THE EFFECTS OF LOW HEAVY METAL CONCENTRATIONS OF IN *ANOPHELES ARABIENSIS* (DIPTERA: CULICIDAE)

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INTRODUCTION

Anopheles arabiensis is a dominant malaria vector species in Southern Africa, and displays plastic behaviour in terms of feeding and resting. It is a member of the *An. gambiae* complex, which is adapting to breeding in polluted waters. As a result of anthropogenic activities, heavy metal pollution is increasingly prevalent in both rural and urban areas at varying concentrations. While heavy metals are toxic in high concentrations, some can serve as critical micronutrients at lower doses. This could include zinc and cobalt, where zinc is essential for enzyme activity, while cobalt is involved in vitamin synthesis. They also contribute to insect development, reproduction, and immunity, and are involved in complex interactions with their gut microbiota. Zinc specifically was seen to positively affect larval development of the insecticide-susceptible SENN strain of *An. arabiensis*, while also increasing adult longevity. This study therefore aimed to determine whether zinc and cobalt could have positive effects at lower concentrations on the major malaria vector *An. arabiensis*, specifically with regards to the gut microbiota.

METHODOLOGY

- Exposure of 100 first instar larvae (SENN) to zinc acetate (100 mg/ml) and cobalt nitrate (1000ppm).
- Midgut dissection of 3-day old non-blood fed adult females that emerged.
- DNA extraction & PCR amplification of the V3-V4 hypervariable region of the 16S rRNA bacterial gene.
- PacBio HiFi sequencing of the amplicons.
- Sequence trimming and filtering with trimGalore, quality control using MultiQC, and bioinformatic analysis in R.

RESULTS

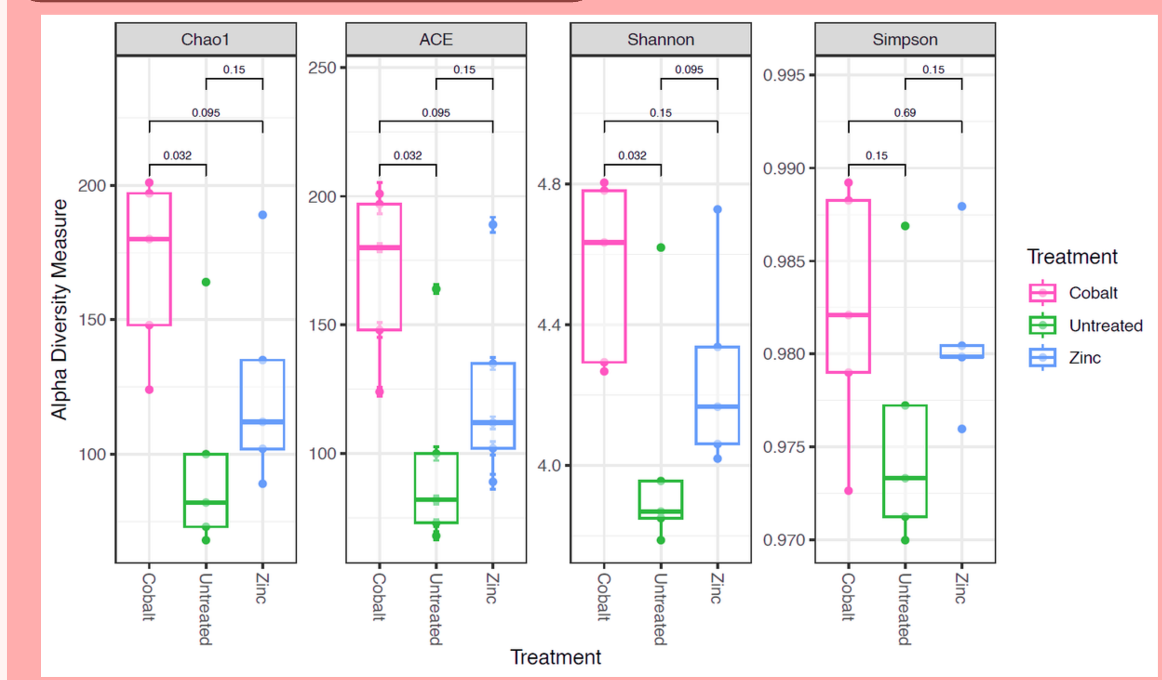

Fig. 1. Alpha diversity (within sample diversity).
Cobalt treatment resulted in significantly higher richness and diversity than no treatment.

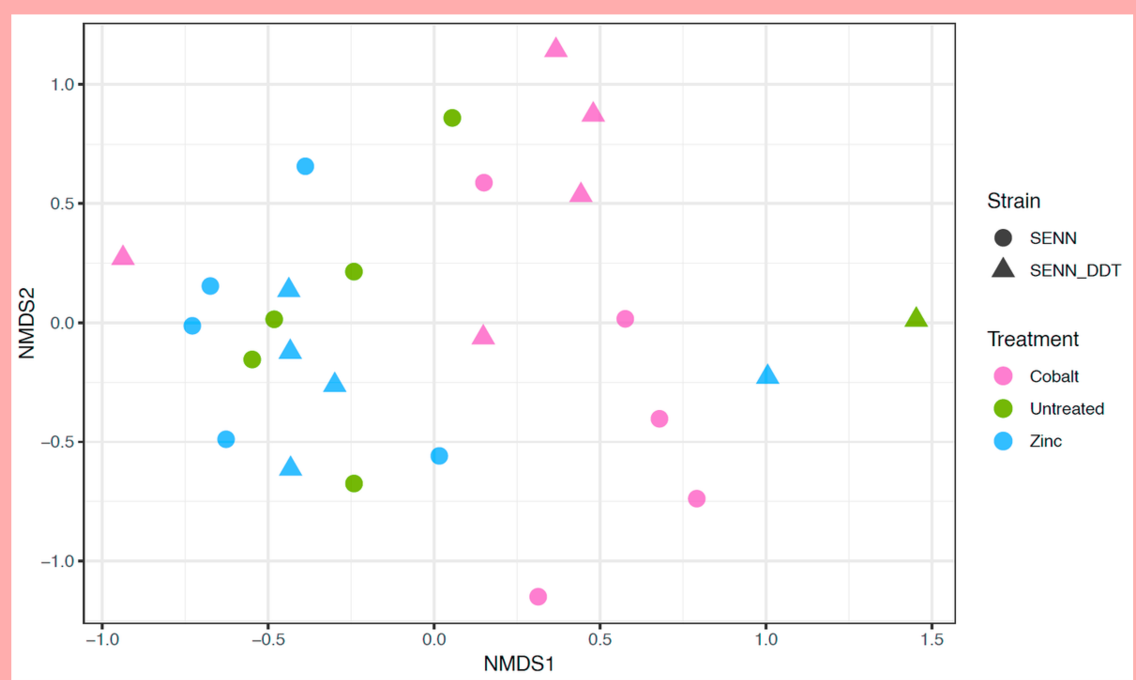

Fig. 2. Beta diversity (between group diversity).
Metal treatment had a significant effect on beta diversity.

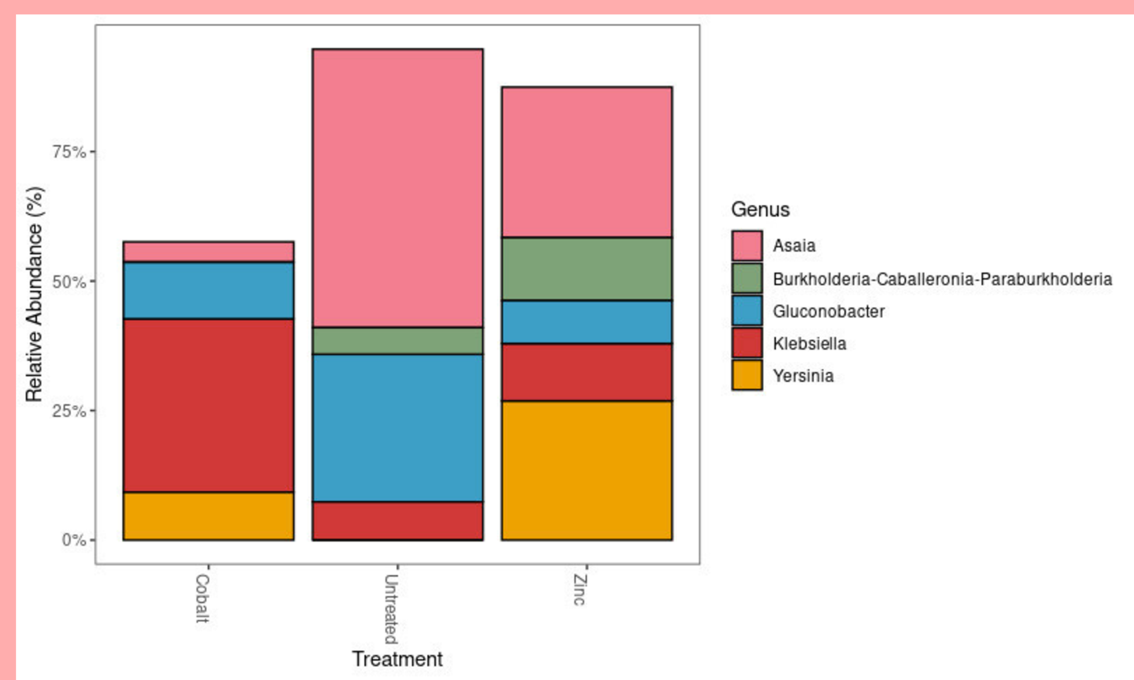

Fig. 3. Relative abundance for SENN.
Metal treatments significantly altered the proportion of relatively abundant genera, with *Asaia* being reduced in treated groups.

★ *Plasmodium*-protective
★ Pesticide-degrading
★ Metal-degrading

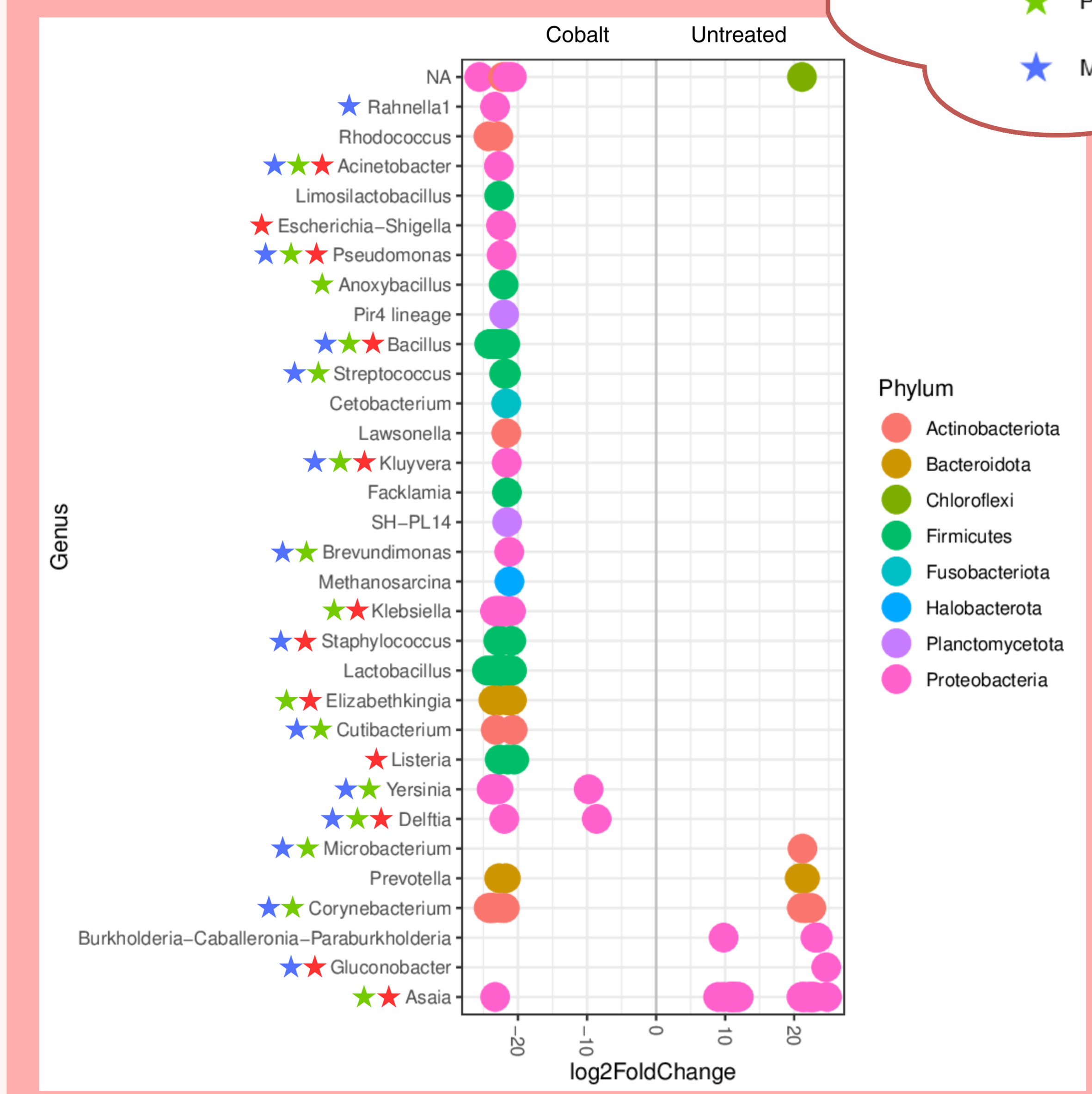

Fig. 4. Differential abundance between cobalt-treated versus untreated groups.

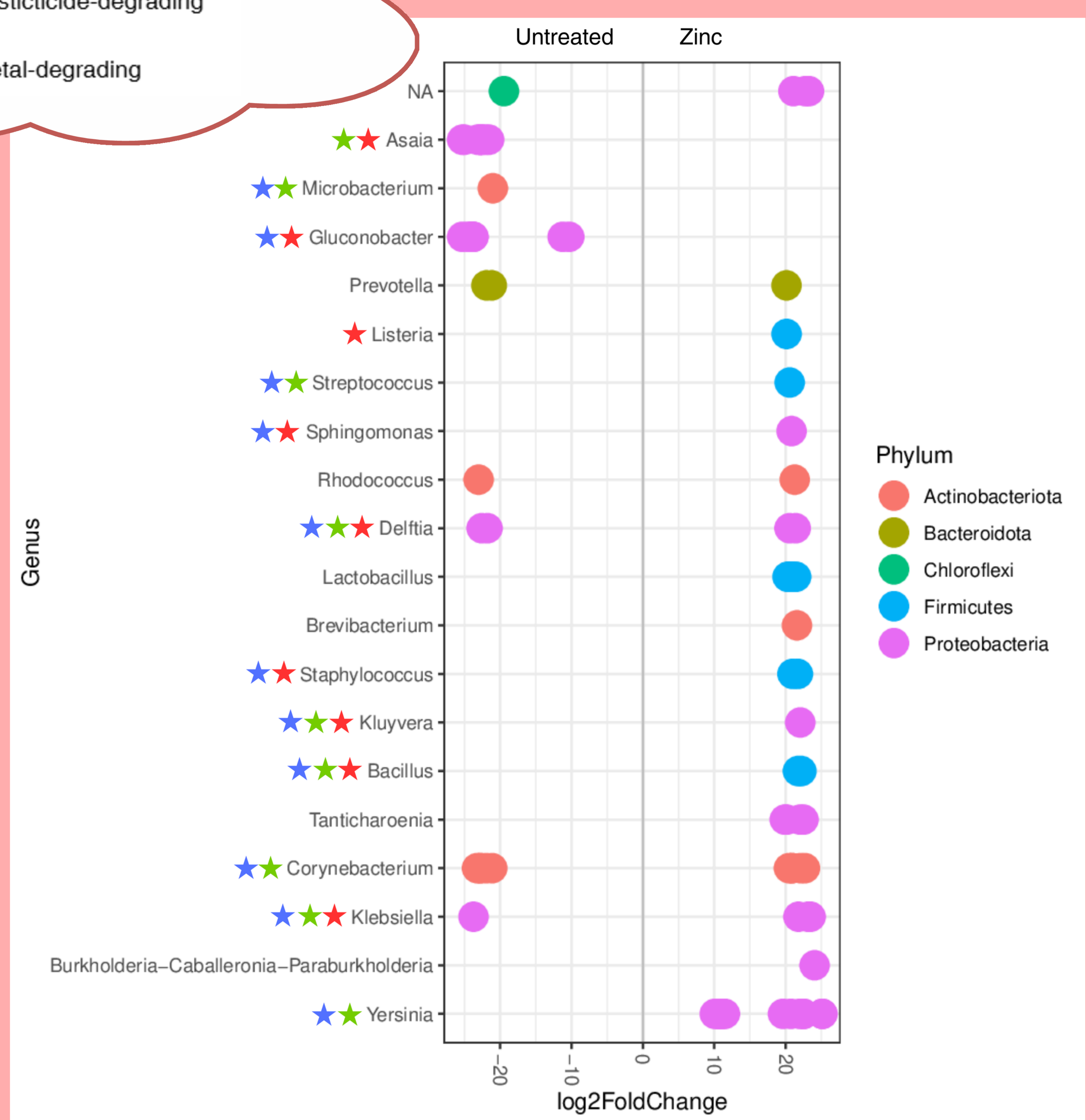

Fig. 5. Differential abundance between untreated versus zinc-treated groups.

Fig. 6. Differential abundance between cobalt-treated versus zinc-treated groups.

CONCLUSIONS

- Cobalt treatment increased alpha diversity, and also resulted in a beta diversity that clustered away from zinc and untreated samples.
- Although both metals increased differential abundance, this change was more evident for cobalt treatment.
  - Many of the differentially abundant genera in the zinc group were also present in the cobalt group.
- These results, coupled with the observation that low doses of these metals had life history advantages, suggests that these metals can serve as micronutrients.
- This suggests that low doses of heavy metals found in urban areas could be advantageous for *An. arabiensis*.
- These findings therefore have implications for the capacity of this species to breed in urban areas.

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