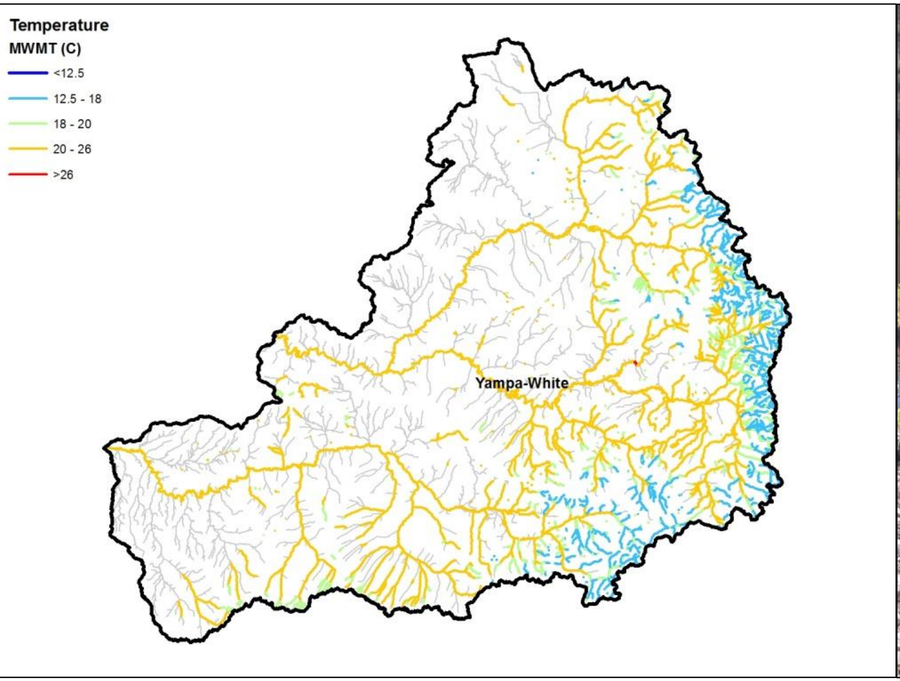
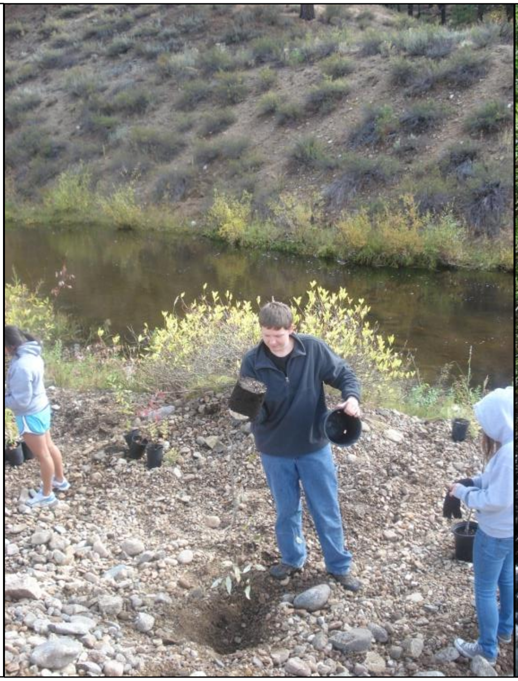
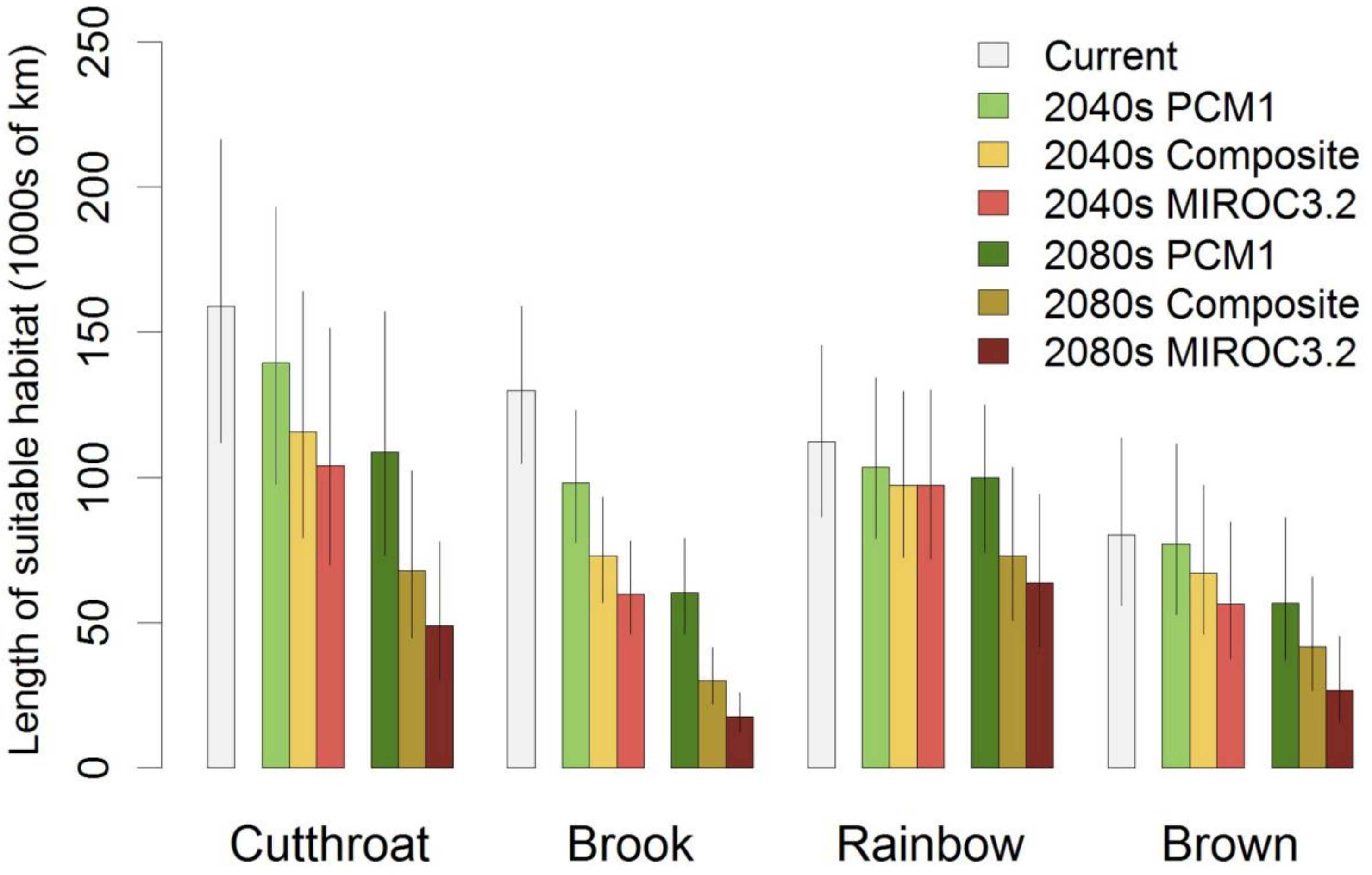
Spatially-Explicit Tools to Guide Climate-Smart Restoration Efforts for Native Trout

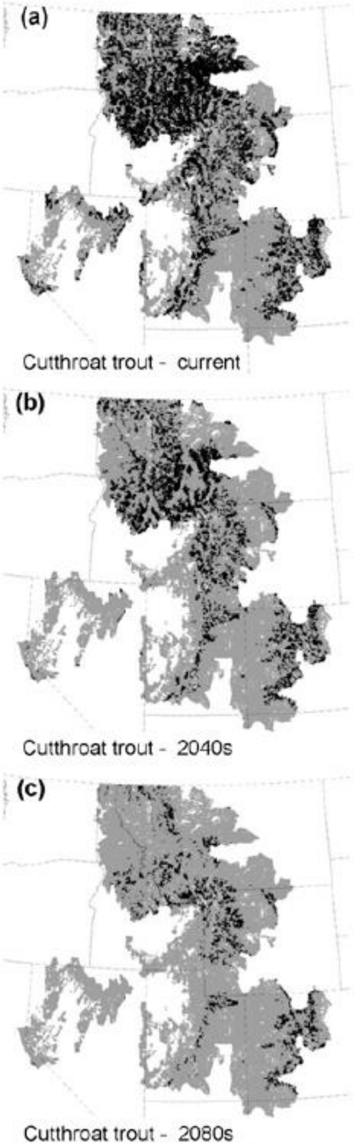




Daniel C. Dauwalter and **Seth J. Wenger**, Trout Unlimited, Boise, Idaho
James J. Roberts and **Kurt D. Fausch**, Colorado State Univ., Ft. Collins, Colorado
Brian Hodge, Trout Unlimited, Steamboat Springs, Colorado

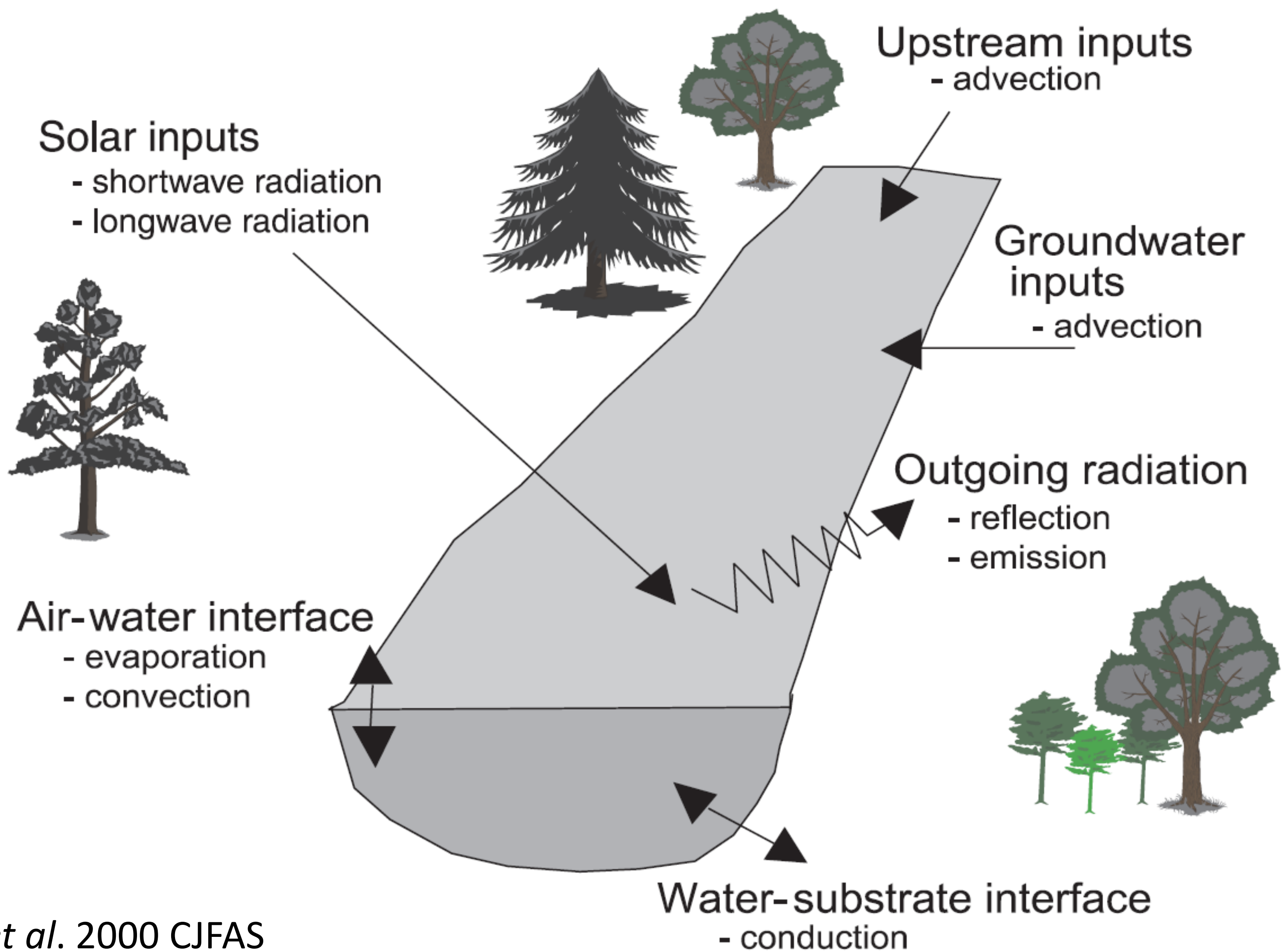
Climate Change and Trout





Wenger *et al*. 2011 PNAS

Stream Temperature



Johnson *et al*. 2000 CJFAS

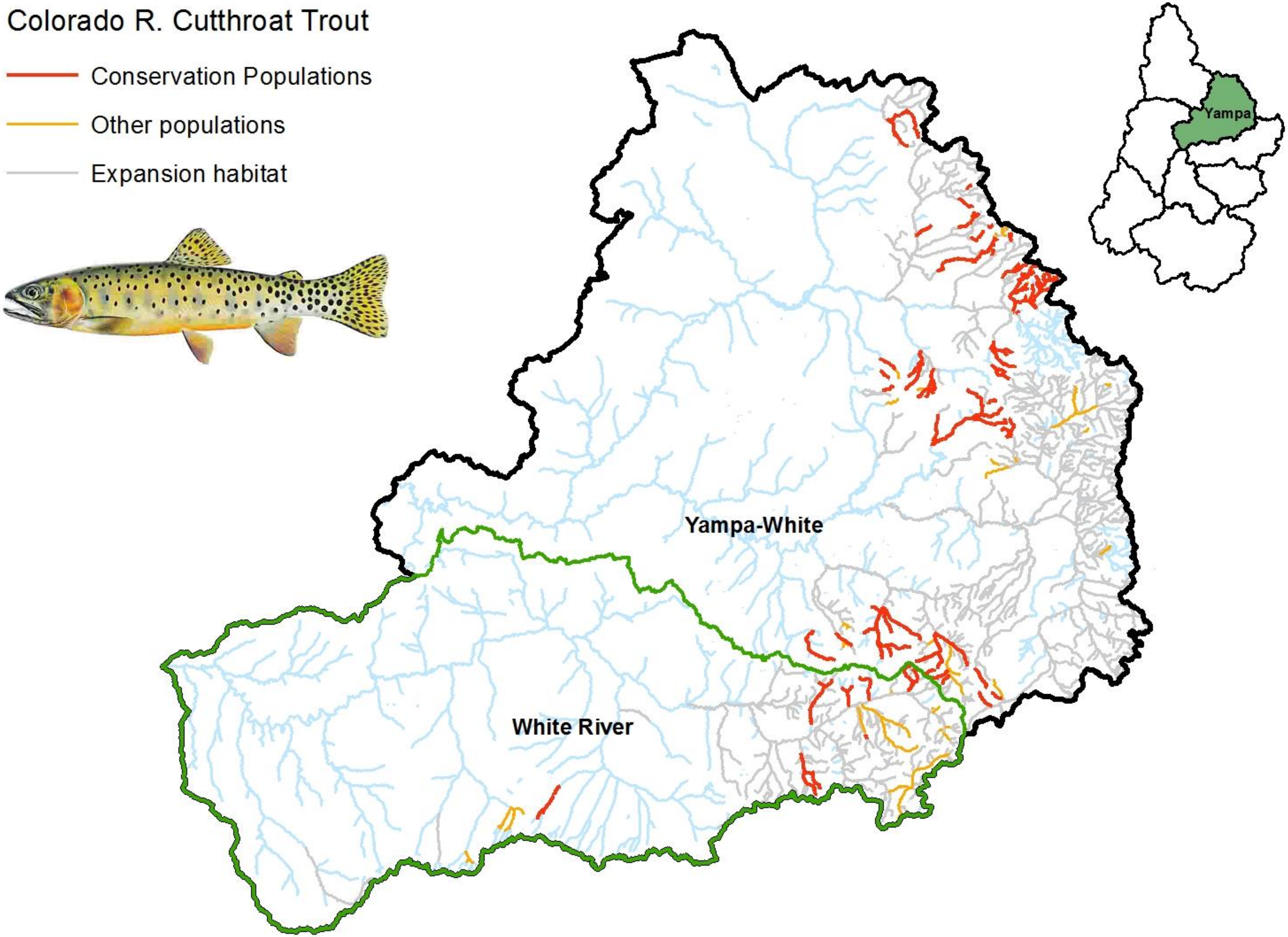
Abandoned mine lands,
Boise River Basin, Idaho

Objective

- Evaluate solar radiation impacts on stream temperatures, Yampa-White basins, Colorado

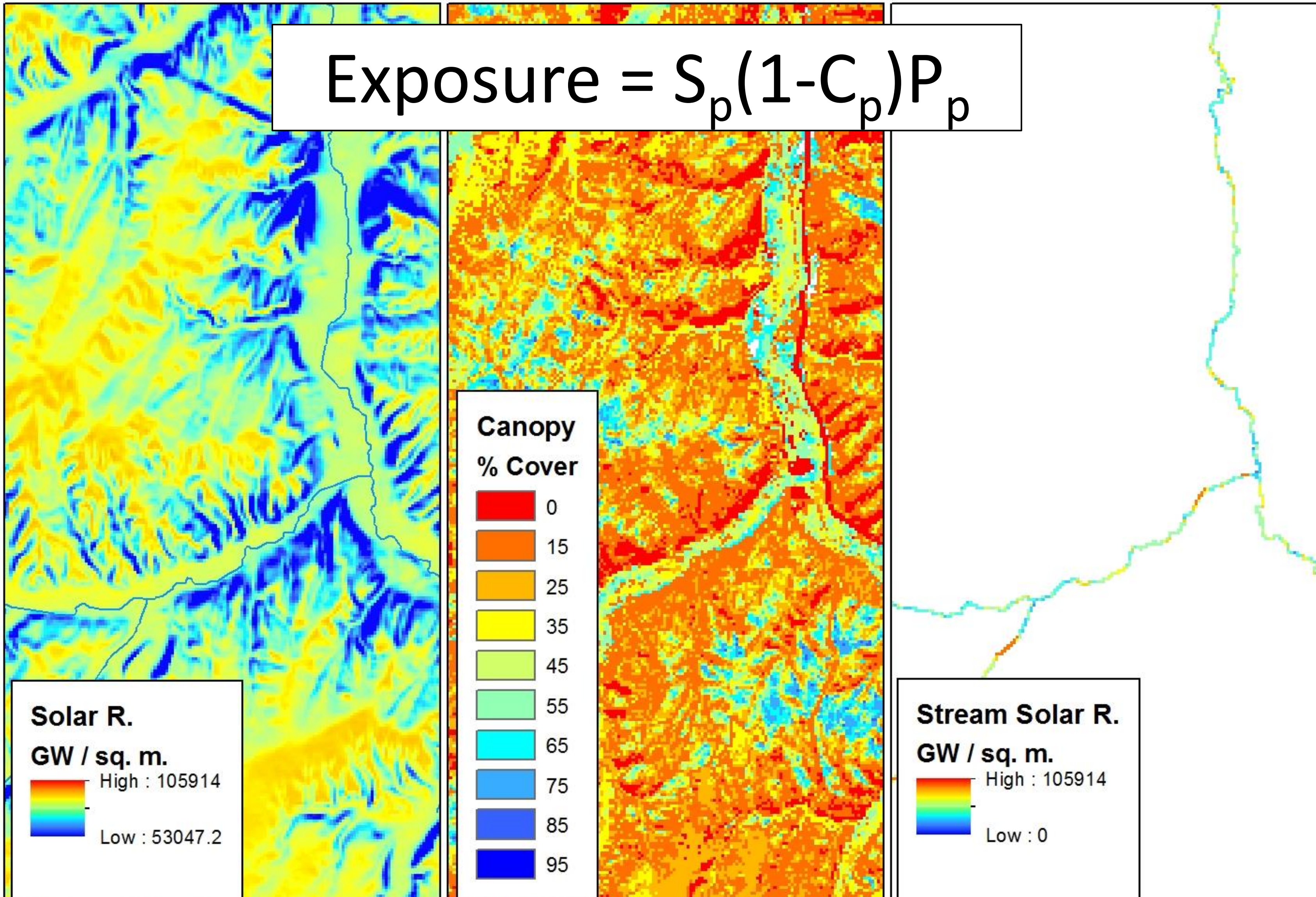
- Determine where riparian restoration can offset climate change impacts to stream temperature and cutthroat trout

Colorado River cutthroat trout (T_{cmax} = 29°C)


Colorado R. Cutthroat Trout
Conservation Populations
Other populations
Expansion habitat
Yampa
Yampa-White
White River

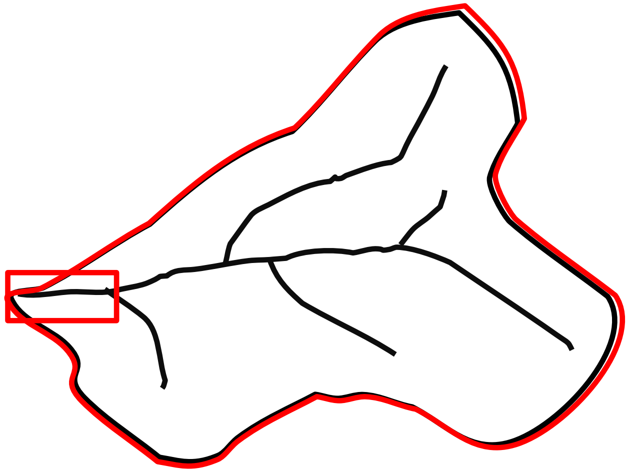
Solar Radiation Exposure

$$\text{Exposure} = S_p(1-C_p)P_p$$



Stream Temperature Model

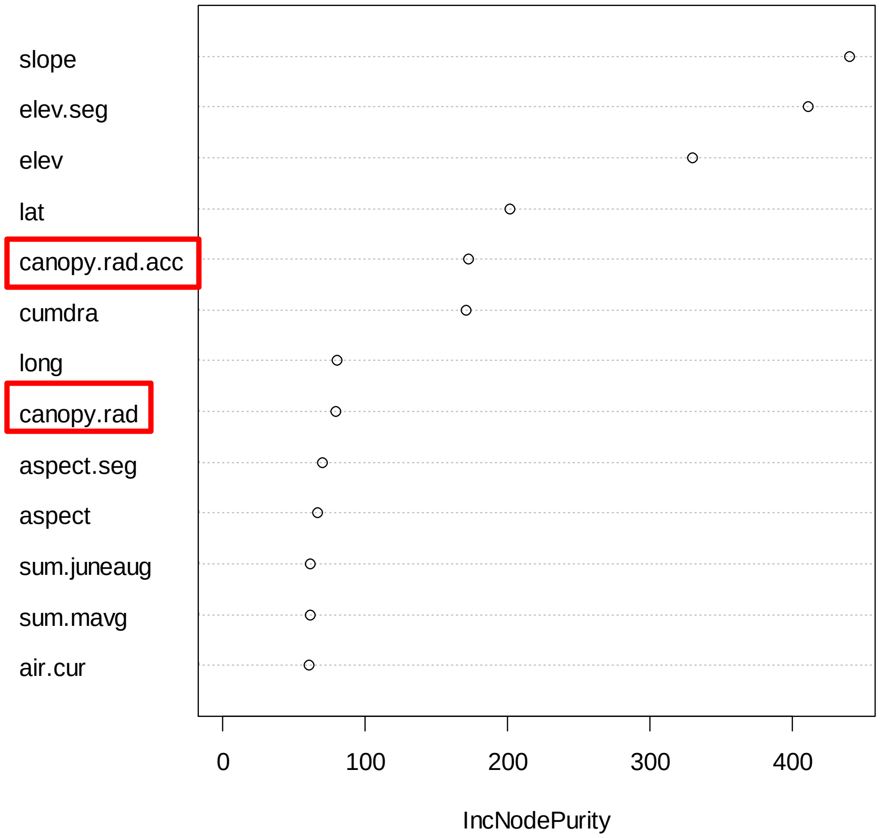
- Max. Weekly Max. Temp = f(Local Solar Radiation, Cumulative Solar Radiation, other covariates)
  - 95 thermographs, 117 summers
  - Random Forest model

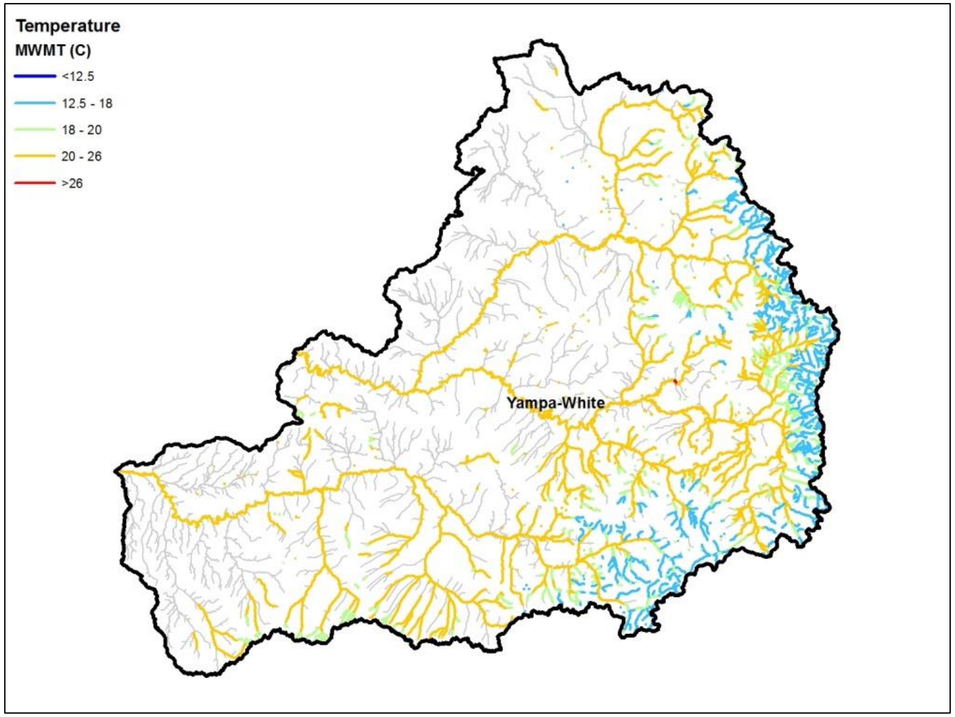


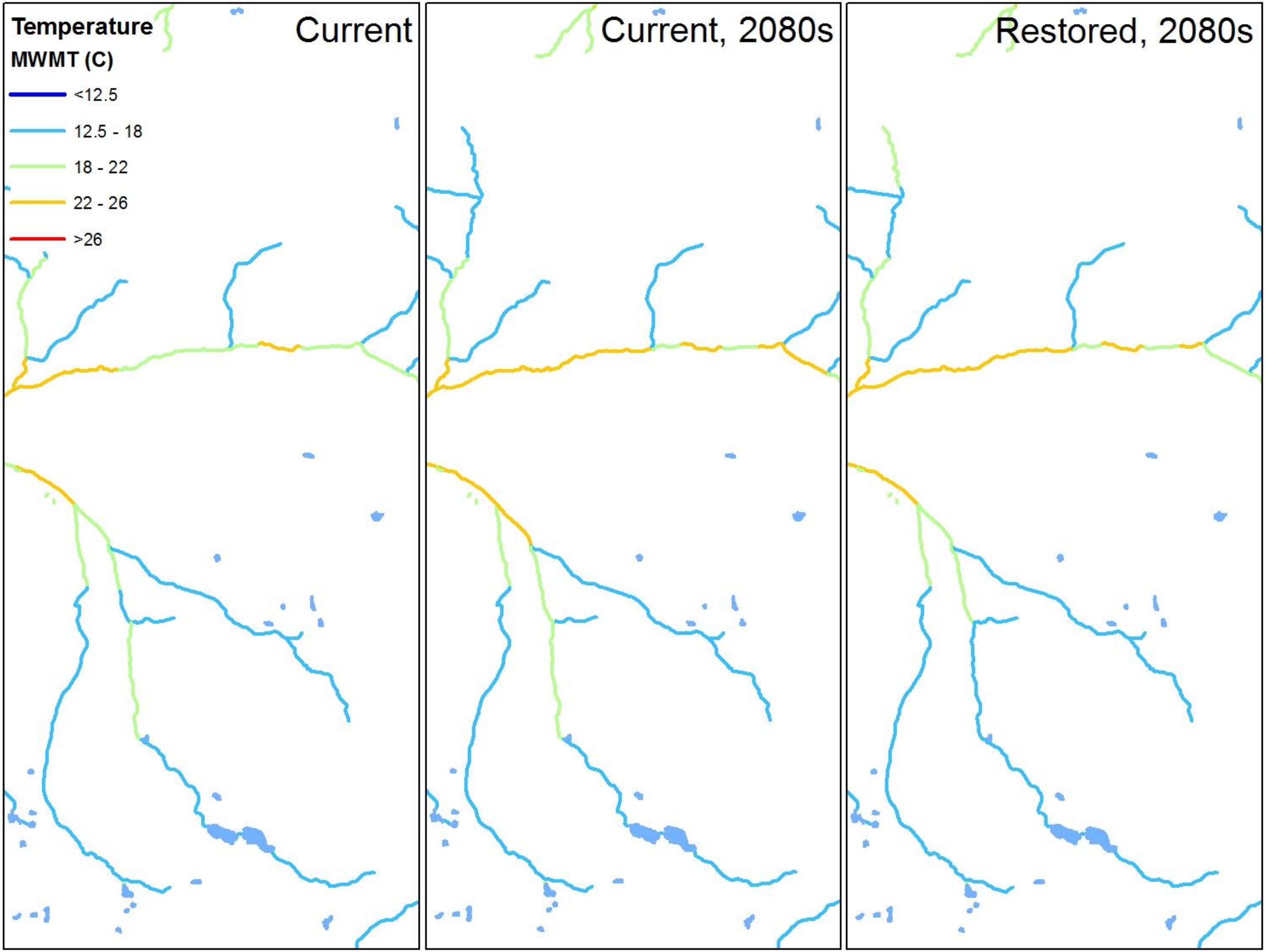
- Climate Scenarios (↑3 – 5°C)
  - 2 GCMs (Hostetler et al. 2011)
  - A2 scenario
  - 2080s
- Predict riparian restoration scenario ~50% canopy cover

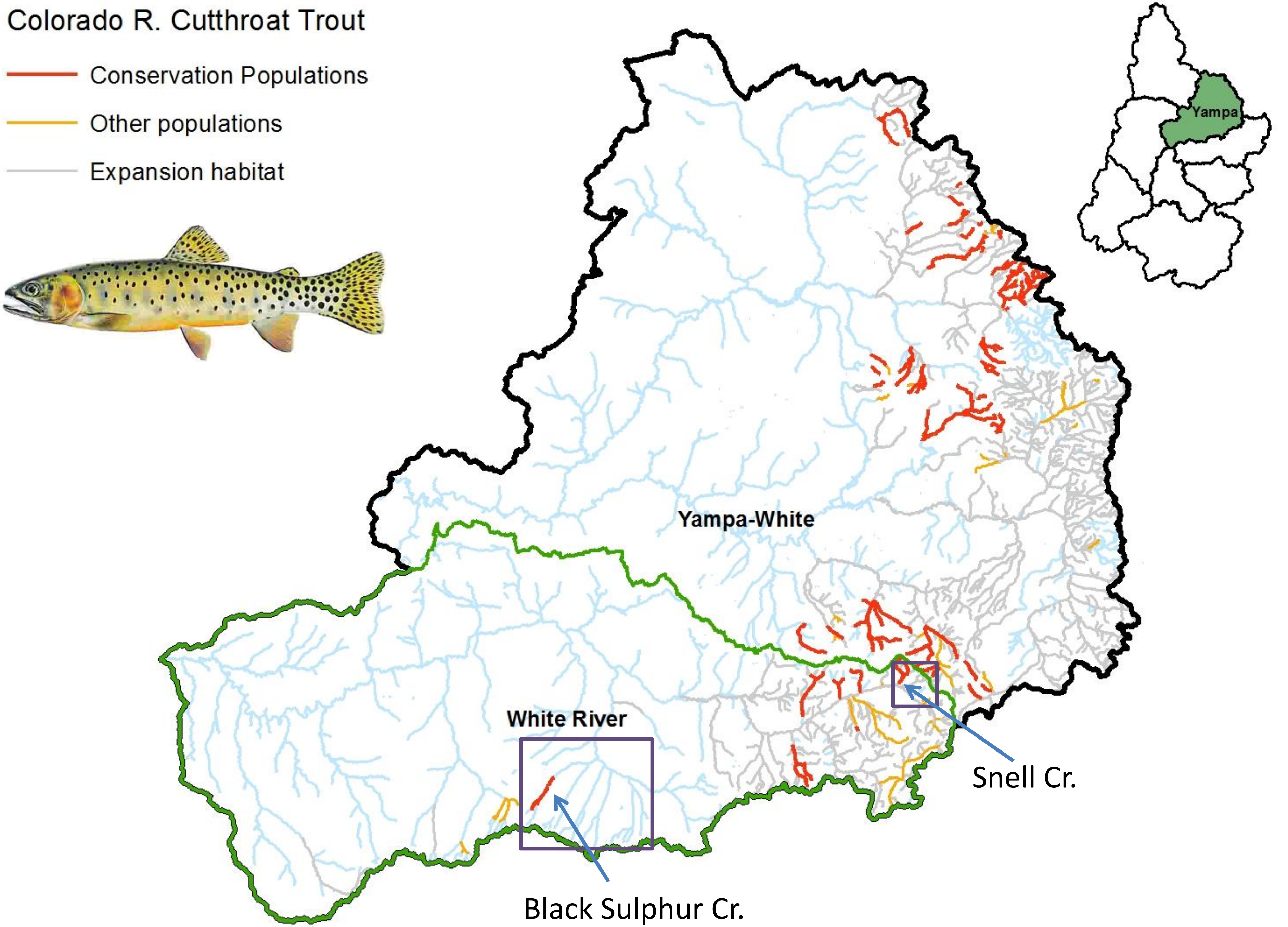
Stream Temperature Model

- RMSE = 2.2°C (10-fold cross-validated)



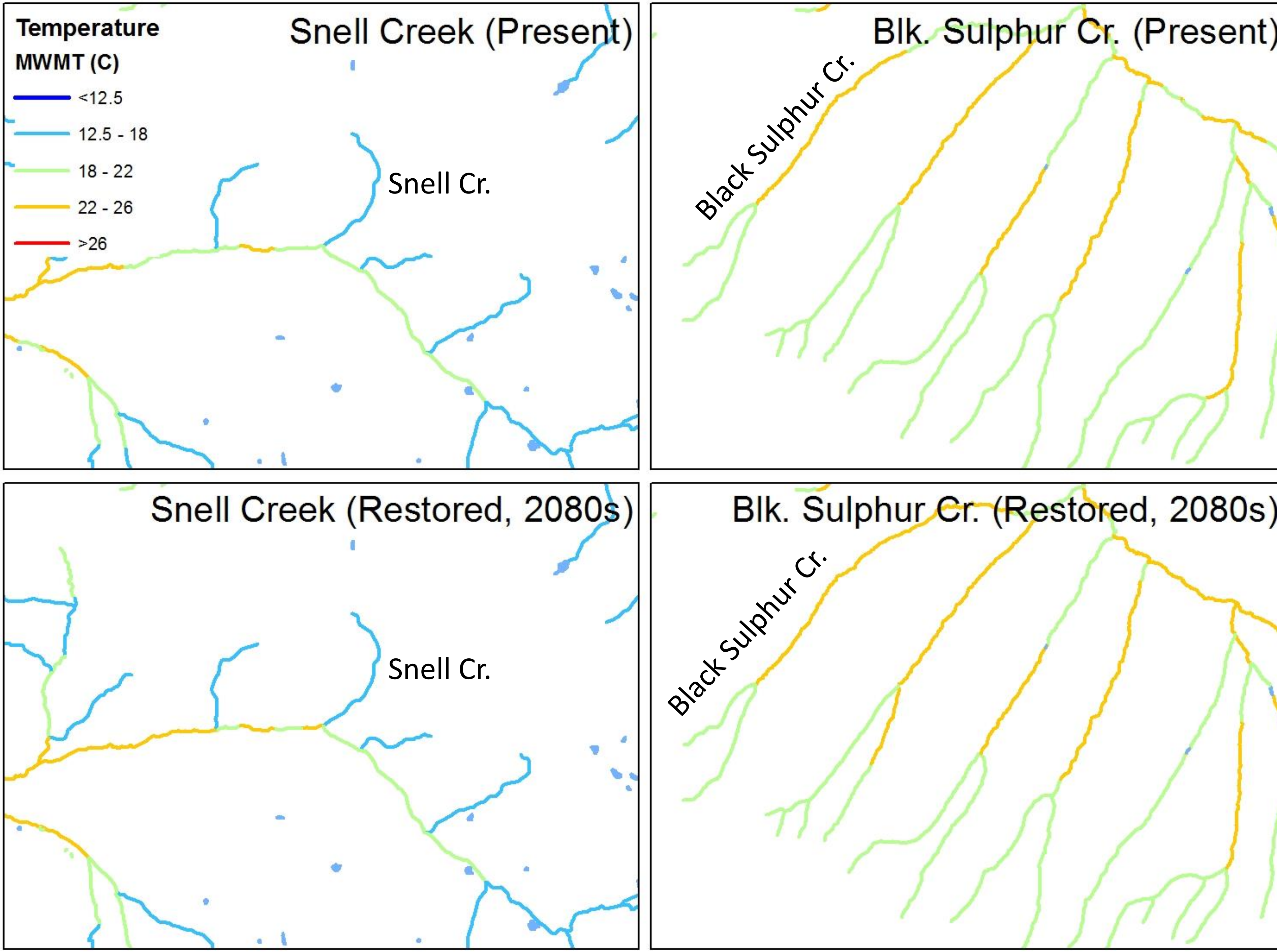



Temperature
MWMT (C)
<12.5
12.5 - 18
18 - 22
22 - 26
>26
Current
Current, 2080s
Restored, 2080s

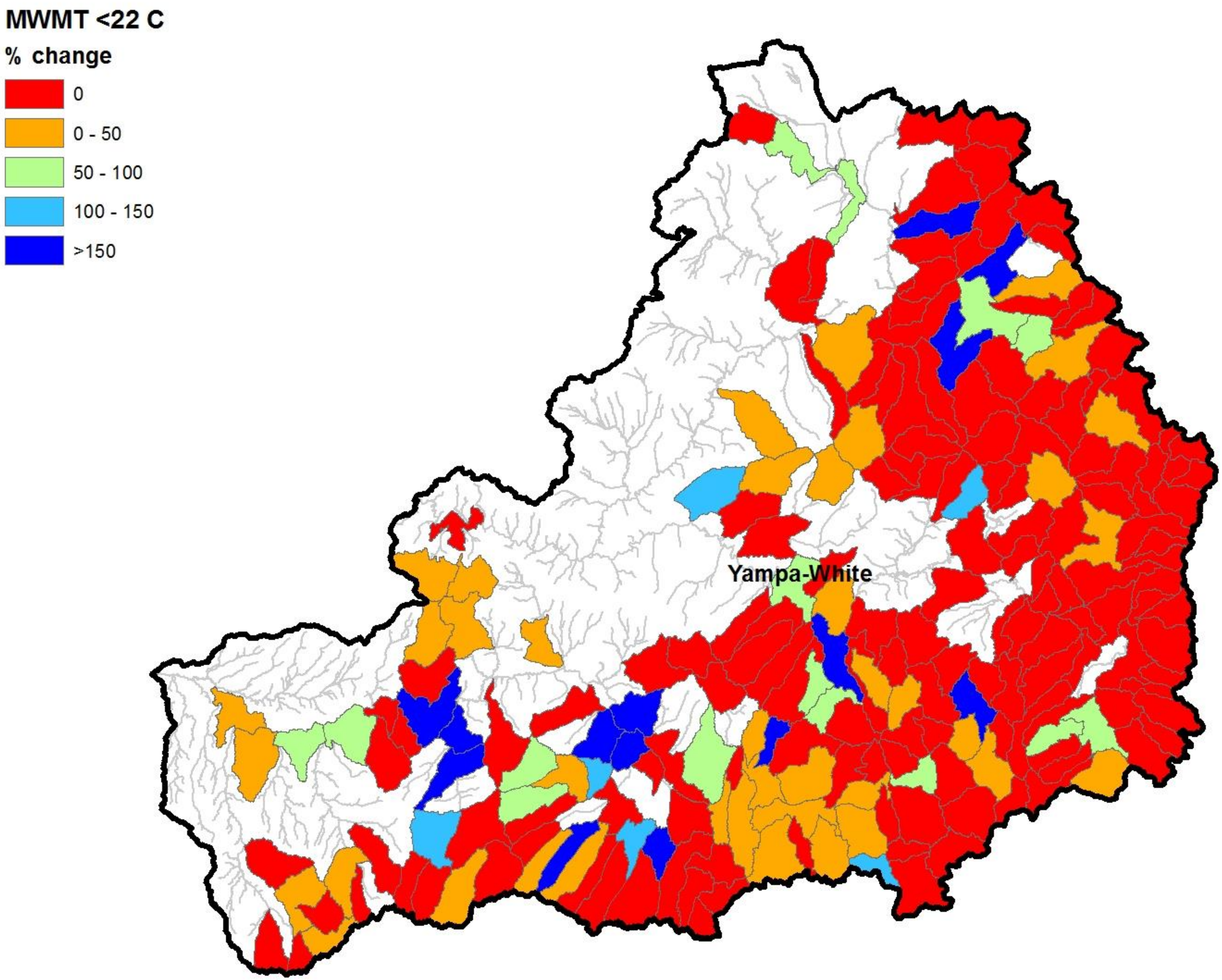

Colorado R. Cutthroat Trout
Conservation Populations
Other populations
Expansion habitat
Yampa
Yampa-White
White River
Snell Cr.
Black Sulphur Cr.

Black Sulphur Creek

Snell Creek



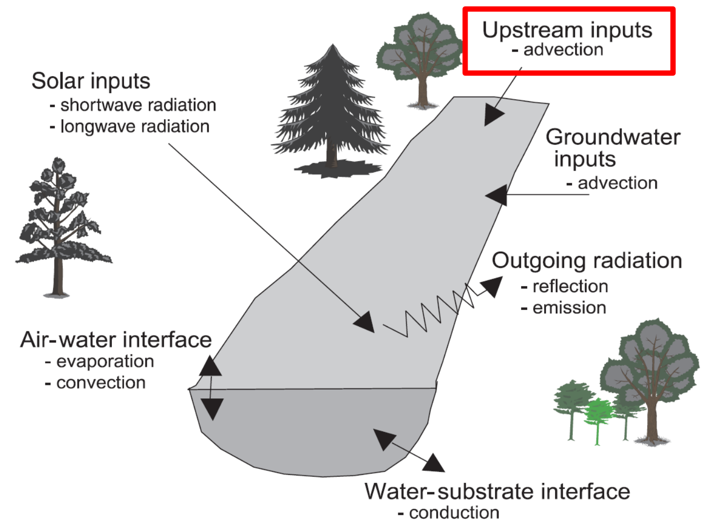
Temperature
MWMT (C)
<12.5
12.5 - 18
18 - 22
22 - 26
>26
Snell Creek (Present)
Snell Cr.
Blk. Sulphur Cr. (Present)
Black Sulphur Cr.
Snell Creek (Restored, 2080s)
Snell Cr.
Blk. Sulphur Cr. (Restored, 2080s)
Black Sulphur Cr.



MWMT <22 C
% change
0
0 - 50
50 - 100
100 - 150
>150
Yampa-White

Summary

- Need watershed-scale restoration to see measureable gains in stream temperature



- Spatially-explicit temperature predictions allow for climate-smart restoration

- Link temperature to species niche models
  - Instream habitat restoration
  - Streamflow restoration (irrigation diversions)

Questions?