

NOTES ON THE WINTER ECOLOGY OF THE YELLOW-THROATED WARBLER (*DENDROICA DOMINICA*) IN THE U. S. VIRGIN ISLANDS

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Abstract: The Yellow-throated Warbler (*Dendroica dominica*) is a rare and irregular resident at the periphery of its winter range in the U. S. Virgin Islands. From November 2002 to March 2003, we located three solitary individuals in disturbed, semiopen coastal sites. One occupied a home range of 3.7 ha. Although coconut palms (*Cocos nucifera*) were present at each site, only one individual spent most of its time foraging in palm crowns. The birds foraged primarily in the crowns of trees, with longer bouts in dicotyledonous trees than in palms. In palms they foraged for arthropods mostly on non-leaf structures in the crown (e.g., twigs, branches, fruits, or fibrous palm structures), less often on leaves (mostly on the dorsal surface of the proximal half), and rarely on trunks. In dicotyledonous trees they foraged mostly on twigs and rarely on leaves or trunks. The only interspecific competitive interaction observed was with a Prairie Warbler (*D. discolor*).

Key words: foraging ecology, habitat use, Nearctic migrant, *Dendroica dominica*, U. S. Virgin Islands, Yellow-throated Warbler

Resumen: NOTAS SOBRE LA ECOLOGÍA INVERNAL DE *DENDROICA DOMINICA* EN LAS ISLAS VIRGENES DE EEUU. *Dendroica dominica* es un residente raro e irregular en la periferia de su distribución invernal, en las Islas Vírgenes de EEUU. Durante el período de noviembre de 2002 a marzo de 2003, localizamos tres individuos solitarios en áreas costeras semiabiertas y con disturbio. Un individuo ocupó un rango de hábitat de 3,7 ha. Aunque los cocoteros (*Cocos nucifera*) estuvieron presentes en cada sitio, un solo individuo pasó la mayor parte de su tiempo forrajeando en las copas de las palmas. Las aves forrajearon principalmente en la copa de los árboles, donde estuvieron más tiempo en árboles dicotiledóneos que en palmas. En estas últimas forrajearon en busca de artrópodos mayormente en estructuras de la copa (ramas delgadas y gruesas, frutos o en estructuras fibrosas de las palmas), con menos frecuencia en hojas (principalmente en la superficie dorsal de la mitad proximal) y raramente en los troncos. En árboles dicotiledóneos individuos de esta especie forrajearon mayormente en ramas delgadas y raramente en hojas y troncos. La única interacción competitiva interespecífica observada fue con *D. discolor*.

Palabras clave: *Dendroica dominica*, ecología de forrajear, Islas Virgenes de EEUU, migrante neártico, uso de hábitat

Résumé : NOTES SUR L'ÉCOLOGIE HIVERNALE DE LA PARULINE À GORGE JAUNE (*DENDROICA DOMINICA*) DANS LES ILES VIERGES AMÉRICAINES. La Paruline à gorge jaune (*Dendroica dominica*) est une espèce rare et irrégulière dans les Iles Vierges américaines situées à la périphérie de son aire de répartition hivernale. Nous avons localisé 3 individus solitaires entre novembre 2002 et mars 2003 dans des sites côtiers perturbés, semi-ouverts. Un des individus occupait un territoire de 3,7 ha. Bien que des cocotiers (*Cocos nucifera*) étaient présents dans chaque site, seul un individu passait la majeure partie de son temps dans les palmes de la couronne. Les oiseaux se nourrissaient en priorité dans la couronne des arbres avec de plus longues périodes dans les espèces dicotylédones que dans les palmiers. Pour les palmiers, ils se nourrissaient d'arthropodes principalement sur les parties non foliaires de la couronne (comme les rameaux, fruits et structures fibreuses), moins souvent sur les feuilles (surtout sur la partie dorsale de la moitié proximale) et rarement sur les troncs. Dans les arbres appartenant aux dicotylédones, ils se nourrissaient principalement sur les rameaux et rarement sur les feuilles et les troncs. La seule interaction interspécifique observée l'a été avec une Paruline des prés (*D. discolor*).

Mots-clés : écologie alimentaire, *Dendroica dominica*, Iles Vierges américaines, migrateur néarctique, Paruline à gorge jaune, utilisation de l'habitat

THE YELLOW-THROATED WARBLER (*Dendroica dominica*) is a relatively common Nearctic migrant that breeds in the eastern United States and the Bahamas, and winters in the southern United States southward through Central America, the northern Caribbean islands, and the Bahamas (Hall 1996). Within its winter range it generally prefers pine

woodlands when available, even when introduced (e.g., Jamaica), but also occurs in semiopen second-growth woodlands, coastal scrub with emergent palms, city parks, and suburban gardens (see references in Arendt 1992, Wunderle and Waide 1993, Hall 1996). Despite its extensive range and large population, few quantitative data have been pub-

lished on its habitat use and foraging ecology when breeding (e.g., Ficken *et al.* 1968, Emlen 1977, Gabbe *et al.* 2002), migrating (e.g., Parnell 1969), and wintering (e.g., Lack and Lack 1972, Emlen 1977, Latta and Wunderle 1996, 1998).

In the United States Virgin Islands (USVI), the Yellow-throated Warbler is a rare and irregular winter resident (Pashley 1988, Pashley and Martin 1988, Leck and Norton 1991). Several surveys of wintering warblers in the USVI failed to find it (Ewert and Askins 1991, Askins *et al.* 1992, Wauer and Sladen 1992, Wunderle and Waide 1993, Steadman *et al.* in press). The only reference to its habitat use in the USVI is by Norton (1979:146), who described it occurring in a “wooded swamp” at Magens Bay, St. Thomas. Here we quantitatively describe its winter habitat use and foraging ecology in the northern USVI.

STUDY SITES AND METHODS

STUDY SITES

During the winter of 2002-2003, we frequently searched for warblers while birding at many coastal and inland sites in St. Thomas, St. John, and associated offshore cays. Between 16 November 2002 and 22 March 2003, we studied solitary Yellow-throated Warblers found at three sites: Magens Bay in northern St. Thomas; St. John Bay in eastern St. Thomas; and Caneel Bay in northwestern St. John. Observations on habitat use and foraging ecology were recorded at Magens Bay on 7 days from 16 November 2002 to 22 March 2003, at St. John Bay on 5 days from 28 November 2002 to 23 February 2003, and at Caneel Bay on 26 February 2003.

METHODS

Habitat use.—Home range size of the Magens Bay warbler was measured with a hand-held Global Positioning System (Garmin GPSMAP 76) at the most distant points where it was observed (i.e., minimum convex polygon); the other warblers were not observed frequently enough to measure home range size.

We recorded the habitat use of each warbler at 10 s intervals. We estimated the height of the tree in which each warbler was perched at intervals of 0-5, 5-10, 10-15, or 15-20 m, measured the length of time (min) spent in each tree, and recorded the amount of time spent perched: (1) in a palm, dicotyledonous (henceforth dicot) tree, or pine; (2) on an open leaf, a non-leaf structure in crown (twigs, branches, fruits, or fibrous palm structures), or trunk

beneath crown; (3) on the dorsal or ventral surface of a leaf; (4) on the proximal or distal half of a leaf; and (5) at a height interval of 0-5, 5-10, 10-15, or 15-20 m above the ground. Although our views of a warbler were often blocked by vegetation, we often were certain which tree it was in and its height interval based on its frequent call notes or by observing it fly out of the tree. We obtained fewer data on substrate use and foraging behavior, which required direct observations, than for type and height of tree, and height of perch. All observations were obtained between 0740 and 1450.

Foraging behavior.—At Caneel Bay only, where the warbler was observed at close quarters for a prolonged period, we recorded whether each foraging attempt occurred: (1) in the air or on bark, leaf, flower, or fruit; and (2) whether an attempt on a leaf was on the dorsal surface, ventral surface, or at the tip. We also recorded the outcome of all interactions with other bird species.

Data analysis.—Because the data taken at 10 s intervals represented time series and did not meet the assumptions of independence (Zar 1998), and because multiple data were obtained from only three individuals, inferential statistical tests were not used. Descriptive statistics were computed with Statistix 7.0 software (Anonymous 2000).

RESULTS

HABITAT USE

Macrohabitat use.—All three wintering warblers were found in disturbed, semiopen coastal sites within a few hundred m of the sea and at an elevation < 10 m above sea level. None was found in the interior of any island or in undisturbed coastal sites.

The warbler at Magens Bay foraged within a moderately disturbed home range (larger or equal in size to a defended territory) of 3.7 ha adjacent to a popular beach. It inhabited a large grove of tall (most 15-20 m) coconut palms (*Cocos nucifera*; family Arecaceae) emerging above a dense, low dry forest (most trees 5-10 m with emergents up to 20 m), and a large grassy area with a mosaic of scattered dicot trees and shrubs, and scattered coconut palms. Although the home range bordered a mangrove swamp (canopy c. 5 m tall) with red mangrove (*Rhizophora mangle*; family Rhizophoraceae) and white mangrove (*Laguncularia racemosa*; family Combretaceae), the warbler was seen flying out of sight into the swamp only twice and was not actually observed in mangrove vegetation.

The warbler at St. John Bay was seen sporadi-

Table 1. Percent use of tree types by solitary Yellow-throated Warblers at three study sites in the U. S. Virgin Islands.

Study Site	Palm	Dicot	Pine	<i>n</i> (min)
Magens Bay, St. Thomas	80	20	—	185.2
St. John Bay, St. Thomas	23	76	1	60.8
Caneel Bay, St. John	0	100	—	154.0
All sites combined	40	60	0	400.0

cally in the highly disturbed grounds of a resort with a large lawn, scattered coconut palms (most 5-10 m tall) and a few palms of other species, three exotic Norfolk Island pines (*Araucaria heterophylla*; family Araucariaceae; about 5-10 m tall), and scattered dicot trees and shrubs (most 5-10 m tall). It was the most difficult warbler to follow, especially when it flew across an open area to similar habitat toward the south where it was never relocated, and was found during only five of 16 searches from December 2002 to March 2003.

The warbler at Caneel Bay was followed continuously in the highly disturbed grounds of a resort, where it foraged in an area with thinly scattered dicots, coconut palms, and other palm species (most 5-10 m tall) within a large grassy area adjacent to hotel buildings.

Microhabitat use.—We obtained 400 min (6.7 h) of data on microhabitat use of the three warblers. The warblers varied greatly in their use of tree types: the Magens Bay bird foraged primarily in palms despite the abundance of dicots, the St. John

Bay bird foraged in scattered dicots and only briefly visited a Norfolk Island pine, and the Caneel Bay bird foraged exclusively in dicots, often within 10 m of palms (Table 1). The length of time spent within a tree by all warblers combined averaged longer in dicots (\bar{x} = 10.8 min, SD = 18.7, range = 0.6-77.0, n = 16 bouts) than in palms (\bar{x} = 3.3 min, SD = 3.6, range = 0.2-16.7, n = 32) and a Norfolk Island pine (0.42 min, n = 1).

The warblers used trees that varied greatly in height and they foraged within a broad range of heights (Table 2). The St. John Bay and Caneel Bay individuals foraged at lower levels in shorter trees than the Magens Bay individual (Table 2). In palms the warblers foraged almost exclusively in the crowns (very rarely on trunk just below the crown), but in dicots they often descended to the lowest branches of the canopy, foraging as low as 2 m above ground and once swooping downward after a flying insect within 1 m of the ground.

In palms, the warblers spent 64% of their time on non-leaf structures in the crown, 35% on leaves, and

Table 2. Percent use of tree height (m) classes and foraging height (m) classes by solitary Yellow-throated Warblers at three study sites in the U. S. Virgin Islands.

Study Site	0-5 m	5-10 m	10-15 m	15-20 m	<i>n</i> (min)
Tree height					
Magens Bay, St. Thomas	6	8	11	75	183.2
St. John Bay, St. Thomas	56	37	7	0	58.8
Caneel Bay, St. John	1	99	0	0	152.7
All sites combined	11	48	6	35	394.7
Foraging height					
Magens Bay, St. Thomas	12	2	11	75	183.2
St. John Bay, St. Thomas	67	26	8	0	56.8
Caneel Bay, St. John	90	10	0	0	152.7
All sites combined	50	8	6	35	392.7

1% on the trunk ($n = 68.7$ min). In dicots, the warblers spent 99% of their time on twigs, 1% on leaves, and 1% on the trunk ($n = 110.7$ min). When foraging in palm leaves, the warblers spent 89% of their time on the dorsal and 11% on the ventral surfaces, and 86% on the proximal and 14% on the distal halves ($n = 23.7$ min).

FORAGING BEHAVIOR

The warblers appeared to feed exclusively on arthropods, which were gleaned from bark, leaves, fruits, or flowers by reaching or flying, or captured in the air while hawking; we did not observe foraging on nectar or fruits. Foraging attempts in dicot trees by the warbler at Caneel Bay occurred mostly on leaves (69%) and to a lesser extent on bark (25%), fruit (3%), in the air (3%), and on a flower (1%; $n = 77$). Foraging attempts on dicot leaves occurred primarily on the ventral surface (83%) and less frequently on the dorsal surface (9%) and at the tip (8%; $n = 53$).

Each warbler was solitary and rarely joined a mixed-species flock. A warbler once foraged simultaneously with a Prairie Warbler (*D. discolor*) and a Bananaquit (*Coereba flaveola*) in the crown of a palm; after a brief chase between the two warblers (initiator unknown), both fed on opposite sides of the crown (the Bananaquit was ignored). A Bananaquit was also ignored on another occasion when feeding simultaneously with a warbler in the crown of a palm. A warbler once ignored a Green-throated Carib (*Eulampis holosericeus*) perched on the same branch only 0.25 m away, and a warbler once flew out of a tree when an American Kestrel (*Falco sparverius*) landed in it.

DISCUSSION

The Yellow-throated Warbler occurs most abundantly in pine woodlands where such habitat occurs within its wintering range (e.g., Wunderle and Waide 1993, Hall 1996) but some routinely winter in dry scrub and disturbed "garden" areas along the coast (W. J. Arendt and J. M. Wunderle unpubl. data). In the absence of native or introduced pine stands in the USVI, the warbler appears to prefer disturbed, semiopen coastal sites with a mosaic of scattered palms and dicots. It may benefit from the landscaping practices of resorts, which maintain lawns and plant scattered palms. The winter home range at Magen's Bay was considerably larger than breeding territories in West Virginia, which ranged from 1.5-3.2 ha ($\bar{x} = 2.3$, $n = 8$; Hall 1996).

Individuals varied in their habitat use. The war-

bler at Magens Bay was clearly a palm specialist, but the warblers at St. John Bay and Caneel Bay appeared to be dicot specialists despite the abundance of palms. Individual differences in habitat use may be related to bill length, which varies geographically among breeding populations (Hall 1996). The Yellow-throated Warbler has been found in coconut palms during winter in Honduras (Bent 1953), southern Florida (Hall 1996), and Dominican Republic (W. J. Arendt unpubl. data), and in palmetto palms (*Sabal palmetto*) in coastal South Carolina during winter (D. B. McNair pers. comm.). Palms may provide a rich source of arthropods that may be relatively neglected by resident and migratory landbirds in the USVI. The only other birds seen in palms during 162.6 min of observing Yellow-throated Warblers were a single Prairie Warbler and two Bananaquits; the former is a fairly common Nearctic migrant and the latter an abundant resident. The shorter bouts of time spent in palm crowns compared with dicot crowns suggest that the food supply of palm crowns is diminished more quickly.

Foraging primarily in the canopy of trees occurs during all phases of the warbler's seasonal cycle (e.g., Emlen 1977). When breeding in Maryland, 90% of their foraging occurred 6-30 m above ground (Ficken *et al.* 1968). While migrating in North Carolina, 62% of their time was spent in the canopy of tall trees and 38% in the canopy of low trees (Parnell 1969). In the Virgin Islands, the warblers usually foraged in the canopy of trees but often descended to the lower canopy branches.

The substrates used for foraging varied greatly from one type of tree to another in the Virgin Islands. In Maryland, breeding warblers foraged 60% of their time on the distal half of tree limbs, 15% on the proximal half, and 18% on tips of foliage (Ficken *et al.* 1968). In Jamaica, wintering warblers foraged entirely for insects 72% of the time on conifer needles, 11% on twigs, 8% on bromeliads, and 8% on flowers (Lack and Lack 1972). In the Dominican Republic, wintering warblers foraged 92% of the time in pines, 4% in dicotyledonous trees, and 4% in the air; within trees they foraged 4% of the time along the inner third of branches, 44% in the middle third, and 52% in the outer third (Latta and Wunderle 1998).

The few competitive interactions observed in the Virgin Islands suggest that competition is minimal. In pine forests of Hispaniola, Yellow-throated Warblers joined interspecific flocks 97% of the time but only two interspecific agonistic interactions were observed among 63 individuals (Latta and Wunder-

le 1996). In the Bahamas, Yellow-throated Warblers foraging at agave (*Agave*) blossoms were outcompeted by other Nearctic warbler migrants (Emlen 1973).

Because this study is based on three Yellow-throated Warblers wintering in what may comprise marginal habitat at the periphery of its winter range, the habitat use and foraging behavior of these birds should not be considered typical of those wintering in more optimal habitat elsewhere.

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