2. MATERIALS AND METHODS

Study sites

Preliminary observations showed that there is a high diversity of marine organisms, including macroalgae at Sirinat Marine National Park. Also, since Sirinat Marine National Park is a protected area, it is an ideal place for an area based marine study (Prathep, 2005).

The study site is located at the coastal area of Sirinat Marine National Park, Phuket, Southern Thailand (8°05'N, 98°17'E) (Figure 1). The park has a variety of habitats including rocky shores, coral reefs and seagrass beds. In addition, there are variations in the degree of wave exposure. Therefore, sampling sites were divided along the shoreline at the intertidal level with different degrees of wave exposure: sheltered, semi-exposed and exposed. In the exposed area, organisms were directly affected by wave action, which was less in semi-exposed and sheltered areas due to protection by fringing reefs. The water current was measured at each site during March 2004 using mini current meter model SD-4 (4A) (Sensordata a.s., Bergen, Norway). The average water current at the bottom was 2 m/s at the sheltered, 4.8 m/s at the semi-exposed and 6.8 m/s at the exposed areas, respectively.

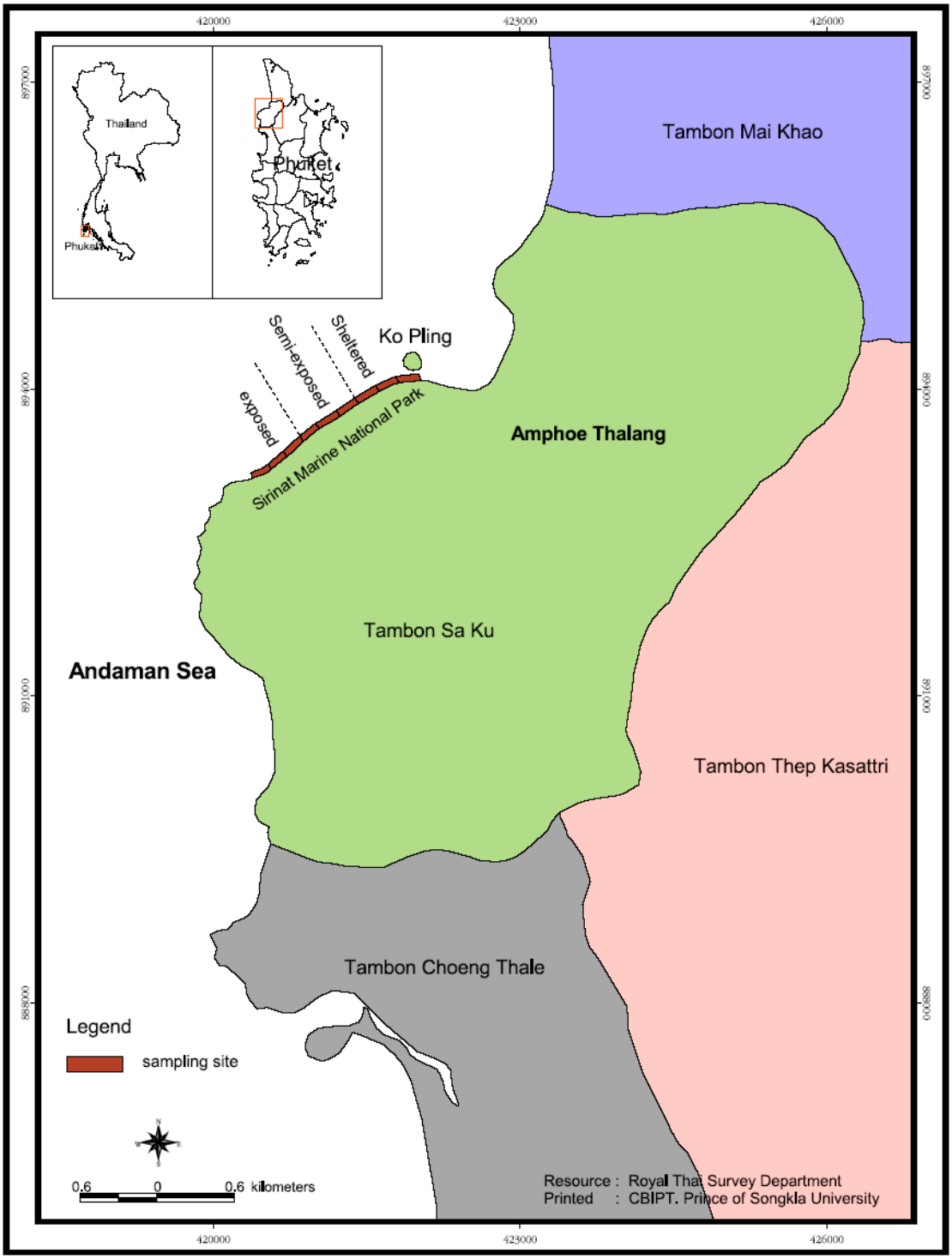

Figure 1. Study area. Location of the transects along the coast of Sirinat Marine National Park, Phuket, Southern Thailand.

Samplings were conducted bimonthly. January and March, 2004 represented the dry season, whilst May, July, September and November, 2004 represented the wet season. The wet season is influenced by the Southwest Monsoon, with an average rainfall of 289.8 mm while the dry season is influenced by the Northeast Monsoon, with an average rainfall of 87.7 mm in 2004 (http://www.tmd.go.th). The study was carried out during low tide when it was feasible to collect all the macroalgae. Skin diving was used when needed.

Methods

2.1 Diversity study

Macroalgae species along the shores were collected as many species as possible. The best time for collecting the macroalgae was during the hours of the falling tide. The complete plants (including the holdfast) were removed from the substrate and placed in the plastic bags. Labels were placed which include location and date of collection. Specimens were brought back to the laboratory where they were preserved in 4% seawater-formaldehyde. Herbarium specimens were also prepared. Voucher specimens were deposited at the Prince of Songkla University herbarium. Samples were examined for gross morphology as well as internal anatomy with the use of various references, the systematic arrangement of algae follows the scheme of Lewmanomont and Ogawa (1995) and others such as Egerod (1971, 1974, 1975), Wei and Chin (1983), Abbott (1988), Huisman (2000) and Littler and Littler (2000).

2.2 Abundance and distribution study

Sampling sites were selected along the shoreline at different degrees of wave exposure: sheltered, semi-exposed and exposed area according to the water currents. In the exposed area, organisms were directly affected by wave action, which was less in semi-exposed and sheltered areas due to protection by fringing reefs. Line transects perpendicular to the shoreline were used to sample macroalgae distribution. Ten of 120 m long equidistant transects were conducted among the different degrees of wave exposure which were located perpendicular to the shore at interval of 100 m. Three lines each were set on the sheltered and exposed areas, and four lines were set on the semi-exposed area. Three of 50cm×50cm quadrats were used to estimate percentage cover of macroalgae at 20 m intervals along the transect, at three shore levels: 0-40 m was upper shore level, 41-80 m was mid shore level and 81-120 m was lower shore level (Figure 2). Percentage cover of macroalgae was estimated visually and the substrates of macroalgae were recorded at the site.

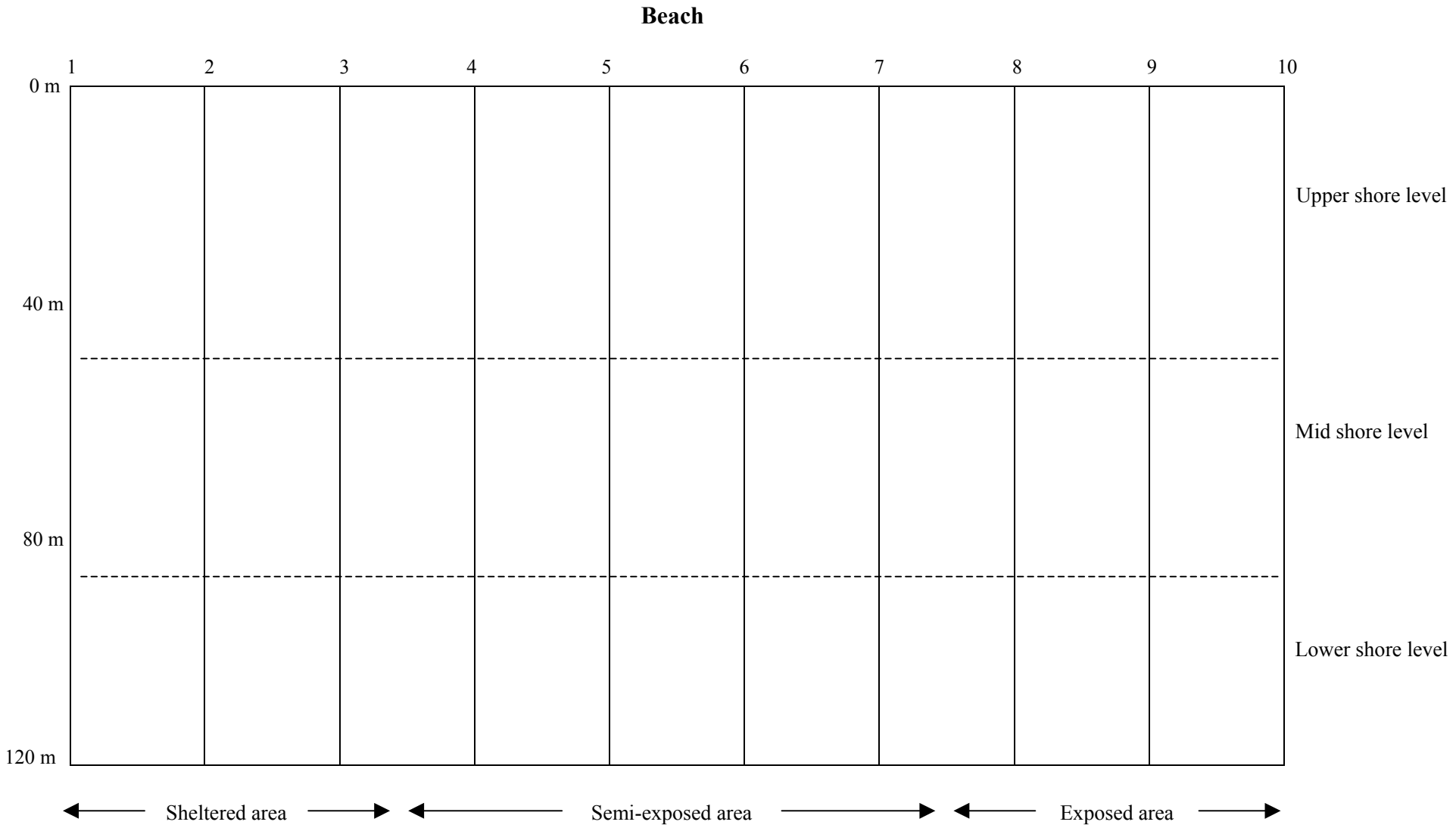

Figure 2. Map of the transects, which were located perpendicular to the shore.

2.3 Variations in morphology and reproduction of *Acanthophora spicifera* and *Chondrophycus tronoi*

Thirty individuals of *Acanthophora spicifera* and *Chondrophycus tronoi* were collected from the sheltered, semi-exposed and exposed areas. Length, diameter and pattern of branching were measured.

The reproductive stages of *Acanthophora spicifera* and *Chondrophycus tronoi* were identified, by compound microscope.

Length was measured from holdfast to the highest portion of a main axis. The plants were cross sectioned at the middle portion of the main axis and their diameters were measured by a micrometer.

The pattern of branching was measured using the Strahler method. Apical branches were referred as primary branch, and two of these meet to form a second order branches and so on to main stem (Barker *et al.*, 1973; Garbary *et al.*, 1980).

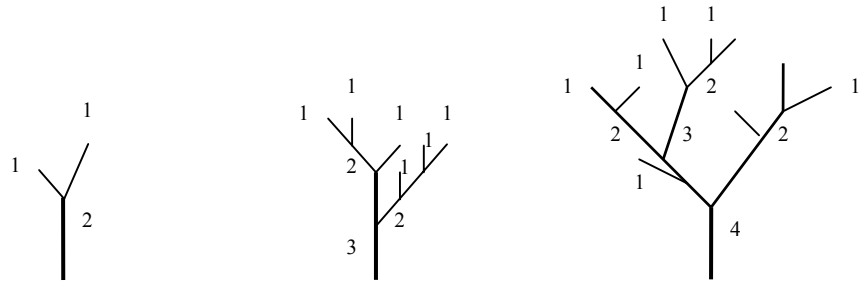

Figure 3. Branching system ordered by the Strahler method (Garbary *et al.*, 1980).

2.4 Physical factors study

Physical factors were measured. A mini-current meter was used to record wave motion. Water samples were collected from study sites and sent for NO_3^- and PO_4^3 nutrient analysis at the Scientific Equipment Center of Faculty of Science. Salinity, temperature and light were recorded in situ using a salinometer, a thermometer and a lux-meter, respectively.

2.5 Statistical analyses

Non-parametric statistics, the Friedman test, was employed to test percentage cover of each species against different sites and seasons. The abundance of each species was calculated by a mean cover value. Distribution of each species was expressed by using mean cover plotted against distance.

The diversity was calculated as a modified Shannon-Wiener index (Díez *et al.*, 2003) as:

$$H' = - \Sigma (n_i /N) \log_2 (n_i /N)$$

where N is the total algal cover and n_i is the cover of the ith species.

Canonical correspondence analysis (McCune and Grace, 2002) was used to examine the relationships between species distributions and environmental factors. Canonical correspondence analysis (CCA) was selected among unimodal methods because this is a direct gradient analysis that displays the variation of vegetation in relation to the included environmental factors by using environmental data to order samples.

Two ways ANOVA were employed to test the effects of sites and seasons on length, diameter and branching pattern of *A. spicifera* and *C. tronoi* using SPSS version 11.5 for windows.