

Effects of Life History Traits in the Mountain White-Crowned Sparrow During Incubation

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Student Undergraduate Research 2017

ABSTRACT

Reproductive success in passerines is dependent upon the fitness of the parents. Knowledge of how life history traits affect fitness is required to understand fitness and nest cycle relations. There was no significance between body mass and wing length and morning off bout frequency found. Blood parasite loads were not examined and therefore not included in data analysis. A larger sample size is needed to conclude any results from this study. Knowing how life history traits relate to fitness, and how fitness influences incubation is crucial in our understanding of *Z. I. oriantha* population dynamics.

INTRODUCTION

Nest success is a crucial component to the conservation of bird populations (Newton 1994) however, many studies have found low success in passerines (Morton 2002; Newton 1994). To assure hatching, females must maintain thermal conditions appropriate for embryonic development (Zerba and Morton, 1983). The primary cause of nest failure is predation (Thompson 2007), which is influenced by parental attendance and nest cycle length (Martin 2000). Along with predation, food availability is another leading factor of nest survival (Zanette et al. 2003). Parents ability to collect food efficiently is directly correlated to nest success (Drent and Daan 1980). Fitness of individuals is directly measured by reproductive success (Morton 2002).

Reproductive success is dependent on the fitness, specifically foraging efficacy of the parents. Drent and Daan (1980) predicted that decreased weight causes increased feeding capacity of parents and is likely to lead to more fledged young. When a bird has no fat and the majority of weight loss is from the body, it becomes lighter and intern becomes slimmer producing less aerodynamic drag (Pennycuick 1975, p. 20 in Norberg 1980). Low body mass may indicate a more efficient flier, birds with low body mass will still need to leave the nest more often. A low body mass indicates a less fit bird because it has less energy reserved.

Energy use varies with wingtip shape in free-flying songbirds (Bowlin and Wikelski 2011). Morrison et al. (2009) found that fledgling puffins with greater wing lengths were more likely to survive to adult hood. In passerines, wing length and wing pointedness are good correlates of flight speed and maneuverability (Pérez-Tris 2001). Typically, longer wings are more common in migratory birds than non-migratory residents (Pérez-Tris 2001).

Blood parasite loads have been to show no significant effect on body mass in passerines (Bennett et al. 1988), suggesting that birds with high parasite loads are feeding more often to maintain their body mass. More antibody responses towards blood parasites were found in mid latitude than high latitude passerine breeders (Owen-Ashley 2008). Owen-Ashely (2008) also observed that birds with high blood parasite loads lost body mass compared to birds with low blood parasite loads.

Variation of these life history traits have been monitoered in the Mountain White-Crowned Sparrow (*Zonotrichia leucophrys oriantha*; MWCS), a migratory

passerine that breeds in montane regions of the Western United States. This subspecies prefers dense willow thickets (*Salix spp.*), where they build cup shaped nests from grasses, twigs, and bark, close to the ground (Morton, 2002). During incubation, the female spends 64.1% of her time on the nest, devoting her energy almost exclusively to brooding and foraging (Morton et al. 1972). For proper embryonic development, eggs need to maintain a temperature between 36 to 38°C (Morton 2002). Weather, predation, and human interference are leading factors of nest failure (Morton et al. 1972).

Female MWCS off bouts during incubation will be affected by the individual's fitness. Greater wing lengths and lower body mass will have a combined effect of fewer off bouts and shorter intervals. We predict that body mass, wing length, and blood parasite loads will have a direct correlation with off bout frequency during incubation. Hypotheses: 1) Morning off bout frequency will decrease as body mass and wing length increase. 2) Morning off bout frequency will decrease as blood parasite loads decrease. The objective of this study is to determine the effects that life history fitness (body mass, wing length, blood parasite loads) have on the incubation of the MWCS, if any.

METHODS

Study Area

This study was conducted in the Elk Mountain range of the Colorado Rocky Mountains. Data was collected in alpine and subalpine meadows near the Rocky Mountain Biological Laboratory. Study sites ranged across elevations: Four low elevation sites in the East River Valley (2924m), one mid-elevation site in Schofield Park (3167m), and three high elevation sites (3465m). Willow (*Salix spp.*) and cinquefoil (*Potentilla spp.*) thickets are the primary dominants. Herbaceous dominants include larkspur (*Delphinium spp.*), corn lily (*Veratrum spp.*), and mountain bluebell (*Mertensia spp.*). The study was conducted from 01 June to 01 August (2017). In this environment, the growing season is short and temperatures range from 23°C (day) to 8°C (night) from early June to Early August.

Bird Capture/ Measurements

Birds were captured using either Potter traps (Wingfield and Farner 1976) or mist nets. Up to eight Potter traps were operated during each trapping period per trap site set. Traps were baited with baked wild bird seed and locked open at least one day prior to commencing trapping to habituate birds to each trap site. Bait quantities within traps were maintained during trapping and traps were checked within a maximum of one-hour intervals to reduce MWCS stress while trapped.

Mist nets were set near the target bird's nest for optimal capture. Mist net attempts were only made in the morning and evenings to avoid over heating the nest in the mid-day heat. Birds were targeted during the eighth day of incubation to the first day of nestling to reduce the chance of nest abandonment. We waited for the bird to either, fly into the net on her way to the nest, or flushed off the nest and into the net.

Upon capture, MWCS's were banded with USGS and color bands, if not already banded. Measurements included culmen length, body mass, abdominal and furcular fat, wing, tail, and tarsus length, reproductive organ status (i.e. brood patch or cloacal protuberance), and crown and stripe width. Blood smears were also collected to estimate blood parasite loads.

Nest Searching and Monitoring

MWCS nest were found using the rope drag technique. When a nest was found it's location was immediately marked with a GPS unit, aged, and flagged three meters from the north and to the south of the nest. Using the Koford technique, voucher images of egg and nestling development were referred to when eggs were candled and nestlings were monitored (Koford 1999). ThermoChronTM button model DS1921G and DS1922L data loggers were used to monitor nest temperature every two minutes during incubation; one data logger was placed in the nest lining (nest) and another is placed 15 cm south of the nest in a similar microclimate as a control (adjacent). Nests were monitored every three to four days to reduce disturbance of the parents.

Statistical Analysis

Data analysis was done using R Statistical Software. A multiple linear regression was run in excel, with body mass and wing length as predictor variables and with frequency of off bouts as the response variable. This analysis was used to determine the percent each life history trait accounted for in the number of morning off bouts. Blood parasite loads were excluded from this test due to insufficient data.

RESULTS

A minimum number of morning off bouts was found to be three (Figure 2.), a mean of 4.166667, and a median of four off bouts with a standard deviation of 0.687184 were found as well. A multiple linear regression was ran finding that 13.1% ($R^2=0.131$) of the variation in off bout frequency is explained by the variables of mass and wing length. The significance of this equation is 0.8101, which is greater than the standard of 0.05 and therefore not significant. Xi is the body mass and xii is wing length in this multiple linear equation ($y = -3.01074 - 0.02264x_i + 0.10228x_{ii}$).

DISCUSSION

I found that body mass and wing length have no significant effect of the frequency of morning off bouts. No significance implies my original hypothesis regarding body mass and wing length is not supported, but these results are inadequate to make any conclusions thus far. Blood parasite loads were excluded from the multiple linear regression analysis due to the lack of time to examine smear slides, resulting in a small sample size. However, if blood parasite loads were added to the analysis I predict that the R^2 value would be higher. I recognize that the analysis done is over simplified and does not produce reliable results at this point. I intend to analyze smear slides and run a more in-depth analysis in the future.

Due to the fact that I only had one season to collect this data, my overall sample size is low and therefore could not meet the assumptions needed for a proper multiple linear regression.

Lacking the proper amount of time to analysis smear slides limits me from looking at the full effects that these life history traits have on MWCS incubation. The low sample size of blood parasite loads, body mass, and wing length is a result of the difficulty to collect sufficient data for this study. About 20 MWCS nests are found during the field season, and of those many are depredated before they could be processed. The time period for optimal capture by mist net is 0600 to 0730 and 1930 to 2000. Birds could only be mist netted between the eighth day of incubation and the first day of the nestling period in order to have accurate body measurements and blood parasite loads during incubation. This period is also the safest time to disturb the nest, as the mother is less likely to abandon to the nest at this point.

In the future, Other body measurements (i.e. culmen, stripe/crown width, tarsus) should be included in this study to gain a broader understanding of which life history traits have the greatest effects on fitness. Culmen length is related to the food options of the bird and crown/stripe width ratio is a good indication of dominance in males (Morton 2002). Understanding a broader spectrum of life history traits' and how they affect fitness can help gage reproductive success more accurately. Going forward, this study should not rely as heavily on the potter trap method of capture. Using potter traps leaves capturing the target bird, to random chance. As a result, the mist net technique should be the primary method of capture. This study was intended to be multiple year project in order to achieve a reasonable sample size that can yield acceptable results. Looking at how adult bird's fitness impacts their reproductive success is a great way to understand how the population will behave.

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Figure 1. Field sites along the East River Valley and Schofield Park, Colorado

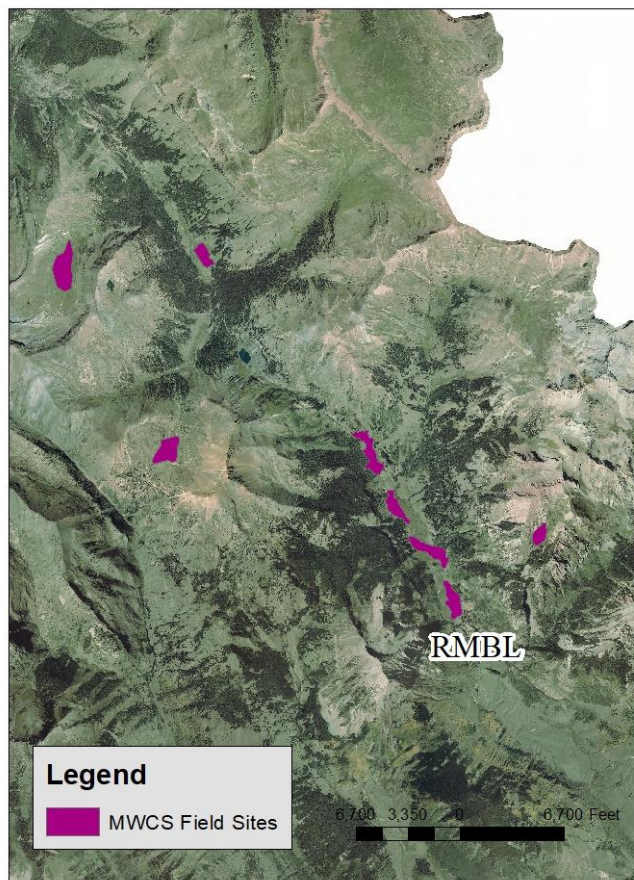


Figure 2.

Nest attentiveness from 0300 to 0700 measured by temperature change.

