

Status and future directions of the Devils Hole Pupfish



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Acknowledgments

- Death Valley National Park-National Park Service
- Ecological Services-US Fish and Wildlife Service
- Fisheries and Aquatic Conservation-US Fish and Wildlife
- Ash Meadows National Wildlife Refuge-US Fish and Wildlife
- Water Resources Division, Fisheries-National Park Service
- Fisheries Division-Nevada Department of Wildlife



Devils Hole pupfish

(overview)



- Species description
 - Location
 - Natural history
 - Conservation concern
- Current habitats
 - Conditions (natural and artificial)
- Update the abundance for 2017
 - Devils Hole (Death Valley National Park)
 - Fish Conservation Facility (USFWS)
- Future management

Location- Devils Hole



Devils Hole pupfish

Natural history and conservation



Cyprinodon diabolis; Wales 1930

- *Cyprinodon diabolis* (Cyprinodontidae)
 - Approximately 25 mm (TL)
 - Mature, < 3 months; Lifespan, 9-12 mo.)
 - Single natural habitat (~ 2 x 6 m)
- Conservation
 - Protected 1967 (USFWS)
 - Endangered Species Preservation Act
 - Documented history of management since 1970s
 - Species jointly managed by NPS, USFWS, NDOW
 - Symbol of aquatic conservation



Federal Protection

- Groundwater Pumping 1960-70s
- Landmark Supreme Court case
 - *Cappaert v. United States* 1976
 - Maintain water level in Devils Hole
 - Intensive management



Grapevine Springs (1972)



Devils Hole Conditions



- Submerged limestone cavern
- Warm! 33.5 – 34°C (93°F)
- Low dissolved oxygen: 2.5 – 3.0 mg/L
- pH: ~7.4
- Energy limited system
- Fluctuations over shelf

8.1 – 87 km SW of Pijijiapan, MX

7 Sept. 2017



8 Sept. 2017



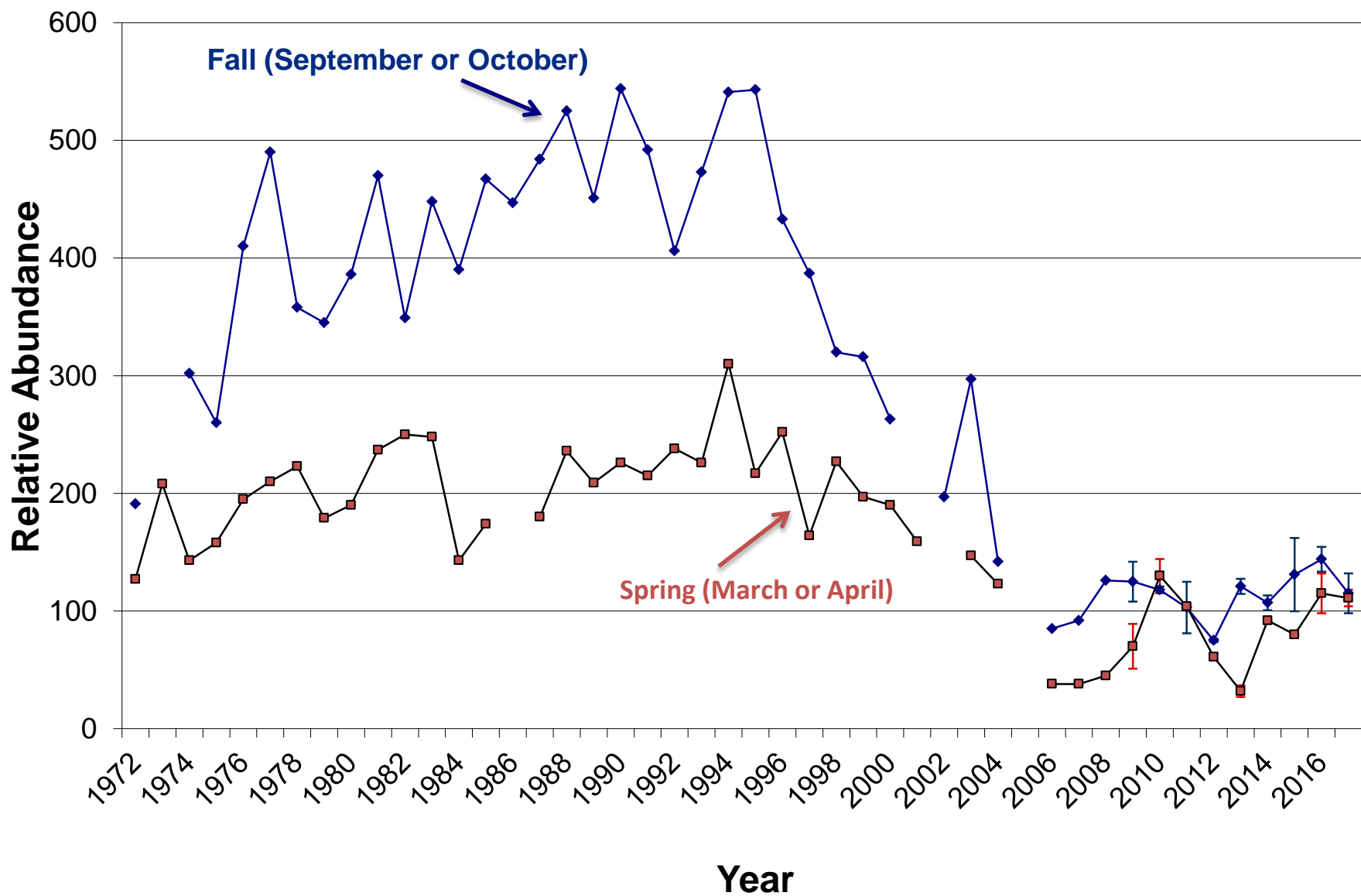
Devils Hole Pupfish Counts

- Fish estimated semi-annually since 1970s
 - Spring and fall
 - Direct count (avg. of first count on consecutive days)
 - Established protocol (4 levels + surface)
- 2017 Fall Count (September)
 - **115 fish**
 - 20% decrease from fall 2016

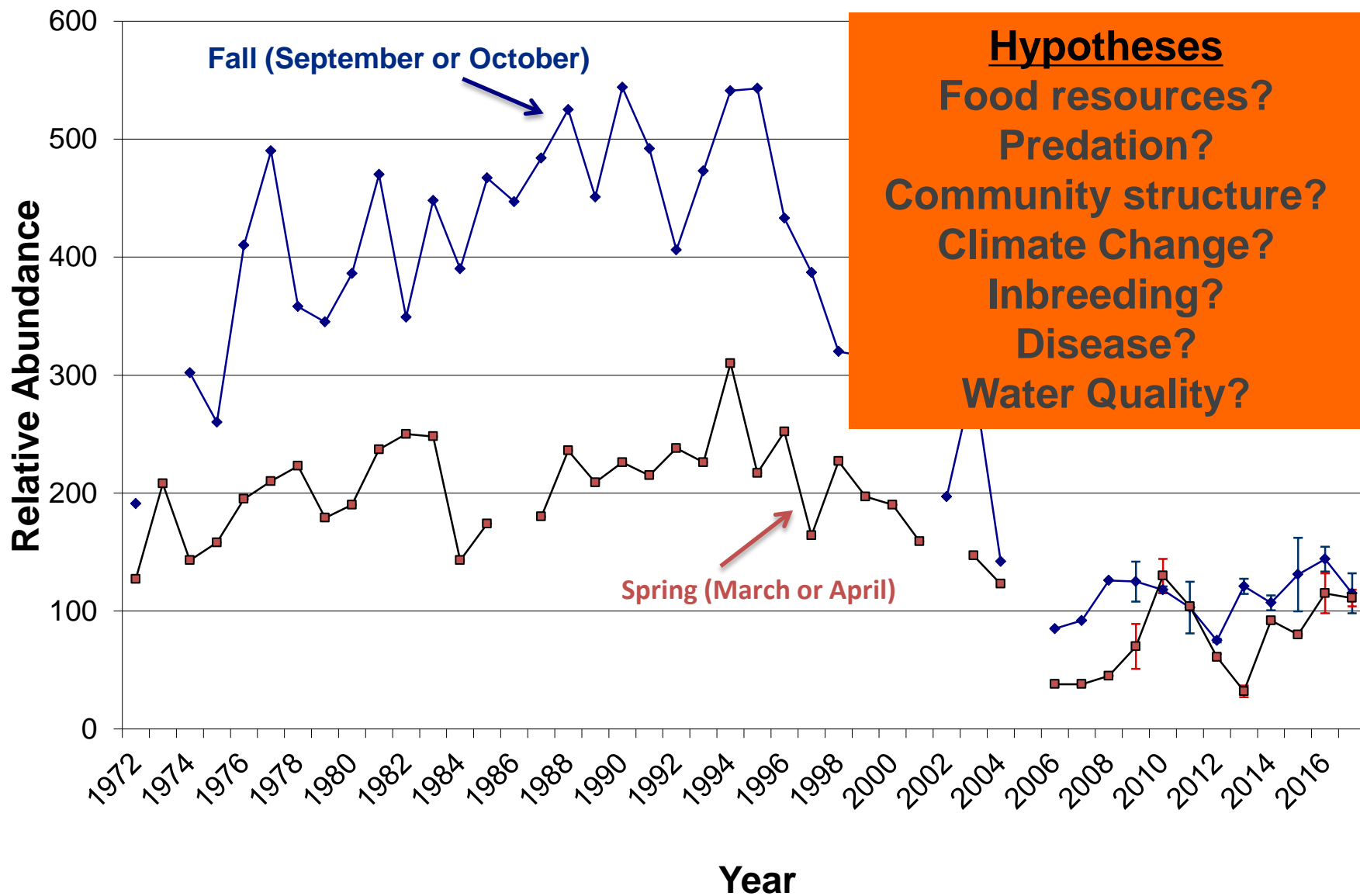
Lower, but not remarkable

- Relative to inter-annual variation
- Record lows of 38 (2006) and 35 (2013)

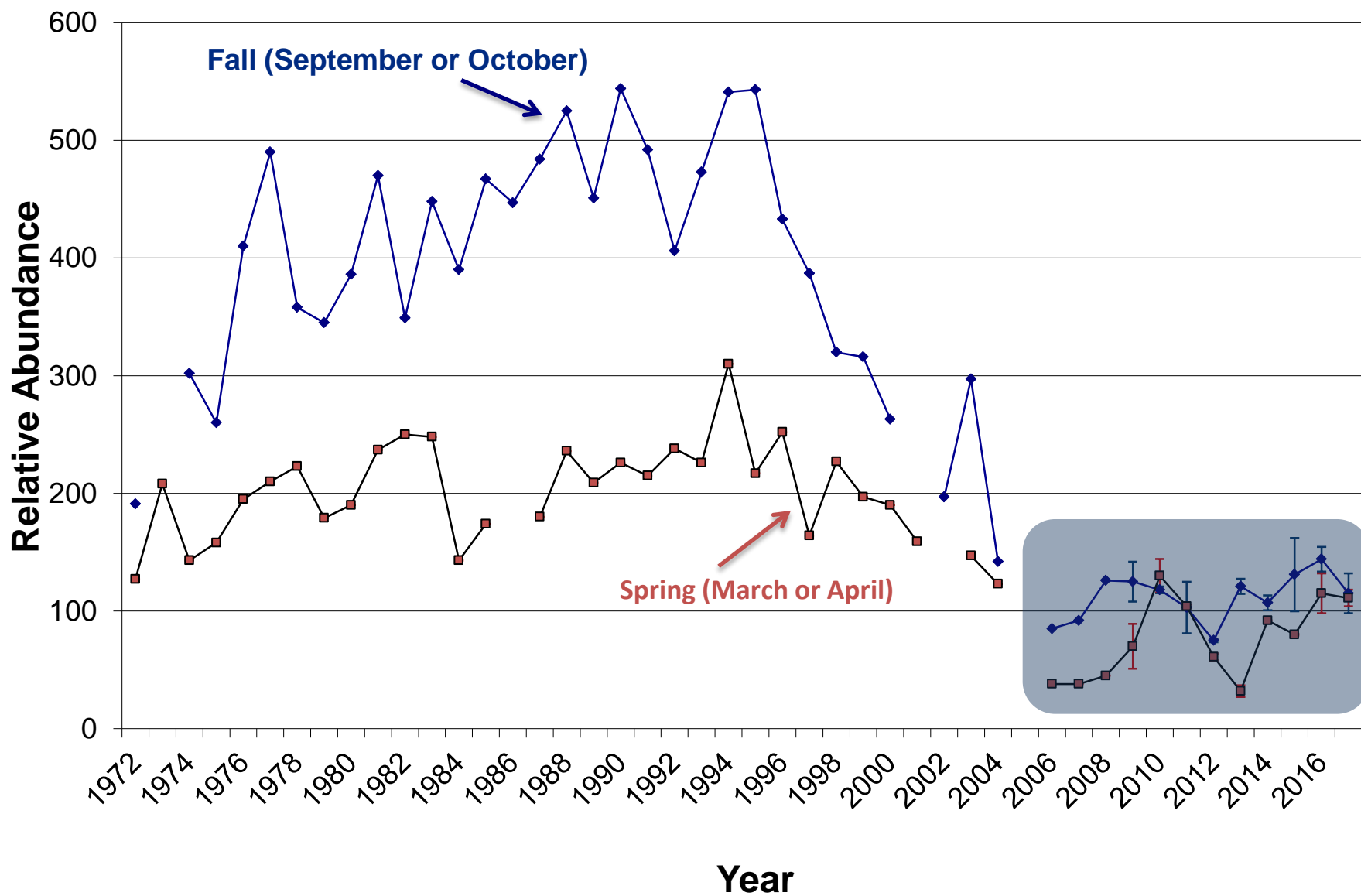
Devils Hole Pupfish Population



Devils Hole Pupfish Population



Devils Hole Pupfish Population



Past Artificial Refuge Populations



Hoover Dam
(1972)

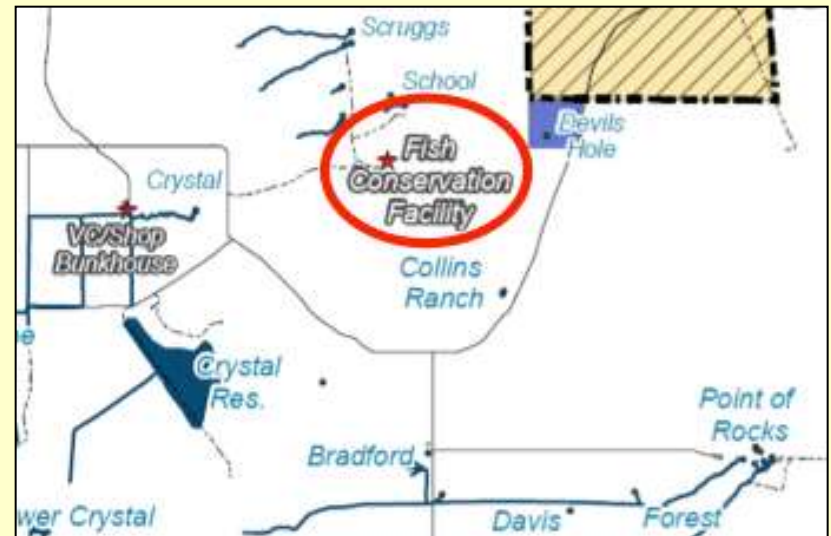


School Springs
(1980)



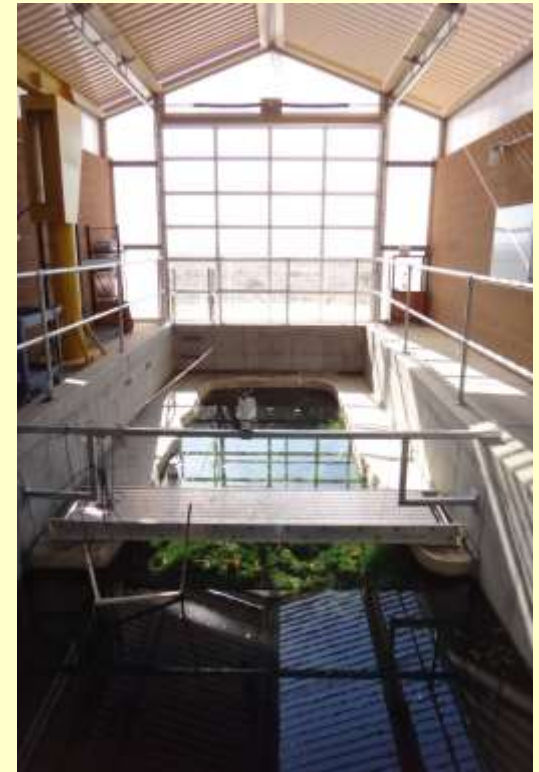
Point of Rocks
(1990)

Ash Meadows Fish Conservation Facility



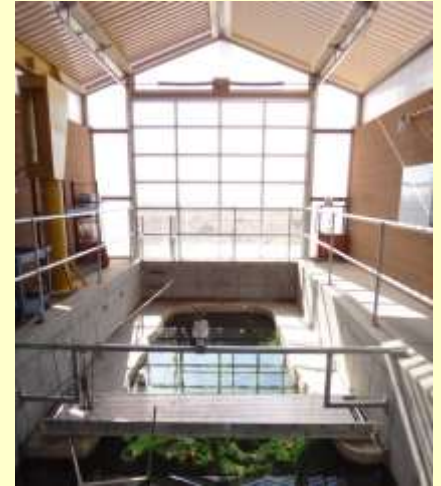
Ash Meadows Fish Conservation Facility (AMFCF)

- Indoor facility 2013
 - Aquaria for early life stage
 - 110,000 gal. Refuge Tank (RT)
 - replicate conditions from wild
- “Devils Hole light” conditions
 - Temperature: 2° ↓ than DH
 - Feeding 2-3x weekly
 - High protein > egg production
 - Antibiotic used > high survival
 - Grows fertilized eggs from DH
 - Released to RT as adults



2017 Abundance AMFCF

- 2017 Total Fish: **92 fish**
 - 85 Adult Fish Refuge Tank
 - 7 ongoing breeding experiment
- Refuge Tank (RT):
 - Reproduction? All life stages evident
 - Eggs to adults (F2 adults)
 - **Sampling reveals many non-viable eggs**
 - **Almost all animals in RT from Devils Hole**
- Husbandry success:
 - 50% eggs from Devils Hole viable
 - > 80% hatch and survive to 15 d
 - 80% of larvae to adults
 - Lifespan 2-3 yrs (vs. 9-12 mo. in Devils Hole)



Abundance of Devils Hole pupfish

- Devils Hole (wild) pupfish abundance at 115 animals
 - Relative stability at +/- 100 for 11 years (ex. 2013)
 - “Typical healthy looking fish”
- Refuge population abundance +/- 92 fish
 - Little evidence of substantial recruitment
 - Refuge Tank abundance due to lifespan in moderated conditions
- Abundance in Devils Hole post 2013 was not impacted by removing 0-10 eggs/month for the Refuge Tank

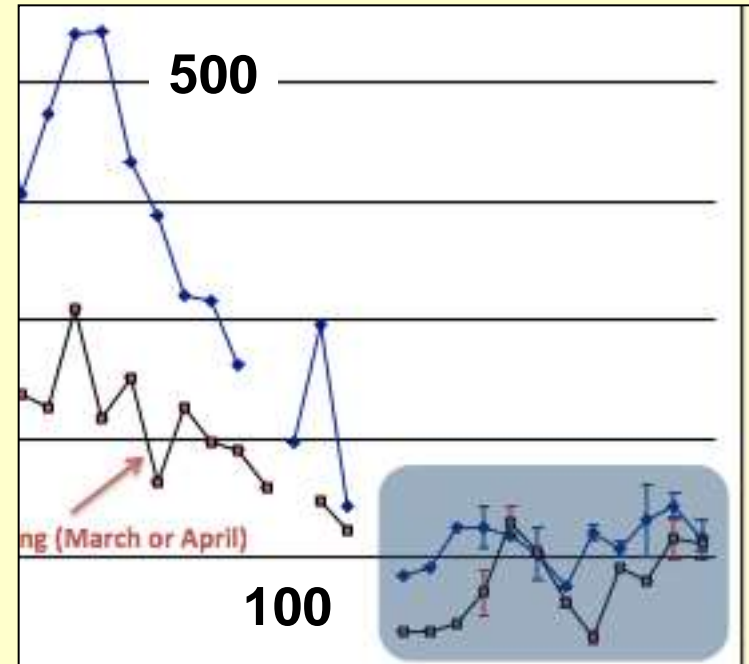
***How secure is the Devils Hole
pupfish?***

200, 400, 800...

One population, two population....

Future the Devils Hole pupfish?

- Low recruitment
 - DH (and very, very low RT)
- Period of stable is atypical
- Evaluate hypotheses
 - Dytiscids in RT
 - Ostracods in DH not historic
 - Predation by DHP
 - Synergistic effects
- Strategic planning
 - Develop contingencies
 - Increase research activities
 - Genetic diversity in RT vs DH



Hypotheses
Food resources?
Predation?
Community structure?
Climate Change?
Inbreeding?
Disease?
Water Quality?