



# The Role of Marine Protected Areas in Coral Reef Ecosystem Resilience in Response to Increasing Sea Surface Temperatures.

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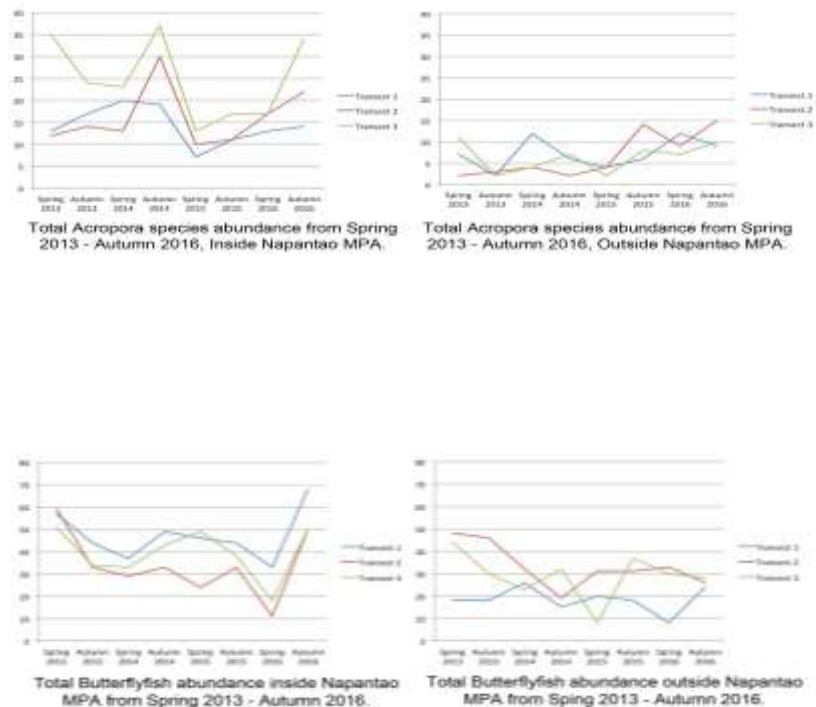


## Introduction and Aims:

- Marine Protected Areas (MPAs) are implemented with the aim of protecting a marine ecosystem by reducing external pressures such as overfishing, excessive tourism and anthropogenic pollution.
- I aimed to establish the effect of Napantao MPA, Southern Leyte, Philippines on coral thermal resilience over a period of increased thermal stress.
- This study examines fish, invertebrate and benthic data inside and outside the MPA boundary over a period of 4 years including the El-Nino year 2015.

## Methods:

- This study used secondary data collected by Coral Cay Conservation (CCC) from 2013-2016 on Napantao MPA.
- The data was collected through permanent survey transects (3 inside the MPA and 3 outside) surveyed twice a year, in Spring and Autumn.
- Fish and Invertebrate data were collected using a belt transect method and a Point-Intercept transect for collecting benthic data.



Both *chaetodontidae* and *Acropora* spp. show strong declines within the MPA beginning in early 2015, however, in 2016, strong patterns of recovery are seen within the MPA, as opposed to continued sporadic declines and inclines seen in both species outside the MPA.

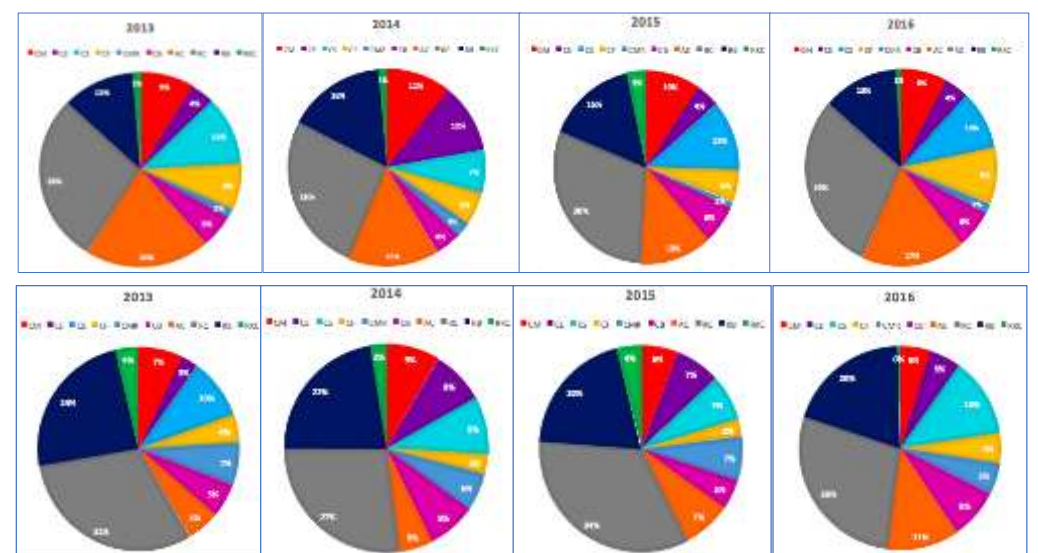
Trends of total abundance of RKC (left) and Herbivorous Parrotfish (*scaridae*) (right) outside Napantao MPA.

The trends of RKC show a strong increase in abundance in 2015, in keeping with increased bleaching as a result of elevated SST. This increase in macro-algae is likely to be the cause of the strong increase in Herbivore abundance seen in Spring 2016; as a result of greater food availability. An increase in Herbivore abundance is likely to reduce macro-algae levels, as seen above, possibly preventing a phase-shift to an algae-dominated ecosystem.

## Key Findings:

- This study provides evidence that MPAs do promote thermal resilience and improve recovery rates of both coral and coral-associated species.
- Change in levels of population bleaching over the El-Nino period was found to be significantly higher ( $P=0.002$ ) outside the MPA; showing a correlation of  $R = 0$  inside the MPA and a positive correlation outside.
- During the period of elevated SST in 2015, coral species and coral dependant fish species showed stronger declines within the MPA, however trends of recovery for both ecological groups showed a stronger increase within the MPA beginning in early 2016; returning to pre El-Nino levels of abundance by the end of 2016.
- Levels of Recently Killed Coral peaked both outside and inside the MPA in 2015, followed by a strong increase in Herbivore abundance outside the MPA in early 2016, likely to be as a direct result of high levels of food availability.

Benthic composition inside Napantao MPA (above) and outside Napantao MPA (below).



CM= Massive Coral; CE = Encrusting Coral; CS = Submassive Coral; CF = Foliose Coral; CMR = Mushroom Coral; CB = Branching Coral; AC = *Acropora* spp.; RC = Rock; RB = Rubble; RKC = Recently Killed Coral.

## Conclusions:

- The significantly higher amount of population bleaching outside the MPA indicates that an MPA, if well managed, does have the potential to reduce levels of bleaching during a climatic event by reducing levels of stress already upon corals from external, controllable sources.
- *Acropora* spp. and Butterflyfish within the MPA both show strong declines in 2015, this is a common finding within MPA assessments that areas of higher biodiversity suffer more severe declines. However, by the end of 2016, both species within the MPA have shown signs of strong recovery with some numbers of abundance reaching higher levels than pre El-Nino.
- Through the reduction of the depletion of key herbivorous fish groups through MPA management, control of macro-algal colonisation can be regained, enabling further post-bleaching recovery, larval settlement and growth; managed fish stocks is key to promoting reef resilience.
- Herbivore abundance has regularly been used as a predictor of algal cover upon a reef (McClanahan 2001), this study corroborates previous findings that herbivores may increase in abundance following disturbance due to increase algal resource availability.