Razorback Sucker Broodstock Evaluation and Genetic Monitoring

Razorback Sucker

- Lake Mohave restoration program initiated in 1991
  - wild larvae are collected and raised at protected sites
  - released at a larger size to prevent predation
- Artificial propagation of hatchery stocks/ wild larval growout
  - millions of fish in 30 years
  - few survived due to predation
- The larger the fish released the greater rate of survival

Razorback Sucker: SNARRC Stocks

- 1981Year Class (81YC)
  - Wild adults collected from Lake Mohave
  - Approximately 20 left
- Paired matings future broodstock (PM)
  - Larval fish from adults spawned at Willow Beach NFH (1994-2003)
- Wild caught future broodstock (WCB)
  - Larval and wild-caught fish from Lake Mohave (8 sites; 1999-2004)

Razorback Sucker: Upper Basin Stocks

- Ouray Complex
  - Ouray NFH
    - Original Green River broodstock started between 1989-1991
  - Grand Valley
    - Originally San Juan and Colorado River broodstock (1989-1993)
    - Green River and Lake Mohave stocks added to increase genetic diversity (sometime after 2003)

Questions

- How diverse are the captive stocks
- How do they compare to the wild Lake Mohave population
  - Lake Mohave - Largest source of genetic variation

Methods

- Total of 657 samples genotyped
  - SNARRC: 81YC (n = 43), PM (n = 71), WCB (n = 248)
  - Ouray: 1989 - 1998 year class (n = 69)
  - Grand Valley (2003 and 2011 inventory)
    - 1992-1995 year classes (n = 93)
    - 2004-2008 year classes (n = 96)
  - Wild Lake Mohave 2000 year class (n = 37)
    - Fin clips from larval fish at Willow Beach

Methods

- Genotyped at 13 microsatellite loci (all facilities)
- Sequenced mitochondrial DNA (SNARRC 81YC and WCB)
  - Cytochrome b (same region/primers as Dowling)
- Examined pairwise relatedness using microsatellites (SNARRC and Grand Valley)

Results - Microsatellites

Statistic	Lower Colorado River Basin			
	LM-Wild	LM-DX: 81YC	LM-DX: PM	LM-DX: WCB
N_A	17.0	14.5	19.3	22.9
A_R	16.1	13.4	16.1	16.2
H_O	0.898	0.884	0.910	0.905
H_E	0.891	0.868	0.890	0.902
F_{IS}	0.006	-0.006	-0.014	-0.002

Upper Colorado River Basin		
GR-OR: 89-98YC	MX-GV: 92-95YC	MX-GV: 04-08YC
13.9	13.4	15.5
12.4	11.6	12.5
0.864	0.884	0.867
0.835	0.846	0.850
-0.021	-0.039	-0.010

Results - Mitochondrial DNA

- 18 haplotypes (17 in WCB; 9 in 81YC)
- Frequency range 0.004 – 0.617
  - Many in low frequency

	mtDNA cyt-b haplotype										
Captive Stock	A	B	C	E	F	G	H	I	J	K	M
LM-DX: 81YC	-	0.042	-	0.316	0.011	-	0.011	-	-	-	-
LM-DX: WCB	0.028	0.095	0.012	0.617	0.051	0.004	0.016	0.004	0.008	0.004	0.008

P	R	S	U	V	Z	BB
0.063	-	0.316	0.137	0.011	-	0.095
0.008	0.067	0.043	0.004	-	0.012	0.020

Results - Mitochondrial DNA

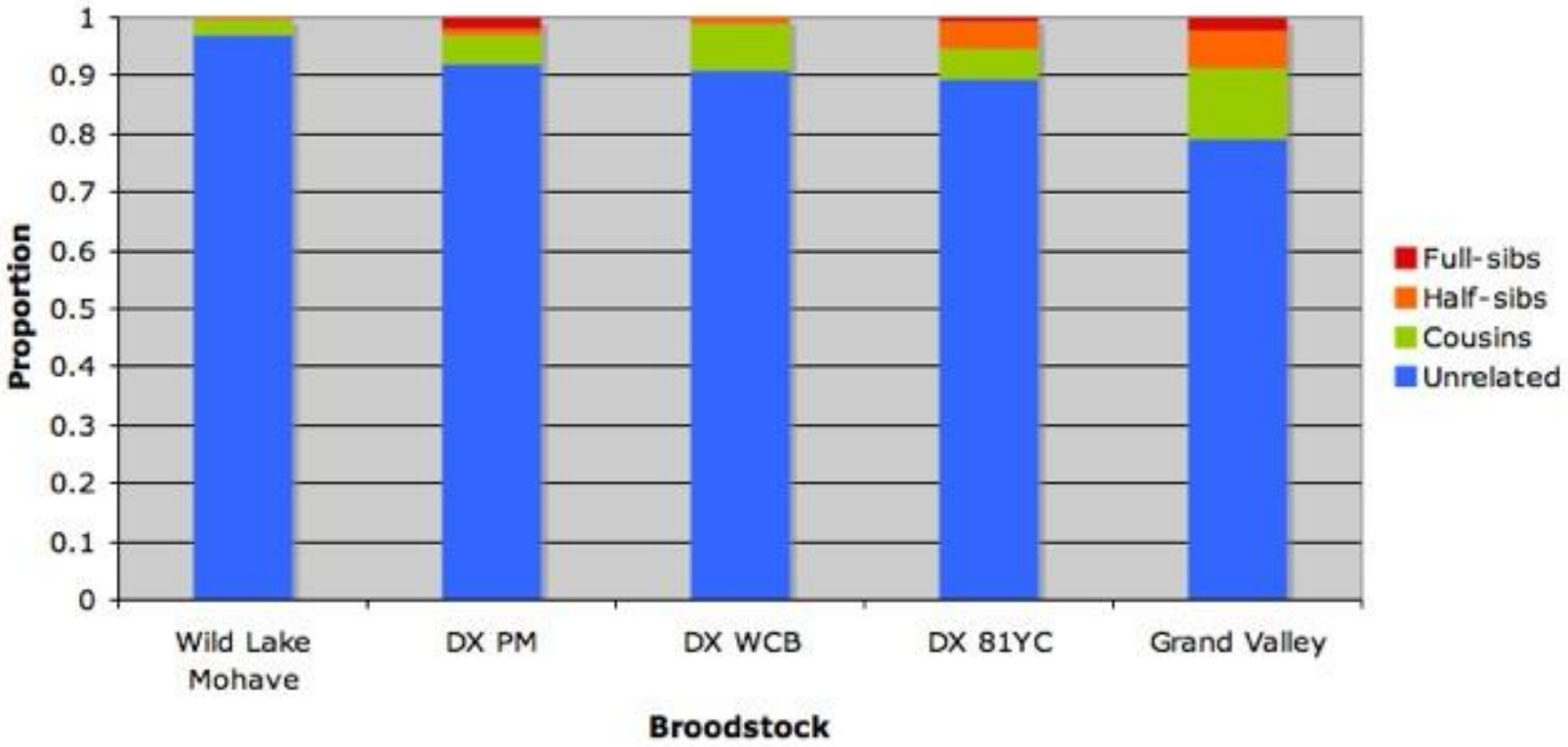
Captive Stock/Population	N	# Haplotypes	Gene Diversity	Allelic Richness[1]
LM-DX: 81YC	95	9	0.78	9.0
LM-DX: WCB	253	17	0.60	14.8
Dowling 1980's	27	9	0.69	8.0
Dowling early 1990's	22	5	0.59	5.0
Dowling late 1990's	223	18	0.66	6.8

1. Current study is based on 95 samples and Dowling et al. (2005) is based on 22 samples.

Results - Pairwise Relatedness

- Relationship (r)
  - Probability that individuals (x, y) share alleles by descent (r_{xy})
    - Unrelated - 0.0 to 0.09
    - Cousins - 0.10 to 0.18
    - Half-Sibs - 0.19 to 0.38
    - Full-Sibs - > 0.39

Results - Pairwise Relatedness



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