From cover letter:

Our paper demonstrates a reproducible protocol to identify target species from predator scat and, further, uses haplotype analyses to assess genetic diversity and probable abundances of prey species within and between scat samples. This novel research provides a powerful tool for quantifying predator-prey relationships. Our study advanced frameworks for processing DNA metabarcoding that enables us to determine the number of individual penguins consumed from scat samples collected from fur seal colonies across multiple sites. In conclusion, seabirds, particularly little penguins, are an important foraging strategy for some long-nosed fur seals. This research provides a critical step towards an up-to-date cumulative impact assessment for threats to little penguins in southern Australia.

Extra text from recent submission:

Additionally, increasingly frequent terrestrial heat waves can cause hyperthermia, whereby little penguins die of exposure to prolonged high ambient temperatures during the critical moult period (Lauren Tworkowski, La Trobe University, unpublished data). Additionally, a major driver of global penguin population vulnerability and decline involves food web changes caused by ocean warming and competition with marine fisheries (Ropert-Coudert et al., 2019).

Conclusions

This study uses a valuable multi-assay framework for identifying and quantifying predation, that can be broadly applied across systems and ecological issues. Here we identify the prevalence of seabird predation and estimate the abundance of little penguin predation by long-nosed fur seals, information that is critical to assessing and managing an emerging wildlife conflict in Australian waters. We identify the genetic remains of between 1–6 individual penguin haplotypes within each long-nosed fur seal scat sample that tested positive for penguins and represent a minimum of 21 little penguins consumed across 99 predator samples. DNA-based diet analysis also identified the remains of multiple seabird taxa within some samples, indicating seabird predation may be a relatively important individual foraging strategy for some fur seals. Using both morphological and genetic diet assays, we estimate an overall range in predation detection of 9–29% for seabirds, and 6–25% for little penguins. These detection rates warrant further monitoring and quantitative investigation through longer-term and more comprehensive sampling programs across southern Australia to provide managers with robust spatio-temporal predation patterns and estimates. Finally, with ongoing genetic technological advancement, we recommend the development of cost-effective assays tailored to the needs of specific wildlife conflict scenarios in order to better quantify these conflicts.

Intro:

Little penguins and other seabirds have been identified in the diets of juveniles, sub-adult and adult male long-nosed fur seals, at two locations in southern Australia: (i) from little penguin DNA in a single scat at a site at the northeastern edge of the range (Hardy et al., 2017); and, (ii) from a 3-year scat sampling program at a large, southern breeding colony where little penguin morphological remains were detected in up to 5.9% of samples, and shearwaters in up to 1.3% of those samples (Page et al., 2005).

Discussion

We identified statistically similar rates of occurrence for seabirds and little penguins from both the genetic and traditional assay methods. However, DNA metabarcoding provided key additional information critical to assessing predator-prey interactions within a wildlife conflict and conservation management context: (i) a prevalence range based on recovered genetic abundance and that is likely to be more reliable than traditional morphological assays; (ii) detection of multiple prey taxa within a single sample; and (iii) identification of genetic diversity enabling estimation of penguin abundances consumed. DNA metabarcoding also offers multiple metrics in addition to occurrence rates and helped to form a consensus here that little penguins are currently the most commonly consumed seabird by long-nosed fur seals in comparison to other seabirds (e.g., procellarids, black-browed albatross, greater crested tern, and Australasian gannet).

Previously, a single fur seal scat containing feathers regardless of amount has been hypothesised to represent one bird (Page et al., 2005).