Penguin trait variation in the Palmer Archipelago

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Study Information

Penguin trait variation in the Palmer Archipelago	Penguin trait variation in the Palmer Archipelago
Description	This study seeks to understand penguin trait variation in the Palmer Archipelago, Antarctica. Specifically, this study seeks to determine if mean flipper length, bill length, and body mass is significantly different across Biscoe, Dream, and Torgersen Island, and if the relationships between traits varies across these islands. By completing these analyses, islands where environmental filtering may be strong and/or species may have low plasticity will be identified, which has practical relevance for determining areas where species may be more vulnerable.
Hypotheses	Part 1: If geographic location is an important determinant of trait variation for penguins on the Palmer Archipelago, then mean trait values will be significantly different from each other.

Part 2: If geographic location is an important influence on trait variation for penguins on the Palmer Archipelago, then the slopes in trait-trait relationships will be significantly different from one another.

Design Plan

Study type	**Other**. Data synthesis and analysis project. Existing data is collated and used for statistical analyses.
Blinding	No blinding is involved in this study.
Study design	I will use the Palmer Penguins dataset, which includes bill length, bill depth, flipper length, and body mass measurements for adult penguins observed on Biscoe, Dream, and Torgensen Islands (Horst et al., 2020). For the purposes of my study, I will only use bill length (mm), flipper length (mm), and body mass (g).

Part 1: I will use ANOVA to test for significant differences in the mean values of the aforementioned traits across the three islands. I will then examine pairwise comparisons for each ANOVA using a Tukey test.

Part 2: I will use linear regression to estimate the relationship between bill length and flipper length, as well as the relationship between flipper length and body mass. Both of these regressions will include an interaction term with island to determine how island moderates the relationship between the two sets of traits. A post-hoc Tukey test will be used to examine pairwise comparisons. ## Randomization

None.

Sampling Plan

None - this project is using existing data, which was collected by Dr. Kristen Gorman with the Palmer Station Long Term Ecological Research Program.

Existing data	**Registration prior to analysis of the data**. As of the date of submission, the data exist and you have accessed it, though no analysis has been conducted related to the research plan (including calculation of summary statistics). A common situation for this scenario when a large dataset exists that is used for many different studies over time, or when a data set is randomly split into a sample for exploratory analyses, and the other section of data is reserved for later confirmatory data analysis.
Explanation of existing data	I will use existing data collected by Dr. Kristen Gorman with the Palmer Station Long Term Ecological Research Program. I have been partially blinded to the data as I have not explored the relationships or summary statistics that I are relevant to this project.
Data collection procedures	The data will be taken from an existing source, specifically the Palmer Penguins dataset. I have removed the bill depth (mm) measurements as I am not using these measurements for the study. Additionally, I have dropped entries with missing data.
Sample size	The data contains 333 penguin observations total. The Biscoe Island subset contains 163 observations, Dream Island subset contains 123 observations, and the Torgensen Island subset contains 47 observations.
Sample size rationale	The sample size is constrained to what is available as it is an existing dataset. I ensured that cleaning and processing would leave at least 30 observations for each group in order to ensure having sufficient observations to conduct statistical analyses.
Stopping rule	None. I am using an existing dataset.

Variables

Manipulated variables	There are no treatments/true manipulations as the data was purely observational. For the purposes of my project, the 'treatments' would be the categorization of penguin measurements by island. The islands in the data are Biscoe Island, Dream Island, and Torgensen Island.
Measured variables	Part 1: The outcome variable will be the mean trait values and the associated p-values for each ANOVA and Tukey test conducted.
	Part 2: The outcome variable will be the estimated slopes and the associated p-values for the modification of the trait-trait relationships by the island interaction term, as well as the p-value associated with the Tukey test.
Indices	None.

Analysis Plan

Statistical models	Part 1: I will use ANOVA to test for significant differences in the mean values of the aforementioned traits across the three islands. I will then examine pairwise comparisons for each ANOVA using a Tukey test. The Tukey test will be performed using the 'emmeans' package.
	Part 2: I will use linear regression to estimate the relationship between bill length and flipper length, as well as the relationship between flipper length and body mass. Both of these regressions will include an interaction term with island to determine how island moderates the relationship between the two sets of traits. A post-hoc Tukey test will be used to examine pairwise comparisons. ## Randomization
Transformations	Data will not be transformed.
Inference criteria	We will use the standard p<0.05 for determining significance for all statistical analyses. Differences in trait-trait relationships will be confirmed visually and with a pairwise comparisons test.

Data exclusion	Entries with missing data will be removed.
Missing data	Entries with missing data will be removed.
Exploratory analyses (optional)	I will examine potential differences in traits across groups by looking at the boxplots of all trait values by island, as well as estimating mean trait values.

References

Horst, A. M., Hill, A. P., & Gorman, K. B. (2020). *Allisonhorst/palmerpenguins: v0.1.0.* Zenodo. https://doi.org/10.5281/zenodo.3960218