PANGAEA
MIKE HORN
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Young Explorers Program -

Malaysia, November 2009
Coral Reef - Reef Check Project

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Compiled by
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1. Reef check

A reef check is a very effective monitoring and data collection tool originally created and used by the international Reef Check association. The reef check system that was used in the Malaysia Young Explorer Program is set up as follows.

Method

A series of scientific transects are laid down on a selected reef. The complete transect is 100 m long, with four 20m sections, each 5m apart. This transects then aids a diver in collecting, without prejudice, data on substrates, fish species and invertebrate in a pre-determined area.

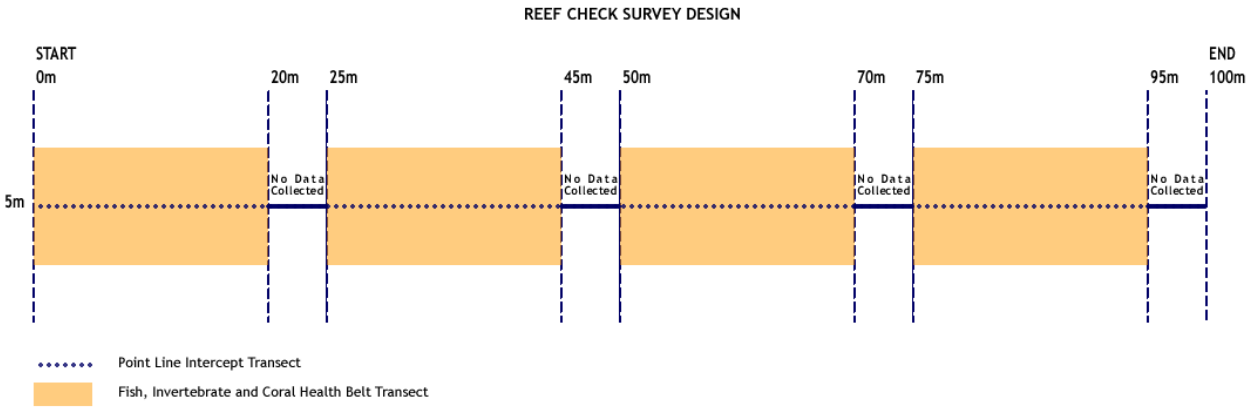


Fig. 1: transect schema (http://members.reefcheckaustralia.org/research/index.cfm)

A coral reef can be split into living and non-living cover. Hard coral are reef builders and therefore essential for coral reefs. The coral condition categories used in the Indonesian region are Poor (0-25%), Average (26-50%), Good (51-75%) and Very Good (76-100%)[1].
The collected data is then analyzed and the results used to evaluate the health of the reef, the biodiversity present on that reef, the effect of human activity on the reef etc.

The table below shows the indicator fish of the reef check and their function in the ecosystem.

Common name	Latin name	Indicators
Butterflyfish (All species)	Chaetodontidae	Overfishing Aquarium Trade
Kerapu (> 30 cm)	Serranidae	Overfishing Aquarium Trade
Grunts/Sweetlips/Margates	Haemulidae	Overfishing
Moray Eel (All species)	Muraenidae	Overfishing
Parrotfish(> 20 cm)	Scaridae	Overfishing
Snapper	Lutjanidae	Overfishing
Barramundi Cod	*Cromileptes altivelis*	Overfishing Live Reef Fish Food Trade *Spearfishing*
Bumphead Parrotfish	*Bolbometopon muricatum*	Overfishing
Humphead (Napolean) Wrasse	*Cheilinus undulatus*	Overfishing Live Reef Fish Food Trade

Table 1: Indicator fish names and ecosystem functions[2]

[1] Habibi, A.; Setiasih, N.; Sartin, J.: A Decade of Reef Check Monitoring: Indonesian Coral Reefs, Condition and Trends; The Indonesian Reef Check Network, 2007

[2] Habibi, A.; Setiasih, N.; Sartin, J.: A Decade of Reef Check Monitoring: Indonesian Coral Reefs, Condition and Trends; The Indonesian Reef Check Network, 2007

Our own experiences

We learned to see, identify, name and count the necessary indicator species, first by going through books and manuals with our expert, Dr. Roswitha Stolz from the LMU (Ludwig Maximilians Universtät) in Munich, then by using waterproof underwater booklets on our training dives. We were taught the correct way to perform a reef check and to collect the data in a scientific manner.
While conducting the surveys we learned a lot about the reefs. We learned to be patient and take our time to discover more and to count all fish and invertebrates.
We were taught by Dr. Roswitha Stolz how to interpret the measured data to be able to conclude the condition of the reef.

At the same time we got firsthand experience on the state of the reefs, learned about the ecosystem, its complexity and its importance for the biodiversity of the seas. Undertaking reef checks in different areas along the northeast coast of Malaysian Borneo gave us the opportunity to see reefs in a range of conditions. We dived in the marine protected area of Sipadan where you find a huge variety of fish, corals and invertebrates and only little damage by human impact. On the other hand we saw reefs which had suffered heavily from dynamite fishing and anchor dropping (e.g. Pegasus reef). We experienced how important the protection of these marine ecosystems is: The protected reefs are full of life, colours and forms. The unprotected ones seem like graveyards.

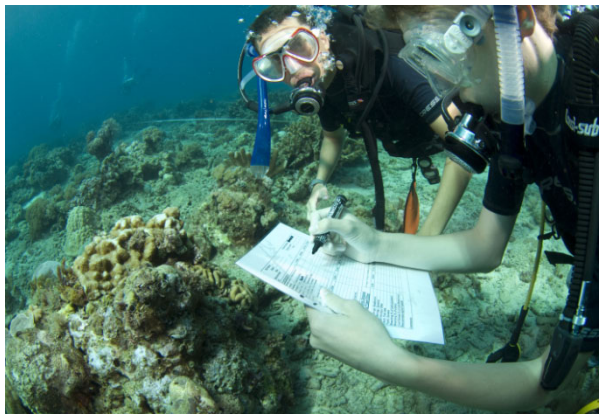



Fig. 2 and 3: Young Explorers performing a reef check (Photo: Mike Horn SARL/Dmitri Sharomov)

Importance of Reef Checks

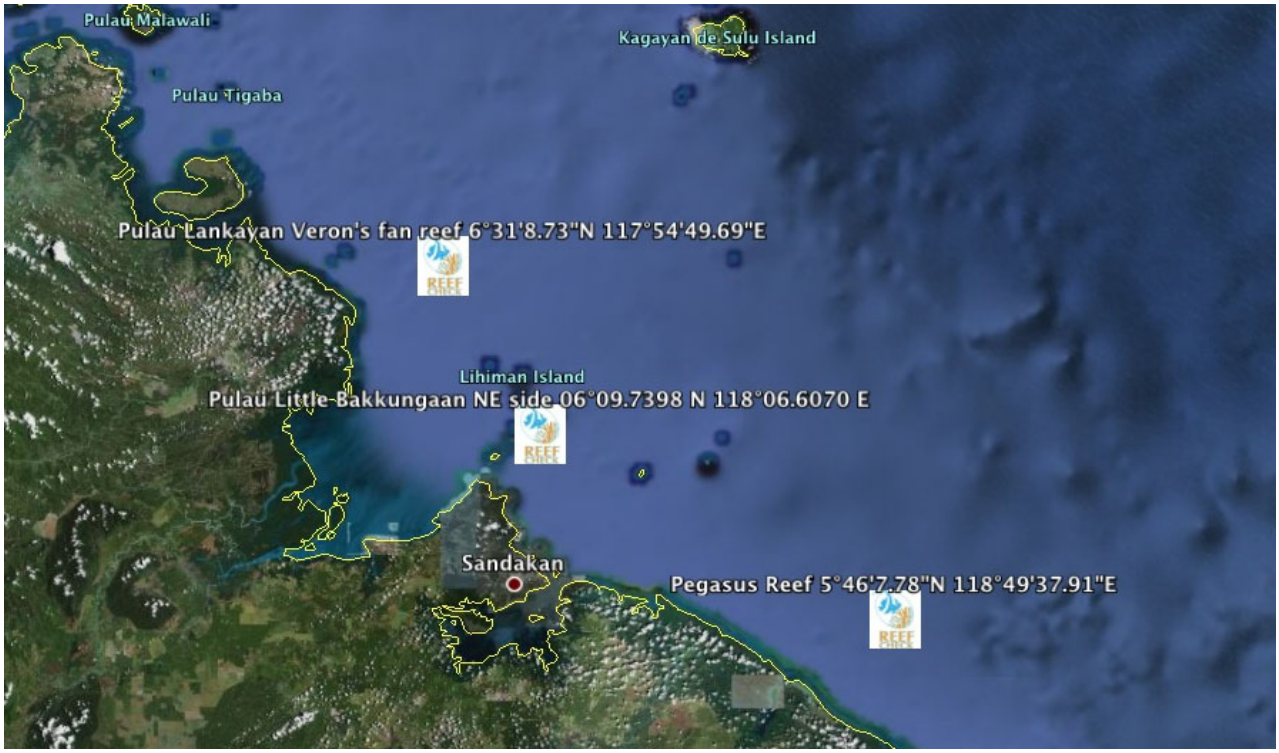
By monitoring coral reef changes over time, we gain insight into how reefs respond to human impacts as well as to crown-of-thorns starfish, cyclones and other natural impacts.
These surveys provide valuable data to scientists without which they would be incapable of continuing their research on coral reefs and this would hinder the growing understanding of coral reefs and how to conserve them.
Reefs in all seas are under enormous pressure: sedimentation, overfishing, destructive fishing, global climate change are only some of the biggest impacts on the reefs.

However our world needs coral reefs. They provide direct sustenance in terms of food especially in the region of South East Asia and are a great source of diversity. Moreover they shelter coastlines from storms and tidal waves and create a substantial source of income for the area through the tourism industry. Research also indicates that coral reef animals like sponges are an important source of medical cures for a number of diseases including, potentially, cancer.

Reef checks help to identify which places need special protection.
We need to maintain the health of the reefs. By performing reef checks we can create a solid

baseline - an original record of coral reef health that can be used for future comparison.
As the reef check program works with volunteers it is not only a good way to collect data. At the same time you teach the volunteers about coral reefs and they'll share their experience with others. Performing reef checks is also about raising awareness!

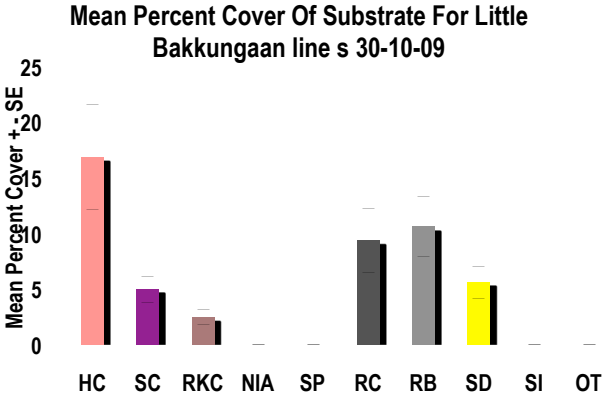
2. Scientific results



2.1. Pulau Little Bakkungaan NE side – Sabah – Malaysia

Date: 30.10.2009 Time: 4:00PM-5:00PM (Local Time)
Coordinates: Latitude: 06°09.7398 N Longitude: 118°06.6070 E
Temperature: Air: 31°C
Water Surface: 29°C
at 3m: 29°C
at 10m: 27°C
Visibility: 25m
Distance from shore: 100 m
to nearest river: 18,5 km
to nearest population centre: 33 km Population size: 200'000

2.1.1. Substrate

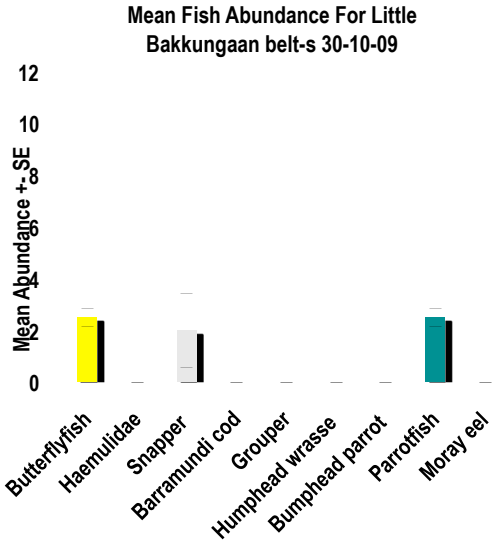


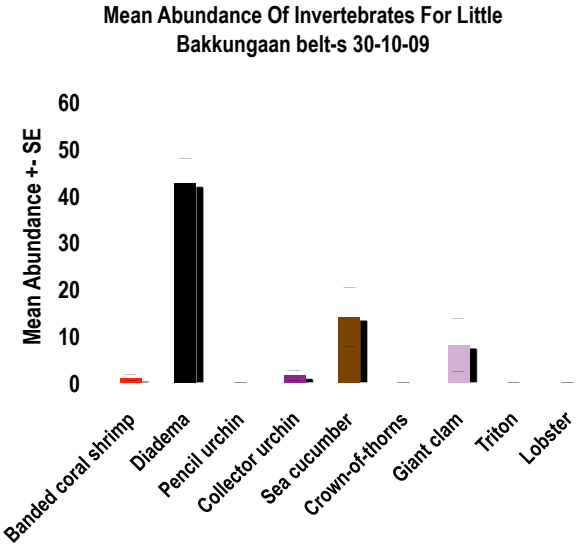
Substrate Code

HC	hard coral	RC	rock
SC	soft coral	RB	rubble
RKC	recently killed coral	SD	sand
SP	sponge	SI	silt/clay
NIA	nutrient indicator algae	OT	other

Among the living substrate hard coral are dominating. Totally hard coral make up 17%, soft coral 7% of the coverage. However 2,5 % of the coral have been recently killed. The other parts of non-living cover can be divided into rock (9%), rubble (11%) and sand (6%).

2.1.2. Fish and Invertebrates





Along the belt transect Butterfly fish, Snappers and Parrotfish were spotted in rather low numbers. Moreover Banded Coral Shrimp, Collector urchin, Sea cucumber, Giant clams and many Diadema were found on Little Bankkungaan Reef

2.1.3. Impacts, bleaching and diseases

Some older signs of dynamite fishing and some fresh signs of anchoring can be found. However these impacts can be considered as low. Some bits of trash, mainly plastic and fishing nets where spotted. Roughly 5% of the coral were bleached and 5% had diseases.

2.1.4. Interpretation of the data – Condition of Little Bakkungaan reef

Considering the categories of hard cover coverage the condition of Little Bakkungaan with 17% hard coral coverage is poor.
The lack of Groupers and Humphead Wrasses and other indicator fish points to overfishing on Little Bakkungan reef.

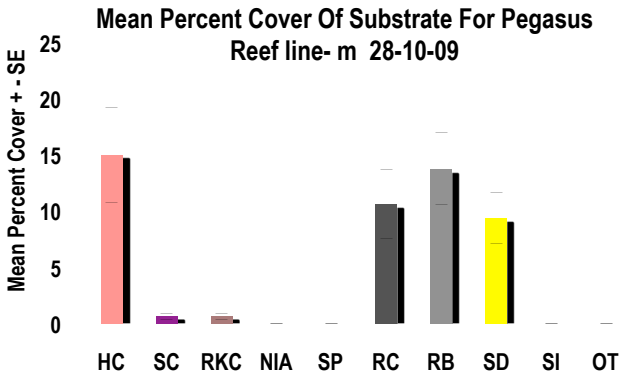
Along the transect a high number of giant clams was found, this indicates low over-harvesting. The number of Diadema is high. This points to a small number of predator fish and as a consequence to overfishing. Diadema are bioeroders, they feed on coral and destabilize the reef. They cause reef erosion if the number of predator fish is too low. However they limit the amount of algae growing on the reef. If the diadema disappear, due to diseases or overfishing, algae would overgrow the coral.

2.2. Pegasus Reef

Date: 28.10.2009 Time: 4:30PM-5:30PM
Coordinates: Latitude: 05°46'07.78" N Longitude: 118°49'37.91" E
Temperature: Air: 31°C
Water Surface: 29°C
at 3m: 29°C
at 10m: 27°C
Visibility: 20m
Distance from shore: 27 km
to nearest river: 27 km
to nearest population center: 78 km Population size: 200'000

2.2.1 Substrate

The only living substrate along the transect was hard coral (15%) and soft coral (less than 1%).
The non living cover can be divided into rubbles (13%), sand (10%), rocks (10%), and recent killed corals (less than 1%).

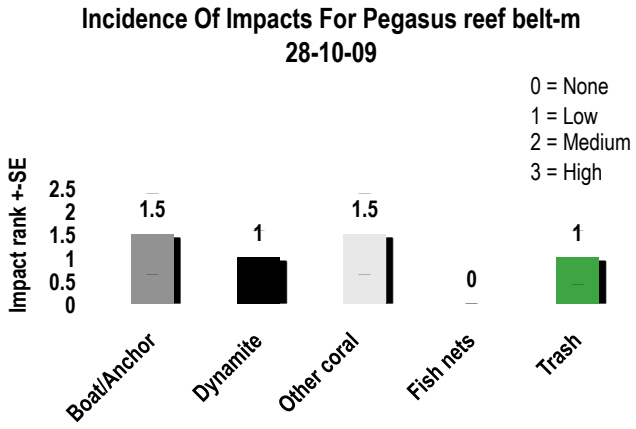


2.2.2. Fish and Invertebrates

Only a small number of fish was found. 2,5 Butterfly fish and only 0,5 Sweetlips and Parrotfish in a 20m section.

A single lobster was spotted; no other invertebrate could be sighted.

2.2.3. Impacts, Bleaching and diseases



The human impacts on the reef were high. Anchor dropping as well as dynamite fishing and other damages have destroyed almost the whole reef. There is also trash, mainly plastic, floating along the reef.

Many coral (>20%) were suffering from bleaching and almost 7% from various diseases including bluish black dots on their outer surface.

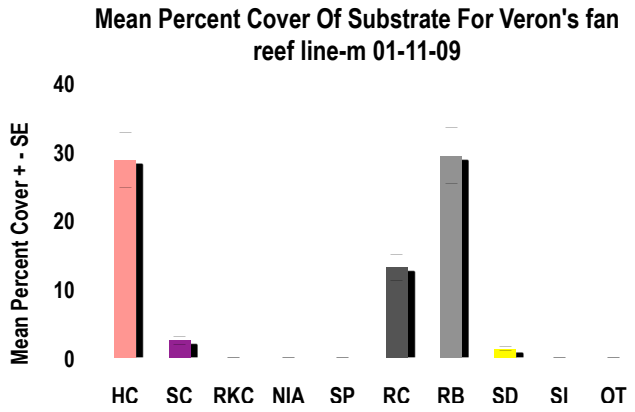
2.2.4. Conclusion – condition of Pegasus Reef

With a hard coral coverage of 15% and less than 1% soft coral the Pegasus Reef can be considered to be in poor condition.
Moreover the low numbers of fish and invertebrates are shocking. Not only due to the low condition of coral but also to the high impact of fishing, the reef is almost dead. The few fish which were spotted were very small. The reef is a highly damaged area presenting no colour. The site is non-sheltered and therefore exposed to human impacts especially boat anchoring, and blast fishing. Trash and bleaching are others reasons which put pressure on the corals' health.

2.3. Veron's fan reef –Pulau Lankayan– Sabah – Malaysia

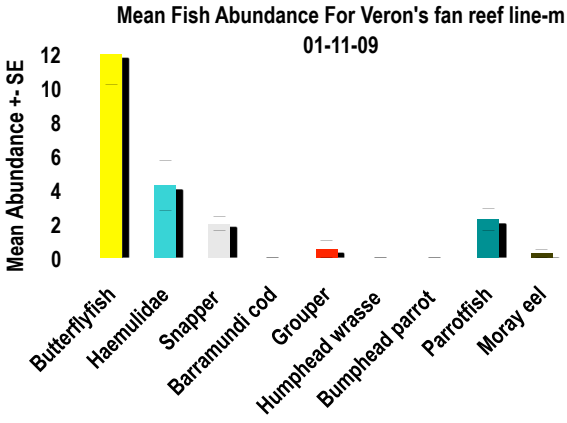
Date: 1.11.2009 Time: 4:30PM-5:30PM
Koordinates: Latitude: 06°31.1455 N Longitude: 117°54.8282 E
Temperature: Air: 31°C
Water Surface: 29°C
at 3m: 29°C
at 10m: 27°C
Visibility: 20m
Distance from shore: 800 m
to nearest river: 22.4 km
to nearest population center: 75 km Population size: 200'000

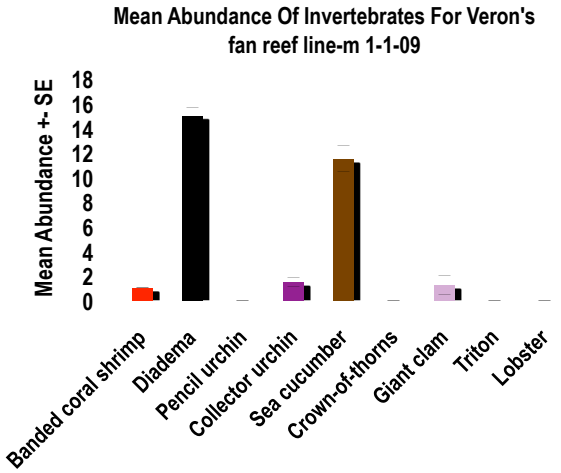
2.3.1. Substrate



On Veron's fan reef (Lankayan Island) the results of the reef check show a high percentage of hard corals (30%) and 5% of soft coral. The non-living coverage of the substrate can be split to 30% rubble, 15% rocks and 2% sand.

2.3.2. Fish and Invertebrates





The graph shows a high amount of Butterfly fish for the Veron's fan reef, followed by Haemulidae (Sweetlips). Almost the same amount of Snappers and Parrot fish could be found. Moreover a low population of Moray eels and Groupers was spotted. A great population of Diadema was found as well as a smaller population of Sea Cucumbers. A low percent of Collector Urchins and Giant Clams could be seen too. Banded Coral Shrimps were rare.

2.3.3. Impacts, bleaching and diseases

The coral on Veron's fan reef were healthy and showed a really low amount of coral bleaching (1%).
Some old signs of dynamite fishing were sighted. No impacts by anchoring or trash were tracked.

2.3.4. Conclusion of the data – condition of Veron's fan reef (Lankayan)

Veron's fan reef is in average condition concerning the hard coral coverage (30%). The variety and abundance of fish as well as invertebrates is high. This indicates a low rate of overfishing respectively overharvesting. However the number of bigger fish like Barramundi or Groupers as well as the amount of Diadema suggests an impact of the fishing industry. On the reef bleaching is rare.

2.4. Comparison of Little Bakkungaan, Pegasus and Veron's fan reef

Pegasus, Little Bakkungaan and Veron's fan reef are all situated along the north east coast of Malaysian Borneo.

Only Veron's fan reef is part of a marine protected area called SIMCA (Sugus Island Marine Conservation Area).
There is a low overall anthropogenic impact: blast fishing and yachts cause changes. There is a medium impact of tourism. Divers and snorkelers from the near Diving Center enjoy the beauty of the coral. In SIMCA limitations and prohibitions of fishing exist and are enforced.

Commercial fishing, recreational fishing, invertebrate or shell collection, anchoring and spear fishing are forbidden. This affects the reef and can be seen in the collected reef check data. On Veron's fan reef the highest hard coral coverage, the biggest abundance and variety of fish and invertebrates, the least bleaching and the smallest signs of human impact could be found. The reef is monitored regularly.

Little Bakkungaan reef is situated at the rim of a marine protected area. Spear fishing, commercial fishing, recreational fishing, invertebrate or shell collection are banned on this reef. The near island is not habituated and at the far northeastern end of the protection area. This allows easy access for poachers. Illegal fishing affects the reef. The conditions are not as good as on Veron's fan reef however better than on Pegasus reef. On Bakkungaan reef there are low impacts of overall anthropogenic activities: commercial fishing, cyanide fishing, blast fishing, harvest inverts for food and yachts.

The state of Pegasus reef is disastrous due to human impacts. This reef is situated offshore without an island. The reef is highly damaged, three fishing boats were anchoring at the reef while we were doing the reef check. During the night light fishing is done. There are medium effects on the reef by blast and commercial fishing and the overall human impacts. Moreover there is a low impact of sewage pollution. These facts show how important the protection of the coral reefs is and how easily they can be destroyed by wrong fishing techniques, overfishing and many other impacts.

3. Artificial reefs

The consequence of dynamite fishing, anchoring and other human impacts is the destruction of coral reefs. It takes a long time for a reef to rebuild, if it does at all. However it is possible to aid the building process by installing artificial reefs.

Pangair – artificial reef project YEP Malaysia

Just in front of the Jetty of Lankayan Island you find the House reef. Many artificial constructions, made out of wood and steel, for example, can be found there. These man-made features in the underwater park provide a habitat for a stunning variety of life.
Within less than a day we planned, constructed and sunk our own artificial reef, Pangair airplane, from Pangaea.

Fig. 8: Planning our artificial reef
(Photo: Mike Horn SARL/Dmitri Sharomov)

Steel rods were bent, sawn and welded by the nine Young Explorers, Mike Horn Team and crew members. Wings and Body were transported separately to the Jetty.
After attaching and sealing a simple battery to the body of the airplane, so we could run a low voltage current through it, the two parts of the construction were sunk. After placing the body, we attached the wings using wire.

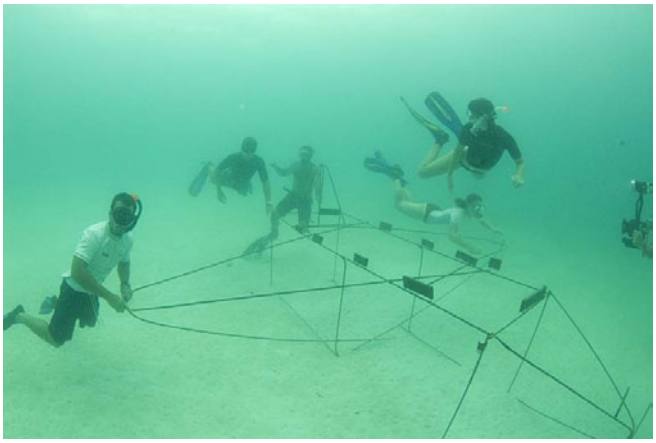


Fig. 9: Pangair
(Photo: Mike Horn SARL/Dmitri Sharomov)

The low current will encourage coral to grow on the steel. And after some years our construction will become a real coral reef, hopefully. Building this structure illustrated how easily you can act for the environment if you just have the determination to start. It actually is a lot of fun as well. It was an eye opening experience because we designed it, built it and installed it in less than a day and mostly on our own.

Underwater play park by Daniel Vivier

My idea would revolve around placing elements usually found on land, underwater. The largest objects would be buildings. I would build large, most probable 2 story, buildings, such as houses, apartments etc. these would be easily accessible through large windows and doors that would be unobstructed and that would allow safe entry and exit for the divers. I would keep the structures quite clutter free on the inside, using the whole structure and its design rather than its contents to create the pleasure for the divers. The buildings would be grand yet simple, foreboding yet intriguing. I ultimately would like to create the feeling of a

ghost town, with a myriad of buildings all around, all in a state that makes it look like the whole town and its occupants left suddenly without taking much. I would also place cars, bicycles and various other objects commonly associated with neighborhoods in the underwater playground.

The playground would essentially be a forgotten underwater world and as time passed, the coral would grow, spread and completely claim all the structures and transform the playground from a sunken suburb to a modern Atlantis.

All the materials used in the underwater playground would be eco friendly materials that are naturally bio degradable and allow the coral to naturally take over. The practices of the underwater park management and dive facility would be completely green and carbon footprint neutral. All transportation would be hydrogen or solar power, at the very least hybrid. The center and dive facility would also use renewable and sustainable fuels and garbage and waste disposal would be done and managed in an environmentally friendly and sustainable manner.

Underwater play park by Kerstin Dörner

The depth of the park should be between 5 and 25 meters. In this depth coral grows best, as there is enough light and it is deep enough not to be harmed by tourist or fishing boats.
My idea is to set up a fish tipi camp.
This camp consists of some tipis in different heights and sizes, a camp fire and a totem pole.

Fig. 10: Plan of the tipi camp

Tipis can be constructed using three, four, five or more poles. The poles could either be wood or steel. Instead of buffalo skin, wire netting is used for the tipi walls. Some tipis have no walls but many poles instead. You can either leave one side completely open or you can cut the wire to make an entrance. If the access is rather small the netting should end 50-70cm before the top. Then small fish have the chance to escape in case a predatory fish enters the tipi.

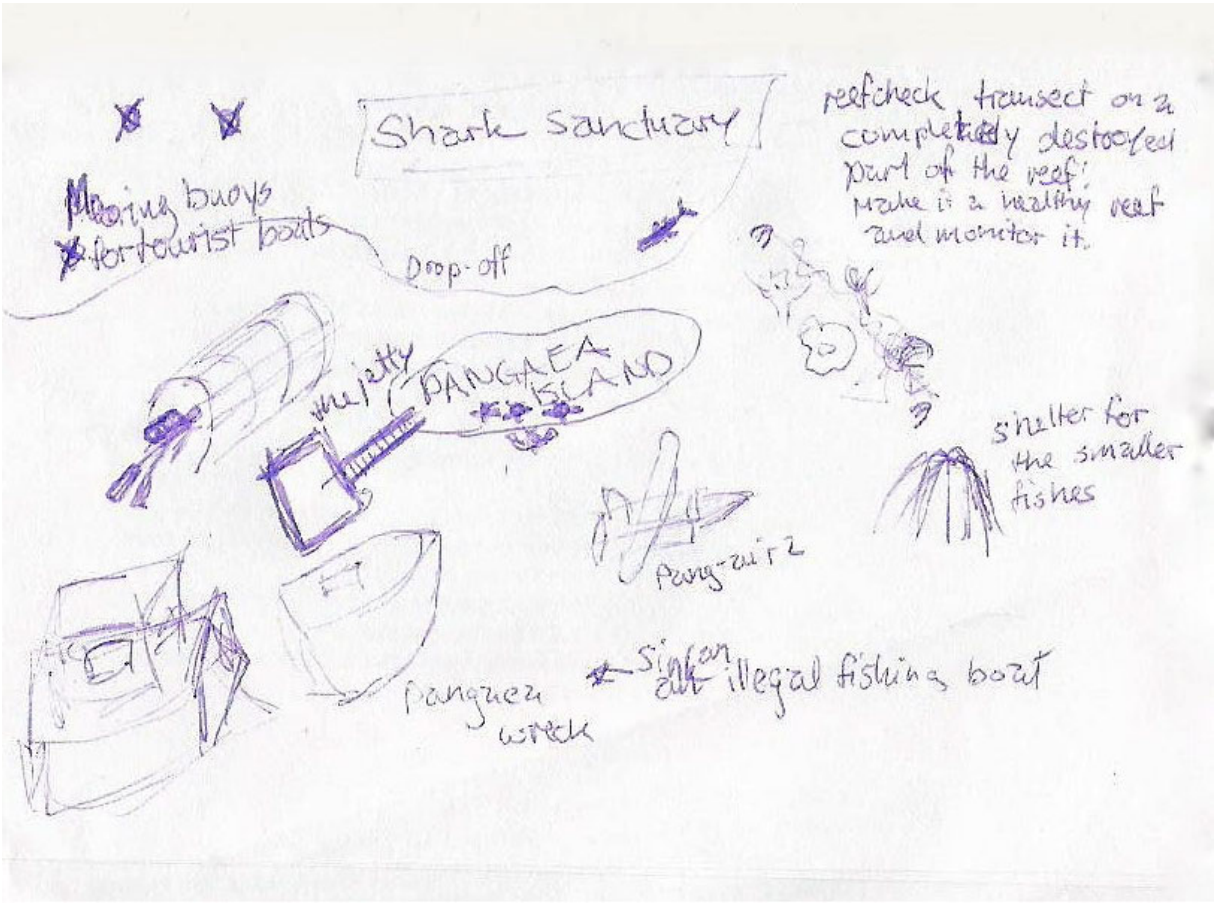
These tipis have a perfect shape to allow coral growth. The surface area, the netting, is large and voltage can be applied easily. Because of its conical shape, more coral will be able to grab a little bit of sun light than they would on a perpendicular wall. Once coral starts growing the structure will become more and more robust.

Underwater play park by Rodrigo Steinman

There will be a pre-structure at the bottom of the sea. This structure can be a circle, a square, a triangle, anything. It will have some holes, which will stand for the pieces that the divers will connect.
By the structure's side there will be a box full of sticks of different forms and sizes, which the extremities all fit in each other and in the wholes on the pre-structure. The diver will choose a stick and connect it either to the pre-structure or the extremity of another stick (that another person has already connected).
As people participate and connect their sticks on the structure, it will get bigger and bigger. It won't have a determined form like a plane, wreck or anything like that. It will be formed as the divers put the sticks together.
There will also be a place where the diver can sign, something like "I helped to build this structure and help the marine life", and then the names and nationalities.
The sticks will be like tubes, with 30-40cm long and 5cm diameter. I can't think of a better material then plastic, something like the water tubes that we use in houses.
It's also necessary to have some data about the marine life's threats, for example: "In Malaysia 20% of Hard Coral has already been killed by dynamite fishing", informing the divers why they need to help the Malaysian marine life.

Plan for a protected island by Michelle Nay

I thought of making another Pang-air and a tunnel for the divers to have fun and a smaller structure for the small fish to hide like they do in a natural coral reef. I'm curious on how the tunnel would look like in some years because I can imagine that it's going to be fantastic to dive under the corals, like a cave!
I would also love to sink an illegal fishing boat there, because it's always interesting to dive in a wreck and there are usually a lot of fish. If possible we could employ the fishermen and let them manage the park instead of despoiling the ocean!
Pangaea-island should be accessible to the tourists, but they should come by boat and moor it at the installed mooring buoys and sleep on the boat.
It depends on the circumstances, but if there's a drop-off on one side of the island it attracts sharks and we could make a shark sanctuary there. On the other end of the island we could make a nesting spot for turtles where they can hatch without any disturbances of people! Therefore there's no hatchery necessary.
To prove the progress of the coral reef we should take a completely destroyed part of the reef and lay a transect there (or better only mark the ends of it) and monitor the reef regularly and hopefully you can see an improvement!
I made a little drawing on how the island could look like...



How to continue...

The first step is to sum up and publish our checks results to inform a maximum of people in order to raise awareness.

Moreover reef checks should be performed at the exact same positions once a year to be able to track the changes of the reefs. It would especially interesting to see if and how the coral grow on our artificial reef Pangair.

We believe that reef checks should be conducted on reefs all around the world, for example in the Mediterranean Sea. For each region indicator species need to be found and a new method of reef checking must be implemented. We need to get diving schools in Italy, Croatia, Greece and other countries involved to be able to monitor the European coral reefs and to protect them