Don't Forget Your Camera

Ian Pfingsten

Out on the lake

As the season changes and spring sets in, some of us camp, hike, or fish, if not all three. This is the time we find ourselves outside enjoying the warming air and leafing branches as we cast a reel in hopes of a bite. While relaxing on your boat headed to your prime fishing hole, you notice something growing in the water. It looks like a plant you did not see the last time you were at this lake, but you think it might not be worth much attention, and you continue with your day of fishing. Later, as you float into your favorite bass cove, you see the plant again, but this time it is much harder to ignore; the same plant is covering the entire cove from the sediment to the water's surface. As you become more concerned, you start to wonder, what is this plant? How did it get to this lake? Who do I tell about it?

Resource availability

Several publicly accessible resources for answering these questions exist online that specialize in species that are non-native to the U.S., which means those species have been moved by humans into the U.S. where they are less likely to encounter natural pests or predators. We are most concerned when non-native species are labeled invasive, meaning they are detrimental to the environment, the economy, and human health outside of their native range. If you need to identify an organism, but you lack a field guide or the knowledge to identify it yourself, then submitting a photo to a national distribution database is another option. If the organism is aquatic, there is the U.S. Geological Survey's (USGS) Nonindigenous Aquatic Species (NAS) Database (nas.er.usgs.gov), which staffs taxonomic experts able to identify public sighting reports. Other databases exist for terrestrial and some aquatic invasive organisms which utilize experts, state-officials, and community members for identifications. Many of these databases have phone apps for mobile reporting and the USGS NAS database has a mobile-friendly reporting website (nas.er.usgs.gov/SightingReport.aspx [use this QR code to access the form]). The NAS database also allows anonymous reporting, while the other databases require user accounts. Once the database curators receive and review your sighting report, and the organism fits the criteria for public display on the database website, then you can view your sighting record on a distribution map with other occurrences in your area (Figure 1).

These databases offer an answer to what organism you find, but what about how the organism arrived in its new location? What if you are interested in more information about the organism's life history, distribution, introduction pathways, chemical, mechanical, and biological control options, and its impacts to human health, the environment, or the economy? The same national databases provide distribution maps and informational pages on many of these topics. Specifically, the USGS NAS database provides peer-reviewed profiles containing most of this information on

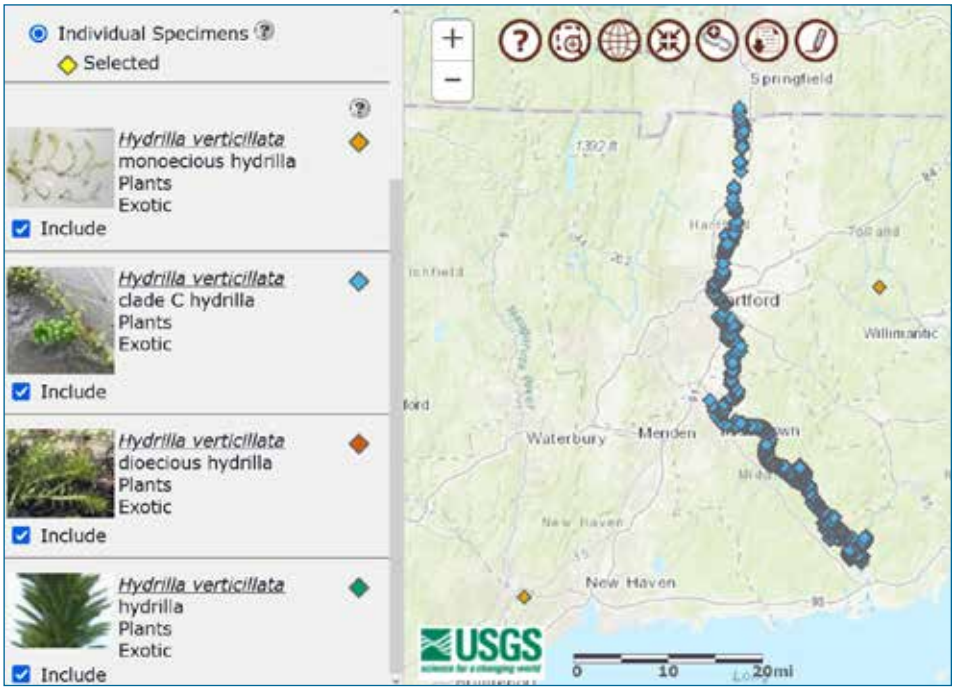

Figure 1. Distribution map of Hydrilla verticillata *in Connecticut. Different colored diamonds indicate* H. verticillata *sightings by biotype or clade.*

aquatic non-native species including citations to references found in the searchable NAS reference database. For example, each species profile in the NAS database has or plans to have in the future a section on known species impacts that summarizes the available literature for a variety of environmental, economic, or human health impacts such as habitat alteration, increased toxicity and disease prevalence, and effects on recreation, infrastructure, and water quality. Many detrimental impacts caused by invasive species are not studied or are assumed detrimental based on anecdotal accounts. By collecting published studies on invasive aquatic species impacts, users can quickly and easily locate available evidence for impacts. Combined with the distribution maps of those aquatic species, users of the NAS database can locate where these impacts are likely to occur.

Responsible stewardship

While researchers and invasive species coordinators are obvious audiences for these occurrence databases, they also provide public access to the information. This means access to public reporting of sightings and access to species distributions and relevant background knowledge of those species. It also means access to new occurrences of non-native species that may be of interest to the public. The occurrence databases provide new reports of non-native species through alert e-mails to individuals upon request. The NAS database alerts the public of aquatic non-native species that are new to the United States or new to individual states, counties, or watersheds. These alerts inform the public of areas potentially at-risk of further species spread, which can help early detection and rapid response efforts to mitigate detrimental impacts (and why reporting these sightings to the national databases is likewise important). When you report the organism to occurrence databases you are also answering the question earlier about who to contact with your sighting, because these databases share information with each other and with invasive species coordinators who can respond to the introduction.

The combined efforts of the public sending reports of invasive species and the stakeholders involved with managing those invasive species encourages responsible stewardship of non-native plants and animals and the resources most likely affected by those organisms. Outreach to the public is one way to empower those with interest in making decisions that affect themselves and their community. Access to resources for identifying invasive organisms, knowledge of their impacts and how to prevent their further spread, and when and where these organisms are recently found can help to empower responsible stewardship. The USGS continues to work with stakeholders and our national and regional data providers to share this information with the public through a variety of accessible media and tools.

Future tools

What do these accessible tools look like? Last fall, Hurricanes Ian and Nicole swept through Florida and decimated coastal towns like Fort Myers. The floods from intense storm surge and rainfall impacted communities and caused widespread damage to the economy and environment. One of those impacts that the NAS database has highlighted since 2017 was the potential movement of aquatic organisms through flood waters caused by these major storms. After Hurricane Harvey devastated southeast Texas in 2017, NAS released its first rendition of the Flood and Storm Tracker (FaST) map showing the watersheds that contained non-native aquatic species prior to a flood event and those watersheds that likely became hydrologically connected due to flooding, providing a potential corridor for aquatic species movement (Figure 2). These interactive maps are hosted on the NAS database and created in two steps: an initial version that provides timely FaST maps via USGS stream gages and National Oceanic and Atmospheric Administration (NOAA) storm surge models to quickly estimate downstream and coastal flood risk and species movement, and a final version of FaST maps that uses USGS stream gages and high-water mark data and NOAA tide sensors to provide evidence of connections between watersheds that occurred through flooding. Having knowledge of where a species is likely to spread by flooding informs the public and stakeholders of where to expect a new invasion of a potentially impactful plant or animal. We plan to improve FaST maps with new water monitoring efforts provided by USGS, NOAA, and the National Aeronautics and Space Administration (NASA).

Sometimes seeing an organism is difficult to near impossible given the time of year or its biology. Sometimes all you are left with is a trace of genetic material from the organism's skin or feces to know if it could be present. This genetic material that is no longer part of the organism is called environmental DNA, or eDNA, and it can be collected and compared to unique strands of DNA that identify the organism. To avoid confusion among the variety of collection and analytical techniques when reporting eDNA detections, the USGS has developed minimum quality standards for displaying eDNA data on the NAS website and maps (Ferrante et al. 2022). This year, NAS plans to begin accepting eDNA reports from those using USGS national standards with the aim of displaying eDNA reports on NAS distribution maps and e-mail alerts to encourage timely and appropriate response by invasive species agencies. Using the best available science on eDNA detections limits reporting of false positive detections that could lead to wasted time and resources in response efforts.

More public products are being developed by USGS to assist in early detection efforts of potentially invasive species introductions. New threats to our environments, economies, and human health are being assessed through collaborations between universities and other federal agencies. One product in development is a nationwide risk assessment of organisms imported into the U.S. This is known as horizon scanning, and the goal is to provide stakeholders with a list of organisms in the trade ranked by their invasive potential in the U.S. We have already finished a national horizon scan for vertebrates imported into the U.S., and we are conducting new horizon scans for invertebrates and plants also in the U.S. trade. A follow-up effort is also underway to determine the hotspots, or potential locations, of invasion by these organisms in the trade into the U.S. by considering suitable habitat conditions that are likely to promote establishment and spread where

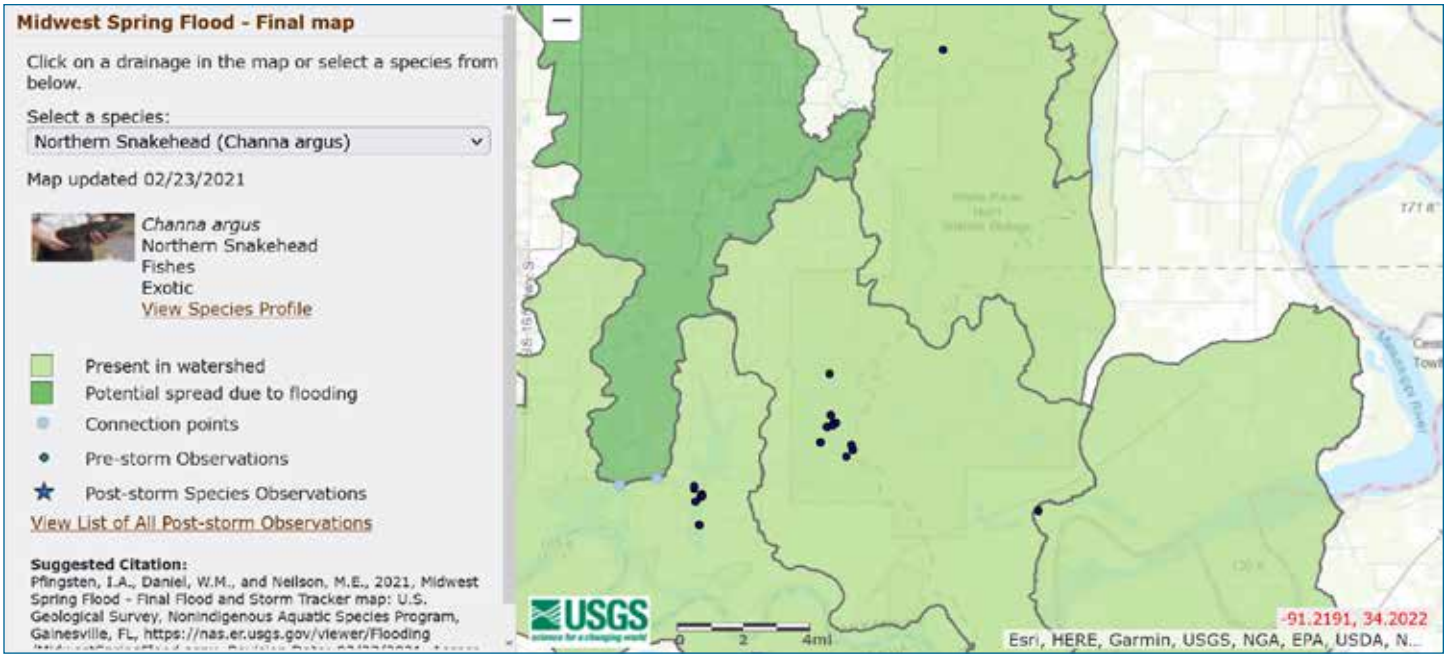

Figure 2. Example Flood and Storm Tracker map of Channa argus *(Northern Snakehead) after the Midwest spring flood event in 2019. Light green areas indicate watersheds where* C. argus *is present, and dark green areas indicate watersheds where there is potential for introduction of* C. argus *via flood waters. Locations of* C. argus *sightings are indicated with dark blue dots, and flood connections across watersheds are indicated with light blue dots.*

those conditions are found. In a similar project involving the northeast U.S., we are working with stakeholders to determine the invasive potential of aquatic plants and animals due to climate change, where the focus is on the suitability of habitat conditions in the next fifty years and the likelihood of aquatic organisms spreading from the western and southern U.S. Another NAS product related to human and animal health risks is underway to provide locations of disease-promoting, aquatic organisms, such as the location of submerged aquatic vegetation with high levels of a cyanotoxin that causes brain lesions in birds and reptiles. The goal is for each of these products to be accompanied by a visual component such as a risk map on the NAS database website.

Return to the lake

Planning another trip out to your favorite fishing spot, you check the weather report and your tackle box. You start to recollect the time when you had all the gear and knowledge you needed, given you had enough bait and patience. The reality sets in that there are additional considerations to enjoyably recreate. From the fishhook waterfleas clinging to your fishing line to the hydrilla tangled on your propellor, these invasive organisms can impact your time on the lake or send you in search of a new pristine fishing hole. Yet, you have access to resources in your smartphone to research, identify, and report the new invasive species found in your lake. With the tools available on the NAS database and other invasive species reporting services, you can provide crucial information needed to reduce the harmful impacts these species may cause in our waters.

You can contact NAS database staff with questions or data requests at: ipfingsten@usgs.gov, 352-264-3517

References

Ferrante, J., W.M. Daniel, J.A. Freedman, K.E. Klymus, M.E. Neilson, Y. Passamaneck, C.B. Rees, A. Sepulveda, and M.E. Hunter. 2022. Gaining decision-maker confidence through community consensus: developing environmental DNA standards for data display on the USGS Nonindigenous Aquatic Species database. *Management of Biological Invasions*, 13(4): 809-832. https://doi.org/10.3391/mbi.2022.13.4.15

Ian Pfingsten is a botanist with the U.S Geological Survey and has specialized in aquatic plants for the Nonindigenous Aquatic Species database since 2015. Along with botanical identification and invasive plant expertise, he creates species distribution maps and handles data requests. Ian has helped publish the NAS Flood and Storm Tracker maps since 2017. Ian oddly finds relaxation as a referee for a local roller derby league, the Gainesville Roller Rebels.

And while you're at it . . .

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