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

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Presentation outline:

Project G

- Little Colorado River (LCR) aggregation
  - LCR
  - Juvenile Chub Monitoring (JCM) – east
  - Total adults & triggers
  - Chute Falls translocations
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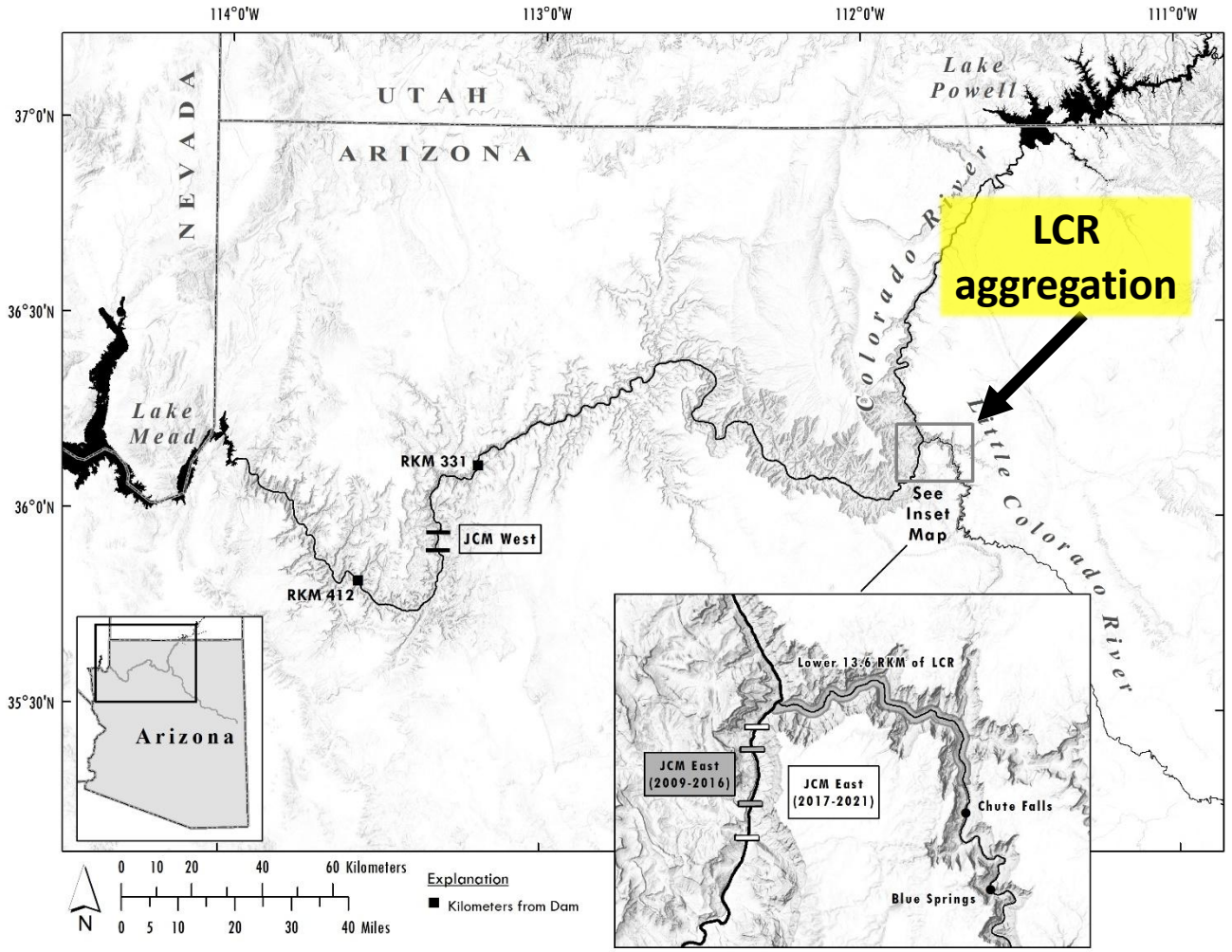
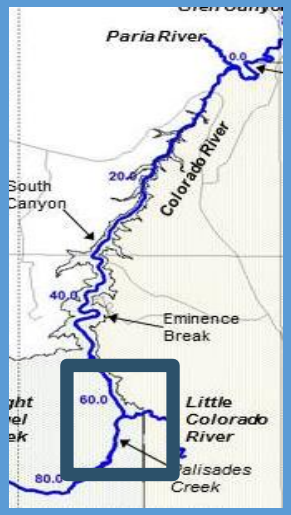
Fixed site monitoring in eastern Grand Canyon



Life history of Humpback Chub in LCR aggregation:



Colorado River

skipped spawning

migrants

outmigration

resident

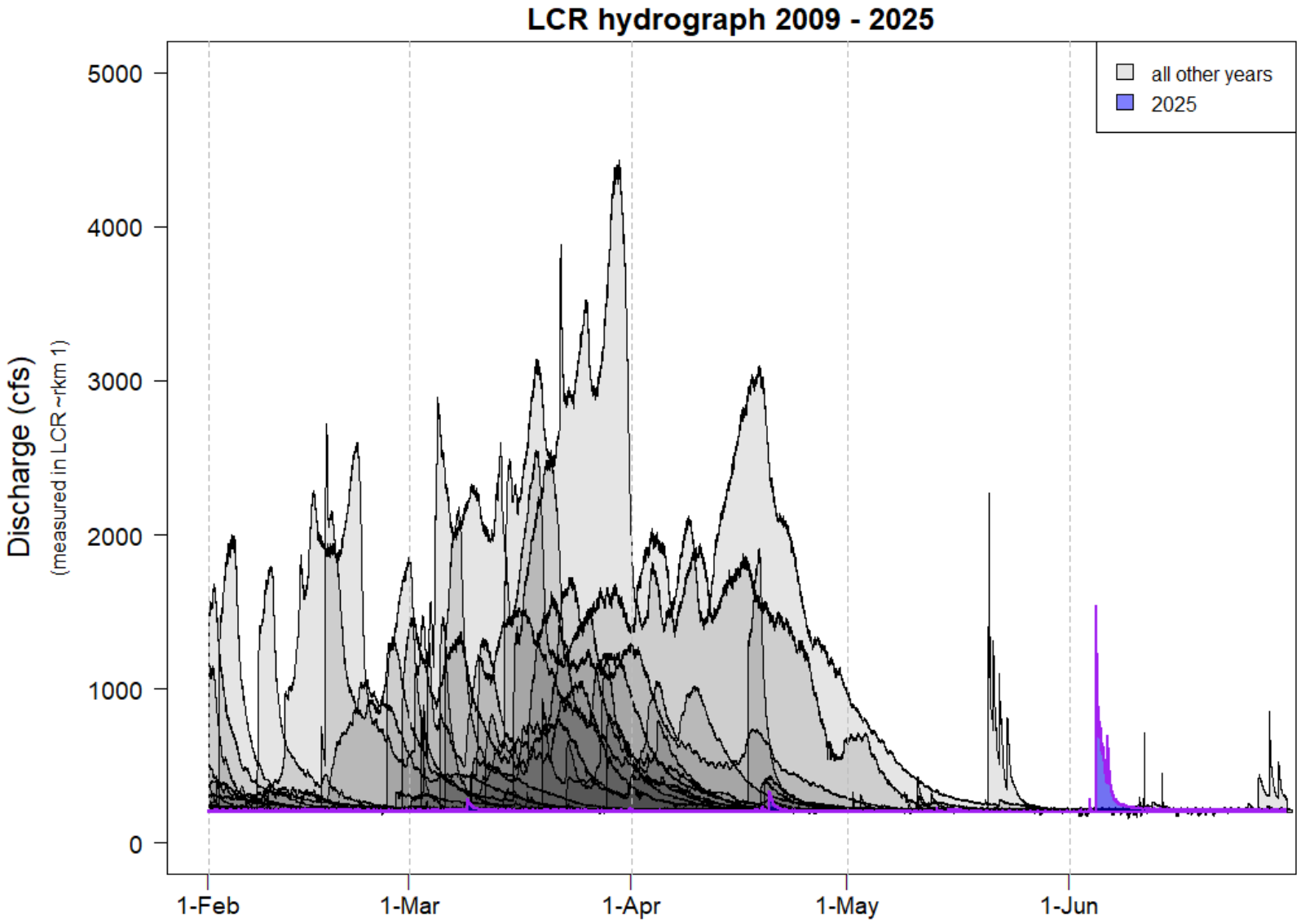
spring spawning migration

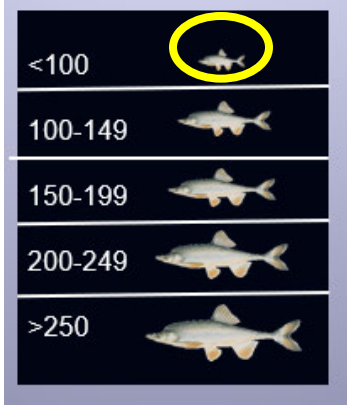
Little Colorado River

Size chart indicator

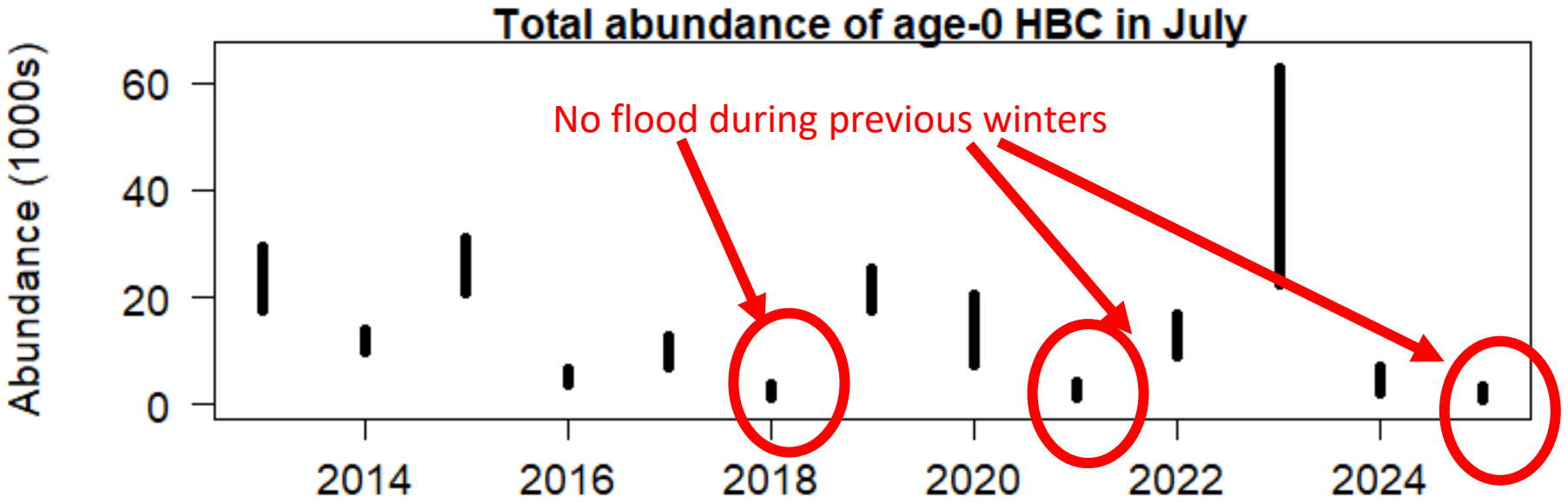
(sizes are mm total length)

Juvenile	<100 
Small subadult	100-149 
Large subadult	150-199 
Small adult	200-249 
Large adult	>250 

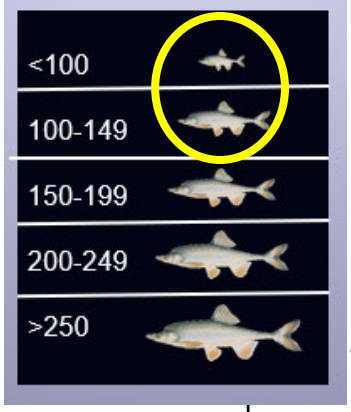




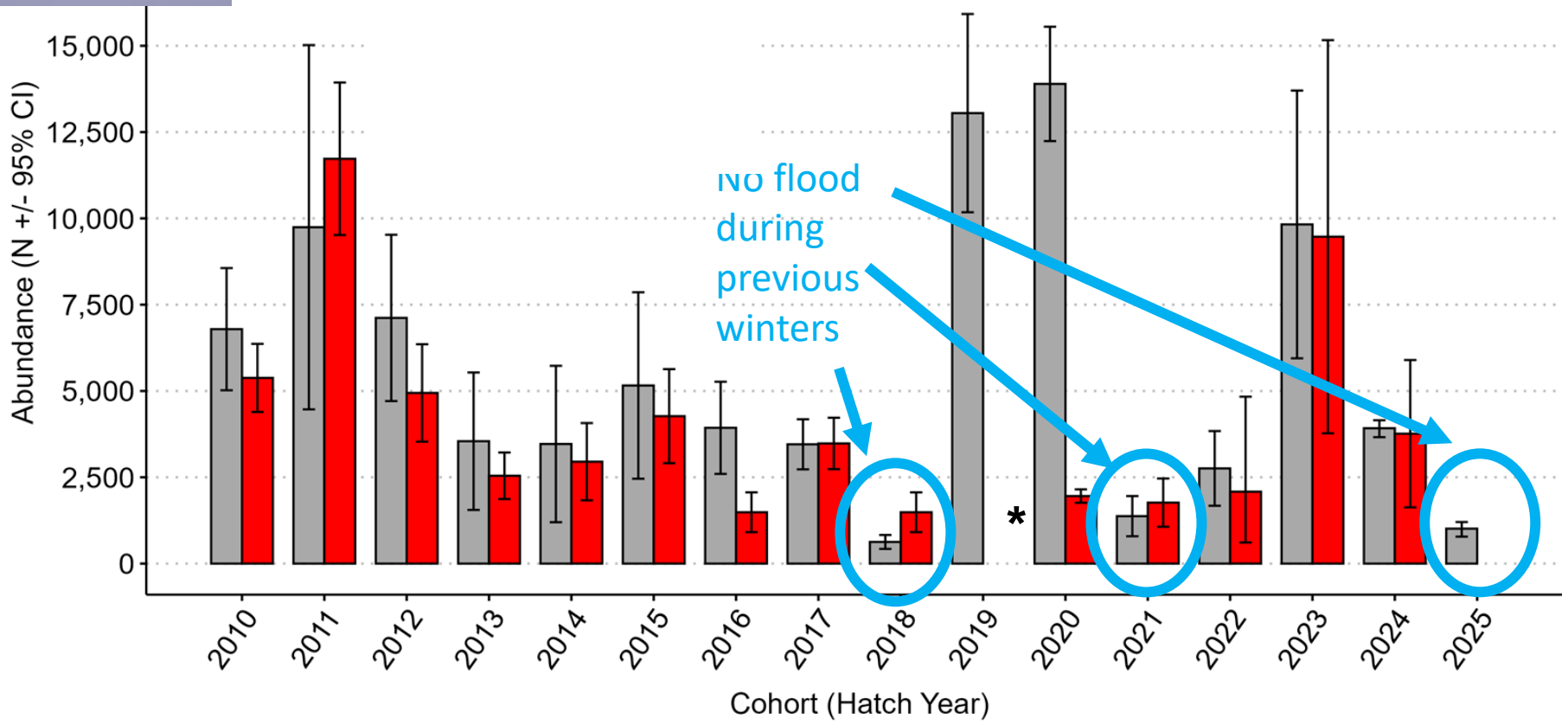
Age-0 abundances in the LCR

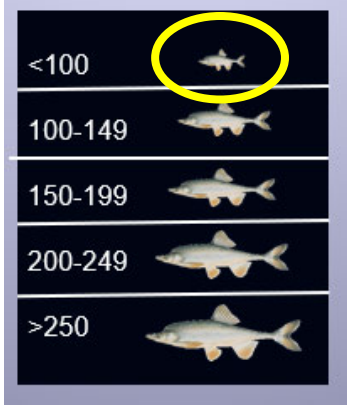


* Abundance estimates from 2020 & 2025 are based on expanding from a small proportion of the spatial area (near the confluence) and may not be fully representative

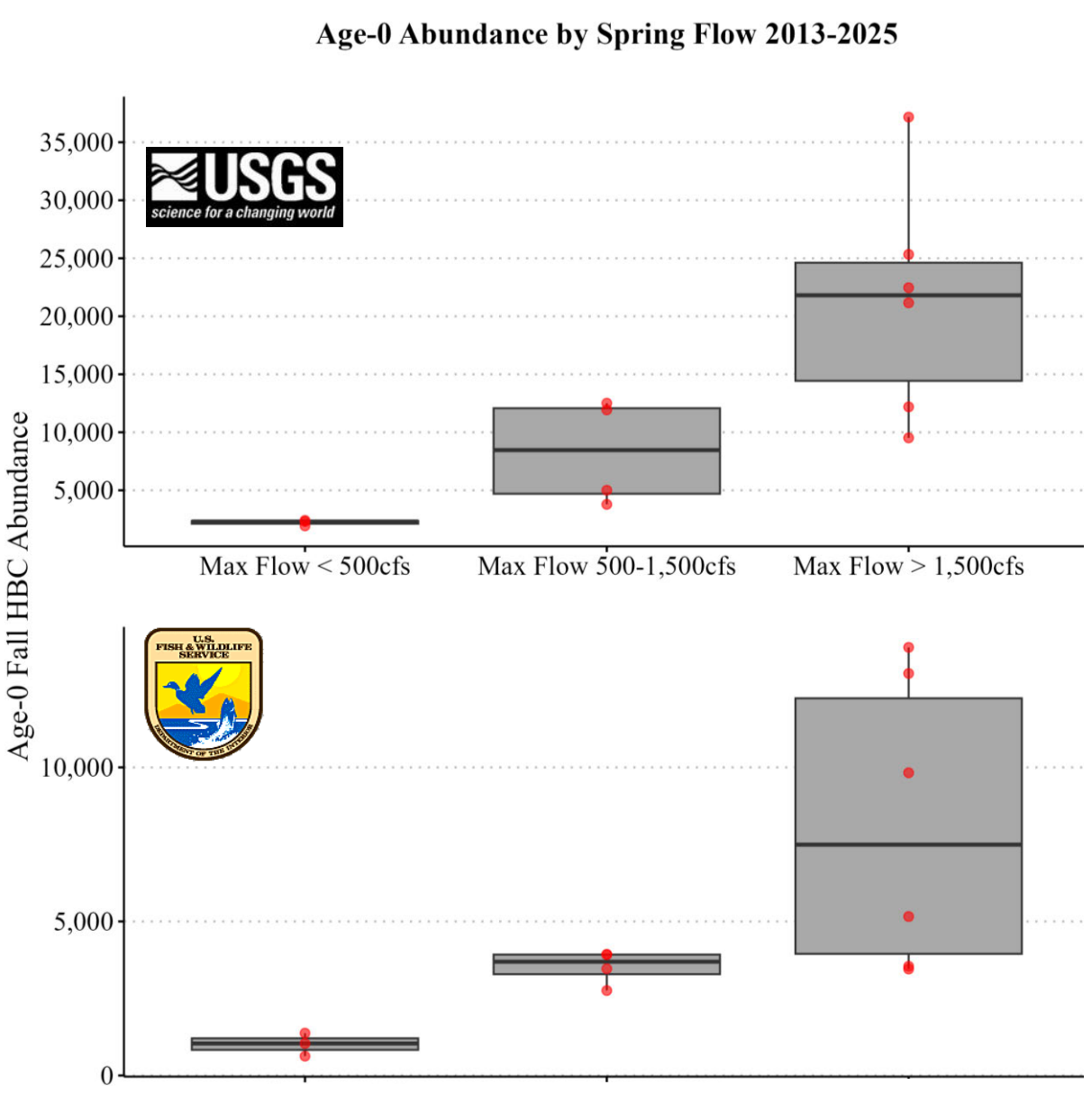


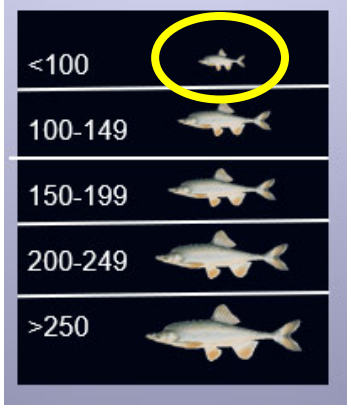
Annual Fall HBC age-0 (gray) and age-1 (red) abundance by hatch year shows a smaller 2024 cohort.



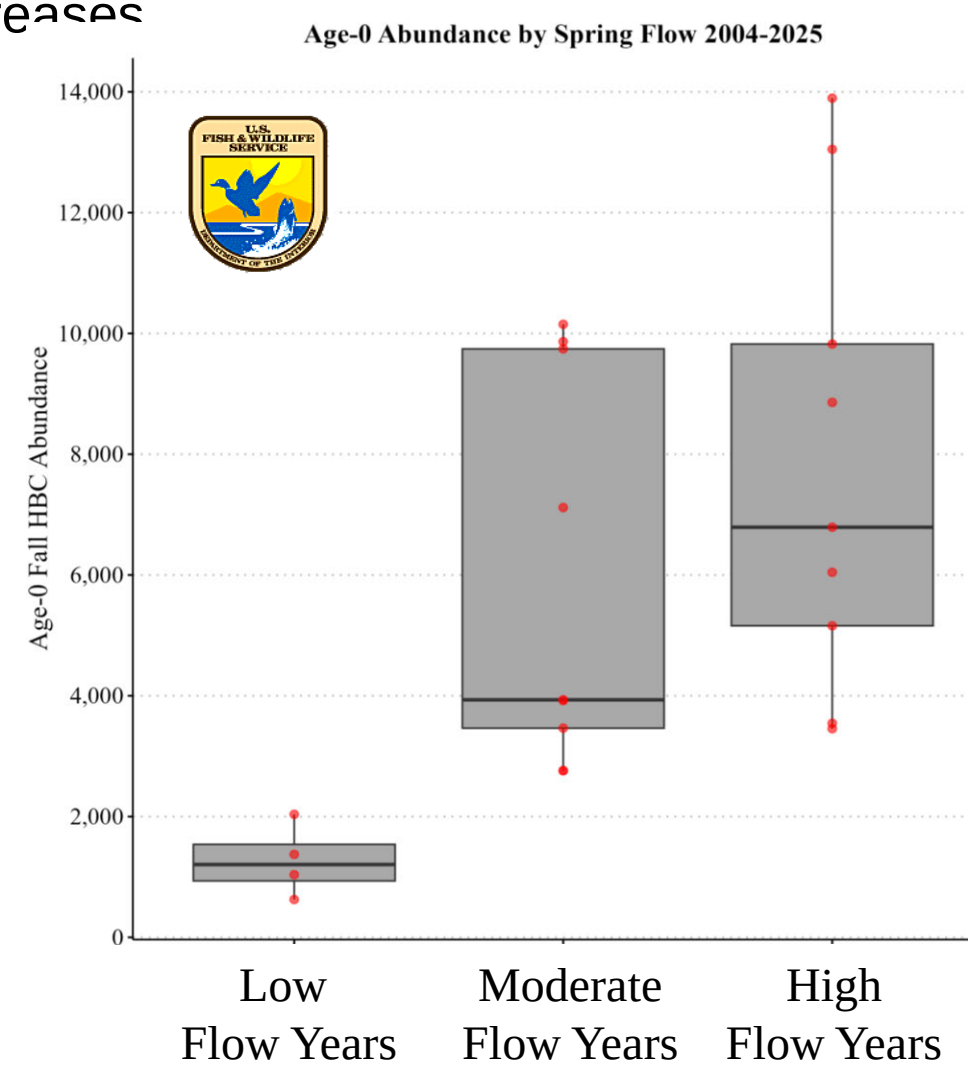


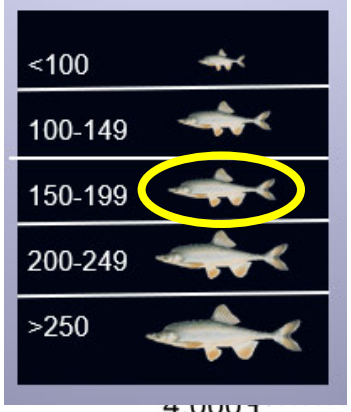
Recruitment may be related to spring flow rates in the LCR



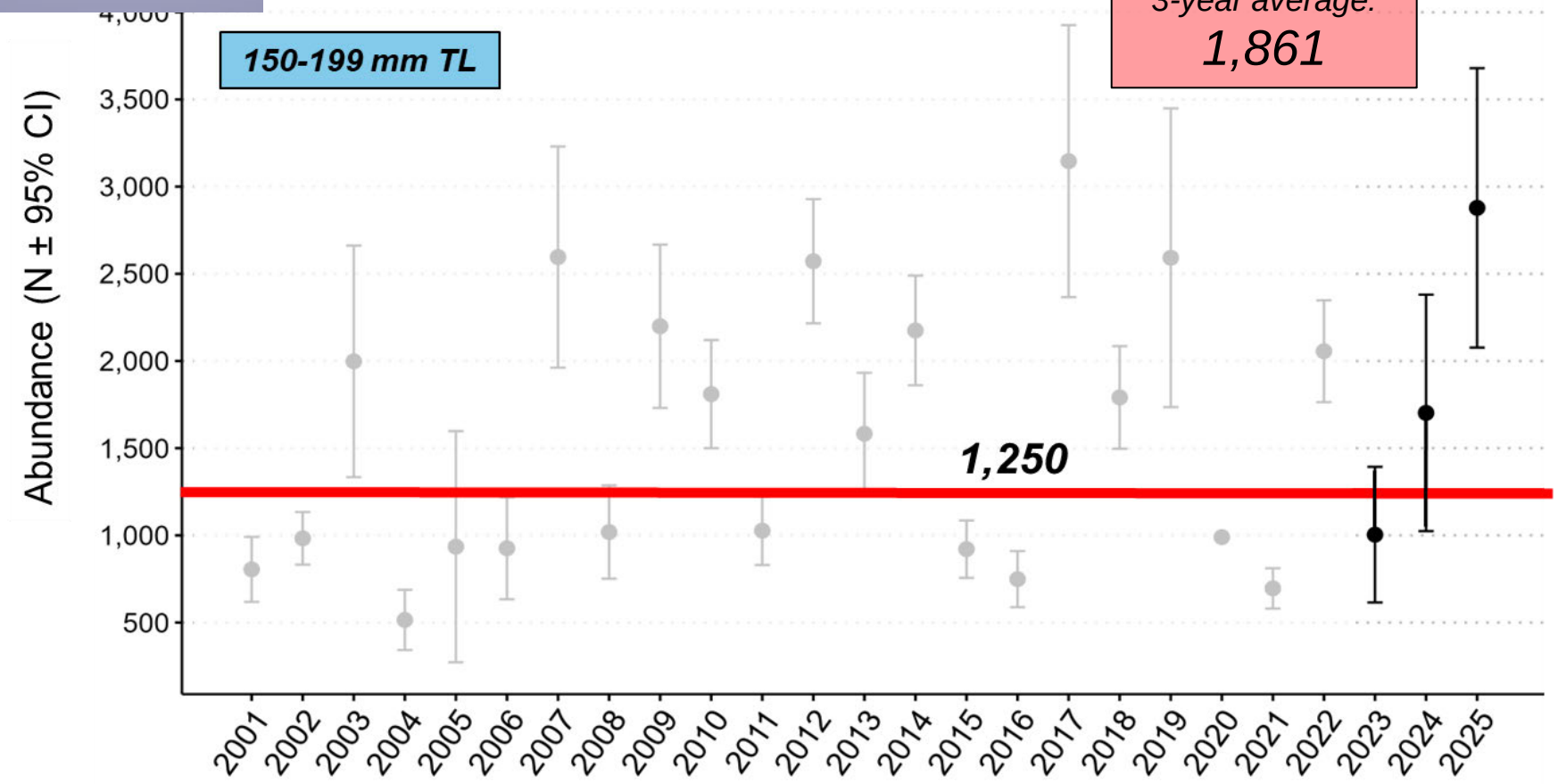


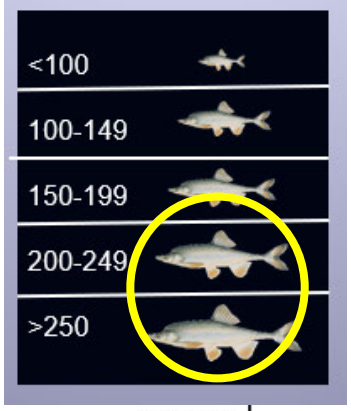
When we include age-0 abundance prior to 2013, the difference between moderate and high flow years decreases



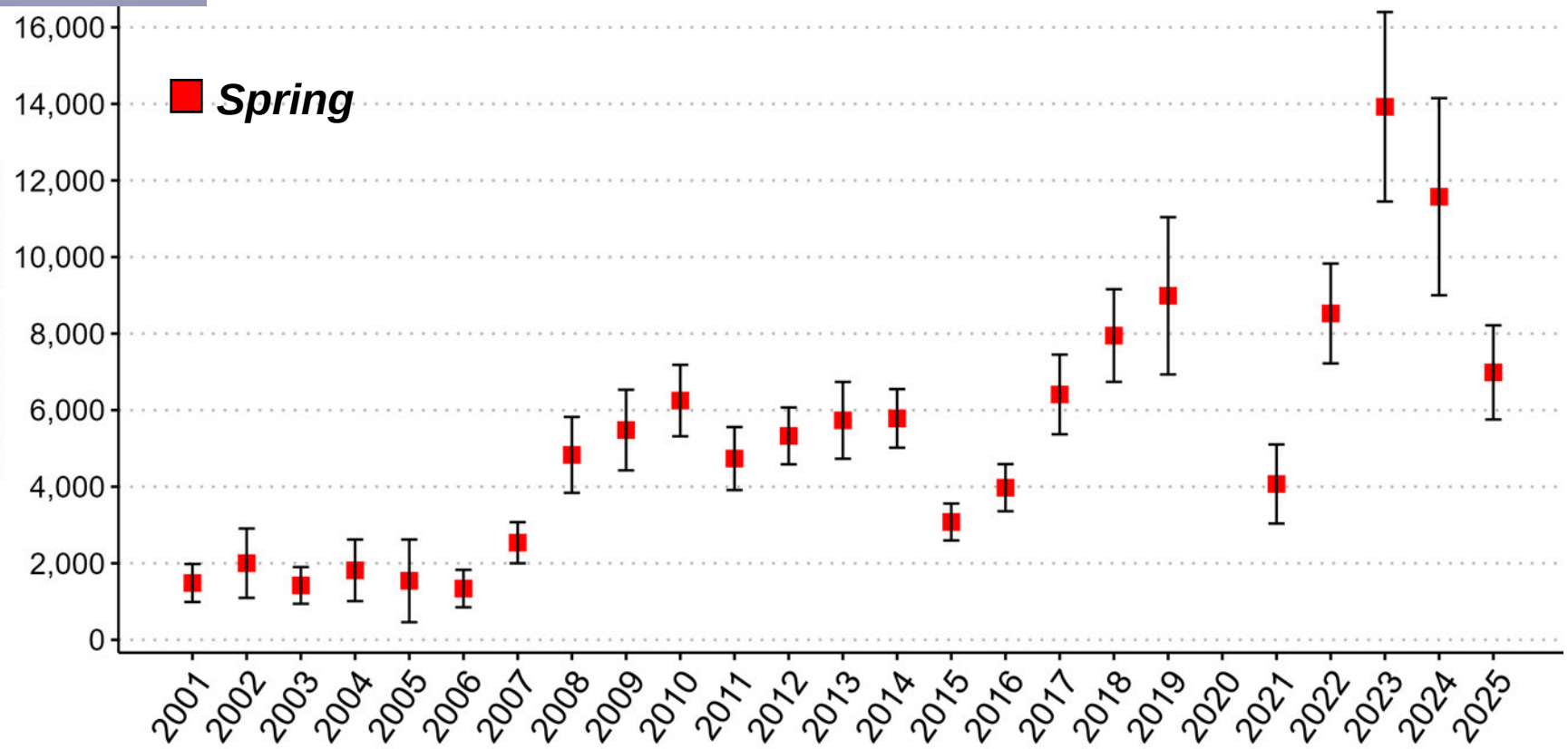


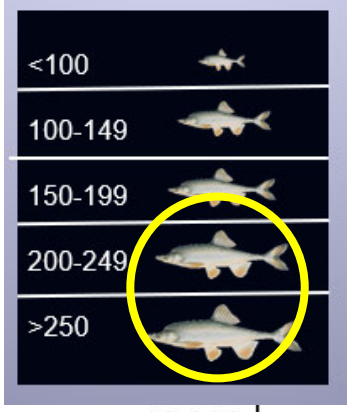
Annual spring abundances of large sub-adult HBC in lower 13.6 km of LCR remains above the trigger.



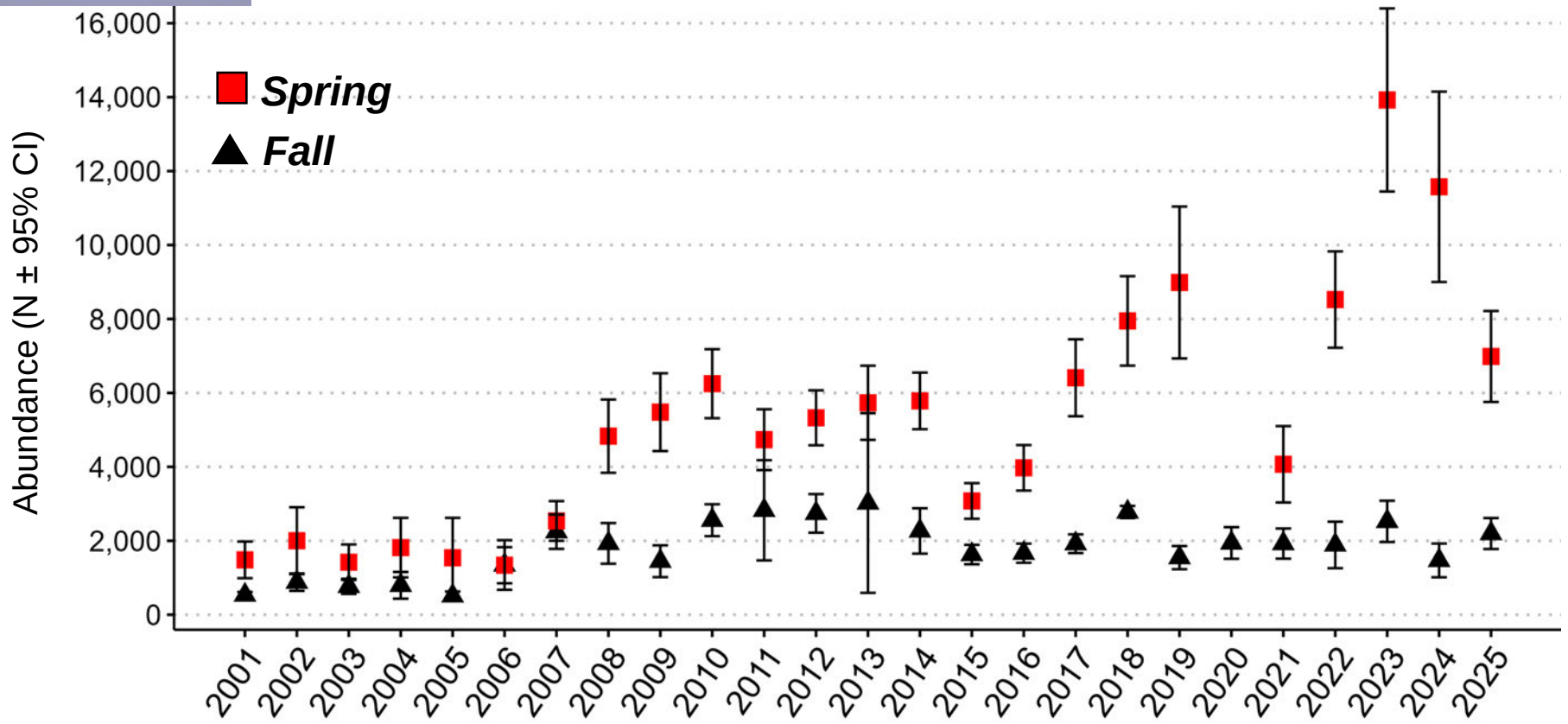


2025 spring adult (≥ 200 mm) abundance in LCR is down from 2023-24, but in line with previous years





Fall adult (≥ 200 mm) abundance of LCR resident HBC has been stable in recent years



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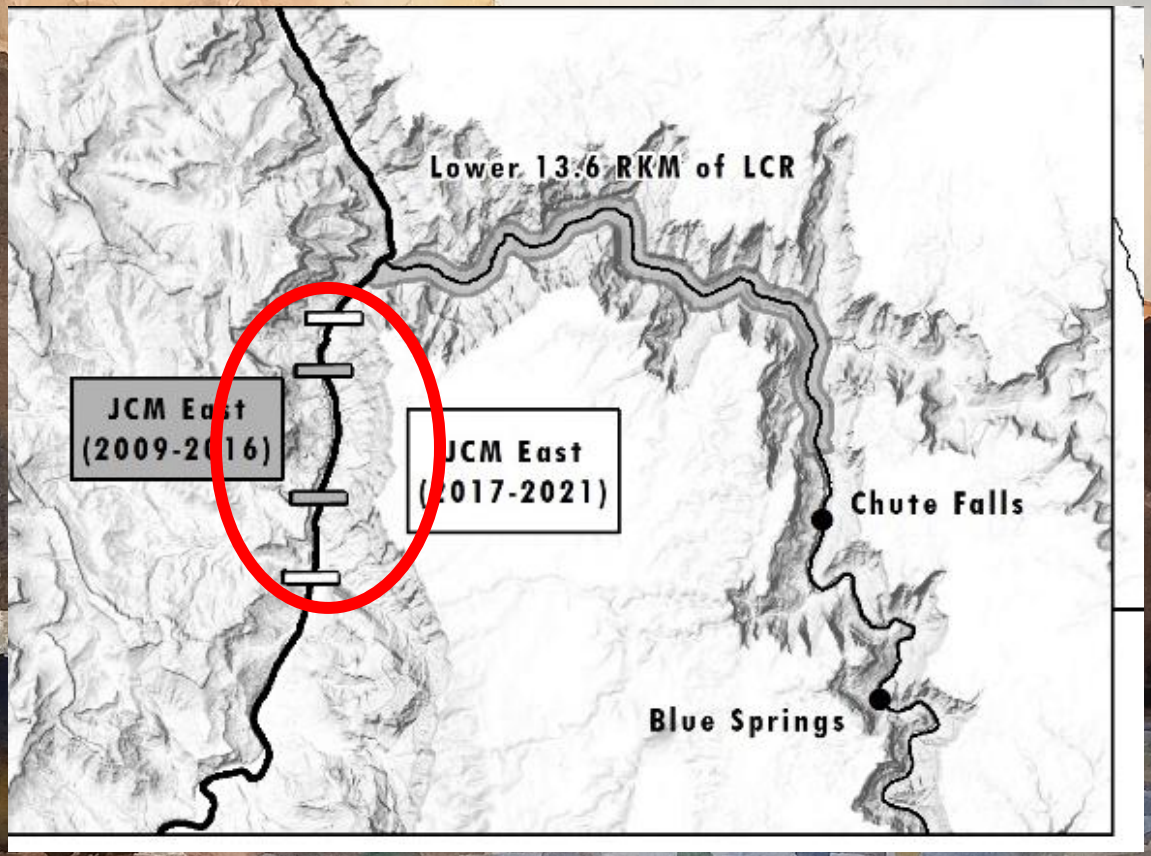
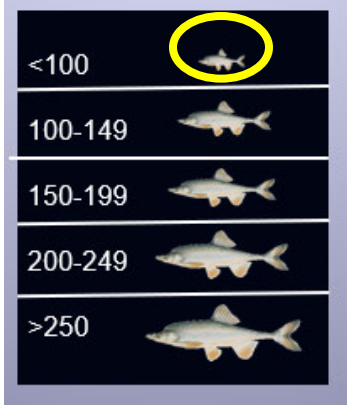
Artwork by Randy Van Haverbeke

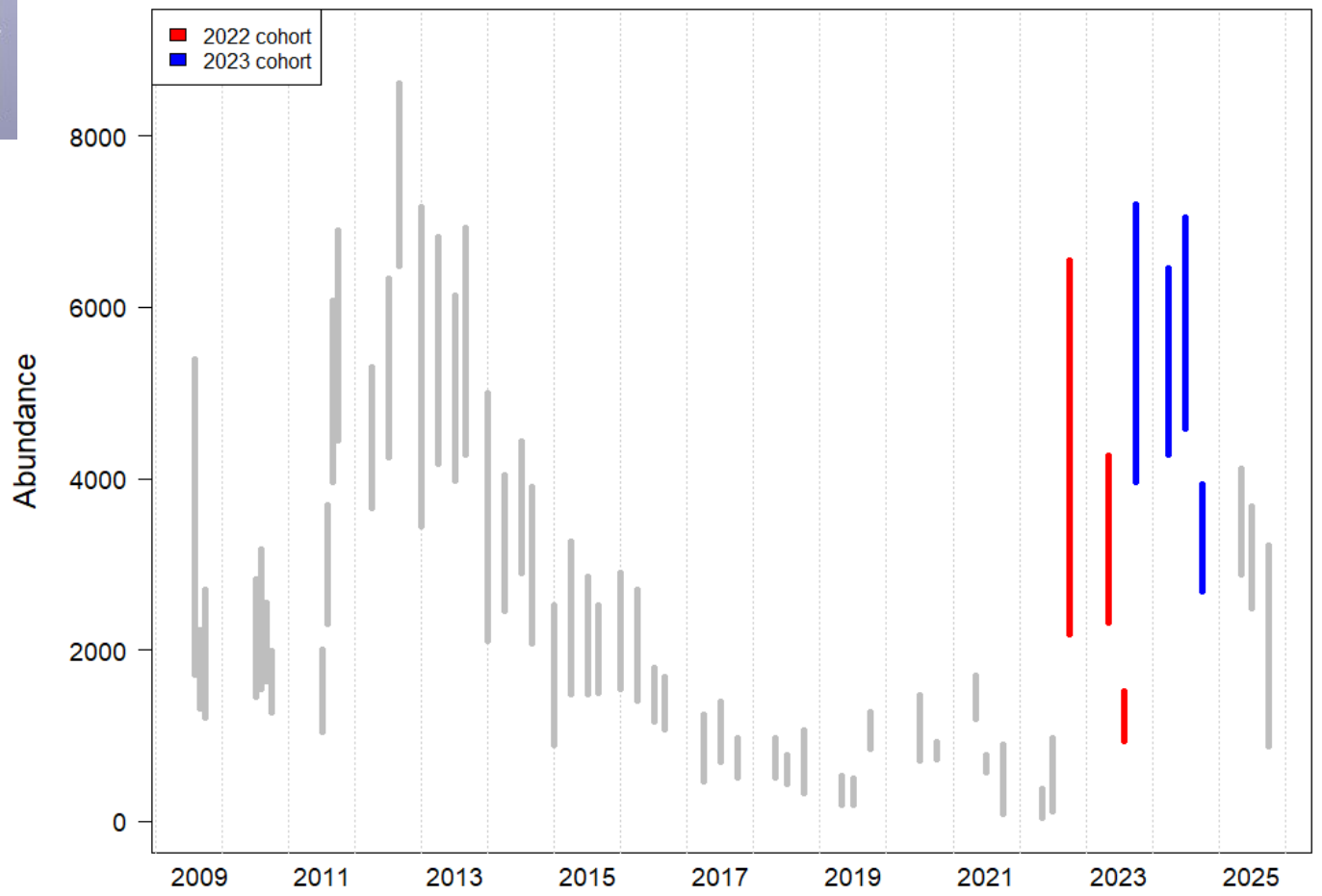
Juvenile Chub Monitoring - east

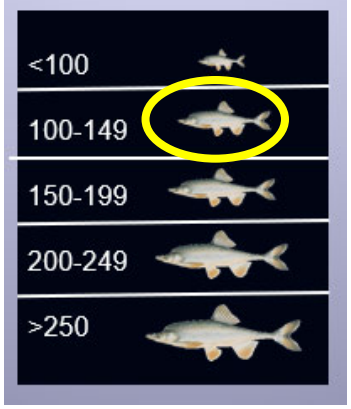


Preliminary Information Subject to Revision. Not for Citation or Distribution.

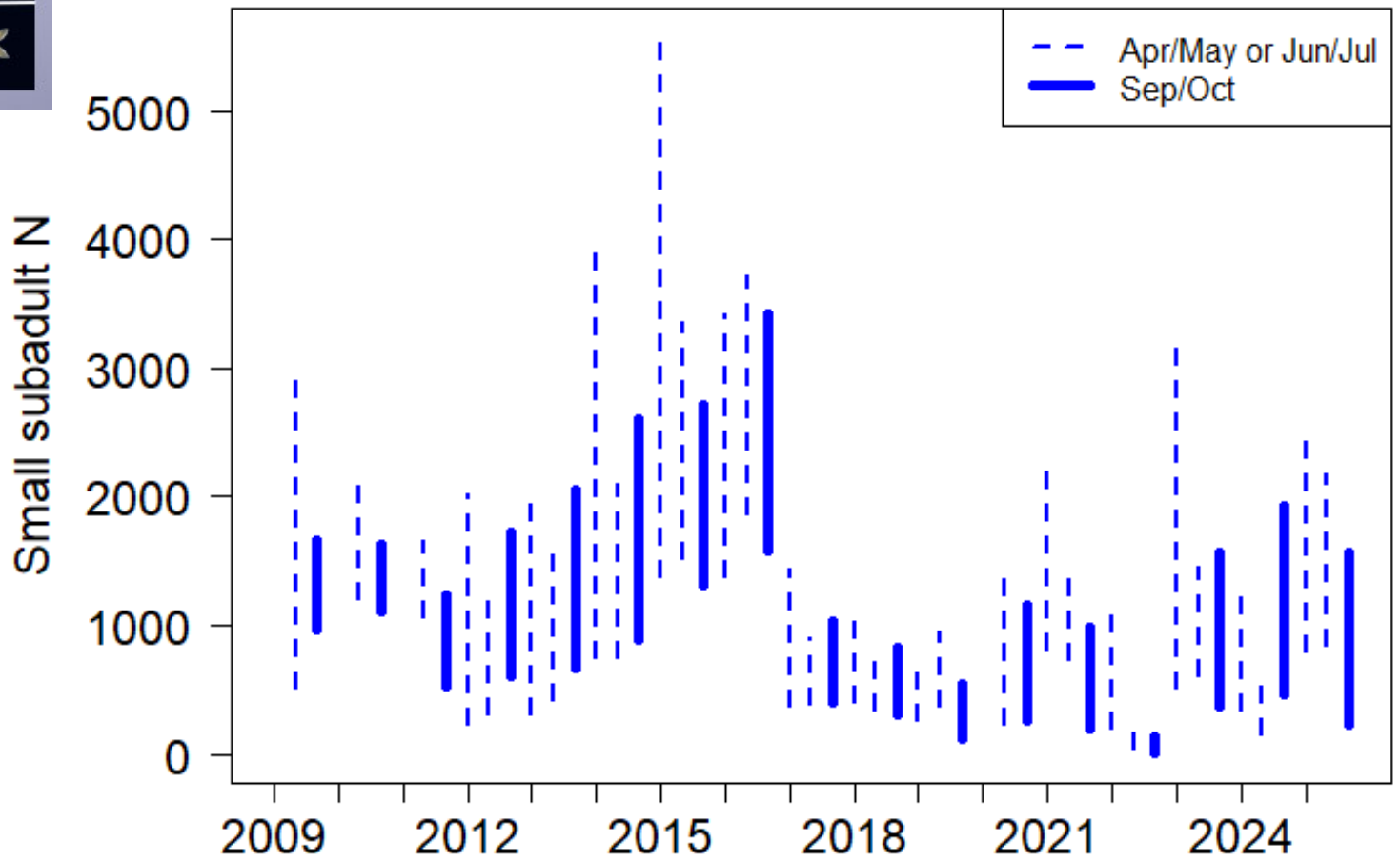


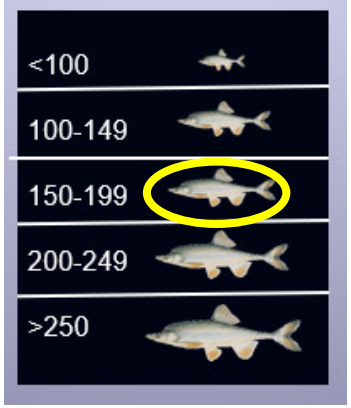
Juvenile abundance in the JCM-east



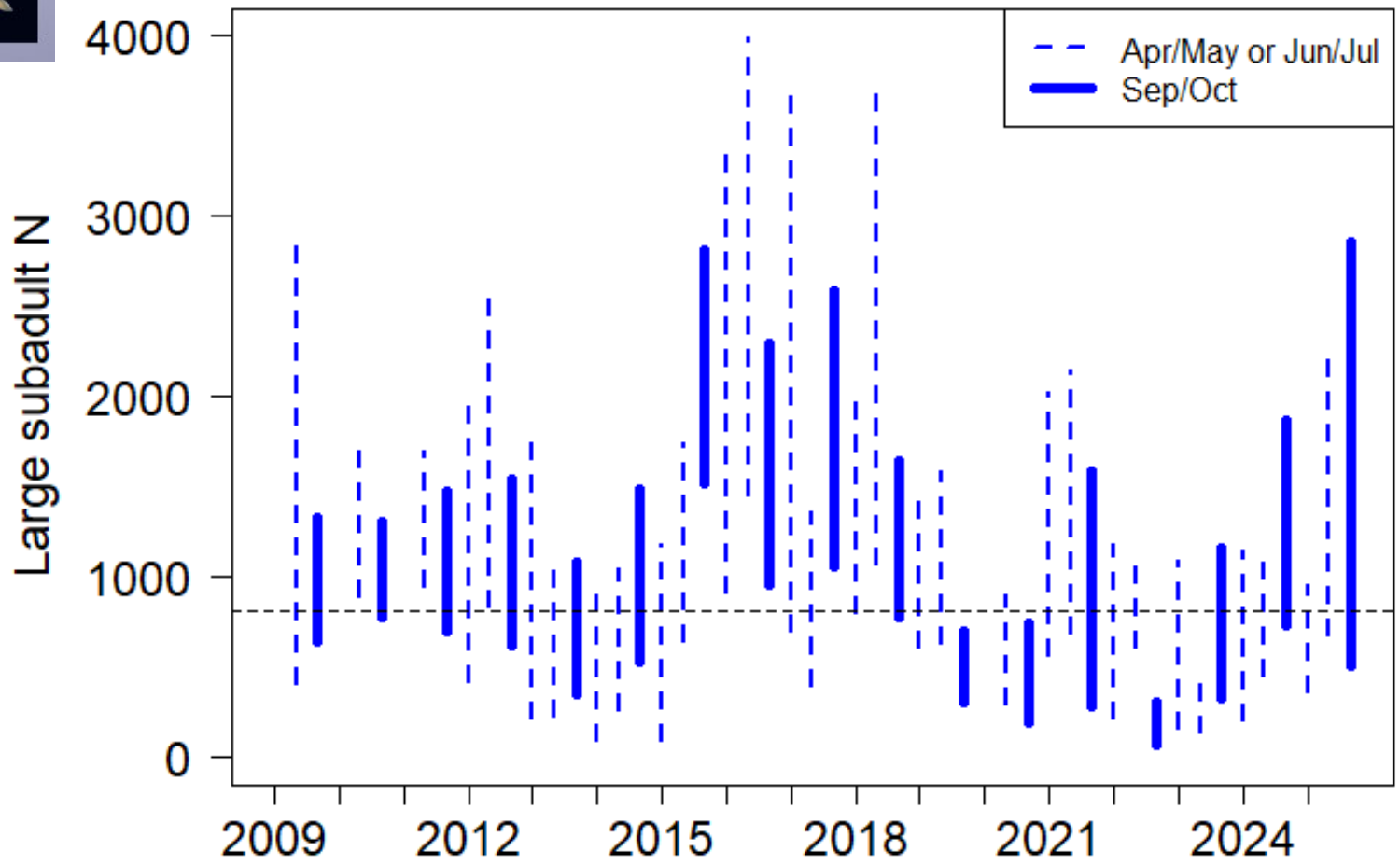


Small subadult abundances in JCM-east

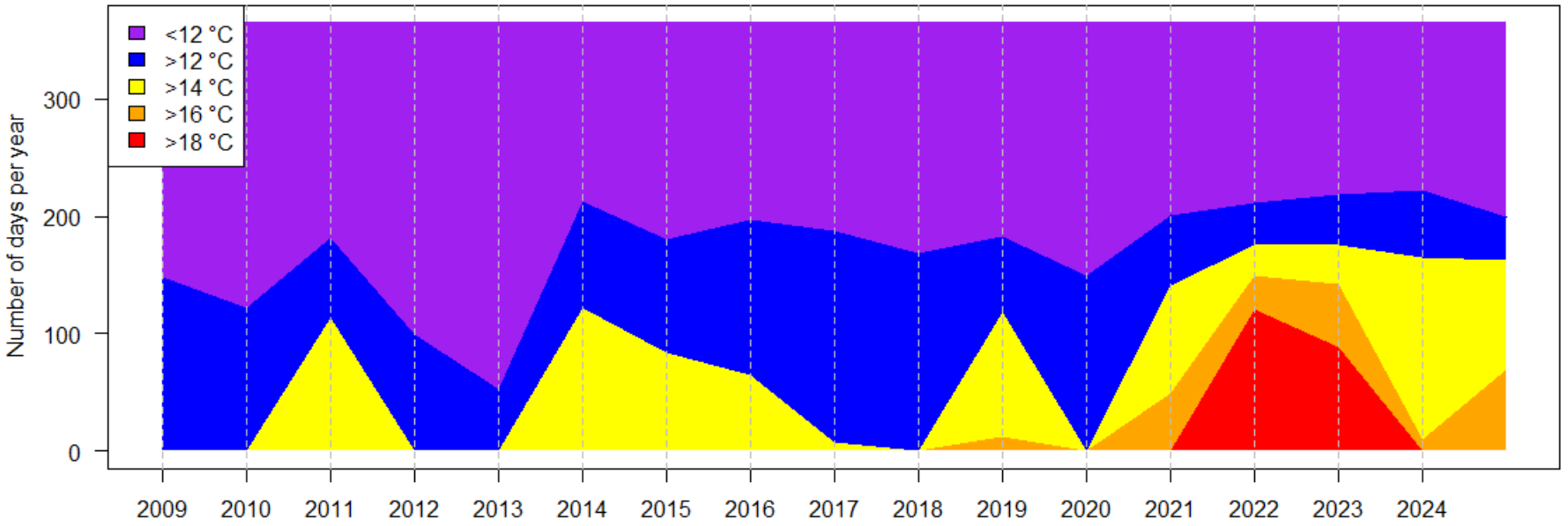


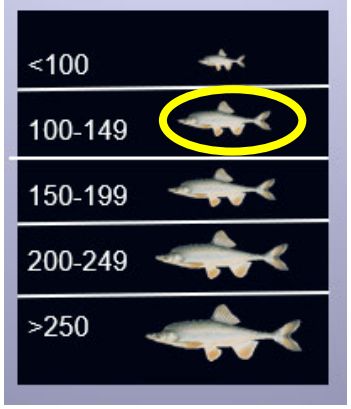


Large subadults in JCM-east are above the trigger

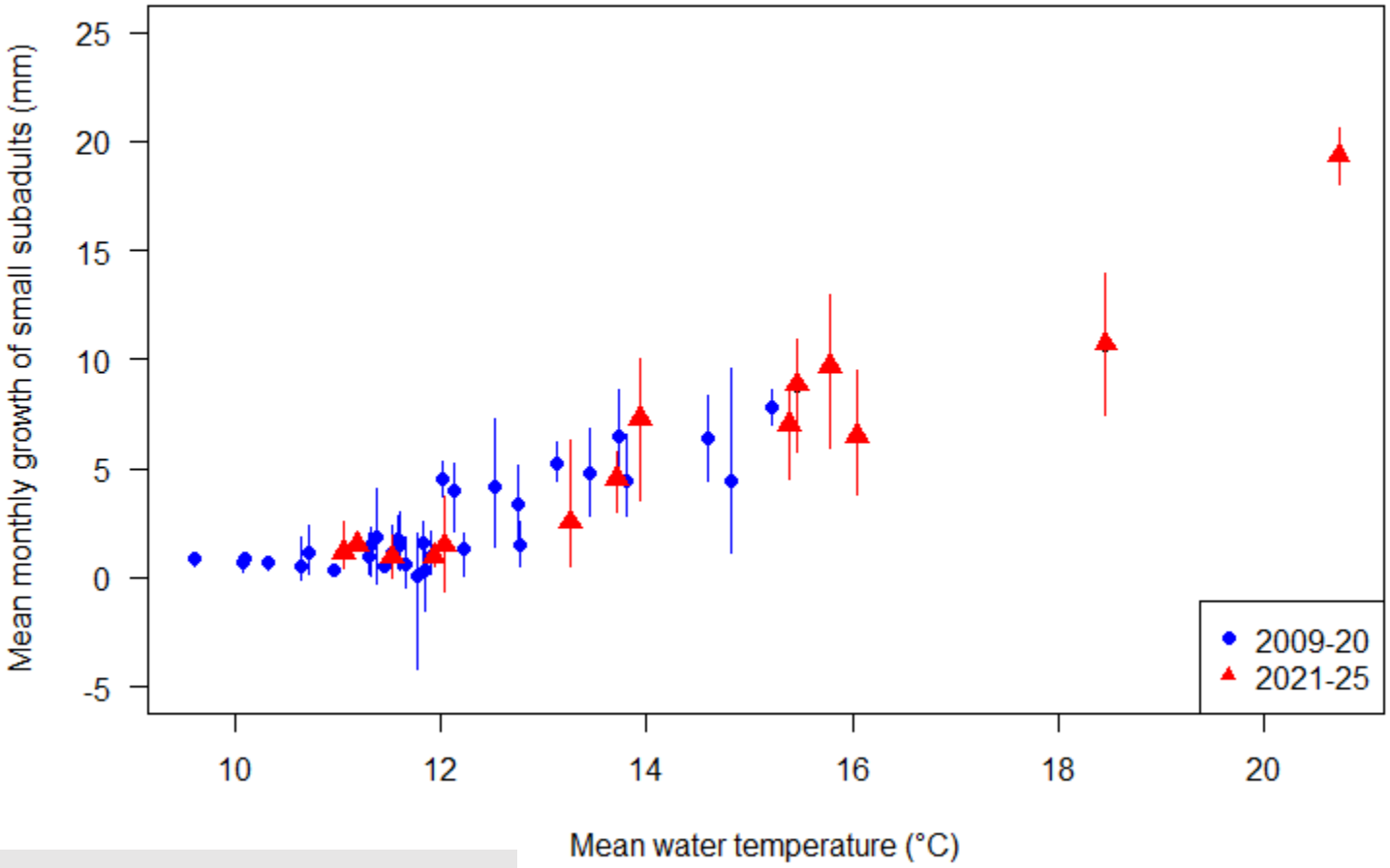


Water temperatures in JCM-East have warmed since the start of JCM monitoring in 2009

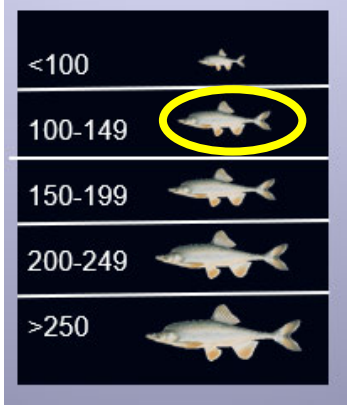




Small subadults grow fast when water temperatures are warm



Growth has been increasing, coincident with water temperatures.



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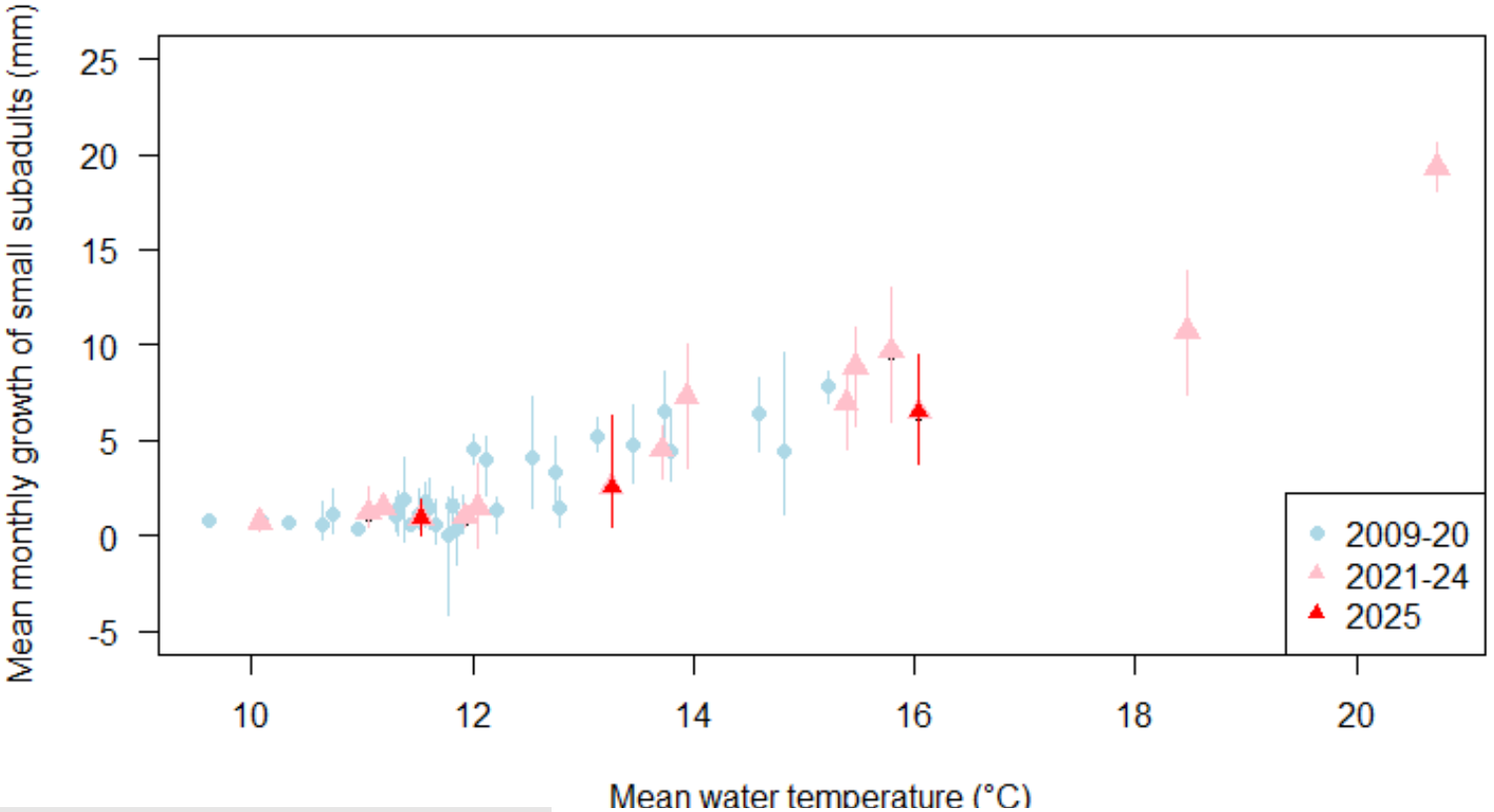

Subadult growth in 2025 was moderate.

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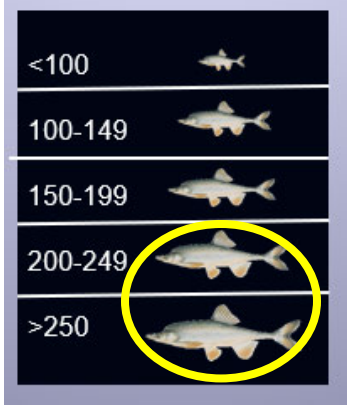
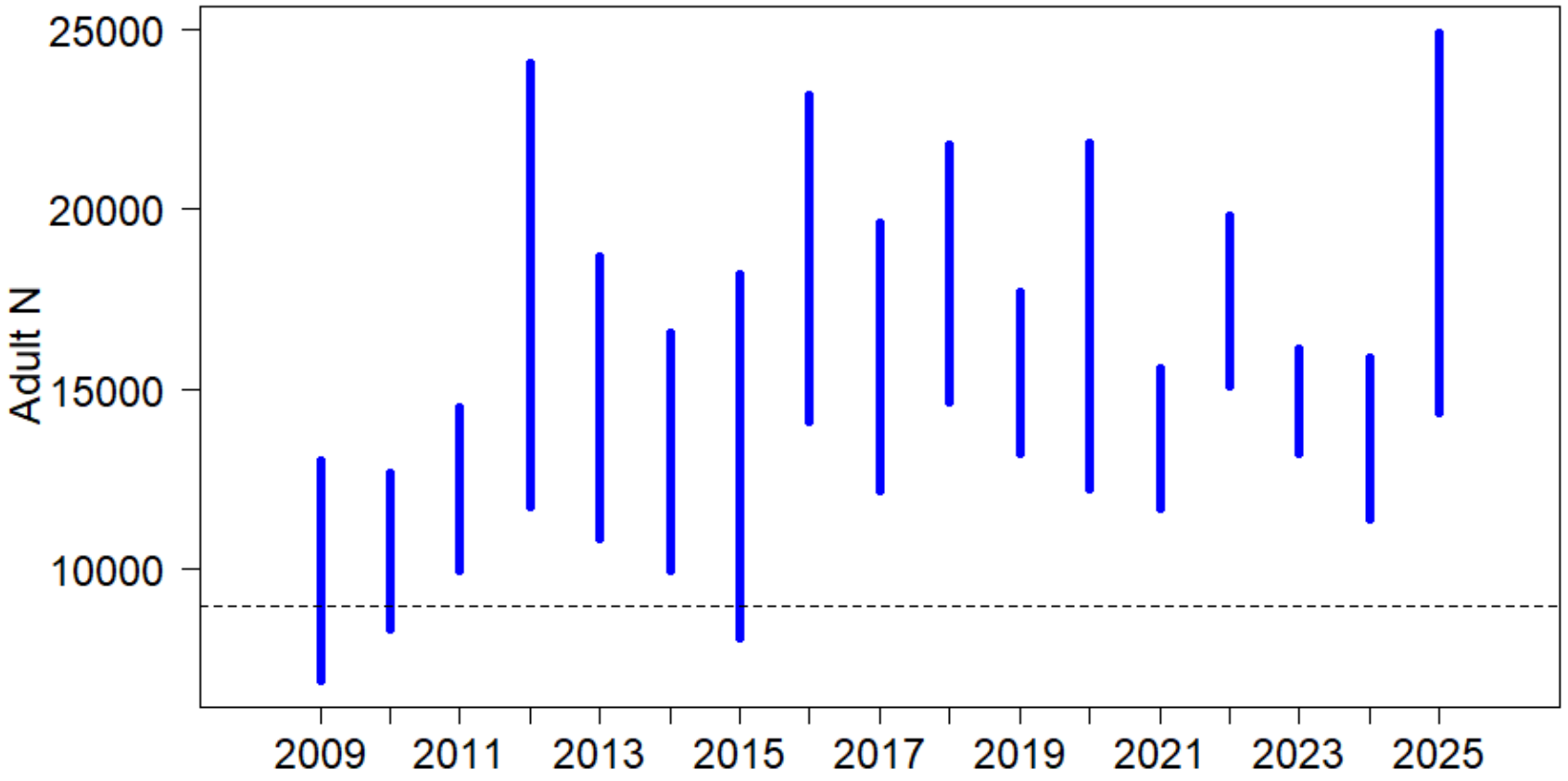


Adult abundances in the LCR aggregation are above the trigger



Take-home points: LCR & JCM East

- Juvenile abundances in 2025 were low
  - Age-0 abundance was very low in LCR, potentially linked to low spring flows
- Subadult abundances
  - Are high due to large 2023 cohort
  - Above the trigger in 2025
- Adult estimates remain high

USGS science for a changing world

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ARIZONA GAME & FISH

Artwork by Lindsay Hansen

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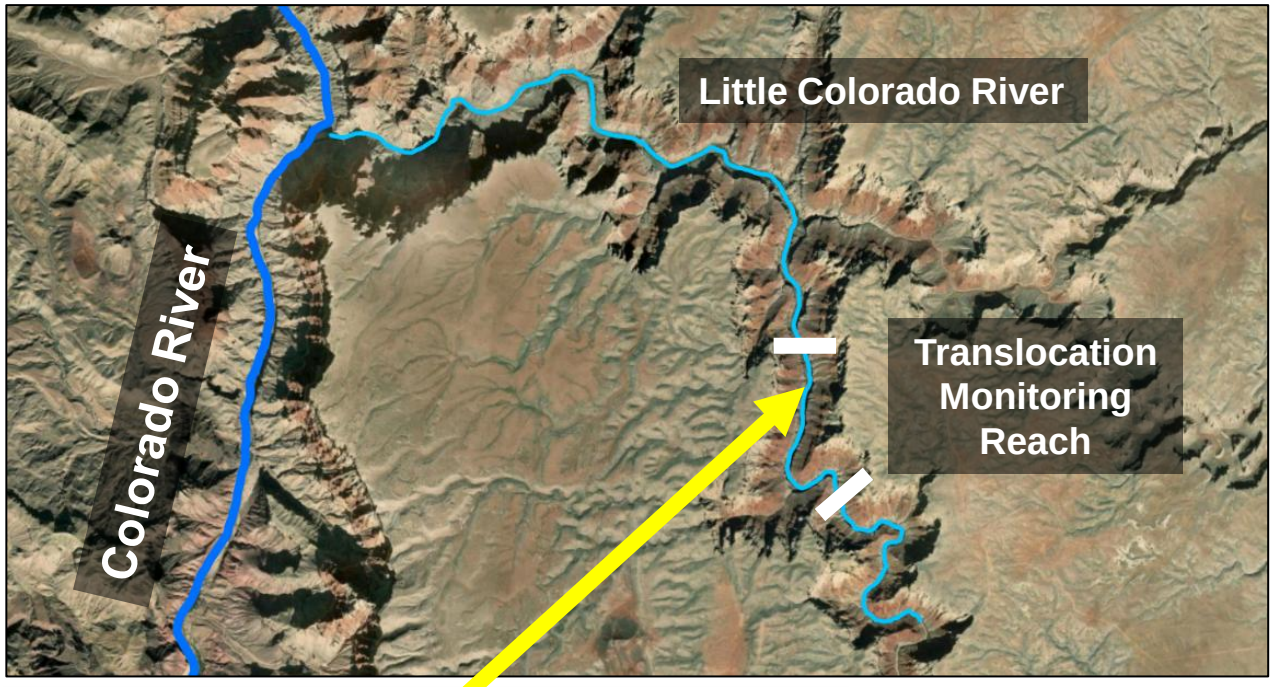
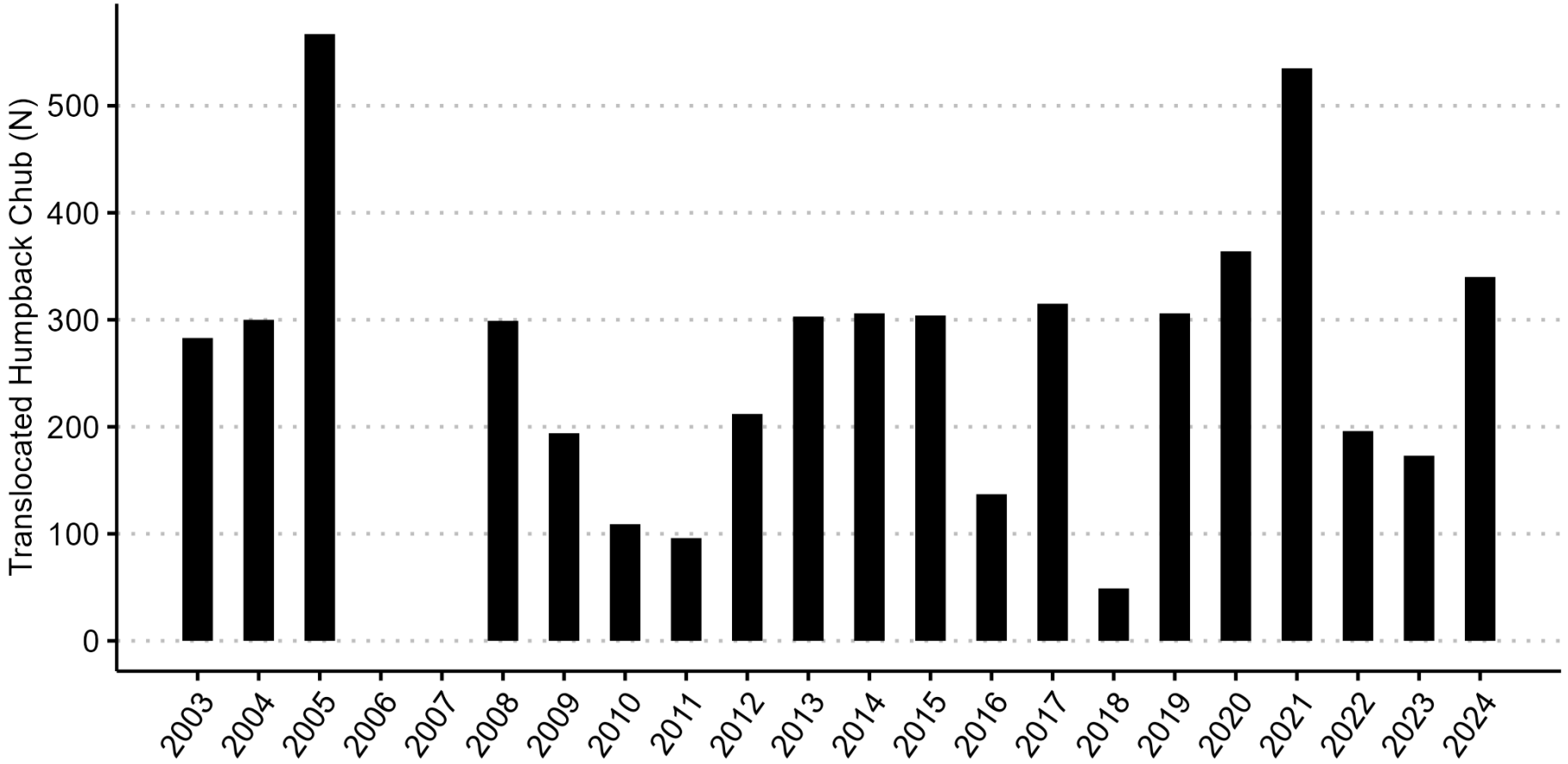
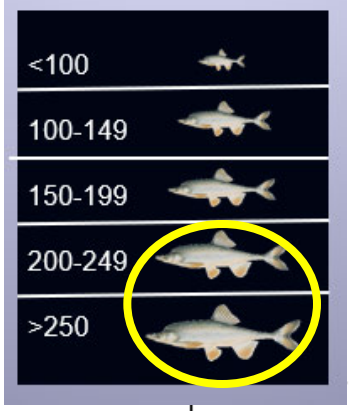
Humpback Chub Translocation and Chute Falls Monitoring



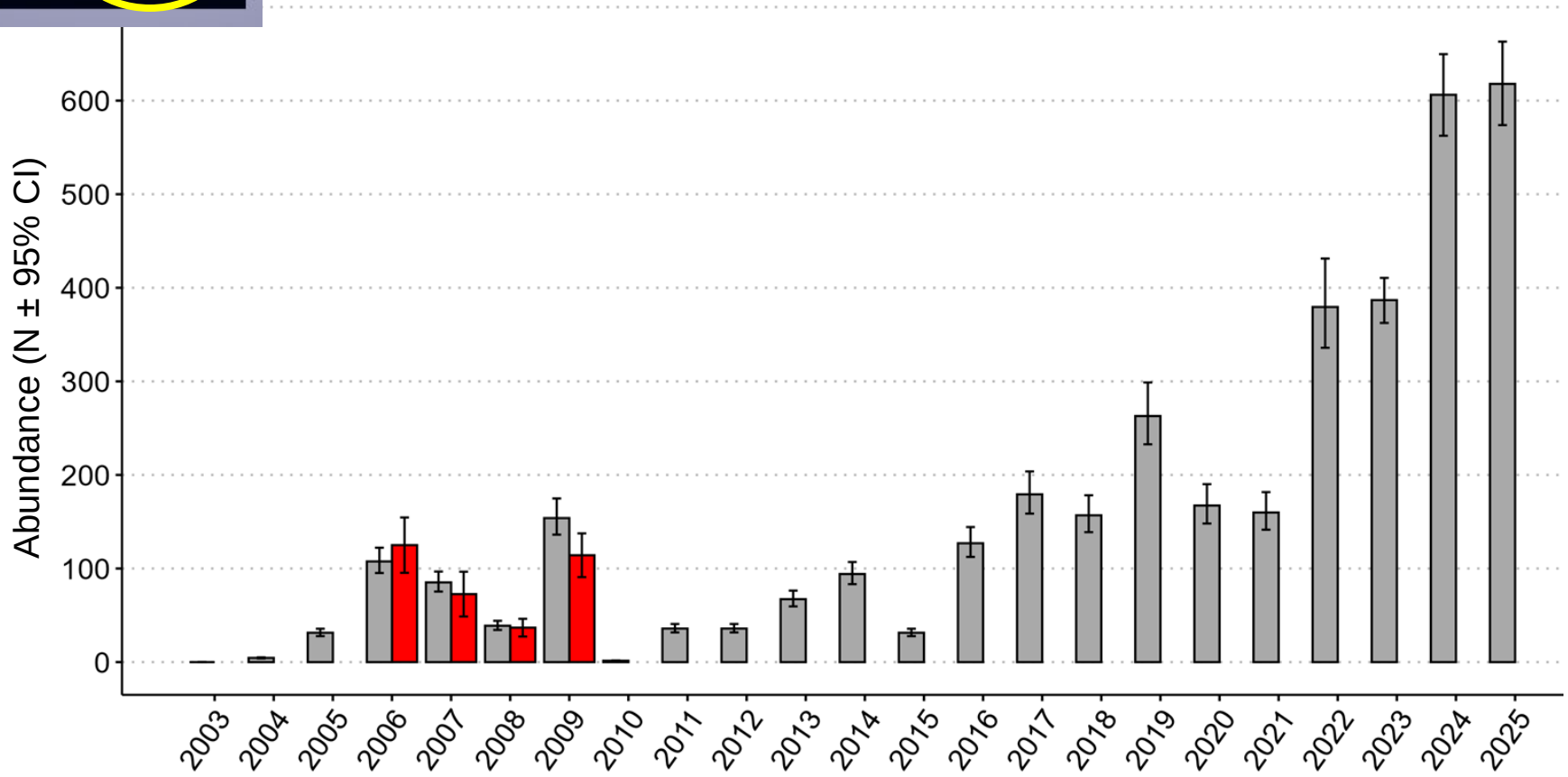
Annual HBC Translocations above Chute Falls

2025: *No Chute Falls Translocation*
2003-2024: 5,500 (50-155mm)

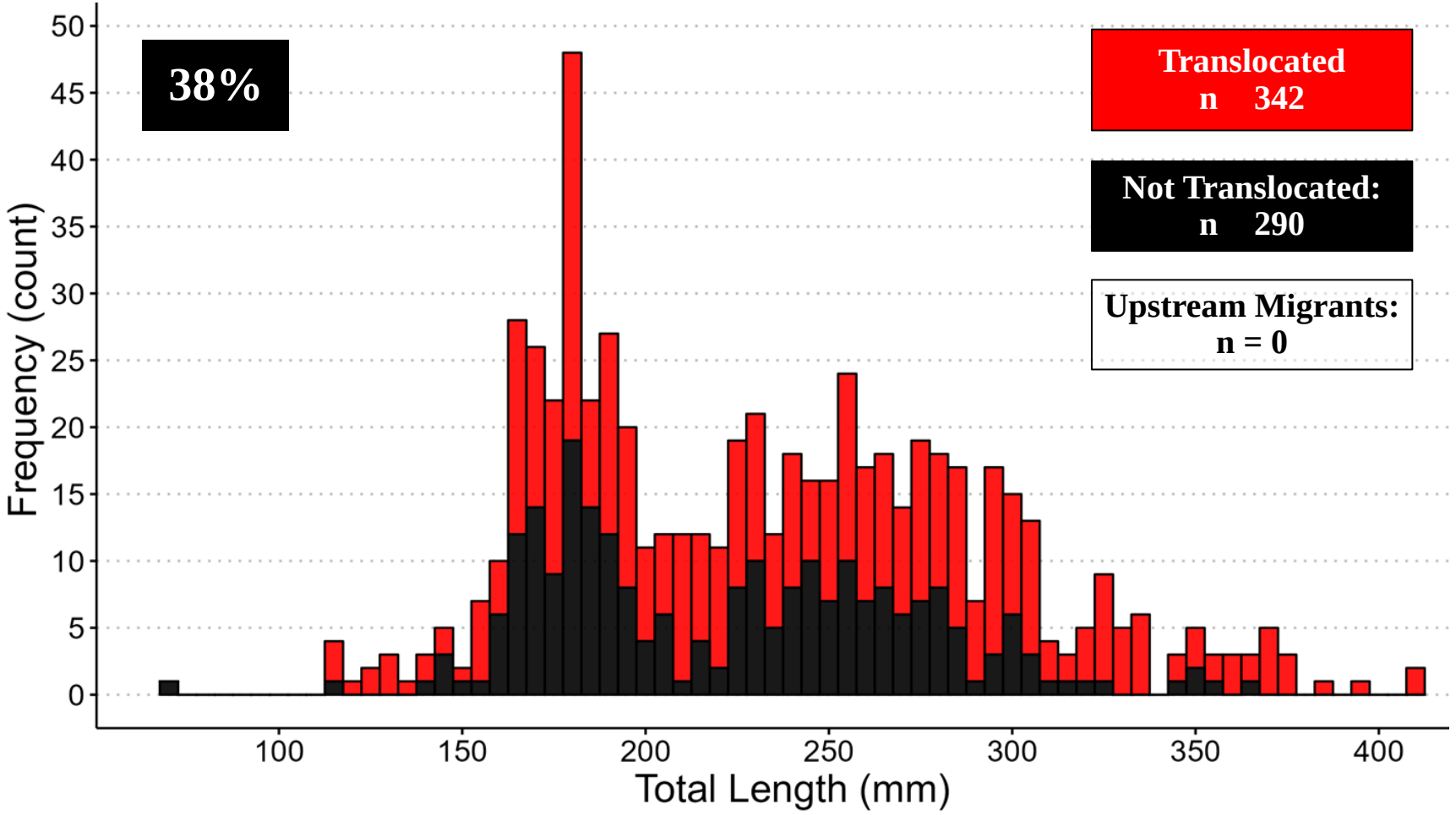


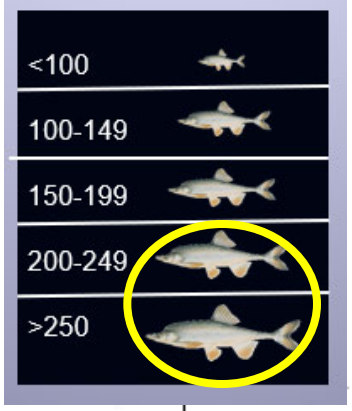


Spring adult abundance *above Chute Falls* shows increasing trend and highest estimates recorded in 2024-25

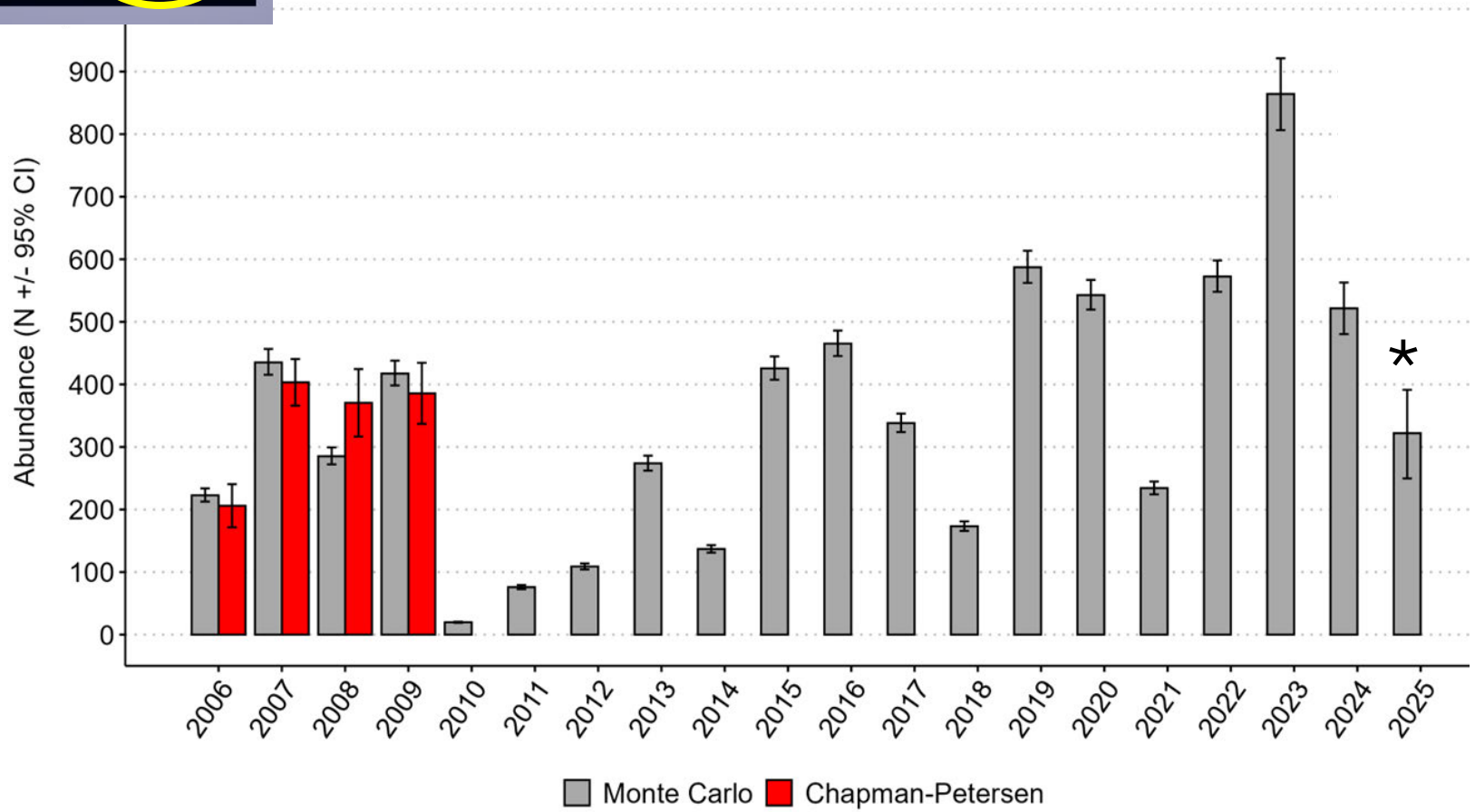


38% of HBC captured above Chute Falls in 2025 were ***not*** translocated there





Adult abundance *between Atomizer and Chute Falls* (0.32 river miles) has decreased since 2023



Summary: Chute Falls Translocations

- Adult abundance in the translocation reach remains high, similar to 2025
- Adult abundance in the Atomizer reach has been declining from its peak in 2023
- Project has shown success in increasing recruitment to adulthood and expanding range of spawning adults
- Evidence of local reproduction and upriver expansion
  - Upstream habitats may be important in non-flood years when age-0 production is low downstream
- No HBC were translocated above Chute Falls in 2025 due to the low age-0 abundance in the system
  - 5,500 total fish have been translocated since 2003

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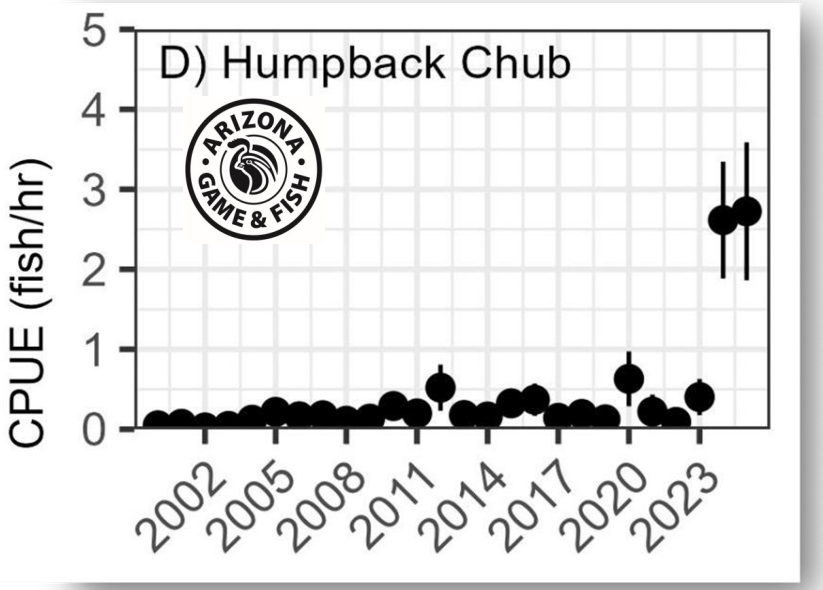
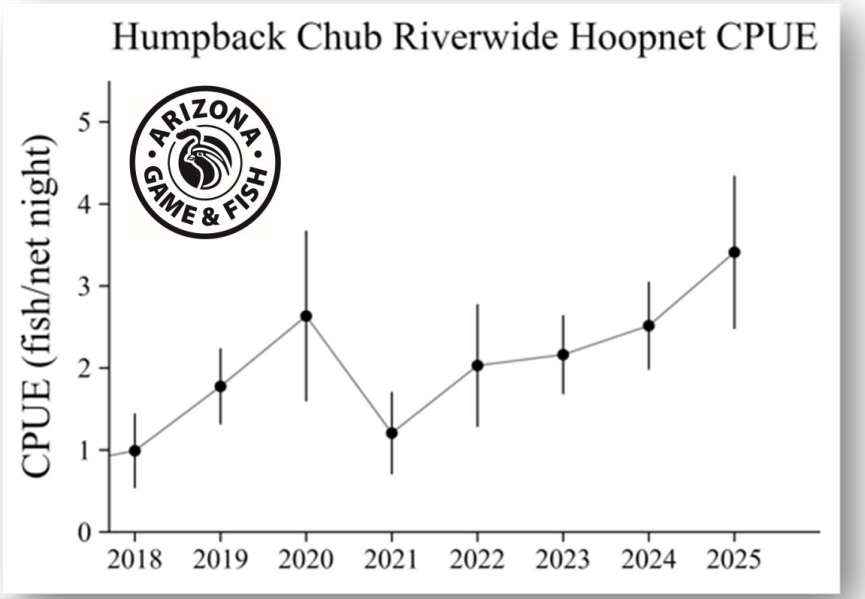
Spring Electrofishing

AGFD electrofishing CPUE shows an increase in spring HBC relative abundance in 2024 and 2025

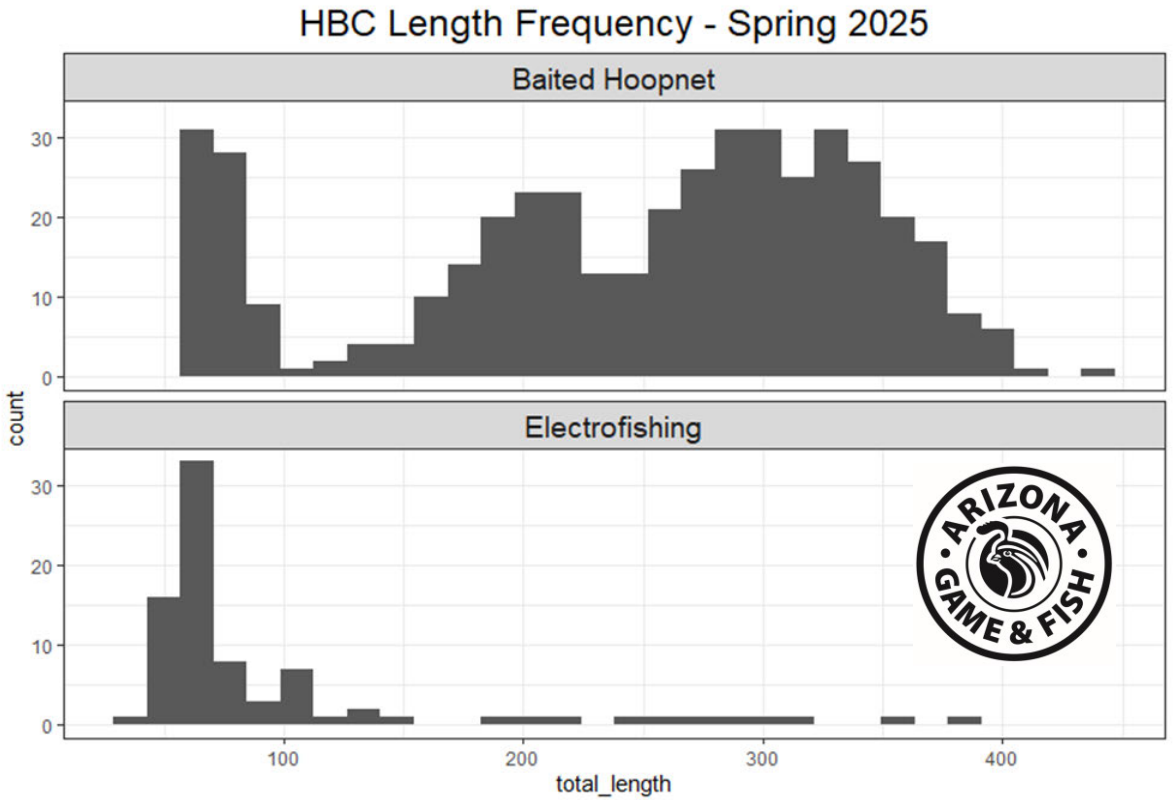




Spring Hoop Nets

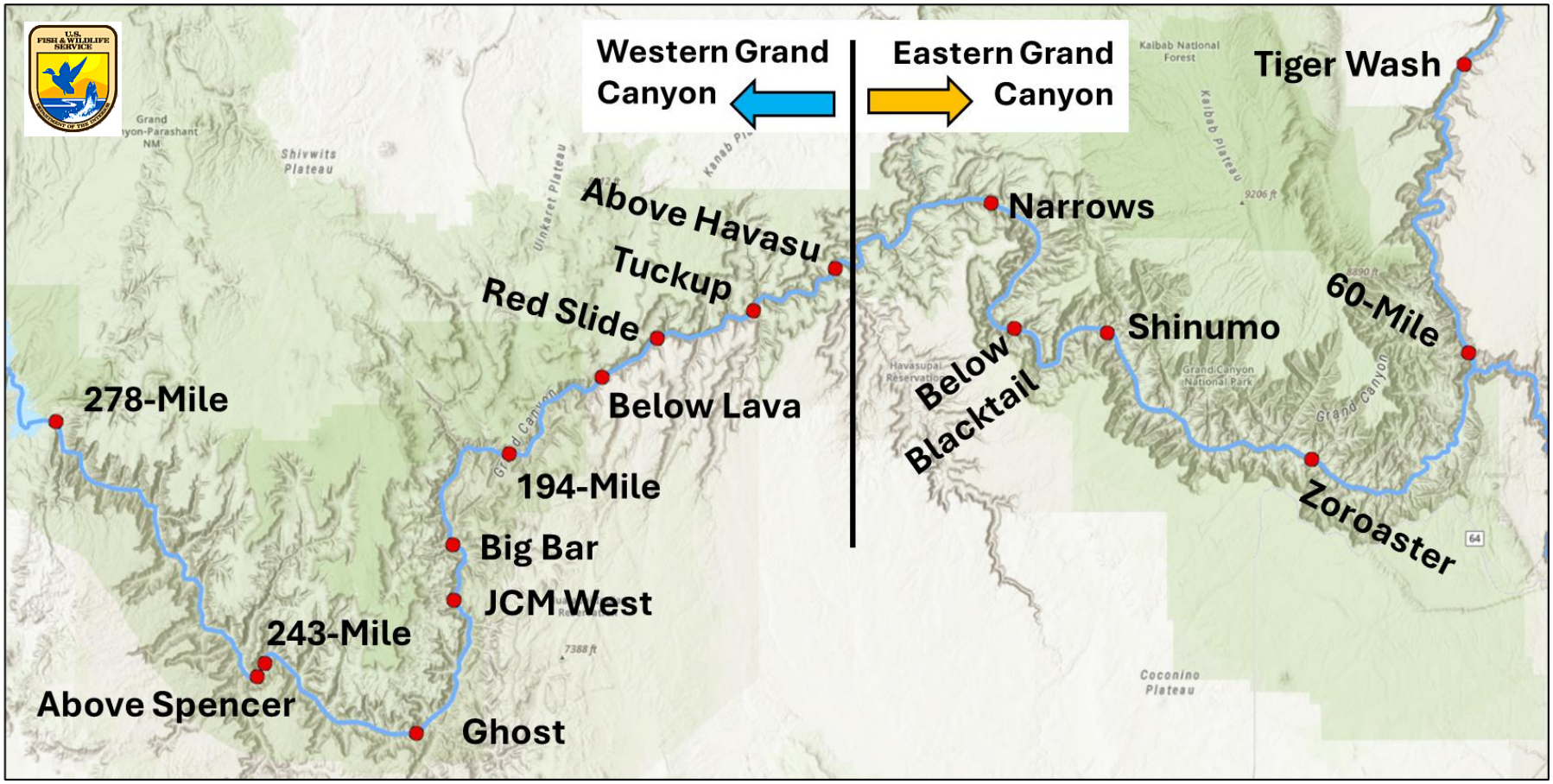
AGFD river-wide hoop net CPUE shows an increase in spring HBC relative abundance since 2017

AGFD river wide spring length frequency distributions show a few size cohorts in hoop nets



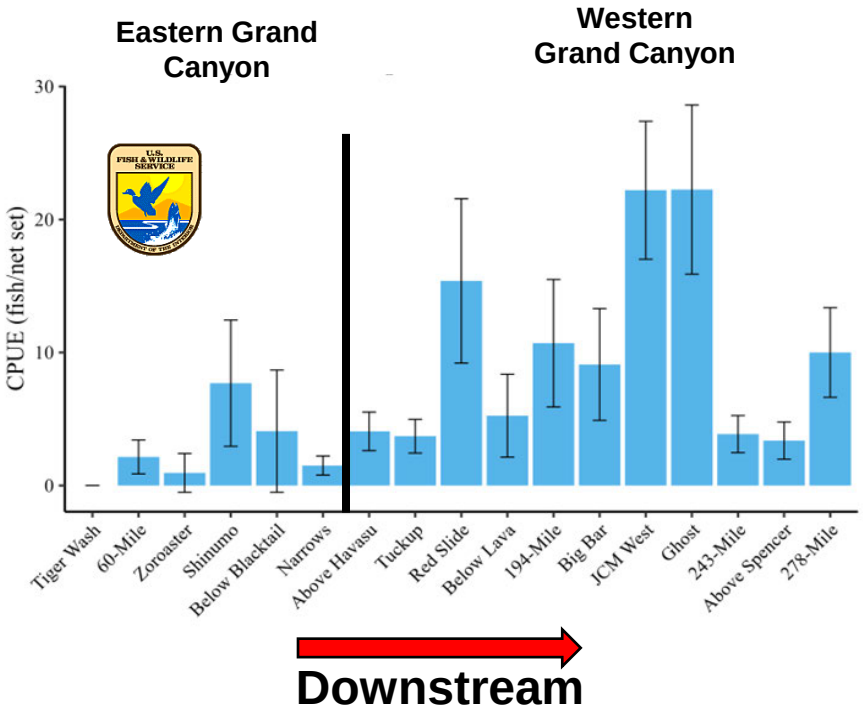
Electrofishing HBC CPUE increases are driven mostly juvenile HBC in Western Grand Canyon

2025 mainstem HBC aggregation monitoring trip sampled 17 sites with hoop nets between RM 27 and RM 278.5 in the fall



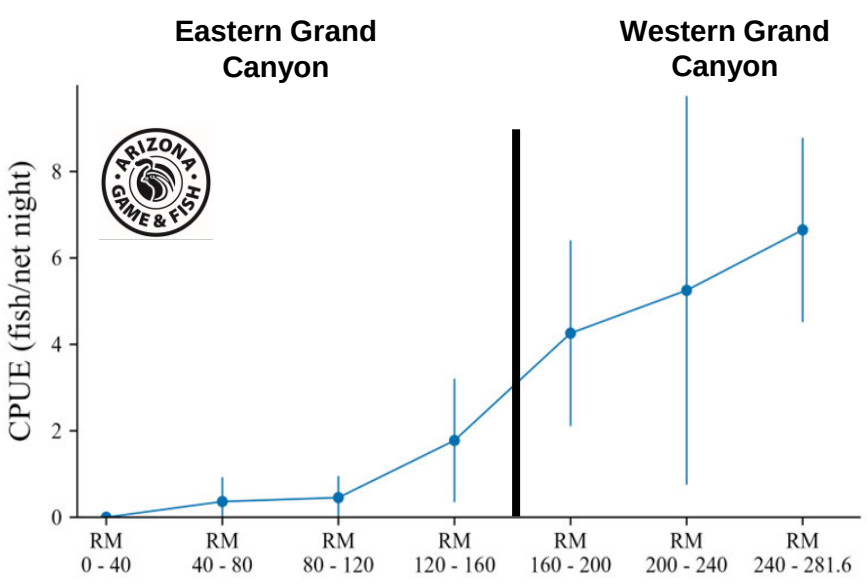
AGFD and HBC Aggregations found most HBC in Western Grand Canyon in 2025

Fall Sampling



Downstream

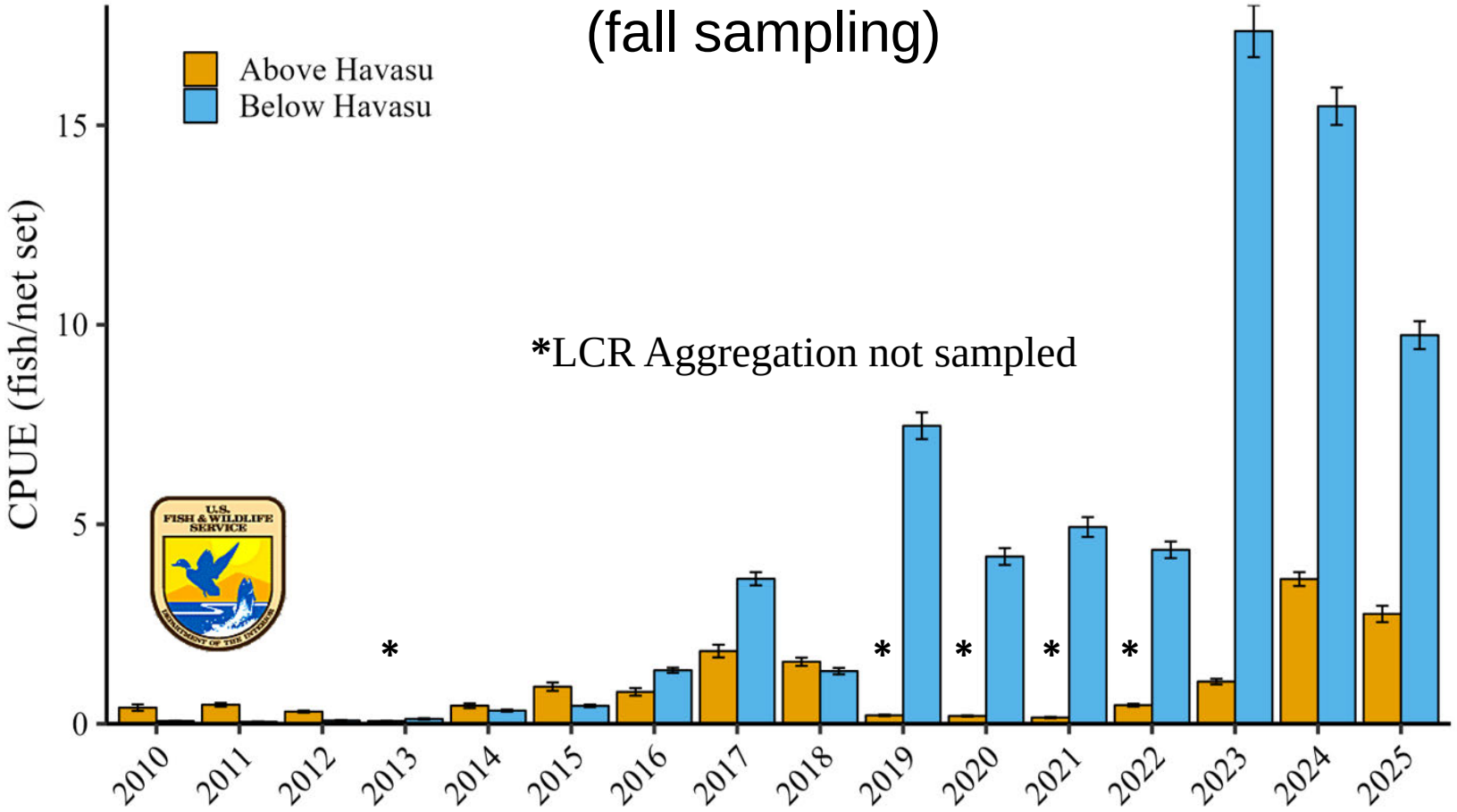
Spring Sampling



Downstream

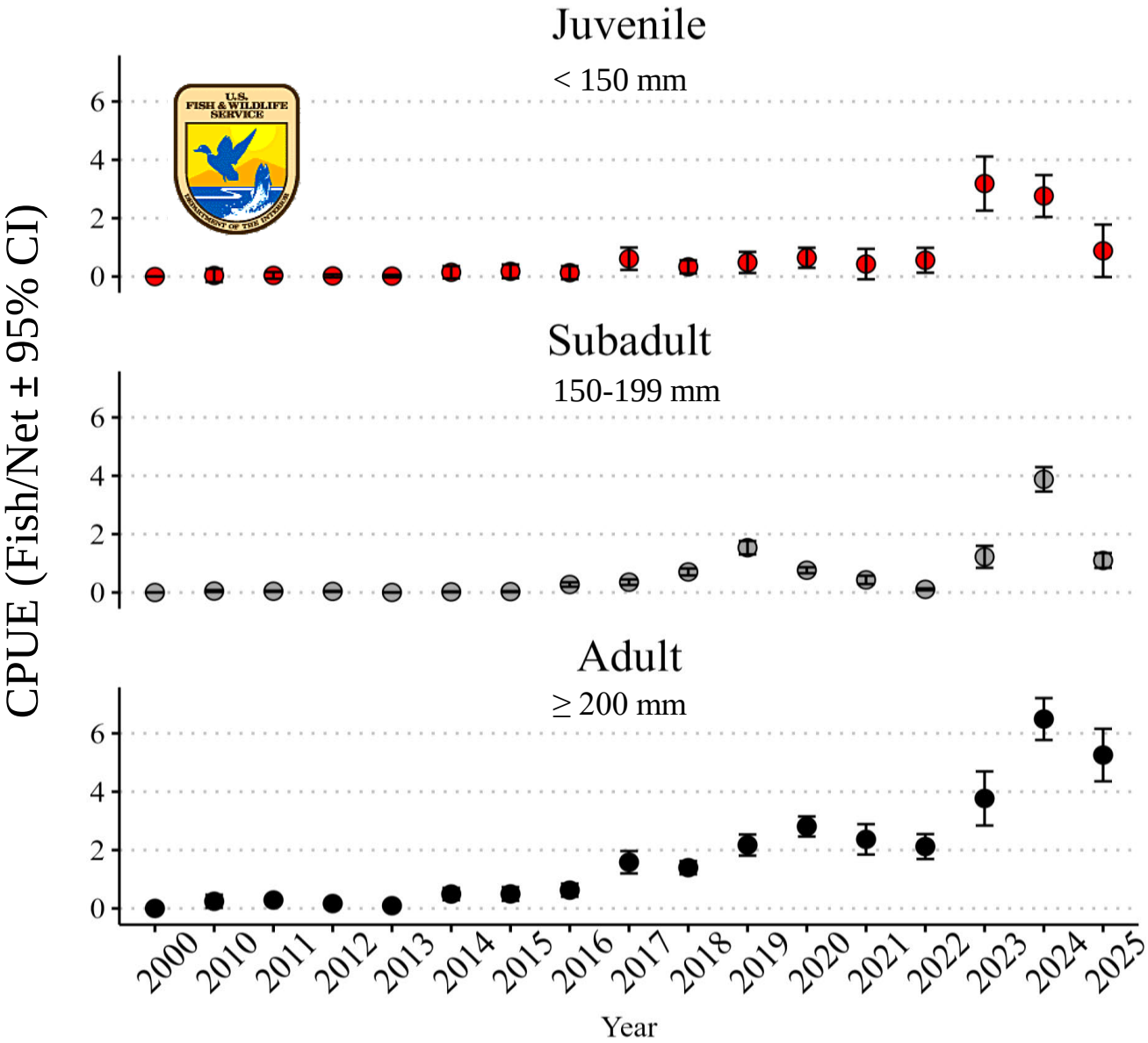
Overall relative abundance (CPUE) is primarily driven by captures in the western Grand Canyon, below Havasu Creek

(fall sampling)

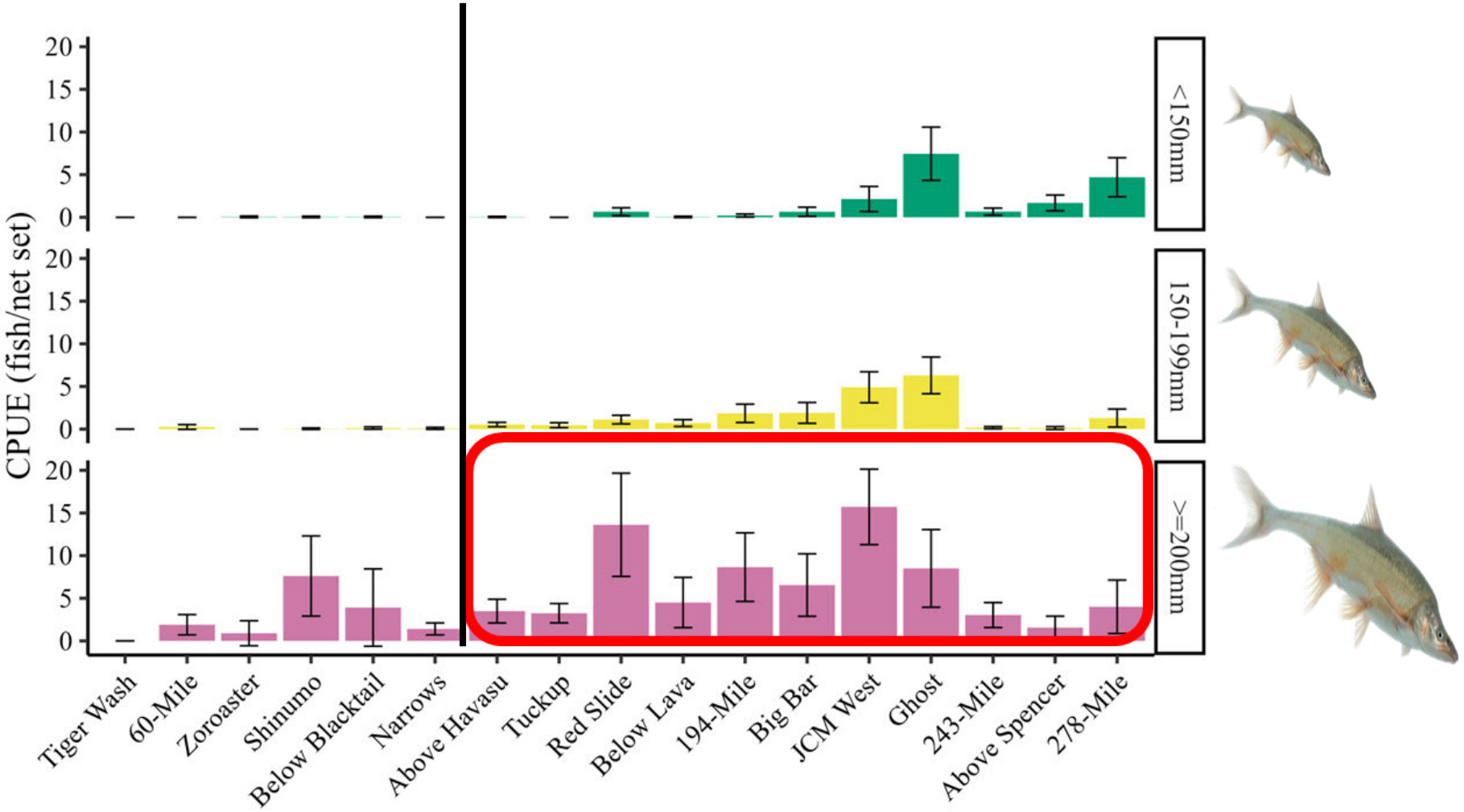


*LCR Aggregation not sampled

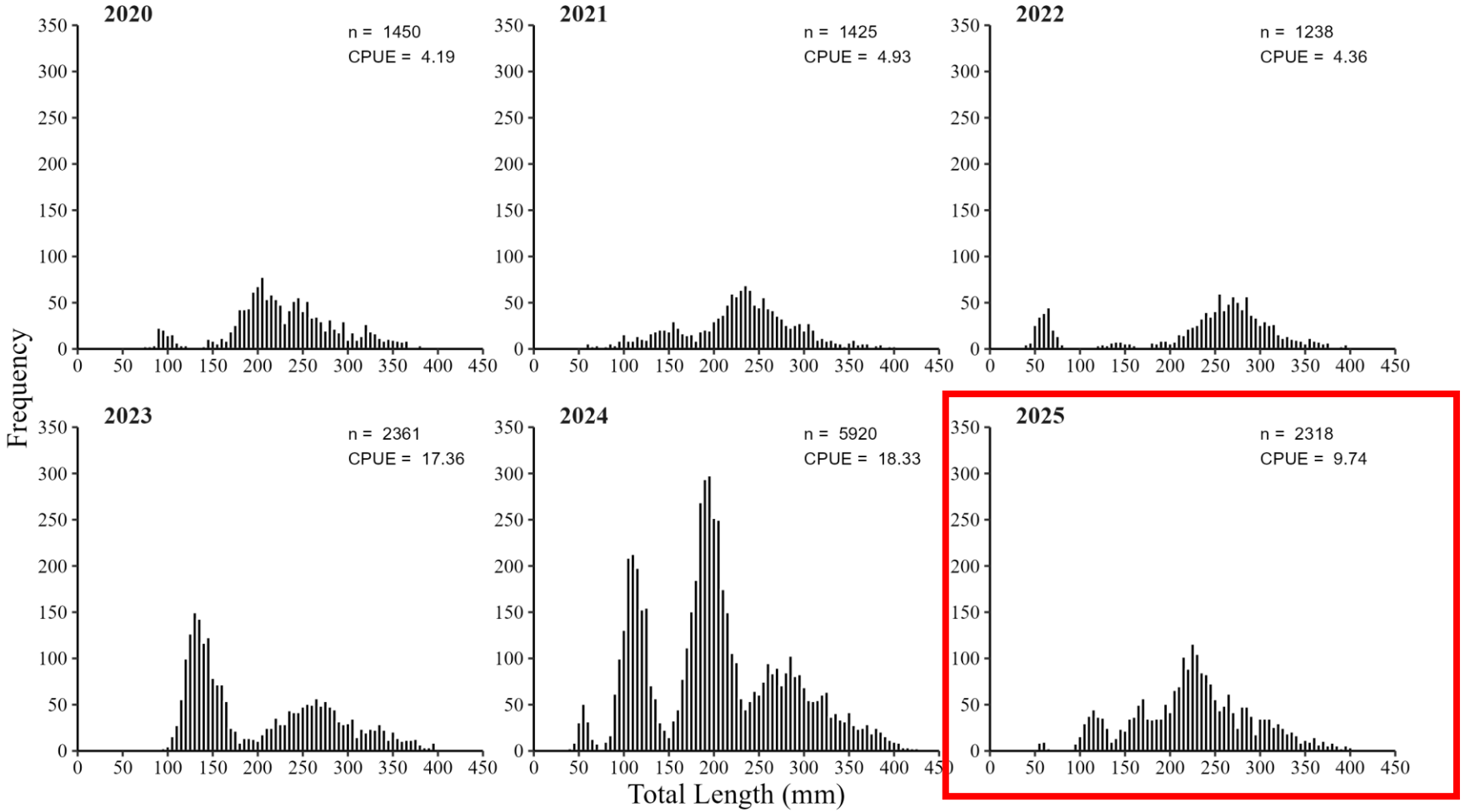
Decrease in 2025 relative abundance is mostly a result of fewer juvenile and subadult HBC in our sampled reaches

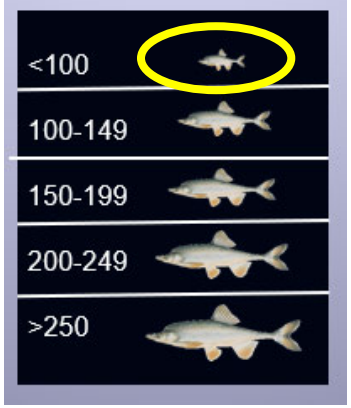


Relative abundance is largely driven by adults in 2025, but smaller fish are also present in some WGC reaches

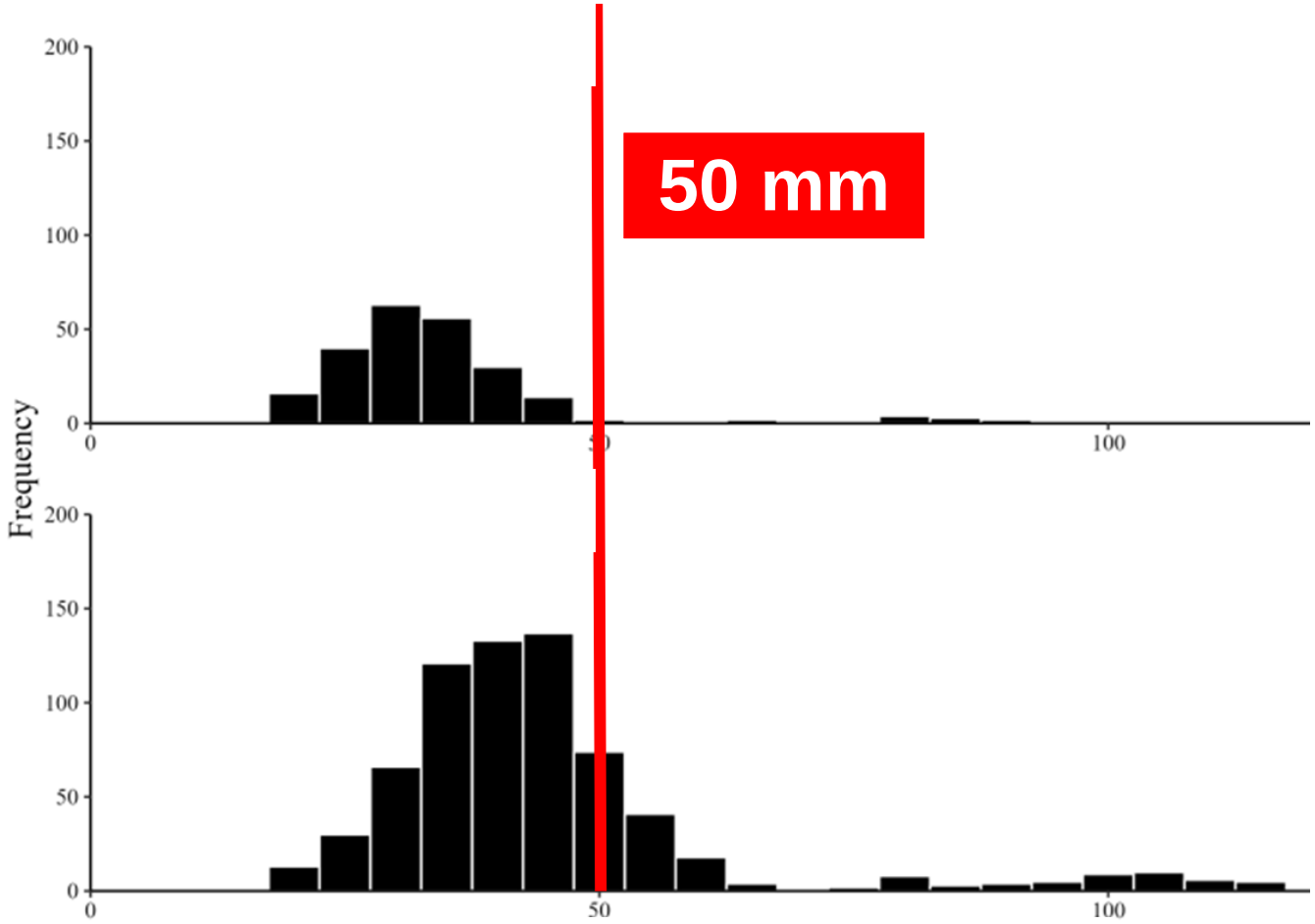


Relative abundance is largely driven by adults in 2025. Fewer juveniles and subadults than 2024.





Age-0 HBC were found in backwaters along Colorado River in September 2025



Dragon Bravo fire runoff during 2025 aggregation monitoring

Summary: HBC Aggregations

- Models suggest continued high adult HBC abundance in western Grand Canyon in 2025
  - Fewer juveniles and subadults than 2024
- Model suggests changes in spatial distribution
- More two-pass mark-recapture events would help reduce uncertainty

Presentation outline:

Project G

- Little Colorado River (LCR) aggregation
  - LCR
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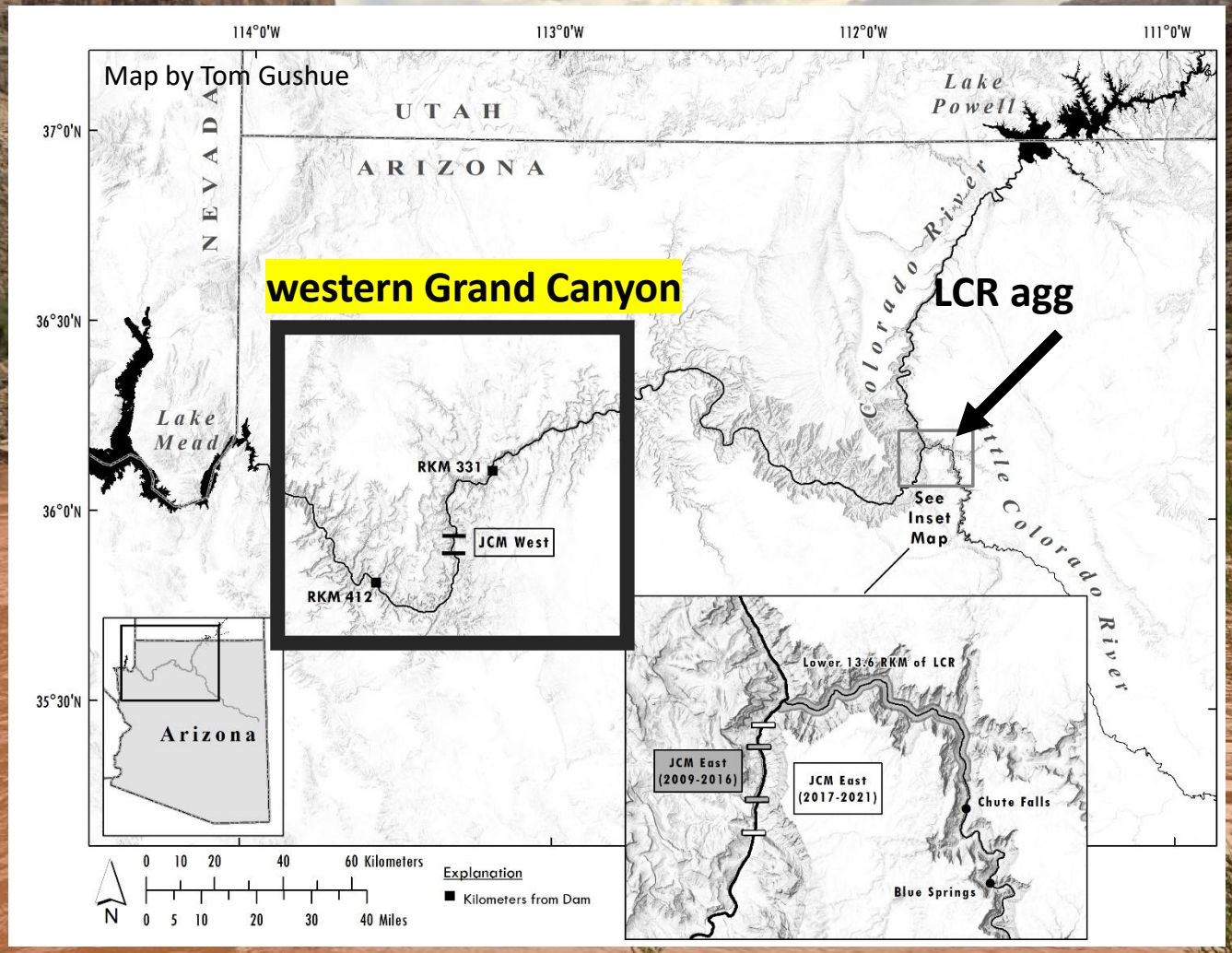


Preliminary Information Subject to Revision. Not for Citation or Distribution.

Photo by Lindsay Hansen

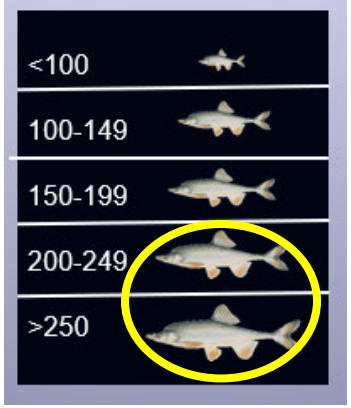
Abundance estimation in western Grand Canyon (Havasu to Pearce Ferry)

1) Mark-recapture to obtain capture probability: Adults and smaller size classes

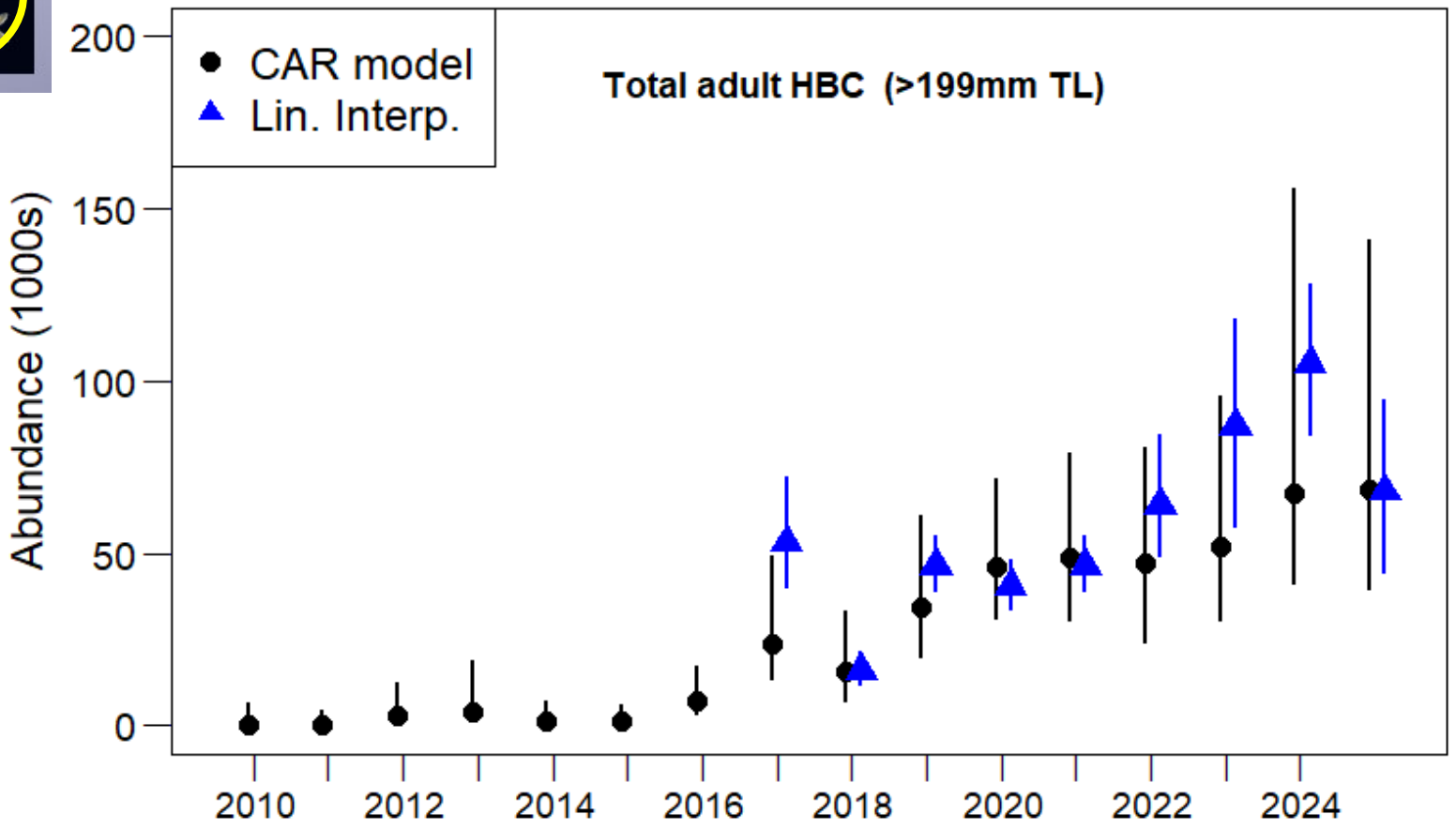
2) Capture probability & catch to estimate density

   -effects of turbidity, temp, etc.

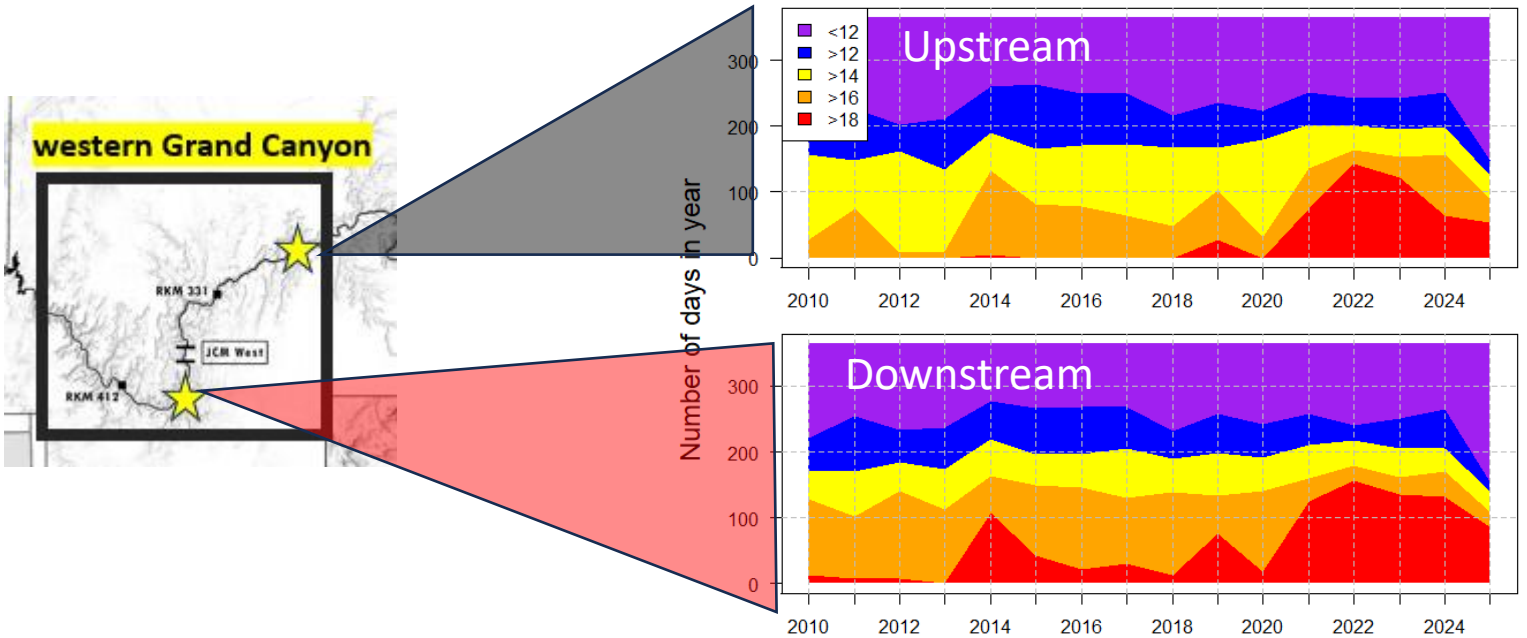
3) Spatial & habitat effects account for non-random sampling

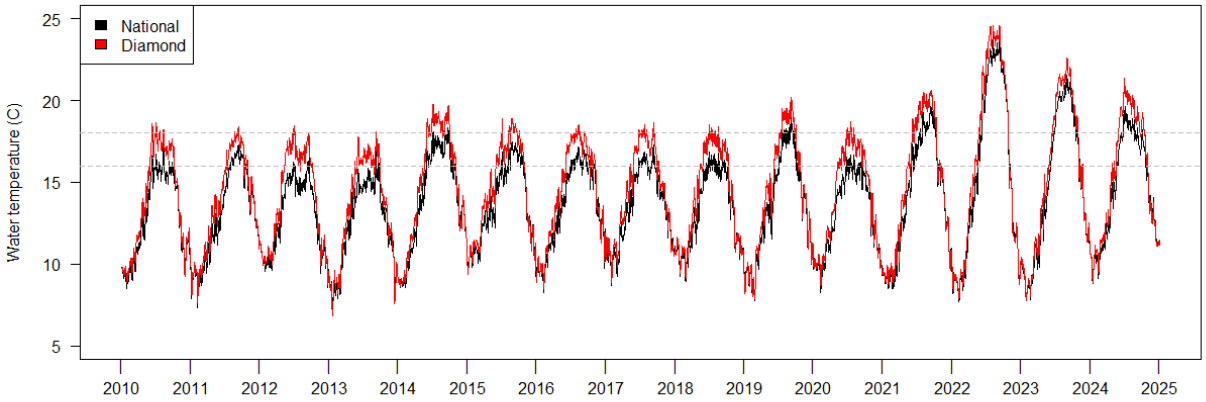


Abundance of adult humpback chub in western Grand Canyon

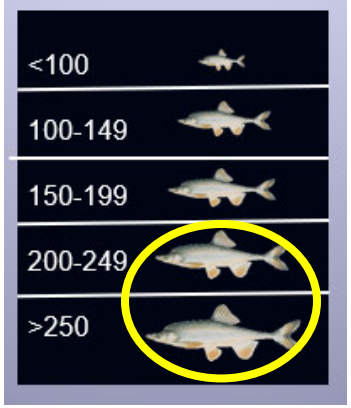


Water temperatures in western Grand Canyon



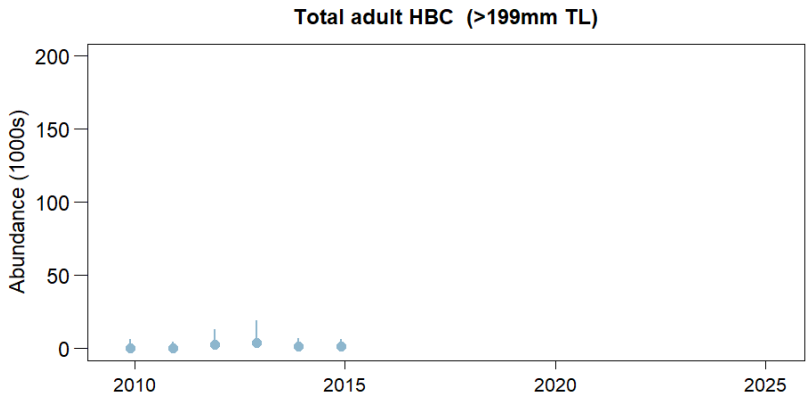


Downstream sites are warmer in summer/fall

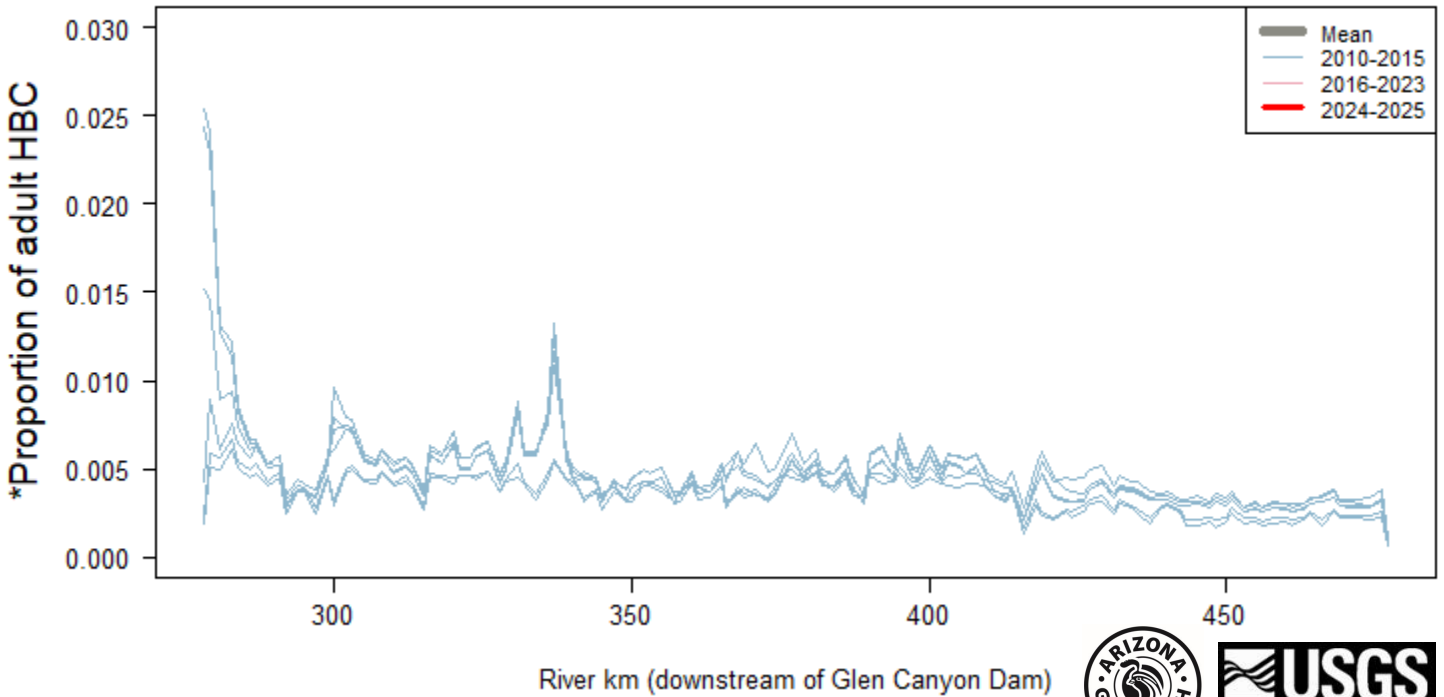


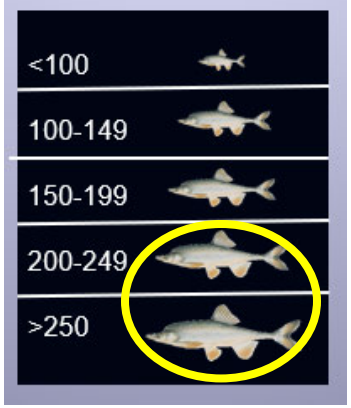
Western Grand Canyon humpback chub abundance (2010-2015)

- Abundance is highest near Havasu Creek (upstream)
- Abundances are very low.



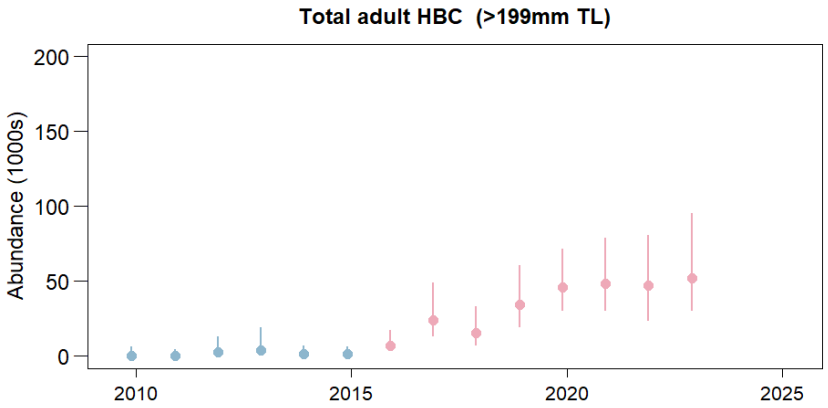
*Refers to the proportion, of the total abundance in western Grand Canyon in each year, that is estimated to be within each 0.1RM bin.





Western Grand Canyon humpback chub abundance (2016-2023)

- Abundance is growing and high
- Most fish in the middle reaches



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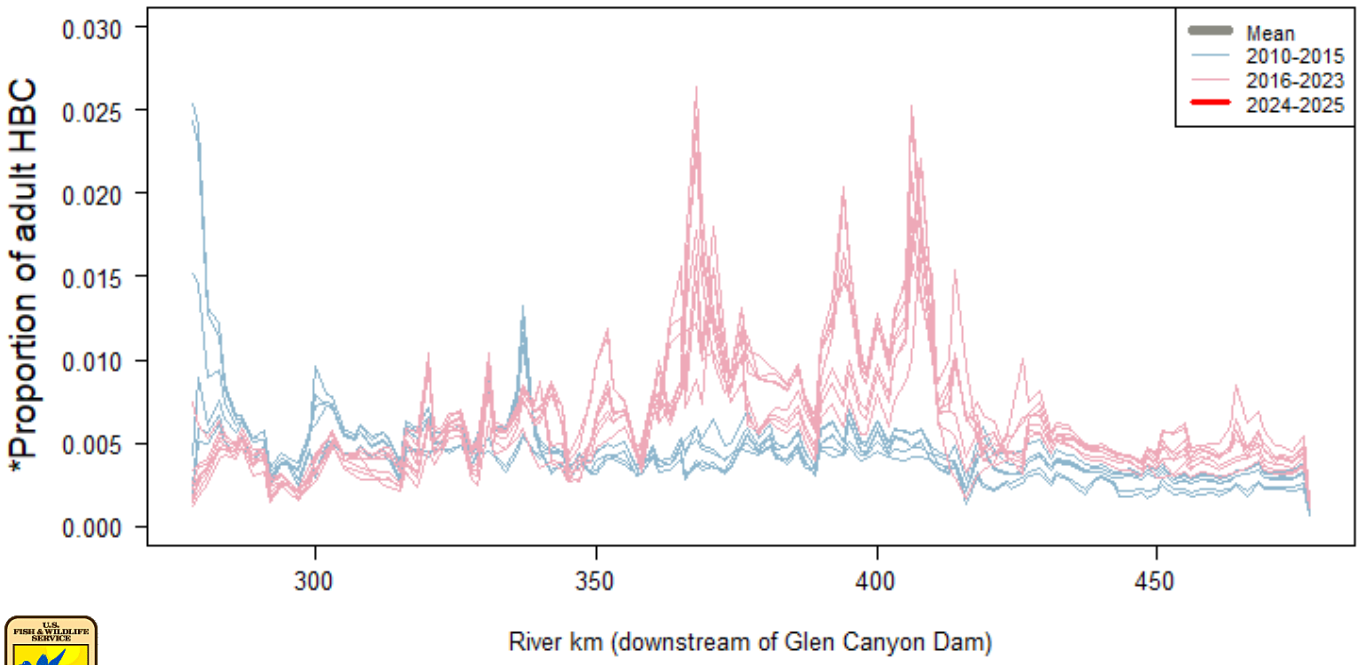
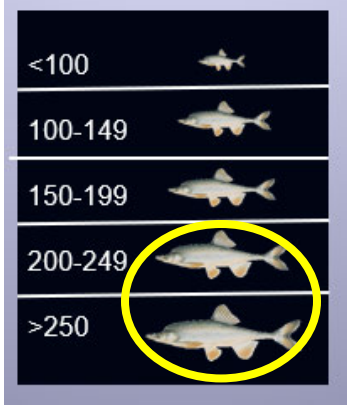
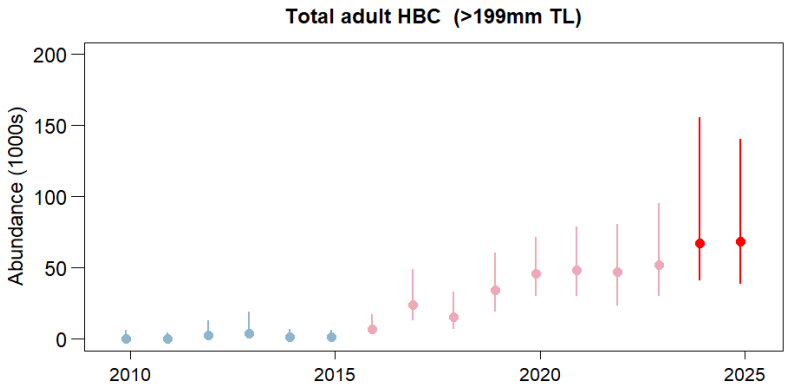




Western Grand Canyon humpback chub abundance (2024-25)

- Potential increase in upstream reaches



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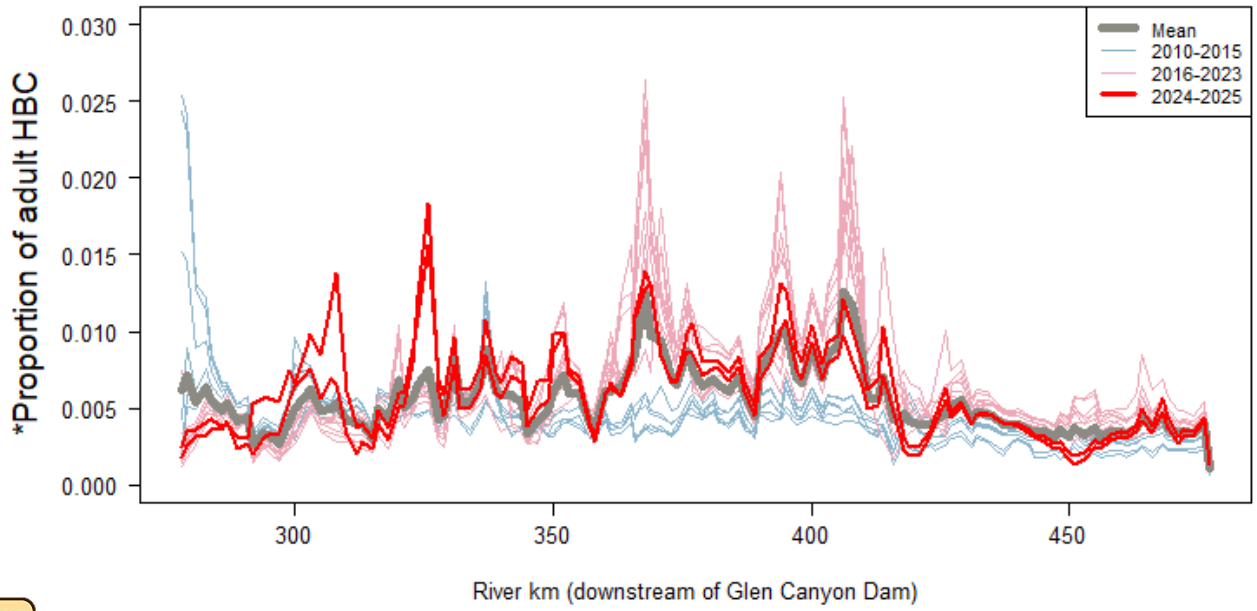
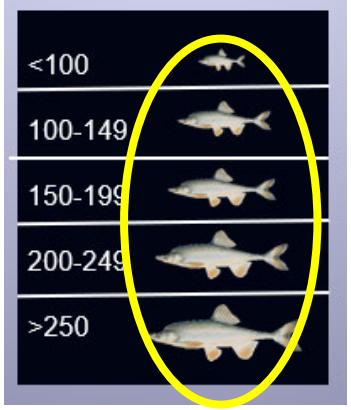
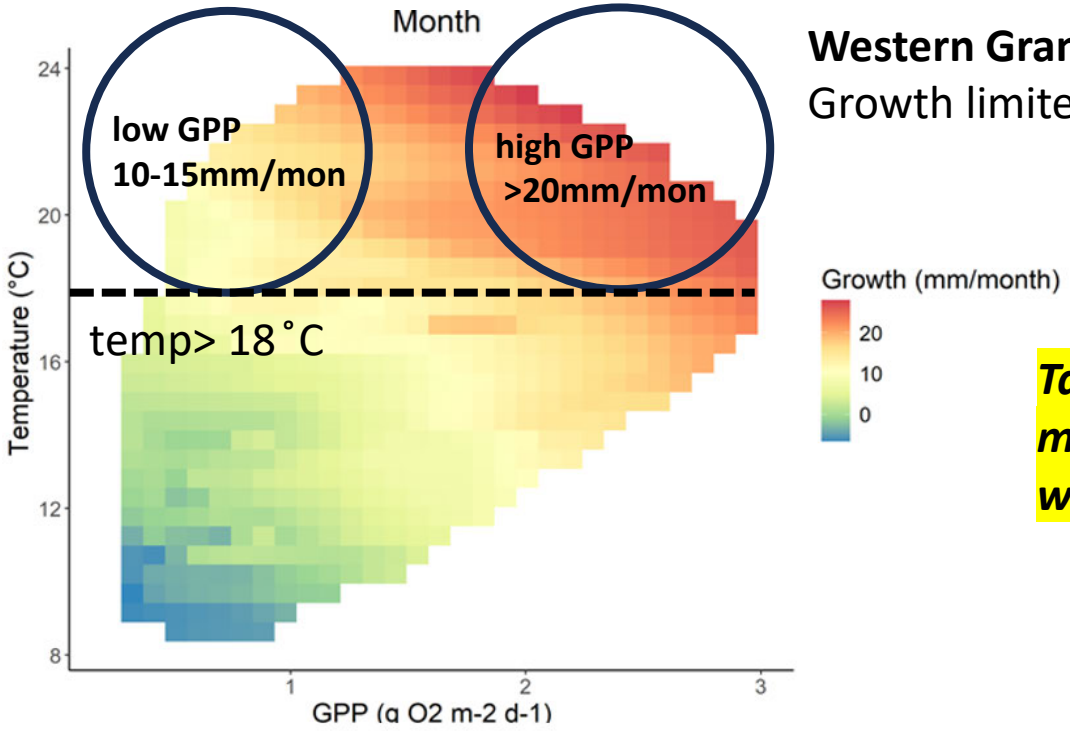




HBC growth: When temperature is no longer limiting, GPP drives growth

Eastern Grand Canyon (JCM-east, colder)
Growth limited by temperature & turbidity

Western Grand Canyon (JCM-west, warmer)
Growth limited by temperature, turbidity,



Take home: GPP (proxy for food) may become more important as water temperatures warm…

From Lindsay Hansen and others, USGS, In Review

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Project G

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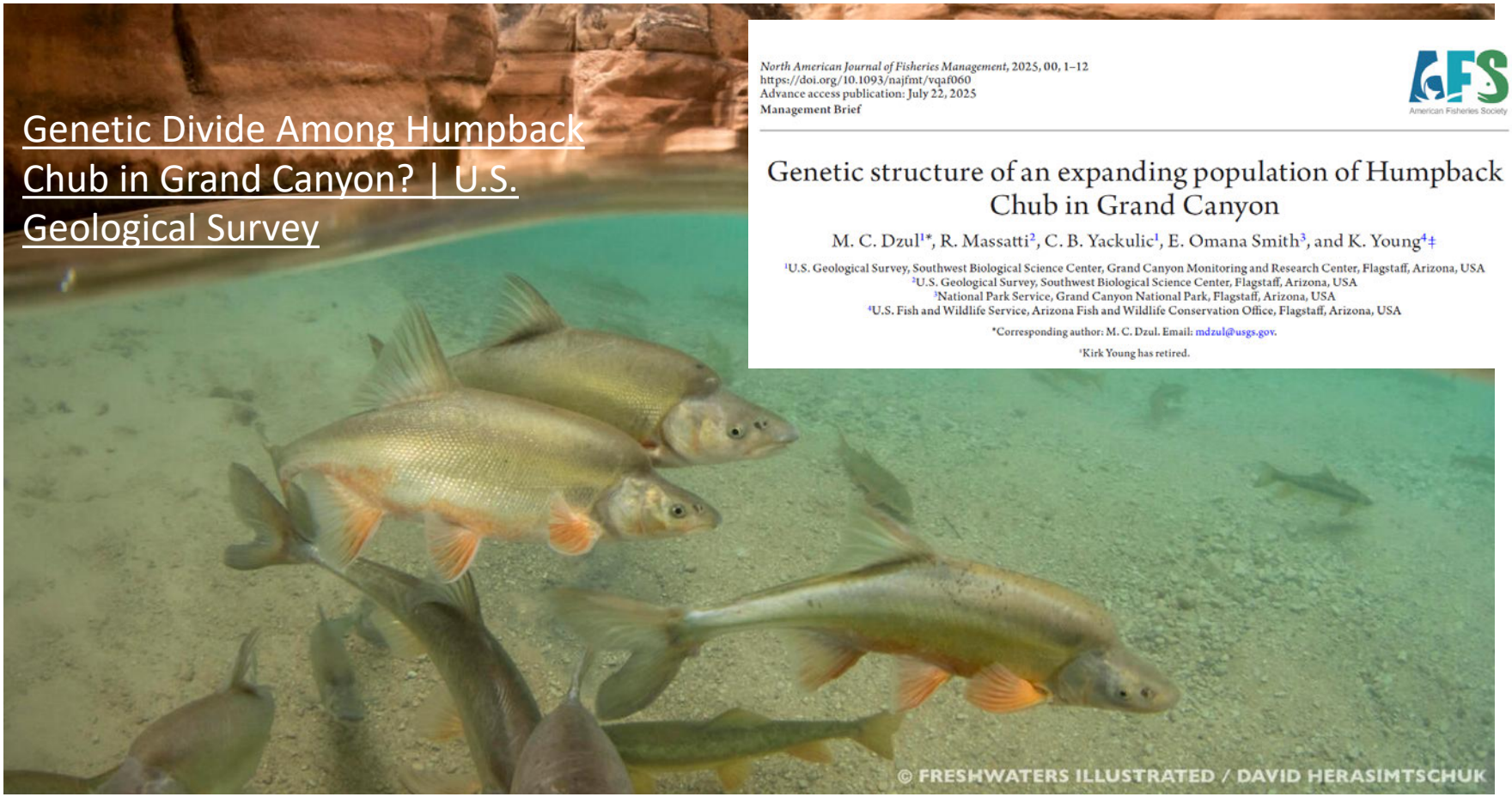
New paper:
Genetic evaluation of humpback chub in Grand Canyon



Dzul, M. C., Massatti, R., Yackulic, C. B., Omana Smith, E., & Young, K. (2025). Genetic structure of an expanding population of Humpback Chub in Grand Canyon. *North American Journal of Fisheries Management*, *45*(5), 929-940.

New paper:
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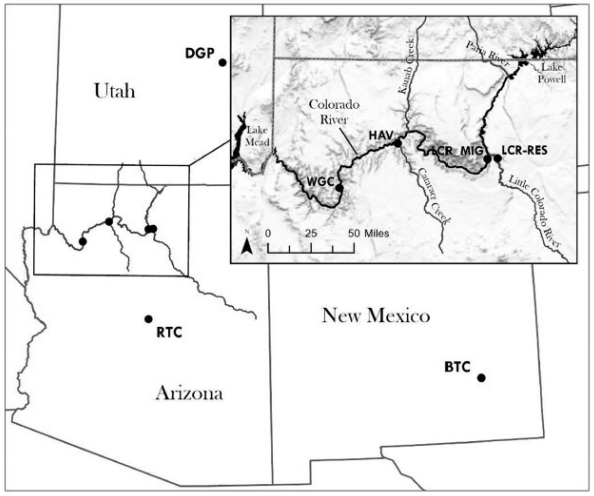


Figure 1. Map of locations of *Gila* spp. used in genetic analyses. Genetic groups included Bonytail (BTC) raised at the Southwestern Native Aquatic Resources and Recovery Center (Dexter, New Mexico); Roundtail Chub (RTC) obtained from Bubbling Ponds Hatchery (Cornville, Arizona) and originally from the Verde River, Arizona; and Humpback Chub (HBC) from the Desolation/Gray Canyon population (DGP), which were obtained from the Southwestern Native Aquatic Resources and Recovery Center but originally collected in the Green River, Utah. Within Grand Canyon, HBC groups corresponded to sampling sites in or near the Little Colorado River (LCR) and included LCR residents (LCR-RES; obtained 10.0–13.5 km upstream of the Colorado River confluence), LCR migrants (LCR-MIG; obtained from the Colorado River, ~1.9–7.2 km downstream from the LCR confluence), Havasu Creek (HAV; obtained from the lower ~6 km of the creek), and western Grand Canyon (WGC; obtained ~239.8–245.4 km downstream of the LCR confluence). (Figure credit: Erica Byerley, U.S. Geological Survey.)

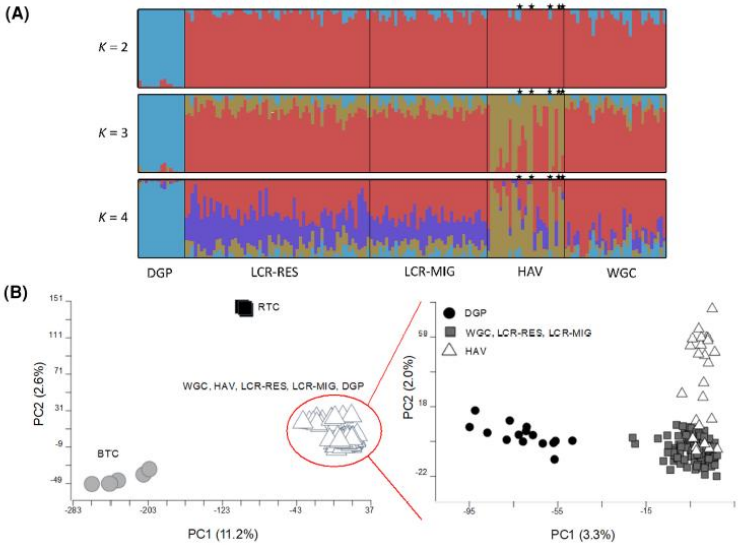
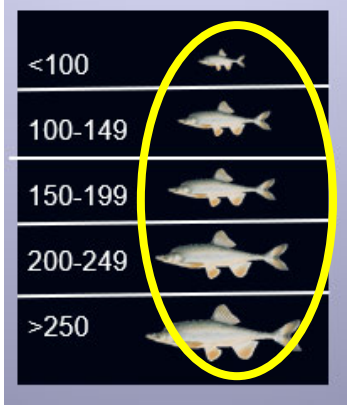


Figure 3. Genetic structure (A) within Humpback Chub (HBC) and (B) among HBC, Roundtail Chub (RTC), and Bonytail (BTC). Plots for *K*-values of 2–4 (panel A) illustrate the hierarchical partitioning of genetic structure. Humpback Chub that were translocated into Havasu Creek (HAV) are denoted with stars above their respective bars. Principal components analysis (PCA) plots (panel B) include all species (left) and only HBC (right). Abbreviations are as follows: DGP = Desolation/Gray Canyon population, LCR-RES = Little Colorado River residents, LCR-MIG = Little Colorado River migrants, and WGC = western Grand Canyon.

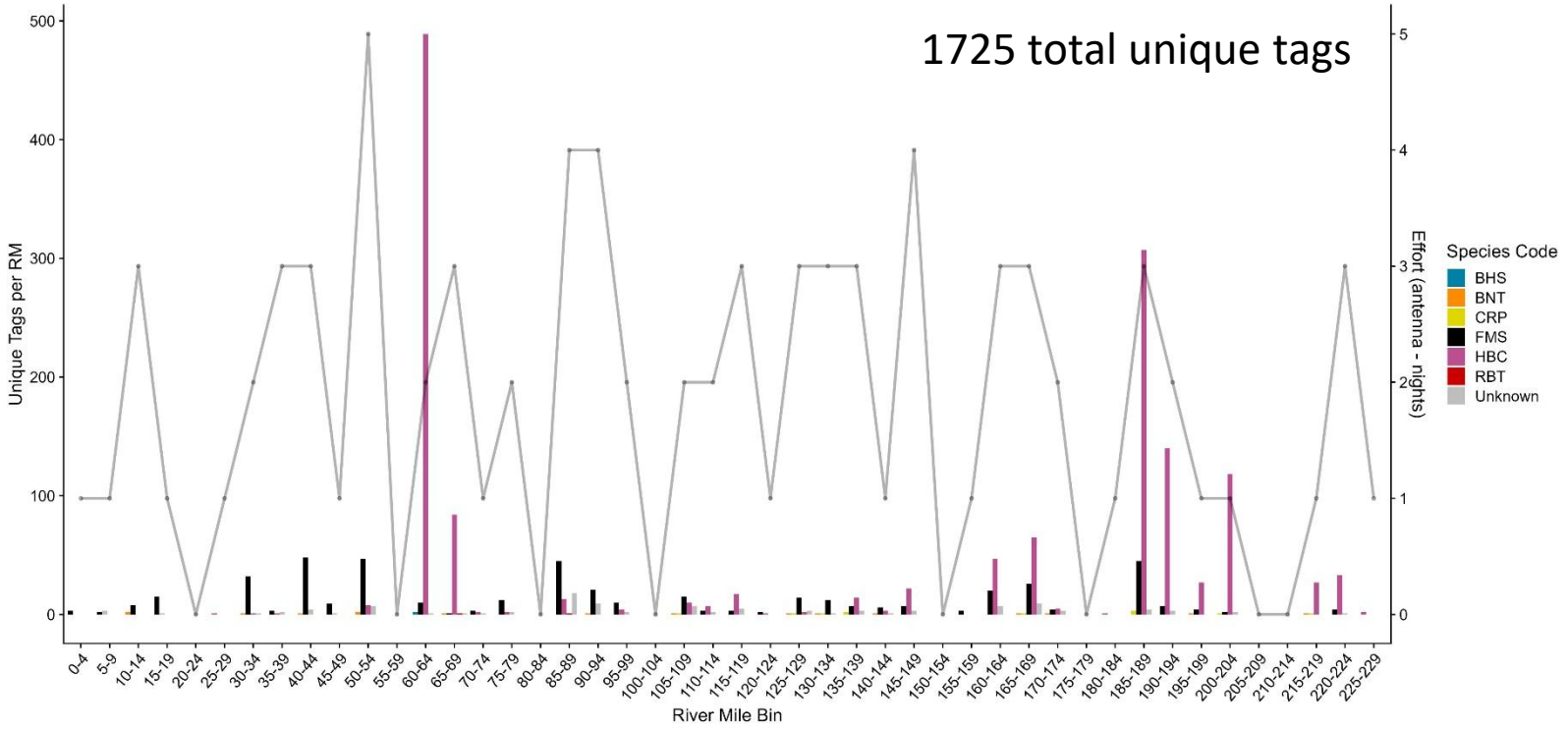
Dzul, M. C., Massatti, R., Yackulic, C. B., Omana Smith, E., & Young, K. (2025). Genetic structure of an expanding population of Humpback Chub in Grand Canyon. *North American Journal of Fisheries Management*, *45*(5), 929-940.



Citizen Science antenna detection pilot study (2025)

Super mini antennas fit in an ammo can!

For more info, check out Ben's poster!

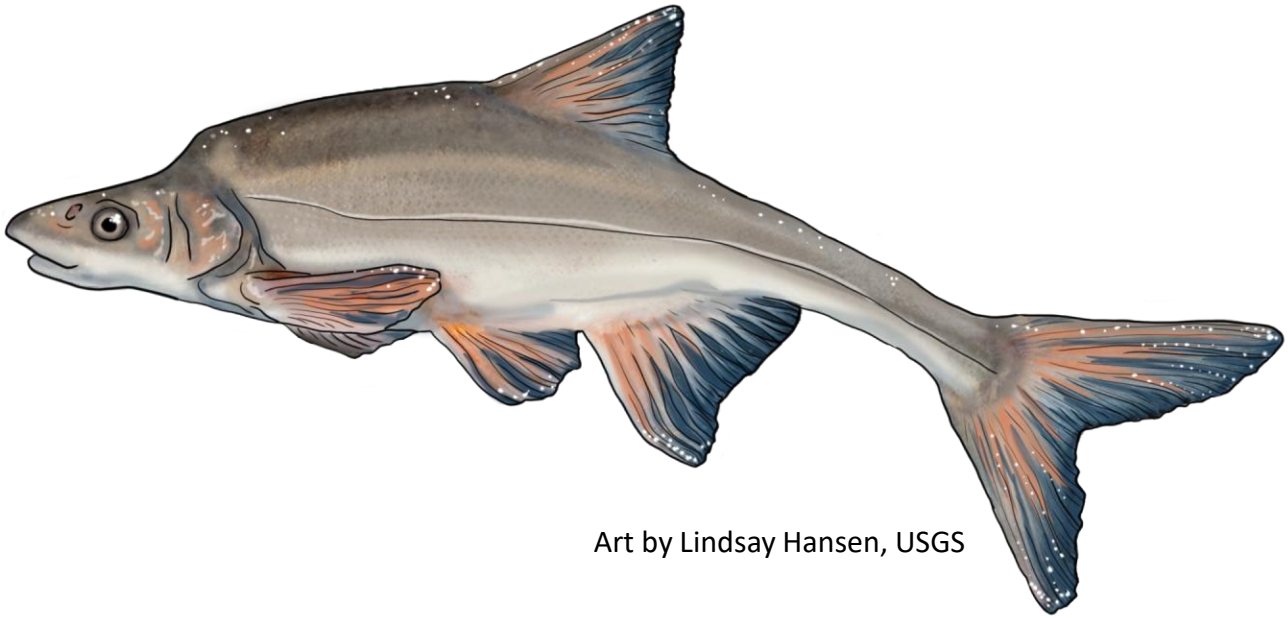


Ben Miller, USGS

Summary: Humpback Chub in Grand Canyon

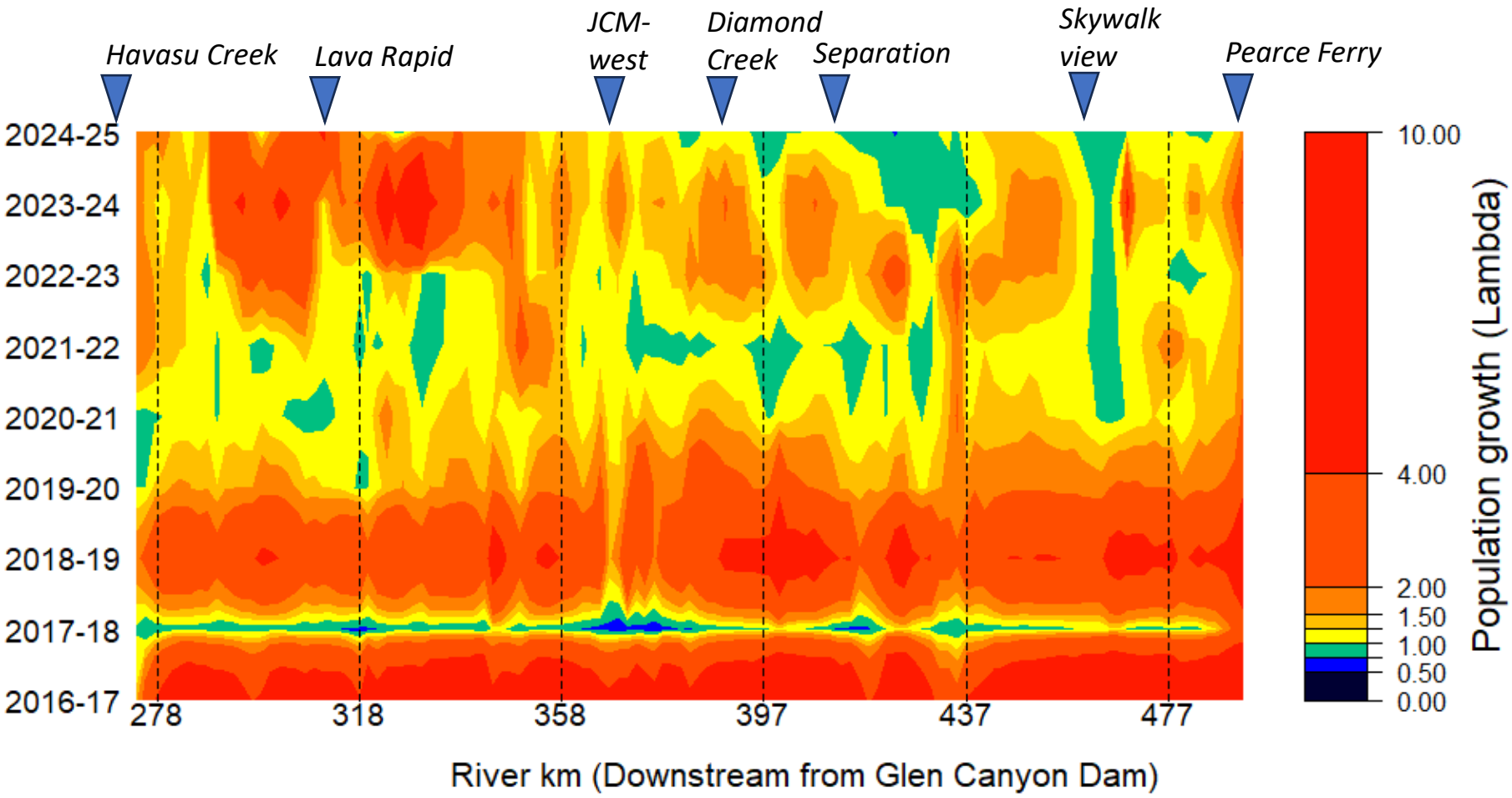
- Eastern Grand Canyon
  - Poor juvenile production in 2024 & 2025
  - Subadults are increasing
  - High abundance of adults
  - Warming water temps over last 5 years accelerates growth
  - Chute Falls translocations: evidence of reproduction, particularly in no-flood years
- Western Grand Canyon
  - Adult abundance is high
  - All size classes present, but fewer small fish in 2025
  - Does temperature limitation affect spatial patterns?
  - As temperatures warm, food may become limiting

Thank You

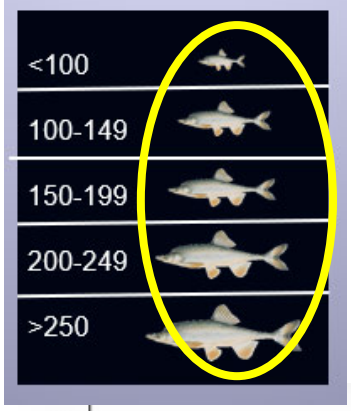


Art by Lindsay Hansen, USGS

Western Grand Canyon humpback chub population growth (2016-2025)



In 2024-25: some preliminary evidence that populations are growing in upstream reaches and stable/decreasing downstream.



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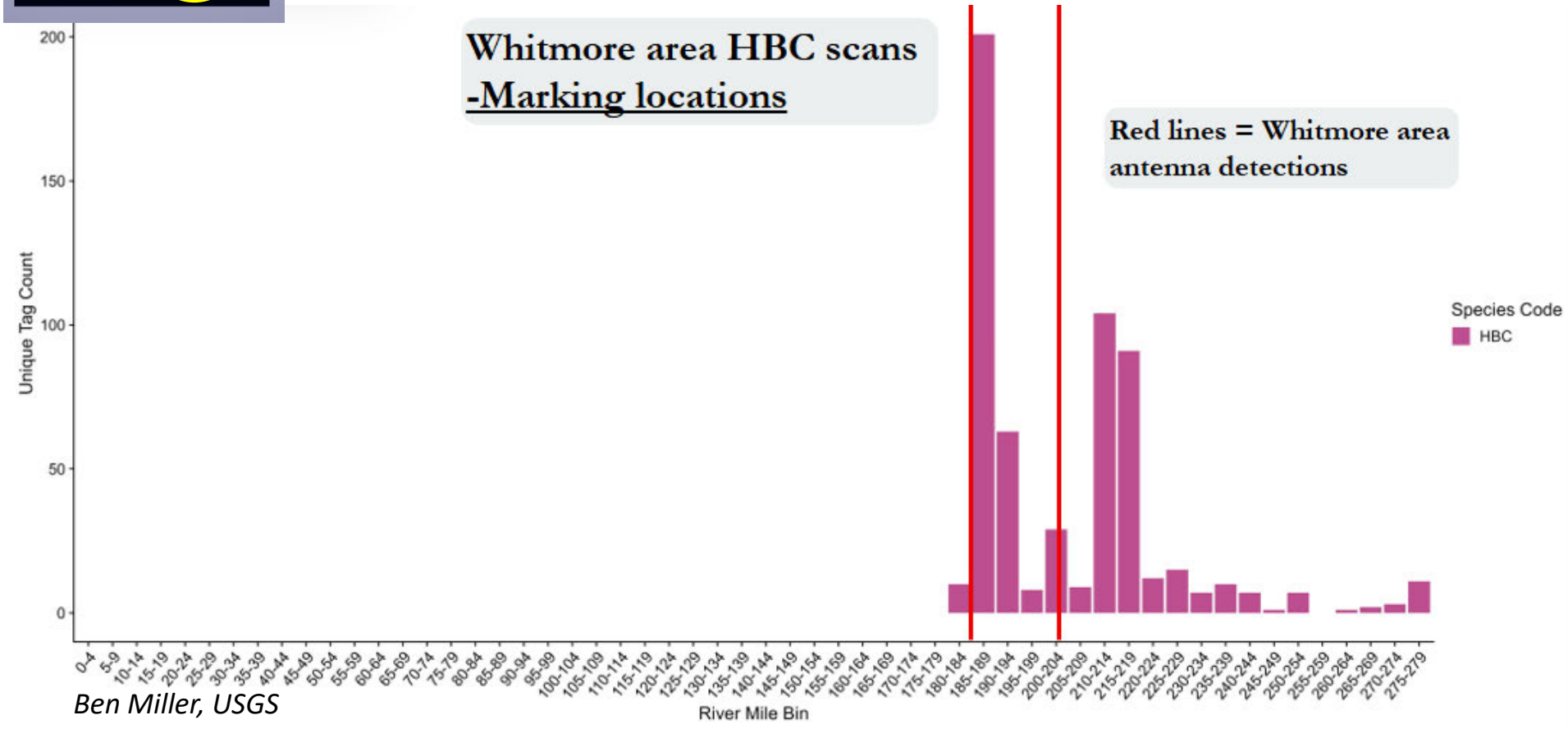

Ben Miller, USGS