The impacts of brown trout (*Salmo trutta*) in streams: the implications of prey identity and habitat

By

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Declaration

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Abstract

Europeans introduced brown trout (*Salmo trutta L.*) into Australia in the 1800's and they are now widespread in the lentic and lotic systems of temperate south-eastern Australia. The literature on salmonids in the streams of other continents provides examples of both weak and strong impacts on the density of stream invertebrates. In Australia, we know little of the impacts that brown trout have on the native invertebrate fauna of freshwater habitats. This thesis aimed to determine the top-down effects of trout predation in small to medium sized headwater streams in Tasmania. My overall hypothesis was that the effects of predatory trout should be spatially heterogeneous in headwater streams, where physical and biological conditions are often variable over small spatial scales.

Initially, I used a survey of five upland forest streams containing brown trout and five nearby highly similar streams that are naturally fishless to address how the top-down impacts of trout are affected by: 1) the identity and behaviour of different invertebrate taxa; 2) inter-reach variation in substrate and flow conditions; 3) and how variation in shading affects the occurrence of trophic cascades. Finally, I conducted an experiment using bank side stream channels that mimicked depositional habitats to test whether the top-down effects of brown trout can induce a trophic cascade in depositional habitats, and whether any trophic cascades are limited to high light environments.

For the surveys, trout had the strongest impacts on mayflies, particularly baetids, which were up to five fold less numerous in the presence of trout. Mayflies were probably vulnerable to trout as they are numerous in the study streams, large bodied, feed on the exposed surface of stones and frequently enter the drift. However, the effects of trout were more marked on the behaviour of invertebrates with five taxa that showed no density effects exhibiting reduced daytime drifting in the presence of trout.

The impacts of trout varied across the stream reach; for example, the density of baetid mayflies were reduced in glide but not riffle or pool habitats in the presence of trout. In contrast, leptophlebiid mayflies and gripopterygid stoneflies were reduced in trout

streams in all habitats, although the effects were stronger on the epi-benthic density of these invertebrates.

I argue that patch-to-patch variation in flow and substrate conditions affect the vulnerability of invertebrates to trout with the strongest impacts under conditions of least complexity. For example, baetid mayflies might be particularly vulnerable in glides because trout are more numerous in glides and can more easily detect baetids in the drift under smooth, low complex flow than they can in the rough, complex flow of riffles. Moreover, within discrete habitats, the effects of trout may be strongest on invertebrates that occupy the structurally simple epibenthic surfaces of cobbles and boulders.

The top-down effects of trout on invertebrates and algae were also affected by shading. For example, algal biomass was higher in trout than fishless streams even under heavy shade; however, the size of the trophic cascade under light shading was over two-fold that observed under heavy shading. Differences between trout and fishless streams in the epibenthic density of baetids were also affected by shading with similar densities under heavy shading, but with 2.1 and 2.8 (respectively) fold higher density of baetids under medium and light shading in fishless than trout streams. Thus, the effects of variation in shading on the growth of algae and on the behaviour of mobile grazers may alter the perceived effects of trout across small spatial scales.

The surveys and artificial stream experiment also indicated weak effects of trout on the fauna of depositional habitats, which may be attributed to a high density of small, cryptic detritivorous invertebrates, such as *Riethia* chironomids, and a low density of mayflies. In the artificial streams, trout did not produce a dramatic top-down cascade, nor did shading influence the effects of trout on algal biomass. I suggest that abundant detritus dampened both the effects of trout and variation in shading by reducing the direct importance of algae to browsers, promoting a fauna whose key members were less vulnerable to predation, and by restricting light supply to benthic algae.

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