

## POST SABBATICAL LEAVE REPORT

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My sabbatical, which involved international travel, was interrupted by the Covid pandemic. Dr. Washington very graciously allowed for several postponements of my start date due to the difficulties of international travel due to the pandemic, a hurricane, as well as my hip surgery.

In addition to that difficulty there were several events that I had planned that could not be completed due to the collapse of a telescope, earthquakes, Covid and the aftereffects of a hurricane (more on those things later). As a result of the cancellation of these activities Dr. Washington allowed me to substitute some comparable activities.

Original statement of purpose:

I have been very fortunate to have been able to participate in several different field experiences when I was a student. One of those experiences was a field biology course in Puerto Rico. We spent 3 weeks travelling across the island studying several different tropical ecosystems. I was then able to assist as an instructor for this course 3 more times as a graduate student (these trips were during the late '80s and early '90s). These experiences provided me with many examples over the years for my classes as well as a passion for fieldwork and tropical biology. Hurricanes have been an important factor in the development of tropical ecosystems in the Caribbean. In 2017 Hurricane Maria hit Puerto Rico and caused extensive damage.

The explanation that unites all of biology, and my favorite subject, is evolutionary theory. In the last few decades several foundational studies have been performed that test and support this explanation for the diversity of life. I would like to visit several of these sites and observe the organisms that were the subjects of these studies for myself.

Marine environments cover approximately 70% of the earth's surface which makes this environment very important for maintaining earth's ecosystems. Coral reefs have the most biodiversity of any marine ecosystem but are threatened by human activities. The Caribbean still has some quality reefs and I would like to visit one I have been to previously and 2 that I have not visited.

### **SABBATICAL DESCRIPTION**

#### **VIEQUES, PUERTO RICO**

Firefly flashes are a memorable part of childhood for many of us. The phenomenon of bioluminescence is not limited to fireflies though – many creatures have this ability, including certain species of algae. There are several places where dinoflagellates bloom in sufficient numbers that they create an incredible light show on moonless nights and two of those are in Puerto Rico. I visited the one on the main island as a student and so this time I chose to visit one on the nearby island of Vieques. The bay where these single-celled dinoflagellates bloom is Mosquito Bay on the south coast of Vieques. When the water is agitated by your paddle, your boat or your hand, the algae emit a flash of light. Collectively, it looks like a firework in the water. It might seem that this activity would be counterproductive to the algae – that flashing like this would make them visible to any creature that might wish to eat them. But banging your paddle on the side of the boat gives a clue as to why such a response might have evolved. When fish move through the water, their movement leaves a trail of light. It is thought that when small fish who eat algae dart through the water, their sudden movement causes these algae to flash around them and the predatory fish are able to spot them. I had hoped to photograph this phenomenon but my equipment was unable to pick it up.

I have seen many species of dinoflagellates under a microscope but I have never seen a bioluminescent species. Dragging a microscope to Puerto Rico is not practical so I ordered a Foldscope to see if I could view them that way. A Foldscope (foldscope.com) is a collapsible microscope that sells for a few dollars and is designed to be used in the field and in the Least Developed Countries (LDC's). My intention with the Foldscope was twofold: 1) does this work as a field microscope and 2) can I find any dinoflagellates and photograph them. I brought along a plankton net which I towed alongside our kayak while in Mosquito Bay. After 30 minutes of towing this through the water I poured the contents into a collection vial. Back at my room I prepared slides for use in the Foldscope to see whether I could find any of the dinoflagellates. The answer to question 1 became apparent rather quickly. The Foldscope does not make a very practical field microscope for wet mounts. It turned out to be difficult to prepare and view wet mounts even while seated at a table with good lighting - and this was for someone who has experience preparing, viewing and identifying slide material with the patience to spend time doing it. I cannot imagine how difficult it would be for a student with little to no experience and little patience to successfully prepare a slide. The answer to question 2 came during the third hour of working with the material. I was able to find a very few cells and photograph one of them. A modest success. I am going to try to modify the foldscope to be more useful for wet mounts.

I then visited a forested area of Vieques to live catch and examine small lizards called Puerto Rican Crested Anoles (*Anolis cristatellus*). These lizards have become a focal point of a controversy within evolutionary theory – the question of whether evolution can repeat itself. Stephen Jay Gould suggested in his book *Wonderful Life* (1989) that, if we replayed the history of life, the way it has played out would not be repeated. He believed that evolution was contingent on too many events to be repeatable. Jonathon Losos in his book *Improbable Destinies* (2017) suggested that not only can evolution repeat itself but it is likely to repeat itself. He cites many examples of this and one of them is Anoles that live on 4 Caribbean islands (Jamaica, Hispaniola, Cuba and Puerto Rico). Anoles have colonized each of these islands separately but have evolved into the same three niches on each island. Evolution has repeated itself 4 times in this case. And what is even more remarkable is that he (and others) has been able to observe them evolving even today. In the countryside this lizard climbs on small branches and tree trunks but in the city glass, metal and painted surfaces are more common. As a result, researchers have been able to measure a number of differences between the urban and rural lizards. One easy-to-see visual difference is the number of lamellae (rows of fine hairs) on their toes. I hoped to see whether I could observe this difference. So, I captured 3 Anoles (my goal was not to repeat the work by Losos, but just to see if I could discern the difference) from a rural site and then 3 Anoles in the city (in San Juan). The method of capturing these anoles is itself, quite interesting. Catching them by hand is not possible – they are too quick. And even if you managed to catch one this way you would likely injure it. But, it turns out, they have no fear of a small dental floss noose. With that in mind I armed myself with a short stick that had a piece of dental floss tied to it with a small noose at the end, just slightly larger than the head of an Anole. This noose is then maneuvered into position and slowly slipped over the head of an Anole. With a little practice this became much easier and I was able to capture and photograph several Anoles with this technique. I then photographed the feet of each Anole and released them unharmed back to their home. After analysis of the photographs I was able to see a slight difference in the number of lamellae on the toes of these lizards. While my sample size was small I was able to confirm the observations of Dr. Losos.

I also visited a small reef off the coast of Vieques. This reef was a short swim from the shore and so was heavily visited. Unfortunately, this often means that the reef will be severely impacted by human activity. And this one was. Very little remained of the coral and so the typical diversity of a Caribbean reef was not present there. The damage is not necessarily due to a person simply swimming along the reef. The damage is done when someone who decides that they need to touch the coral, or take a piece home, or grab a sea fan (a type of soft coral), or kick it with their fin. Monitored visits with reputable providers are more likely to have educated visitors who will not damage the reef.

## SAN JUAN, PUERTO RICO

I then visited the rainforest in Puerto Rico, El Yunque. I was last there in 1994. I was interested to see how the hurricane may have affected the forest. I needn't have worried. The forest rebounded beautifully. It was the human component that was adversely affected. Several trails were closed, including one that I had wanted to visit again. Several roads had also been washed out. These areas were still down to one lane 7 years after Hurricane Maria. It makes me wonder what this would have looked like had I been able to take my sabbatical 3 years ago in 2021.

San Juan was the urban site I chose to capture a few more Anoles. I found a small spot near my hotel that had a small population of Anoles. I prepared my 'Anoling Pole' and set about capturing several Anoles. There were many passersby who wondered just what this man was doing in the small bushes next to the sidewalk (they gave me a wide berth). I was able to visit Miami in December 2021 briefly (before the sabbatical was officially carried out but after my planning was completed) and was unable to find Puerto Rican Crested Anoles.

There was also an excursion to Old San Juan. This is the oldest European settlement on the island (established in 1521). The major attraction here is the fort, Castillo San Felipe del Morro (El Morro). The fort was built by the Spanish beginning in 1539 to protect the Bay of Puerto Rico. It helped fend off many potential invaders over the centuries. It is a magnificent structure.

The community of Old San Juan is characterized by narrow, brick-lined streets and a seemingly endless stream of shops and restaurants. Attempts in the past to 'modernize' this district have been met with local resistance and so the old architecture has been maintained.

I also visited one of the reefs that I had spent time on 30 years ago. Like the reef in Vieques, this reef is easily accessible from shore and so is heavily visited. I had visited this area 4 times in the past, with 8 years between the first and last visits. I noticed a significant change back then during those few years and the reef has not bounced back since then. Having visited a number of reefs in various parts of the Caribbean during the last 35 years I have found that the farther a reef is from land, the better it seems to be. This speaks to how sensitive the coral reef biome tends to be.

I had intended to visit the Arecibo radiotelescope located near the town of Arecibo, Puerto Rico in the Arecibo district. This telescope has been used in some pioneering astronomical studies, including the Search for Extraterrestrial Intelligence (SETI). This is an effort to detect radio signals that might emanate from intelligent beings on planets in our galaxy. Unfortunately, this telescope collapsed 1 December 2020.

## PARADISE ISLAND, NEW PROVIDENCE, BAHAMAS

It was then time to go to New Providence, Bahamas. Several adventures were planned for this island. One of which was to observe invasive Lionfish which have been introduced to the Caribbean. Unfortunately, I was unable to locate any during our snorkeling trips. This is one of the vagaries of studying animals in their natural environment. You can't always be sure if or when you will be able to observe them. So, some supplemental field work was planned.

While I was unable to swim with Lionfish I was able to swim with Caribbean Reef Sharks. This was an unexpected stop to an otherwise typical snorkeling venture.

The reefs I visited in the Bahamas were the highest quality reef I visited during this trip. These reefs were offshore and so visitation is regulated to some degree. I do not believe they were as diverse as my visits to reefs 30 years ago – an observation made by many biologists. This decline has been occurring for several decades, and is due to many factors including warming waters, changes in ocean acidity, overfishing, and visitation by an increasing number of tourists.

The island of New Providence is small, about 1/7 the size of Kalamazoo County. Over the centuries much of the island's nature has been damaged. There is one forest, Primeval National Park, that may represent the closest thing that remains of the original, native forest of the island. But it is small – a mere 7.5 acres. It has never been developed most likely due to its geology. This is a karst region with many deep holes. It would be very difficult to farm or build on this land. And so, it is preserved as a national park. It is so small, so out of the way, that the staff at our hotel and our taxi driver had never heard of it. Small as it was, it was a fascinating landscape to explore.

Bonefish Pond is another national park, this one larger (1235 acres) and better known. This is a coastal national park that protects an estuary, an important breeding ground for fish. As the tide rolls in nutrients are brought into the roots of the surrounding mangroves, and as the tide goes out the waste materials are washed out to sea. The shallow water allows the penetration of sunlight right to the bottom sediments. For these reasons the estuary is a highly productive biome.

Bonefish Pond is also a possible location to find the rare Kirtland's Warbler. I played the song of the Kirtland's Warbler while there but not such siting occurred. This was a very difficult task – and perhaps a bit of wishful thinking. I did see another species of Warbler that lives in Michigan, a Yellow Warbler.

I stayed at the Atlantis Resort on Paradise Island in the Bahamas which has a breeding program for Green Sea Turtles. As a result, the water surrounding this island has a plentiful supply of Green Sea Turtles. I was able to snorkel with these wonderful creatures every day for just over one week.

## DAYTON, TENNESSEE

What began as an effort to provide publicity for a small southeastern Tennessee town, turned into the 'Trial of the Century.' In 1925 the Tennessee state legislature passed a law which banned teaching that humans had evolved from a simpler form of life. An employee of a local mining operation that was shutting down its mine read about the law and suggested to some other local businessmen that a teacher should be found who has taught evolution and a challenge to the law could then be posed. It was thought that this court case would bring reporters and tourists from all over the country and this would fill the local hotel rooms. As the country heard about this town, they believed, tourists would come to enjoy the beautiful countryside. That vision did not work out as planned – what did happen was one of the greatest courtroom confrontations of all time between two of our nations' most famous attorneys. John Scopes was the teacher chosen to serve as the test case for this new statute.

Evolution is one of the few scientific theories whose teaching is challenged regularly across the United States. There was even a local case (Gull Lake) several years ago brought by two teachers who proposed teaching intelligent design in their classroom. The Scopes Trial was among the first legal challenges to this theory. I have faced resistance to teaching evolution in my classes a number of times over my teaching career and so have been very interested in how challenges to teaching evolution have changed through history.

While in the Dayton, TN area I visited historic sites along the Trail of Tears as well as Bryan College, named for William Jennings Bryan, a key prosecuting attorney in the Scopes Trial.

## PADUCAH, KENTUCKY

As I left Tennessee I stopped in Paducah, KY to visit the grave site of John T. Scopes. His gravestone reads 'A man of courage.' This is certainly true. Agreeing to become the defendant in the infamous 'Monkey Trial' was certainly a brave thing to do (even if he didn't quite realize what he was getting into).

## WEST FRANKFORT, ILLINOIS

On the way home from Tennessee I also stopped in West Frankfort, IL to view the total solar eclipse.

## TUCSON, ARIZONA

After a short stop back home, I was on the road again. This time to Tucson, Arizona, a segment that was added to replace some of the adventures I was unable to do in Puerto Rico. One goal of my trip was to visit Saguaro National Park. This park is split into two separate pieces of land – a rather unusual arrangement. I chose to visit the less-visited, eastern portion of the park. The Saguaro cacti are the main draw of the park and dot the landscape everywhere. But there were a number of other plants that were blooming all around. Even though it was late March it was quite hot during the day but very cool at night. Typical desert conditions.

Another added stop was Biosphere 2. This remarkable structure was built as a self-contained ecosystem, completely sealed off from the outside world. Eight people were sealed into this 3.5-acre structure for 2 years with no resources in or out. It was an incredible achievement. To begin the semester in the Biology 100 class we discuss the possibility of life on another planet as well as the possibility of traveling to a planet outside our solar system. This would require a journey of hundreds or perhaps thousands of years. One of the difficulties of long-term space travel will be how to provide food and oxygen to the astronauts. A major goal of the Biosphere 2 project was to study nutrient cycling in ecosystems to determine the feasibility of using a miniature version of earth's ecosystems to support humans in space (either on another planet or while traveling to another planet).

I was also able to visit with an old colleague from KVCC while in Tucson – Bill Lay, former instructor, Dean, Vice President and Director of the Honors Program.

## RESULTING MATERIALS

I generated significant content for my classes – some of which has already been integrated into my classes during Fall 2024 (the bioluminescent dinoflagellates and Anole evolution) with more to be added in coming semesters. Two single-lecture topics will be on the challenges of teaching evolution in public schools (The Scopes Trial history) and the fundamental biomes of Puerto Rico (rainforest, dry forest and coral reefs). A lecture on Biosphere 2 will also be prepared.

## APPENDIX A

I prepared for this sabbatical by reading a number of books before, during and after my travels.

The main theme of this sabbatical, evolution, and the main goal, anole evolution, were sparked by a book I read several years ago, *Improbable Destinies* by Jonathon Losos. This book is an account of instances that suggest that the evolution of some features of organisms can be repeated.

**For the Puerto Rico portion of the trip** I reviewed materials I had from when I traveled there as a student. Some of these were materials prepared specifically for the regions we visited, others were field guides for specific organisms.

*Forester's Field Guide to the Trees and Shrubs of Puerto Rico* by P. Mark S. Ashton.

*A Guide to the Birds of Puerto Rico and the Virgin Islands* by Herbert Raffaele.

**For the Bahamas trip I had one main natural history guidebook.**

*A Natural History of the Bahamas* by Currie, Wunderle, Freid, Ewert, and Lodge., prepared me for the organisms and geology that I would encounter in the Bahamas.

**For the visit to the Scopes Trial Museum I read the following:**

*A Religious Orgy In Tennessee* by H. L. Mencken. This book is a collection of contemporaneous essays written by Mencken. It is a scathing, satirical account.

*The Scopes Trial: A Brief History With Documents* by Jeffrey P. Moran.

*Trial and Error* by Edward Larson. This is considered one of the two most authoritative accounts of the trial.

*Center Of The Storm* by John T. Scopes. This is an account of the trial and his life by the person caught up in the middle of this saga, written decades after the trial.

*Summer For The Gods* by Edward Larson. Another excellent account of the trial.

*The Scopes "Monkey Trial"* by Randy Moore. One more account of the trial.

*A Field Guide to the Scopes Trial* by Randy Moore. This is a guidebook for the tourist sites in town that relate to the trial.

*40 Days and 40 Nights* by Matthew Chapman. This book chronicles Matthew Chapman's visit do Dover, PA for the Intelligent Design court trial in 2005. While this is not a part of the Scopes Trial, it is a continuation of the legal maneuvering to prevent teaching evolution in science classes (Matthew Chapman is the great, great grandson of Charles Darwin).

*Of Pandas and People* by Percival Davis and Dean Kenyon was written as a supplemental high school textbook to present the Intelligent Design idea. While I have read about the book for many years I had never read it. Now I have. It is disappointing that this book would be considered by anyone to be appropriate as educational material for teaching evolution.

I also viewed the movie *Inherit The Wind*. I am a bit chagrined to admit that I had never watched this movie in its entirety. This classic movie purports to tell the story of the Scopes Trial. Alas, it does not. The accuracy of the story is minimal. To add drama, many elements were added which created a story substantially different from what actually happened. Many Americans learned about the trial by watching this movie and so generations have learned a skewed version of history.

I am also reading a new book (August, 2024) about the Scopes trial, *Keeping the Faith: God, Democracy and the Trial that Riveted America* by Brenda Wineapple. This book looks at the social condition of the country leading up to the trial.

**For the Arizona trip I reviewed 2 field guides for the southwestern United States.**

*A Sierra Club Naturalist's Guide* by Peggy Larson.

*The Audubon Society Nature Guide: Deserts* by James MacMahon.

The Biosphere 2 visit was added late and so I was unable to read any books ahead of time. But I read the accounts of two of the biospherians after my visit (I do wish I had read these books ahead of the visit – it really would have been very helpful).

*The Human Experiment* by Jane Poynter. This was mostly an account of the difficulties of being in the biosphere for 2 years with the same group of people (8 total). The difficulties of long-term space travel in a small capsule become very apparent in this story.

*Pushing Our Limits* by Mark Nelson. This is largely a scientific account of the research that was performed in the biosphere. It had relatively little to say about the relationships. It was interesting to read these two books back to back with their very different viewpoints on the adventure.

## APPENDIX B

A log of photographs taken, places traveled to and sites seen as well as miles traveled.

### PHOTOGRAPHIC RECORD

I tend to take a lot of pictures when I visit new places. I took over 5500 photos and short videos during this sabbatical using 2 primary cameras with a few additional photos on my phone.

I also scanned 250 slides from past trips to Puerto Rico to convert them to digital photos.

### PLACES VISITED/SITES SEEN

#### **Puerto Rico**

Vieques

Bioluminescent Bay

Foldscope microscope

San Juan

Old San Juan

El Morro

El Yunque

Snorkeling

#### **The Bahamas**

Nassau

Bonefish pond

Primeval Forest national park

Sea turtles

Snorkeling

#### **Tennessee**

Scopes Trial Museum

Bryan College

The Trail of Tears

John T. Scopes gravesite

#### **Illinois**

Total Solar Eclipse

#### **Arizona**

Biosphere 2

Saguaro National Park

Visited old KVCC friends

### MILES TRAVELED = 9100 MILES

Altogether I flew 7800 miles: Kalamazoo to Puerto Rico to the Bahamas back to Kalamazoo. Then Kalamazoo to Tucson and back.

There was a total of 1300 miles of driving from Kalamazoo to Dayton, TN to Nashville, TN to Kalamazoo.