

DIET OF SOME SPRING MIGRANT LANDBIRDS ON THE CARIBBEAN COAST OF COSTA RICA

JARED D. WOLFE

Humboldt State University, Wildlife Department, 1 Harpst Street, Arcata, CA 95521, USA; current address: USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, 1700 Bay view Dr., Arcata, CA 95521, USA; e-mail: jdwolfe80@yahoo.com

Abstract: Spring dietary patterns of migrants in tropical latitudes are largely unknown. Here I present diet data derived from an analysis of fecal samples for six migrant landbird species during spring migration along the Caribbean coast of Costa Rica. High levels of insectivory were detected for all six species captured. The nature of the data presented is discussed in light of El Niño conditions which immediately preceded the field component of this study. Ultimately, detailed knowledge pertaining to the resources utilized by migrant landbirds will improve our ability to manage Caribbean stopover sites.

Key words: diet, Caribbean coast, Costa Rica, landbirds, Nearctic-Neotropic migrants, spring migration

Resumen: DIETA DE ALGUNAS AVES TERRESTRES MIGRANTES DE PRIMAVERA EN LA COSTA CARIBEÑA DE COSTA RICA. Los patrones dietarios en primavera de los migrantes en latitudes tropicales son casi desconocidos. Se presentan datos sobre la dieta a partir de un análisis de las muestras fecales de seis especies de aves terrestres migratorias durante la migración de primavera a lo largo de la costa caribeña de Costa Rica. Altos niveles de insectivoría fueron detectados en las seis especies capturadas. La naturaleza de los datos presentados se expone a la luz del fenómeno El Niño que precedió inmediatamente al trabajo de campo de este estudio. En última instancia, un conocimiento detallado de los recursos utilizados por las aves terrestres migratorias mejorará la capacidad para manejar los sitios de parada en el Caribe.

Palabras clave: aves terrestres, costa del Caribe, Costa Rica, dieta, migrantes Neártico-Neotropicales, migración de primavera

Résumé : RÉGIME ALIMENTAIRE DE CERTAINS OISEAUX TERRESTRES MIGRATEURS DE PRINTEMPS SUR LA CÔTE CARIBÉENNE DU COSTA RICA. Le régime alimentaire des migrateurs séjournant sous les tropiques au printemps est en grande partie inconnu. Je présente ici des données sur l'alimentation provenant d'une analyse d'échantillons fécaux de six espèces d'oiseaux terrestres en migration printanière le long de la côte caraïbe du Costa Rica. Les six espèces capturées avaient un régime largement insectivore. La nature des données est discutée à la lumière d'un événement El Niño qui a précédé les relevés de terrain. Finalement, la connaissance approfondie des ressources utilisées par les oiseaux terrestres migrateurs permettra d'améliorer notre capacité à gérer les sites migratoires caribéens.

Mots clés : Costa Rica, côte caribéenne, migrateurs néarctiques-néotropicaux, migration de printemps, oiseaux terrestres, régime alimentaire

Studies have revealed that Nearctic-Neotropic migrant passerines (hereafter referred to as "migrants") are potentially limited by factors such as stopover habitat quality, food availability, and climate, in both temperate and tropical latitudes (Moore and Yong 1991, Winker *et al.* 1992, Sillett *et al.* 2000). For example, work in the Caribbean showed that El Niño-induced dry seasons negatively affected survivorship of Black-throated Blue Warblers (*Dendroica caerulescens*), perhaps due to reduced food availability (Sillett *et al.* 2000). Recent evidence suggests that El Niño may influence migrant condition during spring migration in northeastern Costa Rica (Wolfe and Ralph 2009).

Migrants demonstrate high levels of diet and behavioral plasticity when wintering or migrating

within the tropics (Levey and Stiles 1992, Blake and Loiselle 1992, Parrish 2000). Understanding the degree of migrant dietary plasticity, especially in the tropics, is necessary for the implementation of informed management decisions (Rich *et al.* 2004). The majority of tropical dietary studies have focused on resources being utilized during overwintering periods or fall migration (Sherry 1984, Blake and Loiselle 1992, Rappole *et al.* 1993, Levey and Stiles 1992, Parrish 2000); the few published studies pertaining to spring migration in Central America are, in part, contradictory (see Levey and Stiles 1992, Poulin and Lefebvre 1996, Parrish 2000). Surprisingly little is known concerning resource utilization of migrant birds during spring migration in tropical latitudes. The objective of this

study was to quantify the diet of spring migrants along the northern Caribbean coast of Costa Rica by analyzing droppings of captured birds.

STUDY AREA AND METHODS

Between 16 April and 5 May 2007, five banding stations with 10-15 nets each were operated 6 d per week in and around the pueblo of Tortuguero, on the northeast coast of Costa Rica, in Limon Province (10°33'51" N, 83°31'07" W). Tortuguero is dominated by lowland, wet broadleaf tropical forest (Holdridge 1987) that is dissected by canals and rivers that flow east into the Caribbean Sea. The area receives an average rainfall of > 500 cm per year, making it one of the wettest regions in the country (Ralph *et al.* 2005).

This study assumed that captured birds represented *migrating* individuals; this assumption is supported by documented temporal patterns of Neotropical migratory events (Francis and Cooke 1986, Moore *et al.* 1990, Hagan *et al.* 1991). Because nets were opened 15 min prior to sunrise and operated for 5 h, it is assumed that droppings represent food acquired from the Caribbean coastal plain within several h of capture. Monitoring stations were located in primary tropical forest, secondary tropical forest, and coastal scrub. Fruiting plants were common throughout the study area; *Conostegia* (family Melastomataceae) and *Costus* (Zingiberaceae) were dominant in coastal scrub monitoring stations, whereas *Pshycotria* (Rubiaceae), *Piper* (Piperaceae), and *Geonoma* (Arecaceae) were dominant in secondary and primary forest monitoring stations. Tortuguero's wet season begins from mid to late April and continues through January. The wet season is interrupted by a short dry season, usually during September. The prolonged dry season tends to occur through February and March, but even during this period precipitation is common (Janzen 1983).

All migrants were banded with standard U. S. Fish and Wildlife aluminum bands and aged and sexed according to Pyle (1997). Droppings were collected by placing birds in a 13 × 23 cm breathable paper bag until the bird defecated. Each dropping was processed according to an augmented protocol described by Ralph *et al.* (1985) and Fuentes (1994); instead of steaming the droppings, each sample was gently separated by a blunt-nosed probe. Using a 10× field-scope, arthropod parts were identified to Order. Unfortunately, it was not possible to identify many of the well-digested arthropod parts (Ralph *et al.* 1985). Arthropod parts

and fruit matter (pulp, seeds, etc.) were separated and segregated within a Petri dish. Estimates of percent volume of fruit or arthropod matter within each dropping were produced to the nearest 5%.

Four inherent confounding factors may influence dietary results presented here: (1) pieces of hard-bodied arthropods are more likely to pass through a migrant bird's digestive tract, thereby biasing volumetric estimates in favor of hard-bodied arthropods; (2) larger seeds may be regurgitated rather than passed through a small migrant's digestive tract, biasing results in favor of smaller seeded fruit, especially among smaller birds; (3) larger migrants apparently pass more intact arthropods through their digestive tract relative to smaller migrants, biasing arthropod volumetric estimates in favor of larger migrants; and (4) volumetric estimates of droppings are a crude and potentially inaccurate method of inferring proportion of diet.

RESULTS

A total of 86 individual spring migrants were captured, representing six species: Red-eyed Vireo (*Vireo olivaceus*), Eastern Wood-Pewee (*Contopus virens*), Canada Warbler (*Wilsonia canadensis*), Mourning Warbler (*Oporornis philadelphia*), Northern Waterthrush (*Seiurus noveboracensis*), and Swainson's Thrush (*Catharus ustulatus*). Ten of the 86 fecal samples were predominantly uric acid (milky white consistency) which contained no visible arthropods or fruit and were, therefore, not included in the analysis. Migrant dietary composition varied across species but was dominated primarily by arthropods, with only two species producing droppings which contained substantial quantities of fruit: Swainson's Thrush and Red-eyed Vireo (Table 1). Northern Waterthrush was the only other species that also had droppings which included fruit (Table 1). Canada Warbler, Eastern Wood-Pewee, and Mourning Warbler produced droppings that only contained arthropods. Several grains of undigested pollen were identified in a sample derived from a single Red-eyed Vireo capture.

DISCUSSION

One Red-eyed Vireo fecal sample contained pollen; this was unusual given that pollen is often completely assimilated during the digestive process (Roulston and Cane 2000). Due to low sample sizes and a lack of visual corroboration with foraging observations, the extent and ultimate causation of pollen ingestion is unknown (e.g., actual targeting of pollen or byproduct of foraging for insects within

Table 1. Composition of fecal samples from spring Nearctic-Neotropical migrants in Tortuguero, Costa Rica.

Species	<i>n</i>	Percent Arthropods	Percent Fruit	Percent Pollen	Arthropod Orders Identified in Droppings
Canada Warbler	4	100	0	0	Coleoptera, Diptera, Hymenoptera, Lepidoptera larvae
Eastern Wood-Pewee	6	100	0	0	Diptera, Hymenoptera, Coleoptera
Mourning Warbler	17	100	0	0	Orthoptera, Homoptera, Coleoptera
Northern Waterthrush	22	95	5	0	Coleoptera, Homoptera
Red-eyed Vireo	9	70	30	5	Coleoptera, Diptera, Hymenoptera, Orthoptera, Homoptera
Swainson's Thrush	20	50	50	0	Coleoptera, Diptera, Araneae

flowers). Swainson's Thrush and Red-eyed Vireo exhibited heterogeneous dropping composition, in contrast to earlier studies which reported predominantly frugivorous diets among Swainson's Thrushes and Red-eyed Vireos in tropical latitudes (Hilty 1980, Ridgely and Tudor 1989, Blake and Loiselle 1992, Winker 1995).

Little is known concerning the relationship between a stochastic climate and the dietary patterns of migrating birds within tropical latitudes. The 2007 spring migration immediately preceded El Niño like conditions (Climate Prediction Center, National Oceanic and Atmospheric Administration), which can induce a dry signal in the Caribbean (Ropelewski and Halpert 1987, Sillett *et al.* 2000). Climatic variability can alter the phenology of fruiting plants and the abundance of arthropods, even in areas without distinct seasonality.

For example, within wet-tropical forests, dry periods are associated with asynchronous flowering events which may deplete available fruit resources (Wright *et al.* 1999, Williamson and Ickes 2002). Janzen (1973) documented higher levels of insect abundance during dry seasons in relation to wet seasons in wet lowland Costa Rican forests with "mild-dry seasons." The potential synchronous relationship between fruit depressions and elevated insect abundance may have promoted higher levels of insectivory during this study. Unfortunately, previous diet studies have not been conducted at Tortuguero and the general dietary patterns of spring migrant passerines in tropical latitudes are largely unknown. More research is necessary in order to determine the plasticity of migrant diet in association with climatic stochasticity within tropical latitudes. Understanding how migrants respond to climatic variability within a dynamic habitat, such as low-

land tropical rainforests, may ultimately improve our ability to manage Neotropical stopover sites.

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