|  |  |
| --- | --- |
| **Is There a Correlation Between Precipitation Level and Amphibian Species Richness?** |  |

## Objectives

Students completing this module will be able to:

* Evaluate the osmoregulatory challenges faced by organisms in different environments.
* Download, clean, and analyze data from a digitized natural history collection.
* Evaluate a potential correlation between two variables.

**Introduction**

The trade-off between gas exchange and water balance is important constraint in animals. Most terrestrial animals have gas exchange surfaces that are internal, where evaporation is limited and they can be kept moist. For example, mammals’ gas exchange surfaces are inside the moist environment of our lungs. Insects have a system of tubes, called a tracheal system, that brings oxygen directly to the animals’ tissues and can be regulated by pores called spiracles that open and close to reduce water loss.

Amphibians, however, have a mix of terrestrial and aquatic adaptations. For example, most amphibians have an aquatic larval stage with gills for gas exchange. The larvae undergo metamorphosis to become terrestrial adults, which have internal lungs but also perform gas exchange partially across the outer body surface. Sometimes more than 25% of oxygen they use is absorbed directly across the skin. Because of these constraints, amphibians are sensitive to water levels in the environment, and might not be able to exist in habitats that are too dry. In this activity, we will compare the species diversity of amphibians in areas with different levels of precipitation to see if there is evidence of this limitation.

We will be using iDigBio records as an estimate of amphibian species diversity in different locations. **Please note** that the absence of a species record from a specific place cannot be considered proof that it doesn’t occur in that location, so this is *only an estimate of diversity* that we can use to *generate hypotheses*. To test any hypotheses generated using these data, we would need to design and carry out a systematic sampling protocol that would also account for other variables that might influence amphibian species diversity.

**Activity 1: Accessing Your Data**

In the table below, 12 U.S. cities are listed, along with their location, and annual precipitation averages. You and your partner will be assigned one city to investigate. The other team at your table will be assigned a city with a different level of precipitation. Follow the procedure below to collect your data.

*Procedure*:

1. Go to [www.idigbio.org](http://www.idigbio.org)
2. Click on “Search the Portal”
3. In the search tool, click on “Mapping”
4. Select “Circle”
5. Enter the latitude and longitude of your city.
6. Set the radius length at 50 km.
7. Click on “Filters”
8. Select “Add a field”
9. Select “Class”
10. Enter “Amphibia” in the Class filter
11. Wait for your data to load, then download your data file.
12. From the data folder that downloads, open the “occurrence.csv” file and spend a few minutes looking at the types of data that are present.

**Activity 2: “Cleaning” Your Data**

When you opened the file containing your downloaded data, you may have been overwhelmed by the volume of information that it contains. Don't be discouraged, it is fairly easy to eliminate the unnecessary data to get the data you want.

Because we are only interested in species richness, the only column of data we need is the “scientific name” column, which contains the scientific name of each specimen in the collection that meets our criteria.

*Procedure*:

1. Select the column with the header “dwc:scientificName”
   * DWC stands for Darwin Core. This is a set of standards for the organization of biodiversity data.
2. Copy the column and paste it into a blank tab in your spreadsheet.
3. Sort the column alphabetically (Data/Sort)
4. Remove duplicates using the Data/Remove Duplicates command
5. Review the list of names and remove any additional duplicates. For example, misspelled genus or species names would not be removed by the “remove duplicates” command.
6. Remove any rows that contain a Genus, but no species name.

Example:

A screenshot of a cell phone

Description generated with very high confidence

1. If subspecies are listed, remove all subspecies, leaving only one entry for the species.

Example:

A screenshot of a cell phone

Description generated with very high confidence

1. Once you have removed all duplicates, count how many species are present and record your data in the table below.

**Activity 3: Analyzing Your Data**

*Procedure*:

1. Create a scatterplot of the data, with precipitation as the x-variable and amphibian species diversity as the y-variable.
2. Add a trendline.
3. Answer the questions on the lab assessment based on this graph.

**Class Data**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **City** | **Latitude** | **Longitude** | **Annual Precipitation**  **(mm)** | **# Amphibian Species**  **in NHC** |
| **Dry Cities** |  |  |  |  |
| Las Vegas, NV | 36.17 | -115.14 | 106 |  |
| Sacramento, CA | 38.58 | -121.49 | 170 |  |
| Phoenix, AZ | 33.45 | -112.07 | 208 |  |
| Denver, CO | 39.74 | -104.99 | 396 |  |
| San Jose, CA | 37.34 | -121.87 | 402 |  |
| Salt Lake City, UT | 40.76 | -111.89 | 409 |  |
| **Wet Cities** |  |  |  |  |
| Virginia Beach, VA | 36.85 | -75.98 | 1182 |  |
| Providence, RI | 41.82 | -71.41 | 1198 |  |
| Atlanta, GA | 33.75 | -84.39 | 1263 |  |
| Houston, TX | 29.76 | -95.37 | 1264 |  |
| Miami, FL | 25.76 | -80.19 | 1572 |  |
| New Orleans, LA | 29.95 | -90.07 | 1592 |  |

**Activity 4: Interpreting Your Data: Answer the Questions Below**

Does the graph indicate that precipitation levels might be an important factor influencing the diversity of amphibians in a region? Explain your evidence.

Mt. Pleasant, Michigan (43.5978° N, -84.7675° W), home to Central Michigan University, receives, on average, 813 mm of precipitation annually. Based on your analysis, how many species of amphibians would you predict you could find within a 50 km radius of Mount Pleasant?

Go to iDigBio and determine how many amphibian species are on record for Mt. Pleasant. Record that number below. How well does your prediction match the actual number of species on record?

What other factors might also influence the diversity of amphibians in a location?