



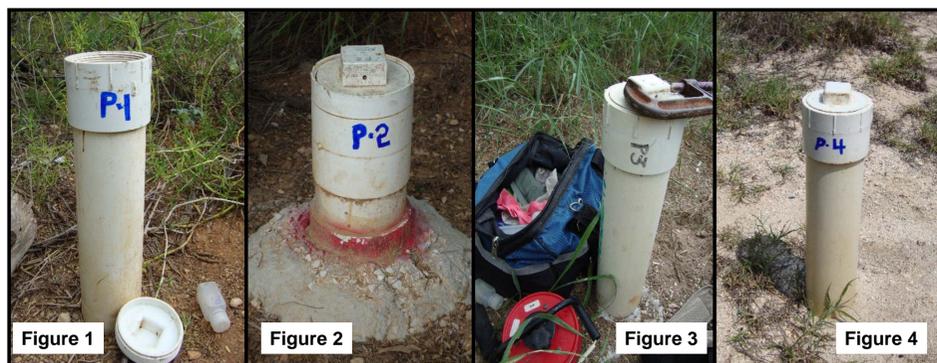
# Ground Water Dynamics of the Littoral Coastal Zone of the Guanica Dry Forest, Puerto Rico

## Abstract

Climatic change may have detrimental effects on the coastal habitats of Puerto Rico due to reductions in rainfall, increase in sea levels, and changes in the hydrology of coastal wetlands. Due to these concerns, a ground water monitoring system was established in October 2008 to study the Guanica Dry Forest ground water dynamics. This study aims to understand the relationship between groundwater levels and tidal fluctuations, rainfall, ground water salinity, and temperature. The risk of salinization of freshwater coastal ephemeral ponds in the Guanica Dry Forest (where the threatened Puerto Rican Crested Toad reproduces) will also be evaluated. Furthermore, this investigation will establish the basis of a long-term study of groundwater dynamics in the littoral coastal zone of the Guanica Dry Forest that could allow the assessment of the impacts of climate change in these sensitive habitats.

## Site Description

Due to its scientific and natural richness, in 1981 the United Nations Educational, Scientific and Cultural Organization (UNESCO), recognized the Guanica Dry Forest (GDF) as a Biosphere Reserve. The GDF is located on the southwest coast of Puerto Rico. It extends from the municipality of Guanica to the municipality of Ponce and measures approximately 4,400 ha. This includes approximately 8 nautical miles and 21 km. of coast. The GDF is the most arid zone in the Island. The rainy season occurs from August to November. Its yearly precipitation is about 30 inches. Temperature fluctuates from 27-38 °C. Relative humidity varies from 65-80%. These characteristics form an environment that can be described as hostile. Species living in this environment possess special adaptations to survive under extremely dry and harsh conditions. The predominant geology is primary sedimentary rocks, mostly karst. The flora has adapted to these extreme conditions. Strong winds, saltpeter and scarce water limit vegetation growth. Even with these limitations, its flora is one of the most diverse in Puerto Rico. There are approximately 550 species of plants in the GDF. From these plant species, 45 are threatened or in danger of extinction. The GDF also hosts diverse fauna including threatened and endangered species. Within these species, the Puerto Rican Crested Toad, *Pelthophryne lemur*, is one of most studied.



## Monitoring System of the Coastal Littoral Aquifer

It consists of four wells in different locations. Well 1, identified as P1, is located at Tamarindo Pond (figure 1). Well 2, identified as P2, is located at Aroma Pond (figure 2). Well 3, identified as P3, is located at Atolladora Pond (figure3). Well 4, identified as P4, is located at Manglillo Beach (figure4). Each well has a U20 HOBO® water level data logger installed (figure 5). They measure temperature, absolute pressure, and are set to read every 30 minutes. Once a week, they are re-set after retrieving stored data.



## Monitoring Station at Tamarindo's Ephemeral Pond

This station is located at the Tamarindo pond. It has a metric scale that measures the water level at the pond (figure 6). It also has two U20 HOBO® water level data loggers installed. One is placed at soil level to read hydrostatic pressure and temperatures of the pond's waters after rain events. The second one is placed high enough that even in rain events, it doesn't get submerged. Its purpose is to measure atmospheric pressure. This pressure is later used with data recorded from the data loggers of the four wells to correct hydrostatic pressure for variations in atmospheric pressure.



## Ground Water Level Measurements

An electronic water level dip meter is used to measure the ground water level once a week. This measurement is then entered into the Hobo Ware Pro computer program, along with the measurements taken from the data loggers of the wells, and the measurements data loggers which record atmospheric pressure in the Tamarindo's Pond Station. This combination calculates and graphs the ground water level during weekly measurements. This is simplified in figure 7.

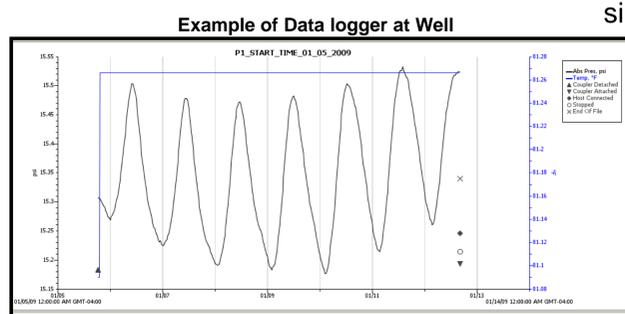
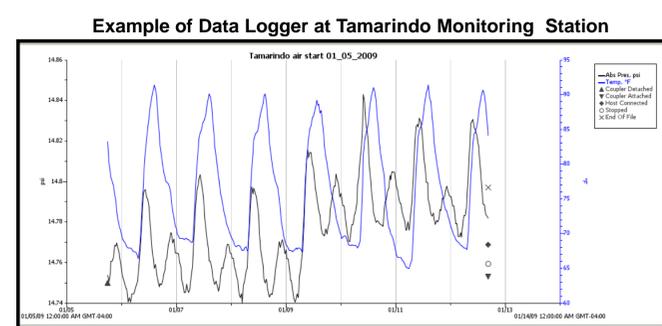
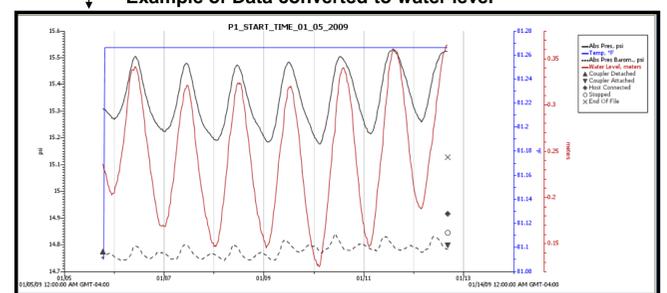


Figure 7

## Water Level Measurement



Example of Data converted to water level



## Salinity Samples

A sample of ground water of each well is obtained with a ground water bailer every 0.5-meter from the top of the well's casing. Beginning close to where the water level was measured prior and ending at the bottom of the well. Every sample is then analyzed using a salt refractometer that measures in parts per thousand (ppt).

## Rainfall and Sea Level Data

Rainfall data is obtained from measurements taken by the Department of Natural Resources in Guánica. Data of sea level is obtained from the web page of the National Oceanic and Atmospheric Administration (NOAA) at Maguëyes Island.

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