Comparison of methods for stream substrate distribution
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Introduction
The Clean Water Act requires states to control sediment-laden runoff from land disturbing activities by monitoring and establishing procedures to protect waterways. Why? When humans use land for development and agriculture, and storms occur, excess sediment is carried through the watershed and deposited in streams. This sediment, stream substrate, is the material that rests at the bottom of a stream, and is classified by size, such as sand, silt. The distribution of the substrate can indicate poor stream health. Excess sediment can cloud water (blocking sunlight needed for aquatic plants), carry nutrients and chemical pollutants, smother bottom-dwelling species, and clog channels (Chesapeake Bay Program, 2018). So, too much sediment can negatively affect stream habitat and biological integrity. Controlling sediment entering streams is critical and must be regularly monitored. The monitoring often included in water quality assessment protocol and is time consuming and tedious. Various monitoring techniques are employed by researchers and agencies, which leads to the question: which is the best technique? The intent of this investigation was to compare techniques and determine the most reliable classifying pebble and sediment distribution. Three techniques were compared to a total sample in order to assess which was best.

Materials and Methods
The first two methods use the heel-to-toe technique for extracting each sample. They also required the observer to average three axes of each pebble. The third technique, the 105 count (Colorado Department of Public Health and Environment, 2015), was most different of the procedures. It implemented 21 equidistant transects split among the reach, with five equidistant extractions along each transect. This procedure also required 105 pebbles instead of 100. A gravelometer (Figure 2) was used in the 105 count technique, which only measured the b-axis of a pebble. Particles measured by the gravelometer were classified into size classes.

Results

The Grab-n-Go was the gold standard used to compare three popular methods in analyzing stream substrate. The three techniques used for this study were the Wolman transect, Wolman zig-zag, and 105 count. They each demonstrated similar results in regards to particle size distribution. This apparent trend was shown in multiple locations (see Figure 3), supporting the recommendation to use any of these techniques for stream substrate monitoring.

Conclusions
Streams need to be monitored and regularly assessed in order to protect watersheds. Clean water is vital to biodiversity and human health and safety. Techniques for monitoring streams include analyzing and classifying substrate, specifically pebbles and smaller sized sediment. A variety of pebble counting methods exist and it appears that one is not necessarily better than the other. This study examined three popular techniques used by experts in stream monitoring. After comparing the three techniques to the gold standard, they appeared to produce results that were not very different.

It is recommended that future studies include additional stream sites, additional trials, and additional techniques. Also, a gravelometer was used for the 105 count technique and a ruler was used to measure axes for the other methods. However, one tool did not seem to be more reliable than the other, meaning a ruler could be used for pebble counting.

References

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