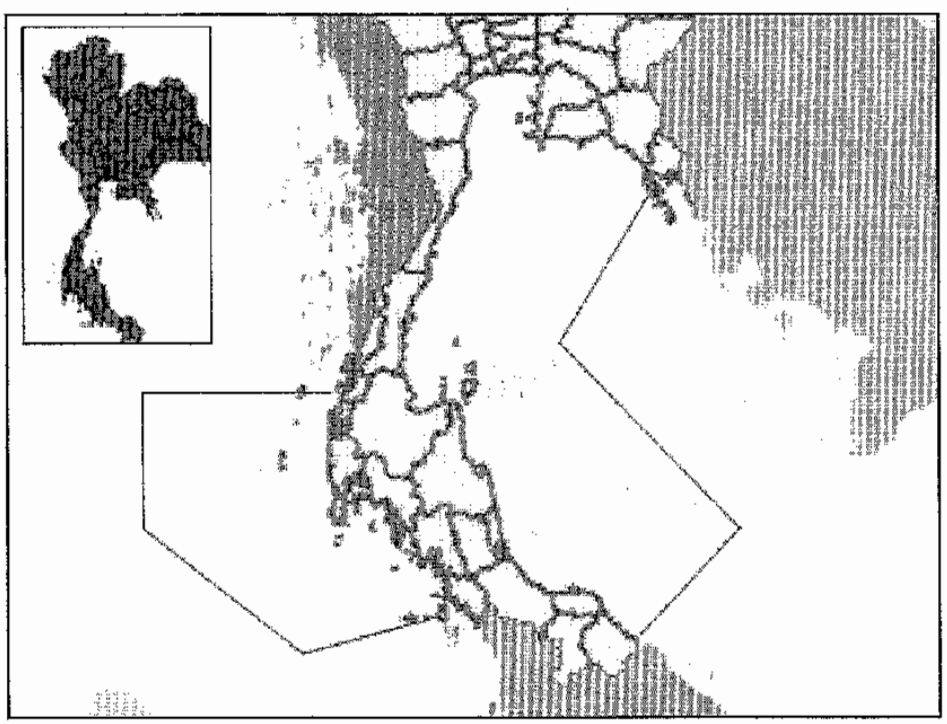

Figure 1.1: Fishing catchment area of Thailand

The Department of Fisheries in the Ministry of Agriculture and Cooperatives provides a regular statistical survey on the quantity and value of marine products landed at various ports in Thailand. The purpose of this survey is to acquire information on the amount and value of marine products at various landing place each year. This information is a prime necessity for fisheries management, investment, and community development. The Department plans to extend the survey domain to cover all major landing places in the country.

Table 1.2 shows, for Thailand for each year over the period 1989-2000, (a) the total quantity of the annual fish catch in thousands of tones (Ktons), (b) the total caught at fishery ports, (c) the value in millions of baht of the fishery port catch, (d) the amount exported and (e) its percentage of the fishery port catch, (f) the resulting income earnings, and (g) the profitability expressed as the ratio of the export earnings to the value of the fishery port catch (Department of Fisheries, 2000b).

year	Total (Ktons)	Fishery ports (Ktons)	Value (M baht)	Export (Ktons)	Port percent	Income earnings	Profit ratio
1989	2539.2	1638.7	11092	875.3	53.4	53705	4.84
1990	2555.4	1676.4	12132	905.0	54.0	61071	5.03
1991	2709.1	1722.3	16129	1087.4	63.1	78463	4.86
1992	2965.7	1530.0	15825	1106.1	72.3	82469	5.21
1993	3048.1	1771.6	19131	1115.1	62.9	91018	4.76
1994	3150.2	1739.2	22998	1214.9	69.9	110285	4.80
1995	3185.0	1748.9	22457	1192.6	68.2	116578	5.19
1996	3112.2	1716.5	25014	1146.9	66.8	110781	4.43
1997	2979.2	1657.6	24288	1181.3	71.3	138624	5.71
1998	3076.6	1723.4	28536	1312.3	76.1	176311	6.18
1999	3166.4	1789.1	33094	1394.1	77.9	165718	5.01
2000	3240.7	1782.8	34752	1356.7	76.1	185750	5.35

Table 1.2: Annual catches and export earnings in Thailand: 1989-2000

It should be noted that the total quantity given in this table includes aquaculture production whereas the corresponding quantity shown in Table 1.1 does not.

The importance of the fishing industry to Thailand's export earnings, in terms of the value added to the catch by exporting this resource, which ranged from 4.43 in 1996 to 6.18 in 1998.

Province	Fishery -port catch (Ktons)	
	1990	2000
Trat	42.6	95.2
Chantaburi	12.4	2.9
Rayong	146.9	78.5
Chonburi	88.0	25.7
Chachoengsao	0.4	2.2
Samutprakan	132.9	213.9
Samutsakhon	114.2	87.5
Samutsongkhram	10.3	5.4
Phetchaburi	2.7	1.5
Prachuap Khiri Khan	41.2	43.9
Chumphon	69.8	61.3
Surat Thani	52.3	18.6
Nakhon Si Thammarat	77.3	170.7
Songkhla	264.1	296.7
Pattani	197.9	280.1
Narathiwat	0.7	3.8
Ranong	160.3	73.4
Phang-nga	44.8	58.4
Phuket	68.5	79.6
Krabi	9.0	19.0
Trang	69.8	69.4
Satun	70.1	94.9
Total	1676.4	1782.8

Table 1.3: Total catch at fishery ports in Thailand in 1990 and 2000

Table 1.3 shows the quantity and value of the total landings at Thailand fishery ports in coastal provinces in 1990 and 2000. The totals are similar for the two years, but the distributions changed substantially over the ten-year period, as illustrated graphically in Figure 1.2.

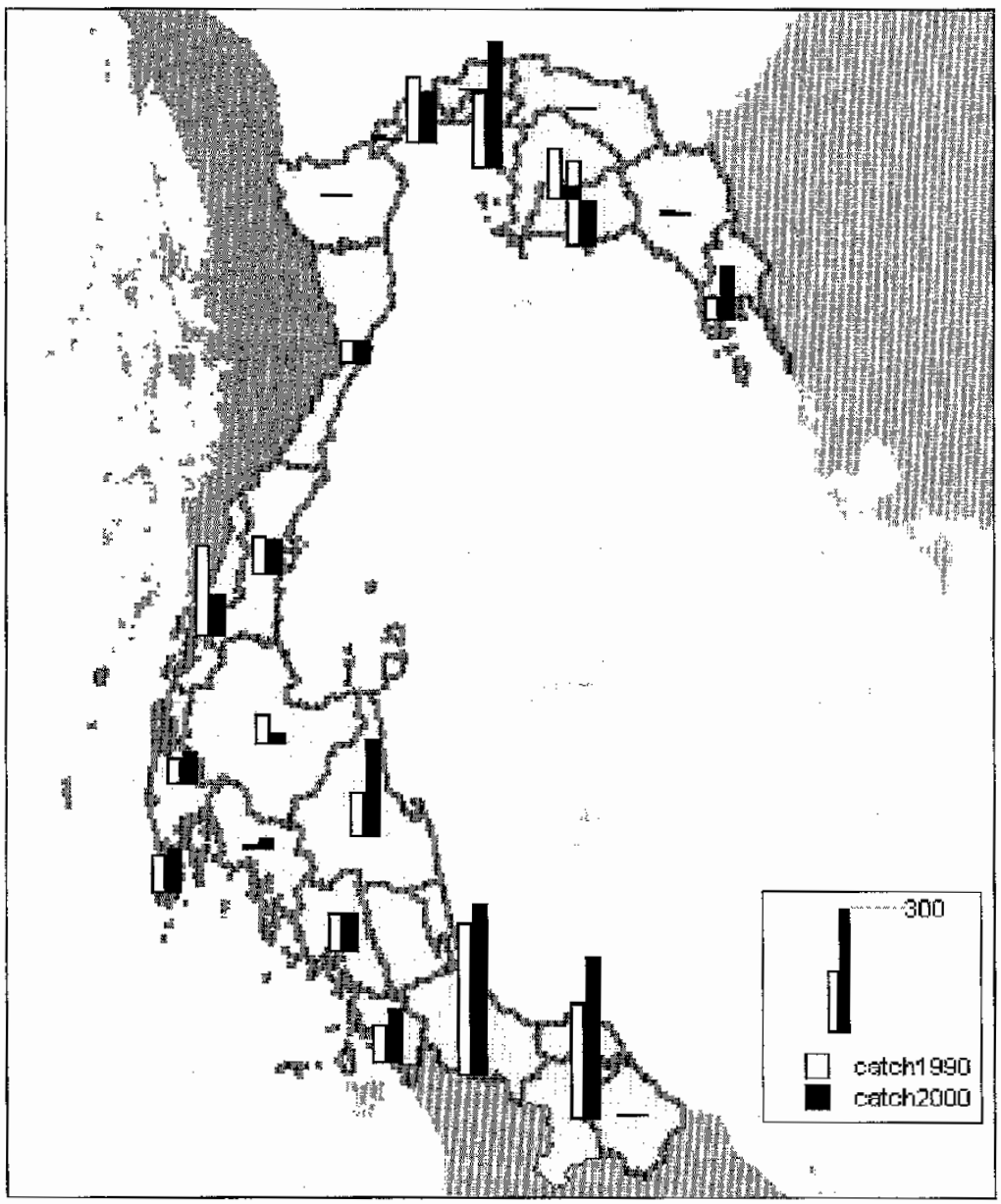

Figure 1.2: Distribution of total catch at fishery ports in Thailand in 1990 and 2000

This statistical map shows that the four most productive provinces in 2000, Songkla, Pattani, Samutprakan and Nakorn Si Thammarat, all increased their production substantially over the preceding decade, whereas Rayong and Ranong declined.

Pattani Fishery Port

Pattani is one of the most important of the 22 provinces of Thailand involved in the sea fishing industry. Its main port is strategically located at the south-western extremity of the Gulf of Thailand. The Fishery Department also records the quantity of marine fish data classified by eight types, (1) Mackerel (2) Other food fish including King mackerel, Tuna, Hardtail scad, Trevallies, Sardinellas, Anchovies, Threadfin breams, Lizard fishes, Red snappers and Big-eyes (3) Shrimp (4) Lobster (5) Squid (6) Crab (7) Scads (8) Trash fish.

Table 1.4 shows these annual data for Pattani Fishery Port for the five years from 1999 to 2003. Food fish other than mackerel provide the largest production component by weight, with 40 percent of the total, followed by scads (27%), trash fish (23%) and mackerel (7%).

year	Quantity of marine fish (millions of tons)							
	Mack-erel	Other food fish	Shrimp	Lobster	Squid	Crab	Scads	Trash fish
1999	13.07	75.13	0.202	0.228	7.49	0.481	37.28	52.26
2000	14.44	89.89	0.071	0.094	6.03	0.231	48.11	41.19
2001	12.26	72.84	0.068	0.079	6.93	0.235	52.25	32.39
2002	11.83	70.46	0.049	0.043	6.34	0.303	59.49	42.22
2003	10.78	59.65	0.018	0.029	4.03	0.243	53.60	40.34
Total	62.38	367.97	0.408	0.473	30.81	1.493	250.73	208.40
%	6.76	39.88	0.044	0.051	3.34	0.162	27.17	22.59

Table 1.4: Total catch at fishery ports in Thailand by type of fish

However, the picture changes when these quantities are converted to monetary values, as Table 1.5 shows. In value terms, food fish other than mackerel account for two-thirds of the total (67.5%), followed by scads (11.7%), mackerel (9.0%), and squid (98%).

Type of fish	Quantity (Ktons)	Avg Value (baht/kg)	Total value (M baht)	Percent value
Mackerel	62,380	31	1934.54	9.04
Other food fish	367,970	39	14452.69	67.51
Shrimp	408	167	63.02	0.29
Lobster	473	56	27.95	0.13
Squid	30,808	56	1704.88	7.96
Crab	1,493	68	93.80	0.44
Scads	250,730	11	2495.73	11.66
Trash fish	208,400	3	635.56	2.97
Total	922,662	431	21408.17	100.00

Table 1.5: Total value of catch at Pattani Fishery Port in 1999-2003 by type of fish

1.2 Objectives

Our data comprise the daily total catches of seafood returned in fishing boats to Pattani Fishery Port for the five years from 1999 to 2003, classified into eight types of fish. We use these data to develop simple but effective and practical forecasting models based on standard statistical analysis methods.

The specific objectives of our study are as follows.

1. To study trends in quantity of marine fish at Pattani Fishery Port 1999-2003.
2. To develop statistical models for forecasting the quantity of the various types of marine fish landed at Pattani Fishery Port, allowing for trend and seasonality.

1.3 Literature Review

There have been several recent statistical studies aimed at developing methods and models based on time series of fish catch data. These include papers by Stergiou and

Christou (1996), Wallace et al (1998), Goni et al (1999), Zhang and Lee (2001), Sbrana et al (2003), and Xiao (2004). The study by Stergiou and Christou applied multivariate statistical time series models to annual catches over a period of 25 years for 16 species in Hellenic marine waters. Their forecasting methods were applied separately to each marine species, and their models included deterministic multivariate models, univariate time series models, multivariate time series models, and empirical models. In each case they found that the annual catches needed to be log-transformed to remove the correlation between the mean and the standard deviation of the time series. However, despite the fact that the models were quite complex, their conclusion was that "not a single best approach was found."

Wallace et al (1998) used both annual and monthly time series analysis of catch per unit effort data for a lobster fishery in Western Australia from 1972 to 1994 to show that time trends in such data depend on the time interval selected. They thus concluded that modellers and managers of fisheries need to quantify the effects of economic and regulatory changes on the temporal and spatial allocation of fishing effort.

In what they claimed as a first attempt to analyse and standardise monthly catch rates from a Western Mediterranean trawl fishery, Goni et al (1999) applied generalized linear statistical models to analyse data from individual boats during the period 1991 to 1996, concluding that such modelling "is a sensible method for obtaining standardised abundance indices of exploited ground fish stocks."

Zhang and Lee (2001) studied stock assessment and management implications of horse mackerel *(Trachurus japonicus)* in Korean waters, based on the relationships between recruitment and the ocean environment. They found that the estimated survival rate of horse mackerel ranged from 0.25 to 0.36, the instantaneous coefficient of natural

mortality was 0.48/year, and the age at first capture was 0.83 years. The annual biomass of horse mackerel in Korean waters was estimated by a biomass-based cohort analysis using annual catch in weight at age during 1965-1995. A method for estimating acceptable biological catch was proposed for dealing with the large differences in the quality and quantity of information and data available.

Sbrana et al (2003) used generalised linear statistical models to investigate factors affecting the crustacean trawl fishery monthly catch rates during the period from 1991 to 1999 in the northern Tyrrhenian Sea of the western Mediterranean. The conclusion from this study was that boats differed in the catching abilities but no specific boat-specific factors could be found to account for these differences, with the single exception of Norway lobster catches, where the boat's size and fishing practice were the major determinants.

Xiao (2004) also used a similar generalised linear modelling approach to analyse the catch and effort data on a specific species, the western king prawn *Penaeus latisulcatus* Kishinouye in the Gulf St. Vincent, Australia, over the period July1995 to June1997. The conclusion from this study was that the current level of fishing effort could not sustain the exploitable biomass of the population at the level of December 1993.

1.4 Study Design and Data

This research objective is to study the trends in the quantity of marine fish at Pattani Fishery Port in Thailand over the last 5 years, from 1999 to 2003 inclusive, with a view to developing a time series forecasting model for assisting the planning process. The study design is cross-sectional type, the observations being daily totals (in kilograms) for the eight fish type classifications listed in Table 1.5.

The variables of interest are the quantities of marine fish landed on each day from 2 January 1999 to 31 December 2003, classified as mackerel, other food fish, shrimp, lobster, squid, crab, scads and trash fish.