

# Post-stocking survival of razorback sucker in Lake Havasu

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# Background



Abraham Karam

- Lake Havasu
  - LCR MSCP Reach 3
  - Between Davis and Parker dams
  - Suite of non-native sport fish
    - ✦ Striped bass
    - ✦ Largemouth bass
    - ✦ Flathead catfish
- Razorback sucker
  - No natural population in Lake Havasu
  - Over 50,000 stocked since 2006
  - Population numbers in thousands
  - Post-stocking survival unknown
  - Spawning aggregates observed
    - ✦ From Laughlin downstream to Needles

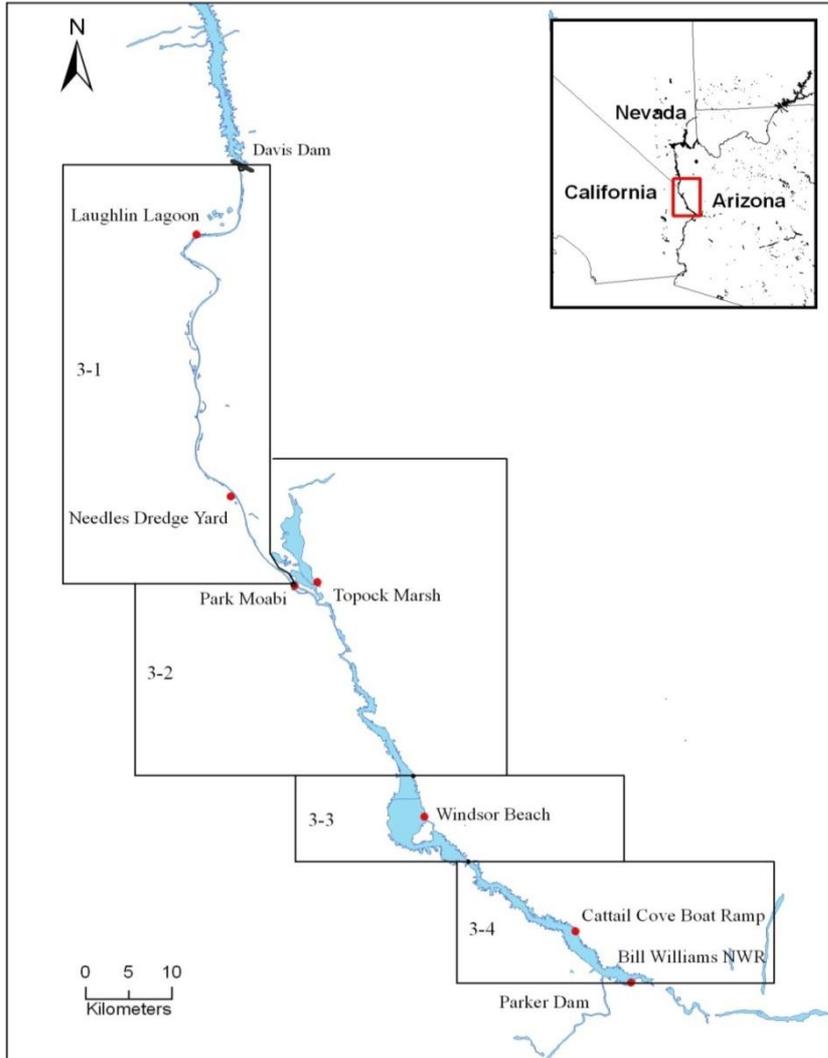


# Objectives

- Increase contacts through PIT scanning
- Assimilate all razorback sucker release and capture data
- Estimate current repatriate razorback sucker population
- Estimate survival of razorback sucker
- Participate in annual multi-agency native fish survey



# Study Area



- Divided into four ‘zones’
  - **3-1** - Riverine clear waters downstream of Davis Dam
  - **3-2** - Topock Marsh, Lake Havasu delta
  - **3-3** - Wide basin of Lake Havasu
  - **3-4** - Lower Lake Havasu, Bill Williams River NWR

# PIT Scanning - Equipment



- Submersible PIT scanners (8)
  - 80 x 80 cm antenna
  - Fully submersible to 10 meters
  - Retrieved via boat hook
  - 24 hour battery life
- Shore based unit (1)
  - 190 x 80 cm antenna
  - 50 meter cable connects logger to antenna
  - 72 hour battery life

# PIT Scanning - Sampling



- 2012
  - January through April
  - Six sampling trips
    - ✦ 3 overnight deployments
    - ✦ 8-10 submersibles
    - ✦ 1 shore based
- 2013
  - December (2012) through April
  - Six sampling trips
    - ✦ 8-13 submersibles
    - ✦ 1 shore based

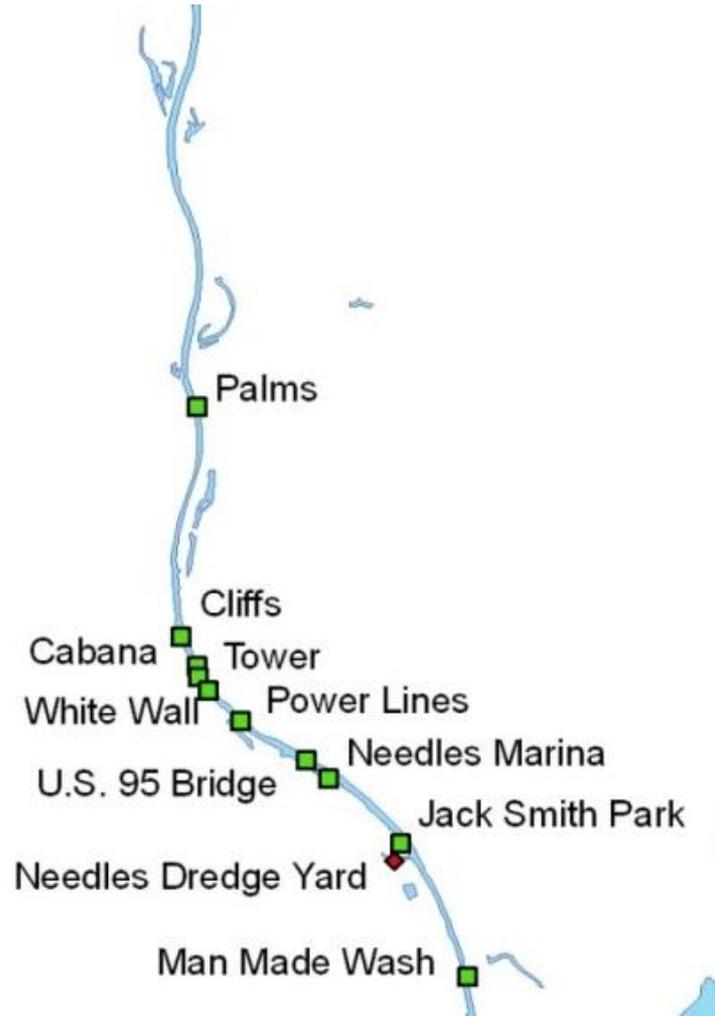


# PIT Scanning in Zone 3-1



- Shore based unit deployed only at Razorback Island
- Submersibles – Laughlin
  - Laughlin Bridge
  - Laughlin Lagoon
  - Razorback Island
  - Razorback Riffle

# PIT Scanning in Zone 3-1



- Submersibles – Needles

- Palms
- Cliffs
- Cabana
- Tower
- White Wall
- Power Lines

# PIT Scanning in Zone 3-2



- Reclamation Scanning

- Park Moabi
- Golden Shores
- Pulpit
- Sand Dune
- Mohave Rock
- Blankenship Bend
- Two Lobe Cove
- Rearing Cove
- Castle Rock
- Clear Bay



# Data Analysis – Population Estimates



- Single census estimate
  - Modified Peterson formula
    - ✦ 
$$N^* = \frac{(M+1)(C+1)}{R+1}$$
    - 2012 Marking period
    - 2013 Capture period
- 134 kHz PIT tagged fish
- PIT scanned or captured



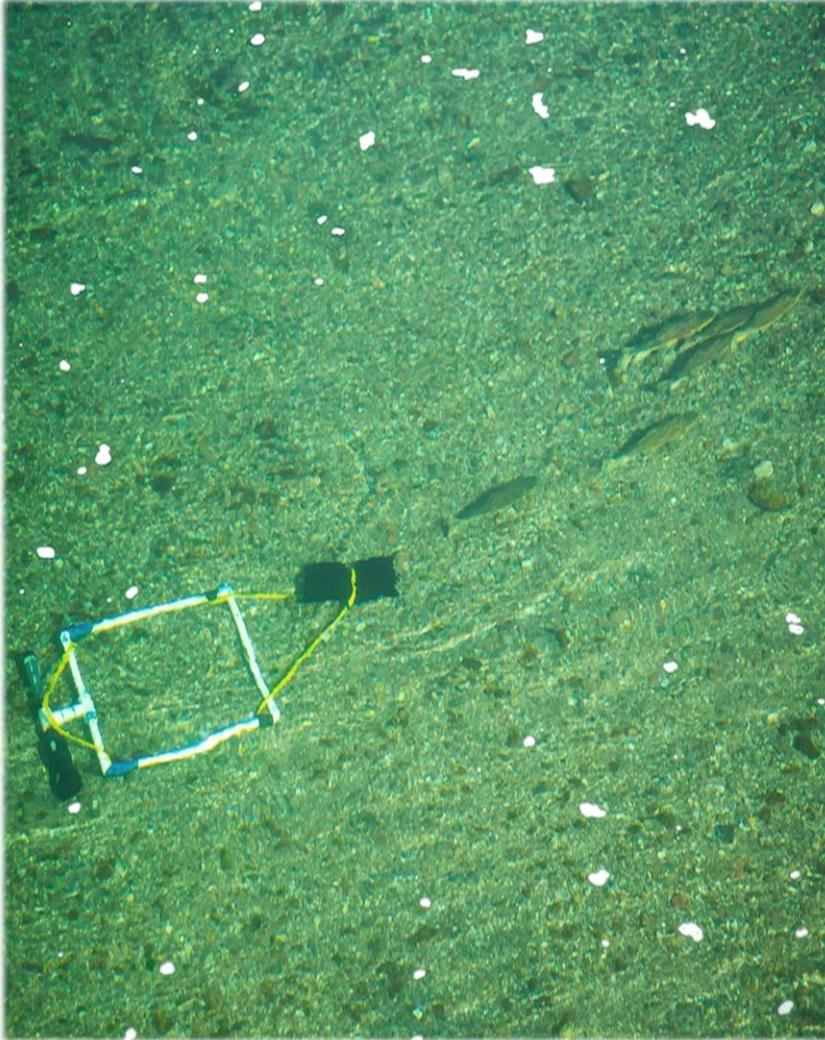
# Data Analysis – Post-Stocking Survival



- PIT scanning and capture data from 2006-2013
- Live recapture model (CJS)
  - Program MARK
  - 2-3 age classes
  - 2 capture seasons per year
    - ✦ Spring (January-June)
    - ✦ Autumn (July-December)
  - Influence of time (cohort), season, and size at release



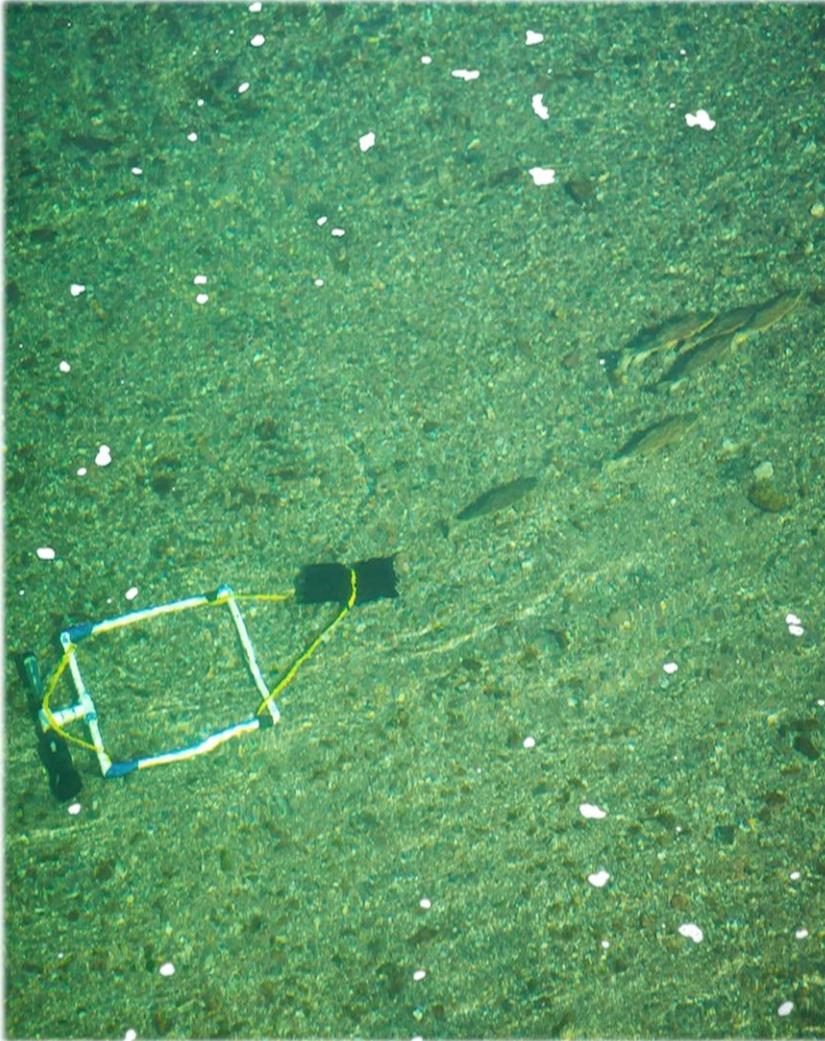
# Results – PIT scanning 2012



- 2,244 total hours scanning
- 763 unique individuals
  - 652 razorback sucker with a 134 kHz PIT tag release record



# Results – PIT scanning 2013



- M&A
  - 3,251 total hours scanning
  - 1414 individuals
- Reclamation
  - 3,466 total hours scanning
  - 994 individuals
- Combined
  - 2,168 individuals
  - 2,110 razorback sucker with a 134 kHz PIT tag release record



# Results – Population Estimates

- 2012 Estimate
  - Based on 2012 and 2013 scanning and capture data
  - Razorback sucker released before December 2011 and tagged with a 134.2 kHz PIT tag

Data source	M	C	R	Estimate (95% CI)
Scanning	726	1310	282	3380 (3008-3700)
Netting	247	85	2	10664 (2962-106640)
Combined	934	1373	284	4524 (4027-5081)

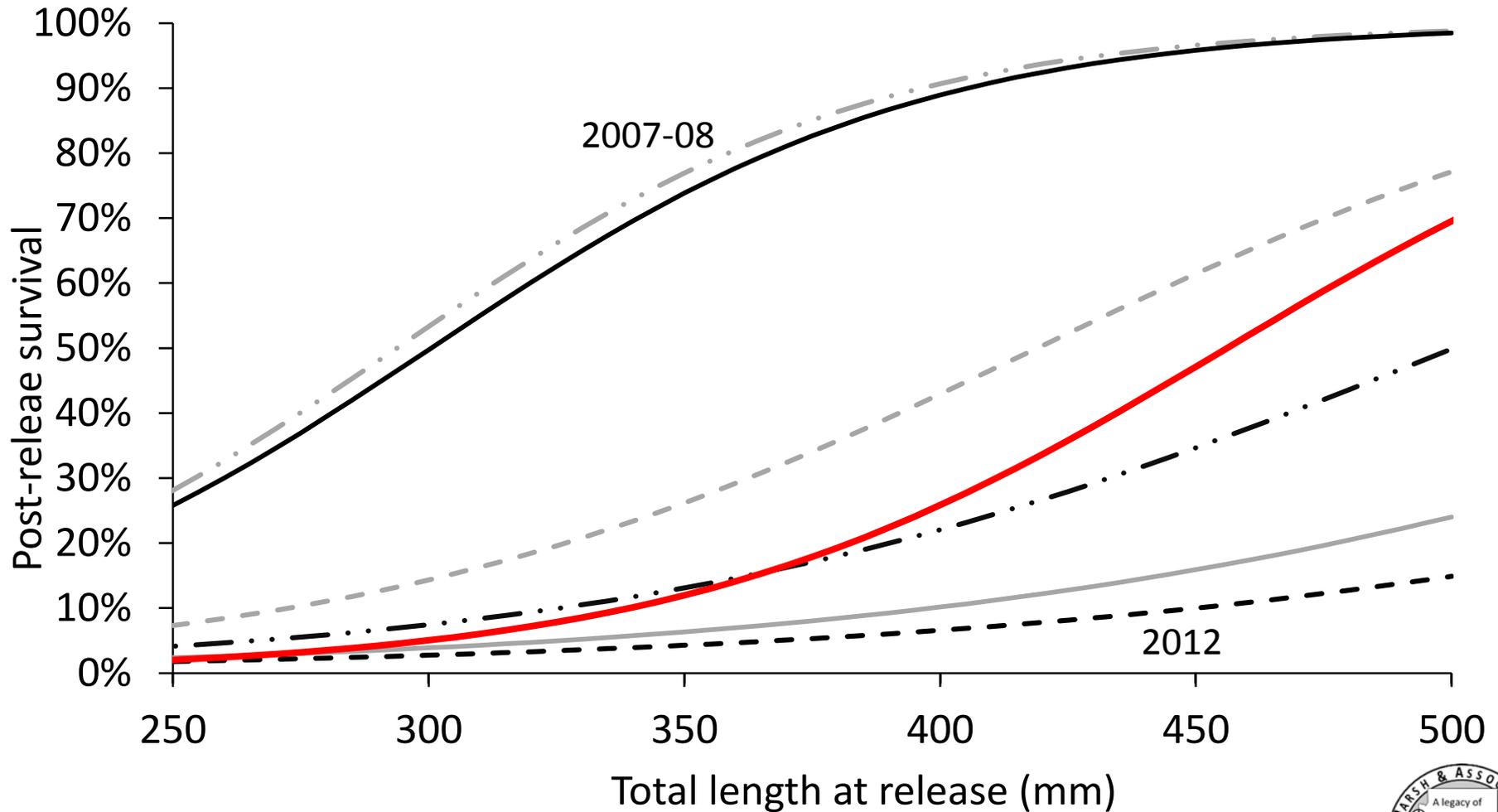


# Results - Survival

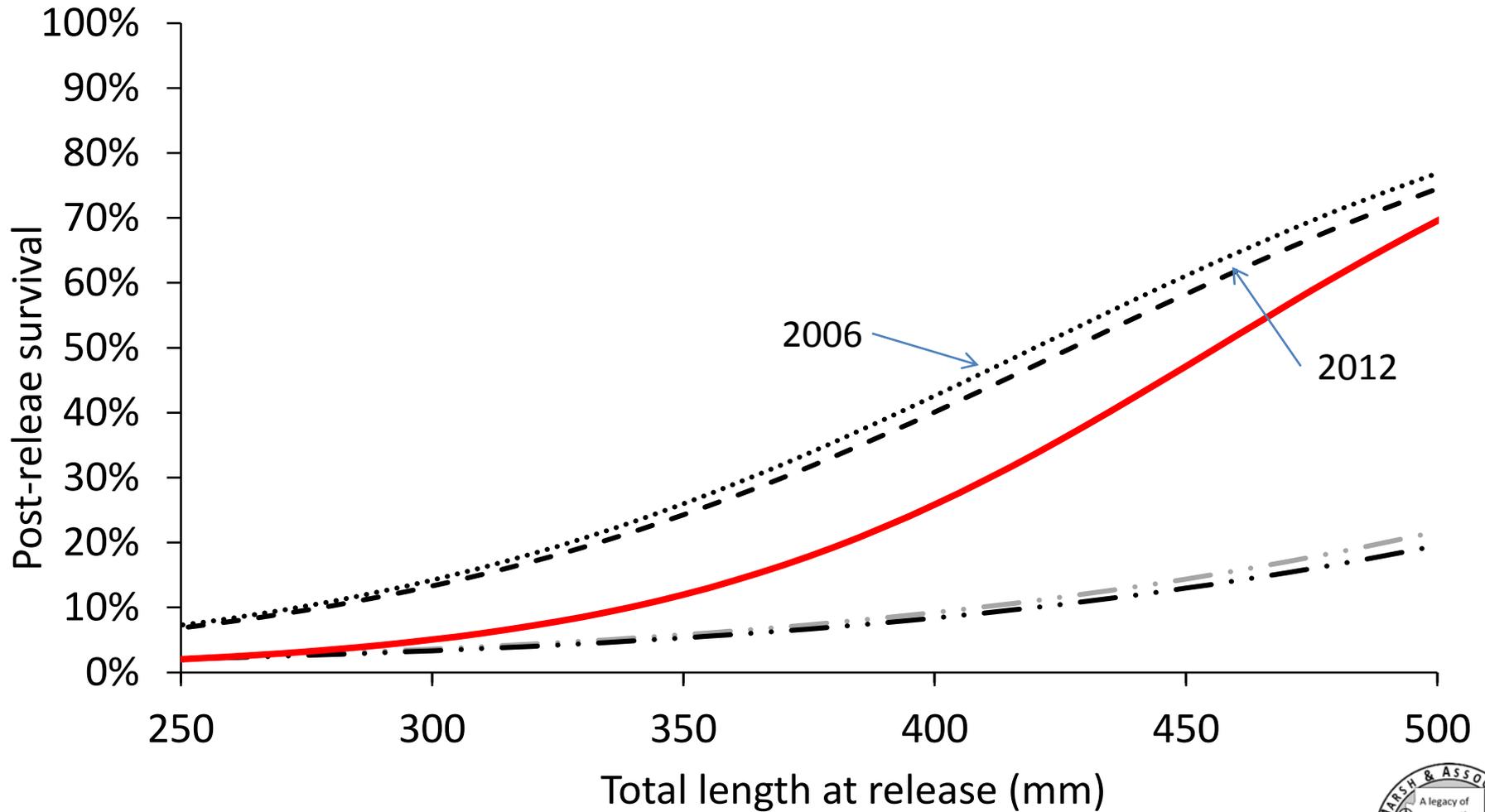
Model	AICc	AICc Weight	No. of Parameters	Deviance
{2 age, time, time, yes}	27636.60	0.9965	31	27574.56
{3 age, time, fixed, seasonal, yes}	27647.87	0.0036	27	27593.84
{2 age, time, seasonal, yes}	27677.98	0.0000	26	27625.95
{2 age, time, fixed, yes}	27683.47	0.0000	25	27633.45
{3 age, time, fixed, time, yes}	27690.94	0.0000	35	27620.88
{3 age, time, fixed, fixed, yes}	27706.70	0.0000	25	27656.67
{3 age, time, time, time, yes}	27712.51	0.0000	28	27656.47
{3 age, time, fixed, time, no}	27934.28	0.0000	37	27860.22
{3 age, time, time, fixed, yes}	27944.96	0.0000	23	27898.94
{3 age, time, time, seasonal, yes}	27971.26	0.0000	25	27921.23
{3 age, time, fixed, seasonal, no}	27976.18	0.0000	28	27920.15
{2 age, time, time, no}	27980.26	0.0000	37	27906.20
{3 age, time, fixed, fixed, no}	27983.62	0.0000	27	27929.59



# Results – Survival Spring Release



# Results – Survival Autumn Release



# Discussion

- PIT scanning greatly increased contact rates
  - Increased precision in population estimate
- Post stocking survival dependent on size at release
  - Relationship not consistent over time
    - ✦ Seasonal?
    - ✦ Annual?
- Post-stocking survival similar to Lake Mohave

# Thanks to our partners for their support

- USBR



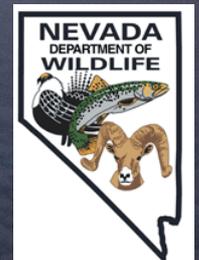
- USFWS



- NPS



- NDOW



- Cross Country Consulting, LLC

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