

Identify the Degradation of Coral Reefs Areas in Jazan Region and the Suggestions Toward Sustainable Conservation

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Abstract: Coastal areas are environmentally and economically important areas supporting a many industrial installations and highly populated areas. One of these areas is Jazan region which is located in the southern part of Red Sea along the coast of Saudi Arabia. It is characterized by the diversity of natural environment e.g. coral reefs, fisheries and vegetation. It is one of the fastest developing areas in the Kingdom which is suffering by the increasing human activities such as reclamation of the coast, urbanization and fishing activities along the coast, resulting in the degradation of coastal areas and marine environment. This study was carried out in order to review and assess the current the status of coastal habitat of coral reefs and identify the degree of degradation of corals. Coral and reef fish assessments were accomplished at three sites offshore islands at Jazan region using Reef Check belt transects and video belt transects. The results showed that fishing activities inflict serious damage to the biota. High extent of bleaching have been observed near the sampling transects and might be attributed to sea surface temperature (SST). Nevertheless, coral reefs in Jazan region showed low levels of anthropogenic disturbances. Coral reef areas and fisheries management should be considered and incorporated in the management plans to reach sustainable development.

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1. Introduction

Coral reefs provide food and income for hundreds of millions of people all over the world, and the damage to these ecosystems will have an indescribable impact, with serious indications already visible (Cesar et al. 2003). The high biodiversity of coral reefs can be attributed to various invertebrate groups, most of which receive little attention in coral reef research (Sawall et al. 2014). In recent decades, 33-50% of coral reefs have been largely or completely deteriorated by a combination of local interventions and global climate change. About half of the live corals have been destroyed in many countries. As the temperature continue to rise, more extensive degradation will inevitably occur over the next two decades (ISRS 2015). According to Stella et al. 2012,

Over half of all coral-associated invertebrates appear to have an obligate dependence on live corals, and this reliance is of great concern in light of severe and ongoing degradation of coral reef habitats. The most important reason for the degradation of corals in Kingdom Saudi Arabia is due to developmental activities (PERSGA 2010). Jazan region suffers from increasing human activities such as reclamation of the coast, urbanization and fishing activities along the coast, causing degradation of coastal areas and marine environment. Moreover, increasing concentrations of nutrients in the sea water are largely linked to discharge of sewage from the treatment plant and port

activities that have a negative impact on the marine environment. We have to evaluate the major threats to reefs to understand its impacting biodiversity and which plays the greatest role (Wilkinson and Buddemeier 1994).

Therefore, it is important to assess the functional components of coral reef communities (corals, fishes, and non-coral benthic invertebrates) along with coral species diversity in order to evaluate the flexibility of ecosystem services to disturbances and stress. Such an assessment along the southern Red Sea with high temperature and nutrients in put is necessary to investigate different scenarios in the future. (IPCC 2007; Knowlton 2001). Thus, the functional assessment of coral reef, in the southern part of Red Sea, may help to interpret the ecological impact of anthropogenic and climate change issues related to Red Sea (Sawall et al. 2014).

A recent investigation on coral communities indicated an increase in community homogenization within the last two decades throughout the Red Sea. This was an alarm related to environmental changes such as global warming (Riegl et al. 2012), which affects some species more than others (De Vantier 2000a), leading to a destruction of some species and a spread of other species (Riegl et al. 2012).

The purpose of this paper is to (1) assess the status of coral reef habitats in Jazan region, (2) identify the main impacts on coral reef degradation

and (3) suggestions for sustainable coral reefs development.

2. Material and Methods

The study area is located between 16° 60' 00 N, 17° 10' 00 N and 41° 75' 00 E, 42° 75' 00 E in the southern Red Sea, including Farasan, Thairan and Amnah. Surveys on coastal and offshore islands were conducted during autumn 2015. Coastline surveys were achieved by vehicle to assess the degradations and the impacts of human activities. On the other hand, three offshore Islands at Jazan region (Farasan, Thairan and Amnah Islands) were selected to do the surveys using SCUBA diving and snorkels. One site (Thairan Island) selected was around 12 km off Jazan Economic city, whereas other site (Amnah Island) is in the south in 13 km off Jazan Port. The last site at Farasan Island is a protected area and characterized by famous traditional fishing and the most important centers of the diving in Saudi Arabia (Location – Fig.1). Coral reef at Farasan, Thairan and Amanh Islands are mostly fringing reefs found mostly in very shallow water.

Data were obtained using the line-intercept transect with combination with quadrat methods according to Global Coral Reef Monitoring Network (GCRMN 2008) and (English et al. 1997 and Wilkinson 2000). Using field investigations, a control site Farasan Island with two off shore islands Amanh and Thairan (Figure 1). At each reef, three replicate transects were laid at each of three depths: the reef

crest at 2 m, 6 m, and 10 m, for a total of 18 transects per reef. All selected sites were opposite to the exposed seaward side or perpendicular to a shallow slope. The data used for the analysis were pooled from three replicate sites in each island.

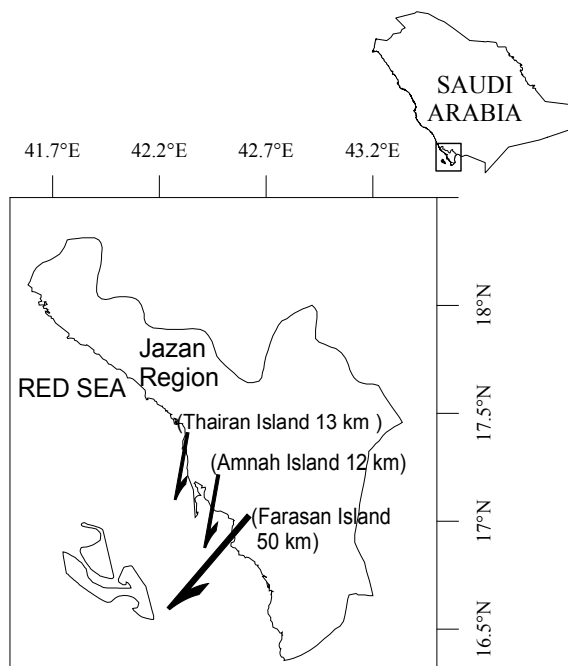


Figure 1. Study area at Farasan, Thairan and Amnah Islands

Table 1. The coordinates of sampling sites on Farasan, Thairan and Amnah Islands

Islands (code)	Sites & Transect codes		
Farasan (D)	D-T1: 42.033122° E, 16.506509° N	D-T2: 42.036772° E, 16.565535° N	D-T3: 42.080877° E, 16.559009° N
Depth	3, 10 m	2, 8 m	3, 11 m
Thairan (K)	K-T1: 42.216375° E, 17.174208° N	K-T2: 42.189715° E, 17.185815° N	K-T3: 42.194900° E, 17.171998° N
Depth	3, 6 m	3, 9 m	2, 8 m
Amnah (A)	A-T1: 42.468667° E, 16.783948° N	A-T2: 42.432855° E, 16.793461° N	A-T3: 42.448794° E, 16.764066° N
Depth	2, 6 m	2, 7 m	2, 9 m

E = Longitude East; N = Latitude North, T= Transect

3. Results and Discussions

Assessment of the status of coral reef habitats in Jazan region

It was found that the three offshore islands suffered varying degrees of physical damage due to unscientific anchoring and needed proper management. However, SCUBA diving recorded that

marine ecotourism in the present scale inflicted no serious damage to the coral beds. Some transect sites were observed to have undergone severe physical damage. The most obvious difference between the control site Farasan Island and the two island sites Amanh and Thairan (at both 3 m and 8 m depths) was the consistently high percentage hard coral cover

(especially *Acropora*) and low percentage cover of soft corals among all transects. On the other hand, significantly low species diversity found at Thairan and Amanah Islands compared to Farasan Island. Total algae percentages were also consistently higher at two island sites Amanah and Thairan compared to the control site Farasan Island.

Dominance branching and tabular species (mainly *Acropora*) were observed in all sites compared to heavier species (e.g. *Goniastrea*, *Favia*, *Porites*, *Favites*) due to the faster growth of branching rather than bulky species. Bleaching was observed in all coral assemblage during survey with higher degree in *Acropora* and slower in bulky species like *Porites*, *Goniastrea*, *Favites* and *Favial*.

Coral communities in Jazan region are facing increasing local threats (expanding fisheries and infrastructures development) along with global threats like climate change. Generally, degradation of coral reefs in the Jazan region has several reasons.

Impacts on coral reef degradation

Dredging and reclamation over fringing reefs is a consequence of the fast growing coastal development activity in coastal Jazan region, which is leading to degradation of coral reefs habitats, as a result of increased sedimentations and raised temperature in lagoon due to reduced flushing.

Discharge poorly treated sewage to the sea increased nutrients and heavy metals. Only about 60% of buildings connected to mains sewage in Jazan city, whereas the rest is disposal into the sea. In addition, fertilizers and pesticides that come from agricultural sources have an impact on the marine environment.

Fishing pressure is higher in southern part compared to other regions in the Saudi Arabian waters of the Red Sea and Farasan Island. However, shallower reefs are affected more than those in deeper part by traditional fishing areas. Fishing activities have great impact on coral degradation e.g. anchoring, throw nets and the very drastic effects of overfishing including Decapoda collection using traps. Fishing around coral reefs cause damage to coral habitats, which will lead to decrease in coral cover, increase bare substratum and shift fish dominance away from area. Gill nets and fishing trapping were noticed during survey even in marine protected area (Farasan Island).

Riegl et al. 2012, in their study on coral communities revealed that “decimation of some species and a spread of other species related to environmental changes such as ocean warming.” The rise of sea surface temperatures, have been implicated in chronic stress and disease epidemics, as well as in the occurrence of mass coral bleaching episodes (Buddemeier et al. 2004). Widespread degradation of coral reef communities are reported due to stress

induced coral bleaching. Reports of increasing coral bleaching prevalence globally reveals that it have become an important factor contributing to the degradation of coral reefs. Rise in seawater temperature have shown to affect coral-associated bacterial communities, shifting them towards pathogenic species (Sawall et al. 2014).

Coral reefs bleaching in Jazan region were observed in all sites. During the surveys all coral assemblages with high in *Acropora* group and slow in bulky species were notable. Seawater surface temperature was recorded 33 °C while the satellites from NOAA showed elevated SST in the south of the Red Sea autumn 2015. However, some fish mortality was observed at Farasan Island may be due to algae bloom. Bloom of *Noctiluca miliaris* (a dinoflagellate) was recorded in Farasan Island. Mortality of six species were recorded during Algae blooms in Farasan Island (*Sardine* (*Sardinella* sp), *Grouper* (*Epinepheus summana*), *Pomacentridae* (*Abududuf saxatilis*), *Parrot fish* (*Scarus* sp.) and *Dolphin* (*Tursiops truncatus*). Fish mortality could also result from algae blooms of the other (nontoxic) species by the development of low oxygen conditions or gill clogging and damage due to mucus secretion and asphyxiation (Claereboudt et al. 2001).

Algae blooms with associated fish mortality, high sea surface temperature and bleaching events were recorded. Crown-of-thorns starfish was recorded during the survey. Predation by crown-of-thorns starfish may upset proportional abundance of coral reefs specially *Acropora* spp.

Towards Sustainable Development

Farasan Island was declared as marine protected area in 1980s, and it as lead to the creation of awareness of the need of protecting the coral island. However, the conservation of coral reefs is not seriously implemented. Destruction of coral reef ecosystem through anthropogenic activities will depend upon people's awareness, involvement and implementation of necessary actions. Coral degradation is caused by inadequate environmental planning guidelines for coastal development; lack of enforcement of regulations and accomplishment of optimal exploitation of marine resources (Gladstone et al. 1999).

Fish diversity is the highest in the southern part than in the northern of Red Sea. The fisheries at Jazan region is mainly traditional than commercial. The small scale fisheries around Farasan Island were previously considered to be sustainably managed through traditional community based practices. The local fisheries in Jazan region were sustainable with only a few target species such as King fish, shrimps and lobsters being overexploited. To reach sustainable development, we should review and update the current

situation and management and thereby ease access to existing information, facilitating follow-on studies and conserve and fisheries management. The traditional fishery in Farasan Island comprises mostly of line fishing around coral reefs and about half the fishing effort occurs within the proposed marine protected area (MPA). Last decade, the improvement in the catch of the artisanal fishery was increased because of increased demand for fish, resulting in the deterioration and destruction of habitats (Gladstone, 2002).

Level of enforcement is very low and many developments linked illegally to shore. The coastal zone management needs more effective enforcement of environmental laws and regulations e.g. (1) no damaging development shall be allowed in protected areas except visitor center's etc, (2) upgrade the wastewater treatment plant to minimize the discharge to sea, (3) reduce the dumping, dredging, reclamation over fringing reefs and encroachment on beach shall not be permitted.

Conclusions and Recommendations

Generally, the coral reefs at inner islands at Jazan region are in better condition compared to the nearby coastal areas which are under stress due to arising from poorly untreated wastewater, increasing infrastructure development, reclamation and dumping in the sea. The ongoing destroy the coral reef habitat through human activity is conservation will depend upon people's awareness, knowledge, attitudes and behavior. Nevertheless the global warming and climate change are the great challenges to reduce the temperature. Under the ongoing threat of climate change and anthropogenic sources still coral reefs communities survive at their strong environmental conditions and may assist in predicting how coral reef communities in southern part of Red Sea may respond to chronic natural stress or anthropogenic impacts.

Bloom-associated fish mortality, high temperature and bleaching events need be recorded and reported annually. Monitoring and collecting physio-biological data will help us to understand the dynamics algae bloom, causative factors and the mechanisms leading to mass fish mortalities in the southern part of Red Sea. Degradation of coral can be avoided in fishing areas if the environmental laws have been implemented.

Well integrated and coordination between different sectors and authorities are challenging to protect the coral reefs and fisheries to reach sustainable development.

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