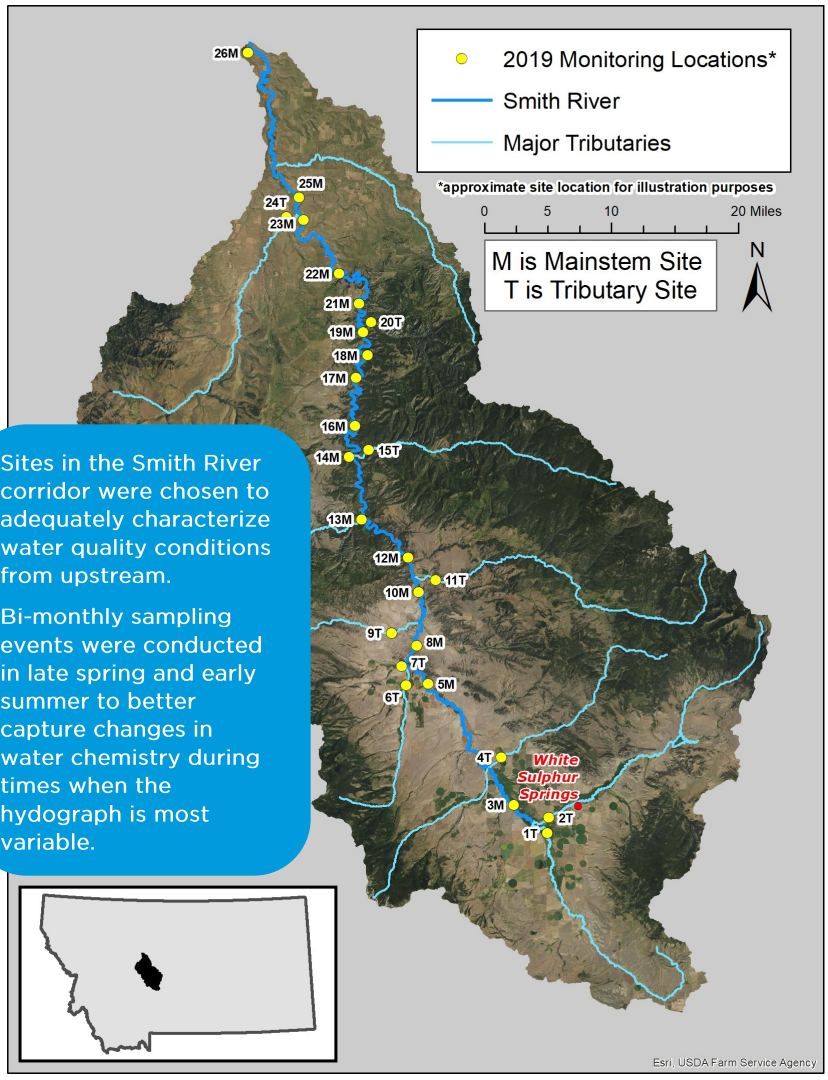
Smith River Nuisance Algae
2018-2019 Field Season Project

In 2015, the Montana Department of Environmental Quality and Montana Department of Fish, Wildlife & Parks began receiving reports from the public of algae reaching nuisance levels in the Smith River. These reports continued through 2017. During 2018, DEQ initiated a three-year project and began collecting data and gathering information to address the question: Why are algae reaching nuisance levels in the Smith River, and why now?

The state has collected water quality data along the main stem of the Smith River and multiple tributaries from the headwaters near White Sulphur Springs to the mouth near Ulm. Sampling has occurred during 2018 and 2019 and will continue through the end of 2020. This effort summarizes DEQ's understandings as of March 2020.



Sites in the Smith River corridor were chosen to adequately characterize water quality conditions from upstream.

Bi-monthly sampling events were conducted in late spring and early summer to better capture changes in water chemistry during times when the hydrograph is most variable.

What is *Cladophora*?

Cladophora glomerata is the dominant algae reaching nuisance levels in the Smith River. It forms long threads that can hinder recreation and impact the health of aquatic life. *Cladophora* is native to Montana.

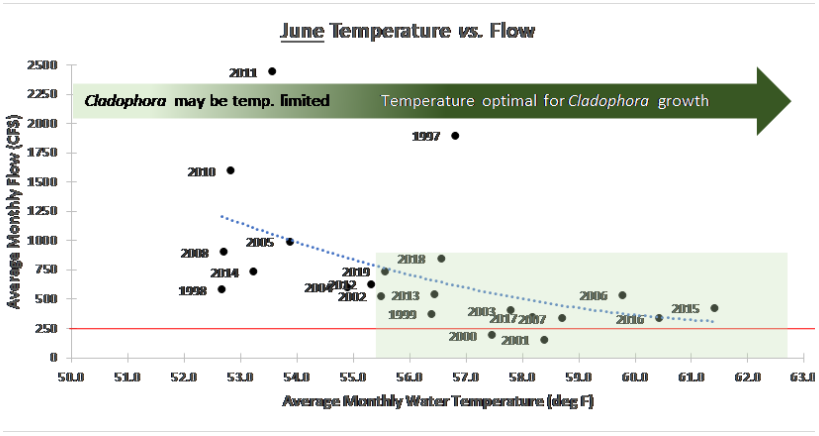
Conditions known to support *Cladophora* growth are:

- Flowing water with a velocity of 0.4-0.7 m/sec
- Sun: clear water allows light to penetrate to the river bottom, stimulating photosynthesis
- Increased nitrogen and phosphorus concentrations
- Water temperature range of 50-77 degrees Fahrenheit
- pH levels greater than 7.0
- Hard water (greater than 121 mg/L $CaCO_3$)

Air Temperature, Water Temperature and Discharge

Air Temperature

Air temperature is an influencing factor of water temperatures mainly during lower flows. Average weekly minimum air temperatures in White Sulphur Springs over a 23-year period (during a typical recreational float season May 15 through July 1) have increased by 3.3 degrees Fahrenheit and are trending warmer. Minimum daily air temperature may influence the length of the *Cladophora* growing season by increasing water temperature. During the same timeframe, average weekly maximum air temperatures have not increased.

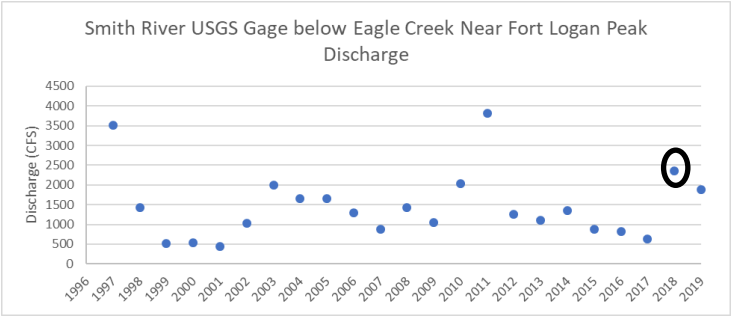


Water Temperature

Water temperatures in the Smith River near Camp Baker are significantly increasing from May 15 to July 1. June is an important month for the Smith River because water temperatures transition from being too cold to support *Cladophora* growth, to warm enough to support rapid *Cladophora* growth. Reports of nuisance algae growth began in 2015 and since then, all Junes have had water temperatures above the minimum threshold of about 55 degrees Fahrenheit, and nuisance growth has been observed.

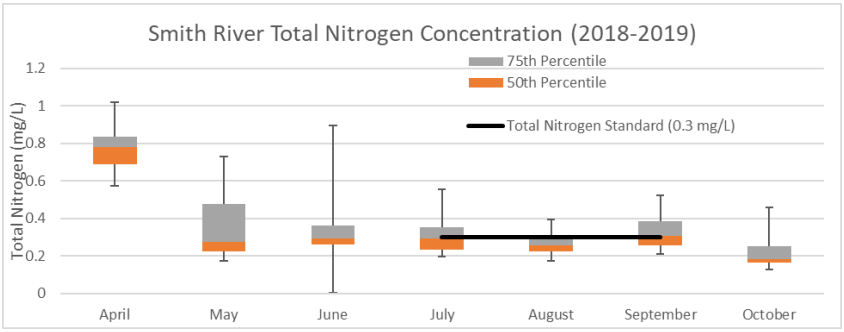
Discharge and Spring Scour

Runoff patterns in the Smith River near Camp Baker have not changed significantly from 1997 to 2018. Flows in 2018 presented the study with a natural experiment to see the affect that near-record high flows have on over-wintering filaments of *Cladophora.* Even with the third-highest peak flow on record, the Smith River still experienced nuisance algae growth. During 2018 *Cladophora* had matured by mid-June in the lower river. During 2019 the entire recreational float reach had significant growth by the end of June . Therefore scouring of overwintering filaments is not a likely factor in reducing nuisance algae growth in the Smith River.



Nutrients & Nutrient Limitation

Algae, like other plants, needs nitrogen and phosphorus for growth when other conditions, such as water temperature and light availability, are right.



In 2018 and 2019, nutrient concentrations reached high enough levels during June and early July to support nuisance algae growth. Algae growth had matured along the entirety of the recreational float reach of the Smith River by end of June and then late summer nutrient concentrations were too low to support high algae growth by late August.

Orthophosphate (the form of phosphorus available for algae uptake) is almost always present (detectable) in the Smith River, which is unusual for western Montana. DEQ implemented an investigation in 2019 to better understand tributary contributions of phosphorus loads in the Smith River. The investigation examined relative contribution of bioavailable phosphorus (dissolved phosphorus plus phosphorus that can readily desorb from suspended sediments) from principle tributaries. In June, Camas Creek and the North Fork of the Smith River were the two largest contributors to the phosphorus load measured at Camp Baker. DEQ will continue to investigate bioavailable phosphorus during the 2020 field season.

Nutrient Diffuser in the Smith River

Nutrient limitation indicates which nutrient is **not** sufficiently available for algal uptake in the water column. To determine nutrient limitation, DEQ deployed nutrient diffusing substrates two times during the growing season (July 1 to Sept. 30) to identify which nutrient (nitrogen or phosphorus or both) was limiting algae growth.

The first deployment of nutrient diffusing substrates (in late June and July) showed little to no nutrient limitation, meaning there were sufficient concentrations of both nitrogen and phosphorus in the water column to support robust algal growth. Nutrient-diffusing substrate results during the second deployment in late summer (late August to early September) showed that nitrogen and phosphorus were both equally limiting algae growth in the Smith River. Late summer is also when nutrient concentrations fell below the nutrient standard and less algae growth was observed.

2018-2019 Field Season Conclusions

June (specifically the first half of June) air and water temperature appears to be trending warmer, which is likely influencing *Cladophora* growth. Water temperatures are now often warm enough to support rapid algae growth in June, when nutrient concentrations are still high enough to support growth. In 2018, a heavy rain event in mid-June produced high flows and turbid water that made visibility to the stream bottom poor—this likely caused a delay in reports of algae growth from recreational floaters to later in the summer. After the runoff, algae was easily observed in 2018 and 2019. As the summer progressed, DEQ observed a strong nitrogen and phosphorus limitation, suggesting that nutrient concentrations are too low for robust algal growth by mid to late summer.


July 16, 2018


July 1, 2019

Predictions

June is likely to manifest nuisance *Cladophora* growth going forward. This is because water temperatures are favorable for growth, and trending warmer, probably driven by air temperatures. The past two season's nutrient data show concentrations are sufficiently available to support growth during June.

The next phases of the project will investigate if resiliency can be provided by nutrient reduction activities in the watershed.

2020 Field Season

Project planning for the 2020 field season is underway. The Smith River Nuisance Algae Study will follow a similar monitoring approach as 2019. The sampling strategy will aim to characterize current conditions upstream to downstream on the main stem, capture the timing of algal growth, continue trend analysis, deploy nutrient diffusing substrates for nutrient limitation analysis and investigate bioavailable phosphorus. An additional year of data collection will further clarify patterns observed from 2018 and 2019 field seasons.

Questions?

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