United States Department of Agriculture
Forest Service

Rocky Mountain Research Station

Air, Water, and Aquatic Environments Program

Providing scientific knowledge and technology to sustain our nation's forests, rangelands, and grasslands

Science BRIEFING

January 7, 2014

Climate Change and Wildfires: Effects on Stream Temperatures & Thermal Habitat

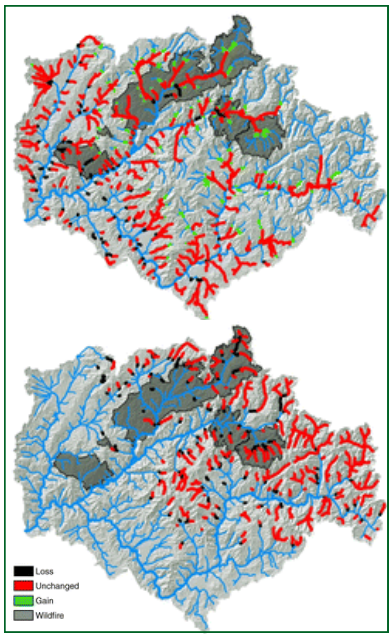
BACKGROUND

Temperature has an important influence on the distribution and abundance of stream organisms. A warming climate is expected to increase stream temperatures, but documentation of such increases is rare and usually limited to trend monitoring at only a few sites. Broader understanding of climate effects on thermal characteristics of streams is needed to inform management strategies, but developing this understanding requires modeling techniques that provide valid interpolations between temperature measurement sites. Widespread use of digital temperature loggers provides abundant data in many places that may facilitate development of broad stream temperature models.

RESEARCH

Research Activity: A large stream temperature database (n = 780) spanning the period from 1993–2006 was compiled from several natural resource agencies within the Boise River basin in central Idaho. A temperature model based on new statistical techniques for stream networks was developed using these data that explained 93% of the variation in mean summer temperatures (average prediction error = 0.74°C) during this period. The model was used to describe how recent wildfires and trends of increasing air temperatures and decreasing summer flows affected stream temperatures and fish habitats across the Boise River basin.

Benefits to Resource Managers: These results suggest a warming climate has begun to affect thermal conditions in the Boise River network and that impacts may be both species and context specific. Where key habitats appear to be at risk, decisions regarding conservation actions should account for local restoration opportunities and potential for future climatic effects. Broader application of similar temperature analyses could also be an important component of regional prioritization schemes for USFS lands.



Changes in thermally suitable habitat for rainbow trout (top) and bull trout (bottom) from 1993- 2006 due to stream temperature increases associated with climate trends and recent wildfires.

KEY FINDINGS

- Stream temperatures and climate change effects can be modeled over entire stream networks (e.g., 2,500 km river network of the Boise basin) using existing temperature databases in combination with new spatial statistical models.
- Mean summer stream temperatures increased by 0.38°C from 1993-2006.
- Warming rates and effects on thermal habitat varied spatially and affected species differently.
- The total length of thermal habitat for rainbow trout was minimally affected by temperature increases, except for small shifts towards higher elevations.
- Bull trout were estimated to have lost 11-20% of the headwater stream lengths that were cold enough for spawning and early juvenile rearing.

MORE INFORMATION

The Stream Temperature Modeling and Monitoring website (www.fs.usda.gov/rm/boise/AWAE/projects/stream_temperature.shtml) provides links to stream temperature resources. For more information, please contact **Dan Isaak**, USFS Research Fishery Biologist, (208)373-4385 or disaak@fs.fed.us.

Keywords: *stream temperature modeling, thermal regime, climate change, aquatic habitat, wildfire*

 Science Briefings can be found: http://www.fs.usda.gov/rm/boise/AWAE_home.shtml