Lab Report
Shannon-Wiener Diversity Index

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Abstract:

Shannon-Wiener Diversity Index is a method used to measure the species diversity presenting in an area. In this lab, we selected two specific areas: one is closer to a stream and the other is near the tree’s trunk. By manually counting each individual of the species and substituting the proportion of each species into the Shannon diversity index formula, we can conclude which area is more diverse along with geographical factors that influence the biodiversity of the area.

Introduction:

Biodiversity is a variety of species. It plays many important roles in our lives. Biodiversity provides us sources of food and medicine, and it helps adjusting disturbance such wild fire and flood. Knowing the species’ richness and evenness of each individual species in a particular area, biologists are not only able to learn the influence of the species in the environment but also are able to estimate how diverse that particular area is and how the biodiversity of the area affects the other ecosystems. However, to measure the accurate numbers of how many individual species living in the area is impractical, especially in microorganism and plants likes grass. Since most animals are moving all the time and in plants it is hard to identify the accurate number of scattering grasses in the area. Therefore, nowadays many methods to measure the diversity of organism are invented to use in different
purposes such as Simpson’s index and Shannon’s index. Dissimilar to Shannon’s index, the Simpson's index is focused on the probability of two species chosen randomly from the community belonging to the same species. Nevertheless, Shannon-Wiener diversity index is one of the popular tools biologists are applying currently to measure the species diversity of the area.

In this experiment, species richness and its relative abundance of two different areas, influenced by differently geographical factors, are identified by using the Shannon diversity index. By comparing the two indexes, we can specify the area with the greatest diversity. The Shannon diversity index is a statistical index, providing the data about rarity and commonness of each species in the area since the index is based on species richness and relative abundance. According to the formula, 

$$H = - (p_A \ln p_A + p_B \ln p_B + p_C \ln p_C + ...),$$

$H$ is the abbreviation of Shannon’s index, and $p$ is the relative abundance of each species while $A$, $B$, and $C$ are the species found in the area. Using this formula and the recorded data of the numbers of each species in the area, it helps the biologist to predict the characteristic of the community. The higher value of $H$, the more diverse a community is. Thus, it reminds biologists to conserve the species diversity before it is too late. Although the Shannon Diversity Index provides us a simple synthetic summary, expressing in two components of biodiversity: the species richness (the number of different species in the community) and the relative abundance (the proportion which represents all individuals in the species), it also has a weakness. The Shannon’s index is hard to use in comparing the communities that differ greatly in their species richness. Therefore, some people prefer to use Simpson’s index instead.

**Materials:**
- Ruler (1)
- Calculator (1)
- 1x1 meter quadrats(2)
- A camera
Procedure:

1. Find an area with same ecosystem and has not less than 5 plants species.
2. Find two 1 x 1 meter- areas, the first area must be closer to a stream and the second area must be further.
3. Identify as many different species of plants. Take a photo of each species.
4. Label the number for each species.
5. Count the number of individual for each species or make a proportion of 1x1 area that is occupied by each species.
6. Record the number of members for each species into the two data tables.
7. Include physical environment for each area into the tables.

Result:

Figure 1: The area closer to a stream
(There are 5 different species of plant in the area as shown in figures 1.1-1.5 below.)
**Figure 1.1:** The first species found at the corner of the area

**Figure 1.2:** The second species found scattering in the area
Figure 1.3: The third species found scattering in the area

Figure 1.4: The fourth species found at the middle of the area
Figure 1.5: The fifth species found at the corner of the area

Figure 2: Area beneath local tree, on a slope
(Identified 5 additional species as mentioned throughout figure 2.1-2.7)
Figure 2.1: The first species found 1 individual sample

Figure 2.2: The second species 4 samples found scarce around mid-top region of the area, also observed growing in group and among area with no grass
Figure 2.3: The third specie, as in figure 1.5 found 2 samples grows in group toward top region of the area

Figure 2.4: The fourth species found 7 samples adjacent to specie #5, grows in one big group
Figure 2.5: The fifth species found 3 samples located on the upper region of the area, grows in one big group.

Figure 2.6: The sixth species found 2 samples growing randomly in the area. One found on top-right corner, another found on mid-bottom region of the area.
Figure 2.7: The seventh species as in figure 1.3, found 111 samples covering the majority region of the area

Calculation:

**Table 1:** The number of individuals of each species found in the area closer to a stream

<table>
<thead>
<tr>
<th>Species</th>
<th>No. found</th>
<th>$P_i$</th>
<th>$\ln(P_i)$</th>
<th>$P_i \ln(P_i)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>0.067039106</td>
<td>-2.702479156</td>
<td>-0.181171787</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>0.167597765</td>
<td>-1.786188424</td>
<td>-0.299361188</td>
</tr>
<tr>
<td>3</td>
<td>96</td>
<td>0.536312849</td>
<td>-0.623037614</td>
<td>-0.334143078</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>0.106145251</td>
<td>-2.242946827</td>
<td>-0.238078155</td>
</tr>
<tr>
<td>5</td>
<td>22</td>
<td>0.122905028</td>
<td>-2.096343352</td>
<td>-0.257651138</td>
</tr>
<tr>
<td>Total</td>
<td>179</td>
<td>1</td>
<td></td>
<td>-1.310405347</td>
</tr>
</tbody>
</table>

$H = 1.310405347 \approx 1.31041$

***Note: The species are in an order according to the order of the figures***
**Table 2:** The number of individuals of each species found in the area further from a stream

<table>
<thead>
<tr>
<th>Species</th>
<th>No. found</th>
<th>$P_i$</th>
<th>$\text{In}(P_i)$</th>
<th>$P_i \text{In}(P_i)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>0.007692308</td>
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<td>-0.037442573</td>
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<tr>
<td>2</td>
<td>4</td>
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<td>-3.481240089</td>
<td>-0.10711508</td>
</tr>
<tr>
<td>3</td>
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<td>0.015384615</td>
<td>-4.17438727</td>
<td>-0.064221343</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>0.053846154</td>
<td>-2.921624301</td>
<td>-0.157318232</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>0.023076923</td>
<td>-3.768922162</td>
<td>-0.086975127</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>0.015384615</td>
<td>-4.17438727</td>
<td>-0.064221343</td>
</tr>
<tr>
<td>7</td>
<td>111</td>
<td>0.853846154</td>
<td>-0.158004249</td>
<td>-0.13491132</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>130</td>
<td>1</td>
<td></td>
<td><strong>-0.652205016</strong></td>
</tr>
</tbody>
</table>

$H = 0.652205016 \approx 0.65221$

***Note: The species are in an order according to the order of the figures

**Discussion:**

To identify which area has the greatest diversity of species, firstly two areas with different in geographical environment are selected to observe how environment affects the biodiversity. Counting number of species, counting members of each species, and calculating the proportion of each species will determine the Shannon diversity index, $-\sum P_i \text{In}P_i$. The higher the Shannon diversity index the area has, the more diverse the area is. In this experiment, one area is close to a stream while the other is close to a local tree. Comparing the Shannon diversity indexes between Table 1 and Table 2, result shows that Table 1 reflect higher diversity from greater Shannon diversity indexes value of 1.3 when Table 2 shows as low 0.65. Factors assumed to cause the differences between the
two would have been level of water and sunlight exposure that result in deficit growth in one area and not the other. In Table 1 or area 1, the location was set in open area, on top of a flat surface elevated next to a pond. The area receives full sunlight as well as water during the day. From closer inspection, the area measured was entirely covered in plantation without any space revealing dirt. On the other hand, Table 2 or area 2 was located on a higher ground, under a local tree which blocks sunlight during a certain period of the day. Since the area is located on a top of a slope, water will naturally flows down much faster when compared to Area 1, resulting in less water within the dirt. In additional, less sunlight will hinder the growth and distribution of the plants itself making it harder for some plant to spread throughout the region. Lastly, on closer observation, area 2 are left with some region without any plantation revealing the dirt surface.

During conducting the experiment which settles in an open area, it is impossible to accurately count number of species found in the specific area and determine the species whether plants are the same species as the others. Counting scattering glasses are very hard, as well as determining plants species by observing their morphological characteristics. These are possible error that greatly affect the Shannon diversity index of the two areas which might lead to the wrong conclusion. Human error such as repeatedly count the same plants also alters the proportion of each species. However these error remind us to be more accurate during collecting data.

**Conclusion:**

Comparing the first area’s Shannon diversity index with that of second area, the area closer to the stream is more diverse due to higher index and abundance of resources near the pond.
References


