**INTRODUCTION**

Yet Arctic-nesting geese are resilient; for example, they can often compensate for poor winter conditions as they migrate north (Clausen et al. 2015).

Many migrants move north in early spring to arrive at staging or breeding areas before food sources are readily available (Si et al. 2015; Li et al. 2020) because it is generally advantageous for offspring survival that adults arrive and initiate nests early (Bêty et al. 2004), though, recent climate change and Arctic amplification of warming have resulted in geese experiencing mismatches in the timing of their optimal food sources as they migrate to and arrive on breeding areas (Lameris et al. 2018).

Researchers have not yet quantified whether low productivity in Greenland white-fronted geese is explained by breeding deferral or failed attempts, and whether such rates are similar or different to those in mid-continent white-fronted geese.

Therefore, we expected that geese with higher ODBA be more likely to succeed in reproduction, and days later in spring migration (e.g., within 2 weeks prior to average initiation of incubation) would have larger weights, as individuals migrating and preparing to incubate/nest guard require more energy than those migrating and not preparing to incubate/nest guard.

**RESULTS**

**Incubation outcome**

Using characteristics of movement and ODBA, successful (full term) incubation was identified in 4 (50%) mid-continent and 6 (23%) Greenland geese.

**Quantifying weather effects on proportion of energy expenditure from feeding**

Time-varying coefficient effects of minimum temperature were stronger overall than precipitation rate. There was a prominent association between minimum temperature and ODBAgraze in Greenland geese, with all but four birds showing a positive relationship for at least one day for 10-14 days prior to the end of the migration period (Fig. 3). This pattern occurred in Greenland geese that deferred or failed as well as those that completed incubation, but it was only present in two of eight mid-continent geese (one successful). There were also indications of a negative relationship between minimum temperature and ODBAgraze in some Greenland geese early in migration. Precipitation rate was important for only one successful mid-continent bird, with a negative relationship at the end of migration, while the relationship was positive earlier during the migration period and short-lived in Greenland geese (Fig. 3).

**Antecedent effect of proportion of energy expenditure from feeding on probability of reproductive success**

The interaction of flyway and antecedent ODBA (the sum of daily ODBA multiplied by daily weight) weakly explained variation in probability of successful incubation. Further, antecedent ODBAgraze and flyway as separate effects did not explain variation in flyway reproductive success (Table 1). The model did not detect any differentially important time points for antecedent ODBAgraze, and all daily weights were close to 0.02, which is equal to 1 divided by 51, the total number of days in the model (Supporting Information Fig. S1).

**DISCUSSION**

. We found consistent and strong effects of daily minimum temperature but not precipitation on nearly all Greenland white-fronted geese as individuals neared breeding areas. There was not a strong relationship between minimum temperature or precipitation rate on mid-continent white-fronted geese during migration from wintering to breeding areas. The interaction of flyway and the cumulative effect of proportion of energy expenditure from feeding explained limited variation in probability of reproductive success, measured as full-term incubation. Further, we did not identify specific time periods that were differentially important for proportion of time feeding or energy expenditure in explaining reproductive success or failure/deferral. Our approach aimed to examine acute effects, and while the stochastic antecedent framework permitted testing of a summarized variable, we did not examine the cumulative effects of weather on ODBAgraze. Therefore, we suggest that despite physical differences experienced by geese in each flyway, incubation outcome and reproductive success is likely due to events and conditions occurring after geese have arrived on breeding areas.

Positive effects of minimum temperature on ODBA in Greenland birds were mainly concentrated in the last week before birds departed Iceland.. We attribute the lack of weather effects on ODBA in mid-continent geese to their ability to move north in smaller increments, thereby adjusting to ambient temperature at large spatial scales to optimize intake, which is potentially less possible for Greenland white-fronted geese due to crossing the North Atlantic and Greenland Ice Sheet.

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