Humpback Chub Population Dynamics throughout the Colorado River Ecosystem

David Van Haverbeke, Maria Dzul, Kirk Young, Charles Yackulic, Mike Dodrill, Dennis Stone, Mike Pillow

Provisional. Do not cite.

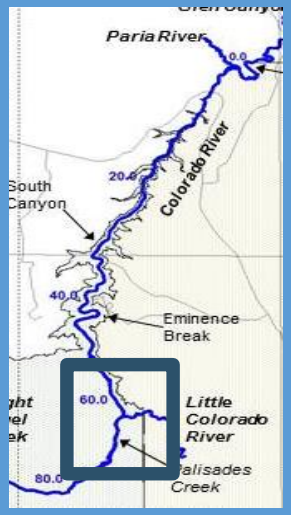
Project G: Humpback Chub (HBC) Population Dynamics throughout the Colorado River Ecosystem

- **Project elements and objectives**:
- G.1: HBC population modeling
- G.2 Annual spring/fall HBC abundance estimates in the lower 13.6 km of the Little Colorado River (LCR)
- G.3. Juvenile HBC monitoring near the LCR confluence
- G.4 Remote PIT tag array monitoring in the LCR
- G.5. Monitoring HBC aggregation relative abundance and distribution
- G.6. Juvenile chub monitoring - West
- G.7. Chute Falls HBC translocations
- G.9. Backwater seining

- **Funding Amount and Source:** $1.47 million AMP

- **Products**: 6 published journal articles, 4 reports, 6 conference presentations (see AMWG annual report)

G.1-3 HBC population monitoring in and around the Little Colorado River



Colorado River

skipped spawning

outmigration

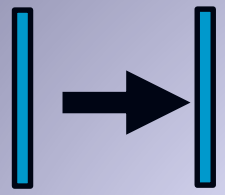
outmigration

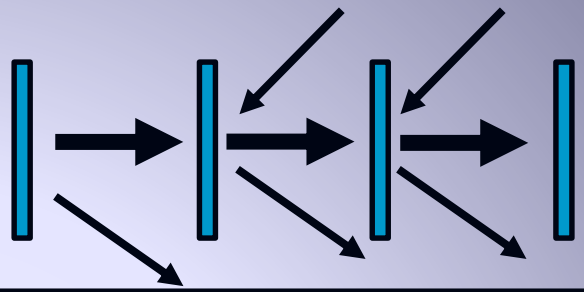
resident

spring spawning migration

Little Colorado River

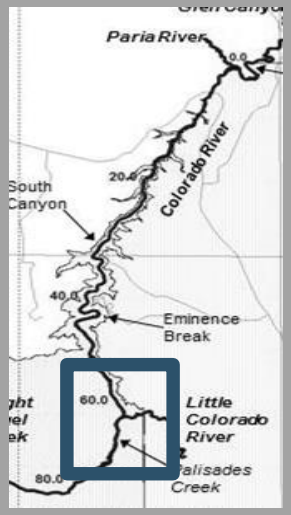
Provisional. Do not cite.





- Closed models:
  - Assumptions: No immigration/emigration and Survival is 100%
  - Requires short time between mark and recapture event
- Open models:
  - Allows for survival and movement
  - Need at least 3 capture occasions
  - More robust to some model assumptions

- It is useful to fit both model types to see whether they agree



Colorado River

skipped spawning

outmigration

outmigration

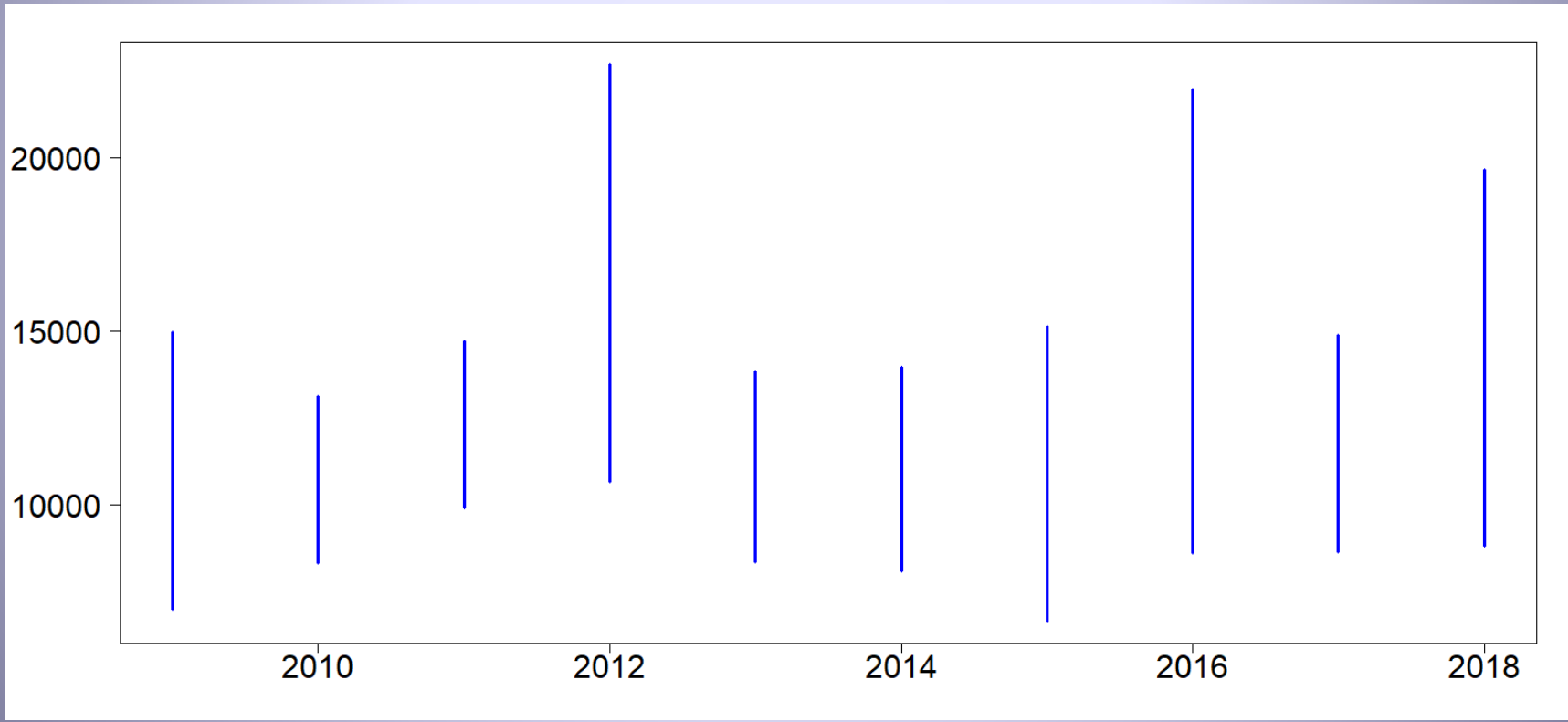
Adult abundance in LCR aggregation

resident

spring spawning migration

Little Colorado River

Adult HBC abundance in LCR aggregation (open model)



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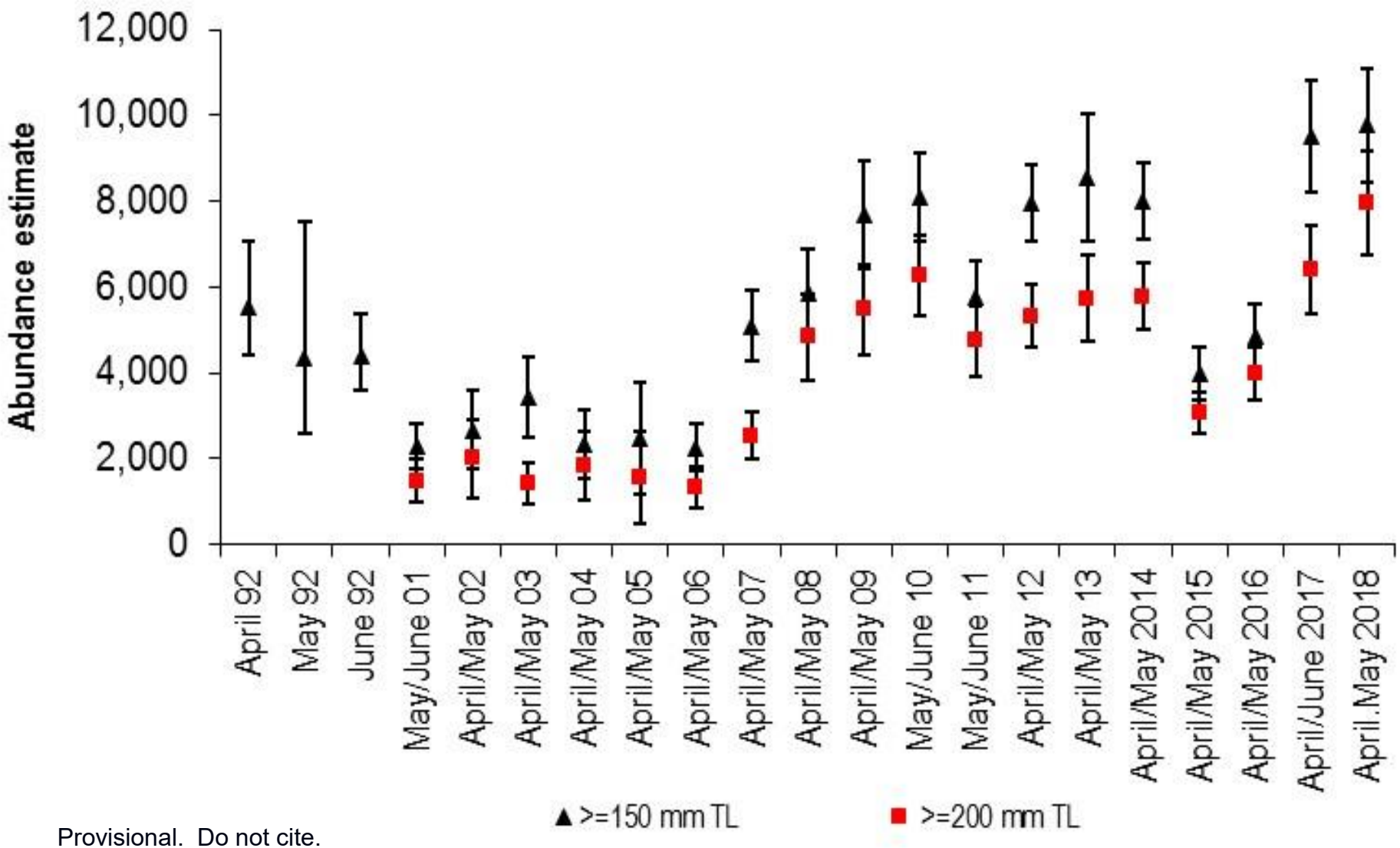
Spring abundances of HBC ≥150 mm and ≥200 mm in lower 13.6 km of LCR (closed model)



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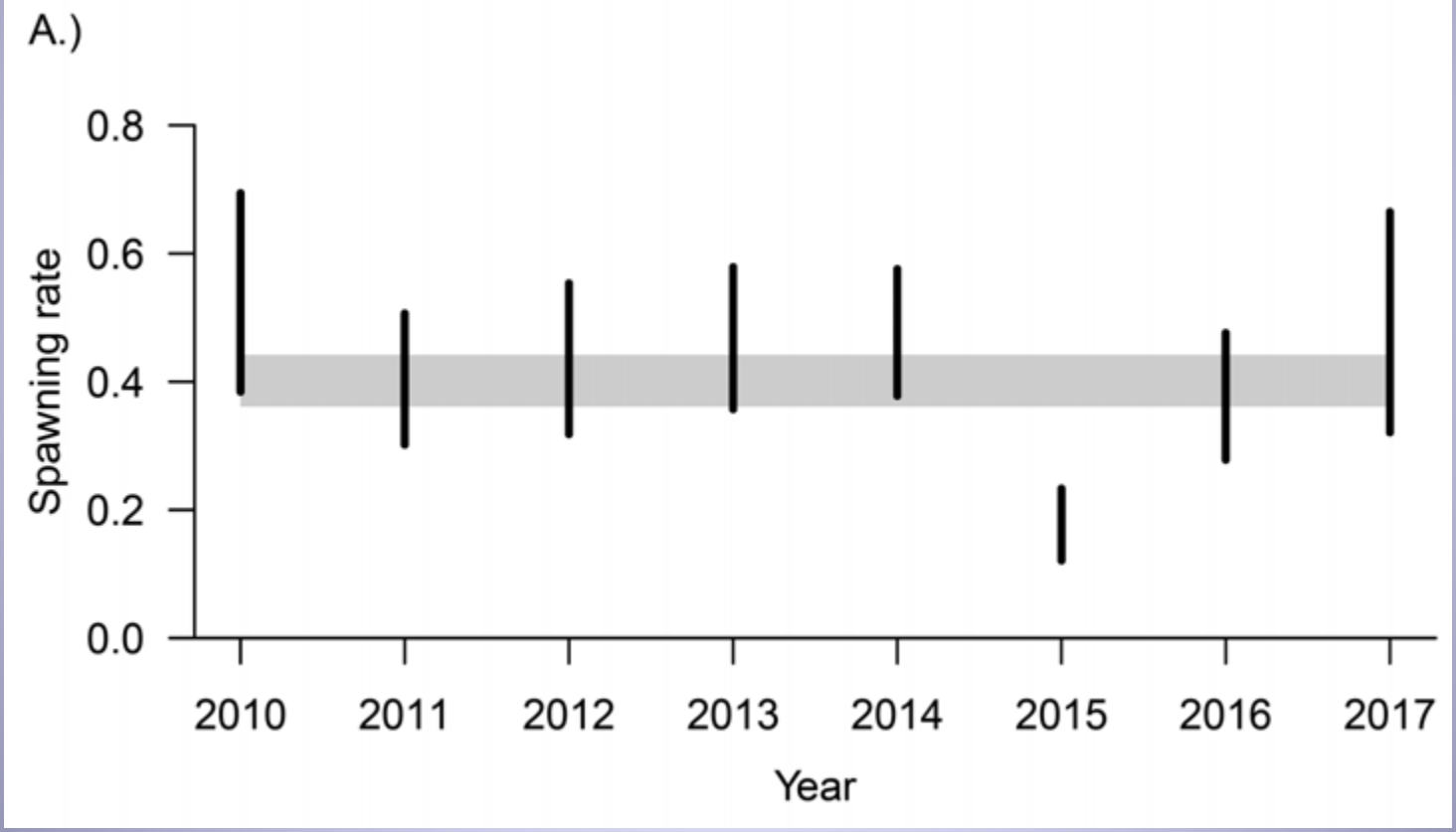
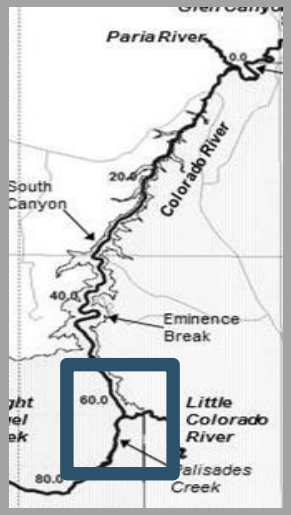
Adult HBC spawning rate (i.e., movement between CR and LCR)

(open model)





Colorado River

skipped spawning

outmigration

outmigration

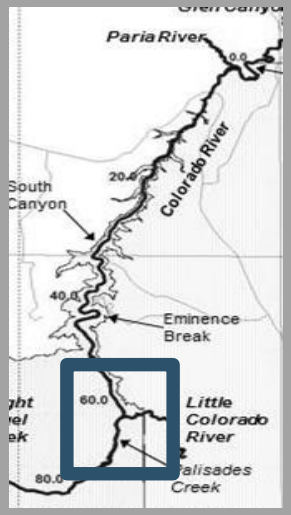
Adult abundance in LCR aggregation

resident

spring spawning migration

Little Colorado River

Provisional. Do not cite



Colorado River

skipped spawning

outmigration

outmigration

spring spawning migration

resident

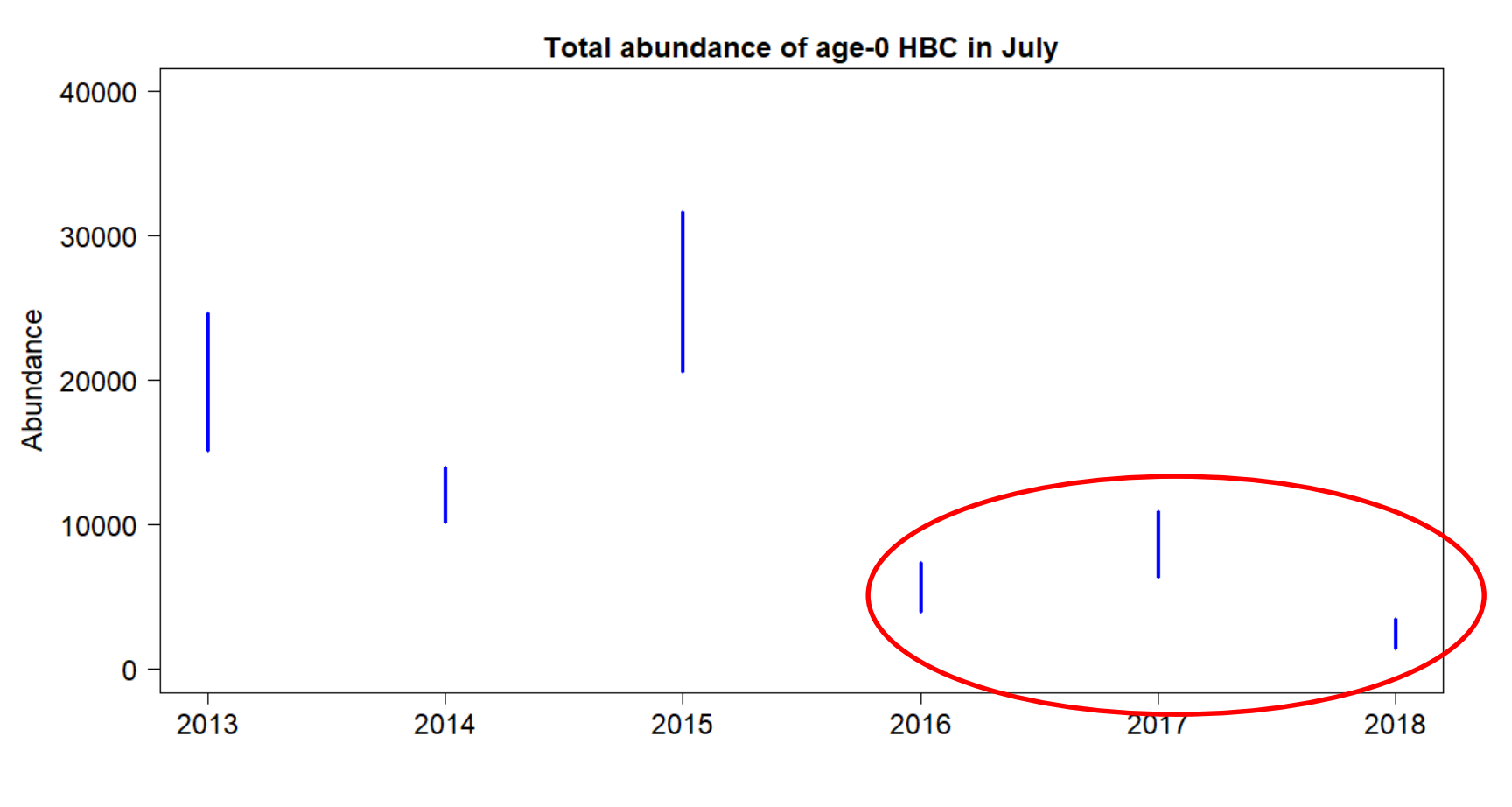
July age-0 abundance in LCR

Little Colorado River

Provisional. Do not cite.

Age 0 HBC abundance in LCR in July

(closed model)



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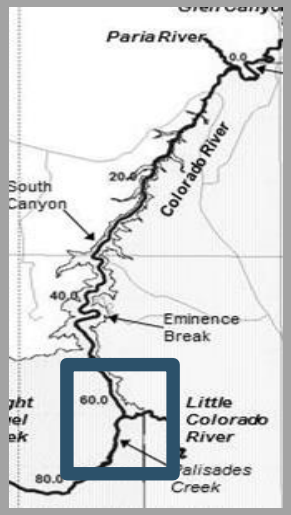

Colorado River

skipped spawning

outmigration

outmigration

spring spawning migration

resident

Fall/spring age-0-1 abundance in LCR

Little Colorado River

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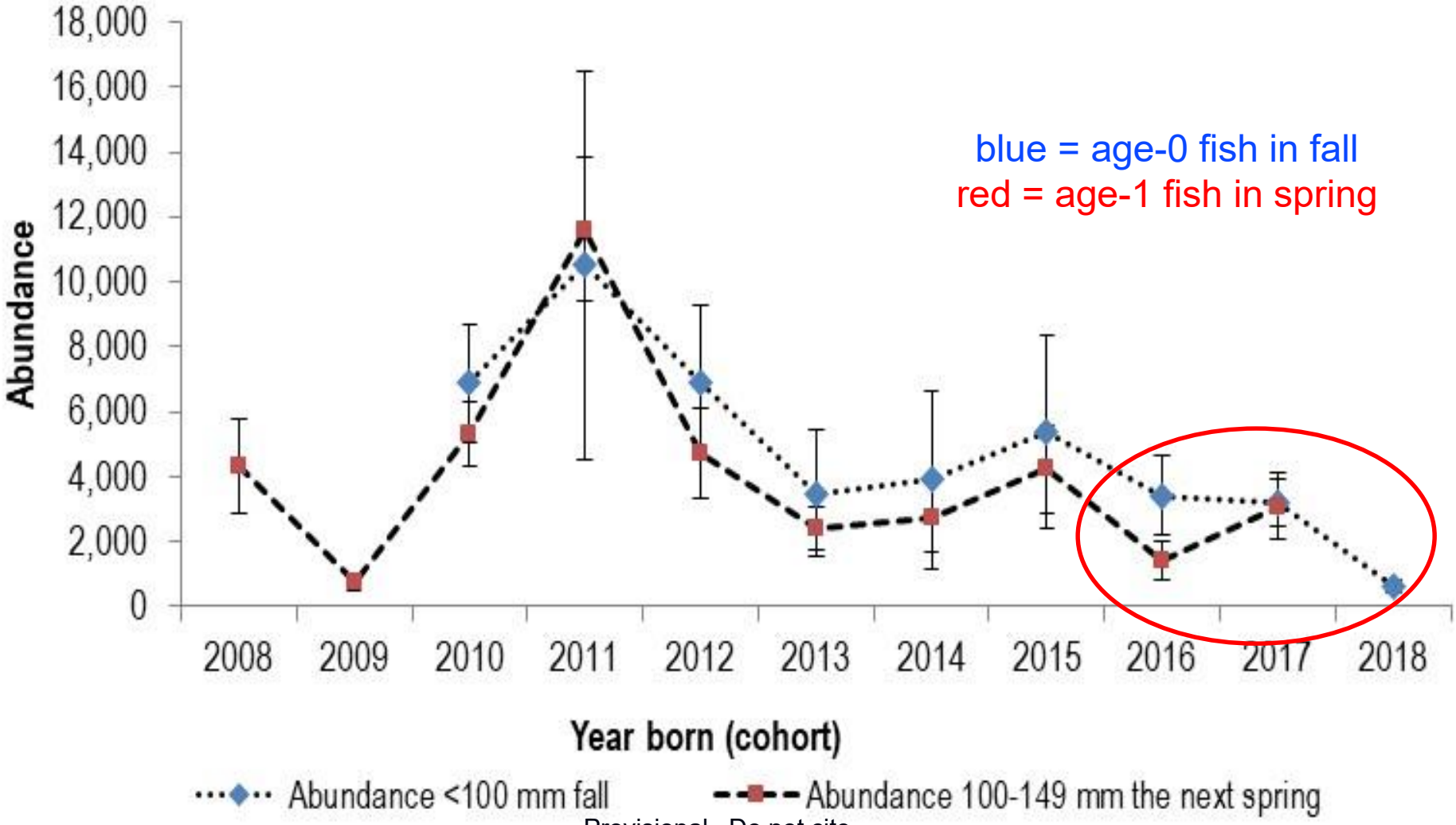
Juvenile HBC abundances
(closed model)



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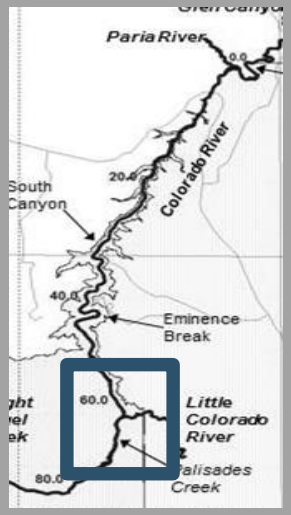


Colorado River

skipped spawning

outmigration

Juvenile abundance in JCM reach

outmigration

resident

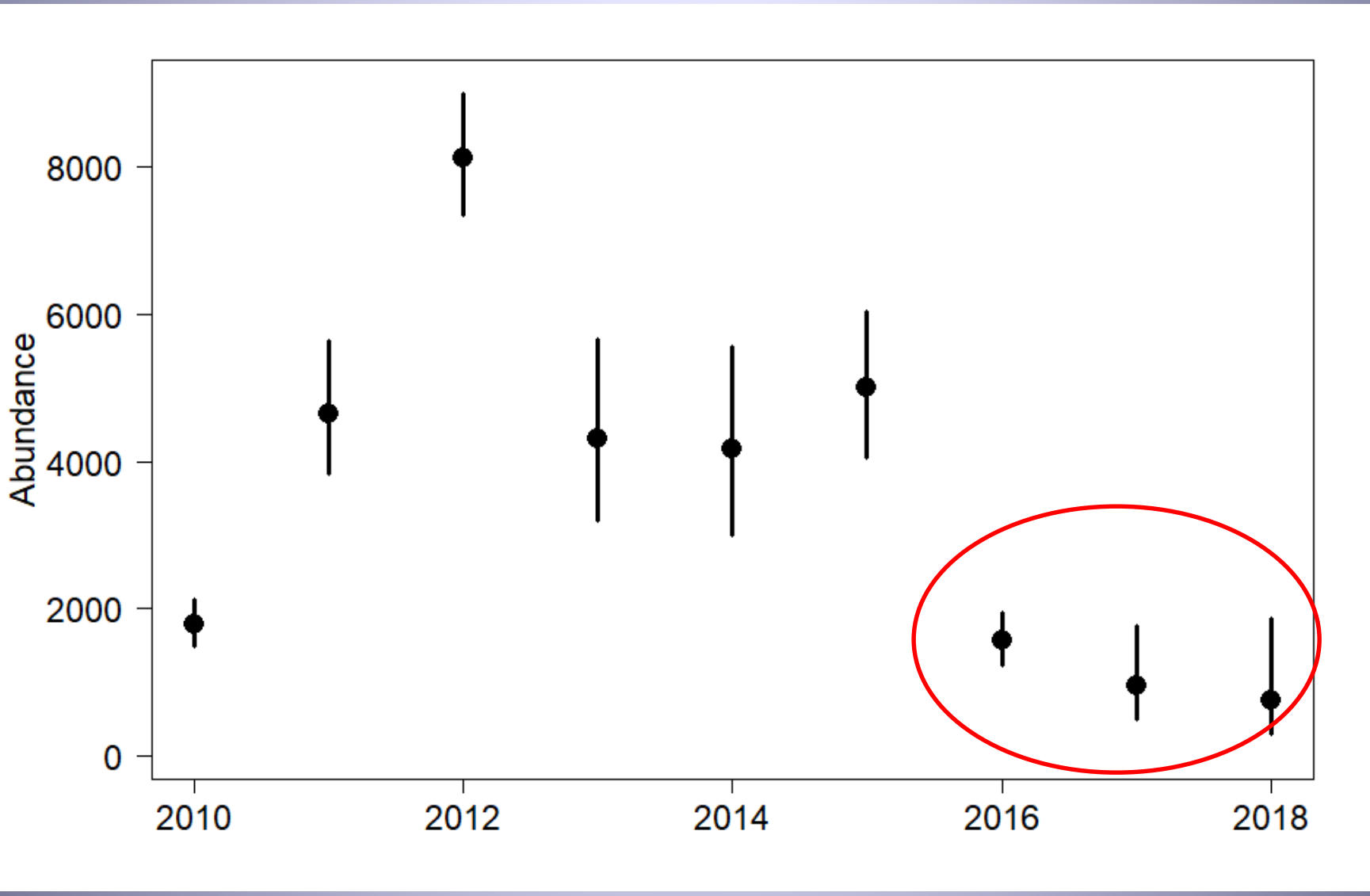
spring spawning migration

Little Colorado River

Provisional. Do not cite.

Fall juvenile HBC abundance in JCM reach

(mostly closed model)



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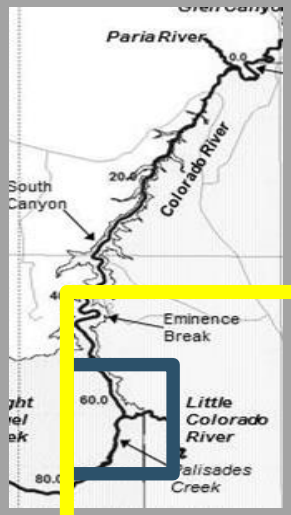


Colorado River

skipped spawning

outmigration

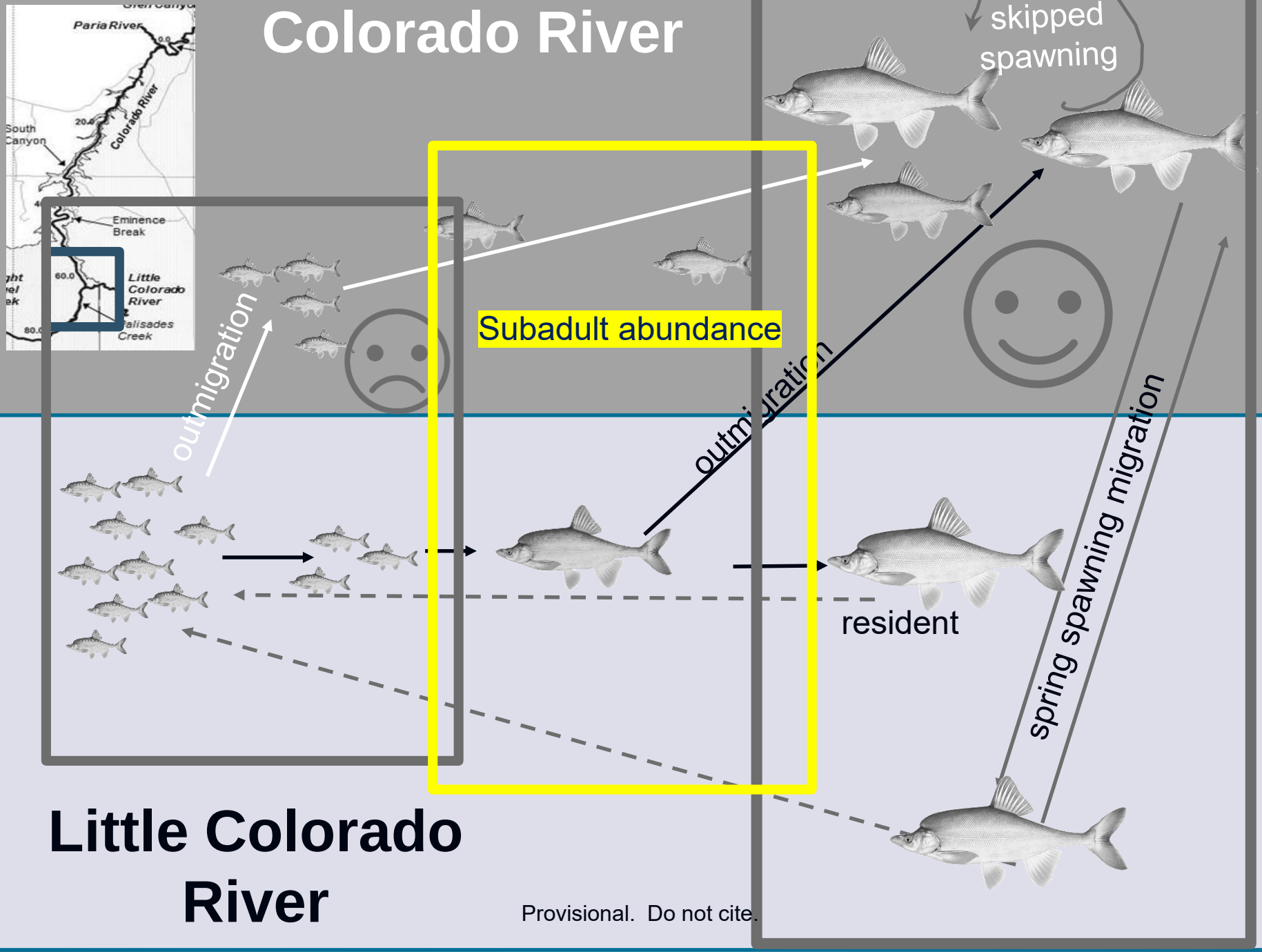
Juvenile abundance

resident

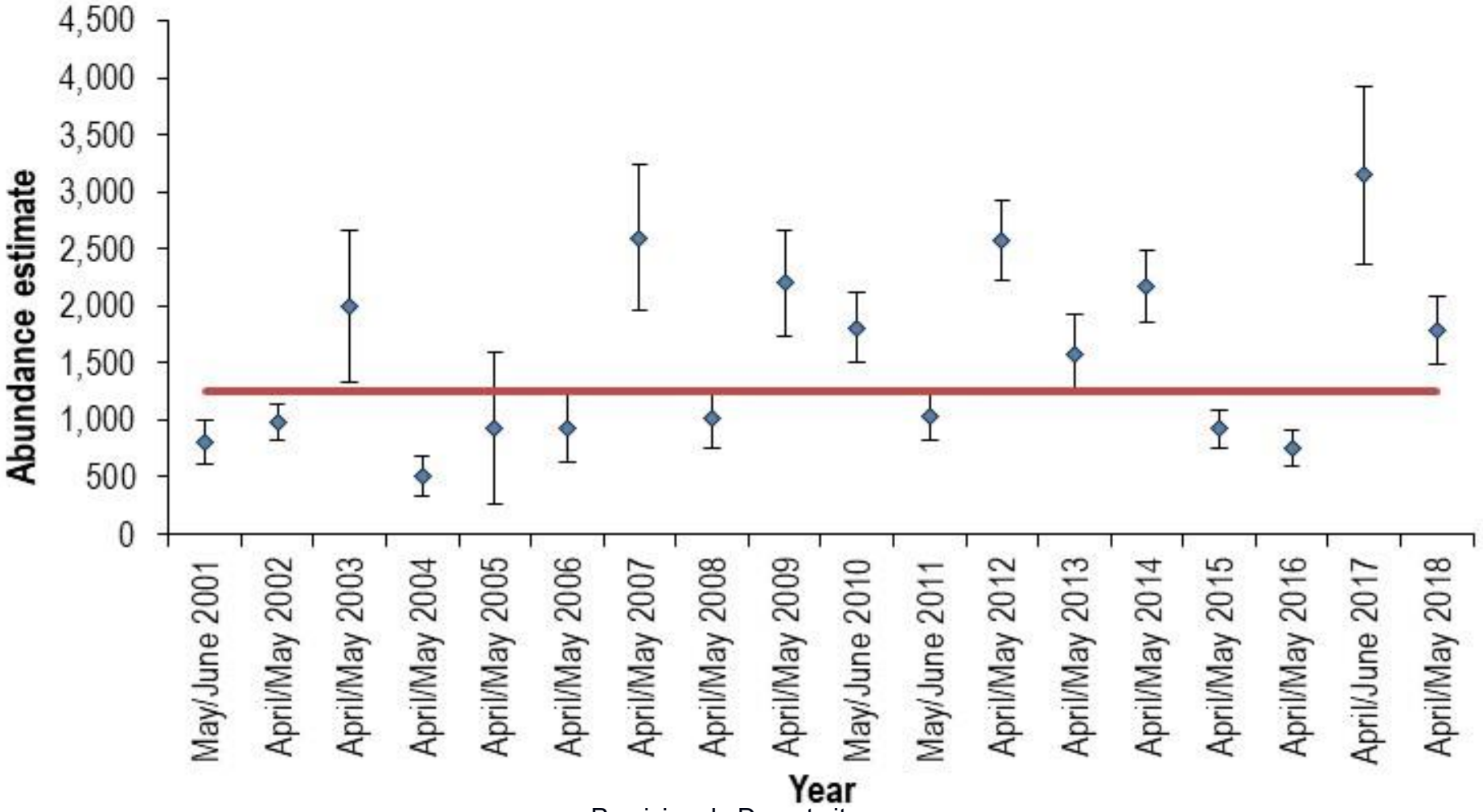
spring spawning migration

Little Colorado River

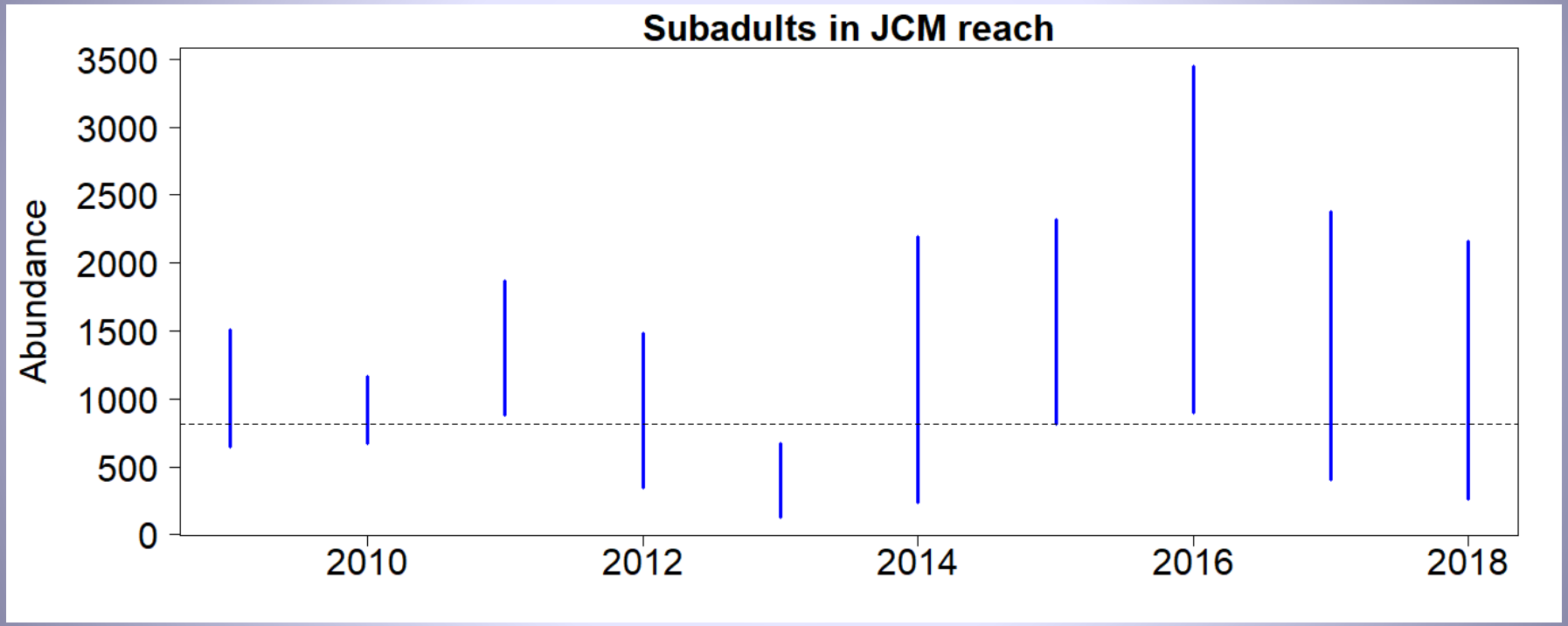
Provisional. Do not cite.


Colorado River
Paria River
South Canyon
Colorado River
Eminence Break
Little Colorado River
Palisades Creek
skipped spawning
outmigration
Subadult abundance
outmigration
resident
spring spawning migration
Little Colorado River
Provisional. Do not cite.

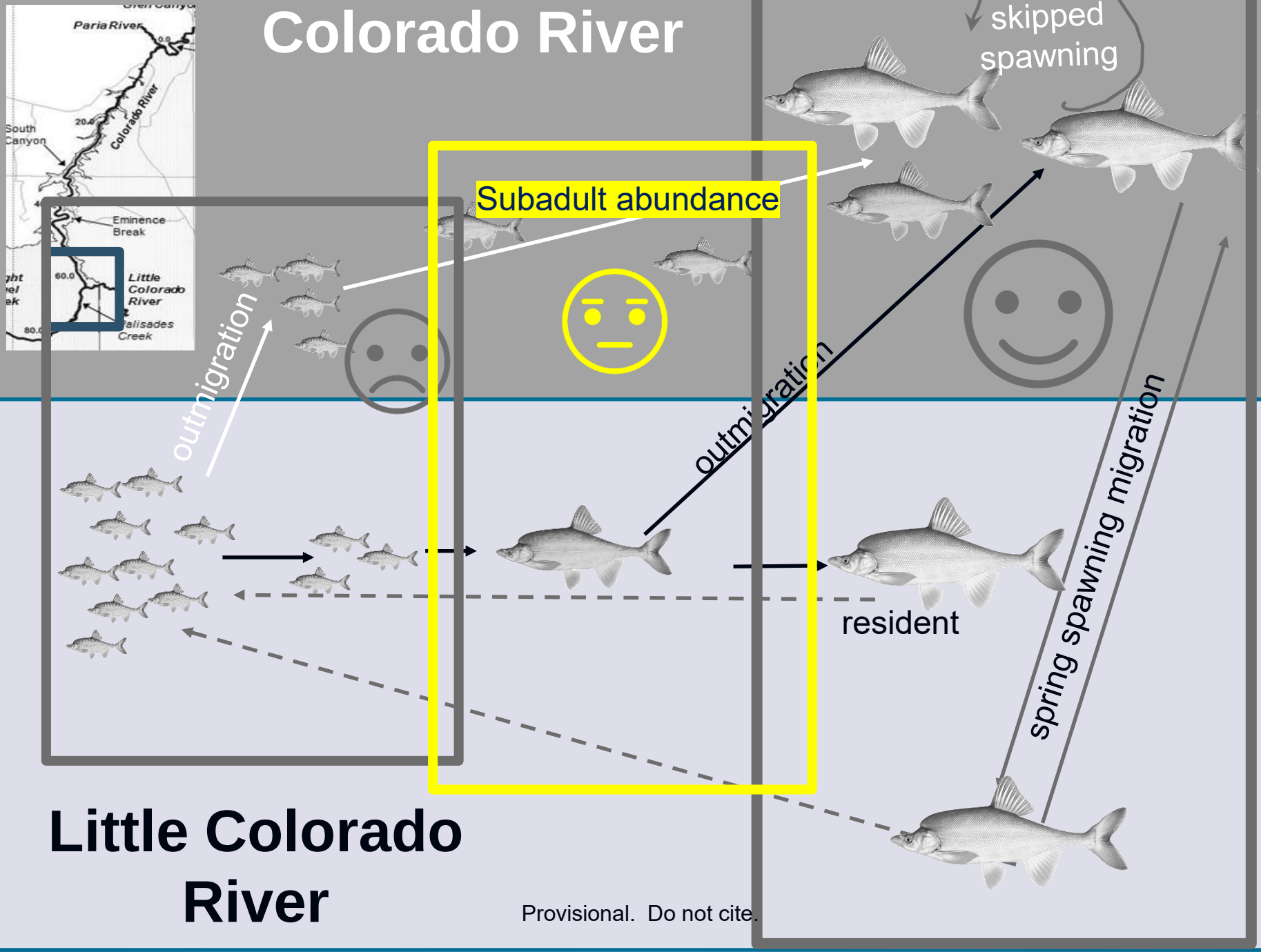
Spring abundances of HBC (150-199 mm) in lower 13.56 km of LCR with new 1,250 trigger (closed model)



Fall HBC subadult abundance in JCM reach
(open model)



Provisional. Do not cite.


Colorado River
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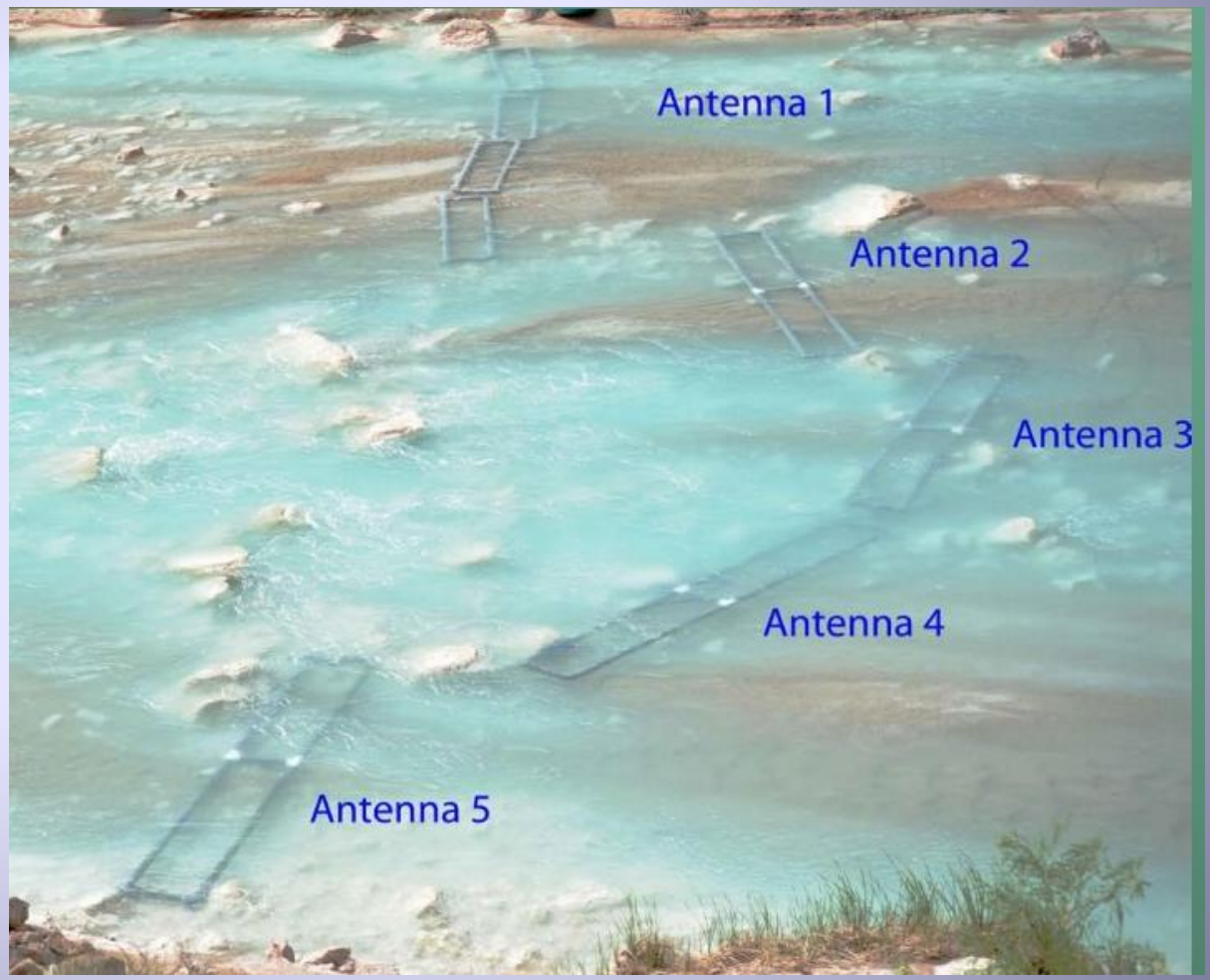
Palisades Creek
skipped spawning
Subadult abundance
outmigration
outmigration
resident
spring spawning migration
Little Colorado River
Provisional. Do not cite.

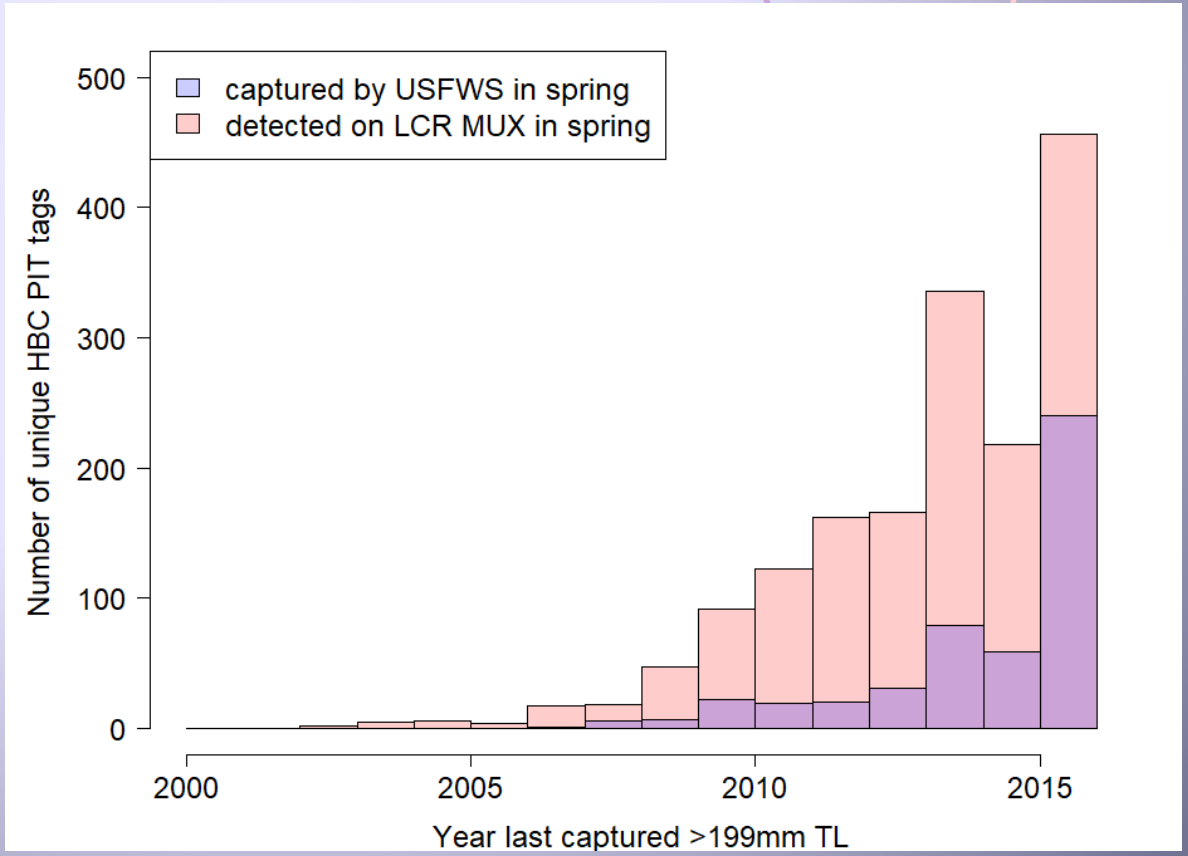
G.4 Remote PIT tag array monitoring in the LCR: Multiplexer (MUX)



Comparison of spring 2017 data show that USFWS and LCR MUX are detecting different components of the HBC population.

LCR MUX is probably better at detecting larger fish that might be trap shy.

	Captured by USFWS	Detected on LCR MUX
All HBC	2860	2622
HBC with previous capture >199mm TL	484	1651



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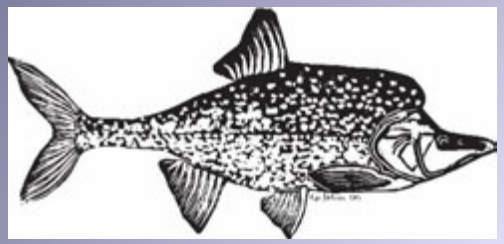
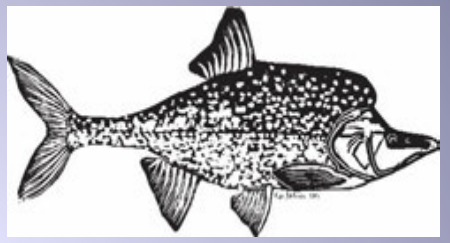


Artwork by Kate Aitchison

Slide Summary



- Adult abundance is steady (possibly increasing), but juvenile production has been low for three years.

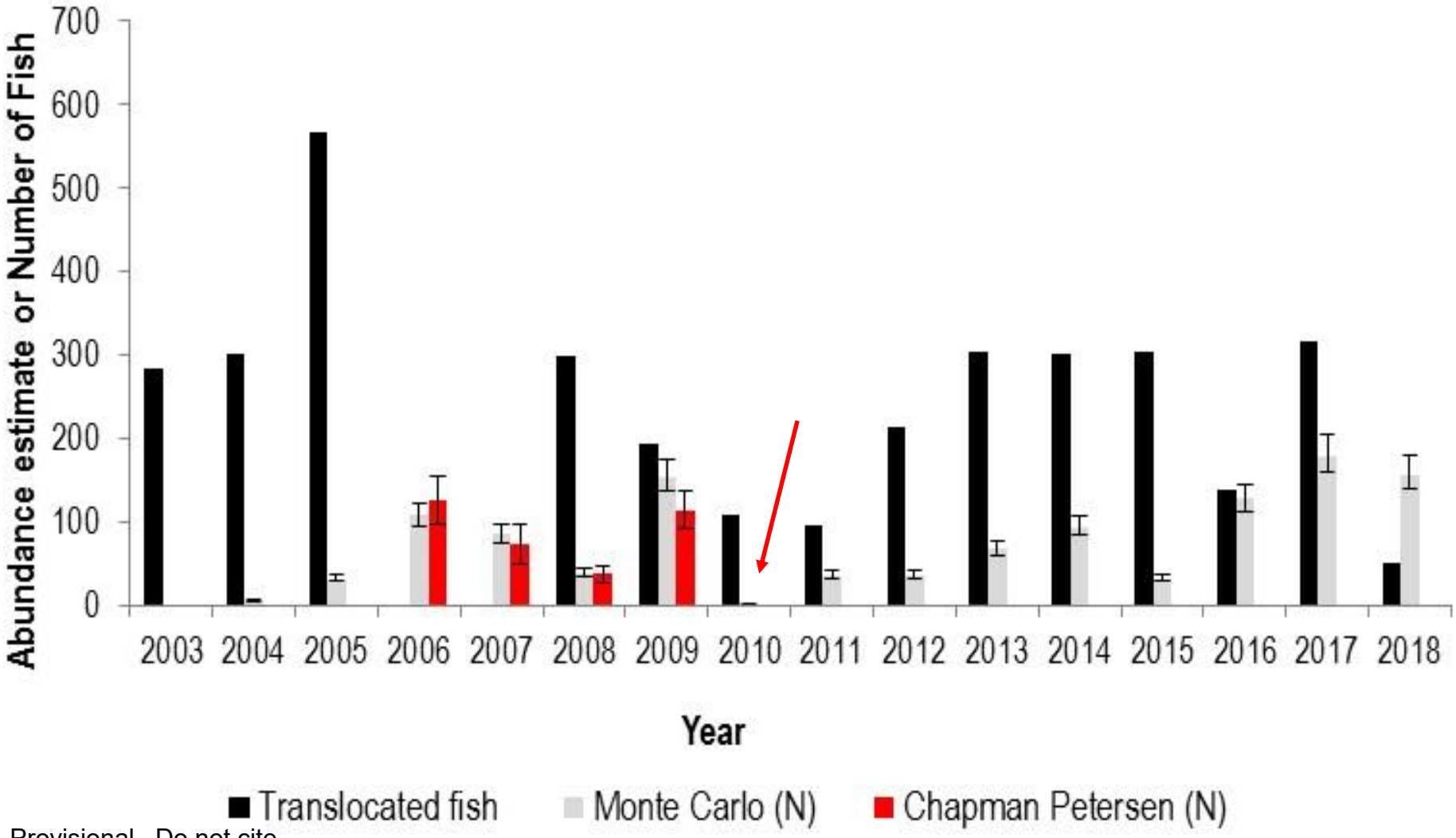
- Autonomous PIT tag antennas (like the MUX) may provide valuable detection information about fish that are hard to sample with hoop nets.

G.7 Chute Falls Translocations

Date, numbers, and sizes of HBC collected from the LCR for translocations (2003-2018)

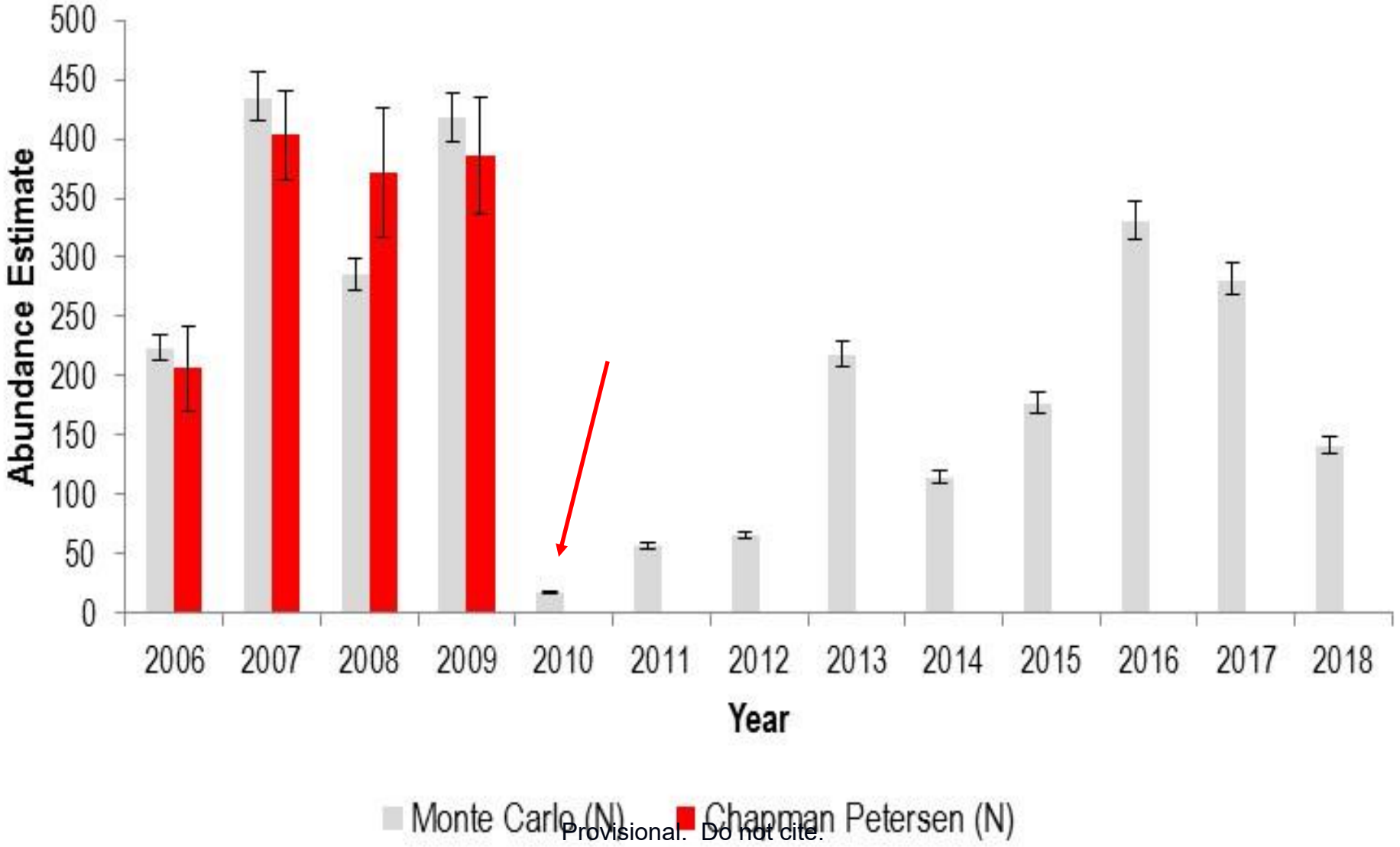
Date	Chute Falls *	Size (mm)	SNARRC	Shinumo	Havasu	Size (mm)	Total
8/1/03	283	50-100					283
7/30/04	299	50-100					299
7/29/05	567	50-100					567
7/22/08	299	~80-130		207		<80	506
10/13/08			300	100		<130	400
7/24/09	194	~80-130	205	83		<80	482
10/10/09				238		<130	238
7/16/10	108	~80-130	175			<80	283
11/5/10				300	300	<80	600
11/9/11	96	~80-130	200		300	<80	596
7/12/12	212	~80-130	202	200	300	<80	914
5/24/13				73		<30	73
7/11/13				99		<80	99
11/7/13	303	~80-130		11	300	<130	614
5/1/14					660	<30	660
10/31/14	305	65-137				<130	305
5/28/15					315	<30	315
11/1/15	303	61-128					303
10/27/16	137	58-146					137
6/16/17			139			<40	
10/26/17	315	66-120					315
10/29/18	49	63-115					49
Totals	3,470		1,082	1,311	2,175		8,038

Above Chute Falls - Number of juvenile HBC translocated (black) and adult abundances (red & grey)



Provisional. Do not cite.

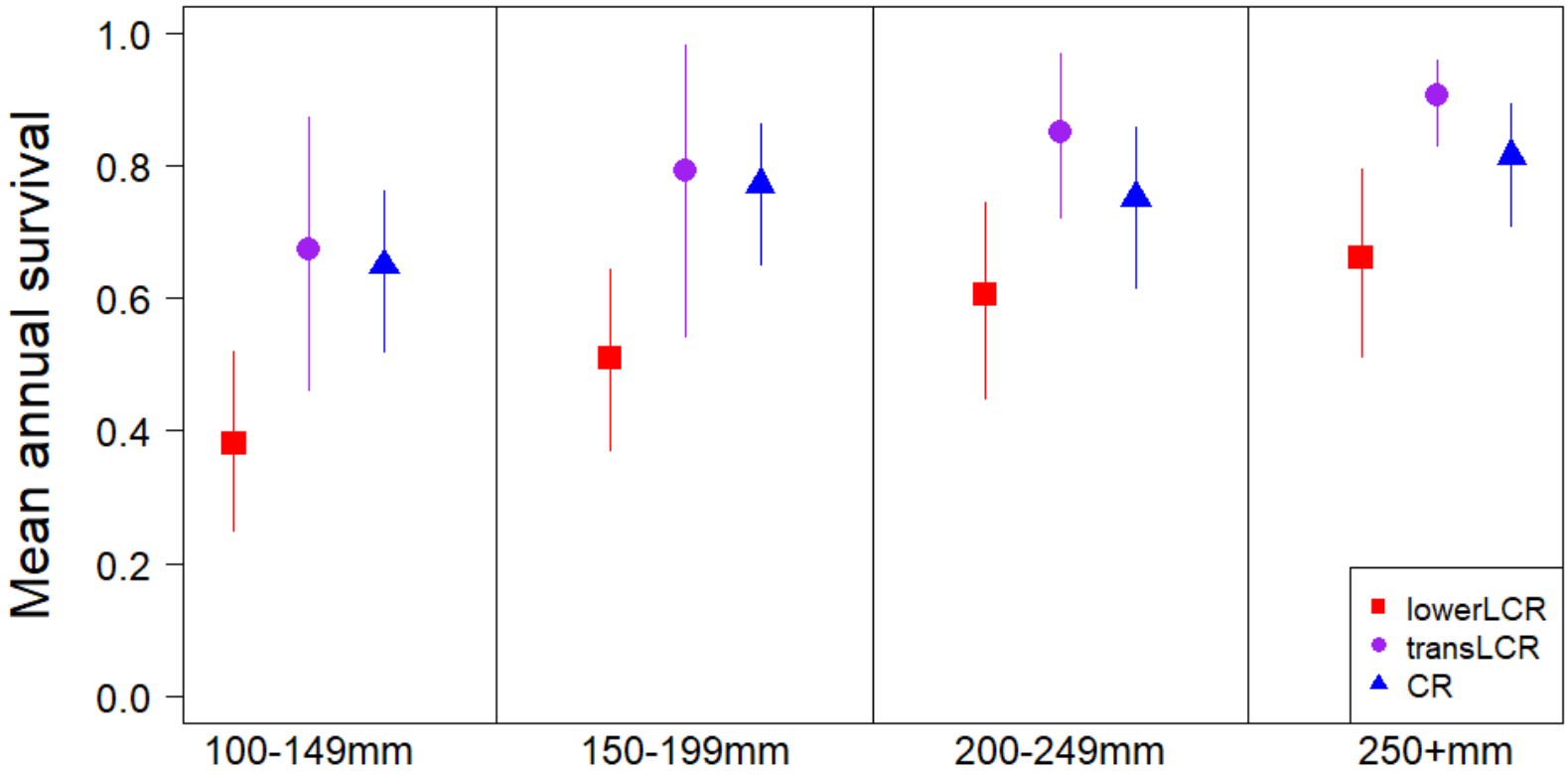
Below Chute Falls (Atomizer reach) - Adult HBC abundances (red & grey)



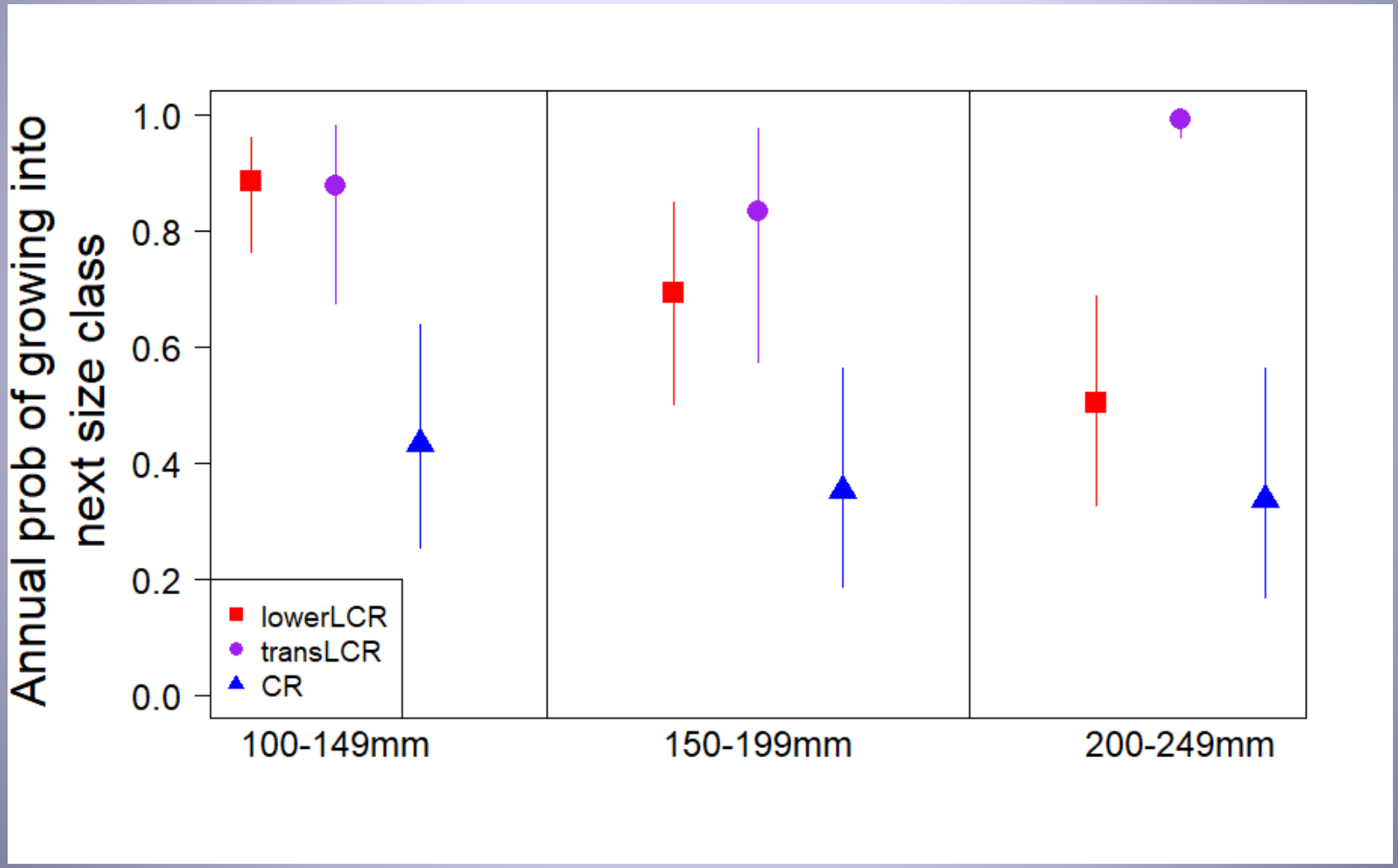
Chute Falls translocation multi-state model

- Multi-state model
- Three different habitats:
  - Lower LCR
  - Translocated LCR (includes upper Atomizer reach)
  - Colorado River
- Each habitat has different growth/survival
- Fish can move between habitats

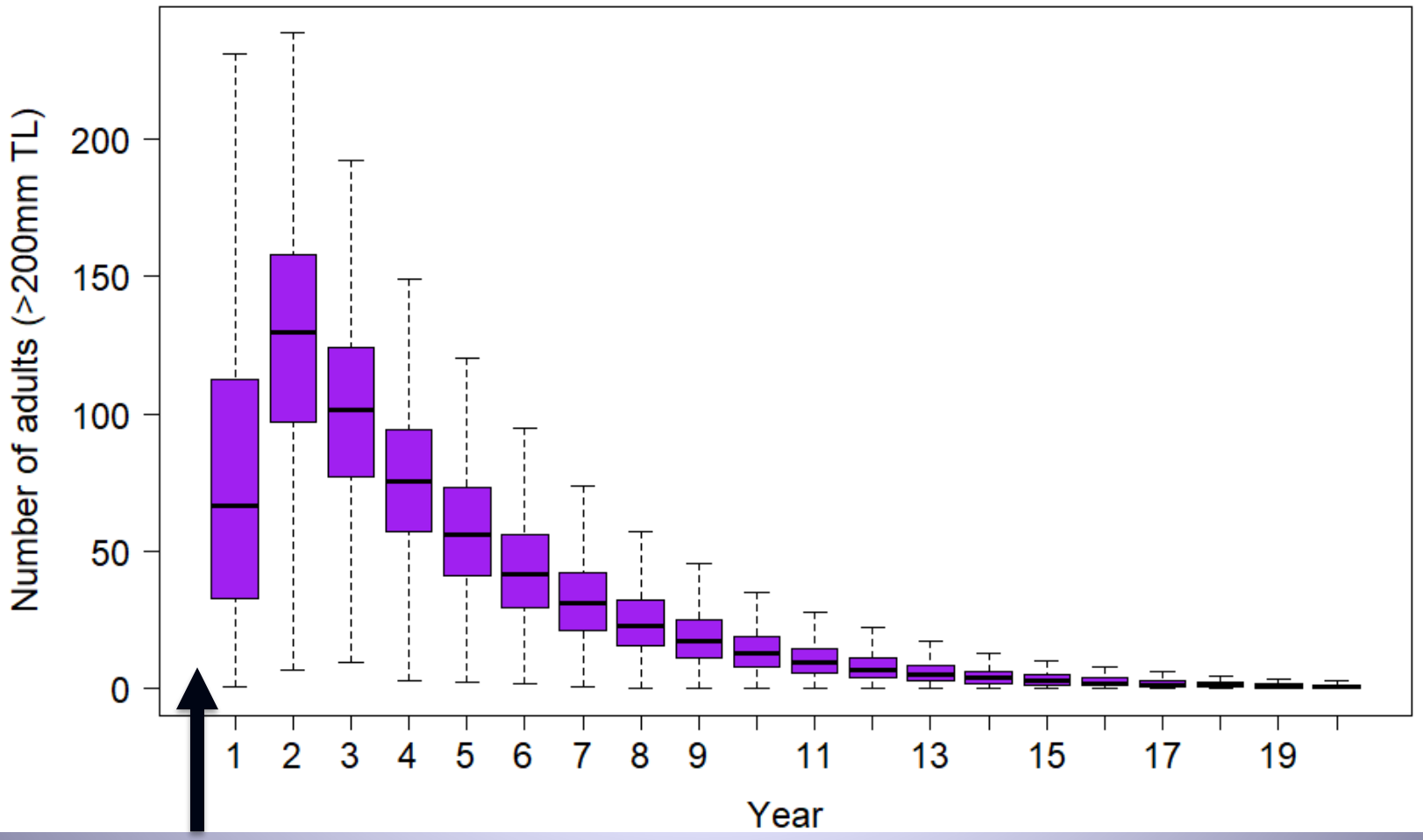
Survival is higher for translocated HBC than for HBC that remain in lower LCR



Growth (probability of moving to next size class) of translocated HBC is similar or faster to that of fish in the lower LCR



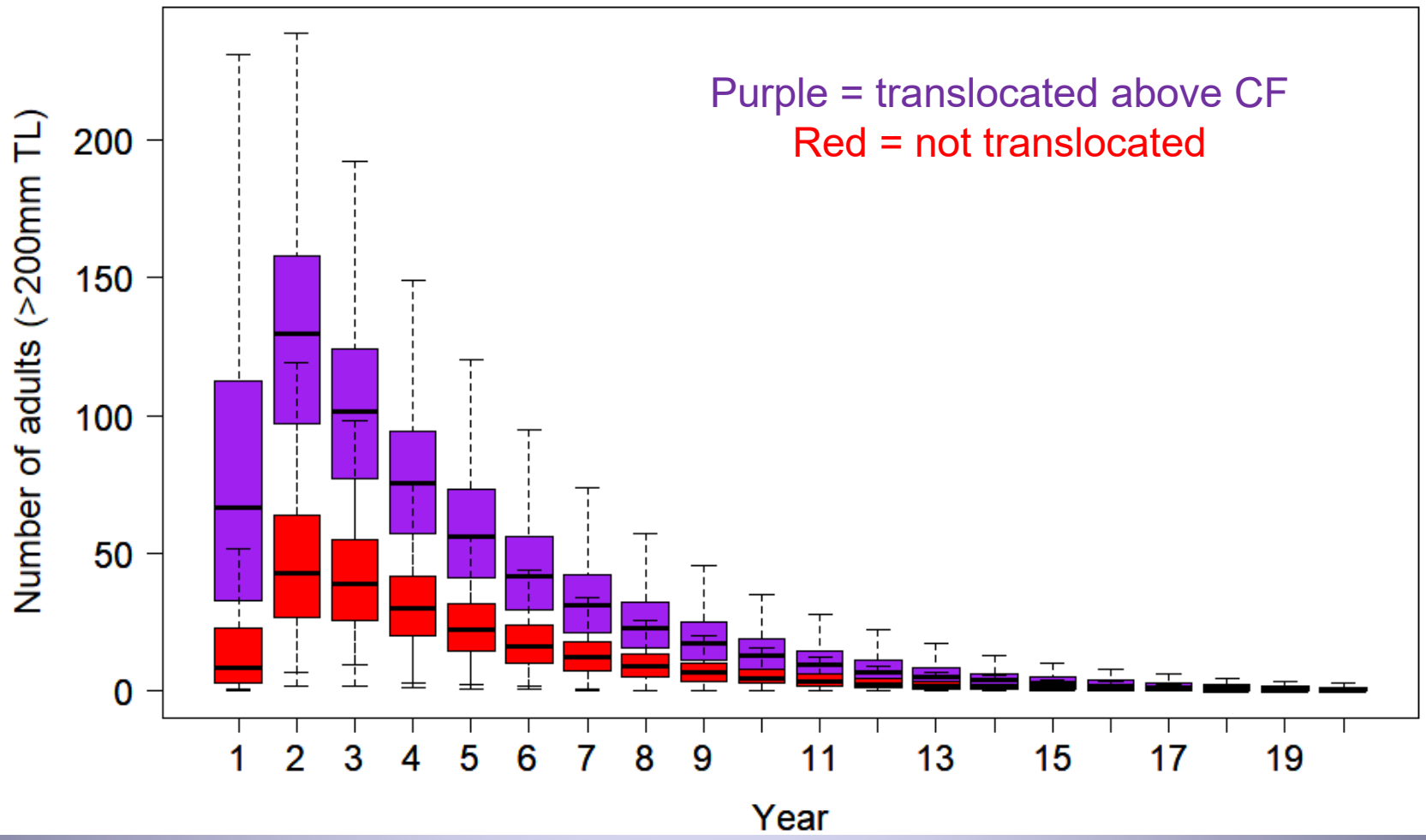
Number of adults that result from a one-time translocation of 300 fish above Chute Falls



Translocate 300 fish in year 0 (80-150mmTL)

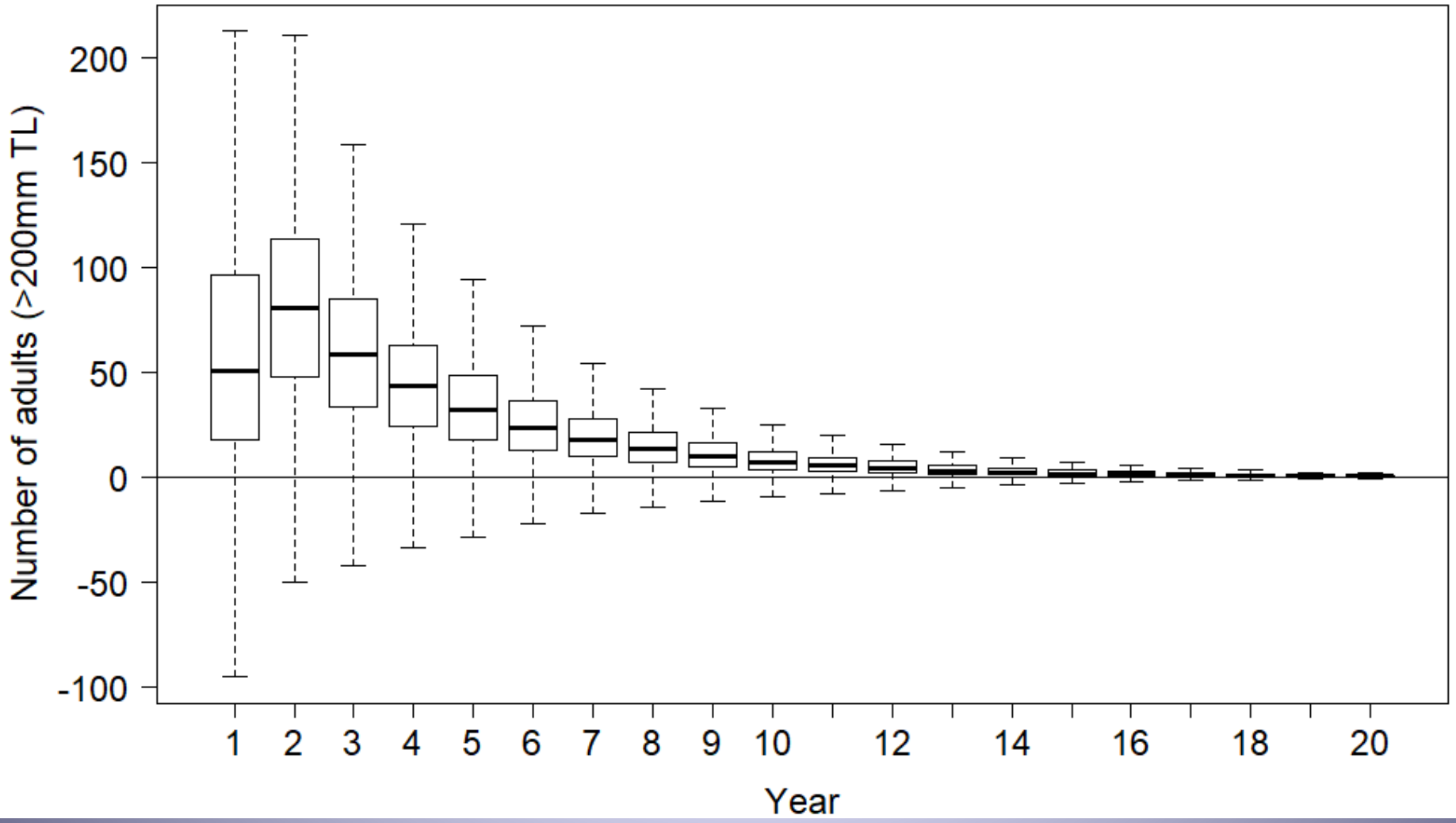
Provisional. Do not cite.

Comparison of HBC that have and have not been translocated above CF

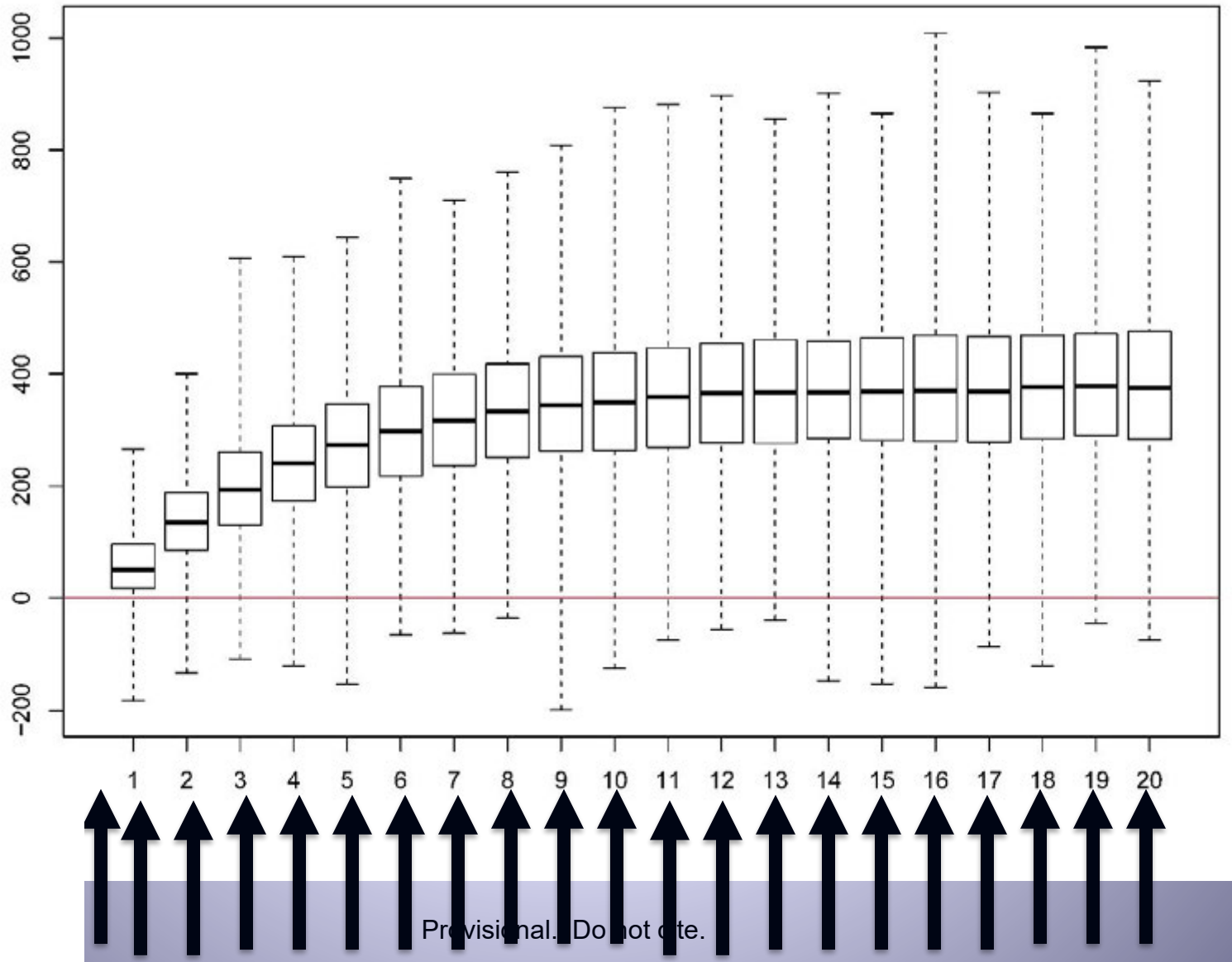


Net benefit of one-time translocation

(difference between two groups in previous slide)



Net benefit of translocating 300 fish every year amounts to 350 extra adults in LCR aggregation



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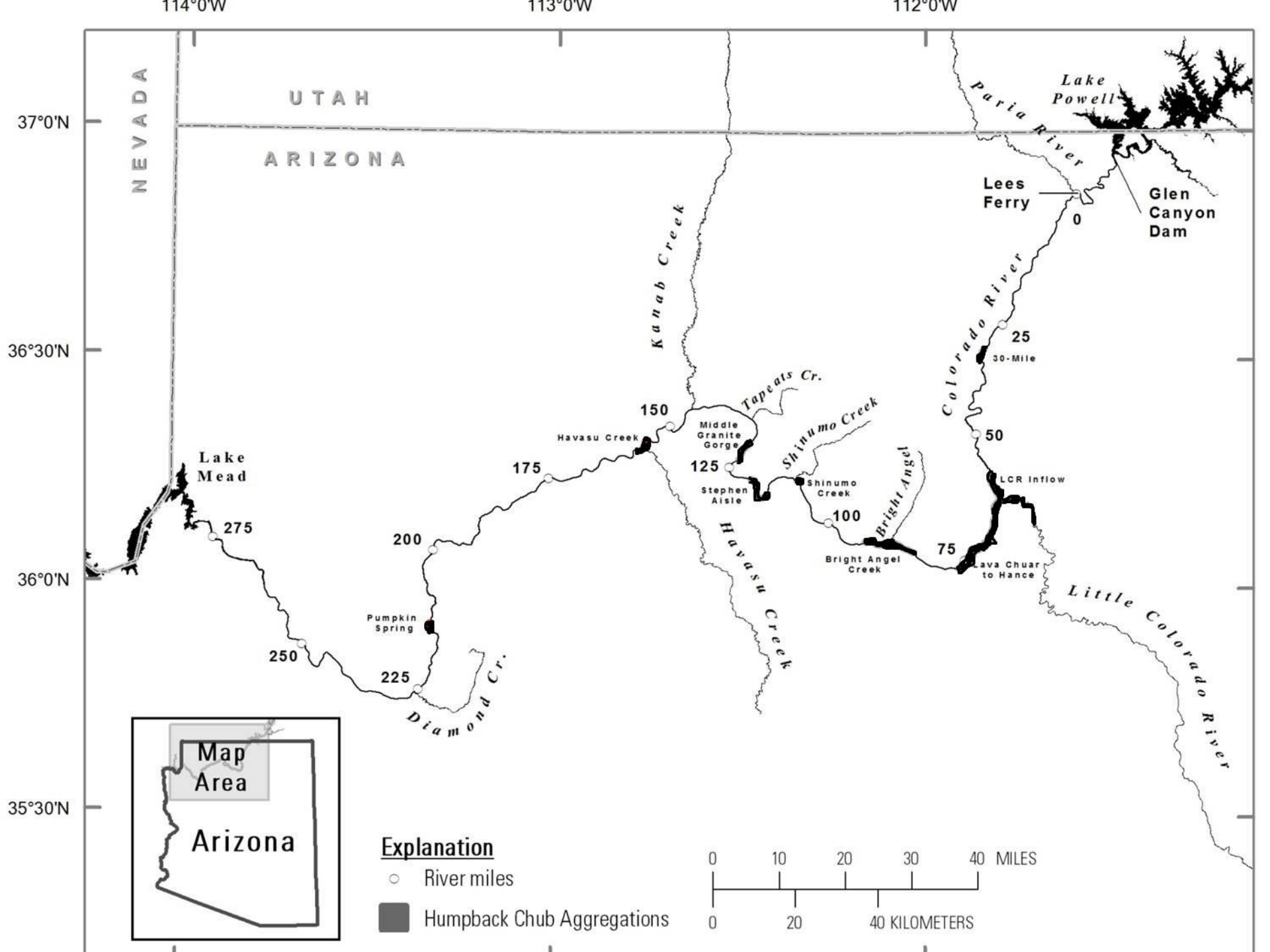
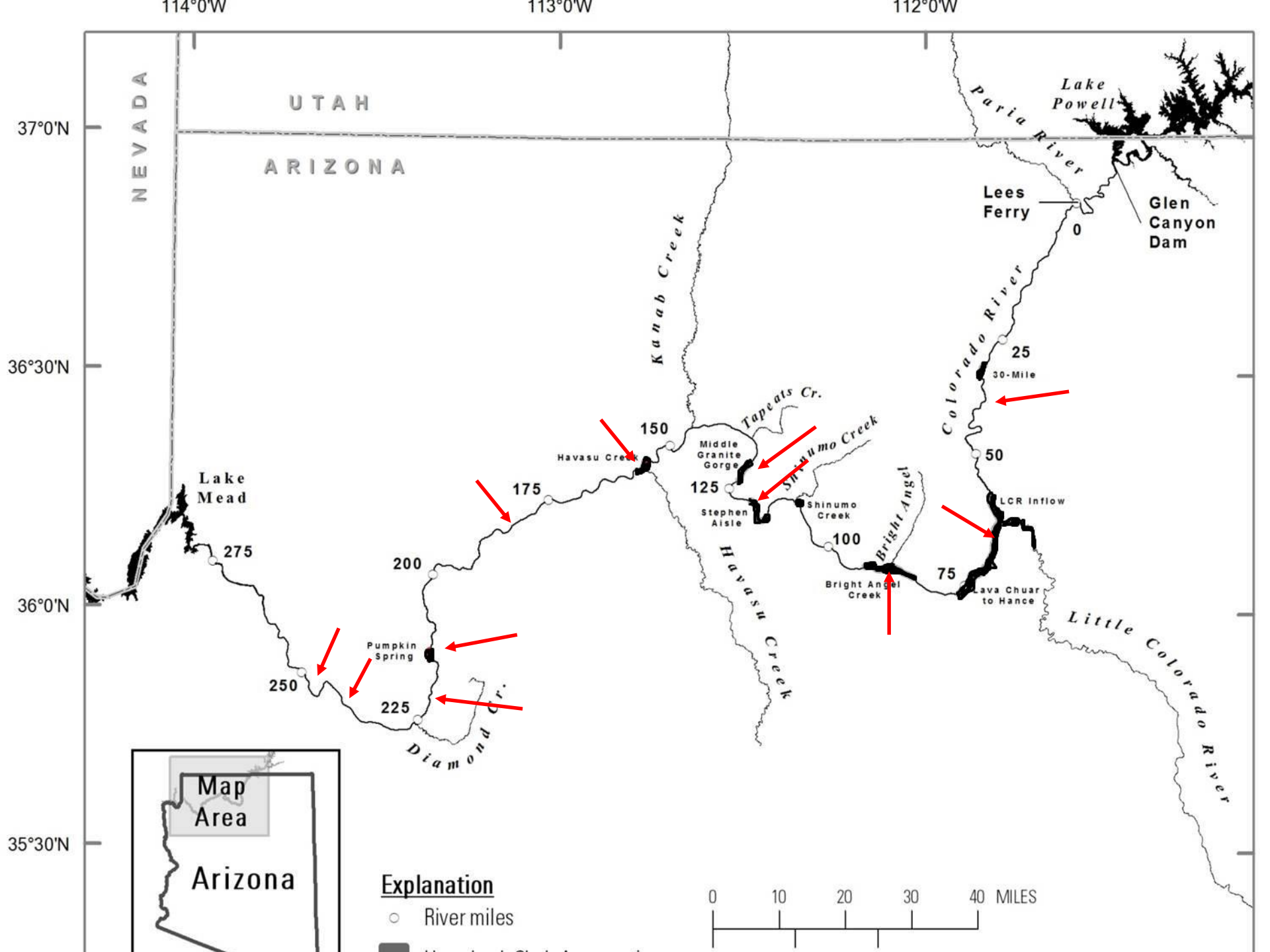
Summary

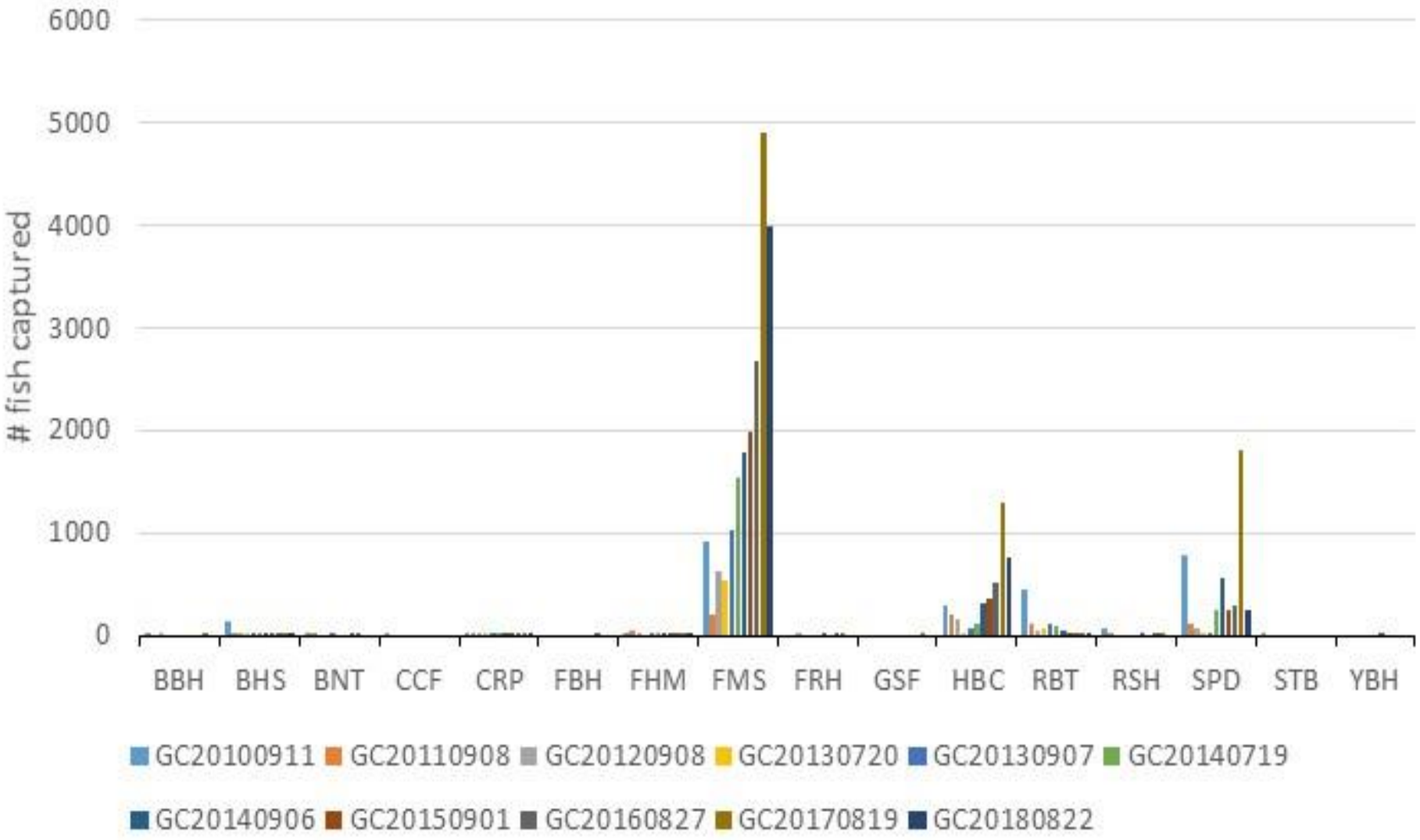
- Higher growth rates and increased survival appear to be a result of translocating fish to above Chute Falls.
- Downstream movement may be one factor ultimately precluding permanent colonization of HBC above Chute Falls.
- Translocations are relatively easy and inexpensive beneficial conservation action.

G.5 Monitoring Colorado River aggregations of Humpback Chub

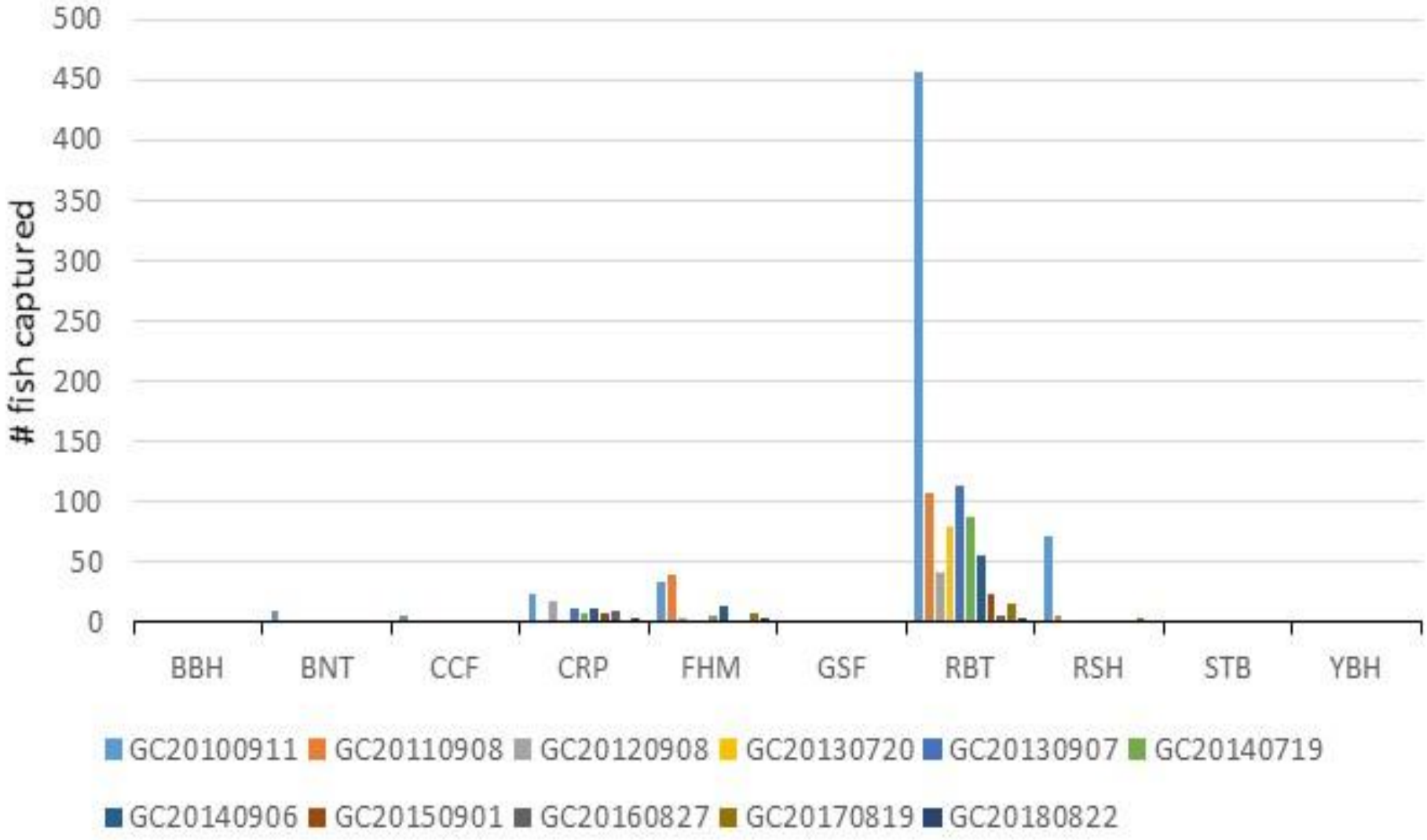

114°0'W
113°0'W
112°0'W
37°0'N
36°30'N
36°0'N
35°30'N
NEVADA
UTAH
ARIZONA
Lake Powell
Paria River
Lees Ferry
0
Glen Canyon Dam
Kanab Creek
Colorado River
25
30-Mile
50
LCR Inflow
Tapeats Cr.
150
Middle Granite Gorge
Havasu Creek
Shinumo Creek
125
Stephen Aisle
Shinumo Creek
Bright Angel
100
Bright Angel Creek
75
Lava Chuar to Hance
Lake Mead
175
275
200
Havasu Creek
Pumpkin Spring
250
225
Diamond Cr.
Little Colorado River
Map Area
Arizona
Explanation
River miles
Humpback Chub Aggregations
0 10 20 30 40 MILES
0 20 40 KILOMETERS


114°0'W
113°0'W
112°0'W
37°0'N
36°30'N
36°0'N
35°30'N
NEVADA
UTAH
ARIZONA
Lake Powell
Paria River
Lees Ferry
0
Glen Canyon Dam
Kanab Creek
Colorado River
25
30-Mile
50
LCR Inflow
75
Lava Chuar to Hance
Little Colorado River
Tapeats Cr.
150
Havasu Creek
Middle Granite Gorge
125
Stephen Aisle
Shinumo Creek
Shinumo Creek
100
Bright Angel
Bright Angel Creek
Havasu Creek
175
200
Lake Mead
275
250
Pumpkin Spring
225
Diamond Cr.
Map Area
Arizona
Explanation
River miles
0 10 20 30 40 MILES

Species catch by aggregation trip (2010-2018)

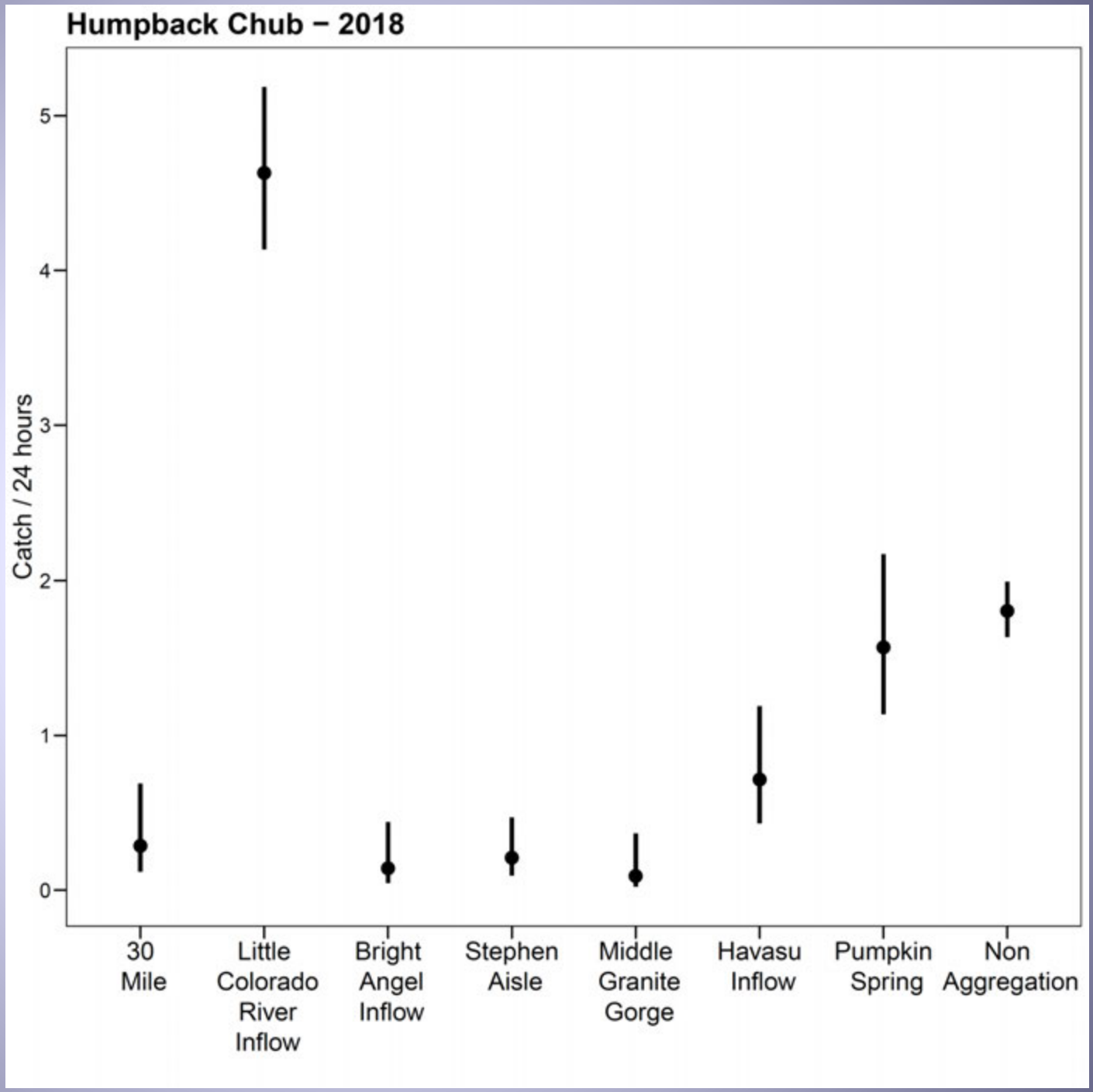


Species catch (nonnatives only) by aggregation trip (2010-2018)



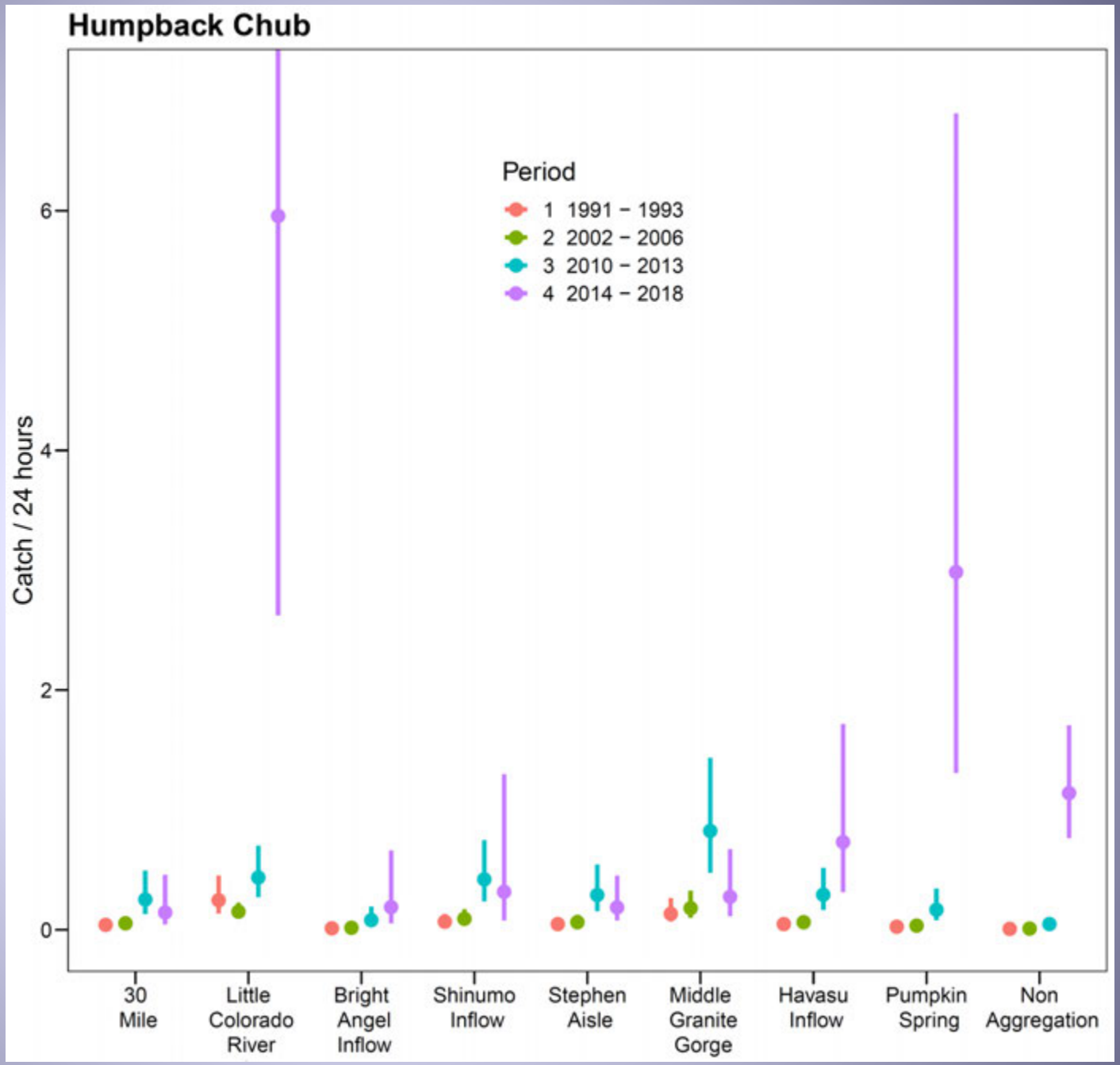
HBC CPUEs at aggregation and non-aggregation sites

2018

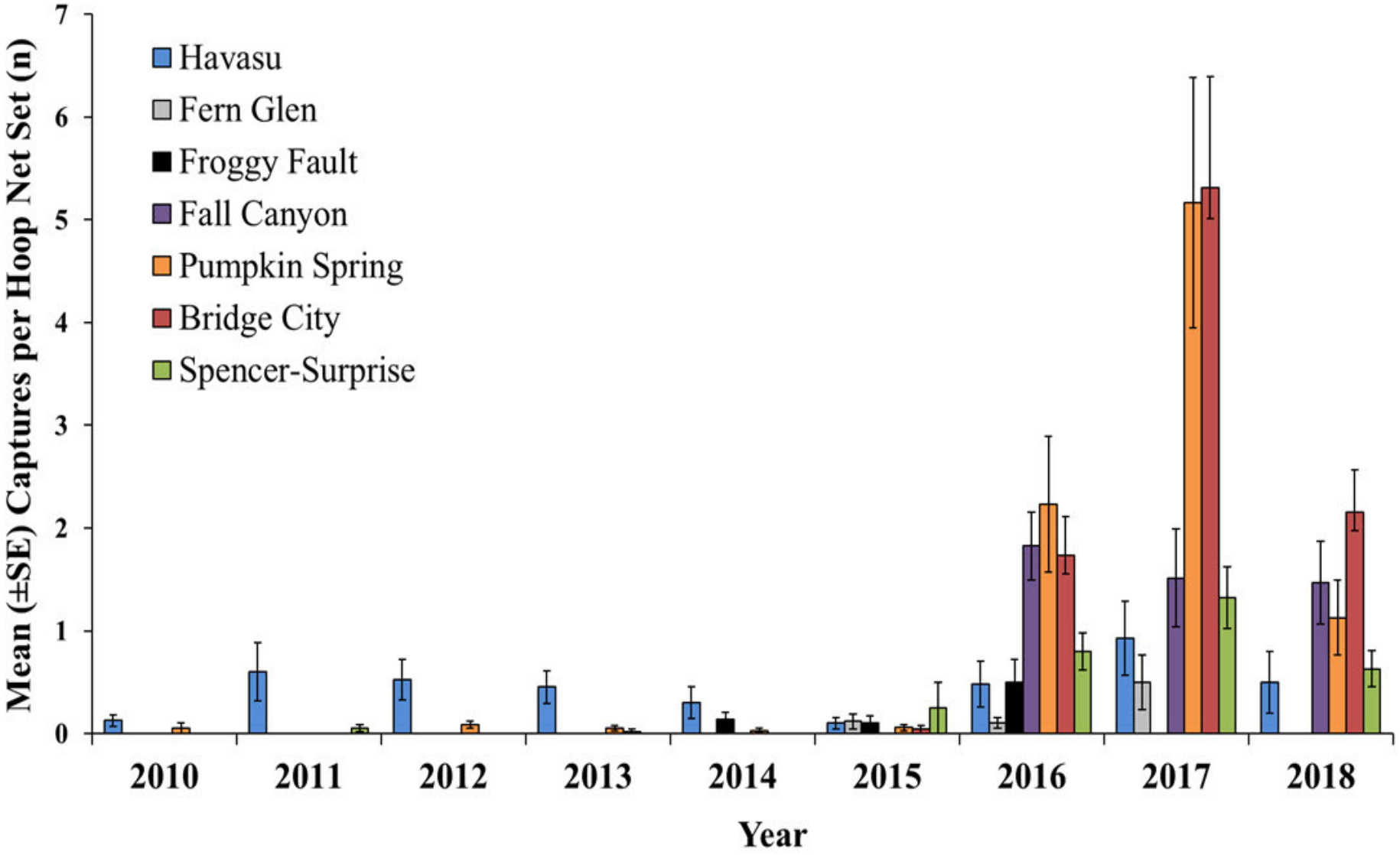


HBC CPUEs at aggregation and non-aggregation sites

Periods

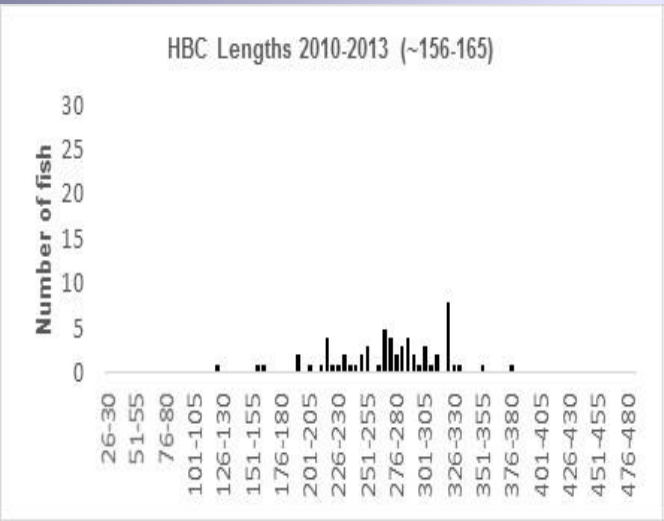


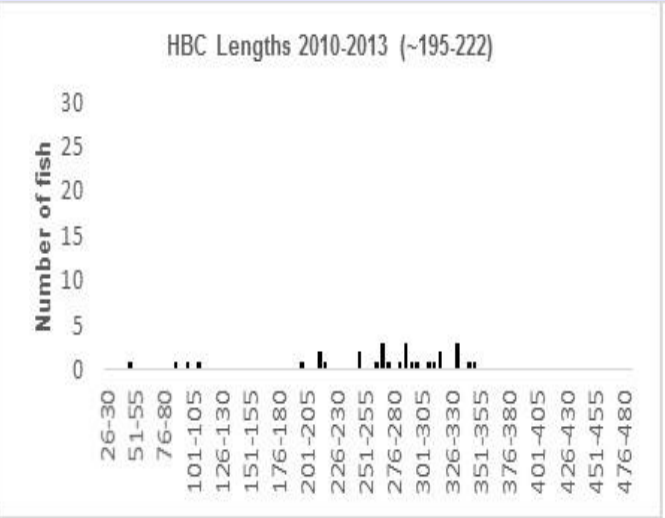
CPUEs of adult HBC by year in western Grand Canyon

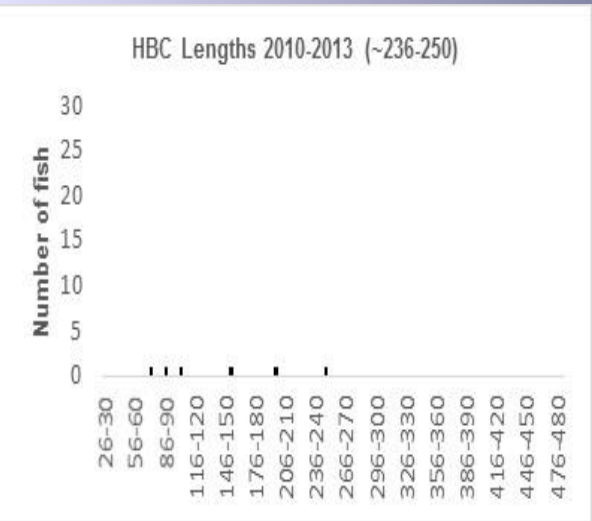


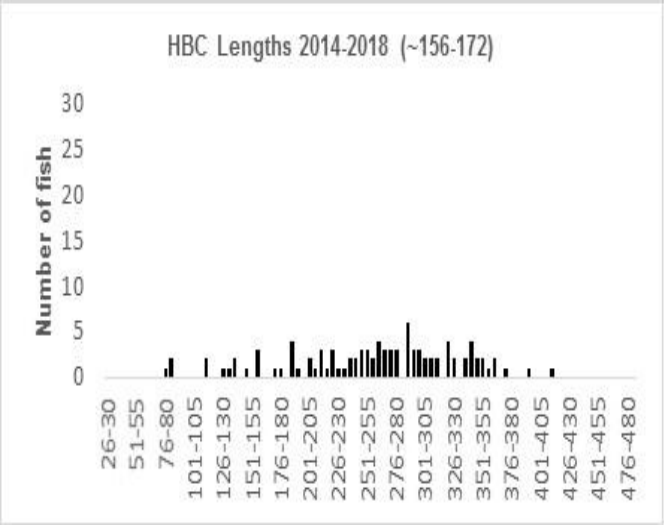
Length frequencies of HBC during agg 2010-2013 trips vs 2014-2018 (western Grand Canyon)

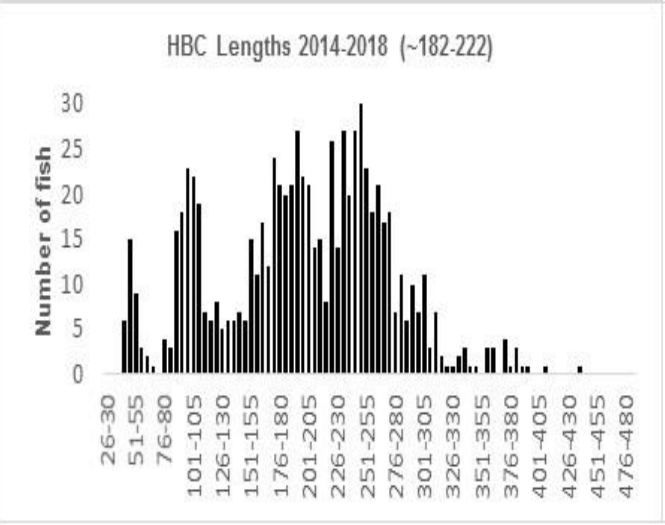
- Reach 1 (Havasu-Lava) Reach 2 (Lava-Diamond) Reach 3 (below Diamond)

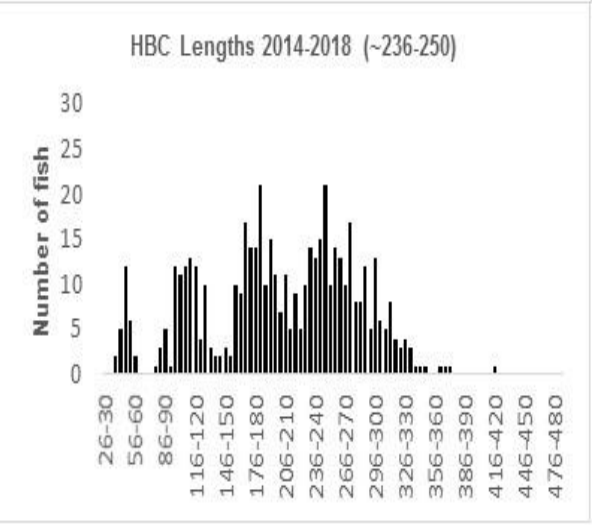




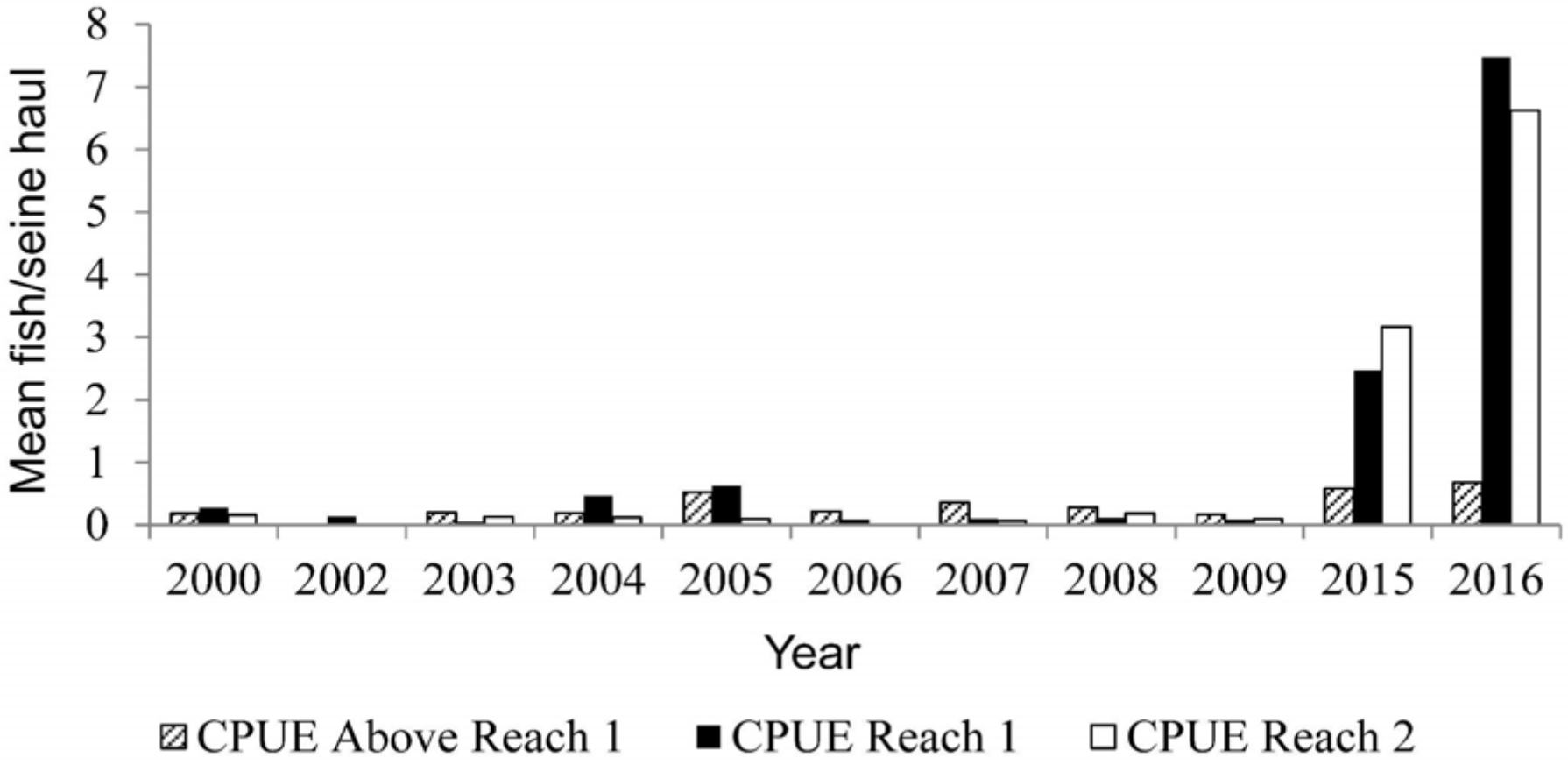








Seining CPUEs of HBC in western Grand Canyon



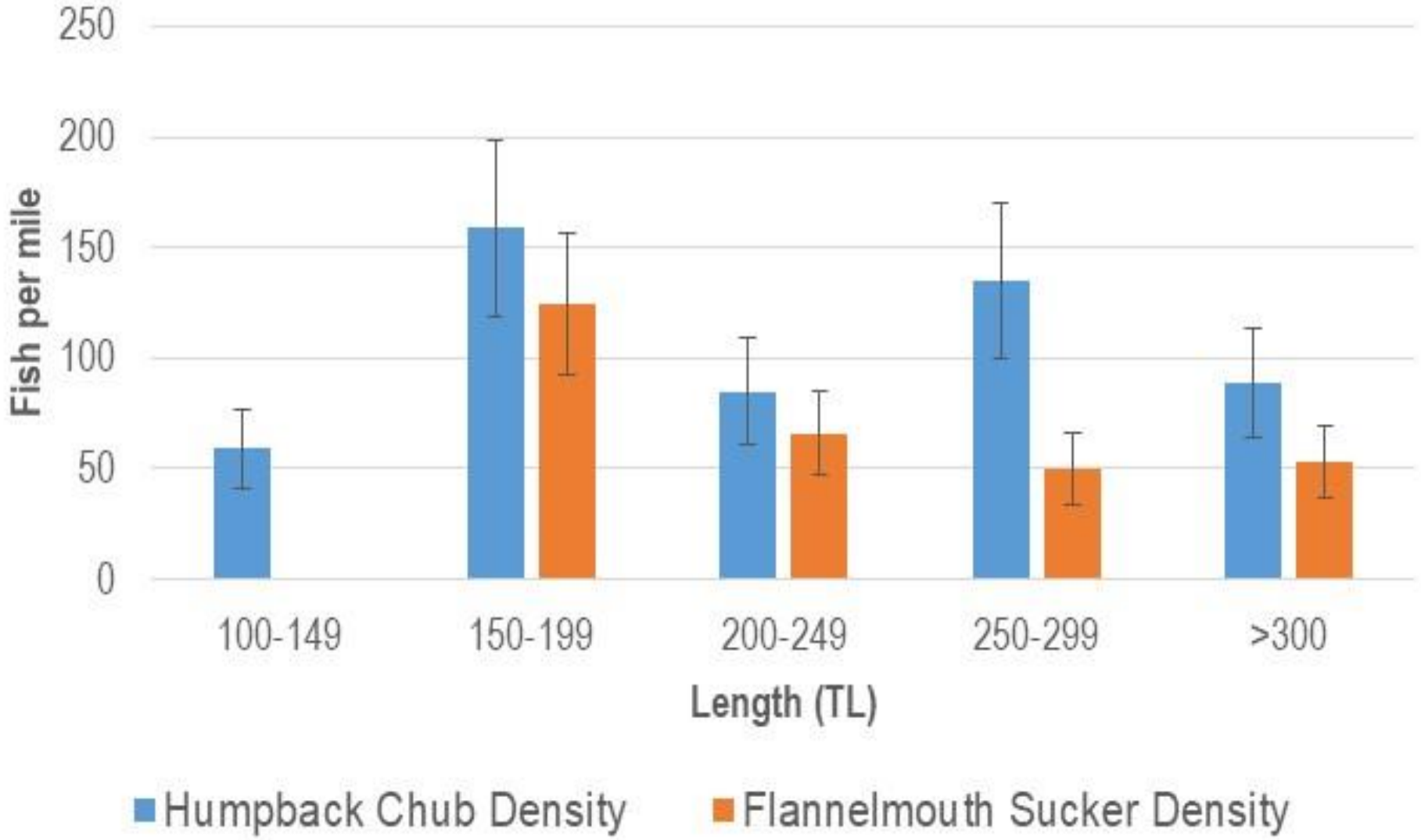
Closed population estimates of HBC and Flannelmouth Sucker (FMS) in the mainstem

- In 2017 we estimated closed abundances of HBC and FMS by size categories in the JCM East and JCM West reaches.
- Our strategy was to use the aggregation trip as a marking event, followed by the JCM monitoring as a recapture trip.
- This was repeated in 2018, but at one additional site below Diamond Creek near Bridge City.

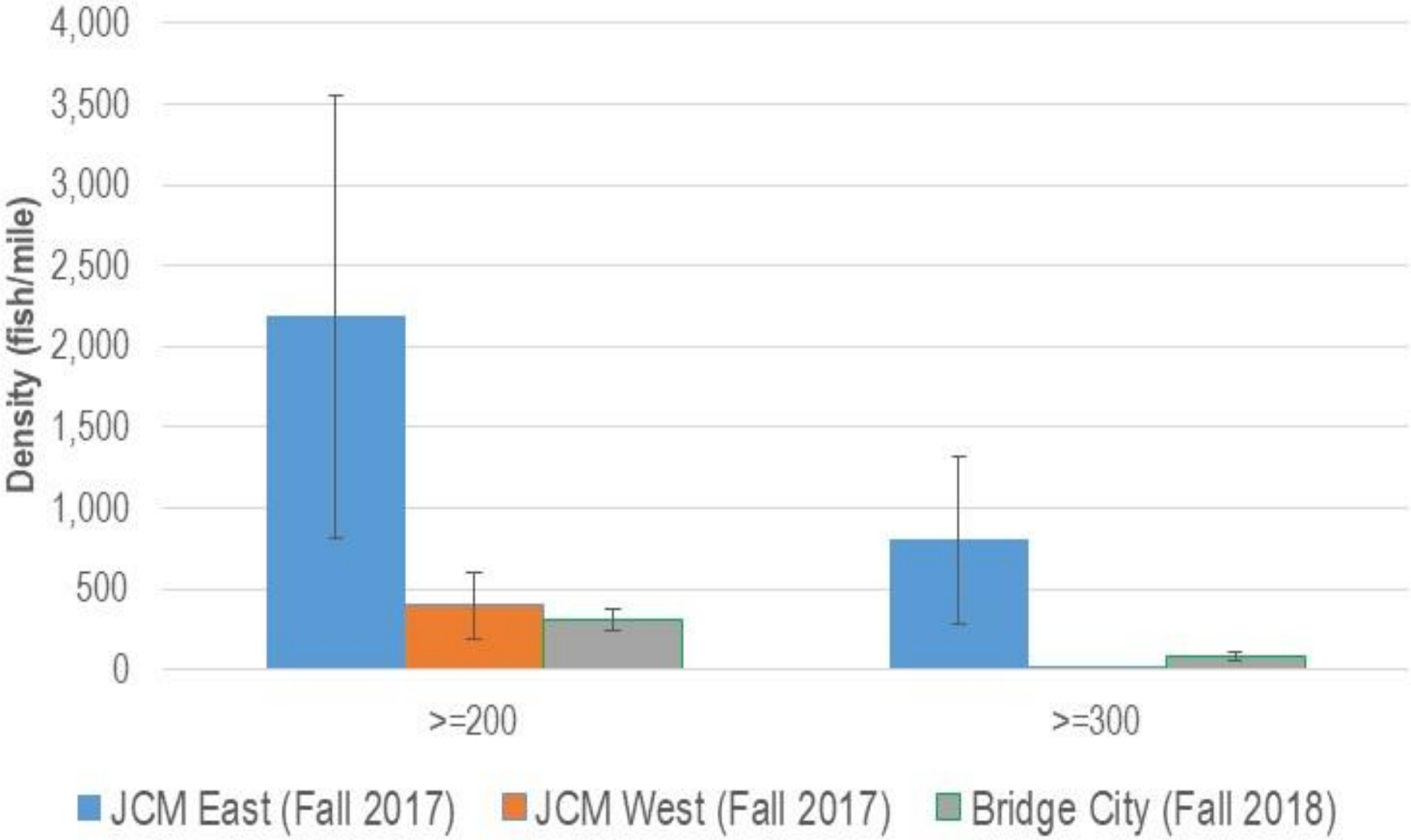
Closed population estimates and densities (fish/mile) of HBC by size class near Bridge City in fall 2018 (RM 236.7-238.7; 2 miles of river)

					95% CI					
Length (mm)	Marked	Captured	Recaptured	N	Lower	Upper	CV	p1	p2	Adj. Density
100-149	10	67	3	140	94	186	0.17	0.04	0.30	63
150-199	81	149	27	385	280	490	0.14	0.18	0.33	174
200-249	28	95	18	199	139	260	0.15	0.19	0.64	90
250-299	41	143	13	324	234	415	0.14	0.09	0.32	147
>=300	20	100	7	214	150	279	0.15	0.07	0.35	97
				1,263						571

HBC and FMS density (fish/mile) in Bridge City reach fall 2018



Adult HBC densities (fish/mile) by size category in the mainstem at 3 select locations



Summary

- Native fish comprised 99.8% of hoop net catches in the mainstem aggregation trip in 2018.
- HBC and FMS hoop net CPUEs continue to be high in western Grand Canyon (although somewhat lower than 2017).
- Since 2014, western Grand Canyon has been populated by HBC representing all size classes.
- Thus far, successful closed mark-recapture efforts for HBC have occurred at JCM East (2017, 2018) and JCM West (2017), and at Bridge City (2018), with the most successful (sufficient recaptures within 50 mm size classes) being at Bridge City (2018).

Thank you