SNOWSHOE HARE ABUNDANCE IN THE WISEMAN AREA OF GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE, ALASKA

Third Annual Study and Summary Report

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INTRODUCTION

In March 1997, resource personnel at Gates of the Arctic National Park and Preserve (GAAR) began a long-term monitoring program of the snowshoe hare (*Lepus americanus*) population in the eastern portion of the park (DiFolco 1997). This project was developed in response to a 5-year furbearer study that discovered unusual sex and age ratios in the lynx (*Lynx canadensis*) population in this area, possibly the result of food stress (Swanson 1994). The close association between lynx and their primary prey, snowshoe hares, has been well documented (Elton and Nicholson 1942, Brand et al. 1976, Brand and Keith 1979). Area residents regularly trap lynx for subsistence purposes; thus, park managers hope to gain a better understanding of the health of the lynx population by monitoring their primary prey, snowshoe hares, as well as continuing to collect information from local trappers. The snowshoe hare project plans to track the hare population through a complete cycle as the population grows from low numbers to its peak and then crashes to low levels again. The purpose of the study is to provide managers with an index of the snowshoe hare population at each stage of this cycle.

This report documents the third year of the snowshoe hare study and summarizes the results of the first three years. I'd like to thank volunteers Davya Baker, Sharon Baker and Michelle Reakoff for their assistance counting tracks, brushing the transects and collecting browse data for the project this year. Thanks also to the Reakoff family for loaning us their leaf rakes, which did an excellent job of brushing out hare tracks and "grooming" the transect lines.

STUDY AREA

Gates of the Arctic National Park and Preserve is located north of the Arctic Circle (66° 33' N latitude) in the central Brooks Range, Alaska (Fig. 1). Two climate zones occur in the park and preserve: the subarctic zone at lower elevations south of the continental divide and the arctic zone to the north and at high elevations. Precipitation is low within the park and preserve and yearly averages fall between 30 - 45 cm in the west and 13 - 25 cm in the north (National Park Service 1986). Snowfall averages south of the divide range between 152 - 203 cm and averages of 89 - 127 cm are typical in the north. Yearly temperatures in the south fluctuate from an average July maximum of 21° C (70° F) to an average January minimum of -34° C (-30° F). Temperatures in the north fluctuate from an average July maximum of 18° C (65° F) to an average February minimum of -23° C (-10° F).

Boreal forest, tundra, and shrub thicket are the major vegetation communities in the park and preserve (National Park Service 1986). The snowshoe hare study area lies in the boreal forest, which covers the southern flanks and valleys of the Brooks Range and is composed of black spruce (*Picea mariana*), white spruce (*P. glauca*), paper birch (*Betula papyrifera*), shrub birch (*B.* glandulosa), aspen (*Populus tremuloides*), and balsam poplar (*P. balsamifera*). Willow

(*Salix* spp.) and alder (*Alnus* spp.) thickets up to 3.5 m in height occur along stream channels and gravel bars. The study was conducted near the eastern park boundary north of Wiseman (Fig. 1).

METHODS

Field Methods:

The 1999 study was conducted February 23rd to March 1st, using the same methods as in the 1998 survey (DiFolco 1998, Golden 1994). The eleven 100m transects established in 1998 in 6 different vegetation cover and composition classes (VCCs)--4 in lightly vegetated areas, 4 in moderately vegetated areas, and 3 in densely vegetated areas--were relocated using a Precision Lightweight GPS Receiver (PLGR) (Fig 2). Track deposition and retention were counted on 5 consecutive days (February 24-28). Tracks were brushed out on the deposition side of the transect following each day's count using leaf rakes. The retention side of the trail was brushed after the third day, and a new set of retention counts began on the fourth day. Falling snow on the sixth day prohibited us from counting tracks that day. A "track" was defined as a single pass by one hare. Generally, up to 3 tracks could be distinguished when hares had passed over the same place. When more than 3 tracks had been deposited in the same place, it was called a "trail" since the number of tracks could no longer be determined. For track calculation purposes, a trail was conservatively approximated to equal 4 tracks.

In addition to recording track deposition, track retention and weather data, we also collected browse data from each VCC. Percentage of species comprising each VCC, percentage of each species showing signs of browsing by snowshoe hares, and several measurements of diameter at point of browse (dpb) were recorded for each browsed species. Notes on girdling and other pertinent information were taken.

To supplement the track and browse data, soil samples were collected from 2 locations along the transect route where hares had been consuming the soil. In addition, Jack Reakoff, of Wiseman, collected soil samples from 4 neighboring areas (Jenny Creek, Buckeye Gulch, Vermont Creek, and Canyon Creek) (Fig. 3) where he had observed high concentrations of use by hares and other herbivores. The soil samples were stored in plastic ziplock bags until they were tested at Northern Testing Laboratories, Inc., Fairbanks, Alaska, for mineral salts (calcium, magnesium, potassium, sodium, and chloride).

Statistical Methods:

Track deposition and retention data were entered into an Excel 97 spreadsheet. The mean, standard deviation, and 95% confidence interval around the mean were calculated for each set of transect deposition data. Browse data were entered into an Access 97 database and the mean DPB was calculated for each species within each VCC.

RESULTS

For brevity, acronyms are used to describe the vegetation cover and composition types (VCCs). The first letter describes the cover classification: L = lightly vegetated, M = moderately vegetated, and D = densely vegetated. Main species composition is listed after the hyphen: W = willows, P = poplars, S = spruce, B = shrub birch, and A = alder.

Track Deposition

Track deposition ranged from 0-9 tracks/100m in lightly vegetated areas, 31-59 tracks/100m in moderately vegetated areas, and 55-67 tracks/100m in densely vegetated areas (Fig. 4; Appendix I). The moderately vegetated M-SPW1 transect averaged as high a deposition rate as the 3 densely vegetated transects. Estimates for M-SPW1 and M-SPW3 include trails (where 1 trail is estimated to equal 4 tracks) as well as individual tracks. No trails were formed on the lightly or densely vegetated transects within a single 24-hr period.

Weather and Track Retention

Satisfactory weather prevailed throughout the survey period until the last (sixth) day when falling snow prohibited us from counting. During the first 5 days of the survey, temperatures were cold (no threat of melting snow), winds were calm, and there was no or only trace amounts of snowfall (Appendix III). In the densely vegetated areas where hare tracks nearly covered the ground, counting tracks was made difficult by the hard-packed snow. We could have missed tracks in these areas due to the snow conditions. Ideal conditions for counting tracks would be for about 5 cm of snow to fall 12 – 24 hours before the count began (Golden 1994).

In general, the number of tracks counted increased throughout the retention count period, although in some cases, the number of tracks remained the same or even decreased from one day to the next. A decrease in the number of tracks could be due to changing snow conditions (e.g. sublimation, blowing snow, etc.), flat light conditions, or observer error. Figs. 5-9 show the results of the first, 3-day set of retention counts; appendix II lists retention data from all 5 days. In the 4 lightly vegetated transects, there were 2-31 tracks (no trails) counted at the end of the first count period (Feb. 24-26), and 0-10 tracks counted at the end of the second count period (Feb. 27-28) (Fig. 5; Appendix II). Substantially more tracks were retained on L-SB1 during the survey's first 2 days than on the other lightly vegetated VCCs, which accounts for the relatively wide range of tracks retained in the light VCCs (the other 3 transects had no more than 3 tracks counted on any single day). In the 4 moderately vegetated transects, 41-90 tracks and 0-3 trails were retained after the first 3 days; 25-71 tracks and 0-1 trails were retained after the next 2 days (Figs. 6 and 7; Appendix II). In the 3 densely vegetated transects, 113-132 tracks and 3-7 trails

were counted on the third day; 77-101 tracks and 0-1 trails were counted on the fifth day (Figs. 8 and 9; Appendix II).

Browsed Vegetation

Browsing by hares was noticeable on most species (including willow, balsam poplar, spruce, alder and shrub birch) within every vegetation type. Browse data are summarized in Table 1.

Willows—Salix spp. were browsed in all 6 vegetation types found along the survey route. Girdling of willows was also evident in each VCC. The average diameter at point of browse (dpb) ranged from 3.1mm in L-SB to 7.5mm in D-WS. The smallest browsed willow stem measured 1mm (in L-SB) whereas the largest measured 12mm (in D-WS).

Balsam Poplar—Populus balsamifera were browsed in the 5 VCCs where they were found. Signs of girdling were apparent in D-WS and M-SPW, but not in D-WPS, M-SW, or L-WA. Average dpb ranged from 3.7mm in D-WPS to 4.9mm in D-WS, M-SPW and M-SW. In all but L-WA, poplars were browsed at a greater percentage than the level of vegetation they represented.

Young spruce tree browsed by hares.

White Spruce—Picea glauca were found in all vegetation types, but were not noticeably browsed in the lightly vegetated VCCs. Only the young, small spruce, up to 1.5m tall, were browsed or girdled. Spruce stems 2-8mm dpb, with an average dpb of 4.4mm were browsed in M-SPW, while browsed spruce stems in D-WPS averaged 3.2mm dpb, with stem diameter ranging from 1.5-5mm. Girdling of spruce—sometimes severe—was evident in each of the VCCs where they were browsed except M-SW.

Shrub Birch—Betula glandulosa were browsed in the 3 VCCs where they were found (L-SB, L-WA and M-SW). In general, smaller stems were browsed from shrub birch (down to 0.5mm dpb) than other browsed species, although stems as thick as 6mm dpb were browsed in L-WA and M-SW. In M-SW, shrub birch represented only 5% of the species composition, whereas nearly a third of them showed signs of being browsed. Also in this area, shrub birch twigs and buds were seen littering the snow where hares had browsed on the shrub and then rejected these parts.

Shrub birch browsed by hares.

Alder—Alnus sp. was found only in L-WA. A cluster of bushes at the edge of this VCC showed moderate signs of browsing and also considerable girdling by hares. Browsed stems ranged from 2-10mm dpb, with an average dpb of 4.5mm.

Soil Samples

Two soil samples were collected from exposed soil along the transect route where hares had frequented. Both were from creek cut banks, one near D-WS1 and the other on M-SPW1. In addition to these samples, Jack Reakoff, Wiseman, Alaska, collected 4 soil samples from what he described as high-grade mineral licks in neighboring drainages that support intensive (seasonal) use by snowshoe hares and moose (Dall sheep also visit some of the licks).

Mineral salts analyses of the 6 soil samples are summarized in Table 2. The samples were tested for calcium, potassium, magnesium, sodium and chloride. In each of the samples, the concentrations of magnesium and calcium far outweighed that of potassium, sodium and chloride. Sodium, which is considered an important nutritional component for most mammals, ranked third or fourth (by weight) in each of the samples.

DISCUSSION

During the first two years of the study, from 1997 to 1998, the snowshoe hare population in the Wiseman area increased several fold (DiFolco 1998). In 1999, the population still appeared relatively high, holding at roughly the 1998 level, with some vegetation types showing greater numbers of hares and some exhibiting less. Fig. 10 summarizes the changes from 1997 to 1999 in snowshoe hare track deposition within the 6 VCCs. Since in 1997 track deposition was counted along the entire length of each VCC rather than in 100m transects, the 1997 data were converted to number of tracks per 100m in order to make comparisons between all 3 years. In addition, data from the 1998 and 1999 surveys were averaged by VCC type (e.g. data from the 3 transects within the M-SPW VCC were combined to produce an average deposition rate for the whole VCC). Track deposition increased in all VCCs from 1997 to 1998. In all VCCs other than L-WA, track deposition also was considerably higher in 1999 than in 1997. In comparing 1999's data with 1998, the moderately vegetated areas and the densely vegetated D-WPS showed a deposition rate that was slightly higher in 1999 than the previous year. In D-WS, however, the number of tracks deposited was lower in 1999 than in 1998. Both of the lightly vegetated VCCs also had fewer tracks deposited in 1999. It may be noted that, as the hare population increases and more trails are deposited, obtaining an accurate count of tracks becomes more difficult since the number of hares which pass over a trail are impossible to measure with our method of counting.

Browse data collected from 1998 and 1999 show a different pattern. Whereas track deposition was greater in D-WPS and less in D-WS from 1998 to 1999, the average diameter at point of browse for all species—willow, balsam poplar and spruce—was greater in both dense VCCs in 1999. The hares seemed to be eating nearly any food that was available, as they even

ate small spruce trees, in some cases leaving only the girdled trunk. In D-WS, spruce needles were observed lying on the snow where hares had chewed off the bark and twigs, though in other areas it appeared the hares had eaten the needles as well. Some plants, particularly shrub birch (found in moderately vegetated VCCs), showed signs of stress from overbrowsing. This was evident by the buds left behind by hares, indicating an intolerably high level of triterpenes in the plant tissues (Dr. John Bryant, professor of plant ecology, University of Alaska Fairbanks, pers. commun.). Buds clipped but not eaten were also observed near a few poplar saplings. It's possible then, that hares in search of better browse had dispersed from the area of D-WS, where more tracks were deposited in 1998 than 1999.

Consuming mineral soils may aid hares in countering the effects of ingested toxins. All the soils collected from mineral licks in and near the study area have extremely high concentrations of magnesium and calcium. This is most likely due to the calcium-rich limestone parent material in the area. By comparison, the amounts of sodium in the soils seem small; however, sodium may still be in concentrations beneficial to hares and other wildlife. As discussed in last year's report (DiFolco 1998), the calcium and magnesium may also benefit the hares by binding the toxic compounds and thus neutralizing them.

Snowfall may also play a key role in the survival of hares and maintenance of a dense population. In our study area, hares ate the bark from stems low to the ground early in the winter when there was little snow. After a heavy snowfall later in the season, new browse became available when the deep snow allowed the hares to reach stems another 3 to 4 feet higher than before. This access to additional winter browse may help the population maintain its high level for another year (J. Reakoff, Wiseman resident, pers. commun.). During a year with low snowfall, hares would not have this advantage and a dense population would likely crash sooner.

The dynamics of a hare population may be confined to relatively small areas, at least in the region of our study. Differences in vegetation, affected by different geological and weather patterns, may influence the rates at which a hare population increases or decreases. North of the study area in the Kuyuktuvuk valley (Fig. 1), the hare population follows a different trend, generally a longer cycle with the high and low population levels lasting longer than seen in our area (S. Schoppenhorst, Wiseman trapper, pers. commun.). Schoppenhorst (Wiseman trapper, pers. commun.) has noted an abundance of willows in the area and theorizes that this may provide more browse or allow the hares to disperse farther during population peaks, thus enabling the hares to maintain a high population for a longer period of time.

Directly related to the health and size of the snowshoe hare population is that of the lynx population. As stated in this report's introduction, the lynx population generally grows larger as the hare population rises, and subsequently plummets (or moves to a different area) following a hare population "crash." However, while the number of lynx in the area may increase with a high hare population, their health may decline. Wiseman trapper Jack Reakoff has observed that the

body condition of lynx worsens when the hare population increases to very high levels and theorizes that this may be due to the plant toxins the hares ingest. Reakoff even noted one year when female lynx "stopped producing litters," which may be related to this toxic effect. (The lack of recruitment that year may have been the result of litters being produced but with stillborn kittens or kittens dying at a very young age, fetuses being aborted or reabsorbed, or the female lynx not ovulating.) These observations correlate with those of biologists in the Anchorage area who have noticed declines in lynx body condition despite the abundance of hares, and also suspect the cause may be toxins ingested by hares (D. Spalinger, Alaska Dept. of Fish & Game nutritionist, pers. commun.).

This relationship may have been what spawned the questions leading to the initiation of this study. The furbearer study conducted by NPS staff in the early 1990's found that trappers were harvesting more female lynx than males and that very few kittens were being trapped (Swanson 1994). Under "normal" conditions, more male lynx are caught, since they tend to roam more than females, and kittens are frequently caught due to their inexperience. Yet while very few kittens were caught, examinations of the lynx found that a high percentage of female lynx, including juvenile females, bore placental scars, indicating pregnancies. The hare population at this time also was reported to be relatively high. If the hares were browsing the vegetation to the extent that plants were producing toxic defenses, then these toxins may have been transmitted to the lynx, affecting their health and reproductive abilities in the same way that the chemical herbicide DDT is passed through the food chain from small birds to raptors which prey upon those birds. Trappers may not have caught many young lynx because very few litters were being produced (ie. pregnancies were terminated without live births or with young so weak they could not survive). Without kittens, or, being pregnant and craving additional nutriment, perhaps the female lynx were moving around just as much as the males.

RECOMMENDATIONS TO MANAGEMENT

During 3 years of study, we have documented a sharp rise in the snowshoe hare population north of Wiseman in Gates of the Arctic National Park. Should the population follow the familiar trend seen in other hare populations, we may expect a rapid decline in this population within the next year or two. The snowshoe hare population "cycle" can be complex and varied, with several factors possibly influencing the health and growth of the population, including vegetation patterns, plant toxins, the presence of mineral licks, and snowfall. This complexity is compounded when lynx are factored into the picture. The next several years of this study will continue to teach us more about the dynamics of the snowshoe hare population in our study area, and how it influences and is influenced by its environment.

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