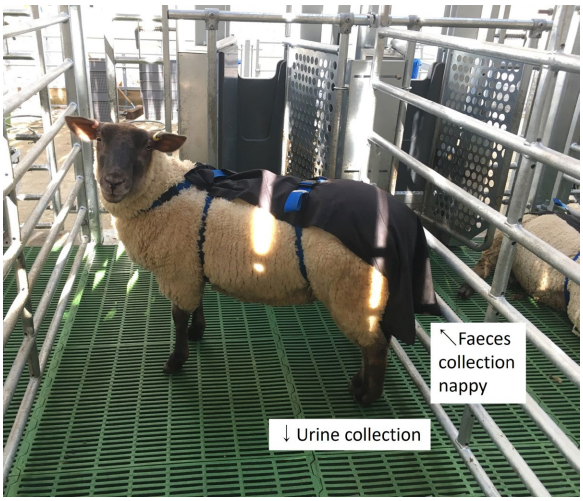
Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20461

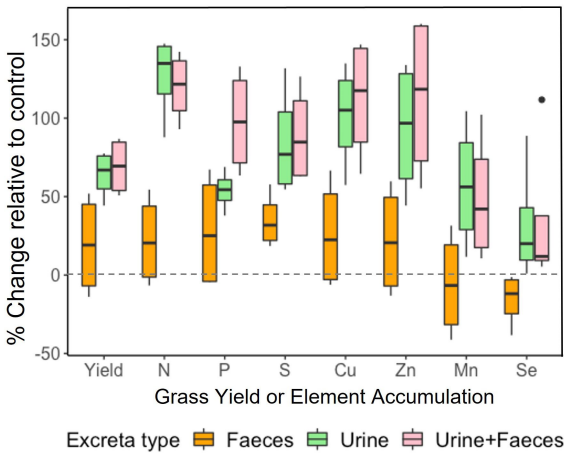
P**ing on the Critical Zone: Micronutrient Dynamics in Pasture Systems

DR. HEATHER L BUSS, PHD[1], PEI-TZU KAO[1,2,3], STEVE P MCGRATH[3] AND MICHAEL RF LEE[4]

[1]University of Bristol
[2]National Chung Hsing University
[3]Rothamsted Research
[4]Harper Adams University

Presenting Author: h.buss@bristol.ac.uk





Food provision, for all lifeforms, is one of the most critical of the critical zone functions and has been subject to widespread human intervention for >10000y. To this day, those interventions focus on increasing yields, with little attention paid to nutritional content. Increasing yields are achieved largely by applying fertilisers, yet even as organic fertilisers (e.g. manures) are increasingly used, micronutrient deficiencies in crops and animals are increasing [1] and freshwaters are polluted by macronutrient runoff. There is urgent need to better understand (micro)nutrient dynamics in agricultural [1] and natural systems from a critical zone perspective, e.g. analysing feedbacks over multiple scales, disciplines, and contexts.

Our work includes studies tracing micro- and macronutrients from nutritional supplements through animals to their excreta [2], into soil and ultimately to forage grass [3] as well as the effects of manure and rooting depth on soil microorganisms and micronutrients. We found that the chemical form (organic or inorganic) of supplemental micronutrients did not affect the micronutrient abundances in sheep urine or faeces nor their accumulation by grass. Although most micronutrients are substantially more abundant in faeces than in urine, only applying urine to soils significantly increased grass yield and micronutrient accumulation. Moreover, applying faeces to some soils even decreased Se and Mn accumulation by grass. PO_4^{3-} can inhibit Se uptake by plants [4], and we found that faeces increased bulk, organic and bioavailable soil P, but also increased loss of bioavailable and organic P over time, even in soils without plants. Microbial Se reduction can also lower Se availability and we found that deep-rooting grass lowered soil microbial biomass and altered communities and micronutrient bioavailability. These effects on Se are potentially critical given that average Se concentrations in UK pastures are below animal requirements. Although supplements can mitigate micronutrient deficiencies, they are not available to all people or animals and contribute to the increasing demand for mineral resources.

[1] Kao et al. (2020) *Adv. Agronomy* 164, 161-229.
[2] Kao et al. (2023) *Scientific Reports* 13, 2747.
[3] Kao et al. (2023) *Plant Soil* https://doi.org/10.1007/s11104-023-05898-8
[4] Sors et al. (2005) *Photosynth. Res.* 86, 373-389.