Population dynamics of two aquatic invasive species in three neighboring Oklahoma reservoirs

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Invasive Species

- Influence ecosystems in novel ways (ecosystem engineers)
- Alter native communities by outcompeting native species or altering food web structure
- Can be economically costly

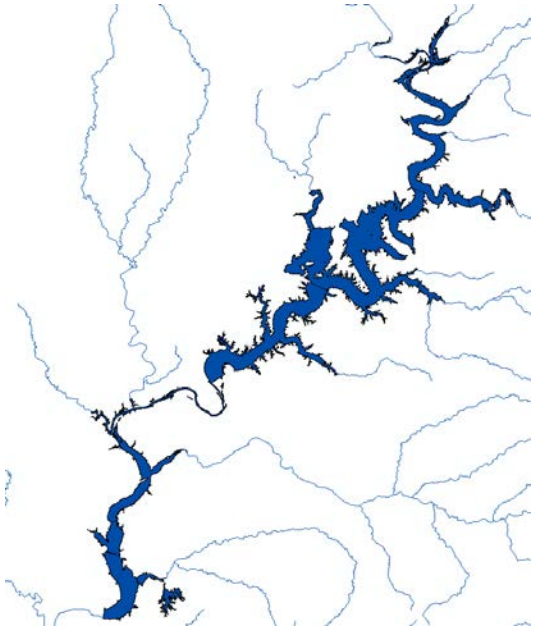
Asian carp

Mustard plant

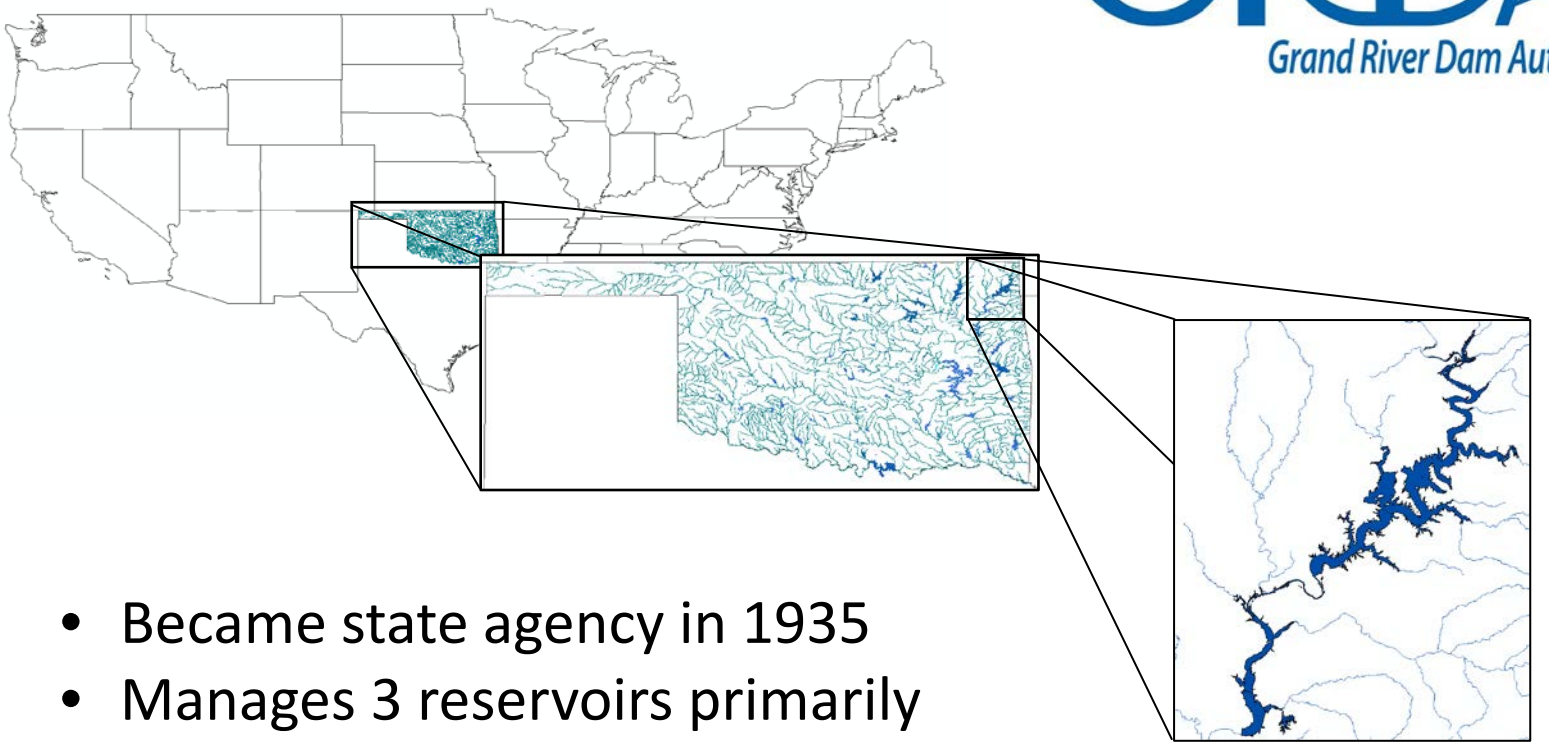
Zebra mussel

Reservoirs

- Man-made systems
- Highly susceptible to invasion
    - Large watersheds
    - Often connected to other reservoirs
    - Human mediated dispersal (fishing gear, boats, etc.)
- Serve as stepping stones to non-invaded systems



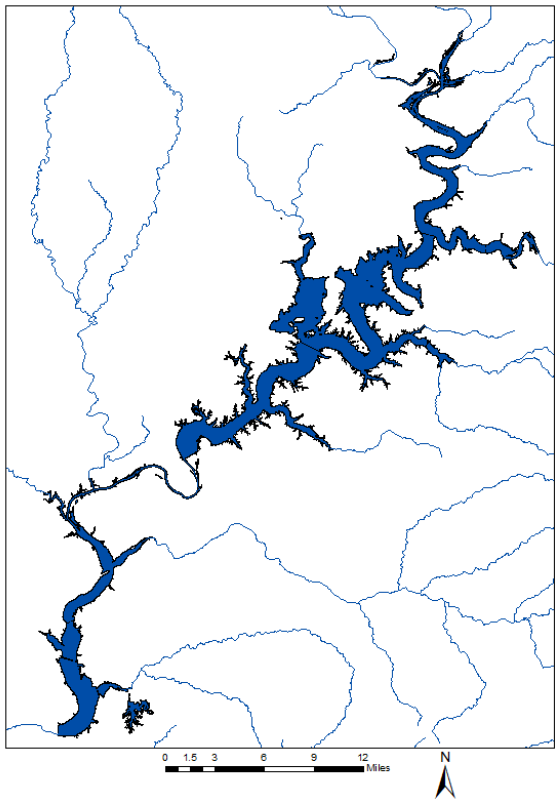
Background



- Became state agency in 1935
- Manages 3 reservoirs primarily used for hydroelectric power
  - Grand Lake
  - Lake Hudson
  - Lake W. R. Holway

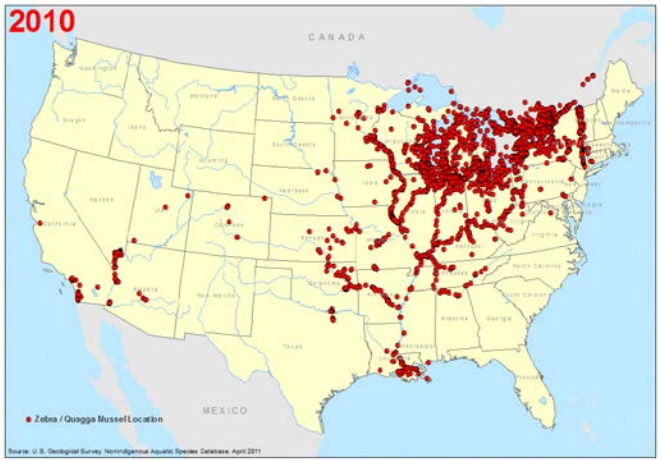
Background

Zebra mussel (ZM)
(*Dreissena polymorpha*)
Detected in Grand
(2006?), Hudson (2007),
and W.R. Holway (2007)

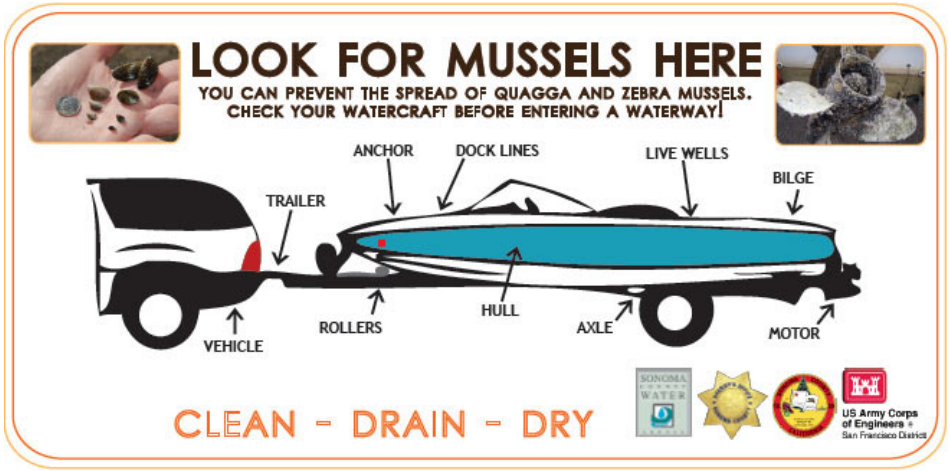


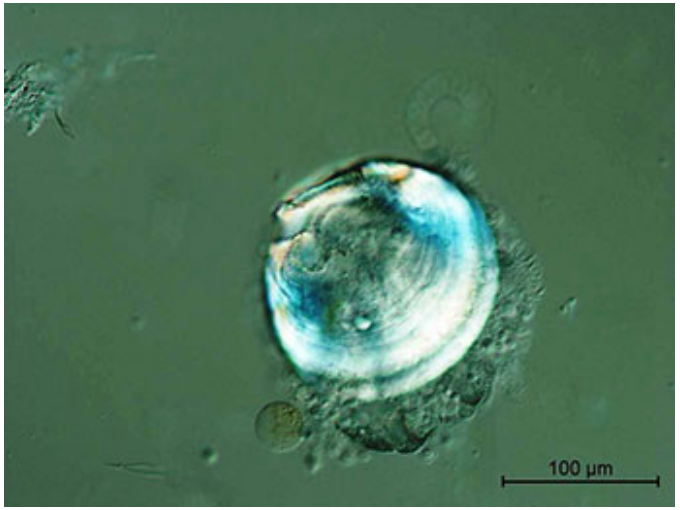
Daphnia lumholtzi (DL)
Detected in Grand (1995)

Zebra Mussels (ZM)
(*Dreissena polymorpha*)



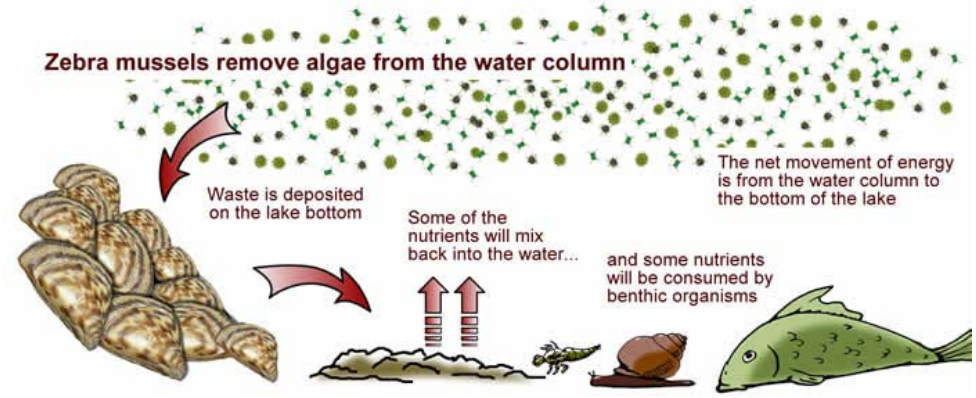
- Invasive in North America (1988)
- Rapidly spreading throughout the U.S.
- Produce free-living larvae (veligers)

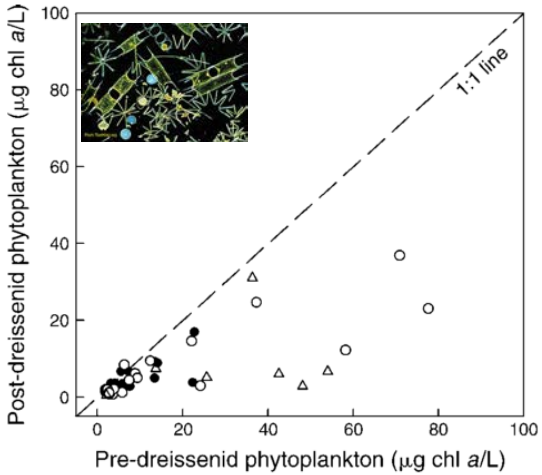


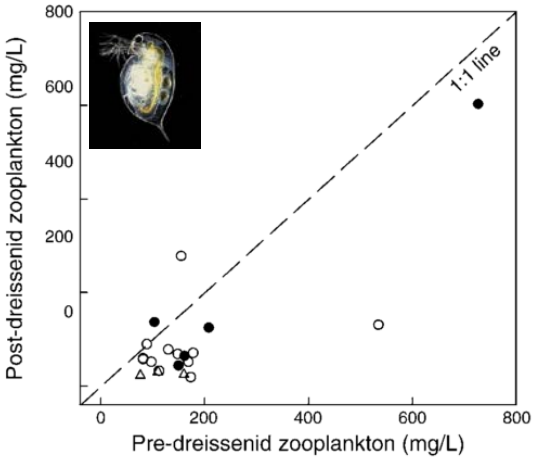


Zebra Mussels (ZM) (*Dreissena polymorpha*)

- Alter nutrient pathways (complex)
- Outcompete native zooplankton
- Ecosystem engineers







Higgins and Zanden (2010)

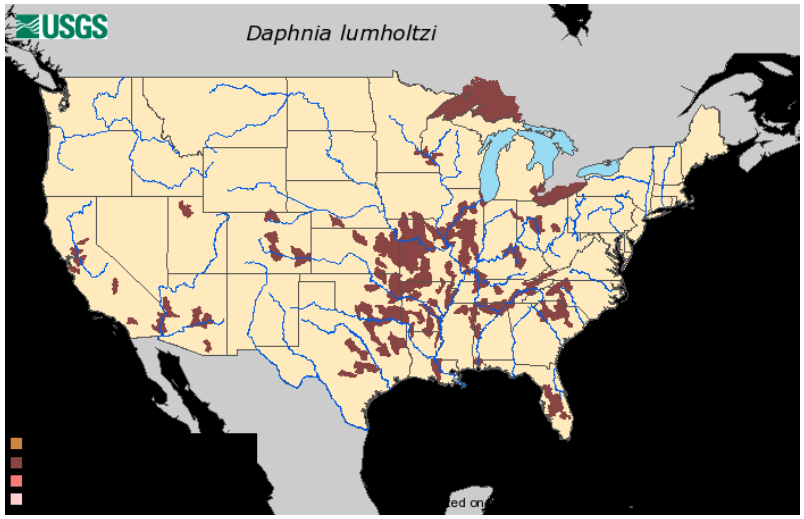
Zebra Mussels (ZM) (*Dreissena polymorpha*)

- Alter nutrient pathways (complex)
- Outcompete native zooplankton
- Ecosystem engineers
- Economic burden

Background

Daphnia lumholtzi (DL)

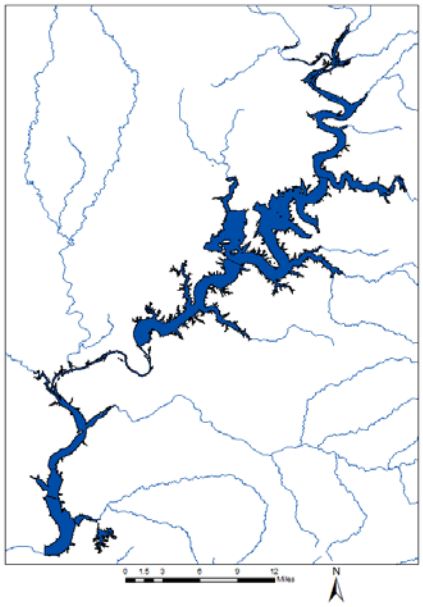
- Exotic cladoceran found in a Texas reservoir in 1990
- Has since invaded lakes and reservoirs throughout the central U.S.
- Large size and spines protect it from predators
- Feared to displace native *Daphnia* species



Background

Within lake dispersal

Downstream dispersal



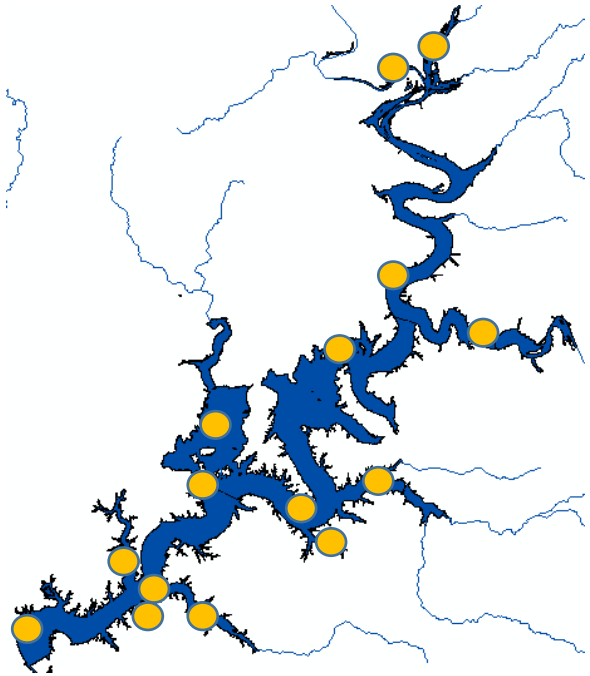
Overland dispersal

Objectives

- Assess the distributions and densities of ZM and DL in GRDA reservoirs
- Identify ecological implications of ZM and DL in GRDA reservoirs

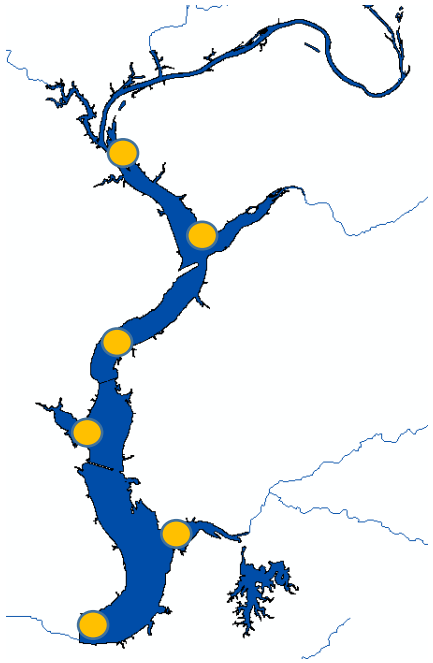
Methods

Grand



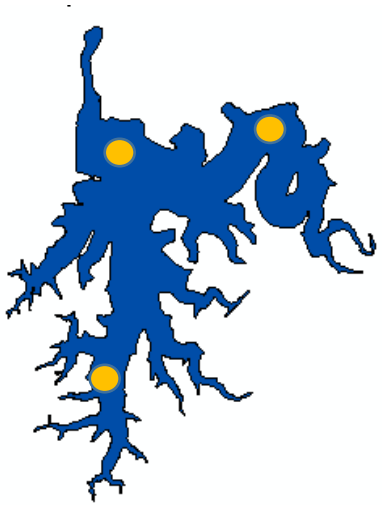
Summer 2014 - Summer 2016

Hudson



Spring 2015 - Summer 2016

W. R. Holway



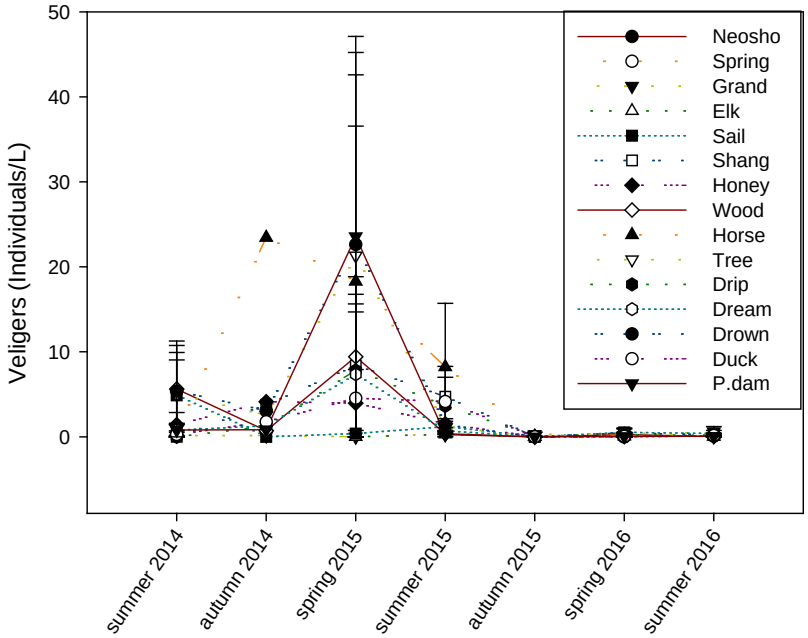
Spring 2015 - Summer 2016

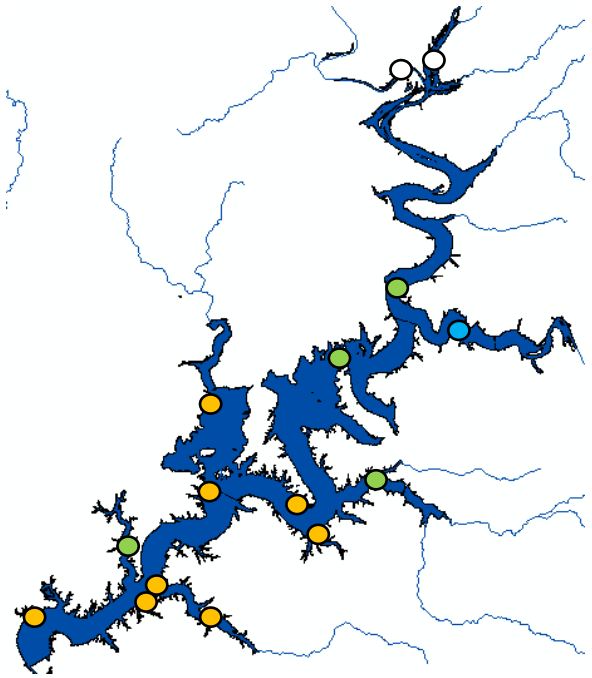
- Zooplankton data were pooled by year and season

Results

ZM densities and distributions

Grand Lake

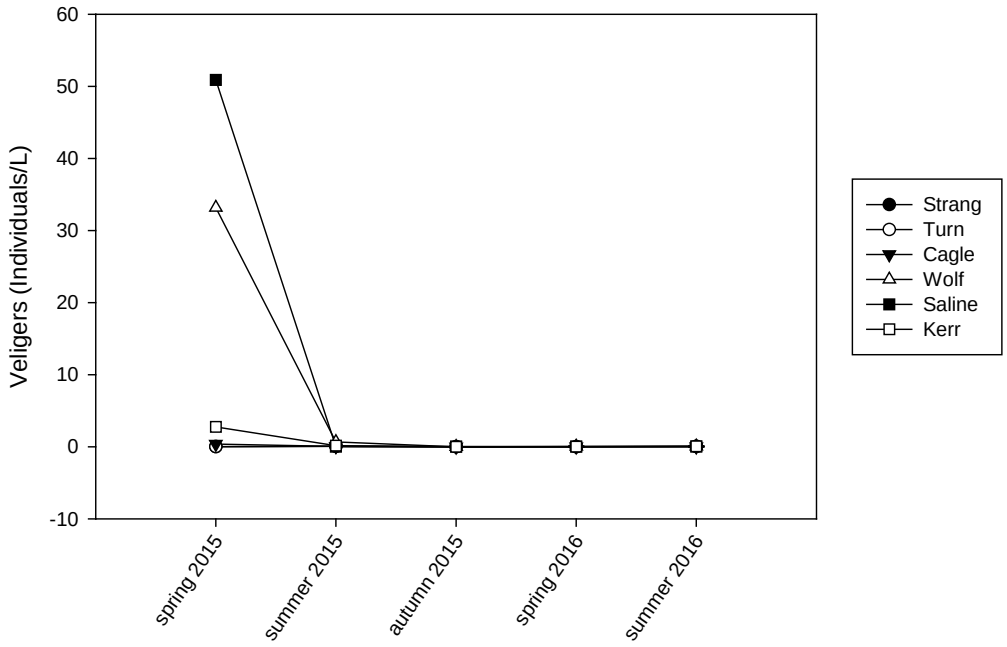




Results

ZM densities and distributions

Lake Hudson



0 Individuals/L
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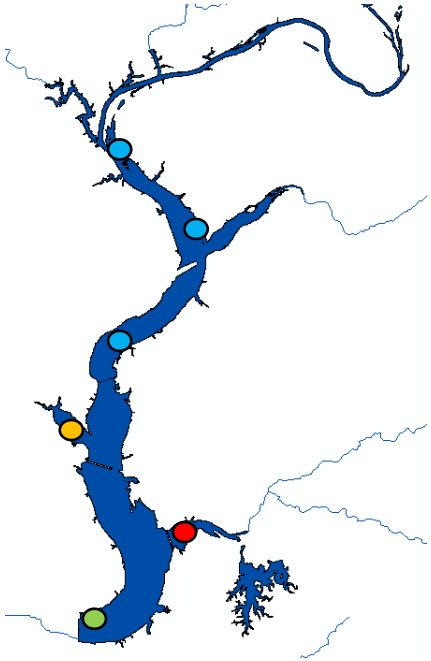
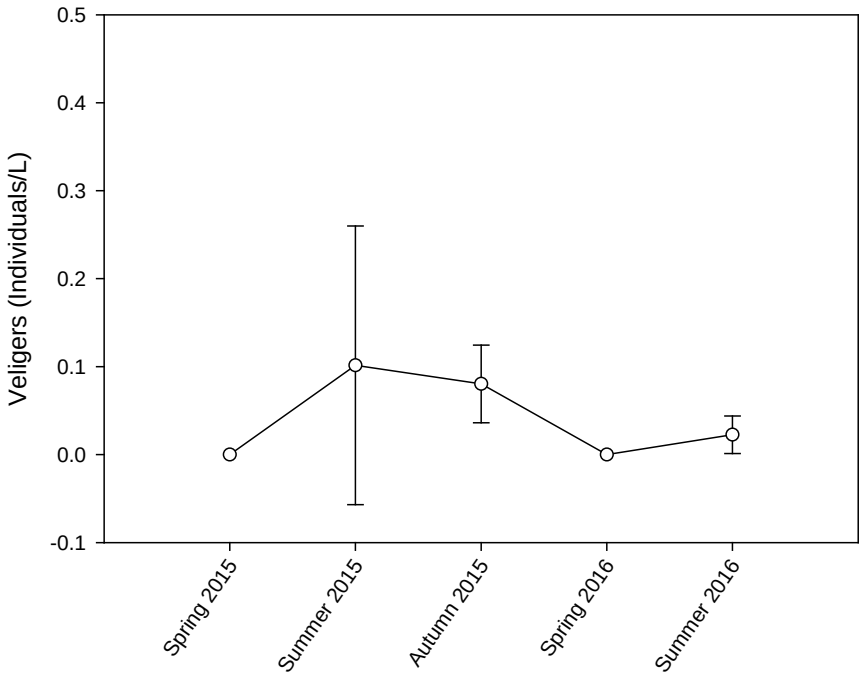
1 - 9 Individuals/L
10 - 49 Individuals/L
50+ Individuals/L



Results

ZM densities and distributions

Lake W. R. Holway



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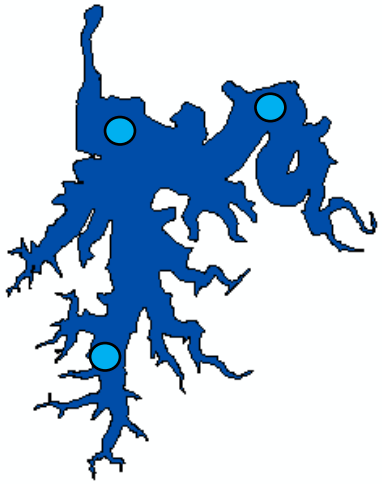
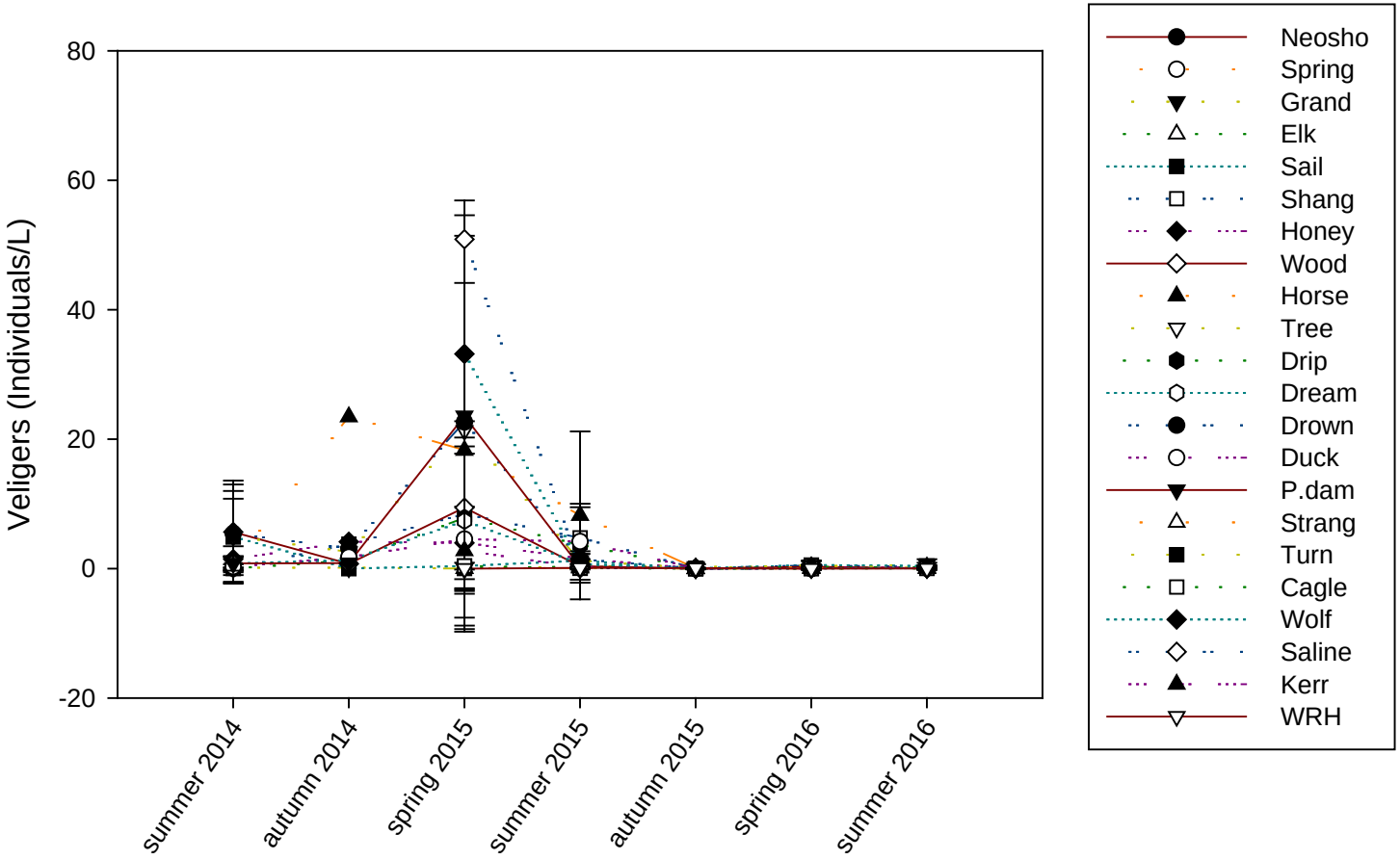
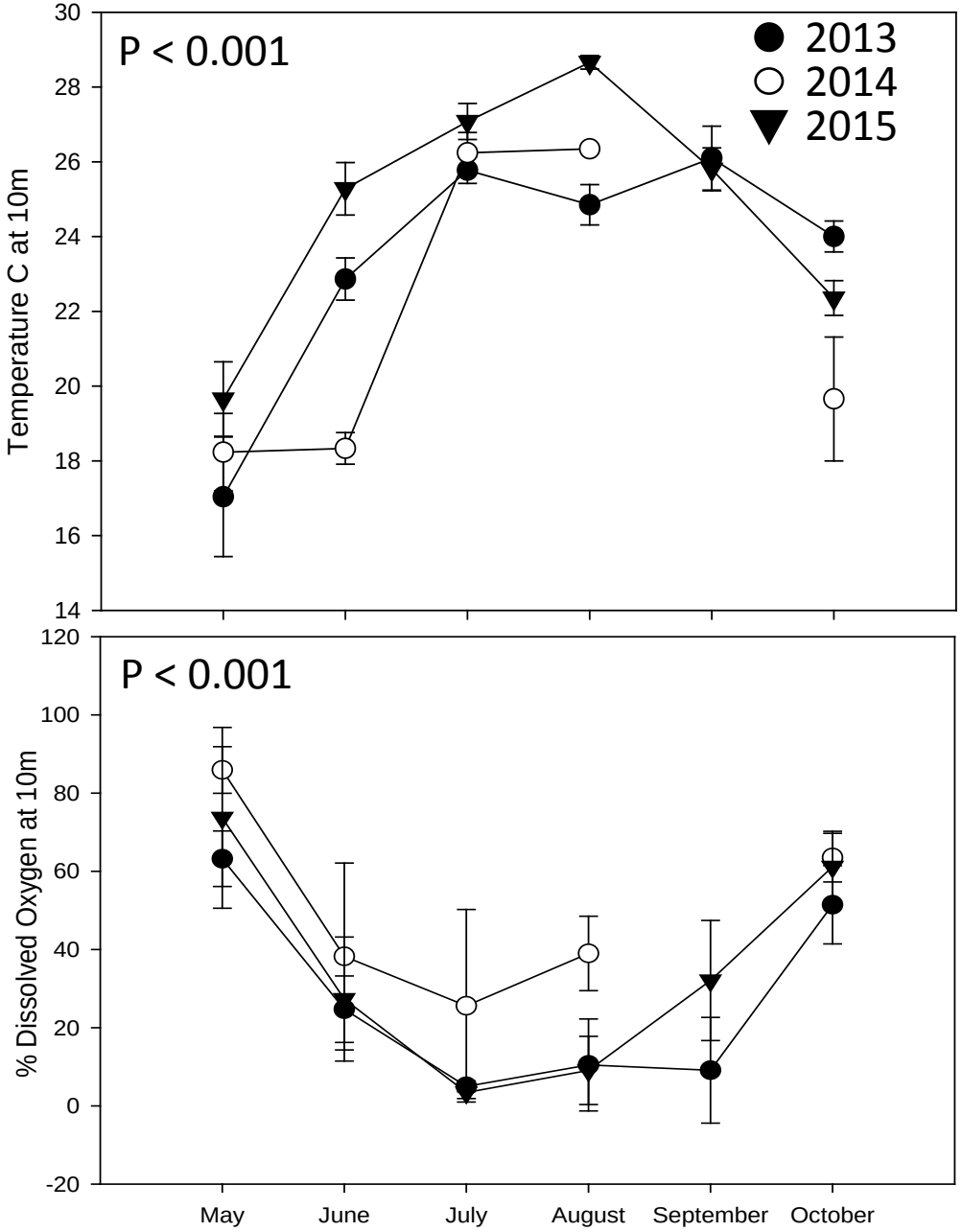


ZM densities and distributions

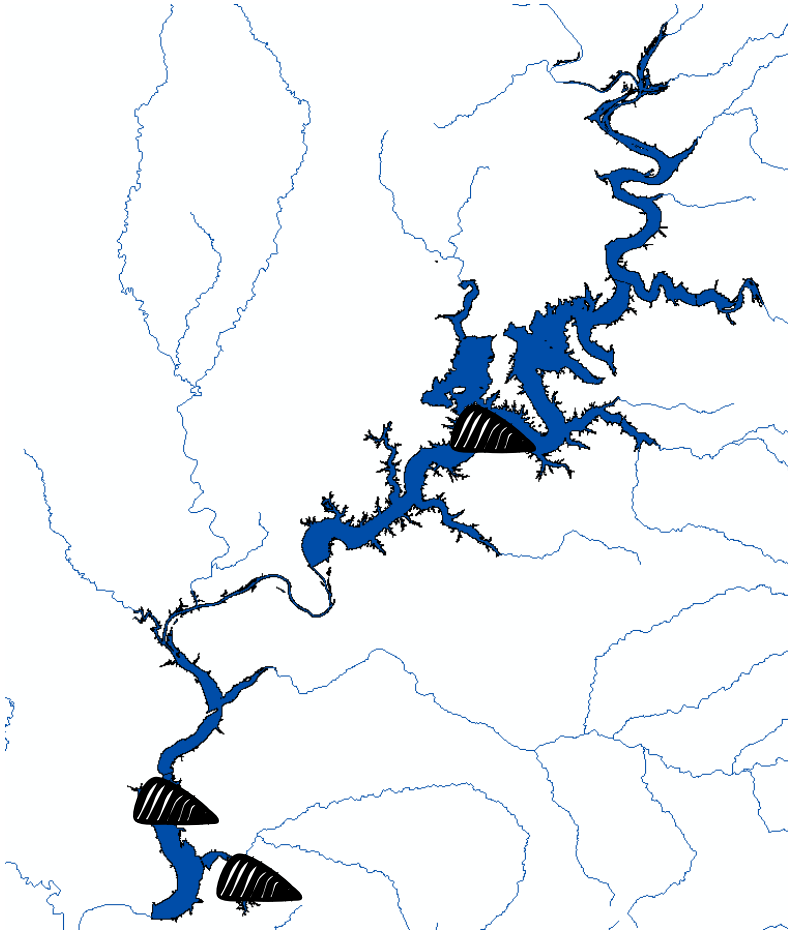


Discussion


P < 0.001
2013
2014
2015
Temperature C at 10m
30
28
26
24
22
20
18
16
14
P < 0.001
% Dissolved Oxygen at 10m
120
100
80
60
40
20
0
-20
May
June
July
August
September
October

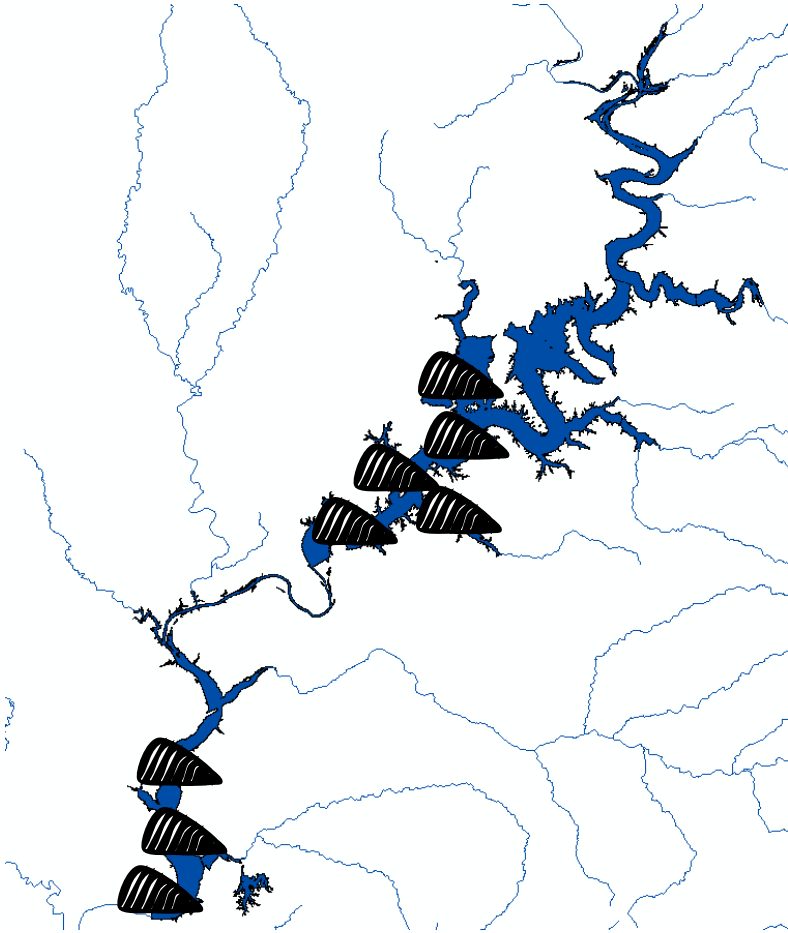
Summary

- Detected in all 3 reservoirs



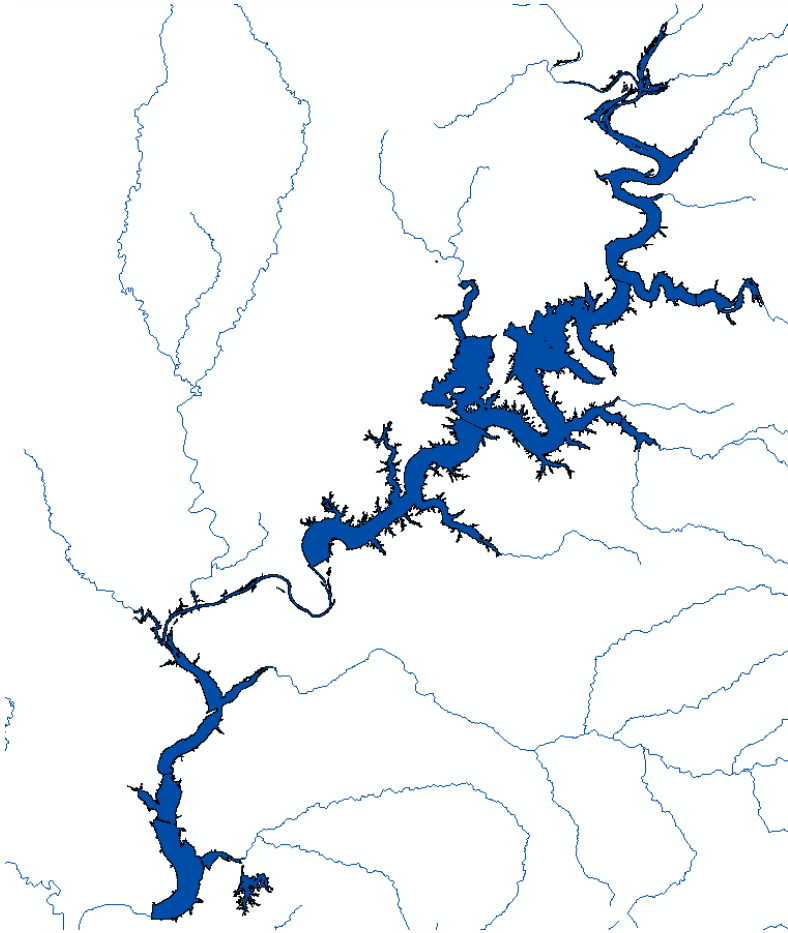
Summary

- Detected in all 3 reservoirs
- Highest densities near lower portions of the reservoirs
- Scarce in W. R. Holway



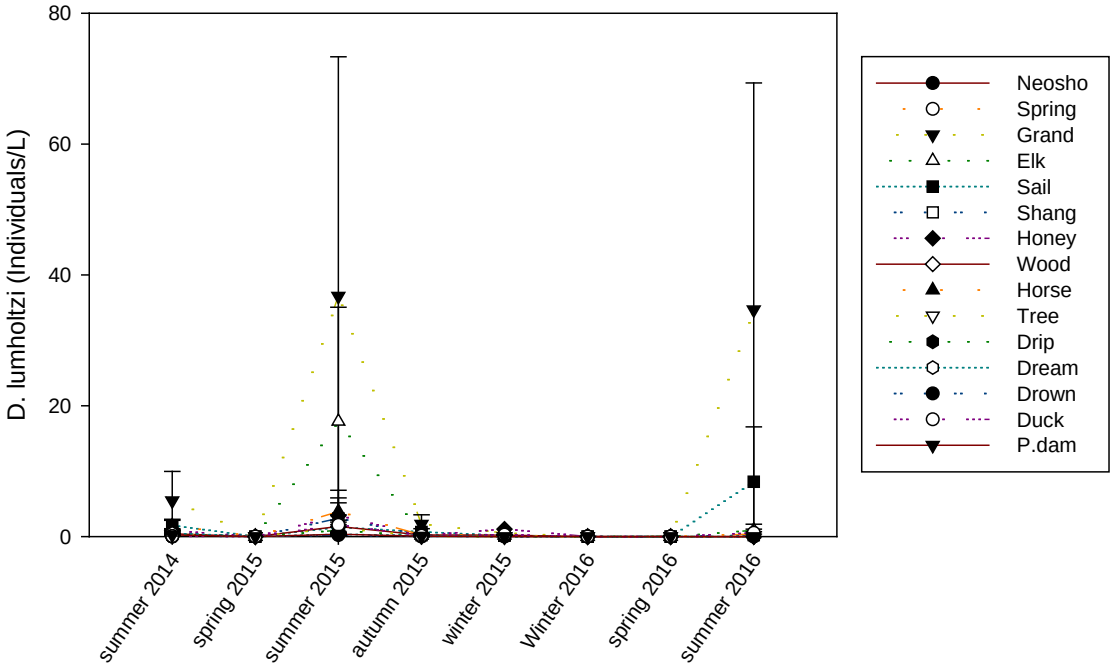
Summary

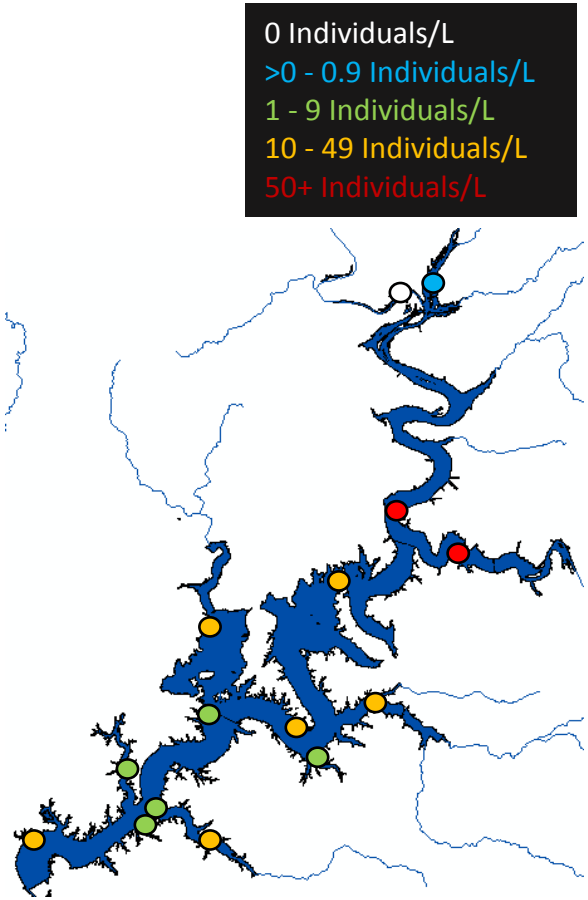
- Detected in all 3 reservoirs
- Highest densities near lower portions of the reservoirs
- Scarce in W. R. Holway
- All three populations crashed during Summer 2015



DL densities and distributions

Grand Lake





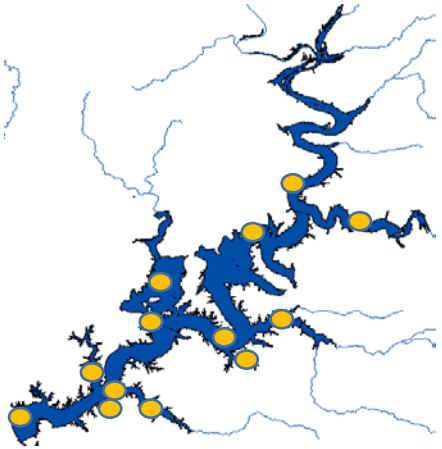
Results

D. lumholtzi

D. mendotae

D. retrocurva

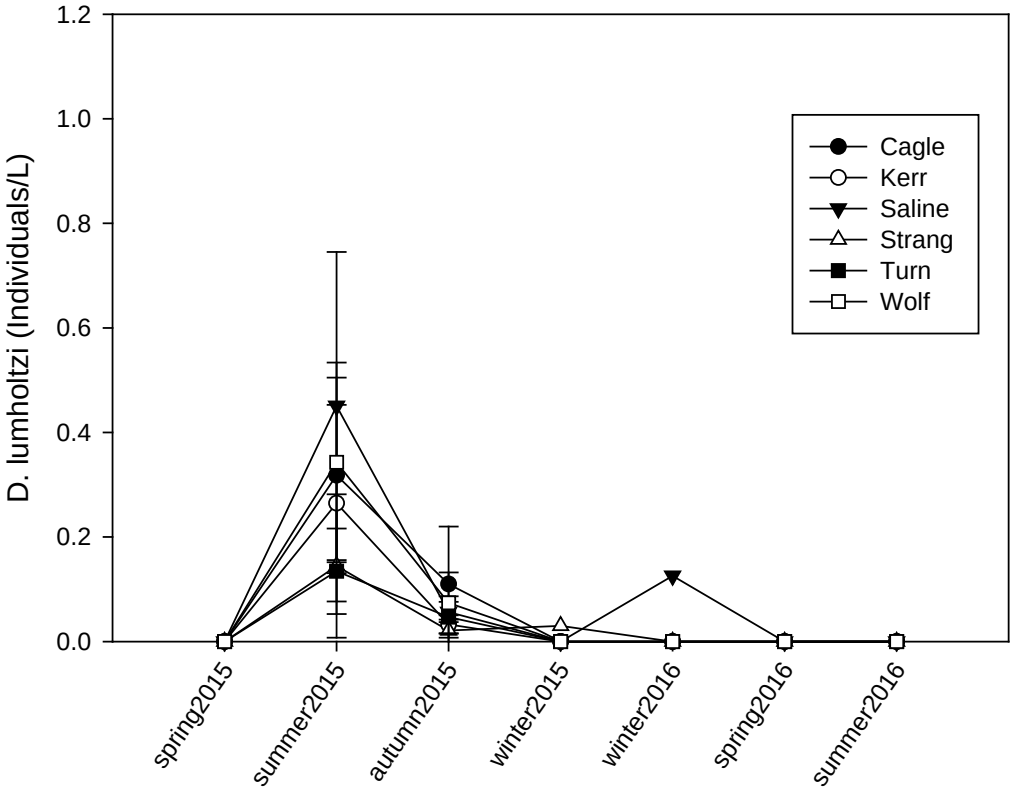
D. parvula



	Grand	Elk	Sail	Shang	Honey	Wood	Horse	Tree	Drip	Dream	Drown	Duck	P.dam
Summer 2014		NA											
Autumn 2014		NA											
Spring 2015													
Summer 2015													
Autumn 2015													
Winter 2015-16													
Spring 2016													
Summer 2016													

DL densities and distributions

Lake Hudson



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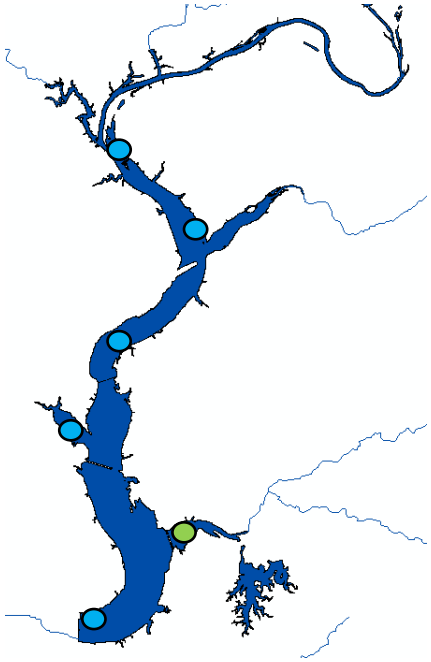
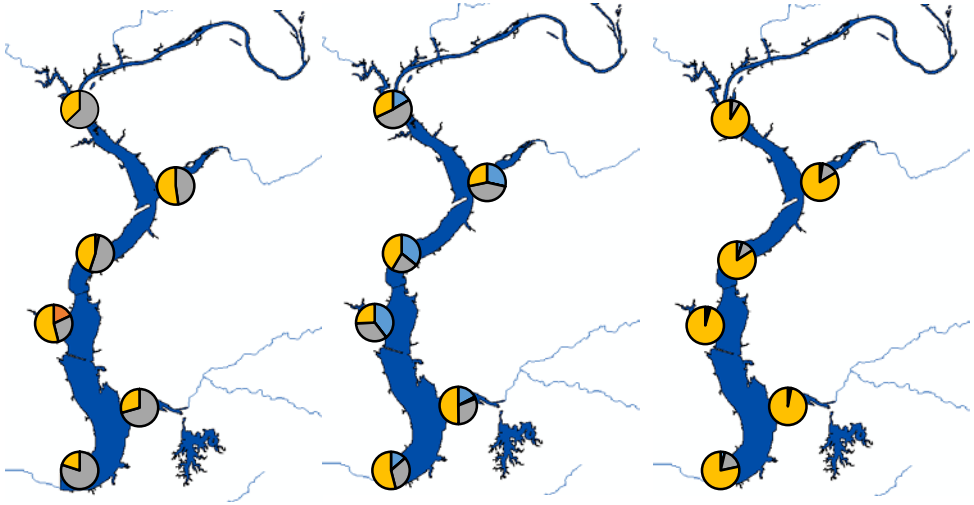


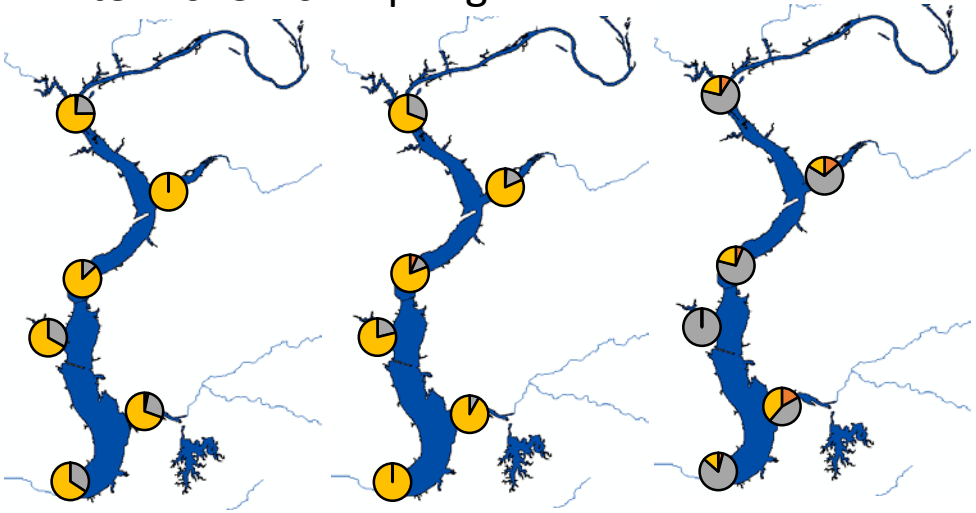
Results

Lake Hudson

Spring 2015 | Summer 2015 | Autumn 2015



Winter 2015-16 | Spring 2016 | Summer 2016



D. lumholtzi

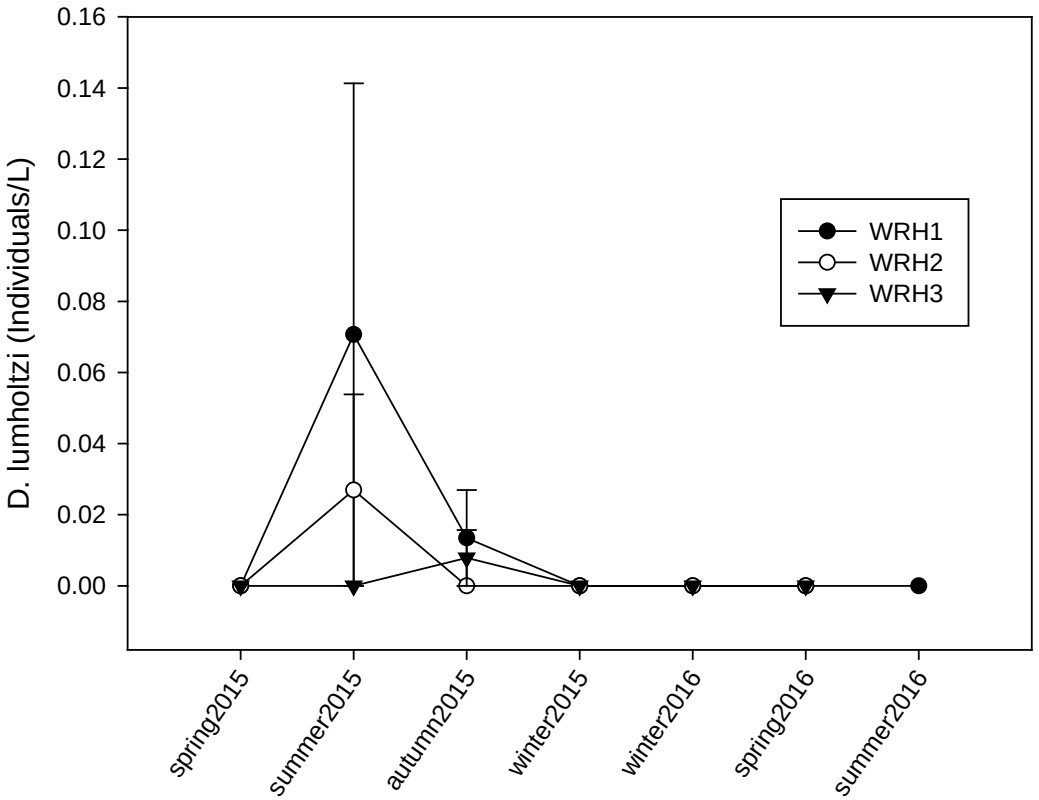
D. mendotae

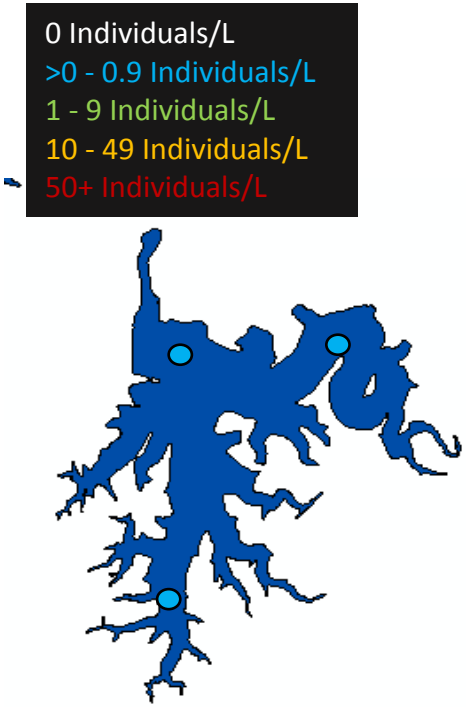
D. retrocurva

D. parvula

DL densities and distributions

Lake W. R. Holway





Summary

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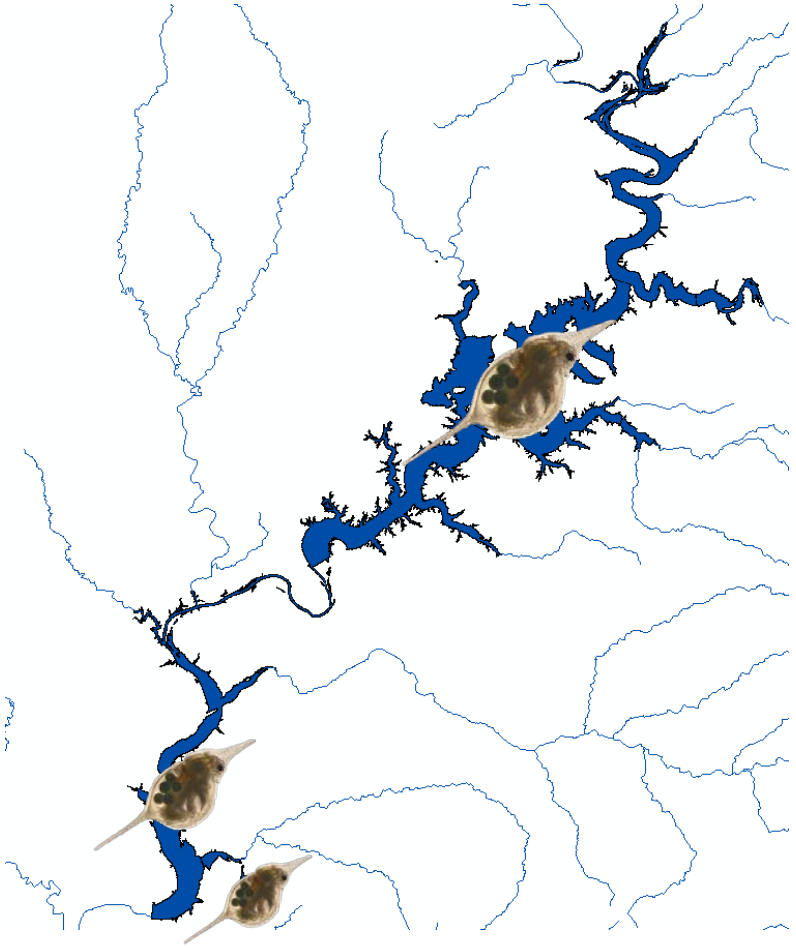
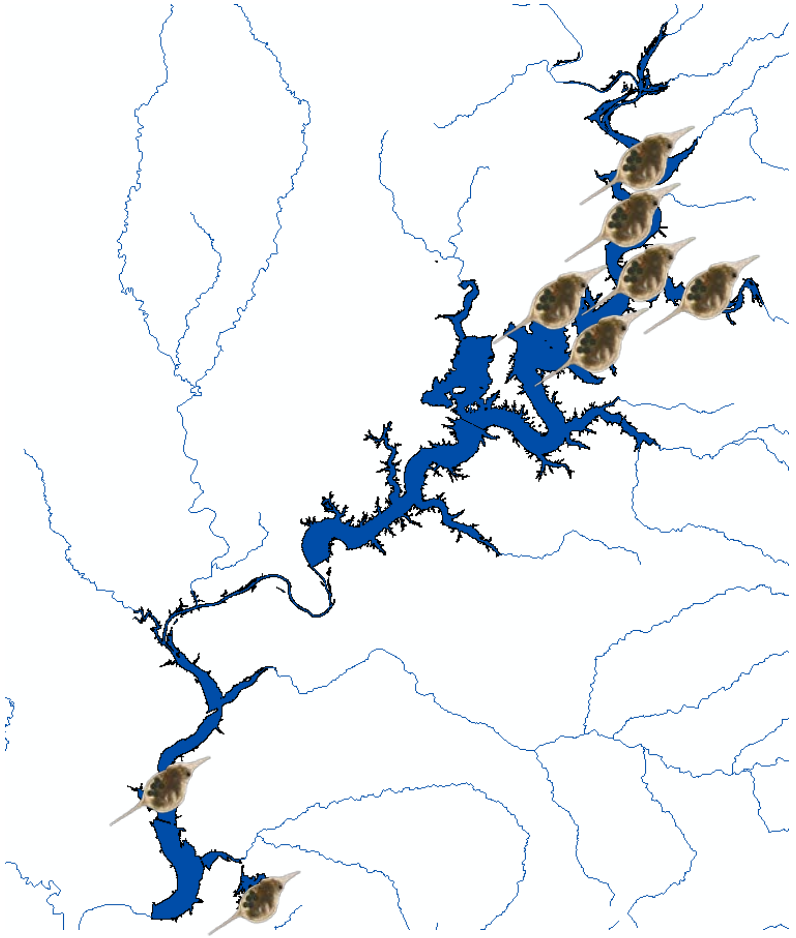


Summary

- Detected in all 3 reservoirs
- Highest densities in Grand (riverine portion)
- Very low densities in Hudson and W.R. Holway



Summary

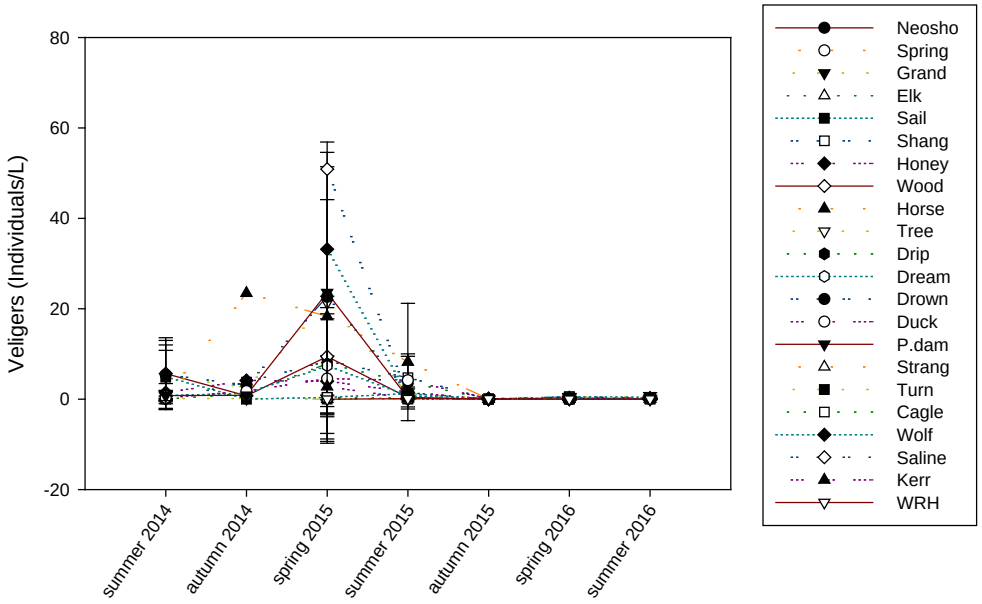
- Detected in all 3 reservoirs
- Highest densities in Grand (riverine portion)
- Very low densities in Hudson and W.R. Holway
- Peaked in summer and autumn
- Frequently co-occurs with native *Daphnia* species

Conclusions

- ZM and DL densities vary within and between reservoirs with higher densities in Grand Lake
- ZM populations crashed in all three reservoirs in Summer 2015 and veliger densities remained low in 2016
- DL does not appear to be negatively affecting native *Daphnia* species

Future Directions

- ZM populations should be monitored long term to:
  - identify processes influencing population crashes
  - determine why they are unevenly distributed across the reservoirs
  - identify potential ecological impacts on invaded reservoirs



Acknowledgements