



Bio-Indicators

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November 2015

AP Environmental Science



What is an indicator species? Examples?



Ways streams become degraded

Nutrient pollution,
Insecticides



Oligotrophic – Nutrient poor
Eutrophic – Nutrient rich



Algal bloom

Ways streams become degraded

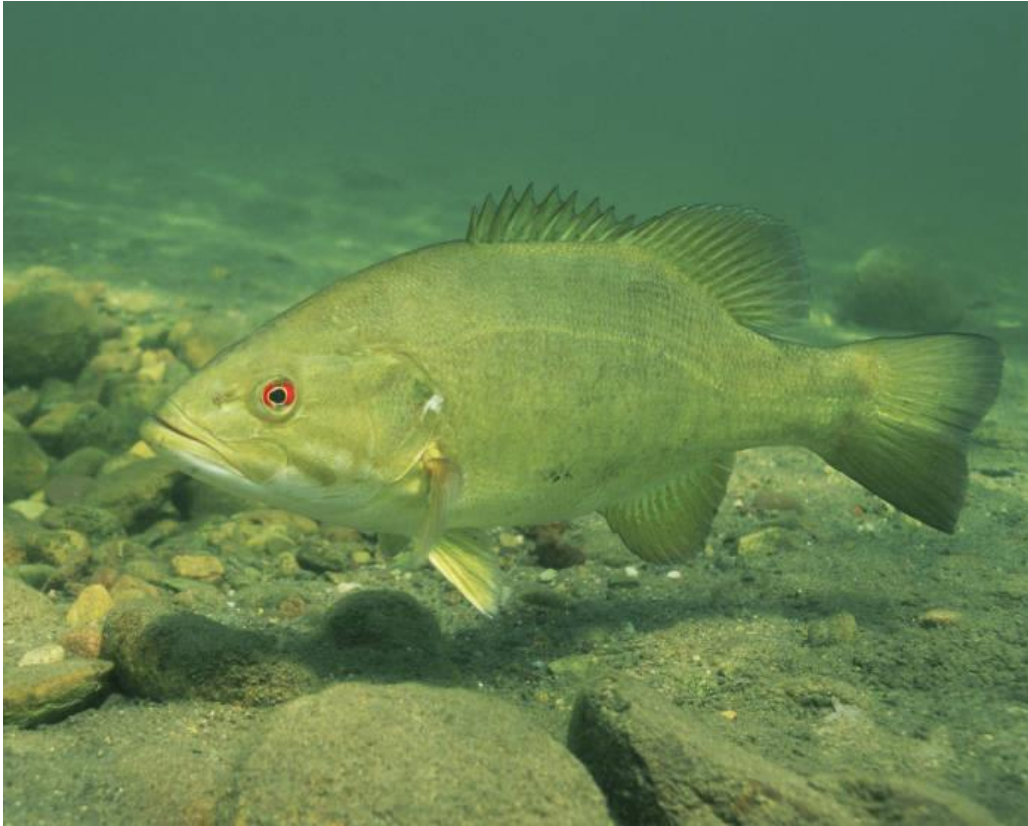
Deforestation



- Increase runoff
- Increase sediment
- Increase sunlight
- Decrease organic matter inputs

Ways streams become degraded

Invasive species

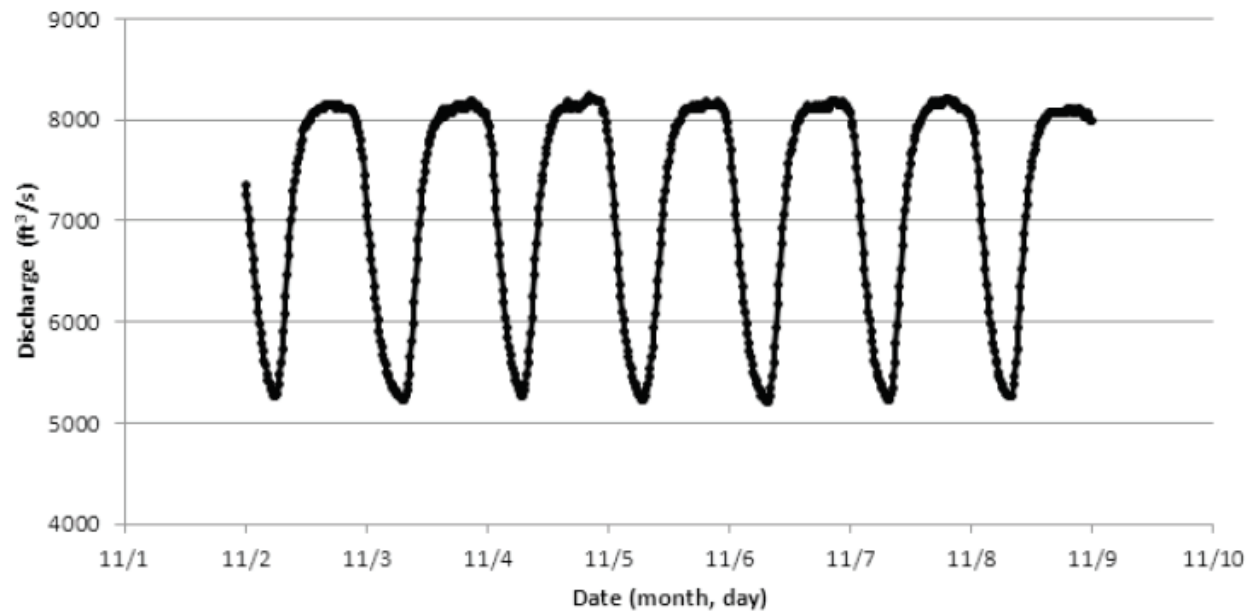


- Compete with native species



Ways streams become degraded

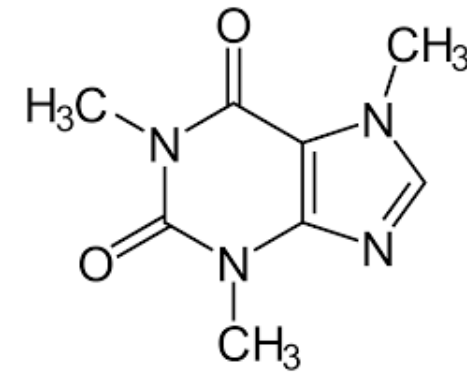
Dams



- Alter flow regime
- Alter temperature
- Trap sediments
- Block fish passage
- Create “lakes” upstream

Ways streams become degraded

Pharmaceuticals/Personal care products
Effects understudied



Caffeine

Ecoestrogens

- Compounds mimicking estrogen (Stahlschmidt-Allner et al. 1997)
- Can enter water from birth control pills
- 33% of smallmouth bass and 18% of largemouth bass were intersex in 111 US waterways (Hinck et al. 2009)
 - No museum specimens were intersex

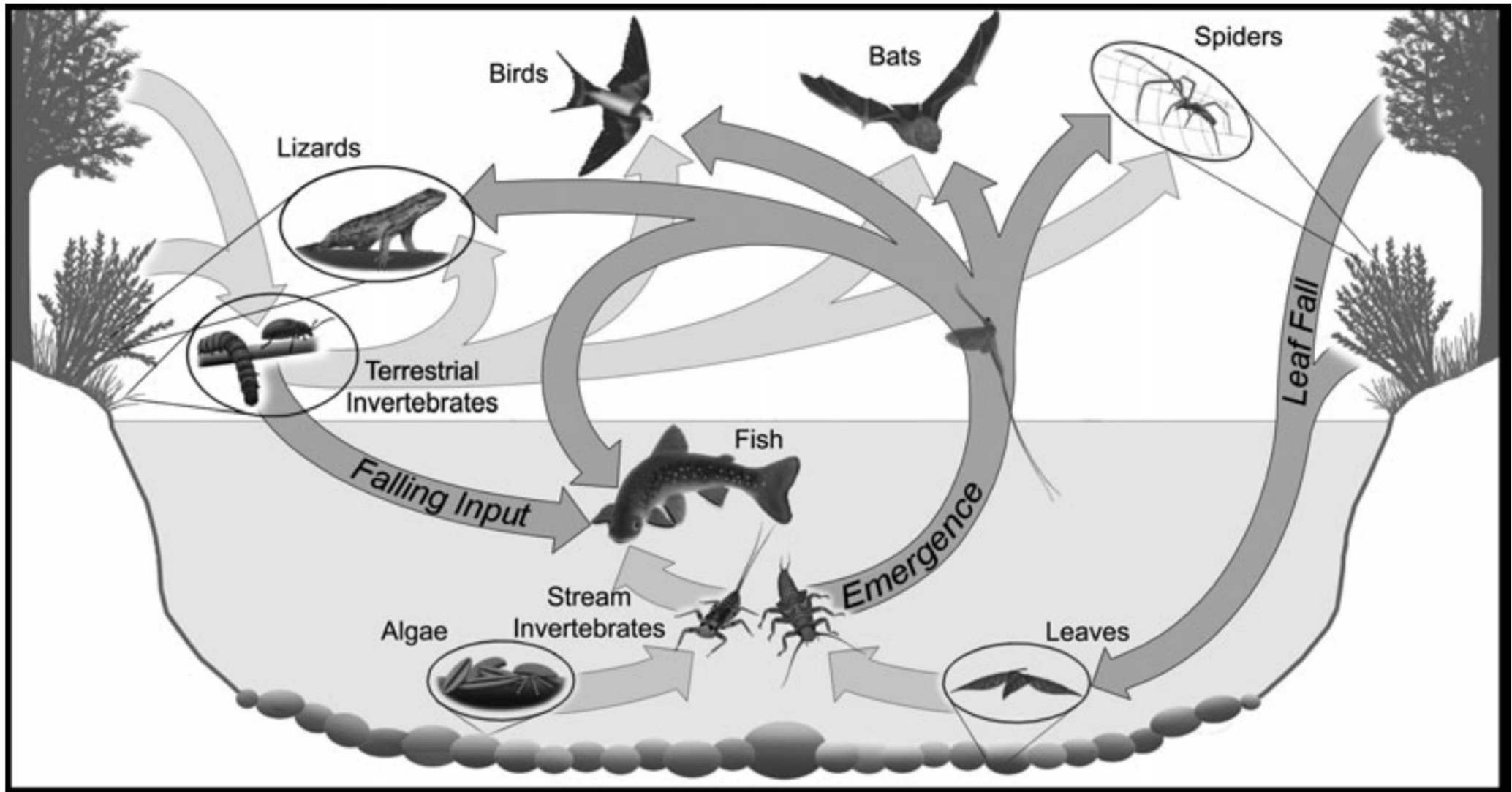
Indicator species

- Tell us if a stream is degraded
- Tell us if a stream has been restored



Why insects?

- Widespread, occur almost everywhere
- Easily collected
- Track changes in resources
- Diversity, allows for differences in water tolerance
- Food for everything



Baxter et al. 2005

EPT Taxa

Ephemeroptera
(Mayflies)



Plecoptera
(Stoneflies)



Trichoptera
(Caddisflies)



Gills



Species as Indicators

Group 1

Great Water Quality



Mayflies
Stoneflies
Caddisflies
Freshwater Mussels

Group 2

OK Water Quality



Dragonflies
Mayflies
Blackflies
Midges

Group 3

Poor Water Quality



Blackflies
Midges
Worms

Stream 1

1 midge species
1 blackfly species
No Fish Present



Stream 2



- 2 Caddisfly Species
- 1 Mayfly Species
- 1 Midge Species
- 1 Blackfly Species
- 1 Generalist Fish Species (Dace)

Stream 3



- 2 Caddisfly species
- 1 Stonefly species
- 2 Mayflies species
- 1 Midge species
- 1 Blackfly species
- 2 Dace (fish)
- 1 trout species

Structural vs Functional metrics

Structure – Who's there

Species

Biomass

Flow

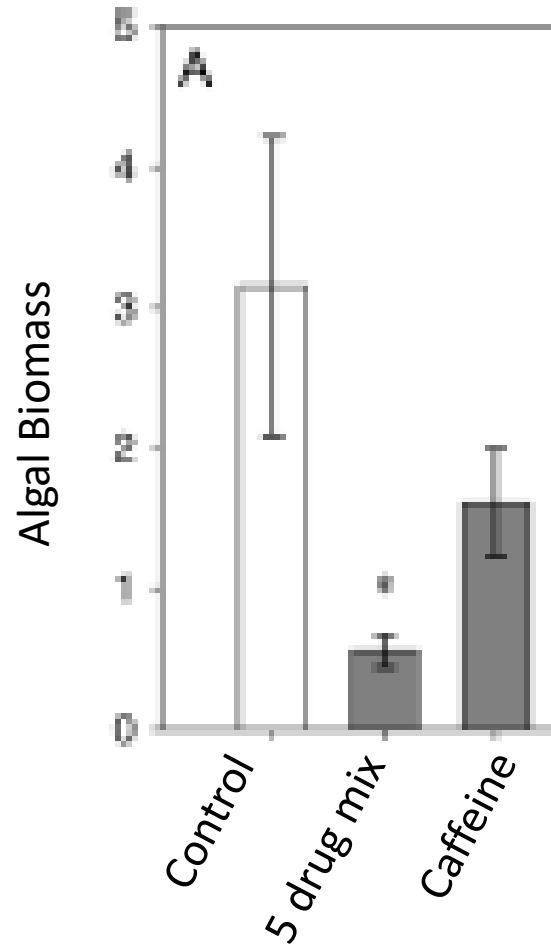
Water quality parameters

Function – Ecosystem processes (rates)

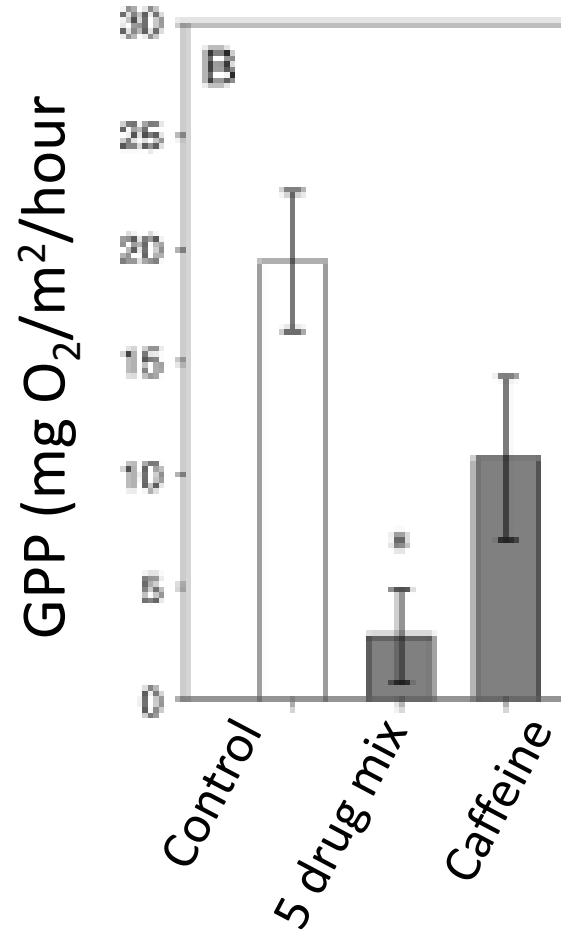
Stream metabolism (Gross Primary Production, Ecosystem Respiration, Net Ecosystem Production)

Decomposition

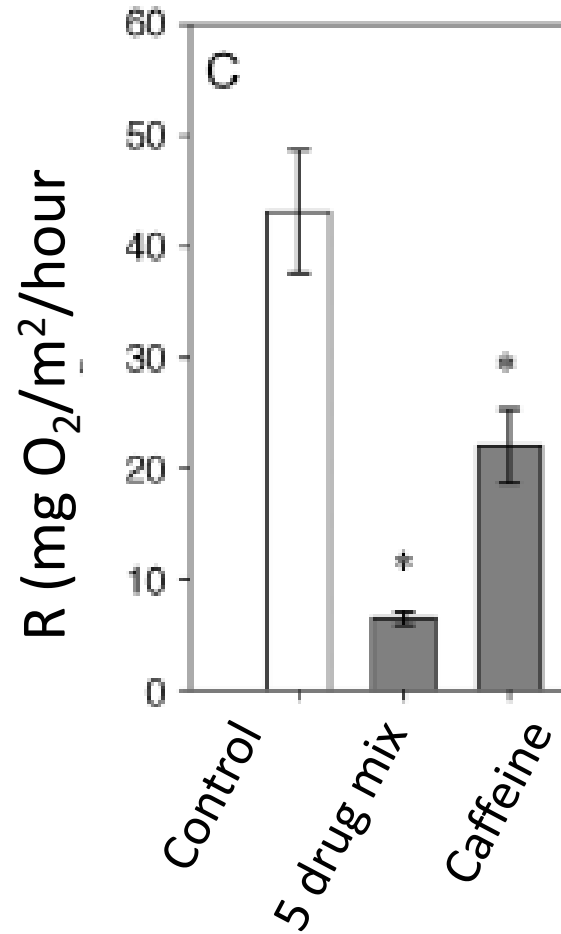
Caffeine reduces algal biomass



Caffeine reduces gross primary production



Caffeine reduces ecosystem respiration



Fossil Creek



- Water diverted for 100 years
- Non-native bass and sunfish

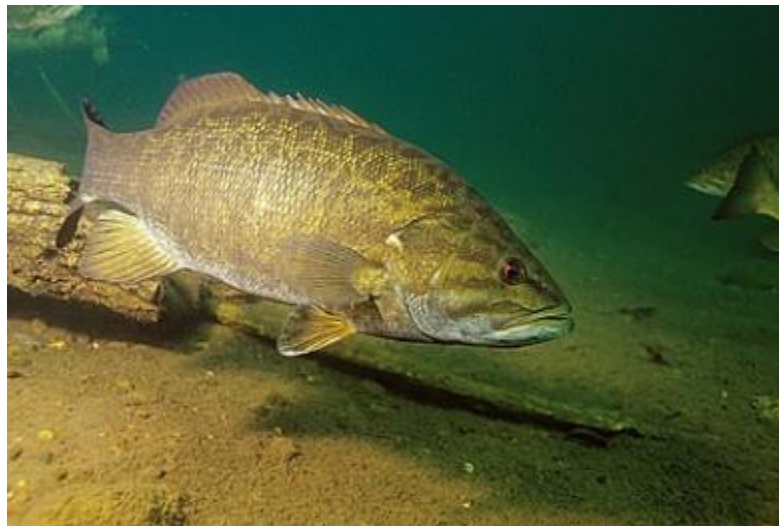
Fossil Creek



- Water diverted for 100 years
- Non-native bass and sunfish
- Removed native fish

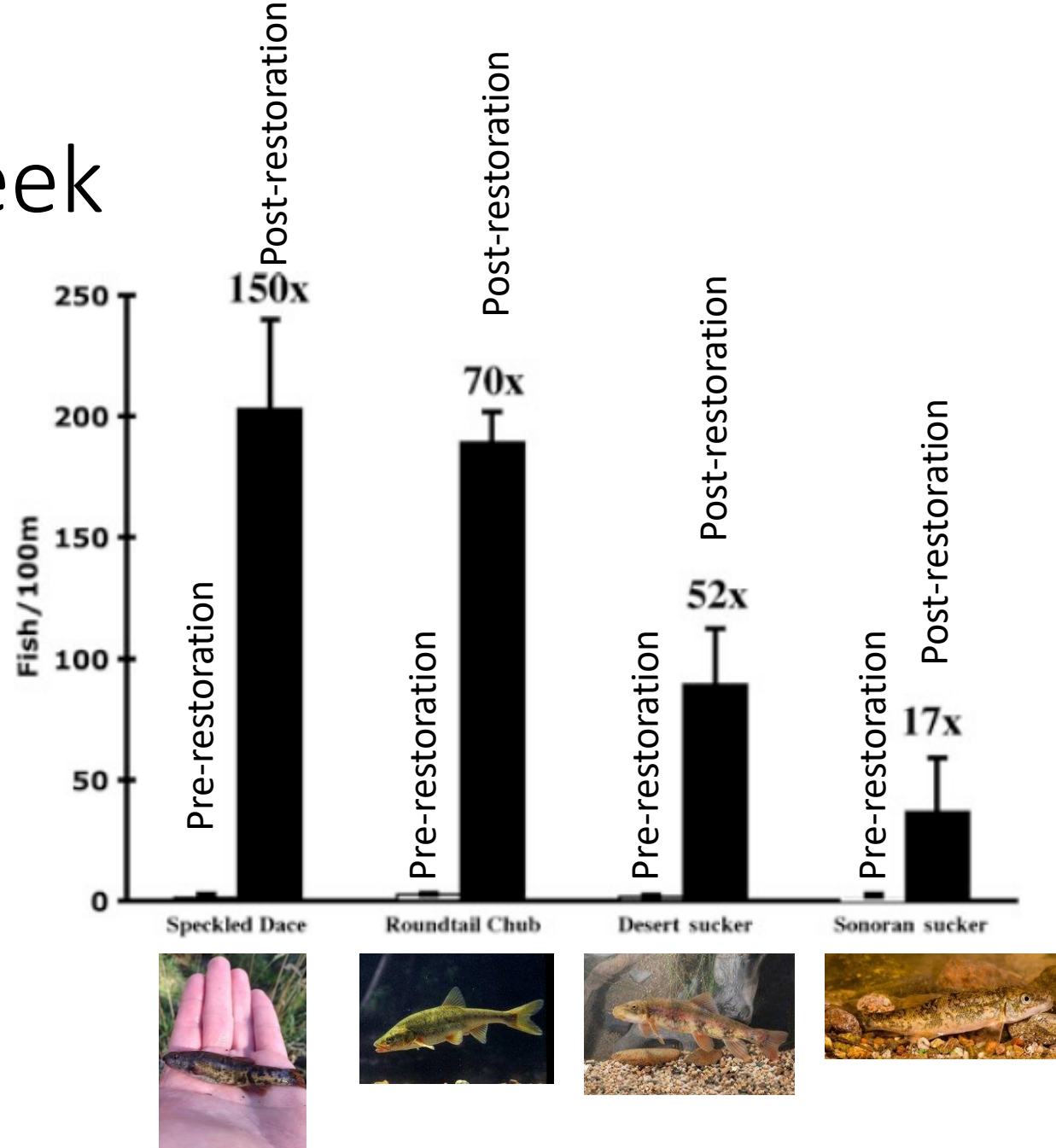


Fossil Creek



- Water diverted for 100 years
- Non-native bass and sunfish
- Removed native fish
- Poisoned the creek
- Constructed fish barrier
- Restored flow

Fossil Creek



Marks et al. 2009