Remote monitoring of razorback sucker in Lake Mohave

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MARSH & ASSOCIATES, LLC

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Lower Colorado River

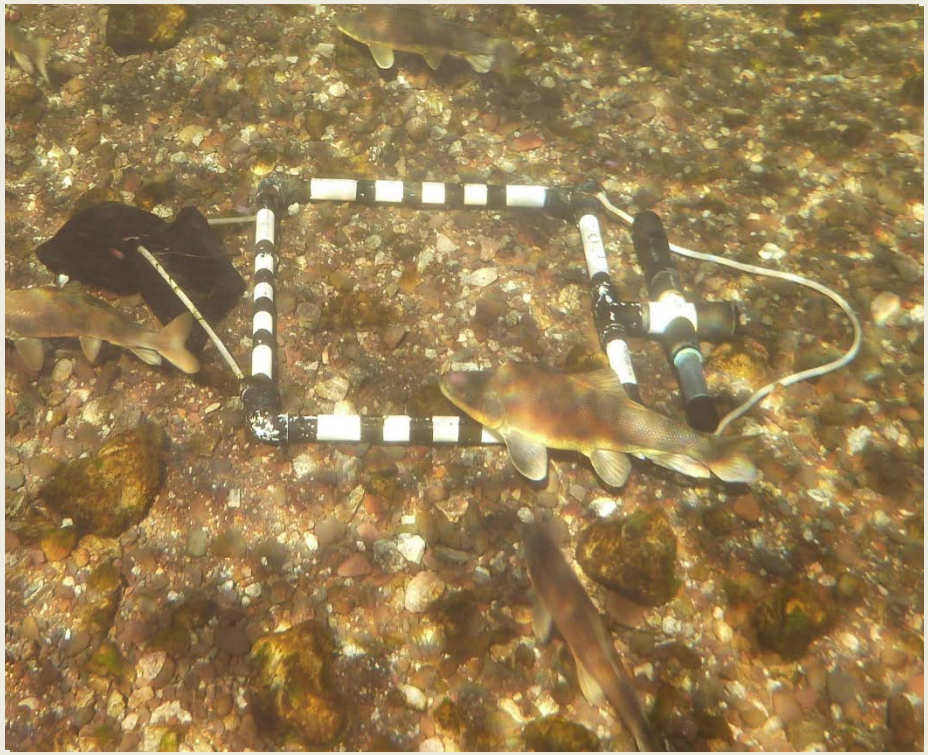
Multi-Species Conservation Program

Background

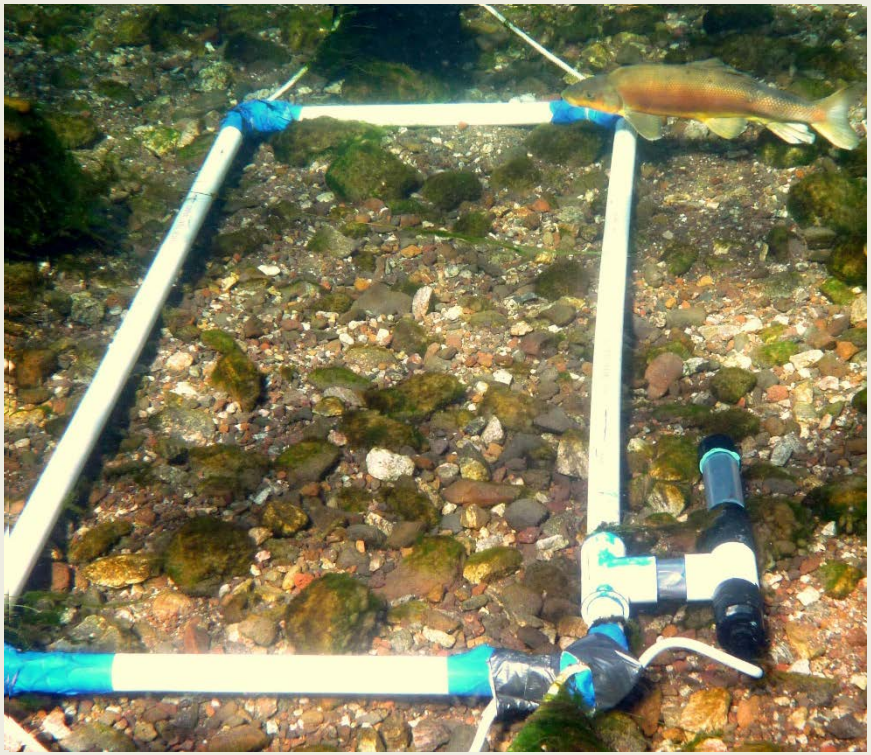
- Razorback Sucker
  - Long lived (>40 years)
  - Federally listed in 1991
  - Over 200,000 repatriated to Mohave
  - Remote and routine monitoring to understand population dynamics
- Lake Mohave
  - LCR MSCP Reach 2
  - Between Hoover and Davis Dams

Portable Remote PIT Scanning

Submersible PIT scanner



Shore-based PIT scanner



Study Area – "Zones"

- General zones established in ~2008
  - Based on geological features, distribution of effort, and fish distribution

Summary

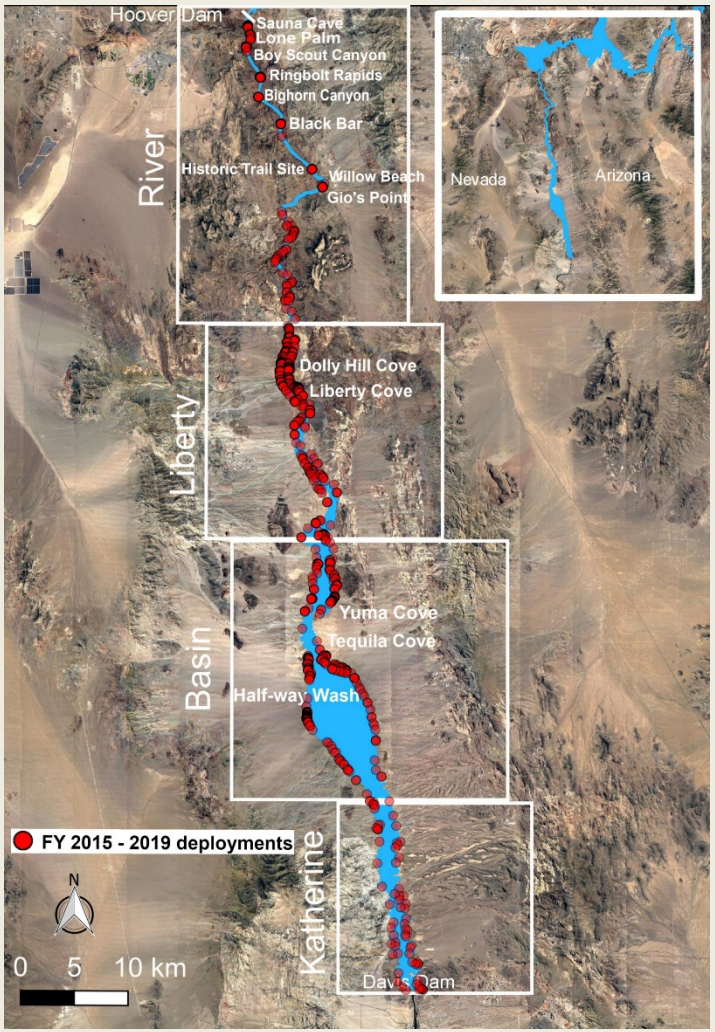
1. Remote PIT scanning
   - Effort and unique contacts through time
   - Scanning by zone – 2019

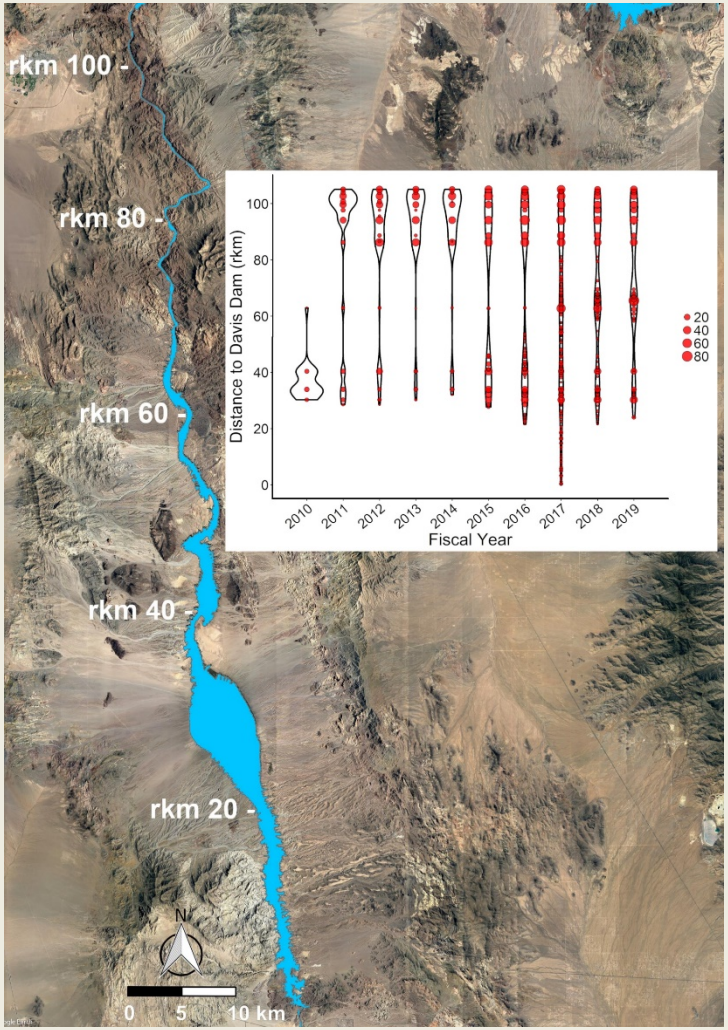
2. Population estimates
   - 2010 – 2018

3. Adult Survival

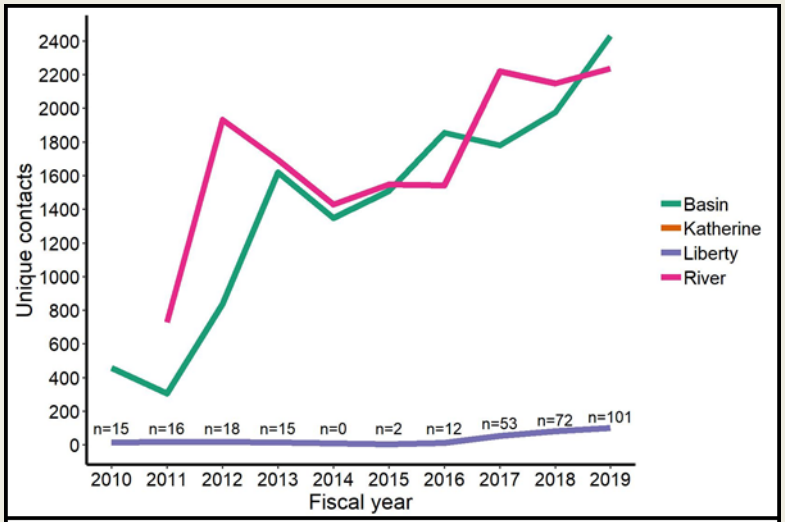
4. Post Stocking Fate
   - Displacement
   - Repatriate Recruitment
   - Spawning Visitation

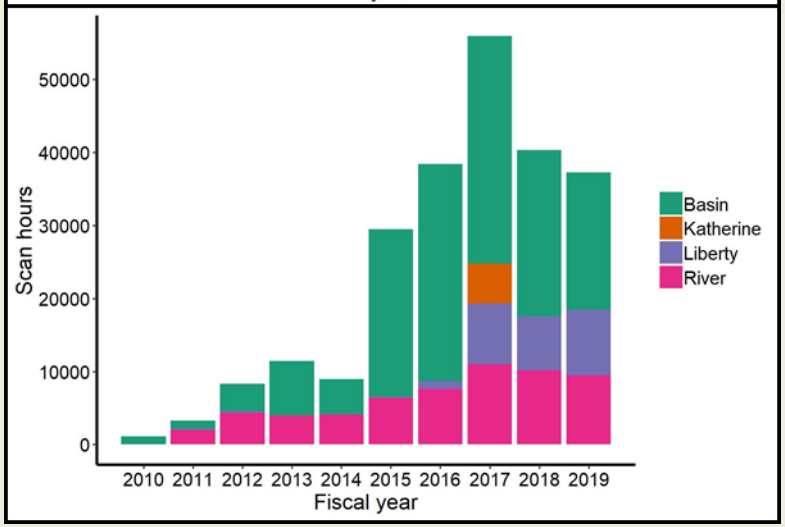
Remote Scanning





Lake-Wide Scanning – 2015-2019



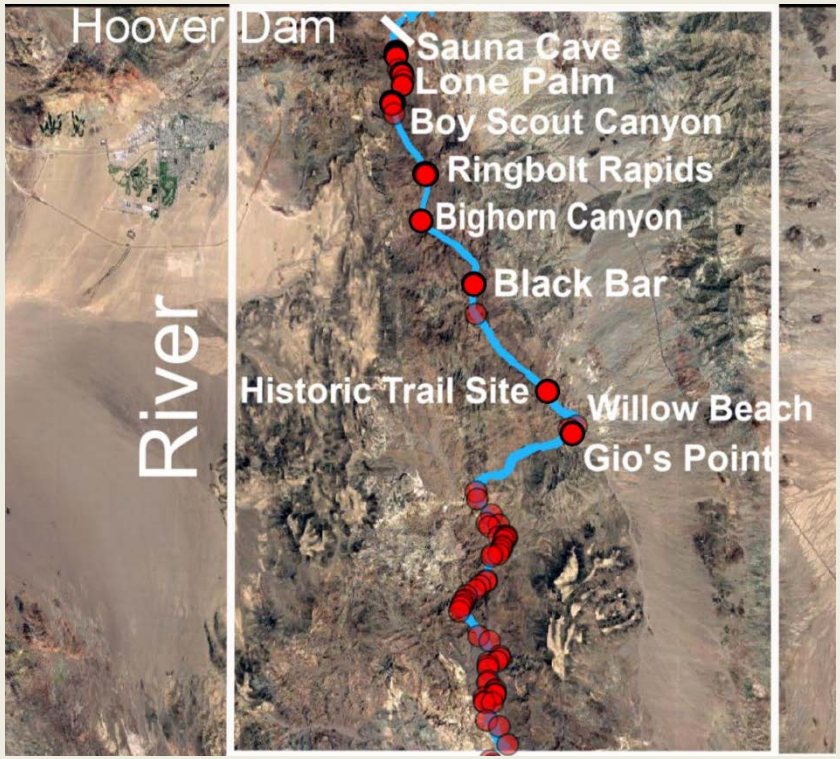


- 201,382 total scan hours (h)
  - Shore-based – 54,384 h
  - Submersible – 146,998 h
- 627,411 total contacts
  - 6,308 unique
    - 5,851 RASU with marking record
      - 5,774 repatriates
      - 13 wild
      - 64 unknown
      - 106 Bonytail Chub (all repatriates)

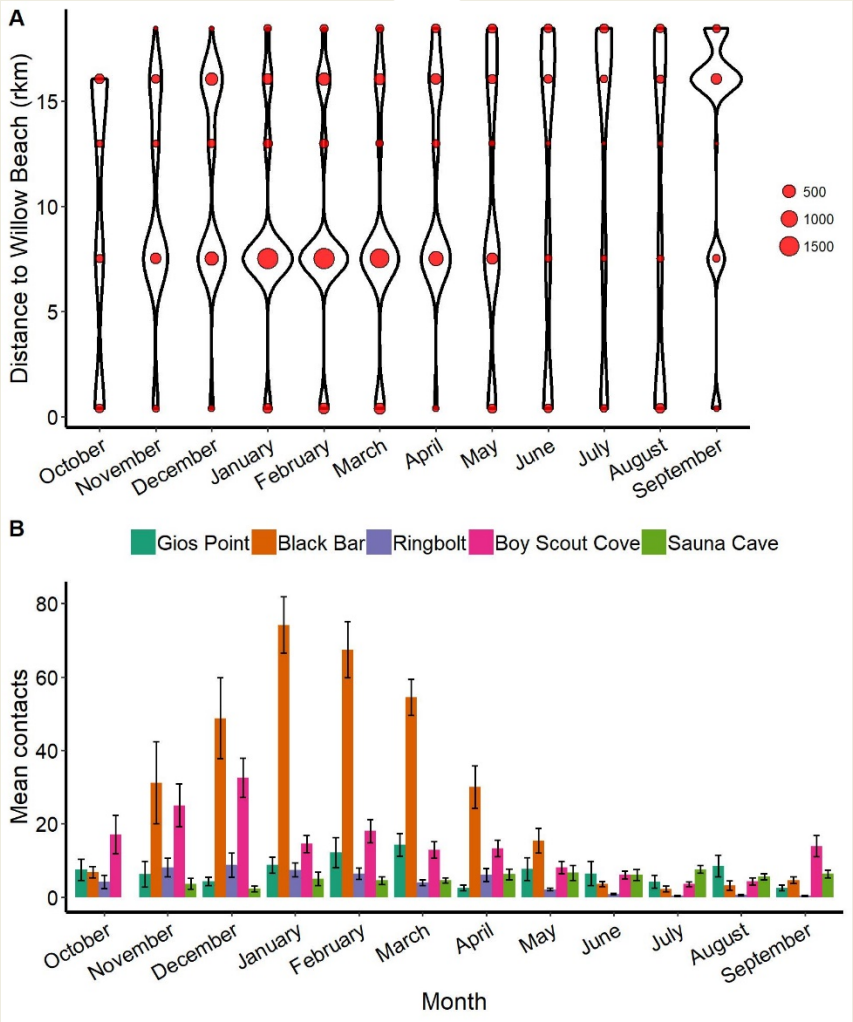
River Scanning – 2015-2019

- Submersible units deployed one week per month
- Five fixed stations
  - Gio's Point
  - Black Bar
  - Ringbolt Rapids
  - Boy Scout Canyon
  - Sauna Cave

- Decreased power consumption
  - Black Bar



River Fixed Station Scanning – 2015-2019

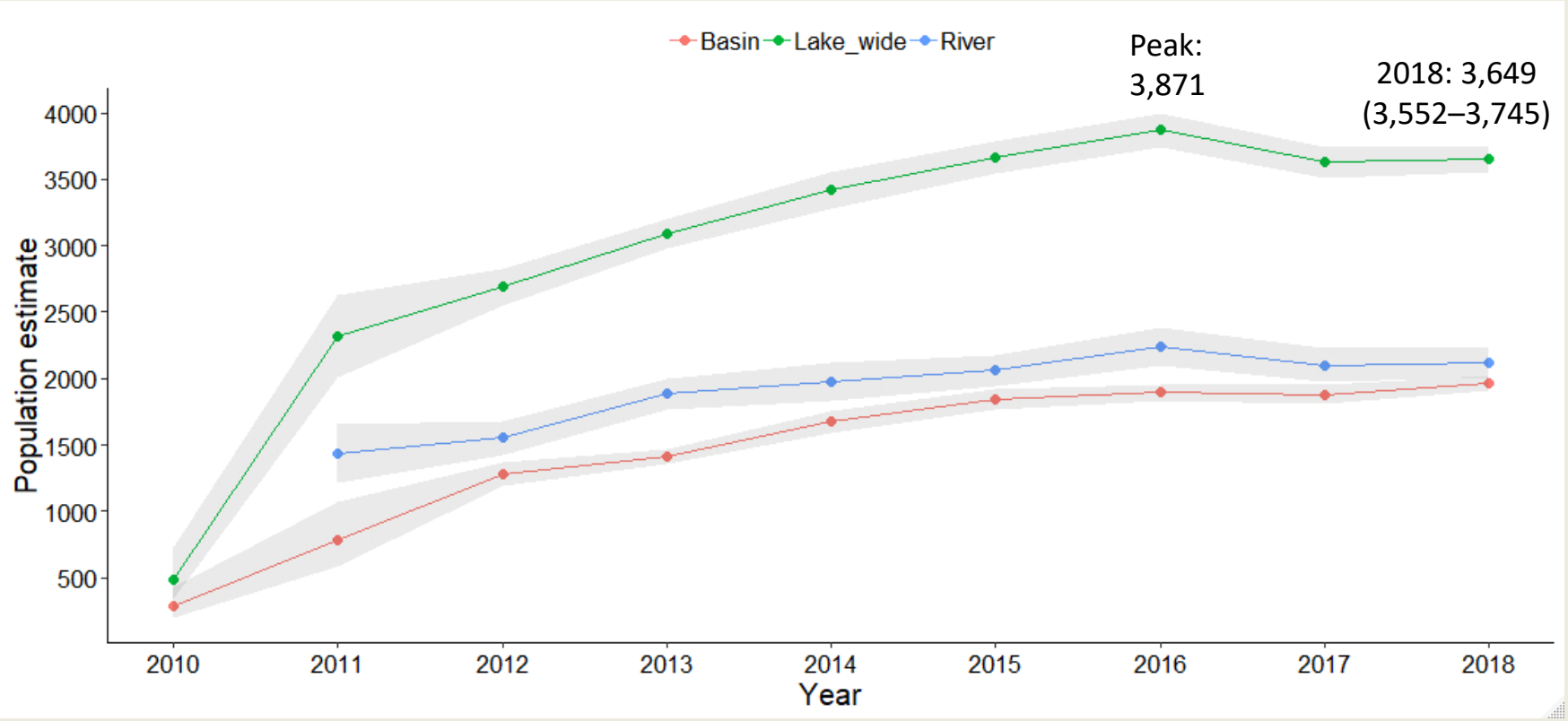


Population Estimates

$$N^* = \frac{(M+1)(C+1)}{R+1} \text{ (Ricker 1975)}$$

- Mark recapture model – PIT scanning
  - Number contacted between January 1 and end of February of previous SY was the mark (*M*)
  - Number contacted between October 1 and April 30 in the current SY was the capture (*C*)
  - Number in common between both years was the recaptures (*R*)

Repatriate Population Estimates, PIT Scanning Data 2010-2019

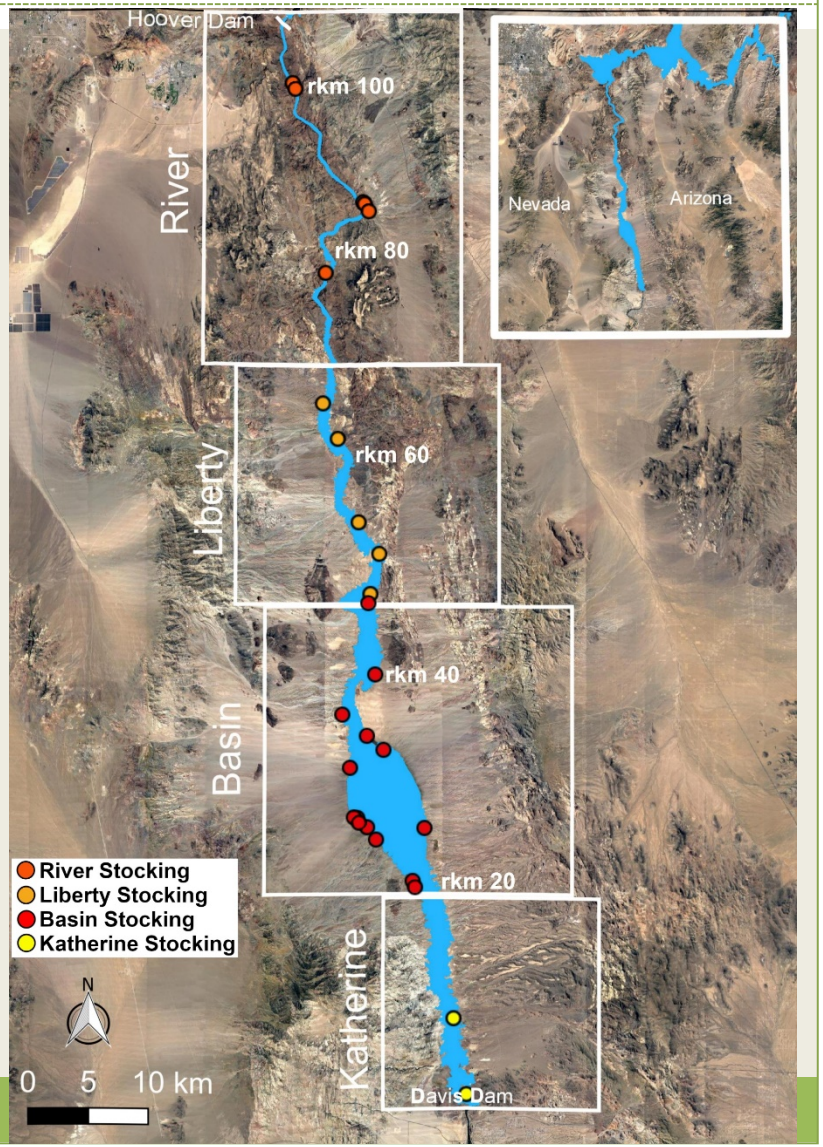


Adult Survival

- Robust mark-recapture model developed
  - Increased amount of remote sensing data available for models
  - Allow for temporary emigration
  - Sampling occasions based on monthly PIT scanning trips December through May
  - Sampling occasions grouped by SY to represent a sample session
  - River or Basin, fish at large for more than 2 years after release SY
- Results: Survival estimates similar between River and Basin; over 0.95
  - Temporary emigration dissimilar between zones dissimilar: lower in Basin and higher in River, confidence intervals overlap
  - Contact probability ranged 0.0012 – 0.508, peaks in February in Basin and December, January or February in River

Stocking Displacement

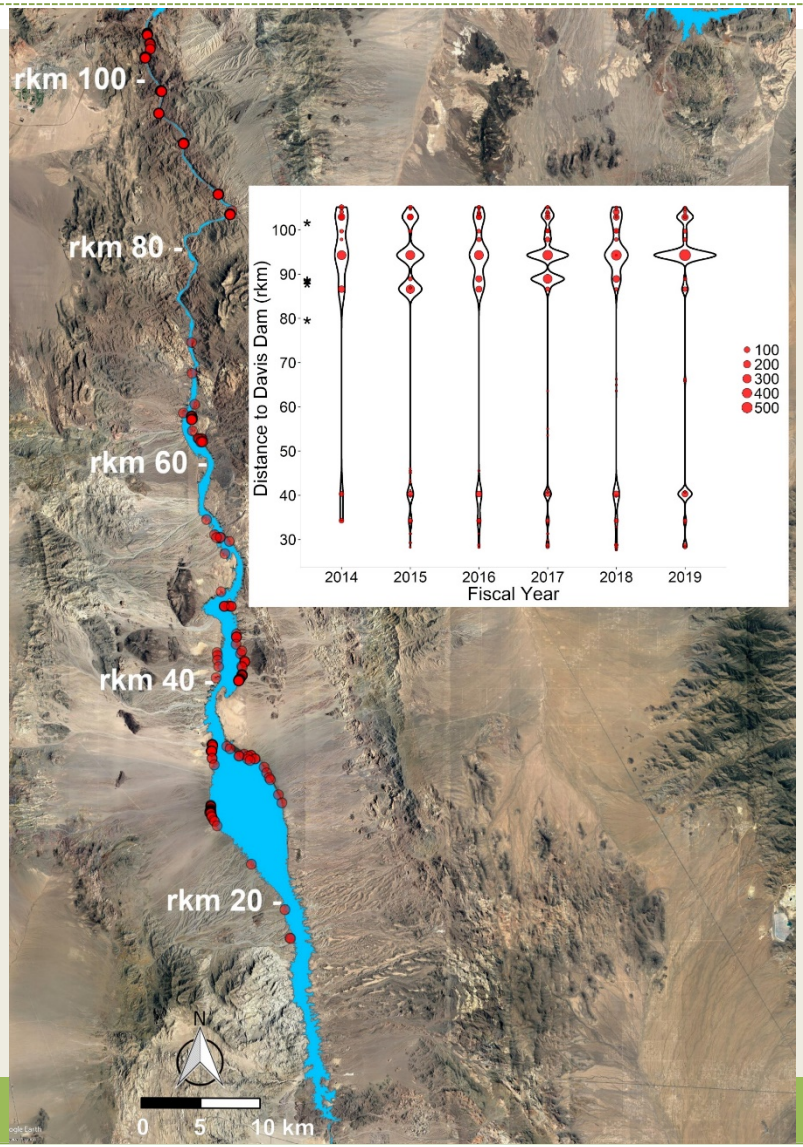
- Objective
  - Determine distance traveled from stocking locations
  - Identify movement between stocks
    - Hatchery-reared individuals stocked from October 1, 2008 – September 30, 2013
    - Calculated distance in reservoir kilometers (rkm) from the locality of contact to Davis Dam



River Stocking Displacement

- 22,922 fish stocked from 2009 to 2013
  - 5.9% contacted
  - Mainly contacted in River and Basin

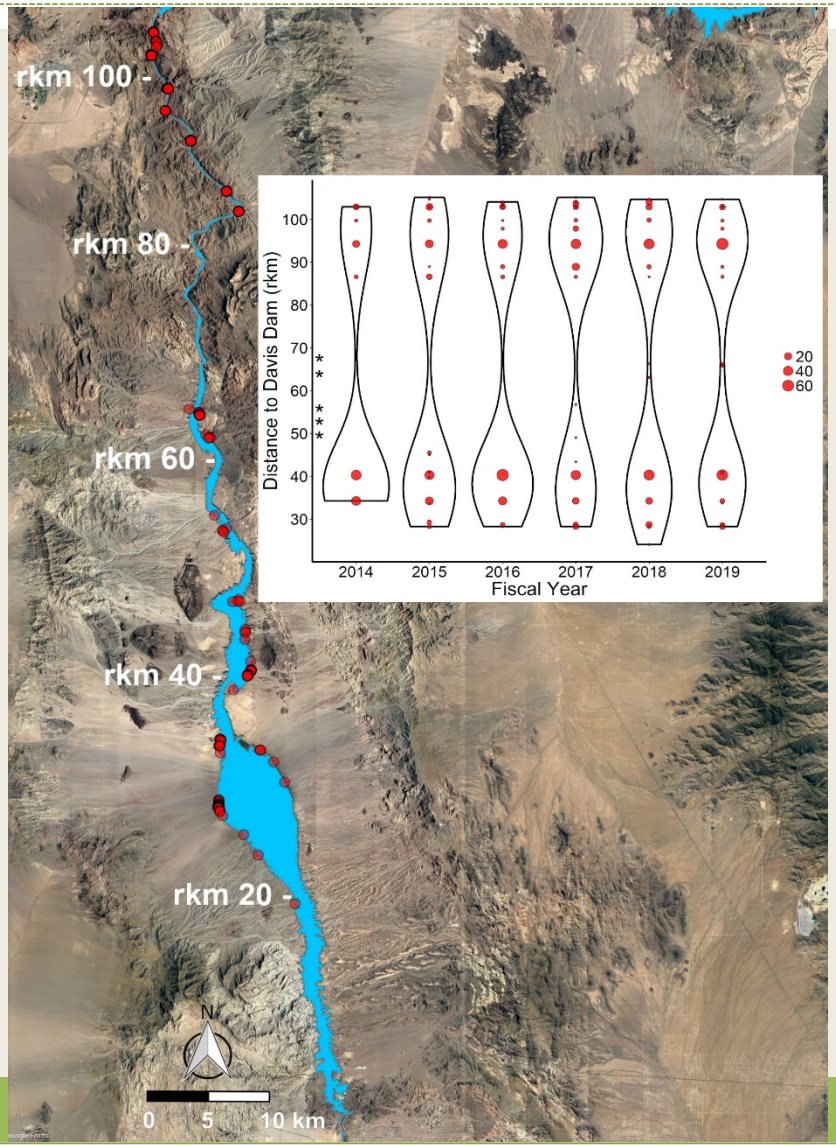
Combination	River	Liberty	Basin	Katherine	n	Percent (%)
1	-	-	X	-	61	4.5
2	X	-	-	-	865	64.3
3	X	-	-	X	1	0.07
4	X	-	X	-	357	26.5
5	X	-	X	X	2	0.1
6	X	X	-	-	34	2.5
7	X	X	X	-	25	1.9
				Total	1,345	100



Liberty Stocking Displacement

- 11,087 fish stocked from 2008 to 2013
  - 1.9% contacted
  - Most fish contacted up or downstream

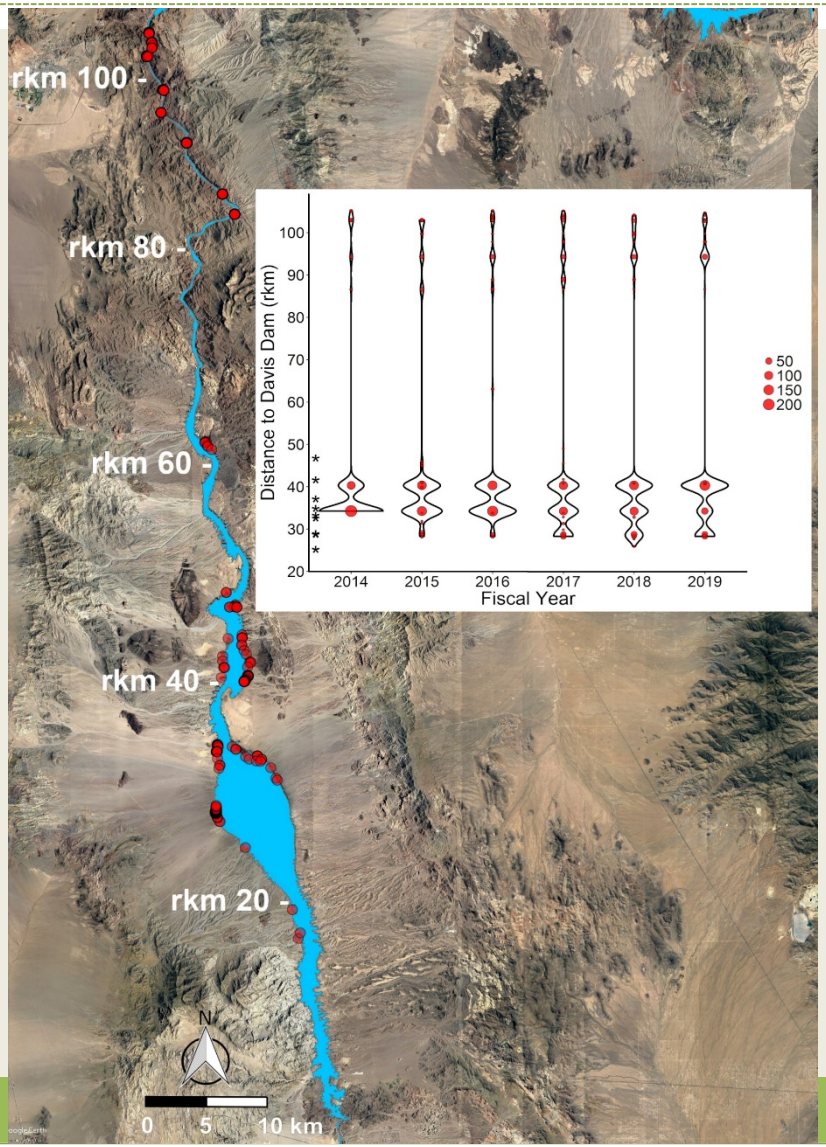
Combination	River	Liberty	Basin	Katherine	n	Percent (%)
1	-	-	X	-	64	30.6
2	-	-	X	X	1	0.5
3	-	X	-	-	1	0.5
4	-	X	X	-	4	1.9
5	X	-	-	-	63	30.1
6	X	-	X	-	68	32.5
7	X	X	-	-	6	2.9
8	X	X	X	-	2	1
				Total	209	100



Basin Stocking Displacement

- 12,214 fish stocked from 2008 to 2013
  - 3.3% contacted
  - Fish mainly contacted in Basin and River

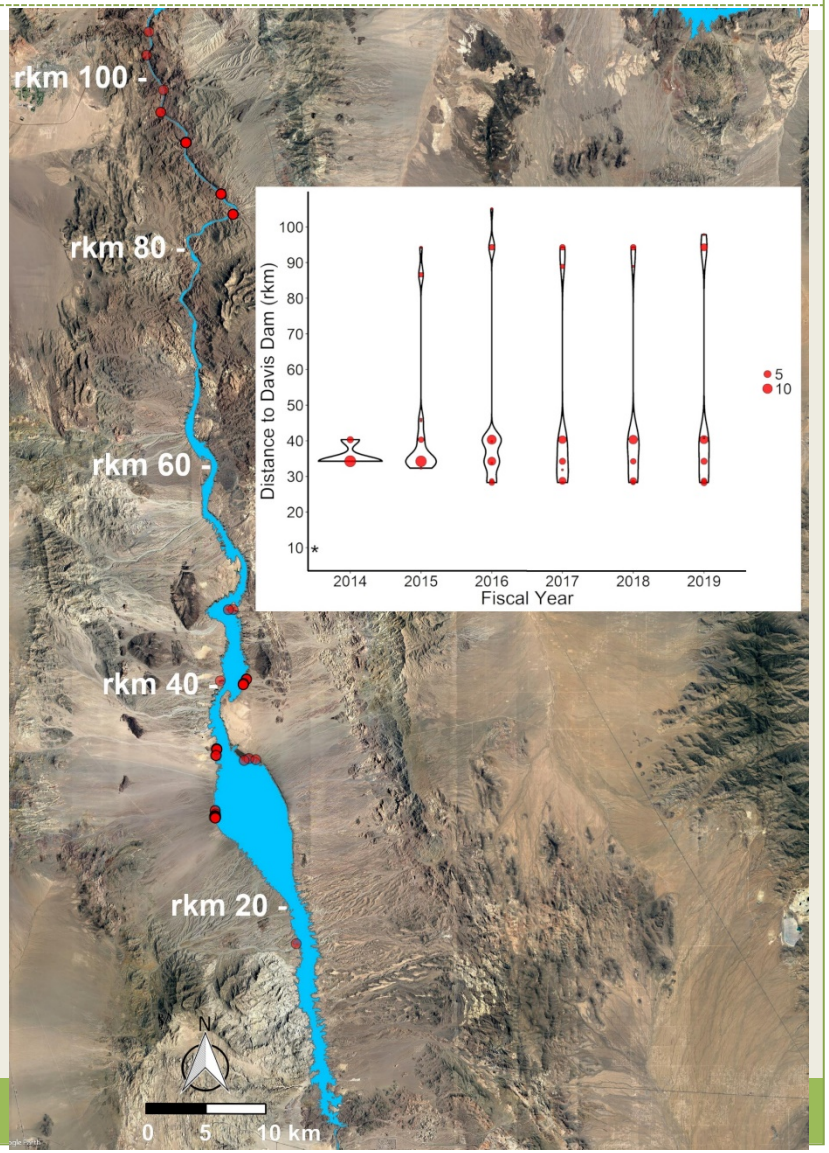
Combination	River	Liberty	Basin	Katherine	n	Percent (%)
1	-	-	X	-	283	69.5
2	-	-	X	X	1	0.2
3	-	X	X	-	3	0.7
4	X	-	-	-	20	4.9
5	X	-	X	-	94	23.1
6	X	-	X	X	1	0.2
7	X	X	X	-	5	1.2
				Total	407	100



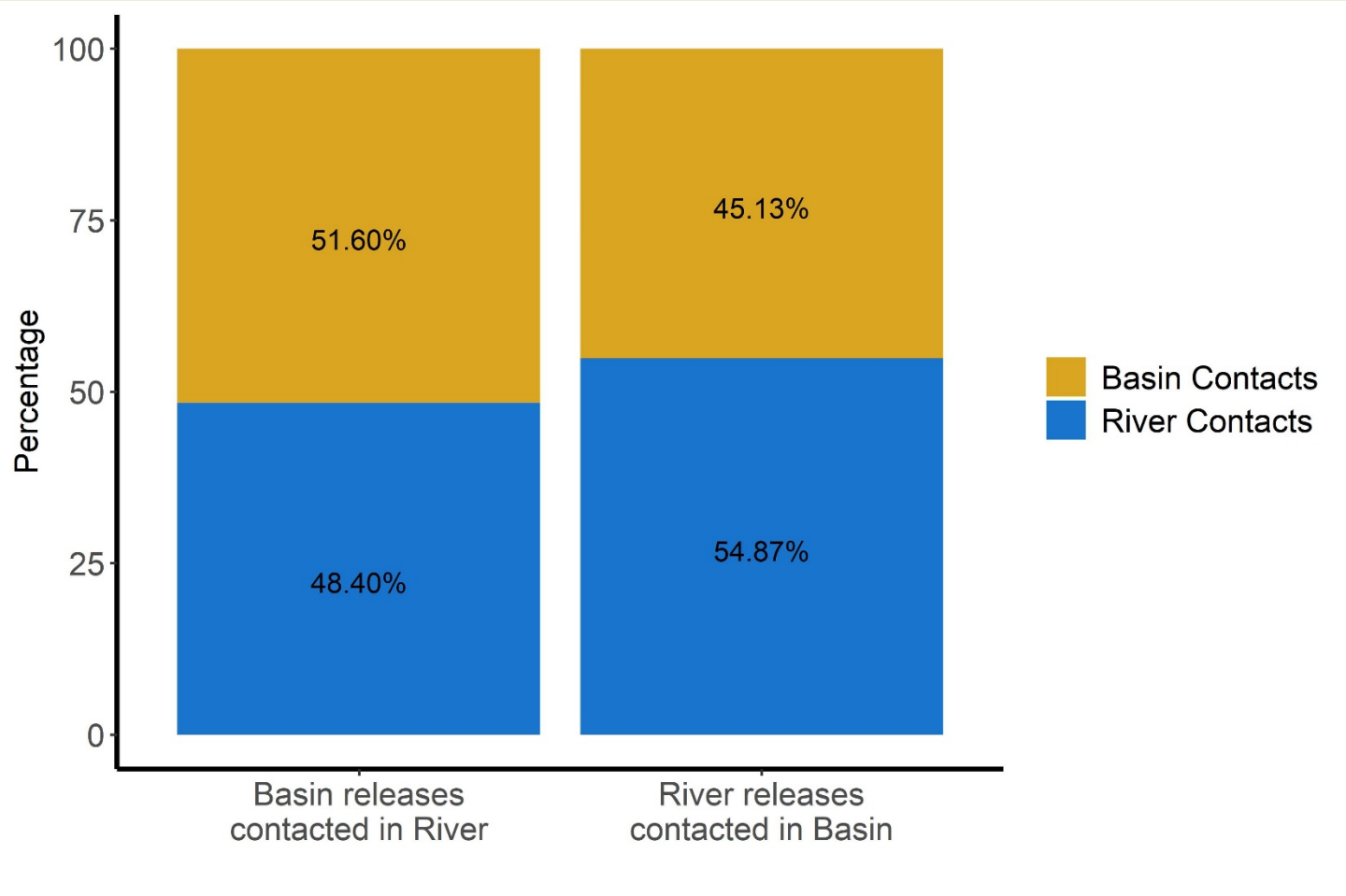
Katherine Stocking Displacement

- 7,092 fish stocked from 2009 to 2013
  - 0.5% contacted
  - Mainly contacted in Basin

Combination	River	Liberty	Basin	Katherine	n	Percent (%)
1	-	-	X	-	27	75
2	-	-	X	X	1	2.8
3	X	-	-	-	3	8.3
4	X	-	X	-	5	13.9
				Total	36	100

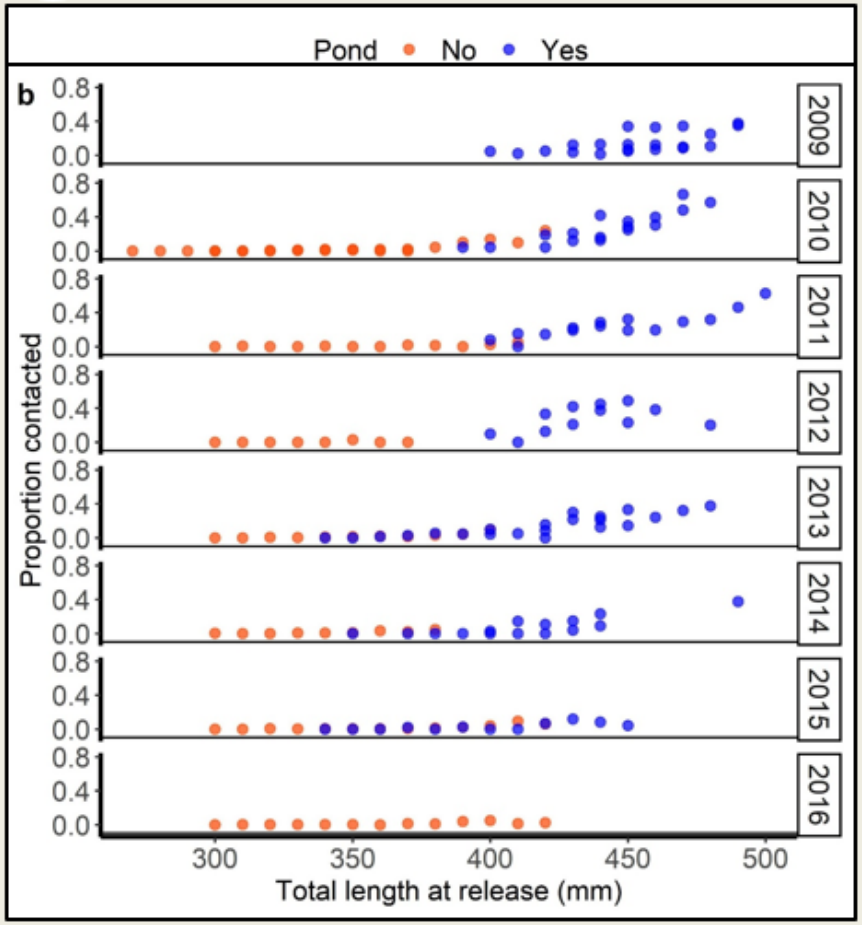


Contact proportions of unique razorback sucker PIT tags that were released in Basin and contacted in River, and released in River and contacted in Basin, for fish stocked from October 2008 to September 2013

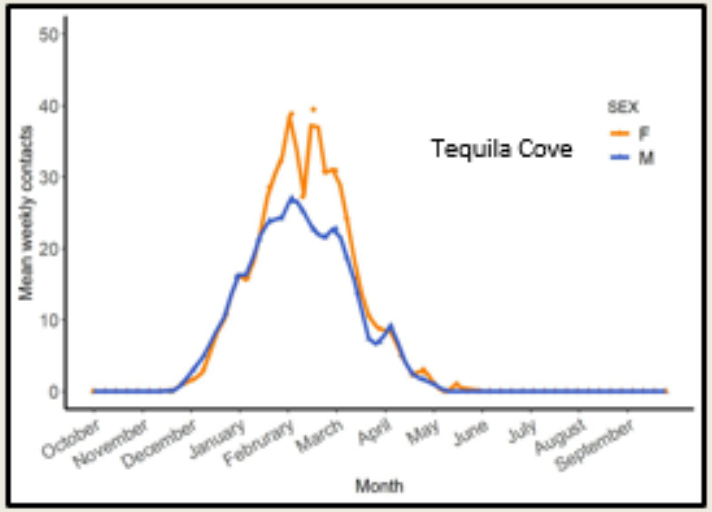


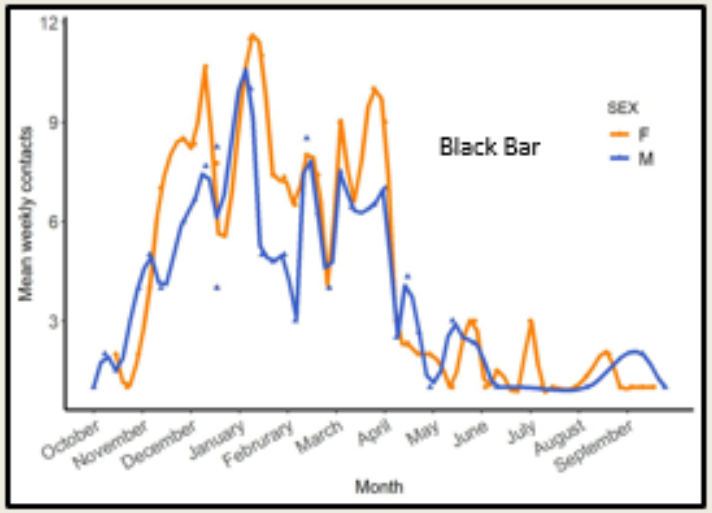
Repatriate Recruitment

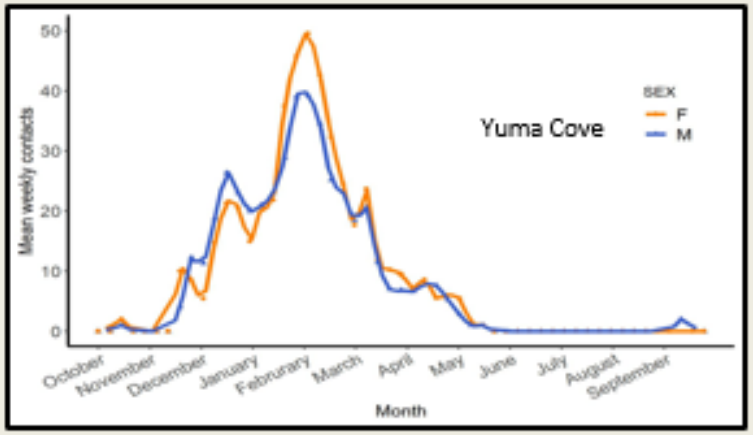
- Majority of fish are contacted; contact proportions can be used
- Data requirements:
  - Size classes (10mm), release SY, pond rearing (yes or no), >2 years at large
  - Also separated by month
- Few to no contacts for fish <400 mm TL
- Release SY accounted for most variation after size at release



Spawning Ground Visitation







Conclusions

- Subpopulations are stable
- Few fish are contacted in Liberty
- More movement occurs between River and Basin than previously reported
- Size at release still most important factor for survival

Thanks to our partners for their support

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