Nutrients in buffer zones:

Exploring the potential role of macroinvertebrates in nutrient retention

A.M. Bakker[a,b], T.V. van der Meer[a,b], M.H.S. Kraak[b] and P.F.M. Verdonschot[a,b]

a: Freshwater Ecosystems, Water & Food, Wageningen Environmental Research, Wageningen University and Research
b: Freshwater and Marine Ecology, Institute of Biodiversity and Ecosystem dynamics, University of Amsterdam

Introduction

Buffer zones (BZs) are vegetated strips between agricultural areas and surface waters that may filter the excess diffuse nutrient flow, preventing eutrophication.

Understanding nutrient retention and removal processes is therefore vital to improve BZs design and efficiency.

The biogeochemical processes in such aquatic-terrestrial transition zones are well known, but the contribution of macroinvertebrates to the retention processes remains understudied (Fig. 1).

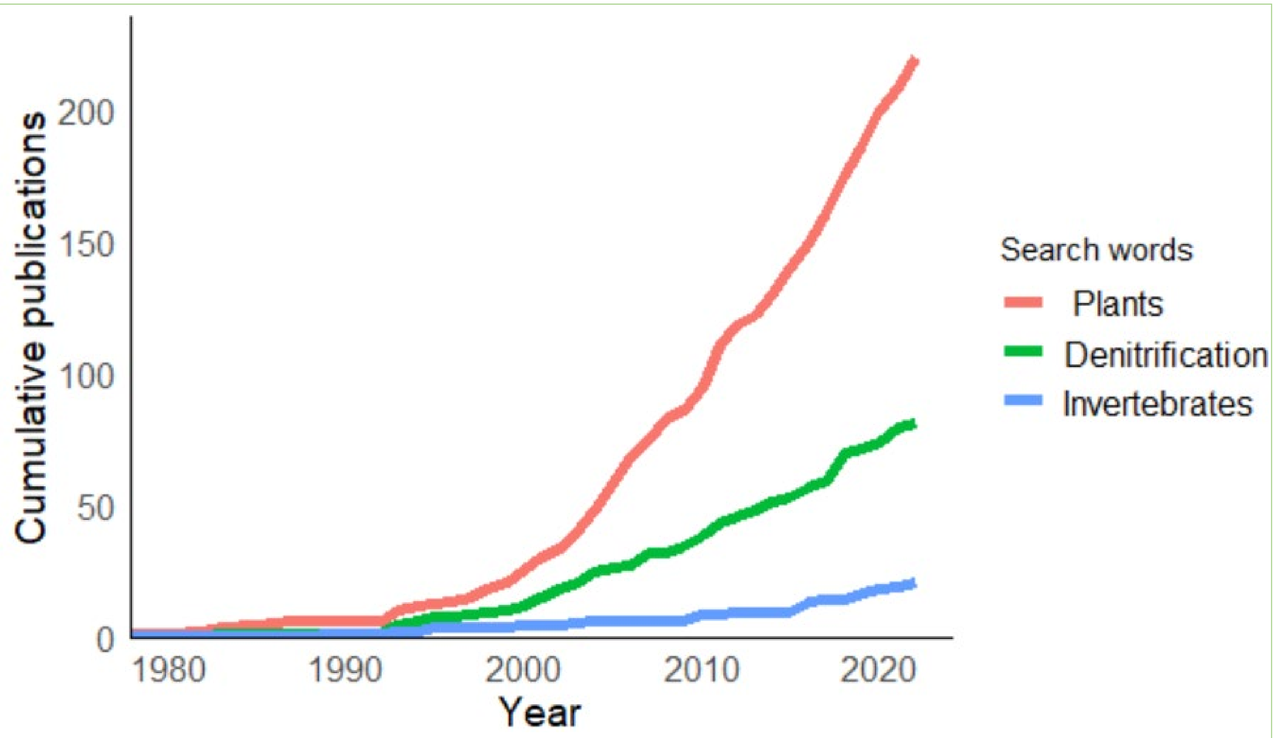


Figure 1: *Cumulative number of publications per year from Scopus per search word: "buffer zone nutrients" in combination with "plants" (red),"denitrification (green), "invertebrates" (blue).*

Aim

To assess the potential role of macroinvertebrates in nutrient retention and removal in buffer zones.

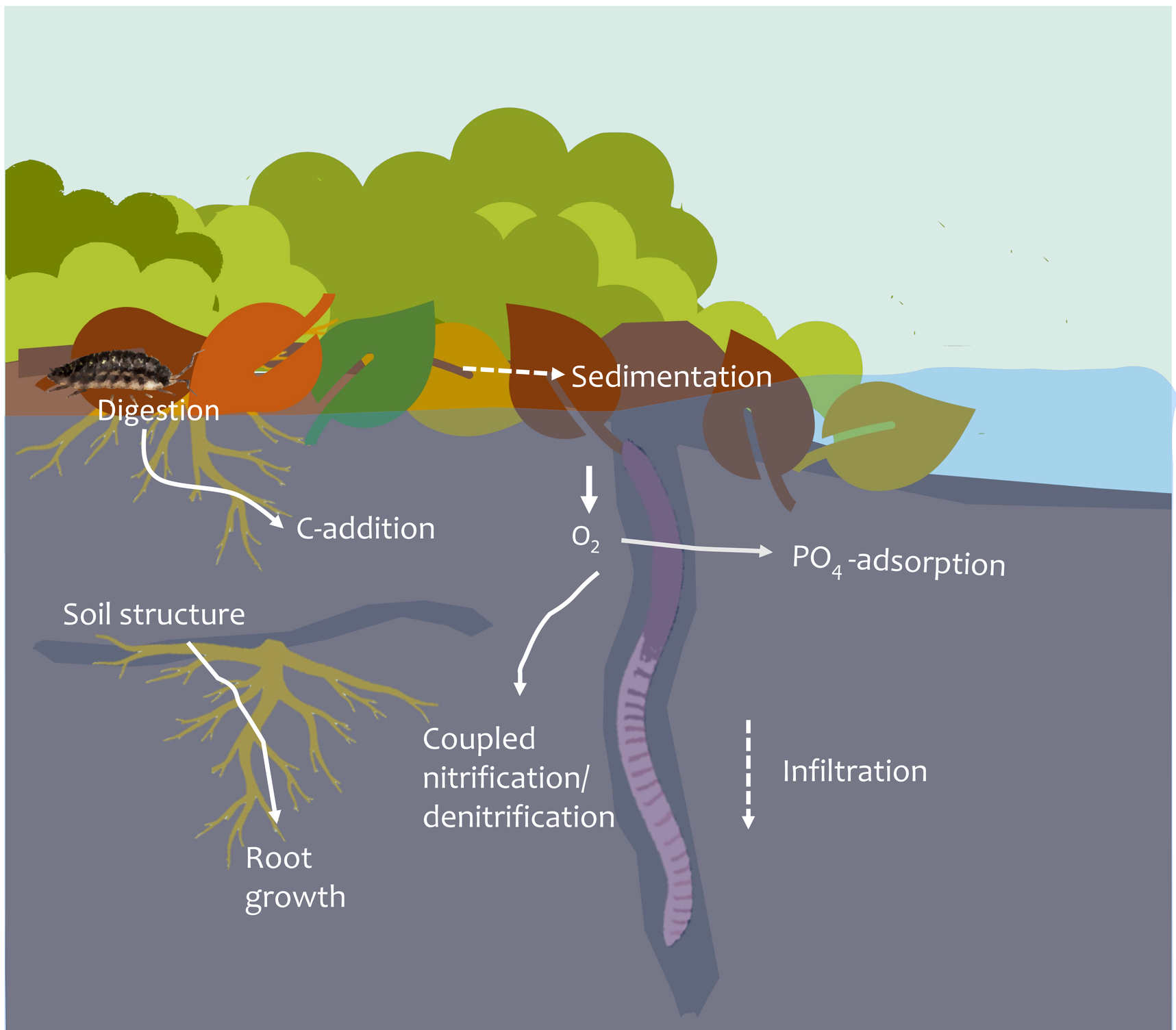
Results and Discussion

Invertebrate driven hydrogeochemical effects

- Earthworms can prevent runoff by increasing **sedimentation** via cast (faeces) depositions.
- Invertebrate burrowing can increase **infiltration and adsorption** of nutrients[1].
- Infiltration can increase **nitrate leaching** in BZs, depending on the hydrological regime.

Invertebrate-microbe interactions

- Invertebrate handling of organic matter can enhance **carbon concentrations** in the soil, while the anaerobic environment of the gut stimulates **denitrification** by microbes.
- Burrowing can increase oxygen concentrations in soils, enabling **coupled (de)nitrification**.
- Within BZs, invertebrates can increase denitrification[3].



Invertebrate-plant interactions

- Invertebrates can alter **plant community composition and functioning** by burrowing and by feeding on plant material[4].
- How these interactions affect nutrient retention and removal in BZs is currently unknown.

Conclusions

- Invertebrates play a major role in nutrient retention and removal processes.
- Future research should assess the quantification of the role of macroinvertebrates in buffer zones.

References
1: Anderson, J. M. (1988). Invertebrate-mediated transport processes in soils. *Agriculture, Ecosystems and Environment*, *24*(1–3). https://doi.org/10.1016/0167-8809(88)90052-7
2: Bradley, R. L., Whalen, J., Chagnon, P. L., Lanoix, M., & Alves, M. C. (2011). Nitrous oxide production and potential denitrification in soils from riparian buffer strips: Influence of earthworms and plant litter. *Applied Soil Ecology*. https://doi.org/10.1016/j.apsoil.2010.11.007
3: McCary, M. A., & Schmitz, O. J. (2021). Invertebrate functional traits and terrestrial nutrient cycling: Insights from a global meta-analysis. *Journal of Animal Ecology*, *90*(7). https://doi.org/10.1111/1365-2656.13489