

Greenland Geese in

Migratory geese are a common sight in eastern North America in fall, winter, and spring. Each year there are extralimital sightings of these birds, especially those of possible Greenland origin. Extralimital reports of Barnacle Geese have been contentious because this species has been popular with wildfowl breeders, and escapes are well known. This analysis explores changing trends in both populations and extralimital occurrences of Greenland geese in North America.

These changes are especially useful in trying to understand North American occurrences of Barnacle Geese. Brant, which also breed in Greenland, are not considered in this survey.

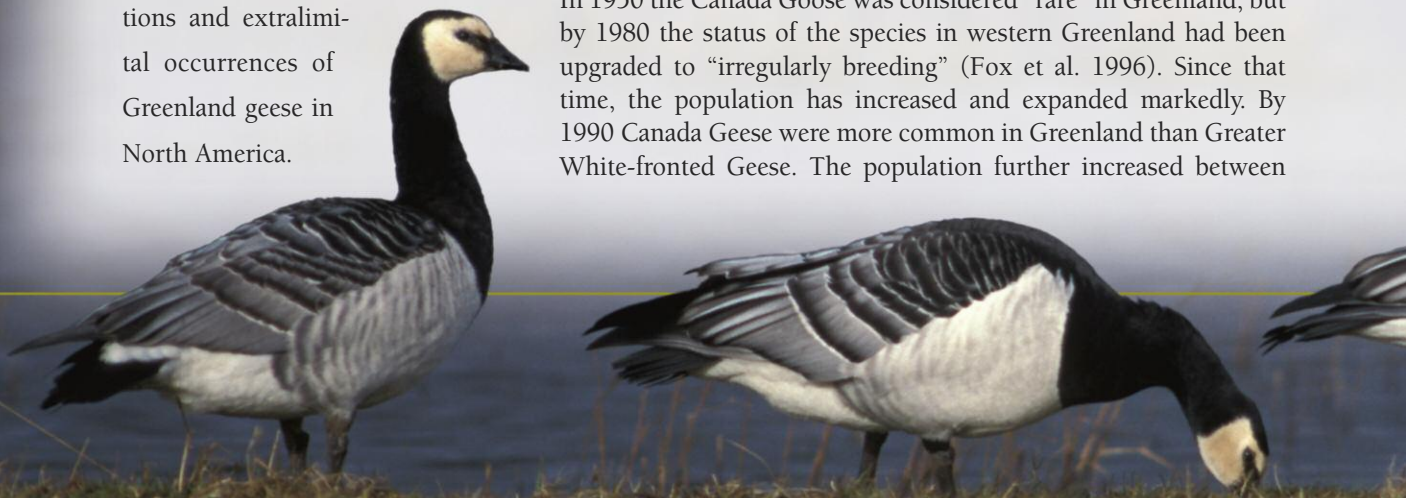
Methods

I thoroughly searched the continental literature (*American Birds—AB*, *Field Notes—FN*, and *North American Birds—NAB*, collectively referred to as *NAB*) for the 25-year period 1979–2004 for reports of geese of possible Greenland origin. In analyzing these reports, I eliminated duplicate sightings suspected of being the same bird, as indicated by regional editors. All plotted data (Figs. 1–5, pp. 52–53) show the date on which a bird was first reported. Sightings of Barnacle Geese over the same 25-year period in the Midwest were collected from additional reports in state journals.

Greenland Goose Species

Canada Goose Complex

In 1950 the Canada Goose was considered “rare” in Greenland, but by 1980 the status of the species in western Greenland had been upgraded to “irregularly breeding” (Fox et al. 1996). Since that time, the population has increased and expanded markedly. By 1990 Canada Geese were more common in Greenland than Greater White-fronted Geese. The population further increased between



North America

1999 and 2005. Now, Canada Geese breed north to the Thule region of Greenland, and molting flocks have been found in southwestern Greenland. They inhabit the same areas as Greater White-fronted Geese but at smaller spatial scales are segregated (A. D. Fox, personal communication). Three populations of the Canada Goose complex have been found in Greenland: the *parvipes* and *interior* subspecies of Canada, along with Cackling Goose (Boertmann 1994, Fox et al. 1996). However, only *interior* Canada Goose regularly breeds in Greenland (Scribner et al. 2003); it winters in the eastern U.S. and Canada from Ontario to as far south as South Carolina (Bellrose 1976). To date, 136 Canada Geese have been collar-banded in Greenland. Of these, 44 different individuals have been sighted 122 times in North America, mostly in Massachusetts, New York, New Jersey, Connecticut, and Pennsylvania, but also from other eastern states and eastern Canadian provinces (Kristiansen et al. 1999; A. D. Fox, personal communication). M. S. Sznatyr (in Perkins 1998) mentions that at least six Greenland neck-collared Canada Geese have wintered in Connecticut.



Snow Goose

Snow Geese breed mostly in northern Greenland in the Thule area, and they also breed sparsely from the northern part of the west coast, across the north coast, and into the northern part of northeastern Greenland (Lambert Land). Although the primary breeding population is the

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Barnacle Goose. Islay, Scotland; February 1994. © David Tipling / VIREO.

The numbers and diversity of wintering geese appear to have been increasing in recent decades in eastern North America. To what extent are these geese drawn from populations that breed in Greenland? This article summarizes recent population trends of migratory geese in North America, and examines the hypothesis that Greenland is a major point of origin for these birds.



Canada Goose (rear) and **Cackling Goose** (front). Clark County, Ohio; November 2004. © Robert Roysse.

Greater Snow Geese subspecies, both blue-morph and white-morph Lesser Snow Geese have been reported as rare summer visitors (Boertmann 1994). There are no estimates of the population of Greenland Snow Geese, but the total population of Greater Snow Geese has been increasing for the past 20 years. There are currently approximately 800,000 wintering in Maryland (Hindman et al. 2005). The Greenland birds migrate with and are part of the main body of this subspecies from north-eastern Canada (Ellesmere Island, Devon Island, and Baffin Island); they migrate through Baffin Island and the Ungava Peninsula to the St. Lawrence estuary around the areas of Montreal and Québec, and south through Lake Champlain; they winter along the Eastern Seaboard (Mowbray et al. 2000).

Pink-footed Goose

Pink-footed Geese breed in northeastern Greenland in the same general regions as Barnacle Geese but are concentrated farther south and are found more sparsely in southeastern Greenland. They winter in the British Isles, mostly in Scotland (Boertmann 1994).

There are 17 reports in *NAB* from eastern North America during the period 1979–2004; many of these represent multiple sightings of the same bird moving around during the fall

and winter seasons. The first listed North American record of Pink-footed Goose occurred in May to early June 1980 at St. Anthony, Newfoundland (AB 34:755). However, there is a record for Pink-footed Goose from before the time of my analysis, from Bombay Hook, Delaware, in November 1953 (FN 51:849). The second North American record came from Cap Tourmente, Québec, in October 1988 (AB 43:69). A single bird was found on Long Island in January 1991 (AB 45:254).

The first record of multiple birds occurred in the spring of 1995 when a gale with northeasterly winds on 25–28 April deposited a

number different species of westbound Eurasian migrants along the headlands of eastern Newfoundland. Included were five sightings of possibly four different Pink-footed Geese (Knowles 1995, FN 49:221). In 1997, 1998, and 1999, single Pink-footed Geese were reported in Québec, Connecticut, Vermont, and Pennsylvania. Then in November 2001 and 2002, there was a series of sightings in Penn-



Snow Goose. Rio Grande, New Jersey; December 2006. © Kevin T. Karlson.

sylvania and Québec that could refer either to an earlier bird or to a new individual. In December 2004, the second record of multiple birds occurred on Prince Edward Island when three birds were documented. They spent the winter between Nova Scotia and Prince Edward Island (NAB 59:230, NAB 59:396), and were considered wild.

There is at least one West Coast record. That record is of two Pink-footed Geese from Washington state in November 2003 (NAB 58:132). Although the birds arrived after a storm system, the record has been questioned on the basis of origin.

Greater White-fronted Goose

Greater White-fronted Geese were rare in the eastern U.S. before 1980. Most reports from that time came from the Hudson-Delaware region (Delaware, Pennsylvania, New Jersey, and Long Island). Surprisingly, there were almost no reports from Atlantic Canada (Newfoundland, Nova Scotia, Prince Edward Island, New Brunswick, and Québec). Early on, Greater White-fronted Geese were often considered to be escapes but, in New York, that view began to yield to the possibility of rare migrants (Kibbe 1981). Sightings continued to increase, and by 1995 the species had become annual in small numbers throughout the Atlantic Provinces of Newfoundland, Nova Scotia, New Brunswick, and Prince Edward Island, as well as in eastern coastal states. The species was considered routine in southern New England by 1999 (Perkins 1999). Ever since birders began to take notice, the Greenland race was reported more frequently. K. Knowles (personal communication) states that, of the Greater White-fronted Geese identified to race from Newfoundland, about a dozen, mostly from hunters, were of the Greenland subspecies.

As discussed by Ely and Dzubin (1994) and Dunn (2005), the names and number of subspecies of Greater White-fronted Goose in North America remain in contention. Gibson and Kessel (1997) describe three subspecies breeding in Alaska: *elgasi*, the largest and darkest (Tule Goose), wintering in the Sacramento Valley; *frontalis*, the smallest and palest (Pacific Greater White-fronted Goose), wintering in western North America; and *gambeli*, large and pale, wintering on the Great Plains and occurring sporadically in the eastern U.S. Other authors refer to birds

wintering on the Great Plains as *frontalis*. The subspecies *flavirostris* breeds in western Greenland and winters in Scotland and Iceland. The Greenland population was about 23,000 in 1950, declined to about 15,000 in 1970, and has since increased. The census of 1991 counted about 29,400 birds (Boertmann 1994) but the species has experienced a



Pink-footed Goose. Scotland; January 2005. © J. Peltomaki / VIREO.

decline since 1999, and it now numbers about 23,000 (Malecki et al. 2000).

Kaufman (1994) warns that bill color alone may not be sufficient to separate the Greenland race and recommends against assigning specific subspecies to field sightings. Rutt (2006) reviews the differences in behavioral and field characteristics of *frontalis* and *flavirostris* based on museum specimens and field observations, and provides the best current information on separating the two subspecies.

During the period 1979–2004, there were 73 reports of Greenland Greater White-fronted Geese in *North American Birds* that were identified as being of the Greenland race or cited as having orange bills. I have taken the entire population to represent Greenland birds, recognizing the possibility of errors. Of these, there was evidence to suspect that three occurrences were of escapes. The temporal distribution for the remaining 70 reports is shown in Figs. 1 & 2, divided between the Canadian provinces (Nova Scotia, Québec, Newfoundland) and the eastern coastal states. Of these 70 reports, 26 are of more than one bird, with the highest count reported in one group as 13 (AB 39:280). Most reports for Greater White-fronted Goose from eastern

North America do not indicate subspecies. The Greenland race is most common in Nova Scotia and Québec and on the Eastern Seaboard from winter to spring.

One Greenland Greater White-fronted Goose, collared in Wexford, Ireland, was seen in Montgomery, Pennsylvania, on 7 December 1990 and was back the following winter at Wexford, where it continued to return until at least the winter of 1993 (A. D. Fox, personal communication). Three other Greenland-banded Greater White-fronted



Greater White-fronted Goose. Atlantic County, New Jersey; February 1995.
© M. Hyett / VIREO.

Geese have been recovered in Canada: New Brunswick, 22 October 1966; Québec, 12 October 1946; and Magdalen Island, Québec, 1 October 1959 (Lyngs 2003; D. Boertmann, personal communication).

There are three sightings of immature Greenland Greater White-fronted Geese in *American Birds*: two adults with four immatures at Kerrsville, Virginia, March 1985 (AB 39:280); two immatures at Economy, Nova Scotia, January 1999 (NAB 53:139) that were suspected of being introduced birds; and an immature that took up residence with domestic waterfowl in Renewes, Newfoundland, in October 1993 (AB 48:82).

Hybridization is common among geese. An adult Greenland Greater White-fronted Goose with three hybrid immatures was seen at Woodbury, Connecticut, December 1989 (AB 44:236), and this same combination was reported in Québec the following April (AB 44:393). Another Greenland Greater White-fronted Goose with a hybrid young was reported in April 1985 in Maryland (AB 39:280).

Barnacle Goose

There are three non-overlapping populations of the Barnacle Goose: the Russian / East Baltic population wintering in the Netherlands and northern Germany; the Svalbard population wintering on the Solway Firth, Scotland; and the Greenland population wintering in western Scotland and western Ireland. The Greenland population, censused at 9,000 in 1959, had grown to 54,000 in 2003 (Worden et al. 2004). Barnacle Geese breed in northeastern Greenland, ar-

iving during May and departing in late August to early September. They are rare in western and southeastern Greenland (Boertmann 1994). They breed on inaccessible cliffs, small islands, and low tundra. Barnacle Geese feed in valleys and coastal fringes and on river banks, usually within one kilometer of the sea or open water (Cramp and Simmons 1977). They roost in salt marshes, on intertidal sandbanks, and on small offshore islands. They rarely travel more than five kilometers from their roost to feed, and they tend to return to the same wintering sites (Owen et al. 1986). These habits are important when considering the legitimacy of extralimital birds. Extralimital occurrences of the Greenland population come from Norway, Germany, and as far south as Valencia, Spain (Roberson 1985, Salomonsen 1959).

Roberson (1985) gives a summary of 74 reports of Barnacle Geese in North America prior to 1980 taken from a wide variety of sources. Eight of these were in the 19th century, and the earliest record was from Rupert House, James Bay, Québec, in 1867 (Todd 1963). Data are sporadic until 1950; by 1960, there were 1–3 reports annually. These reports were not used in the analysis conducted for this article.

There are about 157 reports of Barnacle Goose in *NAB* during the period 1979–2004. Of these, 33 can be disregarded for various reasons, leaving 124 of unknown origin. Of these, only 11, or about 9%, are of more than one bird, and the highest number reported is three. During the period 1979–2004, all other groups of Barnacle Geese with more than three birds were part of a suspected release or were of unknown origin and are discussed below. The only large group suspected of natural origin occurred 29 November 1969 when a flock of seven was reported in Nova Scotia (Palmer 1976, *AFN* 24:14).

Among the reports is a single sighting of an immature

Barnacle Goose on 6 February 1986 at Bombay Hook National Wildlife Refuge (AB 40:262). There are two records of banded birds with no information as to band type (AB 42:244, AB 59:246). And there are three reports of hybrid Barnacle × Canada Geese. There is one report of an immature flightless Barnacle Goose, presumed to be wild, found on Funk Island 25 miles off the coast of Newfoundland on 8 August 1997. Finally, there is only one report in NAB of a summering Barnacle Goose, a bird that spent the summer at Machias, Maine (NAB 59:42). All these records, including those of both known escapes and banded birds, have been excluded from any timing analysis of eastern Barnacle Geese except the immature from Funk Island.

Fig. 3 shows the annual sightings of Barnacle Geese as reported. Each data point represents the total number of reports in fall, winter, and spring. Data of all known duplicate sightings were eliminated. The data show a general trend of increasing sightings over time, with marked increases in the periods 1994–1996 and 2001–2003.

The data for Fig. 3 are further divided by timing in Fig. 4, which shows sightings from Atlantic Canada. Fig. 5 shows sightings from 14 eastern coastal states: Maine, New Hampshire, Vermont, Delaware, Connecticut, Rhode Island, Massachusetts, New York, New Jersey, Pennsylvania, Maryland, Virginia, North Carolina, and South Carolina. As expected, birds seen in northeastern Canada leave in fall and return in spring; in between those seasons, there are winter records in the coastal U.S., raising the possibility that northeastern Canada is a stopover site for individuals wintering along the U.S. East Coast (see Figs. 4 & 5). But the reports also show a higher number of spring sightings than fall sightings in Canada. This same effect is also seen in Fig. 1 for Greenland Greater White-fronted Geese.

The greatest number of reports of Barnacle Geese for eastern North America comes from Québec. This province accounts for 24% of all eastern North American reports and 79% of all Canadian reports in NAB. Almost all come from the St. Lawrence and Ottawa Rivers. Ninety percent of these occur from Ottawa to Montreal along the Ottawa River and from Montreal to about 40 miles north of Québec City around the St. Lawrence River. In the 14 coastal states included in Fig. 5, 70% of all sightings come from five eastern states: New York, Pennsylvania, Maryland, New Jersey,



Barnacle Geese. *England; early winter.* © J. Cancalosi / VIREO.

and Connecticut. These states are the main areas where Barnacle Geese are found in winter, and their range tends to be restricted to the coastal regions for New York and to eastern Pennsylvania.

The map (p. 53) shows both the overall pattern of breeding in Greenland and the major migration routes for the five species of geese discussed here. It is useful to view the overall pattern of breeding and migration to further understand extralimital trends.

Discussion

Canada, Snow, and Pink-footed Geese

There is general agreement that Canada and Snow Geese breed in Greenland and winter on the Atlantic and Gulf coasts of North America.

The four Pink-footed Geese found in Newfoundland on 25–28 April 1995 were judged to be naturally occurring storm-driven spring migrants heading for Greenland. A similar scenario is likely to apply to the fall 2004 sighting of three birds. The remaining reports are of single birds with probable multiple sightings. In proposing that one of these birds was of natural origin, M. S. Szantyr (in Perkins 1998) gives excellent arguments that generally apply to all of these records. Important among his arguments is that aviculturists rarely keep Pink-footed Geese.

In the first case of multiple birds, from 1995, it seems certain that the mechanism of arrival was storm-related. Reports of single birds of this species are about evenly divided between spring and fall, so that storms are probably not the sole mechanism to explain the remaining sightings if they are of natural origin. The 15 reported sightings of single birds would require a minimum of five different in-

Figure 1 • “Greenland” Greater White-fronted Goose. Reports from Atlantic Canada.

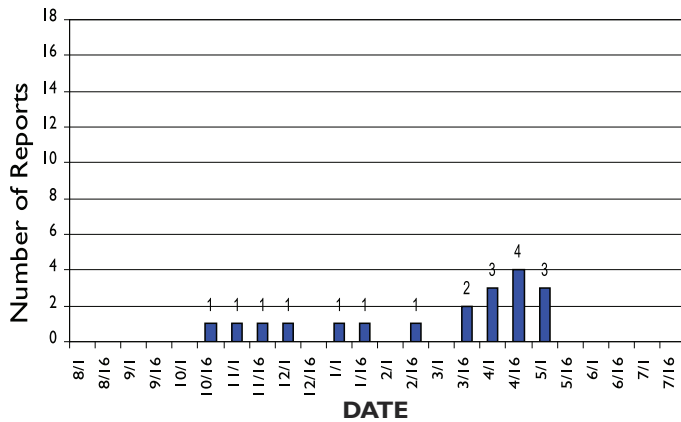


Figure 2 • “Greenland” Greater White-fronted Goose. Reports from U.S. East Coast.

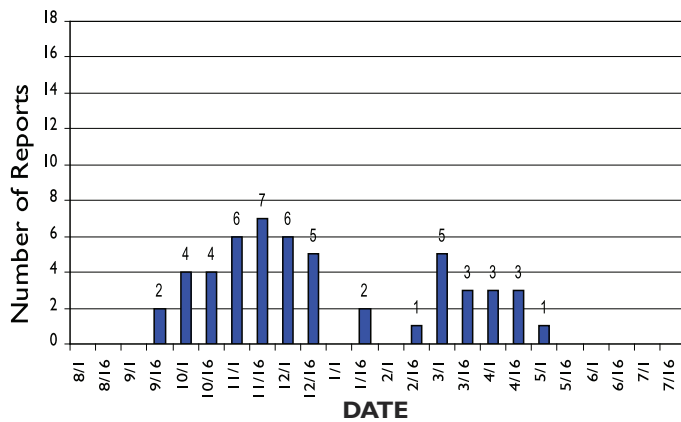
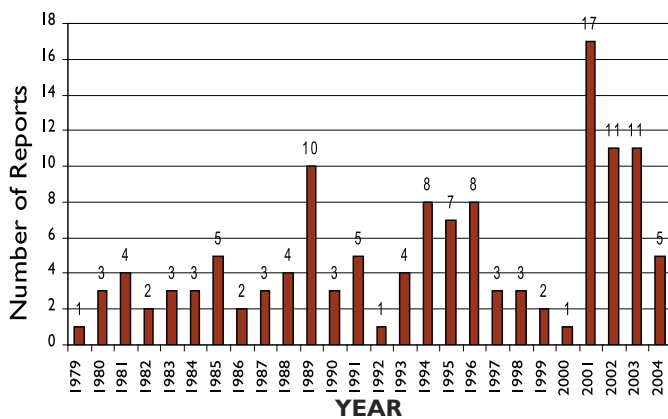


Figure 3 • Annual Records of Barnacle Goose on U.S. East Coast (1979-2004).



Data provided by Dominic F. Sherony; graphs by Kei Sochi.

individuals based on the grouping of dates. Also worth noting is that 60% of all reports in NAB come from Atlantic Canada, with one group of three birds wintering there in 2004–2005. Because the sample is so small (17 sightings), it is not possible to draw further conclusions.

Greater White-fronted Goose

The wild origin of the majority of Greater White-fronted Geese on the Atlantic coast is generally not questioned. Of the more than 70 reports of Greenland Greater White-fronted Geese in NAB, only three are noted as being of suspected captive origin (AB 45:68, AB 45:82, AB 48:408). Almost 40% of the reports are of multiple individuals, and most of these are of 2–5 birds. Only three involve more than seven individuals.

It is debatable whether the numbers of Greenland Greater White-fronted Geese are under-reported or over-reported. In the majority of eastern North American Greater White-fronted Goose sightings in NAB, there is no mention of subspecies. This might cause the number of reports to be artificially low (see Fig. 2). Kaufman (1994) and Rutt (2006) point out that the visual identification of the Greenland race is not trivial, requiring thorough knowledge and careful study.

Greenland Greater White-fronted Geese breed on the west coast of Greenland and migrate to and from their wintering grounds by crossing the Greenland ice cap. Since they breed in close proximity to Canada Geese, it is probable that at least some individuals and groups attach themselves to Canada Geese and follow them on their fall migration to eastern North America. The fact that the Greater White-fronted Geese identified in Newfoundland were all of the Greenland subspecies is a strong indication that this subspecies regularly makes this journey. The Greenland Greater White-fronted Goose collared in Wexford, Ireland, which was found one winter in Pennsylvania and in subsequent years returned to its normal wintering location, indicates that these birds migrate back to Greenland and later correct any migration errors committed at a less-experienced age. The three banded Greater White-fronted Geese recovered in Canada from 1946 to 1966 raise the possibility that this species had

made accidental crossings to North America before Canada Geese became common in Greenland. The 1966 bird was banded as a juvenile and must have arrived in North America of its own accord. The implication is that at least some Greater White-fronted Geese arrive by simple errors in migration direction.

Barnacle Goose

Ryff (1984) proposed that all North American Barnacle Goose sightings are escapes except for a few sightings from Baylot and Baffin Islands, and Labrador, Canada. His argument is based on four factors. First, Barnacle Geese have an instinct to migrate to and from northern Europe, and immatures learn the migratory route from adults. This is a long journey unfor-giving of any error, and Barnacle Geese do not leave Greenland in the face of a nor'easter. The second and principal argument is that this species is extensively bred in private collec-tions throughout the U.S.; escapes are inevitable and geese are long-lived. Thirdly, there are very few credible records of vagrant Barnacle Geese for western Greenland (from the Green-land population), thus eliminating the most likely source of vagrants to North America. And, finally, Pink-footed Goose is very uncommon as a vagrant to the U.S. compared to Bar-nacle Goose. These four arguments form much of the cur-rent thinking in the U.S. concerning Barnacle Goose—and, accordingly, there are very few accepted records of any sighting of Barnacle Goose as being of natural origin.

Escaped Barnacle Geese in North America—and in particu-lar in the eastern U.S.—are well known. Perhaps the most famous incident involved two adults and four immat-ures first seen at Cape Sable Island, Nova Scotia, in early September 1990. Before these birds left in January, they were discovered to be tame (AB 45:244). This same group of birds reappeared numerous times in eastern states until at least 1993. There were no reports in 1994, but four birds were found at Hook Pond, Long Island, 29 January 1995 (FN 49:131) followed by four in Scarborough, Maine, two years later on 12 December 1997 (FN 52:170) and five a month later on 10 January 1998 at Peace Valley, Pennsylvan-ia (FN 52:174). Finally, four Barnacle Geese were found in

Figure 4 • Barnacle Goose. Reports from Atlantic Canada.

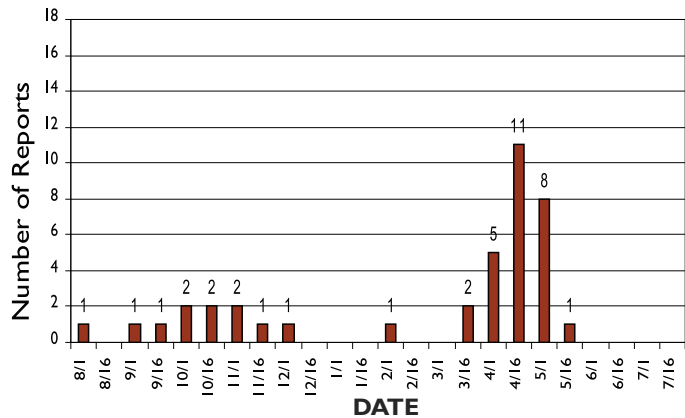
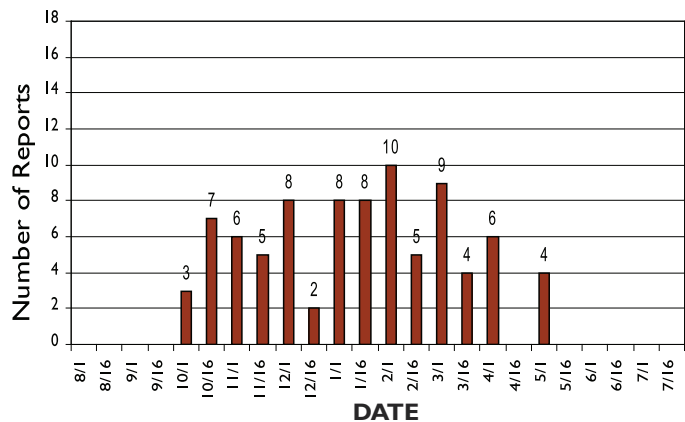
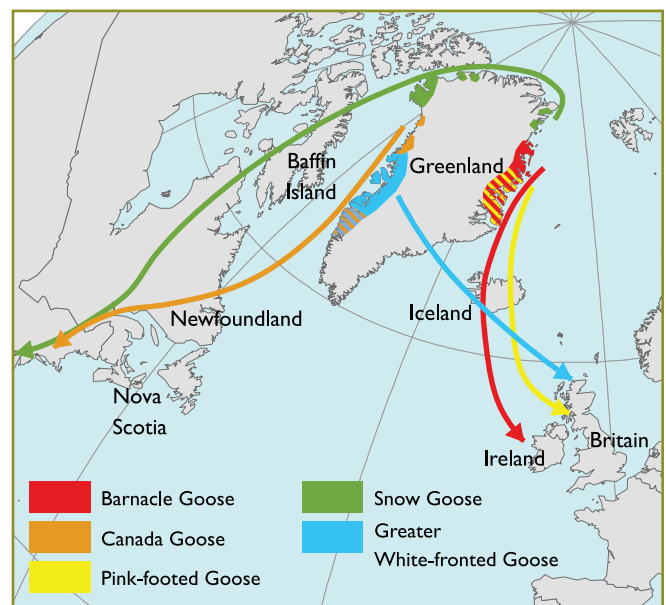


Figure 5 • Barnacle Goose. Reports from U.S. East Coast.



Data provided by Dominic F. Sherony; graphs by Kei Sochi.



Breeding Ranges and Major Migration Routes of Geese that Nest in Greenland. Data provided by Dominic F. Sherony; map by Kei Sochi.



Reports of **Pink-footed Goose** have been increasing in recent years in eastern North America, due apparently to a real increase of birds arriving via natural vagrancy from Greenland. *Montauk, New York; November 2007.* © Gary Chapin.

Dutchess County, New York, and observed from 27 October until 5 November 2003, but the sighting was not published in *NAB*. The sightings through 1993 are likely of the same family group; the remaining sightings from 1995 to 2003 are likely more than one group, and their origin is uncertain. These are all the reports of more than three birds, and none have been included in the temporal data analyzed in this article. The above examples are of multiple birds, but there are many examples of single Barnacle Geese that were confirmed as escapes from private collections or zoos.

Barnacle Geese have been observed throughout the U.S. There are several facets of the occurrences of Barnacle Goose on the Eastern seaboard, some pointed out by other observers (Ringler 1988, Szantyr 1988), which indicate that at least some of the individual birds are of natural origin:

- The eight records mentioned earlier from the 19th century include the early specimen from Rupert House, Labrador, in 1867 and another specimen collected at Jamaica Bay, Queens, New York, on 18 October 1876 (Levine 1998). Another was shot in North Eastham, Massachusetts, on 1 November 1885 (Viet and Petersen 1993). Also, there are two records for North Carolina in this period.
- A Barnacle Goose was banded at Spitsbergen, Norway, and was shot by hunters in Newfoundland in October 1981 (Montevicchi and Wells 1984). Another Barnacle Goose banded at Islay, Scotland, on 9 November 2004 as a juvenile was shot east of Ottawa in eastern Ontario near

the Québec border in the fall of 2005 (Gingras 2006; R. Pittaway, personal communication).

- A Barnacle Goose found in Storrs, Connecticut, on 4 December 2002 associated with Canada Geese that had been banded in Greenland (*NAB* 56:155).
- A Barnacle Goose was first discovered on 25 November 1988 in New Bedford, Massachusetts, (*AB* 43:62) with two Greenland Greater White-fronted Geese. This trio was again seen in Lake Galena, New York, on 2 February 1989 (*AB* 43:290) and finally seen at Kingston, Rhode Island, on 7 April 1989 (*AB* 43:449). Another Barnacle Goose accompanying a Greenland Greater White-fronted Goose was observed at Green Lane, Pennsylvania, on 12 March 1994 (*AB* 48:280, *AB* 48:228).

Although only one of the preceding four examples is of certain natural origin, the other three may well have been of wild birds.

There are two fundamental problems with the premise that eastern North American Barnacle Geese are mostly human-assisted birds (escapes). First, the spatial and long-term temporal distribution of Barnacle Geese in eastern North America suggests that many to most of those seen are wild birds. Second, the number of hybrids seen is insufficient to support a hypothesis of a continuous source of escaped birds into the North American environment.

Ninety percent of all sightings reported in *NAB* of Barnacle Geese come from 14 coastal states and provinces (Nova Scotia, New Brunswick, Québec, Maine, New Hampshire, Vermont, New York, Rhode Island, Connecticut, Massachusetts, Pennsylvania, New Jersey, Maryland, and Virginia). Differences in “area frequency” (number of birds found per unit of area per unit of time) become apparent when we compare the average values for coastal vs. Midwestern states. A block of seven Midwestern states was selected to compare these frequencies (Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, and Missouri). For the Midwestern states, data were obtained from *NAB* and all state records committees.

With the additional sightings for the Midwestern states, the “area frequency” for Barnacle Goose is 0.033 sightings per square kilometer per quarter century. This compares with a value of 0.312 for coastal states and provinces, or a factor of nine times higher. As a comparison, California has had four records of Barnacle Goose in the past 25 years, which translates into an area density of 0.025, similar to that seen in the Midwest. These data show the big disparity in the spatial distribution of this species. The spatial density in California and the Midwestern states is 8–11% that of the coast, and this understates coastal sightings. If most to all continental Barnacle Geese were escapes, we would expect a more-uniform spatial distribution. This argument,

based on spatial distribution only, attempts to quantify views published by other observers (Ringler 1988, Szantyr 1988, Iliff 2002). An alternative interpretation is that the greater values obtained for the East Coast region are due to differential coverage and awareness by birders in the different regions.

If Barnacle Geese are continuously being introduced into the wild as escapes, we would not expect them to migrate to Greenland to breed. If they attempted to breed, we might expect pairings with Canada Geese. We know that such a pairing is possible because of the three occurrences noted in the NAB data and mentioned above. We would expect more records of hybrids if most of the observed population consisted of escaped birds joining wild geese. Furthermore, it is recognized that the number of aviculturists holding waterfowl and the number of Barnacle Geese being held has been decreasing since the mid-1980s, a trend opposite to the increases in Barnacle Geese reports.

There are a few challenges to the idea that Barnacle Geese in North America are primarily of wild origin. Unlike Greenland Greater White-fronted Geese, 92% of Barnacle Goose sightings are of single birds and 9% are of pairs. Barnacle Geese tend to migrate in medium to large flocks. Thus, if most birds in North America are of natural origin, then they are dispersing in a manner that is contrary to expectation. Also, we do not see many reports from Nova Scotia, Newfoundland, and New Brunswick; there are only five sightings from these three provinces during the 25-year period analyzed in this article. The one example of the seven adults seen in Nova Scotia in 1969 is believed to be storm-related, so this mechanism is possible but on the whole unlikely.

Another possible mechanism to explain the vagrancy of this species to North America is by associative migration with Snow Geese. Non-breeding Barnacle Geese, including birds old enough to breed as well as pre-breeders, do not generally mingle with family groups (Cramp and Simmons 1977). Since Barnacle Geese breed as far north as the northern part of northeastern Greenland, they would have some contact there with Greater Snow Geese. It is possible that after molting, some straggling Barnacle Geese associate with Snow Geese, migrate over northern Greenland and join the North American Greater Snow Geese migration south through the St. Lawrence drainage, and then winter on the East Coast of the U.S. The number of birds doing this annually must be small because, as D. Boertmann (personal communication) notes, the zone of contact between Barnacle and Snow Geese in Greenland is small. Palmer (1976) mentions three records of Barnacle Geese from northern Canada that would support this mechanism: one each from Bylot Island, Baffin Island, and northern Labrador. These, plus the distribution of reports in Atlantic Canada, particu-

larly the higher number in Québec and scarcity in other locations, strongly support this hypothesis.

A final possible mechanism is that immatures and non-breeding individuals could simply err in their migration direction, as seen with some of the early Greater White-fronted Goose records, and end up in western Greenland. Four records of Barnacle Goose in North America mentioned previously support this hypothesis: the two instances of Barnacle Geese found with Greenland Greater White-fronted Geese, the one Barnacle Goose found with a Greenland Canada Goose, and the flightless immature Barnacle Goose found on Funk Island. These are all likely natural-origin birds, reaching North America from western Greenland, implying that the number of extralimital Barnacle Geese in that region might be understated.

There are too few reports of single Pink-footed Geese to determine the mechanism of arrival. Pink-footed Geese do not breed as far north in Greenland as Barnacle Geese, and they are less likely to contact Greater Snow Geese. As with most geese, however, some stray within Greenland and may associate with other species that occur in North America.

Summary

The past 25 years have witnessed significant changes in the status of migratory geese that breed in Greenland. Canada Goose has become a regular breeder there. The number of extralimital reports of Greenland Greater White-fronted Geese in eastern North America has steadily grown in the face of a relatively constant population. The population of Barnacle Geese had increased steadily in the past 25 years in Greenland, as has the number of North American sightings.

The prevailing view has been that most Barnacle Geese seen in North America are escaped birds. One fundamental assumption underlying this belief is that Barnacle Geese breed on the east coast of Greenland and migrate unerringly to Europe. The reality is that, as with any population of birds, not every individual follows the expected trend. It is certain that Greenland Greater White-fronted Geese—and almost certain that Barnacle Geese—arrive on their own wing power in North America. Three mechanisms have been proposed for these accidental visits. Furthermore, the spatial and temporal patterns of reports do not support the prevailing viewpoint. They imply that many of the Barnacle Geese seen in North America are of natural origin mixed with some unknown fraction of escaped birds.

There are several ways to tell that a Barnacle Goose is not of natural origin. Tame birds are often escapes. Any Barnacle Goose that returns to the same location away from the main migratory corridor of the St. Lawrence valley and the coastal wintering areas is likely an escaped bird. A single-family group of Barnacle Geese is most likely escaped.

Storm-related birds should be expected to contain more individuals than one family group. Any family group with hybrid Canada Geese needs to be examined carefully because Barnacle Geese do not breed in close proximity to Canada Geese. Any immature Barnacle Goose should be questioned. Of course, any summering or molting Barnacle Geese are very likely escaped birds.

The time has come to pay more attention to potentially extralimital geese. More Greater White-fronted Geese should be critically examined and the Greenland race should be documented to gain a better understanding of the frequency of occurrence of that race. More effort and understanding should be applied to determine the tameness of geese and the reactions of wild vs. human-raised birds. More understanding and documentation of the behavioral patterns of wintering geese would be of value, especially concerning their feeding and roosting habits. We should become more cognizant of the fact that, overall, the data suggest that changes are beginning to occur in the extralimital migratory patterns of Greenland geese.

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