INTRODUCTION

Coral reef ecosystems are among the most biologically diverse and complex marine ecosystems worldwide. In addition to their biological and ecological importance, coral reefs support major economic and physical functions (e.g. food production, tourism, biotechnology development and coast protection) that are essential for many countries (Costanza et al. 1997). This is particularly true in the Pacific Ocean where coral reefs sustain local economy of several Pacific Islands and Territories (Chin et al. 2011). Unfortunately, the frequency and severity of natural (e.g. cyclone, outbreaks of predators, particularly the starfish Acanthaster planci – COTS: crown-of-thorns starfish) and anthropogenic perturbations (e.g. pesticide pollution, rising sea-water temperature, overfishing) on coral reefs greatly increased worldwide over the last three decades. For example, coral reefs currently have to face one of the strongest El Nino, with 93 % of the Great Barrier Reef in Australia that bleached under the effect of high temperatures lasting several months in 2016 (http://www.coralcoe.org.au/). As a consequence of those perturbations, coral reefs suffered unprecedented changes of community assemblages, relocation, decline and ultimately mortality (e.g. Salvat 1980, Wilkinson & Salvat 2012, Lecchini et al. 2012, 2013, Galzin et al. 2016). Thus, today 20 % of coral reefs are already dead, 25 % are in great immediate threat, and another 25 % will be threatened by 2050 due to the effects of coastal development, overfishing and multiple factors associated with global climate change (Chin et al. 2011). In this context of increasing degradation of coral reefs, ecological surveys are needed to document changes in reef communities and the impacts of natural and anthropogenic disturbances. Underwater visual surveys reported the first data on coral cover on the north coast of Western Samoa. Between 2013 and 2015, all living coral genera (Acropora, Leptoria, Montipora, Platygyra, Pocillopora) dropped from 42 % to 0 %. The interaction of crown-of-thorns starfish outbreak in 2010-2014 and unusually high temperature in 2015 could have acted as a deathly combination for the coral reefs in Western Samoa.

MATERIALS AND METHODS

Some underwater visual surveys were conducted in May 2013 and May 2015, on the outer slope of the reef on the North coast of Upolu island, Western Samoa (13°48’354 S; 172°01’915 W), between 10 m and 13 m depth using the photo quadrat method. This site is one of the most diversity at Upolu Island and it is monitored by Fisheries & Environment departments at Samoa (Tiitii 2015). Two stainless stakes were permanently driven into the substrate and separated by 20 m. During the surveys, a stain-
less cable was stretched between the two stakes, and 20 metal markers were used to indicate where a quadrat would be positioned. The quadrat consisted of a 1 m² metallic frame subdivided into 81 squares with strings. A photograph of the quadrat was taken at each position, i.e. 20 positions, with a Nikonos camera (V Body camera equipped with a Nikon D300s/14 mm Nikkor lens, flashes; Fig. 1). Living coral colonies were distinguished at the genus level (Acropora, Leptoria, Montipora, Platygyra, Pocillopora) and coral cover values were obtained as the ratio of the number of points (string crosses) under which a living colony was identified to the total number of points (81) of the quadrat. Thus, living coral covers were compared between the two years.

RESULTS

The living coral cover percentage on the outer slope of the reef on the North coast of Upolu island, Western Samoa was of 42 ± 6.7 % (mean ± SD) in May 2013 (Fig. 2). Among the five main coral genera, the covers of Acropora and Montipora were, respectively, 36 ± 5.1 % and 5 ± 1.3 %, while the three other coral genus (Leptoria, Pocillopora, Platygera) displayed a cover lower than 1 % in 2013. All coral genera dropped to 0 % in 2015 (Fig. 2).

DISCUSSION

Our study reported an unusual coral loss. Within two years, all living corals died, dropping from 42 % to 0 % of living coral cover (Fig. 2). Kayal et al. (2012) reported a coral loss on Moorea reefs (French Polynesia) from 40 % in 2005 to 5 % in 2010 due to COTS and tropical cyclone Oli. Alevison & Porter (2014) underlined a loss of 76 % of stony corals in the Caribbean reefs in 26 years. The dramatic coral loss observed in the present work is likely due to the A. planci outbreak that occurred from 2010 to 2014 in Western Samoa (Tiitii 2015). A. planci consumes all coral genera, but shows preferences for Acropora species (Pratchett 2007), which was the main genus on...
Western Samoa reefs (Fig. 2). Causes of A. planci outbreak still remain uncertain, but abundance of resources (i.e. living corals) could be one explanation in those reefs (Kayal et al. 2012). However, other stressors may have acted simultaneously with COTS to worsen coral decline. The January-May 2015 period was reported as an unusual warm period worldwide and bleaching events have been reported in Western Samoa (Tiitii 2015). High sea temperature is known to make corals expel their symbiotic zooxanthellae and thus bleached (Lesser 2011). The temperature has to drop quickly so that algae can recolonize corals before they die. During mass bleaching events, the rate of coral mortality is highly variable depending on the geographic areas and on the period the sea temperature stays high. For example, the 1997-1998 bleaching event led to a coral mortality varying from 5 % in the Indo-West Pacific (Wilkinson et al. 1999), to 95 % in the Atlantic Ocean (Wilkinson & Hodgson 1999).

Overall, given that the combination of natural and/or human stressors is a developing scenario for the XXI century (Chin et al. 2011), we hypothesized that the interaction of COTS outbreak in 2010-2014 (observed by Tiitii, 2015 at Samoa) and unusually high temperature in 2015 (observed in the world) could act as a killer combination, destroying all alive corals in Western Samoa (Fig. 2). Other stressors could, nevertheless, also explain a part of this coral decline such as overfishing of herbivorous fish or a pesticide pollution. Thus, some future surveys at Samoa and elsewhere in the South Pacific Islands are necessary to validate our observations locally and regionally. The present study provided the first monitoring data on coral cover of Western Samoa and will help scientists, conservationists and reef managers to have access to robust and long-term datasets which today are uncommon for most regions of the world (Bruno & Selig 2007, Wilkinson & Souter 2008, Chin et al. 2011). Such long-term monitoring on several South Pacific Islands will allow to better ensure the persistence of coral reefs through time.

REFERENCES


Received on March 18, 2016
Accepted on May 5, 2016
Associate editor: A. Chenuil

*Vie Milieu*, 2016, 66 (2)