Periphyton Monitoring Pilot Project 2008

Draft Report

Prepared for the South Yuba River Citizen's League

by

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Project Summary

Citizens in the South Yuba watershed have become increasingly aware of algal growth in the river. This growing awareness, as well as a continued interest to learn more about the South Yuba River, led SYRCL to initiate a pilot periphyton monitoring project in the summer of 2008. This project had two primary objectives, to create and implement a periphyton monitoring project that could produce reliable, repeatable and informative results, and to determine whether such a program could be conducted by citizen monitors with only brief introduction to general algal ecology and a single training in periphyton monitoring protocols.

Three sites were selected by the SYRCL staff and monitored by citizen monthly from July to November. Monthly surveys documented a suite of physical habitat and periphyton parameters. Periphyton parameters included color, growth type, length of growth and extant of cover of the dominant periphyton. Biomass was estimated using length and percent cover of periphyton.

Results show a similar biomass pattern across all sites with a measured peak biomass in early August followed by a noticeable drop in early September. Lang's Crossing (below Spaulding Reservoir) consistently had the highest biomass, followed by Washington and then Plavada. Lang's Crossing has a very stable growth type (dominated by brown mats) with variations in growth type occurring at both Plavada and Washington.

Analysis of the first year's data shows the volunteer river monitors were able to conduct the surveys with minimal instruction or oversight, providing valuable data that can help us document and understand complicated patterns of algal growth and community structure in the South Yuba River. This pilot project has specific recommendations for establishing an annual monitoring program, as well as first year of data.

Introduction

Periphyton (attached algae) plays an essential role in river ecology, yet nuisance growth associated with benthic algal blooms is what typically garners attention from scientists and the general public. Citizens in the South Yuba drainage have become increasingly aware of algal growth in the river and suspect these blooms indicate some insult to the general health of the river. Additional information, including a greater understanding of the spatial and temporal patterns of periphyton in the South Yuba River system, is critical to determining cause and effect of algal blooms. To address concerns regarding algal blooms and increase our understanding of river ecology in the South Yuba River, a periphyton monitoring pilot project was initiated during the early summer of 2008.

There were two primary objectives of the pilot periphyton monitoring project. The first objective was to create and implement a periphyton monitoring project that could produce reliable, repeatable and informative results. The second objective was to determine whether such a program could be conducted by citizen monitors with only brief introduction to the protocols and general algal ecology. The South Yuba River Citizens League (SYRCL) operates a water quality monitoring program in the watershed utilizing many citizen volunteers who follow standard training and quality control procedures. This pilot was designed to test the feasibility of implementing a new component of citizen-based monitoring for SYRCL.

Methods

Site Selection

Three sites on the South Yuba were selected from existing sites used for monthly water quality monitoring. SYRCL staff selected the sites to represent a range of watershed conditions as noted in Table 1. Plavada is the most upstream site, located near Kingvale. Langs Crossing is the next site downstream and located immediately below Spaulding Reservoir. Washington is the most downstream site and located immediately downstream of the townsite. Monthly surveys started in June of 2008 and continued through November.

Table 1: Pilot Study Sites in the South Yuba River

Site Name	Elevation	Description
Plavada	1858 m	Headwaters of river located 7 km downstream of Donner Summit Waste Water Plant (discharging October – July). Dry channel during some summers.
Langs Crossing	1362 m	Located 2.5 km downstream of Spaulding Reservoir and 1 km downstream from the confluence with the main spill channel (Jordan Creek).
Washington	790 m	Immediately downstream of the Washington townsite and 2 km above Poorman Creek confluence

Rapid Algal Assessment Survey

Rapid Algal Assessment protocols for periphyton monitoring were adapted from protocols presented in Biggs and Kilroy 2000, Stevenson et al 2006, and Barbour et al 1999.

General protocols are as follows. Basic site information and current conditions are noted on Rapid Algal Assessment Survey (RAAS) sheet A (Appendix X). Once the general area are selected by SYRCL staff, reach length are determined to be no less then ten river widths long and are typically bounded by a distinct change in flow characteristics (usually pools). A minimum of three transects are established at representative riffle or glide habitats in the wadeable sections of the target river reach with relatively easy and safe access. Exact transect location will vary monthly depending on channel depth and flow conditions. Transect data is collected on the RAAS sheet B (Appendix X). Areas with back water, side and mid channel eddies are avoided as much as possible. Transects were revisited each month with slight adjustment upstream or downstream to avoid repeated disturbance from previous surveys.

At each transect, channel width and canopy cover (using a densitometer) measurements are taken. The four measurements of canopy cover are taken at both left and right river margins facing away from the channel, and in the center of the transect, both facing upstream and facing downstream. Each measure of canopy cover will range from 0 (no canopy cover) to 25 (full) canopy cover.

Along each transect, a viewing bucket is used to assess physical and periphyton characteristics. Viewing buckets are five gallons buckets with the bottoms replaced with clear grided plexiglass to more clearly see substrate and to quantify conditions with grid. Multiple “views” of the substrate are spaced at one to four meter intervals depending on channel width, water velocity, substrate conditions, and the homogeneity of periphyton along the transect. Backwaters, side pools, and mid channel eddies are avoided.
At each view, both physical habitat and periphyton assessments are conducted. Physical habitat assessment consists of a depth measurement, an indices for both overall substrate size*, and substrate less then two cm. Substrate less then two cm is an indicator of disturbance because smaller particles are more easily entrained with consequent scouring of periphyton (Francoeur and Biggs 2006).

Periphyton assessments, conducted at each view, document periphyton color, growth type, percent cover (extent of cover, and a ranked length of growth for the primary growth type for the dominate growth type. (see RAAS sheet B for details for each measurement). Current practices include documenting only the primary growth type (which ever growth form is covering the most substrate).

Data analysis

Periphyton biomass estimates are calculated for each transect by multiplying the ranked length of growth index (0-7) with the percent cover value (0-100 %) for a range of biomass Index values from 0 to 700. Monthly data (depth, substrate, biomass index) are averaged per transect and then averaged per site for spatial and temporal comparisons. Calculations include measurements of average and variation. Substrate index is converted to a numerical code* for calculations (bedrock = 1, boulder =2, cobble = 3, gravel = 4, sands = 5, clay/silts = 6). The percent cover based on growth type and color are tracked as well to develop qualitative assessment of changes in algal community composition through time. Changes in growth type are also tracked for similar comparisons.

Results

Spatial Analysis

Physical habitat results are shown in Table 2. As expected, the channel width and depth increases downstream. Canopy cover is minimal for all sites with an average high value of 5.4%. Substrate increases slightly from Plavada (substrate index = 2.89) to Washington (substrate index = 2.67) with greater variation at the Plavada site. The largest substrate was found at Lang’s (substrate index = 2.45), which is most likely are results of its proximity to the Spaulding reservoir Dam. The percent substrate less then two cm decreases from Plavada to Washington with a clear reduction at Lang’s crossing most likely due to Spaulding Dam. This suggests that Plavada is more likely to experience scouring at greater frequencies then Washington and Lang's and that Lang's, with less then 2% substrate in the less then two cm class, will experience scouring flows at a much lower frequency then the other two sites.

Table 2 Summary of physical habitat data, mean ± stdev

Parameter	Plavada	Lang's	Washington	units
Channel width	7.0 ± 2.9	10.75 ± 2.77	16.89 ± 4.77	m
CC	0.91 ± 1.18	5.41 ±4.92	2.26 ± 4.16	%
Depth	12.08 ± 3.18	25.78 ±1.10	27.09 ± 6.67	cm
Dominant substrate	c	b	b/c	
Substrate index (SI)	2.89 ± 0.43	2.45± 0.20	2.67 ± 0.09	
% substrate < 2 cm	28.2 ± 4.67	1.78 ±2.37	10.39 ± 4.18	%

Overall biomass index results are shown in Figure 1. Lang's crossing consistently had the highest biomass index, followed by Washington and then Plavada. Lang's crossing was consistently dominated by brown mats with an increase in filamentous growth in October.. Washington showed a pattern similar to Lang's crossing with an increase in filamentous growth in October however film and filaments were consistently a part of growth type for the Washington site. All three sites followed a similar temporal pattern with respective peak biomass occurring in early August followed by a reduction in biomass by early September. Fall sampling show a slight rise and fall in biomass from September to November.

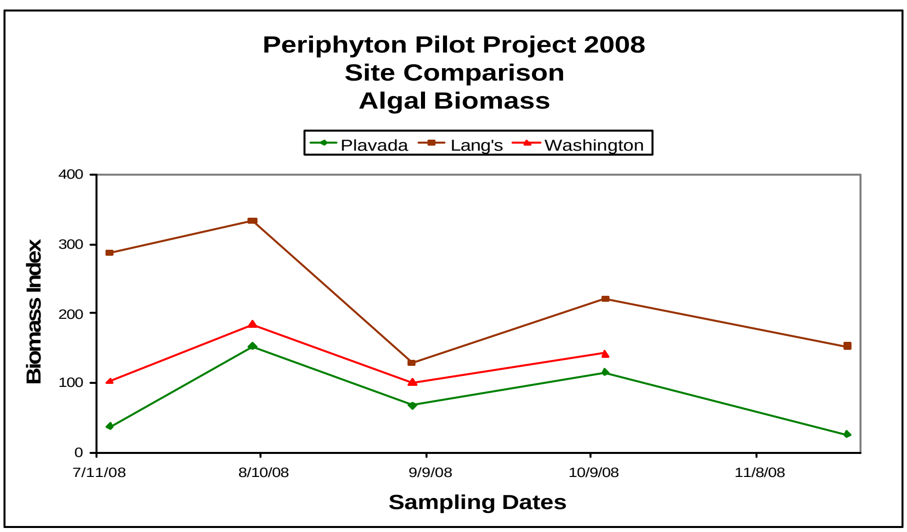

Figure 1 *Overall* Biomass Index for all three sites.

Temporal analysis

Plavada

Biomass index at Plavada ranged from 26 to 150. Dominant growth type showed considerable temporal variation. Periphyton film dominated in July and November while brown mats dominated in September and Filamentous greens dominated in October.

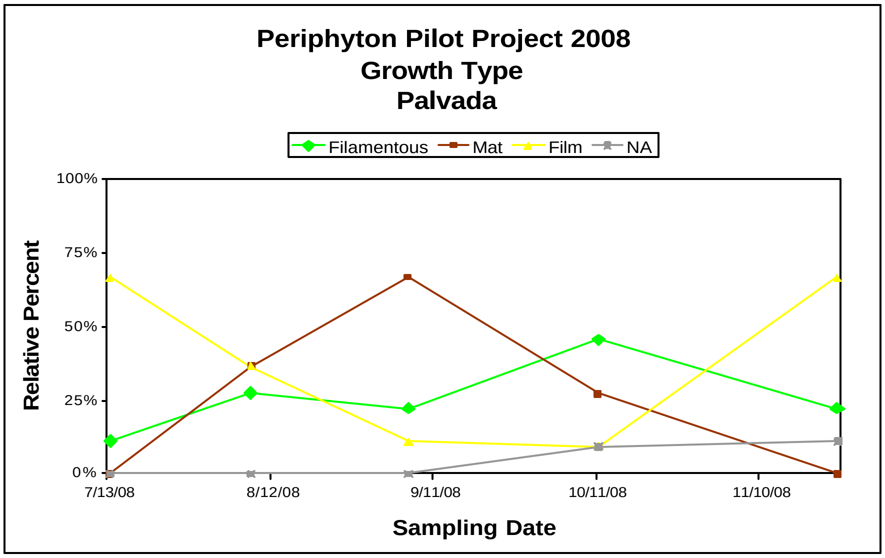

Figure 2 Biomass by growth type for Plavada

Lang's crossing

Lang's crossing consistently had the highest biomass index compared with the other two sites with a peak of 333 in early August and a low of 128 in early September. Growth type was consistently brown mats with an increase in filamentous greens occurring in early October.

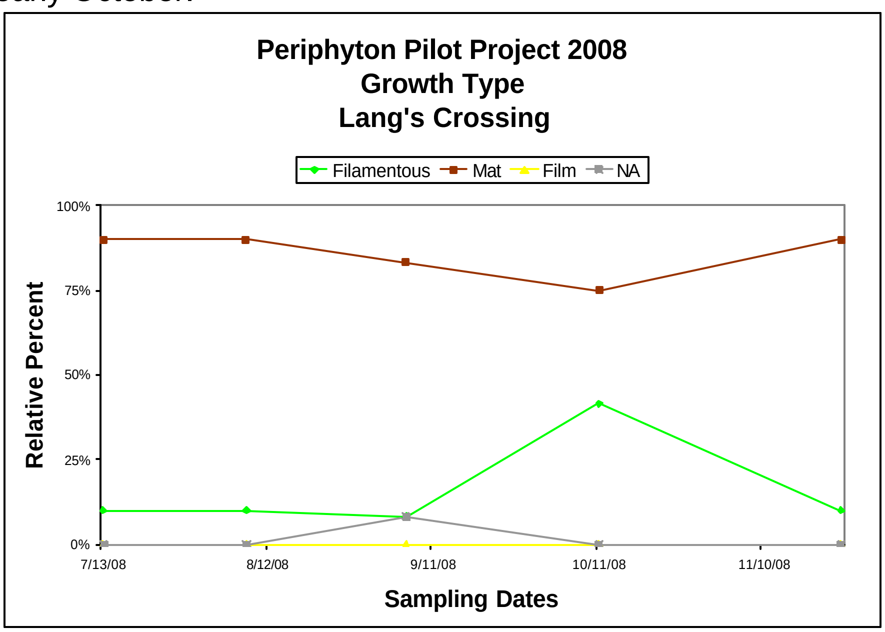

Figure 3. Biomass by growth type for Lang's Crossing

Washington

Washington had a biomass index intermediate to that of Plavada and Lang's with a peak of 180 in early August and a low of 101 in early September. Growth type was mixed throughout the study with brown mats dominating, and filamentous greens and periphyton film maintaining a strong subdominance.

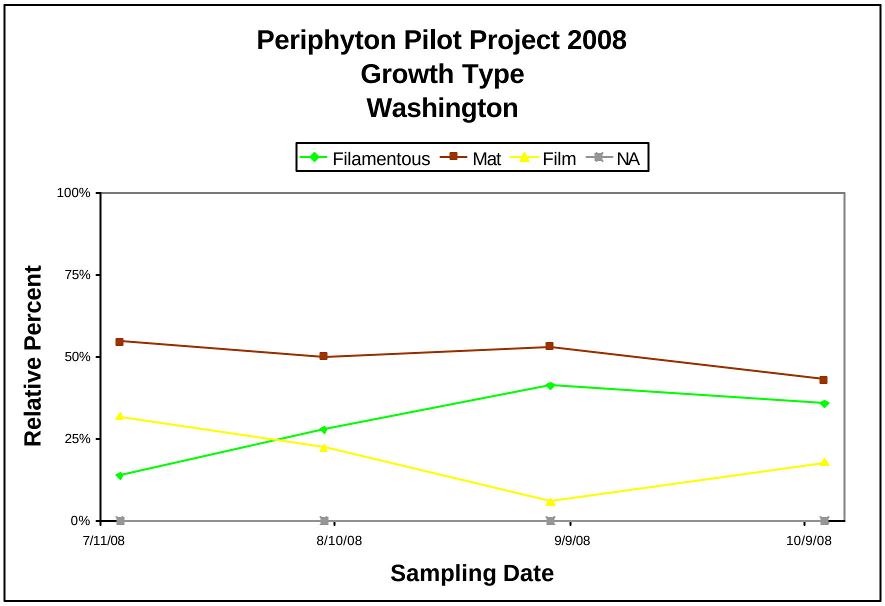

Figure 4 Biomass by growth type for Washington

Discussion

The results of this pilot project suggest that the periphyton monitoring project could produce reliable, repeatable and informative results. Each site had a peak biomass in early August followed by a fairly sharp reduction in biomass during the following month's survey. The fact that these results were repeated across sampling sites and time, despite the use of different monitors among sites, suggests the protocols are reliable and repeatable. Quantification of this temporal trend is informative and useful for understanding the South Yuba River System. A reduction in periphyton biomass in mid to late summer could be associated with an increase in water temperatures and/or an increase in benthic macroinvertebrate herbivory. Although the data can not determine causation it does provide insight into ecosystem patterns, a basis for future investigations, and ultimately leads to a greater understanding in the river ecosystem.

Growth type data also provides insight into the river ecosystem. Lang's showed little variations in growth type, consistently dominated by brown mats, which is typical down stream from dams. On the other hand, Plavada showed considerable variation, fluctuating from periphyton films to brown mats to filamentous greens dominance. This is consistent with a site that experiences higher frequency of disturbance which substrate data suggests. Washington never had a clear dominating growth type most likely due in part to the relative physical heterogeneity at that site.

This periphyton monitoring pilot project was implemented with limited expertise and minimal instruction. After initial instruction, the monitors received no other training. The similar trends and low variation in the data suggest the protocols create enough structure for citizen monitors to conduct rapid algal assessments successfully.

<u>Study Limitations</u>

Several important limitations are identified and discussed below.

1.) The methods are not applicable to non-wadeable stream reaches, therefore significant portion of middle and lower reaches of the South Fork Yuba can not be assessed using these methods.

2.) Biomass index values have not been indexed to a Biomass calculation (ie. chl *a* or Ash free dry weight) therefore data interpretation is limited to relative comparisons within this study but should not be used for cross system comparisons.

3.) Inferences of algal community composition from growth type and color assessments made during algal assessments, although helpful and informative, are limited without taxonomy data.

4.) Current protocols only assess dominate growth type however algal communities are often mixed with complex growth patterns. Without documentation of 'secondary growth type' (non-dominate) important information could be neglected.

Recommendations

Based on the objectives and results of this pilot study, the following recommendations are suggested:

1.) SYRCL should consider implementing a second year of periphyton monitoring using the same protocols but with modestly expanded scope and parameters
2.) Start surveys earlier in the spring (as conditions allow) to attempt to document spring growth patterns
3.) Maintain consistency of methods used in 2008 and store and analyze data for both intra-annual and inter-annual comparisons
4.) Coordinate final modifications of protocol with Bioassessment Workgroup of the California State Water Resources Control Board (citation of draft document).
5.) Add secondary periphyton assessment. This step would not add much complexity to filed assessments and could possibly make assessments easier while providing important information.
6.) Conduct a suite of quality assurance measures
    - Cross check a subset of sample transects with repeated measures by multiple surveyors to evaluate measurement error.

- Analyze subset of periphyton samples from transect surveys for biomass measurements (chl *a* and Ash Free Dry Weight) to index Biomass Index values calculated from surveys.
- Analyze subset of periphyton samples for taxonomy to validate growth and color assessments as well as determine community composition

References

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