Koh Russei Marine Environmental Assessment

Preah Sihanouk, Cambodia

Report on marine resources and habitats

Marine Conservation Cambodia
February 2011

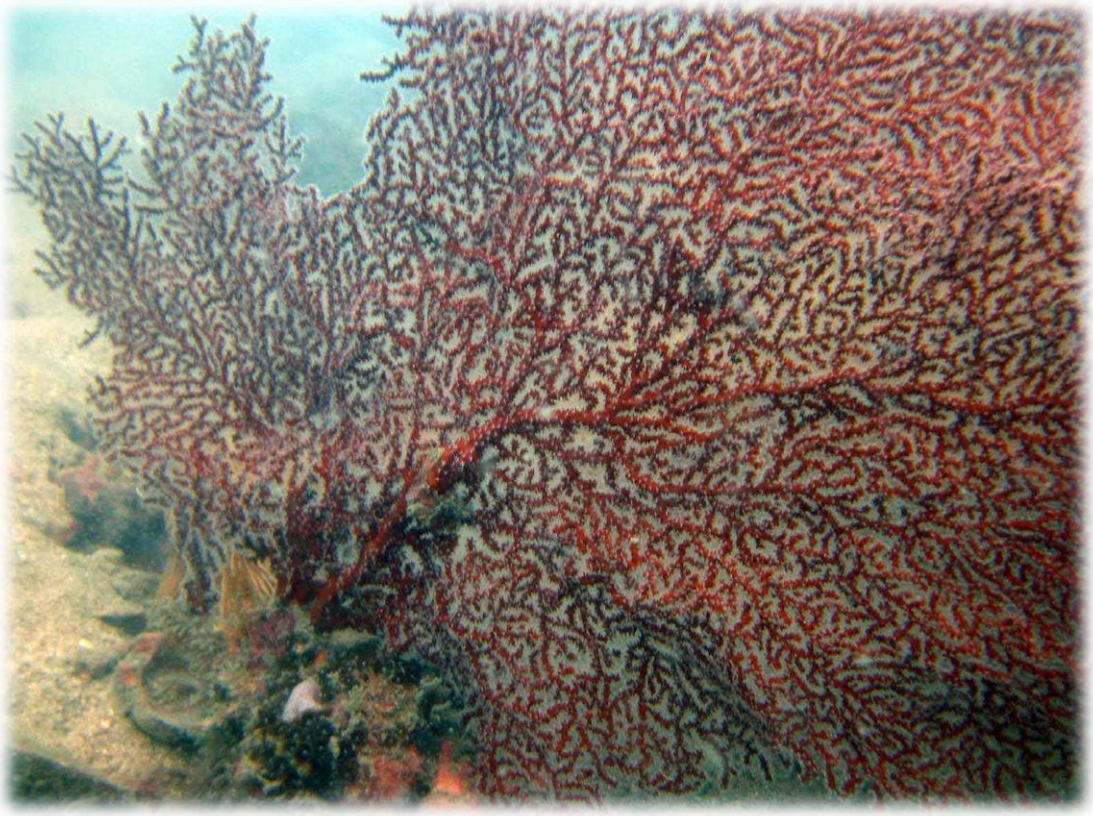

Photo 1 - Soft coral, Koh Russei 2011

In Partnership With:

Report By:

Paul Ferber – Managing Director and Project Founder
Carly Atkins – BSc - Science Officer
Ueli Schmid – Marine Survey Team Leader
Bonny Krell – MA Applied Ecology
Andrea Lee – Photography and Videography
Marine Skopal – MA ICM - ICM Project Coordinator

ABSTRACT

Upon request Marine Conservation Cambodia (MCC) undertook a series of marine surveys to determine the presence and state of health of the coral reef around Koh Russei Island. The Island of Koh Russei lies within the province of Preah Sihanouk, Cambodia. A Total of 15 Sites have been surveyed by the MCC survey Team between the 26th and 28th of February using the Reef Check methodology. Results of this study indicate that at the 15 sites surveyed the overall hard coral cover on the fringing reefs surrounding the shoreline of Koh Russei Island is around 19%. Sand was the dominant substrate with 44.7%. Several damages to corals have been observed mainly resulting from sedimentation and inappropriate fishing methods in the Past. Bleaching did occur in low intensity and should be closely monitored. Overfishing has been observed for both fishes and invertebrates. It is clear that the Marine Resources at Koh Russei Island are under strain and need active protection to stop the degradation of the Coral Reefs.

Marine Conservation Cambodia
Koh Rong Samloem Village, Koh Rong Samloem
Mittapheap District, Sihanoukville
CAMBODIA
info@marineconservationcambodia.org

Acknowledgements

Marine Conservation Cambodia (MCC) has been working on conservation and community livelihoods in collaboration with the Royal Government of Cambodia Fisheries Administration (RGC FiA), local authorities and local communities since 2008. Our Marine Monitoring and Marine Research programs around Koh Rong and Koh Rong Samloem are now well underway: we are currently undertaking marine surveys around Koh Rong Samloem to monitor the Seahorse populations and the coral reefs to assist the FiA in the creation of Marine Fisheries Management Areas (MFMAs), Cambodia's equivalent to Marine Protected Areas (MPAs).

Close collaboration with the FiA and international institutions such as the FAO Regional Fisheries Livelihoods Programme (RFLP) proved that MCC is now respected and credited as a leader in conservation and community work in Cambodia. As such, we were requested to set up the first base line surveys for a continued monitoring program around the Island of Koh Tang and Koh Russei (Bamboo Island).

Paul Ferber	Managing Director and Project Founder, MCC
Carly Atkins	Bsc - Science Officer, MCC
Ueli Schmid	Marine Research Coordinator, MCC
Bonny Krell	MA Applied Ecology – Marine Research Team, MCC
Julia Herbolsheimer	Marine Research Team, MCC
Jacqueline Dodd	Marine Research Team, MCC

All MCC staff and boat crew that joined the research trip and contributed to its success.

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Figures & Illustrations

Picture Credits

All pictures taken by MCC team

List of Abbreviations and Acronyms

FAO	Food and Agriculture Organization of the United Nations
FiA	Fisheries Administration
ICM	Integrated Coastal Management
KRS	Koh Rong Samloem
MCC	Marine Conservation Cambodia
MFMA	Marine Fisheries Management Area
MPA	Marine Protected Area
RFLP	Regional Fisheries Livelihoods Programme
RGC	Royal Government of Cambodia

INTRODUCTION

Coral reefs are the so called "rainforest of the sea" as they are the most diverse marine ecosystems presenting high biodiversity (Knowlton &Jackson, 2008) that provides significant economical goods and services that are critical to human well-being (Conservation International, 2008). This also applies for Cambodia's economy which is largely dependent on the Coastal and Marine sector. Coral reefs, by being a critical habitat for a lot of marine species, support the fisheries (a great part of the national household relies on the primary sector as the main source of employment and income - Wheeleret.al, 2000). Eco-tourism also plays an important role in the national income by attracting and increasing the number of tourists willing to discover these spectacular marine environments (Kim et al, 2004). Indeed an economic analysis of Ream National Park in Cambodia, focusing on recreational activities opportunities related to coral reef, estimated the Present Value (10% discount, 20 years) of the best protection scenario between $21,390 to $699,636 per km^2 of healthy coral reef (Conservation International, 2008).

Unfortunately there is growing scientific and public awareness of the widespread depletion of coral reefs, due to a variety of human activities including destructive fishing practices, overfishing, coastal development and agricultural run-off, as well as siltation, global warming and tourism- associated damage (Kim et al, 2004; GCRMN, 2004; Knowlton & Jackson, 2008). This loss inevitably leads to the decline in the abundance and diversity of reef fish and plants through the loss of structural heterogeneity (Jones et. al, 2004; Bruno & Selig, 2007) placing Cambodia's natural resources at risk (Kim et al, 2004, GCRMN, 2004).

Koh Russei or *Bamboo Island* is an island located about 12 km off the coast of Sihanoukville, Preah Sihanouk Province (**Figure 1**).

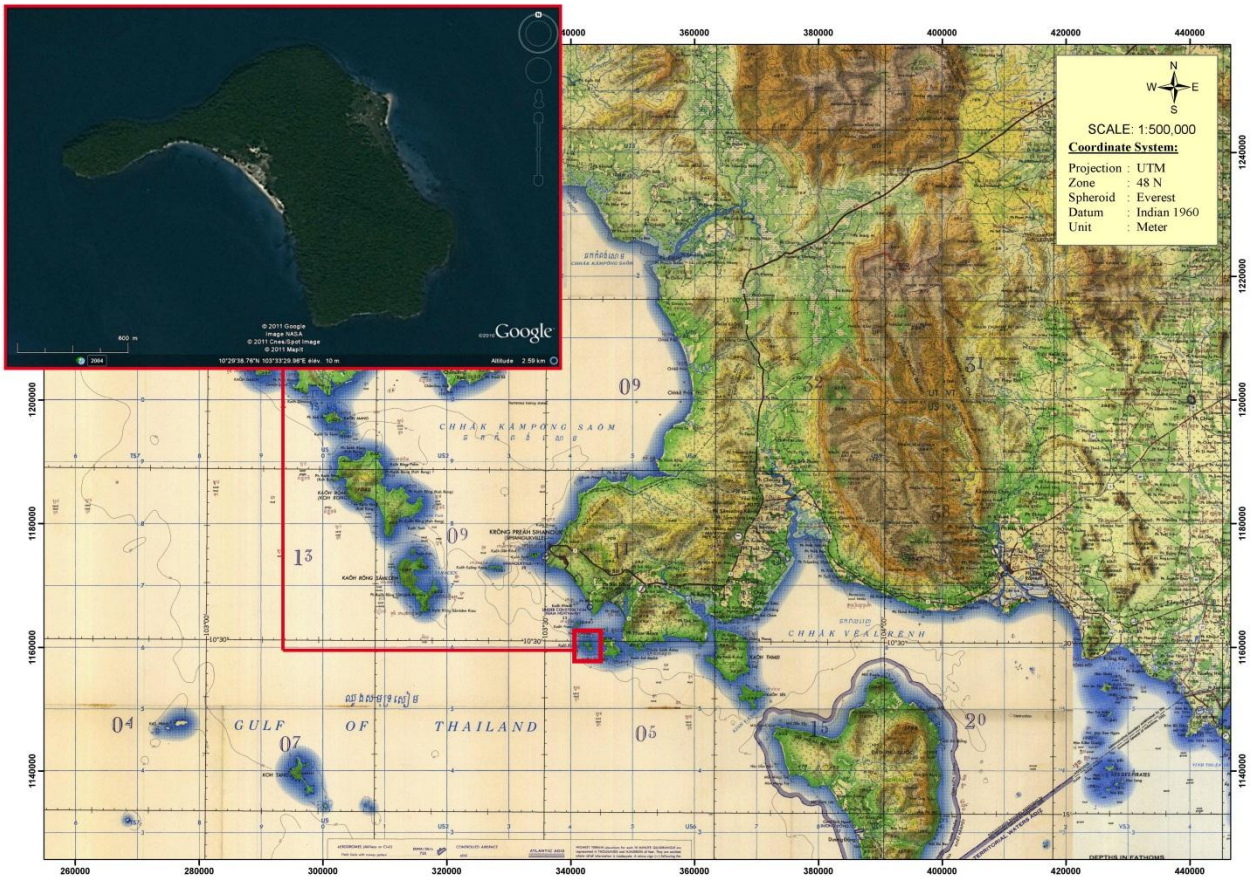

Figure 1 - Location of Koh Russei / Bamboo Island

Information about Cambodia's reef systems is sparse and poorly documented thus far (Kim et al, 2004). Thus, this study aims to provide information on the current health and biodiversity of the marine environment around Koh Russei Island.

The main goals of this survey were:

- To determine the general distribution of coral reefs around Koh Russei Island and to conduct baseline quantitative surveys on the abundance and distribution of reef health indicators such as fish and invertebrates.

- To determine the general reef condition in terms of visible impacts.

- To identify sites for future monitoring programs.

- To identify areas with high biodiversity and healthy coral reefs for the purpose of management and conservation in view of the interest to develop the area as a sustainable eco-tourism destination.

I. METHODOLOGY

Standard Reef Check monitoring was applied for the survey sites around Koh Russei in order to assess the abundance, diversity and composition of selected fish, invertebrate and benthic species. This methodology was used as it provides rapid assessment of coral reef condition and health. Furthermore, it is quick and reliable and based on pre-defined criteria and descriptors.

a. Location of survey sites and reasons for their selection

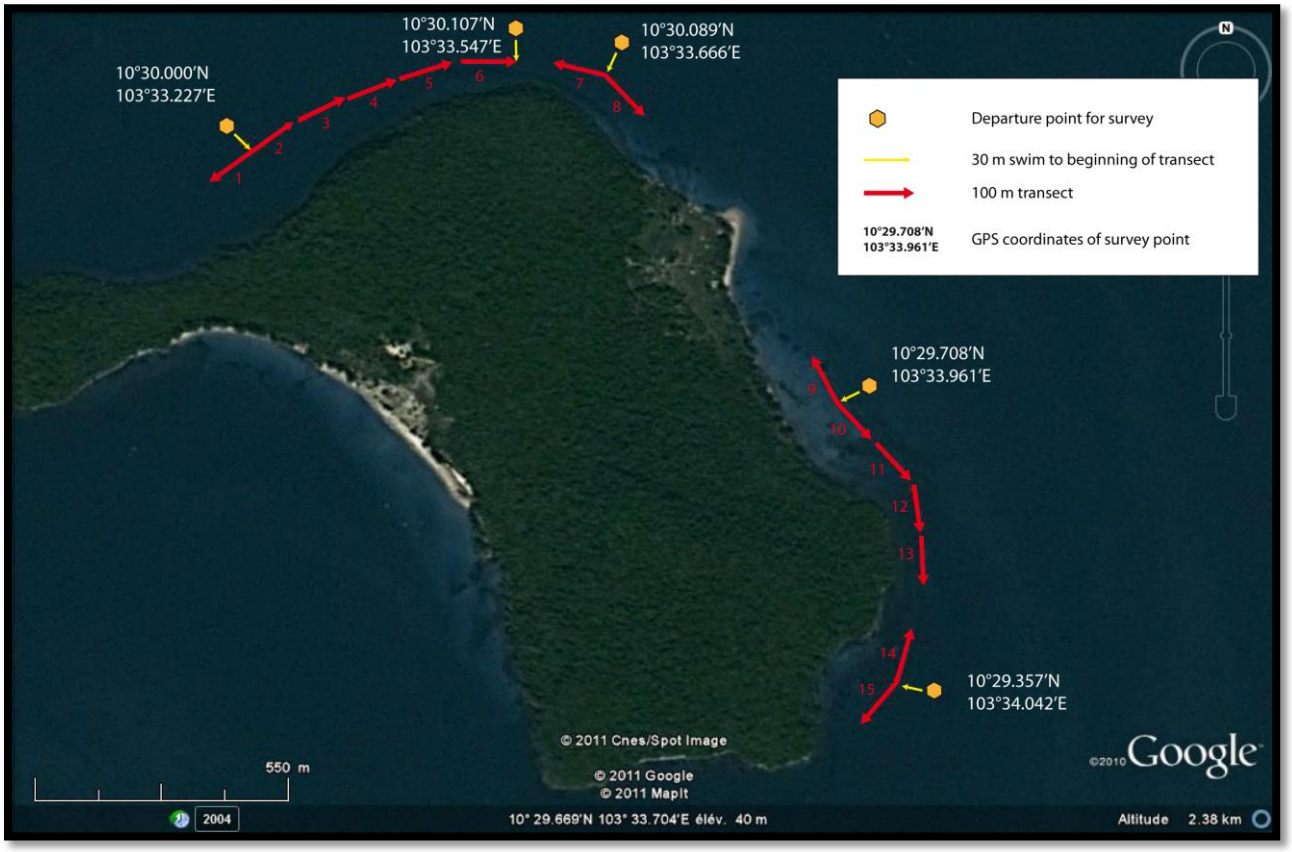

Figure 2 - Location of survey sites (Google Earth 2011)

For this study, 15 survey sites were chosen surrounding the island of Koh Russei (**Figure 1**). The sites were randomly chosen in advance to get the best overall view of the shoreline area then adapted to suit the conditions at the time of surveying. The starting point of each site was chosen at random and four 20-meter (m) transects were laid parallel to the coastline to make

up one complete segment. Each 20m segment was separated by a minimum gap of 5m. In these 5m gaps no data was recorded, as this is needed to ensure independence for each 20m section and provide reliable statistics. The recorded data has been transferred to standard data forms.

b. Type of data collected at each survey site / transect

An overall description of each site was recorded. This included: basic information, natural and human impact, historical facts and protection enforcement. Based on their effectiveness as indicators of overall reef health, certain target species have been chosen by Reef Check. A history of overfishing, aquarium collection, nutrient pollution and sedimentation can all be indicated by these variables. More specifically, the Reef Check methodology designates three different transects: fish belts transect, an invertebrate belt transect, and a substrate line transect (**Figure 3 and 4**).

In order to complete the fish belt transect, divers recorded fish in an area 2.5m on each side of the transect and 5m above. Since fish get easily disturbed by divers the fish belt transect was completed first. In order to record an accurate assessment of the fish population, this portion of the survey was conducted by swimming slowly along the transect, counting the indicator families and species.

The same four 5m wide and 20m long segments were used for the invertebrate belt transect. The divers executed this portion of the survey by swimming slowly in an S-shape pattern on each side of the transect counting the indicator invertebrates. To reassure accurate results, surveyors looked into holes, burrows and cavities.

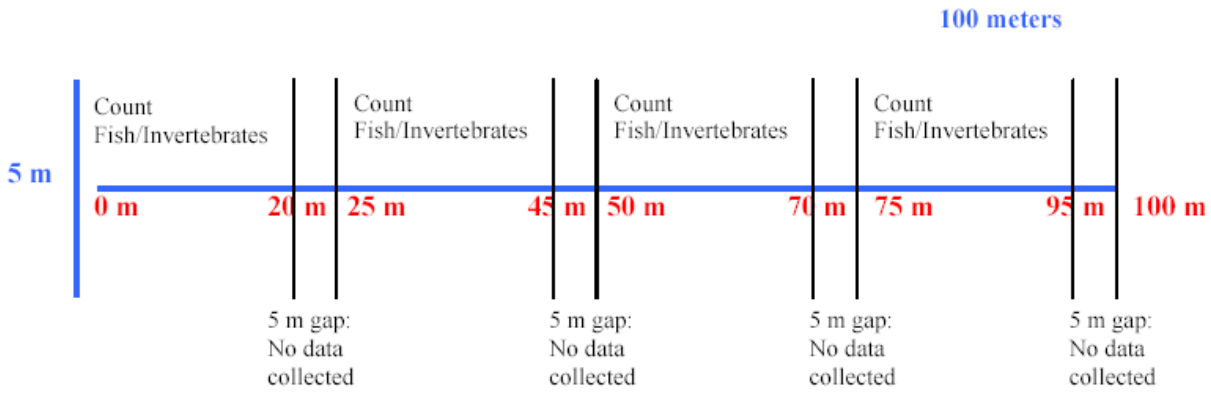

Figure 3 - Fish and invertebrate belt transect count method (in Hodgson et al, 2006)

This transect was used again to conduct the substrate line transect. In a 0.5m interval along the tape, points were sampled to determine the substrate of the reef. The benthic categories used in this assessment included: hard coral, soft coral, recently killed coral, nutrient indicator algae, sponge, rock, rubble, sand, silt/clay and other. Moreover, coral bleaching, anchor damage, dynamite damage, general damage and trash were also estimated along the transect line by the surveyors.

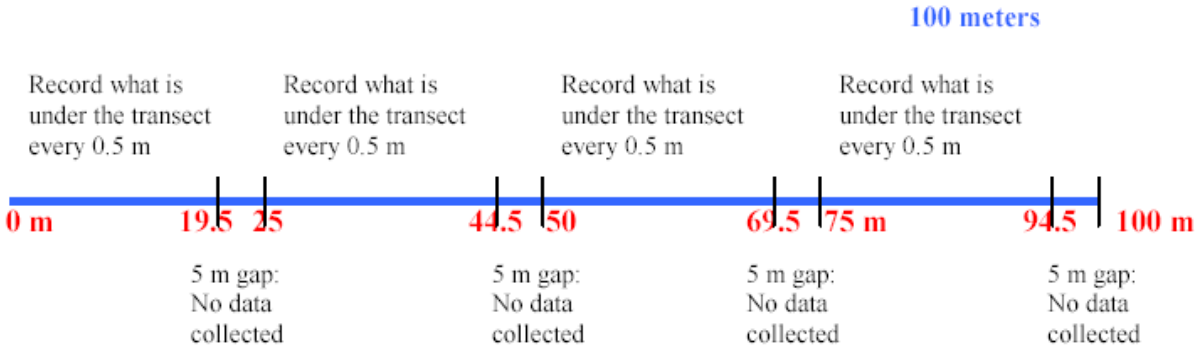

Figure 4 - Point intercept transect count method to determine benthic cover (in Hodgson et al, 2006)

After data had been collected using the reef check methodology, divers swam along the transect and collected extra information on species present at the survey sites. The purpose of this was to create a database list with all marine species that were witnessed during the surveys around Koh Russei Island. This can be used in the future to obtain a complete inventory of marine species present around the Island.

c. Data entry & analysis

To determine the cover percentages of each survey site, the mean percentage of substrate cover, of the four transects was calculated. The total cover composition around Koh Russei Island was estimated by the average composition of all survey sites.

Coral damage was noted in an empiric way by qualifying it in 4 levels of damage: 0- none, 1- low, 2- medium and 3- high. The damage per site has then been estimated as the mean of the four transects. A stacked column graph has then been used to compare coral damages between sites.

Bleaching was estimated for coral Population and Colony. The mean percentage of all sites was calculated by the average bleaching around the Island.

For the Fish and invertebrate transect, the mean abundance of individuals per 100square meter has been calculated for each site. Sites have been compared than using the Stacked column graph.

II. RESULTS

The results from these surveys are shown in a graphical format and aim to provide a picture of Koh Russei's coral reef status.

a. Substrate Composition

The main substrate covers encountered during surveys (**Figure 6**) was Sand with an average percentage of 44.7%, followed by coral, rock and rubble. The average hard coral cover over all 15 surveyed sites was found to be 19%. The highest coral cover was found on Site 3 were it represented 49.3% of the substrate cover at that site. While on Sites 8 a negligible amount was recorded (1.25%). Hard coral cover is an indicator of general reef health as they are reef

builders and it is recognized that reef fish diversity is directly correlated to it. Rock was recorded with an average cover of 14.7%. Site 11 had a particularly high rock cover (49.3%). Rock constitutes an important part of reefs as it provides settling ground for coral larvae. There was a low percentage of recently killed coral with an average of 3% with exception of Sites 3 and 12 that had a particularly high percentage of recently killed coral with 23.75% and 10.63% respectively. At these sites a high amount of sedimentation covering the corals has been found (**Photo 2 and 3**). Nutrient Indicator Algae was not existent or in very low percentage for most of the sites with exception of sites 9 and 10 where it represented 19.4 and 23.8% of substrate cover respectively. This leads to the conclusion that there is a sign of eutrophication in this area. Cover of sponges and soft corals was generally low (< 5%).

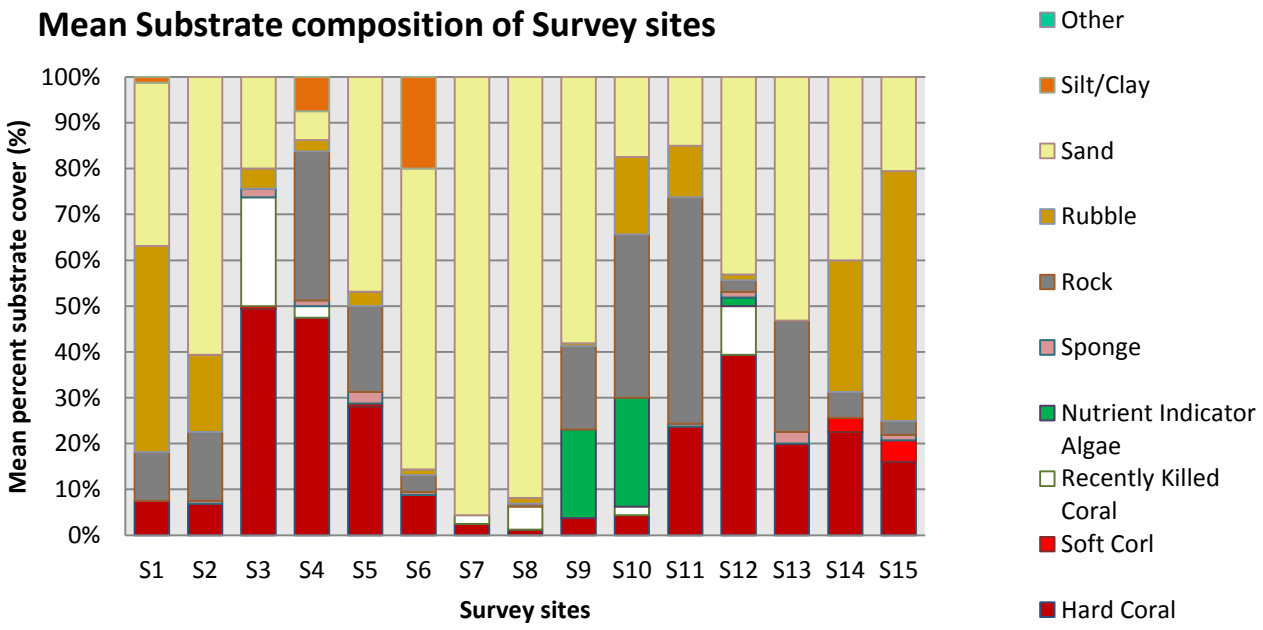

Figure 5 - Composition of mean percentage of substrates cover at the 15 surveyed sites

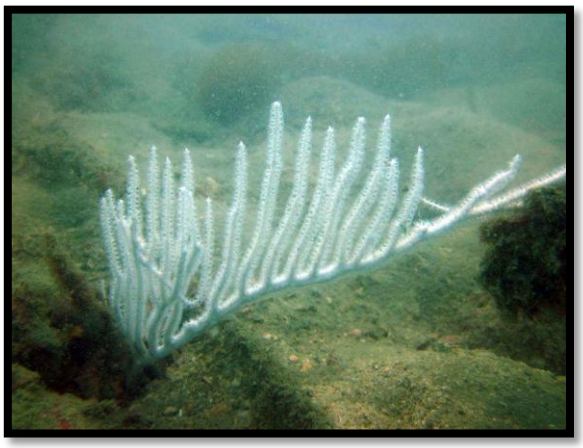


Photo 2 and 3 - Soft coral in heavy sedimentary environment and sedimentation settlement on massive hard coral

b. Impact on Coral

Generally, each coral damage category was found to be low with the exception of coral diseases damages on Site 11 which was medium. Even, when coral damage categories are summed together, the damage was low at most of the sites reaching moderate damages only at sites 14 and 15. Site 11 had the highest amount of coral damage (**Figure 6**) while Sites 3, 4, 6, 7, 8, 10 and 13 had no visible coral damage. Unfortunately sites 7,8 and 10 had an almost insignificant amount of Hard coral, less than 4% (see Figure5) . The effects of fishing in the form of discarded nets or other trash were found on several sites, however when present, it was relatively low. Coral damage resulting from dynamite fishing has been found on Site 11. However it was clear that this happened in the past, no recently killed coral from dynamite fishing.

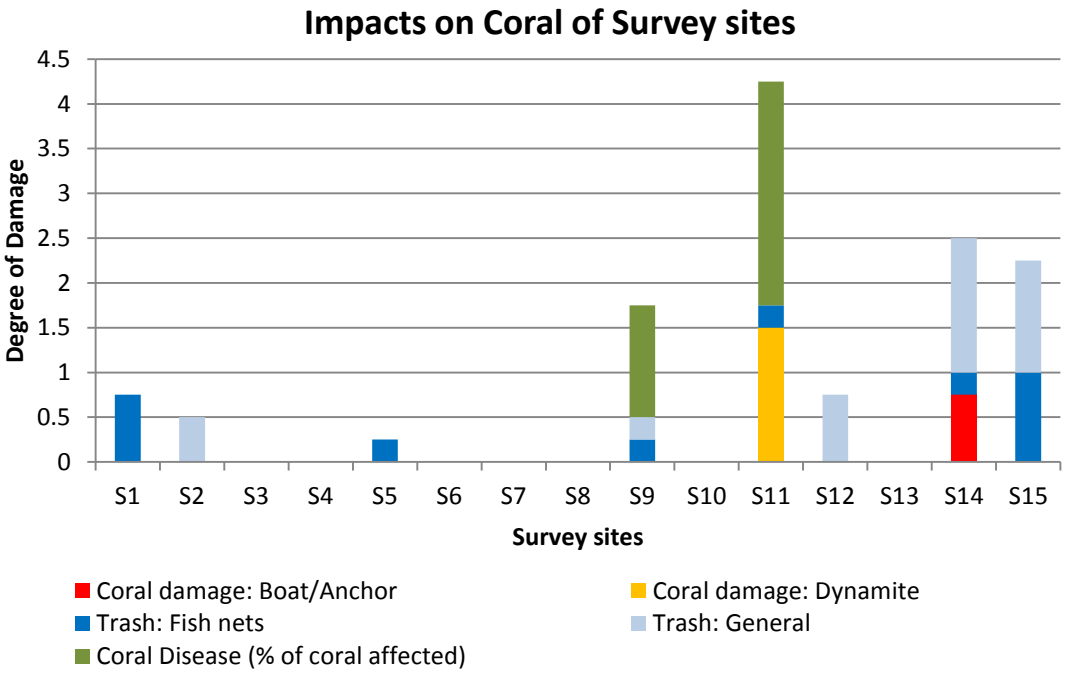

Figure 6 - Composition of mean percentage of coral damage of different categories of the 15 surveyed sites. Damage was categorized in 4 groups: 0-none, 1-low, 2-medium and 3-high

c. Bleaching Impact

This study has reviled that Coral bleaching does occur around Koh Russei Island even if minimal. The mean percentage of Coral Population that was affected by bleaching was 3%, And from this amount only approximately 11% did affect Coral colony (**Figure 7 and 8**).

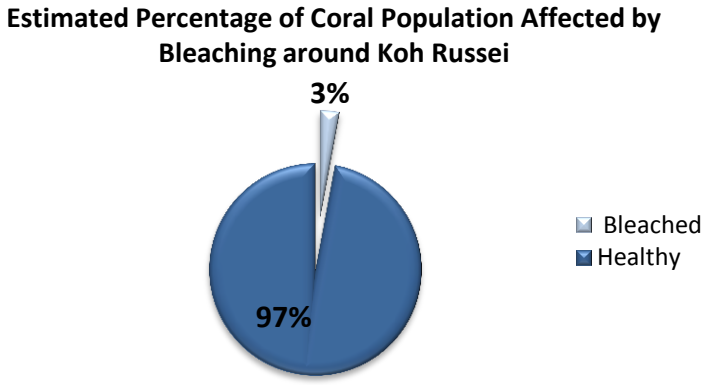

Figure 7 - Mean percentages of Coral Population that are affected or not by Bleaching

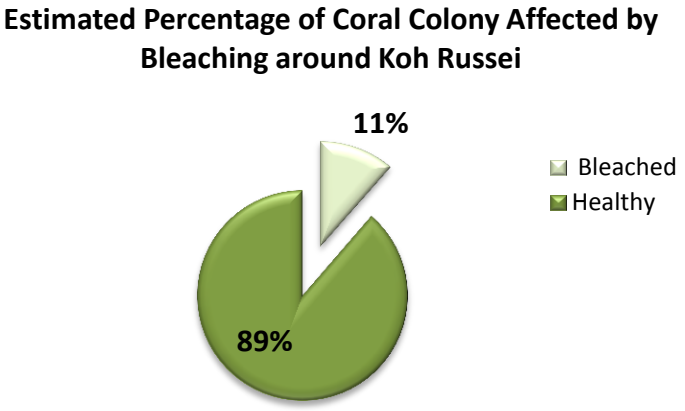

Figure 8 - Mean percentages of Coral Colonythat are affected or not by bleaching

d. Fish Survey

As it can be noticed in **Figure 9** the general abundance of fish species was very low on all sites. No fish has been recorded for sites 8 and 13 and Site 3, with the highest abundance, did not reach 8 individuals per 100m^2. One of the reasons, that so low number of fish was recorded, could be the poor visibility during the surveys which did lay within 0.5 and 3 m during all surveys.

The numbers of Groupers recorded during the survey dives was very low on all sites, though juvenile Groupers are not recorded when specifically using reef check methodology as this methodology allows only the indication of groupers larger than 30cm for its analysis. However a few juvenile Groupers were seen during the survey. Sweetlips were very low or absent from survey sites. The number of Butterfly fish (**Photo 4**) was low on all sites (less than 10 individuals/100m^2) even if it was the family that has been seen more often. The numbers of snapper was low changing between 0 and 2 individuals per 100m^2. The number of Parrotfish bigger than 20cm was insignificant not reaching, in average 1individual per 100m^2. One juvenile exemplar of Barramundi cod has been found on site 11.

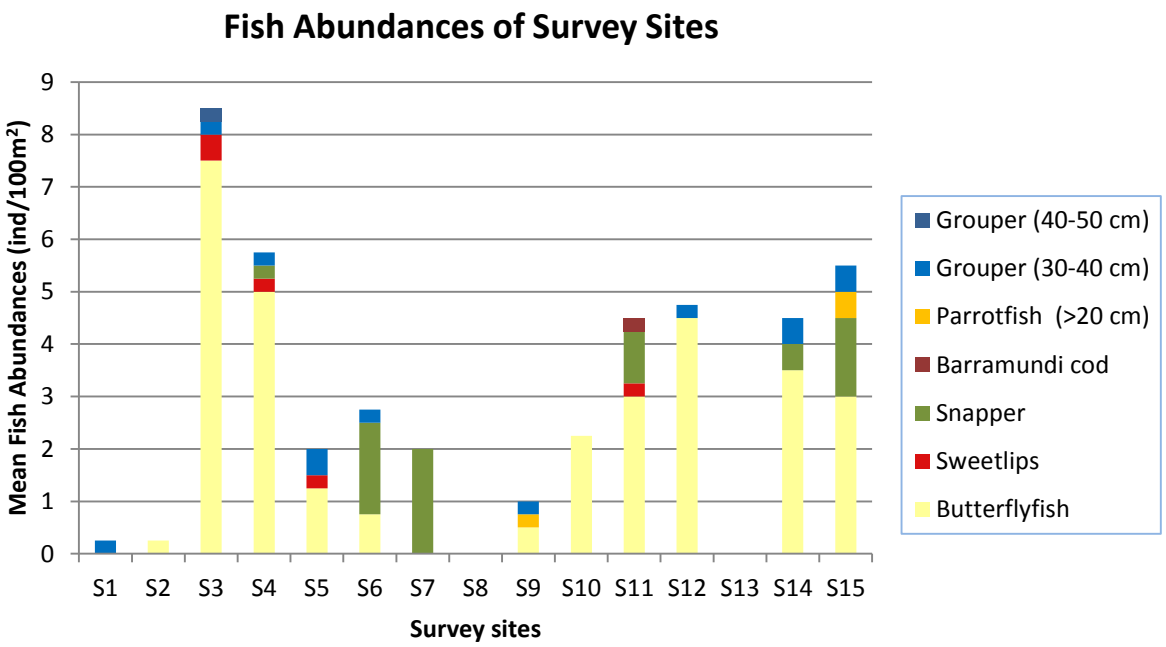

Figure 9 - Fish Abundances of Survey Sites. Mean number of individuals /100m2 has been calculated for each site. Figure shows only observed fish families.

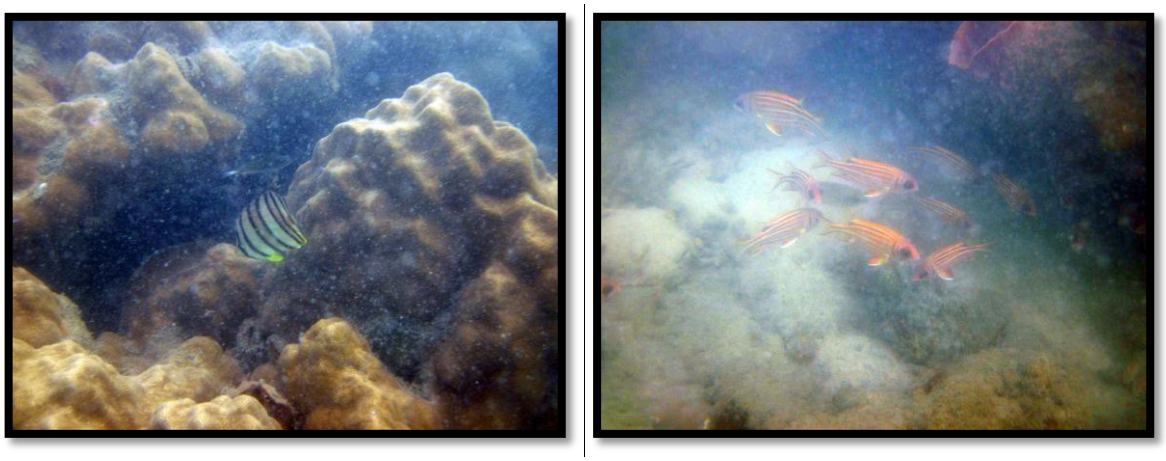

Photo 4 and 5 – Butterfly fish above hard coral and school of squirrel fish

e. Invertebrate Survey

It is possible to observe that there is almost no diversity in Invertebrates around the island (**Figure 10**). Site 6 was the one with the lowest specie richness and abundance. Sea Cucumber abundances were low, maximum 1individuals/100m^2 if not absent, from survey sites, indicating severe over-harvesting. Giant clams (*Tridacna* spp.) are important reef filter

feeders that contribute to the reef structure and rugosity. These organism have been found in very low abundances (generally <1 individual per hectar) and only of small size. This may result from a severe overharvesting as these are an important local food source and have been traditionally harvested for centuries. Relatively high abundances of long-spine (*Diadema*) sea urchins were found on most surveys sites (**Figure 10**). Sites 7 had particularly high densities of these urchins (60 ind. /100m^2) while on site 10 was not found a single individual. These Sea urchins as they are algal-grazing, can play an important role in keeping the reefs clean of algae when there are few herbivorous fish around to fulfill this role. Pencil sea urchin almost didn't exist on survey sites and collector sea urchin was only found on two sites (8 and 15). Coral Banded shrimp, Lobster, Triton shell and crown-of-thorn sea star have not been seen and therefore not included in the graph. It should be taken in mind that some small individuals that like to hide in crevices might have not been seen due to the high turbidity of the water column.

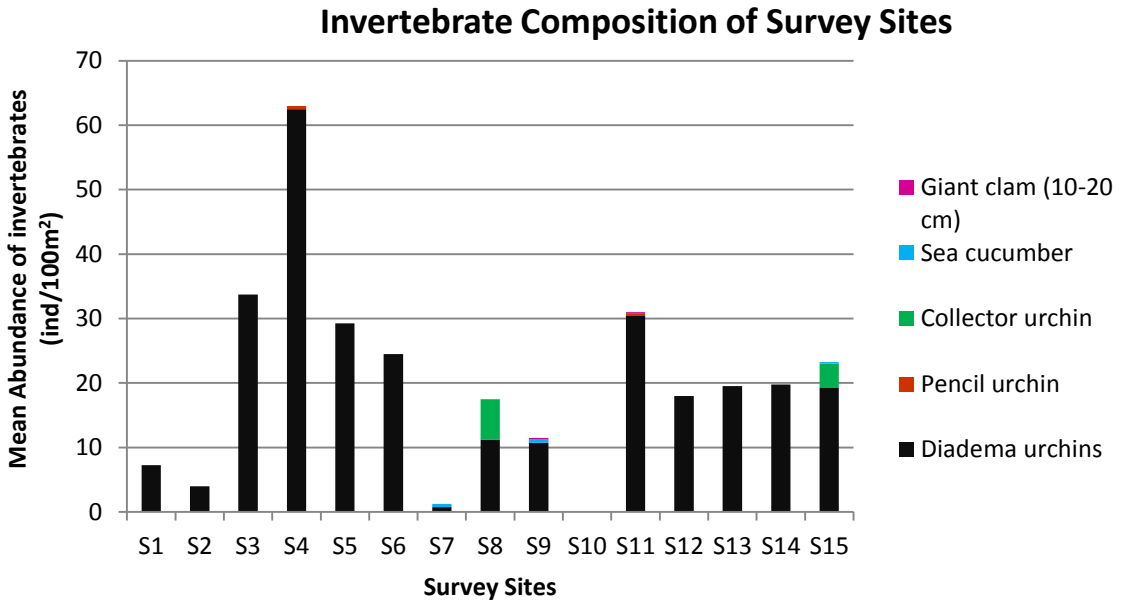

Figure 10 - Invertebrate Abundance of Survey Sites. Mean number of individuals /100m2 has been calculated for each site. Only recorded groups of invertebrates are shown in the graph.

III. Fishing and other activities observed on-site

A large number of bottom trawlers illegally operating in the inshore areas (areas shallower than 20 meters) of Koh Russei were observed at different time of the day (Photo 6 and 7). Undeniably, there is a direct relationship between trawling activities and high levels of water turbidity and sedimentation observed on-site.

Photo 6 - Early morning trawling, Koh Russei 2011

Photo 7 - Afternoon trawling. Marine tourism and trawling activities are hardly compatible. In the background (left) a tourist boat with snorkelers anchored near the shore.

Turbidity resulting from suspended sediments due to trawling activity reduces the light available for photosynthesis by endosymbiotic zooxanthellae within the tissues of corals,

thereby affecting the overall metabolism of a coral reef. Corals depend on the associated zooxanthellae for rapid deposition of calcium carbonate (Chalker 1981); therefore, high turbidity can reduce coral growth rates. Growth may also decrease because of the diversion of energy for the removal of sediment particle. A high amount of sediment covering the coral can lead to their asphyxiation.

Sedimentation is one of several parameters which also affect coral recruitment (Bak & Engel 1979 and Rogers et al. 1984 in Rogers, 1990). Coral larvae cannot successfully establish themselves in shifting sediments. Increases in sediment input (either in suspension or as accumulating particles) could radically alter the distributions of reef organisms by influencing the ability of their larvae to settle and survive.

Often careful planning and implementation of protective measures during construction projects can reduce damage to marine systems. For example, use of silt screens, settling ponds, and berms can reduce adverse effects (Rogers, 1990). Natural drainage patterns should be altered as little as possible. Developers should monitor the effects of coastal construction on nearby marine ecosystems to ensure the sustainability of the goods and services provided by coral reefs and related ecosystems.

Regarding to tourism development, trawling activities are most likely to impact marine tourism volumes: reduced visibility (sometimes less than one meter during the survey), brown waters and corals covered by sedimentation are most unlikely to attract visitors (**Photos 8 to 10**). The issue of inshore trawling needs to be addressed fully and urgently if marine tourism is to be developed; if not, it could take years before the ecosystem recovers and become attractive again.

Besides, potential resource use conflicts were observed between users of the area (Photo12): tourism (tourist boat), small-scale fishing (legal and illegal) and large-scale fishing (illegal) were indeed witnessed operating in the same area. These activities are unlikely compatible: a proper zoning plan could resolve potential future conflicts, most likely to increase along with tourism volumes.

The short underwater video gives a clear view of underwater conditions surrounding Koh Russei.

Photo 8 and 9 – Sponges and corals covered by sedimentation

Photo 10 and 11 - Massive hard coral covered by sedimentation, feather star and mushroom coral (Photo 10). Serious water turbidity and sedimentation can be observed on every photo (Photo 11).

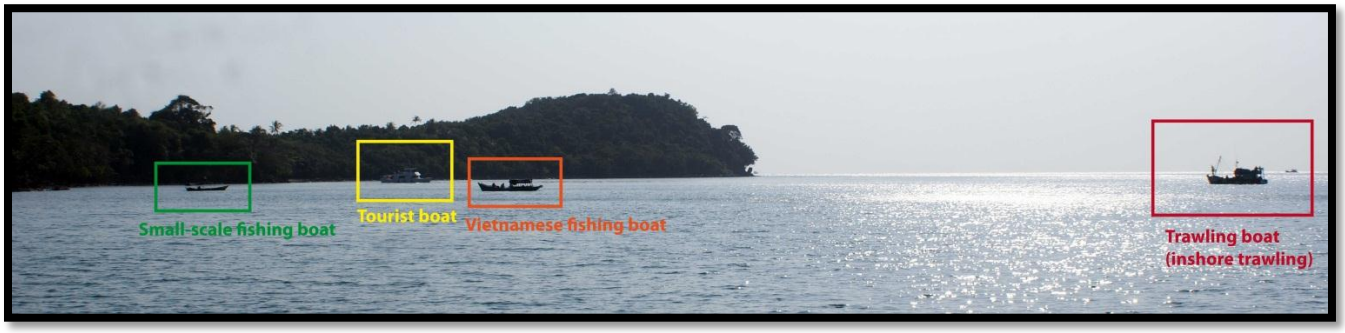

Photo 12 – Potential resource-use conflicts in Koh Russei area, March 2011

DISCUSSION AND CONCLUSIONS

The results of the surveys make clear that the marine resources at Koh Russei Island are under strain and need active protection to stop the degradation of the coral reefs and marine biodiversity areas. There are clear areas of higher biodiversity but these areas show clear signs of overfishing and high sedimentation.

Koh Russei has a great potential to attract tourism to enjoy both the beauty of the island and its surrounding reefs. However, as it is now, the level of degradation caused by sedimentation and water turbidity will directly affect the satisfaction of tourists seeking "tropical island experiences" including visiting the coral reefs. This can unfortunately been seen in Internet reviews and forums where Cambodia is often mentioned in a negative way in regards to its snorkeling and diving locations, with people preferring other neighboring destinations where better protection measures are in place.

GENERAL CONCLUSION

Immediate response to illegal inshore trawling should be addressed and monitored. A Protection Program for the marine ecosystems surrounding the island of Koh Russei, including coral reef rehabilitation programs should be put in place. With proper protection and monitoring, an increase in marine resources and marine environment health should be seen within one year and increase respectively over consecutive years, thus increasing potential for marine ecotourism and visitor volumes.

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APPENDIX: Location of main marine habitats and related threats around Koh Russei Island, Cambodia (March 2011)