

# **Phi Phi Tsunami Dive Camp**

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This project has evolved somewhat over the past 4 months as have our goals and methods. This report will outline the work that has been undertaken, the methods we use and the problems we encounter and precautions to any other groups undertaking similar projects.

## **Short term and long term goals**

Phase 1: Removal of debris caused by the 26<sup>th</sup> December Tsunami from all beaches and underwater areas surrounding the Phi Phi Islands.

Phase 2: Monitoring and rehabilitation of corals in areas badly affected by the Tsunami wave.

Phase 3: Education, conservation and future monitoring of the beaches and reef areas in the Phi Phi group of islands.

## **First Weeks**

Our first efforts were applied for the first few weeks in the shallow sandy areas just off the beach. This first area is/was heavily littered and immediately obvious was the amount of debris that was partially or completely buried by sand. The closer to the beach the more items were buried. In some cases we have found items such as bicycles, cement mixers, cabinets, washing machines buried 1.5 meters beneath the sand with only a portion exposed.

To cope with this we constructed a D.I.Y. sand dredger from 2" PVC piping and connected it to the low pressure supply of a scuba tank. Although the 'airlift' was able to lift the sand, we found that the air supply was far from enough for the amount of work it was needed for. Therefore we decided to leave heavily buried items to a later date when we would be better prepared.

We constructed a makeshift pontoon out of kayaks and proceeded to collect debris with divers underneath and snorkelers on the surface.

In the first couple of weeks we removed approximately 10 tons of debris and averaged 25 people per day.

## **Change of plan**

Although from an aesthetic point of view and also because of the potential hazards to bathers the shallow beach areas are important to be cleared, we decided it would be better to focus our attention on reef areas that would more immediately benefit from the clean up. Although there was a huge amount of debris on the sandy substrate, it was obvious that these areas could wait, whereas areas that had debris covering corals seemed more important in order to prevent further damage to the corals.

Therefore with the use of a boat hired from Phi Phi Scuba, divers and snorkelers proceeded to work along the shallow reef fringing the west side of Tonsai Bay. Surface support crews were assigned jobs according to individual skills and experience. Jobs included in-water assistants, kayak duties, pontoon managers, boat detail, and beach crews. The objective of the surface crews was to streamline efforts made by the divers and to collect the debris located by the divers. At this time we found that due to the amount of debris a ratio of 3 snorkelers per diver was appropriate. On days where we found we had lesser numbers in the surface teams the divers found themselves wasting time waiting for equipment and support.

## **Note**

*It is important to carefully monitor the actions of people whenever working around coral areas. Enthusiasm and the desire to help quite often leads to people attempting to do things beyond the*

*scope of what is possible and can cause more damage than good. We found ourselves needing to repeat time and again the importance of only attempting to do what was really possible.*

At this point we were also given permission by the local 'Or Bor Tor' to dismantle the floating pier and use it as a work station.

The divers were split into buddy teams and were provided lines with plastic bags attached to them. (These lines were long enough to reach the surface). They would attach these lines to items too big to place into bags, but items still light enough to be pulled up by hand to the surface. Buddy teams were instructed that only one person would tie off items whilst the other buddy would carry all the lines and a couple of spare net bags.

Target items included sheets of corrugated metal, pieces of timber, plastics etc. Once the divers had surfaced enough marker bags the snorkelers would reposition the floating pontoon to the area and then pull up the items and place them onto the pontoon. Coloured bags were used to help the snorkelers identify which items could be pulled up. Green bags for liftable items, red bags for items that would need a lifting device to bring up the item. After using all the lines available the divers would use the net bags to collect smaller items like plastics, clothing etc.

#### **Note**

*We found pontoons very useful as work stations rather than having boats moving around the area, which does make the divers very uncomfortable when they hear the engines above them.*

*We also found using the method of long lines better than the method used by other teams that have come to clear up, where they would just tie a plastic bag to the item and then hope that the item would float up to the surface. On many occasions we have found these items have floated off and sunk back onto the reef in another area.*

During this time emphasis was on removing as much metal as possible and timbers that could damage the coral through collision or by covering the corals. At this time it was prudent to allow only divers with a minimum of 100 dives experience.

#### **Important**

*Much of the debris in this area was covered by large quantities of sand which has probably been the hardest obstacle to tackle during this project. Apart from making it harder to remove the item there is an even more important issue which is to avoid stirring up sand in areas close to corals in case of covering the coral polyps. Therefore divers are instructed to carefully remove sand from items (especially sheets of metal) as low to the bottom as possible, so that when lifted to the surface there is very little disturbance and the sand settles quicker.*

*We strongly recommend to any other clean up projects to minimize disturbing the sand as little as possible.*

Whilst most of the divers worked in one area lining off items a second team worked in another area lifting larger objects using 40 ltr water tanks. This job was only assigned to certain divers with appropriate experience and all other divers were cautioned to stay away from the heavy lifting team. Although quite primitive we found using these tanks extremely effective and cheap for lifting even the largest roofs. Since our working depth was from 2 to 9 meters it was not difficult to raise items safely once a good system was found. Once raised the item would be dragged onto the beach by the surface crews.

#### **Note**

*Many of the roof sections removed were already beginning to deteriorate. One worry was that the roof sections could fall apart on ascent. It is important to attach reinforcement ropes to sections of roof prior to raising.*

During March the DMCR arrived in Loh Da Lum Bay to complete the removal of debris started by them previously. Our teams joined Mr Phaitun to assist for the day and the general consensus was that there was hardly any debris left to remove in this bay. (Please see separate assessment- 'Loh Da Lum Bay').

By the middle of March we had collected approx 35 tons of debris and we were averaging 40 volunteers per day (10 to 15 divers) including 10 Thai staff. The funding for the project was now covering the wages for the Thai staff and accommodation and food for all long term volunteers, boat and tank rental, equipment for cleaning and other necessary items. The debris that we had collected was removed and placed onto barges by the private company commissioned by the government to collect the debris on the land. In total they filled 10 truck loads from the items that were recovered.

## **2<sup>nd</sup> Month**

Prior to starting the Phi Phi tsunami Dive Camp the Thai Marine Department had been also working in the area and had left behind a very large pontoon that was piled full with debris. After noticing that some of this debris was starting to blow back into the sea, we chose to commandeer the pontoon, remove the debris, and use the pontoon for our project. This helped us immensely and we proceeded to use this pontoon adjacent to our 2 other smaller pontoons for the next few weeks.

For the following month we stayed in exactly the same area due to the amount of debris. We were systematically moving along as each section was cleared, or to a point where we would have to return later with the sand dredger.

## **R.A.I.D. team**

At the beginning of April we were joined by a French Police team called R.A.I.D. consisting of 18 professional French police divers. They were funded jointly by the French Red Cross and the French Embassy. Arranging the group to come was difficult as some of the authorities had stated that all the work had already been completed and there was no longer any use for them. They assisted in raising some of the larger items including a 7 ton roof that washed into the sea intact. This proved to very difficult and eventually we dragged it out to deeper water, stripped it down as much as possible and have now left it to create an artificial reef. In total the French team worked for 2 weeks and assisted in removing 20 – 30 tons of debris.

Also assisting the French team was the Marine Department, using a zodiac and the large Marine Dept. boat. On departure the Marine Department took back the pontoon that we had been using to great success. The pontoon was then towed to Krabi where it was disassembled and left on the mainland.

## **Body Recovered**

On the 13<sup>th</sup> April we recovered the first and so far, the only, corpse of a woman that was mostly submerged in sand and covered by other debris. The body was sent to Krabi by the local Thai Tourist Rescue Police and is yet to be identified. Although we get daily findings of bones, they invariably result in the discovery of animal bones. Generally if the bones are found on the surface of the sand there is almost no chance of finding other bones as it has probably drifted in from another area. If the bone is still embedded in the sand there is a very good chance of finding more bones.

On occasion we still find the odd human bone.

All bones found are collected and handed to the nurse at the Hi Phi Phi Clinic.

### **Note**

*Considering the state of the area that we found the body and the amount of buried debris there, it would be prudent to assume that there could be more bodies to be found in this area. We have just completed building a new 'airlift' sand dredger that is attached to an old second hand compressor. To reduce the amount of disturbance of the sand, we have also built a filtering tank that helps us to deposit the sand again in another area. Creating a 'coral friendly' sand dredger has been a difficult but important task. We plan to start using the dredger this week. Unfortunately the compressor for the dredger is not powerful enough to give enough lift in the very shallow areas where it is most needed. (Please see our list of requirements).*

*The recovery of human remains should only be undertaken under the supervision of the local authorities and only by selected persons. All other divers are required to move away from the area during the follow up searches and recovery. To assist the authorities in this matter, 3 of our staff have been certified as Thai Rescue Tourist Police Volunteers.*

In the middle of April our teams moved to the tip of Tonsai bay and we proceeded to work back into the bay cleaning both the reef and the beaches. This whole coastline (Tonsai Bay west side) has now been cleaned to about 95%. Most of the work involved here was for snorkelers in the very shallow areas and so our teams were split up to cover 2 areas, with the snorkelers in one and the dive team and their support in another. Our floating pontoons were moved out to the area and we commissioned more longtail boats to ferry the debris from the beaches back to our main dumping zone.

### **Unnecessary Obstruction of Work**

At this point we were instructed by the local authorities to stop dumping debris at the west end of Tonsai Beach as it was deemed too awkward to remove the debris at a latter date. This we found to be inaccurate advice due to the fact that for the previous 2 months the trucks and diggers had already been removing the debris from this area. The result was due to effect us over the next 2 months as we were forced to tow our pontoons to the far end of the bay which has cost us time, manpower and money.

### **Pattern Forming**

From the quantity of large deposits of debris in certain areas, it is possible to dictate the journey made by the tsunami. The larger of the waves entered Loh Da Lum Bay from the north west, traveled into the bay until it met the land on the east side and was forced around the headland until it was traveling south west. The wave then passed over the peninsular where it encountered a smaller wave entering from the opposite direction. The smaller wave was counted out by the larger wave and the larger wave continued through taking 90% of the debris into Tonsai Bay. As the wave receded from the land it took with it debris, the top layer of sand (both on land and in the shallow waters) and a large amount of the shallow water corals and drew them out to sea. From their point of origin, heavier items like building materials, metals and large lumber traveled less distance, sank quicker and the debris more concentrated, whereas lighter and more buoyant items like plastics traveled further, sank slower and the debris more spread out.

*Some of the information from eyewitness accounts of people swept along by the tsunami was used to help reinforce this hypothesis.*

By the end of the 2<sup>nd</sup> month, we were averaging 80 people per day including 30 paid Thai staff and had removed 80 tons of debris. The most common item to remove has been the corrugated sheet metal. Unfortunately, the most awkward material to remove has also been the sheet metal as it is usually covered in sand.

### **3<sup>rd</sup> Month**

#### **The pier**

At the end of April we once again moved locations and started working in the heavily littered area next to the pier. At the same time we started to use a new method with the use of the lift bags and nets that were donated to us by the French R.A.I.D.

Teams of 3 or 4 divers lay large nets on the bottom (each marked with a marker buoy) and proceed to fill the net with as much as it can hold. Smaller net bags are employed to collect smaller debris and once full are placed also in the large net. Once full the marker buoy is replaced by a safety sausage to indicate the net is ready for lifting.

A second team of 2 divers follows up the first team and ties the large net into a packet and then lifts it with two 100 kg lift bags. A long tail boat then ties off the net and then draws the net to the beach where the beach team empties the net onto our dumping site.

This method has been extremely successful and we have increased our volume of recovery immensely.

Items recovered next to the pier included a lot of large masonry. Thousands of paving slabs, bricks and mortar have been removed. These have littered the beach area from 0m – 7m depth. Surface teams have been working for weeks walking the shallows and picking up the masonry by hand. The bricks have been collected and are being used to repair roads around the island that were damaged.

Many coconut trees were also washed into the sea here. The trees are quite buoyant and new trees have appeared over the last few weeks so we included them in the list of things to remove. We believe at least 30 tons of coconut trees have been removed so far.

### **Governor of Krabi**

During a meeting with the governor of Krabi Mr Arnont Promnart, we were informed that he would help us and instructed the Marine Department to return the pontoon to us. He also requested a letter from us outlining what else we needed and this was sent at the beginning of May. As of this writing we have not yet heard back from him or his department.

By the end of 3 months we had collected approximately 120 tons of debris. We averaged 80 people per day (15-20 divers) including 30 Thai staff.

### **4<sup>th</sup> Month**

By the end of May and due to the high tides during this period most of the accessible work for the snorkelers was complete.

There is still work to be done by the snorkel crews but it is more efficient to wait for periods of low tide to continue.

Snorkel teams and beach crews are now focusing on removing debris on the east coast of Loh Da Lum Bay. Due to the rocky terrain it is quite a difficult job operating in the area. Although there is a lot of tsunami debris in this area, much of the debris is pre-tsunami. Large surf coming in from the west is making it impossible for the boats to beach in order to transport the collected debris to our main dumping area and so far all the debris is being collected and bagged for removal at a later date. Meanwhile during the low tide periods the beach teams are walking through the shallow sand flats, removing rice sacks, masonry and plastics. One of the pontoons has been towed around to Loh Da Lum Bay.

As the monsoon season is now upon us we are seeing a drop in numbers to 55 persons a day. Fortunately we are protected in Tonsai Bay from the heavy wave action, but the strong winds now travel across the peninsular making it cold and hard work for our surface support teams. Some days we are forced to stop work due to the weather.

Construction of our new sand dredger is complete. It consists of a second hand low pressure compressor attached to two 2" flexible hoses that draw the sand up to a 1600 liter depositing tank. The tank has a 4" dumping hose that is extendable and deposits the sand away from the area and close to the bottom, thus reducing the amount of disturbed sand.

Work for the sand dredger around the pier has been completed and we are now working in front of Arida Resort where the bulk of the work is for the dredger.

At present we have 4 teams working in different areas. One team is finishing collecting small and loose debris next to the pier. A second team is working with the sand dredger and lift bags to remove partially buried items. A third team is working in the last heavily littered area in front of 'Arida' and the fourth team is working on the fringing rocks and beaches in Loh Da Lum Bay.

By the end of 4 months we have collected 150 tons of debris. We average 60 people per day (15-20 divers) including 25 Thai staff.

## **On hindsight**

On hindsight it would have been better had more heavy machinery for lifting and pulling been rented. Money saved in not using these machines was money lost in time and energy.

The issue of cleaning the mangrove should also have been attended at the beginning of the project and funds and workers found to take care of the work prior to the onset of the monsoon.

Phase 2 of the project could have started earlier, had the correct help been available. Unfortunately there will be little that can be done during the monsoon season in the areas needed.

## **Biggest Obstacles**

1. Sand covering debris and how to deal with it without causing further damage to corals.
2. Lack of experienced divers.
3. Lack of divers with Marine Biology background.
4. Actions caused by local authorities that were unnecessary and detrimental to the efforts of the dive camp.
5. Lack of support of available equipment by the local authorities.

## **ASSESSED AREAS**

### **Tonsai Bay**

For the most part the work in Tonsai Bay to remove the debris is nearly complete. We believe that we can complete the clean up of Tonsai Bay by the end of July, weather pending. The west coast coral reef has sustained very little damage with the least amount of damage towards the outside of the bay. Nearly the whole length of this reef has been totally cleaned. Sea fans, barrel sponges and table corals are noted as the corals most affected.

Closer to the main beach area there is a greater damage to the corals by sand coverage and from being upturned by the tsunami. Bubble corals in this area were mostly smashed and overturned.

The main Tonsai beach area has lost the top of layer of sand revealing a clay substrate. During choppy surf conditions the clay is washing into the sea leaving a thick cloud of clay in the water. What the effect of this runoff is yet to be seen.

One concern for us is how much the loss of surface sand from the beaches, peninsular and shallow reefs will affect further erosion.

The east side of Tonsai Bay showed very little signs of debris and much of the coral is as it was prior to the tsunami. However the shallow top reef has shown many signs of deterioration over the last few years prior to tsunami, due to construction and tourism. The reef in front of Haad Yao (Long Beach) was seriously affected and most of the best snorkeling areas here have been badly damaged.

Haad Yao is a very important reef area due to its depth, and the currents in the area. The reef is popular to pelagic species such as trevallies, barracudas and makeralas. It is also an important nursery for juvenile species. This is possibly why there are so many black tip reef sharks and large groupers in the area. In fact, many fish such as humphead parrotfish, eagle rays, white tip reef sharks, not commonly found in other areas are quite often seen here.

All the beaches in this bay have been 90% cleared of debris. Remaining debris on the beaches consists of either new items that are floating in with the tides, or, masonry and bricks and other items that are appearing as the surface sediments are being washed away, revealing new debris. There is still considerable work to be done.

***Recommendation:*** A coral restoration and monitoring program at long beach here is essential. Local businesses and resorts on Haad Yao need to be informed of the present situation and the importance of controlling actions that effect the survival of the reef.

## **Loh Da Lum Bay**

Most of the debris on the reef has been removed. The shallow beach area and the rocky coastline still has a lot of debris to be collected. Dead corals that were washed into the bay by the tsunami were left all over the beach and during high tide cause a hazard to boat traffic. Some of these boulders are huge and weigh a few tons.

The top surface of sand was washed away revealing the denser clay sub surface.

Hundreds of tons of *Porites Lobora* were washed out of the bay and deposited onto the fringing reef at the mouth of the bay. On inspection many of the huge upturned corals were still alive. On immediate inspection it seems 70% of the reef in this bay is dead, most of which was caused prior tsunami.

The reef on the east side of the bay was already badly affected by the run off from the mangrove estuary prior to tsunami.

The small mangrove situated in the east corner of the bay and at the base of the mountain has lost all of its trees. This may cause a problem as run off from the mountain can enter directly into the ocean here. The estuary is also directly connected to the reservoir that was contaminated during the tsunami. There is concern that more pollutants are now being filtered into the sea during high tides. A filter system to capture debris has been placed across the mouth of the estuary and is monitored regularly.

***Recommendation:** Considering the quantity of dead coral this area is a priority for a coral restoration program. All the dead coral in the shallow flats can be transported to the mouth of the bay and strategically deposited at a point to help create an artificial reef.*

*An inspection by the DMCR and the department for the protection of mangroves is essential for the mangrove forest. Replanting of mangrove shoots would be beneficial and the reservoir needs to be inspected and a plan raised to remove the debris and toxic water therein.*

## **Yong Kasem Bay**

The beach area has been completely cleared, however, periodic clean ups will need to be made. The reef area was damaged slightly with some large *Porites Lobora* turned over and some damage to *Acropora* species. On the whole most of the reef here is still in good condition. Some debris still remains in very small portions (mostly drift woods).

## **Moskito Island**

Not much debris found its way this far out. However there is serious damage to areas of coral on the north west side of the island. The south side of the island has yet to be assessed. Large quantities of corals totally destroyed.

***Recommendation:** Further assessments need to be made in this area. It is an ideal location for a coral restoration program due to the lack of tourist visitors to this site.*

## **Bamboo Island**

Some damage was caused to the forestry department buildings on the island. One very large roof section managed to float to Bamboo Island and is now on the beach. We will arrange for a group to remove the debris on the island.

The shallow reef here was very badly damaged. The reef is very large surrounding  $\frac{3}{4}$  of the island and its loss is significant.

***Recommendation:** Prohibit tourist activities in the area. Set up a 2 year coral restoration and monitoring program.*

### **Hin Klang Reef**

This is a circular mid-sea reef situated between Bamboo Island and Phi Phi Don island. The reef is home to some of the most pristine corals around the Phi Phi Islands. The outer rim of the reef from 2 meters down to 10 meters has shown very little damage from the tsunami. The top of the reef has been damaged almost 90%. *Acropora clathrata*, *Acropora formosa*, *Acropora robusta* and other *Acropora* species are the main corals damaged.

***Recommendation:** Assess the concern that all the new damaged coral may cause further damage to intact corals. Set up coral restoration and monitoring program. Install new moorings on outer part of reef to keep boats away from the damaged areas.*

### **Bida Islands**

Only 5% of damaged corals were noticed on the Bida Islands. Diving and snorkeling revealed still some of the best quality reefs in the area.

***Recommendation:** Monitor illegal fishing practices in this area as many of the fishing fleet are taking advantage of the lack of people in the area post-tsunami, to fish within the marine park.*

### **Phi Phi Ley Island**

Severe damage on the north east side of Phi Phi Ley Island. Multiple table corals overturned and damaged. Very little debris. Loh Samah Beach has been cleaned by the Phi Phi Dive Camp. Other areas showed very little damage with most corals being affected in the shallow water areas only.

***Recommendation:** Set up coral restoration and monitoring program.*

### **Mangrove Forest at Loh Lanah Bay**

Loh Lanah Bay Resort was washed into the mangrove forest. The assessment revealed many tons of debris still in the mangroves. This will become a more serious issue when the tides and higher water levels from the monsoon rains flush the debris out of the mouth of the estuary onto the reef.

***Recommendation:** Further assessment required from the DMCR. Large group of 60 persons needed to remove the debris by hand and machine during low tide times. Project may take 2 – 3 months to complete. We are trying to obtain funding for this project at present. The funding will cover wages, accommodation and food for 60 Thai staff and other equipment. Extremely important.*

### **Overview of coral damage and reef activity**

Most of the reefs survived the tsunami with very little damage. In some cases the reefs seem to look cleaner than prior the tsunami as if the wave washed off the long term build up of sediments. Most areas sustained damage due to their proximity to the beach and their depth. Most corals damaged were in shallow water. New coral growth has also been seen.

In many areas an abundance of fish have been sighted. This may be as a result to the decline in boat traffic and tourists using the reefs.

The reefs that have been cleaned by the camp are far cleaner than any time prior to the tsunami.

### **Personal Items Recovered**

Any items found on the reef are of extreme importance in verifying the presence of any of the 300 hundred people reportedly still missing. All items discovered are carefully logged and itemized. These include wallets, I.D. cards, credit cards, passports, boat licenses and personal telephone books. Any valuables found with these items are logged and kept with the items.

All documents belonging to Thai nationals are returned to the persons if recognized, or presented to the Krabi Police department. All documents belonging to foreign nationals are presented to the specific embassies or DVI teams where available, or the German embassy who will help to give it to the correct embassy.

## **Funding**

All funds received are used to support the activities of the Phi Phi Tsunami Dive Camp only. Funds are used for the following:

- Thai staff wages and accommodation.
- Accommodation for all foreign long term volunteers.
- Lunch and dinner for all foreign and Thai staff.
- Long tail Boat rental
- Dive Boat rental
- Tank rental
- Equipment Rental
- Lifting equipment and other supplies
- Office supplies
- Medical equipment

Also subsidizing the camp are funds received from the sales of items recovered from underwater that are unidentifiable. We have also found on occasion quantities of money underwater which have also been put into the PPDC account to cover costs. On sale for further funding are PPDC tshirts and vcds.

We would like to thank the following groups and individuals that have supported the Phi Phi Tsunami Dive Camp by funding our project:

- Piers Simon Appeal Fund
- Pacific Asia Travel Association
- Sophie Clay
- Kay Jayne Newton
- Luke Simmonds
- PADI Project Aware
- Claire West
- Wendy Rolph
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- Adi Kehl
- Sustainable Ecosystems Institute
- Dan and Jill Patchin
- Marc Michelangelo
- Sophie McGrath
- Les Steggles
- John Pepe

## **Future Funding Needed**

At present the monthly costs range from 600,000 baht to 750,000 baht with approximately 700,000 baht left in the fund. A further amount of approximately 600,000 baht will be needed to continue until the end of July. Furthermore, certain issues have arrived and further funding is required to cover the costs.

1. The governor of Krabi has said that they cannot afford to remove the debris that we have deposited on the land. At present there is still about 100 tons of debris collected by the dive camp and deposited on the land. As a result the owners of the Phi Phi Cabana Hotel are not pleased that the debris is on their land and have refused us to place any more there. Furthermore our mountain of debris is so big, that we have concerns of the debris blowing around during the monsoon season.

Cost for removal will exceed 1,000,000 baht

2. Fund a project to remove all the debris in the mangrove forest near the Loh Lanah Bay Resort. Calculating the use of 60 persons @ 400 baht per day plus food and lodgings, long tail boat rentals and large machinery, costs for this project will probably exceed 3,500,000 baht over a 2 month period.

3. Phase 2 of the project- Reef restoration and Monitoring, is a long term project and requires employing a number of qualified Thai and foreign Marine Biologists and the use of volunteers to monitor the results.

4. Phase 3 of the project, Education and conservation is also a long term project and will require funds to cover advertising and notices regarding conservation and also for educating locals in the area. It will also need to budget to employ a group of Thai Park Rangers to monitor the reefs around the Phi Phi islands. This group can also be responsible for installing and maintaining new moorings. Visitors coming to Phi Phi Island should be made aware that they are coming to a protected marine park.

*Recommendation: A general meeting between the PMBC, DMCR, TAT and the Phi Phi Dive Camp should be held to open discussions on how to work together to promote this project.*

*A system of fining offenders should be outlined and introduced to control activities in the park.*

### **What Do We Need.**

#### **Lift bags**

10x100 kg, 4x200 kg, 2x500 kg. lift bags. Lift bags are constantly needing replacement.

#### **A tractor with a rake and sifting bed.**

Instead of picking up all the rubble by hand, it would be more effective to use a tractor that could comb the beaches. There are still tons of coral rubble needing to be collected in Loh Da Lum Bay and this would have to be the most efficient way.

Each year there are tons of debris that wash up on the shores and this tractor could be used all year round.

#### **Magnetometer and GPS**

Tracking tools such as these would assist us in locating submerged debris under the sand with the hope that we can also discover the whereabouts of still missing persons.

#### **Barge with crane**

Having a barge would free up 30 of our surface support staff and allow them to work on another part of the project.

Last checked, the cost was 15,000 baht per day (450,000 baht per month)

#### **Sand pipe/ sand dredger**

Although we have constructed a sand dredger, our 2<sup>nd</sup> hand compressor cannot give us enough airlift in such shallow water. We need a better and more powerful compressor.

#### **Zodiacs**

Using zodiacs for the 2<sup>nd</sup> phase would be far easier and quicker than using traditional long tail boats.

**Manta Ray Moorings**

Presently, ropes with plastic sheaths are wrapped around large coral 'bommies' or rocks and a float is attached. This causes chaffing to the corals and the ropes do not last long enough. Boat captains still use their anchors to moor much of the time.

A proper mooring system should be installed. Manta Ray moorings are not cheap, but they are long term and would not require too much maintenance.

**Marine Biologists**

Support by professionals with knowledge on reef restoration and mangrove forests.

**Mainland Assistance**

Due to our location on the island it is very hard to obtain the information and details regarding the equipment mentioned above. We need someone that can locate, and price these items.

Quite often we are asked to come up with all the details of the items we need and send in a project summary. We usually do not have the manpower or the access to provide this information.