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TITLE: Reef Habitat Type and Spatial Extent as Interacting Controls on Platform-Scale Carbonate Budgets

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ABSTRACT:

A coral reefs carbonate budget strongly influences reef structural complexity and net reef growth potential, and thus is increasingly recognised as a key 'health' metric. Despite this, understanding of habitat specific budget states, how these scale across reef platforms, and our ability to quantify both framework and sediment production values remains limited. Here we use in-situ census data from an atoll rim reef platform in the central Maldives to quantify rates of both reef framework and sediment production and loss within different platform habitats, and then combine these data with high-resolution habitat maps to quantify contributions to platform wide carbonate budgets. The net reef framework budget for the entire platform is extremely low (0.12 G, where $G = \text{Kg CaCO}_3 \text{ m}^{-2} \text{ yr}^{-1}$), with a very high proportion (143,745 kg or 65.1%) of total framework production generated within the platform margin reef zones, despite these comprising only ~8% of platform area. Net platform-scale sediment budgets are higher (1.04 G), but most is produced in the reef and platform margin hardground habitats, of which ~80% derives from parrotfish bioerosion. Significant quantities of new sediment (up to ~1 G derived from the calcareous green algae *Halimeda*) are produced only in one habitat. All lagoonal habitats have negative or neutral net carbonate budgets. These data demonstrate the marked inter-habitat differences in reef carbonate budgets that occur across reef platforms, and the major dampening effect on overall platform scale budgets when rates are factored for habitat type and size. Furthermore, the data highlights the disproportionately important role that relatively small areas of reef habitat can have on the maintenance of net positive platform scale budgets. Because of the intrinsic link between carbonate production rates and reef-associated landform development and maintenance, these findings also have implications for understanding reef-associated landform stability. In this context the reef island at this site has been highly mobile over the last ~40 years, and we hypothesise that such instability may be being exacerbated by the measured low overall rates of framework and sediment generation.

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