Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
February 20-21, 2013

Agenda Item

Humpback Chub and Nonnative Fish Update

Action Requested

✓ Information item only.

Presenter

Scott VanderKooi, Biology Program Manager, Grand Canyon Monitoring and Research Center, U.S. Geological Survey

Glen Knowles, Chief, Adaptive Management Group, Environmental Resources Division, Upper Colorado Region, Bureau of Reclamation (Reclamation)

Previous Action Taken

N/A

Relevant Science

Glen Canyon Dam Adaptive Management Program Biennial Budget and Work Plan—Fiscal Years 2013–14
http://www.usbr.gov/uc/rm/amp/amwg/mtgs/12aug29/Attach_08b.pdf

December 23, 2011 Final Biological Opinion on the Operation of Glen Canyon Dam including High Flow Experiments and Non-Native Fish Control
http://www.usbr.gov/uc/envdocs/ea/gc/HFEProtocol/Appdx-H.pdf

Background Information

The Bureau of Reclamation received a biological opinion on the operation of Glen Canyon Dam from the U.S. Fish and Wildlife Service in December of 2011. The presentation will review implementation of the 2011 biological opinion with emphasis on conservation measures and a review of biological triggers for nonnative fish control implementation. A review of current population estimates for humpback chub and rainbow trout, survival estimates for juvenile humpback chub, and Colorado River mainstem temperature analysis will also be provided.

RECLAMATION

Managing Water in the West

Humpback Chub and Non-Native Fish Update

Glen Knowles, Bureau of Reclamation
Scott VanderKooi, Grand Canyon Monitoring and Research Center
Glen Canyon Dam Adaptive Management Program
Adaptive Management Work Group
February 20, 2013

U.S. Department of the Interior
Bureau of Reclamation

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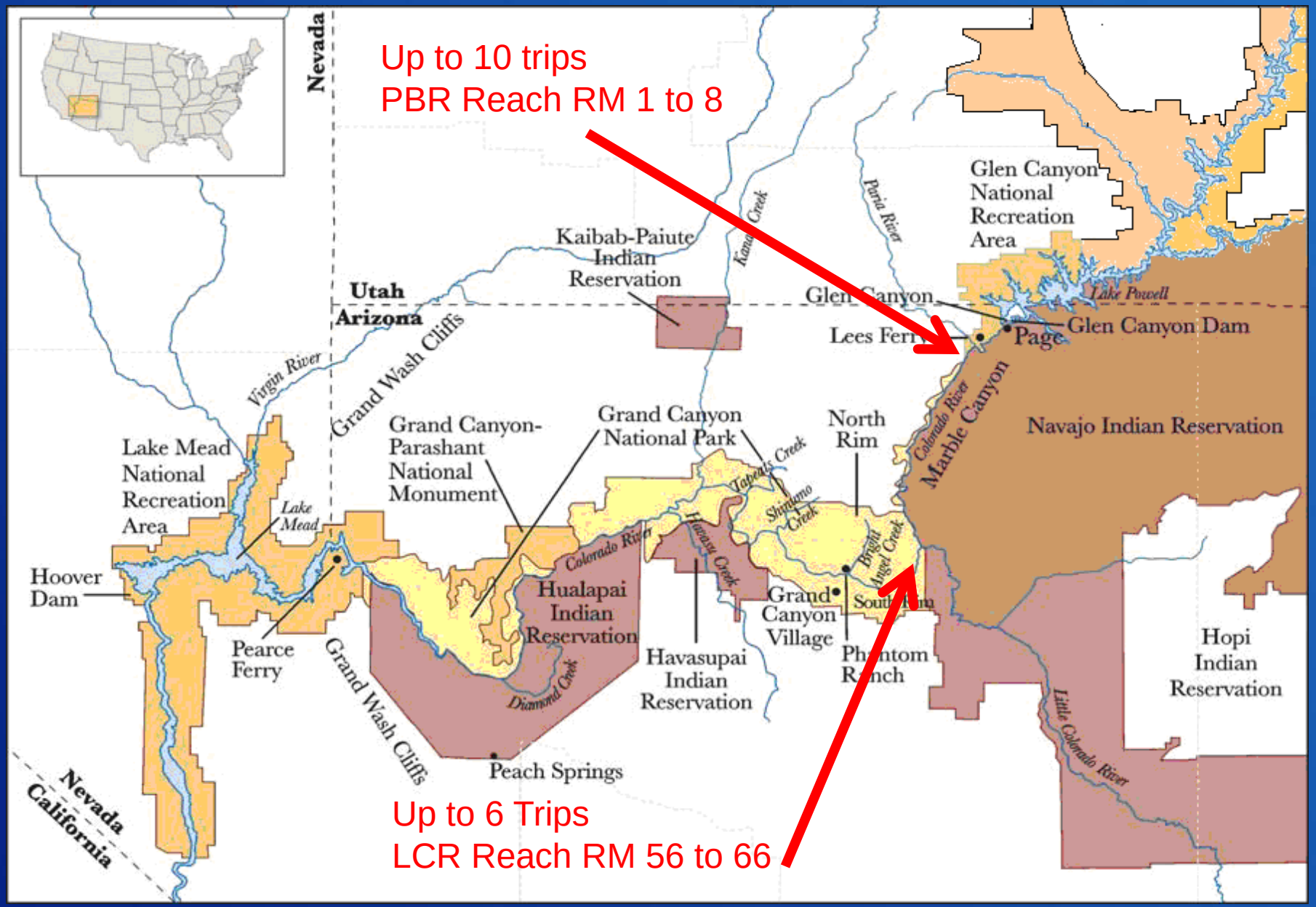
Non-Native Fish Control

- **Final FWS biological opinion on December 23, 2011 on operation of Glen Canyon Dam (MLFF, HFEP, NNFC) through 2020 (EA and FONSI completed May 2012).**
  - ❖ **Non-native fish control is important conservation measure, predation by non-native rainbow and brown trout could reduce humpback chub (HBC) recruitment and the adult population, and threaten recovery.**
- **NHPA MOA NNFC – Reclamation will use live removal or reconsult with tribes and consulting parties.**
- **AGFD detected whirling disease in 2011, 25% detection rate, dropped to 10% in 2012; live removal is not possible.**
- **Reclamation continues to consult with MOA consulting parties.**

RECLAMATION



RECLAMATION

2011 FWS Biological Opinion
Non-native Fish Control Trigger

PBR Removal is considered experimental and only two trips were identified for implementation in the Non-Native Fish Control EA, these were cancelled in 2012 in part due to WD.

In the Little Colorado River, defined by the 2011 FWS Biological Opinion:

1. Rainbow trout abundance from RM 63.0-64.5 exceeds 760 fish and brown trout abundance exceeds 50 fish

AND

2. ASMR estimate of humpback chub falls below 7,000

OR

1. 3 of 5 years subadult humpback chub drop below 910
2. In two consecutive years water temp at LCR does not exceed 12 deg. C
3. Annual survival of juvenile HBC drops 25% in any one year.

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BUREAU OF RECLAMATION

Humpback Chub and Nonnative Fish Update

Scott VanderKooi, SBSC, Grand Canyon Monitoring and Research Center
Glen Knowles, Bureau of Reclamation

Glen Canyon Dam Adaptive Management Program
Adaptive Management Work Group
February 20, 2013

U.S. Department of the Interior
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Age 4+ & Age 2+ Humpback Chub Abundance Estimates

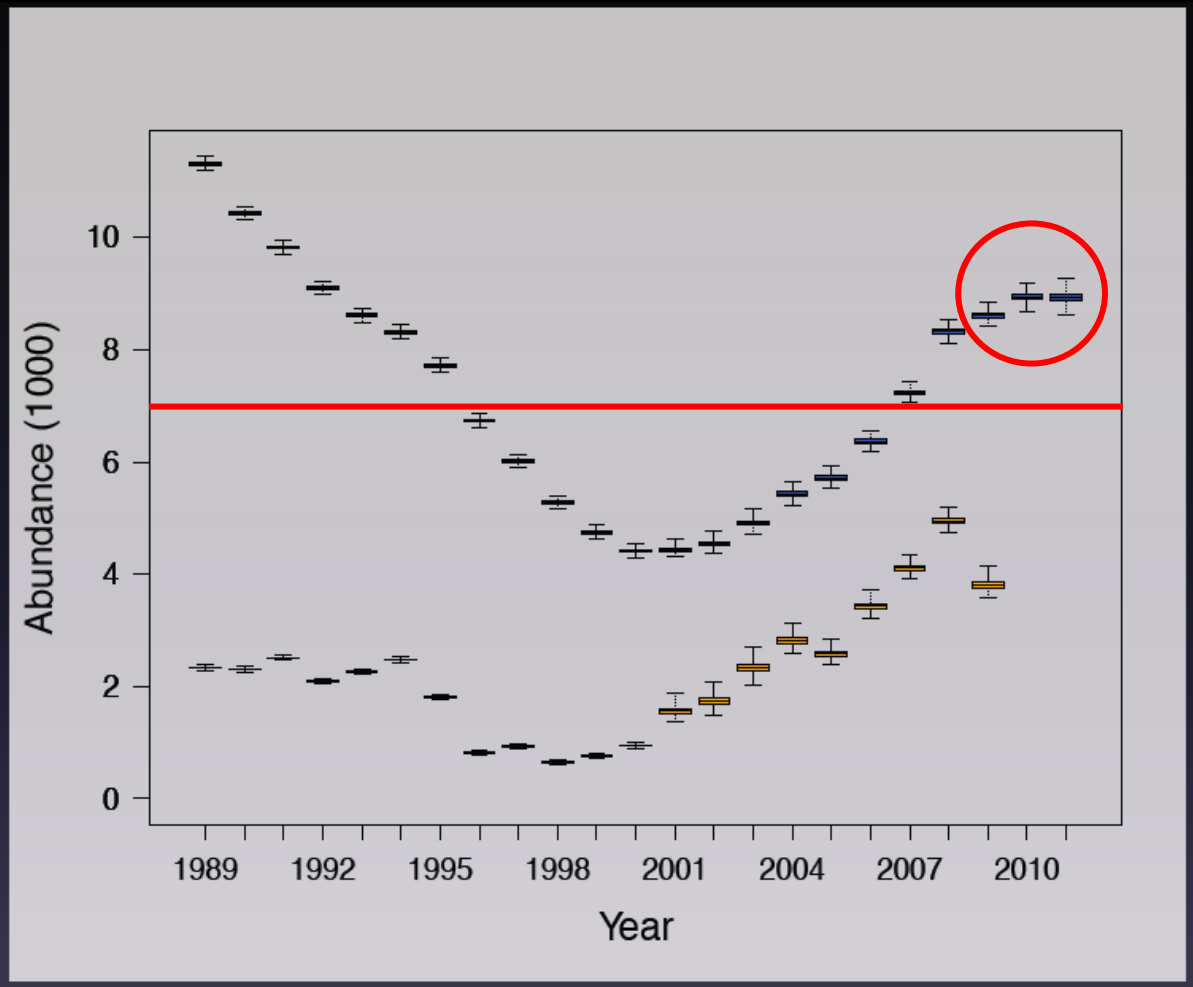
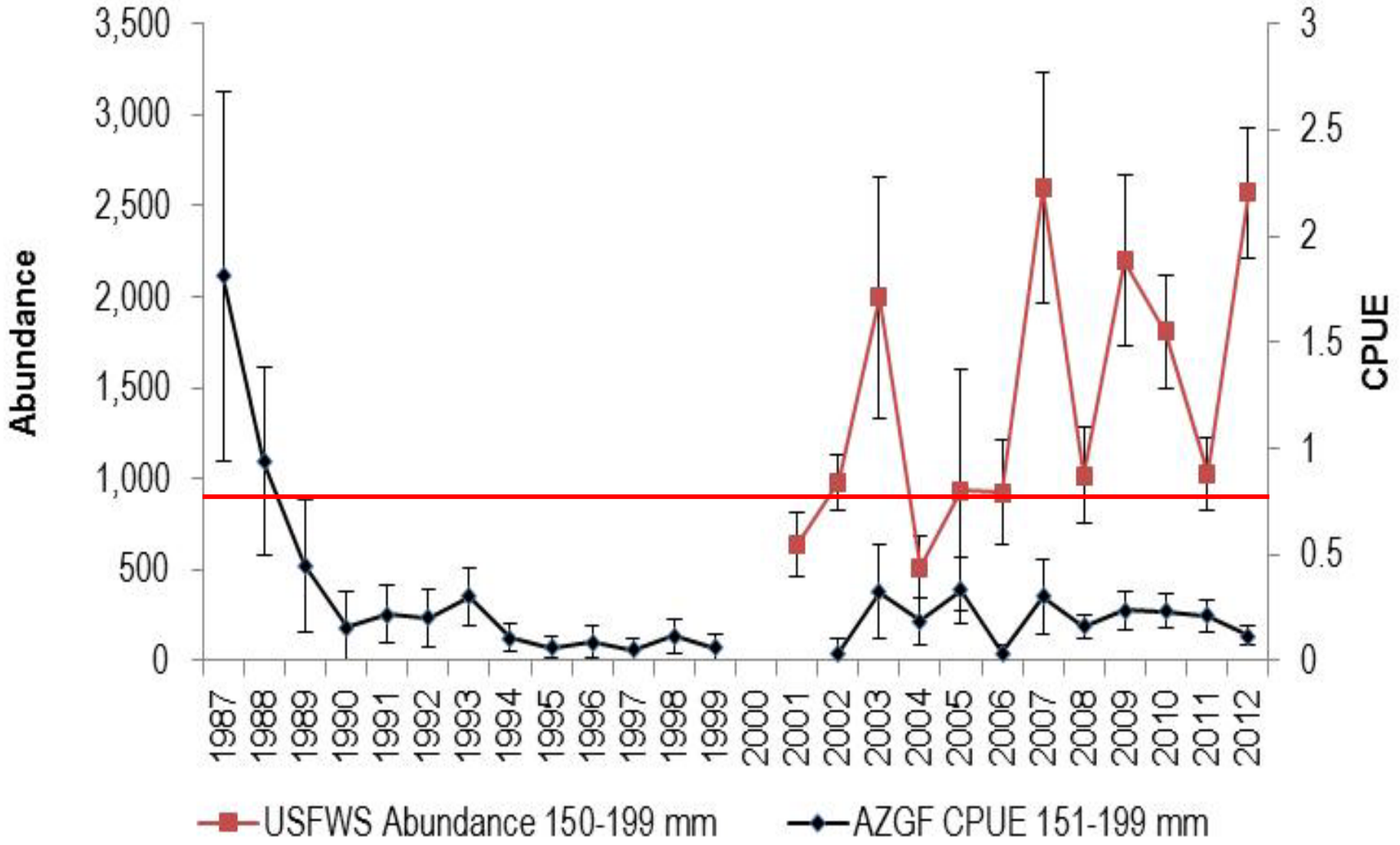
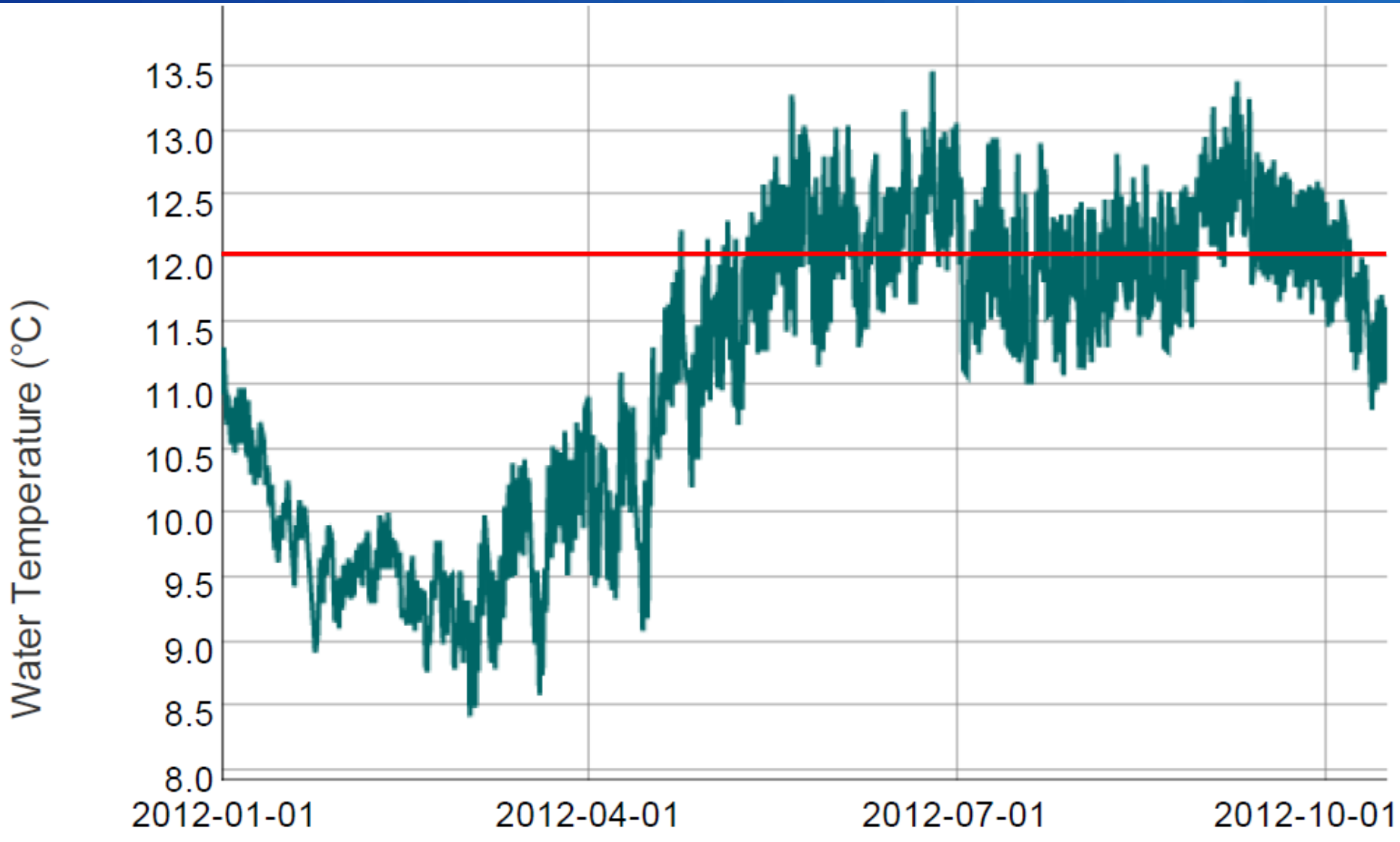


Figure: Marginal distributions for age-4+ (blue) abundance and age-2 recruits (orange). (S. Martell, preliminary data, subject to revision)

Spring Abundance & CPUE Humpback Chub 150-199 mm



2012 Water Temperature at LCR



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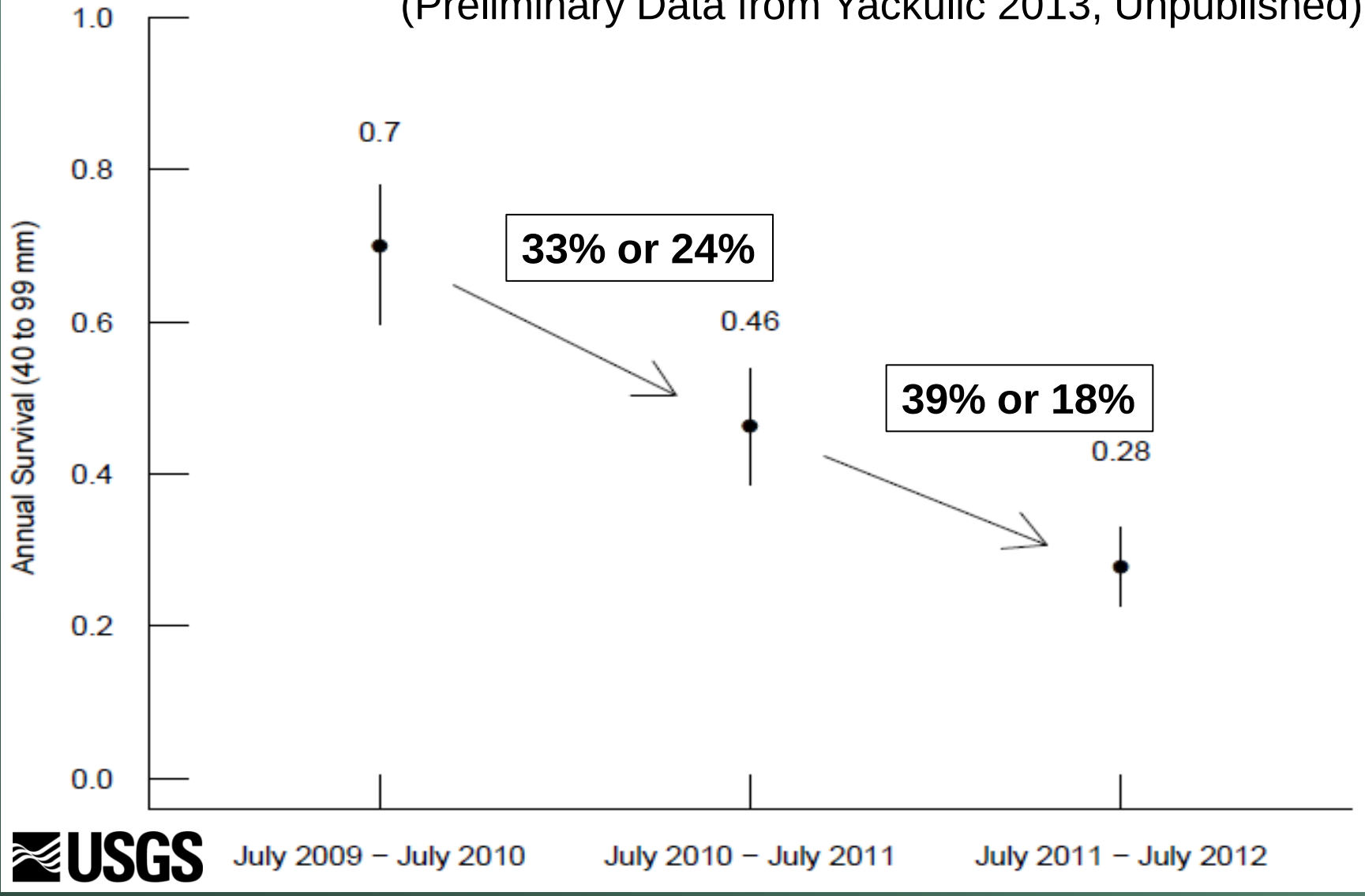
RECLAMATION

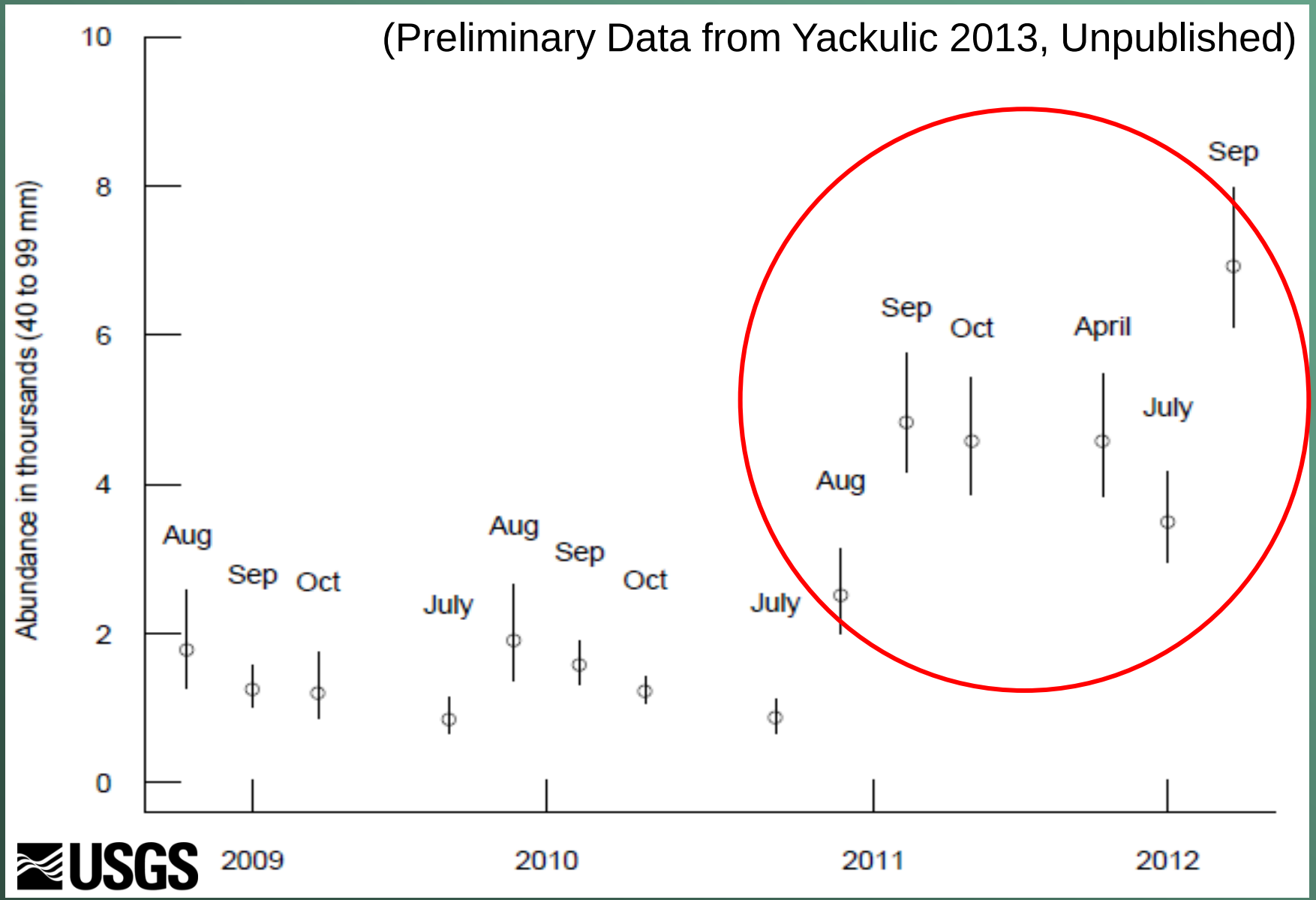
Annual Survival Rates – 40-99 mm Humpback Chub (JCM Reach)

(Preliminary Data from Yackulic 2013, Unpublished)



Abundance Estimates – 40-99 mm Humpback Chub (JCM Reach)

(Preliminary Data from Yackulic 2013, Unpublished)



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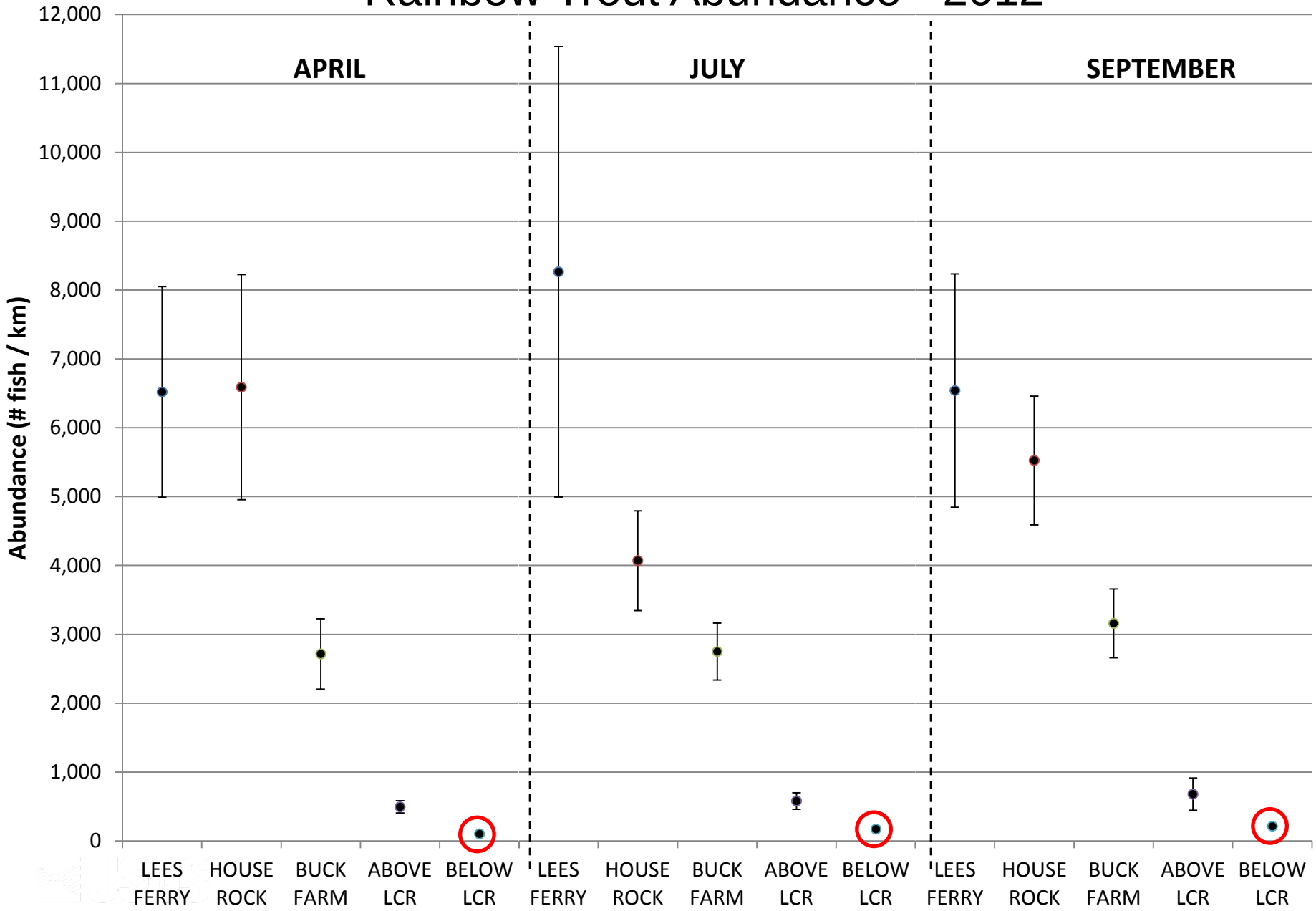
Rainbow Trout Abundance - 2012



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(Preliminary Data from Korman and Yard 2013, Unpublished)

2011 USFWS Biological Opinion Non-native Fish Control Trigger

- Adult humpback chub <7000 fish? No
- OR
- ALL THREE? No
  - 3 of 5 years subadult humpback chub drop below 910? No
  - Temperature <12° C for 2 consecutive years at LCR? No
  - Annual survival of 40-99 mm humpback chub in JCM drops 25% from preceding year? Maybe

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2011 USFWS Biological Opinion Non-native Fish Control Trigger

- **AND**
- **Rainbow trout abundance over 760?** **No**

  Closed model estimates ~450 (330-600)
  [Korman and Yard, preliminary data]
- **AND**
- **Brown trout abundance over 50?** **Unknown**

  8 total caught - no estimate generated
  [Korman and Yard, preliminary data]

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Near Shore Ecology / Fall Steady Flows

Lead: Bill Pine, Univ. of Florida

- The NSE project was designed to assess fish population responses to fall steady flow experiment
  - Direct response metrics: fish growth, survival, abundance
  - Indirect responses: habitat use, movement, selection
- Fill key data gaps in native fish ecology

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Near Shore Ecology / Fall Steady Flows

- Survival similar between flow treatments
- Juveniles < 100 mm survive & rear in mainstem
- Growth declined during fall steady flows
  - Why? Temps. similar, could be food availability
- Juvenile abundance highest in talus, lowest in backwaters
- Positive selection by juveniles for backwaters
  - Little habitat available - difficult to reach conclusions
  - Juveniles can survive & rear without backwaters
- Flow type didn’t affect habitat selection or daily movements

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Near Shore Ecology / Fall Steady Flows

- **Products:**
  - Annual reports and three Master's theses (http://floridarivers.ifas.ufl.edu/NSE.htm)
  - Hayden, Limburg, and Pine. 2012. Using Otolith Chemistry Tags and Growth Patterns to Distinguish Movements and Provenance of Native Fish in the Grand Canyon. River Research and Applications. (http://onlinelibrary.wiley.com/doi/10.1002/rra.2627/abstract)
  - An assessment of movement and habitat use for large juveniles from telemetry – submitted
  - A description of growth and survival of juvenile humpback chub in response to the flow experiment – in preparation
  - Estimation of juvenile humpback chub density in different habitat types – in preparation
  - An evaluation of predation risk for juvenile fish in different habitats – in internal review

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Research and Monitoring Update

Photo: George Andrejko

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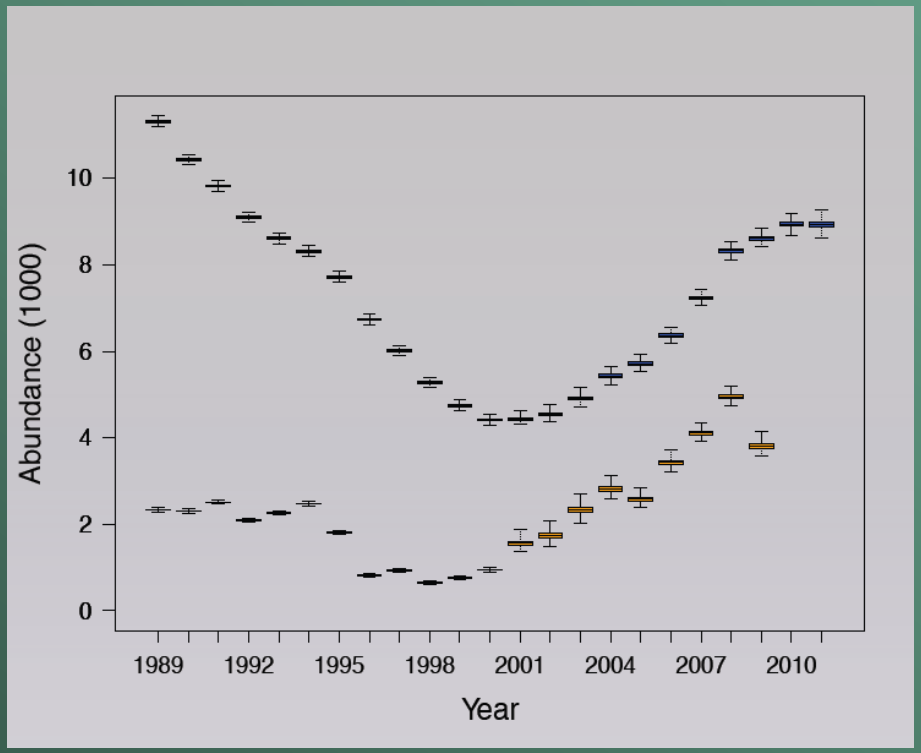
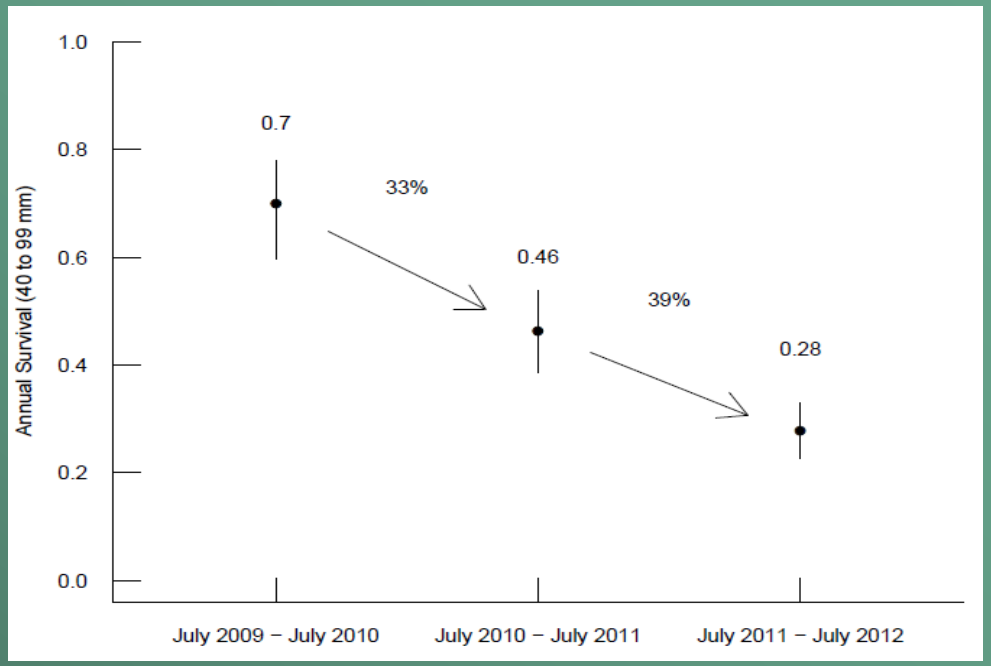
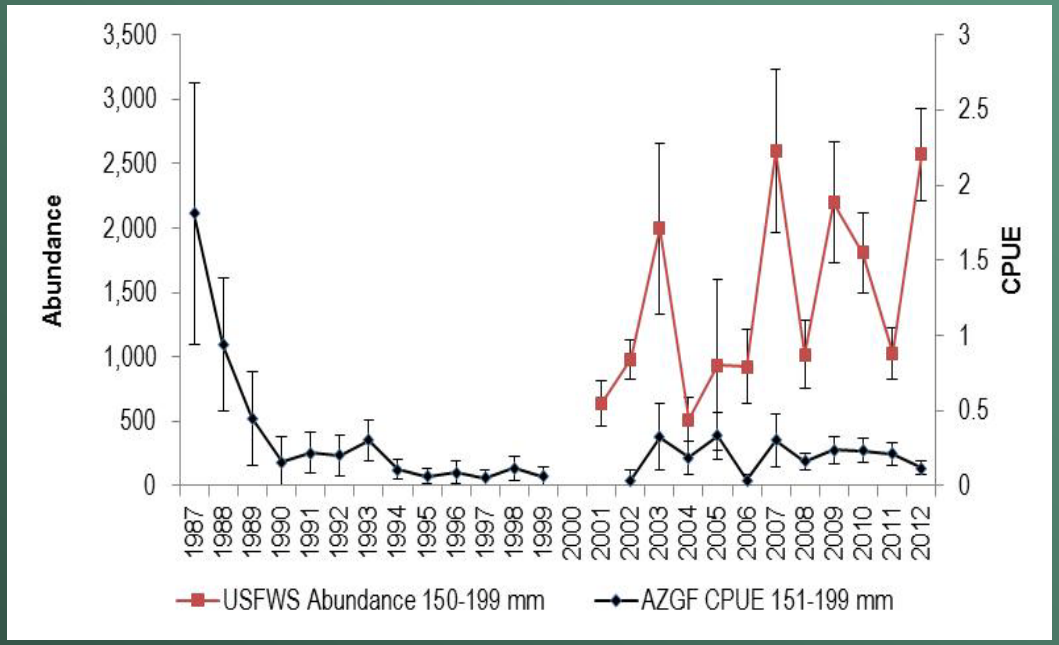
Photo: Randall Babb





Able to generate estimates of survival and/or abundance for key life stages



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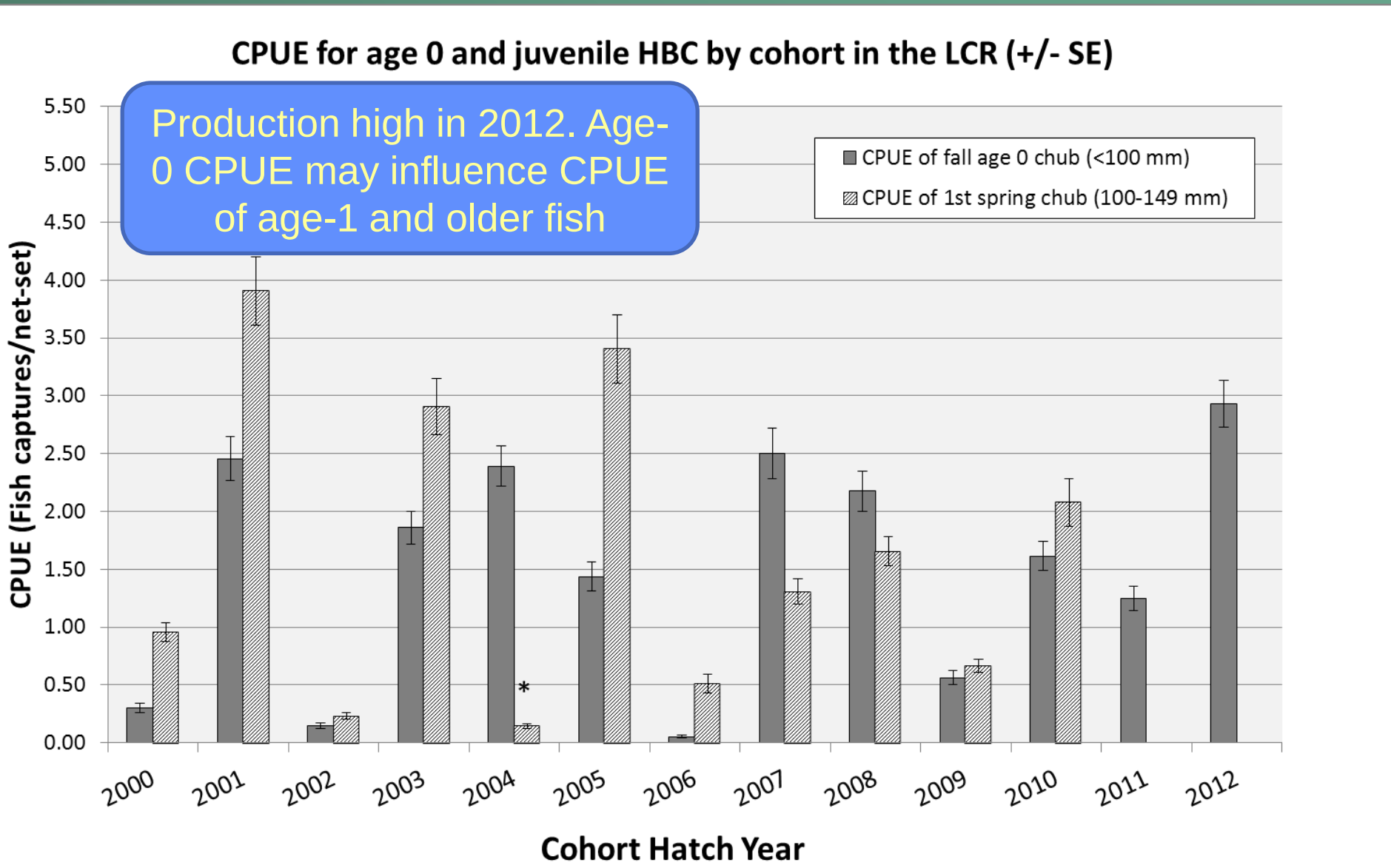

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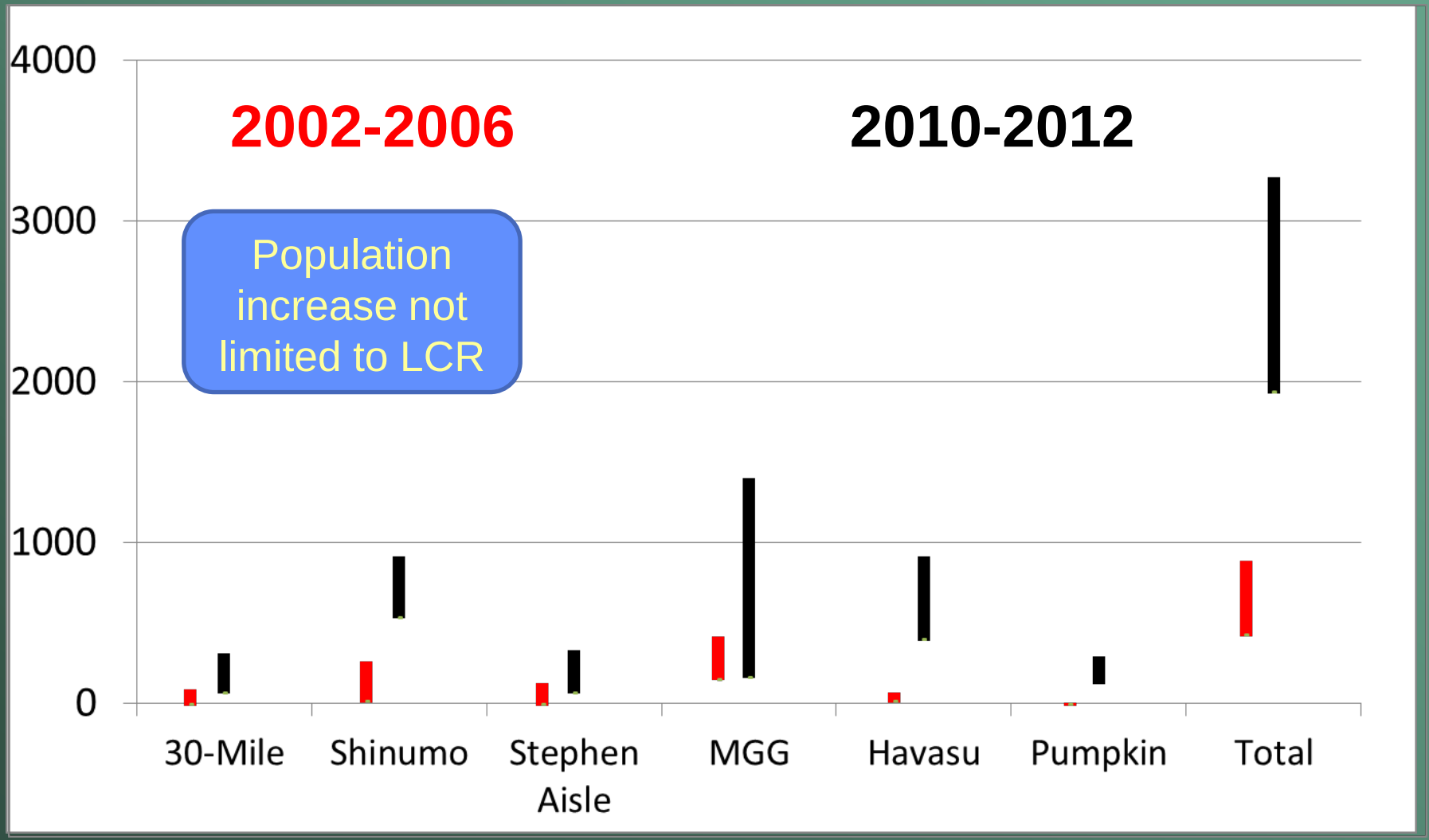
(Preliminary Data from VanHaverbeke and Pillow, USFWS, 2013, Unpublished)

Humpback Chub Aggregations: Abundance Estimates



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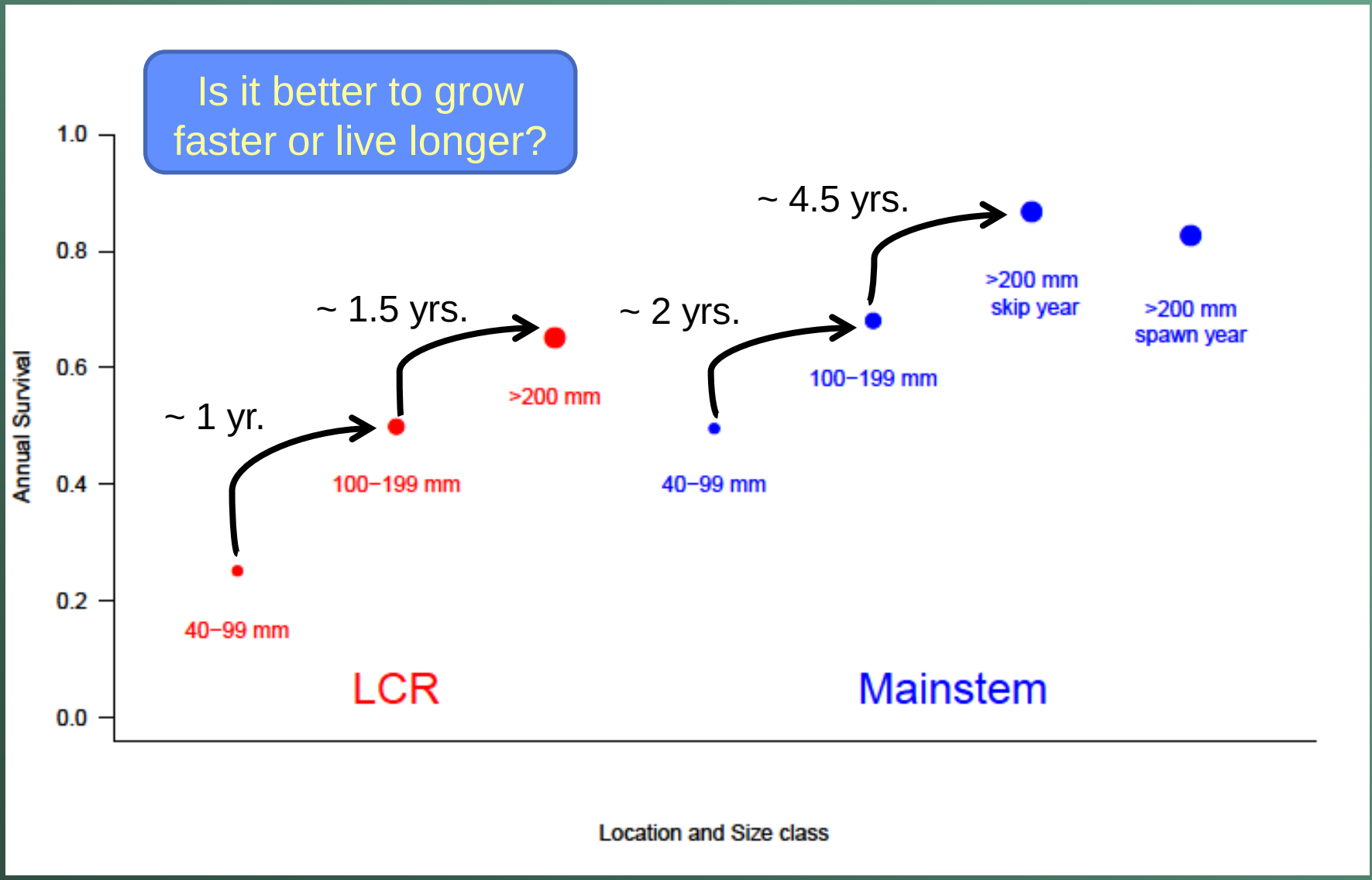
(Preliminary Data from Persons and VanHaverbeke 2013, Unpublished)

Humpback Chub – Mainstem vs. LCR

Tradeoffs Between Growth & Survival



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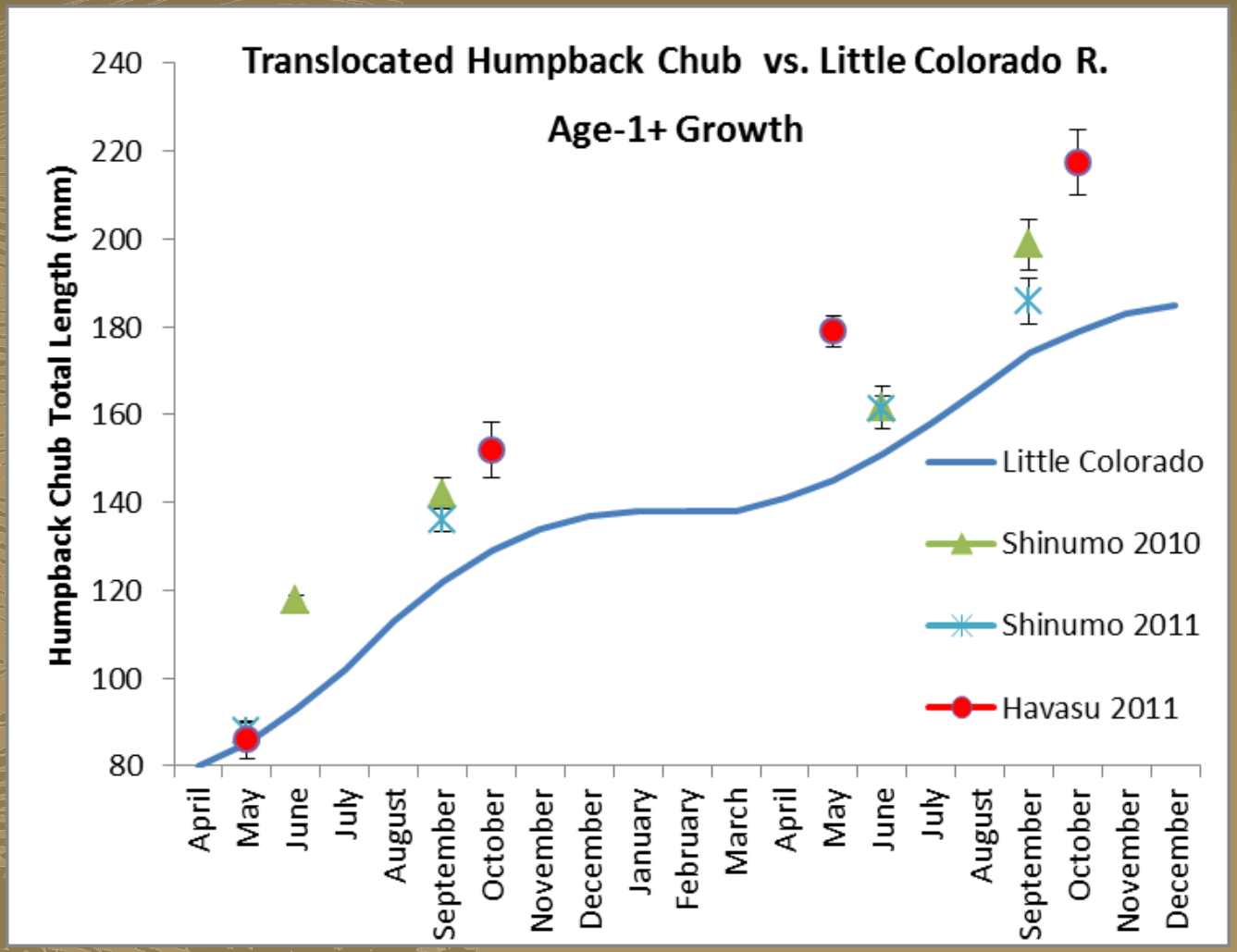
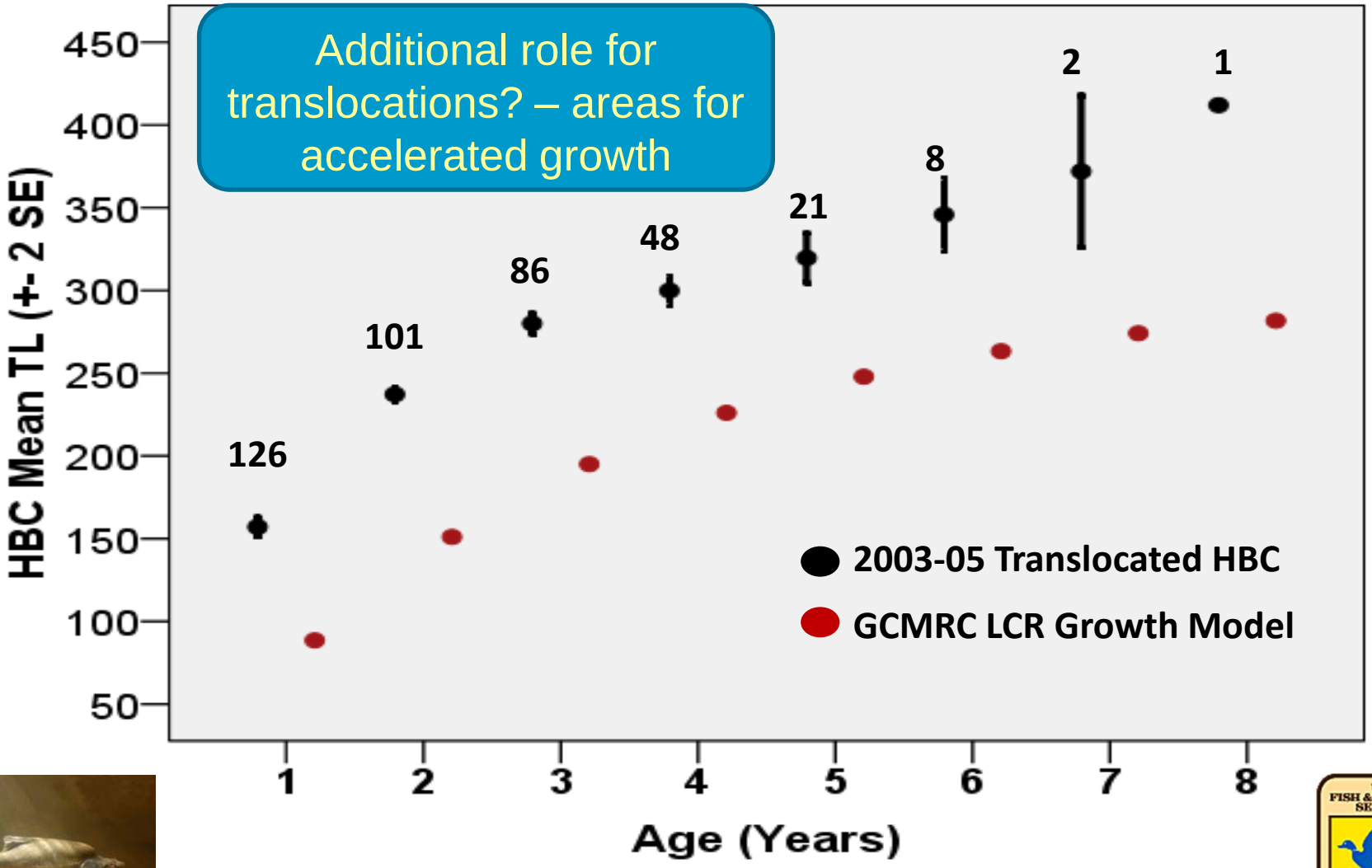
(Preliminary Data from Yackulic 2013, Unpublished)

Growth – Translocated Humpback Chub



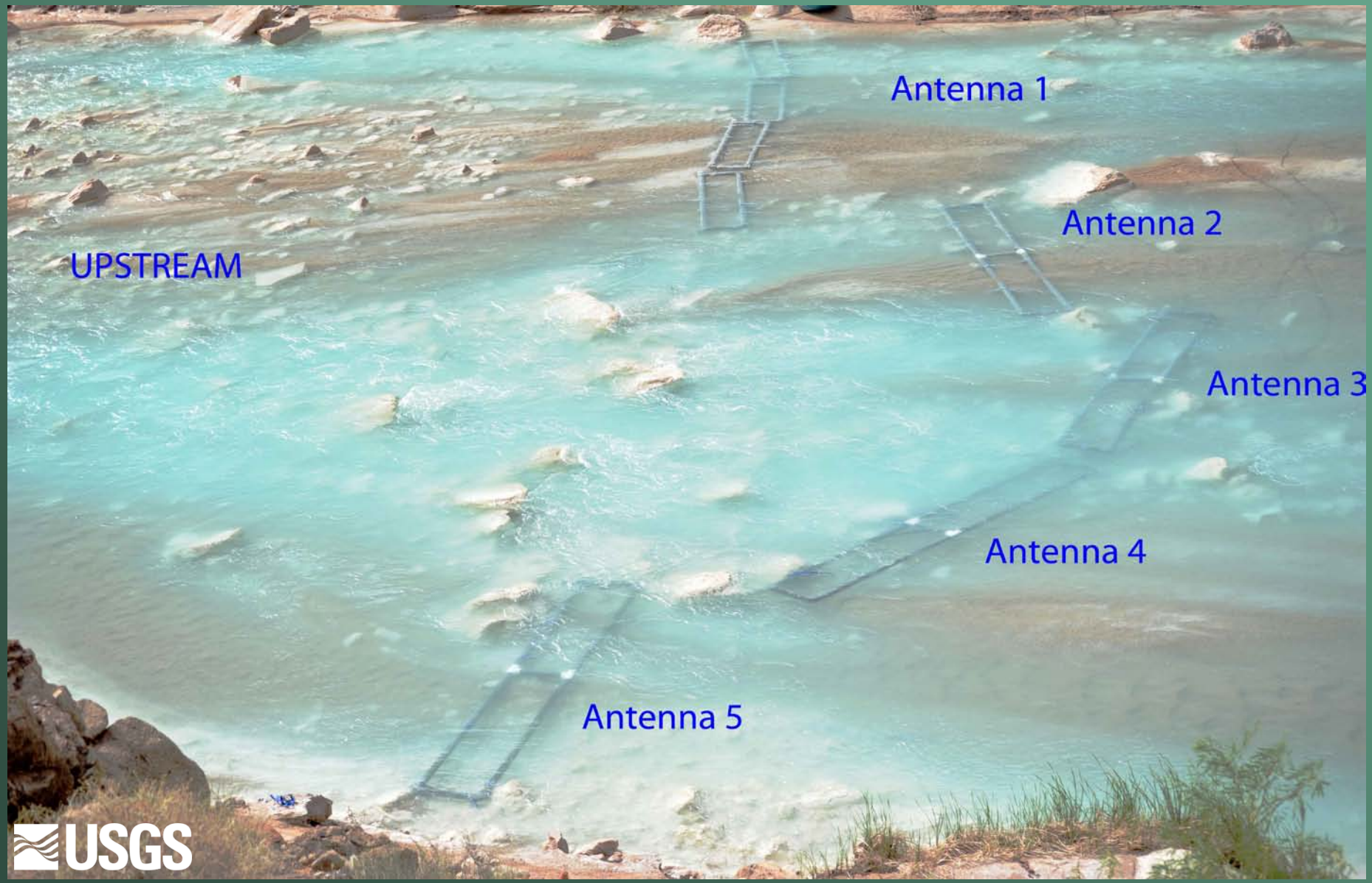
(Preliminary Data from Healy et al. 2013, Unpublished)

Growth – Translocated Humpback Chub
Chute Falls



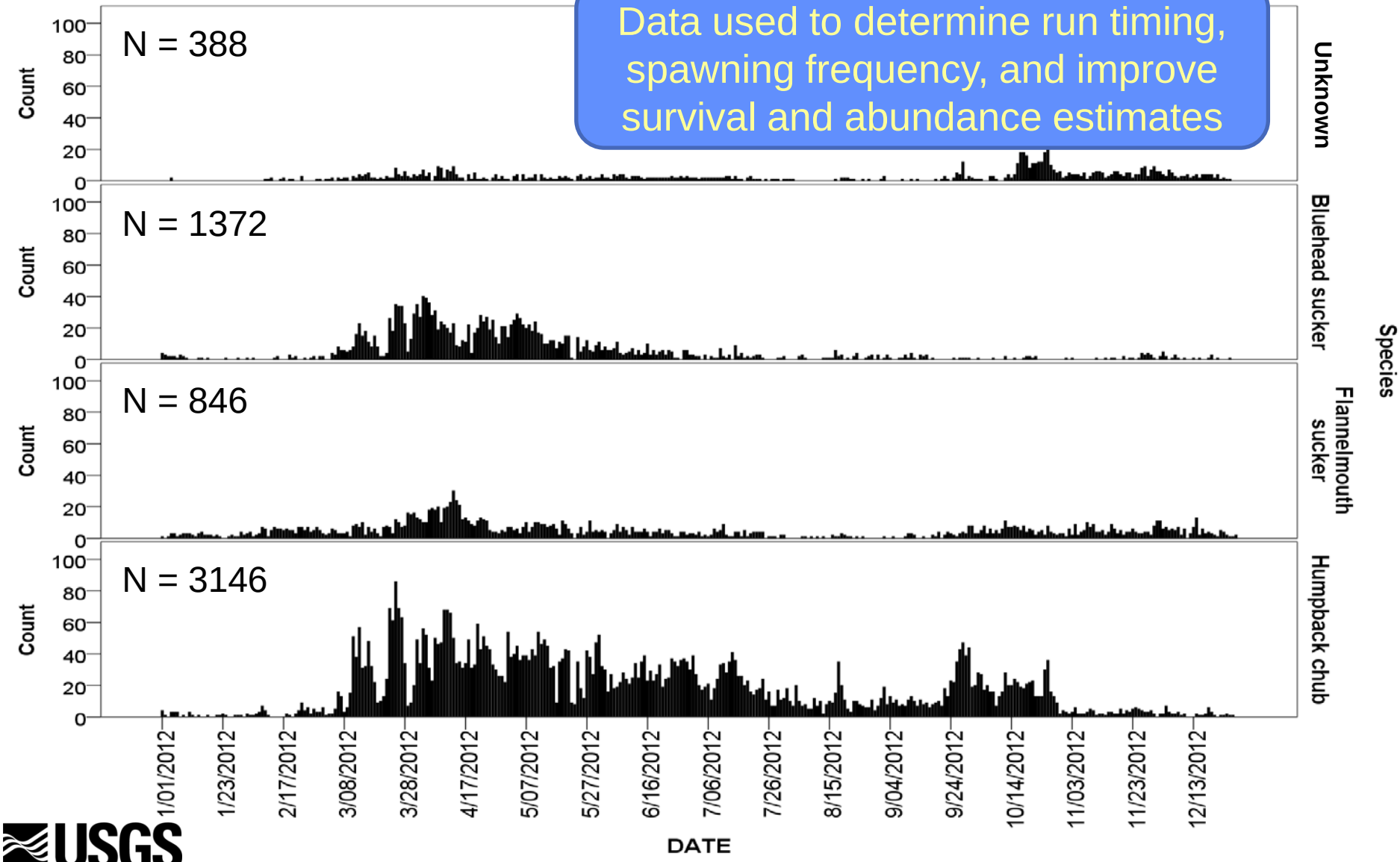
(Preliminary Data from Young et al. 2013, Unpublished)

Little Colorado River PIT-tag arrays



Number of unique fish detected per day 2012

Data used to determine run timing, spawning frequency, and improve survival and abundance estimates



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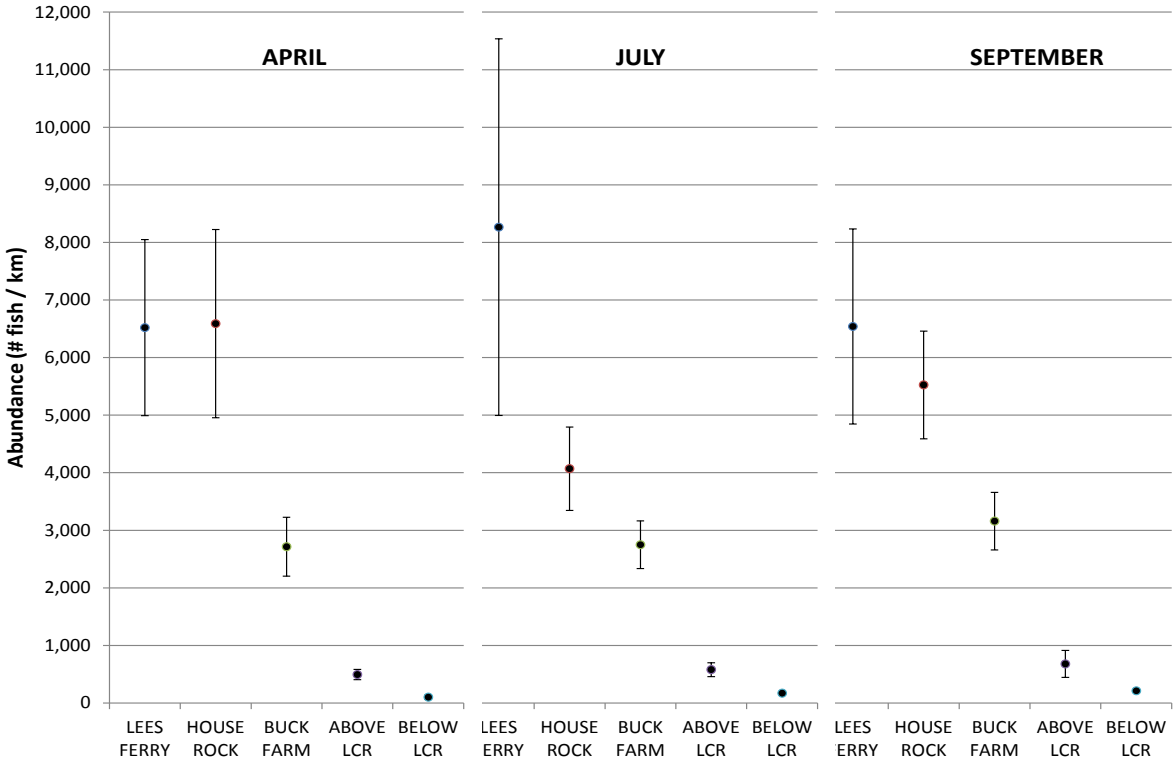
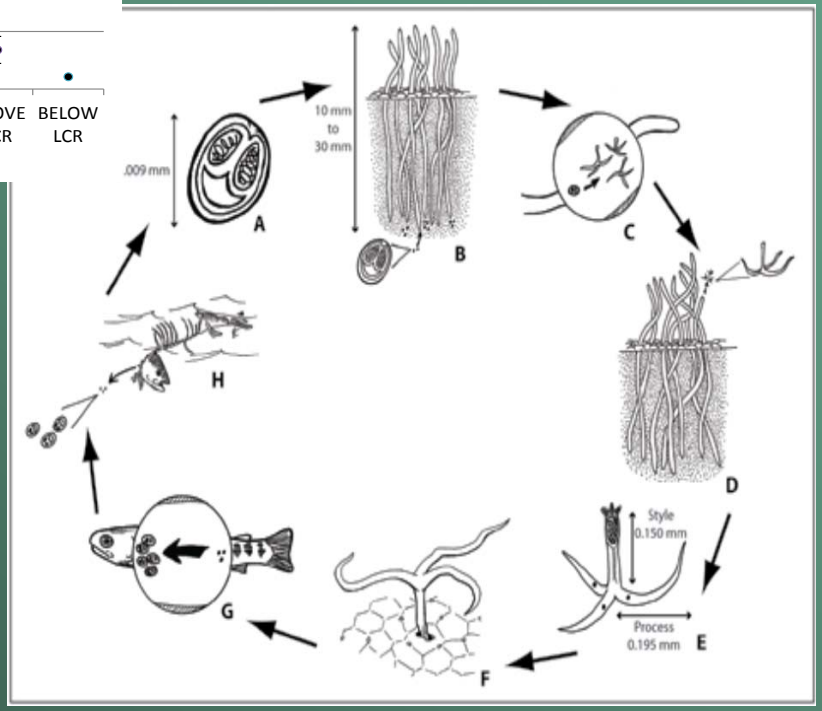
(Preliminary Data from Persons 2013, Unpublished)

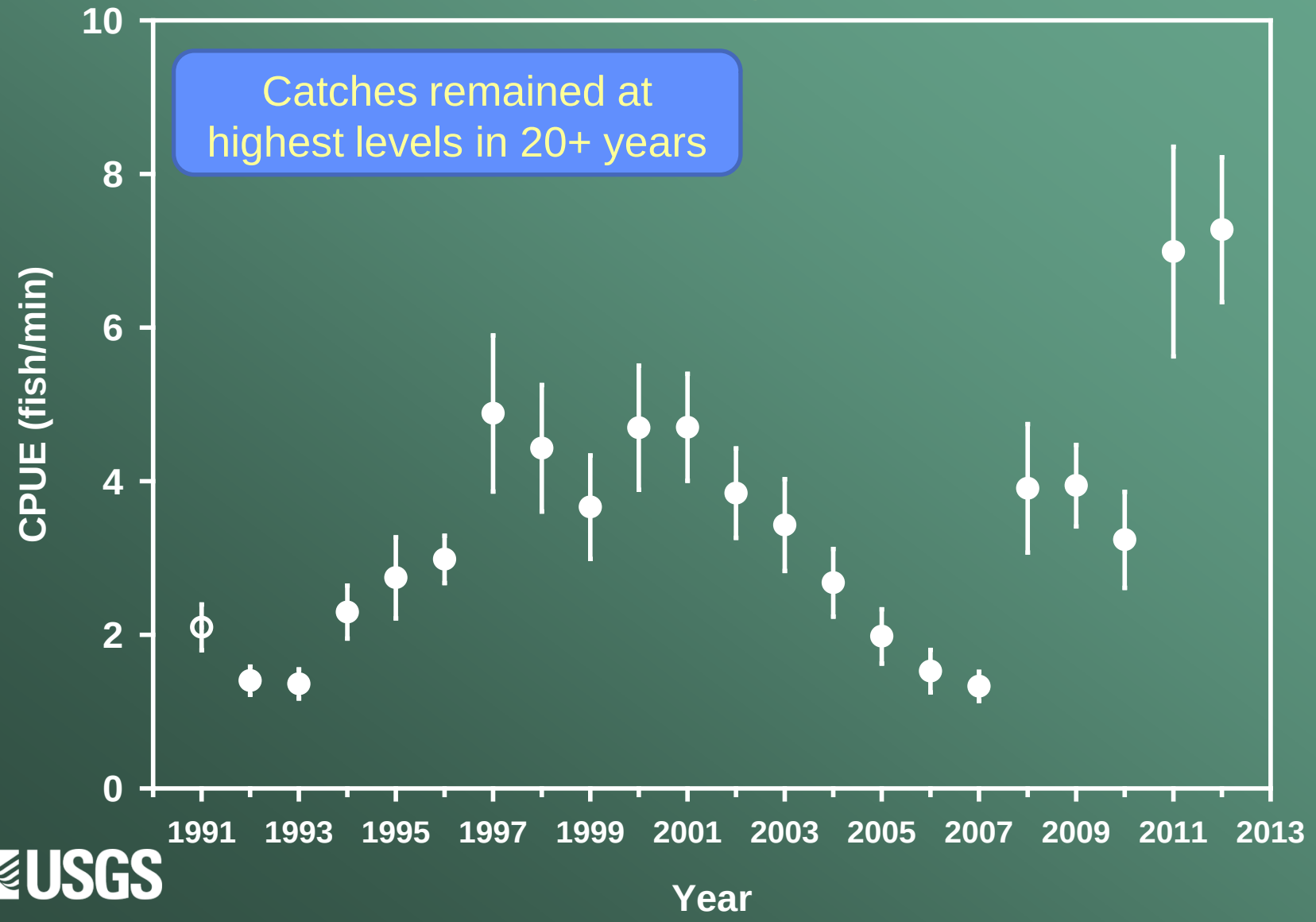


Key findings in 2012: Whirling disease re-detection and trout abundance and distribution in Glen and Marble Canyons



(Figure from Elwell et al., 2009)

Rainbow Trout – Relative Abundance in Glen Canyon



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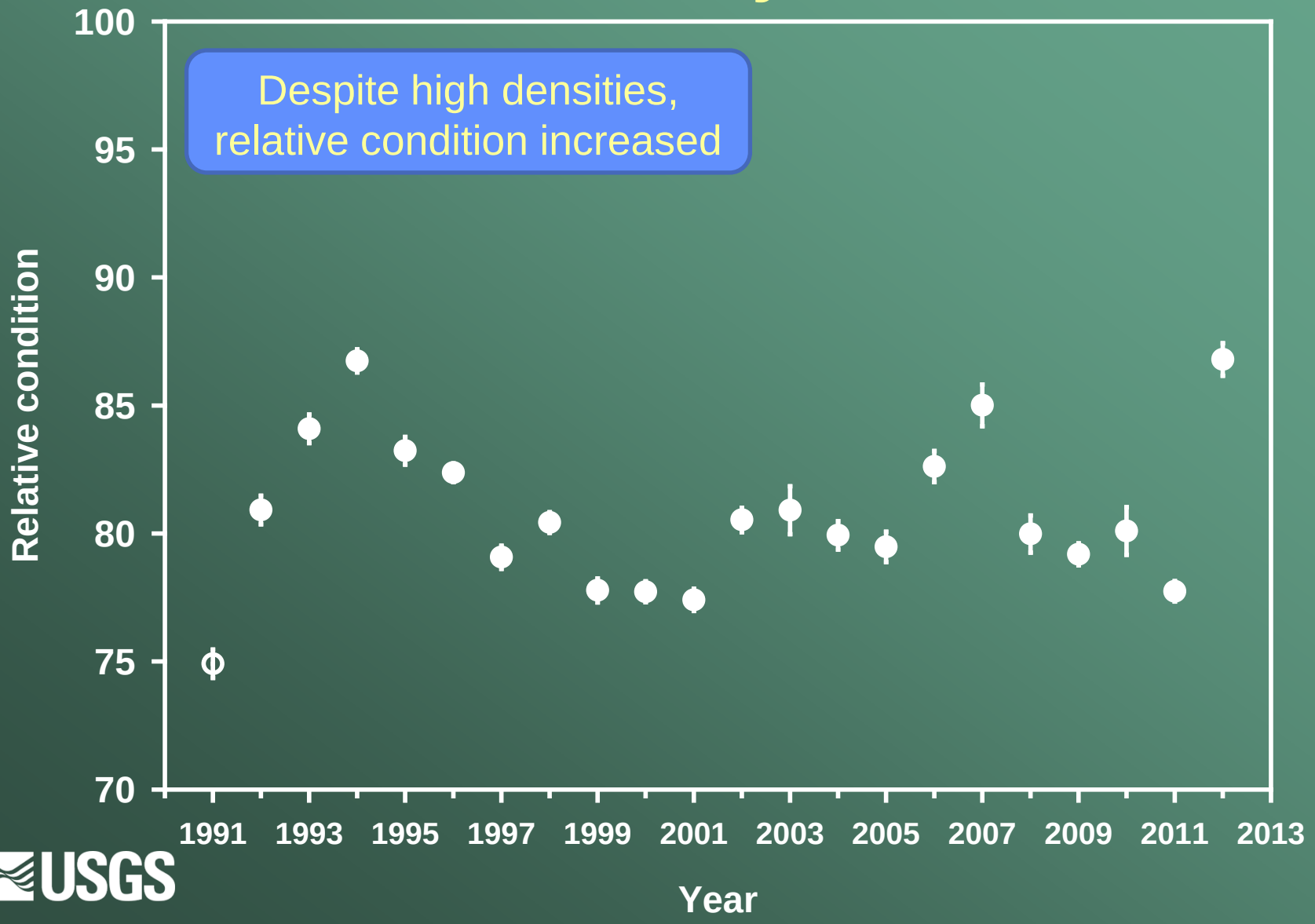
(Preliminary Data from Anderson, AZGFD, 2013, Unpublished)

Rainbow Trout – Relative Condition in Glen Canyon



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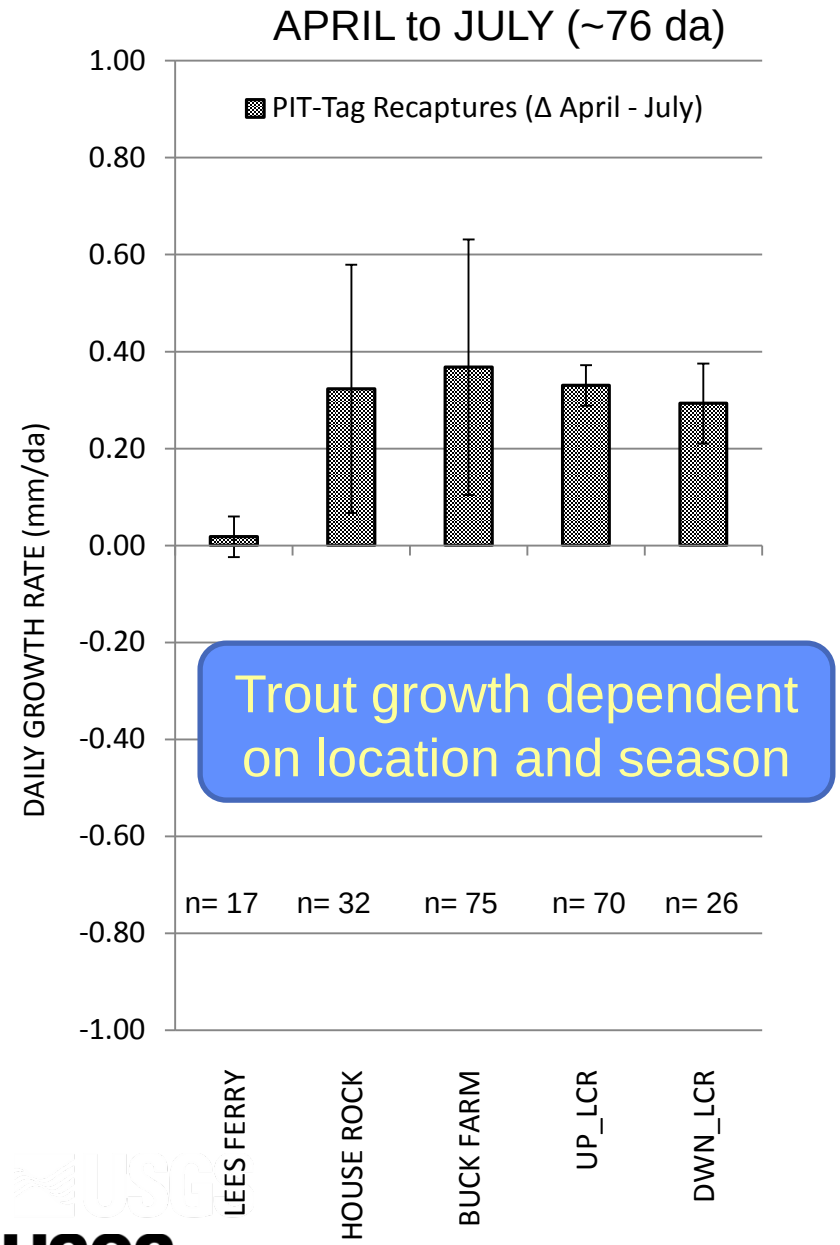
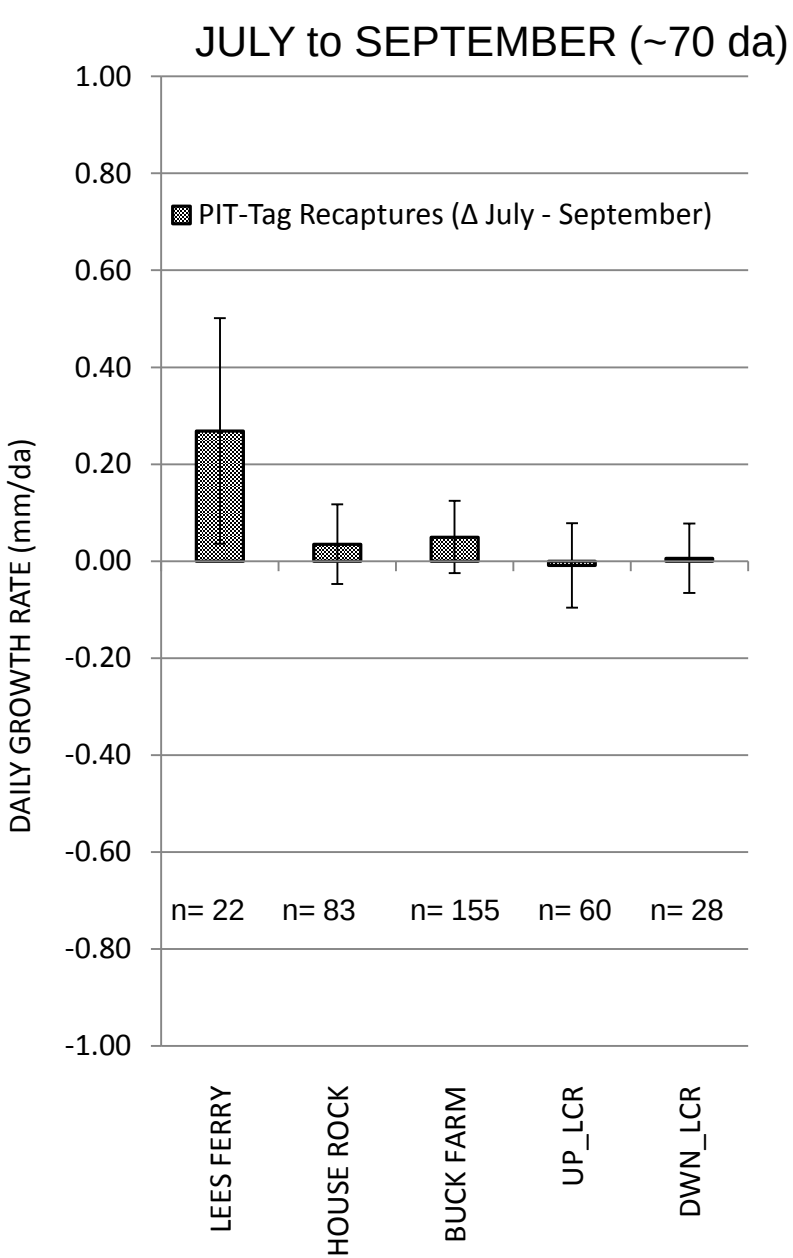
(Preliminary Data from Anderson, AZGFD, 2013, Unpublished)

Rainbow Trout Growth Rates (≥ 150 mm FL)



Trout growth dependent on location and season



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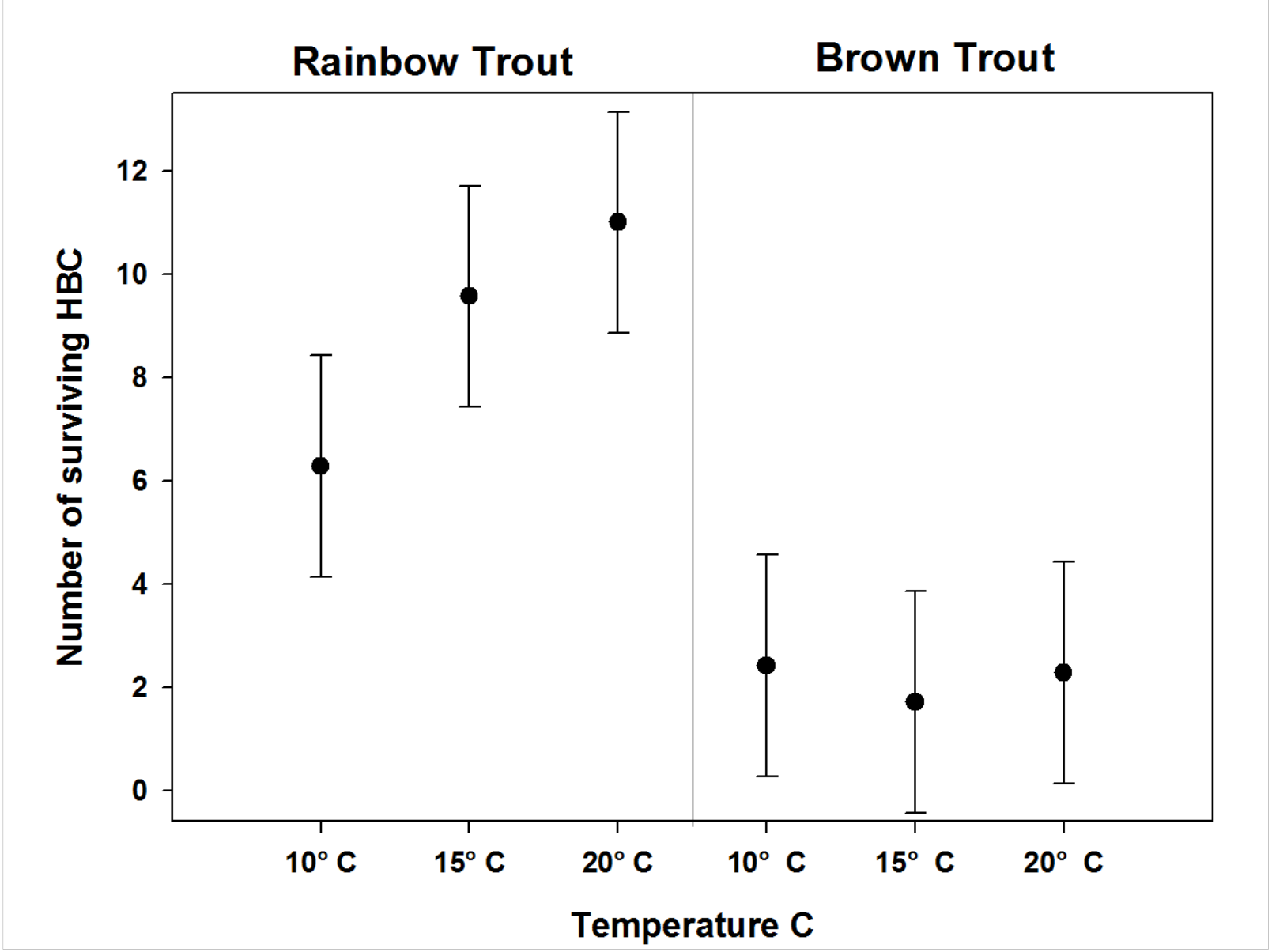
(Preliminary Data from Korman and Yard 2013, Unpublished)



Each point = 10 overnight trials, Error bars = 95% confidence intervals

HBC mean size = 63 mm, Rainbow trout mean size = 328 mm, Brown trout mean size = 280 mm

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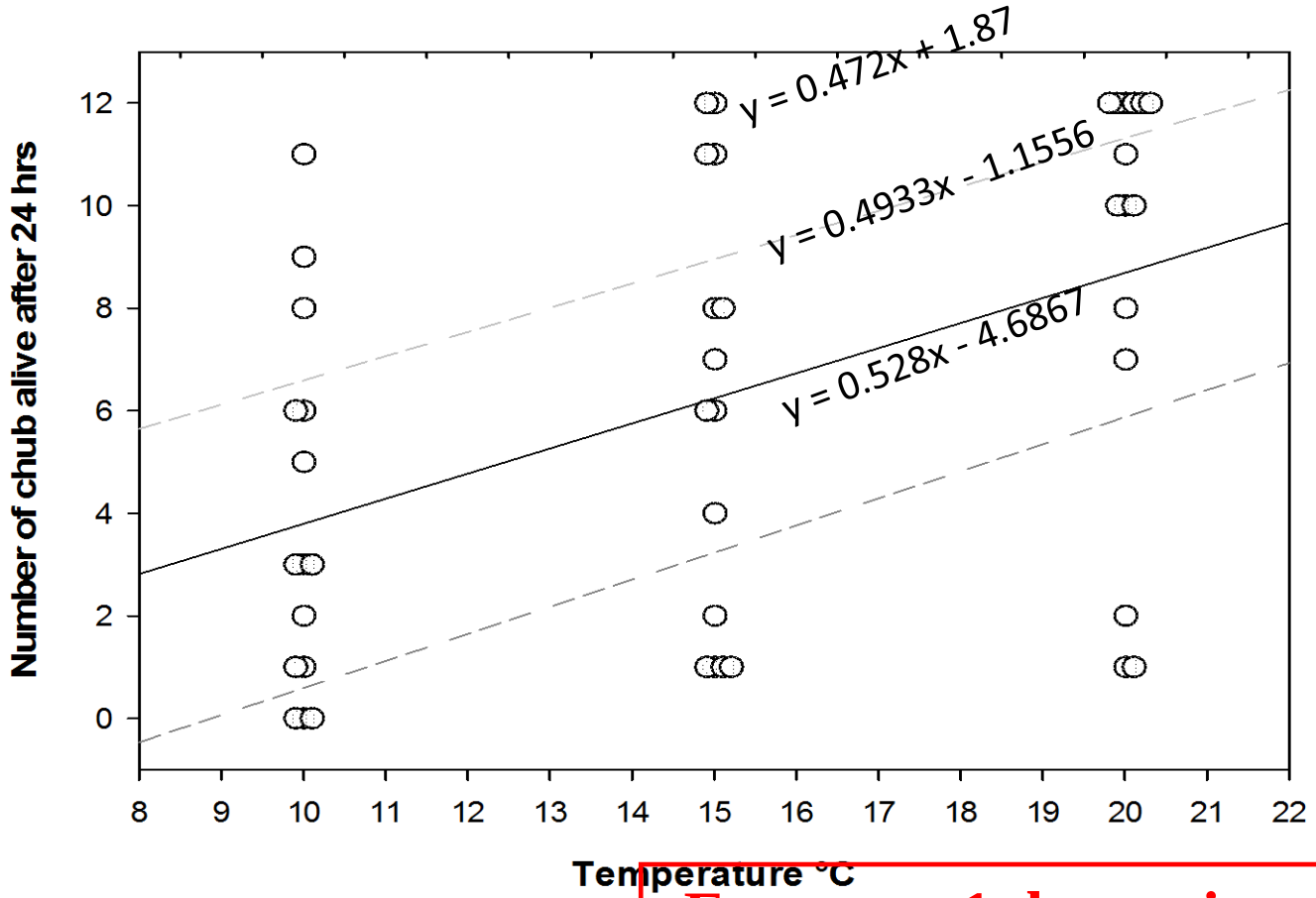
(Preliminary Data from Ward 2013, Unpublished)

All Laboratory Results for Rainbow Trout Predation on Chub



For every 1 degree increase in temp predation vulnerability of humpback chub is decreased by about 5%

(Preliminary Data from Ward 2013, Unpublished)

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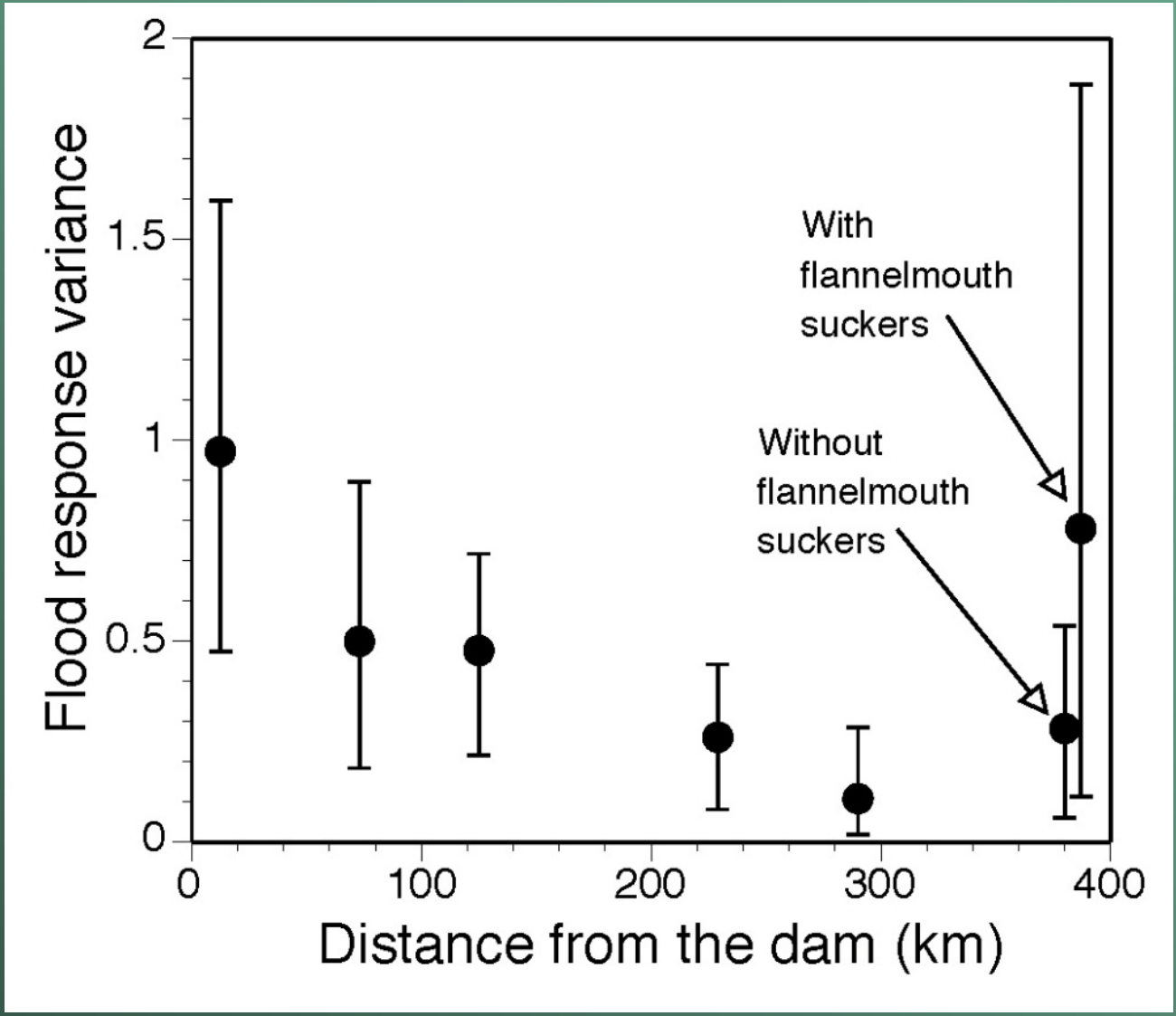
Food Web Response to 2008 HFE

Larger shift in the structure and function of Glen Canyon food web relative to downstream food webs

Glen Canyon food web appears less resistant to perturbation than Grand Canyon food webs



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(Preliminary Data from Kennedy et al. 2013, Unpublished)

Conclusions

- Glen Canyon food web appears relatively unstable
- Food webs as stock portfolios:
  - Glen Canyon food web has a small number of very volatile stocks
  - Downstream food webs have a larger and more balanced portfolio of stocks
- Without changes in food web structure (i.e., more diverse invertebrate assemblage), rainbow trout populations may continue to fluctuate through time

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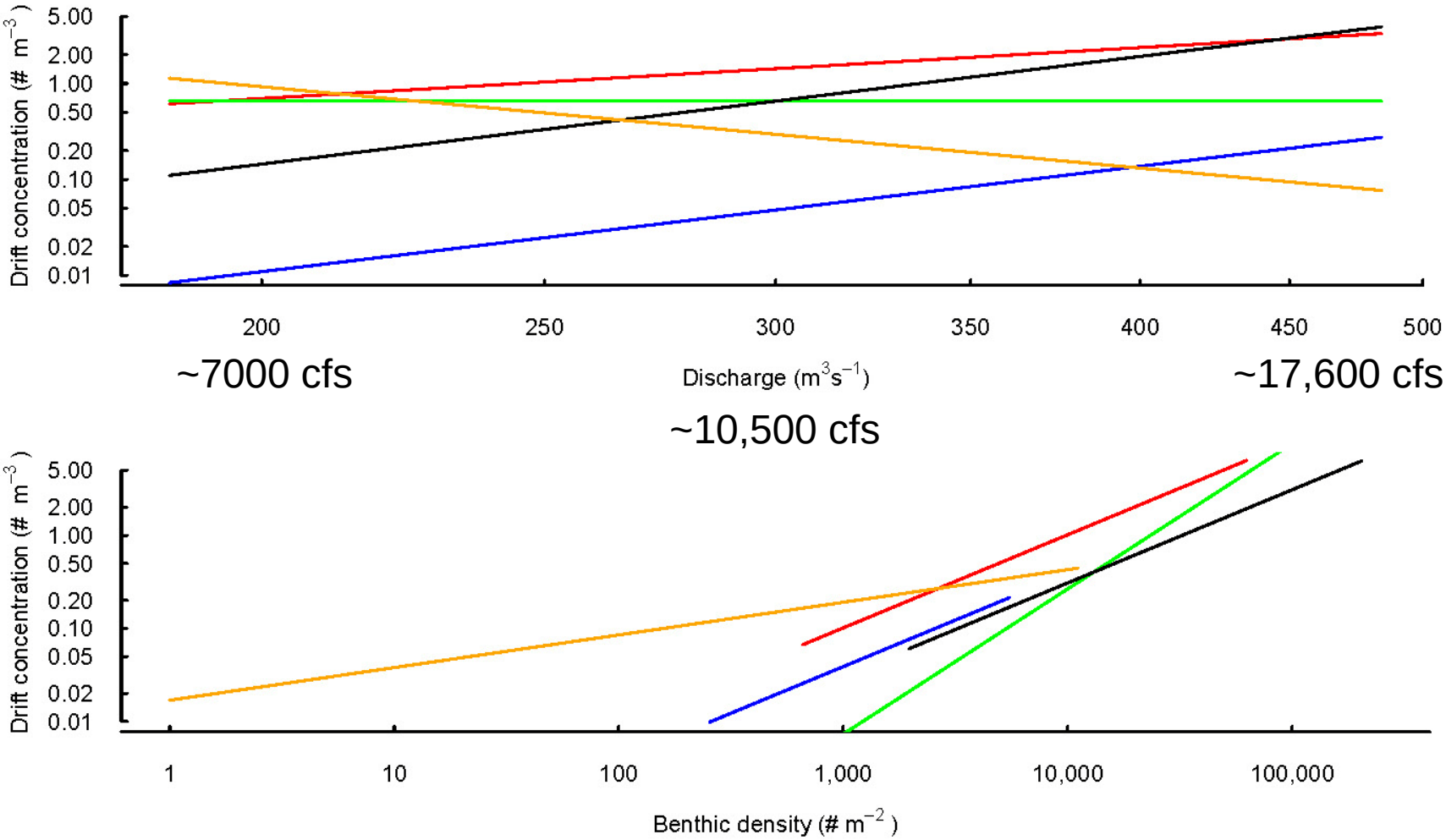
Effects of discharge and benthic abundance on Invertebrate Drift



(Preliminary Data from Kennedy et al. 2013, Unpublished)

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Conclusions

- Benthic density and discharge both affect drift densities in Glen Canyon
- Variation among taxa consistent with other studies
  - Black flies and midges drift at high rates relative to other taxa
  - Larger taxa (Gammarus and mudsnails) show stronger relation with discharge

Caveats

- Only short-term effects evaluated discharge (hours to days)
- Longer-time scales (weeks to months) could yield different results

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Acknowledgements: Thanks to WAPA for funding this study.

Drift distances – characterizing invertebrate drift throughout Glen Canyon

- Drift densities increase through Marble Canyon
- Due to long drift distances (miles) or local conditions?
- Useful to help interpret drift densities at key sites, e.g., Little Colorado River confluence

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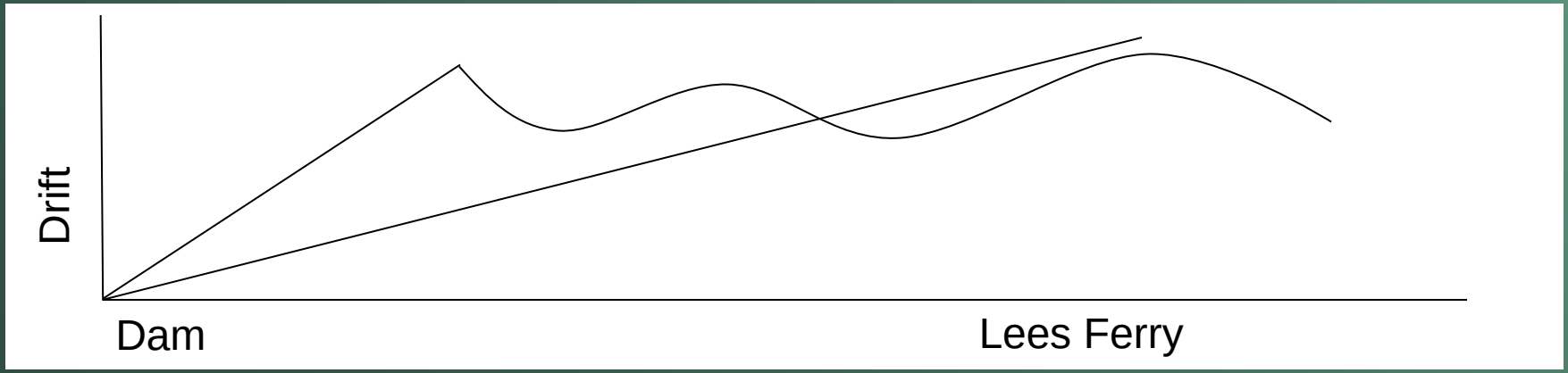
Drift distances—characterizing invertebrate drift throughout Glen Canyon

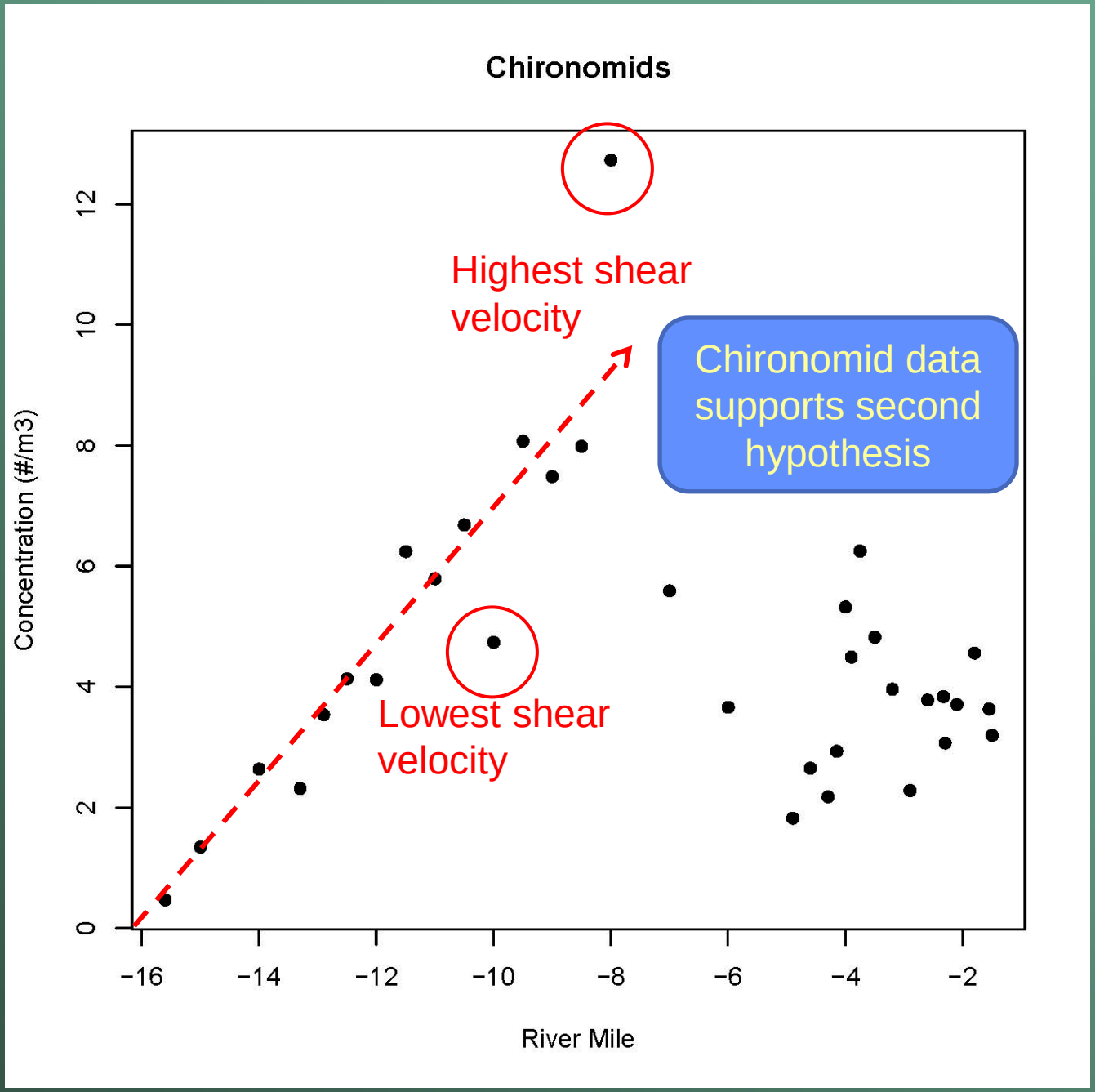
- **But how can we estimate drift distances?**
  - **Sample intensively along a downstream gradient starting from the Dam, where upstream supply = 0, to Lees Ferry**
- **Hypotheses:**
  - **Drift densities increase as a function of distance from the dam**
  - **Smaller scale variation in drift densities related to local geomorphology and/or hydrology**



Shear velocity = Depth*slope

Low/high shear can result in ~30% change relative to baseline

Drift rates decline by ~85% over a distance of 3 miles (rm -8 to -5) in association with a change from run to pool geomorphology



(Preliminary Data from Kennedy 2013, Unpublished)

Acknowledgements

- Mike Anderson and Aaron Bunch – AZG&F
- Brian Healy – NPS
- Josh Korman – Ecometric
- Steve Martell – PHC
- Bill Pine, Mike Dodrill, Colton Finch, and Brandon Gerig – Univ. of FL
- Randy Van Haverbeke, Mike Pillow, and Kirk Young – USFWS
- Luke Avery, Ted Kennedy, Bill Persons, David Ward, Charles Yackulic, Mike Yard – USGS-GCMRC

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Questions?

Important Science Insights of 2012

- HBC
  - Continued increasing trend of HBC since 2009
  - Decreasing survival rates/increasing abundance of juvenile HBC in mainstem
  - Higher survival rates in mainstem than LCR, but higher growth in LCR
  - High abundance of juvenile HBC in LCR
  - Growth rates of translocated HBC
  - Over 3000 individual HBC detected by LCR PIT-tag arrays
    - includes individual translocated to Shinumo Creek
  - Increase in HBC aggregation abundance

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Important Science Insights of 2012

- RBT
  - Whirling disease
  - Continued abundance and distribution trends
  - Condition in Glen Canyon
  - Growth data by site and season
- Predation
  - RBT – HBC survival increases ~5% per 1 °C temperature increase
- Food base
  - Food web stability increases downstream
  - Invertebrate drift
    - Effects of discharge and benthic abundance
    - Drift distance through Glen Canyon

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