



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

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Project G: Humpback Chub (HBC, *Gila cypha*) 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:** \$1,015,966 AMP (\$978,126 spent)

- **Cooperators:** USGS, USFWS

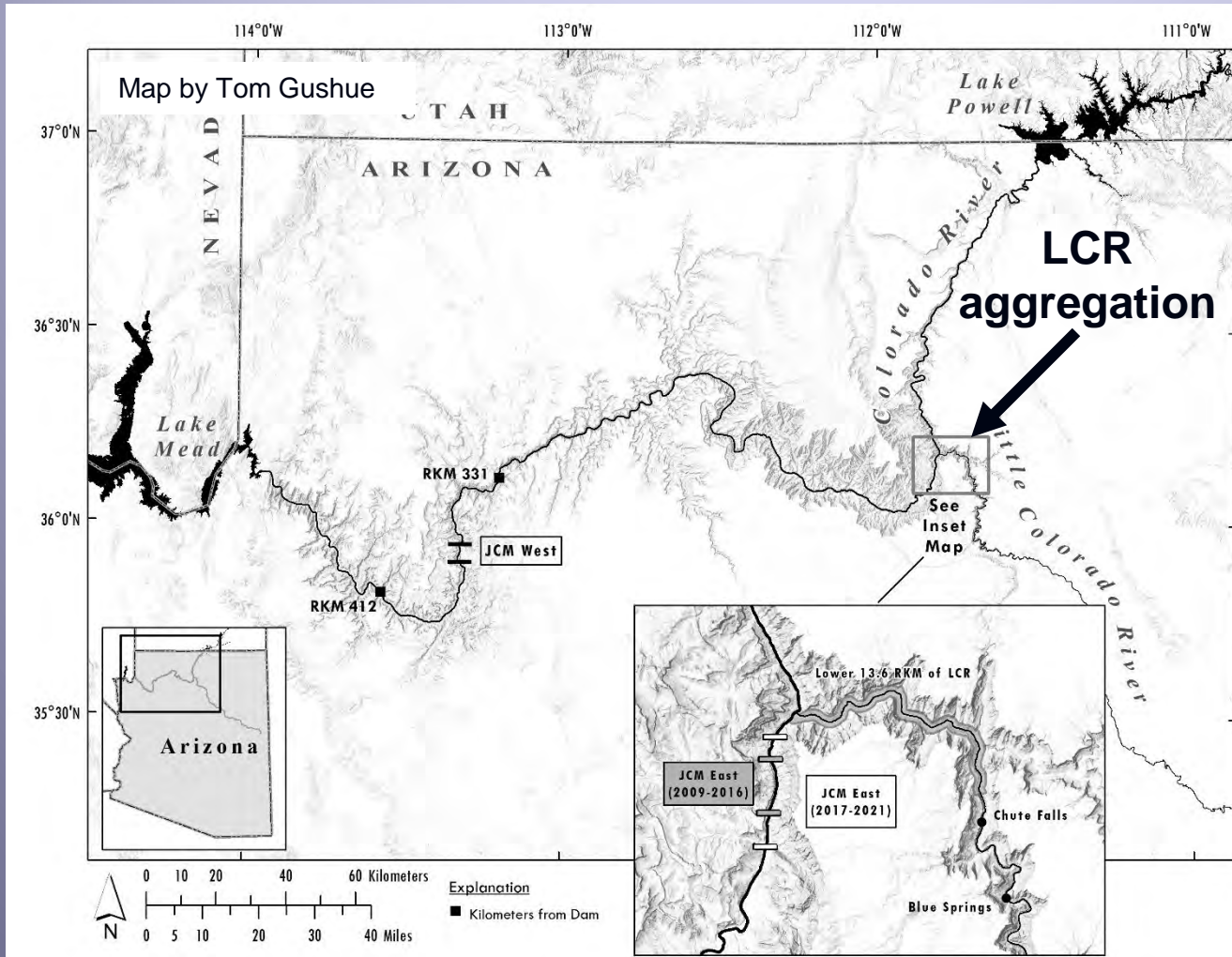
- **Resource Goals:** Humpback Chub, Other Native Fish

Presentation outline (Project G)

- Little Colorado River (LCR) aggregation
 - Humpback chub abundance estimates
 - LCR
 - Juvenile chub monitoring (JCM) -east
 - Implications of warm water temperatures & fast growth
 - Total adults & triggers
 - Chute Falls translocations

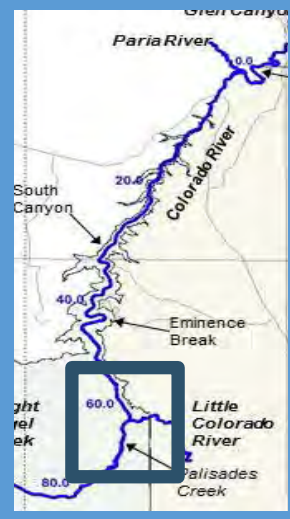
- Western Grand Canyon
 - Humpback chub aggregations monitoring & seining
 - Abundance estimation in western Grand Canyon
 - JCM-west

Fixed site monitoring in eastern Grand Canyon



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Colorado River



outmigration

migrants

skipped spawning

spring spawning migration

resident

Little Colorado River








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 - ■ **LCR**
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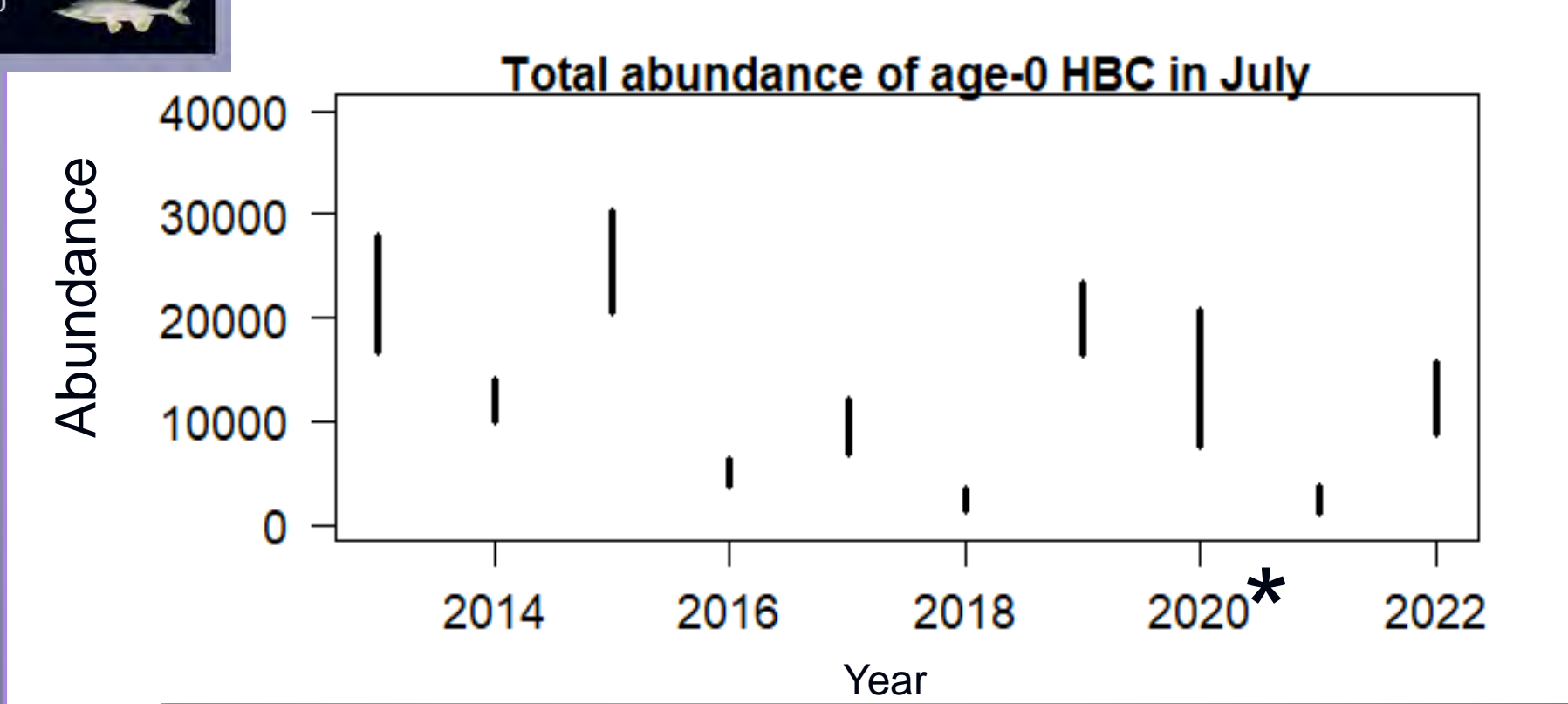
Size chart indicator

(sizes are mm total length)

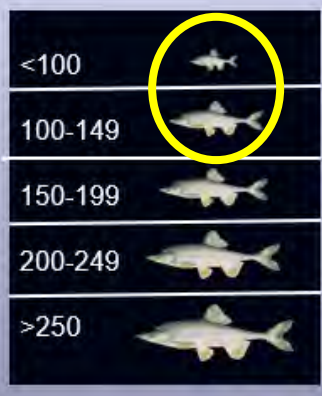
Juvenile	<100	
Small subadult	100-149	
Large subadult	150-199	
Small adult	200-249	
Large adult	>250	



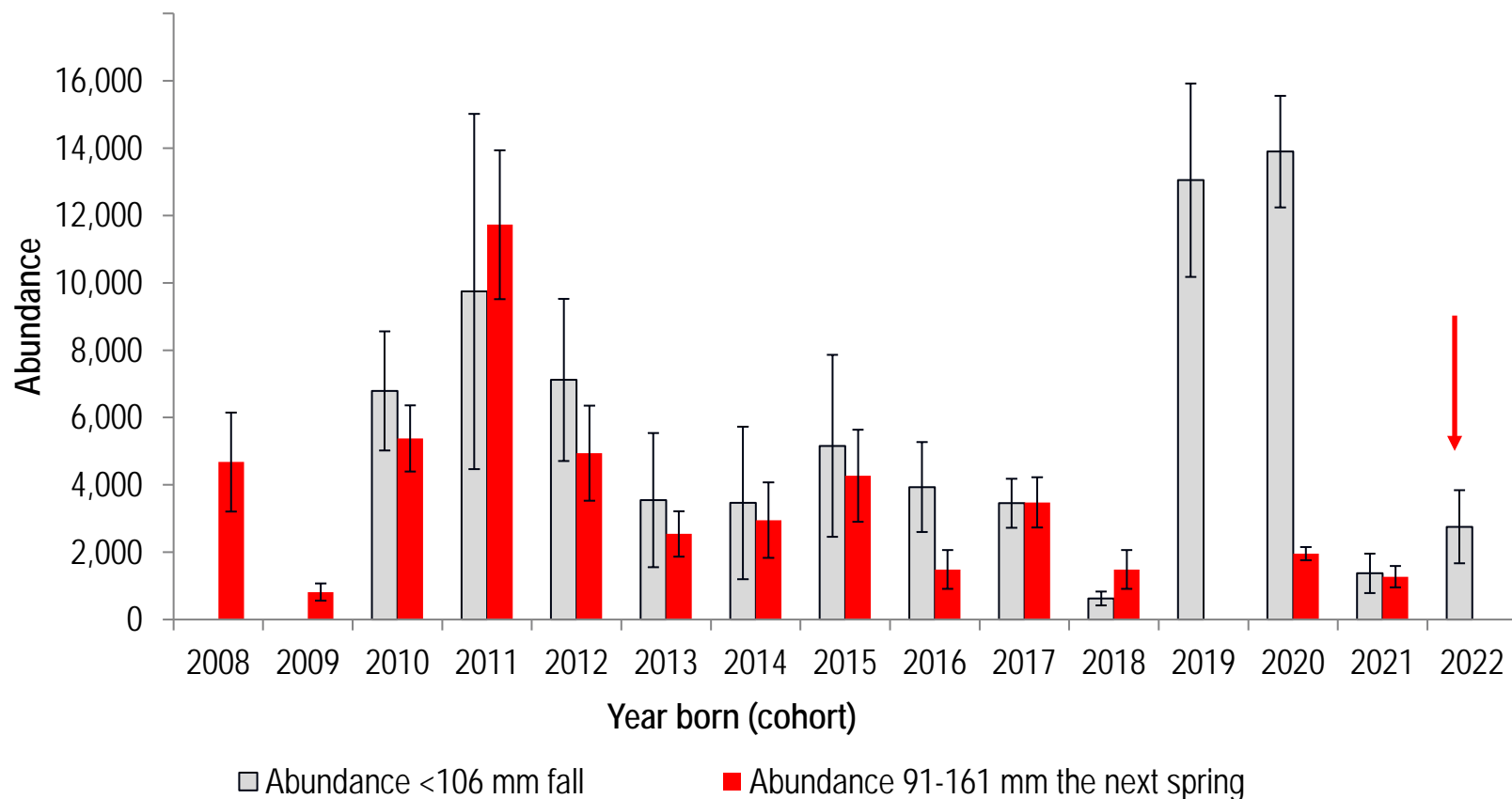
Age-0 abundances in the LCR



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

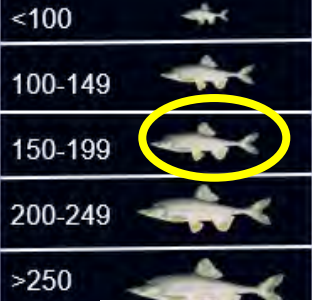


Annual Sept/Oct HBC age-0 abundance (grey) and the following April/May age-1 abundance (red). Note age-0 in 2022 is not particularly high



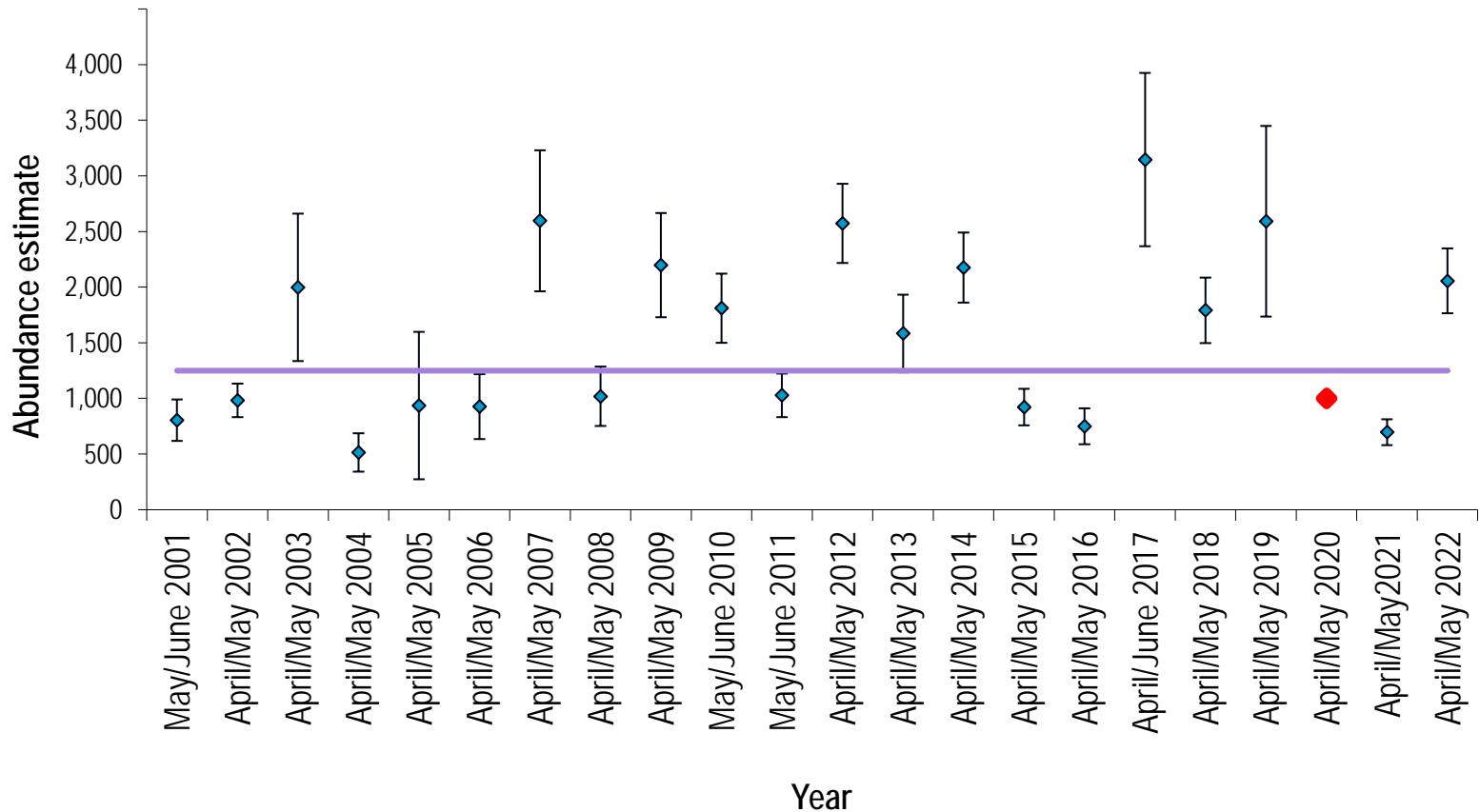
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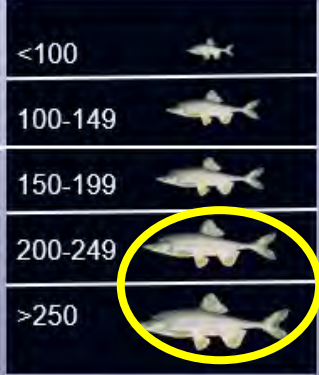




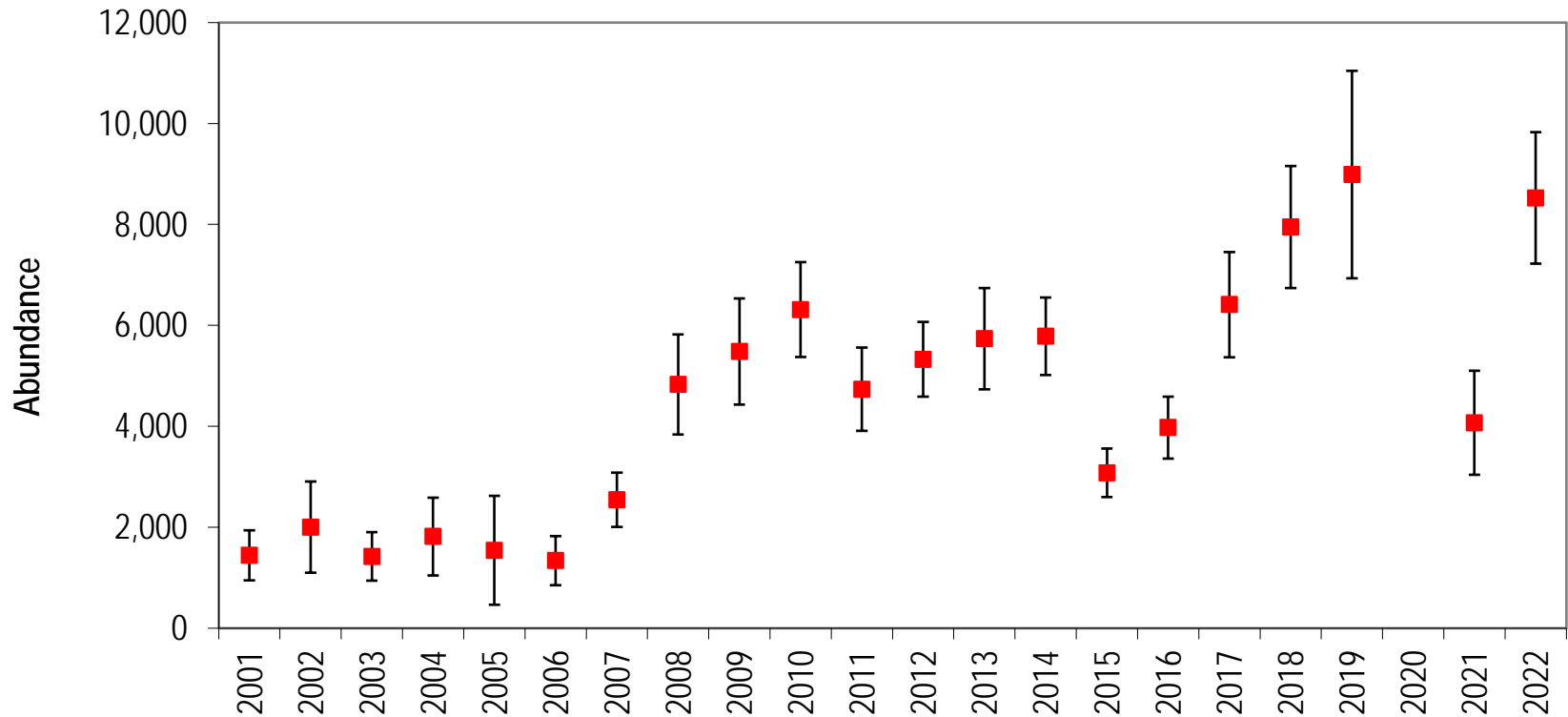
Annual spring abundances of large sub-adult HBC in lower 13.6 km of LCR

No sampling spring 2020, Mean in circle = 1,248, trigger is 1,250

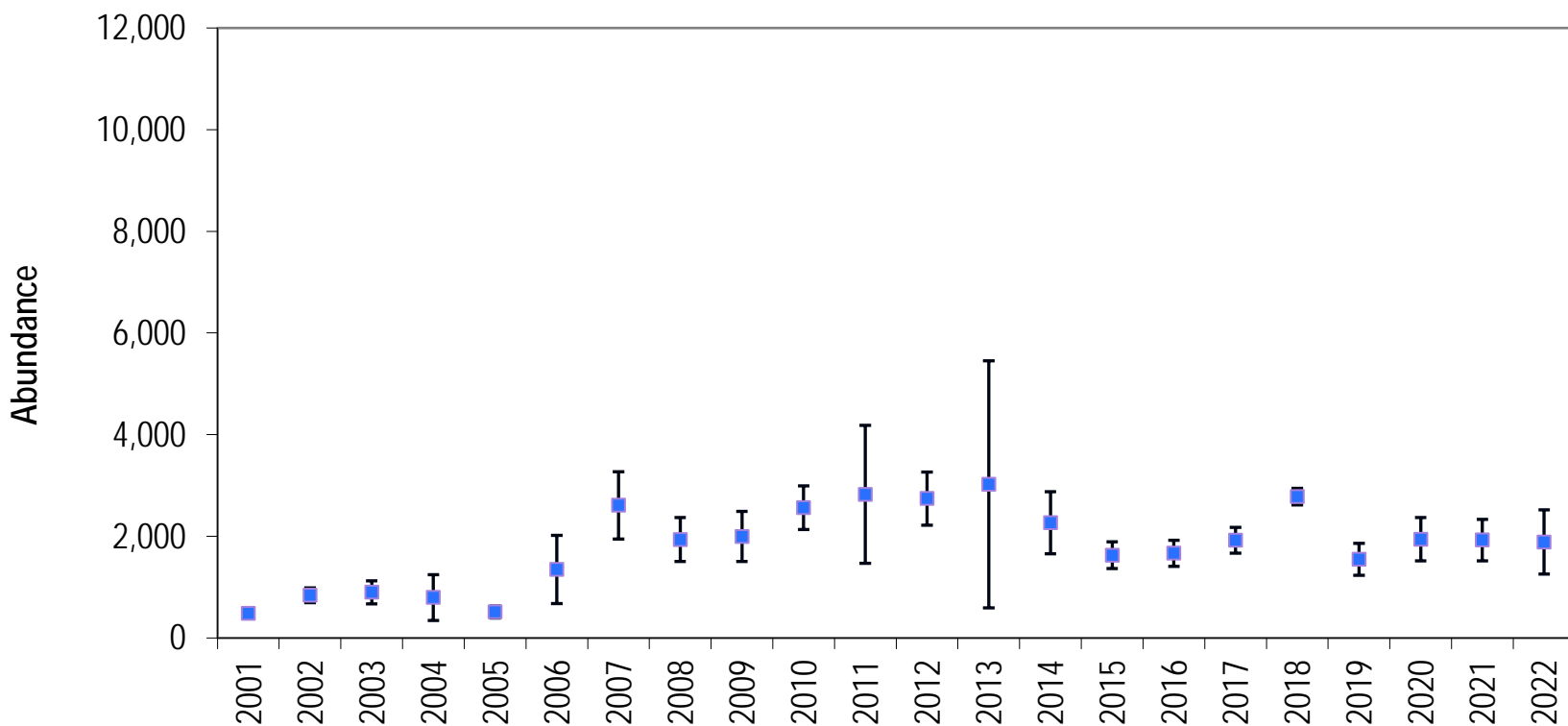
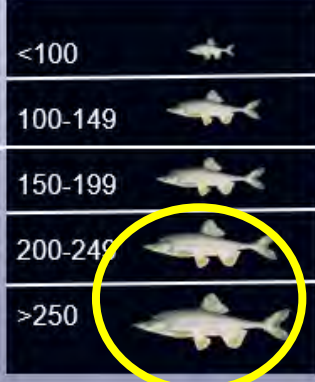




Annual spring abundances of adult HBC in lower 13.6 km of LCR



Annual fall abundances of adult HBC in lower 13.6 km of LCR



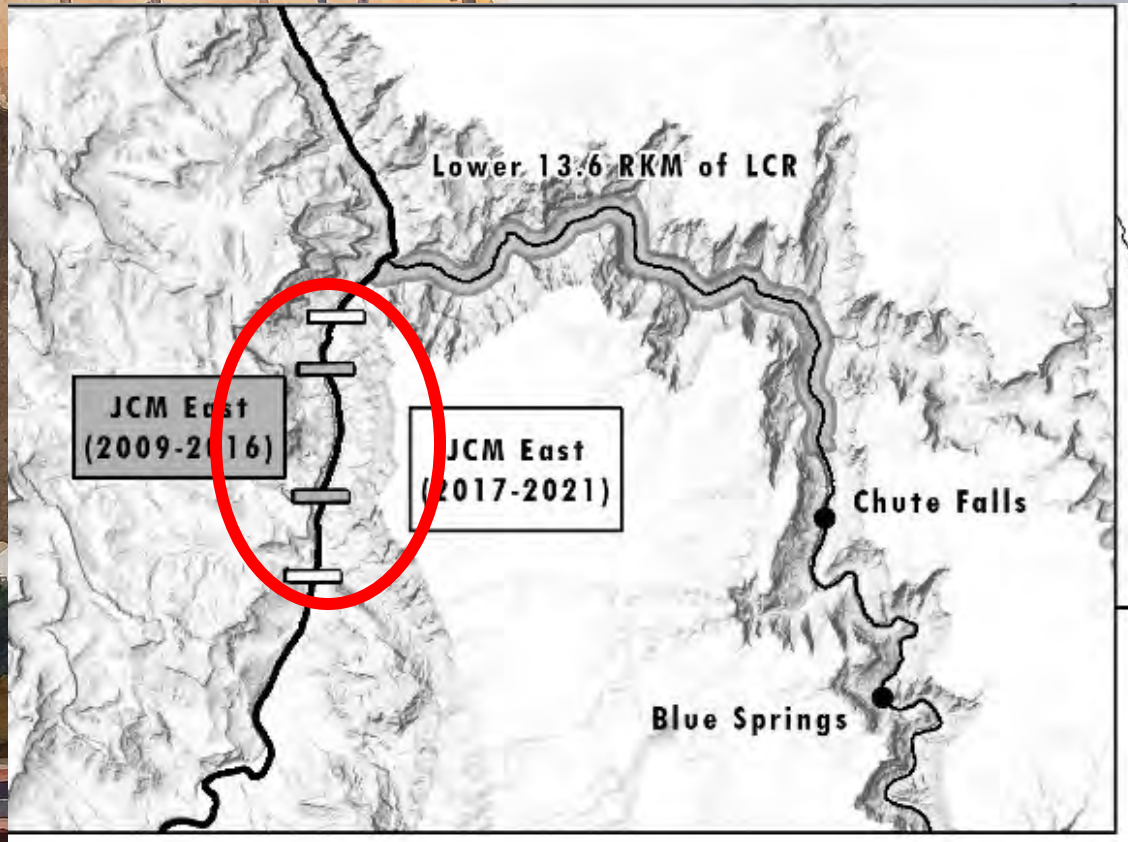
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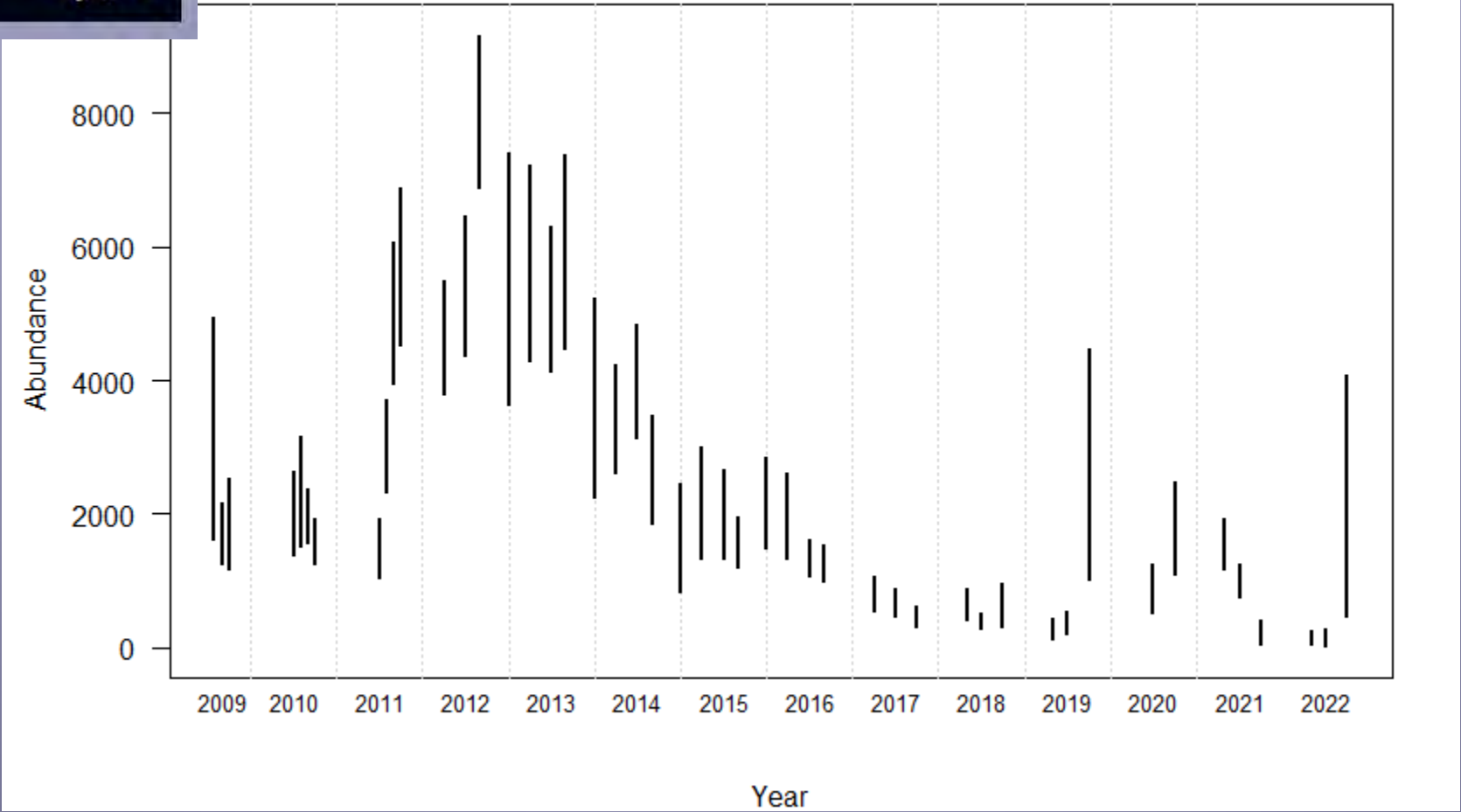
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JCM East

Artwork by Randy Van Haverbeke

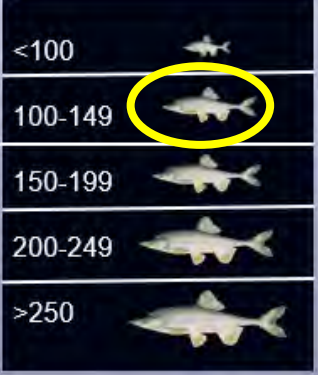


Juvenile abundance in the JCM East

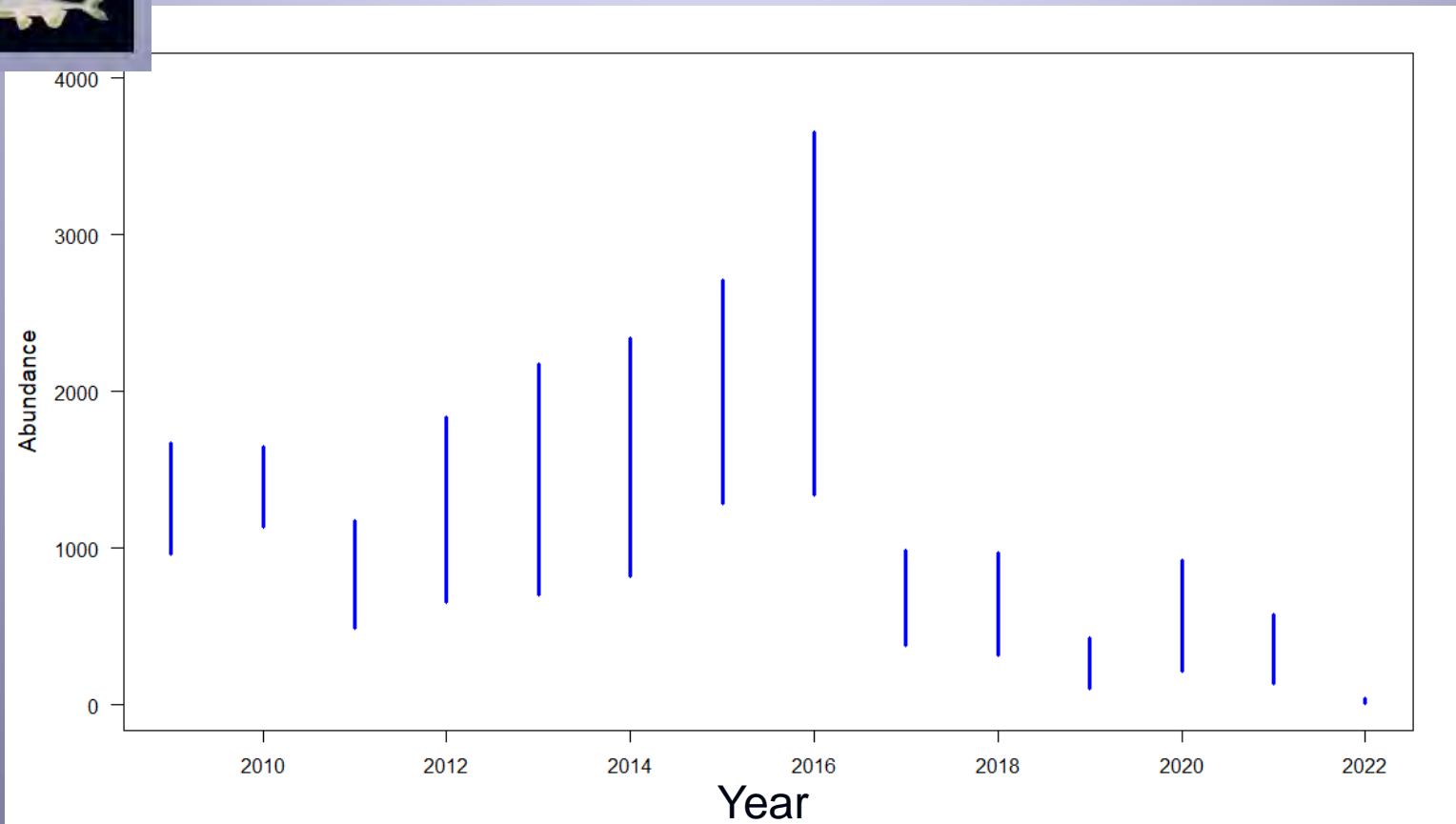


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Small subadult abundances in JCM-east are very low



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<100



100-149



150-199



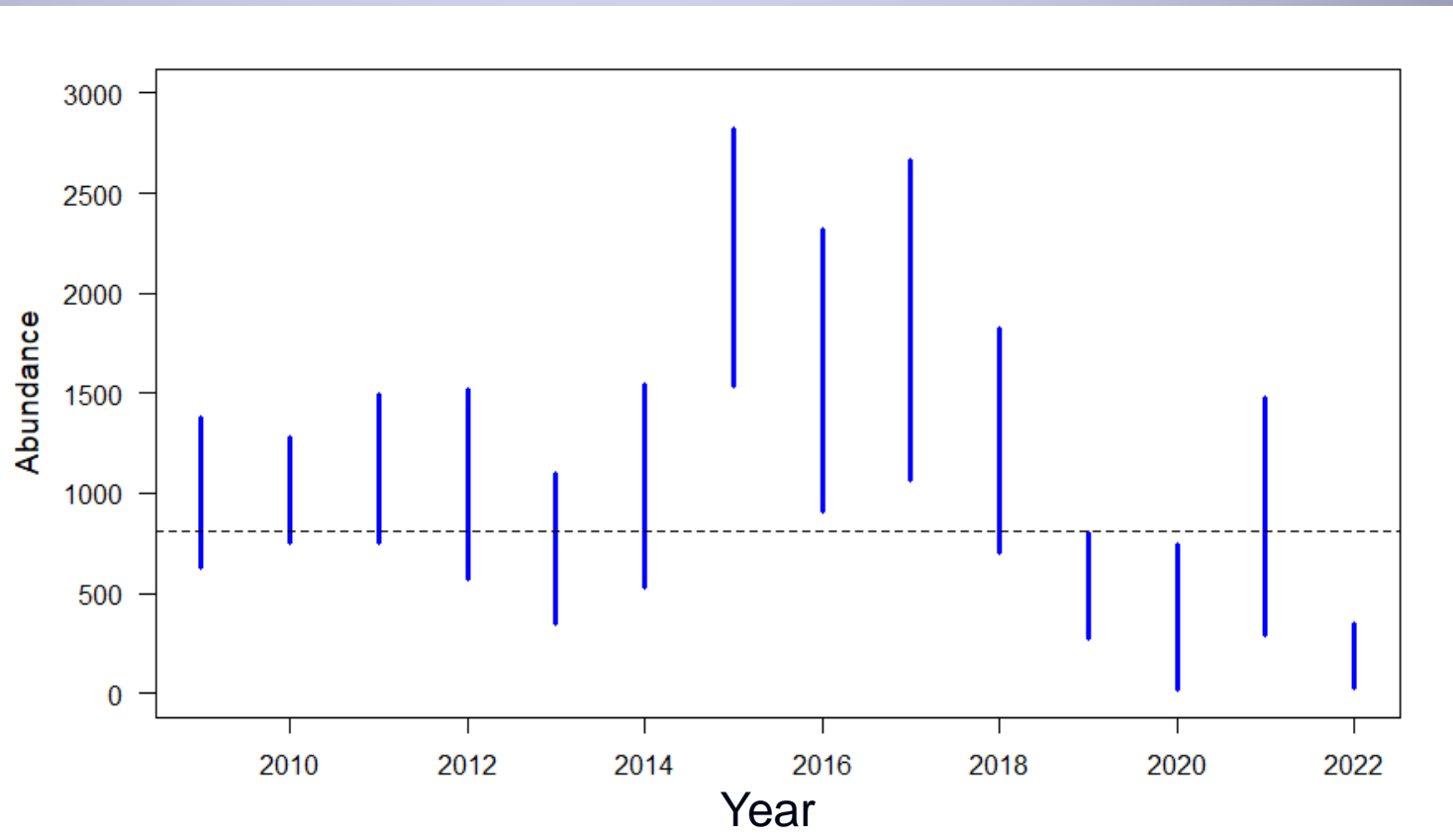
200-249



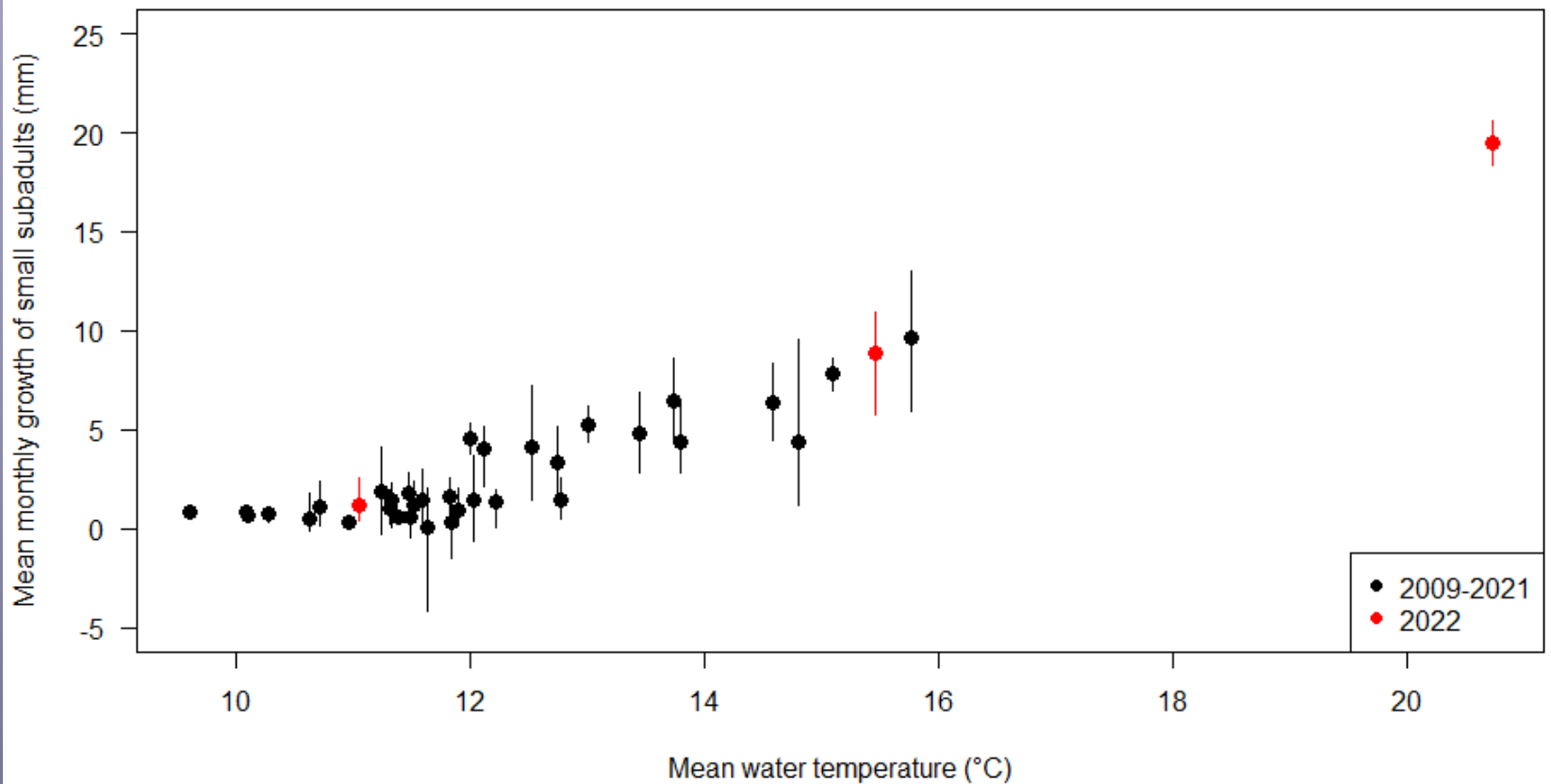
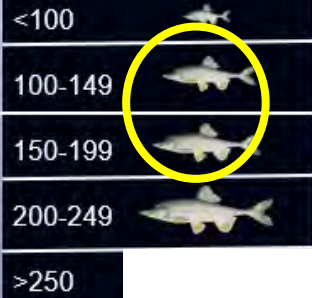
>250

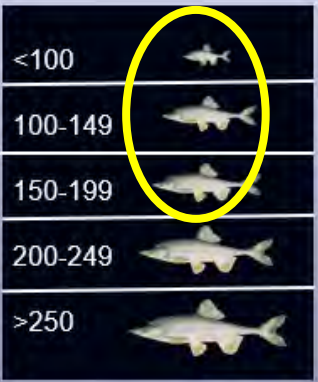


Large subadults in JCM-east are below the trigger

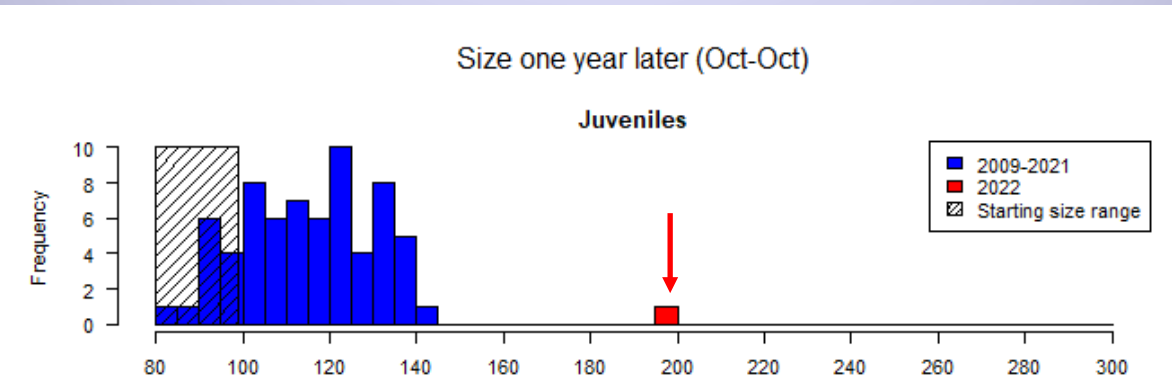


Very high growth for subadults in JCM-East during 2022

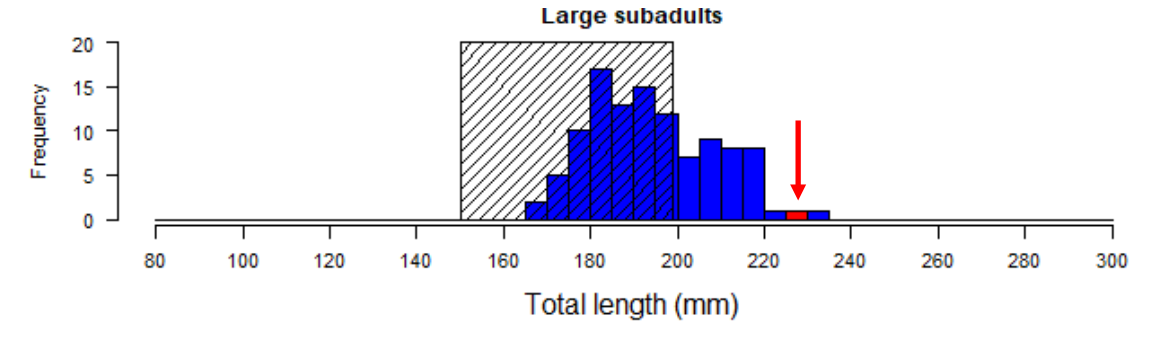




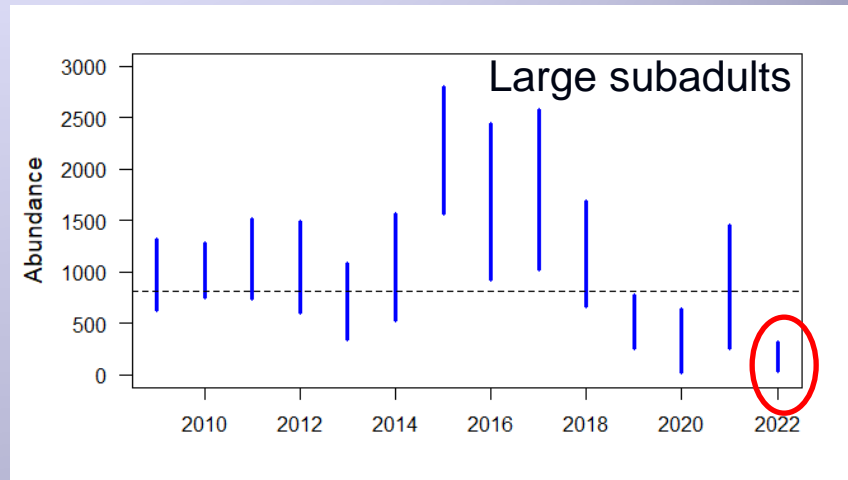
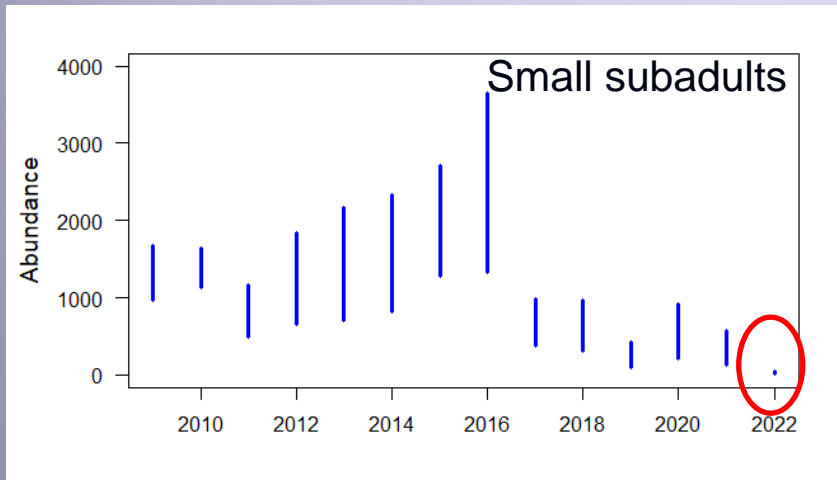
Growth of subadults in JCM-East



- Juvenile & subadult humpback chub grew 60-100mm from Oct 2021-Oct 2022
- Humpback chub in 2022 spent less than a year as small subadults and(or) large subadults



Subadult numbers in JCM-east are low but...



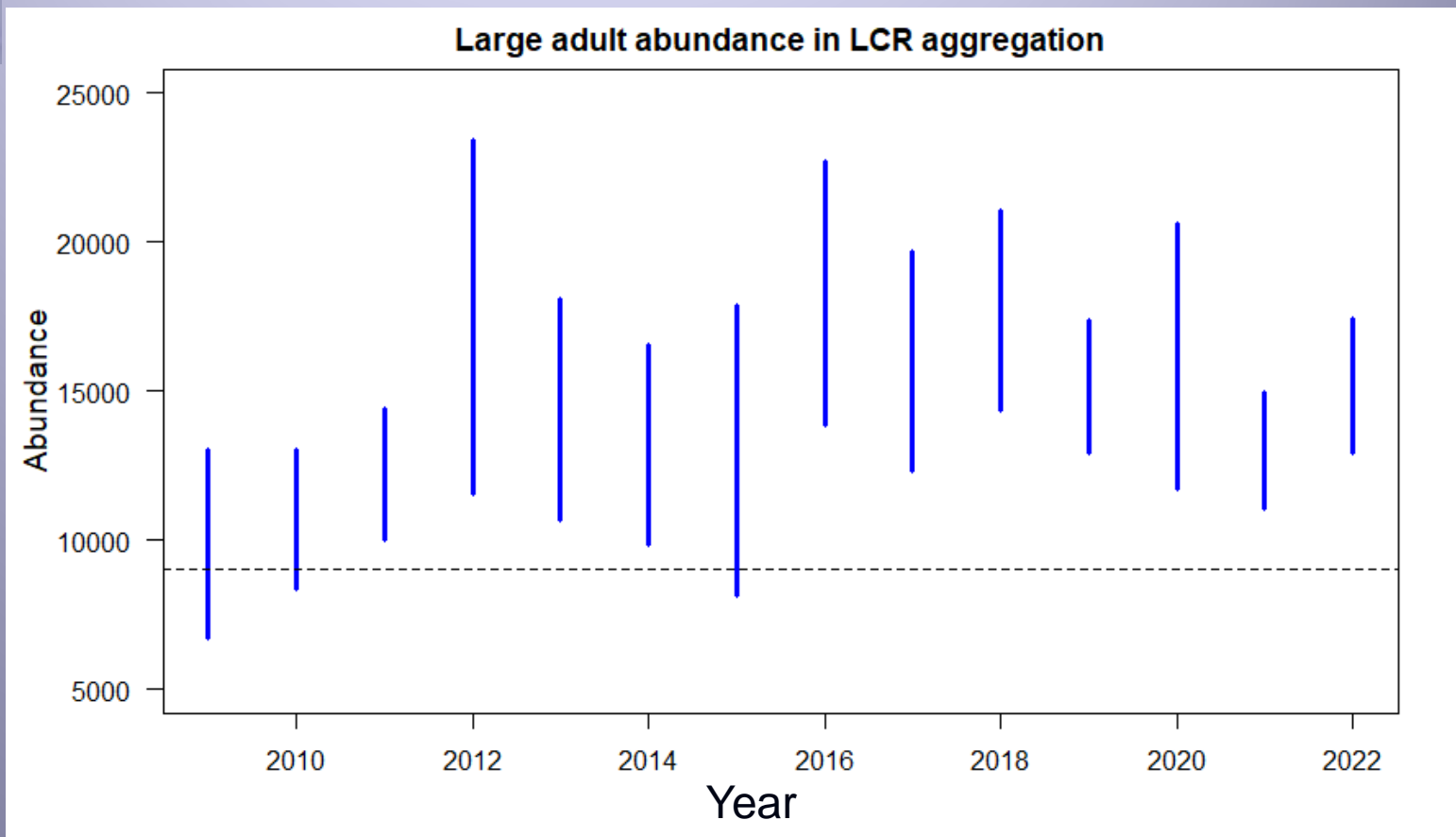
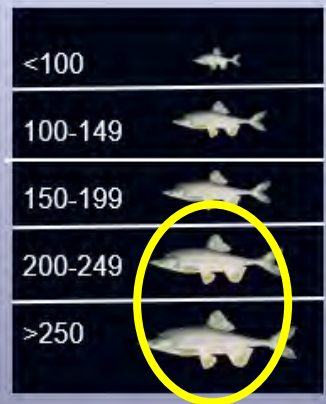
Faster growth means fewer subadults

- Prior to 2020 (cold water – slow growth):
 - ~3 years for large subadults to become adults
 - Large subadults comprised of three cohorts
- In 2022 (warm water – fast growth):
 - ~1 year for large subadults to become adults
 - Large subadults comprised of one cohort

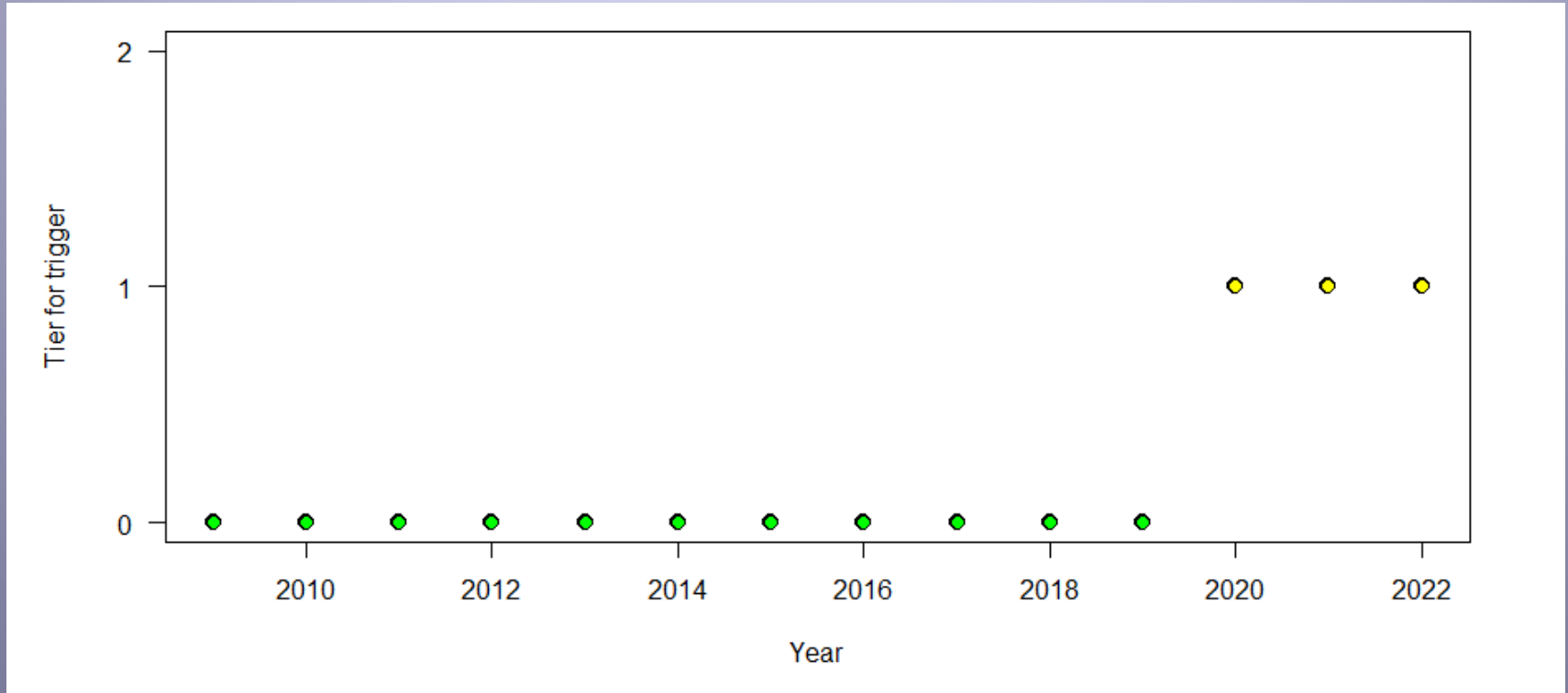
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Adult abundances in the LCR aggregation are above the trigger



Tier for humpback chub trigger* (Metric 3.1)

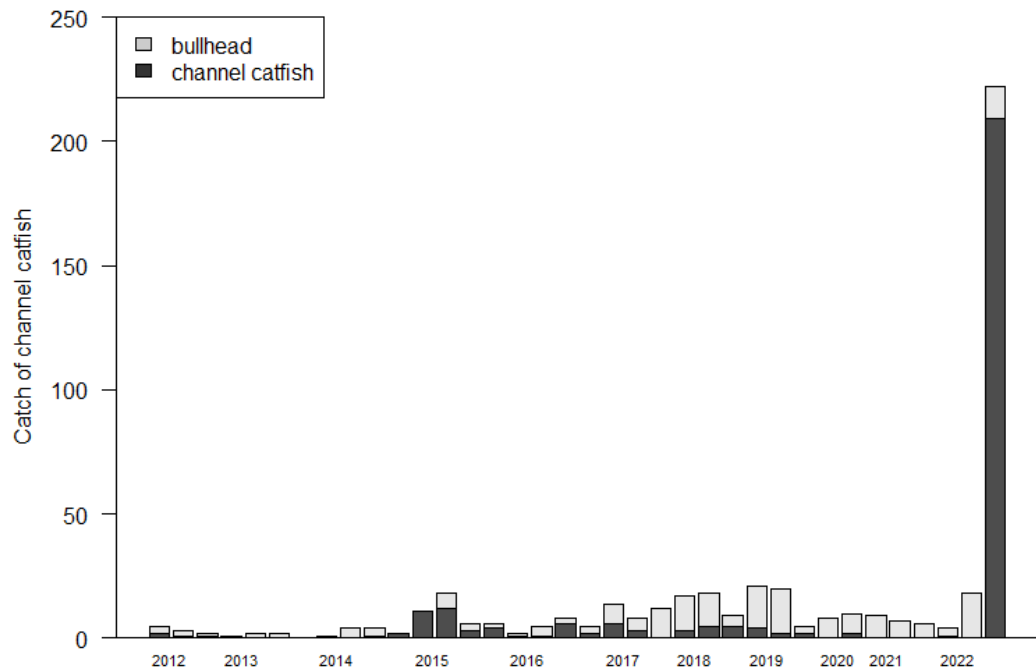


*for more info on triggers, see: U.S. Bureau of Reclamation. 2016. Record of decision, Glen Canyon Dam long-term experimental and management plan, final environmental impact statement. U.S. Department of the Interior, Bureau of Reclamation, Salt lake City, Utah, National Park Service, Lakewood Colorado, Dec. Available at: https://ltempeis.anl.gov/documents/docs/LTEMP_ROD.pdf

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Catch of channel catfish was very high in JCM-East in Oct 2022



- Small channel catfish *Ictalurus punctatus* (~20mm) also captured in the LCR during July 2022 sampling trip
- Increase presumably due to warmer water temperatures in the main-stem

Take-home points

LCR & JCM East

- **Adult estimates remain high**
- **Subadult numbers are low**
- **Warm water temperatures are changing things!**
 - Fast growth = fewer subadults
 - More non-native fishes (channel catfish?)
 - Mainstem spawning near the LCR? (now possible)



Artwork by Lindsay Hansen

Presentation outline (Project G)

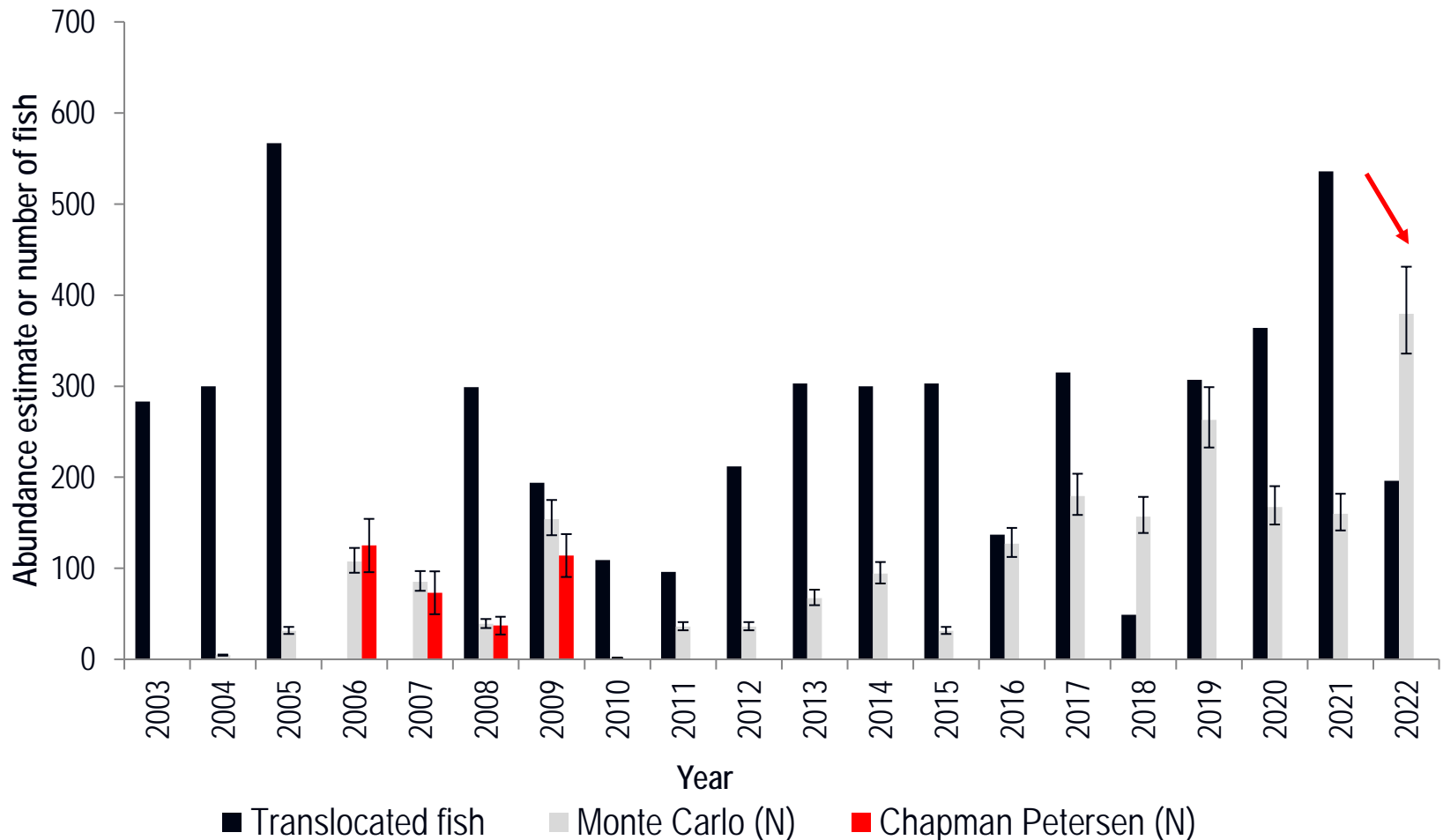
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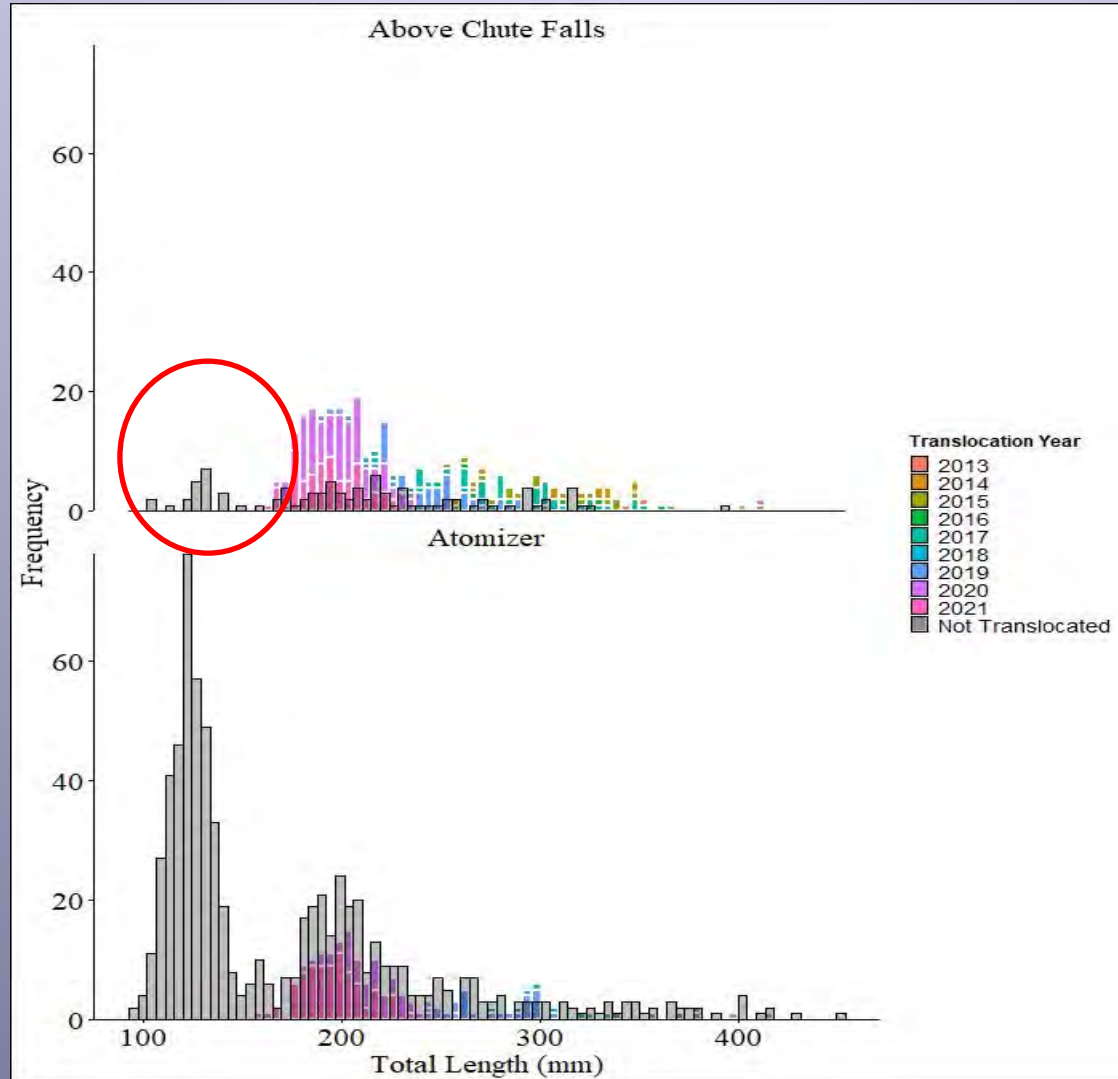
Translocations and Chute Falls Monitoring



Number of HBC translocated annually (black bars) and annual abundances of adult HBC above Chute Falls (red and grey bars)



Length frequencies of HBC in Chute Falls and Atomizer reaches (2013-2021)



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Summary: Chute Falls Translocations

- To address reaching the “trigger” in the mainstem in 2020, we increased the number of HBC translocated to above Chute Falls to 535 in 2021.
- To address reaching the “triggers” in the JCM in 2022, we suggest conducting an additional HBC translocation to above Chute Falls in spring 2023.
- Other options may need to be considered in the future (e.g., continue translocating higher #'s above Chute Falls, transporting juvenile HBC from western Grand Canyon?).

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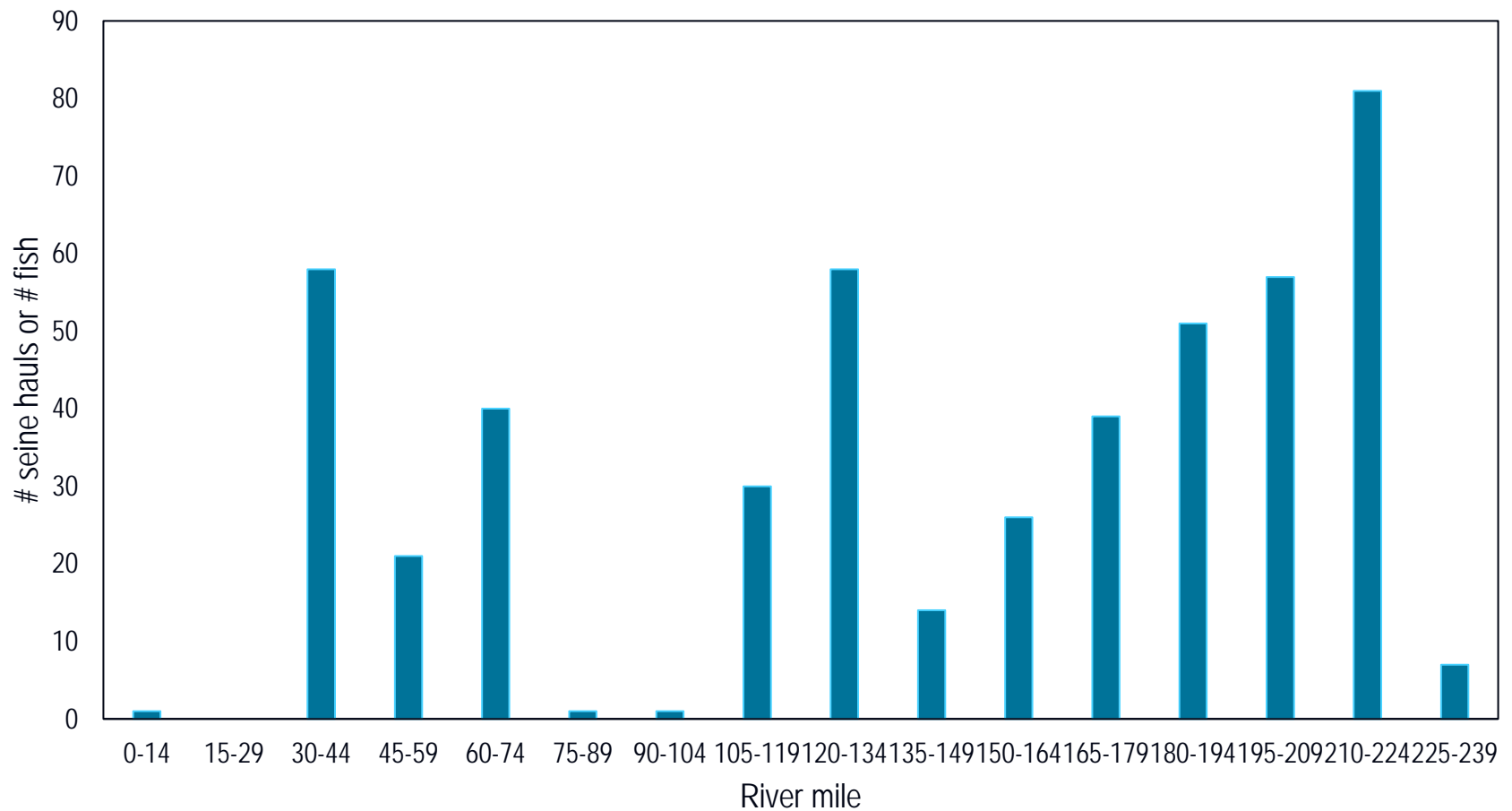
2022 seining trip



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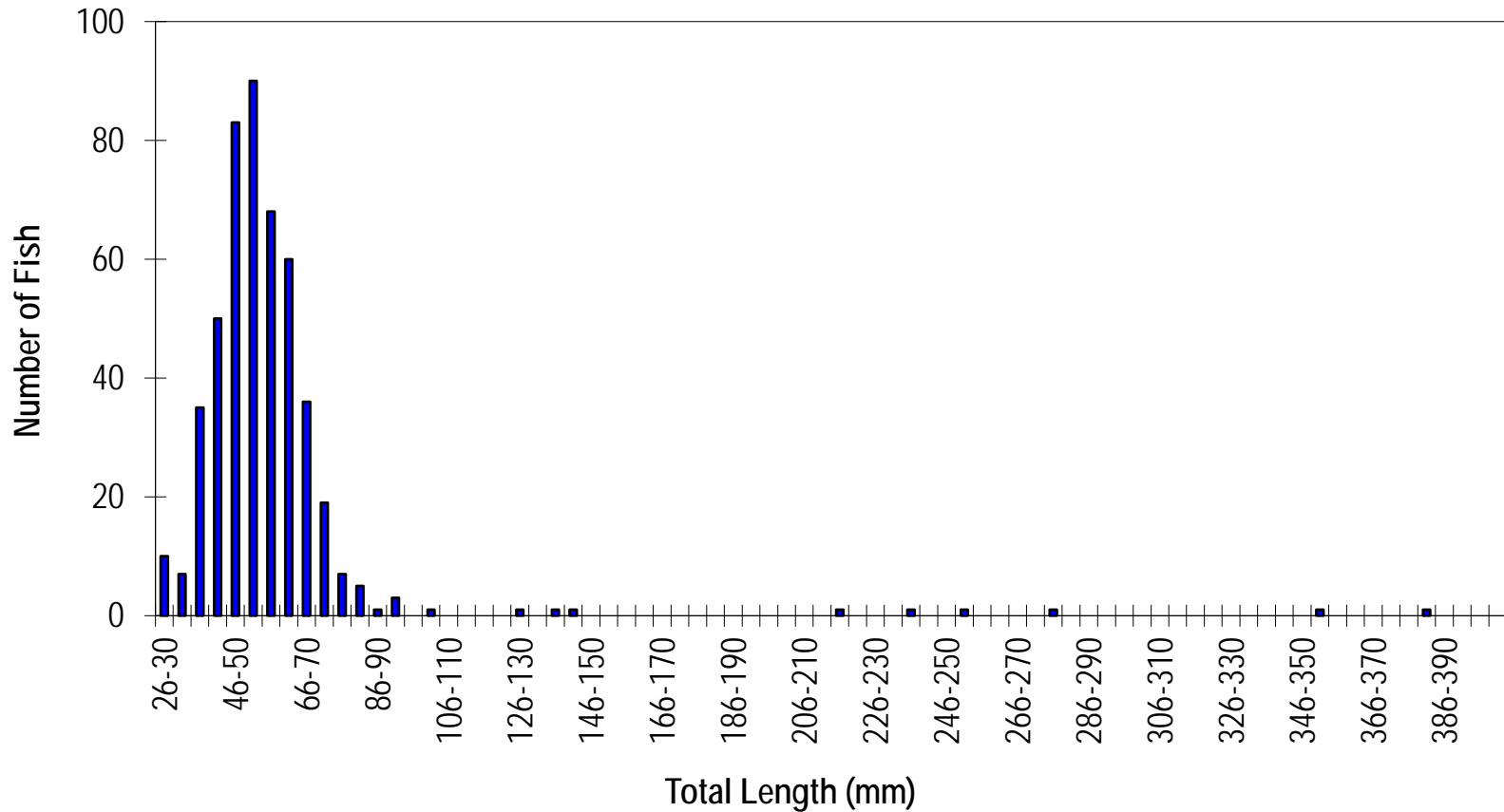
Humpback Chub catches via seining by river mile



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Length frequencies of Humpback Chub captured via seining



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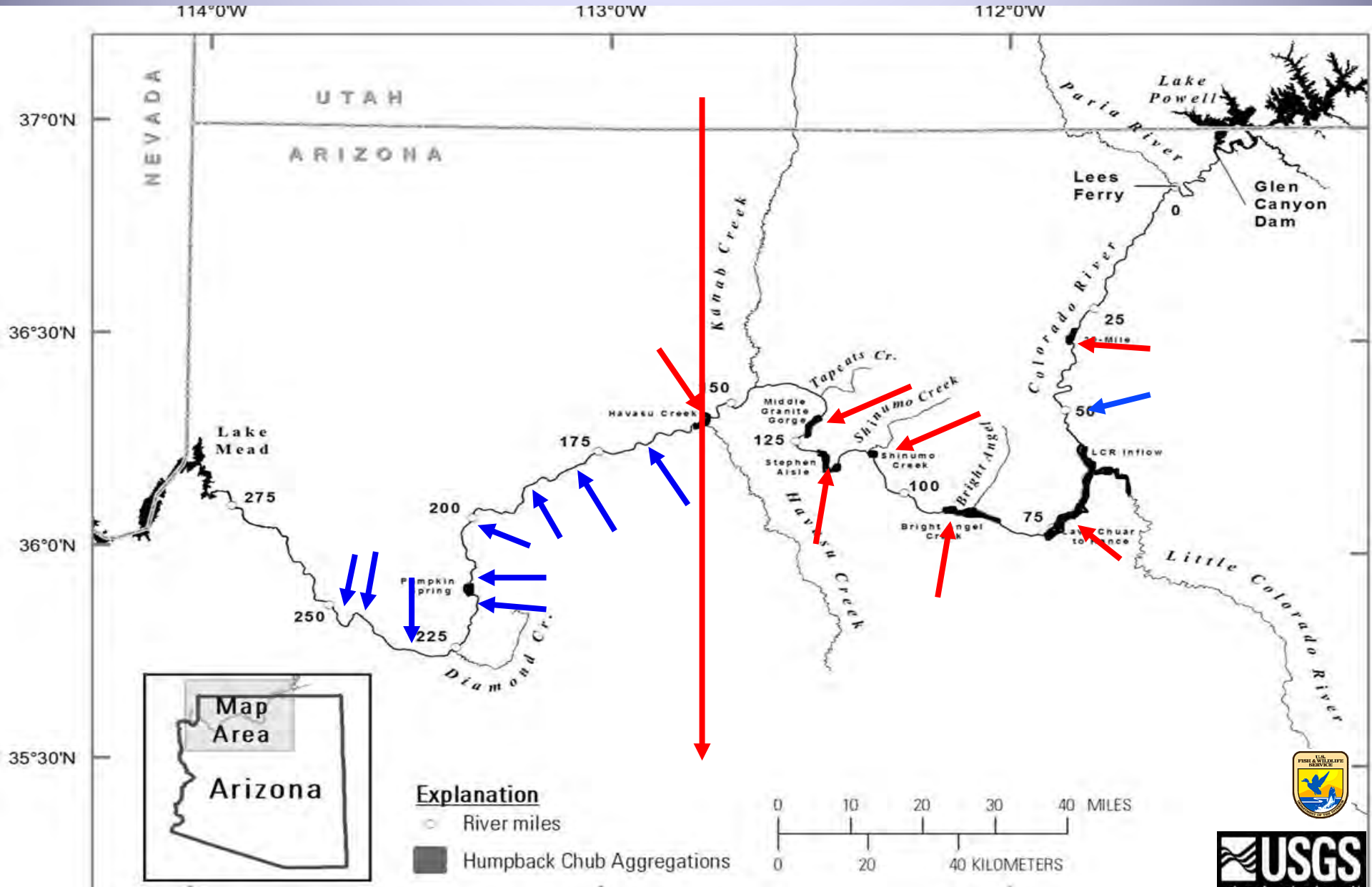
Catch comparison: Seining vs. Hoop netting

Nonnatives		
	Seining	Hoop netting
Bluegill	1	
Black Crappie	5	
Bullhead	1	
Channel Catfish	38	5
Carp	33	7
Fathead Minnow	612	16
Green Sunfish	54	
Gizzard Shad	4	
Plains Killifish	287	
Rainbow Trout	81	14
Striped Bass	55	
Threadfin Shad	3	
Totals	1,174	42
Natives		
Bluehead Sucker	8	3
Flannemouth Sucker	5,185	5,929
Flannemouth x Razorback		3
Humpback Chub	485	1,340
Speckled Dace	1,666	231
Totals	7,344	7,500

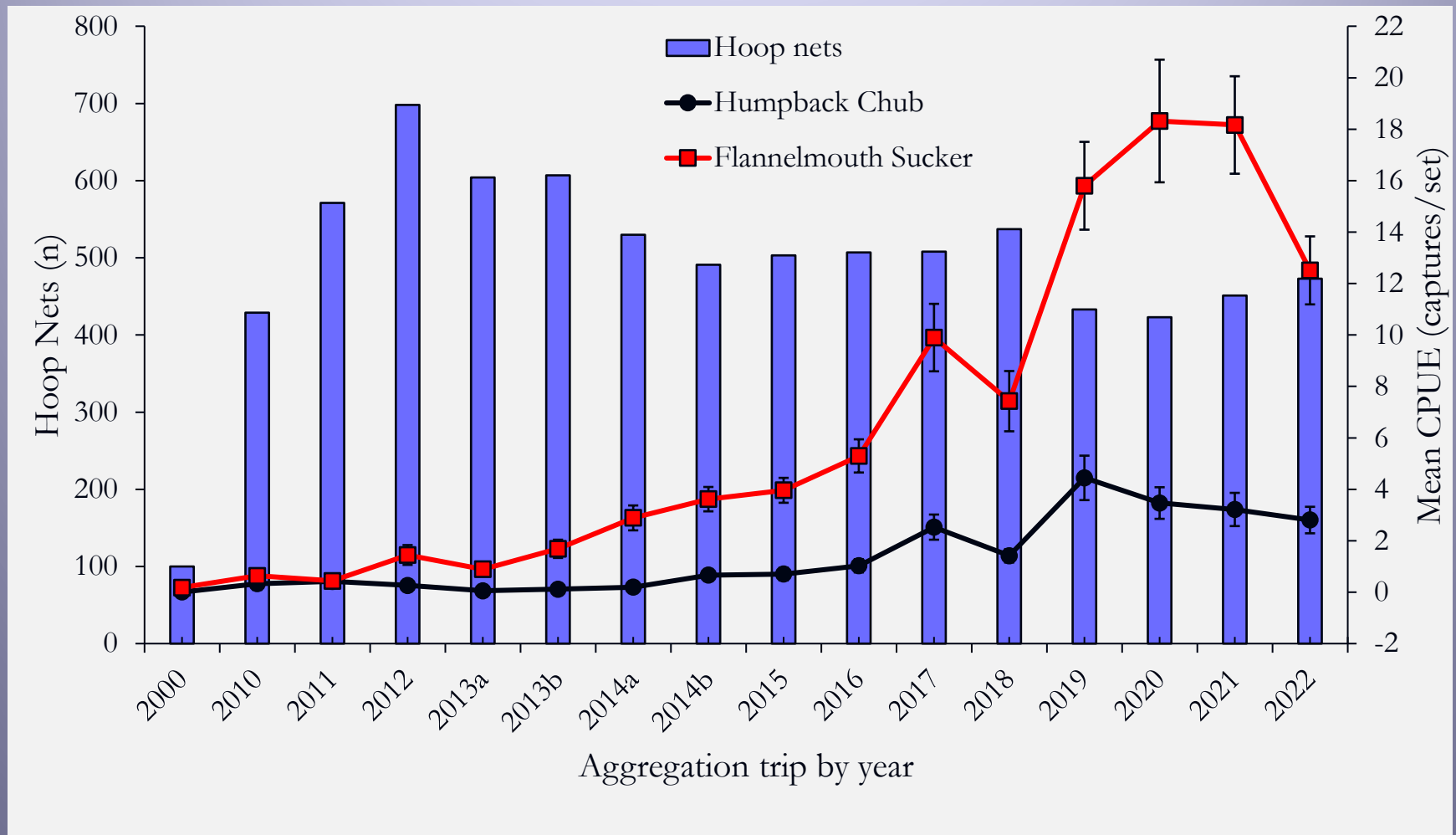
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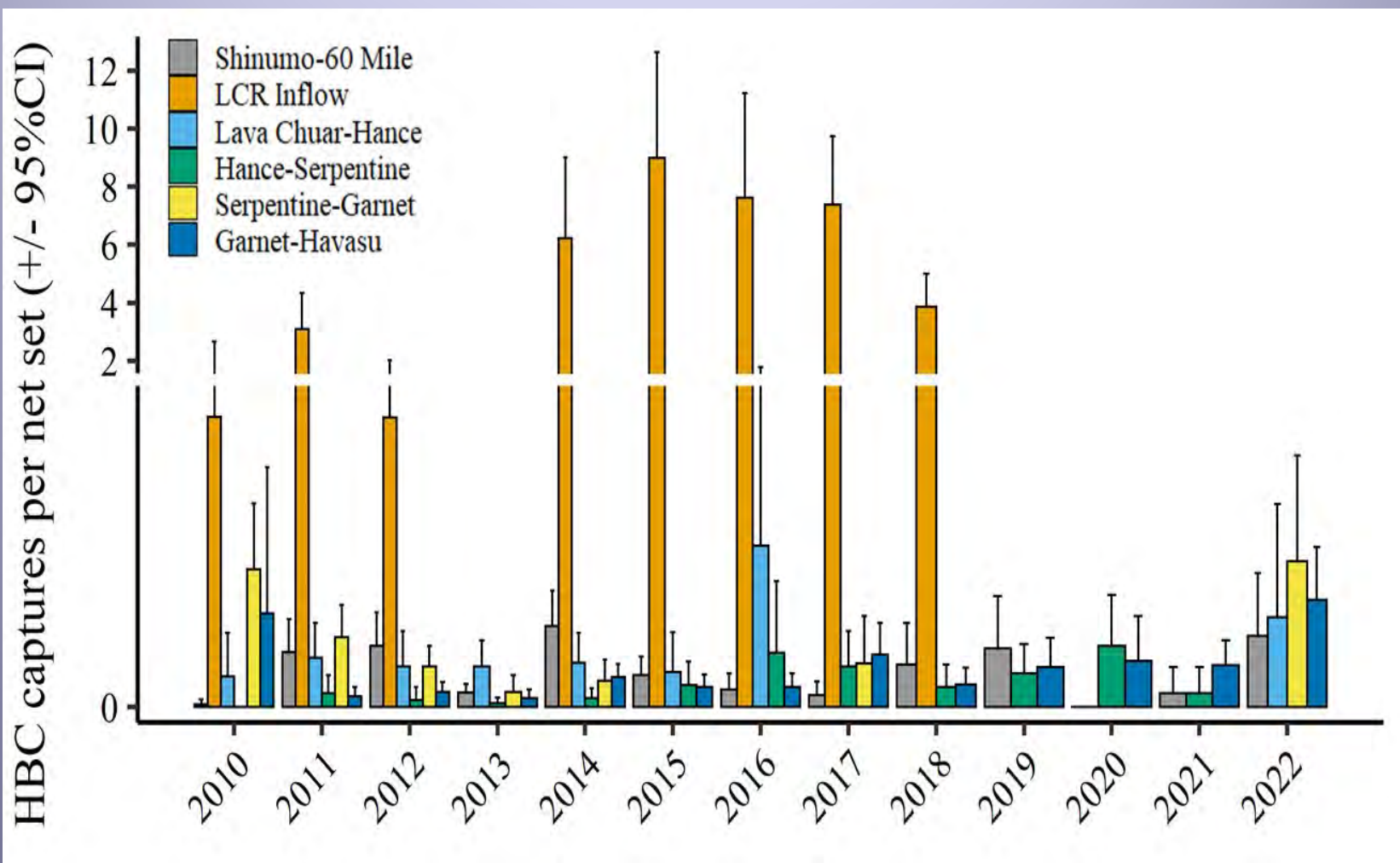
Hoop netting sample sites on 2022 aggregation trip



Annual CPUEs of Humpback Chub and Flannemouth Sucker on aggregation trips 2000 and 2010-2022

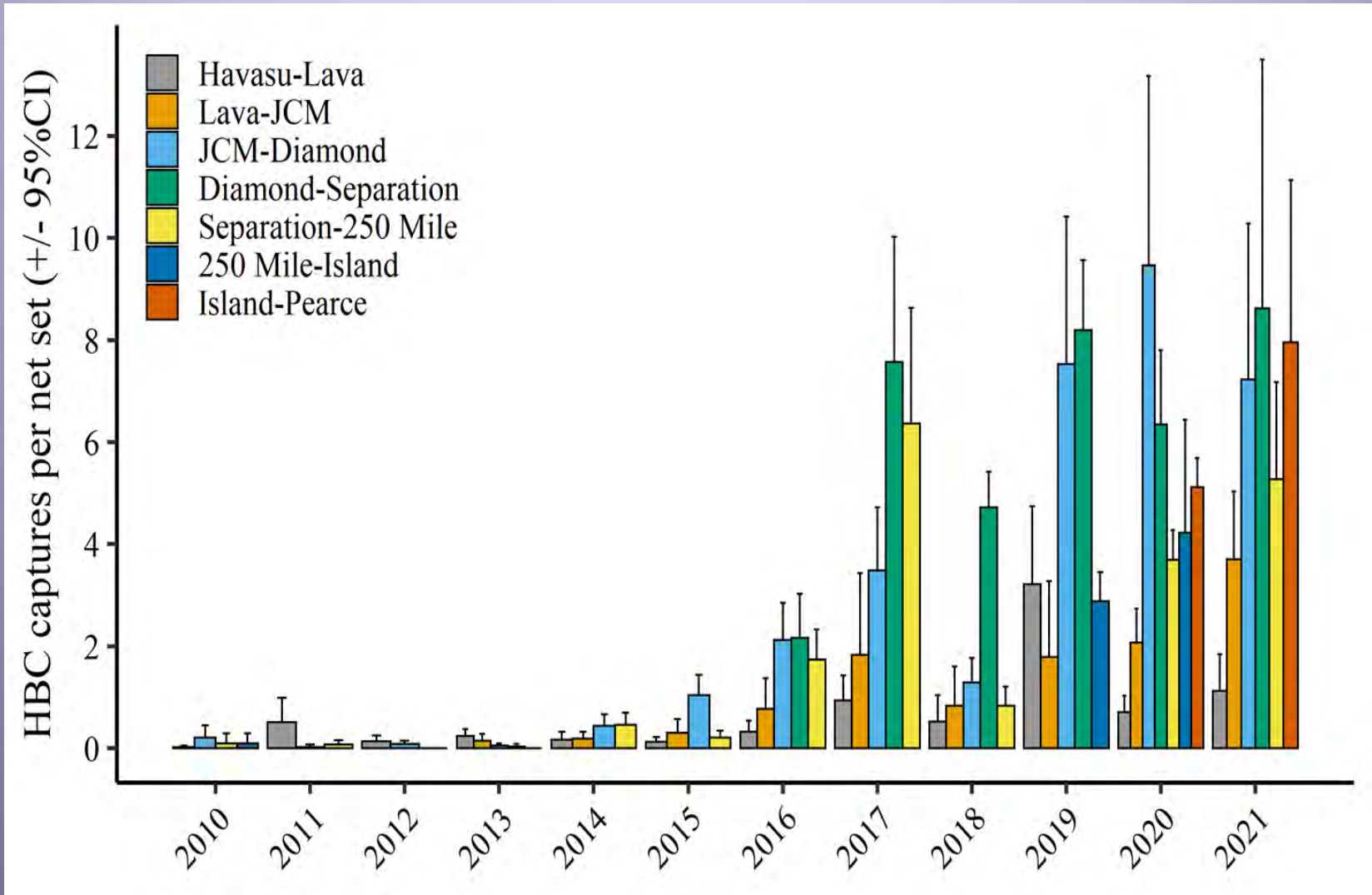


Annual CPUEs of Humpback Chub at sample sites above Havasu Rapids 2010-2022



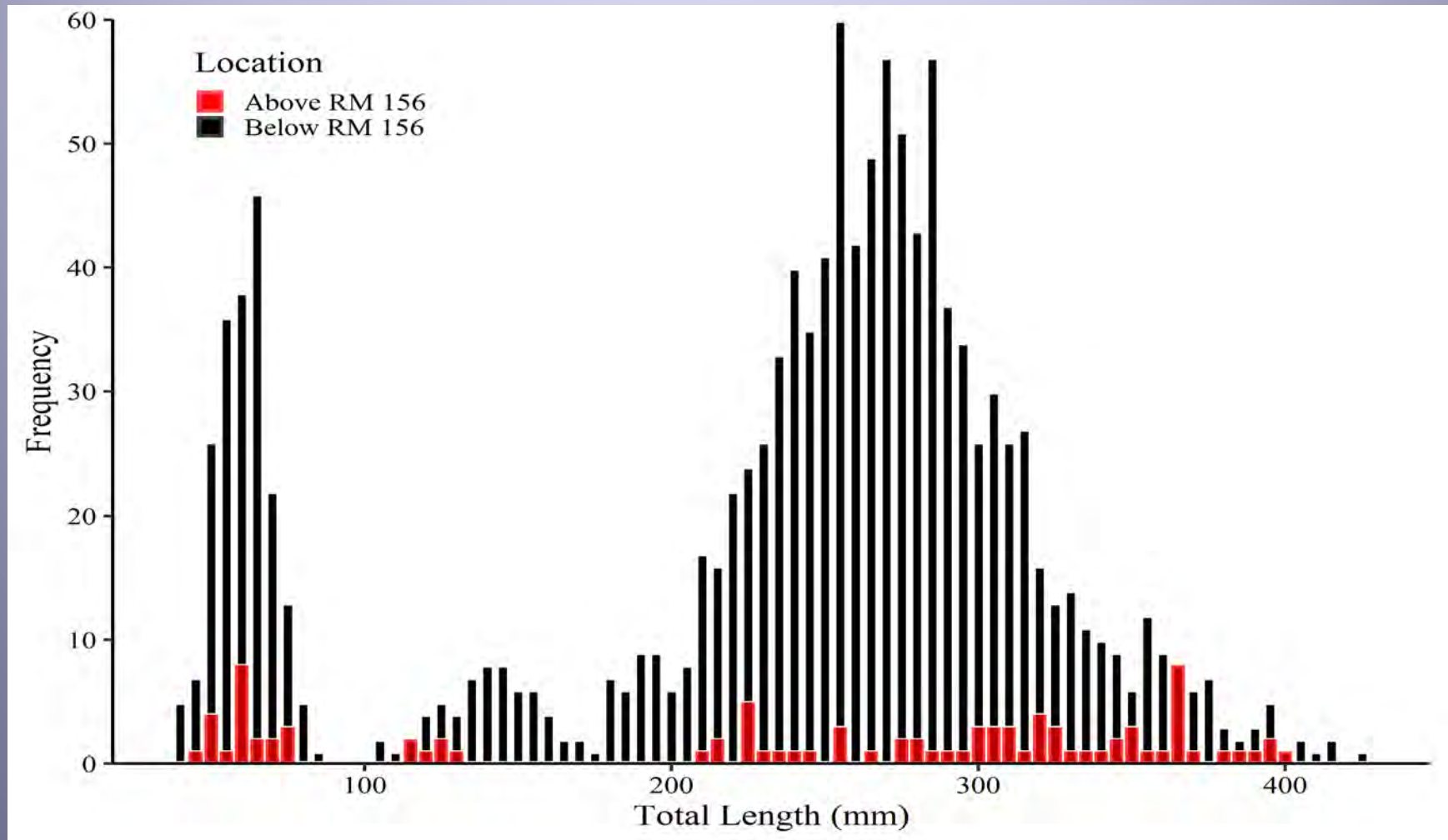
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Annual CPUEs of Humpback Chub at sample sites below Havasu Rapids 2010-2022



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Length frequencies of HBC above and below Havasu aggregation (RM 156)



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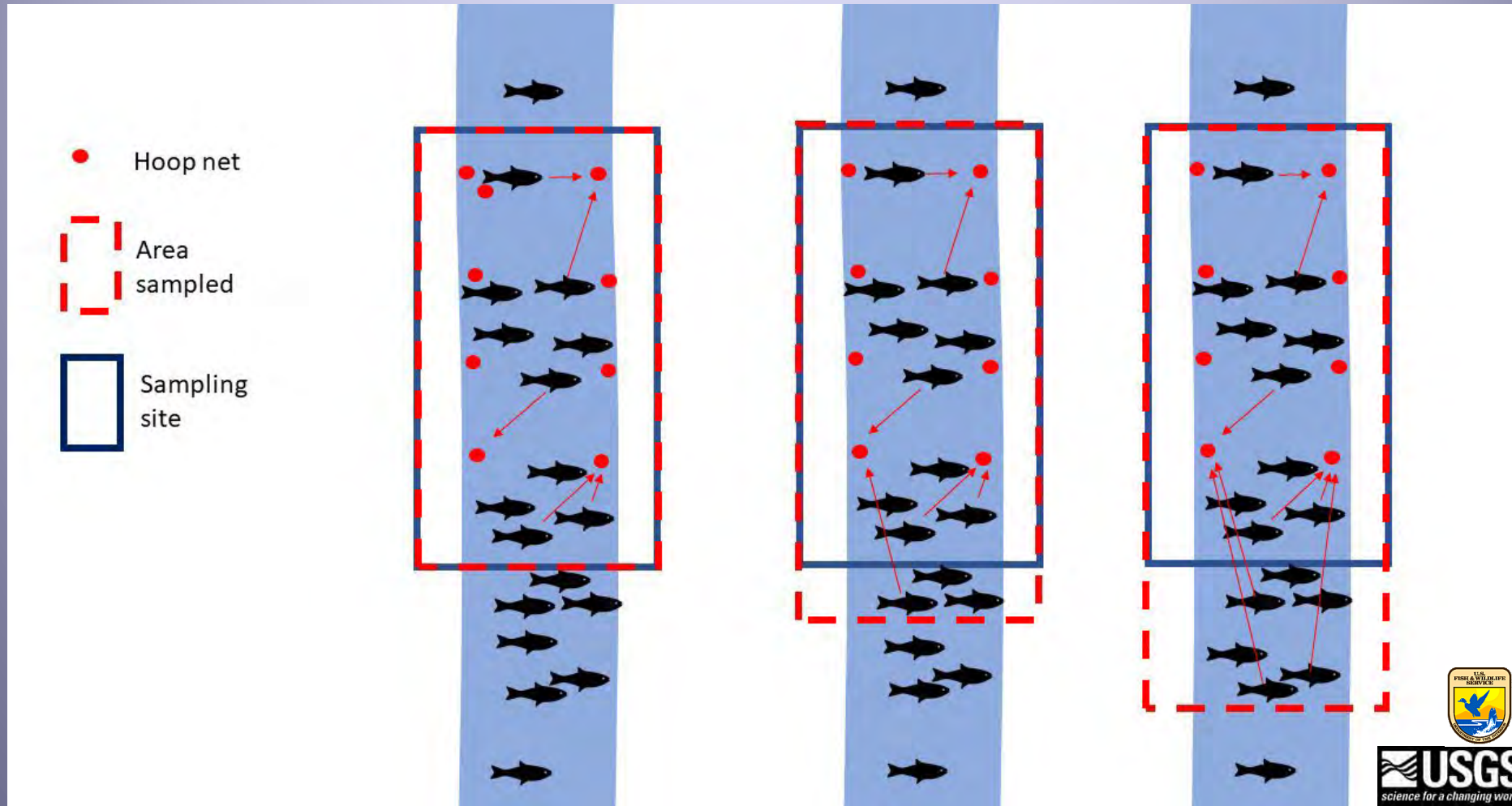


Abundance estimation in western Grand Canyon (Havasasu to Pearce Ferry)

- 1) conduct mark-recapture studies to gain capture probability data.
- 2) Apply capture probability data to catch data to estimate densities of adult Humpback Chub within sample reaches.
- 3) Extend densities between sample reaches and refine estimates by accounting for habitat variability, potential movement, effects of turbidity, temp, etc.
- 4) Spatial & habitat effects account for non-random sampling

Do fish swim to get to the bait?

Or the “superpopulation” (what area are we sampling?)



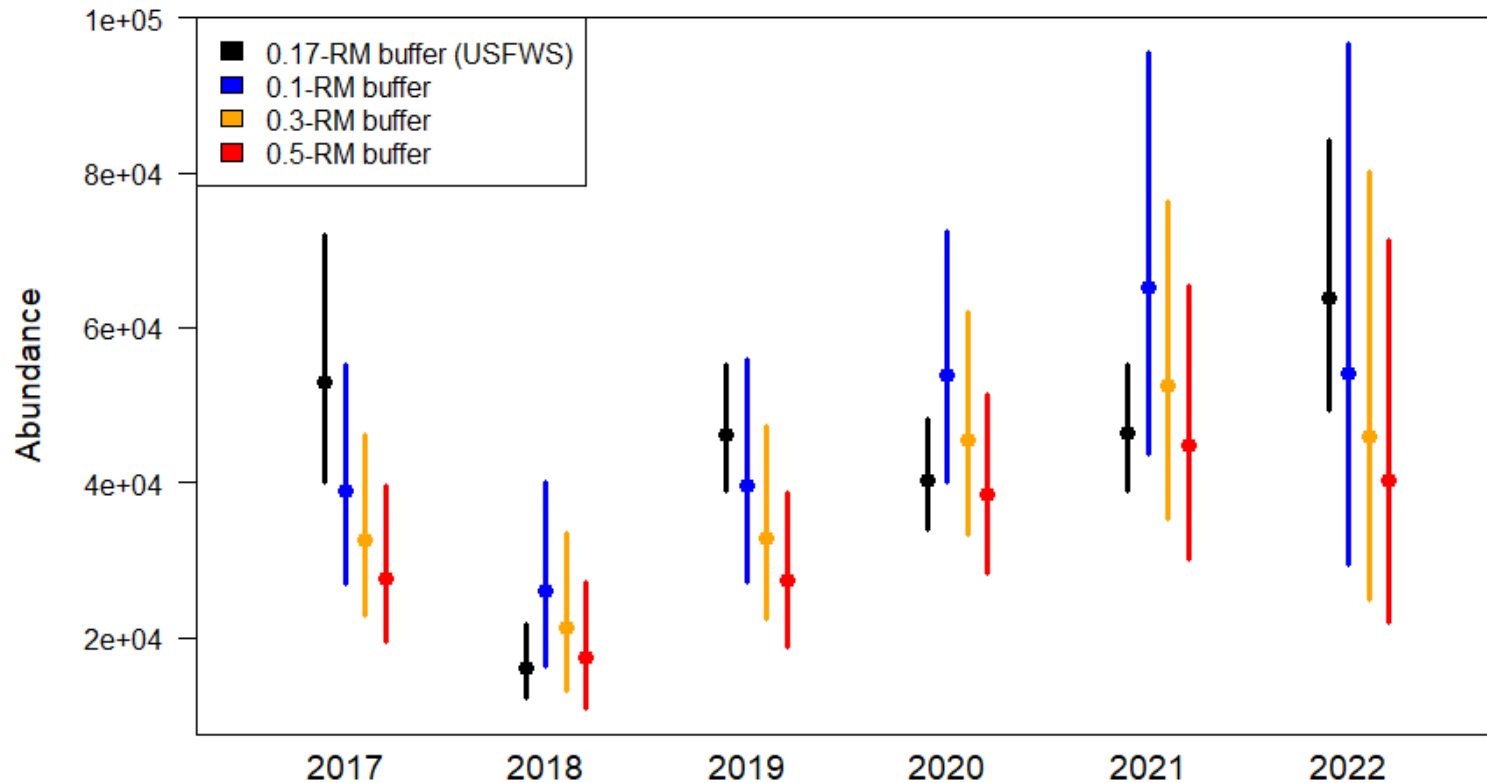
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Area sampled = sampling site

Area sampled > sampling site

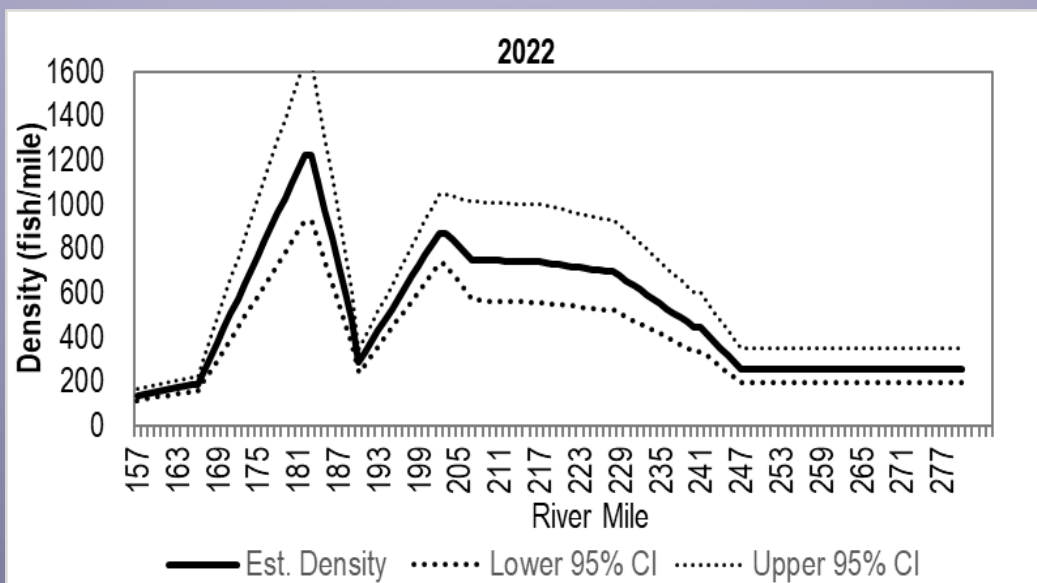
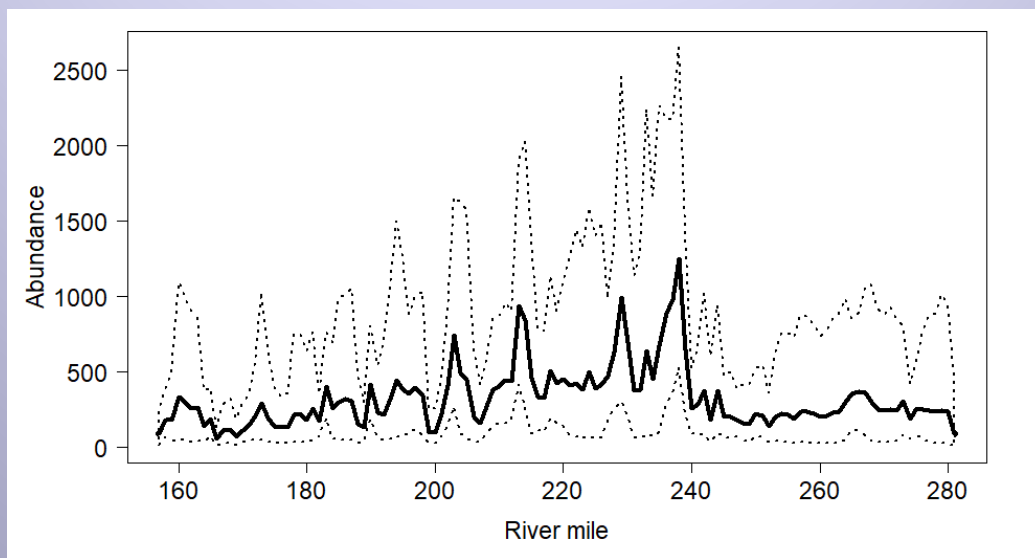
Area sampled >> sampling site

Abundance estimates of HBC in western Grand Canyon (Havasu Rapids to Pearce Ferry) 2017-2022



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An example of density (fish/mile) estimation in western Grand Canyon – the 2022 pattern



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Summary

- Since ~2017, western Grand Canyon has been populated by Humpback Chub representing all size classes.
- Highest densities of adults appear to consistently be between Lava Falls and Separation Canyon (RM 180-240).

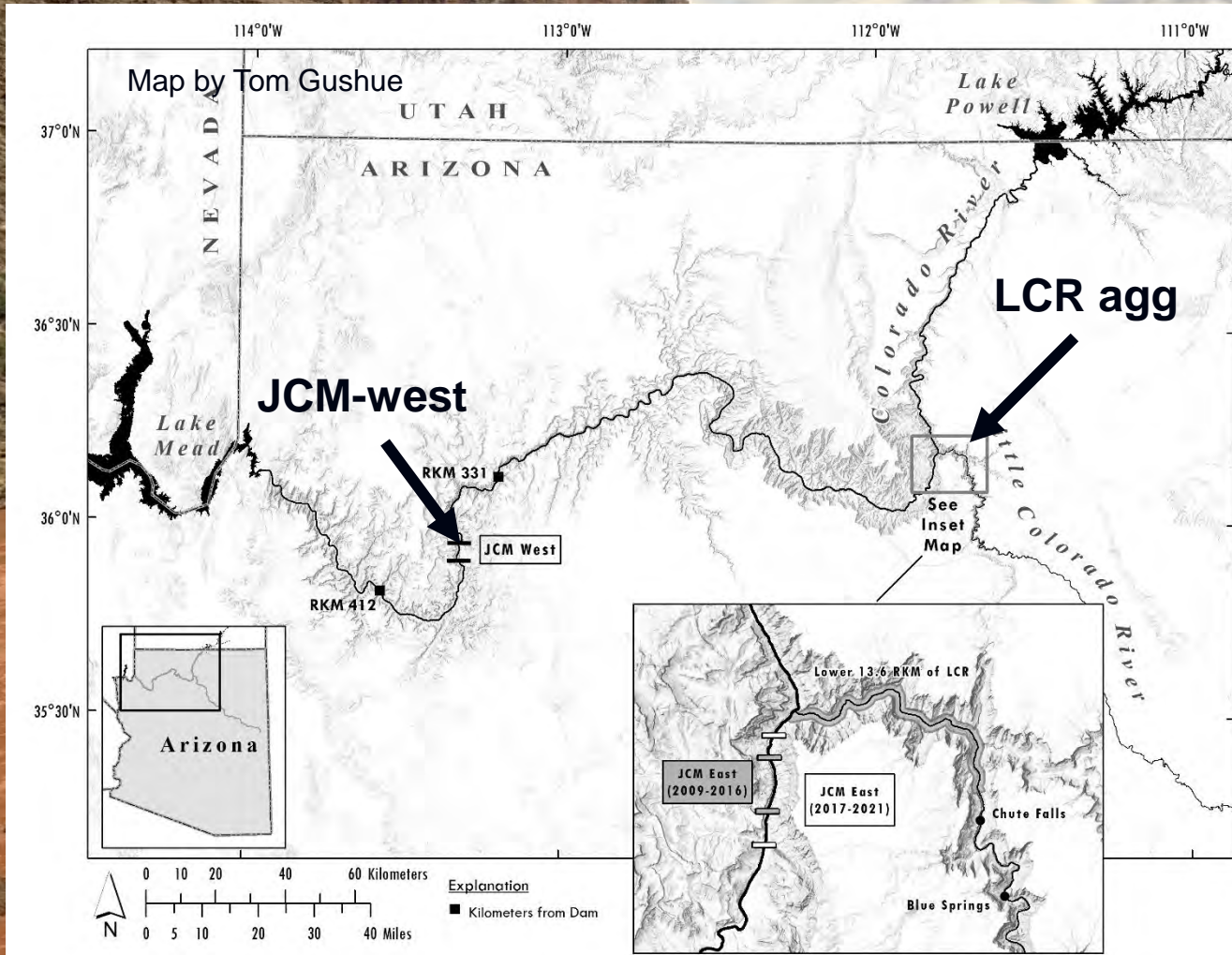
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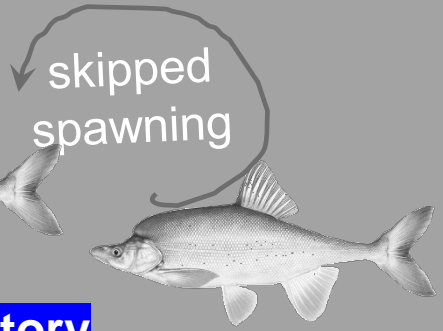
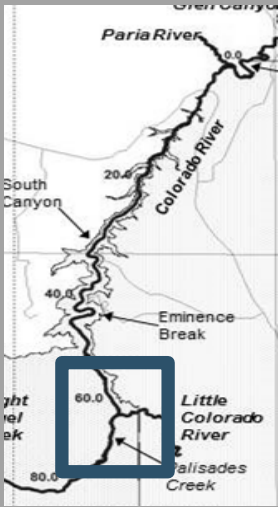
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Fixed site monitoring in western Grand Canyon (JCM-west)

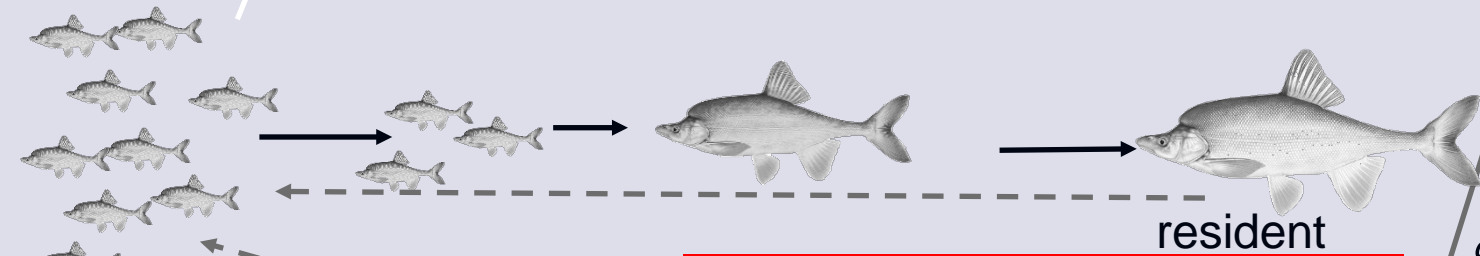


Colorado River



LCR migrants = slow life history

outmigration



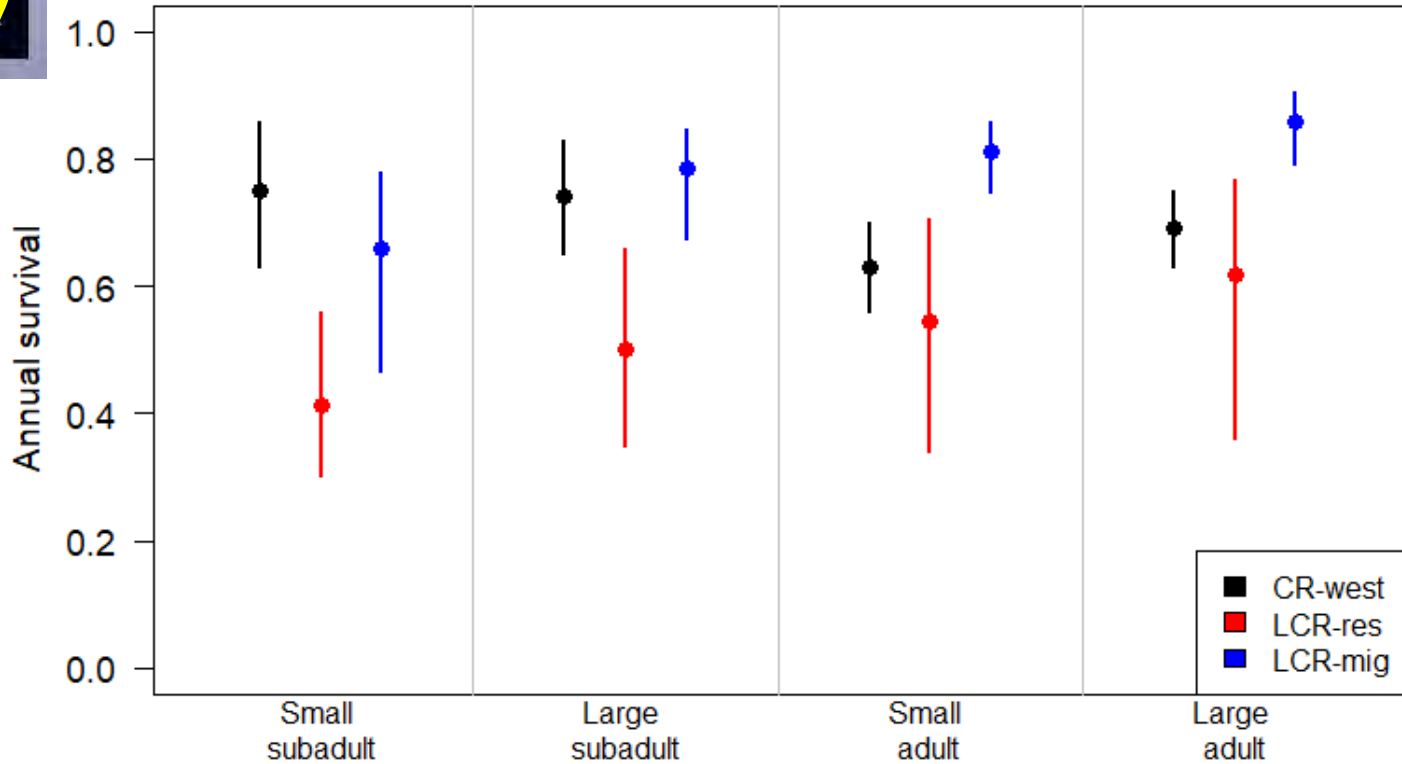
LCR residents = fast life history

resident

spring spawning migration

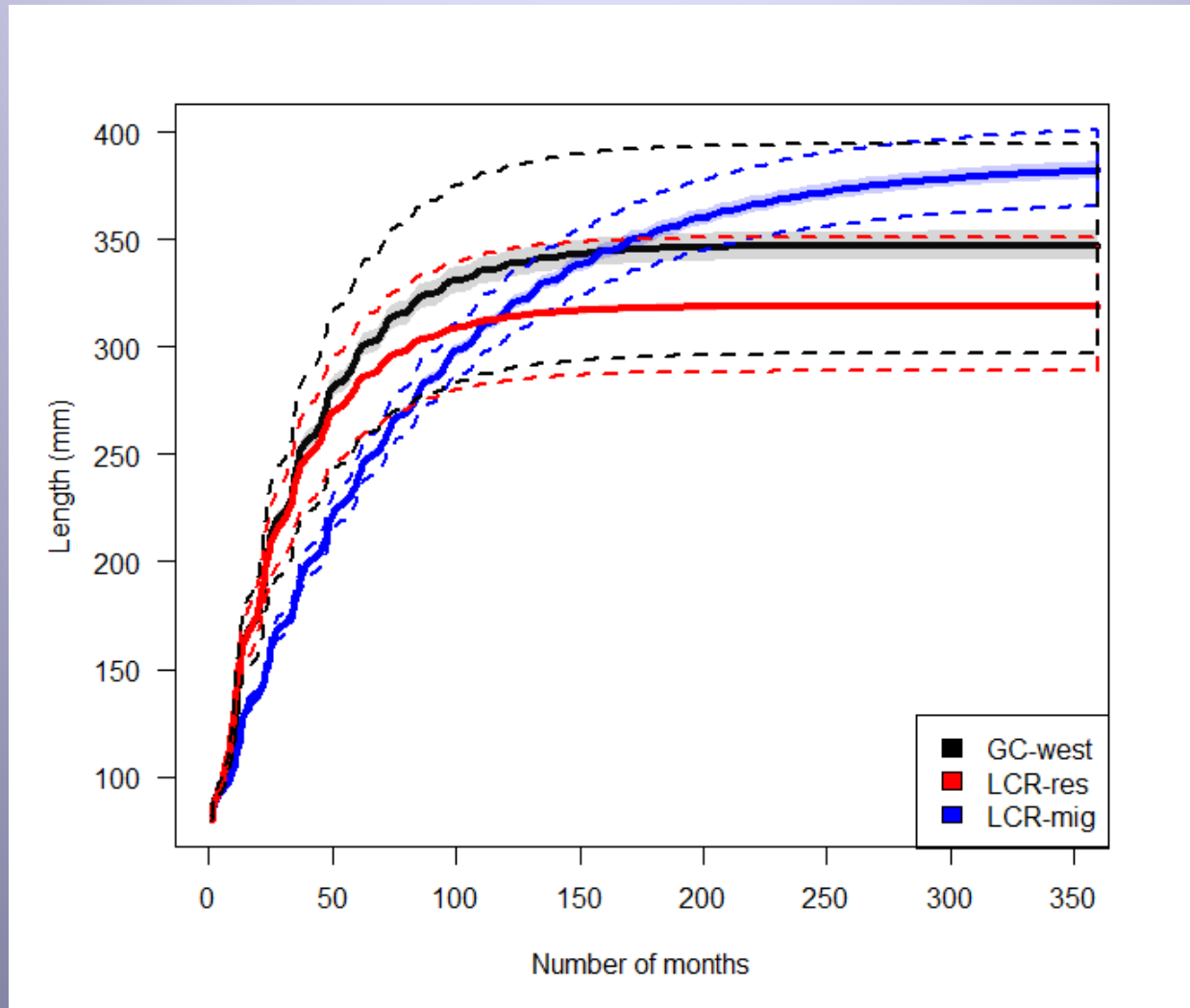
Little Colorado River

Annual apparent survival of humpback chub in JCM-west



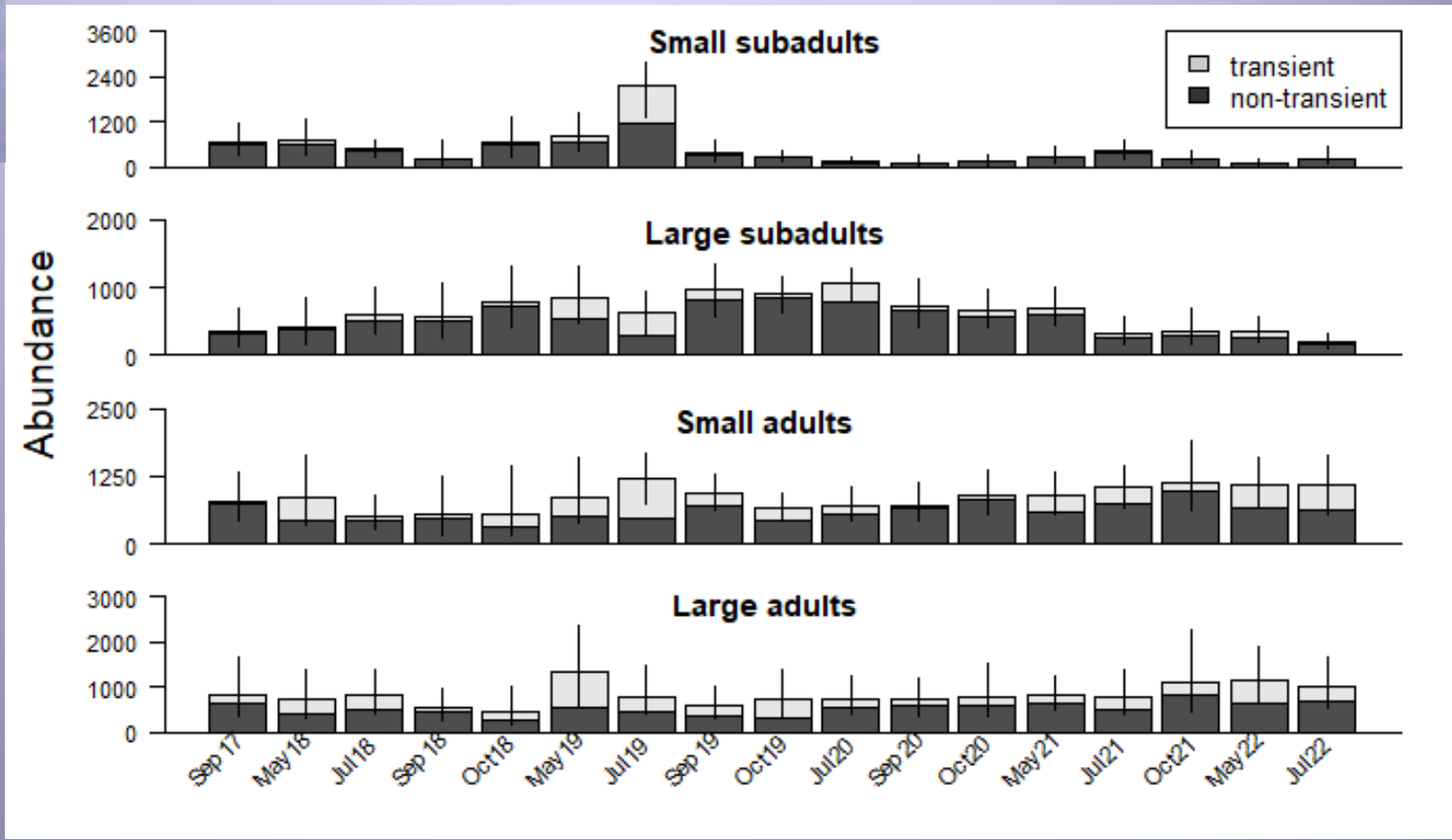
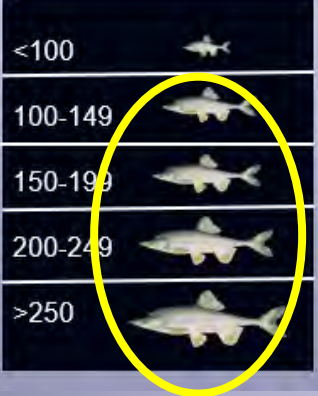
Apparent survival = probability of survival and not emigrating from the study site

Fast growth of humpback chub in JCM-west



JCM-west growth is more comparable to the LCR than JCM-east

Movement of HBC is likely high in JCM-west



Transience is the probability a fish captured in the sampling reach is just swimming through (i.e., only remains in sampling reach for 1 occasion)

Summary: Humpback chub in JCM-west

- JCM-west is unique
 - not similar to LCR-residents or LCR-migrants
- High subadult survival and fast subadult growth
 - Fast population turnover rates
- Low adult survival or high movement?
 - Need more information about movement in western Grand Canyon!

Thank You

Artwork by Lindsay Hansen

