iNaturalist

EXCITING RESEARCH POSSIBILITIES LURK IN ACCESSIBLE DATASET

by **Austin Happel**

Smartphones are seemingly everywhere. It's estimated that 81 percent of Americans and 66 percent of Canadians now own these devices, which are capable of taking photos, logging GPS coordinates, and accessing the Internet. Citizen science projects take full advantage of this technology, having evolved from using pen and paper, to computer, to smart phone apps for collecting and recording data while engaging the public in research.

iNaturalist is one such app. With it, any person can upload geotagged photos of plants and animals, and both they and other iNaturalist users can participate in identifying the organisms. Observations are cataloged by taxonomy, region, and other characteristics, and they can be pooled as iNaturalist projects. For example, the *Amazing Aberrants* project catalogs observations of rare color morphs of species (e.g., albinism), whereas the *Great Lakes Fish Finder* project seeks to increase the number of freshwater fish observations made in the Great Lakes region. To date, more than 28 million observations representing 239,500 species throughout the world have been uploaded to the iNaturalist open-access database.

Of those millions of observations, 1.2 percent are of fish. As a fish nerd, I began to explore this dataset to see how I could both use the data and persuade others to upload fish photos to increase the dataset's size. What angler doesn't already take pictures of their catches? I decided the best way to convince others to begin using iNaturalist was to illustrate how the data could be used for scientific purposes. Maybe I could match the range of a spreading invasive species with that shown in the USGS Nonindigenous Aquatic Species database, or the timing of when a migratory species appears in an area with known spring ice-off periods, or maybe come up with something new as I played with the data.



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Photos taken by iNaturalist users of Creek Chub (top left), Largescale Stoneroller (*Campostoma oligolepsis*; top right), Bluehead Chub (*Nocomis leptocephalus*; bottom left), and Blacknose Dace (bottom right) exhibiting evidence of black spot grub infections.

I began exploring iNaturalist, seeing what fish species were commonly posted, and noting where observations were more common. I also determined what some of the pitfalls of using the data would be. While doing so, I noticed that some of the fish had visible evidence of infection by black spot grub trematodes. These parasites live in fish's flesh, and, as protection, an infected fish's immune system surrounds the trematode with fibrous material and melanocytes, a process that creates the visible black spot that gives the disease its moniker.

Having seen these spots on a few fish, I decided to start categorizing fish on iNaturalist based on black spot presence versus absence. I started with Creek Chub (*Semotilus atromaculatus*) because people seemed to have held them closer to the camera for their photos (likely due to their small size), which made it easier for me to analyze their skin for black spots. Smaller fish also tend to have more translucent skin, making the black spots more visible. After reviewing some 550 Creek Chub photos, I mapped each animal's location using the photos' geotags. I was surprised to see more infected Creek Chub in the southern part of Canada than elsewhere. I then looked at black spots in other species and found the same geographic distribution pattern for infected versus not infected Blacknose Dace (*Rhinicthys* spp), *Nocomis* spp., and *Campostoma* spp.

I recently published these data (Happel 2019). Not only does my publication show there is a pattern to where fish exhibit symptoms of black spot grub infections across North America, it also demonstrates that data collected using citizen-science-based platforms such as iNaturalist can offer exciting research opportunities. Hopefully others will begin to use this large, freely accessible database of observations, and will also promote the contribution of additional fish (and other) observations.

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