



**Snowshoe Hare Abundance in the Wiseman Area of
Gates of the Arctic National Park and Preserve, Alaska**
Sixth Annual Report--Survey 2002



Photo by Melanie Cook

GAAR-03-001
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EXECUTIVE SUMMARY

The snowshoe hare project has been tracking the hare population near Wiseman, Alaska, in Gates of the Arctic National Park and Preserve since 1997. The purpose of the study is to track the hare population through at least one entire cycle in order to provide managers with an index of the snowshoe hare population at each stage of this cycle. This report documents the sixth year of the snowshoe hare study, and the fifth year during which browse data were collected. The methodology used in the study has evolved over the years as new questions crop up and as we learn what methods work—and what doesn't work—in our area.

The hare population had declined noticeably since the previous count a year before, with only one hare sighted during the entire 10 days in the field. No tracks were deposited on the lightly vegetated transects, while an average of 0 – 7 tracks/100 m/day were deposited along the moderately and densely vegetated transects.

Diameter-at-point-of-browse (dpb) data were collected for the fifth year during this study. However, unlike in previous years where measurements were collected only from stems browsed during the current year, this year we measured any browsed stem, regardless of when it had been browsed. This was because we could find only a very few stems that had been recently browsed. Later we discovered that the recently browsed stems were buried under about 20 cm of snow. We also clipped browse samples from the different browse species in each VCC, which were later analyzed for nitrogen and tannin content.

Soil samples were collected and analyzed for the presence of cadmium, copper and arsenic. None of the soils had had more than trace amounts of these metals—not enough to cause health problems in the animals that may consume them.



INTRODUCTION

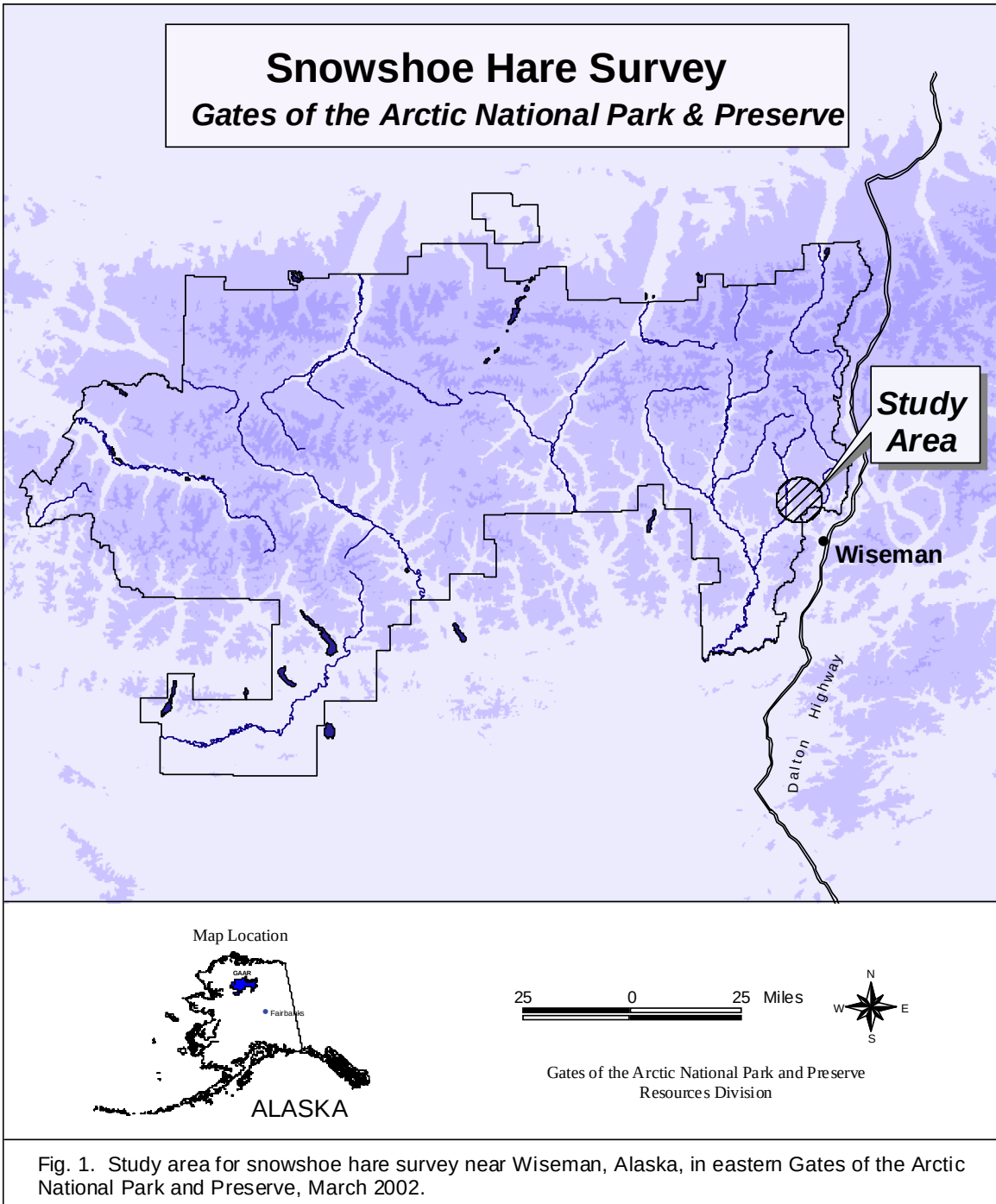
In March 1997, resource personnel at Gates of the Arctic National Park and Preserve (GAAR) began a long-term monitoring program of the snowshoe hare (*Lepus americanus*) population in the eastern portion of the park (DiFolco 1997). This project was developed in response to a 5-year furbearer study that 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 originally planned to track the hare population through a single cycle in order to provide managers with an index of the snowshoe hare population at each stage of the cycle. However, as the study has progressed, additional questions have been raised regarding the hare cycle and its effects on the lynx population. The apparently unique conditions and hare behavior observed in our study area, most notably the consumption of particular mineral soils, warrants further investigation, which may require study through a second hare cycle.

This report documents the sixth year of the snowshoe hare study. In addition to counting tracks and collecting diameter at point of browse measurements, we also collected browse clippings for nutritional analyses and soil samples to test for a few heavy metals.

Many thanks go to Melanie Cook, my very able and cheerful assistant this year, and to my husband, Denny, who was Chief Baby-sitter and who braved deep snow and unbroken trails to collect soil samples for us. I am also most grateful to Jack Reakoff, of Wiseman, who collected additional soil samples for us from the Hammond River drainage.

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).



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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

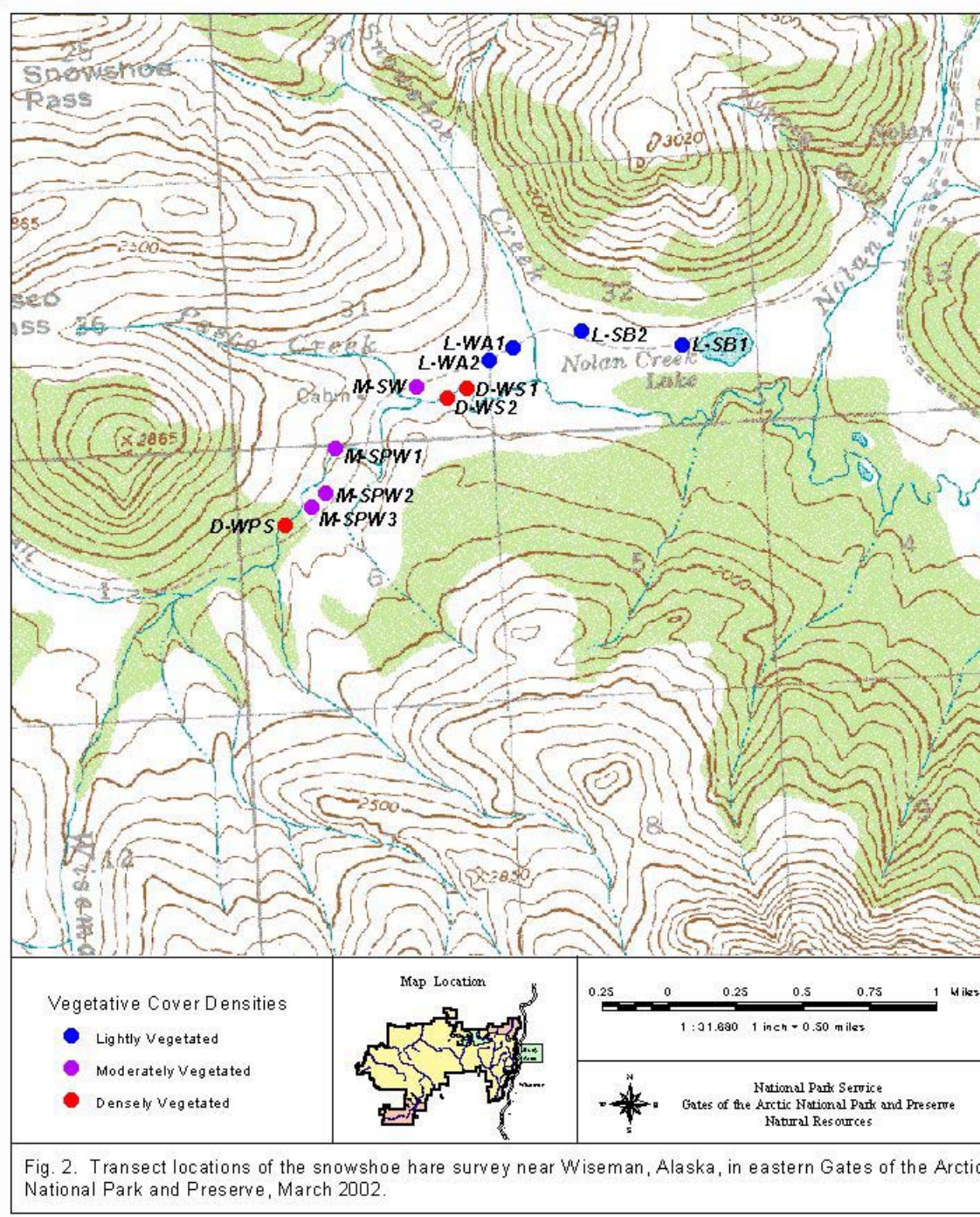
Field Methods:

The 2002 study was conducted March 10-17, using the same methods as we did in 1998 for the track count portion (DiFolco 1998, Golden 1994). We rode snowmachines from Wiseman to the park boundary where the study area begins and then conducted the survey on skis. The 11 100-m 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). We counted track deposition (the number of tracks deposited in one day) and retention (the number of tracks retained over time) on 3 consecutive days. Following each day's count, we erased tracks (since no fresh snow fell) on the deposition side of each transect using leaf rakes to obtain replicate counts of the number of tracks deposited within the last 24 hours. A track was defined as a single pass by one hare. Since very few hares were in the study area this year, no trails (where hares had passed over the same place several times) were formed.

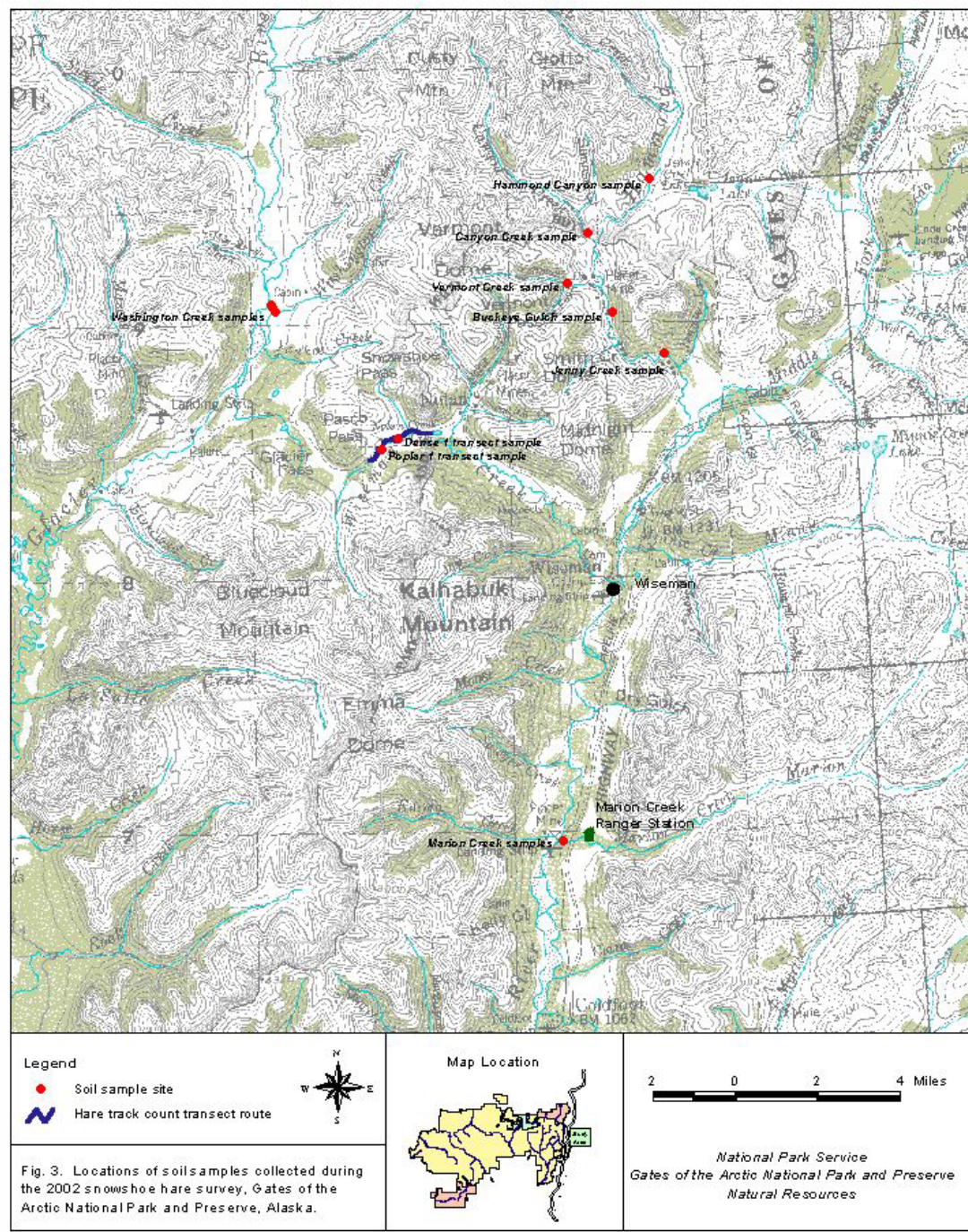
We also collected browse data, including diameter at point of browse (dpb) for the fifth year. Since we could find only a few stems browsed by hares during the current winter, we measured dpb from any stem browsed by hares, regardless of age, although recently browsed stems were noted. We also noted whether the measurement was inaccurate due to missing bark and/or wood.

In addition to dpb measurements, we clipped twigs from browsed poplar, shrub birch, alder and willow. For each sample, we clipped about 25 twigs from each species within each VCC. For most of these, particularly the willow and poplar samples, which were stump sprouts, we had to dig nearly a foot under the snow to reach. The samples were delivered to Rich Kedrowski of the chemical-nutritional lab at the University of Alaska Fairbanks for analysis of nitrogen and tannin content. The proanthocyanadine method (similar to the Folin-Dennis process) was used to determine tannin content. Percent nitrogen gives a measure of the protein content in the sample, while tannins are digestion inhibitors and also may be toxic.

Soil samples were collected again this year from the same locations as in the past. With the exception of the Marion Creek samples, all were collected from soil banks hares visited during peak population years. The Washington Creek samples were collected in different locations than previously because the deep snow and lack of trail in addition to waning daylight made access to the original sites practically impossible. One additional sample not previously collected was taken from the Hammond River (Fig. 3). Northern Testing Laboratories, Inc., analyzed the samples for cadmium, copper and arsenic.



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Statistical Methods:

Track deposition and retention data were entered into an Excel spreadsheet. Each day's track deposition in each 100m transect was averaged (tracks/100 m/day). The mean, standard deviation, and 95% confidence interval around the mean were calculated. Dpb data were entered into an Access database, and the mean dpb for each species in each VCC calculated. The percent nitrogen and tannin data are tabulated on an Excel spreadsheet, also with means and standard deviations calculated.

RESULTS

For brevity, acronyms are used to describe the vegetation cover and composition types (VCCs) and the transects within them. 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 (in order of relative abundance): W = willow, P = poplar, S = spruce, B = shrub birch, and A = alder. A number following the VCC name (1, 2 or 3) distinguishes different transects within the same VCC.

Weather and Track Deposition

Weather was typical of past surveys—generally clear skies and sub-freezing temperatures with occasional breezy days (Appx. III). No snow fell throughout our 10-day stay in the area.

We counted few tracks this year. On 6 of the 11 transects (the 4 lightly vegetated transects, M-SW and D-WS-2) we did not see any tracks over the 3-day count period. We counted an average of only 1.67 tracks/100 m/day on M-SPW-2 and 2 tracks/100 m/day on M-SPW-1 and M-SPW-3. In the densely vegetated VCCs, we tallied an average of 4 tracks/100 m/day on D-WS-1, with D-WPS having the greatest number of tracks deposited, at 6.67 tracks/100 m/day (Fig. 4, Appx. I).

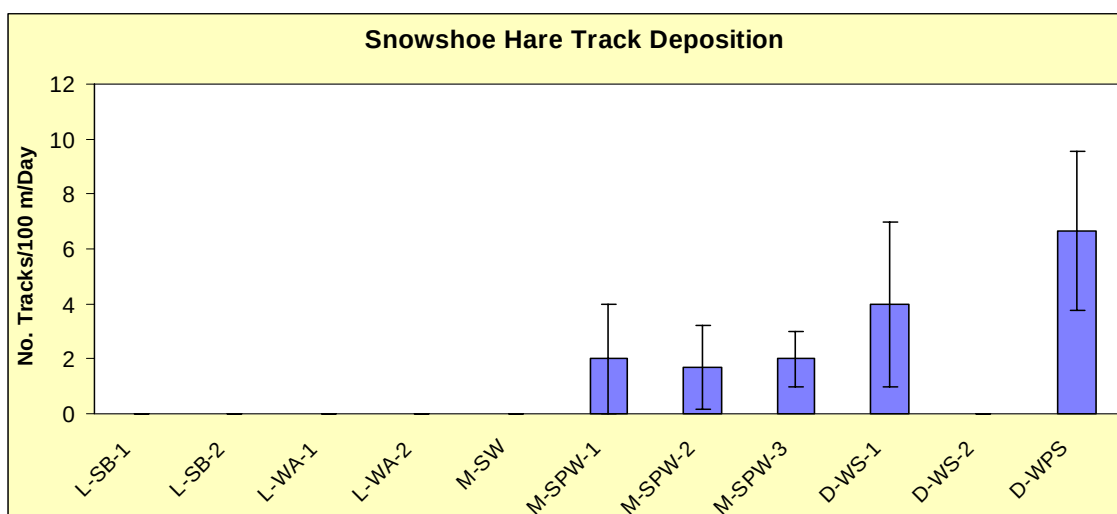


Fig. 4. Deposition of snowshoe hare tracks/100 m/day (+/- 1 SD) on 11 transects, snowshoe hare survey, March 14-16, 2002, Gates of the Arctic National Park and Preserve, Alaska. No tracks were deposited on 6 of the 11 transects during the 3-day count period. VCC codes are as follows: L, M and D = lightly, moderately and densely vegetated cover, respectively; A = alder, B = shrub birch, P = Poplar, S = spruce, W = willow; 1, 2, or 3 distinguishes transects within the same VCC.

Browsed Vegetation

Diameter-at-Point-of-Browse

Of the 1,049 stems measured, only 77 (7.3%) had been browsed during the current season, and all but 2 (which were poplar) of these stems were willow or spruce, the most common species in the area . None of the alder or shrub birch stems found had been freshly browsed. Table 1 summarizes the DPB data, distinguishing between “fresh” and “old” browsed stems, and those measurements which were inaccurate due to extra bark and wood having been chewed off the stem (these were also “old” stems). One note of interest is that in every species in each VCC, the average “inaccurate” measurement was larger than the “old” measurement, even though “old” measurements were of the entire stem diameter and “inaccurate” measurements were of incomplete stem diameters due to the severity of browsing.

Browse Nutritional Analysis

Appendix IV lists the percentages of nitrogen and tannins found in the browse samples; these data are summarized in Figures 5-8. Mean nitrogen was 1.073% dry weight in willows, 1.239% in shrub birch, 1.364% in poplar, and 1.466% in alder. An estimate of crude protein also was calculated, although percent nitrogen may include nitrogen-based defense compounds in addition to proteins. Tannin content ranged across a broader spectrum, from 1.24% in poplar to 11.08% in willows.

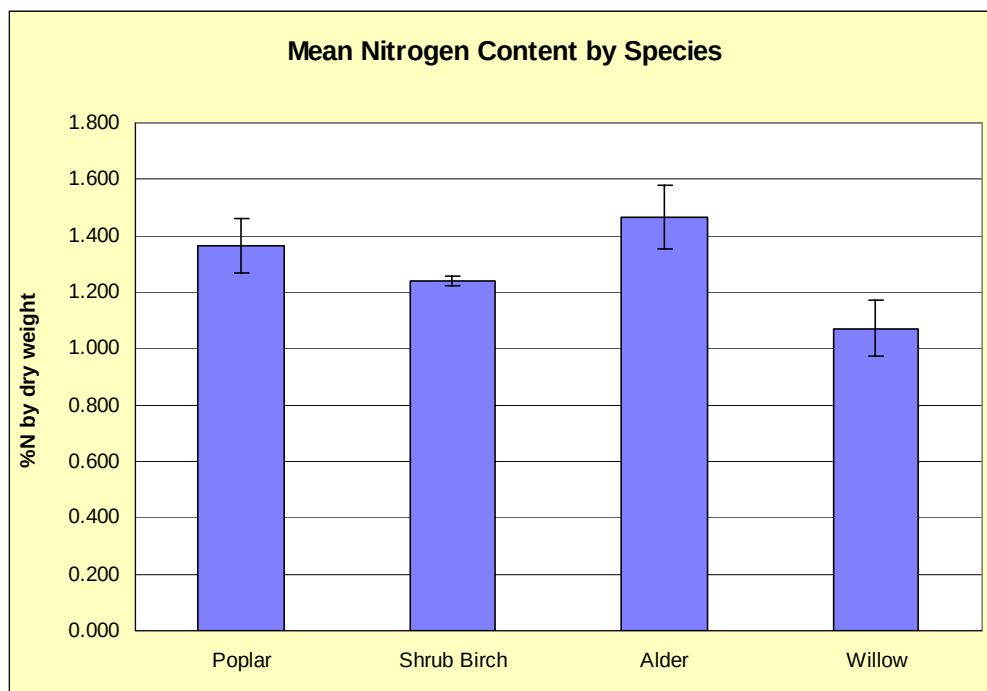


Fig. 5. Mean percent nitrogen content of species browsed by snowshoe hares near Wiseman, Alaska, Gates of the Arctic National Park and Preserve, March 2002. Twigs from several shrubs were combined within each habitat type to make each sample. This graph shows the species from all habitat types combined.

Table 1. Diameter at point of browse (DPB) measurements collected from 6 vegetation cover and composition (VCC) classes along the snowshoe hare survey route, near Wiseman, Alaska, in eastern Gates of the Arctic National Park and Preserve, March 2002. In VCCs, the letters stand for the following: L=light vegetation, M=moderate vegetation, D=D-WS vegetation, W=willow sp., P=M-SPW, S=spruce, B=shrub birch, A=alder. Since very few freshly browsed stems could be located this year, the majority of measurements are from stems browsed in previous years (measurement type=O). Also, several measurements are of stems which had bark and/or wood missing (chewed off) (measurement type=I). Freshly browsed stems are indicated by measurement type=F.

SPECIES	VCC	Measure Type	Ave DPB	Count	SPECIES	VCC	Measure Type	Ave DPB	Count
Alder (<i>Alnus crispa</i>) Shrub Birch (<i>Betula glandulosa</i>)	L-WA	I	7.30	5	Balsam M-SPW (<i>Populus balsamifera</i>)	D-WPS	I	6.85	10
		O	6.17	45			O	4.07	15
	M-SW	I	4.41	16		D-WS	I	5.50	12
		O	3.70	35			O	4.95	38
	L-WA	I	4.00	4		M-SW	I	6.00	23
		O	3.96	46			O	4.74	27
White Spruce (<i>Picea glauca</i>)	L-SB	I	4.25	4	Willow sp. (<i>Salix</i> spp.)	L-WA	I	6.45	20
		O	3.46	46			O	5.73	30
	D-WPS	F	4.50	3		M-SPW	F	6.25	2
		I	8.50	5			I	7.35	24
		O	4.14	42			O	5.19	24
	D-WS	F	5.11	14		D-WPS	F	3.89	37
		I	7.50	3			I	8.73	11
		O	4.65	33			O	5.37	15
	M-SW	F	4.50	5		D-WS	F	6.00	2
		I	7.00	8			I	9.63	8
		O	4.46	37			O	6.20	48
	L-WA	I	5.50	2		M-SW	I	6.37	15
		O	4.46	48			O	4.51	37
	M-SPW	I	6.20	10		L-WA	I	6.88	16
		O	5.21	40			O	5.59	34
	L-SB	F	4.50	2		M-SPW	F	5.05	10
		I	4.90	5			I	6.70	20
		O	3.64	43		L-SB	F	5.03	20
							I	7.75	2
							O	5.15	13
								3.49	35

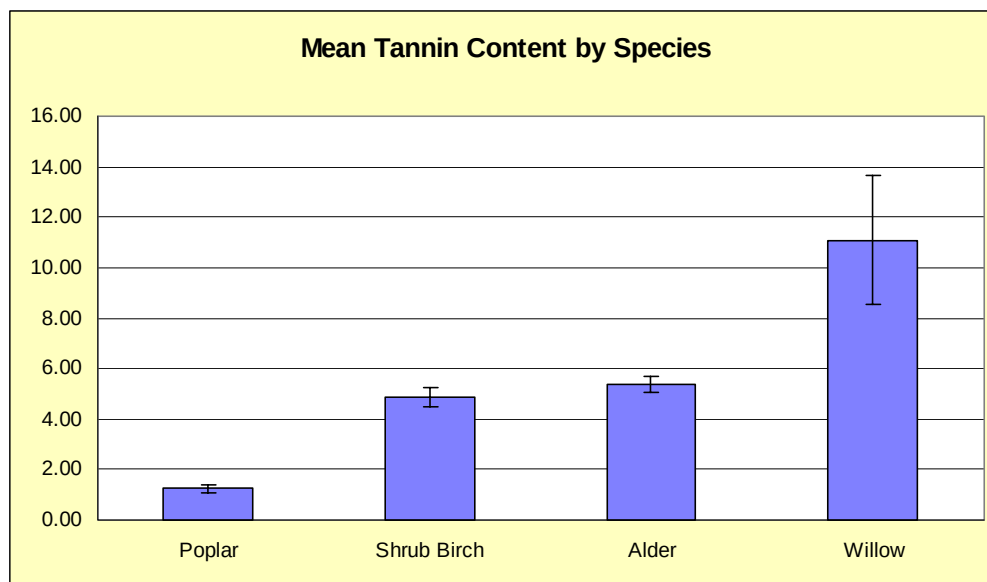


Fig. 6. Mean percent tannin content of species browsed by snowshoe hares near Wiseman, Alaska, Gates of the Arctic National Park and Preserve, March 2002. Twigs from several shrubs were combined within each habitat type to make each sample. This graph shows the species from all habitat types combined.

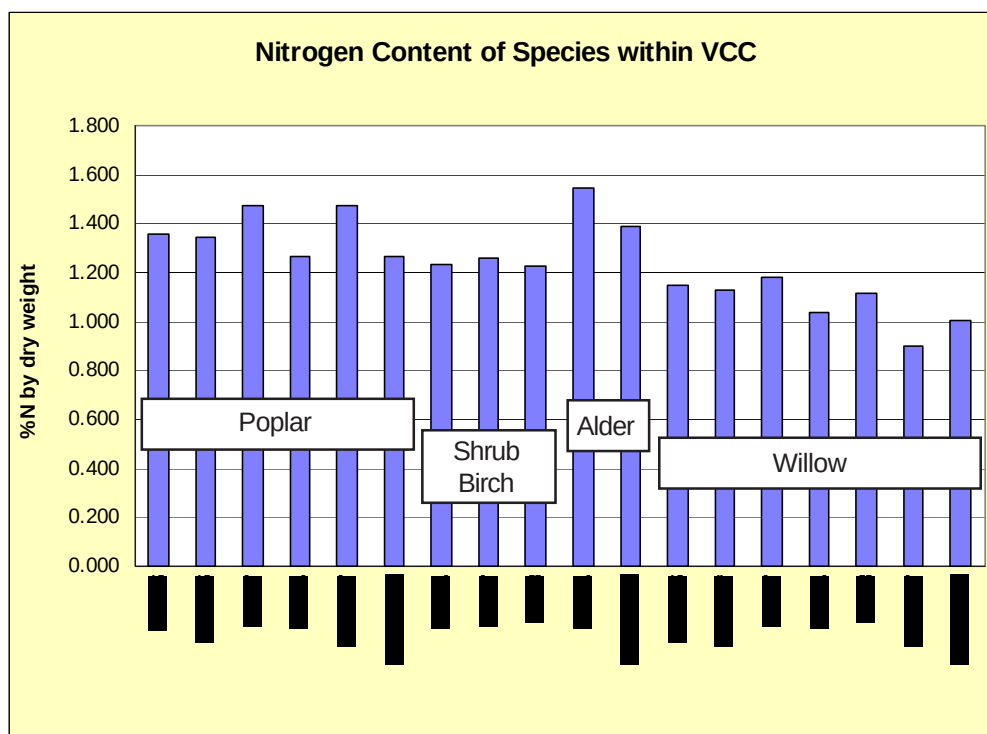


Fig. 7. Percent nitrogen content of species browsed by snowshoe hares within different habitat types near Wiseman, Alaska, Gates of the Arctic National Park and Preserve, March 2002. Twigs from several shrubs were combined within each habitat type to make each sample.

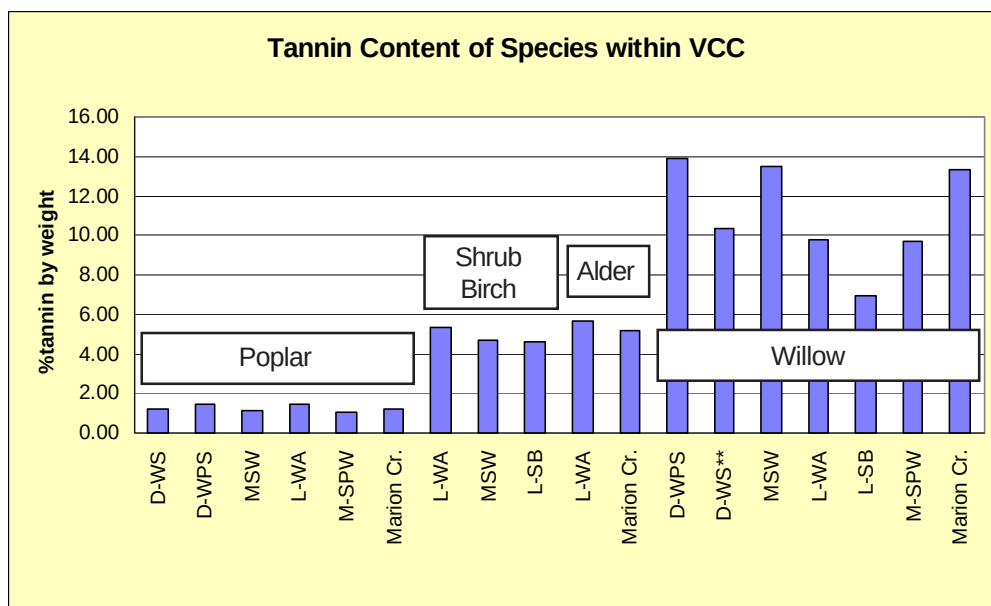


Fig. 8. Percent tannin content of species browsed by snowshoe hares within different habitat types near Wiseman, Alaska, Gates of the Arctic National Park and Preserve, March 2002. Twigs from several shrubs were combined within each habitat type to make each sample.

Soil Sample Analysis

Results from the 12 soil samples that were collected and analyzed for the presence of arsenic, cadmium and copper are shown in Table 2. All had extremely low concentrations of these metals, including the two samples from Marion Creek, which were the control samples.

Table 2. Concentrations (mg/dry kg) of 3 heavy metals in soil samples collected in and around the snowshoe hare survey area, Gates of the Arctic National Park and Preserve, near Wiseman, Alaska, 2002. All results show extremely low levels of these metals.

<u>Sample Name</u>	<u>Arsenic</u>	<u>Cadmium</u>	<u>Copper</u>
D-WS VCC	0.8	0.4	0.9
M-SPW VCC	0.8	0.4	0.9
Washington Ck. #1	0.8	0.4	0.9
Washington Ck. #2	0.8	0.4	0.9
Washington Ck. #3	0.8	0.4	0.9
Jennie Ck.	0.8	0.4	0.9
Vermont Ck.	0.9	0.5	1.0
Buckeye	0.8	0.4	0.9
Canyon Ck.	0.8	0.4	0.9
Hammond Canyon	0.9	0.5	1.0
Marion Ck. #1	0.8	0.4	0.9
Marion Ck. #2	0.8	0.4	0.9

DISCUSSION

After four years at high levels (DiFolco 2002), the snowshoe hare population in our study area appeared to have decreased by the time of our survey in March, 2002. The lack of hare sightings coincided with the lower track count results. During earlier surveys while the population was at its peak, usually several hares would be sighted incidentally daily. This year, we observed only one hare during the entire 10-day period we were in the area. Thus, it appears that the hare population is now approaching the low point of its cycle. We expect that the population will continue to decline over the next year or so and remain at low levels for a couple years while the vegetation recovers and the number of lynx in the area declines.

In addition to few tracks and only a single hare sighting, we found little evidence of stems freshly browsed by hares. The freshly browsed stems that we finally did find were all buried under several inches of snow. In January, the hare population was reported to be a little lower than the previous few years but still holding fairly high (J. Reakoff, Wiseman trapper, pers. commun.). By the time of the survey in March, however, we found little evidence of hares. Snow had likely buried the stems the hares were browsing, and the additional energy expended to dig down to browse or the inability to find browse may have been a cause of increased mortality, resulting in a decline of the population. Additionally, there were many lynx in the area, and predation was certainly a factor in the hare population decline.

Since only a handful of freshly browsed stems could be measured this year, it is difficult to compare dpb measurements with previous years. We can note, however, that D-WPS, where we found the most hare tracks also had the greatest number of freshly browsed willow stems. These stems also averaged the smallest diameter of all the freshly browsed stems (of any species).

The tannin levels in willows were not found to be unusually high or low, but had roughly the same range of values that others have found in browsed and unbrowsed twigs (Rich Kedrowski, unpublished data, pers. commun.). Nitrogen content was roughly the same as or a little higher than that found in other studies (Rich Kedrowski, unpublished data, pers. commun.). It is difficult to compare our data with others' results due to differences in location, variations in the degree of browsing, and other environmental factors. It would be interesting to see if and how much these levels change in our study area during different phases of the local hare cycle.

Hares were not visiting the soil licks in 2002 like they were during 2000, when heavily used trails were packed by hares travelling to and from those sites (J. Reakoff, Wiseman trapper, pers. commun.). The heavy metals tested for was an effort to determine whether this might be a factor leading to the poor body condition observed in lynx during the hare high while hares are consuming soils. The low levels of arsenic, cadmium and copper, however, rule out--at least for these 3 elements--that the condition is due to high levels of these metals.

RECOMMENDATIONS TO MANAGEMENT

1. Continue monitoring the snowshoe hare population. Now that we are approaching the completion of one cycle in the hare population, the benefits of this long-term project are finally being realized.
2. Revise methods to improve quality of counts. Set up transects earlier in the year (e.g. February) and count tracks opportunistically as fresh snow falls. The Marion Creek Ranger has agreed to help with this. Eliminate retention counts, as this costs time and does not add to our knowledge (since we know by now that tracks persist for an extended period of time, barring new snow or severe winds).
3. Plan to expand research into questions relating to the relationships between hares and the soils, plants and lynx in the area. If funding becomes available, these relationships should be studied. Specifically, questions that can be investigated include: a) Do levels of tannins and nitrogen in browse species change under different browsing intensities? How much? b) Why do hares practice geophagy during a certain phase of the population cycle? How does this behavior affect their physiology? c) Why do lynx sometimes exhibit poor physical condition during the hare population high? This condition seems to occur when hares are consuming soil. How is lynx physiology affected by hare geophagy?

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Appendix I. Deposition of tracks on 100m transects from the 2002 snowshoe hare track count survey near Wiseman, Gates of the Arctic National Park and Preserve, Alaska. Vegetation cover and composition (VCC) codes are as follows: L, M and D = lightly, moderately and densely vegetated cover, respectively; A = alder, B = shrub birch, P = poplar, S = spruce, W = willow; 1, 2 or 3 distinguishes transects within the same VCC.

	L-SB-1	L-SB-2	L-WA-1	L-WA-2	M-SW	M-SPW-1	M-SPW-2	M-SPW-3	D-WS-1	D-WS-2	D-WPS
14-Mar-02	0	0	0	0	0	2	2	3	7	0	10
15-Mar-02	0	0	0	0	0	4	3	1	4	0	5
16-Mar-02	0	0	0	0	0	0	0	2	1	0	5
Total	0	0	0	0	0	6	5	6	12	0	20
Mean	0	0	0	0	0	2	1.67	2	4	0	6.67
SD	0	0	0	0	0	2	1.53	1	3	0	2.89

Appendix II. Retention of tracks and trails on 100m transects from the 2002 snowshoe hare track count survey near Wiseman, Gates of the Arctic National Park and Preserve, Alaska. Track retention was counted over 3 days. Vegetation cover and composition (VCC) codes are as follows: L, M and D = lightly, moderately and densely vegetated cover, respectively; A = alder, B = shrub birch, P = poplar, S = spruce, W = willow; 1, 2 or 3 distinguishes transects within the same VCC.

	L-SB-1	L-SB-2	L-WA-1	L-WA-2	M-SW	M-SPW-1	M-SPW-2	M-SPW-3	D-WS-1	D-WS-2	D-WPS
14-Mar-02	0	0	0	0	0	2	3	2	2	0	7
15-Mar-02	0	0	0	0	0	7	2	4	5	0	10
16-Mar-02	0	0	0	0	0	10	2	7	6	0	12

Appendix III. Weather data from the 2002 snowshoe hare track count, conducted March 14 - 16, near Wiseman, Alaska, in eastern Gates of the Arctic National Park and Preserve.

DATE	TIME		TEMP (F)		WIND		SKY		PRECIP
	Start	Finish	Start	Finish	Start	Finish	Start	Finish	
3/14/2002	10:08	11:41	-5	12	slight breeze	calm	clear	clear	0
3/15/2002	11:26	13:07	16	23	calm	calm	overcast thin	overcast thin	0
3/16/2002	11:26	13:05	26	31	5-10mph	5-10mph	overcast	overcast	0

Appendix IV. Nitrogen and tannin content of twigs collected from browsed shrubs in the snowshoe hare survey area near Wiseman, Alaska, Gates of the Arctic National Park and Preserve, March 2002. In VCCs, the letters stand for the following: L=light vegetation, M=moderate vegetation, D=D-WS vegetation, W=willow sp., P=M-SPW, S=spruce, B=shrub birch, A=alder. Marion Cr. is the control site outside the study area.

Date	Site	%N	Crude Protein* (=%N x 6.25)	% Tannin
Poplar				
12-Mar-02	D-WS	1.355	8.469	1.22
12-Mar-02	D-WPS	1.346	8.413	1.46
13-Mar-02	MSW	1.476	9.225	1.12
13-Mar-02	L-WA	1.268	7.925	1.44
15-Mar-02	M-SPW	1.473	9.206	1.03
17-Mar-02	Marion Cr.	1.263	7.894	1.19
Mean Poplar		1.364	8.522	1.24
SD		0.094	0.588	0.17
Shrub Birch				
13-Mar-02	L-WA	1.232	7.700	5.32
13-Mar-02	MSW	1.257	7.856	4.70
15-Mar-02	L-SB	1.228	7.675	4.59
Mean Shrub Birch		1.239	7.744	4.87
SD		0.016	0.098	0.40
Alder				
13-Mar-02	L-WA	1.546	9.663	5.62
17-Mar-02	Marion Cr.	1.386	8.663	5.15
Mean Alder		1.466	9.163	5.38
SD		0.113	0.707	0.33
Willow				
12-Mar-02	D-WPS	1.148	7.175	13.92
12-Mar-02	D-WS**	1.126	7.038	10.38
13-Mar-02	MSW	1.182	7.388	13.46
13-Mar-02	L-WA	1.034	6.463	9.79
15-Mar-02	L-SB	1.112	6.950	6.98
17-Mar-02	M-SPW	0.901	5.634	9.71
17-Mar-02	Marion Cr.	1.005	6.281	13.33
Mean Willow		1.073	6.704	11.08
SD		0.098	0.612	2.57

* Crude Protein is a rough calculation--percent nitrogen may also include nitrogen-based defense compounds in addition to crude protein.

**Some poplar was inadvertently mixed with the willow sample in D-WS. This mistake was not detected until the specimens were ground before processing.