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Ecology
Term Project - Part 3 - Proposal

The Role of Wetlands and The Importance of Peatland Restoration

My fascination with wetlands began when I came across the Bog people– a collection of mummified bodies scientists have been finding buried deep in peatland bogs in Ireland. They are so well preserved that while examining the bodies, scientists were able to determine some of the mummies' last meals before their peculiar and possible sacrificial deaths. Through more research I learned that the preservation of these bodies had to do with the chemical reactions between the decaying matter and the Sphagnum moss' that makes up the bog itself. Bog-type mummies have been found in various parts of the world. Some nations have found bog mummies fully intact with their skin and bones while some have found only fragments of bodies (i.e. torsos, arms, or legs) to suggest sacrificial or torturous circumstances before entering the bog. Many parts of these bog-type mummies can be seen at the National Museum of Ireland's Archeology museum and the British Museum. Many of the bog people exhibited at these museums date back to third-century B.C., a time where throwing bodies into bogs may have been common burial grounds or possibly part of sacrificial practice. The scientific and cultural aspects of the individuals mummified by the bog made me very curious about the ecology of bogs, peatlands, and wetlands as I learned that many artifacts that hail from the Irish bog were found during instances of bog mining, or moss mining. I wondered about the importance of moss mining and then further about the value of wetlands not just in Ireland but in other countries as well. I was surprised to find that many of the world's wetlands have been lost to land conversion and wondered why these ecological areas were being tampered with so heavily. This lead me to my research about wetlands worldwide, their ecological roles and importance, and methods that may help sustain or even restore wetlands that have been lost to short-sighted western ideologies that promoted the conversion of ecological areas such as wetlands.

The concept of working with nature was largely absent in European culture. Many European nations have changed their natural ecological environments to accommodate to growing populations or in pursuit of profit from land. Hydraulic cultures such as communities in Vietnam or Thailand sought to control and dominate the aquatic environment as a means to create reclaimed agricultural land that required wetland beds to be diked and many rivers channeled (Dugan). It was this hydraulic vision of the world that has created the massive loss of wetlands worldwide, which experts estimate as being in the order of around 50 percent of those that once existed. In the United States alone, specialists believe that 52 percent of wetlands which once existed have been lost and 80 percent of that has been to agriculture. The conversion and destruction of wetlands was actively encouraged by the United States federal government for nearly 200 years, starting as far back at 1763 when George Washington set up a company to drain the Great Dismal Swamp of Virginia and North Carolina to convert it to agricultural land (Dugan). This was the first of many legislative actions taken prompting the destruction of

wetlands in America. In the mid-1800s, the United States enacted Swamp Land Acts encouraged sates to build levees, carry out drainage projects, and destroy mosquito infested wetlands. In Europe, the conversion of natural ecosystems is believed to be greater because of the continents high population density and longer history of economic development. For example, 40 percent of the coastal wetlands of Brittany have been lost since 1960, and two-thirds of the remainder are seriously affected by drain and similar activities. In southwest France, some 80 percent of the marshes of the Landes have been drained and in Portugal, some 70 percent of the wetlands of the western Algarve have been converted for agricultural and industrial development (Dugan). It is clear that wetlands have been undervalued due to agricultural and industrial motivations by society, but wetlands are far more valuable and important to the preservation of the Earth than any urban tycoon could comprehend.

The numbers are harrowing as wetlands continue to be converted for agricultural and industrial use– but what is the cost of losing such a large amount of wetlands? Tampering with natural ecological systems can have dire effects and many of policies enacted following the footsteps of the Swamp Land Acts have been re-evaluated and now seen as short-sighted and both socially and economically indefensible. The state of New Jersey has taken steps to protect their local wetlands with legislation such as "New Jersey's Freshwater Wetlands Protection Act," which imposes more rigorous permit criteria than required by the federal EPA's guidelines and establishes buffer zones up to 150 feet adjacent to regulated wetlands (Tubman). That is only but a small part of what the law intends to enforce, but this piece of legislation is rooted in preserving wetlands and saving threatened or endangered species that live in these areas. It is important to emphasize the preservation of these ecological landscapes for the sake of many different species of plants and animals, but wetlands provide much more for the environment than a habitable living space for certain animals and plants.

Through my research of wetlands, I've come across a variety of different studies that look at the effects of wetland loss, wetland water irrigation possibilities, and CO2 production. Wetlands continue to be changed by human action as these coastal mangroves are being cut down for timber, converted to aquaculture (shrimp and fish farms), agriculture, and filled for development. Most mangrove wetlands are filled for a number of purposes including waste management, public health concern, and the creation of real estate (Tiner). These changes to wetlands can create altered hydrology, change in plant communities, shoreline changes, degraded water quality, loss of or diminished estuarine exchange, salinity changes, water pollution, fish kills, increased algal blooms and hypoxia. That is only but a few of the problems that human-induced disturbances to wetlands can cause (Tiner). Experiments and studies conducted in these fields of ecology have every intention of gaining a better understanding of these ecological spaces in hopes to aid the restoration of these mangroves, peatlands, wetlands, and bogs.

Wetlands contain a large amount of the Earth’s total soil carbon. Anywhere between 20 - 30 percent of global soil carbon is stored in wetlands despite covering only a fraction of the Earth’s surface (Tiner). Wetlands have highly anaerobic conditions, meaning that plants that grow in these areas do so with very little available oxygen. These conditions promote high growth rates of plants each year, and during this growth process plants capture carbon dioxide from the air and convert it to plant parts. These ecological areas are great at storing carbon because of these anaerobic properties. Decomposition of organic plant matter occurs slowly in

these environments at the absence of oxygen, so carbon stored in plant material remains intact rather than respired back into the atmosphere (Tiner). The wetlands ability to store large amounts of carbon make them important sinks for atmospheric carbon dioxide and are vital in regulating climate, water supplies and biodiversity.

An experiment that I came across in my research was one conducted by several scientists in Switzerland where in this study they observed three species of *Sphagnum* (*S. fuscum, S. magellancium,* and *S. fallax*) in a glasshouse. They were cultivated at natural density on cores of five different peat types, representing a gradient of increasing disturbance while two water levels were controlled and maintained to stimulate natural and drain situations. These experiments were able to help scientists determine that the *S. fallax* species of *Sphagnum* moss would be best suited in aiding the restoration of peatlands at the specific species re-introduction into the local ecosystem (Grosverneir). Another study that had striking results was an study of Peat CO2 production in natural and cutover peatlands. This was a study on the effects of CO2 production rates from peatland drainage and harvesting. It examined the different factors affecting CO2 production from different types of peatlands and emphasized the necessity of restoring cutover peatlands once they were abandoned to prevent increase in peat temperatures and CO2 production. Peatlands can store copious amounts of store carbon and this study outlines the very dangers that might come with peatland loss and abandonment (Waddington). It is hard proof that peatlands, bogs, mangroves and many other types of wetlands cannot continue to be manipulated by human-induced disturbances. In order to preserve and sustain wetlands it is important to make efforts now and not later as the possibility of complete wetland loss may be closer than its predictions.

I feel that the scientific material and research I have presented accompanied by my interests in wetland preservation and the bog people would suit a book format that would highlight important facts and concepts about how wetland function, their ecological properties, and facts that endanger them. It is most important to me in my research to highlight with this creative book to engage the reader and educate them on the important of wetland restoration and the science behind the importance of restoration. This book would aim to attract the attention of children, students, and people who are not necessarily that interested in science because I want the book to attract and educate a large audience. I think that the inclusion of the bog people would help capture the attention of a reader and put a face to wetland restoration efforts. I am considering compartmentalizing the book by different bog mummies, providing insight on the ecology of the environments they were found in, and tying it back to the importance of wetland restoration. Despite this layout focusing on the bog people, I would want to educate the reader about the threat to wetlands through derisive conversion and degradation tactics and ways that they could help to preserve, sustain, and rehabilitate wetland areas. I would like these forms to exist in an effort to educate about the functions of wetlands, the threat that destroying them poses to the Earth's ecology, and the methods of restoration and preservation that create an optimistic vision of the future of wetlands. I want my project to cast a wide net of readers, attracting the attention of children, students, and individuals not scientifically inclined to communicate that wetland presentation and restoration can start with anyone. Books are powerful ways to reach out to a large group of individuals and can be a useful and long lasting tool to easily illustrate complex concepts that readers can take on to educate themselves at a pace they can control.

Annotated Bibliography

1. Daley, Jason. June 13 2016. A Brief History of Bog Butter. Smithsonian.com. http://www.smithsonianmag.com/smart-news/a-brief-history-of-bog-butter-180959384/. (18 February 2017)

This is a simple and somewhat silly article, but it is a small window into the human interaction with peatland and bog environments as well as some of chemical make up of a bog and why something like butter would preserve as it does buried deep into the ground.

2. Dugan, Dr. Patrick, editor. 2005. Guide To Wetlands. Buffalo, NY. Firefly. Print.

Guide To Wetlands is a book source that has helped illustrate some basic but fundamental concepts that exist in understanding the ecology of wetlands. It speaks of wetlands by region from the Western Europe to the Middle East and Africa and is a good primer for furthering my research on the negative affects of depleting wetlands.

3. Grosverneir, P. April 1997. "Growth Potential of Three Sphagnum Species in Relation to Water Table Level and Peat Properties with Implications for Their Restoration in Cut-Over Bogs." Journal of Applied Ecology Vol. 34: 471-83.

In this study, the relationship between water table levels and peat properties of three Sphagnum species is determined through controlled experimentation. Through these tests the scientists can determine which Sphagnum species can most easily aid bog restoration. This article sheds light on possible solutions to the regeneration of peatlands via the reintroduction of Sphagnum into these degraded areas and identifies through tests which Sphagnum species would best suit this role.

4. Rochefort, Line. Fall 2000. "A Keystone Genus in Habitat Restoration" The Bryologist Vol. 103: 503-8

This is a great source that goes into depth of the importance and role of Sphagnum moss in wetland environments. Rochefort talks of the restoration of degraded peatlands by way of the introduction of Sphagnum back into these environments. It is more of a secondary source but paints a good picture of Sphagnum and its potential to help restore over-mined peatlands.

5. Tiner, Ralph W. 2013. Extent, Threats, and Human Uses of North American Tidal Wetlands p. 246-292 in Tidal Wetlands Primer: An Introduction to Their Ecology, Natural History, Status, and Conservation. JSTOR. 18 February 2017.

This source has an extensive collection of infographics that help to visualize the human uses of tidal wetlands in North America. It is a long but valuable source that helps to outline the uses and potential threats of overuse of wetlands providing insight on the problems at hand with wetland restoration and context into what scientists trying to conserve wetlands are up against.

6. Tubman, Lloyd H. February 1988. "New Jersey's Freshwater Wetlands Protection Act. *Journal (Water Pollution Control Federation),* Vol 60: 176-79.

This source is a good start into looking more into the sorts of policies that have been set into place to promote wetland preservation and reverse wetland degradation. Understanding public policy on different ecological areas exposes the publics view of a certain area and in this case wetlands.

7. Waddington, J.M., P.A. Rotenberg, and F.J. Warren. June 2001. "Peat CO2 production in a natural and cutover peatland: Implications for restoration." Biogeochemistry Vol.45: 115-30.

This source is a study on the effects of CO2 production rates from peatland drainage and harvesting. It examines the different factors affecting CO2 production from natural and cutover peatlands and emphasizes the necessity of restoring cutover peatlands once they are abandoned to prevent increase in peat temperatures and CO2 production. This source is particularly important in helping me understand the role of peatlands in CO2 production and the effects that may be made if they continue to degrade or if efforts are made to restore them.