# Native Fish Conservation & Climate Variability in Southeastern Arizona Doug Duncan and Gregg Garfin

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### **INTRODUCTION**

#### **FISH**

CLIMATE – Drought Climate change



#### INTERSECTION OF CLIMATE & FISH CONSERVATION

WHAT'S NEXT? Plan Protect Adapt Salvage Monitor Research

### **Native fish sites**

#### Unsuitable

- nonnative fish
- landowner resistance

#### Unusable

- sport fishing
- degraded water quality
- other rare aquatic vertebrates



### **FISH STATUS**

- 21 species in southeastern Arizona
- 16 still occur in the area
- 4 are extirpated
- 1 is extinct

- 13 species listed under the Endangered Species Act
  - –9 are listed as endangered
  - –4 as threatened



### **OTHER NATIVE AQUATIC SPECIES**

- 3 ranid frogs
  - lowland leopard
  - -Chiricahua leopard
  - Tarahumara
- 1 salamander
- several garter snake species

### THREATS

- nonindigenous species
- habitat loss



- reduction in habitat quality
  - Habitat destruction and the introduction of nonindigenous species are responsible for the decline of 98% of North American fishes listed as endangered, threatened, or of special concern

## DROUGHT & CLIMATE CHANGE





### DROUGHT

 Meteorological drought: -the departure of precipitation from the norm -the duration of the dry period –hydrological –agricultural

 seasonal predictions, for 3-month seasons, 2 weeks in advance

 predictions based on statistical & dynamical climate models & insights from past climate

 science does not support multi-year or decadal drought predictions

 instrumental & paleoclimate records indicate the SW has a history of multi-year and multi-decadal drought

- multi-decadal drought is controlled by Pacific Ocean-atmosphere interactions, which effect winter precipitation
- persistent Atlantic Ocean circulation is theorized to have a role in multi-decadal drought in the Southwest- particularly summer precipitation
- Given multi-decade "regimes" of ocean circulation, and the severity and persistence of the present multi-year drought, there is a fair likelihood that this drought will persist for many more years



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

#### http://drought.unl.edu/dm

Released Thursday, April 5, 2007 Author: Thomas Heddinghaus, CPC/NOAA **Figure 4b.** Arizona long-term drought status for February 2007.



Source: CLIMAS & NRCS

### **CLIMATE CHANGE**

- climate change scenarios are less certain than drought
- virtually all climate change scenarios predict that the American southwest will get warmer during the 21st century
- precipitation predictions show a greater range of possibilities, depending on the model and emissions scenario
- to maintain the present water balance with warmer temperatures, precipitation will need to increase to keep pace with increased evaporation & transpiration

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## **KEY PROJECTIONS:**

- θ decreased snowpack > rain vs. snow, snowpack accumulation could be shorter, & snowpacks could be smaller
  - θ ironically, due to changes in snow-precipitation characteristics, runoff may decrease even if total precipitation increases
- θ <u>earlier snowmelt</u> > minimum winter & spring temperatures could melt snowpacks sooner, causing peak water flows to occur much sooner than the historical spring & summer peaks
- θ enhanced hydrologic cycle in a warmer world an enhanced hydrologic cycle is expected; flood extremes could be more common causing larger floods; droughts may be more intense, frequent, & longer-lasting

### **KEY PROJECTIONS:**

# θ Precipitation: is likely to change in amount and seasonality

#### θ Runoff: probably will be less

#### θ Less water for in streams -



### **IMPACTS**

- Drought and climate change will:
  - impact watersheds
  - will impact how ecosystems and watersheds function
  - these changes will cause a cascade of ecosystem changes
    - be hard to predict
    - are likely to occur non-linearly
    - Interrelated and interdependent



SYR - FIGURE 8-1



#### INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

IPCC

### INTERSECTION OF CLIMATE & FISH

- drought & climate change, plus historical & continuing threats, will make native fish conservation in SE AZ even more difficult
- The impact of site desiccation is obvious
  - Less obvious effects can occur with drought & a warmer climate. Sites with reduced streamflow, or ponds or pools with low water could become fishless from reduced DO
- We have seen this occur at important natural Gila topminnow sites









DATE 1/ -03 -05 STREAM -05 Cience Creck above SECTION OF STTE NO Generation Canyon NOTES

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- Complete and implement fish salvage protocol
- Important fish populations should be replicated

-Genetic information crucial in determining important populations



 agencies should begin work on identifying & creating potential replication sites

 captive and wild

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- research on specific impacts of climate variability in southeastern Arizona

### **FINALLY**

- uncertainty requires flexibility & adaptive management
  - agencies do not have a good track record of effectively implementing adaptive management, but the conservation of native fish and other aquatic vertebrates requires it

# **QUESTIONS?**



## **For additional information**

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