The Effect of Individual Characteristics and Environmental Conditions on Poweshiek Skipperling Copulation Success in an Ex-Situ Management Program

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PURPOSE & OBJECTIVES

PURPOSE

- Optimize breeding efforts for the Grassland Butterfly Conservation Program at the Assiniboine Park Zoo.

OBJECTIVES

1. Evaluate lineage, age, and maternal site origin of individuals in relation to copulation success.
2. Assess the relationship between temperature, humidity, and sunlight to copulation success.

METHODOLOGY

BREEDING TRIALS

Figure 1. Poweshiek skipperling breeding trials in 2024. Photo credit: Laura Burns, 2024.

- Breeding pairs determined by lineage to maintain genetic diversity.
- Pairs placed in domed pop-ups in outdoor hoop house and behaviours monitored for occurrence of successful copulation (Fig. 1).
- Data collected in summers of 2020 to 2024 (Table 1).

DATA ANALYSIS

Table 1. Summary of breeding trials taking place at the Assiniboine Park Zoo from 2020 to 2024.

Year	# of Trials	# of Mating Events	Date Range (dd/mm-dd/mm)
2020	11	3	03/07-08/07
2021	26	3	03/07-09/07
2022	33	1	18/07-27/07
2023	19	5	23/06-01/07
2024	27	5	11/07-26/07

- Utilized CRAN-R[1], tidyverse[2], here[3], and ggplot2[4] packages to evaluate and visualize relationships between variables and copulation.
- Assessed significance between characteristics and variables via generalized linear mixed models using CRAN-R, glmmTMB[5], pROC[6], and performance[7] packages.

PRELIMINARY RESULTS & DISCUSSION

OBJECTIVE 1

RELATIONSHIP BETWEEN INDIVIDUAL CHARACTERISTICS AND BREEDING SUCCESS

- Modelling was unsuccessful for lineage and maternal site origin characteristics.
- Proportion of copulation events to age showed higher success rate with older males (Fig. 2).

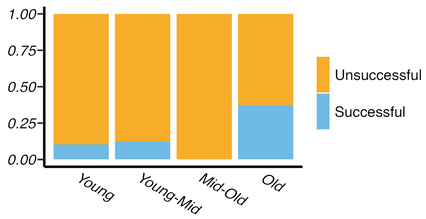

Figure 2. Proportion of copulation outcomes to age category of males in breeding pairs.

- Modelling showed evidence of significance (P-value > 0.05) between male age and copulation, indicating female preference.
  - Young → P-value = 0.000688
  - Young-Mid → P-value = 0.000196
  - Old → P-value = 0.037493

OBJECTIVE 2

RELATIONSHIP BETWEEN ENVIRONMENTAL CONDITIONS AND BREEDING SUCCESS

- Distribution of mean temperature and humidity showed narrower ranges during successful copulation, with some humidity outliers present (Fig. 3).
- Distribution of mean estimated sunlight showed wide variation across breeding trials, with lower sunlight estimates associated with lower occurrence of copulation success (Fig. 3).
- Modelling showed evidence of significance (P-value > 0.05) between environmental conditions and copulation, particularly for temperature and humidity variables as well as interaction (indicated by : between variables).
  - Temperature → P-value = 0.00182
  - Humidity → P-value = 0.00190
  - Sunlight → P-value = 0.04537
  - Temp:Humidity → P-value = 0.02200

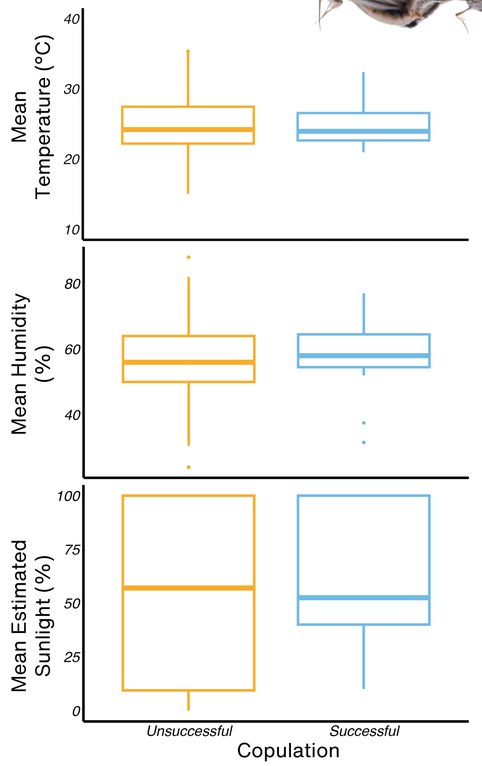

Figure 3. Distribution of mean environmental conditions[8] in relation to copulation outcome.

CHALLENGES & PROBLEMS

- Significant time spent on data wrangling and clean-up for analysis.
- Insufficient data and/or multicollinearity of individual characteristics resulting in unreliable models.
- Class imbalance of response variable (copulation) causing concerns for model performance.

OUTLOOK FOR COMPLETION

NEXT STEPS	DEADLINE
Continue diagnostic efforts and analysis of characteristics versus copulation.	February 7th 2025
Finalize analysis and visualization of environmental variables.	February 14th 2025
Write discussion on results and implications for committee review.	March 13th 2025
Complete final revisions and submit thesis!	March 27th 2025

INTERESTED IN LEARNING MORE ABOUT THE POWESHIEK SKIPPERLING?

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