

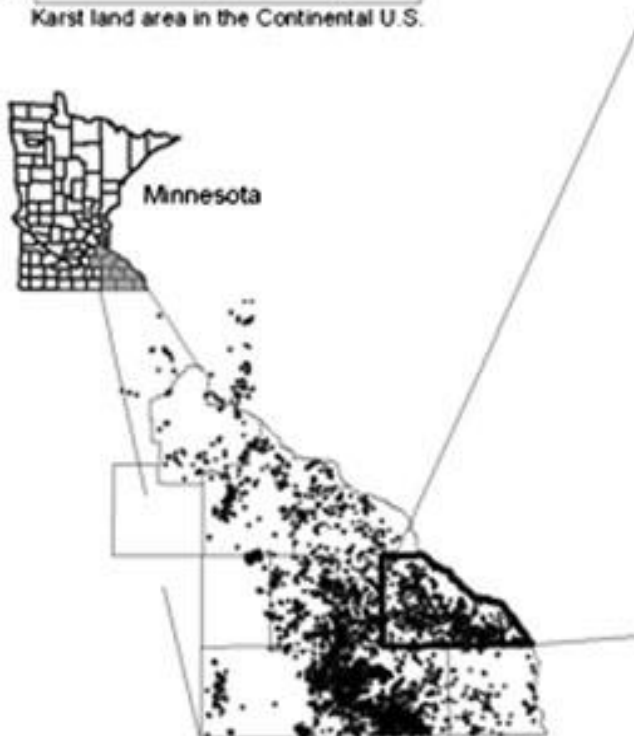
# The impacts of climate change on groundwater-fed streams in the Driftless Ecoregion of southeastern Minnesota



Jennifer Cochran-Biederman, PhD  
Biology Department  
Winona State University

Challenge #1: Coldwater streams are heating up.





**Karst Features in southeast Minnesota**

- Spring
- ▲ Stream Sink / Sieve
- ✦ Sinkhole

# Why temperature matters

- FOOD DEMANDS

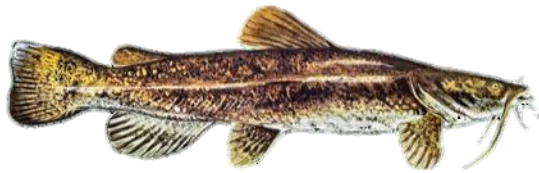
trout eat the most between 6.8 and 19.3 degrees C, and consumption increases with temperature

- METABOLISM

fish growth is regulated by water temperature

- PREY (AQUATIC INVERTEBRATES)

temperature regulates survival, reproduction and emergences



Water temperature (°C)



July

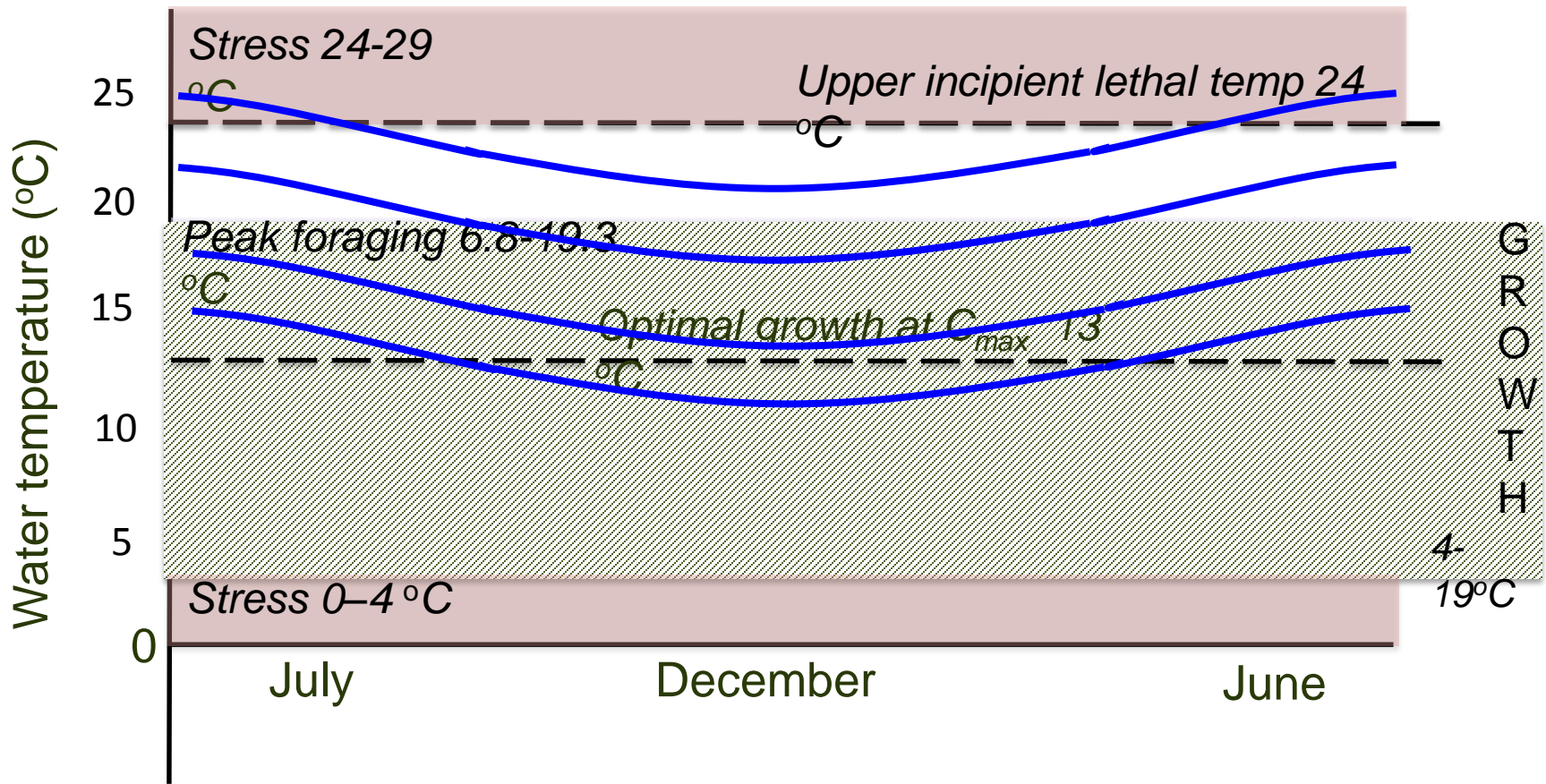
December

June



# IMPACT #1

Water will become too warm to support coldwater fish species and some aquatic invertebrates



# CLIMATE CHANGE AND BROWN TROUT

Unfortunately, most groundwater-fed streams lack the physical characteristics to support warm-water species of game fish



Important food resources may be threatened...

Especially cold-adapted species of Chironomids



Larval form




Adult

*Diamesa* sp. male walking on snow along Trout Brook (Minnesota, USA).

# IMPACT #2

Fewer cold-water fish will negatively impact local tourism



A man in a green shirt and dark pants is fishing in a stream. He is wearing a large, dark-colored backpack that has a child sitting on it. The child is wearing a pink and white striped shirt. The man is holding a fishing rod and looking towards the water. The stream is surrounded by lush green trees and vegetation. The background shows a grassy bank and more trees under a bright sky.

520,000 angler days per year

Vlaming & Fulton 2009

\$48 million toward economy

Gartner et al. 2002

Challenge #2: Longer growing season = intensification or expansion of agriculture?



# IMPACT ON



Increased runoff of sediments and pesticides may diminish important habitat features, including spawning beds, structure, and water quality



# Challenge #3: Increased/altered patterns of precipitation



Rushford, Minnesota 2007

# IMPACT ON



Larger, short term precipitation events may lead to

- short term increases in water temperature
- flooding
- erosion
- runoff of sediments and pollution
- degraded stream habitat

Challenge #1: Rising stream temperatures

**OPPORTUNITY**

**Promote trout fishing!**

Proceeds from trout stamp sales directly fund  
management and conservation





# Challenge #1: Rising stream temperatures

## OPPORTUNITY

Direct management efforts toward practices that mitigate the warming temperatures

- Identify streams with highest resiliency
- Strengthen regulations that promote water quality
- Protect shade trees

Challenge #2: Longer growing season =  
intensification or expansion of agriculture?

## OPPORTUNITY

Southeastern Minnesota should strive for  
healthy, responsible land use practices –  
especially with agriculture and mining

## Challenge #3: Increased/altered precipitation

# OPPORTUNITY

AGAIN - Southeastern Minnesota should strive for healthy, responsible land use practices – especially with agriculture and mining.

Healthy shorelines and streams are more resilient to flood events.

Action #1 – Go fishing! \$\$ is critical for mitigation and management

Action #2 – Support sustainable agriculture and land use practices

Action #3 – Support state policies that promote healthy land use and natural resource management