Effects of Experimental Flows on Freshwater Mussels (Unionidae) Below Red Rock Dam

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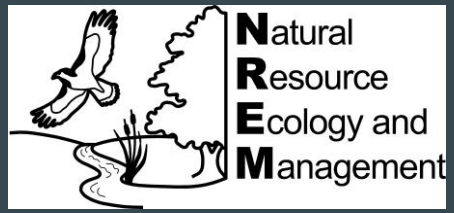
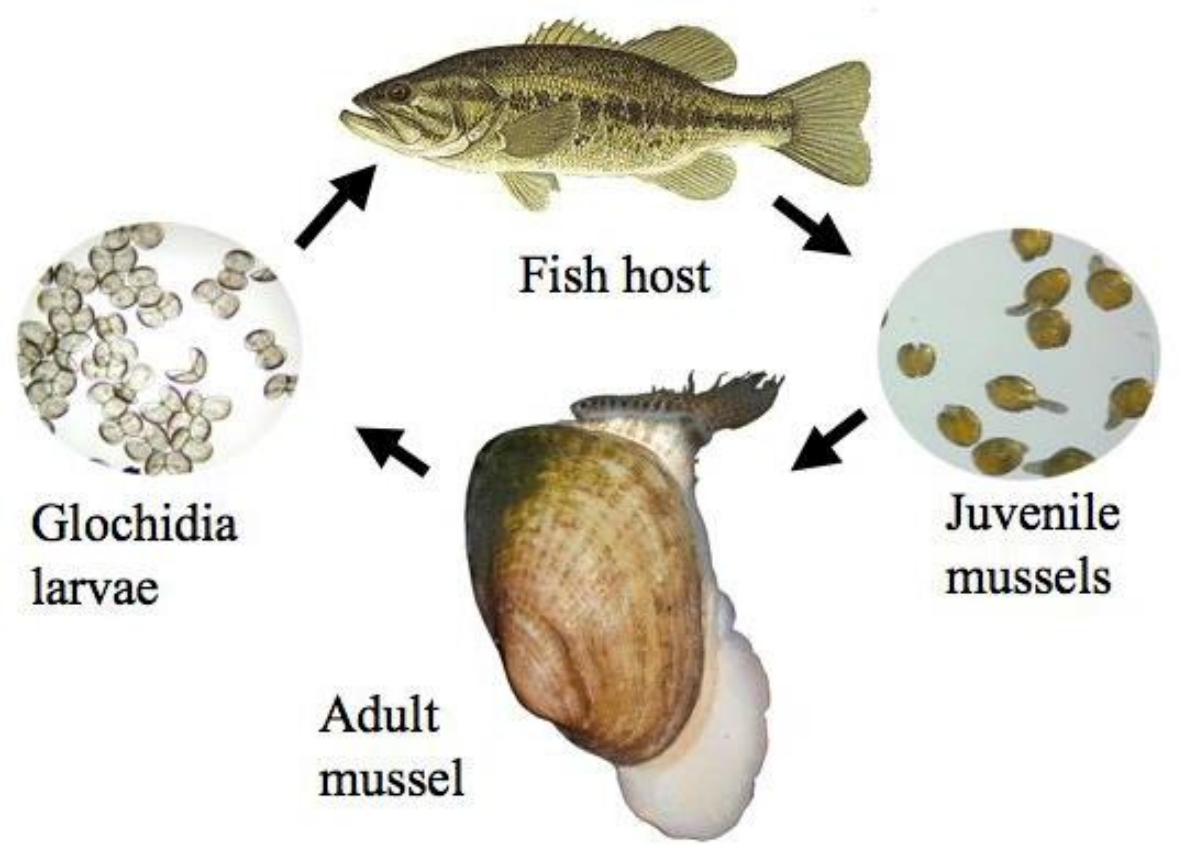


Introduction

- Environmental flows
  - Peak in spring/early summer
  - Peak in mid-summer
  - Lowest in fall/winter
- Impoundments
  - Flow alteration
- Effects on freshwater ecosystems
  - Reliance on seasonal variation

Freshwater Mussel Life Cycle



Introduction

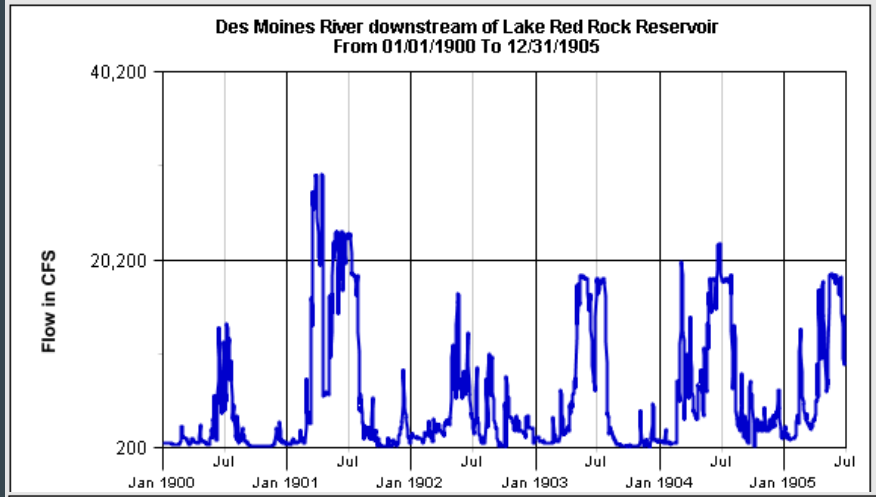
Freshwater mussel life-history strategies (Haag 2012)

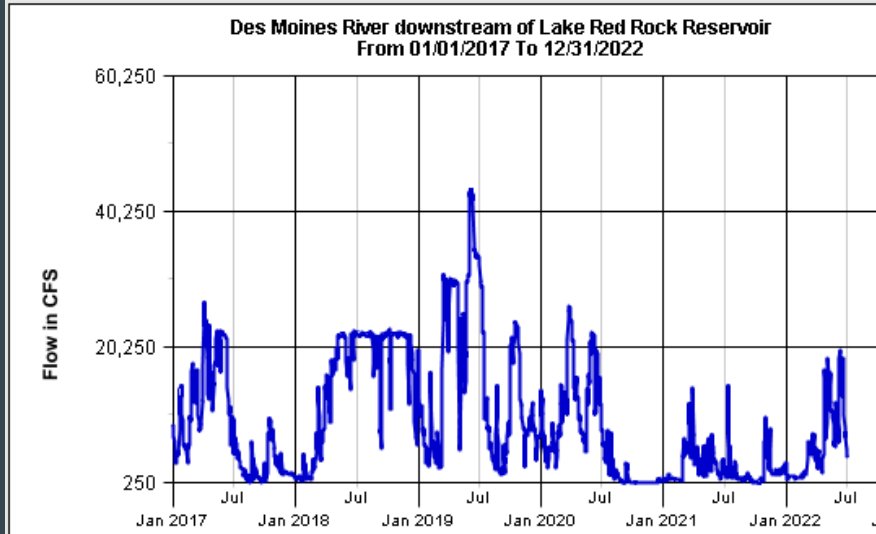
- Opportunistic
  - Short lived, long-term brooders
  - Disturbed/unstable, productive habitats
- Periodic
  - Long and short lived, mostly long-term brooders
  - Unproductive habitat, large environmental changes and stress
- Equilibrium
  - Mostly long lived, short-term brooders
  - Stable and productive habitats

Introduction

Flow effects on guilds (Haag 2012; Ries et. al 2015)

- April – August
- Extended periods of high flow (periodic)
- Below average flow in April, above average in July (equilibrium)





https://rivergages.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=RRDI4&fid=&dt=S&pcode=QR

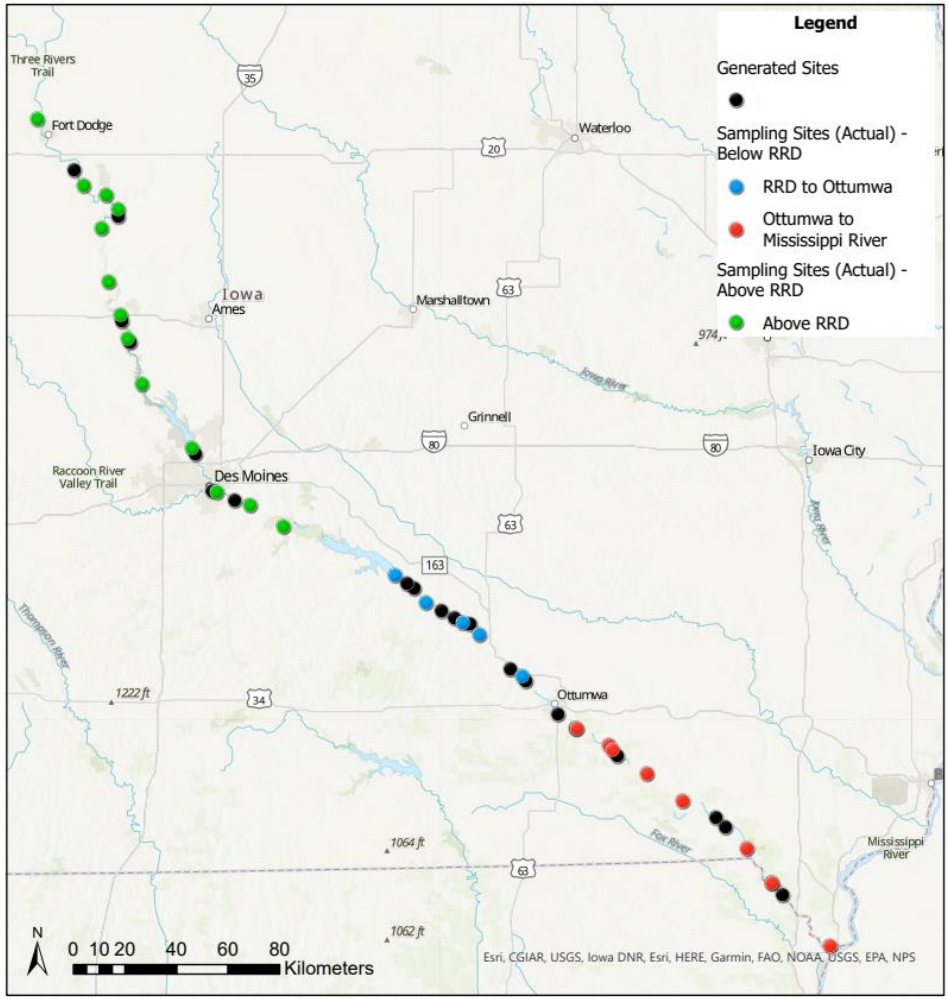
Objectives

1. Determine the effects of experimental flows on species richness and diversity of freshwater mussels with alternative
   life-history strategies.
2. Assess the effects of river flow regime on recruitment, growth, and mortality of three freshwater mussels with alternative life-history strategies.

Methods

Site Selection and Quadrat Generation

- Generalized Random Tessellation Stratified Design (GRTS) method (Stevens and Olsen 2004)



Map 1. Sampling sites on the Des Moines River in Iowa.

Methods

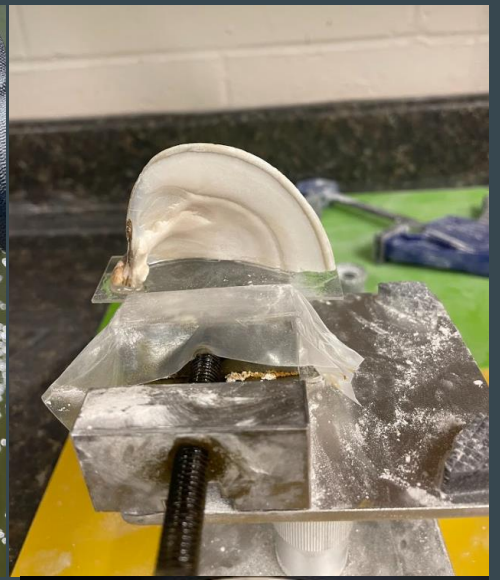
Late June - Late October

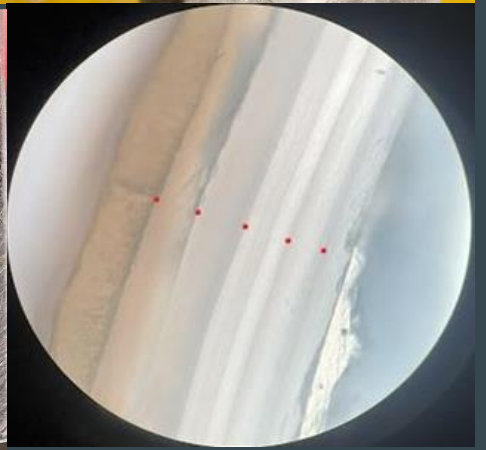
- 52 sampling occasions
- 26 sites
  - 13 above RRD, 13 below RRD
  - 25 quadrats excavated per site
  - Environmental variables recorded
  - 190.6 total hours of visual/tactile searching

Methods

Thin sectioning
- Cut in half
- Mount to slide
- Cut off excess
- Sand

Aging
- View under scope
- Count annuli





Preliminary Results

1422 live mussels, 21 different species

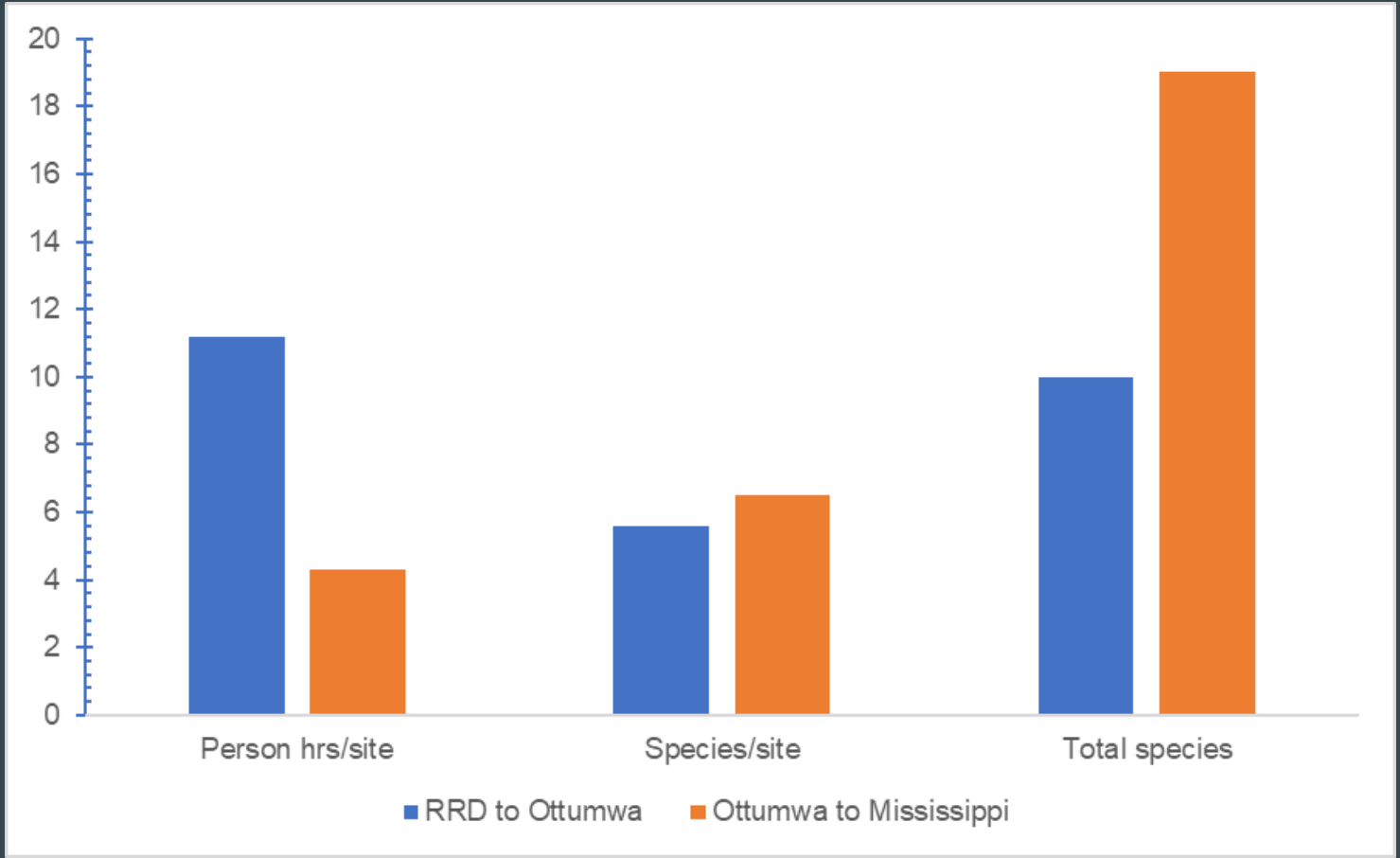
- 417 above RRD, 1005 below RRD

No species of special concern

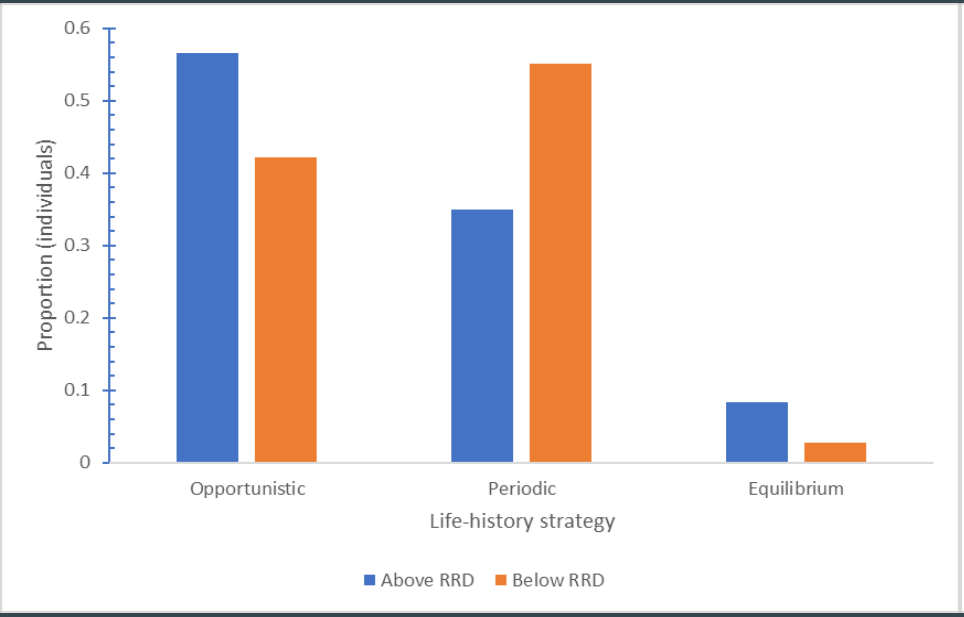
Relict shells of 28 species

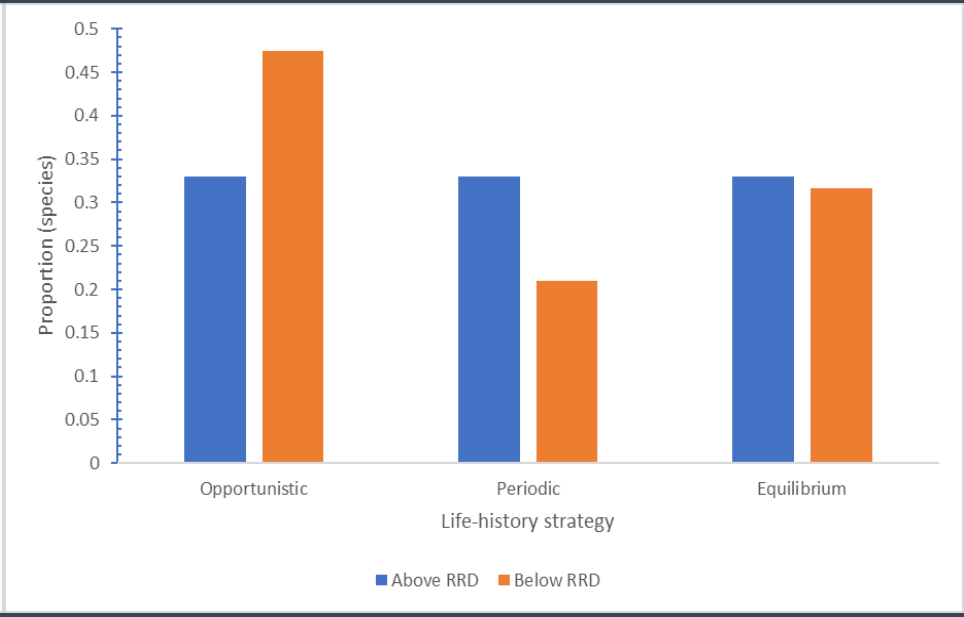
Table 2. Species richness, Shannon diversity and Simpson's diversity indices for freshwater mussel (Unionidae) populations above (n = 13) and below (n = 13) Red Rock Dam on the Des Moines River. Counts were recorded during a series of visual/tactile searches and random quadrat excavation from June 2022 through October 2022. Results are not standardized to represent variation in sampling effort between sampling sites and reaches.

Species	Above RRD	Below RRD
Amblema plicata	-	1
Fusconaia flava	1	1
Lampsilis cardium	106	111
Lampsilis siliquoidea	11	-
Lampsilis teres	-	1
Lasmigona complanata	1	7
Leptodea fragilis	79	200
Ligumia recta	28	40
Obliquaria reflexa	1	41
Obovaria olivaria	-	371
Pleurobema sintoxia	-	3
Potamilus alatus	-	42
Potamilus ohiensis	78	82
Pyganodon grandis	-	7
Quadrula metanevra	-	2
Quadrula nodulata	3	-
Quadrula pustulosa	23	2
Quadrula quadrula	8	19
Toxolasma parvus	78	3
Truncilla donaciformis	-	81
Truncilla truncata	-	8
S	12	19
H'	1.882	1.996
1-D	0.179	0.208


20
18
16
14
12
10
8
6
4
2
0
Person hrs/site
Species/site
Total species
RRD to Ottumwa
Ottumwa to Mississippi

Preliminary Results

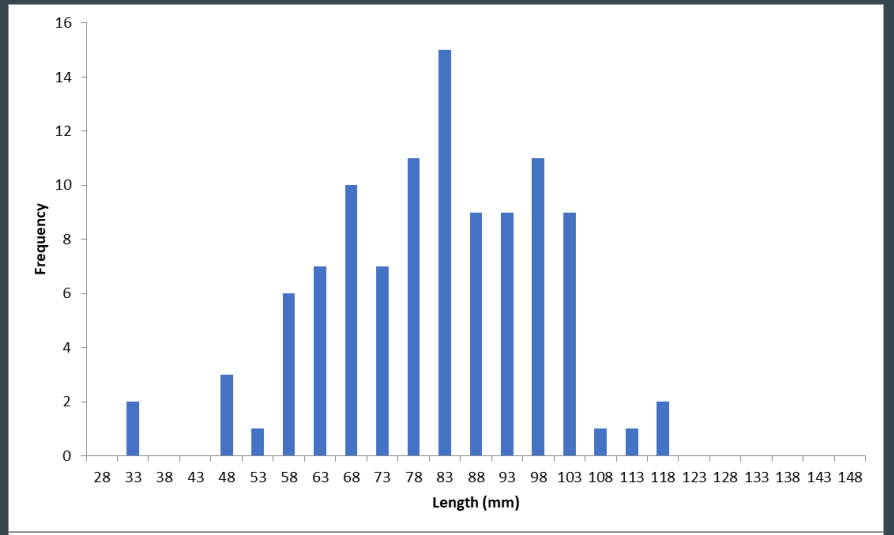


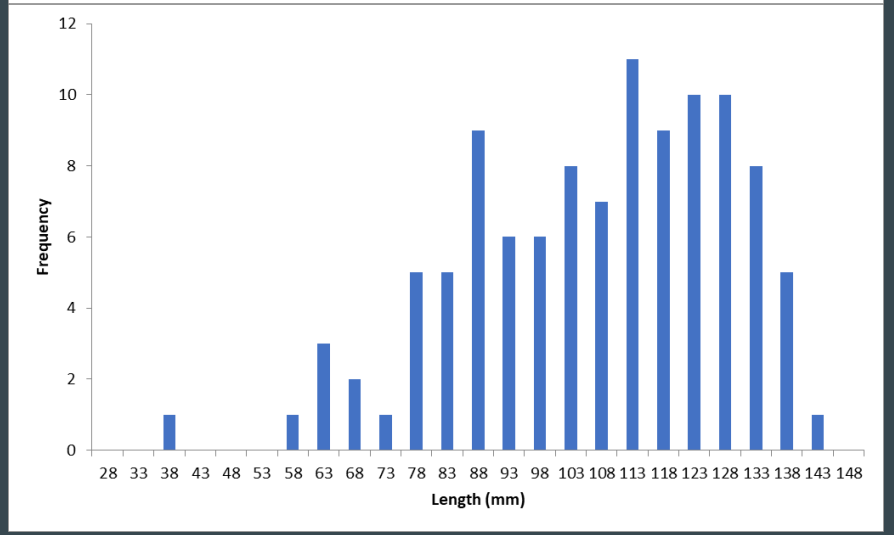


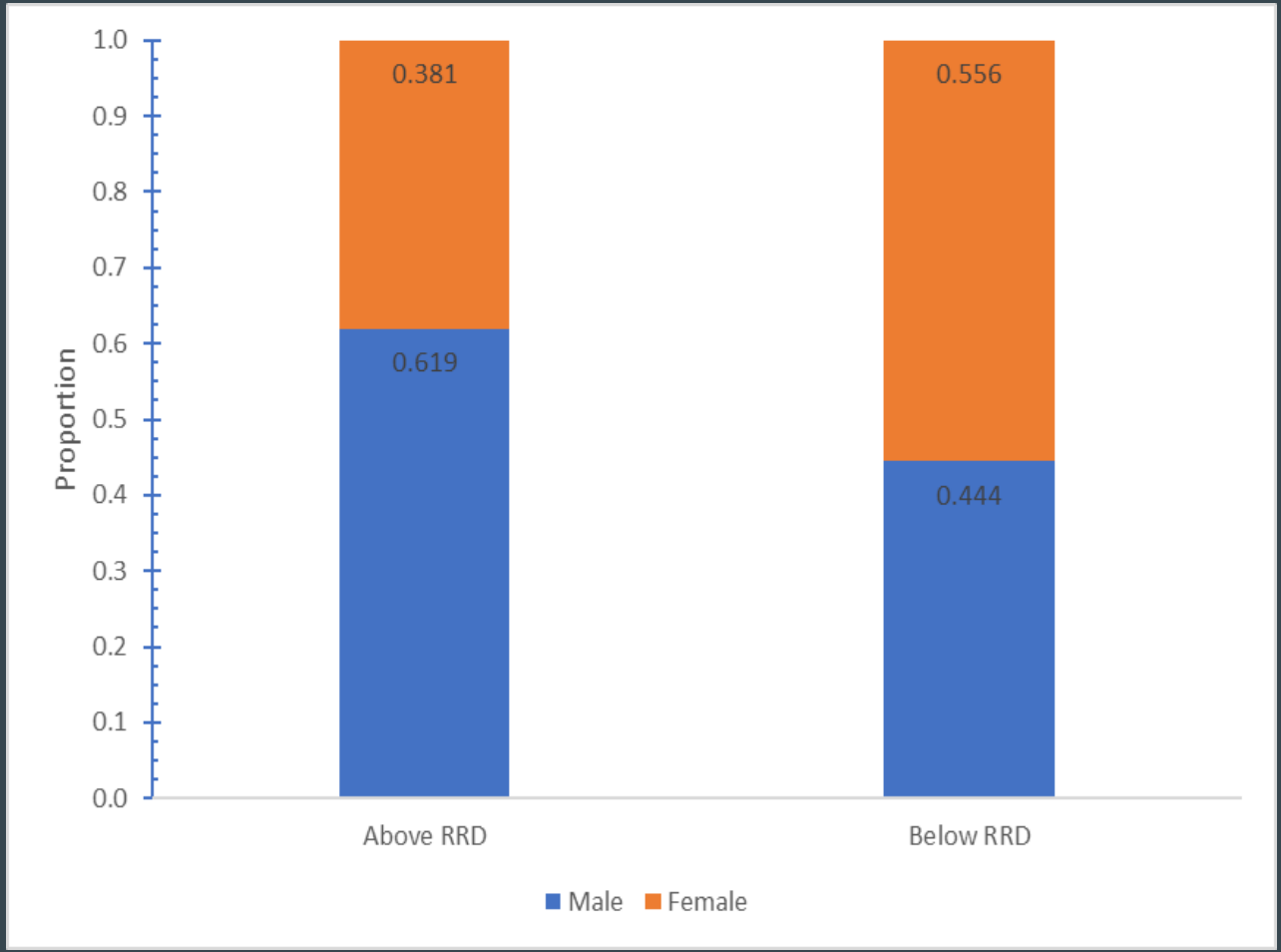
Preliminary Results

- *L. cardium* (Cunnings and Mayer 1992)
  - Natural history
  - Reproduction
- Length
  - Top: Above Red Rock Dam
  - Bottom: Below Red Rock

Photo courtesy of the U.S Fish and Wildlife Service






1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Proportion
0.381
0.619
0.556
0.444
Above RRD
Below RRD
Male
Female

Discussion

Species richness/diversity
- Host fish distribution
- Life-history strategy

L. cardium
- Length
- Sex

Future Work

Spring 2023

- Data analysis
  - Age-class structure
  - Recruitment/mortality and historical hydrological data
  - Species richness/diversity and environmental variables

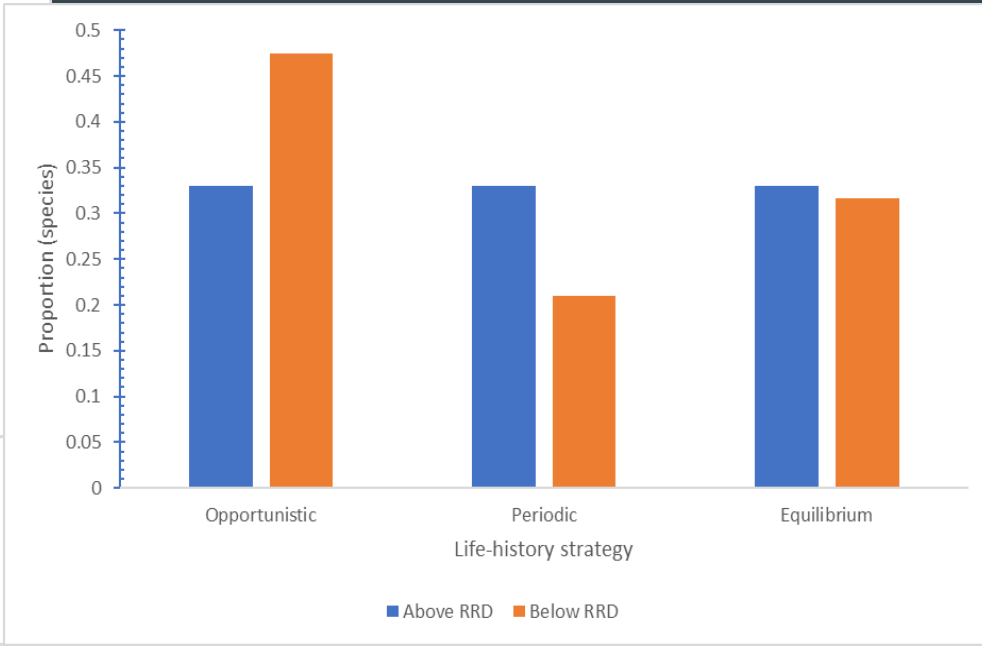
Summer/Fall 2023

- Increase sample size
- Target high-density areas
  - PIT tags

Key Takeaways

1. The Des Moines River is home to a variety of freshwater mussel species
2. Flow volume and release timing affect some species in different ways than others.
3. Many factors potentially influence species richness and diversity.


Proportion of relict species
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Opportunistic
Periodic
Equilibrium
Life-history strategy
Above RRD
Below RRD


Proportion (species)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Opportunistic
Periodic
Equilibrium
Life-history strategy
Above RRD
Below RRD

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