October 2017 Fallout

An unusual combination of weather conditions on the east coast of North American during the 4th week of October 2017 resulted in an extraordinary transport of large numbers of nocturnal migrant songbirds from the southeastern United States to an area including Nova Scotia south to New England as well as Bermuda.

Alix d'Entremont and John Kearney

Hooded Warbler at Daniels Head, CSI, Oct 27. *Photo by Mark Dennis*

Abstract

An unusual combination of weather conditions on the east coast of North America during the 4th week of October 2017 resulted in an extraordinary transport of large numbers of nocturnal migrant songbirds from the southeastern United States to an area including Nova Scotia south to New England as well as Bermuda. The 2017 fallout was roughly similar in numbers of birds involved, but much more geographically extensive than the "great fallout" of 1998. Numbers were greatest in the southernmost coastal areas of the province but extended east along the Atlantic coast of the mainland. Weather analysis indicates that the main source of the fallout birds was likely central Florida with the possibility of additional birds arriving from northern Florida to South Carolina. In all these areas, north and northwest winds below 500 meters altitude were favourable for southbound migration, but at 1500 meters, crosswinds from the southwest would have carried birds northeast over the Atlantic Ocean. We suggest that updrafts from thunderstorms along a frontal system carried songbirds to these higher altitudes and entrapped them in the crosswinds. The species composition of the fallout birds also supports a Florida origin.

Introduction

The high incidence of vagrant birds to Nova Scotia is at least partly related to its geography. The province sits halfway between the equator and the north pole at the eastern edge of the continent and is virtually surrounded by water – its shores and islands acting as first havens for land birds displaced over the sea (McLaren, 2012). Certain weather systems during times of migration are known to make for exciting birding in what is known as a bird fallout, a phenomenon in which many birds are prevented from reaching their intended destinations due to meteorological conditions – some of which make first landfall in Nova Scotia. This can occur in autumn with passing cold fronts – an October 1998 fallout (McLaren et al., 2000) and now, the October 2017 fallout, are both prime examples.

Lucas Berrigan and David Bell, Atlantic Bird Observatory researchers on Bon Portage Island (BP), noted 6 Indigo Buntings, 3 Red-eyed Vireos and 1 Gray Catbird on the island once the rain had abated on the evening of October 26. Well versed in weather patterns and having previously read McLaren et al. (2000), David connected the eastward moving cold front that had brought the rain with the arrival of birds that should be much farther south, and posted to the Nova Scotia Rare Bird Alert (NS-RBA) warning of a possible fallout. The crew at BP was out early the following morning and quickly found more vagrants including Hooded Warbler, White-eyed Vireo and Yellow-throated Vireo – the fallout had occurred!

For those familiar with the paper by McLaren et al. (2000) about the 1998 fallout, the vagrants involved were referred to as "reverse-migrants". Recent publications such as Howell et al. (2014) define "reverse-migrants" as birds whose intrinsic compass is faulty and therefore suffer from misorientation. The term "drift" represents a case where birds begin their migration in the intended direction, but due to adverse winds or rain and an inability to land when over water, have no choice but to simply drift with the wind. The individuals of the October fallouts of 1998 and 2017 were brought to Nova Scotia because of drift.

Yellow-billed Cuckoo, BPI, Oct 28. *Photo by Alix d'Entremont.*

Geographic Extent - Nova Scotia

NS-RBA posts on October 27 of vagrants from *Shelburne* to *Halifax* established that this was a wide-ranging event in comparison to the 1998 fallout, which was restricted to *Shelburne*. October 28 and 29 fell on a weekend, so more of the province was covered during those two days, but there were still data gaps on the Atlantic Coast of mainland Nova Scotia, most evident in *Queens* and *Guysborough*. The map in Fig. 1 is an attempt to visualize where the vagrants arrived during the first full 3 days of the fallout.

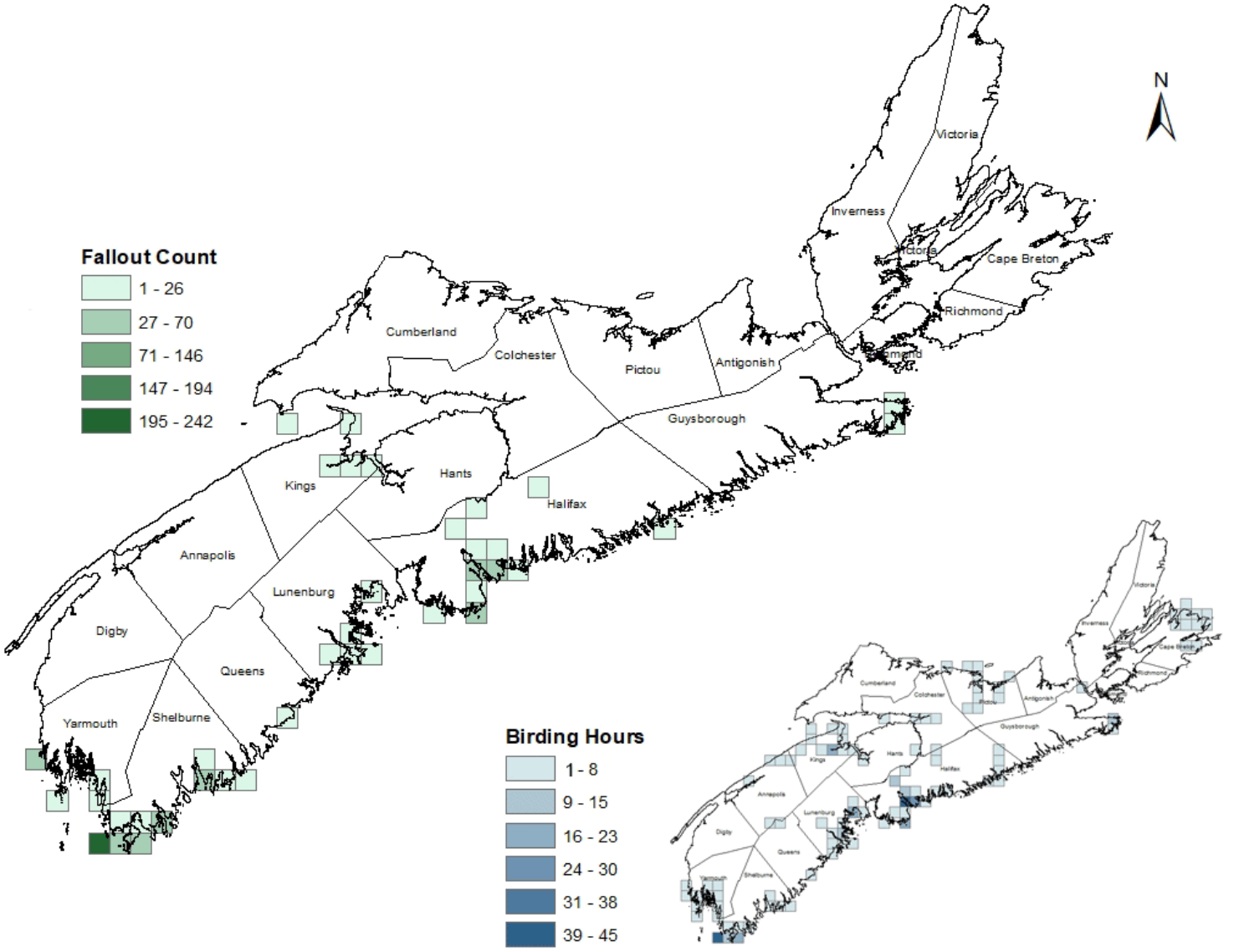


Figure 1. These maps created from eBird data show where vagrant birds were detected (Fallout Count) and which locations were birded (Birding Hours) during the period of October 27-29, 2017. The "Fallout Count" total per square represents how many vagrants were reported in that 10 km by 10 km square. Species that could already have been present in numbers like Yellow-rumped Warbler, Orange-crowned Warbler and Ruby-crowned Kinglet that could have been involved in the fallout were not included in the "Fallout Count" to ensure that the map was representative of fallout birds only. Very few fallout birds were reported away from the Atlantic Coast initially, and most of those were reported after October 27, which could suggest that they had moved from their original arrival locations. The "Birding Hours" total per square represents the total birding hours within each 10 km by 10 km square. It is apparent that the counties of Annapolis, Kings, Colchester, Pictou and Cape Breton were birded, but lacked obvious evidence of a fallout arrival. For the most part, birds that had been entrained in the weather system landed at the very first opportunity, which would have been Nova Scotia's Atlantic Coast. With the winds and the arrival direction of birds on October 26 being approximately s.s.e., the counties in the "wind shadow" received far fewer birds.

Bon Portage Island Arrivals

The birds reported during the 1998 and 2017 fallouts are compared in Table 1. It is important to note that the 1998 event occurred about 2 weeks earlier (11 Oct) than the 2017 (27 Oct) event. Perhaps the most glaring difference between the two years at BP is the number of Gray Catbirds – very few in 1998, but a large number in 2017. Data from eBird seems to suggest that the push of Gray Catbirds out of Florida occurs after mid-October, which explains why there were fewer of them in 1998. Factors influencing the relative abundance between fallouts of Common Yellowthroat and American Redstart don't seem as obvious.

Scarlet Tanager at West Head Rd, *Shelburne*. Nov 11.
Photo by Bill Crosby.

Advances in technology, such as miniaturization, that were only a dream in 1998, gave us the opportunity to track movements of certain birds after their arrival on BP. Banding staff of the Atlantic Bird Observatory fitted 15 of the fallout birds with tiny radio transmitters that send a unique identification number to the Motus Wildlife Tracking System, which logs an approximate location of the transmitter. This automated radio telemetry system has good coastal coverage on mainland Nova Scotia and south through to Virginia, with fewer towers all the way to South America.

The radio-tagged birds included one Golden-winged Warbler, one Hooded Warbler, four Indigo Buntings, one Orange Crowned Warbler, two Summer Tanagers, three White-eyed Vireos, two Yellow-billed Cuckoos and one Yellow-throated Vireo. Both Yellow-billed Cuckoos left during the night of October 27, followed by the Golden-winged Warbler the next morning, two of the Indigo Buntings on the night of October 28, the Hooded Warbler late in the day on November 1, and one of the Summer Tanagers on the night of November 2.

Province-wide Reports

From late October into November, birders were busy checking the best migrant traps for fallout birds. An attempt at quantifying the number of birds that arrived to Nova Scotia is found in Table 2.

Of the 2067 individuals in Table 2, about 42% were from *Shelburne*, 22% from *Halifax*, 18% from *Yarmouth* and 7% from *Lunenburg* – other counties had fewer reports. The percentage from *Halifax* is likely inflated by an uncertain amount since total birding hours there were about twice as high as *Shelburne*. Many of the birding hours in Halifax were likely at inland locations and at locations where fallout birds had already been reported, so an attempt to normalize the percentages has not been attempted. The total number of species recorded in each county also suggests that the bulk of the birds arrived in *Shelburne* – 46 for *Shelburne*, 36 for *Yarmouth*, 35 for *Halifax* and 29 for *Lunenburg*.

Species that were recorded into December included White-eyed Vireo, Blue-headed Vireo, Red-eyed Vireo, Blue-gray Gnatcatcher, Ruby-crowned Kinglet, Hermit Thrush, Gray Catbird, Nashville Warbler, Common Yellowthroat, American Redstart, Northern Parula, Yellow-throated Warbler, Wilson's Warbler, Summer Tanager, Scarlet Tanager, Rose-breasted Grosbeak, Baltimore Oriole and Indigo Bunting. A full list with numbers will be provided in the winter 2017/2018 issue of NS Birds.

Geographic Extent - Eastern North America

While the majority of vagrants arrived in Nova Scotia, many of the same species were reported during a similar time from New Brunswick south to Cape Cod and even Bermuda. The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) is a computer model that can forward or backward trace the trajectory of a hypothetical air parcel at various altitudes over a particular time frame. Runs of HYSPLIT show that the final destination of the storm-brought birds could have varied substantially depending on when and where they left from.

NEXT PAGE: **Table 1. This table compares the species counts at Bon Portage Island during the 1998 and 2017 fallouts. The numbers are combined daily estimates for the three days prior to (8-10 Oct 1998; 24-26 Oct 2017) and following (11-13 Oct 1998; 27-29 Oct 2017) the fallout with duplicates removed. The "Arrivals" column represents an estimate of the vagrants, calculated by removing the counts prior to the fallout from the counts after the fallout. The "%" column relates to the percentage of the total that each species' "Arrival" count represents. The "%" column can be compared between years to assess differences in relative species composition.**

Table 1	Bon Portage I. 1998				Bon Portage I. 2017			
Species	8-10 Oct	11-13 Oct	Arrivals	%	23-25 Oct	26-29 Oct	Arrivals	%
Yellow-billed Cuckoo	0	3	3	0.3	1	14	13	4.0
Chimney Swift	0	0	0	0.0	0	1	1	0.3
Eastern Wood-Pewee	0	1	1	0.1	0	3	3	0.9
White-eyed Vireo	0	1	1	0.1	0	16	16	5.0
Blue-headed Vireo	2	3	1	0.1	1	1	0	0.0
Yellow-throated Vireo	0	5	5	0.4	0	6	6	1.9
Philadelphia Vireo	0	3	3	0.3	0	1	1	0.3
Red-eyed Vireo	2	180	178	15.6	0	35	35	10.9
Ruby-crowned Kinglet	11	22	11	1.0	1	10	9	2.8
Gray-cheeked Thrush	0	0	0	0.0	0	1	1	0.3
Swainson's Thrush	0	0	0	0.0	0	7	7	2.2
Hermit Thrush	0	0	0	0.0	1	6	5	1.6
Gray Catbird	0	10	10	0.9	1	80	79	24.5
Ovenbird	4	20	16	1.4	0	5	5	1.6
Northern Waterthrush	0	4	4	0.4	0	1	1	0.3
Golden-winged Warbler	0	1	1	0.1	0	1	1	0.3
Tennessee Warbler	0	6	6	0.5	0	0	0	0.0
Black-and-white Warbler	0	22	22	1.9	1	1	0	0.0
Orange-crowned Warbler	0	0	0	0.0	1	2	1	0.3
Nashville Warbler	0	0	0	0.0	0	1	1	0.3
Connecticut Warbler	0	2	2	0.2	0	0	0	0.0
Mourning Warbler	0	1	1	0.1	0	0	0	0.0
Common Yellowthroat	11	125	114	10.0	0	5	5	1.6
Hooded Warbler	0	8	8	0.7	0	10	10	3.1
American Redstart	0	91	91	8.0	0	3	3	0.9
Cape May Warbler	0	1	1	0.1	0	2	2	0.6
Northern Parula	0	52	52	4.6	0	12	12	3.7
Magnolia Warbler	2	14	12	1.1	0	4	4	1.2
Bay-breasted Warbler	0	1	1	0.1	0	1	1	0.3
Blackburnian Warbler	0	2	2	0.2	0	3	3	0.9
Chestnut-sided Warbler	0	13	13	1.1	0	1	1	0.3
Blackpoll Warbler	8	6	0	0.0	0	9	9	2.8
Black-th. Blue Warbler	5	2	0	0.0	0	1	1	0.3
Yellow-rumped Warbler	57	190	133	11.7	1	16	15	4.7
Yellow-throated Warbler	0	4	4	0.4	0	14	14	4.3
Pine Warbler	0	0	0	0.0	0	3	3	0.9
Black-th. Green Warbler	0	13	13	1.1	0	4	4	1.2
Palm Warbler	3	19	16	1.4	0	2	2	0.6
Wilson's Warbler	0	0	0	0.0	0	1	1	0.3
Summer Tanager	0	0	0	0.0	0	2	2	0.6
Scarlet Tanager	0	31	31	2.7	0	2	2	0.6
Baltimore Oriole	0	0	0	0.0	0	3	3	0.9
Rose-breasted Grosbeak	0	1	1	0.1	0	3	3	0.9
Blue Grosbeak	0	27	27	2.4	0	0	0	0.0
Indigo Bunting	0	255	255	22.4	0	29	29	9.0
Individual Total	**105**	**1139**	**1039**		**8**	**322**	**314**	
Species Count			**33**				**39**	

Nova Scotia 26 Oct–30 Nov			
Species	**Count**	**Species**	**Count**
Yellow-billed Cuckoo	42	Tennessee Warbler	10
Black-billed Cuckoo	2	Orange-crowned Warbler*	92
Common Nighthawk	1	Nashville Warbler	6
Chimney Swift	4	Common Yellowthroat*	39
Eastern Wood-Pewee	17	Hooded Warbler	22
White-eyed Vireo	80	American Redstart	13
Yellow-throated Vireo	26	Cape May Warbler	19
Blue-headed Vireo*	13	Northern Parula*	61
Philadelphia Vireo	2	Magnolia Warbler	16
Red-eyed Vireo	98	Bay-breasted Warbler	1
Marsh Wren*	4	Blackburnian Warbler	6
Blue-gray Gnatcatcher	2	Chestnut-sided Warbler	3
Ruby-crowned Kinglet*	55	Blackpoll Warbler	22
Veery	1	Black-throated Blue Warbler	9
Gray-cheeked Thrush	2	Palm Warbler	20
Swainson's Thrush	18	Pine Warbler*	30
Hermit Thrush*	38	Yellow-rumped Warbler*	438
Wood Thrush	1	Yellow-throated Warbler	33
Gray Catbird*	310	Prairie Warbler	4
Yellow-breasted Chat*	12	Black-throated Green Warbler	20
Baltimore Oriole*	34	Wilson's Warbler	11
Ovenbird	6	Summer Tanager	38
Northern Waterthrush	1	Scarlet Tanager	26
Golden-winged Warbler	3	Rose-breasted Grosbeak	67
Blue-winged Warbler	4	Blue Grosbeak	6
Black-and-white Warbler	16	Indigo Bunting	263
Count Total 2067			

Table 2. The data for this table were entirely sourced from eBird and span the period from October 26 – November 30, 2017. This date range was selected to ensure greatest geographical coverage by birders at the risk of counting later arrivals like Orange-crowned Warblers. The species listed are the ones whose numbers appeared to show an arrival during the fallout. The counts represent a combination of the highest counts for each species for each location.

** The species annotated with an asterisk (*) warrant comment. Due to the increase of birding activity during the days following the fallout, unusually high counts of certain species could have been partly the result of more effort combined with the individuals from the fallout. There were already some Blue-headed Vireos in the region, but most were reported in early October. The Marsh Wrens were found at least two weeks after the fallout, so their arrival dates are uncertain. Counts of Ruby-crowned Kinglets, Hermit Thrushes, Gray Catbirds, Baltimore Orioles, Blackpoll Warblers, Orange-crowned Warblers, Common Yellowthroats, Northern Parulas, Palm Warblers, Pine Warblers and especially Yellow-rumped Warblers likely include individuals that were already present before the fallout, but clear increases in these species were observed at Bon Portage Island, so numbers should be presented here.*

Bermuda

Many of the vagrant bird species that were found in Nova Scotia during the fallout were also reported from Bermuda on and after October 27. Similar arrival times here and in Bermuda could be explained by differences in wind speed within the storm system. The British Overseas Territory serves as a late fall migration stop-over or even a wintering area for many species of warblers, tanagers, grosbeaks and buntings, but a clear arrival of species from these groups was still detected by local eBirders and banders. For example, Eastern Wood-Pewees are very uncommon on the island in October, but 32 were brought there by the weather event.

Eastern US & New Brunswick

Obvious spikes in reports on or soon after October 27 of White-eyed Vireo and Yellow-throated Vireo and slight rises in reports of Yellow-throated Warbler, Black-throated Green Warbler, Blue-gray Gnatcatcher, Blue-headed Vireo, Indigo

Bunting, Northern Parula and Summer Tanager came from New Brunswick to Cape Cod, with many continuing into December and a few into January. Red-eyed Vireo, Yellow-billed Cuckoo, Hooded Warbler, Gray Catbird, Philadelphia Vireo, Pine Warbler, Rose-breasted Grosbeak and Scarlet Tanager were only reported from e. Maine through to NS during the first few days after the fallout. Certain species that arrived in large enough numbers were noted re-orienting and heading south, evidenced by abnormally late reports in areas south of Nova Scotia such as Indigo Bunting, Northern Parula and Yellow-billed Cuckoo. Species that arrived in NS in very small numbers likely will not allow for regional analysis due to the resultant small sample size and certain species' numbers being masked by birds already present.

Weather Analysis

With very few exceptions, the birds involved in the 2017 fallout were nocturnal migrants that take flight 1-2 hours after sunset and gain altitude in search of favourable weather conditions. The most important of these conditions are wind direction and wind speed, with a tail wind or light wind preferred. In eastern North America, the ideal spring winds are from the south or southwest ahead of a cold front, and in the autumn, from north or northwest behind a cold front. Most small songbirds, like warblers, fly below 500 metres above ground level, while larger songbirds, such as thrushes, will climb to 1,500 metres or more in search of ideal conditions. As weather conditions change through the night, birds will adjust their flying altitude up or down. Less is known about other meteorological conditions, like temperature and cloud cover, which can also affect the altitude of migrating birds. Precipitation, at any time of the night, usually causes the birds to land as soon as possible. Otherwise, songbirds generally begin their descent to land 1-3 hours before sunrise. Sometimes nocturnal migrants can be seen flying for a couple of hours after sunrise if they have been blown off course or need to search for suitable feeding habitat – this is known as morning flight.

This section deals with three different times zones: Atlantic Daylight Time (ADT), Eastern Daylight Time (EDT) and Greenwich Mean Time (GMT). Daylight Saving Time being in effect during late October when the fallout event occurred, results in ADT are at GMT - 3:00 and EDT are at GMT - 4:00.

A preliminary analysis of the weather conditions contributing to the fallout of 2017 was proposed by Team Bird Cast at the Cornell Lab of Ornithology shortly after the event (www.birdcast.info - search for "neotropical transport"). They noted a cold front extending just offshore of the southeast coast of the United States while intensive nocturnal migration was in progress during the early evening of 24 October. These conditions are shown in the radar map above (Fig. 2), where bird migration is indicated by blue-green blooms and rain by irregular shaped green and yellow.

It is thought that birds departing from the southeast coast of the United States were entrained in a stalled frontal system offshore, and having no place to land, flew downwind with the system. In this way, they ended up as storm-driven vagrants in New England and the Canadian Maritimes.

Figure 3 illustrates the reflectivity of radar targets over Jacksonville, Florida at 8 PM EDT on 24 October. The overall bloom shape of the echoes indicates strong bird migration. With echo densities as high as 25 decibels, the number of birds in the air would be approximately 600 per cubic kilometer in some areas. Note also the precipitation to the southeast which appears to include at least one thunderstorm cell (the red spots). This precipitation is part of the cold front that extended up the east coast that night.

Figure 4 shows the radial velocity of the radar targets. Green indicates the targets moving toward the radar while red indicates those traveling away from the radar. The intensity of the colours specifies the speed (in knots) at which the targets are moving in relation to the radar. The gray area is where targets have a zero-velocity relative to the radar. The angle of the boundary between

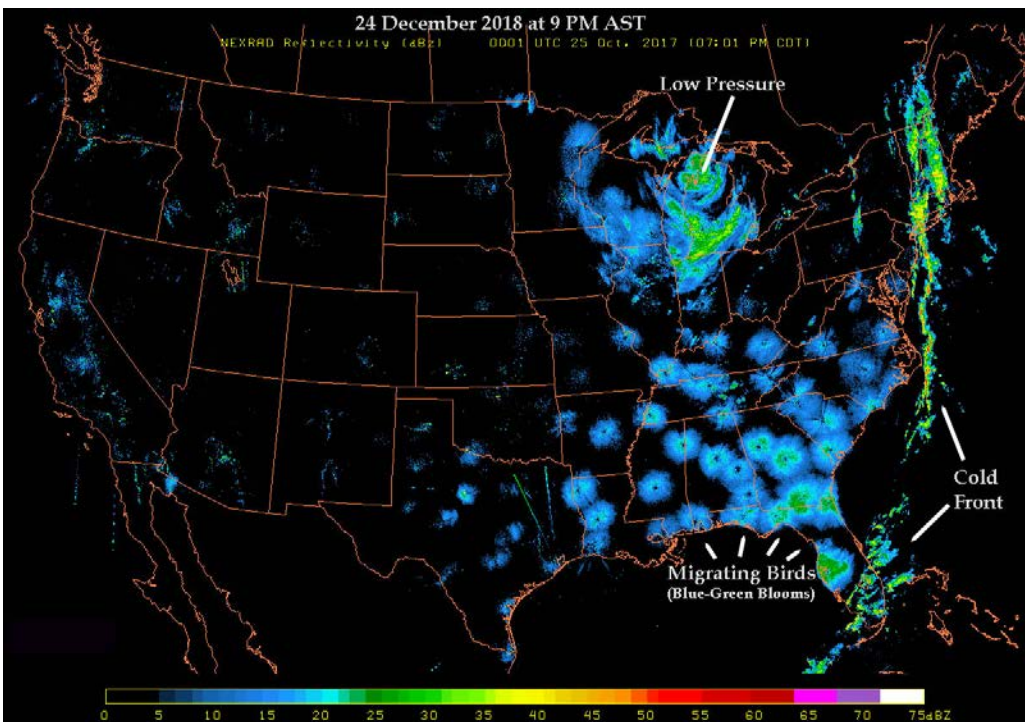


Figure 2: Radar Imagery at 8 PM EDT on 24 October 2017 *(Source map from http://www.pauljhurtado.com/US_Composite_Radar/)*

the green and red areas indicates the direction of movement of the targets. Hence, the migration over Jacksonville that night was heading to the southeast, out to sea towards the cold front.

Surface winds just off the coast of Jacksonville, were north at 8 km/hr. These were ideal initial conditions for migration. As birds approached the cold front, the winds shifted to southwest with wind speeds increasing to up to 33 km/hr. While conditions were no longer ideal for movement to the southeast, they would not seem to be extreme enough for a large diversion of birds toward New England and the Canadian Maritimes.

To better understand weather conditions on the evening of 24 October, a HYSPLIT model was employed. Figure 5 shows the forward trajectories over 48 hours of parcels of air over Jacksonville, Florida, at 11 PM EDT on 24 October.

As indicated in the map and bottom panel of Figure 5, parcels of air and hence, the birds flying in them, at surface level and up to at least 500 meters altitude, would have reached the intended destination in the Bahamas by 2 PM EDT (18:00 GMT 25 Oct) on 25 October. On the other hand, a parcel of air at 1500 meters altitude would have reached Shelburne County in Nova Scotia at 9 PM ADT (00:00 GMT 27 Oct) on 26 October. What was different at 1500 meters over Jacksonville that would have brought birds to Nova Scotia in less than 48 hours?

As illustrated in Figure 6, winds offshore of Jacksonville at 1500 meters were strong from the southwest compared to the light north winds at the surface.

This suggests that birds at 1500 meters were entrained in the cold front and continued downwind until they reached the shores of Nova Scotia.

However, the HYSPLIT model suggests that birds leaving Jacksonville below 500 meters would have been carried to the Bahamas, remaining in northwest winds as the cold front moved further offshore. Why, then, did the birds at 1500 meters not descend by 1000 meters? In a study of a similar fallout in 1998 (McLaren et al. 2000), the authors suggest that convection currents may have played a role in trapping the migrants at higher altitudes. It was noted earlier that thunderstorm cells could be seen on the radar offshore of Jacksonville, indicating that birds may have been lifted by updrafts and carried northeast until there was no alternative other than flying downwind.

The result of HYSPLIT models for Charleston, South Carolina, indicated a similar pattern to that of Jacksonville, with the estimated arrival time of birds in Nova Scotia being a little after 10 PM ADT on 26 October in Lunenburg.

Observers at a banding station on Bon Portage Island, *Shelburne*, reported the first arrivals early during the evening of 26 October. This is earlier than indicated by the forward trajectories of the HYSPLIT models, but some variation of reality compared to the models is likely, given that birds entrained in winds require some movement relative to the wind to maintain stability.

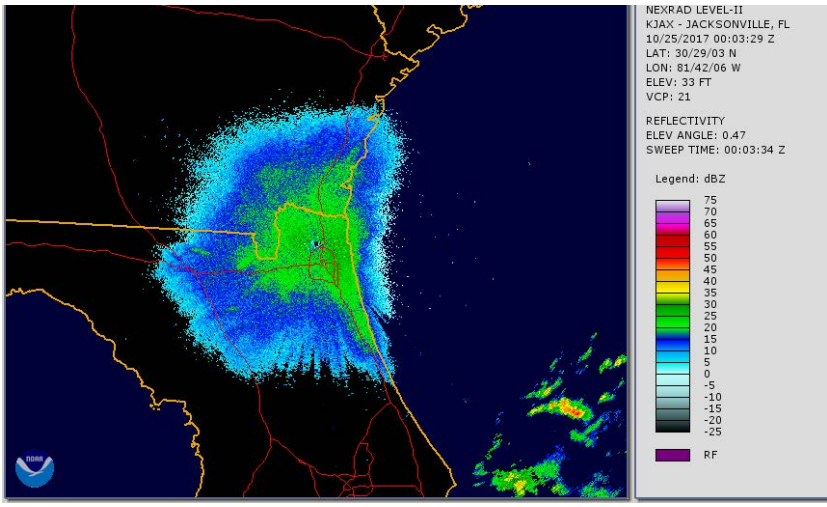


Figure 3: Base Reflectivity Showing Intense Migration at Jacksonville, Florida at 8 PM EDT on 24 October 2017 *(Source NOAA)*

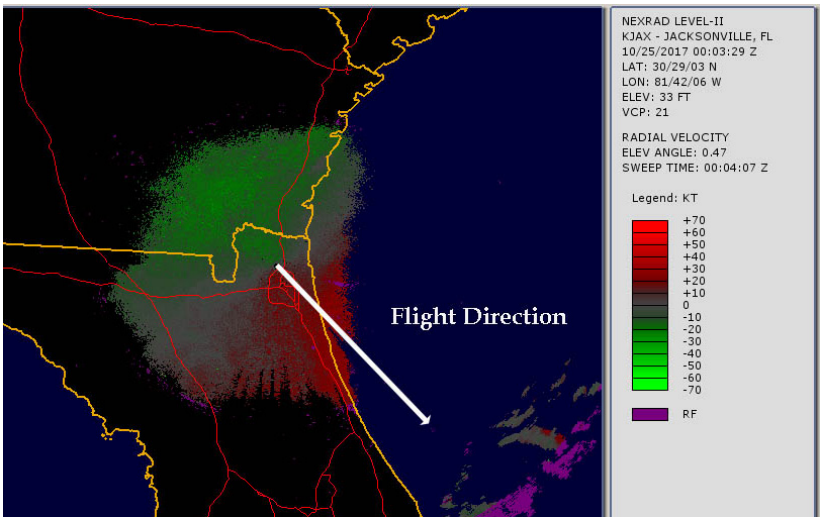


Figure 4: Base Radial Velocity at Jacksonville, Florida at 8 PM EDT on 24 October 2017 *(Source NOAA)*

Backward trajectories from Bon Portage Island were run for a 72-hour period before the observed arrival of vagrants. The results of this modeling are graphed in Figure 7. The model indicates that a possible origin of the birds to first arrive on Bon Portage Island was the west coast of Florida on the Gulf of Mexico, near Tampa. The arrival time on Bon Portage Island was about 8 PM ADT after a 48-hour trip at 1500 meters altitude.

The upper panel of Figure 8 shows the reflectivity of radar targets over Tampa, Florida at 8 PM EDT on 24 October 2017. High density migration is even more widespread than at Jacksonville. One can see a line of thunderstorm cells to the south, southeast, and east of the Tampa area.

The lower panel of Figure 8 indicates that the direction of migration at Tampa was to the south southeast.

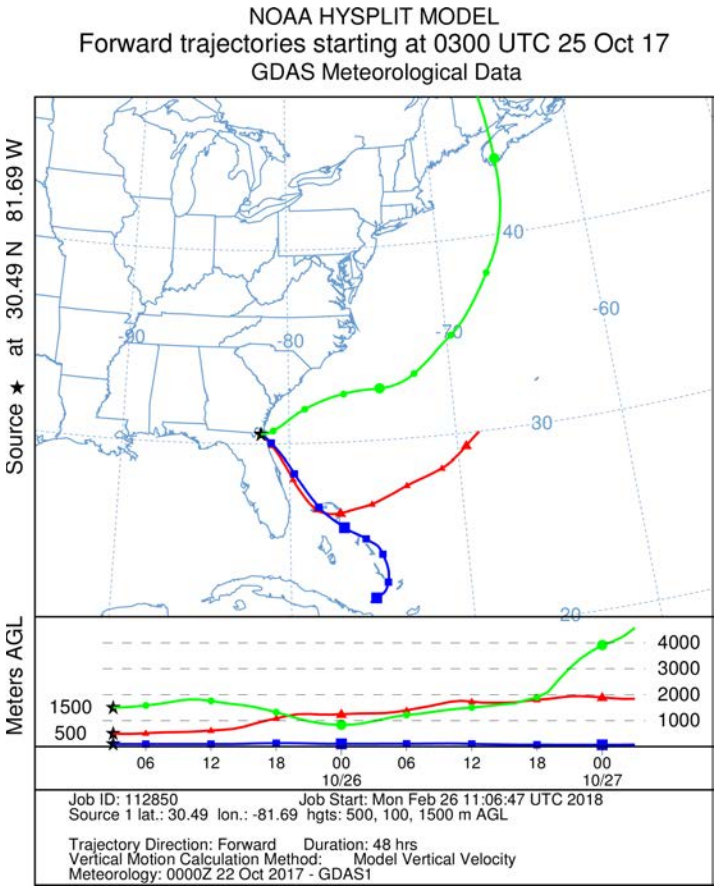


Figure 5: NOAA HYSPLIT Model, Forward Trajectories Starting at 11 PM EDT on 24 October 2017. Time and date in GMT.

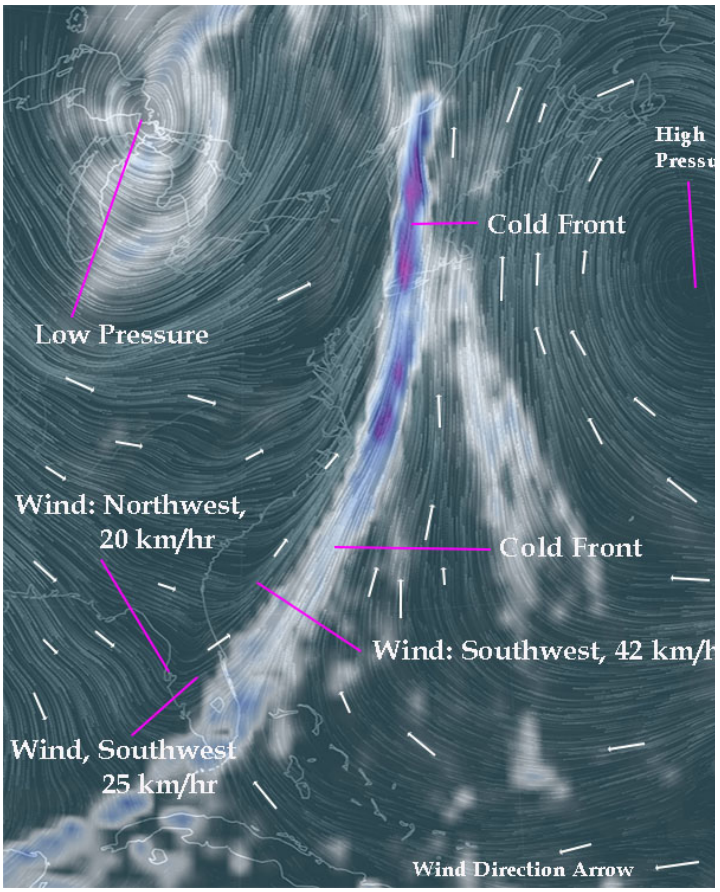
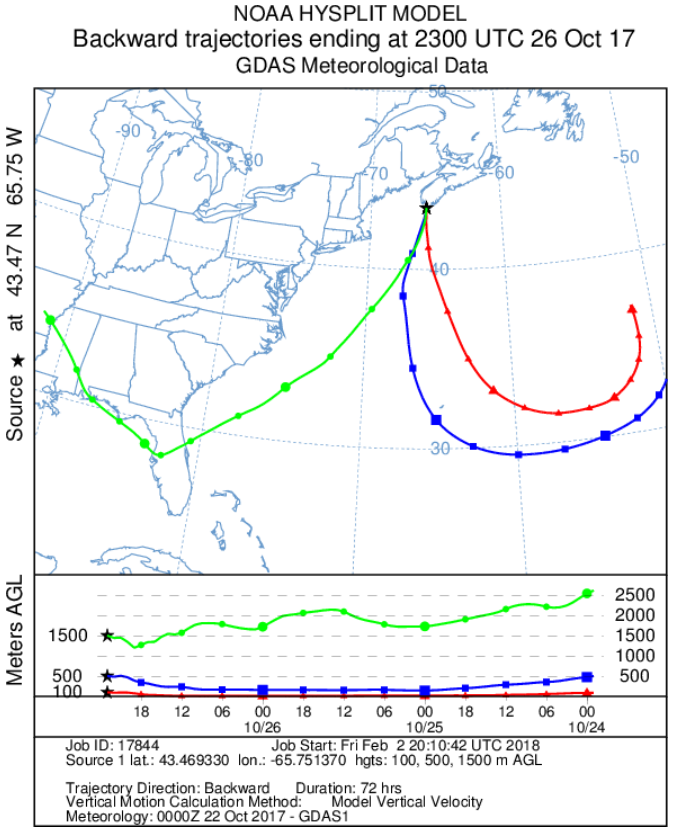


Figure 6: Winds at ~1500 Meters Altitude on 24 October 2017 at 8 PM EDT *(Source: nullschool.net)*



When examining the forward trajectories computed by the HYSPLIT models for Tampa in Figure 9, one notes a similar pattern as for Jacksonville. Birds flying below 500 meters would reach their destinations in Cuba and Honduras while birds at 1500 meters were taken to Nova Scotia.

Note also that there is only a one-hour difference in the arrival times in Nova Scotia between the forward and backward trajectories (Figures 9 and 7). As with Jacksonville, one can ask what kept the Tampa area birds from staying at lower altitudes to maintain a seasonably appropriate flight direction? The radar image for Tampa (Fig. 8, upper panel) also shows thunderstorms, which suggests that migrant birds could have been lifted by updrafts.

A Tampa area origin for the vagrants found by birders in the days after their arrival in Nova Scotia provides a better fit for the species of birds to be expected in late October than a more northerly origin such as South Carolina, Georgia, or perhaps even northern Florida. The forwards and backwards HYSPLIT models clearly show how entrained birds could have been carried along from the Tampa area to Nova Scotia and

Figure 7: NOAA HYSPLIT Model, Backward Trajectories Ending at 8 PM ADT on 26 October 2017. Time and date in GMT.

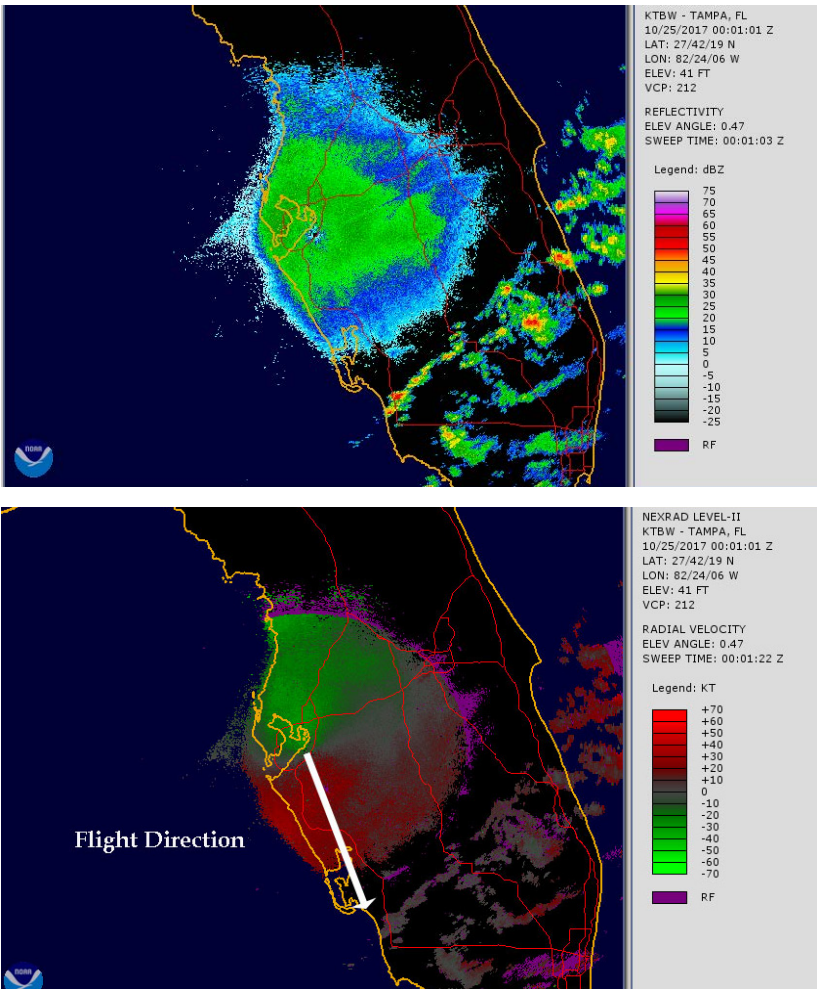


Figure 8: Base Reflectivity (UPPER and Base Radial Velocity (LOWER) at Tampa, Florida at 8 PM EDT on 24 October 2017 *(Source NOAA)*

the strong radar reflectivity in the area suggests heavy migration over a wide front. Nonetheless, the HYSPLIT models also indicate the possibility of multiple origins of vagrants from the East Coast of the United States from Florida to South Carolina where meteorological conditions were similar on the evening of 24 October.

It was nineteen years between the massive fallouts of southern vagrants in Nova Scotia (1998 and 2017). What were the unusual conditions that these two events might have shared? Cold fronts extending the length of the United States east coast are not that rare, nor are upper air winds that are stronger and crosswise to surface winds. The common factor in 1998 and 2017 appears to be strong updrafts that trapped birds in the upper level crosswinds until they were over the ocean and had no choice but to continue flying downwind. Given the configuration of the east coast of North America, a downwind strategy for birds well offshore may have an evolutionary basis. Rather than struggling against headwinds and crosswinds in attempting to return to the coast, birds may have better chances of surviving by letting winds carry them to the eastward-extending land masses of Nova Scotia and Newfoundland.

Unreported Species

The eBird frequency and abundance graphs for Florida, the likely origin of the vagrants, and species-specific migration routes, may offer explanations for the lack of certain species in the fallout. Early migrants such as Louisiana Waterthrush, Prothonotary Warbler, Kentucky Warbler, Cerulean Warbler, Canada Warbler and Bobolink had mostly already left the U.S. by late October. Swainson's Warblers and Yellow Warblers migrate through Florida, but do so in relatively low numbers. Mourning Warblers and Yellow-breasted Chats take an entirely (former) or partly (latter) westerly route during fall. Kirtland's Warbler's population is so small that it was simply a matter of low numbers that it didn't show up here. Bicknell's Thrush and Warbling Vireo are uncommon in Florida, especially in late October. Prairie Warbler is quite interesting because it is as abundant as Northern Parula through Florida during migration, but most of Florida is within the winter range of Prairie Warbler. The abundance of Prairie Warblers in Cuba is relatively stable from the second week of October on, suggesting that not many are leaving Florida during that time.

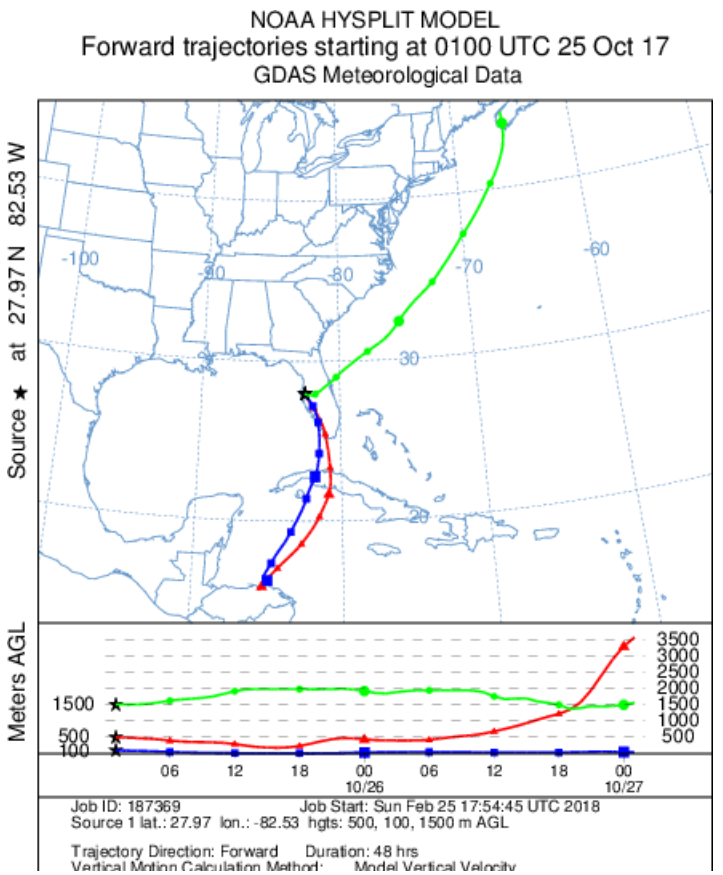


Figure 9: NOAA HYSPLIT Model, Forward Trajectories Starting at 9 PM EDT on 24 October 2017. Time and date in GMT.

Concluding Remarks

The winter 1999 issue of Nova Scotia Birds (Vol. 41, issue 1) dubbed the fallout of October 11, 1998, as the "Great Fallout". Numbers of assumed vagrants recorded in that event totalled 2243 (McLaren et al., 2000). The 2017 total of 2067 (Table 2), while not directly comparable to the 1998 total due to the longer time window, does suggest that both events involved a similar number of birds. The large geographic extent of the 2017 event meant that finding the vagrants took more time. The 1998 data was boosted by the 813 birds observed on Seal I., a location that was not surveyed in 2017. If the October 2017 fallout was a first for you, consider it on par, in terms of numbers of individuals, with the "Great Fallout" that you've been hearing stories about for years.

Acknowledgements

We would like to thank Jason Dain for the creation of the map (Fig. 1) and Dr. Ian Folkins, Department of Physics and Atmospheric Science, Dalhousie University, for providing some initial guidance with the weather analysis. We appreciated the helpful comments to drafts of this paper provided by Eric Mills, David Bell, Mark Dennis, Ian McLaren and Jamie McLaren.

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From Top to Bottom:
Gray-cheeked & Swainson's Thrush at BPI. October 27. *Photo by David Bell.*
Yellow-throated Warbler at Chebogue Pt., *Yarmouth.* Nov 1. *Photo by Joan Comeau.*
White-eyed Vireo at BPI. Oct 28. *Photo by Ronnie d'Entremont.*
Yellow-throated Vireo at Deveau Shore Rd., *Digby*, Nov 2. *Photo by Simon d'Entremont.*