Education and Restoration Suggestions for Toccoa Falls College

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Education and Restoration Suggestions for Toccoa Falls College

I. Purpose

Toccoa Falls College (TFC) is home to a breath-taking waterfall, streams, cove forest, and natural history museum; however, these resources are underutilized by the college itself and the greater community. In Fall 2014 TFC will introduce a new Sustainable Community Development major. In conjunction with this new major, the college’s administration requested our assistance in helping them better utilize the natural resources available on campus. Specific objectives of the administration include higher utilization of Deadman’s Branch Trail, greater use of the Gathany Natural History Museum and environmental education center, development of ecologically-sound stream management practices, and development of environmental education curricula for visiting K-12 students. Additionally, the administration would like to further showcase its namesake waterfall.

Jon Penland, Dean of Christian Ministries at TFC, first contacted us with an initial request for assistance. Following a phone interview with him, the practicum group visited the TFC campus, where we met several faculty members, hiked on trails, visited the Gathany Museum, and saw the lovely Toccoa Falls for ourselves. Based on our visit, we decided to focus on several areas for improvement that would most immediately benefit the college and began researching those topics. We presented our ideas to a number of TFC faculty halfway through the semester via Skype and gathered feedback to further direct our efforts.

In this document we provide (1) suggestions for how to better utilize the Gathany Natural History Museum, with examples from local nature centers and other universities that house on-campus museums as well as sample curricula and lesson plans; (2) suggestions for activities along Deadman’s Branch Trail, including examples of local groups that conduct similar activities and a system of interactive, educational signage; and (3) a restoration trajectory for Toccoa Creek with recommended stream management practices.

II. Gathany Natural History Museum Ideas

Informal Science Centers have been a huge part of the science learning process for most Americans. Falk and Dierking (2010) suggest that up to 95% of the average American’s science knowledge comes from outside of the K-12 classroom. Science Centers play a large role in making science content more impactful than regular classroom activities. The Gathany Center therefore has the potential to be a highly valued educational resource for the Toccoa Falls College, the city of Toccoa, Stephens County, as well as the surrounding communities. We searched the websites of several Georgia nature centers to determine the kinds of educational courses they offer. (Appendix F).

II.A. Local Nature Centers

The Gathany Natural History Museum houses an impressive collection of taxidermied animals, pelts, skulls, and shells, in a lovely building located at the trailhead of Deadman’s Branch Trail. Currently the trail is used by TFC students and faculty for recreation including hiking, running, and occasionally camping. This building could serve as a jumping-off point for activities related to the nearby stream and trail, and it could also be utilized as its own independent educational center. Several local nature centers are provided as examples below; the Blue Ridge Outdoor Education Center (BROEC), Wasega 4-H Center, and Sandy Creek Nature
Center have been chosen as models for comparison, all located in the Piedmont region of Georgia.

The BROEC and Wasega, like TFC, all have property connecting to the Chattahoochee National Forest. This allows these centers the ability to emphasize forest and stream ecology. Sandy Creek Nature Center was included due to proximity to Toccoa and because of the exemplary connections it has with the local educational system. These centers will serve as reference points to compare programming and explore opportunities for TFC to provide informal science education. Perhaps one day in the future, the Gathany Center may share various intellectual and physical resources with these centers to promote environmental education throughout the Northeast Georgia region.

II.A.1. Blue Ridge Outdoor Education Center

Located on 480 acres of forested piedmont approximately 5 miles north of Toccoa Georgia, the BROEC is part of the campus of Camp Mikell, a summer camp and conference center for the Episcopal Diocese of Atlanta. Started in 1993, the BROEC has been offering environmental education opportunities for church and school groups. Operating mainly during the school year, the Camp Mikell property, with its forest, streams, trails, and wetlands, offers a variety of natural settings to explore. The BROEC lists educational programs for visitors with the titles of Appalachian Geography Hike, Nature Center (adaptations, reptiles, amphibians, mammals, birds, water, recycling, paper-making, plants), Team Building/Group Initiatives, Forest Ecology, Aquatic Ecology, Predator-Prey, Land Navigation, Waterfall Hike, Humans and the Forest, and Trek (Blue Ridge Outdoor Education Center [BROEC], 2014a).

II.A.2. Wahsega 4-H Center

About thirty minutes northwest of Dahlonega, Georgia, straddling Ward Creek, is Wahsega 4-H Center. The property that became Wahsega first hosted Georgia 4-H activities in 1943. In the summer of 1946, the site started hosting summer camp. Environmental education courses were first taught in 1988. Today classes offered during the school year include Archery, Astronomy, Challenge Course, Entomology, Forest Ecology, Geology & Soils, Herpetology, High-ropes, Orienteering, Pioneer Life, Stream Ecology, Survival, Wildlife, Discovery Hike, Gold Panning, and Wilderness Art (The College of Agricultural and Environmental Sciences and the College of Family and Consumer Sciences cooperating [CAES & FACS], 2014).

II.A.3. Sandy Creek Nature Center

Sandy Creek Nature Center is located on 225 acres just outside the perimeter of Athens, Georgia, and is situated at the head of the 8-mile greenway that runs into the city (Athens-Clarke County [ACC], 2014a). It contains an education center, several trails marked by educational signage, ponds, and a reconstructed log cabin. The education center has live animals that visitors can interact with, natural history exhibits, aquariums, rainwater harvesters, gardens, an indoor-outdoor bee colony, and insect-inspired metalwork art. The Nature Center hosts Adopt-a-Stream training workshops, summer day camps, naturalist walks, and animal encounters as part of its programming lineup.

Several of its program offerings include Science Rocks, Nature Watch, Star Light Star Bright, Staying Alive, Wacky Weather, From the Mountains to the Sea, Geology Rocks, Mighty Micros, Forces of Nature, Animal Kingdom, and Pond Study.
II.B. Suggestions for Curriculum

For the Gathany Museum to find a successful niche as an educational center for local school groups, the center will need to develop and promote unique programs not currently offered at learning centers in close proximity. Evans, Koul, and Rennie (2007) reviewed a joint project between elementary students and a local environmental center. They described student motivation as associated with real life experiences. These students were able to work on a project that produced a real difference in the community and were then motivated to create as big an impact as possible. This same authentic experience is available for students who come to visit the iconic falls and learn about the health of the creeks which flow through the area. After reviewing the programs offered by these centers and comparing them to science education standards there are several content areas not currently covered in local nature center programming.

Currently most schools use the Georgia Performance Standards or GPS (GPS, 2006) as guidelines for instruction. To help visiting educators and administrators see the value of content being taught at the Gathany Center all activities offered should explicitly (wherever activities are described) state what GPS standards are aligned with each activity. Without GPS standards described for each learning experience offered, teachers will unlikely be able receive approval from administrators to attend the Gathany Center. The education and outdoor leadership departments can collaborate on producing quality lessons that integrate GPS. “Our students are capable of making the lessons and GPS standards, etc. We can make it appropriate for time of year... Teacher Ed. can add the developmental aspect.” (D. Gardner, Skype meeting March 7,
A good starting point for creating lessons is the Environmental Education in Georgia webpage (Environmental Education in Georgia, 2014).

Recently the Lead States have developed a set of standards that can be used to guide science education at all levels. The Next Generation Science Standards (NGSS Lead States, 2013) have already been adopted by ten states. As more states move toward either adopting these standards or modifying them to include local perspectives, the environmental lessons will be more marketable for teachers if they include standards from the NGSS. Some of the standards most relevant to environmental education have already been identified and organized by grade level and content area (See Appendix D).

The Gathany Center has the opportunity to complement regional environmental education while attracting K-12 groups to new and unique learning experiences. Following are several lesson ideas that incorporate local resources and knowledge from the campus to fulfill state-approved science standards.

II.B.1. The Impact of Invasives

Invasive species are organisms that thrive in an area to the extent that they threaten biodiversity levels. Sometimes invasives have been introduced intentionally, such as kudzu for erosion control, and sometimes unintentionally, as the case of the wooly adelgid. The Gathany Center could teach students about the significance of the adelgid and the damage caused by this species on the hemlock population. Students can inspect hemlock trees along the trail looking for adelgids (See Section III.A. Hemlock Grove below). They can use one of the mobile applications created by the Bugwood network (The Bugwood Network, 2014) to capture an image and location of the pest. The class can then follow up by discussing treatment for the hemlock trees and learn about some of the other mobile apps which can help track invasive species.

Invasive plants can also be a problem for forest ecosystems. Georgia’s experience with kudzu is not likely to end anytime soon. Chinese Privet (Ligustrum sinense) is another undesirable invasive species which commonly establishes understory populations in forests, particularly along streambanks. This foreign evergreen shrub can grow up to 30 meters tall and reproduces sexually through berries, which are toxic to many species, and asexually using vegetative runners that run laterally near the soil’s surface. Privet crowds out native plant species by forming dense monoculture thickets. The flowers of privet are not frequented by native pollinators, so encroachment by privet groves leads to declines in local pollinator populations. The most effective treatment for privet is mechanical removal.

Privet has been located along the Beaver Dam Trail. Exposing students to privet and other invasive plants can make them aware of how those species can impact local ecosystems. Students can work to report privet (UGA-CISEH, 2013) examine data of other locations privet has been found (UGA-CISEH, 2014) as well as join up with local organizations to assist in “privet pulls” (Georgia Council of Trout Unlimited [GATU], 2012; Georgia River Network, 2014). Students can also explore different options used to control invasives with the Running Out of Room Between the Hedges assignment (see Appendix G).

II.B.2. Watershed Management

While several nature centers have a course on stream ecology, these courses often deal with the characteristics and health of a single stream. The greater concept of a watershed
consisting of many streams is less familiar to students because they cannot see explicit examples. The Toccoa Falls Campus has the opportunity to display not only the confluence of Beaver Dam Creek and Toccoa Creek, but also the impact of various land uses along the creeks. Exploring two different streams can show visitors the different characteristics of each and help them make connections between those differences and the surrounding land uses.

To increase the impact of this project, the Gathany Center can teach local school teachers how to use the equipment necessary for stream evaluation and then allow the teacher to borrow a loaner set of equipment. This is similar to a practice at the Sandy Creek Nature Center where Adopt-A-Stream equipment is loaned to teachers (ACC, 2014b). Teachers can gather their own data from a waterway close to their school’s property. Students in the class can use a variety of online (See Section III.C. Stream Monitoring) and mobile applications (see Appendix F) to record this data in a public domain. If leaders at the Gathany Center encourage visiting teachers to use a particular platform to share their data then the information becomes useful to the entire community.

Visitors can compare data from their school to data at the Toccoa Falls Campus and to other schools. Producing data throughout the Toccoa Creek and upper Savannah River watershed provides an opportunity for the community to compare the health of local waterways and to start localizing the source of some of the impairments to the river and its tributaries. This evaluation can prompt community action and making the entire watershed a healthier place for everyone. The U. S. Environmental Protection Agency (EPA) offers a web-based map (U.S. Environmental Protection Agency [EPA], 2011) and a local environment database (EPA, 2012) against which data can be compared.

II.B.3. Weather and Climate

Weather is part of the program selection at Sandy Creek Nature Center but not at BROEC or Wahsega. Weather can be easily observed and described, and there are many options in selecting a source of weather prediction. The Gathany Center could choose to purchase a local weather station, with prices ranging from $110 - $1,225 (Ambient Weather, 2014) or use the traditional Sager Weathercaster (Sager & Sager, 1969) which still impresses newcomers with the accuracy of predictions.

Reviewing past weather data helps visitors understand how climate has been described in the past as well as to make informed predictions about how climate may change in the future. Visitors can examine recent changes in temperature online (N.O.A.A. National Climatic Data Center. [NCDC], 2014b). However, perhaps more significant is the weather information available from documents of the early settlers of the Toccoa area. The descriptions of Toccoa climate in the past can be compared to current readings, allowing visitors the opportunity to see what changes have occurred since records were initiated.

Students who are interested in weather can learn to become observers and record data that becomes part of future weather forecasts. The National Weather Service uses a program called the Cooperative Observer Network (COOP) to help gather data in places where not many weather stations are located (NCDC, 2014a). This program gives weather enthusiasts the chance to record and submit data to help forecasters better compute models for future weather predictions.

II.B.4. Phenology and Human Impact
The collection of atmospheric data can lead to a Gathany Center focus on phenology, or the study of seasonal changes. Phenology logs have been kept by some of the most influential naturalists in history including Aldo Leopold. Students can collect observations in a nature journal while beginning to understand the significance of collecting this longitudinal data. If visitors would like to keep a phenology log on a mobile device, they can use the application from the USA Phenology Network (2014).

The data gathered from across the years can help visitors see when the seasons have started to shift. As spring and summer slowly begin earlier and earlier each year, pressure is placed on species to keep up with a shifting seasonal calendar. Longitudinal data also shows the warming of seasons (Intergovernmental Panel on Climate Change, 2013). These selective pressures are pushing species to live on different altitudes of mountain slopes. More mobile species are able to keep up with the changes, while species less mobile, such as some trees, are not able to keep up with the rate of environmental change. Visitors can discuss what may happen to local plant species that can not migrate fast enough to keep up with the changing climate.

II.C. Student Involvement with Nature Centers on College Campuses

The value of service learning has been stressed as a useful vehicle not just for providing students with content knowledge but also in fostering ecological citizenship in college students (Kelly & Abel, 2012). Appendix E lists a variety of educational programs and classes at Toccoa Falls College that have perceived connections to the educational programing possible at the Gathany Center. Students will have the opportunity to lead educational activities as well as work with teachers and other visiting leaders to create successful programs. These professional connections will afford students greater opportunities as they move into the workforce.

Tal & Morag (2009) conducted an action research study on an undergraduate environmental education course at a university in Israel. This university has an environmental garden in the middle of campus which is used both as a retreat for faculty and students and also as a place for learning. The authors review a college level course in which they taught students how to develop, enact, and then reflect upon a field trip for visiting elementary or middle school students. The prospective teachers found the research conducted prior to the field trips and the support provided by teaching mentors helpful as they reflected on the implementation of the field experience. The authors found that teachers who demonstrated teaching and then reflected upon that teaching said that they were now more likely to incorporate a greater number of outdoor experiences into the classroom.

II.C.1. Example Centers Attached to Colleges

Several larger universities have some type of educational center on campus with connections to environmental education. The collaboration between an educational center and the host college is much different for smaller colleges. The following examples provide a model specifically for an educational center existing within the bounds of a smaller college campus.

II.C.1.a. The Environmental Center at Pace University

Amongst those reviewed here, the most similar in physical structure, is Pace University’s Environmental Center. Housed on the Pleasantville NY campus of Pace University, the Environmental Center was started in 1971. Located inside an old farm house, the Center is home to animal exhibits, a small museum, classroom space, and a research library. The center uses the
animals as well as local animal pens and trails to create educational programs for visiting students. This Center may provide an example for the Gathany Center in terms of museum and classroom space (PACE University, 2014).

II.C.1.b. Prairie Nature Center

A regional campus of the Ohio State University, OSU at Marion is home to the Prairie Nature Center. Founded in 1976, local farm land was planted to resemble a native Ohio prairie. The Prairie Nature Center offers courses to school children on local plants and animals as well as ecology and land use. The Center offers guided tours of the 8-acre prairie. Visitors can use resources provided by the center to identify local plants before visiting the Center. The Prairie Nature Center offers all courses outside, demonstrating the ability to conduct a variety of environmental education courses with limited indoor space (The Ohio State University at Marion, 2014).

II.C.1.c. Merry Lea Environmental Learning Center

Merry Lea Environmental Learning Center is associated with Goshen College, a private Mennonite liberal arts college in Goshen, Indiana. The 1,150-acre property of Merry Lea was assumed by Goshen College in 1980 with the help of a land donation and assistance from the Nature Conservancy. The property serves as housing and classroom space for undergraduate and graduate courses. Educational programming serves over 5,000 K-12 students each year. Programs are designed to

- Facilitate experiences in the outdoor world, which inspire exploration, foster a sense of wonder, and share joy;
- Share information about ecosystems and natural processes of northeastern Indiana;
- Provoke interest in life-long investigation; and
- Encourage stewardship, a sense of place, and hope (Merry Lea, 2011).

The religious-based principles used to guide the educational programs for college and K-12 students appear to be similar to those that have been expressed at Toccoa Falls College. TFC and the Gathany Center will need to develop a mission which is reflective of the institution’s values while fostering a welcoming atmosphere to all visitors.

II.D. Preparing Gathany Visitors

Research in education centers has shown that field trips greatly benefit from planning by teachers well in advance of the actual trip. However, many classroom educators fail to provide appropriate student instruction before students visit a learning center (Tal, Bamberger, & Morag, 2005; Rebar, 2012).

Below is a teacher checklist adopted from the Blue Ridge Outdoor Education Center. The website gives a suggested timeline and helpful instructions for teachers or other visitor leaders.

- 5 MONTHS BEFORE ARRIVAL
- Reserve your preferred dates up to a year in advance.
- Estimate number of students and chaperones.
• Read the Lead Teacher Letter [This will need to be edited to meet the programing at the Gathany Center].

3 MONTHS BEFORE ARRIVAL
• Plan for collection of student money. Many teachers will require a non-refundable deposit from students well before the trip or have students pay in monthly installments from the beginning of the school year.
• Send in the signed contract and deposit check to confirm reservations [Developing written agreements and designing a payment plan for visitors will be a large part of the Gathany Center development process].
• Recruit chaperones.
• Make transportation arrangements (school bus, charter bus, other).

2 MONTHS BEFORE ARRIVAL
• Choose your classes and set up your schedule with staff [emphasis added]. Send us your completed Class Selection Form [This form will also need to be modified to reflect Gathany Center programing.].
• Make requests for special services such as special dietary needs (including food allergies), medical needs, housing requirements, etc.
• Plan pre-trip lesson plans and activities [emphasis added]. Create student journals if you wish. If you are interested in ideas regarding journal format and content, please contact xxxx.

1 MONTH BEFORE ARRIVAL
• Assign each student to a field group. Field groups should be mixed gender – contact us to find out how many field groups are needed.
• Send letters and forms home to parents and chaperones – insist that the return deadline be at least a week before the scheduled trip.
• Plan to have a check cut for the remainder of the fees.
• Plan to purchase T-shirts, water bottles, bandanas or stickers if desired. It is helpful if you collect the money ahead of time and make a list of names and sizes. This will save time and headaches on the last morning.
• Encourage students and parents to visit our website.
• Plan and host a Chaperone Orientation Meeting (BROEC, 2014b).

Note the emphasis on teachers notifying the nature center of the courses selected and the suggestion that the teacher plan classroom lessons related to the content of the courses expected to be taught at the nature center. Without prior knowledge of content taught during a field experience, students will struggle to scaffold new knowledge onto existing knowledge.

Zoo Atlanta assists teachers by providing learning activities designed to be implemented before and after the visit to the Zoo (Atlanta Fulton County Zoo, 2014). However, these learning activities are not always specific to the activities requested by teachers during a
field trip. Teachers should provide pre-trip instruction aligned with not only the standards of the course but also the content of the learning activities in the field trip (Tal, & Morag, 2013).

To assist teachers, the Gathany Center will need to build a working relationship with each lead teacher who schedules a visit. This relationship should include assistance in developing properly aligned pre and post-trip learning activities. Conversations with the lead teacher should also include the results of these designed learning activities before the visit to the nature center. Gathany environmental educators should also discuss with lead teachers in advance their respective roles during the learning activities at the Gathany Center. Lavie Alon and Tal (2014) found that while teachers preferred to take students on a guided field trip outdoors, both nature center staff and lead teachers from the visiting schools interviewed after the trip expressed a desire to have more of a ‘co-teaching’ environment during the field trip.

The relationship between environmental educator and teacher continues as the Gathany representative should follow up with teachers after the visit (Tal, Lavie Alon, & Morag, 2014). Depending on the post-trip learning experience agreed upon, the Gathany representative may be directly involved with the teacher and class in helping to facilitate the follow-up activity either in person or remotely via technology. This follow-up experience with the teacher and students who have visited the center provides multiple benefits for the Gathany Center. First, the Center can gather immediate feedback from both teacher and students. Second, the representative can evaluate the effectiveness of the learning experience for visitors. Third, the representative continues to foster the ongoing professional relationship with the teacher and classroom promoting future engagement with the Center.

The development of pre- and post-trip lessons will need to be a multi-departmental partnership. A list of TFC schools, programs, majors, and courses related to environmental education has been compiled in Appendix F. A Gathany Center student worker who is well-versed in environmental education will need to coordinate with members of the teacher education program to create lessons that are aligned with standards that teachers need to meet in classroom instruction. Examples of such lessons can be found online through the Environmental Educator Alliance of Georgia (Environmental Education in Georgia, 2014). A Center representative leading a walk to discuss the merits of stewardship theology will benefit by working with a student majoring in biology who can express the importance of biodiversity and ways in which biodiversity can be protected.

III. Suggestions for Trail Use

Deadman’s Branch is a small tributary to Toccoa Creek that flows from the Chattahoochee National Forest onto the TFC campus. A trail follows the course of this stream, sometimes crossing over it, past granite outcroppings, beaver dams, young hemlocks, numerous flora, and an informal camping site. This trail has gone largely underutilized, though it is well-maintained by the Outdoor Leadership students at the college. The following section suggests installations and learning opportunities to increase the appeal and usefulness of the trail for educational outings. Examples are provided of relevant activities and practices from external organizations that might inspire the trail’s future use. Section IV addresses potential educational trail signage related to these suggestions.
III.A. Hemlock Grove

Idea: Use the hemlock grove as a space to learn about invasive species and forest dynamics through hands-on monitoring of currently healthy young hemlocks. The health of these trees will be tracked over time by allowing classes to observe the trees and record their observations for posterity.

Between the trail and the stream is a grove of young hemlock trees. Eastern hemlock forests face an ongoing threat in the southeastern United States from wooly adelgids, small invasive insects from Asia that feed on the sap of the trees and cause them to die. Healthy stands of hemlocks are becoming rare in the Southeast and deserve some attention when they are found. Besides serving as a lesson in invasive species and parasitism, hemlocks provide the opportunity for hands-on, real-time monitoring of a grove by students; an uninfected group of trees can be watched over the years for signs of adelgids, and at the first signs of infestation, the trees can be spot-treated with insecticide if desired by the college. Grade-appropriate lesson plans related to this grove may include invasive species and pathogens and succession, as discussed in section II.C.1. Following are 3 steps recommended to transform the hemlock grove into a learning experience.

- Add seating in the hemlock grove to make an outdoor classroom. The simplest and least expensive options simply employ logs or stones as seats; materials could be gathered from the surrounding forest and put into place by volunteers.

Set up an informational kiosk in the hemlock grove, similar to the one at the trailhead of Deadman’s Branch Trail.

Place the following information in the kiosk (included in Appendix A):
- identification guide to hemlock trees
- identification guide and information about wooly adelgids
- logbook to record results of class monitoring of hemlocks for presence of adelgids

III.B. Stream Crossings

Idea: Provide easier crossing of streams to avoid schoolchildren falling into the stream, and prevent streambank degradation by confining footpath to a specific area.

There are several points where Deadman’s Branch Trail crosses over the creek. Currently there are no built crossing structures, just natural stones and logs. Getting wet or even falling in may prove entertaining for adults, but class trips of younger students may be better served by stream crossings with built structures in place. Students will not have to traipse up and down the streambank looking for a foothold, and streamside vegetation will not be trampled. Several styles of crossings are possible, from the more natural ones to the more engineered ones with handrails. The expected costs of materials range from free, in the case of stones or logs from the surrounding forest; to less than $100, in the case of building simple bridges from scratch; to over $500 for a prefabricated bridge. We recommend using volunteer labor to craft a “2 hour” bridge for under $100 (Handcrafted Garden Bridges, 2013) or to place stones across the stream.
Intentionally placed stones, footbridge

Footbridges without handrails

Bridges with handrails


III.C. Stream Monitoring

Idea: Involve students in monitoring the water quality of streams around the TFC campus to teach them relevant lessons about stream temperature, biota, chemicals, and pollutants. Monitoring points should be in locations with easy access to the streams.

Monitoring water quality parameters in streams is a fun and easy hands-on activity to involve students in science and the outdoors. With several streams and water bodies available for comparison on the TFC campus, students will see for themselves the differences that the surrounding land use can have on water quality. From temperature differences due to tree cover and parking lots to differences in dissolved oxygen content and phosphorus due to runoff, TFC’s campus can provide a wide range of water quality results. Quarterly monitoring of the streams would be ideal so that TFC has an ongoing record of the health of its streams over time, though regular monitoring would likely need to be taken on by current TFC students rather than just visiting K-12 students.

We recommend establishing a few consistent monitoring locations, including points along Deadman’s Branch, Toccoa Creek before its confluence with Deadman’s Branch, Toccoa Creek after the confluence with Deadman’s Branch, and one in the Falls pool itself. These points represent the major stream branches on the TFC campus. The streams are all quite different, with properties such as temperature and dissolved oxygen content affected by the surrounding land use. Additional points should be monitored where there is a known pollution source or where there are any other noteworthy features of a stream.

The following monitoring equipment is recommended for these streams, in quantities as funds permit:

- LaMotte field kits (average cost: $200-$250 each)
- turbidity tubes (average cost: $60 each)
- kick nets (average cost: $10 each)
- seins (average cost: $10 each)
- microscopes for the laboratory in the Gathany Museum building (average cost: $100-$200 each)
- buckets
- pans
- EasyGel Coliscan kits (average cost: $30 for 10 samples)

Georgia Adopt-A-Stream (AAS) is a volunteer-based program that trains citizens across the state to monitor a water body of their choosing and report their findings on a quarterly to monthly basis (Georgia Adopt-A-Stream, 2014). AAS maintains an online database with the results of water monitoring results, with data freely available to all, and conducts frequent trainings for new recruits throughout the year. Volunteers learn about their watersheds and water quality degradation, and they receive hands-on training in macroinvertebrate sampling and the use of field test kits for common water chemistry qualities such as pH, temperature, turbidity, and dissolved oxygen.

We contacted Harold Harbert, a leader of the AAS program through the Georgia Department of Natural Resources (DNR) who has agreed to conduct training workshops at TFC in chemical, biological, and bacterial testing as desired. While TFC’s biology department possesses knowledge and experience in water quality testing among its faculty, such a training workshop would allow TFC to add their findings to the AAS database as well as train students,
who would then be qualified to lead K-12 monitoring efforts on campus in the future. Hands-on stream monitoring is a great way to introduce younger students to watersheds and get them interested in pursuing a future in science.

III.D. Wildflower Hike

Idea: Teach K-12, college students, and teachers about native flora through immersive wildflower hikes led by experts from the Georgia Plant Conservation Association.

Toccoa Falls has a rich natural history, with records dating back to the 1800s of flora and fauna seen in the area. The registrar of Toccoa Falls College, Kelly Vickers, has compiled a list of all of these historical references to flora and fauna, attached in Appendix B. Located alongside the Chattahoochee National Forest in the foothills of the Blue Ridge Mountains, the Toccoa Falls region is home to several rare and endemic plants such as Sweet Pinesap and Pale Yellow Trillium. As a society we tend to be “plant blind,” not taking notice of the flora around us or giving much thought to protecting rare plants. Introducing students to plants at a young age can help develop interest in native plants, though even adults can benefit from learning about the native flora of their region, as they might not have had the opportunity to see some of the rare natives. Thus, a guided walk with an expert or a self-guided walk with informational signage on the trail can be an eye-opening experience.

Sweet Pinesap (*Monotropsis odorata*)  
Pale Yellow Trillium (*Trillium discolor*)
(images from [http://www.gafw.org](http://www.gafw.org))

The State Botanical Garden is based in Athens, Georgia, and its staff have conducted several plant surveys in the Chattahoochee National Forest region, close to TFC (State Botanical Garden of Georgia, 2014a). We contacted Dr. James Affolter, director of research for the Botanical Garden, who agreed to share records from these surveys; his results are forthcoming. A set of native plant guides relevant to the TFC region can be found in Appendix C.

Separate from but working in close alliance with the Botanical Garden is the Georgia DNR Wildlife Resources Division, which maintains a Plant Conservation Alliance (GPCA) whose mission is to locate and preserve rare and endangered flora (State Botanical Garden of Georgia, 2014b). We contacted GPCA leader Dr. Mincy Moffett of the DNR Wildlife Resources Division. Dr. Moffett has agreed to visit the Toccoa Falls College campus and potentially lead an
educational plant hike and survey for a small group of interested TFC faculty and students. Based on our communications with TFC, this native plant knowledge would be a very welcome addition to the campus knowledgebase. In addition to firsthand identification experience, the plants identified in the survey could be incorporated into future educational signage or relevant apps along the educational trail at Deadman’s Branch. This hike is still in the process of being scheduled.

III.E. Mushroom Foray

Idea: Teach college students and faculty about native fungi through an immersive mushroom hunting foray led by experts.

Fungi are a mysterious and often little-understood taxa, often with mycorrhizal relationships with plants. As such, their presence can give important information about a forest’s health, so it is good to understand and be able to identify local mushrooms.

We contacted the Georgia Mushroom Club about the possibility of leading an educational foray in TFC’s forest (Georgia Mushroom Club, 2014). Secretary Winter Zeiler responded that they were eager to visit, as they are in the search for new locations. However, the Mushroom Club’s knowledge works on a collective basis; it is never a guarantee who will attend a foray or what level of expertise they may possess, and thus they generally conduct forays with 1 or 2 dozen attendees. This number does not take into account members of the TFC community who might attend, and with these numbers the foray would potentially reach an unwieldy 40 people. Such a large expedition might not work for the TFC administration, and as smaller numbers of Mushroom Club attendees might not actually lead to an increase of TFC’s knowledgebase, such a foray might not meet both group’s needs.

III.F. Incorporating Mountain Biking

TFC has an active Outdoor Leadership program, with students maintaining the Deadman’s Branch Trail. Some students have mountain biked on the trail, and the TFC administration expressed an interest in further promoting mountain biking to increase the trail’s use. However, mountain biking generally leads to erosion and trail degradation, which would be unfortunate in such a pristine forest. The decision to allow or encourage mountain biking is a controversial one that must be chosen based on the desired uses and needs of a facility and its users. Following are several examples of how different parks and recreational areas have chosen to deal with bikes on the trails.

The State Botanical Garden, located in Athens, boasts over 6 miles of hiking trails on its land, which are maintained and color-coded. Bicycling is not allowed, to maintain the integrity of the trails. However, several other recreational sites do allow bicycles to increase their recreational use.

The Oconee Heritage Park is a 364-acre space located in Oconee County just outside Watkinsville, Georgia. This park provides several miles of hiking, mountain biking, and equestrian trails, along with a pavilion and historical cabin. Mountain biking and hiking share the same paths, and while the mountain biking does noticeably contribute to path erosion, these paths are
frequently maintained to help prevent extensive degradation. Additionally, some of the paths are clearly oriented towards biking, as they are wide and gravel-covered, so the brunt of use does not fall only on the more pristine, wooded trails.

Stringer’s Ridge in Chattanooga, Tennessee, provides another example of shared hiking and mountain biking trails (Tennessee River Gorge Trust, 2014). Managed by the Tennessee River Gorge Trust, this particular trail system timeshares the paths between uses, so that hikers are not on the trail at the same time as bikers. Signs along different sections of trail specify days of the week intended for bicyclists and the days intended for pedestrians. Such a timeshare may help reduce erosion simply by reducing the time bicycles may be on the trails, while still permitting them.
Trails strictly maintained for off-road bicycling can be found at the Chicopee Woods Trails in Gainesville, Georgia (GainesvilleSorba, 2014). These 21 miles of trail are renowned for being kept in excellent condition, with heavy erosion kept at bay through the diligent work of trail maintenance staff and volunteers. The Gainesville-SORBA (Southern Off-Road Biking Association) manages these trails and works to promote the sport of mountain biking as a whole.

These examples of mountain bikes on trails, ranging from no bikes allowed to mountain bike use only, provide TFC with some possible trajectories for bikes on Deadman’s Branch Trail. If mountain biking is encouraged and becomes a prevalent activity, TFC should consider regular maintenance to prevent damage to the trail from erosion.

IV. Interpretive Trail Media for Toccoa Falls College

Signs are everywhere, from roadways to the grocery aisles, "deliberately planned to serve all the needs of the visitor as they move through" a space (Gross, Zimmerman, & Buchholz, 2006, p. 10). The characteristics inherent in the design of a sign include "an inscribed board, plate, or space that communicates something to the viewer" (Gross, Zimmerman, & Buchholz, 2006, p. 10). This "something" that is communicated divides signs into two categories: information signs and interpretive panels (Gross, Zimmerman, & Buchholz, 2006, p. 10). While the informational sign provides "directions, identification, advertising, warning, rules, or guidance," the interpretive panels tell the story of a "resource, site, or feature" (Gross, Zimmerman, & Buchholz, 2006, p. 10). Both sign types are frequently used in cultural sites throughout the world, such as parks, forests, and other natural areas (Gross, Zimmerman, & Buchholz, 2006, p. 11). The combination of these basic signage types help visitors move through spaces, such as trails, as well as understand the history and background of the area.

To increase usership of some existing trails, TFC seeks to improve signage along the trails. Faculty of the college hope to make their trail system a unique and educational experience with the addition of a new sign system. This system could be multi-tiered, accessing people of all ages through traditional signs, paper handouts, and/or mobile application. By researching the effectiveness of different signage and interpretive media, the best multi-tiered approach for TFC can be determined. Once the most effective methods of reaching trail users is discovered, recommendations for TFC's trail media approach will be proposed through examples of existing cases.

In order to increase overall enjoyed use and education along the trail, the best means of capturing the visitor's attention must be established. This will involve an evaluation of both self-guided, traditional and modern media. Successful recreational interpretation, identified as the multiple means through which parks and trails communicate knowledge to visitors, will "encourage return visits to the sites where people experience high levels of satisfaction" (Wolf, Stricker, & Hagenloh, 2013, p. 59). The ability to convey an educational message and to increase usership, therefore, revolves around user satisfaction with how the message is communicated. Indeed, museum studies have shown that "the way material is communicated to them influences their level of absorption" (Wolf, Stricker, & Hagenloh, 2013, p. 60). The types of media evaluated in terms of user satisfaction are: pamphlets, signage, and multi-media tools such as GPS navigation devices or smart phones.

For each media method, there are benefits and drawbacks. Pamphlets are useful as they can be read at any time during the walk and may be less visually polluting or distracting than signage (Wolf, Stricker, & Hagenloh, 2013, p. 60). Reliance on pamphlet maps to find a location
of interest, however, can create too much additional effort for the user that may reduce the quality of the experience (Wolf, Stricker, & Hagenloh, 2013, p. 60). Signage will provide information at a specific location, minimizing user effort, but a "fine balance between the number and size of panels" needs to be used to avoid visual pollution (Wolf, Stricker, & Hagenloh, 2013, p. 60). Multi-media tools can be "very attractive to visitors as they are novel, multi-sensory and audio-visual," and evidence indicates that people are more responsive to these dynamic, multi-sensory experiences (Wolf, Stricker, & Hagenloh, 2013, p. 60). These tools also require the least amount of effort from the user to obtain interpretive information (Wolf, Stricker, & Hagenloh, 2013, p. 60). While modern media may raise levels of engagement with the interpretive media, dealing with technology can frustrate the people who consider "a nature-based experience as an escape from their technologically-dominated lives” (Wolf, Stricker, & Hagenloh, 2013, p. 60-61).

How can a balance be found that improves user satisfaction while still transmitting the same information? A study comparing the effectiveness of these different types of interpretive media measured visitor satisfaction, word-of-mouth recommendation, short term factual learning, and guidance of visitors through the space by using pre- and post-experience questionnaires (Wolf, Stricker, & Hagenloh, 2013, p. 61). The study also tracked visitors by GPS to measure the level of attracting and holding power of the different media types (Wolf, Stricker, & Hagenloh, 2013, p. 61). Research was conducted at eight stops along a 1.8 km trail (Wolf, Stricker, & Hagenloh, 2013, p. 61). Prior to embarking on the trail, people showed the greatest preference for signage and moderate preference for pamphlets (Wolf, Stricker, & Hagenloh, 2013, p. 64). Modern media that announced stops automatically and offered additional information via touch screen "scored highly," while media without these features were "far less popular" (Wolf, Stricker, & Hagenloh, 2013, p. 61). For these types of media tours, visitors clearly preferred the ability to download the tour on smart phones (Wolf, Stricker, & Hagenloh, 2013, p. 64). As two of the highest ranking interpretive media, a combination of signage and an optional multi-media tour might be used to enhance the trail experience at TFC.

Through a discussion with key faculty members, it was decided that TFC would like their trails' interpretive media to reach the users in three ways: interpretive and directional signage for anybody walking on the trails, botanical signage showing plant names for the college's biology students, and a mobile scavenger hunt app for engaging middle and high school youths. The above research supports a combination of signs and a mobile app as a highly effective means of both reaching and satisfying trail users. In order to aid TFC's process of creating these two types of interpretative media, information on media design and corresponding examples will be given.

First, tips on how to design successful trail signs will be addressed. To get started, decide on a theme that provokes interest and captures the essence of what is to be interpreted about the trail (Westrup, 2002, para. 14). For example, if a trail is located next to an oak woodland, the theme could be "majestic oaks and their habitat" (Westrup, 2002, para. 14). An interpretive signage theme should be "like an array of chapters that relate to and make up the story you wish to tell" (Westrup, 2002, para. 14). "Knowing your audience" and seeing the trail as the visitor would will help engage the current trail users (Westrup, 2002, para. 1, 3). The target audience should be identified, in terms of who currently uses the trail and who else TFC wants to bring to the trail. The content of the signs should then be designed by thinking about what information these types of people would want and what way they would want it given to them. This can
include information of cultural and historical significance, interesting facts on local animal and plant life, and other unique natural conditions of the area (Westrup, 2002, para. 14).

Entice the trail user to want to read the signs by telling a sequenced story over the course of several signs: begin a story on one panel and conclude it on another panel farther down the trail, using illustrations to relay the sequence of the theme (Westrup, 2002, para. 4-5). Avoid overloading the visitor with too much information; provide enough information "to stimulate people and provide guidance for those who want to pursue the topic further" (Westrup, 2002, para. 7). Use amusing question-answer style information, tidbits of information, or interactive and touchable panels to relay the message in a fun and provocative way (Westrup, 2002, para. 10, 12). While considering the many directions in which the signs could go, "be realistic about the amount of staff time, money and other resources needed to create them" (Westrup, 2002, para. 13).

Since TFC wants to engage both the college students already using the trail, as well as school children and other members of the community, their signage will need to appeal to a variety of age groups. Directional signage could be placed at any point where the trail offers a choice to the user, and at key distance points marking 1/2 or 1 mile. Signs with interesting tidbits that even children can understand could engage users of all ages. Interactive displays, such as flip-board panels or appealing to the tactile senses, can make signage seem more interesting (see images below). Pricing for these types of signs vary based on materials and companies chosen. Botanical signs could be small, metal signs stuck in the ground with the common name, Latin name, and maybe even engraved picture of the species (see image below). These signs would only cost about $4 each through the company Smart Garden Signs. These are just some simple suggestions that may help TFC brainstorm sign design. Once the theme and budget is established, the possibilities are only limited by one's imagination.

Second, how does one go about creating a GPS-triggered multi-media tour of a trail? This can be accomplished through several companies, depending on the level of detail included. Before deciding on which company to use, there are a few choices that need to be made. In order to reach the greatest number of users, most likely a company that allows for both iPhone and Android app variations would be the best selection. Determine how many stop points you want to include on your multi-media tour and consider what pictures, links, or information you want
displayed with each stop. Also figure out the budget available for this app. Some apps are available to everyone. The quality of these apps are less professional, but they are low-cost, around $4, and may be better for smaller trails. Some apps are created specifically for the entity purchasing them, which require a monthly fee starting around $25 and rising in price with the level of detail included.

The EveryTrail app (Globalmotion Media Inc., 2013a) is an example of the low-cost applications. It allows clients to map their trip route while moving, add photos and notes, and share the saved trip (Globalmotion Media Inc., 2013b). The downside to this app, however, might be that users have to create a profile in order to access the shared route. This extra step might inhibit user satisfaction. Users can also choose upon downloading the app to just click "try it out." Once the trail tour has been saved, trail users can search for trails near "Toccoa Falls" and find the guide.

The Geotour offers a more tailored app design (Geovative Solutions LLC, 2014b). Clients create the stop point with this app by entering an address, lat/long coordinates, or clicking on a map (Geovative Solutions LLC, 2014a). Clients can then upload audio, images, or descriptions for each location (Geovative Solutions LLC, 2014a). This company also helps clients promote their app by providing a method of embedding in their website, Facebook, or other social media (Geovative Solutions LLC, 2014c). The benefit of this app is that users download the client's specific tour, cutting down on any interim processes between download and immediate tour use.
With this multi-tiered interpretive media approach, TFC can successfully improve the users’ experience of the trail and convey their message more effectively. As stated above, ways to get started on implementing this approach could include deciding on a theme, what information they want to include, and then what types of signs they want this information on. Although further research and thought may need to be conducted on the specific companies, designs, and design techniques before actually deciding on a signage or app design, this research provides an overview.

V. The Merits of Ecological Restoration at Toccoa Creek

The portion of Toccoa Creek which flows through Toccoa Falls College property downstream of the swimming pond is in rough shape. Its banks are lined with rip-rap stones and devoid of vegetation. The land surrounding the banks is maintained as close-cropped turf-grass. The stream is functioning sub-optimally from both an aesthetic and ecological standpoint. Although the short grass provides a clear view of the water, which many people may enjoy, the combination of jagged rocks which line the banks and short mowed grass make the area feel over-managed, engineered, and sterile. A more diverse assemblage of plants along the banks could convey a more natural and vibrant aesthetic. In its current state, the stream is unable to provide habitat to many of the aquatic and terrestrial fauna which would commonly utilize such a place if it existed under more natural conditions. Dead Man’s Branch, one of the creek’s tributary streams, is a good example of the conditions which could be expected of a stream in this region if it were not impacted by development. However, better stream conditions can be achieved without re-creating an entire forest; one of the most feasible and effective steps that Toccoa Falls College can take to enhance the health of Toccoa Creek would be to restore a vegetative buffer.
V.A. The Importance of a Vegetative Buffer

Without a vegetative buffer, ecological quality of the stream suffers in numerous ways; there is no natural protection against erosion (although the rip-rap stones do armor the stream bank), and unregulated exposure to sunlight results in elevated water temperature. The lack of vegetation precludes habitation by insects, birds, and small mammals. Without inputs of organic matter from vegetation around the stream (an important and basic component of a healthy riparian food chain), the stream’s ability to support insect larvae, fish, snails, crayfish, and other freshwater aquatic species is limited. A healthy riparian vegetative community prevents erosion by establishing complex root systems which hold the soil in place and intercepts pollutants which run off of impervious surfaces from developed areas – nearby roads, parking lots, and buildings. The Georgia Stormwater Manual Coastal Supplement provides the following information about the importance of aquatic buffers:

“An aquatic buffer is an undisturbed natural area located immediately adjacent to a river, stream, tidal creek, coastal marshland or other aquatic resource where land disturbing activities are significantly restricted or prohibited. While they function primarily to preserve the integrity of streams, wetlands and other aquatic resources, and protect them from the direct impacts of the land development process, they also provide a number of other important ecological services, including pollutant removal, erosion control and flood attenuation. Although a 75-foot wide aquatic buffer is preferred (Rowe et al., 2007, Franzen et al., 2006), a minimum 25-foot wide aquatic buffer, as measured horizontally from the point where vegetation has been wrested by normal stream flow or wave action, should be established around all of coastal Georgia’s aquatic resources. Aquatic buffers can be of fixed or variable width, but should be continuous and should
not be interrupted by impervious surfaces or bypassed with stormwater outfalls that discharge post-construction stormwater runoff directly into the stream, wetland or other aquatic resource being protected by the buffer. Where aquatic buffers have been significantly altered by clearing, grading and other land disturbing activities, or where they consist exclusively of managed turf, reforestation or revegetation is recommended.”

“Even if site characteristics or constraints only permit the use of a 25-foot wide undisturbed aquatic buffer on a development site, additional “disturbed buffer zones” can be added to extend the total width of the buffer to 75 feet. Although they do not provide the same environmental benefits as undisturbed aquatic buffers.” (Center for Watershed Protection, 2009 pp.4-18 and 4-19.)

V.B. Reasons to Restore

The section of Toccoa Creek on Toccoa Falls College property could greatly benefit from ecological restoration. Various restoration activities could restore the creek as an aesthetic and environmental amenity for the college, and could be conducted with an educational focus which would benefit the college through monetary savings and enhanced (and unique) curriculum opportunities.

Replacing 25-100 feet of grass with a vegetated buffer along both sides of the stream will reduce the need for mowing. Although there may be an initial implementation cost, the college will benefit through long-term savings. Perhaps some of this cost could be offset by persuading a local nursery or botanical garden to donate plant material; donations to assist with restoration efforts are not uncommon practice. Students working through a class or club could possibly grow some of the plants from seed. Student volunteers could be used for much of the actual labor involved in restoring the stream, especially activities related to site preparation and planting. Creating a restoration and management plan could be a valuable opportunity for a class or independent research for a motivated student(s).

The educational potential of an ecological restoration project could be tremendously beneficial both to Toccoa Falls College students and field trippers from local schools. The project would be of particular value to students majoring in Sustainable Community Development; they can learn about water management, ecology, and the impacts that growth and development have on the natural world. Restoration would be an outlet for learning about the ecological function of healthy riparian communities and the negative impacts that can arise from development. Simple lessons in the life histories of different plants (which grow from bulbs vs seed) could be learned experientially and are valuable to students of all ages. Particularly motivated individual students could help achieve entire sub-goals of the project by assigning them as opportunities for independent study. Participation in a restoration project can empower students and teach them that there are simple ways in which a community can reverse environmental degradation and improve the health of the natural world around them. Many people are unaware that ecological restoration exists as an activity and a potential career; participation could broaden students’ ideas about the post-graduation career avenues available to them and inspire a new generation of environmental problem solvers. Lessons learned through hands-on participation make for memorable and enduring educational experiences. Engagement in the restoration of Toccoa Creek will build students’ sense of pride and stewardship in the Toccoa Falls College campus. Community involvement in restoration projects is critical, and students are the core of the Toccoa Falls College community.
V.C. Potential Problems

The Toccoa Creek restoration project would undoubtedly be accompanied by some potential risks and issues which are important to consider. Restoring tall and dense vegetation to the stream will reduce visibility along and across the stream. This could be cause for concern regarding safety and illicit activities. TFC administration should evaluate whether it is important to retain visibility across the stream: do people regularly cross the stream for any reason? Are there any activities which currently take place near the stream which might be impaired by restored vegetation? Perhaps certain points could be established where vegetation would be cropped for visibility.

The implications of providing more habitat for wildlife should also be clear: restored vegetation will attract a variety of desirable animals (fish, crawfish, butterflies, songbirds, etc.), but is also likely to provide a refuge for snakes, raccoons, opossums, foxes, and other animals which could be considered pests. Fears about attracting pest species are often overblown, but it would be negligent to ignore the potential.

The biology department is small, and some pertinent classes (like Ecology) are only taught bi-yearly. The college does not have a botany teacher or many other staff who have the knowledge base for teaching ecology and restoration. One way to address this issue would be to take a slightly different approach from the traditional teacher/pupil curriculum format and build the knowledge from the ground up. The project should be regarded as a long-term interdisciplinary effort which involves collaboration between various school departments and a good deal of learning on the part of professors as well as pupils. Rather than relying on teaching by experts, project leaders should have the desire to build their own understanding of what needs to be done from scratch, and come at it with the unique perspectives informed by their own collective academic and professional backgrounds. Many faculty and staff who participated in a conference call between Toccoa Falls College employees and the authors of this report have already expressed interest in training for knowledge and methodology.

V.D. Restoration Roadmap

In the earliest stages of the project, dedicated faculty and staff (project leaders) could generate a formal restoration and management plan. This document would be compiled through research to address all aspects of the ecological restoration process. Documentation of historical conditions, ecosystem function and identification of desired conditions, and implementation methods – this could all be learned by students and professors alike, at the same time. Professors could guide student research projects which would be combined to create a restoration management plan. Experts or knowledgeable individuals from outside the college could be consulted for guidance, but ultimately the plan would be a product of the Toccoa Falls College community and of educational benefit not just to students, but also to professors who are interested in enhancing their knowledge base and improving their own ability to teach lessons about sustainability in the future.

The project should begin with considerable research into the historical conditions of the place; restoration is often conducted with the goal of reestablishing environmental conditions from an earlier time. The best way to go about this would be to consult written records for information about the stream’s physical characteristics, floral and faunal inhabitants. This information can be supplemented with studies of a reference site – a place that currently manifests the conditions which the restoration team seeks to emulate. It may be impossible to
completely return to historical conditions, especially in the short term; many of the natural processes which will guide the stream to a more desirable state occur over the course of decades, centuries, or millennia. A review of more recent historical documentation can inform how the flood in 1977 altered the character of the stream. Written accounts and photographs or paintings can be equally informative sources of information.

Other questions to address include whether there have been any other events or periods of change in the landscape where the ecosystem was altered over a relatively short period of time. Consider the lake in the same way—it has been there for nearly a century—what can be discovered about its historical conditions? Has it been subject to management problems? Some problems which occurred at various times over a decade ago include habitation by beavers, ducks, and geese. It is not clear whether the beavers were in the pond, damming the Dead Man’s Branch tributary, or both. They were attributed to increased E. coli levels in the pond and eradicated. In the future, it would be wise to consider the potential for accommodating them. An effort should be made to understand the effect that they have on the local stream and lake ecosystems, and the perceived problems which they cause should be weighed against their possible contributions to the biological vitality of the area. They should not be eradicated without solid evidence that they are contaminating the water.

Water quality data collection is a good way to monitor changes in stream conditions over time. Any existing data should be analyzed and regular monitoring should be conducted for ecosystem parameters related to water quality, vegetation, and macroinvertebrate populations. This will allow for assessment of historical and current conditions and future changes following restoration activities. Students could be involved every step of the way, from data collection to the eventual analysis of collected data. It was mentioned that somebody on campus is familiar with water quality monitoring techniques and may have already been collecting data. Outside consultants may be needed for additional technical training; the Georgia Adopt-A-Stream program could be a useful resource.

There are a number of potential activities and methods which could potentially be incorporated into restoration efforts. Removing the rip-rap from the stream’s banks would allow it to return to its natural morphology—it would be able to change course over time and meander as it is naturally inclined to do. This would also restore the natural bank structure and could provide habitat which depends on softer banks and is precluded by rip-rap. Rip-rap stones could be reused by strategically placing them within the stream channel to create riffles and ponds which create habitat and diffuse the water’s energy, lessening its erosive tendency. However, de-armoring the bank could be a short-term source of significant erosion, especially without a well-established vegetative buffer. It would involve significant labor of a potentially more hazardous nature than installing plants. Allowing the stream to change course and meander naturally could also create conflicts with existing infrastructure, especially roads.

A rather simple approach to restoring the vegetative buffer would be to just stop mowing. This is a simple way to encourage the recruitment of new species of vegetation in the short term. However, this approach could easily result in encroachment by invasive plant species such as Chinese privet, which is already present along the bank in small amounts. Invasive plants would need to be weeded out diligently to keep them from rooting vigorously and displacing potential native plant habitat.

A more controlled way to ensure the growth of a healthy variety of native plants would be to manually plant the banks with desired species and manage for invasives. A list of
appropriate plant species could be generated by consulting historical accounts of vegetation in
the region and emulating reference sites. Regardless of the chosen trajectory, the management
plan should be updated frequently with new information and data.

The experiential learning in environmental stewardship offered by ecological restoration
is a unique opportunity which is not yet as prevalent as it perhaps should be. Pioneering the
application of such an activity in an educational setting would strengthen TFC’s offerings to its
students and set it apart from other institutions which offer outdoor educational programs (such
as the nearby Blue Ridge Outdoor Education Center). It is an activity available to any
community, regardless of their resource base; many environmental stewardship activities can be
conducted very affordably, and the results could save money in the long run. The most
important community resources are the drive, organization, and stability to offer long-term
oversight.

Restoration activities need not be limited to Toccoa Creek, either. Ecological
landscaping and recovery activities could be applicable to any number of areas on campus.

V.E. Resources for Further Review
To get started, consult the following list of references for organizing a restoration project
and constructing a restoration and management plan. All documents are easily accessible for
free online:

approach. Ecosystem Management: Applications for Sustainable Forest and Wildlife Resources.
Yale University Press, New Haven, CT, 301-322.

Ecological Restoration: A Framework for Planning/Design Professionals. Landscape
Architecture Technical Information Series Number 2. American Society of Landscape
Architects, Washington, DC.

Washington, DC. www.ser.org/resources.

The following is an interesting article regarding the power of community involvement in
restoration projects:

Casagrande, D. Restoration of an Urban Salt Marsh: An Interdisciplinary
Approach. The Human Component of Urban Wetland Restoration (pp. 254-270); Center for
Coastal and Watershed Systems, Yale School of Forestry and Environmental Studies.

Jon Calabria, Ph.D., ASLA is a professor at the University of Georgia College of
Environment & Design and an excellent resource for matters regarding stream restoration. He
can be contacted via email (jcalabr@uga.edu) or phone: 706-542-0903.

VI. Taking the Next Step
The development and implementation of an informal Science Center will require
extensive planning and careful implementation. Beginning with the suggestions set forth in this
document, members of the TFC community will need to evaluate how prepared the TFC
community is for such an undertaking. Establishing and sustaining the Gathany Museum as an
environmental center will require various forms of capital: social, administrative, and financial. We highly recommend TFC begin to collect data on the motivation levels of the various parties expected to be involved in the management, operations, and attendance of a local nature center.

A second recommendation is to start work on curriculum planning for the center. This curriculum planning may be the work of a small committee, or perhaps students at the college as part of a course or extracurricular group. Similar to the search for support, we recommend gathering information from as many voices in the community as possible to determine which types of learning experiences the Gathany Center can offer to bring the most benefit to the community.

Finally, a third recommendation is to further explore the comparative model centers referenced in this report. Communication with these centers will help provide options for community engagement as well as curriculum development. The connections, once established, can heighten the educational influence of both the Gathany Center and the partner centers. Shared work via the citizen science programs referenced in this document may provide greater data sets for multiple communities to explore and learn from.

This document lays out suggested uses for the Gathany Center and Deadman’s Branch Trail to provide a unique experience for visiting K-12 groups and contribute to the development of an atmosphere of stewardship on the TFC campus. While we have attempted to sift through the myriad resources and examples of educational curricula and facilities, we realize that even our subset is a lot to implement at once. We anticipate that the TFC administration will carry out some of their favorite suggestions and perhaps solicit the assistance of future UGA Environmental Practicum classes to continue working on the topics that align best with the needs of TFC.
VII. References


The College of Agricultural and Environmental Sciences and the College of Family and Consumer Sciences cooperating. (2014, January 2). *Classes*. Retrieved April 28, 2014, from [http://www.wahsega4h.org/ee/eclasses.html#day_class_options](http://www.wahsega4h.org/ee/eclasses.html#day_class_options)


Eastern Hemlock

(*Tsuga canadensis*)

**Leaves:** Evergreen needles occur singly, appearing two-ranked on twigs, flattened, about ½'' long, dark green and glossy above, light green with two-white lines below.

**Twigs:** Slender, tough, yellowish-brown to grayish-brown. Buds egg-shaped, 1/16'' long, reddish-brown.

**Fruit:** Cones ¾'' long, egg-shaped, hanging singly from the tips of the twigs. Under each scale are two small, winged seeds.

**Bark:** Flaky on young trees, gray-brown to red-brown; thick and roughly grooved when older.

**General:** A large, long-lived tree, important for construction timber and as a source of tannic acid for tanning leather. Found in cool, moist woods throughout the commonwealth, Eastern hemlock is the official state tree of Pennsylvania. Ruffed grouse, wild turkey, and songbirds find food and shelter in this tree. Deer browse it heavily when deep snow makes other foods scarce.

(information and images from http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_002216.pdf)
**Hemlock Woolly Adelgid (HWA) in Georgia**

The hemlock woolly adelgid (HWA) is a serious pest of hemlock trees in Georgia. It is an aphid-like insect that feeds on eastern and Carolina hemlock trees. The result of this feeding is eventual tree mortality. The very existence of the eastern and Carolina hemlock species is greatly threatened by HWA.

**History of spread**

HWA was accidentally introduced in Virginia in the 1950s. The insect is native to Japan. HWA was first discovered in Georgia in 2003 near the Ellcott Rock area of Rabun County. The Georgia Forestry Commission does annual surveys to determine the extent of the infested area. The 2009 survey revealed HWA in Rabun, Habersham, Towns, Union, Stephens, White, Lumpkin, Fannin, Gilmer, Dawson, and Murray Counties (see Hemlock Woolly Adelgid Annual Spread Map in Georgia). The adelgid is dispersed by wind, birds, and human activity and is spreading at an alarming rate.

**Identification**

The hemlock woolly adelgid is a tiny insect measuring around 1/16 of an inch long. As the adelgid matures, it produces and covers itself with a white, waxy filament. This waxy covering is used to protect the adelgid and its eggs from drying out and natural enemies. The adelgid is hardest to spot during the summer, as the white filament is not present during this time. Adelgids can be found on the underside of the branch, on the newest growth (Figure 1).

**Life cycle in Georgia**

The life cycle of HWA consists of 2 female, wingless generations per year. In late winter, each adult from the winter generation lays up to 300 eggs in cottony masses attached to the twigs. The eggs hatch in April and crawlers, the mobile nymph stage, move out in search of suitable feeding locations. The crawler inserts a long feeding tube, called a stylet, at the base of a needle. Here the nymph will remain until reaching maturity in late May to early June. A portion of the spring generation will form into winged adults that fly off in search of a spruce tree. No suitable species of spruce is found in North America resulting in the death of the winged adelgids. The spring generation adults that remain on the tree lay 20–75 eggs. These eggs hatch in June and crawlers settle in on the new growth and go dormant for the summer (Figure 2). It is during this time that the adelgids are hardest to spot. In late September, feeding resumes and the nymphs mature by late winter/early spring.

**Damage caused**

HWA causes damage to the tree by feeding on the starch the tree produces. This inhibits the tree’s ability to produce new growth. All ages and sizes of hemlocks can be attacked. Trees that have been infested for a couple of years will have a declining appearance. The needles of the thinning crown will have a dull green to gray color (Figure 3) and lower branches will begin to die. Tree mortality usually occurs after 3–5 years of heavy infestation.

(information from http://www.gatrees.org/forest-management/forest-health/hemlock-woolly-adelgid/)
Appendix B: Flora/Fauna/Geology/Climate/Water of Toccoa Falls and Vicinity


“Not all references are equally weighted as to value. Some are very general, others very specific (such as a detailed water analysis of Garnet Springs in 1908), others lean toward emotive language of the beauty of the Falls and surrounding area.” (K. Vickers, personal communication, March 13, 2014)

1708:
A list of exports in the fall of 1708, included “rice, pitch, tarr, buck and doe skins ‘in the haire & Indian dres’t,’ also some few furs as beaver, otter, wild cat, raccoons, buffaloe and bear skins, some ox and cow hides, a little silk, white oak, pine and cypress fit for masts and shipbuilding, and slaves.”

1715:
“This day we drewe up ower men and marched to tugaloe where ye Indens meat us with ther Eigalles Talles and made their serimoneys.” [Eagle tails]

1760s (1901):
“. . . the song of the turtle dove . . .”
“. . . they learned how to make iron from the scant ore that is found thereabouts . . . Numerous iron instruments, too, are said to have been found in the ground round about.”

1820:
A visitor records his visit to the High Falls, sense of awe in the approach: “You pursue the Tockoa creek, westwardly in its serpentine path, a mile or two before you approach the fall. The hills on either side of the creek are high, abrupt, and the valley through which it meanders, nearly half a mile in width, is covered with large trees and a beautiful shrubbery. You move along, struck with the scenery, yet in an anxiety so breathless to seize the object of your visit, that the mind has no time to feast upon and admire the beauties that surround you. “It must be there, it must be there,” I exclaimed several times to my guide, pointing to where the hills seemed to meet, as we wandered our way along the valley. –When you arrive within around 300 yards of the fall, the valley is shut up, and over the hill (there a solid rock,) tumbles the stream you have been tracing, 180 feet perpendicularly! The stream is about 20 to 25 inches in depth. In falling such a distance, the water of consequence, becomes nearly spray.”

1821:
[Currahee] An 1871 passage recounting experience of 50 years prior: “the summit [of Currahee], which was a bare flat rock, terminating on one side in a sheer precipice, and covered here and there with thick beds of mountain moss, whose gray filaments in a dry time crumble to powder under the foot, but with the slightest moisture in the air furnish delightful seats, soft as cushions of velvet.”
[Currahee and Toccoa Falls] ... an account of red-bugs and seed-ticks: “For more than a day she had been conscious of a very disagreeable eruption which had appeared upon her person, and of which her maid also complained. It was rapidly increasing; she was apprehensive that they were both going into a fever, and would soon need medical treatment. The ‘eruption’ appeared in the form of welts, with a minute spot of crimson in the center of each, attended with intolerable itching. She described the case to Mrs. Walton, who no sooner saw the ailing spots than her good-natured face became a universal smile, as she said:

‘You must be a stranger in these parts, ma’am, not to know the red-bug.’

A moment afterward, being informed that her guest was just from England, she continued:

‘I see upon your clothes what is almost as bad as the red-bugs.’

My aunt was horrified to discover that what she had only supposed to be brown dust upon her clothes was all in motion.

‘What can it be?’ she asked.

‘Seed-ticks,’ replied Mrs. Walton. ‘People say,’ she continued, ‘that when the large tick falls from the cow, it lies upon the ground until it goes to pieces, and then each piece becomes a seed-tick. They climb the nearest spear of grass and hang together in a little ball on its top, until some one passes near enough for them to take hold, when they all leave the grass together, and spread over the person.’

‘Mercy!’ exclaimed my aunt in terror; ‘I shall be eaten alive. Can you do nothing to save me?’

‘Oh yes,’ replied Mrs. Walton, ‘they are easily enough got rid of. You shall not hear from one of them again after you leave my hands.’

Her first aim was to relieve from the torment of the red-bugs. This was effected by a plentiful ablution with soap and cold water to ‘cool the fire of the bites;’ then the welks were wetted with a strong alkali ‘to kill the poison;’ and finally, they were touched with perfumed oil, to smother such intruders as were left, ‘for,’ as Mrs. Walton said, ‘no live thing of that sort can stand grease.’

While this work of insect-murder and of poison-cooling was going on, there was another in process in an adjoining room.

The garments infected with the seed-ticks were stretched over chairs, and were thoroughly fumigated with tobacco-smoke, produced by putting the leaves on live coals in a chafing-dish.

‘A few years ago,’ said the hostess, ‘a lady from the seaboard, an Englishwoman like yourself, came in from a walk in the woods so perfectly covered with these insects that her clothes were brown. I proposed to relieve her, as I do you, by the use of tobacco smoke, but she preferred, instead of undressing, to kill the insects, or drive them from her, by receiving the smoke upon her clothes without taking them off. She succeeded but came near sharing the fate of the insects, for she was not much more able than they to stand the poison of the tobacco smoke.*

[*This unromantic incident is given, just as it occurred, in hopes that it may prove useful to visitors to that beautiful region. There is no greater pest to be encountered there than these troublesome insects, and there is no surer antidote than tobacco-smoke, or snuff rubbed on.]”

1827:
Climate:
“There is no purer water nor any healthier climate on the globe than is found in the northern section of this state. From April to October the mercury generally fluctuates from 80 to 90. It has not been known to rise higher than 96 in any part of Georgia for many years. The changes are quite sudden in winter, and sometimes there is an alteration of 20 in half that number of hours.

Bees are seen gathering honey every month in the year.”

“The rivulet disturbed by no rapids, moves with a gentle current, and drops without warning into a beautiful basin below, expanding into fine rain before it reaches the bottom; and the breeze which always plays there, spreads a thick spray around, and ornaments the falling water, the rock and the shrubbery, with rainbows.

. . . Two beech trees grow near the base which are so closely covered with names down into the very ground, that he who will carve his own, must intrude upon a present occupant. Old and venerable names have been obliterated to give a conspicuous position to some young aspirant for immortality. These beeches, said a lady of our party, are the political world in miniature.” . . .

1833 [1889]:
The memorable cold Saturday was the 7th day of February, 1833, and was the coldest day we have any account of. The chickens froze and fell from the roof dead. Trees froze and burst all that night, making report like guns. The thermometer the next morning was from 4 degrees to 10 degrees below zero.

The stage driver on one of the mail routes south of Habersham froze, and when the horses came to a post office they halted; the postmaster went out to get the mail and found the driver in his seat cold and dead.

1837:
“the rocks still continued to be of a micaceous sandstone, and the surface of the country to be formed of hills and dales. At twelve miles from Clarkesville, I went up a narrow ravine to see the very pleasing waterfall of Tocoa, which is in a semi-circular basin worn out by the water. . . The height of the cascade is about two hundred feet, and the breadth about thirty feet, falling over micaceous sandstone, alternating with hornblende quartzose sandstone very incoherent . . . and the ravine at the same time being filled with beautiful trees in the finest verdure.”

1838:
“Why should we not admit that the inferior species of life, which exists in the vegetable world, is accompanied by an inferior species of sensation,–of susceptibility to pleasure or pain? To me it is a sufficient argument for such a faith, that it honors the Creator, by increasing the amount of enjoyment in his creation. What to most spectators is yonder tree? A beautiful object indeed, but utterly lifeless in any proper sense of the word life. Its existence adds no more to the amount of enjoyment in the universe, than if it were made of stone. To me, on the contrary, it seems, as the wind waves its branches, to feel in every leaf the same delightful coolness that fans so gratefully my own brow. Life, enjoyment, darts from spray to spray, and penetrates to the very centre of the aged trunk. Conceive, then, of a forest of such beings. How different is the belief which represents every leaf and flower through the boundless woods, as instinct with pleasure, from the cheerless imagination that–here is much good timber! There are many things, too, which to my mind confirm this faith. The tendency of leaves to turn toward the sun, of roots to penetrate in
the direction most favorable for obtaining moisture, of climbing plants to turn with so much seeming ingenuity, first one way, then another, in search of a support, and the phenomena of sensitive plants—these things confirm the existence, in the vegetable word, of something approaching to animal instinct, and which may therefore be combined with something approaching to animal feeling. . . . Here and there, however, shrubs, which have grown in the interstices of the rocks, extended themselves to catch that increasing shower, and broke for an instant the glassy curtain, which would reunite directly below them.

1839:
“From Athens, our road lay, as usual, through the thickly-wooded forests, with which all parts of this country are covered, save the few cleared patches of cultivation that are seen at long and distant intervals. Instead of the endless pine-trees of the low-country, however, we had here a great variety of wood, and the roads being hilly, their terminations in successive ranges rising over each other, presented fine masses of vegetation in a great variety of shades of green. The population was so scanty, that for the first ten miles we did not see a single human being, though a flock of fine sheep, and herd of long-bearded goats, were observed grazing without keepers, while hogs abounded in all parts of the woods, where they roam at large during the day, and return to their hog-pens at night.

Of the trees that lined our track on either side, the most prominent and numerous were the walnut, the chestnut, the dogwood, the white-oak, the willow-oak, the acacia, the Lombardy poplar, the black-gum, the sweet-gum, and the sour-gum; all in rich and full foliage, and of large and vigorous growth. The road was pleasantly varied also by the many, streams of running water in the hollows, where beautifully shaded spots invited a momentary stay. In some parts of the forest, there was little of underwood, that we could see through the spaces underneath the trees for half a mile onward, and this was a great relief after the thick and tangled brushwood, which makes an impervious jungle in the greater portion of the way. It is said that wherever the Indian tribes encamped or settled, throughout this region, they always kept the forest cleared of underwood, by annually burning all the rising trees and shrubs. But since their removal from the territory, the present proprietors take no such pains, and, therefore, vegetation is suffered to proceed unchecked in all its wildest exuberance.”

At the hotel where we stopped to dine, were two fine brown bears, that had been just caught in the hills close to town, where they were very numerous. In addition to these, we learnt that the woods and mountains around this place were abundantly tenanted by squirrels, raccoons, minxes, and wolves; the hunting of which afforded good diversion to the young men of the place.

As an especial favour to us, who were declared to be “mighty particular,” a candle was made while we waited for it, some threads of cotton serving for a wick, and this being enveloped in a mass of bees’ wax, was brought to us quite hot from the melting.

The valley itself is about 300 feet in breadth, each of its sides being steep, but thickly clothed with trees and shrubs.
before it reached the bottom it had become like a thin transparent veil of the finest gauze or muslin, through which could be dimly seen the moss and vegetation that had collected on the surface of the rock. From that base, gradually ascending upwards, were several layers or ranges of full foliaged trees, growing apparently out of the crevices of the rock, which appeared to be of micaceous limestone and schist; and on the very edge of the precipice above, were some trees having their roots on the upper platform,

In the woods here we saw, for the first time, the exquisitely beautiful bird called the tanager. It is about the size of our English thrush, of the most brilliant scarlet over all its head, neck, and body, with two jet-black broad stripes or patches on its wings; and as it happened to be seated on a branch of extremely thick foliage and in the full blaze of the sun, its sparkling radiance was like that of a ruby amidst the boughs.

The rivulet, disturbed by no rapids, moves with a gentle current, and drops without warning into a beautiful basin below, expanding into fine rain before it reaches the bottom; the breeze which always plays there spreads a thick spray around, and ornaments the falling water, the rock and the shrubbery with rainbows.

1845:

imagine a sheer precipice of gray and rugged rock, one hundred and eighty six feet high, with a little quiet lake at its base, surrounded by sloping masses of granite and tall shadowy trees. From the overhanging lips of this cliff, aloft, between your upturned eyes and the sky, comes a softly-flowing stream: This making a soft joyous leap at first, and breaks into a shower of heavy spray, and scatters its drops more and more widely and minute, until, in little more than a drizzling mist, it saturates the smooth moss-covered stone, lying immediately beneath. All the way up the sides too, of this precipice, cling, wherever space is afforded, little tufts of moss, and delicate freshly-green vines and creepers, trickling through the black fissures in the granite.

1849:

In summer, ‘Toccoa’ must indeed be a ‘beautiful’ spot, when everything around is fresh and green: when flowers, of which there is here a wild profusion, and in full bloom, and birds are warbling their sweetest melodies.

1854:

[Toccoa Falls] But not only is Georgia rich in beautiful rivers, streams, and cascades, its forests afford an abundant supply of fine timber, consisting chiefly of pine, oak, hickory, mulberry and cedar. Melons grow here in great perfection, and figs are common. Oranges, limes, citrons, pears, peaches, and a few other fruits of mild climates, are also cultivated. A part of the soil is well-suited to the grape vine. The climate is more mild than in the same latitude on the Mississippi River. The mercury in summer rises to ninety degrees, and sometimes as high as ninety-six, or even one hundred.

1854:
The spray lifted by the mountain breeze floats through this little valley, resting lightly upon tree, flower, and stone, imparting to each an appearance of life and vigor. The sides of the chasm seen in the bright rays of the sun—the green leaves of vegetation—the moss-covered boulders, all seem mantled with a golden sheen. . . . The tall pines and firs which gather so thickly upon the brows of the hills

1855:
“The agricultural region yields heavy crops of corn and wheat, while cotton and rice are among the staple productions.”

1857:
Four hours, did we linger around this beautifully romantic spot, climbing up the craggy steeps around, and gathering here and there, the rich autumnal flowers, which gave additional beauty to the scene.

1858:
And still we gaze with eye unsatiated, and heart brim full of joy. We could weave quite a poetic story on the surroundings—the mighty trees that nod their long green plumes in the morning air; their venerable trunks lettered from their roots almost to their tops, “with true love knots and flourishes,” and sacred names, all that now remain to tell us that the originals had ever moved beside those falling waters. We visited the Fall by night. This is the time to commune with the spirit of a Waterfall—silence, save the soft breathings of the musical waters, reigns supreme! Into the clear streamlet we dropped our line, and thought took wing. By turns our inner eye would close, and the visual organ, external, sought in vain for our dancing cork. It had disappeared. We jerked furiously—and lo! Dangling at the end of our hook, was a little fish, favorite of our boyhood, the horny-head! Laugh not, my piscatorial friend, we jerked and jerked until our string was full of the finny tribe, and the savory odor from the frying pan next morning, reached our olfactories long before we left our pallet, and communication straightway took place over the aesophagatic line, conveying grateful intelligence to the parties interested below.

We saw very few peaches in Hall and Habersham, and the apples were almost entirely killed in the latter country. At the time we visited Tallulah Falls, corn was very scarce, and freely brought in that vicinity 75 cts. per bushel and hard to get at that price. A drought of four or five weeks had ruined the fodder, and burnt up the pea vines, and several persons told us they would not make corn enough for seed. This state of things, however, was happily confined to a very small portion of North-Eastern Georgia. Apples from Habersham will not be found for sale next winter in middle Georgia. A good idea of the disastrous effects of the ice in Hall, Habersham and Franklin, last Spring, may be formed from the appearance of the forests. The largest oaks are almost entirely stripped; and saplings are twisted and torn as if by the fury of a hurricane. The weather for several weeks in the region where our tents were pitched, was so cold as to require good fires and thick covering at night to ensure comfort. It was not an uncommon thing for us to sleep under two blankets and then be cold. During our entire visit to Upper Georgia there was not rain enough on any day to lay the dust. This is rather singular as we
learn on reaching home, that rain has fallen frequently and in great abundance during the same time.

1859:
Enclosed I send you the names of a few more of our Indian Apples, which, if you think they would interest the readers of the Cultivator, are at your service.”
Among others, the “Toccoa.—This apple was found in the orchard of Jeremiah Taylor, an old Revolutionary soldier, living near the celebrated Toccoa Falls, in Habersham county, Ga. It ripens in August; is a very delicious, flavored fruit. Toccoa, when rendered in the English language, means “beautiful.”

1867, Apples:
“From Toccoa Falls, Habersham County, Georgia.
“Fruit rather large, conical, irregular or oblong; Skin whitish yeallow, considerably shaded with carmine, and sprinkled with a few brown dots; Stem short, inserted in a deep cavity; Calyx partially closed, set in a rather large basin; Flesh whitish, juicy, tender, pleasant, mild sub-acid; November to February.”—[Downing.]
Perhaps not an early bearer; my trees, set six years, have not yet fruited.

1873:
The Air-Line Railroad, one of the best equipped roads in the country, runs within a mile and a half of Tocoa Falls, the most beautiful cascade in the world. Tourists, however, would do well to carry along an elevator and some red-bug medicine.

1873:
The lands on Tugaloo river, Broad river, Toccoa creek, and Ward’s creek, all in this vicinity, are exceedingly fertile and well cultivated, and many of the inhabitants quite wealthy. Toccoa city bids fair to be a very important place.

1874:
The new city of Toccoa, on the Air-Line Railroad, and near Toccoa Falls, is a flourishing place. Less than a year ago, not a lot had been sold, and now more than 3,000 bales of cotton have been sold there since September last.

1875:
Here only wheat, corn, rye and oats are well adapted to the climate, though much cotton from Franklin and other counties finds market here. Last season more than 5,000 bales cotton sold here.

1878:
The fresh aroma of the sweetly scented woodland, the myriad gems of flora, the tender green leaves of the forests, the sparkling dewdrops upon the silver-crested stones and pebbles, the gurgling rills, dancing, splashing, foaming and leaping down some steep precipice into shaded ravines; singing birds flitting from bough to bough, playful squirrels running up and down the trunks of stately trees, all lent an enchantment to the scene, indescribable by pen or picture.
1878:

THE CATALYTIC SPRINGS are one dozen in number, and within one half mile of the town. They embrace iron, sulphur and alum in their proportion. These springs are of great interest to the town, and will in the course of time become a chief element of its attractions in winter as well as summer. The GARNET SPRINGS are also near the falls, and are highly spoken of. Without the additional attractions in the way of mineral springs, etc., the falls alone will amply repay the seekers of pleasure and beautiful scenery that visit them. . . . The land in this neighborhood is especially adapted to farming purposes, and corn, wheat, oats, cotton and rye are produced in abundance.

1881:

Nature has been kind to these hills in one respect. Such a profusion of wild flowers I never saw in any other country. One ravine was lined on both sides as far as the eye could reach with honeysuckles; great patches of violets and a sort of fleur de lis brightened the ground, and the dogwood reared its head of snow everywhere. The prodigal hand of nature seems to satisfy the natives. I saw, however, a great thicket of yellow roses in front of one cabin, and a shrub with flowers like the fuchsia, which the women said was called “flower of pear.”

1883:

. . . until having driven round its base, the other side loomed radiant in vegetation and musical with birds. White pines waved their branches of silvery green, cypresses jutted from the mountain cliffs, wild cucumbers displayed their light green leaves their clusters of purple flowers, ivies, rhododendrons and azalias stretched in banded ridges of pink, blue and white, and lilies of various shapes and hues drooped their pretty petals and the arbutus made tufted floors of velvet green dotted with white and red.

. . . Our winding path shut out the view in front, but on our right flowed the river, at times deep and sullen, under willows and hazels, festooned with honeysuckle, woodbine and clusters of purple grapes, and anon the stream spread itself over broad pebbly beds. On our left a natural wall of rock rose amid ferns and mosses to the height of our shoulders, overtopped by lofty poplars, chestnuts and oaks. Having followed the path some two hundred yards, we turned around a large rock and stood before Toccoa.

. . . the ranging hills and giant trees, which towered like sentinels for spectators,

. . . Kirby having already turned aside to pick acorns from chestnut oaks, which exposed on the jutting cliff, were beaten down by storms and branched out low and spreading. We moved down the rugged steep, picking up crystals and many colored stones, scaling off flakes of shining mica, and running here and there under the trees of varied foliage.

. . . story of the taking of a mama bear protecting her cubs adjacent to the falls . . .

1886:

Listing:

[Chalybeate refers to the iron content of the Spring noted for its medicinal and therapeutic uses, ranging from colic, depression, weakness, and worms. Resorts were often built near noted mineral springs so the public could take advantage of the health benefits.]

1886:
The mountainous sides, covered with tall nodding pines and leafy oaks, under brush and wild flowers, mingled their bright hues with the darker shades of the forest,

1886:
silver and copper . . . This ore has been found in small quantities in a limestone bluff on the side of the road that leads from Toccoa to Clarkesville in Habersham County.

1893:
the gathering of a large crowd at Garnet springs, near town. . . . That’s a nice place for a picnic. There are springs of mineral and freestone water, good shade, secluded places, wild flowers and pretty scenery

1893:
The scenery is magnificent, and beautiful spots, bright with the blossoms of wild flowers and green with feathery ferns, abound. The temperature is delightfully cool, and in the hottest weather one can get near the falls and be as comfortable as heart could wish. Pure, cold mountain water which needs no ice is abundant, and the ozone laden breeze comes from the mountain sides fresh and invigorating,

1893:

Mineral Springs.

Within the vicinity of Toccoa are several springs of mineral water whose medicinal properties may make our town more desirable as a summer resort, some day.

One of these is known as Garnet spring, and is beautifully situated about a mile from town. Its water is not very unpleasant to the taste, but has a decidedly mineral flavor.

About a half mile further, near the home of Mr. Littleton Edge, are two mineral springs whose waters leave a decidedly disagreeable “farewell” in the mouth. One of these is strongly impregnated with iron, and the other tastes like sulphur. The water from one of these springs is used by some of our citizens, who find it quite beneficial for indigestion.

So far as we can ascertain, none of this water has ever been analyzed. Perhaps it would be a good plan to get some competent chemist to make an analysis of the waters of these springs, for their medicinal properties might be found valuable in the treatment of certain diseases.

1893:

And the temperature in summer is another charm. While it is true that old Sol does not fail to beam warmly upon us at times, yet one here does not become debilitated from the effects of heat as he does in lower latitudes, for hot days here are really rare, and the nights are always pleasant. June is usually the hottest month, but not a night this summer have we failed to sleep under cover. When the sun goes down the temperature rises until the atmosphere is pleasant. You do not have to be taking medicine all the summer, here.
No Mosquitoes and Gnats. And at night when one retires he can sleep without being smothered with a mosquito net, for that troublesome little insect, the mosquito is almost a stranger here. We have been serenaded by the festive mosquito only once this summer, and he was so small that his voice was above high D. That other pestiferous insect, the gnat, is not troublesome.

. . . several mineral springs which possess valuable medicinal properties. One of these, Garnet Springs, is near a little stream and densely shaded, ferns and wild flowers growing in profusion around. This is a beautiful spot and exactly suited to picnic purposes, for which it is frequently used.

1896:

It is said that some one from Atlanta came to Toccoa last week hunting for buried treasure and almost dug up those beautiful beech trees at Toccoa Falls.

The man who had charge of the digging, it seems, took it upon himself to go out there and despoil the falls of one of its greatest attractions. These beech trees were carved with letters, hyroglyphics, names, etc., some of them put there fifty years ago and have grown from a few feet of the ground up fifteen or twenty feet high and are among the limbs now. Beside their lovely historic value the trees made lovely shades, green both winter and summer and it is certainly desecrating the beauty of the falls in killing these trees, as they will most likely die. The name of the party who carried out the digging was Swift, an undertaker in Atlanta, and it turns out he cut off all the roots he could get and shipped them to Atlanta to be used in making embalming fluid.

When the members of the Toccoa Falls land company found out what had happened they were very wrot and Swift soon took himself away from Toccoa. If the trees die it is said Swift will be arrested for trespassing and sued for damages. If these trees die, the way we view the matter, no punishment that he will get is half severe enough for his deed.

1898:

A splendid lake of pure, fresh spring water comes right up to the hotel veranda, on one side, and just in front of the house, not more than 100 feet, is Toccoa creek, with its health giving waters ripples by. One hundred yards up the creek is the majestic Toccoa falls. Here is probably the coolest hotel in Georgia. Surrounded by beautiful forest trees and clear, pure, swift running mountain water, one may soon get back lost health and in a few days become a new person, because of the coolness of the atmosphere and the beautiful and romantic situation. There are no mosquitoes, and no mosquito nets to make life miserable, but the cooling zephyrs at night make a blanket a luxury, even in the hot summer months.

1908:

Garnet Spring. This spring is located in the eastern part of Habersham county about one and a half miles west of Toccoa and only a short distance from Toccoa Falls. The spring is frequently visited by the guests of the Toccoa Falls hotel near by and also by parties from Toccoa. The water which is impregnated with iron salts flows from a crevice in the gneissoid rocks. The only improvement is a rough stone wall surrounding the spring. The flow is not more than one gallon per minute. The mineral constituents of the water as shown by an analysis made by Dr Edgar Everhart Chemist of the Geological Survey of Georgia are as follows:

<table>
<thead>
<tr>
<th>Constituents Determined</th>
<th>Parts per Million</th>
<th>Grains per US Gallon</th>
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<td>Silica</td>
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Probable Combinations

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1909:
It is a typical Georgia town—and more, because it has the mountains, the climate, the water, the beauty and the health of the mountains. Its male population have the energy which ozone in the air and iron in the water gives. With the female population that ozone and that iron, according to some wise provision of nature, make beauty rather than energy.

. . . It is the country back of them and the ozone and iron in them that have enabled the people of Toccoa to accomplish what they have. There are two compresses here because the country sends its cotton to Toccoa.

The country around Toccoa is suitable for stock raising and dairying. The upland country of thousands of acres is adapted to the sheep husbandry. The last few years the people of this section have ascertained that apples, as well as peaches, grow as fine here as anywhere else in the country and is more profitable here than the peach. That there is money in the fruit and berry business here has been definitely settled.

. . . has a vast plantation that has been in cultivation over a hundred years, yet he makes, without any fertilizer, fine crops on the old place. The lands in these valleys and along these rivers make a bale of cotton to the acre and as much as fifty bushels of corn to the acre.

1921:
This secluded spot is probably more appreciated by nature-lovers from a distance who have been privileged to see it for the first time and its wonderful beauty grows with each recurring visit. Here Nature seems to speak in almost audible tones. It reminds one of the opening lines of William Cullen Bryant’s Thanatopsis:

‘To him who in the love of Nature holds communion with her visible forms, she speaks a various language.’

“To many who visit the Glen from time to time, there is nothing but the same heap of stones, the same trees and water. To others with an inborn sense of the beautiful, the inanimate objects seem to take on companionable forms and speak a language unheard by human ears.

The massive boulders, the shelving rocks, the beautiful trees and the hanging vines all add to the almost indescribable scene of beauty.

1928:
Not one half has ever been told of the surpassing beauty of this particular section of the Georgia Piedmont. In recent years when men speak of Toccoa Falls, they do not speak of that silvery sheet spilling itself in entrancing spectacle, but they speak of a superb landscape as well—of mountain grandeur, of shaded valleys, of the trail of the lonesome pine, of rugged oaks, of hillsides garlanded with laurel and rhododendron; of bird life, of springs of pure water gushing from crevasses high up in wooded fastnesses; of the song of brooks that go on forever, like Tennyson’s; of starry, overarching heavens; of that quiet paradise away from the maddening throng and the beaten paths of men. A fitting place it is, indeed to talk with God!
. . .  
The Institute farm makes it possible for the school to raise a large part of its food, including corn, beef, pork, poultry and garden vegetables. A fine school dairy supplies an abundance of milk and butter.
Toccoa Falls Institute also has its own saw-mill, planning-mill, cannery, steam laundry, private water system, and hydro-electric plant. All these things represent convenience, quality and economy.

1940:
Toccoa Falls Park, developed on the land owned by the school, is a beautiful wooded tract where 486 varieties of plants have been found.

1966:
The graveled bed of Toccoa Creek is a favorite hunting ground for collectors of gemstones, and tracings of gold have been panned from its sands.
Appendix C: Native Plants of Georgia

Listed below are several excellent online picture reference guides for native plants of Georgia. While guidebooks and references are no substitute for an in-person guide, they provide enough visual and background information to help an amateur botanist or naturalist identify an interesting native plant.

“Native Plants of North Georgia: A Photo Guide for Plant Enthusiasts”
http://www.caes.uga.edu/Publications/pubDetail.cfm?pk_id=7943

“Georgia Native Plant Society - Native Plant Gallery”
http://www.gnps.org/indexes/Plant_Gallery_Index.php

“Native Plants for Georgia Part III: Wildflowers”
http://www.caes.uga.edu/Publications/pubDetail.cfm?pk_id=7984

The results of annual wildflower pilgrimages in Georgia are posted at the following site and are updated each year with photos and identifications of native plants found on large-scale flower hikes.
http://georgianatives.net/

Lastly, the Native Plant Database can serve as a helpful resource for looking up a plant based on its name or particular features.
http://www.wildflower.org/plants/
### Appendix D: NGSS

Table 1

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<th>Content Area</th>
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**Notes:** NGSS content standards related to environmental education. When designing activities for K12 visitors, environmental educators should create lessons that align with the Next Generation Science Standards. Using Standards other than GPS standards will increase the likelihood of student groups from out of state being able to connect learning experiences as the Gathany Center with curriculum from outside the state of Georgia.
Appendix E: TFC Curricular Areas of Interest

TFC Curricular Areas of Interest*

School of Arts & Sciences
  Humanities and Natural Sciences
    Biology Major/Minors
      Biology
      Ecology (BIO 423)

School of Christian Ministries
  Ministry & Leadership
    Outdoor Leadership and Education Major/Minors
      Environmental Education (OLE 323)
      OLE Internship (OLE 473)
  Youth Ministries Major/Minors

World Missions
  Sustainable Community Development

Others interested in stewardship of creation

School of Professional Studies
  Teacher Education
    Early Childhood
    Middle Grades
    Secondary Education

*School
  Program
    Major/Minor
    Course
Appendix F: Gathany Education Resources
Underlines links are embedded html links (best accessed from the digital file of this document) to specific webpages with information specific to each category listed below.

Citizen Science Projects
Cornell - Citizen Science Central
  • Journey North - Track species which migrate through GA
  • EDDMapS - mapping invasive species in US and Canada

Water monitoring
  • K-State Report: Citizen Science Water Quality Mapping

Mobile Applications (iOS)
  • Creek Watch - Monitor the health of your local watershed

Mobile Applications (andriod)
  • Plant Growth monitoring: My Plant Diary
  • Plant Classification: Plant Morphology
  • Water Monitoring: Citizen Science Water

Local Nature/Science Centers
Educational Programs
  • Blue Ridge Outdoor Education Center: Classes
  • Sandy Creek Nature Center: Programs
  • Georgia Botanical Gardens: Educational Programing
  • Gwinnett Environmental Heritage Center: Education K12
  • Fernbank Science Center: Teacher Resources
  • Chattahoochee Nature Center: Education
  • Elachee Nature Science Center: School Programs
  • Zoo Atlanta: Educator’s Lounge
  • GA Aquarium: School Programs
  • Georgia 4-H
    o Rock Eagle: Class Descriptions
    o Wahsega: Class Descriptions
    o Burton: Class Descriptions
  • Gray’s Reef Marine Sanctuary: Classroom Activities (In classroom lessons only)
  • Oatland Island Wildlife Center of Savannah: Programs

Local Organizations/Monitoring Projects
  • GA Watershed Protection Branch: GA Adopt A Stream
  • Savannah Riverkeeper: Volunteer sign up
  • Trout Unlimited: Savannah River Chapter
  • Georgia DNR: Rivers Alive: Local Cleanups

National/global monitoring projects
  • Globe.gov: Hydrology
  • EPA: National DIrectory of Volunteer Monitoring Programs
- World Water Monitoring Challenge: International Monitoring Project

Education for Leaders
- Georgia Botanical Garden: Teacher Page
- Zoo Atlanta: Teacher Workshops
- Fernbank Science Center: Professional Learning
- Georgia Aquarium: Professional Development
- Environmental Educator Certification: ATEEG
- Georgia River Network: Paddle Georgia
- Gray’s Reef Marine Sanctuary: Teacher Workshops
- Georgia Project Wet: Educator Workshops
- GDNR: Wildlife Resources Division, Project WILD: Educator Workshops
- NOAA: SKYWARN class

Conferences
- Environmental Education Alliance of Georgia: Annual Conference
- North American Association for Environmental Education: Annual Conference

Communication
- EPA Volmonitor Listserver: email listserve

Web Resources
- Georgia Aquarium: Web Resources
- Georgia River Network: Water Trails That Work YouTube playlist
- Georgia River Network: Experience your River
- Georgia State Parks: Historical Resources
- Georgia State Parks: Links & Resources
- Georgia State Parks: Educational Resources
- Georgia Department of Natural Resources: Educational Links
- Rivers Alive: Educational Resources
- Environmental Education in Georgia: Environmental Educational Organizations
Appendix G: Running Out of Room Between the Hedges

Background Information

The Nature of Ligustrum

The name Ligustrum refers to a group of plants within the Olive Family (Oleaceae). Ligustrum is a genus which includes multiple species (examples include Japanese privet, Amur privet, European privet, and Chinese privet) collectively referred to as privets. None of these species are native to North America. Chinese privet, *Ligustrum sinese*, is considered a perennial shrub but may grow to the height of a small tree, up to 30 feet tall. Privet root systems do not grow deep into soils but are often prolific. The plant may reproduce sexually or vegetatively through suckers. Twigs are covered in small hairs. Opposite (found directly across from each other), oval shaped leaves 1/2 to 1 1/2 inches long are found along stems. Leaves are evergreen to semi-deciduous. Chinese privet grows best in open sun but has shown to be highly shade tolerant.

Groups of white flowers form at the end of stems resulting in clusters of dark blue to black berries. These berries are toxic to humans and many other species.

Distribution of *Ligustrum sinese*

Privet as an Invasive Species

Chinese privet came to the United States in 1852 as an ornamental shrub from China. Often used as a hedge, the plant has spread past cultivated areas and into the wild. Privet has now become prevalent throughout the southeastern United States. Chinese privet excels in habitats ranging from dry to wet. It is often found along fence lines,
streams, and forest edges. Unchecked growth will form dense thickets. These thickets crowd out local native plants forming monoculture stands.

**Chinese Privet (Ligustrum sinense) with berries**

© Leslie J. Mehrhoff, University of Connecticut

The loss of plant species diversity in turn reduces the number of animal species which depend on these native plants. Insects such as bees and varieties of birds appear in greater frequency when there is a greater biodiversity amongst plant species. Privet has also been documented as the single greatest threat to some endangered species such as Schweintz’s sunflower.

**A Local Example: The Georgia Piedmont Region**

The piedmont region of Georgia has a geomorphology which lends to the formation of a large number of streams and creeks. While these waterways provide a suitable habitat for many of the region’s plants and animals, the flowing water also serves a means to disperse the fruit of the Chinese privet. Chinese privet is well known for thriving along stream banks and choking out native plant species. Attempts to remove Chinese privet include using mechanical methods such as chainsaws and wood chippers. This type of work is labor and time intensive. Herbicides are used to try and kill the plant. One of the troubles using herbicides is they are often toxic to surrounding vegetation. This can be of particular concern with spraying near creeks or streams which may carry the toxin downstream. The high reproductive rate of Chinese privet along with the fragility of waterways makes controlling the plant a tall order.
About the Author

James Ammons received his B.S.Ed. in Science Education from the University of Georgia. After earning his degree he went into teaching. He taught high school Biology and AP Environmental Science for several years. He is currently working to complete his M.Ed. in Science Education also at the University of Georgia.

James Ammons

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FIRST. Problem Statement

What is the best way to remove Chinese privet and restore native species?

SECOND. Developing Alternative Solutions

Directions: Scientists and horticulturalists have suggested multiple ways to remove Chinese privet. Below you will see six possible solutions to this problem. Work with the others in your group to develop at least 4 new solutions and add them to the list. Make these solutions as realistic as possible. We will be using your ideas to talk about this problem in a little bit. You may use the internet or any other resources provided by your teacher. Write your new solutions in the blanks below.

1. Mechanical removal using chain saws and other cutting tools.

2. Use selective herbicide application.

3. Start a local movement asking local plant nurseries to stop selling Chinese privet.

4. Use animals, such as goats, to clear privet through grazing.

5. Introduce a natural predator, such as a Chinese leaf beetle (Chrysomelidae) species.

6. Start a letter writing campaign asking local or state office holders to prohibit the sale of Chinese privet.

7. 

8.
THIRD. Evaluating the Alternatives

**Directions:** Once your group has come up with a list of solutions to the problem now you will need to decide which solutions are the best. For the next section, your group will decide on ways to judge whether or not a solution really is a good solution. The following list of criteria shows six ways to evaluate a solution to determine if it is a good solution. As a group, think of four more criteria with which you can rate the solutions from the last section. Write your new criteria in the blanks below.

1. Removes as much Chinese privet as possible
2. Restores native plant populations to original state
3. Solution is economically feasible
4. Public will agree to solution
5. Solution leaves the least amount of toxic material on land or into water
6. Solution is sustainable with current resources.
FOURTH. Putting It All Together

**Directions:** Using a copy of the alternative solutions matrix (Appendix A), list the alternative solutions you want to rank and the criteria you will use to rank them. Then decide how you will score each solution (for example scoring system, see Appendix B). Once you have finished scoring each solution, fill in the total points by adding each row. Then move on to “Some Questions to consider” or wait for further instructions from your teacher.

Questions to Consider

1. Consider the biodiversity of a stream along a bank covered entirely in Chinese privet compared to a stream somewhere else in the southeast United States which has no Chinese privet at all. Describe several ways the biodiversity impacts the overall health of these habitats.

2. Draw a healthy ecosystem. Think about how many different species (label them) of organisms are involved in creating a healthy ecosystem.

3. Of the solutions your group evaluated which one do you believe is the best? Is this the solutions which received the highest score when you evaluated all solutions? Explain why or why not?

Follow-Up Activities & Resources

1. Have groups share with the rest of the class the criteria which were used to evaluate solutions. What are some of the similarities between groups; what are the differences? If this same exercise was done at a different school on the other side of the state, would those students have the same criteria as your school? Explain why you think so?

2. Watch a video on identifying characteristics of Chinese privet. Once you leave school, see how many people in your class can find Chinese privet on the way home from school.
Tomorrow, share with the class where you saw Chinese privet, what type of habitat it was living in, and if it was cultivated or growing wild.

http://plants.ifas.ufl.edu/node/231

3. Take time to explore this interactive map to see if Chinese privet has been reported in your area. Do any of the locations you and your classmates noticed in Activity 2. Show up on the map?

http://www.eddmaps.org/distribution/viewmap.cfm?sub=3035

As a class you can report sightings of invasive privet for a national database. You will need a device with GPS capabilities to plot locations. Discuss with your class how you think the information in this database can be useful to different groups of people.


4. Chinese privet is not the only invasive plant in the state of Georgia. Take some time to learn about other invasives in this state. Discuss with your class if there are any steps your class can take to help slow down or prevent the spread of these organisms.

http://www.gaeppc.org/weeds/gpca.html

5. Multiple organizations throughout Georgia are working toward cleaning up Georgia’s waterways. Find a local stream or river clean-up date aimed at removing Chinese privet and other invasives. Some of these groups include:

The Georgia River Network: http://www.garivers.org/

Trout Unlimited of Georgia: http://www.georgiatu.org/
Glossary

- **Invasive species** – a plant or animal species not native to a local habitat. Often times these organisms disrupt local ecosystems by creating adverse effects for one or more native species.
- **Biodiversity** – the amount of different species found within a given ecosystem, biome or other designated area.
- **Perennial** – A plant which has a life span lasting more than two years.
- **Shrub** – a plant designated by have many large stems and often shorter in height than trees, usually under 20 feet.
- **Habitat** – the location in which an organism spends most of its time living and interacting
- **Suckers** – short underground stems of some plants which when broken off from the main plant can form a new organism genetically identical to the parent.
- **Vegetative reproduction** – type of asexual reproduction in plants where new individuals are produced from the parent without the creation of seeds or spores.
- **Evergreen** – a plane which keeps its leaves all four seasons.
- **Deciduous**- leaves which are shed for part of the year, most often in fall.
- **Monoculture** – group of organisms, often referring to plants, which are all of the same species. Monocultures are more susceptible to disease as pathogens can easily spread from one host to the next in close proximity.
- **Native** – originally belonging to a certain area.
- **Ornamental** [plant] – plants grown for decorative purposes.
- **Herbicides** – a chemical used to target and kill plant species. However, these toxins can be a hazard to species other than plants.
- **Reproductive rate** – how quickly one generation of a species can produce the next generation
References


Appendix A

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<th>Alternative Solutions</th>
<th>Evaluation Criteria</th>
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Appendix B

Sample Scoring System

Possible Scores: 1-6

1 → The solution does not meet the criteria at all.
2 → The solution meets the criteria slightly.
3 → The solution somewhat meets the criteria.
4 → The solution meets the criteria fairly well.
5 → The solution does a good job of meeting the criteria.
6 → The solution does an outstanding job of meeting the criteria.

Rank your solutions five times (once for each of the five criteria) using the six point scale described above. For example, if one of your criteria for evaluating solutions related to the destruction of marsh hammocks was public support, look at each solution and rank these solutions in order from highest (6) to lowest (1). The solution that the public would fully support would earn a six, whereas the solution that the public would despise would earn a one. The solutions in the middle would be ranked between two and five. Try not to give two solutions the same score. After ranking the six solutions, add up the values and record the totals. The best solution will have the highest total.