MGP
Masbate Gold Project
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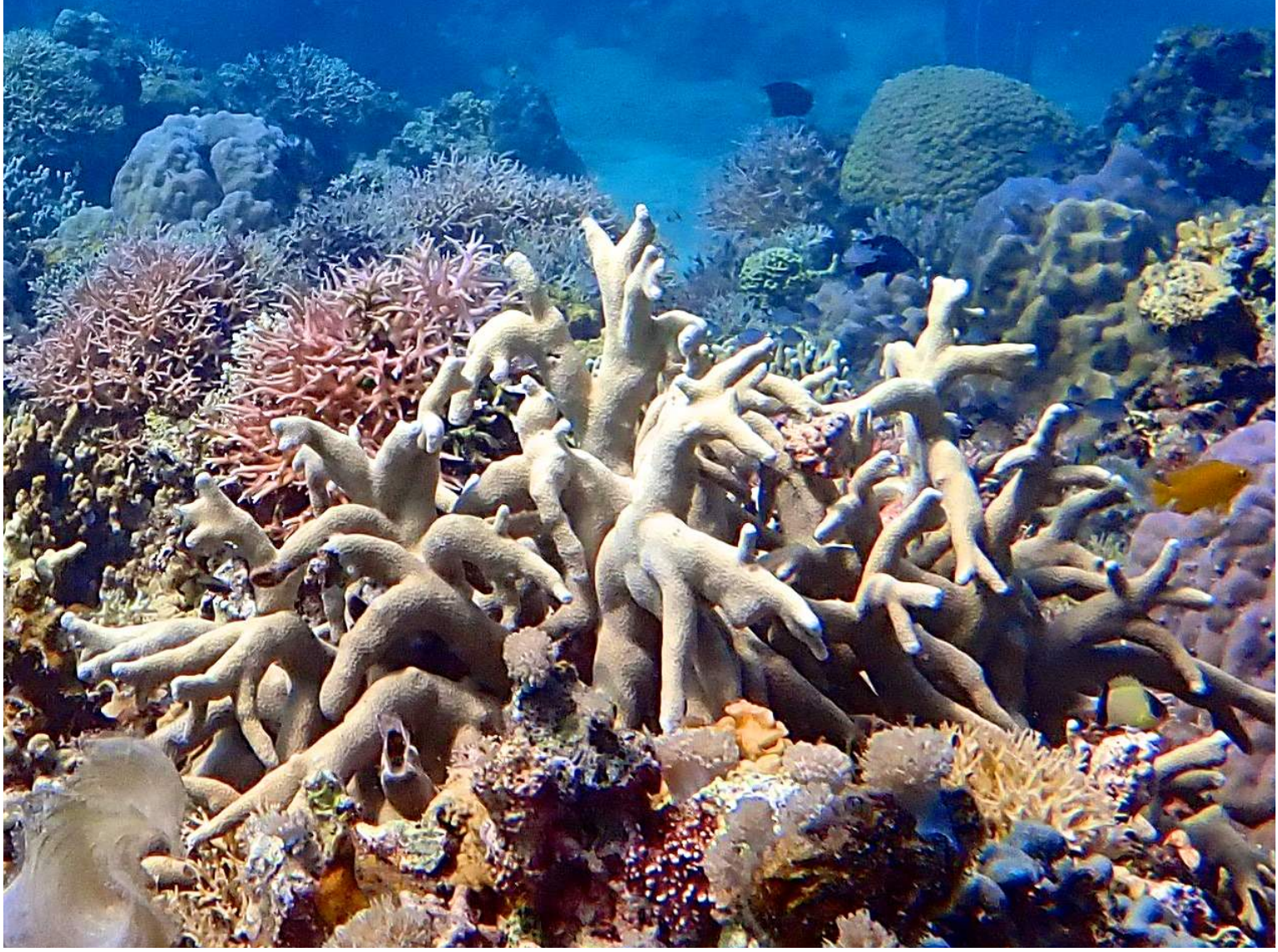
Colorada MPA Coral Recruitment Surveys July 2019



Introduction

Utilising Reef Balls in reef restoration provides a number of benefits to local reefs including increased coastal protection and the rapid propagation of natural coral fragments onto the Reef Ball surface (Montoya-Maya *et al.*, 2016, Fig 1).

Fig 1. Naturally fragmented coral colonies are further fragmented and planted onto Reef Ball structures

Deployment of Reef Balls also provides a settlement surface onto which coral larvae may be able to settle following a spawning episode (Fig 2). While direct planting of coral colonies onto Reef Balls can accelerate physical recovery of the reef, encouraging natural recruitment of sexually reproduced coral larvae is essential for maintaining the genetic stock of local corals, thus promoting resilience to future disturbance events such as coral bleaching.

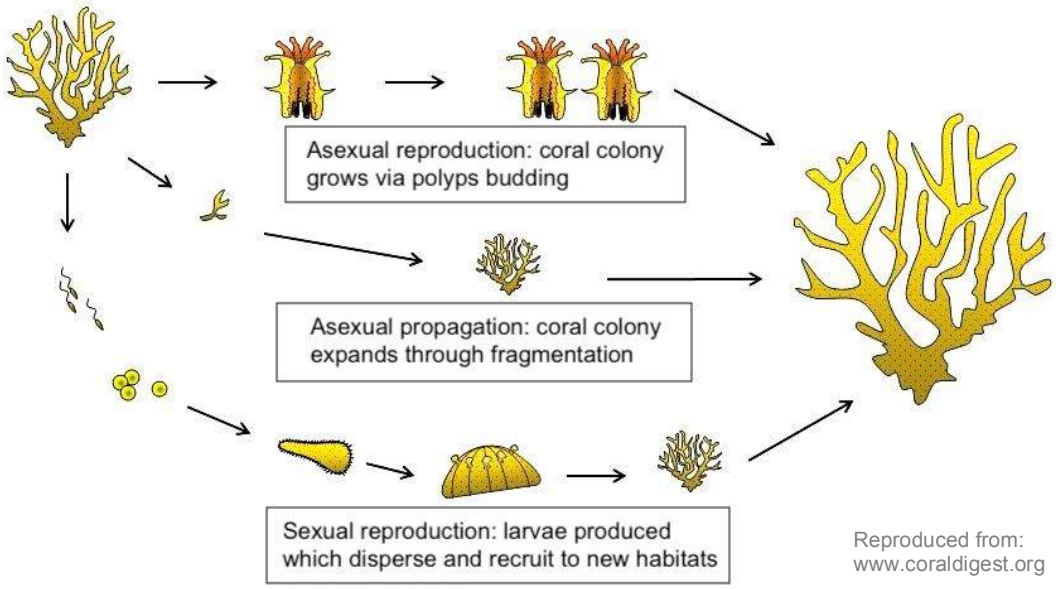


Fig 2. The coral life-cycle: corals may grow and expand through a number of mechanisms including asexually by budding and fragmentation but also sexually via larval settle on to suitable substrate and begin growth into adult colony. All three methods of growth and reproduction are important processes in maintaining coral populations.

Therefore, the on-going assessment of Reef Ball performance as a coral settlement substrate should be an important component in the wider monitoring effort across the Colorada MPA. Here we describe the results of initial surveys to assess the effectiveness to-date of the existing Reef Ball array and discuss further steps for monitoring the success of this project component.

Methods

To assess how Reef Balls deployed across the Colorada MPA may be affecting coral recruitment, night surveys were conducted over two nights in July 2019 using a fluorescent light observation census technique as per Piniak *et al.*, 2005 (Figs 3 & 4). This technique has been shown to be much more effective at detecting recent larval recruits than equivalent daytime surveys for Indo-Pacific coral species (Baird, Salih and Trevor-Jones, 2006). Surveys were carried out on two existing Reef Ball sites, RB2 and RB3. The first of these was deployed in October 2018 with the second in April 2019. The most recent mass coral-spawning event is thought to have occurred April – June 2019. Given this 1-3 month timeframe (between spawning and these surveys) recent larval recruits were therefore likely to be ~<5mm in diameter, so only recruits this size or below were counted in this method. Numerous naturally-settled juvenile colonies greater than 5mm were observed on the array at RB2, indicative of a previous spawning and settlement event. We propose that growth of individual colonies should be assessed and reported on in a separate study.

Fig 3. Equipment used to conduct in-situ fluorescence census. The observer illuminates the quadrat with the blue exciter-filtered light and wears the yellow barrier filter over their dive mask.

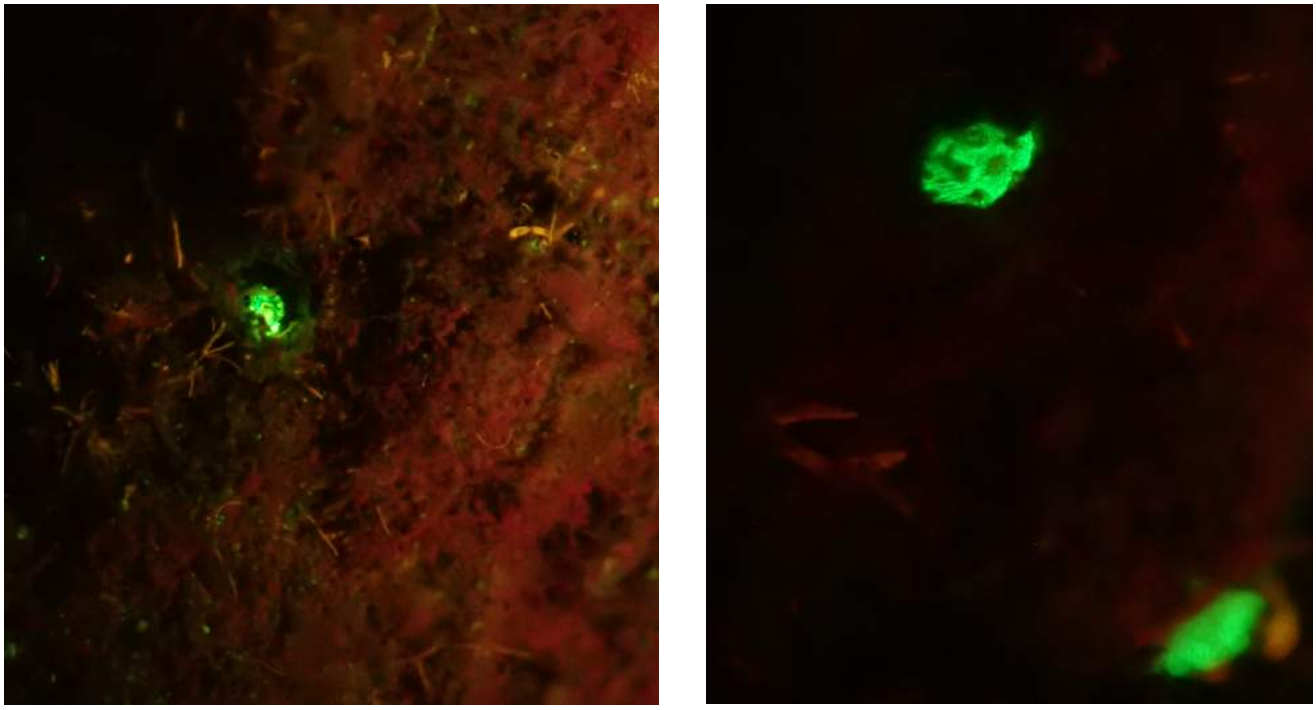


Fig 4. Images of coral recruits counted in this study. Identification of species is unfeasible with this method.

Each survey was conducted across a one-hour dive conducted after dusk between c.1900 and 2000. Observers randomly selected 5 Reef Balls and conducted 4 randomized 25x25cm quadrat surveys on each ball, ensuring that these were distributed across a variety of positions on the Reef Ball – top, bottom, North, South, East and West. Random selection was achieved by observers switching to white light before locating a suitable position for the quadrat. All coral recruits <5mm were counted for each quadrat and recorded on a data sheet.

On the same dives, equivalent random quadrat surveys were also conducted on surrounding sand and rubble substrate – the only settlement substrate that would be available in the absence of a Reef Ball array. Thus each observer conducted 20 quadrat surveys for each substrate type (Reef Ball (RB) and sand/rubble (SR)). Total sample size n=160. Data was collated in a csv file and results analysed in the R statistical analysis package using base code.

Results

Recruit densities were 3x higher for the Reef Ball quadrats than for the surrounding sand and rubble substrate with an average of around 6 recruits per quadrat compared to around 2 per quadrat for the SR substrate.

A non-parametric test indicated that this difference was statistically significant with a less than 0.01% probability that this variance could have occurred by chance (Wilcoxon rank-sum test: $W = 5726$, $p\text{-value} < 0.001$, Fig 5).

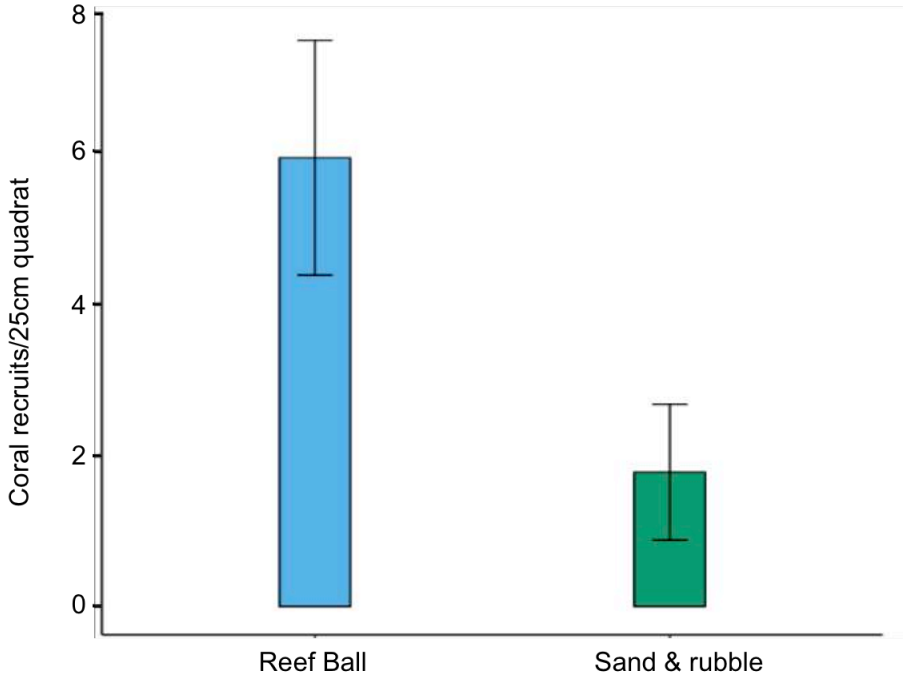


Fig 5. Reef Balls had a mean coral recruit density of 5.93 (±1.55 SEM) recruits per 25cm^2 quadrat while sand and rubble had a mean density of 1.78 (±0.90 SEM).

Discussion

Healthy populations of hard corals and high per cent coral cover on the sea floor are known to be positive drivers of overall reef health and particularly reef fisheries, which are also often crucial for local and regional food security and livelihoods. Enhancing coral recruitment to the reefs of the Colorada MPA is just one means by which reef restoration goals may be achieved, in conjunction with direct planting and propagation of fragmented coral colonies and maintaining overall protection of the MPA itself.

Results presented here show a threefold increase in coral larval recruitment in areas where Reef Balls are deployed. More recruits should equate to an eventual increase in adult colonies, potentially further increasing self-recruitment, enhancing overall coral cover and benefitting fisheries. Timeframes for juvenile – adult growth vary from species to species and these organisms must also necessarily survive the range of stressors, both natural (e.g. cyclones) and anthropogenic (e.g. fishing, coral bleaching etc). We therefore recommend a program of on going monitoring of these naturally settling coral colonies over the long term.

References

- Baird, A. H., Salih, A. and Trevor-Jones, A. (2006) ‘Fluorescence census techniques for the early detection of coral recruits’, *Coral Reefs*, 25 (1), pp. 73–76.
- Montoya-Maya, P. H. *et al.* (2016) ‘Large-scale coral reef restoration could assist natural recovery in Seychelles , Indian Ocean’, *Nature Conservation*, 16, pp. 1–17.
- Piniak, G. A. *et al.* (2005) ‘Fluorescence census techniques for coral recruits’, *Coral Reefs*, 24 (3), pp. 496–500.