

Coral Nursery Program Update

28 August 2011

Chalok Ban Kao and Ao Leuk



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Background

During the summer of 2010 the entire South Asia Sea experienced high sea water temperatures correlated with an extreme ENSO event. During the summer coral reefs all throughout Thailand bleached, many as high as 95-100%, and suffered high rates of subsequent mortality. During this time, the Marine Branch of the Save Koh Tao Group began an adopt-a-reef program to encourage local businesses to take part in the protection of the reefs. Five local dive schools signed onto the program to adopt a total of 7 reef locations (see Figure 1).

After the bleaching event began to subside, the Prince of Songkla University and the Department of Marine and Coastal Resources (DMCR) initiated a coral nursery program, and partnered with the Save Koh Tao Group to put the nurseries in the adopt-a-reef sites. A total of 48 tables were constructed and deployed over the course of a week, with the assistance of local divers and community members. Workshops were held with each business to teach them about the coral transfer and preparation techniques, and how to collect data on the growth of the transferred fragments.

This report discusses the findings and data collected on the two sites managed by the New Heaven Dive School, Chalok Ban Kao and Ao Leuk. The report highlights both the successes and difficulties with the project to aid in the design of future projects around the island. For the sites covered in this report, a total of 12 tables were put down in Chalok Ban Kao, and 6 tables in Ao Leuk.

Methods

The tables used for the nurseries consist of three designs, sloped tables designed to hold coral trays, flat tables designed to hold coral trays, and flat tables to hold coral ropes. Each table holds two 1m x 1m trays, totaling 24 trays between the two sites (16 Chalok, 8 Ao Leuk).

Coral fragments were collected and attached to vinyl tubes to be placed onto the trays or secured in the ropes. Only naturally occurring coral fragments have been used, no healthy corals have been broken or propagated for these sites. Fragments are identified as small, unsecured corals which will most likely be killed by wave action and sand burial. Species used for the nurseries were those for which fragments could be found, and emphasis was placed on collecting a wide range of diverse corals over a large spatial and temporal scale.

Data is collected during the nursery stage and includes a count of living, dead, or missing fragments and volumetric growth rates collected by divers. Photographs of each tray are also taken regularly. After corals reach a size greater than 15 cm in maximum diameter, or appear robust enough to survive on the natural reef, they are transplanted to natural and artificial substrates. A variety of methods are used, including finding naturally occurring holes or drilling holes into dead coral, and securing fragments using wedges (see figure 2 on next page). Corals growing on the rope nurseries are most often moved to artificial reef structures, where they can easily be secured using cables ties or small line.



Picture 1: Coral Nursery tables after construction

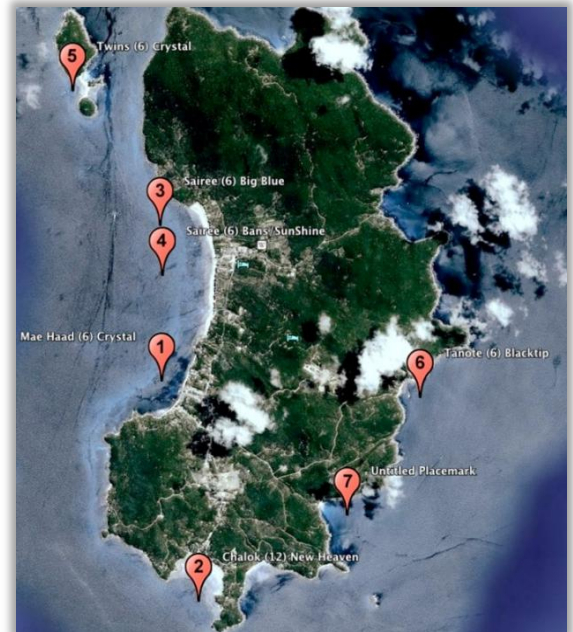


Figure 1 : Map of Coral Nursery and adopt a reef locations

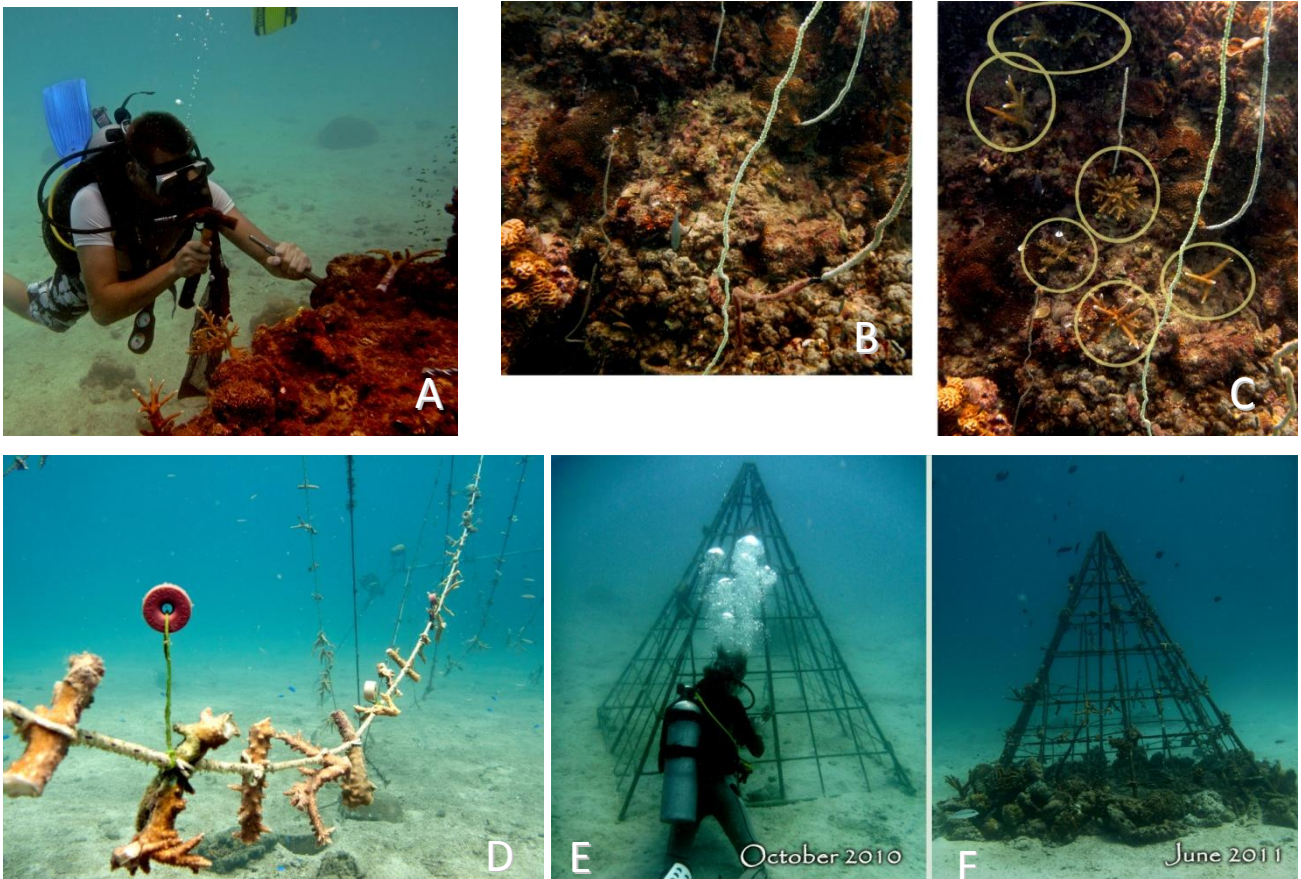


Figure 2 ; Coral Attachment Techniques using corals grown in Vinyl tubes (A-C) or the Rope Method (D-E). Pictures B and C show corals moved from the nurseries and secured on existing, dead substrate using a drill and wedges. Pictures E and F show how coral ropes can be wrapped around artificial substrates

Discussion of Results and Findings

Coral Fragment Survival on the Nurseries

Initial coral survival was very high. Almost no mortality was seen during the first month of the project, which was surprising considering the health state of the local reefs at that time. The nurseries could not be visited during the months of November and December due to the monsoon season, but all of the tables were found to be in good condition in January of 2011, except one table which had been hit with an anchor, but not severely damaged. The corals fragments on the ropes are the most secure, with none being recorded as falling out or missing. Corals in the tubes however were secured less well, with some falling out of the tubes or otherwise not attaching to them (most notably on the sloped tables). Corals found to have fallen out were placed back into the tubes or secured using other methods. Many of the corals had however attached to the tubes, especially those of the *Acropora*, *Pocillopora*, *Astreopora*, and *Porites* genera. Corals that had attached themselves to the tubes showed high levels of health and growth (100% of tagged corals monitored in January coded as 'healthy').

In March of 2011 the island of Koh Tao experienced unusually powerful storms and flooding. During this time wave action was very high in the regions of Ao Leuk and Chalok. In Ao Leuk , both of the sloped tables were destroyed by waves, and all four trays scattered in the sand. In Chalok, many of the corals in the sloped trays fell out of the tubes. More problems were encountered in the September of 2011 when a large Crown of Thorns Starfish climbed onto the



Picture 2 : Collapsed tables in Ao Leuk following storms (trays were found scattered in the sand, but resecured slightly above the bottom before this picture was taken)

tables and consumed a large amount of the corals before being removed by divers in mid-August. These disturbances can be seen in the data tables below:

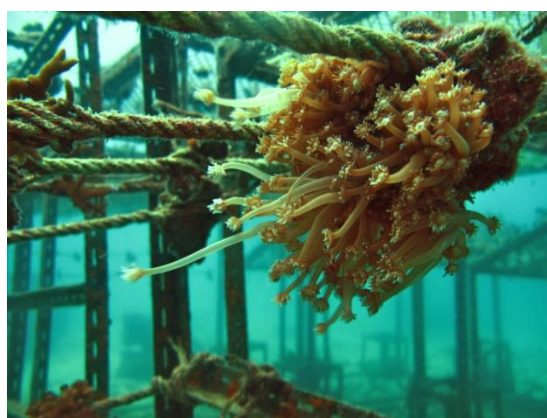
Ao Leuk Nursery damage due to storms Collected on April 15th, 2011

The table below shows the loss of corals on the sloped tables due to the tables collapsing ('GONE' means an empty tube was found, and usually the coral has died in the sands below or reattached elsewhere).

	Living	Dead	Gone	RKC	% living	% Dead	% Gone	% RKC
Rope	57	13	0	0	81.4%	18.6%	0.0%	0.0%
Flat Tables	233	15	14	0	88.9%	5.7%	5.3%	0.0%
Sloped Tables	93	10	118	0	42.1%	4.5%	53.4%	0.0%
Totals	383	38	132	0	69.3%	6.9%	23.9%	0.0%

The data shows that survival was high on all the tables, except the sloped tables which were destroyed by waves (57.9 % of the corals dead or gone). Most of the corals on the rest of the nurseries remained attached, and no corals were lost from the rope nursery. It is possible that the sloped orientation of the trays causes them to catch more wave energy and lift or shake the tables. Over prolonged periods of time this can lead to loss of table integrity. Due to these observations we would recommend that flat tables or rope nurseries be used in wave prone areas.

Of the corals which remained on the nursery, mortality was highest on the ropes. It has been observed that algae overgrowth on the rope nursery is much higher than the other table types. We believe that this is due to the type of rope used, and in the future recommend a purely synthetic rope. Nurseries in the area using polyethylene ropes have very high survival rates and very low algal overgrowth.



Picture 3 : A Goniapora colony growing on the rope nursery

Chalok Nursery damage due to storms and Crown of Thorns predation (data averaged over all table types)

(Note; RKC stands for Recently Killed coral, and indicates coral that was eaten within the last few weeks by the Crown of Thorns (COT).)

	Living	Dead	Gone	RKC	% Living	% Dead	% Gone	% RKC
1/18/2011	--	--	--	--	94.3%	5.7%	0.0%	0.0%
5/5/2011	860	107	153	0	76.8%	9.6%	13.7%	0.0%
8/18/2011	494	75	279	47	55.2%	8.4%	31.2%	5.3%

The data in the table above shows the initial mortality or loss of corals due to the storms March in Chalok Ban Kao, where 13.7% of the corals fell out of the nursery (primarily on the sloped trays, where 20% of the corals were coded as Gone). As seen in Ao Leuk, coral have more difficulty attaching to the sloped tables, and thus fall out more often. There has been no recorded benefit of the sloped tables over the flat ones, and we would recommend discontinuing the use of the sloped tables.

The data collected on August 18th shows the increased amount of recently killed corals due to predation, which was mostly on the flat tables and rope nurseries (due to location of the predator not table design). It is not known how long the starfish



Picture 4 : Recently Killed corals in Chalok due to COT predation

had been on the structures, as divers were unable to visit the site for several months due to low tides and waves, but it was removed immediately upon discovery. We can think of nothing further to do to prevent predators from ascending the nurseries, but our experience highlights the importance of regular maintenance.

Coral Fragment Growth on the Nurseries

Data on coral growth rates has not been fully analyzed at the time of this report’s writing. However, diver observations and perceptions of the corals in the nurseries have been very positive. Hundreds of the corals have already reached a large enough size to be moved off of the nurseries, and have been transplanted to the surrounding areas. Data in the table below from Chalok shows the amount of growth over a 3 ½ month period.

	Average Height (cm)	Average Max Diameter (cm)	Average Min Diameter (cm)	Average number of Branches
5/5/2011	7.6	8.6	5.5	6.3
8/18/2011	11.9	13.3	7.8	9.4
% Increase	56.4%	54.5%	42.6%	49.5%

Table 1 : Averaged data from diver measurements of tagged corals growing on the Chalok Ban Kao Nurseries. The data was collected over a period of 105 days, wherein many of the corals increased in size or number of branches by over 50%.

Corals on all of the nurseries appear to be extending much faster than corals on the surrounding, natural reef areas, and are budding quickly to produce very dense branching growth forms (see picture 5 below). This data will become more interesting as we begin to analyze the differences in the growth rates of the corals between sites and over different seasons of the year.



Picture 5 : Tray number 1 of the Chalok Coral Nursery showing the change in coral size between September 7, 2010, and August 18, 2011.

Conclusion and summary of findings

Our experiences with the coral nurseries have been very positive. We have seen incredible rates of survival and growth when the nurseries are in good condition and well maintained. The only problems that we have had with the techniques of the nursery are the difficulty in getting the corals to attach to the vinyl tubes, and the collapse of the table in Ao Leuk. The tubes do make transfer to the natural reef areas quite easy, but in the future we recommend only using the flat tables for the tube nurseries. For moving onto artificial structures we much prefer the rope method (using polyethylene ropes) which is easier for volunteers attaching fragments to be placed on the nurseries, and easier to transfer off again. No corals were lost from the ropes, and we suspect that it would be more difficult normally for predators to gain access to the corals on the rope nurseries.