A Proposal

Submitted to the DeVlieg Undergraduate Research

Selection Committee

Population Shifts of Aquatic Insects in Post-fire Streams

Presented by

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Abstract

Biotic and chemical components of aquatic systems have been shown to undergo numerous changes in response to watershed disturbances. However, few studies have examined the effects of fire-related disturbances on aquatic systems. Wildfires in the Frank Church River of No Return Wilderness Area during the summer of 2000 have provided a unique opportunity to assess the influence of fire on the ecology of mountain streams. A specific area in need of research is the alteration of carbon inputs into post-fire streams and the subsequent impacts on benthic macroinvertebrates. Fire in riparian areas has the potential to alter inputs of coarse and fine particulate organic matter as well as promote photosynthetic activity of algae and stream side vegetation. It is also quite likely that changes in the composition of carbon inputs will elicit a response from the benthic macroinvertebrate community. Past studies have predicted that post-fire streams should exhibit a temporary shift in the abundance of macroinvertebrates that utilize coarse and fine particulate matter towards those organisms that feed directly on algae. This study proposes to determine if such population shifts have occurred in fire- affected streams of the Frank Church River of No Return Wilderness Area.

Introduction

Aquatic systems such as those contained within the Frank Church River of No Return Wilderness Area (FCRNRWA) offer an excellent opportunity to examine headwater streams that have been relatively unaffected by anthropogenic actions. Buettner (1987) conducted such a study of nine sub alpine and montane zone streams in the FCRNRWA during the summers of 1975 and 1976. Buettner's study provides detailed physical, chemical, and biological parameters that can be used as base line data to determine the nature of ecological changes within these streams over the past twenty-five years. Furthermore, biotic and chemical components of aquatic systems often change in response to disturbances in the surrounding terrestrial habitats. The FCRNRWA wildfires of 2000 offer a unique opportunity to assess the influence of fire on the ecology of mountain streams.

Few studies have examined the effects of fire on aquatic habitats and most of these have focused on changes in water chemistry and nutrient dynamics (Mihuc and Minshall 1995, Minshall et al. 1989, Spencer and Hauer 1991) with little attention applied to responses of aquatic biota. A need exists for such research (biomonitoring) in that the knowledge gained may provide an effective means of predicting trophic responses to disturbances such as fire. More precisely, the use of aquatic insects as indicators in biomonitoring may be one of the most

reliable biotic indicators of disturbance response (Merritt and Cummins 1996 and Loeb and Spacie 1994).

For example, shifts in the trophic interactions of many aquatic insects may be examined to determine the potential effects of changes in organic matter inputs to post-fire streams (Mihuc and Minshall 1995). Herbivore and detritivore insects (shredders) which feed on coarse particulate matter (CPOM), collectors that utilize fine particulate matter (FPOM), and scrapers feeding on attached benthic algae (ABA) may exhibit shifts in abundance and biomass due to alterations in carbon inputs to the system (Minshall et al. 1989). The occurrence of fire has the potential to alter carbon inputs in the CPOM and FPOM forms and promote photosynthetic activity of ABA

It is quite likely these altered carbon inputs will elicit a response from the benthic macroinvertabrate community. Mihuc and Minshall (1995) predicted that post-fire streams would temporally exhibit a diminished abundance of shredders and collectors with a shift towards a higher abundance of scraper insects. These predictions fall in line with an important variable of stream ecosystem theory: If CPOM is reduced; abundance of shredders and collectors will also be reduced (Minshall et al. 1985). This study proposes to employ biomonitoring techniques and data collected by Beuttner (1987) to determine if population shifts of aquatic insects have occurred in those streams affected and those not affected by the 2000 wildfires of the FCRNRWA.

Research Objectives

1) Estimate the abundance and biomass of aquatic insects in fire-affected and non-affected streams.
2) Determine species composition of aquatic insects in fire-affected and non-affected streams.
3) Estimate biomass/primary productivity of ABA in fire-affected and non-affected streams.
4) Establish water quality parameters (pH, alkalinity, temperature, dissolved oxygen, electrical conductivity, nitrogen, and phosphorous) of fire-affected and non-affected streams.
5) Compare all findings with 1975-1976 data to infer the influence of fire on the study parameters.

Hypotheses

1) Abundance and bio-mass of benthic macroinvertebrates in fire-affected streams has decreased compared with non-impacted streams.

2) Shredder and collector insects will show a greater decrease in abundance in fire-affected streams than in non-impacted streams.

3) Scraper insects will show a greater increase in abundance in fire-affected streams than in non-impacted streams.

4) Algal biomass and primary productivity has increased more in fire-affected streams than in no-impacted streams.

Methods

Sample stations will be chosen based on streams sampled by Buettner in 1975-1976 and the pattern of distribution of the 2000 FCRNWA wildfires. In order to provide a control element to the study, four fire-affected and four non-impacted sample sites will be selected. Table I. indicates the proposed sample streams, location and river kilometer where available, and their experimental status (control or experimental). Exact sample site locations may be adjusted upon in-field determination of fire distribution.

Table I. Location and Description of Potential Sample Sites (Beuttner 1987).

Sample Stream	Location (river km)	Experimental Status
Chamberlain Creek	Chamberlain airstrip (29.0)	Control
Chamberlain Creek	Upstream of Chamberlain Airstrip	Experimental
Lodgepole Creek	Mouth (0)	Control
Lodgepole Creek	Headwater (9.7)	Experimental
Big Creek	To be determined	Control
Big Creek	Taylor Ranch (11.3)	Experimental

Beaver Creek	Headwater (12.9)	Control
Beaver Creek	Mouth (0)	Experimental

Location and topographical description of the sample sites will be made with the use of U.S.G.S. maps, information provided by Jim and Holly Akenson, and a global positioning system (GPS). Entry to the FCRNWA will be made by bush plane to the air strip at the Taylor Ranch research station. The Big Creek sample stations will then be accessed by foot from the Taylor Ranch research station. Chamberlain Creek will be accessed by plane with the Lodgepole Creek sites and upper Chamberlain Creek site being reached by foot. Beaver Creek sample sites will be reached by foot from the wilderness area border on Big Creek road.

Quantitative and qualitative sampling of aquatic insects will be carried out using methods described in Loeb and Spacie (1994), Eaton and Lenat (1991), and Hisenhoff (1988). Samples will be preserved in the field using a 70% ethanol solution to wait taxonomic and quantitative analysis at the University of Idaho, Moscow. Alkalinity, pH, temperature, dissolved oxygen, electrical conductivity, and levels of CPOM and FPOM will be determined using techniques outlined in Methods in Stream Ecology (Hauer and Lamberti 1996). Nitrogen and phosphorous analysis will be contracted out to a professional laboratory. Quantitative samples of ABA will be dried in the field, returned to the University of Idaho, and frozen for later chlorophyll and biomass analysis. Calculations used in the analysis of benthic macroinvertebrates will include measurement of biomass (Weber 1973) and a Shannon-Weaver diversity index (Lloyd, Zar, and Karr 1968). At the conclusion of laboratory analyses, data will be compared with the findings of Buettner (1987) and other available data sets.

Timeline

- March-May, 2002: Sample site selection, research planning, development of sampling methods.
- June 15- July 01, 2002: Field sampling of Big Creek.
- July 15 - July 22, 2002: Field sampling of Chamberlain and Lodgepole Creeks.

- July 23-July 26, 2002: Field sampling of Beaver Creek.
- July 02 - August 15, 2002: Laboratory analysis of ABA chlorophyll a, nitrogen and phosphorous analysis, taxonomic and quantitative analysis of aquatic insects.
- August 15 - December 15, 2002: Statistical analysis, research write-up, and presentation.

Description of Support

Drs. Jeffrey Braatne and C.M. Falter will provide the primary guidance for all phases of this project. Dr. James B. Johnson will provide assistance in the taxonomic identification of aquatic insects, advice on sampling methods, and laboratory space. Assistance with statistical procedures will be provided by the Math and Statistics Assistance Center at the University of Idaho.

Proposed Budget

Item	Cost
Flight expenses (Shannon Miller)	$160.00
Flight expenses (Dr. Braatne)	$80.00
Chlorophyll analysis: 24 samples, $1.50 each	$36.00
Nitrogen and Phosphorous analysis: 8 samples, $75.00 each	$600.00
Miscellaneous lab and field supplies	$120.00
Satellite phone (rental and projected cost of minutes)	$50.00
GPS	$250.00
Foodstuffs and hiking supplies	$200.00
Total Projected Costs	**$1,545.50**

Literature Cited

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