COMPARISON OF PLANT DIVERSITY IN ESTUARINE, RIVERINE, AND PALUSTRINE WETLANDS LOCATED IN MARYLAND

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ABSTRACT

Wetlands are among the most biologically diverse areas in the world. The purpose of the study is to measure plant biodiversity in estuarine, riverine, and palustrine wetlands. The hypothesis of the study was an estuarine wetland will display more plant biodiversity than a palustrine and riverine wetland, because an estuarine wetland is relatively larger than the other types of wetlands. Each group randomly identified a sample area and then catalogued the plants found within that area at the test site. The average diversity index ($H' = -\sum p_i \log p_i$) was calculated for each type of wetland. The results presented in this report show that the diversity index of the three types of wetlands tested was relatively the same, refuting the hypothesis.

INTRODUCTION

"A wetland is characterized by the presence of water at a frequency and duration sufficient enough to support wetland vegetation or aquatic life, under normal circumstances."(United, 1977) Each wetland is different from the next and certain characteristics such as location, topography, shoreline features and water type determine which of the five wetland types it is. These types include riverine, palustrisne, lacustrine, estuarine, and marine. A riverine wetland is a body of freshwater that is located by or is a tributary of a river which receives flowing water periodically or continuously through a channel, connecting two bodies of standing water. A lacustrine wetland is a freshwater area situated in a topographic depression similar to a lake, with bedrock shoreline features making up its boundaries. A marine wetland is a saltwater system consisting of highly vegetated portions of an ocean and its shoreline. A palustrine wetland is a non-tidal freshwater area that consists of many trees, shrubs, emergent mosses and lichen with low salinity. An estuarine wetland consists of a large tidal water body which is partially enclosed with an opening connecting it to an ocean and is commonly larger than the other types of wetlands. Although these wetland types all differ, they all display similar hydrology, plants and soils.

Soil type is a defining characteristic of a wetland. Wetland vegetation grows at a faster rate than it decomposes, making the soil highly organic and giving the soil a consistency of peat or muck. Wetland soils are commonly hydric, meaning the soil is saturated and flooded during the wetland vegetation's growing season, long enough for the soil to develop anaerobic conditions. Anaerobic is a state of the soil without the availability of free oxygen. Hydric soils contain many nutrients used by wetland vegetation, creating an abundance of different plants and other organisms. (United, 2003) There are three different categories of wetland plants that are held by the wetland soils. These plant types include emergent, plants with underwater roots and vegetation always above the water; sub-emergent, plants with vegetation partially submerged in the water; and aquatics, wetland vegetation that grows completely under water.

Wetlands are among the most naturally productive areas in the world and provide many contributions to the environment such as atmospheric maintenance. The excess of vegetation, plant roots, and soils act as a filter by attracting undesirable particulate matter making wetlands a partially productive means of wastewater treatment. Wetlands, along with other large plant ecosystems, assist in carbon displacement through photosynthesis and help to maintain the balance of oxygen and carbon-dioxide in the atmosphere. Another environmental contribution of wetlands is they help reduce flood damage by absorbing flood water into the tightly packed wetland soils. These soils are held in place by the many types of wetland vegetation, which are also fish and wildlife habitats, and help to limit shoreline erosion.

Wetlands are excellent hydrologic systems because of the permeable soils that act as a sponge. Hydrology is the movement of water over land and through the earth. The permeability of wetland soils makes it possible for wetlands to help maintain stream flow during dry periods. Water comes up from aquifers (natural underground water deposits) through the wetland soils producing the water and current needed to keep a stream flowing during periods of low precipitation.

Wetlands are some of the most biologically diverse areas in the world. This biodiversity provides humans with utilitarian functions, allowing humans to harvest many different types of plants, animals and fungi for their medicinal and agricultural properties (United, 2003). Also wetlands serve as spawning and feeding grounds for nearly one third of the endangered plant and animal species in the United States. Along with atmospheric maintenance, flood control, maintenance of stream flow, and other functions such as fish and wildlife habitats and shoreline erosion protectors, wetlands are also indicators of the health of the environment because they can be so biologically diverse. Certain organisms living in wetlands are sensitive to pollution and low water levels and the presence or absence of these sensitive organisms gives clues towards the health of that wetland.

Since biodiversity is such an important property in determining a healthy wetland and the health of the environment, the purpose of this study is to measure plant biodiversity in estuarine, riverine and palustrine wetlands. The hypothesis for this group study is that an estuarine wetland will display more plant biodiversity than in a palustrine and riverine wetland because an estuaine wetland is relatively larger than the other types of wetlands.

METHODS

Six wetlands were tested, two riverine, two palustrine, and two estuarine. All of the sites were located in Maryland. At each site visual observations were recorded, these included: the name of the site, the date, the type of wetland (palustrine, riverine, or estuarine), the visual topography of the area around the wetland, the approximate percent of land covered by water within the defined wetland boundary, and the dominant vegetation present.

Piney Reservoir and Twin Churches Road were the palustrine wetlands that were tested. Piney Reservoir, located in Garrett County, was surrounded by hills and was covered with about seventy-five percent water. The dominant plants found at Piney Reservoir were grasses. Twin Churches Road, located in Garrett County, was about eighty-five percent water, had aquatic plants as the most dominant type of plants, and there was a road that bisected the testing site. On one side of the road, the water was deep, and many plants were growing on this side. On the other side of the road the water was shallow and there were fewer plants growing in it. The topography that surrounded this site was relatively flat. The water that flows throw the test site eventually reaches a lake located in New Germany State Park.

Blue Lick Run and 15-Mile Creek were the riverine wetlands that were tested. Blue Lick Run, located in Garrett County, was in an area with many small hills and it had several streams which flowed through the area. The dominant plants found here were grasses and the site was about fifty percent covered by water. 15-Mile Creek, located in Allegany County, was located within a valley and the dominant plants here were also grasses. This site was about forty-five percent water, and the water was shallow and clear.

Edgewater and Otter Creek were the estuarine wetlands that were tested and both were found in Harford County. Edgewater consisted of about ninety-five percent water, and the dominant plants found there were grasses. At this site the land sloped gradually into the water, much like a beach. At Otter Creek the water coverage was approximately fifty percent and the dominant plants were also grasses. Otter Creek was located in a woodland area, and the test site was basically flat.

The class of ten students was divided into two groups of three and one group of four. Each group was equipped with a hula hoop and a data collection notebook. Each site was tested only once during July. In order to randomly sample each site, each group randomly threw the hula hoop four times at each site, resulting in twelve throws for each site, and counted the total number of plant for each species found within the hoop per throw. Then each species was classified as an emergent (E), sub-emergent (S), or aquatic (A) (see *figure 1*). The species that were found were not identify but simply classified as being different from the other species found within the hula hoop.

Site: NAME Test Date

	Species #	Type- A, E, S	Number
THROW #1	S1	A	5
	S2	S	12
THROW #			

Figure 1. Table used to record data at the test sites.

The class calculated the diversity index for each throw at each site using the Shannon Weiner Index of Diversity formula, $H' = -\sum p_i \log p_i$, where p_i is the percent of individual species found. This was calculated by dividing the number of individuals for each species by the total number of individuals found.

After the diversity index was calculated for each throw, those numbers were averaged to produce a total average diversity index for each site. Then the averages for the two sites of the same type of wetlands were averaged to find a diversity index for that specific type of wetland. A series of T-tests were performed on the diversity indices of the three types of wetlands to determine the confidence level of the differences between the types of wetlands. The T-tests were calculated by entering the data into Minitab 12 for Windows computer program. The diversity indices were also calculated for the types of plants (emergent, sub-emergent, and aquatic) found in the types of wetlands. This was done by finding the diversity index for the three types of plants found at each site for each throw, and then the indices were averaged for each of the sites. Then the averages were used to find a diversity index for each of the three types of plants in each type of wetland.

The materials used during this experiment were chosen because they were readily available, easy to use, cost efficient, and were easily transported. The hula hoop was chosen because it provided a boundary for the sampling area. The procedures supplied a simple method of efficiently gathering an accurate sample without unattainable equipment. The equations used were easy to run with the amount of data that was obtained.

Results

The average diversity index calculated for the estuarine wetland was 0.19355. This was the second highest average diversity index. The average diversity index calculated for the palustine wetland was 0.21772. The palustrine wetland had the highest average diversity index. The riverine had the lowest average diversity index, .180942. Figure 2 shows the relationship between the average diversity indices for the three types of wetlands.

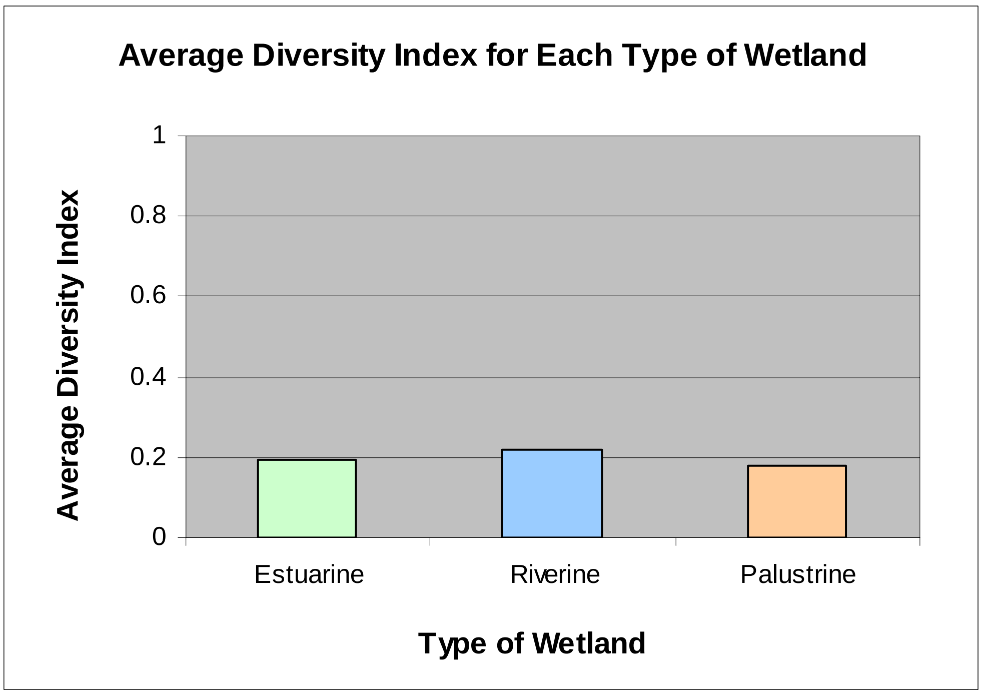

Figure 2

The results of the T-test between the riverine and the estuarine wetland produced a P-value of .464. This means the confidence level was 53.6%, indicating that the average diversity index for the two types of wetlands were not statistically different. When comparing the test results of the palustrine wetland to the estuarine wetland the P-value was .778 which produce a confidence level of 22.2%. There was not a statistical difference between the average diversity indices of these two types of wetlands.

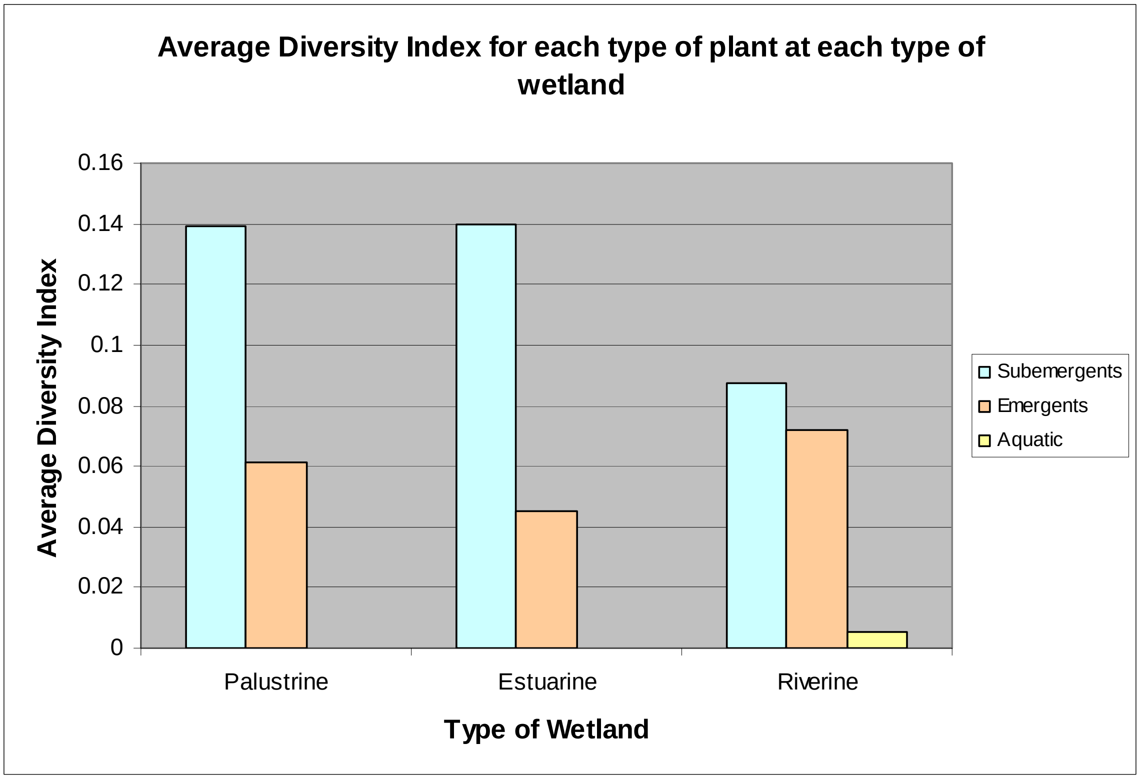

Figure 3.

The average diversity index for each type of plant for each of the different wetland types is catalogued in figure 3. According to figure 3, none of the wetland types were very diverse because the diversity indices were close to zero. However, at each wetland type, the sub emergent plants had the highest average diversity index compared to that of the emergent and aquatic plants. The riverine wetland type had the highest number of emergent plant species. This type of wetland was the only one to have a diversity index value for aquatic plants. The estuarine and palustrine wetlands contained aquatic plants; however, because there was only one aquatic plant species found, the diversity index was zero.

DISCUSSIONS AND CONCLUSIONS

The hypothesis stated that an estuarine wetland would display more plant diversity than palustrine and riverine wetlands because estuaries are relatively larger than the other types of wetlands. The hypothesis is rejected because the data shows that the average diversity between the three types of wetlands is very similar.

Higher diversity can be determined by how close the Shannon-Wiener Index number is to one. The results of these calculations show low diversity index numbers, this could be because our sample sizes are too small or that the wetland itself does not have high plant diversity. The T-test showed how similar or different the wetlands diversity indices were. The T-test P-value for the comparison between the riverine and estuarine types of wetland was 0.464. This value indicated that the two types of wetlands can only be considered different with a 53.6% certainty. Therefore it can not be stated with enough confidence that these wetlands are statistically different. For the comparison of an estuarine and a palustrine, the p-value was 0.778 this p-value indicated a 22.2% confidence that the two wetlands are different. The confidence level was too low to conclude that these two types of wetlands are statistically different.

There are many factors which may have contributed to the similarity in diversity of the three types of wetlands. Time was a factor because we only had two weeks to finish our testing; therefore, there was not a great amount of wetland sites that were tested. Another factor would be each person went into the water only as far as the shallow part of the wetland, so there could have been more aquatic species in the water that did not get included in the data collection. When the hula-hoops were thrown within the wetland, other groups could have recorded the same data from that particular area as the previous group had done.

Some suggestions to improve the data collection would be to have gathered more data from each site so we would have been able to compare the number of species found within the different types of wetlands. We could have spent more time at each site taking notes on weather and location as to why there is very little or a lot of plant life. Maybe we could have been able to test the pH levels at the different sites to see how many different species of plants or number of individuals of the plant types that were found.

Many questions that have risen because of this study include: what types of animals live in wetlands? What kind of effect do they have on the area? How well were the different sites taken care of years before? Have they been polluted in the past? What kinds of pollutants are usually found in wetlands?

LITERATURE CITED

ANTOINE S.S. AND CHIAG M. 2002. Can you save my backyard?. *Science World.* 59,4: 19-21p.

HAMMER, D. 1997. Creating freshwater wetlands. CRC Press, Inc., New York. 406p.

MARYLAND DEPARTMENT OF ENVIRONMENT. 2003. Wetland plants found in Maryland. <http://www.mde.state.md.us/assets/document/wetlandswaterways/wetplant.pdf> Accessed Jun 21, 2003.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY. 2003. MDEQ wetland Identification manual. <http://www.michigan.gov/deq/0,1607,7-135-3313_3687-10333--,00.html> Accessed Jul 9, 2003.

STEIN B. S. 2001. A fragile cornucopia assessing the status of U.S. biodiversity. *Environment.* 43,7: 12-22.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY. 1993-2003. Wetlands. < http://www.epa.gov/owow/wetlands/> Accessed Jul 16, 2003.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY. 1977. Clean water act part 404.