IJVAR International Journal of Veterinary and Animal Research
Uluslararası Veteriner ve Hayvan Araştırmaları Dergisi
E-ISSN:2651-3609 1(3): 49-53, 2018

# The Status of Coral Reefs in The Larak Island, Persian Gulf, from 2012 to 2018

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**Abstract**

Coral reefs are one of the most important marine ecosystems around the world. This ecosystem is the breeding and living ground for vast of animals including corals, fish, mollusks and even sea turtles and dolphins. There is a disaster which is raising more and more by natural effects and more importantly by human origin. Global warming and consequently raising heat endangers the life of living organisms especially immobile ones. Coral reefs belong to the sessile animals that cannot move, migrate or defend themselves as strongly as advanced organisms. Different stressors such as thermal shock result in bleaching coral reefs so that the symbiont algae (zooxanthellae) does not return to the colony which ends to corals' death. Coral Reefs of the Persian Gulf are not the exception and they have been bleached severely during last few years. The study was done by direct observation and via SCUBA diving and photography. The Sea Surface Temperature (SST) data were achieved by NOAA satellite and they were analyzed by Microsoft Excel 2010. Typically, water temperature rises from March to middle of August and decreases again toward December. The most severe bleaching happened in August 2015 in Northern Larak Island while the water temperature was 32.60 °C. However, the water temperature was high even in January, February and March to 22.84 °C. The highest temperature during August 2017 (32.81 °C) was another bleaching peak for North and Eastern Larak Island corals. During this catastrophe in 2017, more than 90% of genus *Acropora* and more than 80% of genus *Porites* were bleached. There was a recovery status in bleached corals in 2018 but dead corals never recovered. Although there are resistant corals in the coral reef ecosystem, heat is a certain stress which can ruin the ecosystem.

**Keywords:** Coral bleaching, Larak Island, Heat shock

## INTRODUCTION

Marine ecosystems provide valuable social - economic services; The sea moderates the Earth's climate through the absorption and storage of atmosphere carbon dioxide and it is the primary source of protein for one seventh of the world's population food [1]. Nevertheless, climate change is expected to have serious consequences for marine ecosystems that affect both the performance and structure in the sea environment [2].

A vast range of stressors including pollution, diseases, overfishing and climate change get many of coral communities away from coral ecosystems [3], [4] and [5]. The scleractinian population is going to reduce in response to various stressful factors including intensification of sea surface temperature around the world.

Tensions which result from climate change, are not equally tolerable among all species [3] and [6]. The species belong to genus *Porites* (Scleractinia: Poritidae) which are finger-like with small polyps show resistance against increasing of ocean temperatures. *Porites* individuals are found in all coral ecosystems around the world and some species of genus Porites show high levels of tolerance to salinity and temperature [7]. On the other hand, *Acropora* is another stony coral genus with small polyps that is structurally important and main maker of calcium carbonate skeletons in coral ecosystems [8]. Nevertheless, the species of this genus are sensitive and vulnerable to high temperatures and get severely bleached against stresses [9].

Coral bleaching is growing fast, and 40% loss of coral covers has been unprecedented for at least last 40 years [10]. The high levels of coral bleaching have increased over the past 20 years and this phenomenon is directly associated with extreme temperatures at sea [11] and [12].

Since there is a strong symbiotic relationship between photosynthetic zooxanthellae and corals, the coral bleaches when this relationship disintegrates due to some stresses [12] and [13]. The algae with high-temperature tolerance are more abundant in reefs that are heavily affected by climate change [14] that leads to less bleaching of corals.

*Symbiodinium* belong to clade D of phylogeny tree, known as the clade members that increase heat tolerance in their coral hosts, are found in the northwestern (Saudi Arabia) and northeastern (Iran) of the Persian Gulf [15] and [16].

On average, roughly 60-80% or even more than 80% of coral reefs are bleached in GBR (Great Barrier Reef of Australia) by 2016, and the difference in bleaching, in various parts, is attributed to the difference of coral taxa [17].

High temperature could be a tension by itself, in the Persian Gulf due to its semi-enclosed conditions, high evaporation and high salinity stress can have significant impacts on the creatures and ecosystems of this area. The highest known bleaching threshold has been observed in the Persian Gulf coral communities [18] and [19]. Despite the exceptional capacity of corals in the Persian Gulf to survive in high temperatures, compared to those in other regions, they are prone to bleach when the temperature exceeds the tolerance threshold [20] and [21]. However, in other regions, the same coral species usually bleach at temperatures above 32° C, while coral colonies in the Persian Gulf endure heat peaks more than 36° C [22] and [23]. The stony coral species of Persian Gulf, are considered to be resistant species in the world [19], which can be considered by many researchers and environmentalists [21].

Although there is little evidence that abnormal states of bleaching have permanent effects on organisms, it might be forever in the case of hot water coral populations [24].

Detailed studies can help to protect endangered species, especially the corals of Persian Gulf, in response to global warming.

# MATERIALS AND METHODS

**SCUBA diving**

The study of corals' status and changes during 7 years was done by direct observation via SCUBA diving and photography.

**SST Analysis**

From January 2012 to April 2018 (more than 6 years), the monthly free Sea Surface Temperature (SST) anomaly (˚C) was achieved by satellite data. This dataset was downloaded monthly as csv files and analyzed by Microsoft Excel 2010. This product is a Multi-Scale Ultra-High Resolution (MUR). SST Analysis created by NOAA ERD and CoastWatch West Coast Regional Node, merged, multi-sensor L4, version 4.1 and by the resolution of 0.01 degree. Foundation SST analysis product is a part of the Group for High-Resolution Sea Surface Temperature (GHRSST) project. SST data were supported by CoastWatch website which were used on other previous studies such as Ramachandran et al. [25]. In order to download the nearest location to the stations (26˚ 53.240' N - 56˚ 20.135'E) (Station 1) and (26˚ 49.542' N - 56˚ 19.085'E) (Station 2), a script was written by Matlab (The MathWorks Inc., 2016, MATLAB and Statistics Toolbox 64-bit, Version 2016a, Release 2016a, Natick, Massachusetts, USA) to get the nearest four location of the station and averaged it for the cell. This average was used as the SST value of the station.

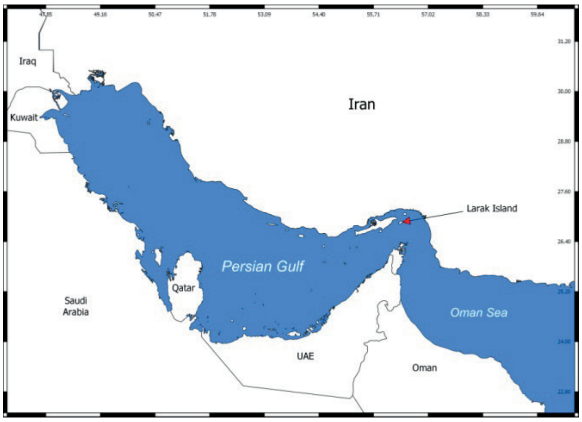


**Figure 1.** Map of Persian Gulf and Larak Island

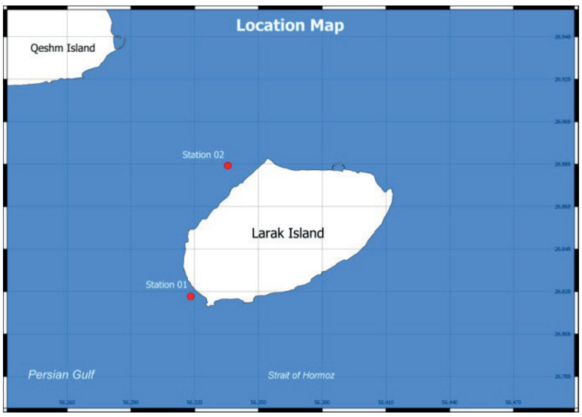


**Figure 2.** Map of Larak Island and desired stations on the North and Southwest.

# RESULTS AND DISCUSSION

Sea Surface Temperatures (SST) in the Larak Island shows tolerances in different years from 2012 to 2018. As it is shown in Temp/Month diagram of Southwest (SW) of Larak Island (Figure 3), SST was the highest in mid-July 2017 (32.93 ºC). Although the temperature decreased toward August 2017, it was the highest one comparison to other years. The year 2012 showed the lowest temperature during last winter and beginning of spring (22 – 23.80 ºC), and it JUMPed to high temperatures in the summer (32.25 ºC), nevertheless no special bleaching was shown during this year or moderate temperate in winter 2013 and heat decrease in summer 2013 may compensate the weaknesses. The sea surface temperature was the highest one in August 2015 in Northern (N) (Figure 4) and SW of Larak Island while the water temperature was 32.60 ºC.

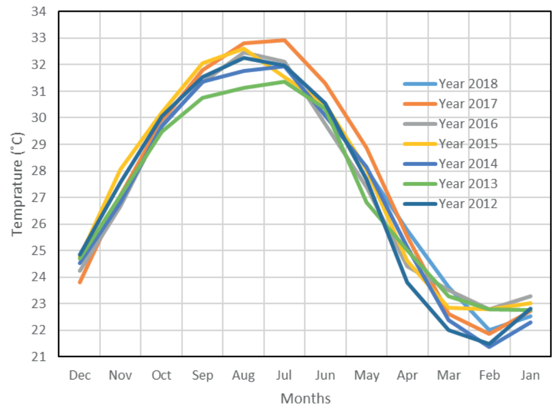


**Figure 3.** Sea Surface Temperature in the Southwest of Larak Island from 2012 to 2018

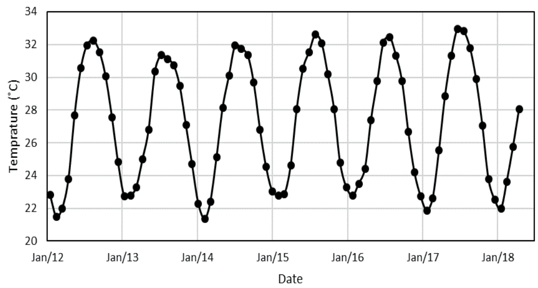


**Figure 4.** Sea Surface Temperature in the North of Larak Island from 2012 to 2018

However, the water temperature was high even in January, February and March to 22.84 ºC. There was a sever bleaching in this period of time. Though the water temperature decreased in 2016, the heat decline was not as low as the status in which corals could recover again and high percentage of corals bleached. The other bleaching peak was during August 2017 while SST was 32.81 ºC in the North and Eastern Larak Island corals. During high temperature in 2017, more than 90% of genus Acropora and more than 80% of genus Porites were bleached. There was a recovery status in 2018while the SST in the winter and summer was the lowest after 2012 and 2013 respectively, but dead corals never recovered.

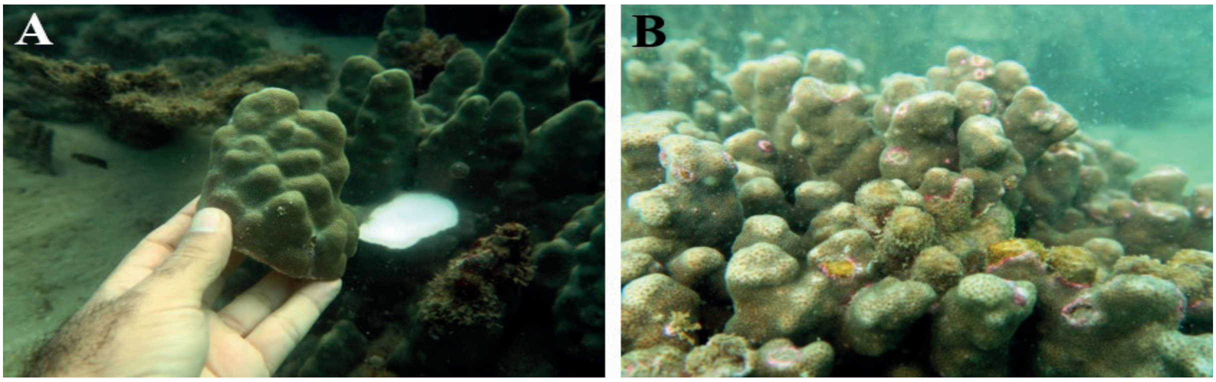


**Figure 5.** Colonies of genus Porites. January 2014, North of Larak Island(A,B)

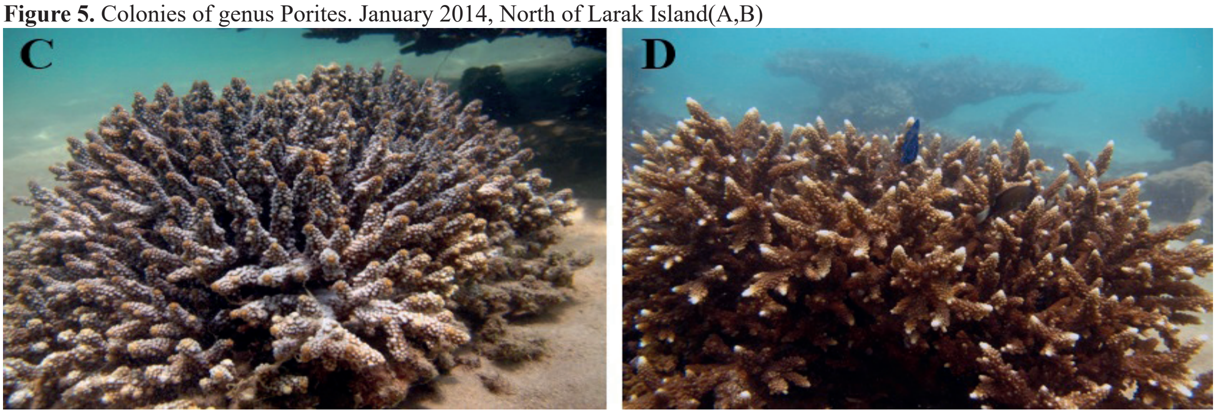


**Figure 6.** Colonies of genus Acropora. Left: April 2014 Southwest of Larak Island(C); Right: July 2014, North of Larak(D) Island

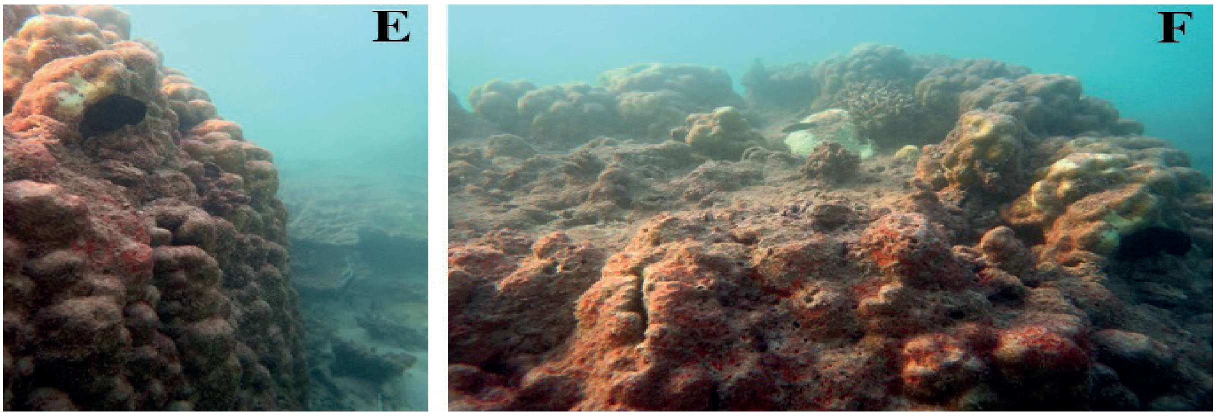


**Figure 7.** Dead colonies of genus Porites. May 2017 North(E) and Southwest of Larak Island(F)

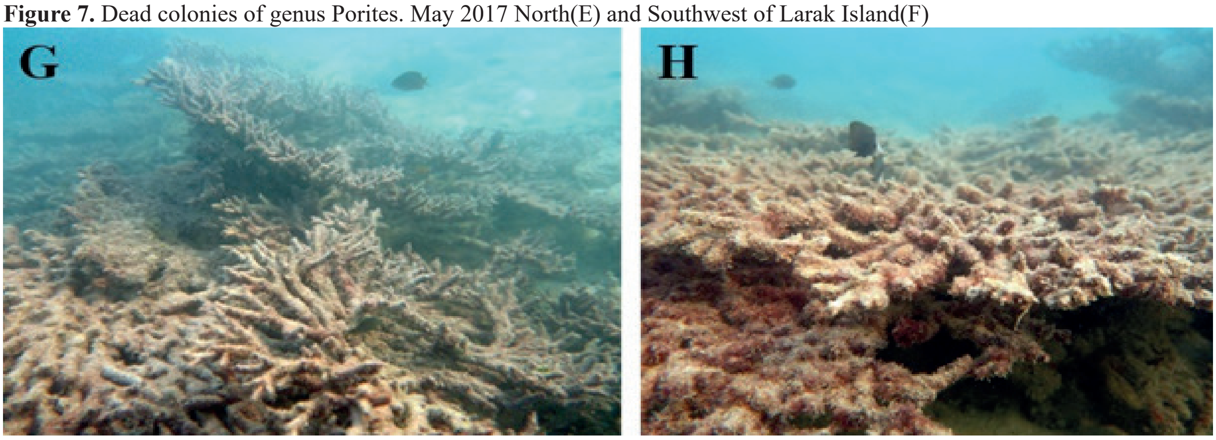


**Figure 8.** Dead colonies of genus Acropora. May 2017 North of Larak Island(G,H)

Climate models suggest that the sea temperature may eventually exceed the current thermal corrosion tolerance in almost all parts of the world and strongly affect the stability of coral reefs [12], [26] and [27]. Oculina *patagonica* bleaches every year, exactly in mid-June when the water temperature is above 24°C. Bleaching continues during spring and summer, where the water temperature reaches 32 °C and more than 80% of population has bleached [12] and [28].

Coral reefs are diverse group that show a wide range of responses to environmental changes, while some coral species may be reduced, others may be stable or even increased. In the past few decades, coral societies have experienced unprecedented changes [6] and [29]. In the Caribbean, for example, in the late 1970s and early 1980s, most of the structurally important acroporid corals were destroyed due to the white band disease [30]. Since then, the spread of some diseases, along with recent bleaching events and other biological disorders, has led to a high mortality rate in other reef-building species such as *Orbicella* spp. [31] and [32].

In the Bay of Thailand, *Porites lutea* tolerates about 10-30 ppt of salinity in diurnal tidal disturbances [33]. The bleached corals degrade physiologically, and the long-term prolongation of this bleaching without recovery will result in the complete destruction and death [34] and [35].

Since the corals obtain more than 95% of their energy from the photosynthesis of algae, disconnection of symbiotic relationship, damages the key function of coral calcification that is caused by light, tissue growth and reproduction [36]. Therefore, the survival of coral reefs strongly depends on adaptation and adaptive responses of corals to the global warming pressure [37].

## CONCLUSION

Results of the present investigation indicate that although coral reef communities of the Persian Gulf are more resistant to heat stress according to the same species in other parts of the world, they have been declined due to sever high temperature.

**Acknowledgment**

The authors would like to acknowledge the support provided by Mr. Eghbal Zobairi for the maps preparation.

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