Standing the Heat: The Influence of Increased Air Temperature on Leach's Storm Petrel (*Oceanodroma leucorhoa*)

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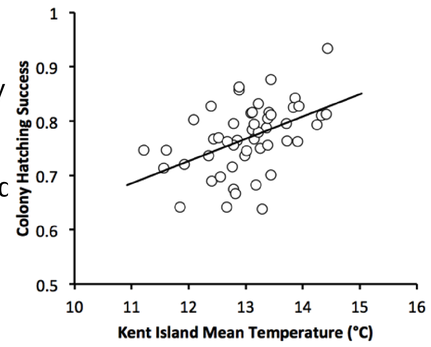
Introduction

- Most seabird species are negatively impacted by climate change, however Leach's storm-petrels (*Oceanodroma leucorhoa*) on Kent Island showed opposite findings

Figure 1. Storm-petrel colony hatching success increases with June-August air temperature at Kent Island from 1957-2007 (Mauck et al. 2012a).



- Air temperature highly correlated with sea surface temperature
- Leach's storm-petrels raise one offspring per year
  - Extensive parental care ~ 110 days total
- **Objective**: Distinguish impact of rising air temperature from rising sea surface temperature
- **Hypothesis:** Increased air temperature will increase reproductive success
  - Lower costs of thermoregulation
  - More energy for self-maintenance or reproduction

Methods

- Conducted at Bowdoin College Scientific State on Kent Island, New Brunswick, Canada
- Treatment groups: **heated** and **sham heated**
  - Temperature increase of 2 ° Celsius
  - N = 10 for each treatment
  - 20 burrows and 37 adult storm-petrels
  - Compared to super control (demography burrows)

Figure 2: Factors that influence reproductive decisions in Leach's storm-petrels

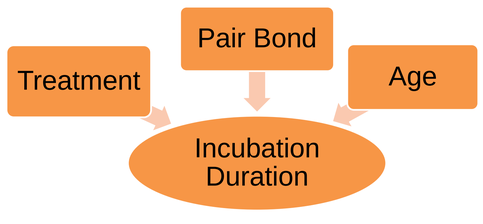


Figure 3: A. Temperature logger, egg, and sham heater (rope) in a burrow. B. Heater outside of a burrow.

- Heaters, sham heaters, and temperature loggers were installed June 20th – June 28th
- 35 days after lay date, burrows checked daily for hatch
- Chick growth measured starting 5th day of life
- Feather growth (Ptilochronology) for energy balance and adult effort

Results

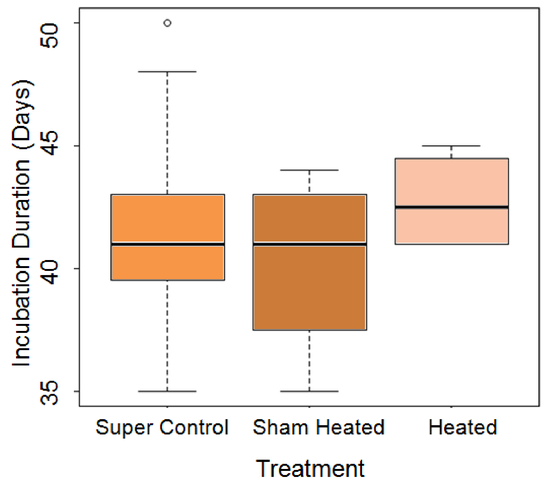


Figure 4: Days from date egg was laid to date egg hatched (incubation duration.) Average values for heated burrows (42.75 days ± 2.1, n =10) were similar to those for sham heated burrows (40.25 days ± 3.9, n = 10), and super control burrows (41.125 days ± 3.7, n = 28.) Bars are maximum and minimum.

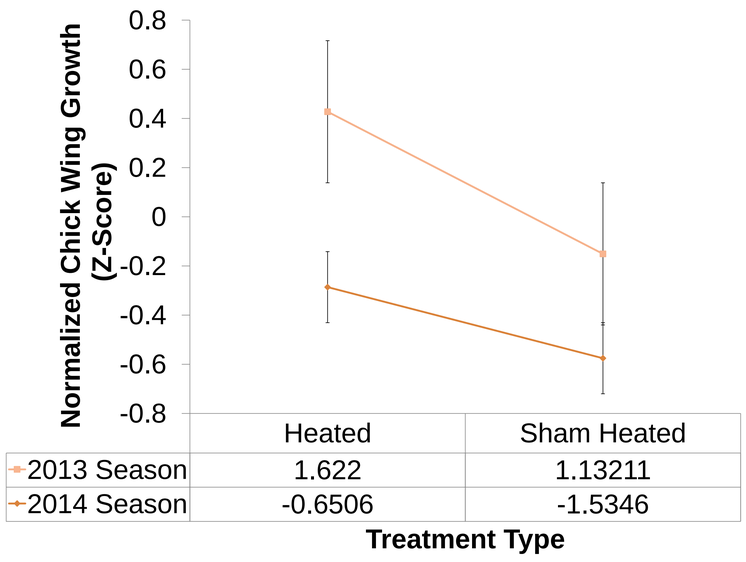


Figure 5: Normalized (z-score) wing length for chicks in both heated and sham heated burrows from 2013 and 2014 (GLM, R^2= 0.43, n = 23, p = 0.33, errors bars are SEM.)

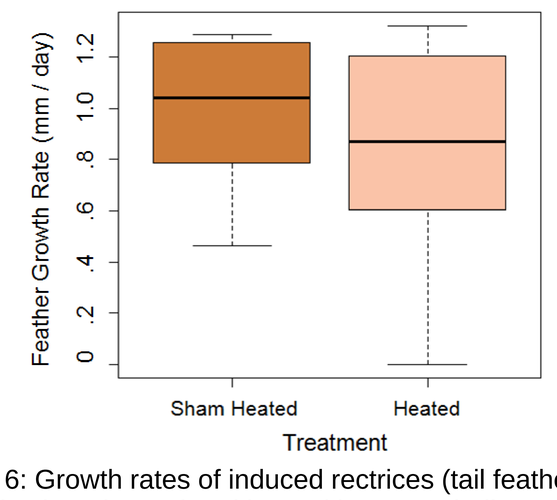


Figure 6: Growth rates of induced rectrices (tail feathers) for adults in sham heated and heated burrows. (Wilcoxon, m = 10, n = 8, W = 33 , p = 0.573 ; Miller Jackknife, m = 10, n = 8, Q = 1.19, p = 0.118; Bars are minimum and maximum.)

Discussion

- Temperature did not influence incubation duration
  - Unexpected values of 35 days (super control and sham heated)
- No difference in hatching success for heated and sham heated (4 of 10)
- Consistent trends in treatments between years
  - Faster wing growth in heated burrows compared to sham heated
- Higher hatching success, faster growth in 2013
  - Air temperature 0.5 ° C warmer in 2013
- Feather growth rates were similar in heated and sham heated
  - High variability – Life history decisions
  - Growth rates from 0 mm / day to 1.3 mm / day

Future Research

- Expanded study scale
  - 80 burrows, 160 adults, 80 nestlings
  - Utilizing geolocators to track foraging distances, durations, and locations
- Assessing adult condition
  - Ptilochronology
  - Corticosterone
  - Oxidative Stress
- Assessing nestling condition
  - Nestling growth and above measures
- The relative importance of SST and increased air temperature
  - Heaters for direct effect
  - Differences due to natural variation in sea surface temperature and air temperature

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References

- Blackmer, A. L., Ackerman, J. T., & Nevitt, G. A. (2004). *Biological Conservation*, *116*(1), 141-148.
- Huntington, C., R. Butler, R. Mauck, A. Poole, and F. Gill. 1996. Birds of North America.
- Mauck, R. A., C. E. Huntington, and P. F. Doherty Jr. 2012a. Society of Integrative and Comparative Biology, Charleston.
- Mauck, R. A., C. E. Huntington, and P. F. Doherty Jr. 2012b. Oikos 121:1379-1390.
- O'Connell, C., C. Villar-Leeman, E. Fricke, D. Gannon, and R. Mauck. 2013. Pages E345-E345 *in* Integrative and Comparative Biology.