# Ecological study and classification of the coral reef on the low Andaman Sea: Influence of the sediments, depth and reef status on the substrate cover and species abundance.

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## Abstract: Aims and objectives

The main purpose of this study is to get a general overview of the coral reefs health in the low Andaman Sea area and to demonstrate how the sediments and depth influence the reefs.

Other reports studying coral reef health have been done in the Andaman Sea but none in this particular area. A complete classification of the coral reef has been done by analyzing the percentage substrate cover, abundance of indicator species, damage of the reef and opinion of the coral reef health based on visual observations.

It is proven that sedimentation has an influence on the coral reef health, however there are no previous studies in this specific area to demonstrate it. In this study the sedimentation problem is analyzed in depth and potential ideas are presented to help resolve the problem.

The results have shown that the sediments have a negative influence on the general health of the reef, this is studied by the status of the reefs, defined by the relation between Live hard coral: Dead hard coral. More abundance of species are present around the reefs in locations where the sediments are considered to be lower. This study indicates that the depth does not have a significant influence on the relation of live to death nor the abundance of species.

## Study Area

The studied area was located in the Low Andaman Sea in two different locations, the Local Island near Ao Nang and the PhiPhi Island national park, Krabi Thailand.

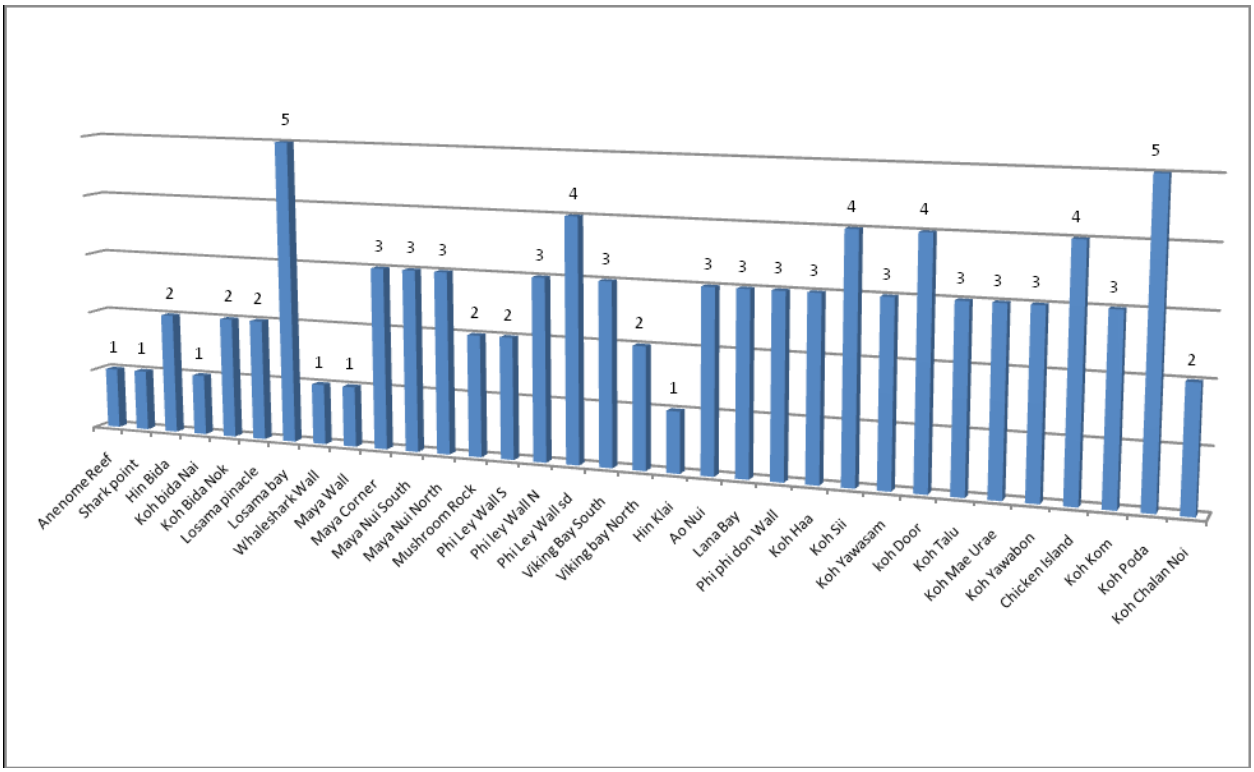
## Survey methodology

The surveys have been conducted using a roving technique which means the data have been collected while diving following a determinate depth between two predefined points and covering a wide distance between 2 and 5 meters, depending on the visibility.

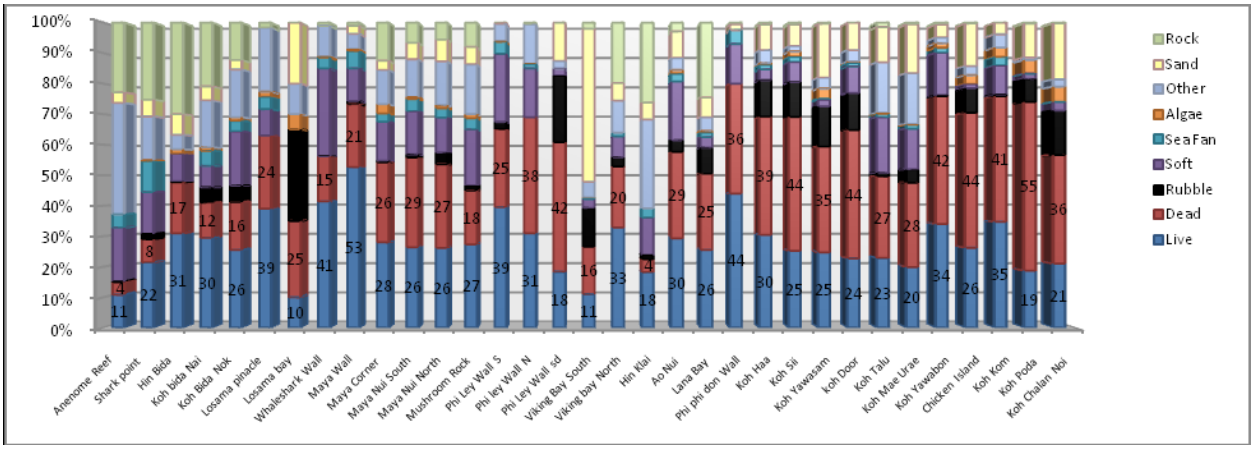
The area survey follows all the perimeter of the islands while collecting samples which represents the indicator species population, coral cover and potential threats. A total area of 296186.1 m2 have been surveyed in two different depths, the deep survey at its maximum depth of each dive site and the shallow survey between 4-6m meters.

## Results

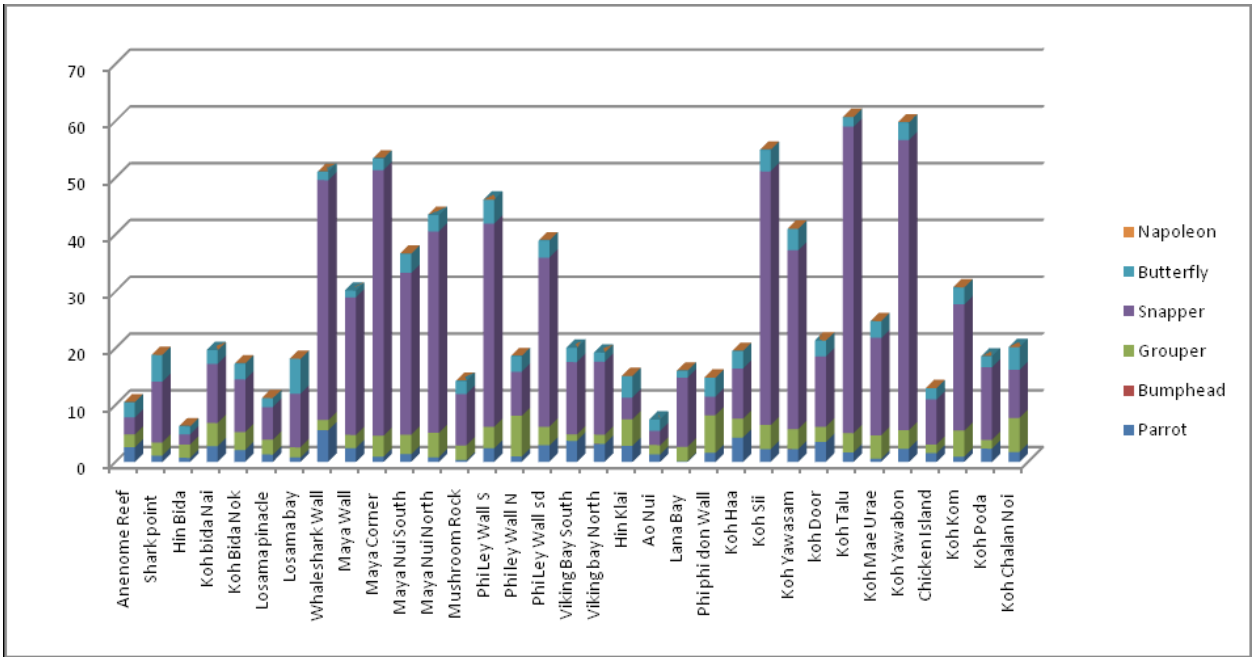
Reef Health Rating / Dive Site



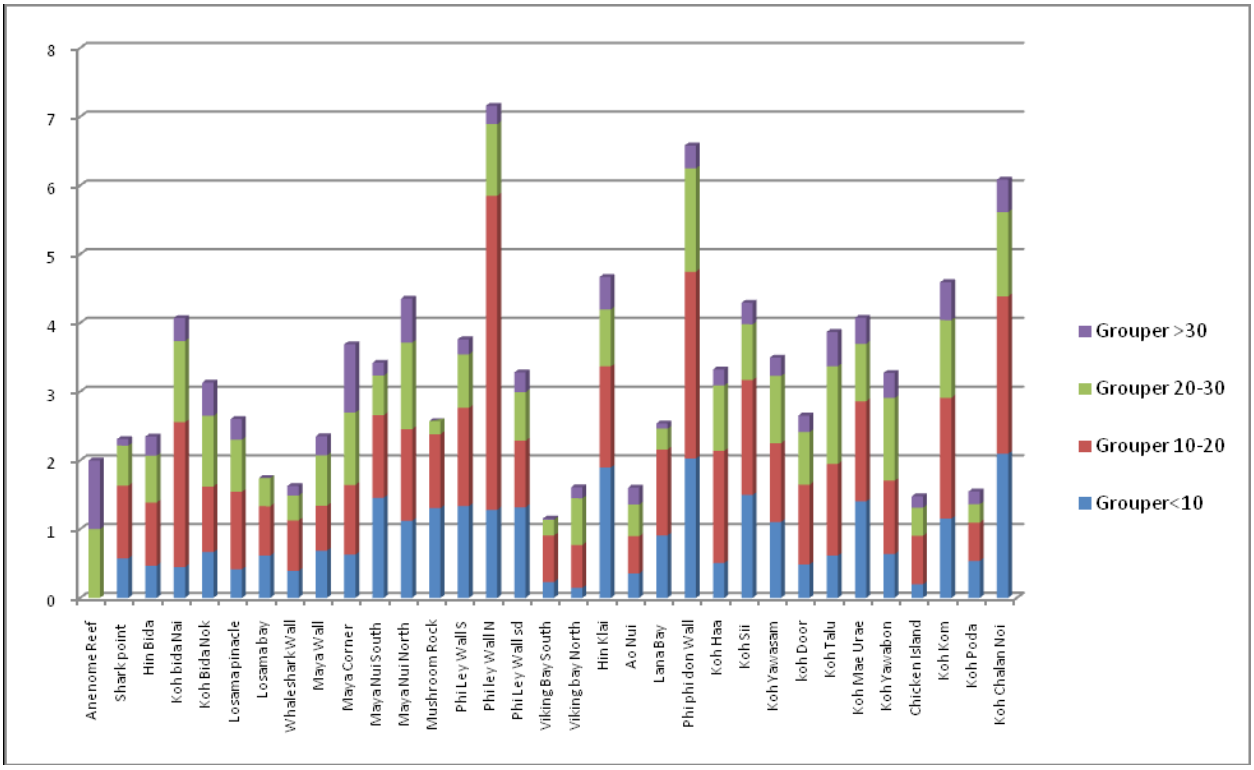
Reef Composition / Dive Site



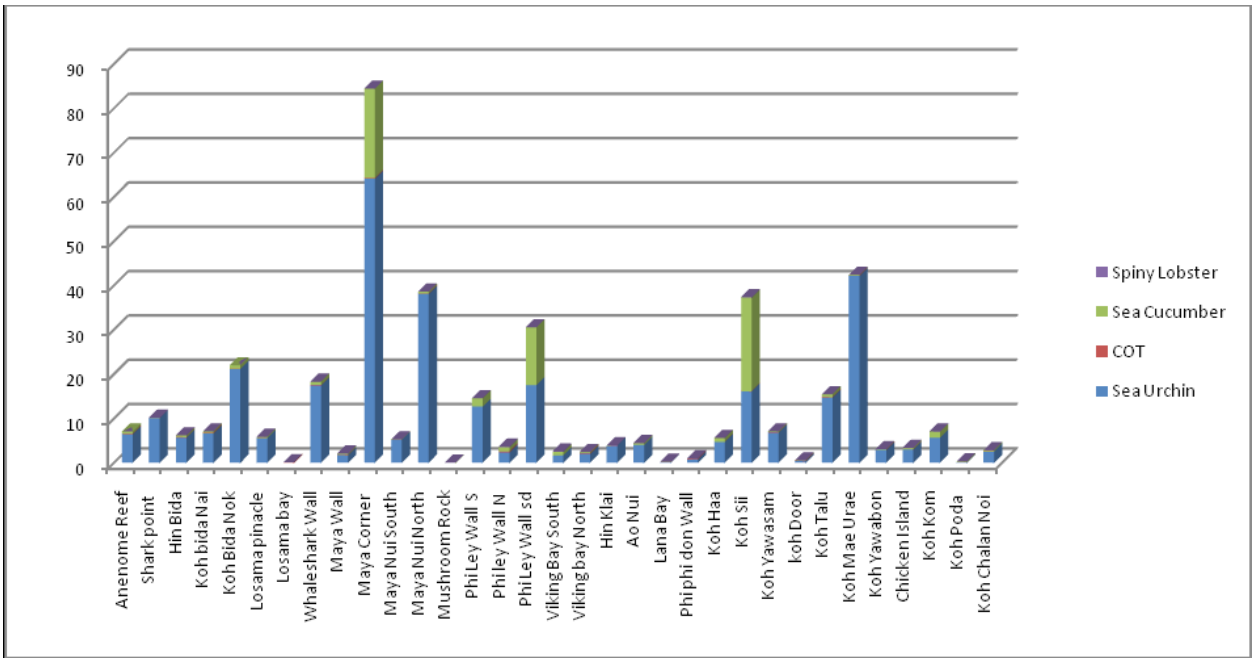

Fish Abundance / Dive Site



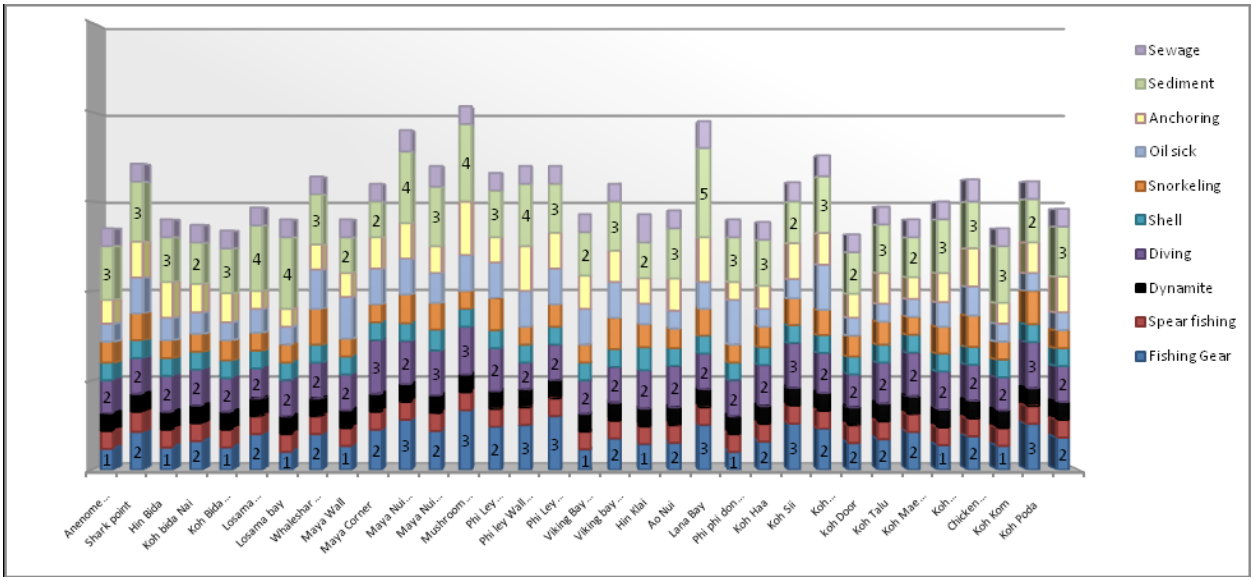
Grouper Population Size Distribution / Dive Site



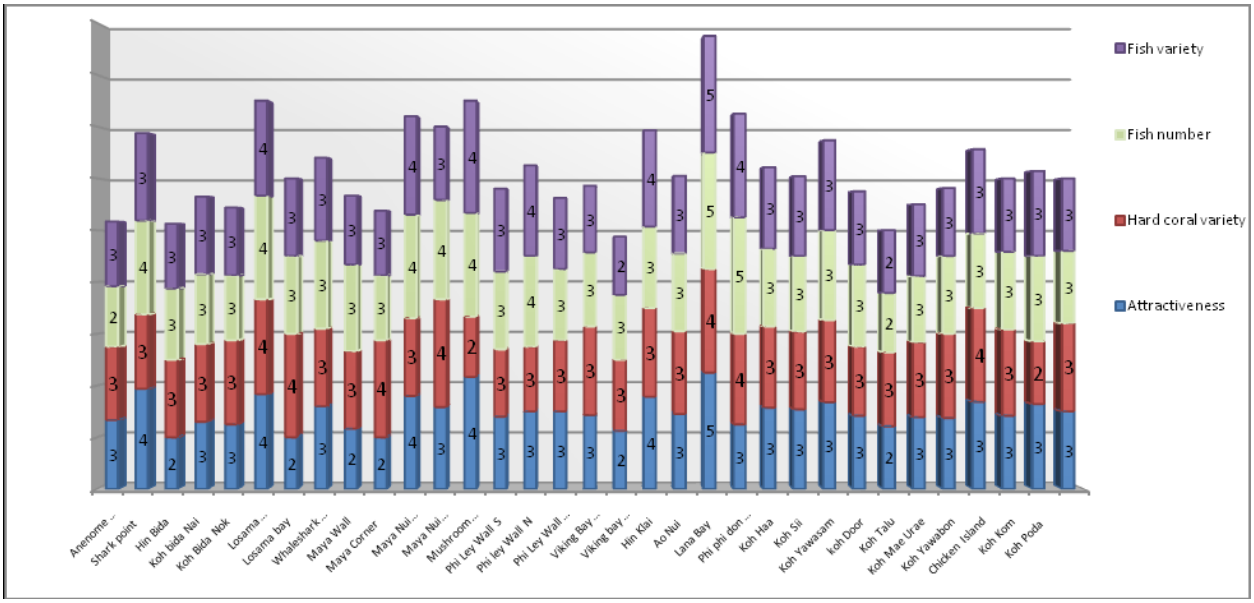

Invertebrates Abundance / Dive Site



Reef Damage / Dive Site




Sedimentation and Reef Status




Sedimentation influences the relation Live/Dead hard coral. More sediment generates a low relation Live/Dead and higher level of dead hard coral and rubble. Otherwise soft corals, sea fan and the organism classified like other show a negative relation with the sediment. Sedimentation is one of several parameters which affect coral recruitment.(2,3,4,5). Coral larvae cannot successfully establish themselves in shifting sediments (6).

Since corals and associated zooxanthellae depend on light for rapid deposition of calcium carbonate (7), high turbidity can reduce coral growth rates(6). Growth may also decrease because of the diversion of energy to removal of sediment particles (8). Turbidity from runoff reduces the light available for photosynthesis by macroscopic turf algae and endosymbiotic zooxanthelae within the tissues of corals, anemones and other organisms, thereby affecting the overall metabolism of coral reef. Excessive sedimentation can adversely affect the structure and function of coral reef ecosystem by altering physical and biological processes (6).

GEnerally, algae are influenced positively by the sediment due to the ability to settle more efficiently on dead coral structures than living structures.

The Reef Status also influences the relation of Live/Dead percentage.

Analyzing both factors together (Reef Status and Sedimentation), shows positive correlation between better Reef Status and less sedimentation. Sedimentation is a major controlling factor in the distribution of reef organisms and in overall reef development as well(9). Sedimentation from dredging and run off constitutes one of the biggest potential sources of reef degradation (6) (10).

Sedimentation influences the abundance of fish. More sediment generates a low abundance of fish. Moreover, the death of major reef-building corals cause from sedimentation, disease or other factors, can lead to the collapse of the entire reef system(6). With a decline in the number of crevices and hiding places that the reef provides, there is a reduction in both the number of species and the number of fish in which the reef sustain (11)(12). Better Reef Status means more abundance in fish population. Coral reef supports a spectacular diversity of fish by providing food, shelter and living space. The Reef Status influences on the abundance of fish. A variety of natural (e.g. coral bleaching, COT predation) and anthropogenic (e.g. overfishing, sedimentation, pollution) disturbances are contributing to a worldwide decline in hard corals(13,14). The reduction in live coral cover associated with a variety of both anthropogenic and natural disturbances may have profound effects on the structure of coral-associated fish assemblages (15).

During the early life stages, a large portion of coral reef fish species is associated with live coral, Previous studies shows, 60 percentage of Indo-Pacific species(16), use live colonies as settlement cue, food source or shelter (13).

Nevertheless butterfly fish are more abundant with higher level of sediment and the abundance of grouper and bumphead parrot fish is not influenced by the sediment. Depending on the specialization of feeding behaviors, some species are more influenced for the sediment level and reef status. Butterflyfishes that are facultative and non-coral feeders are likely to be less affected by the decline of live coral cover (17). Obligate coralivours fish showed the highest decline in their populations when coral mortality occurred. (18).

All the invertebrates except spiny lobster show a negative correlation in relations to sedimentation as well.

Depth

Depth doesn't generally influence the relation of Live/Dead corals neither.

Nevertheless, there are some sessile organisms that are distributed by depth and its influence.

•Anemone and algae are mainly found in shallow depths due to light availability. On the other hand

soft corals and sea fans prefer deeper environment due to higher current flow.

•Dead hard coral presents higher level on the shallow areas due to higher levels of coral bleaching**.**

•Parrot fish usually inhabit on shallow depths due to the higher levels of algae, where butterfly fish follow the

same patterns**.** Grouper that are larger than 30cm inhabit mainly in the deep area of the reef due to the presence of its refuge. Spiny lobster shows higher abundance level on the shallow areas.

Since Low Andaman Islands

are exposed to higher levels of sedimentation, naturally due to the presence of estuary on the area. Sedimentation influences negatively on the Reef Status and the abundance of fish greatly in this area. Never the

less the environment usually buffers the effects of the sediment with a natural defense, such as the mangroves forests and sea

grass beds which are able to trap the sediments as water flows in and out according to tide changes. The mangroves and the sea grass work like natural filter to

prevent excessive sedimentation. Mangroves act as filters to trap fine sediments and improve water clarity, by

binding and holding sediments with their specialized root structures. Nutrients from land may

disperse offshore in relatively clearer waters suitable for coral reef development (19). About 80 percentage of

the suspended sediment brought in from the coastal waters at spring flood tide gets trapped in the mangrove

(20) These two ecosystems have been destroyed through land clearing, coastal development and other

factors, which involves higher level of sedimentation reaching the area where normally would be considered as

a healthy area for reefs.

The mangrove forests has decreased considerably in the last few years. Globally, mangrove

resources are increasingly being lost due to unsustainable utilization and habitat conversion. (21). Alterations in

land use have resulted in the severe decline of natural vegetation and a rapid increase of catchment sediments

(19). Unprecedented development along tropical shorelines is causing severe degradation of coral reef systems from

increases in sedimentation(6). The careful planning and implementation of protective measures during

constructions projects can reduce damage to marine systems (22, 23). The mangrove area in Thailand has been

decreased about 0.12 million Rai between early 2000 to 2004. The South Andaman mangrove areas has decreased in

44,040.41Rai (24). Most of the remaining mangroves (143.961ha) are under concessions designated for

charcoal production (21). The main driving force behind the decline of mangroves in Thailand has been

aquaculture, specially shrimp farming. Moreover, 64 percent of mangrove forests in Thailand were loss between 1960-1990, while costal

development (urbanization, industrial expansion, infrastructure, ports and harbors) accounted for 24

percent(25).

Many previous studies show the relation between coral reef, mangrove and sea grass ecosystems. Rehabilitation of

upstream ecosystem (mangroves) are considered the only way of restoring downstream marine ecosystems

(seagrass and coral reef) in re-establishing the amount of vegetation necessary to trap and binds sediments,

and reduce coastal water runoffs(19). Seagrass and mangrove are highly dependent not only on each other,

but also on prevailing environmental conditions in a dynamic equilibrium(19). Few fish can use mangroves forest

exclusively but must migrate in and out of the mangrove with the tide, occupying habitats when mangroves are

unavailable. These movements connect the mangroves and the alternative habitats from an interconnected

habitat mosaic (26). Connectivity of mangroves with other adjacent habitats has been observed to increase

productivity. For example, close proximity of mangroves and seagrass enhanced productivity of many marine species

(27). Sedimentation can alter the complex interactions between fish and their reef habitat. Juvenile fish species and other organisms depend on mangroves and seagrass beds for food and shelter(6). Loss of seagrass is possibly the first major indication of

offshore waters getting muddier, since seagrass is highly dependent on water clarity(19).

The wave protection is another function what the mangrove provide. By

contrast, the advantage for corals is based on consistently high levels of water clarity primarily and secondarily

on the regular supply of nutrients from terrestrial run off (19). Many other studies shows that the mangroves

have an important role in protecting coastal areas from storms and tsunami damage (27). One of the key attributes of

mangroves is the contribution to high economic value in coastal areas (27). Decline of tropical fisheries is partially attributable to deterioration of coral reefs, seagrass beds and mangroves. The productivity of coastal fisheries is directly correlated with the area of mangrove:

more mangroves means more fish (21). Juveniles and adult fish can gain benefit by

accessing rich feeding areas and/or protective habitats (28). Additionally, mangroves can be important sites for

marine species reproduction (29).

The income of the low Andaman Sea islands residents relies mainly on the tourist and fishery, for

that reason sustainable development of the area which effect mangroves and sea grass should be

improved. Management and conservation of mangroves is clearly needed in these areas (24).

Numerous economic and valuation studies have been carried out on mangrove ecosystem (21). Specifically in

Thailand, the total economic value of mangroves was in the range of 520-667 US dollar per hectare per

year (includes direct uses like timber, fuelwood, wood, animal products, offshore fisheries, coastal protection

and carbon sequestration) but does not include natural services such as biodiversity, culture and heritage(30). An integrate and holistic management of the 3 environment (coral reef, mangrove and sea grass) is absolutely necessary to improve the global health of the coral reef and the abundance of fish. There are plenty information about systems models of interactions among mangroves, coral reefs and seagrass beds (31).

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