

Effects of stream restoration on macroinvertebrate communities & stream sediments

Vasilis Louca
Al Reeve
Maria Lopez
Hernandez
Patrick Armstrong
Logan Johnstone
Kaylie Edwards

Vasilis Louca
Senior Lecturer
University of
Aberdeen

v.louca@abdn.ac.uk

Stream habitat degradation



*Tarland
burn*



- Channelisation
- Removal of riparian vegetation
- Dredging / deepening of channels
- Livestock access to streams
- Excess nutrients
- Erosion
- ...

Impacts on:

- **Habitat complexity**
- **Biodiversity**
- **Atlantic salmon**

Cattie Burn



Cattie Burn: important Atlantic salmon spawning & rearing tributary within the River Dee catchment

Sampling site located on the Ballogie Estate, southwest of Aboyne, Aberdeenshire

Cattie Burn: Before restoration

Main stream channel
channelised &
straightened ~1800s

Cattie Burn: After restoration



- NatureScot's NRF fund
- Restoration: August 2024
- Re-meandered site: 725m

Key aims:

- increase wetted area and habitat complexity
- allow connection to floodplain during flood events
- Increase deposition of sand and fine sediment onto the land



Methods: Sampling

Macroinvertebrate sampling:

- 10 sampling points ~ 75m apart
- Sampling sites:
 - * **Unrestored**, pre-intervention stream channel – *July 2024*
 - * **Restored**, immediately post-intervention channel – *August 2024*
 - * **Restored channel year 2** - *July 2025*
 - * **Unrestored (year 2)**, downstream channel of ~ similar length. *July 2025*

- kick sampling with a 25x22cm kick net

Sediment assessment:

- 1m² quadrat
- Sediment assessment using the Wentworth system (Wentworth 1922)



Methods: Data analysis

- Generalised Estimating Equations analysis (**GEE**)
- Dependent variables: Species richness, SW Diversity, Sediment diversity, proportion of sediment suitable for Atlantic salmon spawning (*% of small: 0.8-2.5cm & large gravel: 2.5-7.5cm categories^{1,2},*)
- Sampling point incorporated in the model as a repeated measures variable
- Predictors for maximum model:
 - Restoration (Pre, post-restoration, post-rest year 2, control channel year 2)
 - Depth, flow, discharge, flow*discharge
- Final model based on best fit using QIC values

Diversity profiles using the Rényi diversity profile

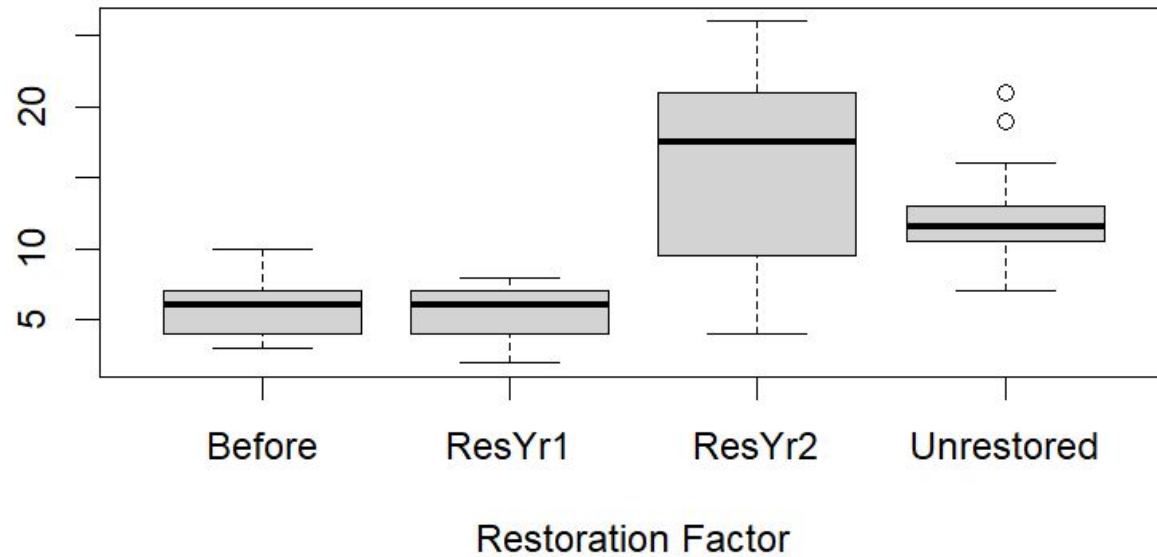
NMDS Ordination to identify distinct communities associated with the different restoration groups

¹Moir *et al*(1998). Hydraulic and sedimentary characteristics of habitat utilized by Atlantic salmon for spawning in the Girnock Burn, Scotland. Fisheries Management and Ecology, 5(3), 241-254.

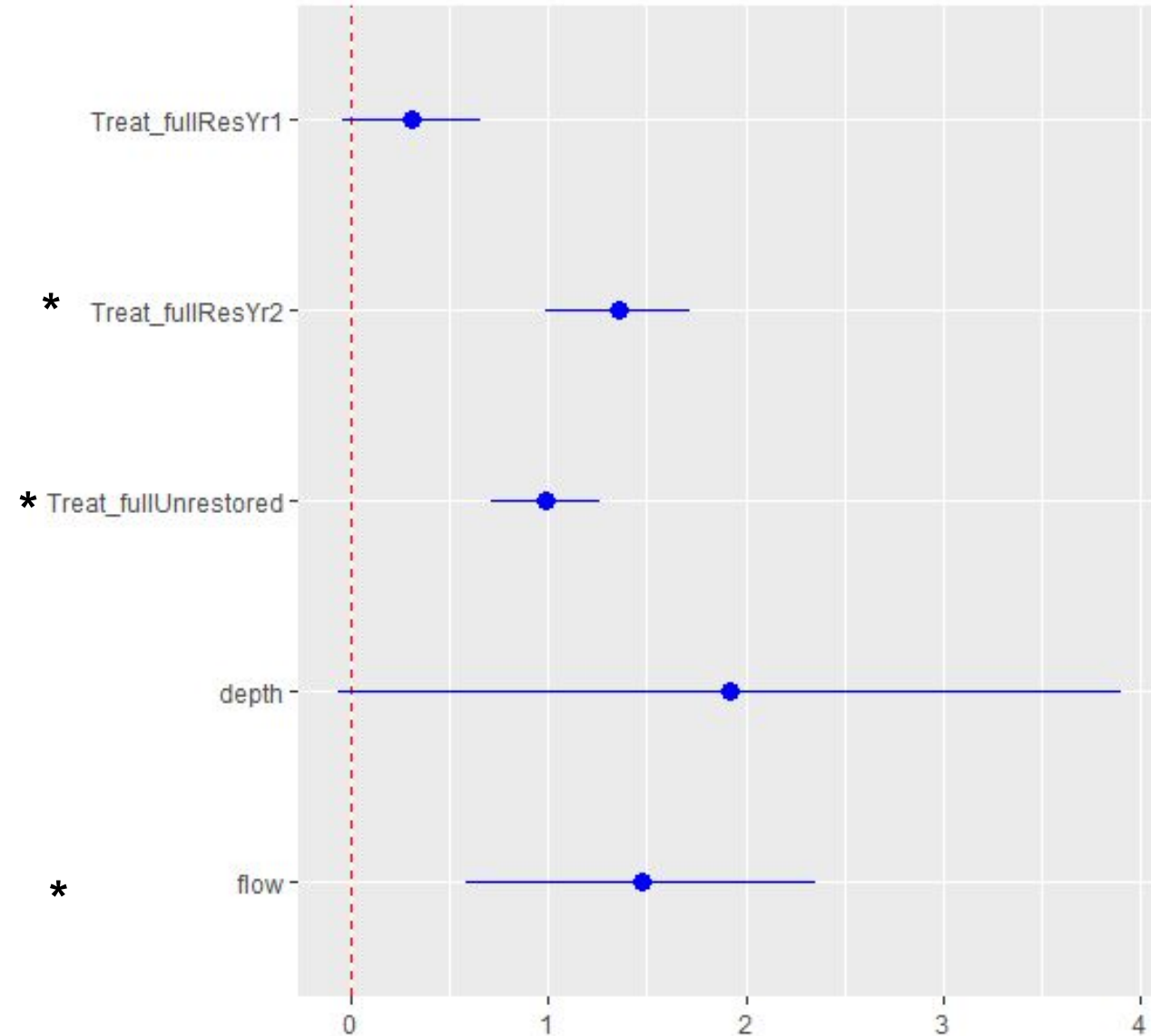
²Wentworth, C. K. (1922). A scale of grade and class terms for clastic sediments. The journal of geology, 30(5), 377-392.

Results: *Biodiversity – species richness*

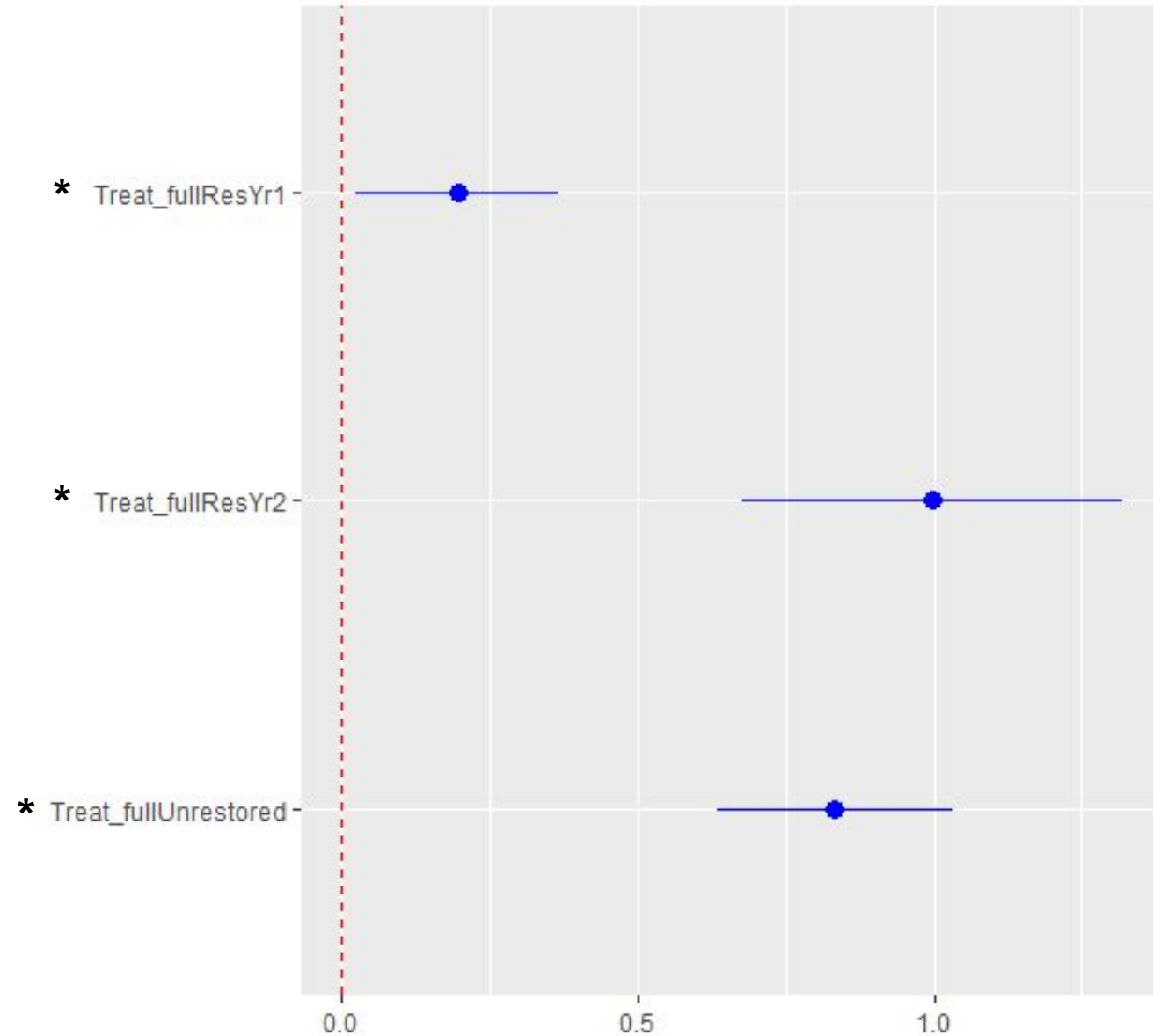
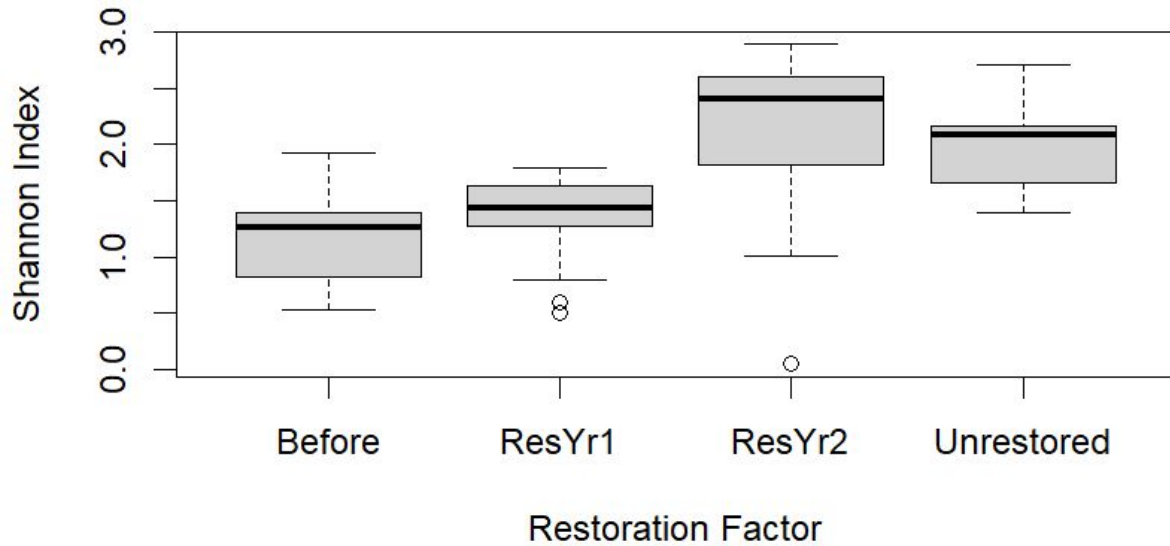
Species Richness



Macroinvertebrate species richness

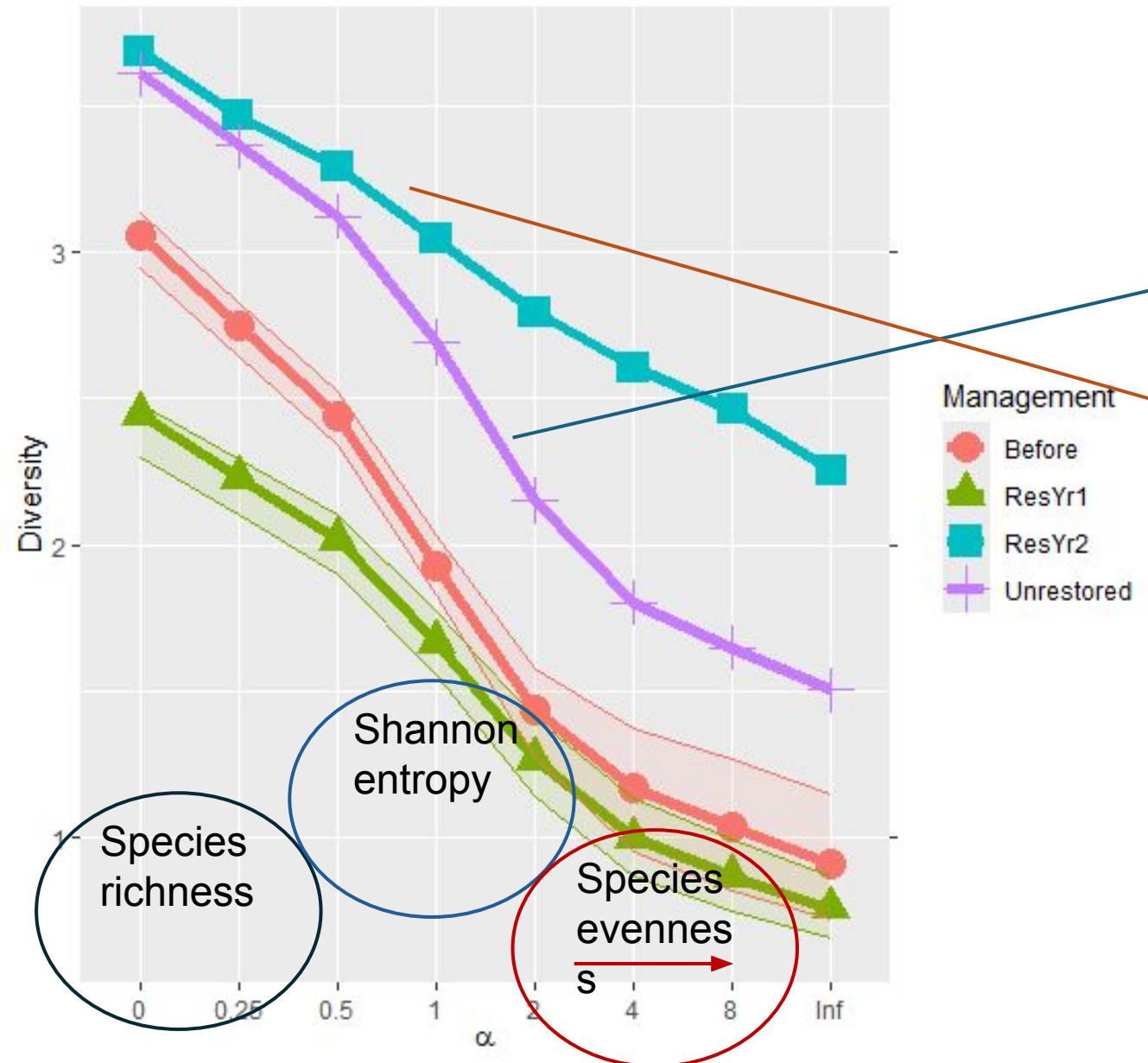


Results: *Biodiversity* – *SW diversity*



Macroinvertebrate species diversity (*SW Index*)

Results: *Biodiversity profiles*

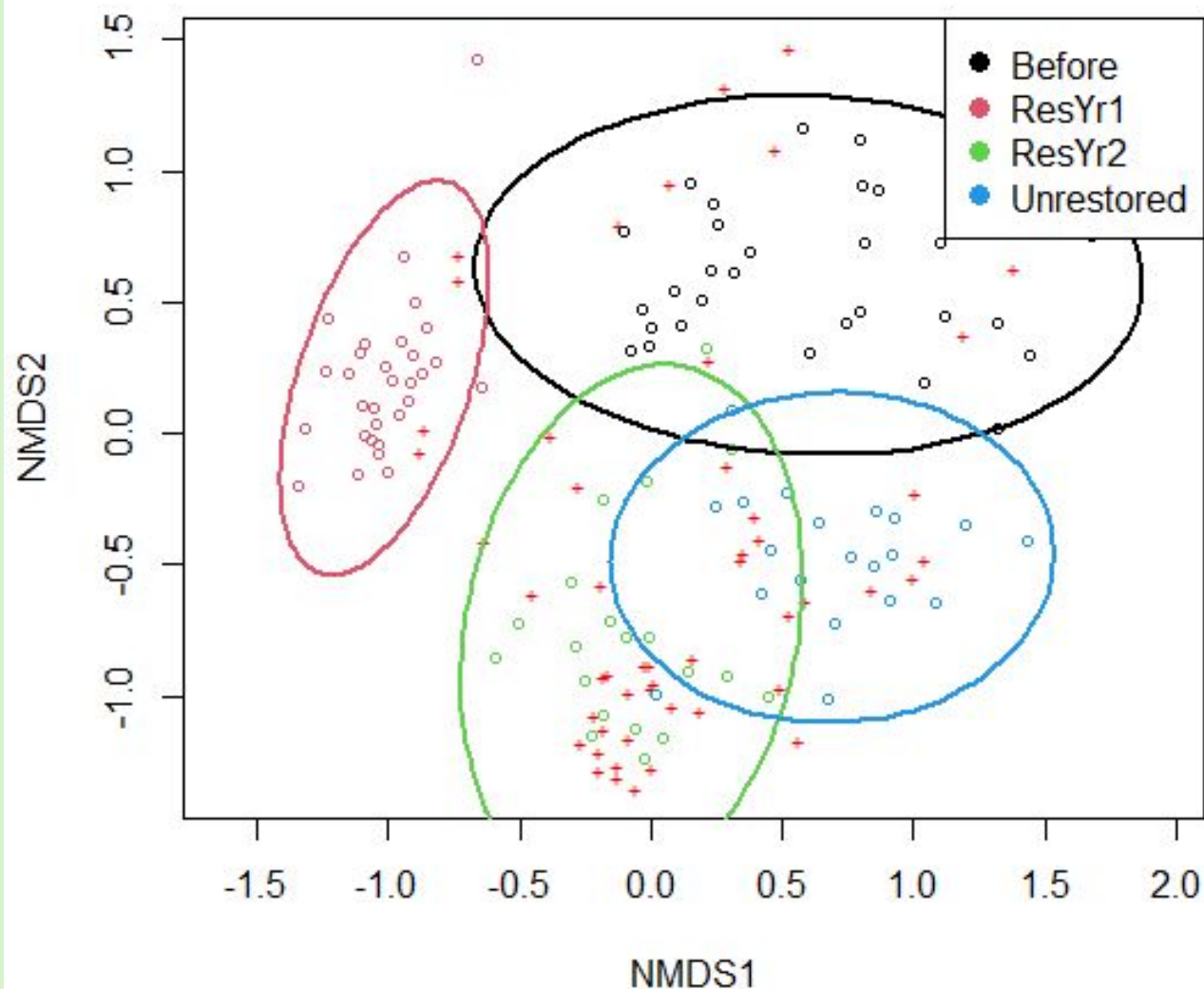


Unrestored site: High species richness, but low evenness

Improved & higher diversity profile for the restored site 1 year after restoration

Results: *NMDS ordination*

NMDS: Cattie Burn restoration

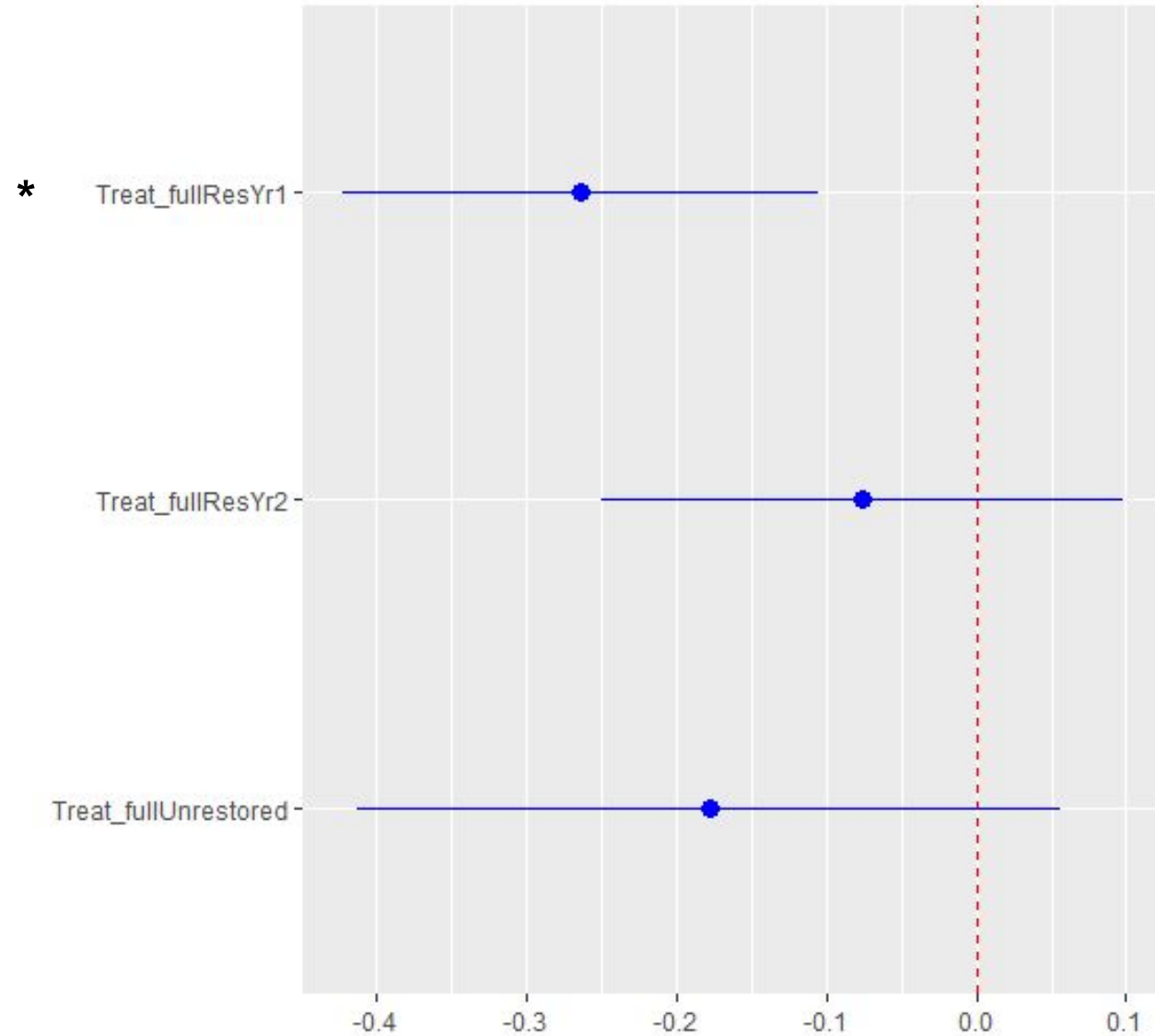
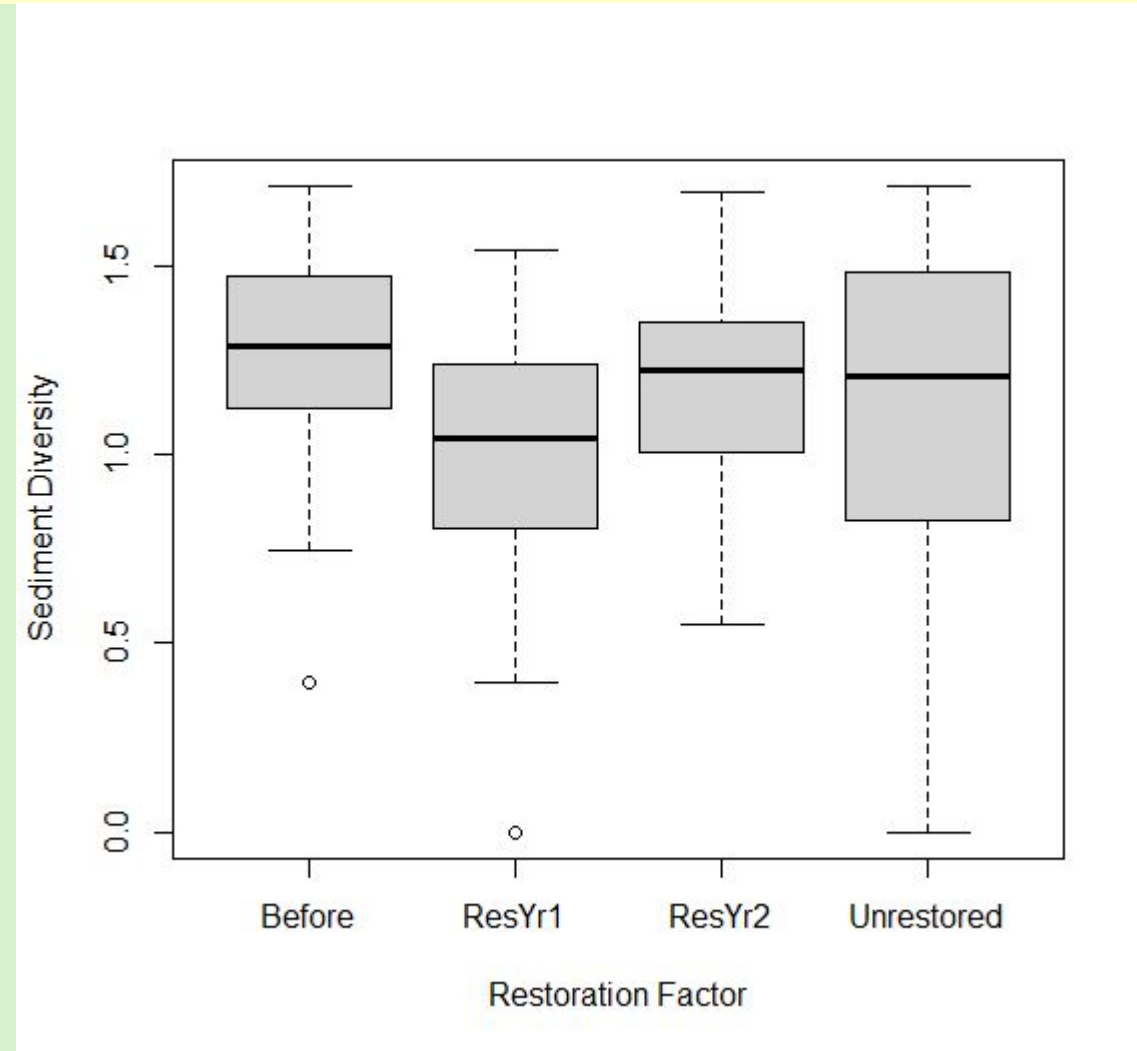


Restoration activities have led to a distinct macroinvertebrate community composition **immediately** post-restoration

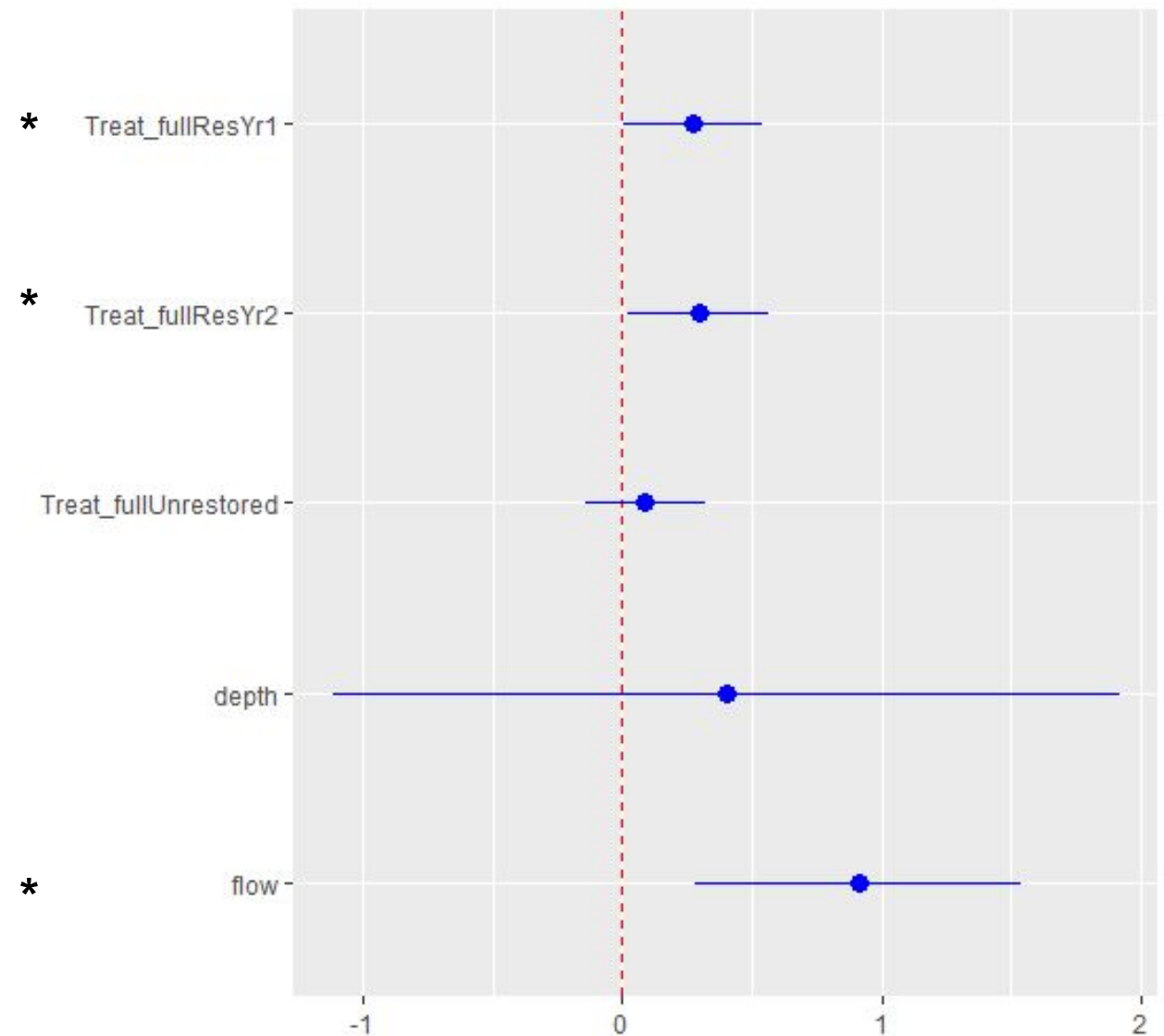
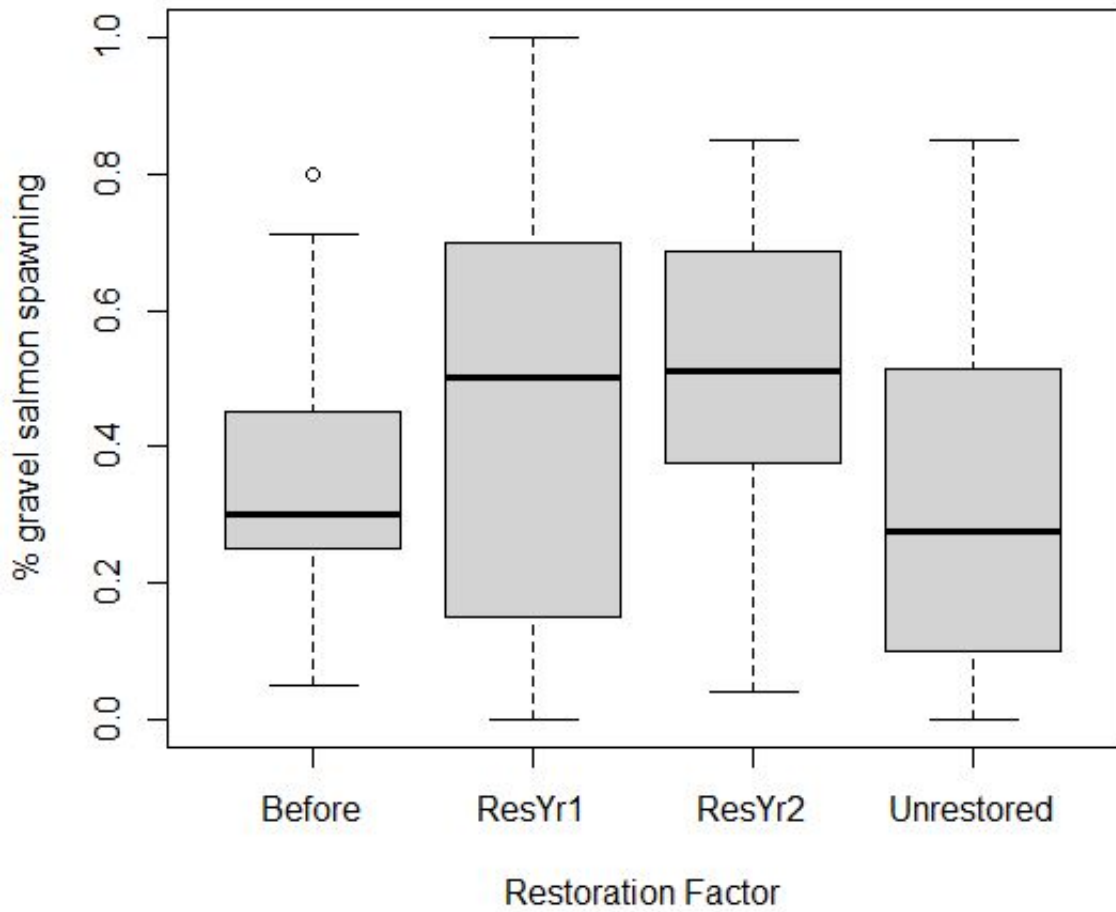
By the following year after restoration, communities becoming more similar to the unrestored downstream site

- > stabilization / convergence of community composition over time

Results: Sediment diversity



Results: % of small (0.8-2.5cm) & large gravel



Conclusions

- Immediate impacts of restoration on macroinvertebrates:
 - no change in species richness
 - increase in diversity
- Clear positive increases in both richness and diversity 1 year after restoration
- Macroinvertebrate communities are very different with distinct diversity profiles
- Positive increases in sediment suitable for salmon spawning immediately after restoration and 1 year on

Acknowledgements



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