**Hypothesis and Sampling Design**

**Overview**

Every good study begins with careful formulation of a hypothesis and a study design that will effectively test that hypothesis. Before any data are generated you will first discuss potential hypotheses with your classmates and carefully craft them. Then, you will choose the species that will allow you to effectively test your hypothesis.

**What to turn in**

Submit a typed set of hypotheses, variables, and rationale as described below, along with a list of species you plan on including in your study. Only one group member needs to upload the document, but all group members’ names must be on the document.

**Hypothesis Testing**

Hypotheses –Hypotheses should be short, direct statements. They should involve only one predictor variable and one response variable.

e.g., Species that reproduce predominantly via lichenized asexual propagules have smaller range sizes than species that reproduce only with aposymbiotic spores.

Variables – List your predictor and response variable. The predictor is the variable that you think is affecting the response variable.

e.g., Predictor: reproductive mode, Response: range size

Rationale – In two to three sentences tell my *why* you proposed your hypothesis based on your knowledge of the biology of lichens.

e.g., Because ascospores are smaller than lichenized asexual propagules we expect that they can disperse farther. The longer-range dispersal ability will likely lead to larger distributions overall. Additionally, because the aposymbiotic spores must resynthesize the symbiosis after dispersal, they form thalli with locally adapted photobionts where they land. Species with predominantly asexual lichenized diaspores, on the other hand, are taking their photobionts with them, which may or may not be adapted to the new habitat to which they disperse.

Develop one or two hypotheses using the format above. You may use the hypothesis included as an example, but you must rewrite the hypothesis and rationale in your own words. If you choose to test the hypothesis above you must develop a second hypothesis. For instance, there are species with different photobionts available for analysis and you could choose to use that as a variable in your study.

**Sampling Design**

Once your hypothesis is developed, it is time to select which species you will use to test your hypothesis. You need to make sure that you include multiple species that are representative of each of your variable. Each additional species that you include adds to your sample size, and thus increases the power of your inference. For instance, if you are interested in comparing the ranges sizes of species that produce soredia and those that produce isidia you need to include at least three species that produce each type of propagule. The more representatives that you include for each of your variables, the stronger your statistical inference will be due to increased sample size.

**Photographs and distributions of all of the following species can be found in the** **‘CURE species introduction’ PowerPoint.**

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| **Family** | **Species** | **Reproductive Mode** | **North American Distribution** |
| Lobariaceae | *Lobaria pulmonaria* | Primarily isidia and soredia, infrequent apothecia, *rate of apothecia and isidia/soredia presence currently unknown* | Widespread in temperate and boreal North America, and in many mountainous areas, extirpated from large areas due to pollution and land-use |
| Lobariaceae | *Lobaria scrobiculata* | Primarily via soredia, infrequent apothecia, *rate of apothecia and soredia presence currently unknown* | Infrequent to rare with disjunct populations in coastal or mountainous western North America, Appalachian Mountains and coastal northeastern North America |
| Lobariaceae | *Ricasolia quercizans (*syn. *Lobaria quercizans)* | Primarily via apothecia, *rate of apotheia presence currently unknown* | Widespread and abundant throughout northeastern and Appalachian North America, extirpated from large areas due to pollution and land-use |
| Parmeliaceae | *Parmotrema arnoldii* | Primarily via soredia, infrequent apothecia, *rate of apothecia and soredia presence currently unknown* | Locally abundant with disjunct populations in coastal western North America, Appalachian Mountains and Great Lakes in eastern North America |
| Parmeliaceae | *Parmotrema austrosinense* | Primarily via soredia, infrequent apothecia, *rate of apothecia and soredia presence currently unknown* | Widespread throughout southeastern North America and often locally abundant, with a disjunct population in coastal southern California |
| Parmeliaceae | *Parmotrema crinitum* | Primarily via isidia, infrequent apothecia, *rate of apothecia and isidia presence currently unknown* | Widespread and throughout eastern North America and coastal western North America, varying in abundance from common to rare depending on region |
| Parmeliaceae | *Parmotrema diffractaicum* | Primarily via soredia, infrequent apothecia, *rate of apothecia and soredia presence currently unknown* | Small population, rare in the southern Appalachian Mountains |
| Parmeliaceae | *Parmotrema internexum* | Primarily via isidia, infrequent apothecia, *rate of apothecia and isidia presence currently unknown* | Widespread but not abundant throughout southeastern North America |
| Parmeliaceae | *Parmotrema mellissii* | Primarily isidia and soredia, infrequent apothecia, *rate of apothecia and isidia/soredia presence currently unknown* | Widespread but not abundant throughout southeastern North America |
| Parmeliaceae | *Parmotrema neotropicum* | Primarily via isidia, infrequent apothecia, *rate of apothecia and isidia presence currently unknown* | Widespread but not abundant throughout southeastern North America |
| Parmeliaceae | *Parmotrema perforatum* | Primarily via apothecia, *rate of apotheia presence currently unknown* | Widespread throughout eastern North America, locally abundant in some areas |
| Parmeliaceae | *Parmotrema perlatum* | Primarily via soredia, infrequent apothecia, *rate of apothecia and soredia presence currently unknown* | Widespread and throughout Appalachia and Great Lakes in eastern North America, and coastal western North America, varying in abundance from common to rare depending on region |
| Parmeliaceae | *Parmotrema reticulatum* | Primarily via soredia, infrequent apothecia, *rate of apothecia and soredia presence currently unknown* | Widespread and abundant throughout eastern North America |
| Parmeliaceae | *Parmotrema simulans* | Primarily via soredia, infrequent apothecia, *rate of apothecia and soredia presence currently unknown* | Small population, rare in the southern Appalachian Mountains |
| Parmeliaceae | *Punctelia appalachensis* | Primarily via lobules, infrequent apothecia, *rate of apothecia and lobule presence currently unknown* | Small scattered population, primarily Southern Appalachian |
| Parmeliaceae | *Punctelia caseana* | Primarily via soredia, infrequent apothecia, *rate of apothecia and soredia presence currently unknown* | Widespread and abundant throughout northeastern and Appalachian North America |
| Parmeliaceae | *Punctelia reddenda* | Primarily via soredia, infrequent apothecia, *rate of apothecia and soredia presence currently unknown* | Small scattered population, primarily Southern Appalachian |
| Parmeliaceae | *Punctelia rudecta* | Primarily via isidia, infrequent apothecia, *rate of apothecia and isidia presence currently unknown* | Widespread and abundant throughout eastern North America |