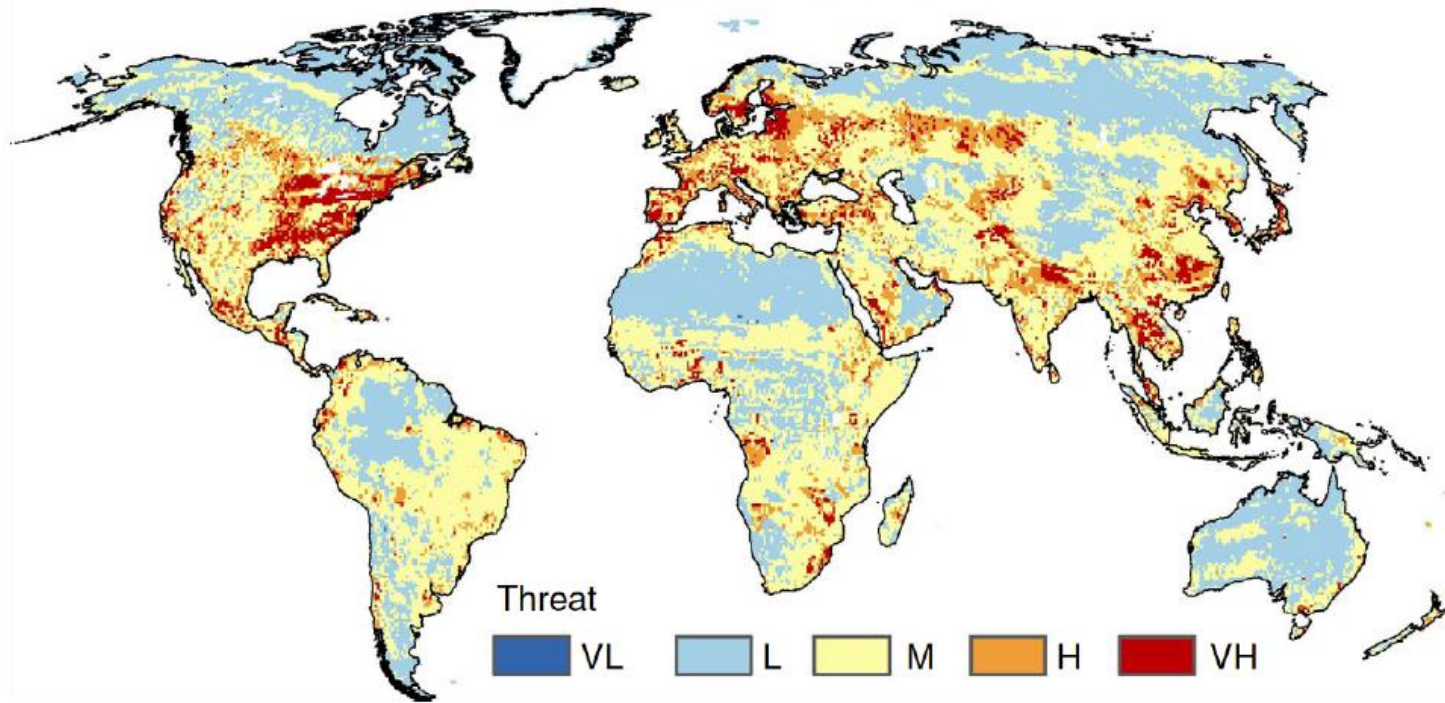


Be AIS AWARE: Mapping AIS Mayhem

Threat from invasive species





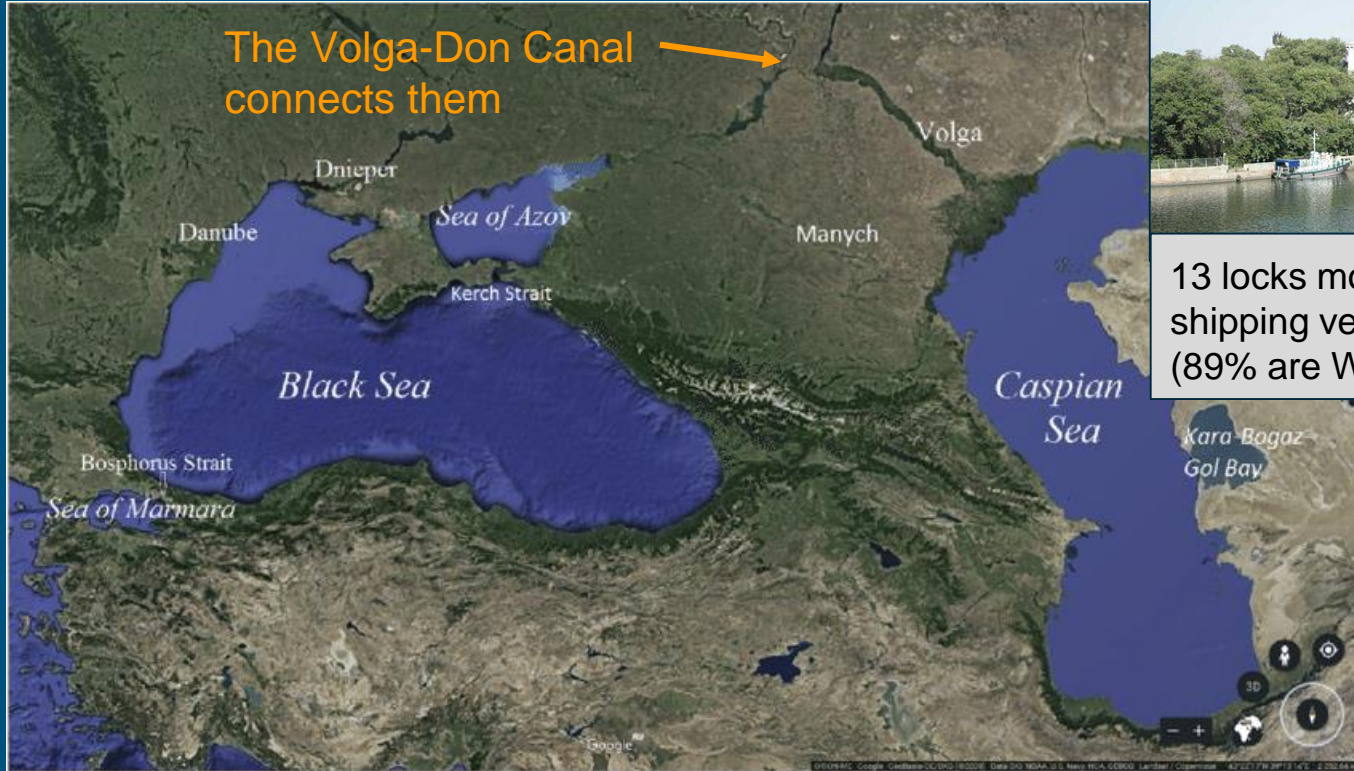
WHERE are zebra and quagga mussels native?

Make a prediction...





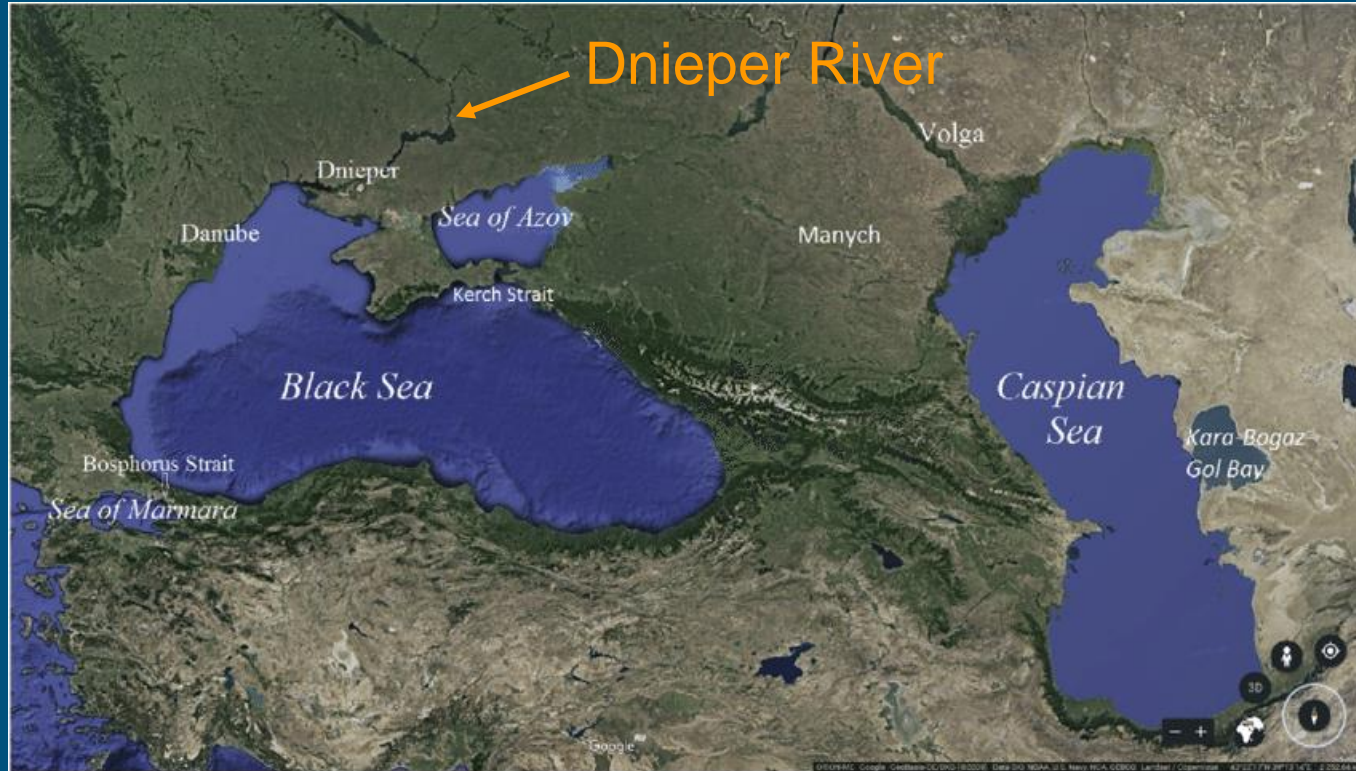
Zebra mussels are native to the Black, Caspian, and Azov Seas



13 locks move the shipping vessels (89% are WESTWARD)

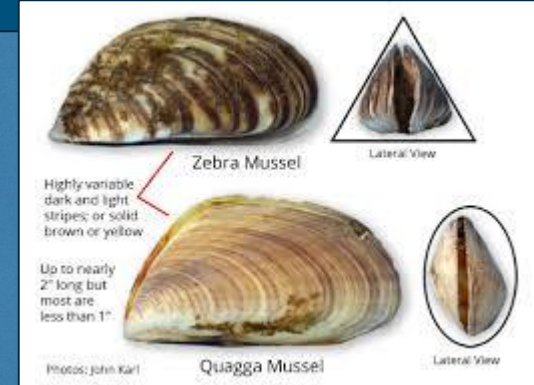
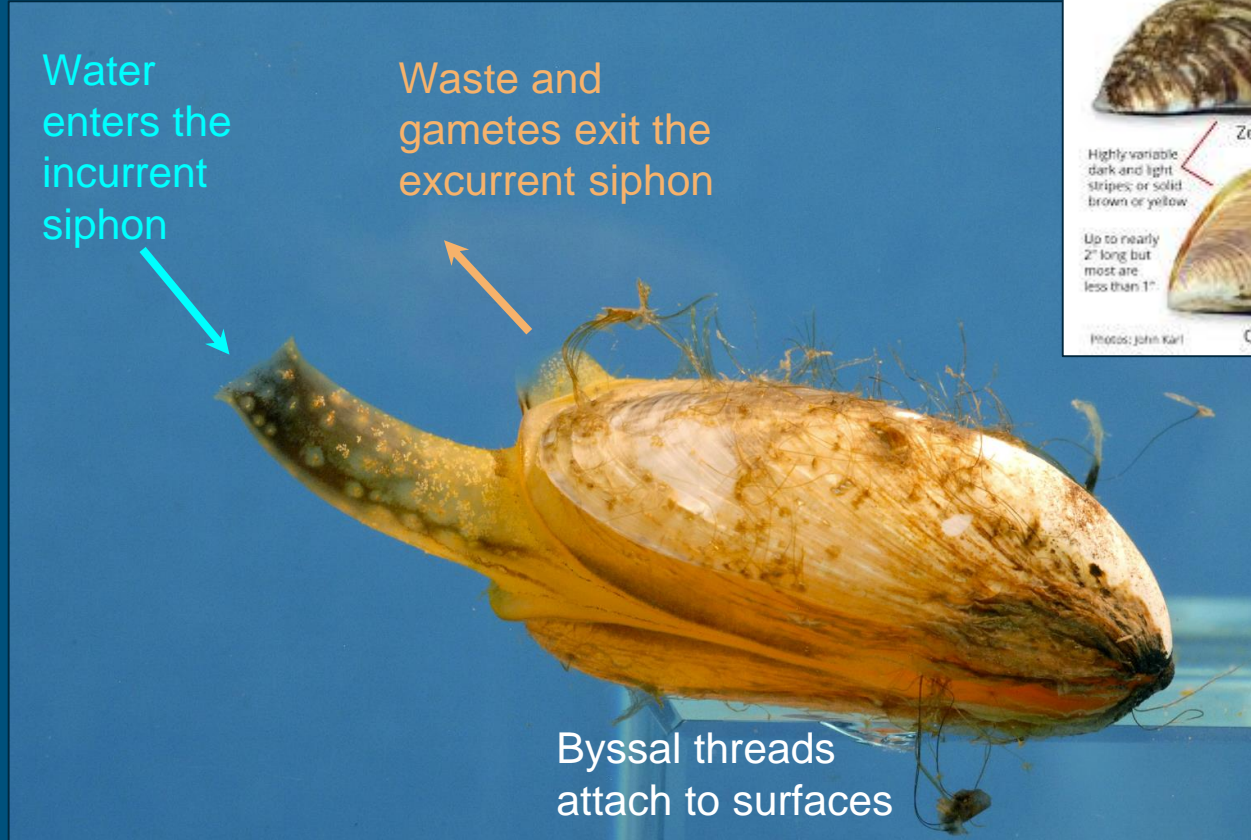


Quagga mussels are native to the Dneiper River



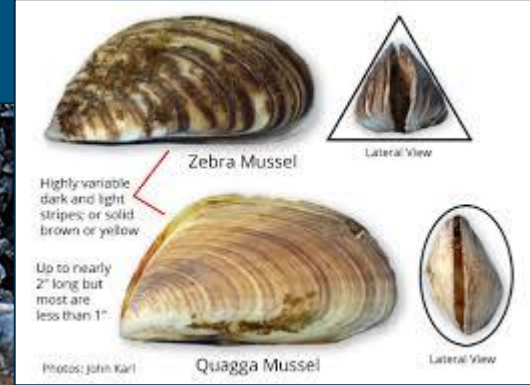


WHAT makes these mussels so invasive?





WHAT makes these mussels so invasive?





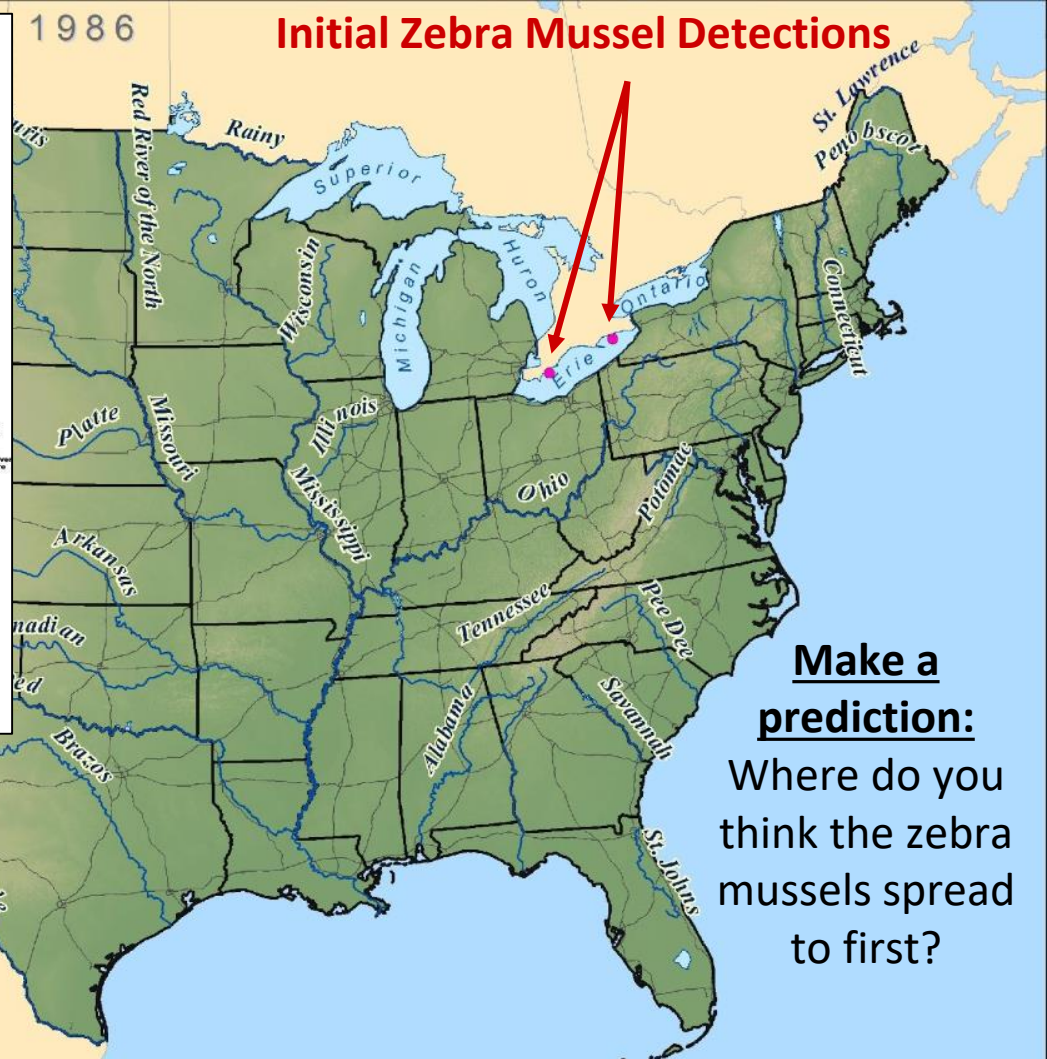
How did the invasive mussels get to the United States?



Cargo ships
released
contaminated ballast
water into the Great
Lakes!

1986

Initial Zebra Mussel Detections



Make a prediction:

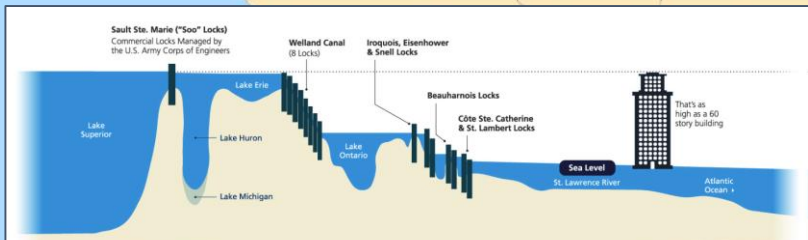
Where do you think the zebra mussels spread to first?



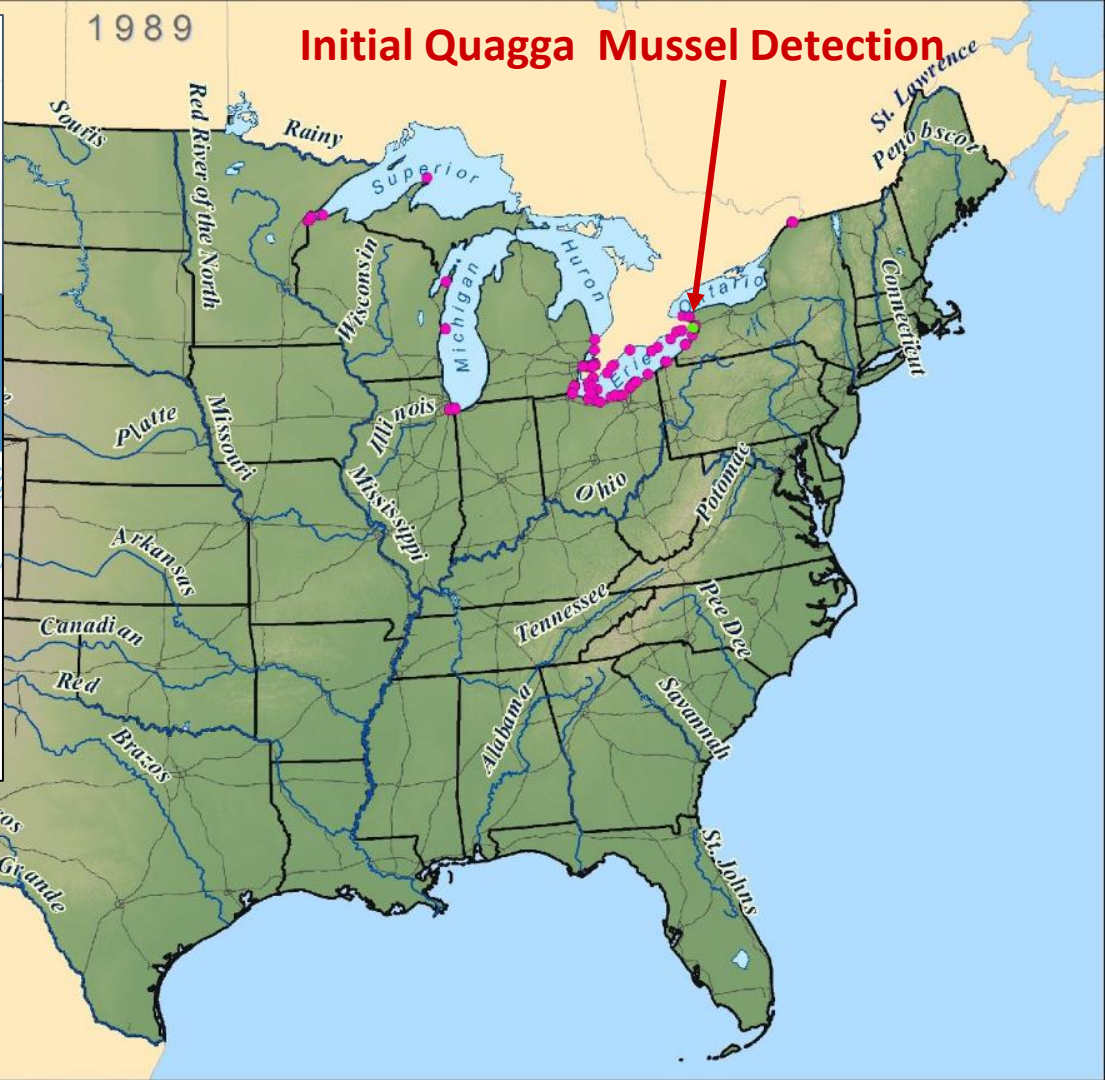
- Zebra Mussel
- Quagga Mussel

1989

Initial Quagga Mussel Detection



- Zebra Mussel
- Quagga Mussel



1990

- Zebra Mussel
- Quagga Mussel



**Where did the
invasive mussels
actually spread
to initially?**

1991

5 years later...

- Zebra Mussel
- Quagga Mussel



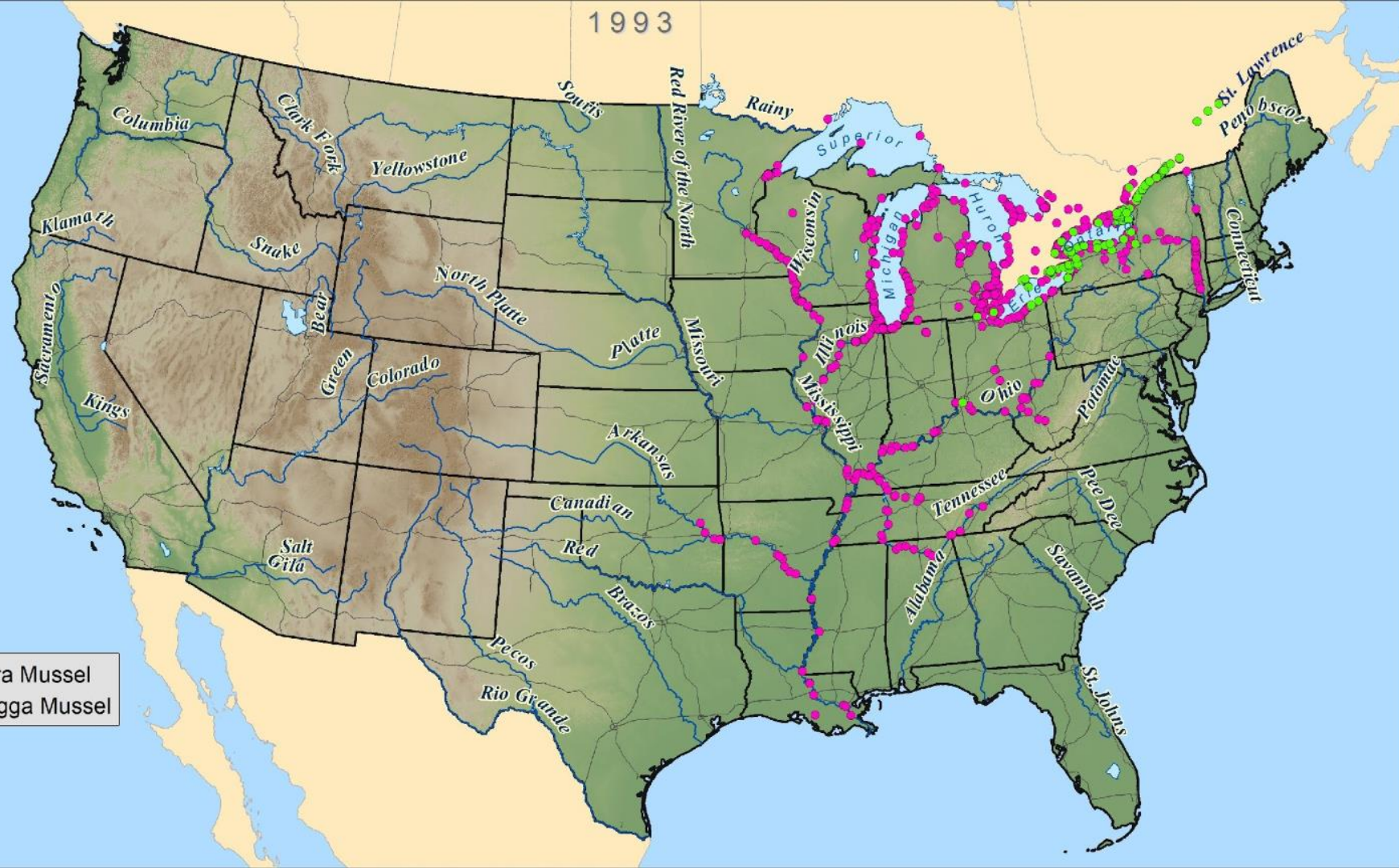
1992

- Zebra Mussel
- Quagga Mussel



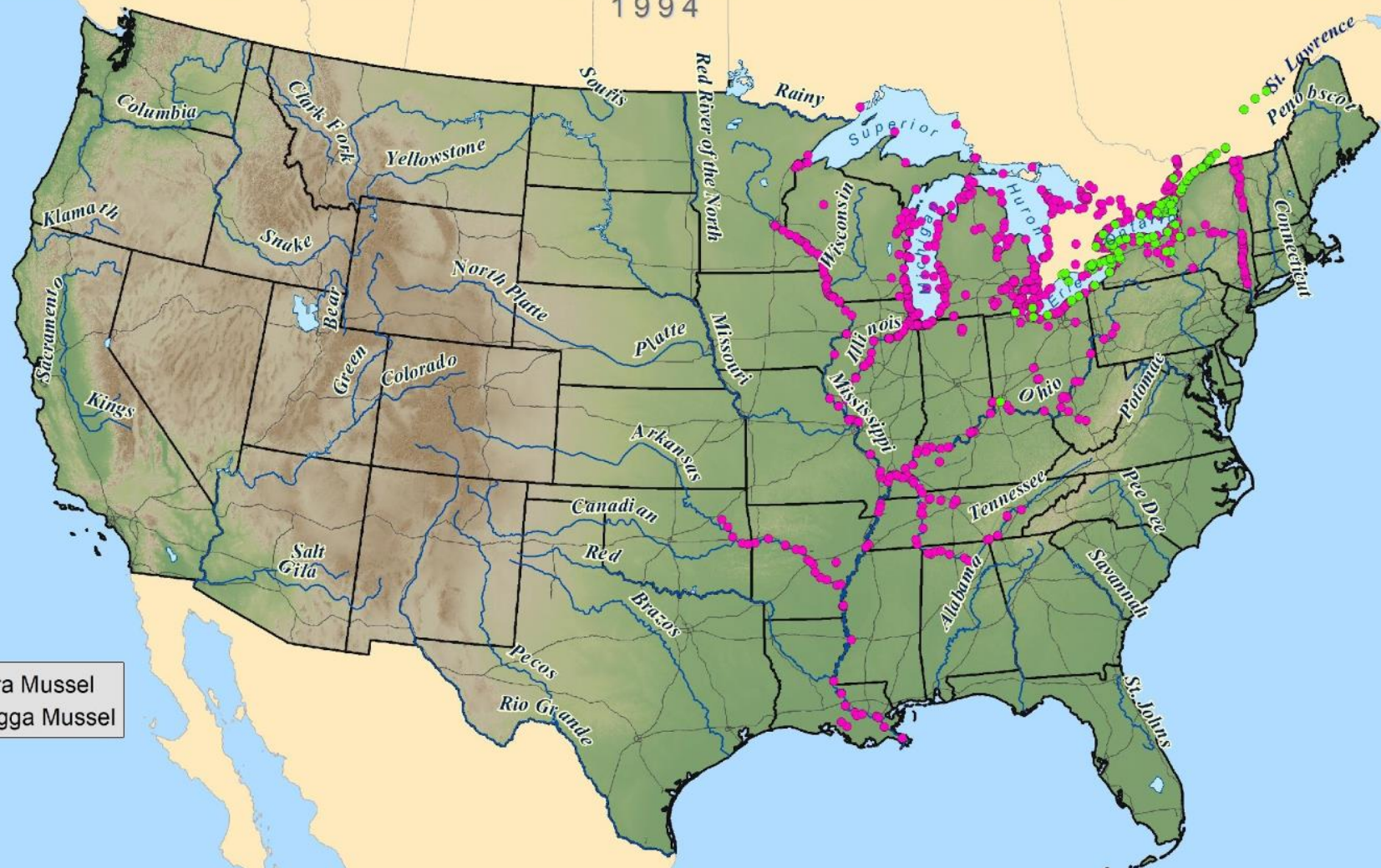
1993

- Zebra Mussel
- Quagga Mussel



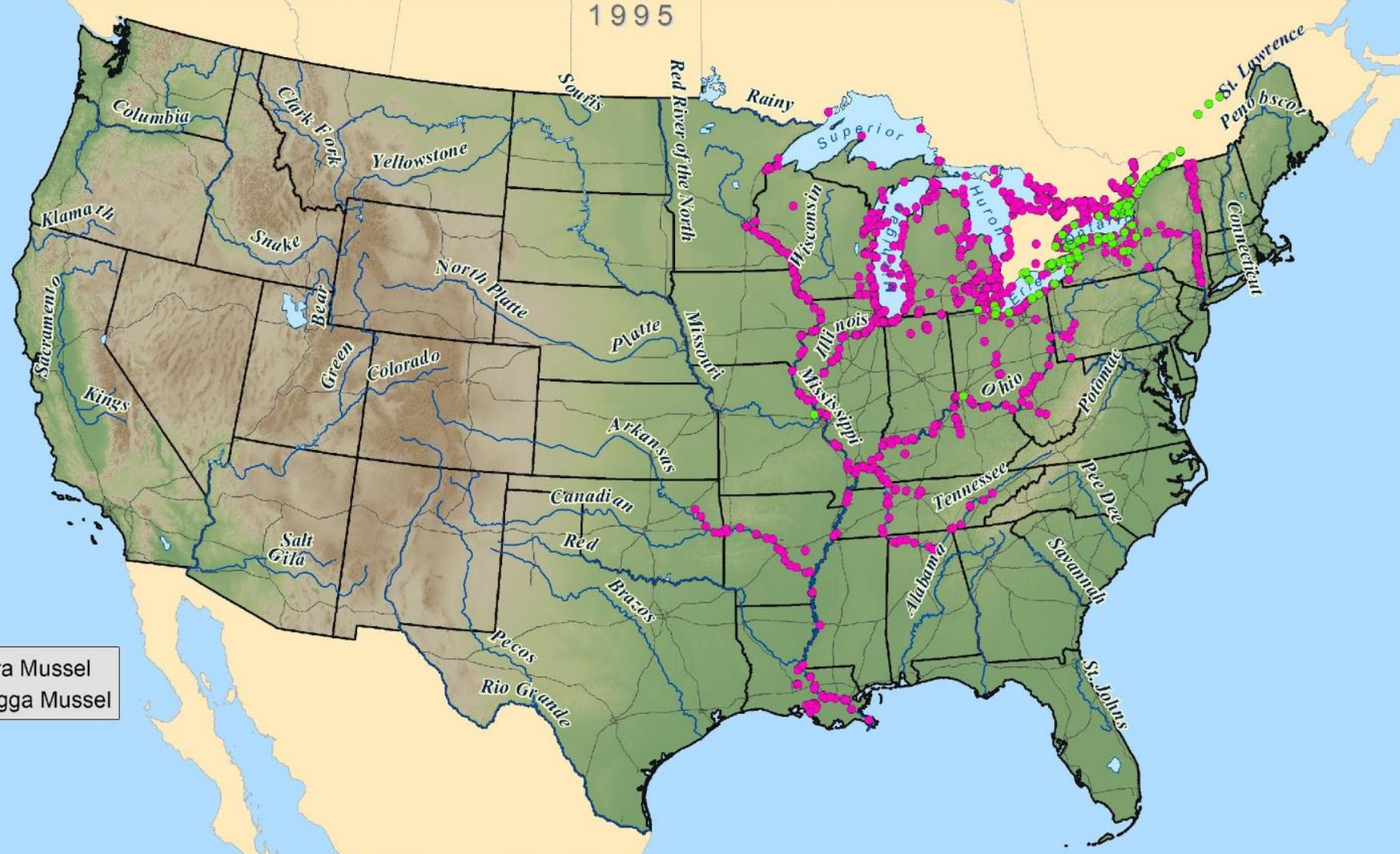
1994

- Zebra Mussel
- Quagga Mussel



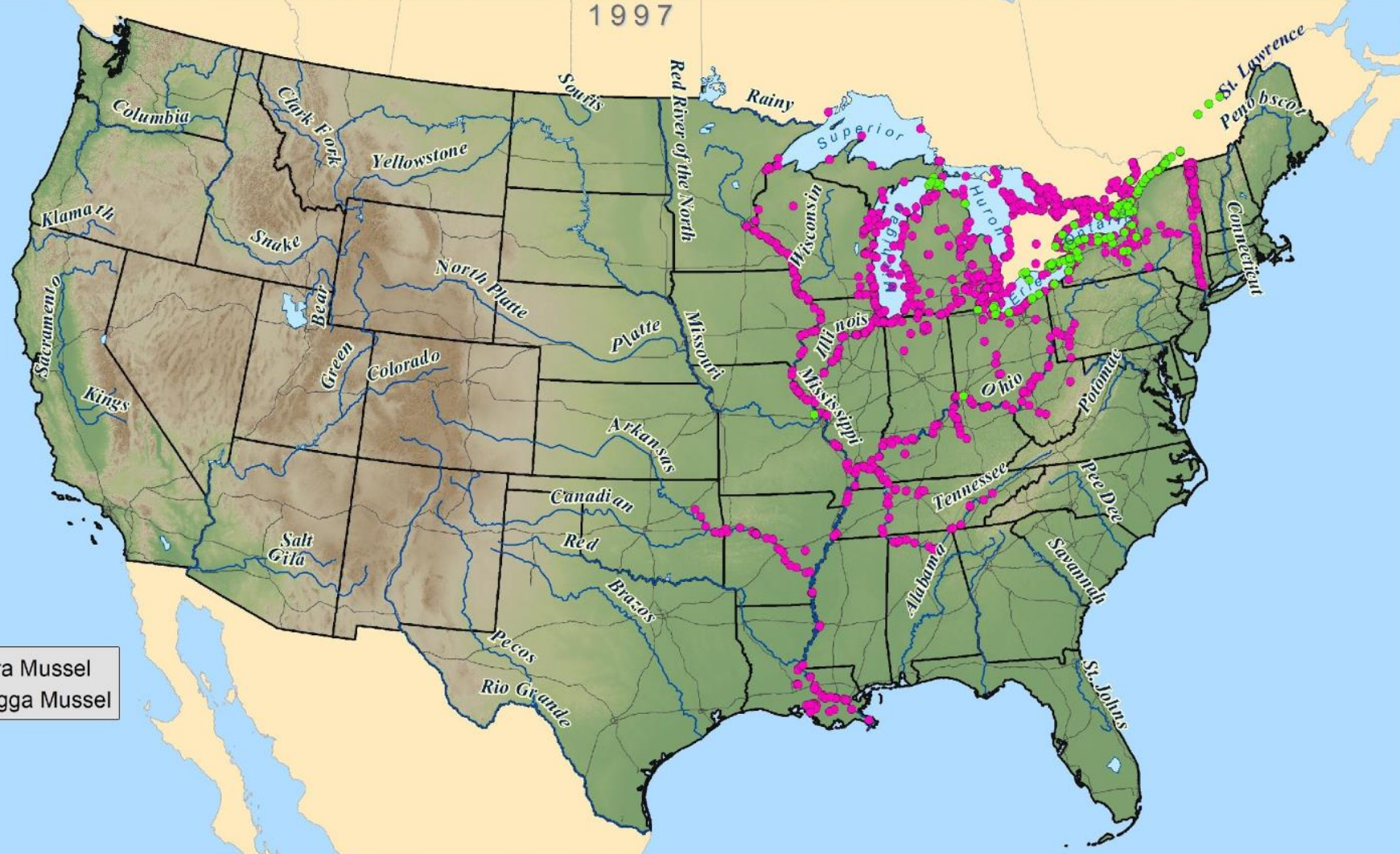
1995

- Zebra Mussel
- Quagga Mussel



1997

- Zebra Mussel
- Quagga Mussel



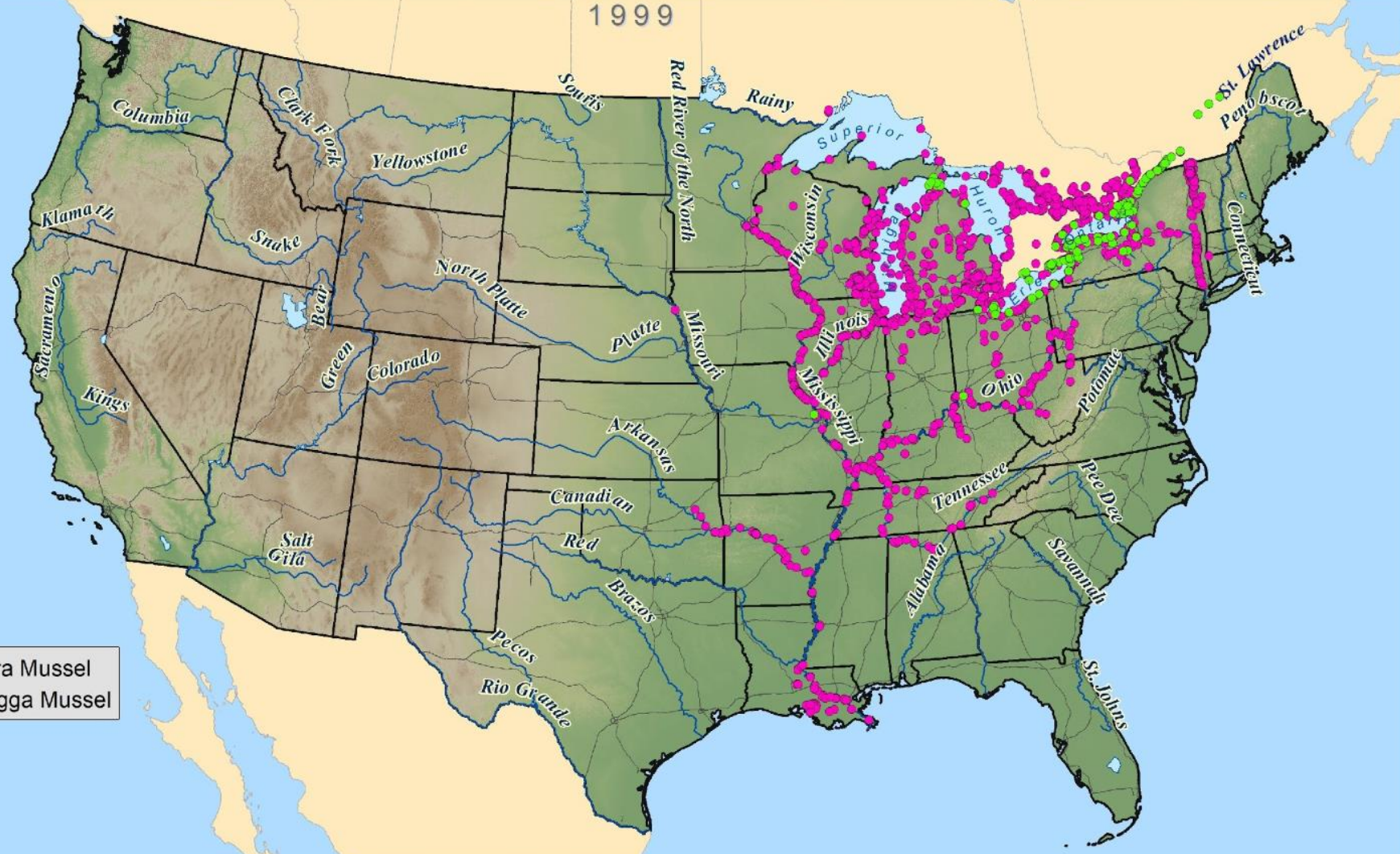
1998

- Zebra Mussel
- Quagga Mussel

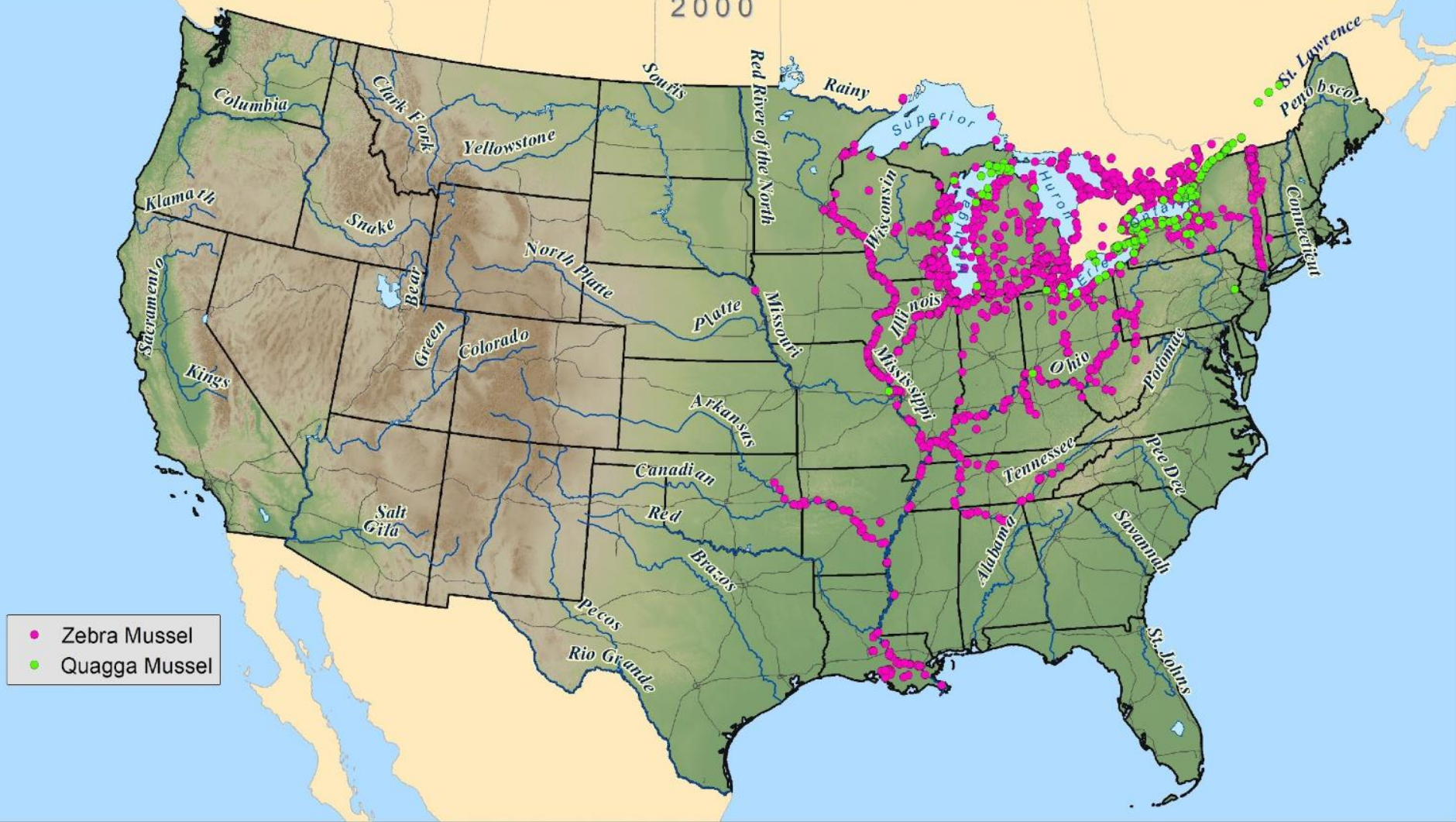


1999

- Zebra Mussel
- Quagga Mussel



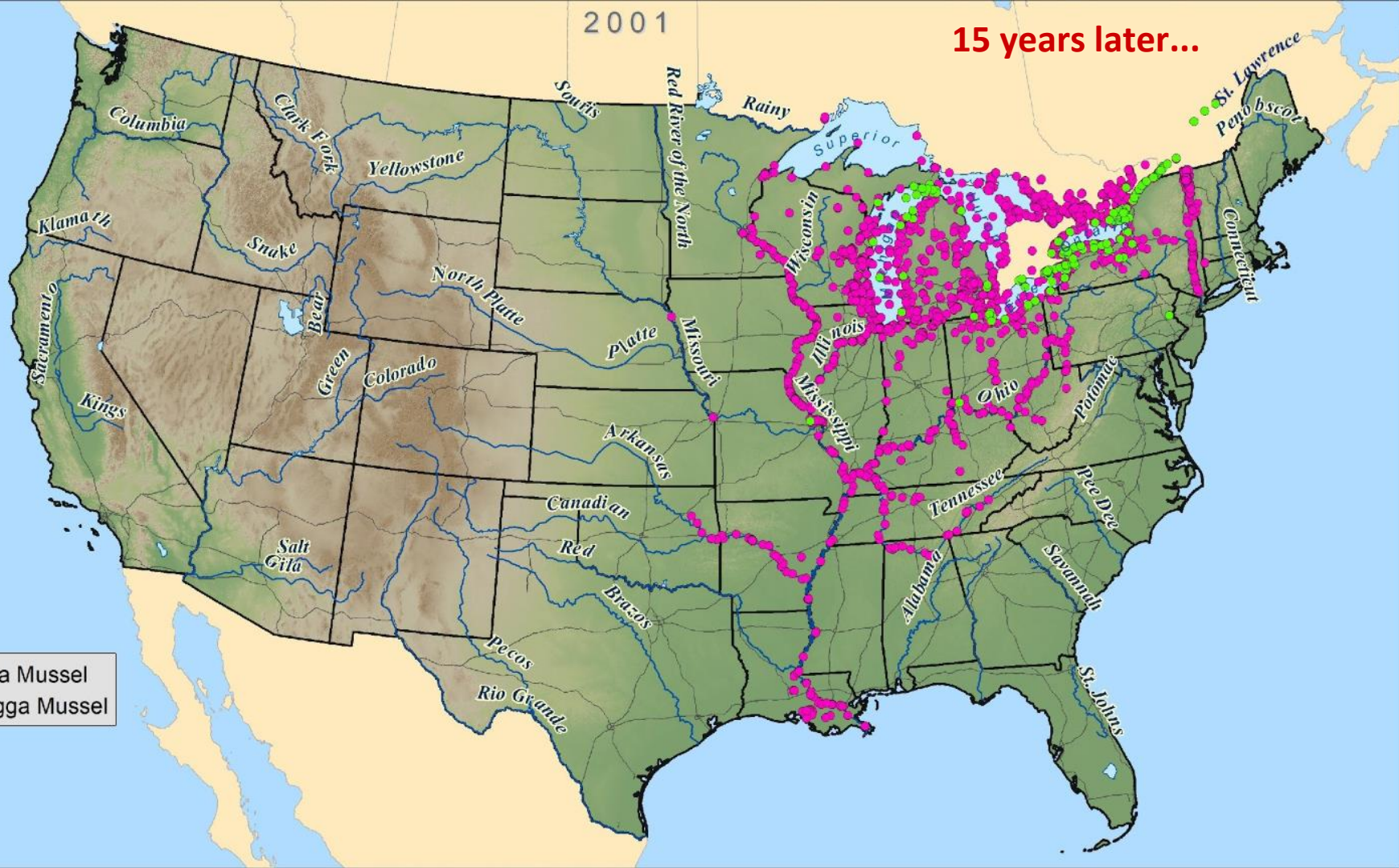
2000



2001

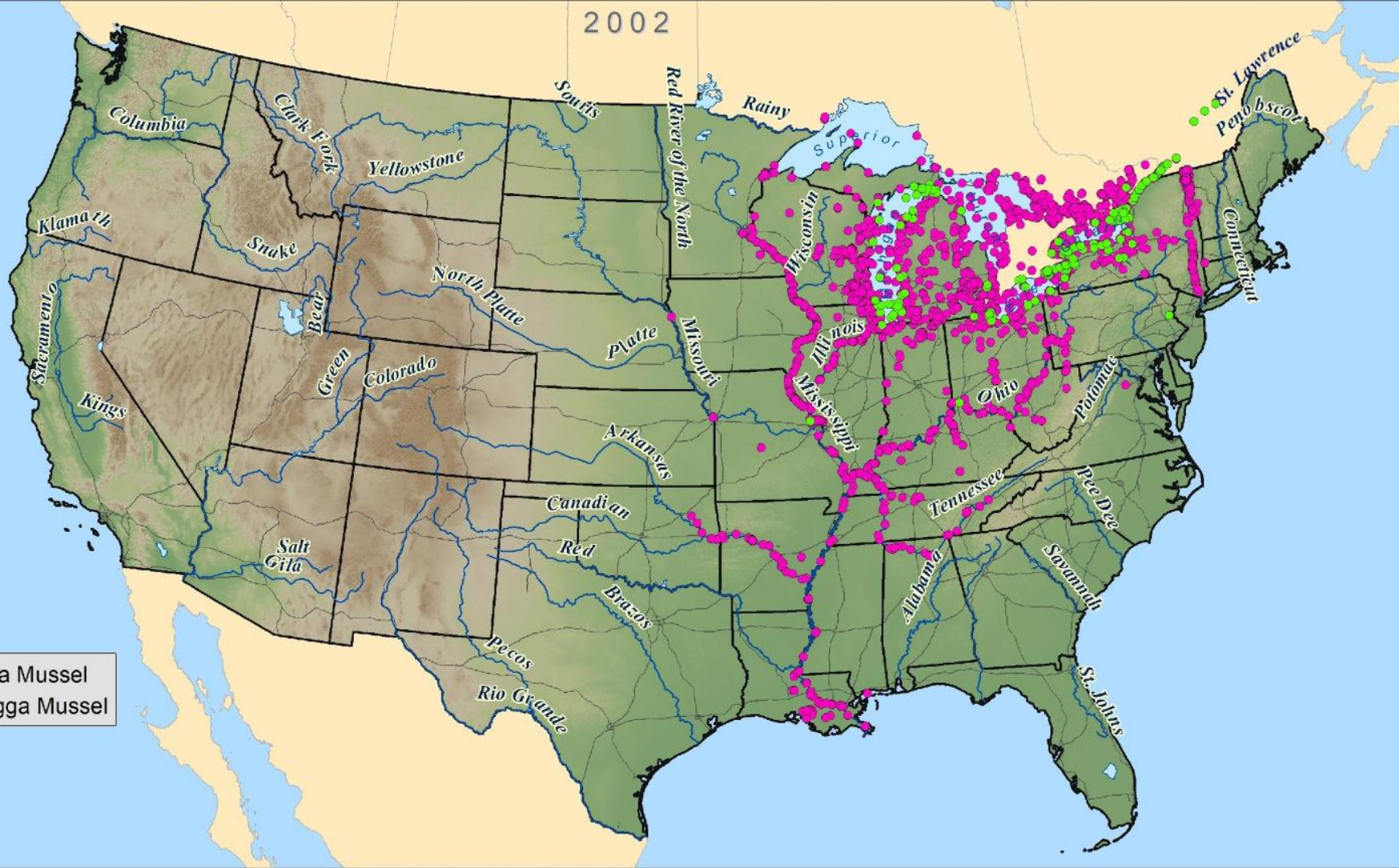
15 years later...

- Zebra Mussel
- Quagga Mussel

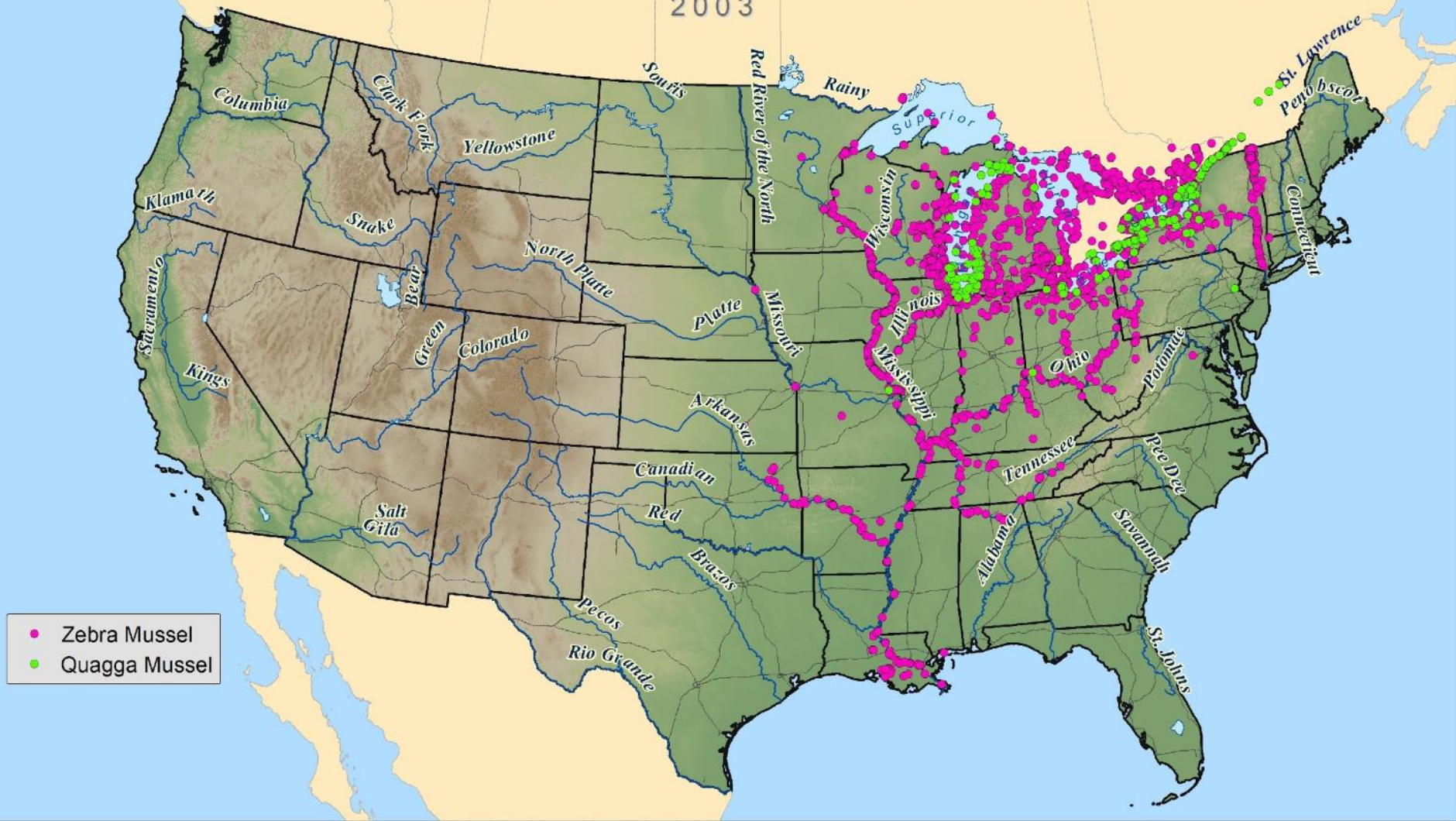


2002

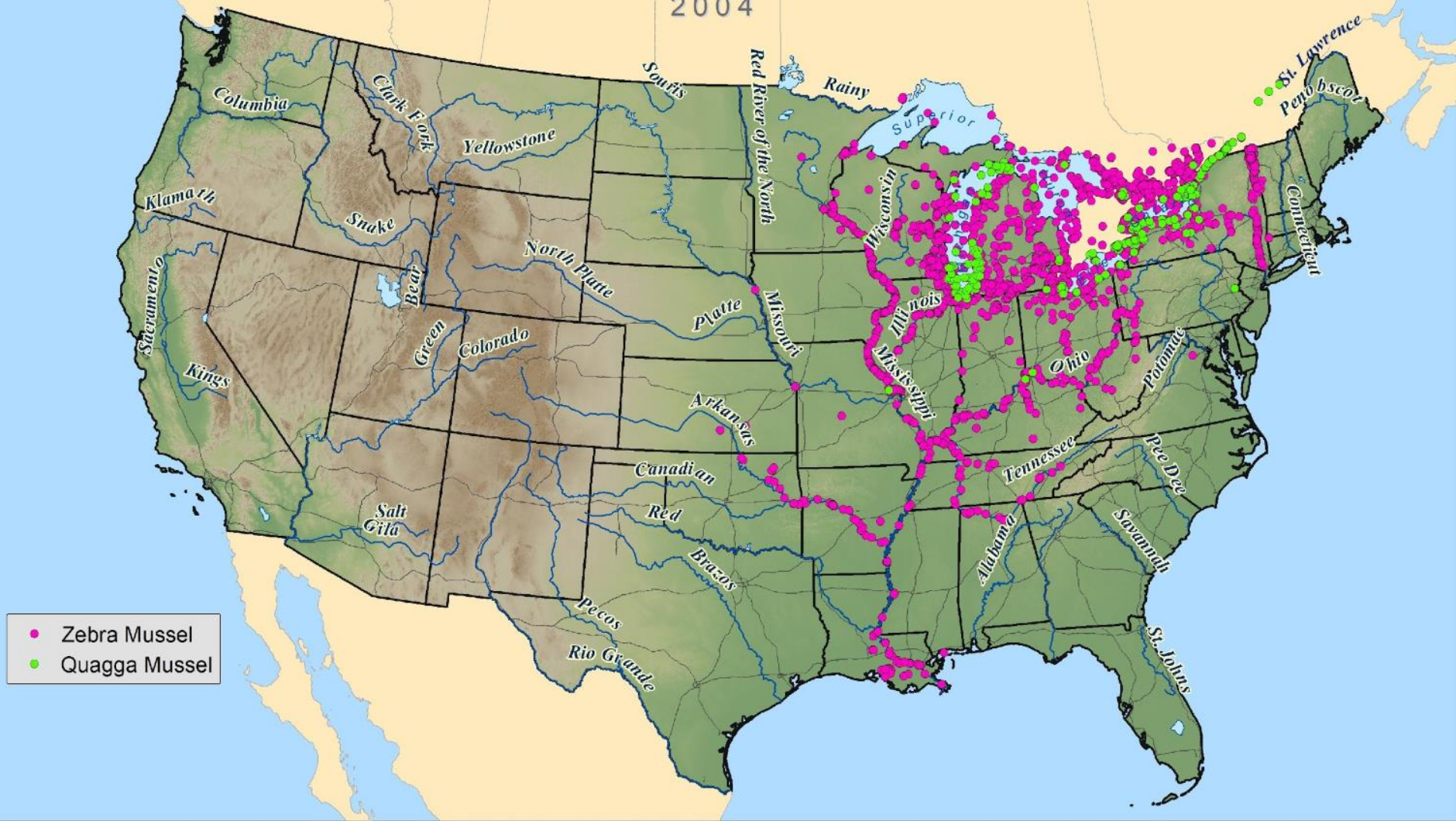
- Zebra Mussel
- Quagga Mussel



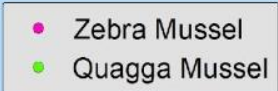
2003



2004



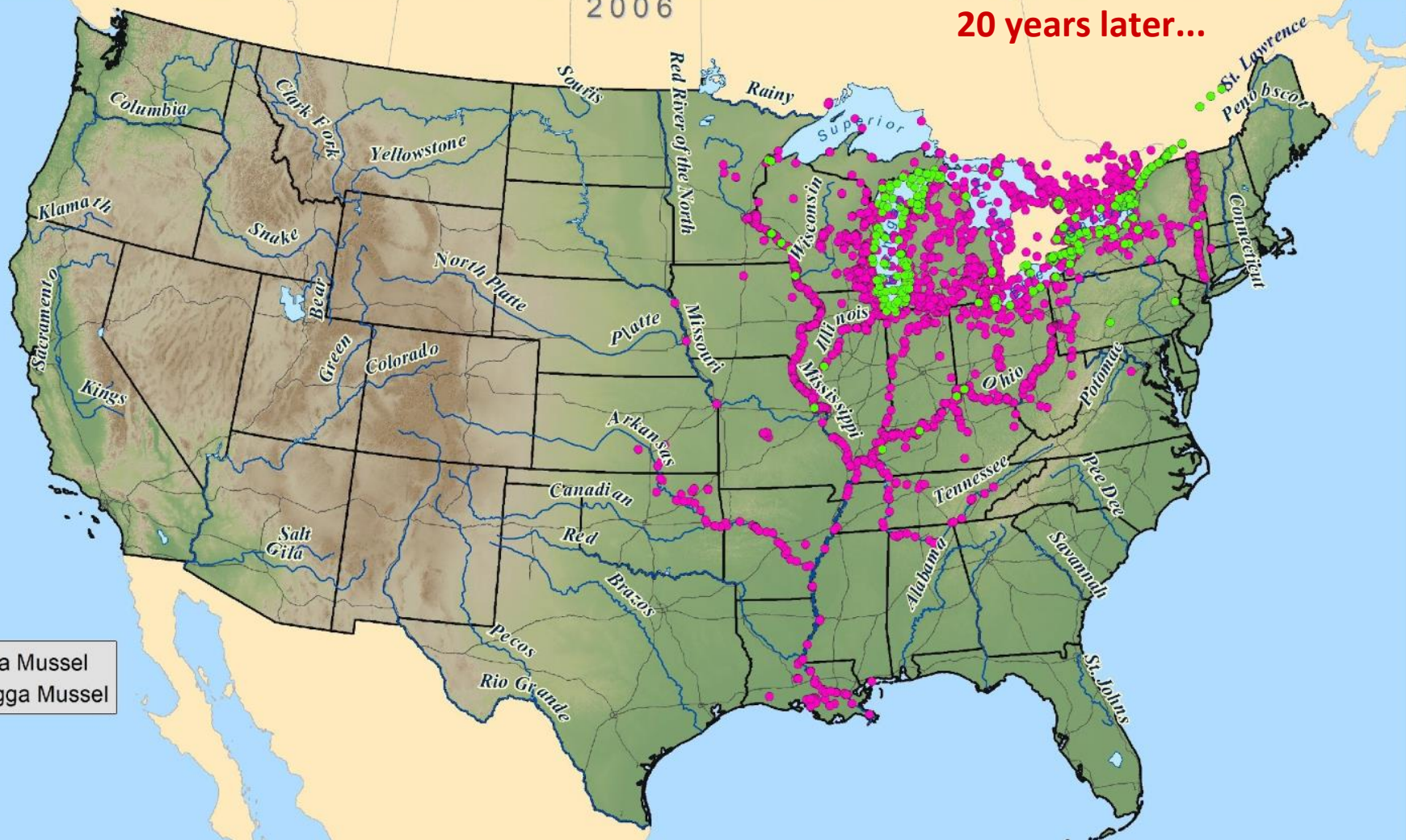
2005



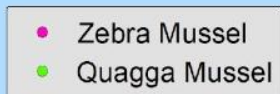
2006

20 years later...

- Zebra Mussel
- Quagga Mussel



2007
They crossed the continental divide! 21 years later...



**30-second
brainstorm...**

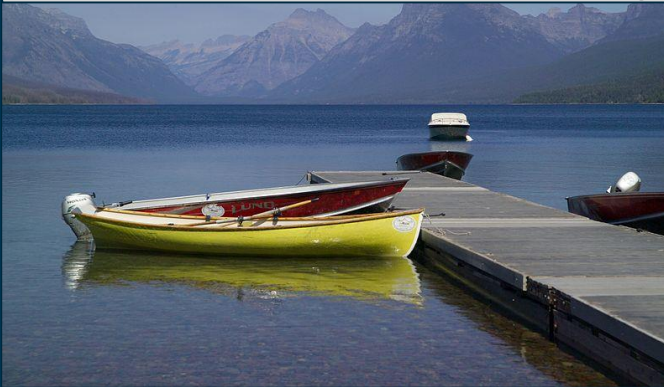
List the ways in which invasive mussels can move and spread to new areas?



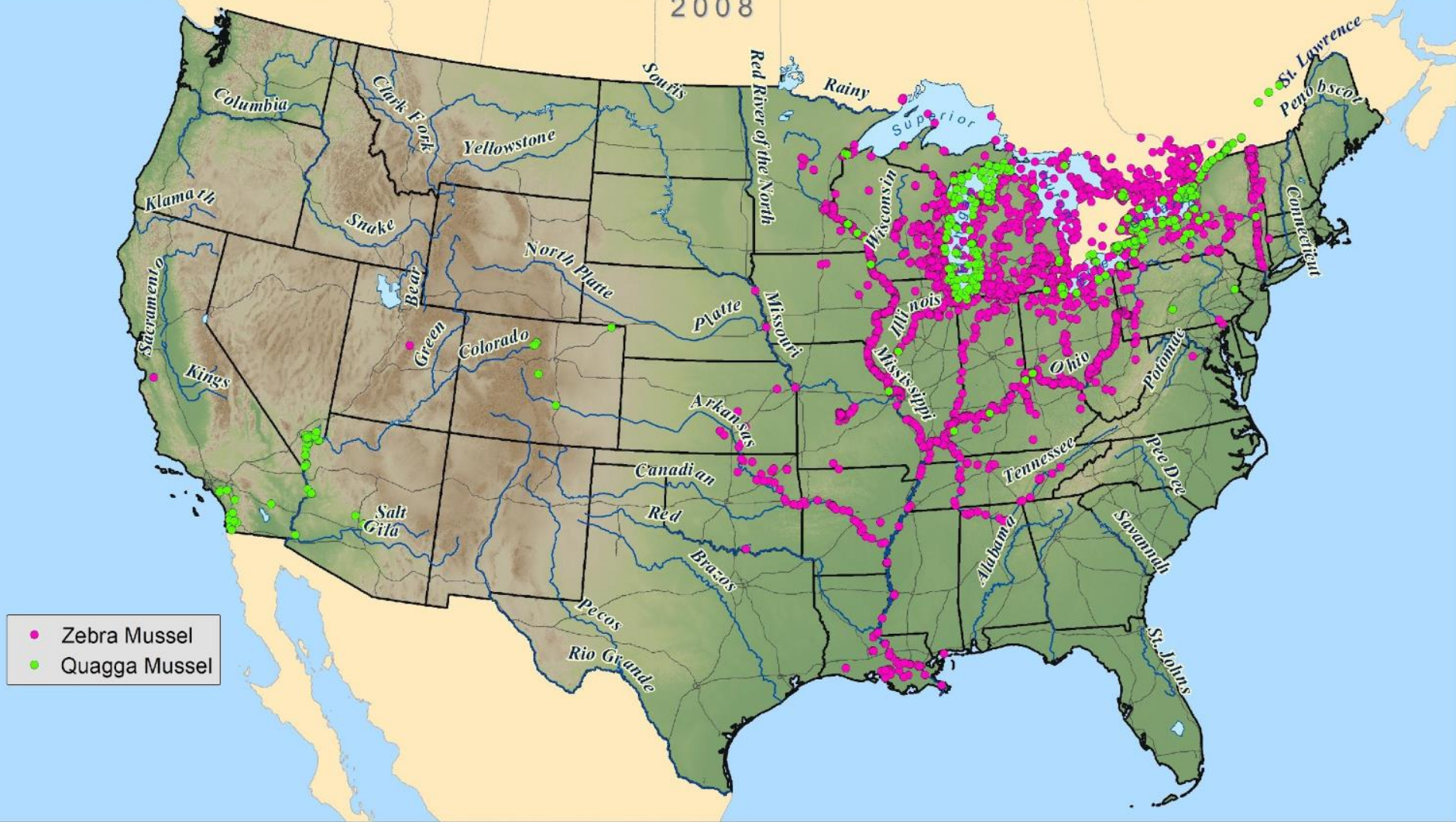
How Do Invasive Mussels Spread?



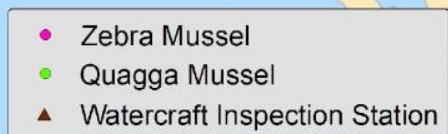
What do all of these photos have in common?



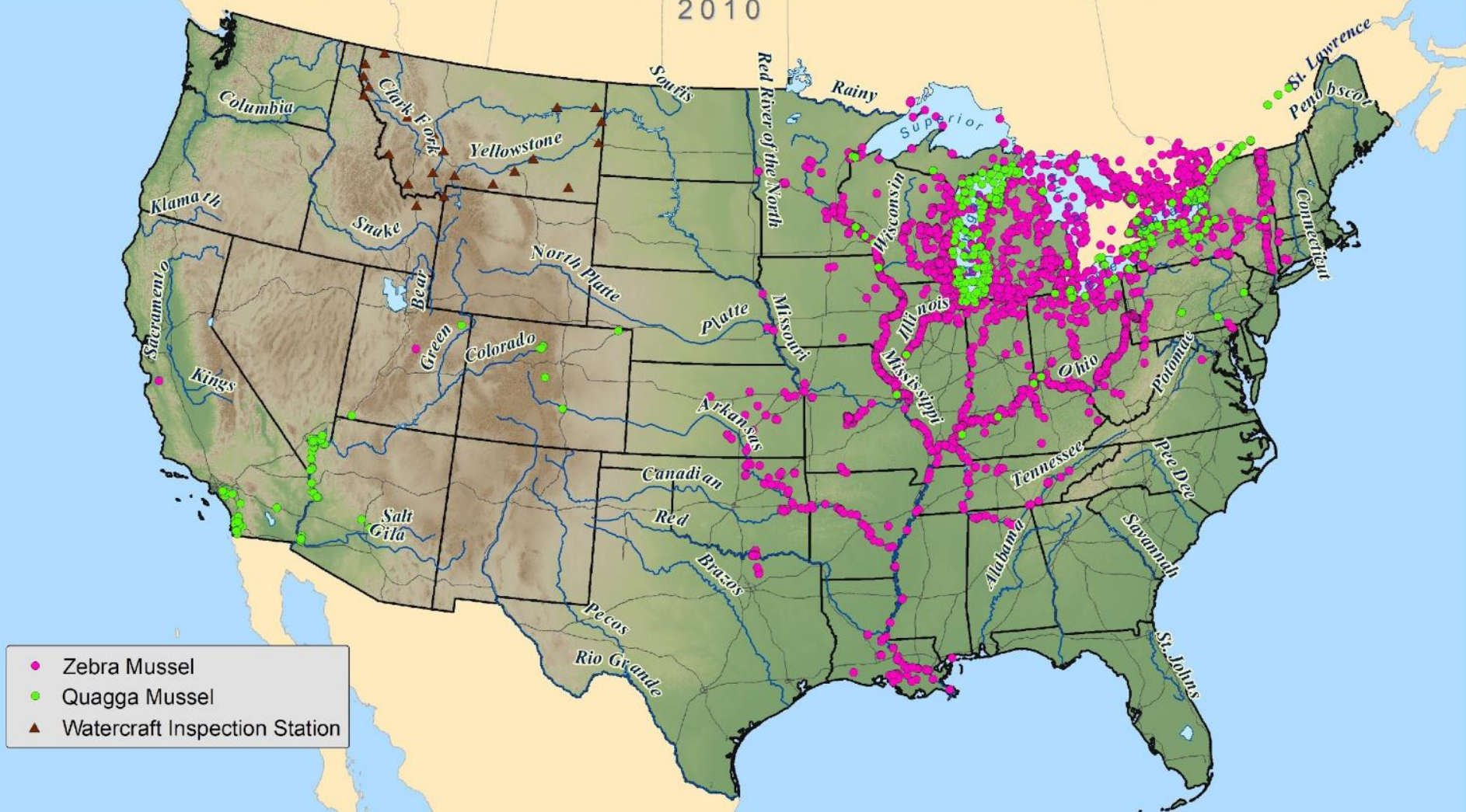
2008



Inspection stations appear in the northwest!

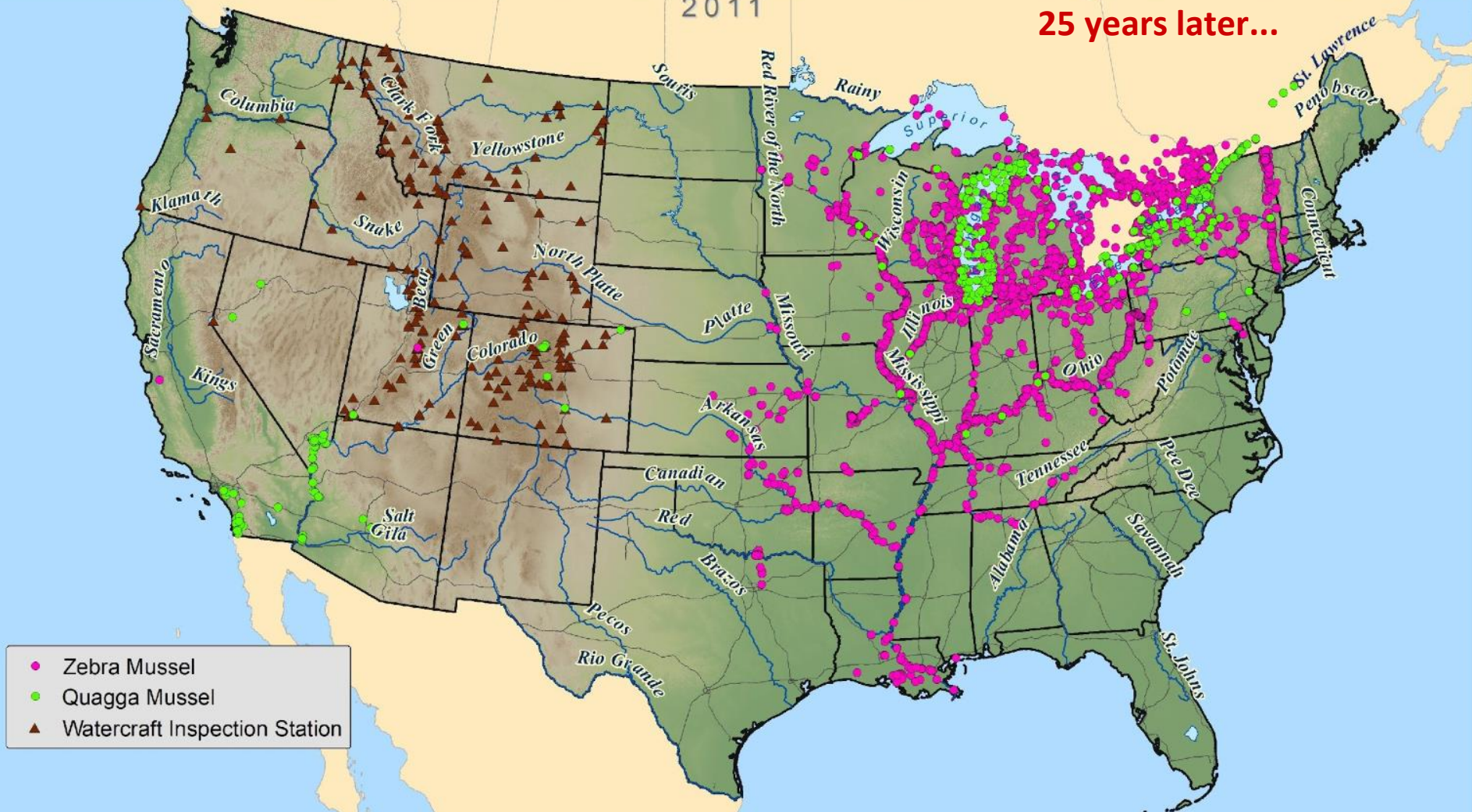


2010

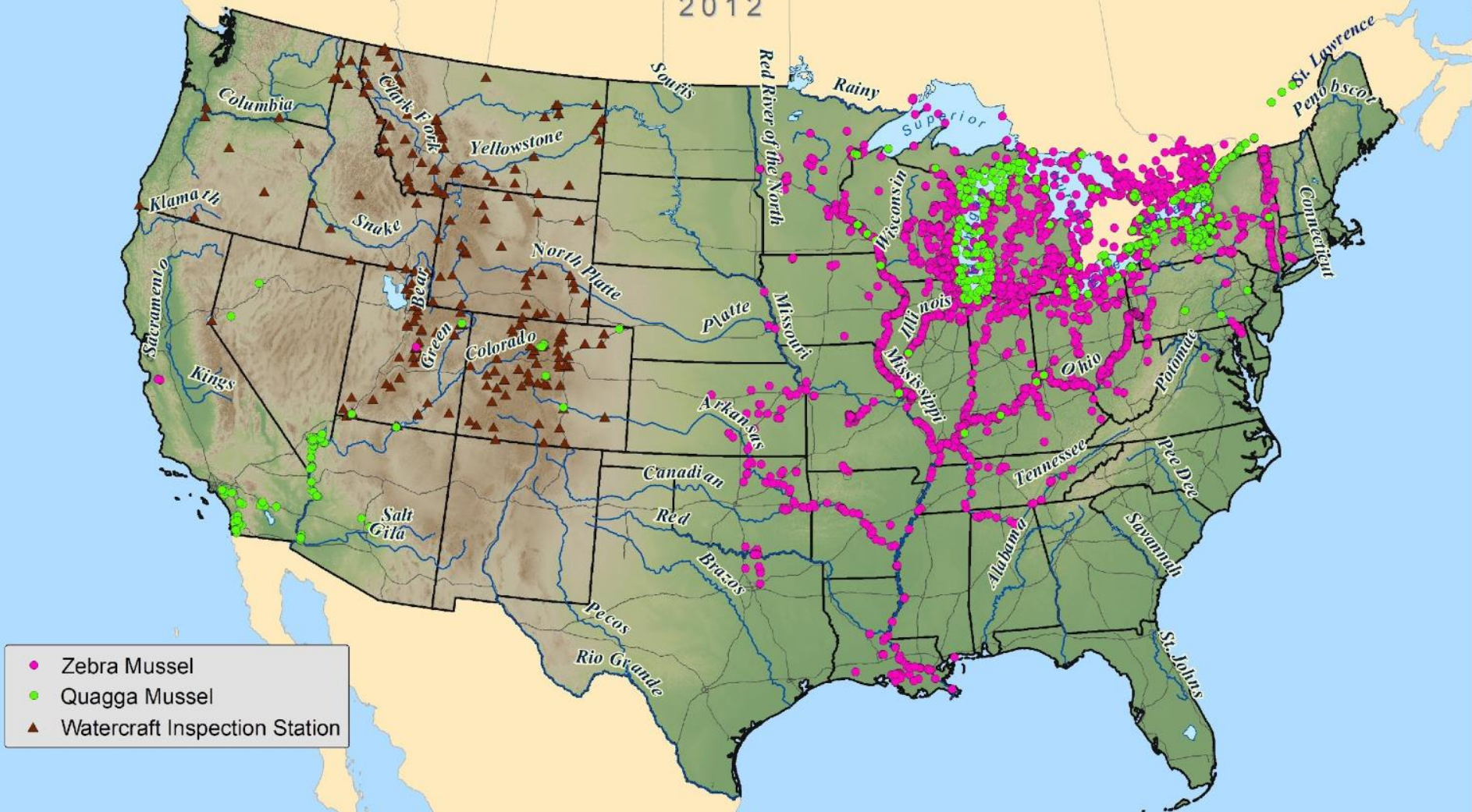


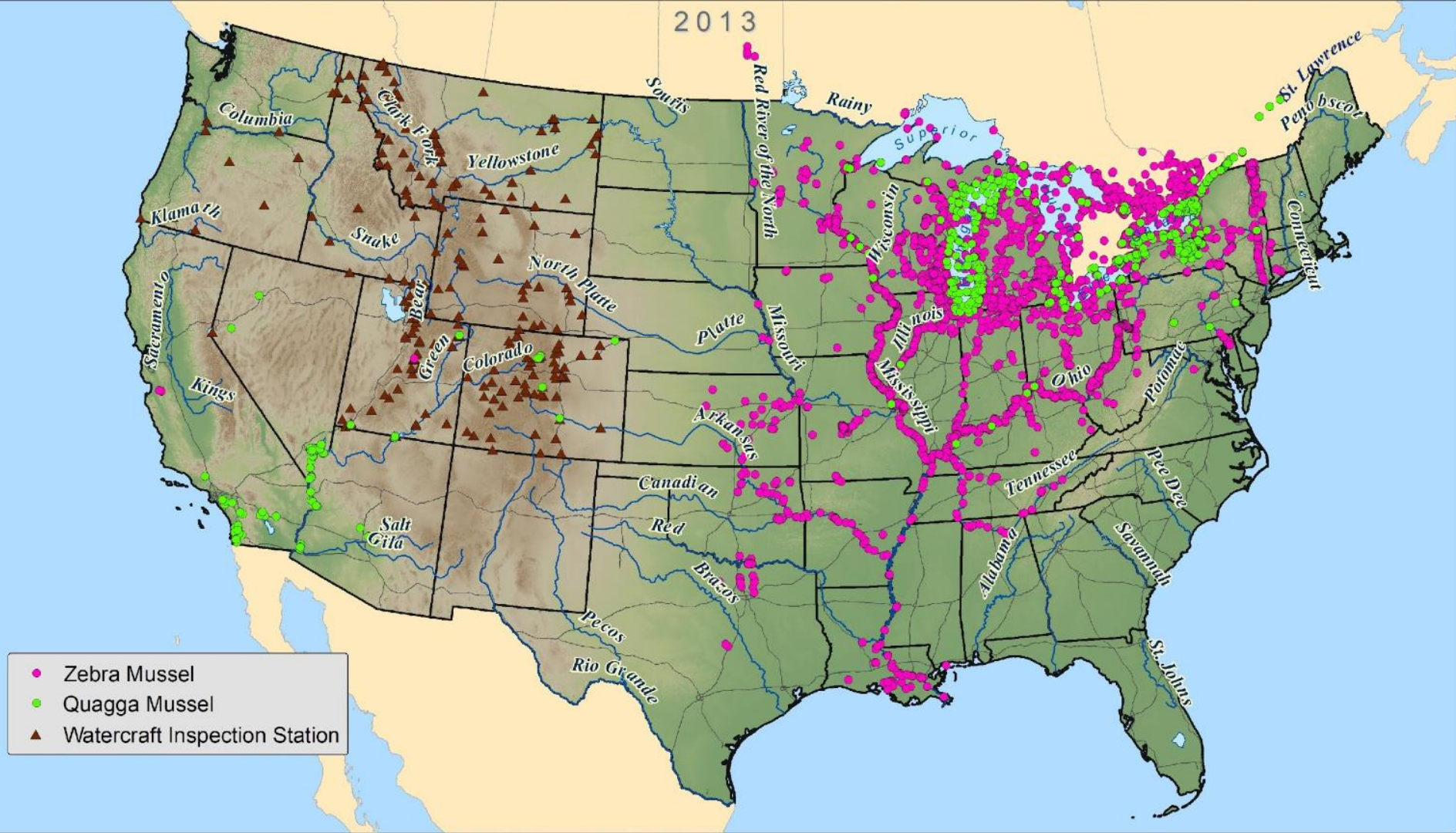
2011

25 years later...

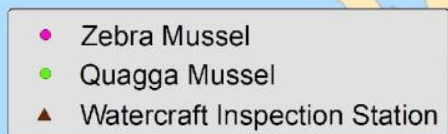


2012

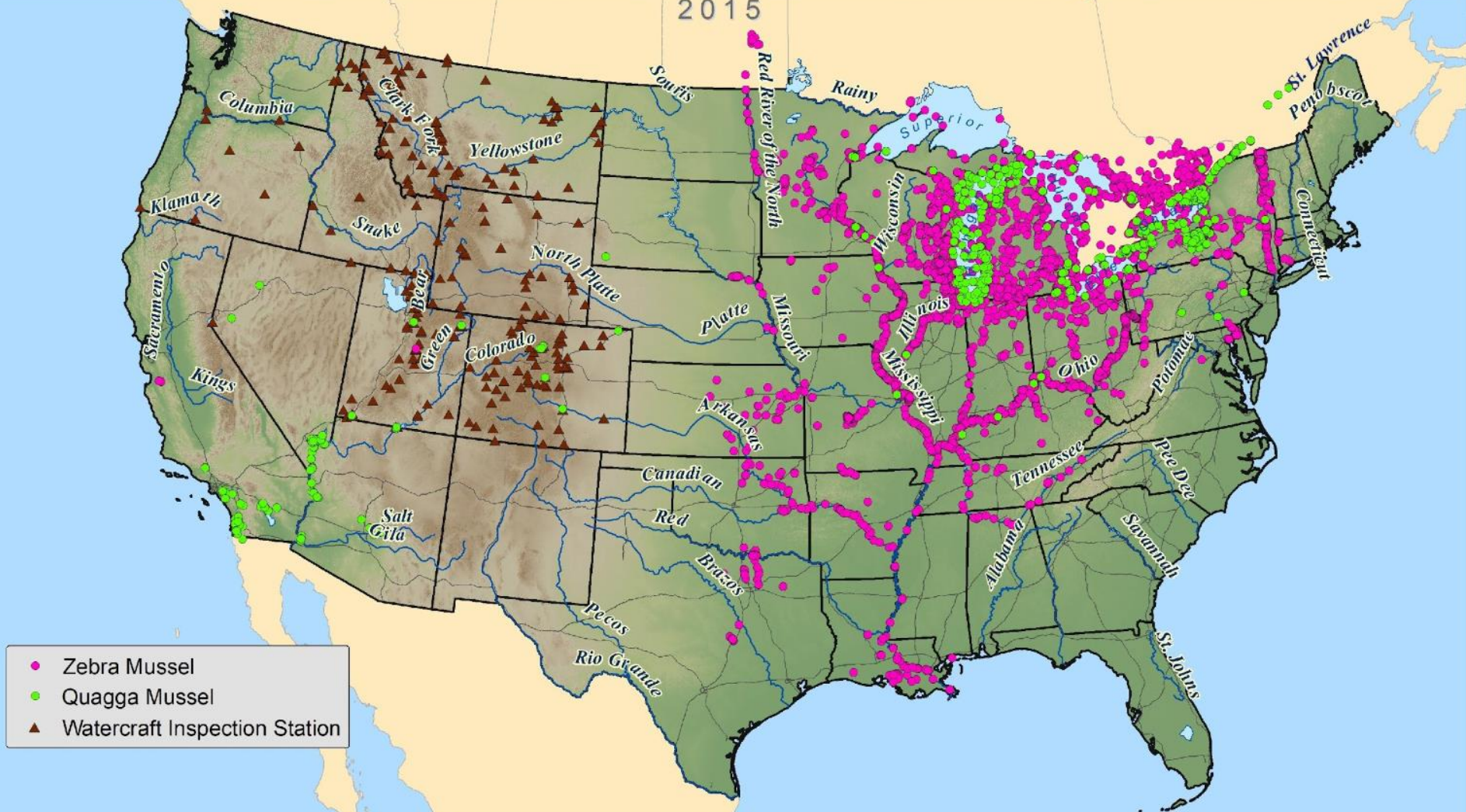




2014



2015

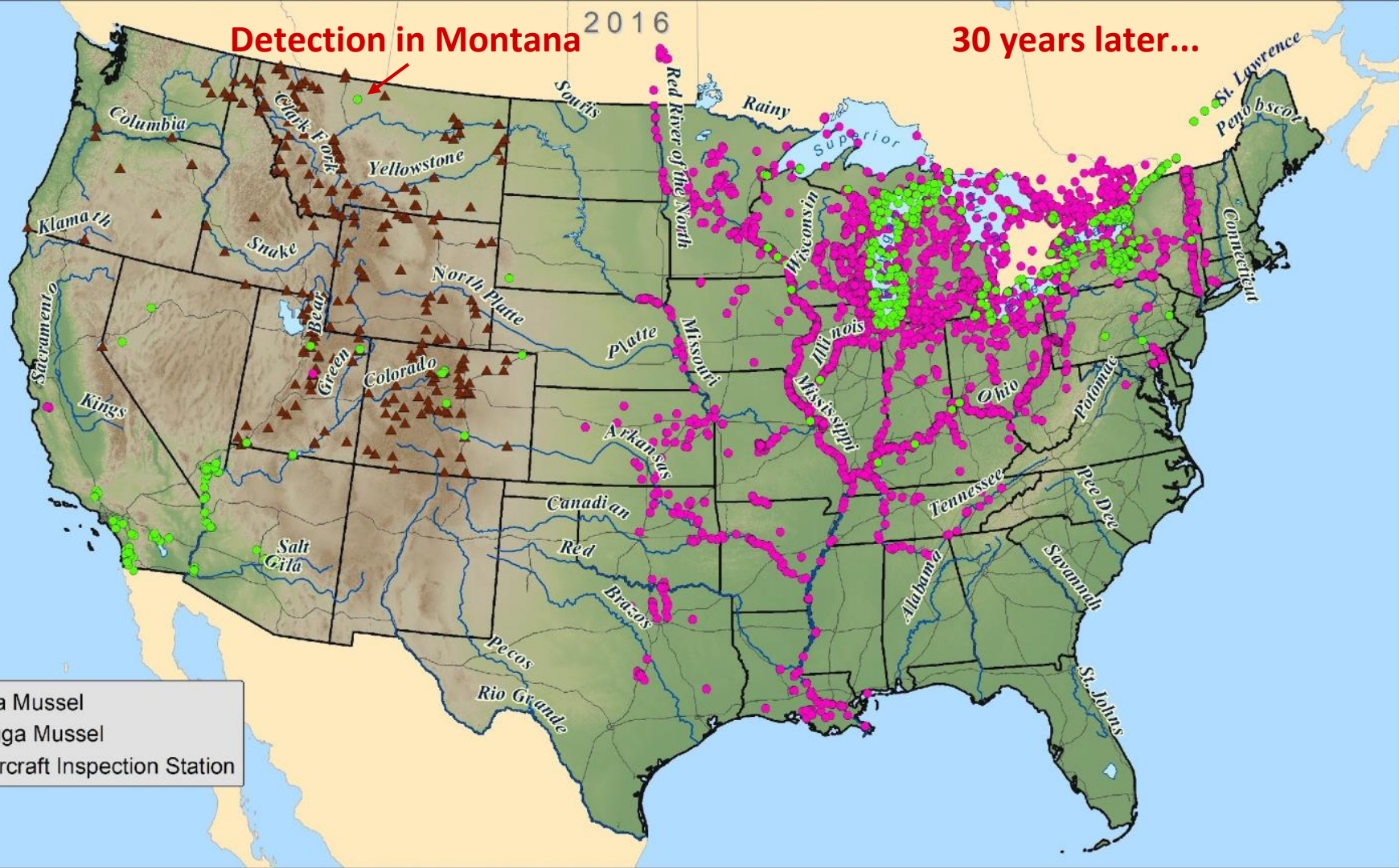


Detection in Montana

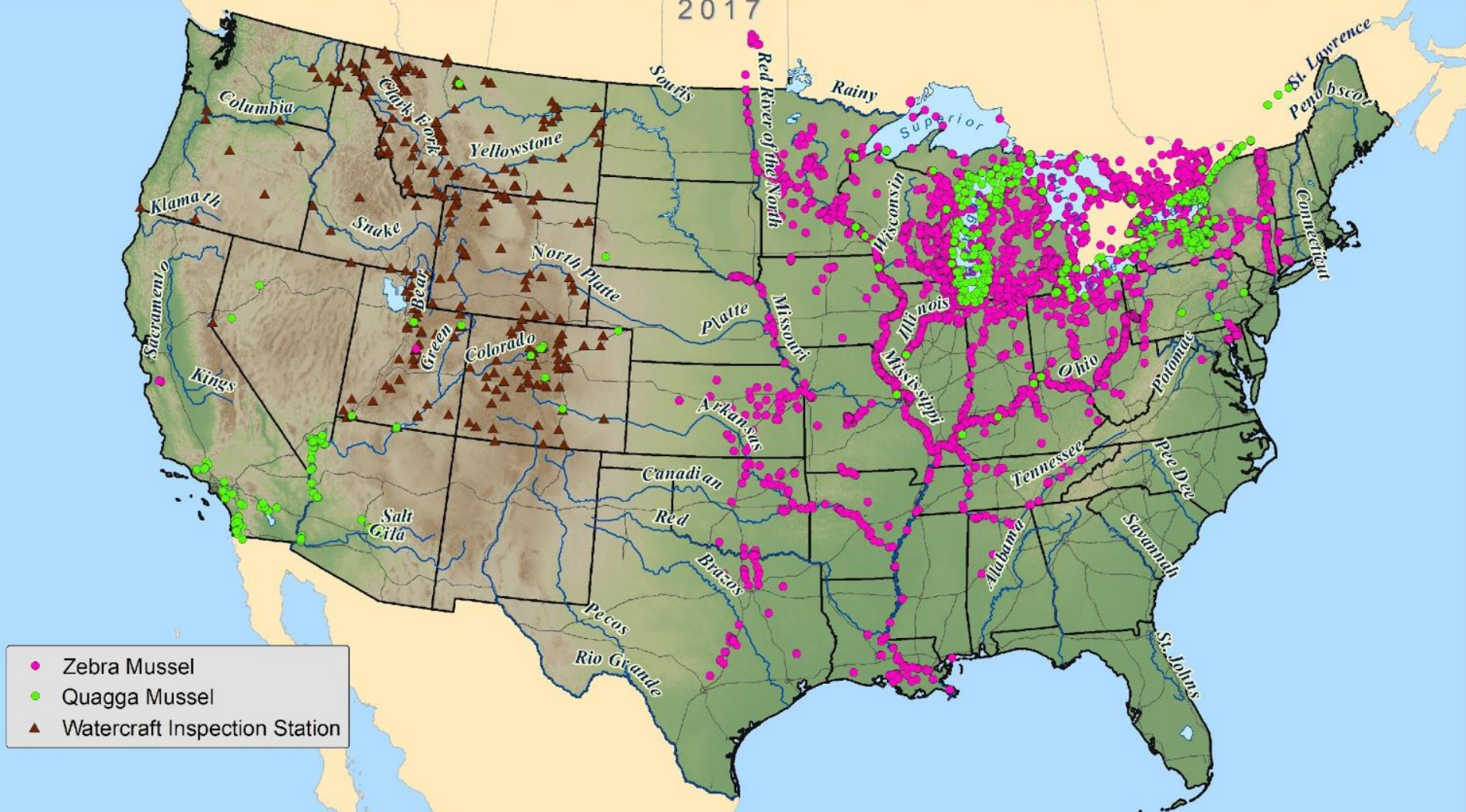
2016

30 years later...

- Zebra Mussel
- Quagga Mussel
- ▲ Watercraft Inspection Station



2017

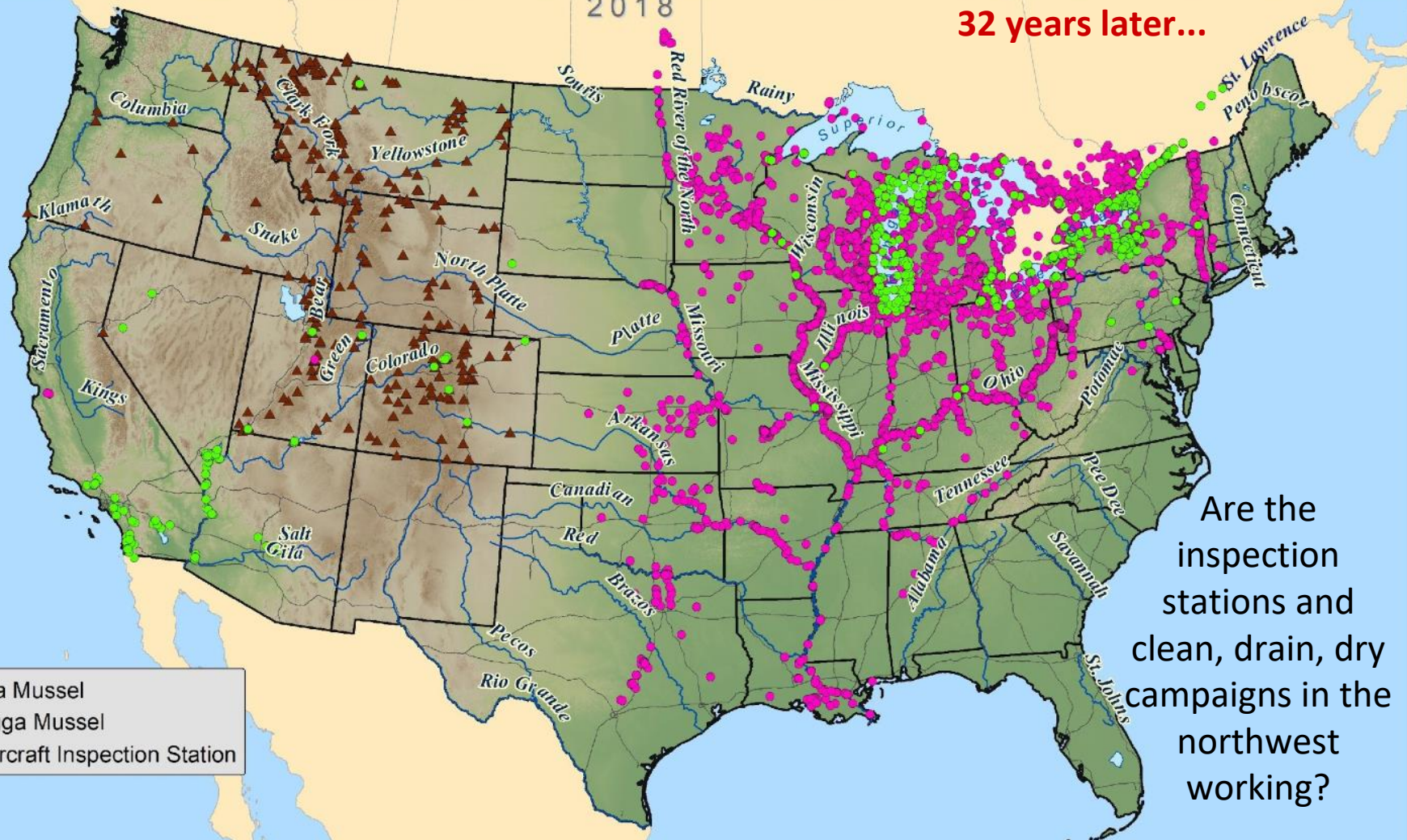


2018

32 years later...

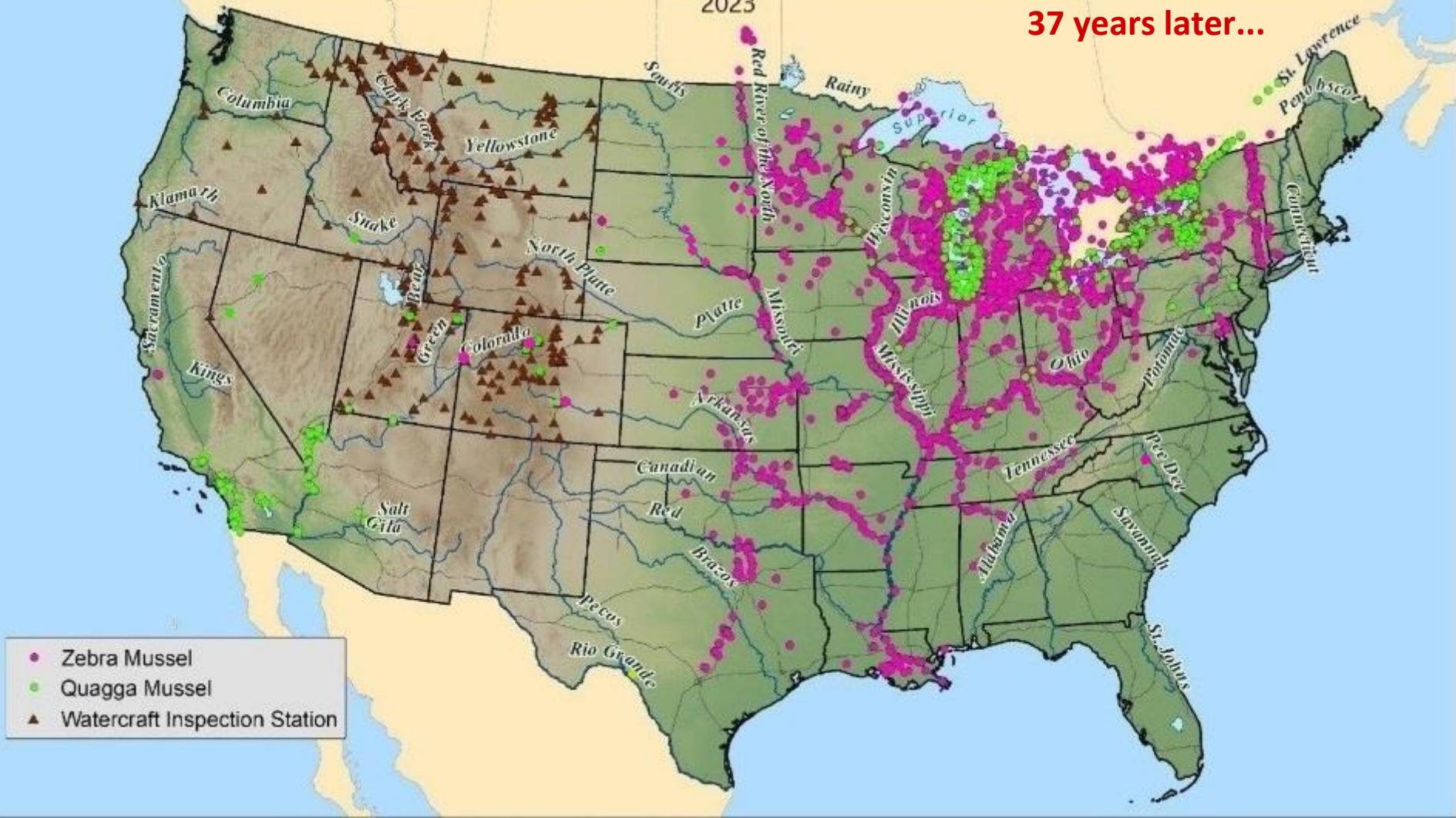
- Zebra Mussel
- Quagga Mussel
- ▲ Watercraft Inspection Station

Are the
inspection
stations and
clean, drain, dry
campaigns in the
northwest
working?



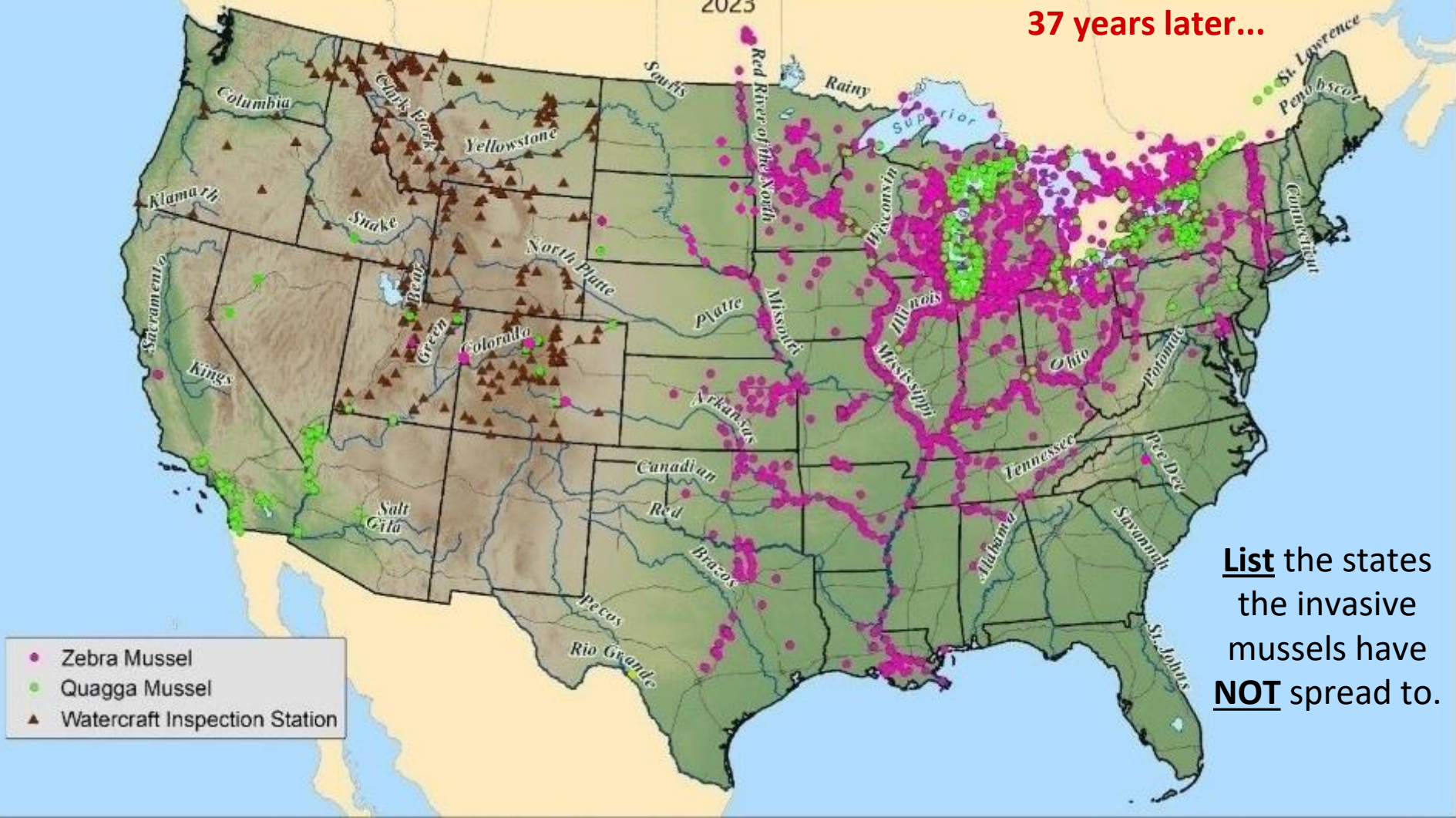
2023

37 years later...



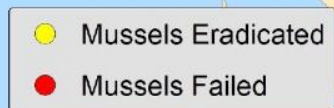
2023

37 years later...



List the states
the invasive
mussels have
NOT spread to.

32 years later...



What are some invasion barriers that could cause a mussel invasion to fail?



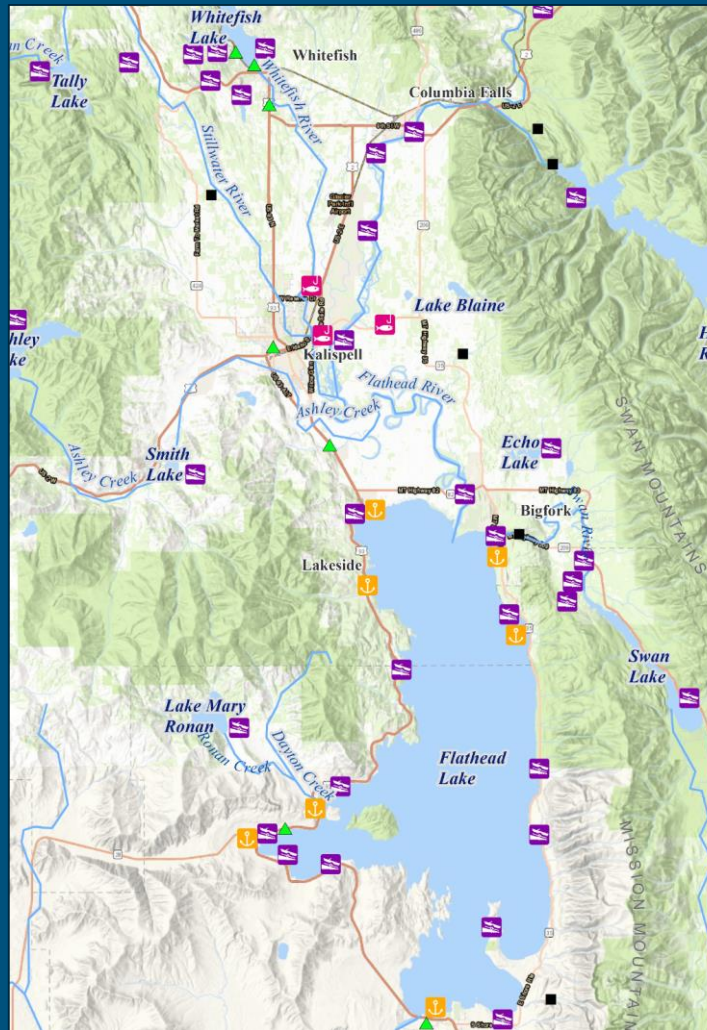
The Columbia River Basin is the last major watershed without invasive mussels!







A river basin
or
watershed
is an area of
land drained
by a river and
its tributaries
to a common
outlet.





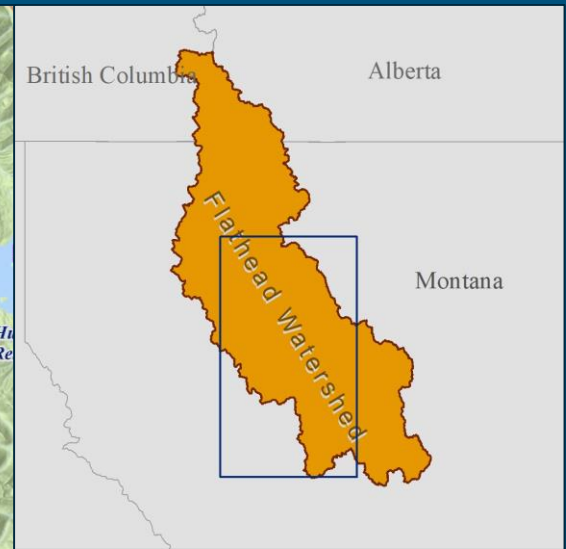
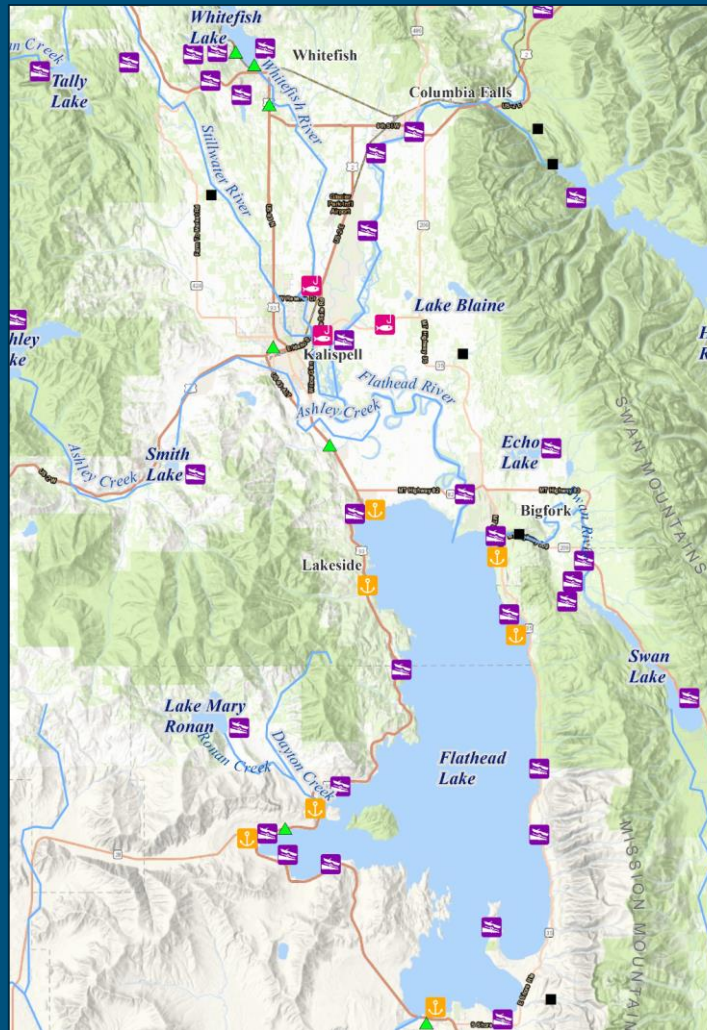
Select a
point of
introduction on
the Flathead
Region Map









-  Watercraft Inspection Stations
-  Marinas
-  Dams
-  Boat Ramps
-  Fishing Access
-  Rivers



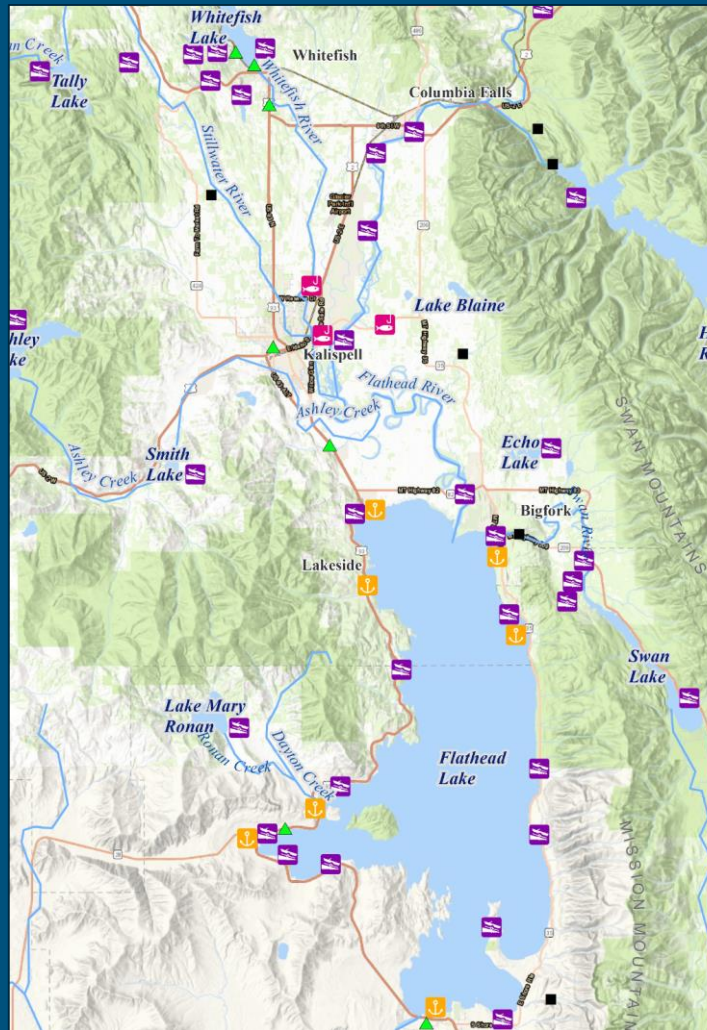
Describe where
the mussels
would disperse
from that
location.









-  Watercraft Inspection Stations
-  Marinas
-  Dams
-  Boat Ramps
-  Fishing Access
-  Rivers



How could the aquatic environment of the Flathead Watershed be impacted by a mussel invasion?

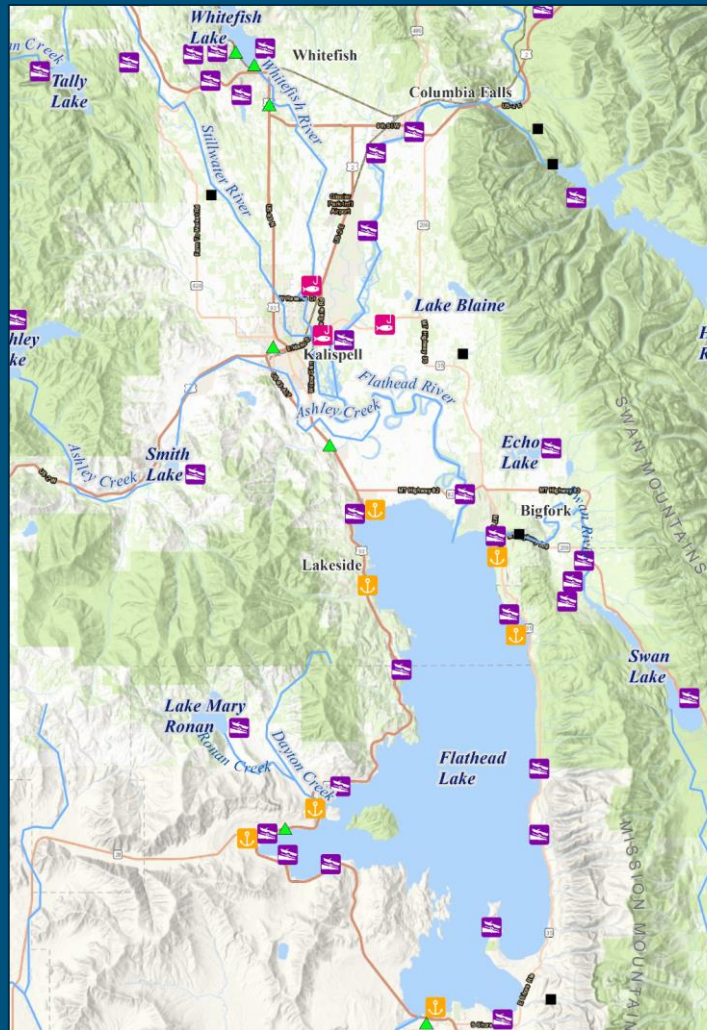








-  Watercraft Inspection Stations
-  Marinas
-  Dams
-  Boat Ramps
-  Fishing Access
-  Rivers



Think of a
personal
connection...

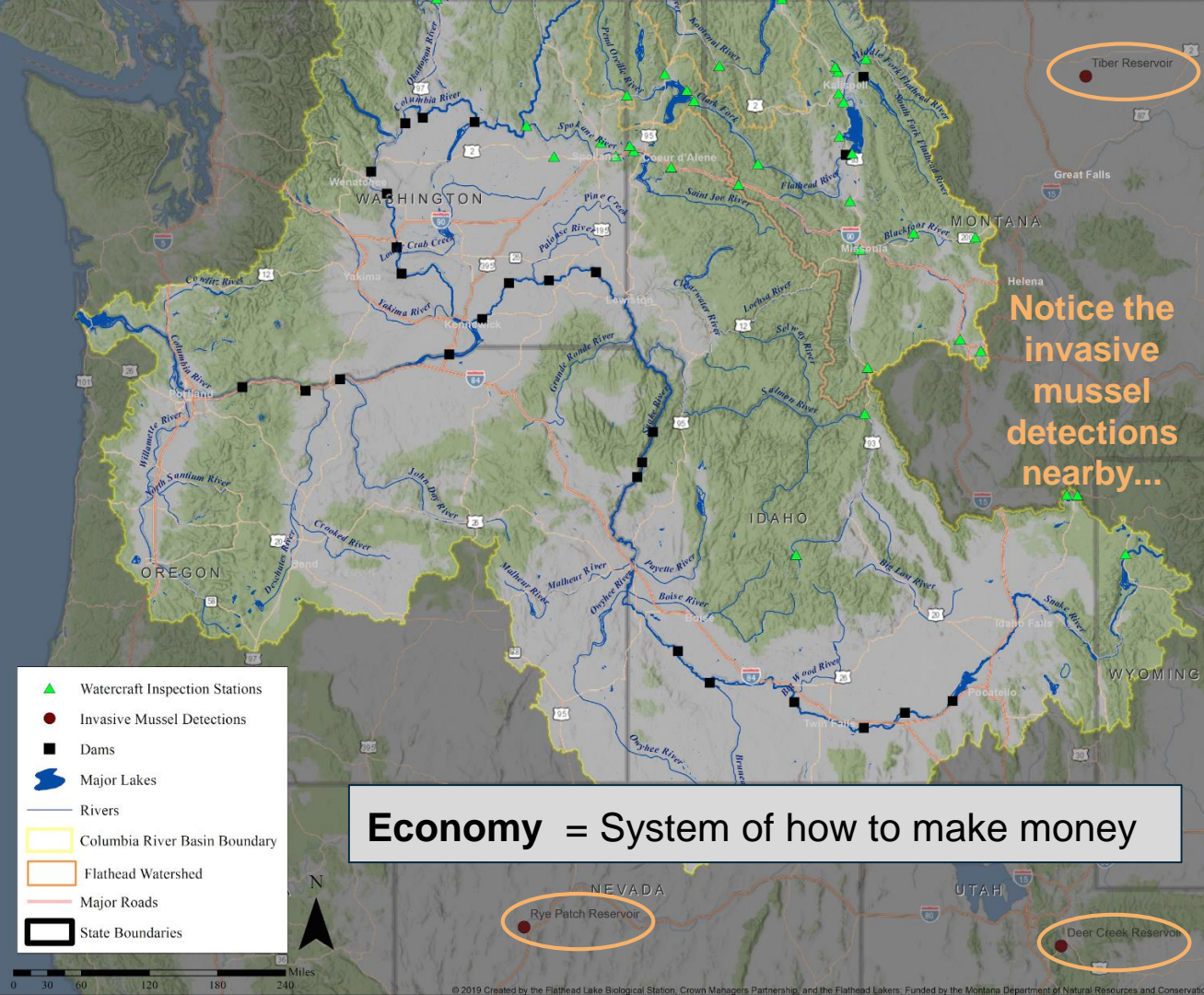
How could a
mussel invasion
impact someone
you know?



-  Watercraft Inspection Stations
-  Marinas
-  Dams
-  Boat Ramps
-  Fishing Access
-  Rivers



Select a topic. Use the map to explain how the Columbia River Basin **economy** could be impacted by a mussel invasion?





We live near the headwaters of the Columbia River Basin...

Why should
we care about
a potential
mussel
invasion?





References

- Slide #1: [Map of invasive species threat by Jeffrey Dukes at Purdue University](#)
- Slide #2: [Photo of zebra mussels on shell by Randy Westbrook \(Bugwood.org / Public Domain\)](#)
- Slides #3-4: [Photo of Black and Caspian Seas by Google Earth](#)
[Photo of Volga-Don Canal by Дмитрий Николенко \(public domain\)](#)
- Slide #5: [Photo of quagga mussels by Great Lakes Environmental Research Laboratory \(CC BY-SA 2.0\)](#)
- Slide #6: [Photo of zebra mussels on posts by thirdwavephoto \(Wikimedia Commons / CC BY 4.0\)](#)
[Photo of mussels on propeller by NPS \(public domain\)](#)
[Diagram of zebra vs. quagga mussels by Minnesota Sea Grant \(photos by John Karl\)](#)
- Slide #7: [Drawing of cargo ship by Holly Church at FLBS \(2019\)](#)
- Slide #8: [Diagram of Great Lakes by On The World Maps](#)
- Slide #11: [Diagrams of the ports along the Great Lakes by the Chamber of Marine Commerce](#)



References

- Slide #31: [Photo of paddle boarder by U.S. Dept. of Agriculture \(Wikimedia Commons\)](#)
[Photo of water skier by Isiwai \(Wikimedia Commons / CC BY-SA 4.0\)](#)
[Photo of boats at Lake McDonald by David Restivo \(Wikimedia Commons / CC BY-2.0\)](#)
[Photo of fly fisherman by Paul Nute \(Wikimedia Commons / CC0 1.0\)](#)
- Slides #8-30/32-44: Mussel detection maps by Natalie Poremba/FLB
- Slide #45: [Photo of Columbia River by U.S. Forest Service \(Wikipedia Commons\)](#)
- Slides #46-49: Flathead Lake Region map by Natalie Poremba/FLBS
- Slide #50: Columbia River Basin map by Natalie Poremba/FLBS
- Slide #51: [Photo of zebra mussels on shell by Randy Westbrook \(Bugwood.org / Public Domain\)](#)