Wilson Bull., 108(1), 1996, pp. 94–103

CENSUSING WINTERING POPULATIONS OF SWAINSON'S WARBLERS: SURVEYS IN THE BLUE MOUNTAINS OF JAMAICA

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ABSTRACT.—Census methods developed for breeding populations of Nearctic-Neotropic migrant passerines are largely ineffective for determining the distribution and abundance of Swainson's Warbler (*Limnothlypis swainsonii*) on its wintering grounds in the Caribbean basin. Using playback of tape-recorded call notes interspersed with advertising songs, I found the warbler to be widespread and relatively common in montane forests of the Blue Mountains of Jamaica. Detection rates with playback varied from 17.8 to 29.2 warblers/10 h along five census transects. Census efficiency was increased by an estimated factor of five to 10 times with the use of tape playback. *Received 23 March 1995, accepted 20 Aug. 1995.*

For conservationists, the apparent decline of some Nearctic-Neotropic migratory birds is a serious concern (Terborgh 1989, Robbins et al. 1989) that demands both rigorous management and quantitative monitoring of breeding and wintering populations. Effective census techniques have been developed for many songbird species (Passeriformes) during the breeding season (Ralph and Scott 1981, Robbins et al. 1986). However, songbirds rarely sing on their wintering grounds and during fall migration, are feathered in duller basic plumages, and hence, are more difficult to detect and identify than during the breeding season. Yet most studies of migrants in the Neotropics employ censusing techniques designed for breeding birds of higher latitudes, with little or no attempt to compensate for the decreased detectability of wintering populations. As this report will communicate, standard point count and transect censusing methods can be relatively ineffective in determining the true abundance of secretive migratory species that winter in dense tropical habitats.

The breeding and wintering biologies of Swainson's Warbler (*Limnothlypis swainsonii*) are among the most poorly known of the migratory wood warblers (cf Meanley 1971, Eddleman 1978, Graves 1992, Brown and Dixon 1994, Thomas 1994). Wintering birds have been reported in the Caribbean basin from the Bahamas, Cuba and the Isle of Pines, Jamaica, Cayman Islands, and the Yucatan Peninsula, casually east to Puerto Rico and the Virgin Islands, and from southern Veracruz south to Honduras (Meanley 1971, AOU 1983, Pashley 1988, Winker et al. 1992). Most wintering records are anecdotal (e.g., Eaton 1953), and, at present, wintering sites where more than one or two individuals can be consis-

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tently encountered per day are known only from certain regions of Cuba (G. Wallace, pers. comm.; Kirkconnell et al., unpubl. ms.). This paper documents the utility of playback techniques for censusing wintering populations of Swainson's Warbler and reports the discovery of what appears to be a major wintering area for the species in the Blue Mountains of Jamaica.

METHODS

Study area.—I surveyed Swainson's Warbler populations along the same trails and roads at Hardwar Gap that were studied by the Lacks, from 2 to 10 February 1995. Hardwar Gap, at the divide forming the boundary between St. Andrew and Portland Parishes in the Port Royal Mountains (an outlier of the Blue Mountains), is accessible along a hard-surfaced road (B1) from Kingston to Buff Bay on the northern coast. Hardwar Gap is one of the most frequent destinations in Jamaica of resident and visiting ornithologists and bird watchers. Both Hardwar Gap and the adjacent Hollywell Park now lie within the borders of the Blue and John Crow Mountains National Park (Muchoney et al. 1994).

Three census transects were established along trails ("forest" transects in Table 1) that pass through a peninsula of upper montane rain forest connected to a much larger block of forest eastward in the national park (see Asprey and Robbins 1953 and Muchoney et al. 1994 for descriptions of habitat). The Hardwar Gap region was extensively affected by Hurricane Gilbert in 1988 (Wunderle et al. 1992), and patches of early successional vegetation were present along all three forest transects, but there was little evidence of cutting or other human disturbance away from roadsides. Transect terrain was extremely steep. Slopes varied from 15° to 70° and were estimated to average over 40°. Significant portions of forest trail No. 3 (Table 1) were at the summit of a knife-like ridge.

The fourth and fifth census routes followed the main road (B1) from a point just below Hardwar Gap to the village of Section, Portland Parish. This road forms the boundary between relatively undisturbed montane forest (upslope) and a patchwork of lightly modified montane forest, coffee plantations, residential gardens, and agricultural scrub (downslope) in the 1 km buffer zone of the national park. The upper and lower sections of the road, although contiguous, were treated as separate census routes (Table 1).

The length of "forest" transects was estimated by averaging the number of steps counted on three downslope trips (at 0.76 m/step). The road transects were measured with a vehicle odometer. Elevations were estimated by multiple readings of a calibrated altimeter.

Census methods.—I used techniques developed for monitoring breeding populations of Swainson's Warblers in the southeastern United States (Graves, unpubl.). Loop cassette tapes (20 s and 60 s) were prepared from recordings (made a with Marantz PMD430 cassette recorder and a Sennheiser ME 80 directional microphone in Virginia and Louisiana) of Swainson's Warbler call notes interspersed with a primary song every 15 s (one song on 20 s loop). Advertising songs were included because they are more easily heard above the low frequency noise caused by rustling leaves and dripping water in the forest understory. The opposite proportion of songs and calls are used to census breeding populations.

Recordings were broadcast from a dual-speaker "boom box" (Sanyo). Power output was variable due to battery use and atmospheric conditions, but the audio output was adjusted before every census run so that call notes were audible to me at a distance of 60 m and songs at a somewhat greater distance (unobstructed by vegetation). The direction of the speakers was rotated every 5 to 10 s until a probable response was detected. During clear weather at Hardwar Gap, Swainson's Warblers responded to tape broadcasts from distances

TABLE 1

CENSUSES OF SWAINSON'S WARBLERS AT HARDWAR GAP, BLUE MOUNTAINS, JAMAICA

Census transect	Census run	Starting time	Census duration (m)	Weather[a]	Number recorded	Cumulative number
Forest trail	1	15:30	45	PC, O, F	1	1
no. 1[b]	2	06:55	120	PC, F	2	2
	3	14:27	68	C	4	4
					[c]18.0 warblers/10 h	
Forest trail	1	07:14	40	C	2	2
no. 2[d]	2	07:55	69	C, PC	3	4
	3	16:21	33	C	0	4
	4	16:55	54	C, PC	2	4
	5	13:21	50	O, F	1	4
	6	14:15	45	O, F	1	4
					18.6 warblers/10 h	
Forest trail	1	12:02	98	O, M, R	1	1
no. 3[e]	2	13:40	84	M, R	1	2
	3	13:18	92	O, F	6	6
	4	14:52	73	F, R	2	6
	5	07:16	178	C	6	10
	6[f]	10:30	70	C, PC	7	12
					23.2 warblers/10 h	
Road (upper)[g]	1	07:05	190	PC	8	8
	2	10:22	98	PC	7	11
	3[f]	10:00	60	O, PC	2	13
					29.2 warblers/10 h	
Road (lower)[h]	1	07:38	54	F, M, R	1	1
	2	08:35	57	F, M, R	1	2
	3	11:31	69	F, M	1	3
	4	12:42	70	F, M	1	3
	5	06:45	72	O	6	8
	6	07:58	84	O	2	9
					17.8 warblers/10 h	

[a] F = heavy fog; M = mist; R = rain; O = overcast; PC = partly cloudy; C = clear.
[b] Length = 1604 m; elevation = 1140–1200 m.
[c] Total number of warblers recorded over all census runs standardized by duration of censuses.
[d] Length = 530 m; elevation = 1140–1200 m.
[e] Length = 1808 m; elevation = 1140–1325 m.
[f] Playbacks only at significant distributional gaps (at distances >150 m from nearest flagging marker).
[g] Length = 2980 m; elevation = 990–1140 m.
[h] Length = 1409 m; elevation = 945–990 m.

as great as 80 to 90 m (usually upslope or downslope). Response was significantly curtailed during periods of heavy mist and rain, probably because the effective range of the tape broadcast was attenuated by noise.

After a warbler responded and its location was marked with plastic flagging, I walked quietly from the area until I could no longer hear the calling bird (80–90 m during clear weather), at which point I resumed playback. Otherwise, tape playback was continuous and only intermittently stopped to listen for suspected responses.

Territory size in wintering Swainson's Warblers is unknown. "Playback-and-follow" trials were performed on more than a dozen individuals. Five warblers followed the playback more than 50 m (66, 80, 113, 119, 122 m, respectively) from the initial point of response (measured from a point perpendicular to the trail or road). Judging from this evidence and the relatively large size of breeding territories (Graves 1992, unpubl. data), I conservatively considered any subsequent response within 150 m of the original discovery point to refer to the same bird unless two or more individuals were heard calling simultaneously in the zone. When in doubt, I attempted to determine the approximate territorial boundary with "playback-and-follow" trials. When a warbler's territorial boundaries were reasonably understood, playback on subsequent census runs in that territory was halted after a response was elicited.

RESULTS

Behavioral responses of Swainson's Warblers to tape playback were variable, ranging from close approaches (4–5 m) to the observer and frequent back-and-forth flights accompanied by vigorous calling, to a subdued approach (8–14 m) accompanied by a few faint chips and ventriloquial "seep" notes, following by rapid disappearance (within 30 s) of the warbler.

On several occasions, vigorous responses often elicited counter-calling from other individuals in adjacent territories (N = 5 different "counter-calling" pairs). In one case, a highly agitated Swainson's Warbler flew across the road only to be promptly attacked by a counter-calling bird. Only once did a warbler respond to playback by giving a primary song (three somewhat incomplete renditions). Although my observations in each territory were necessarily brief, no evidence of territorial overlap or pairing was observed. The intense border displays and skirmishes observed are the first evidence of intraspecific territoriality of Swainson's Warbler on its wintering grounds (cf Eaton 1953). With the exception of the single warbler that sang (presumably male), the sex of individuals was unknown. However, the timid vocal and behavioral responses of some warblers were similar to the behavior of females on breeding territories (Graves, unpubl. data).

Interspecific responses of other wintering wood warblers at Hardwar Gap to Swainson's Warbler call notes and songs were variable. Vigorous counter-calling was elicited from the Ovenbird (*Seiurus aurocapillus*). Common Yellowthroats (*Geothlypis trichas*) frequently approached the speakers and counter-called, and the single Louisiana Waterthrush (*Seiu-*

rus motacilla) encountered during the censuses approached from a distance of >50 m along a stream channel and called. More subdued responses were recorded for Black-throated Blue Warbler (*Dendroica caerulescens*), Black-and-white Warbler (*Mniotilta varia*), American Redstart (*Setophaga ruticilla*), and Worm-eating Warbler (*Helmitheros vermivorus*). The few Prairie Warblers (*D. discolor*) encountered along the road transect and in bracken-dominated swards appeared to exhibit little interest in Swainson's Warbler playback.

Forty-two Swainson's Warblers (68 census records) were recorded on the five census transects. The number of detections ranged from four to 13 warblers/transect (Table 1), and relative abundance varied from 2.13 to 7.77 warblers/km. Playback of taped calls and songs was instrumental in detecting and mapping the locations of individuals. Call notes were heard on only four occasions when playback was not being used. Detection rates were consistently high under clear or overcast skies, but were markedly lower during periods of heavy mist and light rain or immediately afterwards (e.g., forest trail no. 3: census runs 1, 2, and 4 vs 3, 5, and 6). In general, a minimum of three or four census runs under clear or overcast skies was necessary to locate and map Swainson's Warbler territories along each census transect.

Rates of Swainson's Warbler detection along the five transect segments (Table 1) varied from 17.8 to 29.2 warblers/10 h. Because of territorial spacing, the number of individuals recorded along a transect is clearly influenced by its length and the spatial distribution of high-quality habitat. A few tentative comparisons can be made between my data (Table 1) and Lack's (1976: appendices 19 and 20), assuming our rates of movement (0.5–2.1 km/h vs. slow walk) were similar. Lack's "slow walk" censuses through montane forests yielded three Swainson's/10 h (N = 32 h of censuses) but none (N = 12 h) along roadsides at Hardwar Gap. Comparable figures with playback ranged from 18.0 to 23.2 Swainson's Warblers/10 h (N = 18.7 h of censuses) along forest trails and from 17.8 to 29.2 warblers/10 h (N = 12.6 h of censuses) along roadsides. The contrast between the Lacks' and my roadside data are particularly striking.

Wunderle et al. (1992) failed to detect Swainson's Warbler with fixed-radius point count censuses in montane forest at Hardwar Gap either before (December 1987) or after (January 1989) Hurricane Gilbert. Based on my observations and previous work at Hardwar Gap (especially that of the Lack's 1972, 1976), I estimate that the use of playback is five to ten times more efficient than standard point count or transect methods for censusing wintering Swainson's Warblers.

I estimated that tape playback of Swainson's Warbler calls and songs sampled a path approximately 150 m wide along census transects in the

Hardwar Gap area. Detectability is a function of territory placement. The farther a territorial boundary is from the transect, the less likely the occupant will be detected, with or without tape playback. Thus, the cumulative totals in Table 1 represent estimates of the *minimum* number of warblers along each transect.

Mist-netting studies are likely to be less efficient in determining the distribution and abundance of wintering Swainson's Warblers. Because Swainson's Warblers appeared to be territorial and birds were dispersed in the Blue Mountains (2.13 to 7.55 warblers/km of transect), mist nets would have to be scattered widely to capture more than a few resident birds, regardless of the number of net hours. Winter foraging behavior appeared to be remarkably similar to that observed during breeding season (Graves, unpubl. data; see Lack 1976). All foraging motions of Swainson's Warblers observed during February 1995, were directed toward dead leaves, most often in the leaf litter, but also toward dead leaves on fallen logs or inclined tree trunks within 1.5 m of the ground. Undisturbed birds rarely flew more than a few meters and usually close to the leaf litter. If observations from breeding territories might serve as a guide, foraging Swainson's on their wintering territories may walk up to mist nets, appear to inspect the linear net lane and the net itself, and then proceed to walk under or around them. The consequence of large and dispersed territories combined with a terrestrial mode of foraging produce low rates of mist-net capture, even when the habitat is "saturated" by wintering birds. In any event, a large area (ca 100 ha) that would require hundreds of man hours to sample adequately with mist nets may be efficiently censused with playback in one or two days by a single observer.

As a note of caution, density estimates cannot be calculated from data in Table 1. Sections of the census transects were bordered by habitat that appeared to be unoccupied by Swainson's Warblers in the Hardwar Gap area (e.g., bracken-dominated swards along forest transects; coffee, residential gardens, landslides, and agricultural scrub along the road). Transect data also need to be corrected for "switch-back" or "hair-pin" sampling. This situation occurs when census transects switch directions abruptly and the same area is sampled one or more times by the playback broadcast. Wintering density at Hardwar Gap can be estimated only after habitat patchiness and "hair-pin" sampling are accounted for (Graves, unpubl. data).

In summary, Swainson's Warblers appeared to be a widespread and relatively common wintering resident in undisturbed and slightly modified montane forest in the Hardwar Gap region of the Blue Mountains. At present, more than 50,000 ha of apparently suitable habitat occurs within the borders (including buffer zone) of the Blue and John Crow Mountains

National Park (Muchoney et al. 1994). If Swainson's Warbler densities are relatively uniform throughout this montane region, the park may support 17,000–25,000 wintering individuals (Graves, unpubl. data). Regardless, the 42 individuals found at Hardwar Gap constitute the largest known wintering population of Swainson's Warbler.

DISCUSSION

History and status of Swainson's Warbler in Jamaica.—The distribution and abundance of Swainson's Warbler in Jamaica is inadequately known, perhaps owing to its secretive behavior and cryptic appearance. The first specimen from Jamaica was collected by Edward Newton at Hope, St. Andrew Parish, on 8 February 1879 (Newton 1879). This specimen was the first of a series of eight collected by Newton from 1 October to 8 April (1879–1882) at Hope, Hermitage, and Mt. Elizabeth, St. Andrews Parish, and at Port Royal, St. Thomas Parish (Merriam 1885). Bond (1940) overlooked Merriam's paper and referred implicitly to Newton's first specimen as the only record for the island. Five years later, Bond (1945:118) noted that Swainson's Warbler "winters in Jamaica (at least nine records from October 1 to April 8)."

Foreshadowing the findings of Lack some twenty years in the future, Tordoff (1952:321) reported, "I collected three female Swainson's Warblers in the winter of 1946–47 . . . within 15 miles of Kingston. In addition, I saw at least nine others between December 31 and February 7. On two occasions I saw three in one day. My observations indicate that this warbler winters in Jamaica in fair numbers. Six of the individuals that I saw were in dry lowland woods; the rest were in damp forests in the hills north of Kingston (at Hermitage, St. Andrew Parish)."

In the early 1970s, Lack (1976:174–175) found Swainson's Warbler to be "regular in lowland woods and montane forest with thick undergrowth, and also in the tall dark forest with a dense canopy but no undergrowth." Lack recorded 1–3 birds/10 h of observation in dry limestone forest near sea-level at Morant Point and Negril, in arid ruinate forest on Long Mountain, and in rich secondary forest in the Ferry River valley and Mona Wood. In montane forest at Hardwar Gap in the Blue Mountains, he observed three Swainson's Warblers/10 h on slow walks, and six warblers/10 h on fast walks along forest trails, but none along the roadside edges of the forest. Lack also noted that five Swainson's were banded but none was observed in the overgrown gardens at Greenhills, about 1.5 km ENE of Hardwar Gap in Portland Parish.

Compilations of the Gosse Bird Club (1963–1993) indicate that Swainson's Warbler was banded (cumulative total of 25 individuals) or observed nearly annually from 1963 through 1977, most frequently at Mona Woods

near Kingston (see Diamond and Smith 1973). The last published record for Jamaica in the 1970s was reported from the Blue Mountains in October 1977. Inexplicably, there were no additional published reports of Swainson's Warbler in Jamaica during the next 15 years until December 1992.

Three recent unpublished observations have come to my attention. Peter Marra (pers. comm.) banded 3–4 Swainson's Warblers on a 5-ha study site in dry limestone forest at Kew Park, Westmoreland Parish. Russell Greenberg (pers. comm.) observed one or two per day in the Hardwar Gap area during six days of field work in January 1984. Finally, Robert Sutton (pers. comm.) banded Swainson's Warblers at Greenhills in 1978, 1982, 1985, and 1986 (N = 10 individuals). In summary, the field studies of Tordoff (1952), and especially those of Lack and Lack (1972) and Lack (1976), combined with scattered sight and banding records compiled by the Gosse Bird Club (1963–1993), as well as the results of the present study suggest that Swainson's Warbler is a widespread wintering species occurring at low densities in Jamaica.

Conclusions.—The most significant recent advance in population studies of wintering songbirds or resident Neotropical species has been the use of tape-recorded playback of call notes and songs of focal species (e.g., Parker 1991). Among the wood warblers (Parulini; taxonomy of Sibley and Monroe 1990), tape playback has been used successfully to census Black-throated Blue Warblers in Jamaica (Holmes et al. 1989, Sliwa and Sherry 1992) and Puerto Rico (Wunderle 1992), American Redstarts in Jamaica (Holmes et al. 1989, Sliwa and Sherry 1992), Kentucky Warblers (*Oporornis formosus*) in Panama (Mabey and Morton 1992), and Hooded Warblers (*Wilsonia citrina*) in the Yucatan Peninsula (Lynch et al. 1985).

Swainson's Warbler may be added to the list of Nearctic-Neotropic migrants that are most effectively monitored on their wintering grounds with tape playback. Although playback census techniques are perhaps less crucial for wintering species that are behaviorally conspicuous and occupy open habitats (e.g., Palm Warbler [*Dendroica palmarum*]), results from the cited field studies suggest that censusing efficiency can be significantly enhanced for all wintering wood warblers with species-specific tape broadcast.

At Hardwar Gap, the entire wintering warbler fauna could be censused along the same census transects by including call notes of the nine most common species on a single loop cassette or audio compact disc (CD) Black-throated Blue Warbler ([*Dendroica caerulescens*], Prairie Warbler [*D. discolor*], Black-and-white Warbler [*Mniotilta varia*], American Redstart [*Setophaga ruticilla*]; Worm-eating Warbler [*Helmitheros vermivo-*

rus], Swainson's Warbler [*Limnothlypis swainsonii*], Ovenbird [*Seiurus aurocapillus*], Louisiana Waterthrush [*S. motacilla*], and Common Yellow-throat [*Geothlypis trichas*]). Extended cuts of particular species could be played as needed (cut selection on CD or separate loop cassettes). Tape broadcast of "spishing" noises, call notes of a single species, or owl calls, while better than nothing, are less effective in multi-species censuses of wintering warblers (Graves, unpubl.).

ACKNOWLEDGMENTS

I thank Russell Greenberg, Catherine Levy, Brooke Meanley, John Rappole, George Wallace, David Wiedenfeld, and Kevin Winker for insightful comments on the manuscript. Robert Sutton provided banding data. Logistics in Jamaica were greatly facilitated by David Smith and Susan Anderson (Jamaica Conservation and Development Trust, JCDT) and members of the Gosse Bird Club. Harold Thomas, Hyacinth Pascoe, and Dwight Pryce assisted my work at Hollywell. Permission to work in the Blue and John Crow Mountains National Park was granted by Franklin McDonald of the Natural Resources Conservation Authority. Field work was supported by the JCDT in cooperation with Smithsonian Institution.

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