# Gathering Baseline Information on Anchialine Ponds of Eleuthera, The Bahamas

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## Introduction

Anchialine systems are small, inland bodies of marine or brackish water, with subterranean connections to the surrounding marine environment. According to Becking *et al.,* 2011, these ponds were formed during the Holocene Era, in either volcanic rock or limestone. They can be found in coastal regions around the world, including The Bahamas, Hawaii, Indonesia, Palau and Mexico (Becking *et al.* 2011). Anchialine habitats contain unique life due to the isolation of the life inhabiting these ponds (Iliffe *et al*. 2009). These species are endemic, meaning that they are restricted to their habitat, which also makes them very vulnerable to extinction.

*Fig. 1* Discovered pond in Savannah Sound, Eleuthera

### The Problem

Anchialine systems are under threat from human-caused stressors, including:

- Pollution and development around the ponds
- The stocking of ponds with non-native species.

In addition, there is a major lack of data on anchialine systems. Therefore, this project is extremely important in terms of providing information for decisions regarding conservation of these ponds.

*Fig. 2* Development around Victoria Pond in George Town, Exuma.

*Fig. 3* Illegal dumping at Lovers Lane in George Town, Exuma.

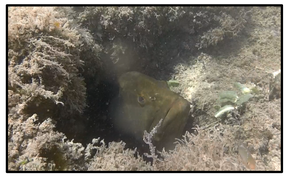

*Fig. 4* Introduced predatory grouper, an example of a species that is stocked in the ponds to harvest.

## Methods

### Physical

Ponds were located by either satellite imagery, or through local knowledge. Once the ponds were located, a GPS was used to map around the perimeter of the pond. A depth sounder was used with a GPS to map the bathymetry of each site.

### Water Quality

Water samples were collected from shallow, medium and deep water using a Van Dorn, a device that traps water at required depths (see fig. 5). Temperature, dissolved oxygen, and salinity were then measured using a YSI (Yellowstone Scientific Instrument) (see fig. 6). pH was measured using a pH pen. Turbidity was measured using a turbidity meter. Water samples were also taken to the lab to test the nitrate, phosphate, and ammonia levels using a LaMotte Smart 2 Colorimeter (see fig. 8).

### Biota Assessment

A Baited Remote Underwater Video (BRUV) is a device that was used to record organisms within the ponds (see fig. 7). It was baited with four chopped sardines and dropped to the bottom of the pond. A GoPro was attached to record organisms for 90 minutes once submerged. A benthic transect was completed to examine bottom composition and algae life. This was conducted with a 1 meter$^2$ quadrat placed every meter long a 30-meter-long tape. In addition, bird and insect life surrounding the pond was observed and recorded.

*Fig. 5* Van Dorn being lowered into the water.

*Fig. 6* YSI meter.

*Fig. 7* GoPro attached to BRUV.

*Fig. 8* Water quality testing using a Colorimeter.

## Purpose

The purpose of our study is to explore and assess the inland ponds of Eleuthera, and to identify the need for their conservation and protection.

## Results

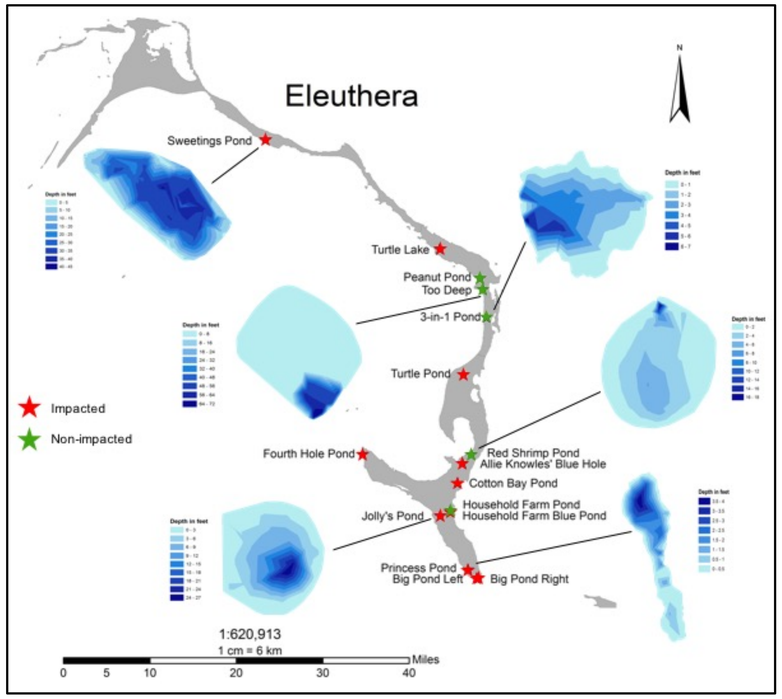


*Fig. 9* Map of Eleuthera showing location of impacted and non-impacted ponds with bathymetry maps for six of the ponds studied.

### Summary of Results

- The maximum **length** varied from 12 to 1,648 m.
- The maximum **depth** ranged from less than 1 to 75 ft.
- **Salinity** ranged from 19.1 to 90 ppt.

An impacted pond has one or more of the following characteristics: contain introduced species, evidence of physical alterations or development, signs of pollution or dumping.

- **68.75**% of the ponds studied were **impacted.**
- **72.72**% of impacted ponds contained **introduced species**.
- **9%** of the impacted ponds contained **endemic species** (see fig. 10).
- **80%** of the non-impacted ponds contained **endemic species**.
- Migratory **birds** were spotted at the majority of the ponds, some of which were threatened species, such as the White-cheeked Pintail Duck.

*Fig. 10* Unidentified red cave shrimp , believed to be *Barbouria cubensis.*

## Discussion

### Physical

Many ponds have very shallow depths with the exception of a deeper area near the edges. These deeper areas are subterranean connections that link to the adjacent seas deep underground.
Due to the wide range in physical characteristics of these ponds, they have been categorized into 5 different types (Becking *et. al.* 2011):

- *Anchialine Pond*: separated from the ocean by a distance of 50-400m. Small and circular basins ranging from 20-100 meters in diameter. Salinities range from 20-26ppt.
- *Blue Chasm*: located 75-220m inland from the sea. Typically a deep blue color.
- *Hyper Saline Pond*: a pond with salinity levels higher than the ocean's, which is 35ppt.
- *Marine Lake*: large and deep bodies of water. Highly connected to the adjacent sea.
- *Man-made Pond*: artificial ponds created by humans.

### Water Quality

Baseline data was collected on the ammonia and phosphate levels of these ponds. This data could serve as a reference point for future studies in determining the human impacts on the water quality of these anchialine systems. High levels of ammonia can be toxic for marine and plant life, causing them to be unable to excrete waste, eventually killing them. Low levels of phosphates cause plants not to grow as robustly.

### Biota Assessment

During the assessment of these anchialine ponds, the observation of birds, such as Least Grebes (see fig. 12), and insects, such as dragonflies are indicators of healthy ecosystems.

*Fig. 11* Seahorse of Sweetings Pond.

*Fig. 12* Least Grebe, *Tachybaptus dominicus.*

In summary, over 68.75% of the ponds examined in this study have been impacted by humans. There is a clear need for immediate conservation of the anchialine systems in order to protect this unique habitat and the life it supports. Future research may be directed towards further investigation of the endemic life contained in these ponds and the connectivity of the sites.

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