Report on a short assessment of the shore vegetation of Five Blues Lake National Park.

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Report to PACT

Introduction

Five Blues Lake is the main attraction of Five Blues Lake National Park (FBLNP), a small, community managed protected area near the Hummingbird Highway in Belize. Five Blues Lake is a karstic lake which receives its inflow from a number of underground sources. The main outflow is a small creek which forms one of the tributaries of Indian Creek. The center of the lake is very deep, reportedly more than 200 ft (60 m), and should probably be classified as a "Cenote". Although the center of the lake is very deep, the shoreline, specifically the northern shore, is rather shallow. These shallow shores have a semi-aquatic graminoid vegetation cover. The extend of these "reedbeds" is mapped quite accurately on the FBLNP trail map.

On May 15, 2001, consultant was approached by PACT representative Lisel Alamilla with the request to conduct a rapid assessment of the graminoid vegetation that appeared to be taking over the lake. The aim of the survey being

a) an assessment of the causes leading to the infestation and

b) provide recommendations for the management of this perceived problem.

Fieldwork was consequently carried out on May 22, 2001.

Methodology

A walkover survey was made on all the trails (including river trail) surrounding the lake.

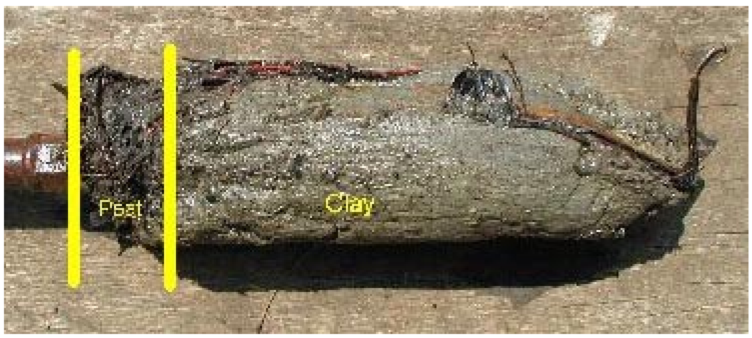
Using an AMS soil auger, 10 soil cores were sampled along the northern shore of the Western lobe of the lake. In addition, the western lobe of the lake was investigated by snorkeling. At the end of the day, and interview was held with Louis Peraza and Joel Raymundo of the Association of Friends of Five Blues Lake.

Plant material was identified using volume I of Standley and Steyermark 1946-1978.

Results

The walkover survey did show some minor erosion of the Blue Morpho Meander as well as on the narrower forest trails (Lake Trail, Danto Trail, River Trail), but the amount was minimal. Moreover, the Blue Morpho Meander is now largely grassed over, which should reduce further erosion.

The soil cores taken in the reed beds revealed a thin layer of peat on top of a thick layer of sticky clay. The peat layer varied in thickness from 8” (20 cm) in shore locations (slightly above current water level) to 1” (2.5 cm) in the actual submerged reed beds. No traces of recent soil deposits (as from recent deposits of eroded material) could be detected in the layering of the core samples.



Picture 2. 20 cm soil core with peat and clay layers indicated

The snorkel survey was hampered by limited visibility, at the moment of the survey the horizontal visibility in the top layer of the water column (2 ft / 60 cm) was less than 6 ft (2 m), while turbidity of the lower layers of the water column was so high that visibility was reduced to about 1 ft (30 cm). Visibility was better near inflow sources (underground streams). Measurements revealed that the reed was rooting up to a depth of 6 ft (1.80 m).

The “reed” is actually a sedge (Cyperaceae) of the genus *Eleocharis.* Using Standley and Steyermark 1946-1978, the species keyed out as *E. intersticta.* This is a wide ranging species with a distribution from Southern USA, the Caribbean through to South America.

Picture 3. Eleocharis intersticta. Note terete, septate culm (= rounded stem divided in sections) and flowering spike

Another conspicuous shore plant noted in the *Eleocharis* beds was a *Pontederia* sp. (Pontederiaceae).

The interview with Louis Peraza and Joel Raymundo revealed some interesting information. Most notably:

1) The sedge has always been present but is reportedly spreading in the last few years.
2) The overall water level of the lake appears not to have changed noticeably.
3) The fluctuations in the lake are reportedly more abrupt than in the past.
4) Turbidity of the water in the lake appears to have become unpredictable and does not necessarily coincide with the local rainfall pattern anymore.

Discussion

One of the main theories attempting to explain the *Eleocharis* "infestation" was that the construction of the parking place, picnic area and connecting "Blue Morpho Meander" had led to disturbance of the soil and that the runoff had led to siltation of the lake. But the distribution of the Eleocharis in the lake does not correlate with the location of the parking place, picnic area and road. Also the core samples taken do not reveal any layering suggesting recent soil deposits. For these two reasons, erosion of these visitors amenities does not appear a significant contributor to any siltation of the lake.

The thickness of the peat layer appears to indicate that the presence of this plant along the shores of the lake is not of recent origin. The relatively thin peat layer in the deeper sections might be indicative of a relatively recent colonization of these parts. This observation corroborates with the observations made by Mr. Pereza.

Since the *Eleocharis* is a shore plant (even though it was found growing in water up to 6 ft = 1.80 m deep), gradual lowering of the average water level in the lake (for example as a result of lower annual rainfall figures) might benefit the plant and cause it to expand. But apparently the overall water level in the lake has not changed. Therefore, this potential phenomenon, although it can not be ruled out all together, does not appear to provide an explanation either.

If lowering of the overall water level is not a factor, then what could have led to the reported increase in the population of the *Eleocharis*? One explanation might be an increase in nutrient availability.

The growing conditions of *Eleocharis intersticta* in Belize were researched by Rejmánková et al. (1996). They report finding this species in Belize growing on peaty clays in fresh water (low chloride content), which was low in nutrients (P, N) and carbonate. They also comment on the high productivity (biomass production) of this species. Except for the carbonate content (which is high in FBLNP), this appears to describe the conditions in FBLNP very well.

Given the limited nutrient needs of *E. intersticta* it is quite conceivable that even a slight increase in available nutrients could lead to expansion of the population. Question remains, what would be the source of these nutrients? An interesting clue to this might be given by the apparent change in the water level fluctuations and the increased turbidity. These 2 factors point to a change in the overall hydrology of the entire system.

Five Blues Lake is a karstic lake, fed by underground streams. During the quick survey, the mouths of three of these underground streams were noted (all on the south shore). Possibly there are more. The three noted all came into the lake just below the current water level of the lake. It is quite possible that there are other underground streams ending in the lake at much greater depth. It appears logical to assume that the water in these underground streams originates from seepage in the karts hills that make up the remainder of the FBLNP. But karstic systems are notoriously unpredictable and a source away from the FBLNP is not inconceivable. An underground link between the lake and St. Margaret Creek / Dry Creek is very possible and even likely. And since the latter is an agricultural area, there is a possibility that the lake is now receiving some agricultural run off! Which would explain an increased nutrient level (if present) and certainly an increased turbidity of the lake.

A more natural cause would be a simple change in the underground river system, the collapse of a cave could release detritus into the underground river system (and even many years accumulation of bat guano).

Recommendations

Although some would see the *Eleocharis* beds as despoiling the natural beauty of Five Blues Lake, they are still very much part of the ecosystem. The underwater stems provide a substrate for a number of sessile algae species and other organisms. Fish and aquatic insects use these *Eleocharis*/algae beds as spawning sites, and this aquatic fauna is then food for birds, otters and other wildlife.

For this reason alone it is not recommended to try to combat the *Eleocharis*. Mechanical removal (by means of an underwater mower) of the *Eleocharis* would cause only temporary relief (since it would certainly grow back) and merely cause an unsightly mess of floating stems, and the sudden release of nutrients caused by the rotting cuttings could even lead to algae blooms and subsequent fish mortality. Physical removal of *Eleocharis* by uprooting entire plants would be very time and labor consuming, and also lead to increased turbidity as the bottom sediments would be disturbed. Moreover, even this would provide only temporary relief.

The causal factors leading to the increase of the *Eleocharis* remain uncertain. But over a longer period it may be possible to unravel the mystery by doing some directed research. For this reason it is recommended to implement the following research:

1) Install a simple water level gauge (near the Canoe dock) and record (preferably on a daily basis, the water level of the lake.
2) Install a simple rain gauge. Preferably as near as possible to the lake but at least (or also) at the head quarters in St. Margaret's Village. Record on a daily basis.
3) Place some marker sticks at the edge of the *Eleocharis* beds in order to monitor any further expansion of the sedge.
4) Map al inflows (underground rivers)
5) Perform yearly water quality testing Focusing on nutrients. Preferably also place sampling stations at the mouths of the underground rivers.

6) Make an inventory of the Aquatic fauna (notably fish, but possibly other indicators such as dragonflies), and continue monitoring on a yearly basis.

Results from this research may for example reveal a discrepancy between water level rise and local rainfall. If such a discrepancy would be detected, this would be a clear indication that the watersheds of the underground streams leading into the lake are not of local origin.

Yearly water quality testing may reveal whether or not there is an inflow of nutrients, by sampling the individual inflows, some information may be gained as to the source of the nutrients.

Monitoring the aquatic flora and fauna may give an indication on whether the ecosystem is actually changing or whether it remains stable.

If it would be at all possible to source of this potential pollution, then actions could be taken to remedy the problem (preventing runoff from entering sinkholes for example). But until such sources are actually identified, there is little hope of actually remedy the situation.

Literature

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