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## Legacy soil phosphorus at Buck Island Ranch

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Agroecology Research Assistant Megan Selva and Buck Island Ranch Intern Scott Dai taking a deep core at a sample point in an improved pasture.

ANNA ODELL PHOTO

For the past few months, at Archbold's Buck Island Ranch, research assistants and interns have been diligently working to collect soil and vegetation samples to create a detailed map of soil phosphorus on Buck Island Ranch, funded through a grant from the Florida Department of Agriculture and Consumer Services. This new project at Buck Island Ranch is a collaborative effort between Archbold, University of Florida and Cornell University with the goal of contributing to the reduction of phosphorus flowing downstream.

## What is legacy phosphorus?

To understand this issue, it helps to start with a history of Archbold's Buck Island Ranch, operated as a ranch from the early 1900s. During the 1950s numerous ditches were connected to the newly constructed Harney Pond Canal, which bisects the Ranch on its way downstream to Lake Okeechobee. This enabled rapid drainage, changing the timing, frequency, and intensity of flow events off the Ranch. The same time heralded the beginning of a worldwide transformation in agriculture as fertilizers became available post-WW2. Fertilizers made ranching more profitable on the nutrient-poor sandy soils of Florida. In the period between the late 1940s through the 1980s, extensive use of fertilizers, including nitrogen, phosphorus and potassium, resulted in build-up of phosphorus (or, the 'legacy P' issue) in ranchland soils that continues to affect water quality today. Since 1986, when reduced P applications were first recommended, P application has declined markedly throughout the watershed and is now regulated, but the legacy of previous fertilizer P applications in soils is still widespread. Today's Best Management Practices for grazing lands, which are currently under another major review, aim to ensure that no more P fertilizer is applied than absolutely needed.

Buck Island Ranch is just 10,500 acres of the total ~1 million acres of ranchlands located in the 2.6 million-acre headwaters of the Everglades, the lands and waters that drain south into Lake Okeechobee. Even though P loads from cattle pastures are low relative to other land uses (on a per-acre basis) the large acreage of ranches in the watershed makes them, cumulatively, a significant contributor to overall P loads. Therefore, ranches have been a focus for improved P control. The challenge is that ranches are a 'non-point source' of P: with sheet flow of shallow surface water across the ranchlands under high water conditions, together with vast and complex ditching and drainage networks, so there is no readily identifiable 'point' source location that can be easily targeted to reduce P loading.

## What can we do about legacy soil phosphorus?

Water management practices that increase retention-detention of drainage waters on cattle pastures are a potential solution to reducing P loads. Since 2005, Archbold has been working on examples of these 'Dispersed Water Management' practices with state agencies. This started with the voluntary program, the Florida Ranchland Environmental Services Project, and transitioned to the Northern Everglades-Payment for Environmental Services program, both offered by the South Florida Water Management District. Ranchers are contracted to provide water management—either water retention or nutrient P removal. These programs, along with multiple other projects of state and federal agencies, are designed to mitigate problems of water quality and quantity to Lake Okeechobee.

With recent funding from the Florida Department of Agriculture and Consumer Services, the Agro-ecology research program collected an intensive grid of soil samples across Buck Island Ranch to make a map of soil P levels. Vegetation samples were collected at the same locations. More than 1,400 soil samples and 47 deep core soil samples were taken during June to October, to be processed in laboratories at Buck Island Ranch, the University of Florida, and Cornell University. Deep core soil samples are about 40" in length are used in this project to determine the amount of P in 6 inches increments of the deep core. Research assistants and interns spent 4-5 hours a day collecting 20-30 samples in the summer heat using trucks, ATVs or by foot to get to sampling locations. Intern Scott Dai says, "As the self-appointed 'Soil Auger', my hands were caked in mud every time I did fieldwork for this project. It'll be cool knowing our hard work will be used by both ranchers and agroecologists."

Finally, on October 15, Anna Odell, Buck Island Ranch research intern finished grinding the last set of vegetation samples. The day before, Megan Selva, research assistant, finished weighing sieved soil samples. Megan states, "This was a challenging project and a fight to get as many samples collected as possible before the rainy season made sampling sites inaccessible. We were fortunate to have three interns, research staff, and ranch staff to finish the sampling successfully." The samples were organized by Alan Rivero, research assistant, and shipped to the University of Florida, for detailed soil content analysis, and to Cornell University for soil isotope analysis.

After the soil P map is made, the next step is to plant harvestable forages in these areas so that plants can start to take up soil P and we can harvest the plants to remove P from these areas.

After the sample analyses are completed, Archbold will build a detailed soil P map for Buck Island Ranch. Dr. Betsey Boughton, Research Director at Buck Island Ranch added: "This will provide insights as to how patchy legacy soils are on a typical ranch and help us identify past management practices might explain higher levels of soil P in some locations. Then we will focus our efforts on areas of higher soil P. The next step is to plant harvestable forages in these areas, so that plants can start to take up soil P and we can harvest the plants to remove P from these areas."