Mating and Breeding Success Decline with Elevation for the Pacific Wren (Troglodytes pacificus) in Coastal Mountain Forests

Author(s) :Lesley J. Evans Ogden, Michaela Martin, and Kathy Martin
Source: The Wilson Journal of Ornithology, 124(2):270-276. 2012.
Published By: The Wilson Ornithological Society
DOI: http://dx.doi.org/10.1676/11-186.1
URL: http://www.bioone4sisisaoh nlull0.1676/11-186.1

differ. We expected Pacific Wrens breeding at high elevation to show a shift to a slower lifestyle with lower annual fecundity and higher survival.

TABLE 1. Number of territories, mating status, nesting success, and survival of Pacific Wrens in relation to elevation on Mount Seymour, British Columbia, Canada.

	Low elevation (100–390 m)		High elevation (750–1,270 m)	
	2003	2004	2003	2004
A. Territories and mating status				
Number of territories	21	18	10	11
Number of unmated territorial males	0	0	3	9
Number of banded males	15	15	7	5
Average total nests/male	2.4	4.0	1.3	2.6
Percent successful nests/male	25	24	0	0
B. Annual local survival				
Adults				
Number banded	28		19	
Number returning the following year	9		0	
Juveniles				
Number banded	50		6	
Number returning the following year	1		0	

We estimated the date-of-first-egg-laid by backdating for nests discovered after onset of incubation and, where hatching and/or fledging events were observed, using average periods of 15 and 17 days for incubation and nestling periods, respectively (Hejl et al. 2002).

Data Analysis.—We used R Version 2.4.0 (R Development Core Team 2006) for all statistical analyses. Clutch initiation dates were standardized between years by subtracting the yearly median. Clutch sizes were not normally distributed and we used a generalized linear model with a Poisson distribution to analyze the response of clutch size to elevation, year, and clutch initiation date. Linear models were used to evaluate the response of clutch initiation (date-of-first-egg-laid), provisioning rates, and incubation and nestling periods to elevation. Log and square-root transformations improved model fit for clutch initiation and nestling period models, respectively. We calculated daily nest survival rates using the logistic exposure method (Shaffer 2004). ANOVA was used to test for differences in morphology and condition (wing chord, tarsus, body mass) of adults and pre-fledging nestling mass among three elevation categories (high, middle, and low elevations) and sex (adults only). Alpha was set at 0.05 and means are reported ± SE.

RESULTS

We located 22 and 24 active nests (containing eggs or nestlings), 73 and 72 potential nests (empty nests constructed and/or maintained and attended by a territorial male) and one and three recently failed nests during the 2003 and 2004 breeding seasons, respectively. Active nests were distributed over an elevation range from 102 to 1,088 m. We did not find active nests above 1,100 m, but did locate one potential nest at 1,270 m and territorial males above 1,200 m in both years. We captured the majority of adults and nestlings at active nests in 2003 and 2004. We found fewer territories in both years, and fewer males successfully obtained one or more mates at higher elevation sites (Table 1). Our sample of banded males at low elevation had more nests (including both active and potential nests) and a higher proportion of their nests were successful compared to high elevation (Table 1).

Clutch Initiation and Clutch Size.—Clutches were initiated over a span of 79 days (40 nests) at low elevation, and over 31 days (6 nests) at high elevation. There was a tendency for later clutch initiation at high elevations, but clutch initiation dates did not differ between elevations ($F_{1,42} = 3.26, P = 0.08$). Nests at low elevations had two peak clutch initiation periods, whereas nests at high elevation had only one peak at a similar time as the second peak period at low elevation (Fig. 1A).

Mean clutch size (including first and re-nest attempts and second broods) was 5.5 ± 0.10 (n = 40) and did not vary with elevation (Dev Resid$_{1,36} = 0.15, P = 0.70$), clutch initiation dates (Dev Resid$_{1,35} = 0.411, P = 0.52$), or with year (Dev Resid$_{1,34} = 0.01, P = 0.93$; Fig 1B). Fledglings produced per eggs laid declined from an average of 0.5 at 200–400 m to 0 above 600 m. It was not

possible to produce a good model for these fecundity data because of our small sample; but the general relationship was non-linear and resembled a threshold with no change up to 400 m and then a decline to zero productivity.

Nest Survival.—The mean daily nest survival across elevations was 0.9660 0.018 (n 5 46

Adult Morphology and Mass.—We observed few morphological differences among adult wrens breeding across elevations (Table 2). Wing chord and tarsus were longer for males than females (wing: $F_{1,88} = 101.26$, $P < 0.001$; tarsus: $F_{1,89} = 8.95$, $P = 0.00$), but neither trait varied with elevation (wing: $F_{2,88} = 0.68$, $P = 0.50$; tarsus: $F_{2,89} = 0.32$, $P = 0.70$). Adult mass varied with both sex of adult and elevation with males being heavier than females ($F_{1,88} = 9.99$, $P = 0.00$); wrens at middle elevations were lighter than those at high or low elevations ($F_{2,88} = 3.65$, $P = 0.03$). Adult mass (males and females pooled) was similar between low and high elevation (low: 9.19 ± 0.10 g, $n = 53$; high: 9.18 ± 0.10 g, $n = 28$), but birds at middle elevations were lighter, especially the four females in our sample (8.66 ± 0.16 g, $n = 11$; Table 2).

Local Adult and Juvenile Annual Survival.—Nine of 28 (33.3%) adults and one of 50 (2%) nestlings banded at low elevation in 2003, returned in 2004, respectively. None of the 19 adults and six juveniles banded at high elevation in 2003 was re-observed in 2004 (Table 1B).

DISCUSSION

Pacific and Winter wrens are reported breeding from sea level to 3,700 m (Heijl et al. 2002), but we found Pacific Wrens on our coastal mountain sites in British Columbia, had lower indices of mating status, fecundity, nestling condition, local survival, and natal and breeding philopatry at high elevations. We found no differences with elevation in clutch size, offspring development times, or per capita parental provisioning of nestlings. Thus, we found no evidence for changes in breeding ecology of Pacific Wrens with elevation and no support for our hypothesis of a shift to a 'slower' life history with increasing elevation. This contrasts to several recent studies of songbirds breeding across elevation gradients in western North America such as Dark-eyed Junco (*Junco hyemalis*), Savannah Sparrow (*Passerculus sandwich*

pairs at low elevation were fledging their first broods.

Pacific Wrens produced fewer offspring with lower mass at high elevation compared to lower elevation, in contrast to fecundity patterns observed for Dark-eyed Juncos (Bears et al. 2008, 2009), Savannah Sparrows (Martin et al. 2009), and Horned Larks (Camfield et al. 2010). Pacific Wrens did not adjust their per capita provisioning of nestlings with increased elevation to compensate for the more rigorous conditions as observed for high elevation finches and tits in Eurasia

HEJL, S. J., J. A. HOLMES, AND D. E. KROODSMA. 2002. Winter Wren (Troglodytes hiemalis). The birds of North America. Number 623.

LEE, J. K., O-S. CHUNG, AND W.-S. LEE. 2011. Altitudinal variation in parental provisioning of nestling Varied Tits (Poecile varius). Wilson Journal of Ornithology 123: 283–288.

LU, X., T. YU, W. LIANG, AND C. YANG. 2010. Comparative breeding ecology of two White-bellied Redstart populations at different altitudes. Journal of Field Ornithology 81:167–175.

MCLACHLIN, R. G. 1983. Dispersion of the western Winter Wren (Troglodytes troglodytes) in the coastal Western Hemlock Forest at the University of British Columbia Research Forest in south western British Columbia. Dissertation. University of British Columbia, Vancouver, Canada.

MARTIN