Lembeh Resort House Reef Project July 2009
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House reef project status report 2009

This is a write-up of observations of the house reef project based on dives conducted 21-26 July 2009. This is a comparative study to our previous work on the House reef (HSR) during November 2006-April 2008.

There are several components to the house reef project, and each of these is discussed separately in the following report.

Wreck
In December 2007 a 15m long wooden boat was deliberately sunk on the deep flat sand of the HSR (about 24msw). Prior to this the boat was half exposed in the neighbouring village, Pintu Kota Kecil.

The wreck is now falling apart. There is not much left of the side planks, these are rotting away. The bow has fallen down altogether. What is remaining is the skeleton of the boat and the rocks piled up inside the wreck, which were used to sink it initially.

Schooling fish have been observed on the wreck since the first day of its sinking. Only some of the species found on the wreck have changed from April 2008, when it was last observed by us*. There are now schooling banner butterflyfish, instead of Moorish idols, and snappers instead of sweetlips, but no result can be drawn from this. Smaller gropers (cods) are still present, mostly inside the wreck. There is not much growth on the structure itself, mostly ascidians and no corals, probably because it is quite deep. As in 2008 there is still a layer of silt on the wreck, so no mentionable sediment deposition is noticeable. The fact is that the wreck has served its purpose well. It has created an extra structure on an otherwise mostly barren sandy bottom, and provides a hiding point for schooling fish on the deeper part of the HSR.

A suggestion for future work on the HSR would be to sink another boat, preferably at the same spot. There are cement pegs on either sides of the wreck which could be used to attach for marker buoys while sinking it.

*Dimpy or the dive guides might have more information about the species in the one year gap April 2008- July2009.

Rope vertical
A vertical rope was placed, on the northern side of the wreck, in December 2007. This was paced in the hope of attracting egg laying squids. This was done after observing squids laying eggs on many other dive sides in the Strait (i.e.: Pantai Parigi, Retak Larry) and also because there are many squids on the HSR. In the most recent observations there is no sign of such activity in form of old or freshly laid eggs. The squids have either not found the rope or they prefer other places to lay their eggs, however, the rope should be checked for this activity at times when squids lay eggs elsewhere in the Strait. It could be a good opportunity for photographers/videographers to be able to document this right on the house reef. There is some growth, on the rope, but not much. The community assembly is similar as on other places in the Strait where there are vertical ropes, usually mooring ropes. The most common settlers are colonial ascidians, hydroids and algae and some resident yellow stripped blennies. The rope is purposely fully submerged so as not to invite fishermen to the HSR, especially so close to the wreck.

Ropes horizontal
We had additionally placed two ropes on the sand at the sandy deep part of the HSR in 2007-2008. One is just south of the wreck, about 20-25 meters away at 22msw. The other one is about 100 meters south of that one at the same depth. There is always something interesting there on the sand and the rope seems to concentrate these animals in the one spot. It also acts as a good reference point for divers on the sand. Frogfish, flamboyant, Tozeuma shrimp, Pegasus seamoth, Nudi “The cannibal” etc. etc. had been observed on the ropes. The ropes are falling apart a little, next time thicker ropes would be a better option.

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In July 2009 an additional rope was placed between the washing machines and the wreck.

Washing machines
There is a set of three washing machine parts, which were placed there in January 2009. In July 2009 there was visible settlement of algae, including encrusting algae and typical fouling organisms otherwise known as sessile invertebrates such as bryozoans, solitary and colonial ascidians and zoanthids.

The hollow structure of the washing machines is also a favourable site for fish hide-outs. There are lionfish, striped pipefish, butterflyfish, and biggeyes inside with gobies both inside and out.

The drawback of these washing machines is that the parts are made of metal and will rust away over time. Plastic could better way to go, but it is also tricky as its surface is very smooth. To increase settlement the surface would need to be roughened (possibly drill holes). The washing machines have been connected together by ropes to create a compact structure and to increase the available 3D area. This **Spiderweb** should attract more fish and marine life in general.

When new material is placed on the HSR it would be better if it is done in one small area, so over time it can create an artificial reef and some kind of reef structure. You could even pile it up on top of each other and secure with ropes. More complex structure would probably attract more life. It should also be easily accessible by swimming. The central deep section of the HSR is good (washing machine spot), as opposed to the spot behind old mandarin area.

Cement peg (old umbrella base)
South of the wreck at 25msw is a cement peg. There can be one more rope attached to it to go up into the water column to act as a squid rope. The squid might for some reason pick this one over the one north of the wreck. It is worth to try. The rope should not go all the way to the surface. The peg looks Ok with some growth on it, but no extraordinary amount of life is there.

Biorock
The Biorocks proved to be so far the biggest success of the house reef project. All three Biorocks are working, even after 2.5 years from installation of the first one, the Tunnel and with very minimum maintenance. There is quite frequent natural settlement of corals on these structures. The settled corals are mostly the brooding species. Brooding species of coral are faster to come and faster to go. They grow easily but are also highly environmentally susceptible and die fast (e.g. *Seriatopora* sp. or *Pocillopora* sp.*)*. These species are always the first coral settlers and a good indication that the surface of the Biorocks is suitable for natural settlement. There are some small colonies of branching *Acropora* sp., and some tiny *Poritidae* as well as many other species observed.

The layer of the $CaCO_3$ on the Biorock is very thin (Fig 1, 2), given the time it had to accumulate from the water column. The expected $CaCO_3$ thickness should be significantly higher. There could be several reasons for that:

1. There are 3 medium sized Biorocks connected to one another and 4 medium sized anodes. For additional anodes (titanium mesh) is the best to contact Tom Goreau communications@biorock.net. Two of the anodes, close to the blob were moved approximately 1.5m closer to the structure in July 2009. The remaining two anodes can be also moved closer to the Biorocks if there is any effect seen from this. The amount of bubbles should be greater when the anodes are closer, hence when there is more current.

2. The shallow sloping topography of the House Reef did not allow us to create these Biorocks closer to their power source. The Biorocks lie about 120m away from the source, which is on the edge of electric current reaching them.

3. The maximum cable diameter available in Manado when the Biorocks were constructed was 3.5mm, which might not be optimal. Thicker cables would increase the amount of electricity reaching the Biorocks.

4. There is a need for a new battery charger. The battery charger needs to have an energy output set for 12 volts with the outgoing current between 25- 30 amperes. The old battery charger had the 12 volt output missing.

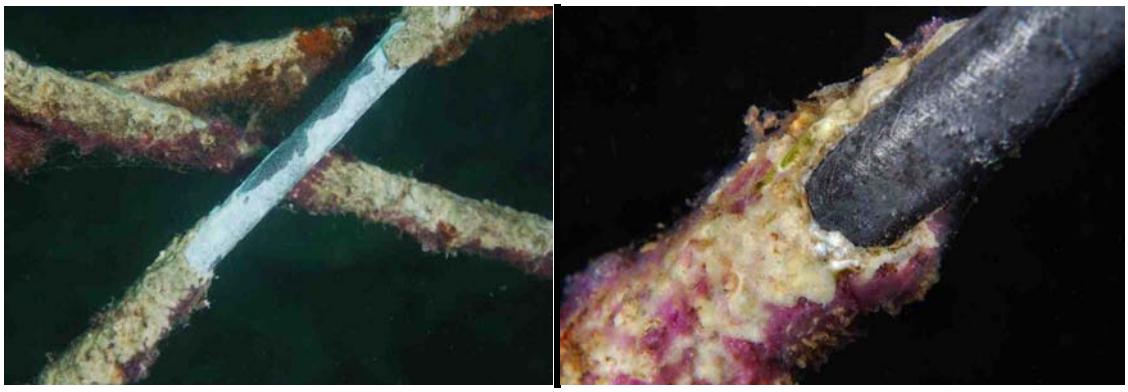

Fig 1, 2: Calcification on the Blob

Nevertheless the Biorocks are working and there is always a large number of fish in or around the structures. There are batfish, triggers, butterflies, damsels, trumpets, gobies, and angel .

There is a need of a regular (monthly) removal of the purple coloured sponge, *Chalinula nematifera* (Fig. 2, 3). *C. Nematifera* is a coral eating sponge and a fast grower, therefore it is a tough competitor for anything else to settle on to the Biorocks.

The coral eating sponge (*C. Nematifera)* (Fig 3, 4) probably settled onto the Biorocks from the water column but was also possibly transported onto the Biorocks with the transplanted coral colonies. When we initially transplanted the corals, we targeted coral colonies which were in some kind of stress (sedimentation, competition, or infected by this coral eating sponge). The colonies, which were infected by coral eating sponge, were cleaned of it, but some remnants might have remained inside the coral colonies. This then spread once again onto the corals and onto the structures. The corals on the structure will most likely die if the sponge is not being constantly removed (Fig:5). This might be a local Lembeh problem, but there is a lot of this particular coral eating sponge around. The sponge settles easily on calcium carbonate surface and therefore settles so readily on the Biorock structures, which have a perfect clean layer of $CaCO_3$.

There has been a lot of research completed lately concerning similar encrusting sponge species, for example *Terpius*, which is also quite a fierce coral eater. In 2008 an outbreak of the *Terpius* sponge was recorded on Green Island south of Taiwan killing 30% of all hard coral.

It had been written that the sponge *C. nematifera* settles mainly on massive corals (i.e. Porites), because it needs sufficient light for the cyanobakteria living inside it to photosynthesise. This is not so in the Lembeh HSR. It also seems to settle quite readily on branching corals. In any case it has been classified as a future possible stressing factor and maybe even threat to coral reefs, (as if there are not enough of those already) and it should be monitored as it might pose a bigger problem than killing the corals on the Biorocks in the future.

Fig 3: *Chalinula nematifera* (Webb)

Fig 4: *Chalinula nematifera* (Biorock, HSR)

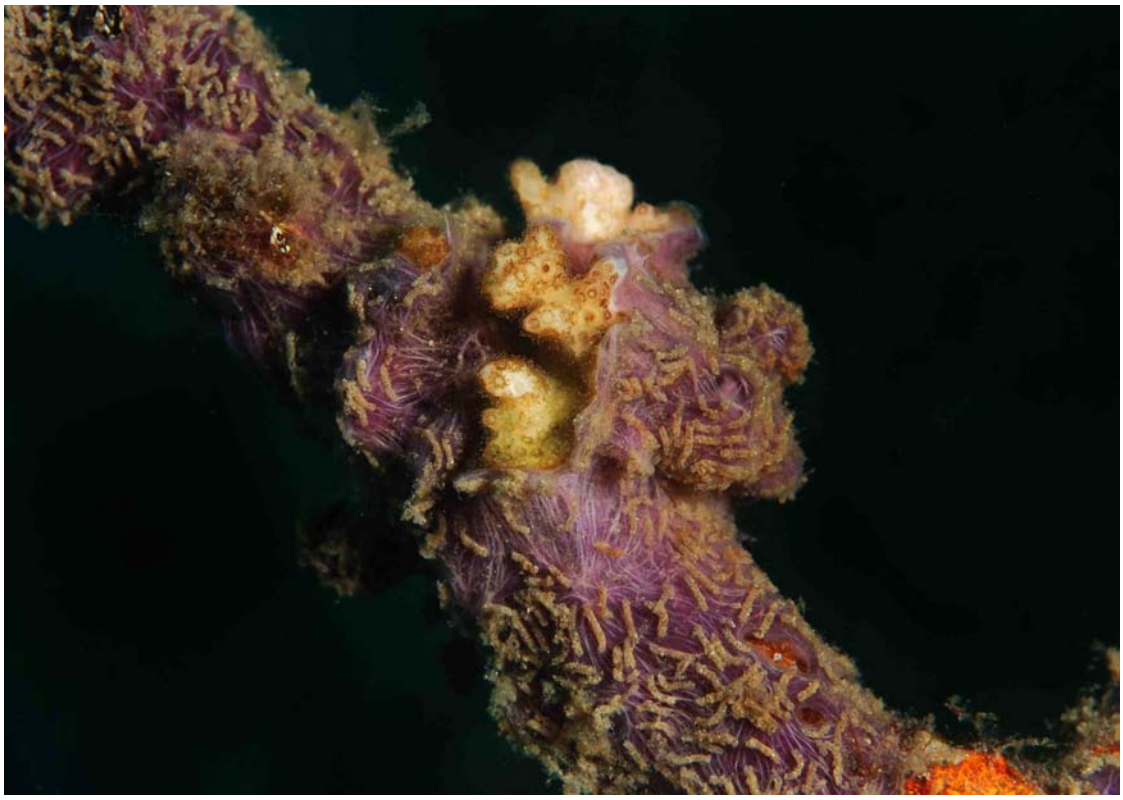

Fig 5: *Pocillopora* sp. Attacked by *C. nematifera* on the Blob.

The other flat, encrusting sponges observed on the structures were of brown/orange coloures (hard to ID) and even though they are not as aggressive as the coral eating sponge, they can be removed with no hard feelings. These sponges act as yet another competition to corals and will also smother them, because they grow so much faster than corals. The same applies to the ascidians growing on the Biorocks.

Competition for space poses one of biggest threats to the newly settled coral spats. Coral spats are a single coral larvae settling naturally from the water column. This coral spat continues to grow into a single polyp (smallest building block of a coral colony; Fig 6). This single polyp will then through rather slow growth lay a skeleton of $CaCO_3$ and then via asexual reproduction called budding, which is in fact everlasting repetition of itself, create coral colony of various morphology and size, depending on the coral species and surrounding conditions (Fig 7).

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Fig 6: Coral polyp

Fig 7: Coral polyp in a small coral colony

The suggestion is to not transplant any more coral onto the structure. The only possible exception would be a colony or a part of colony (quite large) which is in danger of either becoming smothered by sand or otherwise threatened. There is definitely NO REASON to transplant tiny coral fragments onto the Biorock! As stated in previous write ups, small coral colonies have a very small probability of survival and they will most probably, in the conditions of the house reef, die (Fig 8, 9). The reason for that is not only the small size of the colonies but also the added stress factor of high sedimentation due to run off on the house reef. It has been tried and did not work!

Fig 8: Olga's transplanting Oct.08

Fig 9: Olga's transplanting July 2009

Cement Blocks

The blocks in the central section of the house reef (current mandarin fish area) were placed there to consolidate the substrate, which they did. The transplanted corals did not do well and therefore there should not be any more transplanting done! The Blocks though have natural settlement of the following organisms:

* 1-2mm algalfilm
* Sponges (encrusting)
* Sponge (robust)
* Ascidians (both solitary and colonial)
* Coralline algae (purple/pink, very good for future coral settlement)
* *Padina* sp. Mackroalgae
* Coral species (i.e. *Seriatopora* (thorny branching) sp., *Alveopora* sp. and other Porites hard to tell what sp., *Acropora* sp., *Plerogyra* sp. (bubble coral), some Faviidae.
* Bryozoans
* Bivalves- now only skeletons remaining (skeletons made of $CaCO_3$, again a great place for settlement of other marine organisms, i.e.: corals)
* Oysters- now only skeletons remaining

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The blocks placed behind the old mandarin area, which is a 10 minute swim north at 9-14msw, are a little more unsuccessful. The reason for this is most likely increased sedimentation in this area, the substrate is sandy and not rubble, and the structures lie on a slope rather than on flat sand. The blocks are covered by a thick film of silt and this is probably due to the sandy substrate, terrestrial runoff and maybe localised water movements.
Most of the pegs on these northern blocks have been transplanted by fragments of *Anacropora puertogalerie* sp.. Colonies of this species was previously hosting mandarin fish but because it is very fragile it was often broken. Those freshly broken pieces were transplanted onto the northern blocks in approx the same depth. From all of the transplants only 4 show 100% survival and 8 partial survival. The reason that there is any survival at all is probably due to the large size of the transplants.

Otherwise there is the same range of natural settlement on these blocks as on those in the central section (see list above).

Suggestion for the future regarding all blocks: There can be a strong currents running on the house reef and all these blocks are attached into the substrate by metal pegs. The parts of the pegs which are exposed to the seawater will and are rusting away. The blocks should be reinforced by ropes (no need for new ropes, maybe second hand from Bitung). Ropes will probably need reinforcing every 2-3 years, until these block structures overgrow with coral and will hold by themselves, which is the main objective.

There is one more noticeable success with the blocks apart from the natural settlement and that is that they act as fish houses in an area where there was previously only rubble/sand. There were many small reef fish species observed on the blocks feeding or hiding. Invertebrates are also common there. From the mobile invertebrate species there are often large broadclub cuttlefish (*Sepia latimanus*) and sometimes common octopus (*Octopus cyanea*) hiding inside the blocks. Nudibraches sometimes even lay eggs onto the blocks and other gastropods such as cowrieshells as well as echinoderms, mostly starfish, brittlestars and feather stars tend to settle onto them.

Attached articles:

Avila E., Carballo J.L: A preliminary assessment of the invasiveness of the Indo Pacific sponge *Chalinula nematifera* on coral communities from the tropical Eastern Pacific. (2009) Biol. Invasions 11:257–264

Chemical warfare on coral reefs: Sponge metabolites differently affect coral symbiosis in situ. (2007) *Limnol. Oceogranogr*. **(52)2:** 907-911.

Raymundo L.J: Global Climate Change and Reef Resilience Local Action Strategy for Guam. (2008) NOAA gov. state of reef Guam.