Comparison of insect diversity in three types of 1^{st} order streams:
Clear-cut, buffered, and forest

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Introduction

Streams play a vital part in the transport of nutrients and water to the organisms in a forest. Because small order streams make up a great portion of watersheds, these streams are especially important in maintaining a healthy ecosystem.

With forest harvest (logging) and road building, the environments surrounding these small order streams are dramatically altered. Water flow (Jones, 2000), sediment yield, water temperature (Johnson et al., 2000), and surrounding vegetation are all affected by forest harvest. Changes in these important variables have great impacts on not only the physical aspects of the streams such as soil erosion, but they also can also impact the organisms that depend on the stream for survival.

Insects are important part of the food chain that retains important nutrients in the stream. A diverse insect population should retain better the nutrients that are washed into the soil into the streams. In addition, a diverse insect population can better withstand changes in environmental conditions. They are the products of millions of years of evolution by trial-and-error. Once they are lost, they cannot be re-fashioned by humans. Therefore, it is imperative to understand how logging affects the diversity of insects in the small order streams.

This investigation is driven by several key questions:

• Do clear cuts have adverse effects on the diversity of species that hatch in streams?
• Are the currently implemented 30-meter riparian buffers effective in maintaining insect diversity?
• Should this policy be modified to better maintain the diversity of insects surrounding the 1^{st} order streams?

This is the first set of experiments to establish a baseline for future studies. We will measure the species diversity of insects emerging from 1st order streams located in three types of environments:

Methods

(1) Site selection

The study site is in the Two Girls Peak area in Willamette National Forest. Within this study site, three 1st order streams with similar altitude and slope are chosen. One stream is in a clear cut area (CC), one stream is in an area buffered by riparian vegetation (BUF), and one stream is in a forested area (FOR).

(2) Trap placement and insect collection

Five emergence traps are set in each of the streams. Each trap contains a dish of anti-freeze preservative to collect the insects that have been hatched over stream. The traps are set approximately 5 meters apart from each other and numbered 1 to 5, with 1 being the most upstream trap and 5 being the most downstream trap. The traps are set directly over water and left at the site for two weeks. At the end of the two-week study period, insects are collected from each of the emergence traps by pouring the contents of the collection dish into a labeled container and sealed until further processing.

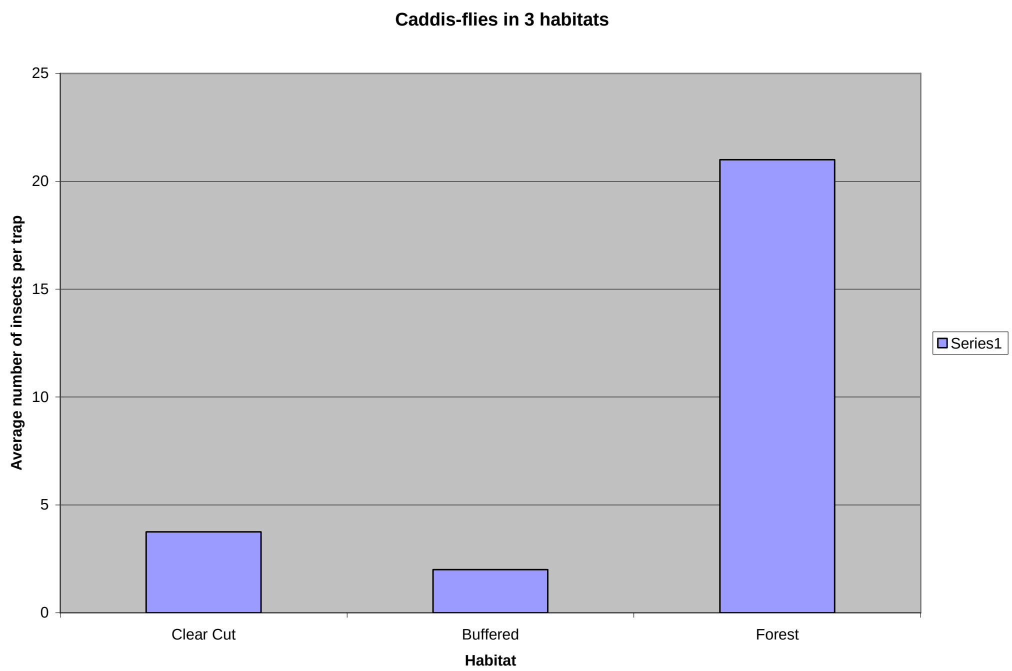
3) Insect sorting

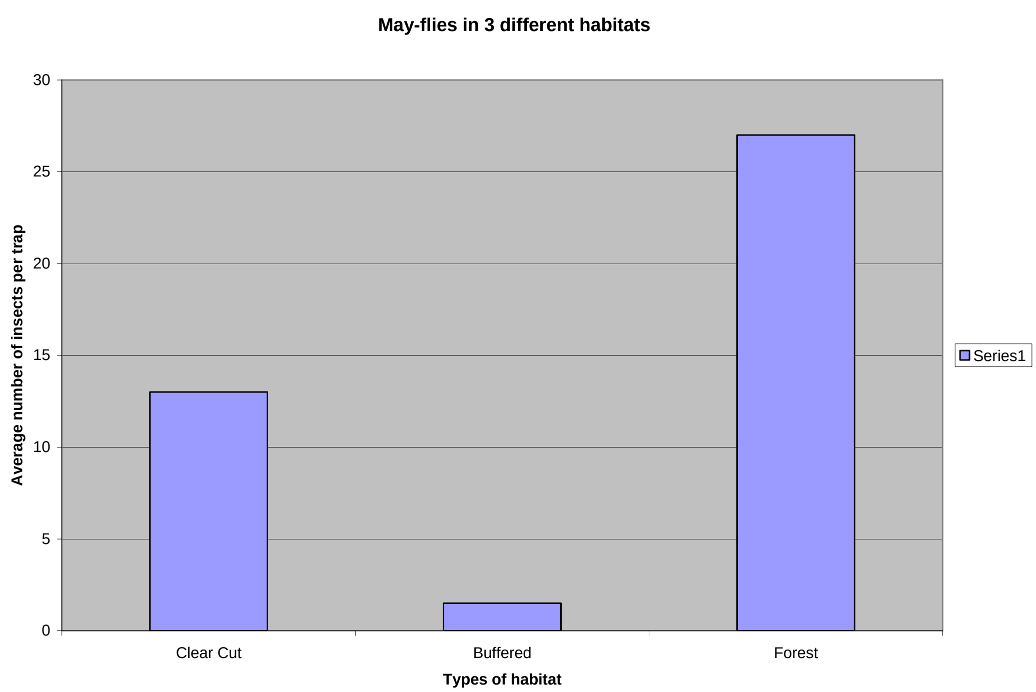
Using forceps, insects from the labeled containers are sorted into individual species and placed into 24-well plates. After all the insects are removed from the initial dish, re-examine the insects in each of the wells and re-sort them into functional categories. The number of species and number of individual insects present in each trap is recorded into the data table for future analysis.

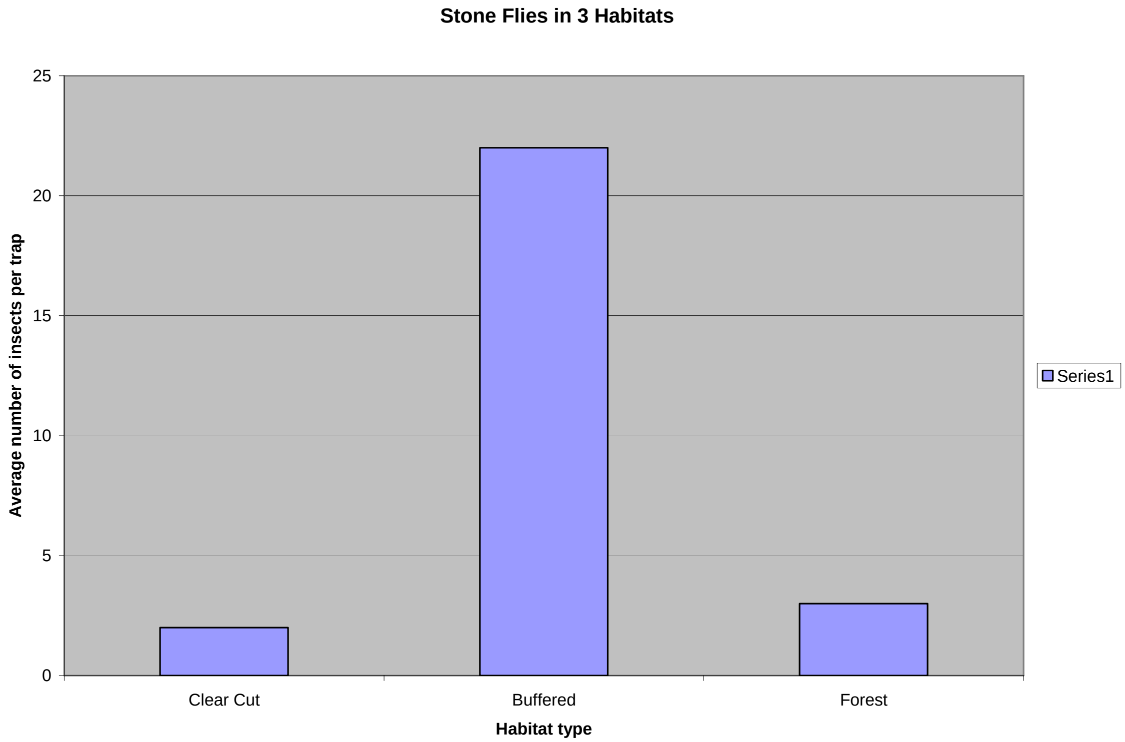
4) Data analysis

The number of insects in each functional group from each stream is compared with the number of insects from other streams other via ANOVA.

Results


Caddis-flies in 3 habitats
Average number of insects per trap
0
5
10
15
20
25
Clear Cut
Buffered
Forest
Habitat
Series1


May-flies in 3 different habitats
Average number of insects per trap
0
5
10
15
20
25
30
Clear Cut
Buffered
Forest
Types of habitat
Series1



Stream type Insect Population	**Clear-Cut**	**Buffered**	**Forest**
Species Richness	Low	Low	High
Species Abundance	High	Low	High

Discussion

At first glance, it appeared that the three different types of streams yielded different varieties of insect populations. Forested streams contained higher populations of both caddis flies and mayflies. Caddis flies existed at greater number (at least by five-fold) in forest streams compared to clear-cut and buffered areas (Top graph). Mayflies existed in higher numbers in the forested streams compared to the other streams (two-fold compared to clear-cut and nearly ten-fold compared to buffered; see middle graph).

These results suggest that forested streams provide the best environment in supporting the insect population. These results also suggest that at least for the two groups of insects (Caddis flies and mayflies), the buffering does not provide an advantage over clear-cut.

The only insect group that did not follow this pattern was the stone-flies, which existed in greater numbers in the buffered stream when compared to the clear-cut and forest. Perhaps the buffered streams presented an excellent habitat for stone-flies. The buffers offered the best of both worlds: a layer of thick vegetation along the stream and access to a different type of vegetation in the clear-cuts nearby.

A preliminary analysis of insect diversity also suggest that forested stream provide the best environment for insect population. Forested stream showed high species richness, while the other two streams showed low species richness. Interestingly, the clear-cut stream showed higher species abundance compared to the buffered stream.

In all, the data suggest that buffered stream does not provide a suitable substitute for the forest stream. However, while these differences are tantalizing, these results should only be considered as preliminary. The differences were not statistically significant when analyzed via ANOVA (p values ranged from 0.150 to 0.240). The findings here need support from further study. To better measure the insect population in the three types of streams studied here, the collection scheme mentioned is duplicated in four more study sites. Additionally, insects will be collected on a continual basis every two weeks to monitor how the diversity of insects changes with time. These efforts will hopefully further our understanding of how changing the nature of a stream affects insect populations.

Reference:

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Jones, J.A. 2000. Hydrologic processes and peak discharge response to forest removal, regrowth, and roads in ten small experimental basins, western Cascades, Oregon. Water Resources Research 36(9): 2642