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NEST SITE CHARACTERISTICS AND REPRODUCTIVE SUCCESS OF THE WESTERN TANAGER (PIRANGA LUDOVICIANA) ON THE COLORADO FRONT RANGE

Karen N. Fischer¹, John W. Prather¹,², and Alexander Cruz¹

ABSTRACT.—From 1999 through 2001 we located and monitored Western Tanager (Piranga ludoviciana) nests in public open-space properties in Boulder County, Colorado. Fifty-four of 58 nests were located in ponderosa pine and the remainder in Douglas-fir. Nests were generally placed near the midpoint of branches in areas of high canopy cover (>50%) in the middle section of nest trees. Nest height varied as a function of nest tree height, and nests were oriented randomly in relation to trunks of nest trees. Tanager nesting success varied annually, with estimates using the Mayfield method ranging from 11.3% in 2000 to 75.3% in 2001. At least 8 nests were predated, and predation was the primary cause of nest failure. Parasitism by Brown-headed Cowbirds (Molothrus ater) occurred in 7 of 17 (41%) nests found during egg-laying or incubation. Clutch size averaged 3.8 in 10 unparasitized nests, but only 2.4 in 8 parasitized nests. Brood parasitism dramatically reduced the number of tanager fledglings produced per nest.

Key words: Western Tanager, Piranga ludoviciana, breeding biology, nest site selection, Colorado.

The Western Tanager (Piranga ludoviciana), a neotropical migrant, is widespread throughout western portions of the United States and Canada. Breeding occurs in open, mixed coniferous-deciduous forests from the southeastern tip of Alaska to the Trans-Pecos region of Texas (Hudon 1999) and east as far as western South Dakota (Peterson 1995). In Colorado the Western Tanager occurs primarily from mid-May until mid-September in montane portions of the state (Andrews and Righter 1992, Versaw 1998).

Western Tanager nests are difficult to locate and monitor since they are often high and well hidden in conifers. Few studies have examined ecological factors that influence reproductive success in the Western Tanager, and most of these are anecdotal or unpublished. To the best of our knowledge, a study by Hudon (1999) in Alberta (n = 7) and Goguen and Mathews (1998) in New Mexico (n = 39) are the only ones that have examined in detail the breeding biology and nest site characteristics of this species. In addition, Project Tanager, conducted by the Cornell Laboratory of Ornithology, examined the effects of habitat fragmentation on tanager species breeding in North America (Rosenberg et al. 1999), but it has limited information on breeding biology or microhabitat characteristics of nest sites (Jim Lowe personal communication). From 1998 through 2001 we collected data on the breeding biology of neotropical migratory birds on open-space properties in Boulder County, Colorado. We present here information on the nest site selection and reproductive success of the Western Tanager.

STUDY AREAS

Nests were located on open-space properties maintained by the city and county of Boulder at elevations of 1600–1900 m in the foothills west of Boulder, Colorado (40°0′N, 105°16′W). On these properties we searched for nests every 2–3 days on 10 plots ranging from 6 to 24 ha in size. These plots are dominated by ponderosa pine (Pinus ponderosa) woodland and savannah with a mixture of Douglas-fir (Pseudotsuga menziesii) at higher elevations. Riparian corridors border some plots, although we located no nests in riparian vegetation. Neither did we locate nests in residential areas, though once again such areas bordered on some plots. All of our plots were within a few kilometers of the city of Boulder and were subject to varying degrees of human disturbance.

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METHODS

We monitored nests at intervals of 2–4 days (normally every 3 days) following standard nest-monitoring protocols (Ralph et al. 1993), until they were no longer active. Attempts were made to limit nest failure due to factors associated with nest monitoring (Martin and Geupel 1993). We determined nest contents by direct observation or by using a 6-m mirror pole whenever possible, but some nests were too high for contents to be monitored safely. For nests that we were unable to directly determine the contents, we relied on adult behavior and nest condition to ascertain whether the nest was active, predated, or abandoned. A search for fledglings was conducted in the vicinity of every nest in which chicks were presumed to have fledged. All nests that were confirmed as being active, either by monitoring the contents or by observing adults sitting on and/or visiting the nest with food, were included in this study.

After nests were no longer active, we measured habitat characteristics at each site using standardized protocols (James and Shugart 1970, Martin and Roper 1988). For each nest, we measured nest tree height, nest tree diameter (dbh), canopy cover over the nest, distance of nest to trunk and to tip of supporting branch, and height of the lowest living branch on the nest tree. All distances were measured with a measuring tape whenever possible. However, it was usually necessary to measure heights of tall trees and higher nests using a Suunto PM-5/360 PC clinometer. Canopy cover was measured by averaging 4 measurements taken with a Lemmon model-A convex spherical densiometer at a distance of 1 m from the nest in the 4 cardinal directions (Lemmon 1957). Additionally, we measured slope and aspect of the terrain around the nest site using a compass and the clinometer. Finally, we documented the location of each nest using a Garmin GPS-12 global positioning system.

We calculated nest success following the method proposed by Mayfield (1975), incorporating modifications suggested by Manolis et al. (2000). For nests of unknown fate, we used the last day the nest was observed to be active as the last active date; for nests of known fate, we used the midpoint between the last active day and the day the nest was observed to be empty or destroyed. We used estimates of the egg-laying/incubation period (13 days) and nestling period (12 days) from a subsample of our own nests from which we could obtain this data (see below).

Shapiro-Wilks W-tests were used to determine whether Western Tanager nests were normally distributed in their placement in relation to measured habitat variables. Linear regression and/or Student’s t tests also were used to search for patterns in nest placement in relation to measured habitat variables. All aforementioned tests were carried out using JMP statistical software (SAS Institute 1995). In addition, we used a Rayleigh test (Zar 1999) to determine if there was a significant directional component to nest orientation in relation to the trunk of the nest tree. Means and standard deviations are provided for numerical data whenever applicable.

RESULTS

We located 17 nests in both 1999 and 2000 and 24 nests in 2001, for a total of 58 nests. Half of these nests came from 2 plots on which we located 75% or more of the active tanager nests in each season; the remainder were located in less rigorously searched areas. Using nests with known dates of laying and fledging, and those for which dates could be extrapolated from available data, we determined that the breeding season extended from 28 May through 29 July. Active nests were observed from 2 June through 29 July. The peak of the breeding season (at least 50% of nests active) occurred between 6 June and 1 July. We have no evidence of 2nd broods.

We found 54 of 58 nests in ponderosa pine and the remaining 4 in Douglas-fir. In general, tanager nests were well hidden along midpoints of branches in the middle portion of nest trees. Canopy cover was high at all nest sites, averaging 71%, and never being less than 31%. This distribution was slightly skewed from normal, with more nests at lower canopy coverage (W = 0.95, P = 0.055). Nests were placed an average of 63% of the distance out toward the tip of the branch in a distribution that was skewed toward the end of the branch (W = 0.95, P = 0.054). Nests were distributed normally in relation to the height of the nest tree (W = 0.97, P = 0.378), with the mean of the distribution at 54% of the height of the tree. Tree height was a good predictor of nest height.
(F = 27.96, R² = 0.34, P < 0.001). We found no significant patterns of nest placement in relation to the other habitat variables that we measured. Nest orientation in relation to trunk of the nest tree was not significantly different from uniform (Bayley’s R = 10.84, z = 1.99, P = 0.16), although there was a slight bias in number of nests oriented toward the south and east. Twenty-nine nests (50%) were oriented between 80° and 200°.

The egg-laying and incubation period lasted 13.0 ± 2 days (range 11–15, n = 3). Nestlings remained in the nest for 12.2 ± 1.5 days after the initial egg hatched (range 11–14, n = 4). One additional nest that fledged young in only 8 days may have fledged only a cowbird. A few late nests may have been 2nd nesting attempts due to a previous failure.

Mean clutch size for nests not parasitized by Brown-headed Cowbirds (Molothrus ater) was 3.8 ± 0.4 (n = 10). Eight of 18 (44%) nests found during egg-laying or incubation were known to be parasitized by cowbirds. These nests contained an average of 2.4 ± 0.9 tanager eggs and 1.1 ± 0.4 cowbird eggs (n = 8). Of 38 nests with known outcome, 28 (74%) successfully fledged at least 1 young (Table 1). Mean number of fledglings produced by all nests with known outcome and for which actual numbers of fledglings could be determined was 1.0 ± 1.3 (n = 28). This number is less than the number of nests with known outcome since we could not accurately determine how many young fledged from 10 successful nests. Mean number of fledglings produced by successful nests that were not parasitized was 2.7 ± 0.7 (n = 15), while parasitized nests fledged only 0.7 ± 1.2 tanager young (n = 3). Mayfield nest success was calculated to be 51.8% for all years combined, but it varied dramatically between years (Table 1). Mayfield nest success was lower than apparent nest success due to the large number of nests located after hatching of the eggs.

**DISCUSSION**

In Colorado the breeding season for Western Tanagers appears to begin in late May and end in early August. We found tanager nests with eggs as early as 2 June, with an estimated 1st date of laying of 28 May. Active nests were present on our study sites through at least 29 July. Records of active nests from the Colorado Breeding Bird Atlas range from 1 June through 7 August (Versaw 1998). Initiation of the breeding season occurs between mid-May and mid-June in most areas (Hudon 1999).

We found only a few patterns in the placement of nests in relation to habitat characteristics. Tanagers did not appear to preferentially orient their nests in relation to the trunk of the nest tree. There was a slight directional component to nest placement (mean orientation 132°), but this was not significantly different from uniform. In general, tanager nests were located on large branches near the middle of nest trees. All but 1 nest were placed 30–90% of the distance from the trunk of the tree to the tip of the branch, in locations with high overhead canopy. Unlike other studies, which have generally reported tanagers as nesting very near tips of branches (Hudon 1999), we rarely found nests in such sites. We believe this may be because high canopy cover is important to Western Tanagers. In ponderosa pines, which often have a distinctly conical shape, nests placed at the tips of branches would normally be very exposed. Therefore, nests may be placed somewhat closer to the trunk of ponderosa pines than they would be in other trees. High canopy cover (77 ± 12%) was also reported over tanager nests in New Mexico (Hudon 1999).

In Colorado, as in other areas (Hudon 1999), Western Tanagers appear to lay 4 eggs normally. We have data on incubation and nestling periods for very few nests since the majority of nests were located after young had hatched. However, these data also support conclusions from other studies. Our nests followed through incubation had eggs hatch in 11–13 days, as compared to other studies that report 13–14 days (Versaw 1998, Hudon 1999). Additionally, the mean nestling period for nests in our study was 12.2 days, which is close to the mean of 11.3 days reported by Hudon (1999). Nesting success was high in 1999 and 2001 but low in 2000 due to a high rate of predation (Table 1). Nests normally fledged fewer young than eggs laid.

Because so few nests have been located during egg-laying and incubation, few studies have reported rates or effects of cowbird parasitism on breeding Western Tanagers. Prior to this study there were only a few records of cowbird parasitism on tanager nests in Colorado (Chace and Cruz 1996, Versaw 1998).
However, in New Mexico cowbirds parasitized 33 of 39 nests (85%) over the course of a 4-year study (Goguen and Mathews 1998). In contrast, Chace et al. (2000) reported 1 of 9 nests parasitized (11%) in Arizona, and parasitism was recorded in only 2 of 39 nests (5%) in British Columbia (Hudon 1999). In our study we found parasitism in 8 of 18 nests (44%) located before the eggs hatched (Table 1). Parasitism varied considerably between years; 5 of 7 nests found with eggs were parasitized in 2001, while only 3 of 11 nests found with eggs were parasitized in 1999–2000 (Table 1). Three additional parasitized nests were found after egg-hatching in 2001, while only 1 parasitized nest was found after egg-hatching in 1999–2000. Additional nests may have been parasitized, but we were unable to differentiate between cowbird and tanager young in many cases because of the difficulty of directly observing these nests.

Cowbirds had a strong negative effect on tanager breeding success. Parasitized nests held an average of 1.2 fewer tanager eggs than unparasitized nests, suggesting cowbirds removed tanager eggs from the nests. In addition, we could confirm that tanager young fledged from parasitized nests in only 2 cases. In one of these cases, the cowbird egg failed to hatch, and the nest fledged 3 tanager young. In the other, 2 tanager nestlings survived to fledge along with 1 cowbird nestling. In at least 3 cases, parasitized nests fledged only cowbird young, with the tanager young either dying or disappearing from the nest. As in our study, parasitized nests in New Mexico contained fewer eggs (2.4) than unparasitized nests (4.0) and fledged lower numbers of young (0.9 fledglings per nest) than unparasitized nests (2.5 fledglings per nest) (Goguen and Mathews 1998).

Table 1. Clutch size and reproductive success of Western Tanagers breeding around Boulder, Colorado, 1999–2001.

<table>
<thead>
<tr>
<th>Year</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. nests</td>
<td>17</td>
<td>17</td>
<td>24</td>
<td>58</td>
</tr>
<tr>
<td>No. successful</td>
<td>7 (41%)</td>
<td>7 (41%)</td>
<td>14 (58%)</td>
<td>28 (48%)</td>
</tr>
<tr>
<td>No. predated</td>
<td>1 (6%)</td>
<td>5 (29%)</td>
<td>1 (4%)</td>
<td>7 (12%)</td>
</tr>
<tr>
<td>No. abandoned</td>
<td>1 (6%)</td>
<td>0</td>
<td>1 (4%)</td>
<td>2 (05%)</td>
</tr>
<tr>
<td>No. unknown</td>
<td>8 (47%)</td>
<td>5 (29%)</td>
<td>8 (33%)</td>
<td>21 (36%)</td>
</tr>
<tr>
<td>No. parasitizeda</td>
<td>1 (17%)</td>
<td>2 (40%)</td>
<td>5 (71%)</td>
<td>8 (44%)</td>
</tr>
<tr>
<td>Clutch size</td>
<td>3.8 (n = 5)</td>
<td>4.0 (n = 3)</td>
<td>3.5 (n = 2)</td>
<td>3.8 (n = 10)</td>
</tr>
<tr>
<td>Exposure days</td>
<td>97</td>
<td>89</td>
<td>189</td>
<td>375</td>
</tr>
<tr>
<td>Mayfield success</td>
<td>69.9 ± 15.1%</td>
<td>11.3 ± 24.5%</td>
<td>76.5 ± 10.3%</td>
<td>51.8 ± 15.8%</td>
</tr>
</tbody>
</table>

*Of 18 nests located before the eggs hatched (6 in 1999, 5 in 2000, 7 in 2001).

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LITERATURE CITED


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