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THE CHANGING PATTERNS OF BRANT MIGRATION IN EASTERN NORTH AMERICA

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Abstract.—The pattern of Brant Migration through the Maritime Provinces of Canada has changed markedly since 1930, and the formerly authoritative accounts by Bent (1925) and Lewis (1937) no longer apply. In the 1930s, use of the coastal route through the Maritimes decreased greatly in favor of a direct movement between New Jersey and James Bay, leaving less than one-tenth of the Atlantic population following the coastal route in spring. Autumnal use of the coastal route virtually ceased by the 1940s. Spring use of Maritimes staging areas decreased between 1960–1964 and 1974–1985, but accounted for about 7% of the total wintering populations in both periods.

CAMBIOS EN LOS PATRONES MIGRATORIOS DE *BRANTA BERNICLA* EN LA PARTE ESTE DE NORTE AMERICA

Resumen.—Los patrones migratorios de *Branta bernicla* han cambiado notablemente a partir del 1930, por lo que los trabajos de Bent (1925) y Lewis (1937) no se ajustan a los movimientos actuales de estos gansos. En la década de 1930 el uso de la ruta costanera a travez de las Provincias Maritime (Cánada) disminuyó considerablemente en favor de un movimiento directo entre New Jersey y la Bahía James. Menos de un 10% de la población del Atlántico tomó la ruta costanera durante la primavera. Para la década del 1940 el uso de este ruta cayó en casi total deshuso durante el otoño. El uso en la primavera de la ruta de las Maritimes disminuyó durante los años 1960–1964 y 1974–1985, con tan solo un 7% de las aves utilizando durante ambos periodos la ruta de Bahía de Fundy/Golfo de St. Lawrence.

The western Atlantic population of Brant (*Branta bernicla*) is known to have changed in numbers dramatically during the last 60 yr (e.g., Rogers 1979). Observations in the Maritime Provinces of Canada in 1960–1984 suggest that Brant migration patterns have changed from earlier descriptions (Bent 1925, Lewis 1937). The accounts by Bellrose (1976) and Palmer (1976) seem to underestimate that change. The errors probably arise from the enormously increased volume of data accumulated since 1930, much of it still unsummarized and unpublished. No handbook compiler dealing with dozens of species can examine all sources of unpublished data, and most major bird journals discourage descriptive papers summarizing such information. I have assembled Brant data from the Maritime Provinces (New Brunswick, Nova Scotia, Prince Edward Island), and review the changes in Brant numbers and movements that became apparent from a comparison of Maritimes records with the overall picture.

SOURCES

The analysis is based on several, non-overlapping sources. A primary source is my repeated observations of Brant along the north shore of Nova Scotia (NS) during 1960–1969 and 1974–1985. An unpublished compilation for the Maritime Provinces (Aug. 1974) by Barry Hughson, then

of the Canadian Wildlife Service (CWS) drew on unpublished sources as well as published data. Very few of my records were included in Hughson's compilation. The published records of the Nova Scotia Bird Society (NSBS Newsletter 1957–1980, Nova Scotia Birds 1981–present) were abstracted, extending Hughson's coverage by 15 yr. The species files in the New Brunswick (NB) Museum (not consulted by Hughson) were abstracted, as the published summaries based on them (Squires 1952, 1976) were extremely condensed. Personal records of David Christie were also consulted.

An aerial survey, by United States Fish and Wildlife Service and CWS personnel, in May 1977 (A. Reed, unpubl. rpt. in CWS files) covered most Brant staging areas in Canada and the U.S.A. within a few days.

BRANT MIGRATION THROUGH THE MARITIMES

Table 1 summarizes the accumulated records of Brant migration from 1960 to 1984 for comparison with earlier periods. One striking feature of the movement through our area is the narrow width of the migration corridor (Fig. 1).

A few Brant reach the Maritimes in February, or late January in some years, but reported numbers seldom exceeded 200 in those months. The main movement evidently begins in March, when several thousands appeared at Grant Manan and at Brier Island, at the mouth of the Bay of Fundy. The last staging area to the southwest is apparently at Cape Cod (cf., Bent 1925, Palmer 1949, Phillips 1932), and the 400 km across the Gulf of Maine would require less than 7 h flight; birds leaving Cape Cod in the morning would reach the Maritimes well before dark. The numbers reported from Grand Manan and Brier Island are far larger than anywhere else around the Gulf of Maine, which suggests directed movement in daylight. The third major concentration area in the Bay of Fundy, at Maces Bay, New Brunswick, is about 1 h flight farther from Cape Cod, but the numbers there peak later, usually in April. Numbers farther south (in Nova Scotia) and northeast (up the Bay of Fundy) are much smaller, perhaps reflecting only dispersal to ice-free areas after arrival. Beaches and intertidal areas in the lower Bay of Fundy are partly ice-covered in winter and early spring, and the March arrival of Brant at Grand Manan and Brier Island probably evolved to match the time when suitable feeding areas there become ice-free.

Suitable areas in the upper Bay of Fundy probably could accommodate only a small part of the population, and the next important staging areas are in Prince Edward Island, northern Nova Scotia and eastern New Brunswick, which usually do not become ice-free until mid-April, a month or more later than at Grand Manan. My earliest record for the north shore of Nova Scotia was 4 Apr. 1968, at Linden. In the 1960s more Brant were seen at Linden than at more easterly locations during April, but in May larger numbers were found at Port Philip and Bayhead (Table 2). After 1970 I rarely found any Brant in the more eastern areas, and few in May. The milder, more open springs recently may allow Brant

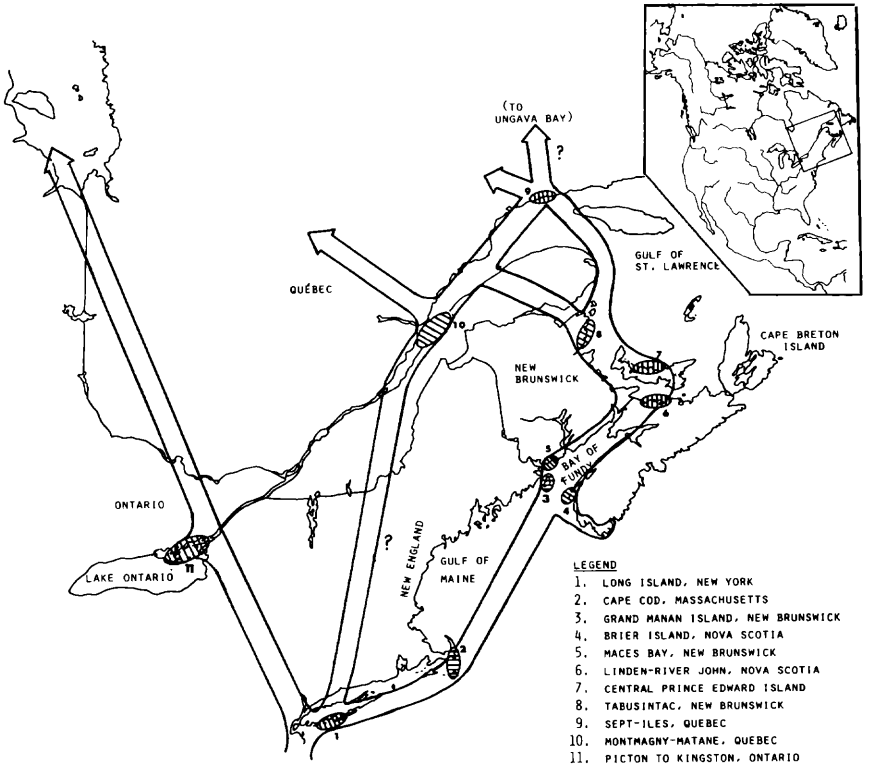

FIGURE 1. Spring migration routes of Brant in eastern Canada, with known (past and present) major staging areas.

to move farther north earlier than in the past. In the 1960s, from mid-April to late May Brant were found regularly in northern Nova Scotia and on Prince Edward Island. Counts on Prince Edward Island exceeded 2000 in the early 1960s, whereas the north shore of Nova Scotia harbored fewer than 1000 Brant. Traditional (illegal) hunting for sea ducks in eastern New Brunswick during April and May disturbed other waterfowl so that few people have made Brant observations there. Jack Wishart, long-time resident of Tabusintac, reported estimates of 6000 Brant as late as 1956, but Hughson and I were unsure whether those were peak counts, or cumulative totals, including repeated sightings, of staging flocks. CWS aerial surveys in 1974 and 1977 found only 1000 and 1400 Brant on those shores. The final departure from the southern Gulf of St. Lawrence varied from about 25 May to 5 Jun. in the 1960s; only in 1961, a very late spring, did I see over 100 Brant on a June survey in Nova Scotia. I saw no Brant east of River John (long. 63°03'W), although E. Holdway (reports to Nova Scotia Bird Society [NSBS]) saw a few at Pictou (62°40'W)—which I did not visit—in most springs in the 1960s;

TABLE 1. Summary, by months, of migration records and counts of Brant in the Maritime Provinces, 1960–1984. Concentration areas underlined.

Area (south to north)	Peak count in area during month (no. of years with records 1960–1985)				
	Feb.	Mar.	Apr.	May	Jun.
Shelburne Co., NS	9 (3)	60 (11)	60 (9)	34 (1) latest 24th/67	
Yarmouth Co., NS		12 (4) earliest 10th/77	45 (3)[a]	40 (1) latest 14th/80	
Digby Co., NS (mainly Brier Island)	100+ (10+)[b]	1000+ (13+)[c]	1000 (16+)	450 (11+) latest 26th (74)	
Annapolis Co., NS		10 (1) earliest 11th/67	3 (1)		
Grand Manan archipelago, NB	2000 (3+)	6500 (8+)	7000 (7+)	8000 (9+)	20 (3+) latest 12th/71
Charlotte Co., NB[d] (except Grand Manan; mainly Maces Bay)	20 (2) earliest 26th/71	900 (13+)	2300+ (19+)	600 (9+)[e] latest 29th/77	
Saint John Co., NB		12 (2) earliest 2nd/75	50 (2)	1 (1) latest 6th/73	
Kings Co., NS		180 (3) earliest 25th/64	72 (8)	225 (5) latest 15th/60	
Cumberland Basin, NS			70 (2) earliest 7th/73		15 (1) latest 9th/74
Albert Co., & S. Westmorland Co., NB			83 (8) earliest 3rd/67	35 (6) latest 29th/81	
Northumberland Strait S, NS & NB (Cocagne Is. to Pictou)		38 (1) earliest 24th/84	970 (14)	842 (12)	143 (5) latest 5th/3 yrs
Prince Edward Island			2280 (8)[f] earliest 5th/81	2202 (6)[f]	few (2) latest 6th/73
East coast NB (Kouchibouguac to Caraquet)		10 (1) earliest 29th/73	700 (3)[g]	1263 (3)[g]	50 (3) latest 12th/70
Bay of Chaleur (Carron Pt. to Dalhousie)			325 (6) earliest 3rd/66	270 (7)	9 (3) latest 12th/61 & 70

[a] 2000 in Argyle Sound in 1975 departed widely from usual pattern.
[b] 700 on 28 Feb. 1964 was early for so many.
[c] 3000 on 6 Mar. 1963 was far higher than any subsequent record.
[d] Peak #s are sums of Maces Bay and St. Andrews counts.
[e] 2000 at Maces Bay in 1977 is far above any other May reports.
[f] Both peaks on 1960 aerial surveys; later peaks (both 1974) were 1230 in Apr. and 870 in May.
[g] Both peaks on 1974 aerial surveys.

TABLE 2. Summary and comparison of Brant migration records by A. J. Erskine, northern Nova Scotia, 1960–1984.

Area (west longitude)	Mean number (frequency of records)[a]			
	1960–1969		1974–1984	
	Apr.	May	Apr.	May
Linden (63°49′)	167 (5/6)[b]	81 (5/8)	38 (5/6)	27 (1/4)
Port Philip (63°43′)	11 (2/7)	145 (9/10)	0 (0/5)	38 (1/3)
Bayhead-Tatamagouche (63°22′)	101 (1/2)	137 (5/8)	0 (0/3)	0 (0/2)
River John (63°03′)	0 (0/2)	94 (5/6)	no data	no data

[a] Omitting zero counts before earliest date or after latest date of record in any year.
[b] "5/6" means Brant seen on five of six visits during migration period.

one spring record at Merigomish Island (62°25′W) in 1977 (NSBS) was exceptional. Hughson noted small numbers seen in Prince Edward Island east to Souris (62°15′W) fairly regularly.

Recent data give few clues as to the destination of Brant that pass through the Maritimes. The former concentration at Sept-Iles, Quebec, (Lewis 1937) seems not to be important now (Bellrose 1976), but Brant using the coastal route may stage farther west. Lehoux et al. (1985) showed Brant using various locations in the St. Lawrence estuary, with peak numbers in the first half of May. These dates seem early for the coastal route, as peak Brant numbers in the southern Gulf of St. Lawrence in the 1960s persisted until late May. The 1977 aerial survey (A. Reed, unpubl.) found 12,000 Brant along the St. Lawrence estuary on 16 May. The 1700 farther east in Quebec, with 5100 in the Maritimes and 1300 in New England east of Long Island, New York, in the same week, added up to over 8000 Brant using the coastal route, which agreed with other estimates in the 1970s (see Table 3). If the 12,000 on the upper estuary of the St. Lawrence arrived by the coastal route, passage through the Maritimes in April and early May would have to be more rapid than is suggested by counts in the larger staging areas of the Maritimes.

One alternative is a direct overland flight bypassing the Maritimes, probably from the Long Island area to the St. Lawrence estuary, as was assumed by Vangilder et al. (1986). No reports of large numbers of Brant migrating overland along such a route have been received (A. Reed, pers. comm.); in view of the high lands along that route, the birds might fly too high to be detected from the ground. Such a flight is energetically possible for Brant, as described by Vangilder et al. (1986), but it has not been verified. In the estuary and northern Gulf of St. Lawrence, eelgrass (*Zostera marina*), a preferred food of Brant, never recovered after the die-off around 1930 (A. Reed, CWS, in litt.), although recovery in the Maritimes was complete. Without the abundant food in the northern Gulf that formerly allowed replenishment of fat reserves by large numbers of Brant, the main benefit to the birds following the longer coastal route is that the population could spread out during March and April, as coastal

TABLE 3. (a) Estimation of spring Brant numbers in the Maritimes and (b) Comparison with winter populations on the Atlantic coast, 1960–1964 and 1974–1984 (figures rounded to nearest 50, except 1977 survey).

	Maximum spring population estimates[a]						
	Mar.		Apr.		May		
(a) Area	1960–1964	1974–1984	1960–1964	1974–1984	1960–1964	1974–1984	1977
i) In Bay of Fundy							
Brier Island	3000	1000	1000	1000	500	450	
Grand Manan	6500	3700	7000	5300	8000	550	
Maces Bay	500	400	2000	1650	150	300	
	10,000	5100	10,000	7950	8650	1300	1513
ii) In Gulf of St. Lawrence							
PEI			2300	1250	2200	850	1093
North NS			1000	350	900	500	2534
East NB			700	700	1300	1250	
			4000	2300	4400	2600	3627
Overall (rounded to 1000s)	10,000	5000	14,000	10,000	13,000	4000	5140

(b)	1960–1964	1974–1984
Winter estimates (from USF & WS unpubl.)	124,600–265,600 mean 197,000	35,000–127,000 mean 89,000
Spring estimates in Maritimes[b] (from above)	12,000 (6%)	6000 (7%)

[a] Highest single day figures covering most concentrations in area shown.
[b] Mean used (rather than maximum) to reduce possibility of duplication between Bay of Fundy and Gulf of St. Lawrence areas within a month.

feeding areas became ice-free, long before staging areas in James Bay and northward were accessible. Dispersal along the coast would reduce pressure on food resources during the period when the birds are building up fat reserves prior to the main movement north to the breeding areas.

There are no recent observations of migration northward beyond the gulf and estuary of the St. Lawrence. The former Sept-Isles staging area would be preferable to the St. Lawrence estuary (Quebec-Matane) mainly for departures northward to Ungava Bay—880 km from Sept-Iles vs. 1050–1200 km from the estuary. The distance to James Bay is comparable from both staging areas. The scarcity of Brant in the northern Gulf now suggests that migration via Ungava may no longer occur (A. Reed, in litt.). Lewis (1937) indicated that Brant did not stop in Ungava Bay, but merely passed there enroute northward. Vangilder et al. (1986) suggested that such a migration would be possible only with good feeding opportunities for replenishing fat reserves before the flight. I conclude that Brant migrating through the Maritimes now continue northward largely or exclusively by way of James Bay.

MacLaren Marex Inc. (1979) reported some Brant around the northern tip of Labrador, and near Frobisher Bay (Ikaluit), Northwest Territories, in May–Jul. 1978, with most birds in 9–10 Jun. Those birds were 300–500 km east of any migration route along the east side of Hudson Bay; possibly they represented remnants (<1000 birds in all) of the former migration by way of Ungava Bay, but drift during migration seems equally plausible as an explanation of their presence.

Fall migration of Brant through the Maritimes now is almost nonexistent. I saw them only once in fall. Similarly, the NSBS records included fall dates in only a few years, notably in 1977 from 15 Nov. onward, with a remarkable estimate of 2000 birds in the Upper Bay of Fundy on 9 Dec. The only recent Brant wings from the Maritimes in the CWS species composition survey also were received in 1977. A few Brant stayed around Brier Island all that winter, the only recent year with records outside of Grand Manan, although Christmas Bird Count reports occur every few years. The earliest fall records were in late October, but one Cape Breton Island record (15 Sep. 1968, 15 birds) and one at Pictou (10 Sep. 1963, nine birds) seemed so aberrantly early that birds of a different (High Arctic?) population might have been involved.

BRANT MIGRATION FARTHER WEST

The major spring movement of Brant in eastern North America now leaves the Atlantic coast near Long Island and runs overland to James and Hudson bays (Bellrose 1976), with a relatively small proportion stopping enroute on Lake Ontario (cf., Quilliam 1965). I saw what were apparently Brant flying northwest in western Quebec almost on a direct line from Long Island to James Bay, on the evening of 22 May 1970. If Brant leave the Long Island coast in the morning, a continuous flight at 60 km/h would bring them to Lake Ontario by afternoon, into western Quebec by evening, and to James Bay by dawn the next day; at 100 km/h (Palmer 1976), Long Island to James Bay would be only a day's flight (14 h).

In fall, the main movement of Brant passes southward through Hudson and James bays and thence overland to the Long Island area (Bellrose 1976). Stopovers on Lake Ontario are less regular than in spring (Quilliam 1965; Sprague and Weir 1984); possibly fall flights pass over that area during darkness, although that would call for evening departures from James Bay, in contrast to the daytime migration suggested in spring.

CHANGES IN MIGRATION PATTERNS

Bent (1925) reported that the main Brant movement in spring followed the coast northeastward to Cape Cod, crossed the Gulf of Maine to the Bay of Fundy, continued across the isthmus to the Gulf of St. Lawrence, and staged at Sept-Iles before departing northward or northwestward overland. Overland migration to the St. Lawrence estuary was considered a minor variant. Lewis (quoted by Bent 1925, Lewis 1937) believed that

almost the entire population stopped at Sept-Iles; however, his estimate of total numbers (about 60,000) seems improbably low, as Phillips (1932), for the same period, cited single-day local counts as high as 80,000 birds in New Jersey. Phillips' estimate of one-third of a million birds as the maximum population in the 1920s is considered realistic (Rogers 1979). Rogers concluded that, after the widespread eelgrass die-off, total Brant numbers were unlikely to have decreased by as much as 90%, as asserted by Cottam (1934); poor reproduction coupled with continued hunting were a more plausible explanation of the decline than mass starvation. Neither Cottam or Rogers seem to have considered that a major shift in Brant migration routes occurred coincident with the disappearance of eelgrass from the coast. Lewis (1937), however, closed his account by asking what route Brant could be using, if most of the population no longer visited Sept-Iles.

Brant began to appear on Lake Ontario during migration sometime during the 1930s (Sheppard 1949). Quilliam (1965) noted Brant regularly at Kingston, Ontario, with single-day counts up to 2000 birds, where earlier observers in 1890 to 1930 had reported no Brant. Thus, the present migration route, passing directly northward from Long Island to James Bay in spring, and in the reverse direction in fall, became established only in the 1930s.

Palmer (1976) suggested that about half the population used the coastal route in spring, but Bellrose (1976) inferred that the majority now use the inland route. Hughson in 1974 (unpublished) concluded that not more than one-tenth of the population use the coastal route in spring. I heard similar views from CWS biologists in the Maritimes as early as 1960, but nothing was published, and Lewis' (1937) account has remained the accepted pattern. My estimates of the numbers passing in spring in comparison with the total winter figures (Table 3) confirm Hughson's assessment, with about 7% of the population using the Bay of Fundy/Gulf of St. Lawrence route. The high numbers on the St. Lawrence estuary in May 1977 remain an anomaly.

The fall migration pattern described by Bent and Lewis was the reverse of that in spring. Palmer (1976) indicated that fewer birds used the coastal route in fall than formerly, and Bellrose (1976) stated that the bulk of the population migrated overland. The late G. F. Boyer (CWS, unpubl.) noted that the fall flight of Brant through the Maritimes had virtually vanished by 1945, and recent evidence supports that view. The second- or third-hand reports quoted by Bellrose (1976) may have reflected only memories of the former situation.

DISCUSSION

As remarked by Hughson, "a crucial unknown, especially of early estimates, is the credibility which can be assigned (to) particular large estimates. . . ." Hughson believed that local ground counts "provide . . . little insight into the magnitude of the flight," in contrast to wide-ranging aerial counts. However, I suggest that, given the few areas at which Brant

stop off in numbers with any regularity, ground counts of known concentration areas provide important insights on population variations. The main caveat is that single counts or estimates must always be tested against the overall pattern. Some reported figures are obviously implausible. Phillips (1932) discounted an alleged 4 million Brant passing Cape Cod in the spring of 1887. A record is in CWS files for Sept-Iles of 492,700 Brant in the spring of 1929, but no other count between 1922 and 1934 exceeded 92,000; probably the 1929 figure involved a clerical error. Most peak counts from the Bay of Fundy in 1935–1959 were round figures of 5000 to 20,000, whereas recent figures from the same areas are a few hundreds to a few thousands; the numbers using the coastal route clearly have declined (cf., Table 2). There may be no valid grounds for dismissing all the earlier large counts as simply guesswork.

Winter estimates of the west Atlantic population of Brant varied from 35,000 to 266,000 (Rogers 1979) between 1935 and 1979. As the total population declined in the early 1930s, the North Carolina wintering stock was depleted while the New Jersey one held its own, thus becoming relatively more important. Following a die-off of Brant during severe ice conditions in New Jersey in 1976–1977, the proportion of the population wintering further south became more important again (e.g., Kirby and Obrecht 1982).

We lack data on trends in the breeding areas of this Brant population. Brant are Arctic nesters, and subject to "boom or bust" variations in reproductive success, (cf., Barry 1962, Phillips 1932). Individual stocks in the north probably have fluctuated greatly in size, and some may have disappeared (Boyd 1979; cf., Palmer 1976). The change in numbers of Brant following the coastal migration route may reflect changes in sizes of particular breeding stocks as well as shifts in migration route. The map by Bellrose (1976, p. 171) showing the coastal route connecting via Ungava Bay to Greenland and Ellesmere Island breeding areas seems less likely than a connection with the north Hudson Bay stocks, and later versions of the same book do not show the Ungava Bay route at all. Phillips (1932) implied that a few hundred thousand Brant formerly used the coastal route. Such large numbers could not have bred in the High Arctic at any recent period; even if some of them formerly travelled north via Ungava Bay, they presumably dispersed westward from southern Baffin Island. Migration via James and Hudson bays has been linked only with Low Arctic breeding areas around Foxe Basin and westward. Overland migrations must be traditional; marine birds are likely to initiate such flights only in the company of others that have used them in earlier years. At times of major population reduction, it would be possible for a particular traditional route to be abandoned (cf., Hochbaum 1955), as the Ungava Bay route seems to have been lost. Recent concern over a return of the eelgrass blight in New England (Kelley 1986) makes it desirable to document what happened to Brant migrations in the northeast over the past 60 yr.

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