



Impact Assessment of Climate Change of Coral Reefs in Busuanga, Palawan

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Abstract: Coral reefs, the home of the most diverse marine habitat, are the direct receptors of anthropogenic disaster - climate change. The drastic increase in temperature causes the degradation of the presently declining status of the coral reefs. The main objective of the study is to assess the impacts of this long-term climate variability on the biophysical condition of these coral reefs. Wroclaw Quantum Geographic Information Systems is used to identify the vulnerable coral reef areas. Markov Chain Monte Carlo Modeling is also utilized in order to determine the optimum scenario in terms of coral bleaching, drop in fish and coral biodiversities, increase in carbon dioxide concentration, the weakening of coral skeletons, and the migration of marine species that have been happening in Busuanga, an island on the Calamian Archipelago of Northern Palawan. Mitigating measures and adaptive capacities are recommended to reduce the threats brought by climate change.

Key Words: coral reefs; climate change adaptation and mitigation; Markov Chain Monte Carlo Modeling; Participatory Action Research

1. Introduction

Coral reefs are home to a total of 25 percent marine species. It has one of the richest biodiversity on Earth. These coral reefs contribute largely to marine livelihood (Tun e al., 2008). The impacts of climate change contribute to the degradation of this vital ecosystem. The major consequences include the alteration of the environment of coral reefs and coral bleaching. However, the issue arises whether these consequences are evident. The significance of the consequences to the welfare of coral reefs is still

questionable. It is uncertain whether it is possible to conserve the coral reefs despite the unavoidable and rapid change of climate.

There is a total of thirty-seven percent (37%) of reefs effectively dead and forty-seven percent (47%) of remaining live reefs at high risk of being destroyed in South-East and East Asia (Wilkinson, 2004). The Philippines, which is part of the Indo-Pacific Coral Triangle with over 237 coral reef sites, is considered to be one with the widest and largest



marine biodiversity, it is reckoned to be at high risk. Busuanga Island of Palawan, a third class municipality, consists of more than 300 species of coral reefs, which are susceptible to natural and anthropogenic hazards. These disasters cause immense impacts, which include the rise of water temperature, the possible alteration of biodiversity, and acidification of the water. With an increase in temperature by 2.4 degrees Celsius in 2080 (Schneider et al, 2007), these coral reefs would result in bleaching and disparate transformation of marine ecosystems and biodiversity would occur (Country Environmental Profile, 2009). As devastating as it may seem, extinction of these reefs will happen and the coral skeletons will be on its weak conditions (Teach Ocean Science, n.d.).

The bleaching or paling of the corals is said to be suitably correlated with noticeable increase of sea temperature (Baker et al., 2008). Coral reefs contain symbionts that help in the process of photosynthesis. These symbionts are called zooxanthellae. As the water temperature increases, the zooxanthellae's cells are damaged rendering unable to help in the process of photosynthesis. When this occurs, the zooxanthellae are removed from the corals the results in paling of the host. The colours of the affected corals could still be restored naturally. However, increasing instances of bleaching and its severity could weaken its ability to rehabilitate itself (Buddemeier, Kleypas & Aronson, 2004).

The impacts of climate change will be evaluated if these are present on the island of Busuanga, Palawan. The study includes: the assessment of the extent on the biophysical changes on the corals, and their biodiversity. The policies regarding coral reef preservation will be determined to assess what areas need improvement and to formulate mitigating measures to further preserve the coral reefs.

2. METHODOLOGY

2.1 Participants

One of the methods used for this study was guidelines from Participatory Action Research (PAR), a research methodology approach to improve the community by changing it and learning from the consequences of change. Having corals as the focus of

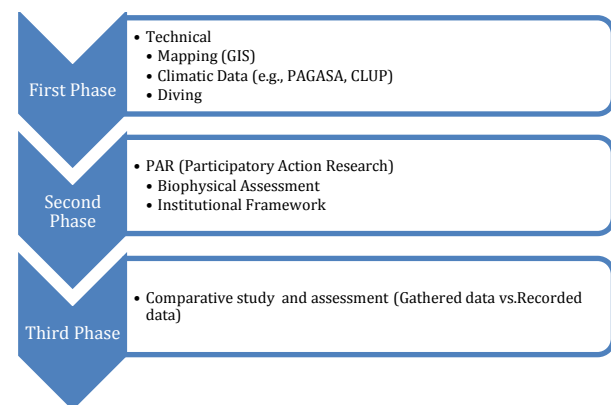
this study, necessary information was obtained through conducting discussion with people with sufficient encounter and knowledge about the subject. The target location was surveyed, and evaluated through personal interview with the local municipal officers, scuba divers, a representative from ethnic minorities, some non-governmental organization (NGO) personnel and residents. The interview was conducted through visiting the interviewee's office or place. Questions and responses were conveyed through dialog and the whole interview was recorded.

2.2 Materials

Materials used were print and online literary citations such as journals, publications, reports, and articles. Assessment was a comparative summary from literary surveys and information regarding the condition of the coral reef in Busuanga, Palawan with respect to the information and observations coming from the actual diving of the proponents of the study. Quantum Geographic Information System was used for the coral reef species geographic distribution and distinguishing their condition.

The questionnaires were divided into three categories--- biophysical assessment, biodiversity of coral reefs and institutional framework. Questions were cautiously chosen to avoid unrelated, leading and misleading inquiries and responses. Answers were basically generated from interviewee's experiences and observations

3.3 Procedure



The initial step for the study was gathering literary citations about the condition of coral reefs in Coron Island, Palawan for the past 20 years.



Climatic data, such as annual rain fall and temperature, for the parameter of this study was gathered to as well to relate the coral condition to climate. The actual condition of the corals was observed by surveying the area of parameter through diving.

The second phase of this study was utilizing the PAR approach. The questions were categorized as biophysical assessment, biodiversity of coral reefs and institutional framework. Biophysical assessment focused on the climate pattern with respect to the condition of corals. Coral species, reef zones and the effects and threats of climate were included in biophysical. Lastly, for the institutional framework, community's response in terms of coral protection initiatives was discussed.

Assessment was executed on the last phase of the methodology. Fish bone analysis was used to summarize the effects and rationalization of the impacts of climate change to coral reefs. At the same time, evaluation of coral condition was carried out. Results from PAR and information gathered from diving were the set as point of comparison of the literary citations to validate the results of this study.

3. RESULTS AND DISCUSSION

The results were all based from the Participatory Action Research

3.1 Biophysical Assessment

a. The water is getting warmer.

Before: In summer, temperature would hardly reach 30 C. In winter (November) water could drop down to 25 to 26.

Now: Temperature is higher than 27. The water actually is uncomfortably warm. Normally people would complain too cold but it is too warm.

b. There is an increase by 1 or 2 degrees definitely in average over a year. It never really gets cold anymore

c. Temperature change occurs during summer. April or May is the warmest time. In June, rains cool the water down and the sun does not affect much the water. It gets slowly cold by temperature in the air. It gets really cold by November and December.

d. Indirect factor: Seen more siltation due to poor soil management such as "Kaingin". A lot of soil is washed off to the river and goes to the ocean and

covers the surface of the ocean thus, blocking the sunlight from passing thru to the corals. This affects the growth of coral reefs.

e. There are over 150 islands within Busuanga island or the Calamyanes group of islands, it is assumed that each island has at least one coral reef.

f. There are damaged coral reef areas around Busuanga. There are of course, damaged coral reefs; however these reefs are not damaged thru environmental damage but due to the increase in population and fishing techniques. The damage is caused by human-induced activities rather than than of the environmental scale.

g. There is a change in weather pattern. Change of weather pattern means more rain. Rain is good but but it washes off the soil that affects the ocean with it the reefs, its habitats and its life.

h. Coral bleaching is not coral dying but it is a stress sign from the corals.

3.2 Biodiversity

a. Over 300 species of corals: hard corals, soft corals, stock horn corals, sponges, sea weeds.

b. Different shapes between hard corals, soft corals, sponges, sea weeds.

c. Same species around the world but different species of algae working on it, producing a different colour.

d. Hard corals are the ones usually seen apart from the areas where large current are present were soft corals are present also.

e. The presence of stock corals and parrot fish is an indication of a healthy coral reef.

f. Corals work together in symbiotic union. Corals are built on corals over a thousand years having large rock structures where corals grow.

g. Mostly brain corals; one of the slowest growing corals in the world grow 2cm a year.

h. Effects of climate change comes from bleaching. The death of an algae in the coral is an indication that the corals will die.

i. Colours of the corals are much more intensive years ago compared to today where the colours are fading.



j. Colours of the corals are fading - turning greyish due to the change in temperature.

3.3 Institutional Framework

- a. NGOs, such as USAID, Green Fins, & Ecofish, are working towards writing policies for coral reef protection
- b. Coron municipality has a code of conduct towards ecotourism
- c.. Divermasters follow the rule "no touch"

Interpretation of Results

Warmer water temperatures brought on by climate change stress corals because they are very sensitive to changes in temperature. If water temperatures stay higher than usual for many weeks, the zooxanthellae they depend on for some of their food leave their tissue. Without zooxanthellae, corals turn white because zooxanthellae give corals their color. White, unhealthy corals are called bleached. Bleached corals are weak and less able to combat disease

4. CONCLUSIONS

It is therefore concluded that the paling of coral reefs is an indication of climate change. The change in temperature may cause stress on coral reefs since they are sensitive in temperature changes. These were seen in the areas of Busuanga, Palawan

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