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1. ABSTRACT

Bamboo corals, long-lived cold water gorgonin octocorals, offer unique paleoceanographic archives of the intermediate ocean. These *Isididae* corals are characterized by alternating gorgonin nodes and high Mg-calcite internodes, which synchronously extend radially. Bamboo coral calcite internodes have been utilized to obtain geochemical proxy data, however, growth rate uncertainty has made it difficult to construct precise chronologies for these corals. Previous studies have relied upon a tie point from records of the anthropogenic $\Delta^{14}C$ bomb spike preserved in the gorgonin nodes of live-collected corals to calculate a mean radial extension rate for the outer ~50 years of skeletal growth. Bamboo coral chronologies are typically constructed by applying this mean extension rate to the entire coral record, assuming constant radial extension with coral age. In this study, we aim to test this underlying assumption by analyzing the organic nodes of six California margin bamboo corals at high enough resolution (<0.5 mm) to identify the $\Delta^{14}C$ bomb spike, including two tie points at 1957 and 1970, plus coral collection date (2007.5) for four samples. Radial extension rates between tie points ranged from 10 to 204 μm/year, with a decrease in growth rate evident between the 1957-1970 and 1970-2007.5 periods for all four corals. A negative correlation between growth rate and coral radius ($r = -0.7$; $p = 0.03$) was determined for multiple bamboo coral taxa and individuals from the California margin, demonstrating a decline in radial extension rate with specimen age and size. To provide a mechanistic basis for these observations, a simple mathematical model was developed based on the assumption of a constant increase in circular cross sectional area with time to quantify this decline in radial extension rate with coral size between chronological tie points. Applying the area-based model to our $\Delta^{14}C$ bomb spike time series from individual corals improves chronology accuracy for all live-collected corals with complete $\Delta^{14}C$ bomb spikes. Hence, this study provides paleoceanographers utilizing bamboo corals with a method for reducing age model uncertainty within the anthropogenic bomb spike era (~1957-present). Chronological uncertainty is larger for the earliest portion of coral growth, particularly for skeleton precipitated prior to bomb spike tie points, meaning age estimations for samples living before 1957 remain uncertain. Combining this technique with additional chronological markers could improve age models for an entire bamboo coral. Finally, the relative consistency in growth rate in similarly-aged corals of the same depth and location supports the hypothesis that skeletal growth may be limited by local environmental conditions.

Keywords: bamboo coral; gorgonin; paleoceanography; chronologies; radiocarbon; growth rate; 14C nuclear bomb spike

2. INTRODUCTION: