Chemical patterns of colony membership and mother-offspring similarity in Antarctic fur seals are reproducible

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ABSTRACT

Replication studies are essential for evaluating the validity of previous research findings. However, it has proven challenging to reproduce the results of ecological and evolutionary studies, partly because of the complexity and lability of many of the phenomena being investigated, but also due to small sample sizes, low statistical power and publication bias. Additionally, replication is often considered too difficult in field settings where many factors are beyond the investigator's control and where spatial and temporal dependencies may be strong. We investigated the feasibility of reproducing original research findings in the field of chemical ecology by performing an exact replication of a previous study of Antarctic fur seals (*Arctocephalus gazella*). In the original study, skin swabs from 41 mother-offspring pairs from two adjacent breeding colonies on Bird Island, South Georgia, were analyzed using gas chromatography-mass spectrometry. Seals from the two colonies differed significantly in their chemical fingerprints, suggesting that colony membership may be chemically encoded, and mothers were also chemically similar to their pups, hinting at the possible involvement of phenotype matching in mother-offspring recognition. In the current study, we generated and analyzed chemical data from a non-overlapping sample of 50 mother-offspring pairs from the same two colonies 5 years later. The original results were corroborated in both hypothesis testing and estimation contexts, with *p*-values remaining highly significant and effect sizes, standardized between studies by bootstrapping the chemical data over individuals, being of comparable magnitude. However, exact replication studies are only capable of showing whether a given effect can be replicated in a specific setting. We therefore investigated whether chemical signatures are colony-specific in general by expanding the geographic coverage of our study to include pups from a total of six colonies around Bird Island. We detected significant chemical differences in all but a handful of pairwise comparisons between colonies. This finding adds weight to our original conclusion that colony membership is chemically encoded, and suggests that chemical patterns of colony membership not only persist over time but can also be generalized over space.

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