A Notable Autumn Arrival Of Reverse-Migrants In Southern Nova Scotia

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ABSTRACT

Unprecedented numbers of apparent reverse-migrant and vagrant southern birds arrived the afternooms of 21 October 1998 in south- ernmost Nova Scotia. Their relative abundances were largely predict- ed by numbers of tower kills recorded during the fall axioms from 1995 to 1999 in northeastern Florida, as well as by the number of each species present in Nova Scotia just prior to the 1998 foliage. Among species that were unusually uncommon at or scarce relative to the northeastern Florida records, excessively large numbers of Scale- d Scapenagers, Blue Groovebreaks, and Indigo Buntings diminished sharply soon after arrival and evidently reappeared on coastal Massachusetts. The many warblers and warblers lingering, and did not later appear in large numbers north south. Weather patterns suggest that the birds departed coastal southeastern United States the evening of 5 October, followed by a stable cold front that began to move rapiddly offshore. Eventually some birds reached a southeastern flow beyond the front and were carried (and probably flow dimension) to the east side of a deepening low north of Nova Scotia. This zone propelled them on toward a small stretch of east and islands at the southeastern extremity of the Province.

INTRODUCTION: THE EVENT

On 11 October 1998, Nova Scotia was experiencing what locals casually refer to as “weather”—gale-storm-force easterlies with driz- zle rain. In late afternoon, Maybank, who then maintained the Nova Scotia Bird Society Bird Information Line, received a phone call from Rita Nicholls, supervisor of the Atlantic Bird Observatory’s banding station on Long Point (Ouellet Island) (Fig. 1). She explained how, during a quiet period) a 5-hour walking stroll on the island, observers had tallied 8 Indigo Buntings and 10 Scarlet Tanagers, and many more in the general area. Although such numbers were unprecedented, both species are regular here in late autumn and neither would require a rare bird alert. However, it was tempting to speculate on what other species might be around.

Maybank’s musings were cut short by a phone call from Myra Newell, a tireless birder on Cape Sable Island at the southern extremity of the province (Fig. 1). Newell could not restrain his jubilation as he reported waves of birds coming in from the sea and hitting the coast at Daniel’s Head (Fig. 1) in the late afternoon. Many birds took shelter in stacked lobster traps, and in one confined area Newell and John Nickerson had encountered four Hooded Warblers, two Worm-eating Warblers, and “many” Indigo Buntings, as well as a few Blue Groovebreaks. This was clearly a major event.

Although the publicity commences the next day, Canadian Thanksgiving, Maybank drove to Cape Sable Island and met Myra Newell at dawn. The weather was still indifferent, with northwest gales, overcast skies, and low temperatures, but the rain had halted. They headed east for the site of the previous evening’s event and managed to count two Hooded Warblers from the lobster traps. Following a birding that more species might be found in nearby sheltered areas of vegetation in the region known as The Haw (Fig. 1), they investigated further and found: Indigo Buntings everywhere, including a single black with more than 100 birds. These were very Blue Groovebreaks and Baltimore Orioles, and warblers and warblers lingered in the woods and groves, among them a Yellow-rumped Warbler and a Yellow-throated Vireo. Then, in a small hollow sheltered from the gales were four additional White-eyed Vireos, a sight never before reported in Atlantic Canada. Among numerous American Redstarts, Northern Parulas, and Black-and-white Warblers, there were an adult male Prothonotary Warbler, two Scarlet Tanagers, and both vireos. By this time Newell had to depart, leaving Maybank to search another adult male Hooded Warbler, another Yellow-throated Vireo, a male Blue-winged Warbler, a female Summer Tanager, and a female Western Tanager.

Curosions to learn if the flocks had also occurred on neighboring peninsulas with a similar east-facing exposure, Maybank headed northeast to Baccaro Point (Fig. 1), where in less than an hour he located a second Prothonotary Warbler, another Yellow-throated Vireo, and 10 Indigo Buntings. Ainslie Peninsula (Fig. 1) was next, where he remained until dusk. Measurable sightings there also included two Blue-winged Warblers, and White-eyed Vireos, and a Golden-winged Warbler in a single bush. Other observers highlighted included a male Hooded Warbler, a Yellow-throated Vireo, and 70 Indigo Buntings. The area is an important Maine’s Sparrow that might have arrived with an influx a few days earlier of White-crowned Sparrows, which were rare present. Other observers made further discoveries, but Maybank alone recorded 27 individuals of nine species that would normally be

![Fig. 1. Southern Nova Scotia with plans mentioned in the text.](image-url)
Fig. 2. Numbers of birds of certain species or species groups of birds estimated in daily census surveys conducted over 10 years at four locations: Cape Lookout, North Carolina; Cape San Blas, Florida; Florida Keys, Florida; and Yucatán Peninsula, Mexico. The species in panel a show that Yellow-rumped ("Myrtle") Warbler numbers are highest in April, and Palm Warbler numbers are highest in May. The species in panel b show that Yellow-rumped Warbler numbers are highest in April, and Palm Warbler numbers are highest in May.

HOLIDAYS AT SAN ISIDRO, ECUADOR
November 17-20, 2000 with Mitch Leysinger
December 23, 2000-January 1, 2001
We were at the site during the month of December, and had the opportunity to observe a number of interesting birds, including the Andean Cock-of-the-Rock and the Andean Tapir.

NEW GUINEA & AUSTRALIA
November 14-December 6, 2000
We had the opportunity to observe a number of interesting birds, including the paradise riflebird and the crested pigeon.

TRINIDAD & TOBAGO
November 23-December 2, 2000
We had the opportunity to observe a number of interesting birds, including the Trinidad Motmot and the Trinidad Tody.

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The author reported to local rate bird alerts, some of which would require documentation. (And that excludes the remarkable count of almost 200 Indigo Buntings.)

Through the week the teams on Bon Portage and Seal islands continued their banding and standardization censusing, and were astonished by peak daily estimates totaling over 500 warblers and vireos, including up to 24 southern vagrant individuals among them. Interestingly, although Scarlet Tanager, Blue Grosbeak, and Indigo Bunting continued to be abundant, their numbers declined sharply after the first day.

The cenotaphia pointed out all week. Maybank returned 16 October with McLaren, Eric Mills, and Elizabeth Stockwell. The weather was again blustery, but the birds continued to delight at most spots reached earlier in the week by Maybank (although the party did not visit Baccaro Point due to lack of time). Despite daily observation by others in the interior, new discoveries were still made, as an R.S. October 16, 16 to 14 October and 26 to 16 October. There is no mention of large numbers of northern vireos and warblers, but southern vagrants included a White-eyed Vireo at Truro on 12 October, and four-five Scarlet Tanagers, a Yellow-throated Vireo, and a Yellow-throated Warbler and three Prothonotary Warblers during 13-14 October. Two Hooded Warblers were noted at Tuckerton on 12 October. The only published mention of a fall migration in relation to the Nova Scotia arrivals were the four Blue Grosbeaks found 11 October on Block Island, R.I., quite far from the storm's center (Ellison and Martin, 1999).

THE LIST
Estimated numbers of individuals of the various species involved in the fallouts in Nova Scotia have been published previously (Brinkley 1999, Ellison and Martin, 1995). Those numbers were generated by Maybank partly by extrapolations from reports that concentrated only on raptors and vagrants to estimate numbers of more
common species. Maybrook had also used counts made by various observers through the week following the fallout, when there were considerable changes in relative abundance of the fallout species.

In the combined daily estimates in cen-
southern areas of Port Portage and Seal islands, normally less migrant and vagrant war-
blers and vireos (along with a handful of fly-
catchers, thrushes, and Gray Catbirds) peaked on 12 October, the day after the storm (Fig. 2a). By contrast, the notable numbers of Indigo Buntings, Blue Grosbeaks, and Scarlet Tanagers dropped sharply (Fig. 2c). Three abundant, hardy species that normally have peak abundances in Nova Scotia in early October or later (Tuft 1985)—Ruby-
crowned Kinglet, Yellow-rumped Warbler (which also winters in numbers) and Palm Warbler (Fig. 2b)—continued to increase for some days after the storm.

For further analysis, we used only the esti-
mated daily numbers of each species in the island census areas 11-13 October, along with numbers tallied by Maybrook during his extensive survey 12 October. We excluded some sparrows that are routine, often in large numbers, at this time of year and that also winter in Nova Scotia: those species generally reckoned as day-
migrants or otherwise unlikely to have flown offshore further south (other sparrows, most juncos other than ortolans; the western vagrants Western Tanagent and Harris’s Sparrow); and those noted amongst trees and brush that were searched (swallows and Bobolinks). The final lists (Table 1) represent relative abundances of the species that arrived in the fallout.

**SPECIES COMPOSITION AND ORIGIN OF THE BIRDS**

Here we use the relative abundances of the fallout species in Table 1.
as an indication of their possible origins. Clearly some species marked as "southern" in Table 1 had undergone reverse migration from somewhere south of New England, presumably some association species had also done so. South of New England, a "good flight" of warblers was in coastal Virginia 23 September 1998 (Birk 1999), and a few concentrations were also found in the southern Atlantic States in September (Davis 1999). By early October, however, most warbler species would have vacated the mid-Atlantic states while still showing peak or near-peak numbers in Florida or on the Gulf Coast (Owen and Garrett 1997). Indeed, there were notable numbers of vireos and warblers in Florida during late September and early October 1998 (Pranty 1999). Local banding records may be quantitatively tentative. For example, on a capture list of 12 species from Orlando, FL, 10-12 October (Pazia Small, Florida Park Service, pers. comm.), only the Common Yellowthroat was among the top ten in both Nova Scotia (Table 1). Many of the fall species also occur in the fall on the Bahamas. There are no quantitative records available from the Bahamas for early October 1998 (Birk Oliver and Tony White, pers. comm.); and records of kills at two towers on Grand Bahama 22 October 1996 (Kahl et al. 1999) do not seem helpful among 333 individuals of 22 species, more than half consisting of Gray-cheeked Thrushes (39), Blackpoll Warblers (21) and Northern Parulas (14), only the last of which was among the top ten in Nova Scotia.

Without sufficient combined records of numbers from banding stations or other quantitative lists from southeastern U.S. at the time of the fallout, we use the extensive data in Crawford (1981a). He presented numbers killed at a northeastern Florida TV tower during the three 1011-day periods of each month from 1955 to 1980. From these we combined the counts for the first two 10-day periods of October. As with the Nova Scotia list (see above), we included only those species that are primarily migratory and excluded those that routinely winter in Nova Scotia. Of the 10 most abundant species in the Nova Scotia fall-out (Table 1; estimate >80), six were among the top 20 in Florida, among the Nova Scotia top 10, all had peak Florida morbidities during the first third of October except for Red-eyed Vireo, which had peaks in the first and second third periods (differing age groups).

The similarity of the ranked abundances at the three Nova Scotia locations (r = 0.666-0.77 in the three comparisons, all P<0.001) is as expected. The high correlation of the combined Nova Scotia estimates with those from Florida (r = 0.51, P<0.001) is also not surprising, as the same would probably be true of any other pair of substantial autumn lists from eastern North America. Of greater interest is the extent to which observed species abundances in Nova Scotia can be explained by their relative numbers at that time in Florida and by other possible influences. Regression using raw numbers (Table 1) have severe statistical problems, with residuals far from normal (Kolmogorov-Smirnov tests, P<0.001), logarithmic transformation of numbers (+1) produces well-fitting models. Almost one-third of the variation (r² = 0.29) in the combined Nova Scotia counts is predicted by the Florida counts alone (r = 0.52, P<0.001). However, some of the pressed-out fallow birds were obviously in the vicinity before 11 October. To correct for the expected presence of such individuals during 11-13 October, we also used models that included the average abundances (log n + 1) of all species that had been detected in the three days prior to 11 October on Bon Portage and Seal Islands (Table 1). Understandably, this sharply increased the amount of variation explained (r² = 0.53), but slightly weakened the relationship of the fallout and Florida estimates (r = 0.491). Similar models fit separately to the data for each island (no pre-fallout estimates available for the mainland counts) increased the amounts of variation explained (r² = 0.56 for Bon Portage, r² = 0.52 for Seal Island), but the relationship between the fallout and Florida abundances was strengthened only for Bon Portage Island (r = 0.58 for Bon Portage, r² = 0.63).
for Sot Island). A surprisingly large amount of variation among the fallout species can thus be explained by expected "background" numbers and the Florida tower kill records.

Regression can also incorporate features that might reflect the abilities of species to undertake or survive sustained flight over the ocean. We hypothesized as additional independent variables migration span crudely as the difference between median latitude of sum-
mer and winter ranges (from Howitt and Webb 1995; National Geographic Society 1999, Ridgley and Tudor 1989, 1994); average or median wing length (from Pyke 1997); average body weight (mostly from Dennis 1993); and interactions among them. The only vari-
able, along with the pre-fallout counts, that added slightly to amount of variation explained ($R^2 = 0.55$) and to the relationship between the Nova Scotia and Florida abundances ($R^2 = 0.52$) after stepwise regression, was body weight ($t = 1.88, P = 0.063$). This seemingly
counterintuitive weakly negative effect of body weight appears to reflect consistent under-representation of the relatively large thrush-
es and mirids, not compensated by over-representation of fewer
large species like Blue Grosbeak.

Probably the most reliably counted birds were the vireos and warblers, which occurred in similar wooded habitats, often flocced
together, and were likely sought. The tower kills for this selected
group, along with the average abundances on the islands prior to the
fallout, indeed explain more variation ($R^2 = 0.68, t = 4.99$ for the
effect of the Florida counts) among the fallout abundances, with no other significant variables. The model using data from Pine Portage
Island alone explained no more overall variation in fallout numbers ($R^2 = 0.66$), but enhanced the apparent explanatory power of the
Florida counts ($R^2 = 0.69$). Use of data from Seal Island alone greatly
increased the amount of variation explained in fallout numbers ($R^2
= 0.72), largely attributable to the prior island counts ($t = 2.71 vs.
4.84 for the effect of Florida counts$).

Given the variations among the various models, it was
surprising to attempt to explain all remaining differences between the
Nova Scotia and Florida lists. In statistical terms, only the regression
for all species on Table 1, using both pre-fallout abundances and
body weights, had a species significantly too common in Nova Scotia
relative to Florida This was the Indigo Bunting (standardized resid-
ual $= 3.54$), with the Blue Grosbeak ($2.79$) and then Scarlet
Tanager ($1.97$) next most deviants, although not significantly so (at
$P = 0.05$). These deviations do not detract from the general conclu-
sion that the fallout originated from an assemblage of species resem-
bling the set of birds usually present at the same season in the south-
eastern United States.

**WEATHER PATTERNS AND ORIGIN OF THE BIRDS**

The easterlies that brought the birds ashore were associated with
depressing low pressure centered south of Nova Scotia and east of
Cape Cod (Fig. 2, 11 October, 18 13, 11:00 ADT). The lack of fallout in
localities in the wind "shadow" to the northwest (Fig. 1), is in
keeping with this pattern. The fewer birds around Little Harbour,
NS (Fig. 1), and lack of recorded sightings beyond that to the
northwest also indicate that a quite compact mass of birds had
become entrained close to the storm's center (see the isobar pat-
terns Fig. 3, 11 October, 18 4). The limited number of species,
smaller number of individuals, and evidently later appearances of
apparent fallout species in coastal Massachusetts (see Introduction)
suggest that those were birds that had resumed southward migra-
tion from Nova Scotia. This hypothesis is reinforced by the sharp
division observed between the Long Island and Brookhaven and
Brooklyn Baitings the day after the Nova Scotia fallout.

Where did they originate? In early evening Oct 10 (Fig. 3, 10
October, 0002) and for more than 24 hours previously, a characteris-
tic "Carolinian front" was nearly stalled along the U.S. east coast, from

![Fig. 3. Surface atmospheric pressure and wind patterns 9–11 October 1998. The wind directions, where strong, probably reflect quite well those at higher altitudes, where birds migrate. The universal times (UT), 00, 12, and 18, are equivalent to 21:00, 09:00, and 15:00 ADT respectively in Nova Scotia, and one hour earlier in Florida.](image-url)

Cape Cod in the north to across northern Florida in the south. The
front was embedded in a shallow trough, with cyclonic flow begin-
ning to develop at its northern end, and moved sharply offshore
overnight 9–10 Oct (Fig. 3, 10 October, 00 and 12). Although the
cold front was weak, with following surface flow only ~1 knots in the
southeastern United States, these conditions generally encourage
migration. As Richardson (1972) found from radar studies in easter-
ern Canada: "Offshore flights to the 50 or 62 were even common or
dense when there were NW or NW winds. Such winds usually
occurred immediately after the passage of cold fronts." Richardson
(1972) also found that landbirds flying toward the West Indies gen-
erally continued southeast-south-southeast at dawn even over the
sea. Southeast movement of birds on 5-knot northwest winds with
passage of a cold front is perhaps the most evident ground distribution
of bird kills at a TV tower at the Tall Timbers Research Station in
Leon County in the Florida panhandle (Crawford 1981b, his Fig. 1,
depicting 25 September 1965). On the other hand, ahead of such
cold fronts where southwest flow prevails, there can be reverse
downwind migration, although this is variable in occurrence and
intensity (Richardson 1978, 1982).

Thus, a large movement of birds off the southeast U.S. coast
could have occurred on the night of 9–10 October. The slackness of
winds (open isobars on Fig. 3) southeast of Florida might suggest
that mass departures would not have originated from the Bahamas.
However, there was also strong convection (cumulus and thunder-
storms) over the Bahamas that could have carried birds aloft: North
of the Bahamas the strong southerly flow in the warm sector could
have triggered downwind, reverse migration by offshore migrants.

More insight can be gained tracking hypothetical parcels of air
using the Canadian Meteorological Centre's trajectory model. Back-
trajectories of air arriving at Cape Sable (Fig. 1) at 12 24 proved
somewhat unconvincing. Parcel at 1000 (surface) and 905 hPa (~9.5
mile altitude) arrived from the northeast. However, air at 850 hPa

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Fig. 4. Trajectory of an imaginary parcel of air originating at Freeport, Bahamas, and tracked over the next three to four days. Positions each day at 12 Z., at 0800 in 0000 ATD in Nova Scotia, are indicated.

(-1 mile up) was traceable to a position -100 miles north of Bermuda 24 hours earlier. Sessories in the Caribbean region can certainly fly at such heights (Richardson 1976), but Bermuda is a most unlikely origin of the fallouts.

Another approach is to trace forward-trajectories from plausible sources. A hypothetical origin from Bahamas (Fig. 4) is revealing. For birds to have left Freeport, connected locally to 925-850 hPa (0.5-1 mile) levels, and then to be carried passively to Nova Scotia by after-

noon 11 October, would have required departure almost a half-day prior to 9 October at 12 Z. (the evening of 8 October). This would have meant staying aloft almost three days. However, the Freeport air parcel was greatly accelerated at these altitudes beginning next day (Fig. 4). Passerines departing east to southeast on the evening of 9 October from the Carolinas to Florida and traveling at flight speeds of -20-25 m.p.h. could easily have been 200 miles offshore at dawn the next day (Ehrich et al. 1988). This would have placed them near dawn on 10 October somewhere between the hypothetical positions (Fig. 4) of the Bahamas air parcel at 12 Z on 9-10 October. The acceler-

ated southeast flow would then have taken them quite close to Nova Scotia by early morning 11 October (Fig. 4). Abetted by dawn-

wind flight, an arrival in southwest Nova Scotia a few hours later, less than two days after departure, is highly plausible. It is also noteworthy that the hypothetical air masses, after reaching Nova Scotia, did not pass near coastal Massachusetts (Fig. 4).

It is also possible that meteorological conditions had concentrate-

ated the birds at departure sites prior to their offshore movements. There were broad south-southeast airflows in the southeastern United States in advance of the progressing front before it reached the coast. If many such migrants had oriented downstream, as noted previously at sites in Louisiana and Georgia by Gauthreaux and Abele (1970), they might have concentrated along the front as it progressed. However, in this instance they cannot explain the arrival of such large numbers from offshore in Nova Scotia.

CONCLUSION

It is clear that the large and diverse assemblage of birds that arrived at southern extremity of Nova Scotia from the east originated much farther south, plausibly from the southeastern U.S., 1500-2500 km distant. This contrasts with Richardsch (1982), who could not con-

clude from radar tracking that autumns reverse migrants in Nova Scotia had traveled more than 400 km from New England. The combi-

nation of offshore movements of cold fronts in the southern U.S. with low pressure developing farther north, is a common meteoro-

logical pattern, and may help explain the unusual frequency of southern vagrants during autumns on Nova Scotia islands (McLaren 1981). The particularly spectacular example of 11 October 1998, after the birds became caught up in southwesternly flow, may have resulted from the slow movement of the storm center off southern Nova Scotia, which ultimately propelled them ashore. Such centers often move rapidly to the northeast and offshore, and must on such occasions carry many more landbirds to a watery end. A plausible case has indeed been made that severe Nova Atlantic storms in autumn may negatively influence songbird breeding populations the following spring (Bulter 2000). The arrival of much greater numbers of Indigo Buntings, Blue Jays, and Scarlet Tanagers relative to their abundances on the Florida list may indicate that they were bet-

ter able to sustain the long flight. The sharp drop in their numbers the day after arrival and their apparent reappearance in coastal Massachusetts may also reflect a robust condition for resumed migration compared with the emus, mostly smaller, obligate insecri-

vores. More insights on effects of the 1998 flood and similar reverse-migration events could be gained by analysis of banding recapture rates and changes of body condition of individuals of the species involved.

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LITERATURE CITED


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