

Understanding the impacts of the 2016 Coral Bleaching event in the WIO using a citizen science approach

Gudka M¹, Obura D¹, Ahamada S², Kloiber U³, Holter T⁴

What is mass-bleaching of coral? When sea temperatures rise above average (1-2°C) for even a few weeks, corals may become stressed and expel the energy-providing symbiotic algae living in their tissues, causing them to turn completely white, and if the algal loss is prolonged, die.^{1,2}

Objectives

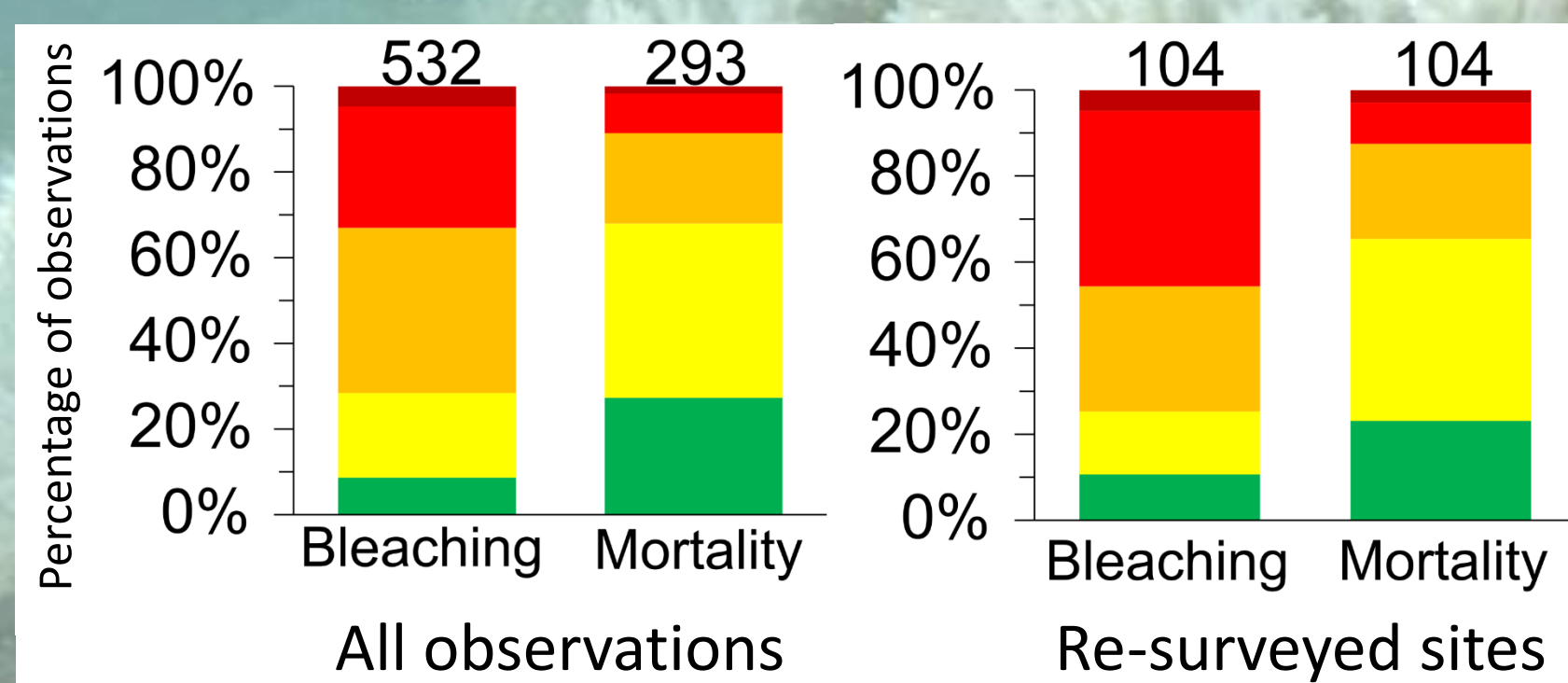
1. Assess the impact of the 2016 coral bleaching event in the Western Indian Ocean (WIO)
2. Increase awareness, preparedness and understanding of coral bleaching events in the region
3. Demonstrate how collecting basic level data can be used to document important trends of a bleaching event in real-time at a regional scale

Methods

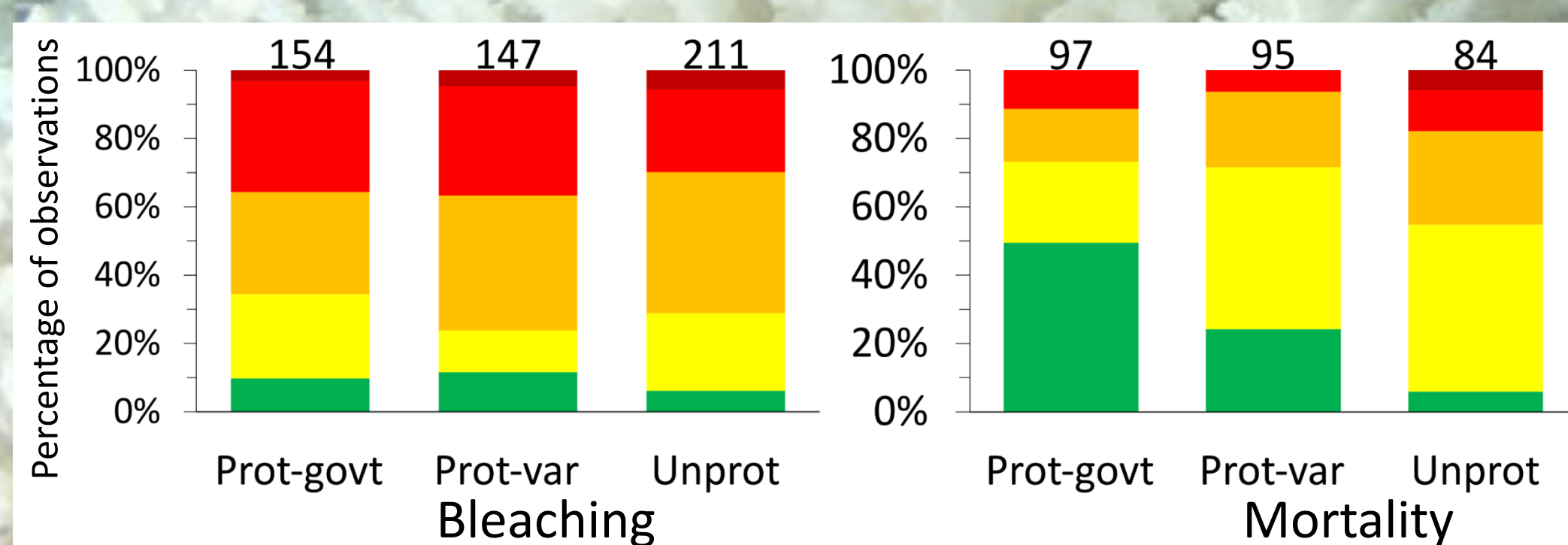
- Data submitted by collectors from across the WIO using an online Google Form
- Data contributors used the methods described in the IOC WIO coral bleaching monitoring manual (Obura, 2014)
- Exploratory analysis was done to visualise the percentage of observations under the different bleaching and mortality severity classes for different groups e.g. months, countries etc.
- Kruskal-Wallis tests were done to assess for significant differences on bleaching and mortality results between independent variables e.g. management regime

Results

- ≈ 35% of sites reported severe bleaching between January and May 2016
- 10% of sites - no evidence of bleaching
- Seychelles most affected - over 50% of reported sites showed severe bleaching
- <10% of sites reported severe mortality between May and September 2016
- ≈ 70% of sites impacted by some level of bleaching-related mortality



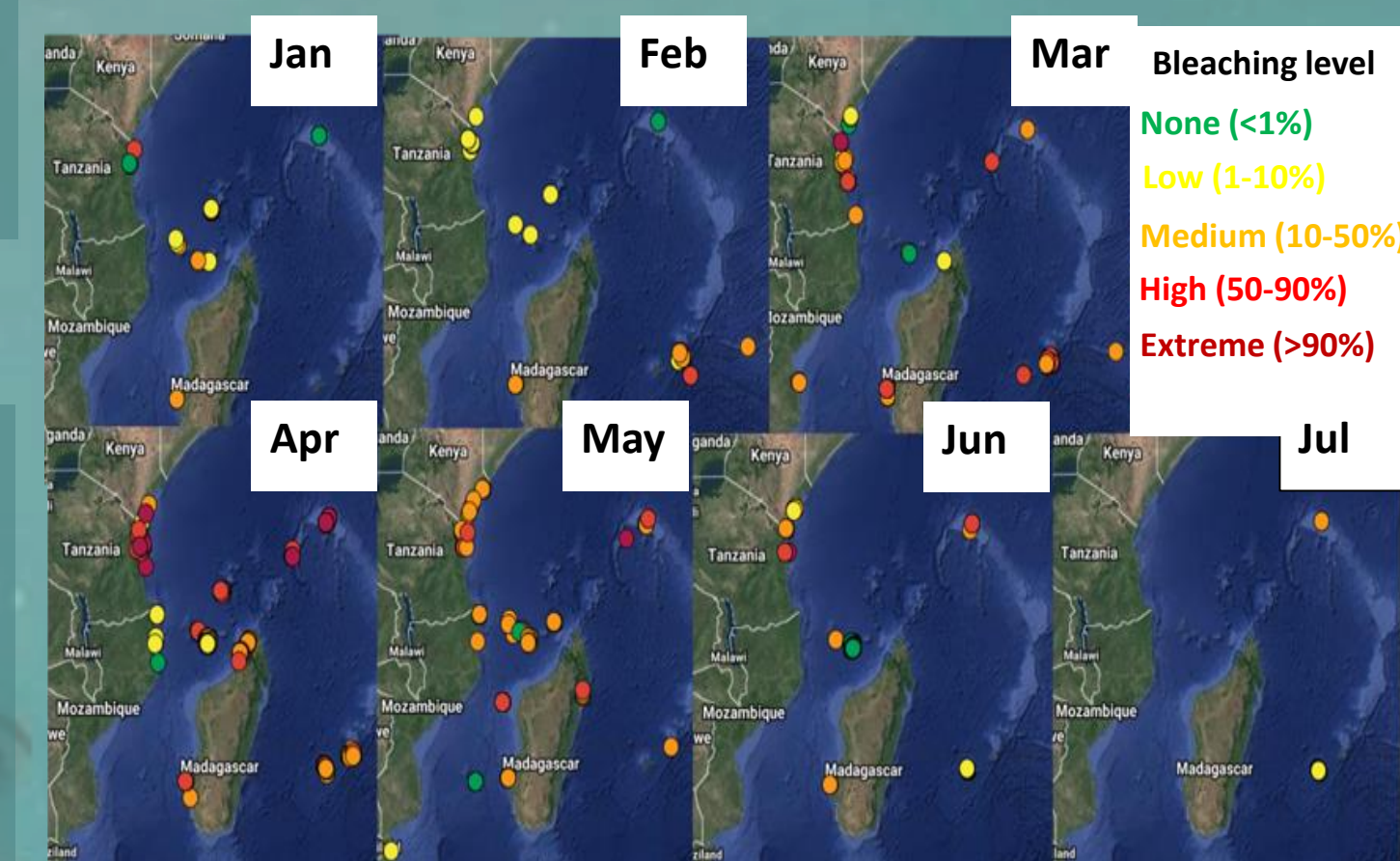
Legend	
Severity category	% coral cover bleached/dead
None	< 1%
Low	1 - 10%
Medium	10 - 50%
High	50 - 90%
Extreme	> 90%



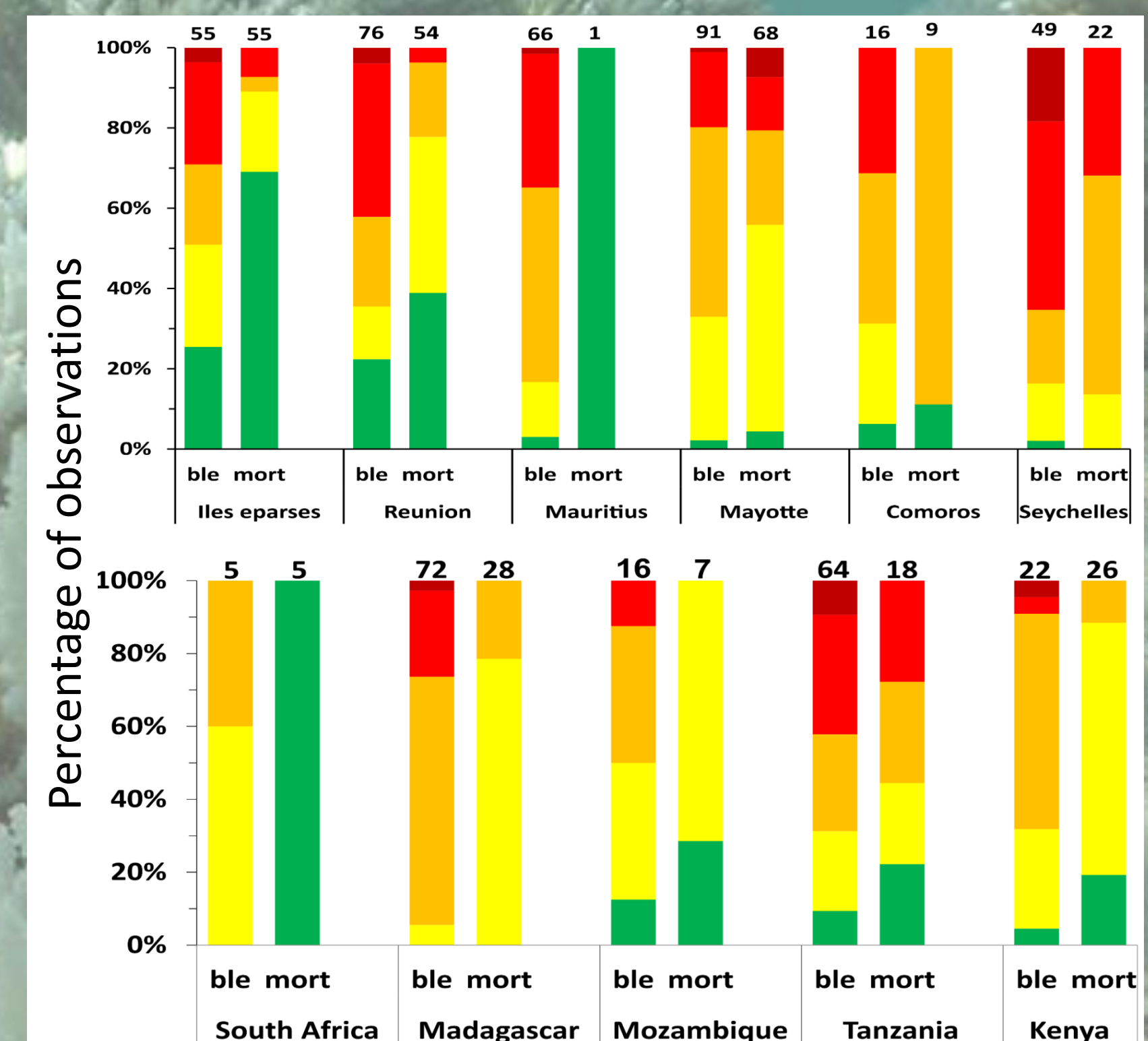
Comparison	Adj. p-value
Mortality Prot-govt - Prot-var	0.04*
Prot-govt - Unprot	<0.001*
Prot-var - Unprot	0.002*

The combination of record hot conditions for 2014-2016 and the high in-phase positive values for both Pacific and Indian Ocean dipoles at the end of 2015, made for very high bleaching risk in the WIO in 2016.^{3,4}

This is the 3rd global bleaching event⁴ and the longest in history!⁵ During the 1st global event in 1998, 16% of living coral was killed globally⁶



Response
 699 observations 55 organisations
 > 80 observers 9 countries



Discussion

Fortunately, high and extreme levels of bleaching did not seem to translate into the same level of coral mortality later in 2016, with the results indicating a recovery on the order of two thirds of bleached corals. This may be due to:

- shortened duration of thermal stress
- progressive acclimation and/or adaptation and selection from past bleaching events

Overall, the study successfully demonstrated how basic data can be used to show trends over a large geographic scale.

Recommendations

- Increased financial support for monitoring and response programmes to cope with expected increase in frequency and number of bleaching events
- Develop individual bleaching response plans with monitoring protocols especially for national institutions
- Undertake a regional quantitative assessment of the impact of the 2016 bleaching event
- Study possible acclimation of coral species and shifts in composition and diversity due to mass-mortality
- Use of similar citizen science approaches for data collection efforts

Author Affiliations

- ¹CORDIO East Africa, Mombasa, Kenya - mgudka@cordioea.net, dobura@cordioea.net
²Indian Ocean Commission, Mauritius - said.ahamada@coi-ioc.org
³Chumbe Island Coral Park Ltd, Zanzibar, Tanzania - ukloiber@gmail.com
⁴Scuba Do Zanzibar, Zanzibar, Tanzania - tammy@scuba-do-zanzibar.com

Photo credits:

Julien Wickel (MAREX), Reunion - julien.wickel@gmail.com



References

1. Brown, B. E. (1997). Coral bleaching: causes and consequences. *Coral reefs*, 16(1), S129-S138.
2. Marshall, P. and Schuttenberg, H. 2006. A Reef Manager's Guide to Coral Bleaching. GBRMPA, Australia, <http://hdl.handle.net/11017/399>
3. Blunden, J., and D. S. Arndt, Eds., 2017: State of the Climate in 2016. Bull. Amer. Meteor. Soc., 98 (8), Si-S277, doi:10.1175/2017BAMSStateoftheClimate.1.
4. US Department of Commerce, National Oceanic and Atmospheric Administration (N. O. A. A), <http://www.noaa.gov/stories/2015/100815-noaa-declares-third-ever-global-coral-bleaching-event.html>
5. US N.O.A.A Coral Reef Watch, <http://www.noaa.gov/media-release/global-coral-bleaching-event-likely-ending>
6. UNEP-Nairobi Convention and WIOMSA (2015). The Regional State of the Coast Report: Western Indian Ocean. UNEP and WIOMSA, Nairobi, Kenya, 546 pp