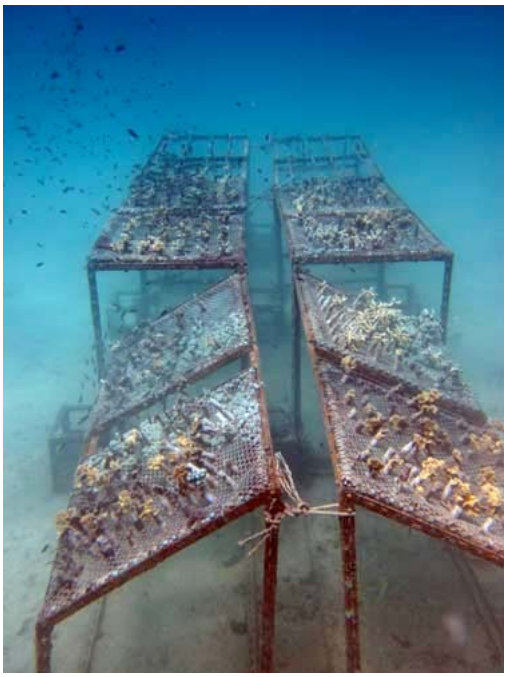
Koh Tao's Adopt-a-Reef Program
Coral Nursery Update

In 2010 the Save Koh Tao Group implemented an Adopt-a-Reef program which asked dive schools to voluntarily 'adopt' a reef they frequently visit and maintain some of the conservation activities like buoy lines, conducting regular clean ups and Reef Check surveys & developing and maintaining coral nurseries.

Being eco minded already we at Eco Koh Tao & Crystal Dive were already doing most of these tasks so we were happy to take on the responsibility for two sites: We selected Mae Haad & Twins.

In September 2009 we joined forces with the Save Koh Tao group, the DMCR (Department of Marine & Coastal Resources and the Prince of Songkhla University, Haad Yai to develop and maintain coral nurseries at our two sites. Others were set up and established around the island with other dives schools at their adopt-a-reef sites. This document is only designed to report our progress & findings over the first 10 months of this project.



Coral nursery tables being prepared for deployment in Mae Haad (left), and much later underwater showing the different methods (Right)

Locations

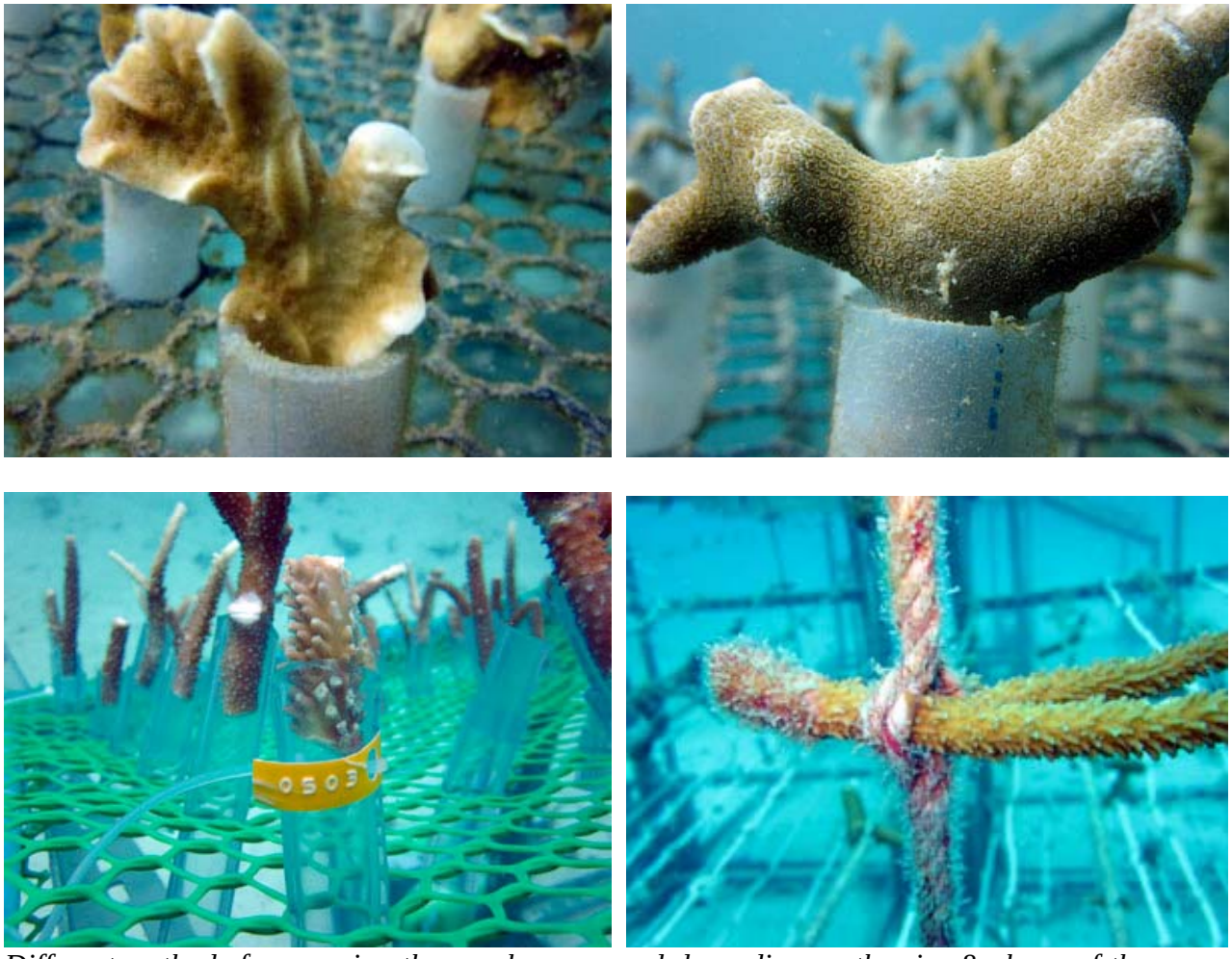
Location #1, Junkyard Artificial Reef, Mae Haad
Location #2, Twins, Koh Nangyuan

Assembly and deployment of the initial coral nursery tables took place in September 2010. It was a two weeks before the first corals were planted on the nurseries using three separate methods of attachment:

Method #1: Corals inserted into PVC tube inserted into a sloping tray at approximately 45° angle.

Method #2: Corals inserted into PVC tube inserted into a tray laying flat.

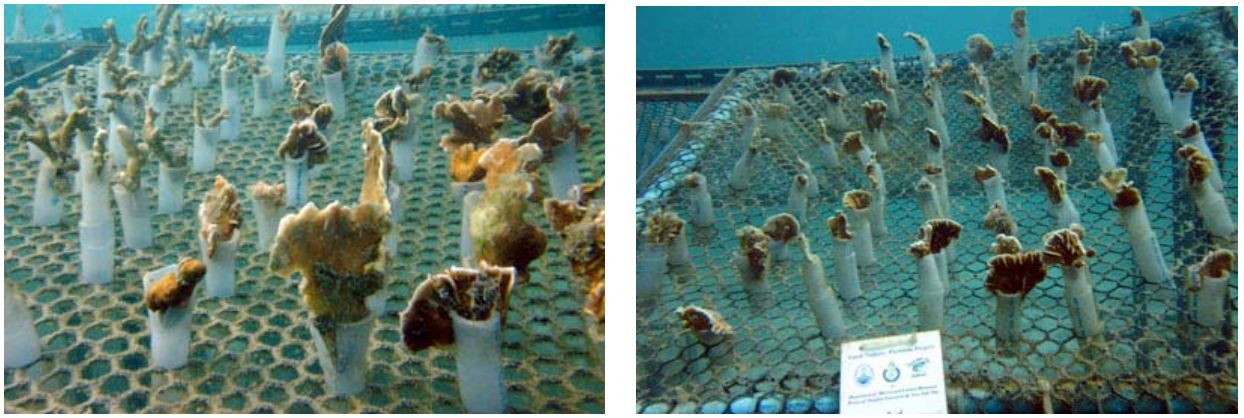
Method #2: Corals inserted into rope.



Different methods for securing the corals were used depending on the size & shape of the caroal fragment. Some of the corals were tagged and tracked using the orange tag pictured here to track and monitor some 60 – 80 corals per nursery.

Fragment Collection
Different corals were selected representing the most appropriate and available coral fragments in the area. Fragments consist of small coral colonies that are compromised by their location, size or lack a solid base from which to grow.

In Mae Haad, Junkyard is quite a distance from the natural reef system (> 80mts) and is subject to probably some of the worst water quality on the island. Due to severe bleaching in 2010 branching *acropora* corals, which are preferable because of their high growth rates, were almost impossible to find here and more readily available species and growth forms were chosen. This was predominantly leafy plate like corals (*pavona sp)*, and branching *porities* corals. A few *massive* species were also chosen for our nurseries at Junkyard.



Fragments secured to the nursery trays in Mae Haad on both flat (left) and sloping (right) trays. Many of the corals in Mae Haad were susceptible to displacement because of their shape (plate pavona sp predominantly) and propensity to be 'squeezed' out of the plastic tubes. It appeared that those on the sloping tables were also more susceptible again to falling out due to the angle of the trays. The angle of the trays was designed to see if it reduced sedimentation .

At Twins, we opted for the more readily available and strategically important branching *acropora* corals. These *acroporas* were hit hard during the bleaching of 2010 but luckily enough survived to provide for population of the nurseries at Twins.

Fragments secured to trays at Twins. The branching acroporas were far easier to secure in the trays and their fast growth rates helped them secure themselves quickly to the tables.

Maintenance & Data Collection

Over the first few months we have collected data & regular maintenance has been essential. Maintenance includes the removal of algae, predators and other fouling organisms (ascidians in the case of Mae Haad). At Twins we've twice had to relocate an inquisitive and hungry Crown of Thorns (*acanthaster planci*) and it was only due to regular inspection & maintenance that the intruder didn't cause more damage.

A diver works to remove encrusting & fouling organisms like the green ascidians pictured below.

Ascidians crowd out the coral fragments (left) creating unwanted space cooperation. A diver relocates a crown-of-thorns sea star (acanthaster planci) from the nursery at Twins (right). Due to regular observation the intruder was moved after causing only minimal damage.

Maintenance also extended to re-attaching corals that had fallen out of the holds or somehow become dislodged from their base. This was especially the case in Mae Haad where the shape of the plate corals makes them more difficult to plant and make their own attachment, an essential element of a successful nursery.

Coral fragments at Twins, February 2011. After 6 months of growth the corals at Twins are developing well with a high survival rate.

Branching acropora sp coral showing basal growth on the plastic tube and a number of branches have formed


Bleaching has been of minimal concern for most of the corals at both nurseries during 2011. This years' sea temperatures have reached 31°Celsius at the end of May, historically our hottest time of the year. Temperatures have stabilised since then with mild bleaching recorded more at Mae Haad than Twins. Mild bleaching has been prevalent on branching porities species and some massive colonies (see images above). No corals have suffered any mortality due to the bleaching and no action has been taken to prevent the bleaching.

Results

Mae Haad, Junkyard

	Alive	Dead/Missing	Total	Survival
Jan 2011	592	36	628	94%
July 2011	458	170	628	73%

Out of the total of 628, by July 2011 a total of 83 fragments have been transplanted onto the artificial reef nearby with mortality currently at 0%! The survival rate dropped by July predominantly due to the number of fragments displaced (missing) from their holders. 95 out of the 170 fragments (56%) listed as dead or missing were in fact the latter.

Twins, Koh Nangyuan

Data currently being collected and processed for Twins.

Continued Maintenance & Transplanting

Over the last few months as the corals have grown and in the case of Twins, outgrown their location we have begun transplanting some of the corals onto alternative substrates. This has been a less than straightforward task not the least because suitable transplant locations are sometimes difficult to find, and the shiny, slippery mature of the tubing the corals have grown in makes their so-called 'secure' base less than secure.


Many fragments have secured themselves well to their new home. The branching acroporas of Twins have by nature developed faster and more extensively than the plate pavona corals that are the most common fragments in Mae Haad. All fragments have struggled to maintain a solid attachment to the plastic tubing due to its slick surface and I would recommend against using it as a base for future projects preferring more suitable surfaces such as cement.

In both locations we have utilised nearby artificial reef structures to accept our transplants with the aim to develop more in the coming months.


Developing artificial reef structures by recycling packaging has so far been a successful in developing suitable transplant locations in Mae Haad. We have had some issues with fragments still dislodging from these locations and adhering them to these new locations (rather than just placing them) will be an important next step. In the coming months with the expansion of the artificial reef at Twins we hope to develop suitable transplant locations for the growing fragments at Twins.

In Twins the branching *acropora* corals have grown amazingly well and many of them are in desperate need of a new home as they start to crowd each other out. Transplanting back onto the natural reef environment is a real and desirable option at Twins where there was high mortality of the *acropora* corals in 2010.

For Earth Day, June 8 2011 we had a group of Divemaster trainees help us transplant corals from the nursery to our artificial structures in Buoyancy World. This was a successful venture allowing budding dive professionals under the requisite supervision to participate in a real, hands-on reef restoration experience.

The main problems associated with this so far has been the **lack of suitable transplant locations**. Artificial reef structures of Buoyancy World have provided SOME transplant location but these have so far been limited. Suitable holes in dead substrate on the natural reef are plentiful, but during the daytime are often used by sea urchins as hiding places. An underwater drill would be handy!

Fragments planted on the 'tree' at Buoyancy World have been placed in the glass bottle that were embedded in the cement structure. So far the corals have struggled to make a secure basal attachment despite the fact we are able to embed the plastic tubing to the base of the coral so it is flush.

Many of the corals are thriving but a few end up on the ground due to lack of adhesive. There removal may be due to predation by wrasse on the symbiotic invertebrates and other predatory fish.

At Junkyard in Mae Haad once again artificial reef structures have provided the only source of transplant locations and these have been in the form of cement bases with pre-fabricated holes to accept the plastic tubing that currently houses the corals. These have been relatively successful so far and will hopefully provide a solid base for many of the corals in the coming months.

Attaching transplants is a tricky but critical phase of this project. Having stable fragments both at the nursery stage and then again at the transplant stage is imperative for a successful project. So far the relatively rudimentary process of jamming corals into PVC tubing has been effective to a point. The tubing is slippery and this lack of texture is extremely difficult for corals to attach a firm base onto. The true test will be if the corals can establish basal growth over their new substrate at the transplanting phase.

The above corals have all been transplanted into artificial structures in Mae Haad. The bases were specially prepared to receive coral transplants using empty tubing to create the holes. This has been relatively successful but fragments are still being dislodged mostly by predatory fish preying on symbiotic invertebrates living among the corals themselves.

Once transplanted the project **is dependent on the success of attachment and growth**. We have tried a few methods so far using both cement bases (Mae Haad) and glass bottles (Twins) and at this early stage of this phase both are proving to be reasonably successful. In both cases no underwater adhesives have been used and I see this as THE major drawback so far. Many corals at both locations have subsequently been found dislodged due to lack of adhesive.

In the coming months we hope to explore different adhesive options including underwater epoxy, quick drying cement applied underwater and possible using superglue if we have structures that can receive corals before being deployed which is unlikely.

A look at Fragment Selections

Fragments selection was chosen by what was available at each site with a preference for faster growing branching corals (and within this group preferably acropora sp.) This was done but with the benefit of hindsight some corals should be excluded from any future projects in these areas as listed below.

a) 

b) 

c) 

d) 

The branching *porities sp* (figure a & b) have attached poorly and grow slowly. They are a rather 'weak' coral being easily overtaken be filamentous algae and encroaching ascidians. I would stay clear of them for future projects. The more robust version of the branching *porities sp* (See figure d) are a more suitable & stable species. They have attached and transplanted will and can be recommended for future projects.

e) 

f) 

The foliose *pavona sp* corals (Figure c, e & f) have fared well where the fragment hasn't been dislodged and the coral has managed to make its own attachment. Once again the more robust version of this genera (figure e) has prospered over the less robust versions (figure c & f) although succss appears to be dependant on the ability to develop their own base, something which is difficult to achieve with these corals using this methodology. The 'flat' plate corals are often subject to dislodging due to their shape and the nature of the plastic tubing to push upwards when squeezed.

g) 

Massive species are suited to the rope style of coral nursery and have done well. The real test will be how well they transfer to their 'next' location and how exactly to do that.

At Twins there is no question that the branching *acroporas* have performed well and are definitely the way to go for future projects because

1. They are easy to fragment and plant
2. They grow readily showing rapid response
3. They create basal growth exceptionally well
4. Twins is deficient in branching corals and needs restoration in this species. Because of their susceptibility to effects of bleaching it would appear they aren't the best coral too choose BUT with the nurseries located a little deeper than most of the branching corals normally grow at Twins (10 – 11mts as opposed to 8 – 9 mts & shallower) we hope to be able to shield them somewhat from the solar radiation that can be so damaging during bleaching events.

Conclusion

At this midway stage in the project the nurseries have proven a great success at

1. Showing a successful reef restoration program for threatened corals so soon after a major bleaching event.
2. Allowed for the development of important knowledge as to the strength and weaknesses and thus the suitability of different genera of corals.
3. Have fuelled the development of artificial reefs as an integrative tool for use with coral nurseries.
4. Have brought divers of lesser experience into the fold of reef restoration and marine conservation.

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July 2011