

Short Communications

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Migration Timing of Canada Warblers Near the Northern Edge of Their Breeding Range

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ABSTRACT.—Canada Warblers (*Wilsonia canadensis*) are one of the last warblers to arrive in breeding areas in northern Alberta and one of the first to depart in autumn resulting in a condensed breeding chronology relative to other locally breeding wood warblers. Males arrived before females during spring migration, while in autumn, adult females departed prior to males. Second-year males arrived later ($P = 0.029$) than after-second year males. Adult males departed later ($P = 0.015$) than adult females. Hatch-year birds departed after adult females but prior to adult males. Female Canada Warblers remained in breeding areas for 62 days while males remained 72 days. These data provide the shortest documented breeding site occupancy estimate for any bird that shows a post-nuptial molt. The short time spent in breeding areas may impose energetic constraints that influence breeding, molt, and survival, particularly for females. Received 21 August 2006. Accepted 7 March 2007.

Migration timing can strongly influence fitness (McNamara et al. 1998) and imposes temporal constraints to completing annual activities including territory establishment, breeding, and molt. Individuals that arrive later likely have tighter time constraints in breeding activities compared to early arriving individuals. Time and energetic constraints are even more intense when populations are at the northern edge of their breeding distribution (Briskie 1995).

The Canada Warbler (*Wilsonia canadensis*) is one of the least studied warblers and information concerning its breeding ecology and population dynamics is mostly lacking (Conway 1999). The northern and most western breeding populations occur in north-central Alberta and eastern British Columbia (Semenchuk 1992, Conway 1999). Canada Warblers

are among the latest warblers to arrive and earliest to depart (Conway 1999) potentially placing time constraints on breeding ecology (Forstmeier 2002, Smith and Moore 2005).

Male neotropical wood warblers generally arrive in breeding areas before females in spring while, within gender, after-second year (ASY) birds typically precede second-year (SY) birds (Francis and Cooke 1986, Morris and Glasgow 2001, Stewart et al. 2002, Smith and Moore 2005). Studies of timing of autumn migration for a variety of wood warblers have offered contrasting results for gender and age-class patterns. Some studies found that hatch-year birds (HY) departed earlier than after hatch-year birds (AHY) (Benson and Winker 2001, Andres et al. 2005, Benson et al. 2006), while others found no difference in age and gender migration patterns in autumn (Morris and Glasgow 2001).

When spring and autumn migration dates are known for breeding areas, it is feasible to estimate the duration the breeding range is occupied (Benson and Winker 2001). For example, Alder Flycatchers (*Empidonax alnorum*) were in breeding areas for 48 days in Alaska (Benson and Winker 2001) but for 72 days in southern Ontario (Hussell 1991). Therefore, northern populations have less time to complete breeding and molt activities than southern populations. Furthermore, individuals at higher latitudes often have lower survival than their southern counterparts and have increased investment in fewer reproductive attempts (Ardia 2005). The objectives of my study were to: (1) document arrival and departure dates for male and female Canada Warblers by age-class, and (2) provide estimates of breeding range occupancy on a study area close to the northern limit of the species range.

METHODS

Study Area and Field Methods.—Migration of Canada Warblers was monitored daily be-

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tween 1994 and 2005 by staff at the Lesser Slave Lake Bird Observatory (LSLBO) on the eastern shoreline of Lesser Slave Lake, Alberta (55° 20' N, 114° 40' W) as part of the Canadian Migration Monitoring Network (Dunn et al. 2006). Birds were captured within a 0.5-ha area of willows (*Salix* spp.) bordered by continuous aspen (*Populus tremuloides*) dominated mixed-wood boreal forest. Spring and autumn migration was monitored continuously in most years between 1 May and 10 June, and between 18 July and 30 September, respectively. Birds were captured using 12 nylon mist nets (30 mm, 3 × 12 m) from 30 min prior to sunrise to 6 hrs (1994–1999) or 7 hrs (2000–2005) thereafter. Net locations have been consistent since 1996, and were not greatly different in prior years.

Captured birds were banded, classified to age and gender by plumage attributes (Rappole 1983) and the extent of skull pneumatization, and checked for breeding characteristics (Pyle 1997). Canada Warblers can be classified in spring as SY or ASY and autumn as HY or AHY. Occasionally individuals could not be reliably classified to age and gender for reasons such as the data not being recorded or intermediate plumage characteristics. Excluding unknown individuals from migration estimates could bias results if they are not a random sample of their gender and age class.

I used raw banding totals because banding effort occurred relatively uniformly throughout spring and autumn each year (Francis and Cooke 1986). Mean arrival and departure date varied between years, probably due to weather conditions, but I did not standardize capture dates to year because the effects of weather can influence both trapping efforts and population differences in migration timing. Data were pooled over the study period as sample sizes of some gender and age-classes were small.

I limited all records to original bandings (92% of all captures) to reduce bias of including birds using the site as a stopover over several days. I excluded birds in spring that were developing breeding characteristics (male: cloacal protuberance, female: brood patches) potentially indicating locally breeding individuals, and those captured after 9 June when most Canada Warbler captures shifted to pre-

viously banded individuals. I limited autumn records to captures after 19 July because prior to this date few Canada Warblers were captured, most captures were already banded, and new bandings likely represented dispersing individuals rather than true migrants (Carlisle et al. 2005). I included birds with breeding characteristics as they can be protracted in autumn migration. Birds that bred locally were likely already banded at adjacent MAPS (Monitoring Avian Productivity and Survivorship) sites during the breeding season.

Statistical Analysis.—I first ascertained if excluding records of unknown age or gender would bias arrival and departure date estimates of known groups using Wilcoxon tests. I only present these results where a difference was found. Kolmogorov-Smirnov two-sample tests were used for spring and autumn migration timing comparisons (Siegel and Castellan 1988, Carlisle et al. 2005). Dates for minimum estimates of breeding range occupancy were calculated by subtracting median arrival dates from median departure dates for adult males and females separately (Benson and Winker 2001). All statistical analyses were conducted with SPSS 13.0 (SPSS 2004) with significance at $\alpha = 0.05$.

RESULTS

Collectively, males arrived earlier than females in spring with ASY individuals arriving prior to SY's of both males and females (Fig. 1). Among males, the arrival date of ASY's was earlier ($D = 1.454$, $P = 0.029$) than the arrival date of SY's. ASY females arrived earlier than SY's, but this difference was not significant ($D = 1.143$, $P = 0.15$).

Males departed later in autumn than females (Fig. 2). A large proportion of autumn HY birds could not be classified to gender and these birds departed earlier than HY males and females ($Z = -6.411$, $P < 0.001$; Fig. 2). There was no difference between classified males and females in autumn departure dates for HY's ($D = 0.879$, $P = 0.42$), but this should be inferred cautiously because unknown HY's preceded males and females. AHY females departed first while AHY males departed last ($D = 1.569$, $P = 0.015$).

Overall, males arrived by 1 June and departed by 12 August, providing an indirect estimate of time spent in breeding areas of ap-

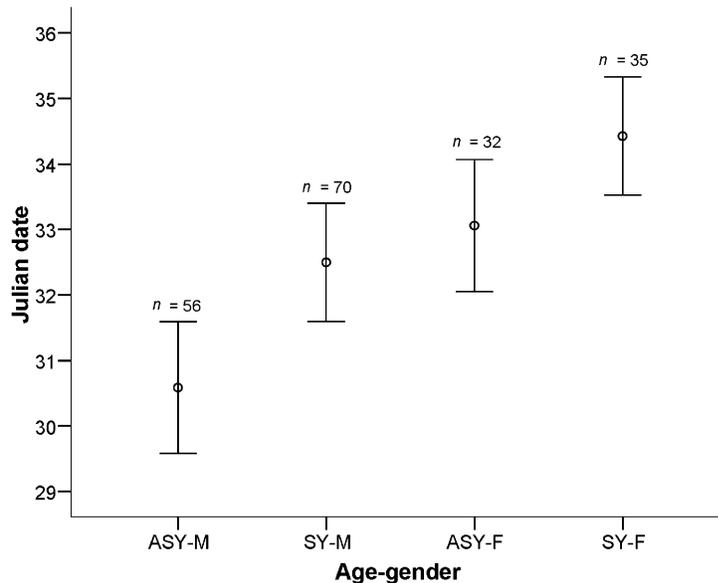


FIG. 1. Arrival of Canada Warblers in northern Alberta. Error bars represent mean and 95% CI of spring arrival date. Julian date 32 = 1 June.

proximately 72 days or 19.7% of the annual cycle. Females occupied breeding areas for approximately 62 days (17% of the annual cycle) arriving by 3 June and departing by 4 August.

DISCUSSION

Arrival and Departure.—Male Canada Warblers in northern Alberta arrived prior to females and older wood warblers arrived prior to younger individuals (Francis and Cooke 1986, Stewart et al. 2002). Males may arrive earlier to acquire better breeding territories (Smith and Moore 2005) while females may arrive later to maximize survival as food is often less available in early spring (Nilsson 1994).

I found protogynous autumn migration in adult Canada Warblers with females departing prior to males. Other studies of wood warblers have reported either that males depart after females for MacGillivray's Warbler (*Oporornis tolmiei*) (Carlisle et al. 2005), Yellow-rumped Warbler (*Dendroica coronata*), and Magnolia Warbler (*D. magnolia*) (Mills 2005) or that females depart after males as for Wilson's Warbler (*Wilsonia pusilla*) (Carlisle et al. 2005). Later departure by males is thought to offer benefits in the following breeding season

through exposure to and defense of potential breeding sites (Forstmeier 2002).

The patterns in departure of age classes of Canada Warblers in autumn are of interest because HY's were intermediate of adult (AHY) males and females. Contrasting migration strategies usually occur between neotropical migrants depending on timing of autumn molt. Carlisle et al. (2005) found strong correlation with molting strategy and migration timing of age-classes; AHY birds molting flight feathers near breeding areas departed later than HY individuals. Adult Canada Warblers have a post-nuptial (basic) molt and the expected pattern is for adults to leave after HY's. Males and females departed at different times and, thus, appear to have different strategies for autumn migration departure.

Indirect Estimate of Breeding Range Occupancy.—A measure of the time spent in breeding areas may indicate temporal constraints on reproduction timing, investment, and reneating ability. These parameters may be more critical for reproductive success at the northern limit of a breeding range compared to more southern locales. Occupancy of only 62 days for female and 72 days for male Canada Warblers in this study is shorter than documented for any other wood warbler, and is

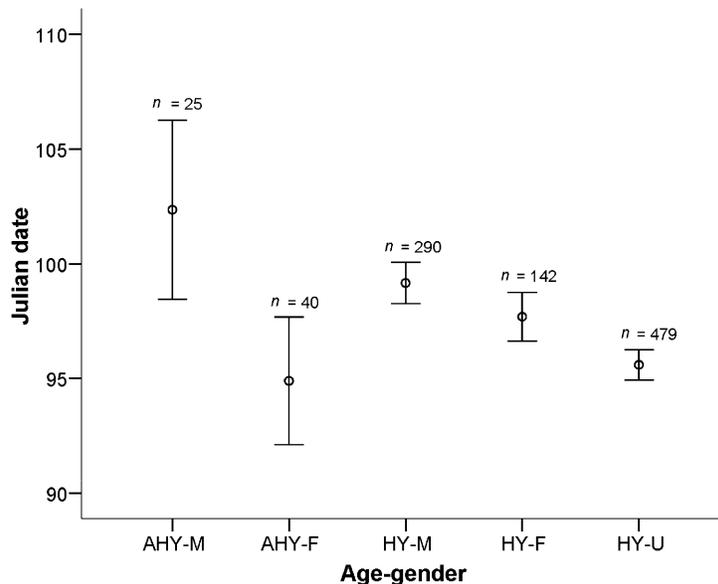


FIG. 2. Departure of Canada Warblers in northern Alberta. Error bars represent mean and 95% CI of autumn departure date. Julian date 93 = 1 August.

the shortest for any bird with a post-nuptial molt on or near breeding areas. Occupancy estimates for six species of wood warblers breeding in Alaska varied from 84 to 108 days (Benson and Winker 2001). Both late spring arrival and the need for early autumn migration offer the ability to test hypotheses concerning reproductive versus survival tradeoffs during temporally constrained periods in breeding areas that may ultimately influence conservation of the Canada Warbler. Future studies could investigate the implications of reduced occupancy time in breeding areas between northern and southern populations of Canada Warblers.

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Occurrence and Condition of Migrating Swainson’s Thrushes in the British Virgin Islands

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ABSTRACT.—Swainson’s Thrushes (*Catharus ustulatus*) migrate widely throughout North and Middle America. In the Caribbean, the species is known to occur only in the western-most Greater Antilles, and there only as a rare migrant. We captured and visually detected migrant Swainson’s Thrushes beginning in 2000 at a banding station on Guana Island, British Virgin Islands. The majority of thrushes captured were adults (79%) and most had no (71%) or little fat (12%) reserves at time of capture; 61% were classified as being in emaciated or poor condition. The poor physiological conditions may have resulted from longer over water flights rather than island hopping. Received 8 September 2006. Accepted 8 January 2007.

The Swainson’s Thrush (*Catharus ustulatus*) is a neotropical migrant passerine broadly distributed across the forested north and mountainous west of North America (Mack

and Wang 2000). Population trends across the species’ breeding distribution are inconsistent and difficult to interpret (Mack and Wang 2000), but there is evidence to suggest long-term declines in eastern North America (Holmes and Sherry 1988, Hill and Hagen 1991, Buckelew and Hall 1994). Recent analysis of Breeding Bird Survey (BBS) data indicates a declining trend (-0.83 ; $P = 0.09$) in the eastern United States (Sauer et al. 2005). Site-specific factors associated with breeding habitat may be influencing population trends (Sauer et al. 1997, Mack and Wang 2000), but population declines may also be related to factors occurring outside the breeding season (Petit et al. 1995, Mack and Wang 2000, Greenberg and Marra 2005). In particular, birds encounter a host of obstacles to survival during migration (Moore et al. 2005). The ecology of *en route* migrants is poorly understood (Heglund and Skagen 2005), which has been a major obstruction to progress on conservation of neotropical migrant birds (Cochran and Wikelski 2005).

An understanding of migration routes is nec-

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