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Using the Citizen-Science App "iNaturalist" as a Laboratory Tool for Hypothesis-Testing

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Interest in citizen-science projects in the college lab has risen dramatically recently. iNaturalist, https://www.inaturalist.org, a free app that facilitates the collection of observations of macroscopic organisms world-wide, can be thought of as a pathway to a CURE (course-based undergraduate research experience) for organismal biology, natural history, and even biodiversity. This app allows users to enter photographs, propose identifications, solicit expert identifications, and to log metadata such as location, time, and date. When species are identified the aggregate data facilitates testing hypotheses about presence/absence in specific locations, frequency, and phenology. Participants received a short introduction to the use of iNaturalist and to its project construction features and then went to a local natural preserve, Gatineau Park, http://ncc-ccn.gc.ca/places-to-visit/gatineau-park/conservation-at-gatineau-park to collect observations.

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Introduction

iNaturalist is a citizen-science digital host for observations of plants, animals, and fungi. It houses photos of over 215,000 species based on 10 years of observations by almost 600,000 observers world- wide. It can be found on the iNaturalist website https://www.inaturalist.org and it "exists" as a mobile app as well, down- loadable from the Apple App Store https://apps.apple.com/us/app/inaturalist/id4213 97028 or, for Android devices, from the Google play store https://play.google.com/store/apps/details?id=org.inaturalist.android
Users install the app on their mobile device and/or go to the web page and create an account then use that account to post images of fungi, animals, or plants they've seen.

Phones now have GPS capabilities and store this GPS data along with other metadata. iNaturalist then creates a database from all users linking the time and date of observations to the locations and thereby produces a comprehensive map of observations for each species.

In addition, the program comes with built-in image recognition, allowing for the app to make suggestions of what was seen based on visual similarity and similar nearby observations. The program is linked to a large community of both observers and identifiers. Once a posted observation gets a certain number of identifiers (anyone with an account, with weight given to proven identifiers) it is labelled as Research Grade.

iNaturalist can be thought of as a pathway to a CURE (course-based undergraduate research experience) for organismal biology, natural history, and biodiversity. The site is curated by a staff and an extensive global community of natural history enthusiasts and experts. When species are identified the aggregate data facilitates testing hypotheses about presence/absence in specific locations, as well as the frequency and timing of occurrence for a species of interest.

In June 2019, ABLE workshop participants received a short introduction to the use of iNaturalist and to its project construction

features and then went to a local natural preserve, Gatineau Park http://ncc-ccn.gc.ca/places-to-isit/gatineau-park/conservation-at-gatineau-park to collect observations. Upon return to campus the participants and I discussed hypotheses that could be tested using iNaturalist. For example, hypotheses included positional biases (are observations more dense around major roads and cities?) and bias based on perceptions of charisma (are observations of "attractive" taxa more abundant than "plain" taxa?) as well as bias based on seasonal access to wildlife habitats.

Participants learned how to edit their uploaded observations and how to enroll in projects. They observed a collective data set (a "Project') built from the ABLE Ottawa meeting site observations. We also discussed the feasibility of including a single-week iNaturalist lab versus a longer project.

Finally, we discussed the 3 major types of projects (Collections, Traditional, and Umbrella projects) and which might be most applicable to each participant's home institution.

Collection projects are fundamentally a search for observations that is saved and combined with a unique logo and URL. This automatically gathers all observations that fit the search criteria set up by the project creator, such as organism type ("mushrooms," "ducks," "frogs," etc.) and/or geographical boundaries recognized by iNaturalist, for example, "The University of Ottawa," or "San Diego State University." iNaturalist has an extensive list of bounded geographic areas such as states in the USA or cities in North America.

Traditional projects are similar to collection projects but participants must ask to join, rendering this type of project better suited to use in a course. Also, the traditional project creator can add special fields to the observation page so that project participants might be prompted to supply additional data, such as temperature, lighting, area of coverage estimates (for estimating plant foliage area), etc. Traditional projects will generate lists of taxa so that the creator, and possibly participating observers, can see what taxa were found in the given area during the project duration. In a traditional project the creator can see the true coordinates of all observations even if the observer chose to "hide" or obscure the location information.

Umbrella projects are a type of metadata project. They can be thought of as a collection of other projects. For example, you might locate a project on "Shore birds of the Chesapeake Bay Ecosystem" and another on "Raptors of the Atlantic Coast of Maryland" and you might create an umbrella project called, "Birds of Maryland and it's bays and shorelines." One great example of an umbrella project is the 2018 City Nature Challenge, a collection of over 60 other projects. https://www.inaturalist.org/projects/city-nature-challenge-2018

Notes for the Instructor

The largest challenge is to determine how to structure the project for your particular lab goals. In order to construct a successful project, you will need to create your own account and enter some observations of your own. iNaturalist requires that you have a minimum number of observations logged before you can create projects.

Even with sufficient observations and IDs (identifications of others' observations submitted), you should create a dummy project to practice the creation and management process. This will likely be a "collection" project. Your home institution is likely geographically recognized by iNaturalist and thus already available for you to define as a test project. Someone may have used your campus for a "Bio Blitz" (a large community-based sampling of organisms from your campus over a single day or weekend) already and you can view previous data by searching for your location.

You will likely need to create a project for each of your institution's semesters or terms during which you plan to have your students participate. Be sure to have your students create accounts that in some way protect their privacy but allow you to determine who they are. Require them to send you their account names in order to assess their participation.

For an example of using iNaturalist data to conduct a class investigation of plant-insect distributions and interactions, see Clement et al. (2018).

Cited References

Clement, WL, Prudic, AG, Oliver JC. 2018. Exploring how climate change will Impact plant-insect distributions and Interactions using open data and Informatics. Teaching Issues and Experiments in Ecology 14:1. http://tiee.esa.org/vol/v14/experiments/clement/abstract.html

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About the Author

Joe Newsome has been a Lab Coordinator for general biology labs at San Diego State University since 2001, and an adjunct professor of physiology at San Diego Mesa College.

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