Individual heterogeneity in fitness in a long-lived herbivore

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Abstract

Heterogeneity in the intrinsic quality and nutritional condition of individuals affects reproductive success and consequently fitness. Understanding differences in energy allocation towards survival and reproduction within and among years might help explain variability in individual fitness. Black brant (Branta bernicla nigricans) are long-lived, migratory, specialist herbivores. Long migratory pathways and short summer breeding seasons constrain the time and energy available for reproduction, thus magnifying life-history trade-offs. These constraints, combined with long lifespans and trade-offs between current and future reproductive value, provide a model system to examine the role of individual heterogeneity in driving life-history strategies and individual heterogeneity in fitness. We used hierarchical Bayesian models to examine reproductive trade-offs, modeling the relationships between within-year measures of reproductive energy allocation and among-year demographic rates of individual females breeding on the Yukon-Kuskokwim Delta, Alaska using capture-recapture and reproductive data from 1988 to 2014. We provide evidence for relationships between breeding probability and clutch size (posterior mean of β = 0.45, 95% CRI = 0.33 – 0.57, SD = 0.06), breeding probability and nest initiation date (posterior mean of β = -0.12, 95% CRI = -0.2 ¬– -0.04, SD = 0.04), and an interaction between clutch size and initiation date (posterior mean of β = -0.12, 95% CRI = -0.2 – -0.04, SD = 0.04). Average lifetime clutch size also had a weak positive relationship with survival probability (posterior mean of β = 0.03, 95% CRI = -0.01 – 0.7, SD = 0.02). Our results support the use of demographic buffering strategies for black brant; reductions in reproductive energy allocation preserve high adult survival rates during years with poor environmental conditions, maximizing future reproductive value. We also indirectly show links among environmental conditions during growth, fitness, and energy allocation, highlighting the effects of early growth conditions on individual heterogeneity, and subsequently, reproductive investment.

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