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Title of Research: *Wetland Agroecoystems in the Maya Lowlands: LiDAR and Multi-Proxy Environmental Change*
CLAG Field Report: Summer 2017

My dissertation research uses a combination of remote sensing techniques and geoarchaeological methods to better understand the land use history of prehistoric agroecosystems in the Maya Lowlands, a region that extends into Belize, Mexico, and Guatemala. I target understudied prehistoric agricultural wetlands using a variety of methods: survey and remote sensing, soil stratigraphy, paleoecology, carbon isotopes, elemental geochemistry, and other geoarchaeological techniques. Through this work, I am answering questions concerning the scale, environmental impact, and types of ancient indigenous wetland management compared to modern wetland management. My research explores the spatial and temporal scales of human occupation, agricultural strategies, and resource depletion within these wetland environments. Through this, I seek to provide new proxy evidence for paleoenvironmental change in these understudied tropical systems.

With the CLAG Student Field Study Award, I was able to successfully complete the final summer of my dissertation data collection within wetland study sites in the Maya Lowlands. The two sites that I targeted for the majority of my seven week stay in Belize were Cobweb Swamp and the Birds of Paradise wetlands. Here, I not only focused on my own dissertation research, but also collaborated with scholars at two research stations, the Programme for Belize Archaeological Project, and the Maya Research Program. Since I have been in collaboration with both of these projects throughout my dissertation, I was able to also assist with data collection for other MA and PhD students working on ecological and archaeological research in the region. Further, I was able to continue to strengthen the ties that I have already made with the Belizean communities as well as our in-country associates and collaborators who provide so much local knowledge and expertise year after year.

The first field site that I worked on for my dissertation this past summer was the ancient Maya urban center of Colha within Cobweb Swamp. Cobweb swamp is a perennial coastal marsh in Belize situated in a low depression of about 40 km^2. This system has been considered as an important long term record of land use and land history, as there is evidence of management and use in this location from the Maya Archaic time period (4,000+ years BP), stretching into the most populous time period of Maya civilization (~1000 years BP). Here, my own research dovetailed with my colleagues in geoarchaeology who were working on chronologies within the structures in the site's core. I was able to collect soil samples around the site for my ongoing research on ancient Maya impacts on soils, as well as lead surveys around the swamp periphery for mapping and water quality sampling. We quickly learned that Cobweb swamp is a difficult area to survey, especially with heavy equipment. While I was not able to successfully collect samples from the swamp itself, the soils that I collected from archaeological contests are

important components to my ongoing dissertation research.

The second area that I focused on for my summer research was the Birds of Paradise wetland that is in located in a watershed within the transboundary region of Belize, Mexico, and Guatemala. I have analyzed and processed samples from eexcavations and sediment cores in other areas within the Birds of Paradise swamp in previous field seasons. Our team's previous research suggests that in this system the wetland began to develop around 1675 years before present, when the stable terrestrial soil transitioned to a wetland soil. This occurred due to a rising water table that was either anthropogenically driven or naturally derived, which caused peats and sediments to deposit on top of terrestrial soil. Previous pollen work conducted by my colleagues and previous stable isotope analyses that I have conducted shows that maize cultivation occurred over the duration of the Maya Classic (1650-1000 BP) and in some cases, into the Maya Postclassic as well. This site is a primary area of interest for my research, and thus it was imperative that I return to this area for more data collection and survey.

In 2016, a consortium of scholars that I am a part of conducted a LiDAR survey of tropical forested wetlands, including the Birds of Paradise wetland. This provided extensive new remotely sensed evidence of anthropogenically modified fluviokarst systems and wetland agricultural underneath the tropical forest canopy. LiDAR (Light Detection and Ranging) is a remote sensing method that uses a laser that pulses light to measure variable distances from an airborne craft to the Earth's surface. Part of my dissertation is to utilize this LiDAR dataset to detect anthropogenically modified systems within wetlands of interest. These anthropogenically modified systems include extensive canals, ditched and raised fields, reservoirs, dams, and terraces. Using the 2016 lidar survey data, I focused on five new portions of the Birds of Paradise system that we had not previously detected to have prehistoric impacts. I placed excavation units on an occupational surface around the fields, three units on canal/field complexes, and one unit on an anthropogenic berm that could have been used as a causeway throughout the wetland system.

All of this was made possible by the support and generosity of CLAG. With this grant, I was able to fund travel to and from Belize for the summer. Further, this funding helped to cover much of my lodging, food, and equipment costs while in the field. I am thrilled to be able to add this summer's fieldwork to the datasets that I have already collected for my dissertation, and am preparing to present my findings at this month's Geological Society of America's annual meeting. After completing the laboratory portions of this research this winter, I will be presenting on these new findings at the Association of American Geographers meeting in the spring of 2018.
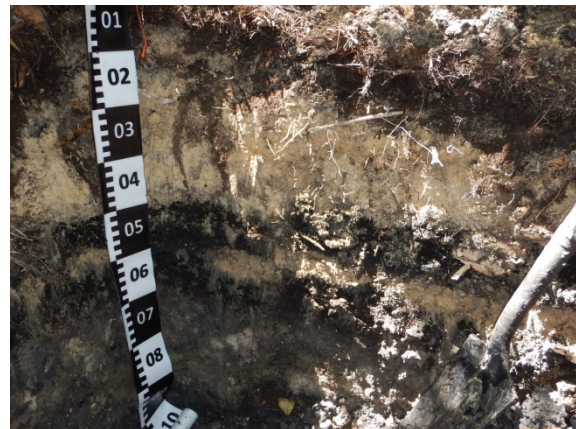
Survey efforts around Cobweb Swamp: Photos by S. Krause and G. Wells.

Newly discovered ancient Maya canal systems in the Birds of Paradise wetlands. Teammates are standing within an area of micro-relief that we recognize to be a remnant canal expression. Students in photo (from left to right: G. Wells, L. Donn, L. Sanchez. Associates in photo (from left to right): P. Magaña, F. Cruz, A. Angeles.) Photo by S. Krause

I directed several excavations within cultural features in the Birds of Paradise wetlands, these are examples of the Geoarchaeological teams at work. Photos by S. Krause and G. Wells.

Examples of soil pits and sampling stratagies throughout the summer research. Photos by C. Doyle and S. Krause

Students at the National Archaeological Park of Lamanai. Photo by S. Krause