

## ***Interactive comment on “Multi-decadal changes in structural complexity following mass coral mortality on a Caribbean reef” by George Roff et al.***

**George Roff et al.**

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Overall, I found this manuscript to be very well written with the methodology easy to follow. The rationale for the study was well justified and the results are compellingly robust and well interpreted. On these grounds I would recommend acceptance after minor revision. I see two areas where revisions may improve the quality of the interpretations:

Response: We thank the reviewer for their careful and detailed comments.

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1) Echinometra decline: the hypothesis of decline is compelling and supported by the observations. I feel it would improve the manuscript however to include any alternative hypotheses (if the authors can think of any) that might explain the decrease.

Response: As Long Caye was designated a marine reserve in 1993 and enforced since 1996, a plausible hypothesis would be that recovery in invertivore densities following enforcement may have placed increase predation pressure on urchins. However, invertivores were never heavily exploited prior to the reserve, and our survey data indicate no change in invertivore populations through time. We have expanded this section to include further discussion as follows:

“Higher biomass of invertivores inside of marine protected areas can substantially increase predation pressure on urchins (Harborne et al., 2009), and may explain the rapid decline in *E. viridis* at Long Caye following diminished refuge potential between surveys. As Long Cay has been an enforced marine reserve since 1996 an alternative explanation to our observed data could be that urchin numbers have declined in response to increased predation pressure following recovery of invertivore fish assemblages. While plausible, we discount this hypothesis as invertivores were not heavily exploited prior to 1996 when the reserve was established, and surveys of fish assemblages indicate no change in invertivores over time (Mumby pers.obs.)” (Lines 190-196)

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2) Only one coral species was studied (albeit importantly the major reef building species), but how well do the authors think the general results reflect patterns playing out in other major reef building corals, such as those growing laterally rather than vertically?

Response: Following comments from Review #1, amended the methods to clarify the monospecific stands of *O. annularis* in the present study and outline the *O. annularis* species complex to avoid confusion.

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The study was conducted in Long Cay (Glovers Reef, Belize, Figure 1a). The reef framework at Long Cay is formed primarily from monospecific stands of *Orbicella annularis* (Ellis and Solander, 1786), which experienced widespread mortality following anomalously high water temperatures (29–32 °C) between early September and mid-November 1998 and hurricane Mitch which occurred simultaneously (Mumby, 1999). Field data were collected in 1998, 2003, 2007 and 2018 from an area of monospecific *O. annularis* dominated framework of approximately 400 m<sup>2</sup> at a depth of 6–12m. *O. annularis* forms part of a species complex (the “*Orbicella annularis* species complex”) along with *O. faveolata* and *O. franksi*. Each species within the complex exhibits a preferred depth zone, with *O. faveolata* dominating shallow reef habitats, *O. annularis* mid-depth habitats, and *O. franksi* in deeper depths (Pandolfi and Budd, 2008).

Secondly, we appreciate the reviewer’s point that trajectories of erosion and complexity will likely differ in other locations and among other closely related taxa. To highlight this point we have amended the results and discussion section to discuss the uniqueness of *O. annularis* frameworks more explicitly:

“High levels of genotypic diversity in *O. annularis* at Long Caye (Foster et al., 2013) and population connectivity to other reefs throughout the western Caribbean (Foster et al., 2012) implies that Long Caye is not unique, and differential growth of surviving ramets may lead to similar changes in structural complexity for *O. annularis* dominated frameworks elsewhere in the Caribbean (e.g. Idjadi and Edmunds, 2006; Edmunds and Elahi, 2007) where growth rates exceed erosion. At colony scales, changes in microhabitat complexity do not appear to have translated into changes in reef complexity, as the erosion of dead ramets is offset by growth of surviving ramets. This apparent stability in reef complexity at Long Caye is intrinsically linked to the columnar growth form of *O. annularis* colonies (Figure 2), and trajectories of erosion and structural complexity will likely vary among other Caribbean coral species with different morphologies (e.g. *O. faveolata*)”.

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