Marine Conservation Management Plan, 2016

Cambodia

With Partners:

Index

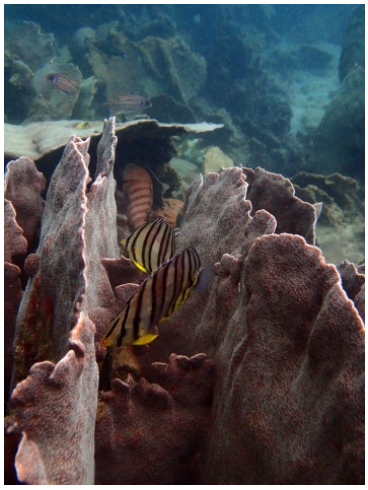
1. Introduction

The kingdom of Cambodia is located in Southeast Asia, between Thailand and Vietnam. It's forests, rivers and seas are home to many rare and endangered species. The inshore islands and coastline contain unique mangrove forests, seagrass meadows and diverse coral reefs. This place, rich in biodiversity, is under intense pressure by a wide range of human activities such as overfishing, destructive fishing methods, looming development and marine pollution.

Due to a turbulent recent history, which devastated the country and its natural environment, the government has very limited human resources, infrastructure and finances to regularly and permanently conduct scientific research and monitoring. However Cambodia is taking steps towards developing a series of marine protected areas to combat increased environmental degradation. Currently, the establishment of the country's first large-scale Marine Protected Area is planned for the Koh Rong area, and a second one is also being developed for the Koh Sdach Archipelago. The local communities around Koh Sdach are willing to get actively involved in the design of the MPA management plans, although awareness and education levels, as well as understanding about natural systems and resource management are low in all groups of the population.

A long term monitoring plan is recommended in order to gather enough data of the archipelago's marine ecosystems and species. This data will serve to enhance knowledge about the status of species, populations and habitats as well as to inform the future management plans and decisions. The educational programs for the community must be designed to increase the education level and raise awareness, which ultimately can facilitate the long-term implementation of a marine protected area, by providing the local groups with the necessary tools to manage their own marine resources.

The present management plan aims to serve as a framework for the development of our Marine Conservation Project in Cambodia, and is designed to maximize the human and material resources available in order to efficiently focus our conservation efforts. It describes the work site, the programs and methodologies employed to achieve the project's objectives.



1.1. DESCRIPTION OF THE AREA

Koh Sdach (King Island) is located in the Gulf of Thailand, around 1.5 km off the coast of Botum Sakor National Park, in the Kiri Sakor district in Koh Kong Province. There are seven main islands in the archipelago; Koh Ampel, Koh Andaek, Koh Chan, Koh Dom Leong, Koh Sdach, Koh Kmauch, Koh Smach and Koh Toteang. Koh Smach is the largest of the islands (c. 30 ha), and Koh Andaek the smallest (c. 4 ha).

Koh Sdach is home to most of the local population, with several small households living on a few of the other islands. The remaining islands are uninhabited except for occasional visits by passing fishermen seeking shelter during bad weather.

The bean-shaped island of Koh Sdach stretches from North to South over a length of around 2.8 km, is rather flat and generally forested. Natural jungle has been replaced in many low-lying areas by coconut trees and forest crops for commercial purposes. Settlements are mainly in the North, while the Southern third is almost non-populated. The tiny Ghost Island/Koh Kmauch lies about 250 metres West, off its southern end. Koh Sdach village is the centre of the Kiri Sakor District and the Koh Sdach Commune, and home to several governmental offices.

The location of Koh Sdach

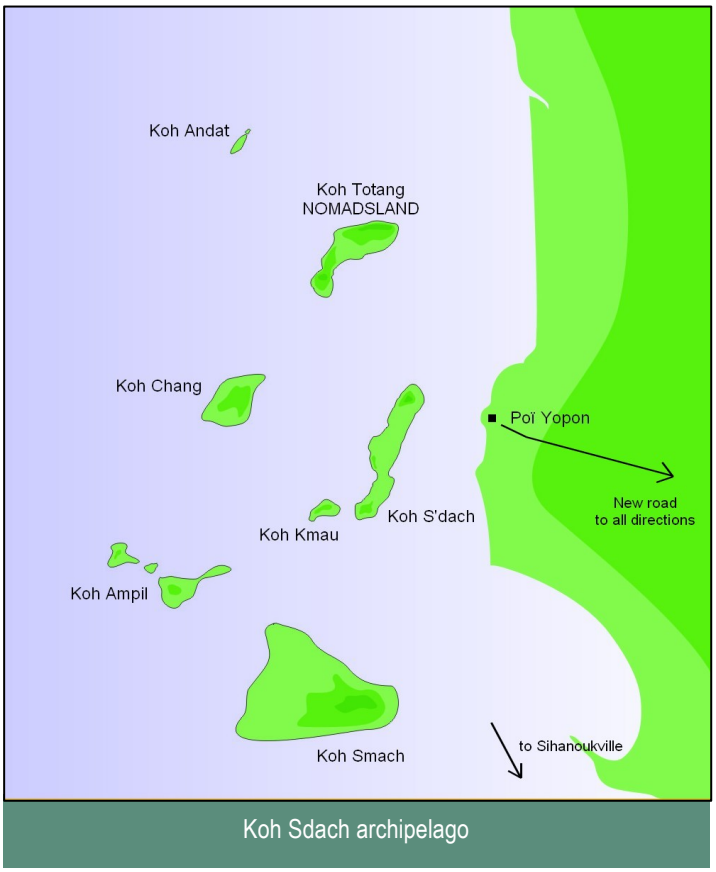
The island provides a very important shipping port on the trade route between Thailand, Cambodia and Vietnam, allowing reliable import and export opportunities. Consequently, the Koh Sdach community is much more affluent than most small villages in coastal Cambodia. The town contains facilities such as a medical clinic, primary and secondary schools, a market, a dry dock, large port and an array of small household shops, bars and restaurants.

Left: Sunrise, tinged by forestfires damaging the rainforest.

Below: We teach classes at the school to lift their English and anti-litter skills.

1.1.1. Human activities

Koh Sdach Village is home to around 670 families giving a total population of around 4,000 people. Fishing is the primary business, with the majority of families economically dependent on the fishing industry, directly or indirectly. Fishing can have negative environmental impacts by threatening rare species and marine ecosystems, especially when the methods used are non-selective. A wide range of non-target benthic and pelagic species are caught accidentally as bycatch, and it becomes difficult to assess the damage to the ecosystem as these events are usually not reported and can reduce populations of important species.



The mainland coastline facing the archipelago is currently undergoing intensive land reclamation due to a new port development in Kampot. Similar reclamation activities in other areas such as Sihanoukville and Kep have been reported to cause damaging environmental changes. Lowered water quality, due to disturbances to the catchment area and associated sediment transport dynamics, could be expected to cause similar effects in this area. Part of the focus of the project is to educate local people about the richness that surrounds them so they realize what they may potentially lose if development is reckless and unsustainable.

2. Marine Habitats

A local soft coral

2.1. CORAL REEFS

Coral Reefs are among the most biologically diverse and productive ecosystems on earth. These tropical marine communities occupy less than 0.1% of the ocean floor, but are inhabited by at least 25% of all marine species. The topographic complexity of reefs provides refuge and feeding opportunities for many fish and invertebrate species. Therefore they are hotspots of marine biodiversity. In many areas they also help foster other marine communities such as mangroves and seagrass beds by providing protection from wave energy.

The coral reefs provide habitat and food resources that support other reef organisms including fish, lobsters, giant clams, and sea urchins. Reefs maintain a network of intimate ecological relationships and delicate food webs. Disruption of coral reef communities can break up these ecological bonds.

Globally, reefs are threatened by overfishing, harvesting of corals for trade, degradation of water quality and the use of destructive fishing practices such as dynamite fishing. However the reefs around Koh Sdach are rich in biodiversity, featuring many forms of Brain, Mushroom, Plate, Staghorn and Whip corals, as well as big areas of soft corals and anemones.

2.2. SANDY SEA BEDS

Sandy sea beds cover the majority area of the world's oceans and serve in a supporting role to coral reefs and sponge beds. They are located in a wide range of marine environments from the edges of coral reefs to within metres of land. Cambodia hosts a large biodiversity of marine species that inhabit the sandy sea beds. Many are bottom-dwelling species such as skates, rays and seahorses. This wide variety of species are the most vulnerable organisms against manmade actions such as trawling and dredging practices, as these devices are towed along the sea beds removing most of the life in their path.

2.3. SEAGRASS MEADOWS

Significant areas of Cambodia's shallow, protected coastal waters offer a suitable habitat for seagrass, providing nursery grounds for many different species. These include fish, crustaceans and other invertebrates, as well as endangered marine species such as dugongs and seahorses.

Cambodia's coastal zone houses one of the world's largest seagrass areas consisting of eight known species. In 2004, it was estimated that seagrass covered 25,240 ha off the coast of Kampot Province alone. Little published data is available but there are strong indications of widespread seagrass habitat destruction due to degradation of water quality through increased turbidity caused by forest clearing, sand dredging, reclamation activities, etc. Destructive fishing practices like trawling and dredging are also major causes of damage. Once again our aim is to preserve these areas and educate about their importance to local ecosystems and the livelihoods of the fishing families who rely on them.

Seagrass beds such as these provide crucial shelter to juvenile fish and invertebrates

2.4. MANGROVE FORESTS

Current IUCN data indicates that the majority of the mangrove areas in Cambodia are found in the Koh Kong province (www.iucnredlist.org), and they are considered to be wetlands of international importance, included as a Ramsar Site. Mangrove ecosystems are highly productive and play an essential role in the lifecycle of many marine organisms. They serve as spawning or nursery grounds for several commercially and biodiversity critical fish species. Mangroves also play an essential role in protecting the coastline and provide an effective buffer against climate change-related sea level rise, cyclonic activity and storm surges.

Mangroves are reported to be damaged and degraded by offshore and estuarine sand dredging and mangrove clearing is being undertaken illegally for use as firewood, charcoal production, saltpan investments, land reclamations and intensive shrimp aquaculture among other uses.

3. Major Threats to the Marine Enviroment

3.1. OVERFISHING

Overfishing is catching more fish than the ocean can produce, leading to depleted fish stocks as the fishing rates exceed the biological capacity for replenishment. Related to overfishing are the fishing methods. Certain types of fishing methods destroy or damage the seafloor habitats where many species of fish and other benthic animals reside. Certain fishing methods are notorious for catching large amounts of bycatch – fish, sea turtles, seabirds and marine mammals – that are unintentionally caught and often incidentally killed in fishing operations.

3.2. DESTRUCTIVE FISHING METHODS

Bottom Trawling: Among all the fishing methods, bottom trawling is the most destructive to our oceans, where a large net with heavy weights is dragged across the seafloor, scooping up everything in its path. Bottom trawling is unselective and severely damages the seafloor ecosystems. The net indiscriminately catches every life and object it encounters. Thus, many creatures end up mistakenly caught and thrown overboard dead or dying. This collateral damage, called bycatch, can amount to 90% of a trawl's total catch. In addition, the weight and width of a bottom trawl can destroy large areas of seafloor habitats that give marine species food and shelter. Such habitat destructions can leave the marine ecosystem permanently damaged.

Blast fishing: Blast fishing or dynamite fishing is the practice of using explosives to stun or kill schools of fish for easy collection. This often illegal practice can be extremely destructive to the surrounding ecosystem, as the explosion often destroys the underlying habitat (such as coral reefs) that supports the fish, and kills many other organisms.

3.3. HARVEST OF LIVE SPECIMENS

There is a big demand for certain tropical marine species that are harvested alive for the aquarium trade and for curios. Cambodia is no exception to this with the area witnessing illegal fishing boats targeting many marine animals including fish, giant clams, seahorses and even the coral itself. This demand comes mainly from neighboring countries and brings high prices that push local communities to use any means necessary to supply the demand.

3.4. DEBRIS AND MARINE POLLUTION

A staggering amount of solid garbage and pollutants such as oil, fertiliser, sewage, and toxic chemicals enter the sea each year. This represents one of the most serious pollution threats to coastal and marine environments. These cause both environmental and human health issues.

The amount of human debris entering the marine environment is of significant concern. Direct impacts of marine debris include aquatic wildlife starvation, suffocation and poor health, as well as human health and safety hazards. Indirect impacts of marine debris include ecosystem alteration and tourism and fishing losses. Items such as plastic bottles and bags, food packaging, and fishing gear are the most commonly sighted. Fishing nets over the corals suffocate the polyps causing their deaths. The plastic that enters the sea suffers physical degradation due to the water movement which breaks it into suspended microplastic pieces. Microplastics are easily ingested by fish, invertebrates and even plankton. There is growing scientific evidence linking them to the passage of deadly, persistent chemicals through the environment, making them more concentrated in larger, predatory marine life.

Left: Discarded net smothers a small coral. **Right:** Volunteers target Styrofoam which breaks down easily.

The Project is working with local communities to find solutions to these problems. Recycling of aluminium cans, plastic bottles and wrappers has been encouraged at community meetings and at the school.

Promotion of reusable items and reduction in plastic purchases has also been done through the creation of posters and the giving away of nearly 100 reusable cotton carry bags with Refuse – Reduce – Reuse – Recycle slogans emblazoned on them in Khmer.

More than 50 people turn up to do a trash clean up around the local Temple and Football pitch. Over 87 Kg of trash was collected and 25 Kg of recyclables.

4. Scuba Diving

When volunteers arrive at the Project, and prior to engaging in surveys and other underwater activities, they receive diver training as needed, depending on their previous dive experience.

4.1. DIVE CENTRE

The project has its own dive center which is a PADI Educational Facility called Projects Abroad Seahorse Dive Center. A large, stable boat which can comfortably accommodate 12 divers is moored in front of the base which makes the daily dive operations easy and smooth. Among the diving equipment we have a Coltri MCH16 dive compressor, aluminum tanks and all the diving gear necessary to ensure safe and comfortable dives.

4.2. PADI DIVE COURSE

Depending on the previous dive experience and on the time the volunteers spend in the project they receive different PADI courses as follows:

Experience on arrival	Project duration	Courses
No prior experience/ qualifications	Less than 4 weeks	PADI Open Water
Open Water (OW) Certificate	Less than 4 weeks	PADI Advanced Open Water
Open Water & Advanced Certificates (or higher)	Less than 4 weeks	Project Related Specialty
No prior experience/ qualifications	4 weeks+	PADI Open Water + Project Related specialty
Open Water (OW) Certificate	4 weeks+	PADI Advanced Open Water + Project Related specialty
Open Water & Advanced Certificates (or higher)	4 weeks+	Project Related Specialty + 1 other Specialty

The Specialty courses available for those volunteers staying 4 weeks, arriving with both PADI Open Water and Advanced certification are the following:

Priority Speciality:

- Peak Performance Buoyancy

Other Specialities available:

- Digital Underwater Photography
- Project Abroad Survey Diver
- Project AWARE Coral Reef Conservation
- Equipment Specialty

5. Projects

5.1. SEAHORSE PROJECT

5.1.1. Background

Seahorses are fish of the genus Hippocampus, members of the family Syngnathidae. They have a horse-like head with a snout that points down, a long snake-like prehensile tail, and eyes that move independently of each other in all directions. Instead of scales, seahorses have thin skin stretched over a series of bony plates that are visible as rings around the trunk. Some species also have spines, bony bumps, or skin filaments protruding from these bony rings.

Currently, many seahorse species are considered “threatened” or “data deficient” on the International Union for Conservation of Nature Red List (IUCN, www.iucnredlist.org), and all seahorse species are listed on Appendix II of the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES, www.cites.org). In Cambodia, seahorses are classed by sub decree of the Royal Government of Cambodia 12/9/09 as endangered species.

Hippocampus kuda at Koh Sdach.

No studies have been previously done about seahorses within the Koh Sdach archipelago. Therefore very little is known about their populations in this area, where the trawling ships are incessantly towing their nets along the archipelago. Many seahorses are vulnerable to be captured by trawls because they live in the same habitats as targeted species, live on the sea floor, and swim slowly. Seahorses are also caught in many other gear types, ranging from beach, shore and purse seines to crab pots. Sometimes fishers sort the seahorses from the bycatch. Many of these seahorses are destined for international trade, but sometimes the seahorses are thrown back (discarded) or sent with the rest of the low-value catch to be processed into fishmeal or fertilizer.

This project aims to establish the first baseline data of seahorse populations in the Koh Sdach archipelago. Due to the lack of research, there is a great potential for advances in our knowledge about seahorses in Cambodia, which may lead to future policies to protect the seahorses. We’ve currently identified four species around the Island.

5.1.2. Objectives

General objective: Assess the presence and estimate the abundance and distribution of Seahorse species along the archipelago, and enhance our knowledge about their habitat preferences and main threats in order to create the first baseline data for future protection plans.

Specific objectives:

1. Find Seahorses and identify the species living in the Koh Sdach archipelago.

2. Determine their preferred habitats and holdfasts along the archipelago.

3. Periodically monitor the areas with presence of Seahorses to assess any changes.

4. Gather a significant amount of data in order to develop a long term protection plan for Seahorse species in the archipelago.

5. Share our data with conservation partners and with local groups to engage more people in marine conservation as well as to reinforce our conservation efforts.

Seahorses spotted on our Seahorse Surveys, with ruler for measuring size in second photo.

5.2. CORAL REEFS PROJECT

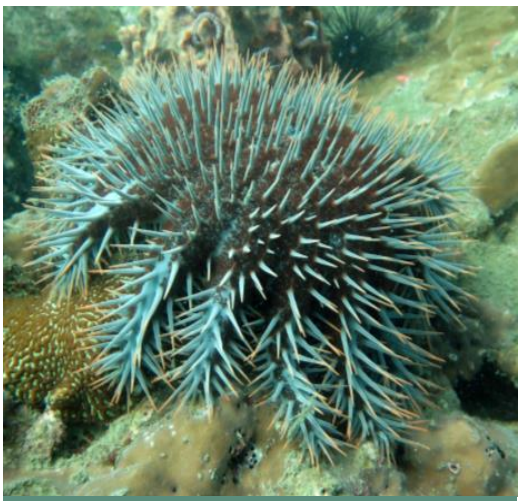
5.2.1. Background

Assessment of the biotic and abiotic substrate found across the Koh Sdach archipelago suggests that the coral reefs in the area are relatively healthy, although threatened by various fishing activities.

Overfishing, seems to already have occurred within the Koh Sdach archipelago. With the recent increase in abundance of illegal fishing boats from neighbouring countries such as Thailand and Vietnam, along with more Cambodian fishing vessels from other coastal provinces, overfishing may alter the reefs significantly in the near future.

Fish population are responsible for keeping a delicate ecological balance within the coral reef food web by removing sick and old individuals or helping prevent algal overgrowth. Some fish families such as snappers (Lutjanidae), groupers (Serranidae) and parrotfish (Scaridae) also exhibit long life-spans up to 50 years and long maturation periods up to 8 years. These characteristics, along with tendencies towards aggregated spawning, make these families particularly vulnerable to intensive fishing.

Our data points toward only 3.5% of all our fish sightings during Reef Surveys being over 30cm in length and despite the presence of some very large cobia, trevally and barracuda, sharks are seldom seen. Fish and crabs seen in the local marketplaces are smaller in size than that of fully mature individuals, and some invertebrate species or families have most likely already been overfished, such as lobsters, top shells, giant clams, Green Turbo snails and sea cucumbers.



A Crown-of-Thorns starfish.

Moreover, many other anthropological pressures on the coral reefs are present in the Koh Sdach archipelago - destructive fishing practices, pollution from discarded fishing gear and trash, increased nutrients in the water from human waste and sedimentation from nearby coastal development. These are sometimes visible while diving and in many cases coral damage and recent death may be attributed more strongly to one stressor than another.

One indicator of poor health and damage to coral reefs is coral bleaching, a naturally occurring phenomenon where stressed host organisms living in symbiosis with zooxanthellae, including most corals and giant clams, become toxic and expel their symbiont, causing the host organism to progressively lose coloration (provided by zooxanthellae) and become partially or totally translucent and expose the skeleton or shell underneath.

Bleaching may occur during above average sea surface temperatures, increased ocean acidity, increased salinity and/or predation stress from corallivores such as the Crown-of-Thorns starfish. In a bleached state the host organism is no longer supplied with essential nutrients from their symbiosis and may die, unless favorable conditions return. Increased sightings of the Crown-of-Thorns starfish, and the lack of this species' predators in the area, coupled with the virulent 2015-2016 El Niño period, could be a cause for concern.

Determining the fishing impact on the local fish communities and the health of the benthic communities will allow us to help focus protective measures and inform relevant policy makers of ecologically and commercially important animal species or families, to ensure the long-term supply of fish to the local fishing industry and to help maintain the ecological stability of the reef for the future.

5.2.2. Objectives

General objective: To establish a long-term surveying program for the coral reefs of the Koh Sdach archipelago in order to assess seasonal and spatial changes in reef composition and health and the relations between the various animal communities. This could serve to identify specific areas of concern and help establish protections of the local marine ecosystems.

Specific objectives:

1. Build up baseline data for fish family abundance, invertebrate abundance and substrate composition of the islands' reefs

2. Identify any seasonal and/or spatial changes of fish and invertebrate abundance

3. Identify any seasonal and/or spatial changes in substrate composition

4. Assess the severity of overfishing in the local fish communities

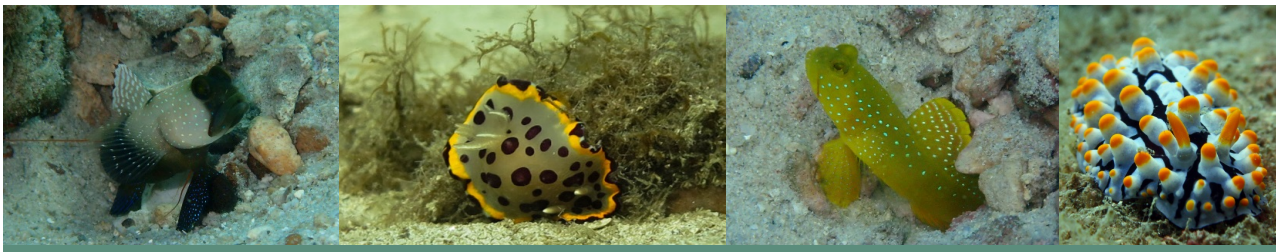
5. Identify any specific fish families or species under immediate threat of overfishing

6. Assess the health of the reefs across the Koh Sdach archipelago

7. Assess the impacts of human development on the local coral reefs and their impacts on the fish and invertebrate communities

8. Identify the prevailing threats to the local coral reefs

9. Supply the local people, Community Fishery committee and relevant policy makers with our data to help create specific measures for the protection of the local coral reefs.



Amazing fish and invertebrates from local surveys

5.2.3. Methodology

Data is collected using underwater visual census techniques on SCUBA. Sites have been chosen at random around the islands. Each site is surveyed at both 5 and 8 metre depths along a 50 metre transect, following an adapted version of the Reef Check methodology. Each survey – a single transect at a given depth - includes a 5m x 5m "tunnel" transect for key fish families, a 5m wide belt transect for key invertebrate families and a 25cm interval point intercept transect survey for substrate composition, reef bleaching and

damage. Water samples are also collected for salinity. The team normally consists of 3 divers - 1 per survey - and a dive leader.

All data is compiled in spreadsheets for analysis following our specific objectives. Prior to all surveys volunteers undergo on-land training presentations and in-water guided training sessions, where specific substrates, invertebrates and/or fish families are pointed out. Volunteers are also encouraged to cycle through identification books after dives to familiarize themselves with the local marine fauna.

A volunteer during a transect survey.

5.3. MARINE POLLUTION PROJECT

5.3.1. Background

The increasing development of coastal human populations brings as a result a massive increase in debris, sewage and toxic chemical load to the marine environment.

The village of Koh Sdach has no garbage collection system at this time. Some items like plastic bottles and aluminum cans are recollected and sold in the mainland. All the other trash generated in every household, such as plastic bags and other plastic items is either burnt, thrown on the ground or, in many instances, thrown directly in the ocean. All three of these activities can transport much of the waste straight into the sea surrounding the town.

The sea along the archipelago has a relentless traffic of fishing boats that are active for long periods of time. Most of them drag nets through the water and others deploy net cages for crabs and fish. These nets break as they are used and a large unknown quantity of nets end up resting on top of the corals, causing suffocation of the polyps and ultimately their death. Many organisms get entangled or trapped within the nets too, and die of starvation or injury.

5.3.2. Objectives

General objective: Clean debris from the ocean, and work with the community against marine pollution through education and assisting in the establishment of a Trash Management Plan.

Specific objectives:

1. Establish a long term program against marine pollution in which the community is actively involved.

2. Determine and compare the relative abundance of different types of trash along the archipelago.

3. Evaluate the rate of reappearance of debris in the areas where the program is established.

4. Generate debris data to use for local conservation management plans.

5. Engage the community in town and beach clean-ups as well as in the development of garbage separation, recycling, and plastic-free events.

6. Contribute to partner organizations with our data through the global network.

Left: Discarded fishing net smothering a coral. **Right:** Once removed the coral polyps can spread back.

5.3.3. Methodology

Dive Against Debris

The collection of debris from the ocean is done with SCUBA and following guidelines from the Dive Against Debris program, developed by the Project AWARE Foundation. With volunteers diving in buddy pairs, the debris found is collected in net bags made from recycled fishing nets previously found in the ocean. Small scissors and cutting tools are taken so nets with portions overgrown with coral or sponge can still be removed without damaging them.

Dive's Against Debris are conducted along the archipelago every week in order to collect as much debris as possible. Enough data should be gathered to be able to study the reappearance rate of debris once certain "debris free" areas has been established and periodically revisited. So far the Project has collected over 1600 kg of debris from our reef DAD dives.

Nets covering corals and being cleaned by volunteers.

Coastal clean-ups

Beach and town clean-ups are also periodically performed, and collected data is shared with our partner organization Ocean Conservancy. Plastic bottles and aluminium cans are collected separately, whilst non-reusable trash is burnt in a controlled manner to turn it back to ash. So far these beach clean ups have captured nearly a tonne of debris and 200 kg of recyclables.

5.4. EDUCATIONAL AND COMMUNITY PROJECT

5.4.1. Background

The Koh Sdach community has educational facilities such as primary and secondary schools and a big portion of the village's population appears to be under 20 years old. We spend a considerable amount of our efforts helping them understand local environmental processes and the importance of protecting these longterm as we believe education of this sector is vital for the future development of the community and the management of the natural ecosystems.

5.4.2. Objectives

General objective: Enhance the integration between the project and the community, and to improve the local people's knowledge of the marine environment and the importance of conservation for a sustainable management of marine resources.

Specific Objectives:

1. Create a positive perception of our Marine Conservation Project in the community.

2. Develop long term educational programs and events for different sectors of the community.

3. Establish periodic town clean-ups with local groups.

4. Help to create a functional and long term garbage separation and recollection system for different types of long lasting garbage.

5.4.3. Methodology

A long term educational program is currently being developed for a local group called the Green Protectors. The Green Protectors is formed by around 12 children, aged 14 to 18, who have gathered with the aim to act towards protecting the environment. The program involves short weekly lectures exploring many topics related to marine biology and ecosystems, human impacts and conservation initiatives, developed in both Khmer and English as a way of reinforcing their English skills. These lectures work in conjunction with learning activities developed by volunteers. Finally, the Green Protectors are also provided basic swimming and snorkeling skills, and in-water sessions observing and spotting marine life.

Eager volunteers having fun with the super friendly local school children during English classes.

Other activities with local groups are being designed, and bi-monthly community events are also created in order to publicly inform the people about our work and to report the results of our surveys and programs. A big potential for many more initiatives exists for this project as fresh, new ideas are being developed, converting this into a dynamic and ever growing project.

5.5. SPECIES DATABASE PROJECT

5.5.1. Background

Current lists of species found in Cambodia are mostly focused on terrestrial vertebrates, marine and freshwater vertebrates found in fishing nets and land plants of national parks. No lists can be found about the local area. A compilation of all the biodiversity of the archipelago can help influence the local community and policy makers towards helping preserve local habitats. We may also provide this data for tourism purposes, for individuals to have the opportunity to observe the local fauna and flora both on land and underwater.

5.5.2. Objectives

General objective: Compile a list of the flora and fauna found in the Koh Sdach archipelago.

Specific objectives:

1. Collect photographs and samples (if applicable) of the various animal and plant species around the Koh Sdach archipelago.

2. Compile a list of these species, properly named and categorized.

3. Provide relevant community leaders, policy makers and other organizations with this list, to help establish awareness and protection programs.

5.5.3. Methodology

During dives, staff and volunteers are encouraged to search for and record new species. These new sightings must be supported with photographs for positive identification.

Volunteers search through photographs taken by previous and current staff and volunteers to add to the database, if these are clear and suitable for identification. Photographs of different life stages and color variations are also collected. The proper scientific naming of organisms, their synonyms and their taxonomy are added to the database and verified using multiple identification books, online databases and other available sources.

This is a large ongoing program requiring constant updating. Landings of fish can also be used to collect data, if supported by the location of the catch. Vegetation and insect surveys can be conducted around the island, and samples collected for visual analysis and record. Treks through the jungle can be conducted to record data about the local reptile, amphibian, bird and mammal communities.

5.6. ARTIFICIAL REEF PROJECT DESIGN

5.6.1. Background

Restoring coral reef habitat has mainly been carried out in two ways: coral farming and constructing artificial reefs. The first is an effective method in the long term, although it is very time-consuming and tedious, requires stable weather, and demands a certain expertise. The other method of constructing artificial reefs may be an efficient, cost-effective strategy for coral damage mitigation and restoration of lost habitat.

Artificial reefs have been used across all oceans to fulfill a variety of roles. They can act as wave breakers to create a surf spot, reduce coastal erosion and promote sedimentation, protect fragile marine habitats from illegal trawling practices, or merely provide new diving sites. Artificial reefs may also be used to create a reef of any shape or size, or enlarge an existing coral reef, in areas where the original reef was damaged, and

promote coral settlement and other faunal recruitment. However, in order for an artificial reef to be successful, many considerations must be taken into account before its placement underwater.

First of all, the materials chosen for the reef must be ecologically inert. These would include glass, stone or concrete. Most of the artificial reef failures around the planet include the use of toxic materials such as rubber or plastic. The use of aforementioned materials also complies with the fact that the structure must be properly weighted or anchored into the substrate. Glass and concrete are heavy materials, and their placement on the sea floor is easier than that of lighter materials. They are also very durable materials, allowing time for corals to settle.

The reef must be oriented properly and constructed in dimensions maximizing surface area (for coral recruitment) while minimizing resistance to water flow. In addition to this, the artificial structure's location must be carefully considered. The reef must not destroy any other benthic habitat, and must not attract biomass from the natural reef but create new biomass. If the artificial reef only aggregates fish to one area, then the site may become fished by the local fishing community. Finally, the artificial reef components must be assembled easily and removable, if deemed unsuitable. The structure may get damaged and could potentially harm the natural reef, or may get overrun by opportunistic invading species.

Artificial reefs in the Koh Sdach archipelago can be an interesting conservation strategy combining the restoration of lost or damaged coral reef habitat, the protection of existing fragile habitat such as seagrass beds from trawling, the promotion of underwater tourism (scuba) to the area, the recycling of ecologically inert materials such as glass and the deterring of other trawling activities in the area.

5.6.2. Objectives

General objective: To build suitable artificial reef structures in the Koh Sdach archipelago

Specific objectives:

1. To build suitable artificial reef structures to enhance reef biomass and promote coral re-colonization in damaged areas

2. To establish a monitoring program for these reefs, recording their productivity and the productivity of the neighboring reef

3. To explore and compare various shapes, sizes and locations of artificial reefs and their effects underwater

4. To build suitable underwater structures to protect fragile marine habitats from illegal trawling activities.

Potential designs for a modular artificial reef that might suit Koh Sdach.

5.6.3. Methodology

The artificial reef modules are planned to be built using concrete blocks containing iron bars, and old glass bottles, the latter having no collection or recycling system here on Koh Sdach. They provide additional 3D-structuring, cavities and surface area. The modules are molded to the shape and size desired. Various modules will be designed, displaying varying cavity and structure dimensions and orientations, producing stratification of the reef, and allowing for easy placement and removal underwater.

Sites, of differing proximity to the reef, will be monitored and compared regularly. Monitoring of the sites includes recording of the colonisation cover, the accretion of sediments around the structure, the species occupying the artificial reef area and the surveying of the adjacent reef(s) for these species, for comparison. The reefs are not marked on the surface to protect the sites from increased fishing at the site.

Sites of fragile constitution such as seagrass beds may also encircled by structures aimed at catching or destroying illegal trawl nets. These would need to be firmly attached to the substrate and not provide shelter for fish.

5.7. CORALWATCH PROJECT

5.7.1. Background

The previous studies of the Koh Sdach Archipelago have noted that the local coral reefs are in good condition, although impacted by many threats. The specific threats of bleaching and ocean acidification, commonly attributed to global warming in more recent times, are of particular relevance to the area, as most of the local reefs are found in warm and shallow waters (30ºC on average during the year, in less than 5m depth).

Using a Coral health chart to study bleaching.

CoralWatch is a global coral reef monitoring program, started in 2012 by the University of Queensland in Australia. They have developed a user-friendly measurement card for individuals to record bleaching and structure on their local reefs. The data is then sent back to CoralWatch for analysis. We shall use this card to gather coral health data on our reefs, keep it for our own analysis and send it to CoralWatch to participate in the global monitoring program.

5.7.2. Objectives

General objective: To assess the prevalence, severity and temporal fluctuations of reef bleaching in the Koh Sdach archipelago.

Specific objectives:

1. To establish a long-term monitoring program on the local coral reefs using coral tagging methods

2. To establish areas of increased risk to reef bleaching and monitor them accordingly

3. To participate in Coral Watch's global coral reef monitoring program by sending them our collected data

5.7.3. Methodology

The chosen site is visited at least once a month by a group of 4 surveyors minimum. At the specific site the same corals are monitored, using coral tagging methods and reproducible transects. The relative bleaching of the corals is recorded using the Coral Health Chart developed by CoralWatch, as well as the structure of the colony, while the data is recorded on a slate underwater.

More sites, with easy access and often revisited, will be selected to expand on this project.

6. The Volunteers' Role

With a maximum capacity of 20 volunteers, the working force of the Marine Conservation Project is very valuable. When the volunteers arrive, they are requested to complete basic and advanced diver training using the PADI system of diver training in order to gain the skills needed to conduct the underwater surveys. Once certified they receive specific training in areas of the project where they will be able to participate in surveys afterwards.

Depending on the length of time that each volunteer stays in the project, different tasks are assigned to them for the short, medium and long term. For the ones staying more than one month, after receiving the training and gaining the necessary skills they are requested to conduct their own project about the subject of their interest with the help and support of the Project Manager and relevant Field Coordinator. They will be able to choose between a wide variety of formats for each subject, and they will be able to propose their own ideas as well.

The engagement of the volunteers in the daily work of this project and with the local life is important for them to understand the current problems and work towards the solutions. This realization is essential for the achievement of the project's aims as they represent the driving force that will help to change the ideas into a reality.

7. Partnerships

7.1. PROJECT SEAHORSE

Project Seahorse is a marine conservation organisation committed to the conservation and sustainable use of the world's coastal marine ecosystems. They compile Seahorse data from researchers and "Citizen Scientists" who submit photos and sightings information to their global database. The group collaborates with other researchers, governments, and local communities to identify population trends for Seahorses globally. By working to protect seahorses, Project Seahorse supports marine conservation more broadly.

7.2. OCEAN CONSERVANCY

Ocean Conservancy educates and empowers citizens to take action on behalf of the ocean. From the Arctic to the Gulf of Mexico to the halls of Congress, Ocean Conservancy brings people together to find solutions for our water planet. Informed by science, our work guides policy and engages people in protecting the ocean and its wildlife for future generations.

7.3. PROJECT AWARE FOUNDATION

Project AWARE Foundation is a growing movement of scuba divers protecting the ocean planet – one dive at a time. With new programs and more online resources than ever before, Project AWARE supports an unprecedented global movement of divers acting in their own communities to protect oceans and implement lasting change. They focus on two major ocean issues that have the most profound consequences for our oceans –Sharks in Peril and Marine Debris.

7.4. FAUNA & FLORA INTERNATIONAL

Fauna & Flora International (FFI) is an conservation non-governmental organization, and conservation innovator that continues to make a lasting impact on global biodiversity. Their mission is to act to conserve threatened species and ecosystems worldwide, choosing solutions that are sustainable, based on sound science and take into account human needs. FFI has built strong relationships with the Royal Government of Cambodia over the past 13 years. FFI assists the national authorities in building up their institutional capacity and in developing environmental policies and legislation. They place equal importance on the inclusion of civil society and the corporate sector in sustainable natural resource management.

7.5. FRIENDS FOR SHARKS

Friends for Sharks is a marine conservation cause working to support charities and increase worldwide awareness of the plight of sharks. They have years of experience diving with sharks, especially Great White sharks, and use their knowledge to bust myths and present truths.

7.6. eOCEANS

eOceans is a comprehensive ecological database combining citizen-science observations from fishermen, divers and other marine explorers. The main projects, eShark and eManta, are online sites which gather data on a broad scale on sightings of shark and ray species, whales, seals, jellyfish and seahorses. eOceans also gathers data on the trash encountered in the ocean, and assess the need for conservation of an area by gathering information on local conservation practices, local fishing effort and localized threats to the marine ecosystem. These data are used to fill important gaps in knowledge by combining their observations with other studies, and provide their results to various governmental or non-governmental bodies to identify management and conservation needs.

7.7. CORALWATCH

CoralWatch is a global reef monitoring program started in 2012 by the University of Queensland in Australia. They have developed a user-friendly coral health card for easy data collection regarding coral reef bleaching. It uses a simple color-coding system and basic structure component which can be applied to most hard corals found worldwide.