

INVESTIGATING THE LIMITING FACTORS OF A RARE, VULNERABLE SPECIES: BICKNELL'S THRUSH

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Abstract. Bicknell's Thrush (*Catharus bicknelli*) is a migratory songbird of high conservation concern. Populations may be limited by events on the northeastern North American breeding grounds or by events on wintering grounds in the Greater Antilles. We use mist-net captures of individuals on both the breeding and wintering grounds to investigate sex ratio variation throughout the life history of Bicknell's Thrush. We identify variation in the sex ratio at two distinct sites in the Dominican Republic and discuss the possibility that females may be limited by dominance interactions with larger, more aggressive males on the winter grounds.

Key Words: Bicknell's Thrush, migratory songbird, montane forest, Dominican Republic, sex ratio, winter habitat segregation.

INVESTIGANDO LOS FACTORES LIMITANTES DE UNA RARA Y VULNERABLE ESPECIE: EL ZORZALITO DE BICKNELL

Resumen. El Zorzalito de Bicknell (*Catharus bicknelli*) es un ave cantora migratoria de gran preocupación entre los conservacionistas. Su población puede estar hoy viéndose limitada debido a acontecimientos sucedidos tanto en sus zonas de reproducción del nordeste norteamericano como en áreas de invernada en las Antillas Mayores. En este examen utilizamos capturas de individuos en redes de niebla, tanto en las zonas de reproducción como en las de invernada, para investigar la variación de proporción sexual durante el ciclo de vida del Zorzalito de Bicknell. Identificamos la variación en la proporción de sexos en dos sitios distintos de la República Dominicana y discutimos la posibilidad de que las hembras, podrían estar limitadas a causa de interacciones de dominio, que ocurren con machos mayores y más agresivos, en las zonas de invernada.

INTRODUCTION

Bicknell's Thrush (*Catharus bicknelli*) is one of eastern North America's most rare and range-restricted breeding passerines. Considered one of the Nearctic-Neotropical migrants of highest continental conservation concern (Pashley et al. 2000, Rich et al. 2004, Wells 2007), Bicknell's Thrush is classified as globally "vulnerable" by the International Union for the Conservation of Nature (BirdLife International 2000). Limited information on the species' ecology and population trends has held back its formal consideration for federal endangered or threatened status in the United States, although its federal status in Canada is to be reviewed in 2009. In the United States, the breeding range of Bicknell's Thrush is naturally restricted to coniferous forests of New York and New England above

915 m elevation (Atwood et al. 1996, Lambert et al. 2005). In Canada, the species is patchily distributed in coniferous forests of the Laurentian Mountains, St. Lawrence River Valley and Maritime Provinces (Rimmer et al. 2001). The species' wintering range is confined to the Greater Antilles, with an estimated 90% of the global population concentrated on Hispaniola (Rimmer et al. 2001).

On both the breeding and wintering grounds, Bicknell's Thrush faces multiple threats. These include climate change (Rodenhouse et al. 2008), acid ion deposition (Johnson et al. 1992, Hames et al. 2002), mercury contamination (Rimmer et al. 2005a), mountaintop development (Rimmer et al. 2001, 2004), forestry operations in Canada (Chisholm 2005, Gardiner 2006), and habitat loss and degradation on the species' Hispaniolan wintering grounds (Rimmer et al. 2001, 2005b;

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Latta et al. 2006). Recent data provide conflicting results on Bicknell's Thrush population trends throughout its breeding range. On New Hampshire's White Mountain National Forest, which supports an estimated 25% of the species' United States population (Lambert et al. 2005), a significant annual decline of 7% was recorded from 1993–2003 (King et al. 2007, Lambert et al. 2008). In New Brunswick and Nova Scotia, annual declines of 19% have been documented over a 5-year period from 2003–2007 (Campbell et al. 2008). In contrast, data from 31 survey routes monitored in every year from 2001–2006 across the United States breeding range showed no consistent trend (Hart and Lambert 2007), although an annual decline of 9% was recorded on 47 routes surveyed annually from 2001–2004 (Lambert 2005). A more recent analysis of United States survey data indicated a significantly increasing trend of 10% from 2001–2007 (Dettmers, Lambert and Hart, unpub. data).

To address the conservation needs of Bicknell's Thrush, the International Bicknell's Thrush Conservation Group formed in 2007. Its initial charge is development of a conservation action plan for the species. Ongoing research examining the factors that limit Bicknell's Thrush survival on both the breeding and wintering grounds will contribute to an informed and effective conservation plan. Here we present preliminary summer and winter demographic data comparing sex ratios during both seasons, and we discuss intersexual dominance interactions during the winter period as a possible limiting factor affecting the survival of females. We also outline recommendations for future research.

METHODS

On the breeding grounds, we have conducted long-term demographic research and monitoring of Bicknell's Thrush at two montane study sites (900–1200 m) in the Green Mountains of Vermont since 1995: Mt. Mansfield (44°32'N, 72°49'W) and Stratton Mountain (43°05'N, 72°55'W). On the wintering grounds, we have conducted both broad-scale presence/absence surveys in Haiti and the Dominican Republic, and intensive studies at two sites in the Dominican Republic. One site is located in the Sierra de Bahoruco (18°12'N, -71°32'W; 1700–1800 m elevation) and is characterized by pristine cloud forest, while a second site consists of moderately disturbed secondary rain forest in the Cordillera Septentrional (19°25'N, -70°8'W; 300–500 m elevation). At both the breeding and wintering grounds sites, birds were captured in passive arrays of mist-nets and by using playback of conspecific song

to lure birds into nets. Approximately 80 μ L of blood was taken from each captured individual with heparinized capillary tubes via brachial venipuncture using sterile 27-gauge hypodermic needles. Blood samples were stored in 0.5 mL blood lysis buffer [100 mM Tris-HCl, pH 8; 100 mM Na₂ EDTA; 10 mM NaCl; 0.5% SDS; White & Densmore 1992]. We extracted DNA from each sample using Perfect gDNA Blood Mini kits (Eppendorf) following the manufacturer's protocol. Extracted DNA was then amplified by polymerase chain reaction to determine gender (Griffiths et al. 1998). All birds were also banded with aluminum bands and a unique combination of color bands for mark-recapture and resighting analysis. At wintering grounds sites, we also conducted radio telemetry studies from 2005–2008 to identify any differences in the degree of territorial behavior between the sexes. Birds were fitted with 1.2 g radio transmitters (Model BD2G, Holohil Systems, Ltd.). Transmitters were attached using the backpack harness method (Rappole and Tipton 1991). All birds were checked for full leg and wing movement before release. Locations were achieved for radio-tagged birds by stealth homing to within an estimated distance that did not force the birds to fly from the area.

RESULTS

Based on capture data in Vermont, the mean sex ratio among breeding adults was 2.5 males:1 female ($n = 1,231$; 1993–2007). The mean sex ratio of fledglings leaving the nest, however, was 1 male: 1.5 females ($n = 27$ fledglings). On the Hispaniola wintering grounds, the mean sex ratio for birds sampled island-wide in 2004 was 1.9 males: 1 female ($n = 142$). At intensive sites, the Sierra de Bahoruco (SDB) population had a highly male-skewed sex ratio of 3.8 males: 1 female ($n = 25$), whereas the population in the Cordillera Septentrional (CS) showed a 1:1 ratio ($n = 25$). There was no significant difference between male ($n = 29$) and female ($n = 12$) mean territory size at either site. Territoriality is the prevailing form of resource defense at both the SDB male-skewed site and the CS balanced sex ratio site, and individual core use areas show minimal overlap. Raw banding return rates at SDB indicated that 23% of birds banded between 2004 and 2007 returned in at least one subsequent winter, whereas return rates at CS during this four-year period were 7%.

DISCUSSION

The male-biased sex ratio of adult Bicknell's Thrushes on both the species' breeding and

wintering grounds, compared to the nearly equal sex ratio among nestlings, suggest that limiting factors act disproportionately on females at some point in the annual cycle. On Hispaniola, males predominate in pristine cloud forest at SDB, where site fidelity as reflected by raw banding return rates is more than 3 times greater than in secondary rainforest at CS. Stronger philopatry at the male-dominated SDB site, coupled with a higher rate of within-season recaptures at this site, suggest that SDB may provide higher quality habitat than the CS site. Additionally, preliminary analysis of fecal samples and stable isotopic composition of blood samples suggest that birds at SDB consume an arthropod-heavy diet whereas birds at CS, where available arthropod biomass is lower than at SDB, rely primarily on fruit (Townsend and Rimmer unpubl. data). There may be an elevated nutritional value to omnivorous birds, especially during pre-migratory fattening, of a diet dominated by arthropods (Long and Stouffer 2003).

It is possible that female Bicknell's Thrushes wintering in the Dominican Republic tend to occupy sub-optimal habitat, such as the CS site, and that this may compromise their overall fitness. Females may preferentially occupy these sites, or they may be forced to inhabit them as the result of dominance interactions with males. For example, in American Redstarts (*Setophaga ruticilla*) wintering in Jamaica, females are limited by agonistic interactions with larger, more aggressive males (Marra et al. 1993, Marra 2000). In this system, females are relegated to lower quality habitat by the behavioral dominance of males who maintain territories in the highest quality habitats. Females wintering in sub-par habitat display lowered body condition at the end of the wintering season which can lower chances of survival during migration (Marra and Holmes 2001) or cause carry-over effects during the breeding season that negatively affect nesting success (Marra et al. 1998, Norris et al. 2003). It is possible that a similar dynamic could be operating among populations of wintering Bicknell's Thrushes.

Further investigations will more closely examine differences in Bicknell's Thrush body condition, survivorship and the quality of dietary items between our SDB and CS study sites. If habitat quality at the CS site, where females at least equal males in abundance and in some years outnumber them, is poor compared to that at the male-dominated SDB site, females may end the winter in poor condition. As a result, females may experience lower survival during the energetically-taxing spring migration. This could have significant impacts on

this species' overall population dynamics and might account in large part for the male-skewed adult sex ratio on the breeding grounds. Further research priorities will include investigation of post-fledging ecology and demography, migration stop-over ecology, migratory connectivity, seasonal carry-over effects, and the use of remote sensing to quantify available habitat on the Greater Antillean winter range. We believe that protection and restoration of mid-elevation secondary forests on Hispaniola may be crucial to the conservation of Bicknell's Thrush.

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