Stream Temperatures in the Upper White River (2019-2020)

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Water temperature influences…

Distribution, growth, and survival of fishes
(Bear et al. 2007; Ziegler et al. 2013; Hodge et al. 2017)

Distribution and abundance of bugs
(Lessard and Hayes 2002; Jacobsen and Marín 2008)

Distribution, growth, and survival of algae
(Graham et al. 1982; Kumar et al. 2009; Ralston et al. 2014)

Objectives:

1) Identify patterns in stream temperature
2) Explore influences on stream temperature
3) Examine thermal suitability for aquatic biota
4) Generate continuous temperature data

Study sites
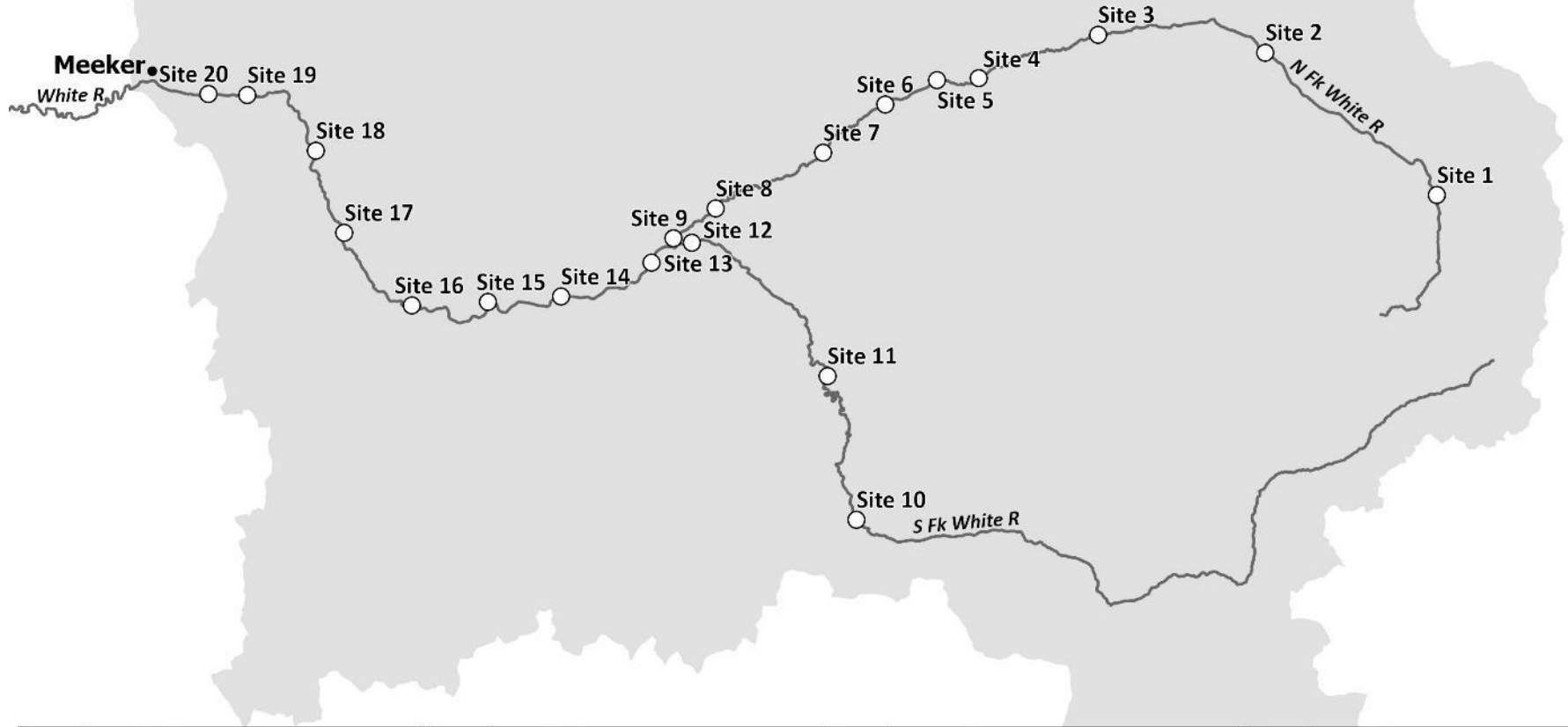
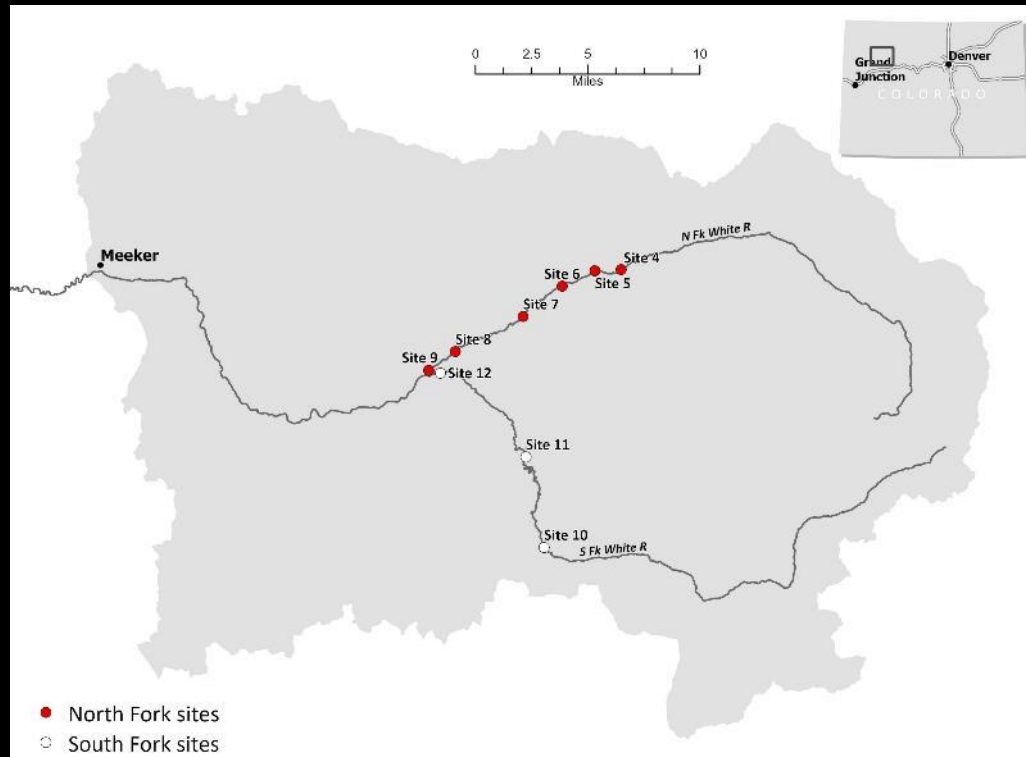| Site #	Description	Site #	Description	Site #	Description	Site #	Description
1	North Fork below Trappers Lake	6	North Fork above Fawn Creek	11	South Fork at CR10	16	Main stem above Miller Creek
2	North Fork below Mirror Creek	7	North Fork at CR14	12	South Fork at Bel Aire S.W.A	17	Main stem above Highland Ditch
3	North Fork below Missouri Creek	8	North Fork at Buford	13	Main stem below Big Beaver Creek	18	Main stem above Coal Creek
4	North Fork below Lost Creek	9	North Fork at Bel Aire S.W.A	14	Main stem below North Elk Creek	19	Main stem below Coal Creek
5	North Fork below Marvine Creek	10	South Fork at USFS Campground	15	Main stem above Dry Creek	20	Main stem above Meeker

Temperature data collection

20 sites

2 loggers per site

1 hourly reading per logger
(± 0.21°C)

Stream temperature vs. time and space

Difference?	Test (α = 0.05)
Among sites	Confidence intervals
	Linear regression
Between forks	ANOVA
Between years	Paired t-test

Influences on stream temperature?

$$\text{StreamTemp} \sim \text{AirTemp} * \text{Flow}$$

Variable	Description	Data source
StreamTemp	Mean daily	Hodge and Eyre (2021)
AirTemp	Mean/max daily-weekly	NOAA (2020)
Flow	(Q) Mean daily	USGS (2020)

Cutthroat Trout temperature targets

Roberts et al. (2013)

30-day mean temperature (M30AT)
Low recruitment	8.0-9.0°C
Optimal growth and recruitment	9.1-18.0°C
Declining growth	18.1-19.9°C
Little or no growth	≥ 20.0°C

7-day mean maximum temperature (MWMT)
Survival	< 26.0°C
Mortality	≥ 26.0°C

$$°F = (°C \times 1.8) + 32$$

Growing degree-days:
Predictor of distribution and development
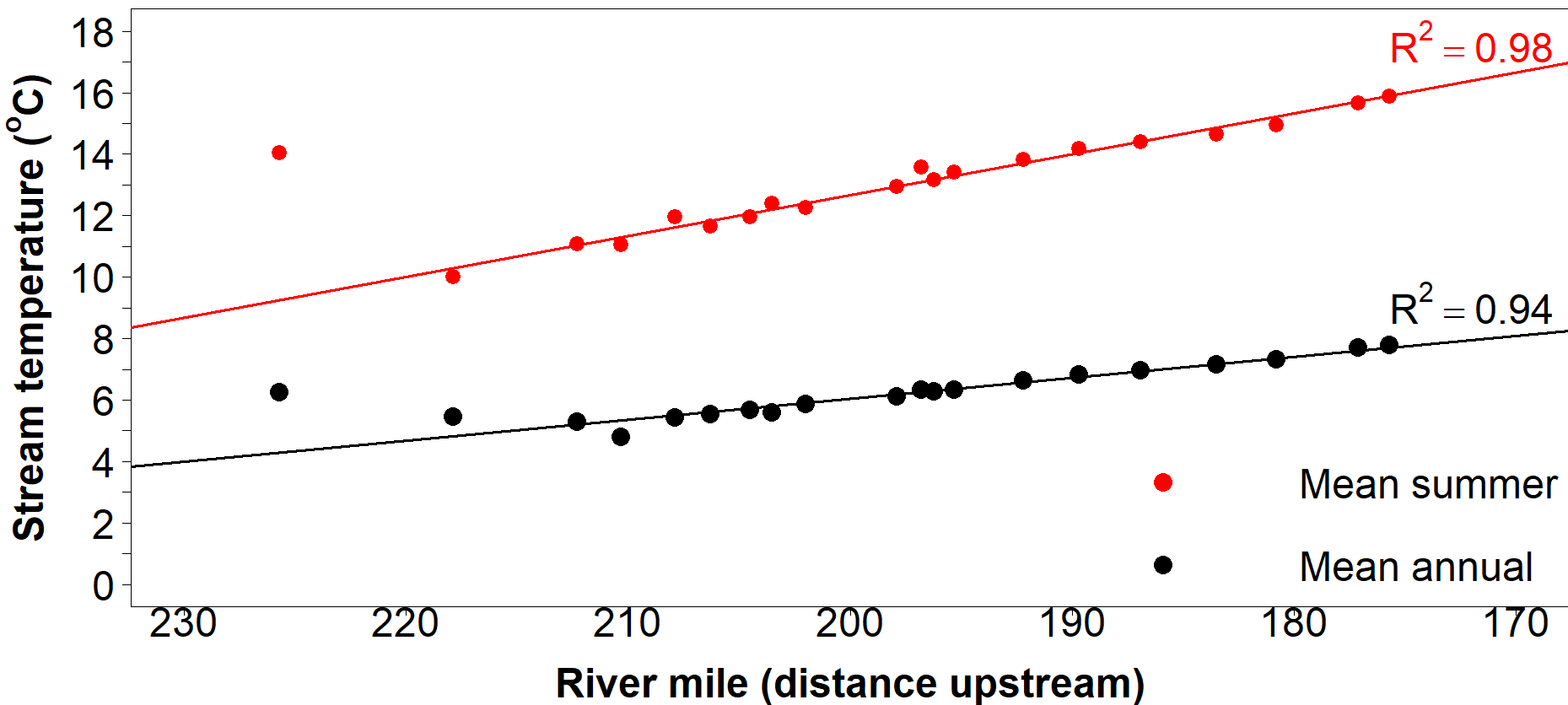(Coleman and Fausch 2007; Ralston et al. 2014; Wittman et al. 2017)

I. Wilson

M. May

$$DEGREE\ DAYS_{day\ i} = \sum_{Jan\ 1}^{day\ i-1} \bar{T}\ (\degree C)$$

Results

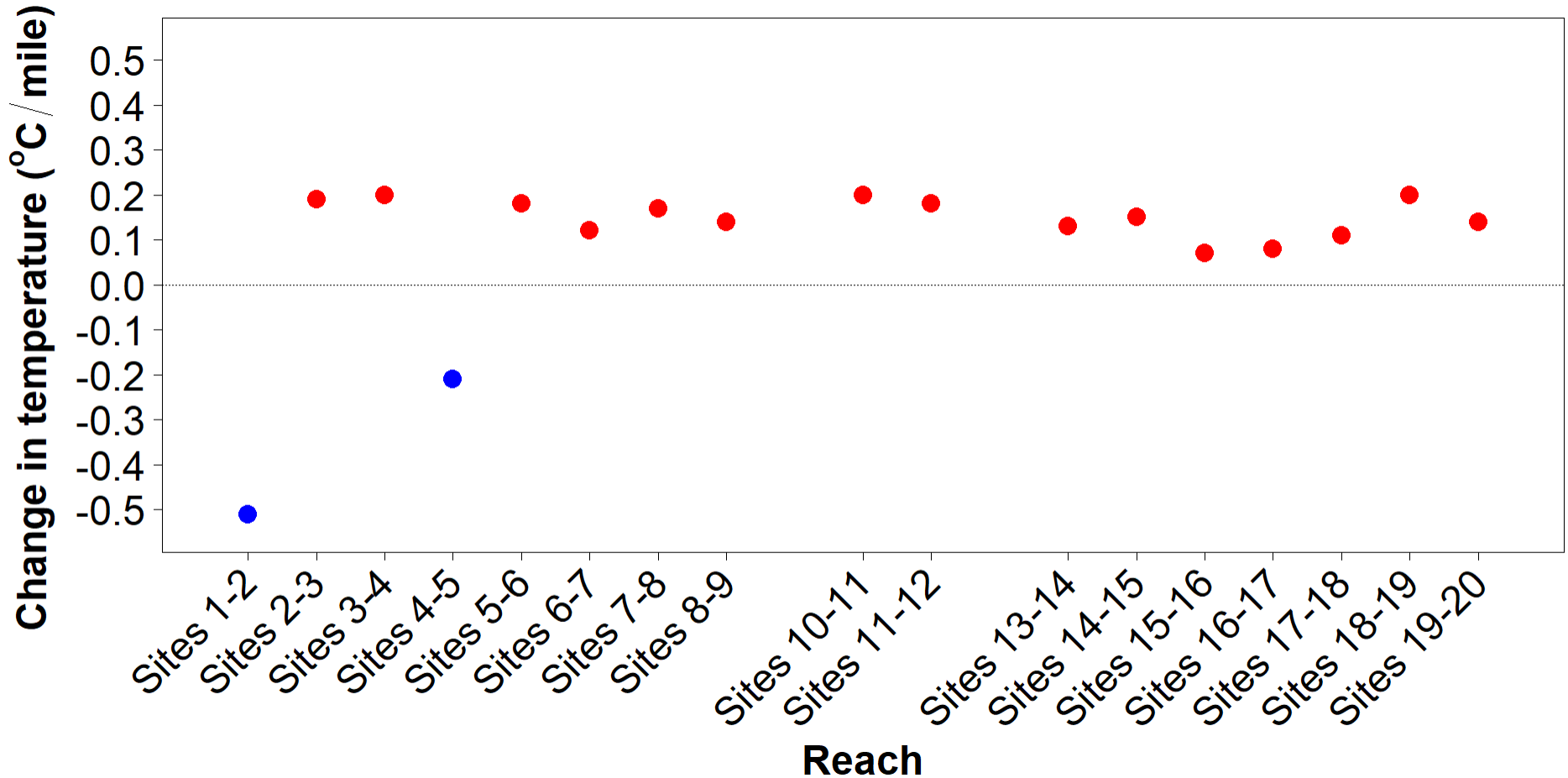Stream temperature (°C)

Date (2019-2020)
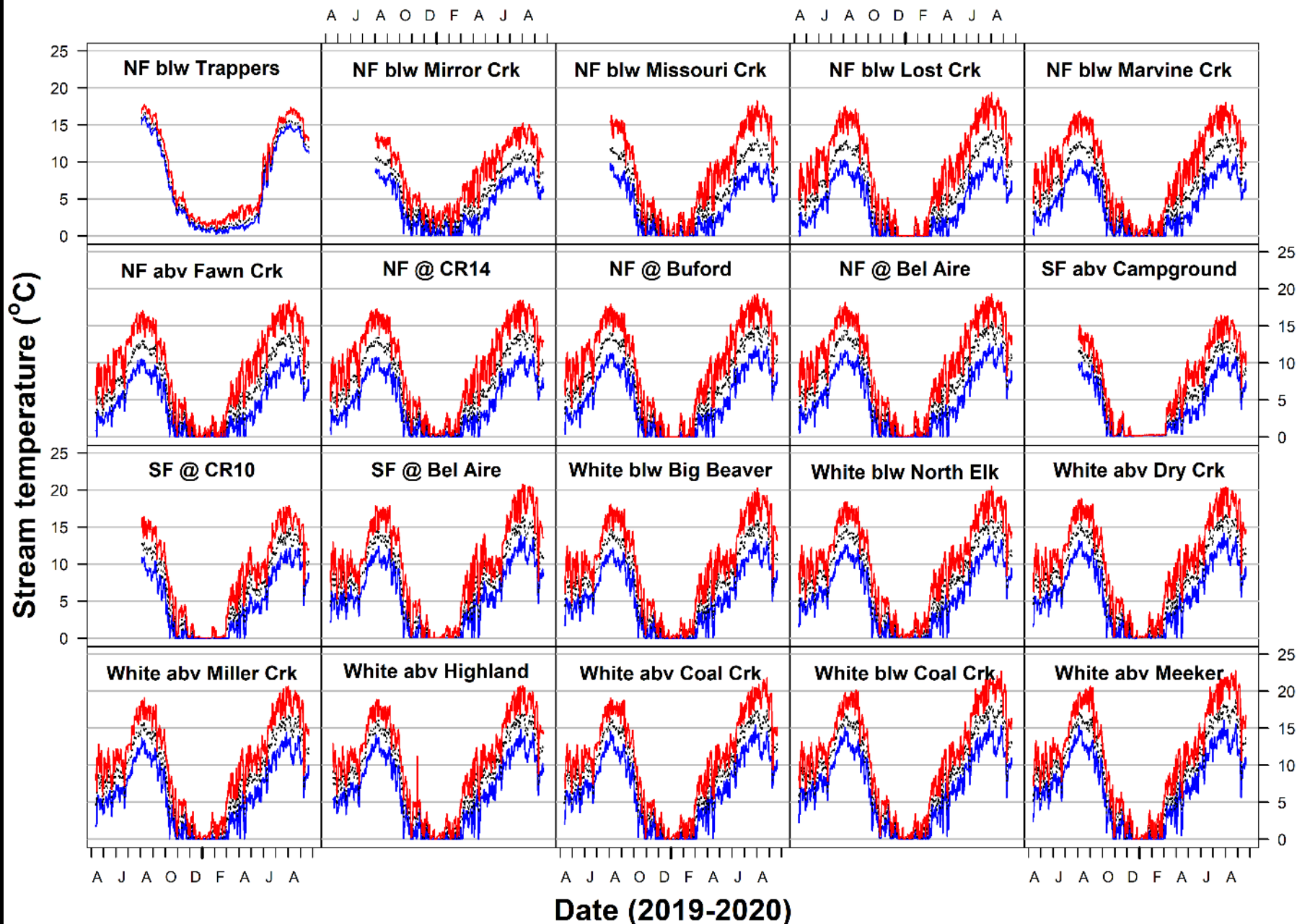
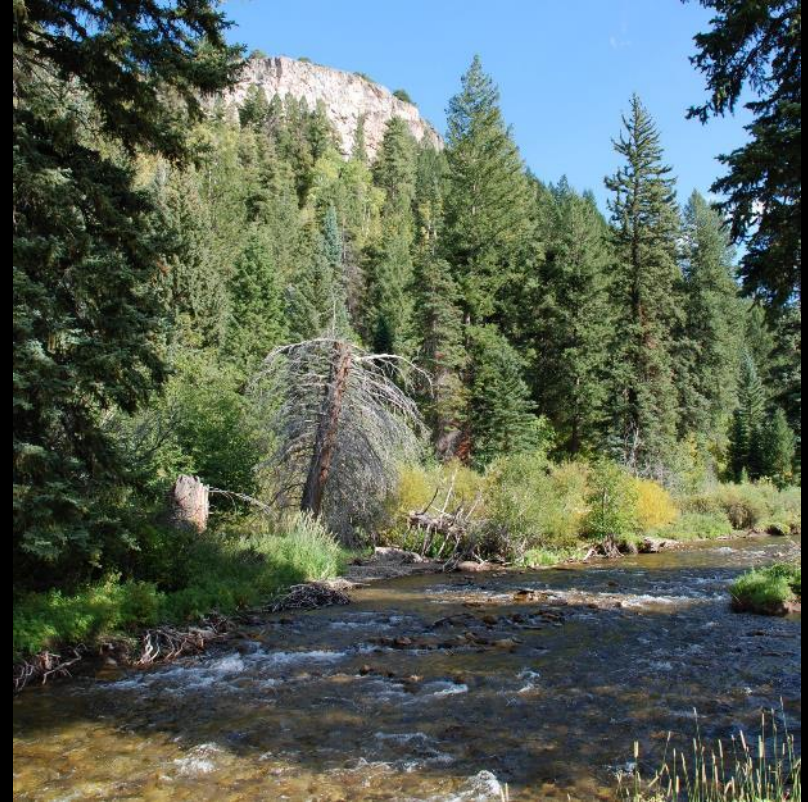# Temperature increased downstream

Heating and cooling varied among reaches
(Summer 2020)

No temperature difference between forks

Mean ± 95% C. L. (°C)

Description	North Fork	South Fork	P
Summer	12.32 ± 0.63	12.33 ± 3.14	0.981
Annual	5.82 ± 0.34	5.57 ± 1.88	0.504

Warmer summer in 2020 than 2019
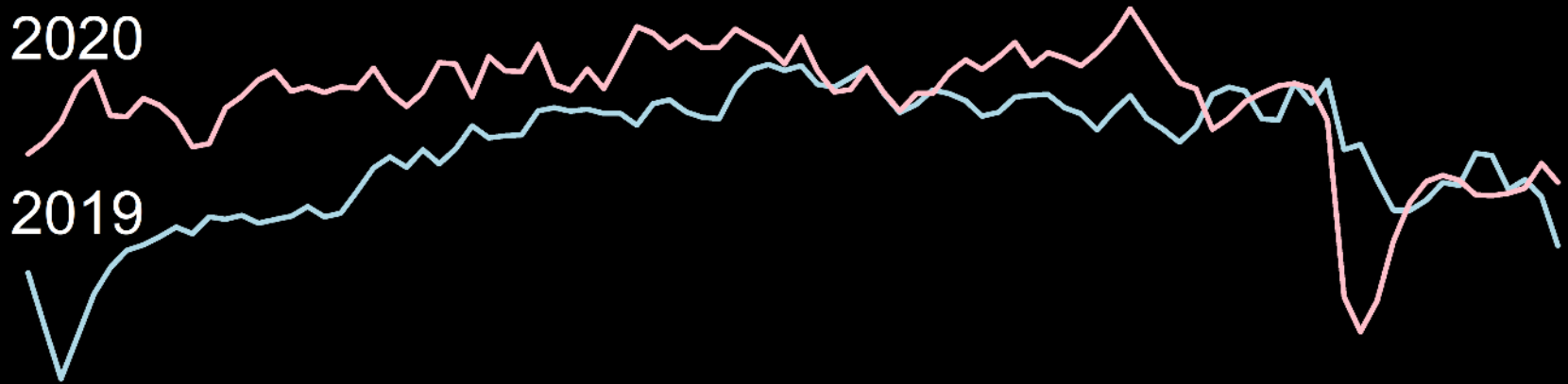
	Mean (°C)			
Period	2019	2020	Δ°C	P
June	8.46	11.53	3.07	<0.001
July	12.34	14.49	2.15	<0.001
August	13.31	14.10	0.79	<0.001
Summer	12.26	13.63	1.37	<0.001

Stream temperature is relatively predictable

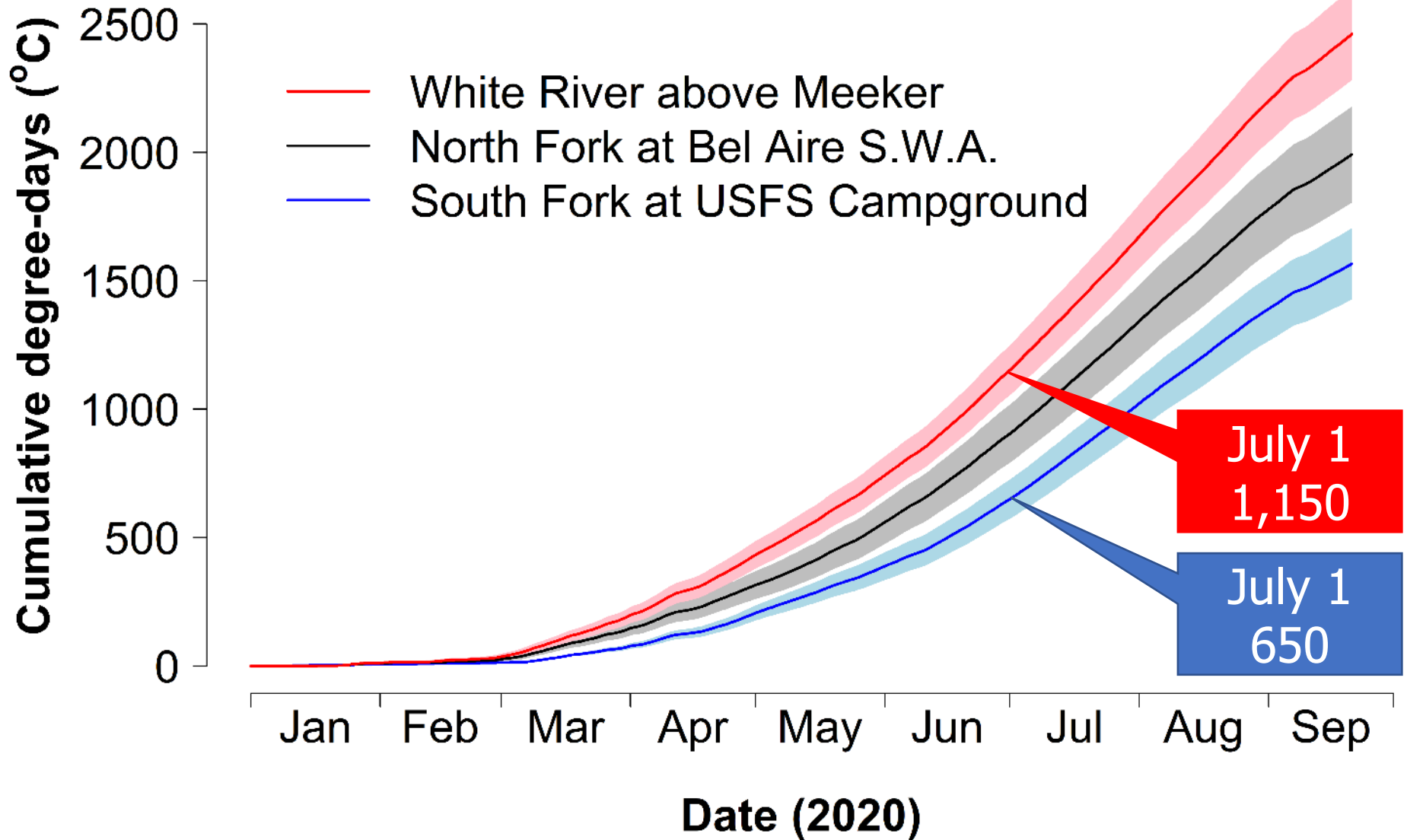| Predictor	Relationship
AirTemp	+ 0.55510
Flow	- 0.00115
AirTemp*Flow	- 0.00001

$$R^2 = 0.95$$
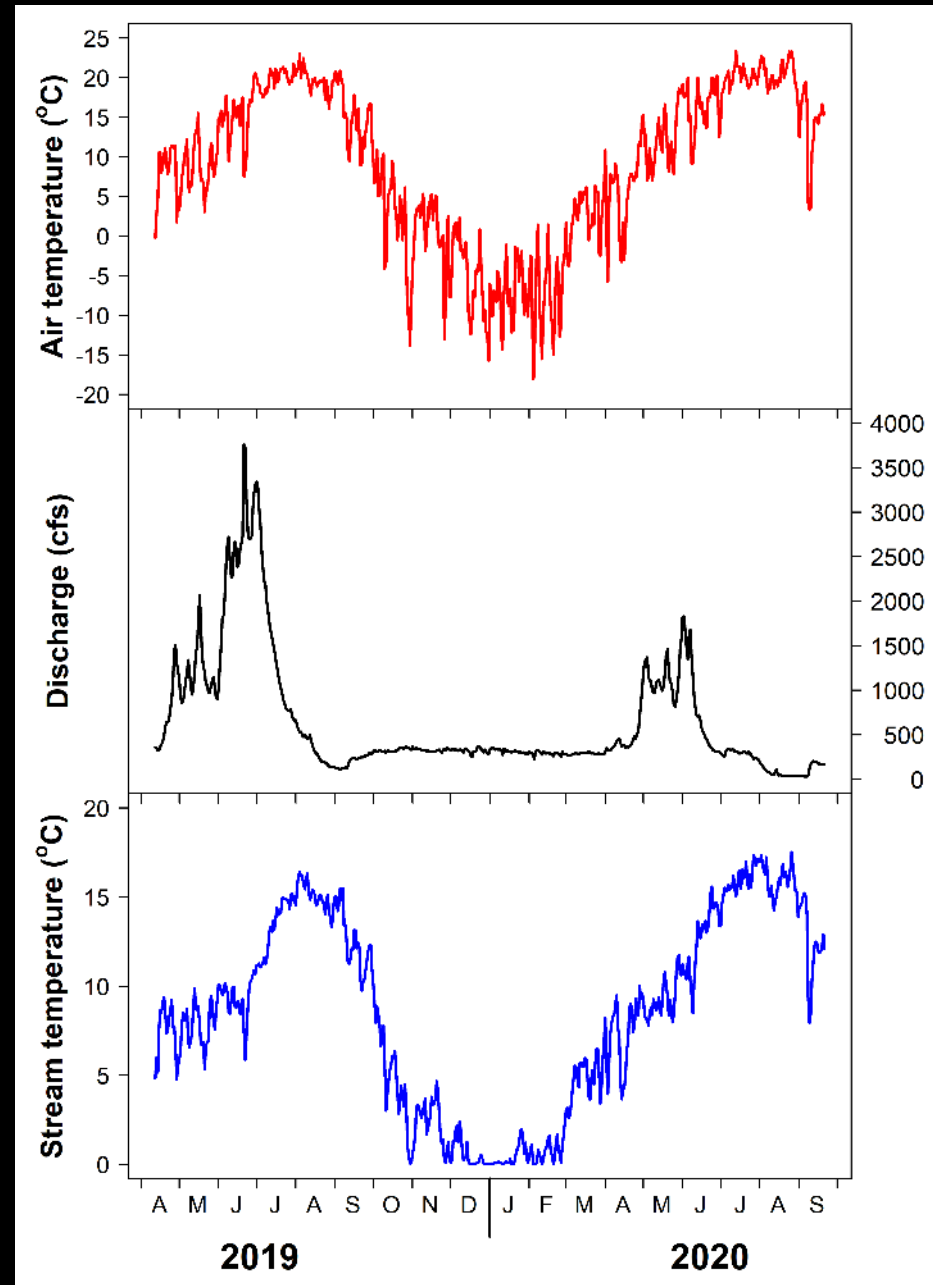
Temperatures suitable for trout
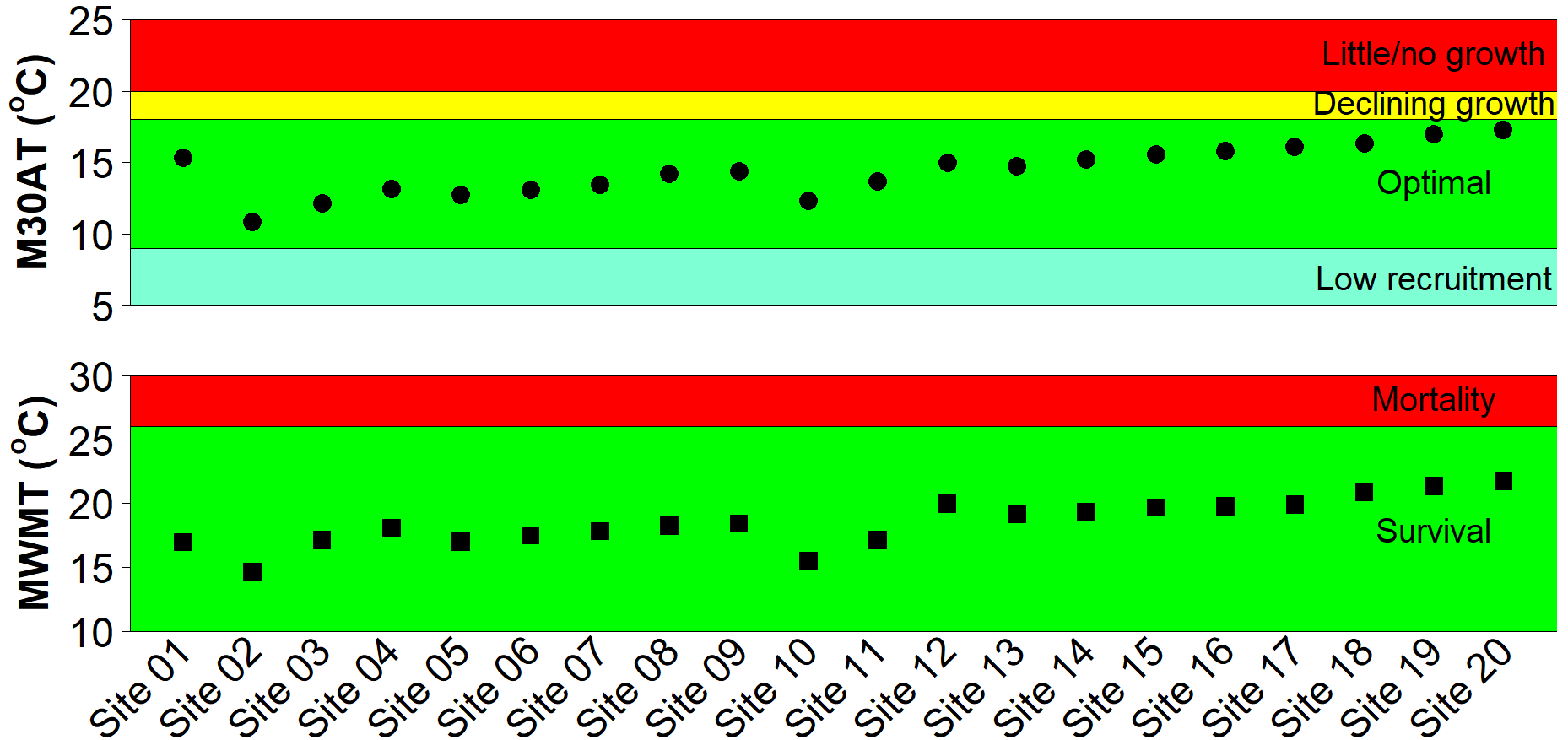
Degree-day accumulations varied

Conclusions on stream temperature

Varied with time and location

Did not differ between forks

Affected by air temperature and discharge

Suitable for coldwater fishes

Stream temperature and fishes, cont.

I. Wilson

Species	Acute criterion (°C)
Mountain Whitefish	21.6
Brook Trout	21.7
Cutthroat Trout	22.1
Rainbow Trout	23.8
Brown Trout	24.6

Brinkman et al. (2013)

Thanks to all participating landowners!

Questions?

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Hodge, B. W., and T. Eyre. 2021. Stream Temperatures in the Forks and Main Stem of the White River in Northwest Colorado (2019-2020). Soon available: https://www.whiterivercd.com/.