Comparison of algal communities of streams on the Pumice Plain of Mount St. Helens

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Abstract

Since the 1980 eruption of Mount St. Helens, the Pumice Plain on its north flank has provided an opportunity to study primary succession on sterile volcanic material. Periphyton samples were collected at 14 reaches across four streams on the Pumice Plain and later processed for examination with light microscopy. A minimum of 300 algal units per slide were enumerated and classified by chloroplast structure of intact cells. This study compared 5 "mid" sites across all streams. Chi-squared analysis revealed significant differences in algal communities among stream reaches.

Introduction

- Mount St. Helens has served as a model for studying primary succession since its catastrophic eruption in 1980 (Wood and del Moral 1987; del Moral 1999).
- The Pumice Plain resulted from the debris avalanche and pyroclastic flows, which deposited a layer of pumice up to 200 m deep over 20 km^2 (Titus and del Moral 1998; Fig. 1).
- Algal community surveys were conducted by Ward et al. (1983) and Rushforth et al. (1986) in streams located in the greater eruption impact area.
- **Little work has been conducted in the newly-formed streams draining to the south side of Spirit Lake.**
- This preliminary study seeks to compare the algal communities from five sites across these streams.

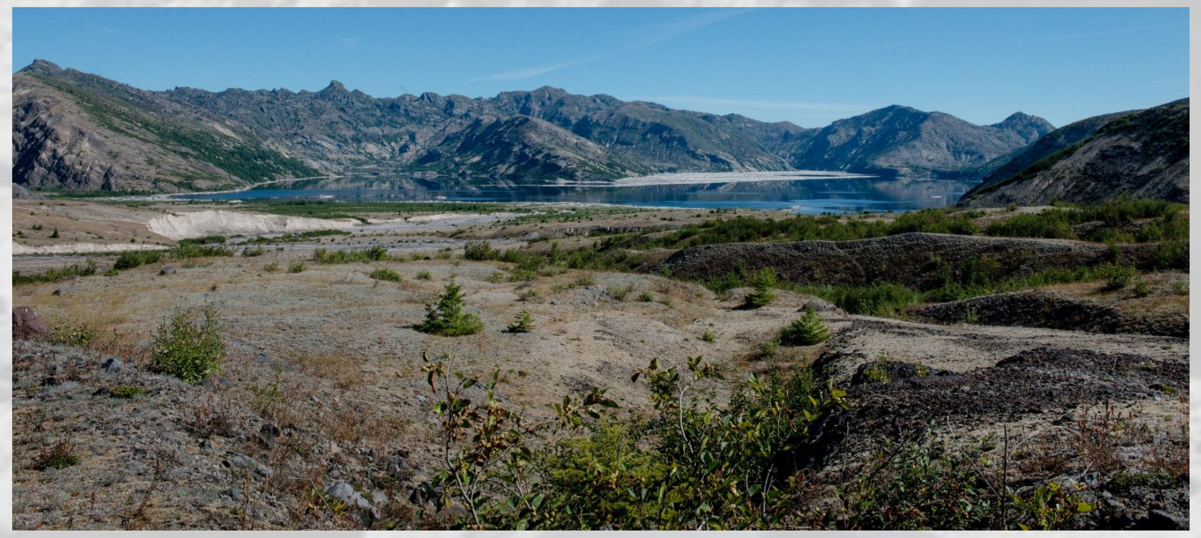

Fig. 1. View of the south shore of Spirit Lake from the Pumice Plain near Willow Springs, illustrating the area's sparse vegetation. Photo by Shauna Bittle.

Methods

__Site description__: The Pumice Plain is located between the north flank of Mt. St. Helens and Spirit Lake (Fig. 2).

- Four streams surveyed:
  - **Willow** and its tributary, **Forsyth**
  - **Clear**
  - **Geothermal**
  - **Camp**
- **Varying** degrees of riparian **vegetation cover**; mostly Sitka alder (*Alnus viridis*) and shrub willow (*Salix sitchensis*) (Fig. 3)

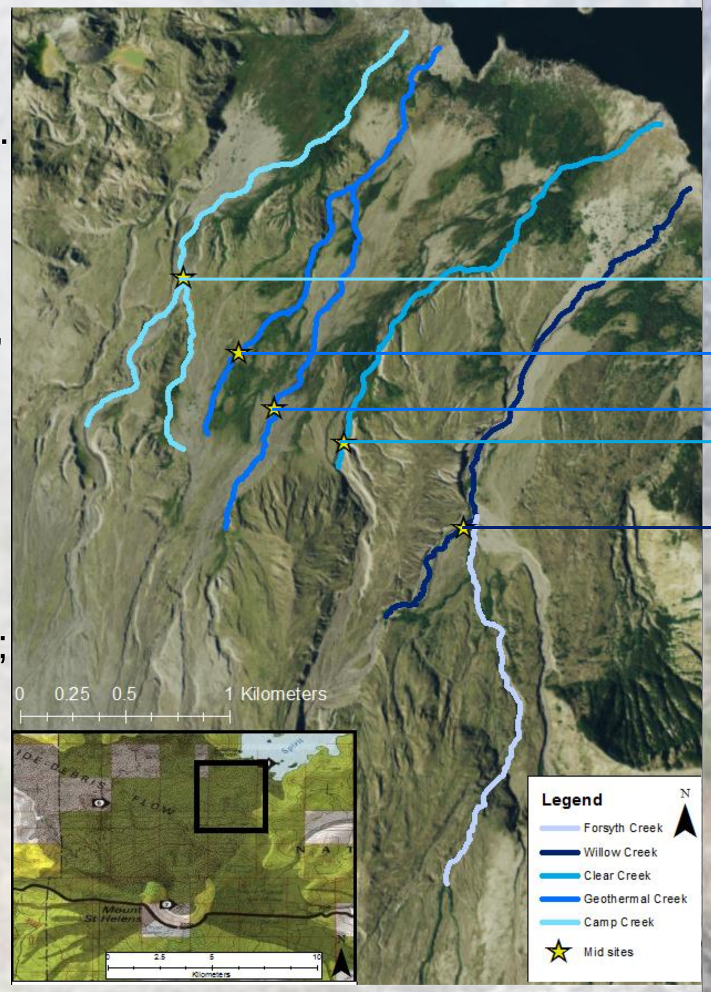

Fig. 2. Map of the four streams studied on the Pumice Plain, with sampling sites identified in the legend.

__Stream surveys__: At each sampling site, we:

- **assessed** physical characteristics, including:
  - **discharge** (Fig. 4)
  - **periphyton** and **canopy cover**
  - **slope**
- **collected macroinvertebrates**
- **collected** a subsample of **water** for alkalinity analyses (Rounds 2012)
- **surveyed vegetation** using 1 m^2 plots (Fig. 6).

__Algae processing__: Periphyton sampled at 14 sites using surface-area adjusted method

- 25-50 ml **preserved** in 1% **Lugol's** solution and transported to lab
- Using 5 "mid" site samples, **wet mounts** prepared according to EPA protocols (Barbour et al. 1999)
- Examined under **1000x magnification** on a compound light microscope (Leica, Buffalo Grove, IL, USA)
- 300 algal units per slide (minimum) were **enumerated** and **categorized** based on chloroplast structures of intact cells (Figs. 5-8)

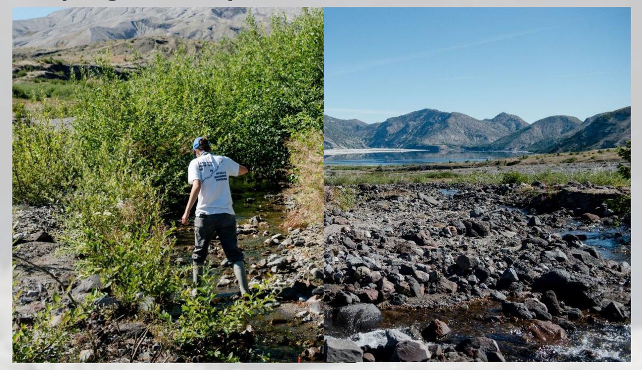

Fig. 3. Contrasting thickness of riparian cover at Forsyth Creek Down (left) and Willow Creek Down (right). Photo by Shauna Bittle.

Fig. 4. ERW and AB taking discharge measurements at Willow Creek Up. Photo by Shauna Bittle.

Results

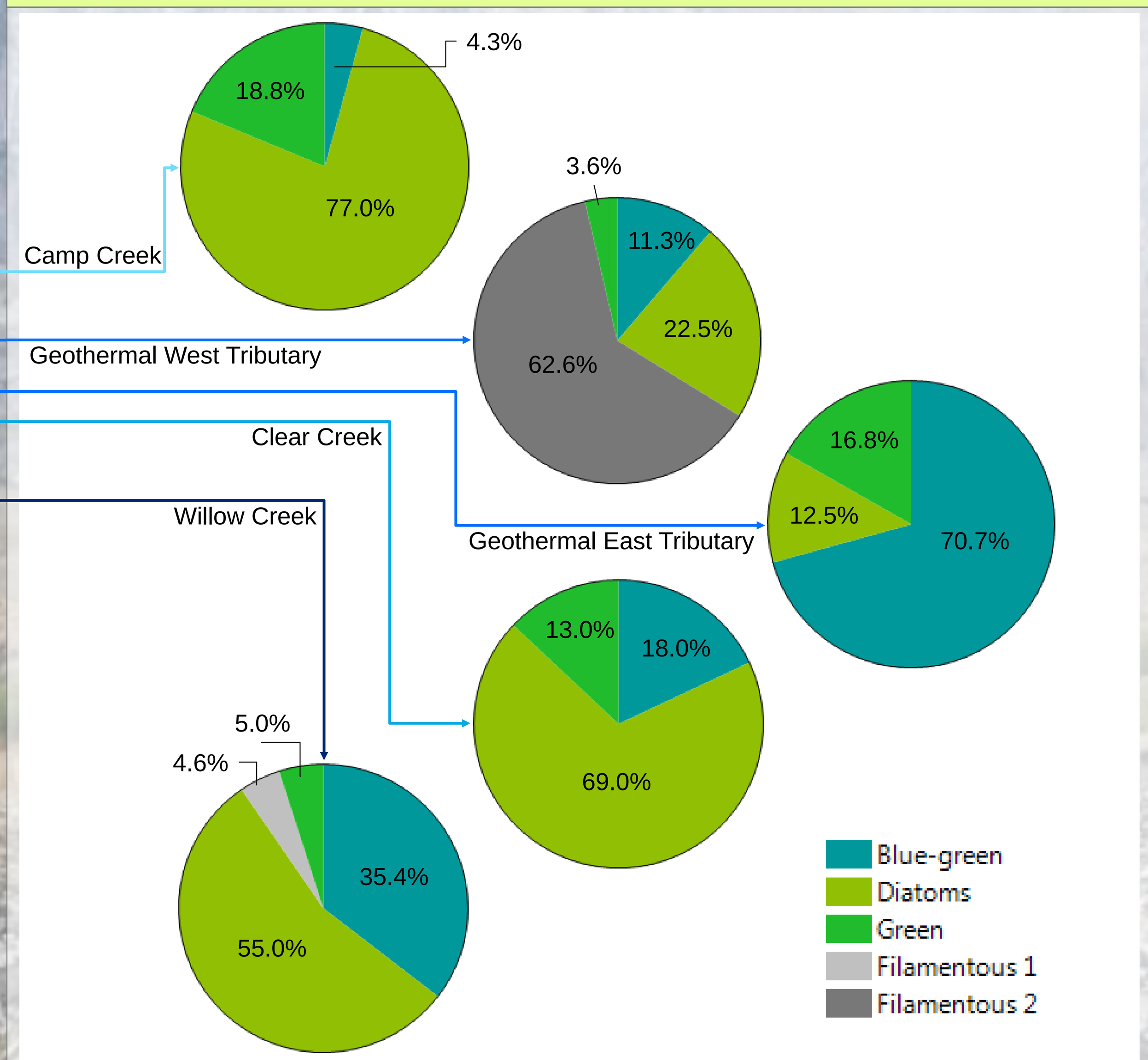

Fig. 5. Pie charts of the frequency (% of total algal units counted per slide) with which different algae classes appeared in wet mounts of the "mid" sites (χ^2=1236.391, n=1512, df=16).

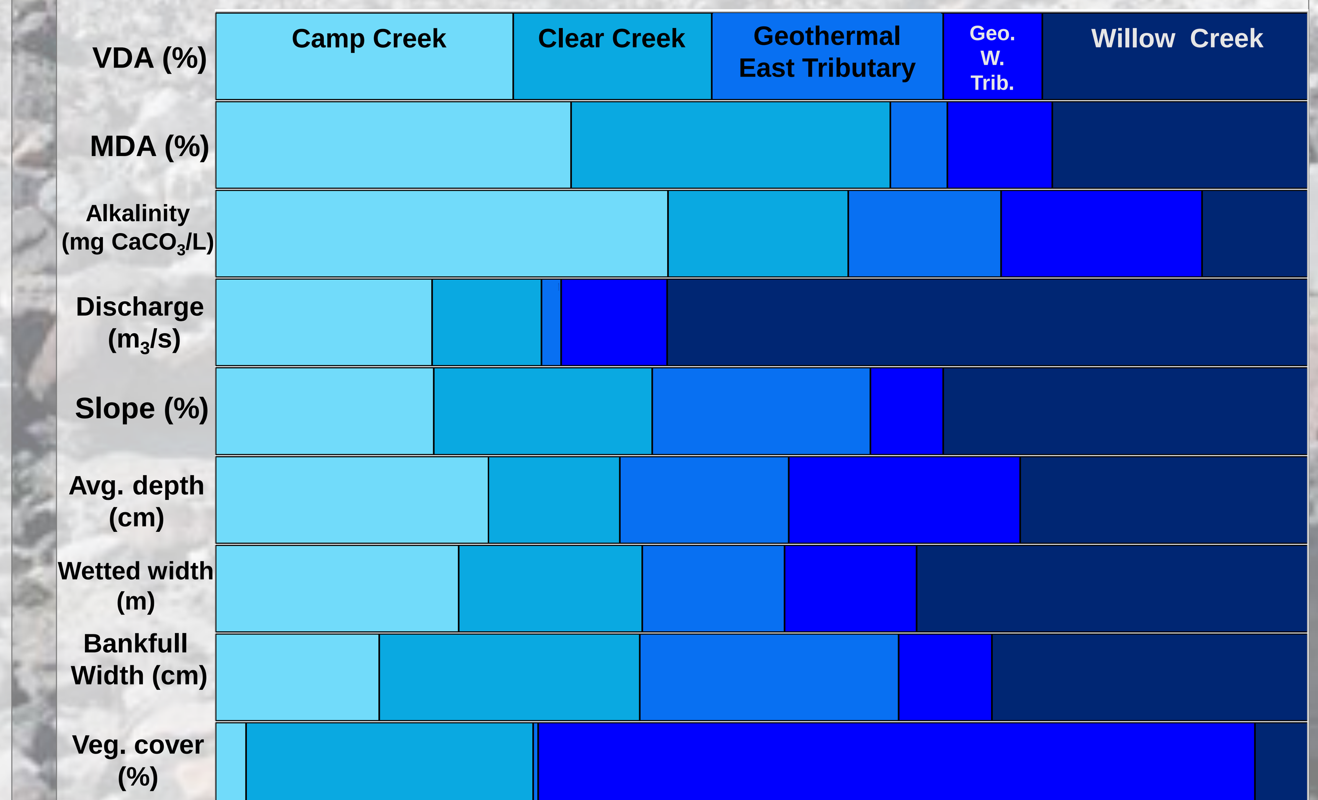

Fig. 6. Treemap of vegetation cover, bankfull and wetted widths, average depths, slope, discharge, alkalinity, and microscopic (MDA) and visual diatom assessment (VDA) at each of the five "mid" sites evaluated for algal communities.

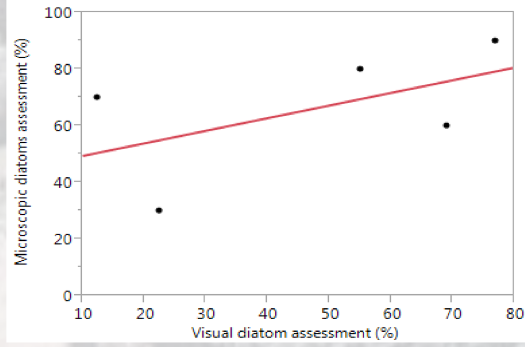

Fig. 7. Linear regression of MDA vs. VDA; p=0.3361, r^2=0.303286, n=5.

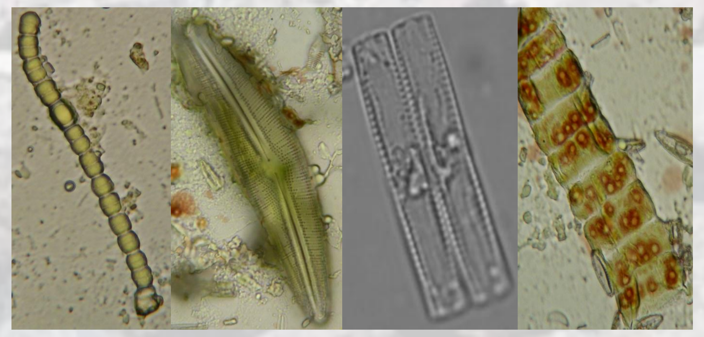

Fig. 8. Color examples of blue-green algae (far left), diatoms (center), and green algae (far right) at 1000X.

Discussion

- Algal **communities differed among** individual stream **sites** (Fig. 5).
- **Visual diatom assessment** and **microscopic diatom assessment** show a **positive trend** but were not significantly correlated, most likely due to small sample size (Fig. 7; p=0.3361, r^2=0.303286, n=5).
- Steinman and Lamberti (1988) observed blue-green algae dominating **thermally-influenced** streams around the blast area; **Geothermal East Mid** also exhibited **blue-green dominance**.
- Two unknown types of filamentous algae **could not be assigned** to standard classification groups.
- "Filamentous 2" forms majority of Geothermal West Mid sample; and **proper identification** could **significantly change** the overall **community structure**.

** References available upon request. **

Future Work

- **Differences** in community structure may be attributed to reach differences in dominant **substrate** type (sand, gravel, cobble, boulder), **canopy** cover, **discharge**, and water **chemistry**.
- **Further investigation** is required to more clearly define the relationships between algal communities within and across streams on the Pumice Plain, especially with respect to the **presence** and **distribution** of **taxa**.
- **Processing** of **algal** and **macroinvertebrate** communities will **continue** over the course of this year.

Acknowledgments

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