

# Snowy Owl Movements: Variation on the Migration Theme

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## 1 Introduction

Snowy owls (*Nyctea scandiaca*) have a Holarctic distribution. Our recent understanding of the movements of these birds was summarized by Holt et al. (1999): "Movements not predictable, related in way not fully understood to abundance of prey species; thought to vary considerably from region to region ... and intensity of movements fluctuates annually; ... populations periodically irruptive, ... when lemming numbers crash. Winters irregularly S [south] to ..." The spatial and temporal relationships among breeding, migration route, and wintering areas of snowy owls are essentially unknown.

Kerlinger et al. (1985) used Christmas Bird Count data to test for periodicity of snowy owl winter distributions in North America (NAM) and of synchrony among regions. They concluded that snowy owls migrated regularly to the central region of Canada and the northern United States of America, but that their winter occurrences in the eastern and western sections of the continent varied dramatically from year to year and were not periodic. Snowy owls rarely winter in the western section. Pitelka et al. (1955) found that snowy owl abundance and nesting at Barrow, Alaska, USA, as in many other areas, were associated with changes in the numbers of lemmings (mostly *Lemmus* sp.). It is widely believed that snowy owls remain in northern breeding areas in winter only when lemmings are abundant; however, there are too few data to confirm how widespread this might be. Certainly, some snowy owl movements and migrations are associated with fluctuations of their prey (Parmelee 1992; Menyushina 1997).

D. Holt leads studies at Barrow, and found that from 1992–1998 there were 38 to 108 breeding owls during the 3 years that nests were found, and from 17 to 49 owls present during the 4 years when no breeding activity was detected (Peterson and Holt 1999). Based on 10 years of snowy owl and lemming surveys at Barrow, he predicted that many snowy owls would breed in 1999, and little or no breeding and few owls would be present in 2001, which was the case. Do owls that do not return to a nesting area survive, and if so where do

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they go; do they nest? Furthermore, we might expect the Barrow breeding area to be a source of snowy owls that could winter to the south, in the western section of NAM. If snowy owls do not migrate regularly to the eastern and western regions of NAM, do owls from the eastern and western regions of the nesting range “funnel” to the mid-continent regions? If they do not, do they remain in the breeding range? Information about the owls’ movements is essential for understanding their ecology and more specifically, what strategy(ies) they exhibit for migration.

We conducted a pilot study to test satellite telemetry techniques for the following objectives: (1) describe postbreeding movements of adult snowy owls; (2) delineate migration timing and routes; (3) identify areas used during winter; and (4) identify areas used in successive breeding seasons. Satellite telemetry is suited to tracking owls in the remote regions, and under the circumstances when the owls’ destinations are unknown.

We used the Argos satellite telemetry system, which comprises polar orbiting satellites, platform transmitter terminals (PTTs), ground receiving stations, and management and distribution of data (Argos 1996). Argos computes the location estimates of the PTTs using principles of the Doppler shift. Since the mid-1980s, tracking of wide ranging birds has been possible because of the development of small PTTs (Strikwerda et al. 1986; Gillespie 2001). Our goal was to obtain location estimates of snowy owls through at least one annual cycle.

## 2 Study Area and Methods

The study area in which we radio-marked snowy owls extends south from Point Barrow, Alaska, USA, encompassing 213 km<sup>2</sup> of the Arctic Coastal Plain. Located on the northernmost tip of Alaska, it is bordered by the Arctic Ocean with the Chuckchi Sea to the west and the Beaufort Sea to the east. Brown et al. (1980) and Peterson and Holt (1999) provide descriptions of our northern Alaska study area.

We received location estimates from the Argos satellite telemetry system once every 4 days and plotted them using ArcView PC-GIS (Environmental Systems Research Institute, Redlands, California, USA). Argos assigns each location estimate a nominal measure of accuracy (location class, LC): LC 3, < = 150 m linear error; LC 2, 150–350 m; LC 1, 350–1000 m; and LC 0, > 1000 m; LC A and B, no accuracy. We usually mapped only LC 1, LC 2, and LC 3. We used 31 g PTTs (PTT100, Microwave Telemetry Inc., Columbia, Maryland, USA) that were programmed to transmit on varying schedules during the year to extend their operation period. We attached the PTTs to the owls as a backpack, using about 5 g of Teflon ribbon (Bally Ribbon Mills, Bally Pennsylvania, USA) as the harness material (Snyder et al. 1989).

### 3 Results and Discussion

We PTT-marked six adult, nesting snowy owls. We lost the radio signal from the male marked in 1999 soon after it departed the Barrow study area. A female marked in 2000 was found dead along a road in the study area in August after her young fledged. Four other females nested successfully, and two were radio-tracked from July 1999 and two from July 2000 into the summer of 2001.

Female snowy owl 25157 (hereafter referred to as 57) departed the nesting area about August 20, 1999 and the other female, 25154 (54), remained until November 24, 1999 (Fig. 1a). In 2000, female 11980 (80) left the nest area about September 9, and 11981 (81), left October 24 (Fig. 2). Thus, unlike snowy owls from some previous studies (Pitelka et al. 1955; Portenko 1989), our birds did not remain on the nesting area after the breeding season. Owl 57 ultimately flew to the coast of Alaska, north over the Chuckchi Sea ice, then to the Alaskan coast again. Voous (1989) noted that snowy owls crossed oceans and used Arctic coastlines, ice flows, and leads in the ice far out at sea during invasion years. Our data reveal that they also use these features after successful breeding. Beginning in December, 57 traveled for 4 months, flying as far south as 59° N, remaining in no area more than 2 weeks. Also in December, female 54 traveled to an area where she remained for more than two and a half months (Fig. 1a). Wintering snowy owls have been reported throughout the region encompassing the Bering Strait and islands, St. Lawrence Island, and the Chukotskiy Peninsula (Fay and Cade 1959; Portenko 1989).

The snowy owls radio-marked in 2000 left the nesting area in different directions (Fig. 2). Owl 81 flew to the Chukotskiy Peninsula coast in December, then to the region that 54 had used the year before, then, for another month on the Chukchi Sea ice. Female 80 left Barrow in September and wintered in southern Alaska at 60° N 146° W, south of snowy owl breeding range, but well within the wintering range (Holt et al. 1999; König et al. 1999).

In late February 2000 owl 54 moved, settled mid-March to early May, then proceeded 1322 km west to settle around 70° N 157° E from June 22 to late September. "Spring flight occurs in this region from early March to early June and egg-laying from mid May into June." (Portenko 1989). On Wrangle Island egg-laying begins from mid- to late May (Menyushina 1997). Thus, it is unlikely that 54 nested in 2000. Nonbreeding adults occur on Wrangle Island and the Chukchi Sea coast (Portenko 1989; Menyushina 1997). Owl 57 used Chuan Bay, where snowy owls can be "prevalent" (Portenko 1989), then flew to 71° N and 147° E until August, and possibly nested about 1928 km from where she had bred the previous year, in Barrow.

After moving in late September 2000, owl 54 stopped by Chuan Bay, before settling on the coast south of the Chukotskiy Peninsula for more than 2 months (Fig. 1b). In August, owl 57 generally reversed her westward spring flight. During October-November she again used Chuan Bay, then in mid-November settled at 67° N 174° E.

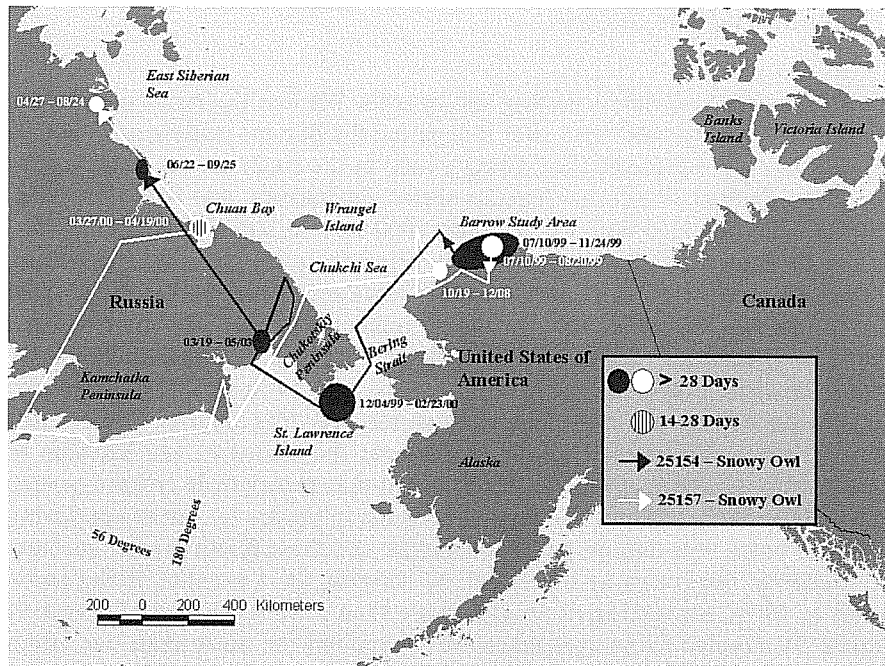


Fig. 1. a. Postnesting movements of two female snowy owls, 1999 - 2000.

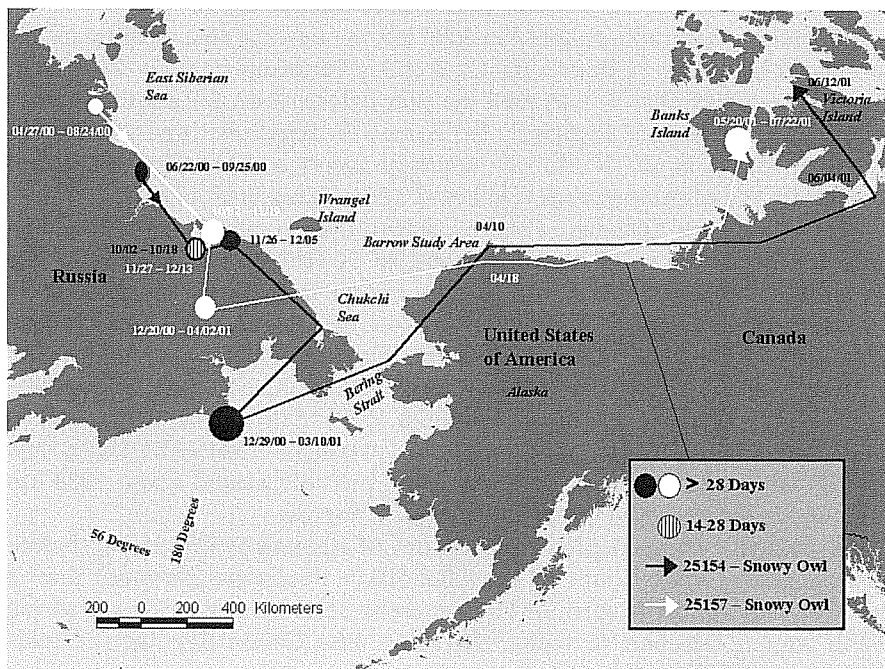


Fig. 1. b. Continued movements of the two adult female snowy owls, 2000-2001

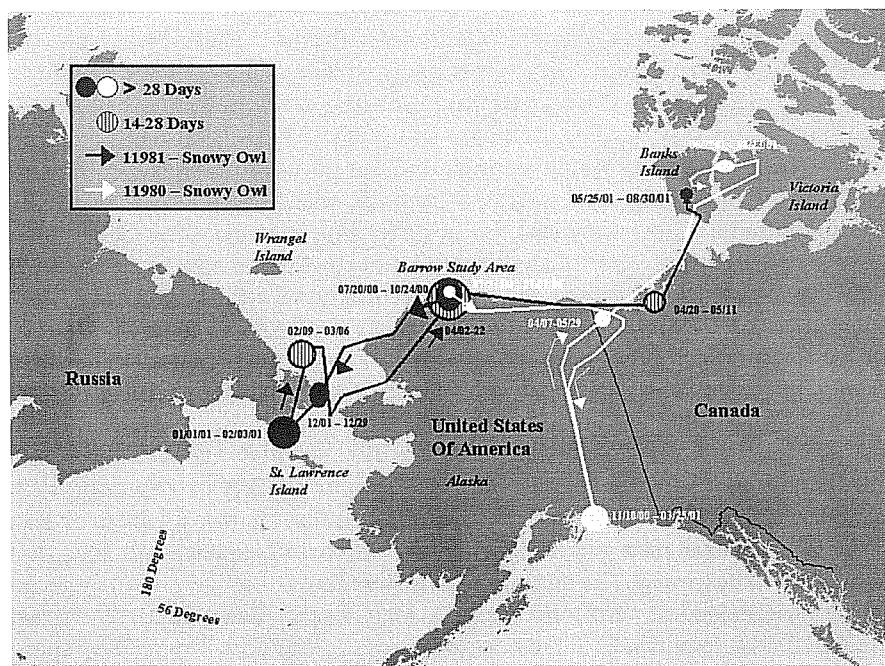


Fig. 2. Postnesting movements of two female snowy owls, 2000 - 2001

Female 54 left her 2001 winter area 4 weeks before 57 departed, but by April, within a week of each other, both passed through Barrow, where they had nested in 1999. They continued east along the north Alaska coastline, into Canada, where 54 crossed onto Victoria Island (May 28), and 57 went to Banks Island (May 20). Female 80 flew from her winter area in late March 2001 to the USA-Canada border and settled for about 7 weeks (Fig. 2). Then she flew east and crossed to Banks Island (June 12). Meanwhile, owl 81 left the Chukchi Sea in March and proceeded to the Barrow area where she had nested the previous spring (Fig. 2). She remained in Barrow in mid-April when 54 and 57 were there. Then, 81 continued into Canada and crossed to Banks Island (May 16). Thus, four females that had nested in Barrow, two in 1999 and two in 2000, had traveled up to 3159 km from different winter areas, and crossed to northwestern Canadian islands within 29 days of each other.

Banks Island and Victoria Island are nesting areas of snowy owls (Manning et al. 1956; Parmelee 1972, 1992). Egg-laying begins in May (Parmelee 1972, 1992). We lost the radio signal owl 54 (June 12), and owl 80 flew from Victoria Island to Banks Island in late August; it is unlikely that they nested successfully. By 20 May, female 57 had settled on Banks Island, and might have nested there, 1548 km from where she might have nested the previous year. Female 81 settled on Banks Island and could have nested there, 628 km from her Barrow nest of 2000.

These snowy owls' annual flights link disparate regions, encompassing nearly one third of the species' Holarctic distribution. These owls from the same nesting area did not winter in the same places. They usually settled in one or more locales for 2 weeks or longer during the winter. Their postnesting distribution reflects the patchiness in time and space that Kerlinger and Lein (1986) noted from winter counts, and supports the suggestion by Kerlinger and Lein (1988) that, prior to January, many snowy owls might be seeking suitable places to spend the nonbreeding season. None of the owls moved to the central zone of the North American Plains, where snowy owls regularly winter, nor did they go to the western zone, where immature birds constitute most of the counts (Kerlinger et al. 1985). Our radio-tracked snowy owls reflect the "inherent variability" and potential for movement among "populations" (Kerlinger and Lein 1986), but did not exhibit regular migration.

No owl returned to the nesting or winter area she had occupied the previous year. Thus, they did not demonstrate regular nesting or wintering area site fidelity. The owls did not travel together, but their paths did cross or join temporarily. Three returned to their former Barrow nesting area in 2001, but all continued eastward. The lemming index was low at Barrow in 2001 and no snowy owls nested in the study area (D. Holt, unpublished data). The great circle distance from their Barrow nesting area to the area where they spent the next breeding season ranged from 628 to 1928 km. These radio tracking results are similar to the banding data that Parmelee (1972, 1992) used to conclude that snowy owls can cover vast areas during their life cycle, and our results confirm they can fly long distances to alternative breeding sites (Holt et al. 1999).

Possibly, some females nested 2 years in a row, while others most likely did not. Referring to the relationships among snowy owl movements, breeding, and fluctuating lemming abundance, Parmelee (1992) wrote, "... the crux of the phenomena is a mobile breeding population of owls ... breeding where and when their prey is abundant." Our data hint at how this might occur. Snowy owls that inhabit regions within which prey abundance fluctuates greatly in time and space move through large areas from year to year, experiencing the area like other species experience their home range. All four owls frequented some areas that they had visited previously. This experience, with other adaptations, could allow them to locate areas of prey abundance sufficient to survive and reproduce successfully in the course of their lives.

Voous (1988) wrote: "Unless it is able to develop other means of surviving the arctic winter and of avoiding life-wasting migrations and irruptions, the snowy owl appears to have reached a terminal point in its evolution." We suggest that the travels of snowy owls are part of a strategy adapted to prey resources occurring in a patchy distribution for relatively short durations in a manner such that they are inadequate to meet a bird's requirements within an area typical of most large raptors' home ranges. We propose to sample snowy owls from several locales within their Holarctic range. By tracking

owls with satellite telemetry we can overcome some of the logistical problems that accompany the multisite approach needed to detect their broad movements and distribution (Kerlinger and Lein 1988). Owls tracked by satellite telemetry can lead us to the areas along their life path (Kenward et al. 2001) where we can study the associations among the owls' behavior and ecological characteristics, survival, and reproduction (e.g. Lundberg 1979) that will reveal the strategy of their unusual movements (Andersson 1980).

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