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SPRING MIGRATION BANDING AT TISHOMINGO NATIONAL WILDLIFE REFUGE, JOHNSTON COUNTY, OKLAHOMA, 2004–2007

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Abstract—We studied use of small habitat fragments by migrant and resident songbirds at the Tishomingo National Wildlife Refuge (TNWR) from 2004 to 2007. We banded birds at 6 study sites in bottomland hardwood forests, upland hardwood forests, wetland scrub-shrub, and upland scrub-shrub habitats. We logged 2,420 mist net hours with an average of 0.4 birds captured/mist net hour. We had 765 total captures of 53 species including unbanded and recaptured birds. Thirty Nearctic-Neotropical and 10 Nearctic-Nearctic migrant species were banded. Ten species were added to the TNWR checklist, and 5 species were confirmed as nesting at TNWR that were not previously documented. We confirmed nesting of 22 species previously not documented in Johnston County. We report new data on age and sex ratios of migrant and resident songbirds at TNWR.

Stopover sites provide critical habitat for migratory birds along major migration pathways in the Central Flyway (Moore and Simons 1992, Winker et al. 1992). However, there is a paucity of data concerning the role of small habitat fragments in the Cross Timbers region of south-central Oklahoma. Intensive economic development, habitat loss, fragmentation, degradation, conversion, energy development, and other anthropogenic factors have decreased the amount of suitable habitat for migratory birds and increased the importance of remaining small habitat fragments during migration. We hypothesize that within the landscape context of the Cross Timbers region, small habitat fragments provide critical stopover habitat for foraging and resting birds before they resume migration. Furthermore, these fragments provide critical nesting habitat for summer residents. Our objective was to use bird banding and area surveys to: 1) document migrant species using small habitat fragments at the Tishomingo National Wildlife Refuge (TNWR) during spring migration, 2) document reproductive condition and nesting of summer residents at TNWR, and 3) document age and sex ratios of migrant and resident birds at TNWR.

Methods

Research was conducted at TNWR (34° 11' N, 96° 38' W), Johnston County, south-central Oklahoma from 1 April to 18 May in 2004–2007. Six banding sites were established in bottomland hardwood forests, upland hardwood forests, wetland scrub-shrub, and upland scrub-shrub habitats around the Cumberland Pool at TNWR. The sites were located with 2 km of each other, with most sites <1 km apart. Not all sites were netted each year due to seasonal flooding. We banded

birds weekly at each site and logged approximately equal numbers of net hours for each banding site. Eight to 10 mist nets, 9–12 m in length with 30–36-mm diameter openings, were used to capture migrant and resident songbirds. Mist nets were opened at dawn and kept open for about 5 h each session. Mist net effort was recorded as mist net hours (= 1 mist net open for 1 hour). We banded birds with United States Biological Survey bands ranging from size 0A to 3. Wing length, tail length, body mass, and other morphometric data were used to confirm species identification, age, and sex (Pyle 1997). We recorded whether or not birds had a brood patch or cloacal protuberance to determine if they were in breeding condition (Pyle 1997). During each banding session, we also conducted a general area survey to detect bird species not captured in mist nets and record opportunistic observations of nests or recent fledglings (Ralph et al. 1993).

Results

From 2004 to 2007, we logged 2,420 mist net hours (2004 = 450, 2005 = 800, 2006 = 785, 2007 = 385). Fewer hours were logged in 2004 because only 3 banding sites were used. Fewer hours were logged in 2007 due to a major flood event. We captured 765 individuals at a rate of 0.4 birds captured/mist net hour (Table 1). Six Ruby-throated Hummingbirds and 1 American Crow were not banded due to lack of specific band sizes (scientific names in Tables 2 and 3). Four individuals escaped before they could be banded including one each of Least Flycatcher, Blue-gray Gnatcatcher, Lincoln's Sparrow, and Painted Bunting.

Table 1. Number of birds captured, recaptured, and birds/mist net hour at Tishomingo National Wildlife Refuge, 2004–2007.

Year	New Captures	Recaptures	Total	Birds/Mist Net Hour
2004	92	0	92	0.37
2005	221	20	241	0.41
2006	279	26	305	0.49
2007	109	18	127	0.29
2004–2007	701	64	765	0.40

From 2004 to 2007, we captured 53 different species (2004 = 20, 2005 = 34, 2006 = 45, 2007 = 29). We had 503 total encounters with 41 migrant species including 460 newly banded birds, 10 unbanded birds, and 33 recaptures (Table 2). Recaptured migrants included Prothonotary Warbler (n = 23), White-eyed Vireo (n = 4), Indigo Bunting (n = 4), and White-throated Sparrow (n = 2). Thirty-one Nearctic-Neotropical migrant species were banded; Indigo Bunting, Swainson's Thrush, White-eyed Vireo, Prothonotary Warbler, and Painted Bunting were most abundant (Table 2). Ten species of Nearctic-Nearctic migrants were banded; White-throated Sparrow, Lincoln's Sparrow, Hermit Thrush, Ruby-crowned Kinglet, and Orange-crowned Warbler were most abundant (Table 2). We had 262 total encounters with 12 resident species including 230 newly banded birds, 1 unbanded bird, and 31 recaptures (Table 2). Recaptured residents included Northern Cardinal (n = 14), Carolina Wren (n = 11), Brown-headed Cowbird (n = 3), Carolina Chickadee (n = 2), and Brown Thrasher (n = 1). All recaptures were birds originally banded during this project at TNWR in 2004–2007.

Table 2. Common name, scientific name, migrant or resident status, and abundance of species captured at Tishomingo National Wildlife Refuge, 2004–2007.

Common Name	Scientific Name	Migrant or Resident	*n*
Northern Cardinal	Cardinalis cardinalis	Resident	107
Indigo Bunting	Passerina cyanea	Nearctic-Neotropical	82
White-throated Sparrow	Zonotrichia albicollis	Nearctic-Nearctic	68
Swainson's Thrush	Catharus ustulatus	Nearctic-Neotropical	55
White-eyed Vireo	Vireo griseus	Nearctic-Neotropical	42
Lincoln's Sparrow	Melospiza lincolnii	Nearctic-Nearctic	31
Carolina Wren	Thryothorus ludovicianus	Resident	29
Carolina Chickadee	Poecile carolinensis	Resident	27
Prothonotary Warbler	Protonotaria citrea	Nearctic-Neotropical	25
Brown-headed Cowbird	Molothrus ater	Resident	21
Painted Bunting	Passerina ciris	Nearctic-Neotropical	20
Tufted Titmouse	Baeolophus bicolor	Resident	14
Blue-gray Gnatcatcher	Polioptila caerulea	Nearctic-Neotropical	11
Gray Catbird	Dumetella carolinensis	Nearctic-Neotropical	11
Kentucky Warbler	Oporornis formosus	Nearctic-Neotropical	11
Acadian Flycatcher	Empidonax virescens	Nearctic-Neotropical	10
Downy Woodpecker	Picoides pubescens	Resident	9
Brown Thrasher	Toxostoma rufum	Resident	9
Common Yellowthroat	Geothlypis trichas	Nearctic-Neotropical	9
Northern Waterthrush	Seiurus noveboracensis	Nearctic-Neotropical	8
Ruby-throated Hummingbird	Archilochus colubris	Nearctic-Neotropical	6
Hermit Thrush	Catharus guttatus	Nearctic-Nearctic	6
Red-bellied Woodpecker	Melanerpes carolinus	Resident	5
Least Flycatcher	Empidonax minimus	Nearctic-Neotropical	5
Eastern Phoebe	Sayornis phoebe	Resident	5
Ruby-crowned Kinglet	Regulus calendula	Nearctic-Nearctic	5
Northern Parula	Parula americana	Nearctic-Neotropical	5
Black-and-white Warbler	Mniotilta varia	Nearctic-Neotropical	5
Yellow-breasted Chat	Icteria virens	Nearctic-Neotropical	5
Yellow-billed Cuckoo	Coccyzus americanus	Nearctic-Neotropical	4
Red-eyed Vireo	Vireo olivaceus	Nearctic-Neotropical	4
Orange-crowned Warbler	Vermivora celata	Nearctic-Nearctic	4
Nashville Warbler	Vermivora ruficapilla	Nearctic-Neotropical	4
Great Crested Flycatcher	Myiarchus crinitus	Nearctic-Neotropical	3
Ovenbird	Seiurus aurocapilla	Nearctic-Neotropical	3
Louisiana Waterthrush	Seiurus motacilla	Nearctic-Neotropical	3
Swamp Sparrow	Melospiza georgiana	Nearctic-Nearctic	3
American Goldfinch	Carduelis tristis	Resident	3
Willow Flycatcher	Empidonax traillii	Nearctic-Neotropical	2
House Wren	Troglodytes aedon	Nearctic-Neotropical	2
Veery	Catharus fuscescens	Nearctic-Neotropical	2
Yellow Warbler	Dendroica petechia	Nearctic-Neotropical	2
Yellow-throated Warbler	Dendroica dominica	Nearctic-Neotropical	2
Mourning Warbler	Oporornis philadelphia	Nearctic-Neotropical	2
Wilson's Warbler	Wilsonia pusilla	Nearctic-Neotropical	2
Summer Tanager	Piranga rubra	Nearctic-Neotropical	2
Pileated Woodpecker	Dryocopus pileatus	Resident	1
American Crow	Corvus brachyrhynchos	Resident	1
Tennessee Warbler	Vermivora peregrina	Nearctic-Neotropical	1
Yellow-rumped Warbler	Dendroica coronata	Nearctic-Nearctic	1
Clay-colored Sparrow	Spizella pallida	Nearctic-Nearctic	1
White-crowned Sparrow	Zonotrichia leucophrys	Nearctic-Nearctic	1
Dark-eyed Junco	Junco hyemalis	Nearctic-Nearctic	1

We added 10 new species to the TNWR bird checklist during banding and area surveys including: Eurasian Collared-Dove (*Streptopelia decaocto*), White-winged Dove (*Zenaida asiatica*), Olive-sided Flycatcher (*Contopus cooperi*), Sedge Wren (*Cistothorus platensis*), Magnolia Warbler (*Dendroica magnolia*), Black-throated Green Warbler (*Dendroica virens*), Cerulean Warbler (*Dendroica cerulea*), Ovenbird, Hooded Warbler (*Wilsonia citrina*), and Scarlet Tanager

(*Piranga olivacea*). We confirmed nesting for 43 bird species at TNWR based on breeding condition, finding an active nest, or observing recent fledglings. Twenty one species were previously confirmed nesting at TNWR or in Johnston County (Reinking 2004). We documented nesting of 22 species not previously confirmed in Johnston County (Reinking 2004; Table 3). We also confirmed nesting of 5 species previously not recorded as nesting at TNWR including: Yellow-crowned Night-Heron, Tree Swallow, Northern Parula, Yellow-throated Warbler, and Kentucky Warbler. The other 17 species were previously recorded nesting at TNWR, but were not counted as "Confirmed" in Johnston County by the Oklahoma Breeding Bird Atlas (Reinking 2004). We captured only adults for Gray Catbird (n = 11), Downy Woodpecker (n = 9), Brown Thrasher (n = 9), and 4 other species (Yellow-billed Cuckoo, Veery, Yellow-throated Warbler, Black-and-white Warbler), but each with sample sizes of $\leq$5. Conversely, we captured 30 subadult Lincoln's Sparrows, but no adults. Similarly, only subadults were captured for Willow Flycatcher, Least Flycatcher, Tennessee Warbler, Yellow-rumped Warbler, Ovenbird, Wilson's Warbler, Summer Tanager, and Clay-colored Sparrow, but each with sample sizes of $\leq$5. We recorded differences in sex ratios among migrant and resident birds. Some species exhibited balanced 1:1 sex ratios such as Acadian Flycatcher (5M:5F) and Common Yellowthroat (5M:4F). We recorded unbalanced sex ratios for some migrant species. Indigo Buntings exhibited a 2M:1F sex ratio. Brown-headed Cowbirds and Kentucky Warblers exhibited a 4M:1F sex ratio, and Prothonotary Warblers had a 5M:1F sex ratio. We captured only male Ruby-crowned Kinglets, Orange-crowned Warblers, and Nashville Warblers, but each with sample sizes of $\leq$5.

Discussion

We studied habitat use by migrant and resident songbirds during spring migration and the onset of the nesting season for 4 years. Migrants outnumbered residents by a 3:1 ratio each April and May. We observed a variety of Nearctic-Nearctic migrants such as Lincoln's Sparrows and White-throated Sparrows that used TNWR especially in April. By May, a wide variety of Nearctic-Neotropical migrants arrived and used TNWR as stopover or nesting habitat. The high recapture rate of Prothonotary Warblers in mist nets was due to concurrent banding of nesting female and male Prothonotary Warblers at TNWR (Wood and Reasor 2006). Other migrants including male Indigo Buntings and White-eyed Vireos were recaptured when they returned to territories held in previous years. Unfortunately, no birds were recaptured that were banded at other study sites. Similarly, none of our banded birds have been recaptured at other sites. If any of our banded birds are recaptured at other sites in the Western Hemisphere, it would provide interesting information about where these birds occur during the nesting season or on their wintering grounds. For example, we banded large numbers of Swainson's Thrush and Lincoln's Sparrow, but we are not sure where these birds nest. They could continue north and nest in the boreal forests of Canada or they may turn northwest and nest in the Rocky Mountains (Ammon 1995, Mack and Yong 2000).

Table 3. Species confirmed nesting in Johnston County during banding and area surveys at Tishomingo National Wildlife Refuge, 2004–2007.

Common Name	Scientific Name
Little Blue Heron	*Egretta caerulea*
Yellow-crowned Night-Heron	*Nyctanassa violacea*
Black Vulture	*Coragyps atratus*
Turkey Vulture	*Cathartes aura*
Broad-winged Hawk	*Buteo platyperus*
Mourning Dove	*Zenaida macroura*
Chimney Swift	*Chaetura pelagica*
Ruby-throated Hummingbird	*Archilochus colubris*
Red-eyed Vireo	*Vireo olivaceus*
Tree Swallow	*Tachycineta bicolor*
Brown Thrasher	*Toxostoma rufum*
European Starling	*Sturnus vulgaris*
Northern Parula	*Parula americana*
Yellow-throated Warbler	*Dendroica dominica*
Prothonotary Warbler	*Protonotaria citrea*
Louisiana Waterthrush	*Seiurus motacilla*
Kentucky Warbler	*Oporornis formosus*
Common Yellowthroat	*Geothlypis trichas*
Yellow-breasted Chat	*Icteria virens*
Indigo Bunting	*Passerina cyanea*
Brown-headed Cowbird	*Molothrus ater*
American Goldfinch	*Carduelis tristis*

We added several species to the TNWR checklist that were previously expected, such as Olive-sided Flycatcher, Magnolia Warbler, Black-throated Green Warbler, and Ovenbird. Several unexpected species were also recorded on our surveys including Cerulean Warbler, Hooded Warbler, and Scarlet Tanager that typically occur to the east of TNWR (Reinking 2004). Eurasian Collared-Dove and White-winged Dove have expanded their range in this area and were detected during area surveys.We confirmed nesting by Yellow-crowned Night-Heron and Tree Swallow, which we did not expect to find nesting at TNWR based on historical records (Reinking 2004). We did confirm nesting by Northern Parula, Yellow-throated Warbler, and Kentucky Warbler, which was expected based on their abundance at TNWR during the nesting season. We confirmed nesting by 22 species in Johnston County that previously had not been documented (Reinking 2004). For Johnston County, according to the Oklahoma Breeding Bird Atlas, 9 of those species were listed as "Probable", 5 listed as "Possible", 3 listed as "Observed", and 5 listed as "Not Observed" (Reinking 2004). We had the advantage of spending significantly more time in the field at TNWR than Breeding Bird Atlas protocols required, and we expected to confirm nesting for many of these species. We captured only adults of residents such as Downy Woodpecker and Brown Thrasher. For residents, this may indicate high habitat quality in which adult birds obtained territories by competition against subadult birds. Adult nesting migrants like Gray Catbird, Yellow-throated Warbler, Yellow-billed Cuckoo, and Black-and-white Warbler, also may have obtained the best habitat available and displaced subadult birds to lower quality habitats in or outside TNWR. For a stopover migrant like the Veery, this is

probably a reflection of small capture rates. Conversely, we captured only subadults for Lincoln's Sparrow, Ovenbird, Wilson's Warbler, and Least Flycatcher. Although capture rates were small, this may suggest that TNWR is off the main migration flyway for these species and subadults may be using stopover habitat away from the main flyway used by adult. Several migrant nesting species exhibited balanced sex ratios such as Acadian Flycatcher and Common Yellowthroat. This result, combined with breeding condition data, indicated that these species had completed their migration to TNWR and established territories by late spring. Other species exhibited slightly skewed sex ratios in favor of males like Indigo Buntings that were still migrating through TNWR in mid-May. Other species had highly skewed sex ratios in favor of males: Brown-headed Cowbird, Kentucky Warbler, and Prothonotary Warbler. We only captured males of some species including Nashville Warbler, Orange-crowned Warbler, and Ruby-crowned Kinglet, although capture rates were small. Skewed sex ratios toward males may suggest that these species were still migrating or a large number of floater males occurred at TNWR during late spring.

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First nesting of Neotropic Cormorant in Oklahoma.—This note documents the first nesting by Neotropic Cormorant (*Phalachrocorax brasilianus*) in Oklahoma. On 2 July 2000, David Arbour observed a Neotropic Cormorant carrying nesting material toward a nesting colony of mostly Cattle Egrets (*Bubulcus ibis*), Little Blue Herons (*Egretta caerulea*), and Anhingas (*Anhinga anhinga*) in Ward Lake, part of the U.S. Forest Service Red Slough Wildlife Management Area (Red Slough). Ward Lake, located about 13 km SSE of Haworth, McCurtain County, is about 180 ha with many willow trees (*Salix nigra*) in which the colony was located. Arbour continued to observe 4–5 Neotropic Cormorants in this area through the end of July but did not locate a nest. On 10 July 2001, Arbour observed, in the same colony, a nest with a Neotropic Cormorant sitting on it and another on a limb beside the nest. On 17 July 2001, he observed another active nest, and he observed a Neotropic Cormorant sitting on each nest 25 July. The two nests were not monitored subsequently, but 1–2 juvenile Neotropic Cormorants were regularly observed in the area through 23 September 2001.

There are usually 1–4 Neotropic Cormorants all summer at Red Slough, but no additional nests have been observed. Vic Fazio (pers. comm.) stated that he encountered an adult Neotropic Cormorant in alternate plumage on 20 July 2001 at Hackberry Flat Wildlife Management Area, Tillman County. He observed an adult in Jackson County on 13 September 2007, and another in Jefferson County. On 29 July 2009, he observed 8 Neotropic Cormorants at Lake Ellsworth in Comanche County but did not see any evidence of breeding in any of these areas. Jim Arterburn (pers. comm.) stated that he found 2 nesting pairs on Ralstin Island at Salt Plains National Wildlife Refuge, Alfalfa County, 16 May 2008, and he found 1 nesting pair in the same area on 18 June 2009.

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