Does elevation change the way current velocity and rock surface area affect benthic community composition in an Andean mountain stream?

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Introduction

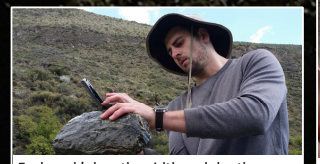
The colonization rates of streambed benthic communities are largely impacted by substrate surface area and current velocity. Larger surfaces permit greater opportunities for shelter and food. Current velocity is critical to the transport of organic and inorganic materials and mixing dissolved oxygen (Loayza-Muro et al. 2010). These are crucial elements of lotic ecosystems and these factors can determine where benthic macroinvertebrate occur in streams.

Higher altitudes streams present challenges of high turbulence, varying degrees of flow, and precipitous slopes (Scheibler *et al.* 2014a), which are thought to limit macroinvertebrate colonization. Andean mountain streams in particular make excellent study sites as they are annually subjected snowmelt, spring thaws, and rain shadow effect (Scheibler *et al.* 2014b) that ultimately increase stream volumetric flux. Mountain streams tend to be most sensitive to human impact and climate change (Scheibler *et al.* 2014a). Sampling macroinvertebrates at different altitudes will help determine the importance and interaction of current velocity, substrate surface area and altitude on species abundance and richness.

Methods

Sample sites within Arroyo Grande, Tunuyán, Argentina, were at 2100 and 3000 m. The streambed velocity of 36 randomly selected rocks from each site were measured with a current meter and recorded.

Rocks were rolled into a Surber sampler net before removing them from the stream.



Each rock's length, width and depth were measured and the surface area calculated.

Macroinvertebrates were sorted, identified and counted in the field.

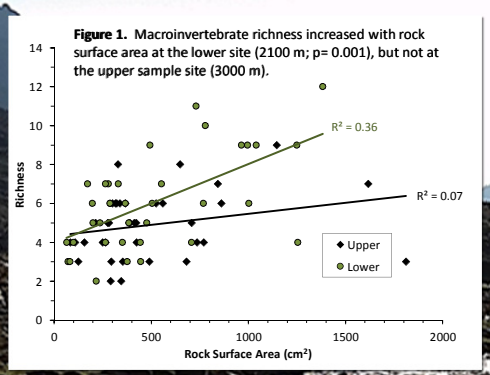


Figure 1. Macroinvertebrate richness increased with rock surface area at the lower site (2100 m; p= 0.001), but not at the upper sample site (3000 m).

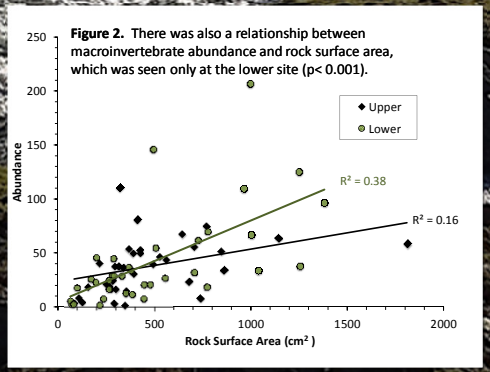


Figure 2. There was also a relationship between macroinvertebrate abundance and rock surface area, which was seen only at the lower site (p< 0.001).

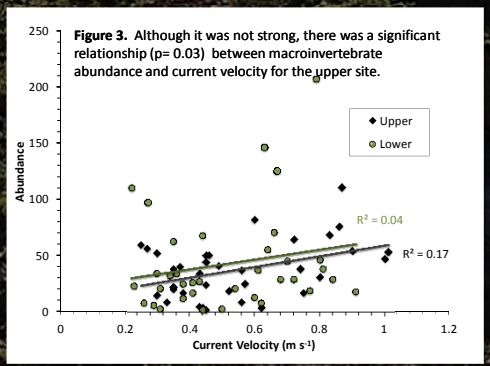


Figure 3. Although it was not strong, there was a significant relationship (p= 0.03) between macroinvertebrate abundance and current velocity for the upper site.

Results

There was a positive relationship between rock surface area and macroinvertebrate richness at the lower site (Fig. 1). Macro-invertebrates numbers responded positively to surface area at both sites (Fig. 2) .

At the upper sample site there was a weak but positive relationship between current velocity and macroinvertebrate abundance (Fig. 3).

Many of the same species occurred at both sites, but in different proportions.

Discussion

High elevations typically have reduced macroinvertebrate richness compared to low elevations, so even small rocks quickly become "saturated" with the available taxa. This may explain why there were no richness relationships for either surface area or current at our high elevation, 3000 m site (Fig. 1). Nor was there a relationship between rock surface and macroinvertebrate abundance at the high elevation site (Fig. 2). This may be because current velocity was more important than surface area for structuring the community at 3000 m (Fig. 3). Blackfly larvae (Simuliidae) were more than six times as abundant at the upper site, and these passive filter-feeders prefer faster current where feeding rates are higher.

Blackfly larvae feeding in current. Note the feeding "fans" extended from head.

Conclusions

Rock surface area and current are both important for structuring mountain stream communities, but our results suggest the relative importance of these factors can change with elevation. Our data show that current velocity was more important at high elevations (likely due to the dominance of filter-feeders), whereas surface area was more critical at lower elevations (likely due to the larger species pool).

Works Cited

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