

Rapid-screen ¹⁴C age distributions of coral fossils from Santiago, Sombrero Chino, and San Cristobal in the Galápagos Islands

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Introduction

Stony corals are valuable archives that track past climate conditions before direct measurements were available through geochemical variations in their aragonite skeletons. Coral fossils from the eastern Pacific can offer high-resolution records of past climate variability in the mid- to late Holocene, up to 6,000 years before present (years BP) (Thompson 2021). However, in the Galápagos Islands and the eastern Pacific (1°S–1°N, 89–92°W), the availability of corals that capture climate variability from the mid- to late Holocene is limited (Thompson, 2021).

Currently, the age distribution of corals found in the Galápagos Islands is unknown, making site selection for paleoclimate reconstruction challenging. This study presents a range and distribution of rapid-screen ¹⁴C ages for 80 corals collected on a field expedition in 2024 from San Cristobal, Santiago, and Sombrero Chino to better understand the availability of coral fossils in the region.

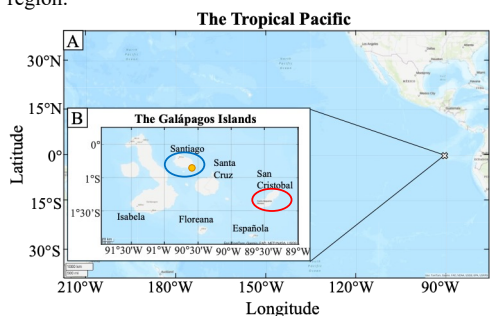


Figure 1: (A) Oceanographic setting of the Galápagos Islands. (B) Map of the Galápagos Islands where study sites are marked by colored ovals. The yellow filled circle represents Sombrero Chino.

Methods

- Coral chips were rinsed thoroughly, dried, then hammered into small pieces, then ground into a fine powder in an agate mortar and pestle.
- Powders were transferred into labelled vials then sealed and wrapped with parafilm.
- ¹⁴C analyses were conducted using an accelerated mass spectrometer at the Keck Carbon Cycle AMS Facility (KCCAMS) at UC-Irvine.
- Rapid-screen ¹⁴C ages were calibrated in CALIB 14C to the marine20 curve for resulting Median Probability Ages (MPA) using a marine reservoir correction of $\Delta R = -33 \pm 104$ (Heaton et al., 2020; Stuiver et al., 1993).

Results

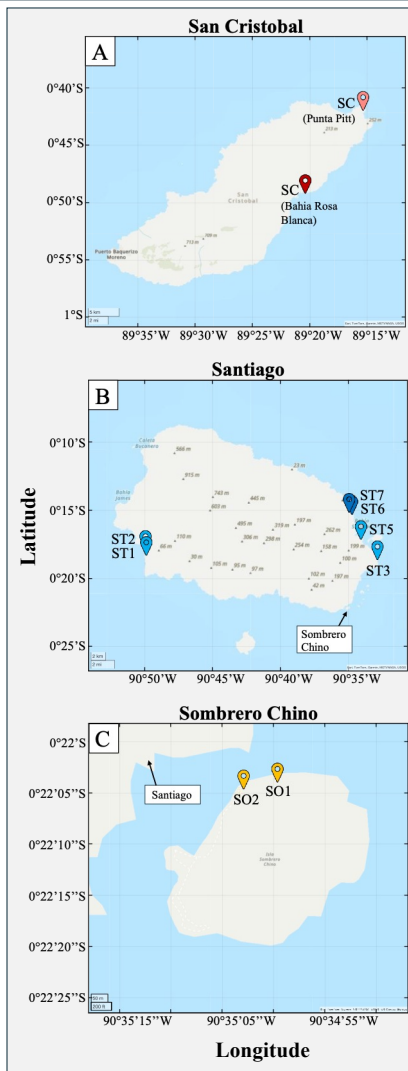


Figure 2: A map of all the sites where coral fossils were collected with site codes and associated common names for (A) San Cristobal (SC), (B) Santiago (ST1-7), and (C) Sombrero Chino (SO1-2).

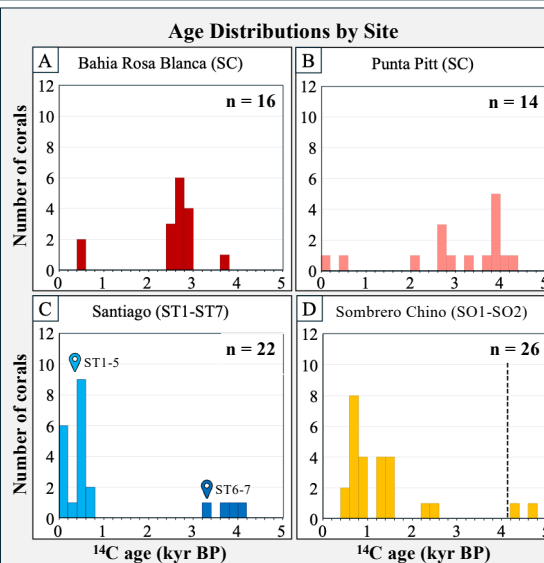


Figure 3: Histograms of the coral age distributions of coral fossils collected in (A-B) San Cristobal, (C) Santiago, and (D) Sombrero Chino. Each bin is 200 years wide. Bolded text indicates the number of samples represented in each histogram. The dashed line indicates the age of oldest coral collected from the Galápagos prior to this study.

Key Results:

Following calibration, rapid-screen ¹⁴C ages indicate the following age ranges:

- 88% of coral fossils collected from Bahia Rosa Blanca on **San Cristobal** had an age between 2,400 and 3,000 years BP (Fig 3A).
- 93% of coral fossils collected from Punta Pitt on **San Cristobal** had an age between 2,600 and 4,300 years BP; outliers were fossils collected underwater nearby (Fig 3B).
- 81% of coral fossils collected from **Santiago** have an age within the last millennium (Fig 3C).
- Outlier samples from **Santiago** that have an age between 3,200 and 4,200 years BP were all collected from ST6-7 (Fig 3C).
- 85% of coral fossils collected from **Sombrero Chino** had an age between 400 and 1,600 years BP; outlier samples fall between 4,200 and 4,800 years BP (Fig 3D).

Conclusions

Prior to this study, coral fossils had not been collected from Santiago and Sombrero Chino for paleoclimate reconstruction. This study expands the spatial range of known fossil locations in the Galápagos Islands. In addition, the oldest recorded fossil collected from the Galápagos prior to this study was dated ~4,200 years BP (Tripp et al., *in review*); we present a fossil with an MPA of 4,693 years BP, expanding the coral fossil age baseline in the Galápagos by ~500 years.

Although these dates provide an estimate of the fossil's age, the uncertainty of rapid-screen ¹⁴C ages can be up to several hundred years (Grothe et al., 2016). For a more precise age, U/Th dating of these fossils would constrain this uncertainty to $\pm 1-30$ years. Overall, these radiocarbon dates provide a necessary baseline in deciding which fossils to process further.

Next Steps

The remainder of the prepared ¹⁴C samples have been sent for X-Ray diffraction to assess the level of calcite remineralization in the coral skeleton. These insights will help us determine whether or not we can use these coral fossils in future climate reconstructions.

¹⁴C dated coral fossils have been CT scanned and are being prepared for oxygen isotope and trace element analyses. Additionally, we can use the presented distributions to select collection sites on future field expeditions.

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Selected References

