Local Conservation Measures Paving a Prudent Path for Bonaire's Corals in a Changing Climate

Medidas de Conservación Locales que Pavimientan un Camino Prudente para los Corales de Bonaire en un Clima que se Cambia

Les Mesures de Conservation Locales Paver un Chemin Prudent pour les Coraux de Bonaire dans un Climat Changeant

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EXTENDED ABSTRACT

Introduction

Bonaire is a small, Dutch Caribbean island north of Venezuela whose economy is largely based on coral reef tourism. For 40 years, the Bonaire National Marine Park has been actively managing its coral reefs through coral reef conservation actions and regulations and tourist and resident outreach. Since the 1970s there has been a slow and steady decline in coral reef cover throughout the Caribbean, but coral cover on Bonaire's reefs, despite also declining, remains high in comparison (Jackson et al. 2017). In 2017, long-term monitoring surveys (2003 - 2017) demonstrated evidence of coral reef resilience with the following significant trends: increased coral cover, an increase in juvenile corals, a decrease in macroalgal cover, and an increase in the abundance of large parrotfish (Steneck et al. 2017). These positive trends may be a result of the combination of a long history of coral reef conservation and outreach measures with relatively recent conservation actions including the development of a wastewater treatment system, the establishment of no-take marine reserves and legislation protecting many vulnerable and important marine species including the protection of all parrotfish. Concurrent with the noted reef resilience trends, Bonaire's reefs suffered widespread, transient (non-lethal) coral bleaching. This study quantifies the incidence of bleaching on Bonaire's westward shore during the 2016 and 2017 bleaching events.

Methodology

To assess incidence of bleaching, ten sites on the western shore of Bonaire, Dutch Caribbean were visited in November 2016 and 2017. The leeward sites from north to south were Playa Funchi, the Rei Willem-Alexander No-Dive Reserve, Karpata, Oil Slick Leap, Reef Scientifico, Playa Lechi (Kas di Regatta), Invisibles and Vista Blue; the Klein Bonaire sites from east to west were Ebo's Special and Mi Dushi. Two 15 m transects were placed haphazardly at 10 and 25 m depths and photos were taken with a Canon GX7 camera every meter along the transects. In 2016, 30 photos and in 2017, 15 photos from each depth were analyzed using ImageJ software to determine the number of pale, partial and fully bleached coral colonies. The photos from 2016 were also used to calculate coral cover.

Results

Both in 2016 and 2017, the incidence of bleaching was widespread and affected more corals at 25m than at 10m. In 2016, the overall incidence of bleaching was 24%, compared to 54% in 2017. In 2016, the mean number of corals that paled, partially bleached or fully bleached was 15.8% (± 4.6 95%CI) at 10 m and 32.6% (± 7.1 95% CI) at 25 m (Figure 1). In 2017, the mean number of corals that paled, partially bleached or fully bleached was 44.2% (± 11.6 95% CI) at 10 m and 63.9% (± 7.2 95% CI) at 25 m (Figure 2). In 2016, mean coral cover was 26.6% (± 9.2 95% CI) at 10 m and 30.8 (± 7.6 95% CI) at 25 m.

Conclusions

Bleaching was an infrequent occurrence on Bonaire's reefs with the first recorded incident in 1998 (no data) and the second in 2005 affecting less than 5% of corals. In 2010, the severe threat of bleaching to Bonaire's reefs became apparent when an estimated 10% of corals at a depth of 10m on Bonaire's leeward coast died as a result of bleaching (Steneck et al., 2011). More recently, coral bleaching has occurred annually with repeated thermal stress affecting Bonaire's corals in 2015, 2016 and 2017 with 8% (DeLeon 2017), 24% and 54% of corals affected, respectively. Unlike in 2010, these recent bleaching episodes were followed with very little to no detectable bleaching-induced or post-bleaching mortality, thus may be considered transient bleaching events (non-lethal). In a region where coral reef health indicators are steadily declining and there is frequent thermal stress, the recent reef resilience trends on Bonaire's coral reefs (Steneck et al. 2017), may be, in part, contributed to local conservation actions. With Bonaire's economy based mainly on tourism, a sector that is growing in both numbers of visitors and resulting stressors to the reef, local conservation measures and sustainable practices are practical and prudent and may make a difference in whether some corals survive repeated thermal stress.

KEYWORDS: Coral bleaching, resilience, Bonaire, tourism, climate change

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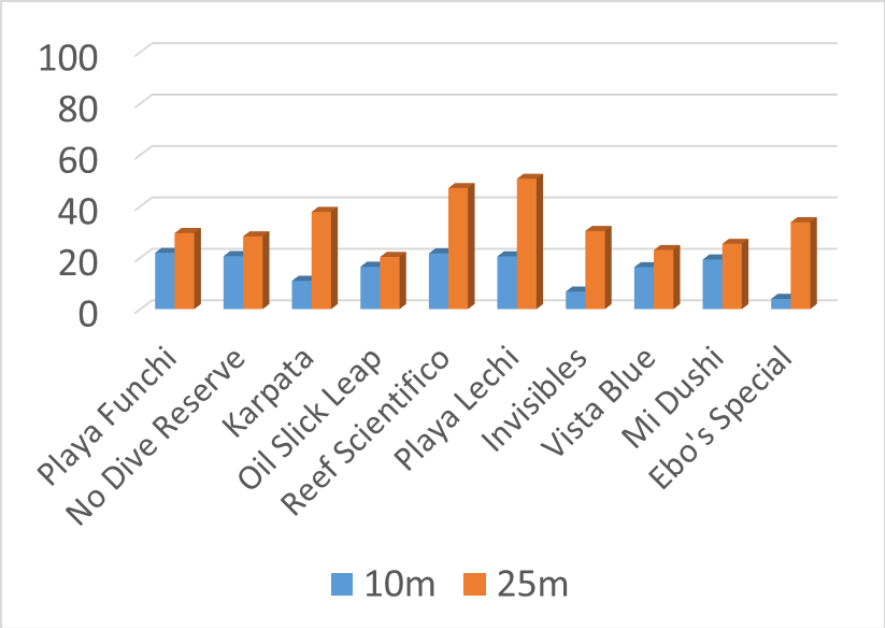

Figure 1. Percentage of corals that were pale or bleached in 2016 at 10 and 25 m depth in Bonaire, Dutch Caribbean.

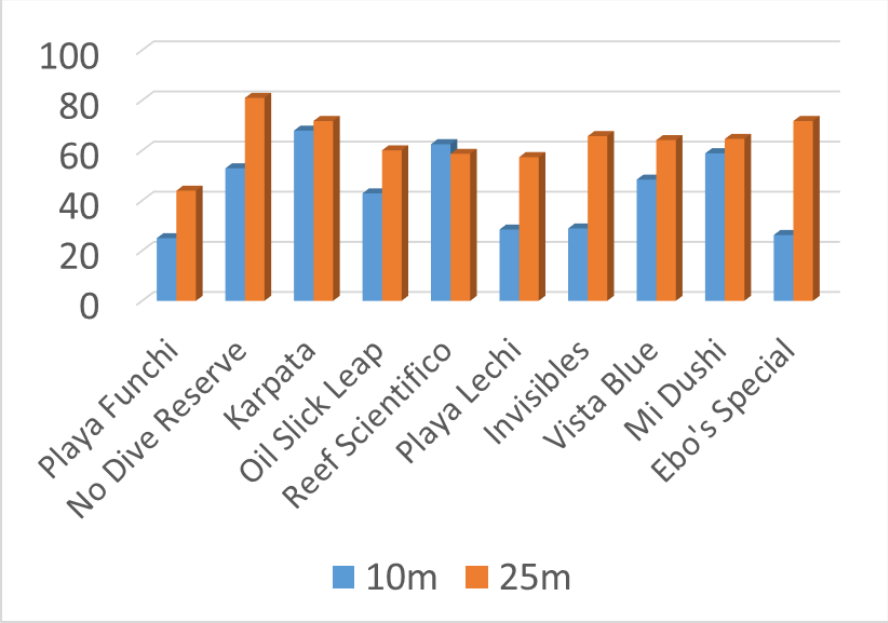

Figure 2. Percentage of corals that were pale or bleached in 2017 at 10 and 25 m depth in Bonaire, Dutch Caribbean.