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
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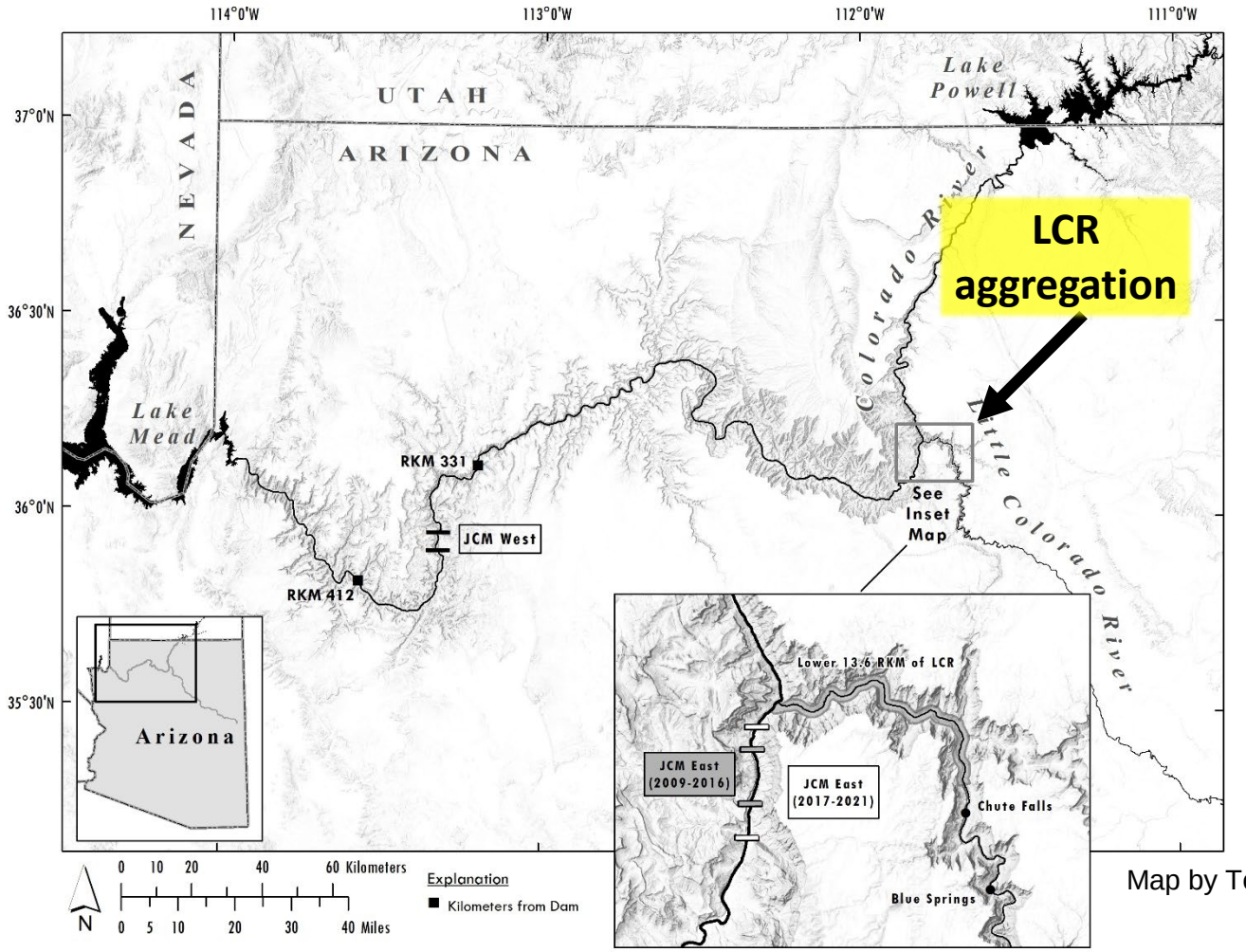
    - Hoop net relative abundance
    - Abundance estimates in western Grand Canyon
  - JCM – west

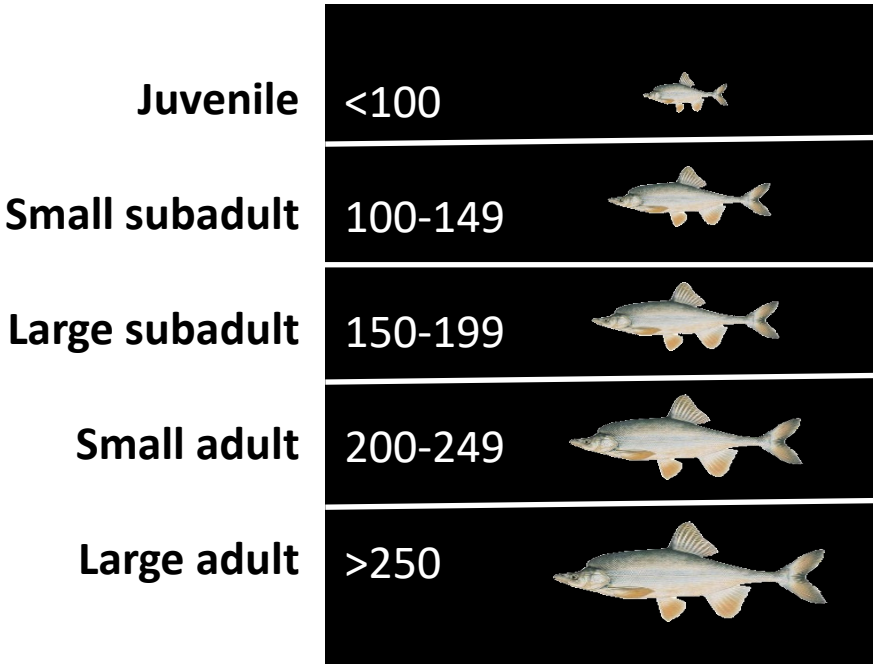
Fixed site monitoring in eastern Grand Canyon



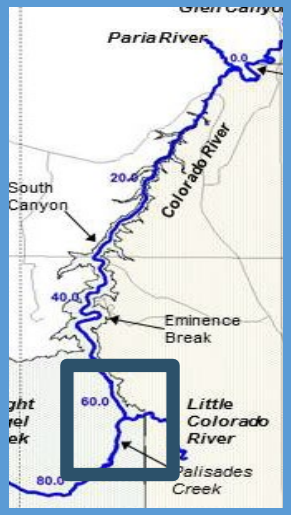
Map by Tom Gushue, USGS

Size chart indicator

(sizes are mm total length)



Life history of Humpback Chub in LCR aggregation:



Colorado River

skipped spawning

migrants

outmigration

resident

spring spawning migration

Little Colorado River

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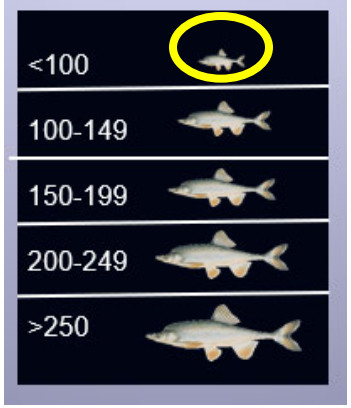
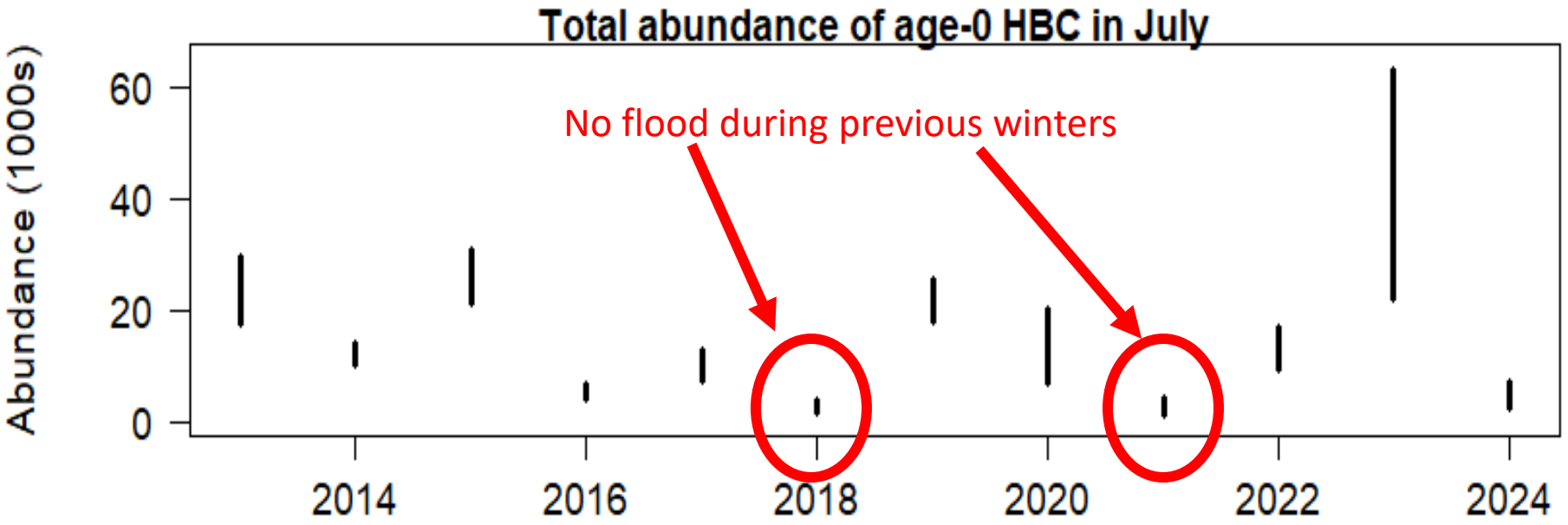
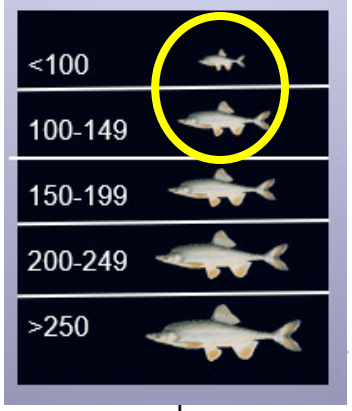


Age-0 abundances in the LCR



* Abundance estimate from 2020 is 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.

*No sampling spring 2020

Fall age-0
Spring age-1

No flood during previous winters

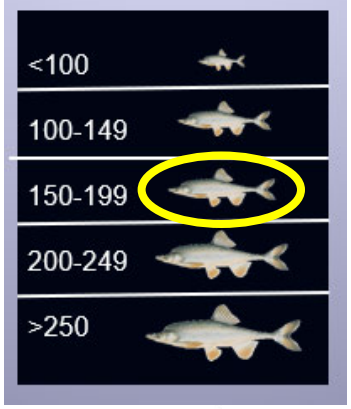
*

Abundance (N +/- 95% CI)

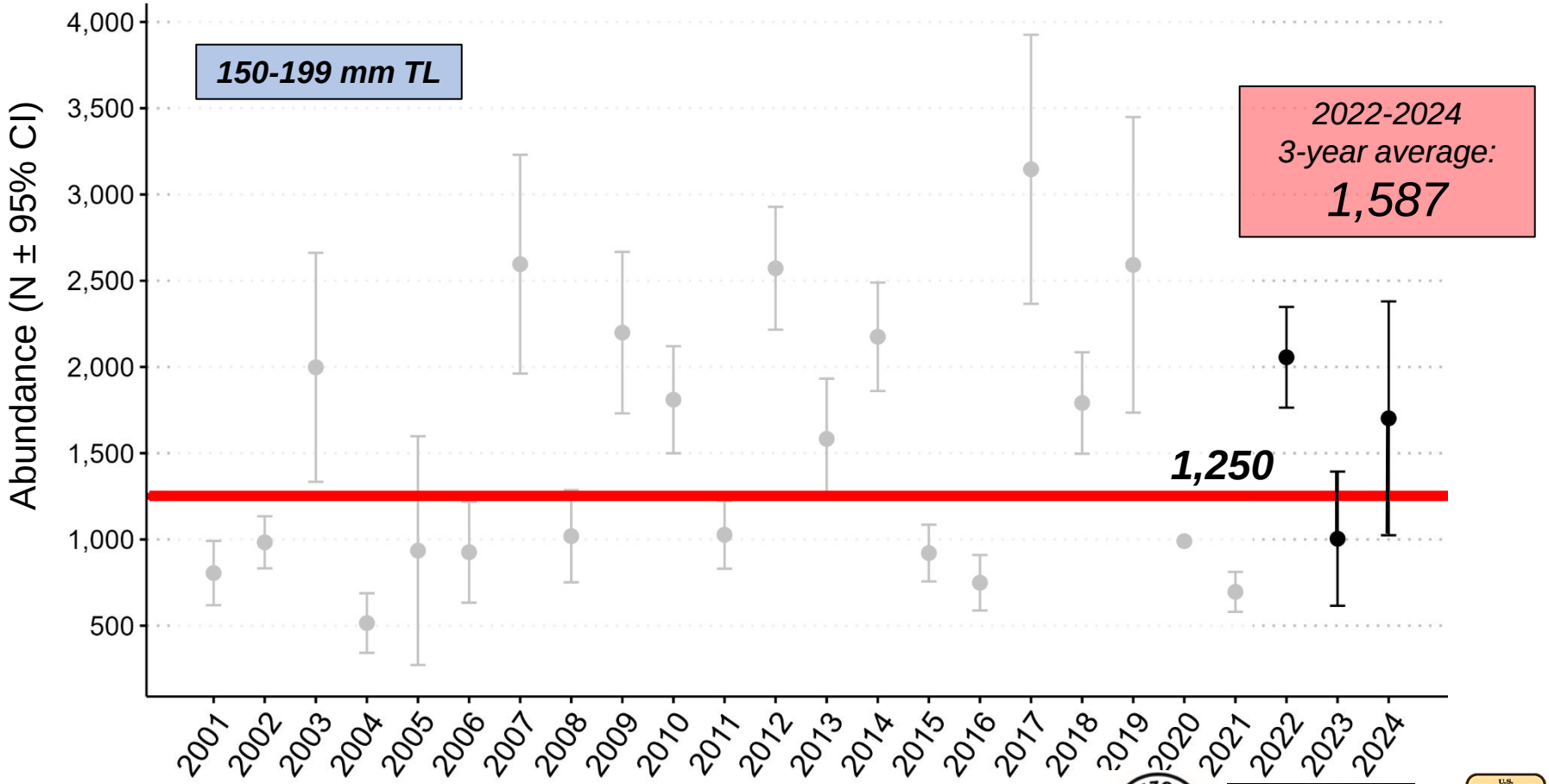
15,000
12,500
10,000
7,500
5,000
2,500
0

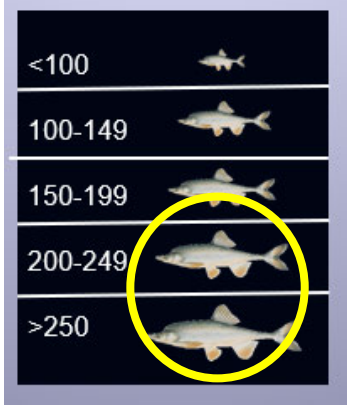
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024

Cohort (Hatch Year)

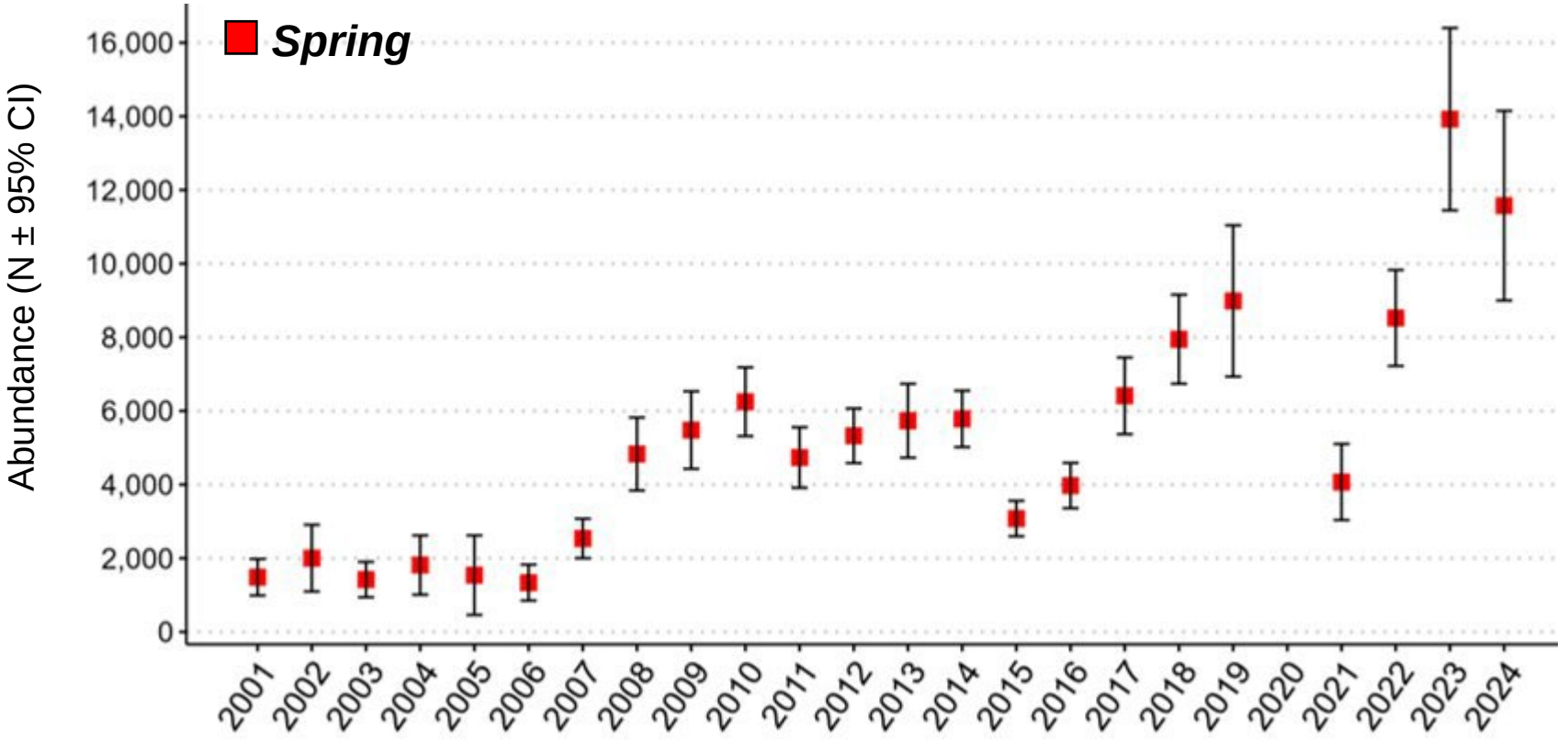


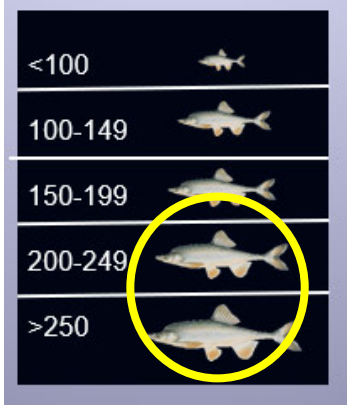
Annual spring abundances of large sub-adult HBC in lower 13.6 km of LCR remains above the trigger.



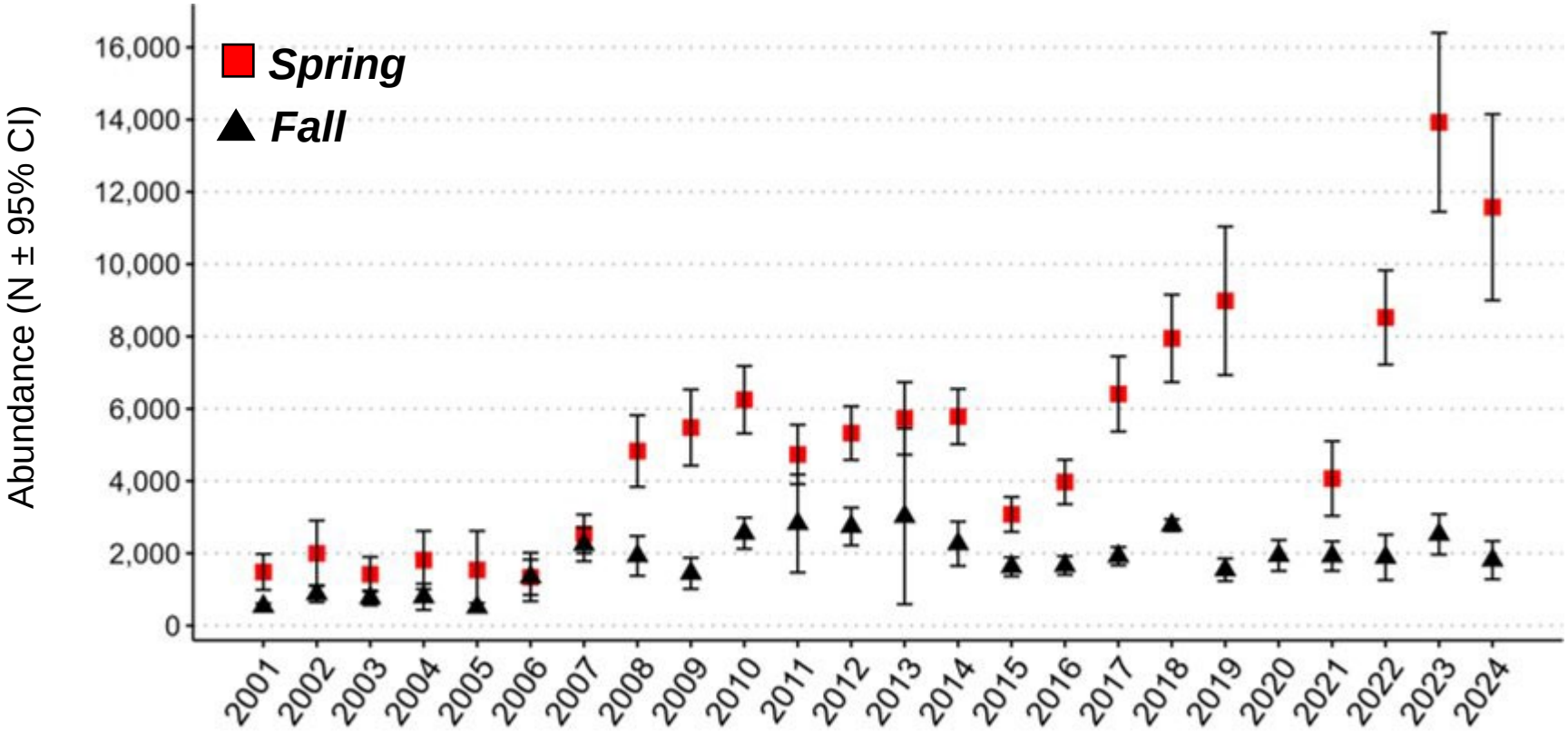


2023-2024 spring adult (≥ 200 mm) abundance shows highest point estimates recorded in LCR





Fall adult (≥ 200 mm) abundance of LCR resident HBC in 2023 is stable in recent years



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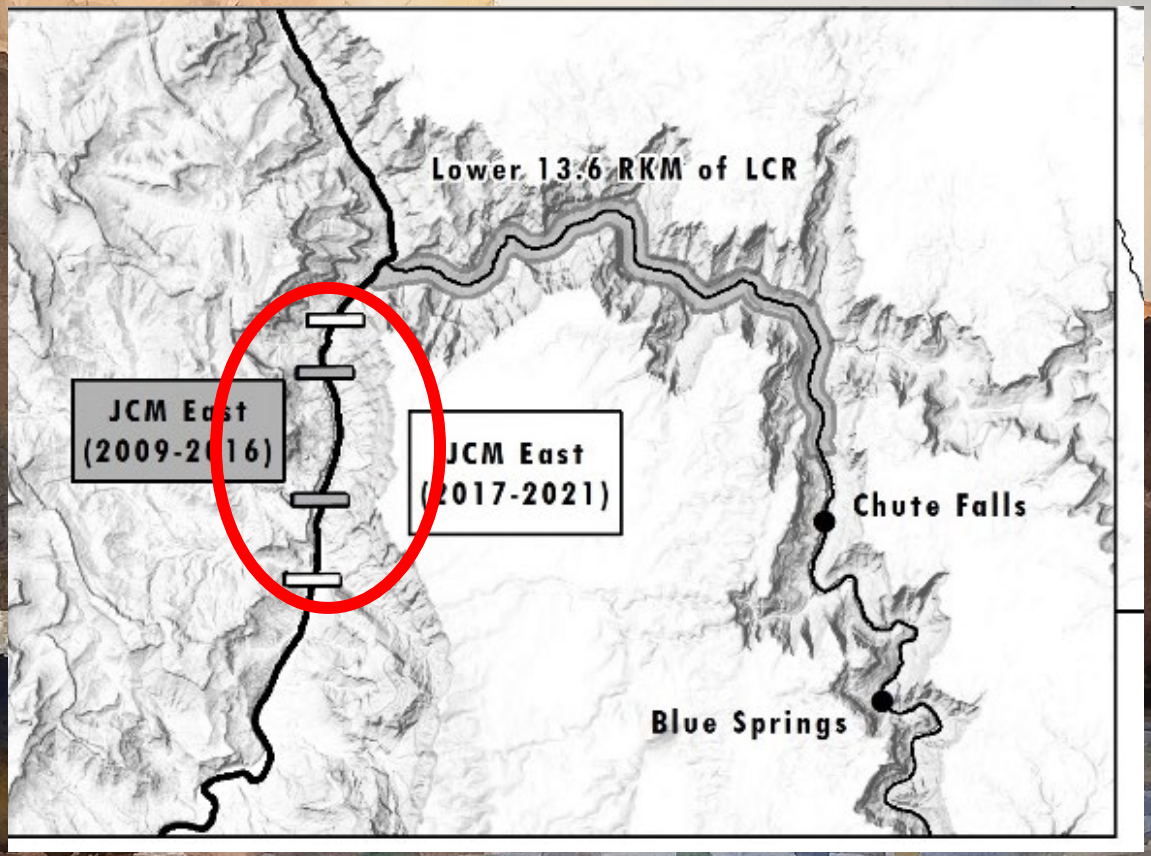
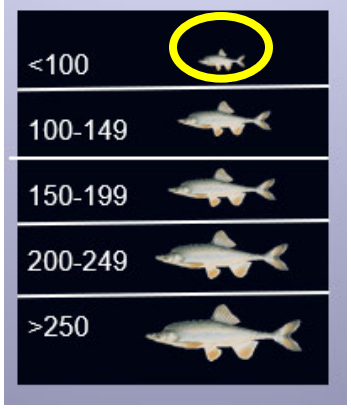
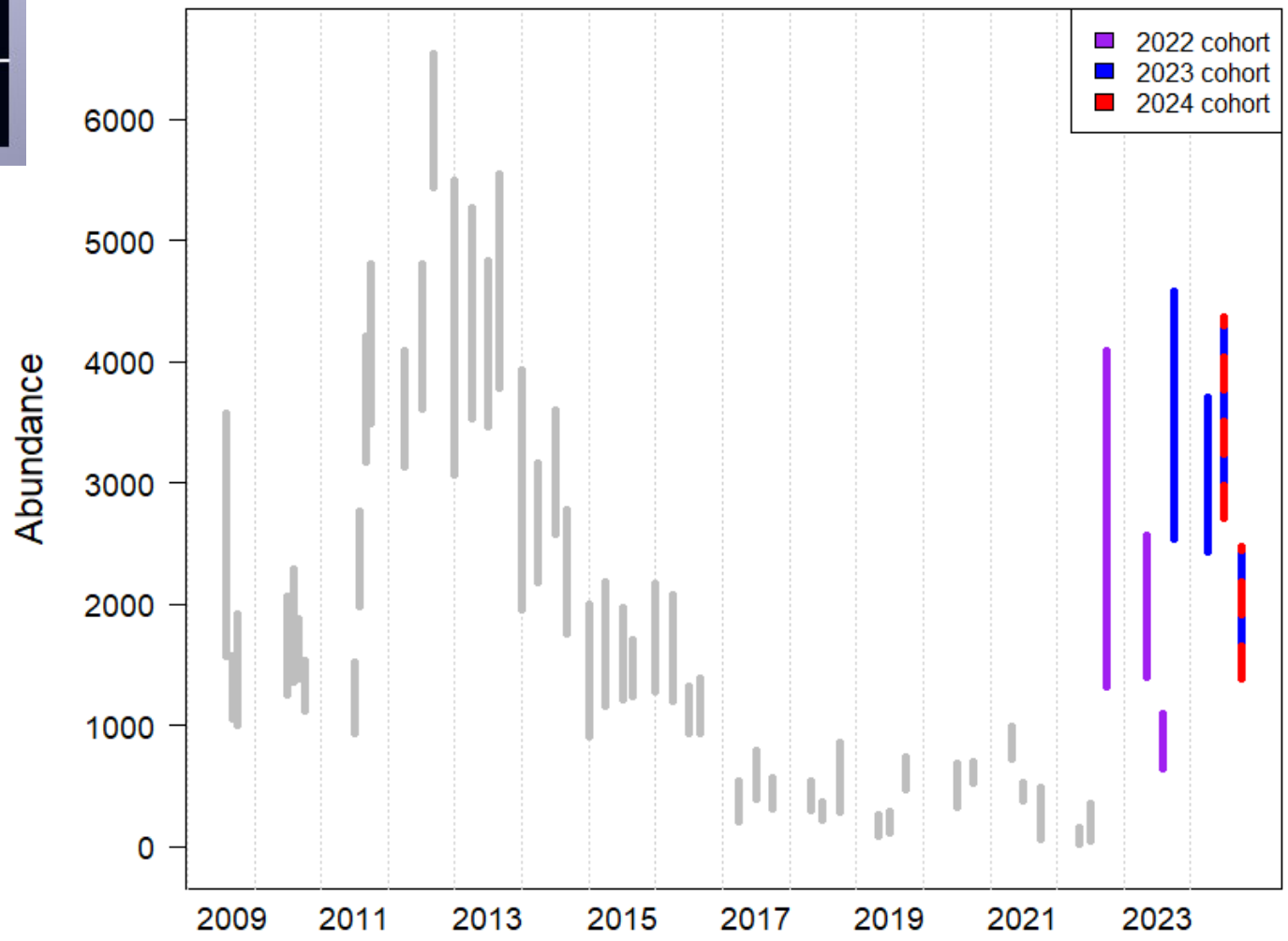
Artwork by Randy Van Haverbeke

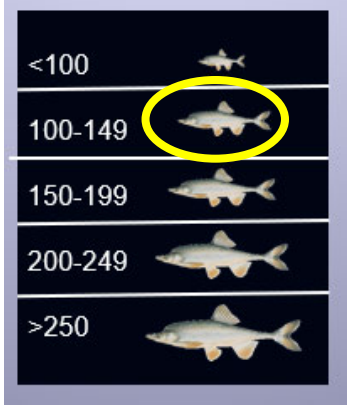
Juvenile Chub Monitoring - east



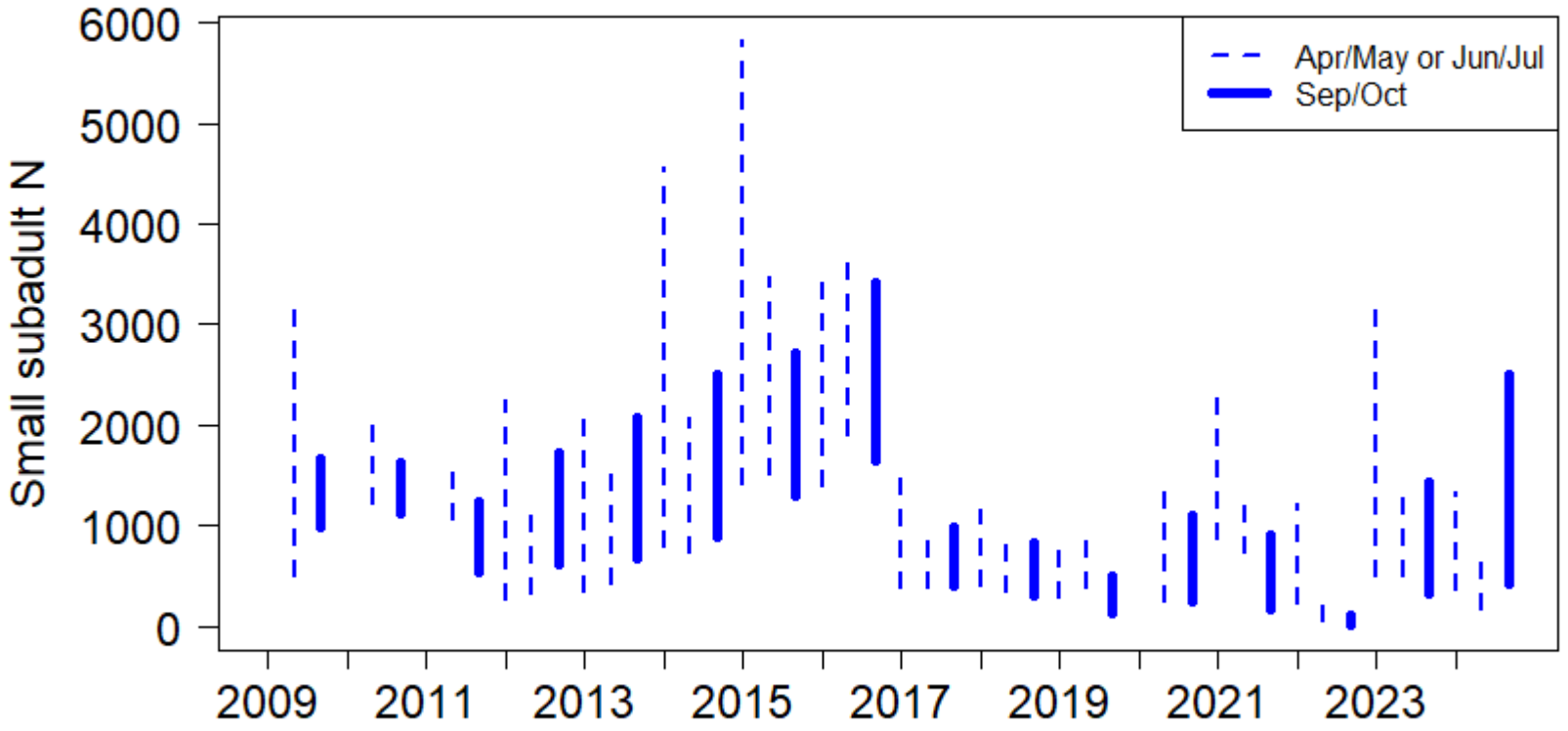


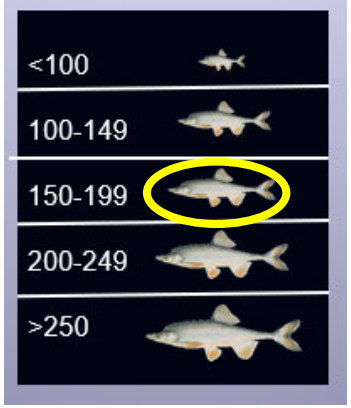
Juvenile abundance in the JCM-east



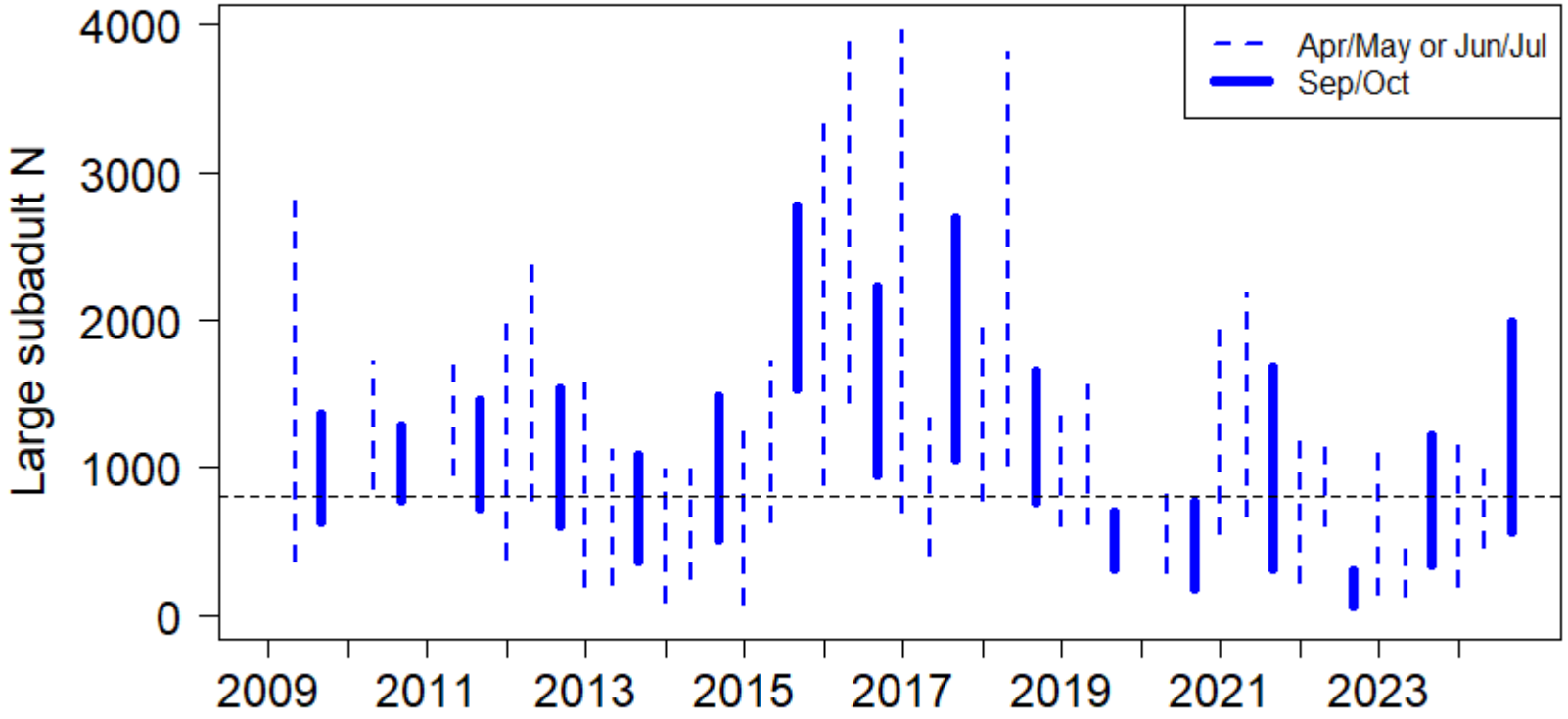


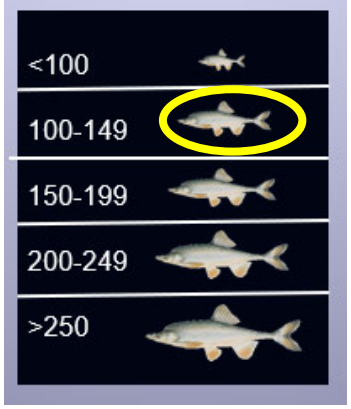
Small subadult abundances in JCM-east



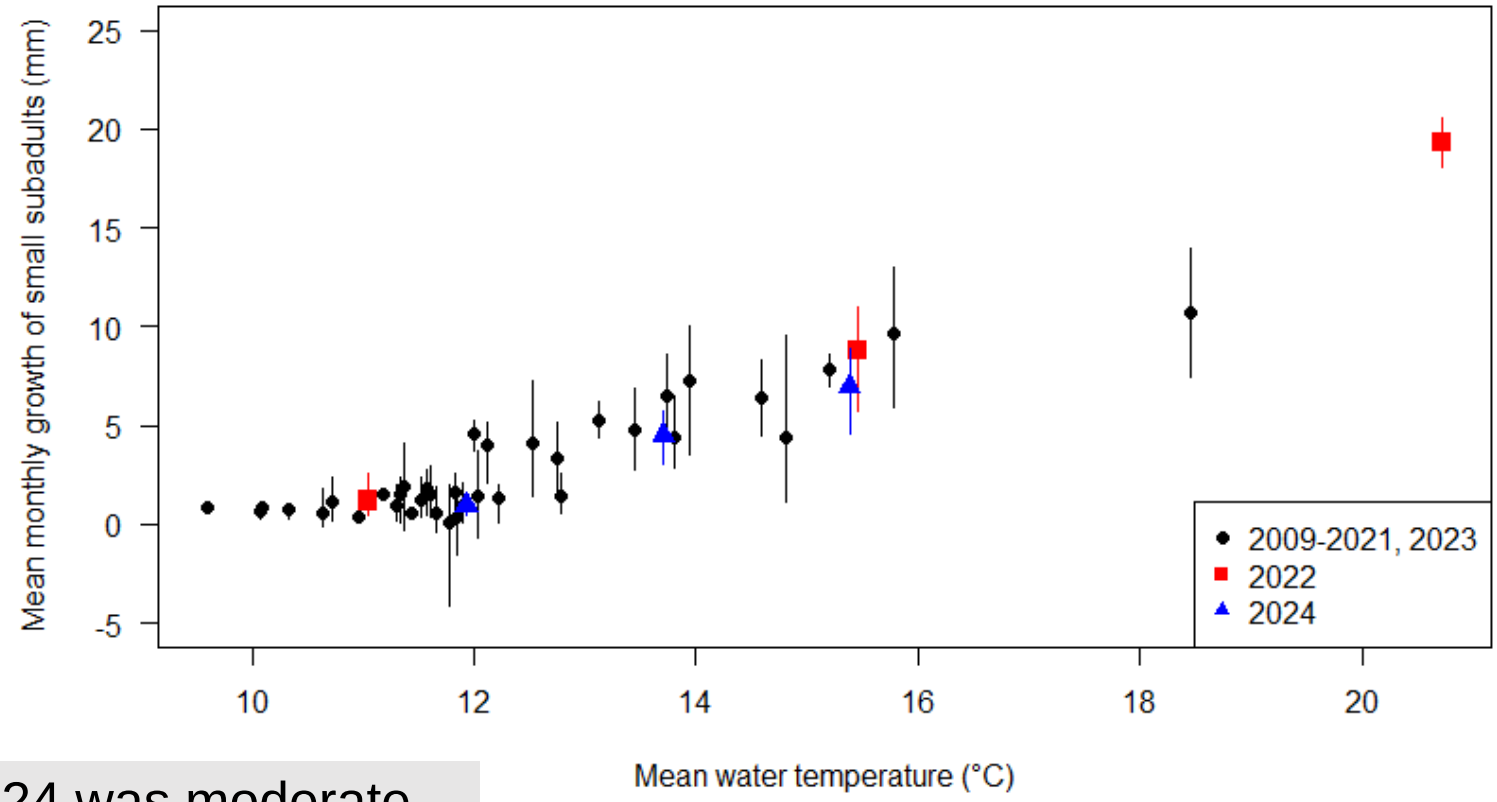


Large subadults in JCM-east are below the trigger





Small subadults grow fast when water temperatures are warm



Growth in 2024 was moderate, much lower than 2022 & 2023.

Likely effect of coolmix

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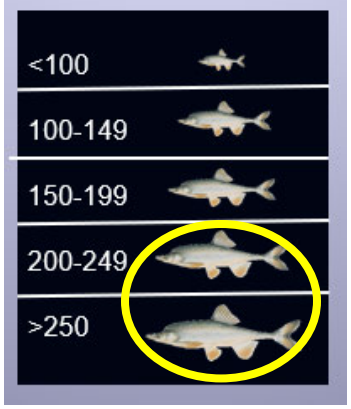
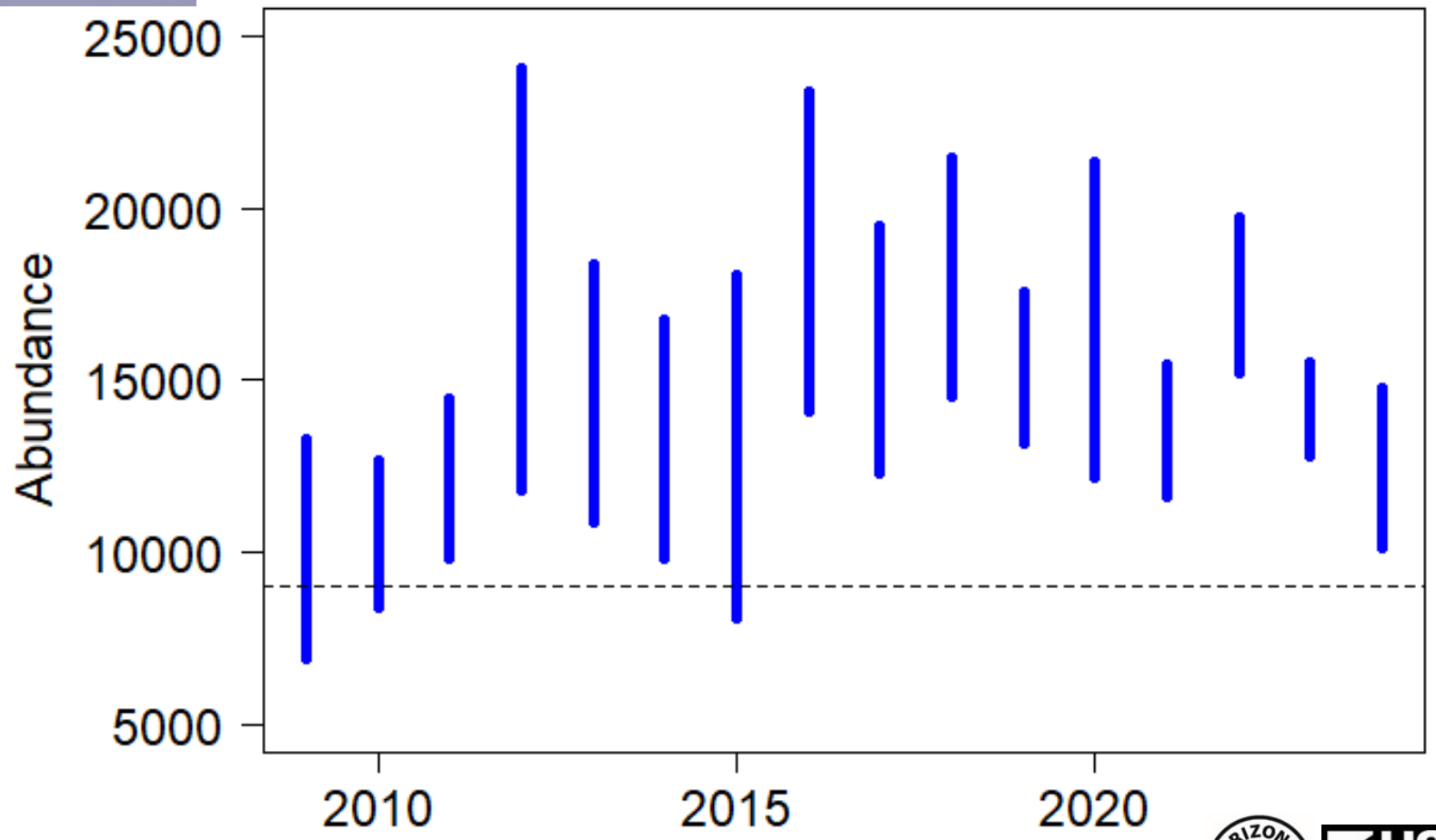
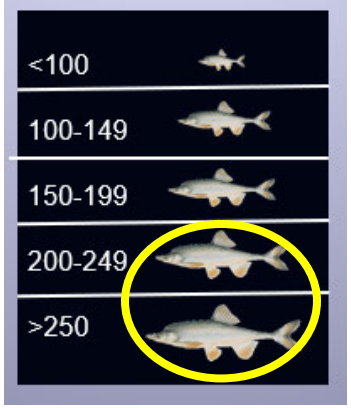


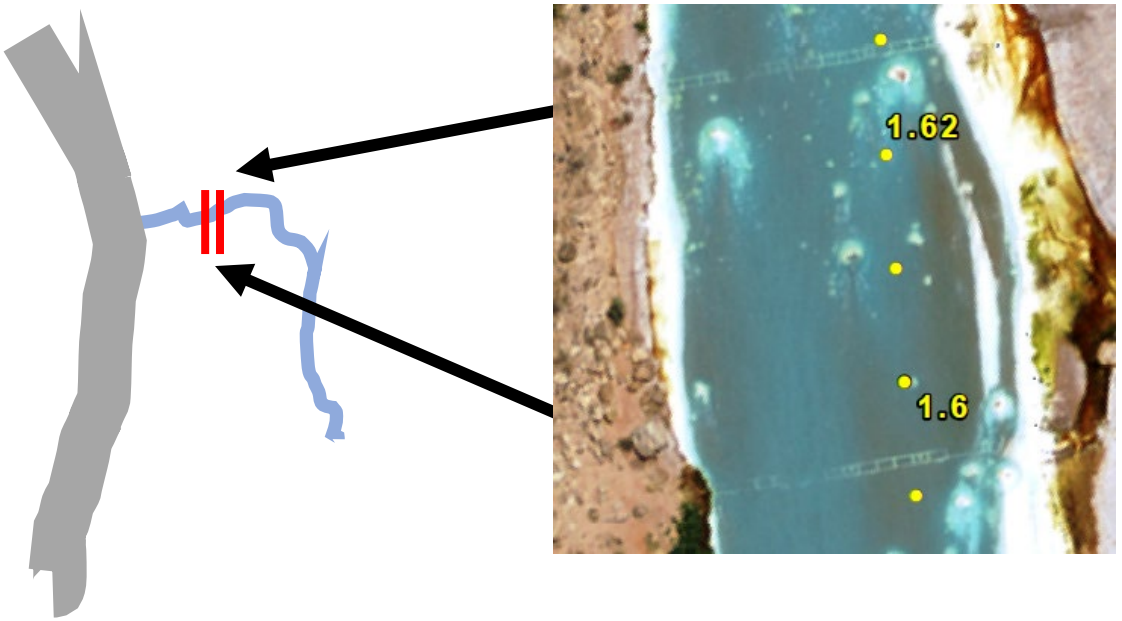
Adult abundances in the LCR aggregation are above the trigger



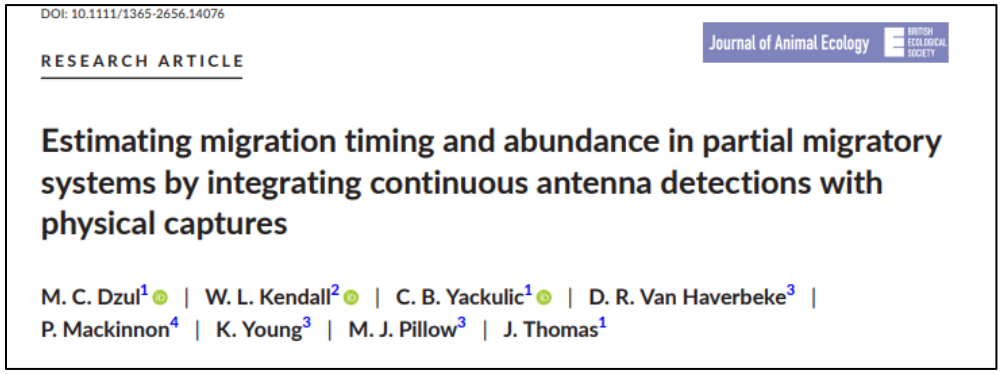


Using PIT antennas to estimating **partial migration** and **movement timing**

In addition to HBC, we also evaluate migrations of bluehead sucker and flannelmouth sucker!



Dzul, M. C., W. L. Kendall, C. B. Yackulic, D. R. Van Haverbeke, P. Mackinnon, K. Young, M. J. Pillow, and J. Thomas. "Estimating migration timing and abundance in partial migratory systems by integrating continuous antenna detections with physical captures." *Journal of Animal Ecology* (2024).


DOI: 10.1111/1365-2656.14076

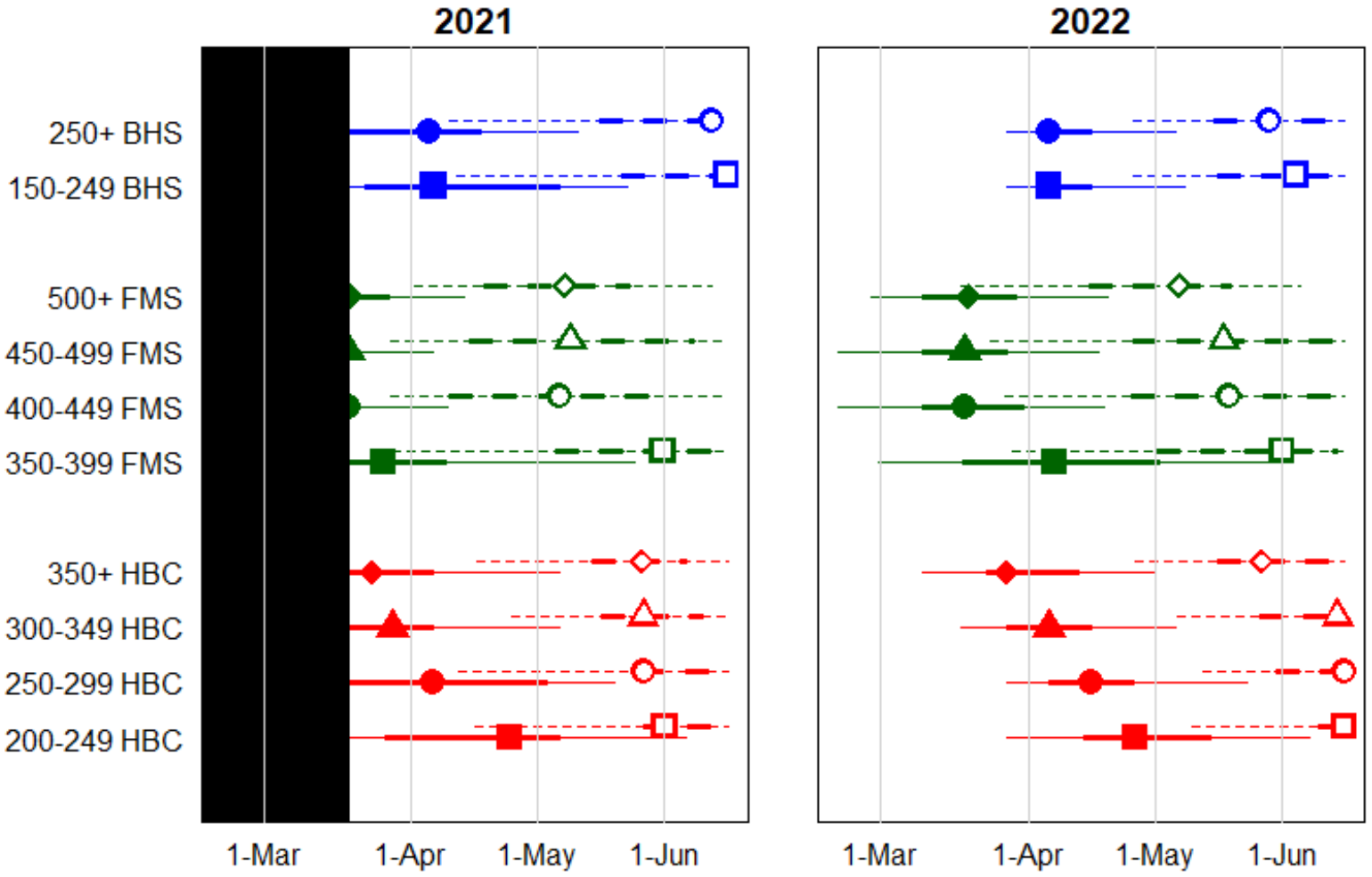
Journal of Animal Ecology

RESEARCH ARTICLE

Estimating migration timing and abundance in partial migratory systems by integrating continuous antenna detections with physical captures

M. C. Dzul[1] | W. L. Kendall[2] | C. B. Yackulic[1] | D. R. Van Haverbeke[3] | P. Mackinnon[4] | K. Young[3] | M. J. Pillow[3] | J. Thomas[1]

Blog version



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Take-home points: LCR & JCM East

- Juveniles in 2024 were low to moderate in the LCR & JCM-east
- Subadult abundances
  - Are increasing and expected to continue to increase in near future
  - but still below the trigger based on JCM-east
- Adult estimates remain high

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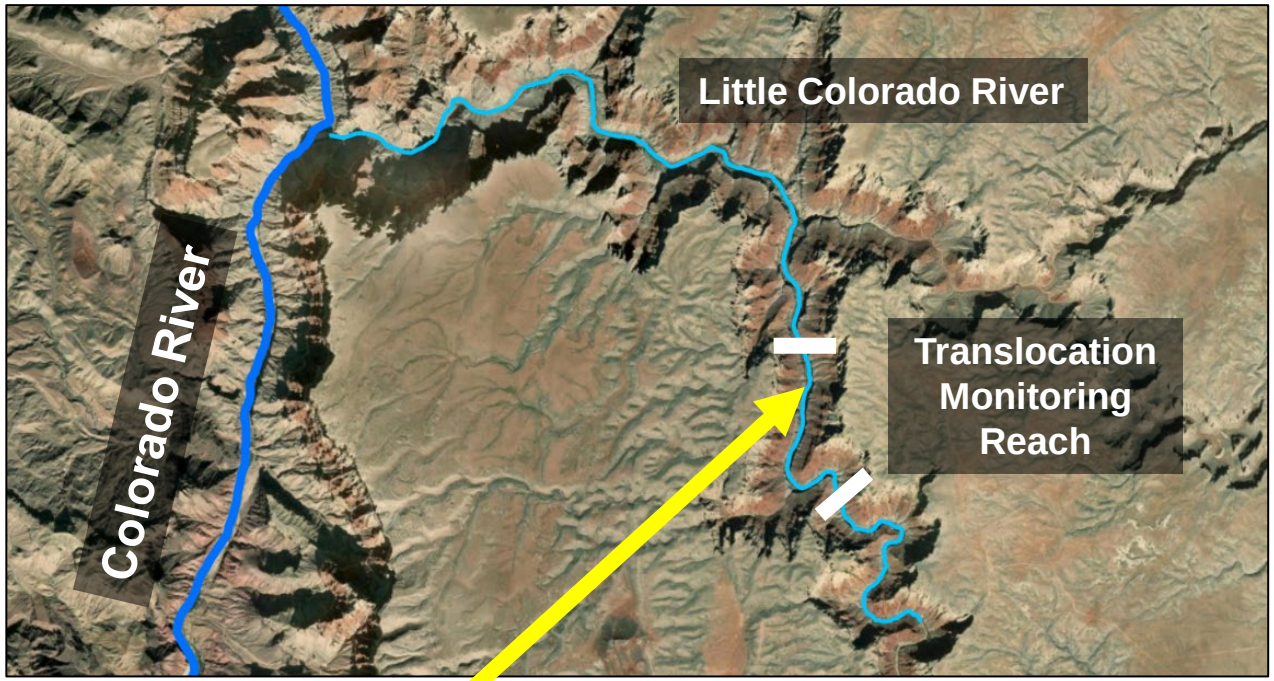
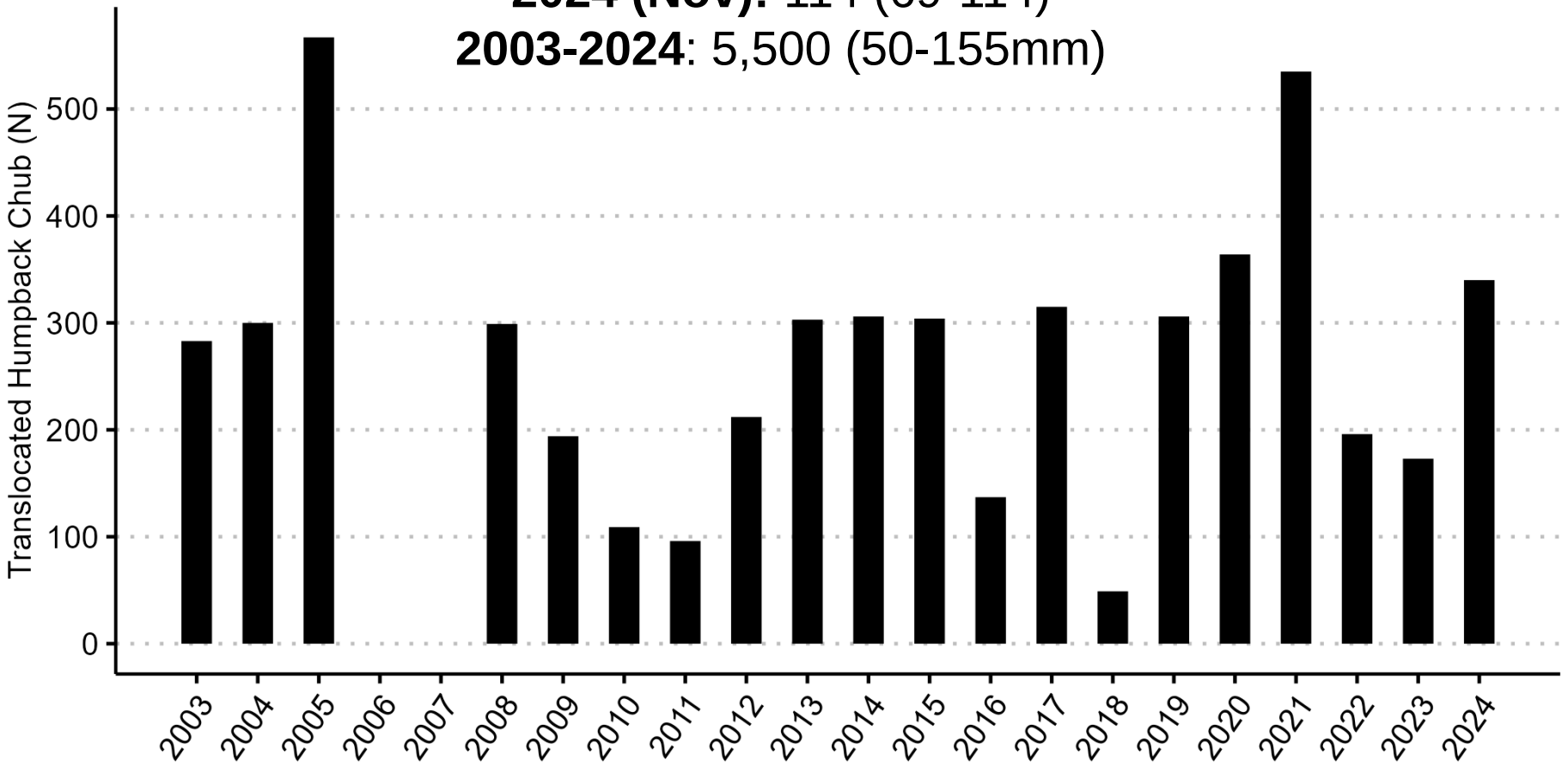
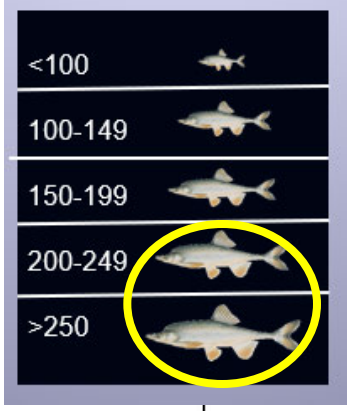
Humpback Chub Translocation and Chute Falls Monitoring



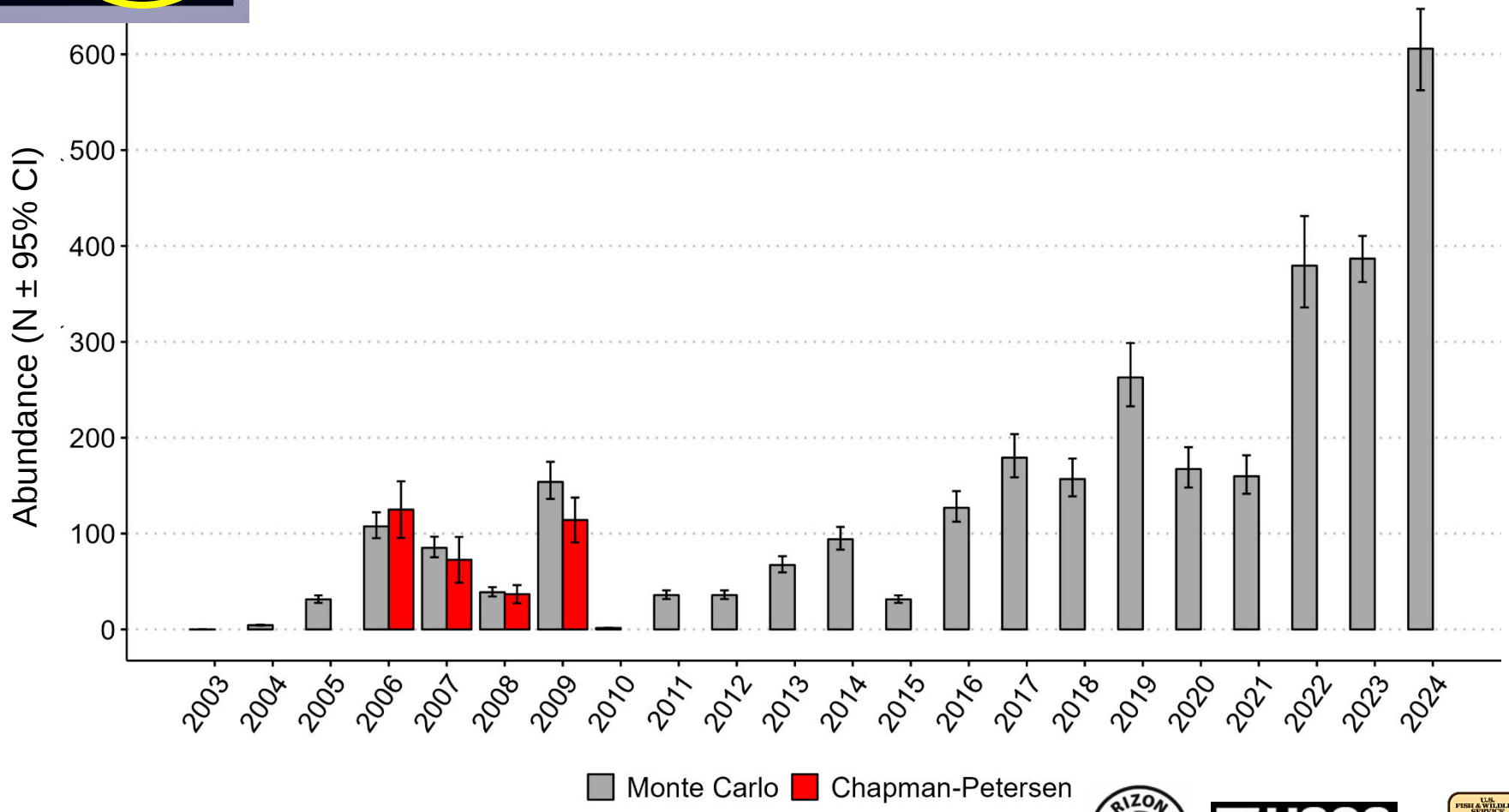
Annual HBC Translocations above Chute Falls

2024 (May): 341 (78-124mm)
2024 (Nov): 114 (69-114)
2003-2024: 5,500 (50-155mm)

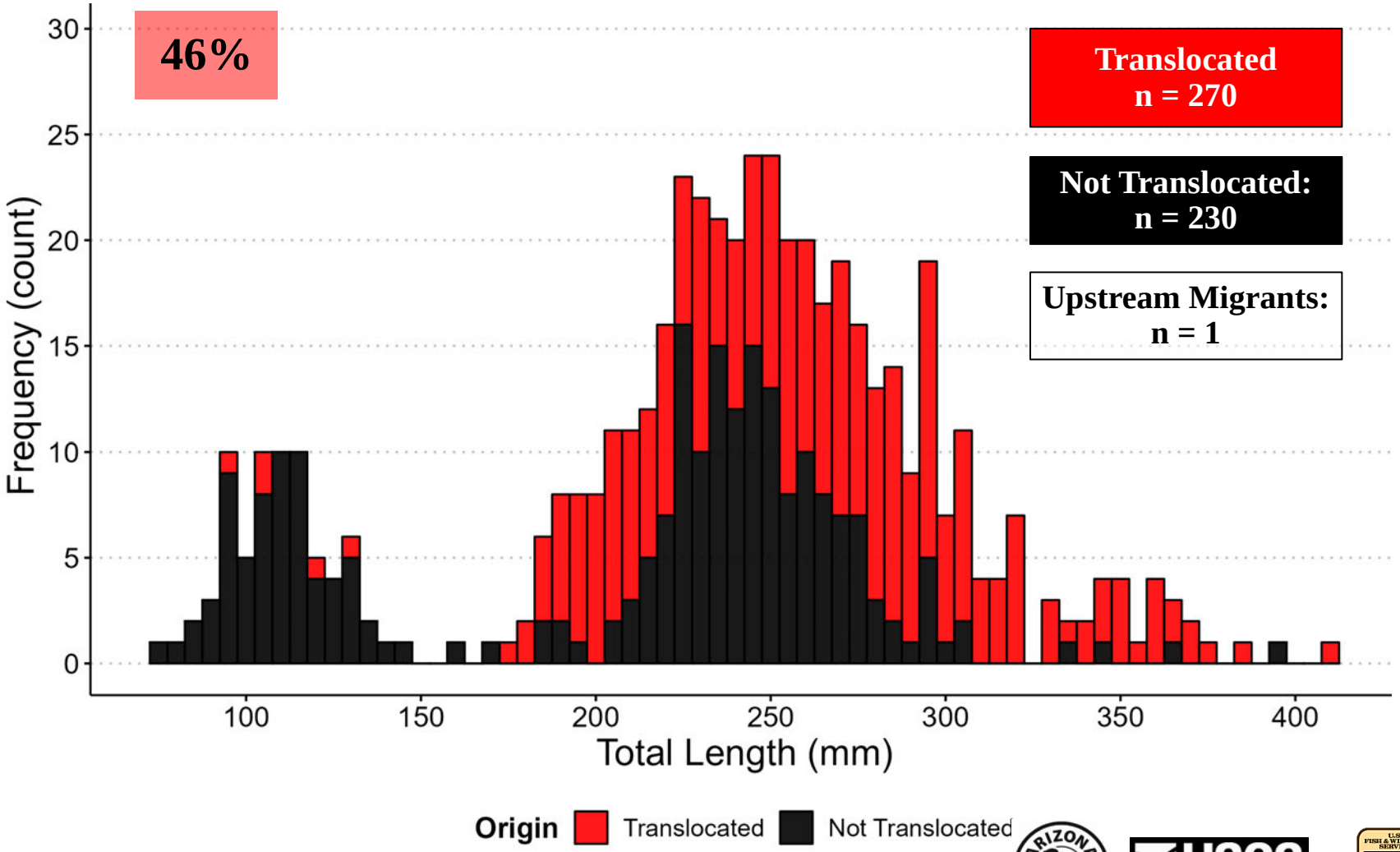




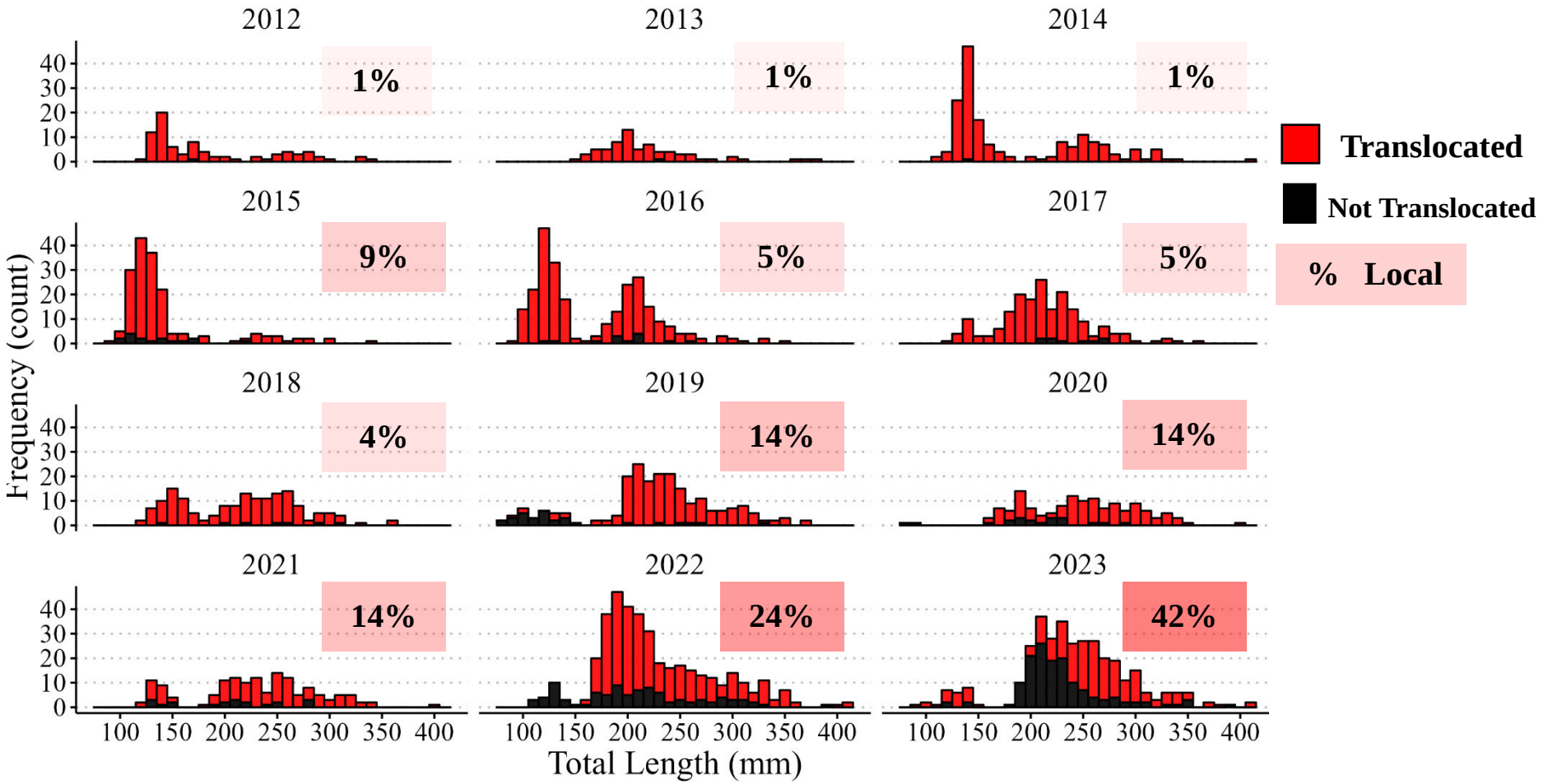
Spring adult abundance *above Chute Falls* shows increasing trend and highest estimates recorded in 2024



46% of HBC captured above Chute Falls in 2024 were ***not*** translocated there

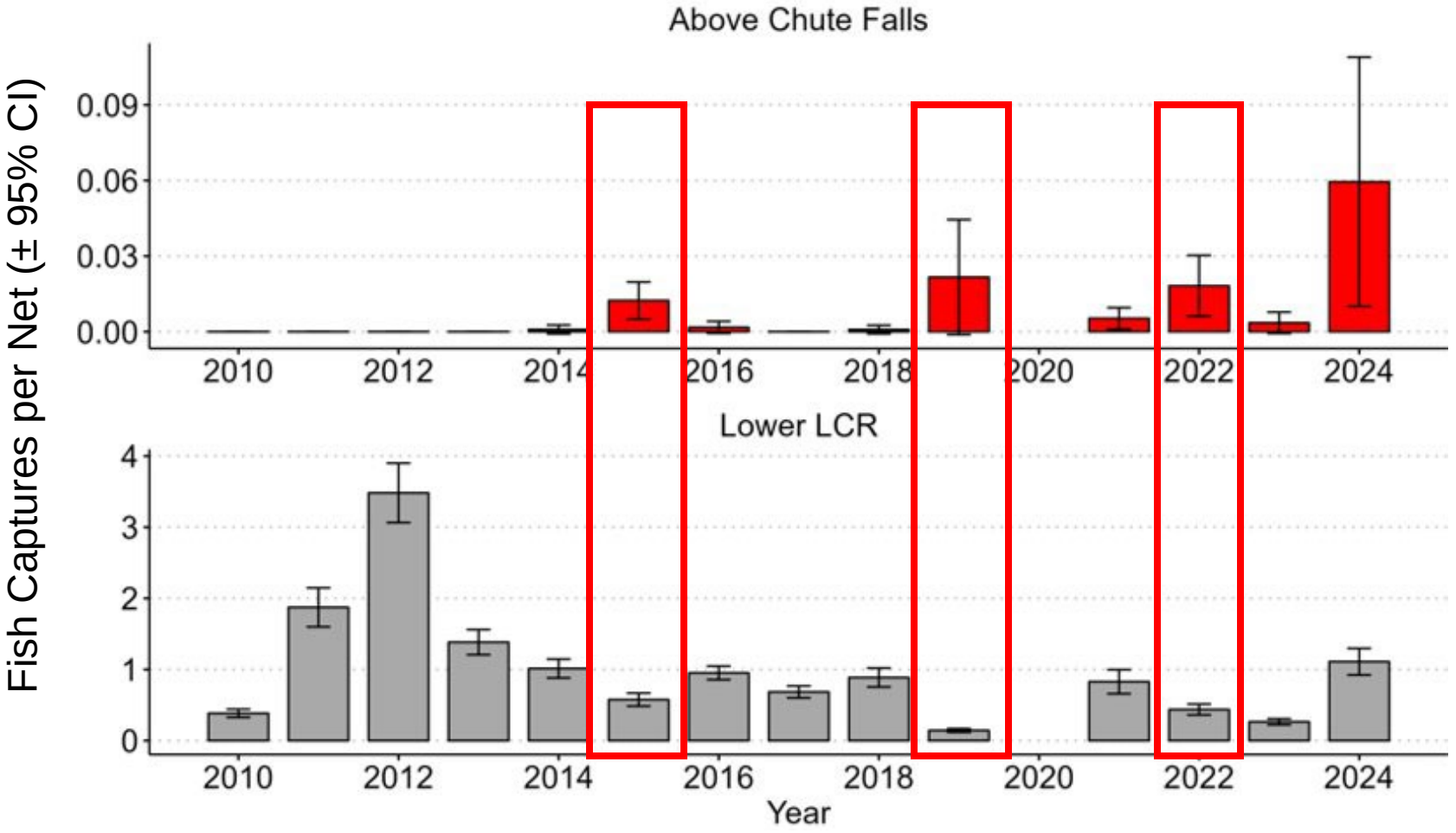


The proportion of local (not translocated) HBC above Chute Falls has increased substantially since 2011



***12** HBC have been documented moving above Chute Falls from below between 2007-2024

Age-1 relative abundance above Chute Falls was higher in years where it was low below the falls



Summary: Chute Falls Translocations

- Adult HBC abundance in the translocation reach remains high and continues to grow.
- 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
- 455 HBC were translocated above Chute Falls in 2024 (two translocations)
  - 5,500 total fish have been translocated since 2003

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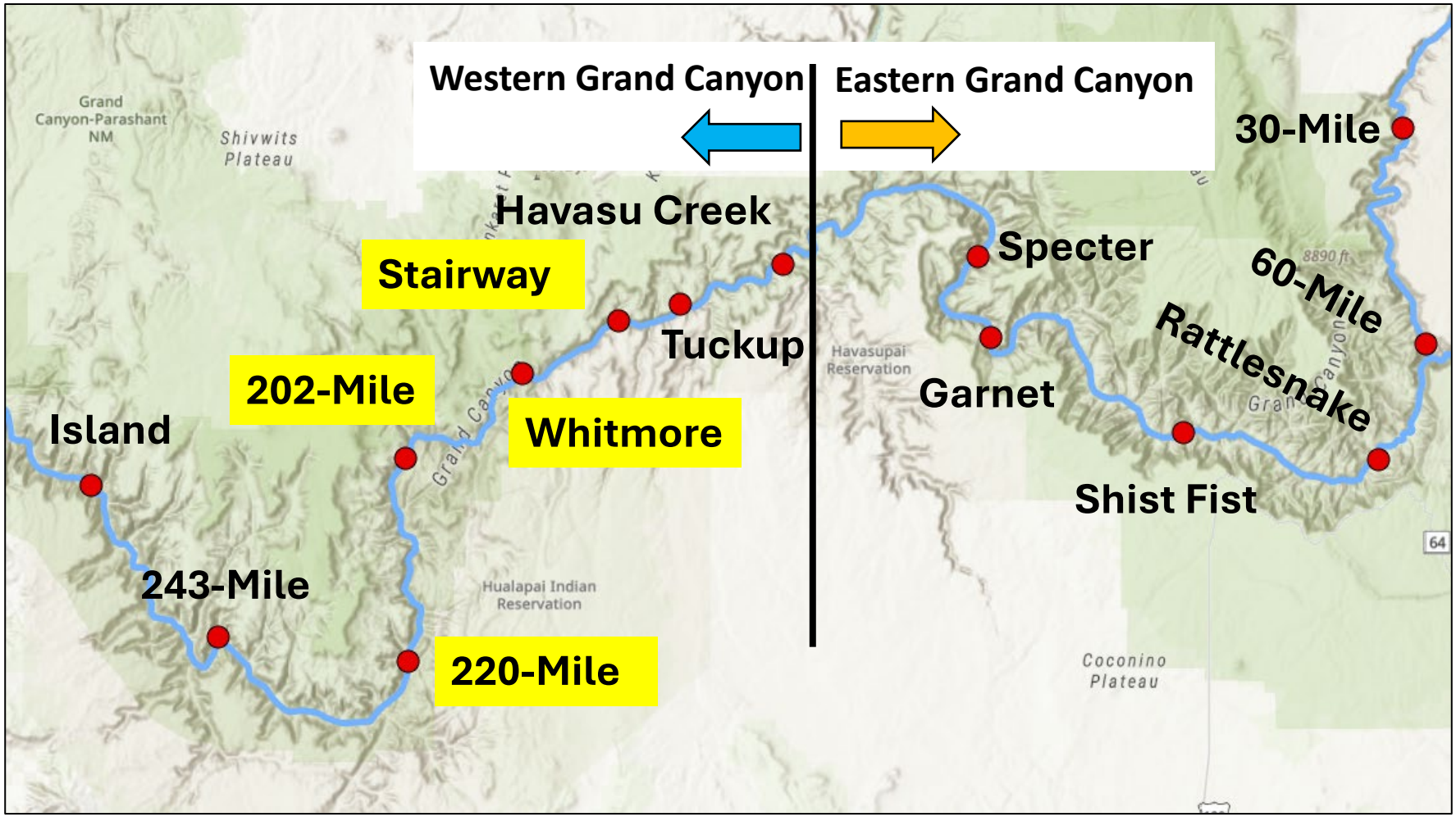
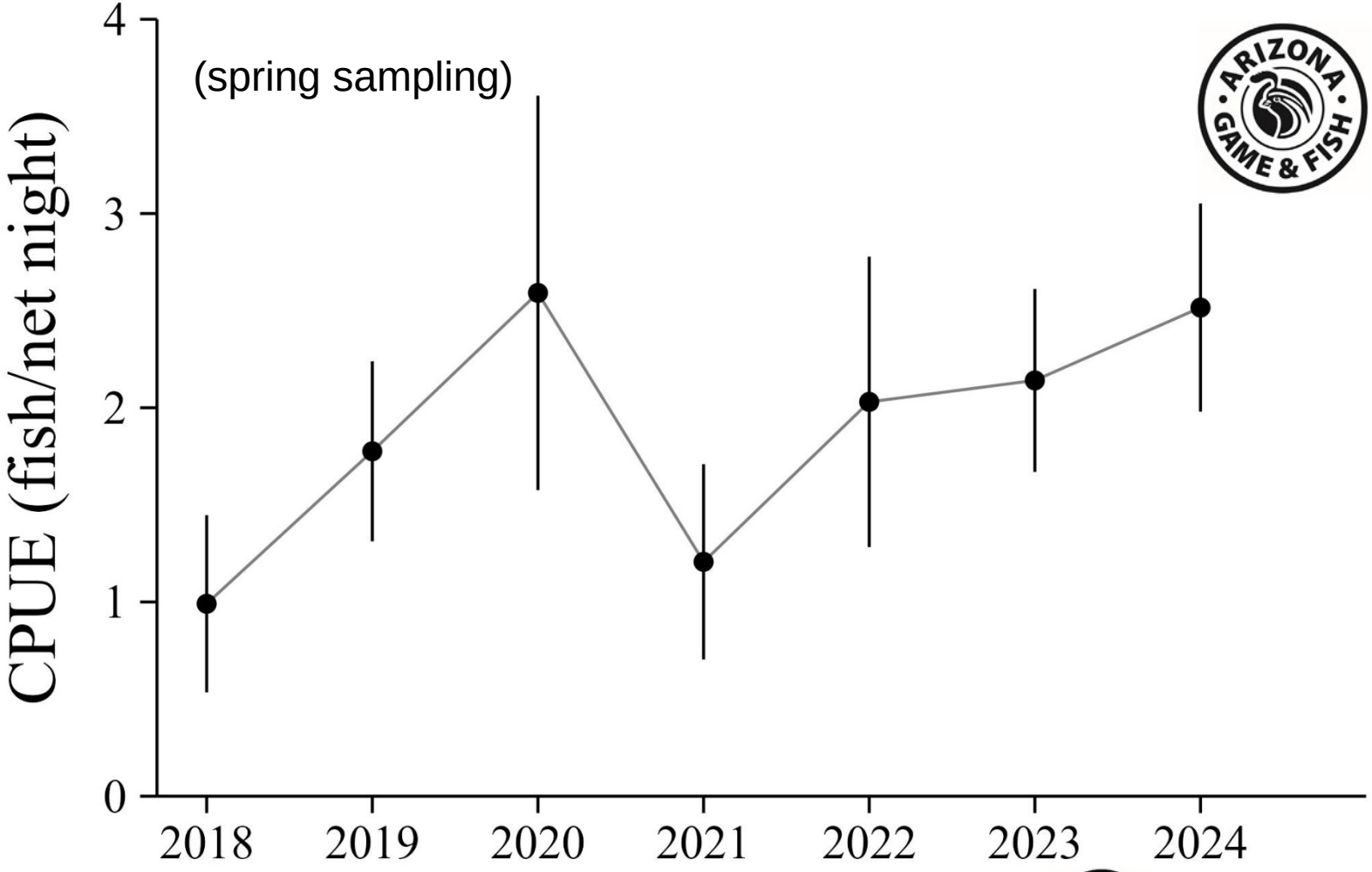
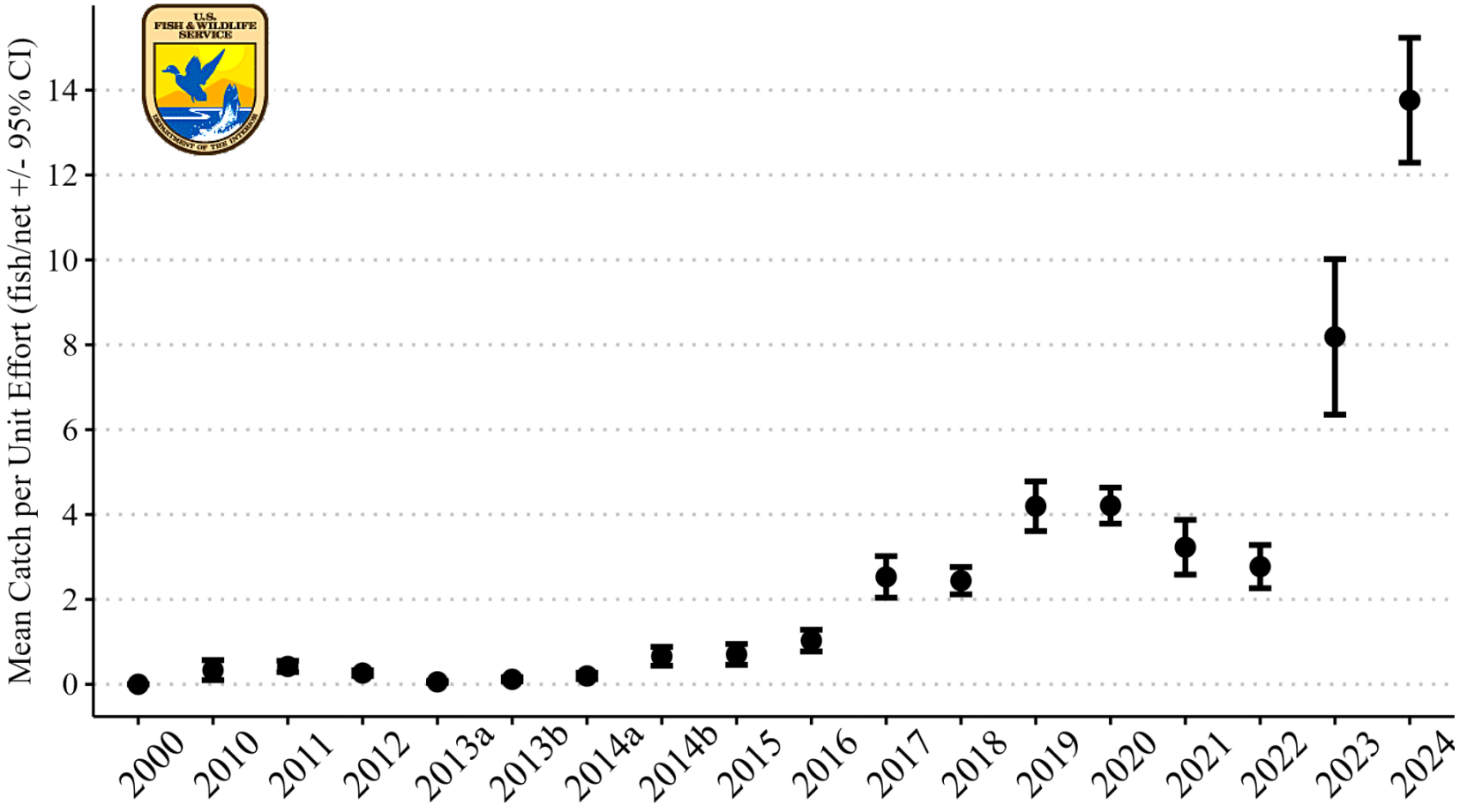
2024 Mainstem HBC aggregation trip sampled 14 sites with hoop nets from 30-mile and Island (RM 266) in the fall



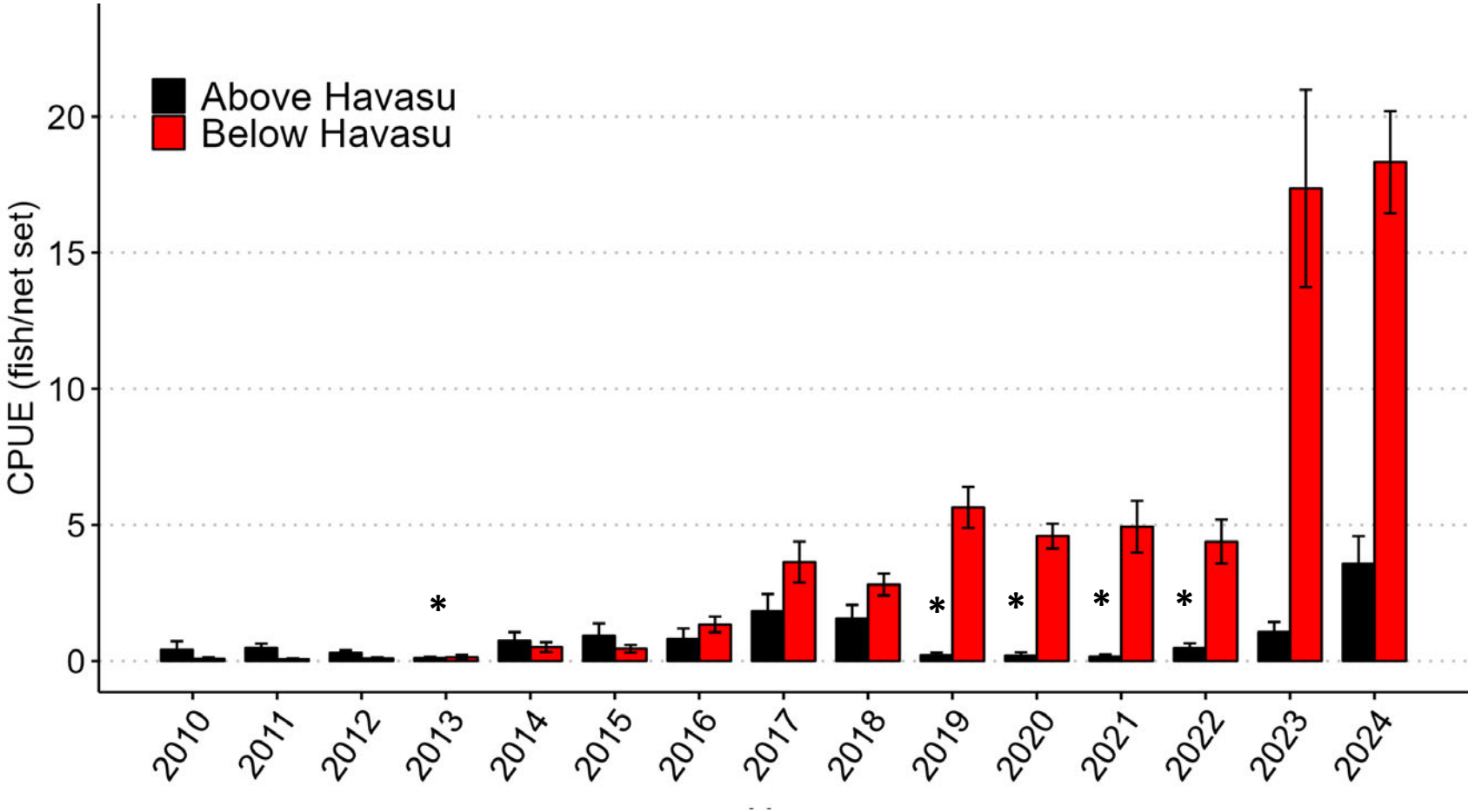
AGFD river-wide hoop net CPUE shows an increase in spring HBC relative abundance since 2017



Overall HBC fall relative abundance at highest level on record

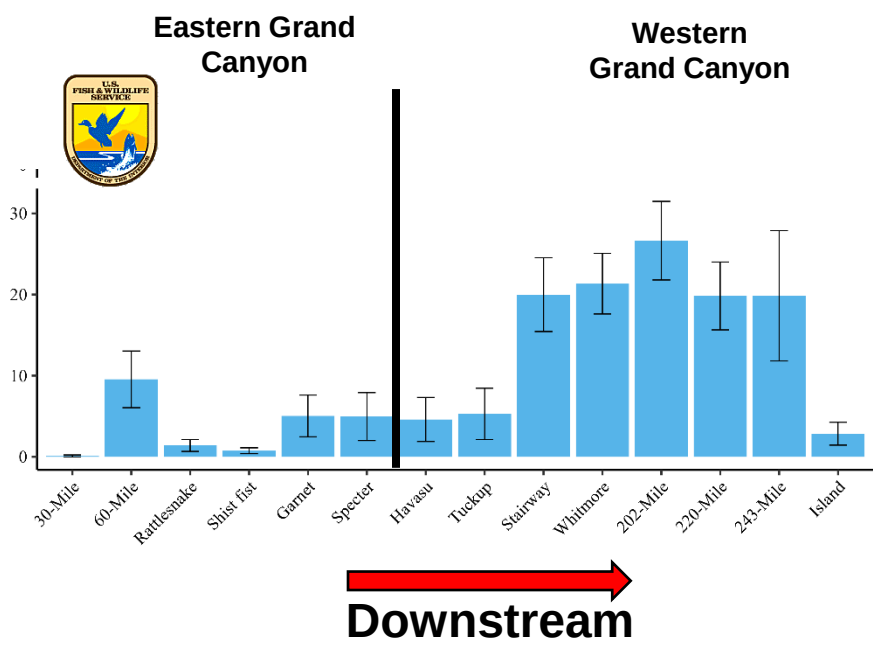


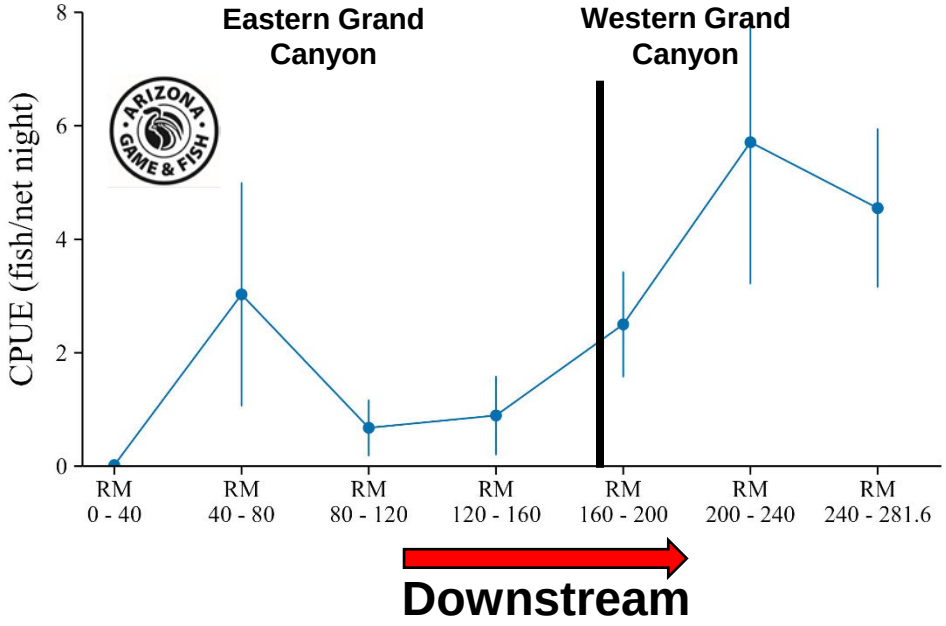
This increase is primarily driven by captures in the western Grand Canyon, below Havasu Creek



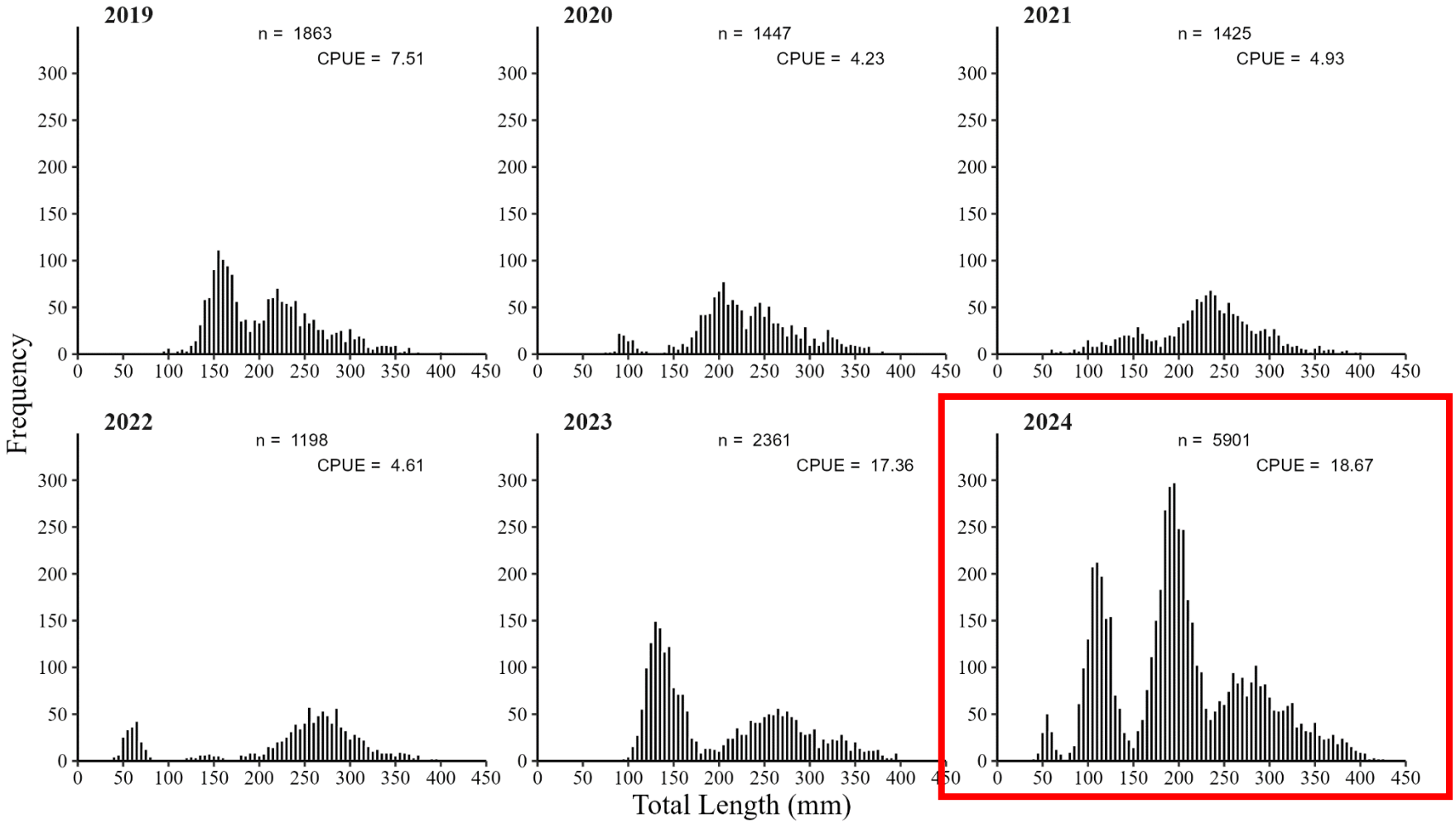
*LCR Aggregation not sampled

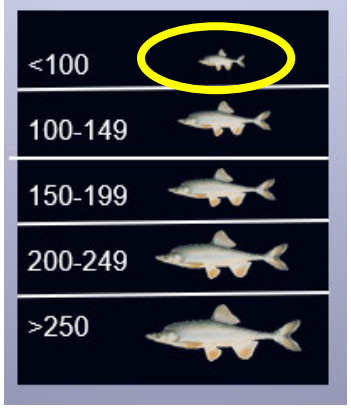
AGFD and HBC Aggregations find most HBC between 200-240 mile in 2024



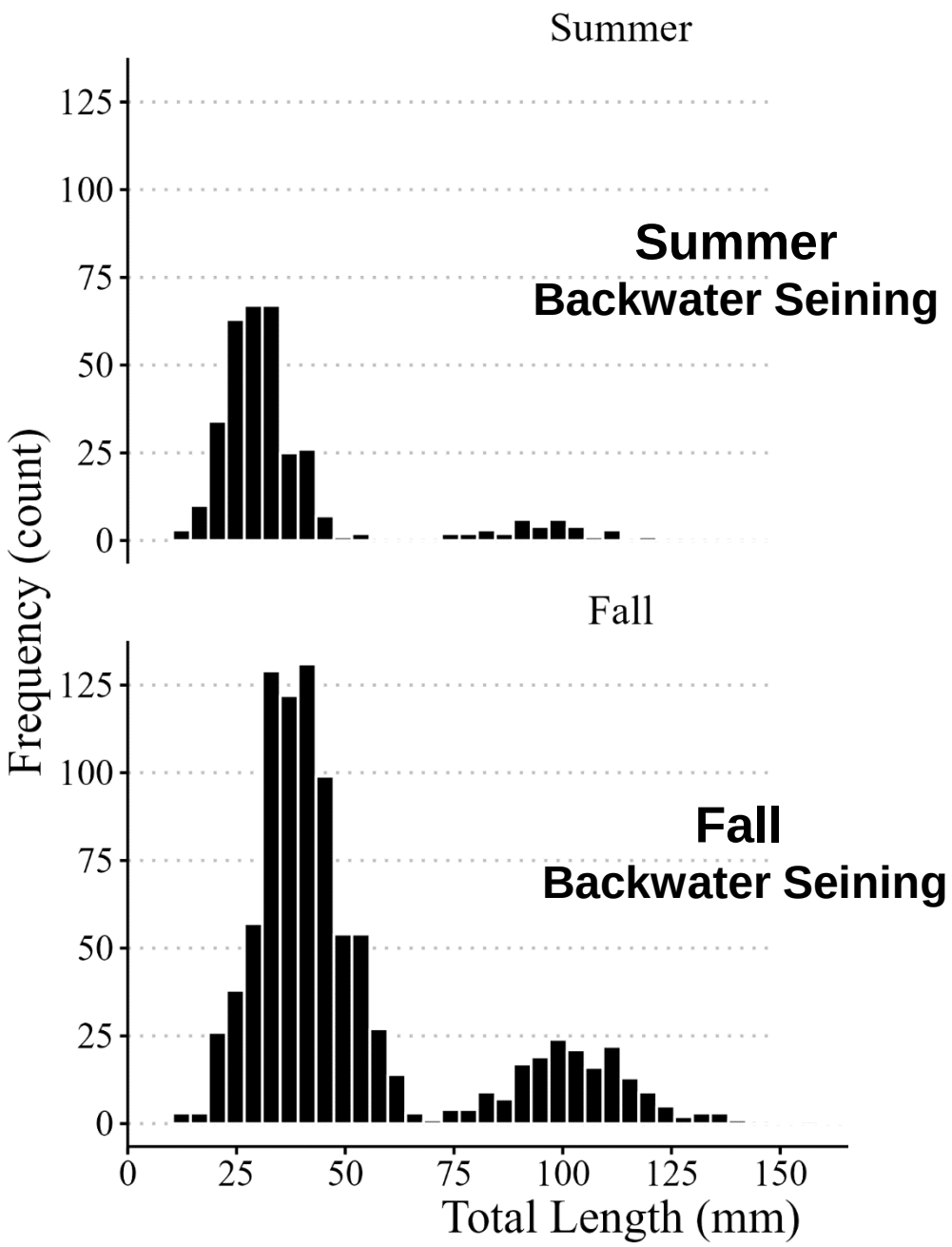


Relative abundance in 2024 is determined by all size classes in western Grand Canyon





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



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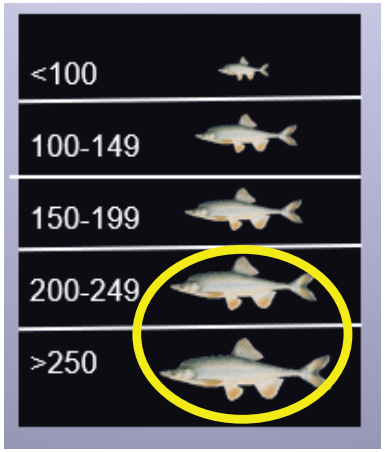
Abundance estimation in western Grand Canyon (Havasu to Pearce Ferry)

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

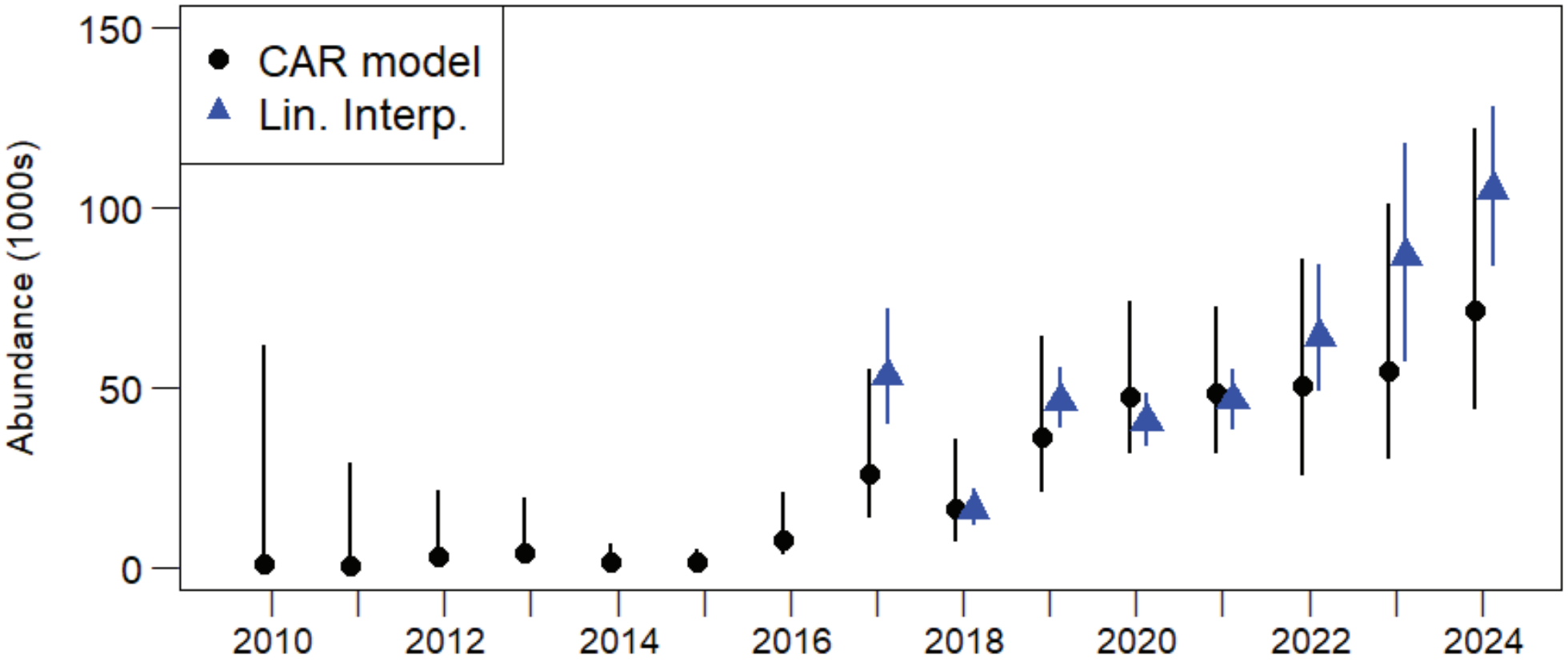
2) Capture probability & catch to estimate density

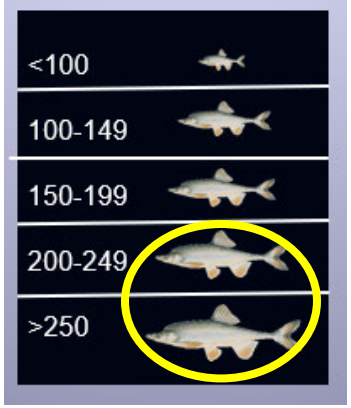
   -effects of turbidity, temp, etc.

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



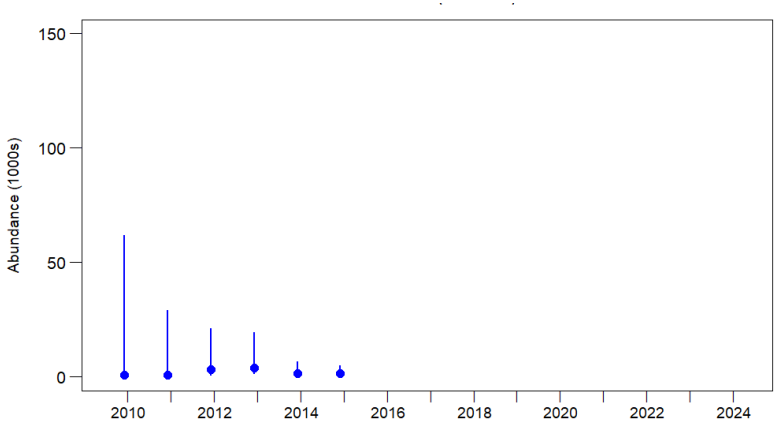
Abundance of adult humpback chub in western Grand Canyon



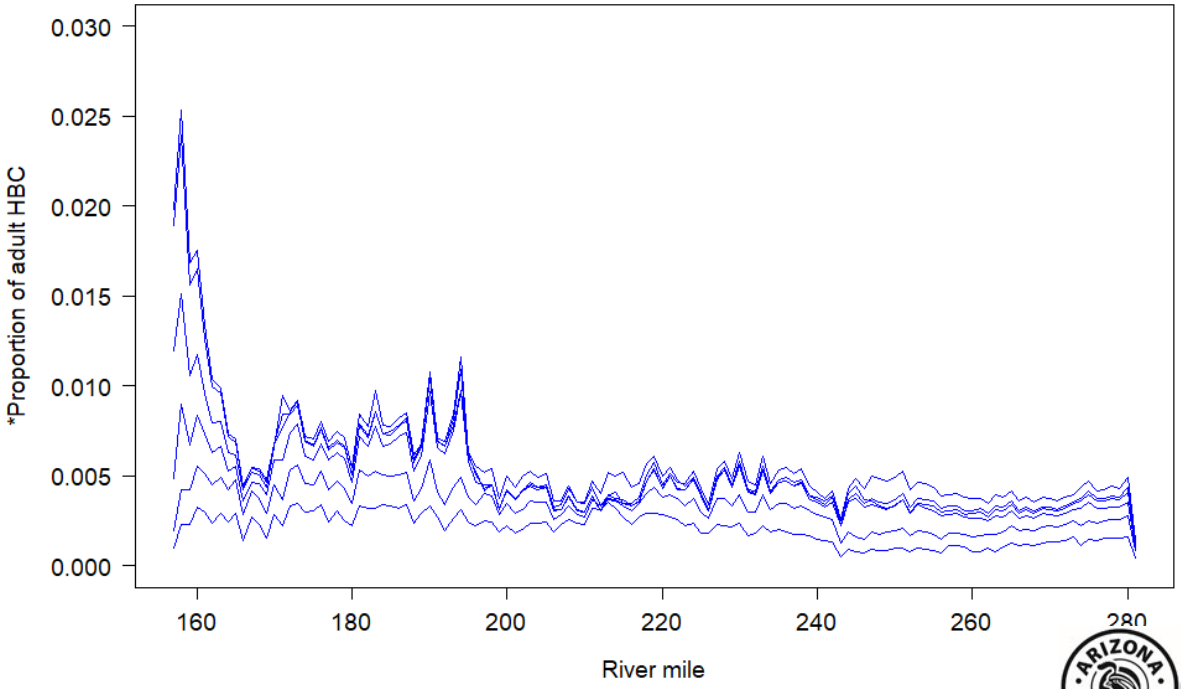


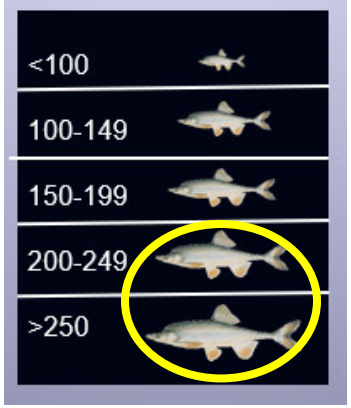
Western Grand Canyon humpback chub abundance (2010-2015)

- Adult abundance is low
- Most fish are in the upper reaches (near confluence of Havasu Creek)



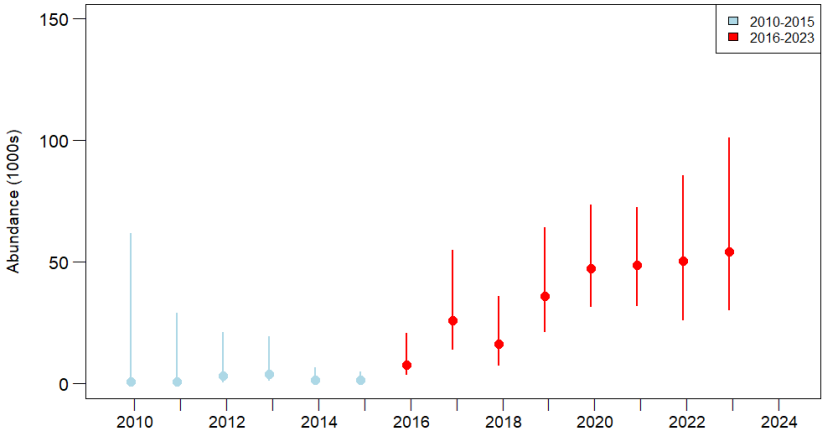
*Refers to the proportion, of the total abundance in western Grand Canyon in each year, that is estimated to be within each 0.1RM bin.



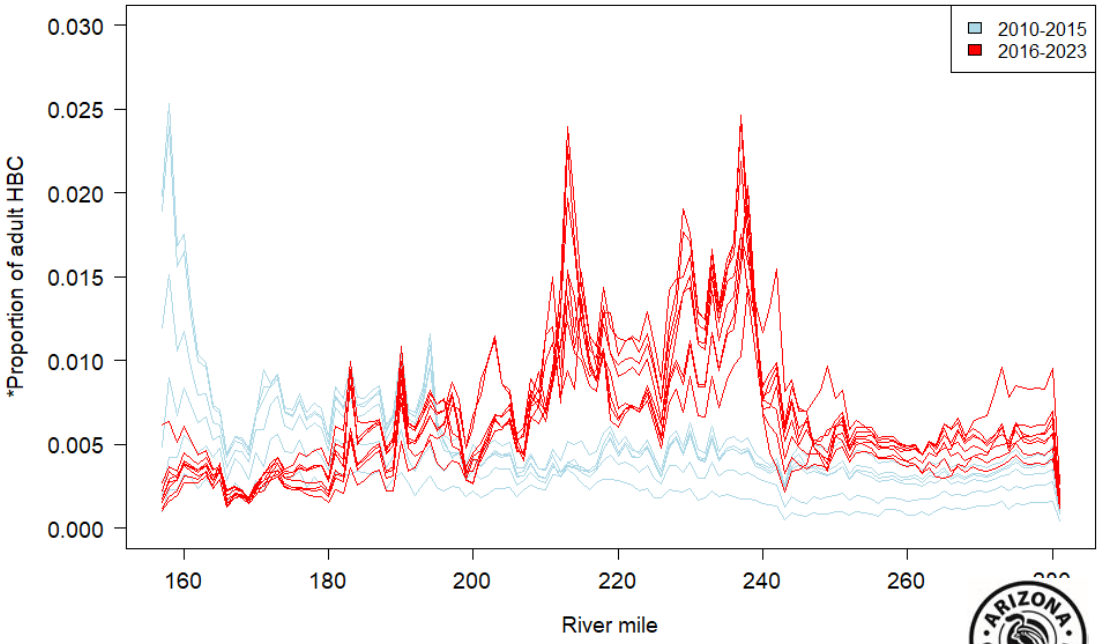


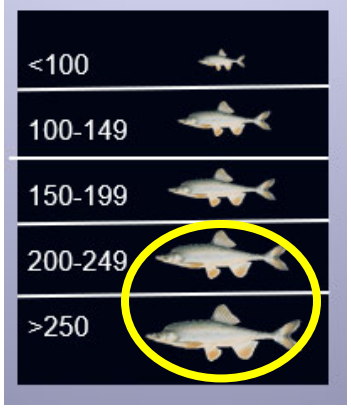
Western Grand Canyon humpback chub abundance (2016-2023)

- Abundance is growing and high
- Most fish in the middle reaches (RM210-240)



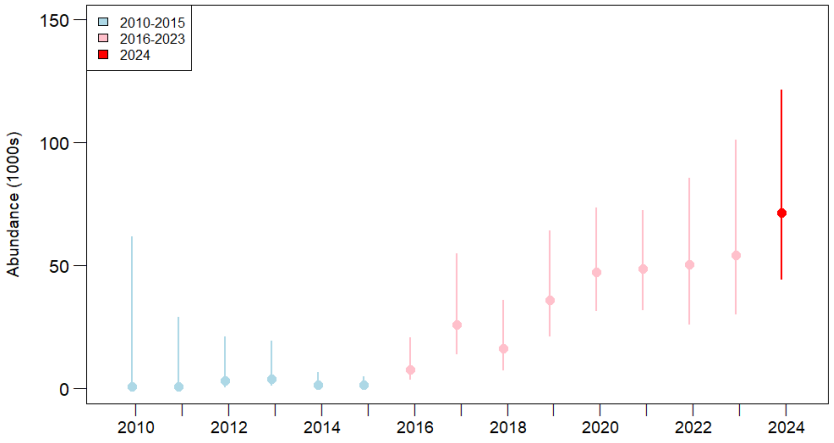
*Refers to the proportion, of the total abundance in western Grand Canyon in each year, that is estimated to be within each 0.1RM bin.



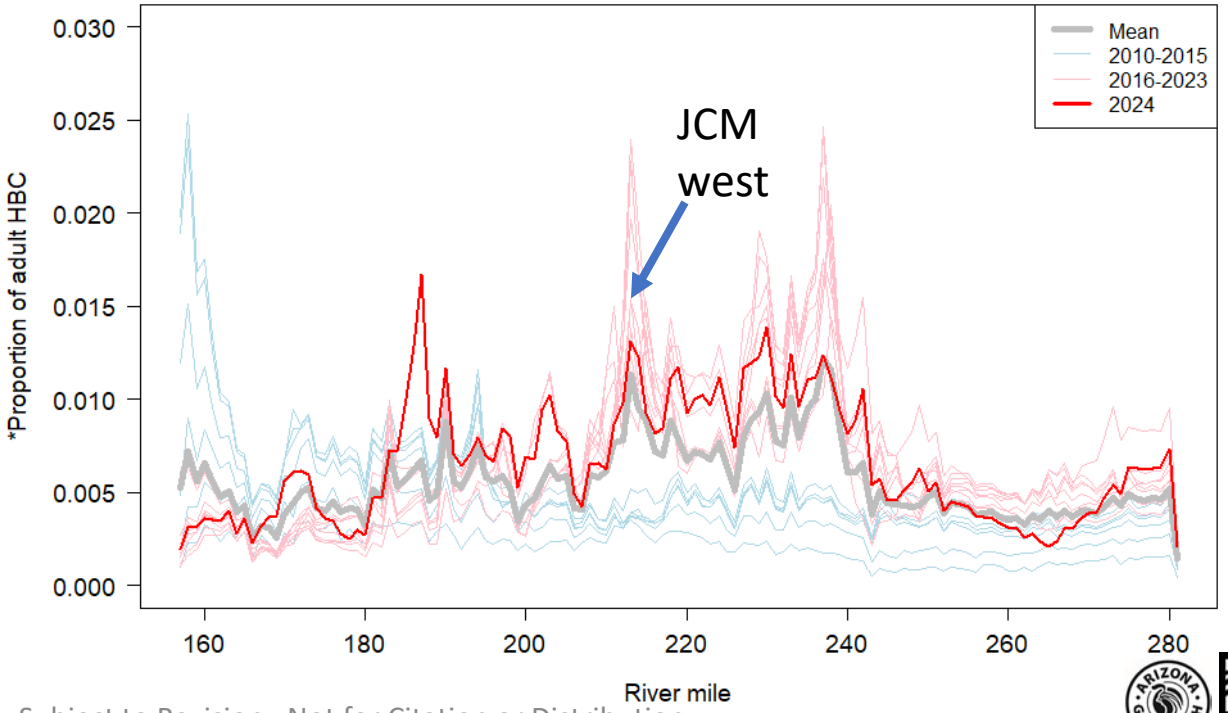


Western Grand Canyon humpback chub abundance (2024)

- All-time high
- Potential increase in upstream reaches (180-200).



*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.



Summary: HBC Aggregations

- Models suggest all-time high of adult HBC in western Grand Canyon in 2024
  - Also lots of juveniles and subadults
- 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
  - Juvenile Chub Monitoring (JCM) – east
  - Total adults & triggers
  - Chute Falls translocations
- Western Grand Canyon
  - Humpback Chub monitoring
    - Hoop net relative abundance
    - Abundance estimates in western Grand Canyon
  - JCM – west

Fixed site monitoring in western Grand Canyon (JCM-west)

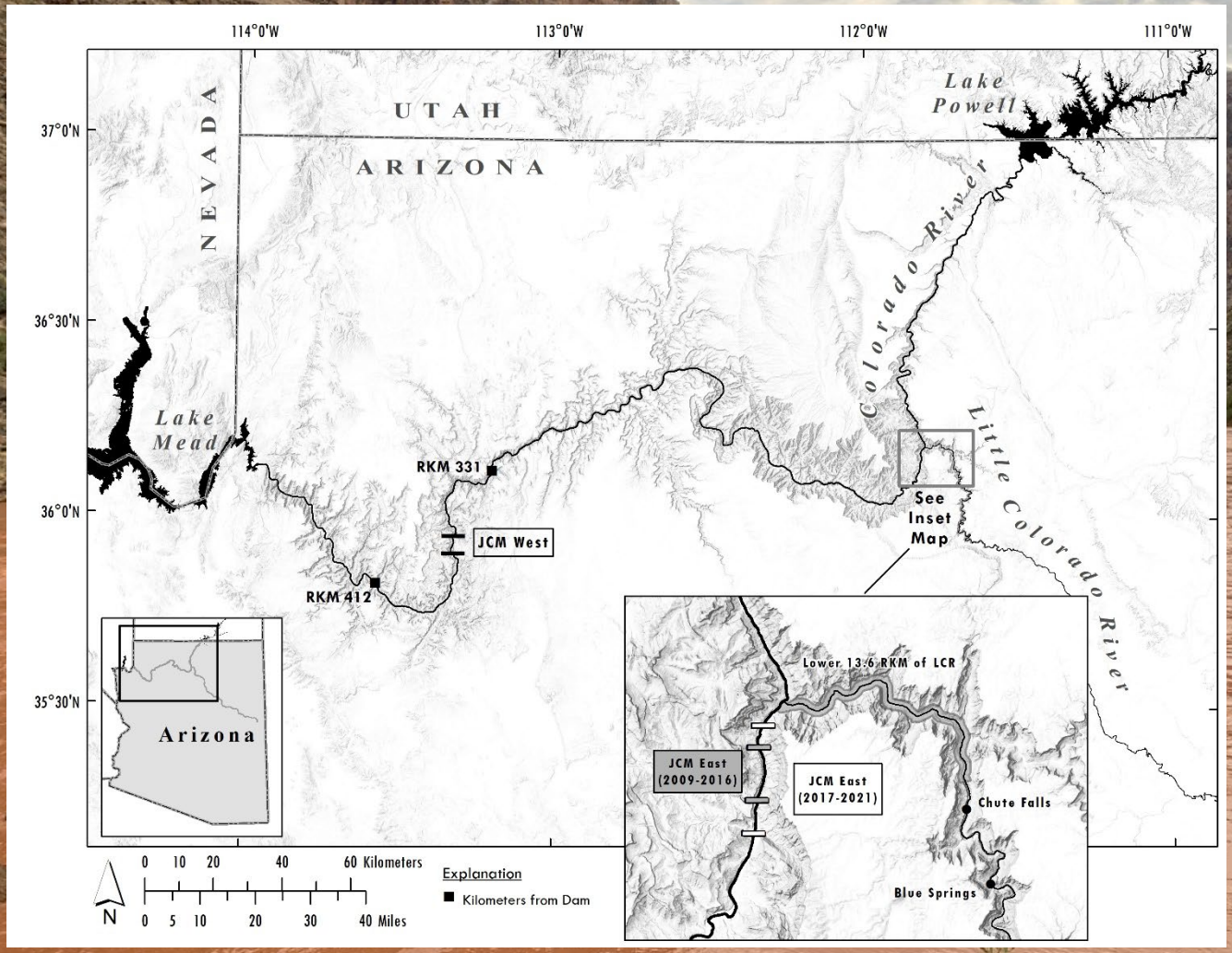
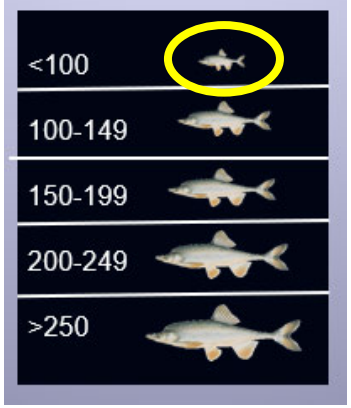
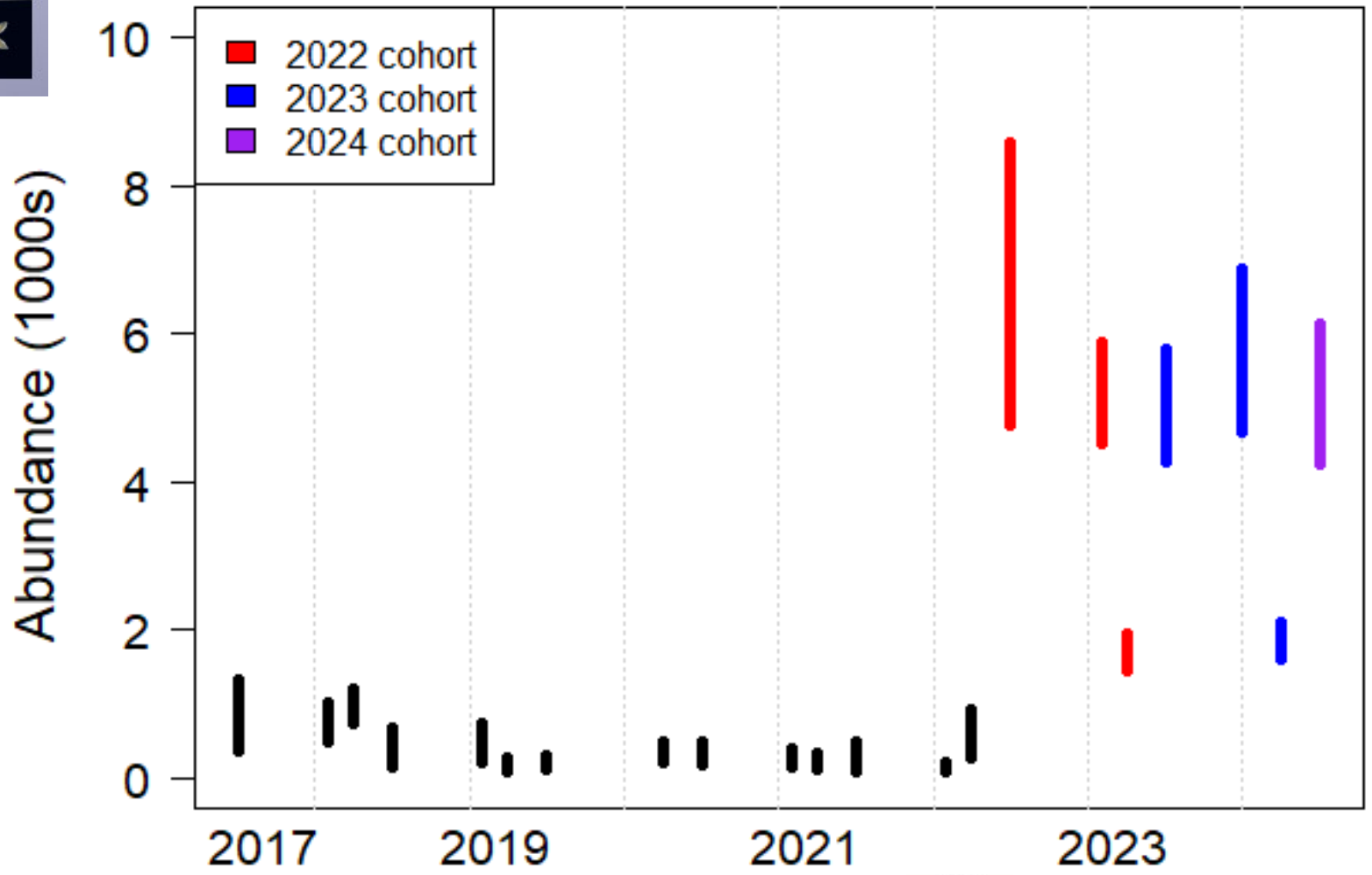
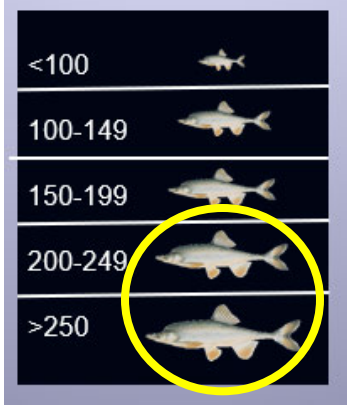


Photo by Lindsay Hansen

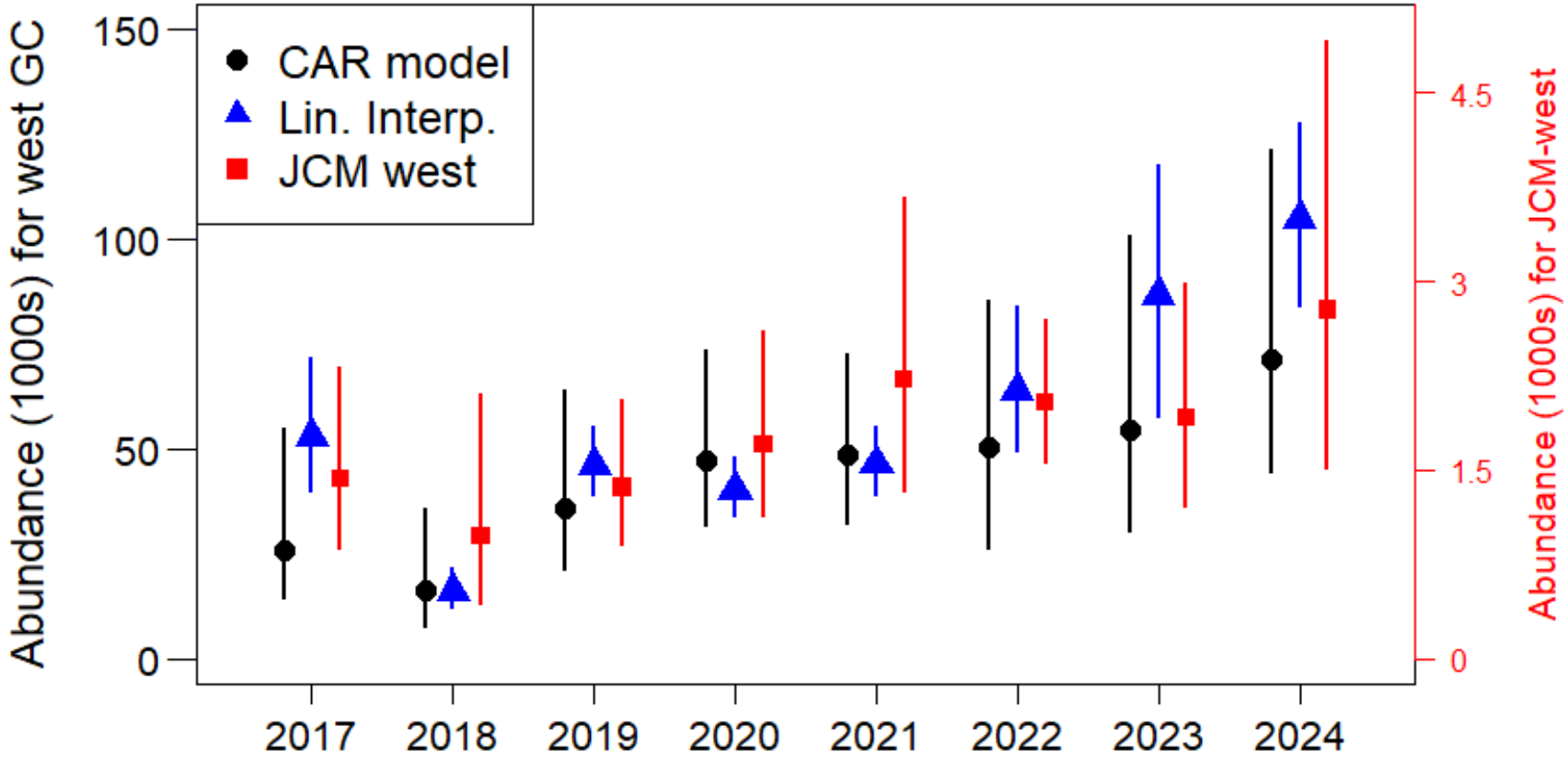


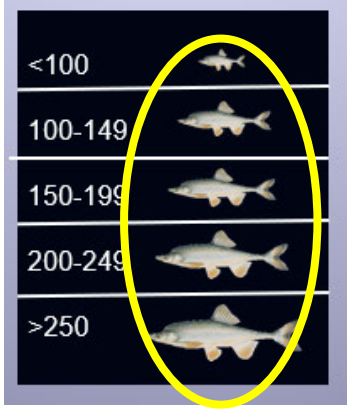
High juvenile abundance in JCM-west in 2022 & 2023





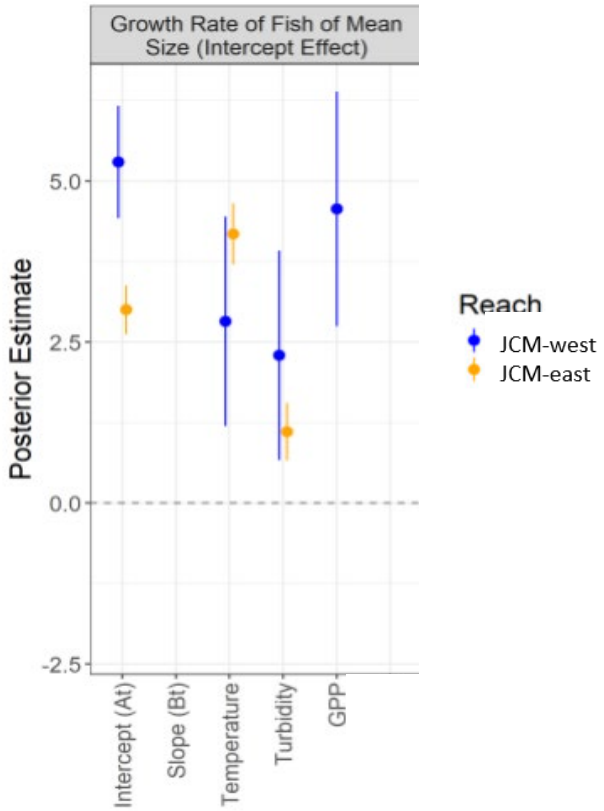
HBC adult abundance in JCM-west compared to western Grand Canyon





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

From Lindsay Hansen and others, USGS, In Prep



Eastern Grand Canyon (JCM-east)
- Temperature (+)
- Turbidity (+)

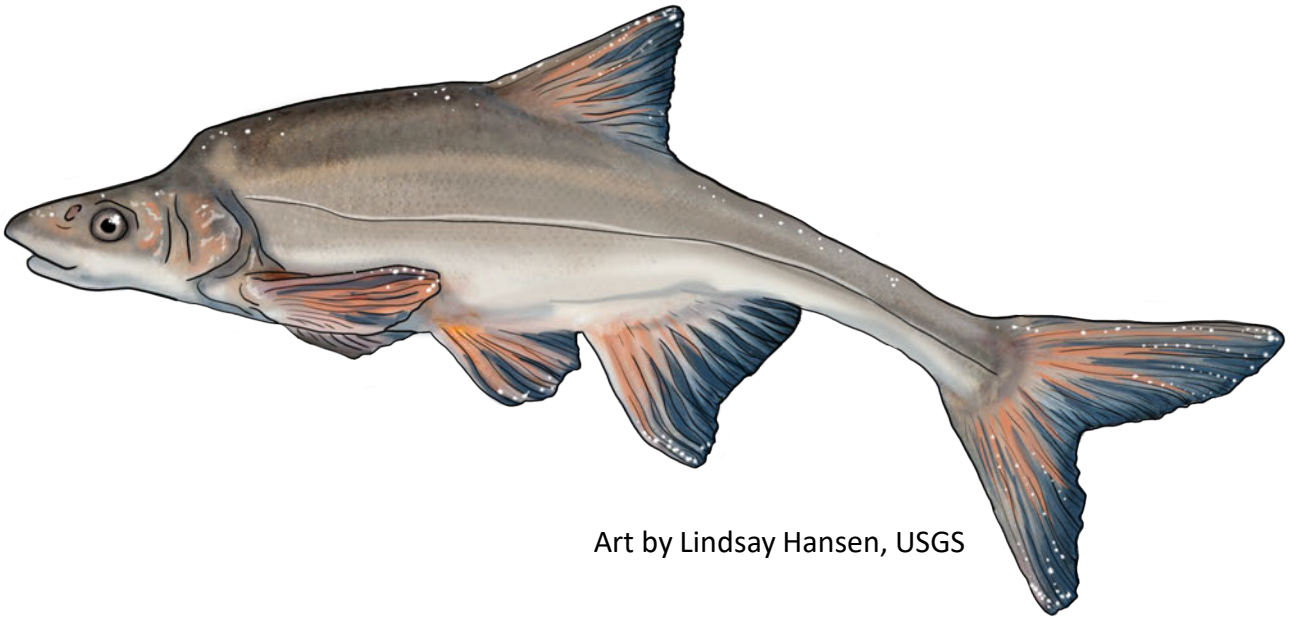
Western Grand Canyon (JCM-west)
- Temperature (+)
- Turbidity(+)
- GPP - Gross Primary Production (+)

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

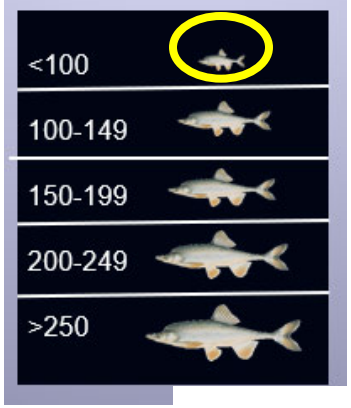
Summary: Humpback Chub in Grand Canyon

- Eastern Grand Canyon
  - Subadults are increasing
  - High abundance of adults
  - Coolmix likely slowed HBC growth in 2024
  - Chute Falls translocations: evidence of reproduction, particularly in no-flood years
- Western Grand Canyon
  - Adult abundance at its highest
  - Subadult abundance is also high
  - All size classes present
  - Growth is more affected by GPP than in the east

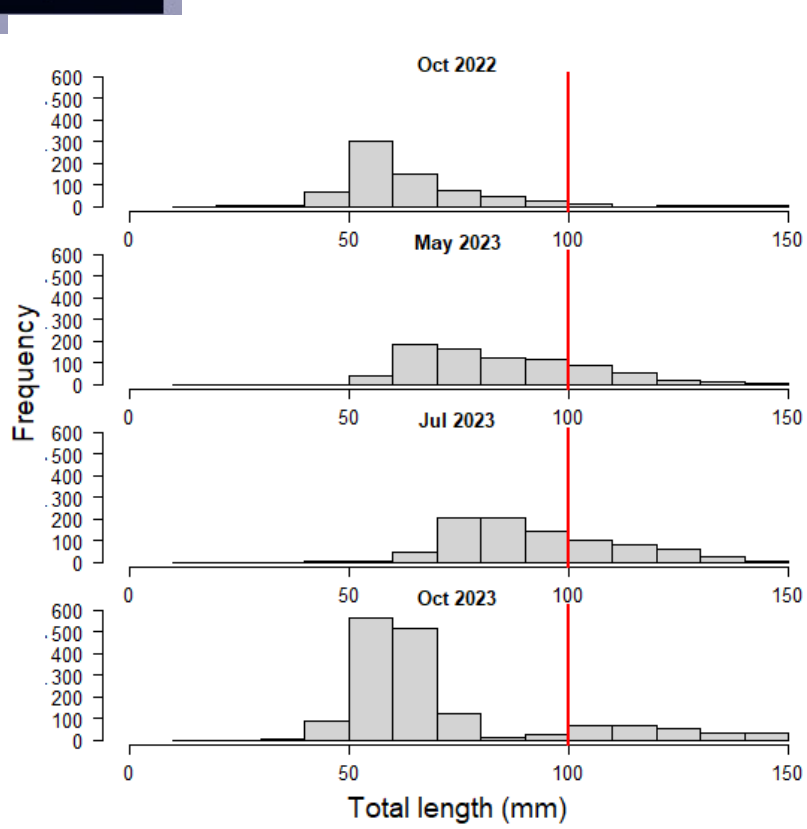
Thank You

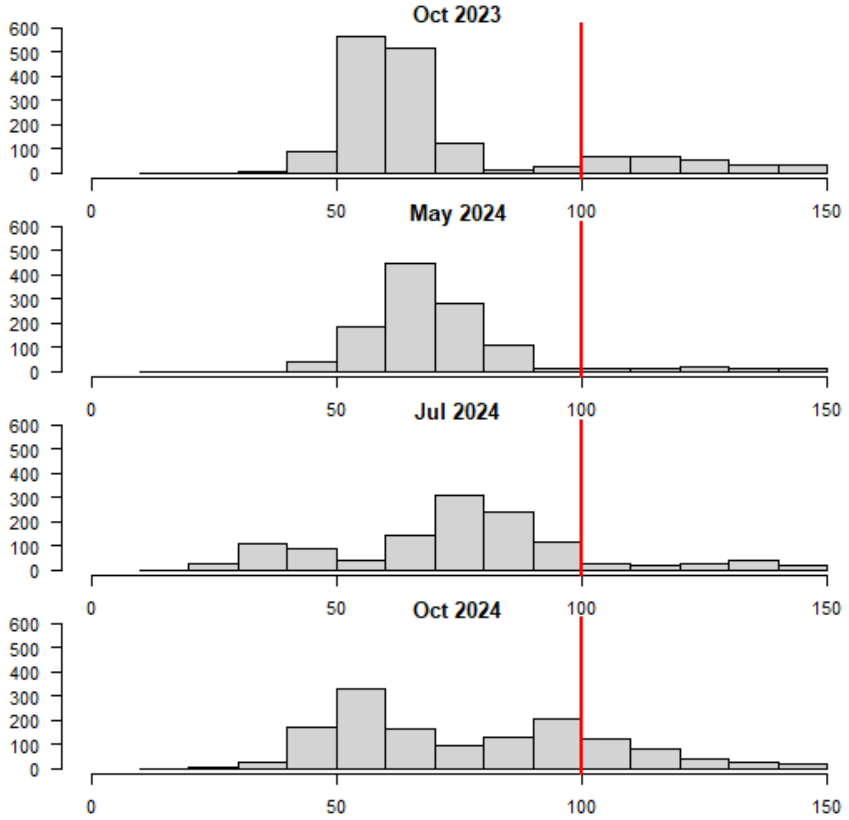


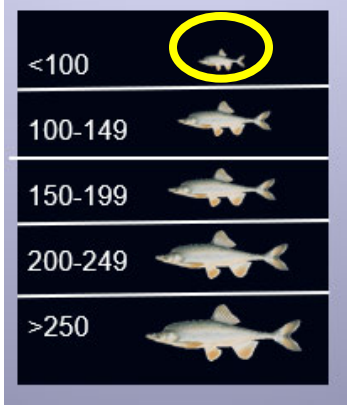
Art by Lindsay Hansen, USGS



Juvenile HBC length-frequency in JCM East

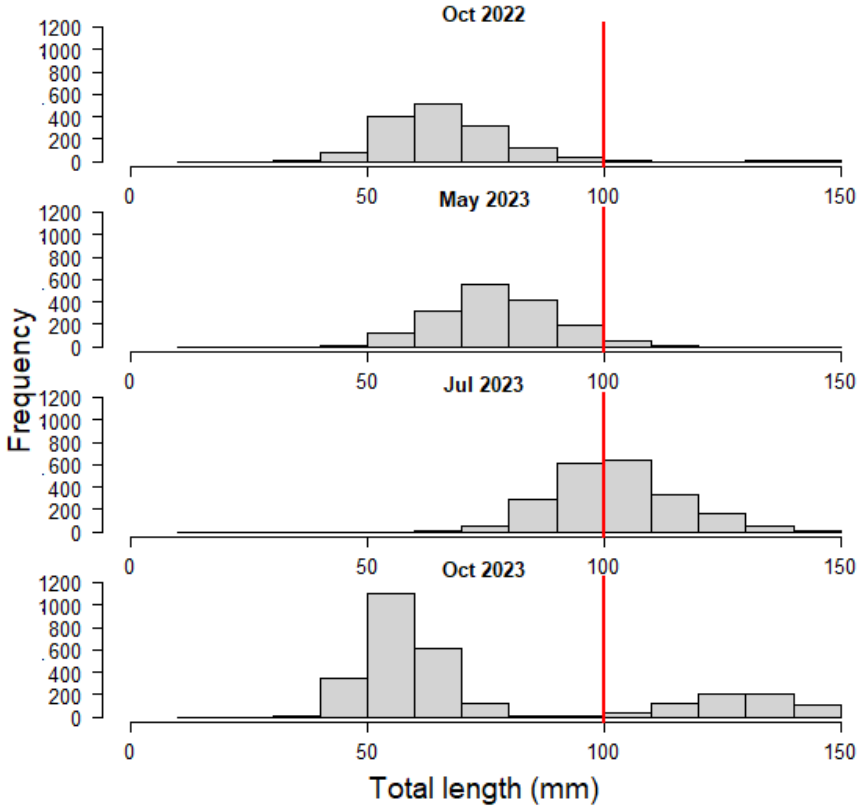


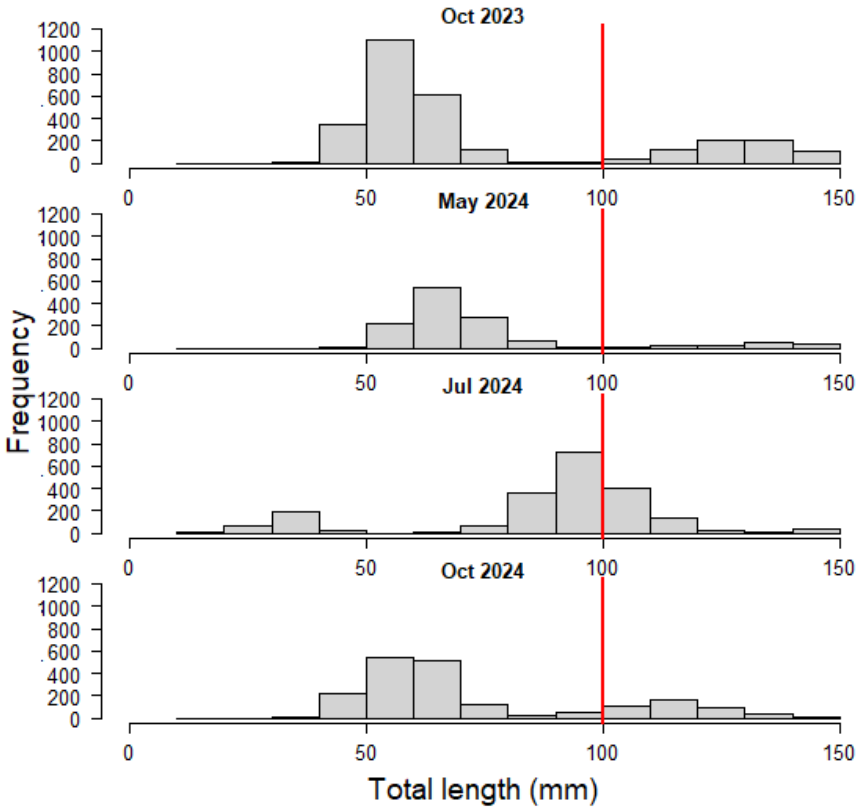


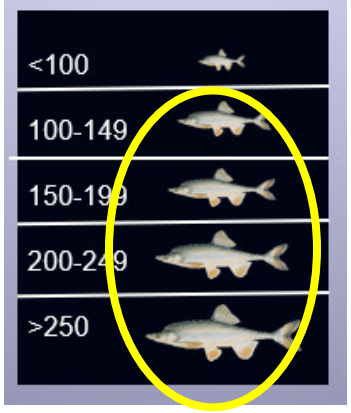


Juvenile HBC length-frequency in JCM West

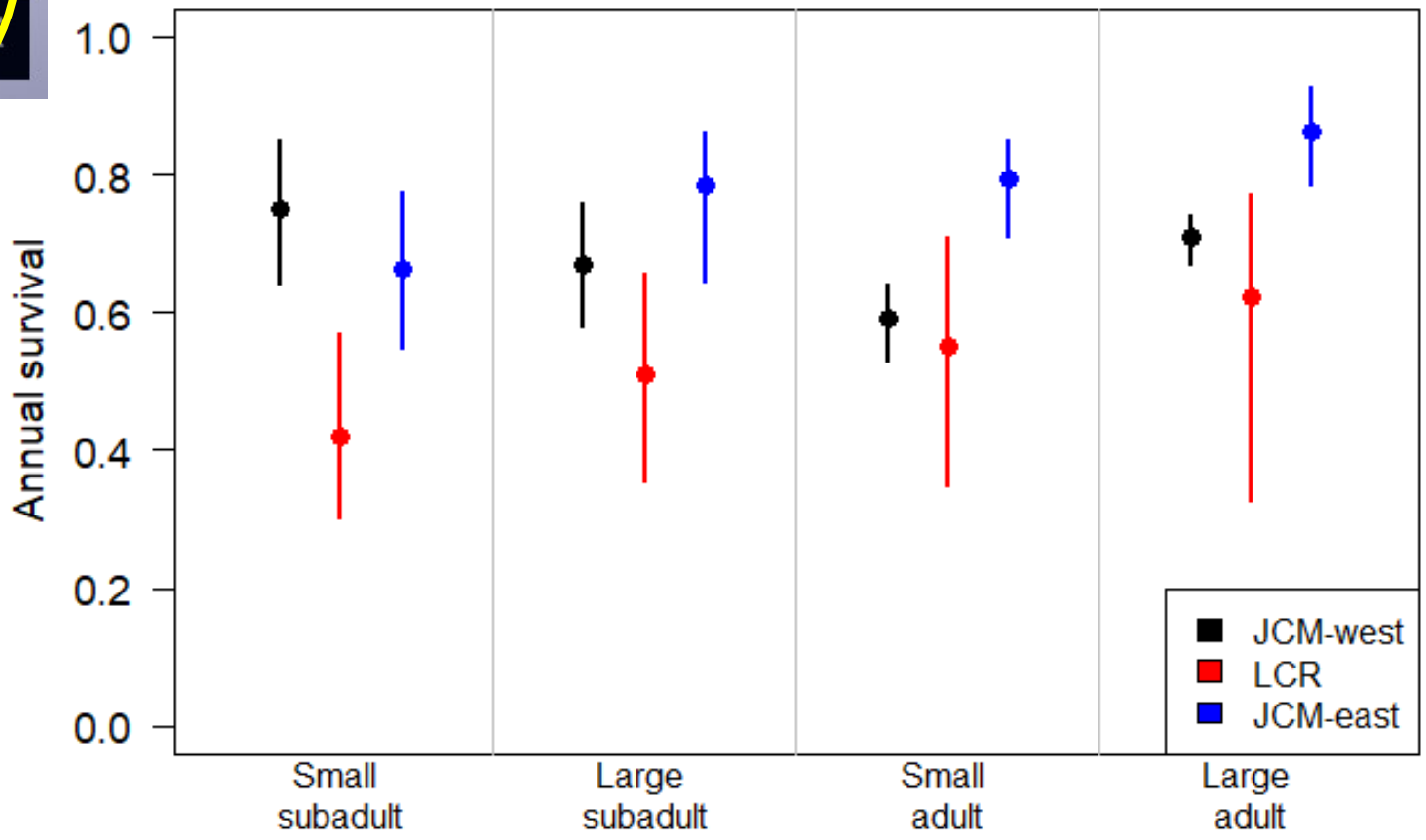
Truncate at 40 on lower end



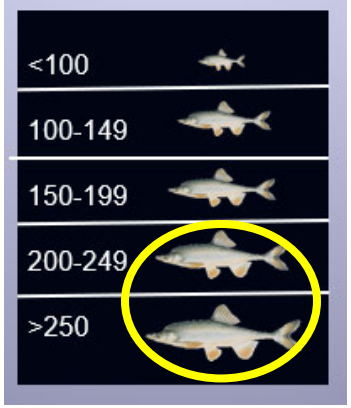




Apparent survival of HBC



Apparent survival = probability of survival and not emigrating from the study site



Abundance of adult humpback chub in western Grand Canyon