Legacy effects of catchment restoration on keystone invertebrate abundance

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Background

- Water quality of lakes and streams were heavily impacted from a century of mining
  - Has been improving since 1970s following emissions reductions and re-greening efforts
- Benthic macroinvertebrates are sensitive and ubiquitous organisms with slow rates of recovery¹
  - Amphipoda and Ephemeroptera were extirpated from many of these lakes due to pollution

Objective

- Examine whether variation in benthic macroinvertebrate abundance correlates with catchment characteristics of 2 lakes in the Sudbury area

Study Area

- Baby Lake: 11.9 ha, 2.7 km from Coniston smelter²
- Daisy Lake: 36.1 ha, 3.5 km from Coniston smelter³
  - Catchment J: received 460+ tons of limestone in 1995⁴
  - Catchment H: valley area naturally protected from smelter emissions

Methodology

Field Methods

- Artificial invertebrate habitats (dendies) installed for 4.5 weeks → samples of benthic macroinvertebrate community
- Terrestrial catchment characteristics → classify each site by degree of reclamation completed and distance from smelter

Ephemeroptera Abundance

- Mayfly abundance increased with distance from smelter (F₁,3₁ = 23.81, slope = 0.42, p<0.001)
- Mayfly abundance differed among study sites when accounting for distance (F₃,3₁ = 21.96, p<0.001) Figure 6
- Mayfly abundance greatest in treated deltas than other sites (post-hoc test: all p<0.01) Figure 6
- Completely restored deltas were the only deltas demonstrating increased mayfly abundance Figure 7

Amphipod Abundance

- Amphipod abundance increased with distance from smelter (F₁,3₁ = 23.87, slope = 0.60, p<0.001)
- Amphipod abundance differed among study sites when accounting for distance (F₃,3₁ = 3.90, p<0.05) Figure 4
- Abundance is greatest in treated deltas than all other site types (post-hoc test: all p<0.05) Figure 4
- Only completely restored deltas showed increased amphipod abundance among delta sites Figure 5

Conclusions

- Complete restoration treatments of severely damaged watersheds beneficial at local scales
  - Re-establishment of extirpated keystone macroinvertebrates → driving bottom-up trophic cascades
- Highlights importance of land-water linkages in landscape restoration
- Demonstrates lasting legacy effects of intensive reclamation efforts on whole ecosystem health and recovery

References


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