Extracts

Giant Aviary Houses Birds For Mercury Study

To learn how tiny amounts of mercury affect wildlife — especially wading birds in the Florida Everglades — University of Florida scientists are beginning a five-year study at the new Wetlands Ecological Research Aviary in Gainesville.

"The research aviary will provide a unique environment for studying the effects of Everglades-appropriate levels of mercury on the development and reproduction of aquatic birdlife," said Peter Frederick, an associate research professor in UF's wildlife ecology and conservation department and leader of the project.

"Results of the research will help wildlife managers and other federal and state agencies determine safe mercury levels for wildlife that may be different from existing human health standards," he said.

Built on U.S. Department of Agriculture land east of Gainesville and managed by UF, the research project is funded by the Florida Department of Environmental Protection, the U.S. Fish and Wildlife Service, the U.S. Geological Survey and the U.S. Army Corps of Engineers.

Frederick said the 13,000-square-foot outdoor aviary, one of the nation's largest, houses more than 160 white ibises. About the size of a chicken, the ibis has a long, decurved bill and blue eyes.

"They are kept in outdoor conditions with plenty of room to fly and lots of water to drink and bathe in — we want the birds to be in as natural an environment as possible," he said.

"The birds are exposed to mercury, but no more than they would get in the wild. When the research is completed, the birds will be placed in zoos."

The reproductive success and health of wading birds such as herons, egrets, ibises and storks in the Everglades are important measures of the success of ecological restoration, Frederick said.

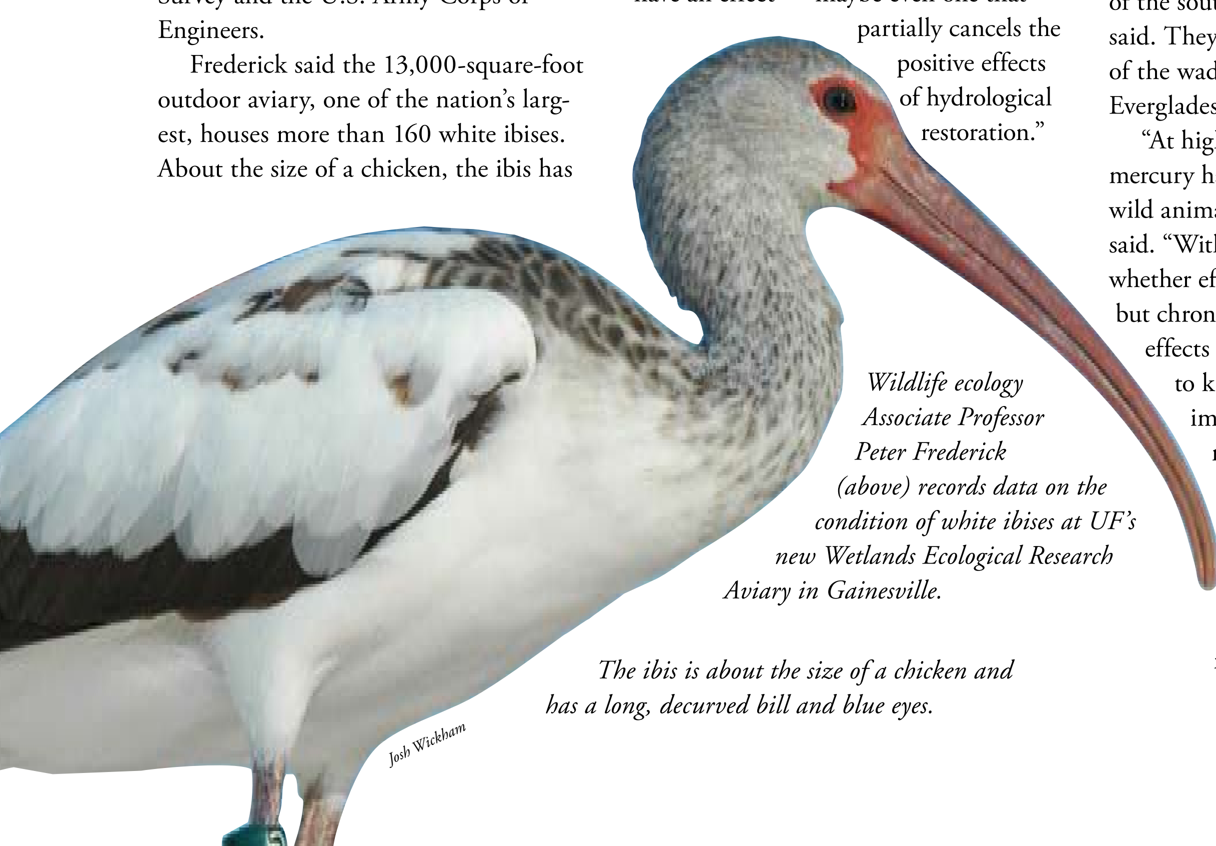
"As the Everglades restoration plan moves forward, we need to increase our ability to predict how wading birds will respond," he said. "We are very confident that the hydrological restoration — getting the water flows right — will be good for wading bird populations. But we are now aware that mercury might also have an effect — maybe even one that partially cancels the positive effects of hydrological restoration."

When fish ingest mercury, either by absorbing it through their gills or by eating other contaminated fish, the toxin is stored in their bodies. Wading birds, which consume large amounts of fish, are particularly at risk for mercury contamination because they are at or near the end of long aquatic food webs that can accumulate the toxin, Frederick said.

Selected because of their abundance in South Florida, white ibises serve as representative fish-eating birds for much of the southeastern United States, he said. They comprise 40 to 60 percent of the wading bird population in the Everglades.

"At high contamination levels, mercury has very obvious effects on wild animals and humans," Frederick said. "With this project, we are asking whether effects also occur at very low, but chronic, contamination levels. The effects we are looking for are unlikely to kill the bird, but they might impair the immune system, reduce foraging abilities or alter hormones to the point that birds don't breed. And these are the things that could affect population size and response to Everglades restoration."

Wildlife ecology Associate Professor Peter Frederick (above) records data on the condition of white ibises at UF's new Wetlands Ecological Research Aviary in Gainesville.



Josh Wickham

The ibis is about the size of a chicken and has a long, decurved bill and blue eyes.

Josh Wickham

In previous research, Frederick and other scientists found a dramatic decline in mercury contamination levels in Everglades wildlife during the past decade. Between the 1930s and 1980s, bird populations in the wetland declined by up to 90 percent depending on species, and Frederick believes mercury contamination may have impaired the restoration of these populations.

"One hint comes from the fact that the numbers of wading bird nests in the Everglades increased by two or three times immediately following the sharp, local decline in mercury," he said. "While tantalizing, that doesn't prove mercury was keeping birds from breeding. For that, you need a controlled experiment, and the new aviary will provide the setting for that work."

Scientists attribute the recent mercury declines in the Everglades to tougher emission standards for power plants and incinerators, along with a big reduction in the use of mercury in household products such as flashlight batteries and paint.

Once the mercury study is completed, the research aviary will be transferred to the USDA and be used for other avian studies.

Peter Frederick, pcf@mail.ifas.ufl.edu

Chuck Woods

Study Questions Need For Biochemical Pathway

Leave it to the bacteria that cause tooth decay to be able to live without something all cells were thought to require.

Scientists have long believed a certain biochemical pathway involved in the folding and delivery of proteins to cell membranes is essential for survival. Now researchers have discovered that *Streptococcus mutans*, the decay-causing organism that thrives in many a mouth, can do just fine without it.

The findings, reported in the December *Proceedings of the National Academy of Sciences*, have rocked the cellular biology scientific community, which has long considered the pathway to be crucial. The report may also explain why strains of the bacteria can survive in the harsh acidic environment they create in the mouth.

"We were met with skepticism … because the dogma was that this biochemical pathway is key for all living cells," said study investigator Jeannine Brady, an associate professor of oral biology at the UF College of Dentistry. "As far as we know, this is the first example of any bacteria that can cope without this pathway."

The signal recognition particle, or SRP, pathway is a primary mechanism by which proteins are chaperoned from cellular assembly lines, where they are made, to the protective outer surface of the cells, where they are inserted. Without a steady infusion of proteins, the membrane weakens and the cell — in this case, a bacterium — becomes unable to protect itself from harsh environmental conditions.

In the human mouth, its natural environment, it is typically *S. mutans* that goes on the attack. When sugary foods are eaten, the *S. mutans* population explodes, excreting lactic acid as it digests sugar. The acid makes life difficult for other helpful bacteria and demineralizes tooth enamel, causing decay.

In an effort to understand how best to combat the tooth-decaying properties of *S. mutans*, Brady and her team set out to learn how the organism was able to survive its own acid. The researchers tinkered with systematically turning off several genes, individually and in combination, to see how the bacteria responded.

"We found *S. mutans* can survive, with normal growth, without the SRP pathway," said Adnan Hasona, a research assistant professor of oral biology and the study's lead author.

The bacteria altered to lack SRP components were able to adapt and survive gradual increases in acid resulting from their own metabolism, suggesting a backup pathway was in place.

But, like goldfish dropped in new water, the altered bacteria could not contend with sudden environmental change. When artificially shocked with acid to a pH below that where tooth demineralization begins, the altered bacteria became sick and unable to grow. Shocking the bacteria with other environmental stressors, such as high salt levels or the presence of hydrogen peroxide, also caused them to weaken, Hasona said.

"So, at least in this organism, we learned the SRP pathway seems to enable it to respond rapidly to environmental stress, but it was not at all necessary for the organism's viability during non-stress conditions," Brady said.

"Really, we started with a very basic question related primarily to *S. mutans*, 'how does this bacteria tolerate acid?'" said Brady. "Asking that question has opened the door much more widely to learning things that are more fundamental about how living organisms insert proteins and how membrane function is determined by proteins.

The study was funded by the National Institute of Dental and Craniofacial Research.

Jeannine Brady, jbrady@dental.ufl.edu

Lindy McCollum-Brounley