Green Sunfish – Status and Trends in the Western Grand Canyon

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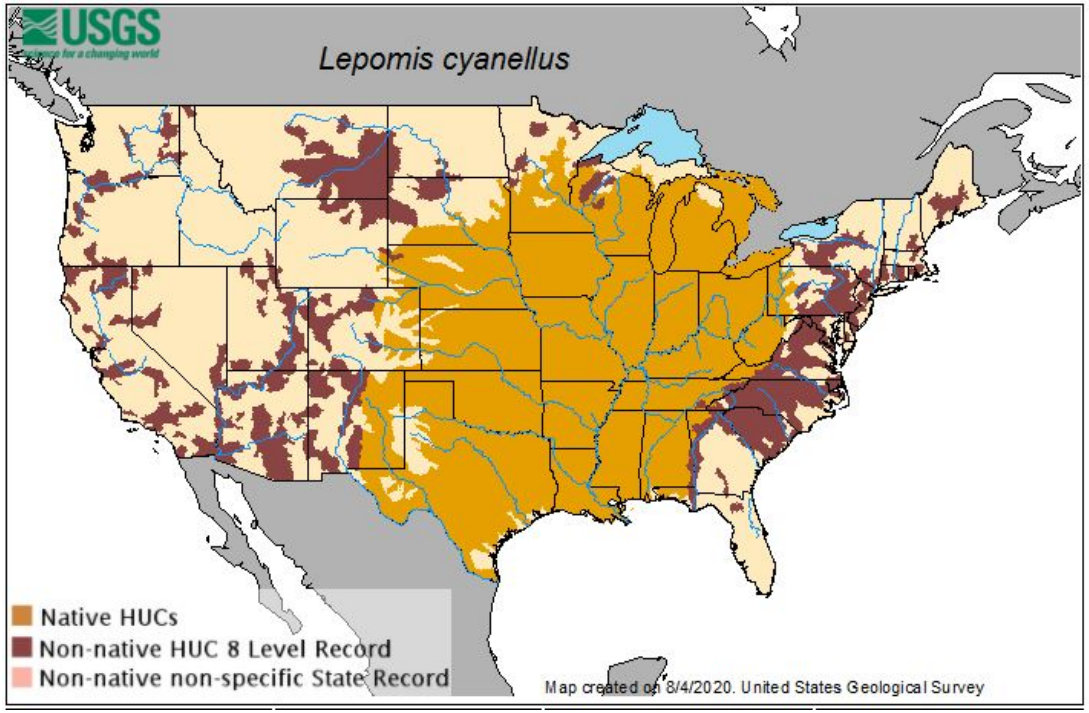
Outline

- Background
  - Green sunfish distribution, ecology, life history
  - Ecological impacts
- Temporal and spatial trends in occurrence in Grand Canyon
  - “Hotspots” and possible sources
  - Potential for expansion – limiting factors
- Relative risk to native fishes
- Potential management and monitoring options

Background – Green Sunfish Range

- Mississippi River Basin, Hudson Bay, Great Lakes, Gulf of Mexico

- Reference: *Pam Fuller, Matt Cannister, and Matt Neilson, 2020, Lepomis cyanellus Rafinesque, 1819: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL.*



Green Sunfish Ecology

- From Fishes of Arkansas (Robison and Buchanan 1984)- "….*tolerance of a wide range of ecological conditions, particularly to extremes of turbidity, dissolved oxygen, temperature, and flow. It is also a pioneering species, readily populating new bodies of water and is among the first fishes to repopulate streams after droughts.*"
- Photo credit: www.fieldherpforum.com

Habitat and Ecology

- Tolerant to wide range of temperatures- Near freezing to 35 °C
- Spawning
  - 19 - 30°C
  - Males build and guard nests
  - Prolonged spawning period
- Morphology – suited for slow velocity habitats and altered flow regimes
- Photo – green sunfish on nest, © Alan Marshall 2007

Habitat and Ecology- continued

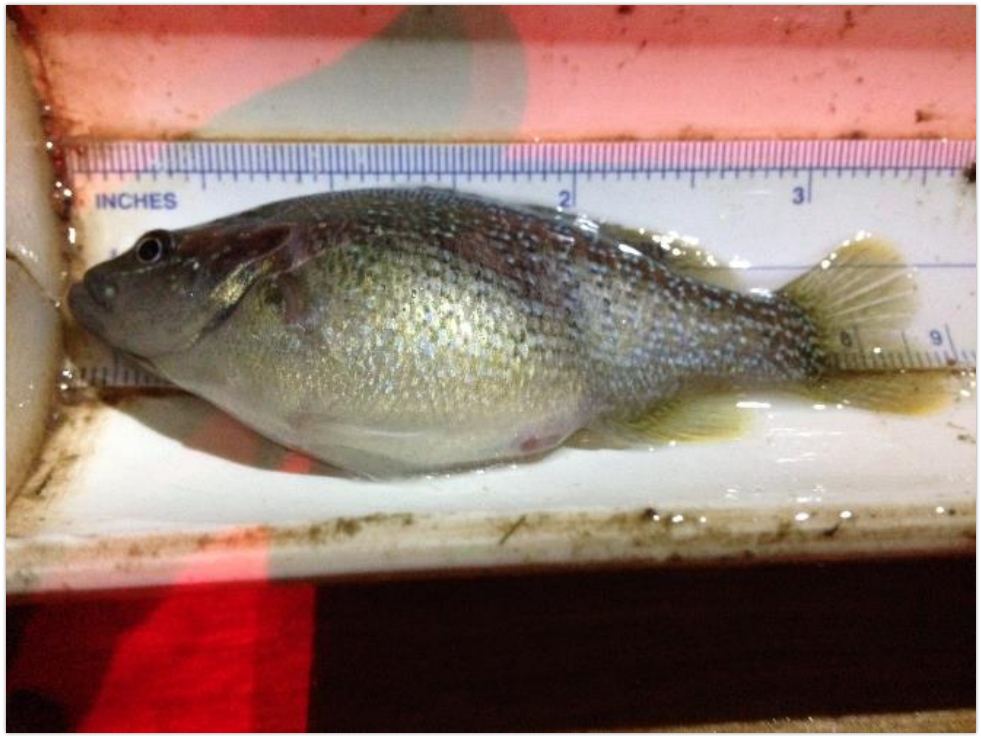
- Drought conditions – advantageous (Rogosch et al. 2019)
  - Crowding into limited habitat
  - Intensifies competition & predation
- High spring flow disadvantage?
- Monsoon flooding - potential displacement or interrupted reproduction?
- Flooding may facilitate dispersal
- Photograph of a green sunfish removal effort, from Bogan et al. 2019

Green Sunfish in the Upper Basin

- Occur in off-channel ponds, backwaters, wetlands, canals and ditches with emergent vegetation – also native fish habitat
- Uncommon in main-channel areas, where temperatures are suitable and warm
- Sampling efficiency?
- Photo of Skippers Island near Grand Junction, from Google Earth

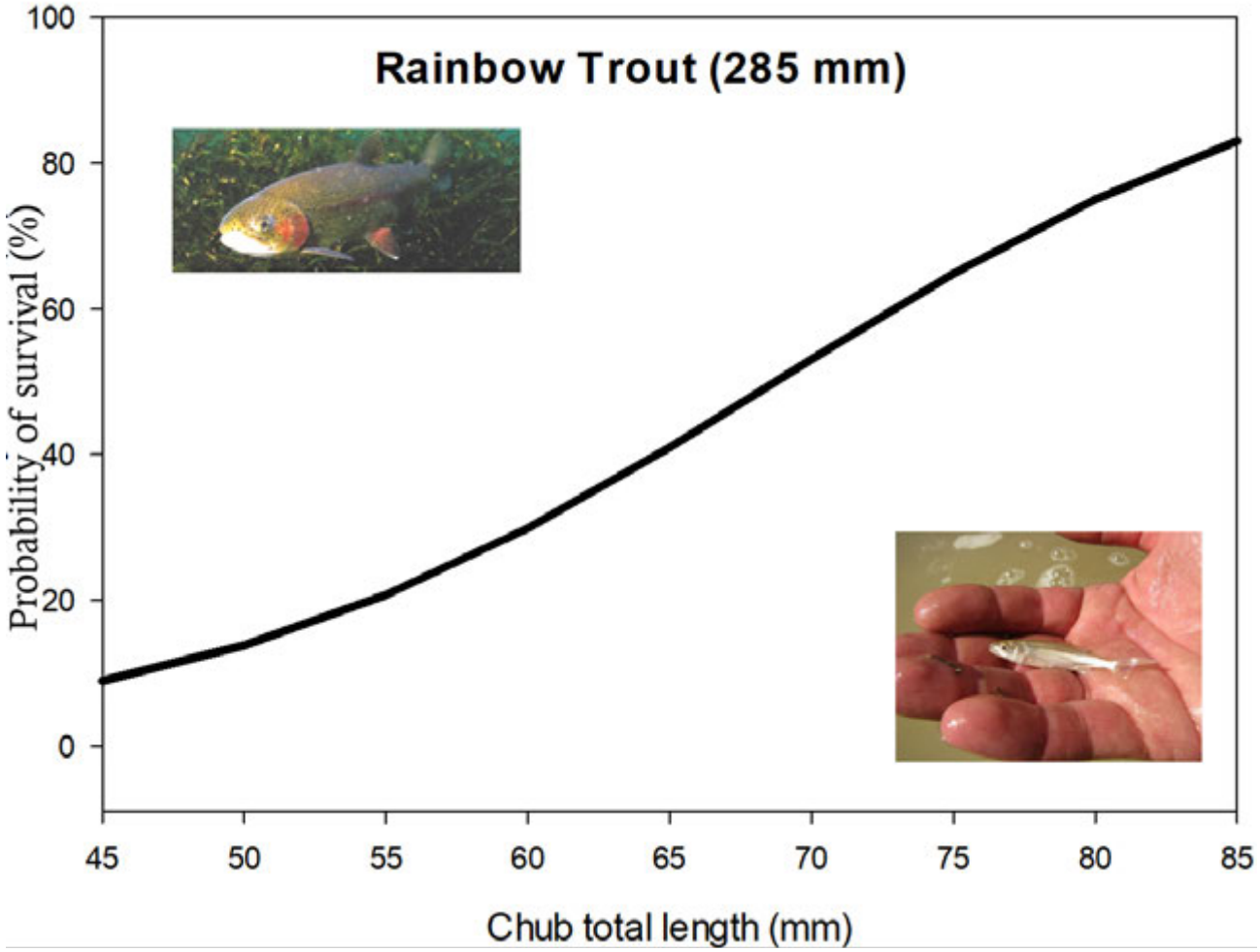
Green Sunfish as an Invasive Species

- Rapid colonizer
- Varied diet – prey on or compete with larval/juvenile fish (Ehlo et al. 2017)
- Responsible for extirpations or suppression of native species (examples):
  - First-order streams of the Piedmont, N. Carolina (Lemly 1985)
  - California roach (Moyle and Nichols 1974)
  - Gila chub predation in Arizona – eliminating recruitment (Dudley and Matter 2000)
  - Potential adverse impacts on juvenile Colorado pikeminnow survival (Karp and Tyus 1990)

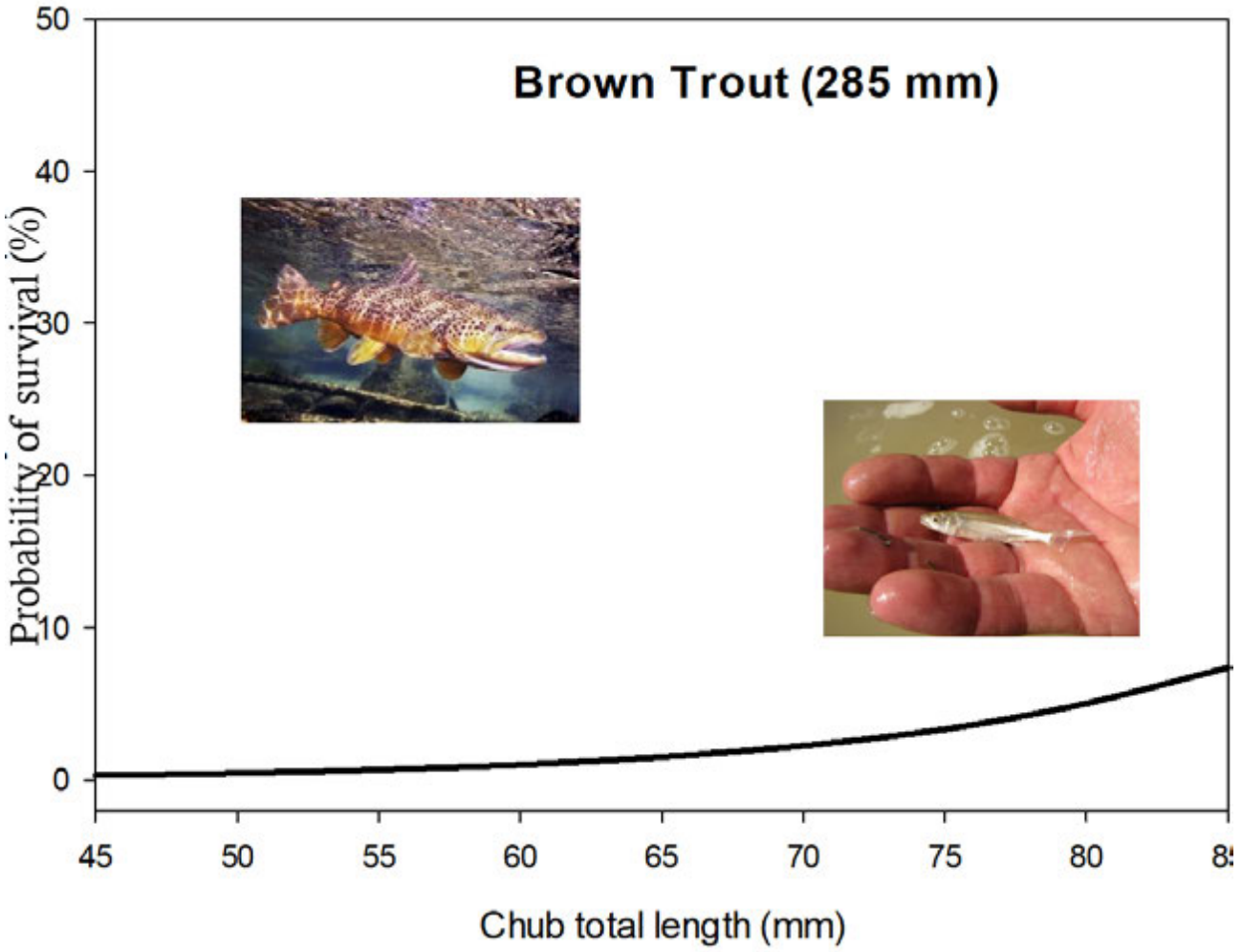


Lab studies of Colorado River predatory fishes- Rainbow Trout

From: Ward and Morton Starner. 2015. Effects of water temperature and fish size on predation vulnerability of juvenile Humpback chub to rainbow and brown trout. Transactions of the American Fisheries Society 144: 1184-1191.



Lab studies of Colorado River predatory fishes- Brown Trout



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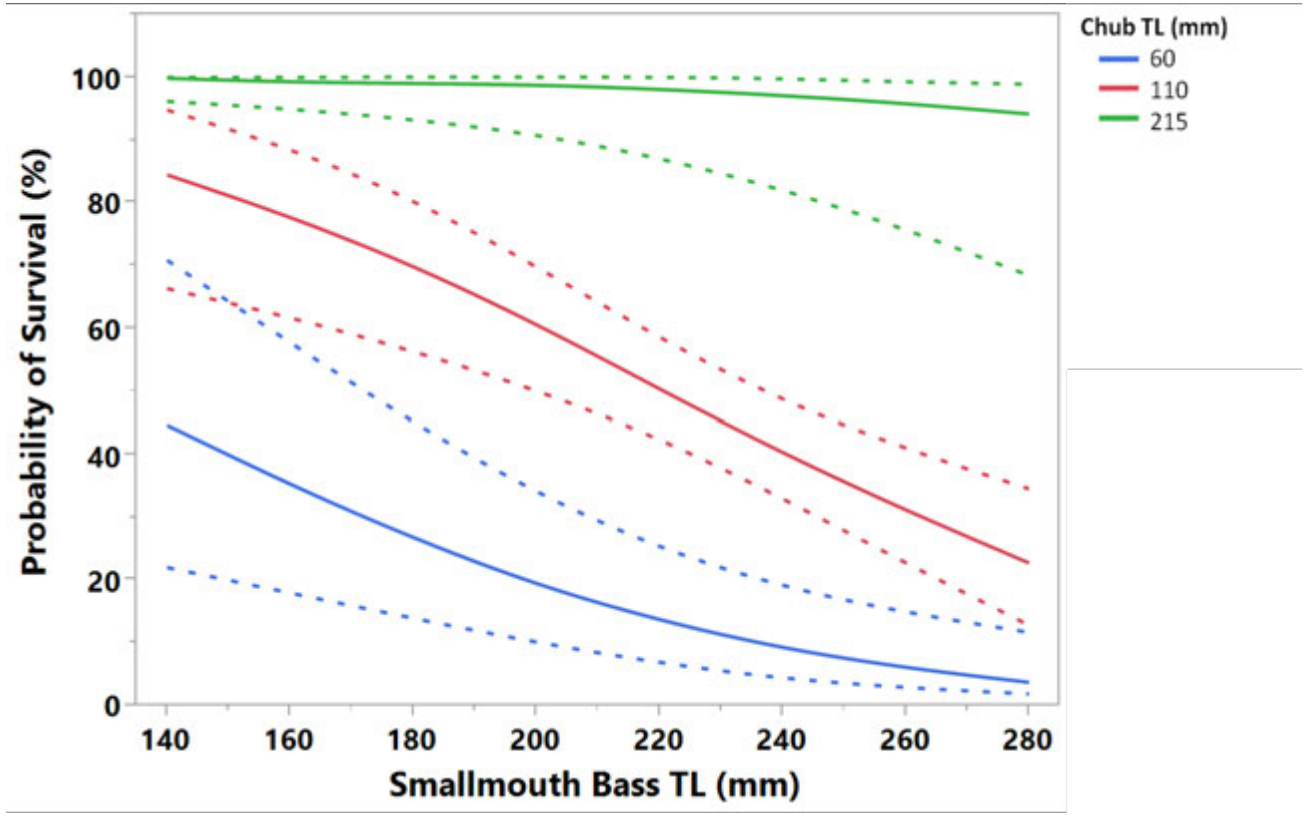
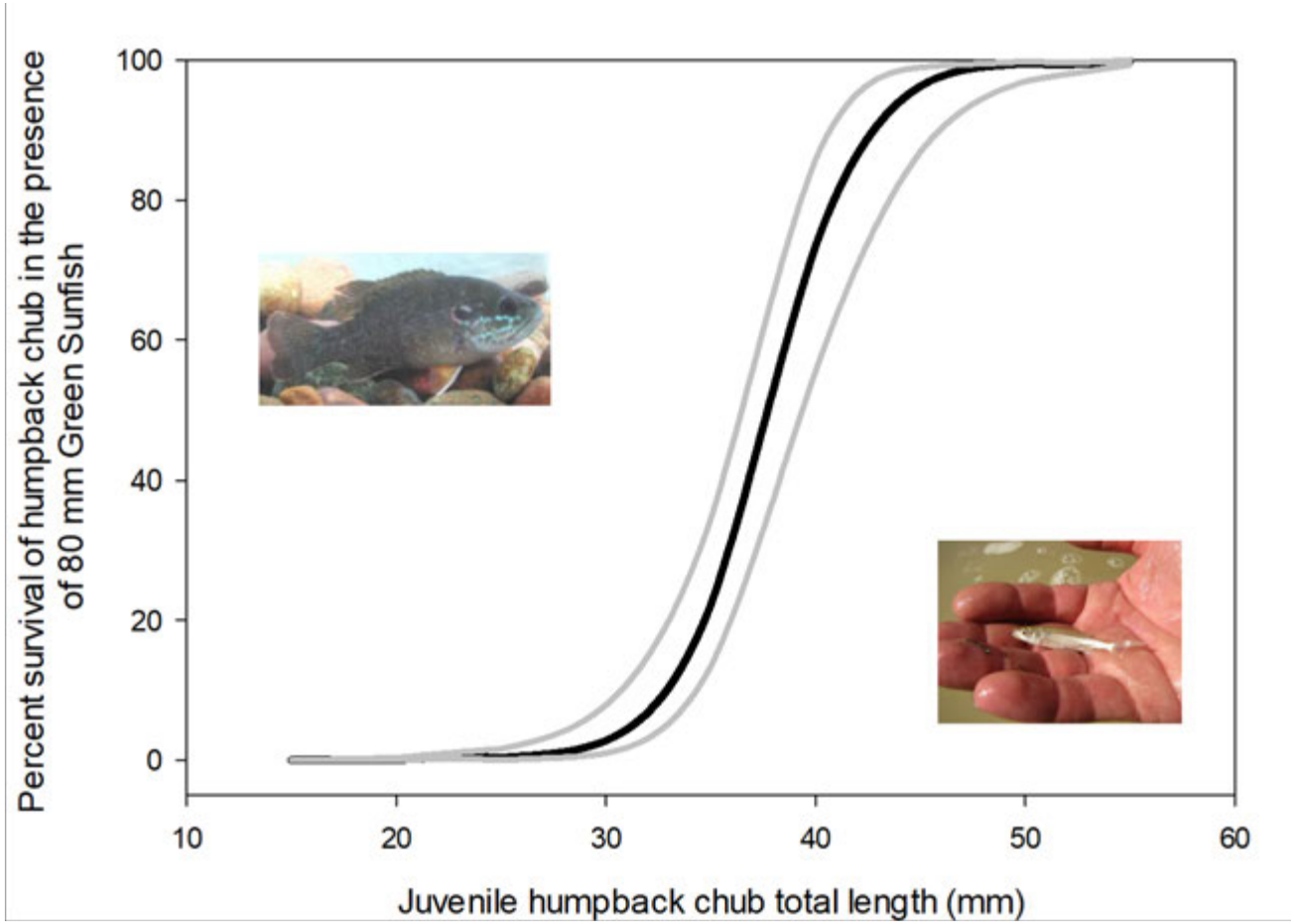
Lab studies of Colorado River predatory fishes- Smallmouth Bass

- This is the same type of data for smallmouth bass. In this case the size of the predator is varying, and 3 different sizes of prey are shown. But the results are similar and the curves are very flat.
- From: Laura Tennant, MS Thesis, 2018



Lab studies of Colorado River predatory fishes- Green sunfish

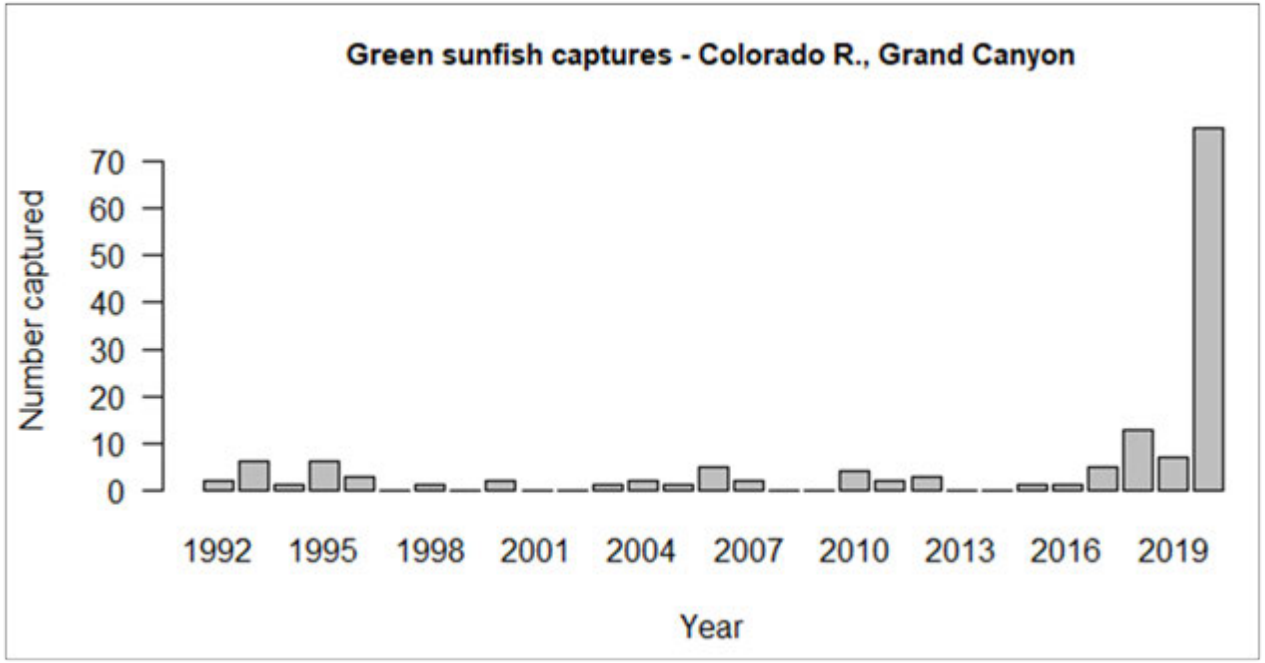
This is the same type of 24-hour predation trial in the laboratory at 20 C. The curve is very different. Why? All of the humpback chub are 100 % vulnerable to predation if green sunfish can fit them in their mouth – but as soon as they are too big to fit in the mouth then predation vulnerability rapidly goes to zero. This is very different than all the other predators examined, and indicates that green sunfish are a very effective, very aggressive predator. Behaviorally small chub are not able to escape this predator if they fit into the mouth of a green sunfish.



Why worry about Green Sunfish?

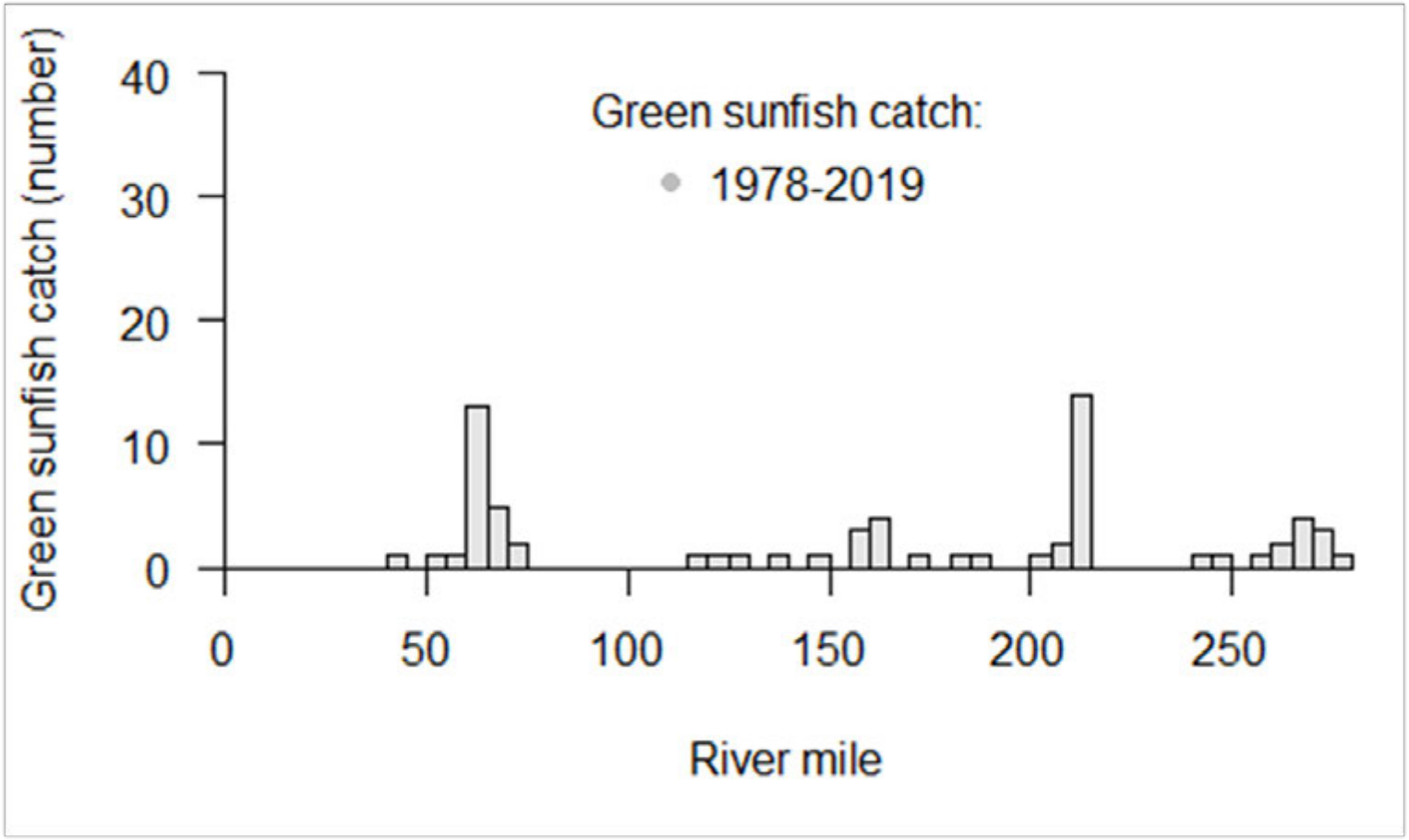
- Consume larger prey relative to their size
- Aggressive/group hunting behavior
- Small size allows them to access prey in shallow, near-shore environments
- Highly fecund
- Spread with flood events
- Typically overtake natural systems

What are the trends in Grand Canyon?



- Grand Canyon, Colorado River data only
- 2020 captures include BIO-WEST, Inc., GCMRC data through August (n=77; preliminary data – may not be all-inclusive)
- Catch NOT standardized by effort – but consistent in recent years

Where are they captured in Grand Canyon? (includes tributaries - adjacent RM)



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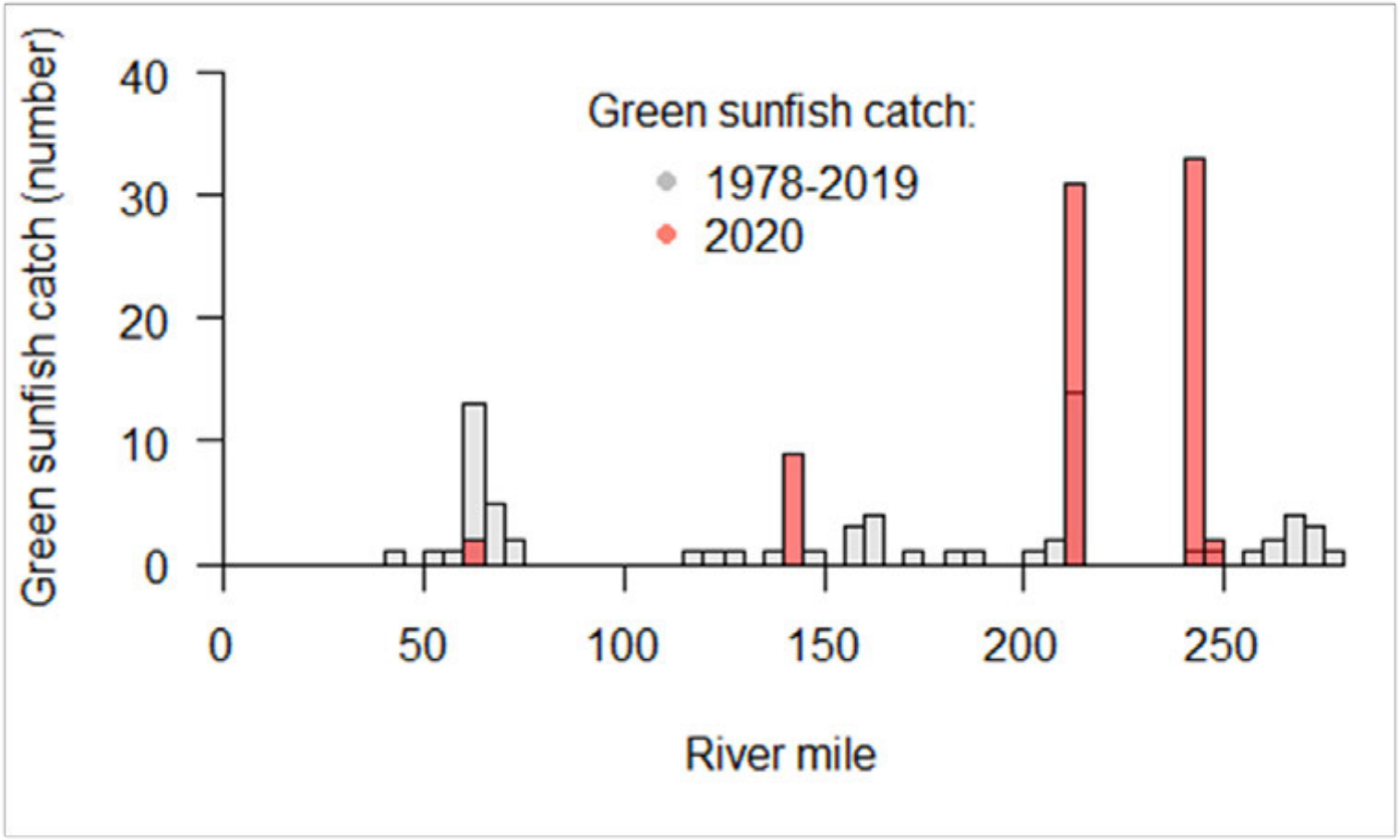
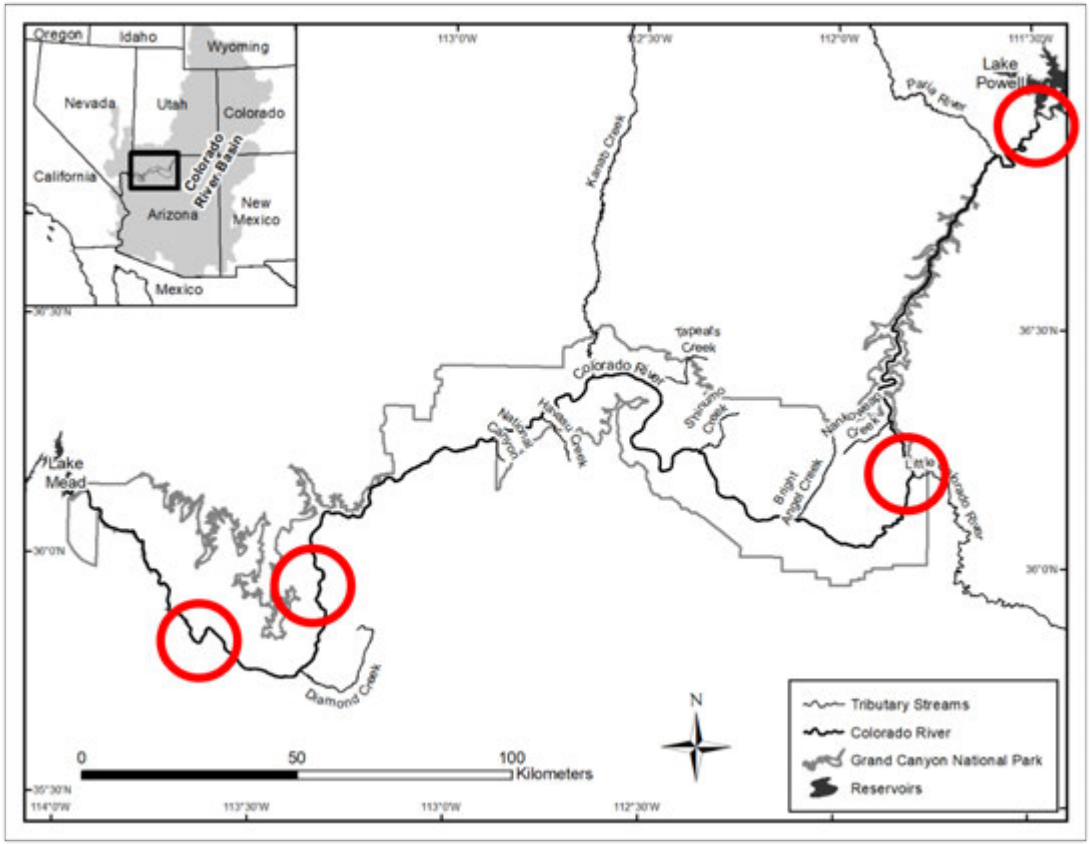


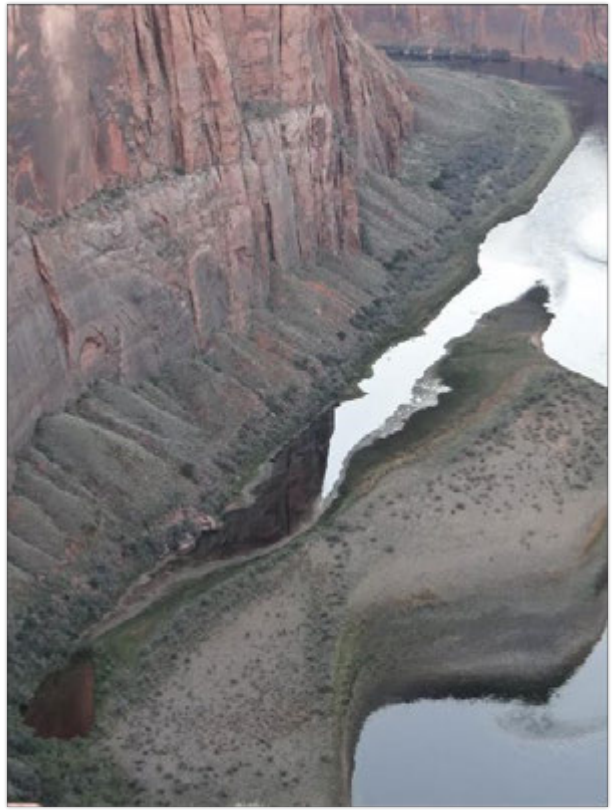
Map showing locations of larger Green sunfish captures within Grand and Glen canyons

- Green sunfish have been captured, from upstream to downstream, at:
  - -12 mile slough in Glen Canyon
  - Little Colorado River in Grand Canyon
  - Around Fall Canyon (river mile 212)
  - River mile 243



Hotspot – Glen Canyon (-12 mile)

- Continued green sunfish production since at least 2015
- Removal efforts planned



Hotspot – Little Colorado River

- Critical humpback chub population
- Concern - dispersal from upstream sources: Upper LCR watershed, -12 mile Slough, Lake Powell
- Slow-velocity, vegetated habitats
- Flooding and associated turbidity may limit green sunfish (continued drought)
- CO_2 may limit dispersal from Upper LCR Watershed

Hotspot – Kanab Creek

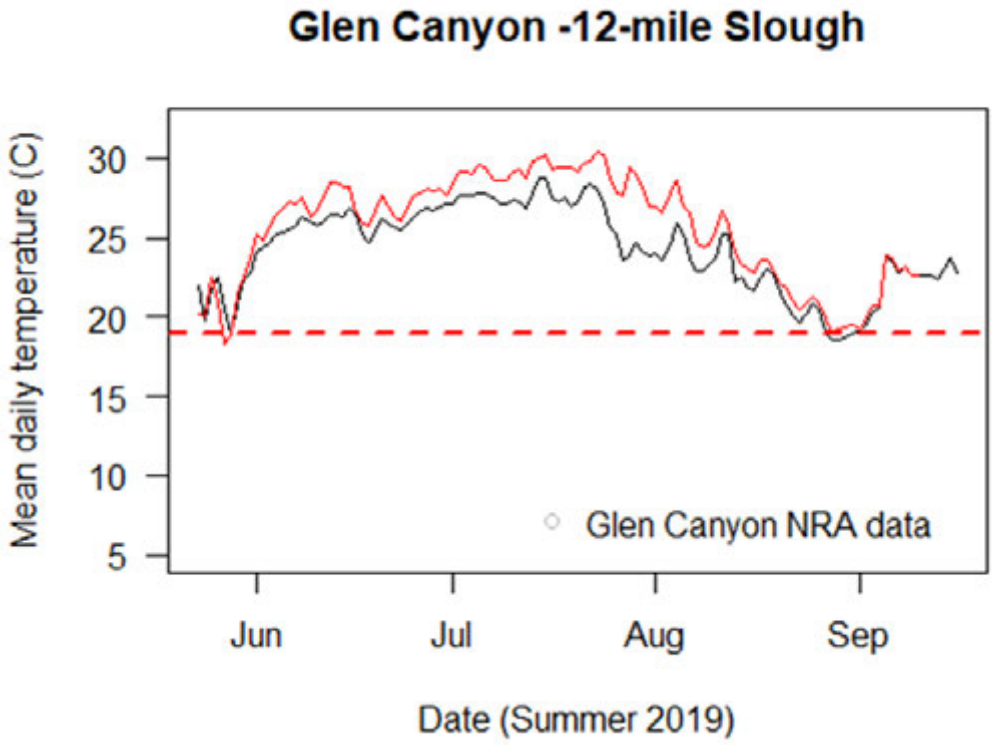
- Monitored ~twice/year via seining - reproduction in 2020
- Subject to extreme flood events
- Watershed extends in Southern Utah

Hotspot – River Mile 243

- Inundated at higher flows
- Humpback chub present
- In 2020 sampling event: ~50-60 green sunfish
- ~27°C

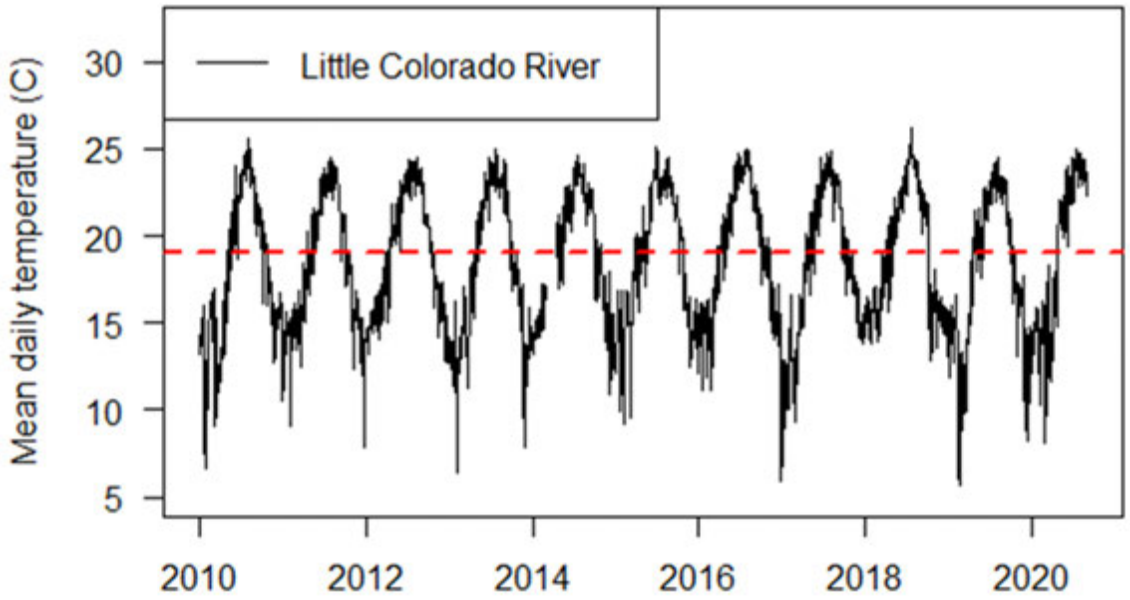
Will the Colorado River support large numbers of green sunfish?

- -12 mile slough – rapid/explosive reproduction noted
- Green sunfish minimum spawning temperature ~19˚ C- temperatures in the slough rarely go below this



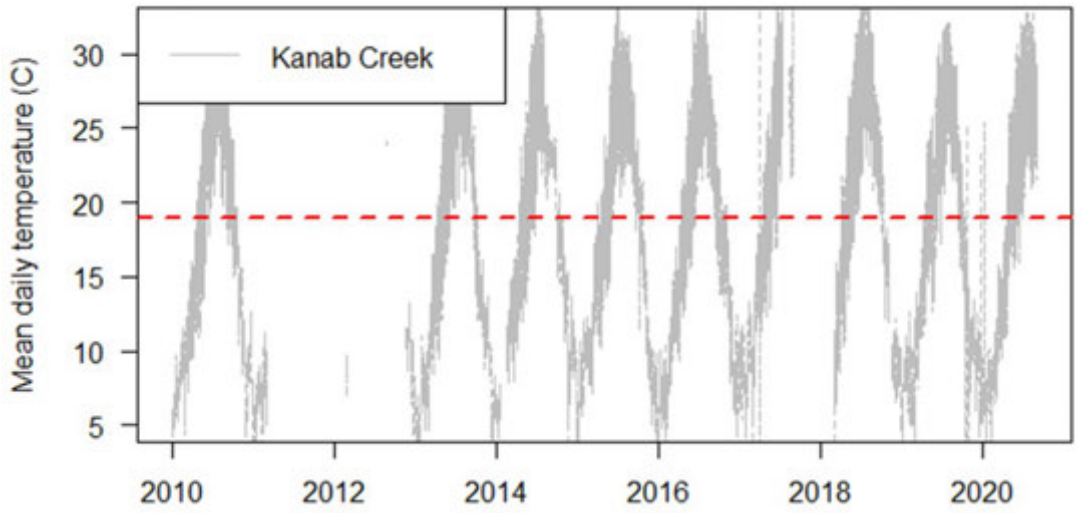
Will the Colorado River support large numbers of green sunfish? Little Colorado River

- Little Colorado River – reproduction?
- Green sunfish minimum spawning temperature ~19˚ C



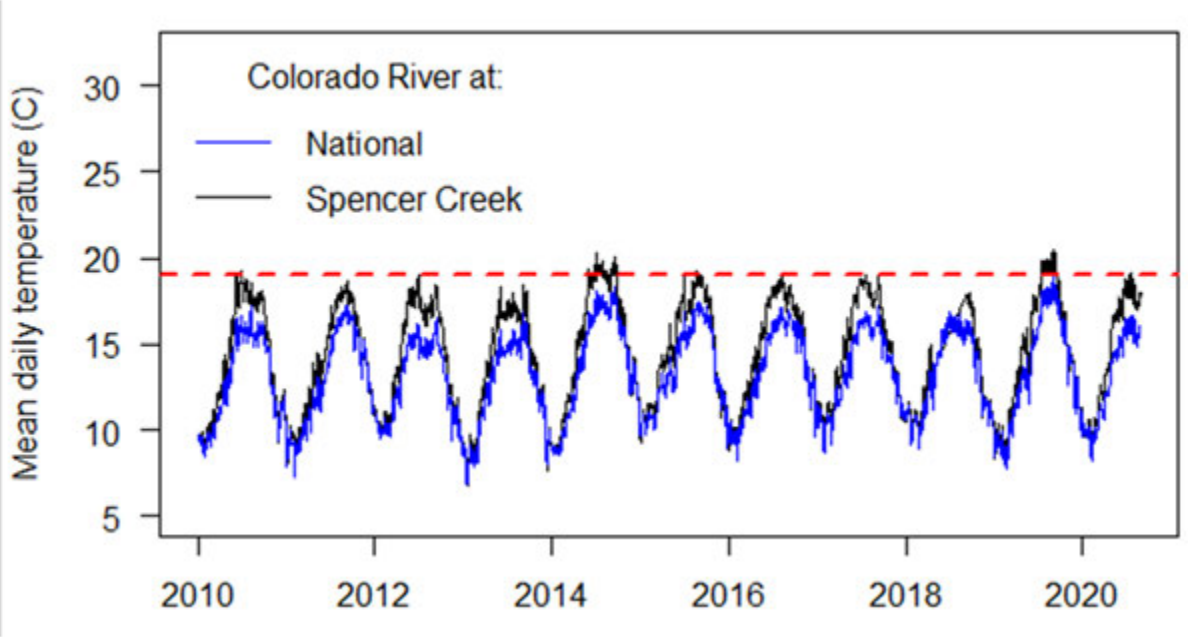
Will the Colorado River support large numbers of green sunfish? Kanab Creek

- Kanab Creek – reproduction noted, 2019-2020
- Green sunfish minimum spawning temperature ~19˚ C



Will the Colorado River support large numbers of green sunfish? National Canyon and Spencer Creek

- Temperature suitable?
- Green sunfish minimum spawning temperature ~19°° C

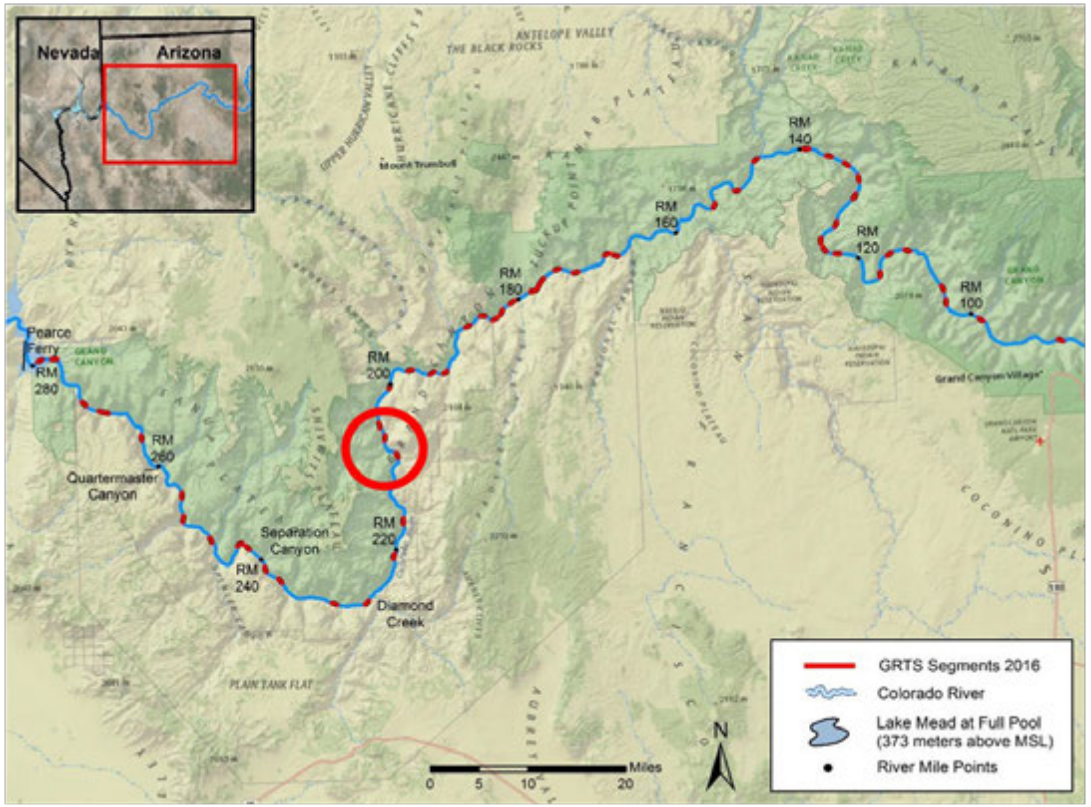


Potential to expand?

- Potential limitations:
  - Colorado River temperatures
  - Fluctuating flows
  - Turbidity may limit predation
  - Limited backwater/off channel habitat
- Uncertainties –
  - Future river temperatures?
  - Sources?
  - Is monitoring adequate?
    - Electrofishing may be less effective

Map of Current Monitoring Areas in Grand Canyon

- “GRTS” sampling locations as part of a razorback sucker study are numerous from river mile 89 to river mile 280
- Juvenile chub monitoring west study focuses on the river around mile 212



Possible control actions – next steps?

- Potential tools
  - Mechanical removal
  - Chemical control in high density areas
- Best options
  - Source identification and control
  - Review and expand hot spot monitoring if necessary- Consider patchy distribution and gear efficiency
  - Prioritize efforts relative to risk (e.g., rainbow and brown trout)

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