**Glen Canyon Dam Adaptive Management Work Group**
**Agenda Item Information**
**August 24-25, 2016**

Agenda Item

Grand Canyon Monitoring and Research Center Science Updates

Purpose of Agenda Item

Bring AMWG members current with the latest research and selected monitoring results from GCMRC

Action Requested

Information item only; we will answer questions but no action is requested.

Presenters

Paul Grams, Research Hydrologist, Grand Canyon Monitoring and Research Center
Joel Sankey, Research Geologist, Grand Canyon Monitoring and Research Center
Scott VanderKooi, Chief, Grand Canyon Monitoring and Research Center

Previous Action Taken

N/A

Relevant Science

N/A

Summary of Presentation and Background Information

Sand inputs to date and sandbar update: Between December 1, 2015, and July 1, 2016, the sand storage in upper Marble Canyon decreased by approximately 700,000 metric tons (mt) (-640,000 to -760,000 mt), while the sand storage in lower Marble Canyon decreased by approximately 110,000 mt (-32,000 to -190,000 mt) and sand storage in eastern Grand Canyon increased by approximately 110,000 mt (-24,000 to 190,000 mt). Sand storage has decreased in Marble Canyon because erosion resulting from normal dam operations has not been replaced by inputs from the Paria River or other tributaries. Rates of erosion were highest during winter and summer when fluctuations peaked at 18,000 to 20,000 ft3/s. Only about 1,300 metric tons of sand has been delivered by the Paria River since June 1, 2016.

Between December 1, 2015, and March 2, 2016 (the date of the last download at RM166), sand storage in east central Grand Canyon (RM87-RM166) decreased by 180,000 mt (-120,000 to -230,000 mt), and sand storage in west central Grand Canyon (RM166-RM225) increased slightly by 92,000 mt (31,000 to 150,000 mt). The sand budgets for east and west central Grand Canyon will be updated through September 1, 2016, following downloads during the upcoming river trip.

Between December 1, 2015, and June 16, 2016, approximately 740,000 mt of sand (710,000 to 780,000 mt) were transported past Diamond Creek (RM225) into western Grand Canyon and the Lake Mead Delta. In summary, there was net erosion in upper Marble Canyon, lower Marble Canyon, and east central Grand Canyon. There was net deposition in eastern Grand Canyon and west central Grand Canyon.

These data are available for inspection at http://www.gcmrc.gov/discharge_qw_sediment/reaches/GCDAMP/.

GCMRC has been monitoring riparian vegetation with multispectral imagery as well as lidar remote sensing data acquired periodically with overflights of Glen, Marble and Grand Canyons. Riparian vegetation has increased in area since completion of Glen Canyon Dam, and analysis of data acquired during the most recent overflight in 2013 shows that vegetation has continued to increase at elevations as low as below 24,000 CFS. Elevated base flows promote the expansion of riparian vegetation onto bare sand habitat and short pulses of high flow, such as controlled floods, do not keep vegetation from expanding onto bare sand habitat. Tamarisk is an invasive riparian shrub that occupies the most area of all riparian vegetation species in the canyons. The tamarisk shrub is preyed upon by the Tamarisk Beetle which has been in this region since 2009. The methods GCMRC uses to monitor changes in tamarisk vegetation associated with the beetle using remote sensing data will be described. The canopy cover of green, healthy tamarisk shrubs decreased from 2009 to 2013 and this decreased the amount of leaf biomass on the shrubs and increased the amount of leaf biomass shed to the floodplain.

Rainbow trout densities remain highest in Glen Canyon and the upstream third of Marble Canyon and lowest downstream of the confluence with the Little Colorado River. Abundance of rainbow trout in all these reaches remains low and at levels even lower than those observed in 2015. Trout densities downstream of the Little Colorado River confluence remain below trigger levels identified in the 2011 USFWS Biological Opinion on nonnative fish control. Mark-recapture efforts in Glen Canyon again show little movement of rainbow trout. On average, marked rainbow trout were recaptured just upstream (0.09 km) of their initial release locations. Unlike in 2013-2015, little evidence of rainbow trout reproduction was detected at sites downstream from Lees Ferry in 2016. Catches of brown trout upstream of Lees Ferry were considerably higher in January and April 2016 in comparison to the same months in 2015. Brown trout catches near the confluence of the Little Colorado River remained low, similar to observations in 2014 and 2015.

Trout removal using electrofishing occurred in the mainstem Colorado River near the confluence with Bright Angel Creek in early February, 2016. This experimental action is being conducted in collaboration with Grand Canyon National Park, consistent with the NPS Comprehensive Fisheries Management Plan and related compliance documents. The removal effort was scheduled for February 2016 to avoid conflicts with a potential November 2015 High Flow Experiment (which did not occur) and associated logistical constraints. Unlike previous efforts in late 2013 and early 2014, turbidity of the river was low for most of the trip which likely increased capture probabilities. Despite these conditions, very few trout were harvested and catches of native fish, including 2 humpback chub, outnumbered nonnatives. All harvested fish were cleaned, vacuum sealed in bags, and frozen for human consumption.

Juvenile humpback chub catches in the mainstem near the Little Colorado River in July were similar to those observed in July 2013, 2014, and 2015. Population estimates generated by the USFWS for

sub-adult (150-199 mm) and adult (> 200 mm) humpback chub in the Little Colorado River were still depressed compared to the highs witnessed in recent years, especially for sub-adults. Spring humpback chub population estimates in the Little Colorado River were 749 (95% CI, 589 to 909) sub-adult fish, and 3,974 (95% CI, 3,360 to 4,589) adult fish. It is unknown at this time if this represents a real decline in the abundance of adult humpback chub, however, there were relatively small cohorts of age 0 chub produced in 2013 and 2014. A similar decline in adults (although not as pronounced) occurred in 2011, thought to be caused by a small cohort of age 0 chub produced in 2009.

# GCMRC Science Updates

## Adaptive Management Workgroup Meeting

## August 24-25, 2016

**Scott VanderKooi**
**Grand Canyon Monitoring and Research Center**
**Southwest Biological Science Center**

U.S. Department of the Interior
U.S. Geological Survey

# Outline

- Biological Opinion Compliance
- Additional Trout Updates
- Green Sunfish
- Fisheries Program Protocol Evaluation Panel
- Partners in Science

USGS

# 2011 USFWS Biological Opinion Non-native Fish Control Trigger

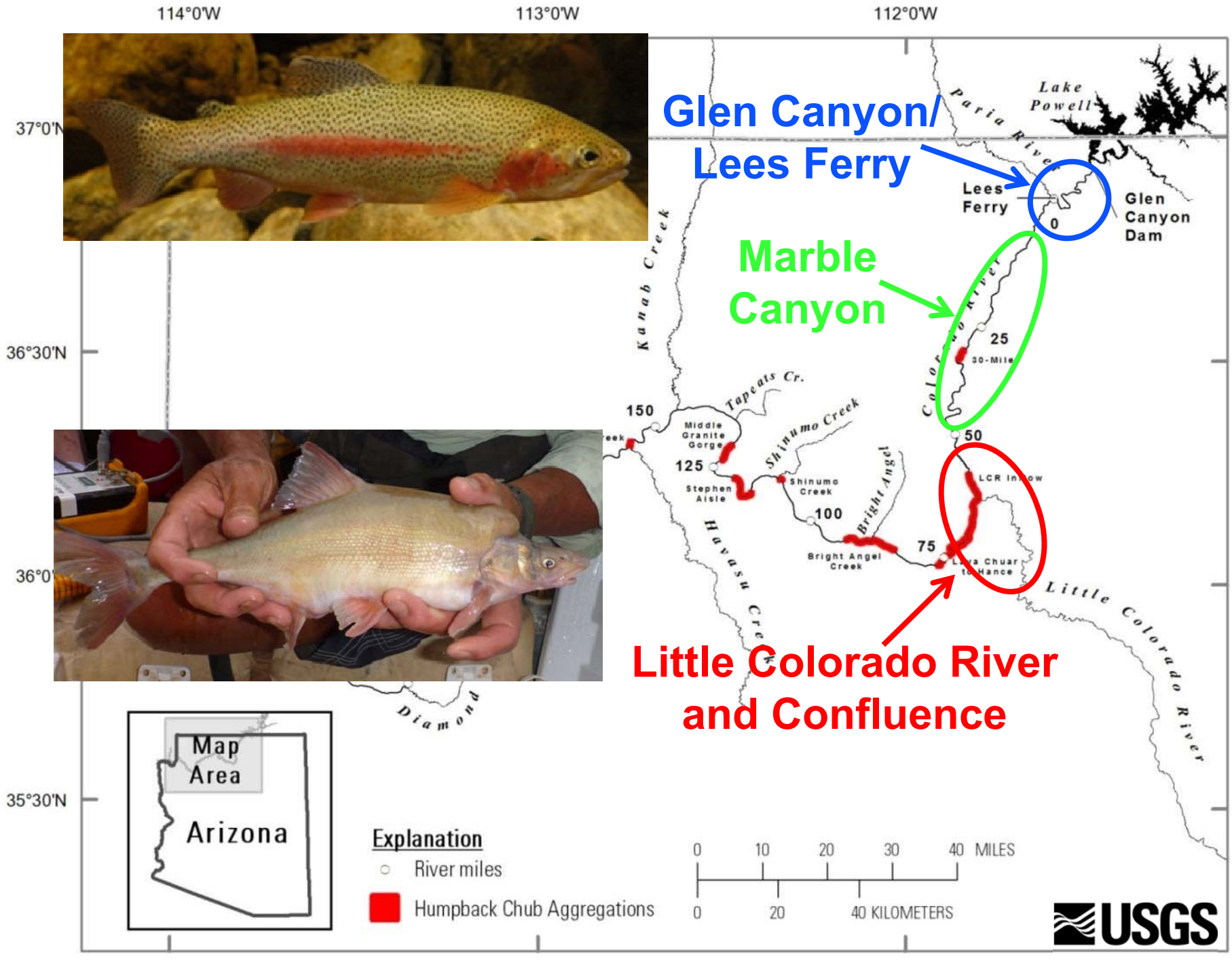
- Adult humpback chub <7000 fish?
- OR
- ALL THREE?
  - 3 of 5 years 150-199 mm humpback chub in the LCR drops below 910?
  - Temperature <12 °C for 2 consecutive years at LCR?
  - Annual survival of 40-99 mm humpback chub in JCM drops 25% from preceding year?

USGS

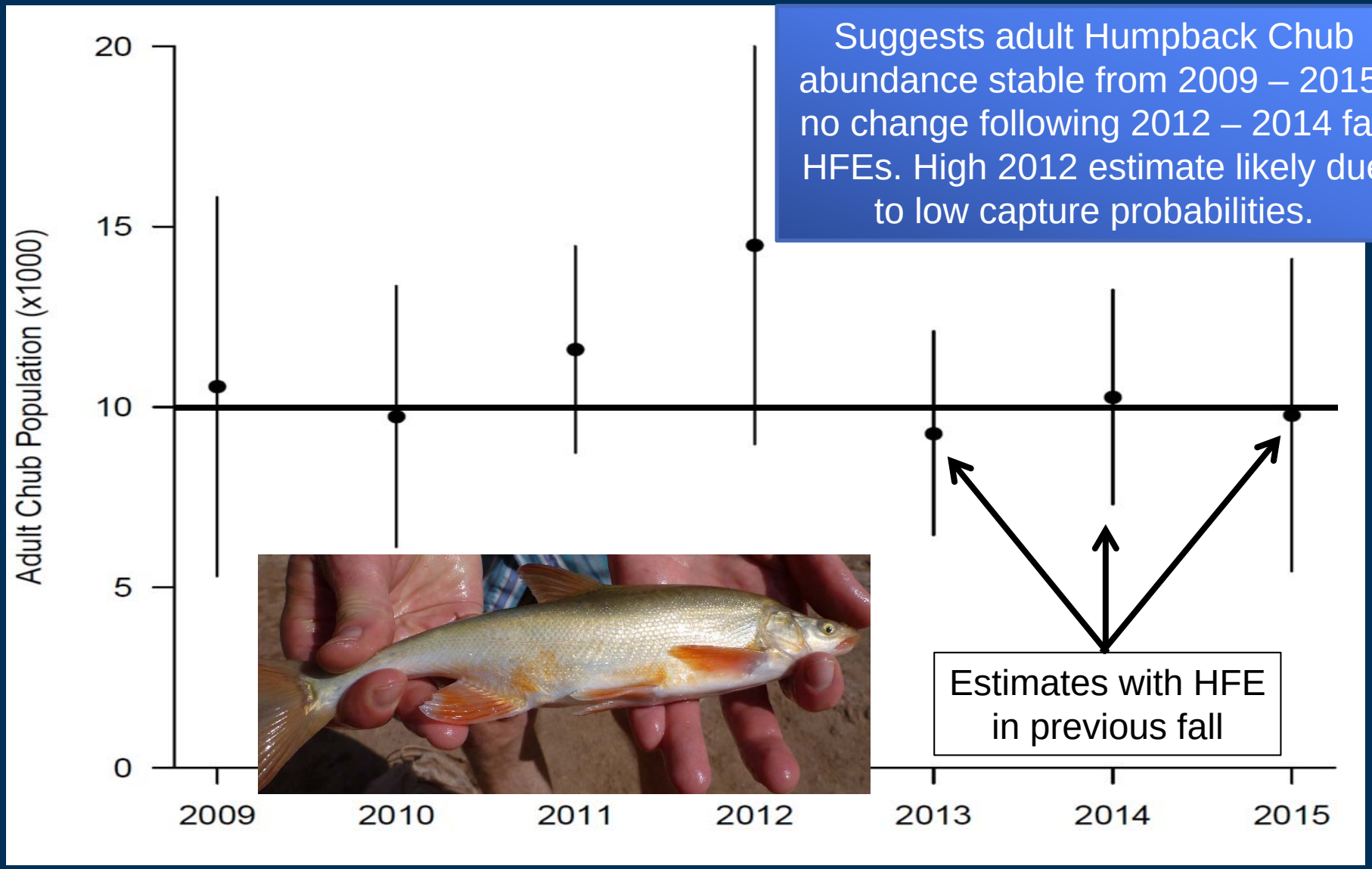
# 2011 USFWS Biological Opinion Non-native Fish Control Trigger

- AND
- Rainbow trout abundance over 760?
- AND
- Brown trout abundance over 50?

USGS


114°0'W
113°0'W
112°0'W
37°0'N
36°30'N
36°0'
35°30'N
Glen Canyon/
Lees Ferry
Marble
Canyon
Little Colorado River
and Confluence
Lake
Powell
Paria River
Lees
Ferry
0
Glen
Canyon
Dam
Kanab Creek
Colorado River
25
30-Mile
50
LCR Inflow
Tapeats Cr.
150
Middle
Granite
Gorge
125
Stephen
Aisle
Shinumo Creek
Shinumo
Creek
100
Bright Angel
Bright Angel
Creek
75
Lava Chuar
to Hance
Havasu Creek
Little Colorado River
Diamond
Map
Area
Arizona
Explanation
River miles
Humpback Chub Aggregations
0
10
20
30
40 MILES
0
20
40 KILOMETERS
USGS

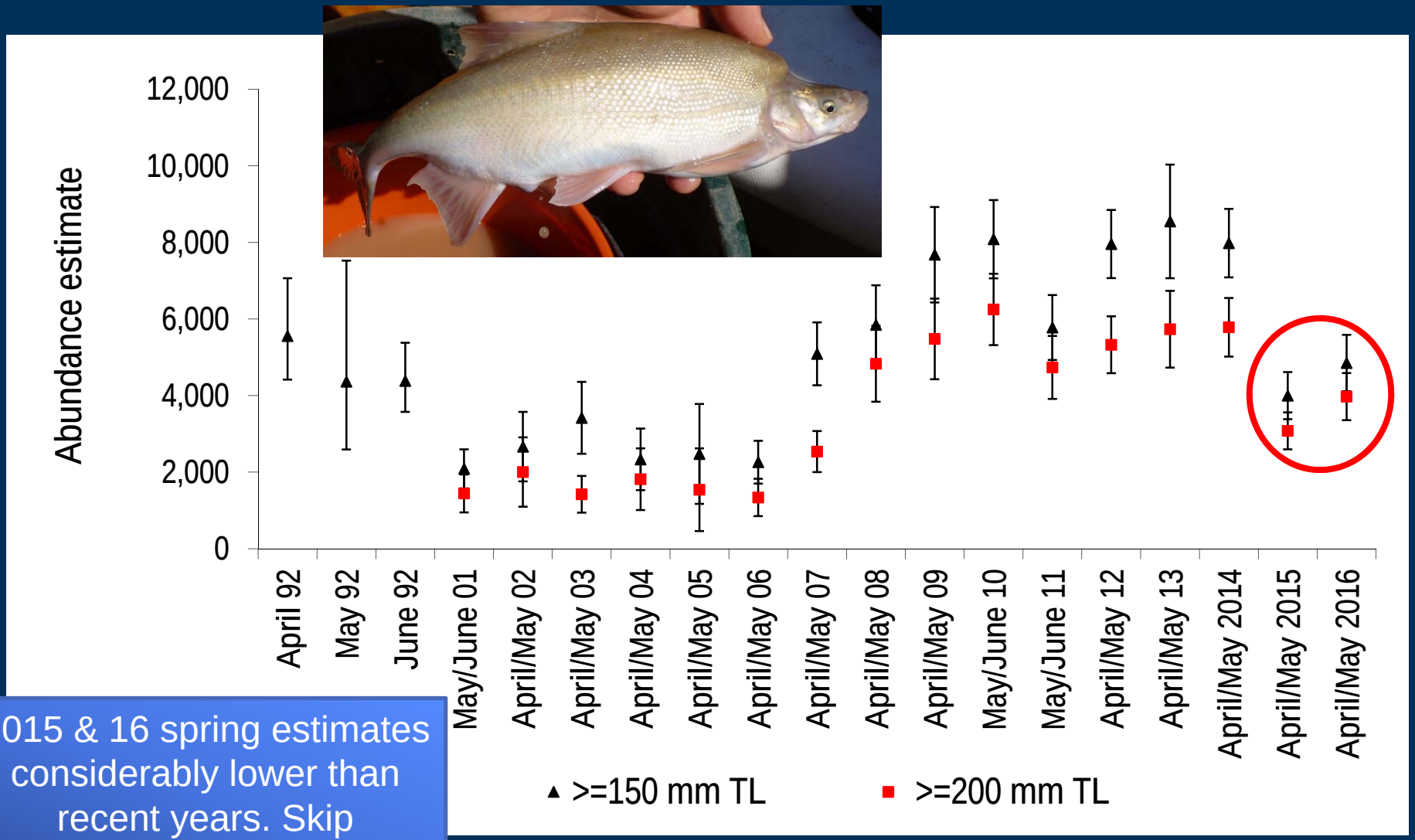
# Adult Humpback Chub Abundance Estimates: Multistate Population Model




USGS

(Preliminary Data from Yackulic 2016. Do Not Cite.)

# Annual Spring Abundance Estimates of HBC ≥ 150 mm and ≥ 200 mm in Lower 13.6 km of LCR



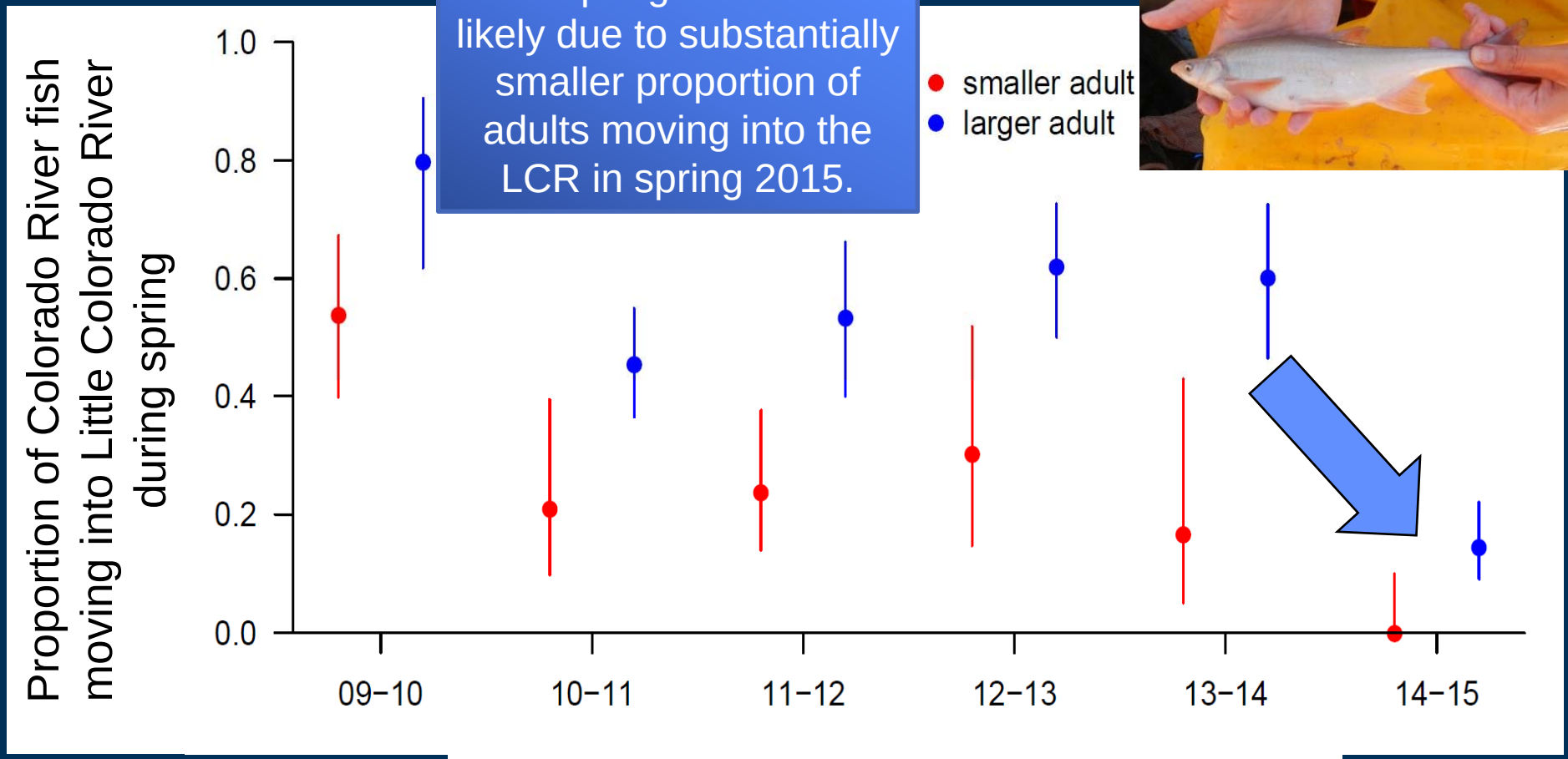

2015 & 16 spring estimates considerably lower than recent years. Skip spawning a likely cause.

(Preliminary Data from VanHaverbeke et al. USFWS. 2016. Do Not Cite.)

USGS

# Proportion of Colorado River fish moving into Little Colorado River during spring

Low spring abundance likely due to substantially smaller proportion of adults moving into the LCR in spring 2015.



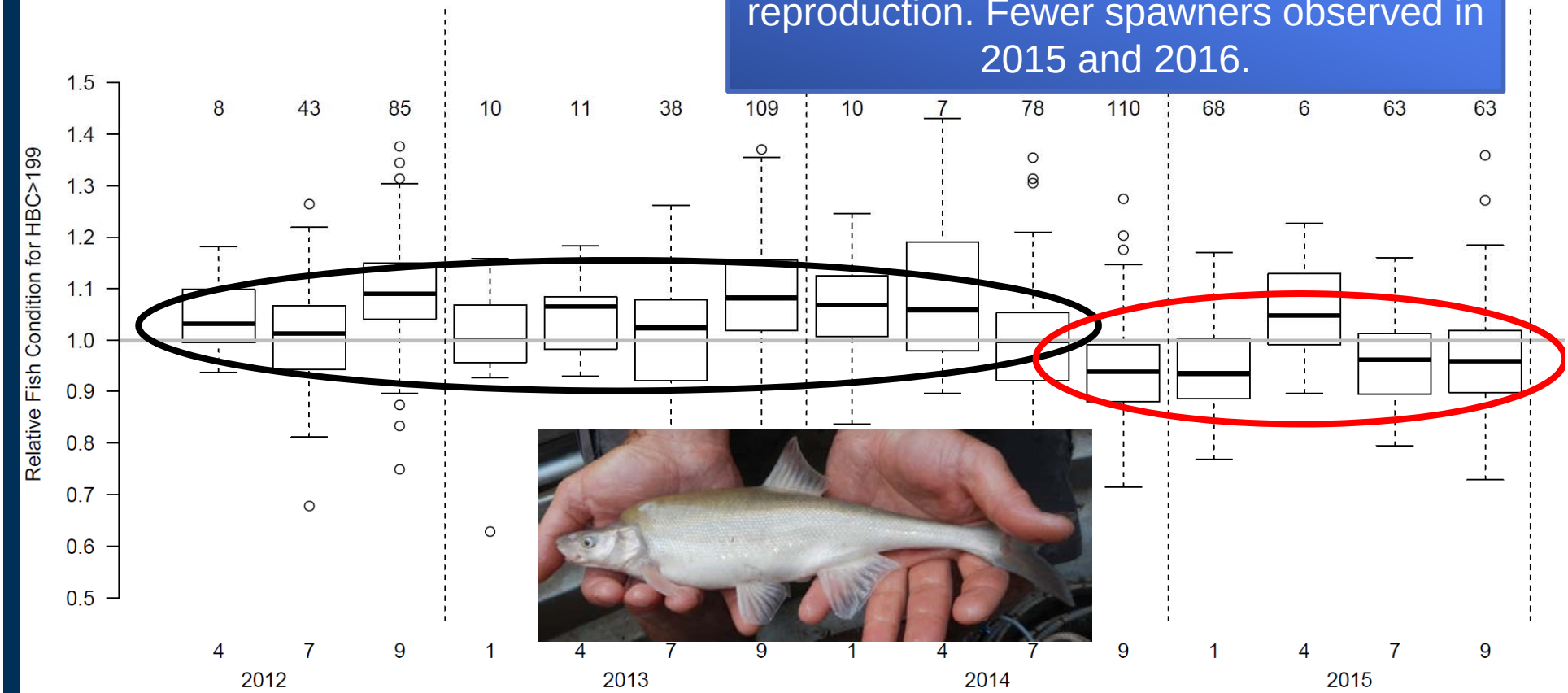

Annual Interval (Sept. to Sept.)

USGS

(Preliminary data from Yackulic 2016. Do Not Cite.)

# Adult Humpback Chub condition: fat (> 1.0) or skinny (< 1.0)?

Lower condition observed since 2014 supports hypothesis of skipped spawning due to less energy available to devote to reproduction. Fewer spawners observed in 2015 and 2016.

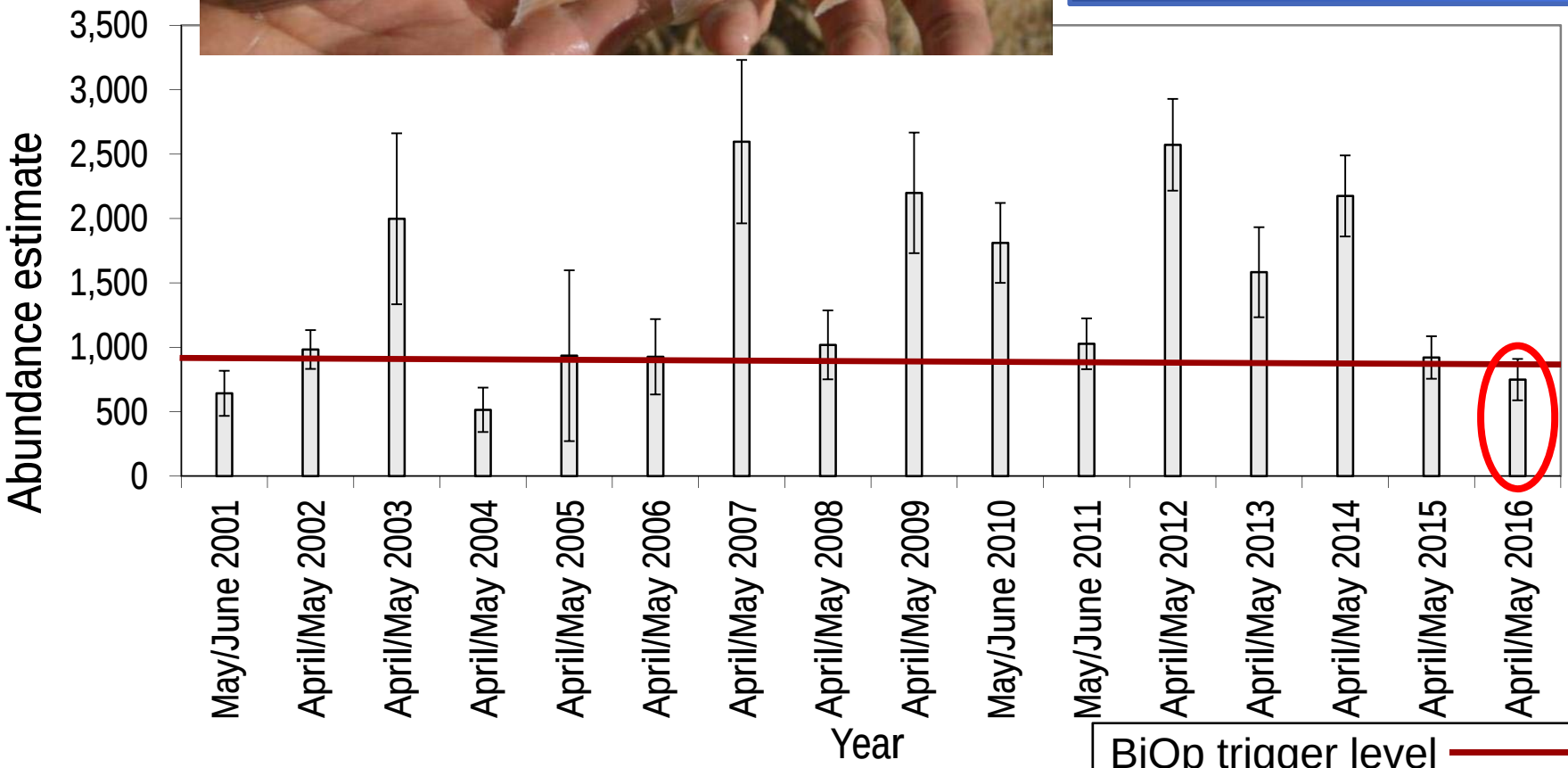



Year and Month

(Preliminary data from Yackulic and Korman 2015. Do Not Cite.)

# Spring LCR 150-199 mm Humpback Chub abundance estimates

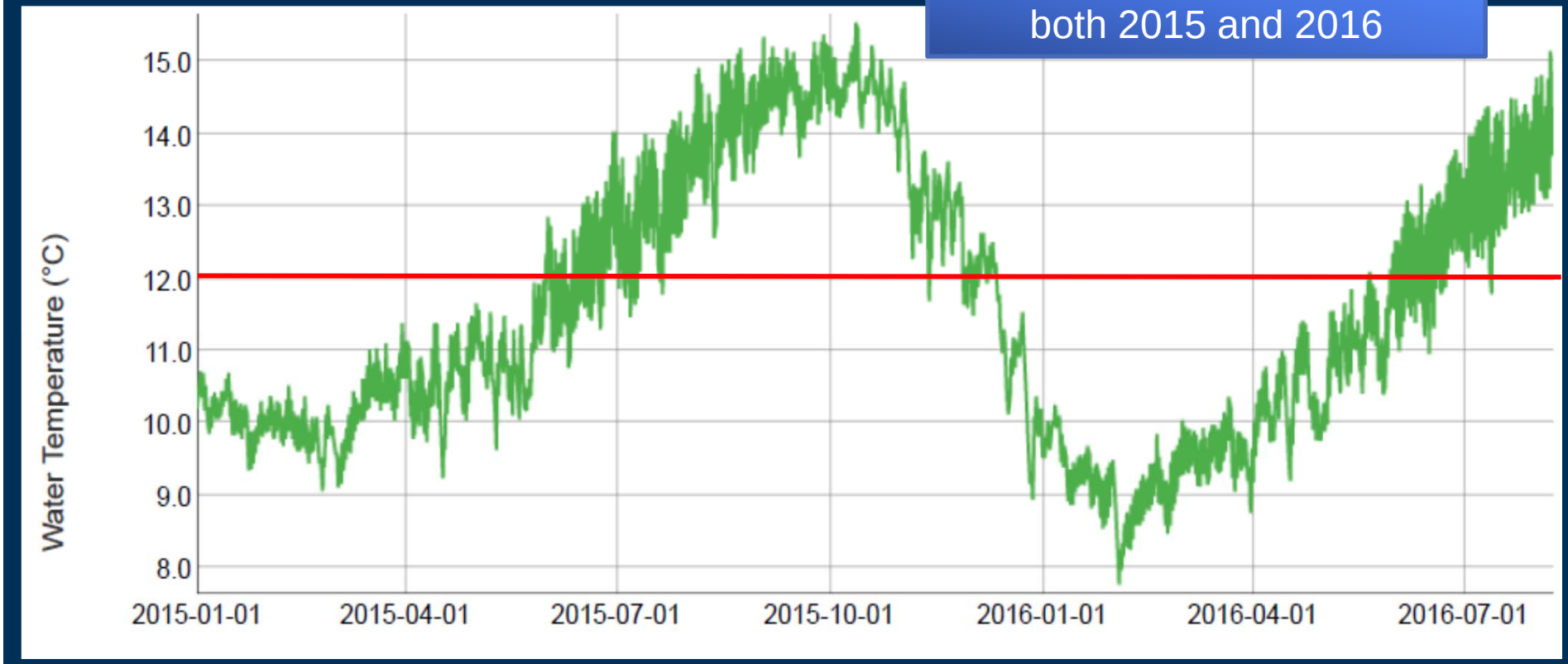
2016 spring abundance estimate for sub-adults fell below BiOp trigger level (< 910 fish).




USGS

(Preliminary Data from VanHaverbeke et al. USFWS. 2016. Do Not Cite.)

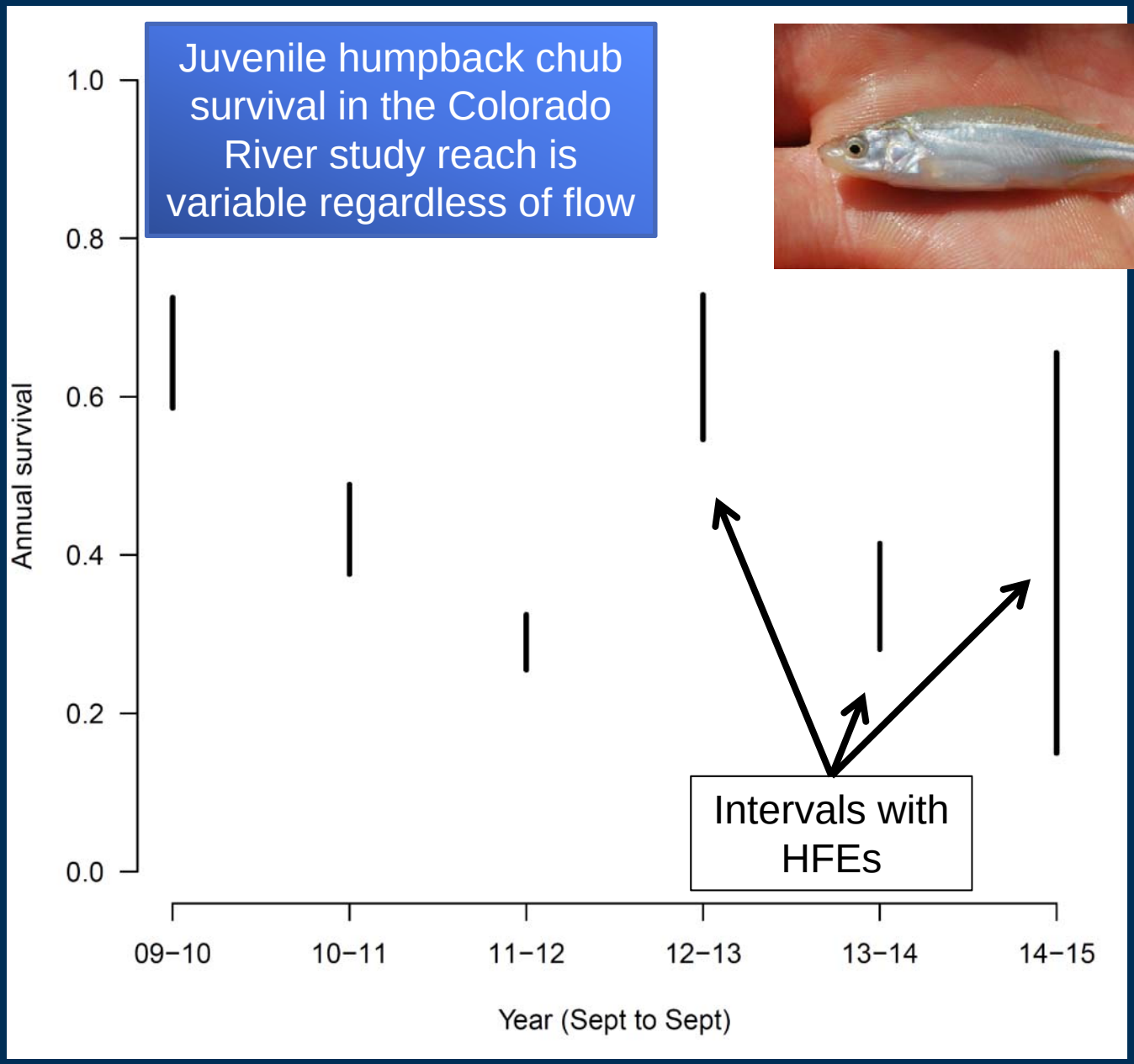
# 2015-16 Water Temperatures: Colorado River near Little Colorado River Confluence




USGS

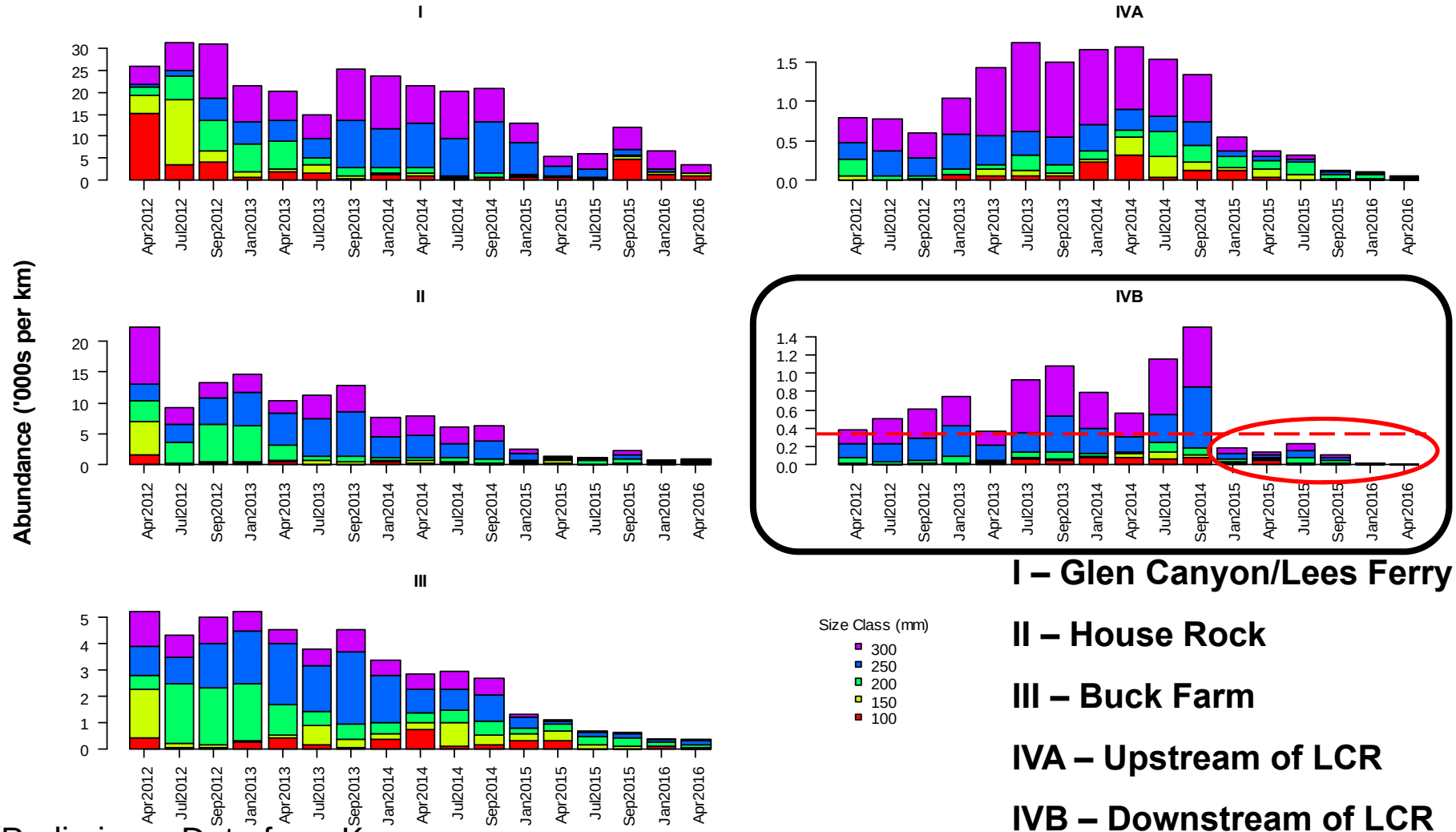
(UGSG gage 09383100: http://www.gcmrc.gov/discharge_qw_sediment/station/GCDAMP/09383100)

# Juvenile Humback Chub Survival Rates



USGS

# Rainbow Trout Abundance By Reach




**I – Glen Canyon/Lees Ferry**

**II – House Rock**

**III – Buck Farm**

**IVA – Upstream of LCR**

**IVB – Downstream of LCR**

(Preliminary Data from Korman and Yard, 2016. Do Not Cite.)

Considerable declines in abundance in all reaches since 2014. Estimates downstream of LCR below NNFC trigger since Jan. 2015.

USGS

# 2011 USFWS Biological Opinion Non-native Fish Control Trigger

- Adult humpback chub <7000 fish? No
- OR
- ALL THREE? No
  - 3 of 5 years 150-199 mm humpback chub in the LCR drops below 910? No*
    *Fell below threshold in 2016
  - 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? No

USGS

# 2011 USFWS Biological Opinion Non-native Fish Control Trigger

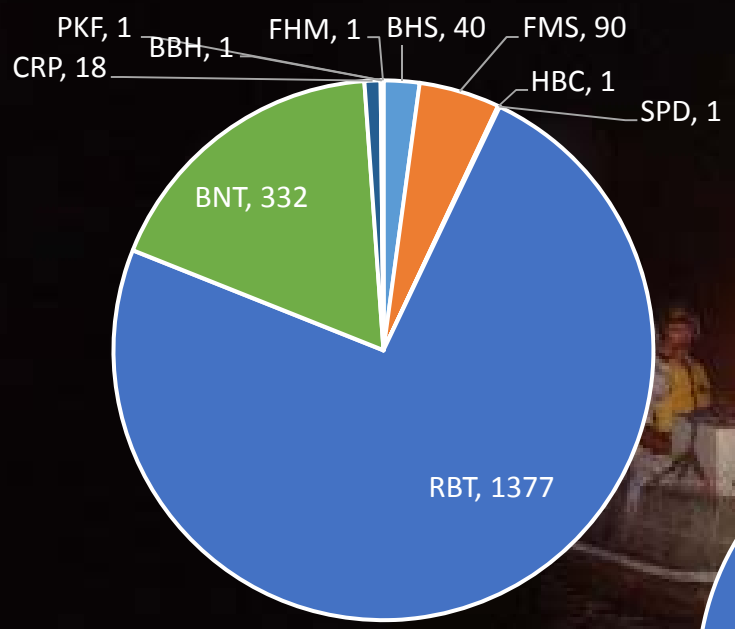
- **AND**
- **Rainbow trout abundance over 760?** **No**
- **AND**
- **Brown trout abundance over 50?** **Unknown**

2016 catches remain low; 3 caught in Jan, 0 in April and July – catches too low to generate abundance estimate
(Yard and Korman, preliminary data)

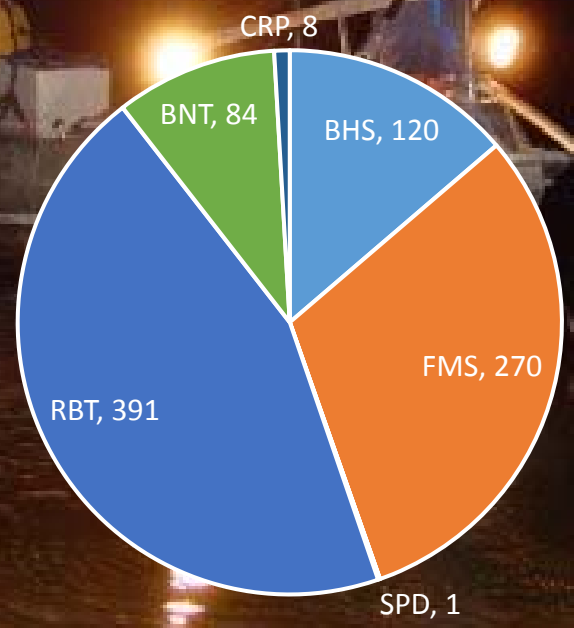
USGS

USGS

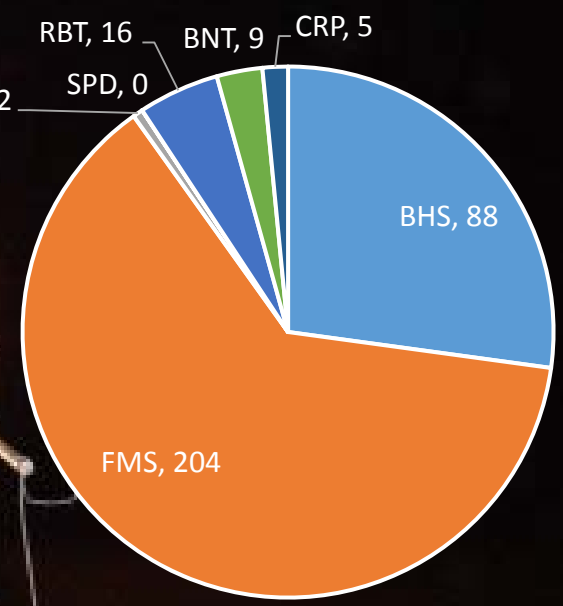
# Bright Angel Inflow– Electrofishing




**2013-2014**




**2014-2015**




**2015-2016**

Trout catches declined from >1700 to 25 despite similar effort and better electrofishing conditions. Native fishes dominated catch in 2016.

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(Preliminary Data from Healy et al. NPS. 2016. Do Not Cite.)

# Beneficial Use

- To date: > 49,000 trout to beneficial use



(Slide courtesy NPS, Grand Canyon National Park)

# Brown Trout Catches in Glen Canyon

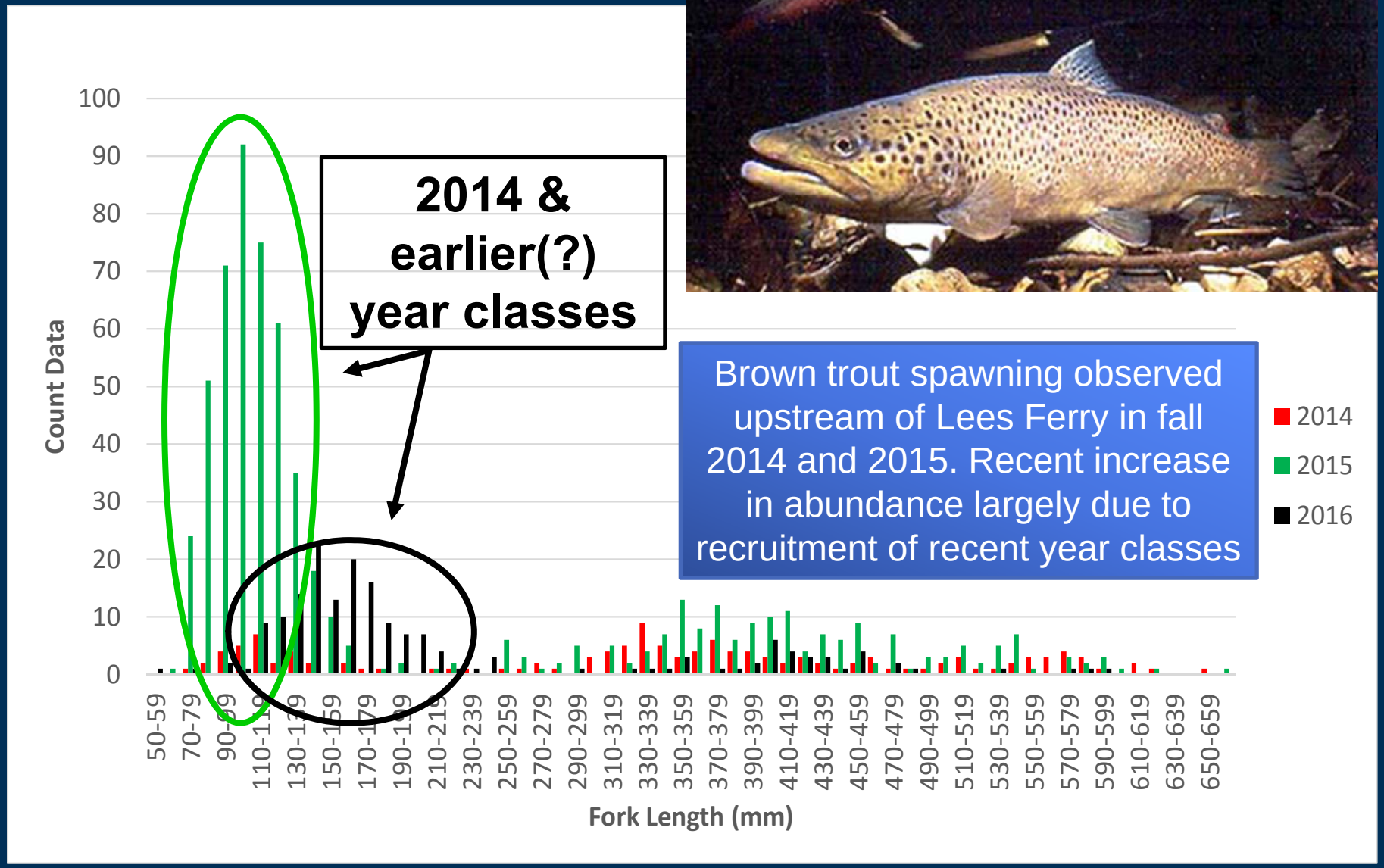
| | |
|---|---|
| 2012 | 47 |
| 2013 | 132 |
| 2014 | 135 |
| 2015 | 580 |

Brown trout catches increasing upstream of Lees Ferry. Still a small proportion (<2%) of overall trout population in Glen Canyon.

USGS

(Preliminary Data from Yard and Korman , 2016. Do Not Cite.)

# Brown Trout Catches in Glen Canyon




USGS

# Green Sunfish in Glen Canyon

**0 GSF captured in slough by AZG&F**
**26 GSF captured in pond by NPS**

USGS (GSF photos courtesy Lisa Winters)

# Fisheries Program Review, Aug 2-5, 2016
## (Protocol Evaluation Panel)

## Charge to the Panel:

- How could the program better balance priorities and trade-offs among its various monitoring and research activities focused on:
  - Rainbow trout in Glen and Marble Canyons?
  - Humpback chub around the LCR confluence and other locations?
  - Statuses and trends of native and nonnative fishes?

- How could the program improve research or monitoring to evaluate the effectiveness of experimental translocations of humpback chub?

- How could the program modify handling of native and non-native fishes to maintain science quality while also better accommodating Native American concerns for the value of all life-forms in the river?

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# Fisheries Program Review, Aug 2-5, 2016
## (Protocol Evaluation Panel)

# Partners in Science/Grand Canyon Youth trip

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USGS

# Partners in Science/Grand Canyon Youth trip

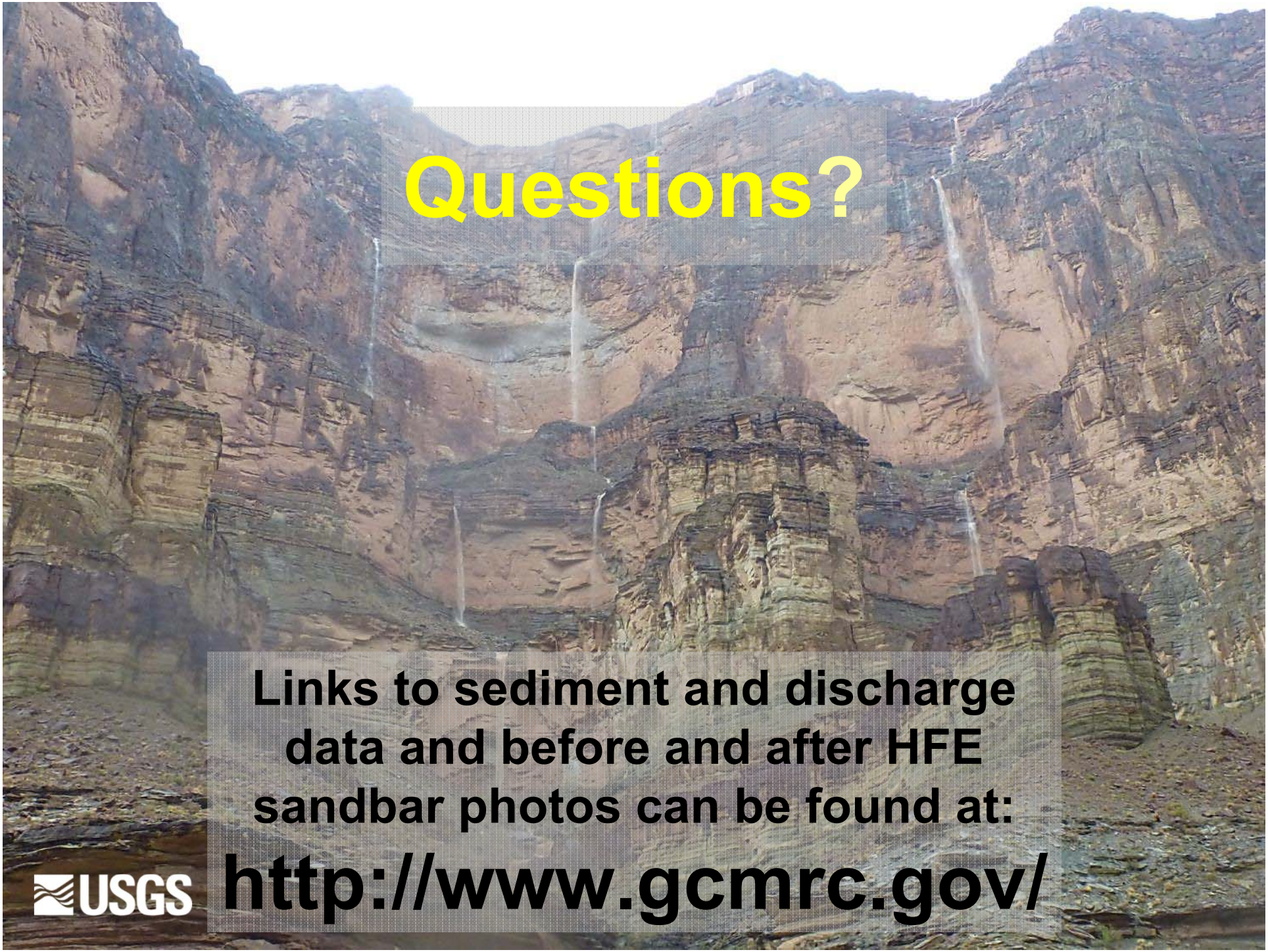
USGS

# Acknowledgements


- Bureau of Reclamation and the Glen Canyon Dam Adaptive Management Program

- Arizona Game and Fish Department
- National Park Service
- US Fish and Wildlife Service
- Ecometric Inc.
- USGS-GCMRC


USGS



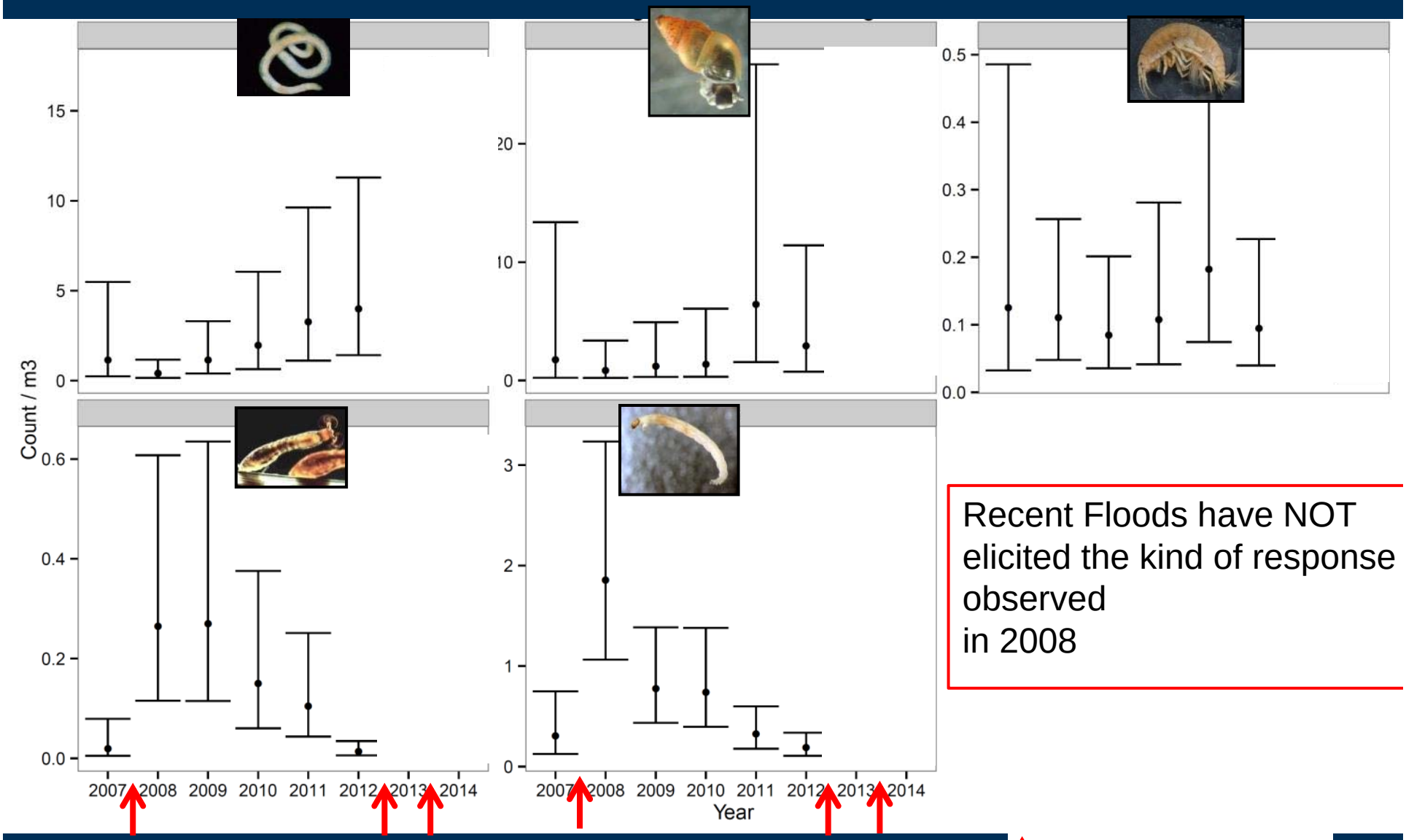
# Questions?

**Links to sediment and discharge data and before and after HFE sandbar photos can be found at:**

**http://www.gcmrc.gov/**

USGS

# Aquatic Insect Drift: Long Term Trends



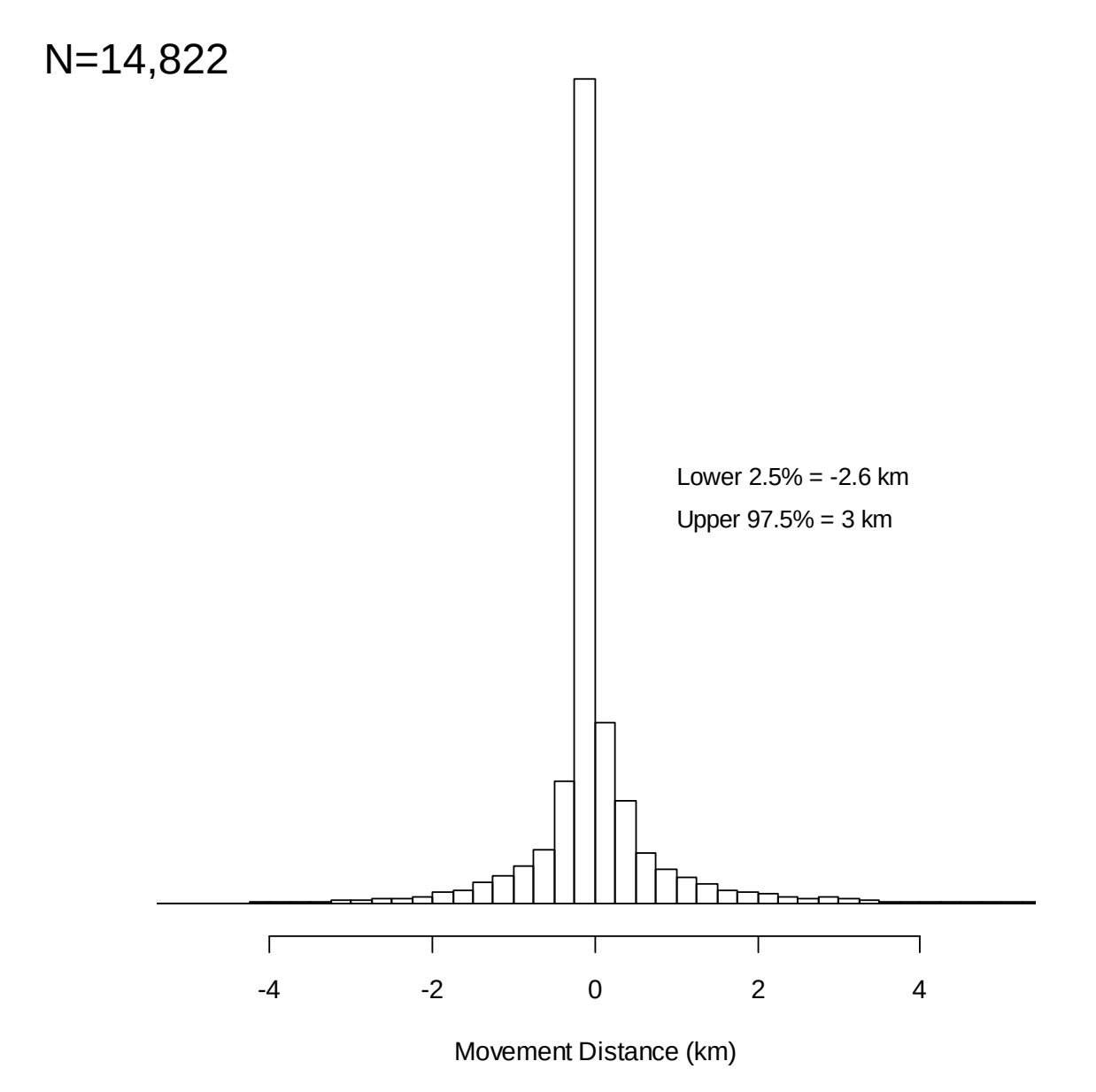

Recent Floods have NOT elicited the kind of response observed
in 2008

Controlled flood

USGS

# Rainbow Trout Downstream Movement

Most rainbow trout move little between marking and recapture regardless of flow




(Preliminary Data from Korman and Yard, 2016. Do Not Cite.)