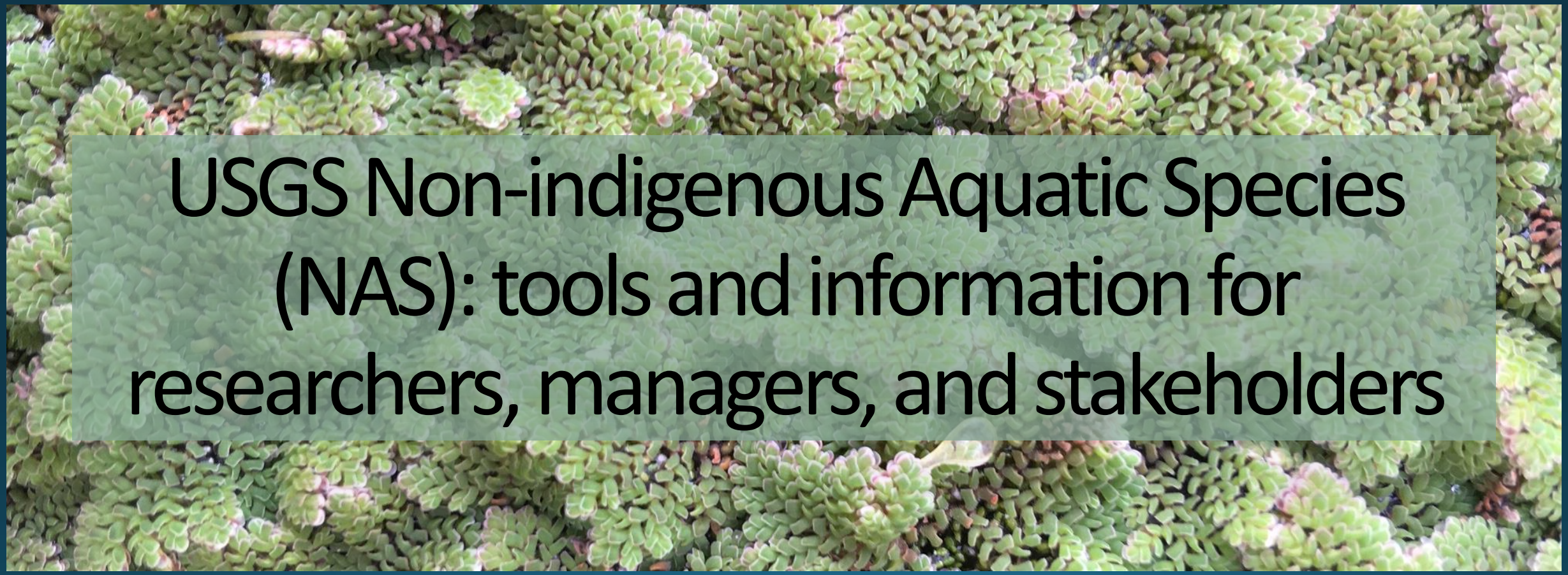


USGS Non-indigenous Aquatic Species (NAS): tools and information for researchers, managers, and stakeholders

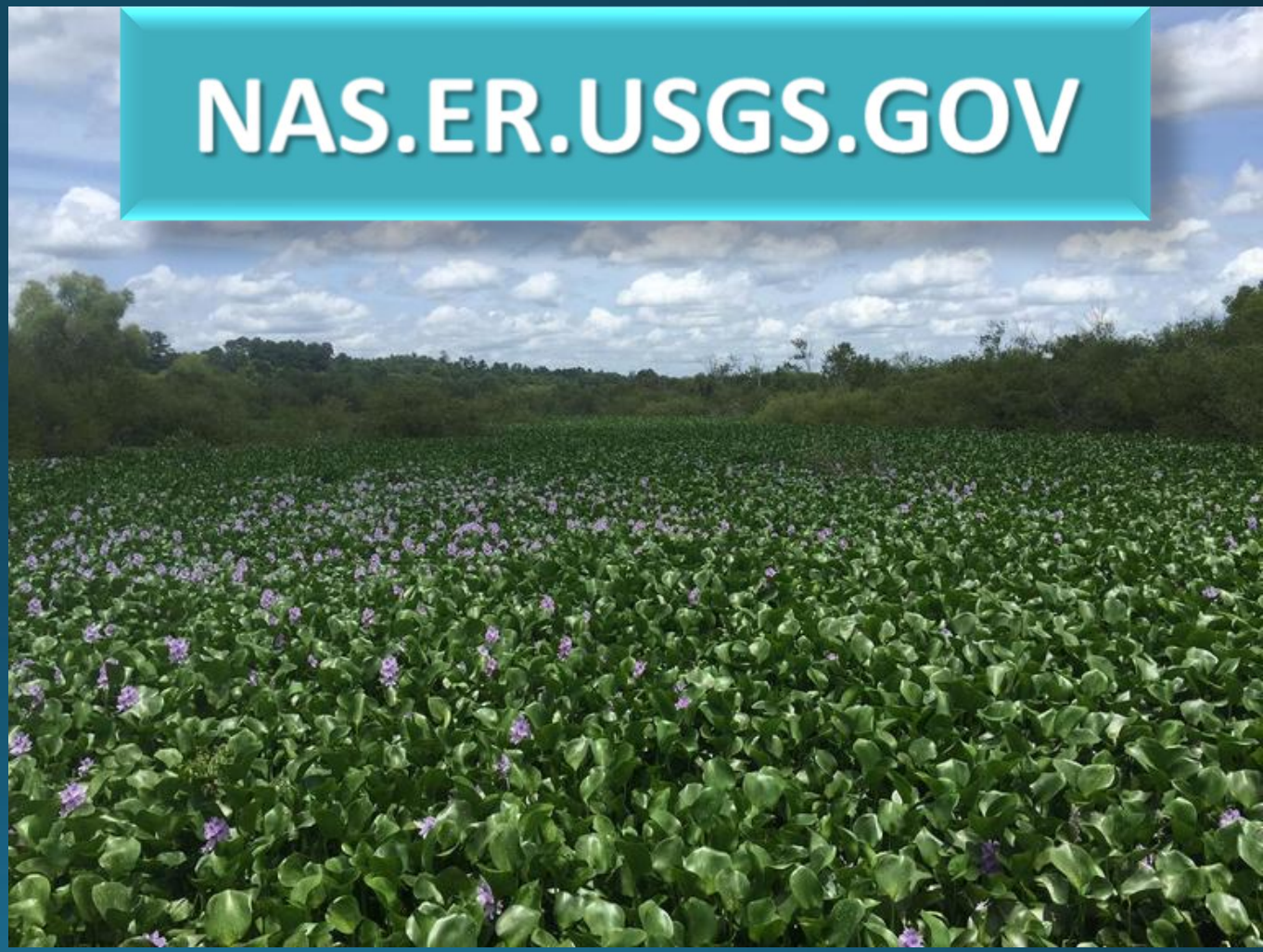
Ian Pfingsten

U.S. Geological Survey

Wetland and Aquatic Research Center, Gainesville, FL

Nonindigenous Aquatic Species Database

- Started from the Nonindigenous Aquatic Nuisance Species Control and Prevention Act of 1990
- Tracks > 1,290 aquatic species
  - Over 600,000 observations
- Across conterminous U.S., Alaska, Hawaii, and U.S. territories
- Data ranges from 1800 – present



USGS science for a changing world

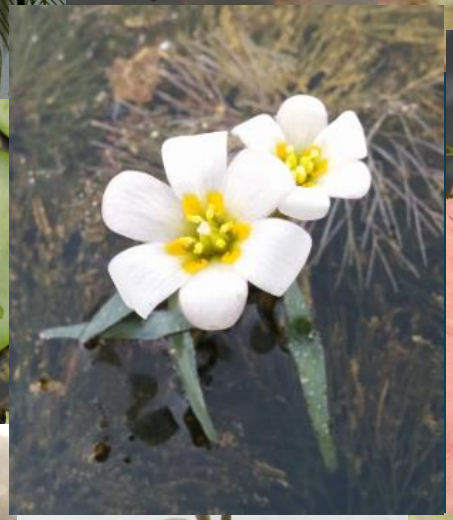
NAS

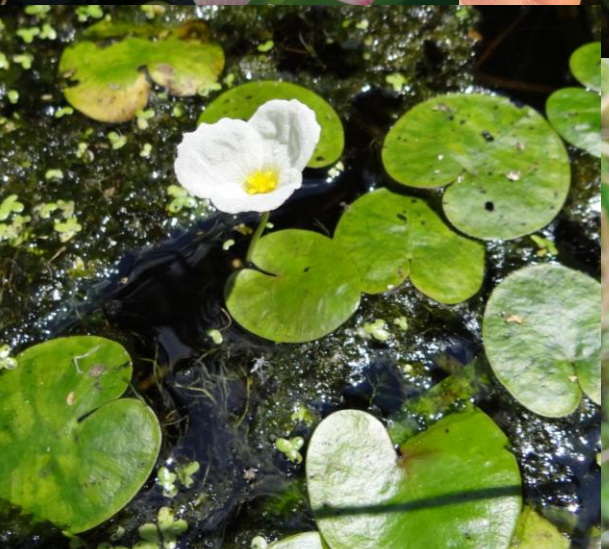












Species profiles

Actionable maps and tools

NAS Database

Data reference library

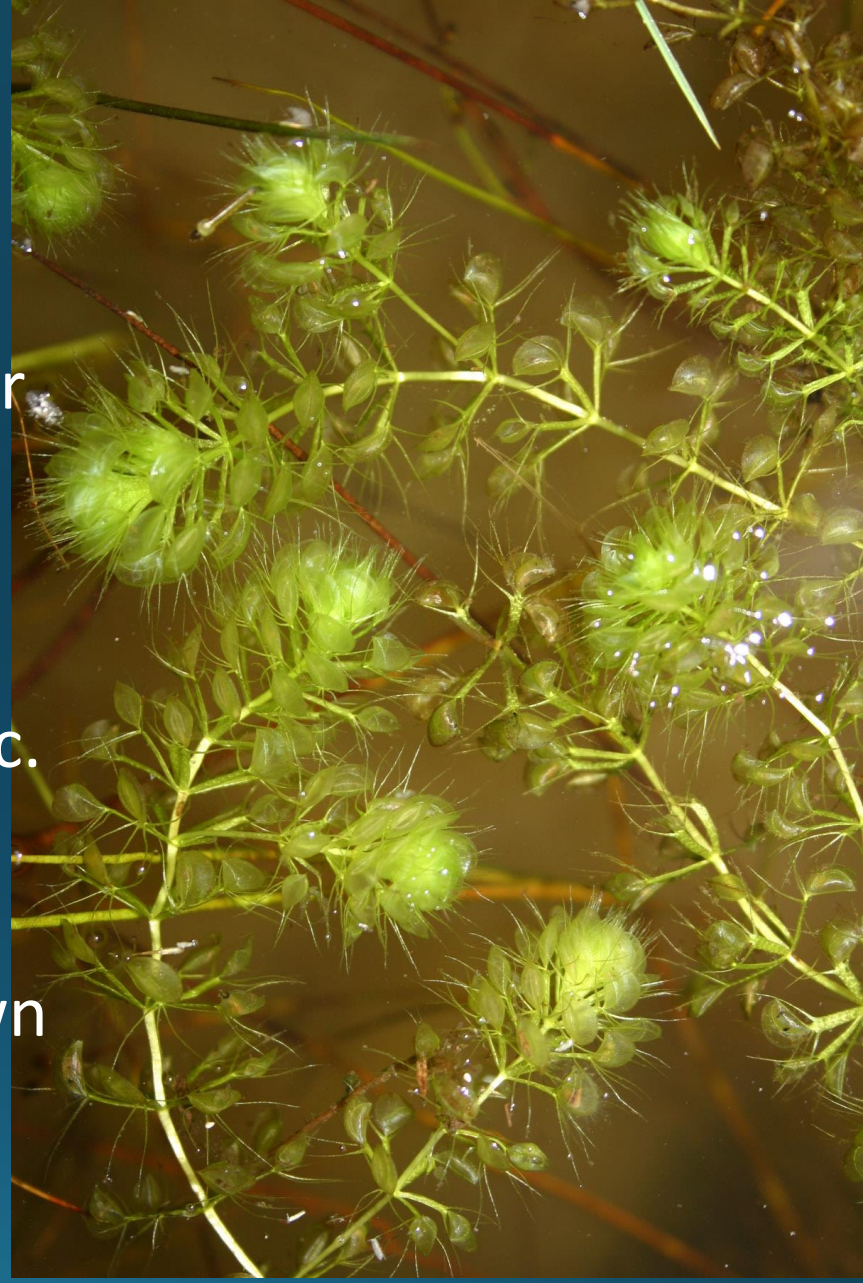
Distribution maps

USGS science for a changing world

NAS

Specimens

- What, where, when, who
- Verified by NAS staff, either directly through photos or from credible reporter
- Potential pathway (vector)
  - Hitchhiker, escaped, released, stocked, planted, etc.
- Population status
  - Established, failed, eradicated, extirpated, unknown
- Reference
  - Literature, Museum, Sighting Report, Pers. Comm.



Waterwheel plant
(*Aldrovanda vesiculosa*)

USGS science for a changing world

NAS

Species Profiles

- Taxonomy
- Identification
- Native Range and Ecology
- Means of Introduction
- Impact of Introduction
- References and Informative Links

Two-horned water chestnut
(*Trapa bispinosa*)

USGS science for a changing world

NAS

Distribution Maps

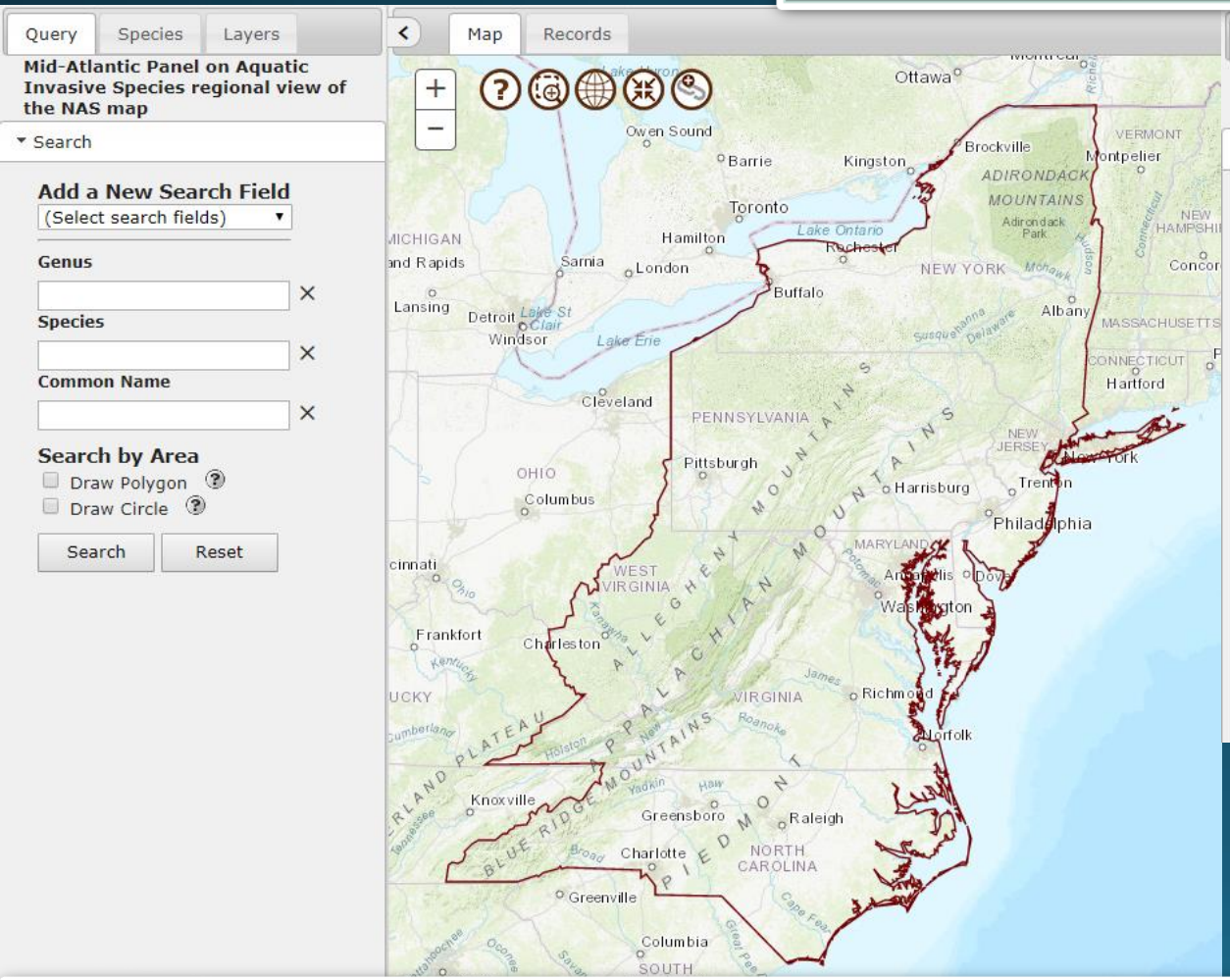
- Real-time Data
  - Can save URL of any map display
- Spatial Queries
- Map Layers
  - Administrative
  - Hydrological
  - Native ranges
- Animated Maps

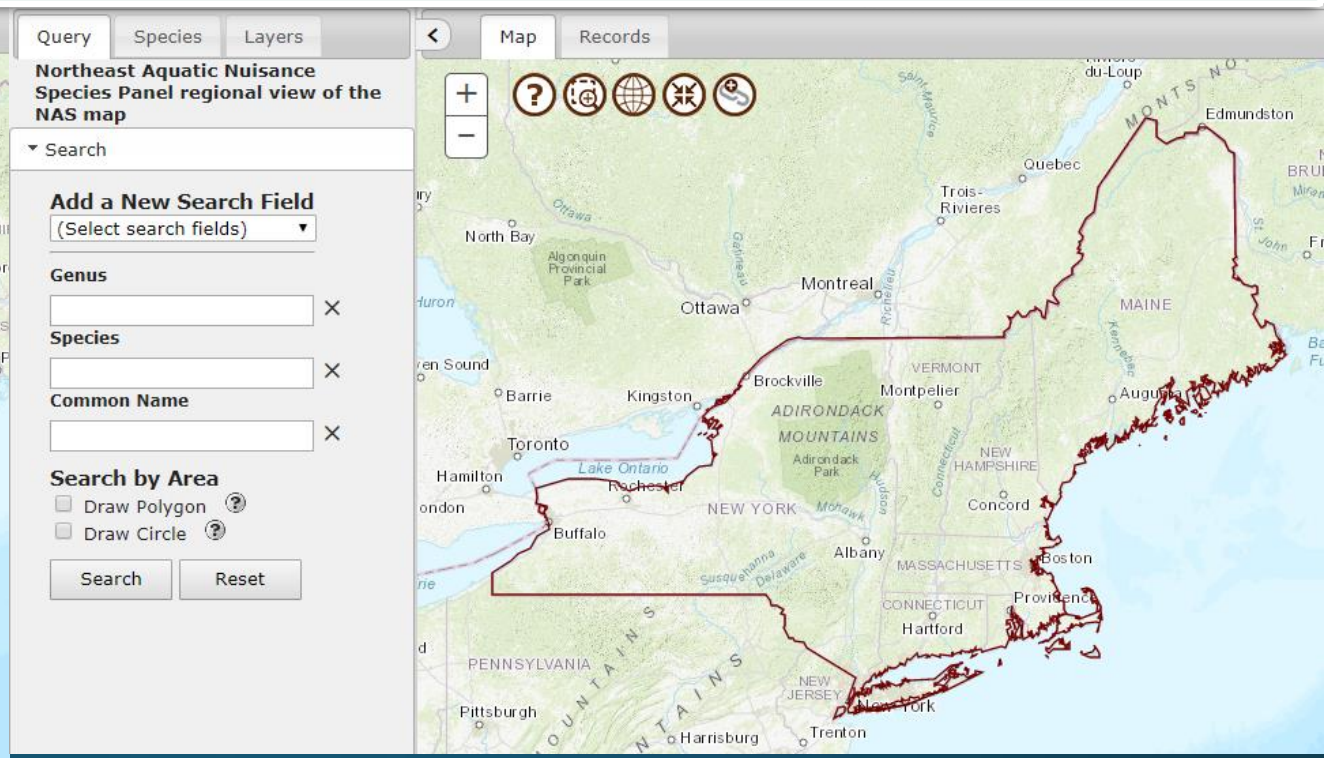
USGS science for a changing world

NAS

Regional Panel Maps

NAS.ER.USGS.GOV/VIEWER/ANSTF_REGIONS/NEANS.ASPX





NAS.ER.USGS.GOV/VIEWER/ANSTF_REGIONS/MAPAIS.ASPX

Giant salvinia
(*Salvinia molesta*)

USGS science for a changing world

NAS

NAS Application Programming Interface (API)

- Provides access to specimens and species information on the NAS database through other applications (i.e., instead of our website)
- See documentation for list of search parameters
  - nas.er.usgs.gov/api/documentation.aspx
- Soon to have access to species' native ranges
  - Currently at the HUC8 level

NAS.ER.USGS.GOV/API/V1

NAISMA
NORTH AMERICAN INVASIVE SPECIES MANAGEMENT ASSOCIATION

The NAS API is now compliant with NAISMA Mapping Standards

naisma.org/programs/mapping-standards

The Five Basic Elements of Invasive Species Inventories:

1. What species was documented?
2. Where on the landscape was this species documented?
3. How large was the area infested by the species documented?
4. When was the information on this species infestation documented?
5. Who collected the documentation of this species infestation?

USGS science for a changing world

NAS

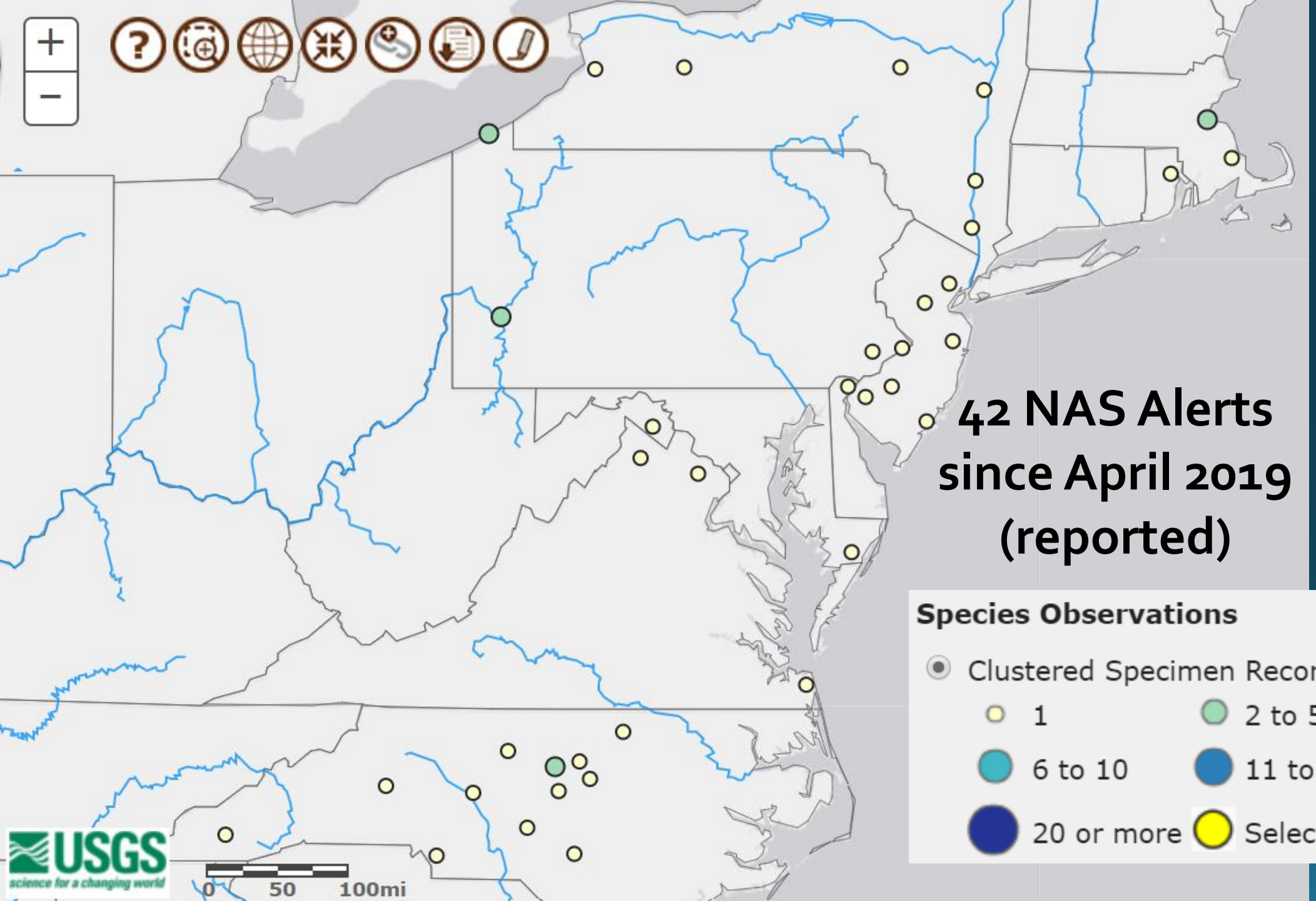
Alert System

- E-mails users of new occurrences
  - Country, State, County, HUC8
- Custom alerts
  - State
  - Individual species and taxon groups
- Verified by NAS staff
  - Will notify states prior to publicizing the alert, if requested or if high profile NAS
    - (e.g., SSW, ZM/QM, etc.)

NAS.ER.USGS.GOV/ALERTSYSTEM/REGISTER.ASPX

USGS science for a changing world

NAS

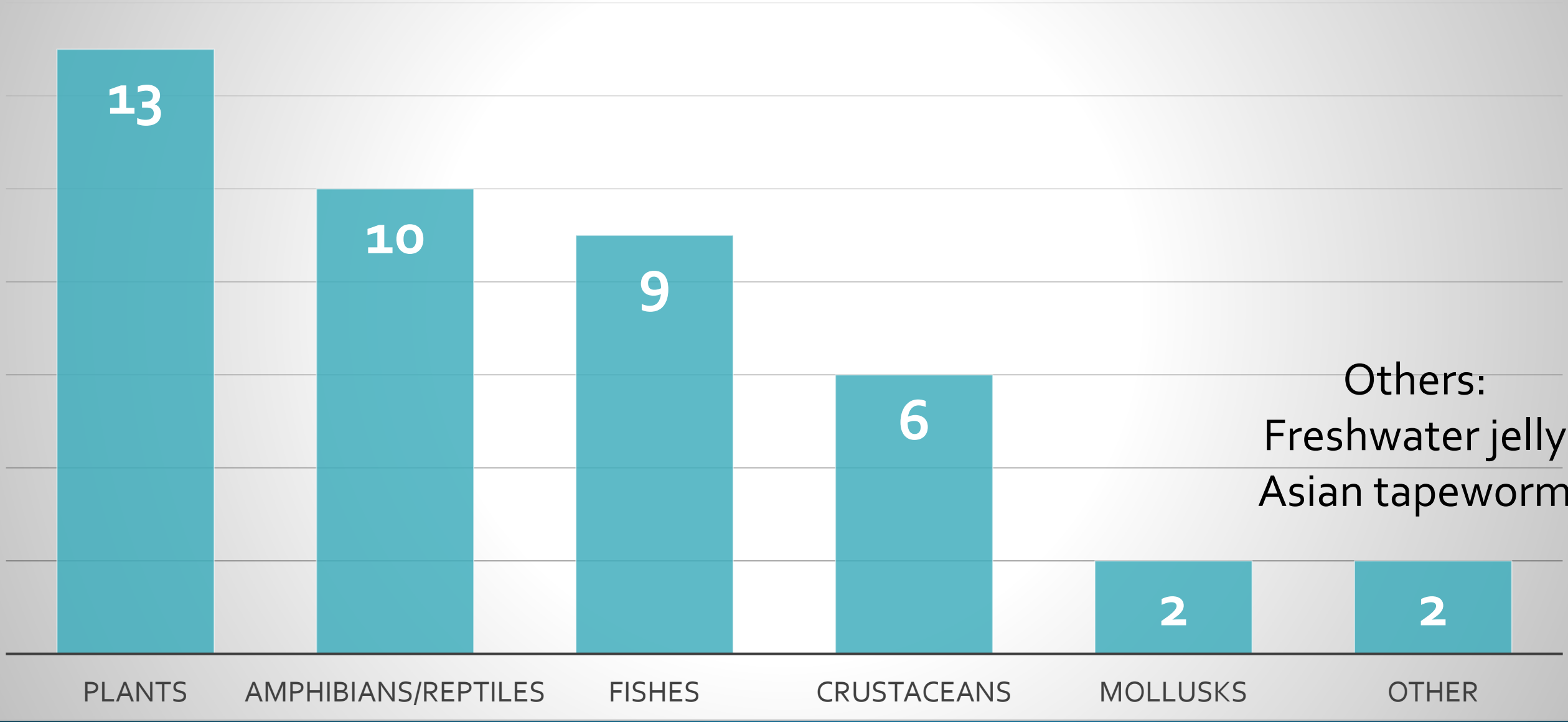


42 NAS Alerts since April 2019 (reported)

Alerts are new to:

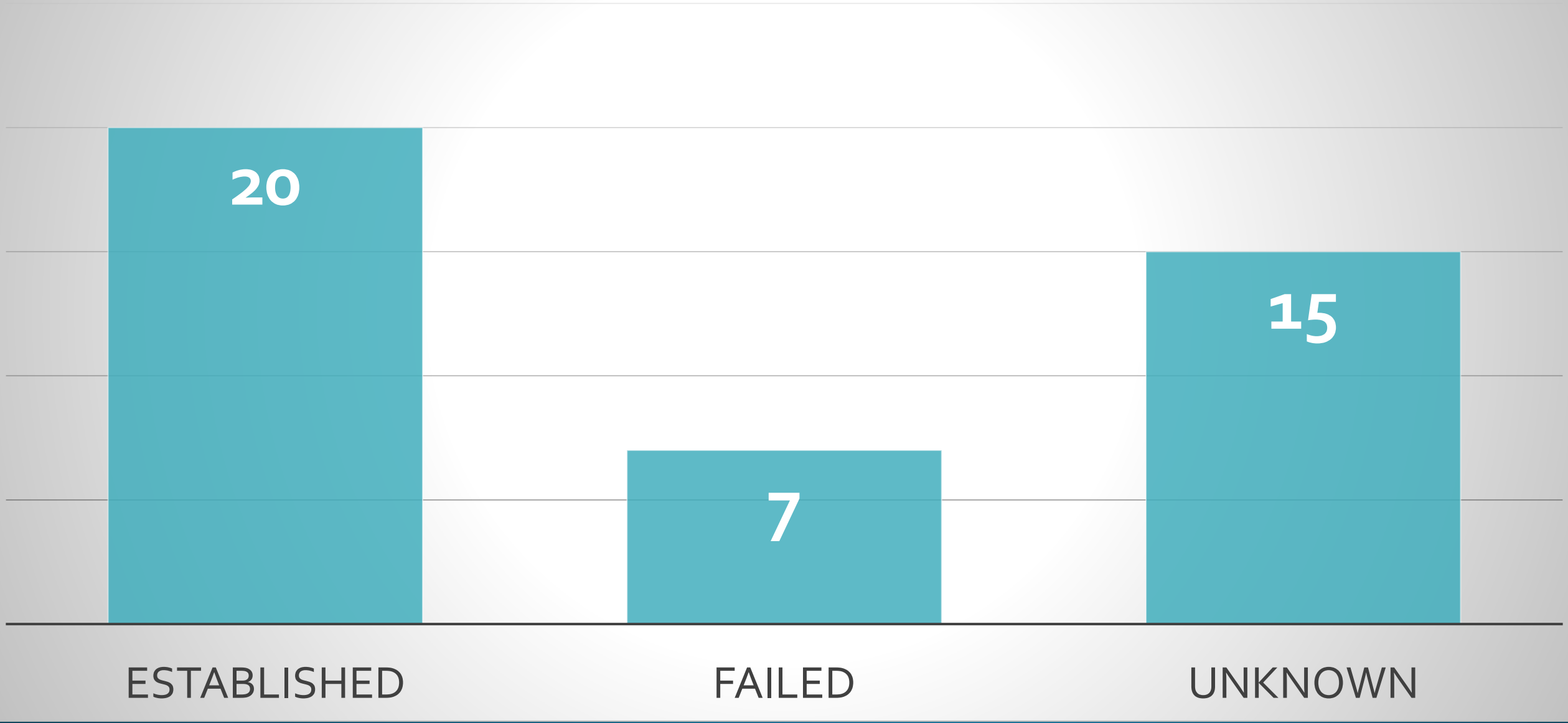
- U.S.
- States
- Counties
- Drainages (HUC8)

Alerts since April 2019

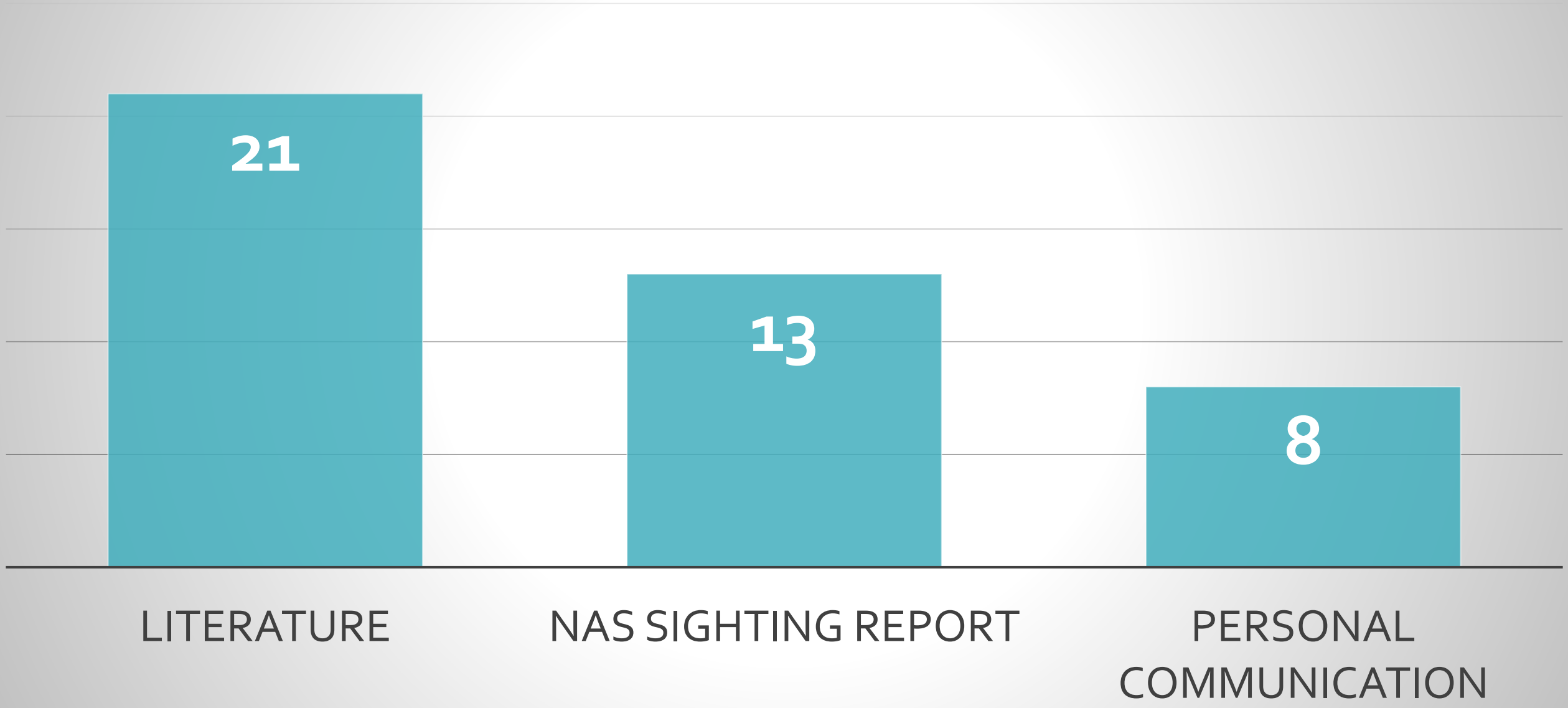


Others:
Freshwater jelly
Asian tapeworm

Alerts since April 2019



Alerts since April 2019



2018-2019

twice

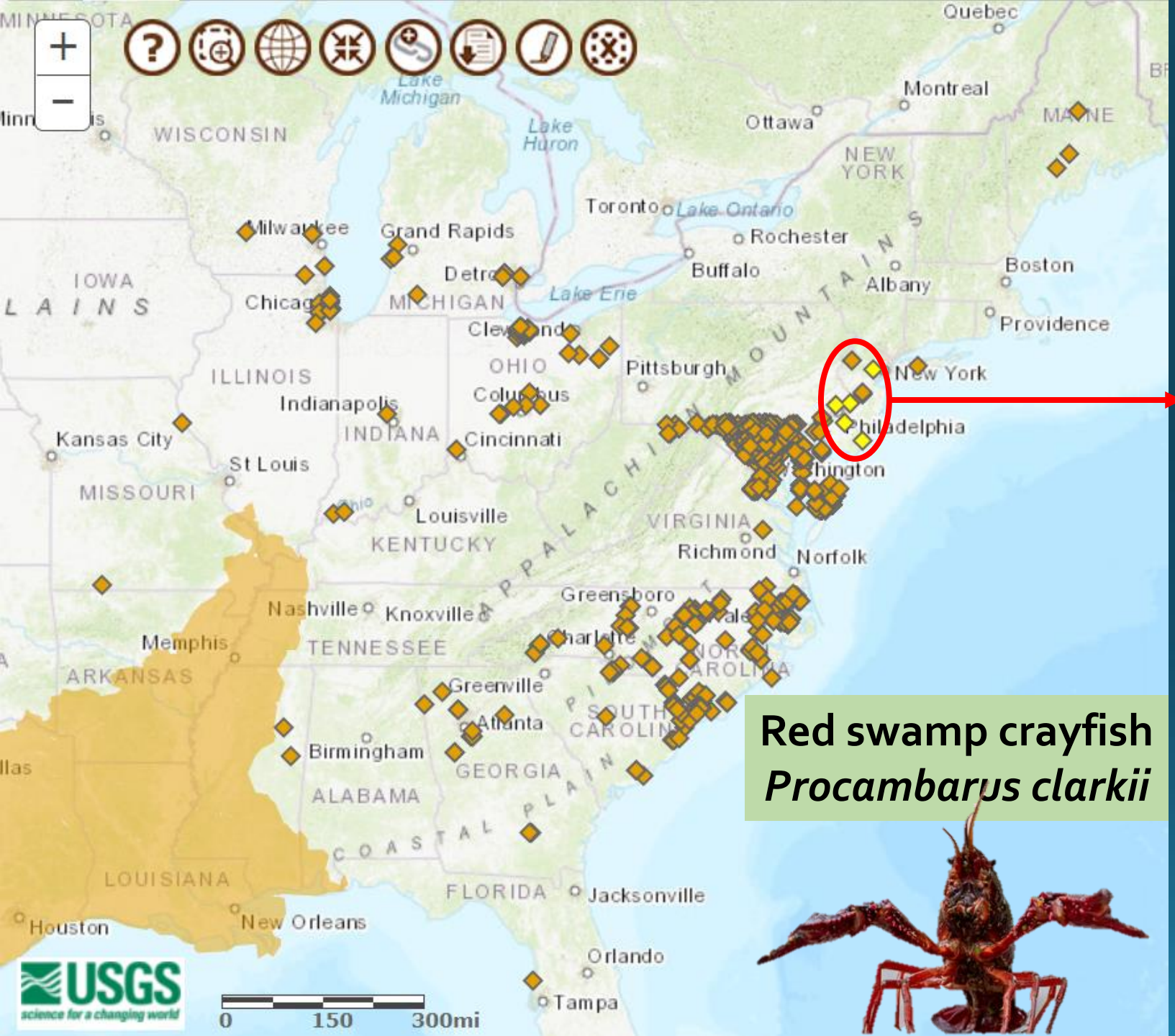
1928-2019

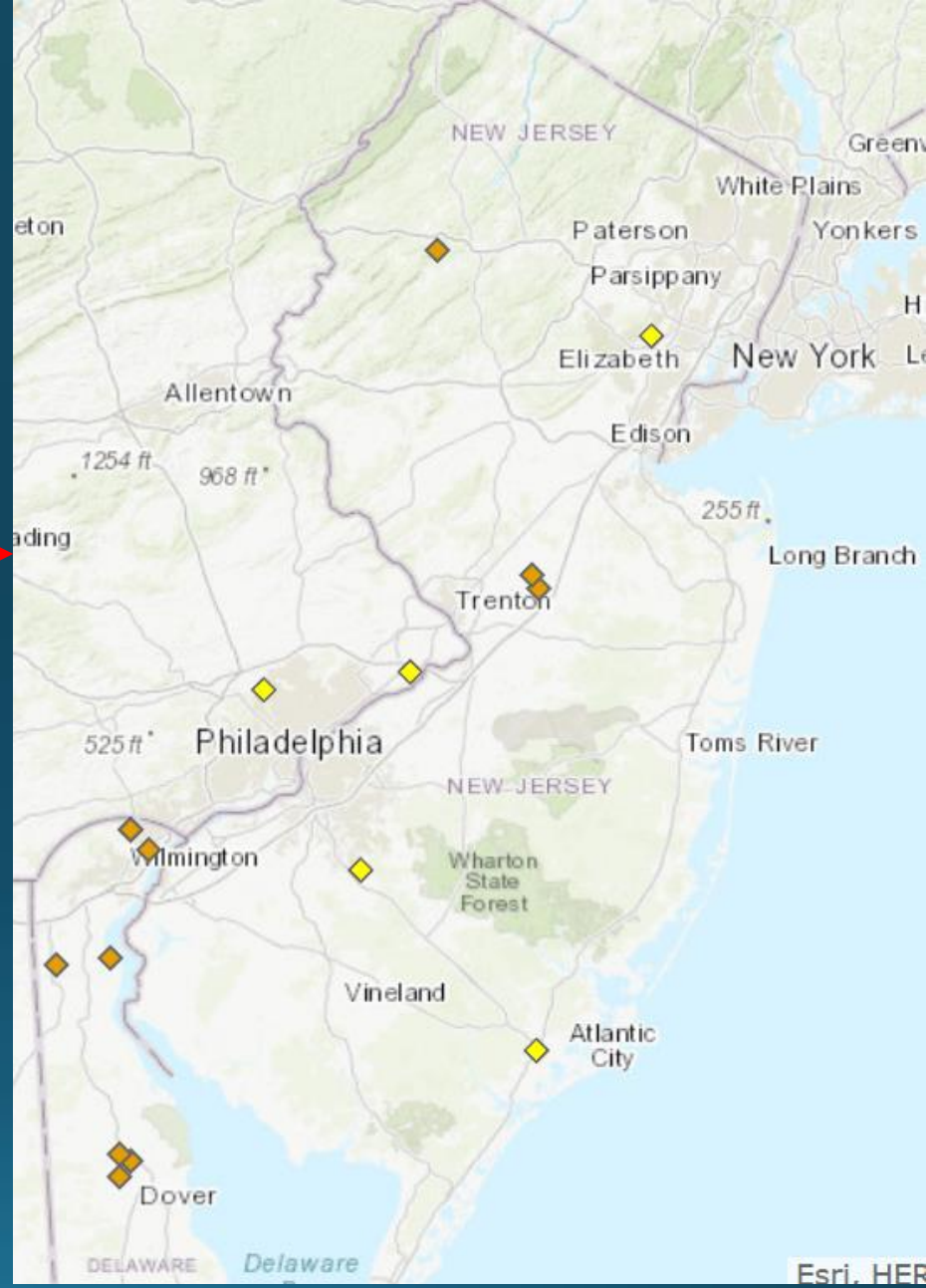
American alligator

Alligator mississippiensis

USGS science for a changing world

NAS





Red swamp crayfish
Procambarus clarkii

NAS

20 or more Selected

Individual Specimens

Selected

Mylopharyngodon piceus
Black Carp
Fishes
Exotic

Include

Mylopharyngodon piceus var. *diploid*
Black Carp (diploid)
Fishes
Exotic

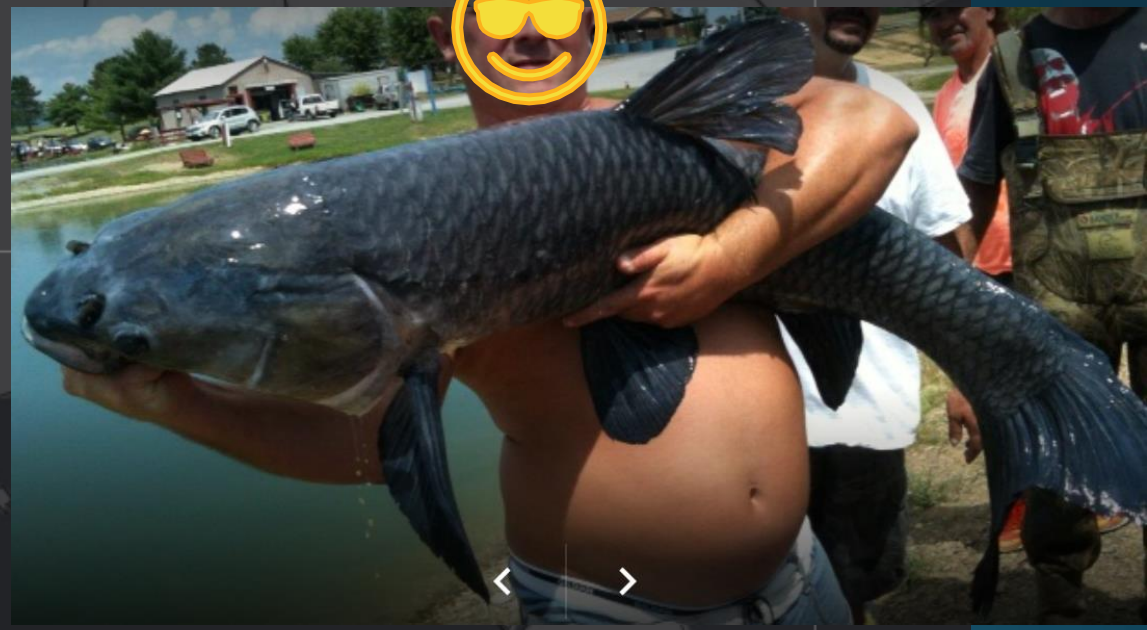
Include

Mylopharyngodon piceus var. *triploid*
Black Carp (triploid)
Fishes
Exotic

Include

Bonus Alert

Fee-for-fishing pond in 2015



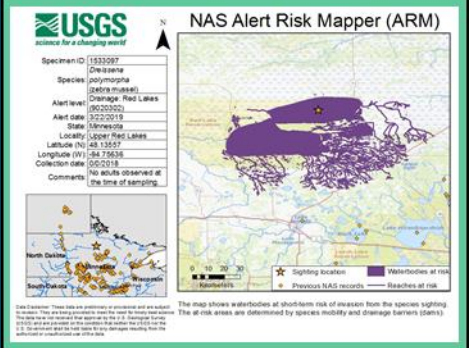
USGS science for a changing world

0 150 300mi

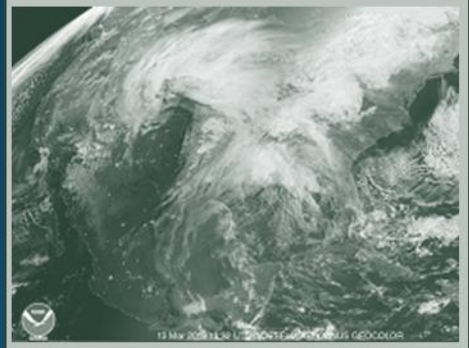
NAS

Actionable Maps and Tools

Alert Risk Mapper

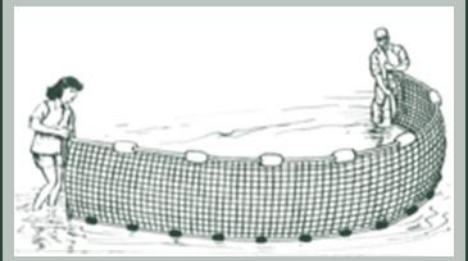


Flood and Storm Tracker



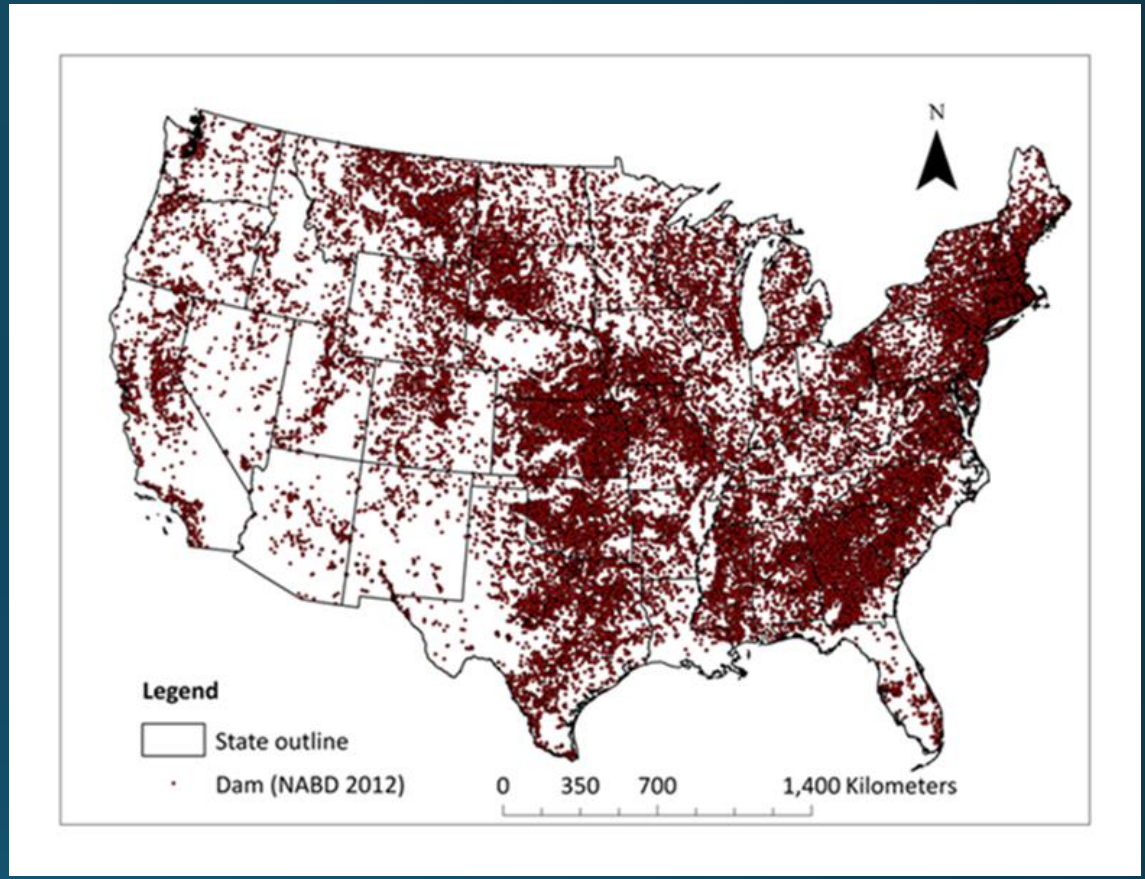
Impact Tables

SEINeD Tool



Alert Risk Mapper (ARM)

- Started in the Spring of 2018 (>300 created!)
- Maps are created for nearly every new NAS Alert
  - Excludes marine introductions, private property, or failed introductions
- Short-term risk assessment (~6 months utilizing)
- Assumes nonanthropogenic movement

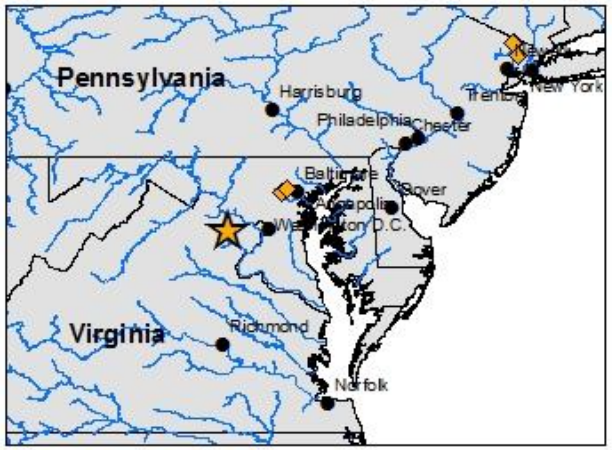


Large dams of the U.S.
(Ostroff et al. 2013)

Aquarium release

USGS science for a changing world

Specimen ID:	1613679
Species:	Misgurnus anguillicaudatus (Oriental Weatherfish)
Alert level:	State: Virginia; County: Fairfax (VA); Drainage: Middle Potomac-Anacostia-Occoquan (2070010)
Alert date:	08/02/2019
State:	Virginia
Locality:	Flatlick Branch, downstream from I-50 bridge, behind Hamlin Ave
Latitude (N):	38.8875
Longitude (W):	-77.4225
Collection date:	07/22/2019



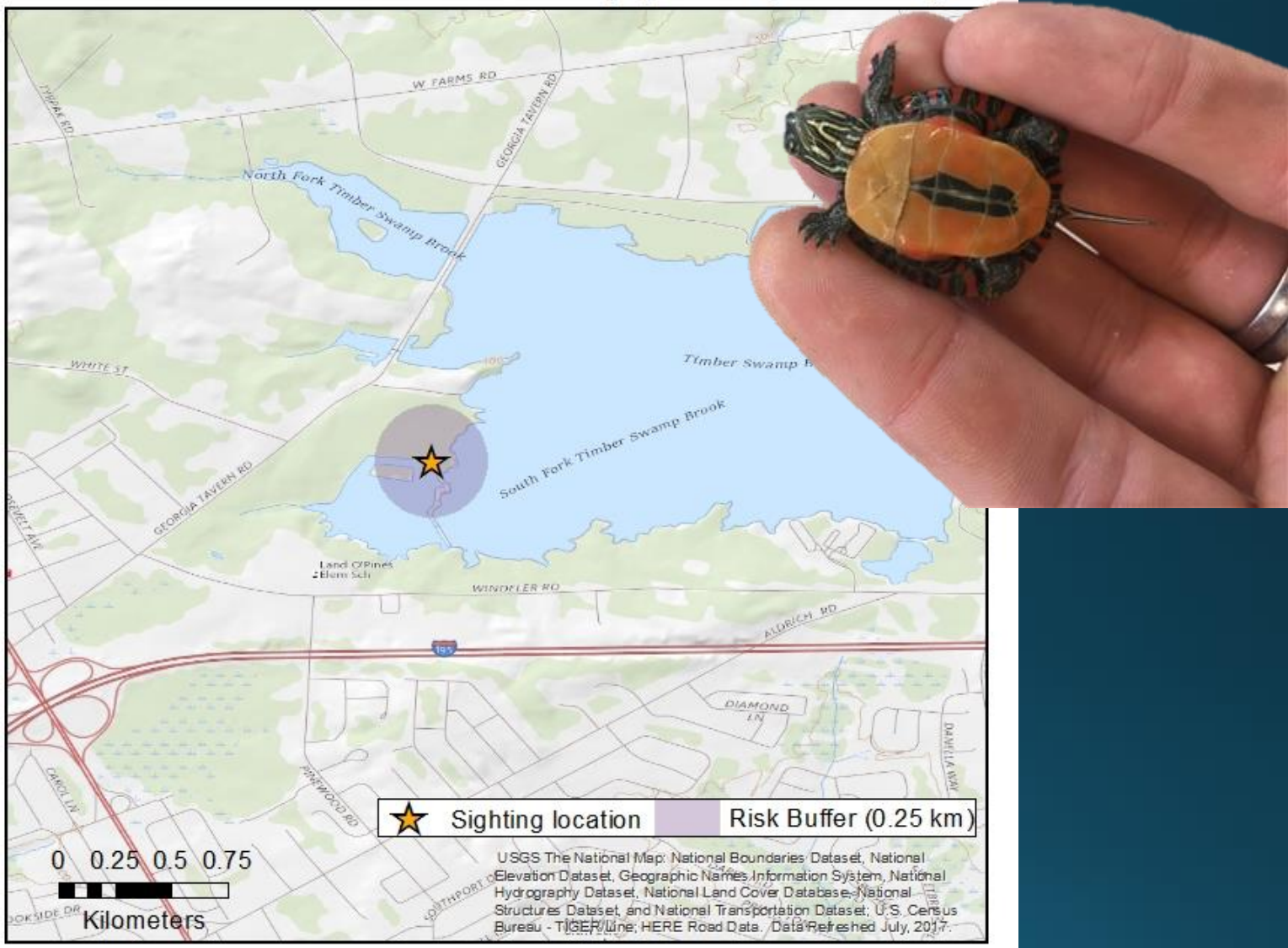
NAS Alert Risk Mapper (A

The map shows waterbodies at short-term risk of invasion from the species sighting. The at-risk areas are determined by species mobility and drainage barriers (dams).

Pet release

NAS Alert Risk Mapper (ARM)

Specimen ID:	1545197
Species:	Chrysemys picta marginata (Midland Painted Turtle)
Alert level:	State: New Jersey County: Monmouth Drainage: Mullica-Toms (2040301)
Alert date:	05/14/2019
State:	New Jersey
Locality:	Edge of the wetland [Manasquan Reservoir]
Latitude (N):	40.1745
Longitude (W):	-74.2201
Collection date:	05/08/2019



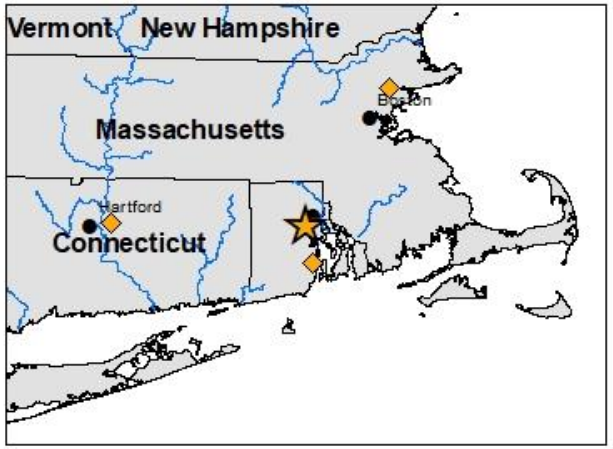
The map shows waterbodies at short-term risk of invasion from the species sighting. The at-risk areas are determined by species mobility and drainage barriers (dams).

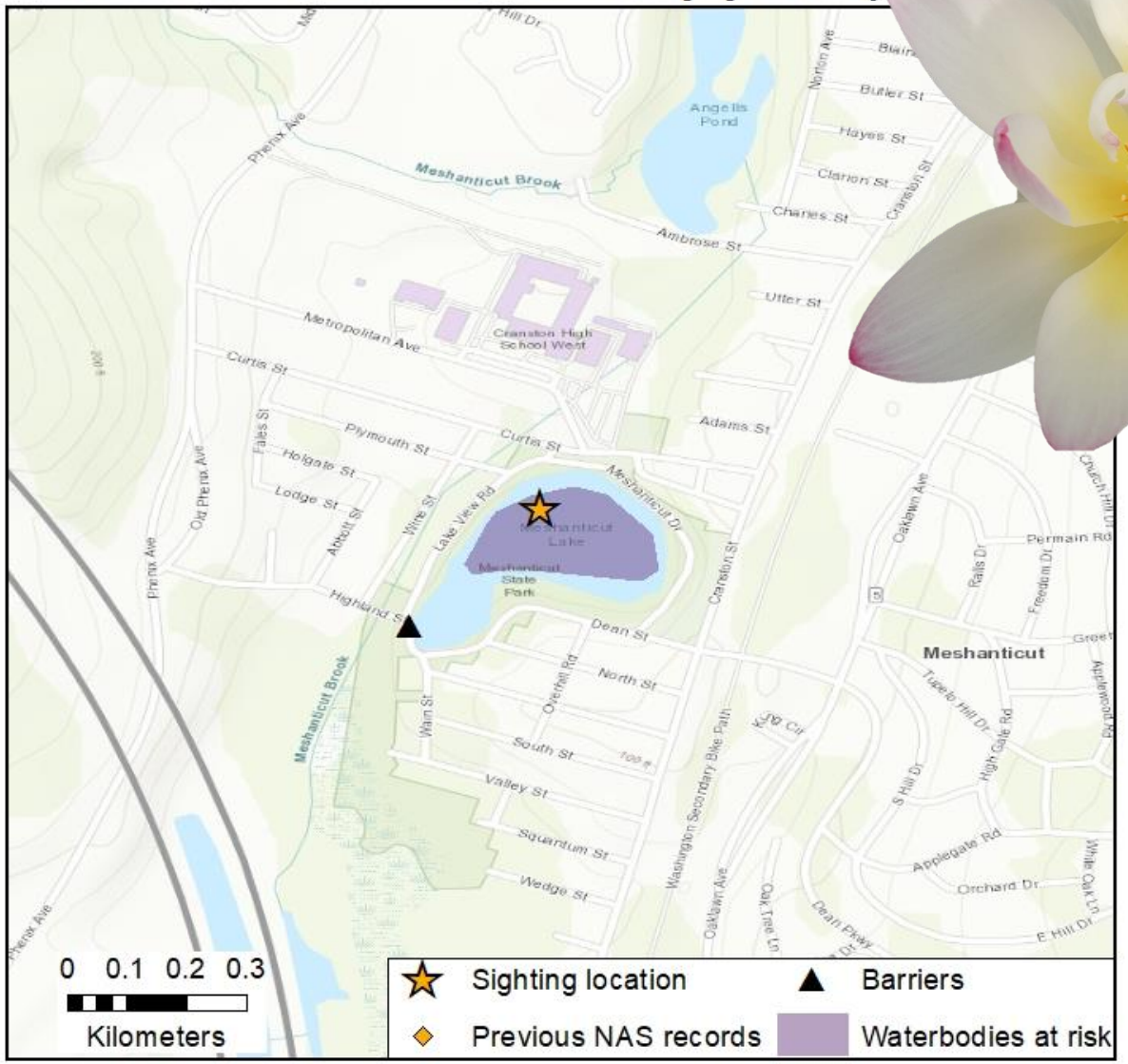
Escaped captivity or planted

USGS science for a changing world

NAS Alert Risk Mapper (AR

Specimen ID:	1613759
Species:	*Nelumbo nucifera* (sacred lotus)
Alert level:	State: Rhode Island; County: Providence (RI); Drainage: Narragansett (1090004)
Alert date:	08/13/2019
State:	Rhode Island
Locality:	Meshanticut Pond, Meshanticut State Park
Latitude (N):	41.7694
Longitude (W):	-71.4763
Collection date:	00/00/2018





The map shows waterbodies at short-term risk of invasion from the species sighting. The at-risk areas are determined by species mobility and drainage barriers (dams).

USGS science for a changing world

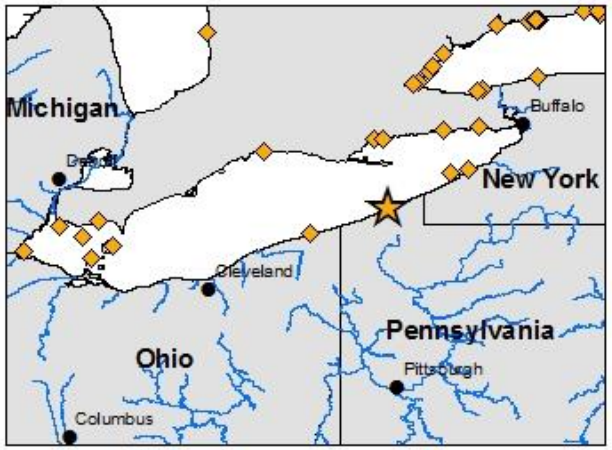
NAS

Ballast?

USGS science for a changing world

NAS Alert Risk Mapper (ARM)

Specimen ID:	1613718
Species:	Hemimysis anomala (bloody red shrimp)
Alert level:	State: Pennsylvania County: Erie (PA)
Alert date:	08/08/2019
State:	Pennsylvania
Locality:	South pier of entrance channel to Presque Isle Bay, Erie County, PA.
Latitude (N):	42.1532
Longitude (W):	-80.0746
Collection date:	07/25/2019



The map shows waterbodies at short-term risk of invasion from the species sighting. The at-risk areas are determined by species mobility and drainage barriers (dams).

USGS science for a changing world

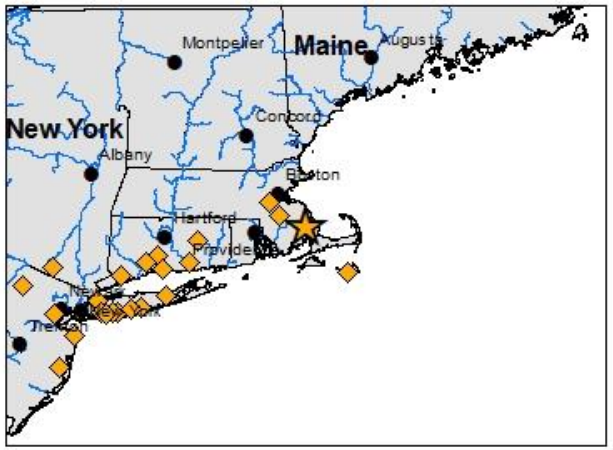
NAS

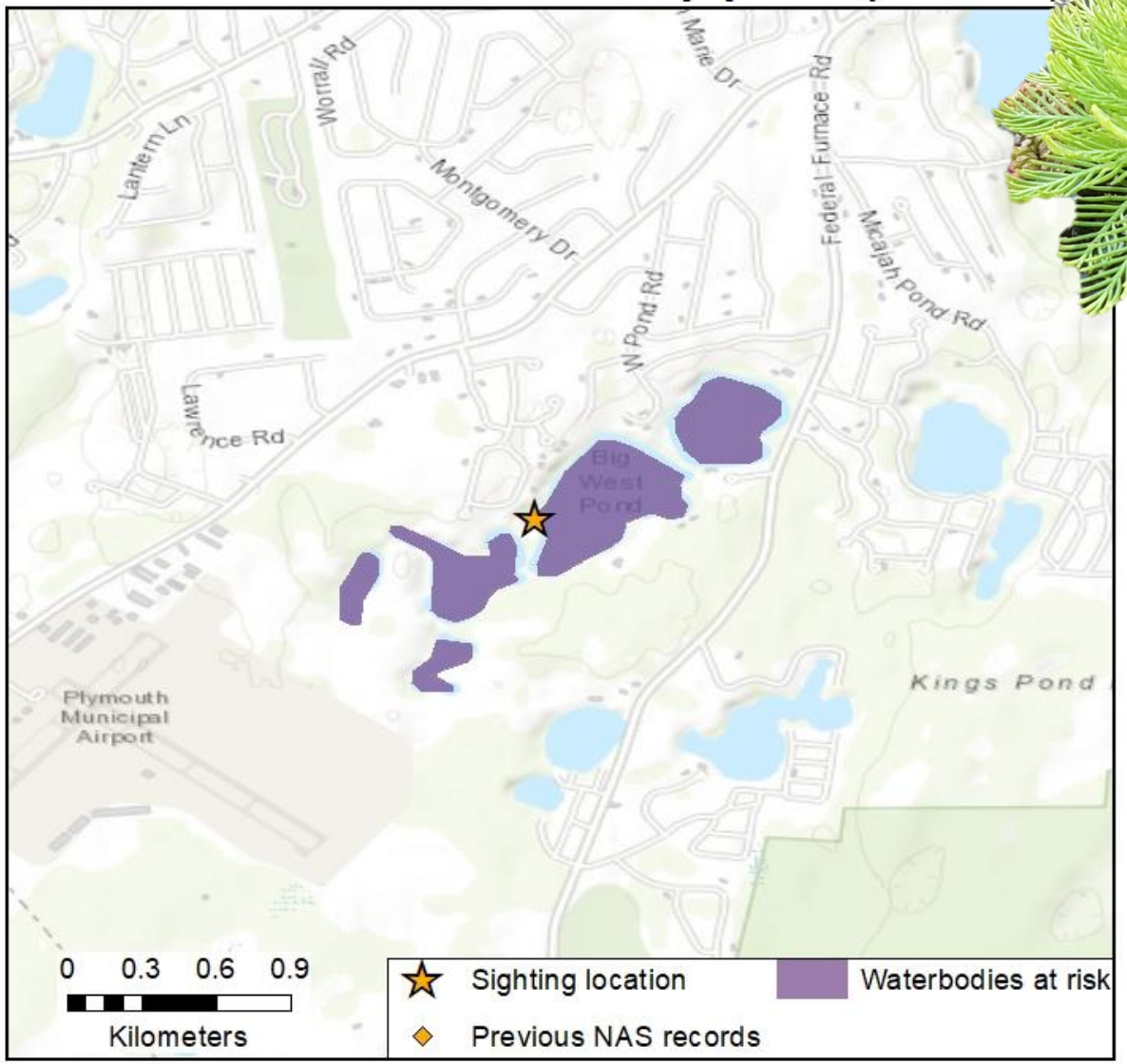
Aquarium release or planted?

USGS science for a changing world

NAS Alert Risk Mapper (ARM)

Specimen ID:	1617548
Species:	*Myriophyllum aquaticum* (parrot feather)
Alert level:	County: Plymouth (MA)
Alert date:	09/11/2019
State:	Massachusetts
Locality:	Small bay on the southwest end of Big West Pond next to Marscot Way
Latitude (N):	41.918
Longitude (W):	-70.7131
Collection date:	09/04/2019





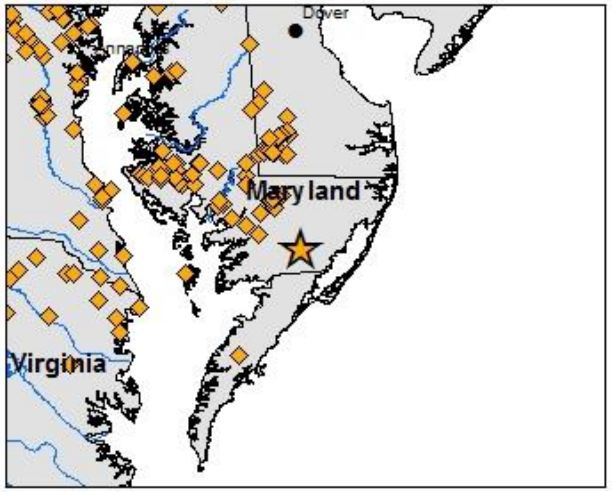
The map shows waterbodies at short-term risk of invasion from the species sighting. The at-risk areas are determined by species mobility and drainage barriers (dams).

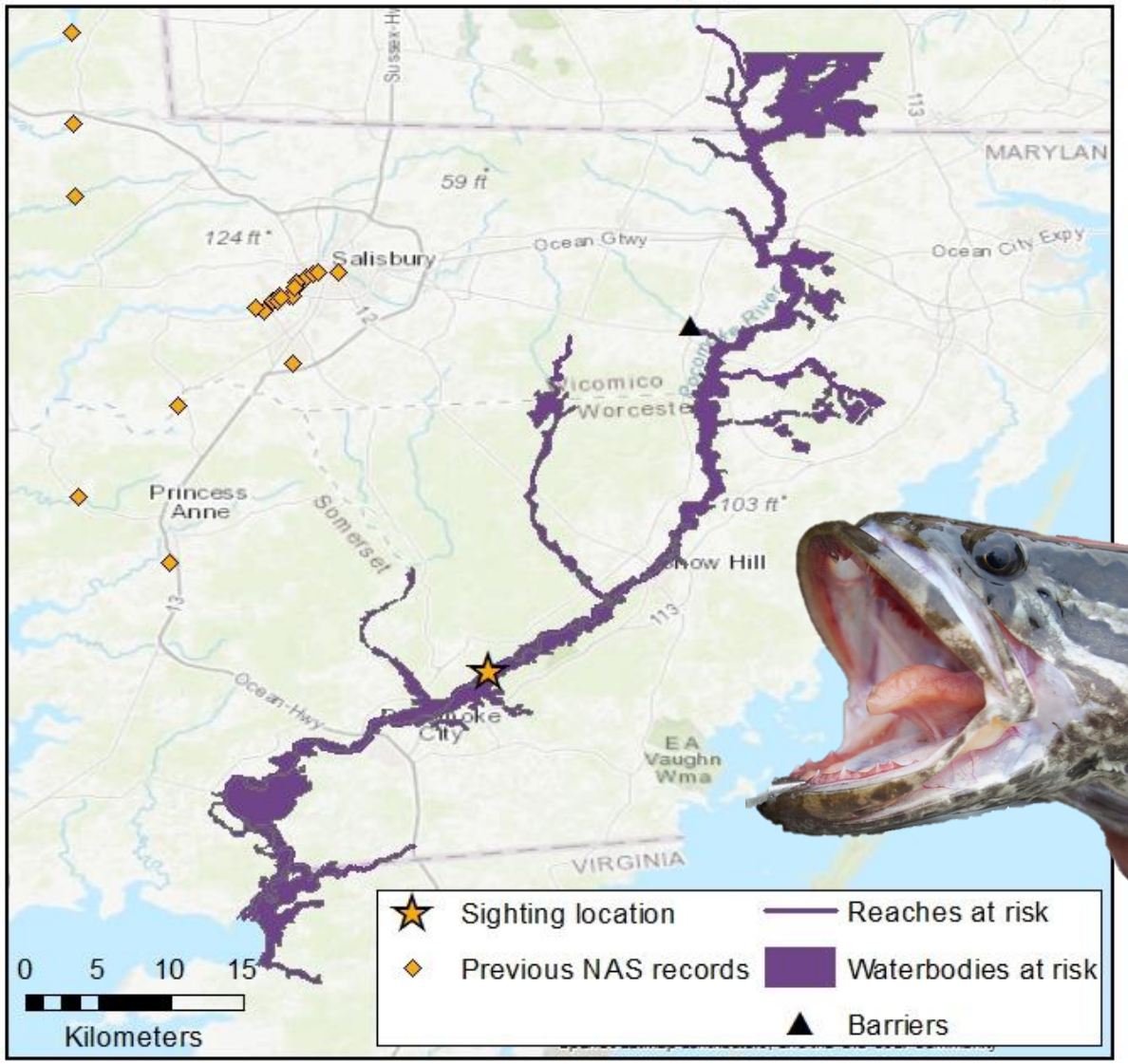
Released for food

USGS science for a changing world

NAS Alert Risk Mapper (ARM)

Specimen ID:	1613664
Species:	Channa argus (Northern Snakehead)
Alert level:	County: Worcester (MD);
Alert date:	08/01/2019
State:	Maryland
Locality:	Pocomoke River
Latitude (N):	38.1182
Longitude (W):	-75.4988
Collection date:	07/00/2019





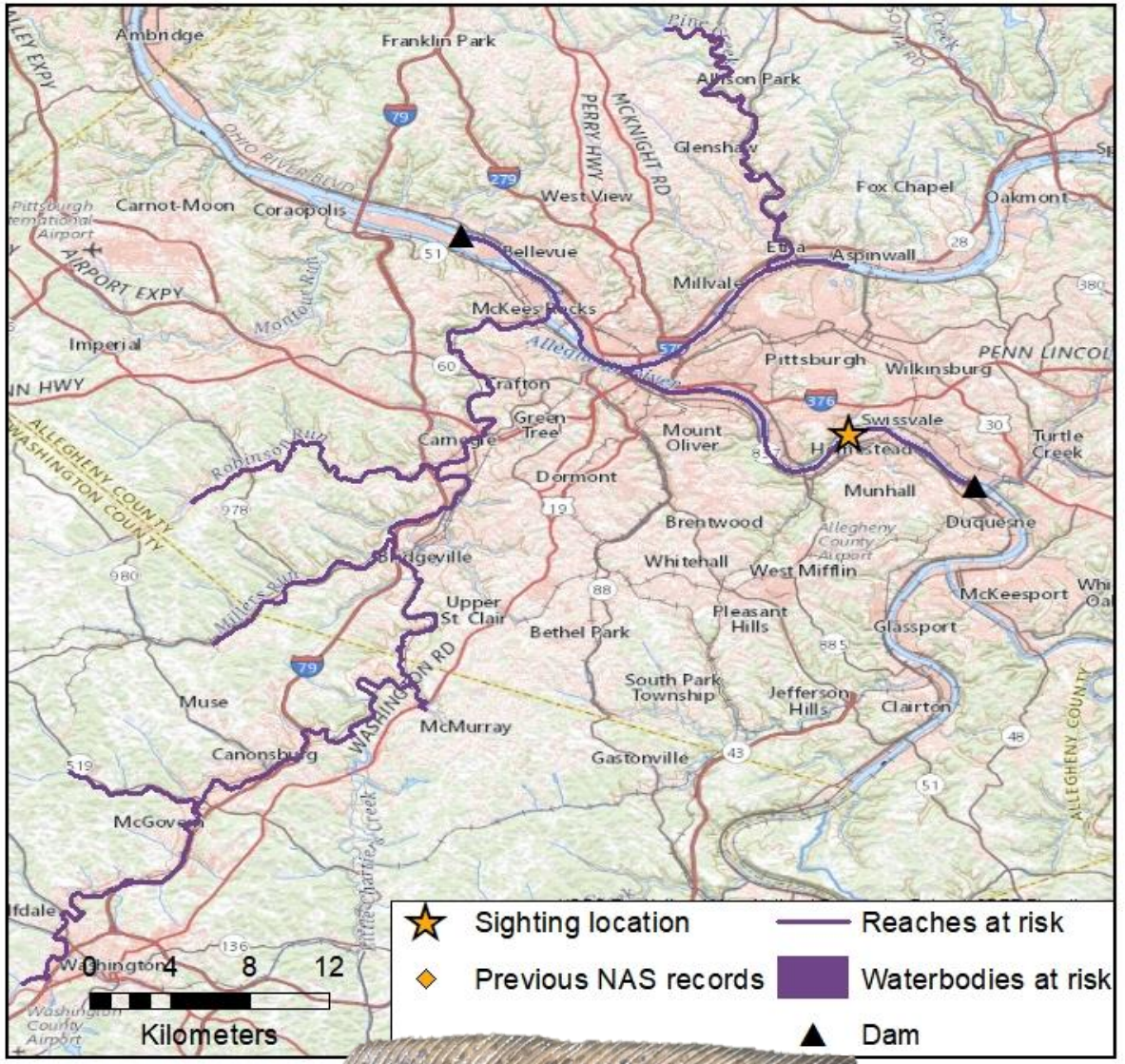
The map shows waterbodies at short-term risk of invasion from the species sighting. The at-risk areas are determined by species mobility and drainage barriers (dams).

Released for food

USGS science for a changing world

NAS Alert Risk Mapper (ARM)

Specimen ID:	1617830
Species:	*Channa argus* (Northern Snakehead)
Alert level:	County: Allegheny (PA); Drainage: Lower Monongahela (05020005)
Alert date:	10/01/2019
State:	Pennsylvania
Locality:	Monongahela River, Pittsburgh, in Duck Hollow area
Latitude (N):	40.4143
Longitude (W):	-79.9149
Collection date:	09/27/2019



The map sh… sighting.
The … (dams).

USGS science for a changing world

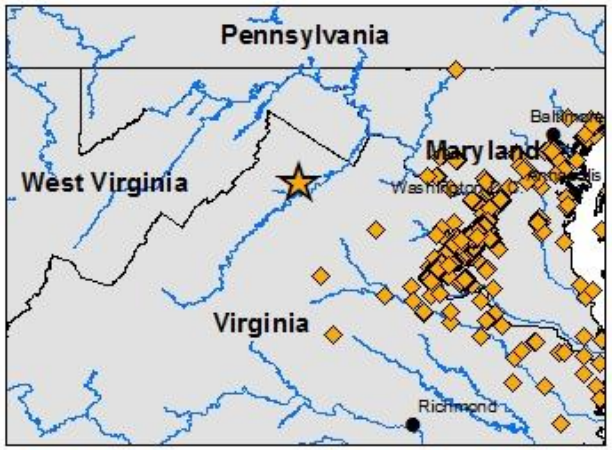
NAS

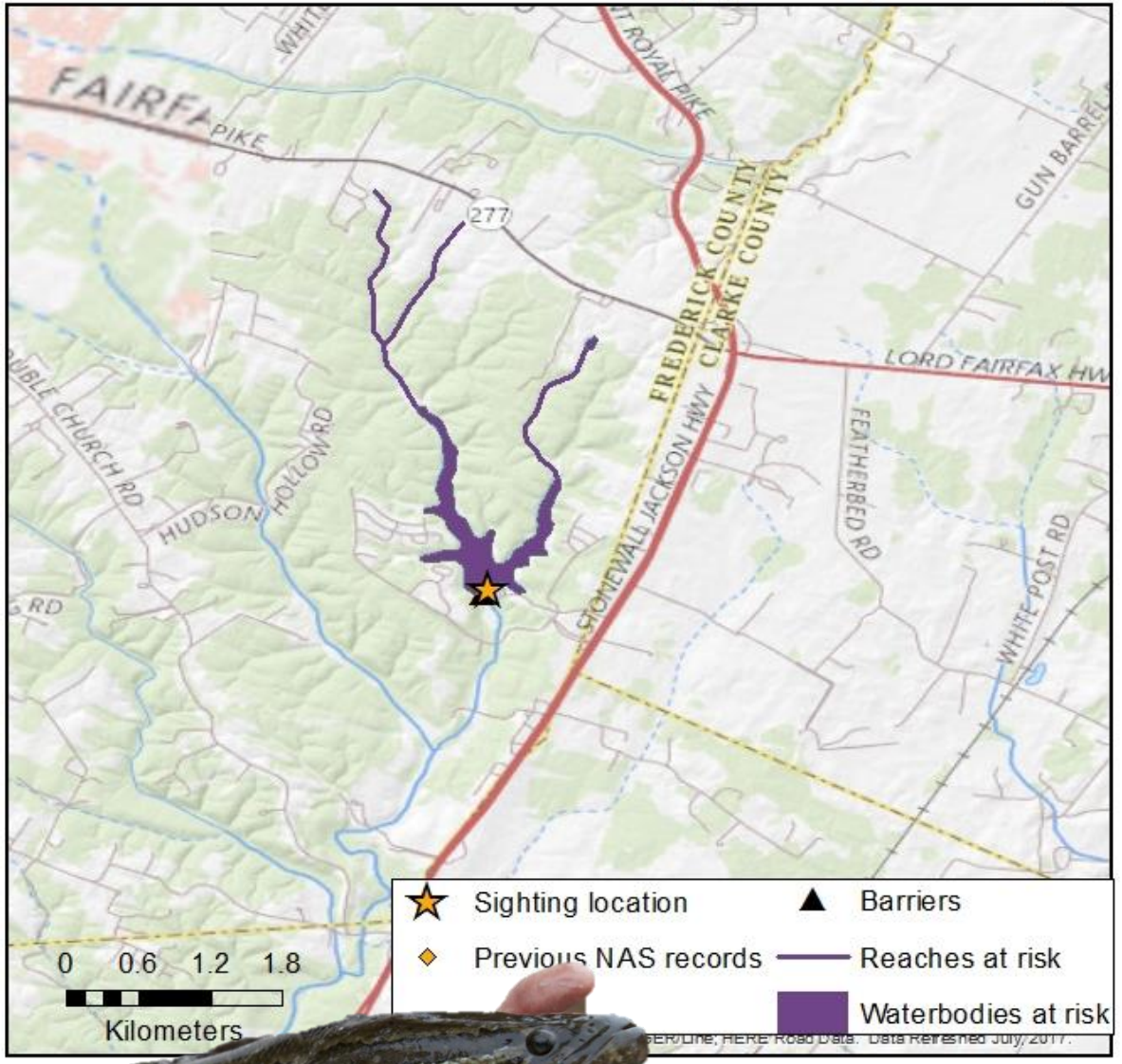
Released for food

USGS science for a changing world

NAS Alert Risk Mapper (ARM)

Specimen ID:	1546604
Species:	Channa argus (Northern Snakehead)
Alert level:	County: Frederick (VA); Drainage: Shenandoah (2070007)
Alert date:	05/23/2019
State:	Virginia
Locality:	Crooked Run, at Lake Frederick
Latitude (N):	39.0428
Longitude (W):	-78.158
Collection date:	05/00/2019





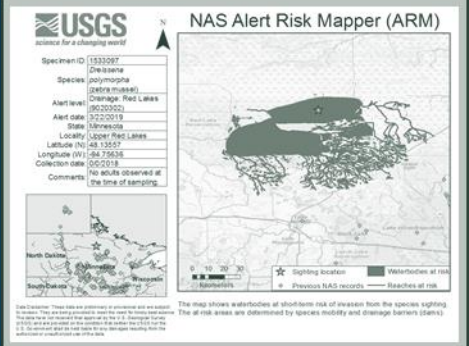
Data Disclaimer: These data are preliminary or provisional and are
to revision. They are being provided to meet the need for
The data have not received final approval by the U.S.
(USGS) and are provided on the condition that neither
U.S. Government shall be held liable for any damages
authorized or unauthorized use of the data.

risk of invasion from the species sighting.
ies mobility and drainage barriers (dams).

USGS science for a changing world

NAS

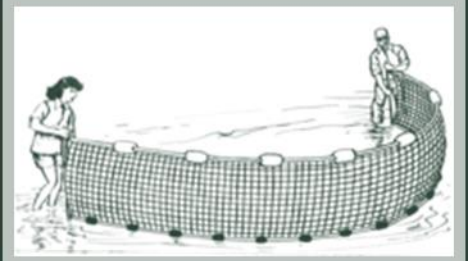
Alert Risk Mapper



Flood and Storm Tracker

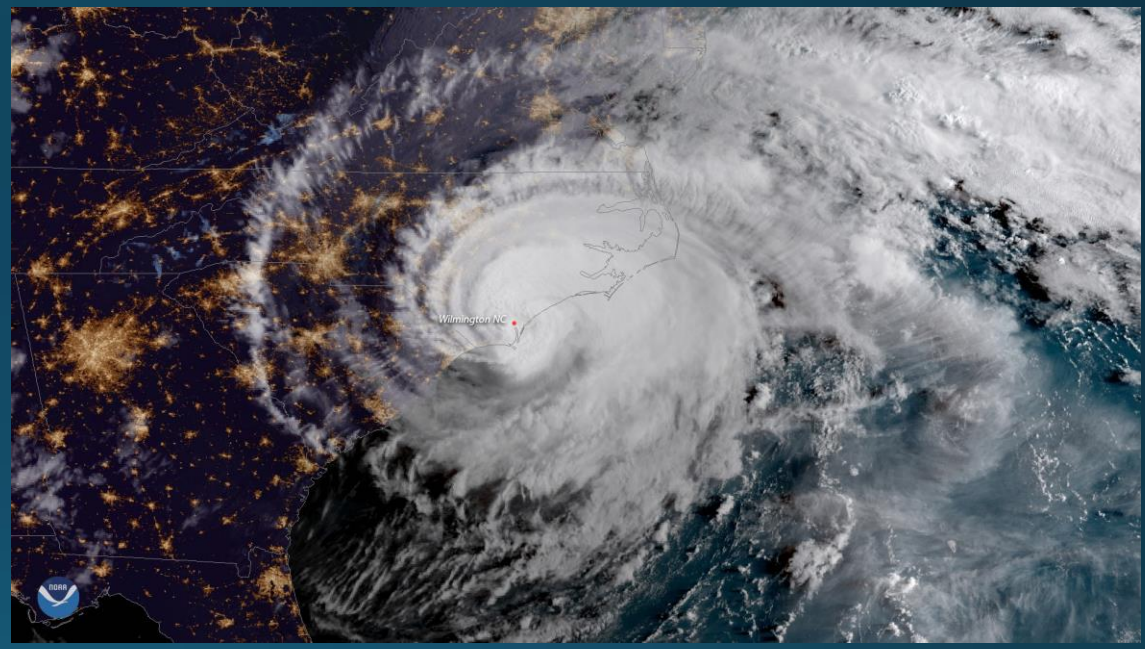
Impact Tables

SEINeD Tool



Flood and Storm Tracker (FaST)

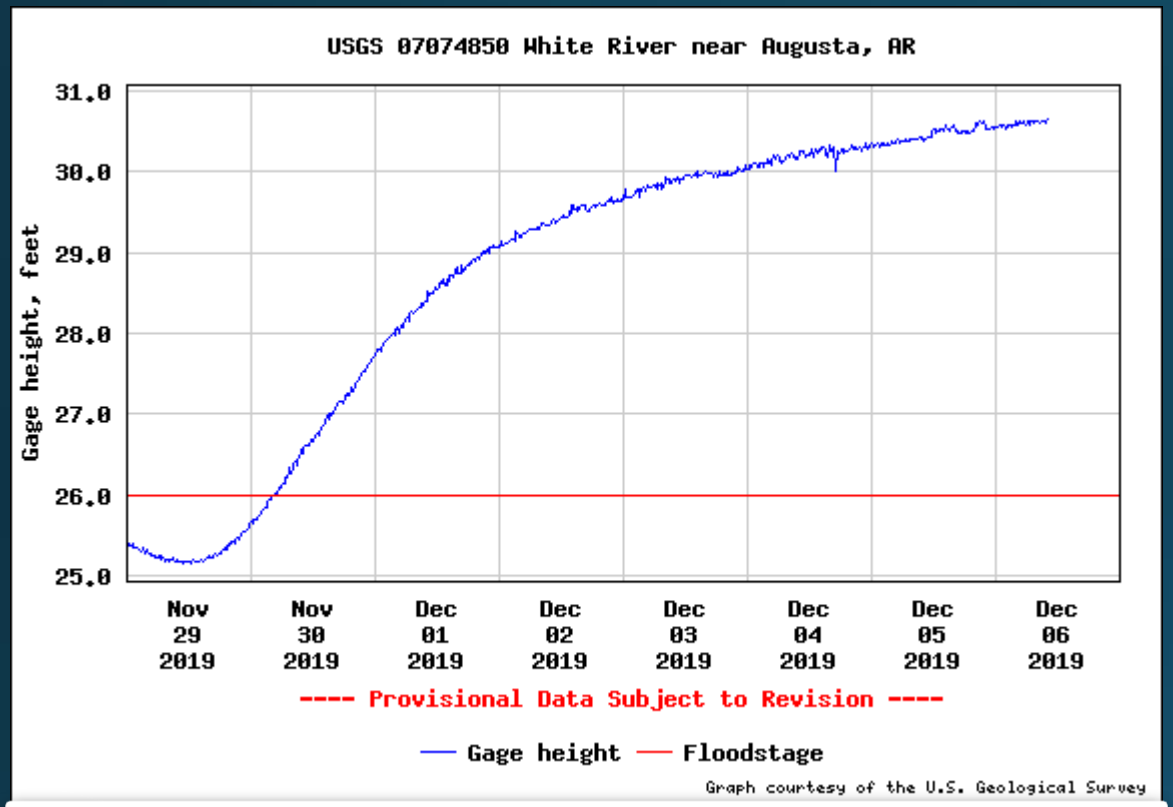
- Flooding during storm and hurricane events has the potential to transport nonindigenous aquatic species.
- As part of the EDRR system, the NAS program is interested in alerting managers of these possible new introductions.
- Help natural resource managers determine potential new locations for individual species, or to develop a watchlist of potential new species within a watershed.



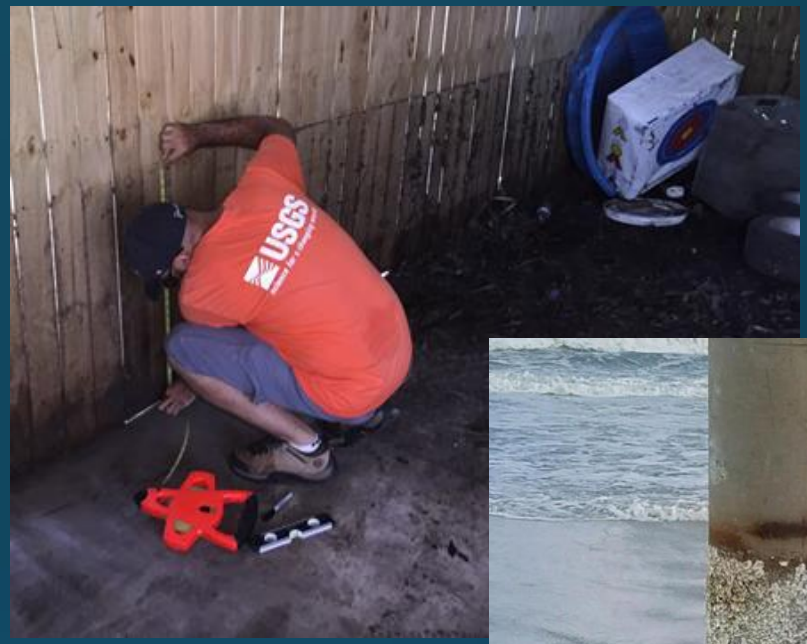
NAS.ER.USGS.GOV/VIEWER/FLOODING

USGS science for a changing world

NAS



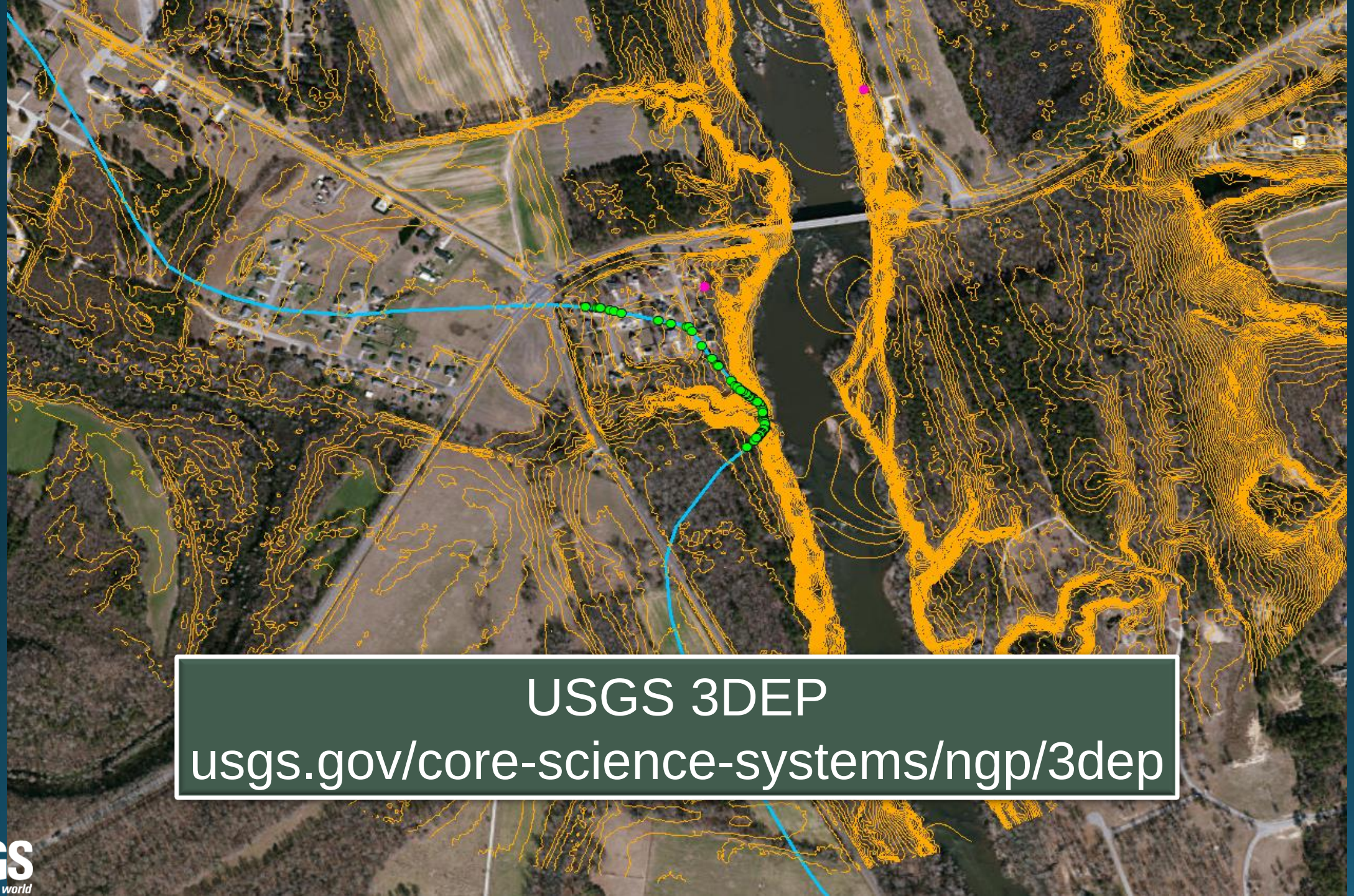
USGS WaterWatch
waterwatch.usgs.gov



USGS Flood Event Viewer
stn.wim.usgs.gov/FEV

USGS science for a changing world

NAS



USGS
science for a changing world

NAS

Midwest Spring Flood - Revised map

Click on a drainage in the map or select a species from below.

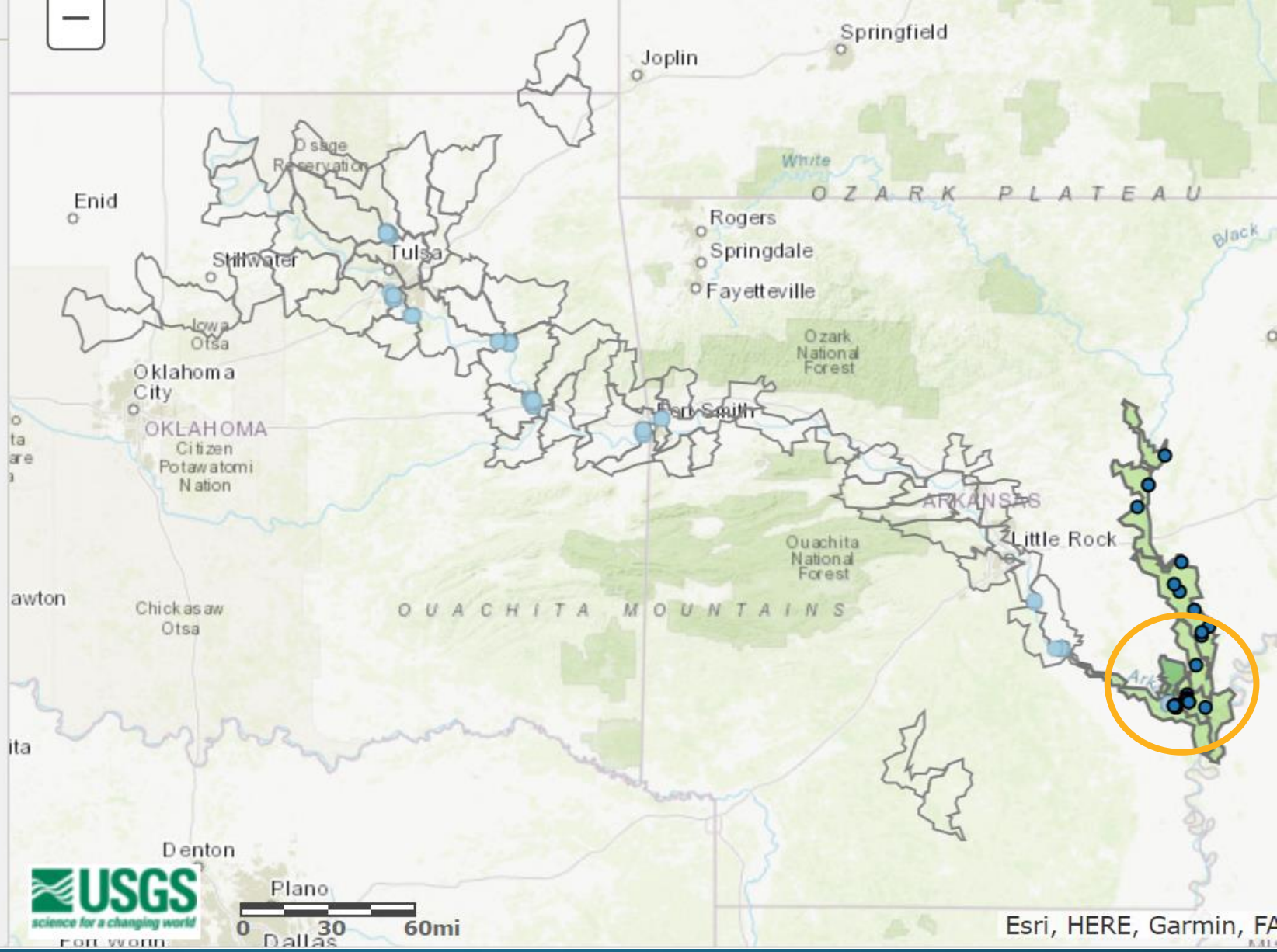
Select a species:

Northern Snakehead (Channa argus)

Map updated 10/24/2019

Channa argus
Northern Snakehead
Fishes
Exotic
View Species Profile

- Present in watershed
- Potential spread due to flooding
- Connection points
- Species Observations



Query

Midwest Spring Flood - Revised map

Click on a drainage in the map or select a species from below.

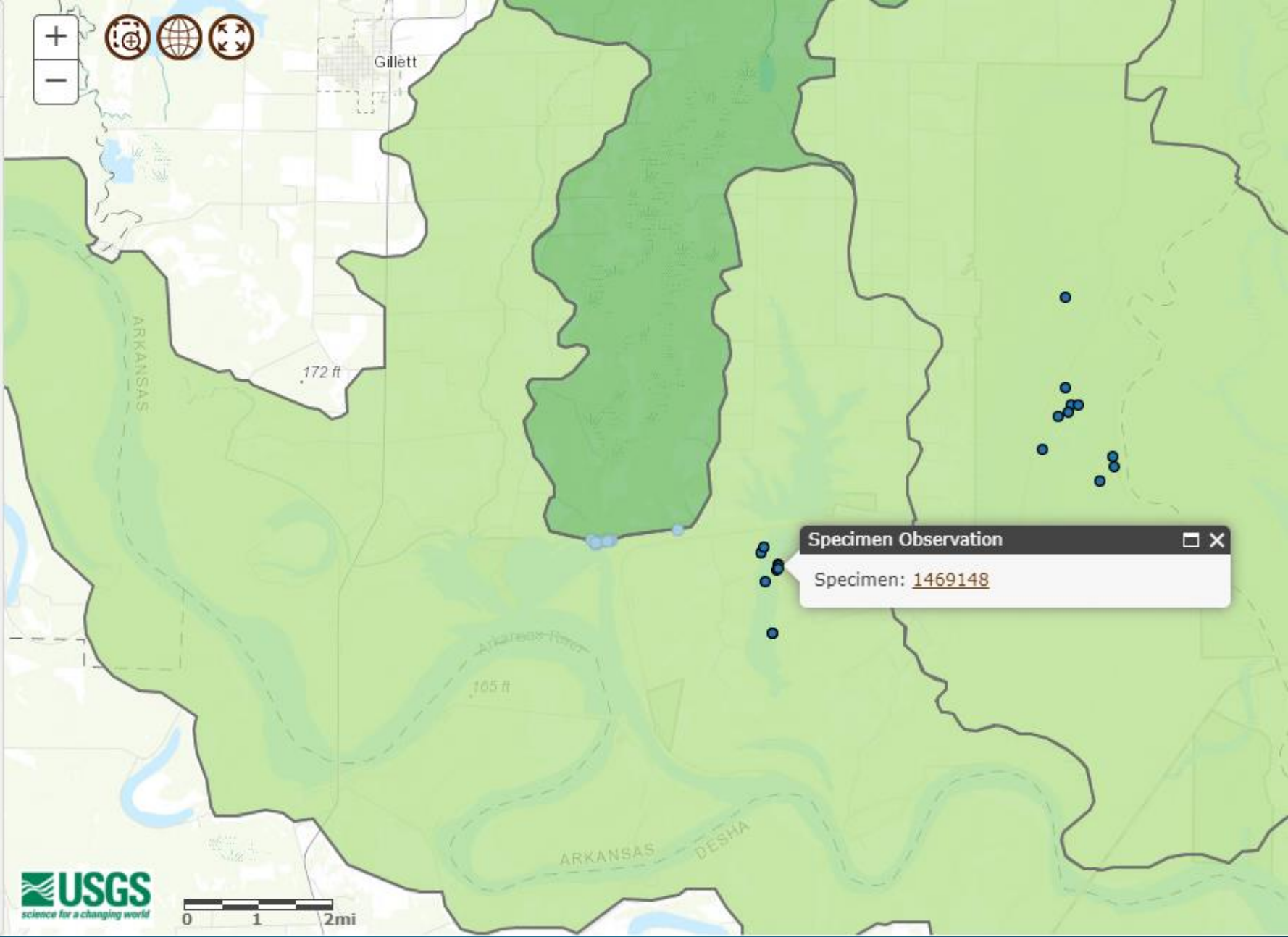
Select a species:

Northern Snakehead (Channa argus)

Map updated 10/24/2019

Channa argus
Northern Snakehead
Fishes
Exotic
View Species Profile

- Present in watershed
- Potential spread due to flooding
- Connection points
- Species Observations



Final FaST maps

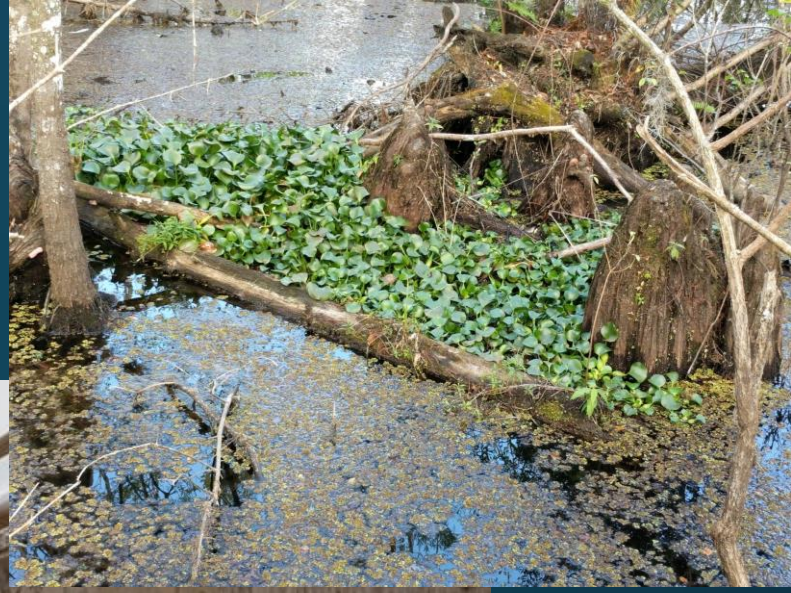
12 months post-storm

Review post-hurricane NAS surveys or sightings to identify any species that could have been transported by flooding.

Review our predictions and see how future maps can be improved based on new introductions.

2017 storms saw 18 species and 33 new sightings potentially being moved by flooding

2018 storms saw 14 species and 18 new sightings potentially moved by flood



Hurricane Florence-
North Carolina

USGS
science for a changing world

NAS

Query

Hurricane Florence - Final map

Select a species:
Channel Catfish (Ictalurus punctatus)

Map updated 10/11/2019

Ictalurus punctatus
Channel Catfish
Fishes
Native
View Species Profile

- Present in watershed
- Potential spread due to flooding
- Connection points
- Pre-storm Species Observations
- Post-storm Species Observations

View List of All Post-storm Observations

Post-storm Observations CLOSE

Species	HUC	Specimen	Date
Cyprinus carpio	0304020803	1617003	06/12/2019
Ictalurus punctatus	0304010402	1616602	11/07/2018
Lepomis microlophus	0302030204	1616582	09/15/2018
Lepomis microlophus	0303000708	1616631	04/02/2019
Morone saxatilis	0304010402	1616601	11/07/2018
Philydrum lanuginosum	0303000708	1617597	09/2019
Procambarus clarkii	0304020803	1545191	05/12/2019

From 1996

Badin Lake Dam

From Nov. 2018

Query

Hurricane Florence - Final map

Select a species:

woolly frogs mouth (Philydrum lanuginosum)

Map updated 10/11/2019

Philydrum lanuginosum
woolly frogs mouth
Plants
Exotic
View Species Profile

- Present in watershed
- Potential spread due to flooding
- Connection points
- Pre-storm Species Observations
- Post-storm Species Observations

View List of All Post-storm Observations

Post-storm Observations

CLOSE

Species	HUC	Specimen	Date
Cyprinus carpio	0304020803	1617003	06/12/2019
Ictalurus punctatus	0304010402	1616602	11/07/2018
Lepomis microlophus	0302030204	1616582	09/15/2018
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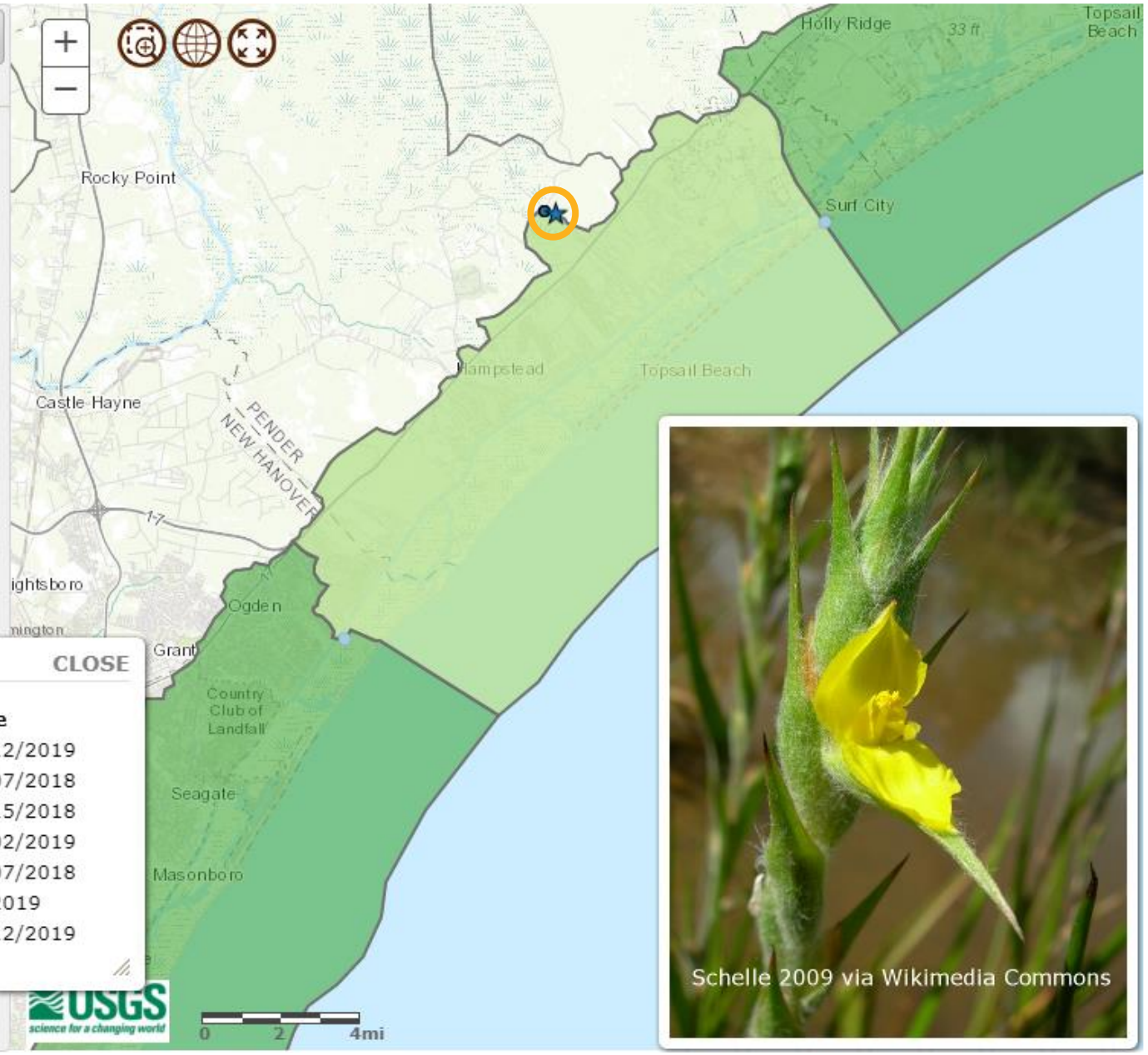

Schelle 2009 via Wikimedia Commons

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Frequently moved by flooding?

WANTED

giant salvinia

Salvinia molesta

WANTED

giant applesnail

Pomacea maculata

WANTED

Suckermouth catfish

Hypostomus plecostomus

WANTED

waterhyacinth

Eichhornia crassipes

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Giant salvinia (*Salvinia molesta*) Post-Hurricane Katrina

Fuller, P.L., M.G. Pursley, D. Diaz, and W. Devers. 2010. Effects of Hurricane Katrina on an incipient population of giant salvinia *Salvinia molesta* in the lower Pascagoula River, Mississippi. Gulf and Caribbean Research 22:63-66

Flood and Storm Tracker (FaST)

Hurricane Harvey - Final map

Gulf coast of east Texas and western Louisiana

August 24, 2017 - September 24, 2017

Hurricane Irma - Final map

Peninsular Florida and Atlantic coast of Georgia and South Carolina

September 3, 2017 - September 30, 2017

Hurricane Maria - Final map

Island of Puerto Rico

September 16, 2017 - October 3, 2017

Hurricane Nate - Final map

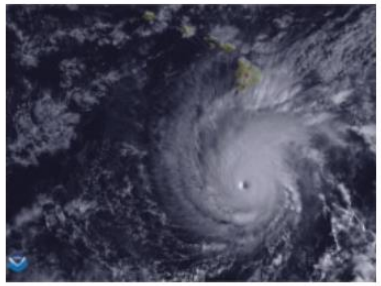
Eastern Gulf Coast states

October 5, 2017 - October 14, 2017

Hurricane Lane - Final map

Hawaiian Islands

August 22, 2018 - September 15, 2018



Hurricane Florence - Final map

The Carolinas

September 7, 2018 - October 7, 2018

Hurricane Michael - Final map

Florida Panhandle

October 8, 2018 - October 15, 2018

Midwest Spring Flood - Revised map

Upper Mississippi River Basin

March 1, 2019 - May 31, 2019

Hurricane Dorian - Revised map

South Atlantic Coast

August 28, 2019 - September 7, 2019

Waterlettuce
(*Pistia stratiotes*)

- 2017: Hurricanes Harvey, Irma, Maria, Nate
- 2018: Hurricanes Lane, Florence, Michael
- 2019: Midwest Spring Flood, Hurricane Dorian

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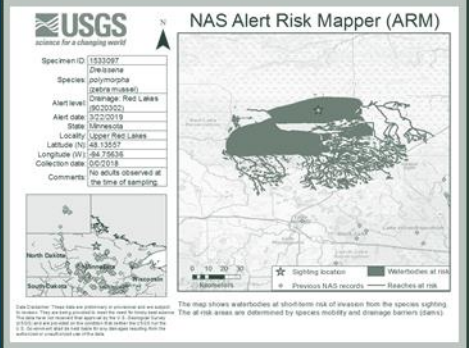
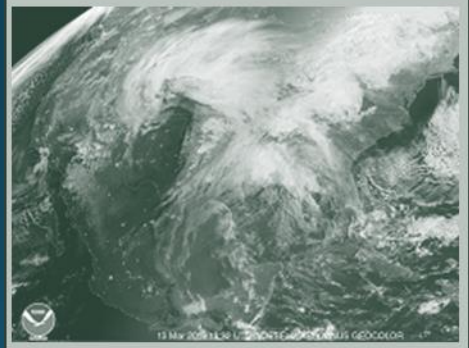
NAS

Alert Risk Mapper

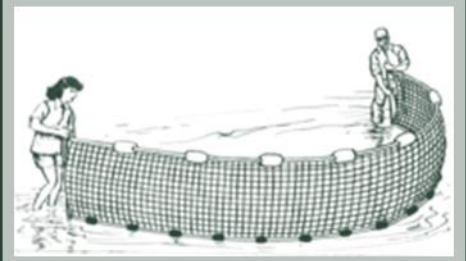


Flood and Storm Tracker



Impact Tables

SEINeD Tool



Impact Tables

Identify the known impacts of 100 biggest priority species for the Gulf and South Atlantic Region

Ecological

Genetic

Competition

Water Quality

Habitat Alteration

Predation/Herbivory

Economic

Infrastructure

Recreation

Commerce

Aquaculture/Agriculture

Property Value

Harvest

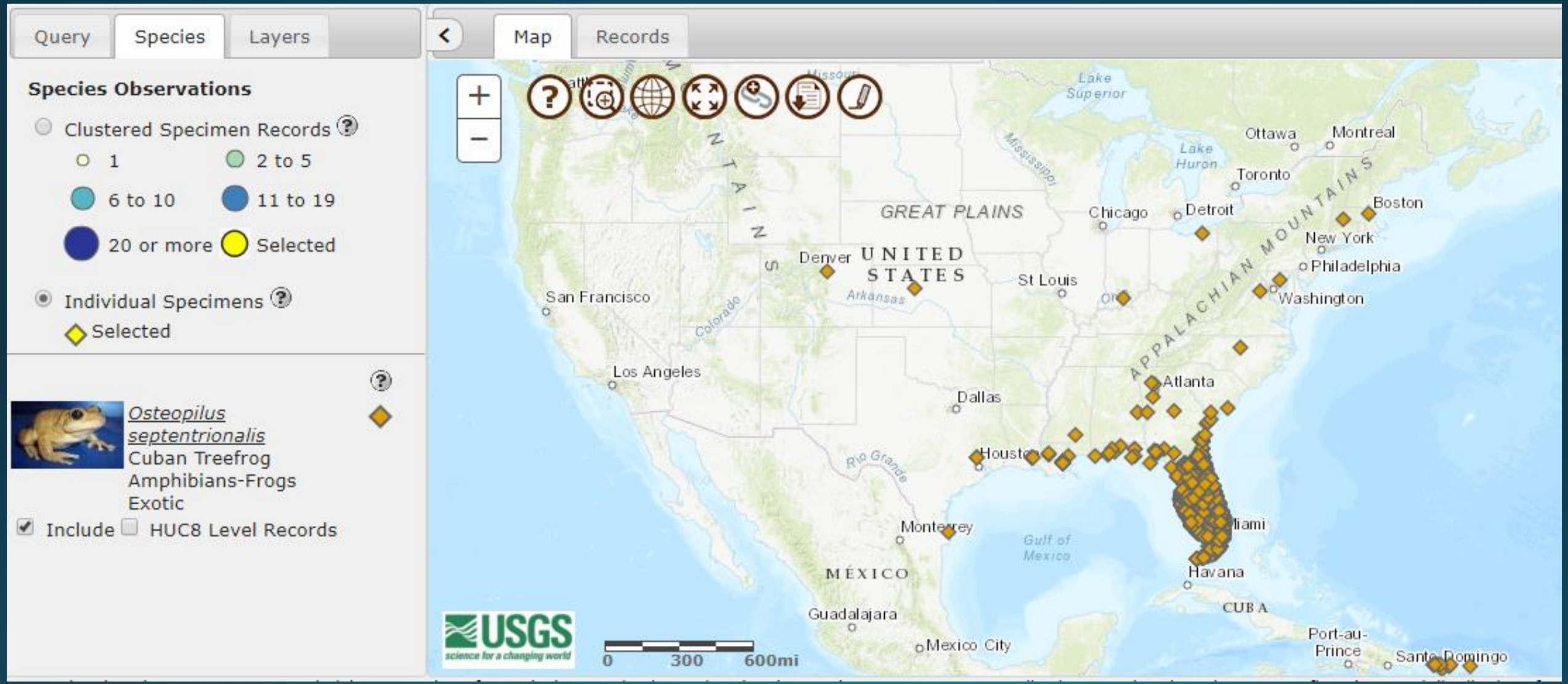
Health

Human Health

Disease/parasite/toxic

Impact Tables

Cuban Treefrog (*Osteopilus septentrionalis*)



Impact Tables

Entered Date: 8/9/2019 1:27:11 PM Entered by: CRM Changed Date: 10/30/2019 12:46:10 PM Last Change by: JP

Species ID: ** 57

FIND NEW or EDIT (erase number for a "new" ID)

Osteopilus septentrionalis, Cuban Treefrog

Reference: ** 32514 VIEW FIND NEW or EDIT

Impact Type: ** Predation/Herbivory

Study Type: ** Observational

Study Location: ** Field

Impact Description: Cuban treefrogs prey on native treefrogs, such as the green treefrog Hyla cinerea.

Notes:

Great Lakes Region:

submit

** = required fields

Associated TSNs:

Add to List | Fetch Scientific Names from ITIS

Please enter a TSN number first.

Associated TSNs		Scientific Name (from ITIS)
173505	✗	*Hyla cinerea*

Impact Tables

Species ID: 57
FIND
Filter by Selected Species
Clear Filter

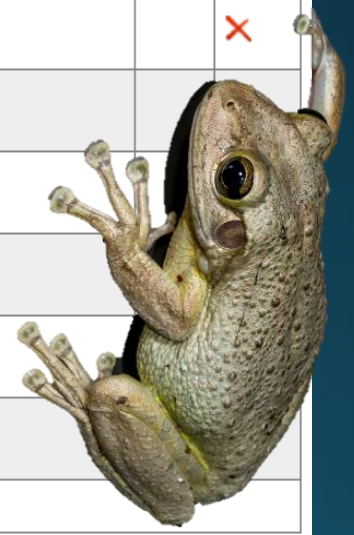
Osteopilus septentrionalis, Cuban Treefrog

Add New Impact for Selected Species

1 2

Edit	Impact ID	Species ID	Impact Type	Impact Description	Study Type	Study Location	Reference Number	Associated TSNs	Great Lakes Region	Notes	Delete
	1786	57	Predation/Herbivory	Cuban treefrogs prey on native treefrogs.	Experimental	Laboratory	14110	173505			
	1787	57	Predation/Herbivory	Cuban treefrogs prey on native treefrogs, such as the green treefrog Hyla cinerea.	Observational	Field	32514	173505			
	1788	57	Predation/Herbivory	The presence of Cuban treefrogs decreases the abundance of native green treefrogs Hyla cinerea throu...	Experimental	Field	19802	173505			
	1844	57	Competition	The presence of Cuban treefrogs decreases the abbundance of native green treefrogs Hyla cinerea thro...	Experimental	Field	19802	173505			
	1845	57	Competition	Cuban treefrog tadpoles inhibit the growth and development rate of Hyla cinerea (Green treefrog) tad...	Experimental	Laboratory	14240	173505			
	1846	57	Competition	Cuban treefrog tadpoles inhibit the growth and development rate of Bufo terrestris (southern toad) t...	Experimental	Laboratory	14240	173475			
	1847	57	Competition	Cuban treefrogs have been observed enganging in mating behaviors with southern leopard frogs (Lithob...	Anecdotal	Field	14124	164375			
	1848	57	Competition	Male O. septentrionalis have been observed displaying mating behavior (amplexing, or "embracing") wi...	Observational	Field	21008	173475, 173505, 775116			
	1849	57	Competition	Native treefrogs, including the green treefrog Hyla cinerea, alter their calling effort in habitats ...	Observational	Field	32522	173505			
	1850	57	Competition	Cuban treefrog larvae reduce the survivability, size, and larval duration of the larvae of the nativ...	Experimental	Laboratory	32523	173475, 173504			

1 2



USGS science for a changing world

NAS

Impact Tables

NAS - Nonindigenous Aquatic Species

Home | Alert System | Database & Queries | Taxa Information | Report a Sighting

Osteopilus septentrionalis
(Cuban Treefrog)
Amphibians-Frogs
Exotic

Collection Info
Point Map
Species Profile
Animated Map

Impact Type	Impact Description	Reference Number	Reference
Predation/Herbivory	The presence of Cuban treefrogs decreases the abundance of native green treefrogs *Hyla cinerea* through…	19802	Rice, K. G., J. H. Waddle, M. W. Miller, M. E. Crockett, F. J. Mazzotti, and H. F. Percival. 2011. Recovery of native treefrogs after removal of nonindigenous Cuban Treefrogs, Osteopilus septentrionalis. Herpetologica 67(2):105-117.
Competition	The presence of Cuban treefrogs decreases the abundance of native green treefrogs *Hyla cinerea* through…	19802	Rice, K. G., J. H. Waddle, M. W. Miller, M. E. Crockett, F. J. Mazzotti, and H. F. Percival. 2011. Recovery of native treefrogs after removal of nonindigenous Cuban Treefrogs, Osteopilus septentrionalis. Herpetologica 67(2):105-117.
Infrastructure	The species has caused power outages when coming in contact with electrical equipment	32513	Dahm, D. 2018. Tree frog causes Kissimmee power outage; 800 customers lose power for more than hour. ClickOrlando.com. Orlando, FL. https://www.clickorlando.com/strange-florida/tree-frog-causes-kissimmee-power-outage. Created on 05/11/2018. Accessed on 03/04/2019
Human Health	Cuban treefrogs secrete a noxious chemical that can cause burning in the eyes and nose of humans and...	32514	Johnson, S.A. 2007. The Cuban Treefrog (Osteopilus septentrionalis) in Florida. Publication WEC 218:1-7. http://edis.ifas.ufl.edu/uw259.

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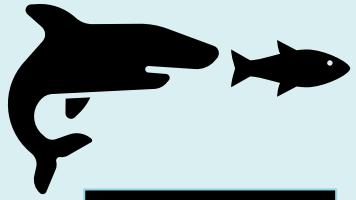
NAS

Impact Tables

E – Experiment
O – Observed
A – Anecdotal

Ecological



Predation

Competition

Economic

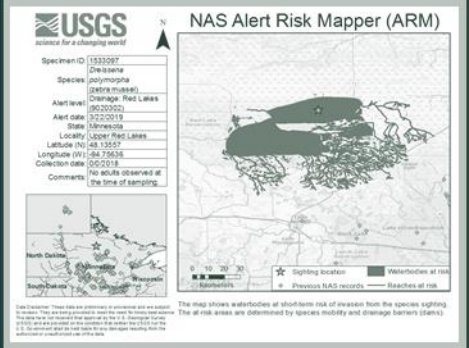
Infrastructure

Health

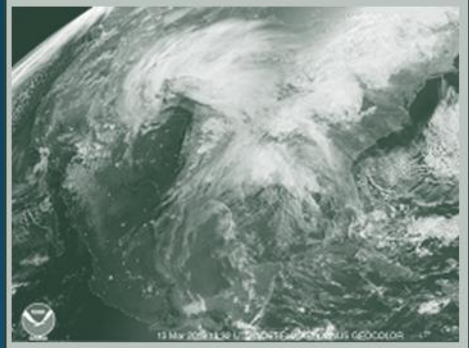
Human Health

SEINeD tool

Alert Risk Mapper

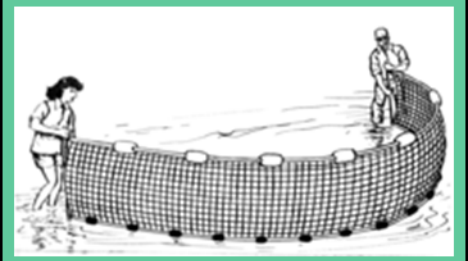


Flood and Storm Tracker



Impact Tables

SEINeD Tool



SEINeD tool

Have you SEINeD your fisheries data?

- The SEINeD tool will allow stakeholders to upload a biological dataset collected anywhere in the conterminous US, Alaska, Hawaii, or US Territory that can be screened for invasive or non-native aquatic species occurrences.

Give the user a CSV file of:

- Native and non-native occurrences
- Spatial accuracy of the sighting location
- Taxonomic accuracy of the specimens
- Additional spatial layers
  - Hydrologic Unit Codes (8, 10, 12 HUCs)
  - National Hydrography Dataset (NHDPlusV2)

Hydrilla
(*Hydrilla verticillata*)

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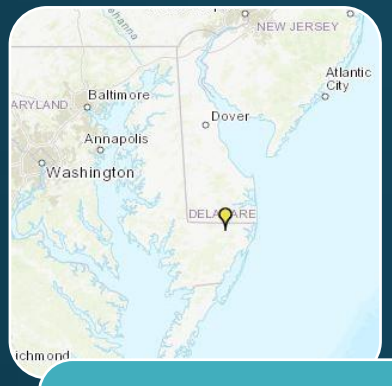

Check the spatial accuracy of the sighting location

- Based on user provided state and county information

Check the indigenous status of the species at the sighting location

- Native ranges developed for USGS NAS and CSAS's Aquatic Gap

Provide additional spatial information about the sighting location

- Hydrologic Unit Codes (HUCs)
- National Hydrography Dataset (NHDPlusV2)

Species	Latitude	Longitude	State	County
Noturus insignis	39.59	-77.82	MD	Washington
Noturus insignis	39.15	-77.52	MD	Montgomery
Micropterus salmoides	39.59	-77.82	MD	Montgomery
Micropterus salmoides	39.59	-77.82	MD	Washington
Pylodictis olivaris	39.15	-77.52	MD	Montgomery
Carp	39.15	-77.52	MD	Montgomery

Species	Latitude	Longitude	State	County	Taxa error	Spatial error	Non-native	HUC 8 (Number)	HUC 8 (Name)
Noturus insignis	39.59	-77.82	MD	Washington				2070008	Middle Potomac-Catoctin
Noturus insignis	39.15	-77.52	MD	Montgomery				2070008	Middle Potomac-Catoctin
Micropterus salmoides	39.59	-77.82	MD	Montgomery		X			
Micropterus salmoides	39.59	-77.82	MD	Washington			X	2070008	Middle Potomac-Catoctin
Pylodictis olivaris	39.15	-77.52	MD	Montgomery			X	2070008	Middle Potomac-Catoctin
Carp	39.15	-77.52	MD	Montgomery	X				

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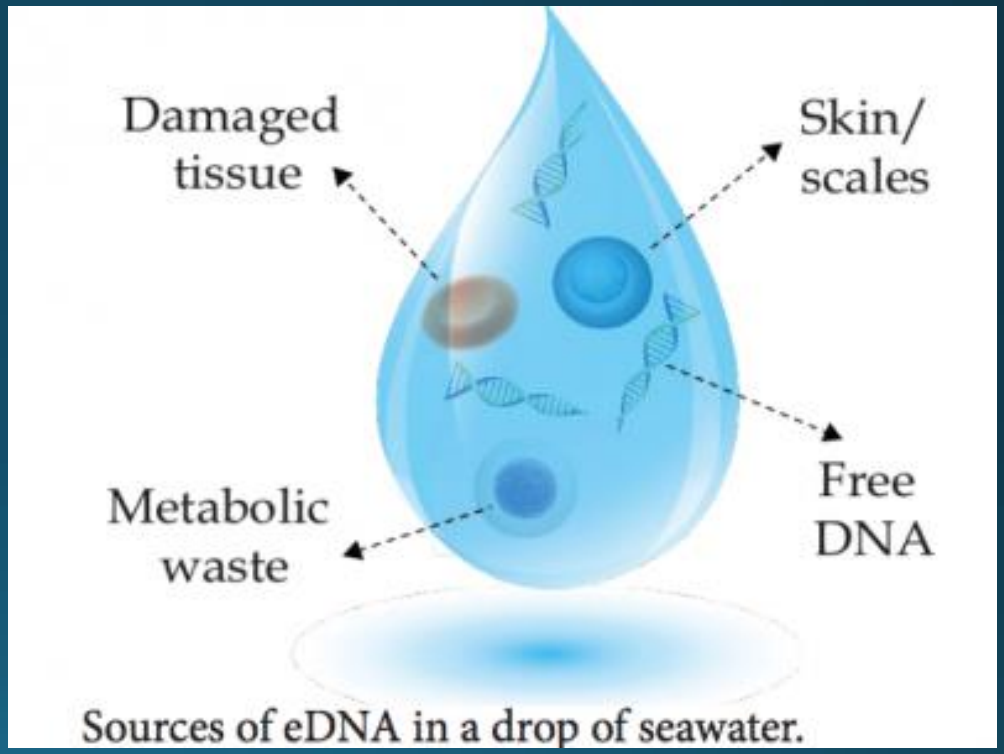
eDNA in the NAS Database



Sources of eDNA in a drop of seawater.

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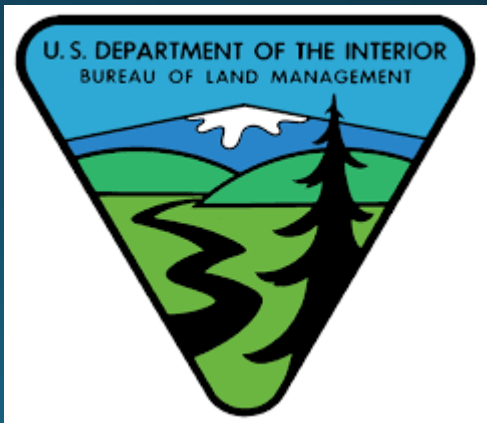
eDNA in the NAS Database

- First effort to aggregate **ALL** aquatic invasive species eDNA data in a single database
- Collaborative effort with:



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NAS's approach to adding eDNA

- Inform a State **first** of any eDNA sighting
- Development conservative minimum data standards to help guide eDNA monitoring and adding information into the Database
  - Based on consensus of agencies and experts
- Use an easy to interpret hierarchy of statuses to help understand what a positive eDNA sighting means
- Work closely with the eDNA community (Federal and State)

Regional townhall eDNA webinars

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- Wesley Daniel- Inverts, Mollusks, Herps, and Mammals

wdaniel@usgs.gov

- Amy Benson- Carps, Snakeheads and Dreissena mussels

abenson@usgs.gov

- Matthew Neilson- Fishes and Technical details

mneilson@usgs.gov

- Ian Pfingsten- Plants

ipfingsten@usgs.gov

- Cayla Morningstar- Mollusks

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- Jonathan Freedman- Fishes and Herps

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- Justin Procopio- Fishes and Crayfishes

jprocopio@contractor.usgs.gov

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@USGS_NAS

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Thank you!

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