**ALAN E. LEVITON STUDENT RESEARCH AWARD REPORT**

# *Long-term Stable Isotope Ecology of Galápagos Tortoises (Chelonoidis sp.)*

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Mr. Conrad is the recipient of the 2017 AAAS, Pacific Division Alan E. Leviton Student Research Award.
Dr. Emily Lena Jones was his advisor for this research project.
Images provided by Mr. Conrad.

After Bishop Tomás de Berlanga discovered the Galápagos off the west coast of modern-day Ecuador on March 10, 1535 C.E., he wrote to the Sacred Imperial Catholic Majesty in Rome and described finding, "nothing but seals, and turtles, and such big tortoises, that each could carry a man on top of itself," inhabiting the Islands (Slevin 1959:14-17). Berlanga identified so many tortoises that the Spanish named the Islands "Galápagos," meaning "tortoise". Unfortunately for the tortoises, their discovery in 1535 led to centuries of anthropogenic impact and overexploitation. When whaling vessels arrived in 1795 the extent of this process increased dramatically, a state that continued into the 1970s until widespread conservation efforts began. Humans ate tortoises, killed tortoises for oil, transported tortoises to museums and private collections, and introduced invasive mammalian competitors on the Islands. The net effect of these activities is a contemporary tortoise population that has suffered species extinctions, habitat destruction and substantial population decreases.

The purpose of this study is to use stable isotope analysis of Galápagos tortoise bone collagen, bone apatite, keratin and skin sampled from museum-collected specimens, and one 1850s Gold Rush-era sample from San Francisco, California, to document tortoise dietary preferences and vegetation dynamics on these Islands prior to (and during) major anthropogenic impacts in the 19$^{th}$ and 20$^{th}$ centuries. The AAAS-PD Alan E. Leviton Student Research Award funded analytical costs associated with analyzing 180 stable isotope samples from tortoises curated at the California Academy of Sciences, the American Museum of Natural History, the Smithsonian National Museum of Natural History, and the London Natural History Museum. This included analyzing carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), hydrogen ($\delta D$) and oxygen ($\delta^{18}O$) stable isotopes for tortoises originating on Pinta, Isabela, San Salvador, Rabida, Pinzon, Santa Cruz, San Cristobal, Santa Maria and Española Islands.

In addition to support from the AAAS-PD, this project received funding from the University of New Mexico Center for Stable Isotopes Pilot Grant Award, and the California Academy of Sciences Brett Stearns Award for Chelonian Research. Analysis of tortoises housed at the London Natural History Museum was approved by an Endangered/Threatened Species Wildlife permit (#MA09206C-0) through the U.S. Fish and Wildlife Service.

Results suggest Galápagos tortoises consume a diverse diet both between and within species and thus islands (Figure 1). These results are not surprising, the Galápagos Islands are diverse, and vegetation is often regionally specific within the archipelago. There is also a strong relationship between bone apatite and collagen for tortoises, which likely relates to their slow metabolic rate (Figure 2). Finally, several islands appear to show long-term changes over time. In one example from Pinta Island, tortoises shift towards a more C3 diet from the late 19$^{th}$ to early 20$^{th}$ century (Figure 3). These data will ultimately have important implications for the future conservation and rewilding of tortoises in the Galápagos.

*Slevin, J.R. 1959 The Galápagos Islands: A History of Their Exploration. San Francisco: California Academy of Sciences.*

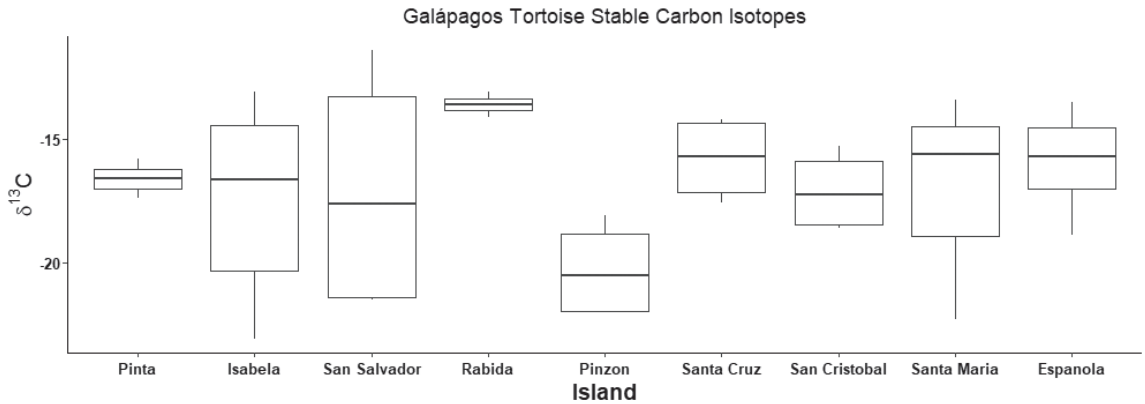


**Figure 1.** Boxplots of preliminary stable isotope data for Galápagos tortoises collected from various islands in the archipelago.

***See TORTOISES, page 10***

*TORTOISES, from page 9*

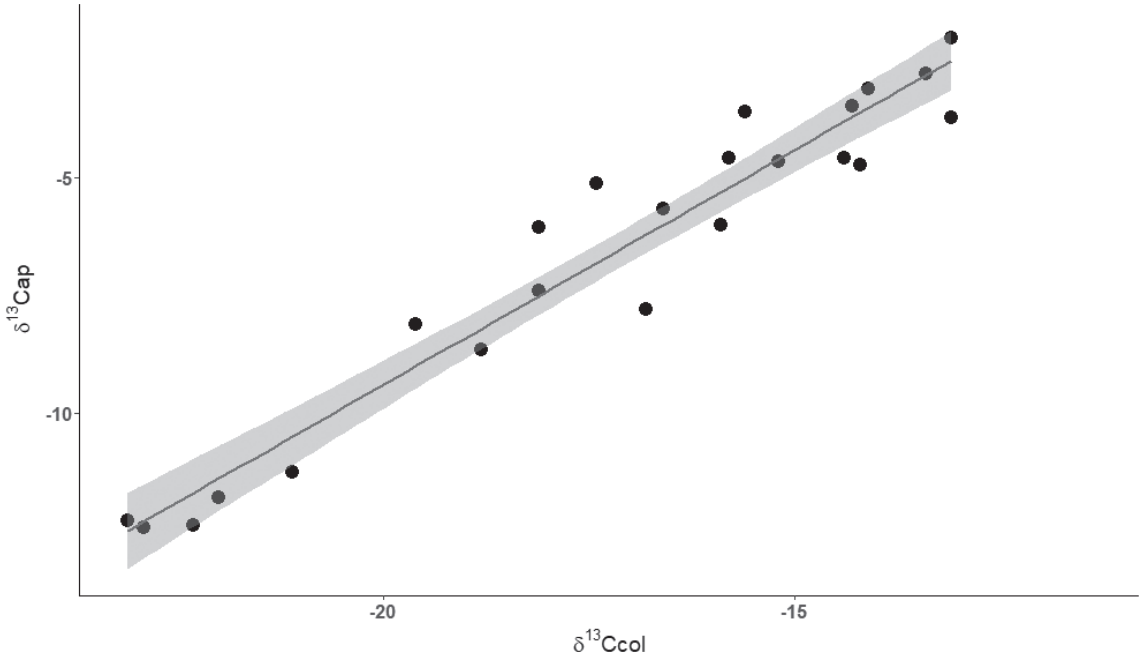


**Figure 2.** Relationship between bone collagen and bone apatite carbon stable isotopes.

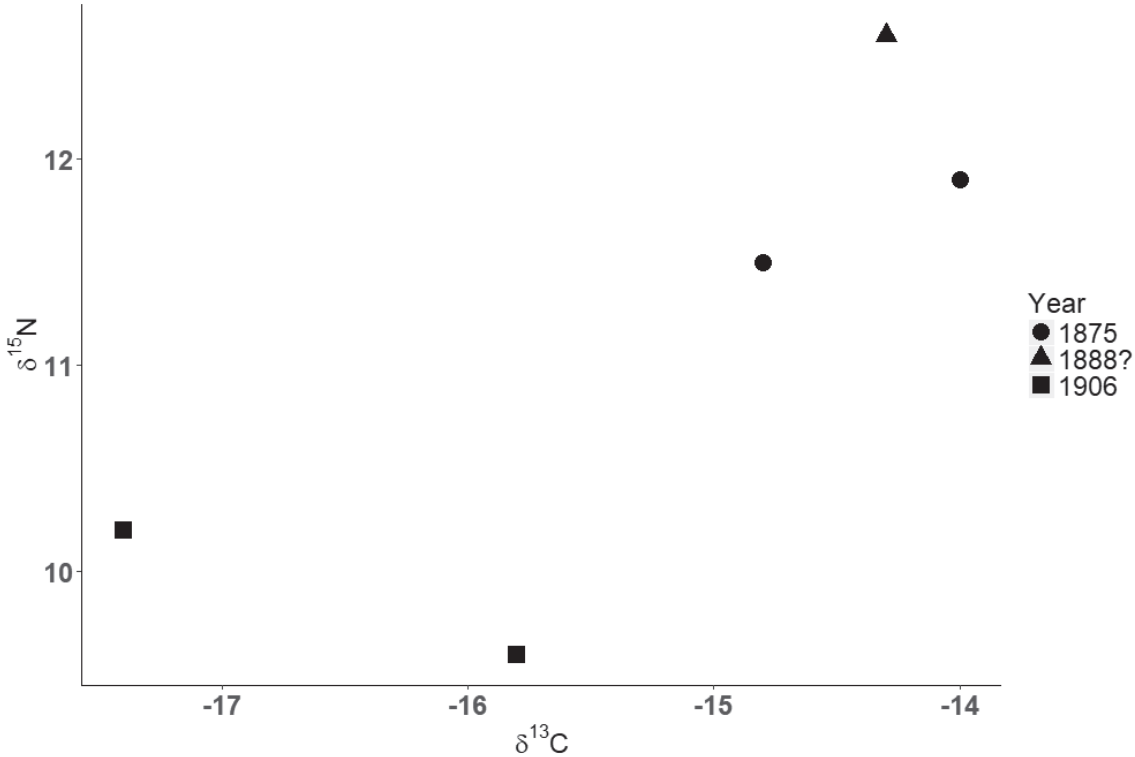


**Figure 3.** Carbon and nitrogen isotopes from tortoises (*Chelonoidis abingdonii*) collected on Pinta Island.