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IMPACTS ON STREAM FOOD WEBS OF NATIVE AND EXOTIC FOREST: AN INTERCONTINENTAL COMPARISON

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Abstract. Native pine-forest streams from Maine and North Carolina, USA, and exotic pine-forest streams from New Zealand were compared to assess the effects of geographic location on three aspects of community structure: (1) taxonomic composition, (2) trophic structure (summarized in terms of functional feeding groups), and (3) food web structure (as connectivity food webs). In addition, pine-forest assemblages in New Zealand were compared to assemblages from New Zealand native forest and grassland streams. Taxonomic similarity was, as expected, low for invertebrates, but there were strong similarities in the algal assemblages in different geographic locations. Trophic structure analysis was unable to distinguish either geographic or land-use effects. Food web analysis revealed structural similarities between the pine-forest streams, regardless of location, but there were clear differences among land uses in New Zealand. Pine-forest streams were typified by food webs with few algal species, low internal connectance and a relatively square shape. Grassland food webs were more triangular in shape and exhibited high internal connectance, while native forest food webs had intermediate characteristics. The results show that the native stream biota, despite a distinct species composition, can adapt to a novel riparian vegetation type and produce trophic and food web structures that are difficult to distinguish from those in the country of origin.

Key words: biogeography; exotic vs. native forests; food web; invasions; Maine (USA); New Zealand; North Carolina (USA); streams.

Introduction

Invasions have always been a key force in structuring biological communities. In the natural case, invasions of new areas, geographical separation, and subsequent divergence from source stocks have contributed significantly to the evolution of diversity. In recent times, the rate of invasions has increased exponentially as a result of human activities (Vermeij 1991, Townsend 1996) and the mixing of biotas from widely separated landmasses has potentially severe negative consequences for biodiversity. The plight of island fauna subject to invasion by exotic predators has been well documented (Vermeij 1991, Atkinson 1996, Vitousek et al. 1997) as have the effects of exotic plants on terrestrial communities (e.g., Vitousek 1990). Invaders may have no discernible effects, may drive vulnerable competitors or prey to extinction or may have widespread consequences that resonate through the food web, such as the impacts of brown trout in New Zealand streams (Flecker and Townsend 1994, McIntosh and Townsend 1994, Huryn 1996). Invaders also have the potential to alter physical environments, chemical conditions, and biogeochemical cycles of the areas they colonize. The deliberate transplantation by humans of exotic flora and fauna into new locations provides ecologists with the opportunity to test the resilience of native communities to the arrival of invaders.

Invasions induced by humans extend beyond the introduction of a single species into an existing native setting, sometimes involving the transplantation of an entire exotic landscape. The planting of North American conifer species for timber production is widespread in Europe, South America, South Africa, and New Zealand (Le Maitre 1998). The ecosystem consequences of such conversions are often profound in terms of alteration to soil structure (Ormerod et al. 1993), water yields (Fahey and Jackson 1997), and biogeochemistry (Reynolds et al. 1995, Ventura and Harper 1996). Afforestation of riparian zones has also been shown to impact on stream productivity and benthic invertebrate communities (Edwards and Huryn 1995, Harding and Winterbourn 1995, Friberg et al. 1997, Clenaghan et al. 1998). This is partly a result of disturbance due to forest management, and partly due to changes in the natural disturbance regime (via impacts on hydrology) and in energy supply (as sunlight and as organic matter entering the stream).

Afforestation of New Zealand stream margins by Monterey Pine (*Pinus radiata* D. Don) has occurred as gully land, which is marginal for pastoral farming, has been converted to plantation forestry. New Zealand has no native riparian vegetation type equivalent to such a conifer monoculture. Conifers in New Zealand, such as kauri (*Agathis australis*, Salisbury), *Libocedrus* spp. (kawaka, pauhatea), the podocarps (miro, totara, matai,

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