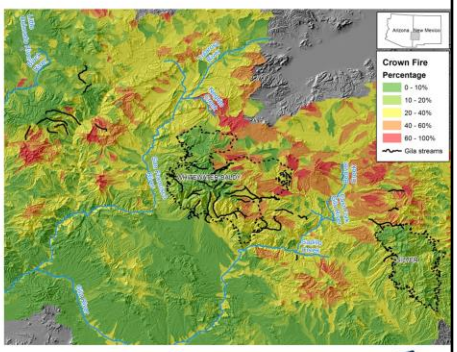
Integrating Wildfire Resiliency and Thermal Refugia into Climate Smart Conservation for Native Trout in the Southwest



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NFWF

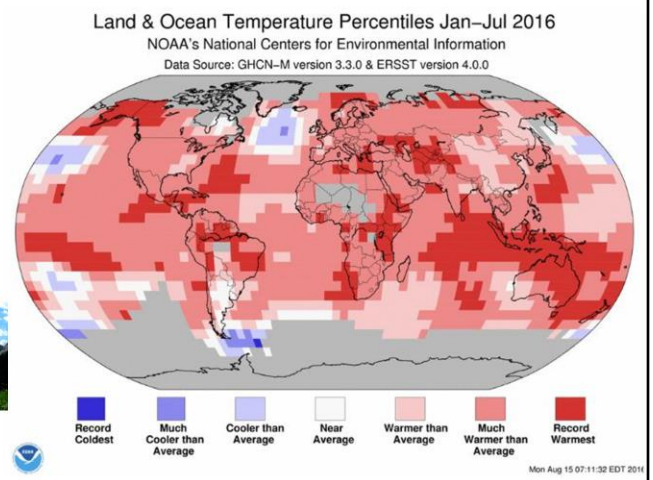
TROUT UNLIMITED

Wild Trout XII Symposium, 28 September 2017
West Yellowstone, Montana

Our Climate

- Sound like a broken record?

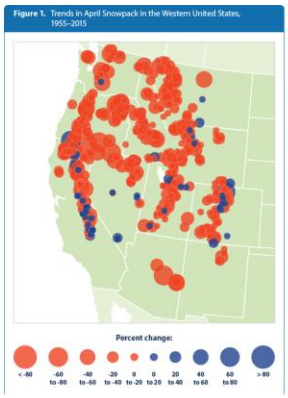
Glacier National Park, MT



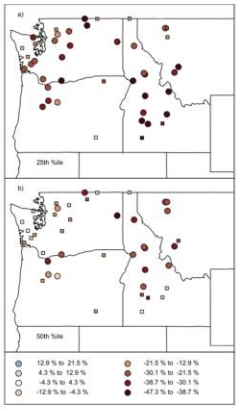
Our climate is warming. 2015 and 2016 were the hottest years on record. And we repeatedly hear that temperature records are being broken. It's starting to sound like a broken record.

Snowpack, Streamflows, Wildfires

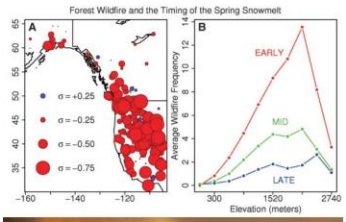
- Drier, lower, and more catastrophic



Mote and Sharp 2015 Bull.Am.Met.Soc.



Luce and Holden 2009 Geo. Phys. Let.

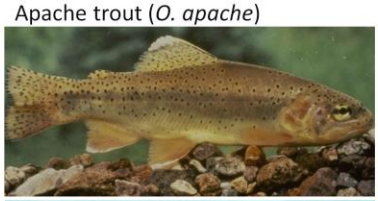


Westerling et al. 2006 Science

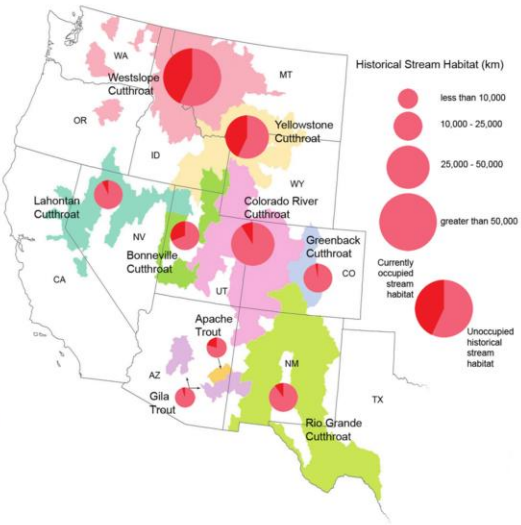
In the western US, this has meant that our snowpack is melting earlier (red circles indicate negative April snowpack trends), streamflows during the driest years are getting lower, and that our forests are drying out earlier leading to increased frequency of catastrophic wildfires.

Southwestern Trout

Apache trout (*O. apache*)



Gila trout (*O. gilae*)



Haak and Williams 2013 J. Cons. Planning

Our western native trout live in these habitats, and most of them occupy only a fraction of their historical range. This includes those with small historical ranges, like the Apache trout and Gila trout.

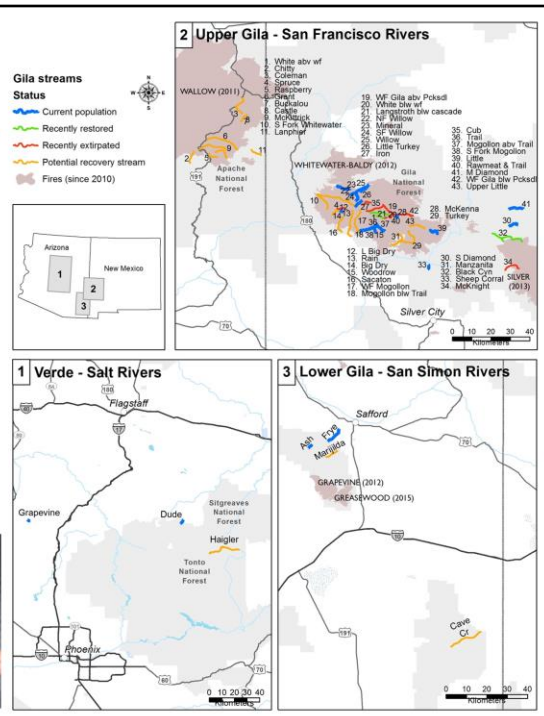
Objectives

1. Wildfire history in range of SW trout
2. Least vulnerable Gila trout streams
   - Wildfire, Temperature

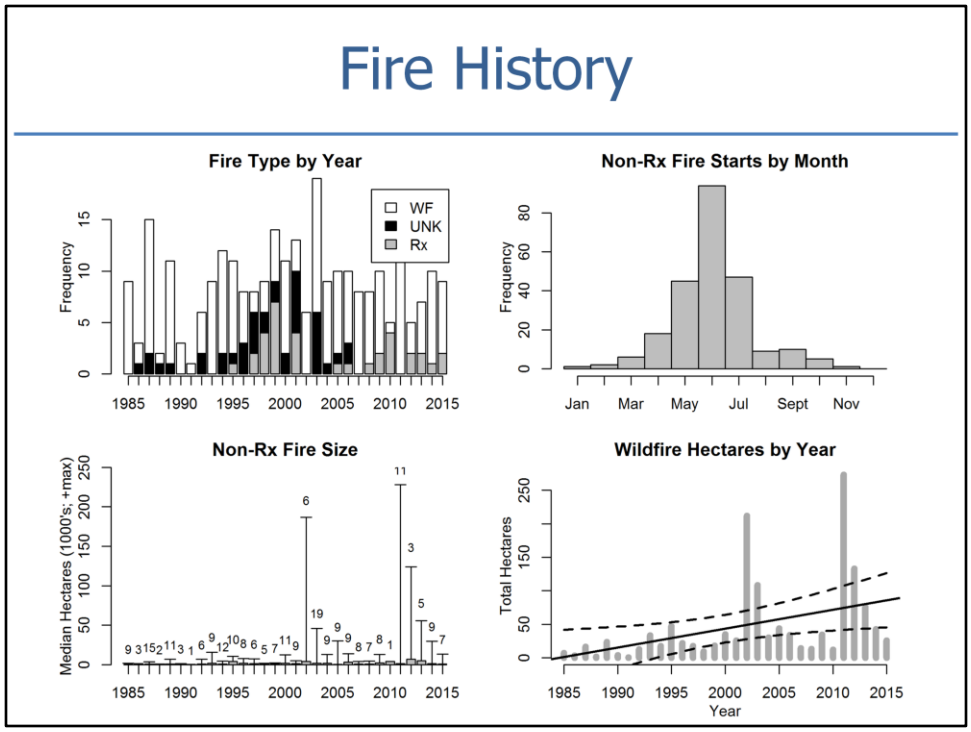
Our objectives were to evaluate specifically wildfire trends in the historical range of Apache and Gila trout, Gila trout range encompasses the Apache trout range in the Salt River, and evaluate the vulneratibility of Gila trout to future wildfires and stream temperatures.

Gila trout

- 57 streams
- 14 extant pops
- 3 recently restored
- 25 recovery streams



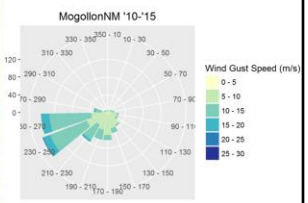
We evaluated 57 Gila trout streams, including the core in the Upper Gila R, as well as the lower Gila (Mt. Graham), and Verde and Salt R.



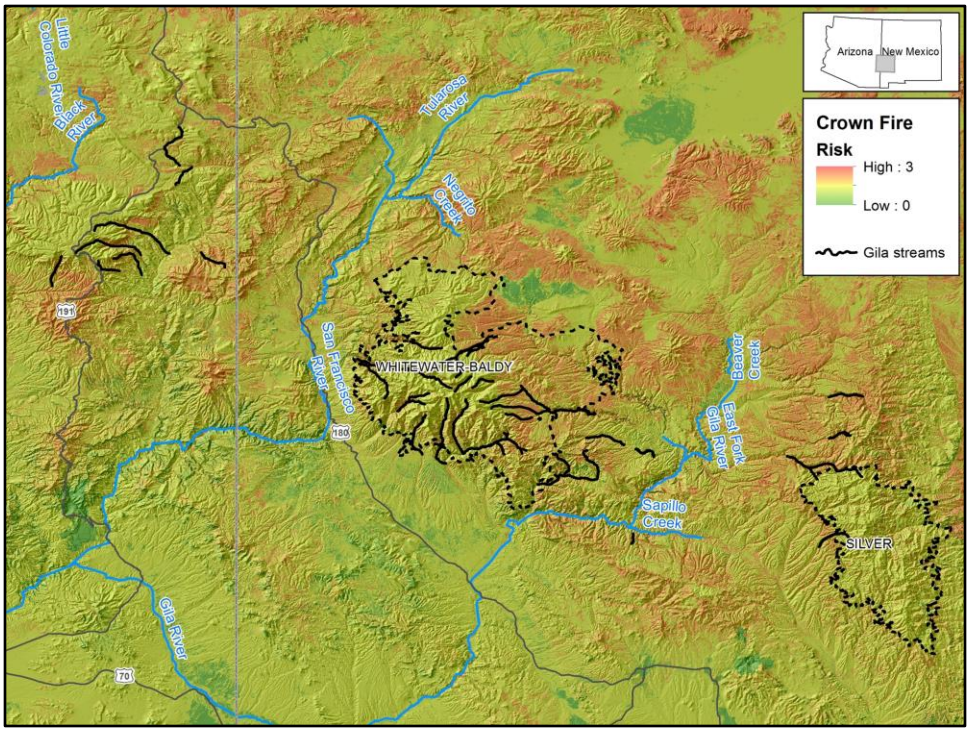
Variable number of fires in Gila and Apache range since 1985, including Rx fires. Most fires start in May to July at hottest time of year and beginning on summer monsoon season. Median fire size has increased slightly, but large catastrophic fires have increased (Wallow, Whitewater-Baldy). Total acres burned is increasing since 1985.

Crown Fire and Debris Flows

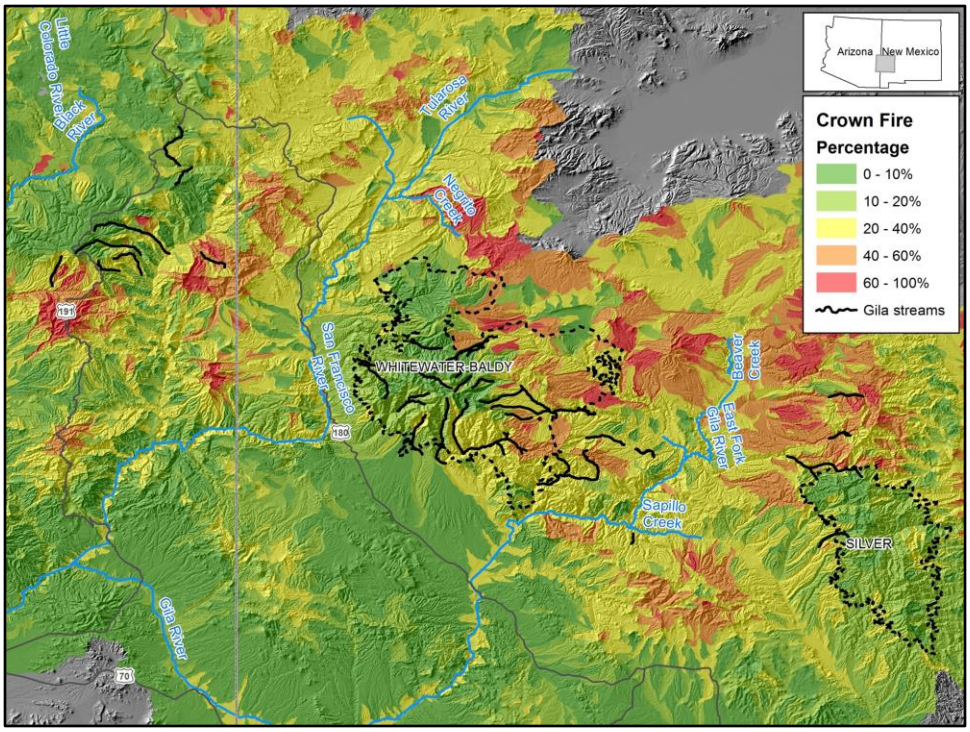
- FlamMap
- Topography
  - Wind routing
  - Wind speed
  - RAWS
- Vegetation
  - Fuel moisture



We know that wildfires can affect fish in streams by superheating water and changing water chemistry due to ash flows, wildfire can also trigger debris flows that can re-arrange stream channels. All of these are influenced by fire severity.



…Outputs spatially explicit estimates of crown fire severity (30-m) for the landscape. Red is the highest risk, followed by orange as moderate.



Summarized crown fire risk using NHD+ hydrography, a common spatial framework for aquatic systems. This map shows the percentage of a catchment that is moderate-to-high risk. Black lines are the Gila trout streams. Dotted black lines are recent fires: Whitewater-Baldy and Silver (2011, and 2013). You can see how our fire risk predictions account for past burns in the western portion of the WWB perimeters. There is low fire risk in areas that burned the hottest during that fire.

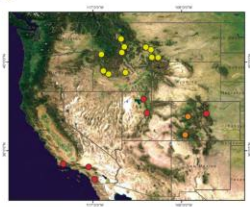
Debris Flow Probability

Predicting the probability and volume of postwildfire debris flows in the intermountain western United States

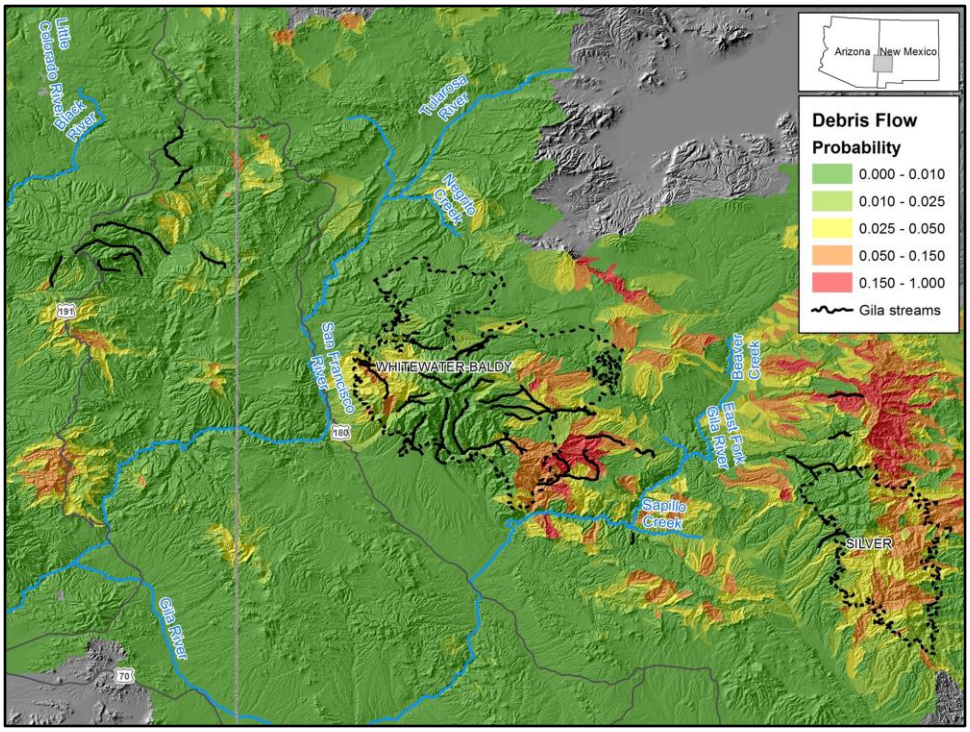
Susan H. Cannon[1,2], Joseph E. Gartner[1], Michael G. Rupert[3], John A. Michael[3], Alan H. Rea[1], and Charles Parrett[4]
[1]U.S. Geological Survey, Box 25046, Denver Federal Center, MS 966, Denver, Colorado 80225, USA
[2]U.S. Geological Survey, 201 East 9th Street, Pueblo, Colorado 81003, USA
[3]U.S. Geological Survey, 230 Collins Road, Boise, Idaho 83702, USA
[4]U.S. Geological Survey, Placer Hall, 800 J Street, Sacramento, California 95819, USA

GSA Bulletin 2010

- >30% slope
- Mod-high burn severity
- Rainfall intensity (mm/h)
- Clay content
- Liquid limit



Fire severity influences debris flow likelihood. Can use fire risk inputs in this model to predict probability of debris flow, along with rainfall intensity and important soil characteristics that reflect infiltration and water holding capacity. Inset map shows locations of data used to fit models in Cannon et al. 2010.

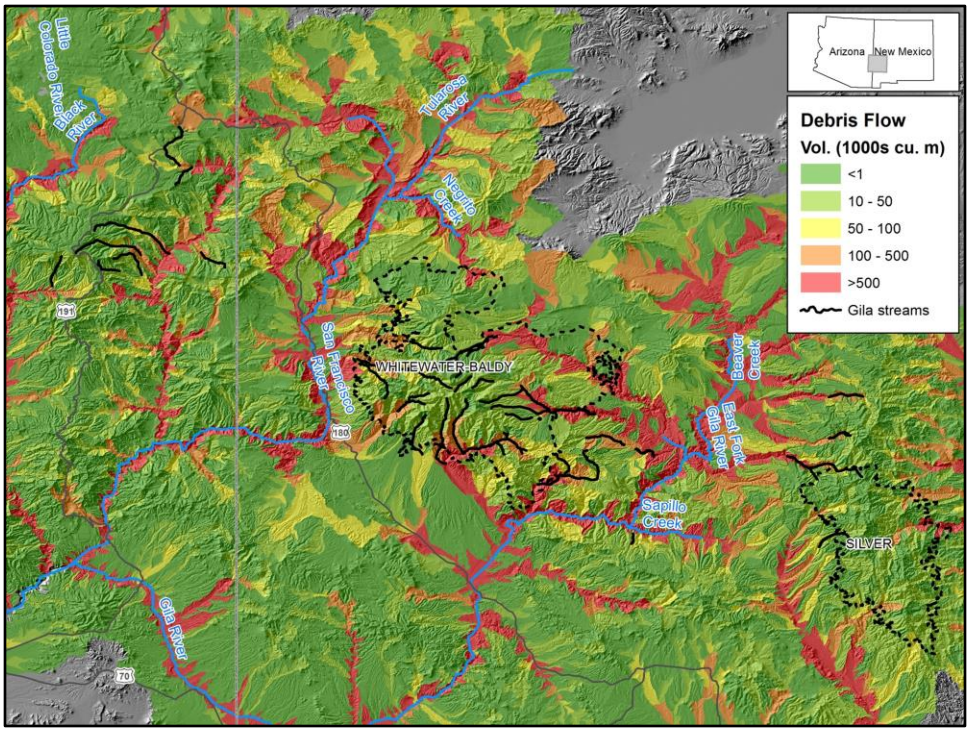


If we take our fire risk predictions and plug them in to the debris flow risk models, this map shows the probability of a debris flow occurring given crown fire risk. Note that we see spatial variation, but overall probabilities are low. This is a question model transferability. Given what we've observed, the debris flow probabilities are likely lower than they should be, but the spatial variation is still usefull in a relative sense.

Debris Flow Volume

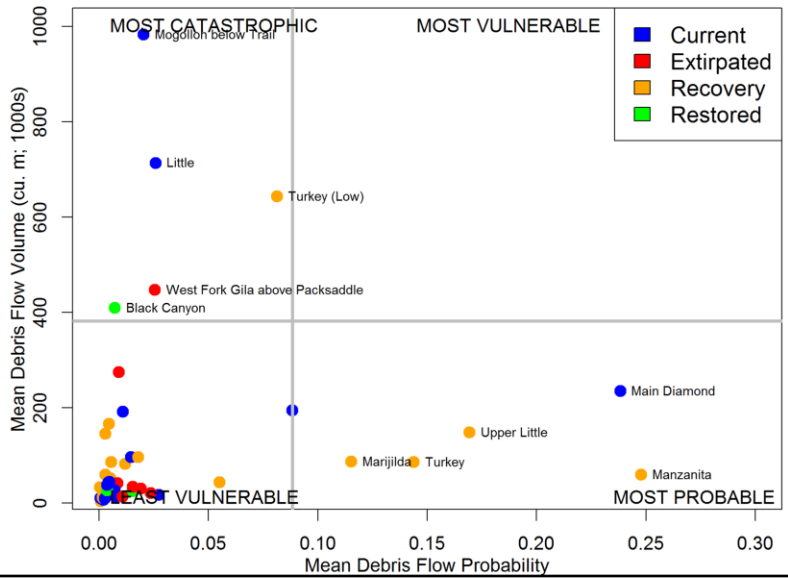
- Basin area (km^2)
- % mod-high burn severity
- Total rainfall (mm)

They also developed models of debris flow volume should a debris flow occur. Basin size, % mod-high burn severity, and total rainfall.



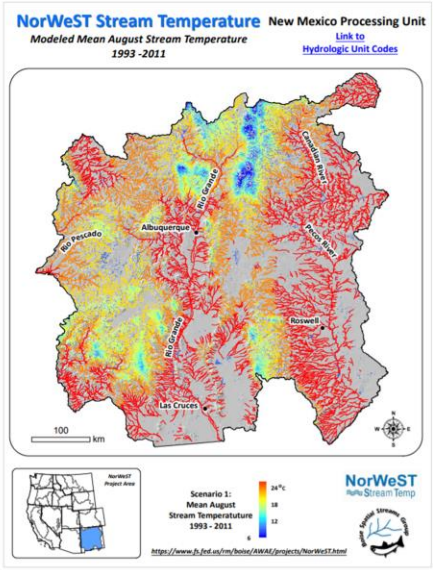
Spatial predictions on NHD+ catchments. Higher volume in larger streams, but also spatial variation in small systems.

Debris Flow Vulnerability



Temperature Vulnerability

- NorWeST (2080s)
- Minimum °C
- Habitat <18.5°C
  - 18.5 = 95th percentile



Also evaluated risk to future temperatures using NorWeST stream temperatures models. Two metrics: minimum 2080s mean August C within stream, and extent of habitat below 18.5C threshold in 2080s. 18.5C is the 95th percentile of mean August C within extant populations of Gila trout.

Temperature Vulnerability

- NorWeST
- Minimum °C
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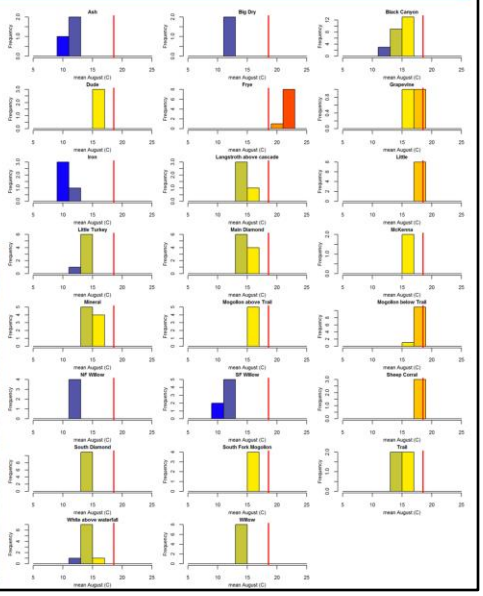
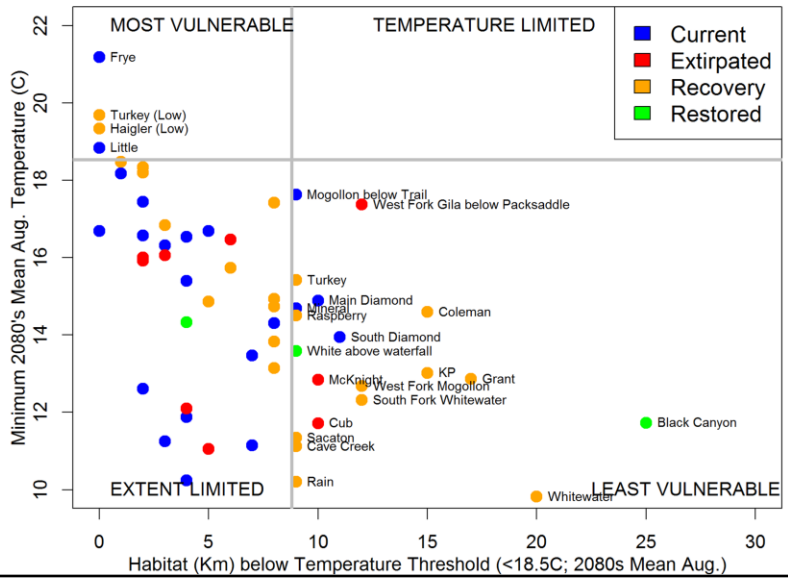


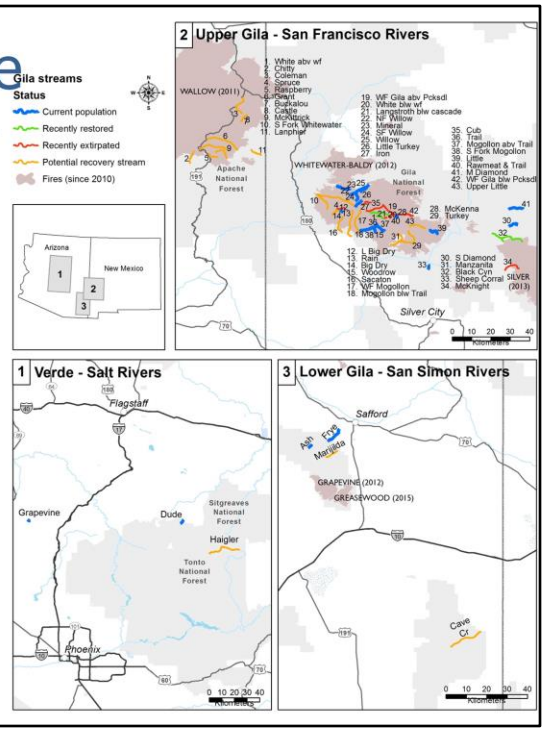
Summarize by Gila trout streams. Vertical red line is the 18.5C reference. Some streams well below, some are completely above temperatures currently occupied by Gila trout.

Temperature Vulnerability



Least Vulnerable

- Extant
  - Little Turkey
  - NF & SF Willow
- Restored
  - White R
- Extirpated
  - Cub, Whiskey
- Recovery
  - Coleman, Grant



Application

- Accounts for past fires (Whitewater-Baldy)
- Low debris flow probabilities
  - Still relative
- Sense of climate risk:
  - Recovery planning
  - Decision support tools


(Technical Review Draft, April 2002)

GILA TROUT (Oncorhynchus gilae)

(Third Revision)

RECOVERY PLAN

(Original Approved: January 12, 1979)
(First Revision Approved: January 5, 1984)
(Second Revision Approved: December 8, 1993)

Prepared by John Pitenger (Purchase Order 2018196251)

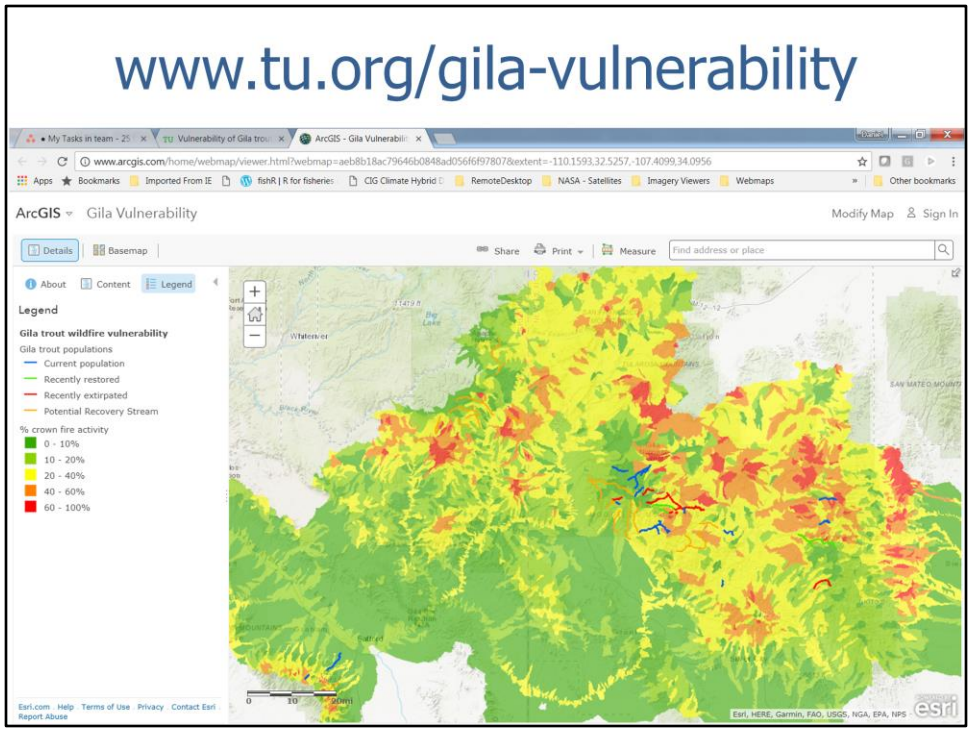
for

Region 2
U.S. Fish and Wildlife Service
Albuquerque, New Mexico

Approved: _____
Regional Director, U.S. Fish and Wildlife Service

Date: _____

Our model, through vegetation, accounts for past fire history. Low fire risk in recently burned areas, suggest that they may be safe after channels stabilize from past fires. Debris flow probabilities seem low, which may be a model transferability problem. However, there is still spatial resolution that seems reasonable. All this is simply information that informs the broader recovery planning process. Can be used informally, or formally in a decision support tool as has been done for bull trout (Falke et al. CJFAS).



Data are made available via a webmap, so if we missed dome 'recovery' streams, you can zoom around and look at fire and temperature values for specific watersheds and stream segments.


Questions?
W. Fk. Gila R. (J. Brooks)