

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 (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 50 corals collected on a field expedition in 2024 from the southernmost Galápagos Islands, Española, Isla Gardner, and Floreana, to better understand the availability of coral fossils in the region.

The Tropical Pacific

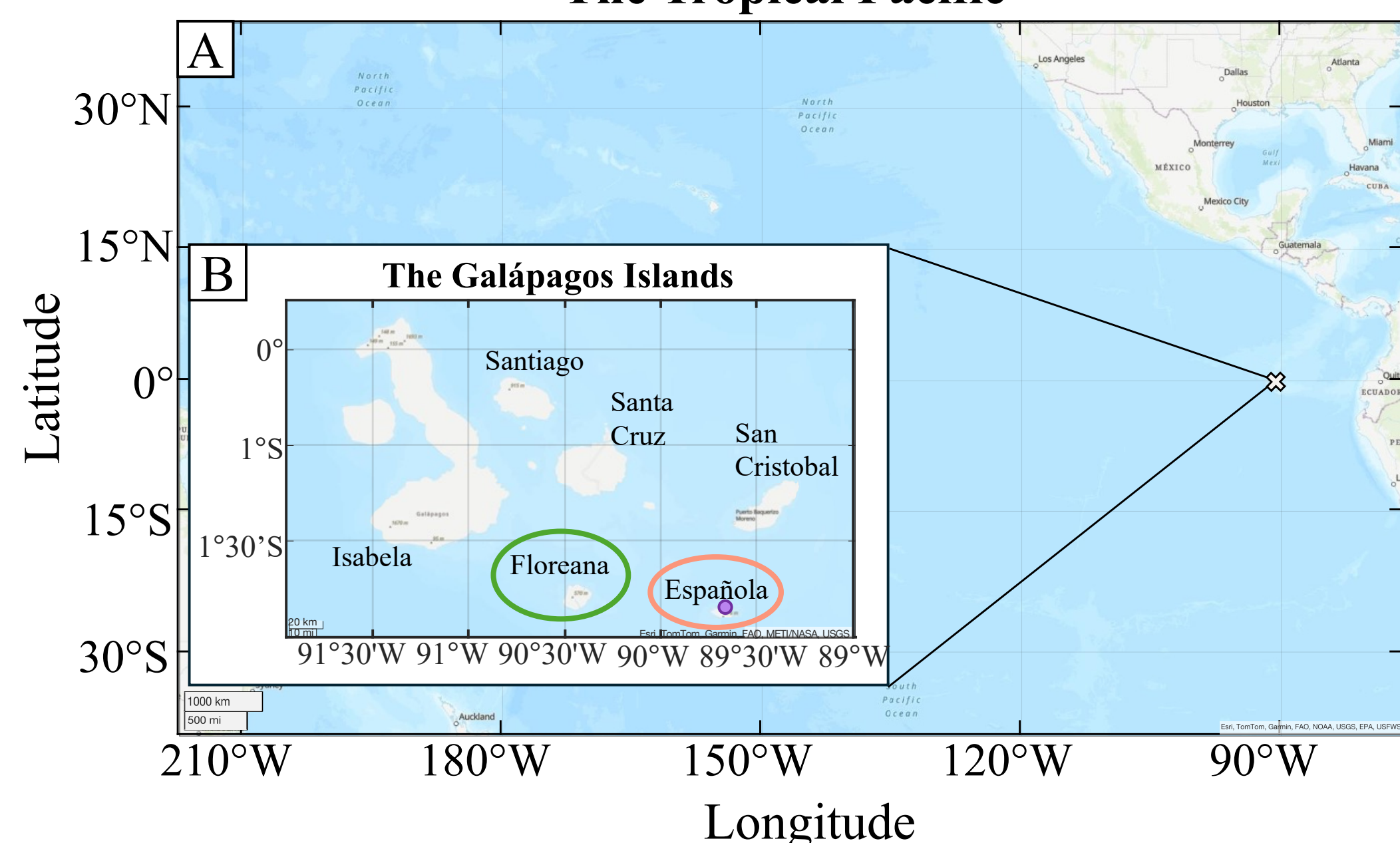


Figure 1: (A) Oceanographic setting of the Galápagos Islands. (B) Map of the Galápagos Islands where study sites are marked by colored ovals. The purple dot denotes the location of Isla Gardner

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

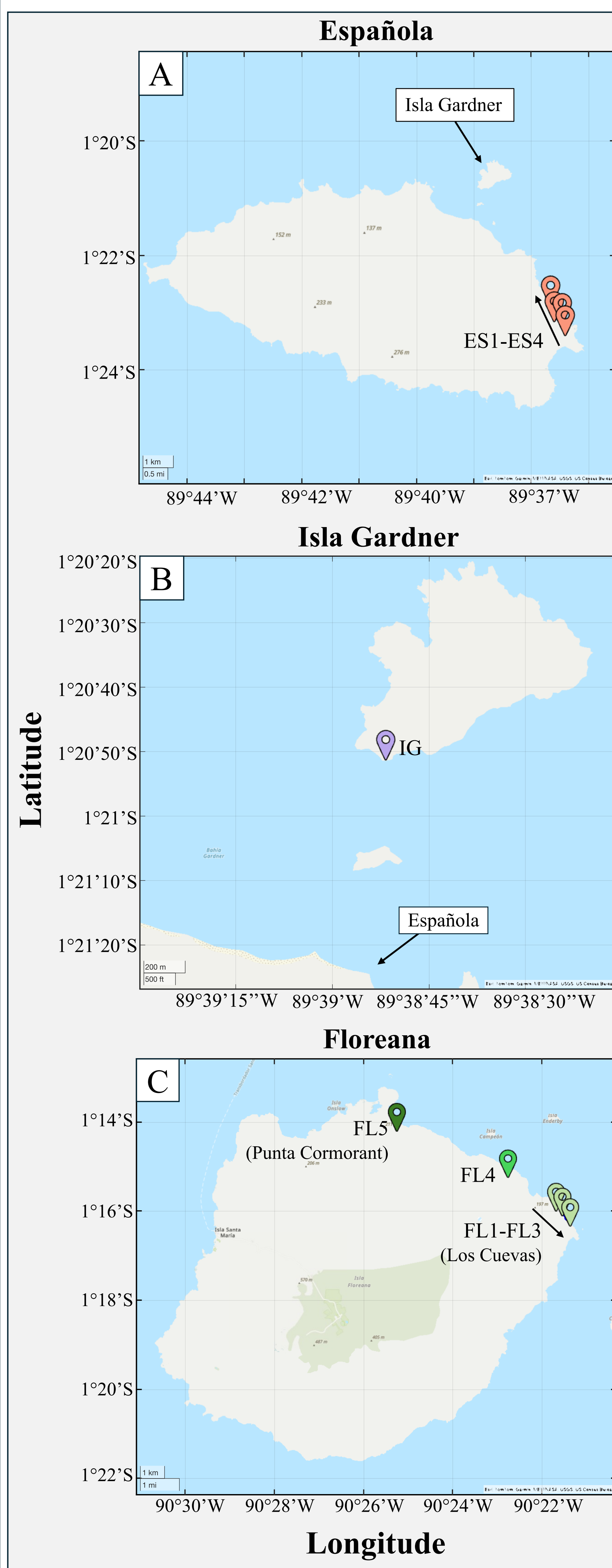


Figure 2: A map of all the sites where coral fossils were collected with site codes and associated common names for (A) Española (ES1-ES4), (B) Isla Gardner (IG), and (C) Floreana (FL1-FL5). Arrows indicate the direction of field sites.



Age Distributions by Site

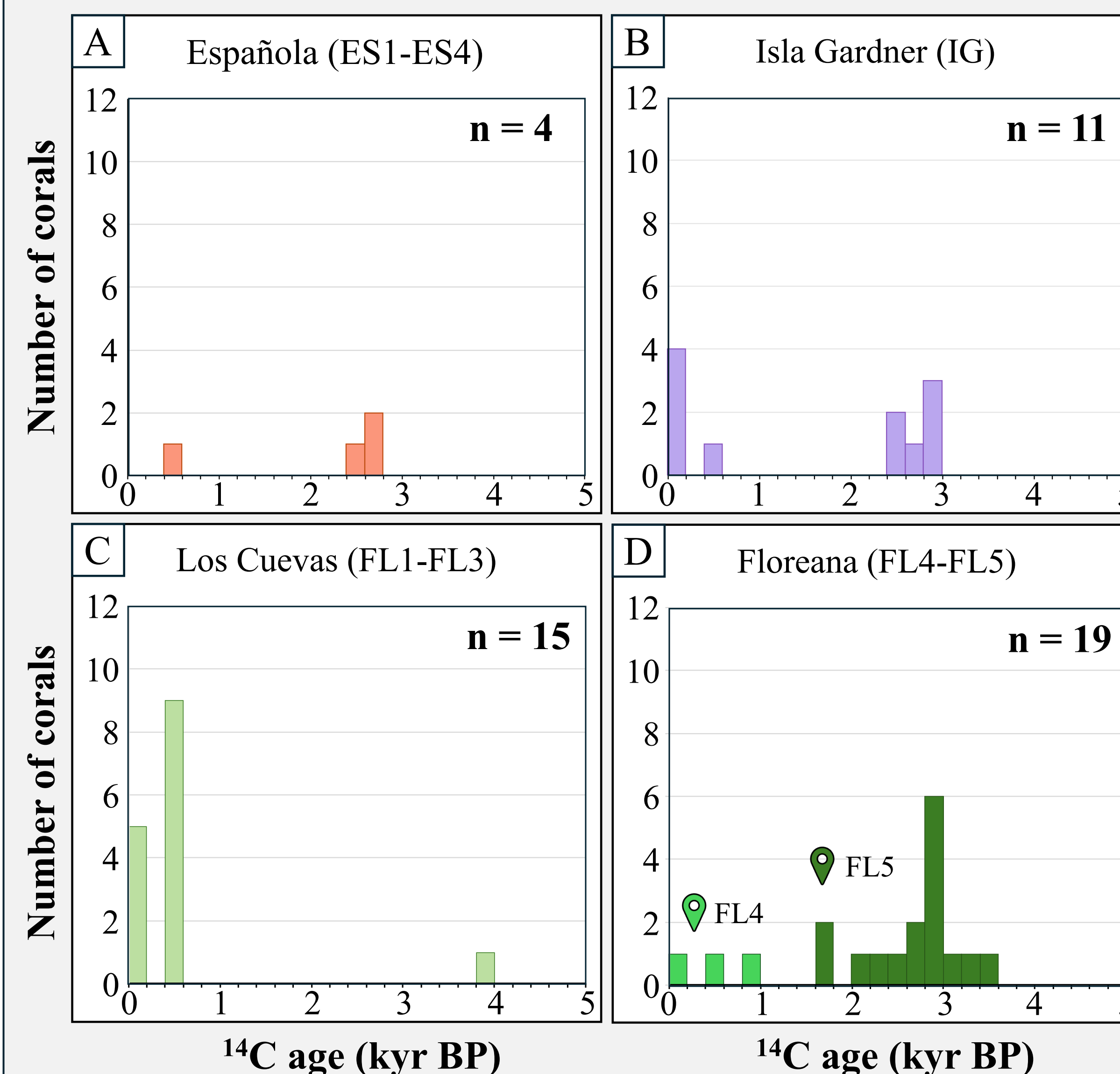


Figure 3: Histograms of the age distributions of coral fossils collected in (A) Española, (B) Isla Gardner, and (C-D) Floreana. Each bin is 200 years wide. Bolded text indicates the number of samples represented in each histogram.

Key Results:

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

- The small sample size at **Española** reflects the poor condition of available corals. However, three of the four collected corals had an age between 0 - 3,000 years BP (Fig 3A).
- 54% of ages of coral fossils collected from **Isla Gardner** had an age between 2,000 - 3,000 years BP (Fig 3B).
- 87% of coral fossils from Los Cuevas (FL1-FL3) in **Floreana** had an age between 0 - 1,000 years BP; one outlier sample is dated to 3,835 years BP (Fig 3C).
- 73% of coral fossils from **Floreana** at FL4-FL5 had an age between 1,700 - 4,000 years BP (Fig 3D); All outlier samples were collected from FL4.
- Outlier samples from **Floreana** at FL4-FL5 had an age within the last millennium and were all from FL4.

Conclusions

Prior to this study, coral fossils had not been collected from Los Cuevas, Española, and Isla Gardner. This study expands the spatial range of known fossil locations in the southernmost Galápagos Islands. Because each island has its own oceanographic conditions, having a long temporal range for each island is critical for interpreting long term changes in climate. This study expanded on the significance of Floreana as a site for paleoclimate reconstruction as it extended its temporal range into the last millennium; previously this range was restricted to 2-4,000 years BP (Tudhope et al., 2008).

Although these dates provide a general 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 and we are awaiting results.

¹⁴C dated coral fossils have been CT scanned and are now being prepared for paleoclimate reconstruction using oxygen isotopes and trace elements.

Acknowledgements

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Selected References

