**Shannon - Wiener Diversity Index**

Shannon-Wiener Index denoted by **H = -SUM[(p*i*) × ln(p*i*)]**   
**SUM** = summation   
**p*i*** = proportion of total sample represented by species *i*   
Divide no. of individuals of species *i* by total number of samples   
**S** = number of species, = species richness   
**Hmax = ln(S)** Maximum diversity possible   
**E** = Evenness = H/Hmax

Example 1: Uneven plant community

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species (*i*) | No. in sample | p*i* | ln(p*i*) | (p*i*) **×** ln(p*i*) |
| Big bluestem | 60 |  |  |  |
| Partridge pea | 10 |  |  |  |
| Sumac | 25 |  |  |  |
| Sedge | 1 |  |  |  |
| Lespedeza | 4 |  |  |  |
| S = | Sum = |  |  | Sum = |

H =   
Hmax =   
E =

Example 2: Even plant community

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species (*i*) | No. in sample | p*i* | ln(p*i*) | (p*i*) **×** ln(p*i*) |
| Big bluestem | 20 |  |  |  |
| Partridge pea | 20 |  |  |  |
| Sumac | 20 |  |  |  |
| Sedge | 20 |  |  |  |
| Lespedeza | 20 |  |  |  |
| S = | Sum = |  |  | Sum = |

H =   
Hmax =   
H =

**Homework Exercise**

**1.  Species diversity** - In the first tables of Problems 1 and 2, you are given species names in Column 1 and the number of individuals in Column 2 out of a sample size of 200 observations. **Fill in Columns 4, 5, and 6 and calculate** species richness (S), Shannon-Wiener Index (H), Hmax, and evenness (E) to 3 decimal places.

Which Problem has higher species diversity?

**2. Functional diversity** - Go back to Column 1 and assign a functional group to each species after the slash /. The groups are based on these growth habits: warm-season grasses (wsg), cool-season grasses (csg), leguminous forbs (leg, not vines), nonleguminous forbs (forb), vines (v), shrubs (shr), and trees (tr). FYI, purpletop and yellow foxtail are warm-season grasses.

<http://plants.usda.gov/growth_habits_def.html>

Then go to the second table for each problem to recalculate Column 2 with the number of individuals for each functional group. **Calculate** ***functional diversity* for each group** the same way you would calculate species diversity. Do not distinguish between annuals and perennials. You can code the functional groups in the first tables using the abbreviations in parentheses above.  Determine their grouping by using the classification table from the plants database retrieved from <http://plants.usda.gov/java/>

and Ernst Seed catalog <http://www.ernstseed.com/speciesmix-search/>

If PLANTS calls a plant “tree shrub”, you call it “shrub”.  
    a.  Which Problem has greater functional diversity, 1 or 2?  
    b.  Write a few sentences comparing the two plant communities in terms of the types of species and the nature of diversity.  
    c.  What would be a good way to quantify the degree of invasion by exotics?

**Problem 1  Species diversity index calculation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Species (i)** | **Functional group** | **No. in sample** | **pi** | **ln(pi)** | **(pi) × ln(pi)** |
| Eastern gamagrass |  | 6 |  |  |  |
| Big bluestem |  | 18 |  |  |  |
| Lanceleaf coreopsis |  | 10 |  |  |  |
| Virginia wildrye |  | 6 |  |  |  |
| Orchardgrass |  | 12 |  |  |  |
| Beaked panicgrass |  | 8 |  |  |  |
| Purpletop |  | 14 |  |  |  |
| Purple coneflower |  | 10 |  |  |  |
| Butterfly milkweed |  | 12 |  |  |  |
| White heath aster |  | 4 |  |  |  |
| Tick trefoil |  | 2 |  |  |  |
| Goldenrod |  | 18 |  |  |  |
| Partridge pea |  | 8 |  |  |  |
| Buttonbush |  | 2 |  |  |  |
| Northern spicebush |  | 8 |  |  |  |
| Virginia creeper |  | 14 |  |  |  |
| Witch hazel |  | 18 |  |  |  |
| Greenbrier |  | 20 |  |  |  |
| Green ash |  | 2 |  |  |  |
| Grey dogwood |  | 8 |  |  |  |
| S = |  | Sum = 200 |  |  | Sum = |

S = \_\_\_\_\_\_ H = \_\_\_\_\_\_\_ Hmax = \_\_\_\_\_\_\_\_ E = \_\_\_\_\_\_\_\_\_

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Functional group** | **No. in sample** | **pi** | **ln(pi)** | **(pi) × ln(Pi)** |
| Warm-season grasses |  |  |  |  |
| Cool-season grasses |  |  |  |  |
| Legume forbs |  |  |  |  |
| Nonlegume forbs |  |  |  |  |
| Shrubs |  |  |  |  |
| Trees |  |  |  |  |

**Problem 2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Species (i)** | **Functional group** | **No. in sample** | **pi** | **ln(pi)** | **(pi) × ln(Pi)** |
| Sideoats grama |  | 2 |  |  |  |
| White clover |  | 4 |  |  |  |
| Indiangrass |  | 4 |  |  |  |
| Little bluestem |  | 8 |  |  |  |
| Yellow foxtail |  | 6 |  |  |  |
| Wood oats |  | 6 |  |  |  |
| Junegrass |  | 6 |  |  |  |
| Canada wildrye |  | 2 |  |  |  |
| Ky. bluegrass |  | 2 |  |  |  |
| White wild indigo |  | 4 |  |  |  |
| Jap. honeysuckle |  | 28 |  |  |  |
| Kudzu |  | 18 |  |  |  |
| Trumpet creeper |  | 34 |  |  |  |
| Smartweed |  | 2 |  |  |  |
| White vervain |  | 8 |  |  |  |
| Queen Anne’s lace |  | 4 |  |  |  |
| Elderberry |  | 18 |  |  |  |
| American elm |  | 22 |  |  |  |
| Sugarberry |  | 14 |  |  |  |
| Black locust |  | 8 |  |  |  |
| S = |  | Sum = 200 |  |  | Sum = |

S = \_\_\_\_\_\_ H = \_\_\_\_\_\_\_ Hmax = \_\_\_\_\_\_\_\_ E = \_\_\_\_\_\_\_\_\_

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Functional group** | **No. in sample** | **pi** | **ln(pi)** | **(pi) × ln(Pi)** |
| Warm-season grasses |  |  |  |  |
| Cool-season grasses |  |  |  |  |
| Legume forbs |  |  |  |  |
| Nonlegume forbs |  |  |  |  |
| Shrubs |  |  |  |  |
| Trees |  |  |  |  |
| Vines |  |  |  |  |
| S = | Sum = 200 |  |  | Sum = |

S = \_\_\_\_\_\_ H = \_\_\_\_\_\_\_ Hmax = \_\_\_\_\_\_\_\_ E = \_\_\_\_\_\_\_\_\_