

**Common Cleaning Agents and Their
Effect Upon
The Sibun River**

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Table of Contents

<u>Introduction</u>	<u>3</u>
<u>Materials & Methods</u>	<u>4</u>
<u>Chemicals</u>	<u>4</u>
<u>Other cleaning agents used</u>	<u>5</u>
<u>Organisms</u>	<u>7</u>
<u>Supplies and Techniques</u>	<u>8</u>
<u>Results</u>	<u>9</u>
<u>Table 1. Research project Results</u>	<u>11</u>
<u>Conclusion</u>	<u>12</u>
<u>Photographs</u>	<u>13 -14</u>
<u>Sources</u>	<u>15 -16</u>

Introduction

The Sibun, one of Belize's major river systems, provides local residents with many resources they are dependent upon to live. From the essential crops of the flood plains to the drinking water of the river, the Sibun supplies plants, animals, and humans surrounding it with a majority of their needs. With the dependencies of this immense amount of life in mind, cleaning agents that seep into the Sibun bring up the question of safety. Is the ecosystem safe from the dramatic effects that local cleaning agents could bring? Can lowered levels of these cleaning agents bring less harm to their network?

With the smallest creatures having such an immense effect upon the larger ones in our complex ecosystem, studies of bio indicators like damselflies, mayflies and hellgrammites will help to produce results all can benefit from. This research project will reflect the effects of common cleaning agents, such as bleach, upon their environment. Will lowering the levels of certain cleaning agents in the area have a decreased affect upon certain bio indicators in the stream and in turn the surrounding environment? Is the current cleaning agent in use causing harm to the stream and the environment now?

Materials & Methods

Chemicals

Bleach

Sodium Hypochlorite or Sodium Chlorate is commonly known as household bleach. According to the local villagers, it is used by farmers as a pesticide along the flood plains of the Sibun River and also as a cleaning agent by locals along the Sibun. The chemical composition of bleach is referred to as NaClO. NaClO's elemental composition consists of one atom each of Sodium, Chlorine, and Oxygen. By itself, or combined, Sodium Hypochlorite can prove deadly to almost anything it comes in contact with.

At the Cave's Branch Estate of 58,000 acres, in Belize, the guides and staff utilize bleach for a variety of uses. First and for most, bleach is readily used to clean the floors, walls, and any surfaces needing disinfected after their families or the tourists, students, and professors use their facilities. Locals and the staff are seen regularly at the edges of streams that lead to the Sibun River laundering their clothes and belongings with their own household bleach solution they have concocted for their community.

Keeping the resort sanitary is one of the Cave's Branch Resort's major concerns. Dishes, restrooms, bedding, towels, and even the kitchen used to prepare all the meals all require the assistance of bleach to keep sanitary. Every day, while

out experiencing more exciting attractions of Belize, the Cave's Branch staff is busy cleaning up from the day before, everything that the visitors have disturbed. Dishes, laundry, every surface, and every piece of soiled linen is dutifully being cleaned for their next use, which is soon to come. When asked what they used to clean, "mostly bleach", was the sweet reply of the housekeeping staff. All of the bleach washes down through the drains, and onto the grounds on each furious sanitation routine. What isn't caught by the existing septic systems, makes its way through the ground, and ground water, eventually seeping back into the river. This entire process raises concern to all that it destroys along the way, as well.

Bleach can also seep into the Sibun River from the many acres of crops lining it, or from locals cleansing their houses and belongings. Bleach is also commonly used to disinfect water in order to make it safe to drink. It allows for the deactivation of pathogens in the water in turn detoxifying it. Doing the same to the bio indicators in the stream can break down the life cycles of all organisms and creatures dependent upon it and surrounding it. The entire ecosystem dependent upon these bio indicators is doomed to destruction if anything attempts to break this precious cycle.

(Other cleansing agents used)

Local farmers and villagers use a variety of cleansers in their daily lives besides household bleach. Fabuloso, Disicin, and Flash detergent are also the most

commonly used. Upon the grounds is a very nice building set up to hold all the cleansers being used around it. In full stock were several crates of bleach at 3.7%. This is the same concentration as our own household bleach we pick up at our local grocery store. (M.S.D.S. Ch. Bleach, 1.)

Fabuloso is also available at our local supermarkets. In comparison, both do not hold the same ingredients. Fabuloso common to North America consists of concentrations of the active ingredients, Propylene Glycol Propyl Ether and Sodium Dodecyl Benzene Sulfonate . (M.S.D.S. Co. Fabuloso, 1.) The Fabuloso of Belize stated that Glutaraldehyde .05% was the active ingredient. Per Dr. Linda Young, professor in Microbiology, Glutaraldehyde is commonly used in North America throughout hospitals and medical clinics to limit the growth and destroy Salmonella, Pseudomonas aeruginosa and Staphylococcus aureus.

Disicin, despite its common availability throughout Belize, does not seem to exist in North America. The label there stated the only active ingredient in Disicin is Dimethyl Benzyl Ammonium Chloride 2%. This chemical compound is commonly found within such well known cleansers throughout North America like Lysol and Clorox. (M.S.D.S. Rbn. Lysol, 1).

Flash is also unable to be found throughout North America except for local import from outlining countries. Flash's active ingredient is stated to be "<5% Nonionic surfactants", per the material safety data sheet. Despite every staff

member's insistence that it was a common cleanser, no bottle could be found. Maybe in future visits it can be located to determine the accuracy of exact ingredients.

Despite the variety of cleansers, Bleach was chosen to use in the experiment. Throughout the trip to Belize, it was shown to be used much more often, just as the locals stated. In future experiments, different cleansers should be tested for their effect upon the environment and bio indicators common to the Sibun. This could help to ensure the safety of the local environment even further.

Organisms

Bio indicators are organisms on earth that represent the status of the local environmental health. Local organisms commonly found in the Sibun River will be used for our research on this water quality project. Lack of a bio indicator commonly found in that area indicates that the health of the surrounding environment is poor. Measuring the effect of local cleaning agents against the bio indicators found will assist us in deciding what the next step should be in managing the cleaning agents use by locals and farmers.

Damselflies (*Agriocnemis femina femina*), hellgrammites (*Corydalis cornuta*), and freshwater fish (*Gambusia yucatana*) are commonly found in the Sibun River system and used as bio indicators of such. We will be using different

percentages of common cleaning agents against these types of bio indicators to determine if changes need to be made in order to sustain the local environment.

Many different specimens of freshwater fish, damselfly larva and hellgrammites were found in the streams and river. We will be researching the effects of common household bleach against these specimens.

Supplies and Techniques

In our research with the three healthy specimens each of Freshwater Fish, Damselfly Larva, and Hellgrammites, each set of three were labeled, (A), (B), and (C) respectively. We used (9) petri dishes, one for each specimen, (2) pipettes, and (6) various beakers. Each organism was observed under 5% concentration of bleach, a 10% solution of bleach, and a 20% solution of bleach for the effects upon each. Due to the lack of lively organisms, and time to perform a second experiment, this test was only performed once. In future visits, secondary tests would be very beneficial to ensure accuracy.

We also used test kits to determine the concentration of bleach already present in the river as a basis of our research. All of this research was done on the Sibun River in the Cayo District of Belize.

The climate surrounding the location of the specimens was sunny and clear. The water was mildly turbulent, flowing approximately five to ten miles per hour. The temperature reached 86 degrees with humidity of 90%. The water samples

were collected from the Sibun River from numerous students using hands, tweezers, nets, and other various techniques to obtain the specimens.

One method used was referred to as the “kick net” technique. A net, approximately three feet by five feet, had two poles attached to the shorter sides. Students held each pole, with net outstretched, and placed it in the water, down to the river bottom. Other students would position themselves thirty to forty feet upstream, and kick up the gravel to dislodge possible specimens. Specimens caught in the net were carefully placed in cups, test tubes and other available containers.

Other students used tweezers and their hands to pick specimens off rocks, trees and the river bottom. Along with their abrupt relocation, all specimens were a bit shaken from the bumpy ride and rush to get out of the rain. In future visits, adding some safety and stabilization equipment to prevent shock and fatalities may be quite beneficial.

Results

The water test results brought forth a level of 3.5 ppm of chlorine for unmodified river water. Three solutions were made for this experiment. A 5% solution of bleach was made with 9.5 ml of river water added to .5 ml of chlorine bleach. A 10% solution was made with 9 ml of river water with 1 ml of chlorine

bleach. Finally a 20% solution was made with 8 ml of river water with 2 ml of chlorine bleach.

Freshwater fish had the highest sensitivity to all concentrations. Fish A, in 5% solution, died after 8 minutes. Fish B, in 10% solution, died after eight minutes. Fish C, in 20% solution, died after six minutes. Freshwater Fish proved to be the most sensitive, by the following results.

Damselfly larva showed to have a much stronger tolerance to the same solutions. Larva A, in a 5% solution, was alive and released back into the Sibun after 1.5 hours when test was concluded. Larva B, in a 10% solution, died after thirty six minutes. Larva C, in a 20% solution, died after twenty nine minutes. Despite losing Larva B and C, Larva A proved that damselflies have already adapted to the increasing levels of chlorine in the Sibun River. 5% is a very high level regardless of being the least we tested.

Hellgrammites proved to still be “indestructible” as the locals described. Hellgrammite A, B, and C all survived 5, 10, and 20% solutions for 1.5 hours. Specimen A walked out of the solution (and was immediately returned), after eight minutes of sitting in it. Specimen B ran away for ten seconds and was also returned. Despite the escapes, and added ten seconds for specimen B’s escape, they all survived and seemed unscathed. Gills were still working perfectly in

stream water after experiment. Future research could help to see just how indestructible these fascinating creatures are and why.

Table 1. Research Project Results

	5 % Bleach Solution <u>A</u>	10% Bleach Solution <u>B</u>	20% Bleach Solution <u>C</u>
Gambusia yucata	(15:34-15:42) Fatal after 8 minutes	(15:45-15:53) Fatal after 8 minutes	(15:53-15:59) Fatal after 6 minutes
Agriocnemis femina femina	(16:02- ∞) Released after 1.5 hrs	(16:05-16:41) Fatal after 36 minutes	(16:05-16:34) Fatal after 29 minutes
Corydalis cornuta	(16:02-∞) Released after 1.5 hours	(16:03-∞) Released after 1.5 hours	(16:04-∞) Released after 1.5 hours

Conclusion

In result of our research upon the quality of water in regards to local use of common cleaning agents, we can conclude that more research still needs to be done to ensure accuracy. The water testing results for chlorine already shows a definite threat. 3.5 ppm calculates to be very close to ~ 4.005 ppm (4mg/l), the top of the E.P.A.'s legal safety limit for drinking water. (Water, 1). Many of the locals were seen drinking the stream and river water, amongst many other daily living routines they involve the water in and think it is safe.

Amongst other dreadful effects upon the bio indicators in the river, chlorine can cause eye/nose irritation and stomach discomfort in humans. If this legal limit is reached, the effects could be devastating. If the water were to reach limits that killed all the freshwater fish, for example, the entire food chain reliant upon them to live, would die off, or have to relocate, causing even more dreadful reactions. Something needs to be done, to ensure that these dangerous chemical levels do not rise within the water systems in this area. More research needs to be done to determine if the levels are increasing and if an intervention may be needed to ensure the safety of the surrounding environment.



Bio indicators collected from Sibun River, and used for experiment: (Top: freshwater fish, bottom left, damsel fly larva, bottom right Hellgrammite).



Common Cleansers of Belize

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