Monitoring Humpback Chub in the Little Colorado River and Colorado River, Grand Canyon

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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 Humpback Chub Monitoring - West
- G.7. Chute Falls HBC translocations

- **Funding Amount and Source:** $1,172,824, AMP

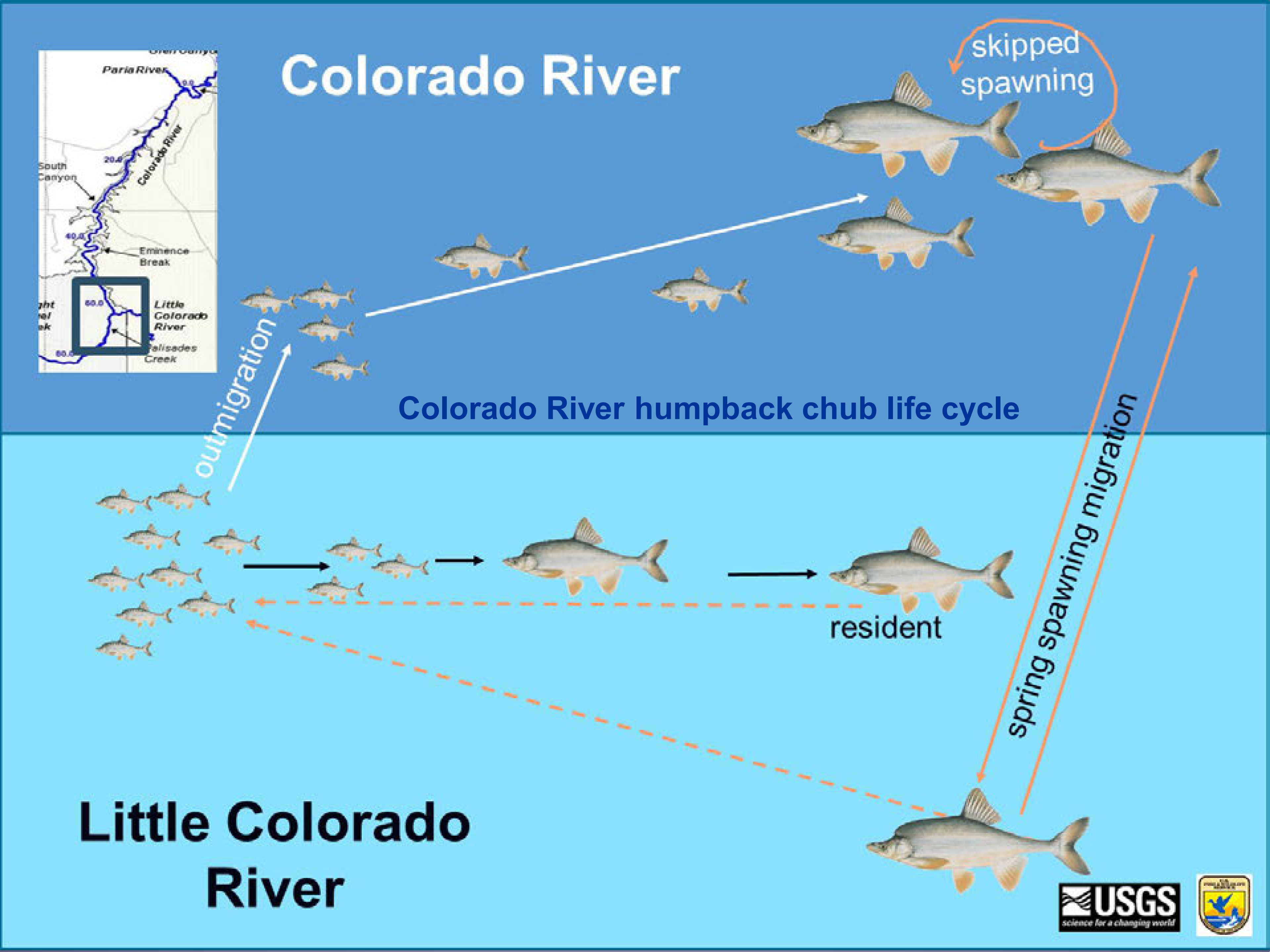
- **Cooperators:** USGS, USFWS

- **Resource Goals**: Humpback Chub, Natural Processes, Other Native Fish

Presentation outline (Project G)

- LCR aggregation
  - Update on abundance (G.1, G.2, G.3)
  - Incorporation of antennas into models (G.1, G.4)
  - Chute Falls translocations (G.1, G.7)

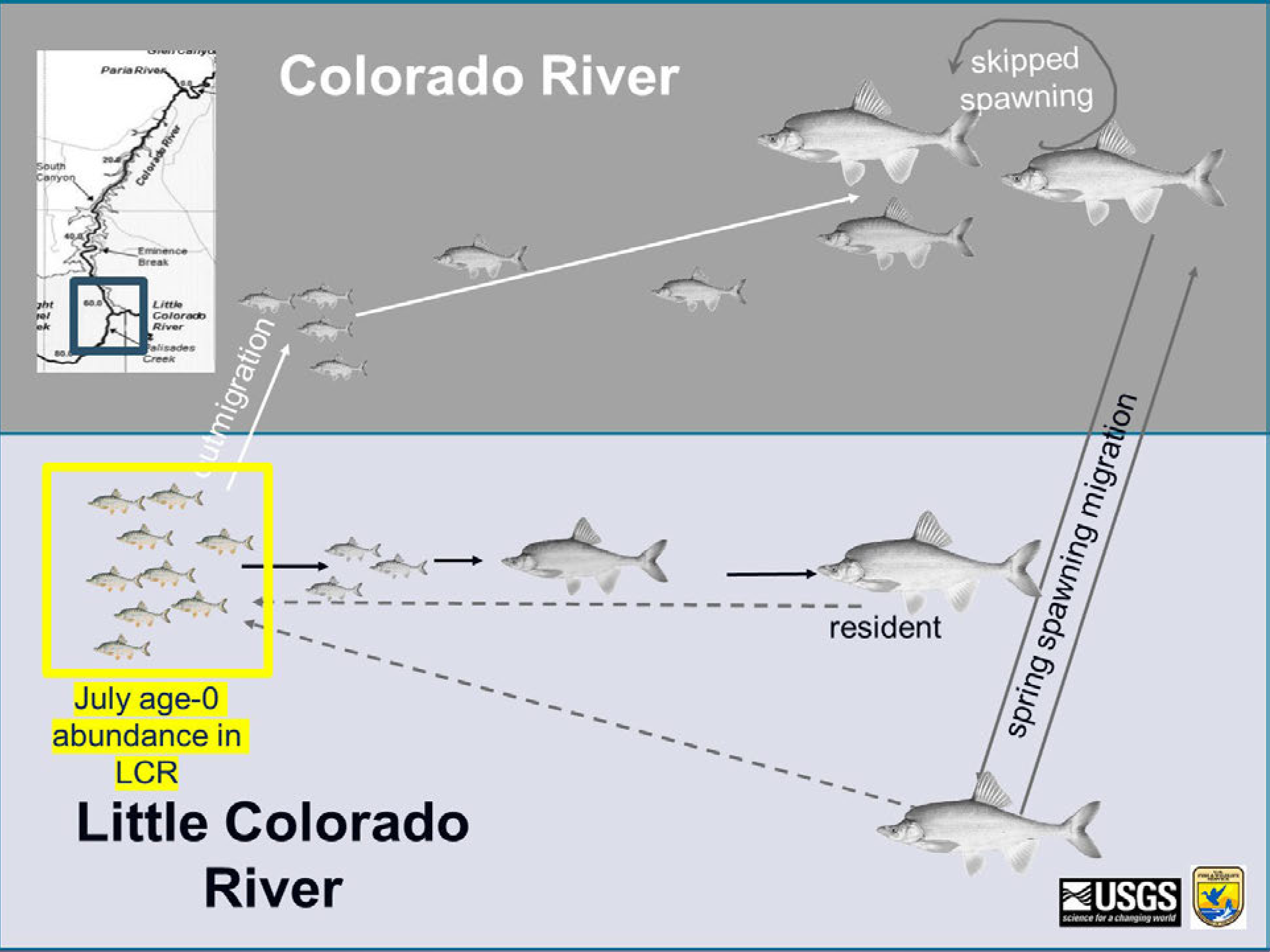
- Mainstem Grand Canyon
  - HBC aggregations (G.5)
  - Fall Canyon (G.1, G.6)

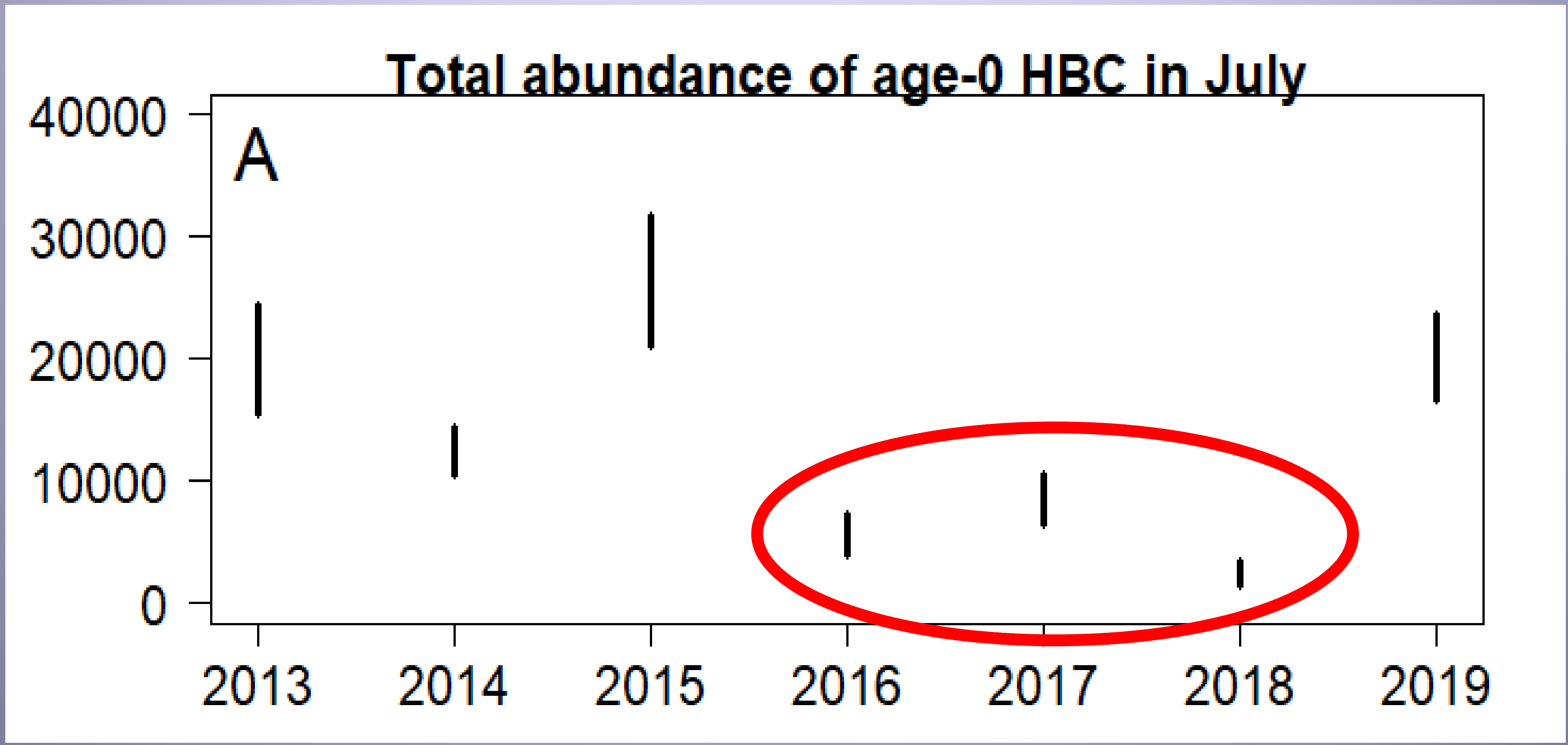


Colorado River
skipped
spawning
Paria River
South
Canyon
Colorado River
Eminence
Break
Little
Colorado
River
Creek
outmigration
Colorado River humpback chub life cycle
resident
spring spawning migration
Little Colorado
River
USGS
science for a changing world

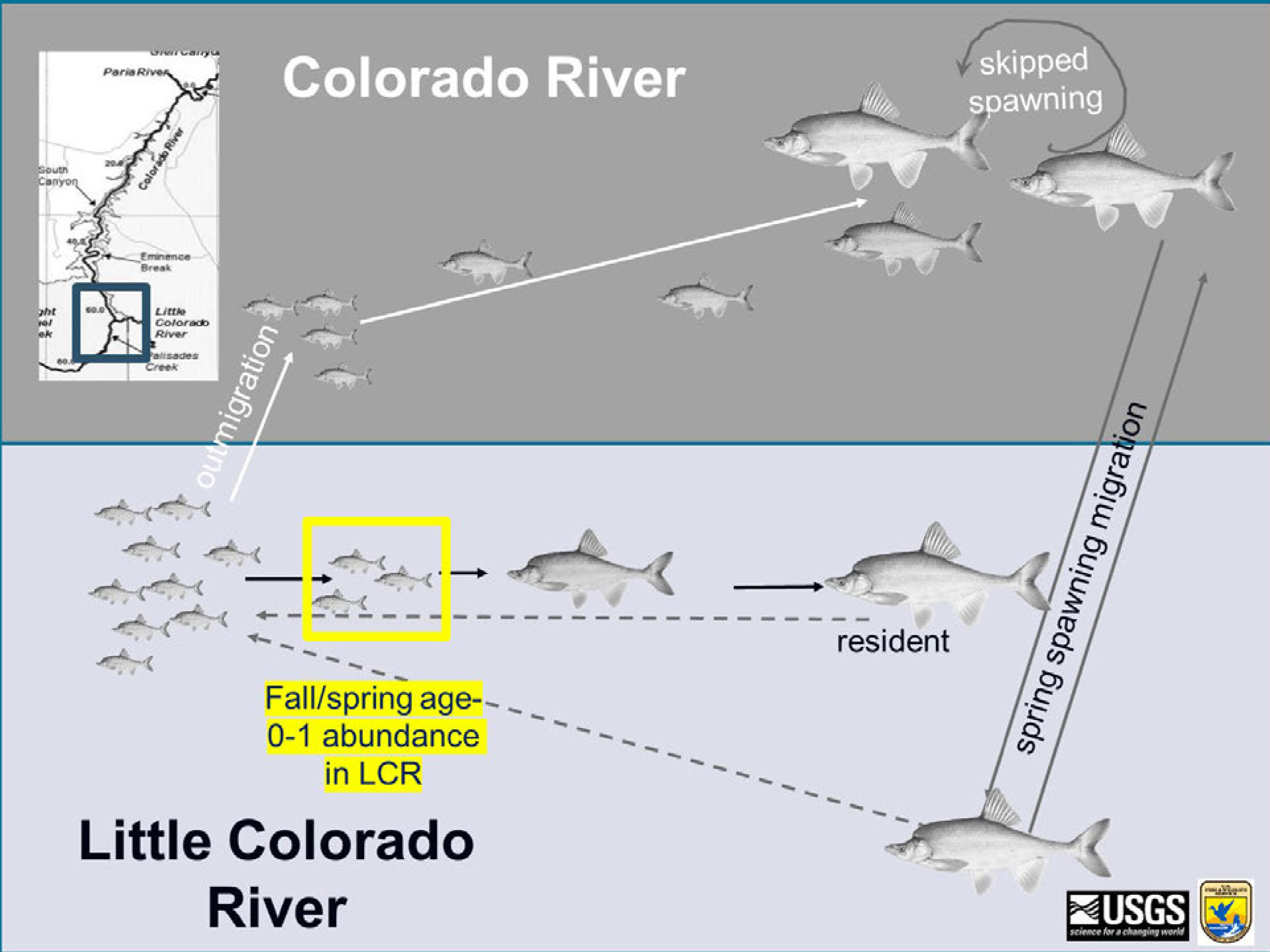
Monitoring in lower 13.57 km of LCR

Mainstem monitoring in juvenile chub monitoring (JCM) reach


Colorado River
Paria River
Colorado River
South Canyon
Eminence Break
Little Colorado River
Palisades Creek
skipped spawning
outmigration
spring spawning migration
resident
July age-0 abundance in LCR
Little Colorado River
USGS
science for a changing world

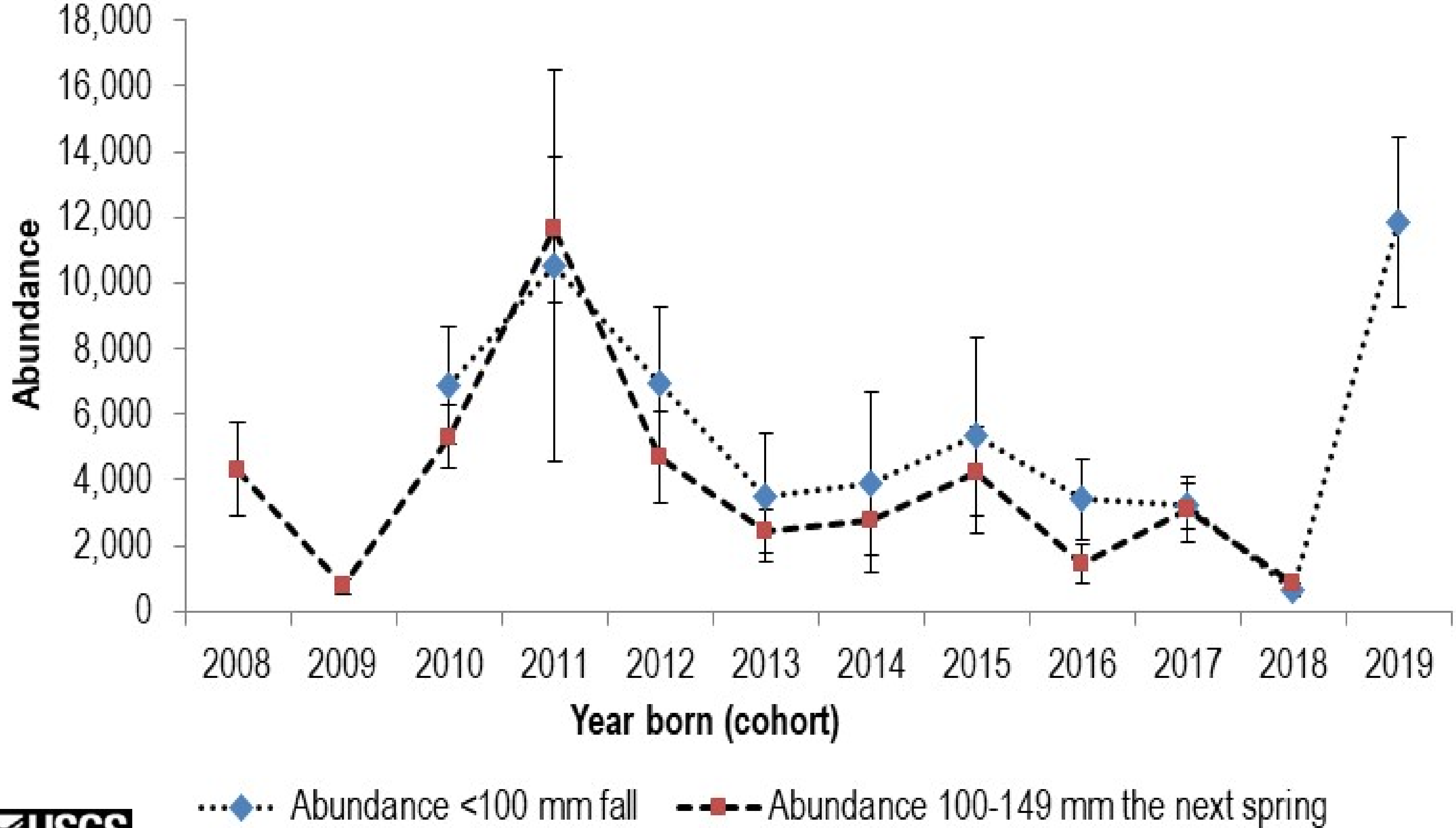


Provisional data. Do not cite.



Colorado River
Paria River
South Canyon
Colorado River
Eminence Break
Little Colorado River
skipped spawning
outmigration
resident
spring spawning migration
Fall/spring age-0-1 abundance in LCR
Little Colorado River
USGS
science for a changing world

Annual fall HBC age-0 abundance (blue) and the following spring age-1 abundance (red)



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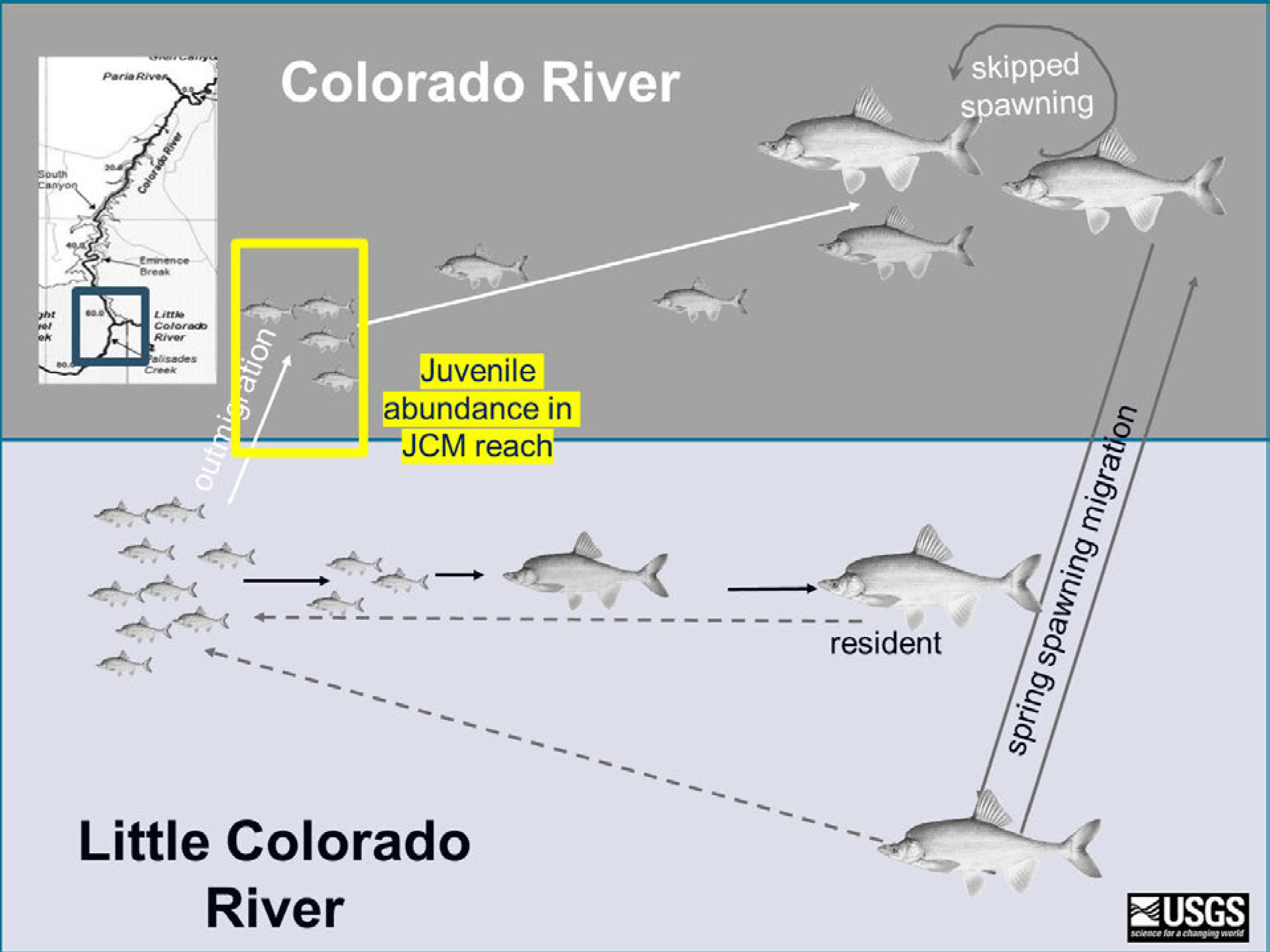
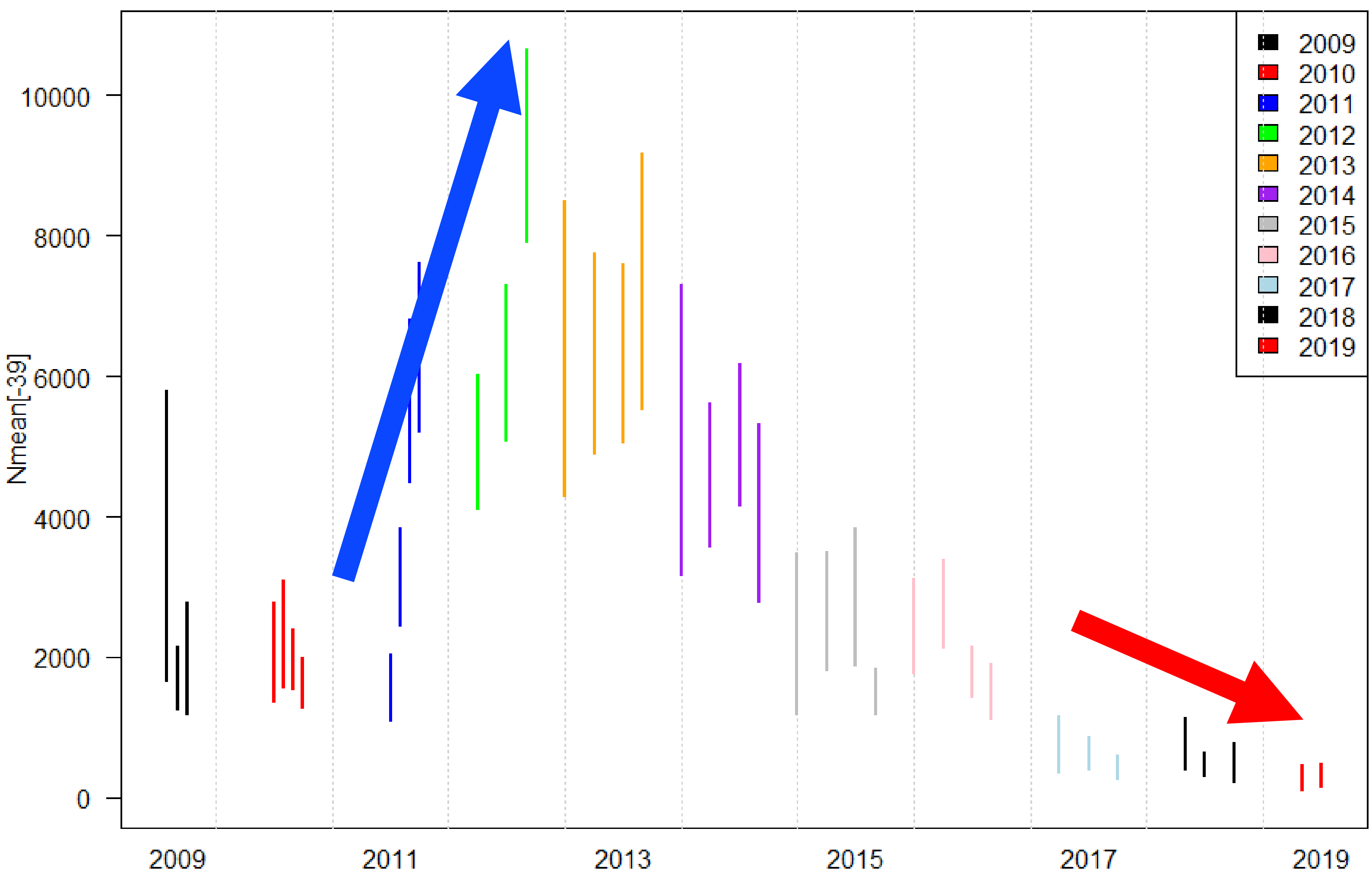

Colorado River
Paria River
South Canyon
Colorado River
Eminence Break
Little Colorado River
Creek
skipped spawning
Juvenile abundance in JCM reach
outmigration
resident
spring spawning migration
Little Colorado River
USGS
science for a changing world

Juvenile abundance in the JCM-reach (<100mm TL)



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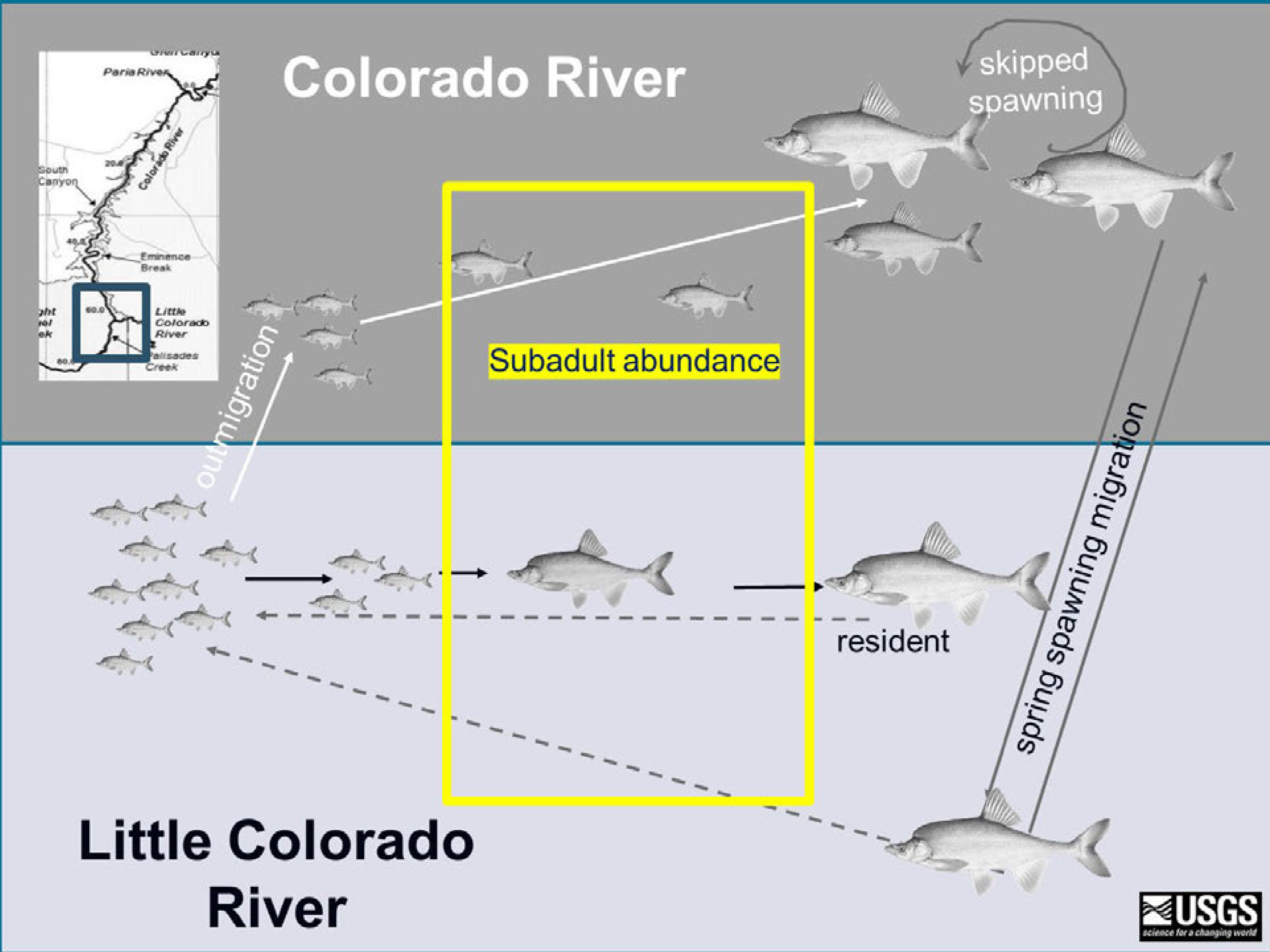
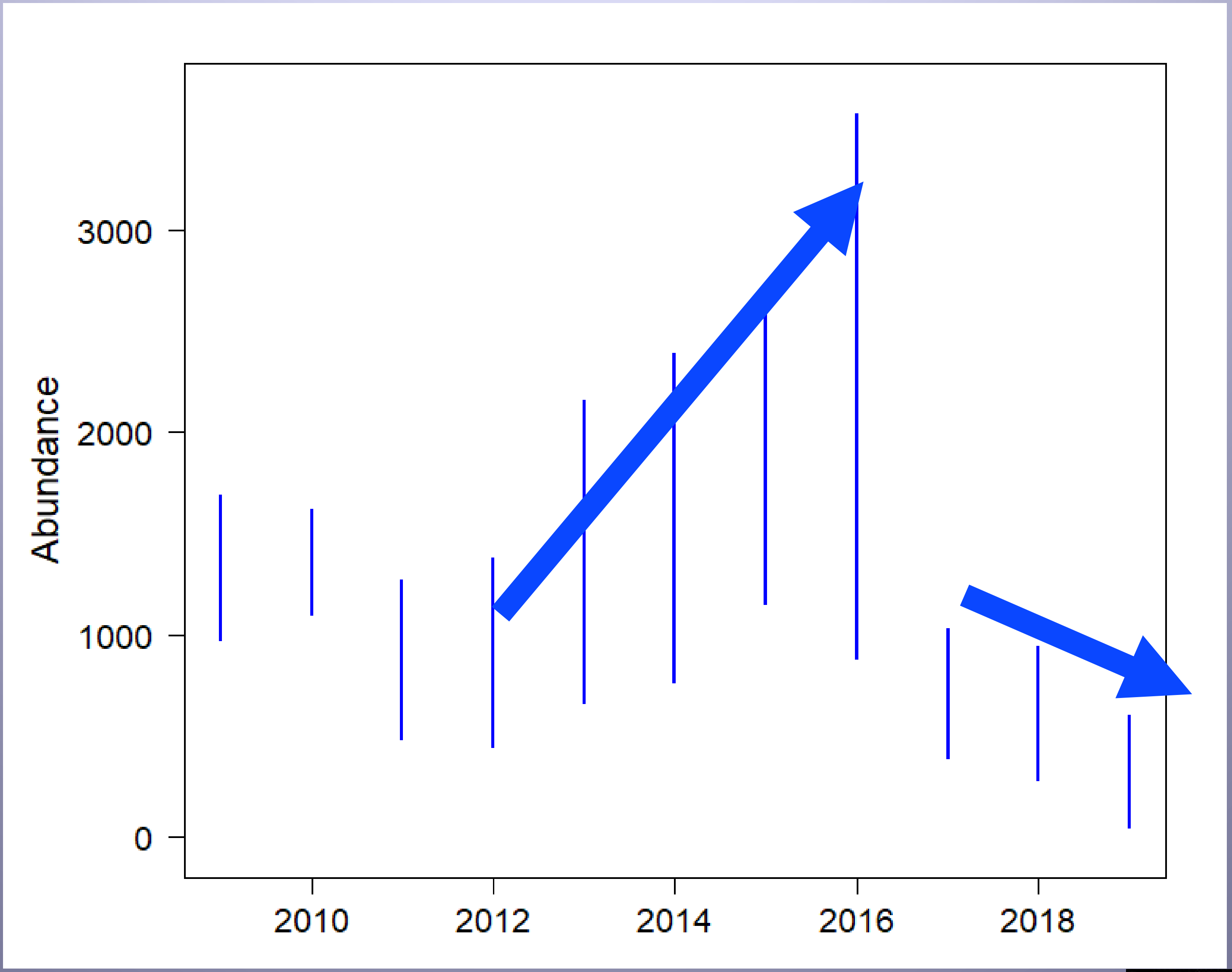


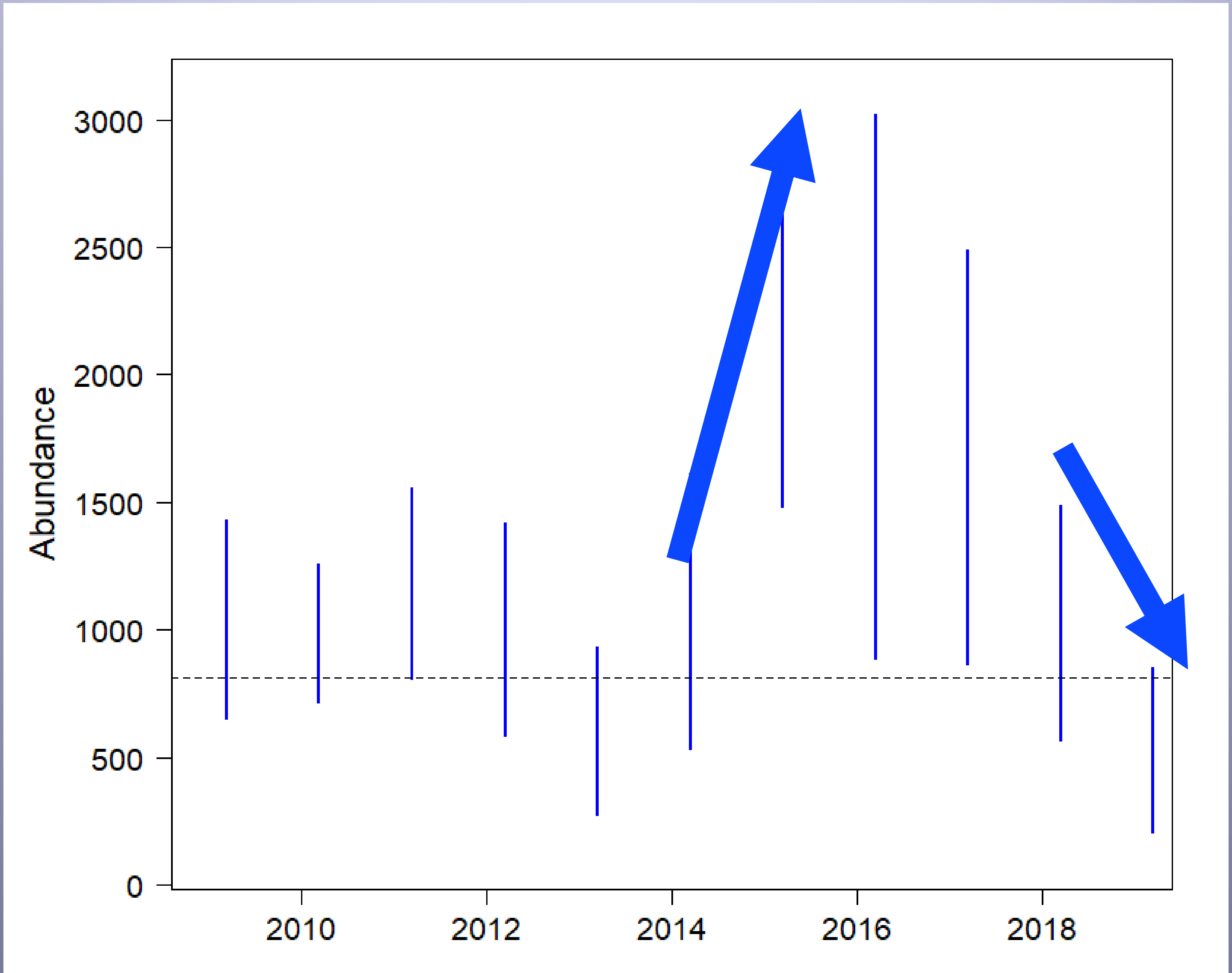
Colorado River
Paria River
South Canyon
Colorado River
Eminence Break
Little Colorado River
Creek
skipped spawning
outmigration
Subadult abundance
resident
spring spawning migration
Little Colorado River
USGS
science for a changing world

Fall abundances of small subadult humpback chub in the JCM reach (100-149mm TL)



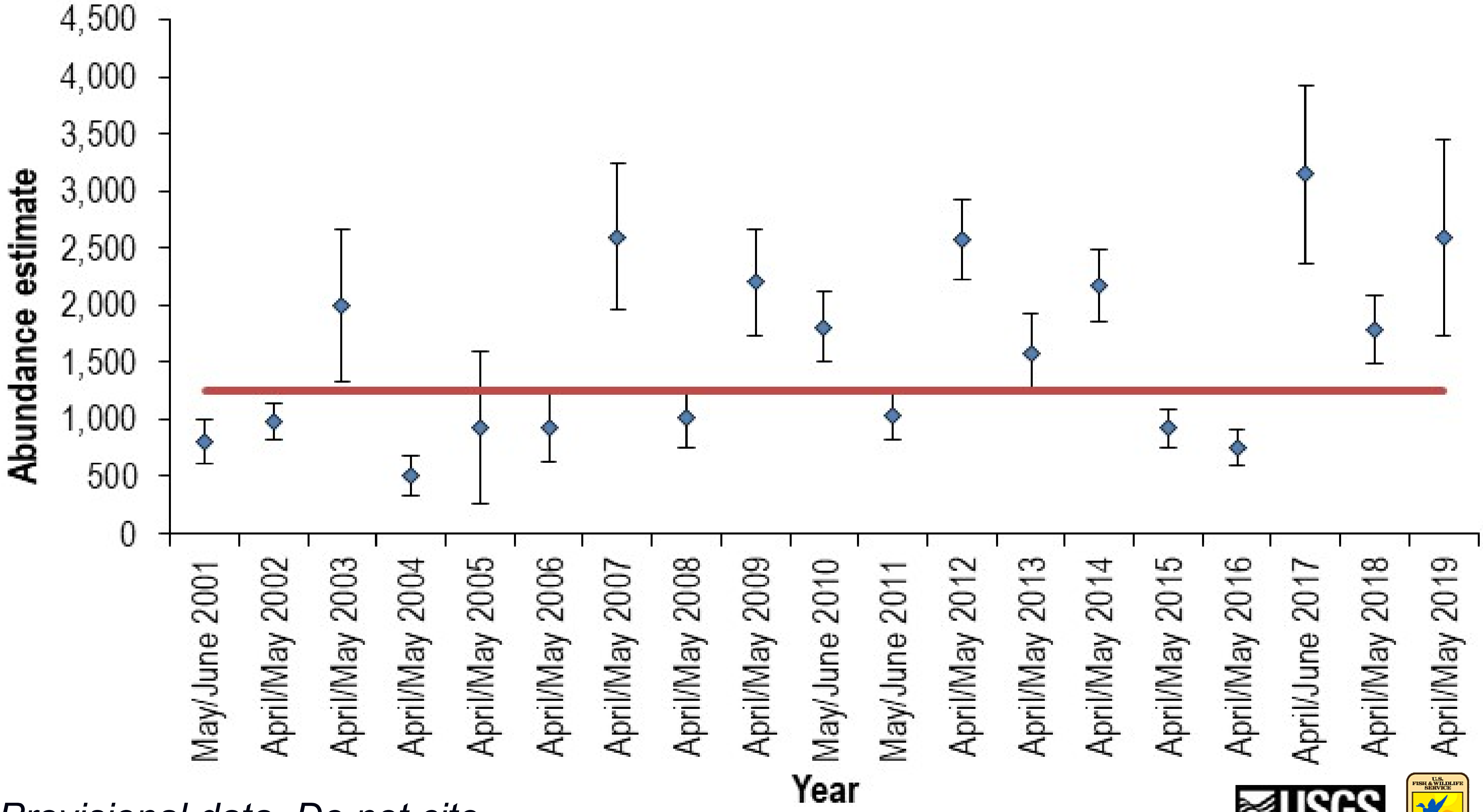
Provisional data. Do not cite.

Fall abundances of large subadult humpback chub in the JCM reach (150-199mm TL)

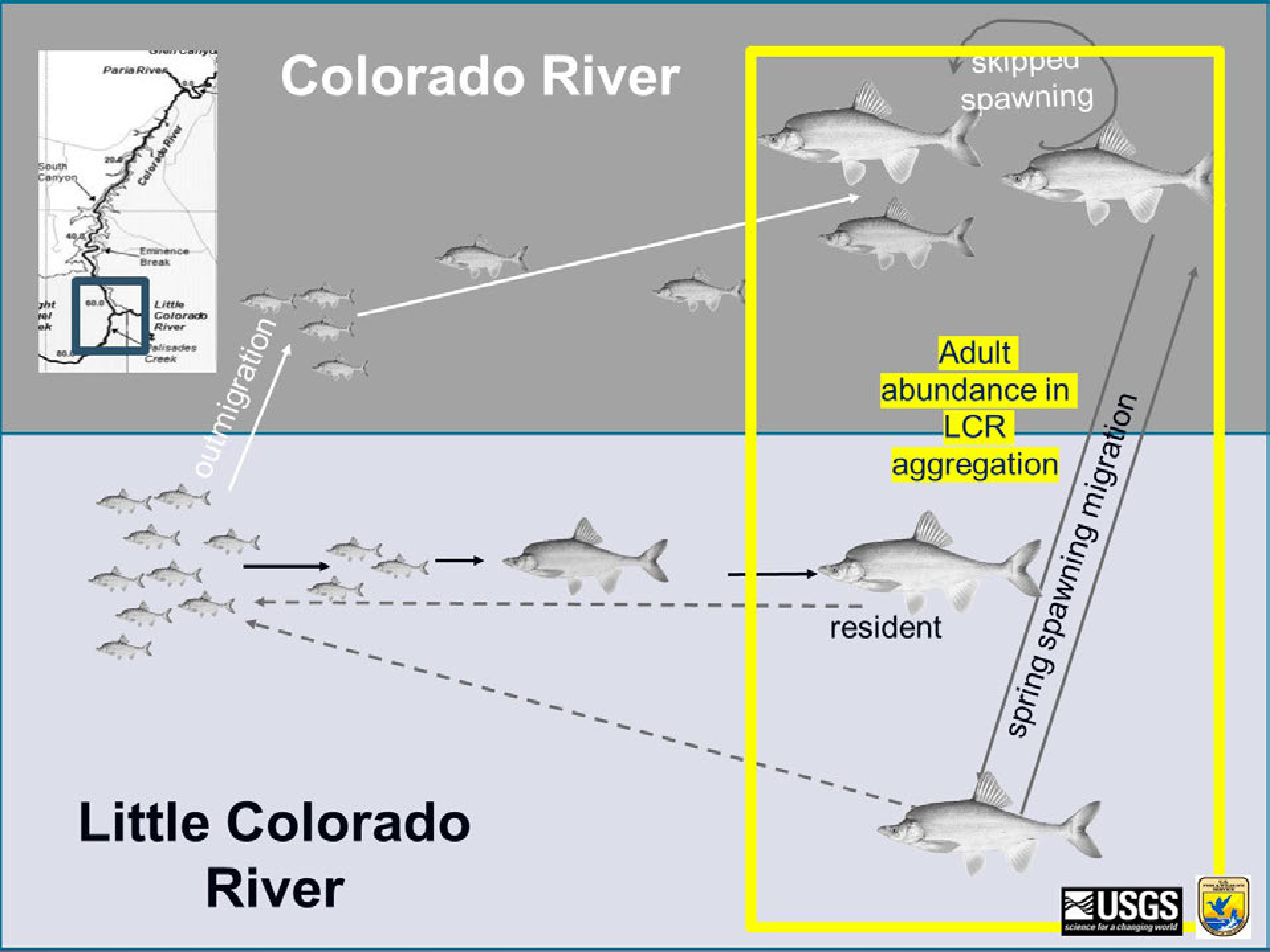


Provisional data. Do not cite.

Annual spring abundances of HBC 150-199 mm in lower 13.6 km of LCR

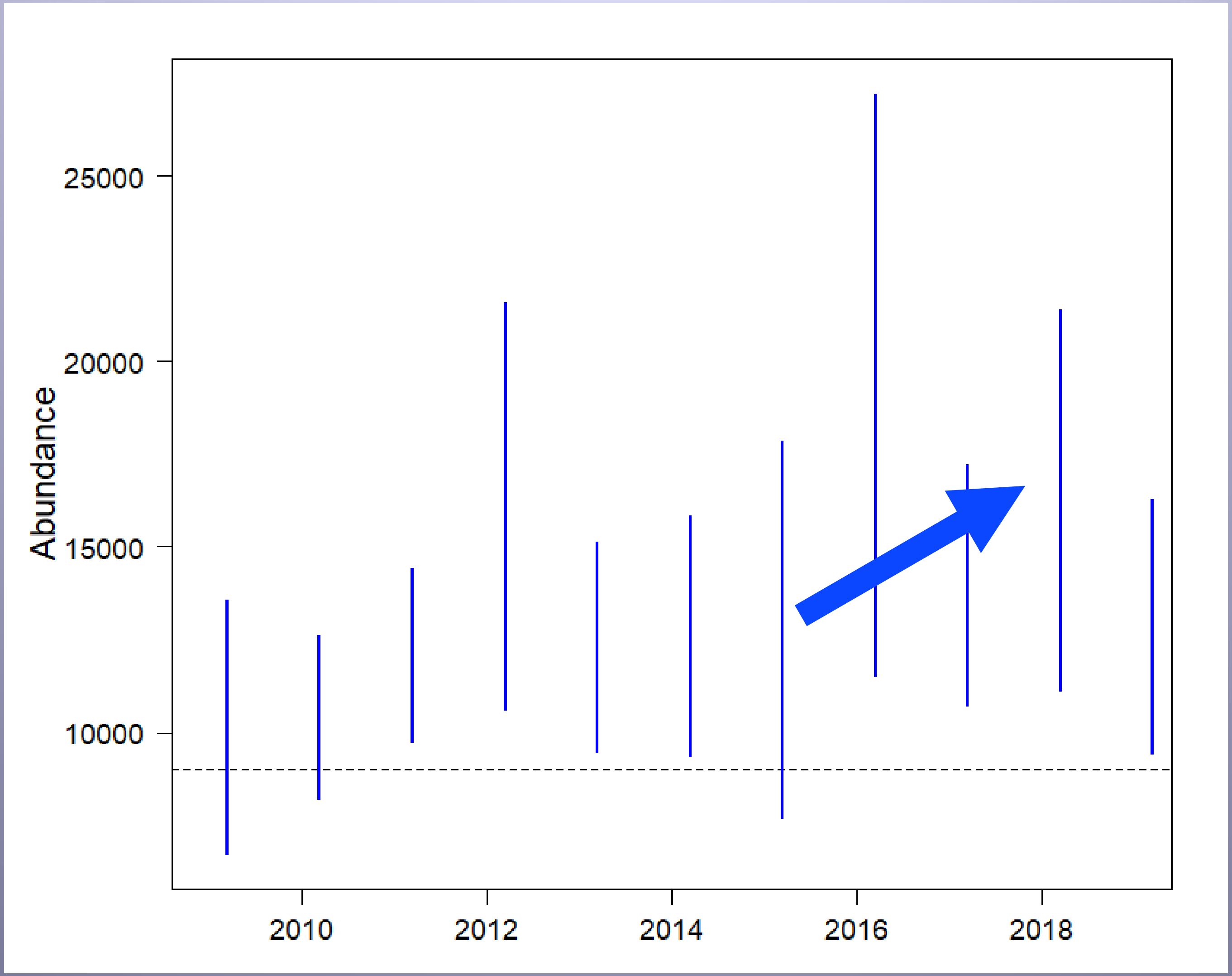


Provisional data. Do not cite.



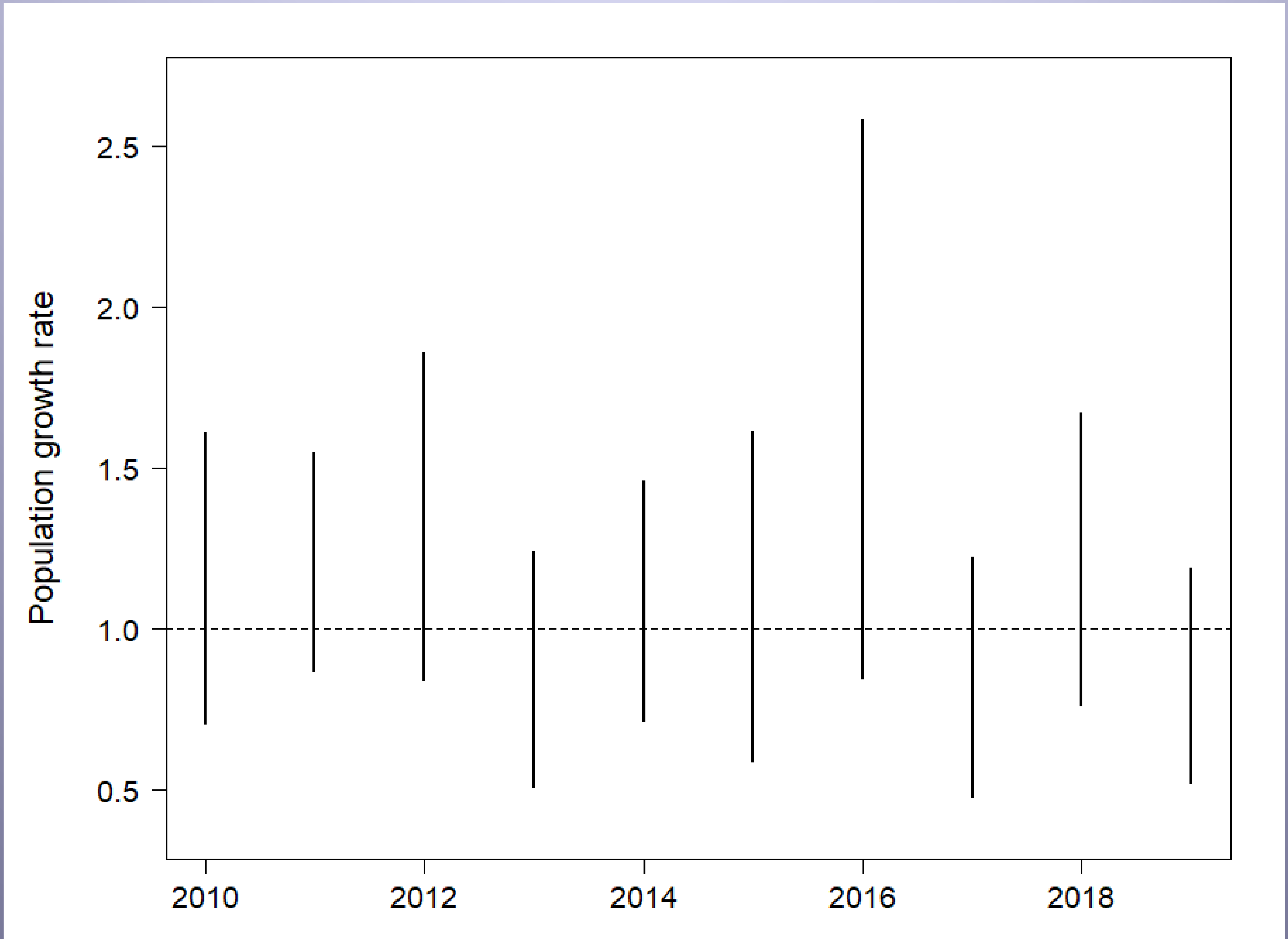
Colorado River
skipped spawning
Paria River
South Canyon
Colorado River
Eminence Break
Little Colorado River
outmigration
Adult abundance in LCR aggregation
spring spawning migration
resident
Little Colorado River
USGS
science for a changing world

Fall abundances of adult humpback chub in the LCR aggregation (>199mm TL)

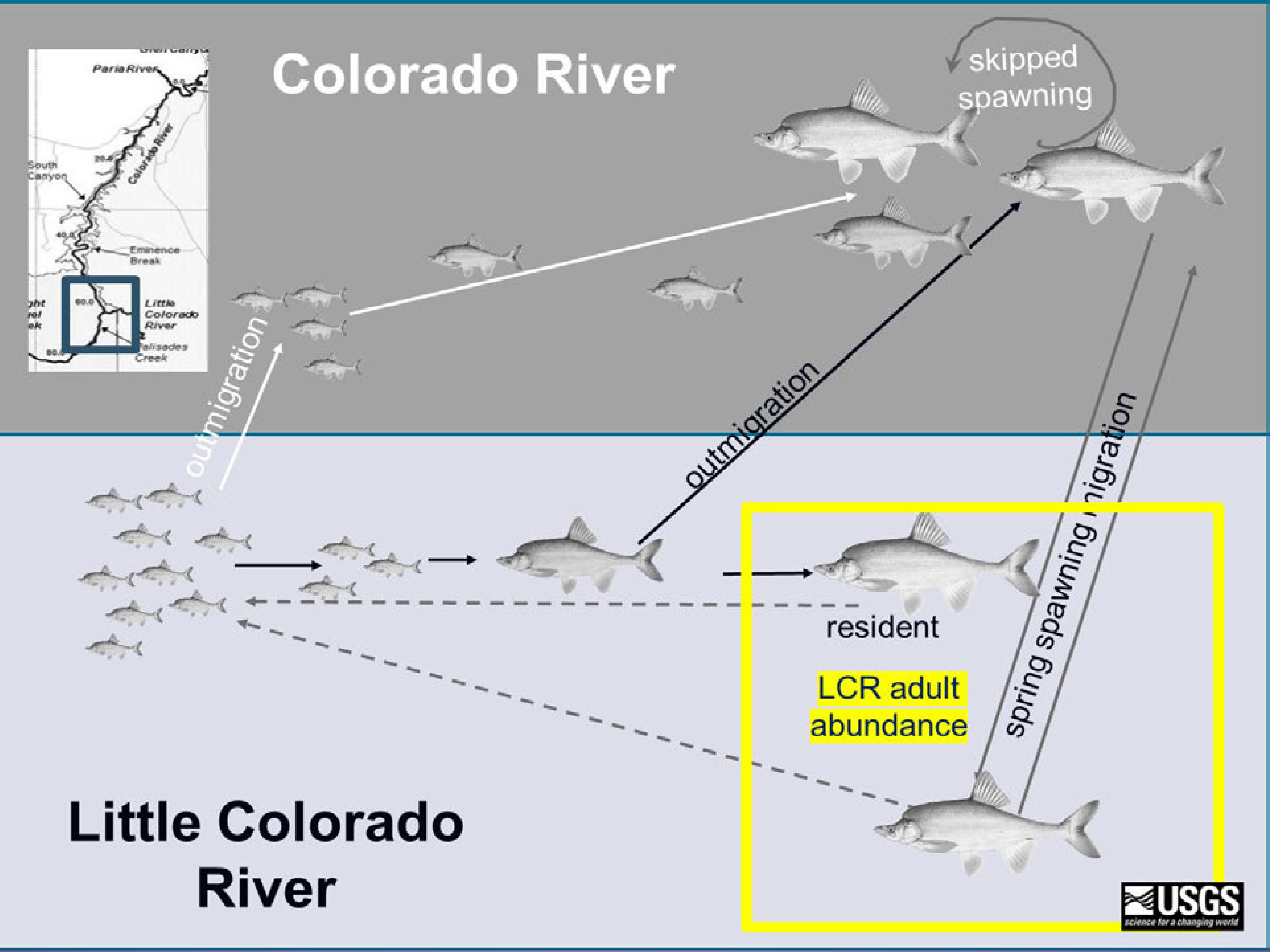


Provisional data. Do not cite.

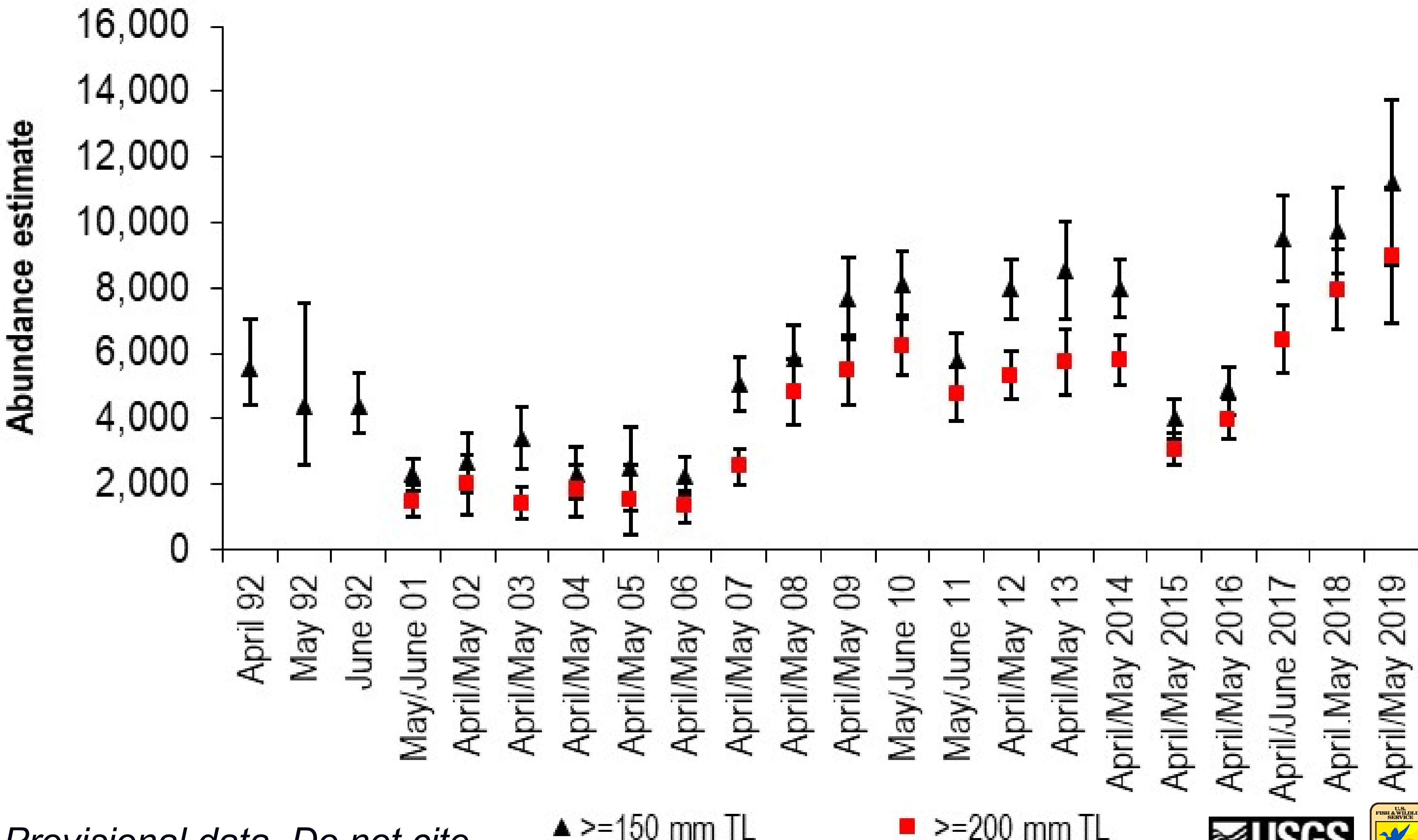
Population growth rate for adult humpback chub in the LCR aggregation (>199mm TL)



Provisional data. Do not cite.

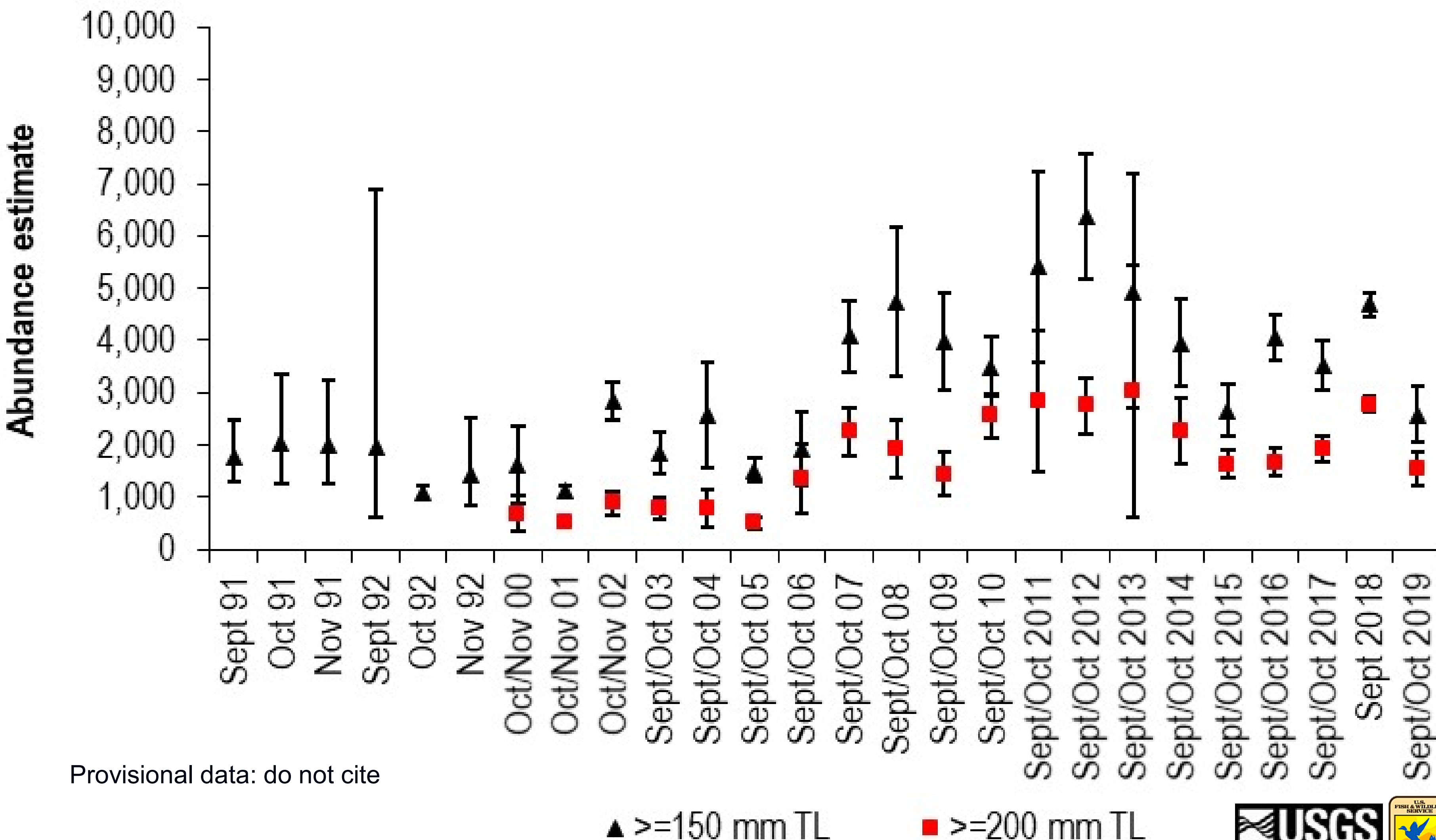

Colorado River
skipped spawning
outmigration
outmigration
spring spawning migration
resident
LCR adult abundance
Little Colorado River
Paria River
South Canyon
Colorado River
Eminence Break
Little Colorado River
USGS
science for a changing world

Annual spring abundances of HBC ≥150 mm and ≥200 mm in lower 13.6 km of LCR



Provisional data. Do not cite.

Annual fall abundances of HBC ≥150 mm and ≥200 mm in lower 13.6 km of LCR



Provisional data: do not cite

Summary

- Juvenile humpback chub abundance was low 2016-18, but 2019 was a good production year in the LCR
- In the CR abundance trends are largely influenced by 2011 & 2012 cohorts. Trends in the LCR are different from the CR.
- Subadult abundance is declining in the JCM reach due to low age-0 production from 2013-2018.
- Adult humpback chub population remains stable, though low abundance of subadults in JCM-east signals potential for future decline

Presentation outline (Project G), cont.

- LCR aggregation
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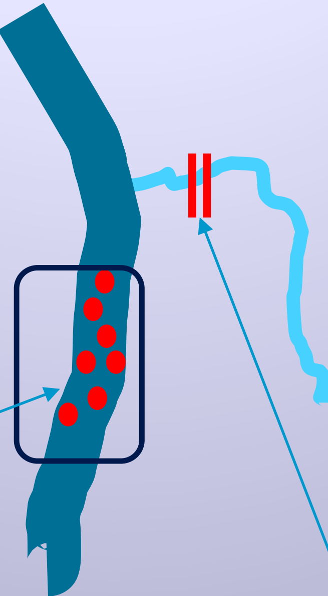
  - Chute Falls translocations (G.1, G.7)

- Mainstem Grand Canyon
  - HBC aggregations (G.5)
  - Fall Canyon (G.1, G.6)

Antenna data



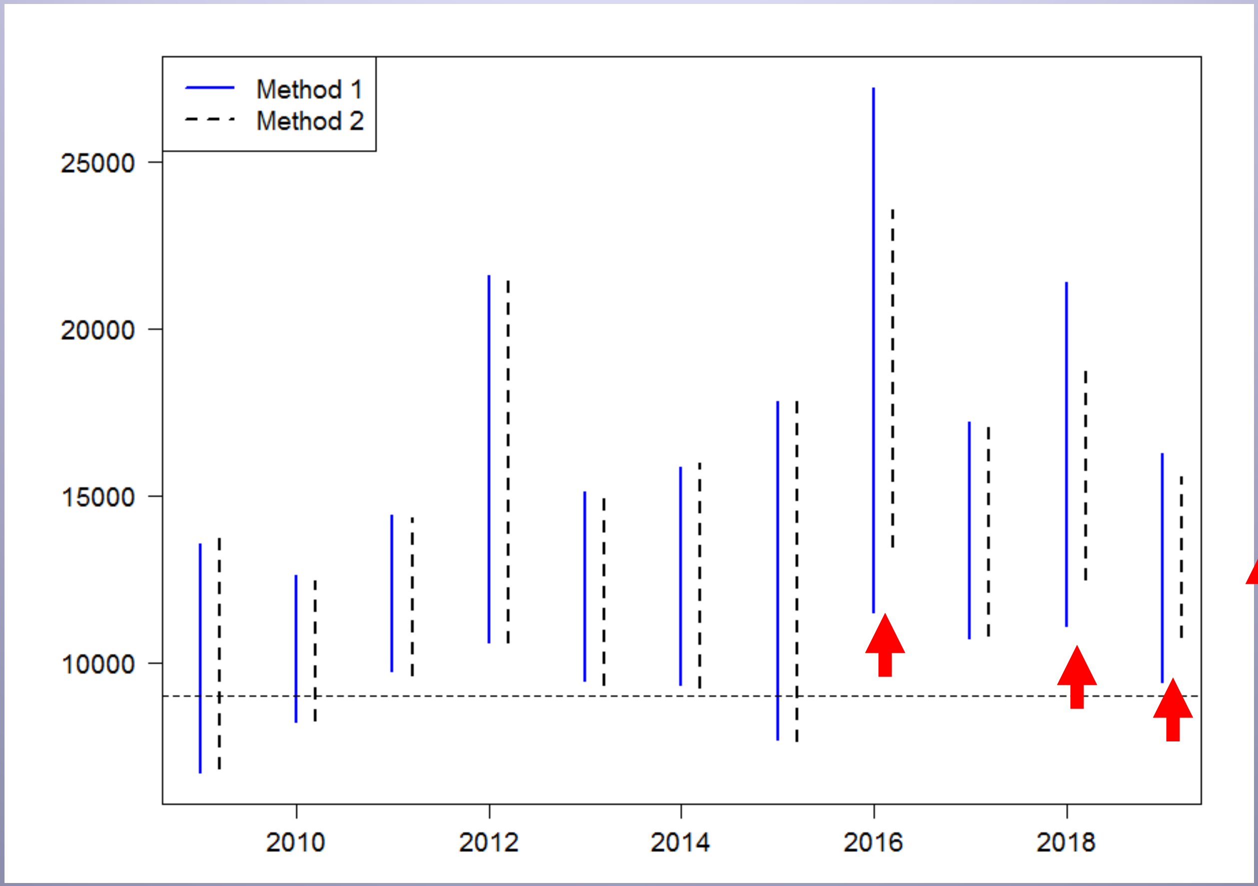
Submersible PIT antennas in the CR (**UFO**)

Deployed during trips

PIT tag array in the LCR: Multiplexer (**MUX**)

Deployed continuously

Fall abundances of adult humpback chub in the LCR aggregation (>199mm TL)



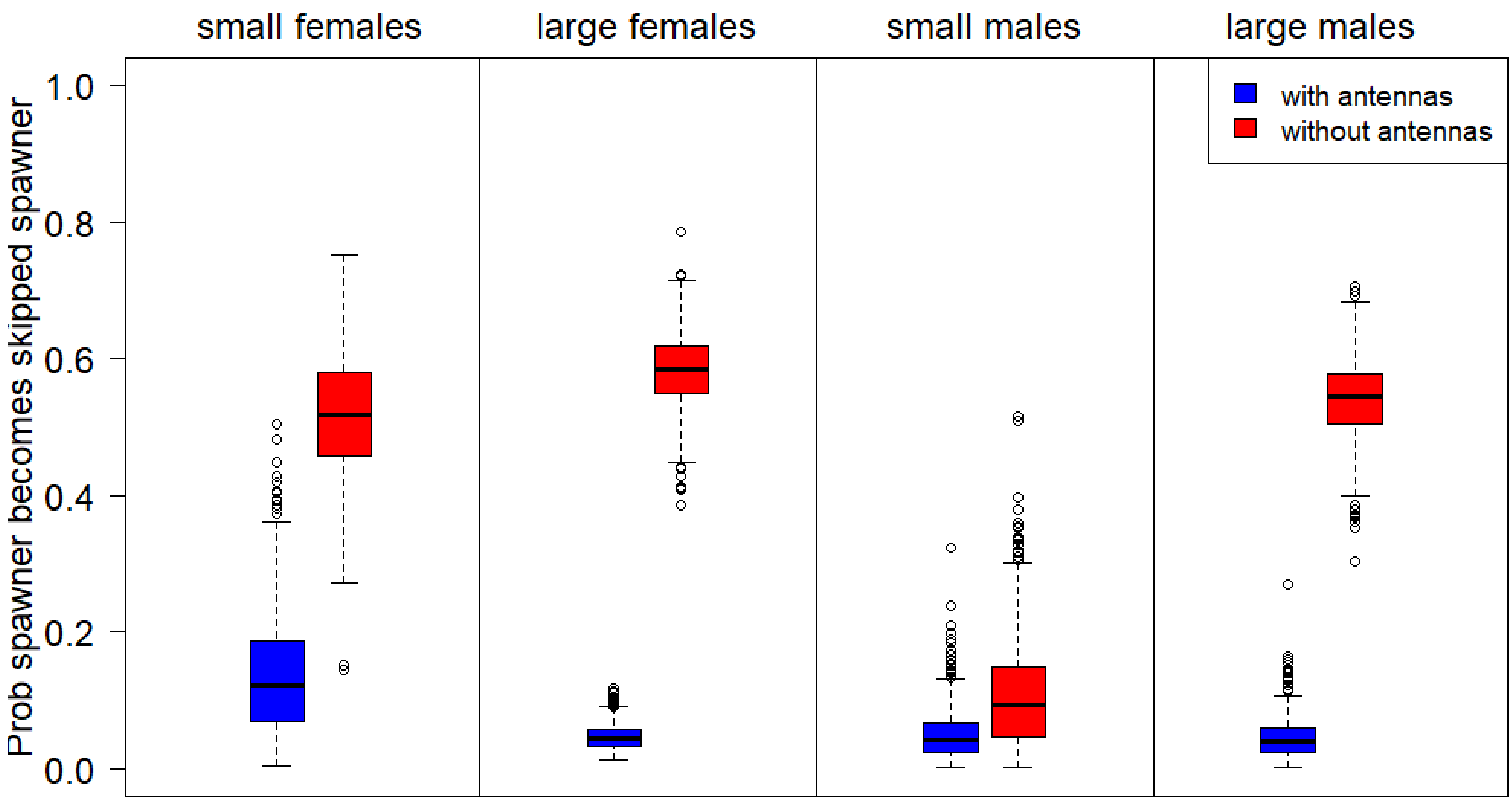
Years when UFO antenna were deployed

Method 1: Treat unmarked and marked fish the same (physical captures only)

Method 2: Calculate abundance separately for marked and unmarked fish (uses antenna detections for marked fish)

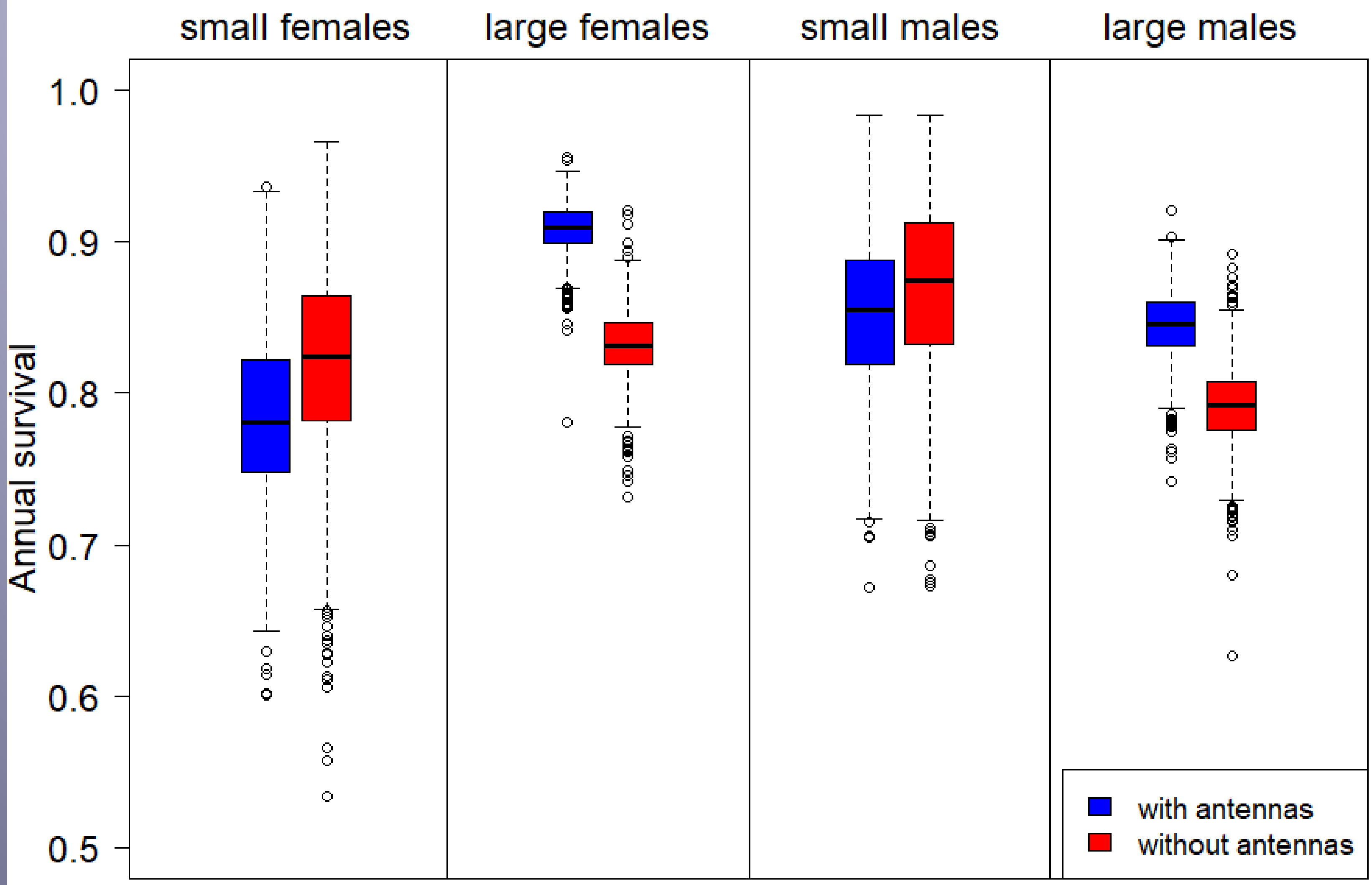
Provisional data. Do not cite.

Results: Probability of skipped spawning



Provisional data. Do not cite.

Results: Survival



Provisional data. Do not cite.

Summary, cont.

- Antenna data provide useful information because they are increase detection probabilities, particularly for larger fish

- We hope to continue to use antennas and develop new mark-recapture methods for antenna data

Presentation outline (Project G), cont. 2

- LCR aggregation
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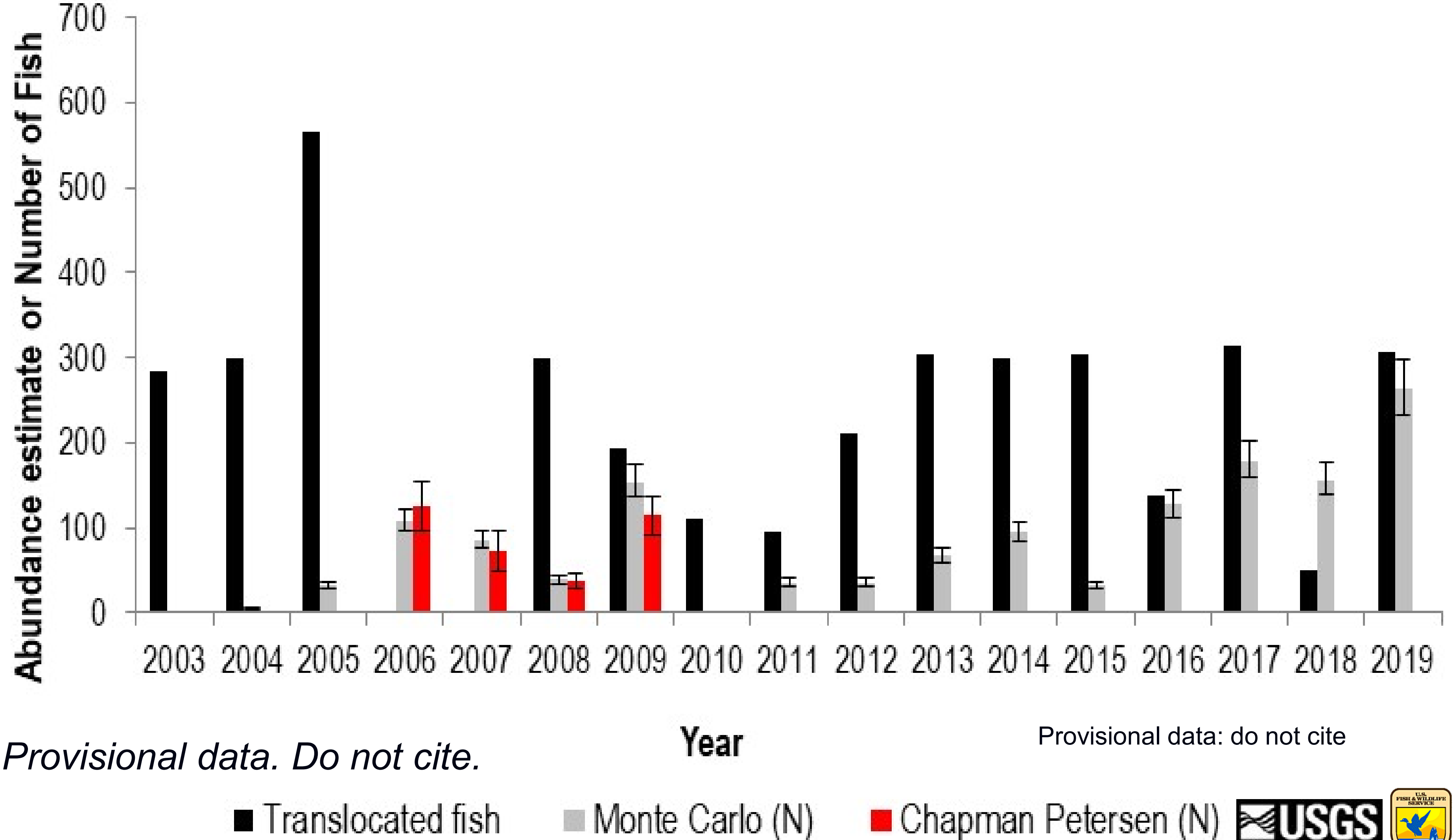
Translocations and Chute Falls Monitoring

Numbers and sizes of Humpback Chub collected from the Little Colorado River for translocations (2003-2019)

Date	Chute Falls *	Size (mm)	SNARRC	Shinumo	Havasu	Size (mm)	Total	Capture Location	Capture Location (km)	Tag
8/1/03	283	50-100					283	Boulders	~1.15-3.15	VIE
7/30/04	299	50-100					299	Boulders	~1.15-3.16	VIE
7/29/05	567	50-100					567	Boulders	~1.15-3.17	VIE
7/22/08	299	~80-130		207		<80	506	Boulders	~1.15-3.18	PIT
10/13/08			300	100		<130	400	Boulders	~1.15-3.18	
7/24/09	194	~80-130	205	83		<80	482	Boulders	~1.15-3.18	PIT
10/10/09				238		<130	238	Coyote	~7.56--9.85	
7/16/10	108	~80-130	175			<80	283	Boulders	~1.15-3.18	PIT
11/5/10				300	300	<80	600	Coyote	~7.56--9.85	
11/9/11	96	~80-130	200		300	<80	596	Coyote	~7.56--9.85	PIT
7/12/12	212	~80-130	202	200	300	<80	914	Coyote	~7.56--9.85	PIT
5/24/13				73		<30	73	Boulders	~1.15-3.18	
7/11/13				99		<80	99	Coyote	~7.56-9.85	
11/7/13	303	~80-130		11	300	<130	614	Coyote	~7.56-9.85	PIT
5/1/14					660	<30	660	Riverwide	0-13.56	
10/31/14	305	65-137				<130	305	Coyote	~7.56-9.85	PIT
5/28/15					315	<30	315	Riverwide	0-13.56	
11/1/15	303	61-128					303	Coyote	~7.56-9.85	PIT
10/27/16	137	58-146					137	Coyote	~7.56-9.85	PIT
6/16/17			139			<40	139	Riverwide	0-13.56	
10/26/17	315	66-120					315	Coyote	~6.9-10.5	PIT
10/29/18	49	63-115					49	Coyote	~6.9-10.5	PIT
6/18/19			250	400		<40	650	Coyote	~6.9-10.6	N/A
10/24/19	306	52-94					306	Coyote	~6.9-10.5	PIT
Totals	3,776		1,471	1,711	2,175		9,133			

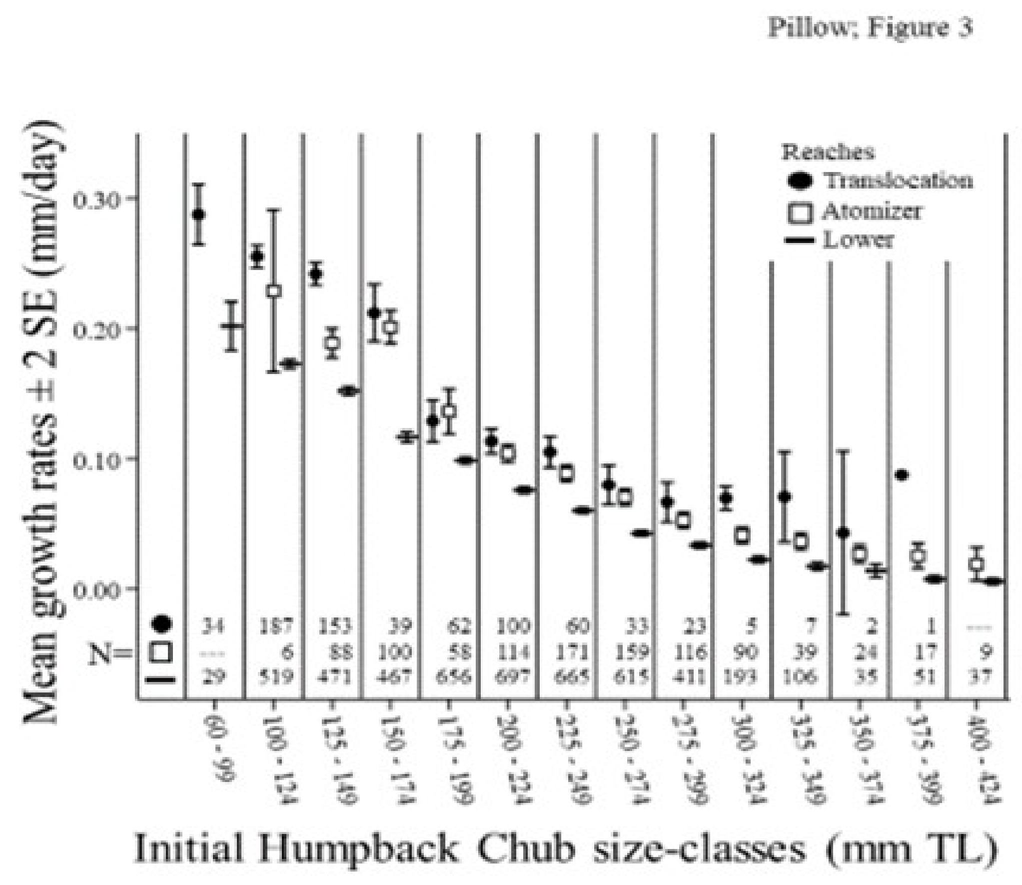
Provisional data: do not cite

<u>Above Chute Falls</u> - Number of juvenile HBC translocated (black) and adult HBC >=200 mm abundances (red & grey)



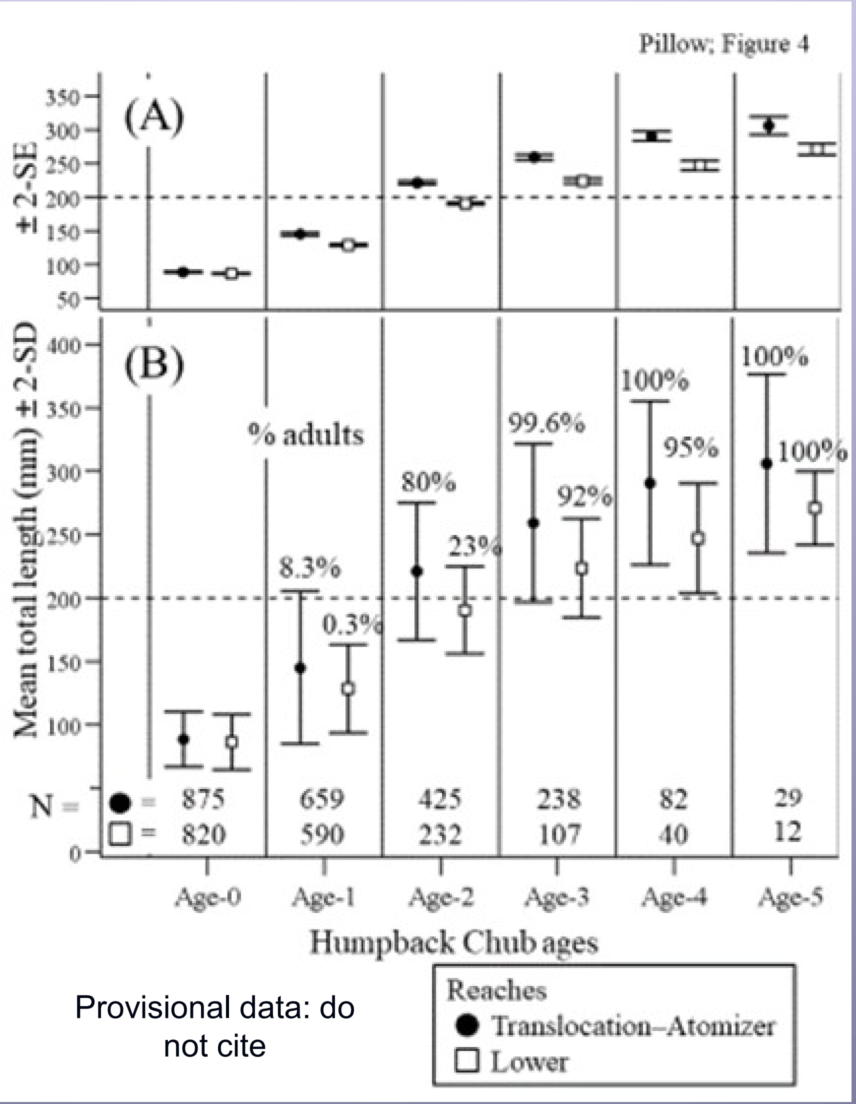
Provisional data. Do not cite.

Growth (mm/day) of HBC in Chute Falls, Atomizer, and Lower reaches of LCR (Stone et al., in review)



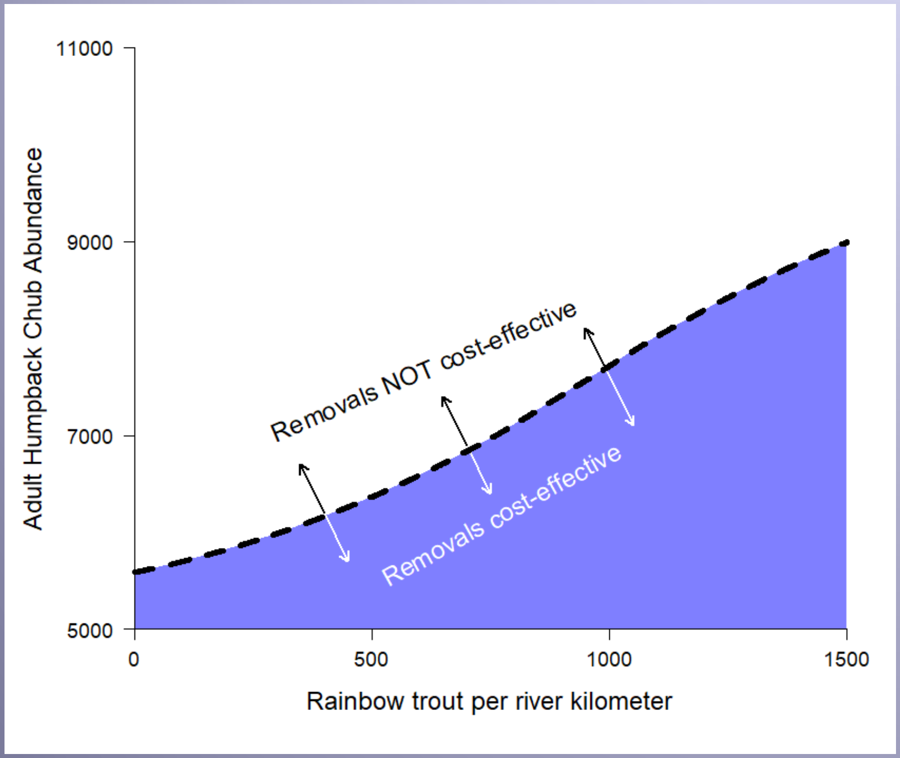
Provisional data: do not cite

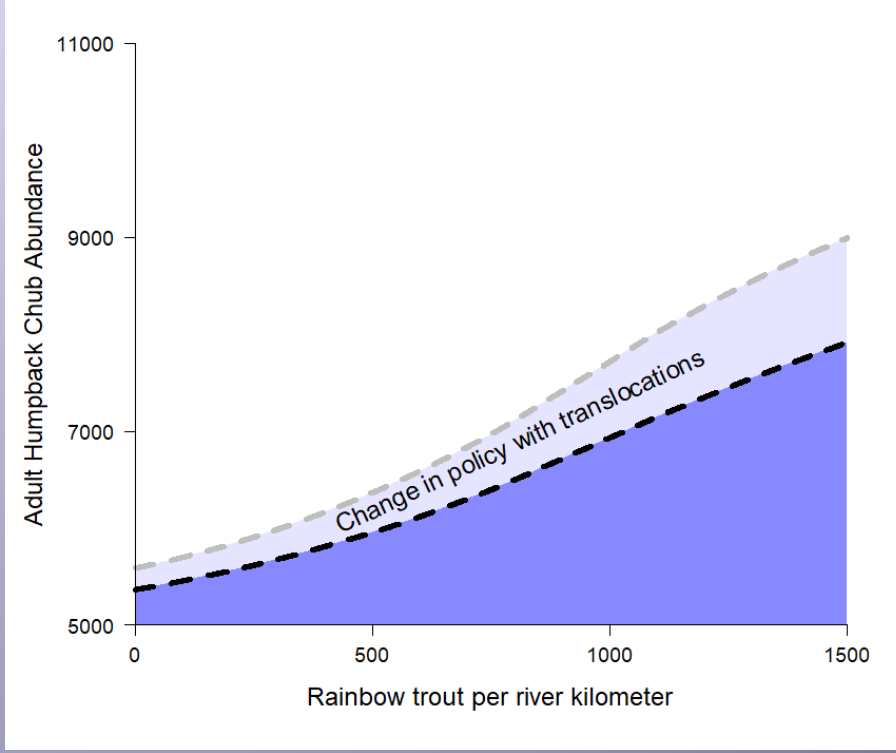
HBC reach adulthood significantly faster in the Chute Falls and Atomizer reaches than in Lower LCR (Stone et al., in review)



Provisional data: do not cite

Comparing translocations to trout removals





Provisional data. Do not cite.

Summary, cont. 2

- Significantly higher growth rates are a result of translocating HBC to above Chute Falls.
- With higher growth rates comes significantly quicker time to reach adulthood (hence a headstart for reproduction).
- Translocations are relatively easy and inexpensive beneficial conservation actions compared to other options that may be much more expensive and politically difficult to implement.

Presentation outline (Project G), cont. 3

- LCR aggregation
  - Update on abundance (G.1, G.2, G.3)
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  - Chute Falls translocations (G.1, G.7)
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  - HBC aggregations (G.5)
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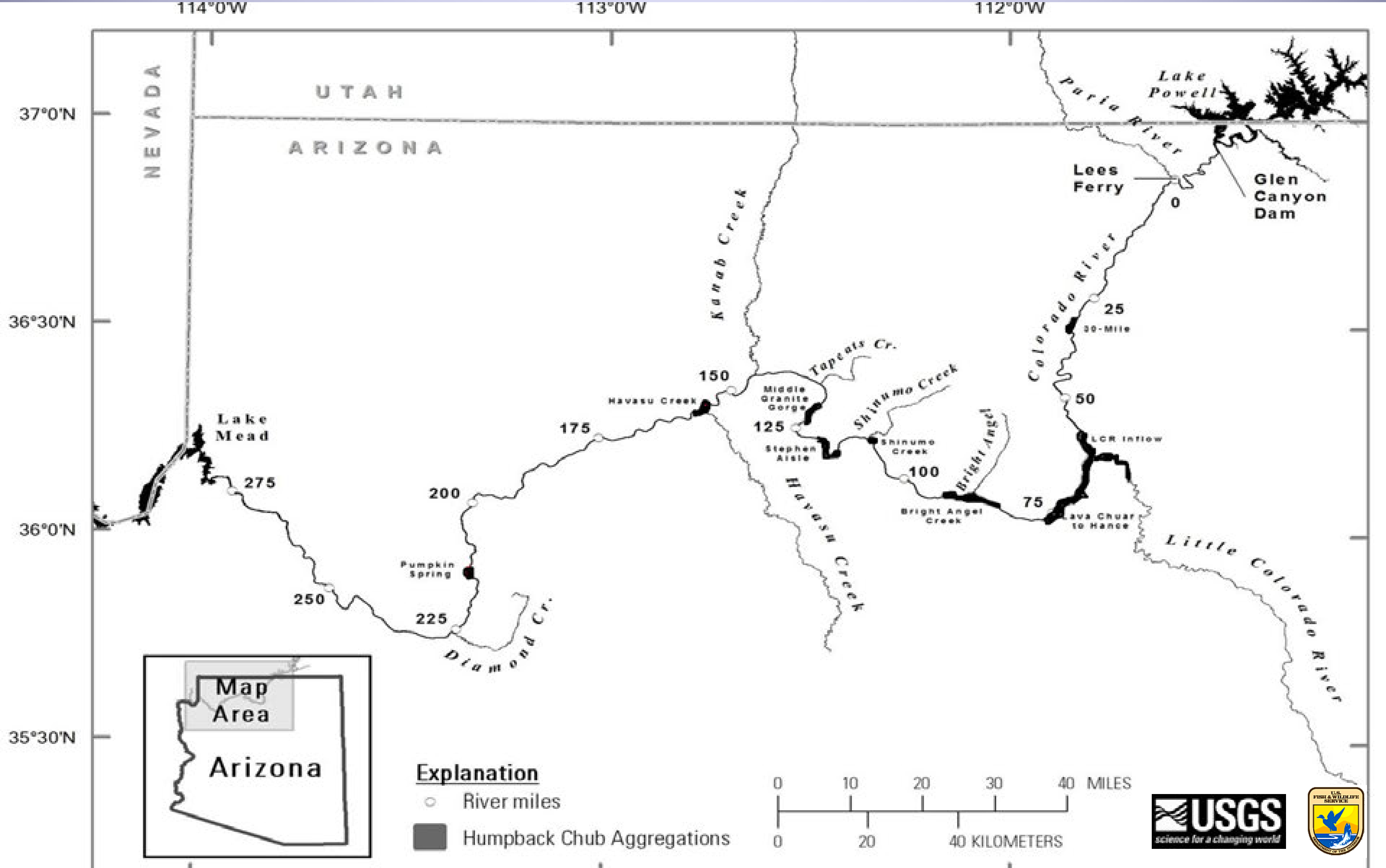
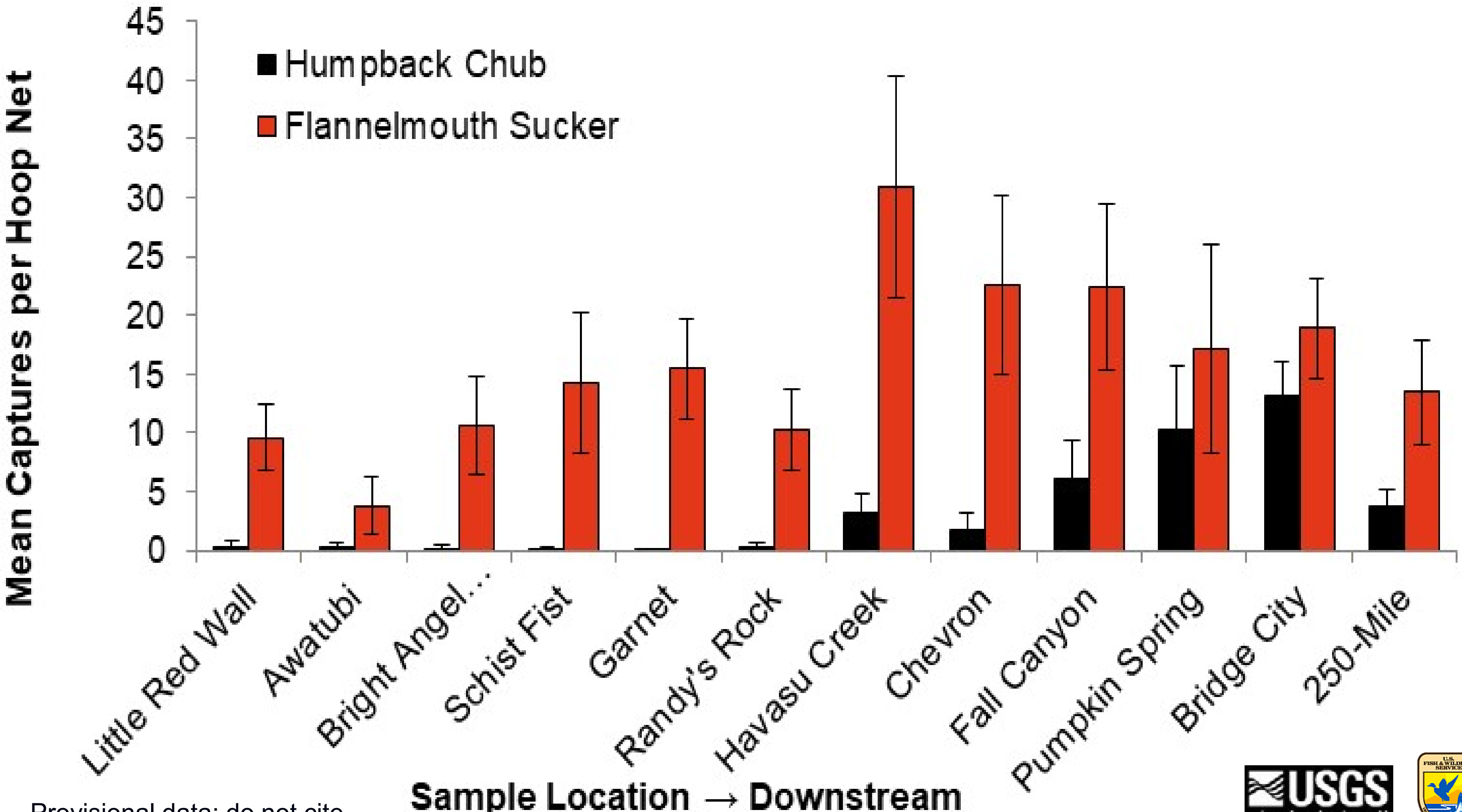
Mainstem HBC monitoring

Map of humpback chub aggregation sites

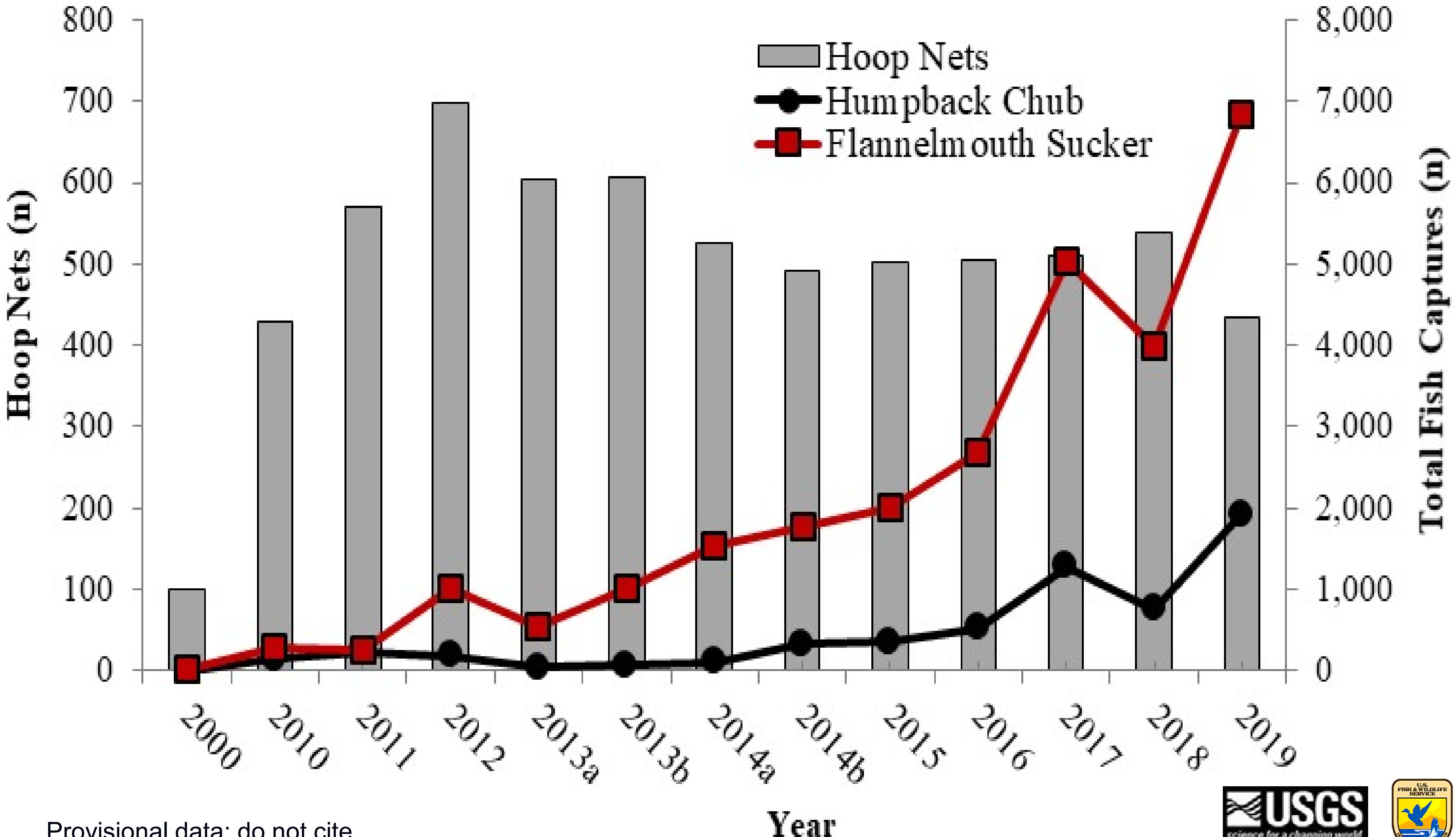


CPUE of HBC and FMS at sampling sites during 2019 aggregation sampling



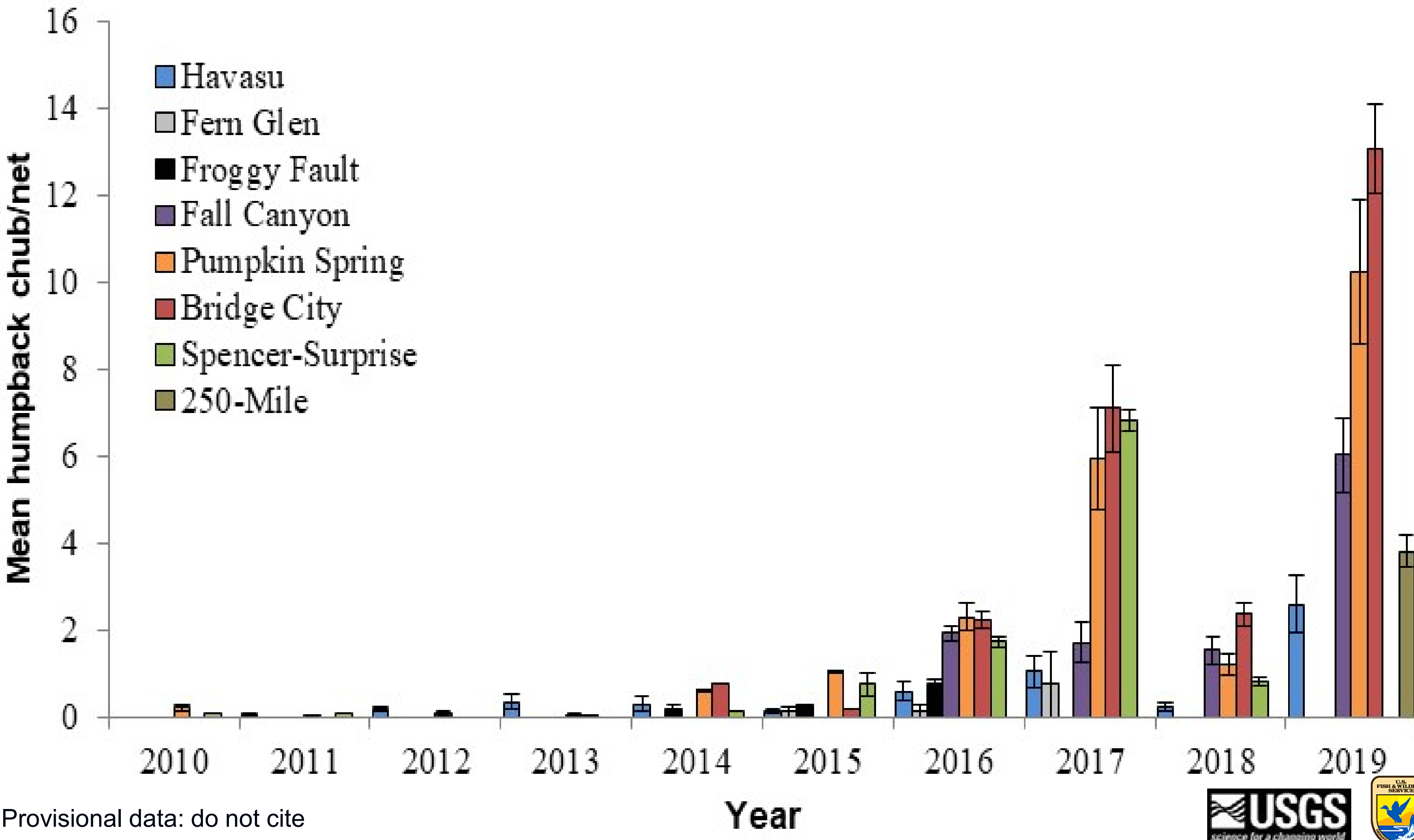
Provisional data: do not cite

Effort (# nets) and catch of FMS and HBC on aggregation trips (2000 and 2010-2019)



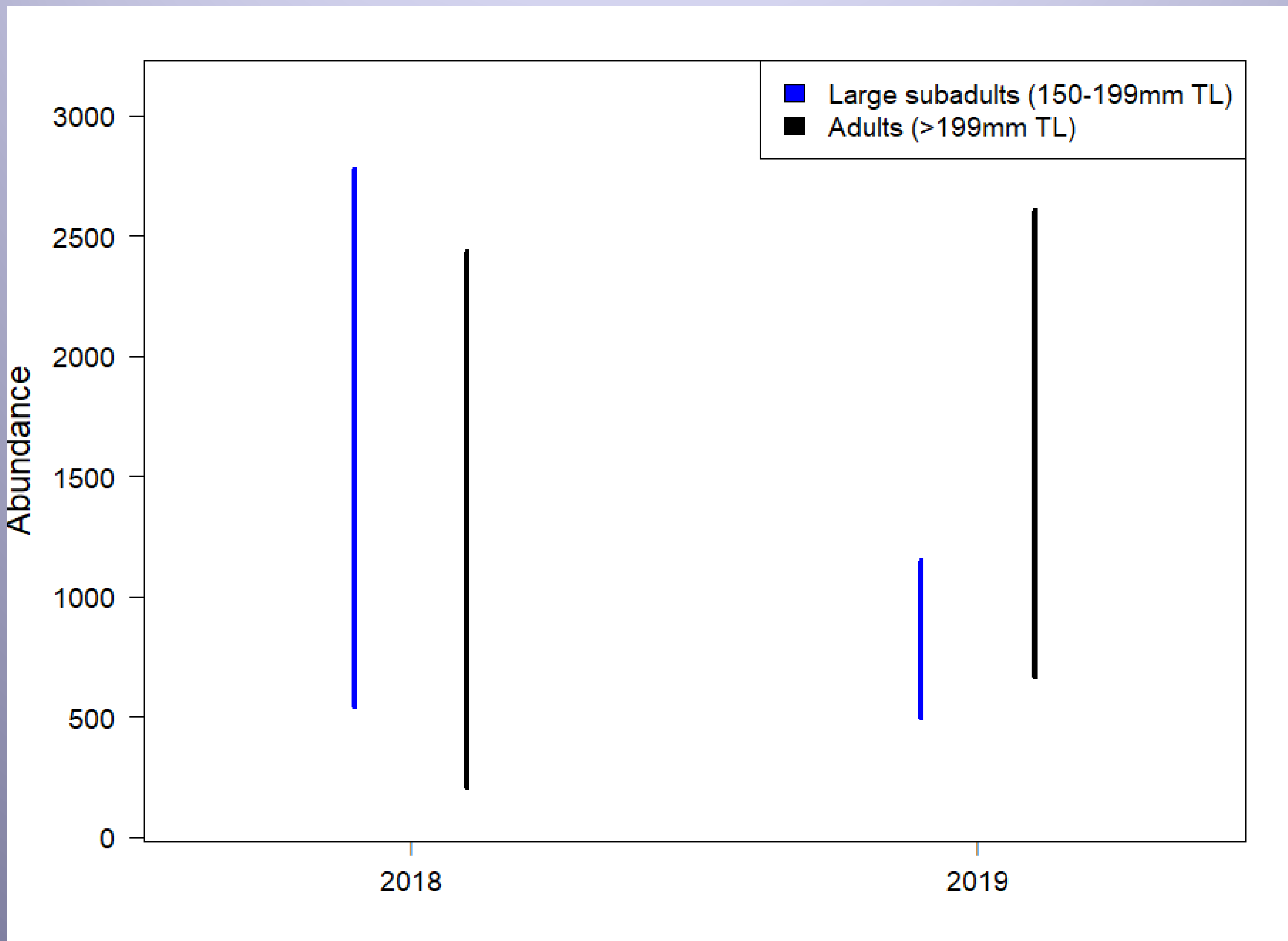
Provisional data: do not cite

CPUE (fish/net) of adult HBC at sampling sites in western Grand Canyon (below 156 mile)



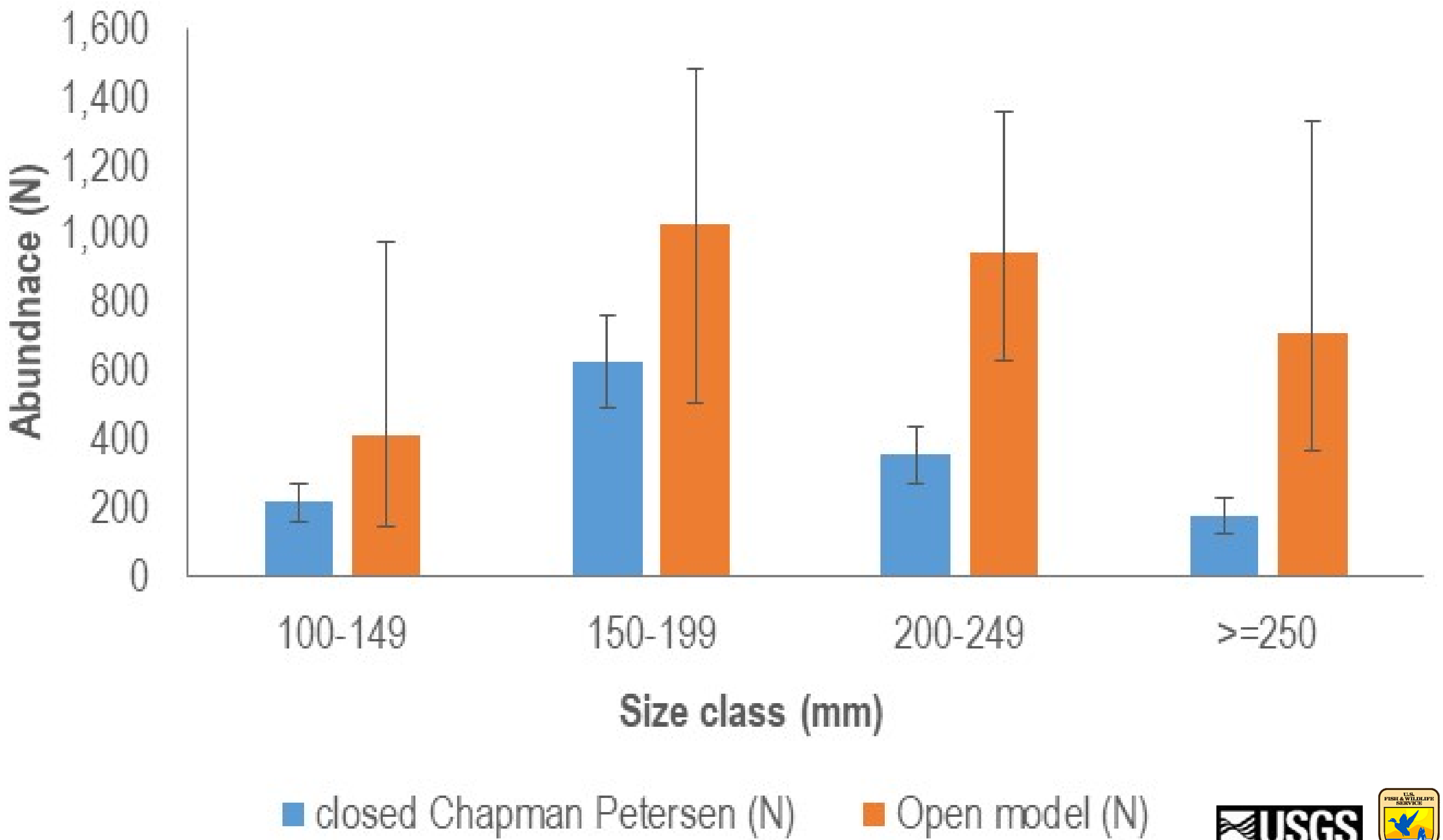
Provisional data: do not cite

Fall abundance estimates in JCM-west (Fall Canyon)



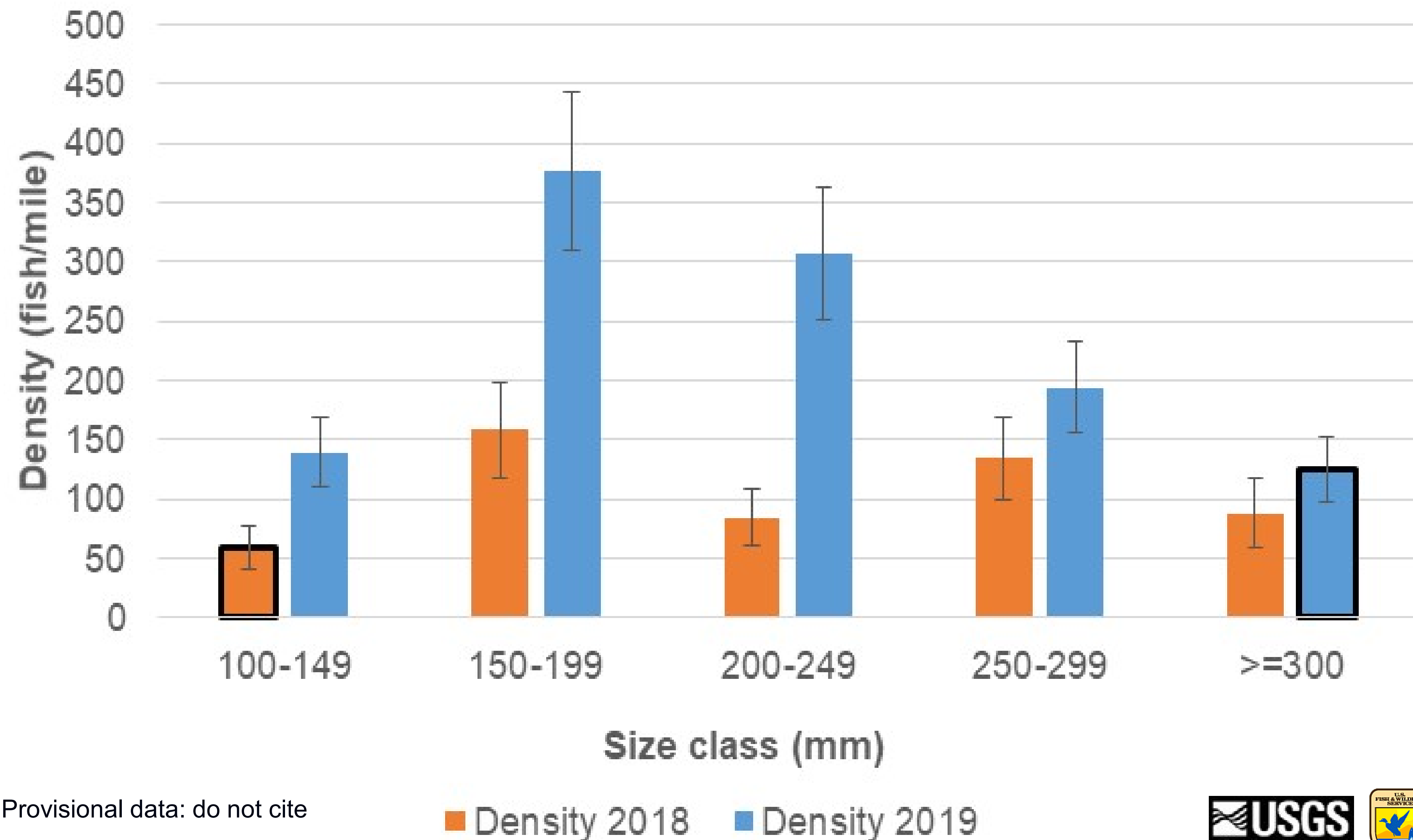
Provisional data. Do not cite.

Closed vs open model abundance estimates of HBC by size class in JCM West reach August/September 2019



Provisional data. Do not cite.

2018 and 2019 density estimates (fish/mile) of HBC at Bridge City (2 mile reach)



Provisional data: do not cite

Summary, cont. 3

- CPUEs of HBC and FMS have been increasing recently in Grand Canyon, particularly in western Grand Canyon below Havasu Creek. This is a recent phenomenon.

- Since 2017, we have conducted closed mark recapture studies on HBC and FMS at four sites on mainstem aggregation trips: JCM East, JCM West, Bridge City, and 250 mile, and open modeling at JCM East and JCM West.

Thank You