Algae in the White River near Meeker

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Meeker River Watch
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Overview

- What's the problem?
- Why worry?
- What are the causes?
- What should be done?

NB: the purpose of this presentation is to help organize discussion and planning. The findings presented are not definitive. USGS and CPW studies are still in progress.

The Problems

1. Overgrowth of the green filamentous algae *Cladophora glomerata*

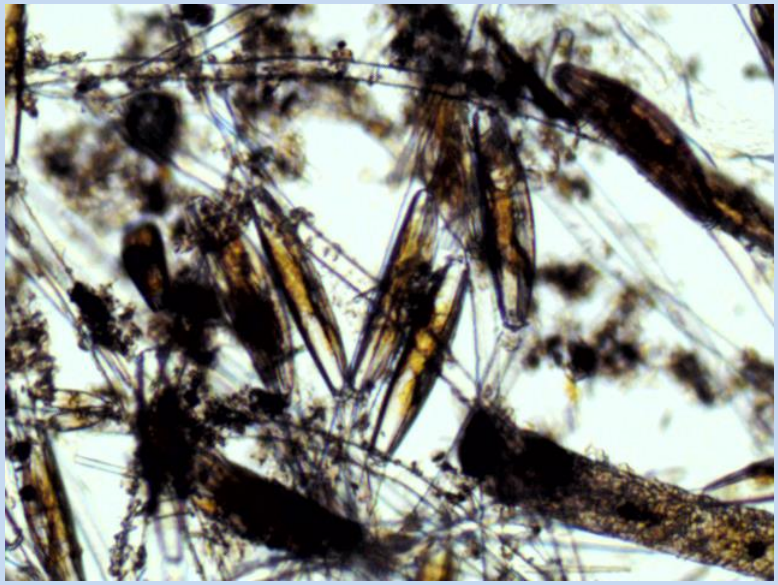
A known nuisance species that requires high concentrations of N and P

The Problems

2. Diatom overgrowth, probably *Cymbella janischii* or *C. mexicana*. (Tentative identification by Sarah Spaulding, USGS.)

Photo by Peter Brixius

Similar to Didymo ("rock snot") in its stalk and mat structure, but requiring higher N and P concentrations. Not previously identified in NW Colorado (see EMAP survey).



Photomicrograph by Bob Dorsett

Extent of the problem

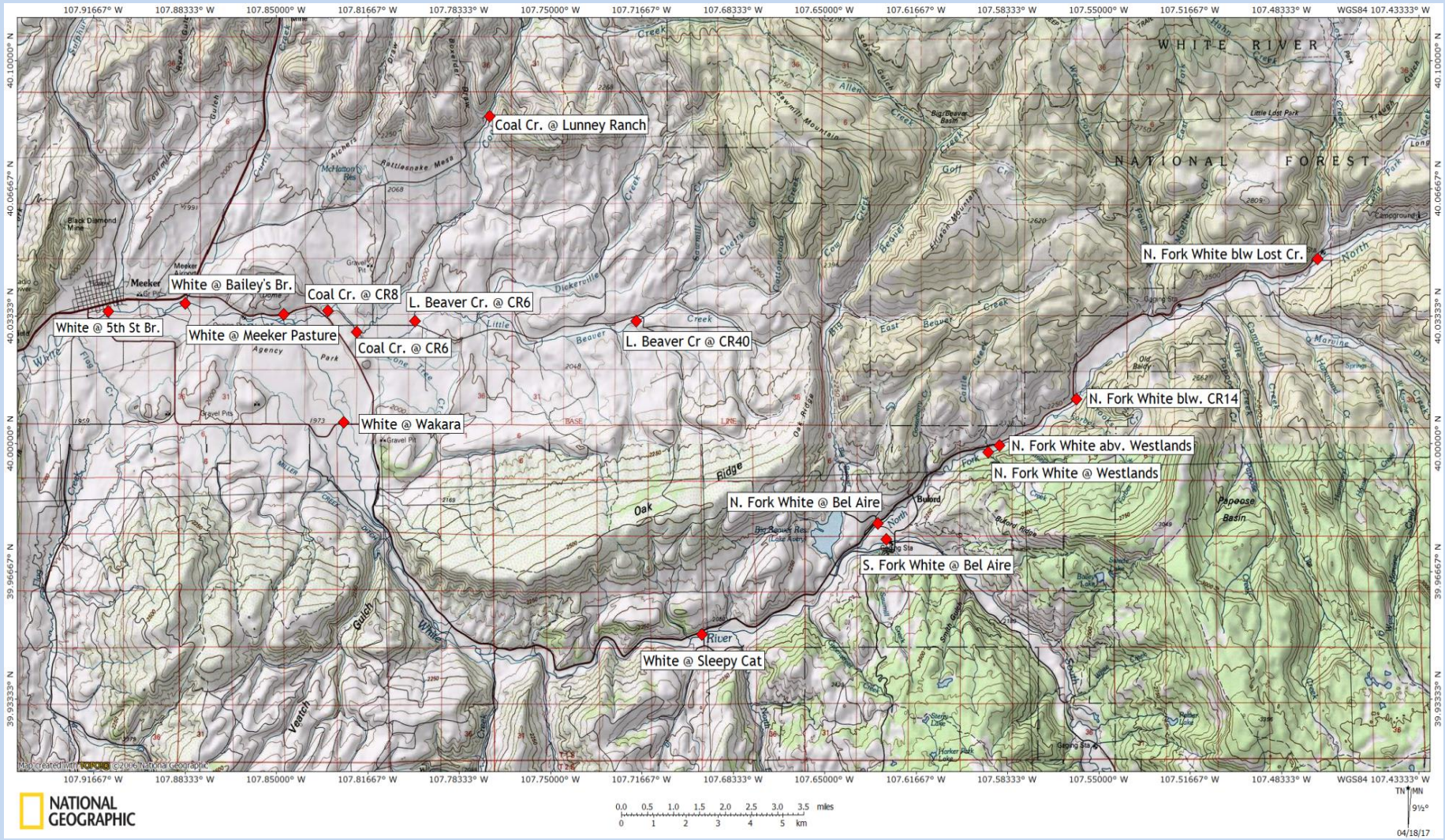


Image credit Mindi May

Table 1. Algae cover on the bottom of the White River at various locations upstream from Meeker, July 2017. Estimates by visual inspection from bank or bridge, expressed as % coverage on transect from bank to bank.

location	% cover	temp (℃)	comments
N. Fork below Lost Creek	0	16	clear water, cobble rock types easily distinguishable, evidence of diatoms on underside of cobbles; lots of caddis, several mayfly nymphs and stonefly shucks
Fritzlan's bridge	< 10%		green algae scattered on a few rocks, mostly near banks
bridge at rocking C lazy S	40%		some rocks in the current completely covered and showing fronds waving downstream
Westlands ~ 2 mi. below Pot Hole Ranch	80%		bright green essentially bank to bank and continuous along the channel
Sleepy Cat	80%	16	algae fronds green in current, loaded with sediment near banks, possible "rock snot" visible on cobbles near bank; several caddis, mayfly adults, one damselfly larva, egg jelly
Wakara	80%	16	brown with sediment near banks, green in current; many caddis and some snails
Bridge at hot springs	80%	16	algae fronds loaded with sediment near banks; some caddis, leeches, chironomid larva
Meeker 5th St. Bridge	90%		river bottom mostly brown, algae loaded with sediment; few caddis, no mayflies or stoneflies

Why worry about algae?

1. Impact on fish, macroinvertebrates, and other river life
2. Fouls water intake and treatment facilities
3. Economic and esthetic impact
   -- fisherman won't come
   -- nuisance odors and appearance
4. Potential contamination of other streams
5. Potential health impacts
   -- algae serves as a substrate for bacterial growth

Effect of Algae on dissolved oxygen concentrations

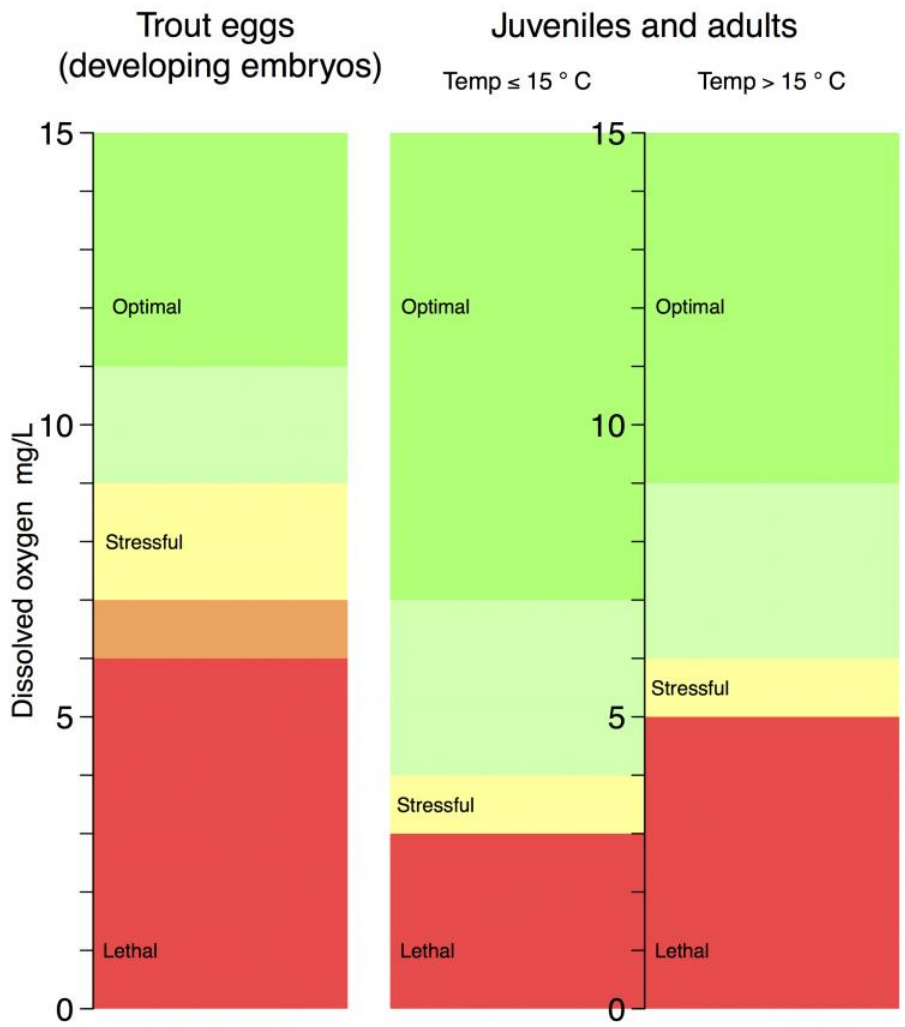
Table 2. Dissolved Oxygen in the White River at 5th St. Bridge, Meeker, CO, determined by Winkler Method. Sample on July 27 was collected at 1330 h under bright sun. Sample on July 29 was collected at 0430 h in the dark.

date	time	flow (cfs)	water temp (°C)	DO (mg/L)	% saturation
07/27/2017	1330	324	20	9.1	101
07/29/2017	0430	279	17	6.0	62

Observation: macroinvertebrate counts in the river are low where algae covers the substrate, and key indicator species are missing.

Average dissolved oxygen requirements for salmonids

Genera *Oncorhynchus* which includes Rainbow Trout and *Salmo* which includes Brown Trout



References: Chapman, G. 1986. Ambient water quality criteria for dissolved oxygen. U.S. E.P.A. EPA 440/5–86–003. 46 pp

Raleigh, R.F., T. Hickman, R.C. Solomon, and P. C.Nelson. 1984. Habitat suitability information: Rainbow trout. U.S. Fish Wildl. Serv. FWS/OBS–82/10.60. 64 pp

Raleigh, R.F., L. D. Zuckerman, and P. C.Nelson. 1986. Habitat suitability index models and instrem flow suitability curves: Brown trout, revised. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.124). 65 pp.

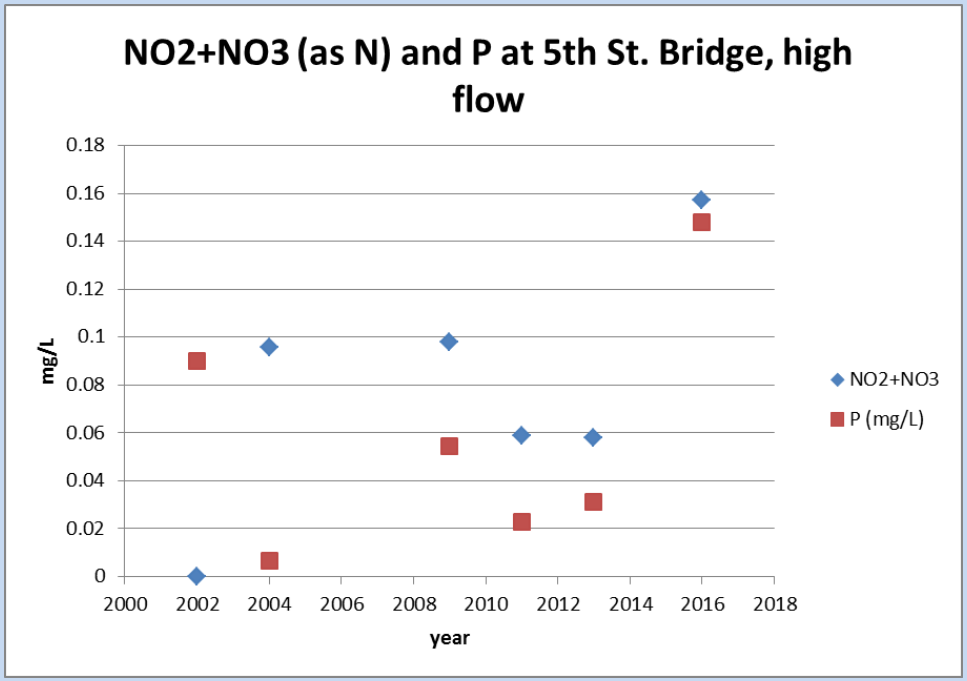
Almost certainly there are many factors contributing to the algae bloom and not just one single cause. Following are suspect contributing factors identified so far.

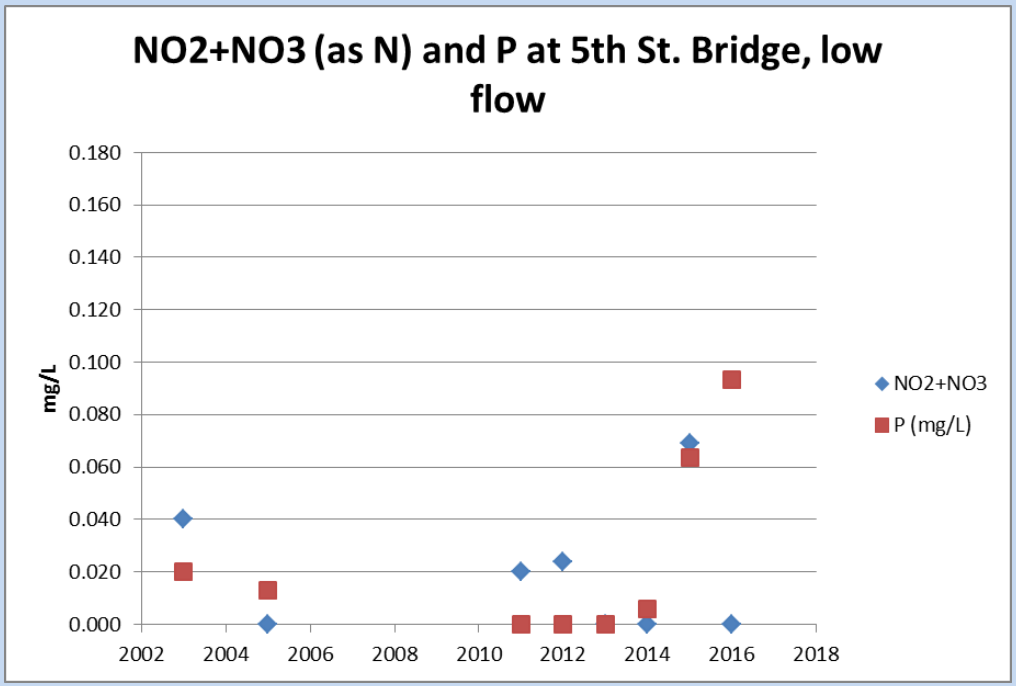
1. Excess nutrients
2. Engineered changes in river hydraulics
    a. Sediment disturbance (?)
3. Pond incubators
4. Insecticides (?)
5. Changes in the flow regime

There may be others.

Probable causative factor: Excess nutrient load.

- Note that USGS found elevated P in 2018 samples.





River Watch data

C. glomerata is a biological indicator of elevated N and P.

Stancheva et al 2016,
Stevenson et al 2014

Possible sources of excess nutrients: fertilizers, animal waste, leaky septic systems, and fish food.

Google Earth image September 2014, upper White River

Fish food is a rich source of nitrogen, phosphorus, and other nutrients.

Nutrient	Min / Max	Amount
Crude Protein	MIN	32 %
Crude Fat	MIN	3 %
Crude Fiber	MAX	6 %
Phosphorus (P)	MIN	0.80 %
Additional Analysis	-	Ruminant Meat and Bone Meal-Free. Contact local manufacturing plant for current feed tag. %

Nutrient content of Purina Game Fish Chow®

Related questions: where do the transplanted fish come from? Has hatchery water carried invasives into the White River system?

Probable contributing factor: modified river hydraulics

Constructed fish catchments on upper White River. Google Earth image September 2014.

A related question: Does dredging contribute to increased nutrient load, carried by disturbed sediments?

Possible factor: algae-loaded ponds draining into the river

Pond draining into upper White River. Google Earth image September 2014

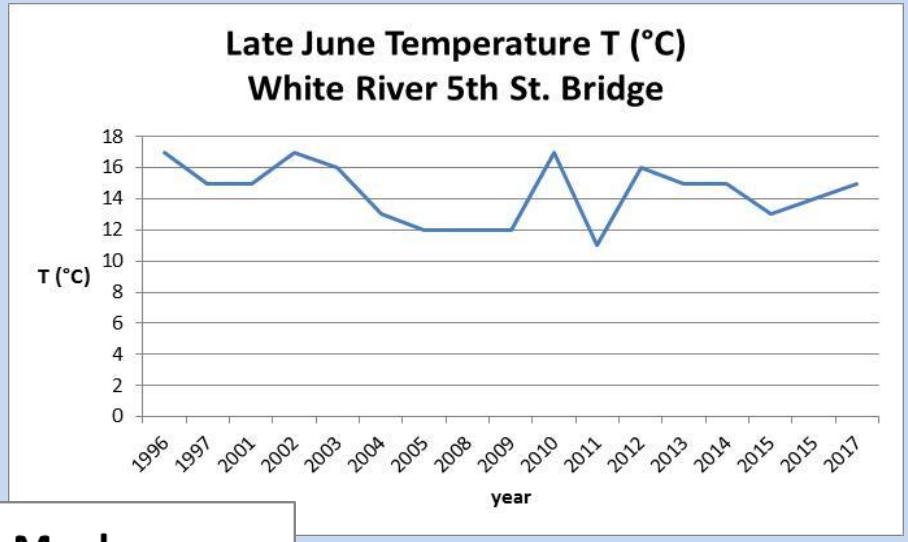
Possible contributing factor: insecticides

Photo credit Tallman Aerial Spraying

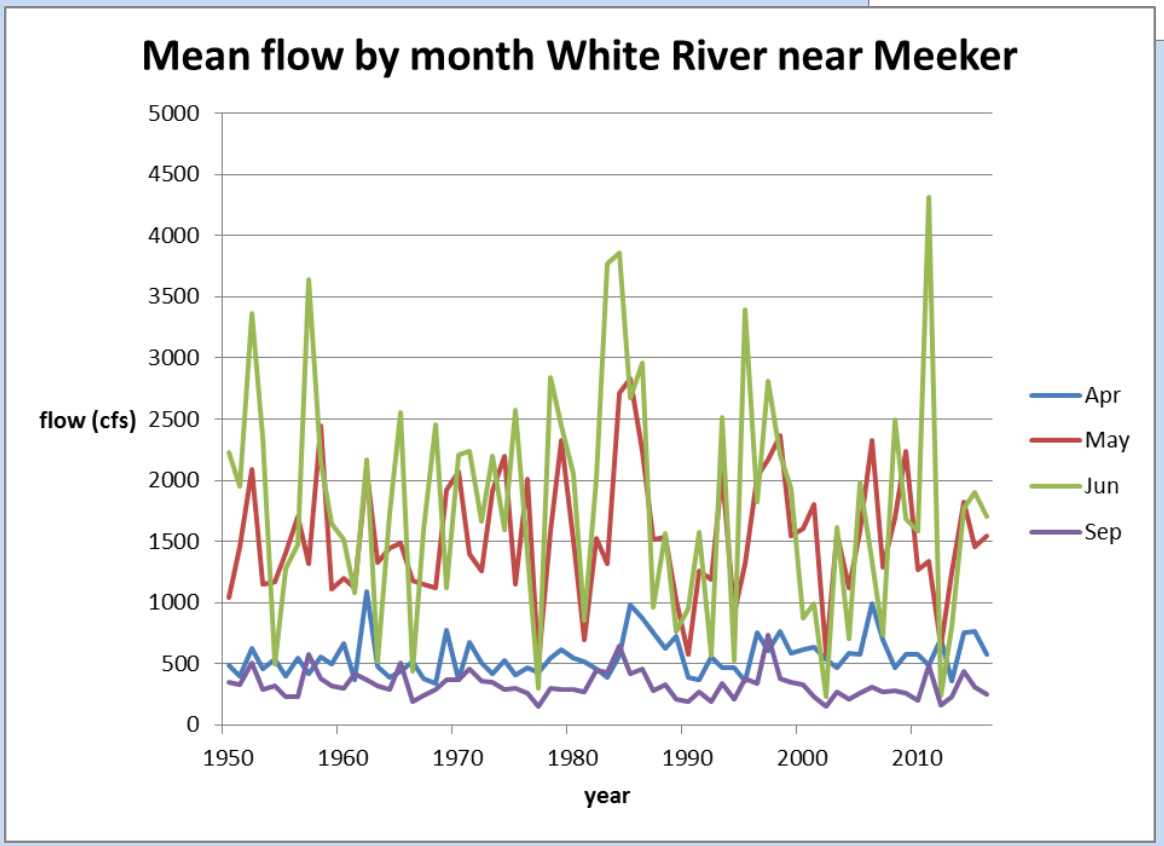
Rationale: Aquatic invertebrates graze on algae. Malathion lv and Kontrol 30-30 (permethrin) are highly toxic to aquatic invertebrates. If invertebrate populations drop, more algae grows.

Possible factors: change in physical parameters

- Note USGS finds upward trend in river temp



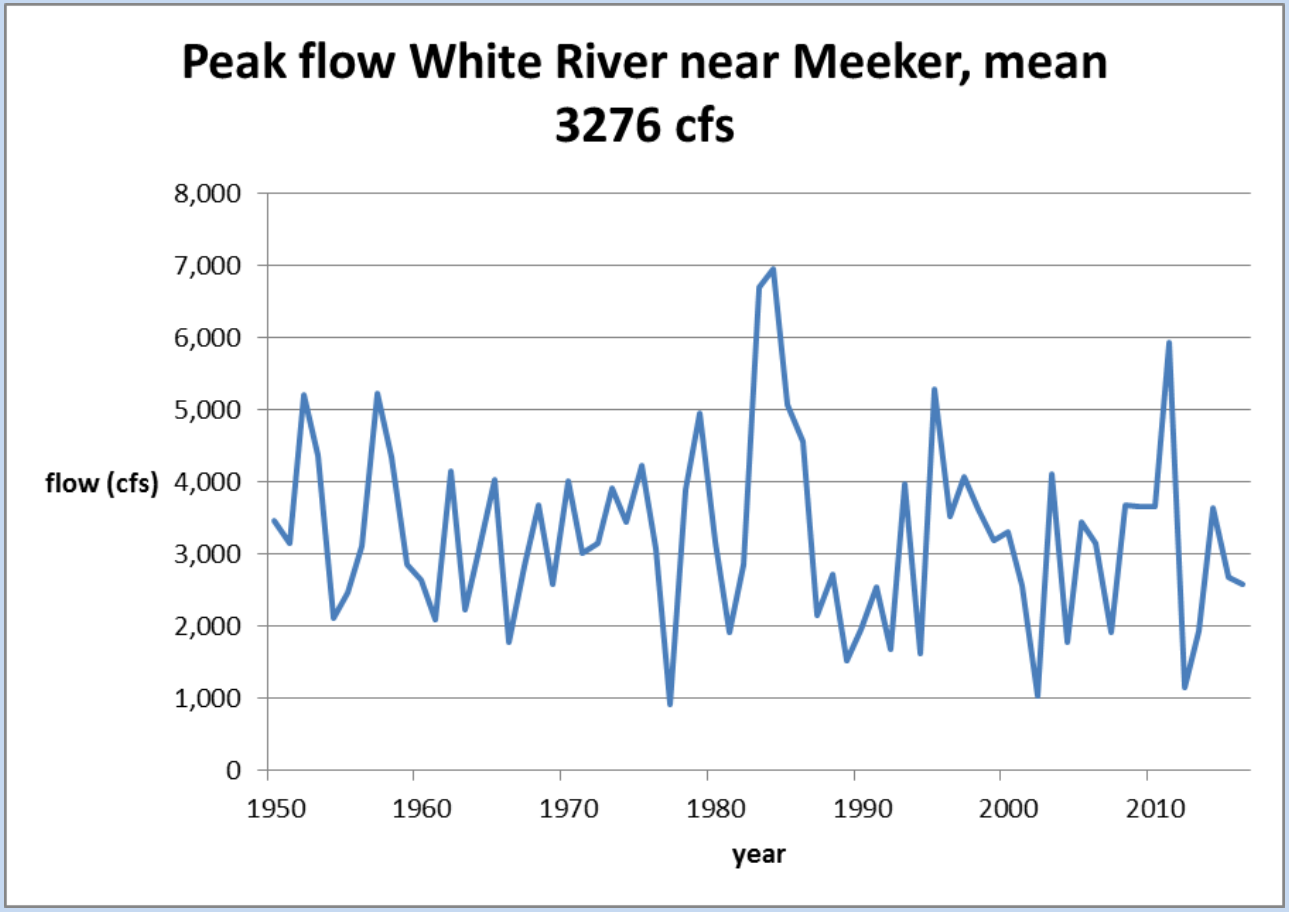
Meeker River Watch data



April data shows evidence of earlier start to Spring runoff.

Data from USGS gauge station 09304500 Near Meeker, CO. USGS NSIP

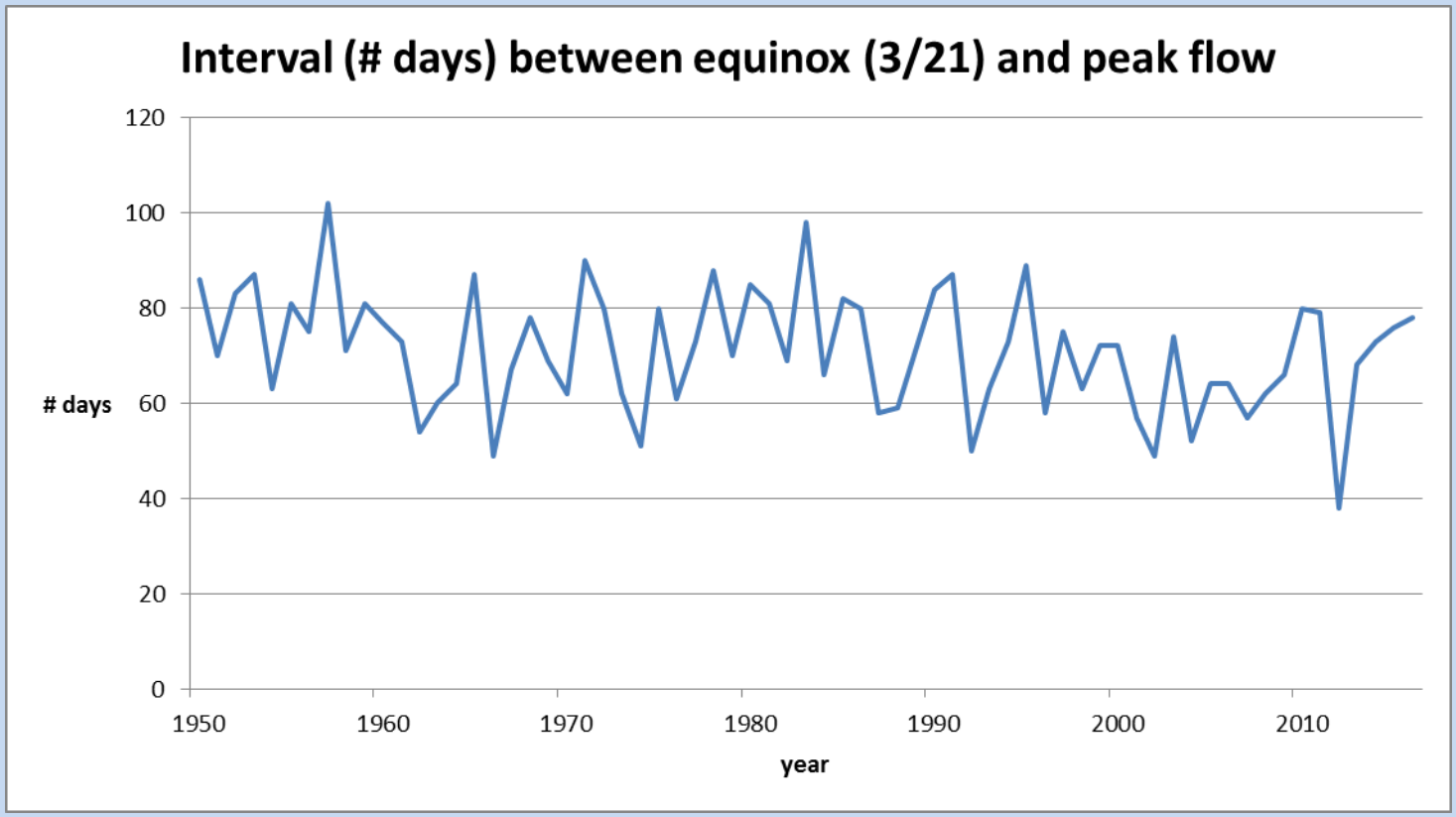
Possible factor: decrease in scouring flows



Regression analysis shows downward trend.

Data from USGS gauge station 09304500 Near Meeker, CO. USGS NSIP

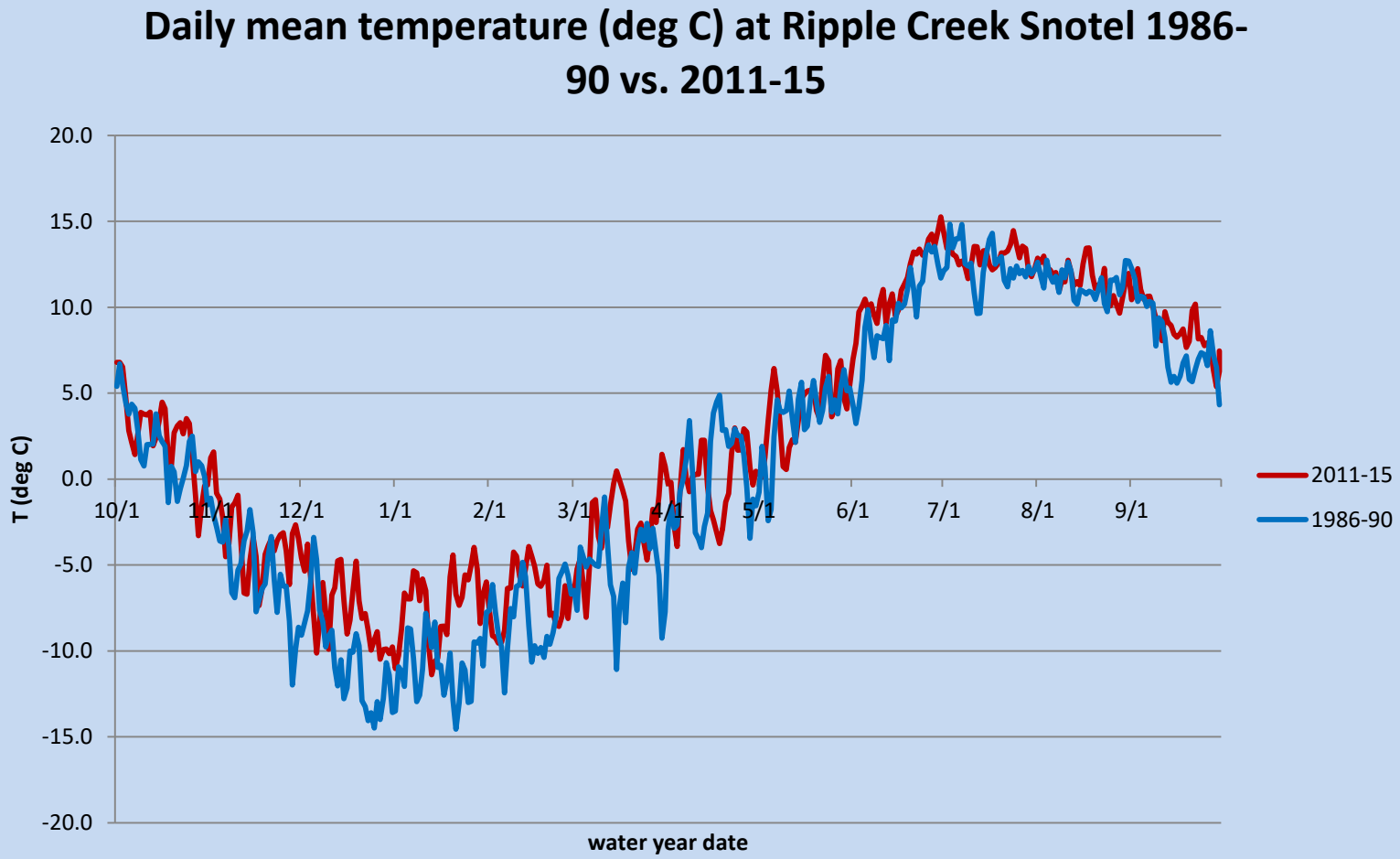
Possible factor: earlier runoff



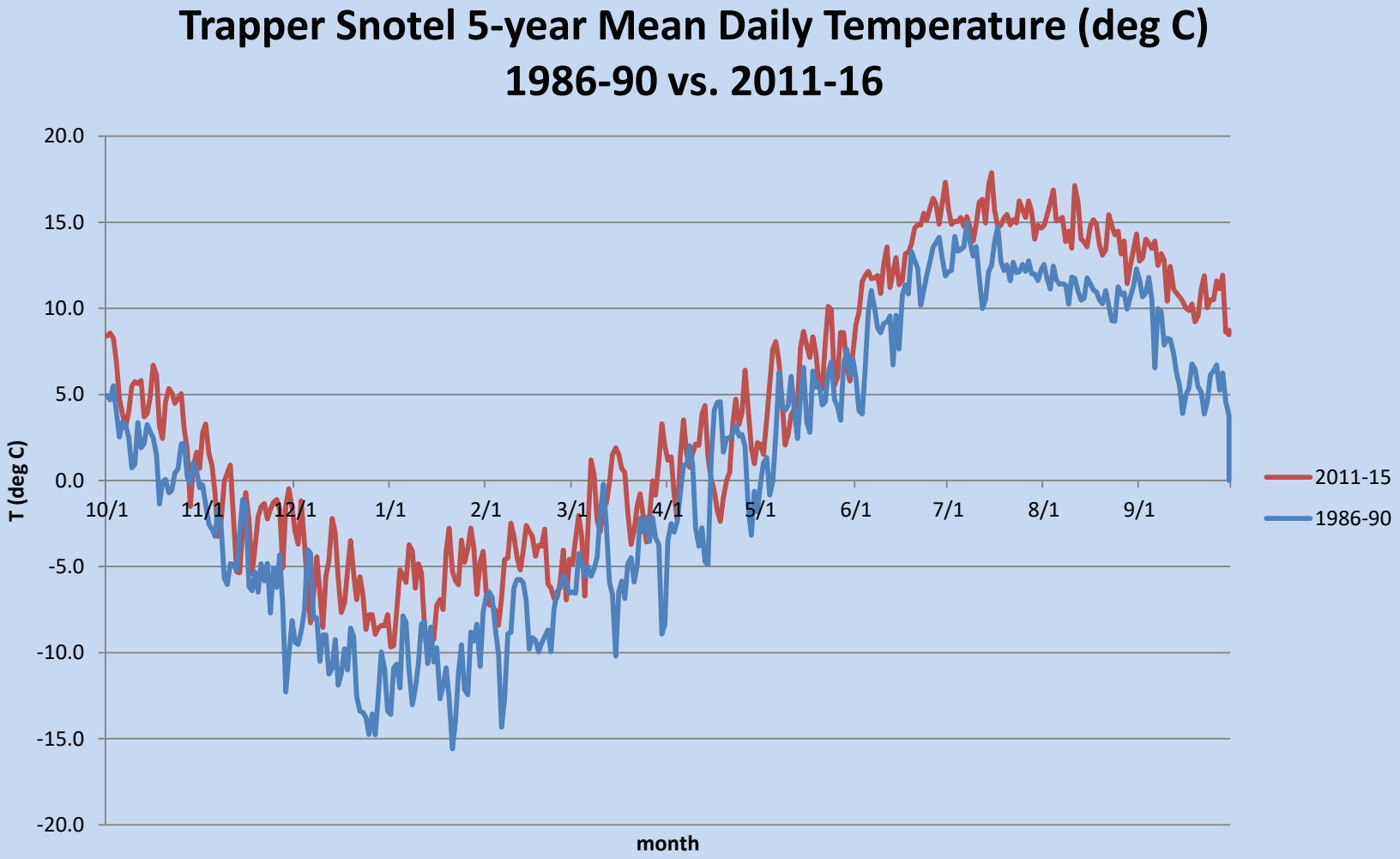
Data from USGS gauge station 09304500 Near Meeker, CO. USGS NSIP

Downward trend, i.e. earlier peak flow, is statistically significant. This gives algae a longer growing season.

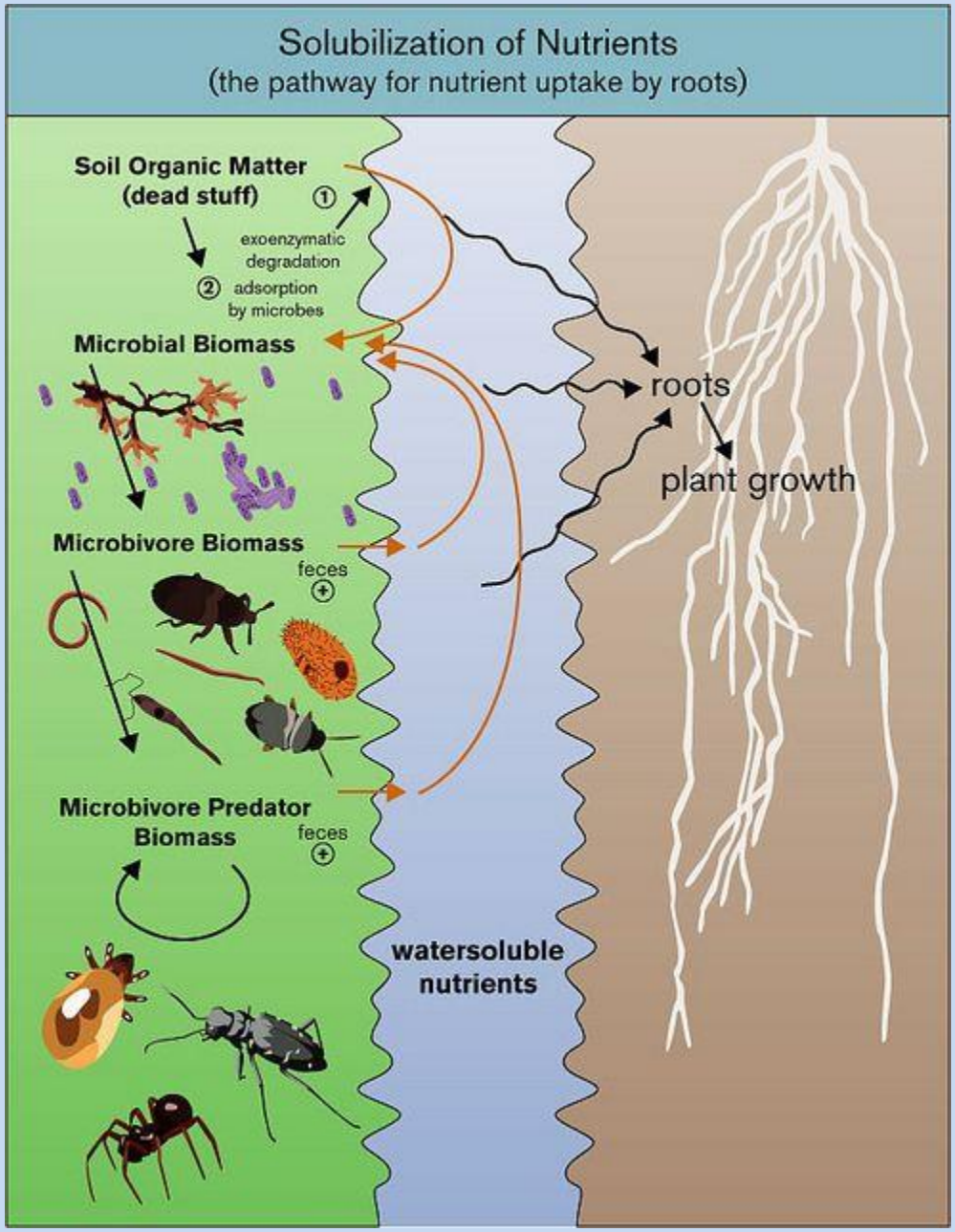
Why the earlier peak flow?



Winters at Ripple Creek are about 2.2 degrees C warmer today than in 1986.



Winters at Trapper Lake are about 3.6 degrees C warmer today than they were thirty years ago.



One more possible factor in the headwaters: Soil microbes control the Nitrogen cycle. Late snowpack at higher elevations, another possible consequence of climate change, reduces microbial uptake of N. This increases spring runoff of inorganic N. (Brooks et al, 1998)

What should be done?

Immediate actions:

1. Advise fishermen and boaters to clean boots, gear, and boats.
2. Test algae mats for pathogens, especially near well sites and swimming holes.

Recommendations pending further investigation:

1. Minimize or eliminate fertilizer runoff and runoff from animal waste.
2. Minimize or eliminate commercial fish food in the river system.
3. Minimize or eliminate insecticides along the river.
4. Minimize or eliminate dredging and pond construction.

What should be done? (cont'd)

Additional data collection:

1. Finish nutrient sampling, to locate sources.
2. Confirm identification of diatoms and algae in profile along the river.
3. Sample sediments for pesticide burden.
4. Track invertebrate MMI's (diversity of aquatic insects)
5. Consult Army Corps re: hydraulics and runoff.

And:

Plan for a changing climate.

This problem will not go away without long-term commitment by all the people along the river. The river will clean itself, over many years, but only if we reduce nutrient loads and preserve normal river hydraulics.

Acknowledgements:

Thanks to Michaela Taylor, CPW and the River Watch staff for training and equipment; Meeker Regional Library for facilities; Bob Tobin, Joe Dungan, and Mindi May for data; Sarah Spaulding for assistance with diatom identification; Bev Devore-Wedding and the late Bill Turner for starting and sustaining Meeker River Watch; and the many students at Meeker High School who have collected data over the years.