

# Links between bacteria derived from penguin guts and deposited guano and the surrounding soil microbiota

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**Abstract** Penguins are an important indicator of marine ecosystem health and a major contributor of nutrients to terrestrial ecosystems in Antarctica. Their stomach microbiota is influenced by both the prey consumed and their foraging environment in the sea. As penguins feed at sea and breed on land, they might be expected to transfer microbes (e.g. prey-associated and marine bacteria) as well as nutrients from their stomachs while regurgitating food or in their guano to the surrounding terrestrial environment. However, most research attention to date has focused separately on the penguin gut microbiota (via cloacal/guano samples) and the terrestrial soil microbiota, and any relationship between them has yet to be established. Here, we analysed the bacterial communities in stomach regurgitates and cloacal swabs from the same individual birds, freshly deposited guano and rookery soils of two

*Pygoscelis* penguins that breed sympatrically on Signy Island (South Orkney Islands, maritime Antarctic) using a high-throughput DNA sequencing method. Our data do not support the hypothesis that bacteria transferred from penguin guts and/or deposited guano make a significant contribution to the communities of the surrounding terrestrial microbial ecosystem. In both penguin species, composition of bacterial communities differed between the four sample types, with Jaccard similarities ranging between 10 and 36%. Assemblages of the dominant and co-occurring bacterial communities in rookery soils were either significantly negatively correlated or not correlated with the three other sample types. Sample-specific communities were also identified in this study, contributing around 63% of the identified diversity overall.

**Keywords** Antarctic · Bacterial input · Microbial diversity · Terrestrial environment

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## Introduction

Penguins are an important indicator species of marine ecosystem health in Antarctica, being amongst the top marine consumers (Brooke 2004), with populations strongly influenced by environmental factors (Boersma et al. 2009; Forcada and Trathan 2009; Boersma and Rebstock 2014). In our recent study (Yew et al. 2017), prey-associated and marine bacteria were confirmed to be present in the microbial communities of penguin stomach regurgitates, suggesting an influence of their diet and foraging environment on the gut microbial community.

Penguins are also a key contributor of nutrients to terrestrial ecosystems in Antarctica (Heine and Speir 1989). Guano deposited by penguins fertilises the typically