


changing seasons: low pressure



Fall Migration: August through November 1998

Franklin's Gulls made headlines from the Midwest to the South Atlantic Coast Region, as what must have been many thousands were displaced eastward from their normal fall migratory route through the middle of the continent—along with scores of waterfowl species and cranes. This Franklin's, though, was part of an earlier movement, itself above average if annual, eastward into the mid-Atlantic states. The Chesapeake Bay and Potomac River basin have hosted many more Franklin's than have surrounding regions over the past few decades, with over 70 records here, but this first-winter bird was a first for well-watched Calvert County, Maryland, August 31, 1998. Photograph/Marshall J. Iliff.

EDWARD S. BRINKLEY*

Every autumn holds some superlative event in the history of amateur bird study. On the local level, the exceptional experience may be of a single individual bird that brightens the fall: consider the emotions that must have accompanied the discovery of Illinois's first Whooping Crane in 40 years, or a Prothonotary Warbler huddled not far from a Golden-winged Warbler in Nova Scotia—in the middle of October. In fall 1998, each month was punctuated, at some spot on the continent, by a remarkable weather event, a displacement of significant numbers of birds from their typical migration routes or stopover sites. In several cases, hurricanes and tropical storms caused the displacement, but in two other noteworthy instances, nontropical low-pressure systems transported a hodgepodge of birds into areas where they are rarely seen, or rarely seen in large numbers.

In Nova Scotia, a fallout of passerines October 11 was, according to Blake Maybank's correspondents: "exhilarating. Exhausting. Perhaps we've been spoiled for good!" "The fallout almost defies description." "An incredible concentration of rarities on one place 34 species of warbler in one county in the second week of October—has that ever happened anywhere else in North America north of Mexico?" A month later, November 10–12 and beyond, a fierce cyclone (termed "an inland hurricane—Category 3" by editor Daryl Tessen) swept across the Great Plains, into the Great Lakes, and eastward toward the Atlantic. It moved many thousands of waterfowl, cranes, and, without recorded precedent, massive numbers of Franklin's Gulls eastward of typical passage and wintering areas. Hurricanes' transportation of birds has been a staple of the Changing Seasons (Kaufman 1977, DeBenedictis 1986, Lehman 1989, Brinkley 1997, Patten 1998), and strong frontal passages and reverse-migration events also pepper past columns. But there were superlatives in 1998 beyond past events.

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The Whooping Crane and the warblers, those bright spots in the sport of birding, turn out to be parts of much larger patterns—patterns detected and communicated through networks of birders across the continent. With this communication accelerating at a dizzying pace, and the stream of observations shared over the internet already overwhelming even the most assiduous archivists, the number of distinctly weather-related bird reports is too great to digest in the Changing Seasons; and so, as in several past columns, commentary here is limited to the most extreme events. In the cases of the tropical cyclones, however, I have made some attempt at broader synopses, along with some contextual notes on the displacement of certain species by such storms in the past. The desire here is not simply to refine understanding of weather's effects for the purpose of finding "vagrant" species (though this may be one benefit) but to continue efforts to understand how birds work with various weather patterns: which systems or conditions are favorable for foraging, migration, and nesting, and which are adverse—and, if adverse, what specific behaviors of the birds indicate to us that they have been affected negatively? In the larger view, it is not too soon to ask if our own activities have begun to show drastic effects on global weather patterns, then how should our conservation strategies for birdlife anticipate the increasing weather-related losses they may incur?

AUGUST AND SEPTEMBER'S HURRICANES AND TROPICAL STORMS

September is traditionally the most active month for Atlantic hurricanes, and this past autumn was not exceptional in that regard. The 14 tropical cyclones this year, however, was once again a high number—almost six above the average since 1886—and 10 of these became hurricanes. Seven tropical cyclones made landfall in the United States, more than twice the annual average, with damage estimated at six and a half billion dollars.

The 1998 Atlantic season was also one of the deadliest in history and had the strongest October hurricane on record, *Mitch*, a Category 5 storm. Tropical cyclones claimed an estimated 11,629 lives in 1998, most of which were related to Hurricane *Mitch* in Central America: not since 1780 has an Atlantic hurricane caused so many deaths. Of the 10 hurricanes in 1998, three were "major" hurricanes (Category 3, 4, or 5 on the Saffir-Simpson scale). This means that the four-year period of 1995–1998 had a total of 33 hurricanes, an all-time record for any four-year period. Predictions for 1999 are for more above-average activity, and, if increases in hurricane activity are indeed linked conclusively to atmospheric carbon-dioxide levels (e.g., Emanuel 1987), then long-term global models may be accurate in predicting both more frequent and more intense tropical cyclones in coming years.

The 35-day period from August 19 to September 23 was positively furious: 10 named tropical cyclones formed, and on September 25, four Atlantic hurricanes were on the move at one time—the first time such has been observed since 1893. Among the noteworthy bird storms in the year were *Bonnie*, *Charley*, *Earl*, *Frances*, *Georges*, and *Mitch*. Tropical Storm *Hermine* crossed into southeastern Louisiana near Cocodrie September 20, with sustained winds of 40 mph, but it produced no known avian fallout.

Bonnie developed from a tropical wave over the Atlantic 900 miles east of the Leeward Islands on August 19 and became a tropical storm August 20. Late on the 21st, the storm strengthened into a hurricane 200 miles north-northeast of Hispaniola. *Bonnie* then strengthened to its maximum, with winds of 115 mph, late on the 23rd while 175 miles east of the Bahamas, then turned toward the

northwest and the southeastern U. S. coast. As its center neared the Carolina coast, the storm stalled just off Wilmington, North Carolina, on August 25–26. The eye of the storm made landfall near Wilmington as a Category 2 hurricane early on the 27th. While moving slowly over eastern North Carolina, *Bonnie* weakened to a tropical storm but restrengthened into a hurricane as it moved into Virginia waters, where it passed off to the northeast and out to sea.

Charley developed from an area of low pressure in the the southeastern Gulf of Mexico. The system formed into a depression and strengthened into a tropical storm on August 21 about 275 miles off the southern Texas coast. *Charley* reached its peak intensity of 70 mph before moving inland near Port Aransas the following day. After landfall, a slow-moving circulation aloft persisted in the vicinity of Del Rio, where flooding rains devastated that area August 23–24. Though rains were heavy on the coast, *Charley* apparently lacked the wind strength to move seabirds any distance inland. Texas editors Sexton, Lasley, Lockwood, Sekula, and Shackelford report that "the storm was significant ornithologically for what it didn't produce there was no major passerine fallout from the storm, and there were essentially no inland pelagic strays." Nevertheless, *Charley* did move a good number of Magnificent Frigatebirds on the coast, and in interior areas large numbers of southbound Black Terns and shorebirds (notably Buff-breasted and Upland sandpipers) were "put down."

Hurricane *Earl* developed as a tropical storm over the southwestern Gulf of Mexico on August 31, becoming a hurricane 150 miles south-southeast of New Orleans. After briefly attaining windforce of 100 mph, the storm flirted with the Gulf Coast and made landfall near Panama City, Florida, on September 3, becoming extratropical while moving northeastward through Georgia that day.

Frances formed in the Gulf of Mexico 160 miles east of Brownsville on September 8, becoming a tropical storm two days later in its move to the north and northwest. The storm's winds strengthened to 65 mph as it moved ashore north of Corpus Christi on September 11. *Frances* moved northward to the Texas/Oklahoma border where it dissipated on September 13. Though washed-out roads and other hazards prevented birders from assessing the storm's cargo, "a storm wreck of epic proportion was apparent" nevertheless, with "one of the most impressive tallies of storm-blown strays in many years," as the Texas editors describe it. Magnificent Frigatebirds and Sooty Terns were present in good numbers at many Texas sites, and at least 14 Sabine's Gulls were recorded from interior lakes, where other waifs included Red Phalarope, Pomarine Jaeger, and an array of coastal terns. Undoubtedly a great many interesting passerine migrant records in mid- to late September are attributable to *Frances* as well.

Georges formed in the far eastern Atlantic from a tropical wave on September 15, becoming a tropical storm on the 16th. The storm reached hurricane-strength on the 17th and in the next several days reached a peak intensity of 155 mph, a Category 4 storm with central pressure of 937 mb attained on the 20th, 420 miles east of Guadeloupe. *Georges'* landfalls were numerous: the first at Antigua in the Leeward Islands on the 20th, the next over the U. S. Virgin Islands and Puerto Rico on the 21st (winds 115 mph), thence to the Dominican Republic on the 22nd (winds 120 mph). After crossing the Hispaniolan mountains, *Georges* again made landfall in eastern Cuba on the the 23rd with winds of 75 mph, continuing along the northern coast of Cuba for most of the 24th. Early on the 25th, *Georges* moved into the Florida Straits and reintensified, making landfall near Key West on the 25th (winds 105 mph). The storm continued on a west-northwest to northwest track on subsequent days, slowing down as it drenched coastal portions of Alabama,

Mississippi, and Louisiana September 27–28 and made a final landfall near Biloxi, Mississippi, on the 28th, with 105-mph winds. The storm was downgraded to a tropical depression by mid-morning on the 29th, 35 miles north-northeast of Mobile, Alabama. The remaining weak circulation center moved off the South Carolina coast on October 1.

Hurricane *Mitch* formed in the southwestern Caribbean Sea from a tropical wave 360 miles south of Kingston, Jamaica, on October 21, becoming a hurricane three days later. The storm reached a minimum central pressure of 905 mb (identical to that of *Camille* of 1969) about 40 miles southeast of Swan Island on October 26, the fourth lowest pressure measured in an Atlantic hurricane in the twentieth century. Winds of 180 mph made *Mitch* a strong Category 5 hurricane. The Caribbean island of Guanaja was first ravaged by the storm on the 27th; on the 29th, *Mitch* made landfall about 70 miles east of La Ceiba with 100-mph winds. The storm moved southward over Honduras and Guatemala and weakened to a tropical storm on the last days of the month, producing very heavy rains over portions of Honduras, Nicaragua, and neighboring countries, where the associated floods killed thousands of people. By November 4, the center had reemerged over the Gulf of Mexico and had again become a tropical storm, accelerating along a frontal boundary in the eastern Gulf. *Mitch* made a final landfall near Naples, Florida, on November 5 (winds 60 mph). By mid-afternoon of the 5th the storm had moved offshore of southern Florida and had become extratropical. Both *Mitch* and *Georges* were responsible for a few displaced birds on the North American continent, but their most significant impact was on the islands of the Caribbean and, in the case of *Mitch*, on the adjacent Central American mainland. Although several years will pass before the effects of these storms are understood, even for well-studied environments such as Puerto Rico's mountains (see Robert Norton's West Indies column), one should not necessarily assume the worst at this point.

Among the waifs of hurricanes, truly pelagic seabirds are typically in the minority, and this seems particularly true in years such as 1998, when Gulf Coast strikes outnumber those on the Atlantic seaboard. Other than in North Carolina and Virginia, very few tubenoses were noted in concert with 1998's tropical cyclones. In the history of storms that affect the Gulf of Mexico rather than the Atlantic coast, this is quite the norm and stands to reason, as the Gulf's waters hold far fewer tubenoses than do the neritic waters of the western North Atlantic (see Peake 1996). Band-rumped Storm-Petrels, noted twice in Texas after Tropical Storm *Frances*, are an exception to the rule, as they appear to be relatively common in the deepwater zones of the Gulf of Mexico. Single Cory's and Audubon's shearwaters and a Masked Booby were found dead in Cameron Parish, Louisiana, September 16, probably also done in by *Frances*. Observers in North Carolina reported moderately large numbers of dead Cory's Shearwaters on barrier beaches following *Bonnie*, but numbers of tideline corpses following hurricanes' passage are otherwise scarce in the literature, and large-scale mortality is virtually unknown in such cases in the western North Atlantic (an exception is found in *Auk* 16: 247).

Earl and *Frances* also both displaced many Magnificent Frigatebirds, particularly into the New Orleans area, whereas *Georges* apparently put seven frigatebirds into interior Alabama September 29–30, one into interior Mississippi October 7, and another as far as Pulaski County, Virginia, October 6. Frigatebirds have a fascinating history of storm displacement in the Atlantic and Gulf of Mexico. Many of the 90 or so eastern records north of the Carolinas since 1880 show little obvious association with particular tropical storms,

and their near-regular appearances on the Carolina coasts during the warm months suggest that they sometimes move northward on southwesterlies, outside the context of tropical cyclones (Brinkley, unpubl.; cf. Mlodinow 1999). On the other hand, as birds with extremely low wingloading, frigatebirds may be all the more sensitive to displacement and may move (that is, flee) well ahead of the center of the low pressure (see Lehman 1989 on *Gilbert* of 1988). A Magnificent at Chincoteague N.W.R., Virginia, September 20–27 thus may have been an early refugee from *Georges*, but the bird was so far from the storm's center that such an association would be undemonstrable, in the absence of a larger pattern, such as *Gilbert* showed. A paper on the displacement of frigatebirds into Florida's interior, interestingly, finds that the average number of frigatebirds appearing away from the coast differed little between major storms, minor storms, and more typical weather (McNair, in ms.).

Georges may have been responsible in part for the very unusual South Polar Skua action on the southeastern U. S. coast this fall. One on Jekyll Island, Georgia, stayed from at least October 16 through November 5, and another, in Florida at Fort Clinch October 7–10, remained here after rehabilitation October 18–25. Later, after *Mitch* had moved offshore of southern Florida November 5, another South Polar frequented Smyrna Dunes Park November 9–17. Inland and onshore Pomarine Jaegers were widely reported in hurricane-swept areas, with at least three in Florida very probably moved inland (following *Earl* and *Georges*), and another at Fort Morgan, Louisiana, September 12, after *Frances*. An unidentified jaeger, probably a Pomarine, was 20 miles inland in Mobile County, Alabama, September 29, clearly the issue of *Georges*. Gulls, other than the ubiquitous Laughing Gulls in the Southeast, are not often noted in the context of tropical cyclones, and the unprecedented numbers of Sabine's Gulls associated with Tropical Storm *Frances* (14+ Texas reports) was reminiscent of some of 1996's storms (Brinkley et al 1997). Elsewhere in the interior, however, record-high numbers of Sabine's were noted at widely separated locations; an increase in observer effort or a productive breeding season, or both, may be contributing factors to some of the Texas counts.

Terns are among the most conspicuous and widespread birds displaced by hurricanes, and though the numbers of terns detected may not be high, the variety is often very much so. Ten species of tern, plus Black Skimmer, were found in the southeastern states in the context of hurricanes, many of them deep into the interior, where rare. Gull-billed Tern, typically an early migrant, is among the least common tern species noted in tropical cyclones, especially storms that strike the northern half of the Atlantic seaboard. Hurricane *Bonnie* produced one at Sneads Ferry, North Carolina; *Georges* pushed another to Hattiesburg, a third for inland Mississippi. Another early migrant, Least Tern, was noted only early on, during Hurricane *Bonnie*, at Goldsboro, North Carolina. Not quite as early a migrant, Sandwich Tern is nonetheless generally scarce as a storm-waif. One at Lake Jackson, Florida, September 3, was clearly the work of *Earl*, and two at Goldsboro August 27 were undoubtedly put there by *Bonnie*. Royal Terns, probably the most numerous tern species detected as a storm waif, were noted after *Georges* in interior Alabama September 30, after *Bonnie* in interior North Carolina August 28 (with Forster's Terns), and interior Florida after *Earl*. It should be noted, though, that Royals have a minor history of wandering well into the continent's interior without apparent storm-transportation; two 1998 records in Florida and one at Callaway Gardens, Georgia, for instance, show no correlation with the year's tropical cyclones. *Georges* may have been the force that brought Florida's coastal and inland Brown Noddies to Homestead and

Boynton Inlet, where rare, September 25–26. Inland Black Skimmers were found in Georgia twice: September 11, after Hurricane *Earl*, and September 30, after *Georges*. Another *Georges* skimmer on September 30 in Henry County was inland Alabama's fourth, and Florida had three *Earl*-birds September 3, one in Leon County and two at Lake Jackson.

Terns that normally migrate across the continent's interior are often widely grounded by decaying tropical systems inland. About 45 Caspian Terns at Sam Rayburn Reservoir, Texas, following *Frances* September 13, may well have been grounded interior migrants. *Bonnie* felled four Black Terns at Lake Phelps, North Carolina, and 60 Blacks were at the Orangeburg Sod Farms, South Carolina, following *Earl* September 4. Of course, these birds may just as easily have been displaced from the pelagic zones, where Black Terns are common at this season.

Truly pelagic terns, however, have no presence in the continent's interior outside the context of storms. In North America, pelagic species are limited to Bridled and Sooty terns, and the latter has typically outnumbered the former by about 9:1 in the history of storm-displacement of these two species since 1869 (in 1996, about 15:2; in 1998, 9:2). Preliminary calculations of Bridled Tern's wingloading and aspect ratio suggest that Bridled has a higher wingloading than Sooty (32 as opposed to 24) and similar aspect ratio (10 versus 9.9; calculations made per Pennycuik 1989; Brinkley unpubl.). This relationship fits well with comparisons of other species groups in other families of pelagic birds, such as Procellariidae and Hydrobatidae within most groups, taxa with both relatively lower wingloading and higher aspect ratio values tend to be those that show greater propensity toward long-distance displacement. These numerical values, of course, relate to foraging and other strategies: the highly pelagic aerialist such as Sooty Tern has lighter wingloading as a result of evolution for covering vast expanses of ocean efficiently, for postnesting dispersal, foraging, colonization, and other aspects of its natural history.

Hurricane *Bonnie* produced a Bridled Tern at Goldsboro, North Carolina, August 27, and four at the Chesapeake Bay Bridge-Tunnel August 28–29; *Frances* put Bridleds into Cameron Parish, Louisiana (7 birds) and Calaveras Lake, Texas (2 birds); and *Georges*-related Bridleds were singles at Fort Walton Beach, Okaloosa County, Florida, September 28–29 and Henry County, Alabama, September 30. A minimum of 16 Sooty Terns was found during and after *Frances* in Texas, and "many" were seen and found dead after the same storm in Cameron Parish. An immature September 16 at Shreveport, Louisiana, was farther-flung. In Florida, *Earl* downed Sooty Terns at Newnans Lake and Lake Jackson September 3, but surprisingly few Sooties occurred on the heels of *Georges*; an immature at Pensacola and adults at Fort Walton Beach and Homestead were the only birds listed. In North Carolina, three Sooties were inland at Jordan Lake, and, in Virginia, 17 were at the Chesapeake Bay Bridge-Tunnel, during *Bonnie*.

Finally, in the roster of ruffled feathers, various long-legged waders and shorebirds were found in unexpected locations, and some of these "potluck" records strongly suggest storm-transportation or grounding. An immature Greater Flamingo at Fort Pierce September 28 and an adult at St. George Island October 23–24 were thought to have been displaced by Hurricanes *Georges* and *Mitch*. A recent article on hurricane displacement of flamingoes is much recommended (McNair and Gore 1998). Some of the Roseate Spoonbills noted in augmented numbers in central Texas in September were believed to have been moved inland by *Frances*. Shorebirds turn up in the strangest places after tropical cyclones, and their point

of entrainment in the storm is often difficult to surmise. *Bonnie*'s cargo in interior North Carolina included inland Black-necked Stilt, Long-billed Curlew, Marbled and Hudsonian godwits, and Red-necked Phalarope. Texas editors also comments on the effect of *Frances* on migrant passerines, surely an underinvestigated phenomenon.

Of particular interest, too, are the behaviors of the various seabirds displaced by such storms, in particular their flight behaviors during and following entrainment. As for *Bertha* and other storms in 1996, birders active after *Bonnie* and later tropical cyclones logged a wealth of observations of seabirds moving along with these intense systems.

In North Carolina, for example, it was apparent that tubenoses displaced into the sounds west of the barrier islands (the Outer Banks) were sufficiently disoriented or weakened by slow-moving *Bonnie* that some shearwaters and storm-petrels were still present a week after the storm's passage, when Tropical Storm *Earl*'s winds grazed the Carolinas. In most cases, observations of tubenoses in the sounds were made possible by windward shorelines or bridges, especially bridges oriented roughly perpendicular to the wind direction. In hurricanes that strike the Atlantic coast, the wind often shifts from northeast (prior to passage) to southwest (after passage), so that bridges or shorelines running east–west appear to be most productive.

In the case of *Bonnie*, on August 27, the Highway 264 bridge at Manteo (which runs east–west over the Croatan Sound) "corralled" a single Cory's Shearwater, two Black-capped Petrels, a dark-morph gadfly petrel (presumably a Herald [Trinidad] Petrel), two Band-rumped Storm-Petrels, and one small black-and-white shearwater (Manx or Audubon's). The flight behavior of all these tubenoses trapped in the waters on the south side of the bridge was identical: all flew upwind and away from the bridge, in a southwesterly direction, into a south–southwest wind of 20–25 knots. Gradually, the wind moved them northward, closer to the bridge ("backwards," inasmuch as their orientation was southwestward), and when within several hundred meters of the bridge, the birds became more active in flight, moving upwind more rapidly, often in powered flight rather than dynamic arcs, and then repeating the process, "slipping" slowly backward toward the bridge.

A week later, on September 4, observers noted that wind from the northwest, following *Earl*, concentrated a handful of Cory's and Greater shearwaters on north side of the Daniels and Baum bridges, east–west structures that cross the Roanoke Sound east of Manteo. These birds had clearly been deposited by *Bonnie*, as offshore charter fishermen reported seeing numbers of storm-petrels and shearwaters in the sounds during the week of August 28 through September 3. These shearwaters' behavior was similar to that of the birds in the Croatan Sound, though they frequently alit on the water, drifted closer to the bridges, then flew upwind, away from the bridges (repeating the process later). By contrast, the Currituck Sound bridge, a much larger structure, had concentrated only a single seabird, a Pomarine Jaeger, on August 27. This bridge runs north–south. Curiously, only one Bridled and three Sooty terns were seen in association with *Bonnie* in interior North Carolina.

After slowly crossing eastern North Carolina over the night of August 27, *Bonnie* moved off the coast of northeastern North Carolina and southeastern Virginia, where it restrengthened to a hurricane. After its passage just east of the mouth of Chesapeake Bay, with onshore gusts of up to 90 knots, observers at the Chesapeake Bay Bridge-Tunnel (which runs north–south for 17 miles across the mouth of Chesapeake Bay) on August 28 noted similar flight behavior in tubenoses and tropical terns. Rather few tubenoses were seen (as expected with hurricanes that pass to the east of the coast) but

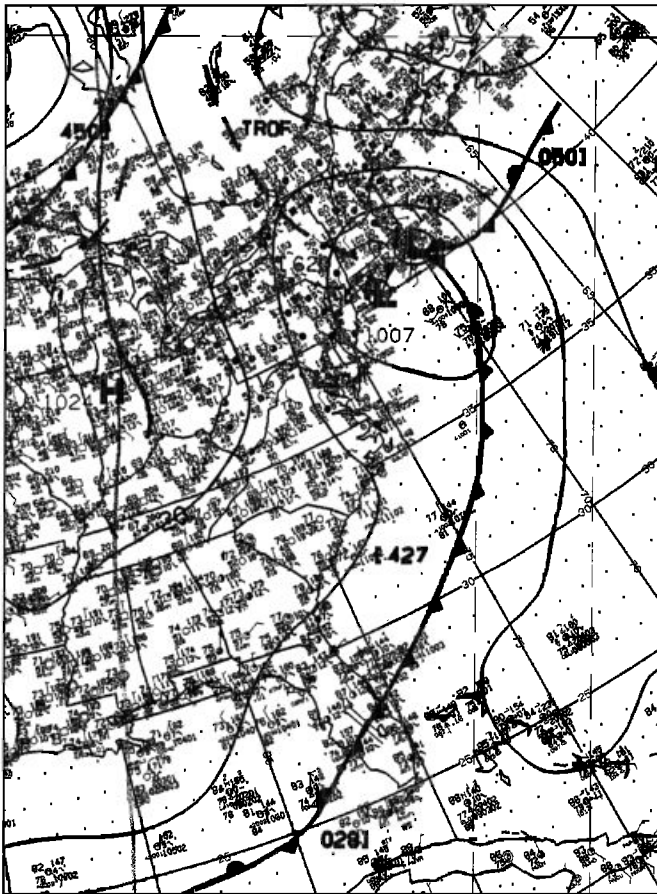


Figure 1. A surface map showing isobars for the low-pressure area (here off the New England coast, October 10) that drew thousands of migrant passerines from southern climes, presumably from around Florida, northward over the ocean to southwestern Nova Scotia and Cape Cod. National Climatic Data Center, Asheville, North Carolina.

quite a few dark-backed *Sterna* were in evidence. Of those tubenoses seen—singles of Cory's Shearwater, Black-capped Petrel, Band-rumped Storm-Petrel, along with several unidentified storm-petrels—all but the Band-rumped Storm-Petrel were flying into the 35- to 45-knot northwest wind (thus oriented roughly toward the bridge-tunnel), but in this case, moving off in a northeasterly direction. This cross-wind movement was most interesting in context of the birds' physical orientation upwind: the birds were not, as in North Carolina, hemmed in by the bridge (they were not on its windward side) but rather were slightly in the lee of the structure, oriented a bit north of northwest, and so traveling gradually offshore with the wind, though decidedly not downwind. Of great interest, too, was the observation that 17 Sooty and four Bridled terns were mostly employing the same sorts of locomotion as the tubenoses, the Sooties in particular.

It will take many more observations of this sort before speculation about these behaviors can become hypotheses, but in light of the recent work by Larry Spear and David Ainley on seabirds' flight behaviors (see Spear and Ainley 1997a, 1997b), particularly their observation that tubenoses for the most part tend to fly upwind more routinely than downwind, we may be another step closer to understanding how and why certain seabirds "wreck" during tropical cyclones and what behaviors they show in coping with this displacement.

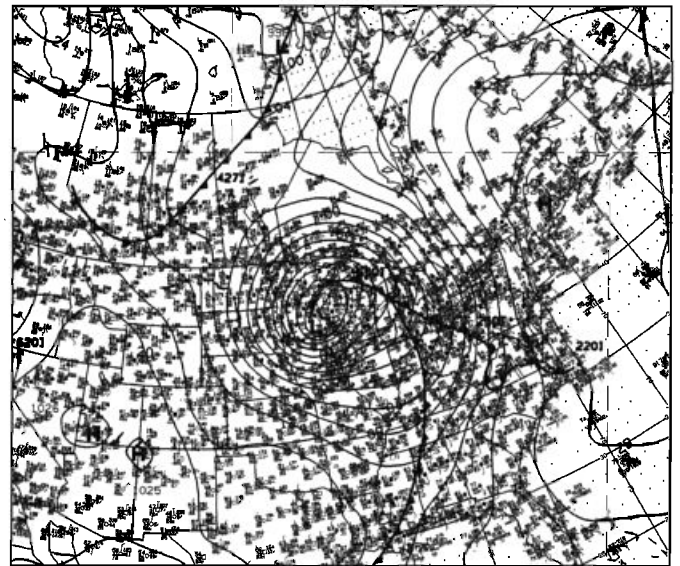


Figure 2. A surface map showing the tightly-packed isobars of the "Great Storm," the low-pressure cell that moved thousands of cranes, geese, and Franklin's Gulls well east of typical passage corridors (here November 10). National Climatic Data Center, Asheville, North Carolina.

THE OCTOBER FALLOUT IN NOVA SCOTIA

What Bruce Mactavish calls the "most astonishing fallout of autumn passerines ever witnessed in the Region" occurred in the far southwestern corner of Nova Scotia beginning October 11. Three days before, a cold front had reached the Atlantic coast and stalled from Cape Cod to northern Florida. Forecasters often call such a system a "Carolinas front," as influence is felt in areas to the north and the south of the mid-Atlantic areas. The front then pushed offshore over the night of October 9–10, and birders up and down the eastern seaboard anticipated good numbers of migrants, as are typically found in coastal hotspots after a night of north and northwesterly winds. If the structure of this front was not particularly uncommon, its timing and movement must surely have been (see McLaren 1981). Positioned in a shallow trough, the counterclockwise flow of a low-pressure area, its slow-moving center just off New England coast (Figure 1), ensured that northern and northwesterly winds indeed prevailed along the coast and offshore that night, triggering strong migration along the entire seaboard. At its periphery offshore, however, a strong southwesterly flow prevailed, so that birds overshooting the coastline at night, or birds bound for off-continent wintering grounds, found themselves in unfavorable winds. Such birds then engage in "reverse migration," moving downwind presumably in an effort to save valuable energy resources that would be quickly exhausted in attempts to fly into a headwind.

What must have happened, according to Ian McLaren and Blake Maybank, is that these reverse migrants, moving to the northeast over the Atlantic through the day on October 10, would have encountered deteriorating conditions as they approached the center of the low that evening. With the prevailing easterly and southeasterly winds off Nova Scotia (and to a lesser extent Cape Cod) of the following morning, the surviving birds would have made landfall at the first possible opportunity. On Cape Sable Island, Shelburne County, Nova Scotia, the birds began raining down on the island at about 3 PM. Here warblers and other migrants were seen coming in off the ocean on the heels of a southeast wind with rain, at about the same time. Bird banders on Bon Portage Island and Seal Island saw the

same phenomenon, in miniature. One imagines with difficulty the adrenaline-soaked astonishment of local birders tallying totals such as 700 Indigo Buntings, 120 Blue Grosbeaks, a Black-billed and 14 Yellow-billed cuckoos, 95 White-eyed, 20 Blue-headed, 32 Yellow-throated, four Warbling, six Philadelphia, and 925 Red-eyed vireos, one Western, eight Summer, and 100 Scarlet tanagers, or the hordes of warblers (almost 3000 warblers of 34 species). Most of the birds were gone within a week.

McLaren and Maybank attempted to correlate estimated relative abundances of the migrants seen in Nova Scotia with long-term records of tower kills of nocturnal migrants in northwestern Florida (where, it seems plausible, the bulk of Nova Scotia's fallout may have originated). They found that some proportions of birds in Nova Scotia were roughly suggestive of a Florida origin, especially the eight most abundant species: Red-eyed Vireo, Northern Parula, Black-and-white Warbler, American Redstart, Common Yellowthroat, Scarlet Tanager, Blue Grosbeak, and Indigo Bunting—all species largely absent from eastern North America north of Florida at this time of year and all species with high or highest mortalities in the tower-kill data from the first third of October. Statistically speaking, though, some of these more abundant species in Nova Scotia were present in numbers much higher than the data from Florida would have predicted (American Redstart, Common Yellowthroat, Scarlet Tanager, Blue Grosbeak, and Indigo Bunting) and likewise the proportions of other less numerous species were either too high (Hermit Thrush, Black-throated Blue and Black-throated Green warblers) or too low (Gray Catbird, Palm Warbler, House, Marsh, and Sedge wrens, Brown Thrasher, Wood, Gray-cheeked/Bicknell's and Swainson's thrushes, Nashville Warbler) to fit the data from Florida's tower-kills precisely. Adjusting the statistics with variables such as median wing-span and migration distance (possible indices of hardness for migration over open ocean) apparently did not affect these discrepancies.

McLaren puts the question: "Are wrens, thrushes, and mimids low-altitude migrants, particularly loathe to fly over water?" Certainly, the altitude of migratory flight and the readiness to fly over water would be possible variables that could explain the discrepancies between tower-kills (which probably over-represent proportions of low-altitude migrants) and the fallout's birds. The degree of difficulty in detection of less (or more) conspicuous species in certain terrains can also prove decisive when comparing data sets such as these. The possibility exists, too, that migrants from many different sites on the southeastern U. S. coast (not just Florida) were caught up and entrained by the low. The behaviors of terrestrial species that become entrained in storms over the ocean make for instructive comparison to those of pelagic seabirds displaced into equally dangerous terrestrial environments: in both cases, the birds' efforts appear to be to minimize the energy expended in entrainment (if not always the distance travelled during entrainment) and to minimize the time spent in the hostile environment. As one would expect, flight behaviors to achieve these goals appear to vary widely among groups of birds.

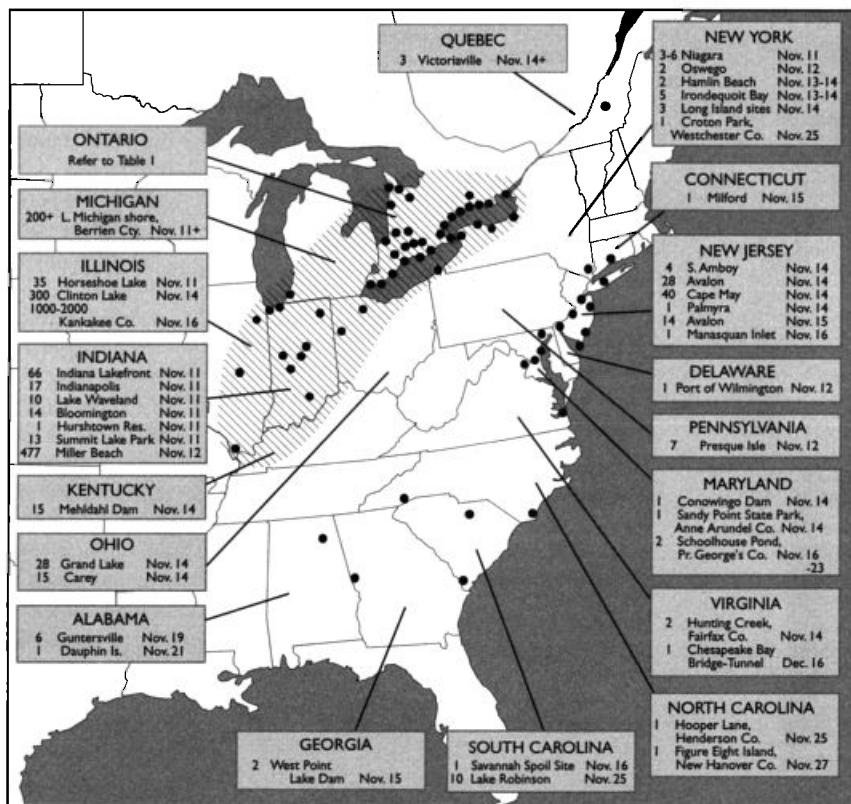


Figure 3. Records and reports of Franklin's Gulls following the "Great Storm" of November 9–11, 1998. The greatest fallout of gulls was detected between the Upper and Lower Great Lakes, south and southwest of Lake Michigan, and on the coast of New Jersey.

THE "GREAT STORM" OF NOVEMBER

Though at least one frontal passage October 3–5 moved enormous numbers of Snow Geese well east of their usual passages (with at least 10,000 birds in New Brunswick), it was the "Great Storm" of November 9–11 that was responsible for enormous displacements of geese, cranes, gulls, and other late migrants from the Great Lakes to the mid-Atlantic beaches and beyond. With winds of 50 to 70 mph, (and gusts of 90 to 100 mph) and the lowest barometric pressure on record for the Midwest, this storm was one of the strongest of the twentieth century for the midcontinent—in a corridor that regularly sees powerful low-pressure systems (Figure 2). After moving across the Great Plains, the system moved northeastward over Lake Superior, and the states from Iowa to Indiana had screaming westerlies that shifted northwest, while on Lake Michigan, southerly winds gradually shifted to the west. Veteran observer Dinsmore noted that the storm "produced one of the greatest mass migrations of waterfowl and arguably the largest migration of Sandhill Cranes recorded in Iowa this century."

The Franklin's Gull flight was without precedent for most states and provinces that recorded its progress (Figure 3). By the second week of October, large flocks (counts up to 60,000) had been staging in Iowa, the raw material for the displacement that would occur a month later in states and provinces east of the Mississippi River. The greatest numbers were found along a southwest/northeast axis from Illinois and Wisconsin through Michigan to Ontario, in other words, to the south of Lakes Superior, Huron, and Michigan (and for the most part north of, or along the northern shores of, Lakes Erie and Ontario). In Michigan and Wisconsin, probably more than 3000

**AUTUMN RECORDS OF FRANKLIN'S GULL
IN ONTARIO
FOLLOWING THE "GREAT STORM"**

NUMBER	LOCATION	DATES
1	Kingsville	November 11
1-63	Point Pelee	November 11-19
1	Cobourg	November 11-14
4	Presqu'île	November 11
1-27	Kettle Point	November 11-12
10	s. shore Lake Ontario, n. shore of Lake Erie, Niagara Frontier	November 11-12
1	Pickering	November 12
4	Humber Bay	November 12
3	Long Point	November 12
1	Oshawa	November 13
5	Owen Sound	November 14
3	Wolfe Island	November 14
1-10	Fanshawe Reservoir, London	November 13-21
19	Pittock Reservoir, Woodstock	November 18
10	Warton	November 18-19
6	Laurel Creek Reservoir, Waterloo	November 19
18-62	n. central Elgin County, se. Middlesex County	November 19-25
2	Port Perry (inland)	November 19
30+	Rondeau	November 19+
6-10	Oliphant (Lake Huron)	November 19-20
2	Van Wagner's Beach (Lake Ontario)	November 19
5	Toronto	November 19
2	Port Tyerse (Lake Erie)	November 19
3	Kincardine (Lake Huron)	November 19
3	Tavistock Sewage Ponds	November 19
2	Minesing Flood Plain	November 20+
4	Port Standley/Lake Erie	November 20+
6	fields n. of Ingersoll	November 20+
4	Wildwood Reservoir, St. Marys	November 20+

were detected, largely along the shores of Lake Michigan, but large flocks could be found inland for several days after the storm's passage. As many as several thousand were also found in interior Illinois, and 477 passed Miller Beach, Indiana, in only an hour and a half on November 12! As the winds died down, there was apparently some movement of birds into southern Indiana, according to editor Ken Brock. To the northeast, in Ontario, where well over 300 birds were recorded, the greatest concentrations were apparently in Middlesex, Elgin, and Oxford counties.

Where the birds went following their eastward displacement is difficult to discover. Some birds surely moved south, as noted in downstate Indiana, and records such as those of 10 Franklin's Gulls at Lake Robinson, South Carolina (northwest of Hartsville), November 25 suggest that large numbers may have passed undetected in reservoirs east of the Blue Ridge and Appalachian Mountains. Editors Paxton, Burgiel, and Cutler track the movement of small numbers along the Delaware River and Lake Ontario shoreline (where the sight of four adult Franklin's Gulls at Irondequoit Bay was extraordinary) and truly astonishing numbers along the Atlantic coast of New Jersey, where the Avalon seawatch noted at least 42 birds November 14-15, with similar numbers estimated at nearby Cape May on the 14th (where only a dozen single Franklin's had ever been recorded previously!). The concentration of birds on the Jersey shore may not simply be an artifact of greater observer effort (as at the seawatch, or at Cape May Point): observers in New England and coastal Virginia had been alerted to the phenomenon over the internet and made daily, diligent efforts to find Franklin's Gulls, for the most part without success. New Jersey's position to the southeast of the storm may have been ideal for the concentrations of gulls here—though why

and how the entrained birds would have ended up here is not immediately obvious.

Not surprisingly, some birds lingered into December at the southern extremes of the movement (at Cape May and near Cape Charles), but small numbers persisted into December even in Ontario (last birds being singles on December 1 in north-central Elgin County and December 5 at Turkey Point) and Michigan and Wisconsin. Florida saw above-average numbers of Franklin's Gulls in late November, involving some 14 birds in the last ten days of the month, and some of these were surely part of the eastward displacement.

Small numbers of Black-legged Kittiwakes and Sabine's Gulls were also noted in the context of this storm, but cranes were far more conspicuous, at least in the Midwest. Counts of Sandhill Cranes went through the roof, with between 2000 and 7000 birds moving south in Wisconsin, about 540 at Hitchcock Wildlife Management Area in Iowa, and 100 in Clay County, Missouri. Whooping Cranes were seen twice in Iowa and once in Illinois, all on November 11, with a single flyover at Illinois Beach State Park providing the Illinois's first firm record since 1958. On the same day, Iowa hunters saw a flock of seven to eight birds in Brenner County, and a single bird came to rest among Snow Goose decoys in Polk County!

Greater White-fronted Geese set records in the Southern Atlantic Coast region (where editor Ricky Davis noted "a major easterly shift in their migration"), as well as in Pennsylvania, Appalachian and interior Ohio, the Indiana lakeshore, western Florida, Mississippi, and Alabama. Snow Geese, along with small numbers of Ross's Geese, were also noted in greater numbers in often untraditional locations following the Great Storm; to what degree these augmented numbers reflect population increases in this case is unknown, but November 11-13 saw great Snow Goose flights in the six states of the Middlewestern Prairie region and in Louisiana and western Florida. Following the Storm, a strong count of 2300 Ross's Geese was made in Colorado County, Texas, and "unprecedented" numbers of Ross's were found in Québec (a flock of seven) and in all the states of the Middlewestern Prairie region. Perhaps connected to the weather event, Wisconsin and Michigan both recorded "unusually large numbers" of Richardson's Canada Goose (*hutchinsii*). Many locations across the border states and provinces reported very high counts of Tundra Swan during and after the Storm. A Wisconsin group of 8000 to 10,000 along the Mississippi River south of LaCrosse was impressive and equally so flocks of 10 and 14 in Québec, 14 in Vermont, and 16 and 28 in central and southern Massachusetts. Few editors, perhaps surprisingly, mentioned large concentrations of ducks displaced eastward by the storm. An Oldsquaw concentration at Point Beach, Iowa, of some 30,000 to 40,000 birds was most definitely scattered by the Storm, but to what parts is unknown.

WHITHER LA NIÑA?

El Niño/Southern Oscillation (ENSO) has received much attention in recent Changing Seasons columns (Price 1997, Patten 1998), particularly for the recent powerful El Niño event, which began in the middle of 1997 (Kaufman 1997, 1998) and had begun to abate by the spring of 1998 (Wamer 1998). By autumn 1998 the phenomenon had given way decisively to a so-called La Niña event, in which colder-than-normal waters move into the areas previously warmed. In sharp contrast to 1997, La Niña's associated weather patterns in 1998 encouraged, or at least did not hinder, the formation of strong tropical cyclones in the southern North Atlantic and Gulf of Mexico.

Other than this relationship, though, it is difficult to say what effects La Niña has had in the past year: perhaps because cooler waters are a bit closer to the "norm" on the North American west coast, the

effects of La Niña on birdlife are especially difficult to countenance in this informal forum. Certainly, the season lacked the incursion of large numbers of commoner warm-water seabird species well north of typical range (or lingering there late into the season): species such as Brown Pelican and Heermann's Gulls, for instance, did not make headlines. The heavy rains of the previous fall were for the most part absent, and thus Guy McCaskie writes in the Southern Pacific Region that migrants were able to pass through southern California without being grounded. On the other hand, eastern-central California did have at least one major low-pressure system in late September and early October that appeared to move migrants strongly toward the coast and offshore islands, whereas Seattle (following a very dry early autumn) recorded its rainiest November ever. The autumn and early winter were mild, and the winter would continue to be so, very much as in the previous winter, whose warmth was, in most media, tied to the presence of a strong El Niño.

In fact, despite the changeover to La Niña, regional editors in the Middle Pacific Coast and British Columbia write of the lingering effects of El Niño, and editor Norton of the West Indies region invites readers to consider the effects of El Niño for the tropical Atlantic (see that column for a relevant website reference). Writing for central and northern California, editors Roberson, Singer, Terrill, and Rottenborn hypothesize that both "El Niño/Southern Oscillation and more long-term oceanic warming in the eastern Pacific may be at least partially responsible for [the] rash of ultra-rarities" in California's ocean waters in recent years (see the cover of this issue). They continue: "Overall oceanic food availability decreases dramatically during warm-water years, resulting in birds dispersing much more widely than normal. Food may become relatively restricted to localized nearshore patches, and wandering birds may find and frequent these patches." Indeed, as several observers in California have noted, it is not the initial strong El Niño warming that produces the high counts of warm-water pelagic birds off that state but rather the *subsequent* year. Counts of Least Storm-Petrel and Xantus's and Craveris' murrelets appear to bear out this contention.

The impact of the oscillation on bird populations is difficult to assess in the absence of comparable data sets from past decades, as with all global climactic phenomena. As we await results of long-term monitoring projects, though, it will be profitable to stay abreast of the big picture: to this end, Daphne Gemmill of the National Oceanographic and Atmospheric Administration has assembled a bibliography of papers in the biological sciences relevant to ENSO's potential effects on birdlife. Many of these make fascinating, disturbing reading.

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