Genetic evaluation of bonytail reproduction at Imperial Ponds

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Bonytail (*Gila elegans*) background

- Experienced drastic declines due to dam construction, water diversion and habitat changes, non-native species
- Listed as endangered species (1980)
- Broodstock was established in 1981 with less than 8 contributing individuals, low genetic diversity
- Hatcheries used for production needs

A Conservation Plan for Native Fishes of the Lower Colorado River

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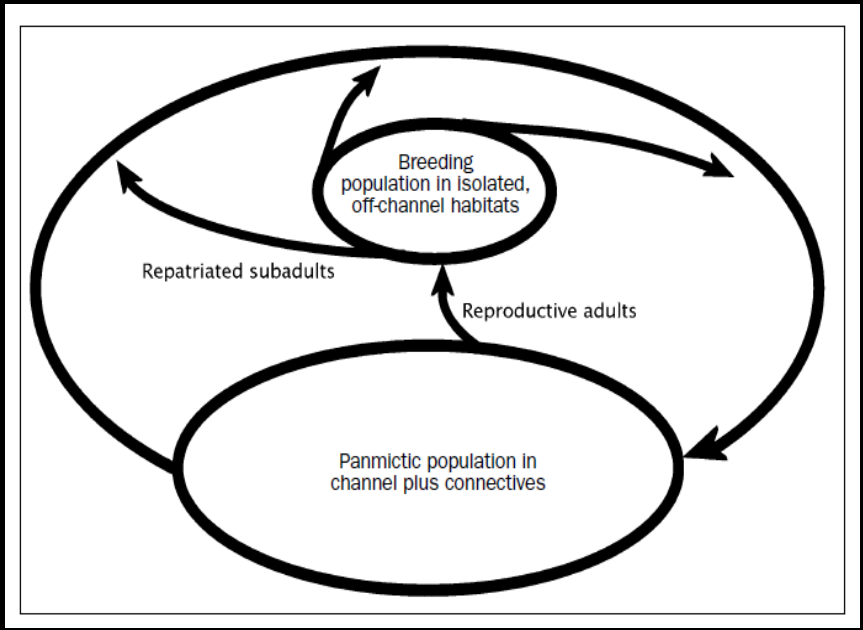
- Stock adult bonytail into off-channel ponds
- Able to mate naturally
- Absence of non-native species
- Subject to selection pressures
- Still exposed to some predation



Variance in Reproductive Success

- Highly fecund species
- Aggregate broadcast spawners
  - All individuals have the opportunity to mate
  - Only few may be successful
  - Random mating?
- Increase risks of adverse genetic effects like inbreeding depression

Mohave backwaters- 2014-2016

- 3 years + 2 backwaters stocked with 80-100 males and females annually
- Genetic data collected from adults and progeny produced in backwaters
  - (n= 4,130)
- Most adults contributed offspring (82-97%)
- Both sexes mated multiply
- Number of mates and family size were strongly correlated
- Positive correlation between adult size and metrics of reproductive success
- Strong interactions between sample year and backwater
  - Environmental factors are the primary driver of variance in reproductive success

Osborne, M. J., Sanchez, A. V., Dowling, T. E., & Turner, T. F. (2018). Variance in Reproductive Success is Driven by Environmental Factors, not Mating System, in Bonytails. *Transactions of the American Fisheries Society*, *147*(6), 1100-1114.

Objectives

1. Quantify the contribution of adults to offspring production

2. Assess whether reproductive output is correlated with the number of breeding partners

3. Assess whether genetic diversity is maintained between parents and offspring

Imperial Ponds 2017-2019

Imperial Ponds 2017-2019

- Three ponds (#2, 5, 6) stocked with 150 males and 150 female adult bonytail
- Date of initial stocking: March 21st 2017
- Sampled ~ every 2 weeks post stocking to monitor for reproduction- larvae first detected in mid April
- Calculate genetic diversity parameters across 18 microsatellite loci
- Conducted parentage analysis of individuals using genetic data analyzed with the program Colony

Genetic Diversity

Similar between ponds and parents & offspring

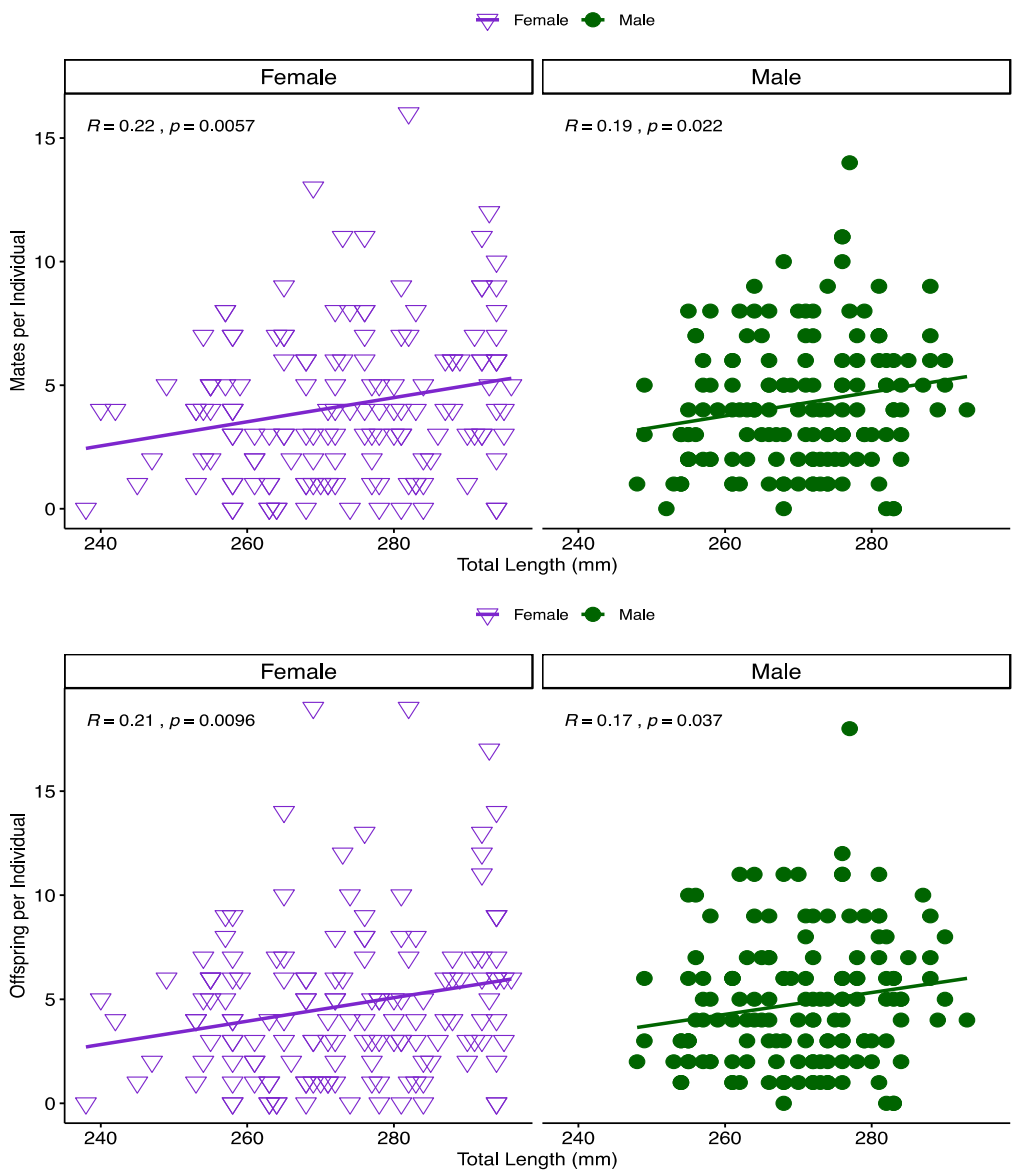
Pond	Sample	n	H_{ec}	H_{oc}	F_{IS}	$N_{ac(n=25)}$
IP Pond 2	Adults	300	0.764	0.76	0.022	8.6
IP Pond 2	Larvae	105	0.767	0.731	0.065	8.8
IP Pond 2	YOY 2017	446	0.761	0.732	0.054	8.6
IP Pond 2	Recruits 2017	95	0.759	0.761	0.015	8.7
IP Pond 2	Recruits 2018	126	0.771	0.759	0.029	8.5
IP Pond 5	Adults	300	0.773	0.755	0.040	8.7
IP Pond 5	Recruits 2017	9	0.757	0.754	0.000	5.57*
IP Pond 5	Recruits 2018	25	0.763	0.735	0.051	8.5
IP Pond 6	Adults	300	0.774	0.77	0.023	9
IP Pond 6	Recruits 2017	8	0.702	0.757	-0.072	4.88*
IP Pond 6	Recruits 2018	16	0.778	0.763	0.009	5.99*

Reproductive Success

- Pond 2: 91-95 % of stocked individuals contributed offspring
- Pond 5: 36% of stocked individuals contributed offspring
- Pond 6: 20 % of stocked individuals contributed offspring

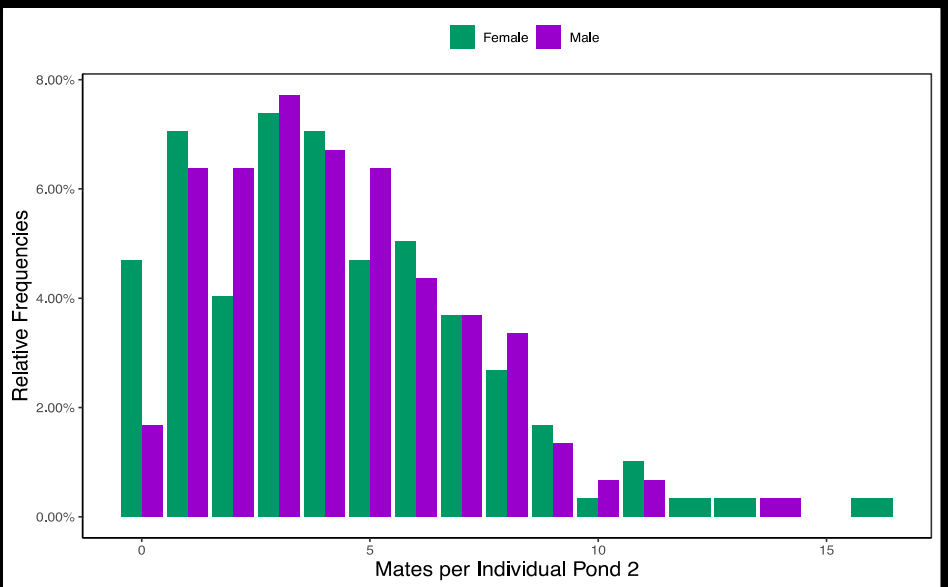
	Males		Females	
Pond 2	Mates	Offspring	Mates	Offspring
k	3.849	4.246	3.78	4.225
Variance k	6.724	9.502	8.247	12.452
St Dev k	2.593	3.082	2.872	3.529
Std Var k	1.747	2.212	2.178	2.947

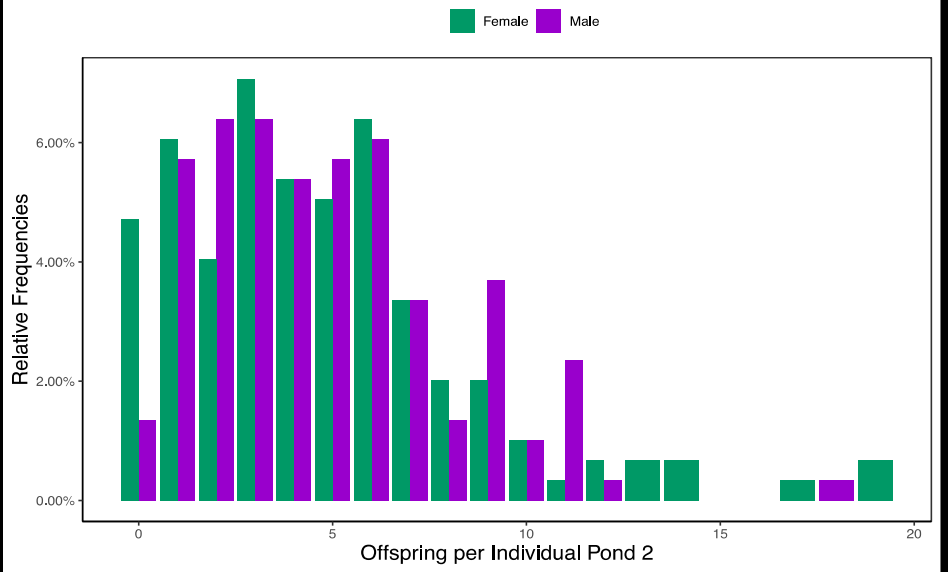
k= mean # offspring/mates



Standard Length and Reproductive Success (Pond 2 only)

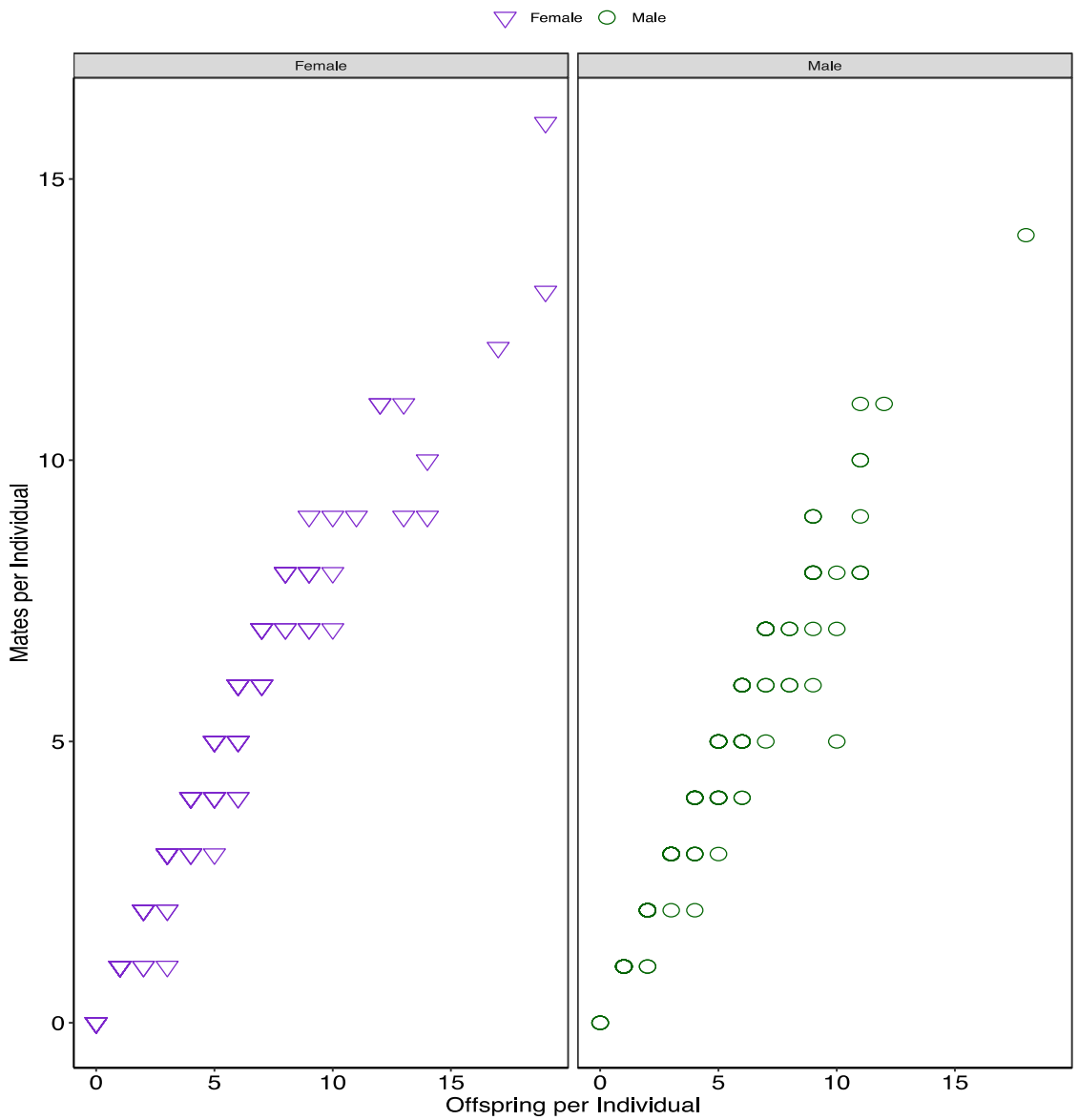
- Larger females/males had more mates and more offspring.





Pond 2

- Variance in reproductive success among individuals
- Majority of individuals have more than one mate and contributed multiple offspring.
- Average number of mates/offspring did not differ between males and females



Strong correlation between the metrics of variance in reproductive success

Imperial Ponds 2017-2019

- Bonytail reproduction detected in ponds # 2, 5 and 6

- Genetic diversity similar between ponds and was maintained between parents and offspring in all ponds

- Reproductive contribution of males and females was high in pond 2
- Males and females made equal contributions in all ponds
- More mates=more offspring in pond 2
- Larger females and and males (at stocking) had more mates and offspring

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Museum of Southwestern Biology

American Southwest Ichthyological Researchers

Lower Colorado River Multi-Species Conservation Program

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