

CONSERVATION IMPLICATIONS OF MULTIPLE HABITAT USE
BY NORTHERN WATERTHRUSHES DURING THE NONBREEDING SEASON

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Abstract.—Using evidence from individually-marked birds and radio-telemetry, we studied daily and seasonal habitat use of Northern Waterthrushes (*Seiurus novaboracensis*) in Puerto Rico during the nonbreeding season from 1999 to 2001. Our study was conducted in mangrove habitats along the southwest and east coasts and near ponds and washes in mesquite savanna in the southwest. Of 29 radio-equipped birds we found a dominant pattern of overnight roosting (87.8% of radioed birds) in coastal red mangroves (*Rhizophora mangle*), regardless of the habitat used for daytime feeding. Birds left feeding areas just before dusk, sometimes flying as far as 1.8 km to coastal red mangroves. These same birds returned to their feeding areas over a broader range of times the following morning. We also observed individuals shift feeding areas (60.0% of birds followed for 3 or more days) over the course of days, weeks, and months. The combination of daily movements between habitats and longer term shifting of feeding areas suggests that this species selects multiple habitats that meet daytime feeding and night-time roosting requirements. Due to these movements, habitat preferences of individual birds cannot be inferred from short-term diurnal censuses or mist net data alone. These findings document the need to consider multiple habitats as well as habitat mosaics when conserving Northern Waterthrushes and other species.

Key words: *habitat use, Northern Waterthrush, Puerto Rico, Seiurus novaboracensis*

Resumen.—IMPLICACIONES CONSERVACIONISTAS DEL USO DE MÚLTIPLES HÁBITAT POR *SEIURUS NOVABORACENSIS* DURANTE LA ESTACIÓN NO REPRODUCTIVA. Estudiamos mediante individuos marcados y radiotelegrafía, el uso de hábitat diario y estacional de *Seiurus novaboracensis* en Puerto Rico, durante las estaciones no reproductivas de 1999 al 2001. Nuestro estudio se desarrolló en manglares a lo largo de las costas este y suroeste y en lagunas de las sabanas del suroeste. De 29 individuos marcados con radio encontramos un patrón dominante de descanso nocturno en áreas costeras de mangle rojo (*Rhizophora mangle*) (87.8% de las aves con radiotransmisores), independientemente del tipo de hábitat empleado para la alimentación durante el día. Las aves abandonaron sus áreas de alimentación justo antes del atardecer; en ocasiones volando hasta 1,8 km hacia las áreas costeras de mangle rojo. Estos mismos individuos regresaron a las áreas de alimentación en la mañana siguiente en un rango más amplio de tiempo. También observamos individuos que cambiaron sus áreas de alimentación (60,0% de las aves monitoreados por tres o más días) durante los días, semanas y meses. La combinación de los movimientos diarios entre los hábitat y los cambios a largo plazo de las áreas de alimentación sugiere que esta especie selecciona hábitat múltiples que cumplen sus requerimientos de alimentación durante el día y de descanso durante la noche. Debido a estos movimientos, las preferencias de hábitat de aves individuales no pueden ser inferidas a partir de censos diurnos a corto plazo o de las capturas en las redes ornitológicas solamente. Estos hallazgos apoyan la necesidad de considerar los hábitat múltiples y los mosaicos de hábitat cuando hablamos de la conservación de *Seiurus novaboracensis* y otras especies.

Palabras claves: *Puerto Rico, Seiurus novaboracensis, Señorita de Manglar, uso de hábitat*

NEARCTIC-NEOTROPICAL migratory birds show a diversity of habitat-use patterns among species. These differences include season-long territory occupancy (Holmes and Sherry 1992), often with social dominance hierarchies (Marra *et al.* 1993). Other species use ephemeral and discreet habitats (i.e. floaters; Winker *et al.* 1990) or nomadic foraging on short-lived food sources (Greenberg 1984), or alternatively, consistent, if temporary, occupancy of sites within a season (Lefebvre and

Poulin 1996, Reitsma *et al.* 2002). These habitat use patterns may also be combined with off-site roosting behavior (M. Baltz, pers. comm., Staicer 1992, Reitsma *et al.* 2002, this study). The factors that lead to these habitat use differences are only partially understood, yet they have clear management and conservation implications regarding the differing importance of single and multiple habitats for each species.

The Northern Waterthrush (*Seiurus novaboracensis*)

sis) over-winters in the southern United States, Caribbean, Central America and northern South America (Eaton 1995). This species is generally found in coastal wetland habitat, especially mangroves, where they are often abundant (Lefebvre *et al.* 1992, Wunderle and Waide 1993). We found more than half of all migrant passerines in Puerto Rican mangroves were Northern Waterthrushes (Reitsma and Hunt, unpublished data). Individual Northern Waterthrushes are found in well-defined locations (e.g., feeding areas), during daylight hours for days, weeks, and months (Schwartz 1964, Reitsma *et al.* 2002). However, birds usually move to different locations for nighttime roosting, even from habitats that support high densities of feeding areas (Reitsma *et al.* 2002).

Individual birds also shift to new feeding areas in an unpredictable manner. Coastal wetland habitats in much of the Caribbean Basin become progressively drier from September to April due to extended periods of low precipitation from January through March. This may be the primary reason individual birds relocate to moister areas (e.g., Lefebvre and Poulin 1996). However, our evidence indicates factors in addition to habitat moisture level are operating on Northern Waterthrush behavior.

Our objective was to better understand habitat use of Northern Waterthrushes during the nonbreeding season. We used radio-telemetry to monitor Northern Waterthrush movements and habitat occupancy in locations in eastern and southwestern Puerto Rico. We documented the daily movement to and from roost sites, and the locations and shifts of feeding areas during continuous short (several days) and discontinuous longer (months and seasons) time periods.

STUDY AREAS AND METHODS

This study was conducted at the Cabo Rojo National Wildlife Refuge (CRNWR) on the arid southwest coast, and at the Roosevelt Roads Naval Station (RRNS) on the eastern shores of Puerto Rico during the three nonbreeding seasons, 1999-2001. CRNWR's dominant plant community is mesquite-savanna but there are also ephemeral ponds and wet washes that flow into red mangroves (*Rhizophora mangle*) on the nearby coast. Washes generally have standing water through the first half of the nonbreeding season (October into January). Ponds usually contain standing water throughout the season, although not in all years. Due to our interest in the use of red mangroves as roosting sites for birds that

used other habitats for feeding areas, we attached radio transmitters to 17 birds (15 individuals) along the washes and ponds during January and March 1999 and 2000.

Roosevelt Roads Naval Station has extensive areas of mangroves, but relative abundance of white (*Laguncularia racemosa*), black (*Avicennia germinans*), and red mangrove differs among the numerous mangrove forest areas. Unlike red mangroves, black and white mangroves grow in areas that are not constantly flooded with salt water. Our radio-telemetry study sites included a predominately mature white mangrove area, a mixed age and density black mangrove area, and an area with red and black mangrove and scrub habitat. We collected location and movement data on 12 radio-equipped birds (11 individuals) during October, January and March 2000 and 2001.

All Northern Waterthrushes were captured in mist nets. Each bird was weighed, color-banded, and scored for furcular fat. Wing chord, tarsus, and tail length were also measured. When possible, we determined sex using a combination of wing chord and molecular techniques as described in Reitsma *et al.* (2002) and age using plumage criteria as in Pyle (1987). We attached radio transmitters on the upper back by trimming scapular feathers and using five-minute epoxy. Transmitters (Holohil Ltd.) averaged 0.78 g and a 3 wk battery life. The range of reception was ≥ 1 km in open habitat but was restricted to a few hundred meters in thick vegetation. When possible, we increased our detection range by using hilltops and towers near the study areas. With telemetry, we were able to follow individual Northern Waterthrush movement between feeding and roosting areas.

RESULTS

During the three nonbreeding seasons from 1999-2001, we followed 29 Northern Waterthrushes (26 individuals) on 34 days for a total of 123 bird-days (range 3-10 days, $\bar{x} = 4.2$ days/bird). We observed behavioral changes associated with handling, banding and applying a radio transmitter only immediately after release. One bird roosted near its release site adjacent to feeding area after being released just before dark. Otherwise, within one hour all birds appeared to be behaving normally. We observed or suspected no mortality related to this study. Birds were only temporarily encumbered because radio transmitters fell off all birds within 2 weeks of application. Of the 29 radio-equipped birds, 27

Table 1. Northern Waterthrush movements among habitats from radio-telemetry studies in two locations in Puerto Rico: Cabo Rojo National Wildlife Refuge (CRNWR) and Roosevelt Roads Naval Station (RRNS), 1999-2001. Number (percentage).

Variable	CRNWR	RRNS	Total
# of birds with radio transmitters			
1998/1999	9	0	9
1999/2000	8	3	11
2000/2001	0	9	9
Total ^a	17	12	29
# of days of telemetry data	21	13	34
# of bird-days	79	44	123
# of bird-nights roosted			
in red mangroves	72 (91.1)	36 (81.8)	108 (87.8)
not in red mangroves	7 (8.6)	8 (18.2)	16 (12.2)
# of bird-days moved to red mangrove roost site from non-red mangrove feeding area	66 (83.5)	31 (70.5)	97 (78.9)
# of birds (of 29) that roosted in red mangroves	16 (94.1)	11 (91.7)	27 (93.1)
# of birds that shifted feeding areas ^b	8 of 14 (57.1)	4 of 6 (66.7)	12 of 20 (60.0)

^aThree individuals had a radio-transmitter in two seasons (two at CRNWR, one at RRNS).

^bBirds with 3 or more days of data.

(93.1%) regularly used roost sites in red mangroves distinct from feeding areas (Table 1). Using data of birds from CRNWR where we have the most accurate measurements, the distance traveled from feeding areas not in red mangroves to roost sites in red mangroves varied depending on habitat distribution from 600 m to over 1800 m ($\bar{x}$ = 1.3 km, n = 16). Birds typically departed for roost sites 10 to 20 min before dark. Return from roost sites was more variable, especially later in the season, but usually occurred within a few hours of sunrise. Only two birds (6.9%) in our study that had a feeding area away from red mangroves did not roost in red mangroves. One bird remained on its feeding area on a pond in CRNWR, the other moved from its feeding area to a roosting site in black mangroves in RRNS. Three birds (10.3%) had both feeding areas and roosting sites in red mangroves. We observed no seasonal differences in the use of red mangroves for roosting

from October to March. We were unable to determine age of 10 or sex of 17 of 29 birds with radio-transmitters. However, seven were males and five were females. Five birds were in their first year, 14 were older than their first year. Our limited data suggest no age, or sex differences in use of red mangroves for roosting.

Although individual birds consistently used well-defined feeding areas both in the short term (days) and seasonally (months), they did not aggressively defend these areas. However, of those we monitored for more than three days, 12 of 20 (60.0%) shifted their feeding areas from one location to another (Table 1). Birds were sometimes absent from their feeding areas for days or weeks but later returned. In the case of the birds using the washes and ponds within the mesquite savanna in CRNWR, we noted a clear shift from washes with standing water to partially dried ponds between January and March

(at which time the washes were completely dry). At RRNS, although the habitat moisture was not measured, it did not obviously change.

DISCUSSION

Northern Waterthrushes in Puerto Rico clearly demonstrate two distinct movement patterns in coastal habitats: (1) movement between daytime feeding areas to nighttime roosts, the latter usually in coastal red mangroves; and (2) shifting of daytime feeding areas from one location to another within a single nonbreeding season, and often within the period of a single week. Collectively, these patterns have several implications concerning how this species uses habitat during the nonbreeding season.

Most Northern Waterthrushes we studied in Puerto Rico used red mangroves for roosting, usually moving from other habitats used for feeding. This was documented using radio telemetry as reported here and from a previous study of color-banded birds at a site in southwestern Puerto Rico (Reitsma *et al.* 2002). In that study, Northern Waterthrushes captured in mist nets (aligned along a distinct boundary between red and black mangroves) suggested mass movement into red mangroves from black mangrove and presumably other feeding areas in the evening and the reverse in the morning (Reitsma *et al.* 2002). Adaptive and non-adaptive genetic predisposition may be alternatively suggested as possible explanations for the use of red mangroves for roosting; however, our study did not address proximate or ultimate causes. Nevertheless, the predominance of this behavior indicates that coastal red mangrove habitat is important to this species. Because of the high density of Northern Waterthrushes in red mangroves and their widespread use of this mangrove type for roosting, it is important to preserve this valuable and disappearing habitat.

The consistent use of small non-territorial feeding areas suggests some advantage to certain areas, presumably in response to food availability. However, the use of these feeding areas varies over time. This species feeds primarily on the ground by probing and turning over litter, except for birds whose feeding areas are in red mangroves. Birds in red mangrove forage on near-horizontal roots near the surface of the water. We have evidence from other mangrove forests in southwestern Puerto Rico (Reitsma *et al.* 2002) that Northern Waterthrushes leave black mangrove sites when they are flooded

and return when the water level recedes. At CRNWR there was an obvious link to moisture levels along washes in scrub/mesquite uplands. Data from the washes and ponds in the southwest suggests they desert feeding areas that dry out. Drying conditions in March 1999 at CRNWR resulted in many Northern Waterthrushes (≥ 10) occupying overlapping feeding areas within a single 0.33 ha semi-dry pond.

Not all birds followed a predictable pattern. At RRNS, our data suggest a pattern of Northern Waterthrushes abandoning areas that dry, but certain individuals shifted into scrub habitat that remained dry most of the year (Reitsma pers. obs.). Thus, the ability to move to new areas may be an adaptive response to ephemeral habitats that change over short time intervals.

In addition to Northern Waterthrushes, we observed a pattern of daily movement to roost sites in red mangroves from a small sample of Prairie (*Dendroica discolor*) and Prothonotary Warblers (*Protonotaria citrea*) using mist netting and radio telemetry at RRNS (Reitsma and Smith, unpublished data). Large flocks of Gray Kingbirds (*Tyrannus dominicensis*) also moved to and from red mangroves for roosting (pers. obs.). In an earlier study, we documented a consistent pattern of movement of Northern Waterthrushes between a black mangrove site and a large adjoining red mangrove area in southwestern Puerto Rico (Reitsma *et al.* 2002). These patterns indicate the need to consider habitat at multiple scales when managing for some species. This result carries implications when considering which habitats to conserve. Northern Waterthrushes use multiple habitat types for different functions. While Northern Waterthrushes may occupy and successfully over-winter in a variety of habitats, most select feeding areas that are in close proximity to red mangrove roost sites (Hunt *et al.* 2005). Northern Waterthrushes occupy a range of habitat types during the day, but most shift their feeding areas as conditions change over the season.

Finally, our data from telemetry indicate that Northern Waterthrushes move considerable distances and often through multiple habitats, some of which are used only when passing to and from roost sites. Therefore, one must use caution when inferring patterns of relative abundance or habitat preference from census or mist net data. Although the relative importance of the multiple habitat types used is unknown, each habitat may provide essential requirements. This suggests that although preserv-

ing mangrove habitat should be the highest priority, preserving other habitat types would likely enhance the overall survival of this species over the nonbreeding season, especially if these habitats are contiguous with coastal red mangroves. Comments from anonymous reviewers and the editors improved this paper.

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