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THE EFFECTS OF REDUCTION IN TROUT DENSITY ON THE INVERTEBRATE COMMUNITY OF A MOUNTAIN STREAM[1]

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Abstract. An experimental reduction in trout density was carried out for 4 yr to determine whether the numbers or species composition of aquatic invertebrates would be affected. In a Colorado stream, the standing crop of trout (mainly *Salvelinus fontinalis*) prior to this study was 4.86 g/m^2, typical of infertile trout streams. Repeated electroshocking of a 1220 m long experimental section kept trout stocks at 10–25% of this initial value during the summers of 1975–1978.

Density of invertebrates in the benthos (number of invertebrates per square metre) showed no consistent differences between the trout removal section and upstream and downstream control sections for the majority of taxa examined. Drift density (number of invertebrates per 1000 cubic metres) also failed to show an effect of the trout removal. Some taxa were significantly more abundant at one site than another, but this was attributable to changes along the stream gradient or differences in phenology among the sites rather than experimental reduction of trout. As trout stomach content analysis revealed very intensive grazing on a few taxa of aquatic insects, their failure to increase in the trout removal section was unexpected.

Statistical analysis showed that because of the variability of the system, a doubling or halving of numbers must occur to be detectable. Within these limits, it is concluded that removal of trout had no significant effect on the prey community, and two explanations are offered. Trout may actually consume only a small fraction of total prey, although this conclusion is limited by inability of current techniques to sample the benthos fully. It is also likely that because streams do not provide areas where fish are predictably absent, the invertebrate community is highly adapted to fish predation and so is not sensitive to manipulations in fish density.

Key words: *aquatic insects; benthos; drift; field experiment; predator; prey;* Salvelinus fontinalis; *stream.*

INTRODUCTION

The ecology and feeding of stream-dwelling salmonids has been studied extensively, from the standpoint of the fish. Production and population dynamics (Northcote 1969), growth and metabolism (Hoar et al. 1979), and food consumption and composition of diet (Elliott 1973, Allan 1981) compose a voluminous literature. Relatively little attention has been paid to the role of fish from the viewpoint of the invertebrate community. As a consequence it is not known whether trout severely limit invertebrate abundance and perhaps determine community composition as Paine (1966) showed for the top predator, a starfish, in a marine intertidal community. Some authors (e.g., Mann 1978) have concluded that invertebrate stocks are very heavily grazed, which suggests that the presence or absence of trout would substantially alter prey densities. Others (e.g., Mundie 1974) have speculated that food may be well in excess of requirements.

The principal goal of this study was to determine whether the presence or absence of the top predator, trout, affected the numbers or species composition of the prey community, invertebrates, in a mountain stream. An indirect answer to this question may be provided by a comparison of amount eaten to amount available, and Allan (1982*b*) makes such an analysis. The most direct approach is either to add or remove trout in a field experiment, as reported in the present paper.

No demonstrable increase in population numbers or change in species composition compared to control sections resulted from a 4-yr experimental reduction in numbers of trout. Because trout apparently consumed a substantial fraction of prey present (Allan 1982*b*), and only a few species comprised the majority of their prey, this was unexpected. It is suggested that actual invertebrate densities must be substantially underestimated to account for this discrepancy, and that invertebrates in streams are highly adapted to the presence of fishes, with the result that changes in predation pressure do not markedly alter the prey community.

EXPERIMENTAL DESIGN

The basic concept was to reduce predation by trout in one section of stream relative to natural control sections, and determine whether invertebrate populations were affected. The trout removal (TR), or experimental, section was a 1220-m length of stream (Fig. 1). The 700-m section upstream from the upper end of the TR section was designated the upstream control (UC); the first 1000 m downstream from the lower end of the TR section formed the lower control

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