Table 2: Species that were overrepresented or underrepresented by each method (see text).

	OVERREPRESENTED	UNDERREPRESENTED	
NOCTURNAL FLIGHT CALLS	Purple Martin Barn Swallow American Pipit Cedar Waxwing Cape May Warbler Western Palm Warbler Bay-breasted Warbler Scarlet Tanager Savannah Sparrow Grasshopper Sparrow Bobolink	Alder Flycatcher "Traill's" Flycatcher Yellow-bellied Flycatcher Least Flycatcher Red-eyed Vireo House Wren Ruby-crowned Kinglet Gray Catbird Veery Swainson's Thrush Wood Thrush Blue-winged Warbler Golden-winged Warbler Tennessee Warbler Orange-crowned Warbler Nashville Warbler Magnolia Warbler Blackpoll Warbler Yellow-rumped Warbler	Black-throated Green Warbler Ovenbird Connecticut Warbler Mourning Warbler Wilson's Warbler Canada Warbler Lincoln's Sparrow Swamp Sparrow Wlute-crowned Sparrow Rose-breasted Grosbeak
MIST-NET CAPTURES	Yellow-bellied Flycatcher Alder Flycatcher "Traill's" Flycatcher Ruby-crowned Kinglet Swainson's Thrush Gray Catbird Orange-crowned Warbler Nashville Warbler Magnolia Warbler Yellow-rumped Warbler Northern Waterthrush Connecticut Warbler Mourning Warbler Wilson's Warbler Canada Warbler	Purple Martin Tree Swallow Barn Swallow House Wren American Pipit Cedar Waxwing Blue-winged Warbler Cape May Warbler Black-throated Grn Warbler Blackburnian Warbler Western Palm Warbler Scarlet Tanager Savannah Sparrow Bobolink Baltimore Oriole	
WINDOW COLLISIONS		Yellow-bellied Flycatcher Alder Flycatcher "Traill's" Flycatcher Least Flycatcher Red-eyed Vireo Purple Martin Tree Swallow Barn Swallow House Wren Ruby-crowned Kinglet Gray-cheeked Thrush American Pipit Cedar Waxwing Blue-winged Warbler	Golden-winged Warbler Orange-crowned Warbler Black-throated Blue Warbler Black-throated Green Warbler Western Palm Warbler Bay-breasted Warbler Connecticut Warbler Scarlet Tanager Savannah Sparrow Bobolink Baltimore Oriole

Nocturnal flight call recordings underperformed other methods for 28 species (Table 2). For 19 of these species, this was due to ambiguity in identifying the nocturnal flight calls (Table 1). The remaining 9 species, including a variety of flycatchers plus kinglets, vireos, and catbirds, were under-sampled by this method primarily because they are not known to vocalize during their nocturnal migratory flights. Nocturnal flight calls outperformed the other two census methods for 11 species (Table 2). These included open-country species such as Bobolink and Savannah and Grasshopper Sparrows, as well as several forest canopy-dwelling species such as Scarlet Tanager and several species of warbler. Species overrepresented in our nocturnal flight call data set also paradoxically included several species whose migration is primarily diurnal, and whose vocalizations we recorded primarily between 5 a.m. and 7 a.m.

Summary:

What's the best method for censusing migrants?

Our methodological comparisons suggest that a combination of mist-netting and nocturnal flight call recording would render the most complete and informative overall picture of migratory songbird abundance, especially if combined with additional methods including analysis of weather radar images and standardized day-time bird observations.

Mist-net data are subject to well-known methodological biases. However, for many shrubland and woodland understory species, mist-net samples are a uniquely valuable censusing method.

The utility of nocturnal flight call recordings as a migrant songbird censusing technique is significantly limited by identification constraints. Nonetheless, nocturnal flight calls provide an essential complement to mist-net data, particularly for species of open country or forest canopies whose flight calls are species-diagnostic. Moreover, data on unidentifiable nocturnal flight calls add additional information on the overall abundance of migrating birds.

Window collision data sets do not add the capacity to effectively census any additional species not already covered by the former methods. Nonetheless, window collision data may be a valuable source of monitoring data, revealing possible sampling biases in other census methods, and possibly adding power to monitor other migrant species not considered in this study, such as American Woodcock.