CHAPTER 2

MATERIALS AND METHODS

1. Description of the study area

1.1 Climate

The climate of Phuket is humid tropical and is maninly controlled by the Southeast Asian monsoons, namely the northeast monsoon and southwest monsoon. The northeast monsoon (December-March) from the Chinese mainland or the North Pacific brings a dry season. The southwest monsoon (May-October) from the Indian Ocean brings large amounts of rainfall. April and November, of which the directions are changeable, are two transitional periods between the two monsoons. The mean annual precipitation and the mean temperature for ten years (1969-1979) are 2,266 mm and 27.9 ^{o}C respectively (from Chansang, 1980). Monthly values of rainfall and temperature at Phuket over ten years (1969-1979) are given in Fig. 1. Rainfall shows a pronounced variation. Temperature is not much different.

1.2 The study area

This study was carried out in a mangrove forest at Ko Maphrao, a small island east of Phuket Island, Southern Thailand (98^{o} 25' E, 7^{o} 56' N). The forest is located in the southwest corner of Ko Maphrao shown in Fig. 2. The mangrove forest is relatively undisturbed, except

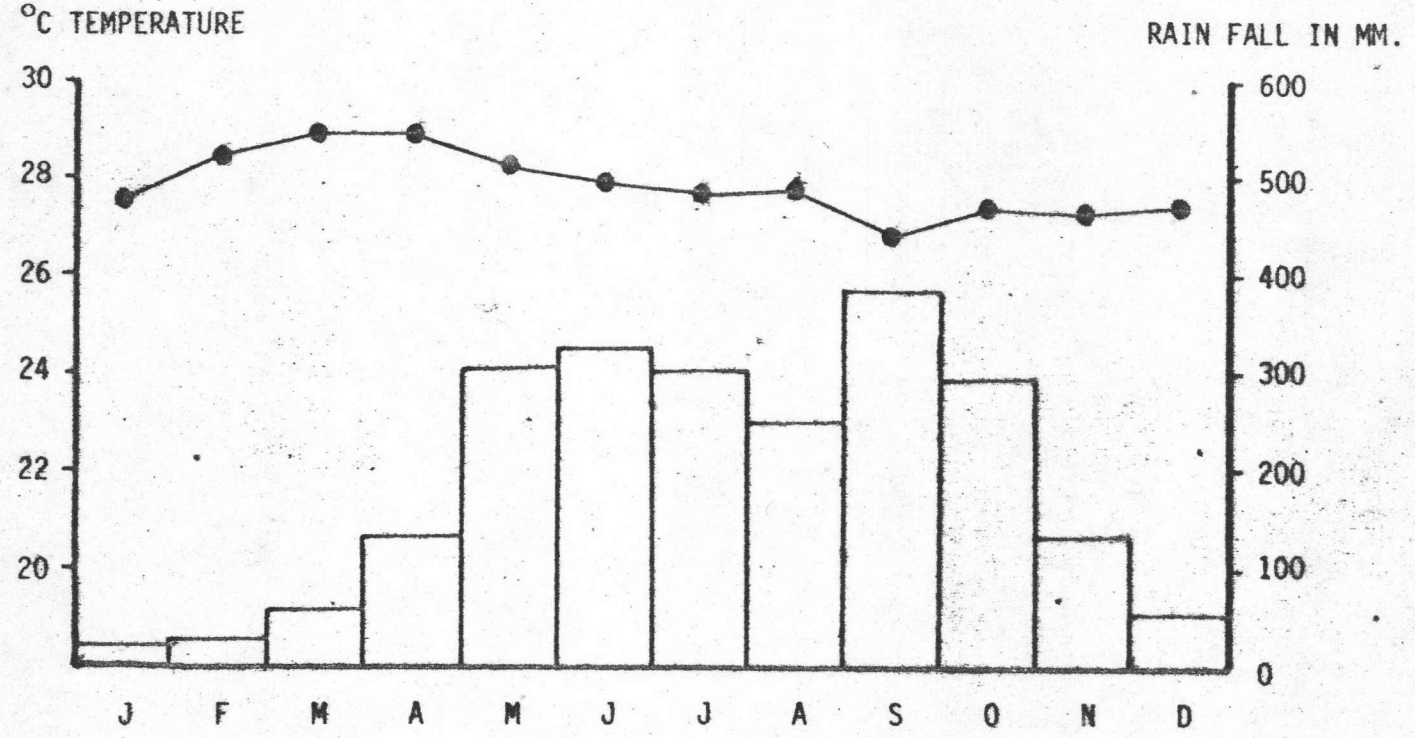

Figure 1. Monthly values of rainfall and mean temperature at Phuket during 1969 - 1979 (from Chansang, 1980)

some cutting for local use. There is some collection of shrimps, fishes in the channels and the crab, *Scylla serrata*, in the mangroves for local consumption.

Ko Maphrao is in Sapam Bay, which is a shallow bay bordered by mangrove fringes. There are small streams and drainage discharging freshwater from land into the bay. The bay is well protected during both monsoon periods. The bottom of the bay is characterized by muddy environment which supports various species of marine commercially important animals. The fishermen collect the clam, *Anadara granosa*, and catch the shrimp, mostly *Penaeus merguiensis*, in this area.

Estimated from an aerial photograph, the mangrove area is about 1.1 km^2. There is a main channel which forks into smaller channels running through the forest to the edge of the mangrove forest. The channel mouth opens to the sea in the southwest corner of the island. There are sand dunes deposited at the channel mouth. The west side of the mangroves is bordered by sandy beach and some beach vegetation occur, e.g. *Cassurina sp.*, *Pandanus sp.*, *Thespesia sp.*, *Hisbiscus sp.*. In the south and southwest, there is a foreshore mud flat exposed at low tide for about 60 meters.

The study area was divided into four sampling stations from land to sea as shown in Fig. 2. Three stations are in the mangrove and one station is on the mud flat. Study of the forest structure is in progress at the Phuket Marine Biological Center. Brief descriptions of these stations are as follow:

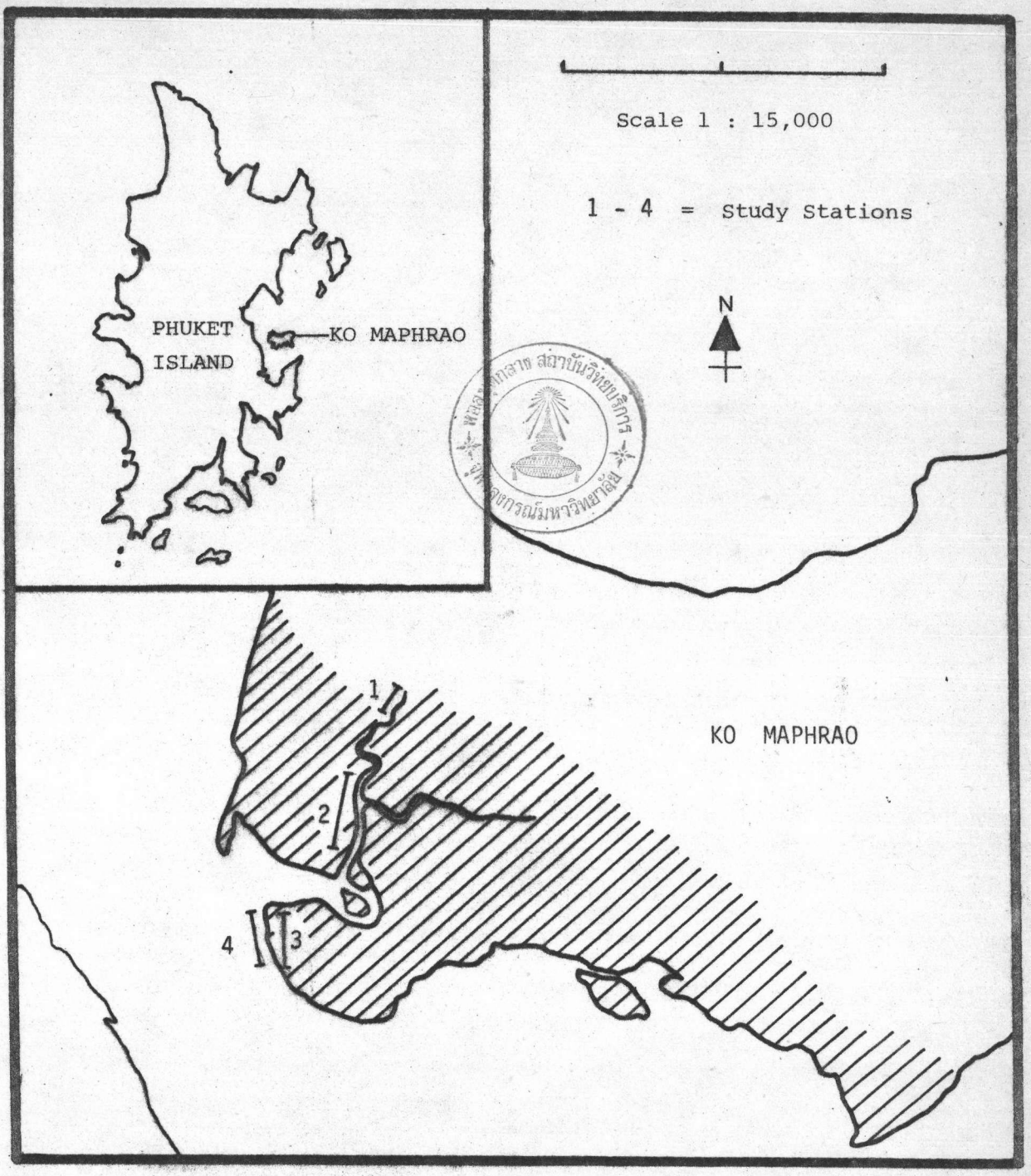

Figure 2 Map of the study area, Ko Maphrao, showing the study stations of the mangrove forest (shaded area). Small insert map shows the position of Ko Maphrao in the east of Phuket Island.

STATION 1 (The innermost station)

It is in the landward zone of the mangrove forest. The dominant species are *Phoenix padulosa, Excoecaria agallocha, Heritiera littoralis, Scyphiphora hydrophyllacea,* and *Nypa fruticans,* interspersed with a few trees of *Brugiera cylindrica, Avicennia officinalis.* A typical feature of this zone is the association of several mounds of the mud-lobster, *Thalassina anomala.* Some mounds are topped by *P. padulosa.* The substratum is coarser compared to the other stations studied.

STATION 2 (The middle station)

Station 2 is in the middle zone of the mangrove forest. Along the channel banks, *Rhizophora apiculata* is the dominant species. Other mangrove species which commonly associate with the *R. apiculata* community or occur sparsely are *Avicennia officinalis, Ceriops tagal, Xylocarpus granatum,* and *A. alba.*

STATION 3 (The seaward fringe of mangrove forest)

It is in the seaward mangrove zone. The fringing mangrove trees are predominantly *Sonneratia alba.* They form a tall, dense fringe and they are possibly the pioneer species of this mangrove forest. This zone can be referred to as a *Sonneratia alba* zone. Behind this fringe and further inside, *S. alba* is replaced by *Rhizophora mucronata* and then *R. apiculata.*

STATION 4 (The mud flat biotope)

This a bare area devoid of mangrove plants. Small puddles of standing water occur during low tide. There are mangrove leaf cones,

sticking upright in the mud. They are formed by polychaetes, *Diopatra sp.* and *Marphysa sp.*. The substratum is soft and semifluid at the lower area, and it becomes firmer higher up the shore. A distance of about 60 meters is exposed during low tide.

2. Macrofauna collection

Prior to quantitative samplings, two qualitative surveys were conducted to collect the animals from the mangrove area and mud flat. The animals were collected from soil (infauna), ground surface (epifauna), prop roots, trunks, branches and leaves of mangrove trees, and dead and rotten wood. Animals which came up with tides were also collected by scoop nets. It should be pointed out that some of these species were not present in the sampling quadrat and they are shown in Appendix 1 without density value.

Quantitative samplings were carried out during the period of April-May, 1978. Epifauna and infauna were sampled randomly within each station. The number of random samplings are shown in Appendix 1. A half meter square quadrat was placed at each sampling point. Larger animals, especially the running crabs, were handpicked first within the quadrat. Infauna were collected by digging up soil to a depth of about 25 cm. Below this depth, animals are rarely found, except some big burrowing crabs and mud-lobster, *Thalassina anomala*. The soil was then sieved through a 1 mm mesh size sieve for collecting smaller animals which were retained on the sieve. This similar method was employed by Sasekumar (1974) and Frith et al. (1976).

All animals were sorted and preserved in alcohol and then counted and weighed. It is almost impossible to obtain the density and biomass per m^2 data for tree dwelling animals. The fauna were thus not sampled quantitatively. Data obtained for density and biomass figures have been multiplied by four to give the values per m^2.

3. Identification

Most specimens, apart from polychaetes, were identified by using literature and comparing them with the reference materials in the Reference Collection at Phuket Marine Biological Center. The reference meterials had been identified or confirmed by the recognized authorities (see Serene and Lundoer, 1974; Lundoer, 1972; Frith et al., 1976; Frith, 1977; Tantanasiriwong, 1979a, 1979b).

The previous identification of some polychaetes in the reference materials was found confusing and wrong. Probably this might be due to the poor preservation and the loss of some taxonomically important parts of the body. The polychaetes were newly identified by Dr.Jorgen Hylleberg and Mr.Anuwat Nateewathana so as much as possible to genera and species. Some are probably new to science. Detailed polychaete taxonomy is now under investigation of them and the results will be published later in PMBC Research Bulletin, Thailand

In addition, some species were checked by some taxonomists. List of groups is indicated as followed:

Alpheidae : Drs. A.H. and D.M. Banner,
University of Hawaii.

Porcellanidae	: Dr. R.B. Manning, Smithsonian Institution, through Dr.D.W. Frith.
Xanthidae	: Ms. Srisupree Kongkayen, Scientific Museum, Sukhumwit.
Uca spp.	: Dr.D.W. Frith, Monash University Australia.
Mollusca	: Ms.Ratsuda (Tantanasiriwong) Mianmanus University of Miami.
Fishes	: Mr.Anuwat Nateewathana and Mr. Vudhichai Janekarn, Phuket Marine Biological Center.

The specimens from the study have been deposited at Phuket Marine Biological Center.

4. Biomass

Animals from each plot were sorted into major taxonomic groups (see Table 1) and then weighed. Before weighing free water adhering to the surface of the samples was removed by placing the animals on blotting paper. These wet weights, which included inorganic materials, such as the calcareous portion of shell and the water trapped within the body spaces, were multiplied by appropriate factors to convert them to weights of dry tissue.

The conversion factors (Table 1) were obtained by drying representative species (at least 40 samples) of each taxon in an electric oven at 105°C for 24 hrs. Prior to drying, molluscs and crustaceans were

Table 1 Dry weight of animals as a percentage of wet weight

Major taxon	Percent
Sea anemone	12
Nemertea	23
Sipuncula	16
Polychaeta	18
Crustacea	17
Gastropoda	5
Pelecypoda	4
Fishes	24

decalcified by dissolving all the calcareous structures in 20% HCL solution. This method was employed by Williams and Thomas (1967). The conversion factors have also been used by Nateewathana and Tantichodok (1980) to estimate dry weight biomass of Ko Yao Yai mangrove macrofauna.

5. Soil analysis

Soil samples were collected from each quadrat within each station to determine particle size, water content and organic content. Each soil sample was collected adjacent to each plot in which the macrofauna were sampled.

One hundred grams of each soil sample were dried in an electric oven at 105^{o}C for 24 hrs and then weighed again. The loss in weight represented the amount of water in soil sample. Mean value of weight loss for each station was calculated and expressed as a percentage of wet weight.

Care was taken to remove rootlets, fragments of leaves, twigs etc., if present, from the dried soil samples in determining grain size and organic content. To determine grain size, fifty grams of dried soil from each sample was sieved through graded sieve series (2.0, 1.0, 0.5, 0.25, 0.125, and 0.063 mm in diameters) for 15 minutes in an automatic sieving machine. The soil samples retained on each of these sieves were weighed to 0.1 g accuracy. Mean value of each grain size for each station was estimated and expressed as percentages of the total weights. From these results, the mean particle diameters of soil in each station were determined by plotting cumulative curves of percentage composition and reading particle diameter values along the line for 50% composition.

For determination of organic content, fifteen grams of dried soil samples were ashed in a muffle furnace at 550°C for three hours and then reweighed. The loss of weight represented the organic content. Mean value of each station was calculated and expressed as a percentage of dry weight.

6. Salinity and pH of soil pore water

Salinity and pH of soil pore water were determined by digging a twenty centimeter deep pit and measuring the water seeped from the soil. Salinity was measured with a refractive salinometer and pH with a field pH-meter (Radiometer 29). Five readings were taken from each station and mean values were calculated.

7. Shore profile and tidal inundation

Shore profile was determined by measuring depths of water at different points on the banks along the channel from land toward the sea and the distances between them.

Based on the tidal predictions from tide timetables for Thai Water (Hydrographic Department, Royal Thai Navy) at Ko Taphao Noi, Phuket, together with the shore profile, the number of tides inundating each station per year (January-December, 1978) were estimated and expressed as a percentage of total number.