A wide-angle photograph of the Glen Canyon Dam, a massive concrete structure spanning a deep, narrow canyon. The dam is surrounded by high, reddish-brown rock walls. The Colorado River flows through the canyon below the dam. The sky is filled with white and grey clouds, and the overall scene is brightly lit. The text is overlaid on the right side of the image.

# **Glen Canyon Dam Adaptive Management Program**

## **Brown Trout Workshop**

**21-22 September 2017  
Tempe, Arizona**



# Glen Canyon Dam Adaptive Management Program

Brown Trout Workshop 2017

## Section Title: II. Scientific Background

**Section Lead:** Scott VanderKooi, US Geological Survey

**Section Authors:** Rich Valdez<sup>1</sup>, SWCA; Bob Schelly, National Park Service; Dave Rogowski, Arizona Game and Fish Dept.; and Scott VanderKooi, US Geological Survey

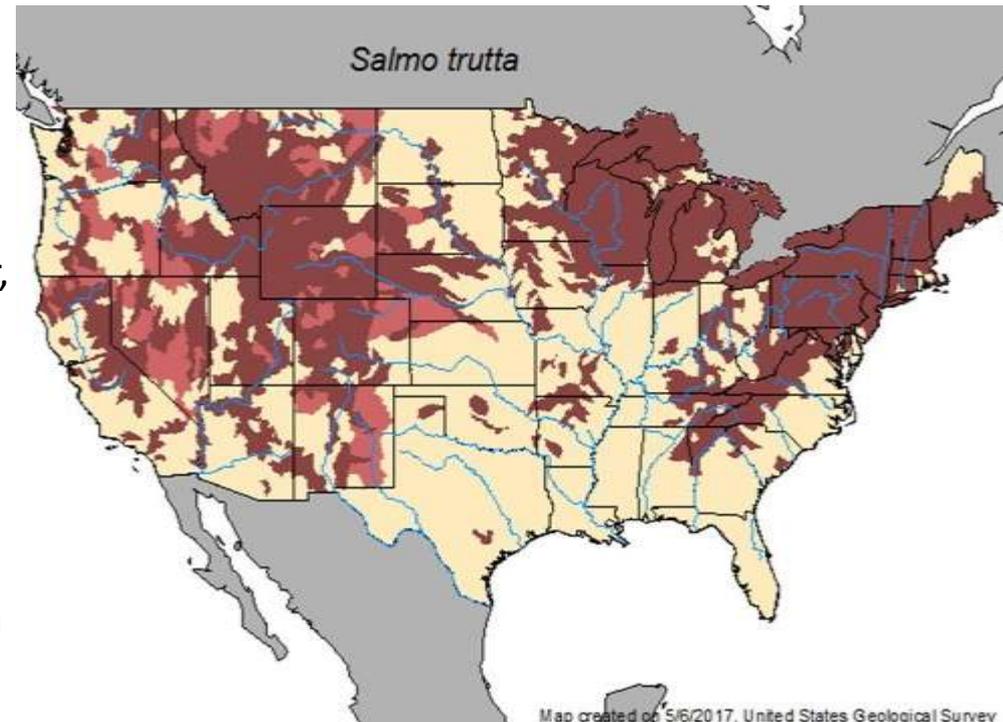
**In collaboration with the following:** Mike Yard, Charles Yackulic, David Ward, and Ted Kennedy, all at US Geological Survey

## History of Brown Trout in North America

1. Cold-water fish species that inhabits streams, river, and lakes, and is capable of migrating to and from salt water.
2. Original distribution is Europe, North Africa, and Western Asia.
3. First imported to U.S. from Germany in 1883 and stocked in Pere Marquette River, Michigan, by the U.S. Fish Commission.
4. Stocked in virtually every state of the country, including the Grand Canyon in Arizona.
5. “German brown trout” “Loch Leven” “von Behr trout”

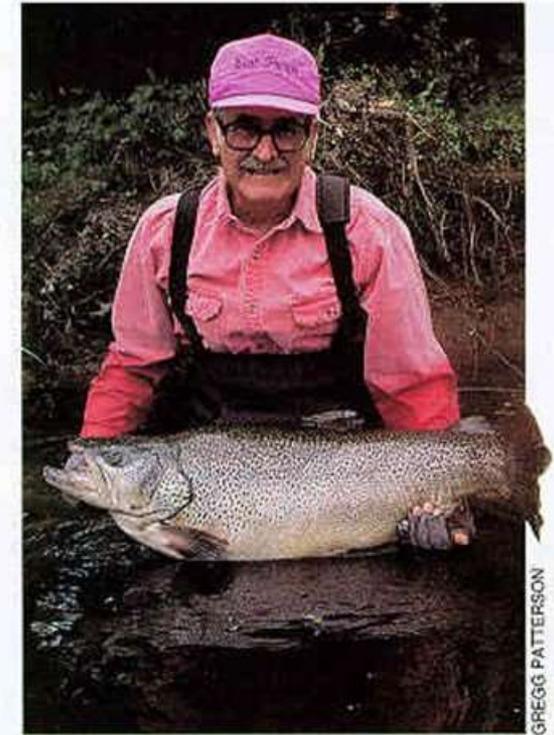


*Joseph R. Tomelleri*



## Brown Trout Food Consumption

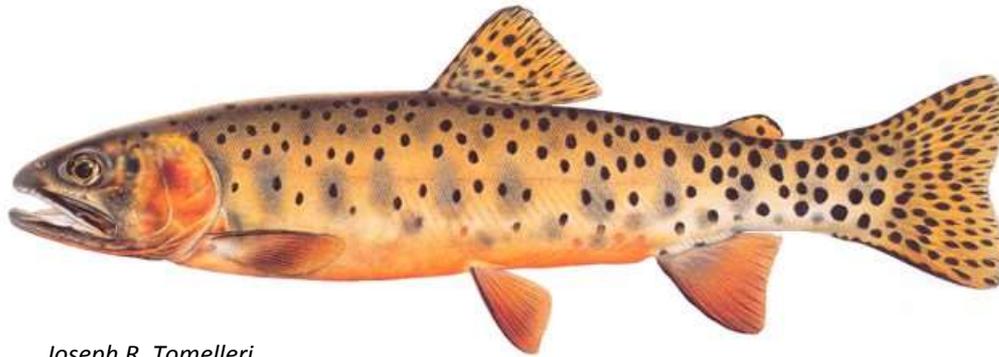
1. Capable of large range of prey (zooplankton to large fish).
2. Piscivorous at 20-25 cm; increasing prey size with fish size; grows large size (40 lb).
3. Ontogenetic diet shift = high energy intake and high growth efficiency.
4. Reproduces and grows at wide temperature range.



North American record  
brown trout = 40 lb 4 oz  
(Little Red River, AR, 1992)

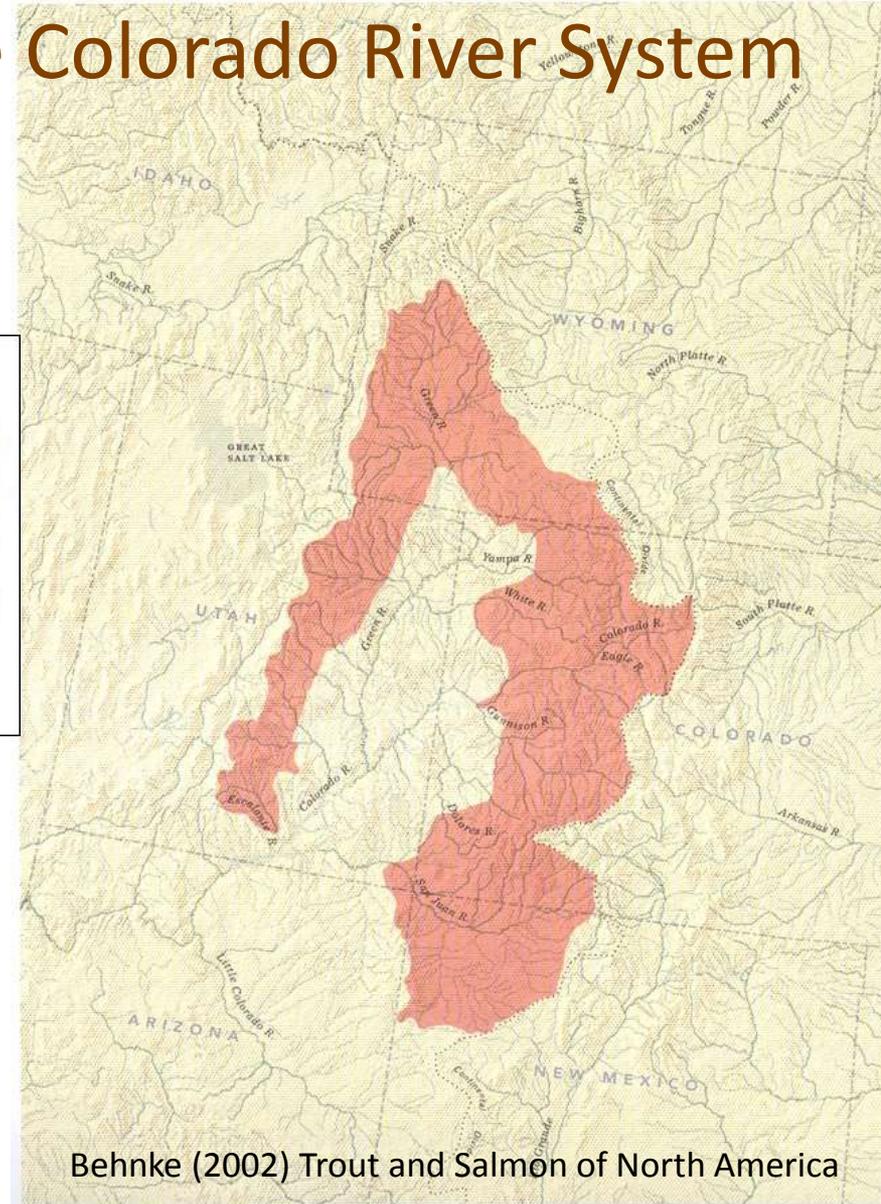
## Trout Species Native to the Colorado River System

### Colorado River Cutthroat Trout (*Oncorhynchus clarki pleuriticus*)



Joseph R. Tomelleri

- Descendant of Yellowstone cutthroat trout
- Headwater transfer from upper Snake River to upper Green River ~ 10,000 + ya
- Furthest downstream in Escalante and San Juan Rivers

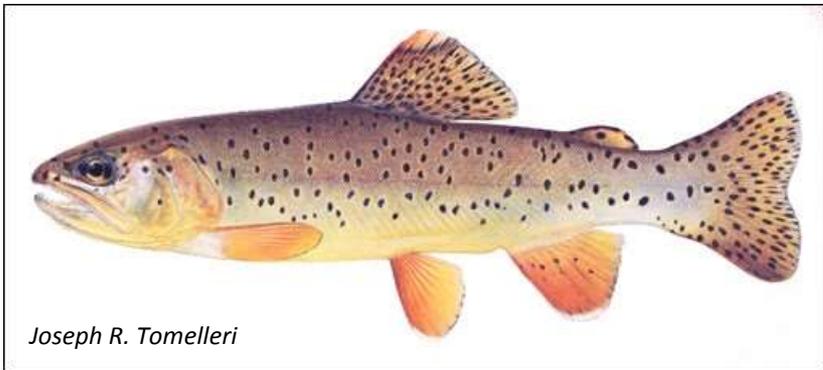


Behnke (2002) Trout and Salmon of North America

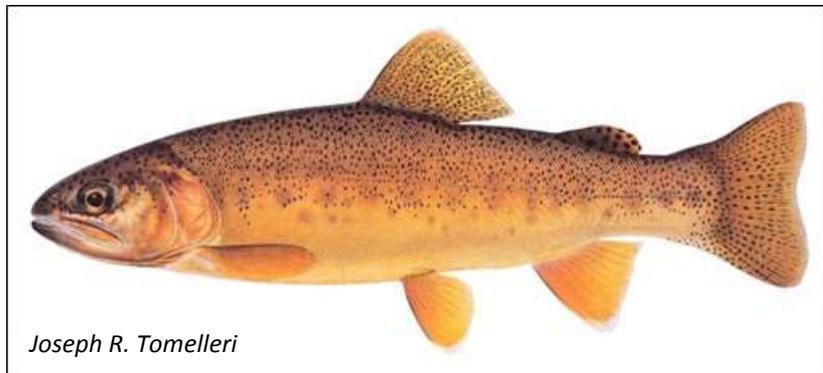
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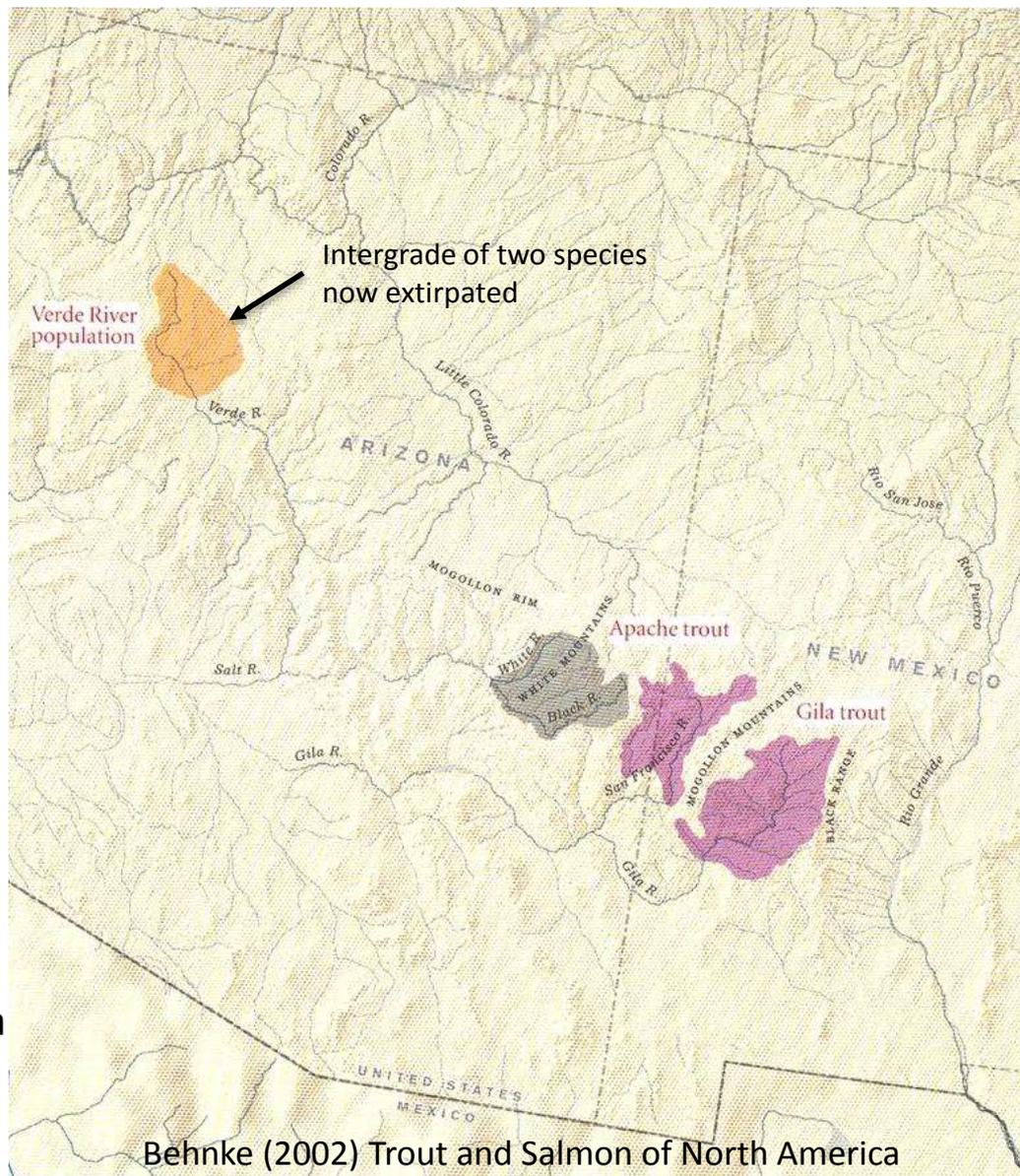
## Apache Trout (*Oncorhynchus gilae apache*)



## Gila Trout (*Oncorhynchus gilae gilae*)



- Related to rainbow trout
- Originated from Gulf of California 0.5-1 mya
- Found only in upper Gila and Salt Rivers



## History of Fish Stockings in Grand Canyon National Park

- Grand Canyon National Park established in 1919.
- National Park Service began stocking fish in tributaries to provide recreational fishing opportunities for park visitors.
- Focus of introductions was trout species in cold tributaries (Bright Angel, Shinumo, Clear, Havasu, Tapeats, Phantom, Garden, and Diamond Creeks).



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## Six Salmonid Species Stocked in Grand Canyon

| Species  |                        | Lees Ferry                | Clear Cr.        | Bright Angel Cr.                            | Phantom Cr. | Garden Cr. | Shinumo Cr. | Tapeats Cr. | Havasu Cr.             | Diamond Cr. |
|--|------------------------|---------------------------|------------------|---|-------------|------------|-------------|-------------|------------------------|-------------|
|    | <b>Rainbow Trout</b>   | 1964-98                   | 1940             | 1923, 1924, 1932-42, 1947, 1950, 1958, 1964 | 1942        |            |             | 1923, 1940  | 1931, 1944, 1948, 1954 | 1970, 1971  |
|    | <b>Brown Trout</b>     |                           |                  | 1930, 1934                                  |             | 1930       | 1926, 1930  |             |                        |             |
|    | <b>Brook Trout</b>     | 1977-78, 1980-83, 1985-87 | 1928, 1931, 1934 | 1920  |             |            |             |             | 1927                   |             |
|    | <b>Cutthroat Trout</b> | 1979                      |                  |   |             |            |             |             |                        |             |
|  | <b>Coho Salmon</b>     | 1971                      |                  |   |             |            |             |             |                        |             |
|  | <b>Kokanee Salmon</b>  | 1967                      |                  |   |             |            |             |             |                        |             |

\*\*In winter 1931-32, the National Park Service installed a field hatchery at Roaring Springs that served Bright Angel Creek and nearby drainages.

Do Not Cite or Distribute

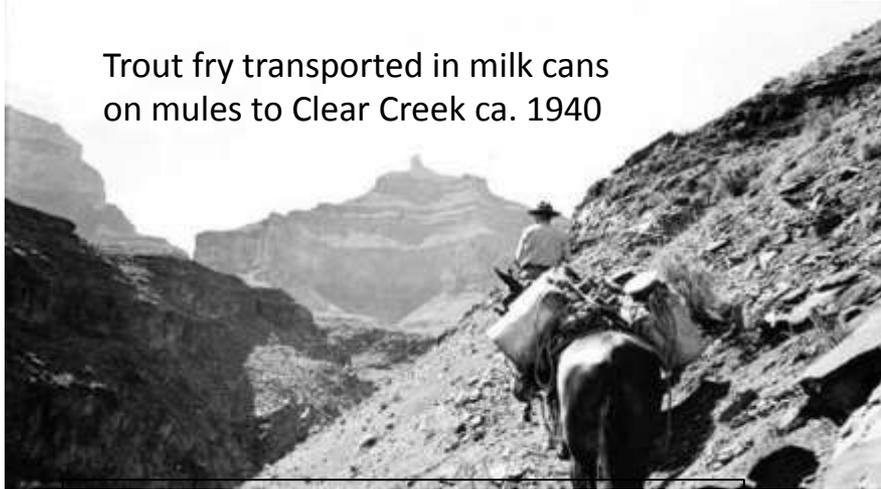


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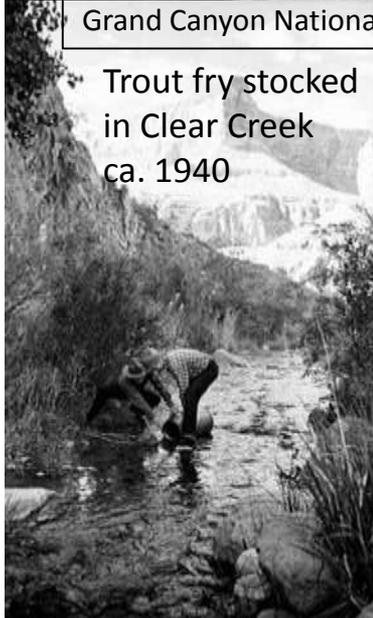
## Brown Trout Stockings in Grand Canyon

Trout fry transported in milk cans on mules to Clear Creek ca. 1940

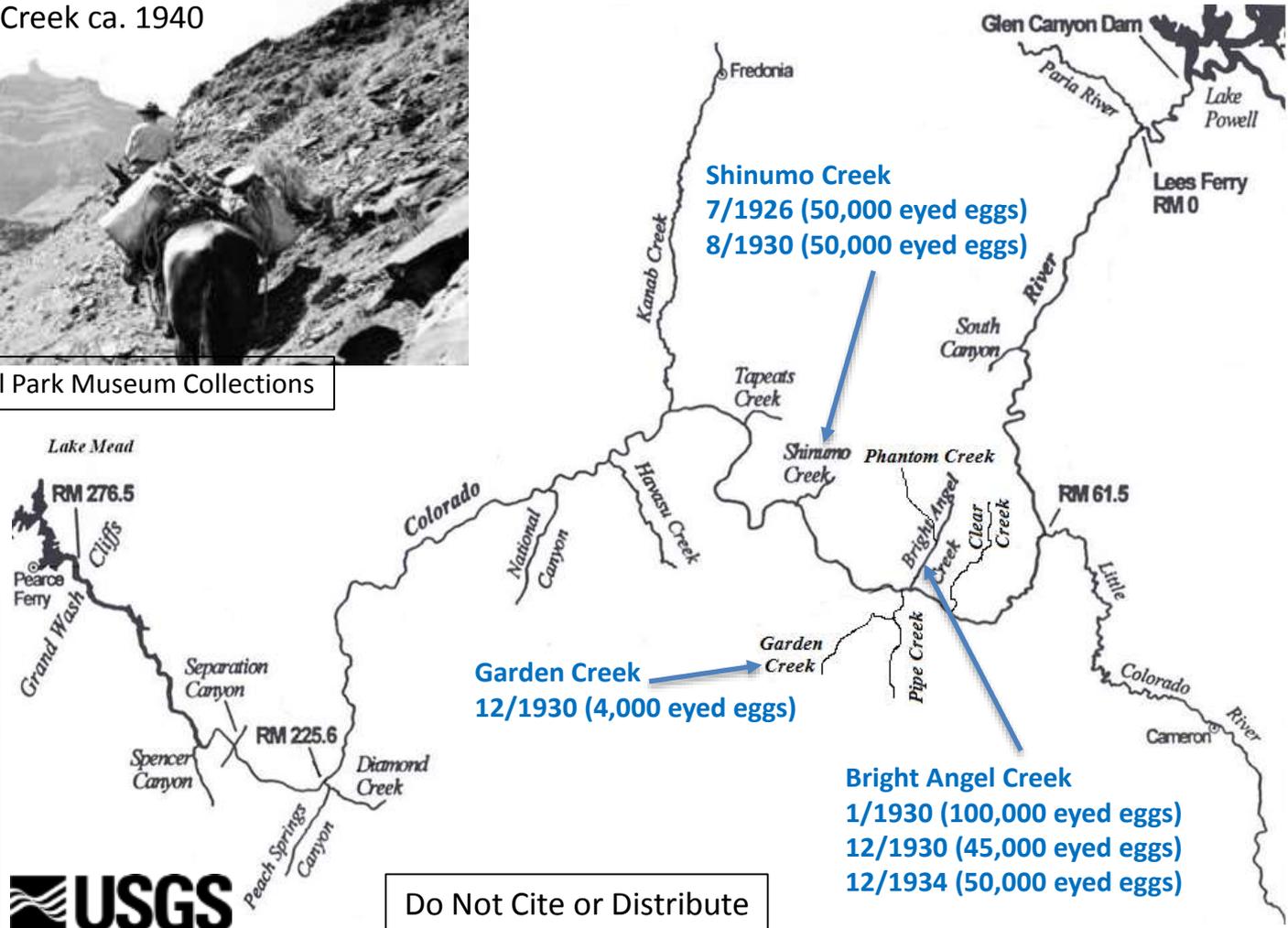


Grand Canyon National Park Museum Collections

Trout fry stocked in Clear Creek ca. 1940



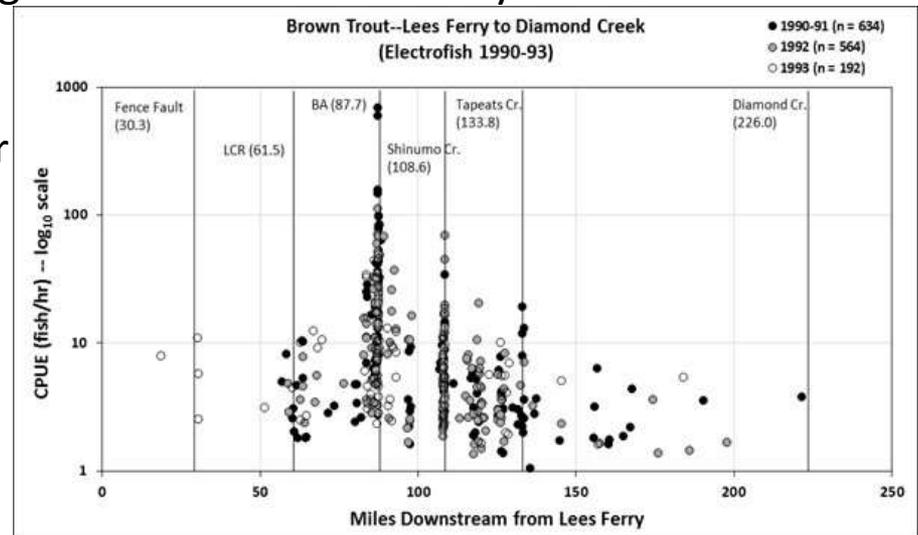
1926 – 1934 (299,000 eyed eggs in 3 tribes)



Do Not Cite or Distribute

## Fish Surveys of the Colorado River and Tributaries (Lees Ferry [RM 0] to Diamond Creek [RM 226])

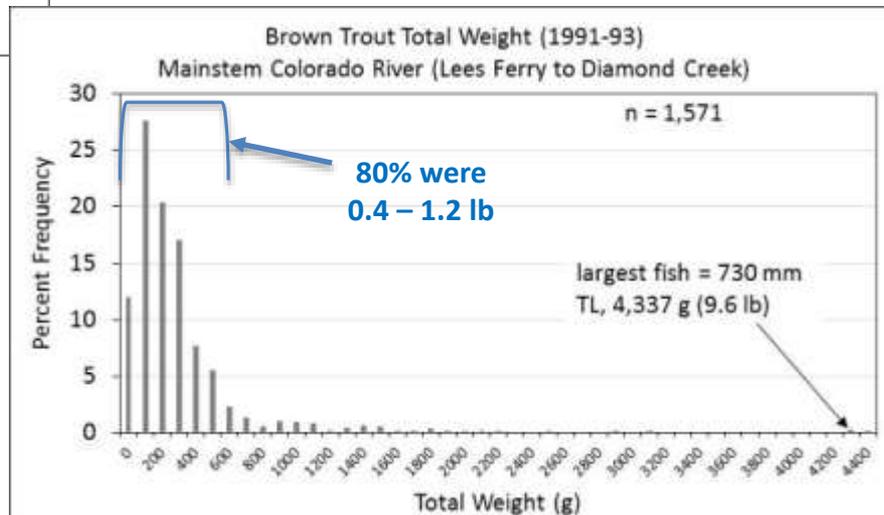
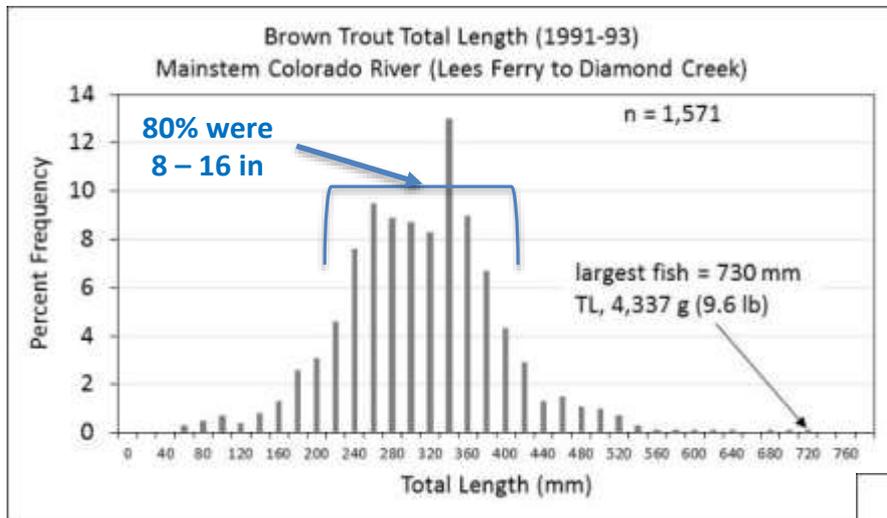
1. 1968 (Miller and Smith 1972) and 1970–1976 (Suttkus et al. 1976): no brown trout from mainstem or tributaries.
2. 1977–1979 (Carothers and Minckley 1981): low catch rates of brown trout in mainstem from Little Colorado River (LCR) to Shinumo Creek; brown trout in Phantom & Shinumo Creeks.
3. 1984 to 1986 (Maddux et al. 1987): no brown trout from Lees Ferry, low catch rates downstream to LCR, highest catch of adults/subadults from LCR to Bright Angel Creek, moderate catch from Bright Angel Creek to National Canyon.
4. 1990–1993 (Valdez and Ryel 1995): brown trout primarily downstream of LCR, with highest catch rates in and near confluence of Bright Angel Creek, Shinumo Creek, and Tapeats Creek.
5. Arizona Game and Fish Department (Makinster 2010, 2011; Rogowski 2017)



# Glen Canyon Dam Adaptive Management Program

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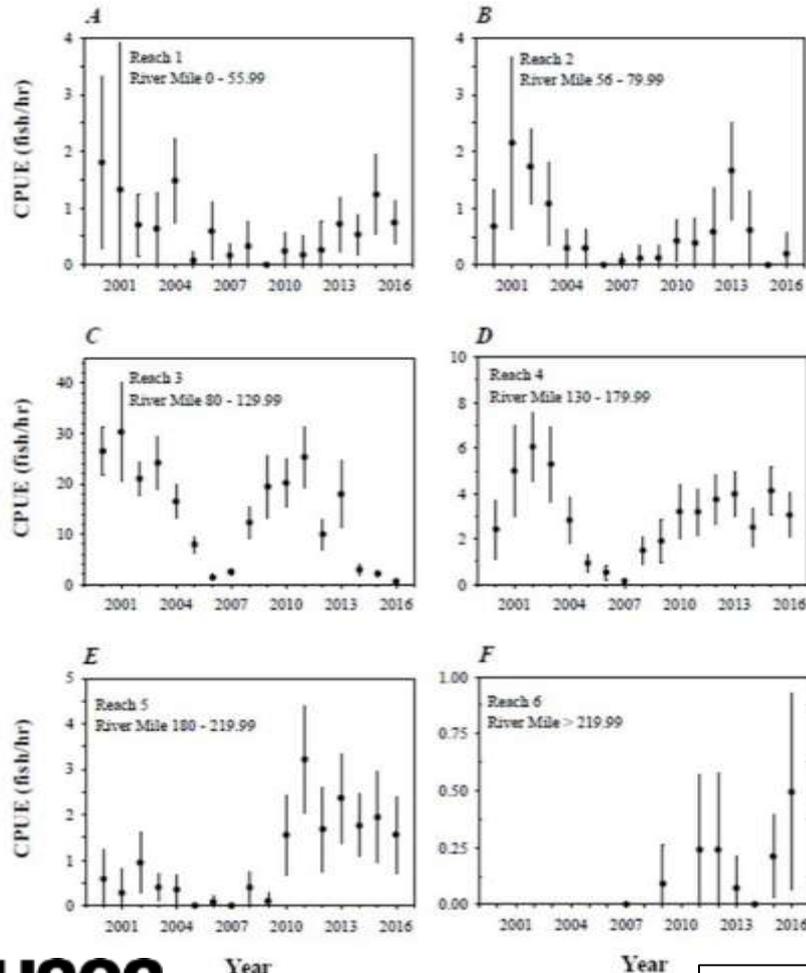
## Brown Trout Total Lengths (TL) and Weights in Colorado River



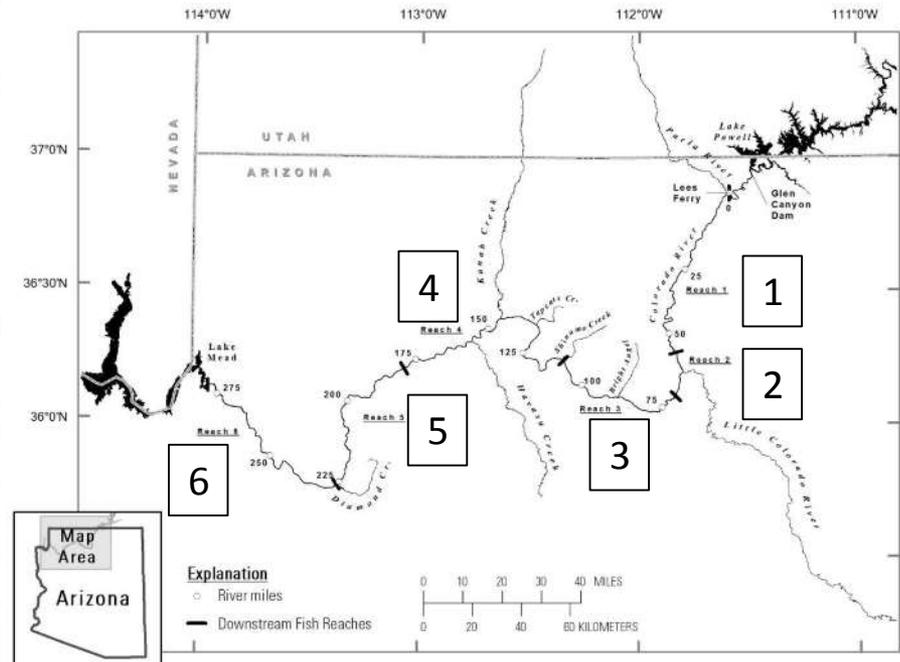
# Glen Canyon Dam Adaptive Management Program

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## AZ Game & Fish Dept. Fish Surveys of the Colorado River Lees Ferry (River Mile 0) to Pearce Ferry (River Mile 280)



- Number of brown trout differ by reach and vary over time.
- Brown trout below Diamond Creek, starting in 2007.

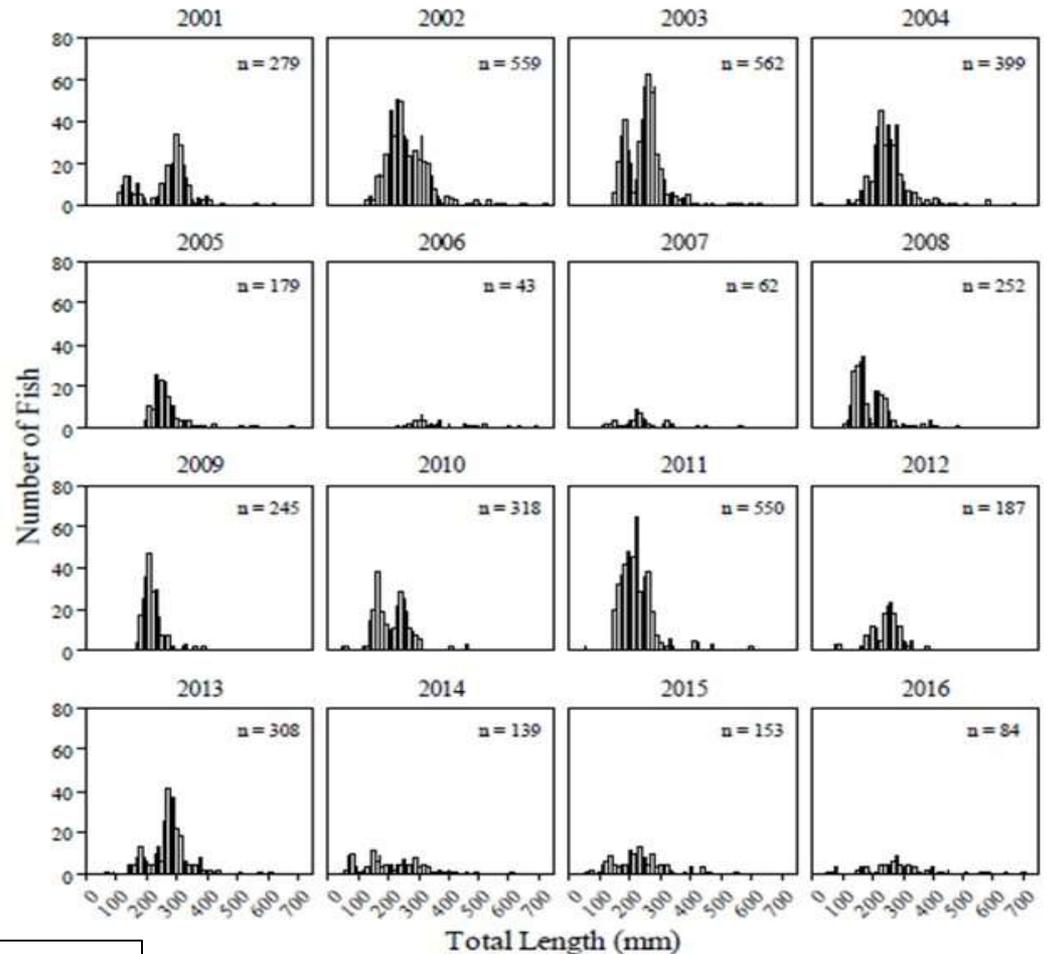


## AGFD Fish Surveys of the Colorado River Lees Ferry (River Mile 0) to Pearce Ferry (River Mile 280)



*Joseph R. Tomelleri*

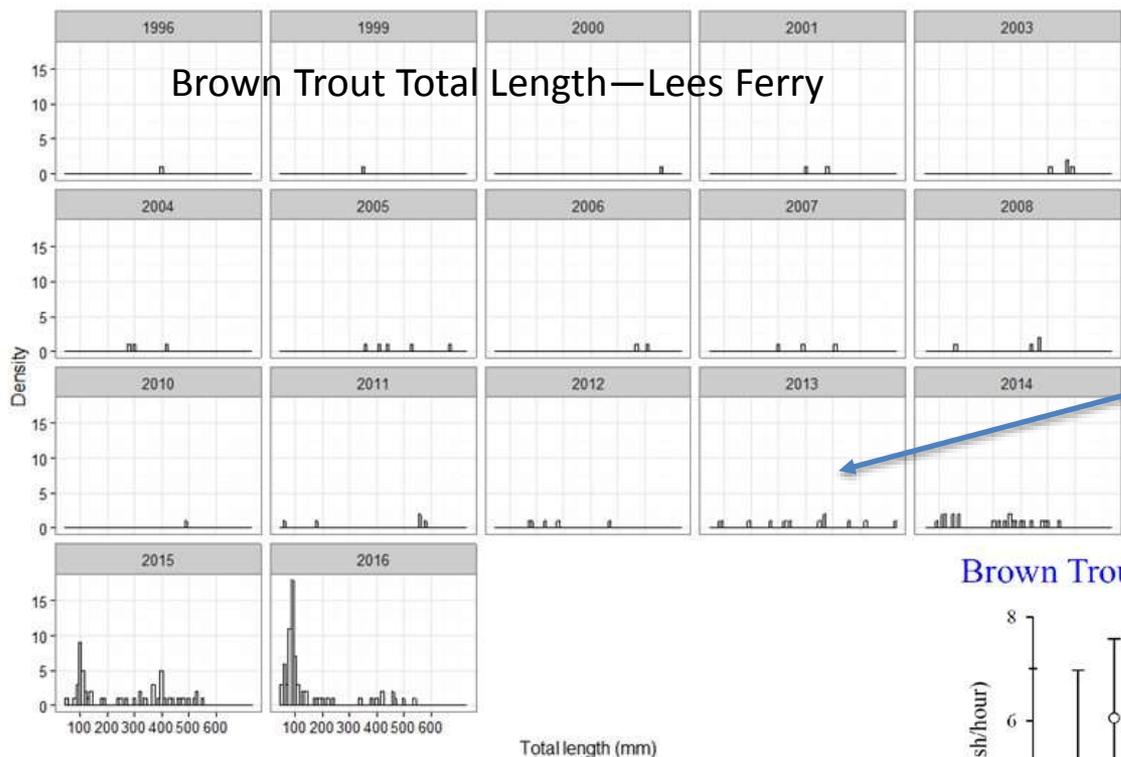
- Majority of brown trout in mainstem are 150 to 400 mm TL (6 – 16 in.).
- This size range is similar to B/W data for 1990-93.
- Brown trout become piscivorous at 200-250 mm TL; hence, most of the fish in the canyon can be considered potential predators—and competitors for invertebrate food supplies.



# Glen Canyon Dam Adaptive Management Program

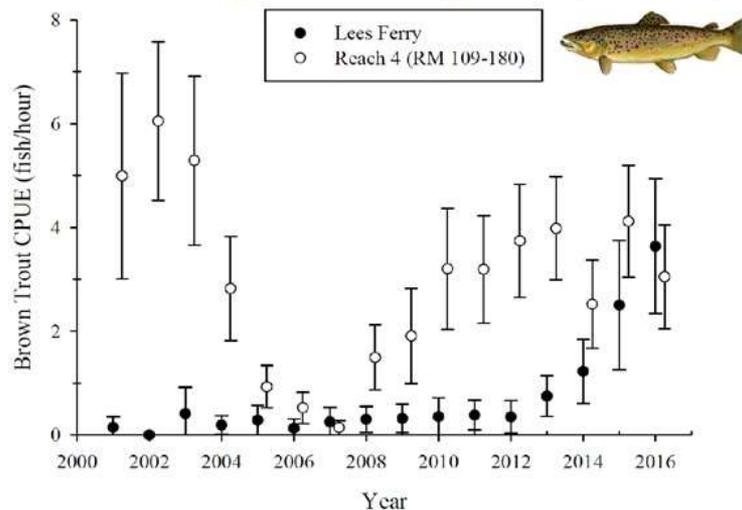
Brown Trout Workshop 2017

## Brown Trout Lengths and Weights in Lees Ferry Reach



- No brown trout in Lees Ferry in 1986
- 1-5 brown trout caught annually 1996 thru 2012
- Increase in number and age distribution starting in 2013
- Some are 540 mm long (20+ in)

### Brown Trout avg. electrofishing CPUE (fish/hour)



Rogowski (2017) AGFD Annual Report



## Summary

1. There are no trout species native to the Colorado River or its tributaries through Marble or Grand Canyons.
2. Brown Trout were introduced into 3 tributaries in 1926, 1930, and 1934 (Bright Angel, Shinumo, and Garden Creeks); but not into Lees Ferry or the mainstem.
3. Brown Trout remained confined to tributaries until after 1963.
4. Cold mainstem temperatures provided conduit for movement.
5. Brown Trout numbers remain low and variable in mainstem.
6. Brown trout were not reported in Lees Ferry prior to ~1996, low catch rates 1996 to 2012, followed by increase in 2013.