CHAPTER 4

DISSCUSSION

1. Coral reef condition

Kang Kao coral reef is in an estuary area characterized mixed tide (tend to be semidiurnal tide). Thus the corals in the intertidal zone (shallow zone) are mostly dead coral and microatoll due to the effect of exposure to air during low tide especially during May - July and wind wave action during Northeast Monsoon. Diadema setosum also plays significant role in modifying the reef (Tsuchiya et al, 1986). Thus, there are always available space for boring organisms, various algae especially, turf, filamentous and coralline algae. Kamura and Choonhabandit (1986) reported that this zone is abundantly inhabited by various algae particularly filamentous and coralline algae. Diadema setosum were the most abundant grazers which would graze on algae turf substrates including dead coral and various juveniles of sessiles, encrusting and boring organisms. The grazing activities also affected coral larvae settlement as well as prevent the overgrowth of algae over coral colonies (Glynn et al, 1979).

Consequently the deep zone is subtidal area where dense coral patches of Porites lutea are found. The coral colonies particular Porites lutea in this zone are usually consist of dead part at the base. However, the results reported that this zone was composed of more sand and live coral than dead corals since the dead portion did not appear in the photo. The destruction such as grazine by Diadema setosum would also occur at the base of coral colonies. Porites lutea were usually found overlying each other or dispersing on sandy substratum due to braking off or overgrowth.

2. Influence of some environmental factors which might facilitate the bioerosion by boring organisms

2.1 Physical parameters i.e. tide, current, temperature and salinity

The study site is located in the estuarine environment, thus, the tide is the most influencing factor on current pattern over the reef. Suhayda and Roberts (1977) described that the wave driven currents and mixed tide cycle driven current tend to flow continuosly on shore over the reef with greatest velocity at low tide. This current possibly affects on the pelagic larvae of various boring organisms William et al (1984) concluded that at Great Barrier Reef most of benthic invertebrates were most abundant in spring-summer when currents on the outer reef were almost entirely unidirectionally (long shore current).

For other environmental factors such as light intensity, salinity and temperature, these factors may affect boring organisms on some aspects, for instances, optimum condition for spawning, stimulation succession of various species. During experimental period, it was found the high salinity fluctuation in range 16-32 ppt in March to September due to the tidal and runoff effects which was charactered of estuarine environment.

2.2 Wave energy

Wave energy acts as the influencing physical factor to several conditions at each study point. It could affect some important factors as sedimentation rate and suspended solids. Adey (1978) reported that the growth potential of dominant corals relative to wave energy. Moderate wave energy favors vertically rapid growth that is porous and uncemented, hidh wave energy favors slow but compact growth. Highsmith (1980) and Highsmith (1981) reported that fast-growing coral could not protect the exoskeletons with living tissues, so they were easily bored by sponges, polychaetes and bivalves. Furthermore, wave action may indirectly prevent the larval recruitment by resuspending bottom sediment which affected stability of surface substrates.

2.3 Sedimentation rate and suspended solids

The maximum sedimetation rate in November which was affected directly by the northeast monsoon. In addition, the minimum sedimentation rate was in May which is summer period. At the location of low sedimentation rate the surrounding conditions seemed to facilitate the increase of boring sponge and polychaete borers. This phenomenon might be due to the availability of protective surface of substrates. Otter (1937) concluded that sediment layer on substrate would probably form an efficient barrier against the attack of the majority of boring organisms. Moreover, at the location of high sedimentation rate which was induced by wave, the settling sediments on coral substrates would cover on the surface and winnow again over again. It disturbed the stability of substrates for borer recruitment. Thus, the succession of boring organisms could be possible at the bottom surface of coral blocks.

2.4 Primary productivity

The study area is one of the most productive and fertile in the Gulf of Thailand, thus the results of NPP were relatively high. The data showed that NPP reached the highest peak in November which was 1,848.99 $mgC/m^2/day$ in shallow zone and 3,150.00 $mgC/m^2/day$ in shallow zone and 592.50 $mgC/m^2/day$ in deep zone. These values were regarded as high primary productivity. Highsmith (1980) noted the relationship between primary productivity and percentages of coral heads with boring bivalves. Highsmith (1980b) reported that the abundance of boring sponges and bivalves with concomitant damage to coral skeletons should also increase, especially, if productivity is raised above 150-200 $mgC/m^2/day$. The primary productivity also played the significant role on species diversity of infauna on coral head (McCloskey, 1970). Furthermore, the incline of primary production tended to relative the total number increasing as shown in Figure 9, 27. As well as McCloskey (1970) discussed that the most successful cryptofaunal communities would happen while the primary productivity is lowest. These may be relative organic matter due to primary producers settling meanwhile was added by algal production during summer period. These productions seemed to play the role on food induction which may facilitate to borers succession. Base on Highsmith estimation coral reef at the study site might be destroyed mainly by both sponges and bivalves . However, the results indicated that bivalves: Lithophaga spp. and Gastrochaenids were the most abundance borers in coral colonies (Porites lutea).

Anyhow, although the benthic primary productivity due to algal communities, prior to the shallow zone, was not investigated. It would play the important roles on the dynamic of some boring polychaetes on coral blocks as their food sources (MacGeachy and Stearn, 1976). Particularly, the polychaetes; Dodecaceria sp. is a deposit feeder which dominantly occurred in the shallow zone with the most abundant algal succession on coral blocks. At that time, the grazing due to Diadema setosum was inhibited by the limiting depth whilst the lowest tide in day time. As the coral communities in study site directly face the Northeast Monsoon wind around November to January, wave energy end current are important parameters in effecting the size and on this dynamic of these coral communities.

3. Comparison on the composition of boring organisms in shallow and deep zones.

3.1 Composition of boring organisms in Porites lutea

All of the predominant infauna found in Porites lutea coral heads, were borers which inhabited by boring or penetrating into substrates. However, the sample collection showed the number variation of some predominant borers such as Phascolosoma sp.D which was the most dominant in shallow zone. This species seemed to vary in abundance. In shallow zone they disappeared in November, but in deep zone they were absent during November 1985 to March 1986. This might result from spawning period. Rice and MacIntyre (1982) found that Phascolosoma perlucens and P. varians were generally observed to having spawn in April and Paraspidosiphon steestrupi in June at Carrie Bow Cay, Belize, in the Atlantic Barrier reef. Therefore, the appearance of boring sipunculids may depend upon species, other controlling factors and zoogeography. Particular environment factor, the most important of which are water agitation, light intensity, depth, including also reef zonation. Moreover the result also indicates that Phascolosoma sp.D was obviously clumped distribution with very high standard deviation. On the other hand, sipunculans, Phascolosoma sp.B was the dominant borer in deep zone. Analysis of species association revealed that almost all dominant borers in deep zone were not strongly associated with each other. In shallow zone these borers exhibited significant biological interaction with each other, for example, Phascolosoma sp.D was found together with Phascolosoma sp.B which may require the same environmental factors. However it was not found with Phascolosoma sp.A; Lithophaga lima and Hypsicomus sp.A. The presence of both Lithophaga spp. and Hypsicomus sp. which are filter feeders may decrease the chance of other borer larvae to settle in the same area. The result from dispersion analysis obviously showed the clumping distribution analysis obviously showed the clumping distribution of these boring sipunculids which may cause by their asexual reproduction i.e. constricting the posterior end to form a new individual.

The important boring polychaetes species belong to the following families : Eunicidae, Lumbrineridae, Darvilleidae, Spionidae, Cirratulidae and Sabellidae (Huchings, 1986). However in this study, the boring polychaetes found are mostly family Sabellidae, Eunicidae and Flabelligeridae as reported in Mak (1980), Tsuchiya et al (1986) and Moordee, (1987). These borers were found distinctly different in both quantity and quality between zones. Hypsicomus sp.A was one of the three dominant borers in Porites lutea in deep zone. Hypsicomus sp.A was one of the three dominant borers in Porites lutea in deep zone.

While Eunice sp. became abundant in shallow zone. This may due to presence of such as endolithic algae (McGeachy and Stearn, 1976). On the contrary, Hypsicomus sp.A in deep zone was filter feeder which was increasingly abundant with increasing depth. It was found that suspensions in water column also increase in quantity per unit volume area. Hypsicomus sp.A varied in density and disappeared in May. This variation might be influenced by spawning period which was expected to be in late summer or early rainy season. However, Davies and Hutchings (1983) reported that these worms were long life borers so they possibly disappeared as a result of dynamic succession. Following study of longer duration is needed to understand the cause and effect. Pherusa parmata were also more abundant in deep zone than in shallow zone. This may due to the abundance of food supply.

The ability to bore into hard substrates is well developed within three families of bivalves. Hutching (1985) described that the Pholadidae were exclusively borers using primarily mechanical means of penetration : such as the Gastrochaenidae and some species of Mytilidae. These boring bivalves inhabited predominantly in Porites lutea in both shallow and deep zones. The most important boring bivalves were Lithophaga spp., particular L. lima which settled on both live and dead corals. Evseev (1981) found that the lithophagids settling on the live and dead coral Stylophora mordax and Acropora palifera. Moreover he also found that this bivalve could penetrate successfully under the coenosarc and bore into the coral skeleton at a distance between 30-50 mm from the outer surface of coral heads. Lithophaga teres and L. malaccana were also found boring on Porites lutea which were collected from the shallow zone. The dispersion analysis obviously showed that the dominant Lithophaga lima was clumpedly distributed. Furthermore, Gastrochaena cuneiformis and Spengleria mytiloides were also found in dead part of live corals. Spengleria mytiloides could be found in two stages : one is the mature stage and another is active stage as shown in Figure 16. The active stage efficiently penetrate into coral substrates. All of boring bivalves are planktivores. Highsmith (1980) reported that number of boring bivalves was related to plankton primary productivity and the potential of the latter would influence the abundance of boring sponges as well. Likewise, the result of net primary productivity (NPP) which is always much more fertile in deep zone is corresponded with the number of boring bivalves. Moreover, Lithophaga lima were usually found at both living and dead coral parts. So this reflected requirement of available substrates for planktonic larvae to recruit.

3.2 Composition of boring organisms in coral blocks

Within the duration of this study succession of various cryptofauna was observed which suggested the strong seasonality of availability and/or survival of planktonic larvae similar to those studied conducted in Great Barrier Reef reported (Davies and Hutchings, 1983; and Hutchings and

Bamber, (1985). Phascolosoma spp. and Aspidosiphon spp. became the common species found in coral blocks both in shallow and deep zones after 4 months. This finding differs from the study by Hutchings and Bamber (1985). They found boring sipunculid worms became common after 6-9 months of exposure. The sipunculid number in coral blocks which were collected from deep zone, increased rapidly until 10 months. The dynamic of sipunculid boring was discussed by Hutchings (1981). Some fishes such as Trigger fishes (Balistidae) are known to break off pieces of coral with their powerful jaws and eat the borers and infaunal animals. Besides, puffers (Tetraodontidae), wrasses (Labridae) may also expose borers to predation by breaking off pieces of coral while feeding. In addition, Diadema setosum are the most effective biological control by their grazing on algae including boring organisms (field observation). The predation by some filter feeders are also the inhibiting factors of boring sipunculids succession (Rice and Macintyre, 1982). These sipunculids were concentrated in deep zone more than in shallow zone. In addition, the Biological Index were ranked to find out the dominant borers for comparing and investigating the dynamics of borer composition. The results confirmed that the species mentioned before were predominant borers in deep zone. In shallow zone, the coral blocks were remarkably bored by cirratulids : Dodecaceria sp.. Cirratulids : Dodecaceria sp. are known to be able to bore actively into corals (Hutching, 1974). Megalomma quadrioculatum was the dominant boring polychaetes in deep zone. This species acted as pioneer borers only in the summer period (May to July). However, according to the rare appearance of these polychaetes in Porites lutea which were collected during September '85 to May '86, they seem to be short life borers. They possibly spawn in summer which water temperature is rather stable and the salinity up to 32 ppt. Furthermore, the currents seem to be unidirection due to the influencing of tide as aforementioned. In case of sipunculid borers, the recruitment tended to increase on coral blocks with time. Moreover, the boring sipunculids in shallow zone seem to be under control by some environmental factors as their number were quite consistent throughout the study. Two possible explanations are given. The new sipunculids succession might be due to unavailability of sufficient solid substratum in coral blocks that were initially bored by filter feeders which preyed upon the sipunculan pelagic larvae. Another, due to catatrophic, particularly, the coral blocks in shallow zone which almost emerged at certain time were suitable for algal growth. These plants subsequently as sediment trap. Thus, it prevents the settlement of borer larvae on coral substrates. The composition and ranking of Biological Index of other borers; sipunculids and polychaetes, were different from April to July. During this period the lowest tides usually occur in day time. This phenomenon might act as the stress for organisms in shallow and deep zones. This may facilitate or inhibit the succession of various borers and thus effect the borer compositions in each zone. Although both zones are distinctly seperate. The effect of exposure period is considered as a cause for the difference in diversity index of these 2 zones. The coefficients of association of borers were insignificant in shallow zone, but in deep zone there was the negative species association among Megalomma quadrioculatum and all sipunculid borers; Phascolosoma spp. and unidentified phascolosomatids. This may due to some effects such as biological competition between borers themselves and zonal distribution.

Furthermore, the total numbers of boring organisms in deep zone were generally higher than in shallow zone except at line B which was affected by a number of Dodecaceria sp. due to their specific habitat preference for their feeding. On the other hand, sipunculid borers appeared to be the most abundant at line E. This line is considered having moderate wave enegy as deduced by yearly sedimentation rates. Although Bombley (1979) concluded that sipunculans mainly occurred in low energy environment. Rice and MacIntyre (1982) reported that they occurred in greatest abundance in high energy reef areas. In this study line E was the most abundant of coral inhabitants as the availability of substrates for boring sipunculid recruitment. Further investigation is needed before any conclusion can be made. Boring sponges appeared in several coral blocks but they did not succeed to colonize on the underneath surface as large colonies. Bergquist (1978) reported that in intertidal locations sponges were not physiognomic organisms. They frequently occurred in pool, shade, crevices but did not cover large areas. This phenomena may due to predation pressure. Especially in this study area, Diadama setosum is the most important biological control on several cryptofaunal organisms. Moreover, the pelagic larvae may be afffected by predation of spionid and sabellid polychaetes. In addition, some coral reef fishes also predate on settling boring sponges larvae. The physical factors such as temperature, salinity which can also become limiting factors for species distribution of sponges (Bergquist, 1978). Under this study, salinity fluctuation at Kang Kao Island is rather large. The results showed that the coral blocks at line G which could determined the lowest sedimentation rate, have abundantly appeared with the obviously large chamber in coral blocks.

3.3 Comparison of borer numbers in various zones and coral substrates

Boring sipunculids and polychaetes in coral blocks were more abundant than in live Porites lutea in both shallow and deep zones. The phenomenon could be explained by some specific characteristics of coral substrates. Living tissues of Porites lutea act as the active protector against boring attacks. Likewise, Bak et al (1982) concluded that the corals themselves have at least two additional aggressive processes which could result in diminishing borer abundance, that is interfered by epifauna and sweeper tentacles. In addition, Bak and Steward-Van Es (1980) discussed that the corals could prevent the colonisation of other spatial competitors and excavating organisms by tissue regeneration on superficial demage. On the contrary, the coral blocks which are without living tissues would be available substrates for borer succession particularly on the bottom surface. McCloskey (1970) concluded that the cryptofaunal communities would not develop until the coral dies, it was then attacked and penetrated by boring species which make the burrows for non-boring species later. This is because the boring organisms could avoid their predators; mostly grazers such as fishes and black urchins (personal field observation, Hatcher 1983) including being buried by sediment.

The borer species composition of borers in between Porites lutea and coral blocks were different. This also due to the exposure time of Porites lutea was longer than coral blocks. Other studies also indicated that abundance of borers were found in coral blocks might be influenced by exposure time (Davies and Hutchings, 1983; and Hutchings and Bamber, 1985).

4. Estimation and comparison of bioerosion rates

4.1 Bioerosion on live coral

The results showed that the most effective borers in shallow zone were polychaetes with percentage of excavated area equal to 4.52 $\pm$ 7.02 %. On the contrary, boring bivalves were more effective in deep zone by the combination of chemical and mechanical mechanismss, they presented bored area upto 11.76 $\pm$ 9.28 % Boring sipunculids and sponges also appeared more effective agents in this zone. Porites lutea in deep zone appeared to be fast-growing. Adey (1978) summarized that moderate wave energy favors vertically rapid growth which is porous and uncemented. Highsmith (1981a) commented that fast-growing coral species construct skeletons low density and so they were easily bored and destroyed by sponges, polychaetes and bivalves. In addition, from the results it is shown that plankton primary productivity in deep zone was higher than in shallow zone. This might facilitate the bioerosion activities of the planktivore borers such as bivalves and sponges as Highsmith (1980) discussed that the number of boring bivalves was highly correlated with plankton primary productivity.

The maximum bioerosion rates did not show the significant difference between zones. however, these are merely estimated values, the actual rates could not be obtained because sample collection and estimation method are very difficult to achieve in field.

4.2 Bioerosion on coral blocks

The net erosion rates on coral blocks were almost equal between shallow and deep zones. The dynamics of maxinum bioerosion which exhibited the highest average maximum bioerosion rate at line G, mostly due to boring sponges. This line was considered to be a specific optimum microhabitat of boring sponges owing to the effect of lowest yearly sedimentation rate. Wilkinson (1983) commented that the substrates suitable for boring sponge recruitment should be far away sediment loading. Gerrodette and Flechasing (1979) reported that sediment effect the pumping activity of sponges. Additional, the high variation of salinity gradient according to tidal cycle in estuarine environment in run off season may affect boring sponges and any which inhabit in this area. The minumum bioerosion rate was up to 66.72 $\pm$ 54.84 $gm/m^2/yr$ in shallow zone and 130.48 $\pm$ 127.54 $gm/m^2/yr$ in deep zone. So they obviously exhibited significant difference of bioerosion in each zone. Nevertheless, not only the minumum bioerosion rate was related to number of both sipunculids and polychaetes but the maximum was also related to number of polychaete borers as well. Thus this means that both organisms are the most important borers in new coral substrates, similar to that reported by Davies and Hutchings (1983) and Hutchings and Bamber (1985). But these results were different from the hypothesis of Highsmith (1980). Although both density and porosity of each coral block are approximately equal the bioerosion rates were different. This may result from the effect of other environmental factors at each study point.

Furthermore, the net erosion, maximum and minimum bioerosion rates were compared to show that bioerosion rate by borers was greatly less than net erosion, this phenomenon may be cause by grazing effect of Diadema setosum which were abundant in Kang Kao coral reef (field and microscopic observation and Tsuchiya et al 1986). In addition, the bioerosion caused by polychaetes was up to 35.36 ± 30.29 $gm/m^2/yr$ in shallow zone and 101.78 ± 109.80 $gm/m^2/yr$ in deep zone. They also attained the highest bioerosion rate at the same location as boring sponges. It was found that all of boring polychaetes were Megalomma quadrioculatum. However sipunculid borers became abundant at line E which might be suitable location for their recruitment.

4.3 Comparison of bioerosion rates of Porites lutea and coral blocks

Consequently, the results illustrated that bioerosion rates both in Porites lutea and coral blocks in deep zone were higher than in shallow zone. This may due to higher density and more diverse of boring organisms in deep zone. Furthermore, some environmental factors might failitate the favorable conditions for boring. The bioerosion rate on Porites lutea was higher than coral blocks due to longer exposure time. Actually, all of Porites lutea colonies were approximately more than 5 years of age. Thus, they were more exposed to boring activity.

5. Succession of borers on coral blocks

Comparison of cryptofauna succession on coral blocks were illustrated as in Figure 25. They displayed the member of some crustaceans; isopods and amphipods, and several epifauna such as bryozoa, juvenile hermatypic corals, barnacles and encrusting bivalves as well as the report of Tamiyavanich et al (1978) which studied at Ao Phai which followed exposure time. Furthermore, polychaete and sipunculid borers also increased when the coral blocks were submerged longer. In addition, most of borers generally occurred underneath surface and sides of coral blocks. Because, they were able to avoid the grazing by Diadema setosum and smothering by the numbers of borers in shallow zone was higher than in deep zone. This might result in higher succession of borers in the former.

The total number of borers, including polychaetes and sipunculids, in deep zone tended to increase eventhough after study period. This phenomenon indicated that all of borers regularly occurred and recolonized the coral blocks. As primary productivity had a negative correlation with species diversity of infauna, and the results also presented that NPP in both shallow and deep zones, continually decreased borer like eunicids and spionids performed boring with endolithic algal bands, so the worms might use algae as a source of food.

On the other hand, the coral blocks were independently attacked by each boring organisms depending upon the location of coral blocks. The investigation on coral blocks could explain certain aspect of succession on *Porites lutea* later. The *Porites lutea* could be directly attacked by some boring bivalves : *Lithophaga* sp. on both live and dead coral part as reported by Evseev (1981). The succession of these boring organisms have irregular recruited over experimental period. They were obviously illustrated that the sequential borers succession as in Figure 28. Some borers could independently attack on coral blocks without the specific pioneer borers such as some polychaetes borers. Hutchings and Bamber (1985) commented that despite the availability of larval sipunculids and sponges for recruitment, newly laid coral substrates were not bored by these organisms until 9-12 months of polychaetes boring had occurred. In case of the results of the experiment, it was found that both polychaete and sipunculid borers appeared in 4-8 months which might depend upon starting time until July which the number of borers was the minumum in both zones. Consequently, this period also showed the highest succession of boring organisms. This is in accordance with McCloskey (1970) finding that the succession usually increased while NPP is decreasing.

Moreover, in shallow zone, the sipunculid numbers after 6 months were relatively constant until the end of the study period. In contrary, polychaete borers had the highest peak during March to May and then decreased. The results exhibited that some coral heads were exposed, or about to, whilst the tidal was lowest. This might affect

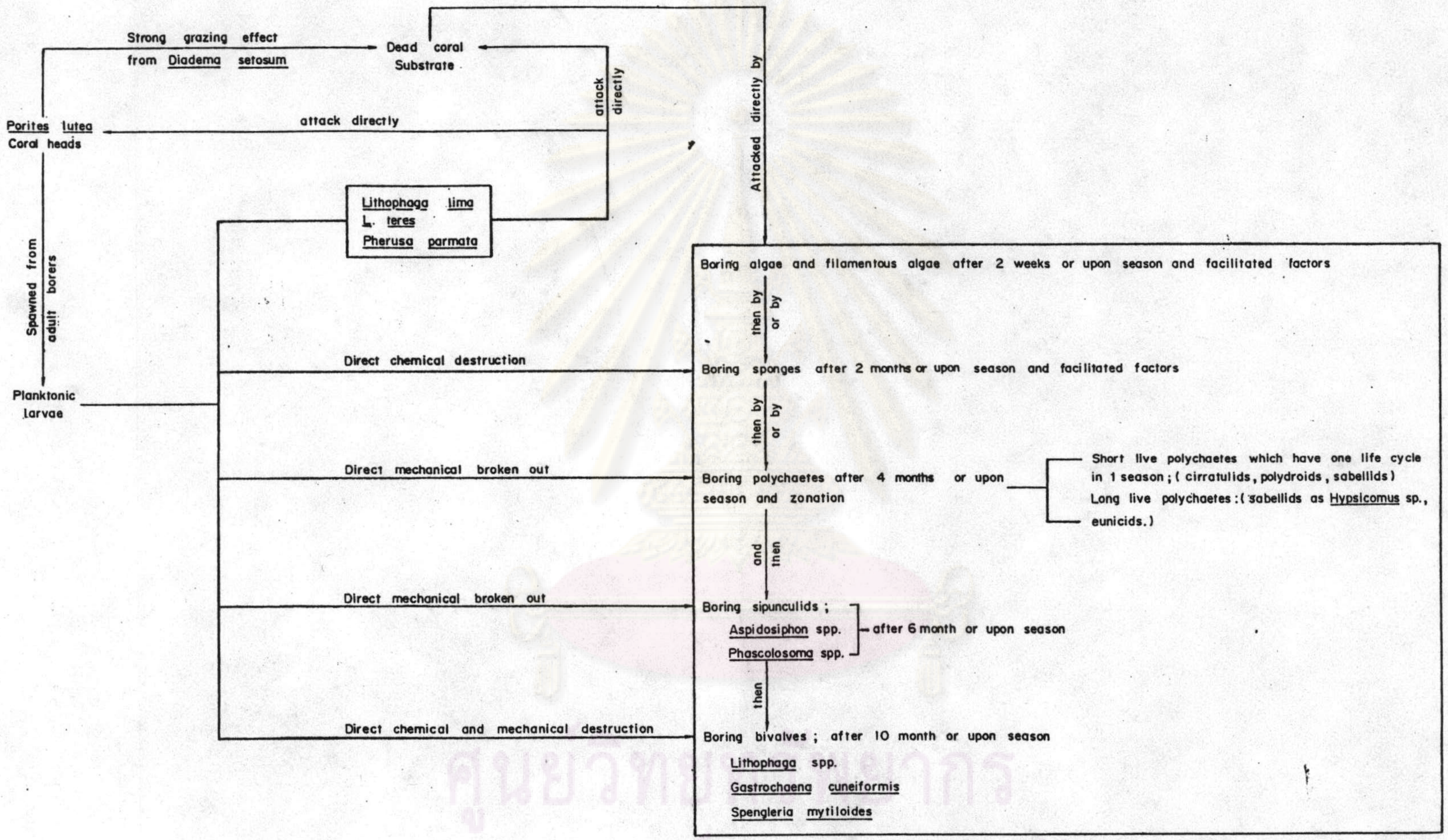

Figure 28 Flow diagram illustrates the expected succession phenomenon of predominant boring organisms on coral substrates : Porites lutea. (Modified from McCloskey, 1970)

boring organisms in coral blocks due to the stress conditions, and as the consequence results in the absence of some borer species of being replaced by the others. Furthermore, both highest peaks might be induced by the increasing of polychaete borers; Dodecaceria sp. which instantly occurred in shallow zone but Megalomma quadrioculatum the dominant one in deep zone at that time.

The occurence of boring organisms in coral blocks including alternated predominant borers, is similar to the studied elsewhere (Davies and Hutchings, 1983; Hutchings and Bamber, 1985; and Kiene, 1985). MacGeachy and Stearn (1976) discussed that the polychaete or spawning period of each organism. Hutchings and Bamber (1985) suggested that polychaetes, in some way, modify the coral substrates making it more attractive to other types of boring organisms. However, the results obviously showed that not only polychaete borers acting as the pioneer one to modify the coral substrates, but sipunculid borers also displayed the same activity on coral blocks. In addition, succession of several cryptofauna mostly occurred on the underneath surface of coral blocks which suggested that these organisms could escape from their predators such as black urchins (Diadema setosum)and some coral reef fishes. Moreover, some interfering events like sedimentation and sediment winnowing, due to wave energy which would prevent cryptofauna recruitment, did not affect to the underneath surface. So, this surface was suitable for various cryptofauna particular boring organisms. This phenomenon was possible corresponding in general at the base of colonies which was naturally dead part of living Porites slutea in both shallow and deep zones.

6. Roles of boring organisms on coral reef ecosystem

The boreholes which various borers had excavated the calcium carbonate from interior of the exoskeleton. They have displayed the microhabitat of non boring organisms for more successful colonization on coral substrates. Hutchings and Bamber (1985) suggested that the composition of borers varied over time and the initial borers were short lived polychaetes which in some way modified the coral substrated and made it suitable for other agents of bioerosion. Furthermore, these boresholes also act as the protection from their predators. This seems to be the premanent microhabitat for both boring and non boring organisms including the various juveniles of marine animals which inhabit in coral reef.

Besides, the carbonate sediments are derived from breakdown of primary framework, bioerosion plays and important role in controlling the grain size, shape and texture of coral reef sediment (Scoffin et al. 1980). Moreover, the results of the present study provide the mechanism of producing the sediment and demonstrate the importance of biological destruction to the budgets of $CaCo_3$ within reef systems. The results could demonstrate the borer effects on bioerosion and sediment producers in coral reefs on the diagrammetic which was modified from Otter (1937) as shown in Figure 29. This figure also illustrates the roles of boring organisms on coral reef erosion including the carbonate sediment transportation outer and inner of coral reef.

In addition, particular coral species, for example Porites lutea could reproduce by fragmentation (Highsmith, 1980). The boring organisms would weaken the coral skeleton. So, the portions of colonies are simply broken off or separated from the rest of the colony by physical factors such as currents wave and storms. This phenomenon was also found at Kang Kao coral communities. Porites lutea grow over each other and the new coral colonies are always found along the sandy bottom nearby the parent colonies.

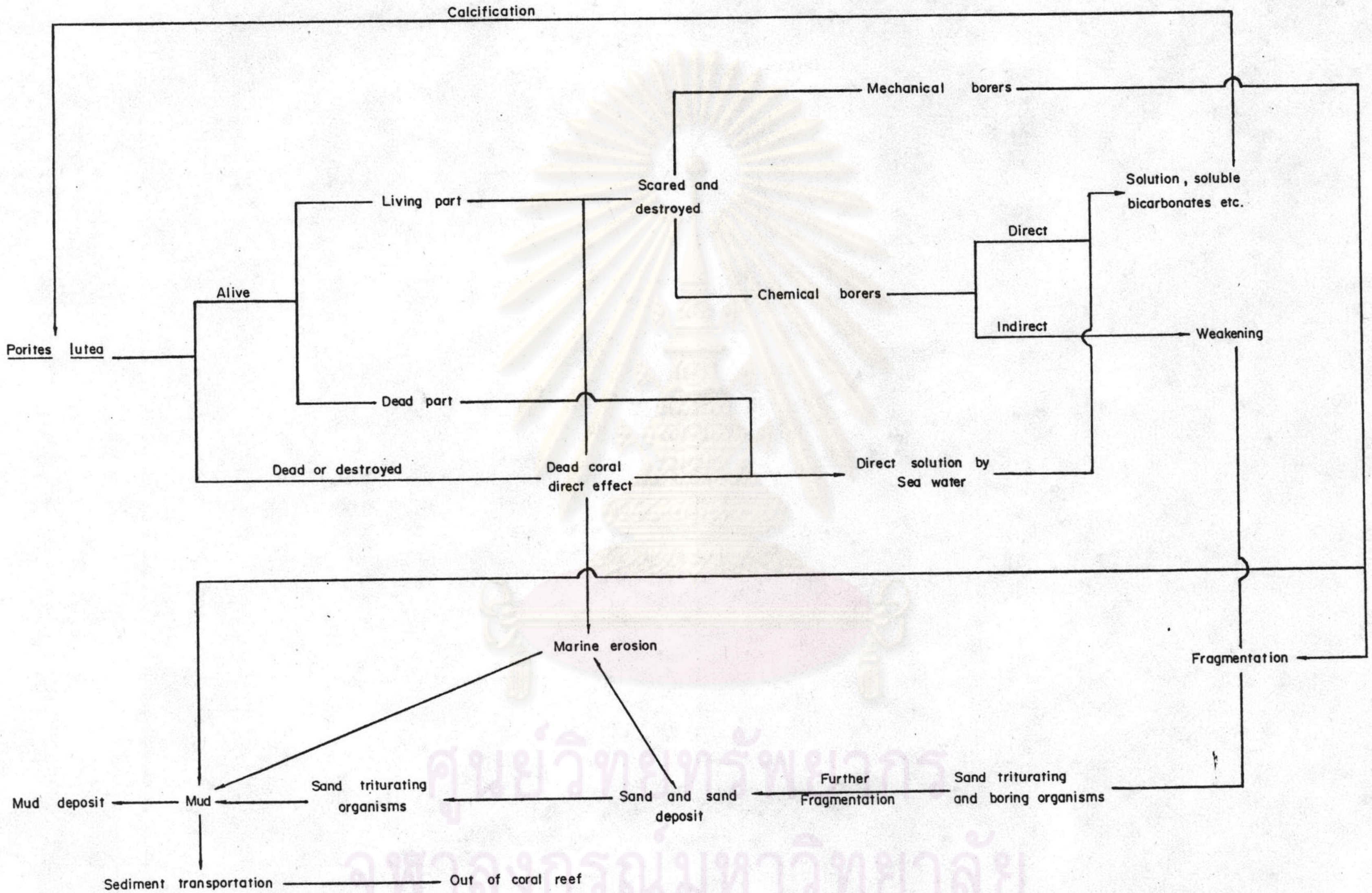

Figure 29 Diagrammetic of borer effects on bioerosion and sediment producers in reef corals: <u>Porites lutea</u>. (Modified from Otter, 1937)