The effect of nutritional stress and life history on the rate of telomere loss in black-legged kittiwake and red-legged kittiwake chicks

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ABSTRACT Slow-track species such as the red-legged kittiwake (*Rissa brevirostris*) and fast-track species such as the black-legged kittiwake (*R. tridactyla*) respond differently to environmental pressures. We examined how nutritional stress may affect the rate of telomere loss, a proxy for life expectancy, in these two seabirds. We did not find a significant effect of nutrition on telomere dynamics. However, there was a difference in species effect, with black-legged kittiwakes having an increase and red-legged kittiwakes a decrease in telomere length. This result may reflect differences in life history.

INTRODUCTION

- Slow-track species (red-legged kittiwake, *Rissa brevirostris*)
  - Longer lifespan
  - Lower reproductive output
  - More energy into self-maintenance
- Fast-track species (black-legged kittiwake, *R. tridactyla*)
  - Shorter lifespan
  - Higher reproductive output
  - Less energy into self-maintenance
- QUESTION: Will chicks of one of these species be better able to cope with a low quality diet than the other?
- Telomeres
  - Ends of DNA gradually lost with each cell division
  - Factor in physical aging
  - Longer telomeres may indicate longer lifespan
  - Rate of change used to quantify effects of diet and life history
- HYPOTHESIS**:**
  - In ideal dietary conditions, slow track species will have the least amount of telomere loss
  - Alternative hypothesis: more oxidative damage from faster growth will lead to individuals with a high quality diet having greater telomere loss
- PREDICTIONS:
  - Black-legged kittiwakes chicks will experience greater telomere loss than red-legged kittiwakes
  - Nutritionally stressed chicks will experience more telomere loss than chicks fed *ad libitum*

METHODS

- Nutritionally stressed chicks fed low quality fish
- Blood samples taken at 10 days and 35 days old
- Quantitative polymerase chain reaction (qPCR) used to measure relative telomere length

RESULTS

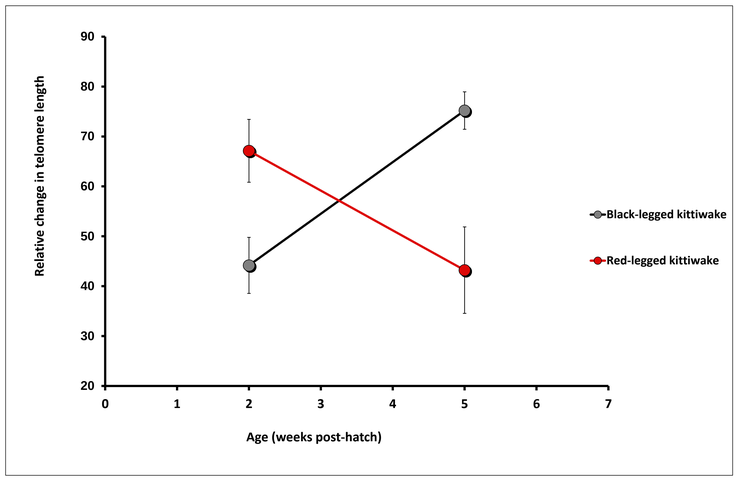

Figure 1. Black-legged kittiwakes showed an increase in telomere length across all treatments. Red-legged kittiwakes showed a decrease in telomere length across all treatments. ($p < 0.001$)

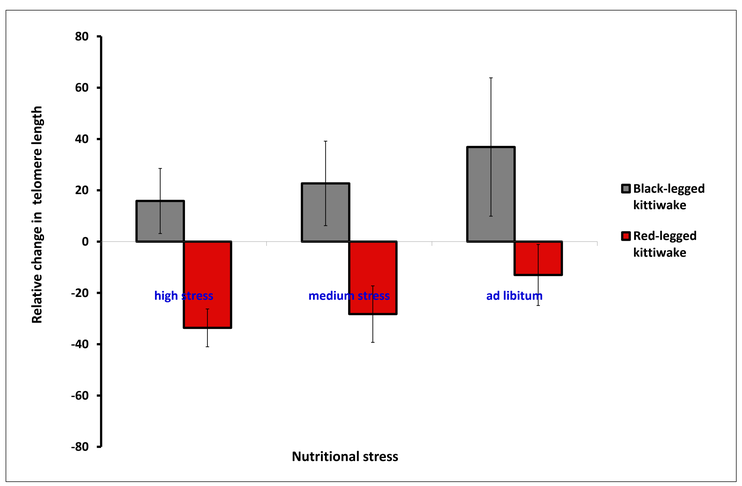

Figure 2. Black legged kittiwakes showed greater telomere gain with higher diet quality. Red-legged kittiwakes showed less telomere loss with higher diet quality. However, diet quality did not have a significant effect on change in telomeres. ($p > 0.05$)

DISCUSSION

- Telomerase
  - Enzyme that rebuilds degraded telomeres
  - Likely caused increase in telomere length in black-legged kittiwakes
- Life history:
  - Black-legged kittiwake
    - ➢ Wider habitat range
    - ➢ Greater range of offspring per reproductive event
    - ➢ Greater range of average growth rate
    - ➢ May indicate more phenotypic plasticity
    - ➢ May allow a greater range of responses depending on conditions
  - Red-legged kittiwake
    - ➢ Smaller ranges in habitat, offspring number, and growth rate
    - ➢ Narrower range of responses to different conditions
- Why would black-legged kittiwakes put energy into increasing telomere lengths post-hatch while red-legged kittiwakes do not?
  - Black-legged kittiwakes will probably eventually suffer telomere decrease
  - Delaying attainment of maximum telomere length
    - ➢ Can endure greater telomere loss when reproduction begins
    - ➢ Red-legged kittiwakes, which produce at a slower rate, don't need this buffer

REFERENCES

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