**Project EDDIE: Assessing The Risk of Invasive Species Using Community Science Data Module**

Spatial Analysis Learning Objectives

* To understand how we can use spatial biodiversity and community science data to answer ecological questions
* To utilize and download large-scale biodiversity data from online repositories including a citizen science database called iNaturalist
* To learn to make maps that examine species distribution patterns and how they change depending on the species you are observing

Invasive Species Learning Objectives

* To understand the threat invasive species pose to native species and ecosystems
* To use spatial biodiversity data to assess the threat posed by invasive species in a given region
* To determine if community science data is documenting the occurrence of invasive species

Why This Matters

Community science projects provide novel data on species occurrence and can help scientists and land managers to understand where species are found. Community science data are also often both spatial and ecological, and can be used to help you address a variety of different questions and give you exposure to novel skills. In this activity, you will examine geospatial data from a widely used community science platform - iNaturalist - can accurately predict the risks posed by invasive plant species. This is important because it exposes you to GIS tools and analyses through the program QGIS, helps you to gain experience in data management and organization, and because it addresses an important applied ecological question.

Outline of Activity

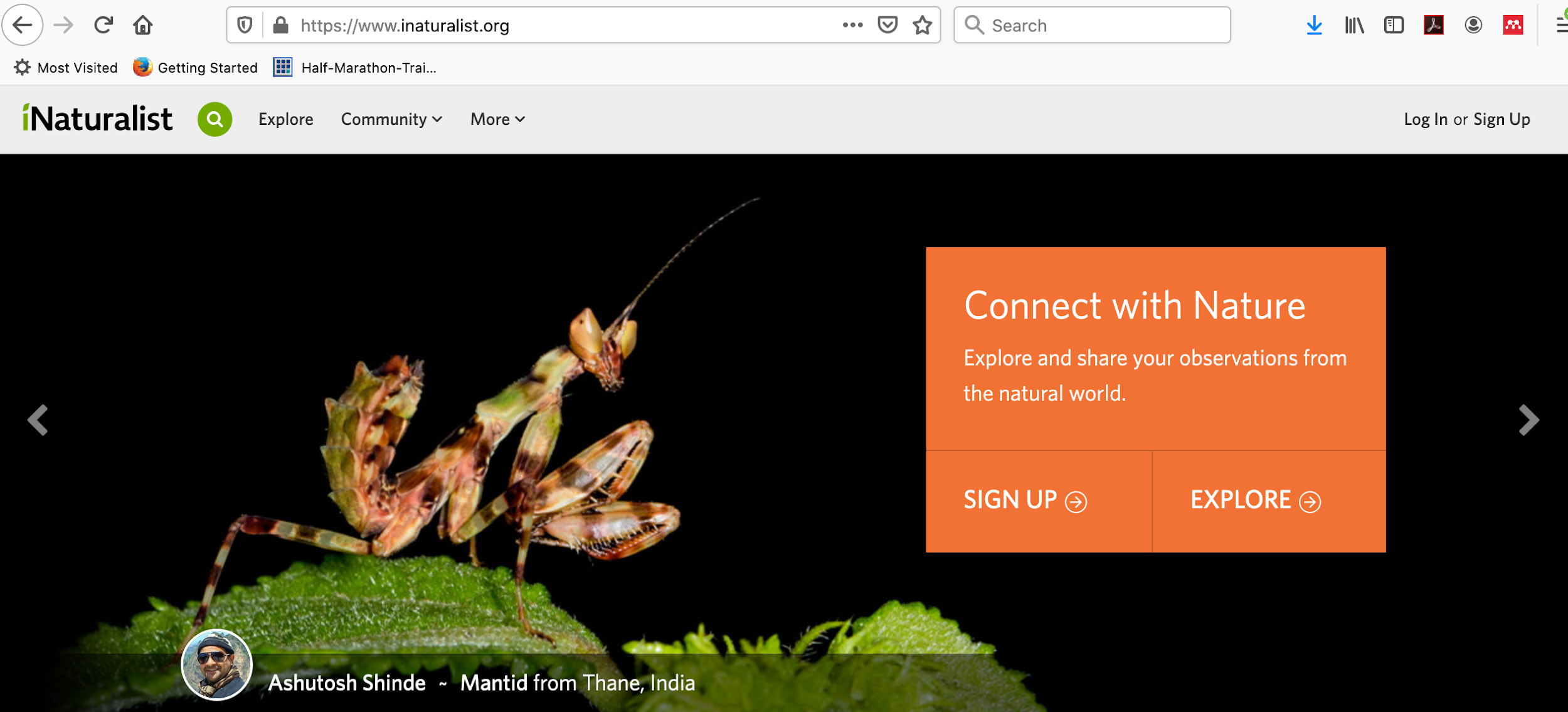
1. Pre-Class Activity: You will read pre-assigned paper on invasive species and create an account with iNaturalist
2. Activity A: You will have a brief discussion on invasive species and community science (including a focus on iNaturalist as a tool for biodiversity data collection)
3. Activity B: You will use data from iNaturalist and the open access mapping program QGIS to explore the spread and distribution of a common invasive plant
4. Activity C: You will determine if community science data can accurately assess the threat posed by invasive species

**Pre-Class Activity:**

*Invasive Species Pre-Assigned Readings:* You will read the pre-assigned paper by Early et al. (2016) that examines the impacts of invasive species on native ecosystems. This article is open access and is intended to provide context for the activity and general information on the threats posed by invasive species.

Early et al. (2016) Global threats from invasive alien species in the twenty-first century and national response capacities. *Nature Communications* **7**, Article Number: 12485.<https://www.nature.com/articles/ncomms12485>

*Setting up an account with iNaturalist:* You will create their own free iNaturalist account. To do this, visit [www.inaturalist.org](http://www.inaturalist.org) and click on the button that says sign up in the top right corner. This will allow you to set up an account and username so that you can download species occurrence data.



Website: <https://www.inaturalist.org/>

**Activity A: How do we examine the spread and distribution of invasive species?**

*Class Discussion & PowerPoint Presentation:* Class will begin by going through a brief presentation about the importance of invasive species. You will then have interactive small group discussions that examine the following themes and questions:

1. What is an invasive species?
2. What are some common examples of invasive species and what are their impacts?
3. Why is it important to know where invasive species are found?
4. What areas are at greatest risk from invasive species (both today and in the future)?

You will then have a brief discussion about iNaturalist and the role of community science data collection. This will include discussion on the following themes:

1. The purpose of iNaturalist
2. Who collects data?
3. How you can use these data to answer ecological questions?

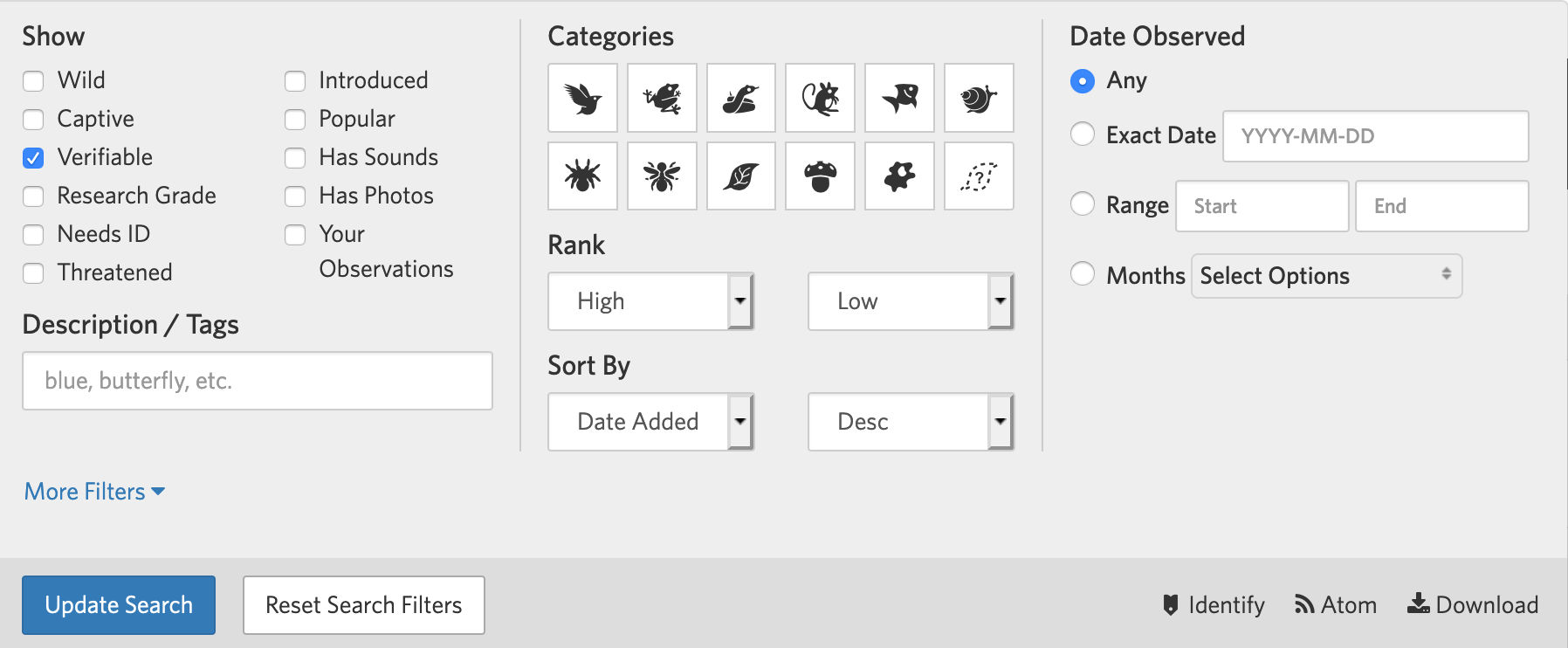
**Activity B: What is the spatial distribution of invasive species?**

In this section, you will examine the spread of a common invader using iNaturalist and QGIS. You will use iNaturalist to download species occurrence records for the common invasive plant - *Lonicera japonica* (Japanese honeysuckle). To help you understand the purpose of this, your instructor will provide a brief overview of this invader and why it is important.

*Downloading Data For A Common Invasive Species From iNaturalist*:

These instructions can be used to download data for any species. For this activity, you will use data on *Lonicera japonica* because this is a common and widespread invasive species.

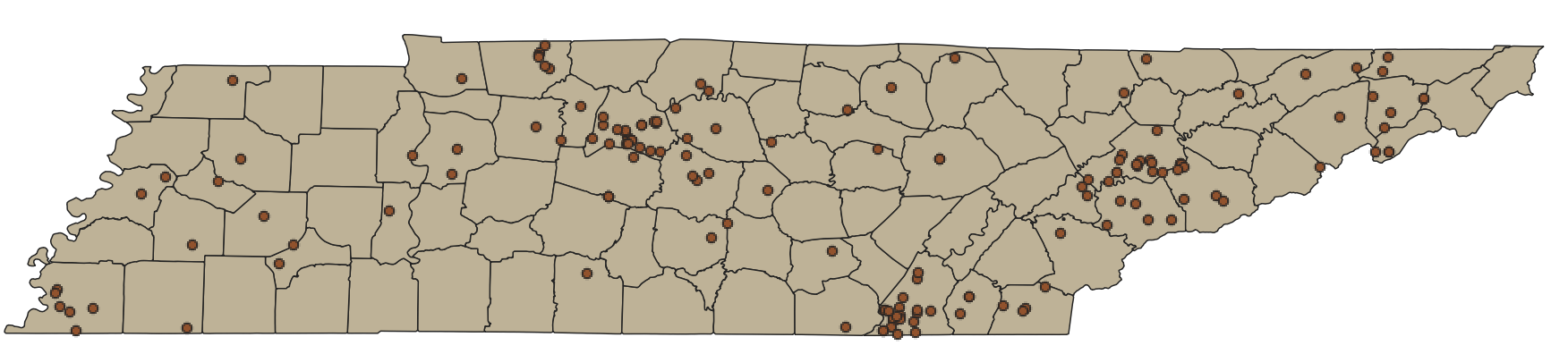
1. Go to [www.inaturalist.org](http://www.inaturalist.org) and log in to your account.
2. Once you are logged in, click on the button at the top of page that says Explore.
3. From there, enter into the species box on the top right “Lonicera japonica” and in location enter “Tennessee”
4. Once you have done this, click the filters button on the top right. This should bring up a box that looks like this:



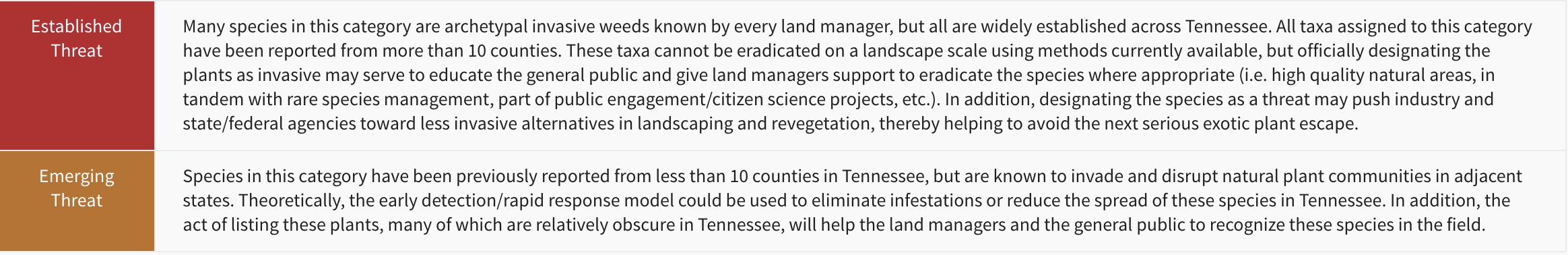
1. Once you have done this, make sure the verifiable box is checked and then click on the download button in the bottom right corner of the box.
2. This will take you to the export observations page where you can create a query.
3. De-select everything by hitting the none box at the top, and then re-select id, latitude, and longitude. This will decrease the size of the CSV file and make it easier to work with.
4. Scroll down to the bottom of this and then select create export.
5. This will take a few minutes to download, but once it is done (time depends on file size), you will need to click on the download button. This will begin the download of a CSV file that it is in a zip form.
6. Once the download is complete, unzip the file and open the file in Excel to make sure that it is properly formatted as a CSV and that it includes latitude and longitude data.

*Mapping Invasive Species Occurrence Data in QGIS:*

1. Begin by opening up the Long Term Release of QGIS
2. Choose a state and load a basemap that has the county boundaries. If you do not already have a basemap, you can download the shapefile from the following website: http://www.tngis.org/administrative-boundaries.htm
3. For the purposes of this lab, we will focus on Tennessee, but again if you are using another state, the map will be similar and have points and county boundaries.
4. Once you have loaded in this basemap, add in the CSV layer (as a delimited layer file). When you are finished, this should like similar to this map:



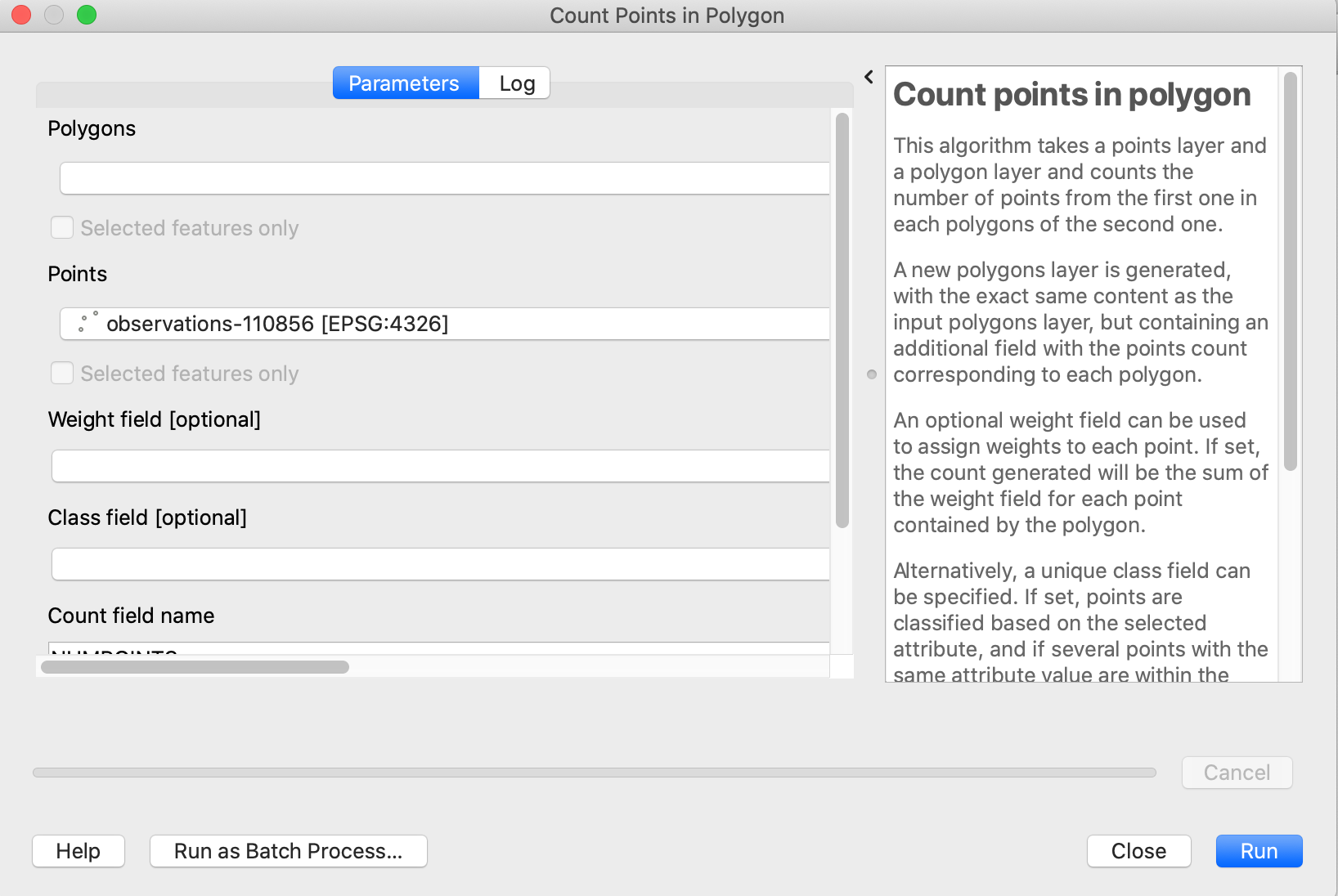
*Tennessee Ranking of Invasive Species:* The Tennessee Invasive Plant Council classifies invasive plants into two different threat categories: Established and Emerging Threats. These threat categories are based on the number of counties in which these invasive species are found:



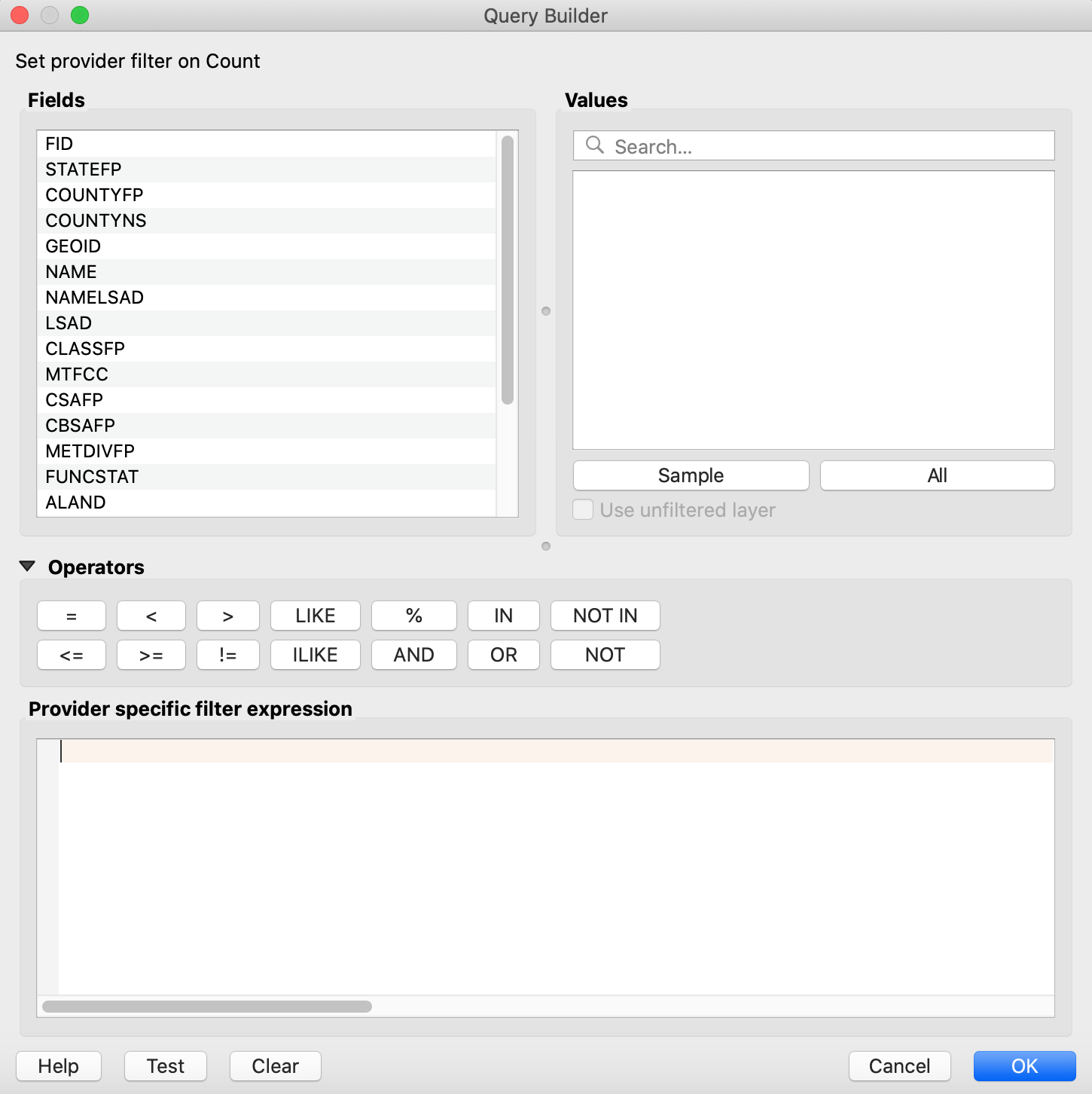
Source: <https://www.tnipc.org/invasive-plants/>

*Determining If Community Science Data Accurately Assesses Threat of Invasive Species*: In this next step, we will evaluate if data from iNaturalist accurately predicts the threat posed by an invasive species according to the Tennessee Invasive Plant Council Ranking system. To do this, we will need to learn how to filter and sort data in QGIS and then to compare this to the TN rankings.

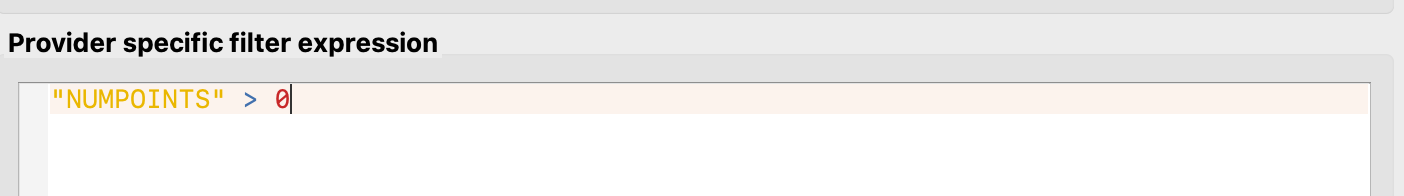
1. Click on the vector button on the top menu of QGIS and this will lead you to a dropdown menu.
2. Go to analysis tools and then select ‘count points in polygon.’
3. When you do this, a new box will pop up that looks like this:



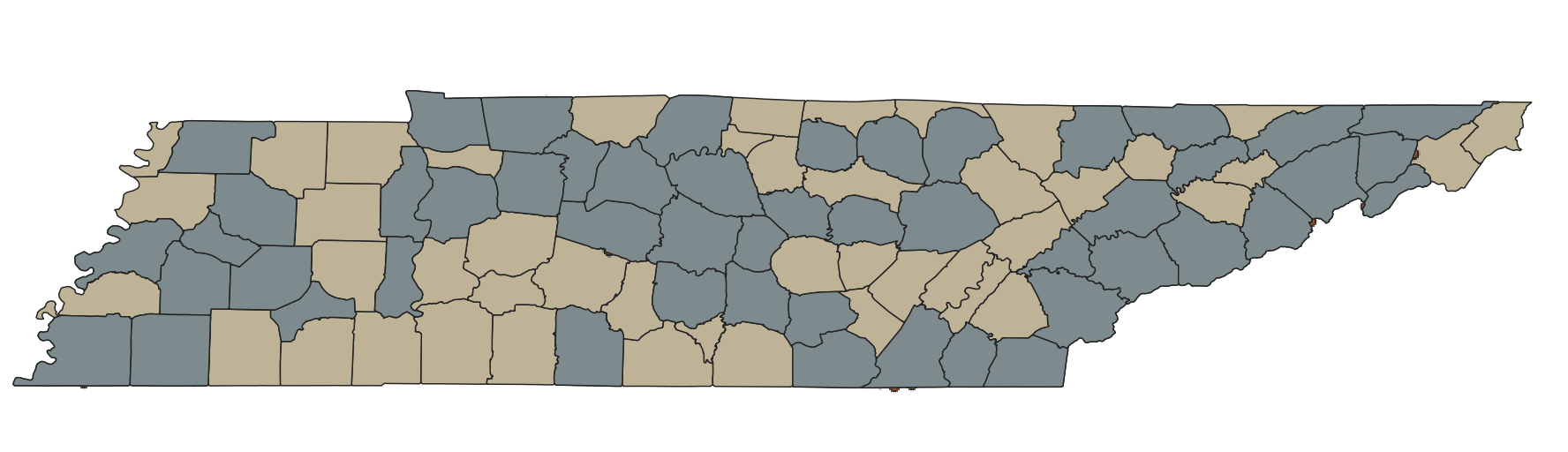
1. Once you have done this, enter your TN counties map as the polygon layer by using the dropdown menu and enter your points layer as the points layer using the dropdown menu.
2. When you have done this, select run. This takes some time, so be patient.
3. When this finishes running, a new layer will appear. This new layer will look just like the county layer because it has merged the point/shapelayer files together.
4. To determine the number of counties that have points in them, you will have to filter your file.
5. To do this, left click (right click on PC) on the new layer that you just created and then select filter.
6. This will take you to a box that looks like this:



1. In this box, you need to scroll down and click the mouse on the field entitled “NUMPOINTS.”
2. Once you have clicked on this, then click on the “All” button on the right side. This will give you a list of all the numbers that are in the polygons (so the total # of points).
3. Go back to the field box and then double click on “NUMPOINTS,” then select the greater than sign and then double click on the 0 button. If you have done this correctly, it should look like this:

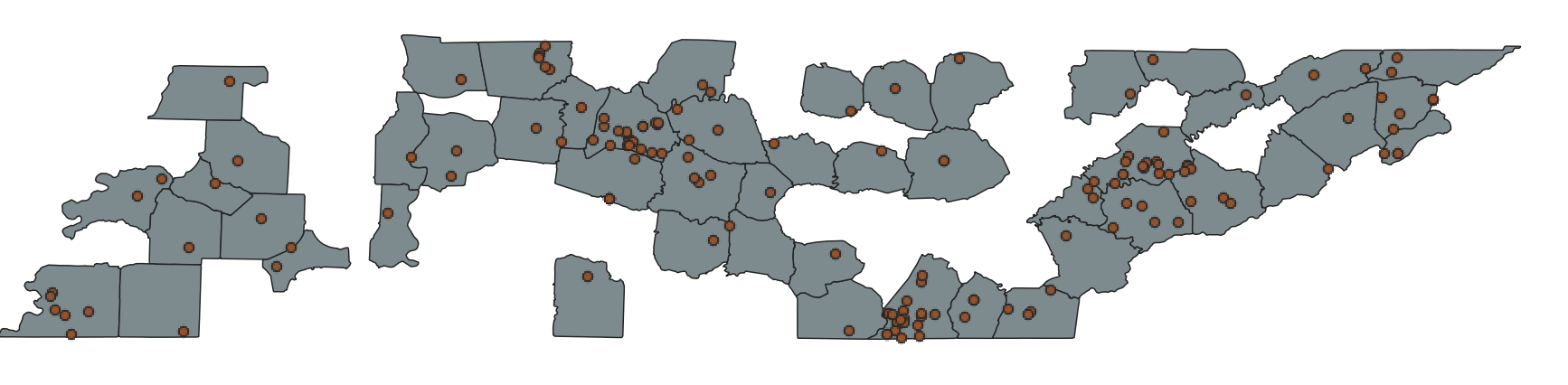


1. Once you have this, it will create a map of all the counties that have more than one occurrence data.
2. Then, to determine the total number, left click (right click on PC) on the layer and select attribute table. At the top, it will tell you the total count.
3. In addition, you should have a map that now looks like this:



*Editing the Map To Show Only Counties With Invasive Species Present:* The next step is to adjust the colors of the map and the layer visibility. To do this, use the following steps:

1. Click your mouse on the TN county layer map.
2. Then click on the view button on the menu at the top and select “Hide Selected Layers.” This will eliminate all the counties underneath.
3. From there, you can then move the point layer up by selecting it and dragging it over the “Count Layer” that you created.
4. This should result in a map that looks like this:

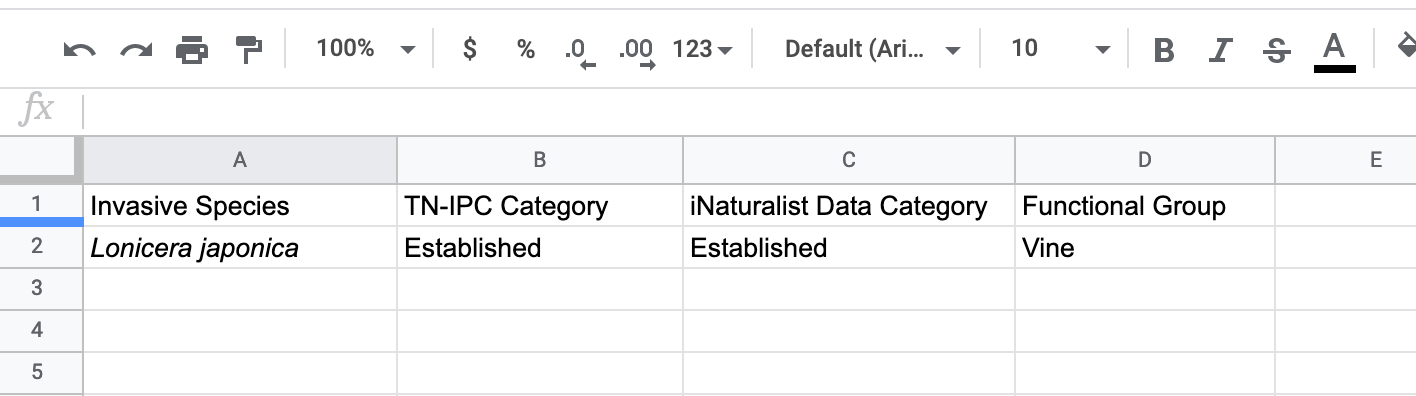


1. After you have created this map, discuss what you know about these counties across Tennessee with a partner (or in small groups) and then talk about what type of geographic environments this invasive species may prefer or be found in.

**Activity C: Can Community Science Data Accurately Predict The Threat of Invasive Species?**

The next step in this project is to explore how different invasive species are distributed across Tennessee to look beyond just Japanese honeysuckle. To do this, you will work to download data on five invasive species of their choice from the Tennessee Invasive Plant Council website and determine if the rankings for these species matches the category level from TN-IPC. You can select the invasive species by going to the following website and downloading the list of TN Invasive Plants. <https://www.tnipc.org/invasive-plants/> and then repeat the steps in iNaturalist and QGIS with your 5 new species to determine how many counties they are present in.

Following completion of these activities, you will aggregate your data together in a class Google Sheet that includes the categories pictured below. Additional columns could be added including functional class or numbers of counties from different ranking systems to increase the analysis.



**Concluding Thoughts**

This activity was designed to help you with several important goals:

1. To understand how invasive species are distributed across geographic areas.
2. To examine how we can use community science data to assess invasive species distributions.
3. To help determine whether there is a disconnect between expert opinion on invasive species and the data that is being added by community science participants.