

DETRITAL COMPOSITION IN FIRST ORDER STREAMS:

Accuracy of a Segment Within the River Continuum Concept

San Miguel County, Colorado



Colten Rogers

Telluride High School

Telluride Institute: Bridal Veil Living Classroom

Abstract

The following study tests the accuracy of the River Continuum Concept detritus classification and location by examining two 1st order streams, Leopard Creek and Bridal Veil Creek, near Telluride, Colorado. Directly addressed in this study is whether or not the River Continuum Concept is correct in saying that there is a larger amount of CPOM in higher gradient/energy 1st order streams than in low energy and gradient streams. To determine this, detritus collecting kicks were performed twice on both streams where the amount and percentage of each detritus size was recorded, then graphed. The resulting data showed that the River Continuum Concept was, in this case, incorrect. It was discovered that the lower gradient Leopard Creek contained more CPOM than the higher gradient Bridal Veil Creek. It was concluded that this procedure should be repeated multiple times with some minor adjustments to get definite answers for conclusions.

Intro

The Telluride region is surrounded by a number of 1st order tributaries that head the San Miguel Watershed. Most of these streams start in high elevations and eventually join up with the San Miguel River which is a 3rd order waterway at its confluence with the Dolores River eighty miles downstream. The River Continuum Concept theorizes that the distribution of aquatic insects can be predicted based on the food supply available in different energy and elevation of streams. The concept states that there will be a higher concentration of coarse particulate organic matter (CPOM, > 1 mm) than fine particulate organic matter (FPOM, 50um-1 mm) in high elevation 1st order streams. As you move down the watershed the rivers get larger with less energy. The lower energy

allows the detritus to settle and be decomposed into smaller particles. Additionally, as river systems drop in elevation and velocity there is a higher abundance in microbes which further and more rapidly decompose particulates. In these 2nd, 3rd, and 4th order streams you begin to see a higher concentration of FPOM than CPOM. The following study tests the accuracy of the previously described portion of the River Continuum Concept by examining two such 1st order streams, Leopard Creek and Bridal Veil Creek. I predict that there will be a higher concentration of CPOM at the base of Bridal Veil Creek than at the bottom of Leopard Creek due to a higher stream gradient at Bridal Veil Creek.

Site Description

Telluride and the San Miguel River basin are located on the Eastern portion of the San Miguel County, Colorado. This area is constricted by large mountains and deep valleys which dictate the path of many small 1st order streams such as Bridal Veil Creek and Leopard Creek. Hanging above Telluride is the Bridal Veil Basin where one finds the origin and body of Bridal Veil Creek which flows from 12,400 to 9,000 ft. within four miles; the basin is composed of bedrock from volcanic activity called breccia. The hard composite is relatively new and does not allow for much soil buildup to occur; this also prevents excessive amounts vegetation from growing and constricting the stream itself. Data collection was performed in a high energy reach of Bridal Veil Creek which is heavily influenced by steep slopes and massive boulders which allows for little overhanging vegetation to grow. Each sampling kick was extracted from crucial chokes

in the creek's path where most of the water was forced through the collection net.

Leopard Creek pulls its headwaters from the top of Dallas Divide at 9,000 ft. The Divide Valley is built upon ancient sedimentary rock with more than enough soil for flourishing vegetation to grow and constrict Leopard Creek. Over the course of its 12 mile journey Leopard Creek drops only 1,720 ft and makes its low-energy journey through this heavily wooded valley. Leopard Creek data was pulled from an excessively low energy portion where the creek meets its end in the San Miguel River. The major contributing factors which influence the data in this area are the extreme amounts of overhanging vegetation that drop detritus into the water.

Methods

Data collection began at 10:00 a.m. on August 13th 2009 at the base of Bridal Veil Creek. At this location two detritus collecting kicks were performed over the course of two hours. A kick is a process of collecting detritus buildup by dislodging it from underneath rocks on the bottom of a stream bed and collecting the detritus in a fine net as it runs down stream. Kick 1 was performed and the detritus was deposited on a sorting tray with one cm grid lines. Then by the use of thumb forceps, all of the inorganic materials and live insects were removed from the tray and discarded. Again by the use of thumb forceps, all of the ultracoarse particulate organic matter (UCPOM, see chart 1) was situated so that it evenly (none overlapping) covered a percentile of the grid. The percent of coverage was recorded (see chart number two for percentile scale) and a corresponding number was given to represent the approximate percentile. The same process was used to record the percentile of coverage for coarse particulate organic

matter (CPOM), medium particulate organic matter (MPOM), and fine particulate organic matter (FPOM). While assigning a rating value for every size of detritus (1-6 points, see chart), a best guess estimate for precise percent coverage was also recorded.

EX: CPOM= “3” (26-50%), best guess could be 35 % depending on what you see.

Chart 1

Detritus Classification	Size
FPOM	>1mm
MPOM	1mm-1cm
CPOM	1cm-3cm
UCPOM	3cm+

Chart 2

Grouping number | Percent coverage

Trace	< 1%
1	1-5%
2	6-25%
3	26-50%
4	51-75%
5	76-95%
6	96-100%

This same process was used in Kick 2 which was performed 20m upstream at another crucial choke in the stream flow (similar to Kick 1) where most of the “kick water”, or the water containing kicked up detritus, would be forced through the fine collection net. Later that evening (4:00-5:00 p.m.) both kicks for Leopard Creek were performed in the exact same way as the previous two at Bridal Veil Creek, each at the bottom of their drainage system.

Shortly after sorting detritus and recording blank tray percentages, a certain amount of data analysis and straightforward manipulation was done to simplify and quantify results. To do this the blank tray percentile was subtracted from the overall sample (100%) and the sample was re-proportioned to make 100%. For example, if the blank tray percentile was 35 the detritus would total 65%. Thus, each detritus category: (UCPOM, CPOM, MPOM, FPOM) percent estimate was divided by .65 to result in a proportional augmentation of each detritus category. Finally the revised data from kicks

1 and 2 at Bridal Veil were combined to create one average percentile data collection. The process used to find the data average of both Leopard Creek and Bridal Veil was as follows. Combine the data from the CPOM category (example $36\% + 40\% = 76\%$) and divide by two ($76/2 = 38\%$ average). Repeat this step for each detritus size category.

Results

Both Bridal Veil Creek and Leopard Creek had somewhat similar end results. However, none of which supported the original hypothesis.

Bridal Veil Creek was the higher energy and gradient (17.2%, see chart 2) stream which was also very cold (47°F). It contained a higher concentration of UCPOM (39%) than any other single detritus size at Bridal Veil. Combining that with the CPOM (20%) cements the idea that the larger organic matter was the dominant detritus type. Surprisingly there was a larger minority detritus collection of MPOM (31%) and FPOM (9%) at Bridal Veil than at Leopard Creek.

Leopard Creek had a much lower energy and gradient (2.5%, see chart 2) but was much warmer (61°F). Amazingly the UCPOM (60.5%) and CPOM (23%) dominated the percentile coverage for this location. This and the amount of MPOM (12%) combined with FPOM (2.5%) are completely contrary to the hypothesis.

Chart 1

Detritus Percentile

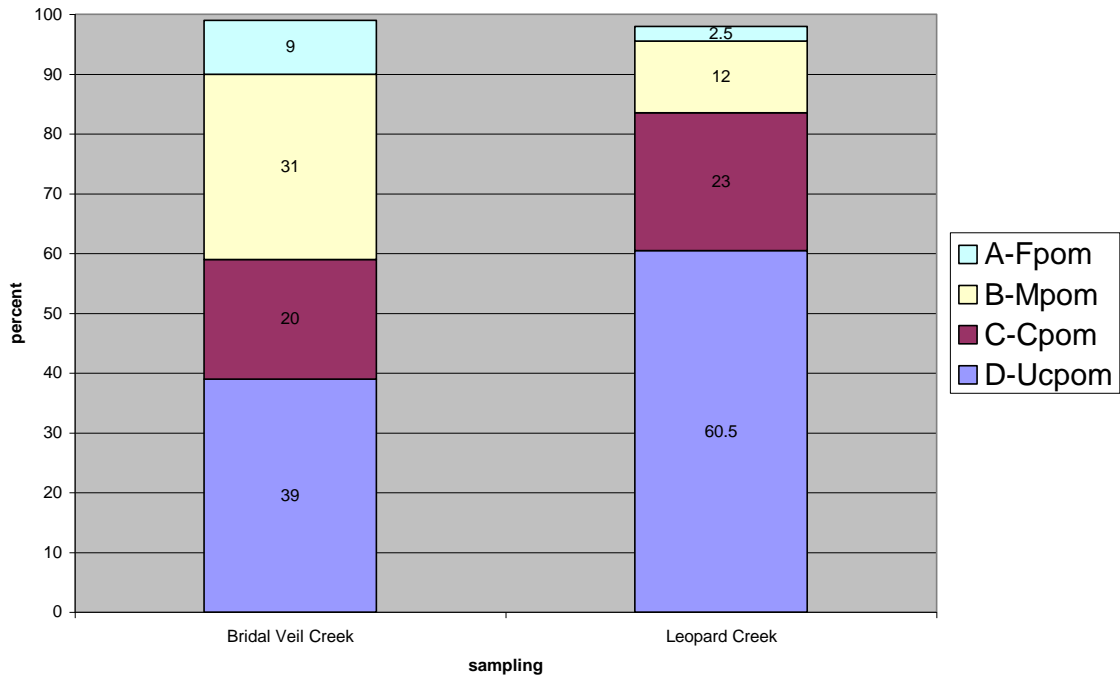
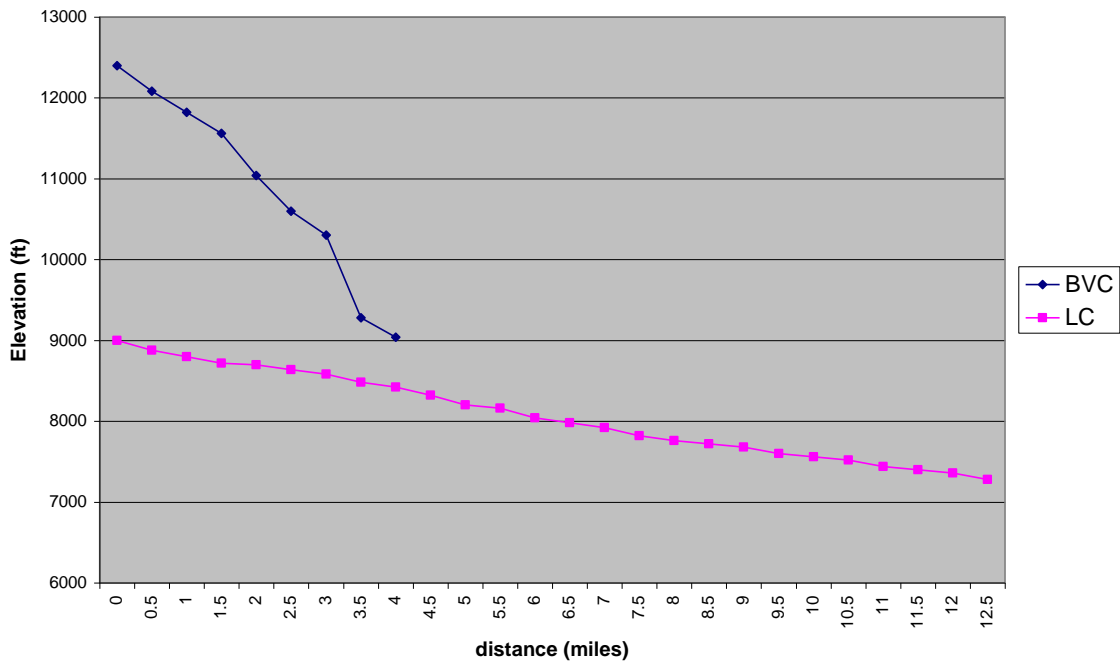


Chart 2

stream elevations



Discussion

This study hypothesized that there would be a higher concentration of CPOM at the bottom of Bridal Veil Creek than at the bottom of Leopard Creek due to the higher stream gradient and energy at Bridal Veil. Surprisingly the results of my data collection refuted my hypothesis and the relating River Continuum Concept. It was concluded that, contrary to my hypothesis and the Continuum Concept, there was a significantly higher amount of UCPOM and CPOM in the much lower energy/gradient Leopard Creek. However, the composition of the UCPOM and CPOM at Leopard Creek was also very different than it was at Bridal Veil Creek. At Bridal Veil the larger detritus was singular bodies of matter such as sticks and leaves; at Leopard Creek the detritus consisted of tightly compact bodies of dead lichen, moss, leaves and other fungus that could not be separated without changing the consistent method for arranging the detritus (pinching protruding sections of detritus and gently lifting them into place). This is odd due to the fact that the warmer water temperature at Leopard creek makes the microbial decomposer population increase rapidly which should result in a shortage of large detritus. Had they been broken up these detritus masses might have fallen into the FPOM category. Also the much higher energy and gradient Bridal Veil Creek contained a higher concentration of FPOM than Leopard Creek. This is usually highly unlikely because the water is moving too fast for detritus to settle and decompose. Also the water temperature is far too cold for a massive microbial decomposer population to speed up the decomposition process.

The River Continuum Concept generalizes 1st order streams as headwaters (no tributaries flowing into them) and further classifies them as high gradient, high energy, and dominated by CPOM or UCPOM. Bridal Veil Creek fit these criteria exactly so therefore was chosen to serve as a study site. Leopard Creek was chosen because it fits under the headwater category (thus a 1st order stream) but it is the opposite of Bridal Veil when looked at in the sense of energy, gradient, and detritus. Due to Leopard Creek's low gradient and low energy it was assumed that it would behave (very fine detritus) like a 2nd or 3rd order stream, which are classified in the River Continuum Concept as slow moving and deep.

With close review of this study it was concluded that a future repetition might use adjustments to force a more accurate and improved outcome. For instance, an improvement for accuracy could include a larger number of kicks at each location to get a more centralized and refined average of detritus amounts or percentages. Also fine, ultrafine, coarse, and ultracoarse detritus, as defined by the River Continuum Concept (Vannote, et al.), could be sized and taken into account, rather than creating a manageable scale easily seen by the naked eye. This of course would more accurately confirm or refute the River Continuum Concept. However this method would require the use of very fine screens and microscopes to determine the percentage of detritus in the water. In the future variations of this study could be undertaken such as using an actual 2nd or 3rd order stream to test against the 1st order stream. In the end, this would ultimately produce the most justifiable product.

Works cited

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