

AN ECOLOGICAL COMPARISON OF TWO STREAM
SECTIONS WITH AND WITHOUT NATIVE FISH
POPULATIONS, IN YELLOWSTONE NATIONAL PARK

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A study of benthic macroinvertebrate communities above and below a natural barrier to fish movement (6 m high) on Raven Creek, a tributary of Pelican Creek in the Yellowstone Lake watershed, was undertaken in July, 1977. This project is part of a U.S. Fish and Wildlife Service ecological evaluation of stream sections with and without native (cutthroat) trout populations. In July 1978 a similar study was undertaken on sections of Virginia Creek with and without introduced (brook) trout populations. A final progress report will be completed by June 30, 1979.

Study Objectives

- A. The purpose of this investigation is to identify the components of the benthic macroinvertebrate community in fish and fishless sections of Raven Creek, and
- B. To determine if there are differences between these communities in relation to species composition, distribution, abundance, and drift activity.

Methods

Benthic macroinvertebrates were collected quantitatively using a circular sampler (Jacobi 1978) on rubble and gravel substrates 100 m upstream and 400 m downstream from 6 m high falls on Raven Creek. Six samples were collected at each site from similarly composed substrates with a current velocity of 0.5 m/sec and water depth of 10-30 m.

Drifting macroinvertebrates were collected simultaneously from sites 100 m upstream and 400 m downstream from the falls using two 0.1m² vertical frame nets (placed at the edge and thalweg). Nets were exposed for 20 minutes centering on the following times: 11:45, 16:45, 20:45, 22:03, 00:52, 05:26, 07:05, and 09:06.

Electrofishing for fish population estimations (Salmo clarki lewisi) was conducted by personnel of the U.S. Fish and Wildlife Service. A 200 m long section below the 400 m downstream benthic station was sampled. In addition, fish stomach samples were collected and analyzed from 48 fish (comprising size classes 63-99 mm, 111-145 mm, 155-201 mm, and 352-406 mm).

Physical and chemical measurements (D.O., pH, temperature, discharge, and conductivity) were taken in the field while more complex chemical analyses (hardness, alkalinity, N-NO₃) were performed by the Environmental Task Force Laboratory of the University of Wisconsin, Stevens Point.

Results and Discussion

Similar physical and chemical characteristics were present at the two study sites (Table 1). The only significant difference was in discharge; approximately 28% more at the downstream site.

Instream vascular plants were absent at the study sites. Instream vegetation was represented by moss Fontinalis (antipyretica) and an alga Nostoc (parametoides).

A total of 38 invertebrate taxa including benthos and drifting immatures and adults was collected (Table 2). The same dominant taxa were present above and below the falls.

Though numbers of benthic macroinvertebrates were higher in the downstream area, 2207/m² vs. 1562/m², total benthic biomass was greater upstream than downstream, 14.8 g/m² vs. 13.0 g/m², respectively. This indicates that specimens (instars) were larger upstream than downstream, an average weight of 9 mg vs. 6 mg, respectively. Smaller specimens may drift over the falls and account for a greater number (density) and thus a lower individual average weight downstream. Fish predation downstream may also "crop off" larger specimens.

In the upstream fishless section, benthic macroinvertebrates exhibited a steady rate in drift before sunrise, a slight drop during sunrise, followed by a rise extending through mid-day to a sharp increase at sunset. The highest drift rate, 901/m² and 2.6 g/m², was followed by a sharp decrease before midnight which then leveled off preceding sunrise.

Downstream, the drift pattern consisted of a sharp depression at sunrise, a mid-morning rise, mid-day maintenance preceding a sharp rise at sunset, followed by a sharp decrease before midnight. The lowest values for biomass and numbers were observed here at sunrise, 0.09 g/m² and 17/m², respectively (Fig. 1).

Trout stomach analyses showed the fish were feeding heavily on aquatic invertebrates. Emerging adults of Plecoptera (stoneflies), Ephemeroptera (mayflies), Trichoptera (Caddisflies), and Diptera (flies) were the dominant food items.

Recommendations and Conclusions

It is difficult to make management recommendations (for an upstream fish or fishless condition) from only one set of observations. Though the fish and fishless sections contained similar dominant taxa, there were evident

differences in behavioral patterns for drifting aquatic macroinvertebrates. The decreased rate downstream at sunrise was perhaps due to cessation of feeding activity after satiation. Also at sunset, a more than two-fold higher drift rate was observed upstream (over downstream). Again the lower downstream values at this time may be due to predation by trout.

Kroger (1974) observed a rise (bi-modal) in drift rates (of selected invertebrate taxa) after darkness. As he indicated, this nighttime drifting might have evolved as a behavioral protective mechanism due to the interaction between drifting invertebrates and trout feeding habits.

Benthic density (numbers) in the upstream fishless section did not show the two to six-fold increase over the downstream fish section as found by Allen (1975). Invertebrate densities are influenced by fish predation (Warren et al. 1964) but not in the manner nor magnitude suggested by Allen (1975).

It is therefore suggested that Raven Creek remain in its present condition. Its fish and fishless sections would afford a prime location for further study of invertebrate behavior. It is a unique environment and should remain so.

Acknowledgments

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TABLE 1. Physical and chemical characteristics above and below 6m high falls on Raven Creek, Yellowstone National Park, July, 1977

| Location | Substrate | Discharge | Cond. µmhos | pH | Total Hardness ³ | Ca Hardness | Alk. D.O. | N-NO ₃ |
|-------------------------|-------------|-----------------------------------|----------------|-----|--------------------------------|----------------|-----------|-------------------|
| Upstream ¹ | 5-30cm rock | 2.54 cfs (0.07m ³) | 122 | 7.4 | 48 | 22 | 50 -- | 0 |
| Downstream ² | 5-30cm rock | 3.24 cfs (0.09m ³) | 120 | 7.4 | 48 | 22 | 50 15.0 | 0.04 |

1 100m above falls

2 400m below falls

3 all the following in mg/l

TABLE 2. Tentative list of aquatic invertebrates collected in Raven Creek, Yellowstone National Park, July, 1977.

| Taxon - common name | |
|--------------------------------|-----------------------------------|
| Order | Plecoptera - stoneflies |
| Family | Capniidae |
| | <u>Eucapnopsis brevicauda</u> |
| | <u>Capnia confusa</u> |
| Family | Chloroperlidae |
| | <u>Alloperla</u> sp. |
| Family | Perlidae |
| | <u>Doroneuria theodora</u> |
| Family | Perlodidae |
| | <u>Arcynopteryx compacta</u> |
| | <u>Sweltsa albertensis</u> |
| | <u>Cultus aestivalis</u> |
| | <u>Isoperla phalerata</u> |
| | <u>Isoperla ebria</u> |
| Family | Nemouridae |
| | <u>Podmosta delicatula</u> |
| Family | Pteronarcidae |
| | <u>Pteronarcella badia</u> |
| Order | Ephemeroptera - mayflies |
| Family | Ephemerellidae |
| | <u>Ephemerella</u> sp. |
| | <u>E. margarita</u> |
| | <u>E. doddsi</u> |
| | <u>E. tibialis</u> |
| | <u>E. aurivilli</u> |
| Family | Heptageniidae |
| | <u>Cinygmula</u> sp. |
| | <u>Epeorus</u> sp. |
| | <u>Heptagenia</u> sp. |
| Family | Siphonuridae |
| | <u>Ameletus sparsatus</u> |
| Family | Baetidae |
| | <u>Baetis</u> sp. |
| | <u>Centroptilum</u> sp. |
| Order | Trichoptera - caddisflies |
| Family | Brachycentridae |
| | <u>Brachycentrus occidentalis</u> |
| | <u>Micrasema aspilus</u> |
| Family | Hydropsychidae |
| | <u>Parapsyche</u> sp. |
| Family | Rhyacophilidae |
| | <u>Glossosoma montana</u> |
| | <u>Rhyacophila</u> sp. (A and B) |
| | <u>R. bifila</u> |
| Order | Diptera - true flies |
| Family | Tipulidae - true crane flies |
| | <u>Antocha monticolor</u> |
| | <u>Hexatoma</u> sp. |
| | <u>Limonia</u> sp. |
| Family | Chironomidae - midges |
| Order | Lepidoptera - Aquatic moths |
| Order | Coleoptera - beetles |
| Family | Elmidae |
| | <u>Optioservus quadrimaculate</u> |
| | <u>Zaitzevia parvula</u> |
| Class Turbellari - flatworms | |
| Class Oligochaeta - roundworms | |

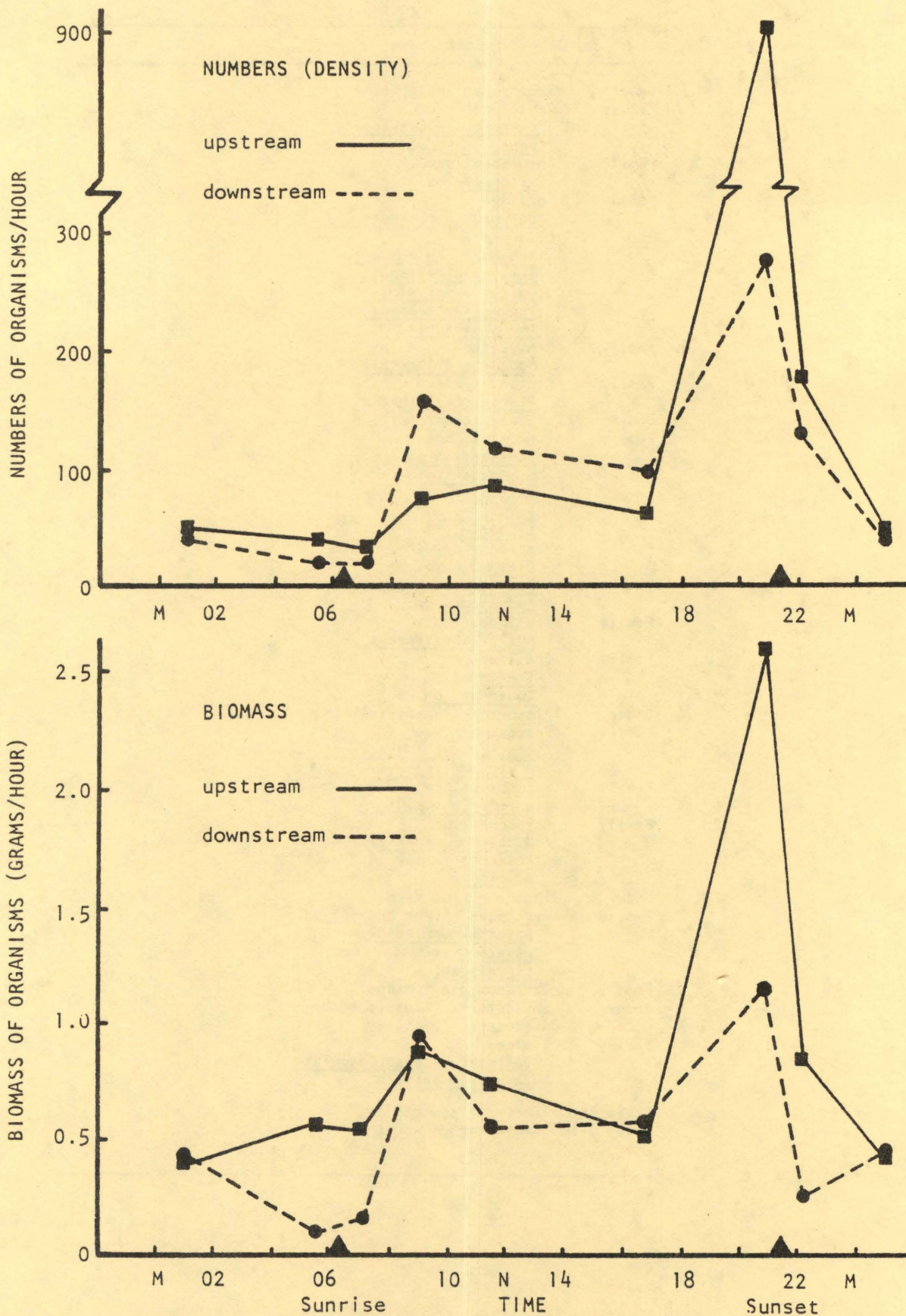


Fig. 1. Drifting benthic macroinvertebrates upstream and downstream from 6m high falls on Raven Creek, Yellowstone National Park, July, 1977.