SPECIES DISTRIBUTION AND POPULATION STRUCTURE OF FAVIID CORALS (SCLERACTINIA:FAVIIDAE) ON CORAL REEFS IN THE GULF OF THAILAND

NARINRATANA KONGJANDTRE

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER DEGREE OF SCIENCE IN BIOLOGICAL SCIENCE

GRADUATE SCHOOL

BURAPHA UNIVERSITY

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The thesis of Narinratana Kongjandtre has been approved by the examining committee to be partial fulfillment of the requirements for the Master Degree of Science in Biological Science of Burapha University

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นรินทร์รัตน์ คงจันทร์ตรี: ชนิด การกระจายพันธุ์ และโครงสร้างประชากรของปะการังแข็งวงศ์ Faviidae ในอ่าวไทย (SPECIES DISTRIBUTION AND POPULATION STRUCTURE OF FAVIID CORALS (SCLERACTINIA: FAVIIDAE) ON CORAL REEFS IN THE GULF OF THAILAND) อาจารย์ผู้ควบคุมวิทยานิพนธ์: วิภูษิต มัณฑะจิตร, ปร.ด., สมถวิล จริตควร, ปร.ด., พิชัย สนแจ้ง, ปร.ด. 203 หน้า. ปี พ.ศ. 2547. ISBN 974-383-512-1

ศึกษาความแตกต่างของสถานที่ และถิ่นที่อยู่อาศัยต่อการกระจายพันธุ์ของปะการังในวงศ์ Faviidae และกลุ่มประชากรและความหนาแน่นของปะการังที่ต่างๆ โดยใช้วิธี belt transects ขนาด 45 ม^2 บันทึกชนิด ขนาดและจำนวนโคโลนีของปะการังในวงศ์ Faviidae ทุกก้อนที่พบใน transect จากทั้งหมด 11 หมู่เกาะตลอดทั้งอ่าวไทย ตั้งแต่จังหวัดชลบุรีถึงจังหวัดตราด และจังหวัดประจวบคีรีขันธ์ถึงจังหวัดสุราษฎร์ธานี

พบปะการังในวงศ์ Faviidae ทั้งสิ้น 37 ชนิดจาก 24 จีนัส บริเวณที่พบจำนวนชนิดของปะการังวงศ์ Faviidae สูงสุดคือหมู่เกาะหมาก พบ 33 ชนิด รองลงมาคือหมู่เกาะช้าง พบ 30 ชนิด บริเวณหมู่เกาะเต่าพบจำนวนชนิดของปะการังกลุ่มนี้น้อยที่สุดคือ 18 ชนิด ในขณะที่บริเวณหมู่เกาะอื่นพบประมาณ 20-29 ชนิด ความชุกชุมของปะการัง Faviidae แตกต่างกันตามสถานที่และแหล่งที่อยู่อาศัยในบริเวณที่ตื้น (reef flat) และที่ลึก (reef slope) สามารถแบ่งองค์ประกอบชนิดของปะการังวงศ์ Faviidae ในแนวปะการังต่างๆได้เป็น 5 แบบคือ 1) แนวปะการังที่มีปะการังรังผึ้ง (*Goniastrea*) เป็นชนิดเด่น, 2) แนวปะการังที่มีปะการังวงแหวน,ปะการังช่องเหลี่ยมและปะการังสมองร่องยาว (*Favia*, *Favites*, *Platygyra*) เป็นชนิดเด่น, 3) แนวปะการังที่มีปะการังวงแหวน, ปะการังช่องเหลี่ยมและปะการังรังผึ้ง (*Favia Favites* และ *Goniastrea*) เป็นชนิดเด่น, 4) แนวปะการังที่มีปะการังดาวใหญ่ (*Diploastrea*) เป็นชนิดเด่น และ 5) แนวปะการังที่พบปะการังในวงศ์ Faviidae น้อย เนื่องจากมีปะการังในวงศ์อื่นเป็นชนิดเด่นเช่นปะการังเขากวาง หรือปะการังโขด ขนาดของปะการังในวงศ์ Faviidae ที่พบมากอยู่ระหว่าง 1-40 ซม. โดยปะการังวงแหวนและปะการังช่องเหลี่ยมที่พบมากมักจะมีขนาดประมาณเล็กไม่เกิน 10 ซม. หรืออยู่ระหว่าง 11-20 ซม. ปะการังรังผึ้งและปะการังสมองร่องยาวมักพบขนาด 11-20 ซม. และ 21-40 ซม. ประชากรของปะการังวงศ์ Faviidae เป็นกลุ่มประชากรที่คงอยู่หลังจากปรากฏการณ์ปะการังฟอกขาวที่เกิดขึ้นในอ่าวไทยเมื่อปี 2541

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Corals of the family Faviidae are the dominant group within coral assemblages in the Gulf of Thailand. This study investigated on species, distribution pattern and size distribution of the colonies. The belt transects of 45 m^2 were employed through 11 islands along the Gulf of Thailand with 8 islands from Chonburi to Trat Province and 3 islands from Prachuap Khiri Khan to Surat Thani Province. In total, 13,123 faviid colonies were found with 37 species belonged to 24 genera. Mark and Chang islands had the highest species richness (33 and 30 species, respectively). Tao Islands had the lowest species richness (18 species), whereas, the other islands had around 20-29 species. The colony abundance and area covered by faviid corals varied significantly depending on habitats and locations. Species composition of faviid corals in term of genus could be divided into 5 groups. 1) Reefs dominated by *Goniastrea*. 2) Reefs dominated by *Favia, Favites* and *Platygyra*. 3) Reefs where *Favia, Favites* and *Goniastrea* were common. 4) Reefs dominated by *Diploastrea heliopora* and 5) Reefs where few faviid corals were found. The size frequency of faviid species was considered from the abundant species. Colony diameter was described within 5 categories as 1-10 cm, 11-20 cm, 21-40 cm, 41-60 cm and >60 cm. The colony sizes of most faviid corals were represent by the 1 to 10 cm, 10 to 20 cm and 21 to 40 cm diameter categories. These results showed that current populations of faviid corals are those that survive the 1998 coral bleaching phenomena in the Gulf of Thailand.

ABBREVIATION

In ordination plot from PCA, study sites and scientific names were given in abbreviation. For study sites, abbreviations are presented in Table 1.

Abbreviation used in text is as follows:

Abbreviation	Meaning
CHYPSER	*Cyphastrea serailia*
CYPCHA	*Cyphastrea chalcidicum*
DIPHEL	*Diploastrea heliopora*
ECHLAM	*Echinopora lamellosa*
FAVFAV	*Favia favus*
FAVSPE	*Favia speciosa*
FROTUM	*Favia rotumana*
FVTABD	*Favites abdita*
FVTPEN	*Favites pentagona*
GCFASP	*Goniastrea* cf. *apsera*
GONPEC	*Goniastrea pectinata*
GONRET	*Goniastrea retiformis*
LEPPRU	*Leptastrea pruinosa*
PLADEA	*Platygyra deadalea*
PLAPIN	*Platygyra pini*
PLASIN	*Platygyra sinensis*
Cyphastr	*Cyphastrea*
Diploast	*Diploastrea*
Goniastr	*Goniastrea*
Leptastr	*Leptastrea*
Montastr	*Montastrea*
Platygyr	*Platygyra*

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CHAPTER 1
INTRODUCTION

Introduction

Coral reefs are one of the most diverse and productive marine ecosystems (Sorokin, 1995; Birkeland, 1997). However, many coral reefs worldwide are facing declines in biological diversity (Wilkinson, 1998, 2000; Birkeland, 1996). These declines have resulted from a number of disturbances such as monsoons, typhoons and hurricanes, coral bleaching phenomena and anthropogenic factors such as coastal development, tourism, wastes and destructive dynamite fishing practices. These have caused declines in habitat and species diversity. Therefore, reef communities have attracted attention worldwide.

Understanding ecological processes of coral reefs at the community level is an important first step in understanding this complex ecosystem (Loya, 1972). Earlier work in the 1980s on coral reefs in Thailand focused on taxonomy (Ditlev, 1976, 1978, 1980). More recently, quantitative reef surveys were concentrating on benthic coral assemblages (Ditlev, 1976, 1980; Srithunya, 1981; Sakai et al., 1986; Jiravat, 1985; Phongsuwan, 1986; Phongsuwan, 1991). This provided information in many areas including species and distribution of corals, status and community structure of coral assemblages (Srithunya et al., 1981; Siriratanachai et al., 1983 a,b; Sakai et al., 1986, Chantrarung, 2002), recruitment rate of corals (Yeemin, 1998), and rehabilitation of coral (Siriratanachai, 1984; Chunhabundit et al., 1998). Recently, maps of coral reefs in Thai water were produced providing information on distribution of coral reefs, extent of reefs, reef condition and general morphology of reefs (Chansang et al., 1999).

There are numerous studies, which include aspects of coral biology and ecology, but little information is available on population biology of coral species (Bak & Meesters, 1998). These include the composition of coral populations in term colony of size – frequency distributions. From the previous studies on coral reefs in the Gulf of Thailand, the majority of dominant coral species in terms of area covered was *Porites lutea*. Faviid corals (Family Faviidae) were also dominant and diverse in term of both genera and species. (Srithunya et al., 1981; Jiravat, 1985; Sakai et al., 1986; Chou et al., 1991; Sudara et al., 1992; Yeemin, 1995; Yingchon, 1997; Chantrarung, 2002). Recently, Chantrarung (2002) found the major families of coral in the reefs along the east coast of Thailand to be Faviidae, Acroporidae, Poritidae and Agaricidae. In many coral reefs, the most abundant species in terms of area occupied were Acroporidae, Poritidae and Faviidae. The conditions favoring each varied. Thus, in near-shore reefs where the water was turbid, *Porites lutea* and faviid corals were dominant (Srithunya et al., 1981; Sakai et al., 1986; Phongsuwan and Chansang, 1992). In contrast, in offshore sites with clear water *Acropora* dominated (Srithunya et al., 1981; Sakai et al., 1986; Phongsuwan and Chansang, 1992).

The coral community in the patch reefs along the eastern coast of Thailand is dominated by species in the Faviidae. Chantrarung (2002) reported, where Faviidae are common species in every reefs site, which including *Favia pallida*, *Favites abdita*, *Platygyra daedalea* and *Goniastrea retiformis*.

Faviidae have had a long evolutionary history from the mid Jurassic and are well adaptated to the environment (Birkeland, 1997; Veron, 2000). Most of faviid species are widely distributed across the Indo-Pacific. Some species are restricted to the inter-tidal habitats and upper reef slope which occur over a wide range of environments (Veron, 2000). In low to moderately turbid water, coral eliminate sediment by becoming them sticky with mucus. However, they die, when exposed to high turbidity water. In many massive corals such as *Symphillia*, *Lobophyllia*, *Fungia*, *Galaxea* and also faviid corals are actively expel sediments due to well-developed septa and relative large and tall corallites (Loya, 1972; Sorokin, 1995).

Due to the environmental changes (Wilkinson, 1998, 2000; Birkeland, 1996), hence, many corals died, it is interestingly to know after coral-bleaching phenomena, How is the present status of coral assemblage in the eastern coast of Thailand, especially the Faviidae which are highly tolerance species. How does the population structure of faviid corals in this area? Whether or not different physical influences governed by hydrology and geomorphology, affect the coral population on the reefs in the Gulf of Thailand?

Objectives

1. To determine species and distribution of faviid corals along the Gulf of Thailand.

2. To determine spatial variability of species composition and population structure of faviid corals.

3. To know the present status of faviid corals along the east coast of the Gulf of Thailand after 1998 coral bleaching event.

Hypothesis

Coral assemblages exhibit difference in corals composition and population structure of faviid corals among islands, reef or habitat.

Contribution to knowledge

1. To describe species and distribution of faviid corals along the Gulf of Thailand.

2. To describe spatial variability of species composition and population structure of faviid corals in the Gulf of Thailand.

3. To describe the present status of faviid corals along the Gulf of Thailand after the coral-bleaching event.

Scope of study

Reef sites were selected from the islands along the Gulf of Thailand. Included 8 islands from the eastern Gulf of Thailand and 3 islands from the western Gulf of Thailand. At each islands 3 reefs were randomly chosen.

Study reefs were selected according to the coral reefs Thai waters and also from a preliminary survey at the reef sites.

Area covered by faviid corals was calculated by assuming each species as either a massive circular growth form and or an encrusting square growth form. The area of massive growth corals was calculated as a circle using colony's radius (¶ r^2). Encrusting coral areas were calculated as a square using the longest measure (x^2).

CHAPTER 2
LITERATURE REVIEWS

Scleractinian Corals

Most reef living corals in reefs belong to the class Anthozoa. Only two of their families are related to another class of Cnidaria - Hydrozoa: Milleporidae and Stylasteridae. The class of Anthozoa includes two subclasses Hexacorallia (or Zoantharia) and Octocorallia, which are different in origin as well as in their morphology and physiology. Reef construction is mostly performed by hermatypic corals, which form massive calcareous (aragonite) skeletons. The group of hermatypic corals is represented mostly by the order Scleractinia of subclass Hexocorallia. Two species in this group belong to the order Octocorallia (*Tubipora musica* and *Heliopora coerulea*), and several species to class Hydrozoa (hydrocorals *Millepora* sp. and *Stylaster roseus*). The hermatypic corals harbor the algal symbiont zooanthellae, which greatly accelerates the processes of calcification, thus enabling their host corals to construct massive colonies. The hexacorals from other orders of the subclass Hexacorallia: Corallimorpharia, Antipatharia and Ceriantharia, include some species of the order Zoanthidea as well as most octocorals of the subclass Octocorallia, and are colonizing animals. They also produce hard skeletons or hard elements from calcareous material, and thus participate in the production of crumb lime material (Sorokin, 1995).

The communities of scleractinians inhabiting on coral reefs over the world consist of almost 800 species, which belong to ca.110 genera and 18 families. Most of scleractinians live in warm waters where the temperature does not drop below 18-19 ° C. They can be found at a depth of 80-100 meter and are limited by light, which they need for symbiotic zooxanthellae. The composition and diversity of scleractinians vary according to different reef areas and regions (Sorokin, 1995).

Hard corals are classified in Phylum Cnidaria, Class Anthozoa, Subclass Zooantharia, Order Scleractinia or Madreporaria (Sorokin, 1995). Suborder Faviina consists of seven families, Faviidae, Trachyphyllidae, Oculinidae, Meandrinidae, Merulinidae, Mussidae, and Pectinidae (Ditlev, 1980; Veron et al., 1977; Veron, 1986, 2000). The Faviidae is one of the most diverse families of hermatypic corals. Among $\simeq$ 800 species coral of hard corals worldwide, Faviidae contains 126 species belonging to 24 genera. It is the largest group in terms of genera and rank next to the Acroporidae in term of number of species and overall abundance in most reef biotopes throughout the Indo-Pacific (Veron et al., 1977; Veron, 1995)

The corals in Family Faviidae construct colonies of massive form. Colonies formed by extra-tentacular budding or intra-tentacular budding. Corallites are varied, that consist of phaceloid, plocoid, cerioid or meandroid with exsert and dentate septa, paliform lobes are commonly developed. Similar Families are Merulinidae, Trachyphyliidae and Mussidae. The majority of faviid genera are easily recognized because they are composed of a small number of species, which have a number of distinctive characters in common (Veron, 1986, 2000). Identification characteristics of corals in Family Faviidae are present in Figure 1-2.

Reproduction

Corals reproduce both asexually and sexually. Asexual reproduction in corals includes several processes by which one coral colony forms additional, colonies through the separation of tissue-covered fragments or through the shedding of tissue alone. Sexual reproduction is more complex, and requires the fusion of two gametes, egg and sperm, to form embryos which develop into free-swimming planula larvae.

1. Asexual Reproduction

Asexual reproduction in corals is helpful to separate colony growth from the formation of new colonies. Colonies grow through the asexual process of budding, during which new polyps form. Additional polyps can form when one polyp divides into two (intra-tentacular budding), or sometimes a new mouth with tentacles can simply form in the space between two adjacent polyps (extra-tentacular budding). If the polyps and tissue formed by these asexual processes remain attached to the parent colony, the result is considered growth and is seen as an increase in colony size. If polyps or buds are detached from the parent colony and give rise to new colonies, we consider this to be asexual reproduction. New coral colonies can be formed by asexual reproduction in several ways (Birkeland, 1997).

1.1 Fragmentation

Fragmentation is common among finely branched or relatively thin plating corals. Corals fragments may detach from parent colonies as a result of wave action, storm surge, fish predation on associated animals, or other sources of physical impact. If a fragment lands on a solid bottom, it may fuse to the surface and continue to grow through budding.

1.2 Polyp bailout

Pieces of living tissue may leave the underlying coral skeleton, and through the use of cilia that cover the outer surface, swim and drift in the water column until coming into contact with an appropriate surface for settlement and attachment.

1.3 Parthenogenesis

It is possible that coral larval may arise from unfertilized eggs, through a process known as parthenogenesis. While eggs are produced, they are not fertilized by sperm, but develop directly. This asexual mechanism for production of embryos has been observed in plants and many clonal organisms.

2. Sexual Reproduction

Unlike asexual reproduction that produce exact copies of the parents, sexual reproduction offers two opportunities for new genetic combinations to occur: (1) crossing over during meiosis in the formation of eggs and sperms, and (2) the genetic contribution of two different parents when an egg is fertilized by a sperm. These serve to add genetic variation to populations, which may lead to enhance survival of a species.

In general hard corals can be gonochoric or hermaphroditic. If a species has separate males producing sperm and females producing eggs, it is said to be gonochoric. If, however, a single individual of a species is capable of producing both eggs and sperm, it is said to be hermaphroditic. Corals display two distinct modes of reproduction that differ in the way the gametes come into contact with each other. Sexual reproduction of corals can be classified depending on mode of reproduction as brooding species and spawning species. In brooding species, eggs are fertilized internally, with the embryo developing to the planula stage inside the coral polyp. Alternatively, spawning species release eggs and sperms into the water column, where subsequent external fertilization and development take place. The difference between the two modes of reproduction influence many aspects of coral ecology. Including the transfer of symbiotic algae to the larvae, the period during which larvae possess the ability to successfully settle and metamorphose (competency), dispersal of larvae, biogeographic distribution patterns, genetic variability, and even rates of speciation and evolution (Richmond, 1990)

The planula larvae of most scleractinian corals spend some time in the water column before setting. Certainly, coral dispersal and settlement patterns are largely determined by the duration of the planktonic phase. Brooded planulae may settle quickly within a few hours or slowly within a few days after release from their parent polyps. In contrast, externally developed planulae require a minimum 4 days planktonic period until settlement (Yeemin, 1998). It depends on 1) the prevailing hydrological conditions, 2) the competency period of the planulae, 3) their vertical distribution in water column and 4) their substratum selection and choice of settlement site. Most of faviid corals are hermaphroditic spawners (Birkeland, 1997).

Colony sizes and growth rate

1. Colony size measurement

The population structure of coral species has been little studied in the field, presumably because of the extreme requirements of underwater survey efforts to collect-colony-size data (Meester et al., 2001). However, it has been addressed mostly in demographic studies that include modeling of population growth, general conclusions may be drawn from the shape of the populations under several conditions. Soong (1993) analyzed population of Carribean corals (Panama) from similar depths using a linear scale and found populations were skewed to the right, i.e., with most colonies relatively small and only a few large colonies. The method of measuring colony size: he used maximum width times maximum length. Whereas Meesters et al. (2001) measured length, width, and height and approximated the colony to geometrical shape. Also, they suggested that ignoring height in calculating colony surface area has tremendous influence on surface area estimations. Furthermore, this effect is species-dependent and basically the consequence of the general morphology of the species concerned. However, some studies measurements of colony diameters and surface area were recorded from photographic (Brown et al., 1986; Hughes and Connell, 1987). Endean et al. (1997) determined the size of each massive colony, their measurement was of the greatest horizontal extent of the colony and the second was made normal to the first through the mid-point of the colony, again in the horizontal plane. Then average of these yielded as the average diameter of the colony. van Wosik and Done (1997) studied each coral colony was allocated to one of four size classes based on maximum diameter: 1-50 cm, 51-100 cm, 101-300 cm and > 301 cm. While Sakai (1998) examined the relationship among colony size polyp size and egg production of *Goniastrea aspera*, he grouped the colonies into three size classes: small (S$\leq$ 60 polyps, or $\leq$ 4.5 cm in mean colony diameter), medium (M; 60-150 polyps, or 4.6-9 cm) and large (L; >150 polyps, or > 9 cm). In this study maximum diameter were measured and grouped into 5 size classes, 1-10 cm, 11-20 cm, 21-40 cm, 41-60 cm and > 60 cm, respectively and calculated surface area by using maximum width and colony geometrical surface.

2. Colony size-frequency distribution

2.1 Colony size relate to age

Although colonies rarely exceeded to 40 cm in diameter, a wide range of sizes was found in most faviid species. However, the most abundance sizes were the first-three sizes. Because of the very low growth rates ($\leq$ 0.5 cm in diameter/yr) of most colonies and because the majority of colonies of most species had diameters greater than 10 cm, their ages appear to span decades (Endean et al., 1997).

The difficulties of relating size of coral to age are well known and the actual ages of the colonies in the study area could not be determined. Although some colonies showed mean annual increments consistent with published radial growth rate of approximately 5 mm/yr (1 cm in diameter/yr) for species of *Platygyra* and *Goniastrea* (Babcock, 1985), many colonies did not show detectable changes in size within the limits of experimental error and some colonies had definitely regressed in size (Endean et al., 1997).

Hermatypic corals are clonal modular organisms and their life cycle is complicated by fragmentation, fission, fusion and partial mortality. Brown et al. (1986) indicates fusion resulting from, a) possible previous partial mortality of a colony which has subsequently recovered and where lateral growth has reunited separated parts of the colony, and b) from individual recruits, presumably of the same genotype, which settled down in close proximity to one another. Overgrowth of one colony by another was also noted. Individuals of similar size may differ greatly in age (Meesters et al., 2001). The importance of size rather than age in determining the fate of an organism has received much attention recently. Morphology, physiology, trophic relationships and ecological niches, among others, are all directly or indirectly affected by size and, no doubt, size has always played an important role in evolution (Soong, 1993).

Many aspects of the dynamics of coral population have recently been related to colony size. For example, relative rates of growth in colony area decrease with increasing colony size. Similarly, whole colony mortality also declines sharply among larger colonies. In contrast, rate of partial mortality (shrinkage) and fission of colonies increase with size. Much less to know concern the role of colony age because of the difficulties of accurately estimating it without damaging the colony (Hughes & Connell, 1987).

Meesters et al. (2001) addressed in almost all studies that deal with population structure, colony-size classification is linear and distribution are very skewed to the right according to Brown et al. (1986). Most life-history variables in coral ecology, however, vary exponentially with colony size. Bak and Meesters (1998) suggested that using a logarithmic scale to construct size-frequency distributions might be more appropriate for the study of populations. If exponential growth rates are normally distributed and new recruits are of equal size or normally distributed, the size distribution of plants after a period of growth will be log normal distribution. However, Loya (1976a) stated coral colonies often have sigmoid growth curves, indicating that early growth is exponential. Since the patterns of relative abundance, the size-frequency distributions, arise from the interplay of many independent factors, distributions are likely to be log normal distribution. Furthermore, although size and age are not directly related in corals, they should be strongly correlated if partial mortality is low, such as in small corals (Meesters et al., 2001).

Hughes and Connell (1987) showed that size effects are stronger than age effects but that colony age often has a significant influence on dynamic, even within a single size class. In addition, they found every size class contains both young and old colonies. Mortality depended greatly on colony area; the size effect was highly significant for all three taxa (*Acropora*, *Porites* and *Pocillopora*). In contrast, they found no significant effect of age on mortality. Their data showed that 25% of old colonies (older than 4.5 yr) were killed but that almost all larger than 50 cm^2 survived (colony measured from 1 m quadrate photographic). Thus, most of the old colonies that died were also small. Relative growth also declined with increasing age, regardless of initial size. They rejected the hypothesis of equal growth rates for old and young colonies (greater than or less than 4.5 yr, respectively). Overall, young colonies of *Acropora* and *Porites* were four times more likely than older colonies to increase their area by more than 100% whereas older colonies were twice as likely to compress. *Pocillopora* colonies showed the same trended to have insufficient numbers of young colonies. The simultaneous classification of corals into age and size categories shows that colonies of the same age often vary greatly in size (and vice versa).

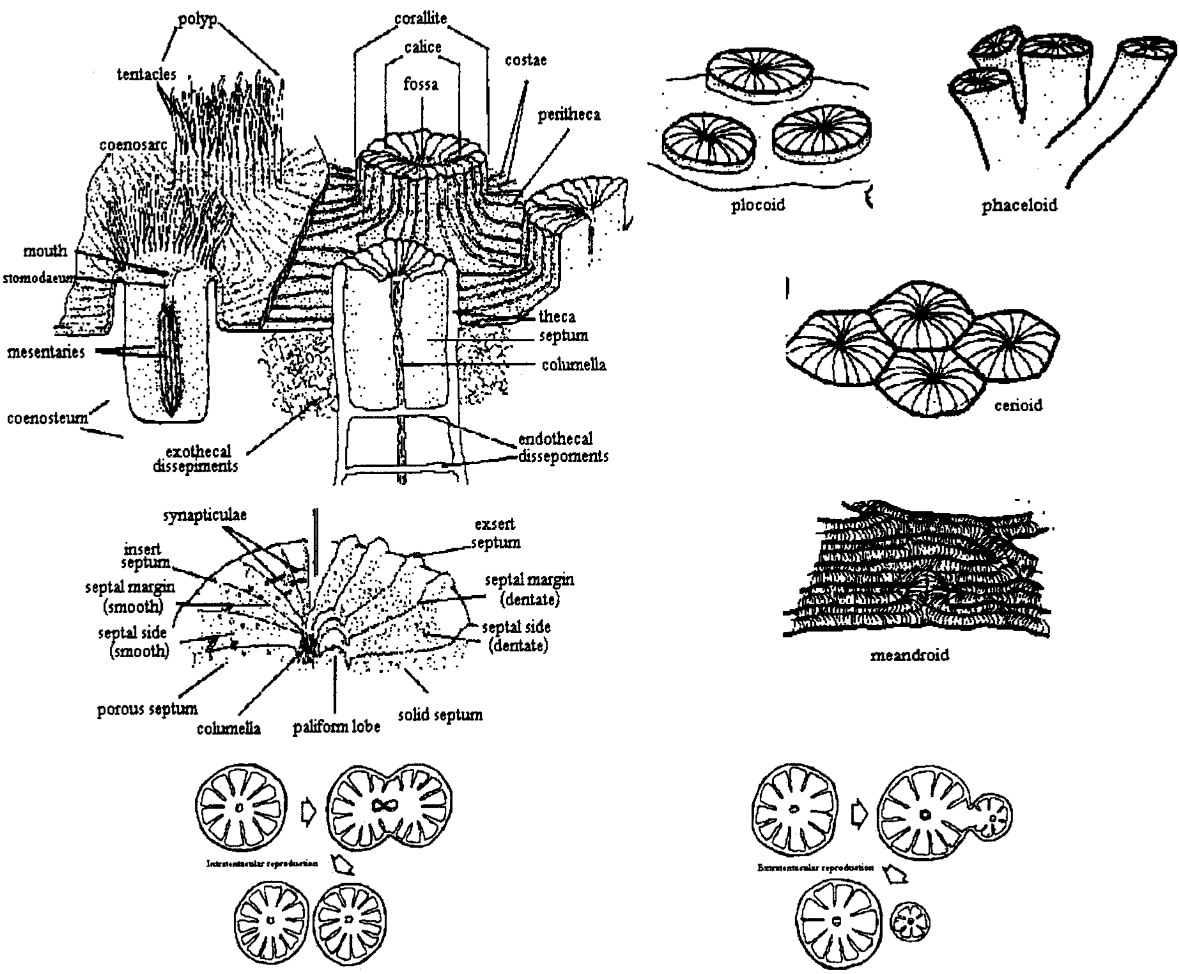
2.2 Colony size and reproductive strategy

Sakai (1998) found egg production of *Goniastrea aspera* was affected by colony size, polyp size and budding mode. The colonies became actively reproduce at a size of 60 polyps, and the polyp volume of the reproductive colonies was significantly larger than that of the pre-reproductive colonies. In massive coral colony, polyps in the central area contribute to colony growth, increasing the surface area of the colony. However, large colony size cannot be attained without expansion of the attachment area as well. As a colony becomes bigger, its total fecundity becomes greater with an increase in the number of fecundity, non-marginal polyps play a role in promoting high colony fecundity (Sakai, 1998). Correspondingly, Soong (1993) stated within species of scleractinian reef corals, rates of total colony mortality are inversely related to colony size. Total growth potentially increases with increasing colony size, along with competitive and regenerative abilities. Total fecundity also generally increases as coral colonies become bigger.

Between species, reef corals obviously vary greatly in their colony size structure and maximum colony size; but the relationship between life history characters and size of coral species has not been well studied. Colony size at first reproduction seems to increase with increasing colony size of the species (Soong, 1993).

Small species start reproducing early. They brood larvae and have relatively high rates of recruitment. Large species, on the other hand, delay reproduction until they reach larger sizes, since continuous growth is less likely to be interrupted, whereas the short generation times of small species may be favored in unstable habitats. Hence, size in massive coral is an important species character that correlates with many reproductive traits. It is very likely that other life history characters and perhaps evolutionary rates could also be related to the size structures or maximum size of coral species (Soong, 1993).

Identification characteristic of Faviidae



Intra-tentacular budding

Extra-tentacular budding

Figure 1 Coral skeleton and corallites form of Faviidae: Wood (1983)

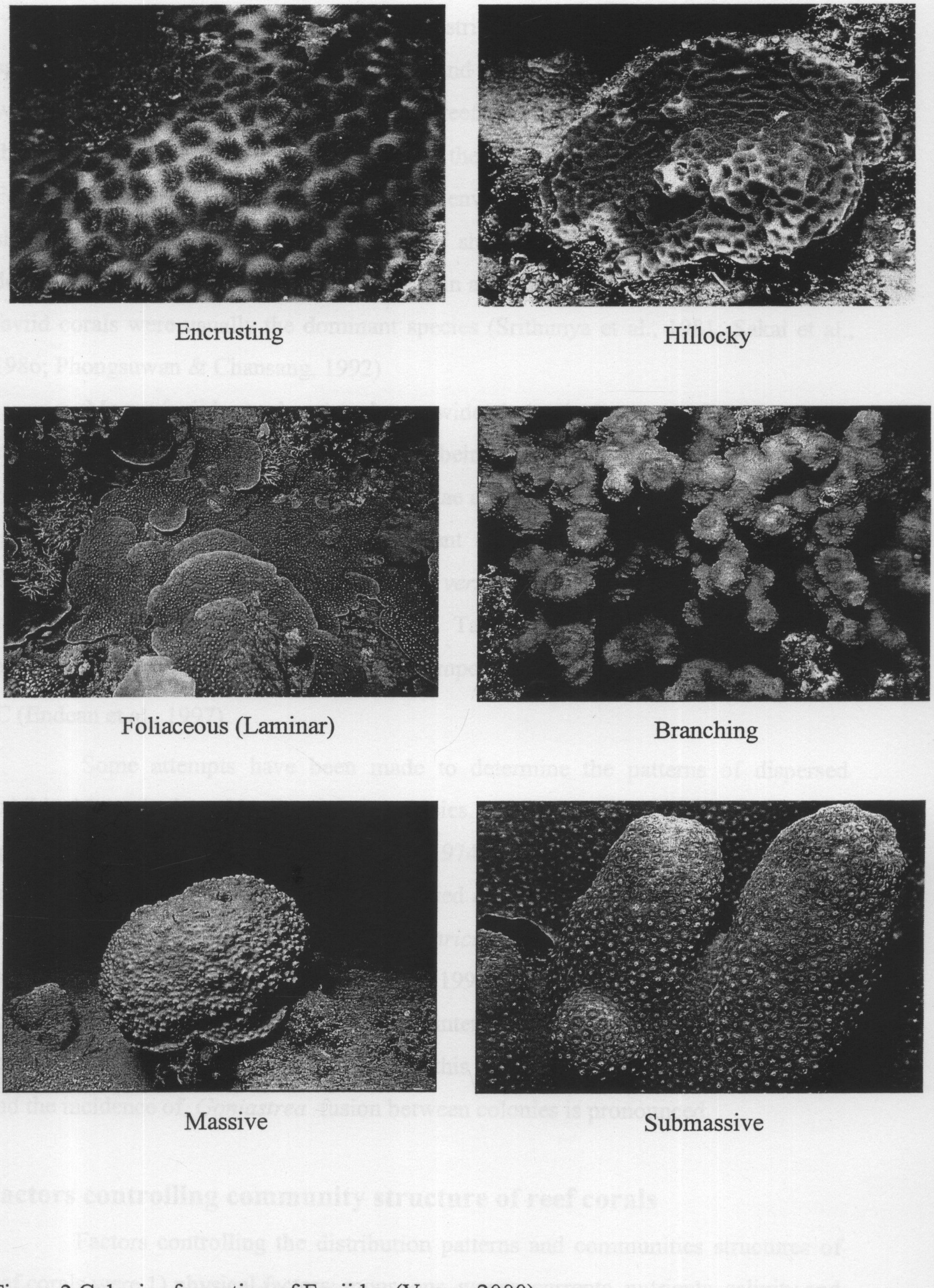


Figure 2 Colonies formation of Faviidae (Veron, 2000)

Distribution

Most faviid species are widely distributed across the Indo-Pacific. Some species are restricted to inter-tidal habitats and upper reef slope, which occur over a wide range of environments. In many coral reef sites the most abundant species with the greatest area covered were usually from the families Acroporidae, Poritidae, and Faviidae. These species occur in different environments ranging from distance to shore to the degree of human impact. Off shore coral reefs in clear water were dominated by *Acropora* species. In contrast, in areas with higher turbidity *Porites* and faviid corals were usually the dominant species (Srithunya et al., 1981; Sakai et al., 1986; Phongsuwan & Chansang, 1992)

Many faviid corals also have wide latitudinal range. Colonies from subtropical localities are usually distinct, being relatively heavily calcified when compared with tropical localities. The Faviidae are also widespread, with a number of species living in the warm Kurashio current along the coast of Honshu (Japan). However, the widely distributed *Plesiastrea versipora* is exceptional in being a truly eurythermic species being found between Tanabe-Wan, Japan and Bass Strait, Australia, where the annual mean surface temperature are approximately 28 ° and 16 °C (Endean et al., 1997).

Some attempts have been made to determine the patterns of dispersed exhibited by colonies of particular coral species. Colonies of most species showed an aggregated (clumped) dispersion. Stimson (1974) found that colonies of *Pocillopora meandrina* in Hawaii were uniformly dispersed and Abel et al. (1983) examined that Caribbean corals *Siderastrea siderea* and *Agaricia agaricites* had abnormally uniform or regular dispersions (cited in Endean et al., 1997). Brown et al.(1986) found the size structure of *Goniastrea favulus* among the intertidal corals around Ko Phuket, abd found the largest colonies where densities of this species are high (30 colonies per m^2) and the incidence of *Goniastrea* fusion between colonies is pronounced.

Factors controlling community structure of reef corals

Factors controlling the distribution patterns and communities structures of reef corals were 1) physical factors; monsoons, waves, currents, nutrients, salinity and turbidity of water; 2) social factors: formation of monospecific, interspecific and reproductive pattern and 3) natural disturbance and anthropogenic disturbance; for example the extreme events of coral bleaching.

1. Physical stresses

1.1 Monsoon and sedimentation

Lara et al. (1992) studied zonation and community of Veracruz coral reefs in Mexico where the coral reefs are in an area with high concentrations of river sediment. They suggested that the location, diversity, coverage and topographic complexity of the reefs are influenced by dynamic interaction between turbid fresh or blackish water from rivers and currents of marine water. Lara et al. (1992) found the zonation forms band perpendicular to the dominant currents in the offshore reefs. This pattern is probably the combined result of wind, currents and sedimentation unique to the Veracruz region. Different reefs have different scleractinian species richness, diversity, living corals and topography. Dominant Southeast wind in Veracruz induces coastal currents that interact with the river deltas. It is postulated that the variability in the spatial patterns of sediments is the main cause of the variability in the development of the leeward slope of Veracruz coral reefs.

The topography of reefs in the Inner Gulf of Thailand is governed by Southwest wind and under the similar condition as Veracruz reefs (Lara et al., 1992). A numbers of physical factors as mentioned above are the consequence of the differences in diversity and complexity of coral assemblages in each part of the Gulf of Thailand. Chansang et al. (1992) found that growth of *Acropora formosa* during the rainy season was less than in the dry season. This is in agreement with the finding on growth of *Acropora formosa* in the southern part of Phuket (Charuchinda & Helleberg, 1984). Chansang et al. (1992) suggested that light may be an important factor in controlling such growth, as light intensity during the rainy season is less than in other seasons.

1.2 Wave and current

Shallow subtidal habitats, including coral reefs are frequently dominated by wave-induced oscillatory flow, which prevents the formation of a steady-state boundary layer. As depth increase, depending on local geography, large-scale currents (tidal, drift) and wind-driven surface flow become increasingly important. In habitats with strong wave action, is benefit to passive suspension feeders such as corals, which rely on particles moving from the water above the substratum down to coral capture surfaces. Development of a thick boundary layer over organism surface may, in fact, in habitat particle, dissolve gas or nutrient movement across that layer. For at least some coral species, low flow speeds decrease the rate of prey encounter and capture, although species not relying on zooplankton capture (e.g. plating corals) may capture more particles at low speeds by gravitational deposition of particulates. Strong near-substratum flow, however, can also mean the increased probability of organism dislodgment; acceleration forces dominate during wave surge, for example, and the force differential experienced by sessile organisms acts to break them or remove them from the substratum (Sebens & Done, 1992).

They also suggested the hypotheses:

1. Water flow acts directly as a major selective force to determine the composition of coral assemblages on different part of a coral reef.

2. Following major disturbance, the effects of selection by flow regime may become obscured by differences in the rate at which certain morphotypes increase their bottom coverage.

3. In the absence of major disturbance, compensatory processes of recruitment, growth and mortality may result in a more constant mix of growth forms over long periods of time.

Sebens and Johnson (1991) note that certain corals with large polyps and elongate tentacles have difficulty keeping the tentacles extended, and thus feeding in high flow, whereas stubby branches with small polyps capture more particles with increasing flow because the down stream tentacles are not deformed substantially, and particle capture is thus very successful in turbulent eddies behind tentacles. In fast flow, therefore, tentacles assist each other rather than interfere. Porter (1976) explained similar morphological patterns base on photosynthetic arguments (branching and small polyps as optimum for photosynthesis in high light regimes, shallow). Although the logic of this explanation is compelling, it appears that feeding in rapid flow (e.g.; shallow habitats) is also enhanced by coral morphology.

Mundy and Babcock (1998) stated that phototactic responses of coral planulae are not limited to simple recognition of light/dark extremes. For planulae of some coral species, the spectral composition of the light environment is clearly as important as light intensity for settlement and metamorphosis (e.g. *Goniastrea favulus*, and *Montipora peltiformis*). Additionally, settlement of coral planulae my not be linearly related to either intensity or spectral quality. Planula from the con-generic corals *Goniastrea favulus* and *Goniastrea aspera* which have similar adult distribution patterns, restricted to shallow reef flat habitats show contrasting response to variation in intensity and spectral quality of light. Settlement density of *Goniastrea favulus* decreased in response to a shift from shallow water light spectra to deep-water light spectra. In contrast, settlement density of *G. aspera* decreased in response to decreasing light intensity, but was independent of spectral quality. These results indicate that optimal light environment for settlement of coral planulae could be species specific. Moreover, species in the same genus with similar vertical distributions cannot be assumed to respond in a similar manner.

Mundy and Babcock (1998) found few planulae of *Goniastrea aspera* or *Platygyra daedalea* settled down on vertical plate sides under all light treatments. This appeared to be in response to a preference for cryptic settlement sites by these planulae (positive thigmotaxis). Planulae of *P. daedalea* and *G. aspera* were observed to preferentially settle in grooves and indentations, particularly under the high and medium light intensity treatments. Babcock and Mundy (1996) also found light-dependent selection on settlement plate surface in the field and in laboratory aquaria, in the absence of confounding factors such as sediment, grazing or biotic cues. However, the ecological function of such behavior in planulae of species with restricted depth distributions is unclear, and may only benefit species which occur over wide depth ranges, such as *P. daedealea*.

Some reports indicated that *Oxypora lacera*, *Platygyra daedalea*, *Goniastrea aspera*, and *P. sinensis*, juvenile mortality with depth is not consistent with adult depth distributions. Bax and Engel (1979) reported that species composition of juveniles was identical to adult distribution patterns at a range of depths. If adult distribution is not determined by post-settlement mortality, as indicated in refer reports, larval behavior before and at settlement may be a primary factor in establishing depth distributions of coral species (Mundy & Babcock, 1998).

2. Social factors

The contribution of competition among corals and other benthic organisms has received considerable attention. Sheppard (1979) showed that competitively aggressive species dominate certain zones in the Chagos Atolls. Chadwick (1991) demonstrated this among three species of ahermatypic corals and a corallimorph off California. The effect of dominance hierarchies and networks on zonation patterns in difficult to demonstrate, especially in the species-rich reefs of the western Pacific.

The existence of space among the major benthic categories (hard-corals, soft corals and *Porites*) found in the sites is not surprising given the abilities of members of these groups to interact either via sweeper tentacles, mesenterial filaments, and allelopathy. Also, corals and soft-corals have been shown to redirect their growth away from the region of contact (Licuanan & Bakus, 1992).

The anisotropic pattern found is important, suggesting some sort of "downstream-upstream" factor in the site responsible for the patterning. Water movement would be the most likely cause of such anisotropy. Tidally induced long shore currents are very strong in the Puerto Galera, Philippines. Conceivably, these currents mediate dispersion of allomones, the direction where in mesenterial filaments or sweeper tentacle act, or recruitment patterns (Licuanan & Bakus, 1992).

The essentially random arrangements among benthic fauna in the deeper transect, could be due to the lower cover in this site leading to reduce interactions. How differences in the wave-disturbance regime (e.g. position within an embayment) relate to the interactions found on a broader scale was mentioned by Licuanan and Bakus (1992).

3. Natural disturbance and anthropogenic disturbance

3.1 Coral bleaching

The impacts of the 1998 bleaching event will not be fully understood for some time. However, it is clearly that reefs will be modified as the result of this bleaching event. In short term (< 5 years), reefs formerly dominated by branching species will be dominated by non-living substrate supporting only a low percentage cover of living corals of which the majority will be massive species (Zahir, 2000).

The post bleaching studies show that only small amount of living coral cover remains on the reefs (Zahir, 2000; Turner et al., 2000; Rajasuriya &

Karunarathna, 2000). In common with many other reefs through the Indo-Pacific region, the massive and sub-massive corals survived the mass mortality, particularly *Porites*, *Goniopora*, *Acanthastrea* and *Diploastrea*. Branching and tabular *Acropora* and branching *Pocillopora* were mostly dead and are now either standing or reduced to rubble (Hashimoto et al., 1999; Zahir, 2000; Turner et al., 2000; Rajasuriya & Karunarathna, 2000). Dead standing coral is brittle and is reduced in storm waves causing abrasion. Calcareous algae, zoanthids and corallimorpharians are binding rubble in shallow waters in sheltered sites (Turner et al., 2000). In the Gulf of Thailand we could found dead standing corals and binding zoanthids and corallimorpharians at Saket Island Rayong Province, Ao Tean Tao Island Surat thanee Province, for example.

Two years after mass mortality event, Turner et al. (2000) found that recruitment to the degrade reefs is patchy and low, with 35% of the sites surveyed showing no recruitment. In particular, recruitment is low for fast growing *Acropora* and *Pocillopora* (<20 recruits per hactare at most sites) that used to dominate the reefs. Recruitment that has occurred is greatest on more sheltered reefs in bay and may be related to suitable consolidated substrate. Recruits are vulnerable to fish and sea urchin predation and to breakage, abrasion and removal during storms (Turner et al., 2000). As a consequence of this study in the Inner Gulf of Thailand faces a number of problems for example, a high density of sea urchin (Yeemin et al., 1998), low salinity and sedimentation (Sakai et al., 1986; Manthachitra, 1994).

The reef assemblages in the Gulf of Thailand appear to have experienced the greater mass mortalities of corals in the Pacific Ocean following the 1997/98 bleaching event, probably because they are mostly shallow (<10 m. depth).

3.2 Predator: Acanthaster planci

Some reefs in Thailand that had experienced on *Acanthaster*-predated. In the mid 1980's, many of the reefs of the Adang-Rawi Island Group, Tarutao National Park, Satun Province, were severely damaged. There was markely increase in population density of *Acanthaster planci* resulting in extensive predation of the reef on the north coast of that island (Geater et al., 1987). The eight years following *Acanthaster*-predation, Geater et al. (1994) found a living coral cover just about 10%. Continuing structural changes in the substrate in the years following predation may also have contributed to the poor rate of coral recolonization. Immediately after predation the coral skeletal structure of the reef, though largely abiotic, was largely intact, and included large areas of branching and tabulate *Acropora*. Throughout the subsequent succession of settlement, the dead coral branches have repeatedly broken resulting in a slow collapse of the substrate and a lowering of the reef profile. Many young newly settled coral colonies might have been unable to survive such mechanical distributions (Geater et al., 1994). However, there has not yet been reported the *Acanthaster* damaged reef in the Gulf of Thailand. Even though, *Acanthaster* damage did not occurred in the Gulf of Thailand but the dead coral branches due to coral bleaching event were subsequent the succession ability of settlement

3.3 Anthropogenic disturbance

Many of diverse reefs in the Gulf of Thailand have been badly degraded and will require even greater protection if they are to recover. Fishing gear, boat anchors and especially sedimentation and siltation from coastal development activities continue to place many of these recovering reef at risk (Sudara & Yeemin, 1997).

Patterns in population structure in relation to the reef's position and environmental setting

Endean et al. (1997) found that in many cases the sites considered most heavily degraded had the largest mean colony size. Measuring massive colony size or coral cover, interpreting larger measurement as positive signals, can obscure a decline in reef quality. Mean size can be the same or even increase, because populations shift toward dominance by older (larger) individuals. Small colonies do not contribute much to total cover. However, in this study colony sizes in their populations there were small to medium sizes.

van Wosik and Done (1997) determined whether such proposed differences in (ecologically) long-term dynamics can be recognized in a survey of community structure and size frequencies over a large number of well developed and incipient reef (reefs with narrow reef flat) in a wide range of environmental settings in the southern of Great Barrier Reef. There were markedly differences among the regions in reef development, taxonomic composition and densities of all major benthic groups. They found in region where reefs were large and well developed supported on average 21.7% coral cover and higher than average densities of colonies in all 13 scleractinian families recorded, particularly, Faviidae, Poritidae and Acroporidae. The densities of *Porites* spp. and faviids were well above average of colonies. In region where the incipient reefs overall, average coral cover was 12.8% and corals tended to be small. Moreover, densities were below average in the genus *Acropora* and those of families Faviidae and Pocilloporidae. By contrast, they were above average in encrusting *Montipora* spp. and *Porites* spp. This region was strongly dominated by arborescent colonies.

In this study, could be classified coral assemblages into three types of reef developed. For example, coral assemblages were large and well developed such as reef at Kram Island, Monnai Island. The incipient reefs in this study were Randokmai Islands, Eraa Island, for example. The coral assemblages where extensive reef flats on leeward shores and strongly dominated by *Acropora* were reef at Kudee Island, Singh Island and Sang Island.

van Wosik and Done (1997) found the region where reefs were developed supported higher densities of "slower-growing corals" and "arboresent corals" than incipient reefs region. Moreover, the "slower-growing corals" within the families Faviidae, Poritidae, Agariciidae, Mussidae, Siderastreidae, Caryophyllidae, collectively, all sizes of these corals (particularly 1-10 cm and 11-50 cm) were much more abundant in well developed reefs region than incipient reefs region. van Wosik and Done (1997) indicated that there were significant correlations between a site's taxonomic composition and three site descriptors: depth, distance to the mainland, and exposure. These correlations were significant only when taxa were defined to the level of genus. Pooling genera and species into their taxonomic families resulted in the loss of all significant correlations.

van Wosik and Done (1997) subdividing coral into their size classes resulted in significant correlations with two additional site descriptors: island location and mean annual tidal range. Surprisingly, "distance from river" and "shelf depth" were poorly correlated with taxonomic composition. Site ordinations based on scleractinian corals were negatively related to "depth" and positively related to "distance to the mainland". However the use of size classes in addition to taxonomy, there were two very strong correlations.

In this study, population of faviid corals was determined, however the patterns in population structure in relation to the reef's position and environmental setting not yet been studied. van Wosik and Done (1997) addressed that size classes of corals species at each study site probably resulted in correlations with two very strong correlations: a positive correlation with "distance to the mainland" and a strong negative correlation with "mean annual tidal range". However, the mean annual tidal range in the Gulf of Thailand is rather small. In addition to there the distance to the mainland and distance from river are correlated with the population of faviid corals in the Gulf of Thailand.

Coral Reefs in Thai Water

The coastal zone of Thailand consists of coastlines along the east and the west coast of the Gulf of Thailand and the coastline along the Andaman Sea, these belonging to 24 provinces. The total length of the Thai coastline is 2,871.6 km.

1. The East Coast of the Gulf of Thailand

The east coast of the gulf of Thailand can be divided into two parts. The inner gulf shaped as "ก ". There are four major rivers that flow into the inner part of the Gulf of Thailand; mangrove forests dominate most of the costal areas of the inner part of the gulf. However, several islands in the inner part of the gulf harbor scleractinian corals. The inner most islands, Sichang Islands, has an unique type of coral reef community. The major factor that affects coral growth in this area is freshwater runoff and flooding from land during the rainy season. After Sichang Islands, there is Pattaya, which consists of Lan and Phai Islands. The coral communities around these islands have been damaged by activities from tourism south of Pattaya. The area of Sattaheep is controlled by the Royal Thai Navy and the coral communities are in relatively good condition. On certain islands within this area, turtle conservation and coral rehabilitation projects have been performed. Some reefs around Sameasan Islands have been affected by military training over the past 20 years and by constant discharge of sewage from the city of Sattaheep and nearby small villages. (Poosuwan, 1999; Yeemin et al., 2001).

The outer gulf along the east coast, the coral communities around small islands in Rayong Province had been in very good coral condition but due to illegal dynamite fishing and increasing tourism, the coral communities of several islands are now damaged. Farther along the east coast to Chanthaburi most of the coastal area is a mangrove. However, coral reefs are found in a patchy distribution along the shore where there is no river runoff (Chaolaw Coral Beach) and around a few small islands. (Poosuwan, 1999)

There are many islands with coral reefs in Trat Province. The coral reefs in this area are well developed and in good condition. Recently anthropogenic disturbances, such as aquarium fish collection and local fishing by using toxic chemical are major causes of degradation. Some coral reefs are now totally damaged (Yeemin et al., 2001).

2. The West Coast of the Gulf of Thailand

The inner part of the west coast consists of mud flats and is without coral reefs. There are many offshore islands; such as Talu Islands, Chumphon Islands, Samui Island, Tao-Pangan Islands along the west coast from Prachuap Khiri Khan Province, Chumphon Province, Surat Thani Province and southward along the coast. Coral reefs in this part of the Gulf of Thailand are exposed to storms. The branching growth form of *Acropora* spp. was the most dominant in a few small islands in Prachuap Khiri Khan.

At Chumphon, coral reefs are the best developed on the east side of islands. There are many islands with corals in good condition. Further south to Surat Thani, there are several islands which harbor well developed coral reefs. Samui Island, Pha-ngan Islands and Tao Islands are the famous tourist places and are undergoing severe degradation. (Poosuwan, 1999; Yeemin et al., 2001).

Previous Work on Coral Reef Assemblages in Thai Water

In general, studies on coral reefs in Thailand have been done since 1976. These studies have emphasized taxonomy (Ditlev, 1976, 1980; Jiravat, 1985; Phongsuwan, 1986), ecology (Sakai et al., 1986), distribution of coral assemblages (Srithanya, 1981; Siriratanachai et al., 1985) and other reef organisms (Ittiwiwat, 1990), anthropogenic impacts on reef ecosystems and coral reef management (Chansang & Phongsuwan, 1993).

1. Distribution of coral in Thai water

1.1 Gulf of Thailand

Srithanya et al. (1981) studied the distribution pattern of coral at Lan Islands. They found 48 species of scleractinian corals belonging to 23 genera and one species of Milleporidae (fire coral).

Sirirattanachai et al. (1983 a, b) studied the condition of coral reefs on Raet, Yoh Ielao and nearby islands in the Sattaheep District. They addressed the deterioration of coral reefs in this area and claimed that it was caused by illegal dynamite fishing and sewage discharge from nearby villages.

Jiravat (1985) studied taxonomy of scleractinian and faviid corals collected from the Gulf of Thailand and found 14 families 46 genera and 90 species of the former and 12 genera and 20 species of the latter.

Sakai et al. (1986) investigated the distribution and community structure of hermatypic corals in the Sichang Islands. He reported the coral reefs in this area were dominated by *Porites lutea* in terms of area covered and number of colony. Eighty-five species of scleractinian corals and one species of fire coral (*Millepora* sp.) were found. There were 30 species belonging to 12 genera of faviid corals found in this study.

Kongjandtre and Manthachitra (2001) studied species and distribution of faviid corals in Chonburi and Rayong Province. Thirty-four species belonging to 12 genera of faviid coral were found.

1.2 Andaman Sea

Ditlev (1976, 1978) studied stony coral from the west coast of Thailand. He found 183 species of scleractinian corals belonging to 65 genera 17 Family. There were 17 genera 55 species of faviid corals.

Phongsuwan (1986) studied scleractinian coral at Adang-Rawi Islands; he recorded 140 species belonging to 47 genera 14 Family were found. There were 11 genera 26 species of faviid corals.

2. Environmental impacts on community structure of coral assemblages

Studies on population/community structure of coral assemblages are limited in Thailand, the recently study by Chantrarung (2002) being a notable exception. Most previous studies reported only the genera status of coral reefs and dominant species in each area. (Sudara et al., 1988, Brown et al., 1996; Yeemin and Sudara, 1998; Chevaporn et al., 2000). Some monitoring of coral communities has been followed in the Andaman Sea, especially around the coast of Ko Phuket which has been regularly monitored over 16 years (Chansang et al., 1981). Seasonal sea surface temperature (SST) has been monitored also in the past. Brown, Dunne and Chansang (1996) reported that monthly mean SST for the Phuket area for the last 50 years indicated the highest seasonal temperature of 30.3 °C was recorded in May of 1991 and 1995. The next highest seasonal SSTs were in 1988 and 1966 (30.11°C and 30.09 °C respectively in April). There were bleaching years of 1991 and 1995, however no bleaching was observed in 1988, thus, bleaching could be occurred when the SST up to 30.3 °C or higher (Brown et al., 1996).

CHAPTER 3
MATERIAL AND METHOD

Study area

This study was conducted on coral assemblages along the Gulf of Thailand, there were eight islands along the east coast Chonburi to Trat province and three islands from Prachuap Khiri Khan to Surat Thani along the west coast (Figure 3). In each, three reefs were selected. In each reef, two habitats were selected, mid flat (1-3 meter depth) and mid slope (3-6 meter depth), which differed in substrate types, depth and wave action. The term "site" was used to represent each habitat at each reef (Table 1).

The description of each reef is as follows:

1. East coast of the Gulf of Thailand

1.1 Sichang Islands

Sichang Islands are a group of islands in the inner part of the Gulf of Thailand and in Chonburi Province (Figure 4). They are 15 km. westward from Sriracha coastline. Mostly, the shoreline of KangKao Island and the small islands nearby consist of rocky cliffs and beaches. Coral assemblages extend 30 meter from rocky shoreline. In the westward of the islands have been governed by southwest monsoon in the rainy season.

1.2 Phai Islands

Phai Islands are under controlling of the Royal Thia Navy, which are located 25 km of Pattaya city and 12 km of Lan Islands (Figure 4). Shoreline differs between two sides of the island. In the northern and eastern side of the island the beaches are sandy and rocky. In the western part of the island is very steep rocky cliffs line to shoreline. Coral assemblages develop only on the northern and the eastern part, of the island, while in the western part corals grow on rock.

1.3 Kram Islands

Kram Islands are located 5 km westward from Sattaheep district and are controlled by the Royal Thai Navy. Coral assemblages develop on the northern and the eastern part of these islands because these sites are to the leeward in the monsoon season (Figure 4).

1.4 Samet and Kudee Islands

Samet and Kudee islands are in Rayong Province. Samet Island is located 8 km. southward from Ban Pae (Figure 5). Coral communities at Samet Island almost envelop around the island, except along the northern part and the sandy beaches along the eastern part of the island. Kudee Islands is located 10 km northward of Samet Islands.

1.5 Mon Islands

Mon islands are located 7 km. southward from Leam Tal in Klang District, Rayong Province. There are 3 islands in this group, which are arranged in a northern-southward direction, Mon Nok, Mon Klang and Mon Nai islands (Figure 5). These islands are received by river runoff from Pra-sae River.

1.6 Choalaw Beach

Choalaw beach is in Chanthaburi Province; coral assemblages in this area had been developed as a patch reef parallel to the shoreline with the distance of 300-1,300 meter from the shoreline. Each patch has diameter range between 50-500 meters wide with less than 5 meters deep (Figure 6).

1.7 Chang Islands

Chang Island is the second biggest island in Thailand next to Phuket. Coral assemblages developed at the northern, western and southern part of the island. While there has been limited corals growth in the eastern part, which receives by river run off from Vain River and sedimentation from the island itself. Chang Islands consists of many smaller islands around the large island (Figure 7).

1.8 Mark Islands

Mark Islands are those between Chang and Kud islands and consist of three big islands, Mark, Kradad and Rang islands as well as a number of nearby small islands (Figure 7).

2. West coast of the Gulf of Thailand

2.1 Talu Islands

Talu Island is the biggest island in Prachuap Khiri Khan Province. Talu Island and nearby islands; Singha Island and Sang Island belong to Bangsapan District (Figure 8). *Acropora* are the dominant species in this area.

2.2 Chumphon Islands

Chumphon is on the west coast of the Gulf of Thailand. There are approximately 50 islands in this area (Figure 9). Reef information is well developed in the eastern and southern part of the islands because these sides are in protected leeward from the northeast monsoon.

2.3 Tao Islands

There are approximately 100 islands belong to Koh Samui District, Koh Pa-ngan and Donsak District. Mostly, coral reef formation had occurred in the western and southern part of the islands, which is protected from the Northeast monsoon. Tao Islands consist of four islands located 70 km. far away from the mainland (Figure 10).

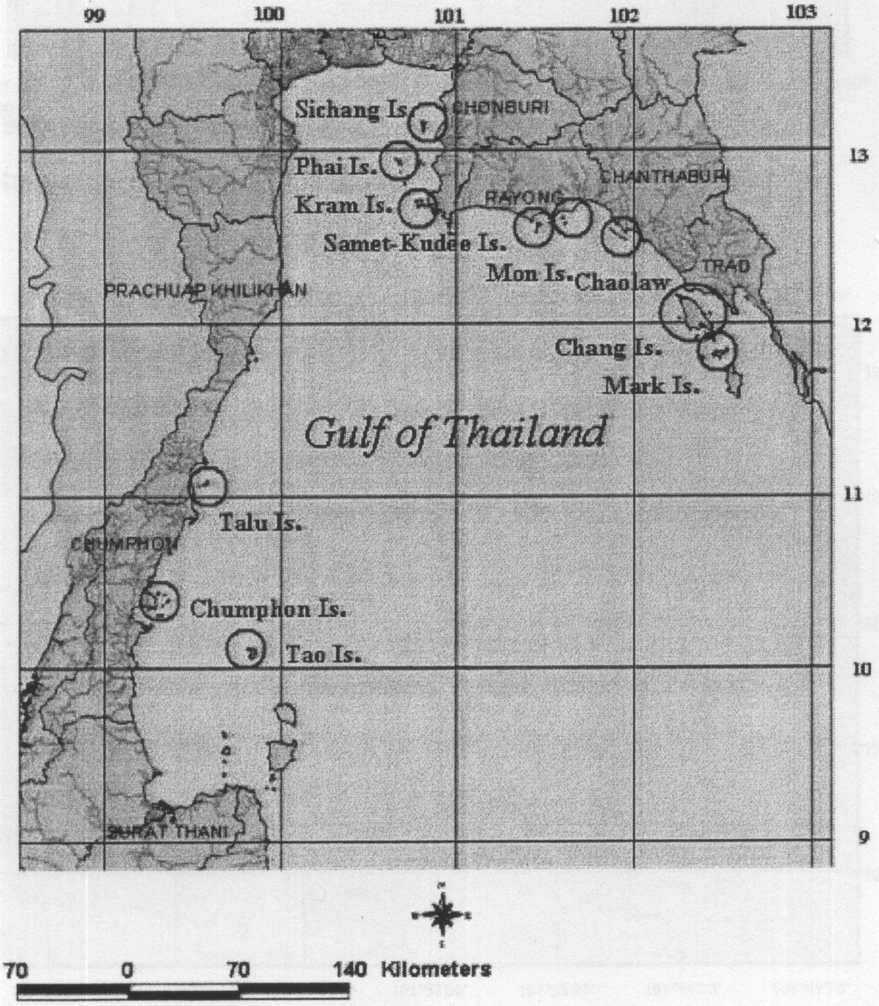


Figure 3 Study sites of corals in the Gulf of Thailand.

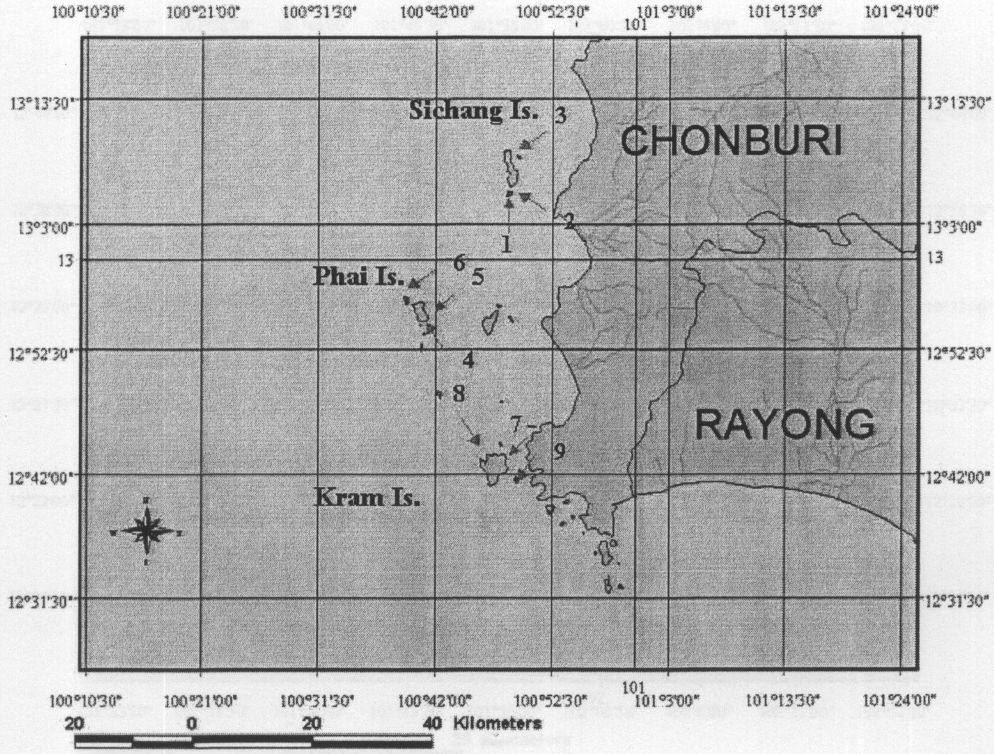


Figure 4 Study sites of corals in Chonburi Province.

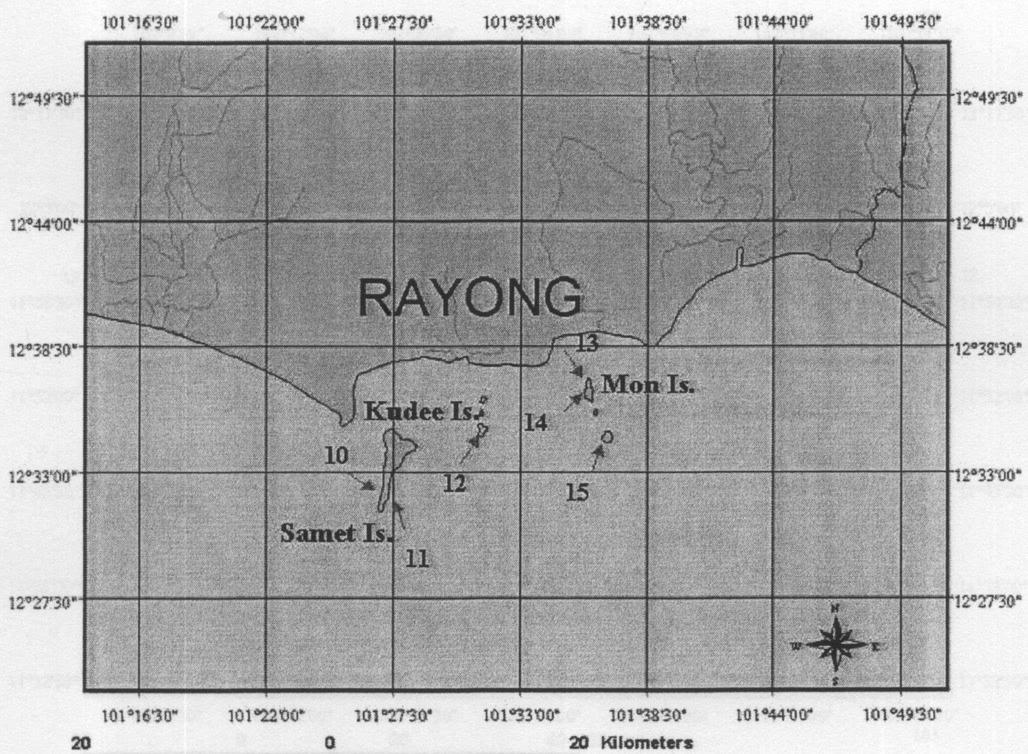


Figure 5 Study sites of corals in Rayong Province.

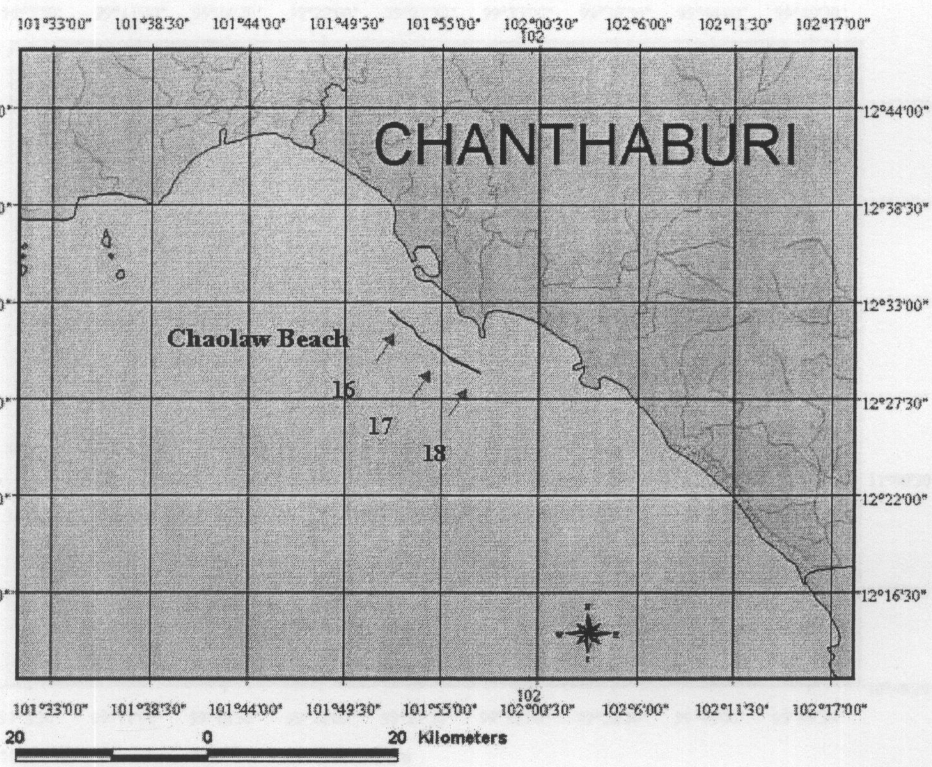


Figure 6 Study sites of corals in Chanthaburi Province.

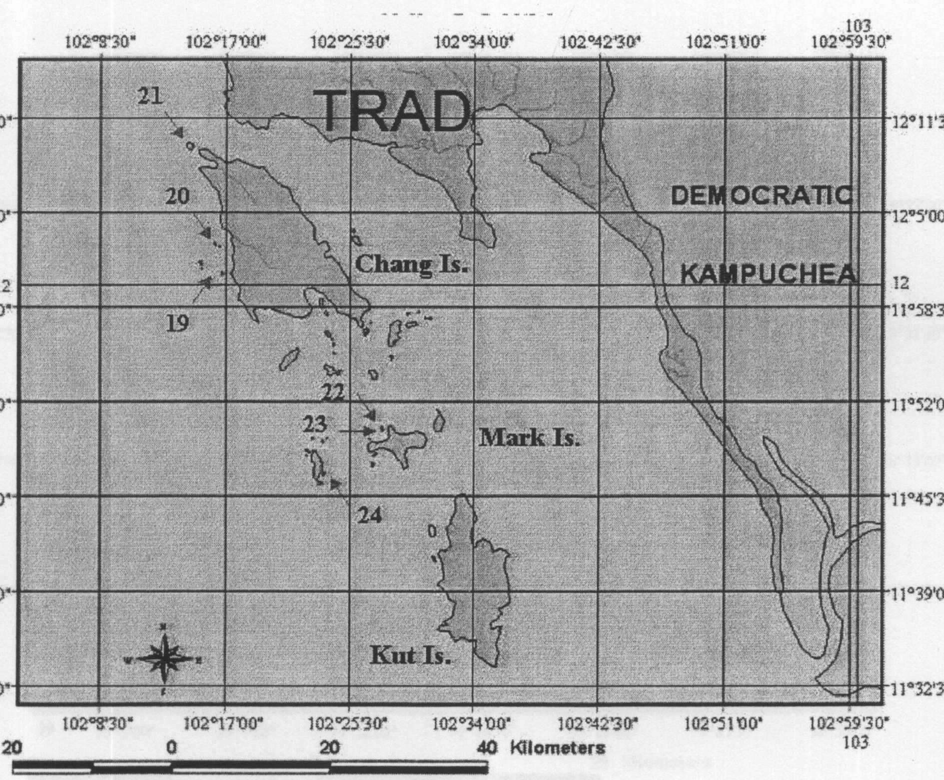


Figure 7 Study sites of corals in Trat Province.

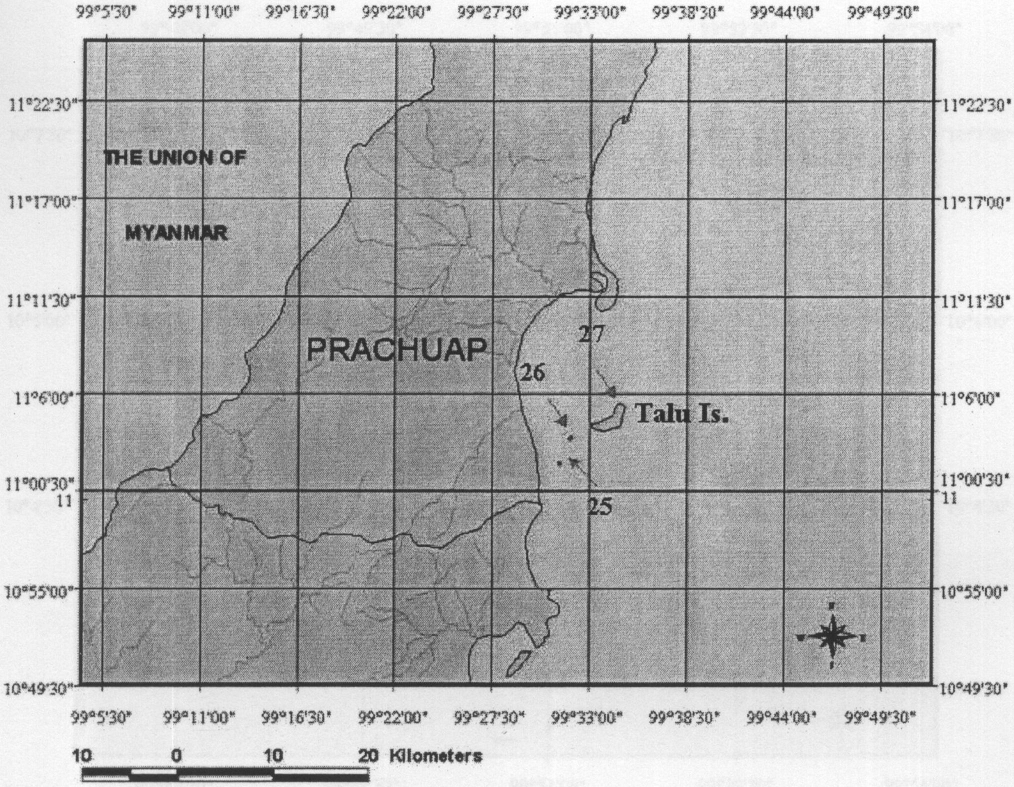


Figure 8 Study sites of corals in Prachuap Khiri Khan Province.

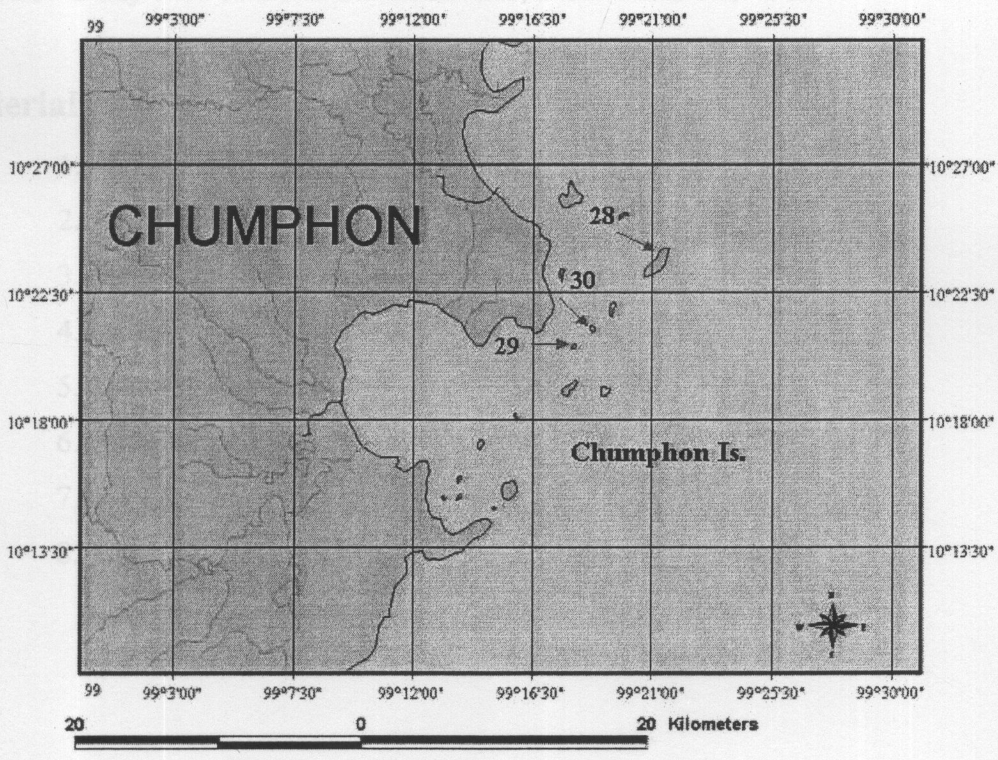


Figure 9 Study sites of corals in Chumphon Province.

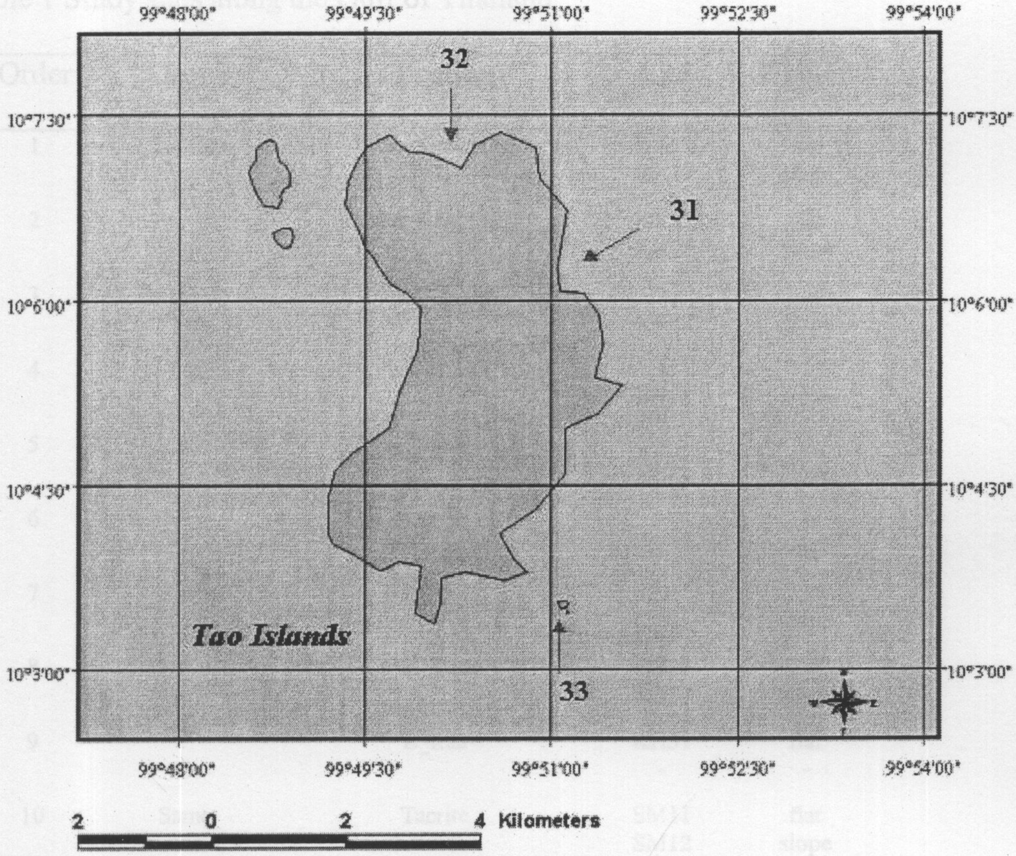


Figure 10 Study sites of corals at Tao Islands, Surat Thani Province.

Material

1. Measurement tape (30 meter long)
2. 1.5 meter T-bar
3. Slate board with pencil
4. Ruler
5. Scuba diving gear
6. Hammer and chisel
7. Bucket
8. Tag

Table 1 Study sites along the Gulf of Thailand

Order	Group	Location	Site	Habitat
1	Sichang	KangKao_St.C	KK11 KK12	flat slope
2		KangKao_St.E	KK21 KK22	flat slope
3		RanDokMai	- KK32	- slope
4	Phai	Phai (South)	- PH12	- slope
5		Phai (Tonglang)	- PH22	- slope
6		Learm	- PH32	- slope
7	Kram	Nah_Bann	KH11 KH12	flat slope
8		Pudsawan	KH21 KH22	flat slope
9		E_Raa	KH31 -	flat -
10	Samet	Tacrite	SM11 SM12	flat slope
11		Kiw Nok	SM21 -	flat -
12		Kudee	SM31 SM32	flat slope
13	Mon	Monnai_naban	- MU12	- slope
14		Monnai_Tonleab	- MU22	- slope
15		Monnok	- MU32	- slope
16	Chaolaw	101 55' 19.8" E 12 32' 13.6" N	- CL12	- slope
17		101 55' 20.9" E 12 31' 53.2" N	- CL22	- slope
18		101 55' 44.4" E 12 31' 32.8" N	- CL32	- slope
19	Chang	Monnok (Trat)	- CH12	- slope
20		Suwan	CH21 CH22	flat slope
21		ChangNoi	CH31 CH32	flat slope

Table 1 (continued)

Order	Group	Location	Site	Habitat
22	Mark	Kam	MA11 MA12	flat slope
23		Mark	MA21 MA22	flat slope
24		Rang	- MA32	- slope
25	Prachuap	Sang	PR11 PR12	flat slope
26		Singha	PR21 PR22	flat slope
27		Talu	- PR32	- slope
28	Chumphon	Matra	CU11 CU12	flat slope
29		Lawa	CU21 CU22	flat slope
30		E_Radd	- CU32	- slope
31	Tao	Hinwong	TA11 TA12	flat slope
32		Ao_Mung	- TA22	- slope
33		Gong_SaiDang	- TA32	- slope

Methodology

1. Taxonomic study

Coral specimens were collected along 120 meter transect parallel to the shoreline and cover all habitats (reef flat to reef slope). All species of coral in Family Faviidae were recorded and collected. Small colonies or a small portion (10x10 cm.) of healthy-looking specimens were carefully removed from the edge of colony with the aid of chisel and a heavy hammer, labeled with previously numbered tags and placed into bucket under water.

All specimens were placed in fresh water for 1-3 days for natural decomposition. To clean coral, water was used to remove coral tissue from the skeleton and then dried under sunlight.

Coral specimens were tagged and labeled with scientific name, collected location and province, date and collector. For example;

> CREST
>
> Ref. No…02/32……………………………….
>
> Scientific name:…*Platygyra daedalea*…………
>
> Location:…Rang Island, Trat Province ……….
>
> Habitat:…slope……………………………………..
>
> Date:…28 Apr 02 ……………………………………..
>
> Collector…Narinratana Kongjandtre……………

Coral skeleton were identified under a stereomicroscope. An identification and description of the species were carried out base on Veron et al. (1977) and Veron, (1986, 2000).

2. Population structure

The sampling design was under the multistage balance design; there were three factors consisting of islands (11 islands), reef (three reefs in each islands) and habitat (two habitats in each reef). There were four replications in each habitat (site). The sampling design is present in Figure 11.

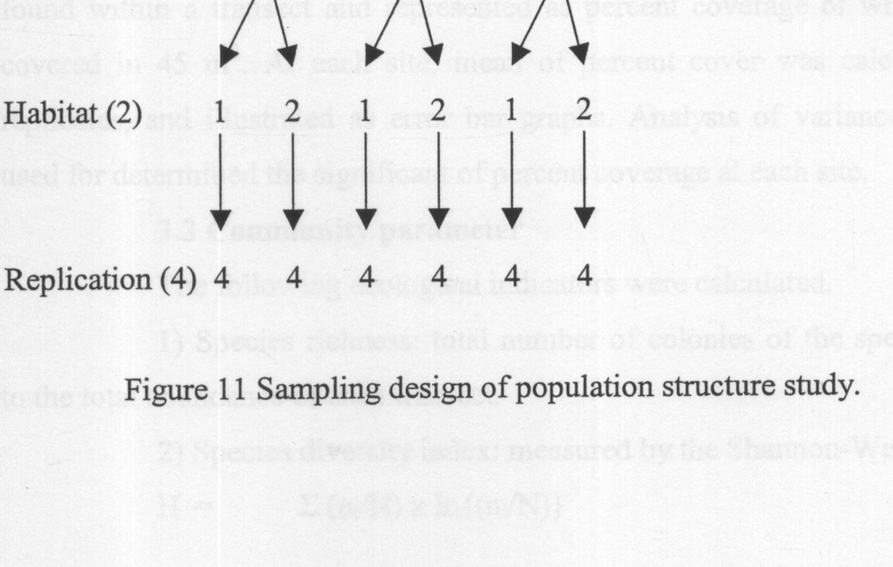


Figure 11 Sampling design of population structure study.

In each site, sample 4 random replicates of a 30 x 1.5 meter belt transect were allocated for a total area of 180 m^2 each. Transects were positioned with their long axis parallel to the shoreline and were separated by approximately 3-5 meter. On each transect, faviid corals were identified, measured colony size (diameter) and counted within transect.

Relative area covered was calculated by assuming each coral species is a massive form or encrusting form. Area of massive forms was calculated assuming the shape to be circular and measuring the colony's diameter as circle using colony diameter (¶ r^2). Area of encrusted form was calculated assuming the shape to be a square using the longest side in encrusting species (x^2).

3. Data analysis

3.1 Distribution of faviid corals

Distribution data were summarized in a table.

3.2 Colonies abundance and area coverage

3.2.1 Colony abundance

At each site, mean of total abundance of whole faviid corals was calculated from four replicates. Therefore, mean abundance of whole faviid corals at each site was expressed as colonies per 45 m^2. They were illustrated as range of standard error graph. Analysis of variance (ANOVA) was used to determined the significance of total abundance at each site.

3.2.2 Area coverage

Total area covered was summarized from area covered of each colony found within a transect and represented as percent coverage of whole faviid corals covered in 45 m^2. At each site, mean of percent cover was calculated from four replicates, and illustrated as error bar graphs. Analysis of variance (ANOVA) was used for determined the significant of percent coverage at each site.

3.3 Community parameter

The following ecological indicators were calculated.

1) Species richness: total number of colonies of the species with respect to the total abundance of each transect.

2) Species diversity index: measured by the Shannon-Weaver function.

$$H = \Sigma (n_i/N) \times \ln\{(n_i/N)\}$$

Where n_i = abundance of each species N = number of individuals

3) Evenness index:

$E = H'/H_{max}$ ($H_{max} = \ln S$)

To determined whether or not each site has the same species richness, diversity and evenness over testing factors; location, station and habitat, ANOVA (Nested or Hierarchy design) was applied.

ANOVA model as follows:

$Y = \mu + A_i + B_{j(i)} + C_k + AC_{ik} + BC_{jk(i)} + e_{ijkl}$

Where A = Island group,	i = number of groups
B = Location,	j = number of locations
C = Habitat,	k = number of habitats
e = replication,	l = number of replications

3.4 Coral composition analysis

Consideration on species composition of faviid corals, it was carried out in term of colonies abundance and area cover data. To examine whether or not each site had the same species composition over testing factors; group, location and habitat, Multivariate Analysis of Variance (MANOVA) was used.

Number of colony of each species was transformed in term of ln (x+1) and relative area cover was transformed in term of square root (x+1). To decrease the influence of a few dominant species that could over come common species, and to prevent the influence of rare species, these species were deleted from the data set. Therefore, the transformed value was emphasized on common species.

Principle Component Analysis (PCA) (Chatfield and Collins, 1980) was employed as a posteriori test for MANOVA to help identified the nature of any significant difference detected by MANOVA.

3.5 Population structure analysis

To examine population structure of faviid corals was considered from abundance of these species. The number of colony was counted and categorized as abundance species (> 400 colonies) and common species (100-400 colonies). Those species that contained less than 100 colonies were considered as uncommon and rare species. To prevent the influence of these species, they were deleted from the data set.

Colonies diameter was categorized into 5 categories as following; 1-10 cm., 11-20 cm., 21-40 cm., 41-60 cm. and > 60 cm.

MANOVA was used to test hypothesis that whether or not each species has the same size distribution over testing factors; group, location and habitat. Analysis of Variance (ANOVA) was employed as a posteriori test for MANOVA to help identified the nature of any significant difference detected by MANOVA.

For calculating, computer program SPSS 10.0 for window (Norusis, 1994) and PCORDWIN were used. For statistical analysis, a significant level of 0.05 was used through out the study.

CHAPTER 4

RESULTS

Key to genera of Family Faviidae

Key to genera of Faviidae

Corallum foliaceous → *Echinopora*

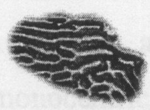
Corallum arboresent

Corallites plocoid → *Echinopora*

Corallum massive

Valleys meandroid

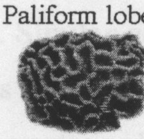
Paliform lobes and columella centers absent



Columella solid, wall-like → *Leptoria*

Columella a continuous tangle of spines → *Platygyra*

Paliform lobes and/or columella centers present

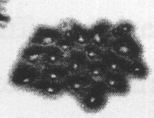


Valleys short, wide → *Oulophyllia*

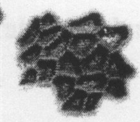
Valleys elongate → *Goniastrea*

Corallites cerioid

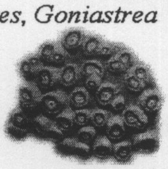
Paliform lobes absent → *Platygyra*



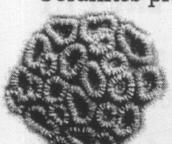
Paliform lobes present



Without center corallite → *Favites, Goniastrea*

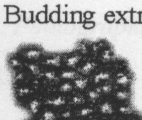


Corallites plocoid



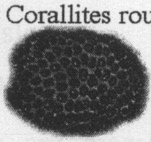
Budding intratentacular → *Favia, Barabattoia*

Budding extratentacular



Corallites angular (subplocoid) → *Leptastrea*

Corallites rounded, small (less than 3 mm in diameter)



Coenosteum costate → *Plesiastrea*

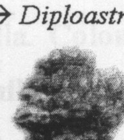
Coenosteum granulated → *Cyphastrea,*

→ *Echinopora*

Corallites rounded, large

Septa greatly thickened near wall → *Diploastrea*

Septa not thickened → *Montastrea*



Corallum black with white septa → *Oulastrea*

Species of coral in Family Faviidae

From this study faviid species found *in situ* were collected, and identified in laboratory. Coral specimens from previous study (Kongjandtre & Manthachitra, 2001) were also used with specimens from this study. Thirty-seven species were found and confirmed in laboratory with 33 undoubted species and 4 doubtful species (*Favia* cf. *truncatus*, *Goniastrea* cf. *aspera*, *Goniastrea* cf. *pectinata* and *Platygyra* cf. *contorta* and *Montastrea* cf. *salebrosa*). The description and remark on each species as follows.

1. Genus *Favia* Oken, 1985

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000).

Characters: Colonies are usually massive, either flat or dome-shaped. Corallite are mostly monocentric and plocoid. Daugther corallites are formed by intratentacular budding. **Similar genera:** *Favia* is similar to *Favites* but the latter has cerioid corallites. This distinction is sometimes arbitrary in which case *Favia* corallites are further characterized by subdividing equally, whereas *Favites* corallites usually subdivide unequally, producing daughter corallites of different sizes. *Favia* is distinguished from *Barabattoia* by having less exsert corallites and intratentacular budding.

1.1 *Favia matthaii* Vaighan, 1918

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/6; Kram Chonburi/ slope 99/9; Kram Chonburi/ slope

99/97; KangKao Chonburi/ flat

Characters: Colonies are massive and usually small. Corallites are crowded and circular with middle sized corallites (averaging 8-12 mm diameter). Septa are thickened, exsert or ragged, with large teeth near the wall. They have well developed paliform lobes forming a crown around the columella. **Colour:** Usually brown or grey with walls and calices of contrasting colours. **Similar species:** Readily distinguished from *Favia pallida* and *F. speciosa* by the exsert or ragged septa and paliform crown.

Discussion: These specimens are similar to holotype of *F. matthaii* illustrated in fig. 60-61(no.99/9) in the monograph by Veron et al. (1977); for this specimen septa are finely dentate. In addition, specimen no. 99/6 is similar to fig. 58-59 in this monograph except the corallites of this specimen are much more irregular and they are some thick and irregular primary septa.

The obvious variation among species occurred in the development of septa together with paliform crown. Specimen no. 99/97 tends to have thick and irregular primary septa. In addition, no. 99/97 has more indistinct paliform crown.

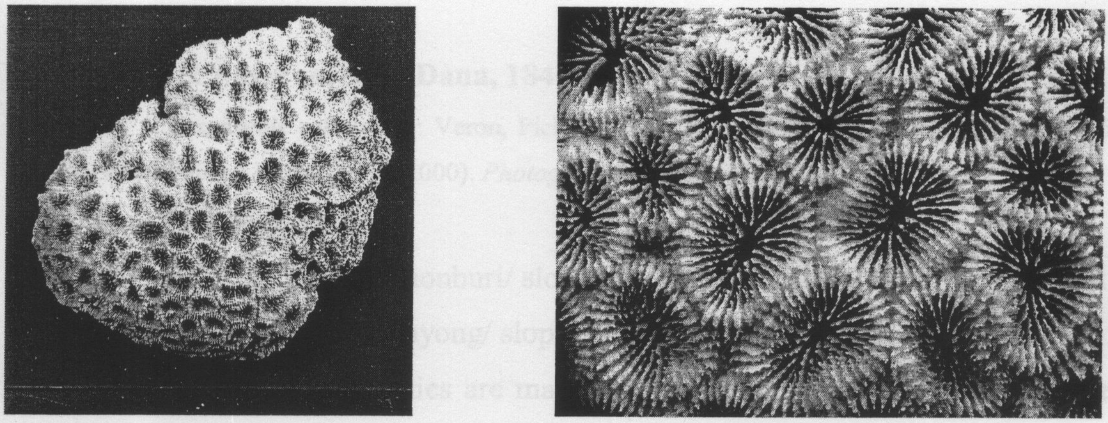


Figure 12 Specimen number 99/9 *Favia matthaii*

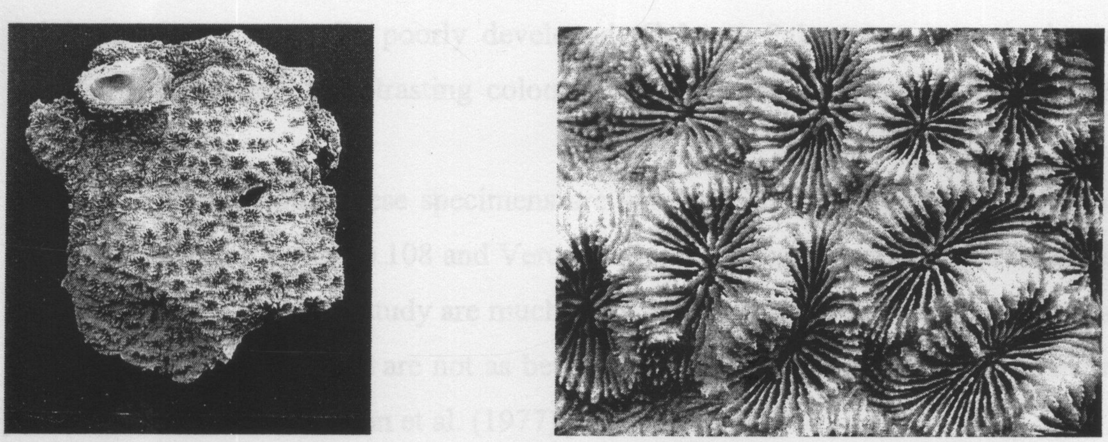
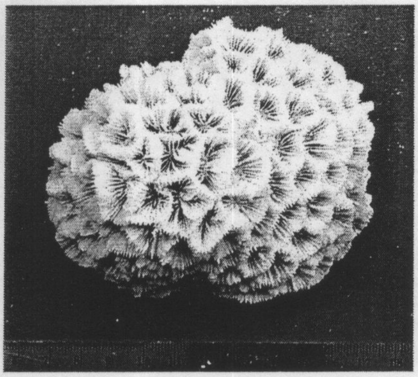


Figure13 Specimen number 99/6 *Favia matthaii*



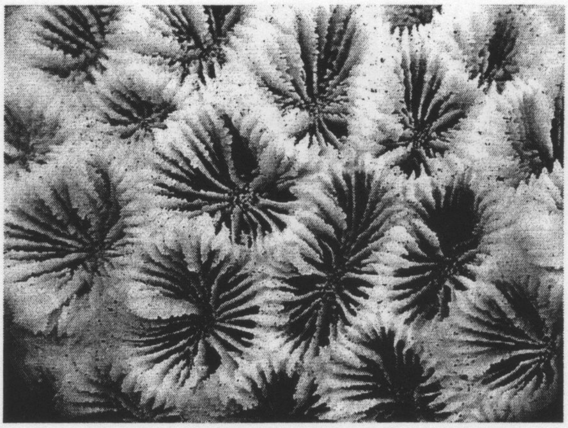


Figure14 Specimen number 99/97 *Favia matthaii*

1.2 *Favia speciosa* Dana, 1846

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/78; KramNoi Chonburi/ slope 99/162; KangKao Chonburi/ flat

99/164; MonNai Rayong/ slope 02/1; Kraboong Trat/ slope

Characters: Colonies are massive, with encrusting periphery. Corallites are circular with middle sized (6-13 mm diameter) and closely compacted in shallow water, more widely spaced in deeper water. Septa are fine, numerous and regular. Paliform lobes are usually poorly developed. **Colour:** Pale grey, green or brown usually with calices of contrasting colours. **Similar species:** *Favia pallida* and *F. truncatus*.

Discussion: These specimens are similar to the holotype of *F. speciosa* illustrated in Veron (2000) p.108 and Veron et al. (1977) fig. 45, except that corallites of the specimens form this study are much more crowded. Another character that also contrasts is these specimens are not as better developed paliform lobes than in *Favia pallida*, as described in Veron et al. (1977) p.36.

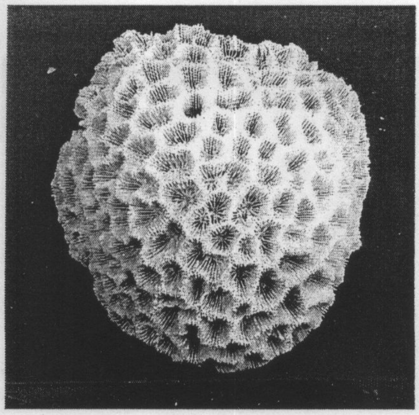
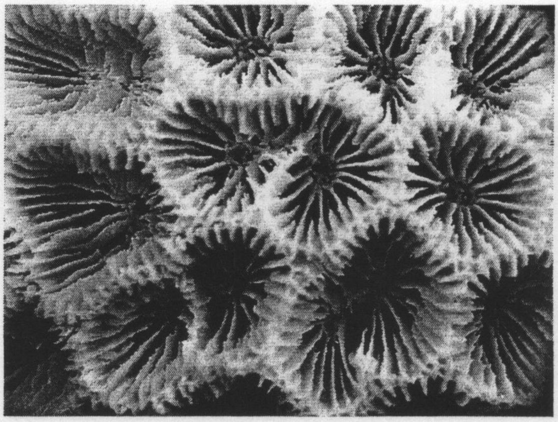
 

Figure15 Specimen number 99/162 *Favia speciosa*

1.3 *Favia* cf. *truncatus* Veron, 2000

Taxonomic references: none. **Identification guides**: Veron (2000). *Photographs*: Kampee Patisayna

Material studied:

02/5; Mark Trat/ flat

Characters: Colonies are massive, flat or hemispherical. Corallites are typically inclined on the colony surface, facing downwards on hemispherical surfaces. Corallites are middle sized (6-10 mm), corallites walls have sharp rim except for colonies from very shallow water, in which the lower part of the wall of inclined corallites is commonly immersed, giving the upper part a hooded appearance. Septa are widely spaced and irregular in size. Paliform crowns are well developed. **Colour:** Uniform yellowish-green or brown. **Similar species:** *Favia speciosa* and *F. pallida*, both of which have larger corallites with less exsert septo-costae. The inclined corallites, giving a hooded appearance, are usually make colonies recognizable underwater.

Discussion: The specimen of this species shows characteristics that fit well with those described by Veron (2000). However, more details are needed because this is a new species, which first described in Veron (2000).

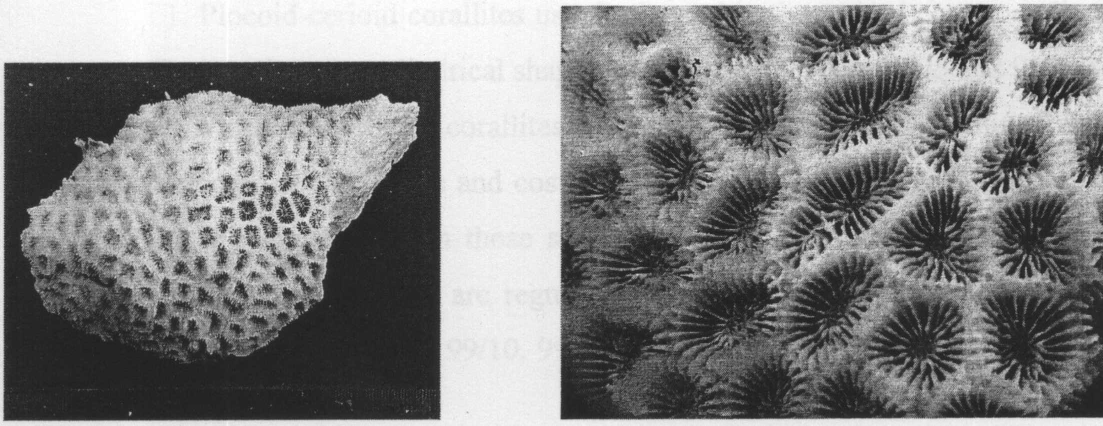


Figure16 Specimen number 02/5 *Favia* cf. *truncatus*

1.4 *Favia pallida* (Dana, 1846)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986).

Identification guides: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/1; Kram Chonburi/ flat — 99/2; Kram Chonburi/ slope

99/3; Kram Chonburi/ flat — 99/4; Kram Chonburi/ flat

99/10; Kram Chonburi/ flat — 99/19; Kram Chonburi/ flat

99/20; Kram Chonburi/ flat — 99/25; Kram Chonburi/ flat

99/76; KramNoi Chonburi/ slope — 99/77; KramNoi Chonburi/ slope

99/79; KramNoi Chonburi/ slope — 99/119; MonNai Rayong/ slope

99/126; MonNai Rayong/ slope — 99/159; Kudee Rayong/ slope

99/174; MonNai Rayong/ slope — 99/175; MonNai Rayong/ slope

02/2; Rang Trat/ slope — 02/3; Lim Trat/ flat

02/4; Rang Trat/ slope

Characters: Colonies are massive. Corallites are circular in medium sized (6-12 mm), closely compacted in shallow water, more widely spaced in deeper water. Septa are widely spaced and characteristically irregular. Paliform lobes are usually poorly developed. **Colour:** Pale yellow, cream or green, with dark brown or green oral discs. **Similar species:** *Favia speciosa,* which has more conical corallites with finer and more septa, which seldom has distinctively dark oral discs. *Favia truncatus* has corallites inclined on the colony surface.

Discussion: Variation of these specimens could be divided into 4 groups.

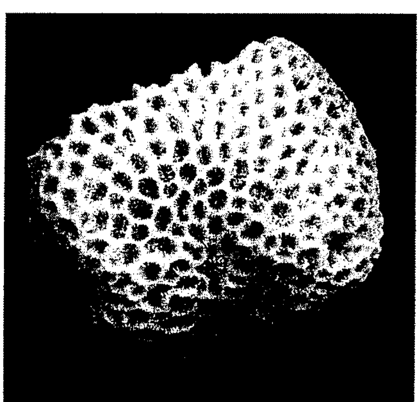
1. Plocoid-cerioid corallites usually have thin thecae and correspondingly thin septa. Their calices are cylindrical shape. (Specimens no.99/1, 99/25 and 99/76)

2. Plocoid corallites; corallites are usually circular and have thin skeletal structures including septa, thecae and costae. Calices being of shallow cone shaped, less crowded and shallower than those specimens in group1. Septation is variable among different colonies. Septa are regularly dentate. The columella may be very small. (Specimens no.99/2, 99/3, 99/10, 99/19, 99/20, 99/77, 99/119, 99/126, 99/174, 99/175 and 02/3)

3. These specimens are similar to group 2. However, thecae are thicker than those of group 2, septa are irregularly dentate and well-developed paliform lobe. (Specimens no.99/4, 02/2 and 02/4)

4. Corallites are irregular in shape and moderately exert. Septa, conspicuously exsert, are thicken along their outer margins and over thecal rim. (Specimens no. 99/79 and 99/159)

Veron et al. (1977) mentioned that this species is the most variable species of *Favia* on the Great Barrier Reef. *Favia pallida*, this intra-biotope variation usually included a wide range of corallite shapes and sizes, a wide rang of septal characteristic (including number, thickness, development of dentations, development of paliform lobes, degree to which they are exsert) and some variation in the structure and appearance of the thecae. Similar collections from other biotopes may have different range of skeletal variation, which readily allow confusion with other species, notable *Favia favus, Favia matthaii* and *Favia speciosa*.



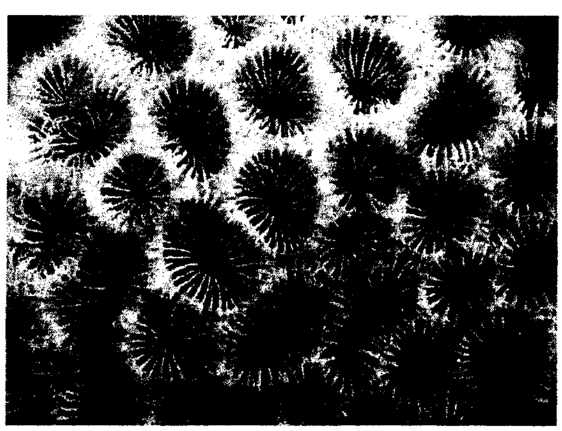


Figure17 Specimen number 99/76 *Favia pallida*

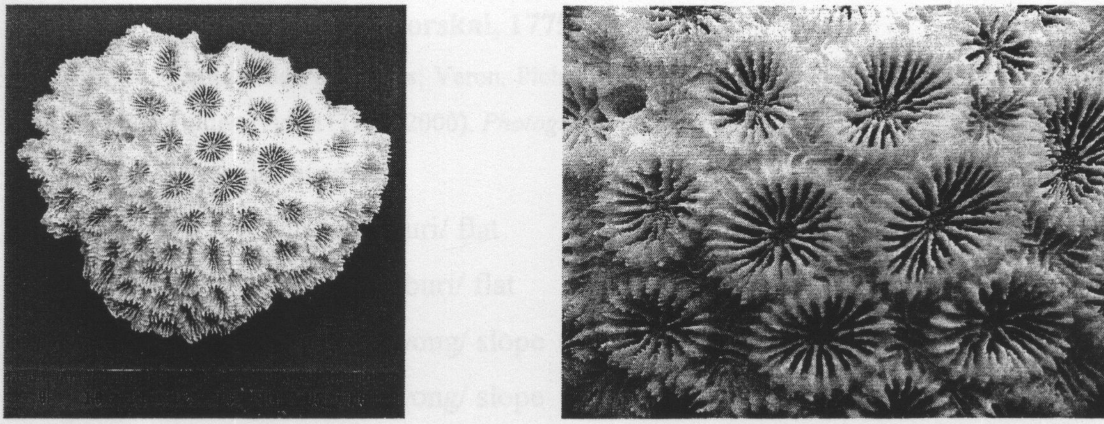


Figure18 Specimen number 02/3 *Favia pallida*

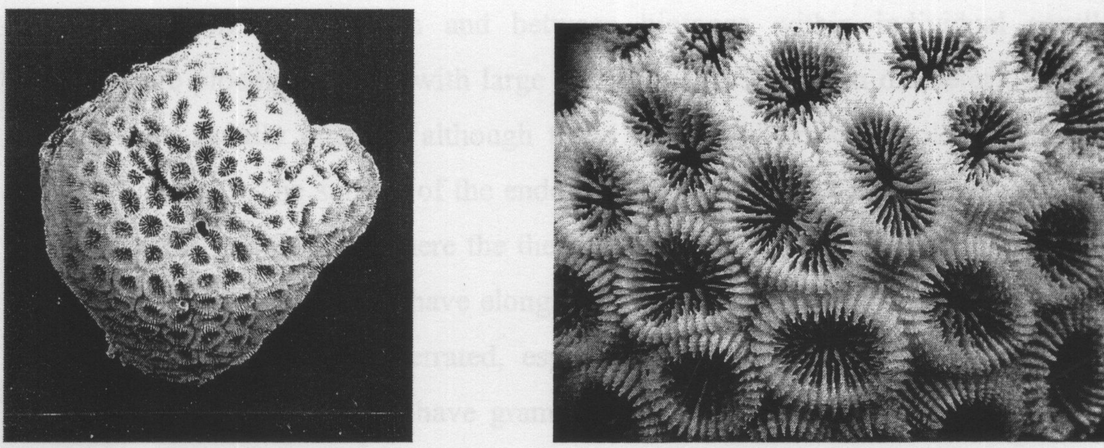


Figure19 Specimen number 02/4 *Favia pallida*

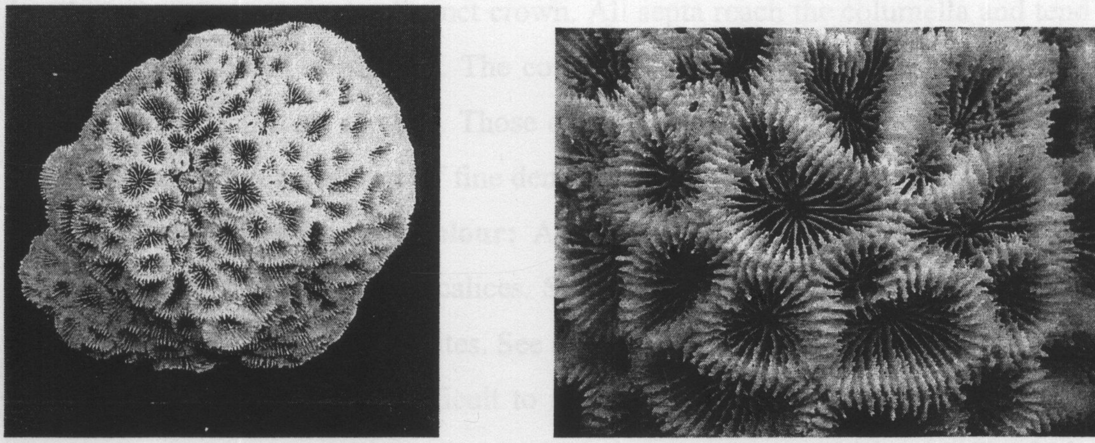


Figure20 Specimen number 99/159 *Favia pallida*

1.5 *Favia favus* (Forskal, 1775)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/5; Kram Chonburi/ flat	99/12; Kram Chonburi/ flat
99/17; Kram Chonburi/ flat	99/95; KangKao Chonburi/ slope
99/158; Kudee Rayong/ slope	99/160; Kudee Rayong/ slope
99/167; Kudee Rayong/ slope	02/9; Chang Noi Trat/ slope
02/10; KangKao Chonburi/ flat	

Characters: Colonies are massive, rounded or flat. Skeleton structures are very varying both within and between biotopes within individual coralla. Corallites are plocoid, conical with large corallites (12-17 mm in diameter). Conical corallites are usually circular, although those of rapidly growing colonies may be irregular in shape. The surface of the endotheca is almost always cylindrical. Calices are deep or (as in corallites where the theca is not exsert) shallow. Septa are usually not form distinct orders. They have elongated, irregular, inwardly sloping dentations. These dentations are finely serrated, especially their tips, which frequently form minute horizontal fans. Septa have granulated sides. Septa are normally thickened above the theca, and regularly exsert within the one corallite. The formation of paliform lobes is extremely vary among different coralla; some are hardly recognized, in others they form a single, distinct crown. All septa reach the columella and tend to form some sort of paliform lobe. The columella is small and trabecular. Costae are equal; intercostals ridges are rare. Those of adjacent corallites are frequently aligned. They always have regular rows of fine dentations. The coenosteum is usually blistered with exothecal dissepiments. **Colour:** A wide variety for example green, yellow, brown, often mottled, with pale calices. **Similar species:** *Favia speciosa,* which has smaller, and more compact corallites. See also *F. rosaria* and *F. maritima.*

Discussion: It is difficult to identify the specimens due to the variation among them such as corallites size, conical shape and septa thickness. The lack of specimens of the species variation to compare with them is such a confused situation. However, there are some specimens that corresponded with those described by Veron et al. (1977), i.e., conical corallites are usually circular but sometimes those of rapidly growing colonies corallites are irregular in shape. The surface of the endotheca is almost cylindrical. Calices are deep especially in corallites that the theca is not exsert (specimens no. 99/158, 99/160, 99/167, 02/10) and some colonies corallites are shallow with plocoid (specimens no. 99/5, 99/17).

Specimen no. 02/9 is obviously different from the others. Corallites are crowded and have low walls. Extra-tentacular budding is common. Septa have fine teeth and paliform lobes are inconspicuous. These corresponded well with *F. rosaria* however, this species was a new species described by Veron (2000) and did not occur in Thai water. It is a lacking in description and figure of the holotype to confirm the variation among similar species.

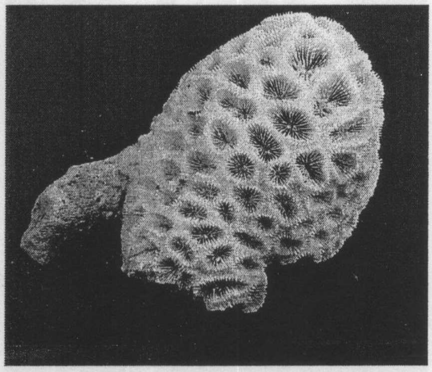
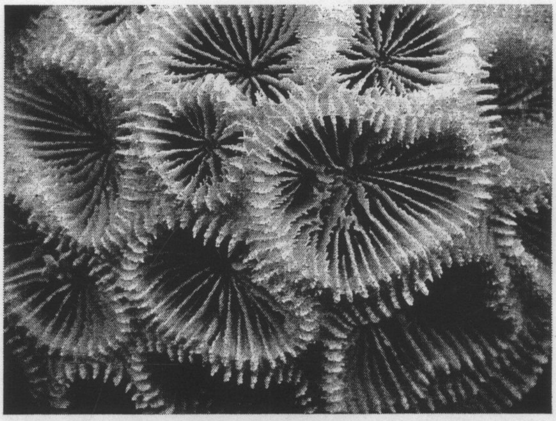



Figure 21 Specimen number 02/10 *Favia favus*

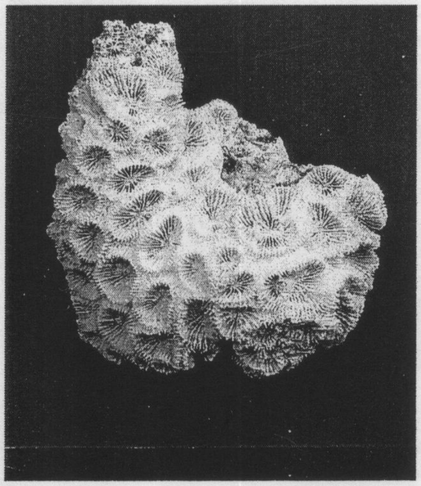
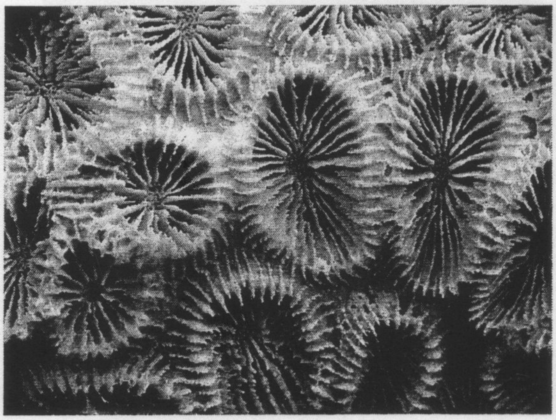



Figure 22 Specimen number 99/5 *Favia favus*

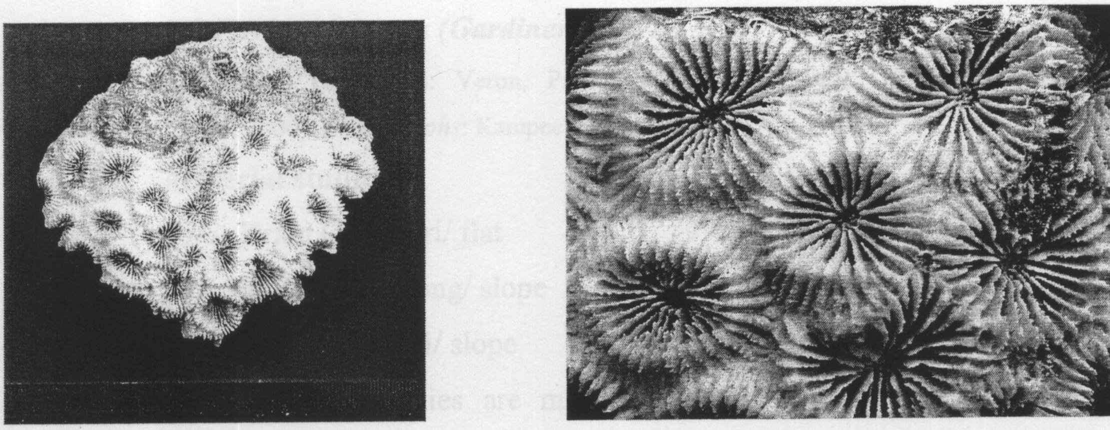
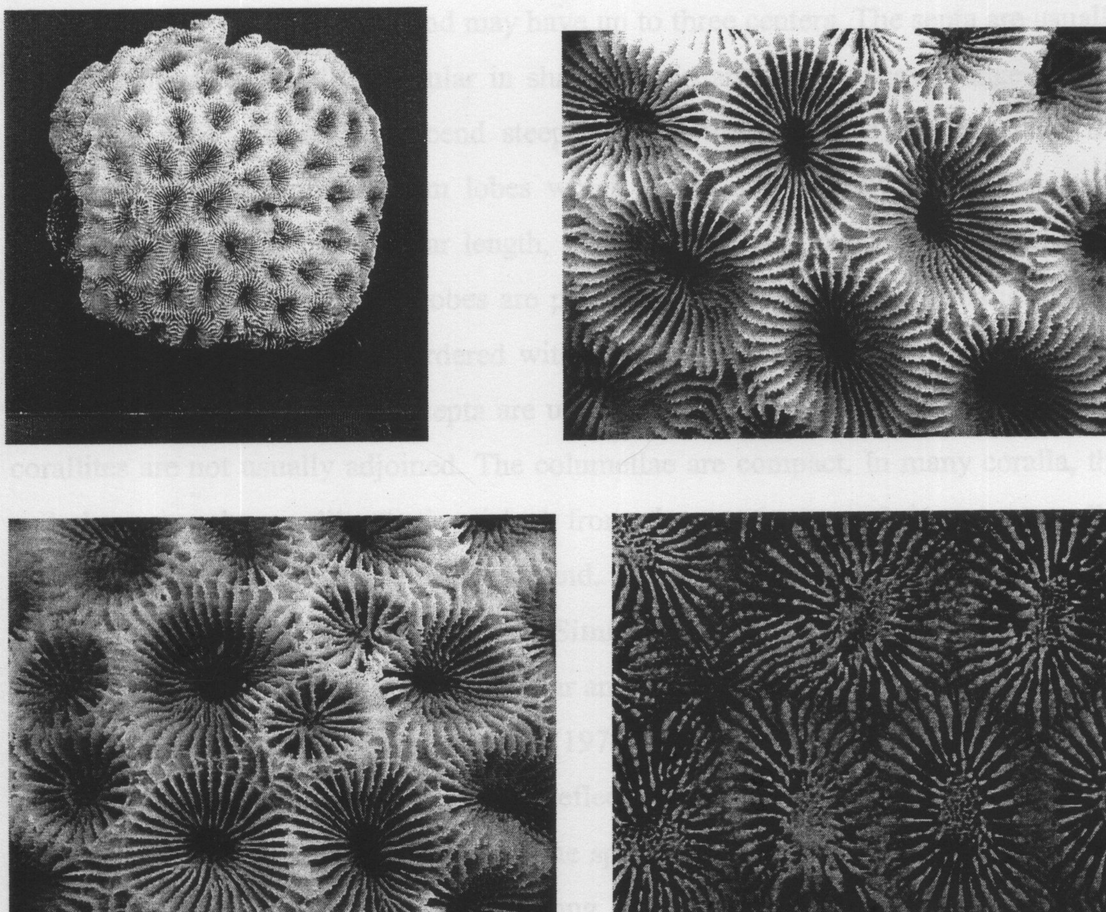


Figure 23 Specimen number 99/17 *Favia favus*



(Photograph *F. rosaria*: Veron, 2000)

Figure 24 Specimen number 02/9 *Favia favus* that corresponded to *F. rosaria*

1.6 *Favia rotumana (Gardiner, 1899)*

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/7; Kram Chonburi/ flat	99/11; Kram Chonburi/ flat
99/151; Kudee Rayong/ slope	02/6; Kra Nakhon Si / slope
02/7; Kra Nakhon Si/ slope	02/8; Kra Nakhon Si / slope

Characters: Colonies are massive, usually rounded, cerioid to sub-plocoid. Corallites are typically irregular in shape, usually being monocentric, but sometimes forming short irregular valleys containing up to three centers. Corallites on convex surfaces are clearly sub-plocoid, those on flat surfaces are crowded, becoming cerioid and irregular in shape, and may have up to three centers. The septa are usually thin and characteristically irregular in shape and in appearance they plunge steeply inside the wall. All septa descend steeply inside the thecae. Those reaching the columella usually form paliform lobes which are seldom conspicuous. They have prominent dentations of irregular length, giving the septa a ragged appearance. The inner margins of the paliform lobes are prominently dentate. Many dentations form horizontal synapticular fans bordered with granulations. The sides of the septa and endotheca are granulated. The septa are usually irregularly exsert. Those of adjacent corallites are not usually adjoined. The columellae are compact. In many coralla, the endotheca can be readily distinguished from the exotheca, and in most coralla, vesicular exotheca dissepiments are found. **Colour:** A wide range, usually with contrasting corallite walls and oral discs. **Similar species:** *Favia matthaii*, which also has irregular septa but corallites are circular and smaller.

Discussion: Veron et al. (1977) mentioned the wide diversity of environments occupied by this species is reflected in the wide variation of its calicular structures. In this collection there are some specimens which are difficult to separate from *F. favus* due to the variation among species. However, the specimens that corresponded well to *F. rotumana* were classified (specimens no.02/6, 02/7, 02/8). Character of prominent dentations which giving septa a ragged appearance was used when specimens were difficult to identify, with *Favia rotumana* having a more ragged appearance than *F. favus* (specimens no.99/7, 99/11, 99/151).

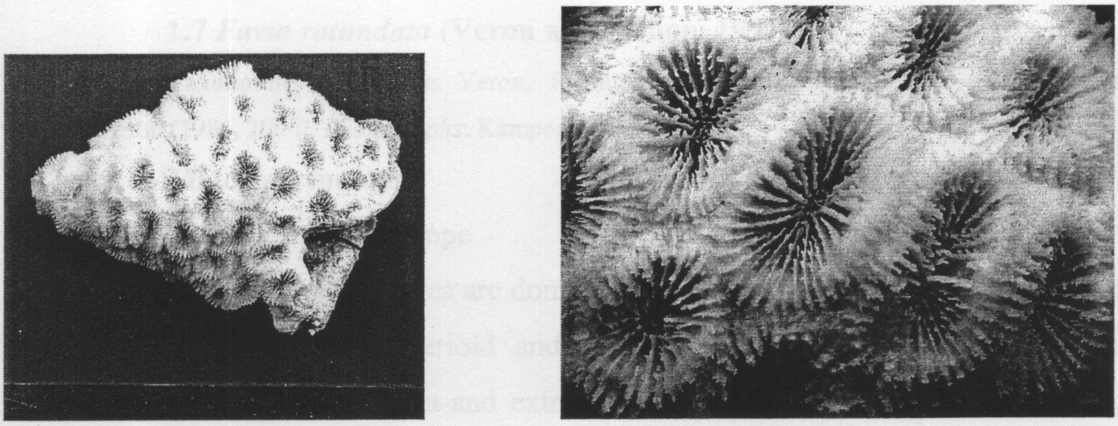


Figure 25 Specimen number 02/6 *Favia rotumana*

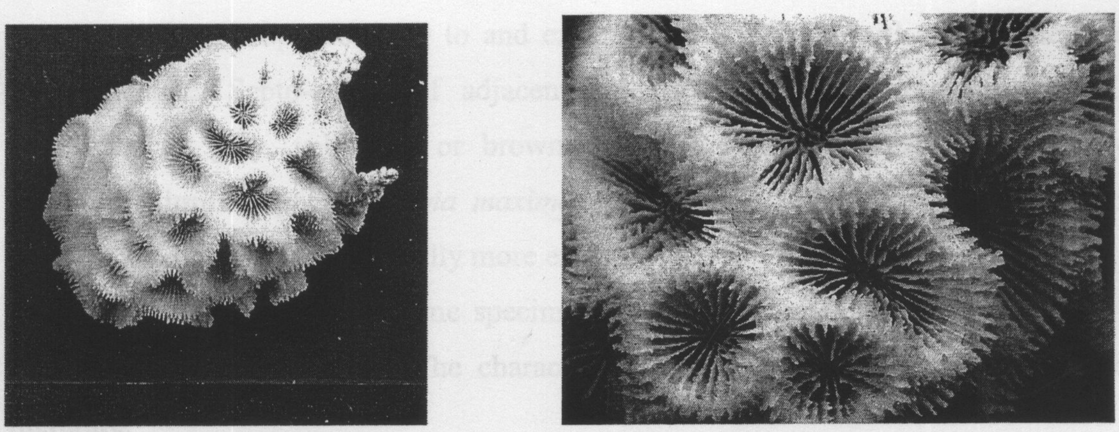


Figure 26 Specimen number 02/8 *Favia rotumana*

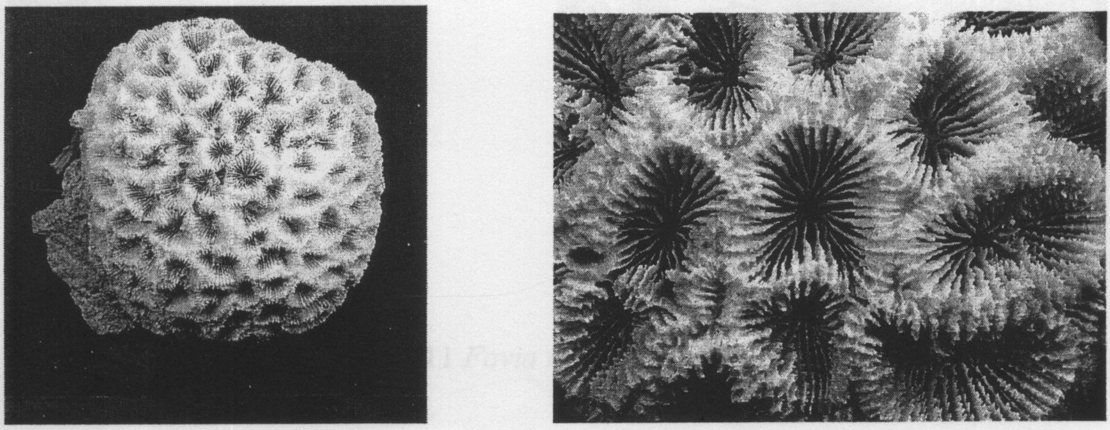


Figure 27 Specimen number 99/11 *Favia rotumana*

1.7 *Favia rotundata* (Veron and Pichon, 1977)

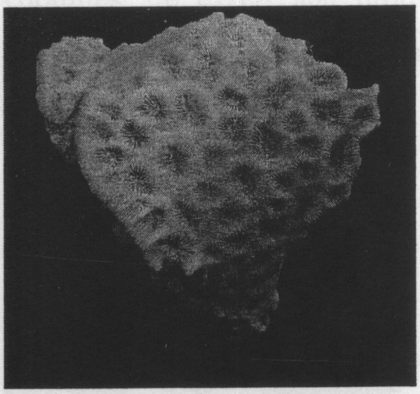
Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

02/11; Rang Trat/ slope

Characters: Colonies are dome shaped or flat. Corallites are thick walled and circular, tending to be cerioid and very large corallites (19-22 millimeters diameter). Budding is both intra-and extratentacular, monostomdaeal intratentacular budding being predominant. Septal margin dentations become larger towards the center and on paliform lobe margins, especially on the first order. Septo-costae develop in size, proportionately to and exsert correspondingly with septa. They are finely dentate. Septo-costae of adjacent corallites are usually regularly joined. **Colour:** Pale grey, yellowish or brown. Corallite rims are usually distinctively coloured. **Similar species:** *Favia maxima* and *F. veroni*, which have corallites of similar size, but these are generally more exsert.

Discussion: Only one specimen of *F. rotundata* found in this study, it being found at Rang Island. The characters described are typical of those in the literature.



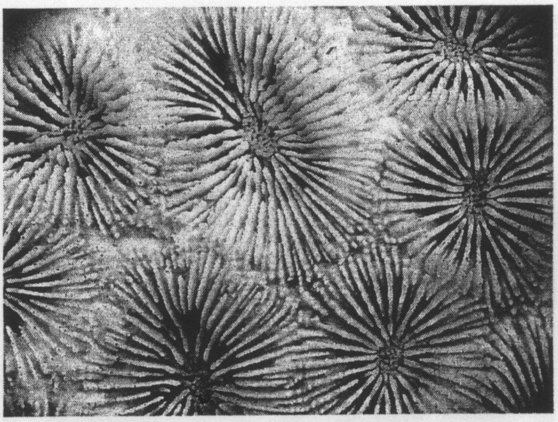


Figure 28 Specimen number 02/11 *Favia rotundata*

2. Genus *Barabattoia* Yabe and Sugiyama, 1941

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000)

Characters: This is a genus of convenience to accommodate two species that appear to have affinities with each other, but which are outside the boundaries of

Favia. Colonies have tubular corallites which fuse irregularly. Budding is primarily extratentacular. **Similar genera:** *Favia,* which has plocoid rather than tubular corallites and primarily intratentacular budding.

2.1 *Barabattoia amicorum* (Milne Edwards and Haime, 1850)

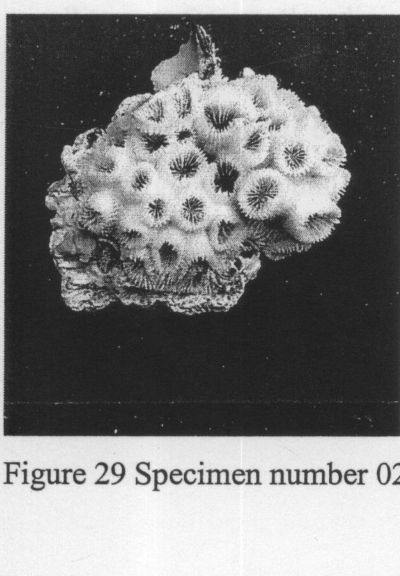
Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

02/12; Mark Trat/ slope 02/13; Rang Trat/ slope

Characters: Colonies are massive and usually small (6-11 mm). Corallites are plocoid to tubular. The latter growth form appears to be a result of deposition of sediment within and around colonies, allowing only exsert corallites and protruding pars of colonies to grow. Thus these colonies are usually found only in close proximity to sediments, usually in turbid water, and therefore have a very irregular appearance. Budding is primarily extratentacular. Coastae are equal and well developed. Paliform lobes are usually poorly developed. Columellae are small and compact. **Colour:** Usually brown, cream or green with pale oral discs. **Similar species:** *Barabattoia laddi*, which has longer corallites and alternating costae.

Discussion: These specimens show common characters of the species, corallites are exsert and protruding. However, in the east coast of Thailand *B. amicorum* was found only at Mark and Rang Islands, which has clear water.



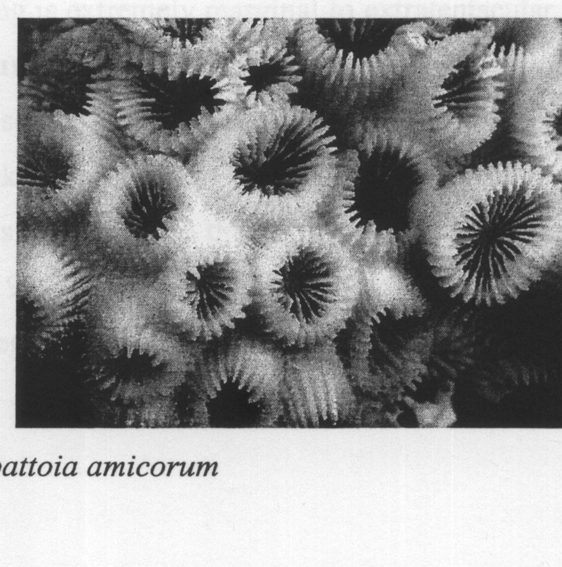


Figure 29 Specimen number 02/13 *Barabattoia amicorum*

3. Genus *Favites* Link, 1807

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000)

Characters: Colonies are usually massive and either flat or domed-shaped. Corallites are monocentric and cerioid, occasionally subplocoid. Adjacent corallites mostly share common walls. Paliform lobes are seldom well developed. **Similar genera:** *Favites* is similar to *Favia* also to *Goniastrea*. *Goniastrea* may be cerioid like *Favites,* in which case it is distinguished by the presence of exsert paliform lobes, and also by having a regular pattern of septa with relatively fine teeth.

3.1 *Favites pentagona* (Esper, 1794)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/157; Kudee Rayong/ slope

02/16; Suwan Trat/ flat

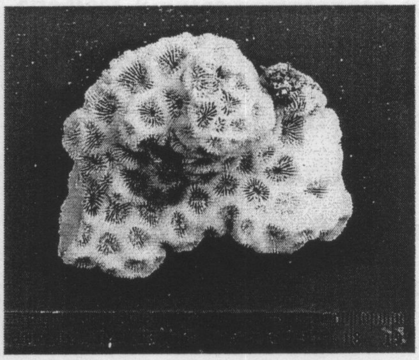
02/14; ChangNoi Trat/ slope

02/15; E raa Chonburi/ flat

02/17; Suwan Trat/ flat

Characters: Colonies are encrusting, massive or sub-ramose, sometimes forming irregular columns. Corallites are cerioid thin walled and angular, with diameter seldom exceeding 6 mm. Septa are few in number, those septa reaching the columella have well developed paliform lobes which form a distinctive crown around the columella. The septa are variably exsert over the thecae; those of adjacent corallites are frequently adjoined. Budding is extremely marginal to extratentacular in all coralla in the present series. **Colour:** Often brightly coloured, brown or red, commonly with green or brown oral discs. **Similar species:** *Favites bestae* and *F. micropentagona.* The paliform crown makes this species *Goniastrea*-like.

Discussion: These specimens are similar to the holotype of *F. pentagona* illustrated in fig. 122-124 Veron et al. (1977), except the specimen no. 02/17. Which has thinner walls and septa are thin and regular. This specimen looks like *Goniastrea.*



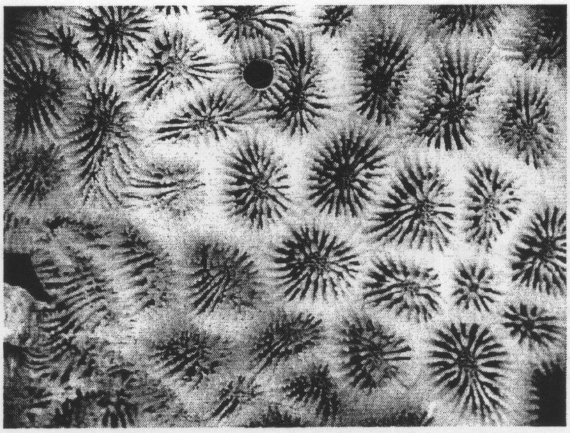
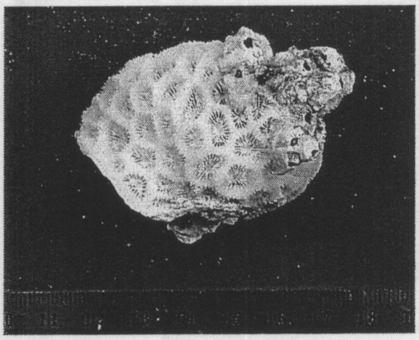


Figure 30 Specimen number 02/15 *Favites pentagona*



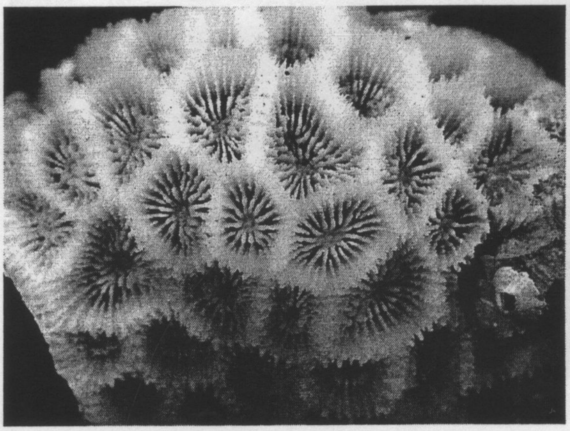


Figure 31 Specimen number 02/17 *Favites pentagona*

3.2 *Favites chinensis* (Verrill, 1866)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/152; Kudee Rayong/ slope 02/18; Kudee Rayong/ flat

Characters: Colonies are massive and rounded. Corallites are shallow, angular to subplocoid, with thin walls. Corallites are quite small sized (6-9 mm), mature corallites are 10-13 mm in diameter and tend to be angular or irregular in shape. Septa are straight and even. They vary in thickness but are usually spaced regularly and relatively widely. There are no paliform lobes, if present, are short rounded and inconspicuous. The columellae are well defined, compact, and seated deep within the calices. The thecae are thin and angular. Those of adjacent corallites are aligned across the wall. **Colour:** Usually yellow or greenish-brown. **Similar species:** *Favites complanata*, which has longer, more excavated corallite with thicker walls. See also *F. bestae*.

Discussion: The specimens of this species show characteristics that fit well with those described by Veron et al. (1977) and Veron (2000), especially specimen no. 99/152. Except specimen no. 02/18 that has deeper calices than those described in literatures reviewed. However, paliform lobes of this specimen are very distinct and well developed.

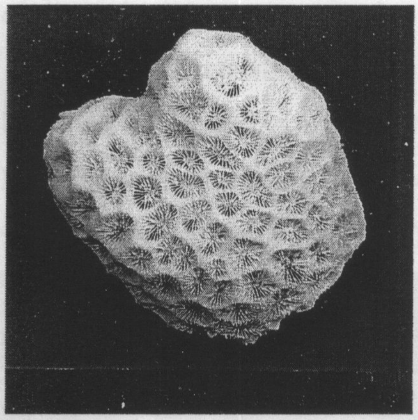
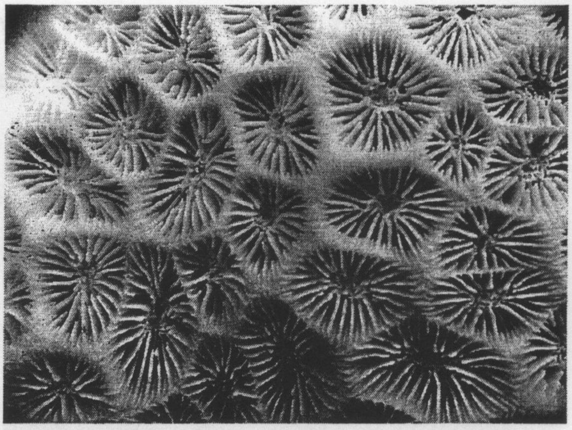



Figure 32 Specimen number 99/152 *Favites chinensis*

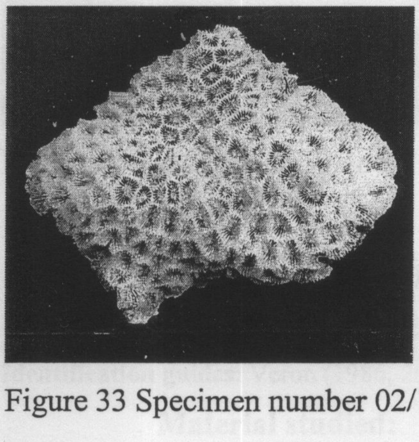
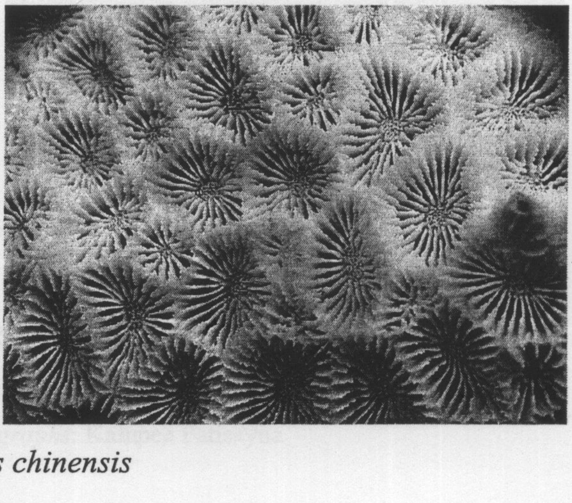



Figure 33 Specimen number 02/18 *Favites chinensis*

3.3 *Favites halicora* (Ehrenberg, 1834)

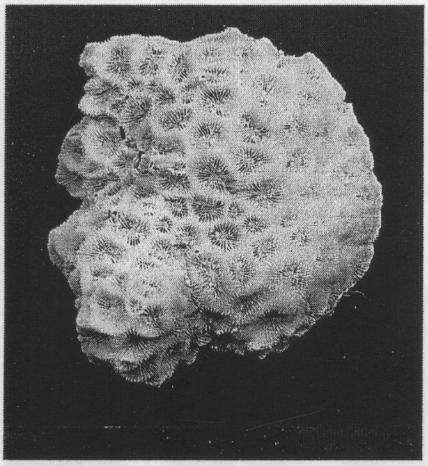
Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

02/19; PrawNok Trat/ flat　　02/20;Randokmai Chonburi/ slope

Characters: Colonies are massive, either rounded or hillocky. Coralla have a similar range of growth forms as *Favites abdita*. Corallites have very thick walls; they are cerioid with a tendency to become subplocoid. Corallites with middle sized (10-13 mm in diameter). Septa are usually equal, although some corallites have a second and alternating cycle of reduce size. Paliform lobes may be developed which may from a distinct paliform crown. Budding is both intra- and extre-tentacular. **Colour:** Usually uniform pale yellowish- or greenish- brown. **Similar species:** *F. abdita*, which has more angular corallites with thinner walls and no paliform lobes.

Discussion: In this study, these specimens fit well those from exposed biotopes in Great Barrier Reef Australian waters (Veron et al., 1977). Coralla tend to have calices, which are sub plocoid and plocoid with thickend thecae, similar to fig. 98 and 100 in Veron et al (1977).



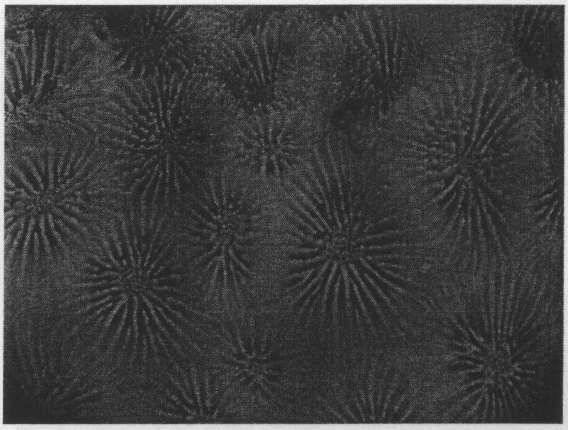


Figure 34 Specimen number 02/19 *Favites halicora*

3.4 *Favites abdita* (Ellis and Solander, 1786)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/13; Kram Chonburi/ slope　　99/14; Kram Chonburi/ flat

99/15; Kram Chonburi/ slope　　99/16; Kram Chonburi/ flat

99/21; Kram Chonburi/ slope　　99/22; Kram Chonburi/ flat

99/23; Kram Chonburi/ flat　　99/24; Kram Chonburi/ flat

99/91; KangKao Chonburi/ slope 99/96; KangKao Chonburi/ slope

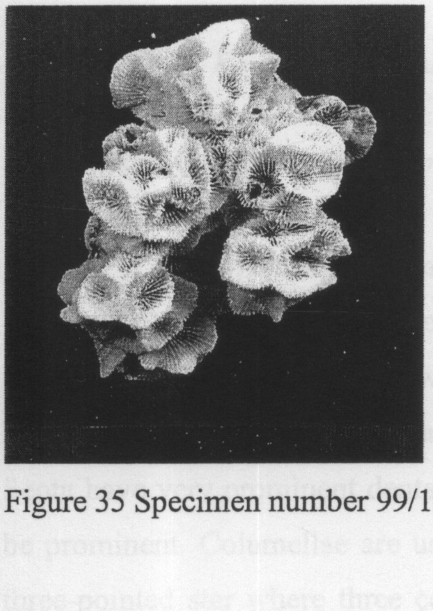
99/124; MonNai Rayong/ slope 99/148; Kudee Rayong/ slope

99/149; Kudee Rayong/ slope 02/21; KangKao Chonburi/ flat

02/22; Randokmai Chonburi/ slope 02/23; Mark Trat/ flat

Characters: Colonies are massive, either rounded or hillocky. Corallites are rounded rather than an angular appearance, middle sized with thick walls. Mature calices are usually 7-12 mm in diameter. Septa are straight, with moderately exsert teeth, regularly spaced, and are usually uniform thickness. Paliform lobes are either absent or weakly developed but do not form a conspicuous crown. Thecae are usually thin and irregular on hillocky parts and broad on flat sides where calices are shallow. Budding is always intratentacular and usually very unequal. **Colour:** Colour of living colonies is variable. Dark in turbid environment, otherwise pale brown with brown or green oral discs. **Similar species:** *Favites halicora* and *F. flexuosa.*

Discussion: Characters of these specimens matched well with those described by Veron et al. (1977). More massive coralla (no. 22/23) usually have much deeper calices with angular outlines. The thecae are very thin. Encrusting coralla (no. 99/124) is similar to fig. 90 in Veron et al. (1977). The septa usually have very long, inwardly projecting dentations.



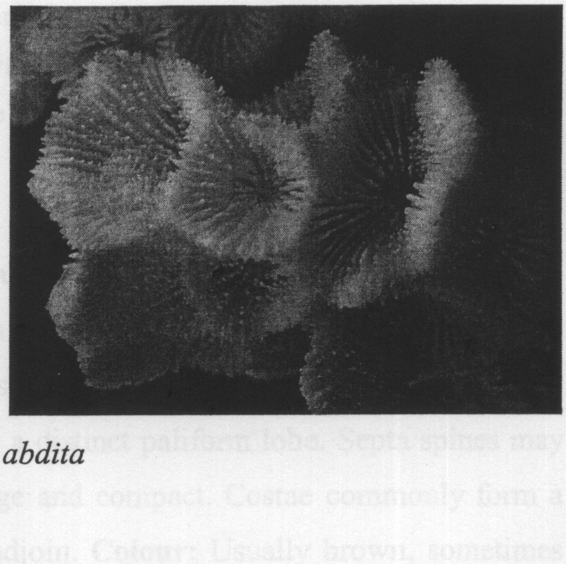


Figure 35 Specimen number 99/16 *Favites abdita*

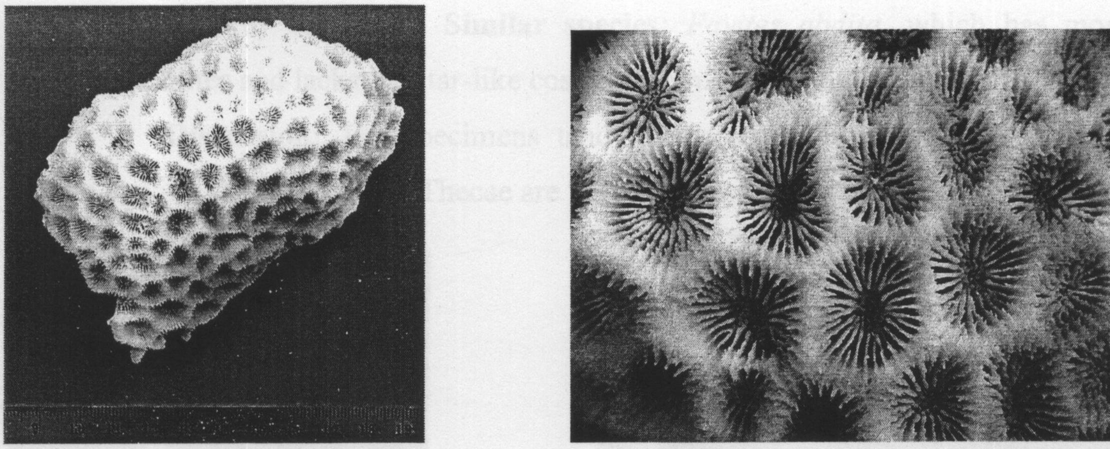


Figure 36 Specimen number 02/23 *Favites abdita*

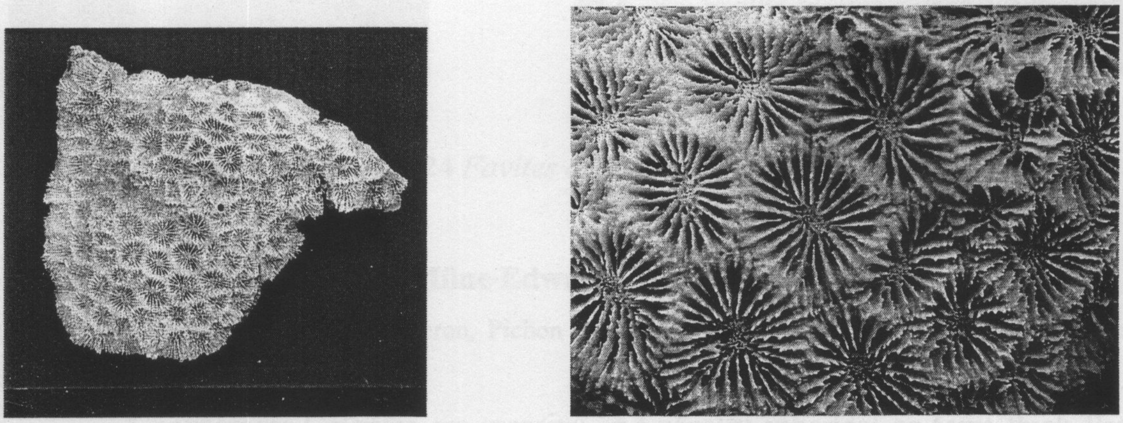


Figure 37 Specimen number 99/124 *Favites abdita*

3.5 *Favites complanata* (Ehrenberg, 1834)

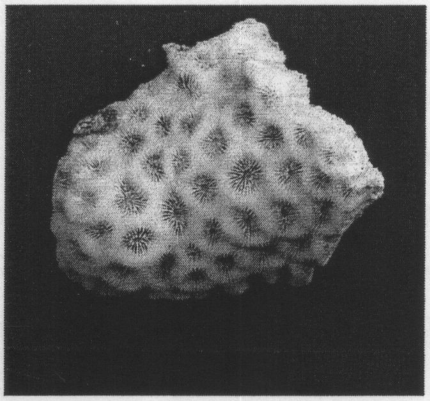
Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

02/24; ChangNoi Trat/ flat 02/25; Rang Trat/ slope

Characters: Colonies are usually massive with slightly angular corallites. Corallites have thick, rounded walls, with middle size. Corallites are approximately 10-11 mm in diameter, cerioid or slightly sub-plocoid, and slightly angular in outline. Septa have very prominent dentations and a distinct paliform lobe. Septa spines may be prominent. Columellae are usually large and compact. Costae commonly form a three-pointed star where three corallites adjoin. **Colour:** Usually brown, sometimes with green or grey oral discs. **Similar species:** *Favites abdita*, which has more angular corallites and lacks the star-like costal pattern. See also *F. chinensis*.

Discussion: The specimens tend to become sub-plocoid with circular calices, having shallow calices. Thecae are very thick and prominent paliform lobes.



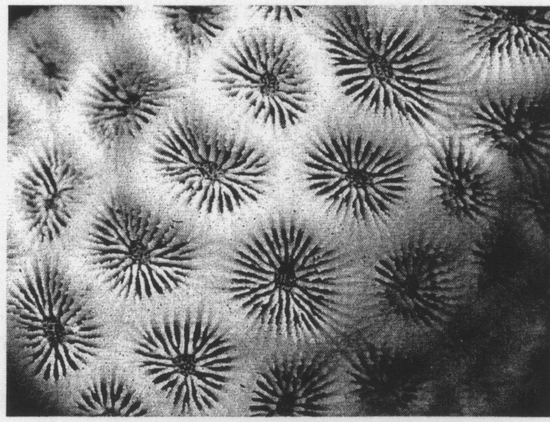


Figure 38 Specimen number 02/24 *Favites complanata*

4. Genus *Goniastrea* Milne Edwards and Haime, 1848

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000)

Characters: Colonies are massive and usually spherical or form thick flat plates. Corallites are monocentric and cerioid, to polycentric and meandroid. Paliform lobes are well developed. Meandroid colonies have well defined columella centers. **Similar genera:** *Goniastrea* has similarities with *Favites, Leptoria* and *Platygyra*. *Platygyra*, like *Goniastrea,* can be cerioid or meandroid but has weakly developed (if any) paliform lobes and columella centers which are seldom distinguishable.

4.1 *Goniastrea retiformis* (Lamarck, 1816)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/26; Kram Chonburi/ flat

99/27; Kram Chonburi/ flat

99/28; Kram Chonburi/ flat

99/29; Kram Chonburi/ flat

99/101; MonNai Rayong/ slope

99/120; MonNai Rayong/ slope

99/137; Kudee Rayong/ slope

Characters: Colonies are massive, tending towards spherical, hemispherical, or columnar growth forms which frequently exceed 1 meter across, common in intertidal zones. Corallites are cerioid monocentric with straight-sides walls having 4-6 angels which give a neat cellular appearance. Calices are mostly uniform in size, 3-5 mm in diameter. First order septa are slightly exsert. They plunge steeply within the calice to the level of the columella, then develop large paliform lobes which form a distinctive crown. The columellae are small trabecular. **Colour:** Uniform cream or pale brown, occasionally brown, pink or green. **Similar species:** *Goniastrea edwardsi*, which has thicker walls and septa and more irregular corallites. See also *G. minuta*.

Discussion: The characters of the specimens are corresponding to *G. retiformis* described by Veron et al. (1977) and Veron (2000). The most distinct variation appearing among specimens is that specimen no 99/101 has very thin walls and thin paliform lobes.

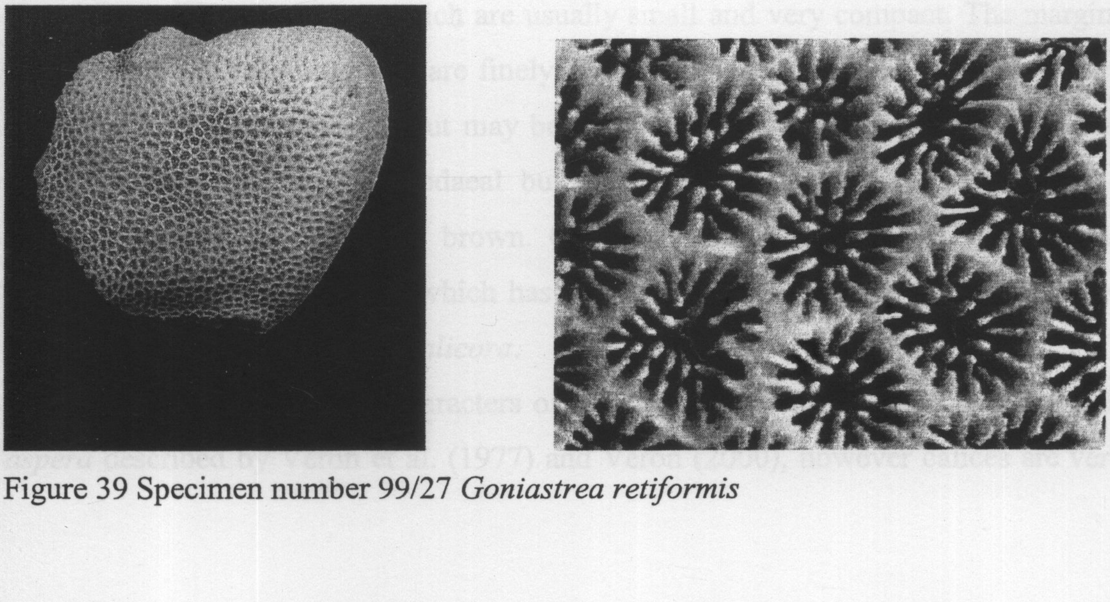


Figure 39 Specimen number 99/27 *Goniastrea retiformis*

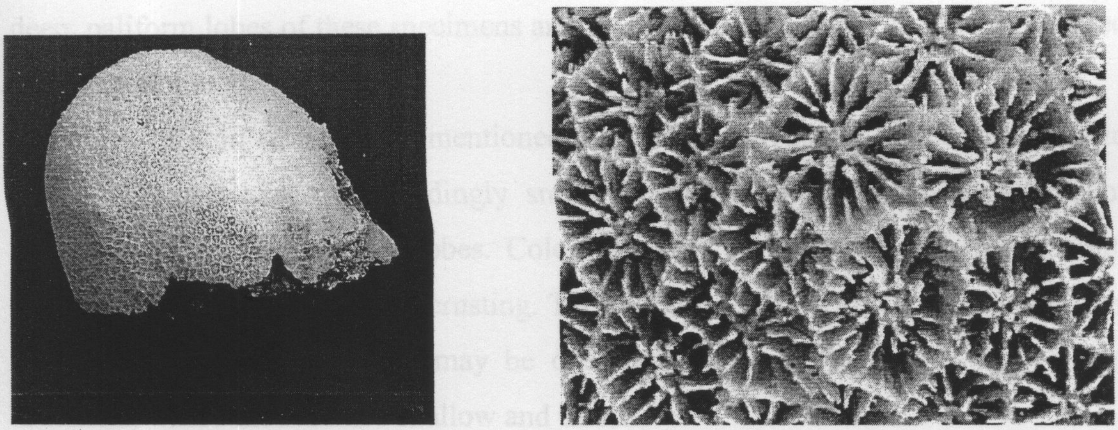


Figure 40 Specimen number 99/101 *Goniastrea retiformis*

4.2 *Goniastrea* cf. *aspera* Verrill, 1905

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/163; KangKao Chonburi/ flat   02/28; Lim Trat/ slope

Characters: Colonies are massive to encrusting. Corallites are cerioid with straight-sided walls, angular in shape and have thick walls with 7-10 mm in diameter. The thecae are usually thin and the corallites deep and cellular in appearance. Septa are very evenly spaced and only slightly exsert. They are either of the same order or are regularly arranged in two alternating orders which descend abruptly. The paliform crowns are usually very conspicuous, with the paliform lobes regularly spaced and very board. The inner margins of the paliform lobes descend vertically to the columellae, which are usually small and very compact. The margins of the septa and paliform lobes are finely dentate. Paliform lobes are well developed in colonies from turbid water but may be absent in colonies from exposed habitats. Budding is usually monostomodaeal but may be tristomodaeal in areas of rapid division. **Colour:** Usually pale brown. Corallite centers are often cream. **Similar species:** *Goniastrea edwardsi*, which has similar skeletal structures but smaller. See also *Favites pentagona* and *F. halicora*.

Discussion: The characters of the specimens tend to correspond with *G. aspera* described by Veron et al. (1977) and Veron (2000), however calices are very deep, paliform lobes of these specimens are not developed as much as those illustrated in the liturature.

Veron et al. (1977) mentioned that in shallow, turbid water variations in calice structures are correspondingly small, being mostly restricted to degree of development of the paliform lobes. Colonies of *G.* cf. *aspera* found in this study usually small and coralla are encrusting. The thecae are thin with very deep corallites and cellular appearence. This may be due to the geomorphology in the Gulf of Thailand, where the reefs are shallow and turbid.

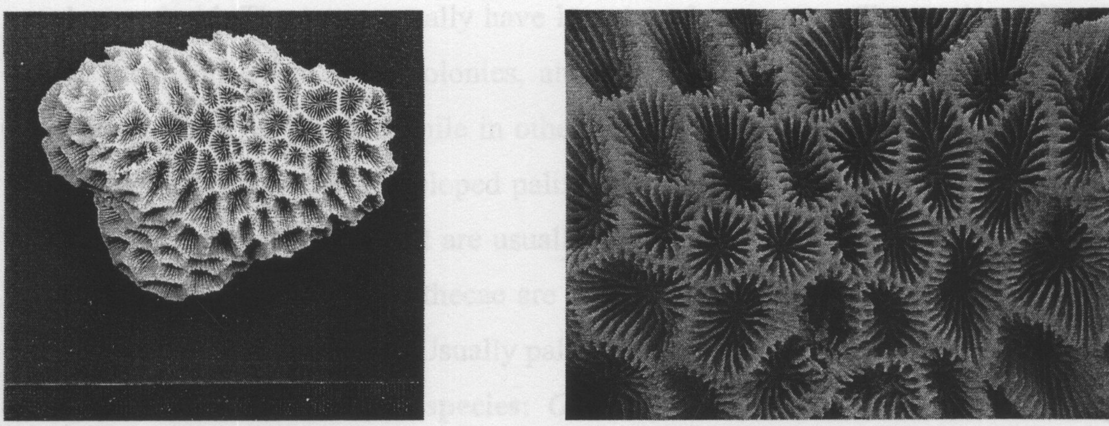


Figure 41 Specimen number 99/163 *Goniastrea cf. aspera*

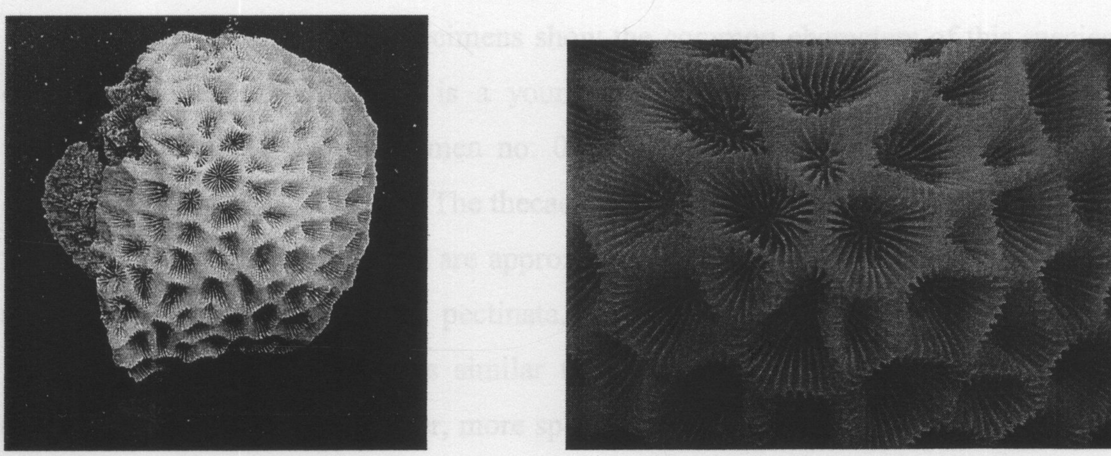


Figure 42 Specimen number 02/28 *Goniastrea cf. aspera*

4.3 *Goniastrea pectinata* (Ehrenberg, 1834)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/30; Kram Chonburi/ slope
99/116; MonNai Rayong/ slope
99/117; MonNai Rayong/ slope
99/127; Kudee Rayong/ slope
99/173; Kudee Rayong/ slope
02/26; Lim Trat/ slope
02/30; Moh Trat/ flat

Characters: Colonies are submassive or encrusting. Corallites are cerioid to submeandroid. The latter usually have less than four centers. Two orders of septa can be distinguished in most colonies, although in some the second order may be extremely reduced or absent, while in others it may be confused with the first order. First order septa have well-developed paliform lobes or a series of paliform lobes in the form of large dentations and are usually slightly exsert. Walls are thick paliform lobes and well developed. The thecae are of variable thickness but do not show the extremes of variation. **Colour:** Usually pale brown or pink but may be dark brown in deep or turbid water. **Similar species:** *Goniastrea edwardsi*, which has markedly smaller corallites and *G. australensis* which has valleys of similar width but is usually fully meandroid. See also the merulinid *Merulina scheeri*.

Discussion: The specimens show the common characters of this species, except specimen no. 02/30; it is a young colony that has quite poor developed paliform lobes. However, specimen no. 02/26 shows the obvious variation among others is the thickness of thecae. The thecae are very thin; they are almost 1 mm thick, whereas, those specimens above are approximately 1 mm thick. I doubt whether this specimen is a variation among *G.* pectinata, it could be *G. favulus*.

This specimen looks similar to *G. favulus* in fig. 167 in Veron et al. (1977) with thin thecae. However, more specimens are needed to illustrate a variation of the species.

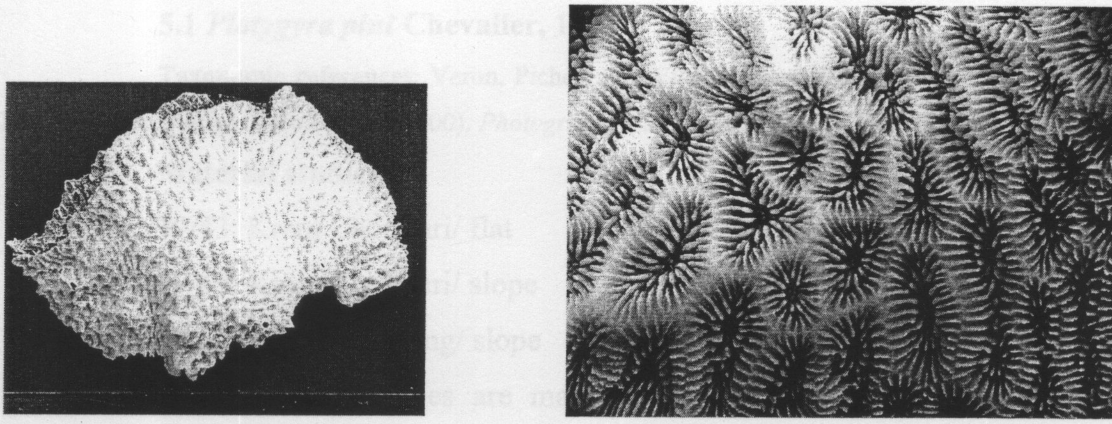


Figure 43 Specimen number 99/172 *Goniastrea pectinata*

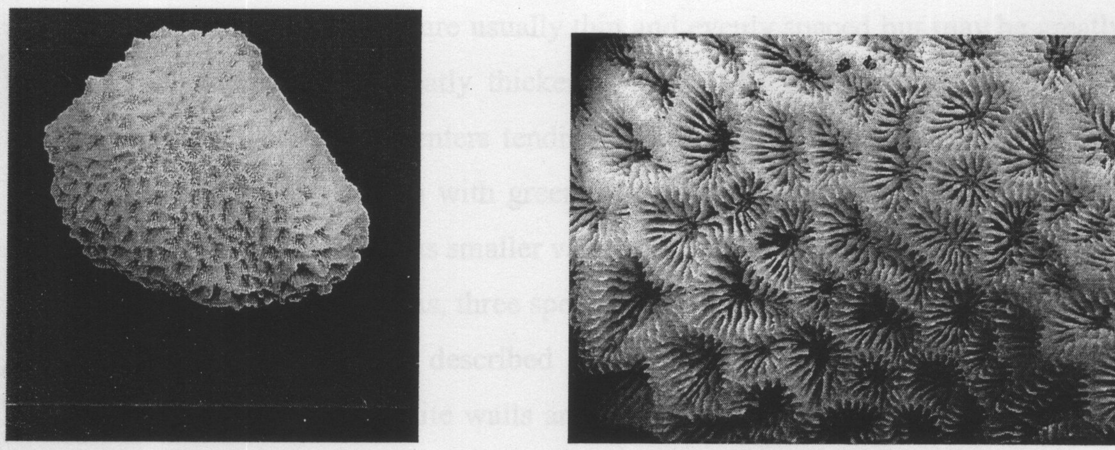


Figure 44 Specimen number 02/26 *Goniastrea* cf. *pectinata*

5. Genus *Platygyra* Ehrenberg, 1834

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000).

Characters: Colonies are massive and either flat or dome-shaped. Corallites are usually meandroid but may be cerioid. Paliform lobes are not developed; columellae seldom form centers, but rather form spongy wall-like structures. **Similar genera:** *Platygyra* is similar to *Goniastrea* and *Leptoria*. *Goniastrea* has well developed paliform lobes and columellae centers. *Leptoria* is more meandroid than *Platygyra*, usually has distinctive and more solid wall-like columellae, and has uniformly space septa of equal size.

5.1 *Platygyra pini* Chevalier, 1975

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/43; Kram Chonburi/ flat	99/46; Kram Chonburi/ flat
99/49; Kram Chonburi/ slope	99/72; KramNoi Chonburi/ slope
99/154; Kudee Rayong/ slope	

Characters: Colonies are massive and are round or flat, sometimes encrusting. Corallites are monocentric or form short valleys usually with one or two recognizable centers. The walls are usually relatively thick with rounded edges, although this is variable. Septa are usually thin and evenly spaced but may be greatly thickened in colonies with greatly thickened walls. The trabecular columellae are usually well developed, with centers tending to form at the end of valleys. **Colour:** Usually grey- or yellow- brown with green or cream valley floors. **Similar species:** *Platygyra ryukyuensis*, which has smaller valleys with thinner walls.

Discussion: Whereas, three specimens from reef slope correspond with *P. pini* from reef slope biothopes described by Phongsuwan (1986). These specimens have thin septa, although corallite walls are thick. Columellae are poorly developed. On the other hand, specimen no. 99/43 from reef flat has rather thin walls. Septal dentations are large, irregular exsert and some are long.

In specimen no 99/46, this specimen is very distinguished from the others. Corallites are monocentric and short valleys. Corallite walls are thin; septa are thin and evenly spaced. In some corallites, rows of dentations form very distinctive paliform crown. However, paliform lobe development is variable in individual corallites. Columellae are developed as short ridge (lamellar columella) along the valleys.

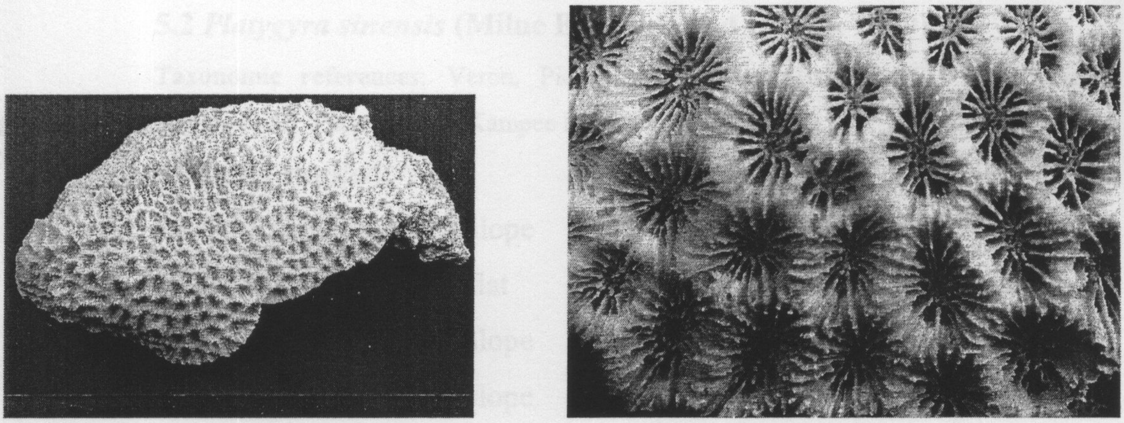


Figure 45 Specimen number 99/72 *Platygyra pini*

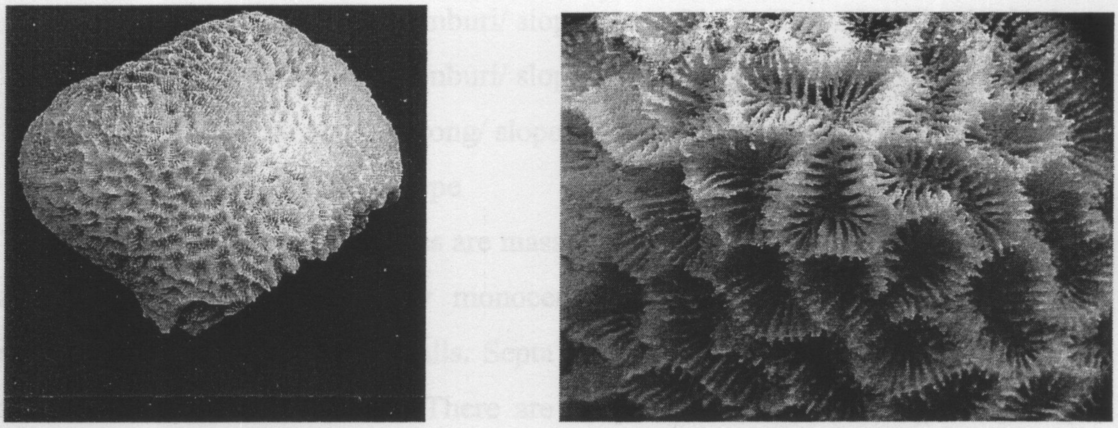


Figure 46 Specimen number 99/43 *Platygyra pini*

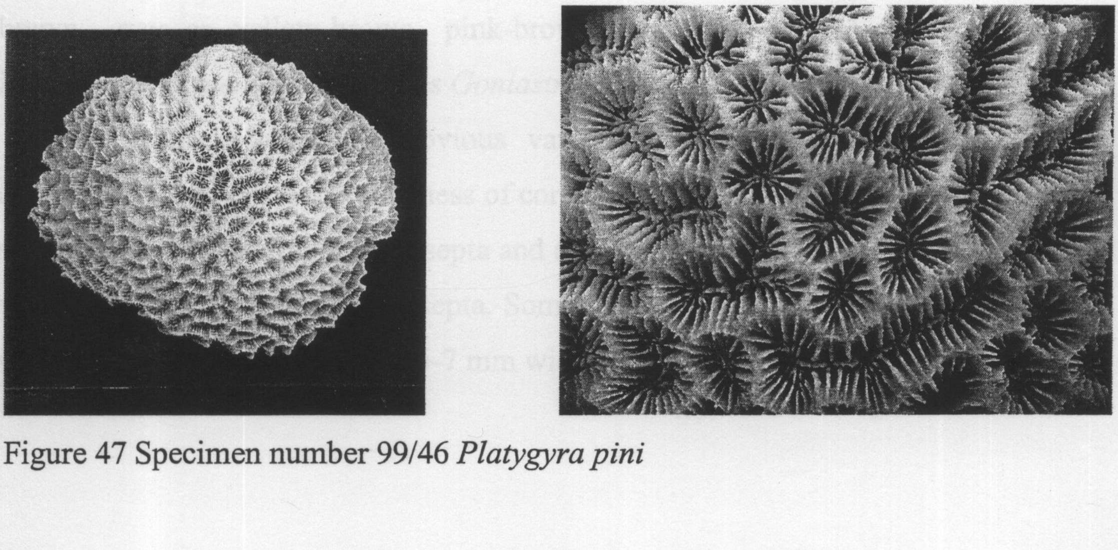


Figure 47 Specimen number 99/46 *Platygyra pini*

5.2 *Platygyra sinensis* (Milne Edwards and Haime, 1849)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides:** Veron (1986, 2000). *Photographs:* Kampee Patisayna

Material studied:

99/41; Kram Chonburi/ slope	99/44; Kram Chonburi/ slope
99/45; Kram Chonburi/ flat	99/47; Kram Chonburi/ flat
99/48; Kram Chonburi/ slope	99/50; Kram Chonburi/ flat
99/51; Kram Chonburi/ slope	99/52; Kram Chonburi/ flat
99/53; Kram Chonburi/ slope	99/54; Kram Chonburi/ slope
99/55; Kram Chonburi/ flat	99/56; Kram Chonburi/ slope
99/69; KramNoi Chonburi/ slope	99/70; KramNoi Chonburi/ slope
99/71; KramNoi Chonburi/ slope	99/99; KangKao Chonburi/ -
99/112; MonNai Rayong/ slope	99/150; Kudee Rayong/ slope
02/29; Rang Trat/ slope	

Characters: Colonies are massive and rounded, occasionally flat. Valleys are usually very short; mostly monocentric, but some colonies do have long meandering valleys with thin walls. Septa are thin and slightly exsert. Viewed from above they are evenly spaced. There are no paliform lobes, although large septal dentations may occur where the septa descend vertically. Columellae are narrow and largely composed of loosely intertwined trabeculae. **Colour:** Variable dull, dark-brawn, gray or yellow-brown, pink-brown or bright colours. **Similar species:** *Platygyra ryukyuensis*. Resembles *Goniastrea favulus* underwater.

Discussion: The obvious variations seen among specimens are the thickness of thecae and the wideness of corallites. Some specimens seem to have thin, sharp thecae with slightly exsert septa and are evenly spaced. On the other hand, some specimens have irregular exsert septa. Some specimens have narrow valleys (4-5 mm width) whereas; the others have 6-7 mm width.

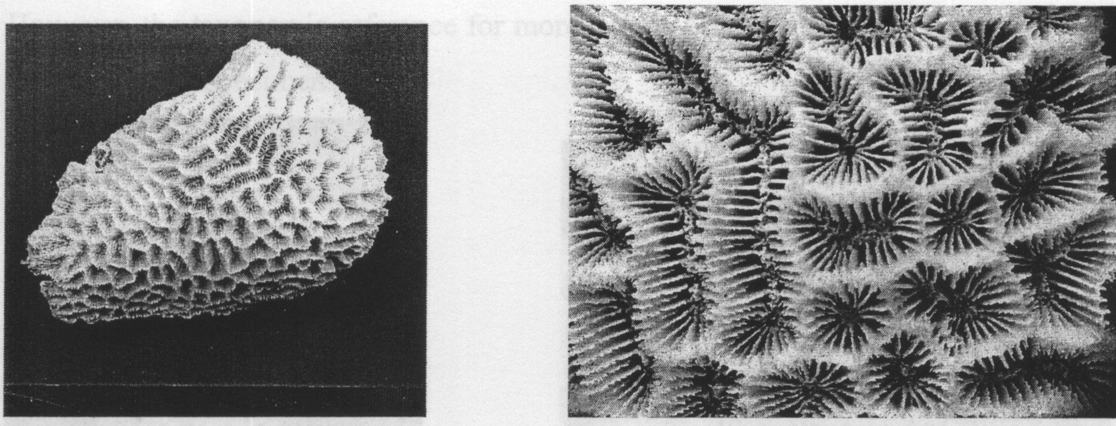


Figure 48 Specimen number 99/41 *Platygyra sinensis*

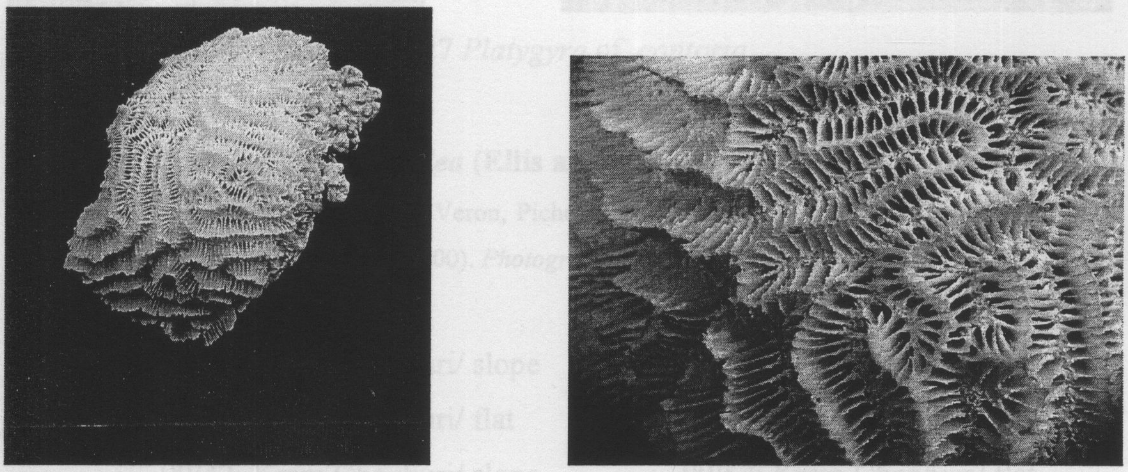


Figure 49 Specimen number 99/112 *Platygyra sinensis*

5.3 *Platygyra* cf. *contorta* Veron, 1990

Taxonomic references: none. **Identification guides**: Veron (2000). *Photographs*: Kampee Patisayna

Material studied:

02/27; MonNok Trat/ slope

Characters: Colonies are massive, encrusting or columnar. Valleys are usually long and relatively straight at colony margins that become short, sinuous and contorted towards the colony center. Walls are thin. Septa are highly irregular. **Colour:** Red, grey, pale yellow or green, with valley walls and floors of contrasting colours. **Similar species:** *Platygyra verweyi*, which has shorter valleys.

Discussion: In this collection there is only one specimen which shows the typical characters of *P. contorta*, described as a new species by Veron (1990).

However, the taxonomic reference for more details about this species is not available to confirm this specimen.

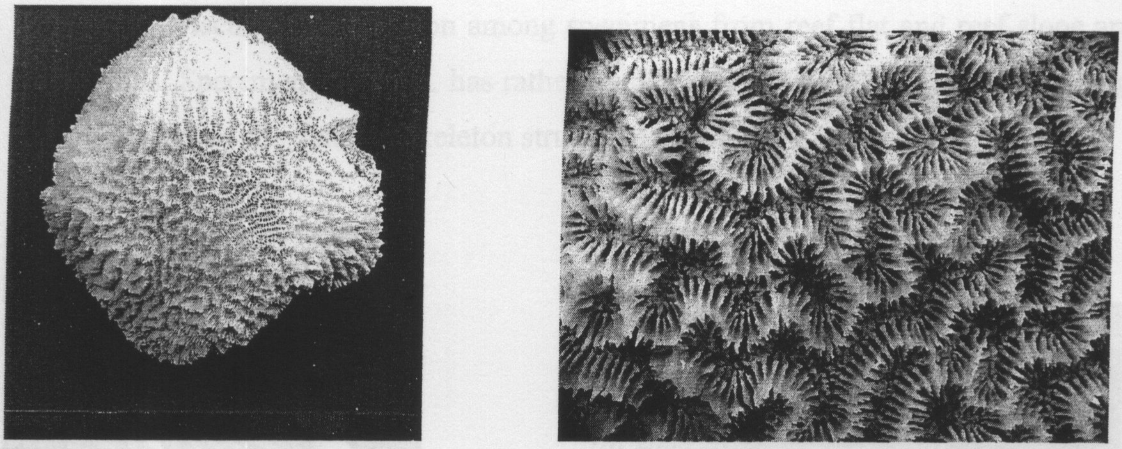


Figure 50 Specimen number 02/27 *Platygyra* cf. *contorta*

5.4 *Platygyra daedalea* (Ellis and Solander, 1786)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/37; Kram Chonburi/ slope | 99/38; Kram Chonburi/ flat

99/39; Kram Chonburi/ flat | 99/40; Kram Chonburi/ flat

99/42; Kram Chonburi/ slope | 99/57; Kram Chonburi/ flat

99/73; KramNoi Chonburi/ slope | 99/107; MonNai Rayong/ slope

02/32; Rang Trat/ slope

Characters: Colonies are massive, either rounded or flattened; sometimes they are encrusting. Valleys are usually long, although some colonies have short valleys and some have mixtures of both. The walls are usually thick, narrow and often perforated. Septa are very exsert, usually having pointed or ragged tips, and are frequently adjoined by fine trabecular linkages above the wall. Septa of the first two orders are usually equal. They have large dentations, especially on their lower edges where they are frequently twisted to form a horizontal plate. They descend abruptly down into the valleys. Fine granulations are presented on the sides of the septa. Paliform lobes are usually found only in short, broad valleys and are poorly developed. The spongy, trabecular columellae are of variable widths but are usually conspicuous. Centers are not usually formed or form only where valleys join. **Colour:**

Commonly brightly coloured, usually with brown walls and gray or green valleys. **Similar species:** *Platygyra lamellina*, which has thicker walls and neat rounded septa.

Discussion: Variation among specimens from reef flat and reef slope are not obvious. Specimen no 99/57, has rather rounded walls like *P. lamellina* with long valleys. However, the detailed skeleton structures are close to *P. daedalea.*

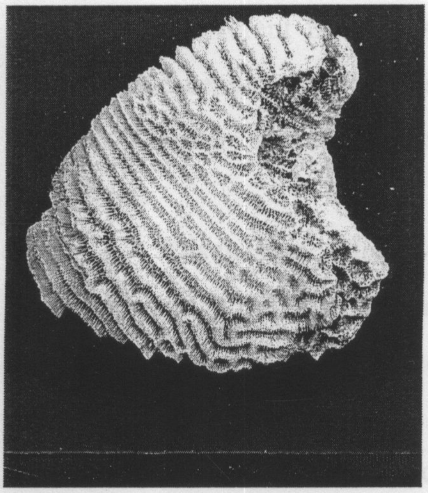
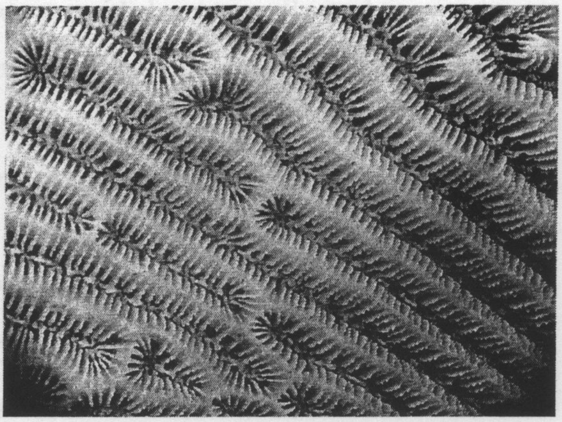



Figure 51 Specimen number 99/57 *Platygyra daedalea*

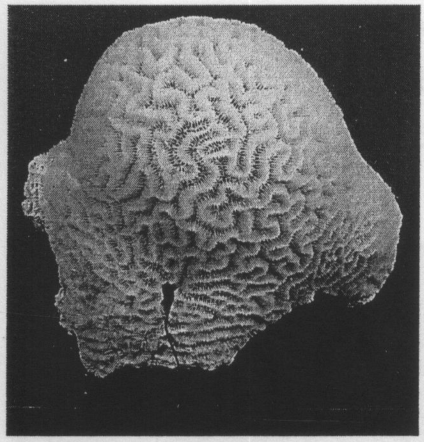
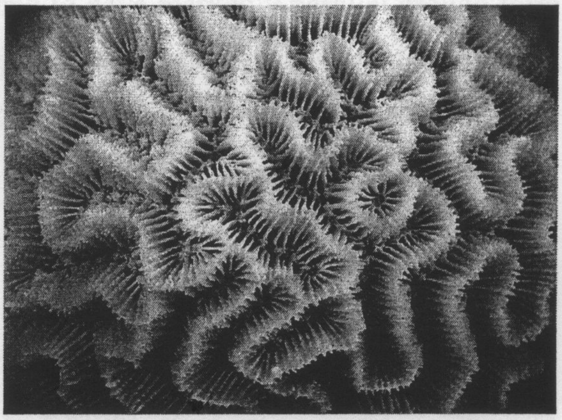



Figure 52 Specimen number 02/32 *Platygyra daedalea*

5.5 *Platygyra lamellina* (Ehrenberg, 1834)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

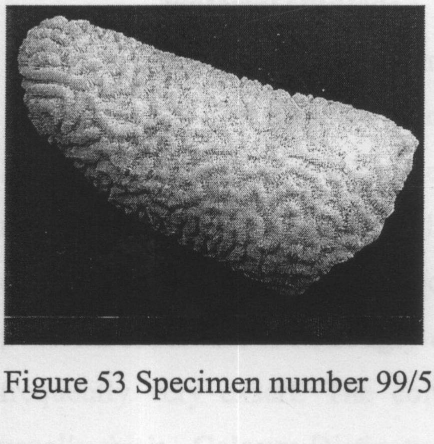
Material studied:

99/58; Kram Chonburi/ slope 02/33; Lim Trat/ flat

Characters: Colonies are massive and rounded, occasionally flat. Valleys are always elongated except on concave surfaces where they may become short, even monocentric. The walls are thick, neat and rounded. Septa are continuous across the walls and slightly exsert. Septal dentations are usually evenly distributed around the septa and, as with other *Platygyra* species, which they may form tiny horizontal plates. They are no paliform lobes. The columellae are usually narrow and not significantly different from those of *P.* daedalea. There is little tendency to form a recognizable center. **Colour:** Usually brown or with brown walls and grey or green valleys. **Similar species:** *Platygyra daedlea*. Resembles *Goniastrea austrlensis* underwater.

Discussion: *Platygyra lamellina* is usually distinguished from the much more common *P. daedalea* by the presence of a much thicker wall and markedly more rounded, less exsert septa. Colonies of *P. lamellina* which have short valleys are readily distinguished from *P. sinensis* by thicker wall and differences in septal structure. They are distinguished from *P. pini* by the absence of paliform lobes and differences in the structure of the columella.

Underwater, *P. lamellina* is sometimes difficult to distinguish from *Goniastrea australensis*, as these species tend to have markedly parallel growth form modifications within the same biotope. Coralla of the latter species are distinguished by the normal presence of well defined centers and abundant paliform lobes.



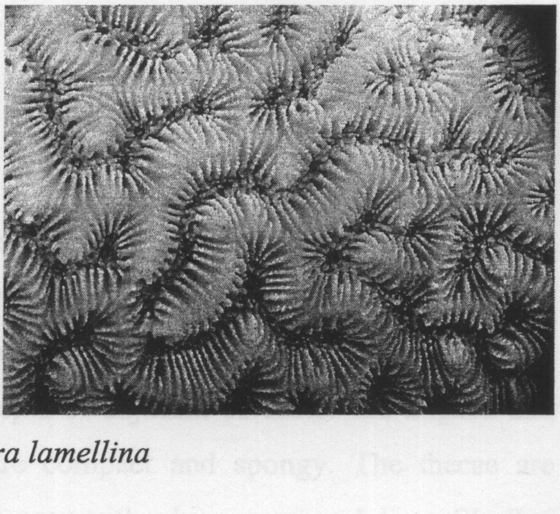
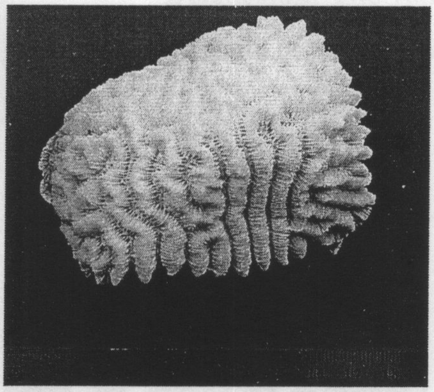


Figure 53 Specimen number 99/58 *Platygyra lamellina*



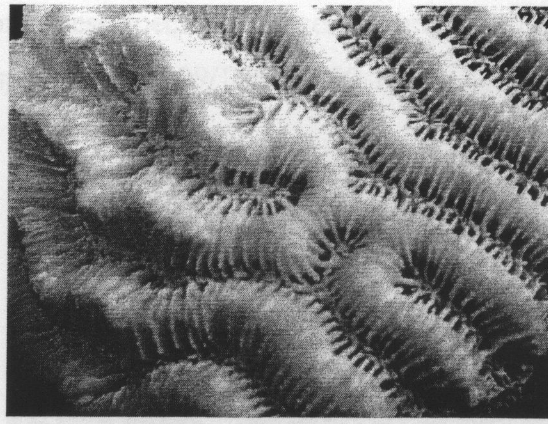


Figure 54 Specimen number 02/33 *Platygyra lamellina*

6. Genus *Oulophyllia* Milne Edwards and Haime, 1848

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000)

Characters: Colonies are massive and monocentric to meandroid, composed of large valleys with widely spaced, ragged septa and acute thin walls. Paliform lobes are usually present. Polyps are large and fleshy and tentacles are extended only at night. When tentacles are retracted, polyps have a coarse reptilian texture. Mouths are conspicuous. **Similar genera:** *Oulophyllia* is similar to *Platygyra* and *Favites,* both of which have smaller skeletal structures.

6.1 *Oulophyllia bennettae* (Veron and Pichon, 1977)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977 as *Favites bennettae*). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/18; Kram Chonburi/ slope 99/165; Kudee Rayong/ slope
99/166; Kudee Rayong/ slope

Characters: Colonies are massive with large angular corallites, which may have up to three columellae. Mature calices are approximately 10 mm in diameter. Septa are widely spaced and very prominent. They have well developed paliform lobes and are strongly dentate. Septa of adjacent corallites are aligned and frequently very exsert. The columellae are compact and spongy. The thecae are usually thick. **Colour:** Distinctive greenish-grey with white-green oral discs. **Similar species:** All other *Oulophyllia* species are more meandroid. See also *Goniastrea palauensis* and *Favites flexuosa.*

Discussion: The variation among these specimens is very lightly calcified and brittle septa and corallites occurred in specimens no 99/165 and 99/166.

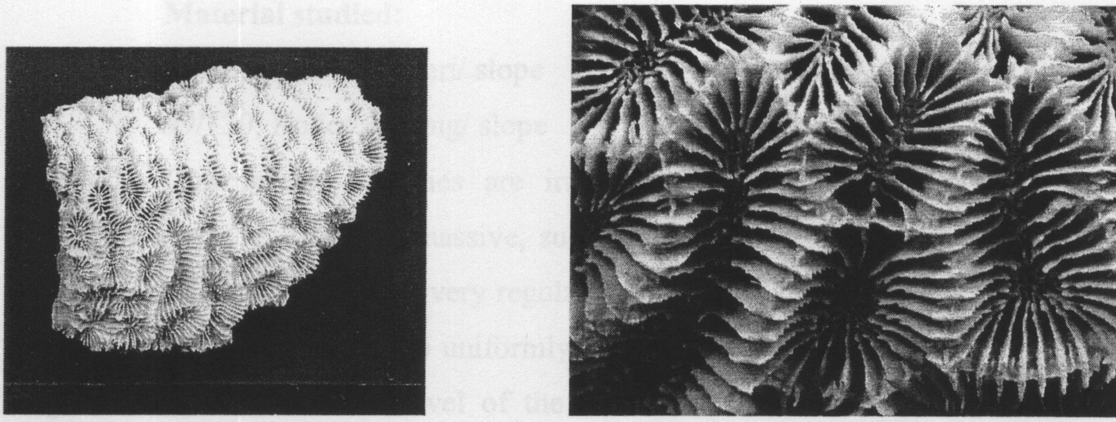


Figure 55 Specimen number 99/18 *Oulophyllia bennettae*

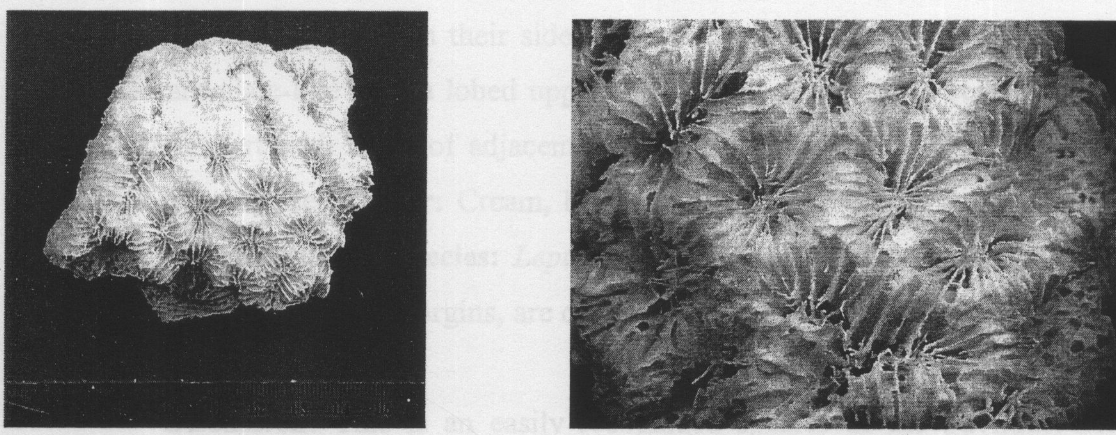


Figure 56 Specimen number 99/166 *Oulophyllia bennettae*

7. Genus *Leptoria* Milne Edwards and Haime, 1848

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000).

Characters: Colonies are massive or encrusting with sinuous valleys and neatly arranged equal septa and no paliform lobes. **Similar genera:** *Platygyra,* which is less sinuous; meandroid species also have coarser corallites. See also *Goniastrea,* which is less meandroid, has columellae forming distinct centers and well developed paliform lobes.

7.1 *Leptoria phrygia* (Ellis and Solander, 1786)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phonsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

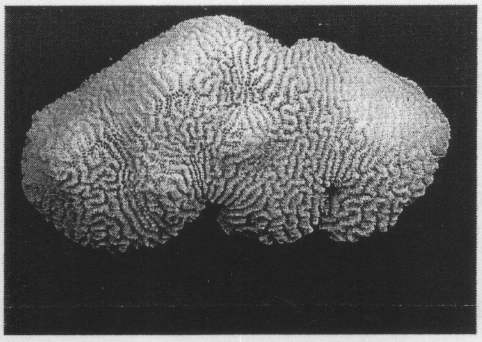
Material studied:

99/32; Kram Chonburi/ slope 99/106; MonNai Rayong/ slope

99/130; Kudee Rayong/ slope

Characters: Colonies are irregular in shape, usually having gently undulating surfaces. They are massive, submassive or ridged, with an even surface and dense skeleton. Valleys are very regular in appearance, have constant width, and are usually very deep. Septa are uniformly spaced and are of equal size. Septa have long horizontal lobes at the level of the columellae which form a series of bars connecting the septa to the columellae. The septa have fine dentations down their margins and fine granules down their sides, both are arranged in synapticular rows. Columellae are plate-like with a lobed upper margin and do not form centers. Septa are regularly exsert with those of adjacent valleys usually adjoined. The thecae are always thick and dense. **Colour:** Cream, brown or green, with walls and valleys of contrasting colours. **Similar species:** *Leptoria irregularis*, which has larger valleys that are straight at the colony margins, are distinctively coloured and have columellae, which are not plate-like.

Discussion: This is an easily recognized species of the Faviidae. The characters of the three specimens are as described by Veron et al. (1977) and Veron (1986, 2000).



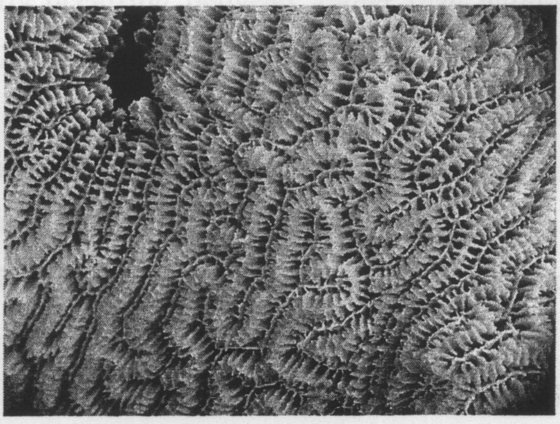


Figure 57 Specimen number 99/106 *Leptoria phrygia*

8. Genus *Montastrea* Blainville, 1830

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000).

Characters: Colonies are massive, either flat or dome-shaped. Corallites are monocentric and plocoid. Daughter corallites are predominantly formed by extratentacular budding (from the walls of parent corallites). Some intratentacular budding may occur. 'Groove and tubercle' formations (tiny tubes of tissue-thin epitheca formed by polychaete worm) are usually found. **Similar genera:** *Montastrea* is a poorly defined genus, but the species within it are usually easily recognized. It is readily separated from the other massive faviid genera with extratentacular budding (*Plesiastrea, Diploastrea, Leptastrea* and *Cyphastrea*) because each of these has well defined characters.

8.1 *Montastrea curta* (Dana, 1846)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

02/45; KangKao Chonburi/ flat   02/46; Lim Trat/ flat

Characters: Colonies are spherical, columnar or flattened. Corallites are circular and widely spaced or closely compacted. Mature corallites are moderately exsert and usually circular; sometimes they are squeezed into irregular shapes. Calices are 4-7 mm in diameter and have no groove and tubercle formation. The width of calices varies greatly, this variation mostly occurring between, rather than within, colonies. Small paliform lobes are usually developed. The columellae are small, trabecular or spongy and compact. Costae of the adjacent corallites are not adjoined. Budding is entirely extratentacular. **Colour:** Cream or orange on reef flats, often with colours concentric to the oral discs. Usually dark brown when in shaded habitats. **Similar species:** *Montastrea salebrosa*, which has smaller more exsert corallites. See also *Favia stelligera*.

Discussion: These specimens are corresponded with those described by Phongsuwan (1986). The specimens are very similar to *Favia pallida* but the latter has slightly larger corallites and has a predominance of intratentacular budding.

Specimen no 02/46 has squeezed corallites into irregular shapes. However, the corallites morphology is not exactly same as figures 257-263 in Veron et al. (1977). The paliform lobes are not well developed as described, whereas the extra-tentacular budding are very distinct.

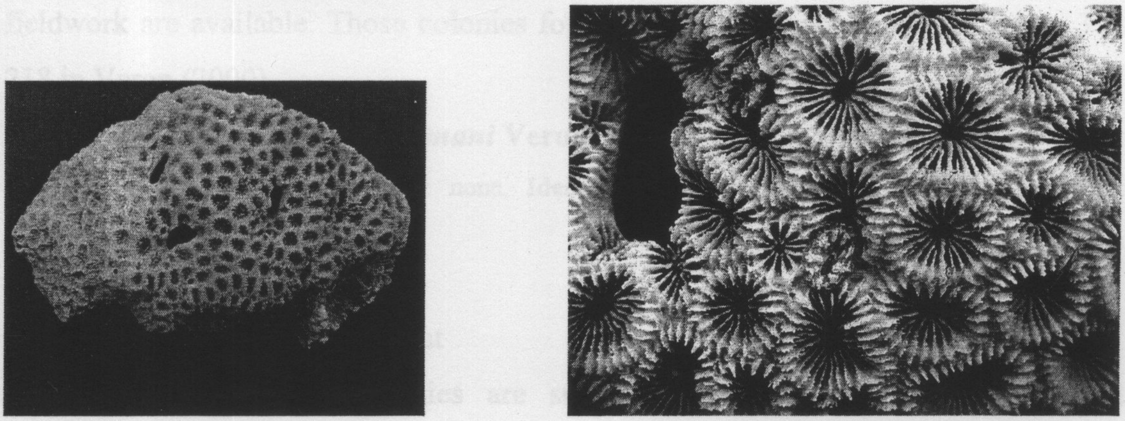


Figure 58 Specimen number 02/45 *Montastrea curta*

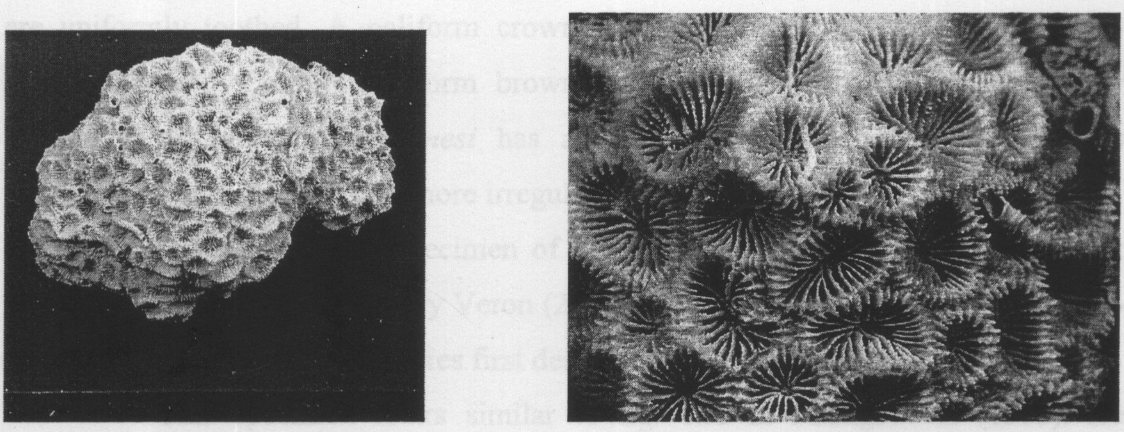


Figure 59 Specimen number 02/46 *Montastrea curta*

8.2 *Montastrea* cf. *salebrosa* (Nemenxo, 1959)

Taxonomic references: none. **Identification guides**: Veron (2000).

Material studied: none

Chatacters: Colonies are massive and mostly spherical. Corallites are circular and closely compacted. Corallites are small (3-4 mm diameter), exsert and have very thick walls. Corallites may face different directions according to place of budding. Septa are evenly spaced and strongly alternate. Costae are strongly beaded. Paliform crowns are well developed. Columellae are small. **Colour:** Tan or cream, sometimes with dark centers. **Similar species:** *Montastrea curta*. See also *Favia stelligera*.

Remarked: No specimen

Discussion: The specimens are unavailable, only photographs in fieldwork are available. Those colonies found in this study are similar to figure 3 p. 218 in Veron (2000).

8.3 *Montastrea colemani* Veron, 2000

Taxonomic references: none. **Identification guides:** Veron (2000). *Photographs:* Kampee Patisayna

Material studied:

02/36; Mark Trat/ flat

Characters: Colonies are submassive to encrusting, with compact rounded corallites 5-7 mm diameter. 'Groove and tubercle' formations are well developed. Two cycles of septa clearly alternate; both are thickened over walls and are uniformly toothed. A paliform crown is well developed. Budding is entirely extratentacular. **Colour:** Uniform brown or brown with green centers. **Similar species:** *Montastrea valenciennesi* has a similar appearance underwater and is distinguished by having larger, more irregular corallites.

Discussion: The specimen of this species shows characteristics that fit very well with those described by Veron (2000). However, more details are needed to confirm because this is new species first described in Veron (2000).

This specimen looks similar to fig. 126 in Phongsuwan (1986). He described that they are subplocoid, with polygonal mature corallites, about 6 mm in diameter. This species is distinctly characterized by the presence of a groove or tubercle structures between corllites. However, he described these specimens as *Montastrea valenciennesi* which Veron et at. (1977) and Veron (1986, 2000) described that *Montastrea valenciennesi* has hexagonal corallites, 8-15 mm in diameter.

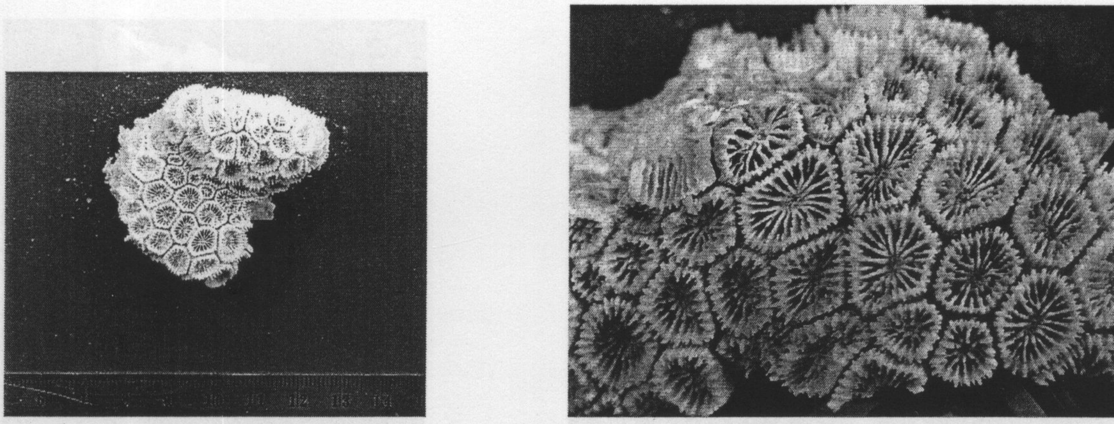


Figure 60 Specimen number 02/36 *Montastrea colemani*

8.4 *Montastrea valenciennesi* Chevalier, 1971

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

02/34; Mark Trat/ flat 02/35; Kraboong Trat/ flat

Characters: Colonies are usually massive submassive or flattened, sometimes encrusting. Corallites are distinctly polygonal, usually hexagonal with angular corallites 8-14 mm in diameter. Calice diameters are uniform in some colonies, very variable in others. Some colonies have an even regular surface, while other s have tightly interlocking, twisted calices giving a very convoluted appearance. "Groove and tubercle" formations are well developed. Long and short septa strongly alternate, are thickened over walls and are uniformly toothed. **Colour:** Usually green, brown or yellow with white septa and sometimes green oral discs. **Similar species:** *Montastrea colemani*. See also *M. magnistellata*.

Discussion: These specimens are corresponded with those described by Veron et al. (1977). Specimen no 02/34 shows the variation in corallites size, looks similar to fig. 279 whereas, the other specimen shows the characters similar to fig. 280 in Veron et al. (1977).

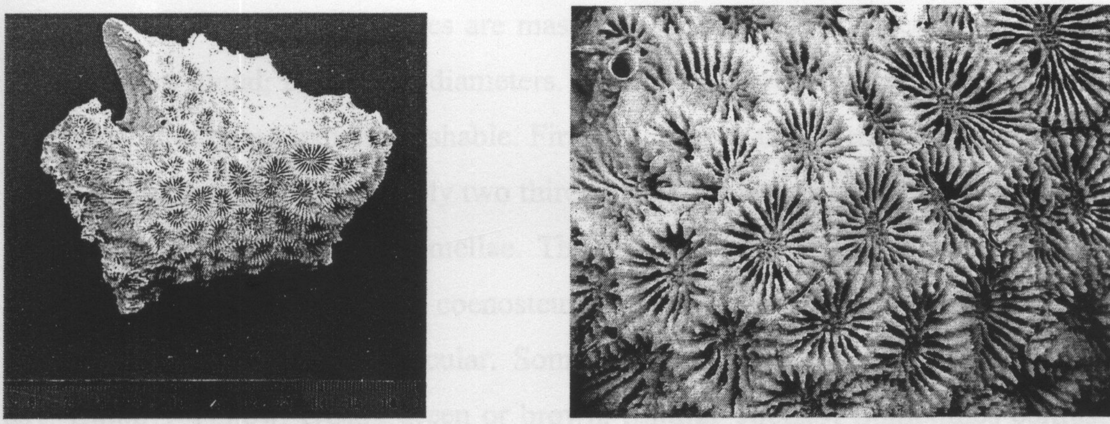


Figure 61 Specimen number 02/34 *Montastrea valenciennesi*

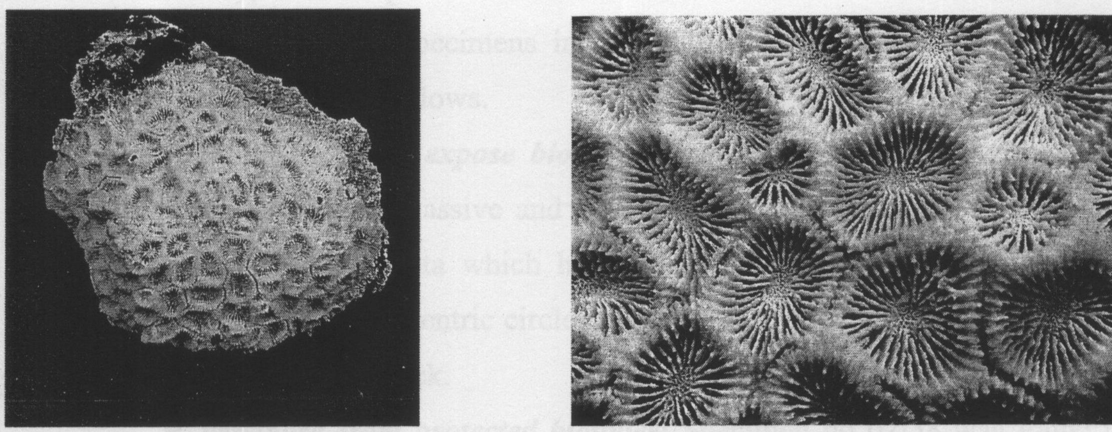


Figure 62 Specimen number 02/35 *Montastrea valenciennesi*

9. Genus *Plesiastrea* Milne Edwards and Haime, 1848

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000)

Characters: Colonies are massive, rounded or flattened. Corallites are small, rounded, plocoid and are formed by extratentacular budding. **Similar genera:** This is poorly defined genus. *Plesiastrea versipora* is the only common and widespread species.

9.1 *Plesiastrea versipora* (Lamarck, 1816)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

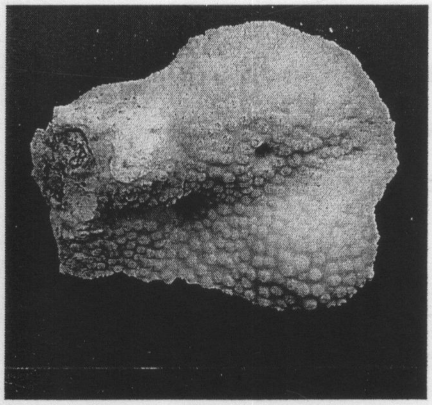
02/37; Talu Prachuap/slope 02/38; Rang Trat/ slope

Characters: Colonies are massive or encrusting, sub-cerioid or plocoid. Corallites are round, 2-4 mm in diameters. Septa are in three orders, those of the first two sometimes being indistinguishable. First order septa are exsert to varying degrees and project inwards approximately two thirds of the calice radius. Paliform lobes form a neat circle around small columellae. The columella are small, usually consisting only of a few pinnacles. The coenosteum may be smooth, or ornamented with granules. Budding is extratentacular. Sometimes tentacles are extended during the day. **Colour:** Yellow, cream, green or brown. **Similar species:** Sometimes confused with other faviids with corallites of similar size notably *Favia stelligera* and some *Montastrea* and *Cyphastrea* species.

Discussion: The specimens in this collection show skeletal variations corresponding to biotopes as follows.

P. versipora from expose biotopes: Specimen no 02/37 was found in exposed biotopes. Colony is massive and relatively dense. Calices are shallow and densely packed with thick septa which have thick, wedge-shaped paliform lobes. Frequently there are two monocentric circles of paliform lobes, both on the first order septa. Thecae and costae are thick.

P. versipora from protected biotopes: Specimen no 02/38 was found in protected biotopes. Colony is massive and characteristically has a low density. Like *Cyphastrea* species from similar biotopes, the corallites are set well apart and are relatively exsert. The thecae are thin and the coenosteum are blisters.



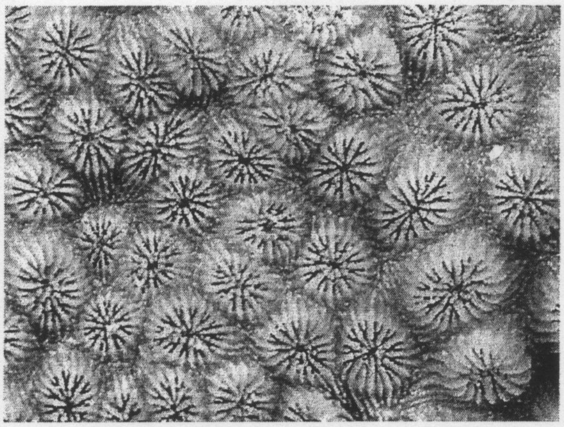


Figure 63 Specimen number 02/37 *Plesiastrea versipora*

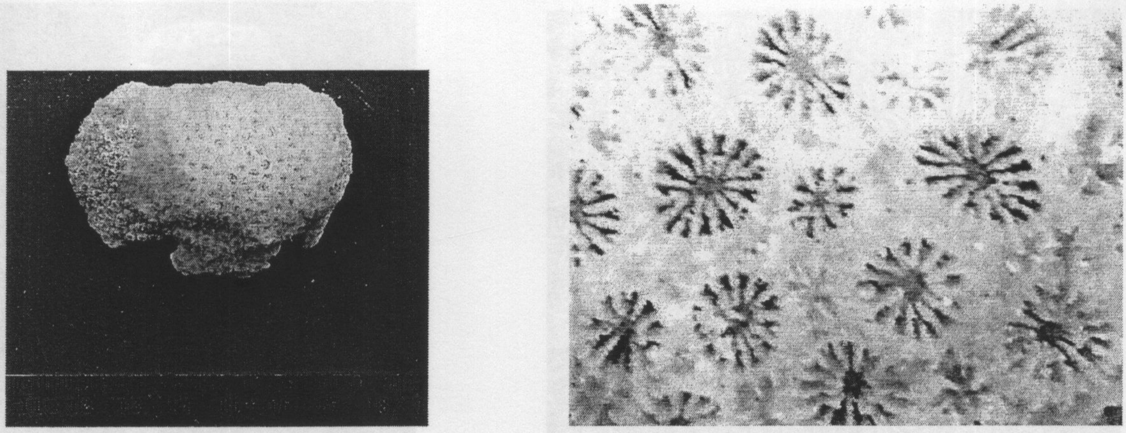


Figure 64 Specimen number 02/38 *Plesiastrea versipora*

10. Genus *Oulastrea* Milne Edwards and Haime, 1848

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000)

Characters: This genus has only one species, see *Oulastrea crispata.*

10.1 *Oulastrea crispata* Milne Edwards and Haime, 1848

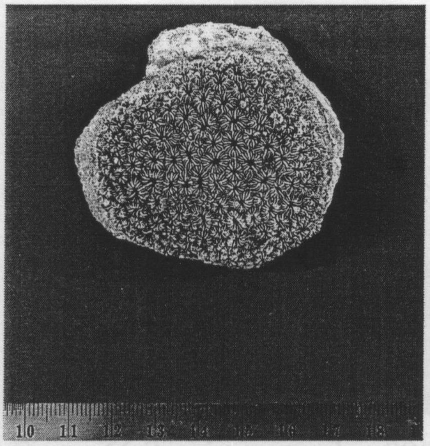
Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/100; KangKao Chonburi/ slope

Characters: Colonies are encrusting and small (5-10 cm across). Corallites like a small *Montastrea* which are of uniform size (2-5 mm) and are closely compacted. Long and short septa are alternate. Paliform lobes are well developed. Tentacles are sometimes extended during the day. **Colour:** Black with white upper margins to septa. Dried skeletons are also black and white. **Similar species:** None.

Discussion: This is an easily recognized species of Faviidae because skeletons are black with white septa.



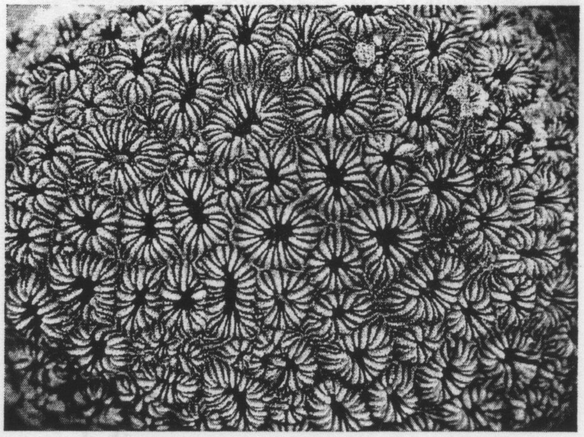


Figure 65 Specimen number 99/100 *Oulastrea crispata*

11. Genus *Diploastrea* Matthai, 1914

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000)

Characters: This genus has only one species, see *Diploastrea heliopora.*

11.1 *Diploastrea heliopora* (Lamarck, 1816)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/31; Kram Chonburi/ flat 99/105; MonNai Rayong/ slope

99/132; Kudee Rayong/ slope

Characters: Colonies are dome-shaped with an even surface and may be up to 2 meters high and 5 meters across. They are characteristically symmetrical in shape, with a very uniform surface. The skeleton is dense and very hard. Corallites form low cones with small openings and very thick walls. Columellae are large. Septa are equal and are thick at the wall and thin where joining the columellae. Tentacles are extended only at night. **Colour:** Usually uniform cream or grey, sometimes greenish. **Similar species:** None. This is one of the most easily recognized and least variable of all massive corals.

Discussion: Crossland (1952) appropriately comments, "This species is one of the few corals immediately recognizable, and which has been given this specific name by almost all authors. The numerous figure published show no striking variation: only the toothing of the septa may be more or less pronounced".

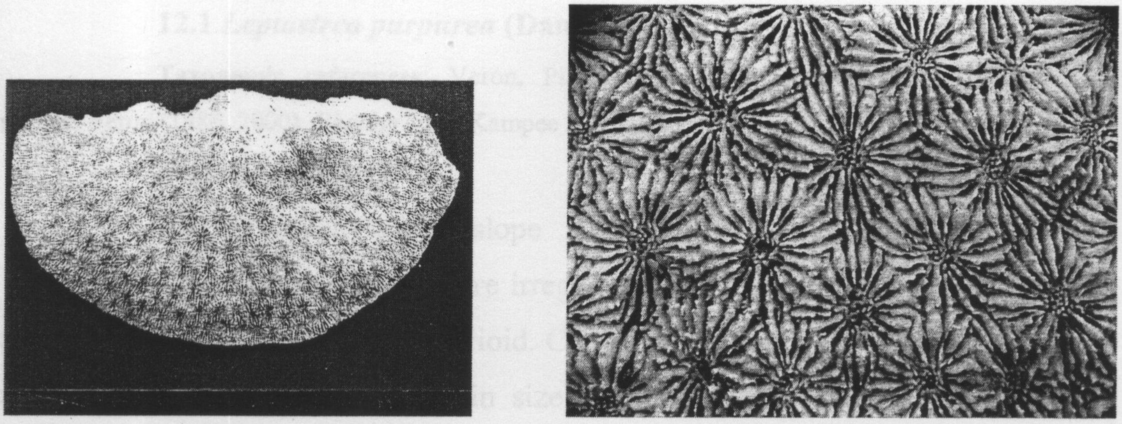


Figure 66 Specimen number 99/31 *Diploastrea heliopora*

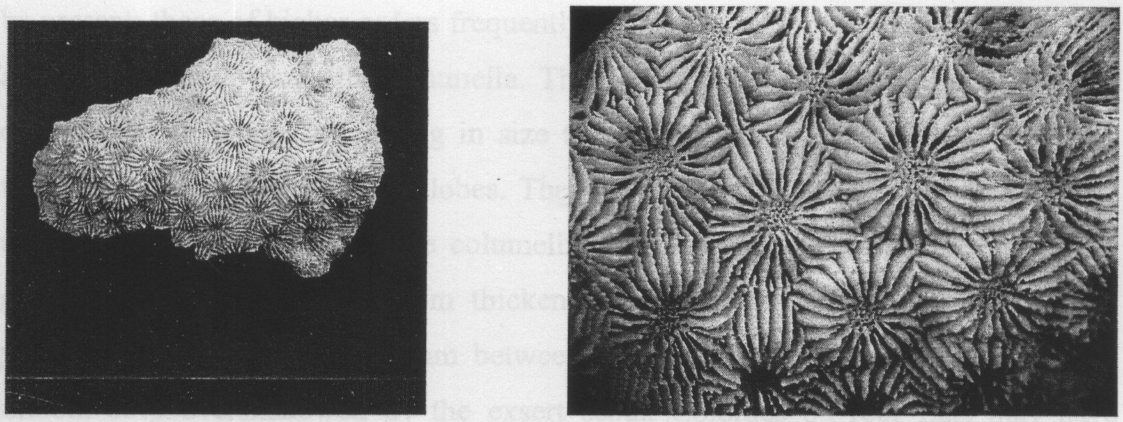


Figure 67 Specimen number 99/132 *Diploastrea heliopora*

12. Genus *Leptastrea* Milne Edwards and Haime, 1848

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000)

Characters: Colonies are massive, usually flat or dome-shaped. Corallites are cerioid to subplocoid. Costae are poorly developed or absent. Columellae consist of vertical pinnules. Septa have inward projecting teeth. The upper surfaces of colonies of most species growing in intertidal habitats are usually pale. Tentacles are sometimes extended during the day; in *Leptastrea pruinosa* they are always at least partly extended. **Similar genus:** *Leptastrea* is a well-defined genus closest to *Cyphastrea* which is plocoid with widely separated corallites.

12.1 *Leptastrea purpurea* (Dana, 1846)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/131; Kudee Rayong/ slope

Characters: Colonies are irregular, encrusting, and massive or flat with angular shaped. Colonies are sub-cerioid. Corallites are always discrete and polygonal and are characteristically variable in size (2-11 mm in diameter), smaller calices usually occurring in clusters at the base of depressions or around worm or gastropod holes. There are a wide variation of septal arrangements, four incomplete cycles may be present; those of higher orders frequently fuse with lower ones or else extend only a short distance towards the columella. They may be smooth edged but are usually dentate, the dentations increasing in size toward the calice center, where they may form inwardly sloping paliform lobes. Their edges are straight or gently curved and usually slope gently towards the columellae. Their sides are usually conspicuously granulated. The septa are seldom thickened above the thecae. Costae are usually poorly developed; the coenosteum between adjacent corallites is usually a narrow, smooth strip overshadowed by the exsert septa. Colonies on reef flats may have several corallites in shallow valleys. Septa are tightly compact, approximately similar in size, and have margins that slope uniformly towards the corallite center. Coloumellae are small and compact. **Colour:** Usually pale yellow, greenish or cream on the upper surface and dark sides. **Similar species:** *Leptastrea transversa*, which has more uniformly sized corallites and less compact septa with plunging inner margins. *Leptastrea pruinosa* has septa in more distinct orders and tentacles extended during the day.

Discussion: The specimen of this species shows characteristics that fit very well with those described by Veron et al. (1977). This specimen corresponded with *Leptastrea purpurea* from protected biotopes. Colonies growing in turbid water are usually thin and encrusting. Calicular structures tend to close together with *Leptastrea pruinosa*. Septa are moderately exsert.

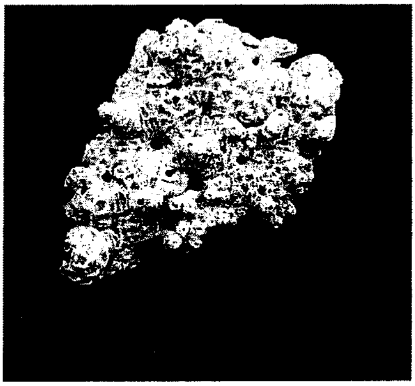
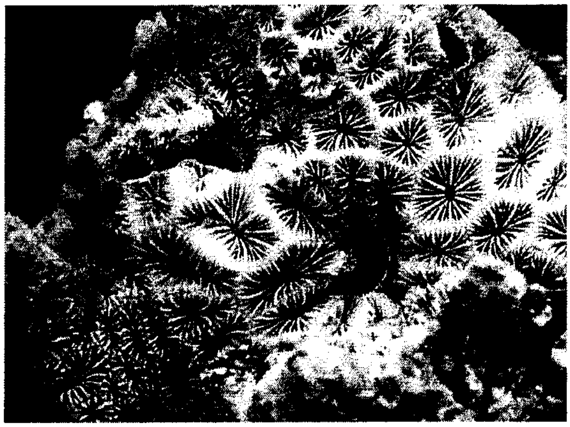
 

Figure 68 Specimen number 99/131 *Leptastrea purpurea*

12.2 *Leptastrea pruinosa* Crossland, 1952

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/81; KangKao Chonburi/ slope 02/42; Mark Trat/ flat

Characters: *Leptastrea pruinosa* is difficult to identify from *Leptastrea* purpurea. *Leptastrea pruinosa* is readily recognized underwater. Polyps are frequently expanded during the day whereas *Leptastrea purpurea* are usually nocturnal and colour differences are usually striking. Whereas *Leptastrea purpurea* is usually creamy-yellow, *Leptastrea. pruinosa* is usually a dark chocolate brown, normally with a green oral disc. Sometimes *Leptastrea pruinosa* are pale or green, almost white and sometimes very bright. Occasionally, the stomodeum is a different colour from the surrounding oral disc. Septa are in distinctive cycles and have granulated sides and margins. Septa are in 3-4 regular orders. They may descend into calices with gentle slope. The first two orders septa always reach the columellae and the first are most exsert. All septa have dentations of the first two order septa are formed into indistinct paliform lobes surrounding or intermixing with columella which are composed of one or a few pinnacles. **Colour:** Commonly chocolate brown or pink with green or cream calices. **Similar species:** Readily identified underwater by having extended polyps during the day. Skeletons are differentiated from *Leptastrea purpurea* by having granulated septa giving a frosted appearance.

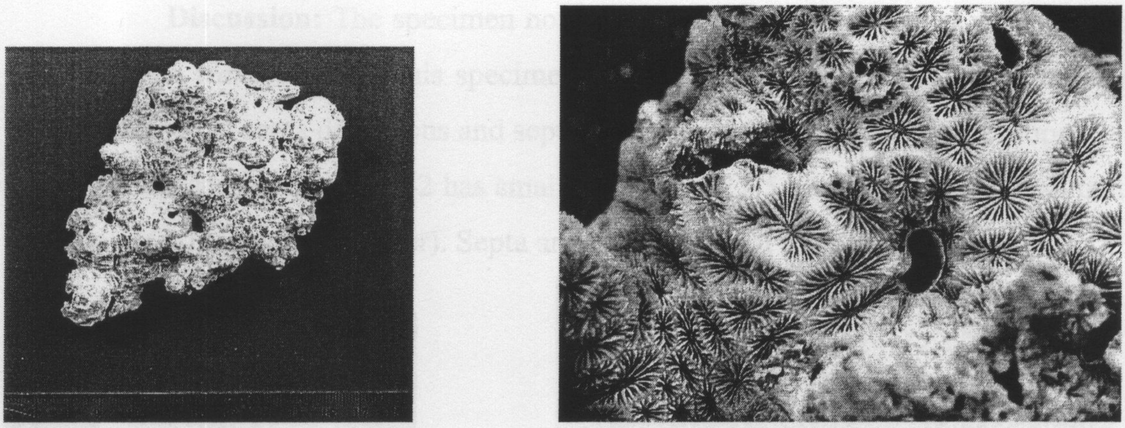


Figure 68 Specimen number 99/131 *Leptastrea purpurea*

12.2 *Leptastrea pruinosa* Crossland, 1952

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/81; KangKao Chonburi/ slope 02/42; Mark Trat/ flat

Characters: *Leptastrea pruinosa* is difficult to identify from *Leptastrea* purpurea. *Leptastrea pruinosa* is readily recognized underwater. Polyps are frequently expanded during the day whereas *Leptastrea purpurea* are usually nocturnal and colour differences are usually striking. Whereas *Leptastrea purpurea* is usually creamy-yellow, *Leptastrea. pruinosa* is usually a dark chocolate brown, normally with a green oral disc. Sometimes *Leptastrea pruinosa* are pale or green, almost white and sometimes very bright. Occasionally, the stomodeum is a different colour from the surrounding oral disc. Septa are in distinctive cycles and have granulated sides and margins. Septa are in 3-4 regular orders. They may descend into calices with gentle slope. The first two orders septa always reach the columellae and the first are most exsert. All septa have dentations of the first two order septa are formed into indistinct paliform lobes surrounding or intermixing with columella which are composed of one or a few pinnacles. **Colour:** Commonly chocolate brown or pink with green or cream calices. **Similar species:** Readily identified underwater by having extended polyps during the day. Skeletons are differentiated from *Leptastrea purpurea* by having granulated septa giving a frosted appearance.

Discussion: The specimen no 99/81 has corallites characters very similar to *Leptastrea transversa* but this specimen can be distinguished from the former by the appearance of septa dentations and septa descend into calices very gentle slope.

The specimen no 02/42 has smaller corallites (2-5 mm in diameter) than that one above (3-11 mm in diameter). Septa are extremely neat in appearance.

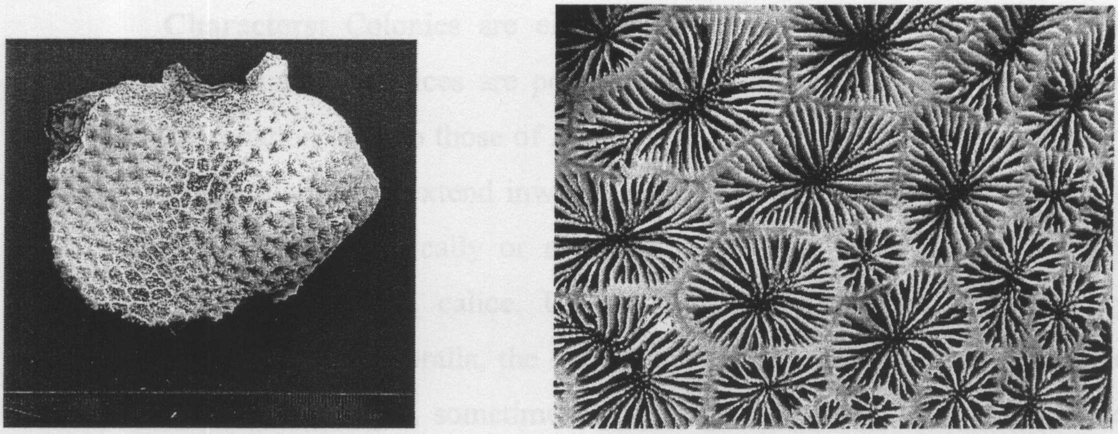


Figure 69 Specimen number 99/81 *Leptastrea pruinosa*

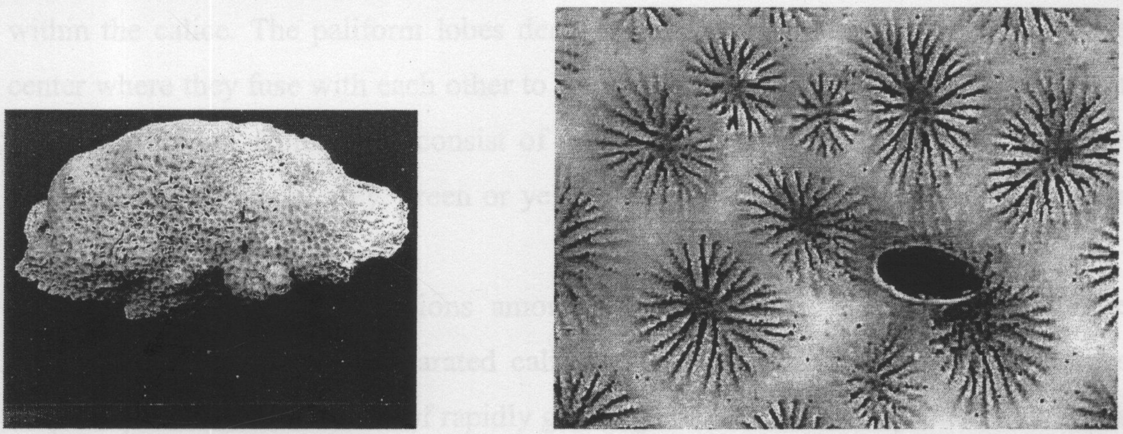


Figure 70 Specimen number 02/42 *Leptastrea pruinosa*

12.3 *Leptastrea transversa* Klunzinger, 1879

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/60; Kram Chonburi/ flat
99/64; Kram Chonburi/ flat
99/75; KramNoi Chonburi/ slope
99/85; KangKao Chonburi/ slope
99/93; KangKao Chonburi/ slope
99/113; MonNai Rayong/ slope
99/114; MonNai Rayong/ slope
99/122; MonNai Rayong/ slope

99/128; Kudee Rayong/ slope   99/135; Kudee Rayong/ slope
99/142; Kudee Rayong/ slope   99/143; Kudee Rayong/ slope
99/144; Kudee Rayong/ slope   99/169; Kudee Rayong/ slope
99/170; Kudee Rayong/ slope   99/171; Kudee Rayong/ slope
02/41; Talu Prachuap/ slope

Characters: Colonies are either massive or encrusting and flat with angular, cerioid corallites. Calices are polygonal, 2-9 mm in diameter. They show much less size variation than do those of *L. purpurea*. The septa are characteristically deeply plunging; usually they extend inwards approximately two-thirds of the calice radius before descending vertically or near vertically. The septa usually strongly dentate near the base of the calice. Up to four orders may be present, very occasionally a fifth. In most coralla, the first two orders are indistinct; they become thickened on the inner margin, sometimes appearing arrow-shape as in *Cyphastrea* species. Second order septa are sometimes fused with those of the first order, deep within the calice. The paliform lobes dentations become vertical towards the calice center where they fuse with each other to form compact, elongated base, supporting a series of papillae. Columellae consist of a few pinnules aligned in a row and often fused. **Colour:** Usually grey, green or yellow with dark sides to the colony. **Similar species:** *Leptastrea purpurea*.

Discussion: Variations among these specimens are thickening of the walls, creating small, well-separated calices. Such thickening and crowd corallites frequently occurs on the sides of rapidly growing colonies whose tops have thin walls and smalls, frequently dividing corallites.

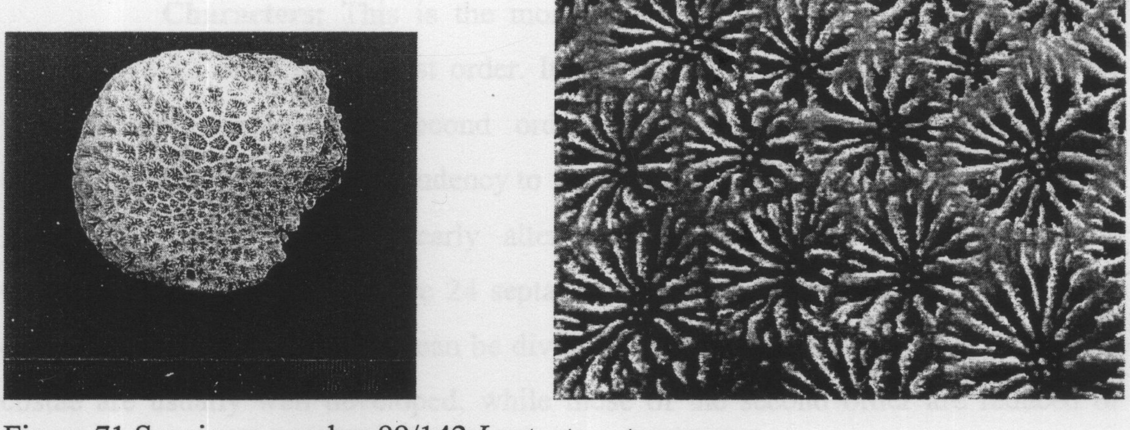


Figure 71 Specimen number 99/142 *Leptastrea transversa*

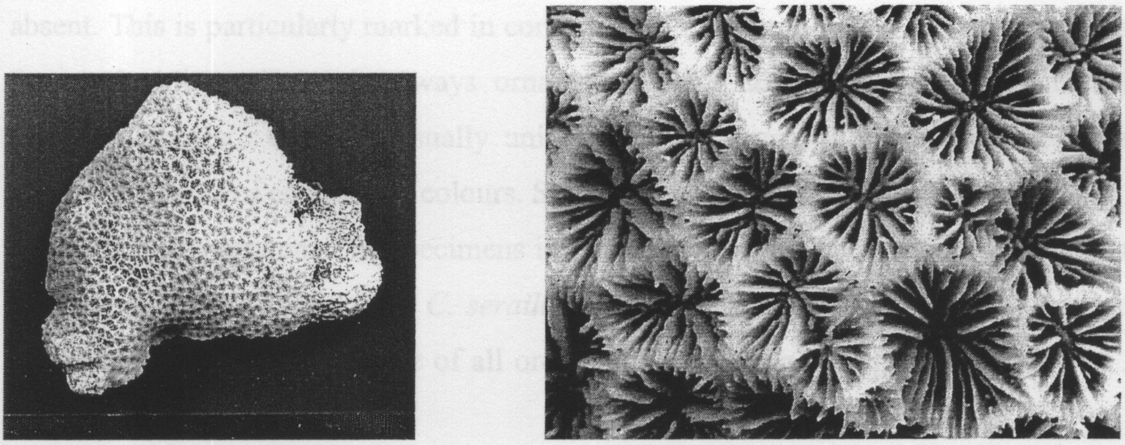


Figure 72 Specimen number 02/41 *Leptastrea transversa*

13. Genus *Cyphastrea* Milne Edwards and Haime, 1848

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides**: Veron (1986, 2000).

Characters: Colonies are massive or encrusting. Corallites are plocoid, with small calices. Costae are generally restricted to the corallite wall; the coenosteum is granulated. Tentacles are usually extended only at night. **Similar genera:** *Cyphastrea* is a well distinguished by having larger corallites with better developed paliform lobes and by having costae of adjacent corallites in contact, with no coenosteum granules.

13.1 *Cyphastrea chalcidicum* (Forskal, 1775)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/84; KangKao Chonburi/ slope	99/89; KangKao Chonburi/ slope
99/118; Kudee Rayong/ slope	02/39; Rang Trat/ slope

Characters: This is the most readily recognizable of the *Cypahstrea* which have 12 septa of the first order. It is primarily characterized by having very unequal septo-costae, with second order costae being abortive. Colonies are encrusting to massive, with a tendency to form columns. Corallites are usually widely spaced and conical, with clearly alternating costae which are easily visible underwater. Mature calices have 24 septa in two markedly unequal orders. In some coralla, septa of the first order can be divided into two hexameral cycles. First order costae are usually well developed, while those of the second order are reduced or absent. This is particularly marked in corallites with exsert thecae. The coenosteum is frequently blistered and is always ornamented with large numbers of granulated exothecal spines. **Colour:** Usually uniform brown, green or cream with corallite walls and calices of contrasting colours. **Similar species:** *Cyphastrea serailia*.

Discussion: The specimens in this collection have characters that make it difficult to separate them from *C. serailia*. In these specimens, corallites appearance similar to *C. seralia*, the costae of all orders are subequal as in the appearance of *C. serailia*.

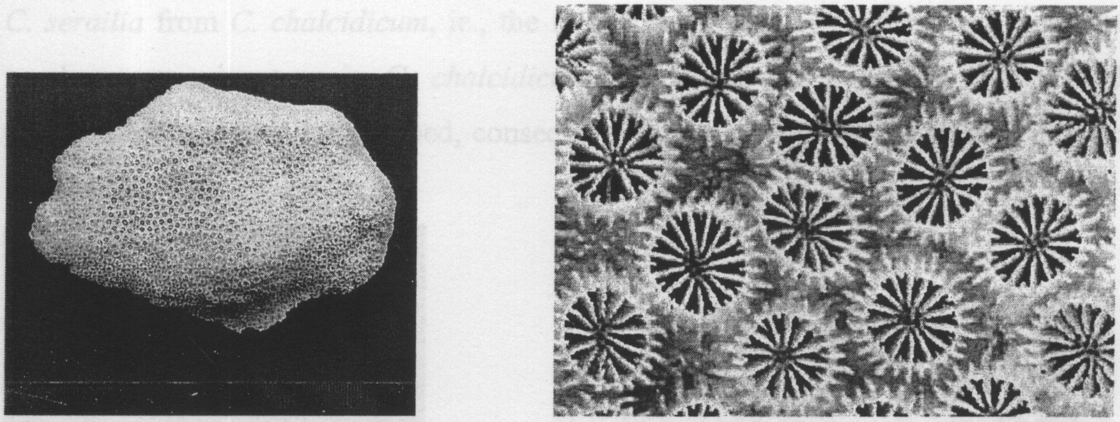


Figure 73 Specimen number 99/84 *Cyphastrea chalcidicum*

13.2 *Cyphastrea serailia* (Forskal, 1775)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/63; Kram Chonburi/ slope 99/177; MonNai Rayong/ slope

Characters: Colonies are usually massive or sub-massive sometimes encrusting. Corallites are round and equal in size. Calices of mature corallites are 1.5-3 mm in diameter. Septa are in two very unequal orders of 12 each. First order speta usually cannot e differentiated into two cycles. They may plunge steeply or slope gently to the columellae. They usually have irregular, elongated dentations which point inwards. A paliform crown is usually present, the paliform lobes having a wide variety of shapes which vary from elongated pinnules to thick triangular wedges. Second order (tertiary cycle) septa seldom extend inwards more than half the calice radius. All septa are granulated on their margins and sides. The columellae are usually inconspicuous and trabecular. The costae are equal or subequal and are frequently poorly developed. They are heavily ornamented with granulated perithecal spines. The coenosteum is often largely composed of dissepimental blisters and is always covered with granulated exothecal spines. Costae do not alternate strongly. **Colour:** Usually uniform or mottled grey, brown or cream. **Similar species:** *Cyphastrea chalcidicum*, which has well developed alternating costae. *Cyphastrea micropthalma* has 10 primary septa.

Discussion: As Veron et al. (1977) gave the specific rules for separating *C. serailia* from *C. chalcidicum*, ie., the former has costae of the first two cycle not nearly so prominent as in *C. chalcidicum*. All costae are poorly developed and paliform lobes are well developed, consequently these specimens are classified to be *C. serailiai*.

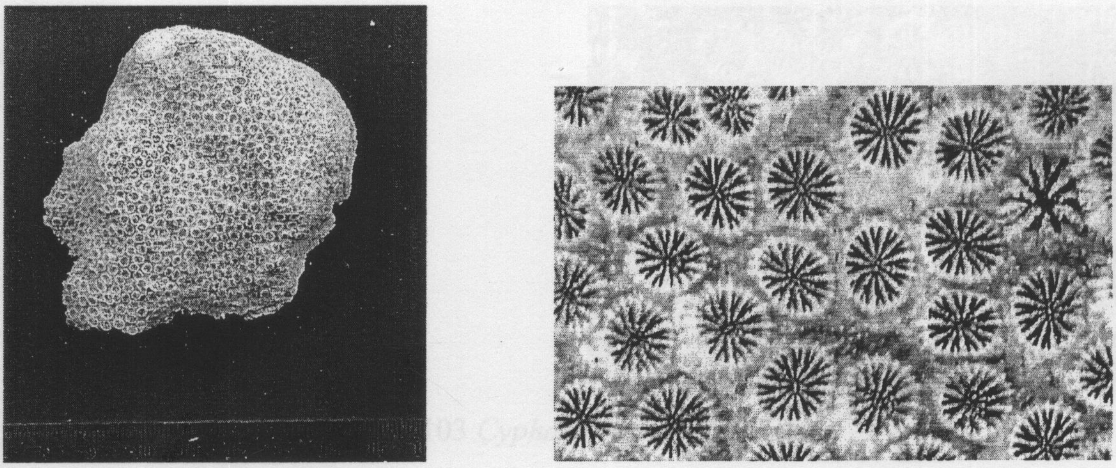


Figure 74 Specimen number 99/177 *Cyphastrea serailia*

13.3 *Cyphastrea microphthalma* (Lamarck, 1816)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/88; KangKao Chonburi/ slope
99/90; KangKao Chonburi/ slope
99/102; MonNai Rayong/ slope
99/103; MonNai Rayong/ slope
99/115; MonNai Rayong/ slope
99/139; Kudee Rayong/ slope
99/140; Kudee Rayong/ slope
99/141; Kudee Rayong/ slope

Characters: Colonies are submassive, becoming thin encrusting plates where light levels are low. They commonly grow as mobile balls (corallites).

Corallites are tall and conical; compact in colonies exposed to strong light, widely spaced in encrusting colonies. They usually have 10 primary septa although this varies among corallites. First order septa reach the columella while second order exsert in the calice, about one-fourth of the calice radii. All septa have relatively prominent, irregular dentations. The latter are usually developed as long spined-trabeculae. The prominent paliform lobes develop on first order septa. Costae are usually equal and support elongated, spinulated trabeculae which extend across coenosteum. **Colour:** Brown, cream or green, sometimes other colours. Septa are commonly white. **Similar species:** *Cyphastrea microphthalma* is readily identified by its 10 primary septa which are visible underwater.

Discussion: In this collection, corallites are slightly exsert and less conical in shape. There are no obvious variation among the specimens.

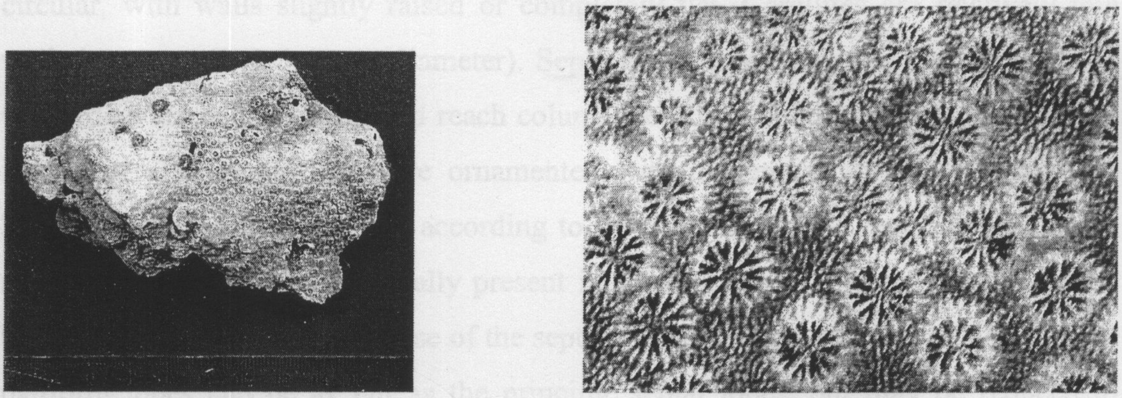


Figure 75 Specimen number 99/103 *Cyphastrea microphthalma*

14. Genus *Echinopora* Lamarck, 1816

Taxonomic references: Veron, Pichon and Wijsman-Best (1977). **Identification guides:** Veron (1986, 2000).

Characters: Colonies are massive, arborescent or laminar or mixtures of these forms. Corallites are plocoid, with calices up to 10 mm diameter. Septa are exsert and irregular. Columellae are usually prominent. Costae are mostly restricted to the corallite wall. The coenosteum is granulated. Tentacles are extended only at night. **Similar genera:** *Cyphastrea,* which is distinguished by having a massive or encrusting growth-form and smaller corallites. *Echinopora* has a superficial resemblance to *Echinophyllia* species (Pectinidae), especially *E. echinoporoides.*

14.1 *Echinopora lamellosa* (Esper, 1795)

Taxonomic references: Veron, Pichon and Wijsman-Best (1977), Phongsuwan (1986). **Identification guides**: Veron (1986, 2000). *Photographs*: Kampee Patisayna

Material studied:

99/38; Kudee Rayong/ slope	99/59; Kram Chonburi/ slope
99/65; KramNoi Chonburi/ slope	99/66; KramNoi Chonburi/ slope
99/68; KramNoi Chonburi/ slope	99/87; KangKao Chonburi/ slope
99/110; MonNai Rayong/ slope	99/111; MonNai Rayong/ slope
99/121; MonNai Rayong/ slope	99/133; MonNai Rayong/ slope
99/134; MonNai Rayong/ slope	02/44; MonNok Trat/ slope

Characters: Colonies are thin laminae arranged in whorls or tiers or, rarely, forming tubes, unifacial laminae tending to grow horizontally. Corallites are circular, with walls slightly raised or completely flat. Corallites are relatively thin walled and small (2.5-4 mm diameter). Septa are in three irregular orders. The first two orders are equally thick and reach columellae. Third order septa are rudimentary if present. The septal sides are ornamented with numerous, slightly elongated or lamellar granulations, arranged according to the direction of the septal trabeculae. A ring of paliform lobes is generally present in front of the first two cycles of septa., bearing graunules similar to those of the septa on their margin and lateral sides. These paliform lobes can be as tall as the principle septal lobes, but may be reduced to vertically projecting spiniform processes. Paliform lobes are connected to the septa by the fusion of subhorizontal dentations, leaving between them a vertical row of pores. The columellae are well developed, spongy and composed of the distal part of sub-vertical or slightly inclined trabeculae. Costae are variable developed equal or subequal, generally more distinct towards the upper margin. The exotheca is compact, composed of fused costae which are sometimes hardly distinguishable except in the peripheral area of the colony where they become laminar. These exothecal costae bear numerous, well developed spines, close to each other and arranged in regular, parallel rows except close to the corallites, where their disposition becomes confused. These exothecal spines have the same structure as the costae spines, and there is often a remarkable continuity, and uniformity of aspect between exothecal spines, costal spines and septal lobes. **Colour:** Amber, pale to dark brown or greenish, often with darker brown or green calices. **Similar species:** *Echinopora gemmacea*.

Discussion: *Echinopora lamellosa* displays a wide range of variations. Variations in growth forms and colony shapes, and wide variation in the development of septa and paliform lobes and in their ornamentation. In particular, spines may be more or less developed, and more or less granular or echinulate even in the same colony.

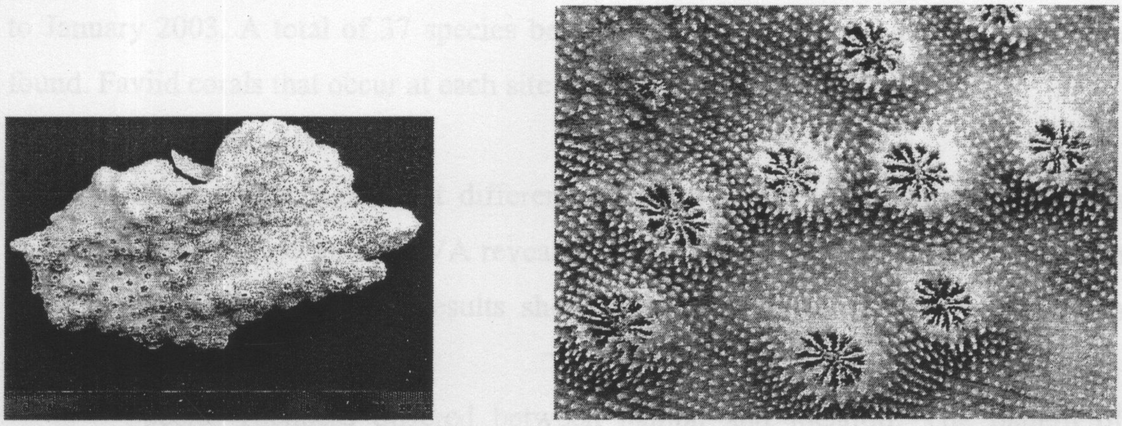


Figure 76 Specimen number 99/65 *Echinopora lamellosa*

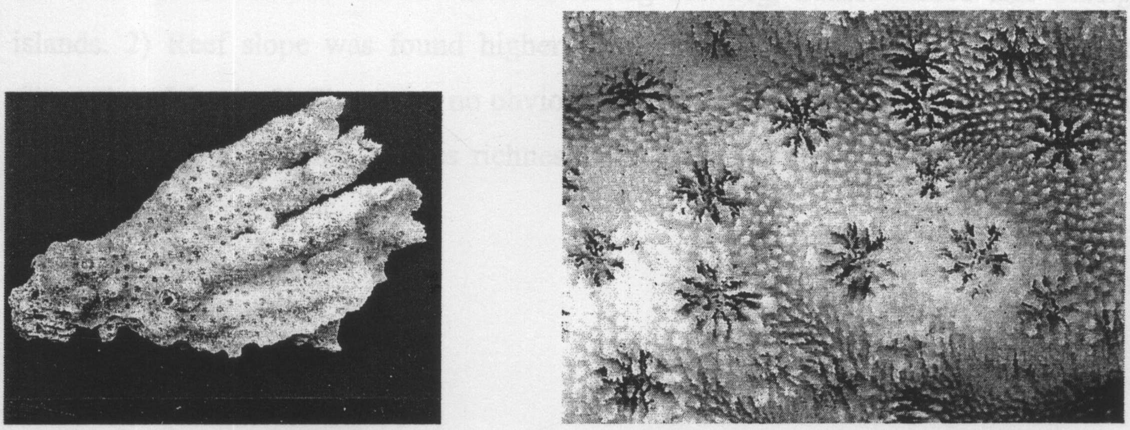


Figure 77 Specimen number 99/66 *Echinopora lamellosa*

Species and distribution

Distribution of corals in Family Faviidae was considered as 1) species and distribution 2) species diversity and 3) species composition. The results are as follows;

1. Distribution of faviid corals

There were 13,123 colonies of faviid coral counted on 47 sites of 33 reefs on 11 islands covered the area of 8460 m^2 along the Gulf of Thailand during April 2002 to January 2003. A total of 37 species belonging to 14 genera of faviid corals were found. Faviid corals that occur at each site were summarized in Table 2.

2. Species diversity

There was a significant difference of both Species Richness and Species Diversity Index (Table 3). ANOVA revealed a significant difference from interaction between habitat*location. The results showed that the difference between habitats depended on location (Figure 78).

Species Richness differed between habitat and location. The pattern of species richness revealed 3 groups. 1) Reef flat was higher species richness than that of reef slope in the east coast which including Sichang, Samet-Kudee and Chang islands. 2) Reef slope was found higher species richness than that of reef flat at Chumphon Islands. 3) There was no obviously pattern found in Kram, Mark and Talu islands. It was found that species richness and species diversity index showed that same pattern of coral.

Table 2 Distribution of corals in Family Faviidae in each island along the Gulf of Thailand.

Scientific name	Inner Gulf			East Coast					West Coast		
	Sichang	Phai	Kram	Samet	Mon	Chaolaw	Chang	Mark	Talu	Chumphon	Tao
Genus *Favia*											
Favia matthaii	+	+	+	-	+	-	+	+	+	-	-
Favia speciosa	+	+	+	+	+	+	+	+	+	+	+
Favia cf. truncatus	-	+	-	+	-	+	-	+	+	+	+
Favia pallida	+	+	+	+	+	+	+	+	+	+	+
Favia favus	+	+	+	+	+	+	+	+	+	+	+
Favia rotumana	-	+	-	+	-	+	+	-	-	-	-
Favia rotundata	-	-	-	-	-	-	-	+	-	-	-
Genus *Barabattoia*											
Barabattoia amicorum	-	-	-	-	-	-	+	+	-	-	-
Genus *Favites*											
Favites pentagona	-	+	+	+	-	+	+	-	+	+	+
Favites chinensis	-	-	-	+	-	+	+	-	-	+	-
Favites halicora	+	+	-	-	-	-	+	+	+	+	-
Favites abdita	+	+	+	+	+	+	+	+	+	+	+
Favites complanata	+	+	-	+	+	+	+	+	+	-	-
Genus *Goniastrea*											
Goniastrea retiformis	+	+	+	+	+	+	+	+	+	+	+
Goniastrea cf. aspera	+	+	+	+	+	+	+	+	+	+	-
Goniastrea cf. pectinata	+	-	-	+	+	+	+	+	-	-	+
Goniastrea pectinata	-	+	+	+	+	+	+	+	+	+	+
Genus *Platygyra*											
Platygyra pini	+	+	+	+	+	+	+	+	+	-	-
Platygyra sinensis	+	+	+	+	+	+	+	+	+	+	+
Platygyra cf. contorta	-	-	-	-	-	-	+	-	-	-	-

Table 2 (continued)

Scientific name	Inner Gulf			East Coast					West Coast		
	Sichang	Phai	Kram	Samet	Mon	Chaolaw	Chang	Mark	Talu	Chumphon	Tao
Platygyra daedalea	+	+	+	+	+	+	+	+	+	+	+
Platygyra lamellina	-	-	+	+	+	-	-	-	+	-	-
Genus *Oulophyllia*											
Oulophyllia bennettae	-	+	-	+	+	-	-	+	-	-	-
Genus *Leptoria*											
Leptoria phrygia	-	-	+	+	-	-	-	+	+	+	-
Genus *Montastrea*											
Montastrea curta	+	-	-	+	+	+	+	+	+	-	-
Montastrea cf. salebrosa	-	+	+	+	-	-	+	+	+	+	+
Montastrea colemani	-	-	-	-	-	-	-	+	-	-	-
Montastrea valenciennesi	-	-	-	+	-	-	-	+	-	-	-
Genus *Plesiastrea*											
Plesiastrea versipora	-	-	-	-	-	-	-	+	+	-	-
Genus *Oulastrea*											
Oulastrea crispata	+	+	-	-	+	+	+	+	-	-	-
Genus *Diploastrea*											
Diploastrea heliopora	-	-	-	+	+	-	+	+	+	+	+
Genus *Leptastrea*											
Leptastrea purpurea	+	+	+	+	+	-	+	+	+	+	+
Leptastrea pruinosa	+	+		+	+	+	+	+	+	+	-
Leptastrea transversa	+	+	+	+	+	-	+	+	+	+	+
Genus *Cyphastrea*											
Cyphastrea chalcidicum	+	+	+	+	-	+	+	+	+	+	+
Cyphastrea serailia	+	-	+	+	+	-	+	+	+	+	+

Table 2 (continued)

Scientific name	Inner Gulf			East Coast					West Coast		
	Sichang	Phai	Kram	Samet	Mon	Chaolaw	Chang	Mark	Talu	Chumphon	Tao
Cyphastrea microphthalma	-	-	-	-	+	-	+	+	-	-	-
***Genus* Echinopora**											
Echinopora lamellosa	-	+	+	+	+	-	+	+	+	+	+
Total Species	**20**	**24**	**20**	**29**	**24**	**20**	**30**	**33**	**27**	**22**	**18**

Table 3 ANOVA test between species richness, species diversity index and evenness index of faviid corals.

Source		df	Species Richness			Species Diversity Index			Evenness Index		
			Mean Square	F	Sig.	Mean Square	F	Sig.	Mean Square	F	Sig.
ISLANDS	Hypothesis	10	85.2	1.727	.142	.87	1.551	.197	.0040	2.057	.084
	Error	20.269	49.3			.56			.0019		
REEF	Hypothesis	22	47.2	2.063	.165	.55	1.214	.422	.0019	1.350	.359
	Error	7.001	22.9			.45			.0014		
HABITAT	Hypothesis	1	3.3	.146	.714	1.52	3.318	.111	.0016	11.128	.013*
	Error	6.991	22.9			.45			.0014		
ISLANDS * HABITAT	Hypothesis	6	34.7	1.517	.298	.61	1.337	.353	.0024	1.735	.244
	Error	6.994	22.9			.45			.0014		
HABITAT * REEF	Hypothesis	7	22.9	3.444	.002*	.45	3.432	.002*	.0014	.805	.584
	Error	139	6.6			.13			.0017		

Table 4 ANOVA test between total abundance and total area cover of faviid corals.

Source		df	Total Abundance				Total Area cover			
			Type I Sum of Squares	Mean Square	F	Sig.	Type I Sum of Squares	Mean Square	F	Sig.
ISLANDS A	Hypothesis	10	402468.96	40246.89	6.29	.00*	1730.34	173.03	1.30	.28
	Error	22	140666.96	6393.95			2917.08	132.59		
REEF B (A)	Hypothesis	22	140666.96	6393.95	.97	.52	2917.08	132.59	1.19	.34
	Error	22	143790.60	6535.93			2445.88	111.17		
HABITAT C	Hypothesis	1	114369.70	114369.70	17.49	.00*	2120.59	2120.59	19.07	.00*
	Error	22	143790.60	6535.93			2445.88	111.17		
ISLANDS * HABITAT	Hypothesis	10	668367.69	66836.77	10.22	.00*	3820.07	382.00	3.43	.00*
	Error	22	143790.60	6535.93			2445.88	111.17		
HABITAT * REEF	Hypothesis	22	143790.60	6535.93	12.67	.00*	2445.88	111.17	4.80	.00*
	Error	198	102135.16	515.834			4578.20	23.12		

Sig. * ≤ 0.05; statistically significant at .05 level.

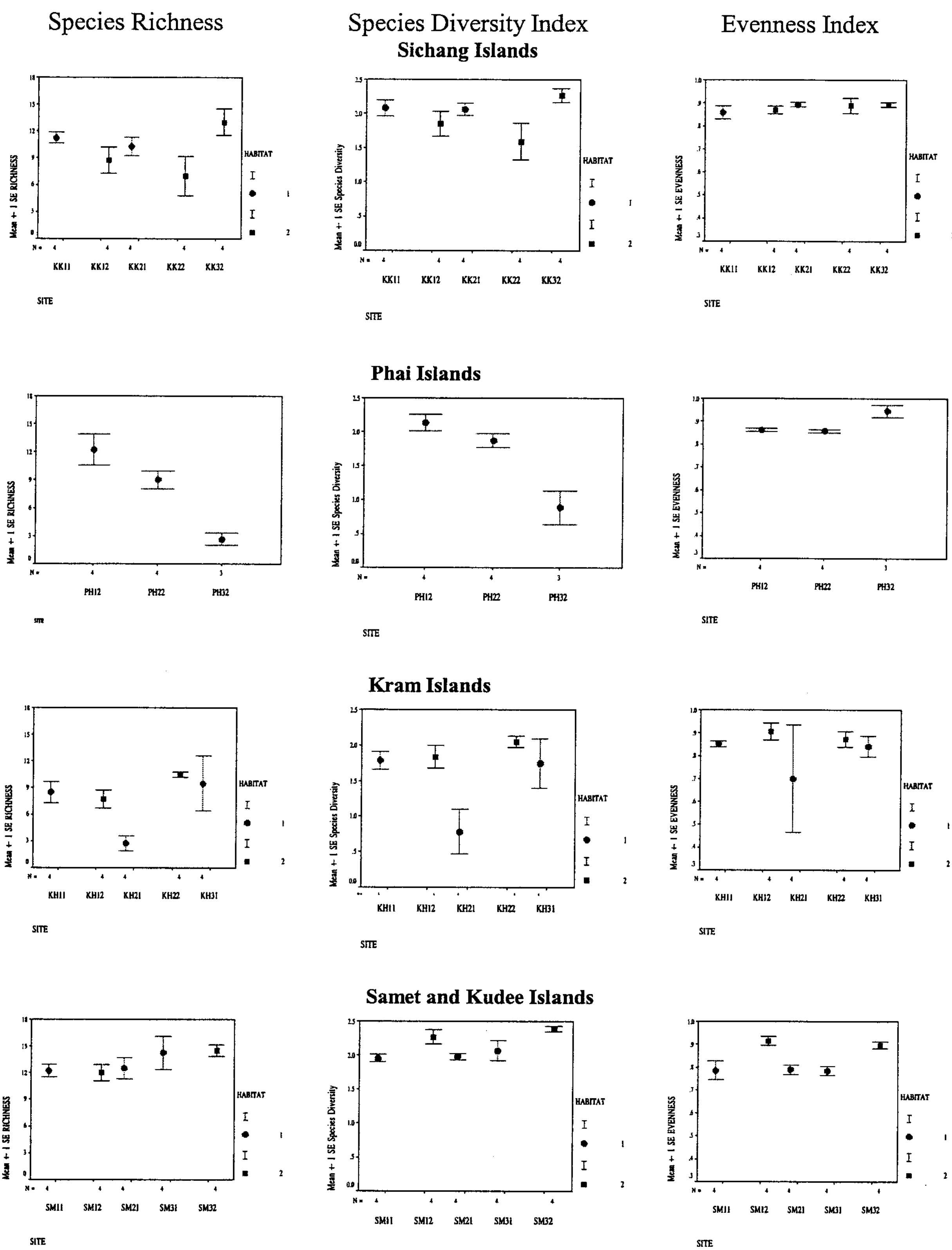
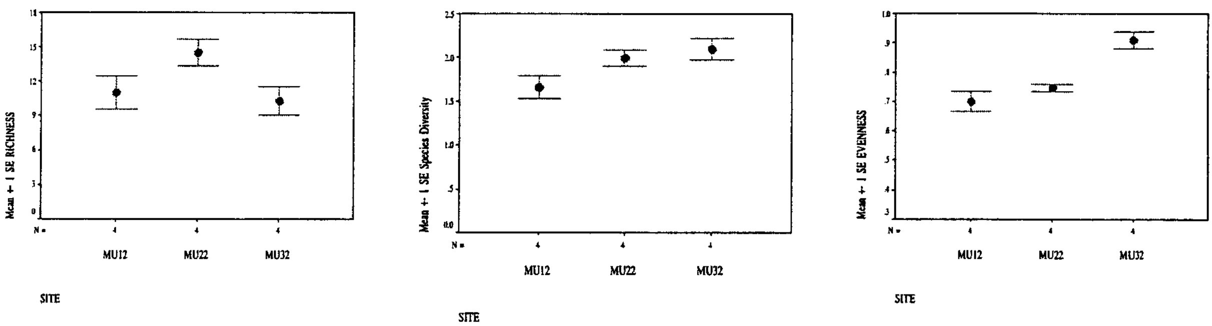


Figure 78 Community parameters at each site along the Gulf of Thailand.

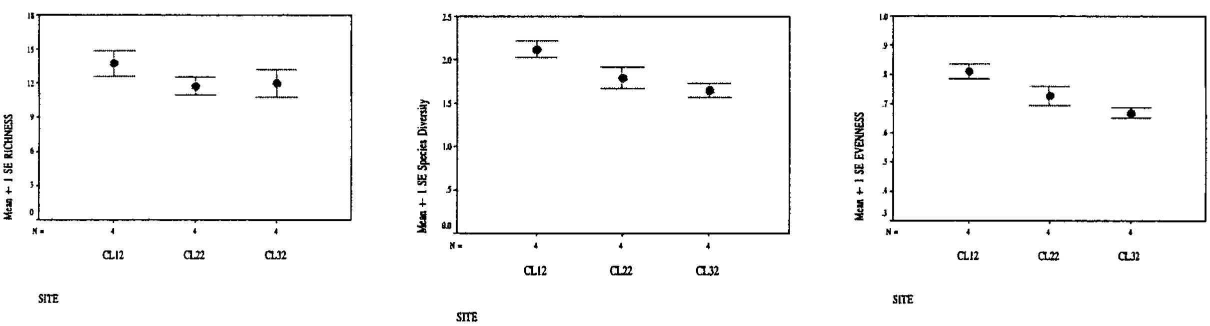
Habitat: 1= reef flat 2 = reef slop

Species Richness | Species Diversity Index | Evenness Index

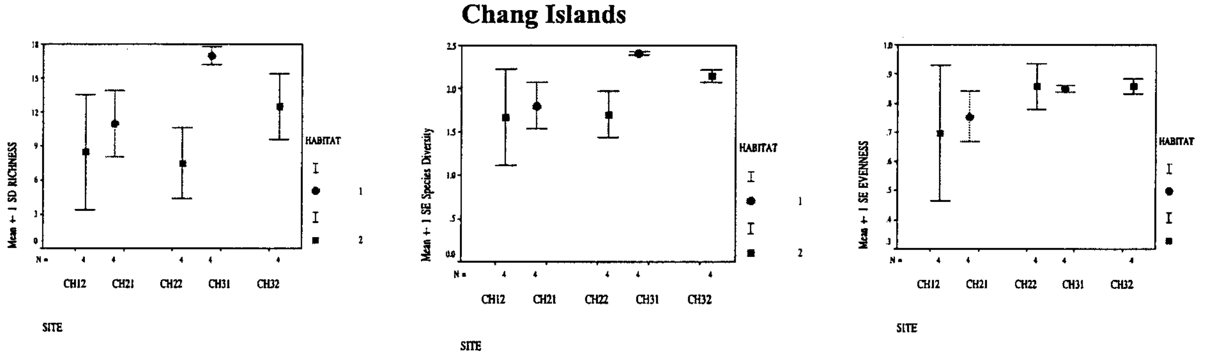
Mon Islands



Chaolaw Beach



Chang Islands



Mark Islands

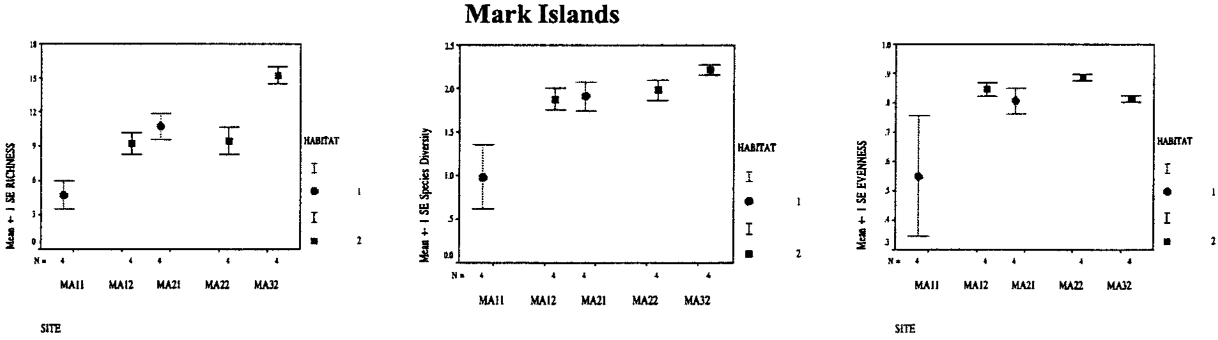
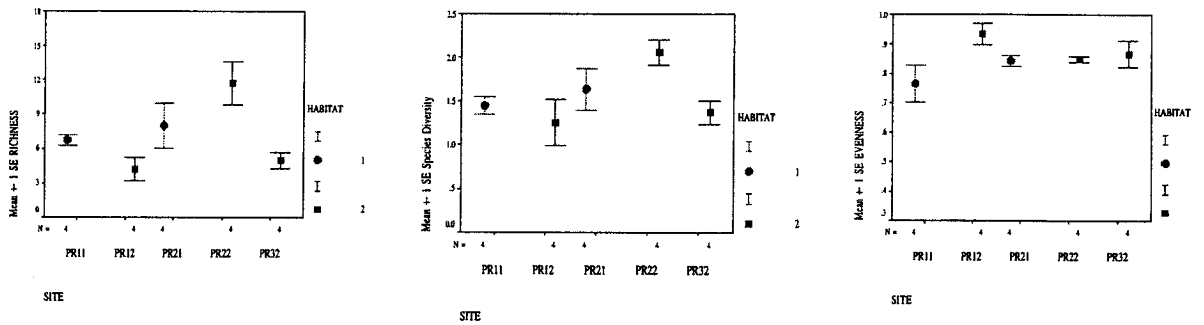


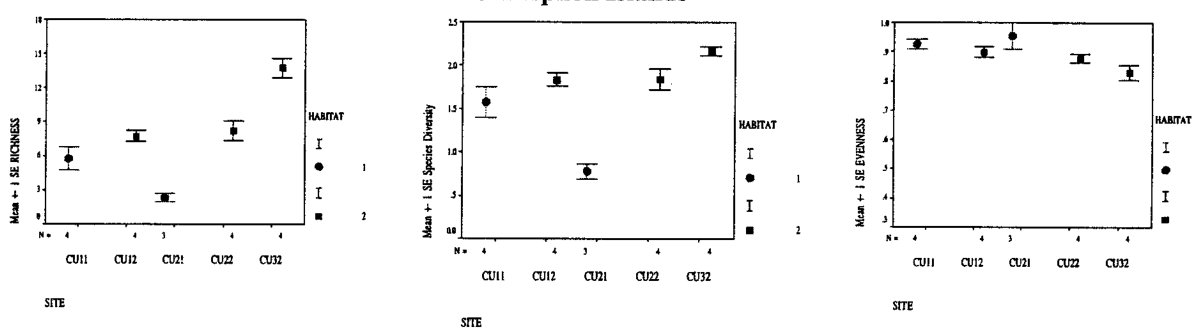
Figure 78 (continued)

Species Richness | Species Diversity Index | Evenness Index

Talu Islands



Chumphon Islands



Tao Islands

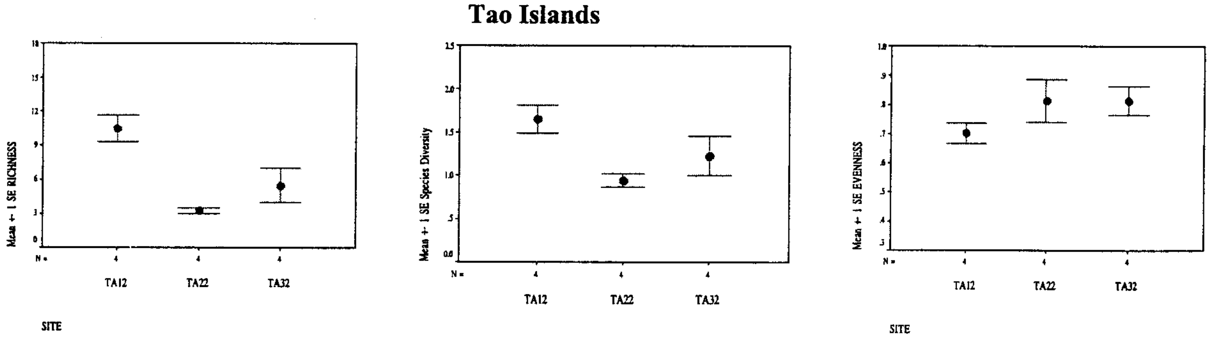


Figure 78 (continued)

3. Colonies abundance and area cover

Analysis of variance (ANOVA) was used for determined the significant of total colony abundance and total percentage cover of whole faviid corals at each reef assemblage. Colonies abundance and area cover of faviid corals were significantly different among location and habitat. This indicated the different between habitats depend on location. The result showed as in Table 4.

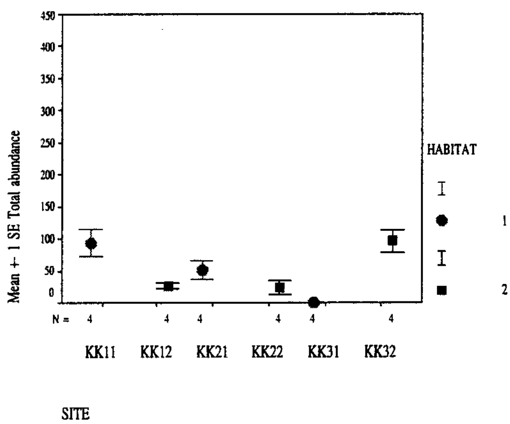
3.1 Colonies Abundance: Total colonies abundance of faviid coral in each islands group could be divided into 3 groups (Figure 79). Most of study sites had moderate mean colony abundance (20-100 colonies/45 m^2). The highest mean colony abundance (> 200 colonies/45 m^2) was found at Chaolaw Beach. High mean colonies abundance (101-200 colonies/45 m^2) was found at the reef flat of Kudee Island, Suwan Island and Changnoi Island and reef slope at Monnai Island and Rang Island. The last group had lowest mean colony abundance (fewer than 20 colonies/45 m^2) was found at reef flat at Ao Pudsawan Kram Island, Suwan Island, Matra Island, Lawa Island and reef slope at Ao Mung and Gongsaidang Tao Islands.

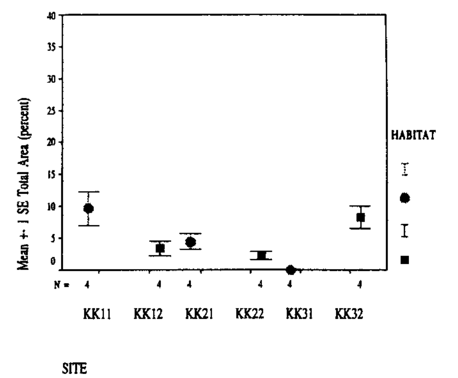
3.2 Area cover: Total area cover of faviid corals at each islands group could be divided into 3 groups (Figure 79). First group had high area cover (> 15% area cover) was found at Mon Islands and Chaolaw Beach. Second group had moderate area cover (5-15% area cover) was found at Sichang Islands, Samet and Kudee Islands, Talu Islands, Chumphon Islands and Tao Islands. Third group, low area cover (< 5% area cover) was found at Phai Islands, Kram Islands, Chang Islands and Mark Islands.

The results showed that, there was difference in colonies abundance and area cover of faviid corals at each Island. The pattern of distribution could be classified in to 2 patterns. 1) There was higher colonies abundance on reef flat than on reef slope at Sichang Islands, Kram Islands, Samet and Kudee Islands and Chang Islands. 2) There was higher colonies abundance on reef slope than reef flat at Phai Islands, Mon Islands, Chaolaw Beach, Mark Islands, Talu Islands, Chumphon Islands and Tao Islands.

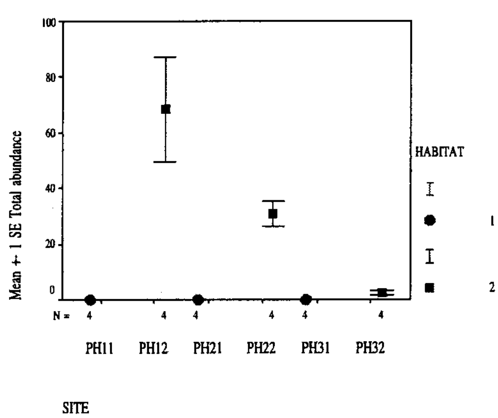
Total Abundance | Total Area Cover (%)

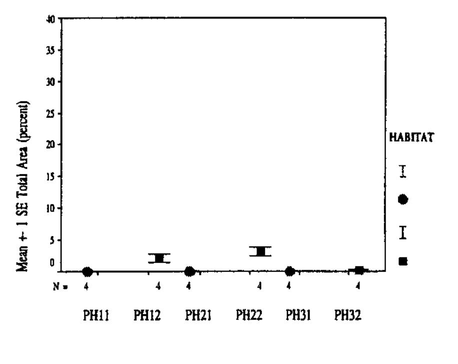
Sichang Islands



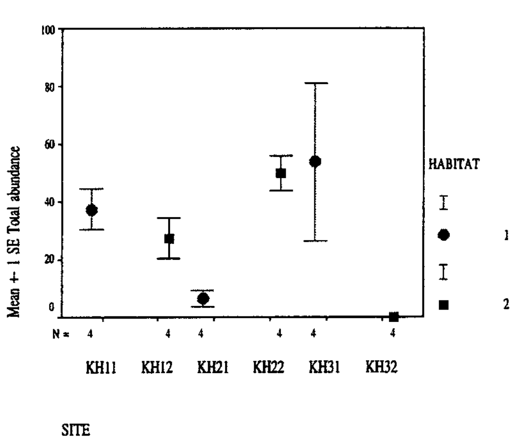


Phai Islands





Kram Islands



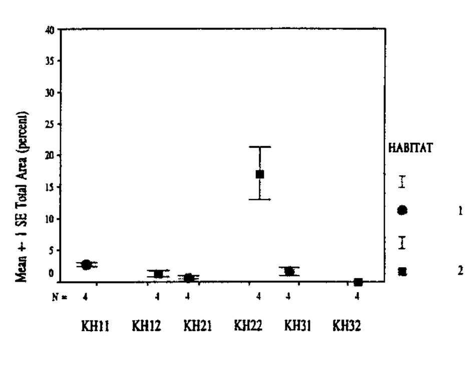


Figure 79 Colonies abundance (colonies/45m^2) and area cover (% cover) of faviid corals.

Habitat: 1 = reef flat 2 = reef slope

Total Abundance | Total Area Cover (%)

Samet Islands

Mon Islands

Chaolaw Beach

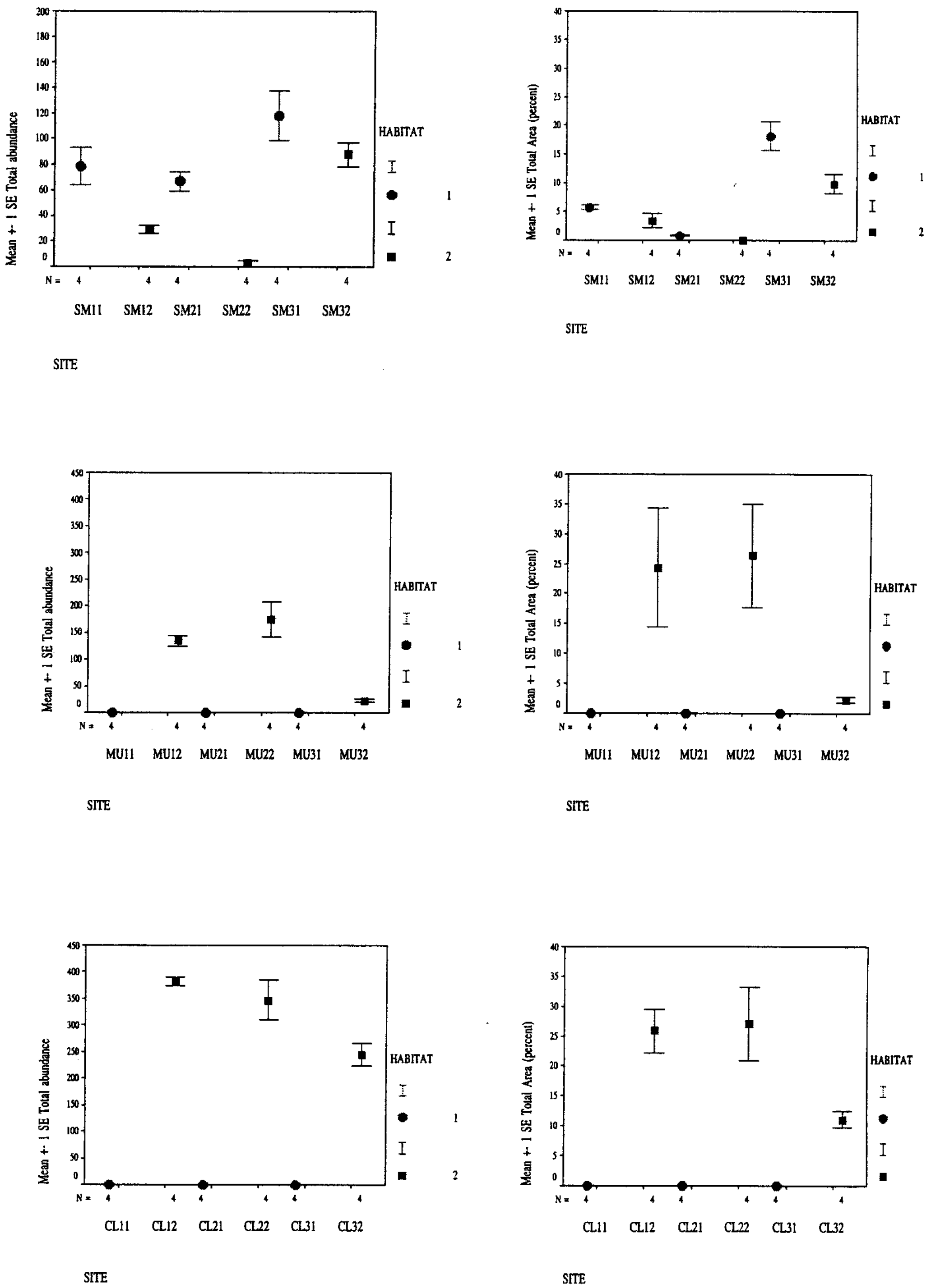
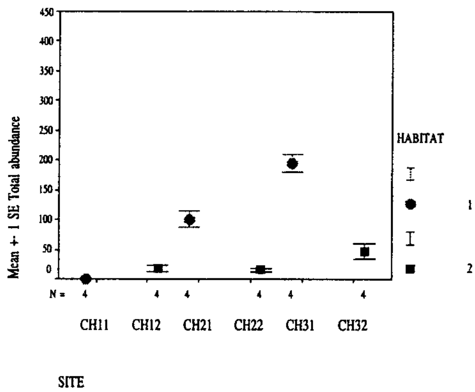
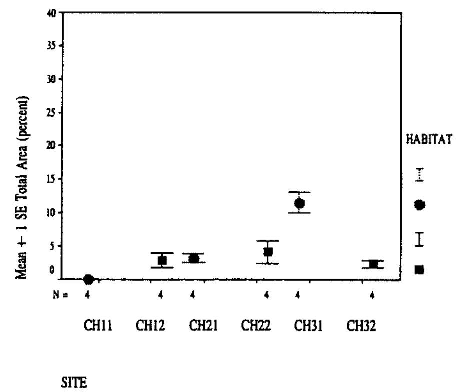


Figure 79 (continued)

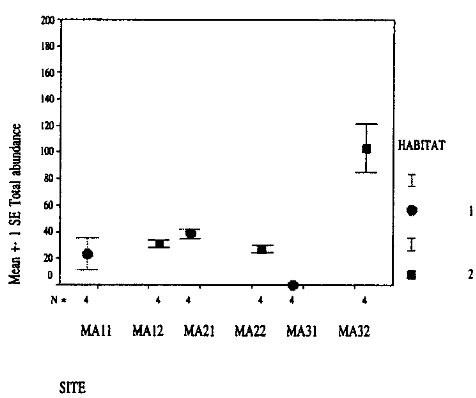
Total Abundance | Total Area Cover (%)

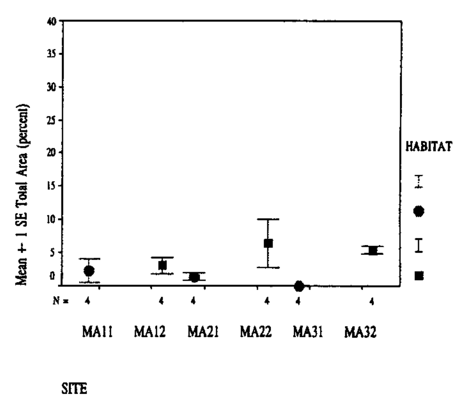
Chang Islands



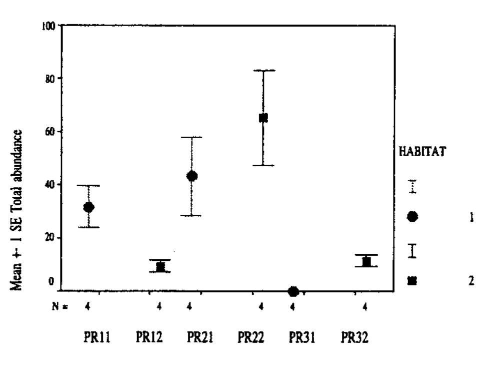


Mark Islands





Talu Islands



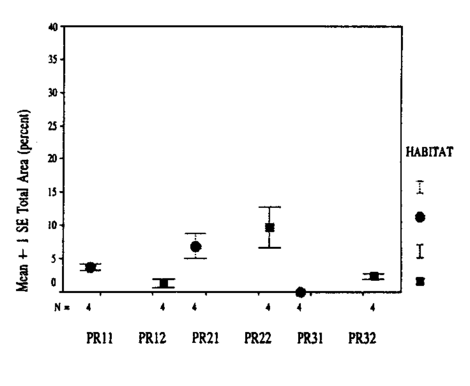
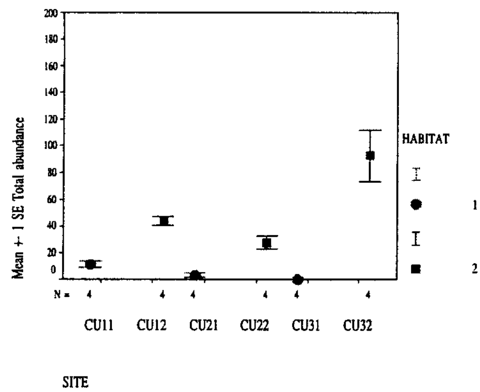
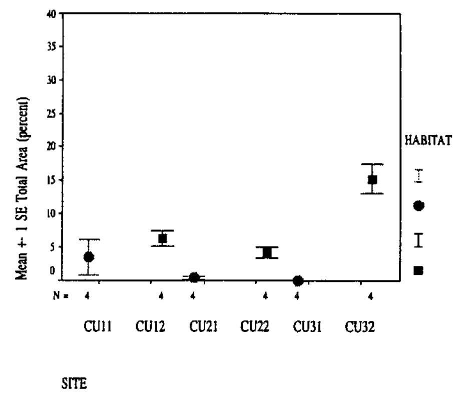


Figure 79 (continued)

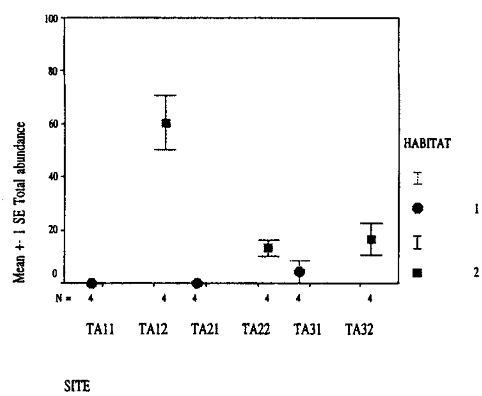
Total Abundance | Total Area Cover (%)

Chumphon Islands





Tao Islands



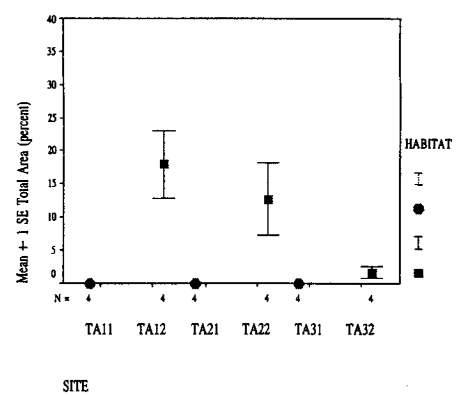


Figure 79 (continued)

Population structure

1. Coral composition

Principle Component Analysis (PCA) was used to determined coral composition of faviid corals in the Gulf of Thailand. An ordination is a map of the samples, usually represent in two or three dimensions, in which the placement of samples, rather than representing their sample geographical location, reflects the similarity of their biological communities. In this analysis, taxa in terms of species and genus were used.

1.1 PCA examined by species

An empirical rule-of-thumb might be that a picture that accounts for as much as 70-75% of the original variation is likely to described the overall structure rather well. Colony abundance data showed that % of variance explained by the first two PC axes is very low: 31.2% for axis1 and 10.0% for axis2. Cumulative % of variance was 41.2% whereas, area covered data represented 65.9%. There are shown in Figure 80-81, the pictures are likely to be very unreliable. However, the details for each composition are represented in Table7.

Table 5 Results of PCA from colonies abundance of faviid corals on coral assemblages along the Gulf of Thailand.

AXIS	Eigenvalue	% of Variance	Cumulative % of Variance.	Broken-stick Eigenvalue
1	258.8	31.2	31.2	105.3
2	83.2	10.0	41.2	79.3
3	74.7	9.0	50.2	66.4
4	60.9	7.3	57.5	57.7
5	48.9	5.9	63.4	51.2
6	45.1	5.4	68.8	46.0
7	38.6	4.7	73.5	41.7
8	28.1	3.4	76.9	38.0
9	26.2	3.2	80.1	34.8
10	22.5	2.7	82.8	31.9

Table 6 Results of PCA from area cover of faviid corals on coral assemblages along the Gulf of Thailand.

AXIS	Eigenvalue	% of Variance	Cum.% of Var.	Broken-stick Eigenvalue
1	28.7	37.0	37.0	15.1
2	22.5	28.9	65.9	10.8
3	8.5	10.9	76.8	8.6
4	6.0	7.7	84.5	7.2
5	3.5	4.5	89.0	6.1
6	3.3	4.2	93.2	5.2
7	1.4	1.8	95.0	4.5
8	0.9	1.2	96.2	3.9
9	0.8	1.0	97.2	3.3
10	0.7	2.8	98.0	2.9

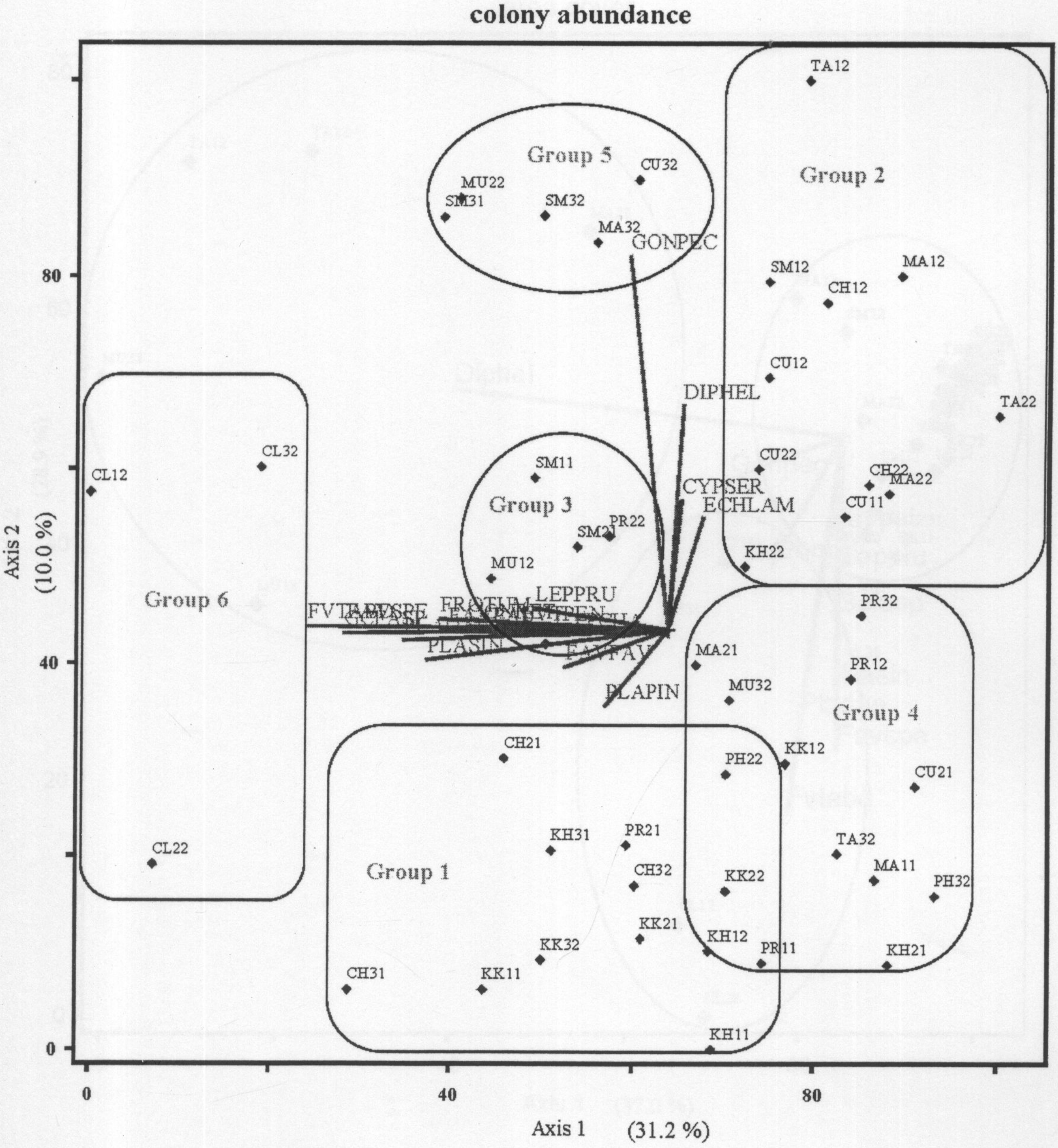


Figure 80 Ordination plot based on colony abundance illustrated study sites (◊) and faviid species (radius line) that responsible for each study sites of coral assemblages along the Gulf of Thailand.
XXyz : XX = islands, y : 1 = reef1, 2 = reef 2, 3 = reef 3,
z : 1 = reef flat, 2 = reef slope (see page 34)

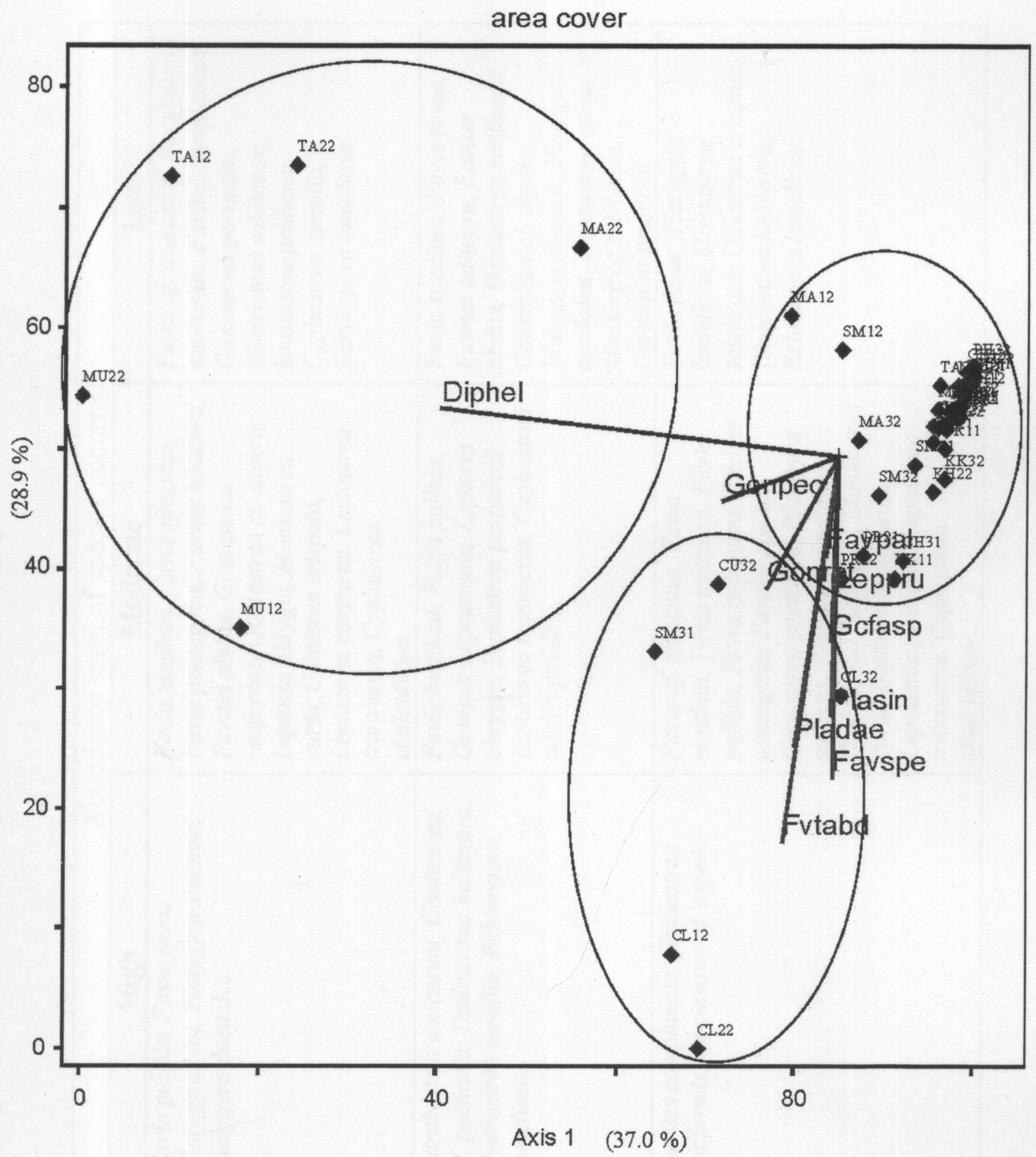


Figure 81 Ordination plot based on area cover illustrated study site (◊) and faviid species (radius line) that responsible for area cover on each study sites along the Gulf of Thailand.

XXyz : XX = islands, y : 1 = reef1, 2 = reef 2, 3 = reef 3, z : 1 = reef flat, 2 = reef slope (see page 34)

Table 7 Showing the difference between each group were influenced by the dominant faviid species.

Group	Sites	Abundance level of species occurred		
		High	Moderate	Low
1	KK11, KK21, KK22, KK32, KH11, KH12, KH31, CH21, CH31, CH32, PR11, PR21	*Favia pallida, Favia favus Platygyra pini, Platygyra sinensis, Platygyra daedalea.*	*Favia matthaii, Favia speciosa, Favia pentagona, Favites halicora, Favites abdita, Goniastrea retiformis, Goniastrea cf. aspera, Leptoria phrygia, Montastrea curta, Oulastrea crispata, Leptastrea purpurea, Leptastrea transversa, Cyphastrea chalcidicum.*	*Favia cf. truncatus, Barabattoia amicorum, Favites complanata, Goniastrea pectinata, Montastrea salebrosa, Leptastrea pruinosa, Cyphastrea serailia, Echinopora lamellosa.*
2	KH22, SM12, CH12, CH22, MA12, MA22 CU11, CU12, CU22, TA12	*Barabattoia amicorum, Goniastrea cf. pectinata, Diploastrea heliopora, Cyphastrea serailia, Echinopora lamellosa.*	*Favia matthaii, Favia pallida, Goniastrea pectinata, Leptoria phrygia, Leptastrea purpurea, Leptastrea transversa, Cyphastrea michropthalma.*	*Favia speciosa, Favia favus, Favites halicora, Favites abdita, Goniastrea retiformis, Goniastrea cf. aspera, Platygyra sinensis, Platygyra deadalea, Montastrea curta, Montastrea salebrosa, Leptastrea pruinosa.*
3	SM11, SM21 MU12 PR12, PR22	*Favites complanata, Goniastrea retiformis, Goniastrea cf. aspera.*	*Favia cf. truncatus, Favia matthaii, Favia speciosa, Favia pallida, Favia rotumana, Favites pentagona, Favites abdita, Goniastrea pectinata, Platygyra sinensis, Platygyra daedalea, Oulophyllia bennettae, Montastrea curta, Leptastrea purpurea, Leptastrea pruinosa, Leptastrea transversa, Cyphastrea chalcidicum.*	*Favia favus, Platygyra lamellosa, Montastrea salebrosa, Oulastrea crispata, Diploastrea heliopora, Echinopora lamellosa.*

Table 7 (continued)

Group	Sites	Abundance level of species occurred		
		High	Moderate	Low
4	KK12, KH21, PH22, PH32, MU32, MA11, MA21 PR12, PR32, CU21, TA32	*Leptastrea pruinosa, Leptastrea purpurea*	*Favia matthaii, Favia pallida, Favia favus, Platygyra sinensis, Leptastrea purpurea, Leptastrea transversa.*	*Favia speciosa, Favia pallida, Favia favus, Favia cf. truncatus, Favites abdita, Goniastrea retiformis, Goniastrea cf. aspera, Goniastrea pectinata, Platygyra sinensis, Platygyra daedalea, Montastrea curta, Cyphastrea chalcidicum, Echinopora lamellosa.*
5	SM31, SM32, MU22, MA32, CU32	*Favia pallida, Goniastrea retiformis, Goniastrea pectinata, Diploastrea heliopora, Leptastrea purpurea, Leptastrea transversa.*	*Favia speciosa, Favia favus, Favites pentagona, Favites abdita, Favites complanata, Goniastrea cf. aspera, Platygyra sinensis, Platygyra daedalea, Montastrea curta, Montastrea salebrosa, Cyphastrea chalcidicum, Cyphastrea serailia, Echinopora lamellosa.*	*Favia cf. truncatus, Barabattoia amicorum, Platygyra pini, Platygyra lamellina, Leptoria phrygia, Oulophyllia bennettae, Cyphastrea microphthalma.*
6	CL12, CL22, CL32	*Favia speciosa, Favia pallida, Favia rotumana, Favites pentagona, Favites abdita, Goniastrea cf. aspera, Platygyra sinensis, Platygyra deadalea, Leptastrea pruinosa.*	*Favia favus, Goniastrea retiformis, Goniastrea pectinata, Platygyra pini, Cyphastrea chalcidicum*	*Favites complanata, Montastrea curta, Oulastrea crispata.*

1.2 PCA examined by genus

A clear distribution pattern of faviid corals at the species level was not detected by PCA. However, at the generic level, two components were identified, one is colony abundance representing the first two PC axes 65% of variance, and a second is area covered, 75% of variance (Table 8-9).

The details for corals composition are illustrated into five reef types (Figure 82, 83).

1. Coral assemblages were dominated by *Goniastrea* spp. There were seven sites with reef slope at Ao Tonleab and Hadd Naban Monnai Island, and Kudee Island reef flat at Kudee Island and Ao Tacrite Samet Island. The other 2 slope sites were located at Rang and E-radd islands. *Goniastrea* spp. was not only dominated in this sites but *Leptastrea* spp. was also dominated.

2. Coral assemblages were dominated by *Favia* spp., *Favites* spp. and *Platygyra* spp. There were reef patches in Chaolaw Beach, Chanthaburi Province and reef flat at ChangNoi Island, Trat Province on both number of colony and area covered.

3. Coral assemblages in which *Favia*, *Favites* and *Goniasterea* were common. There were nine sites with 5 reef flat sites at Station C and Station E KangKao Island, E-raa, Suwan and Singha islands. Four reef slope sites at Randokmai, southern of Phai Island, Changnoi and Singha islands. In these sites *Oulastrea* is also dominated.

4. Corals assemblages in which the number of colonies was dominated by *Diploastrea*, were found at Ao Hinwong and Ao Mung Tao Island, Kam and Mark islands. The area covered by *Diploastrea* was high at Ao Mung, Ao Hinwong Tao Island, Hadd Naban and Ao Tonleab Monnai Island and Mark Island, respectively.

5. Coral assemblages were no corals dominated, rather there were only a few colonies of faviid corals at these sites. Coral assemblages in these sites included: reef slope at station C and station E KangKao Island, reef slope at Ao Tonglang Phai Island, reef slope at Learn Island, reef flat and reef slope at Hadd Naban Kram Island, reef flat and reef slope at Ao Pudsawan Kram Island, reef slope at Ao Tacrite and reef flat at Ao KiwNok Samet Island, reef slope at Monnok Island, reef slope at Monnok Island (Trat Province), reef slope at Suwan Island, reef flat at Kam Island, reef flat at

Mark Island, reef flat and reef slope at Sang Island, reef slope at Talu Island, reef flat and reef slope at Matra Island, reef flat and reef slope at Lawa Island and reef slope at GongSaiDang Island.

Table 8 Results of PCA from the colony abundance of faviid genera.

AXIS	Eigenvalue	% of Variance	Cum.% of Var.	Broken-stick Eigenvalue
1	201.7	54.2	54.2	102.1
2	41.1	11.0	65.3	68.3
3	28.7	7.7	73.0	51.3
4	26.4	7.1	80.1	40.1
5	19.8	5.3	85.4	31.6
6	17.4	4.6	90.1	24.9
7	11.9	3.2	93.4	19.2
8	10.2	2.7	96.1	14.4
9	5.3	1.4	97.5	10.2
10	4.9	1.3	98.9	6.4

Table 9 Results of PCA from the area cover of faviid genera.

AXIS	Eigenvalue	% of Variance	Cum.% of Var.	Broken-stick Eigenvalue
1	32.8	41.3	41.3	24.9
2	26.7	33.7	75.0	16.1
3	8.6	10.8	85.9	11.7
4	4.4	5.6	91.5	8.7
5	3.1	4.0	95.5	6.5
6	2.1	2.6	98.2	4.8
7	.7	.8	99.1	3.3
8	.5	.6	99.8	2.0
9	.1	.1	100.0	.9

Almost a high number of faviid colonies are the consequence of high area cover. However, at Mark and Kam islands were found higher number of *Diploastrea* colonies than those at Monnai Island. Whereas, area cover of this coral at Monnai Island was greater than that of Mark and Kam islands. The high area cover at Monnai Island was due to the larger size of colony.

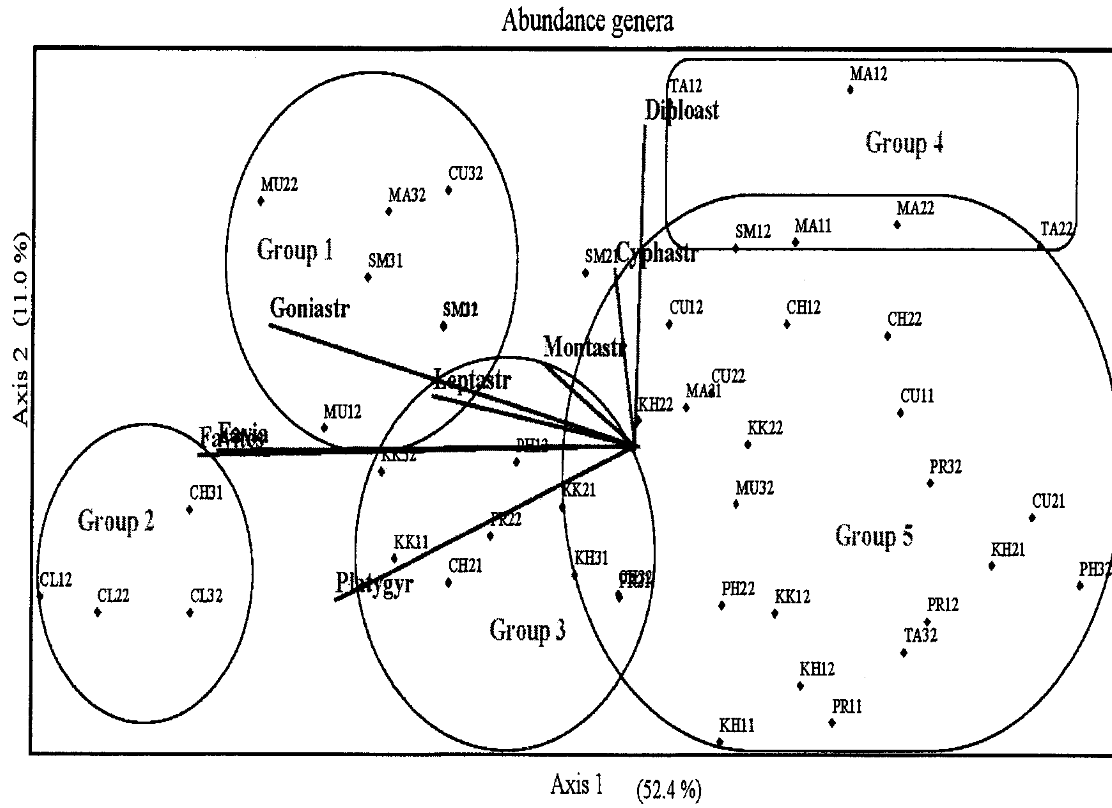


Figure 82 Ordination plot from the results of PCA illustrated study sites (◊) and faviid genera (radius line) that responsible for the grouping of each study sites of coral assemblages along the Gulf of Thailand.

XXyz : XX = islands, y : 1 = reef1, 2 = reef 2, 3 = reef 3,

z : 1 = reef flat, 2 = reef slope (see page 34)

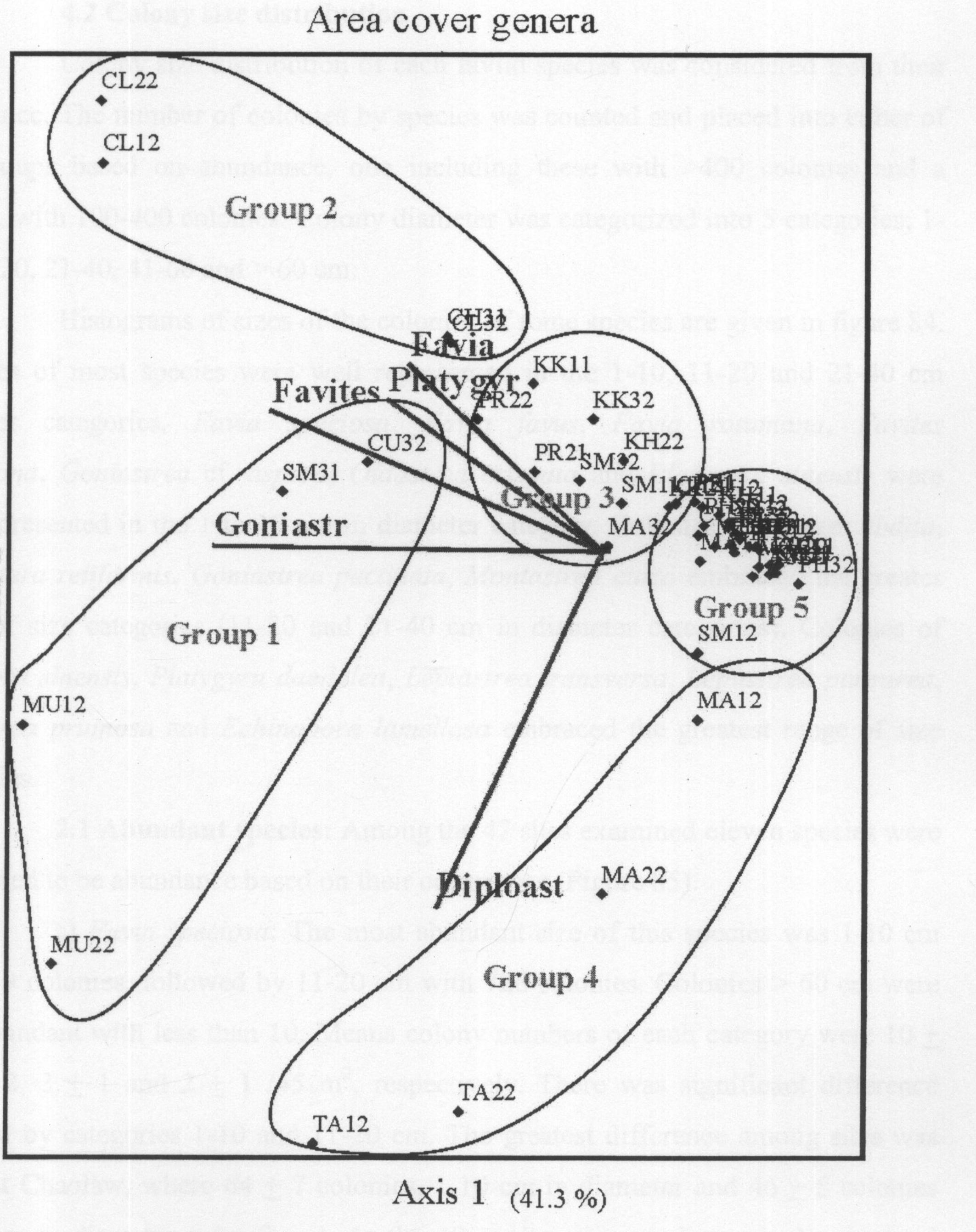


Figure 83 Ordination plot from the results of PCA illustrated study site (◊) and faviid genera (radius line) that responsible for each study sites of coral assemblages along the Gulf of Thailand.

XXyz : XX = islands, y : 1 = reef1, 2 = reef 2, 3 = reef 3,

z : 1 = reef flat, 2 = reef slope (see page 34)

4.2 Colony size distribution

Colony size distribution of each faviid species was considered from their abundance. The number of colonies by species was counted and placed into either of two groups based on abundance, one including these with >400 colonies and a second, with 100-400 colonies. Colony diameter was categorized into 5 categories; 1-10, 11-20, 21-40, 41-60 and > 60 cm.

Histograms of sizes of the colonies of some species are given in figure 84. Colonies of most species were well represented in the 1-10, 11-20 and 21-40 cm diameter categories. *Favia speciosa*, *Favia favus*, *Favia rotumana*, *Favites pentagona*, *Goniastrea* cf. *aspera*, *Oulastrea crispata* and *Platygyra sinensis* were well represented in the 1 to 10 cm in diameter category. Colonies of *Favites abdita*, *Goniastera retiformis*, *Goniastrea pectinata*, *Montastrea curta* embraced the greater range of size categories (11-20 and 21-40 cm in diameter categories). Colonies of *Platygyra sinensis*, *Platygyra daedalea*, *Leptastrea transversa*, *Leptastrea purpurea*, *Leptastrea pruinosa* and *Echinopora lamellosa* embraced the greatest range of size categories.

2.1 Abundant species: Among the 47 sites examined eleven species were considered to be abundance based on their occurrence (Figure 85).

a) *Favia speciosa*: The most abundant size of this species was 1-10 cm with 919 colonies, followed by 11-20 cm with 726 colonies. Colonies > 60 cm were least abundant with less than 10. Means colony numbers of each category were 10 $\pm$ 2, 8 $\pm$ 2, 3 $\pm$ 1 and 2 $\pm$ 1 /45 m^2, respectively. There was significant difference occurred by categories 1-10 and 11-20 cm. The greatest difference among sites was found at Chaolaw, where 64 $\pm$ 7 colonies, 1-10 cm in diameter and 46 $\pm$ 8 colonies 11-20 cm in diameter were found. At the other sites mean colony numbers ranged from 1-10 /45 m^2.

b) *Favia favus*: This species was found at all areas. Overall, the most abundant size was 1-10 cm with 383 colonies, followed by 11-20 cm with 197 colonies and 21-40 cm with 32 colonies. Mean colony numbers of the smallest two categories were 5 $\pm$ 1 and 3 $\pm$ 1 /45 m^2, respectively. This species could be found regularly in every sites ranged from 1-10 /45 m^2.

c) *Favites pentagona*: In this study, *F. pentagona* was not found at Sichang, Mon and Mark islands. Overall, the most abundant size was 1-10 cm with 342 colonies, followed by 11-20 cm with 61 colonies and 21-40 cm with less than 10. Colonies with 1-10 cm diameter 15 $\pm$ 5 /45 m^2 whereas, for other categories abundance varied numbered between 1-3 /45 m^2. This species was most abundant at Chaolaw, Samet and Chang islands, where colony numbers were 20-30 /45 m^2 whereas, on the other sites colony numbers ranged from 1-5 /45 m^2.

d) *Favites abdita*: This species was found at all sites. Overall, the most abundant size was 11-20 cm with 713 colonies, followed by 21-40 cm with 524 colonies, 1-10 cm with 344 colonies, 41-60 cm with 71 colonies. Colonies > 60 cm were least abundant with about 20 colonies. Mean colony numbers of each category were 5 $\pm$ 1, 8 $\pm$ 2, 6 $\pm$ 1, 3 $\pm$ 1 and 2 $\pm$ 1 /45 m^2. This species was most abundant at Chaolaw, where colony numbers were 40-50 /45 m^2 whereas; at the other sites 1-10 /45 m^2 was typical.

e) *Goniastrea retiformis*: This species was found at all study sites. This species was varied in size. Overall, the most abundant size was 11-20 cm with 352 colonies, followed by 21-40 cm with 331 colonies, 1-10 cm with 215 colonies, 41-60 cm with 80 colonies and > 60 cm with 24 colonies. Mean colony numbers of each category were 3 $\pm$ 1, 5 $\pm$ 1, 5 $\pm$ 1, 3 $\pm$ 1 and 2 $\pm$ 1 /45 m^2, respectively. This species was most abundant at Mon Islands, where colony numbers was about 2 times that found at other sites.

f) *Goniastrea cf. aspera*: This species was found at all areas, except at Tao Island. Overall, the most abundant size was 1-10 cm with 553 colonies, followed by 11-20 cm with 167 colonies and 21-40 cm with 32 colonies. Mean colony numbers of each category were 9 $\pm$ 2, 4 $\pm$ 1 and 2 $\pm$ 1 colonies/45 m^2, respectively. This species was most abundant at Chaolaw and Samet-Kudee islands, where colony numbers ranged from 21 $\pm$ 7 /45 m^2 about 2 times greater than on the other sites.

g) *Goniastrea pectinata*: This species was found at all areas, except at Sichang Islands. There was varied in colony size. Overall, the most abundant size was 11-20 cm with 361 colonies, followed by 1-10 cm with 348 colonies, 21-40 cm with 221 colonies, and 41-60 cm with 55 colonies. Colonies > 60 cm were least abundant with approximately 20 colonies. Mean colony numbers of each category were 6 $\pm$ 1, 6

$\pm$ 1, 4 $\pm$ 1, 2 $\pm$ 1 and 2 $\pm$ 1 colonies/45 m^2, respectively. This species was most abundant at Monnai Island, particularly at Ao Tonleab, where colony numbers ranged from 20-30 /45 m^2. While at other sites 1-10 /45 m^2 was typical.

h) *Platygyra pini*: This species was found at all study areas, except at Chumphon and Tao islands. Overall, the most abundant size was 11-20 cm with 70 colonies, followed by 1-10 cm with 53 colonies, 21-40 cm with 47 colonies and 40-60 cm with 16 colonies. Colonies > 60 cm were least abundant with less than 10. Mean colony numbers of the smallest-three categories were 3 $\pm$ 1 /45 m^2 and the two-largest categories were 2 $\pm$ 1 and 1 /45 m^2, respectively. This species was most abundant at Kram Island, where colony numbers of each category was 4 $\pm$ 1 /45 m^2 whereas; the other sites 1 /45 m^2 was typical.

i) *Platygyra sinensis*: This species was found at all areas. There was varied in size, overall, the most abundant was 11-20 cm with 448 colonies, followed by 21-40 cm with 435 colonies, 1-10 cm with 297 colonies and 41-60 cm with 96 colonies. Colonies > 60 cm were least abundant with less than 20. Mean colony numbers of each category were 4 $\pm$ 1, 5 $\pm$ 1, 5 $\pm$ 1, 2 $\pm$1 and 1 /45 m^2, respectively. This species was most abundant at Chaolaw, where colony numbers of each category ranged from 10-20 /45 m^2.

j) *Platygyra daedalea*: All coral sizes were found at all study areas. Overall, the pattern of *Platygyra daedalea* was similar to that for *Platygyra sinensis*. Mean colony numbers of each category varied from 3 $\pm$ 1 /45 m^2 for the smallest three to 2 $\pm$ 1 /45 m^2 for the largest two categories. Greatest abundance was found at Chaolaw with colony numbers of each category was 5-10 /45 m^2 whereas, the other sites 1-4 /45 m^2 was typical.

k) *Leptastrea transversa*: This species was found at all areas, except at Chaolaw Beach. Overall, the most abundant size was 21-40 cm with 169 colonies, followed by 11-20 cm with 163 colonies, 1-10 cm with 92 colonies and approximately 25 colonies for the largest two categories. Mean colony numbers of each category were 2 $\pm$ 1, 3 $\pm$ 1, 3 $\pm$ 1, 2 $\pm$ 1 and 1 /45 m^2, respectively. This species was most abundant at Mon Islands, where mean colony numbers of each category ranged from 5-10 /45 m^2.

2.2 Common species: Among the 47 sites examined, eight species were considered to be common based on their occurrence.

l) *Favia rotumana*: This species was found at Phai, Samet, Chaolaw and Chang islands. Overall, the most abundant size was the smallest with 151 colonies, followed by 11-20 cm with 66 colonies and 21-40 cm with 10 colonies. Mean colony numbers of each category were 8 $\pm$ 3, 4 $\pm$ 1 and 1 /45 m^2, respectively. This species was most abundant at Chaolaw, where colony numbers were about 6-8 times that found at other sites, particularly category 1-10 cm with 8-30 /45 m^2 whereas, at the other sites 1-3 /45 m^2 was typical.

m) *Favites halicora*: This species was found at Sichang, Phai, Chang, Mark, Talu and Chumphon islands. Overall, the most abundant sizes was 21-40 cm with 78 colonies, followed by 11-20 cm with 75 colonies, 1-10 cm with 33 colonies and 41-60 cm with 7 colonies. Mean colony numbers of each category were 3 $\pm$ 1, 4 $\pm$ 1, 4 $\pm$ 1 and 2 $\pm$ 1 /45 m^2, respectively. This species was most abundant at Chang Islands, where each category colony numbers ranged from 5-10 /45 m^2.

n) *Montastrea curta*: This species was found at Sichang, Samet, Mon, Chaolaw, Chang, Mark and Talu islands. However, colony numbers was not so high. Overall, the most abundant was 11-20 cm with 86 colonies, followed by 21-40 cm with 51 colonies, 1-10 cm with 33 colonies and 41-60 cm with 5 colonies. Mean colony numbers of each category ranged from 1-3 /45 m^2. This species was most abundant at Sichang Islands, where each category colony numbers ranged from 1-8 /45 m^2.

o) *Oulastrea crispata*: This species was found at Sichang, Phai, Mon, Chaolaw, Chang and Mark islands. The most abundant category was the smallest category with 5 $\pm$ 1 /45 m^2. This species was most abundant at Phai Islands, where colony numbers were 10 $\pm$ 3 /45 m^2.

p) *Diploastrea heliopora*: This species was found at Samet, Mon, Chang, Mark, Talu, Chumphon and Tao islands. Overall, almost 50% of colony numbers were larger than 60 cm. Colonies > 60 cm were 3 $\pm$ 1 /45 m^2 whereas, the other categories1/45 m^2. This species was most abundant at Tao Islands, with 5 $\pm$ 2 /45 m^2.

q) *Leptastrea purpurea*: This species was found at all areas, except Chaolaw. Overall, the most abundant size was 21-40 cm with 70 colonies, followed by 11-20 cm with 50 colonies, 1-10 cm with 31 colonies and 41-60 cm with 11 colonies. Colonies > 60 cm were least abundant with less than 5. Mean colony numbers of each category ranged from 1-2 /45 m^2. This species was most abundant at Phai Islands, where colony numbers of each category ranged from 3-5 /45 m^2.

r) *Leptastrea pruinosa*: This species was found at all areas, except Kram and Tao islands. Overall, the most abundant size was 11-20 cm with 84 colonies, followed by 21-40 cm with 80 colonies, 1-10 cm with 37 colonies and 41-60 cm with 24 colonies. Colonies > 60 cm were least abundant with less than 5. Mean colony numbers of each category were 2 ± 1, 3 ± 1, 3 ± 1, and 1 /45 m^2, respectively.

s) *Echinopora lamellosa*: This species was found at all areas especially reef slope, except Sichang Islands and Chaolaw. Overall, the most abundant size was 21-40 cm with 50 colonies, followed by 11-20 cm with 44 colonies, 41-60 cm with 30 colonies, > 60 cm with 29 colonies and 1-10 cm with 13 colonies. Mean colony numbers of each category was approximately 2 /45 m^2.

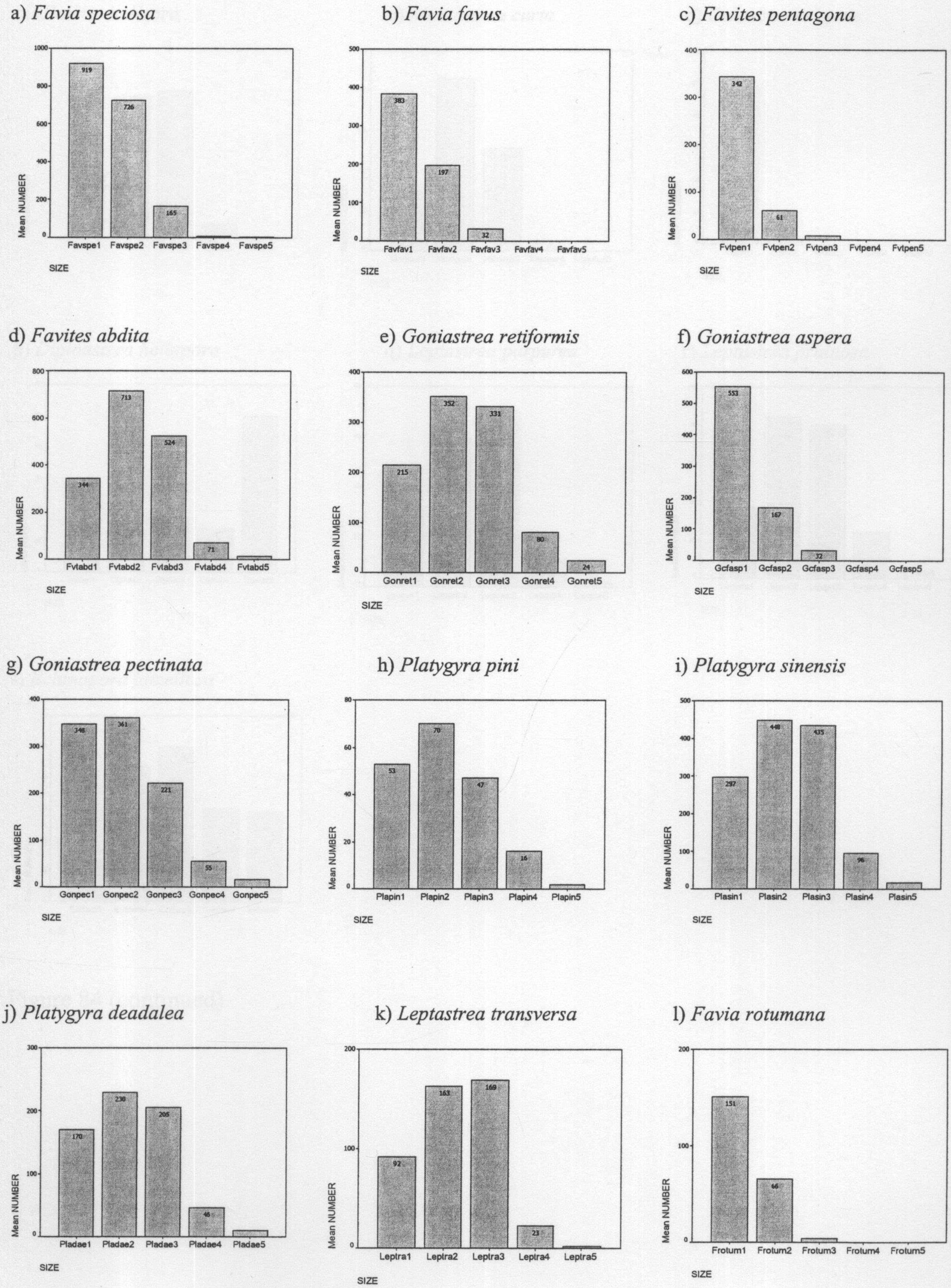
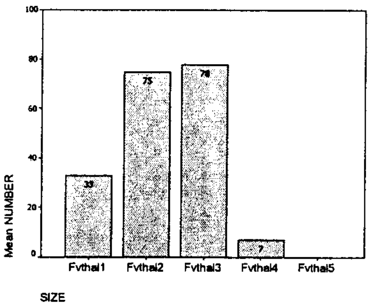
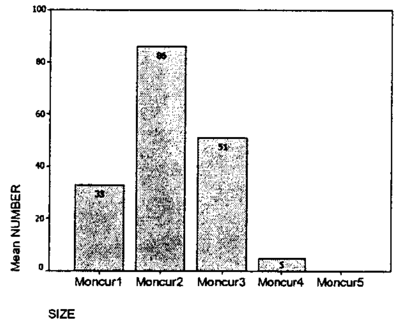


Figure 84 Overall size frequency distributions of the most abundance faviid species.

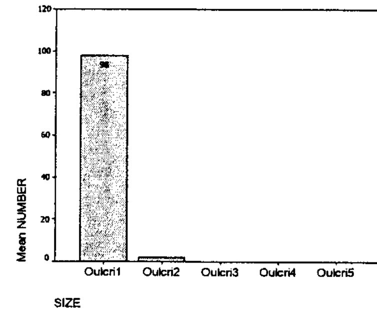
m) *Favites halicora*



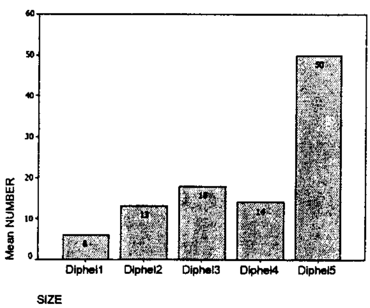
n) *Montastrea curta*



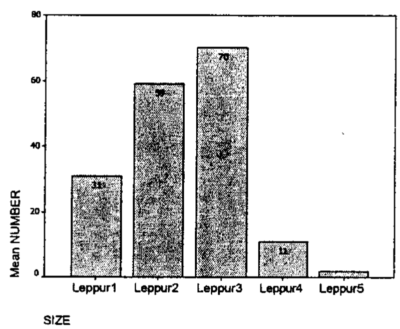
o) *Oulastrea crispata*



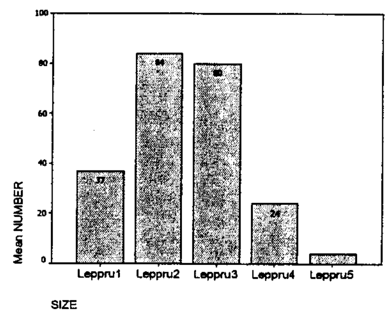
p) *Diploastrea heliopora*



q) *Leptastrea purpurea*



r) *Leptastrea pruinosa*



s) *Echinopora lamellosa*

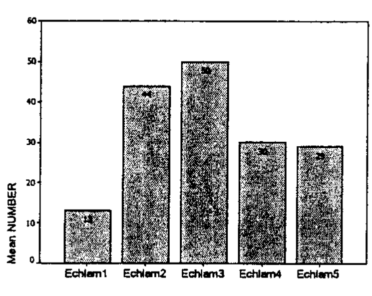
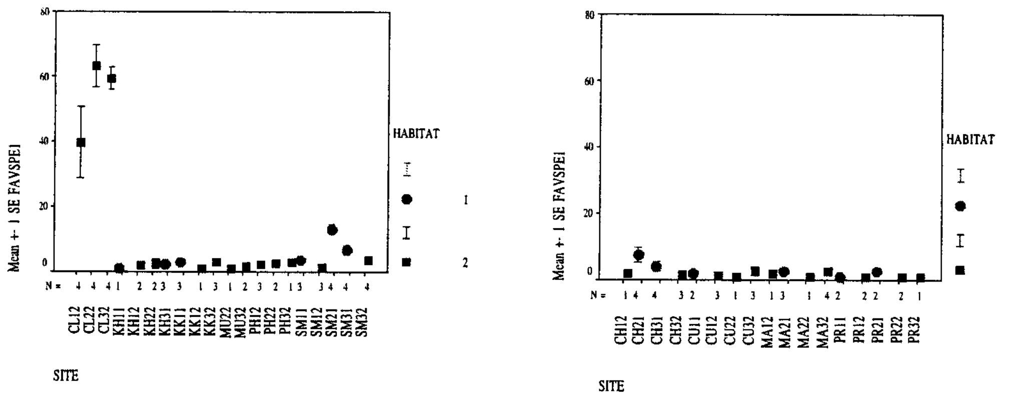
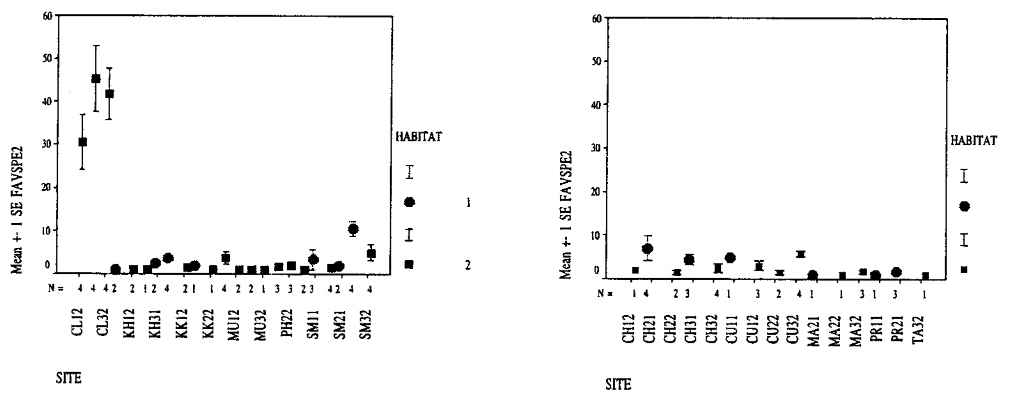


Figure 84 (continued)

Favia speciosa Size 1-10 cm diameter



Favia speciosa Size 11-20 cm diameter



Favia speciosa Size 21-40 cm diameter

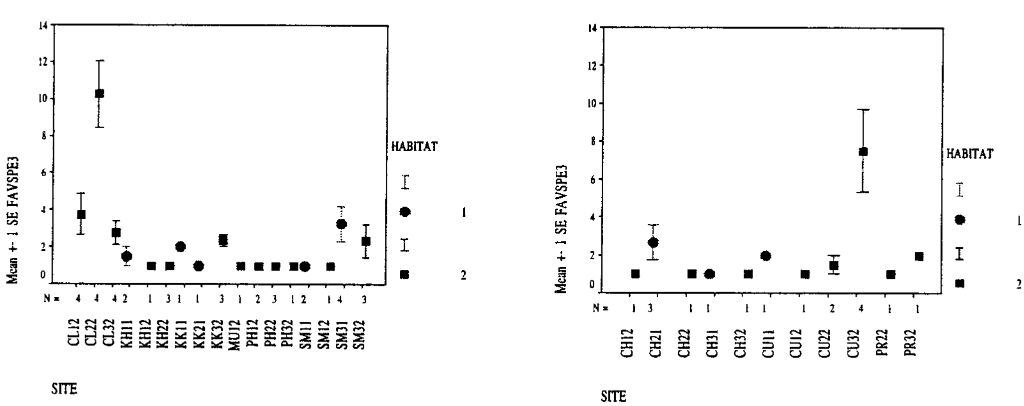
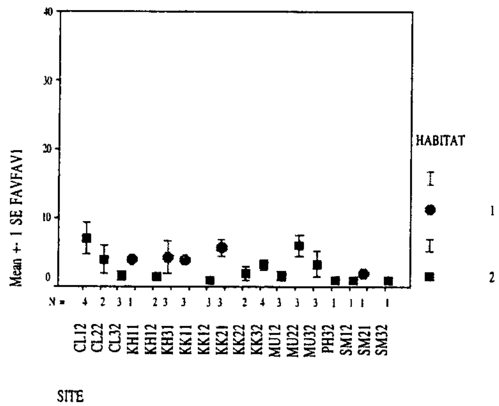
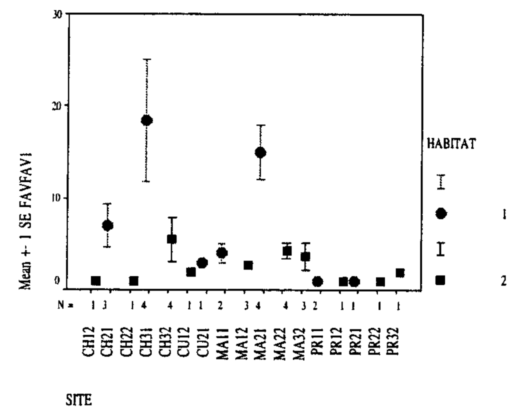


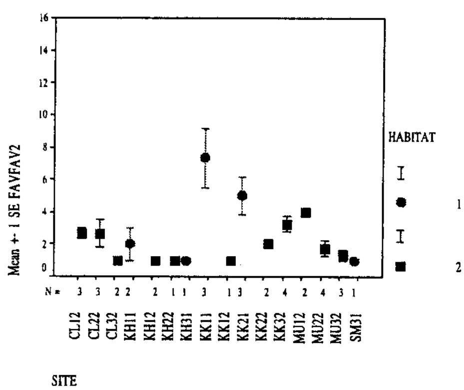
Figure 85 Colony size frequency (clonies/45m^2) of abundance species of faviid corals.
Habitat 1 = Reef flat 2 = Reef slope

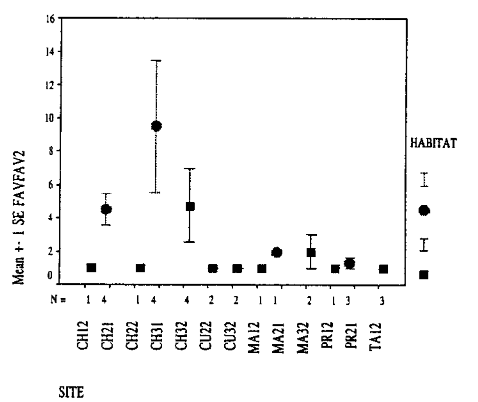
Favia favus Size 1-10 cm diameter



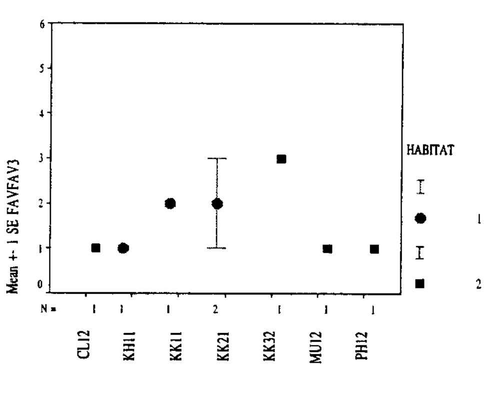


Favia favus Size 11-20 cm diameter





Favia favus Size 21-40 cm diameter



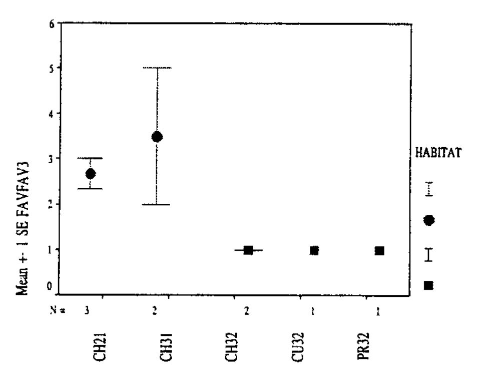
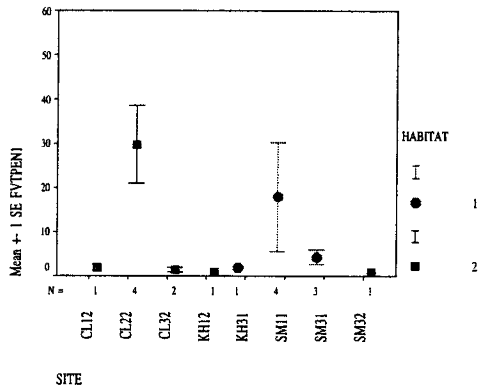
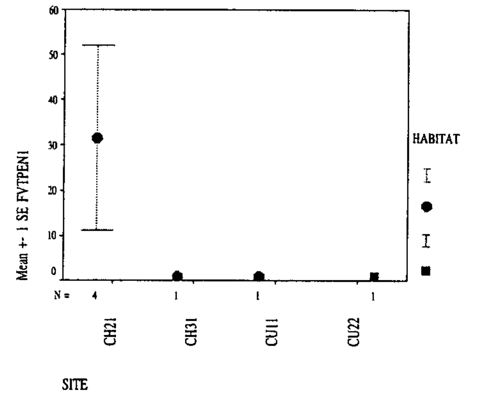


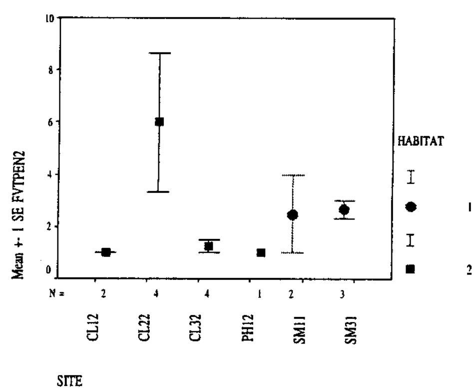
Figure 85 (continued)

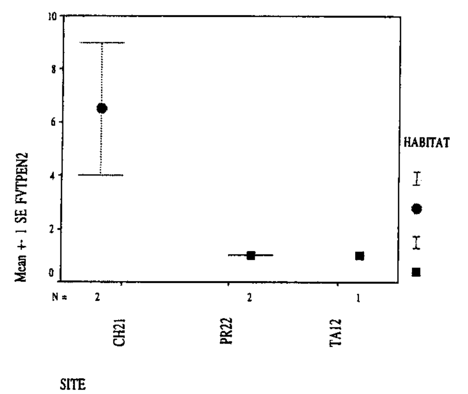
Favites pentagona Size 1-10 cm diameter



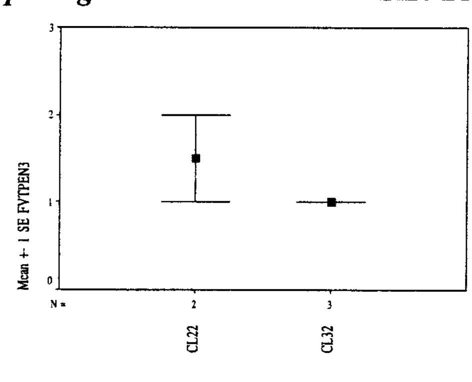


Favites pentagona Size 11-20 cm diameter





Favites pentagona Size 21-40 cm diameter



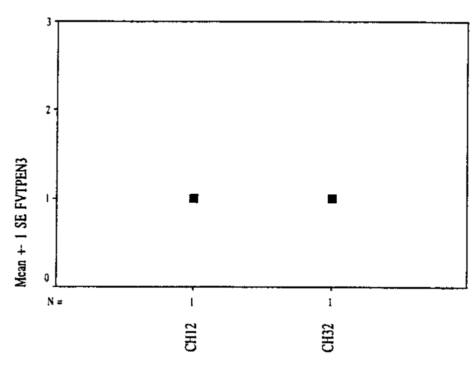
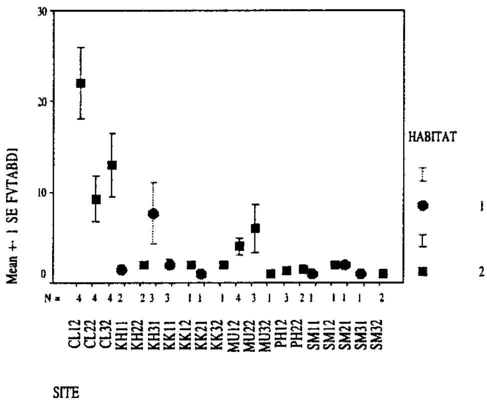
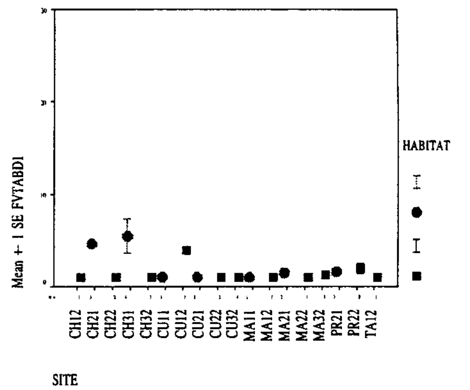


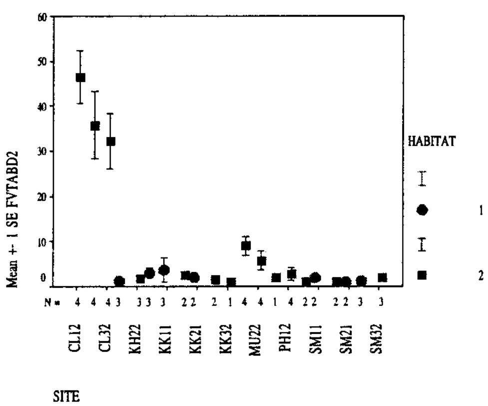
Figure 85 (continued)

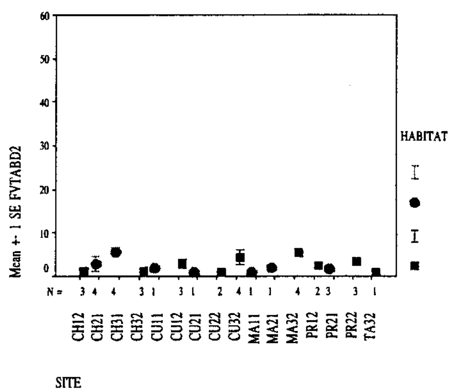
Favites abdita Size 1-10 cm diameter



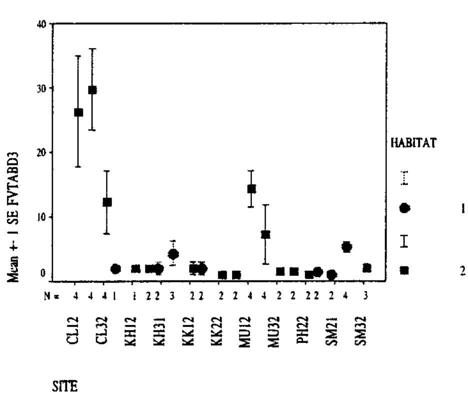


Favites abdita Size 11-20 cm diameter





Favites abdita Size 21-40 cm diameter



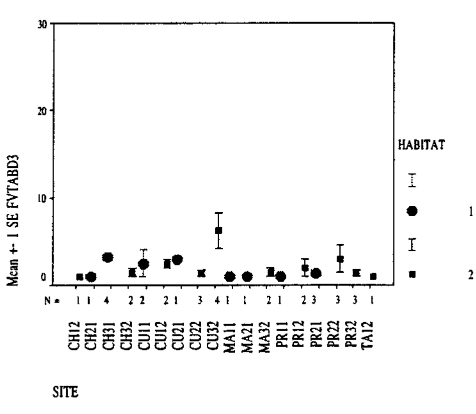
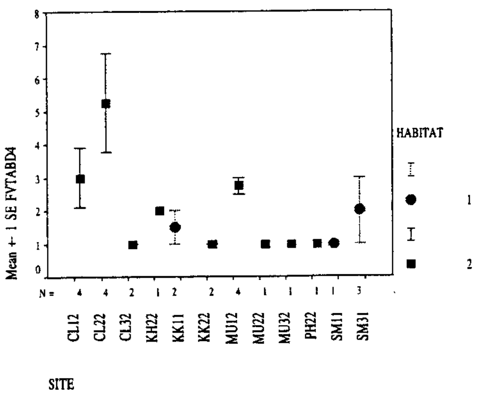
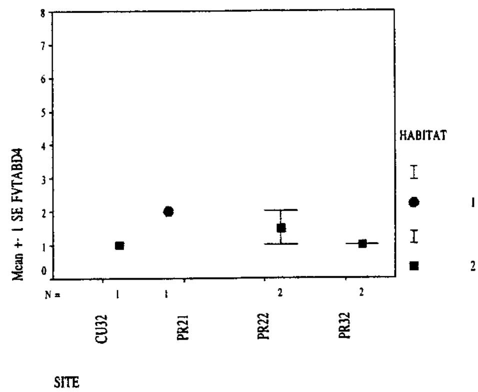


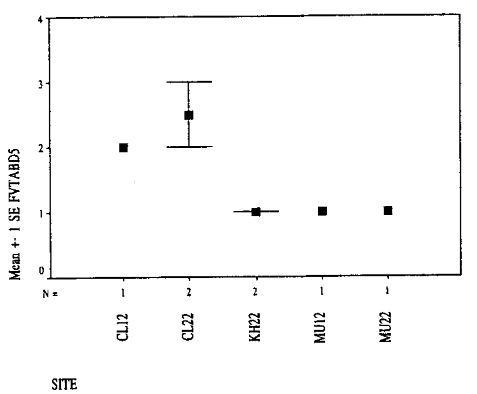
Figure 85 (continued)

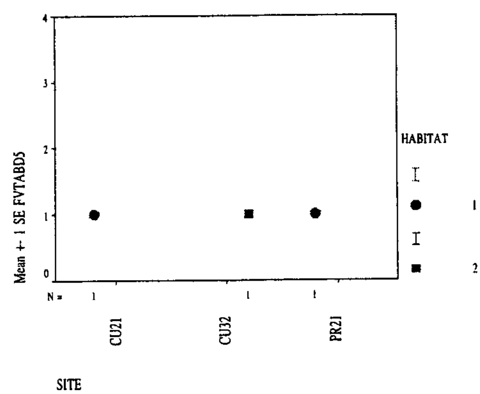
Favites abdita Size 41-60 cm diameter



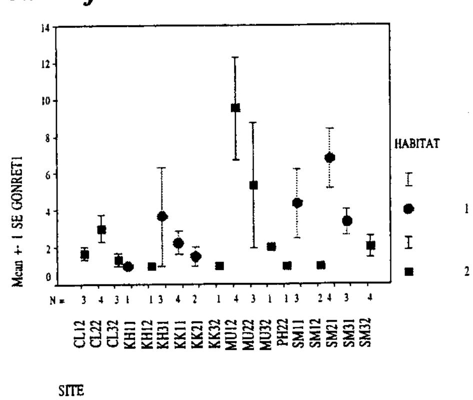


Favites abdita Size > 60 cm diameter





Goniastrea retiformis Size 1-10 cm diameter



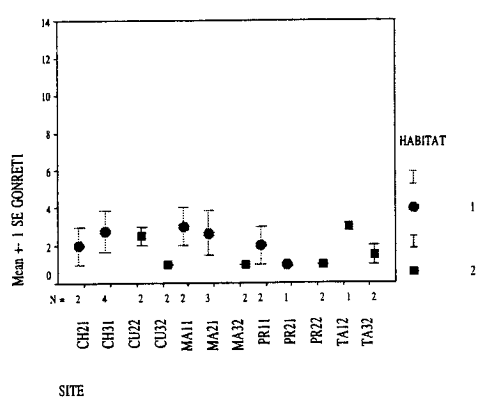
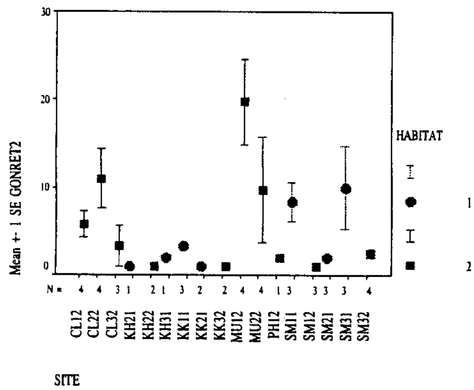
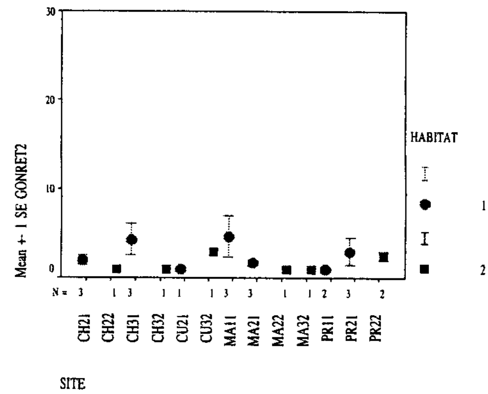


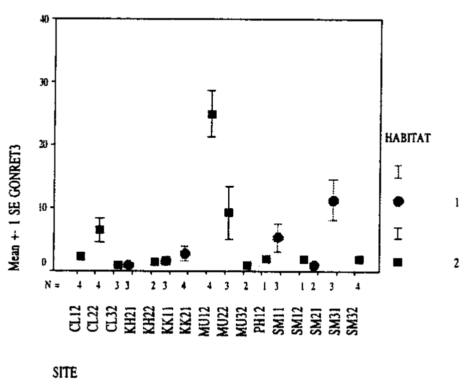
Figure 85 (continued)

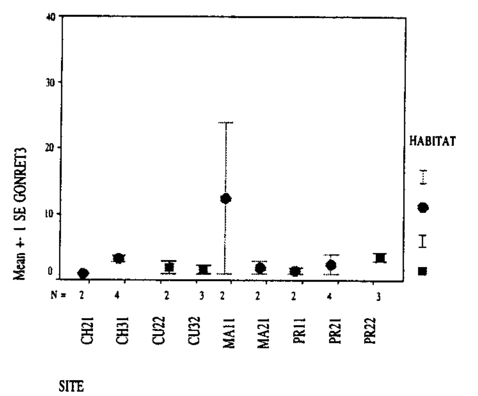
Goniastrea retiformis Size 11-20 cm diameter



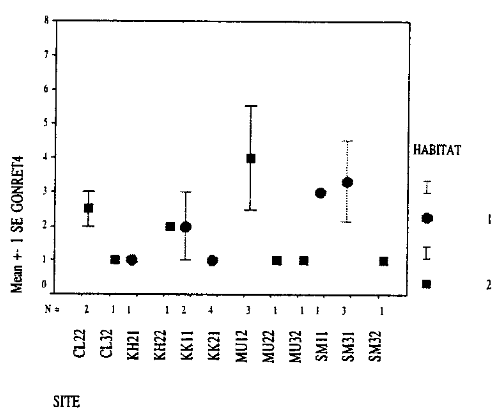


Goniastrea retiformis Size 21-40 cm diameter





Goniastrea retiformis Size 41-60 cm diameter



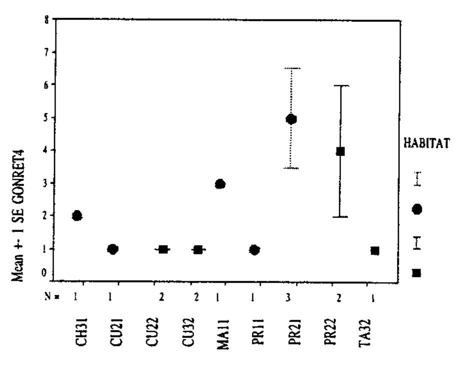
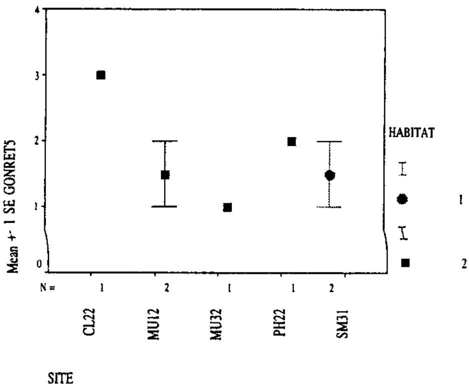
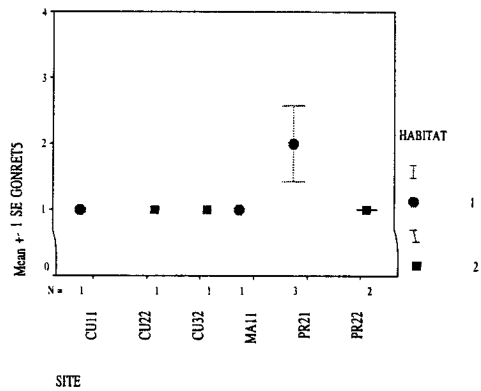


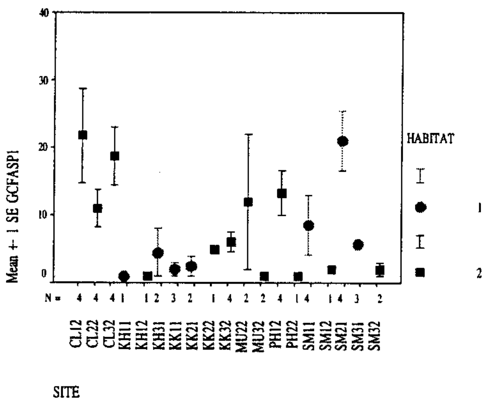
Figure 85 (continued)

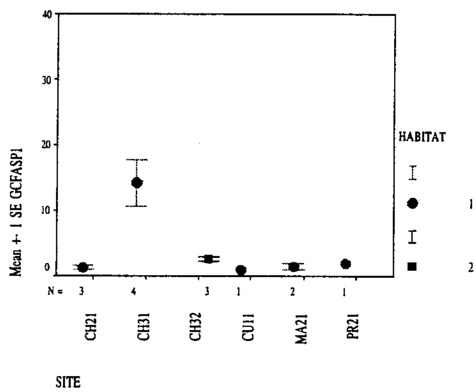
Goniastrea retiformis Size > 60 cm diameter



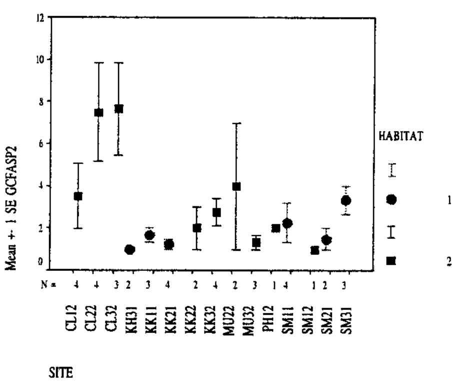


Goniastrea cf. aspera Size 1-10 cm diameter





Goniastrea cf. aspera Size 11-20 cm diameter



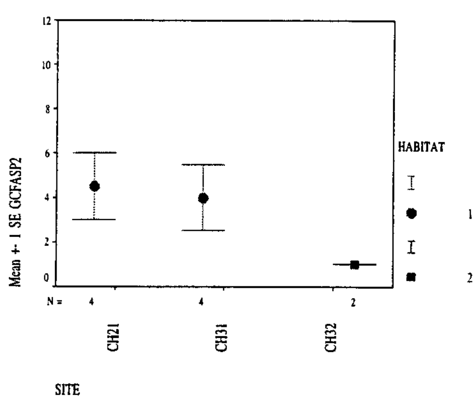
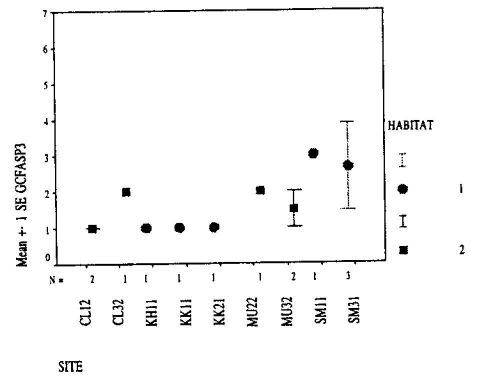
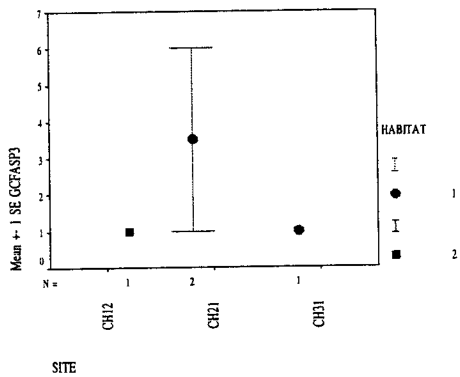


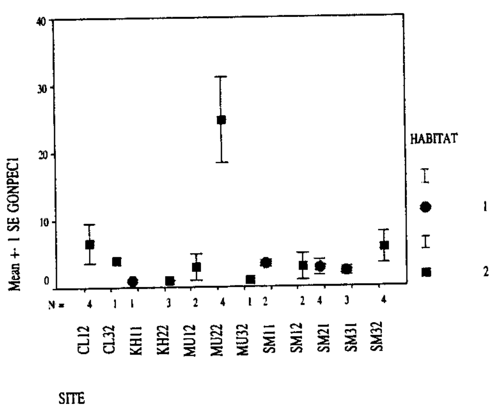
Figure 85 (continued)

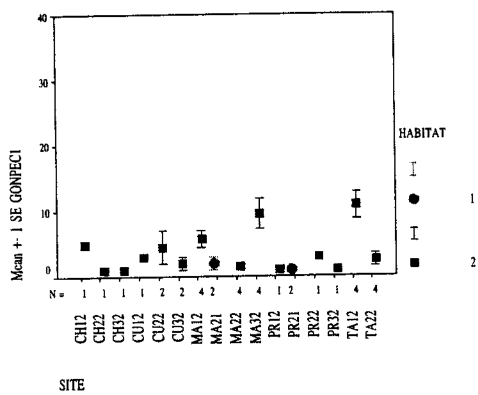
Goniastrea cf. aspera Size 21-40 cm diameter



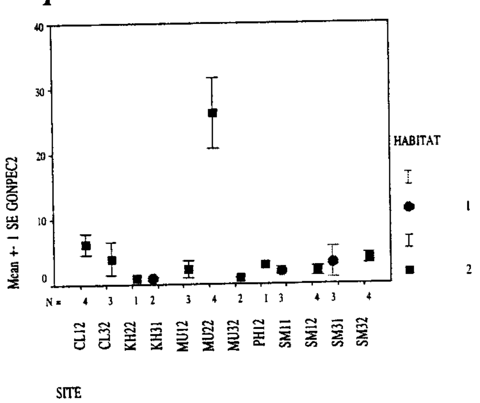


Goniastrea pectinata Size 1-10 cm diameter





Goniastrea pectinata Size 11-20 cm diameter



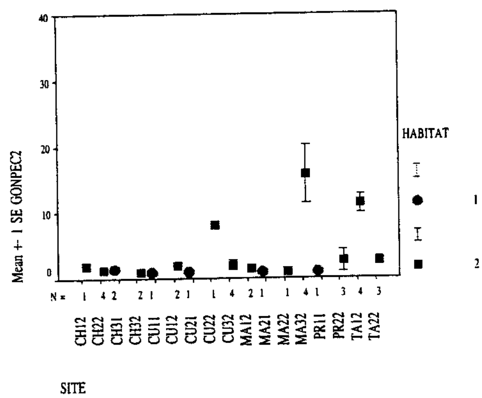
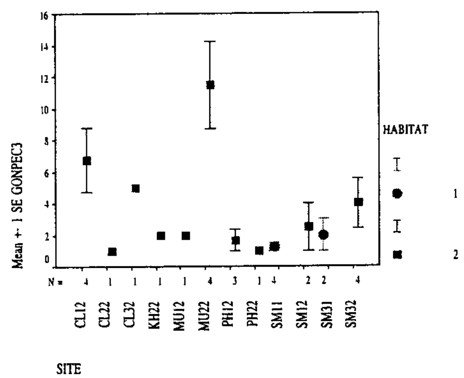
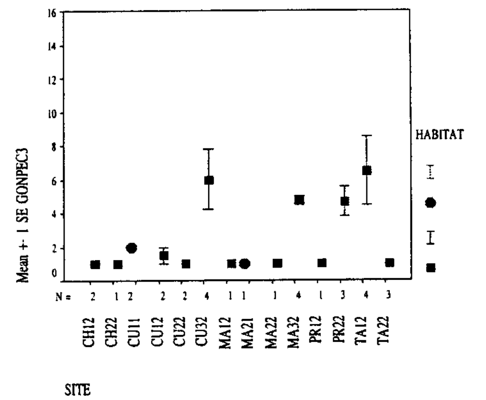


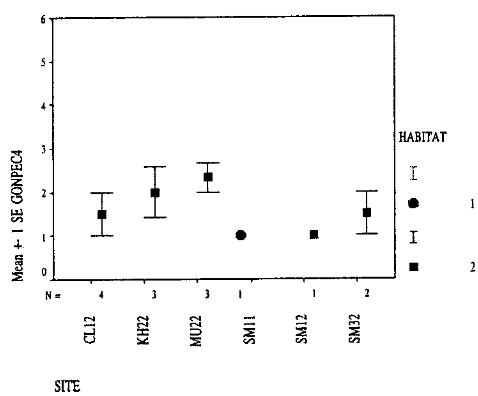
Figure 85 (continued)

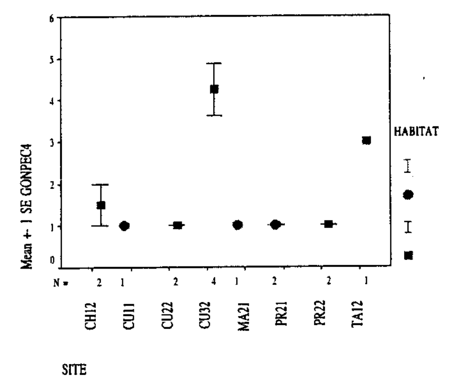
Goniastrea pectinata Size 21-40 cm diameter



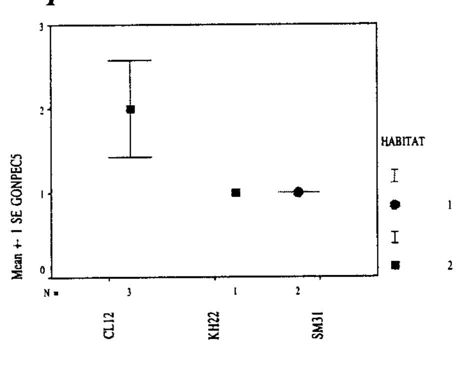


Goniastrea pectinata Size 41-60 cm diameter





Goniastrea pectinata Size > 60 cm diameter



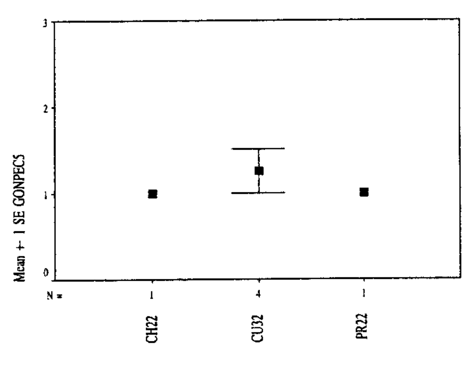
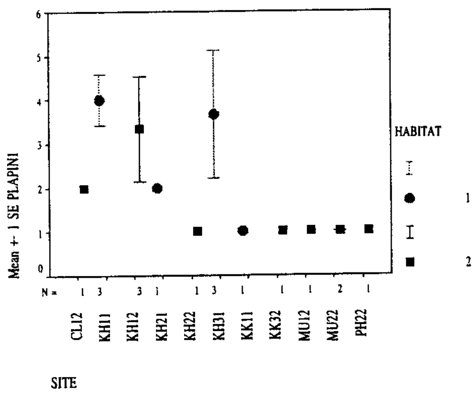
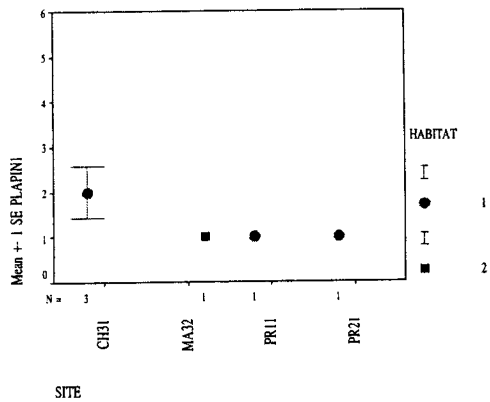


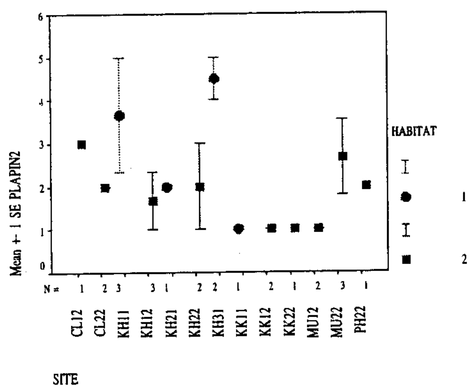
Figure 85 (continued)

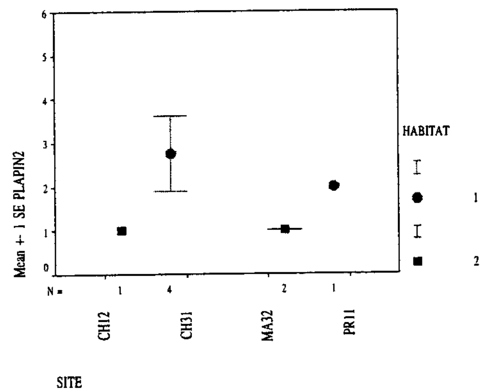
Platygyra pini Size 1-10 cm diameter



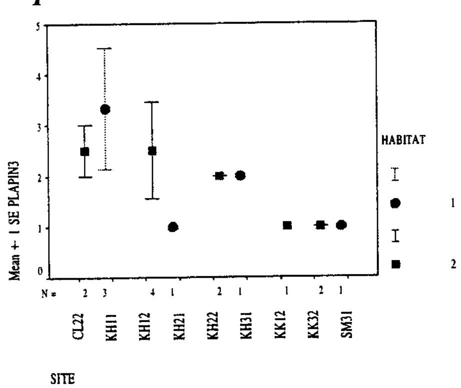


Platygyra pini Size 11-20 cm diameter





Platygyra pini Size 21-40 cm diameter



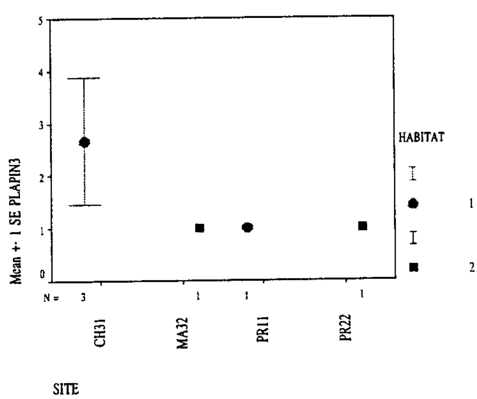
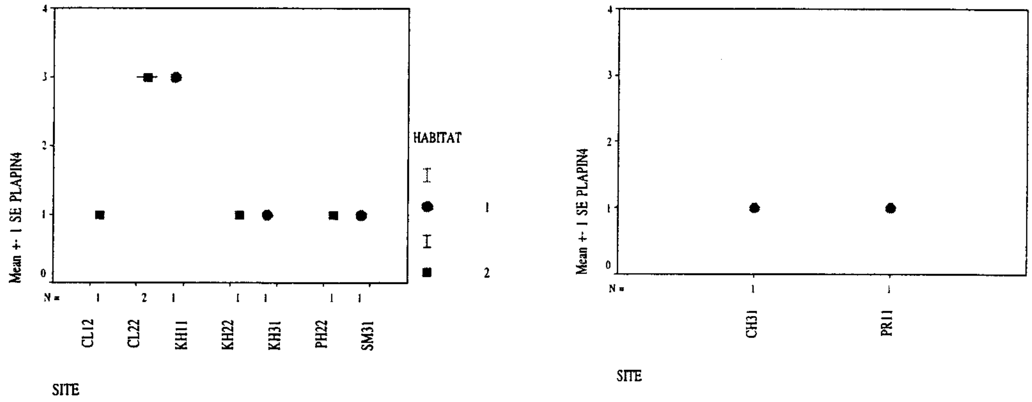
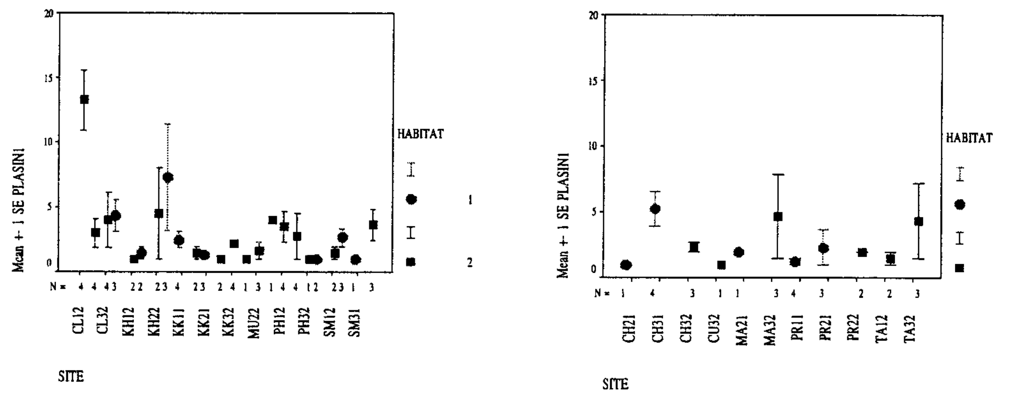


Figure 85 (continued)

Platygyra pini Size 41-60 cm diameter



Platygyra sinensis Size 1-10 cm diameter



Platygyra sinensis Size 11-20 cm diameter

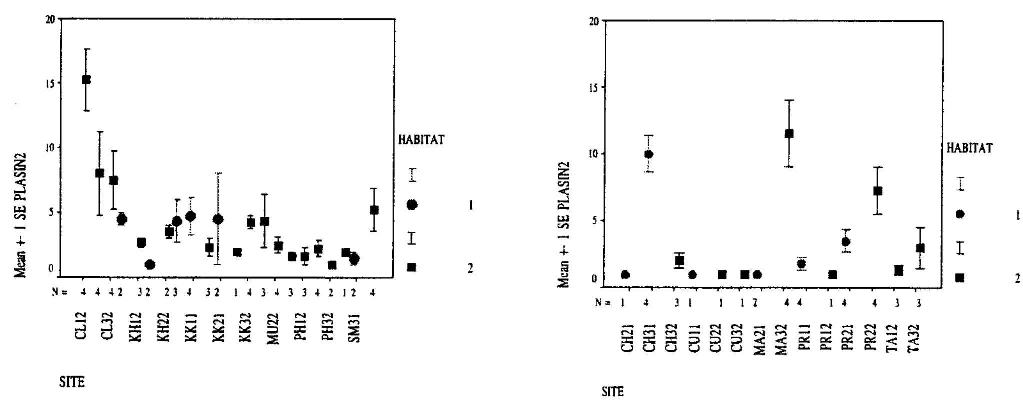
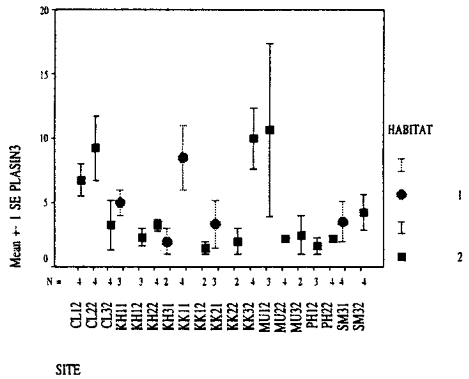
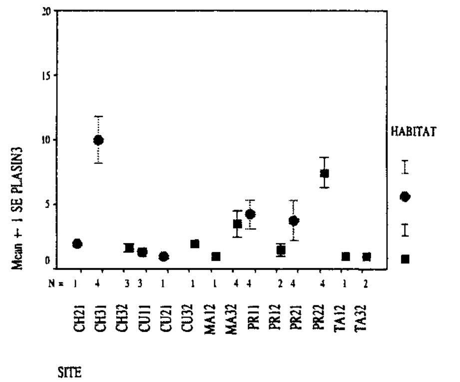


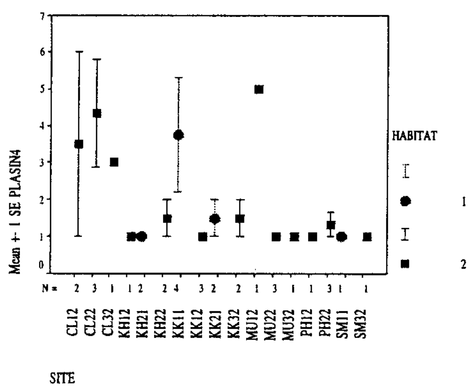
Figure 85 (continued)

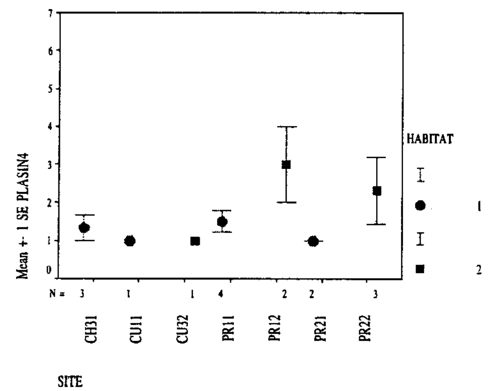
Platygyra sinensis Size 21-40 cm diameter



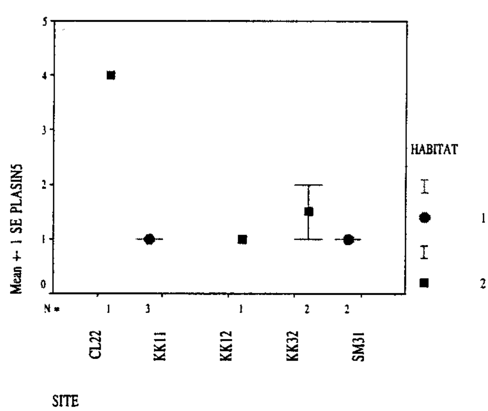


Platygyra sinensis Size 41-60 cm diameter





Platygyra sinensis Size > 60 cm diameter



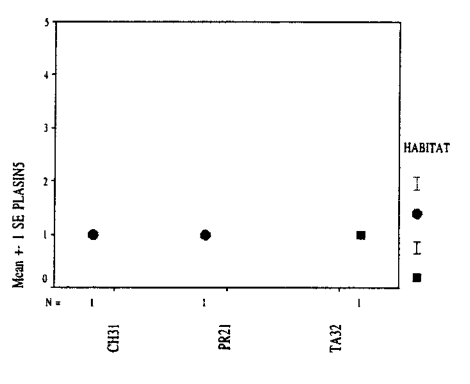
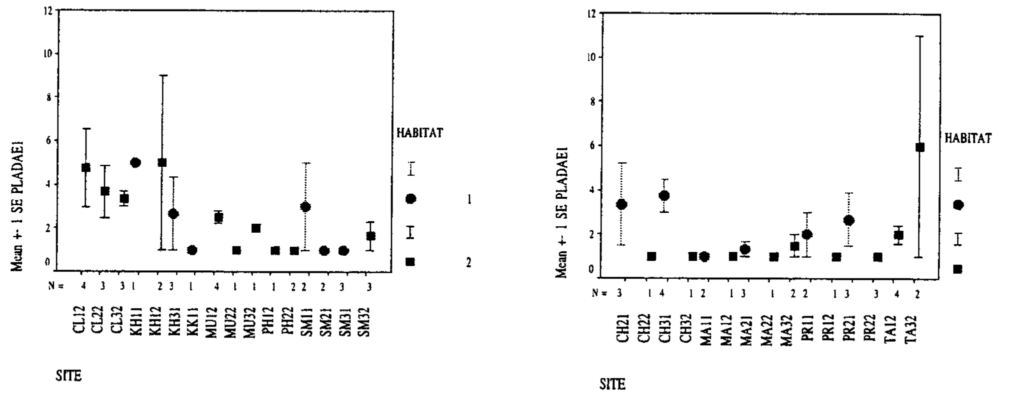
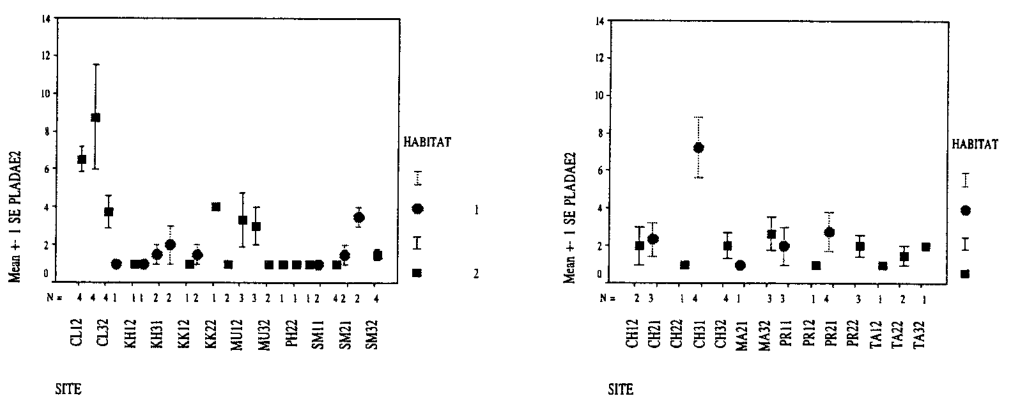


Figure 85 (continued)

Platygyra daedalea Size 1-10 cm diameter



Platygyra daedalea Size 11-20 cm diameter



Platygyra daedalea Size 21-40 cm diameter

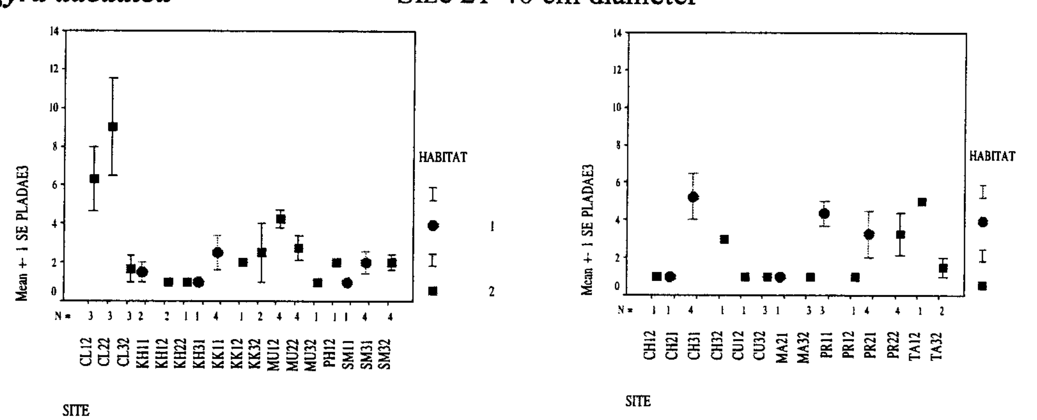
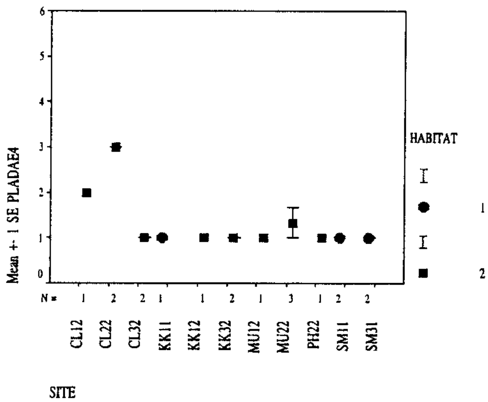
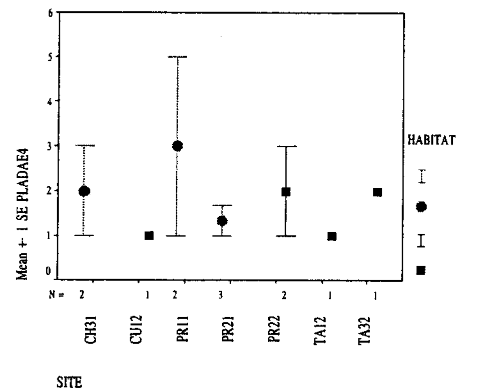


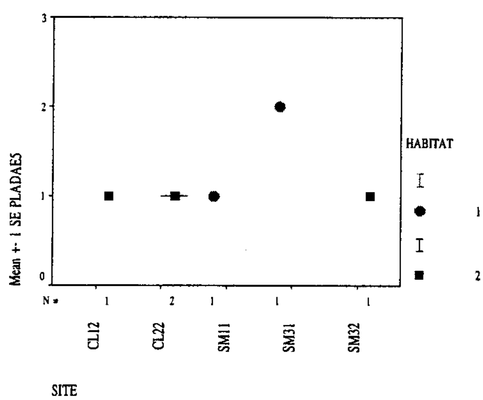
Figure 85 (continued)

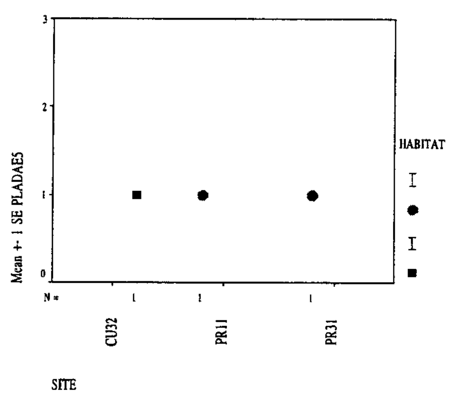
Platygyra daedalea Size 41-60 cm diameter



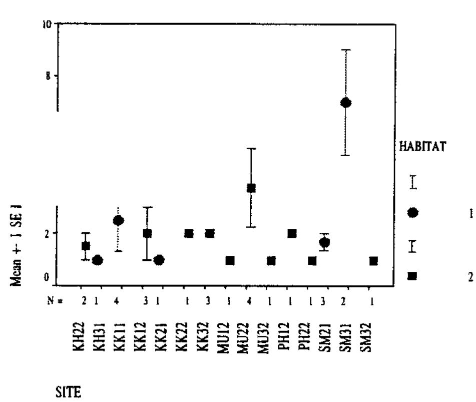


Platygyra daedalea Size > 60 cm diameter





Leptastrea transversa Size 1-10 cm diameter



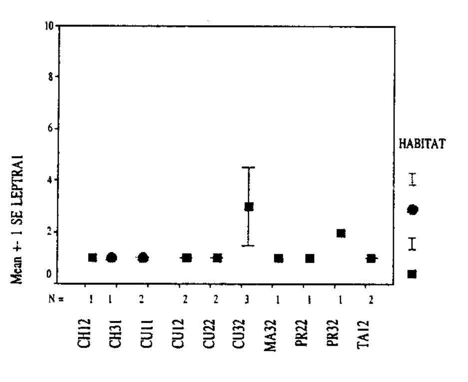
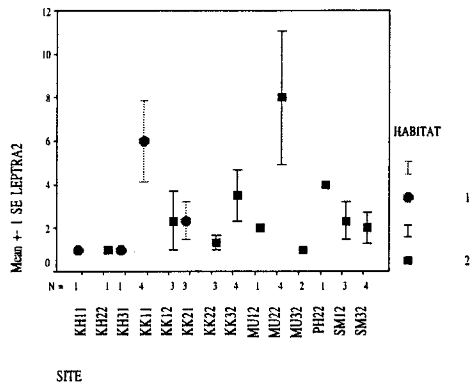
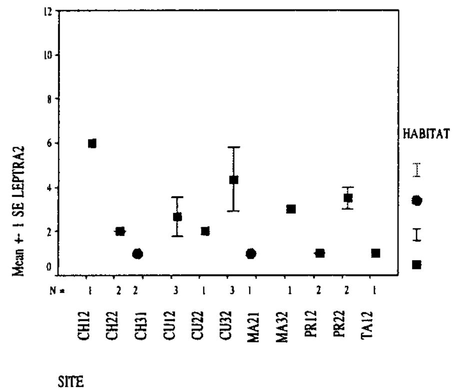


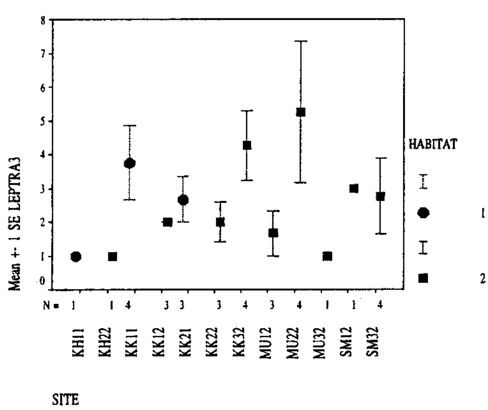
Figure 85 (continued)

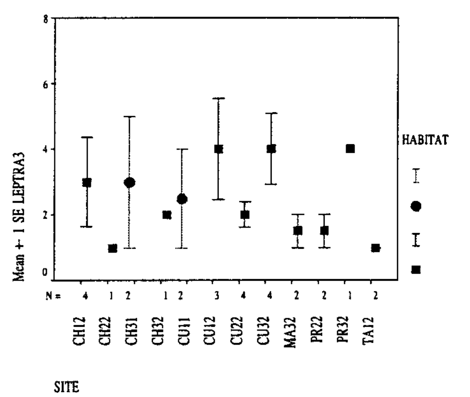
Leptastrea transversa Size 11-20 cm diameter



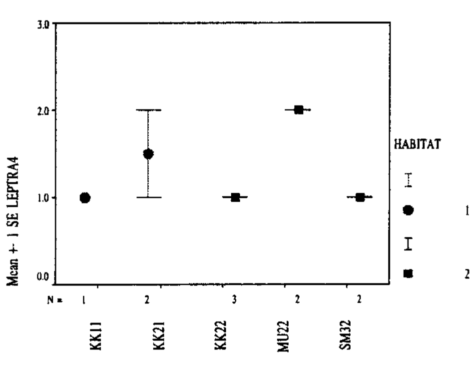


Leptastrea transversa Size 21-40 cm diameter





Leptastrea transversa Size 41-60 cm diameter



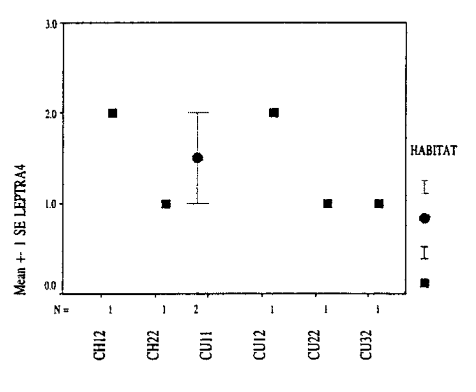
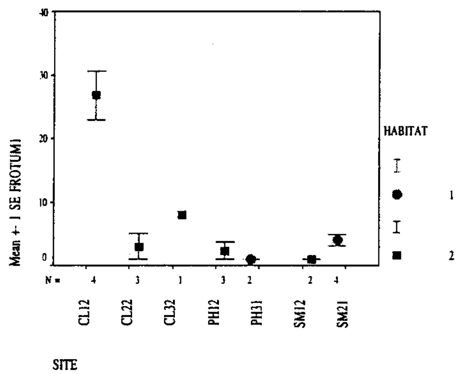
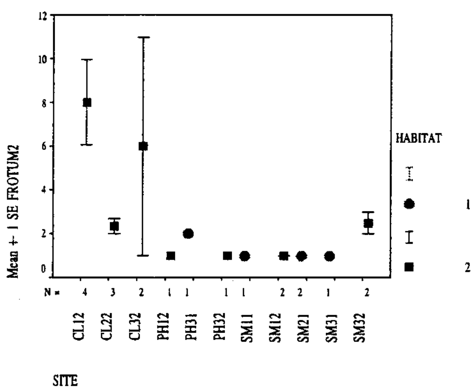


Figure 85 (continued)

Favia rotumana Size 1-10 cm diameter



Favia rotumana Size 11-20 cm diameter



Favia rotumana Size 21-40 cm diameter

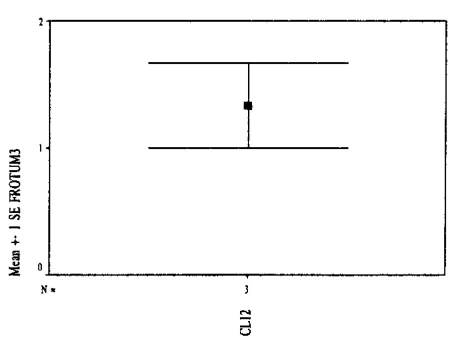
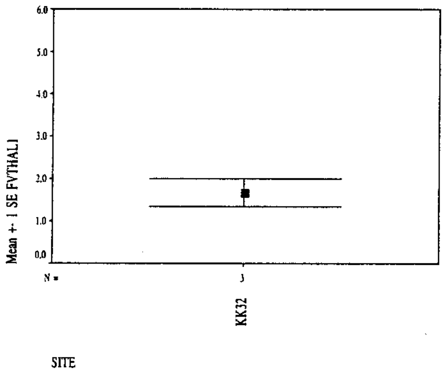
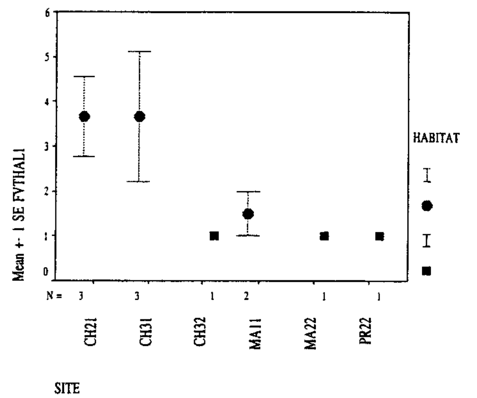


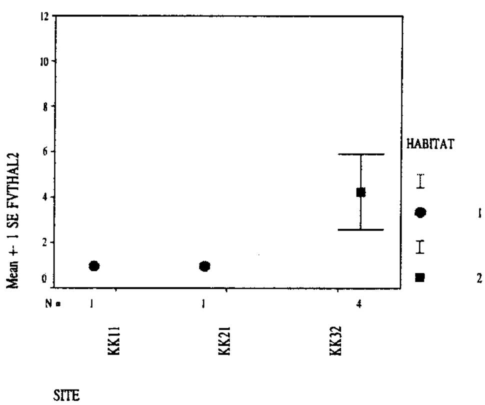
Figure 86 Colony size frequency (clonies/45m^2) of common species of faviid corals.
Habitat 1 = Reef flat 2 = Reef slope

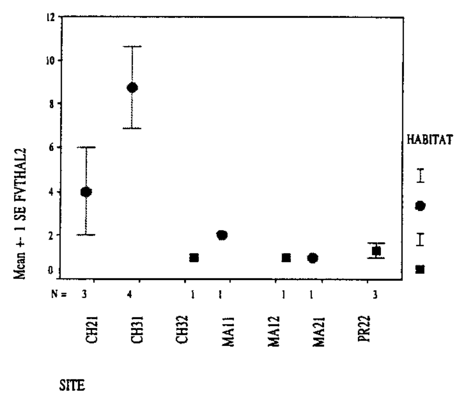
Favites halicora Size 1-10 cm diameter



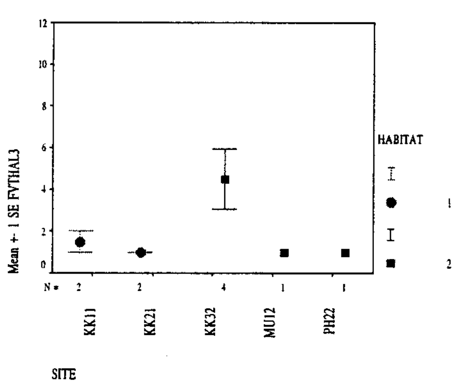


Favites halicora Size 11-20 cm diameter





Favites halicora Size 21-40 cm diameter



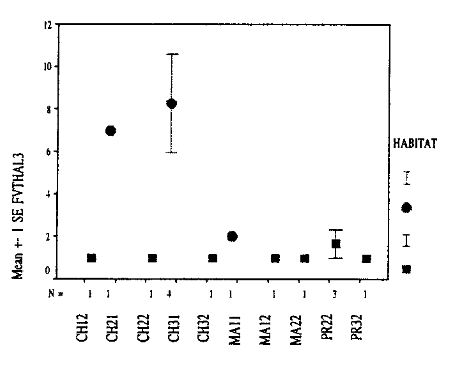
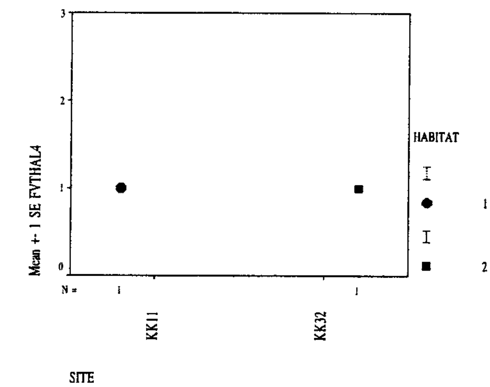
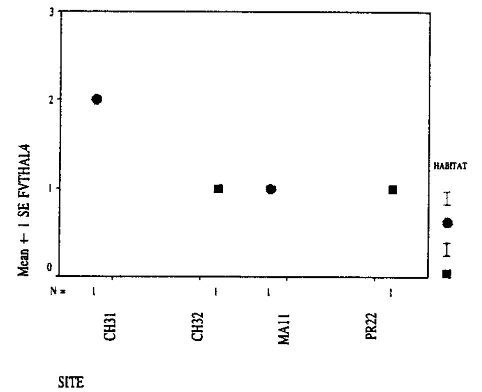


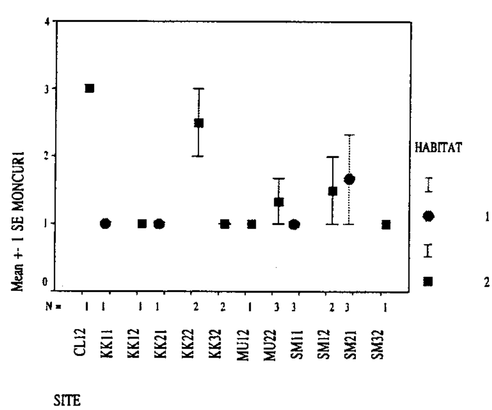
Figure 86 (continued)

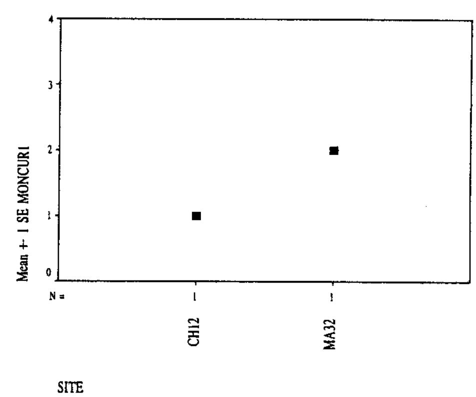
Favites halicora Size 41-60 cm diameter



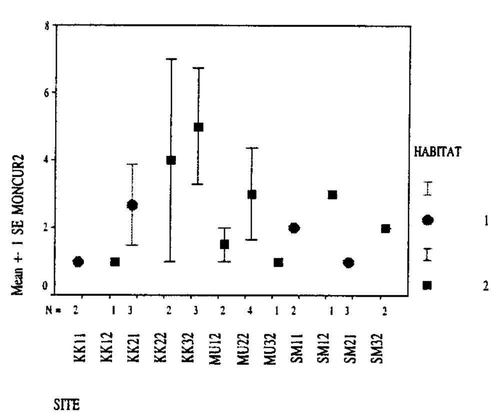


Montastrea curta Size 1-10 cm diameter





Montastrea curta Size 11-20 cm diameter



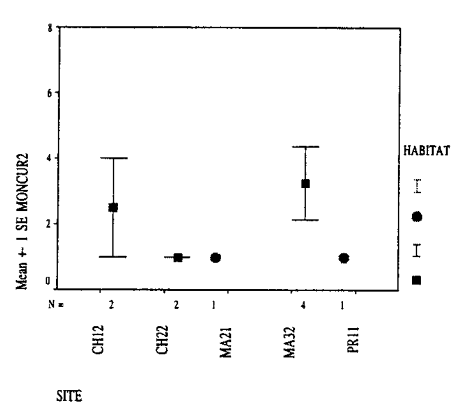
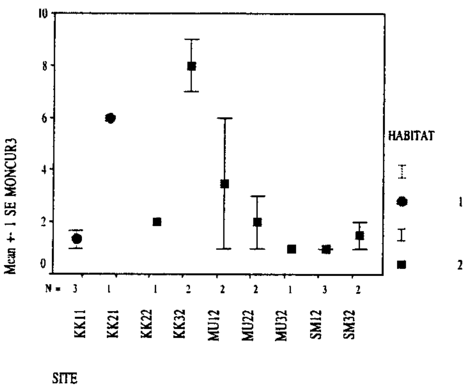
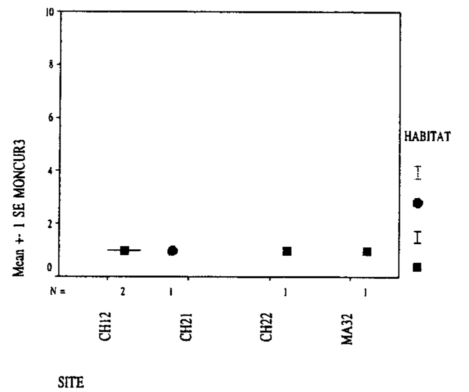


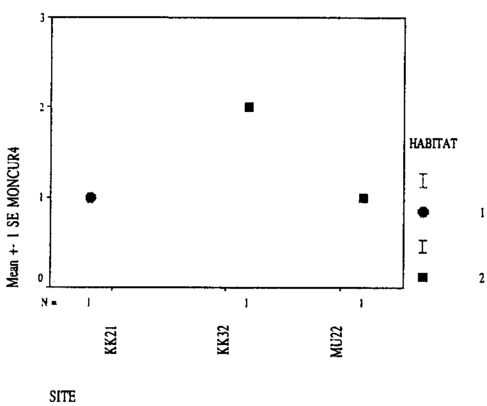
Figure 86 (continued)

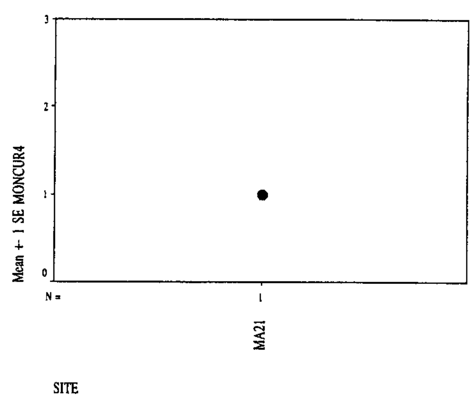
Montastrea curta Size 21-40 cm diameter



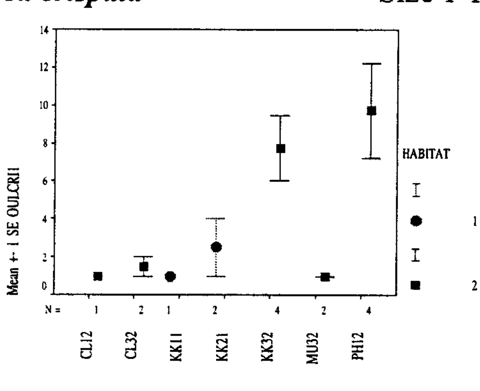


Montastrea curta Size 41-60 cm diameter





Oulastrea crispata Size 1-10 cm diameter



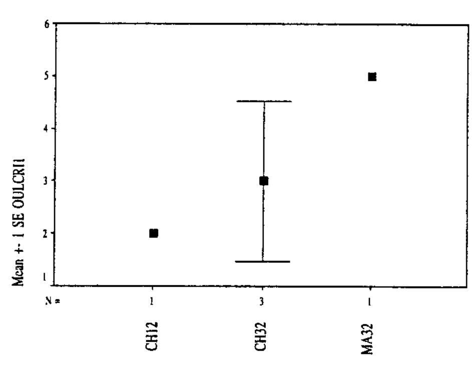
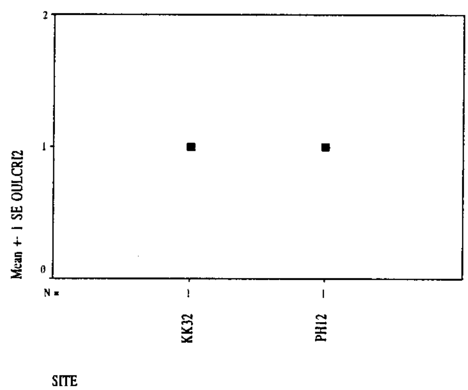
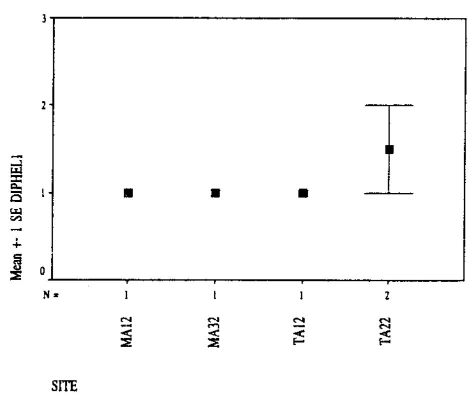


Figure 86 (continued)

Oulastrea crispata Size 11-20 cm diameter



Diploastrea heliopora Size 1-10 cm diameter



Diploastrea heliopora Size 11-20 cm diameter

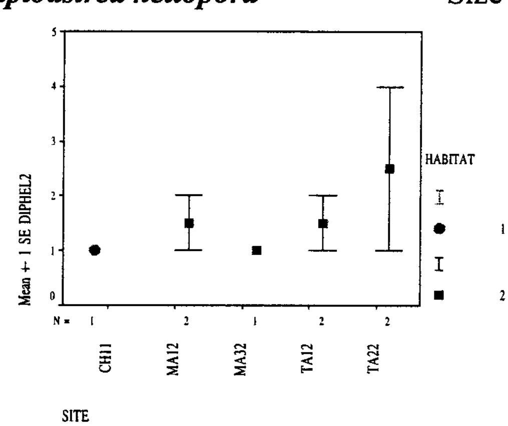
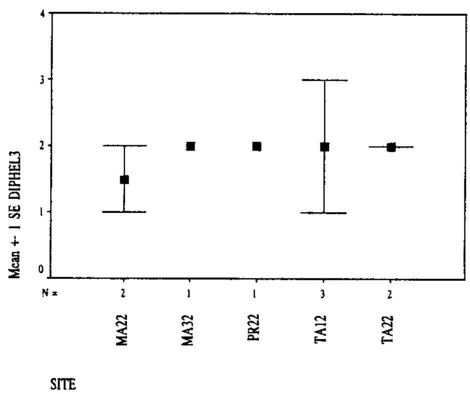
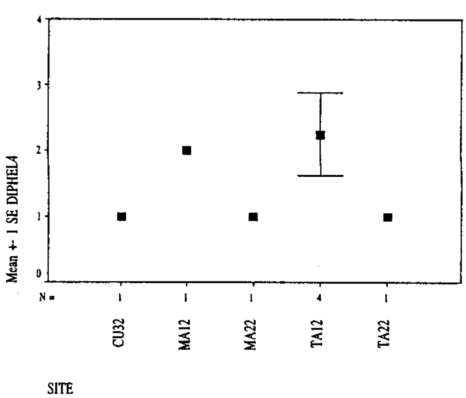


Figure 86 (continued)

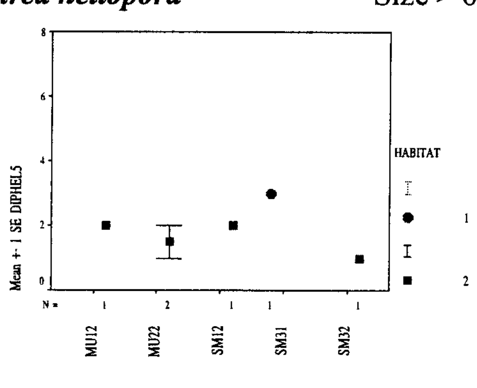
Diploastrea heliopora Size 21-40 cm diameter



Diploastrea heliopora Size 41-60 cm diameter



Diploastrea heliopora Size > 60 cm diameter



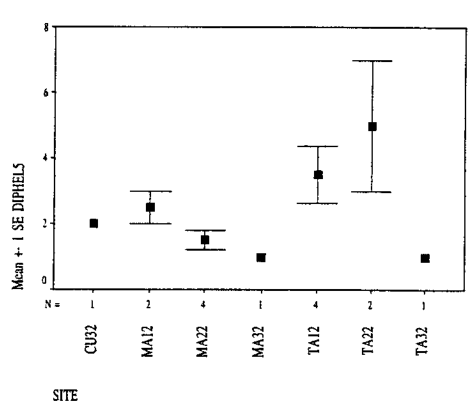
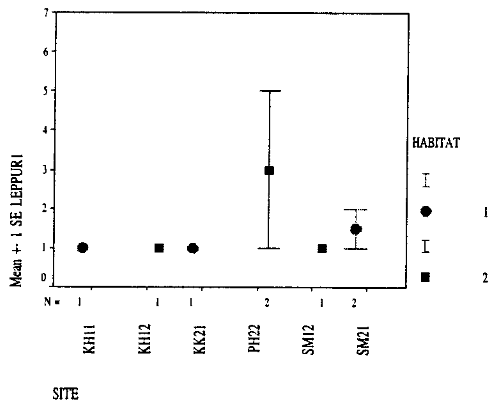
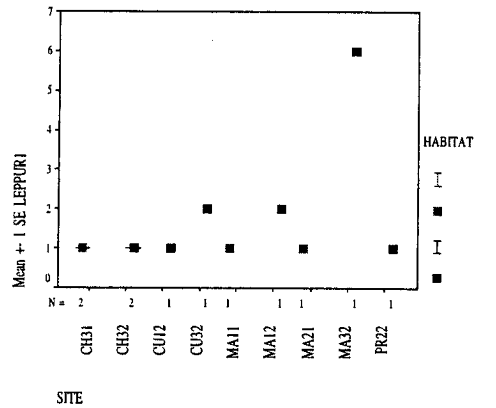


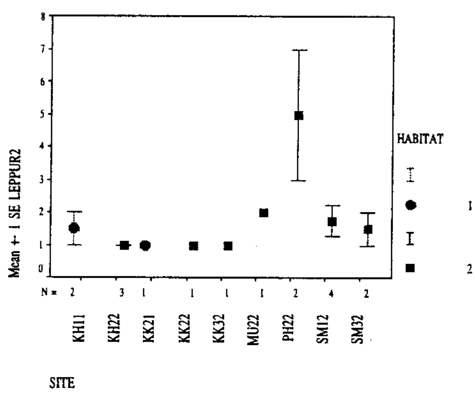
Figure 86 (continued)

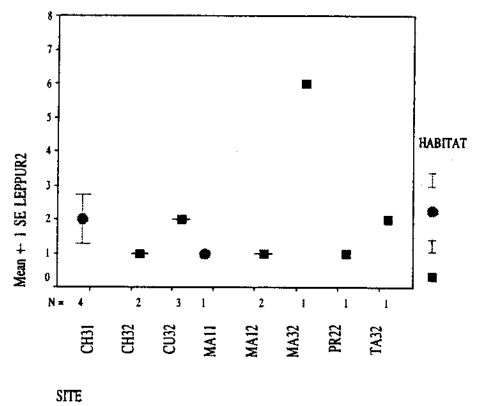
Leptastrea purpurea Size 1-10 cm diameter



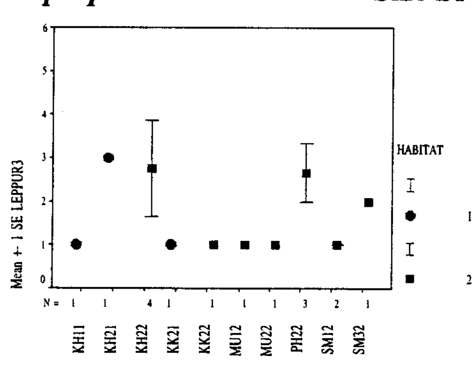


Leptastrea purpurea Size 11-20 cm diameter





Leptastrea purpurea Size 21-40 cm diameter



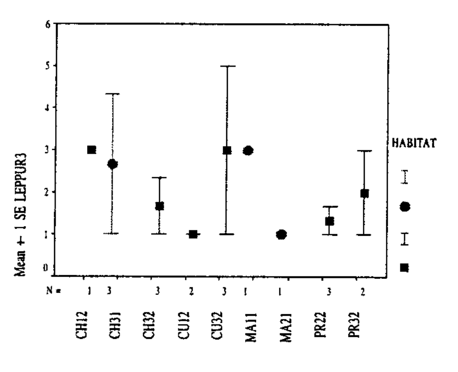
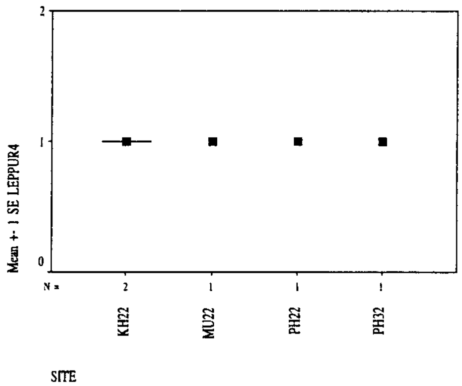
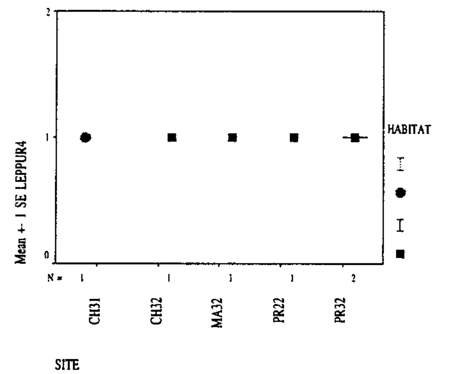


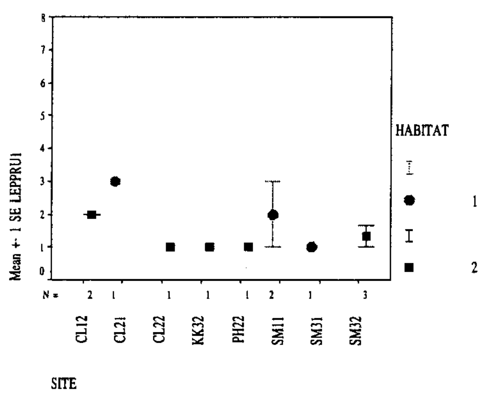
Figure 86 (continued)

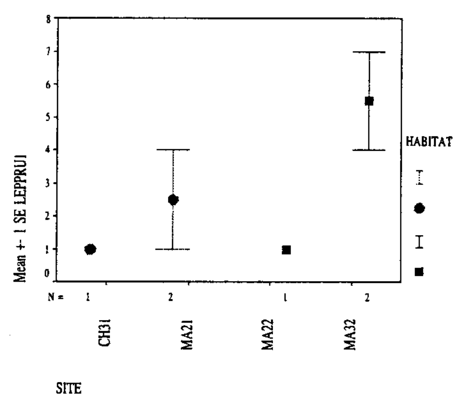
Leptastrea purpurea Size 41-60 cm diameter



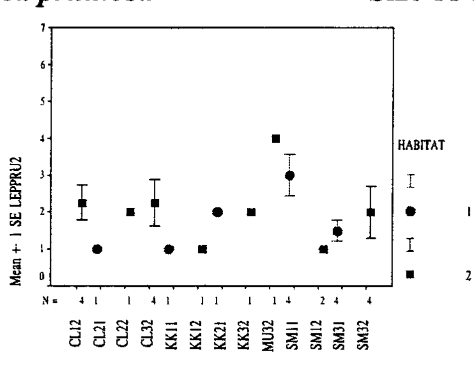


Leptastrea pruinosa Size 1-10 cm diameter





Leptastrea pruinosa Size 11-20 cm diameter



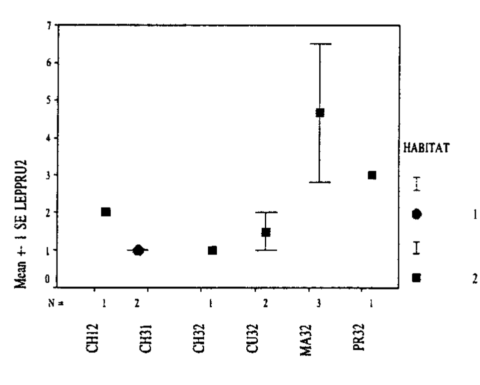
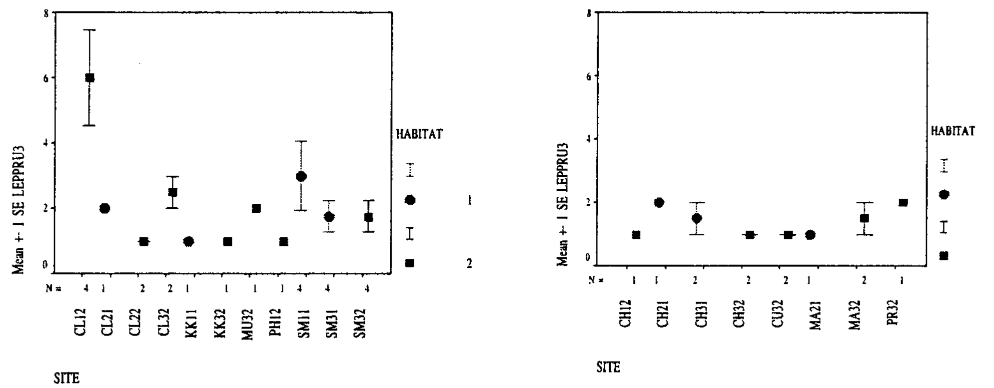
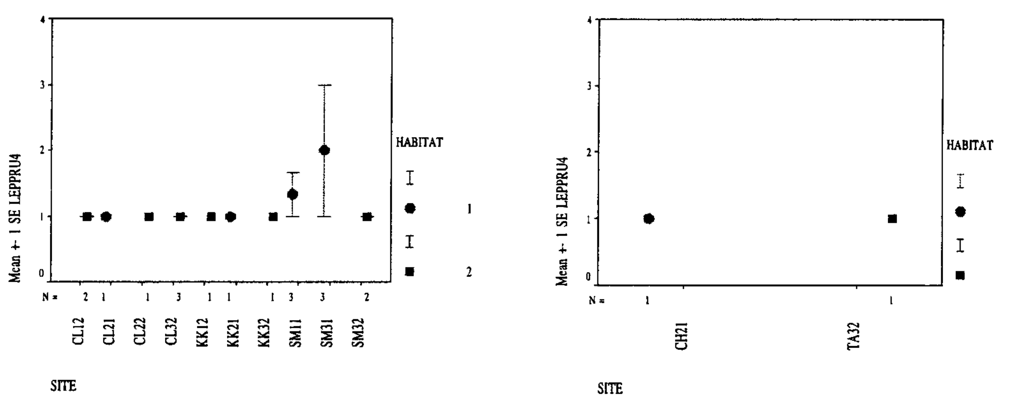


Figure 86 (continued)

Leptastrea pruinosa Size 21-40 cm diameter



Leptastrea pruinosa Size 41-60 cm diameter



Echinopora lamellosa Size 1-10 cm diameter

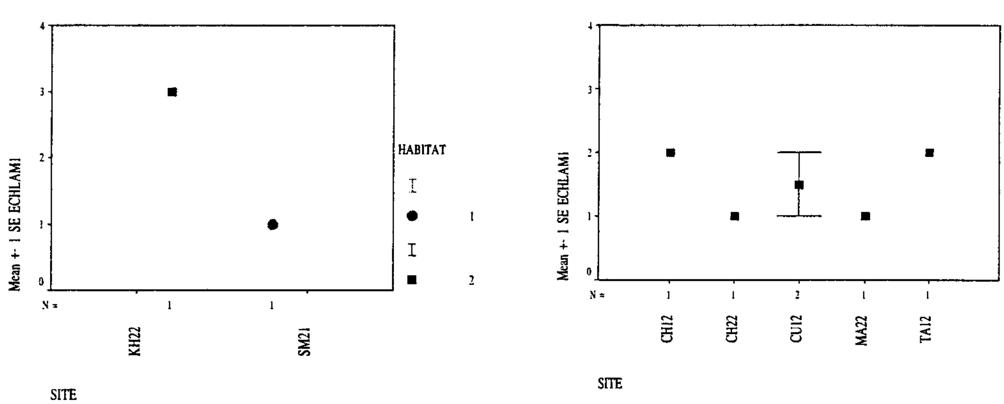
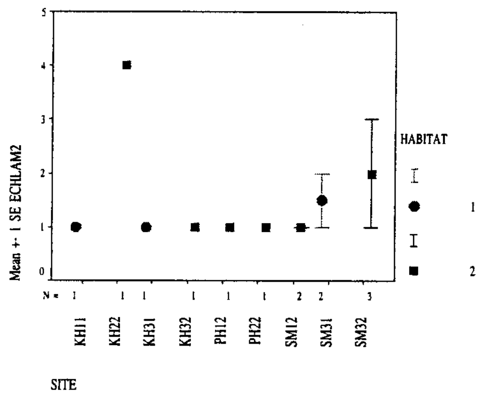
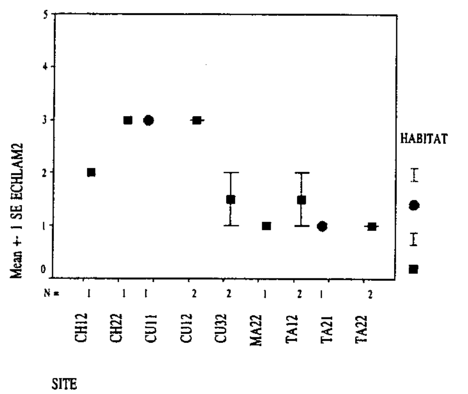


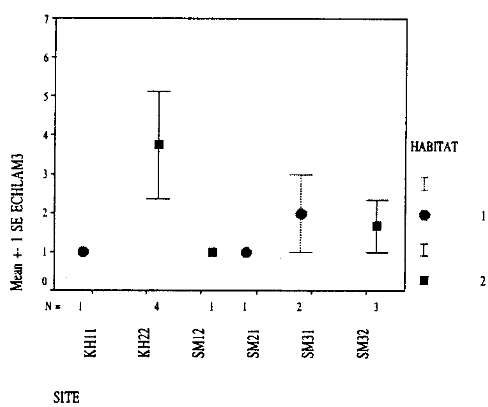
Figure 86 (continued)

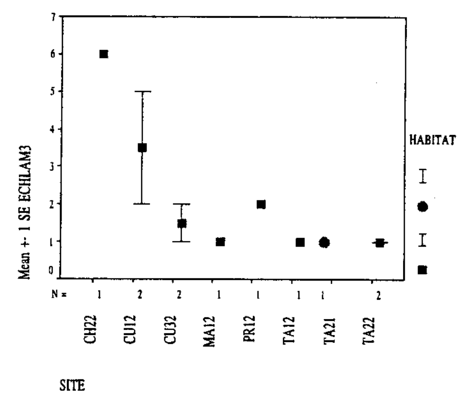
Echinopora lamellosa Size 11-20 cm diameter



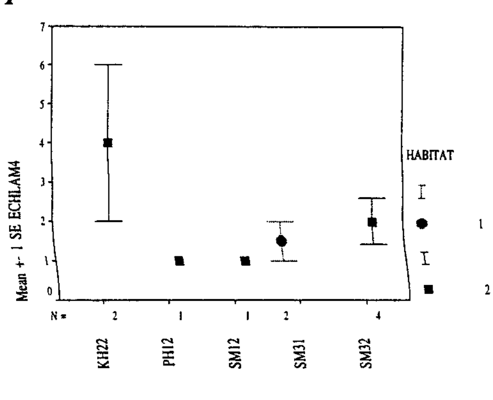


Echinopora lamellosa Size 21-40 cm diameter





Echinopora lamellosa Size 41-60 cm diameter



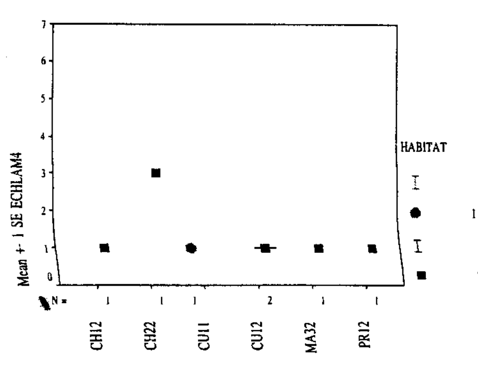
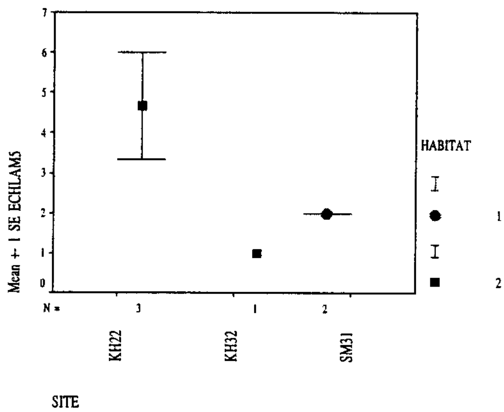


Figure 86 (continued)

Echinopora lamellosa Size >60 cm diameter



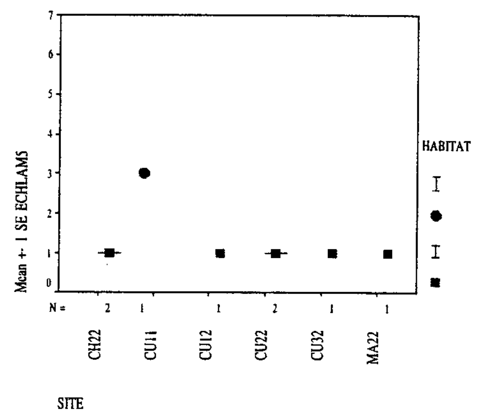


Figure 86 (continued)

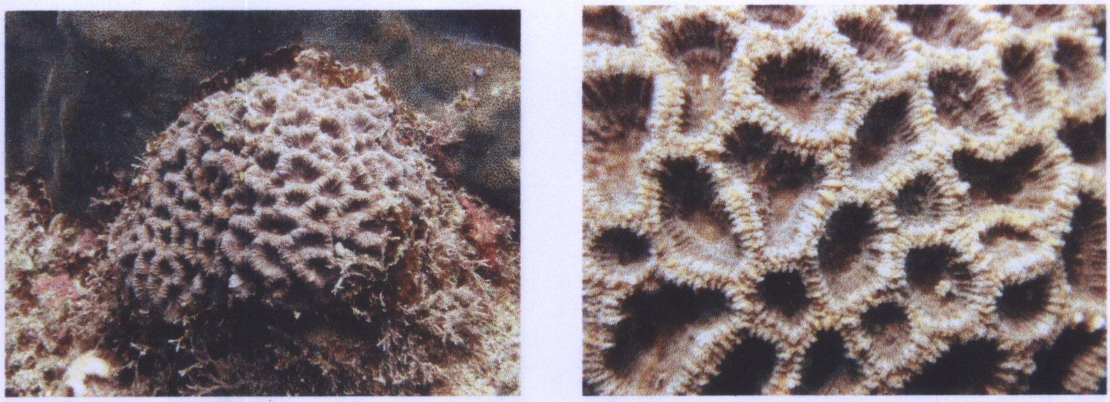


Figure 87 *Favia matthaii*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

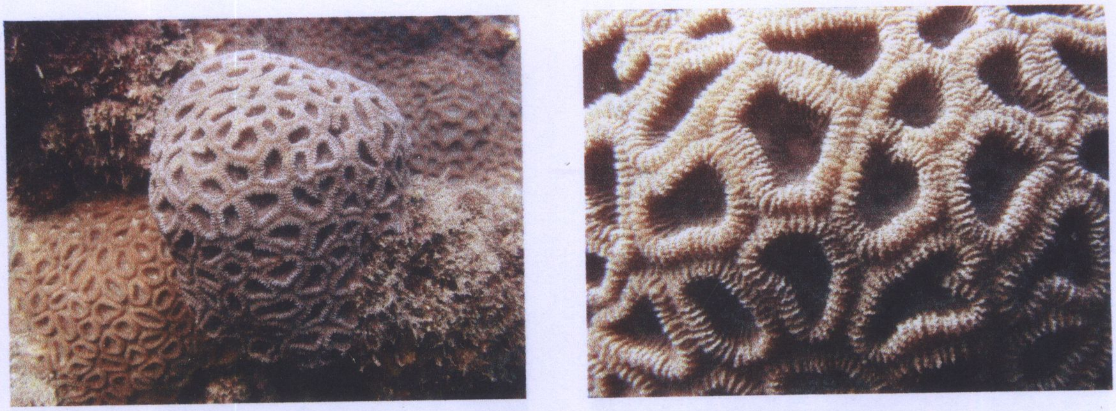


Figure 88 *Favia speciosa*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

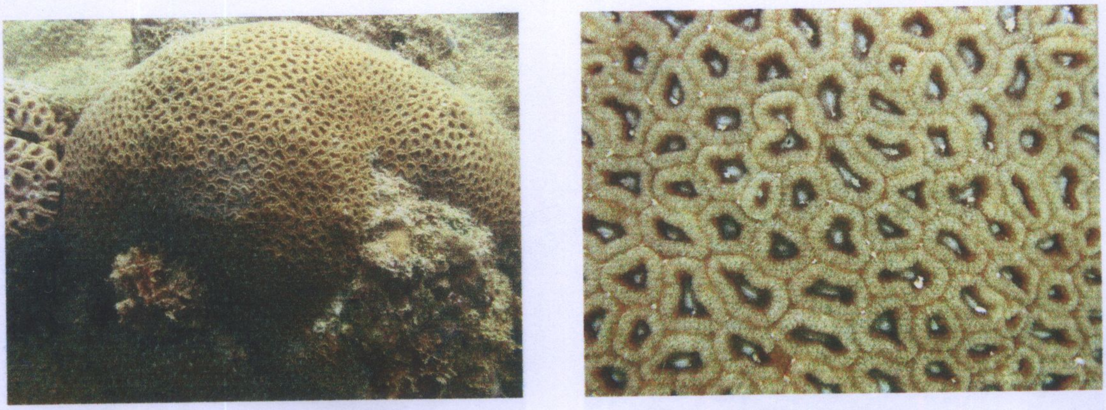


Figure 89 *Favia cf. truncatus*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

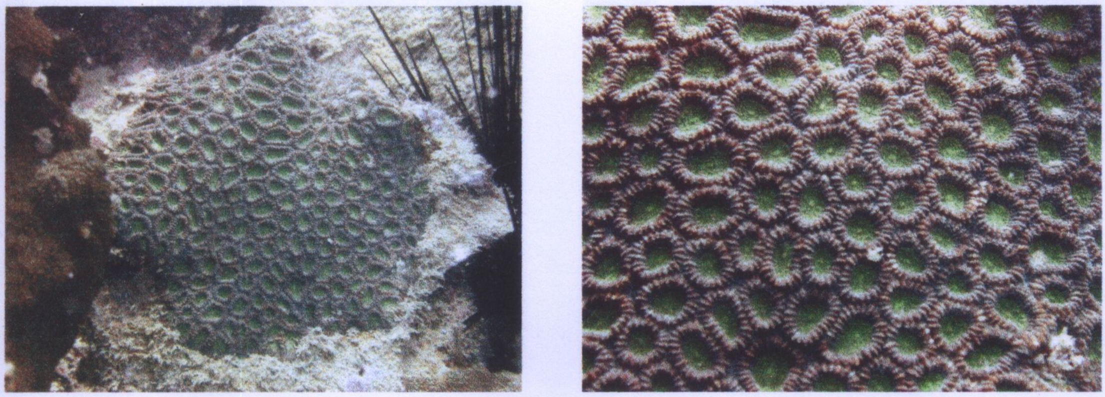


Figure 90 *Favia pallida*

Photograph: Kampee Patisayna Location: Samet Island Rayong Province.

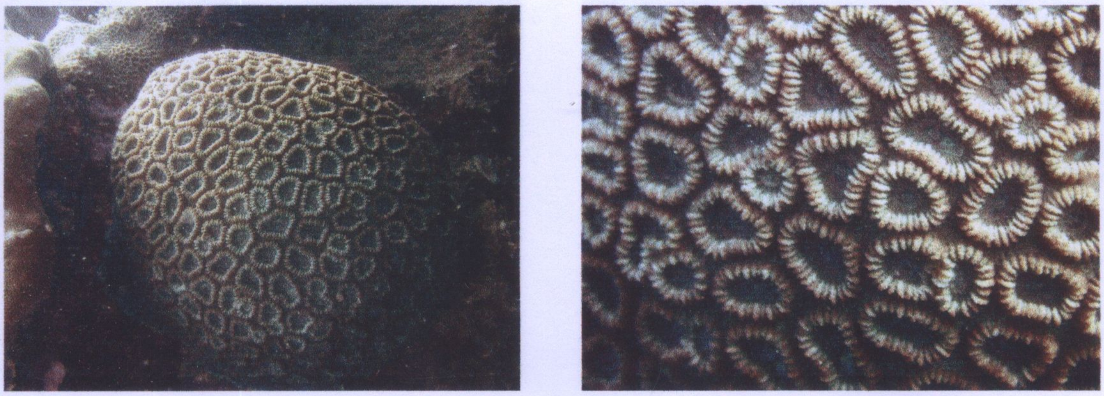


Figure 91 *Favia pallida*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

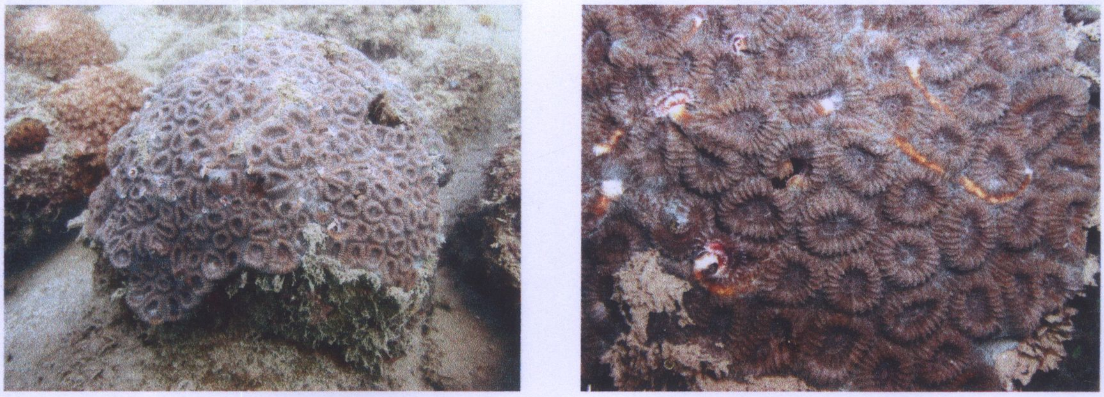


Figure 92 *Favia favus*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

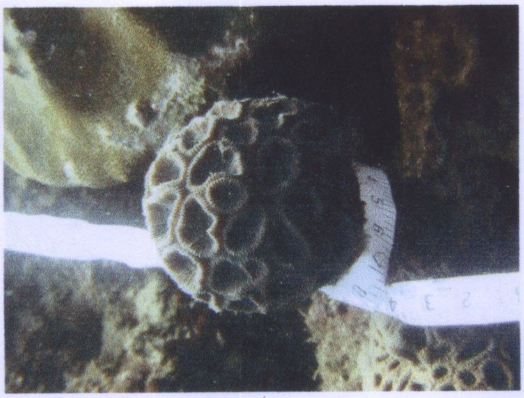


Figure 93 *Favia favus*

Photograph: Kampee Patisayna

Location: Chaolaw Chanthaburi Province.

Figure 94 *Favia rotumana*

Photograph: Kampee Patisayna

Location: Kra Island Nakhonsri Province.

Figure 95 *Favia rotundata*

Photograph: Veron (2000)

PS. Photographs in the field are unavailable.

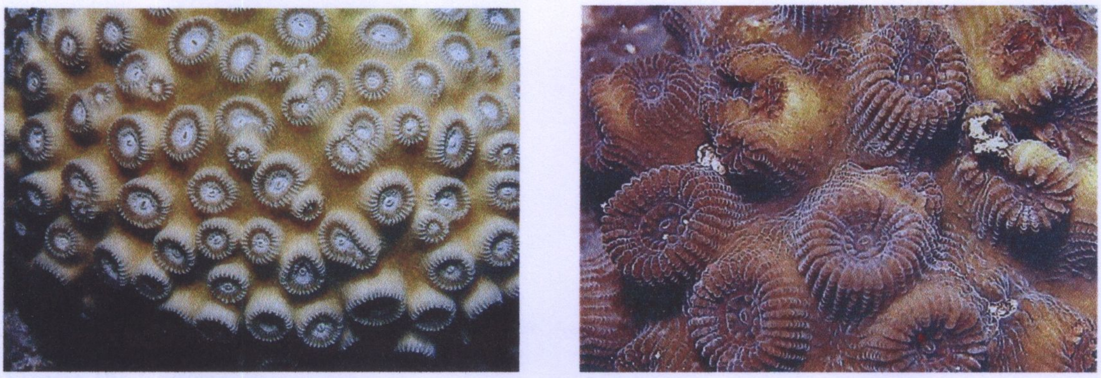


Figure 96 *Barabattoia amicorum*

Photograph: Veron (2000) PS. Photographs in the field are unavailable.

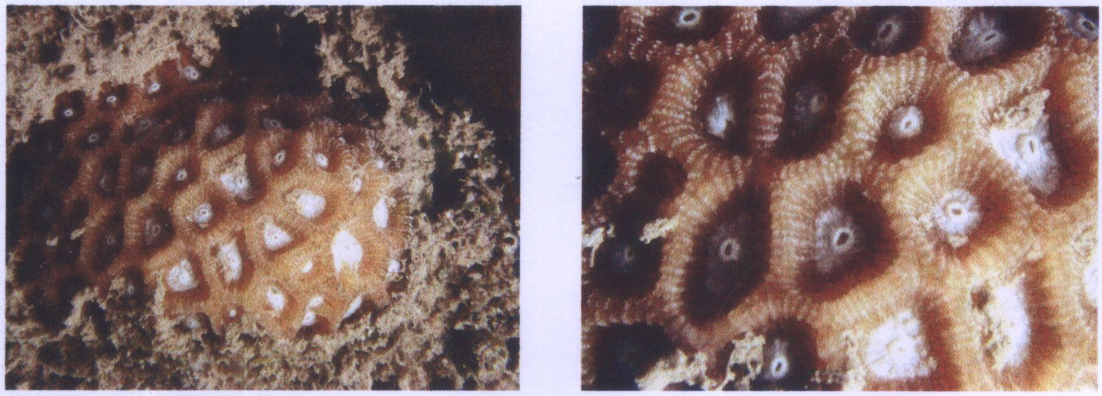


Figure 97 *Favites pentagona*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

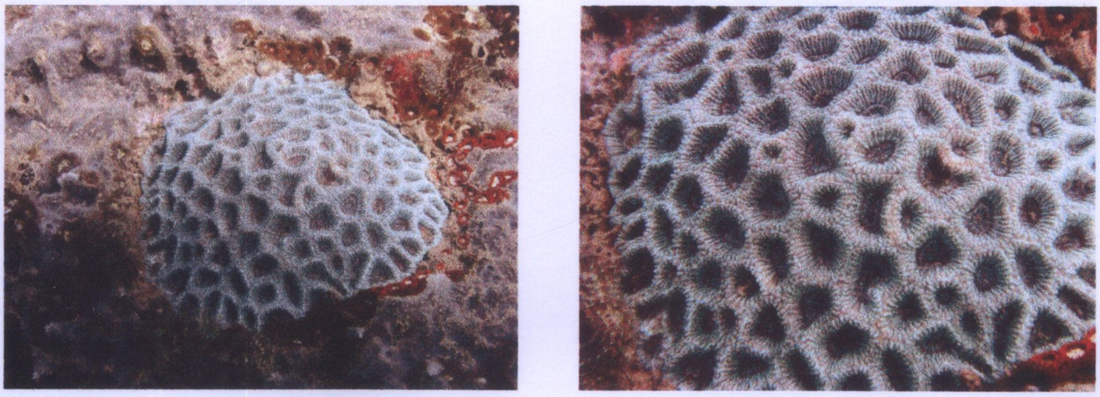


Figure 98 *Favites pentagona*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

Figure 99 *Favites chinensis*

Photograph: Veron (2000) PS. Photographs in the field are unavailable.

Figure 100 *Favites halicora*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

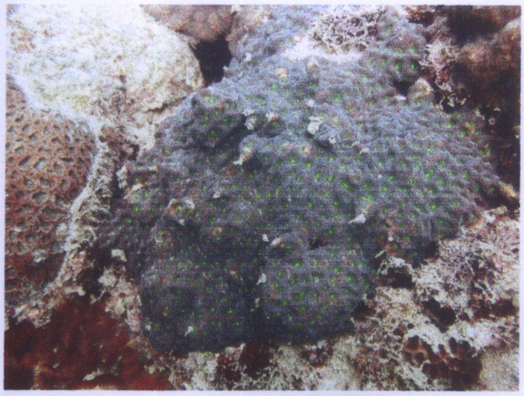


Figure 101 *Favites abdita*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

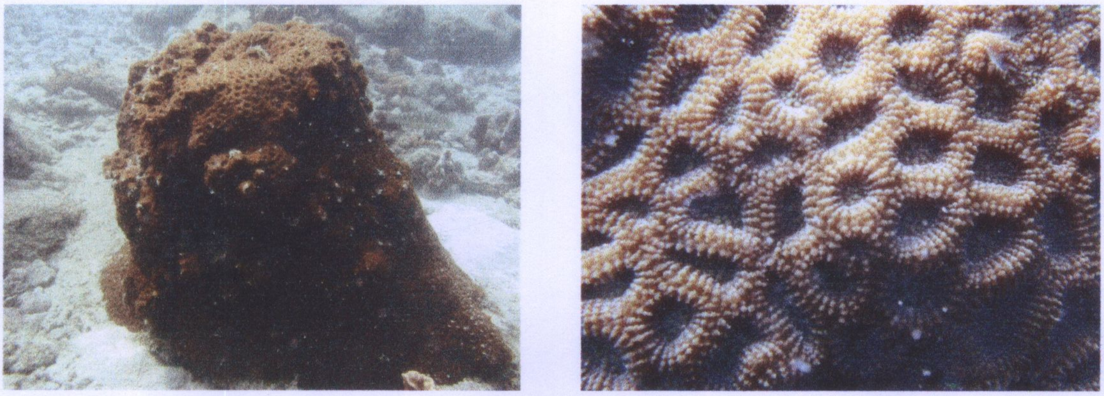


Figure 102 *Favites complanata*

Photograph: Kampee Patisayna Location: Samet Island Rayong Province.

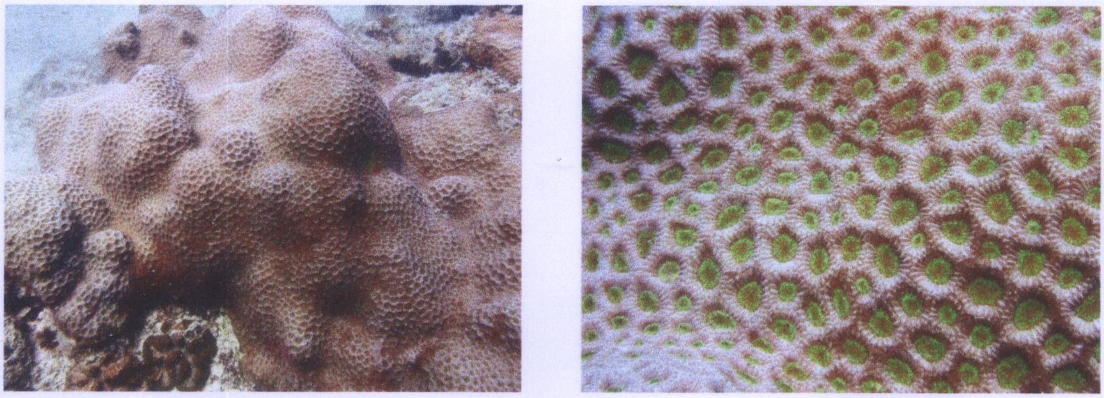


Figure 103 *Favites complanata*

Photograph: Kampee Patisayna Location: Samet Island Rayong Province.

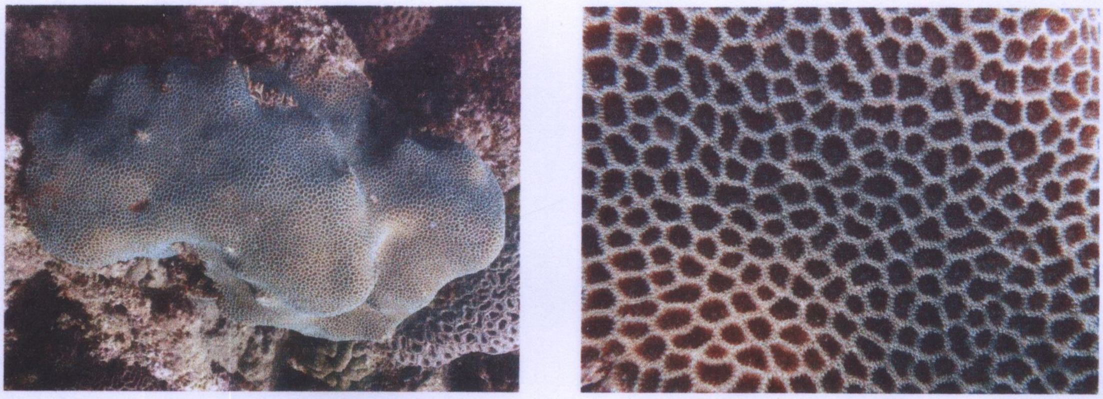


Figure 104 *Goniastrea retiformis*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

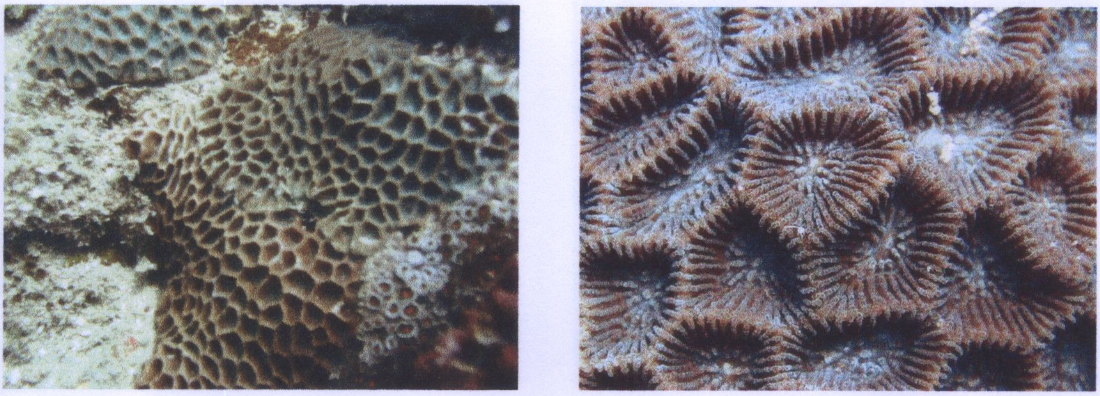


Figure 105 *Goniastrea cf. aspera*

Photograph: Kampee Patisayna Location: Monnai Island Rayong Province.

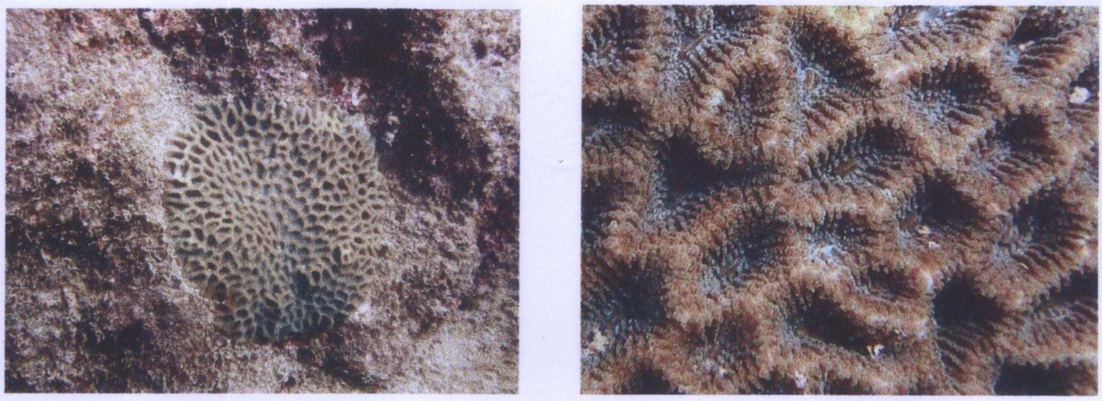


Figure 106 *Goniastrea cf. aspera*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

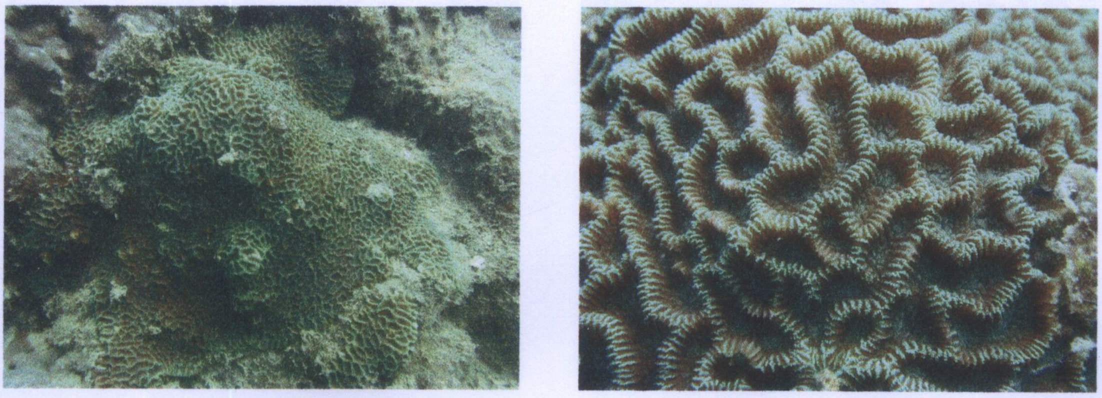


Figure 107 *Goniastrea pectinata*

Photograph: Kampee Patisayna Location: Samet Island Rayong Province.

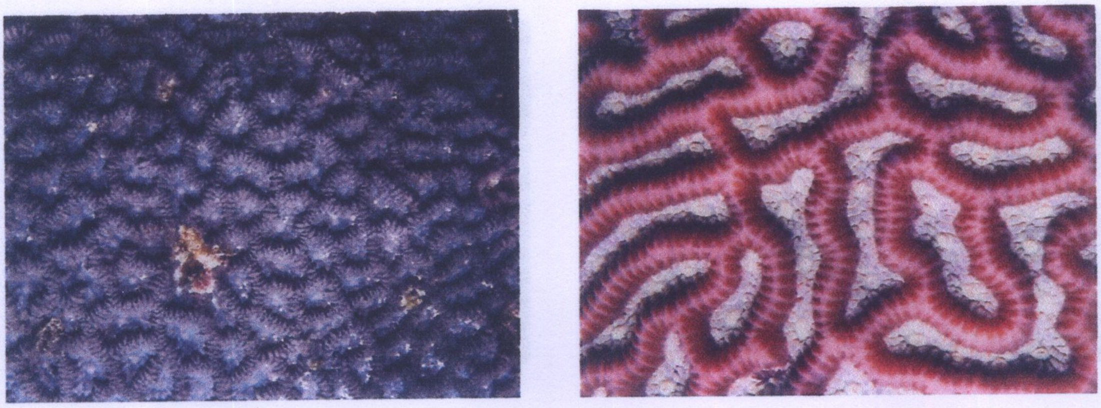


Figure 108 *Platygyra pini*
Photograph: Veron (2000) PS. Photographs in the field are unavailable.

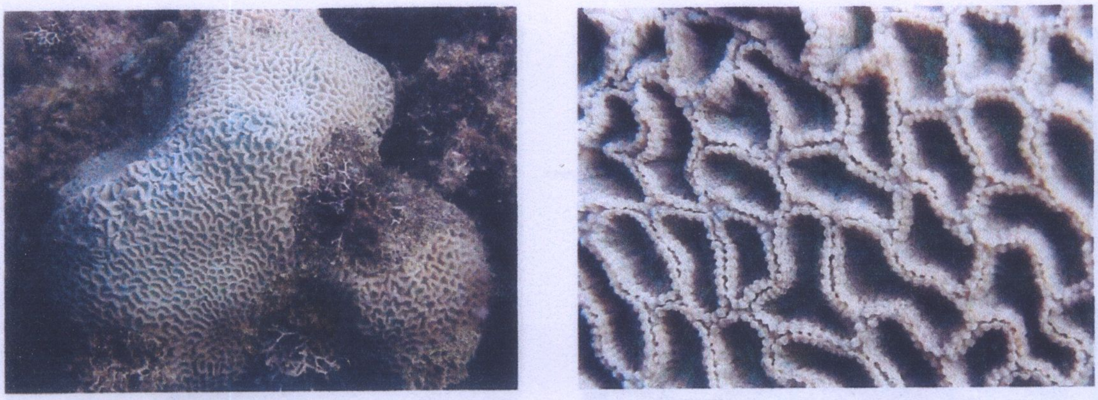


Figure 109 *Platygyra sinensis*
Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

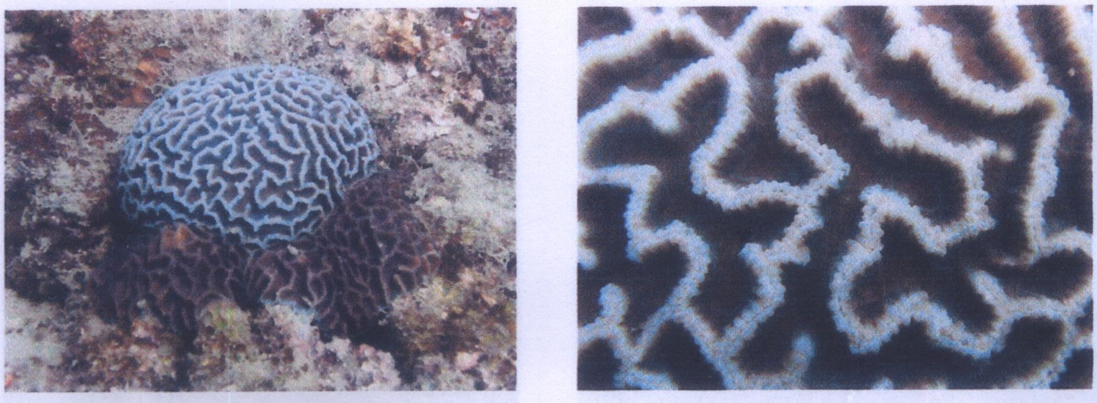


Figure 110 *Platygyra sinensis*
Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

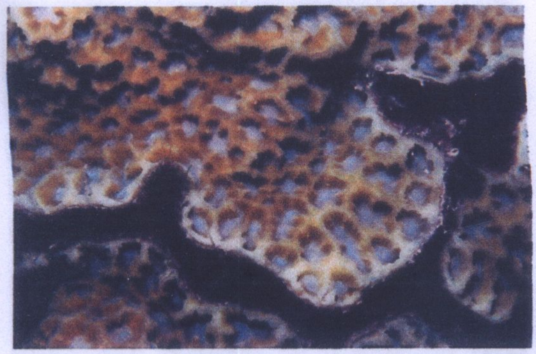


Figure 111 *Platygyra* cf. *contorta*

Photograph: Veron (2000) PS. Photographs in the field are unavailable.

Figure 112 *Platygyra daedalea*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

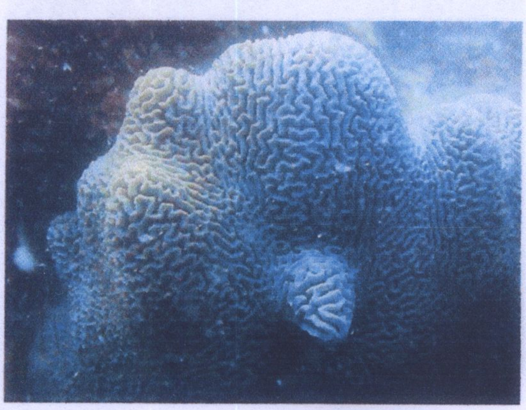


Figure 113 *Platygyra daedalea*

Photograph: Kampee Patisayna Location: Kudee Island Rayong Province.

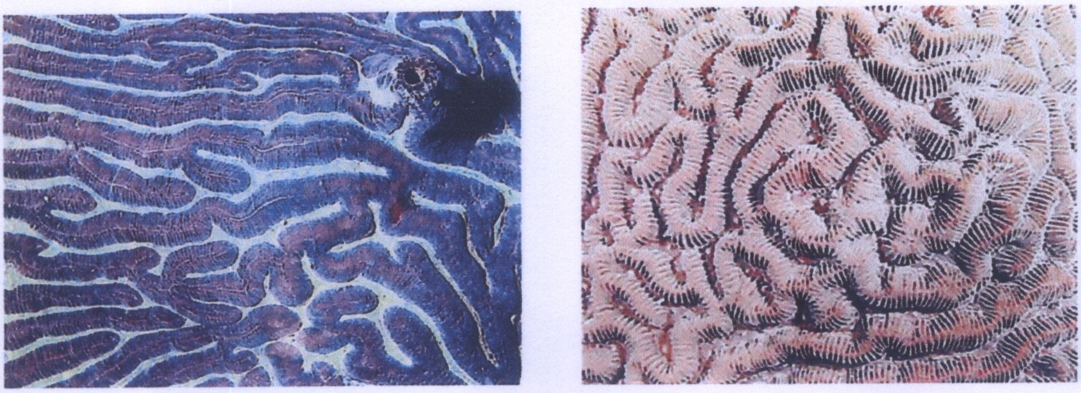


Figure 114 *Platygyra lamellina*

Photograph: Veron (2000) PS. Photographs in the field are unavailable.

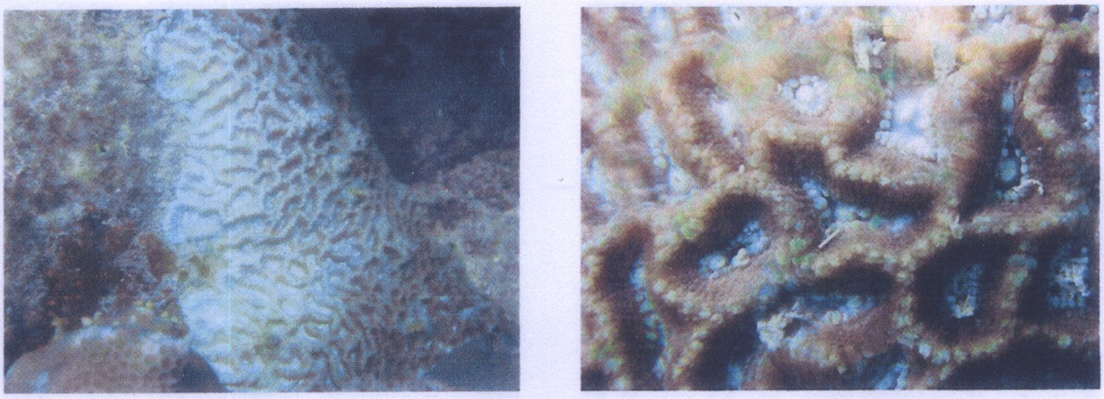


Figure 115 *Oulophyllia bennettae*

Photograph: Kampee Patisayna Location: Monnai Island Rayong Province.

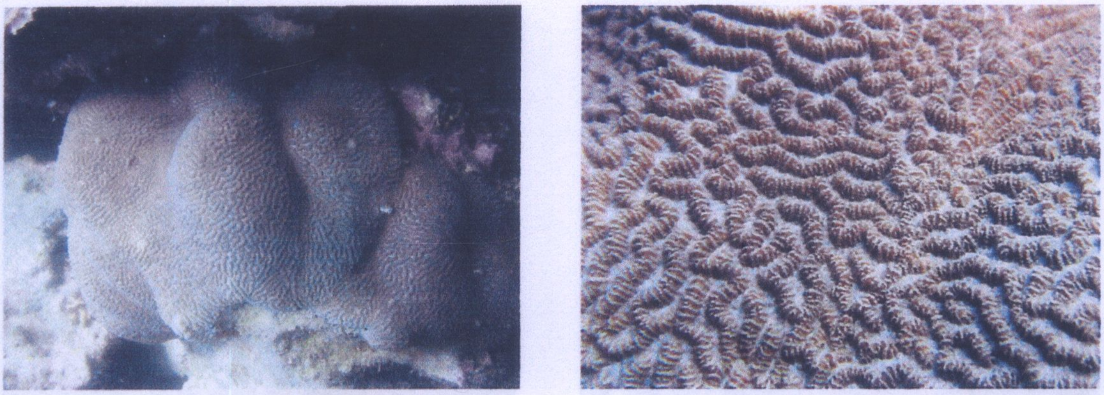


Figure 116 *Leptoria phrygia*

Photograph: Kampee Patisayna Location: Kudee Island Rayong Province.

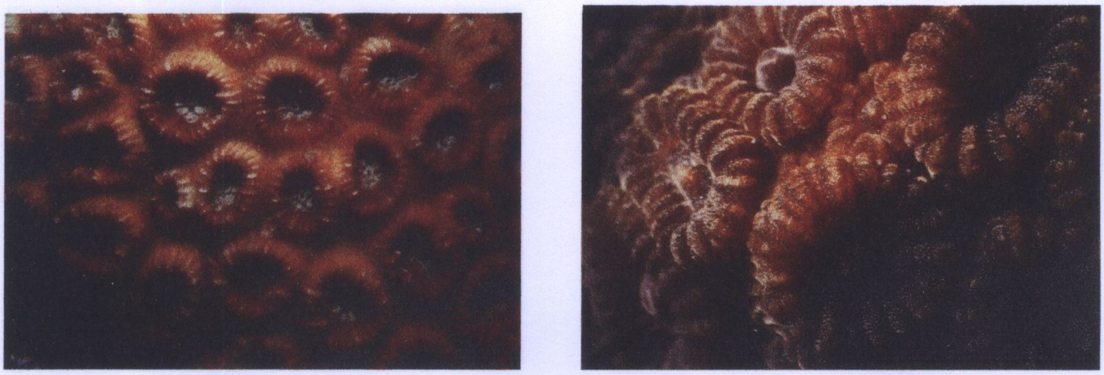


Figure 117 *Montastrea curta*

Photograph: Veron (2000) PS. Photographs in the field are unavailable.

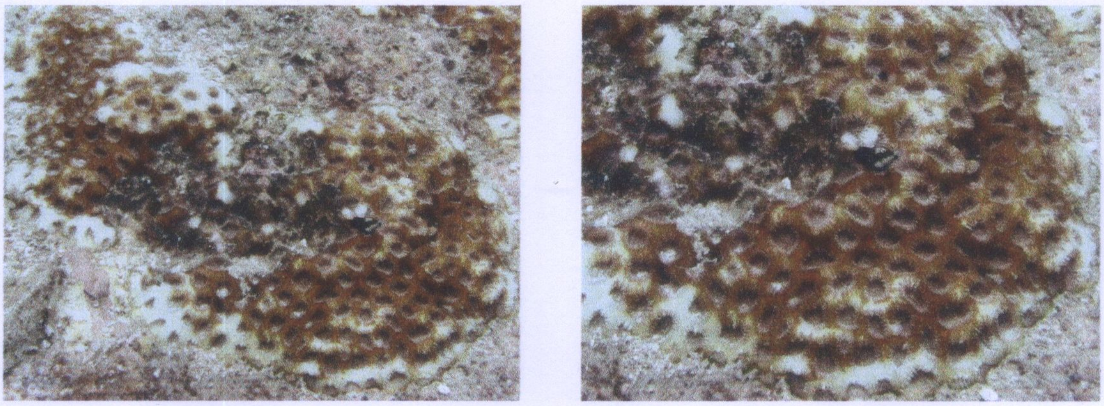


Figure 118 *Montastrea* cf. *salebrosa*

Photograph: Kampee Patisayna Location: Tao Island Surat Thanee Province.

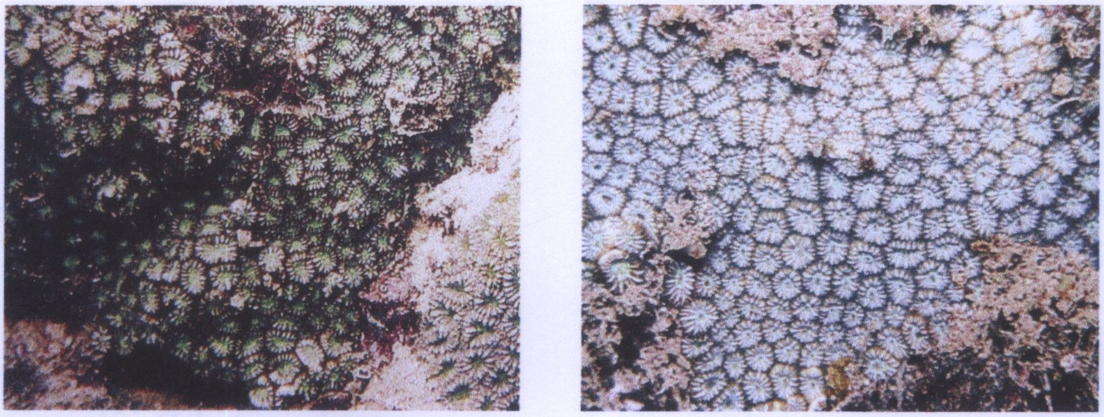


Figure 119 *Montastrea colemani*

Photograph: Veron (2000) PS. Photographs in the field are unavailable.

Figure 120 *Montastrea valenciennesi*

Photograph: Veron (2000)

PS. Photographs in the field are unavailable.

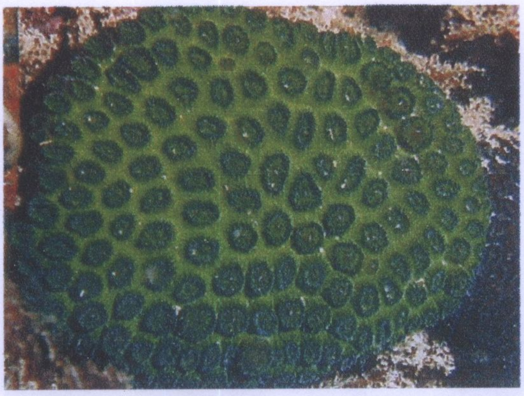


Figure 121 *Plesiastrea versipora*

Photograph: Veron (2000)

PS. Photographs in the field are unavailable.

Figure 122 *Oulastrea crispata*

Photograph: Varan Suwanno

Location: Monnai Island Rayong Province.

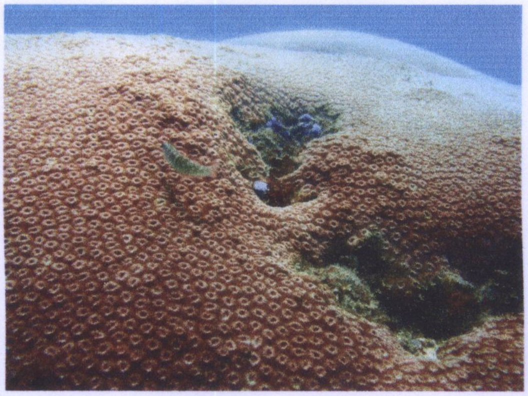
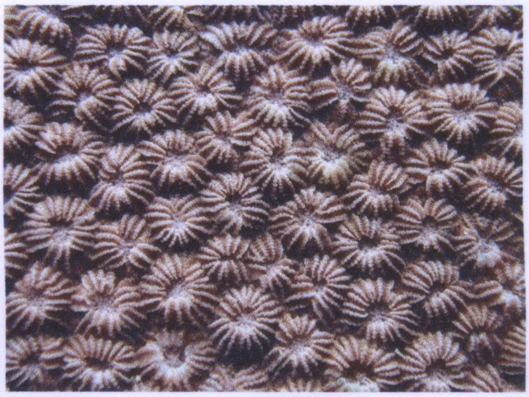



Figure 123 *Diploastrea heliopora*

Photograph: Varan Suwanno Location: Monnai Rayong Province.

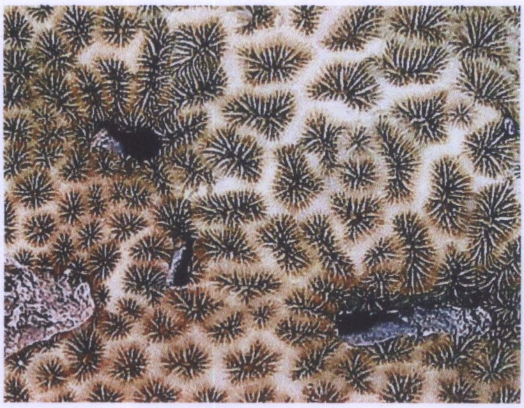
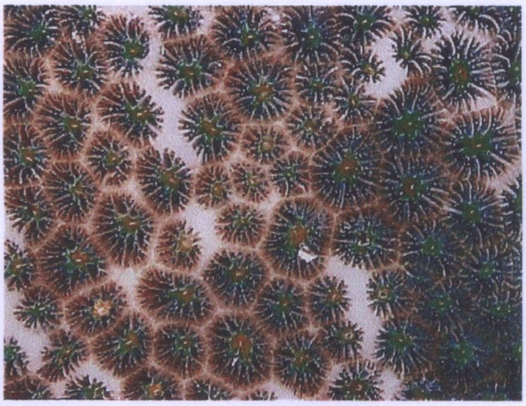



Figure 124 *Leptastrea purpurea*

Photograph: Veron (2000) PS. Photographs in the field are unavailable.

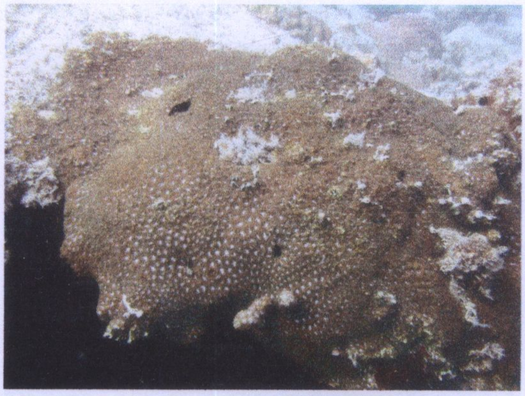



Figure 125 *Leptastrea pruinosa*

Photograph: Kampee Patisayna Location: Samet Islands Rayong Province.

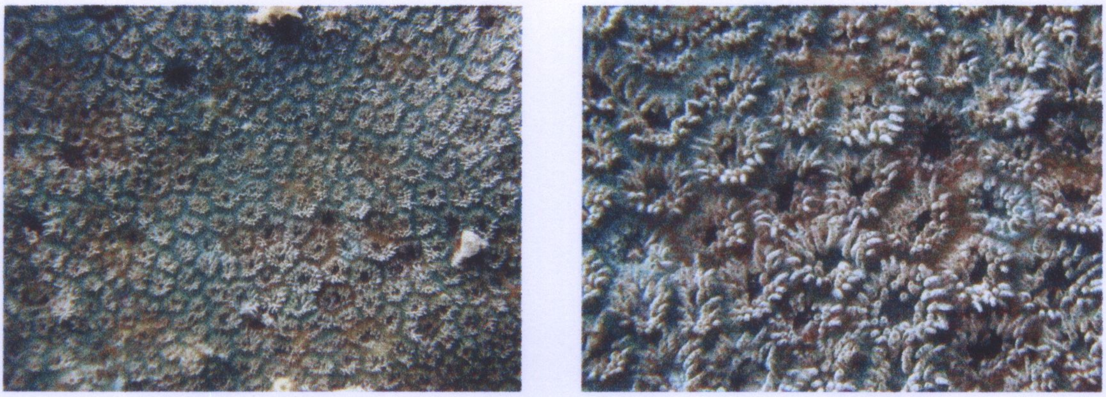


Figure 126 *Leptastrea pruinosa*

Photograph: Kampee Patisayna Location: Samet Islands Rayong Province.

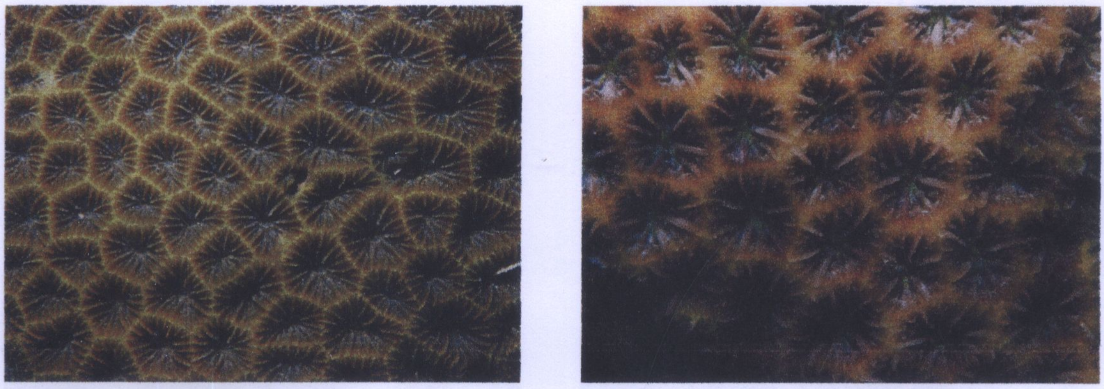


Figure 127 *Leptastrea transversa*

Photograph: Veron (2000) PS. Photographs in the field are unavailable.

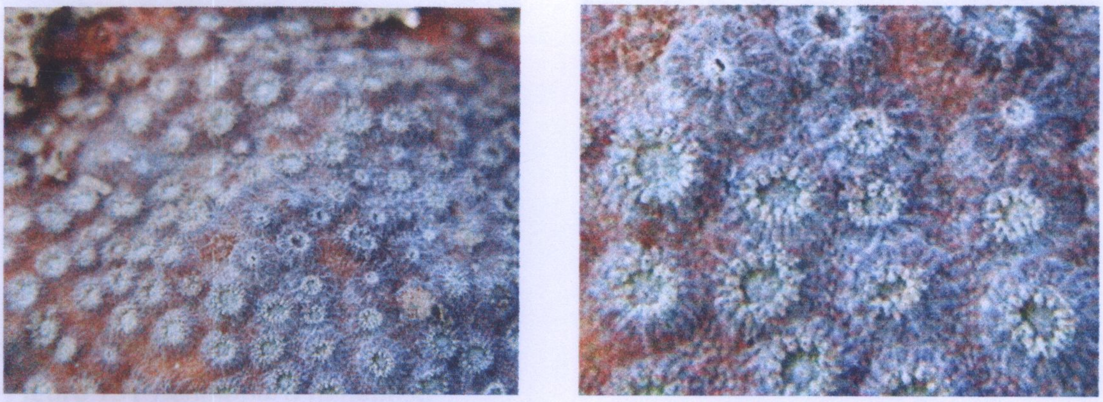


Figure 128 *Cyphastrea chalcidicum*

Photograph: Kampee Patisayna Location: Chaolaw Chanthaburi Province.

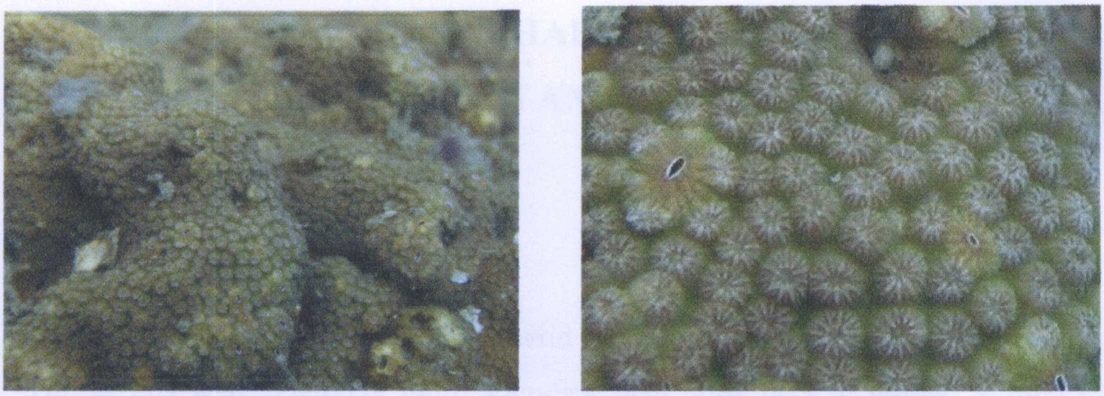


Figure 129 *Cyphastrea serailia*

Photograph: Srisakul Piromvaragorn Location: Monnai Island Rayong Province.

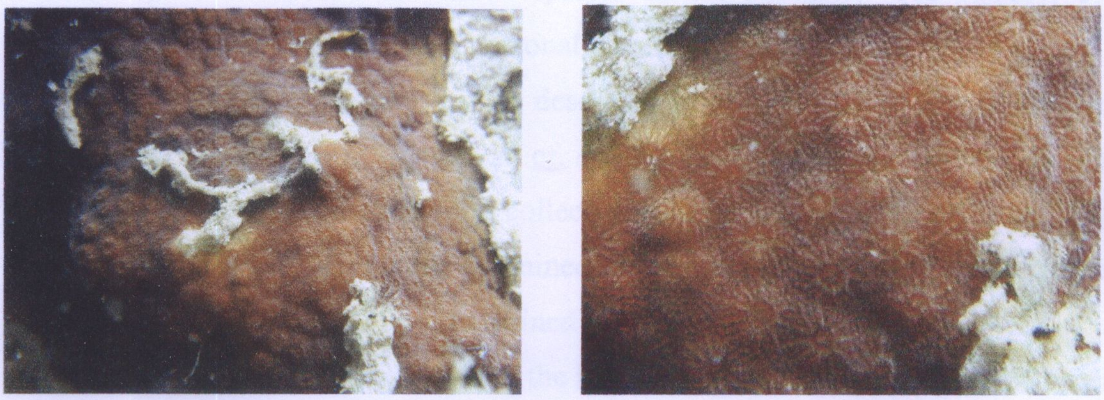


Figure 130 *Cyphastrea microphthalma*

Photograph: Kampee Patisayna Location: Samet Island Rayong Province.

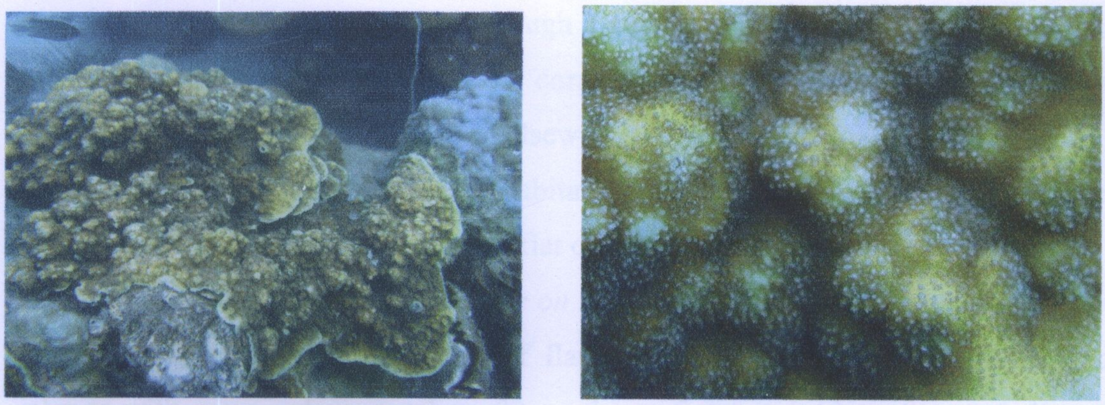


Figure 131 *Echinopora lamellosa*

Photograph: Srisakul Piromvaragorn Location: Rang Island Trat Province.

CHAPTER 5
DISCUSSION AND CONCLUSION

Discussion

1. Spatial Variation

In this study, a total of 37 faviid species belonging to 14 genera were found. The faviids were relatively more abundant than other taxa of corals. A total of 53 species belonging to 14 genera were reported in Thailand; thirty-eight species were found in the Gulf of Thailand (Jiravat, 1985; Sakai et al., 1986; Khongjandtre & Manthachitra, 2001) and fifty-three species in the Andaman Sea (Ditlev, 1980; Phongsuwan, 1986; Phongsuwan, personal communication).

There are four species were described from Thai waters for the first time; *Montastrea* cf. *salebrosa*, *Montastrea* cf. *colemani*, *Platygyra* cf. *contorta* and *Favia* cf. *truncatus*. Coral specimens were collected from an area of 8,460 m^2 from 47 sites belonging to 33 reefs. This study examined the largest and the largest number species of faviid corals that has yet been examined in this study.

Mark and Chang islands had the highest species richness (33 and 30 species, respectively). Tao Islands had the lowest species richness (18 species) whereas; the other Islands had 20-29 species. Number of species of corals tends to increase from the inner Gulf of Thailand toward the outer Gulf (Eastern part of Thailand). Water circulation from South China Sea through the outer gulf is much better than the inner gulf providing a better opportunity for coral larvae from Pacific Ocean to settle areas around Chang and Mark islands than elsewhere (Chantrarung, 2002).

Distribution pattern of reef habitats can be divided into 2 types, gaviid corals were either more abundant on the reef flat or on the reef slope.

1. Colony abundance greater on the reef flat: found at Sichang Islandswith mean colony numbers 73 on the reef flat and 49 on the reef slope, Samet-Kudee islands with mean colony numbers 88 on the reef flat and 40 on the reef slope and Chang Islands with mean colony numbers 153 on the reef flat and 27 on the reef slope.

Sakai et al. (1986) found at reef flat of KangKao Island was dominated by *Porites lutea* and *Pavona frondifera* was the next most abundant in density and area covered as did *Platygyra deadalea*. Reef slope was characterized by *Porites lutea, Montipora hispida* and *Echinopora lamellosa*. At Station E, reef flat was characterized by *Porites lutea* and *Platygyra daedalea* which are the next most abundant corals both in density and coverage. Reef slope was characterized by unattached *Acropora formosa* on the sandy bottom.

Manthachitra (1994) stated that massive corals such as *Favites, Platygyra, Diploastrea, Lobophyllia, Astreopora* and *Leptoseris* dominated the reef flat at Kudee Island. Boonprakob et al. (1998) found that the foliose form of *Pavona* sp. was commonly found followed by massive corals at Ao Kiw Na Nok.

2. Colony abundance greater on reef slope: found at Mon Islands with mean colony numbers 111 on the reef slope, Mark Island with mean colony numbers 32 on the reef flat and 54 on the reef slope, Chumphon Islands with mean colony numbers 8 on the reef flat and 55 on the reef slope and Tao Islands with mean colony numbers 5 on the reef flat and 30 on the reef slope.

Chansang et al. (1999) reported 25-35 % living coral covered on reef slope at Phai Island. Most abundant were the massive corals such as *Porites lutea*, *Galaxea* sp., *Lobophyllia* sp., *Platygyra* sp. and *Favia* sp. Reef width at Rang Island was 10 m. and extended to 5 m. depth which coral community was in very good condition. Living coral covered was 30 % of its reef covered with living coral. *Porites* sp., *Symphyllia* sp., *Favia* spp. and *Favites* spp. were dominant. Talu Islands had approximately 30-60 % of its reef covered with living coral. Most abundant corals were *Acropora* branching and tabulate.

Chantrarung (2002) found 40-50 % of its reef covered with living coral on reef slope at Monnai Island. There were a few numbers of large and very large colonies of *Porites lutea* and *Astreopora*. Conversely, most abundant were the large corals (50-100 cm in diameter) of *Platygyra, Favia, Favites* and smaller sizes of *Galaxea*, *Pavona*, *Montipora*, *Echinopora* and *Acropora*.

Sudara et al. (1988) reported that *Acropora* is dominant on reef flats of the assemblages near Chumphon. *Porites lutea* and other massive corals were dominant in reef slopes. Chankong et al. (2003) found that *Diploastrea heliopora*, *Pavona* spp., *Echinopora lamellosa* and massive corals are dominant at reef slope of Ao Mung Tao Island.

Assemblages of faviid corals exhibited differences in structure among sites. Manthachitra (1994) suggested that reef assemblages in the Gulf of Thailand are influenced by the southwest and northeast monsoons. Reefs on the same island but differentially exposed to the two monsoons may therefore differ in their assemblage structure. In the Gulf of Thailand, reefs on the eastern side of an island typically have well developed reefs. Spatio-temperal variability is the characteristic of both extant and fossil coral reefs (Pandolf, 1996; Karlson & Conell, 1998; Huges et al., 1999 cited from Edmunds, 2000). Thus, coral reefs routinely exhibit striking differences in community structure among sites throughout the Caribbean and Pacific (Connell, 1973, Porter & Meier, 1992; Edmunds & Brono, 1996 cited from Edmunds, 2000). Results from this study on the population structure of faviid corals varied significantly among locations and habitats.

2. Corals Composition

Principle Component Analysis was used to determine species composition of faviid corals in the Gulf of Thailand. An ordination is a map of the samples, usually in two or three dimensions, in which the placement of samples, rather than representing their sample geographical location, reflects the similarity of their biological communities.

In this analysis, taxa in terms of species and genus were used. However, species data showed that the % of variance explained by the first two PC axes is very low: 31.2% for Axis1 and 10.0% for Axis2. The picture is likely to be very unreliable therefore; genera data (52.4% for Axis1 and 11.0% for Axis2) was used to represent in faviid communities.

Clarke and Warwick (1994) suggested that PCA is not normally recommended for species data. The painstaking work involved in sorting and identifying samples to the species level has resulted in community analysis for environmental impact studies being traditionally regarded as labor-intensive, time-consuming and therefore, relatively expensive. One practical means of overcoming this problem is to exploit the redundancy in community data by analyzing the samples to higher taxonomic levels such as family or phyla, rather than to species. If results from identifications to higher taxonomic levels are comparable to a full species analysis, this means that: a) a great deal of labor can be saved, b) less taxonomic expertise is needed. For the marine macrobenthos and meiobenthos, aggregations of the species data to higher taxonomic levels have been made and the resultant data matrices have been subjected to several forms of statistical analysis to see how much information has been lost compared with the full species-level analysis. Although such experiments have not often been done for other components of marine biota (e.g., plankton), results from the benthic studies are remarkably encouraging in that very little information appears to be lost in the aggregation process.

Composition of faviid corals at the generic level was divided into 5 groups: those dominated by 1) *Goniastrea*, 2) *Favia*, *Favites* and *Platygyra*, 3) *Favia*, *Favus* and *Goniastrea*, 4) *Diploastrea*, and 5) Those with no dominant species.

***1. Coral communities that were dominated by Goniastrea*:** where typically found on reef flats and reef slopes at intertidal fringing reefs or rocky shoreline reefs that exposed to wind and wave. Which was consistent with the earlier observation by Veron (1986) found *Goniastrea* is commonly found on intertidal flats of fringing reefs and rocky shorelines, harbor breakwaters. They are resistant to desiccation and can tolerate several hours of exposure to tropical sun at low tide and also muddy condition and low salinity.

Study sites that were dominated by *Goniastrea* are consisted of the reef slope at Ao Tonleab and Hadd Naban (southwest and western of Monnai Island, respectively), reef flat at Ao Tacrite (southwestern of Samet Island), reef flat and reef slope at Kudee Island (northwest of Kudee Island), reef slope at Rang Island (western) and E-Raad Island (western). Manthachitra (1994) mentioned that all of these sites are well-developed reef and most of them are exposed to wind and wave action.

***2. Coral communities that were dominated by Favia, Favites and Platygyra*:** where the high sediment loads contained in discharges. Water is extremely turbid especially at reef sites at Chaolaw Beach and reef flat at ChangNoi Island. Turbidity is caused by the many rivers in this region of Chanthaburi Province. It is also exposed directly to the southwest monsoon. In accord, Veron (1986) found *Favia*, *Favites* and *Platygyra* to be common corals in shallow reefs particularly those where the water is turbid. Moreover, *Platygyra* are commonly found on upper reef slopes and on reef flats.

3. Coral communities that were dominated by Favia, Favites and **Goniastrea** but somehow, *Oulastrea crispata* was also dominated. Where typically found on reef flats at depth at 1 m at low tide, low salinity or on the steep and narrow reefs that exposed to wind and wave. There were regularly exposed to high turbid and low salinity especially, reefs in Chonburi Province due to water discharged from many rivers nearby. *Oulastrea crispata* is common found on bedrock in turbid water. In accord, Veron (1986) mentioned the suitable environmental for *Favia*, *Favites* and *Goniastrea* are in shallow water where the water is often turbid. They can tolerate several hours of exposure to sunlight at low tide, muddy condition and low salinity. Chen et al. (2003) found *O. crispata* is common found on shallow reef depression and on turbid bay bedrock inhabited by only a few other corals. Several studies have suggested that *O. crispata* is resistant to adverse environmental conditions (Chen et al., 2003; Lam 2000 a, b).

Study sites that were dominated by *Favia, Favites* and *Goniastrea* are consisted of the reef flats at station C and station B KangKao Island, E-raa, Suwan and Singha islands. Reef slopes at Randokmai Island, Southern of Phai Island, Changnoi and Singha islands.

4. Coral communities that were dominated by **Diploastrea:** where typically found on reef slope in both protected and exposed reef habitats. Which was consistent with the earlier observation by Veron (1986) found *Diploastrea* occurs on both exposed and protected reef habitats but is usually uncommon except on some back reef margins. Chankong et al. (2003) reported *D. heliopora* was a dominant species at Ao Mung, *Diploastrea* covered 45-60% of its reef covered with living coral. Similarly to, Ao Hinwong, *D. heliopora* distributed on reef slope (Chansang et al., 1999). At the other sites of Tao Island, Yeemin et al. (1994) found *Pocillopora damicornis* and *D. heliopora* dominate at Chalok Bankao Bay and Nang-Yuan Island.

Study sites that were dominated by *Diploastera* are consisted of Ao Hinwong and Ao Mung Tao Island, Kam and Mark islands in high density of *Diploastrea* colonies. Moreover, in high percent coverage of coral at Ao Mung, Ao

Hinwong Tao Island, Haad Naban, Ao Tonleab Monnai Island and Mark Island, respectively.

5. Coral communities with no dominant species. There was low density of faviid corals where numbers of other taxa of corals were dominated. There could be found reefs dominated by *Porites lutea*, *Porites (Synaraea) rus*, *Pavona* or *Acropora*. In this study, large colonies of *Porites lutea* dominated the reefs at KangKao, Phai, Learm, Ao Tacrite Samet, Monnok (Rayong) and Suwan islands whereas, smaller colonies of *Porites lutea* were dominated at Talu, Matra and Lawa islands. Kam and Mark islands were dominated by *Porites lutea* and *Porites (Synaraea) rus* which was consistent with the earlier observations by Sakai et al. (1986), Sudara et al. (1988) and Manthachitra (1994). *Pavona* were dominated at the reef slope of Ao KiwNok (Samet Island), Monnok Island (Trat Province) whereas, *Acropora* and small colonies of *Pocillopora* were dominated at Ao Pudsawan Kram, reef flat at Ao KiwNok Samet and Sang islands.

Study sites with low density of faviid corals are consisted of the reef slope at St. C and St. E KangKao Island, reef slope at Ao Tonglang Phai Island, reef slope at Learm Island, reef flat and reef slope at Haad Naban Kram Island, reef flat at Ao KiwNok Samet Island, reef slope at Monnok Island (Rayong Province), reef slope at Monnok Island (Trat Province), reef slope at Suwan Island, reef flat at Kam Island, reef flat and reef slope at Matra Island, reef flat and reef slope at Lawa Island and reef slope at GongSaiDang Island.

3. Population Structure

Generally most colonies were relatively small with only a few being large.A notable exception to this was *Diploastrea heliopora* with relatively large colonies > 60 cm. Colonies of most species were in one of three size categories the smallest 1 to 10 cm, included *Favia speciosa*, *Favia favus*, *Favia rotumana*, *Favites pentagona* and *Goniastrea aspera*. Intermediate, 11 to 20 cm and 21 to 40 cm diameter categories included *Favites abdita*, *Favites halicora*, *Goniastrea retiformis*, *Goniastrea pectinata*, *Platygyra pini*, *Platygyra sinensis*, *Platygyra daedalea*, *Letastrea transversa*, *Leptastrea purpurea*, *Leptastrea pruinosa*, *Montastrea curta* and *Echinopora lamellosa*. Endean et al. (1997) found that *Favia pallida*, *Platygyra daedalea*, *Favites abdita* and *Montastrea curta* were well represented in the 16 to 20 cm in diameter category. Colonies of *Goniastrea australensis*, *Goniastrea aspera*, *Goniastrea retiformis*, *Platygyra daedalea*, *Montastrea curta*, *Montastrea auunligera*, *Favia pallida*, *Favites abdita*, *Cyphastrea micropthalma* and *Cyphastrea serailia* embraced the greatest range of size categories (> 30 cm diameter). Between species, reef corals obviously vary greatly in their colony size structure and maximum colony size; but the relation between life history characters and size of coral species has not been well studied (Soong, 1993; Meesters et al., 2001).

This study has shown that colony size structure of each faviid species mostly was skewed to right of size distribution curve. Fong and Glynn (1998) found the size distribution of *Gardineroseris planulata* at Uva Island reef to be nearly normally distributed with highest number of corals ranged from 80 to 100 cm in diameter. From 1970 to 1980,coral were subjected to predation from *Acantaster planci* resulting in a dramatic decline in the size structure of the *G. planulata* population. With most colonies < 40 cm in diameter. In 1982/1983 there was a very strong ENSO event. By 1993, the corals began to recover from these disturbances and some larger colonies were observed. However in 1993 and 1994, there was an increase in the number of colonies in the 21 to 40 cm in size class and a decrease in the number of colonies in the 41 to 60 cm size class. In contrast, Bak and Meesters (1999) and Meesters et al. (2001) mentioned that environmental deterioration would skew populations to left of size distribution curve. They concluded that, differences between populations appeared related to environmental degradation. In the reefs bordering a heavily urbanized coastal region, size-frequency distribution of populations of many species were found to have relatively few colonies in the smaller size classes and larger colonies.

The population structure of coral species has been little studied in the field; presumably because of a particular requirement to collect the information underwater, collect colony-size data. Population study has been addressed mostly in demographic studies that included modeling of population growth (Hughes & Jackson, 1985; Fong & Glynn, 1998). Meesters et al. (2001) suggested a possible explanation for Fong and Glynn (1998) worked, may be that *Acantaster planci* effectively forages in a “line transect”, and consequently smaller colonies have less chance of being encountered and attacked; larger colonies are relatively more affected, so populations under predation pressure tend to develop a surplus of smaller colonies.

Size distribution of faviid corals from this study are skewed to right of distribution curve according to Fong and Glynn (1998). One of basic principles in tropic ecology is the energetic advantage of feeding on larger colonies it is, therefore, a possible explanation that there was some disturbance happened on coral population in the Gulf of Thailand. Particularly, encountered and attacked large faviid colonies, as disturbance caused a transfer of colonies from the larger to smaller size classes. It is, therefore, more colonies moved from smaller into larger size classes. At present, faviid population is in the period of recover and entered the larger size classes. Some colonies had attained relatively large sizes indicating their long-term persistence.

This study suggested that, for the Family Faviidae coral bleaching was not a major contributor to their population size and structure in the Gulf of Thailand in 1998. In contrast, for corals in the Family Acroporidae was a significant factor to the health and structure of their population. Whole-colony mortality is rare among corals; however, size structure is known to change in response to different factors and intensity of disturbances on population of each coral.

Conclusion

1. A total of 37 species belonging to 14 genera of faviid corals were found in this study. A total of 53 species belonging to 14 genera are recorded reported in Thai waters. Thirty-eight of 53 species were found in the Gulf of Thailand and fifty-three species were found in the Andaman Sea.

2. Mark and Chang Islands had the highest species richness (33 and 30 species). Tao Islands had the lowest species richness (18 species), whereas, the other islands had moderate (20-29 species).

3. Number of species, distribution and population structure of faviid corals varied significantly among locations and habitats. Faviid assemblages exhibit difference in community structure among sites. Habitat, location and group have inconsistent pattern.

4. Number of species and genus were used to analyses community structure by Principle Component Analysis. However, species data set showed low variance

that explains by the first two PC axes. The picture is likely to be very unreliable therefore, genus data was used to represent in faviid communities.

5. Genera composition of faviid corals could be divided into 5 groups. The communities dominated by 1) *Goniastrea*, 2) *Favia*, *Favites* and *Platygyra*, 3) *Favia*, *Favites* and *Goniastrea*, 4) *Diploastrea*, and 5) those with no faviid coral dominant.

6. Colony sizes of most faviid were represented by the 1 to 10 cm, 11 to 20 cm and 21 to 40 cm diameter categories.

7. General conclusion on the population structure could be drawn from the size frequency curve of populations. In this study the distribution are skewed to right.

8. A possible explanation was that disturbance happened on coral population in the Gulf of Thailand particularly, have impact on large faviid colonies.

9. Faviid populations are in the period of recovery and entered the larger size classes.

10. The mortality of faviid corals due to coral bleaching. Different factors and intensity cause different impact on population size of each coral.

Recommendation

Recommendations on interesting research topics are as follow:

1. Growth rate of corals in Thai waters.
2. Present status of coral communities along the Gulf of Thailand.
3. Reproductive strategy and cycle of corals along the Gulf of Thailand.
4. Connectivity among coral assemblages in the Gulf of Thailand.

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APPENDIX

Table 8 MANOVA detected on colonies abundance of Faviid corals.

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	6.31	9.42	320	1760.00	.00
	Wilks' Lambda	.00	12.77	320	1625.04	.00
	Hotelling's Trace	33.56	17.32	320	1652.00	.00
	Roy's Largest Root	12.94	71.17[b]	32	176.00	.00
LOCATION	Pillai's Trace	8.05	3.39	704	4136.00	.00
	Wilks' Lambda	.00	4.40	704	3144.60	.00
	Hotelling's Trace	22.72	5.32	704	3632.00	.00
	Roy's Largest Root	4.52	26.57[b]	32	188.00	.00
HABITAT	Pillai's Trace	.84	29.36[a]	32	167.00	.00
	Wilks' Lambda	.15	29.36[a]	32	167.00	.00
	Hotelling's Trace	5.62	29.36[a]	32	167.00	.00
	Roy's Largest Root	5.62	29.36[a]	32	167.00	.00
GROUP * HABITAT	Pillai's Trace	5.37	6.39	320	1760.00	.00
	Wilks' Lambda	.00	8.70	320	1625.04	.00
	Hotelling's Trace	26.41	13.63	320	1652.00	.00
	Roy's Largest Root	14.76	81.21[b]	32	176.00	.00
LOCATION * HABITAT	Pillai's Trace	7.43	2.99	704	4136.00	.00
	Wilks' Lambda	.00	3.82	704	3144.60	.00
	Hotelling's Trace	19.55	4.58	704	3632.00	.00
	Roy's Largest Root	3.73	21.95[b]	32	188.00	.00

a) Exact statistic b) The statistic is an upper bound on F that yields a lower bound on the significance level.

Table 9 MANOVA detected on area cover of Faviid corals.

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	4.42	7.10	198	2090.00	.00
	Wilks' Lambda	.00	10.10	198	1723.68	.00
	Hotelling's Trace	15.79	14.21	198	1960.00	.00
	Roy's Largest Root	7.77	82.10	18	190.00	.00
LOCATION	Pillai's Trace	5.07	3.51	396	3546.00	.00
	Wilks' Lambda	.00	4.33	396	2576.91	.00
	Hotelling's Trace	11.02	4.95	396	3206.00	.00
	Roy's Largest Root	2.48	22.29	22	197.00	.00
HABITAT	Pillai's Trace	.71	24.51	18	180.00	.00
	Wilks' Lambda	.29	24.51	18	180.00	.00
	Hotelling's Trace	2.45	24.51	18	180.00	.00
	Roy's Largest Root	2.45	24.51	18	180.00	.00
GROUP * HABITAT	Pillai's Trace	3.22	4.99	180	1890.00	.00
	Wilks' Lambda	.00	7.44	180	1603.65	.00
	Hotelling's Trace	13.25	13.12	180	1782.00	.00
	Roy's Largest Root	9.07	95.26	18	189.00	.00
LOCATION * HABITAT	Pillai's Trace	4.49	2.98	396	3546.00	.00
	Wilks' Lambda	.00	3.57	396	2576.91	.00
	Hotelling's Trace	8.96	4.03	396	3206.00	.00
	Roy's Largest Root	2.05	18.38	22	197.00	.00

a) Exact statistic b) The statistic is an upper bound on F that yields a lower bound on the significance level.

Table 10 MANOVA test on colony size distribution of *Favia speciosa*.

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	1.09	2.38	18	75.00	.00
	Wilks' Lambda	.08	5.17	18	65.53	.00
	Hotelling's Trace	9.13	10.99	18	65.00	.00
	Roy's Largest Root	8.90	37.10[b]	6	25.00	.00
LOCATION	Pillai's Trace	.14	1.34[a]	3	23.00	.28
	Wilks' Lambda	.85	1.34[a]	3	23.00	.28
	Hotelling's Trace	.17	1.34[a]	3	23.00	.28
	Roy's Largest Root	.17	1.34[a]	3	23.00	.28
HABITAT	Pillai's Trace	.06	.56[a]	3	23.00	.64
	Wilks' Lambda	.93	.56[a]	3	23.00	.64
	Hotelling's Trace	.07	.56[a]	3	23.00	.64
	Roy's Largest Root	.07	.56[a]	3	23.00	.64
GROUP * HABITAT	Pillai's Trace	.07	.14	12	75.00	1.00
	Wilks' Lambda	.93	.13	12	61.14	1.00
	Hotelling's Trace	.07	.13	12	65.00	1.00
	Roy's Largest Root	.05	.35[b]	4	25.00	.83
HABITAT * LOCATION	Pillai's Trace	.02	.19[a]	3	23.00	.90
	Wilks' Lambda	.97	.19[a]	3	23.00	.90
	Hotelling's Trace	.02	.19[a]	3	23.00	.90
	Roy's Largest Root	.02	.19[a]	3	23.00	.90

Table 11 ANOVA for posteriori test on colony size of *Favia speciosa*.

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	FAVSPE1	21472.52	6	3578.75	30.71	.00
	FAVSPE2	9802.32	6	1633.72	20.00	.00
	FAVSPE3	117.25	6	19.54	1.67	.16
LOCATION	FAVSPE1	309.28	1	309.28	2.65	.11
	FAVSPE2	213.25	1	213.25	2.61	.11
	FAVSPE3	18.57	1	18.57	1.59	.21
HABITAT	FAVSPE1	146.46	1	146.46	1.25	.27
	FAVSPE2	106.10	1	106.10	1.29	.26
	FAVSPE3	2.06	1	2.06	.17	.67
GROUP * HABITAT	FAVSPE1	36.09	4	9.02	.07	.98
	FAVSPE2	19.26	4	4.81	.05	.99
	FAVSPE3	14.67	4	3.67	.31	.86
HABITAT * LOCATION	FAVSPE1	51.04	1	51.04	.43	.51
	FAVSPE2	1.50	1	1.50	.01	.89
	FAVSPE3	.10	1	.10	.00	.92
Error	FAVSPE1	2912.58	25	116.50		
	FAVSPE2	2041.29	25	81.65		
	FAVSPE3	291.21	25	11.64		

a R Squared = .883 (Adjusted R Squared = .822)
b R Squared = .832 (Adjusted R Squared = .745)
c R Squared = .344 (Adjusted R Squared = .003)

Table 12 MANOVA test on colony size distribution of *Favia favus*.

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.52	.42	9	18.00	.90
	Wilks' Lambda	.55	.30	9	9.88	.95
	Hotelling's Trace	.69	.20	9	8.00	.98
	Roy's Largest Root	.44	.88[b]	3	6.00	.49
LOCATION	Pillai's Trace	.13	.20[a]	3	4.00	.89
	Wilks' Lambda	.87	.20[a]	3	4.00	.89
	Hotelling's Trace	.15	.20[a]	3	4.00	.89
	Roy's Largest Root	.15	.20[a]	3	4.00	.89
HABITAT	Pillai's Trace	.40	.91[a]	3	4.00	.51
	Wilks' Lambda	.59	.91[a]	3	4.00	.51
	Hotelling's Trace	.68	.91[a]	3	4.00	.51
	Roy's Largest Root	.68	.91[a]	3	4.00	.51
GROUP * HABITAT	Pillai's Trace	.49	1.29[a]	3	4.00	.39
	Wilks' Lambda	.50	1.29[a]	3	4.00	.39
	Hotelling's Trace	.96	1.29[a]	3	4.00	.39
	Roy's Largest Root	.96	1.29[a]	3	4.00	.39
HABITAT * LOCATION	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	5.00	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	3	3.00	1.00

Table 13 ANOVA for posteriori test on colony size of *Favia favus*.

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	FAVFAV1	127.37	3	42.45	.67	.59
	FAVFAV2	50.59	3	16.86	.41	.74
	FAVFAV3	3.22	3	1.07	.86	.50
LOCATION	FAVFAV1	29.28	1	29.28	.46	.52
	FAVFAV2	2.19	1	2.19	.05	.82
	FAVFAV3	2.198E-02	1	2.198E-02	.01	.89
HABITAT	FAVFAV1	135.20	1	135.20	2.15	.19
	FAVFAV2	26.45	1	26.45	.65	.45
	FAVFAV3	4.05	1	4.05	3.25	.12
GROUP * HABITAT	FAVFAV1	1.16	1	1.16	.01	.89
	FAVFAV2	4.35	1	4.35	.10	.75
	FAVFAV3	2.92	1	2.92	2.35	.17
HABITAT * LOCATION	FAVFAV1	.00	0	.	.	.
	FAVFAV2	.00	0	.	.	.
	FAVFAV3	.00	0	.	.	.
Error	FAVFAV1	376.21	6	62.70		
	FAVFAV2	243.17	6	40.53		
	FAVFAV3	7.46	6	1.24		

a R Squared = .438 (Adjusted R Squared = -.124)
b R Squared = .256 (Adjusted R Squared = -.488)
c R Squared = .578 (Adjusted R Squared = .156)

Table 14 MANOVA test on colony size distribution of *Favites pentagona*.

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	1.50	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	2	.00	.
LOCATION	Pillai's Trace	.99	116.51[a]	2	1.00	.06
	Wilks' Lambda	.00	116.51[a]	2	1.00	.06
	Hotelling's Trace	233.03	116.51[a]	2	1.00	.06
	Roy's Largest Root	233.03	116.51[a]	2	1.00	.06
HABITAT	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	1.50	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	2	.00	.
GROUP * HABITAT	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	1.50	.
	Hotelling's Trace	.00	.[a]	0	2.0	.
	Roy's Largest Root	.00	.00[a]	2	.00	.
HABITAT * LOCATION	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	1.50	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	2	.00	.

Table 15 ANOVA for posteriori test on colony size of *Favites pentagona*.

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	FVTPEN1	.00	0	.	.	.
	FVTPEN2	.00	0	.	.	.
	FVTPEN3	.00	0	.	.	.
LOCATION	FVTPEN1	1296.00	1	1296.00	3.78	.19
	FVTPEN2	56.25	1	56.25	1.86	.30
	FVTPEN3	.25	1	.25	1.00	.42
HABITAT	FVTPEN1	.00	0	.	.	.
	FVTPEN2	.00	0	.	.	.
	FVTPEN3	.00	0	.	.	.
GROUP * HABITAT	FVTPEN1	.00	0	.	.	.
	FVTPEN2	.00	0	.	.	.
	FVTPEN3	.00	0	.	.	.
HABITAT * LOCATION	FVTPEN1	.00	0	.	.	.
	FVTPEN2	.00	0	.	.	.
	FVTPEN3	.00	0	.	.	.
Error	FVTPEN1	685.00	2	342.50		
	FVTPEN2	60.50	2	30.25		
	FVTPEN3	.50	2	.25		

a R Squared = .654 (Adjusted R Squared = .481)
b R Squared = .482 (Adjusted R Squared = .223)
c R Squared = .333 (Adjusted R Squared = .000)

Table 16 MANOVA test on colony size distribution of *Favites abdita.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.96	27.09[a]	1	1	.12
	Wilks' Lambda	.03	27.09[a]	1	1	.12
	Hotelling's Trace	27.09	27.09[a]	1	1	.12
	Roy's Largest Root	27.09	27.09[a]	1	1	.12
LOCATION	Pillai's Trace	.96	27.00[a]	1	1	.12
	Wilks' Lambda	.03	27.00[a]	1	1	.12
	Hotelling's Trace	27.00	27.00[a]	1	1	.12
	Roy's Largest Root	27.00	27.00[a]	1	1	.12
HABITAT	Pillai's Trace	.00	.[a]	0	.0	.
	Wilks' Lambda	1.00	.[a]	0	1	.
	Hotelling's Trace	.00	.[a]	.0	2	.
	Roy's Largest Root	.00	.00[a]	1	0	.
GROUP * HABITAT	Pillai's Trace	.00	.[a]	0	0	.
	Wilks' Lambda	1.00	.[a]	0	1	.
	Hotelling's Trace	.00	.[a]	0	2	.
	Roy's Largest Root	.00	.00[a]	1	.0	.
LOCATION * HABITAT	Pillai's Trace	.00	.[a]	0	0	.
	Wilks' Lambda	1.00	.[a]	0	1	.
	Hotelling's Trace	.00	.[a]	0	2	.
	Roy's Largest Root	.00	.00[a]	1	0	.

a Exact statistic
b Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+LOCATION * HABITAT

Table 17 ANOVA for posteriori test on colony size of *Favites abdita.*

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	FVTABD1	216.75	1	216.75	27.09	.12
	FVTABD2	918.75	1	918.75	2.94	.33
	FVTABD3	444.08	1	444.08	10.96	.18
	FVTABD4	10.08	1	10.08	2.24	.37
	FVTABD5	1.33	1	1.33	2.66	.35
LOCATION	FVTABD1	216.00	1	216.00	27.00	.12
	FVTABD2	337.50	1	337.50	1.08	.48
	FVTABD3	140.16	1	140.16	3.46	.31
	FVTABD4	4.16	1	4.16	.92	.51
	FVTABD5	.16	1	.16	.33	.66
HABITAT	FVTABD1	.00	0	.	.	.
	FVTABD2	.00	0	.	.	.
	FVTABD3	.00	0	.	.	.
	FVTABD4	.00	0	.	.	.
	FVTABD5	.00	0	.	.	.
GROUP * HABITAT	FVTABD1	.00	0	.	.	.
	FVTABD2	.00	0	.	.	.
	FVTABD3	.00	0	.	.	.
	FVTABD4	.00	0	.	.	.
	FVTABD5	.00	0	.	.	.
LOCATION * HABITAT	FVTABD1	.00	0	.	.	.
	FVTABD2	.00	0	.	.	.
	FVTABD3	.00	0	.	.	.
	FVTABD4	.00	0	.	.	.
	FVTABD5	.00	0	.	.	.

Error	FVTABD1	8.00	1	8.00		
	FVTABD2	312.50	1	312.50		
	FVTABD3	40.50	1	40.50		
	FVTABD4	4.50	1	4.50		
	FVTABD5	.50	1	.50		

a R Squared = .982 (Adjusted R Squared = .946)
b R Squared = .801 (Adjusted R Squared = .402)
c R Squared = .935 (Adjusted R Squared = .806)
d R Squared = .760 (Adjusted R Squared = .280)
e R Squared = .750 (Adjusted R Squared = .250)

Table 18 MANOVA test on colony size distribution of *Goniastrea retiformis*.

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	2.06	1.37	28.00	36.00	.18
	Wilks' Lambda	.00	2.57	28.00	23.05	.01
	Hotelling's Trace	33.32	5.35	28.00	18.00	.00
	Roy's Largest Root	30.43	39.13[b]	7.00	9.00	.00
LOCATION	Pillai's Trace	.89	12.80[a]	4.00	6.00	.00
	Wilks' Lambda	.10	12.80[a]	4.00	6.00	.00
	Hotelling's Trace	8.53	12.80[a]	4.00	6.00	.00
	Roy's Largest Root	8.53	12.80[a]	4.00	6.00	.00
HABITAT	Pillai's Trace	.155	.27[a]	4.00	6.00	.88
	Wilks' Lambda	.84	.27[a]	4.00	6.00	.88
	Hotelling's Trace	.18	.27[a]	4.00	6.00	.88
	Roy's Largest Root	.18	.27[a]	4.00	6.00	.88
GROUP * HABITAT	Pillai's Trace	.54	1.82[a]	4.00	6.00	.24
	Wilks' Lambda	.45	1.82[a]	4.00	6.00	.24
	Hotelling's Trace	1.21	1.82[a]	4.00	6.00	.24
	Roy's Largest Root	1.21	1.82[a]	4.00	6.00	.24
HABITAT * LOCATION	Pillai's Trace	.79	5.92[a]	4.00	6.00	.02
	Wilks' Lambda	.20	5.92[a]	4.00	6.00	.02
	Hotelling's Trace	3.94	5.92[a]	4.00	6.00	.02
	Roy's Largest Root	3.94	5.92[a]	4.00	6.00	.02

a Exact statistic
b The statistic is an upper bound on F that yields a lower bound on the significance level.
c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 19 ANOVA for posteriori test on colony size of *Goniastrea retiformis.*

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	GONRET1	185.20	7	26.45	9.84	.00
	GONRET2	836.53	7	119.50	2.76	.07
	GONRET3	1381.32	7	197.33	7.59	.00
	GONRET4	10.18	7	1.45	.38	.89
LOCATION	GONRET1	49.35	1	49.35	18.36	.00
	GONRET2	41.67	1	41.67	.96	.35
	GONRET3	5.22	1	5.22	.20	.66
	GONRET4	.48	1	.48	.12	.72
HABITAT	GONRET1	.10	1	.10	.03	.84
	GONRET2	5.74	1	5.74	.13	.72
	GONRET3	10.47	1	10.47	.40	.54
	GONRET4	.20	1	.20	.05	.82
GROUP * HABITAT	GONRET1	9.30	1	9.30	3.46	.09
	GONRET2	44.10	1	44.10	1.02	.33
	GONRET3	34.93	1	34.93	1.34	.27
	GONRET4	10.94	1	10.94	2.88	.12
HABITAT * LOCATION	GONRET1	29.85	1	29.85	11.10	.00
	GONRET2	87.81	1	87.81	2.03	.18
	GONRET3	105.37	1	105.37	4.05	.07
	GONRET4	5.22	1	5.22	1.37	.27
Error	GONRET1	24.18	9	2.68		
	GONRET2	389.35	9	43.26		
	GONRET3	233.91	9	25.99		
	GONRET4	34.18	9	3.79		

a R Squared = .919 (Adjusted R Squared = .820)
b R Squared = .723 (Adjusted R Squared = .384)
c R Squared = .868 (Adjusted R Squared = .707)
d R Squared = .442 (Adjusted R Squared =-.241)

Table 20 MANOVA test on colony size distribution of *Goniastrea* cf. *aspera.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	1.36	1.25	12	18.00	.32
	Wilks' Lambda	.11	1.17	12	10.87	.39
	Hotelling's Trace	4.30	.95	12	8.00	.54
	Roy's Largest Root	3.43	5.15[b]	4	6.00	.03
LOCATION	Pillai's Trace	.30	.57[a]	3	4.00	.66
	Wilks' Lambda	.70	.57[a]	3	4.00	.66
	Hotelling's Trace	.42	.57[a]	3	4.00	.66
	Roy's Largest Root	.42	.57[a]	3	4.00	.66
HABITAT	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	5.00	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	3	3.00	1.00
GROUP * HABITAT	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	5.00	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	3	3.00	1.00
HABITAT * LOCATION	Pillai's Trace	.10	.15[a]	3	4.00	.91
	Wilks' Lambda	.89	.15[a]	3	4.00	.91
	Hotelling's Trace	.11	.15[a]	3	4.00	.91
	Roy's Largest Root	.11	.15[a]	3	4.00	.91

a Exact statistic

b The statistic is an upper bound on F that yields a lower bound on the significance level.
c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 21 ANOVA for posteriori test on colony size of *Goniastrea* cf. *aspera.*

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	GCFASP1	1350.69	4	337.67	5.02	.04
	GCFASP2	42.30	4	10.57	.78	.57
	GCFASP3	10.42	4	2.60	.71	.61
LOCATION	GCFASP1	89.28	1	89.28	1.32	.29
	GCFASP2	3.57	1	3.57	.26	.62
	GCFASP3	3.968E-03	1	3.968E-03	.00	.97
HABITAT	GCFASP1	.00	0	.	.	.
	GCFASP2	.00	0	.	.	.
	GCFASP3	.00	0	.	.	.
GROUP * HABITAT	GCFASP1	.00	0	.	.	.
	GCFASP2	.00	0	.	.	.
	GCFASP3	.00	0	.	.	.
HABITAT * LOCATION	GCFASP1	4.55	1	4.55	.06	.80
	GCFASP2	9.55	1	9.55	.70	.43
	GCFASP3	.47	1	.47	.13	.73
Error	GCFASP1	403.16	6	67.19		
	GCFASP2	80.87	6	13.47		
	GCFASP3	22.02	6	3.67		

a R Squared = .782 (Adjusted R Squared = .564)
b R Squared = .407 (Adjusted R Squared = -.187) c R Squared = .331 (Adjusted R Squared = -.338)

Table 22 MANOVA test on colony size distribution of *Goniastrea pectinata.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	2.26	1.30	28	28.00	.24
	Wilks' Lambda	.00	1.73	28	15.84	.12
	Hotelling's Trace	23.28	2.07	28	10.00	.11
	Roy's Largest Root	19.75	19.75[b]	7	7.00	.00
LOCATION	Pillai's Trace	.59	1.47[a]	4	4.00	.35
	Wilks' Lambda	.40	1.47[a]	4	4.00	.35
	Hotelling's Trace	1.47	1.47[a]	4	4.00	.35
	Roy's Largest Root	1.47	1.47[a]	4	4.00	.35
HABITAT	Pillai's Trace	.78	3.74[a]	4	4.00	.11
	Wilks' Lambda	.21	3.74[a]	4	4.00	.11
	Hotelling's Trace	3.74	3.74[a]	4	4.00	.11
	Roy's Largest Root	3.74	3.74[a]	4	4.00	.11
GROUP * HABITAT	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	5.50	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	4	3.00	1.00
HABITAT * LOCATION	Pillai's Trace	.00	.[a]	.0	.00	.
	Wilks' Lambda	1.00	.[a]	0	5.50	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	4	3.00	1.00

a Exact statistic
b The statistic is an upper bound on F that yields a lower bound on the significance level.
c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 23 ANOVA for posteriori test on colony size of *Goniastrea pectinata*.

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	GONPEC1	1068.88	7	152.69	1.76	.23
	GONPEC2	1675.68	7	239.38	7.66	.00
	GONPEC3	252.38	7	36.05	2.26	.15
	GONPEC4	15.00	7	2.14	2.43	.13
LOCATION	GONPEC1	8.53	1	8.53	.09	.76
	GONPEC2	1.20	1	1.20	.03	.85
	GONPEC3	16.13	1	16.13	1.01	.34
	GONPEC4	3.33	1	3.33	3.78	.09
HABITAT	GONPEC1	36.30	1	36.30	.42	.53
	GONPEC2	26.13	1	26.13	.83	.39
	GONPEC3	6.53	1	6.53	.41	.54
	GONPEC4	7.50	1	7.50	8.51	.02
GROUP * HABITAT	GONPEC1	.00	0	.	.	.
	GONPEC2	.00	0	.	.	.
	GONPEC3	.00	0	.	.	.
	GONPEC4	.00	0	.	.	.
HABITAT * LOCATION	GONPEC1	.00	0	.	.	.
	GONPEC2	.00	0	.	.	.
	GONPEC3	.00	0	.	.	.
	GONPEC4	.00	0	.	.	.
Error	GONPEC1	604.16	7	86.31		
	GONPEC2	218.75	7	31.25		
	GONPEC3	111.41	7	15.91		
	GONPEC4	6.16	7	.88		

a R Squared = .648 (Adjusted R Squared = .196) b R Squared = .886 (Adjusted R Squared = .740)
c R Squared = .712 (Adjusted R Squared = .341) d R Squared = .807 (Adjusted R Squared = .560)

Table 24 MANOVA test on colony size distribution of *Platygyra pini.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.44	.80[a]	3	3	.57
	Wilks' Lambda	.55	.80[a]	3	3	.57
	Hotelling's Trace	.80	.80[a]	3	3	.57
	Roy's Largest Root	.80	.80[a]	3	3	.57
LOCATION	Pillai's Trace	.15	.17[a]	3	3	.90
	Wilks' Lambda	.85	.17[a]	3	3	.90
	Hotelling's Trace	.17	.17[a]	3	3	.90
	Roy's Largest Root	.17	.17[a]	3	3	.90
HABITAT	Pillai's Trace	.13	.16[a]	3	3	.91
	Wilks' Lambda	.86	.16[a]	3	3	.91
	Hotelling's Trace	.16	.16[a]	3	3	.91
	Roy's Largest Root	.16	.16[a]	3	3	.91
GROUP * HABITAT	Pillai's Trace	.00	.[a]	0	0	.
	Wilks' Lambda	1.00	.[a]	0	4	.
	Hotelling's Trace	.00	.[a]	0	2	.
	Roy's Largest Root	.00	.00[a]	3	2	1.00
HABITAT * LOCATION	Pillai's Trace	.58	1.40[a]	3	3	.39
	Wilks' Lambda	.41	1.40[a]	3	3	.39
	Hotelling's Trace	1.40	1.40[a]	3	3	.39
	Roy's Largest Root	1.40	1.40[a]	3	3	.39

a Exact statistic
b Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 25 ANOVA for posteriori test on colony size of *Platygyra pini.*

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	PLAPIN1	2.50	1	2.50	1.28	.30
	PLAPIN2	1.22	1	1.22	.32	.59
	PLAPIN3	1.22	1	1.22	.26	.63
LOCATION	PLAPIN1	.00	1	.00	.00	1.00
	PLAPIN2	1.56	1	1.56	.41	.54
	PLAPIN3	3.06	1	3.06	.65	.45
HABITAT	PLAPIN1	.86	1	.86	.44	.53
	PLAPIN2	2.34	1	2.34	.62	.46
	PLAPIN3	5.388E-02	1	5.388E-02	.01	.91
GROUP * HABITAT	PLAPIN1	.00	0	.	.	.
	PLAPIN2	.00	0	.	.	.
	PLAPIN3	.00	0	.	.	.
HABITAT * LOCATION	PLAPIN1	9.38	1	9.38	4.81	.08
	PLAPIN2	.21	1	.21	.05	.82
	PLAPIN3	8.621E-03	1	8.621E-03	.00	.96
Error	PLAPIN1	9.75	5	1.95		
	PLAPIN2	18.75	5	3.75		
	PLAPIN3	23.25	5	4.65		

a R Squared = .567 (Adjusted R Squared = .220)
b R Squared = .222 (Adjusted R Squared = -.400)
c R Squared = .158 (Adjusted R Squared = -.516)

Table 26 MANOVA test on colony size distribution of *Platygyra sinensis.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	1.39	1.82	28.00	96.00	.01
	Wilks' Lambda	.13	2.08	28.00	77.13	.00
	Hotelling's Trace	3.30	2.29	28.00	78.00	.00
	Roy's Largest Root	2.21	7.60[b]	7.00	24.00	.00
LOCATION	Pillai's Trace	.09	.51[a]	4.00	21.00	.72
	Wilks' Lambda	.91	.51[a]	4.00	21.00	.72
	Hotelling's Trace	.09	.51[a]	4.00	21.00	.72
	Roy's Largest Root	.09	.51[a]	4.00	21.00	.72
HABITAT	Pillai's Trace	.03	.20[a]	4.00	21.00	.93
	Wilks' Lambda	.96	.20[a]	4.00	21.00	.93
	Hotelling's Trace	.03	.20[a]	4.00	21.00	.93
	Roy's Largest Root	.03	.20[a]	4.00	21.00	.93
GROUP * HABITAT	Pillai's Trace	.14	.89[a]	4.00	21.00	.48
	Wilks' Lambda	.85	.89[a]	4.00	21.00	.48
	Hotelling's Trace	.17	.89[a]	4.00	21.00	.48
	Roy's Largest Root	.17	.89[a]	4.00	21.00	.48
HABITAT * LOCATION	Pillai's Trace	.17	1.11[a]	4.00	21.00	.37
	Wilks' Lambda	.82	1.11[a]	4.00	21.00	.37
	Hotelling's Trace	.21	1.11[a]	4.00	21.00	.37
	Roy's Largest Root	.21	1.11[a]	4.00	21.00	.37

a Exact statistic

b The statistic is an upper bound on F that yields a lower bound on the significance level.

c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 27 ANOVA for posteriori test on colony size of *Platygyra sinensis.*

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	PLASIN1	148.89	7	21.27	3.23	.01
	PLASIN2	485.39	7	69.34	5.96	.00
	PLASIN3	184.75	7	26.39	1.02	.43
	PLASIN4	25.81	7	3.68	1.19	.34
LOCATION	PLASIN1	1.44	1	1.44	.21	.64
	PLASIN2	5.35	1	5.35	.46	.50
	PLASIN3	45.94	1	45.94	1.79	.19
	PLASIN4	4.24	1	4.24	1.37	.25
HABITAT	PLASIN1	.10	1	.10	.01	.89
	PLASIN2	8.04	1	8.04	.69	.41
	PLASIN3	.45	1	.45	.01	.89
	PLASIN4	.17	1	.17	.05	.81
GROUP * HABITAT	PLASIN1	1.21	1	1.21	.18	.67
	PLASIN2	14.03	1	14.03	1.20	.28
	PLASIN3	6.47	1	6.47	.25	.62
	PLASIN4	8.26	1	8.26	2.66	.11
HABITAT * LOCATION	PLASIN1	5.34	1	5.34	.81	.37
	PLASIN2	7.13	1	7.13	.61	.44
	PLASIN3	.58	1	.58	.02	.88
	PLASIN4	2.80	1	2.80	.90	.35
Error	PLASIN1	157.99	24	6.58		
	PLASIN2	278.78	24	11.61		
	PLASIN3	615.78	24	25.65		
	PLASIN4	74.33	24	3.09		

a R Squared = .498 (Adjusted R Squared = .269) b R Squared = .651 (Adjusted R Squared = .491)
c R Squared = .279 (Adjusted R Squared = -.052) d R Squared = .357 (Adjusted R Squared = .063)

Table 28 MANOVA test on colony size distribution of *Platygyra daedalea*.

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	2.22	1.25	20	20.00	.31
	Wilks' Lambda	.00	1.92	20	7.58	.17
	Hotelling's Trace	59.42	1.48	20	2.00	.47
	Roy's Largest Root	55.92	55.92[b]	5	5.00	.00
LOCATION	Pillai's Trace	.83	2.48[a]	4	2.00	.30
	Wilks' Lambda	.16	2.48[a]	4	2.00	.30
	Hotelling's Trace	4.96	2.48[a]	4	2.00	.30
	Roy's Largest Root	4.96	2.48[a]	4	2.00	.30
HABITAT	Pillai's Trace	.62	.84[a]	4	2.00	.60
	Wilks' Lambda	.37	.84[a]	4	2.00	.60
	Hotelling's Trace	1.69	.84[a]	4	2.00	.60
	Roy's Largest Root	1.69	.84[a]	4	2.00	.60
GROUP * HABITAT	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	3.50	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	4	1.00	1.00
HABITAT * LOCATION	Pillai's Trace	.88	3.85[a]	4	2.00	.21
	Wilks' Lambda	.11	3.85[a]	4	2.00	.21
	Hotelling's Trace	7.71	3.85[a]	4	2.00	.21
	Roy's Largest Root	7.71	3.85[a]	4	2.00	.21

a Exact statistic
b The statistic is an upper bound on F that yields a lower bound on the significance level.
c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 29 ANOVA for posteriori test on colony size of *Platygyra daedalea*.

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	PLADAE1	78.65	5	15.73	8.58	.01
	PLADAE2	74.05	5	14.81	.80	.59
	PLADAE3	39.26	5	7.85	.70	.64
	PLADAE4	2.97	5	.59	.60	.70
LOCATION	PLADAE1	5.714E-02	1	5.714E-02	.03	.86
	PLADAE2	12.01	1	12.01	.65	.45
	PLADAE3	11.20	1	11.20	1.01	.36
	PLADAE4	4.62	1	4.62	4.70	.08
HABITAT	PLADAE1	2.59	1	2.59	1.41	.28
	PLADAE2	.78	1	.78	.04	.84
	PLADAE3	5.09	1	5.09	.45	.52
	PLADAE4	.93	1	.93	.95	.37
GROUP * HABITAT	PLADAE1	.00	0	.	.	.
	PLADAE2	.00	0	.	.	.
	PLADAE3	.00	0	.	.	.
	PLADAE4	.00	0	.	.	.
HABITAT * LOCATION	PLADAE1	.37	1	.37	.20	.66
	PLADAE2	1.83	1	1.83	.09	.76
	PLADAE3	.74	1	.74	.06	.80
	PLADAE4	5.47	1	5.47	5.56	.06

Error	PLADAE1	9.16	5	1.83		
	PLADAE2	92.16	5	18.43		
	PLADAE3	55.41	5	11.08		
	PLADAE4	4.91	5	.98		

a R Squared = .899 (Adjusted R Squared = .738)
b R Squared = .490 (Adjusted R Squared = -.325)
c R Squared = .504 (Adjusted R Squared = -.290)
d R Squared = .740 (Adjusted R Squared = .325)

Table 30 MANOVA test on colony size distribution of *Leptastrea transversa*.

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.63	.76	18	51.00	.73
	Wilks' Lambda	.46	.75	18	42.91	.74
	Hotelling's Trace	.96	.73	18	41.00	.75
	Roy's Largest Root	.68	1.94[b]	6	17.00	.13
LOCATION	Pillai's Trace	.07	.38[a]	3	15.00	.76
	Wilks' Lambda	.92	.38[a]	3	15.00	.76
	Hotelling's Trace	.07	.38[a]	3	15.00	.76
	Roy's Largest Root	.07	.38[a]	3	15.00	.76
HABITAT	Pillai's Trace	.31	2.29[a]	3	15.00	.11
	Wilks' Lambda	.68	2.29[a]	3	15.00	.11
	Hotelling's Trace	.45	2.29[a]	3	15.00	.11
	Roy's Largest Root	.45	2.29[a]	3	15.00	.11
GROUP * HABITAT	Pillai's Trace	.00	.[a]	0	.00	.
	Wilks' Lambda	1.00	.[a]	0	16.00	.
	Hotelling's Trace	.00	.[a]	0	2.00	.
	Roy's Largest Root	.00	.00[a]	3	14.00	1.00
HABITAT * LOCATION	Pillai's Trace	.06	.35[a]	3	15.00	.78
	Wilks' Lambda	.93	.35[a]	3	15.00	.78
	Hotelling's Trace	.07	.35[a]	3	15.00	.78
	Roy's Largest Root	.07	.35[a]	3	15.00	.78

a Exact statistic
b The statistic is an upper bound on F that yields a lower bound on the significance level.
c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 31 ANOVA for posteriori test on colony size of *Leptastrea transversa*.

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	LEPTRA1	10.95	6	1.82	.45	.83
	LEPTRA2	59.46	6	9.91	.75	.61
	LEPTRA3	34.86	6	5.81	.77	.60
LOCATION	LEPTRA1	3.96	1	3.96	.98	.33
	LEPTRA2	3.55	1	3.55	.27	.60
	LEPTRA3	4.476E-02	1	4.476E-02	.00	.93
HABITAT	LEPTRA1	1.29	1	1.29	.32	.57
	LEPTRA2	30.17	1	30.17	2.31	.14
	LEPTRA3	.66	1	.66	.08	.77
GROUP * HABITAT	LEPTRA1	.00	0	.	.	.
	LEPTRA2	.00	0	.	.	.
	LEPTRA3	.00	0	.	.	.
HABITAT * LOCATION	LEPTRA1	3.92	1	3.92	.97	.33
	LEPTRA2	8.01	1	8.01	.61	.44
	LEPTRA3	3.05	1	3.05	.40	.53
Error	LEPTRA1	68.52	17	4.03		
	LEPTRA2	221.97	17	13.05		
	LEPTRA3	128.03	17	7.53		

a R Squared = .227 (Adjusted R Squared = -.182)
b R Squared = .313 (Adjusted R Squared = -.050)
c R Squared = .232 (Adjusted R Squared = -.175)

Table 32 MANOVA test on colony size distribution of *Favia rotumana*.

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.57	1.211	4	12.00	.35
	Wilks' Lambda	.43	1.309	4	10.00	.33
	Hotelling's Trace	1.30	1.307	4	8.00	.34
	Roy's Largest Root	1.29	3.890	2	6.00	.08
LOCATION	Pillai's Trace	.64	4.532	2	5.00	.07
	Wilks' Lambda	.35	4.532	2	5.00	.07
	Hotelling's Trace	1.81	4.532	2	5.00	.07
	Roy's Largest Root	1.81	4.532	2	5.00	.07
HABITAT	Pillai's Trace	.33	1.268	2	5.00	.35
	Wilks' Lambda	.66	1.268	2	5.00	.35
	Hotelling's Trace	.50	1.268	2	5.00	.35
	Roy's Largest Root	.50	1.268	2	5.00	.35
GROUP * HABITAT	Pillai's Trace	.00	.	0	.00	.
	Wilks' Lambda	1.00	.	0	5.50	.
	Hotelling's Trace	.00	.	0	2.00	.
	Roy's Largest Root	.00	.000	2	4.00	1.00
HABITAT * LOCATION	Pillai's Trace	.00	.	0	.00	.
	Wilks' Lambda	1.00	.	0	5.50	.
	Hotelling's Trace	.00	.	0	2.00	.
	Roy's Largest Root	.00	.000	2	4.00	1.00

a Exact statistic
b The statistic is an upper bound on F that yields a lower bound on the significance level.
c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 33 MANOVA test on colony size distribution of *Favites halicora.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.83	.71	6	6.00	.65
	Wilks' Lambda	.19	.83	6	4.00	.59
	Hotelling's Trace	3.95	.65	6	2.00	.70
	Roy's Largest Root	3.91	3.91	3	3.00	.14
LOCATION	Pillai's Trace	.10	.08	3	2.00	.96
	Wilks' Lambda	.89	.08	3	2.00	.96
	Hotelling's Trace	.12	.08	3	2.00	.96
	Roy's Largest Root	.12	.08	3	2.00	.96
HABITAT	Pillai's Trace	.00	.	0	.00	.
	Wilks' Lambda	1.00	.	0	3.00	.
	Hotelling's Trace	.00	.	0	2.00	.
	Roy's Largest Root	.00	.00	3	1.00	1.00
GROUP * HABITAT	Pillai's Trace	.00	.	0	.00	.
	Wilks' Lambda	1.00	.	0	3.00	.
	Hotelling's Trace	.00	.	0	2.00	.
	Roy's Largest Root	.00	.00	3	1.00	1.00
HABITAT * LOCATION	Pillai's Trace	.00	.	0	.00	.
	Wilks' Lambda	1.00	.	0	3.00	.
	Hotelling's Trace	.00	.	0	2.00	.
	Roy's Largest Root	.00	.00	3	1.00	1.00

a Exact statistic
b The statistic is an upper bound on F that yields a lower bound on the significance level.
c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 34 MANOVA test on colony size distribution of *Montastrea curta.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.45	.58	8	16.00	.77
	Wilks' Lambda	.58	.54	8	14.00	.80
	Hotelling's Trace	.64	.48	8	12.00	.84
	Roy's Largest Root	.52	1.04	4	8.00	.44
LOCATION	Pillai's Trace	.15	.66	2	7.00	.54
	Wilks' Lambda	.84	.66	2	7.00	.54
	Hotelling's Trace	.19	.66	2	7.00	.54
	Roy's Largest Root	.19	.66	2	7.00	.54
HABITAT	Pillai's Trace	.07	.30	2	7.00	.75
	Wilks' Lambda	.92	.30	2	7.00	.75
	Hotelling's Trace	.08	.30	2	7.00	.75
	Roy's Largest Root	.08	.30	2	7.00	.75
GROUP * HABITAT	Pillai's Trace	.02	.08	2	7.00	.91
	Wilks' Lambda	.97	.08	2	7.00	.91
	Hotelling's Trace	.02	.08	2	7.00	.91
	Roy's Largest Root	.02	.08	2	7.00	.91
HABITAT * LOCATION	Pillai's Trace	.16	.66	2	7.00	.54
	Wilks' Lambda	.84	.66	2	7.00	.54
	Hotelling's Trace	.19	.66	2	7.00	.54
	Roy's Largest Root	.19	.66	2	7.00	.54

a Exact statistic
b The statistic is an upper bound on F that yields a lower bound on the significance level.
c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 35 ANOVA test on colony size 1-10 cm of *Oulastrea crispata.*

Source	Type I Sum of Squares	df	Mean Square	F	Sig.
GROUP	181.07	5	36.21	3.38	.03
LOCATION	40.69	2	20.34	1.89	.19
HABITAT	18.31	1	18.31	1.70	.21
GROUP * HABITAT	.00	0	.	.	.
LOCATION * HABITAT	.00	0	.	.	.
Error	128.58	12	10.71		
Total	826.00	21			

a R Squared = .651 (Adjusted R Squared = .419)

Table 36 MANOVA test on colony size distribution of *Diploastrea helipora.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.55	1.88	2.00	3.00	.29
	Wilks' Lambda	.44	1.88	2.00	3.00	.29
	Hotelling's Trace	1.25	1.88	2.00	3.00	.29
	Roy's Largest Root	1.25	1.88	2.00	3.00	.29
LOCATION	Pillai's Trace	.70	3.58	2.00	3.00	.16
	Wilks' Lambda	.29	3.58	2.00	3.00	.16
	Hotelling's Trace	2.39	3.58	2.00	3.00	.16
	Roy's Largest Root	2.39	3.58	2.00	3.00	.16
HABITAT	Pillai's Trace	.00	.	.00	.00	.
	Wilks' Lambda	1.00	.	.00	3.50	.
	Hotelling's Trace	.00	.	.00	2.00	.
	Roy's Largest Root	.00	.00	2.00	2.00	1.00
GROUP * HABITAT	Pillai's Trace	.00	.	.00	.00	.
	Wilks' Lambda	1.00	.	.00	3.50	.
	Hotelling's Trace	.00	.	.00	2.00	.
	Roy's Largest Root	.00	.00	2.00	2.00	1.00
LOCATION * HABITAT	Pillai's Trace	.00	.	.00	.00	.
	Wilks' Lambda	1.00	.	.00	3.50	.
	Hotelling's Trace	.00	.	.00	2.00	.
	Roy's Largest Root	.00	.00	2.00	2.00	1.00

a Exact statistic

b Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+LOCATION * HABITAT

Table 37 MANOVA test on colony size distribution of *Leptastrea purpurea.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.98	13.38	4.00	1.00	.20
	Wilks' Lambda	.01	13.38	4.00	1.00	.20
	Hotelling's Trace	53.52	13.38	4.00	1.00	.20
	Roy's Largest Root	53.52	13.38	4.00	1.00	.20
LOCATION	Pillai's Trace	.00	.	.00	.00	.
	Wilks' Lambda	1.00	.	.00	1.00	.
	Hotelling's Trace	.00	.	.00	2.00	.
	Roy's Largest Root	.00	.00	1.00	.00	.
HABITAT	Pillai's Trace	.25	.33	1.00	1.00	.66
	Wilks' Lambda	.75	.33	1.00	1.00	.66
	Hotelling's Trace	.33	.33	1.00	1.00	.66
	Roy's Largest Root	.33	.33	1.00	1.00	.66
GROUP * HABITAT	Pillai's Trace	.00	.	.00	.00	.
	Wilks' Lambda	1.00	.	.00	1.00	.
	Hotelling's Trace	.00	.	.00	2.00	.
	Roy's Largest Root	.00	.00	1.00	.00	.
HABITAT * LOCATION	Pillai's Trace	.00	.	.00	.00	.
	Wilks' Lambda	1.00	.	.00	1.00	.
	Hotelling's Trace	.00	.	.00	2.00	.
	Roy's Largest Root	.00	.00	1.00	.00	.

a Exact statistic
b Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 38 MANOVA test on colony size distribution of *Leptastrea pruinosa.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	1.55	1.78	9	15.00	.15
	Wilks' Lambda	.03	2.31	9	7.45	.13
	Hotelling's Trace	11.21	2.07	9	5.00	.21
	Roy's Largest Root	10.04	16.74	3	5.00	.00
LOCATION	Pillai's Trace	.49	.96	3	3.00	.51
	Wilks' Lambda	.50	.96	3	3.00	.51
	Hotelling's Trace	.96	.96	3	3.00	.51
	Roy's Largest Root	.96	.96	3	3.00	.51
HABITAT	Pillai's Trace	.11	.12	3	3.00	.94
	Wilks' Lambda	.88	.12	3	3.00	.94
	Hotelling's Trace	.12	.12	3	3.00	.94
	Roy's Largest Root	.12	.12	3	3.00	.94
GROUP * HABITAT	Pillai's Trace	.36	.58	3	3.00	.66
	Wilks' Lambda	.63	.58	3	3.00	.66
	Hotelling's Trace	.58	.58	3	3.00	.66
	Roy's Largest Root	.58	.58	3	3.00	.66
HABITAT * LOCATION	Pillai's Trace	.00	.	0	.00	.
	Wilks' Lambda	1.00	.	0	4.00	.
	Hotelling's Trace	.00	.	0	2.00	.
	Roy's Largest Root	.00	.00	3	2.00	1.00

a Exact statistic
b The statistic is an upper bound on F that yields a lower bound on the significance level.
c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

Table 39 MANOVA test on colony size distribution of *Echinopora lamellosa.*

Effect		Value	F	Hypothesis df	Error df	Sig.
GROUP	Pillai's Trace	.90	.54	6	4.00	.75
	Wilks' Lambda	.25	.32	6	2.00	.87
	Hotelling's Trace	2.33	.00	6	.00	.
	Roy's Largest Root	2.03	1.35	3	2.00	.45
LOCATION	Pillai's Trace	.00	.	0	.00	.
	Wilks' Lambda	1.00	.	0	1.50	.
	Hotelling's Trace	.00	.	0	2.00	.
	Roy's Largest Root	.00	.00	2	.00	.
HABITAT	Pillai's Trace	.23	.15	2	1.00	.87
	Wilks' Lambda	.76	.15	2	1.00	.87
	Hotelling's Trace	.30	.15	2	1.00	.87
	Roy's Largest Root	.30	.15	2	1.00	.87
GROUP * HABITAT	Pillai's Trace	.00	.	0	.00	.
	Wilks' Lambda	1.00	.	0	1.50	.
	Hotelling's Trace	.00	.	0	2.00	.
	Roy's Largest Root	.00	.00	2	.00	.
HABITAT * LOCATION	Pillai's Trace	.00	.	0	.00	.
	Wilks' Lambda	1.00	.	0	1.50	.
	Hotelling's Trace	.00	.	0	2.00	.
	Roy's Largest Root	.00	.00	2	.00	.

a Exact statistic

b The statistic is an upper bound on F that yields a lower bound on the significance level.

c Design: Intercept+GROUP+LOCATION+HABITAT+GROUP * HABITAT+HABITAT * LOCATION

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