

Freshwater Mussels: General Ecology and TPWD Funded Research in the Lower Guadalupe River Basin

Clinton Robertson, River Studies Program - TPWD



TEXAS
PARKS &
WILDLIFE

Why all the fuss about mussels?

- **Indicator species for water quality and overall river/stream health**
 - Intolerant of poor water quality and habitat modifications
- **Filter feeders**
 - Remove suspended solids/nutrients from the water column improving water quality
- **Important part of the aquatic food web**
 - Provide food for aquatic and terrestrial species
 - Increase benthic macroinvertebrate diversity and biomass





Golden Orb *Quadrula aurea* – Cibolo Creek





Smooth Pimpleback *Quadrula houstonensis* – San Saba River



Mussel Habitat Requirements

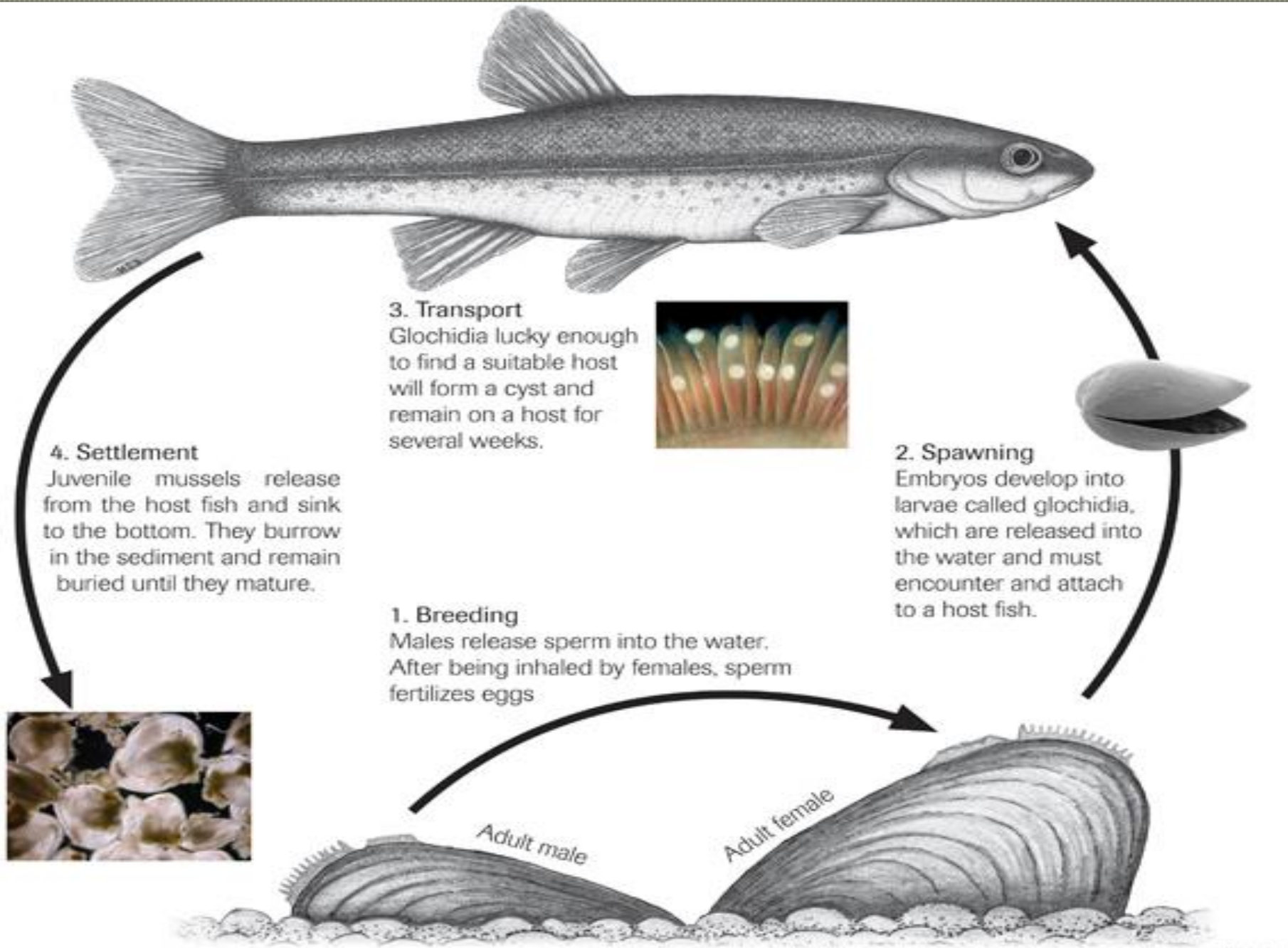
- Substrate
 - Stable substrates with finer sediments in interstitial spaces
- Depth
- Water Velocity
 - High enough to transport food to the mussel
 - Not too high to dislodge the mussel
- Complex hydraulic variables
 - Shear Stress
 - Relative Shear Stress
 - Froude number
 - Reynolds Roughness number
 - etc...



Mussel Life History

Texas Fatmucket *Lampsilis bracteata* – North Llano River





Life cycle of a typical freshwater mussel.

Texas Fatmuck *Lampsilis bracteata* – North Llano River





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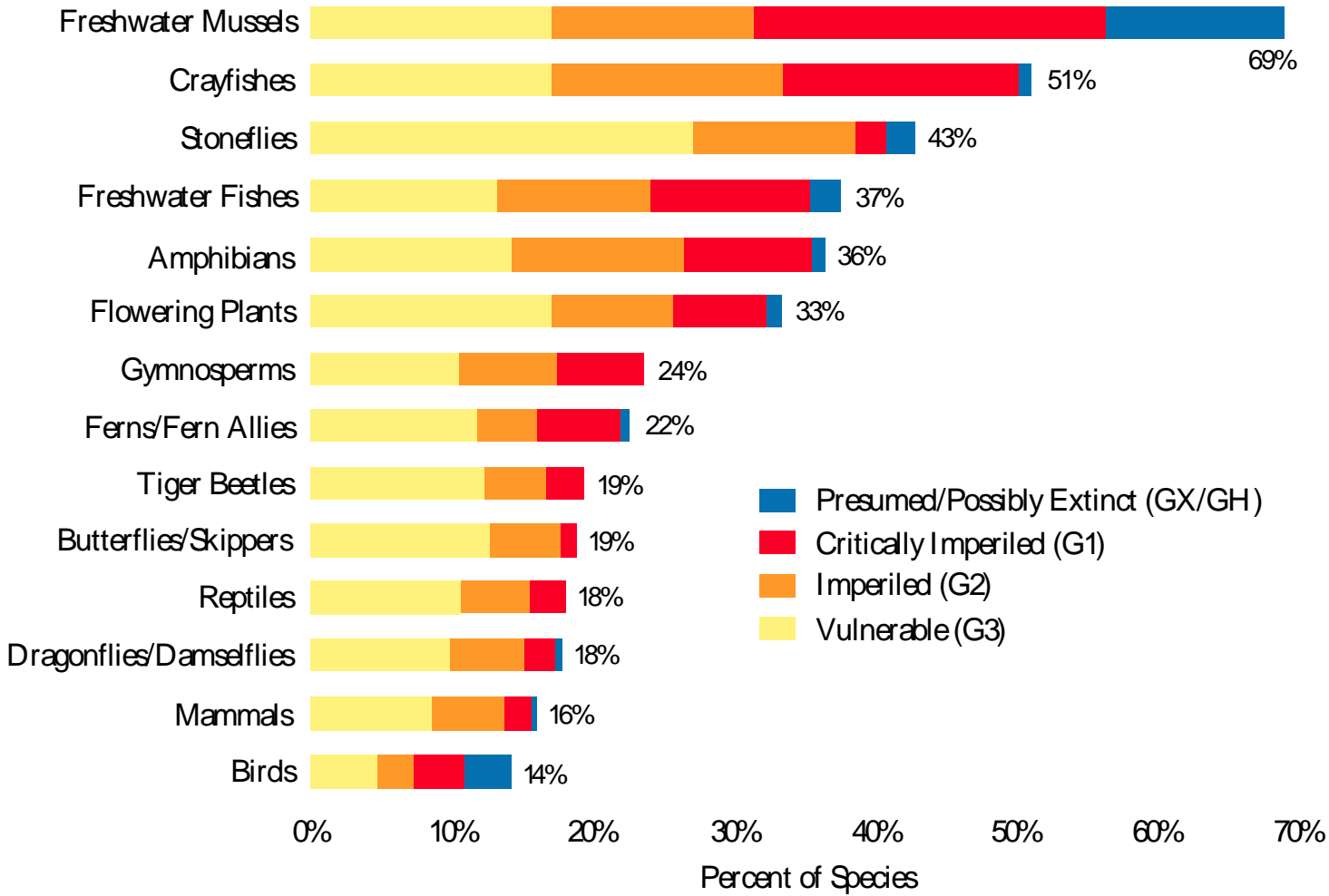


Mussels at Risk



Texas Hornshell *Popenaias popeii* – Devils River

Proportion of species at risk by plant and animal group



Source: *Precious Heritage* (2000) © TNC, NatureServe

Factors for Mussel Declines

- ◉ Sensitivity to poor water quality
 - Juveniles and glochidia are most sensitive
- ◉ Immobility
 - Mussels located mostly where they drop off host fish and remain there most of their life
- ◉ Habitat alterations
 - Dams
 - Flow alterations
 - Land-use changes
- ◉ Loss of Fish Hosts
 - Fish passage
 - Habitat alteration

Mussels in Texas

- ~52 species of mussels in Texas
- 15 species placed on the state threatened list January 2010

Threatened Freshwater Mussels (Bivalvia: Unionidae) of Texas



Fusconia askewi
Texas Pigtoe
TPWD-Threatened



Fusconia lananensis
Triangle Pigtoe
TPWD-Threatened



Lampsilis bracteata
Texas Fatmucket
TPWD-Threatened
ESA-Candidate



Lampsilis satura
Sandbank Pocketbook
TPWD-Threatened



Obovaria jacksoniana
Southern Hickorynut
TPWD-Threatened



Pleurobema riddellii
Louisiana Pigtoe
TPWD-Threatened



Popenaias poppeii
Texas Hornshell
TPWD-Threatened
ESA-Candidate



Potamilus amphichaenus
Texas Heelsplitter
TPWD-Threatened



Potamilus metnecktayi
Salina Mucket
TPWD-Threatened



Quadrula aurea
Golden Orb
TPWD-Threatened
ESA-Candidate



Quadrula houstonensis
Smooth Pimpleback
TPWD-Threatened
ESA-Candidate



Quadrula mitchelli
False Spike
TPWD-Threatened



Quadrula petrina
Texas Pimpleback
TPWD-Threatened
ESA-Candidate



Truncilla cogyata
Mexican Fawnsfoot
TPWD-Threatened

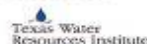


Truncilla macrodon
Texas Fawnsfoot
TPWD-Threatened
ESA-Candidate

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Free poster copies are available to educational, state, or federal management agency personnel. For posters or information email:
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Federal status of the Texas freshwater mussels (Unionidae) listed by the State of Texas

U.S. Fish and Wildlife Service, Southwest Region

DRAFT
updated

Sep-2016

Mussel Species		Package Name and Grouping ²	Historic Range Texas River Basins (+other states)	Federal ESA Listing Status ³	Federal Register Reference	Priority Bin or LPN ⁴	Status in Texas ⁵
Common Name	Scientific Name ¹						
false spike	<i>Quadrula</i> (=Fusconia) <i>mitchelli</i>	Central Texas Mussels (FY18)	Brazos, Colorado, Guadalupe	Petitioned. Positive 90-day finding made. FWS action is a 12-month finding (FY18).	12/15/09, 74FR66260	BIN 1	Threatened
Texas fatmucket	<i>Lampsilis bracteata</i>		Colorado, Guadalupe				
Texas pimpleback	<i>Quadrula petrina</i>		Colorado, Guadalupe - possibly will be split to 2 species by basin	Candidates. Petitioned with positive 90-day findings and warranted 12-month findings. FWS action is a proposed listing determination (FY18).	12/15/09, 74FR66260; 10/06/11, 76FR62166	LPN 2	Threatened
Texas fawnsfoot	<i>Truncilla macrodon</i>		Brazos, Colorado				
triangle pigtoe	<i>Fusconaia lananensis</i>	East Texas Mussels (FY19)	Neches, San Jacinto	Petitioned. Positive 90-day finding made. FWS action is a 12-month finding (FY19).	12/16/09, 74FR66866	BIN 3	Threatened
Louisiana pigtoe	<i>Pleurobema riddellii</i>		San Jacinto, Trinity, Neches, Sabine (+LA)				
Texas heelsplitter	<i>Potamilus amphichaenus</i>		Neches, Trinity, Sabine				
golden orb	<i>Quadrula aurea</i>	Texas Quadrula Species (FY20)	Guadalupe, San Antonio, Nueces-Frio	Candidates. Petitioned with positive 90-day findings and warranted 12-month findings. FWS action is a proposed listing determination (FY20).	12/15/09, 74FR66260; 10/06/11, 76FR62166	LPN 8	Threatened
smooth pimpleback	<i>Quadrula houstonensis</i>		Brazos, Colorado - possibly will be lumped with other <i>Quadrula</i> spp.				
Mexican fawnsfoot	<i>Truncilla cognata</i>	Rio Grande Mussels (FY22)	Rio Grande, Pecos, Rio Salado	Petitioned. Positive 90-day finding made. FWS action is a 12-month finding (FY22).	12/15/09, 74FR66260	BIN 3	Threatened
Salina mucket	<i>Potamilus metnecktayi</i>		Rio Grande (+NM, Mexico)				
Texas hornshell	<i>Popenaias popeii</i>	-	Rio Grande (+NM in Black R.)	Proposed Endangered on Aug 10, 2016. Final Rule (or withdrawal) with Critical Habitat pending.	08/10/16, 81FR52796	-	Threatened
southern hickorynut	<i>Obovaria jacksoniana</i> (=arkansasensis)	-	Mobile?, Neches (+MS, AR, LA, OK, MO, AL, TN)	None. Petitioned with negative 90-day finding. No FWS action expected.	03/23/10, 75FR13717	-	Threatened
Texas pigtoe	<i>Fusconaia askewi</i>	-	Neches, Sabine, San Jacinto (+LA)	None. No FWS action expected.	-	-	Threatened
sandbank pocketbook	<i>Lampsilis satura</i>	-	Neches, Sabine (+AR, LA, MS)	None. No FWS action expected.	-	-	Threatened
Ouachita Rock pocketbook	<i>Arkansia</i> (=Arcidens) <i>wheeleri</i>	-	Red (+OK, AR) - tributaries	Endangered since 1991.	10/23/91, 56FR54950	-	-

Notes: 1 - Taxonomic treatment reflects Howells, R.G. (2014) Field Guide to Texas Freshwater Mussels, second edition. BioStudies, Kerrville, Texas. (May 2015 errata).

2 - Grouping based on similar ranges for multi-species packages for listing or findings under the Endangered Species Act; subject to change and see National Listing Workplan

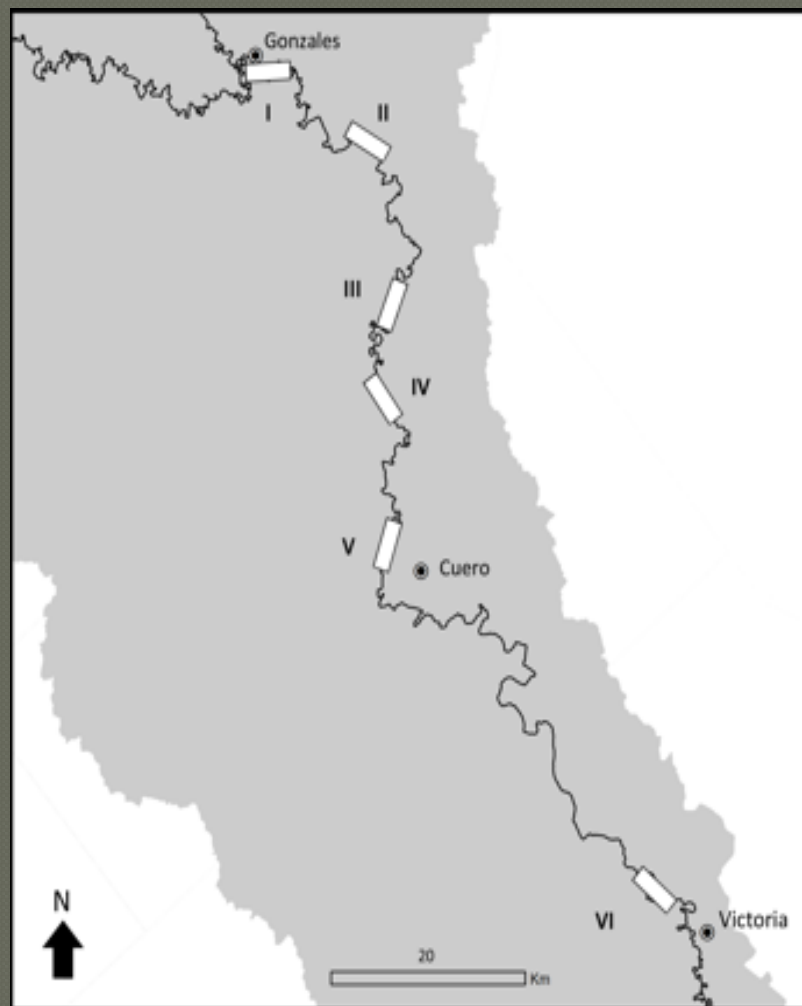
3 - Listing status under the Endangered Species Act. MDL is the multi-district litigation settlement agreement. Projects are based on current workload plans.

4 - Priority Bin Number or Listing Priority Number (LPN) as reported in the 7-year National Listing Workplan (Sept 2016 Version)

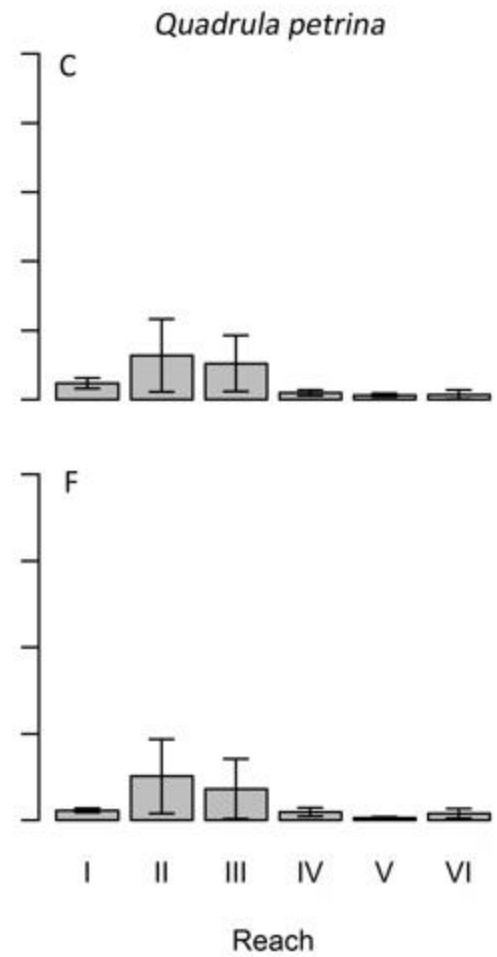
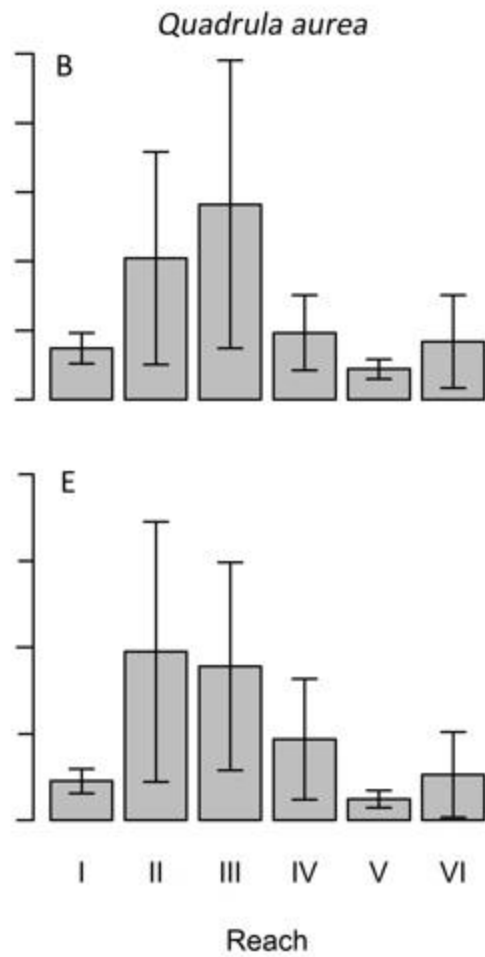
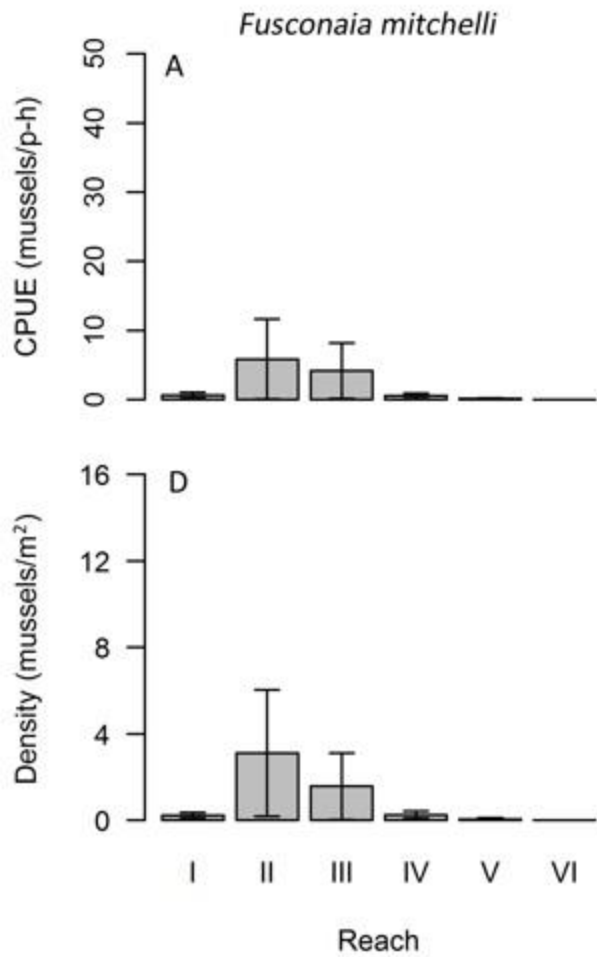
 5 - Listing status by the State of Texas (<http://www.tpwd.state.tx.us/huntwild/wild/species/endang/animals/invertebrates/>)

TPWD Funded Research

- Distribution and habitat associations of freshwater mussels in the Lower Guadalupe River, Texas - Texas A&M University IRNR
 - Quantitative mussel survey from Gonzales to Victoria
 - 21,119 total mussel collected representing 13 species.



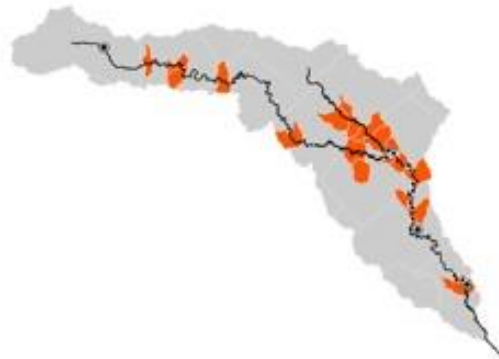
Species		Abundance	
		n	prop
<i>Amblema plicata</i>	threeridge	12,233	0.58
<i>Arcidens confragosa</i>	rock pocketbook	19	0.00
<i>Cyrtonaias tampicoensis</i>	Tampico pearlymussel	1,345	0.06
<i>Lampsilis hydiana</i>	Louisiana fatmucket	49	0.00
<i>Lampsilis teres</i>	yellow sandshell	588	0.03
<i>Megalonaias nervosa</i>	washboard	573	0.03
<i>Pyganodon grandis</i>	giant floater	7	0.00
<i>Quadrula aurea</i>	golden orb	4,624	0.22
<i>Fusconaia mitchelli</i>	false spike	652	0.03
<i>Quadrula petrina</i>	Texas pimpleback	893	0.04
<i>Quadrula verrucosa</i>	pistolgrip	2	0.00
<i>Toxolasma parva</i>	lilliput	107	0.00
<i>Toxolasma texasense</i>	Texas lilliput	27	0.00



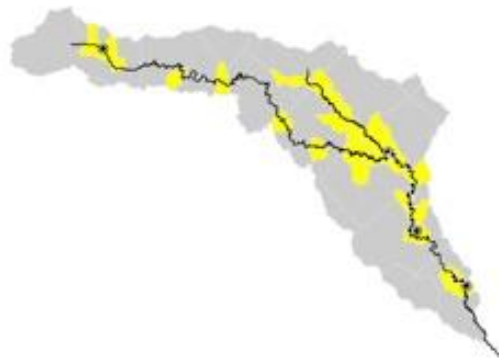
All known records

Records from this study

Fusconaia mitchell



Quadrula aurea



Quadrula petrina

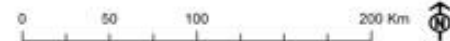
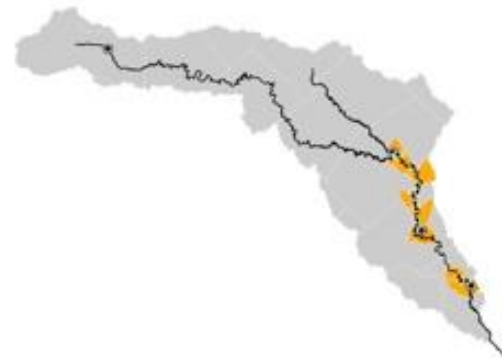
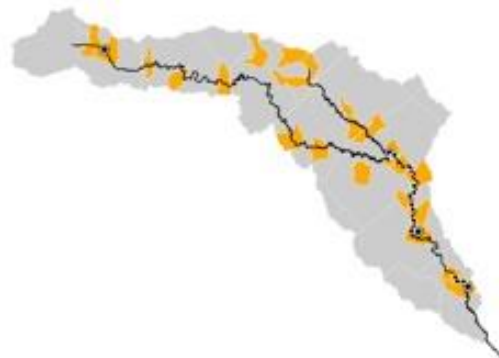


Table 2. Species-mesohabitat associations based on indicator species analysis. IndVal represents the test statistic, *A* is the probability a site belongs to a specific habitat based on the presence of a species, *B* is the probability of finding a species at a site belonging to its associated habitat and *p* is the level of significant ($\alpha = 0.05$).

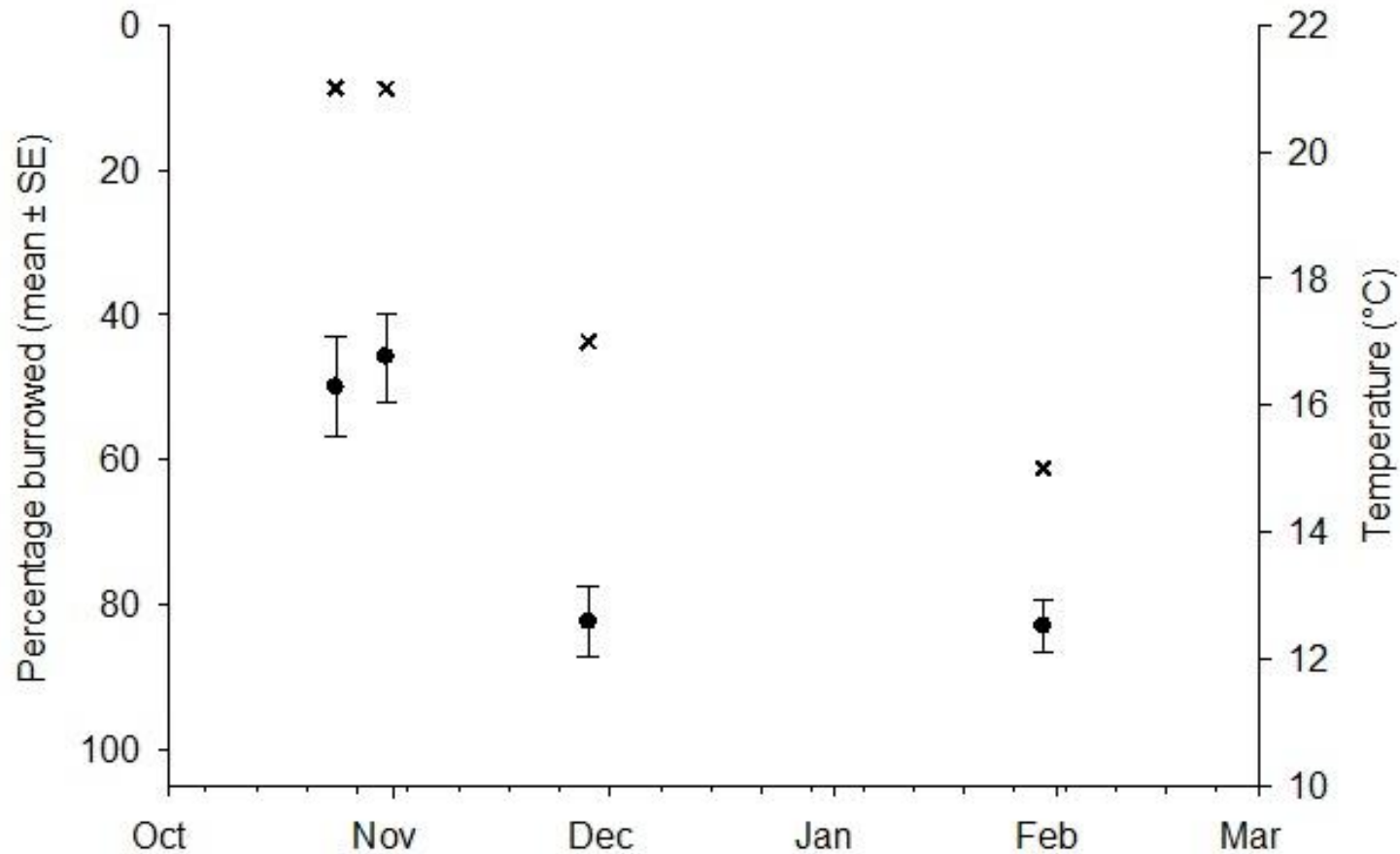
Species	Habitat type							Statistics			
	BH	BPS	BW	FPS	MC	P	R	<i>A</i>	<i>B</i>	<i>IndVal</i>	<i>p</i>
<i>Amblema plicata</i>	x							0.34	1.00	0.58	0.081
<i>Arcidens confragosa</i>	x							0.40	0.27	0.33	0.335
<i>Cyrtonaias tampicoensis</i>	x							0.35	1.0	0.59	0.036
<i>Lampsilis hydiana</i>	x							0.57	0.64	0.60	0.002
<i>Lampsilis teres</i>	x							0.34	1.00	0.58	0.023
<i>Megalonaias nervosa</i>	x							0.31	0.55	0.41	0.695
<i>Pyganodon grandis</i>			x					1.00	0.20	0.45	0.075
<i>Quadrula aurea</i>							x	0.53	0.90	0.69	0.019
<i>Fusconaia mitchelli</i>							x	0.91	0.90	0.91	0.001
<i>Quadrula petrina</i>							x	0.61	0.90	0.74	0.003
<i>Quadrula verrucosa</i>				x				1.00	0.09	0.30	1.000
<i>Toxolasma parva</i>				x				0.68	0.18	0.35	0.378
<i>Toxolasma texasense</i>		x						0.64	0.27	0.42	0.107



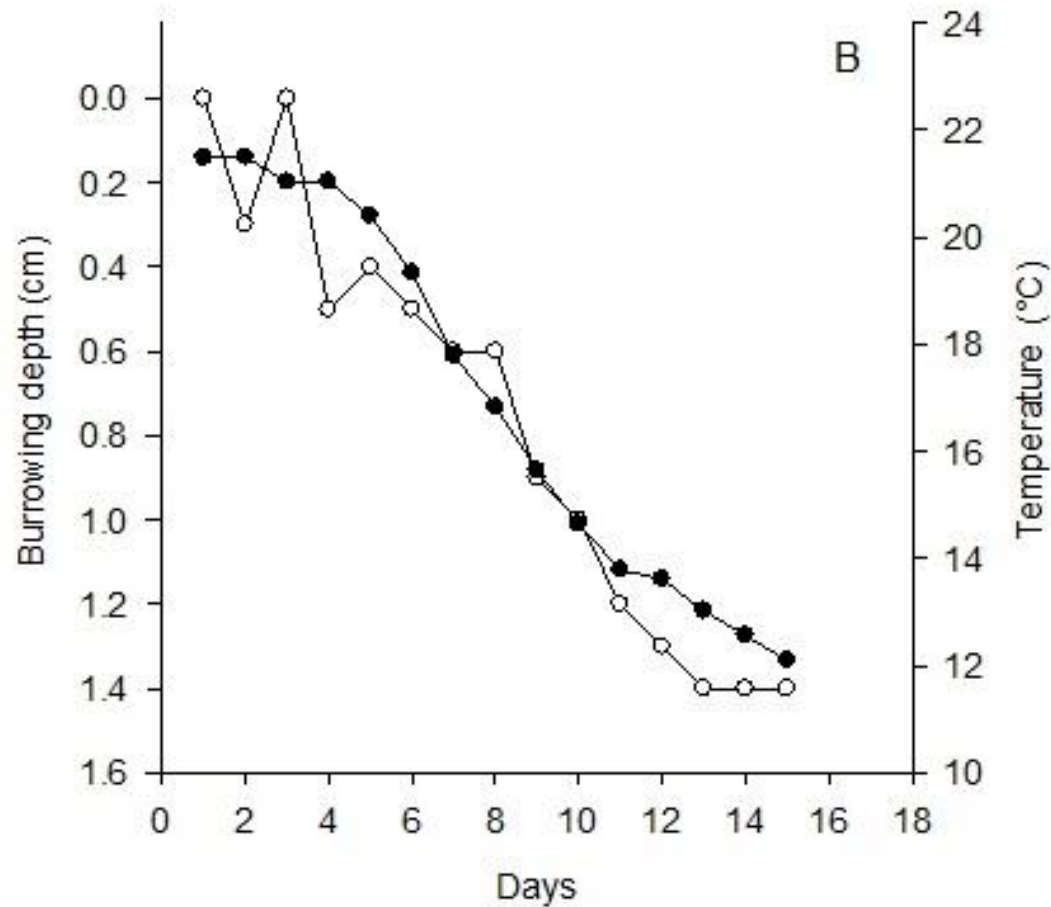
Temperature

- ◉ Vertical Migration of Freshwater Mussels
– Texas State University
 - Laboratory/Field study to assess seasonal vertical migration in mussel species
 - Golden Orb and Texas Pimpleback from the Guadalupe River utilized

Temperature - Field Surveys



Temperature - Laboratory Experiments

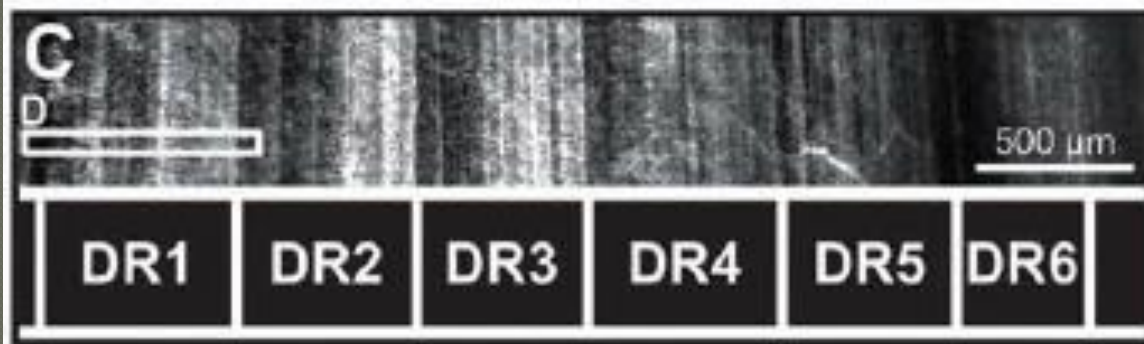
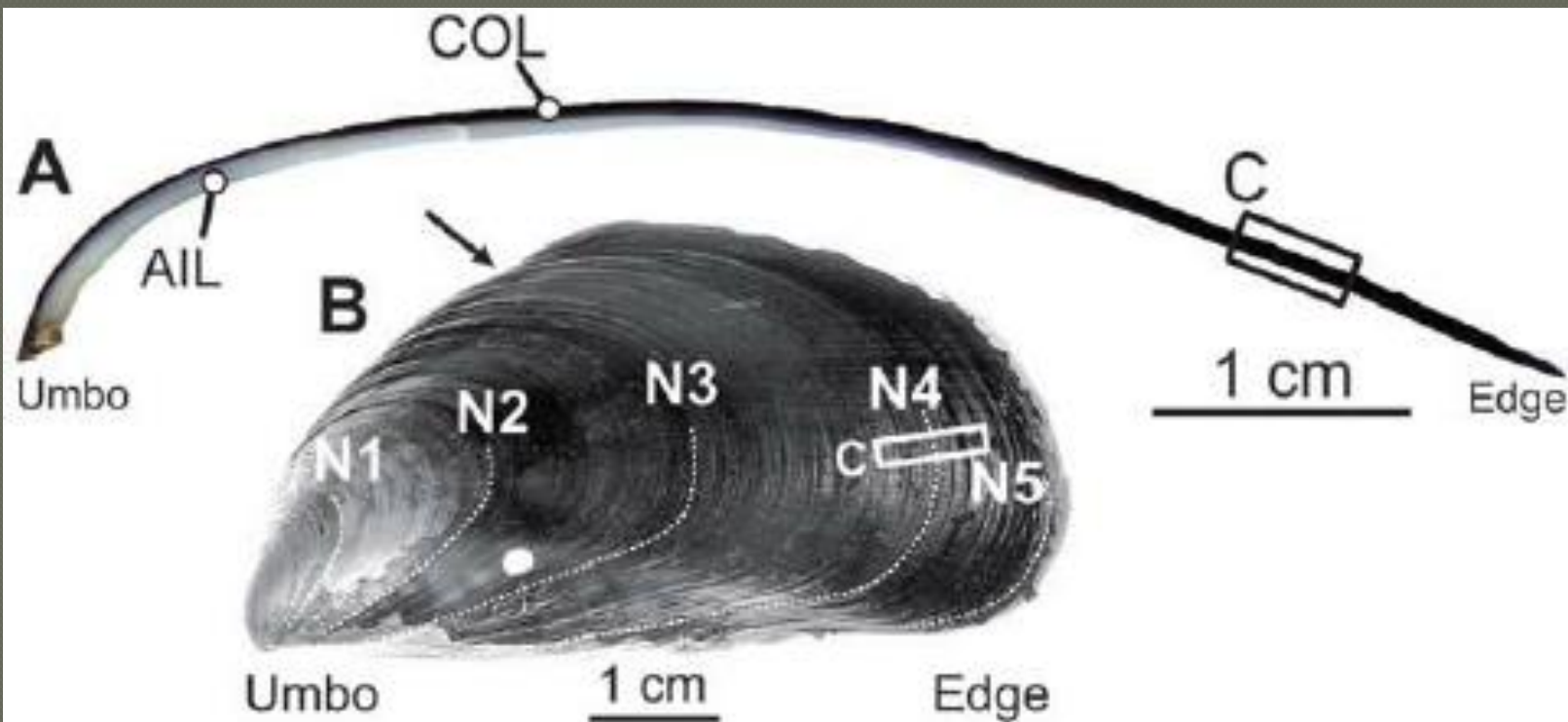


Temperature

- Upper thermal tolerance limits of Golden Orb and False Spike in the lower Guadalupe River – Texas A&M University IRNR
 - Laboratory study to assess the upper thermal tolerance limits of Golden Orb and False Spike

Age and Growth

- Age, growth and environmental exposure histories of threatened freshwater mussels assessed with sclerochronology and shell stable isotopes – Texas A&M Corpus Christi and UT – Marine Science Institute
 - Use shell thin-sectioning to determine the age of Golden Orb and Texas Pimpleback from the lower Guadalupe River



Fish Hosts

- ◉ Host fish use of three rare Central Texas mussel species – Texas A&M University IRNR
 - Laboratory assessment of fish host suitability for Golden Orb, False Spike and Texas Pimpleback from the lower Guadalupe River

Contaminants Assessment

- The Impact of Environmental Contaminants on Texas Unionid Mussels in the Guadalupe Basin – Texas State University
 - Assess the impact of urban and agricultural contaminants (metals, nutrients) on Threeridge and Golden Orb.
 - Ag, silver; Al, aluminum; Cd, cadmium; Cr, chromium; Cu, copper; Hg, mercury; Ni, nickel; Pb, lead; and Zn, zinc and Se (selenium, a non-metal)



Questions?

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