



Revitalize Ocean Sustainability



Foreword

Oceans could satisfy the most important world food deficiency in protein by providing affordable protein for almost two billion people.

Coral reefs are home to over 1 million diverse aquatic species including thousands of fish species and considered as the rainforests of the Oceans. Coral reefs and related ecosystems have a global estimated value of USD 2.7 trillion per year or 2.2% of all global ecosystem service values. This includes tourism and food.

Oceans are polluted and Coral reefs are endangered by a variety of human activities including plastic pollution, overfishing, destructive fisheries, coastal development, chemical pollution, and careless tourism.

Revitalization of Ocean Sustainability is to showcase a solid foundation for Sustainable Development.



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Abstract

Coral reefs are one of the most productive marine systems in Thai waters, both in the Andaman Sea and the Gulf of Thailand. The status of reefs throughout Thailand has changed over time due to natural as well as human disturbances. Artificial reefs have been used for a long time to accumulate fish, create fishing grounds, increase the harvest of primary production, utilized as submerged breakwaters and providing wave attenuation for shoreline erosion control plus habitat enhancement. Therefore, many countries have been involved developing artificial reefs to enhance resources and production, in addition to researching for materials and methods to solve problems and achieve greater outcomes. Apollo (Thailand) Company Limited realizes the importance of coral reef ecosystems and therefore provides financial support to the Plant Genetic Conservation Project under the Royal Initiative of Her Royal Highness Princess Maha Chakri Sirindhorn.

This project has constructed using Reef Ball™, Seadome PSU-MHA1 artificial reef units along the eastern shore of Samaesarn Island during February 2018. The individual units were 1.45 meters high and base diameters of 1.5 meters. Approximately 100 seadome artificial reef units were installed for coral reef restoration and environmental enhancement. A monthly field surveys were carried out, 12 months, during March 2018- February 2019. During the study, there were 107 species from 53 genera of marine phytoplankton, 41 species from 33 genera of zooplankton, 5 genera of macroalgae (*Padina*, *Dictyota*, *Lobophora*, *Ceramium* and *Hypnea*), 6 species of fouling fauna (oyster (*Ostrea* spp.), spiny oyster (*Spondylus* sp.), scaled worm snail (*Serpulorbis* sp.), sea squirt ascidian (*Aplidium* sp.), rock barnacle (*Balanus* sp.) and red encrust sponge (*Monanchora* sp.), 4 species of benthos (black sea urchin (*Diatema setosum*), top shell (*Trochus niloticus*), green-spined salmacis (*Salmacis sphaeroides*) and medusa worms (*Synaptula* sp.), 12 families of fish larvae and 86 species from 34 families of coral reef fishes. The physical parameters especially tidal current, has a major role to control the movement of the sediment as well as seadome. However, there was low effect of the sedimentation on the seadome area after one year.

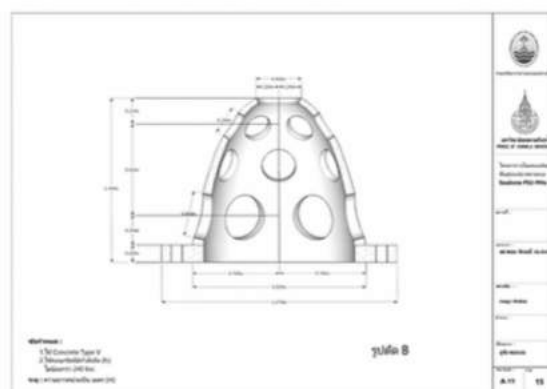


Fig 1. Reef Ball™, Seadome PSU-MHA1 artificial reef units

Executive Summary

The Research Program on Artificial Reef Structure as Supporting Coral Reef Habitats to Enhanced the Biological Resources at Samaesarn Island, Chon Buri Province, Thailand during 2018-2020

This Research Program had 8 projects (1 Installation and 7 research projects) those cover both biological and physical aspects. This first phase of the program was performed during 2018 to 2020. The first year was the installation of the artificial reef, Seadome PSU-MHA1 (Fig 1.), at the outer reef slope of the eastern part of Samaesarn Island. This site was selected according to the feasibility study from 3 dominated sites. Then, a total of 100 units were installed on February 2018. All of the monitoring works were carried out after that. The data were collect monthly of bi-monthly depending on the objectives of the research projects. The results during the year 2019 of 6 projects were summarized as following.

1. Species composition of fouling organism on the artificial reefs at Samaesarn Island

The data on the species and their abundance of fouling fauna were collected after the installation 1 month and 4 more times during July, August and November 2019. It was found that on the 1st month, there was a few fouling fauna settle on the seadome. On the 6th months after installation, there were 6 species of fouling fauna still living on the outer surface of the seadome. They were, oyster (*Ostrea* spp.) spiny oyster (*Spondylus* sp.) scaled worm snail (*Serpulorbis* sp.) sea squirt ascidian (*Aplidium* sp.) rock banacle (*Balanus* sp.) and red encrust sponge (*Monanchora* sp.). All of these fouling fauna can be found on every

2. Species composition of benthic organism, mollusk and echinoderm on the artificial reefs

The data on the species and their abundance of benthic mollusk and echinoderm were collected after the installation for 1 month and then collected another 5 times after that. It was found that there are at least 4 species of benthos found on the Seadome. They were, black sea urchin (*Diatema setosum*), top shell (*Trochus niloticus*), green-spined salmacis (*Salmacis sphaeroides*) and medusa worms (*Synaptula* sp.) The result showed no different over the time of surveying. This result showed the migration of these animals over a short time.

3. Species composition of planktons on the artificial reefs at Samaesarn Island

The marine phytoplankton and zooplankton were sampling after the seadome installation for 1 month. The plankton samples were collected for 6 time during March 2019 to August 2019. There were the planktons data collected on March 2018 that will be used as pre-installed period. (1 year before the installation) The plankton samples were collected on 8 station which laying above the seadome installation area (which has 2 control stations) The results showed that, before the installation), there are 45 genera and 85 species of marine phytoplankton found in these areas. For the zooplankton, at least 26 species from 23 genera could be found. For the larvae of marine fauna, there were 12 groups found during this time. There were 2 unidentified Cnidaria also found in this area. The result showed that Copepods is the most dominant zooplankton found in this area with 11 families 11 genera and 12 species. For the phytoplankton, there were 107 species from 53 genera were found. The most dominant family were Chaetoceraceae which found 20 species from 2 genera. While Rhizosoleniaceae found 18 species from 5 genera. For the dinoflagellate, Ceratiaceae were the most diverse group.

There were 41 species from 33 genera of zooplankton found during this study period. The larvae of zooplankton were 29 groups which most of them are the member of the Phylum Cnidaria which can be classified into 3 groups. The most diverse group was the Phylum Arthropoda those found 23 species from 19 genera. Phylum Protozoa was the next diverse group which found 14 species from 10 genera. There were only 2 species from 2 genera of Chordata be found during this survey. It was found that copepod was the most diverse group of zooplankton with a total of 20 species from 16 genera and 20 species. This results illustrated the same trend on the present of marine plankton distribution in the Gulf of Thailand and tropical zone.

4. Species composition of coral reef fishes on the artificial reefs at Samaesarn Island

The diversity of fishes found around the artificial reef area was evaluated for 1 year during March 2018 to February 2019. There were 86 species from 34 families recorded during this period. Pomacentridae was the most diverse group with 10 species. Gobiidae was the next diverse group with 7 species. There were 6 species of Serranidae recorded during this time. When considered the abundance of each species, it was found that *Neopomacentrus filamentosus*) was the most dominant species which represent approximately 35% of total fishes recorded.

The next abundance species were *Neopomacentrus cyanomos* 19%, *Parioglossus philippinus* (7%), *Caesio cuning* (7%), *Neopomacentrus azysron* (5%), *Sargocentron rubrum* (4%), *Siganus javus* (3%), *Cheilodipterus quinquelineatus* (2.7%), *Parioglossus formosus* (2%), *Pomacentrus cuneatus* (2%), *Lutjanus vitta* (1.5%) and *Ostorhinchus endekataenia* (1.3%). The rest of 73 species were found less than 1% of the total abundance. It should be noted that, after the colonized of demersal fishes to the artificial reef, the pelagic fishes were found more frequently which may be attract by the demersal groups. The species of this group were such as *Diagramma pictum*, *Cephlopholis* spp. and *Sargocentron rubrum*.

5. Species composition of fish larvae on the artificial reefs at Samaesarn Island

Species composition of fish larvae on the artificial area was investigated at two station during May, 2018 to August, 2018. The sample was collected by larvae net that has a diameter of 1 meter. A total of 24 samples was collected during this study period. It was found that there was a total of 12 of fish family found around the artificial reef area while there was 11 fish family found on the reference area.

6. The efficiency improvement of artificial reef by implanted *Sargassum*

The macro brown algae *Sargassum* was attached to the seadome by wire cable immediately after the installation of the seadome. The aim of the study was to compare the results of seaweed implant and not-implant on the living organisms. The study was starting on February 2018 and monitor the result every month from March 2018 to February 2019. It was found that Black sea urchin (*Diadema setosum*) and Java rabbitfish (*Siganus javus*) visit the seadome immediately after implant the *Sargassum* and nip on the algae. However, there was some part of the *Sargassum* left behind until now. Furthermore, There were other macroalgae settled on the surface of seadome. They were *Padina* sp., *Ceramium* sp., *Dictyota* sp., *Lobophora* sp. and *Hypnea* sp.

7. The Oceanographic Study on the artificial reef area at Samaesarn Island.

The water current at the artificial reef was conducted monthly during March to August 2018. The current meter was set up close to the artificial area with the distance around 10 m. from the group C. The depth of this area is 6-7 meter from mean sea level. The current meter was tire up to the buoy rope at the mid depth. The current meter was setting up to record the data every 1 minute for 25 hours. The data was analyzed by average for every 15 minutes. This result was also analyzed with the tidal level at the same time with 15 minutes interval. The study was conducted every months between March to August 2018.

The result indicated that the current along the Tean beach move in the North-South direction according to the dimension of the island. The velocity of water current at moderate speed had high variation. When the current velocity change, it cannot conclude the type those are standing wave or progressive wave because these phase changing all the time. This result indicates the complexity of the relation with environmental factors of the surrounding area such as wind, wave, island morphology, water channel and also artificial

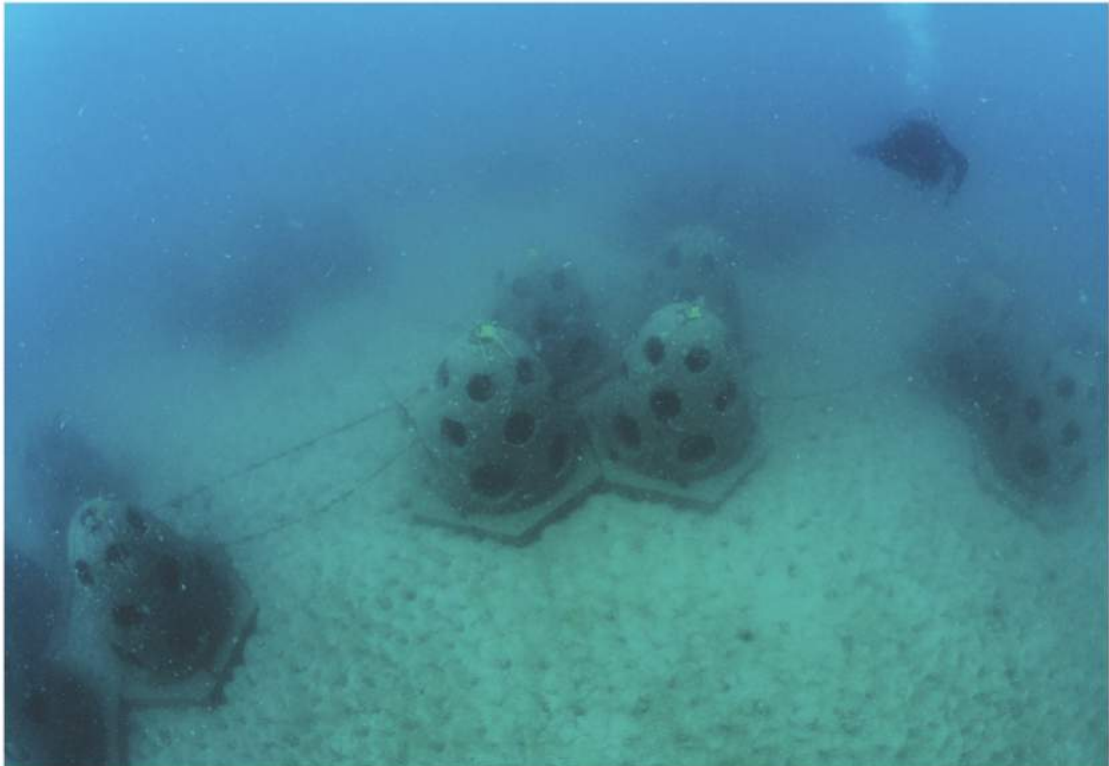
For the sedimentation rate, the monthly data indicate the corresponding pattern with current velocity. However, there was a temporal variation of sedimentation rate which high sedimentation usually related with low current velocity. The low water current was high during low current velocity on 16 May to 13 June. On the other hand, low sedimentation rate occurred during high current velocity on 17 April to 16 May. The sedimentation rate at had Tien was high when compare with other area because of the diffusion of the sediment on the sea floor from the influence of wave. This result cause low sedimentation around the Seadome and then it can sit on the same position as it was first installed.

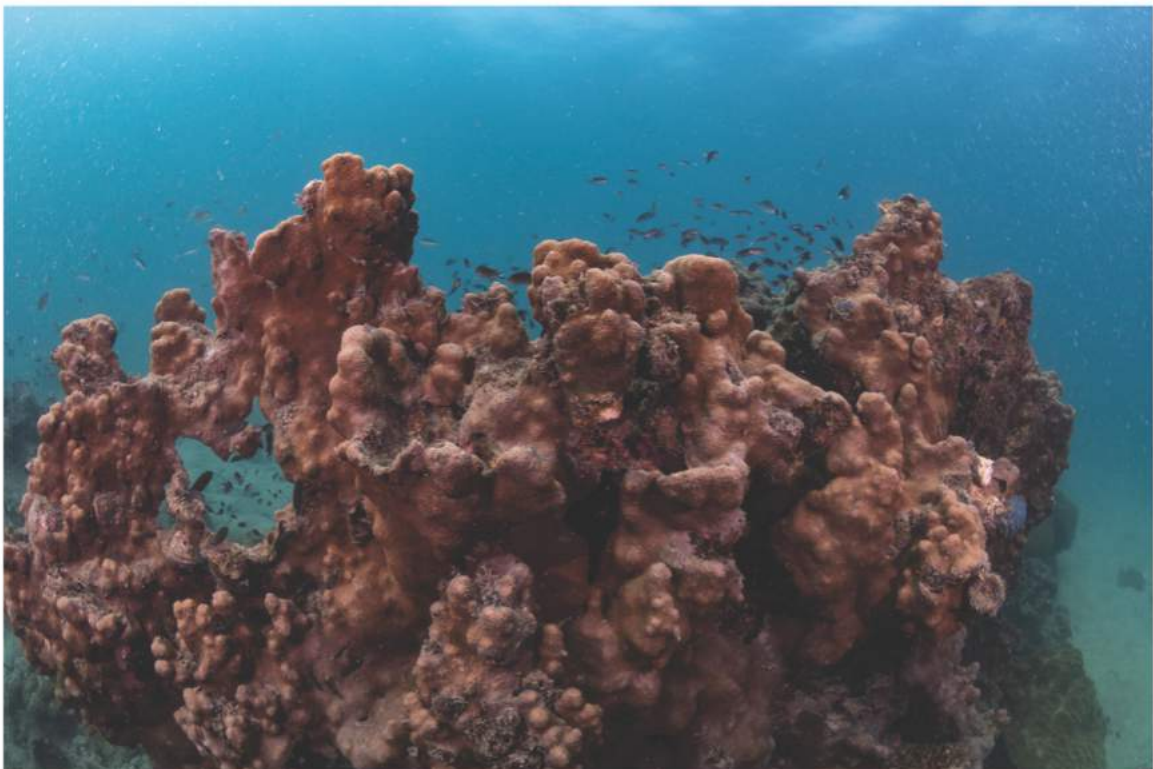


Fig 2. Reef slope before the project began













Conclusion

After the installation of seadome, the first group of living organisms that visit the area was the fishes, especially pelagic fishes. The seadome with implant algae was the most attractive for the herbivorous fishes. The next group was sea urchin especially *Diadema setosum*, which are also the grazer on algae. A big group of sea urchin move from the outer reef slope to the seadome area immediately after installation. However, 12 months after seadome installation, the recovery of *Sargassum* and new settle species were also observed. The physical parameters especially tidal current, has a major role to control the movement of the sediment as well as seadome. However, there was low effect of the sedimentation on the seadome area after one year. In our opinion, we are satisfied with the results of this program.

