Equation 1: $\chi = S \times R$

where χ = surface length of the coral (cm), S = planar mean width of the coral colony (determined assuming coral colonies are circular with a diameter equal to the mean of the two diameters measured in the photoquadrats, cm^2), and R = a taxon specific rugosity measure for each taxon. R translates 2-dimensional mean planar width into an estimated 3-dimensional (true) length. Second, we separated the coral taxa found at our six sites into four morphological groups (Table 1 of Edmunds and Perry, 2023) -- massive, submassive, encrusting/plating/foliose, and branching/corymbose/columnar – and used morphology-specific equations to convert 3-dimensional colony metrics into colony-level carbonate production values (Equations 2–5). These equations are implemented in ReefBudget Caribbean v2.

Equation 2,
Massive:

$$CP_i = \left(\left(\left(g + \cdot \left(\frac{\chi}{\pi} \right) \right) \right)^2 \pi - \cdot \left(\frac{\chi}{\pi} \right)^2 \pi \right) \cdot \times \cdot d$$

Equation 3, Submassive: $CP_i = g \times \chi \times d$

Equation 4, Encrusting/plating/foliose: $CP_i = h \times (g \times d) + 0.1 \times g \times \chi \times d$

Equation 5, Branching/corymbose/columnar: $CP_i = (\chi \times c_a \times g \times d) + (\chi - c_a \times \chi) \times 0.1 \times g \times d$

Where CP_i = carbonate production of taxon i by colony, g = growth rate (cm y^{-1}), χ = surface length of the colony (cm^2), d = skeletal density (g cm^{-3}), h = number of colony "edges" (normally 2), and c_a = proportion of the colony that is growing axial branches.