TABLE 2. Characteristics of recaptures, sex ratios, and territorial behavior for the winter resident warblers in this study.

Species	% recaptures	x̄ time of recapture[a]	Longest recapture	Sex ratio (M/F)	Territorial behavior?[b]
Northern Parula	3	7-0	7-0	7/10	No
Cape May Warbler	0	—	—	6/5	No
Prairie Warbler	0	—	—	3/4	No
Black-and-white Warbler	22	1-11	4-0	5/28	No
American Redstart	15	1-11	7-0	11/32	No
Prothonotary Warbler	50	3-0	4-0	1/1	U[c]
Ovenbird	16	1-8	2-0	U	Yes
Northern Waterthrush	0	—	—	U	U
Hooded Warbler	0	—	—	1/2	U
Wilson's Warbler	0	—	—	0/1	U

[a] Mean time of recapture and longest recapture are shown in years-months.

[b] Territorial behavior as determined by recording the number of the net where captures occur. No territorial behavior is suggested when a species is caught in overlapping net numbers.

[c] Either unable to sex or sample sizes too small to determine territorial behavior.

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JOHN FAABORG, *Division of Biological Sciences, University of Missouri–Columbia, Columbia, Missouri 65211 and* WAYNE J. ARENDT, *Institute for Tropical Forestry, P.O. Box AQ, Rio Piedras, Puerto Rico 00928.* Received 24 May 1983; accepted 28 April 1984.

House Sparrows Kill Eastern Bluebirds.—Competition for nesting cavities between Eastern Bluebirds (*Sialia sialis*) and introduced species such as European Starlings (*Sturnus vulgaris*) and House Sparrows (*Passer domesticus*) is mentioned often as a cause of the well-documented decline in bluebird numbers in the eastern United States (e.g., Zeleny 1978). Presentations of stuffed House Sparrow skins elicit aggression from both male and female bluebirds; furthermore, the frequency and pattern of bluebird aggression to models of House Sparrows is consistent with the interpretation that bluebirds defend nesting cavities

TABLE 1. Contingency table analyses using the G-test for independence of deaths of adult Eastern Bluebirds with and without evidence of traumatic death (presence or absence of contusions on head and/or breast) versus later or previous occupancy of the nest site by House Sparrows.

	Later occupant			Previous occupant		
	BB	HS	Totals	BB	HS	Totals
Contusions						
No	5	0	5	6	1	7
Yes	1	18	19	0	18	18
Totals	6	18	24[a]	6	19	25[b]
	$G = 19.157$, $df = 1$, $P = 0.0001$			$G = 21.812$, $df = 1$, $P = 0.0001$		

[a] Later occupant unknown for 4 dead adults, 1 of these 4 had head contusions.
[b] Previous occupant unknown for 3 dead adults, 2 of these had head contusions.

from usurpation by House Sparrows (Gowaty 1981). This note reports the deaths of adult and nestling bluebirds in circumstances that implicate aggressive competition with House Sparrows as the cause. Besides direct observation, correlational evidence including records of House Sparrow occupation of nesting boxes and incorporation of bluebird bodies into House Sparrow nests associates traumatic death of bluebirds with competition from House Sparrows.

During 6 seasons of routine monitoring of from 90 to 300 nesting boxes (every 1–4 days from March through August 1977–1982) in Pendleton and Anderson cos., South Carolina, I discovered 28 dead adult bluebirds in nesting boxes. The heads and/or breasts of 20 of these dead bluebirds showed evidence of violent trauma: in 18 the crown was bloody, denuded of feathers, and the skull cracked. Twice contusions and abrasions were visible on their backs and breasts as well.

In 18 (90%) of the traumatic bluebird deaths, House Sparrows were at the nesting boxes on my visits to boxes *preceding* my discovery of dead bluebirds. House Sparrows were also at these nesting boxes *after* 18 (90%) of the traumatic bluebird deaths. Bluebirds were at these nest sites only once after the discovery of a dead bluebird with contusions. The contingency table analyses (tests of independence using the G-statistic from Sokal and Rohlf 1981) in Table 1 indicate that traumatic deaths of bluebirds are not independent of either (a) later or (b) earlier occupancy of the nest boxes by House Sparrows. Attempted predation by cats or other mammals could explain some of these traumatic bluebird deaths. However, because all of the bluebirds discovered dead with contusions were on the farm and orchard study sites having populations of House Sparrows, while none occurred on study sites lacking House Sparrow populations, aggressive competition from House Sparrows seems a parsimonious conclusion supported by the above contingency analysis.

Among the total 28 dead, adult bluebirds, 13 were females and 15 males; 9 (69%) of the females and 11 (74%) of the males had contusions, abrasions, and other signs of traumatic death. Eighty-five percent of the adults with traumatic wounds died during the breeding season (March–August) with 40% of these deaths occurring in May. The frequency of traumatic deaths varied by year: 1977 = 1, 1978 = 3, 1979 = 6, 1980 = 0, 1981 = 1, 1982 = 9. However, the yearly variation in traumatic deaths is not correlated significantly with the percentage of total nesting boxes used by House Sparrows. Traumatic deaths were recorded at 17 nest boxes; dead bluebirds were found in 3 of these boxes twice—and 2 of these cases occurred within several days of the previous discoveries.

Female bluebirds, and less frequently male bluebirds, enter the nesting boxes during aggressive encounters with House Sparrows (pers. observ.). I hypothesize that bluebirds either enter the boxes to explore or in defensive maneuvers that render them vulnerable to House Sparrows perching on the hole and pecking at them.

On 15 May 1981 from 1230 to 1330 I watched a male House Sparrow repeatedly enter a nesting box containing five 12-day old nestling bluebirds. On each visit the House

Sparrow remained in the box for 1 to 3 min. The House Sparrow entered and exited flying quickly and silently without stopping to perch on the front of the box. The adult male and female bluebird residents were foraging from a high wire 30 m behind the nesting box where their view of the nest hole was obscured. I interrupted the sparrow's visits after the first 20 min and found 5 bluebird nestlings, 4 of which had bloody crown wounds; of these 4 one was already dead. Within 5 min of returning to my blind, a male House Sparrow entered the box and the pattern of entrance and exit at 1 to 3 min intervals resumed. At 1330 four nestlings were dead and the fifth died the next day. The head wounds of these nestlings were similar to head wounds on dead adult bluebirds. On 13 July 1981 I found a brood of 2 nestlings with similar wounds in a neighboring box. On 1 August 1978 at a nest box in an orchard study site, a third brood of 4 nestlings died with similar contusions.

House Sparrows will build their nests over the bodies of dead bluebirds. I have recorded this 3 times. On 15 May 1978 in a box at a pasture-feed lot study site, I found an adult male bluebird, with traumatic wounds on its head; the ventrum faced a back corner of the nesting box; his right wing was stretched out and up and incorporated into the dome of the House Sparrow's nest! Upon discovery the nest was still incomplete, but one House Sparrow egg lay on the bottom of the box. On each of the two following days one more egg was added. On the fourth day, the eggs were gone, but the nest and the now very rotten carcass of the male bluebird were undisturbed. I removed the House Sparrow nest and the body of the bluebird. On the next day, a new House Sparrow nest was begun in the box. On 13 April 1981 on the same pasture and feed-lot study site mentioned above, I found another dead male bluebird underneath a House Sparrow's nest. It was a new nest and egg-laying had not begun. On 7 June 1982 at a pasture study site, I found a dead female under a House Sparrow's nest containing one egg. Four days earlier the nest box had been empty; however, this banded bluebird had successfully nested in the same box throughout May.

I more confidently made the connection between dead adult bluebirds and nest site competition with House Sparrows after watching a House Sparrow killing nestling bluebirds (described above). However, even without that direct graphic demonstration, the circumstantial and correlational evidence supports the conclusion that House Sparrows kill Eastern Bluebirds and suggests that the interactions of these two species might be well studied from the perspective of the current debate over how competition affects community structure.

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PATRICIA ADAIR GOWATY, *Department of Zoology, Clemson University, Clemson, South Carolina 29631.* (Present address: *Section of Neurobiology and Behavior, Cornell University, Ithaca, New York 14853.*) Received 7 June 1983; accepted 5 July 1984.

Inland Breeding by the Glaucous-winged Gull.—Most species of gulls in North America breed in marine or coastal areas but a few species—such as the Franklin's (*L. pipixcan*), Bonaparte's (*L. philadelphia*), Ring-billed (*L. delawarensis*), and California gulls (*L. californicus*)—have adapted to the inland environment and now breed there almost exclusively. Apparently the inland and marine environments are sufficiently different that most gull species have adapted to breeding in one or the other because few species breed in both. In North America exceptions include the Mew (*L. canus*), Herring (*L. argentatus*), and Great Black-backed (*L. marinus*) gulls (American Ornithologists' Union 1983).

Here, we present evidence that another marine or coastal species, the Glaucous-winged Gull (*L. glaucescens*), is now breeding in small numbers in inland habitats in Wash-