Sustaining the Southwestern Ecological Laboratory

Spring 2017

Prepared By
The Environmental Studies Capstone Group

Zach Brown
Daniel Buffington
Dori Cresanta
Thomas Gromatzky
Sam Guess
Hailey Johnson
Austyn Laird
Anja Thomsen
Farrell Stucky
Garrett West

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Executive Summary

The 25-acre Southwestern Ecolab was established in 2014 to provide students in the science and environmental fields practical, field-based experience in an interactive environment. It also served the dual function of allowing Southwestern University to attain tax-exempt status on this parcel of land. However, the Ecolab site faced several challenges including a lack of maintenance and history of poor management. Additionally, the Ecolab course lacked a clear curricular structure and walking path decreasing accessibility of the site. Together, these issues prevented the formalization of this space and associated classes into the Southwestern curriculum. In 2017, the Environmental Studies Capstone group decided to address and resolve these issues by outlining the following goals: 1) Clean-up the Ecolab by removing trash from the site and improving the accessibility of Ecolab through the construction of a trail, 2) Identify invasive species within the Ecolab and create a species distribution model of one of these species using GIS applications in order to create a protocol for their future control, 3) Develop a curricular structure for Ecolab, 4) Secure grant money to continue funding of projects, and 5) Create a land management and protocol plan to provide guidelines for future research and classroom use.

To accomplish these goals, students researched Ecolabs at other universities to determine how to proceed. Legal issues, tax law, budgetary concerns, safety issues, and project feasibility were all considered. While the Capstone group worked together towards one mission, students split into multiple groups to accomplish complementary goals. Also, a previously established Land Use Committee (Appendix D) consisting of several Southwestern professors and staff was reconvened to address the upkeep, management, and funding of Ecolab. Through the collaboration of students, faculty, and the Land Use Committee, a strategic framework was then developed with the overarching goal of sustaining the Southwestern ecological laboratory.

This specific document reflects upon these aforementioned efforts and has been written with the intent to give future users of the Ecolab a historical background of Southwestern's specific ecological site, a literature review regarding the utilization of living laboratories within Institutions of Higher Education (Section 2), a baseline curricular structure for an Ecolab course at Southwestern University (Section 3), and potential research opportunities that are made available through living laboratories (Section 4). This document also provides visuals for the Ecolab site, as well as, necessary administrative forms for accessing and conducting onsite research (See appendices). The accompanying **Southwestern Ecological Laboratory Land Management Protocols & Practices** document contains a more in-depth analysis regarding land management procedures and safety concerns of Ecolab. Additionally, this document explores the possibility of teaming up with third party organizations for community outreach projects.

Finally, Sustaining the Southwestern Ecological Laboratory briefly describes other projects that

contributed to the Spring 2017 Capstone. These projects include the trail construction (Spring 2017), and a GIS project mapping invasive species of the area. This map is to be used for future reference as a guide for removing and preventing future invasive expansion of these species. For more information regarding these projects as well as specific forms and examples concerning curricular structure, stakeholder contact information, safety and liability concerns and protocols, and tax information see the attached appendices.

Mission Statement

The goal of the Southwestern University Ecolab is to encourage the study of local ecosystems through the preservation and maintenance of an outdoor research laboratory that enriches the academic experience of the Southwestern campus community.

1. Introduction & Background

The Southwestern Ecolab is an ecological research site intended to grant students the opportunity to gain experiential research skills in the context of a living laboratory.

Ecolab exists on university-owned land east of campus. Most of the land had not historically been used for academic purposes. Rather, the university leases it to local ranchers who use the land primarily for cattle grazing and hay production, providing Southwestern with an agricultural tax exemption. In Spring of 2014, a committee appointed by Southwestern's president, Dr. Burger, discussed creating an "ecological zone" incorporating most of the land that Southwestern was currently leasing. However, at the time Southwestern lacked sufficient financial and human capital to create a large singular zone, thus shifting focus to a hopeful yet much smaller ecological zone. Fortunately, in similar timing, Williamson County Appraisal District addressed a 25-acre portion of the land that lacked adequate fencing and regular crop production. Therefore, the plot of land failed to meet the requirements for agricultural tax exemption status. The threat to the tax exemption status left the university to determine an alternative use for the lands. In 2014, it was decided then to designate the 25-acre portion of land as an "ecological laboratory". This allowed for the university to acquire a tax exemption available under Texas Tax Code § 23.51, which allows for ecological research by a public or private university.

In the Fall semester of 2014, Ecolab became an opportunity for students to gain experience in conducting chemical water quality analysis including pH, turbidity, conductivity, chloride, nitrate, on-site pH, on-site dissolved oxygen, and phosphorus testing. Initially, six students were interested and became involved in this research opportunity. At the time, this group of students were paid to conduct research by a grant administered through the Environmental Studies Program, which allocated a small portion of funding from a 2009 Andrew W. Mellon Foundation grant.

By Spring of 2015, this funding ran out and the number of students involved decreased to four. However, these remaining students realized the potential of Ecolab to provide students the opportunity of developing valuable environmental field research skills. Thus, they applied for a King Creativity Grant, which was approved Fall of 2015. This grant provided funding for new pertinent research and analyses equipment. For example, waders were purchased to expand collection sites for chemical water quality analysis. Additionally, Game Cams purchased through this fund have allowed for a basic biodiversity inventory of Ecolab to be created. Furthermore, the acquisition of a dissolved oxygen probe and pH probe has enabled sediment and soil analysis to be conducted.

Other Ecolab activities have involved the application of Geographic Information Systems (GIS). The application of GIS has been utilized for projects, such as conducting historical analysis of the land through georeferenced aerial photography, mapping the fluvial systems of Ecolab through LiDAR remote sensing, and using photosphere technology to create a virtual tour of Ecolab. Restorative efforts involving the removal of solid waste and invasive plant species (namely, *Ligustrum lucidum*) on the land have been implemented as well through GIS applications.

Upon recognizing the value of these research opportunities, students presented the idea to President Burger to formalize these activities into a course curriculum. Through student-professor collaboration, a curriculum developed with the first independent Ecolab class being offered in Spring 2017. Ecolab has the potential to be readily integrated into the curriculum of courses for several departments, including chemistry, biology, and environmental studies. This process is already occurring as classes such as chemistry of the environment and first-year-seminars have visited the Ecolab to conduct chemical water quality analysis. The significant student-driven interest in developing Ecolab exemplifies the interest in developing this space into a long-lasting program of Southwestern University.

Southwestern University's promotion of these previously mentioned research activities is due to the obtained tax exempt status, which covers any site owned by an institution that is used for on-site student research. To date, the tax exemption status of Ecolab remains consistently unthreatened and is monitored by the Williamson County Appraisal District who serves as a central stakeholder in Ecolab. This exemption is also a primary concern for the Southwestern Finance Office who decides the monetary worth of Ecolab. Moreover, increased involvement of Southwestern students and faculty in Ecolab research and curriculum extend the pedagogical worth of Ecolab establishing the desire to preserve and maintain the 25 acres.

As noted before, Ecolab faces several environmental, structural, and curricular challenges, thus the space has faced difficulty in being comprehensively integrated into Southwestern's

curriculum and is under-utilized by Southwestern faculty and students. Since the space once lacked a clear walking path and has also historically been used for dumping trash, it has faced multiple liability and safety issues. This deflects many professors and faculty's interest in using this space.

The 2017 Capstone group's recognition of these issues led them to construct a clear quarter mile hiking path. To commence construction, the Capstone group applied and received a Green Fund grant that supports projects which continue sustainability initiatives on the Southwestern campus. By securing the necessary financial capital, the group then hired an Austin based company, the S&S Trail Company. The trail project does not jeopardize current tax exemptions, and in fact, arguably further preserves the land by enhancing accessibility of Ecolab, and thus functionality of the space for recreational and/or research practices. The overall construction of this trail completes a piece of the five primary goals previously outlined.

The 2017 Environmental Studies Capstone group hopes that by fulfilling these goals, Ecolab will be ultimately enhanced and formalized within Southwestern curriculum, and will be further ingrained into the sustainability mission and core principles of Southwestern University.

2. Literature Review

2.1 Sustainability in Higher Education & the Southwestern Experience

Institutions of Higher Education (IHEs) have become fundamental agents in developing the theory and practice of sustainability. IHEs can function as centers of learning and research, and often act as communities within larger cities. Therefore, they are uniquely positioned to promote sustainability as educators, practitioners, and as community partners. In this way, universities have become "living laboratories for sustainability" (Evans & Karvonen, 2011), and are able to offer a more diverse range of benefits and positive impacts through the implementation of sustainability programs. These include, reduced utility costs, more efficient and effective landscaping practices, improved standing among peer institutions, and greater appeal to prospective students and faculty (Barlett & Chase, 2004; Brown & Hamburger, 2012; Carlson, 2006). Furthermore, universities have found that the promotion of sustainability practices and the incorporation of sustainability into IHE curriculums and programs better prepare students to address complex global issues in a dynamic world where environmental issues have gained increasing salience (Cortese, 2003).

Institutions of Higher Education are not isolated in this curricular process. Organizations such as the International Sustainable Campus Network (ISCN) and the Advancement of Sustainability in Higher Education (AASHE) work to provide support, funding, and networking opportunities for IHEs that understand the responsibility they have in shaping a sustainable future through the cultivation of innovative, critical thinkers.

For the past decade, sustainability measures have been operationalized on Southwestern campus and sustainability has become an important facet of the campus culture. This has been accomplished by implementing clean energy initiatives (the campus is now powered by 100% renewable energy thanks to a student-led initiative), promoting environmental awareness and literacy on numerous fronts, providing grant opportunities to encourage student-driven social and ecological sustainability initiatives. The campus has also invested in LEED (Leadership in Energy and Efficient Design) certified construction, implementing campus-wide waste and recycling programs, instituting numerous energy and water conservation programs, and championing numerous other sustainability initiatives.

In addition, Southwestern university has signed on to broader national and international sustainability agreements, joined national organizations, and attended local and national conferences to formalize support for sustainability and broaden its network of partners and support structures. In 2009, Southwestern University committed to sustainability by signing the American College and University President's Climate Commitment (ACUPCC) and in 2014, it became a member of the Association for the Advancement for Higher Education (AASHE). In 2015, Southwestern applied for certification with the Sustainability Tracking and Rating System (STARS); it achieved "Silver" status later that year.

Southwestern University is now in the position to further develop opportunities for sustainability research and practice through the establishment of an ecological laboratory. Numerous other institutions have already established fieldwork laboratories for environmental research, pedagogy, and practice, and the following section provides a brief overview of their experience.

2.2 Ecological Laboratories and Institutions of Higher Education

Institutions of Higher Education have recognized how living laboratories can create a space for experiential learning, as well as enhance the employability and versatility of students by making visible the connections between economic, environmental, and social systems through applied learning practices. Cortese (2003) argues, "compartmentalized knowledge without connection to larger system interaction results in viewing many interdependent challenges as separate, hierarchical, and competitive." Living laboratories cultivate an interdisciplinary research experience that minimizes the challenges presented by funding isolated intradepartmental research projects, and helps to prepare students for a smooth transition into the workforce or graduate-level schooling. This preparation is achieved through the learned practical research skills students acquire in living laboratories, as well as, the learned ability to deduce information from observations in natural landscapes with an open inquiry format. Employers often look for hands-on experience to ensure that young professionals can apply their learning in a manner that directly benefits their ongoing projects, and Ecolabs provide a space for achieving this.

Moreover, this research approach facilitates opportunities for students to connect with professors and become inspired to begin long and short-term independent research projects. Multiple methodologies and fields of study are then incorporated instead of isolated research efforts by individual departments. The significant collaboration between students and professors necessary in this research approach, enhances student engagement, innovative thinking, and increases the energy and productivity of students (Kelly and Schaefer, 2015). While traditional laboratories offer a space for developing research skills, the exposure of students to a more unconventional living laboratory would further develop skills in adaptability and creativity through collaborative and experientially applied learning (Filho, Shiel, and Paco, 2016; Evans & Karvonen, 2011).

Furthermore, an understanding of the interrelationship between university administration, faculty members, students, and community stakeholders is also developed through the utilization of Ecolabs by IHEs, providing a real-world understanding of bureaucratic decision making and protocols. Despite this reality, undergraduate educators often underutilize experiential learning and technical training due to scheduling and coordination difficulties concerning transportation and expenses related to Ecolabs (McCleery et al. 2005). These concerns, coupled with liability and safety issues related to transportation to Ecolab, as well as, potential injuries or environmental risks at the site, tremendously reduce interest in utilizing outdoor spaces for experiential learning. However, a number of IHEs have addressed these issues and have utilized and incorporated Ecolabs within university curriculum (University of Wisconsin-Madison, Marian University, University of Georgia, Unity College, Williams College, Sewanee: The University of the South) .

University Ecolabs are used for multiple applications, including education and restoration, research and generation of new ideas, recreation, and community outreach. Through these applications, IHEs have diversified and distinguished their curriculum and have increased interdisciplinary connections through the incorporation of an Ecolab within humanities courses. The following examples of this incorporation demonstrate both large and small-scale application of this natural learning environment within IHEs, detailing specifically how these Ecolabs are used.

2.3 Incorporation of Ecological Laboratories at Larger Universities

Many universities have used Ecolabs to facilitate a better understanding of natural landscapes as a means of achieving restoration of disturbed ecosystems. For example, through the restoration efforts conducted at the University of Wisconsin-Madison Arboretum, a new concept in ecology emerged: Ecological Restoration (UWM, 2017). This concept has shaped the methodological process in ecological education of a natural space at other large Universities as well (Marian University: The Nina Mason Pulliam Ecolab (NMP); University of Georgia: The Savannah River Ecological Laboratory (SREL)). While the University of Wisconsin is a much larger institution compared to Southwestern University, this example exposes how new research concepts and

methodologies can develop through use of a living laboratory.

Specific projects where the integration of restoration and education are exemplified can be seen in the projects conducted within the NMP. Some of these projects include the student-faculty conducted analysis of beaver biology through mapping and describing beaver canals, analysis of how wetlands affect water quality, collection of baseline data on groundwater chemistry, conduction of cost/benefit analysis on various types of predation-protection mechanisms for saplings along Crooked Creek, and development of GIS databases (NMP, 2017). Additionally, the SREL, which is the first national environmental research park, contains the presence of onsite nuclear and industrial facilities providing students with an exceptional opportunity to study natural and disturbed ecological systems within the same region (SREL, 2017). Activities relating to this unique characteristic, include population dynamics and toxicology of fish and percentage of radionuclide distribution of overwintering waterfowl. The SREL receives funding from the National Nuclear Security Commission to conduct these analyses and is credited for publishing over 2,500 research articles to research.

In addition to education and restoration, these IHEs have also used Ecolabs as an outlet for increasing community engagement. Each have developed multiple programs that invite volunteers to participate in citizen science, increasing the agency and salience of environmental challenges among community members. For example, according to the UWM Arboretum website, volunteers are invited to participate in bird watching and collection of breeding and migratory patterns as well as monitor bumblebee and dragonfly populations. Simultaneously, volunteers develop conservation techniques concerning this species through this process. The UWM maintains partnership with The Xerces Society and Bumble Bee Watch organizations to sponsor and promote this volunteerism (UWM, 2017). Marian University also promotes this type of volunteerism while additionally inviting Girl Scouts, Boy Scouts, and K-12 groups to become involved within the NMP as well (NMP, 2017).

The SREL incorporates similar strategies of community engagement in addition to displaying exhibits throughout local and regional events. Live animals and plants are used throughout these exhibits, with the purpose of providing education about the biodiversity of the local natural environment (SREL, 2017). These exhibits further increase public awareness about the interrelationship occurring between local ecosystem health and the well-being of living organisms. While community engagement currently maintains distant attainability at Southwestern University, these previous examples indicate how IHEs can cultivate sustainable mindsets among both attending students and community members in the future. The goal in achieving sustainability is then both unified, diversified, and operationalized on a larger scale. The following section will expand on how these educational, recreational, and community engagement opportunities are materialized on small-scale IHEs.

2.4 Incorporation of Ecological Laboratories at Smaller Institutions

While many small liberal arts institutions have incorporated Ecolabs within their curriculums, the following examples of these institutions contain the most relevance to Southwestern University: the "Wet Lab" of Unity College in Unity, Maine, Hopkins Memorial Forest (HMF) at Williams College, and the Domain at Sewanee: The University of the South in Sewanee Tennessee. Each of these institutions have integrated an interdisciplinary incorporation of Ecolabs within their liberal arts curriculum, and exemplify the significance of student collaboration in formalizing these sites. For example, "The Wet Lab" relies heavily on students to maintain and upgrade the Wet Lab Facility, while also participating in coursework related to the Ecolab space (The Wet Lab, 2014). These institutions greatly encourage student input for research efforts. For example, in The Wet Lab students have proposed research projects for the study of marine invertebrate organisms. All projects must be registered with The Wet Lab and students must create small educational displays to inform visitors and other students, which is like the exhibitions of the SREL.

Likewise, student involvement is exemplified on the Domain at Sewanee University. The University invites students to participate in the land management planning of the Domain. For example, goals of the 2012 Domain Strategy White Paper, (outlining land management goals of the Domain), was authored and applied with heavy student involvement in implementing these goals (The Domain, 2015). Students are also authoring other documents concerning biodiversity of the area and comprehensive management plans for specific sections of the vast area the Domain includes.

The interdisciplinary incorporation of Ecolabs is demonstrated through these IHEs as well. At the HMF, research is applied through a variety of disciplines including biology, chemistry, environmental science, geology, and history (HMF, 2017). Some research projects conducted through these disciplines have included the analysis of ant/treehopper mutualism, land-use patterns and impact on pollination and flower productivity, and examination of historic use of the landscape through accumulation of forest vegetation data. At the Domain, ecological processes, biodiversity, and land-use history of this site is specifically incorporated into courses such as geology, forestry ecology, biology, and humanities courses including archaeology, environmental arts, and religion and environment. Through the applied research conducted in the Domain and interdisciplinary integration of this natural space throughout various scientific, environmental, and humanities courses, the IHE curriculum is unified and environmental stewardship is established in the process.

Through these programs, students are afforded the opportunity to gain hands-on field research skills, knowledge in various research and land-use strategies. Students also gain experience in educating local primary school students about HMF ecology and historical use of the land. Sustainable ways of thinking about natural resources are then contemplated and disseminated.

Finally, student and community interest of Ecolabs at these IHEs has been harnessed from the recreational activities offered through these sites. At the Domain and HMF, for example, these activities include camping, hiking, restricted and regulated horseback riding, mountain biking, rock climbing, and deer hunting. Community engagement is achieved by each of these IHE's workshops and volunteer programs involving community members and K-12 students. At the HMF, Students have opportunities to gain experience in field research through the possibility of becoming Ecolab research assistants to professors. These students then can educate and mentor K-12 students. Students are then able to improve collaboration and teamwork skills in the process.

These educational, recreational, and community outreach opportunities that Ecolabs offer exemplify how Southwestern University can develop the practical research skills of students through the integration of knowledge acquired within a natural environment. This added content and skill development would strengthen the environmental studies program while also diversifying the humanities department as well. The previous examples of these benefits provide ideas on how Southwestern can achieve this interdisciplinary incorporation of Ecolab. These ideas have been taken into consideration within the following section concerning applied research opportunities for the Southwestern Ecolab.

3. Developing Courses & Class Research Projects for the Southwestern Ecolab

The environmental studies program partnered with the physics department as a joint effort to create a Fall 2017 to Spring 2018 faculty position that is responsible for teaching a four-credit Ecolab course. A baseline curricular structure has been created with the intent of establishing topics with accompanying laboratory modules that will utilize the Ecolab site, while still giving the instructor freedom to design their own variation of the course. These labs could be used in the Ecolab course itself or could be adopted by other courses. The proposed curricular structure for Southwestern's Ecolab course is based on professor input, courses implemented at similar institutions of higher education, and student feedback on previous/existing Ecolab courses.

3.1 Proposed Course Structures for Ecolab

This framework is intended to provide a sample course model that may be adapted as seen fit according to the interests, abilities, and time constraints of a given class instructor. The course is divided into four units with distinct fields of study intended to accommodate various field research interests and build a broad experience base for students. To ensure the continuity of activities and research within Ecolab, all research and projects conducted by this course are expected to be compiled into the formal report by the end of each semester for the University Land Use committee to review.

Although interdisciplinary, the Ecolab course will be housed by the environmental studies program. It is expected to count as a natural science lab credit that meets twice a week for an hour and fifteen minutes. However, a typical science course at Southwestern traditionally meets twice a week for the same amount of time but with an additional three-hour lab period. We recommend that Ecolab adopts this traditional structure for the course to provide students with an enough time to conduct labs. In the introductory class, lab modules for the course must not require knowledge of statistics, experimental design, or any advanced biological or chemistry concepts.

There are four adaptable lab modules with overlapping themes of study that comprise the curricular organization of the Ecolab course. These topics include: environmental quality (soil, water and air), meteorology, restoration projects, and biodiversity. Examples of these lab modules can be found in Appendix F. These modules will be based upon students developing research questions and studies with a faculty advisor to incorporate in-depth, course-based undergraduate research experiences (CUREs). This model is consistent with other natural science courses offered at Southwestern. These types of inquiry-based courses are intended to discourage students from relying on professors for guidance during a lab experiment.

When formulating the proposed units, the 2017 Capstone group had to determine what types of labs would be most effective for Southwestern. For the unit environmental quality, it was determined that labs implementing studies utilizing various methods to test soil, water, and air conditions in Ecolab would be best. Lab modules to achieve this goal may take an equipment and chemical analysis approach, a bio-indicator approach that uses sensitive animal or plant species as proxies for environmental quality, or a combination of these strategies to generate a more holistic understanding of how to track environmental conditions. This is intended to provide students with experience in taking samples, examining trends in their data, and making informed inferences about how the results of these environmental quality metrics may impact ecosystem health.

With current plans to build a weather station, the Ecolab class will be able to apply data on meteorological variables related to climate conditions to their wildlife, water and soil quality, and restoration lab modules. The data collected from the weather station will allow students to study the effects of changing atmospheric variables in Ecolab. In addition to applications with lab studies, students can contribute these data to national climate research projects. These projects will track climate change and air quality and allow students to understand the importance of these variables on ecosystem health.

The restoration unit of the class will provide a basis for measuring the effects of anthropogenic disturbance at Ecolab and allow students to implement management plans to mitigate these concerns and protect Ecolab's value as a research site. These efforts will ensure and maintain

suitable conditions for the biological community in Ecolab during the course. Studies within this unit of the course are designed to illustrate the value of emphasizing native species abundance while allowing students to understand the challenges posed by exotic species and conduct research that informs management plans to minimize these deleterious effects.

As with all applied labs in a 4-credit Ecolab course, the primary challenge in the creation of these research projects is the development of a curriculum that is engaging, teaches standard procedures, and accommodates broad learning outcomes while being concise enough to comprise a single 2-3-week unit. One helpful way of achieving these intended goals is to create lab protocols that draw upon the skills and knowledge of prior projects. This synthetic approach creates a frame for sequential learning and allows for more flexibility in temporal limitations of the units or labs. The biodiversity unit of the course serves as an accumulation of previous projects. Biodiversity labs can afford students opportunities to learn standard wildlife and vegetation assessment protocols, while also contributing to the ongoing characterization of the health and abundance of life existing in Ecolab. At this point in the course, students should have expanded their overall skills and knowledge regarding field research. As such, students will be more prepared to conduct wildlife or vegetation labs with more liberty and flexibility. This creates an ideal opportunity for the Ecolab instructor to encourage inquiry-based labs allowing students to design their own study parameters to explore their passions and personal research interests. Thus, the biodiversity unit is the ideal final topic of the course.

At the end of each unit, students will write a field report that reviews background literature on the module topic and synthesizes their experience with the lab. The Land Use Committee will oversee the modules and ensure they follow the protocols outlined in the Land Management Practices and Protocols. By outlining this curricular structure, the implementation of Ecolab at Southwestern is streamlined as a course-based, field research site. Secondly, it ensures the continued application of Ecolab as a Southwestern course.

4. Opportunities for other Classes and Research Projects

Apart from its use for the Ecolab course, the area can potentially be used as a research site for professors, other classes, and students working on independent studies. Courses such as environmental GIS, intro to climate science, other environmental studies courses and courses in chemistry, biology, and physics would be most applicable. Several independent student-led projects are already being implemented and though separate from the course, these projects can still benefit the course and site if they are continued or built on in the future.

Other IHEs of a similar size have utilized their environmental laboratories for courses in varied disciplines. Not only have these similar institutions like Sewanee University and Williams College incorporated their use and study of living laboratories into the curriculum under science-

based departments, (environmental studies, biology, geology, forestry ecology, chemistry), but they have also incorporated their use of these sites as they pertain to humanities-based departments, such as history, fine arts, and religion. These courses exist under titles such as environmental arts, environmental history, and religion and the environment. While humanities classes have not been successfully implemented at Southwestern's Ecolab, this is something that could be considered in the future.

4.1 Biodiversity

A potential project that would benefit data collection in Ecolab is establishing a small, simple bird blind. This would take the form of a low wooden wall disguised with brush or camouflaging print, with a bench behind it. Observers would be hidden from birds and be able to observe birds without disturbing them by moving around. Bird data gathered by Spring 2017 Ecolab class can be used to determine the most useful place to build this. Future students can contribute to this project to build a more complete inventory of birds present in Ecolab throughout the year, (as current data will be confined to spring and may not be representative of the birds found in Ecolab in summer, fall or winter).

Another future project is the installation of a frog call recording device. This would enable data to be collected on amphibian species abundance without requiring human presence. One of these devices is set to be installed in the late 2017 spring semester and will generate baseline data to be applied in future research projects advised by Dr. Benjamin Pierce, Dept. of Biology. This data could be utilized for a variety of studies in the future such as measurement of human presence and changing land-use impacts on frog populations, as well as, comparing frog data with game cam and weather station data to study the interrelated elements of Ecolab.

4.2 GIS

The application of GIS-based field ecological research allows students to build skills with technical and visual representation functions. Due to increasing demand for GIS-based experience for professional ecological research, future implementation of this into the Ecolab course would provide students with important skill and knowledge development in this field. Ongoing efforts to characterize the species health and abundance of Ecolab would also be enhanced by incorporation of GIS components to field research. GIS will not be a prerequisite for introductory level Ecolab courses. However, students can be encouraged to complete this course prior to or concurrently with the introductory Ecolab class to strengthen their field research abilities. One of the benefits of having completed GIS prior to taking the Ecolab course is that it would be feasible to supplement to each applied project unit within the course.

Vegetation surveys conducted in Spring 2017 have shown that there are several invasive species present within the Ecolab, such as Ligustrum. By using GIS, it is possible to create a distribution model of where these species are located. This will help protect those areas from the detrimental

effects of the invasive species (see Appendix C). Independent research on the ecological niche of a species and mapping of the species distribution, allows researchers more ability to predict where invasive species are likely to grow. This type of information will be useful with the respect to the land management plan and possibly help facilitate the treatment of invasive species plants in the future.

4.3 Water and Soil Quality

Initially, water and soil quality analysis were conducted in Ecolab to gain the tax exemption status Ecolab now maintains. Yet, Ecolab still provides an excellent outlet for continued research opportunities and applied projects directly involving soil and water quality. In the current 25 acres that Ecolab possesses, one can gain general knowledge of aquifer types and properties. One can also conduct soil and water tests indicating the current health of Ecolab, as well as show the impact and influence from surrounding agricultural methods and University pollution. By monitoring soil quality, one can increase productivity by identifying soil nutrients or soil chemical factors that are limiting plant growth; one can increase fertilizer use efficiency by indicating appropriate rates for different soils and crops; one can protect the environment by preventing over fertilization; and finally, one can identify polluted or contaminated soil and prep for remedy of such issues. Like the benefits of soil testing, water quality testing can also determine pollution levels and other biological health indicators. From testing water quality, one can gain valuable information necessary to protect and maintain the surrounding ecosystem.

What's more, water and soil quality monitoring can be implemented into the Ecolab curriculum to provide hands on experiences aimed at developing specific technical and vocational skills, introduce the learner to concepts learned during lectures, and apply the data gathered in the field. The learning outcomes for a course derived from soil and water analysis would be the following: understand the fundamental laws and equations to describe groundwater flow processes, learn how to use analytical and numerical models as a tool to solve groundwater flow problems and assess hydrodynamic parameters, conduct quantitative analysis of groundwater problems, and finally comprehend numerical modeling of groundwater flow and transport. As prerequisites to the course, students are expected to have at least a basic knowledge in hydrogeology (Darcy's law, porosity, etc.), general geology, mathematics and physics. Alongside practical exercises and hands-on work, lecture classes aim to convey course background and review basic material, develop knowledge of advanced course concepts, and touch on technical field methods.

4.4 Meteorology

University field research stations enhance environmental sustainability by helping to preserve a natural setting for future generations, fostering research and monitoring of local ecosystems and their component biodiversity, and provide training and information on field and laboratory work for the next generation of researchers, students, faculty, and outside community. The Southwestern University Ecolab can contribute to the study of meteorology. The 2017 Capstone

group has received a Green Fund grant to construct a weather station onsite. With the addition of this weather station, Southwestern University, via air quality sensors, will be able to provide a continuous data stream of meteorological variables related to climate change. Data is collected from equipment such as an anemometer to measure wind speed and direction, barometer to measure atmospheric pressure, thermometer, rain gauge, relative humidity sensor, solar irradiance sensor, and data logger. The weather station will also allow data to be collected on carbon dioxide, various sulfides, ozone, etc.

The data collected from the weather station's air quality sensors will be accessible online and help support the larger network of weather stations along the IH-35 corridor. This network will track climate change and air quality in the region and help with further study and research in courses and majors such as Ecolab, environmental studies, physics, and all others related to meteorology.

4.5 Restoration and Conservation

Restoring the land of Ecolab is the priority, to do this, clean-up days need to be readily integrated component of the course. When holding a restoration day, it is important to consider the following:

- **Weather**
    - Always be sure to bring water and sunscreen on hot days. If it is raining or thundering, leave the site immediately.
- **Equipment**
    - Be sure to bring all necessary equipment for a clean-up day. This includes gloves, trash bags, clippers, etc. These can be found in the garden greenhouse. Ask a member of the garden for permission to borrow the items and return them immediately following clean-up. Everyone participating in the clean-up day must wear gloves so be sure to bring enough pairs.
- **Protocol Forms**
    - Every Southwestern student in the Ecolab class must sign the Ecolab Site Protocol before working or visiting Ecolab. These forms should be kept by the instructor. If a student is not the Ecolab class and is participating in the clean-up day or visiting the site, they must sign a Volunteer Waiver form. Return these forms to the Ecolab instructor following the clean-up day. If an individual is participating the clean-up day and is not a Southwestern student, a visitor agreement may be required. Contact Norma Gaines (gainesn@southwestern.edu) and Craig Erwin (erwinc@southwestern.edu) for more information.
- **Other**
    - If an individual must leave the cleanup day early, they must inform others that they are leaving prior to exiting the site. Do not leave without informing others.

When picking-up trash or conducting trail maintenance be mindful of wildlife and existing projects such as the gamecams. Take care not to disturb wildlife or alter projects in anyway. Use the Ecolab app (*add info*) to see the location of current projects. Additionally, be sure to dress appropriately according to the Ecolab protocol (i.e. long pants, appropriate shoes, etc.). Further, be mindful of snakes, insects, and other animals when conducting restoration work.

Since habitat restoration involves intentional landscape changes, it is important to design the habitat modifications to best suit the broadest range of native species with strategies to mitigate the dominance of invasive competitor species. In terms of flora, invasive species are detrimental because they compromise the abundance of biodiversity within an ecosystem by outcompeting native plants and limiting the animal species they support. With respect to invasive species control, there are a variety of possible methods but careful consideration must be taken to avoid unnecessary damage to the ecosystem.

For valid research to take place that does not compromise the integrity of the ecosystem, there needs to be an active conservation effort for the land associated with Ecolab. Conserving the land will allow the environment to maintain its current biodiversity and possibly foster incentive for more of the SU's land to be brought under conservation-oriented management practices. Maintenance of these conservation practices will ensure Ecolab's value as a site for ecological research opportunities. The overall intention is to have minimal human interference, except in manners intended to enhance biodiversity and overall ecosystem health. By taking this approach, researchers will be given the opportunity to conduct their studies within a thriving ecosystem. The trail construction will further help with conservation by allowing accessibility of the site and diminishing the impact of negative human presence in Ecolab, as it should be the only area where foot traffic occurs.

Habitat restoration is an increasingly important effort with urbanization trends affecting the integrity of most of the world's ecosystems. When looking at restoring local habitats, it is important to perform thorough evaluation of the area's biodiversity to get a general sense of its condition and provide valuable context for research projects. Most environmental degradation has occurred across large spans of the landscape, and proper restoration efforts must be conducted with insight into the nuanced qualities and sensitivities of a given region.

Approaching research and activities in this way, gives students involved with the Southwestern Ecolab first-hand knowledge of the effects of proper conservation and restoration techniques. When done successfully, these management techniques contribute to positive biological diversity. The Southwestern University Ecological Laboratory Land Management Protocols and Practices document outlines the guidelines, policies, and initiatives relevant to contribute to the conservation and restoration of SU's Ecolab.

5. Outreach and Engagement

5.1 Potential Community Partners and Projects

The Southwestern University Ecolab has the potential to engage with several entities in both the public and private sectors. These relations can be mutually beneficial for both the University and the partnering organization, some examples of potential community partners are:

- Georgetown ISD
- Williamson County
- Williamson County Conservation Foundation (WCCF)
- City of Georgetown
- Texas Parks and Wildlife
- Georgetown Parks and Recreation

In its beginning stages, the goals of Southwestern's Ecolab should focus on the needs of the campus community. However, as Ecolab progresses into the future the goals can be predetermined to meet the needs of the City of Georgetown, Williamson County, and eventually at a state, national, or even global level. Ecolab can offer many educational opportunities to the community in the future, especially to the Georgetown Independent School District. To expand the outreach of Southwestern University through the means of Ecolab, the university should consider developing a positive private-public relationship. This relationship allows Southwestern, as a private institution, to have a larger outreach because of its relationship with the public. There are benefits to this type of relationship, such as a larger recognition for Ecolab, educational opportunities for nearby schools, and recreational opportunities for the community.

Despite the potential positives of a private-public relationship, some issues do arise. Currently, the risk management system focuses on protection of members of the campus community (i.e. staff, faculty, and currently enrolled students). Therefore, if anyone outside of the campus community wishes to visit Ecolab, they must sign a liability waiver and read the field site protocol (details can be found in the Land Management Practices and Protocols document). However, a comprehensive set of protocols for allowing schools and other institutions to access the Ecolab has not been fully developed yet. To address these issues, Southwestern University needs to develop a protocol that protects the university but also allows for community engagement.

5.2 Potential Community Outreach Projects

There are several projects that Southwestern University's Ecolab can implement to strengthen its relationship with the greater community. The Southwestern University Ecolab can offer a wide range of educational experiences to meet the needs of differing classrooms, school programs,

churches, or other organizations. These environmental and ecological outreach initiatives could substantially promote environmental literacy amongst the Georgetown community. Correspondingly, Ecolab could provide a unique pedagogical opportunity by allowing students and professors to lead public activities and discussions. An example discussion to be lead could pertain to the various plant and animal species covering those that are invasive and their impact on local ecosystems. The implementation of these public ecological discussions would help establish or bolster a baseline environmental education for those in the community. These types of community discussions pave the way for new ways of community involvement and learning. These types of literacy programs have been successfully executed by Marian University and have helped with community education and engagement.

School Programs

In addition to broad outreach programs, the university can potentially reach out to specifically the Georgetown ISD community. This can be achieved through differing grade school programs. Much like the benefits of Ecolab for the campus community, these programs can be offered to also engage the Georgetown ISD community in a real, living, classroom. The goal of the school outreach program is to enhance environmental awareness and appreciation for elementary, middle, and high school age students and encourage them to consider careers in the sciences. These programs can be formatted around the curricular parameters of each school, to allow students to engage with Ecolab based from their academic ability.

Volunteer Service Opportunities

These opportunities would allow the community to engage with the Southwestern Ecolab through acts of community service in exchange for volunteer hours. Individuals or organizations in the community can volunteer through Southwestern University and aid in Ecolab's upkeep. This would include activities such as trail maintenance, trash pickup, and could also offer a potential educational opportunity emphasizing the importance of proper land management.

6. Capstone 2017: Preparing the way for a Sustainable Ecolab

6.1 Trail Construction

In the past, Ecolab was extremely overgrown and had historically been used as a dumping site. This made Ecolab unsafe and contributed to the environmental degradation of Southwestern and the Georgetown community. To rectify this, the environmental studies capstone class proposed an ongoing restoration project. This plan started with the construction of a quarter mile long hiking path around the exterior of the fluvial system of Ecolab. The hiking path begins from Smith Creek Road, down to the cattail pond, and then follows along the edge of the pond and stream. It continues to the wooded area before looping back around connecting along the side of the pond. The trail is made of crushed concrete which was chosen because it is a post-recycled

material and has a low environmental impact. The construction of the trail was executed by S&S Trails and was built over a 5-day period in April of 2017.

6.2 Restoration Projects

Despite Southwestern-affiliated visitor compliance with leave no trace principles, at least once each semester, involved courses, researchers, and campus community volunteers will set aside a day to clear the Ecolab of undesirable waste materials. This event will continue to be necessary due to the proximity of the site to a major highway and Georgetown community members using the Smith Creek road-side of Ecolab as a dumping site. Restoration specific projects entail the removal of invasive species both flora and fauna, as well as water quality assessment with the potential for future restoration work.

Figure 1. **Top left:** game camera mounted on a tree in Ecolab; **Top right:** coyote caught on game camera; **Bottom left:** game camera photo of Red-Tailed Hawk; **Bottom right:** game camera photo of Bobcat

6.3 Wildlife

Using game cameras, the capstone group has been able to monitor the diverse wildlife on the 25 acres of Ecolab. Some of the species that have been observed on this small parcel of land are white tail deer, coyotes, bobcats, raccoons, armadillo, otters, hawks, and even a great blue heron. The Ecolab community plans to continue to monitor these species for the purposes of creating species distribution models. The monitoring of these species and subsequent mapping of some

help with research and restoration initiatives of specific wildlife habitats. Using the data gained on these game cameras, the university can be more aware of any potential threats for any endangered species that end up on the Ecolab.

6.4 Mapping Projects

Currently, a species distribution model is being created to identify the spread of Ligustrum and predict where it will be most problematic in the site. In the future, students will be able to map the spread of different invasive species by creating a digital elevation model and determining where they will go (Appendix C). While current lab work only allows for the study of plant life, in the future it is hoped that the basic model provided will help track animals as well.

6.5 Land Management Protocols and Procedures

The Southwestern Ecological Laboratory Land Management Protocols and Practices document was created to develop guidelines for research, recreation, and conservation onsite at Ecolab. For questions regarding what actions are permitted or prohibited in Ecolab, one can reference this document to see the proper steps for projects to be undertaken. All necessary administrative forms regarding access (research and recreational) and/or changes to Ecolab can be found within this document.

7. Recommendations for Future Projects

7.1 Trail Extension

In the beginning stages of trail construction, it was proposed, for in the future, for the trail to connect with the lower portion of trails already in existence on campus. This would require an extension on the current trail already in place at Ecolab. The path would have to run through two tree lines and eventually would ideally connect the ecological site to the main campus. This would also require an easement on the 25-acre plot of land being leased for agriculture in between Ecolab and the University. This connecting trail would allow easy foot traffic between the two entities, increasing accessibility of the site without the use of a motor vehicle, and decreasing overall liability for the University. Furthermore, SUPD would have easier and quicker accessibility of the site increasing the overall safety of Ecolab.

7.2 Curricular Structure

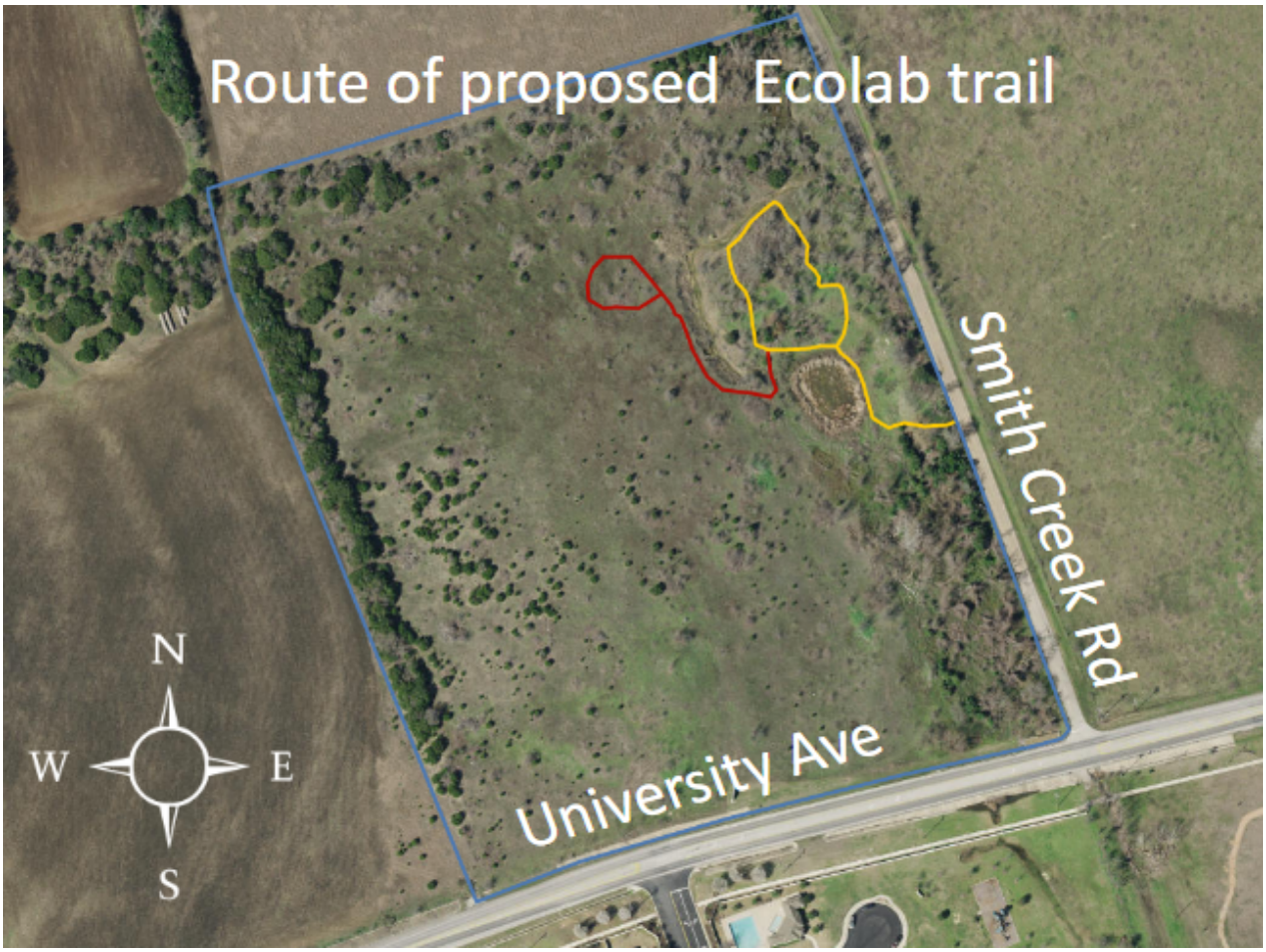
The current form of the Ecolab course is a prototype that is subject to change in future semesters based on the feedback provided by involved students and faculty. We anticipate a few challenges with the existing class schedule that may lead to a shortage of class time to conduct full lab experiments. For this reason, as mentioned before, we recommend adopting a more traditional natural science lab course schedule in which a weekly, three-hour lab period is set aside from the two lecture-style classes to conduct field lab work. It is expected that many students will have limited experience with field research since this course has no prerequisites.

As a result, this course would benefit from having an upperclassman work as a teaching assistant (TA) to help students when conducting experiments and alleviate logistical challenges for the instructor. Currently, students are required to travel to or from the Ecolab by car. We suggest that the hired TA also assist with transporting students to the Ecolab using one of the Southwestern shuttle vans. This would help reduce the risk of accidents and ensure that students arrive to the Ecolab at the same time to begin collaborating with one another on labs. However, this would likely be temporary and with the trail expansion, students would hopefully be able to access the site without the use of a vehicle.

In the future, lab modules could also be adapted to suit the expertise of other natural science faculty to ease the transition of students to advanced research projects after completing the Ecolab course. Long-term research projects are ideal for meeting this goal, however implementing these may run the risk of limiting the flexibility and level of student-inquiry built into the class structure. Adopting lab modules that accommodate faculty research backgrounds would increase the support-base for students in the course and potentially alleviate the instructor from being the sole lab work advisor. Given the students in this course have no formal scientific methods training, broadening the faculty-support base for the class is a convenient means of quickly getting students familiar with standard research practices.

Appendices

A: Map



The blue line signifies the current boundaries of Ecolab. The yellow line represents the completed trail thus far while the red line signifies another part of the trail that was proposed, cleared, but has not been completed due budgetary limitations and structural challenges within this part of the trail.

B: Wildlife Reports

A survey of bird species (spanning from the beginning of February to early April of 2017) was conducted to establish a baseline species inventory for the birds present in Ecolab. This survey is far from complete, as bird's habits and migrations change dramatically throughout the year, and Ecolab would benefit from extension of similar consistent observation of birds throughout other seasons. As of April 2017, these are the birds sighted in Ecolab:

Very Common (over 20 sightings)
Great-Tailed Grackle, Northern Cardinal, Northern Mockingbird, and White-Winged Dove

Common (between 5 and 20 sightings)
Barn Swallow, Mourning Dove, Turkey Vulture

Uncommon (between 2 and 5 sightings)
American Crow, Brown-Headed Cowbird, Carolina Wren, Cedar Waxwing, Eastern Phoebe, European Starling, Great Blue Heron, Killdeer, Lesser Goldfinch, Lincoln's Sparrow, Red-Winged Blackbird, Ruby-Crowned Kinglet, and White-Crowned Sparrow

Rare (only sighted once)
Bewick's Wren, Black Vulture, Blue-Gray Gnatcatcher, Crested Caracara, Field Sparrow, Grasshopper Sparrow, Northern Rough-Winged Swallow, Red-Tailed Hawk, Red-Shouldered Hawk, Scissor-Tailed Flycatcher, Neotropic Cormorant, Yellow-Crowned Night Heron.

Species number 32 overall, but due to the limited scope of the study it should not be considered exhaustive. It should be noted that several birds very common in the surrounding neighborhood or campus areas, such as the European Starling, the Black Vulture, and the Red-Tailed Hawk, were listed as "Rare" or "Uncommon" in Ecolab, demonstrating a noticeably different species inventory than the surrounding, more developed areas. One somewhat misleading statistic should also be explained: The Brown-Headed Cowbird was listed as "Uncommon" because the species was only sighted in 4 separate instances; two of these sightings, however, were of a flock numbering over 100 individuals.

C: GIS Projects

Ecological niche modeling is an applied research project with GIS components that relate to information covered in the biodiversity and restoration units of this course. To effectively manage both native and invasive species, tools such as GIS have been used to map their distribution. Furthermore, this tool can be used to predict habitat that species are likely to occupy in the future. Niche models can predict species' geographic ranges based off environmental data that directly affects the dispersal of a given species. There are some instances where a species is not present in suitable habitat because they are unable to disperse or have yet to be physically translocated to the area, which creates research opportunities for students. The use of niche modeling allows researchers to determine the location of a species and therefore the ability to make inferences on whether there is a correlation between where it is found and what is viewed to be an ideal habitat for this species. To conduct a lab in which students could use ecological niche modeling, it would be necessary for students to have a specific species to survey and to research the types of conditions that are favorable or unfavorable to its habitation within a certain region. Once this is determined, students can survey for the species they choose and obtain the coordinate points of each plant using a handheld GPS unit. With this information, the location and quantity of this species can be visually represented using ArcMap. As a result, students can determine if there is any correlation between environmental variables and where there is a higher quantity of a species. For example, current studies are being conducted on the abundance and location of the invasive tree species, Ligustrum Lucidum, within the Ecolab. Results from these types of studies have the potential to guide management Ecolab efforts and provide restoration projects for future classes to implement.

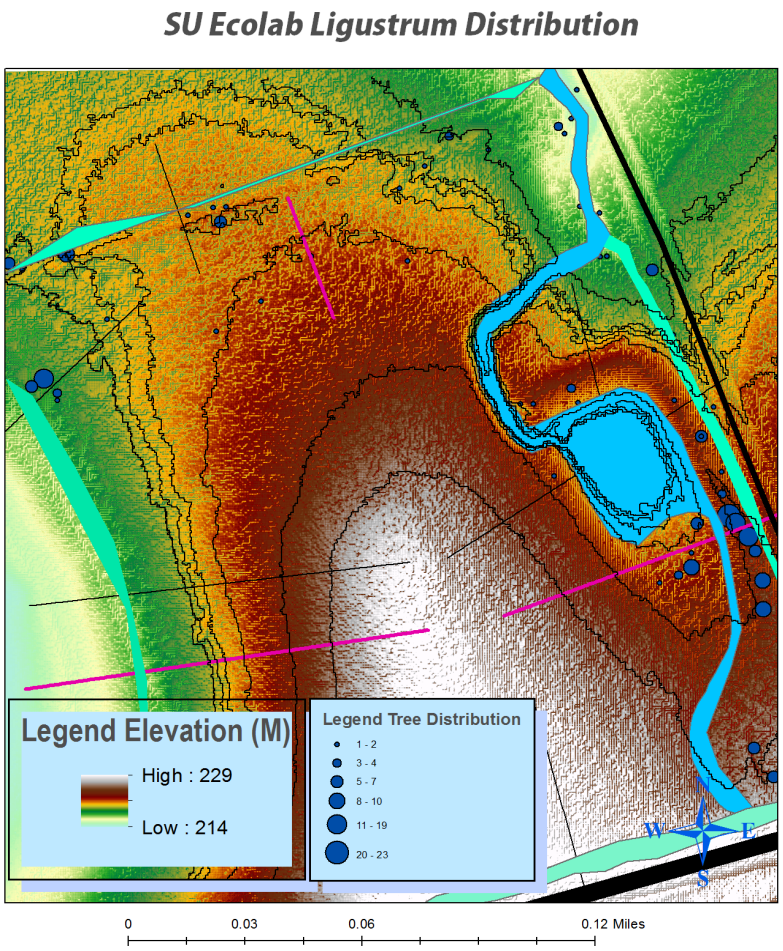


Figure _: example of a GIS study of the invasive species *Ligustrum Lucidum*

An additional project option for applying GIS to Ecolab fieldwork is an environmental quality assessment that uses lichen as a bio indicator of ecosystem health. Lichen are an ideal family of organisms to apply for a study with this objective because they are stationary, relatively easy to identify, and are sensitive enough to air contaminants to have population dispersals that are affected by proximity to human development. Due to the role of lichen in the decomposition process this lab calls for students to follow an established criterion to categorize the woody debris a specimen is growing on. This process helps students become familiar with the ecological roles of these lichens, which enhances their ability to locate and identify specimens. After identification training students are expected to assess lichen populations on randomly selected trees throughout a study area and collect GPS waypoint data from handheld units. This lab procedure involves charting data of the distribution of lichen in each area using standard sampling methods and can demonstrate how to map ecological communities with geospatial technologies. This lends possibilities for students to explore unique research questions about why different species of lichen occupy their existing ranges by examining environmental variables and proximity to human development.

D: List of Stakeholders, their Contact Info, and their Responsibilities

Contacts for authorizing changes to Ecolab

Land Use Committee

- Professor of Religion, Laura Hobgood (hobgood@southwestern.edu , Phone: 512-863-1669)
- Professor of Biology, Romi Burks (burksr@southwestern.edu , Phone: 512-863-1280)
- Professor of Biology, Benjamin Pierce (pierceb@southwestern.edu , Phone: 512-863-1974)
- Assistant Professor of Environmental Studies, Joshua Long (jlong@southwestern.edu , Phone: 512-863-1493)
- Director of Community-Engaged Learning, Sarah Brackmann (brackmas@southwestern.edu, Phone: 512-863-1987)

Finance and Administration

- Vice President, Craig Erwin (Erwinc@Southwestern.edu , Phone: 512-863-1472)
- Executive Administrative Assistant for Finance & Administration, Norma Gaines (gainesn@southwestern.edu , Phone: 512-863-1472)

Facilities & Campus Services

- Associate Vice President for Facilities Management, Mike Miller (mikemiller@southwestern.edu , Phone: 512-863-1425)
- Director of Campus Safety and Risk Management, Michael DeLance (delancem@southwestern.edu , Phone: 512-863-1677)

Physical Plant

- Manager of Facilities & Maintenance Operations, Shorty Schwartz (schwartw@southwestern.edu , 512-863-1991)

E: Liability Forms, Tax Documents, and Safety Protocols

Waiver and Release of Liability, Assumption of Risk and Indemnity Agreement

I have elected to voluntarily participate in the following volunteer program/event at Southwestern University: Ecolab Cleanup Project is a volunteer event that involves various clean-up and improvement projects on campus. The event is scheduled for _____.

ELECTIVE PARTICIPATION: I acknowledge that my participation is elective and voluntary.

RULES AND REQUIREMENTS: I agree to conduct myself in accordance with the rules and requirements of this event, including the prohibition of any alcoholic beverages or illegal drugs at the event. I am affirming and attest that I am physically fit and able to conduct clean-up, gardening, painting, and other various improvement related tasks without suffering from serious health risks.

INFORMED CONSENT: I have been informed of and I understand the various aspects of this event, including the dangers, hazards, and risks inherent in physical event activities. I understand I could sustain serious injuries, unlikely but including death because of my participation in this program/event. This could result from actions, inactions, negligence or fault of Southwestern University or others, condition of equipment used, facility conditions, weather conditions, or negligent first aid operations or procedures. I further understand and agree that any injury, illness, property damage, disability, or death that I may sustain by any means is my sole responsibility.

RELEASE AND WAIVER OF LIABILITY: I, on behalf of myself, my personal representatives, heirs, executors, administrators, agents, and assigns, HEREBY RELEASE, WAIVE, DISCHARGE, AND COVENANT NOT TO SUE Southwestern University, including its governing board, directors, officers, employees, agents, volunteers, students for any and all liability, including any and all claims, demands, causes of action (known or unknown), suits, or judgments of any and every kind (including attorneys' fees), arising from any injury to myself or others, property damage or death that may occur as a result of my proceeding with this event. I further agree that Southwestern University and the releases are not in any way responsible for any injury or damage that I sustain because of my own negligent acts.

ASSUMPTION OF RISK: I understand that there are inherent risks and dangers associated with participating in event activities and that there are dangers that cannot be fully foreseen. Specifically, the risk of injury while participating in events and activities related to this program/event that may include, but are not limited to, clean-up, gardening activities, potential

snake bites, animal encounters, contact with poison ivy and general participation and interaction with other participants or members of the public.

INDEMNITY: I, on behalf of myself, my personal representatives, heirs, executors, administrators, agents, and assigns, AGREE TO HOLD HARMLESS, DEFEND AND INDEMNIFY THE RELEASEES FROM ALL LIABILITY, including all claims, demands, causes of action (known or unknown), suits, or judgments of any and every kind (including attorneys' fees), arising from any injury to myself or others, property damage or death that may occur because of my proceeding with this volunteer event.

PERSONAL MEDICAL INSURANCE: I agree that I have and am currently covered by personal medical health insurance and that I am responsible for all medical expenses, health services that I may require because of proceeding with this volunteer program/event.

SEVERABILITY: If any term or provision of this agreement shall be held illegal, unenforceable or in conflict with any law governing this agreement, the validity of the remaining portions shall not be affected thereby.
I have read and fully understand the terms of this waiver and release of liability. I understand I have given up substantial rights by signing this agreement, and sign it freely and voluntarily. By my signature, I represent that I am at least eighteen (18) years of age, the minimum age required to be able to participate in this volunteer campus beautification event.

Date: _____
Signature of Participant: _____
Print Name of Participant: _____
Address: _____

2017 Southwestern Visitor Agreement

VISITOR'S AGREEMENT

SOUTHWESTERN UNIVERSITY
P. O. Box 770
Georgetown, Texas 78627-0770
Phone: (512) 863-6511
FAX: (512) 863-1436

VISITOR'S AGREEMENT

Dated: _____

_____

NAME OF SU SPONSOR:

_____

NAME OF PERSON VISITING CAMPUS (hereinafter, the "VISITOR"):

_____

LOCATION OF EVENT/SERVICE:

_____

DATE AND TIME OF EVENT/SERVICE:

_____

Time(s) of services: _____

(month) (date) (year) to (month) (date) (year)

SU CONTACT OR SPONSOR: (Name)

_____

PHONE: Area Code _____ Business_____

Cell_____

NATURE OF CAMPUS VISIT:

_____

COMPENSATION: _____ Dollars ($_____)

Binding Nature of Agreement. This Agreement shall be binding upon and inure to the benefit of the University and the Visitor and their respective heirs, legal representatives, successors and assigns; provided, however, that the Visitor shall not assign its rights or delegate its duties hereunder without the prior written consent of the University.

Indemnification. The Visitor shall indemnify and hold harmless the University from all claims, suits, actions, liabilities, damages, costs and expenses of any nature whatsoever, including, but not limited to, reasonable attorney's fees and court costs incurred or suffered by the University, for or on account of any bodily injury, illness, death, slander, libel, invasion of privacy, property damage, or other injury, loss or damage suffered by any person or person's property (including loss of use inflicted upon, caused to, received

or sustained by any person or persons property) where the same arises out of, or results from any act or omission, negligent or otherwise, of the Visitor, their officers, directors, shareholders, employees, servants, agents, contractors, or persons employed by the Visitor's agents or contractors in the execution or performance of this Agreement. **The Visitor shall indemnify and hold harmless the University as provided in this section (i) regardless of the fact that an act or omission of the University, negligent or otherwise, contributed to the cause of bodily injury, illness, death, slander, libel, invasion of privacy, property damage, or other injury, loss or damage suffered by any person or person's property, and**

(ii) regardless of the fact that the person who is injured, suffers loss, or damage or whose property is damaged is (a) the University, (b) the Visitor, (c) an officer, director, trustee, shareholder, employee, servant, agent, or contractor of the University or the Visitor, or (d) any other person whomsoever.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first written above.

SOUTHWESTERN UNIVERSITY
Georgetown, Texas
By: _____ (SU Sponsor)
Date: _____, 20__
By: _____Craig Erwin
Vice President for Finance and Administration/CFO
Date: _____, 20__

VISITOR
Name: _____ (Signature)
Name: _____(Printed)
Title: _____
Mailing Address:
_____

_____

_____

Phone No. _____

(Area Code)
Date: _____

Fieldwork Site Safety Protocol (Waiver) – Ecolab

This protocol is designed to help reduce the risk of injury and provide a layer of safety for students/employees during fieldwork to Ecolab site. All students/employees taking part in fieldwork exercises have a responsibility to adhere to safe standards of behavior listed in this safety protocol. Faculty members/project leader is responsible to review this protocol as well as any other specific instructions with all participants.

Accessing the site

Site should be accessed by car - via RT 29 (University Ave.) to Smith Branch Road. See map for details. Follow parking rules.
Students are not permitted to access site by bike along Rt 29.
Students are not permitted to access the site during hours of darkness.
No camping is allowed. No fires are allowed.
A primitive path will be periodically maintained by Physical Plant grounds crew to provide a three-foot-wide path to the pond area. If the path appears to be overgrown, please contact Physical Plant at 863-1914.

Field safety protocols

Personnel accessing the site should wear heavy duty long pants (blue jeans), hiking or work style boots, long sleeve shirt. Work gloves are recommended. Knee high rubber boots or hip waders are recommended to access the pond. Depending on the nature of your fieldwork, snake chaps should be considered. Inform your instructor/supervisor of any serious allergies to poisonous plants or insects. Discuss your participation with your instructor/supervisor. If authorized to proceed, participants with severe allergies should bring an up to date Epi-Pen for emergencies. Sun and eye protection – hat, sunglasses or shaded safety glasses should be worn. Students and employees should always travel in "at least" pairs to access the site to conduct survey or field work. Working alone is not permitted. Cellular phones should be in your possession always. Keep track of weather conditions, immediately leave the field and seek shelter in event of severe weather conditions. Students should check in with their instructor when they plan to conduct fieldwork. Upon returning to campus, check back in with your instructor.

Student waiver/release form

For students accessing the site for academic related work and credit no release form is required.
For student organizations or volunteers who have been approved to visit the site for non-academic purposes, a waiver/release form will need to be signed. Contact the Director of Campus Safety & Risk Management for a current form.

Precautions

Beware of various types of snakes along path as well as the pond and surrounding fields. To reduce the potential for snake bites, make consistent noise and be very cautious of your steps and path. Beware of poisonous plants (poison ivy, etc.). The poison ivy plant has shiny, green leaves in groups of three and a red stem. The oils in the plant can cause an allergic reaction that results in various forms of itchy dermatitis. Beware of other animals, pests and insects such as rats, spiders, ticks and scorpions. Seek medical attention for injuries. If injured and in need of general assistance, you may contact Campus Police at 512-863-1944 or for emergencies, call 911 and describe your specific location.

I have read and understand the fieldwork safety protocol and precautions. I understand there are risks while participating in this fieldwork. I agree to abide by the above rules and practice a high level of care to prevent injuries.

_____

Student Name Printed

_____

Student Signature

_____

Date

_____

Faculty Instructor Printed Name Course Name

** Faculty instructor/project leader should keep original copy filed at departmental level

F: Curriculum Modules: Lab Examples

F.a: Environmental Quality

One potential EQ lab for the Ecolab course focuses on soil quality by using nematode diversity and abundance as a proxy to measure the degree of anthropogenic disturbance. This is possible because of the vital roles that various nematode species play in recycling nutrients and balancing microbial populations in soils. Nematodes are also ideal candidates for this type of bio-indicator study because they are relatively easy to sample and categorize by amateur taxonomists into genuses found in specific soil types and limited in distribution by various environmental pollutants. This lab also transitions well from or into the biodiversity section of the course and facilitates student exposure to unconventional, yet effective and easy-to-observe tests for the environmental quality parameters.

Nematodes as Indicators of Soil Health
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.366.6521&rep=rep1&type=pdf#page=43

For more labs related to Environmental Quality please see the following sources:

- *Soil*:

Mapping soils, vegetation, and landforms: An integrative physical geography field experience
http://geo.msu.edu/geogmich/pdfs/2005-pg%20paper%20barry%20county.pdf

Experimental Protocol for Manipulating Plant-induced Soil Heterogeneity
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4151341/

- *Water*:

Teaching groundwater flow processes: connecting lecture to practical and field classes
http://www.hydrol-earth-syst-sci.net/17/1975/2013/hess-17-1975-2013.pdf

- *Air*:

Improved biomonitoring of airborne contaminants by combined use of holm oak leaves and epiphytic moss
http://s3.amazonaws.com/academia.edu.documents/42944485/Improved_biomonitoring_of_airborne_conta20160222-15792-6991lv.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1492723649&Signature=BS%2BBeIYxml%2Bplt8GlgyGdy%2B1DLE%3D&response-content-disposition=inline%3B%20filename%3DImproved_biomonitoring_of_airborne_conta.pdf

The Lichen-GIS Project, Teaching Students How to Use Bio Indicator Species to Assess Environmental Quality
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3577157/

F.b: Meteorology

With the approved grant for installing a weather station in Ecolab, students can conduct labs with meteorological components. Each unit in the Ecolab class is expected to last approximately three weeks and thus students have numerous occasions to obtain data related to cloud cover, temperature, rainfall measurement, and wind. Students will become proficient at interpreting weather observations and understanding how the climate impacts the ecosystem. For example, students could make a hypothesis based on these factors to predict bird or vegetation surveys. This could be useful in both the fall and spring semester because students could make a hypothesis on changes in foliage composition.

Enhancing environmental sustainability through a university field station.
https://www.utoledo.edu/nsm/lec/research/glgl/publications/LECbookchapter.pdf

For more labs related to Meteorology please see the following sources:

Toward a standardized metadata protocol for urban meteorological networks
http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-12-00096.1

Using a Native Landscape to Integrate Undergraduate Research into Variety of Science Classes for both Majors and Non-Majors-A Framework
https://www.researchgate.net/profile/Paul_Ruscher/publication/292134019_Using_a_Native_Landscape_to_Integrate_Undergraduate_Research_into_Variety_of_Science_Classes_for_both_Majors_and_Non-Majors-A_Framework/links/56a936e308ae2df8216511a7.pdf

F.c: Restoration

One potential restoration lab is an investigation into native pollinator and prairie plant cover using a multispecies seed sowing experiment. Using a broad range of native and naturalized plants, students can sow seeds into undisturbed and experimentally disturbed field plots. This experiment focuses on measuring change in ecosystem metrics including functional group composition, native plant abundance, cover, and diversity over a multi-year period of study. The findings from these lab studies can be applied to land management practices in the Ecolab and help advising the best models for enhancing the native species diversity of the Ecolab.

Restoration of prairie community structure and ecosystem function in an abandoned hayfield: a sowing experiment.
http://kindscher.faculty.ku.edu/wp-content/uploads/2010/10/Kindscher-Foster-Murphy-2007-Restoration.pdf

F.d: Biodiversity

One potential lab dealing with biodiversity would be an investigation of invasive species' effects

on plant community structure that draws upon skills and knowledge from a GIS or Conservation lab that discusses what invasive species are and provides examples of why they present challenges for ecosystems. This plant community structure lab collects plant diversity, abundance, and distribution data on 25-meter transects in both affected and less disturbed areas of a research site. A potential drawback for utilizing this lab as the biodiversity research project is it may limit experience and data collection to vegetation and not provide insight into wildlife study methods. A potential solution for this limitation is to incorporate an invertebrate study that supplements the project with a second wildlife component to this lab that characterizes insect, mollusk, and nematode composition within the same 25-meter transects. This lab would afford students the opportunity to make larger connections about more complex plant-insect interactions and how this process plays a role in the dynamic community structures of plants.

Investigating effects of invasive species on plant community structure.
http://www.nabt.org/websites/institution/File/pdfs/american_biology_teacher/2008/070-08-0479.pdf

An additional possibility for a biodiversity research project involves sampling arthropods using various methods and making predictions about the microbial community that occupy the exoskeletons of different insect types and testing these hypotheses by growing bacteria cultures from swabbing the exterior of different families of insects. This lab affords opportunities for students to gain understanding and experience with testing how macro animal composition of a given ecosystem depends on extensive interactions with the microbial world of bacteria to perform essential biological functions. Additionally, aseptic techniques used in this lab to prevent cross-contamination with human microbial communities provides opportunities for students to make connections about how these interactions with microbial communities play foundational roles in their own health and everyday living. Due to the influence of water, soil and meteorological conditions on bacterial and invertebrate health and abundance, prior experience with a lab in one or both areas can be drawn upon to reinforce teaching goals and ensure comprehension of basic theories necessary to make educated predictions to guide student involvement with this research project.

“Bugs on Bugs”: An Inquiry-Based, Collaborative Activity to Learn Arthropod & Microbial Biodiversity.
http://www.bioone.org.navigator.southwestern.edu:2048/doi/pdf/10.1525/abt.2015.77.5.2

For more labs related to Biodiversity please see the following sources:

A multi-week inquiry for an undergraduate introductory biology laboratory
http://science.widener.edu/~vatnick/JCST_1998.pdf
An Inquiry-based investigation into freshwater diatom ecology

https://www.researchgate.net/profile/Jay_Hodgson/publication/308296167_An_Inquiry-Based_Investigation_of_Freshwater_Diatom_Ecology/links/57ecfd9c08ae93b7fa96b391.pdf

An Open-Ended Investigative Microbial Ecology Laboratory for Introductory Biology
http://files.eric.ed.gov/fulltext/EJ943875.pdf

Bridging the Undergraduate Curriculum Using an Integrated Course-Embedded Undergraduate Research Experience (ICURE)
http://www.lifescied.org/content/14/1/ar4.full

G: Sample Ecolab Syllabus

INSTRUCTOR: Barcus Ruter OFFICE: Cullen Tower OFFICE HOURS: By Appointment
PHONE: 512-863-XXX EMAIL: pirate@southwestern.edu WEBSITE:
http://www.southwestern.edu/departments/environmental/ecolab/

Course Description:
The purpose of this course is to expose students to applications of Environmental and Conservation Studies through (1) environmental monitoring and (2) conservation/restoration projects. Students will participate in environmental monitoring - collecting, analyzing, and sharing information - from the Southwestern Ecolab. In this course, environmental monitoring encompasses a variety of activities, including rigorous research and long-term surveillance. This course examines management and policy issues relating to conservation, while providing scientific background to understand these issues. Students will collaborate on a semester long project focusing on the management of the Southwestern Ecolab. In addition to the four required units, all students are expected to work an additional 10 hours in the Ecolab as part of their enrichment requirement.

Inquiry Based Learning (IBL):
This course will involve a inquiry based learning (IBL) type structure in which students use critical analysis, discussion and problem solving to drive their own education experience. Research has shown that students gain more understanding and retain information longer if they are required to use an active learning approach. As an Ecolab student, you will be working collaboratively with your peers in small groups (3-4 students per group) to complete a variety of labs related to Environmental Quality, Meteorology, Biodiversity and Restoration. Student-led participation in Ecolab will increase as the semester progresses. This is intended to strengthen scientific skills by requiring more personal involvement and collaboration to develop research questions and procedures instead of following a standardized experimental protocol. Furthermore, because of the nature of this class, students will apply what they might already know to tackle hands-on projects to achieve a physical and tangible result. Although students will be working in groups for much of the course, students will also be required to demonstrate their understanding on each unit through final reports that will be reflective on the experience, methods and outcomes that were achieved when working with peers.

Course Objectives & Learning Outcomes:
1. Students will be introduced to basic field-based scientific analysis and methods.
2. Students will conduct hypothesis-based research on natural ecosystems.
3. Students will be introduced to basic conservation techniques, strategies & related env. policies
4. Students will apply this work in a way that aims to conserve and improve the ecological laboratory.

Instructor Expectations of Students:
Students are expected to engage with course materials, participate with fellow students, and to read the assigned material. The instructor expects that each of the assigned reading responses will be completed within a week of distribution. Activities in the Ecolab should be documented and can include sampling, conservation work, and site improvement. A final experiment should be conducted utilizing data collected in the Ecolab.

Southwestern University Honor Code:
Students are expected to adhere to Southwestern's Honor Code. Cheating and plagiarism will be met with zero tolerance. Please refer to the honor code on the SU website:
http://www.southwestern.edu/academics/honorcode/

Students with Accommodations:
Students with accommodations must contact the assistant director of Access and Academic Resources for testing accommodations. To arrange accommodations students should contact the Center for Academic Success (phone: 863-1286; email: success@southwestern.edu). Students seeking accommodations must notify this office at least two weeks before the services are needed. It is the student's responsibility to discuss all necessary accommodations with the appropriate faculty member well in advance.

Religious Holidays and Observances:
The course schedule for this class is based upon the SU Academic Calendar, which does not recognize all religious holidays or observances. Please notify the instructor right away if you plan to miss class because of a religious observance. We will work together to accommodate your request.

Attendance Policy:
Regular attendance is mandatory. Excused absences include serious illness, family emergency, or conflict with official SU activity (such as performances or athletics). They may also include emotional or mental health issues deemed significant by SU Counseling Services. Each student will be allowed two unexcused absences during the semester. If you miss class more than twice, the instructor reserves the right to reduce your final grade by one letter grade. If you are absent five times or more, I will request an administrative withdrawal and a failing grade from the registrar.

Late Work Policy:
Each student is expected to submit all required assignments by the assigned due date. Failure to do so will result in a penalty of half of a letter grade reduction per day the assignment is late. Extensions will be considered under special circumstances.

Participation Policy:
Participation is based upon an individual's attendance as well as their engagement with the course. Students are obligated to come to class prepared and ready to complete assigned tasks. Cell phone use unrelated to academic purposes won't be tolerated & will result in a lower participation grade for that day.

Navigation and Transportation to Ecolab:
Ecolab is located east of campus along the corner of University Avenue and Smith Creek Road. No student is permitted to walk or bike from the main campus to Ecolab. Students must travel to and from the Ecolab in their personal vehicle or their peer's vehicle. Carpooling is encouraged. As a safety precaution, all students are required to abide by a buddy system and go to the Ecolab with at least one other person. Upon arrival, students should park their vehicle along the shoulder of Smith Creek Road with caution and consideration of potential conditions that could cause vehicles to become stuck.

Lab Modules and Field Reports:
Laboratory modules will be interrelated and will contain one project associated with the specific content of each module that students will collaboratively organize. Upon completion of each module, students will be required to complete a field report detailing their hypothesis, methods, and results. (See Appendix H for an example outline of an excellent field report).

Ecolab Final Report:
Individual unit reports are to be compiled into a final group report by the end of the semester and submitted to the professor, who will then pass it on to the Land Use Committee for review. It is possible to work with collaborators if relevant and approved by the instructor. The final report should address all the experiments and activities that have taken place at the Ecolab. This report will be utilized to help maintain the tax-exempt status of the site. It will be publically shared on the Ecolab website, so this should be high quality work.

Evaluation Methodology:
- Laboratory Modules (2) @ 15pts each = 30%
- Field Reports (4) @ 5pts each = 20%
- Final Group Report (Group Project) = 20%
- Participation and Attendance = 10%
- Ecolab Enrichment Projects = 20%

Ecolab Enrichment Projects:

Game Cam - Surveys of the animal wildlife of the Ecolab provides insight to the multiple users

of the land. This work involves capturing images with a camera trap and documenting attributes of what was found. We are looking for seasonality in animal migration and a better understanding on how the lab is used by animals. Options for more in-depth projects: predicting species distribution and behavior patterns based on this data, then research to see if they line up with other studies

Water Sampling - Water quality is a host of measurements that can provide an overall idea of ecosystem health. These measurements can include but are not limited to fecal chloroform, pH, turbidity, hardness, phosphate, etc. These measurements are useful in identify anthropogenic impacts on a system like sewage, pollution, fertilizer, and others. This is a continuation of the original research began on the Ecolab and provides students a good opportunity to collaborate with the Chemistry department. This activity is increasingly important as the Ecolab sees more use to determine if heightened anthropogenic activity may affect water quality and the organisms that depend on healthy water conditions.

GIS Data development - Collecting available GIS data from government and environmental agencies will help in the modeling of the natural systems in the Ecolab. This activity involves data minds and generating a data organization system to create multiple layers of information to be in a GIS. To participate in this work, it is recommended to have completed the Environmental GIS course prior to taking this class. However, there could be other ways to participate with GIS data collection for hours, such as mapping out the distribution of a species with GPS units, that is still applicable to students without GIS experience.

Vegetation Survey - Working in small teams, students will identify and locate plant species throughout Ecolab. Students will collect samples and use a plant identification manual to identify plant species. Additionally, students will mark where these species are located using a paper map or GPS units to provide the general geographic location of the samples. This can then be used to design more in-depth experiments around, such as how a certain action would affect the distribution and health of a plant species, as well as provide a general overview that can be used to help better understand the health of the ecosystem.

Ecolab Cleanup - Removing the direct human impact of trash dumping and other signs of human activity from the Ecolab is critical to restoration of the lab. People have used the site for hunting, camping, and disposing of unwanted appliances and furniture.

Grant Writing for Restoration and Infrastructure Projects - Engage with students and faculty working on Ecolab to learn about potential projects that may require grant funding to implement (bird deck, additional trail, water crossings, erosion buffers, signs). Develop detailed plans and draft a Green Fund grant to fund the project. This type of work is ideal for multiple students to collaborate on. It is advised to seek the advice of an older peer or faculty member to

support this process and increase the likelihood of success.

Land Management Plan - Working with the Capstone group, or advanced Ecolab students to update land management plans that outline the procedures and policies of Ecolab use. With a diverse range of plant and animal species, it is integral to understand not only what species are present but their distribution and impact on the ecosystem. Conducting laboratory practicums in this course is intended to inform land management techniques and practices with the goal of improving the health of ecosystem. Activities to accomplish this will include a plant survey, mapping plant species distribution, and invasive species removal.

H: Outline of an Example Field Report

Abstract (Approx. 250-word summary)

Introduction (1-2 pages)

- *Brief literature Review:* What is known about your issue? / What have others determined about it? This should include a minimum of two sources.
- *Research Question:* What are you trying to discover?
- *Hypothesis:* What is the expected results from your experiment. This should be a maximum of 2 sentences to conclude research question.

Methods (less than 1 page)

- Include procedures and protocols with citations when necessary

Results (less than 1 page)

- Report results
- Use tables, graphs, and maps

Discussion (1-2 pages)

- Discuss the results.
- Did you reject the null hypothesis?
- What future work can be done?
- What were the limitations of the study

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