ORIGINAL ARTICLE

Density of coral recruits on dome-shaped coral nurseries in Mu Ko Chumphon National Park, the western Gulf of Thailand

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Abstract. Natural recruitment is an important recovery process in coral reef. Coral reef areas were decreased cause by climate change around the world. Therefore, several shaped of the artificial reef were designed to enhance the available substrate for coral recruitment. Knowledge of coral recruitment is required for understanding and managing coral reef ecosystems. This study quantified the abundance and taxonomic composition of juvenile corals on natural reefs and their relationships with dome-shaped coral nurseries in Mu Ko Chumphon National Park, the Western Gulf of Thailand, after deployed for one year. Dome-shaped coral nurseries were set up at Ko Rang Kachiu and Ko Ngam Yai. The results showed that the total density of coral recruits at Ko Gnam Yai was higher than that at Ko Rang Kachiu after six months (36.50±11.26 and 8.50±2.51 recruits/m^2) and one year (69.79±10.26 and 39.77±4.51recruits/m^2). The coral recruits of *Pocillopora* and *Porites* were commonly observed in shallow reef flats and reef slopes at Ko Rang Kachiu and Ko Ngam Yai. After one year, size-frequency distribution of coral recruits ranged from 0.3-3.0 centimeters. The average sizes of coral recruits at Ko Rang Kachiu and Ko Ngam Yai were 1.79±0.30 and 0.84±0.23 centimeters, respectively. A better understanding of coral recruitment pattern is necessary for planning and managing of coral reef recovery in a global warming crisis.

Keywords: *Coral nursery, Coral reef, Coral recruit, Self-seeding, management*

1. Introduction

Coral populations in various temperature zone tend to have the ability to tolerate the change of temperature likewise the coral in the leeward pool and also the coral in the area where high tide and low tide are very different (Schoepf et al. 2015). These naturally heat-tolerant corals are excellent experimental animals for research into the mechanisms and timeframes involved in creating high-temperature endurance (Schoepf et al. 2015; Ruiz-Jones and Palumbi 2017; Camp et al. 2018). These corals are particularly critical to the sustainability of coral reefs because they have the ability to transfer heat-tolerant genetic features to coral larvae in fluctuated temperature locations. The genetic variety of corals will be expanded, lowering the chance of extinction (Bay et al. 2017; Anthony et al. 2017; van Oppen et al. 2017). The thermal adaptation mechanism of coral reefs was studied by transplanting corals between reefs in different temperature conditions on a regular basis. After the experiment, the physiology, gene expression, and coral ecology were examined, given crucial information for restoring and managing coral reefs affected by global climate change (Palumbi et al. 2014).

Coral reefs can be self-recovery by producing coral recruitment which releases planular larva every year under the full moon. Temporal variation in coral recruitment patterns are important data to understanding

population dynamics and coral resilience response to human activities and natural disturbances (Hughes et al. 2010; Yeemin et al. 2012; Sutthacheep et al. 2013; Yucharoen et al. 2015). Several factors affected to coral recruitment i. e., live coral cover on the reefs, abundance and diversity of planula larvae, recruitment cues, inhibition and competition from other benthic organisms, grazing intensity, reef connectivity, hydrodynamic condition, temperature, nutrients, light intensity, and sedimentation (Hughes et al. 2000; Salinas-de-León et al., 2013; Yeemin et al. 2012; Putthayakool et al. 2017; Suthacheep et al. 2019). An important strategy to increase coral reef area is active coral restoration. Several restoration projects were carried out in the past three decades with various methods including several models of artificial reef. Artificial reefs were used to increase coral recruitment (Thongtham and Chansang, 1999; Yeemin 1997; DMCR 2003; Yeemin et al. 2006).

This restoration project was designed to select stress-tolerant corals under stressful environment with an innovative model, dome-shaped nurseries. This study aims to assess coral recruitment on dome-shaped nurseries after the installation for six months and one year.

2. Materials and Methods

2.1 Study sites

The study sites were located at Ko Rang Kachiu and Ko Ngam Yai in Mu Ko Chumphon National Park, the Western Gulf of Thailand. Mu Ko Chumphon National Park is managed by the Department of National Parks, Plant and Wildlife Conservation (Figure 1).

2.2 Coral nursery design

Artificial reefs were designed as dome-shaped concreates with hole inside the dome shape to reduce weight and increase the space for marine organisms such as fish (Figure 2). Pilot nursery structures were placed at Ko Rang Kachiu and Ko Ngam Yai in March 2021.

2.3 Data collection

Coral recruits were observed on the dome-shaped nurseries by SCUBA diving. Randomly placed quadrats (16x16 cm^2) on the dome-shaped nurseries and took photos with a scale. All visible coral recruits ($\leq$ 5 cm in diameter) were counted and identified to a genera level. Data were analysed with a student T-test to examine the difference in the density of coral recruitment between Ko Ngamyai and Ko Rang Kachiu. The size class distribution of coral recruits was assessed.

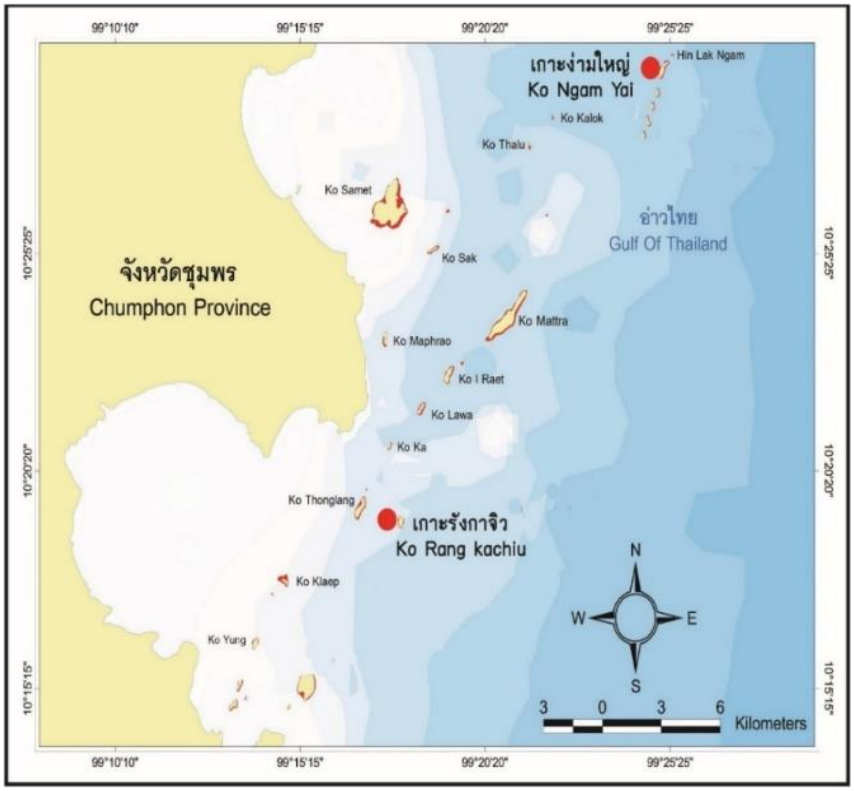

Figure 1. Map of study sites at Mu Ko Chumphon National Park

Figure 2. The pilot coral nursery structure

3. Results

The density of coral recruis at Ko Ngam Yai was higher than that at Ko Rang Kachiu after installation for six months (36.50±11.26 and 8.50±2.51 recruits/m^2) and one year (69.79±10.26 and 39.77±4.51recruits/m^2). The recruits of *Pocillopora* and *Porites* found on the dome-shaped coral nurseries are commonly observed in shallow reef flats and reef slopes at Ko Rang Kachiu and Ko Ngam Yai (Figures 3 and 4). After one year, the size frequency distribution of coral recruits ranged from 0.3-3.0 centimeters. The average sizes of coral recruits at Ko Rang Kachiu ad Ko Ngam Yai were 1.79±0.30 and 0.84±0.23 centimeters (Figures 5 and 6). Underwater photos of coral recruits on dome-shaped coral nurseries are showed in Figures 7 and 8.

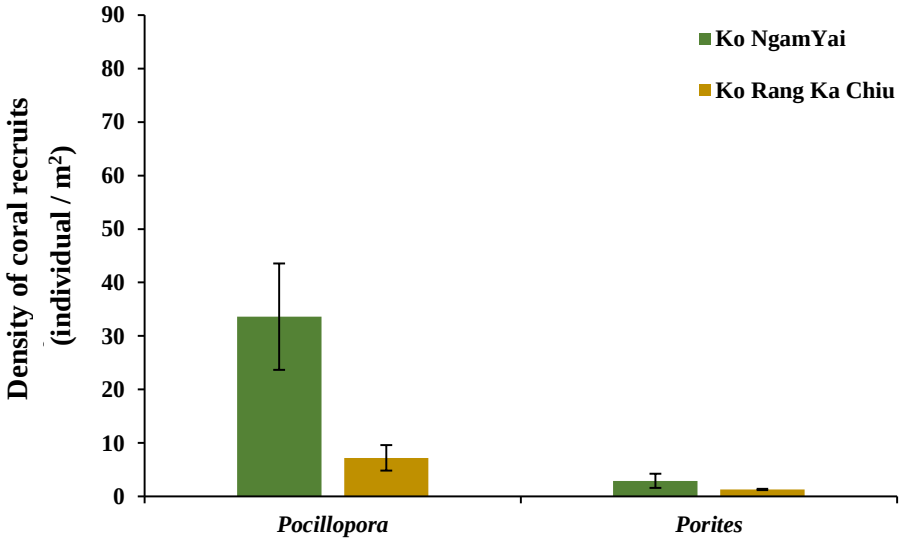

Figure 3. Density of coral recruits (ind./m^2) on dome-shaped coral nurseries after six months (Mean±SD)

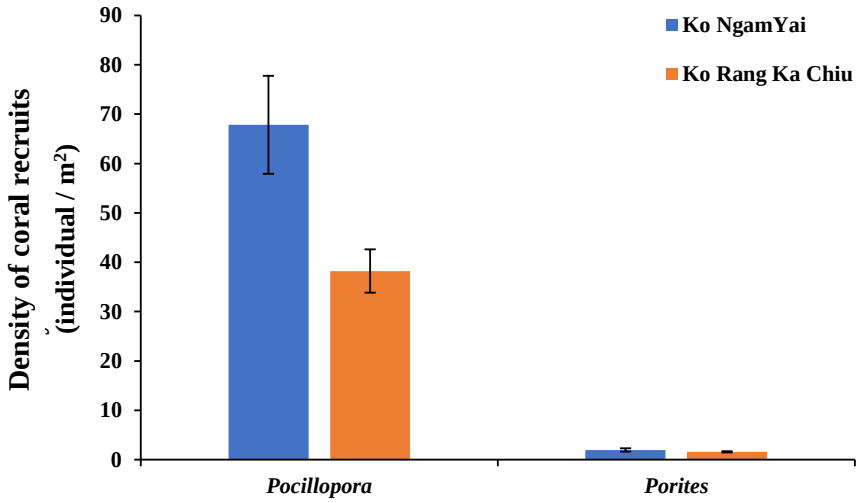

Figure 4. Density of coral recruits (ind./m^2) on dome-shaped coral nurseries after one year (Mean±SD)

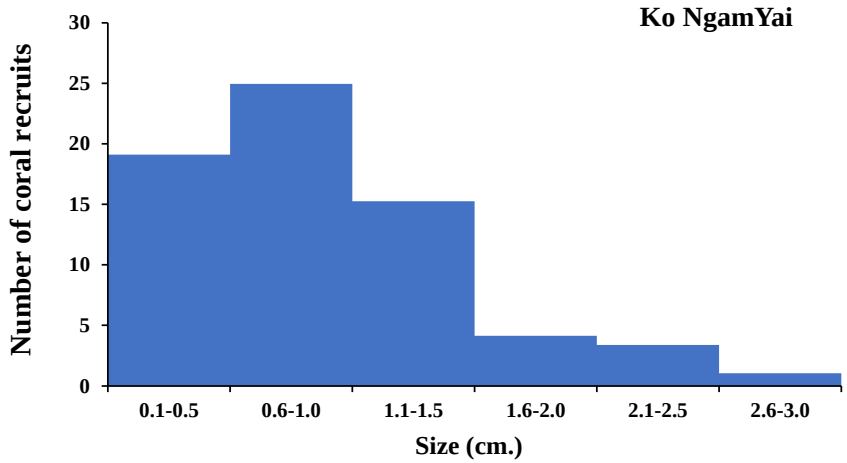

Figure 5. Size-class of coral recruits (ind./m^2) on dome-shaped coral nurseries after one year

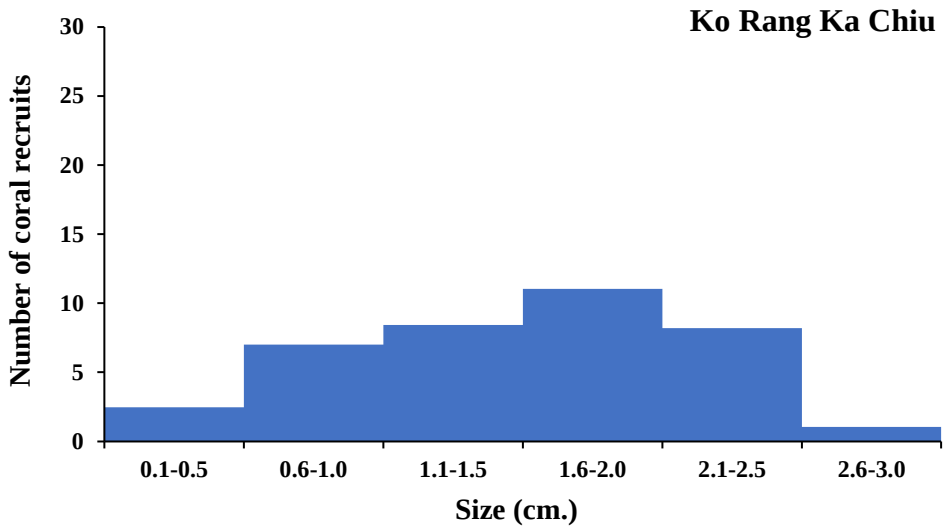

Figure 6. Size-class of coral recruits (ind./m^2) on dome-shaped coral nurseries after one year

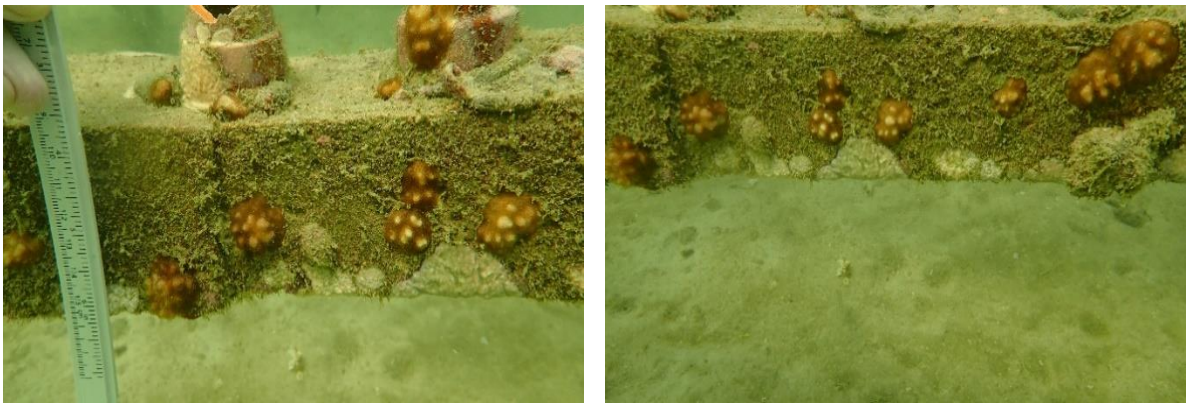

Figure 7. Coral recruits on dome-shaped coral nurseries at Ko Ran Ka Chiu

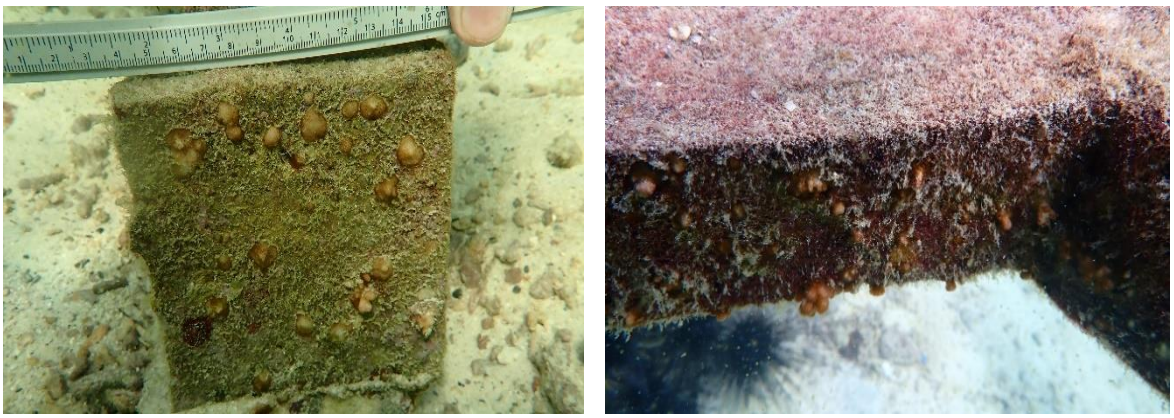

Figure 8. Coral recruits on dome-shaped coral nurseries at Ko Ngam Yai

4. Discussion

The coral reefs in the Gulf of Thailand have experienced severe mass bleaching events over the last three decades. Anthropogenic disturbances from coastal development, sedimentation, overfishing, and tourism activities have also impacted on coral reefs. (Yeemin et al. 2012; Sutthacheep et al. 2013). The density of coral recruits has been proposed as an important factor for understanding natural recovery potential of coral reefs and coral community structure and

dynamics (Hughes et al., 2010; Gilmour et al., 2013; Graham et al., 2015). Based on our research, the data showed the density of coral recruits after six months and its increasing after installation of dome-shaped coral nurseries for one year. This indicates that an active coral restoration project is helpful for enhancing coral recruitment and recovery after severe disturbances. Several restoration projects in Thailand have been successful to improve coral reef health (Thongtham and Chansang 1999; Yeemin 1997; DMCR 2003; Yeemin et al. 2006). A long-term monitoring program is needed for understanding coral recovery processes and benefits to ecotourism and local communities.

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