Real-time monitoring and reporting of the leading edge of aquatic invasions: the USGS NAS Alert System

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Nonindigenous Aquatic Species Database (NAS)

- Central repository for spatially referenced biogeographic records of introduced aquatic species
  - Over 170,000 records for 1,050 spp.
  - Data from 1790 to present

http://nas.er.usgs.gov
Terminology

- **Nonindigenous** – any species introduced outside of its native range
  - Includes ‘exotics’ and ‘transplants’
  - No claims about invasiveness or value judgments
Organisms Tracked

- Aquatic organisms introduced to fresh, brackish, and marine waters of USA
High-profile species

- Zebra/quagga (*Dreissena*) mussels
- Lionfish (*Pterois volitans/miles*)
- Asian Tiger Shrimp (*Penaeus monodon*)
- Snakeheads (*Channa* spp.)
- Asian carps (Silver/Bighead) (*Hypophthalmichthys molitrix/nobilis*)
NAS Database Design

- Relational database (SQL Server)
  - 9 major tables
  - 60+ fields, including
    - Location information
    - Taxonomic information
    - Temporal information
    - Documentation/source of information
    - Pathway/Status information
NAS specimen records

- Capture basic information about NAS species sighting
  - What?
  - Where?
  - When?
Database services/capabilities

- Species-specific fact sheets
- Point mapping
- Web-based queries
Mapping

Disclaimer: Number of records does not imply species abundance. Recommended browsers are Firefox, Chrome and IE9 or above.
NAS Alert System

- Added in 2004
- Allow for timely notification of introductions into new areas
  - Email notification of new records in NAS database documenting range expansion
  - Taxonomic and region-based notifications
  - Users can customize amount of information received
NAS Alert System

- State Watch

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Please alert me when:

any nonindigenous species is found in a new area in the following states:

- Alabama
- Alaska
- Arizona
- Arkansas
- California
- Colorado
- Connecticut
- Delaware
- District of Columbia
- Florida
- Georgia
- Hawaii
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Kentucky
- Louisiana
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Mississippi
- Missouri
- Montana
- Nebraska
- Nevada
- New Hampshire
- New Jersey
- New Mexico
- New York
- North Carolina
- North Dakota
- Ohio
- Oklahoma
- Oregon
- Pennsylvania
- Puerto Rico
- Rhode Island
- South Carolina
- South Dakota
- Tennessee
- Texas
- Utah
- Vermont
- Virgin Islands
- Virginia
- Washington
- West Virginia
- Wisconsin
- Wyoming

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Regions: New England, Mid-Atlantic, South, Midwest, Southwest, West
Costal: Atlantic, Gulf of Mexico, Pacific, Great Lakes
NAS Alert System

- State Watch
- Group Watch

Please alert me when a nonindigenous species from the following group(s) is found for the first time in the United States, or is found in a new area (state, huc8, or county):

- Amphibians-Frogs
- Amphibians-Salamanders
- Fishes
- Mammals
- Reptiles-Crocodilians
- Reptiles-Lizards
- Reptiles-Nakes
- Reptiles-Turtles
- Annelids-Oligochaetes
- Annelids-Polychaetes
- Coelenterates-Anthozoan
- Coelenterates-Hydrozoan
- Coelenterates-Scyphozoan
- Crustaceans-Amphipods
- Crustaceans-Barnacles
- Crustaceans-Cladocerans
- Crustaceans-Copepods
- Crustaceans-Crustaceans
- Crustaceans-Crustaceans-Crayfish
- Crustaceans-Isopods
- Crustaceans-Lobsters
- Crustaceans-Ostracods
- Crustaceans-Mysids
- Crustaceans-Plankton
- Crustaceans-Shrimp
- Mollusks-Bivalves
- Mollusks-Gastropods
- Mollusks-Nudibranchs
- Mollusks-Cephalopods
- Nematodes
- Polyplacophors
- Sponges
- Tunicates
- Plants
NAS Alert System

- State Watch
- Group Watch
- Species Watch

Please alert me when

These specific species expand their range (into a new state, a new drainage (HUC8), or new county within a state)

- **Northern Snakehead** *(Channa argus)*
- **Black Carp** *(Mylopharyngodon piceus)*
- **Silver Carp** *(Hypophthalmichthys molitrix)*
- **Bighead Carp** *(Hypophthalmichthys nobilis)*
- **Round Goby** *(Neogobius melanostomus)*
- **Zebra Mussel** *(Dreissena polymorpha)*
- **Quagga Mussel** *(Dreissena rostriformis bugensis)*
- **Ruffe** *(Gymnocephalus cernuus)*
- **Lionfish** *(Pterois volitans/miles)*
The 10 most recent alerts are available at Alert Archive.

Total of 1284 alerts match your criteria. Click on the link to get details about the collection.

<table>
<thead>
<tr>
<th>Date</th>
<th>Species</th>
<th>New Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/16/2014</td>
<td>Pimeleid hybrid catfish</td>
<td>Country: US</td>
</tr>
<tr>
<td></td>
<td>Phractocephalus hemiolopterus x Pseudoplatusoma x</td>
<td>State: MO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>County: St. Genevieve (MO)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drainage: Cahokia-Joachim</td>
</tr>
<tr>
<td>7/14/2014</td>
<td>Black Carp</td>
<td>County: Lauderdale (TN)</td>
</tr>
<tr>
<td></td>
<td>Mylopharyngodon piceus</td>
<td></td>
</tr>
<tr>
<td>7/7/2014</td>
<td>zebra mussel</td>
<td>Drainage: Redeye (7010107)</td>
</tr>
<tr>
<td></td>
<td>Dreissena polymorpha</td>
<td></td>
</tr>
<tr>
<td>7/7/2014</td>
<td>Grass Carp</td>
<td>County: Gallis (OH)</td>
</tr>
<tr>
<td></td>
<td>Ctenopharyngodon idella</td>
<td>Drainage: Raccoon-Symmes (5990101)</td>
</tr>
<tr>
<td>7/7/2014</td>
<td>Grass Carp</td>
<td>County: McHenry (IL)</td>
</tr>
<tr>
<td></td>
<td>Ctenopharyngodon idella</td>
<td></td>
</tr>
<tr>
<td>7/1/2014</td>
<td>zebra mussel</td>
<td>County: Wright (IA)</td>
</tr>
<tr>
<td></td>
<td>Dreissena polymorpha</td>
<td>Drainage: Boone (7100005)</td>
</tr>
<tr>
<td>&quot;Bonus&quot;</td>
<td>quagga mussel</td>
<td>State: CA</td>
</tr>
<tr>
<td></td>
<td>Dreissena rostriformis bugensis</td>
<td></td>
</tr>
<tr>
<td>7/1/2014</td>
<td>quagga mussel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dreissena rostriformis bugensis</td>
<td></td>
</tr>
</tbody>
</table>
Broadcast via Twitter

The Nonindigenous Aquatic Species (NAS) Program provides a central repository for spatially referenced biogeographic accounts of introduced aquatic species.

Joined June 2011
NAS Alert System

Report received

Record entered into database

Program searches database(s) for previous records of the species in the same:

- Country
- County
- State
- HUC (drainage)

New area of occurrence

Collection >2 years ago

Internal Alert only

Collection <2 years ago

Enters Alert System

"False Alert"

"Alert Worthy"

Record too old

No alert generated

Alert sent

Alert added to archive
System users/subscribers

- 882 current subscribers (1860 over system lifetime)

- Who uses the system?

- What information are they interested in:
  - States?
  - Species/taxonomic groups?
Wide diversity of users

User Affiliations

Percent of total subscribers (N = 882)

- @gmail.com = 70
- @fws.gov = 46
- @yahoo.com = 44
- @usgs.gov = 37
- @nps.gov = 35
User interests
States

Subscribers by State

- California: 185
- Florida
- New York
- Pennsylvania
- Oregon
- Texas
- Washington
- Louisiana
- Alabama
- Wisconsin

Number of Subscribers

130, 140, 150, 160, 170, 180, 190
Species

Subscribers by Species

- Zebra Mussel: 323
- Northern Snakehead: 264
- Black Carp: 229
- Silver Carp: 228
- Bighead Carp: 226
- Round Goby: 202
- Ruffe: 188
- Quagga Mussel: 155
- Lionfish: 97
Taxonomic groups

Subscribers by Taxonomic Group

- Fishes: 317
- Mollusks
- Crustaceans
- Amphibians
- Reptiles
- Mammals
- Plants
- Coelenterates
- Annelids
- Tunicates
Alerts

- 1455 alerts sent through system over its lifetime (up to 2014-07-01)

- Basic overview of sent alerts:
  - Geographic hierarchy
  - Taxonomy
  - Source
Geographic hierarchy of alerts
Geographic hierarchy of alerts

![Bar chart showing the number of alerts by geographic level from 2004 to 2014.]

- **Country (n = 47)**: 63, 116, 98, 266, 155, 175, 166, 146, 121, 106, 43
- **State (n = 258)**: 116, 98, 266, 155, 175, 166, 146, 121, 106, 43
- **Drainage (n = 799)**: 98, 266, 155, 175, 166, 146, 121, 106, 43
- **County (n = 279)**: 266, 155, 175, 166, 146, 121, 106, 43
- **Bonus (n = 72)**: 266, 155, 175, 166, 146, 121, 106, 43
Source vectors of alerts
Alert taxonomy
Information sources of alerts

![Alert Sources](image)

- Personal communication: 974
- News: 206
- Database: 67
- Specimen: 52
- Report: 50
- Journal Article: 48
- Web Page: 36
- Other literature: 22

Percent of total alerts ($N = 1455$)
Summary

- The NAS Database Alert System provides timely and rapid information on novel introductions and range expansions
  - To a wide user audience
  - Across a wide range of taxonomic and geographic interests
For more information, registration, or to report sightings:

http://nas.er.usgs.gov