An Assessment of the Effects of Environment and Human Interference on the Coral Reefs of Palk Bay and Gulf of Mannar Along the Indian Coast

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ABSTR CT

The environmental and man-made changes that affects the coral growth and associated animals and fishery in Palk Bay and Gulf of Mannar along the Indian coast are discussed. Quarrying of corals for industrial use has turned out to be a serious threat to the reefs. Removal of corals in several places has caused settlement of sand and growth of sea-grass and algae at former sites of well developed reefs. This is preventing the settlement of planulae and recolonisation of corals. In some of the islands in Gulf of Mannar, there is clear indication of sea erosion due to higher degrees of wave action caused by the removal of reefs that fringed the shores. The reefs of Palk Bay along the Mandapam Peninsula show signs of recolonisation of corals after intensive quarrying coupled with the catastrophic damages caused by the Cyclone of December 1964. Though, there is notable improvement in the number and size of all types of corals, it is the ramose species that are gaining better foothold on the reefs. This visible improvement towards recolonisation was effected within 7 to 10 years after major mortality to corals. It is suggested that prospects of recovery of the reefs in Gulf of Mannar where destruction is significant, is rather bleak since the prevailing environmental conditions are unfavourable for settlement of planulae. Attention is drawn to the necessity of chalking out measures of conservation to protect what is left of our reefs.

INTRODUCTION

Corals form one of the most successful marine benthic communities of tropical waters, capable of building extensive reefs of various types. Coral reefs are scattered over an area of 190,000,000 S. Km. in the warmer seas of the world and corals enjoy a vertical distribution from shallow intertidal zone to great abysses, though active reef-building is restricted below 90 m. Their success throughout space and time "may be attributed to wide adaptability of some species combined with high degrees of specialisation in others" (Yonge, 1968). There are many recent reports of large scale destruction and deterioration of reefs from several parts of the world, due to biological, ecological, geological and man-made reasons. As early as 1936 Stanley Gardiner pointed out the wide regression of coral growths all over the tropics. The agencies that adversily affect the growth of corals have been recently summarised by both Stoddart (1969) and Endean (1972). The objective of the present paper is to review the past findings and to discuss further some of the recent findings on the destructive and constructive forces that are operating on the coral environs of southeast India. A few notable changes towards recovery of corals on the reef of Palk Bay after their large scale destruction in early nineteen sixties are also traced. The data presented herein are mostly based on the author's observations of the reefs for nearly a decade, wherein he has taken stock of the changing faces of the reefs regarding both destruction and construction. In an earlier communication the present author (Pillai 1971 *a*) stated that the coral reefs of southeast India are fast deteriorating due to the large scale silting in the inshore waters and on the reefs as well as unrestricted quarrying for industrial purposes. The results of a re-survey of the reefs after an interval of nearly three years, further strengthen the need for a rational exploitation of corals. The information presented on the recovery of corals in Palk Bay appears to be of considerable interest in view of the contradictory opinions expressed by various workers in the past on the time requirement for visible changes towards recolonisation of reef corals after catastrophic mortality.

REGIONAL SETTING

Apart from the as yet undescribed reefs off the Gujarat coasts, the reefs of Gulf of Mannar and Palk Bay are the only major coral formations along the mainland coast of India. A discontinuous barrier-termed Mannar Barrier–extends over a distance of 140 km. from Tuticorin to Pamban in the Gulf of Mannar. This barrier reef rises from a shelf less than 35 m. deep, but up to 25 km. wide. The Gulf floor steeply slopes to 300 m. from the outer edge of this shelf (Stoddart and Fosberg, 1972). The Mannar Barrier possesses a chain of nearly 20 islands all along its length with fringing reefs around them, probably of a secondary development. Some of these reefs have already been discribed by Pillai (1971 *a*), Reddiah (1971), Stoddart and Fosberg (1972), Rajendran and David (1972) and Mergner and Scheer (1974).

In Palk Bay there is a fringing reef almost running parallel to the Mandapam Peninsula which extends along the northern and northeastern shores of Rameswaram Island. Pillai (1971 *b*) has described the structure and zonation of the reef at Mandapam while Foote (1888; 1890), Thurston (1895), and Sewell (1935) have made references to the reefs of Rameswaram Island. The present report is mostly based on the reef of Palk Bay and Gulf of Mannar in the vicinity of the Central Marine Fisheries Research Institute at Mandapam. The details of the coral fauna of these reefs are found in Brook (1893) Bernard (1905), Matthai (1928), Gravely (1927), and Pillai (1969: 1969 *a*; 1969 *b*; 1969 *c*; 1971 *a*; 1971 *b*; 1972).

FACTORS AFFECTING ADVERSELY THE GROWH OF CORALS AND THEIR ROLE ON SOUTHEAST INDIAN REEFS

Freshwater and silt may kill corals. Predators including several coral eating fishes may do damage to corals. Borers lead to the erosion of individual coral colonies and subsequent erosion of reefs (Ormond and Campbell, 1971: Ormond *et al*, 1973: Yonge, 1968). Cyclones have caused mass mortality of corals in some parts of the world (Stephenson, Endean and Bennett, 1958: Stoddart, 1962; 1965: Pillai, 1971 *a*). Dark water and Oil pollution will kill corals on a reef (Guppy, 1889). Corals and coral reefs had been elevated from the water level by geological disturbances resulting in the present day raised reefs throughout the tropics. Utilisation of corals by man as raw material in industry as well as building material has caused considerable destruction to living reefs in some parts of the world.

Lately there are reports of the echinoderm *Acanthaster planci* causing considerable destruction to corals by predation throughout the Indo–Pacific (Ormond and Campbell, 1971; Ormond *et al.*, 1973; Endean and Stablum, 1973). In the following pages the impact of some of the above cited agencies on the reef of Palk Bay and Gulf of Mannar is discussed.

Predators :

We have very little specific information on the coral predators of our waters. The coral eating fishes and molluscs, if any, need further investgation. *Acanthaster planci* is not known to occur in our reefs and there is little information on other echinoderm, if any, feeding on corals. However, it may be stated that the author kept a few colonies of *Favia pallida* in an aquarium tank along with a specimen of *Pentaceraster australiensis,* a common intertidal and reef inhabiting starfish of this area. Next morning it was observed that two of the specimens of *Favia* were fed on by the starfish levaing clean skeletons. But the same starfish did not eat polyps of the same species of coral again, even when starved for nearly two weeks and showed signs of weakening. When the bivalve *Donax faba* was put into the tank the starfish devoured them in large numbers. The author has not seen the starfish feeding on corals in nature.

Borers :

Sponges, polychaetes, barnacles, bivalves and echinoderms are the major boring invertebrates commonly found on coral reefs. A dead coral colony is immediately subjected to the action of borers leading to the erosion and breakdown of the former (Yonge, 1963). Among the boring polychaetes, *Polydora* sp, *Potamella* spp and *Sabella porifera* are commonly met with in our reefs (Kumaraswamy Achari, personal communication). A detailed account of the boring porifera is recently given by Thomas (1972) who has recorded at least 20 species of sponges belonging to 9 genera divided among the families Spirastrellidae, Clionidae, Japsidae and Halinidae that can bore into coral skeletons. Among these, Clionidae with 8 species known, is the most destructive. *Cliona cilata*, *C. vastifica* and *C. orientalis* are fairly common in both massive and ramose corals. He (Thomas, 1972) has also stated that *Spirastrella inconstans* and *S. cuspidifera* of the Spirastrellidae may grow to a considerable size causing destruction to substratum. *Delectona, Thooce, Dotona, Japsis, Aka. Halina* and *Samuss* are the other major boring sponges of this area. Thomas (1972) felt that these organisms form a significant biological agent in the erosion of corals. Some of them are capable of boring as deep as 7.5 cm. in massive *Porites* spp.

Boring bivalve molluscs play an important role in the breakdown of reefs (Gardiner, 1903; Ottor, 1931). They bore into the coral skeleton by both chemical and mechanical means. Reports of the boring bivalves of our waters are found both in Gravely (1927) and Satyamurthi (1956) However, a recent review by Appukuttan (1972) appears to be the most comprehensive account available on this group of animals from Palk Bay and Gulf of Mannar. Appukuttan (1972) has listed 17 species of bivalves that are generally found boring into both massive and ramose coral skeletons. They belong to the families. The following genera are mentioned: *Lithophaga* (5 species) *Botula* (1 species) *Venurupis* (1 species) *Aloides* (1 species), *Petricola* (2 specise), *Gastrochaenia* (3 species) *Phaladidea* (1 species) *Parapholas* (1 species) *Diplothyra* (1 species) and *Jounnetia* (1 species) are the most destructive biological agents to the corals. Though dead massive and ramose corals are their usual target of attack, rarely the present author has collected *Lithophaga nigra* from living *Porites solida*. Appukuttan (1972) states that Lithophags burrow as deep as 170 mm. into the coral skeleton, *Botula* upto 25 mm, *Petricola lithophaga* to about 35 mm. and *Pholadidea cheveyi* to 50 mm. The dead basal parts of ramose corals such as *Acropora* and *Pocillopora* are also found bored by these bivalves. Practically every massive coral, brought ashore by the fishermen for industrial purpose in this area possesses one or two burrows of bivalves, a clear indication of the damages done to corals.

EFFECT OF SEDIMENTATION

The deleterious effects of silting on the growth of corals is well known, though it is not impossible for many coral species to thrive in turbid waters (Marshall and Orr, 1931; Pillai, 1971 *b*). The present author has fully discussed the adverse impact of silting on the Palk Bay reef. During the northeast monsoon the wind agitated waves stir up shore sand that makes the lagoon water muddy in Palk Bay. This has influenced the zonation of corals in this reef to a great extent. Coral genera such as, *Favia, Favites, Goniastrea, Platygyra* and *Symphyllia* with large polyps, capable of removing sand particles deposited on them, thrive well on the shoreward side of Palk Bay reef where the deleterious effects of silting is of considerable magnitude. Small polyped corals such as *Acropora* and *Moutipora* that require clear water are more common on the deeper outer side of the reef where the effect of silting is less than on the lagoon and shoreward sides of the reef (Pillai, 1971 *b*). Several corals die yearly during northeast monsoon period as evidenced bý the freshly killed corals found on the reef soon after the calm conditions are set in the Bay, after the northeast monsoon. Pillai (1971 *a*) has already recorded an instance of large scale mortality of corals in Gulf of Mannar due to silting.

MORTALITY OF CORALS DUE TO CYCLONE

In an earlier communication Pillai (1971) has briefly discussed the mechanical damage to corals done by the December, 1964 cyclone. It was observed that the branching corals were subjected to considerable damage due to mechanical force of high waves during cyclone. The foliaceous corals such as *Echinopora lamellosa* and *Montipora foliosa* along with alcyonarians, were also killed in large numbers. Some of the post-cyclonic changes on the growth of corals in Palk Bay are dealt with later in this paper.

SEA LEVEL CHANGES AND MORTALITY OF CORALS

Extreme daily or seasonal low tides may expose intertidal coral colonies resulting in their death. In several cases it was observed that the central top portion of massive colonies is dead while their peripheral parts continue to grow. Many of the micro-atolls throughout the Indo-Pacific might have been formed by the death of the central part of coral thickets and their subsequent erosion. Recently Stoddart (1969, p. 452) has reported cases of dead coral colonies in Solomon Islands, which he thinks is due to seasonal changes in sea level, permitting rapid growth of corals during part of the year when sea level rises, followed by their death when the water level falls. The present author recored extensive areas of dead *Acropora formosa* at Thonithurai in Palk Bay

at very low tides in August 1964. It might be possible, these colonies were filled during an extreme low tide, as no other reason could be attributed to their death at that time. Sea level changes due to local disturbances or of eustatic disturbances have caused the emergence of coral reefs above the sea level as evidenced by the raised reefs throughout the tropics. The geologists as well as the biologists agree that Ceylon was part of the mainland of India till the Miocene Epoch and had intermittant conncetion till Holocene (Recent Epoch) (Wadia, 1953; Silas, 1965). The raised coral reefs are reliable indicators of relative sea level changes. There exist outcrops of raised reefs in the Ramanathapuram District, mostly along the Palk Bay shore. Some of these reefs were already described by Foote (1889) Sewell (1935) and recently by Stoddart and Pillai (1972). Sewell (1935) suggested a relative change in the levels of sea and land in this area to the extent of 2.44 m. There existed a well preserved elevated reef at Manacadu Point near the Mandapam Railway Station till December, 1964. It was composed of mostly large faviids and *Porites* and was situated nearly a metre above the present sea level (Pillai, 1967, unpub.). The mechanical force of the high waves formed during the 1964 December cyclone has smashed and washed away most of the coral colonies and what is left out today is only their basal portions. An outcrop of raised reef, in a well preserved condition at Pamban in Rameswaram Island is having an elevation of nearly 1.5 metres from the present sea level (Stoddart and Pillai, 1972).

A Holocene highstand of the sea is thought as an explanation to the formation of raised reefs (Fairbridge, 1961). Stoddart (1971) has reviewed the problem of sea level changes and the formation of sand cays in the light of available data on the radiometric ages of raised reefs. He has shown that many of the available data really indicate ages older than that of Daly's Holocene highstand. Further, the radiometrically determined ages of the various raised reefs throughout the Indo-Pacific of more or less the same elevation give no clear indication of a Holocene transgression or Holocene sealevel stability (Stoddart and Pillai, 1972).

A sample of *Porites* from the raised reef of Pamban showed an age of 4020+160 B. P. (Stoddart and Pillai, 1972) while another sample from Ceylon from an elevation of 0.9 m. is of the age 2990+220 B. P. (Hubbs *et. al.*, after Stoddart and Pillai, 1972). In view of the notable age differences of the raised reefs within the Central and Western Indian Oceans, Stoddart and Pillai (1972) suggested that the raised reefs of South India are the result of local disturbances that brought out relative changes in the levels of sea and land nearly 4000 years B. P. Change in sea level has brought out emergence of raised reefs and the death of corals in South India.

MAN-INDUCED CHANGES ON CORAL REEFS

Among the biological, physical and artifical factors that are recognised herein as adversely affecting the growth of corals, the human interference is of utmost importance. Mahadevan and Nayar (1972) and Pillai (1973) have voiced their concern on this problem while pleading for a rational exploitation of the coral resources of our waters. Corals are used as a source of calcium carbonate as also building blocks and rubble for construction of roads (Walker, 1962; Krishnamoorthi, 1969, Kasiviswanathan, 1969; Mahadevan and Nayar, 1972). In South India, corals are used in large scale as a raw material by the calcium carbide industry. The low phospherous content of the coral skeleton makes it an ideal raw material for this industry. The local Government, it appears, have leased out extensive areas of reef to this industry and large scale quarrying was in progress for the last one or more decades. Though no precise data are available on the quantity of corals quarried annually, some reasonable assessment is provided by both Mahadevan and Nayar (1972) and Pillai (1973). Pillai (1973) observed that during 1964–67 period at least 250 cubic metres of corals were removed daily from the reef of Palk Bay in fair seasons. Mahadevan and Nayar (1972) estimated the exploitation of corals to the tune of 60,000 cubic meters (about 25,000 metric tons) per annum from Palk Bay and Gulf of Mannar together. A recent survey by the author in January 1974, at Vedalai — a small fishing village near Mandapam — shows that at least 20 large country boats are engaged in coral quarrying from the islands of Gulf of Mannar. Each boat is manned by four or five, and bring ashore an average of 6 cubic meters of corals per boat per day. Since the fringing reefs of the landward sides are mostly exhaused, current operations are centred at the windward sides of the islands. Not all the 20 boats are working every day, but on an average 10 boats are landed. A rough estimate will show that, monthly, at least 1200 cubic metres of corals are brought ashore. The three small islands opposite to Vedalai–viz. New Island, Manauli Island and Hare Island, were subjected to quarrying since 1969. The author's very frequent visists to these reefs from 1964 to 1969 and again 1973 to 1974 after a gap of nearly four years enable him to trace some of the changes he noticed on these islands due to intensive quarrying of corals.

Since 1967 or early 1968 the reef of Palk Bay is not quarried due to the fact that almost all the limestone deposits and massive living corals were removed prior to this period. To–day, the reef is composed of mostly non-calcareous boulder rocks with intermittant sandy areas. Both massive and ramose corals grow on this boulders. Pillai (1971 *b*) has given details of distribution of corals on this reef and the coral fauna. Before quarrying operations were started on the reefs of Gulf of Mannar the author observed in 1965 that these island reefs displayed a luxuriant growth of massive, foliaceous and ramose corals with their associated animal communities. In Manauli Island, New Island and Hare Island the shoreward side of the reefs were composed of large colonies of *Favites abdita, Favia pallida, Platygyra lamellina, Goniastrea* spp. *Symphyllia recta, Porites* spp. and the ramose forms like *Montipora digitata, M. divaricata* and *Pocillopora damicornis*. Most of the colonies ranged from 40 to 60 cm. in spread and a few colonies of *Porites* were upto 2 metres in diameter. Towards the outer side of the reefs large platforms (2 to 3 metres in diameter) of *Echinopora lamellosa* and *Montipora foliosa* were present. Many of them provided substratum to other corals. The seaward side of the reefs harboured extensive thickets of *Acropora surculosa, A. humilis* and

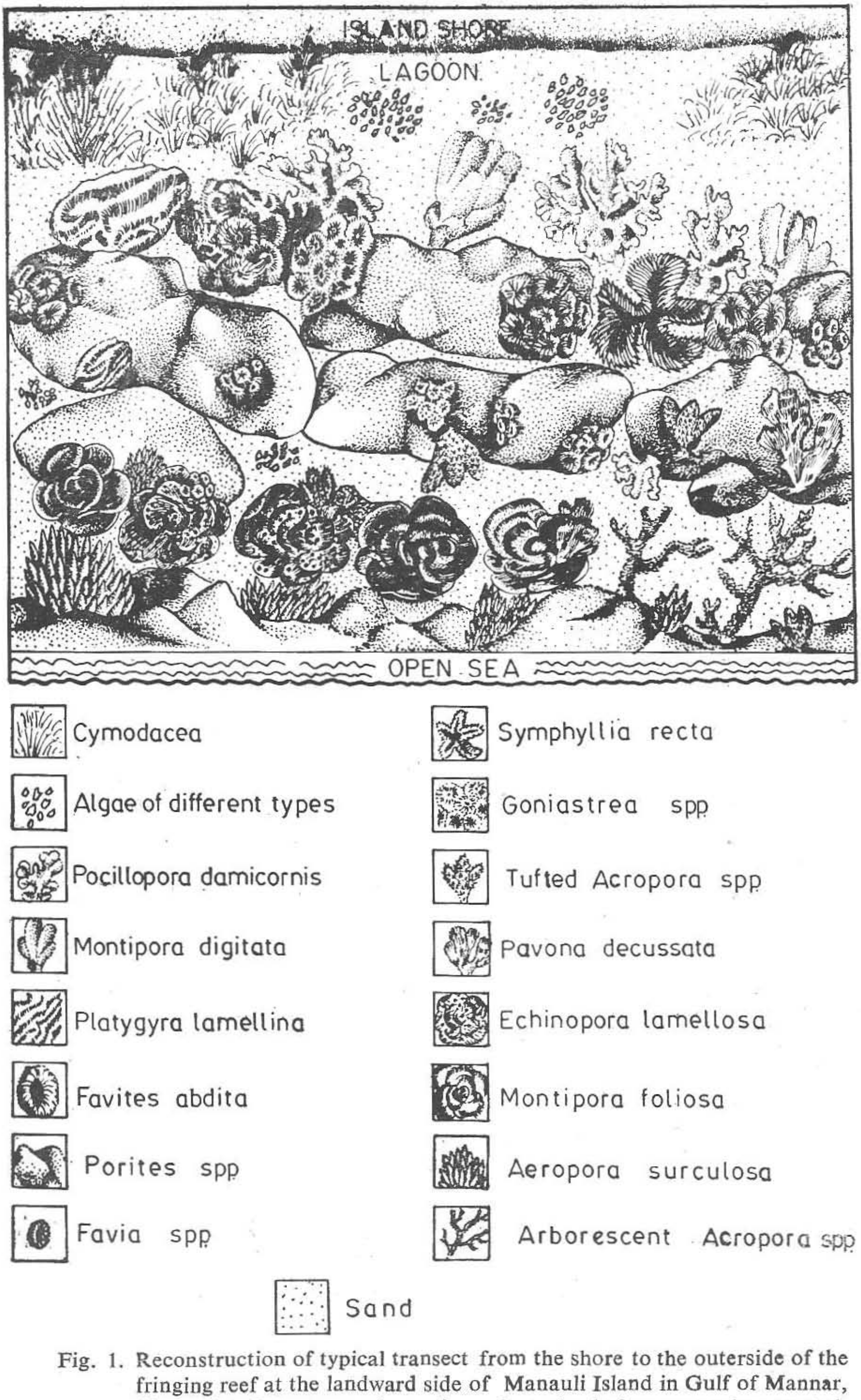

Fig. 1. Reconstruction of typical transect from the shore to the outerside of the fringing reef at the landward side of Manauli Island in Gulf of Mannar, illustrating the pattern of zonation of corals, before quarrying started. Based on author's observation during 1964. (Not drawn to scale).

A. nobilis (Figure 1). As per visual estimate 60–70 per cent of the reef appeared to be covered by living corals. (For a list of corals from these islands reference may be made to Pillai, 1972). The short-stemmed *Acropora* such as *A. humilis* and *A. erythraea* and *Pocillopora damicornis* were found on almost all parts of the reef. Needless to say, these reefs supported a rich and varied reef associated animal community including many fishes.

In January, 1974 when the author revisited some of his earlier collecting places, after a lapse of nearly four years, it was found that the frining reefs were almost totally removed. In these islands anything like a reef is not in existence now, nor one can collect several of the species that flourished there. The area that once supported the reefs is now covered over by sand with loose lying, occasional colonies of *Acropora* or foliaceous corals that were thrown out by workers. *Porites* and faviids are rare. On the sandy areas, the sea grass – *Cymodocea* and algae such as *Sargassum, Hypnea, Gelidiella* and *Gracilaria* have started growing (Fig. 2). The edible sea weeds themselves are being collected in large quantities by the local people. It may also be pointed that the removal of the reefs has allowed a high degree of wave action on the shores on Manauli Island leading to visible signs of erosion.

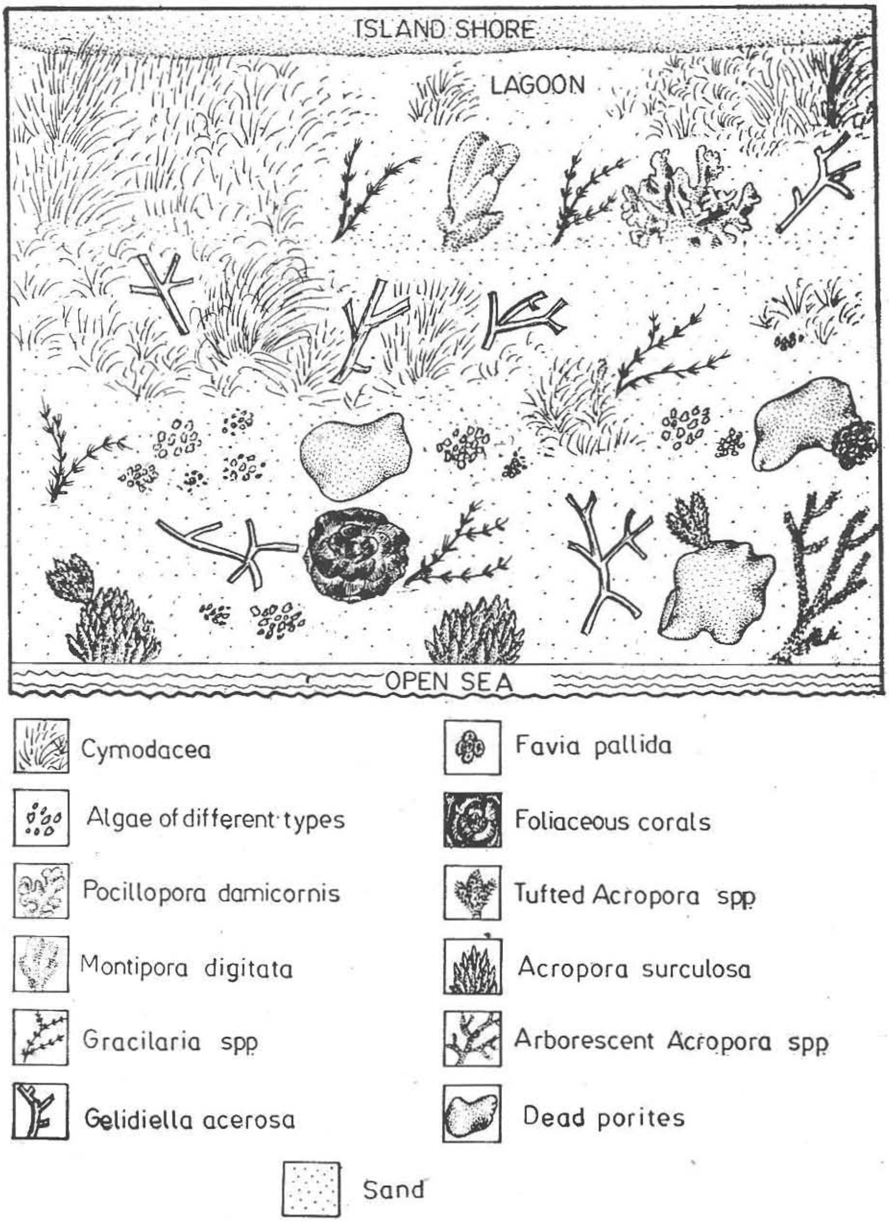

Fig. 2. Representation of the condition of the same transect in Figure 1 as seen in January, 1974, after intensive quarrying for a period of nearly 10 years.

PROSPECTS OF RECOLONISATION AND RECOVERY OF REEFS

Palk Bay:

It is worth comparing the conditions of the reef of Palk Bay along Mandapam Penisula of 1965 with that of the present. There is marked improvement in the number and size of coral colonies on this reef during the last 7 or 8 years. *Acropora corymbosa* has become the most dominant element on the reef, though the zonation pattern of corals on this reef already described by Pillai (1971*b*) remains unaltered. On the shoreward side *Favia pallida* shows notable improvement both in number of colonies and size. The presence of very young colonies clearly indicate planular settlement and colony formation of many species of corals. At the outer side of the reef. *Acropora corymbosa* covers almost 25 to 30% of the reef surface. The frequency of occurrence of all the species on this reef has certainly increased, though I have not resurveyed by transect of 1965 (Pillai, 1971 b) for a numerical assessment. However, the present survey did not reveal any additional faunal element other than already listed by Pillai (1971 b). The slow growing *Porites* is still rare, almost every large colony having been removed during quarrying. *Pocillopora damicornis* and *Montipora divaricata*, both very common at certain sites on the reef during early sixties have some how dwindled. A large number of colonies of alcyonarians were killed during the 1964 cyclone and they have not yet started reappearing on the reef. The rejuvenation of the reef has considerably favoured the coral associated fishes and many of them are very common at present supporting a small fishery during the calm seasons. The gear used is trap. The major components of the catch are *Siganus java, Callyodon gibbon, Upeneus vittatus* and *Lethrinus frenatus*. Lal Mohan (un pub) estimated the catch to the tune of 1500 Kg. per month from a stretch of nearly 1.5 Km. length of the reef.

In a recent review Endean (1972) has summarised the necessary conditions for recolonisation of reef corals after large scale mortality. Availability of planulae and hard substratum for their settlement are *sine qua non*. The ecological conditions should remain favourable. It will be interesting to evaluate the existing ecological conditions of the reefs of southeast coast of India and their influence in the maintenance and growth of reef. Recolonisation of corals in Palk Bay was possible within a decade because of the presence of non calcareous hard substratum left out during quarrying, on which planulae could settle. The destruction of corals was not total, a few colonies left out, produced planulae. The post-cyclonic period did not bring any marked change such as deposition of mud or other debris capable of preventing planular settlement. The deleterious effect of silt on the coral growth of southeast India was discussed by Pillai (1971b) and Mergner and Scheer (1974). Pillai observed that during northeast monsoon, when turbulent conditions prevail, the corals of Palk Bay show retardation of growth due to interference of silt stirred by wind agitated waves. Logically, lesser the wind speed, lesser the wave action and silting. To examine whether there is any correlation between the faster growth of corals and speed of the wind, the speed of the wind during the month of January 1962 to '73 was analysed during which period a comparatively active growth of corals was seen, especially from 1968. The average speed of the wind at 17.30 hrs. during January 1962 to January 1973

(Figure. 3) shows no marked variation and 1972 registered the lowest. However, there cannot be any direct relationship between the average wind speed and degree of silting due to wave action; since a very high wind even of a short duration may agitate the near shore water which will stirr up large quantity of beach sand which will get suspended in the lagoon and shore wards side of the reef. But the number of days in January 1962 to '73 with the speed of wind at 17.30 hrs. registering 8 or more knots (Figure. 4) shows some notable variations. During 1962 to '68 such days showed a gradual increase when corals of Mandapam did not show any visible active growth. Further post mansoon period revealed a large number of freshly killed corals. However, from 1969 to '73 the number of days in January with 8 or more knots of wind gradually diminished correlated with a very active visible growth of all species of corals.

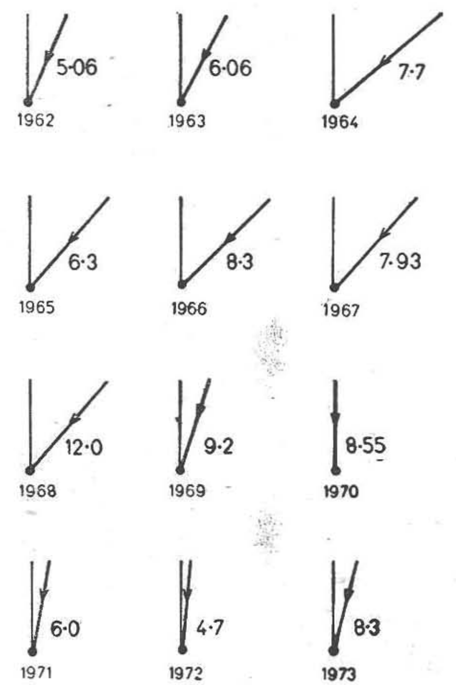

Fig. 3. Average speed and direction of wind during January, 1962 to 1973 at Pamban at 17.30 hrs. The figures indicate the arithmetic monthly mean speed and the arrow the direction. Data from the Daily Weather Report, Poona.

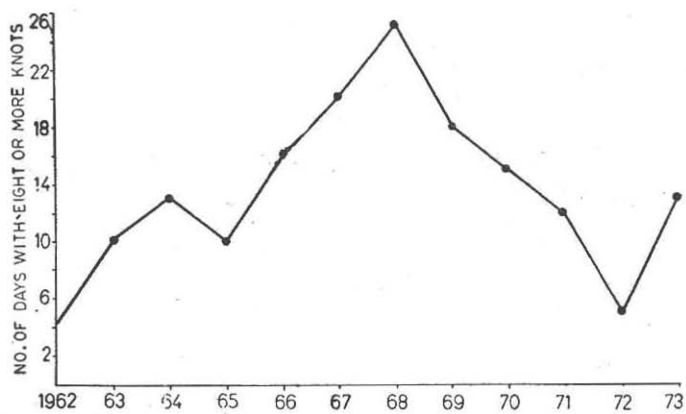

Fig. 4. Number of days in January 1962 to 1973 with speed of the wind registering more than 8 knots at 17.30 hrs. Source of data as in Figure 3.

Gulf of Mannar :

From the above discussion it is apparent that the conditions in Palk Bay at present are very favourable for the recolonisation of reef corals after large scale mortality in early nineteen sixties. On the contrary, the existing ecological conditions in Gulf of Mannar seems to be unfavourable for planular settlement and colony formation. The reefs of Gulf of Mannar islands hardly had any non-calcareous boulders, the reef frame-work was of *Porites* and other massive corals. This resulted in almost total removal of hard substratum from the reef leaving sandy bottom. More and more sand was deposited at the former sites of reefs by waves. Sea-grass and several other algae gradually started growth on this sandy bottom starting a new ecological succession. The presence of sand and growth of vegetation coupled with the lack of hard substratum will totally prevent the settlement of planulae. Further, few living colonies are left on the former sites of reefs and what is left is also dying out due to movement of sand and silting due to unchecked wave from the open sea. The waves are stirring up large quantities of sand from the shores of the islands and making the near shore water muddy and unsuitable for coral growth. Probably, no more growth of corals will take place in forseeable future along the shores of these islands where destruction to reefs is total.

TIME REQUIREMENT FOR THE RECOVERY OF DEVASTATED REEFS

The present observations on the reefs of Palk Bay are of some value in assessing the time requirement of a coral community to re-establish on a reef after large scale mortality. Stoddart (1965) observed that, after three years of a hurricane, on British Honduras, the only corals present were those that survived the storm itself. The repairs to damage was local in many places even after seven years; where there was total destruction, repair was practically nil, while where damage was minor, repair was rapid (Stoddart, 1969). Based on a resurvey of the cyclone affected British Honduras reefs Stoddart (1974) stated that it is impossible to forecast the period of reef-recovery. According to him, the earlier estimate of 10 to 20 years (Stephenson, Endean and Bennett, 1958 in Low Isles) are too low and the period could be closer to a century.

As pointed out earlier, the ramose corals of Palk Bay showed considerable improvement in number of colonies and their individual size within 10 years of large scale death. This shows that significant improvement will occur on our reefs, if conditions for planular settlement and growth remains favourable, within a period of 20 to 25 years similar to Australian reefs studied by *Stephenson and et al* (1958). It seemsthat the Indo-Pacific reefs have a faster rate of growth than the West Indian reefs studied by Stoddart. However, it is impossible to predict the time requirements for the formation of consolidated reef which may involve scores of years or even centuries. In our own waters where destruction of reefs due to quarrying for industrial purposes, is total, recovery and formation of a reef is only a wishful thinking.

CONSERVE REEF TO SAVE THEM

In an earlier communication the present author (Pillai, 1953) pointed out the necessity of imposing strict measures of conservation as well as legitimate quarrying to save our reefs from total destruction. The author's 1974 survey of the island reefs undoubtedly indicates that if exploitation is continued at the present rate, in another 10 years we will not be having anything to speak of corals and coral reefs in our shores. Once the reefs are destroyed to a state now seen in Manauli, New Island and Hare Island, there seems to be absolutely no chance of their recovery. Along with the reefs, their associated, fishes and other marine animals are also destroyed which will upset the ecological balance. It is a case, where scientists, administrators, the industry that utilises the corals and every one interested in our marine life, should collectively pay their attention.

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