A YEAR IN THE LIFE OF TEXAS ZEBRA MUSSELS

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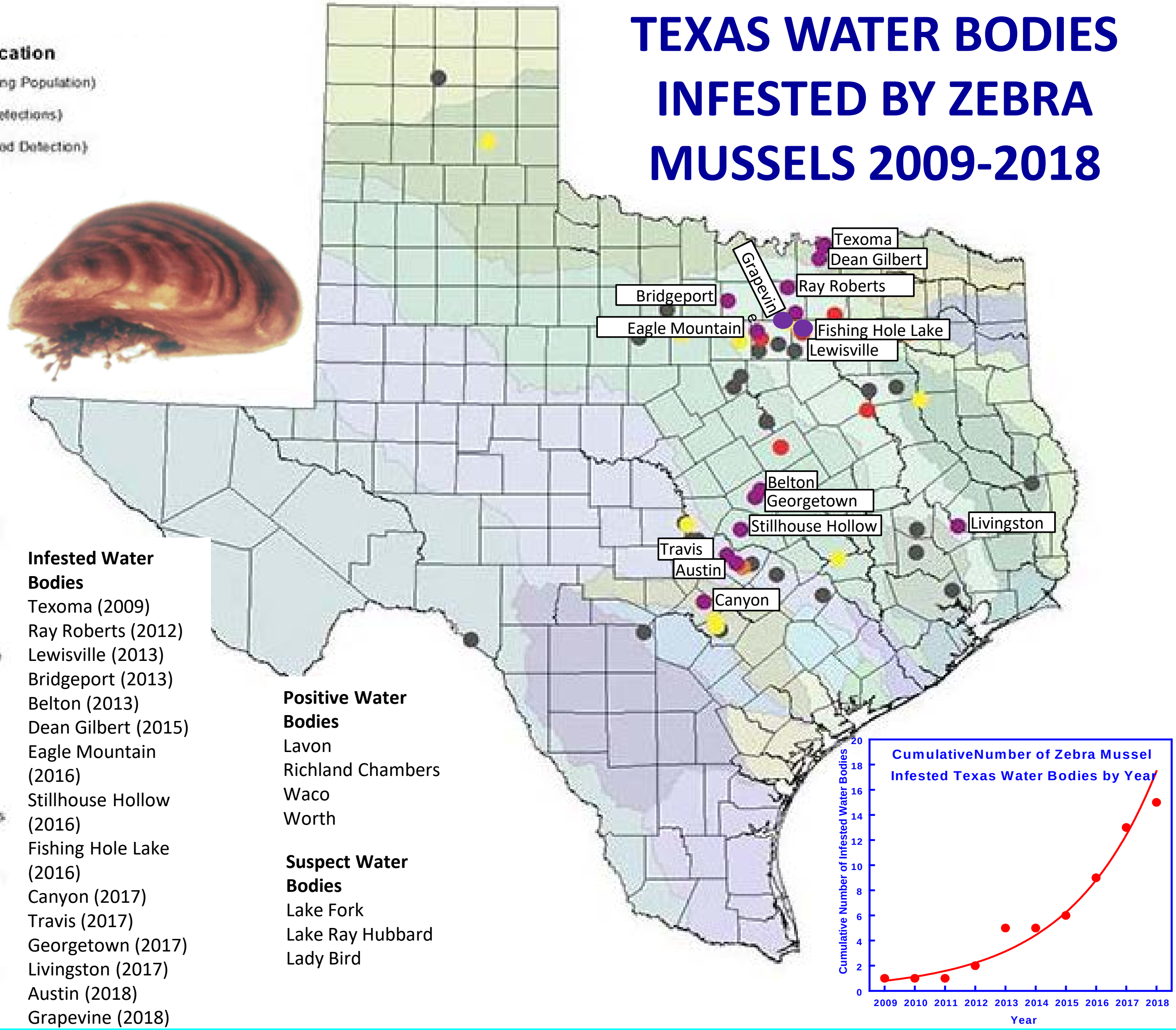
GSARP Meeting
October 30, 2018
San Antonio, Texas

TEXAS PARKS & WILDLIFE

Center for Biological Macrofouling Research

Zebra Mussel Status as of October 2018

TEXAS WATER BODIES INFESTED BY ZEBRA MUSSELS 2009-2018



Infested Water Bodies

Texoma (2009)
Ray Roberts (2012)
Lewisville (2013)
Bridgeport (2013)
Belton (2013)
Dean Gilbert (2015)
Eagle Mountain (2016)
Stillhouse Hollow (2016)
Fishing Hole Lake (2016)
Canyon (2017)
Travis (2017)
Georgetown (2017)
Livingston (2017)
Austin (2018)
Grapevine (2018)

Positive Water Bodies

Lavon
Richland Chambers
Waco
Worth

Suspect Water Bodies

Lake Fork
Lake Ray Hubbard
Lady Bird

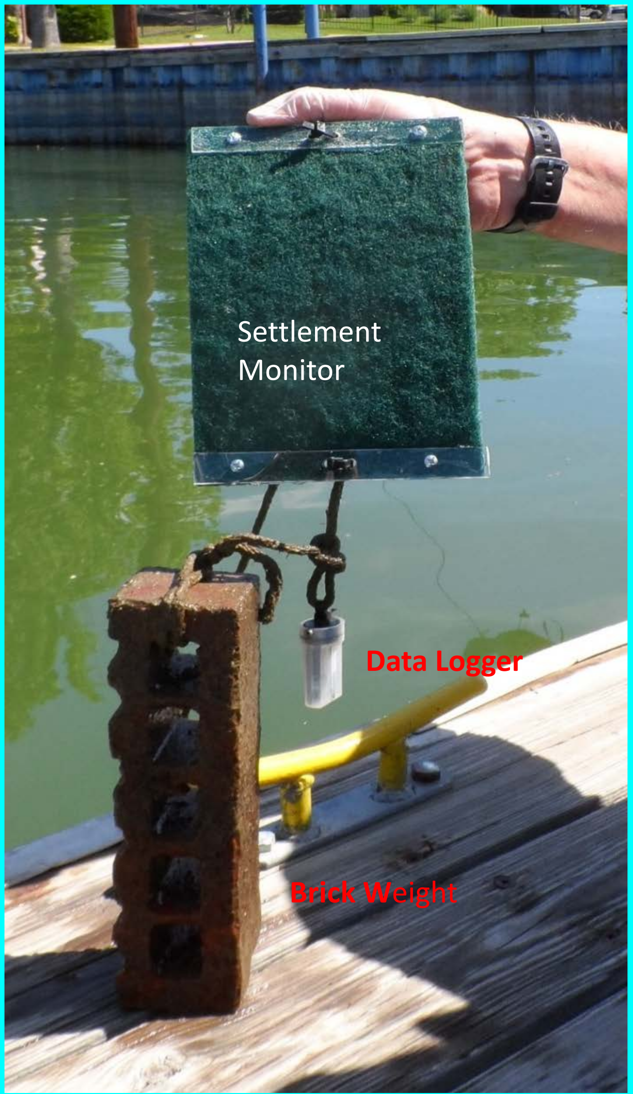
Presentation Outline

- Study Sites
  - Lakes Texoma (Red River – Infested 2009), Ray Roberts (Trinity River-infested 2012 and Belton (Brazos River – Infested 2013)
  - Course of the study (August 2016 – August 2017)
- Aspects of zebra mussel population dynamics studied
  - Mussel seasonal cohorts, growth rates and spawning periods
  - Temperature impacts on spawning and juvenile settlement and adult mussel life spans
  - Mussel settlement periods and density
  - Impacts of low pH and low oxygen concentrations on mussel reproduction and density
  - Size distributions of veliger larvae in relation to juvenile settlement
  - Impact of lake water level variation on mussel densities
- Conclusions
- Acknowledgements

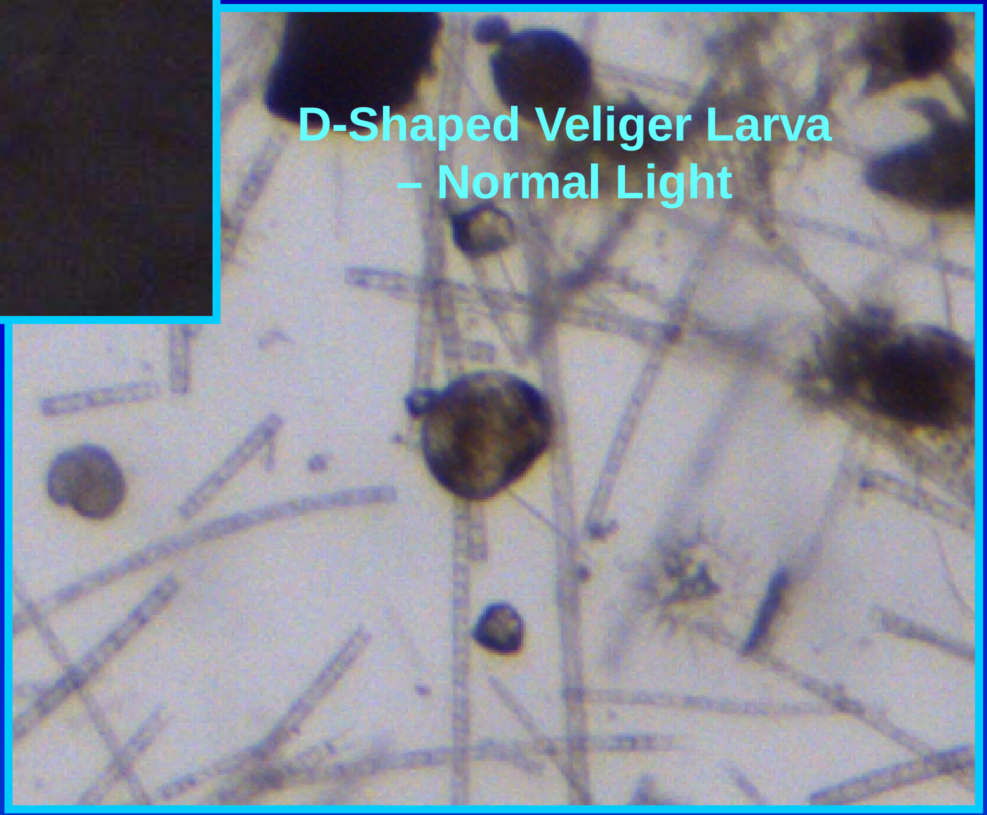
Methods

- Zebra mussel size distributions, cohort growth rates and densities
  - Mussels were settled on earlier deployed house bricks held at a constant depth of 1.5-2.0 m from floating marina docks
  - Randomly sampled (n >100) monthly, shell lengths determined
  - Mussel densities were determined from scouring pad settlement monitors (15.2 x 20.3 cm) (n = 4-7) at each sampling location
    - Deployed prior to start of study
    - Attached mussels of each size cohort were counted in the field at 10X followed by re-immersion
- Spawning periods
  - 3-4 vertical plankton net (60 µm mesh) plankton net tows taken monthly
  - Combined into a single sample and preserved in 70% ethyl alcohol
  - Microscopically examined for veliger larvae in the laboratory with cross polarized light
  - Surface water temperature measured hourly with data loggers throughout the study
- Veliger size distributions
  - Shell lengths of >100 randomly chosen veligers (if available) from each sample were measured to the nearest 0.01 µm with a binocular dissecting microscope and digital camera
- Impact of pH and oxygen concentration on mussel densities
  - Surface water pH and oxygen concentrations were measured at each sampling visit
- Impact of water level variation on zebra mussel maximum annual densities
  - Maximum mussel densities compared to degree of annual lake level fluctuation from 2012 to 2017

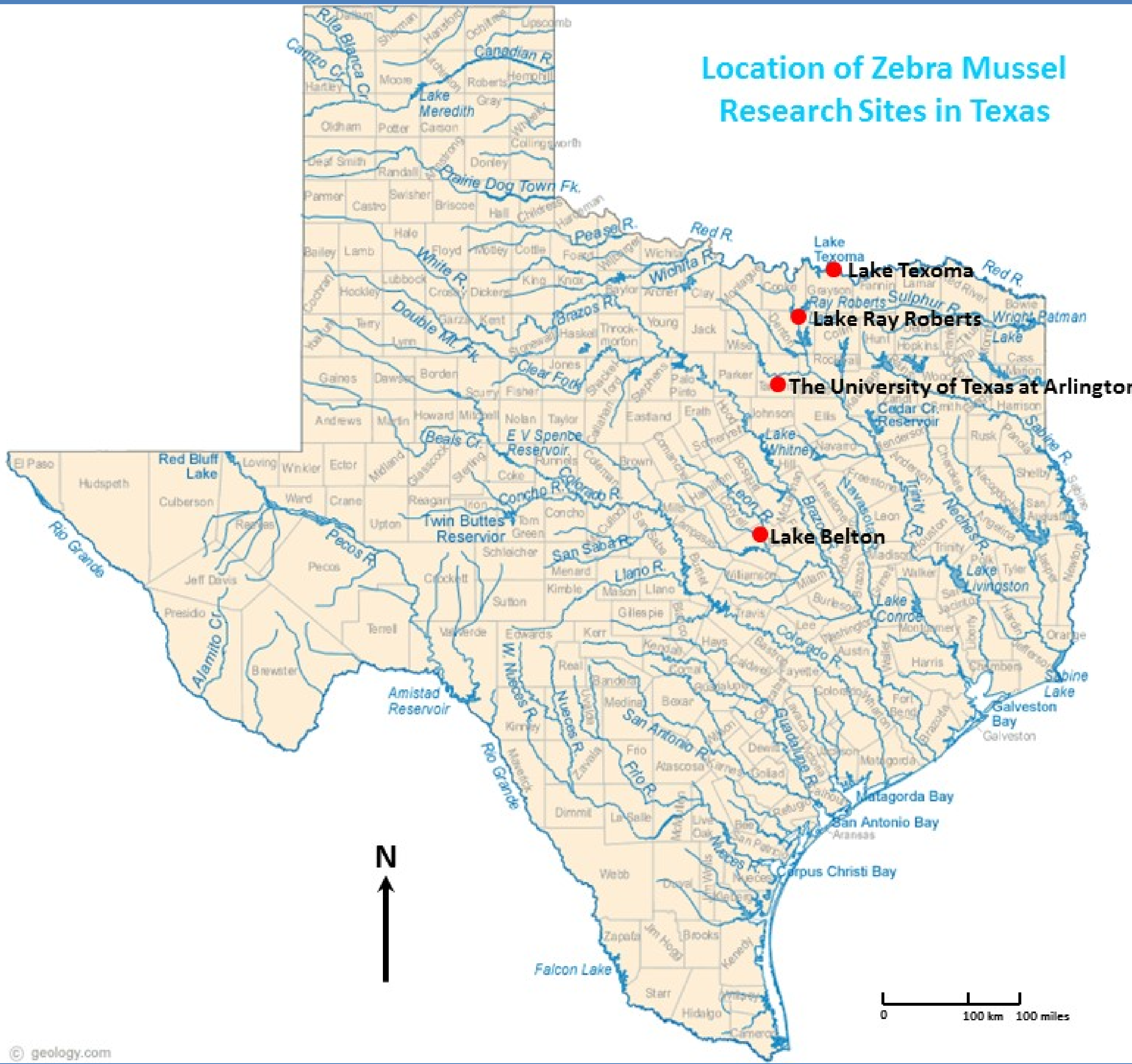
Field Sampling Photos



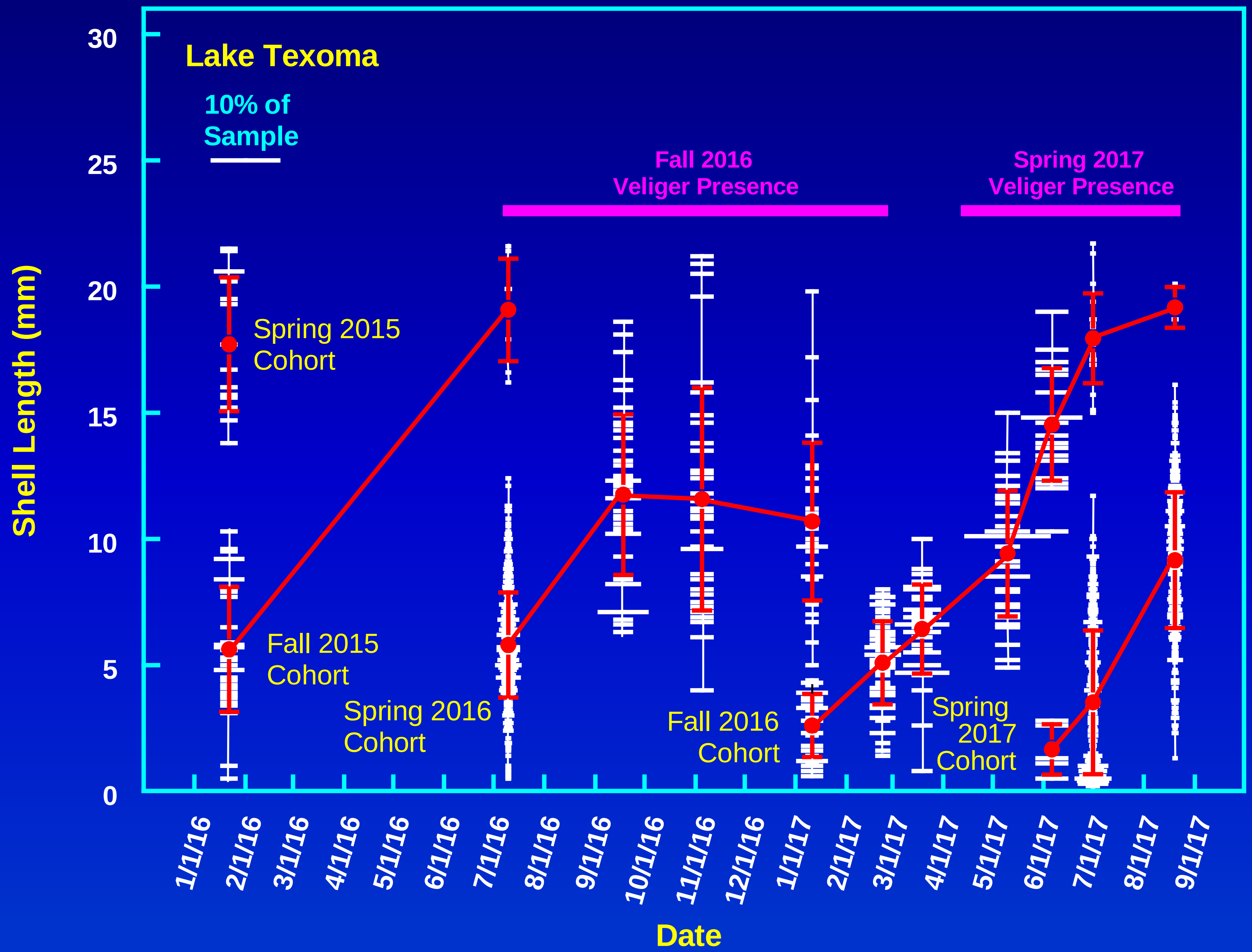
Polarized Light Microscopy



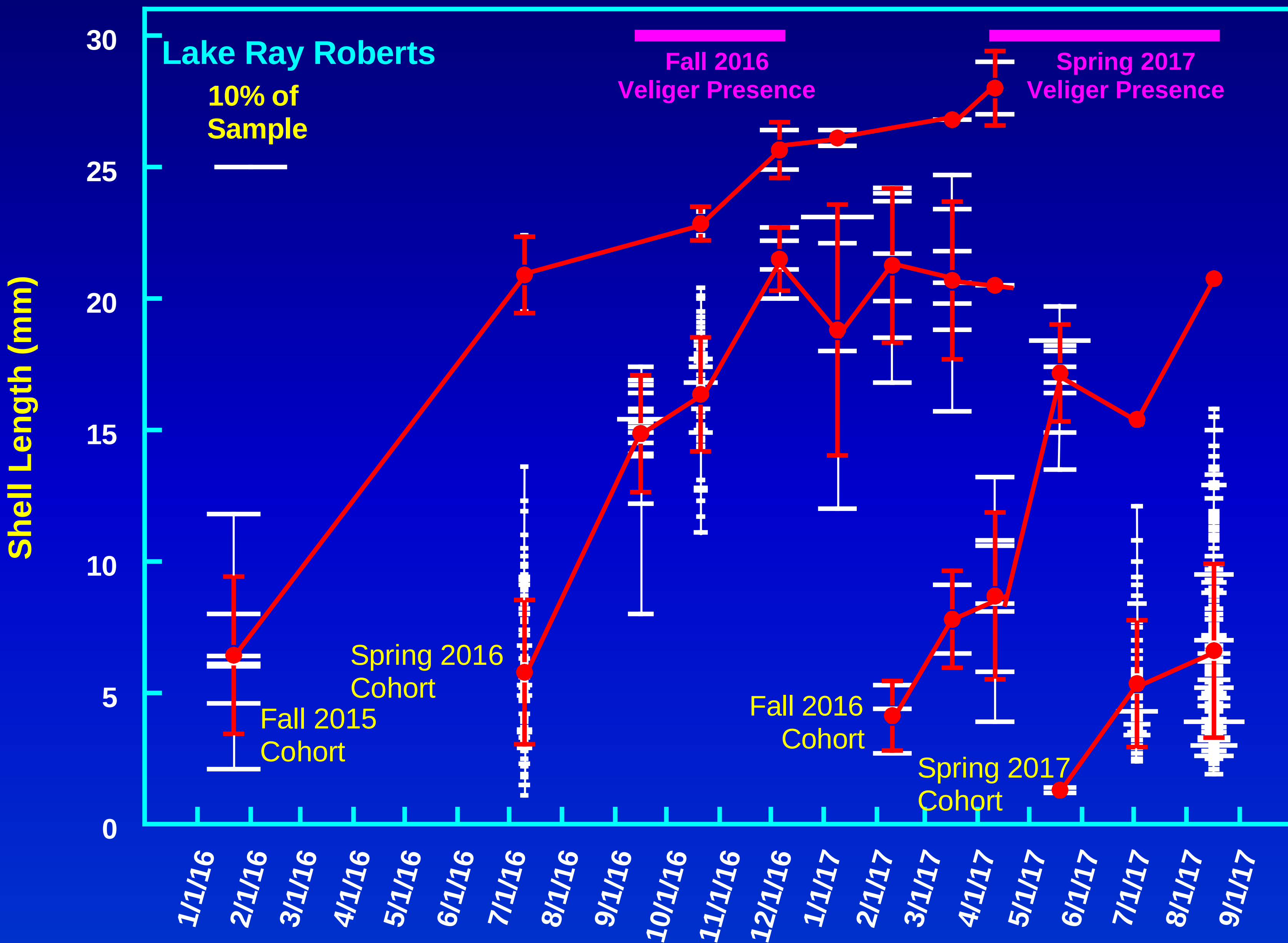
Location of Zebra Mussel Research Sites in Texas



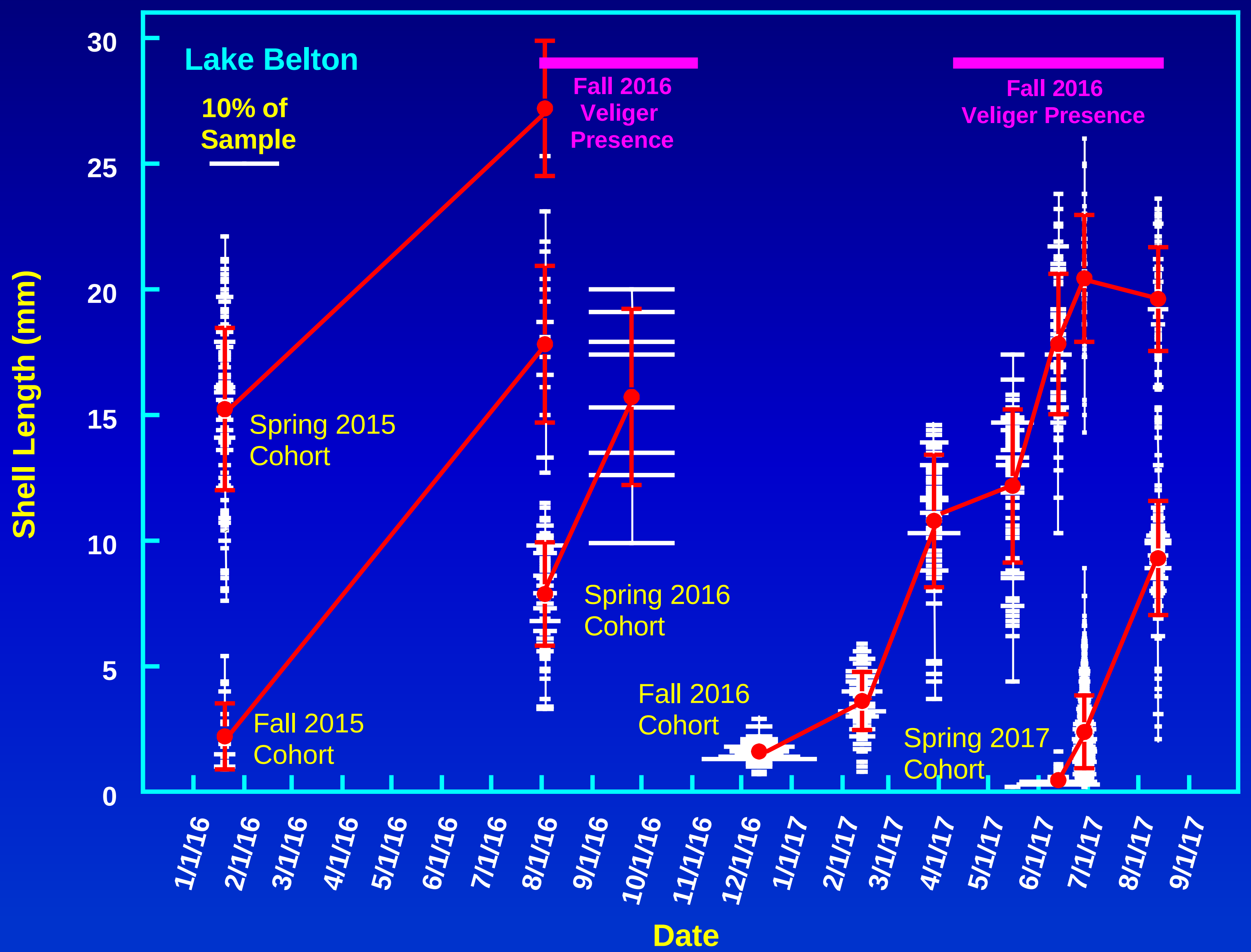
Lake Texoma Mussel Shell Length Distributions Through Time



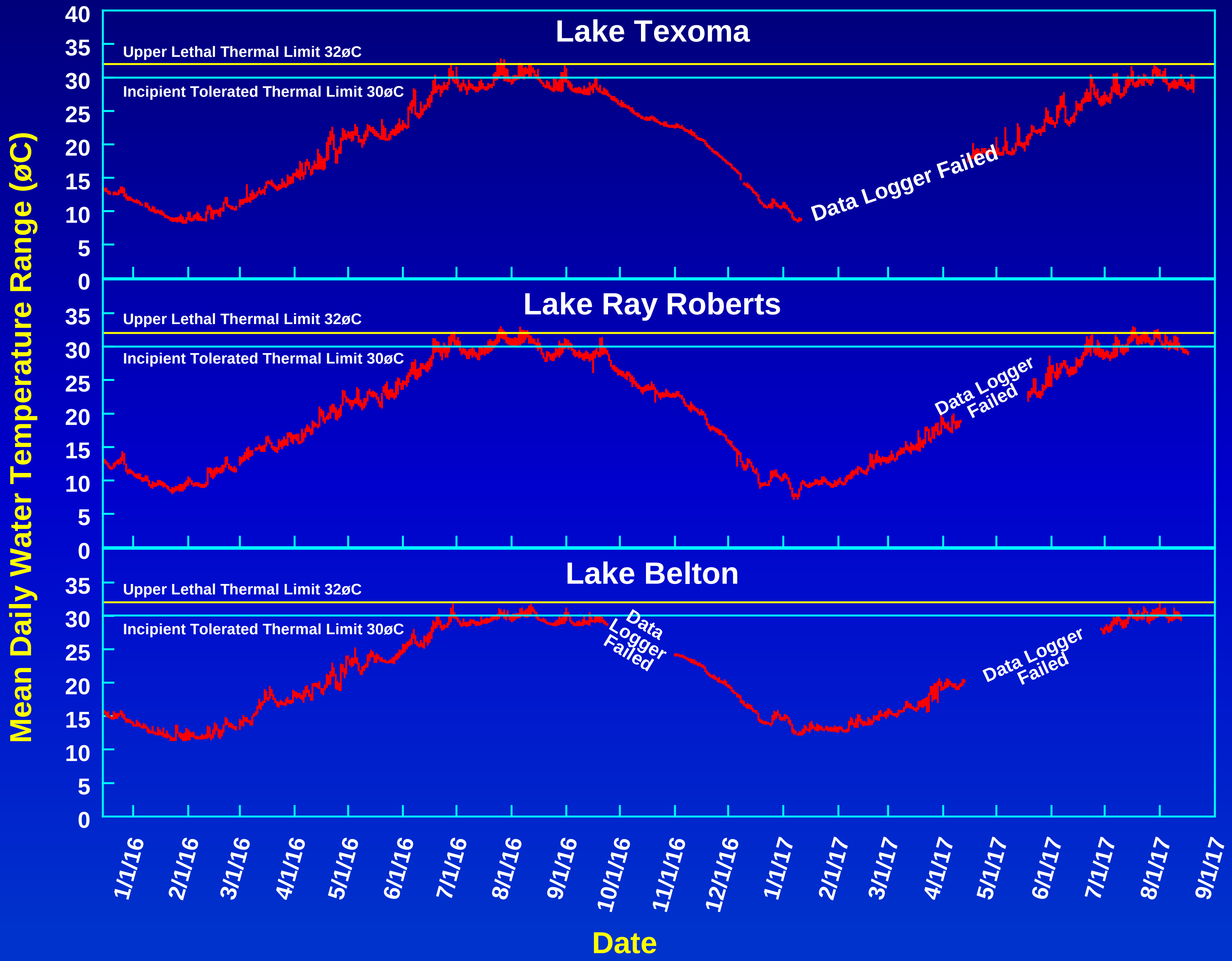
Lake Ray Roberts Mussel Shell Length Distributions Through Time



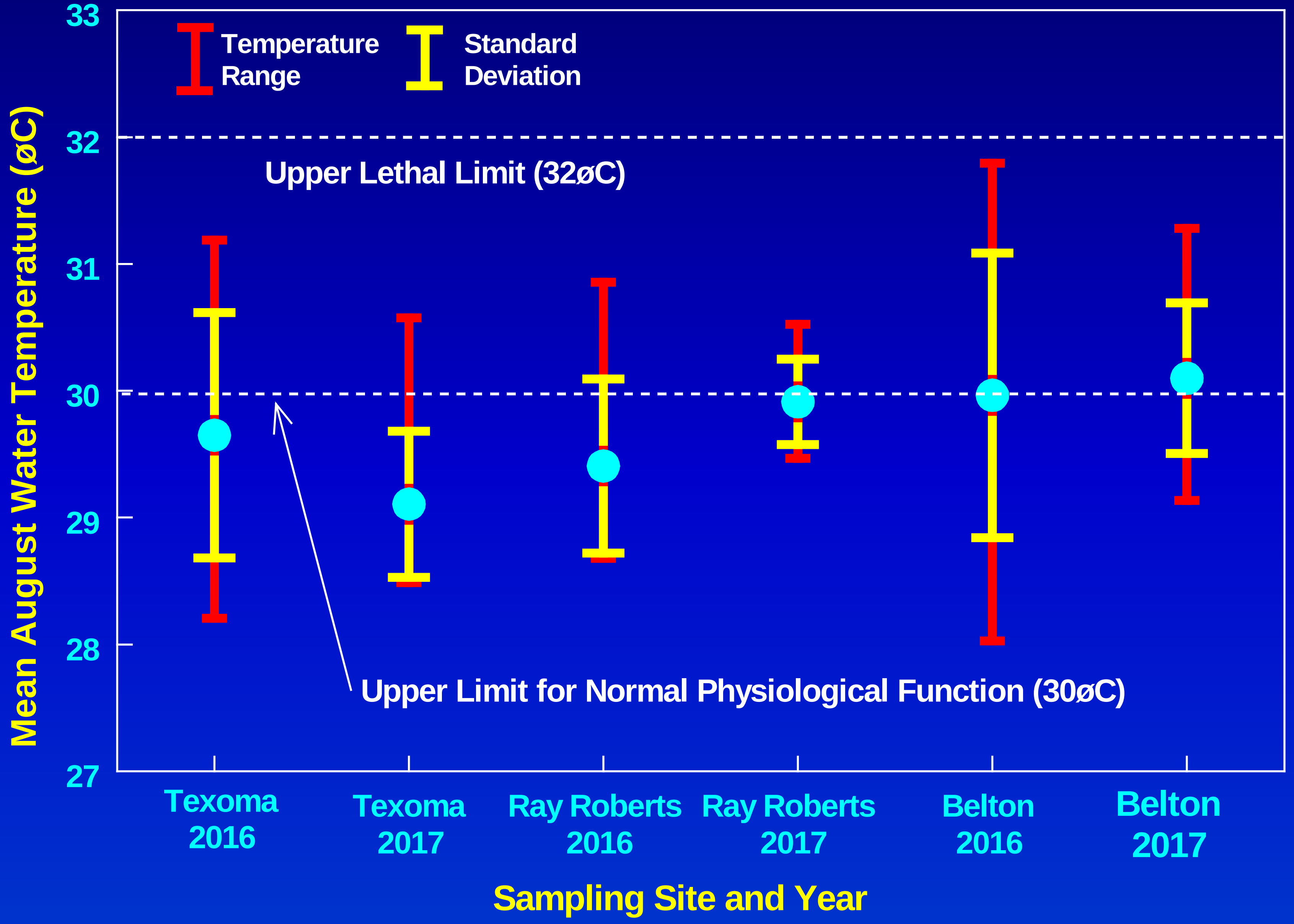
Lake Belton Mussel Shell Length Distributions Through Time



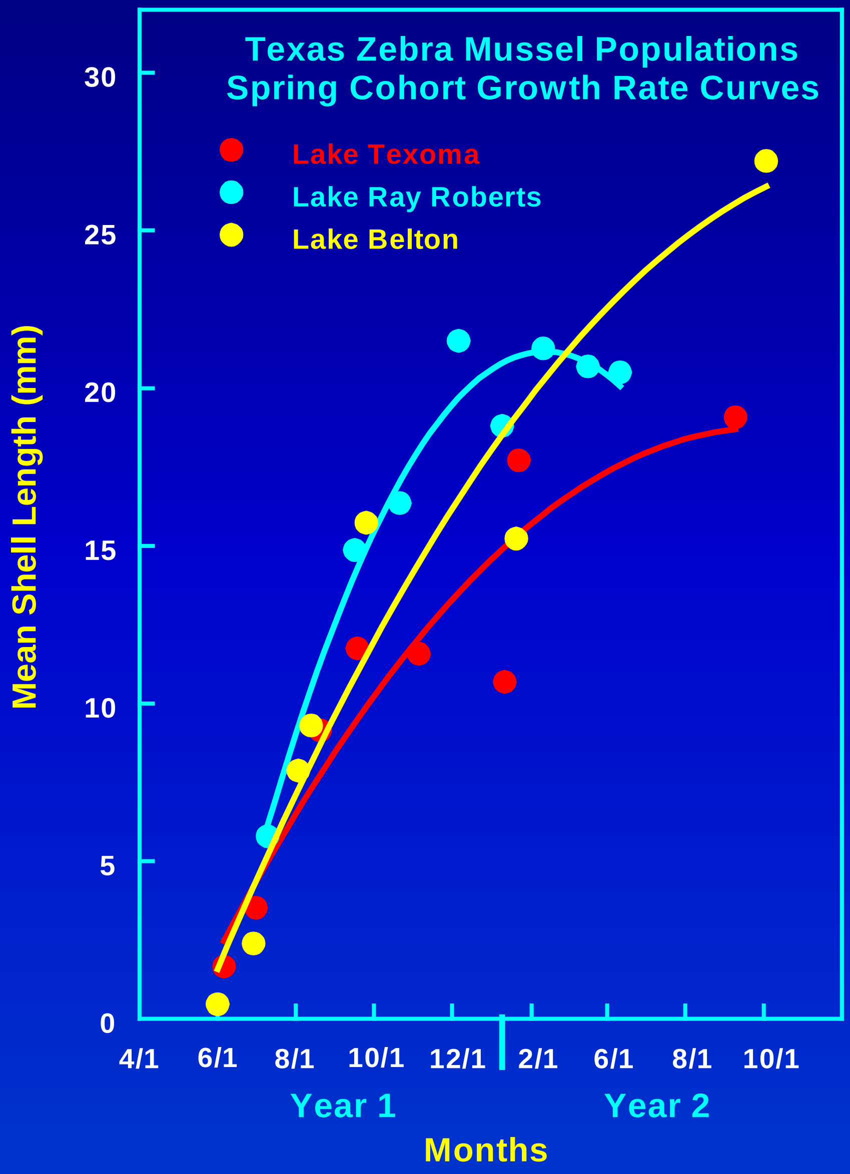
Daily Surface Water Temperature Range through Time

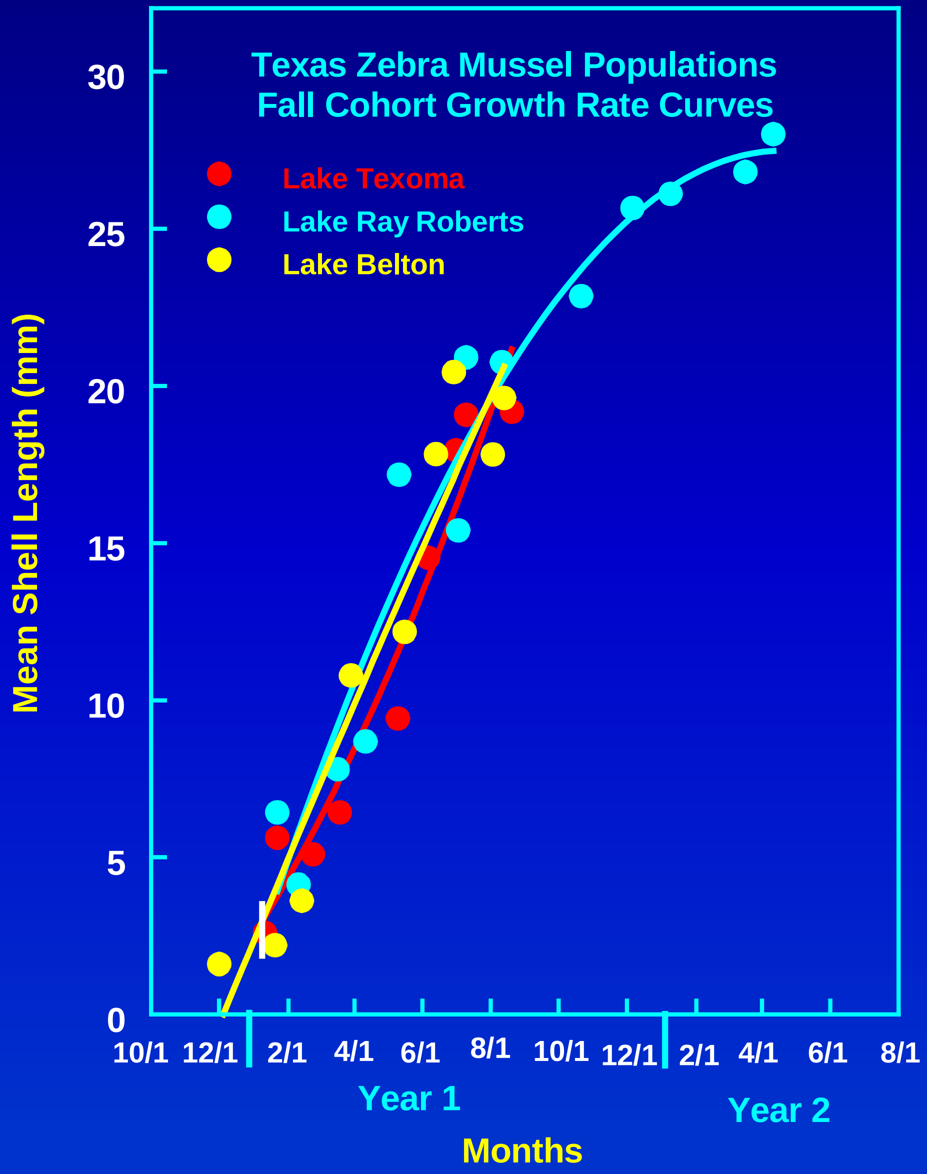


Mean Daily Surface Water Temperatures in August 2016

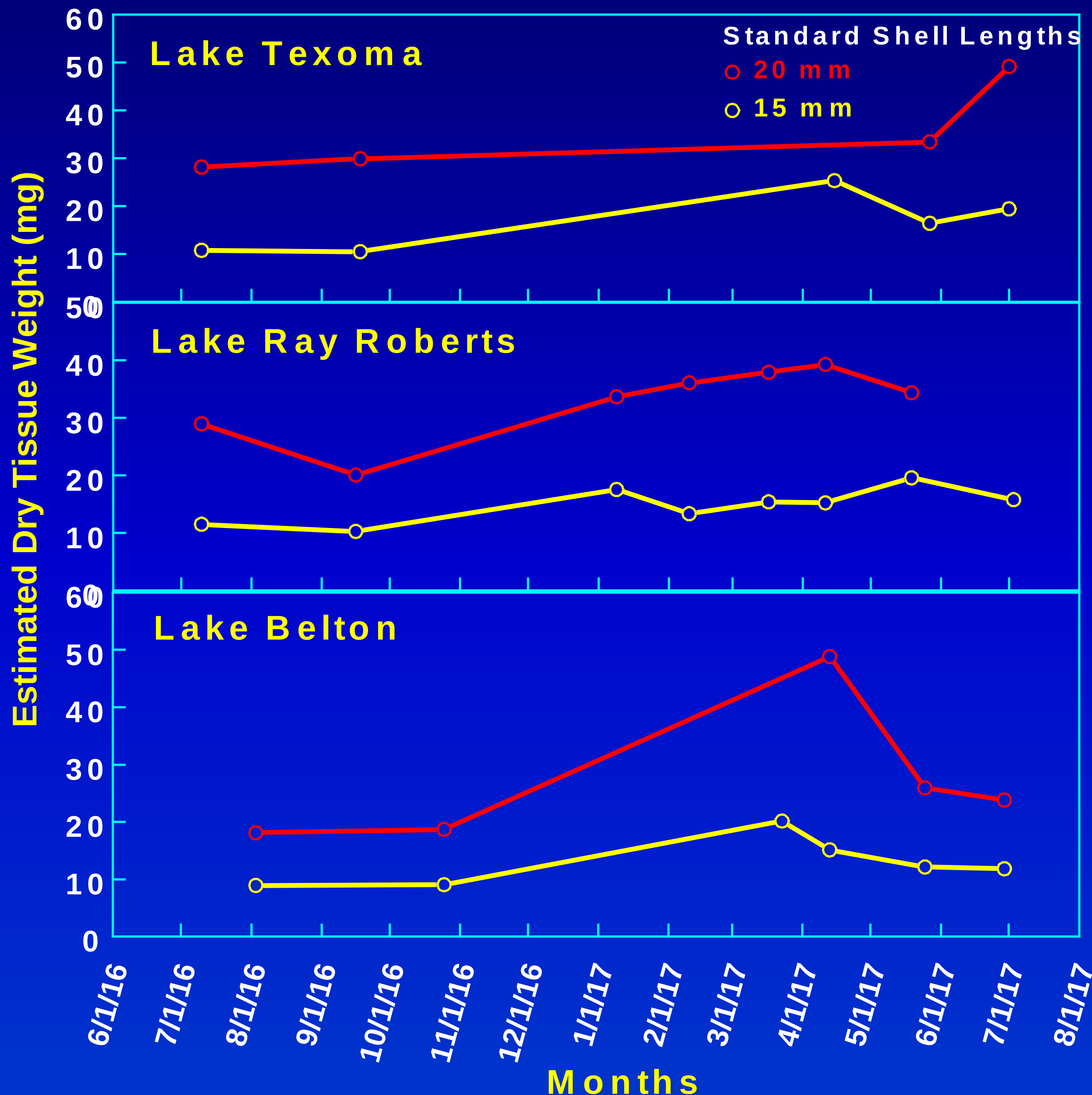


Comparison of Fall and Spring Zebra Mussel Cohort Growth Rates at Lakes Texoma, Ray Roberts and Belton

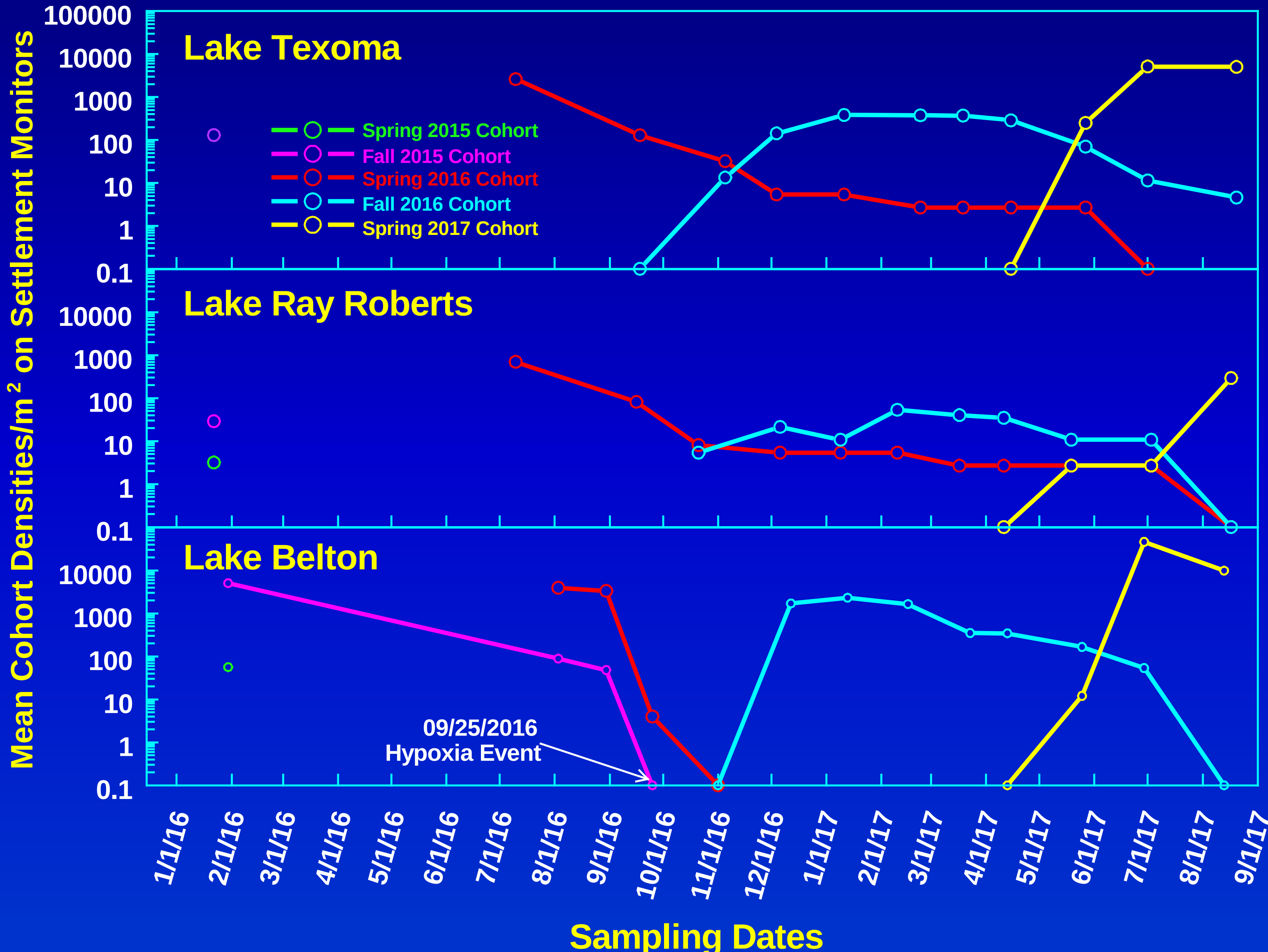




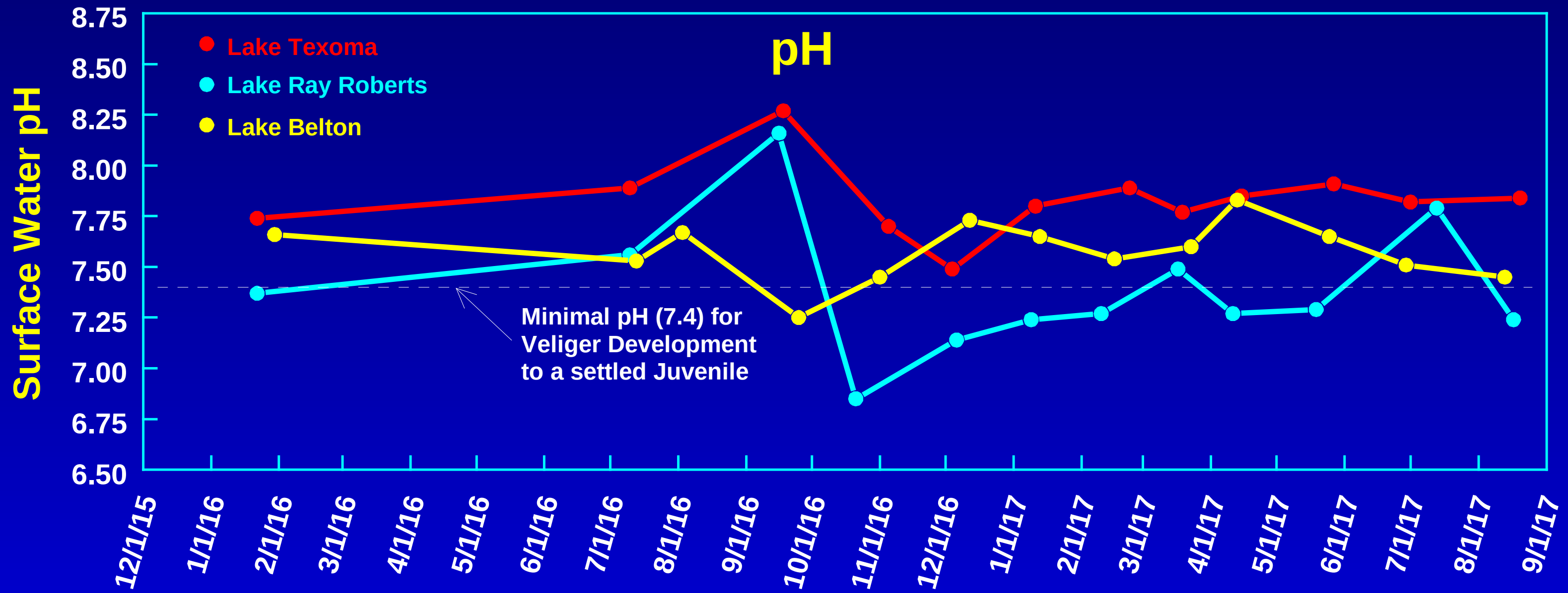
Estimated Dry Tissue Weights for 15 and 20 mm Shell Lengths

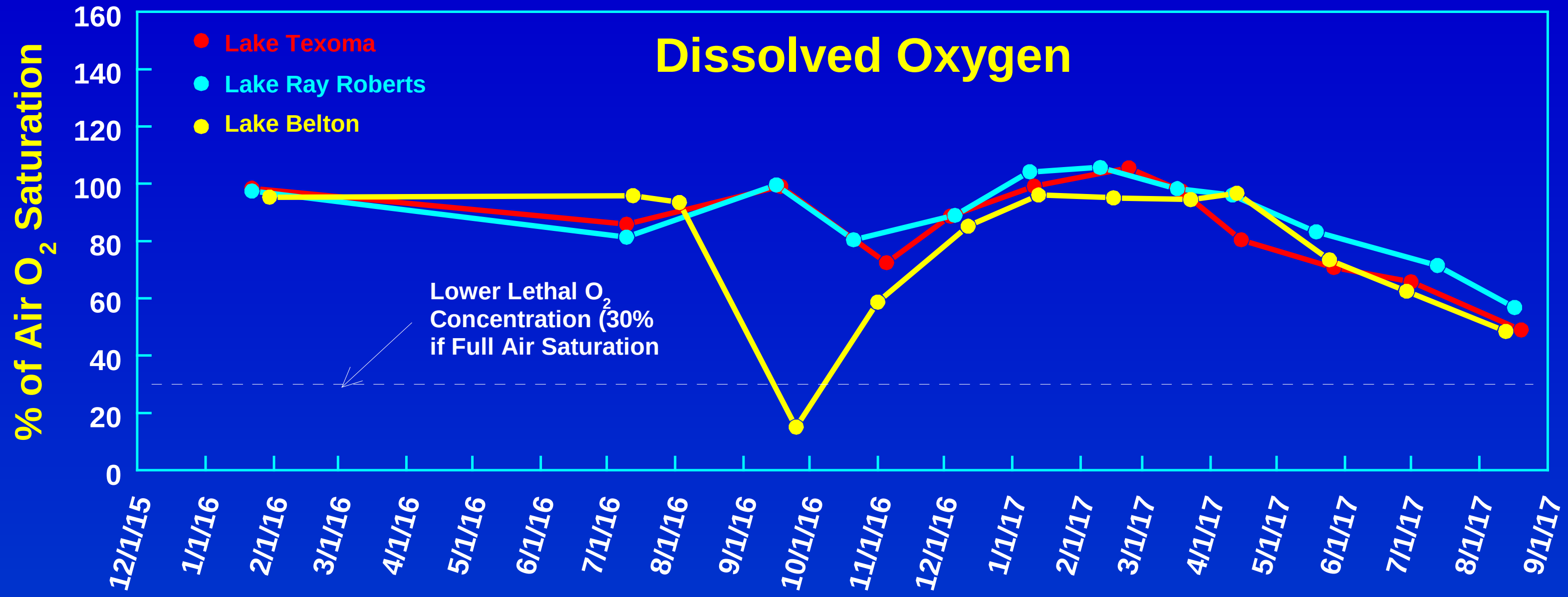


Mean Mussel Cohort Densities on Settlement Monitors in Lakes Texoma, Ray Roberts, and Belton (8/16 – 8/17)



Surface Water pH and Percent Dissolved Oxygen Saturation

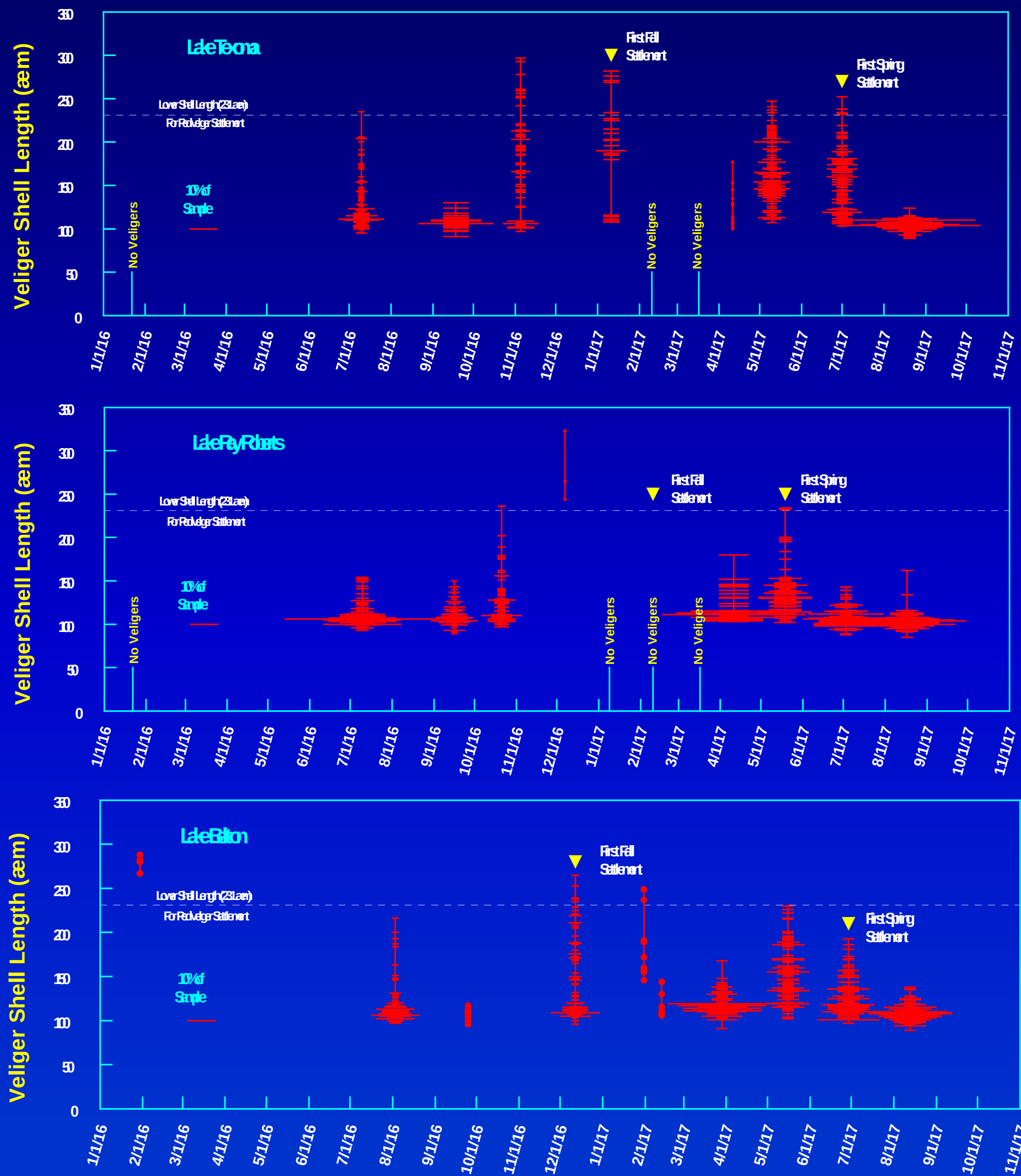




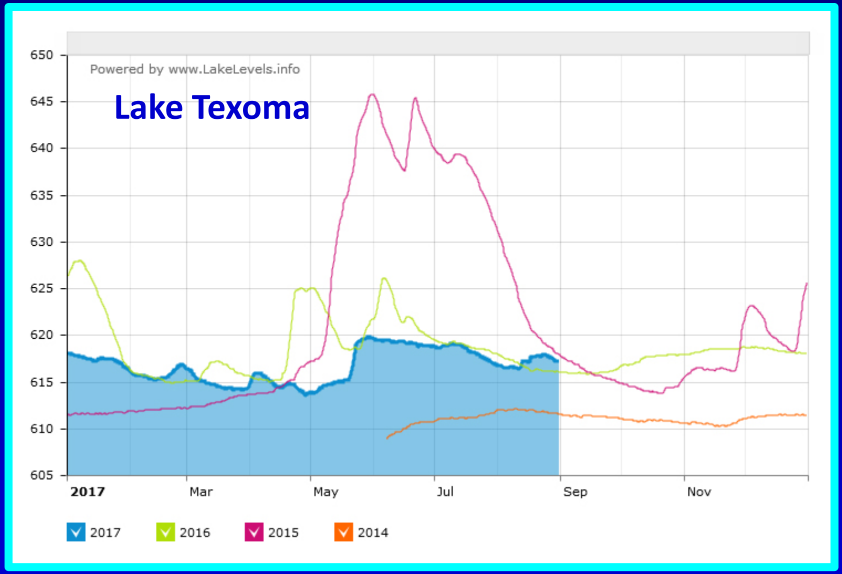
Veliger Shell Length Distributions Through Time (8/16 – 8/17)

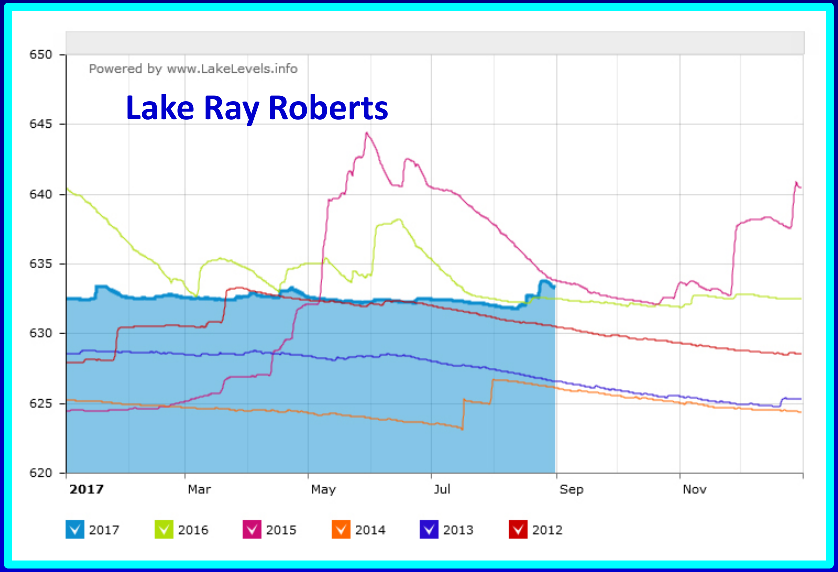
and

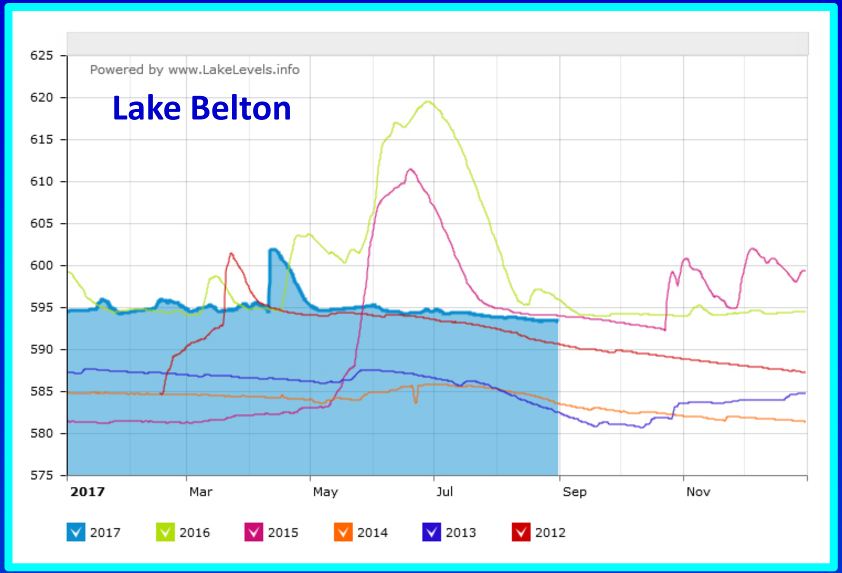
Times of Initial Spring and Fall Cohort Juvenile Mussel Settlement



Annual Water Level Variation in Lakes Texoma, Ray Roberts, and Belton (2012-2017

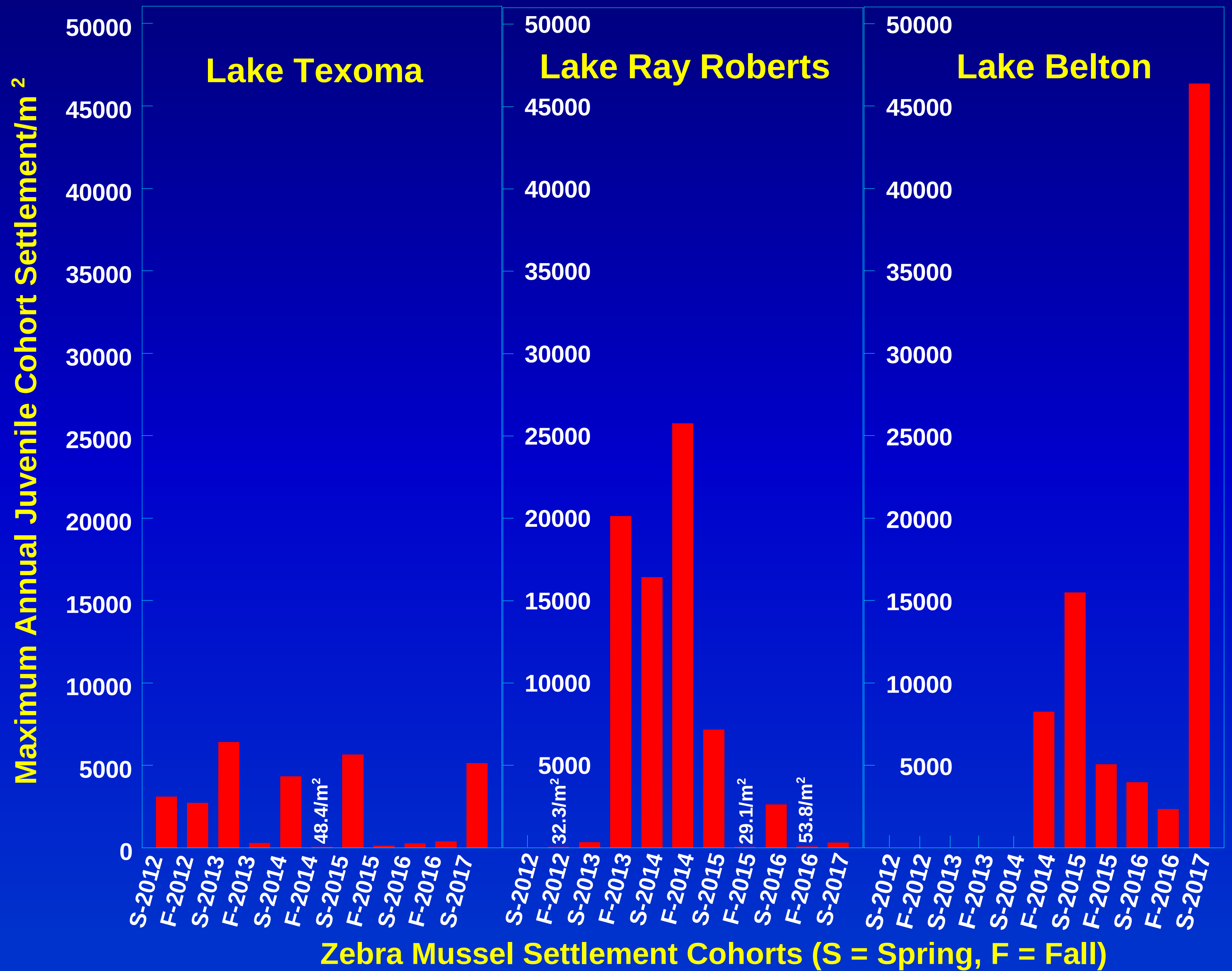




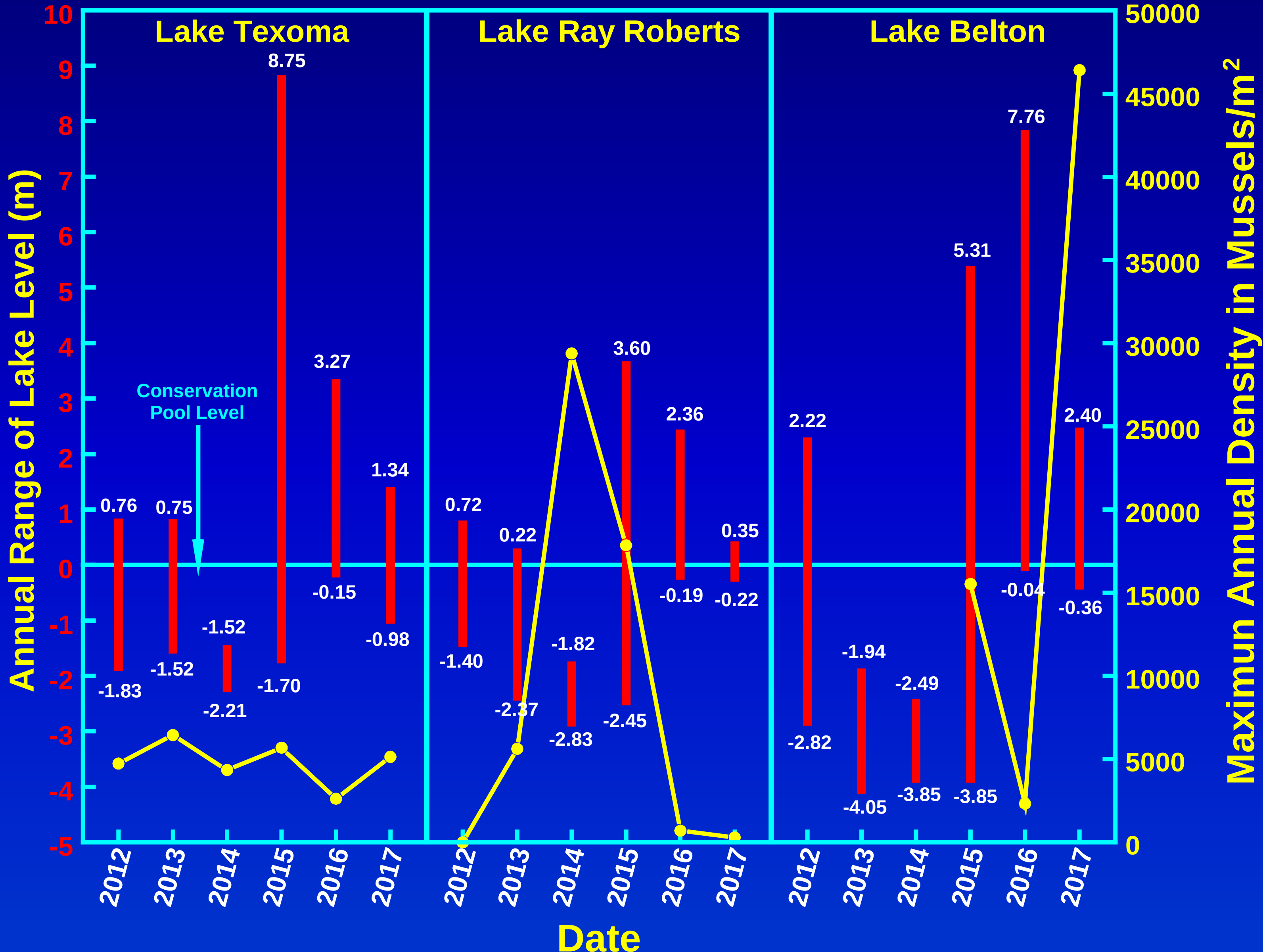


- Historically high water levels occurred in all three lakes during the spring – summer floods of 2015
- Flooding resulting in existing mussel populations being submerged in a hypoxic hypolimnion leading to mass mortality
- The 2015 spring mussel cohort settled in high water areas and were lethally emersed by receding water levels

Maximum Spring and Fall Mussel Settlement Densities in Lakes Texoma, Ray Roberts and Belton 2012-2017



Maximum, Annual Lake Water Level Variation Relative to Maximum Mussel Density on Settlement Monitors, 2012-2017



Conclusions

- Zebra Mussels had distinct spring and fall periods of spawning and juvenile settlement
  - Spring spawning initiated in May-June (>16°C), suppressed by summer water temperatures (>30°C)
  - Fall spawning initiated October-November at <25°C, suppressed by low winter water temperatures (<16°C)
  - Rapid shell growth rates with spring and fall cohorts reaching shell lengths of 20-30 mm within 12-14 months
    - 2-3 years required in northeastern US and European populations to reach similar shell lengths
  - Texas mussel cohort life spans were 1-1.5 years (3-4 years in northeastern US and Europe)
- Veligers reached settlement-competent sizes for abbreviated times during a spawning period
  - Caused settlement to occur 2-4 weeks or more after spawning
  - Applying molluscicides only when settlement-competent pediveligers occur in the plankton to prevent mussel fouling could reduce molluscicide costs and the molluscicide release into source waters
- Mussel cohort densities varied between the studied lakes and over years
  - General trend for decline in settlement and adult densities with increasing length of lake infestation.
  - Mussel densities suppressed in Lake Ray Roberts after 11/2016 when pH was <7.4 required for veliger development to a settled juvenile.
    - Mussel densities are now extremely low
  - Decline in O_2 concentration to 15% of air saturation resulted in near extirpation of the Belton population.
  - Extensive water level variation during spring-early summer in 2015 resulted in major reductions in mussel densities in all three lakes through 2016.
  - Variation in physical parameters such as pH and O_2 concentration and in lake levels are likely to cause Texas zebra mussel populations to experience “boom-bust” population dynamics.

Acknowledgements

- This study was supported by a grant from the Texas Parks and Wildlife Department
  - Monica McGarrity
  - Brian VanZee

- Colette O'Byrne McMahon assisted with all aspects of the field work and note taking.

- We are indebted to the support and cooperation of the managers and staffs of the marinas at which the study was undertaken.
  - Lake Texoma: Eisenhower Yacht Club
  - Lake Ray Roberts: Lake Ray Roberts Marina
  - Lake Belton: Frank's Marina

Thanks For Your Attention