

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



GAAR-98-007
October 1998

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INTRODUCTION

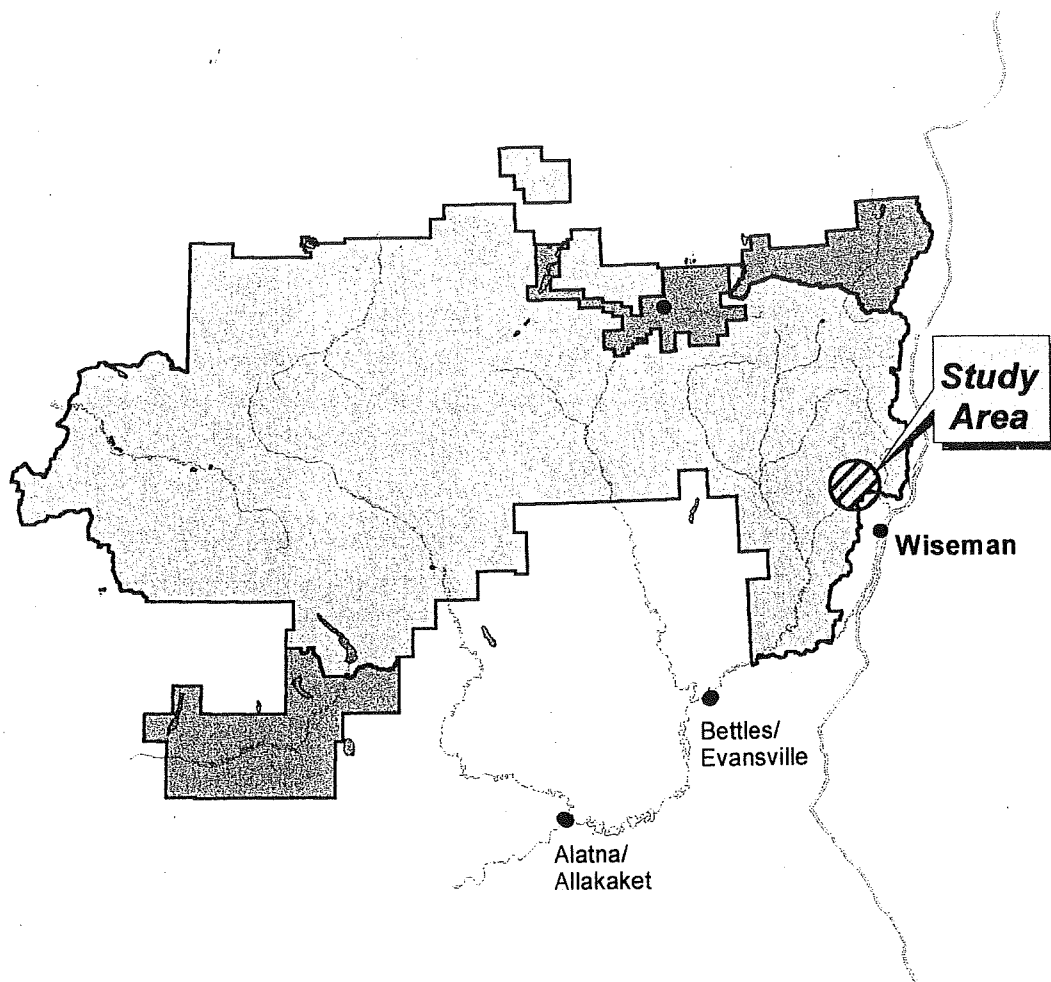
In March 1997, resource personnel at Gates of the Arctic National Park and Preserve (GAAR) began a long-term monitoring program of the snowshoe hare (*Lepus americanus*) population in the eastern portion of the park (DiFolco 1997). This project was developed in response to a 5-year furbearer study that 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 second year of the snowshoe hare study. I'd like to thank Dave Schmitz for his assistance counting tracks, and the folks of Wiseman who shared their observations, knowledge of the area, and hot tea with us.

STUDY AREA

Gates of the Arctic National Park and Preserve is located above 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).



- Towns
- - - Dalton Highway
- ~ Rivers
- ▬ Park Boundary
- Park
- Preserve
- Park and Wilderness

Map Location



National Park Service Gates of the Arctic National Park and Preserve Natural Resources

25 0 25 50 Miles



Fig. 1. Study area for snowshoe hare survey near Wiseman, Alaska, in eastern Gates of the Arctic National Park and Preserve, March 1998.

METHODS

Field Methods:

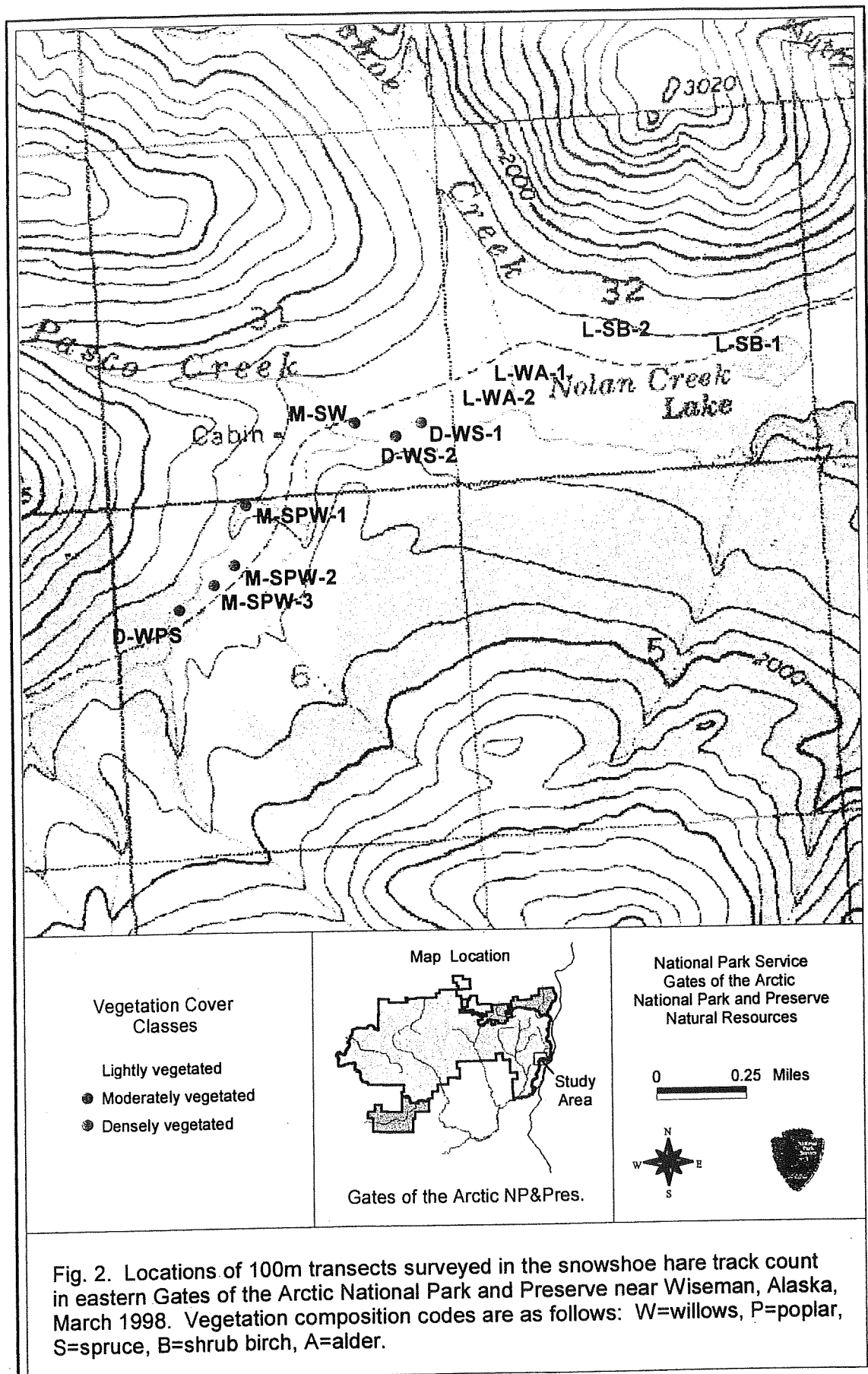
The study was conducted 23-31 March 1998, using the same methods as in the 1997 survey (DiFolco 1997, Golden 1994). However, since the number of snowshoe hare tracks had increased dramatically over the previous year, we counted tracks along a number of 100m transects rather than the entire lengths of each vegetation composition and cover (VCC) type. The 100m transects were started at randomly selected points along each VCC (Fig. 2). Four 100m transects were marked in lightly vegetated areas, 4 in moderately vegetated areas, and 3 in densely vegetated areas. Latitude and longitude coordinates for each VCC type and each 100m transect were collected with a Precision Lightweight GPS Receiver (PLGR) (Appendix I). Track deposition and retention were counted on 4 days. 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.

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 also.

Following a tip from Wiseman resident and trapper Jack Reakoff, we traveled via snowmachine to Washington Creek, about 4 miles north of the survey transect (Fig. 3), to observe use of the area by snowshoe hares. Reakoff informed us that hares use this area even during the lowest period of the hare cycle. He had noticed that hares ate the dirt from the bare bluffs along the creek. Soil samples were collected from 3 of the bluffs along the creek and browse data were collected at one location on the creek floodplain. The soil samples were stored in plastic ziplock bags. Later, Northern Testing Laboratories, Inc. tested the samples for mineral salts (Calcium, Magnesium, Potassium, Sodium, and Chloride). I also performed a mechanical analysis using University of Alaska Fairbanks facilities to determine the percentages of sand, silt and clay of each sample.

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.



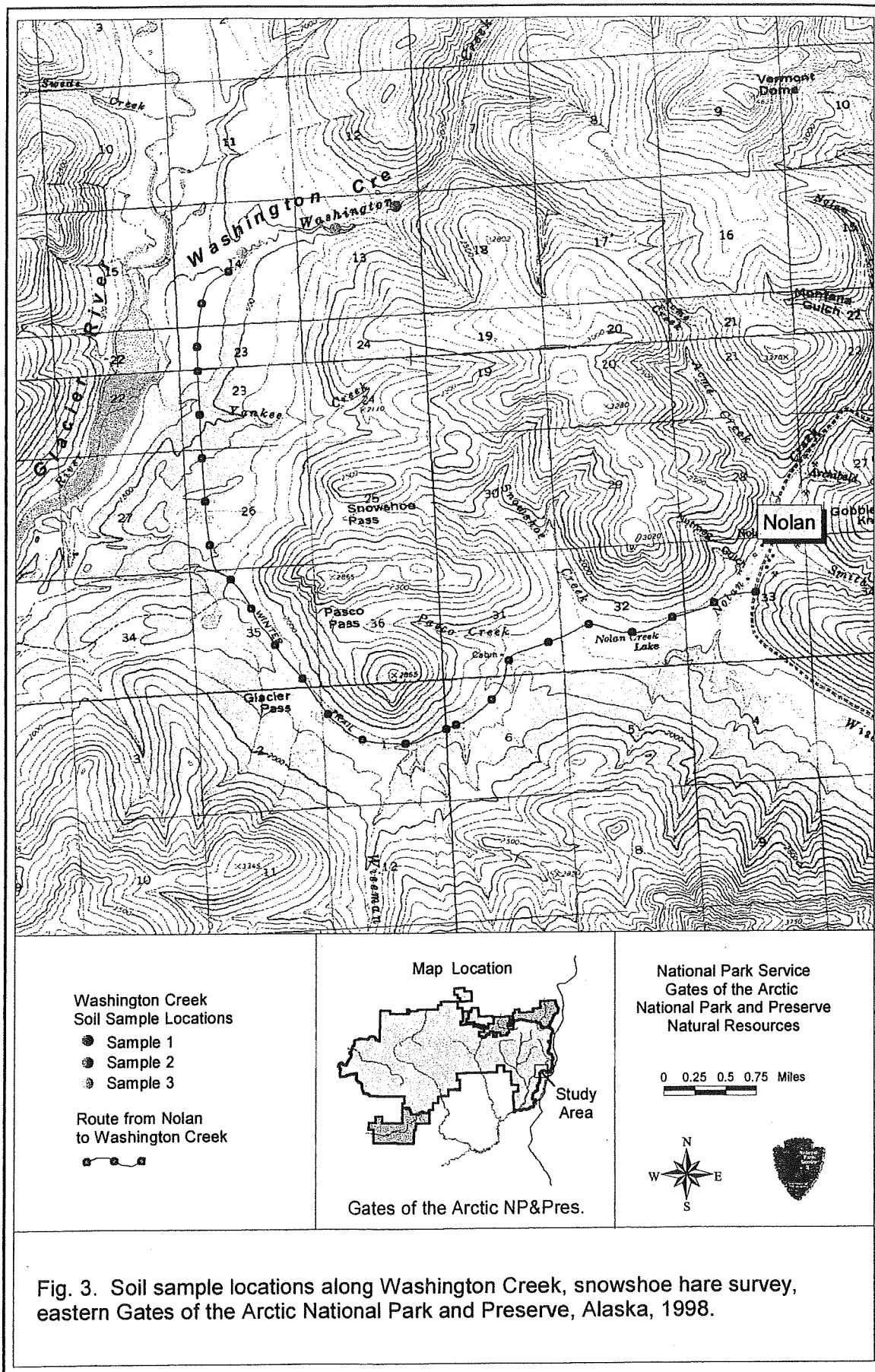


Fig. 3. Soil sample locations along Washington Creek, snowshoe hare survey, eastern Gates of the Arctic National Park and Preserve, Alaska, 1998.

RESULTS

Although tracks were counted on 4 days, the first day's count was thrown out of the calculations because snow conditions were not good for tracking (see Weather and Track Retention section below). Dave Schmitz saw one hare cross directly in front of him, yet he could not find its track due to the hard snow conditions. After a new snowfall on March 26-27 however, we counted tracks on three consecutive days and felt that these counts were accurate.

Track Deposition

Track deposition ranged from 7-14 tracks/100m in lightly vegetated areas, 28-49 tracks/100m in moderately vegetated areas, and 63-85 tracks/100m in densely vegetated areas (Fig. 4 and Appendix II). Estimates for moderately and densely vegetated areas included trails as well as individual tracks. Since individual tracks could not be distinguished after 3 hares had passed over the same spot, a trail was conservatively approximated to equal 4 tracks. No trails were formed in the lightly vegetated areas within a single 24-hr period.

Weather and Track Retention

A lack of fresh snow, thick crust over granular snow, and above freezing temperatures combined for very poor tracking conditions on March 25, the first day we attempted to count tracks. Although we collected deposition and retention data that day, these data were tossed in the final analysis since they were obviously inaccurate (Appendices II and III). The following 2 days, however, brought 25mm of fresh snow and lower temperatures, which made track counting much easier.

In general, the greatest number of tracks were counted the first day (March 28), with a moderate increase the second day (March 29), and a leveling off by the third day (March 30). Light snowfall after the first day (2mm) and second day (4mm) probably contributed to the decrease in track retention. By the third day, there were 14-37 tracks and 0-2 trails counted along the 4 lightly vegetated transects (Figs. 5 and 6), 37-55 tracks and 6-14 trails on the 4 moderately vegetated transects (Figs. 7 and 8), and 54-86 tracks and 17-24 trails counted in the 3 densely vegetated transects (Figs. 9 and 10).

Browsed Vegetation

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

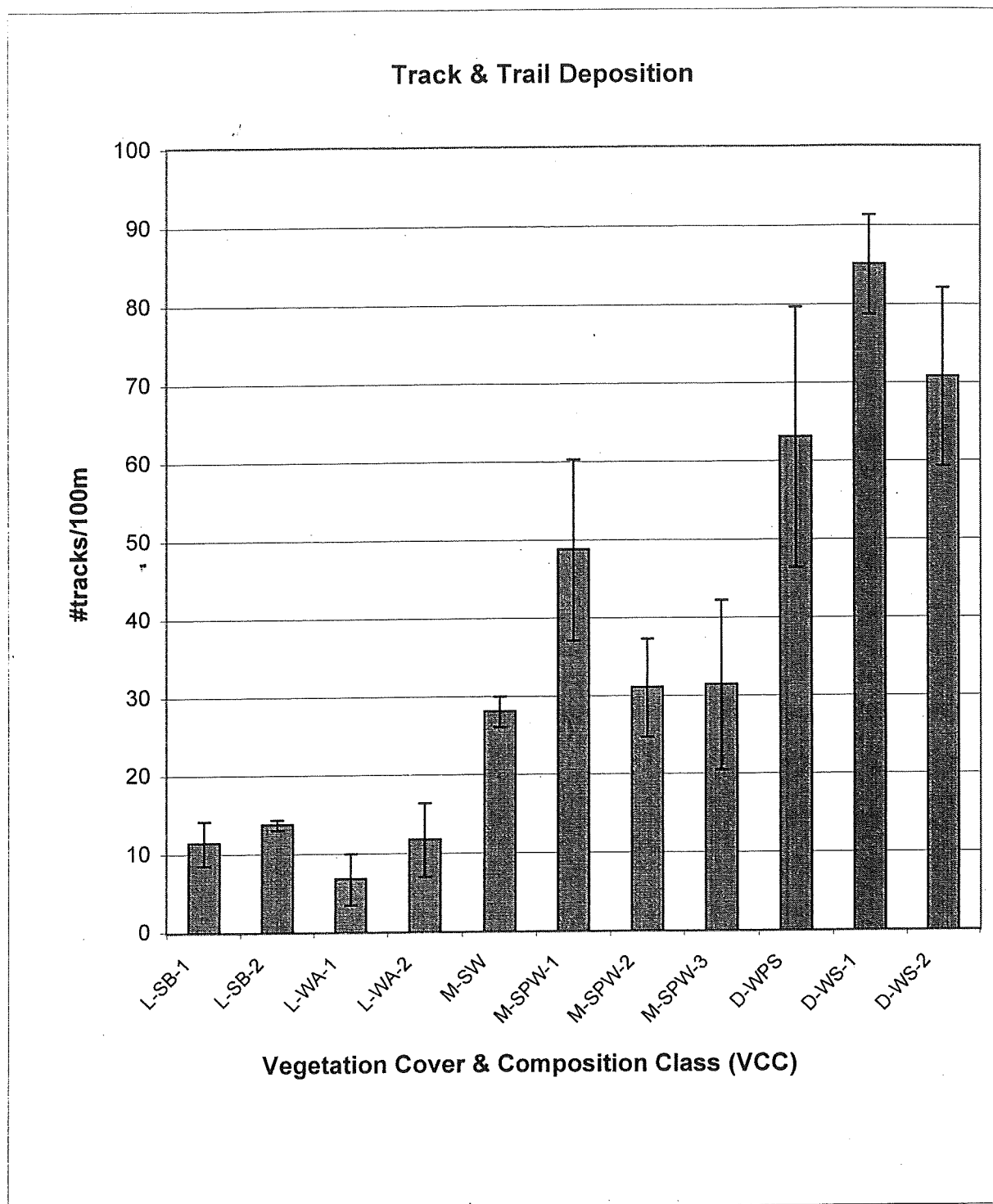


Fig. 4. Three-day average of snowshoe hare track deposition (95% confidence intervals), snowshoe hare track count survey, eastern Gates of the Arctic National Park and Preserve, Alaska, March 28-30, 1998. Trails included in moderate and dense VCCs as 1 trail = 4 tracks (no trails formed in light VCCs). In VCCs, letters stand for the following: L=light vegetation, M=moderate vegetation, D=dense vegetation, W=willows, P=poplars, S=spruce, B=shrub birch, A=alder.

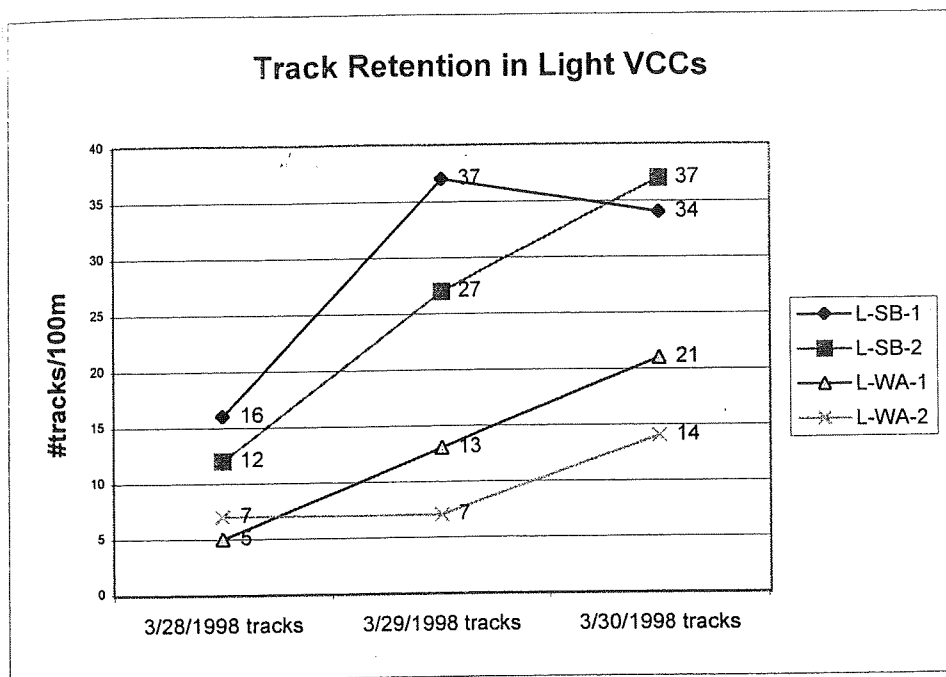


Fig. 5. Retention of snowshoe hare tracks in 4 lightly vegetated transects, snowshoe hare track count survey, eastern Gates of the Arctic National Park and Preserve, Alaska. Vegetation cover classes (VCCs) were defined as: L-SB = light cover (L), comprised mainly of spruce (S) and shrub birch (B); and L-WA = light cover of willows (W) and alder (A). There were 2 transects in each of these 2 VCCs.

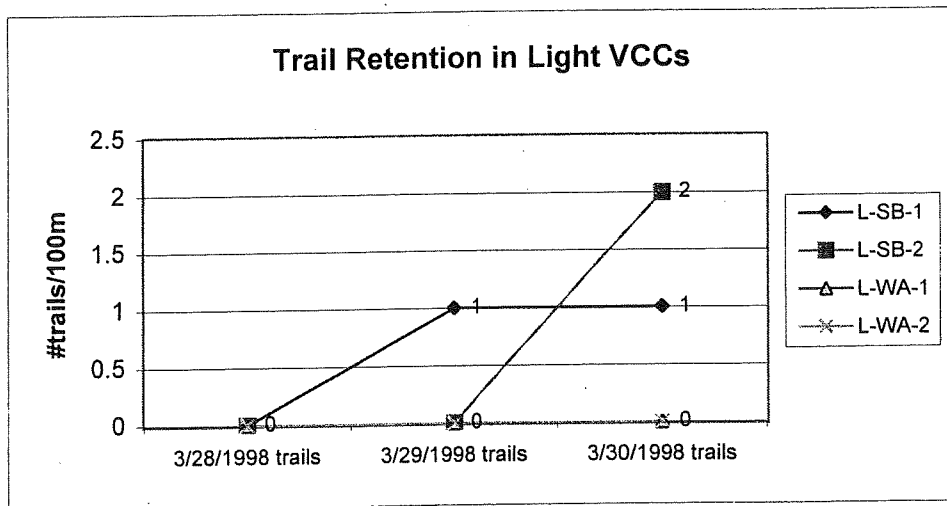


Fig. 6. Retention of snowshoe hare trails (1 trail = 4 tracks) in 4 lightly vegetated transects, snowshoe hare track count survey, eastern Gates of the Arctic National Park and Preserve, Alaska. Vegetation cover classes (VCCs) were defined as: L-SB = light cover (L), comprised mainly of spruce (S) and shrub birch (B); and L-WA = light cover of willows (W) and alder (A). There were 2 transects in each of these 2 VCCs.

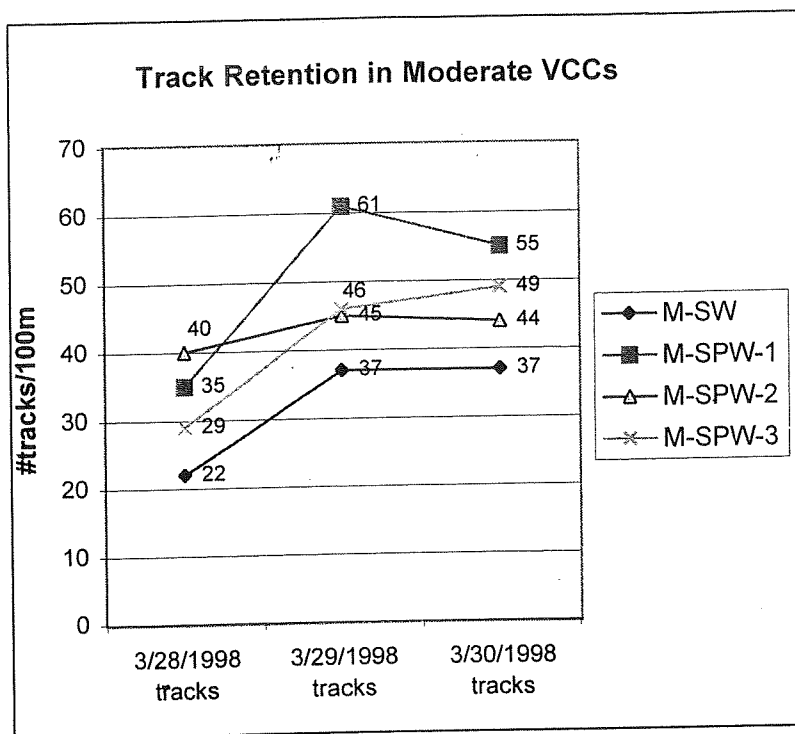


Fig. 7. Retention of snowshoe hare tracks in 4 moderately vegetated transects, snowshoe hare track count survey, eastern Gates of the Arctic National Park and Preserve, Alaska. Vegetation cover classes (VCCs) were defined as: M-SW = moderate cover (M), comprised mainly of spruce (S) and willows (W); and M-SPW = moderate cover of spruce, poplar (P), and willows. There was 1 transect in M-SW and 3 transects in M-SPW.

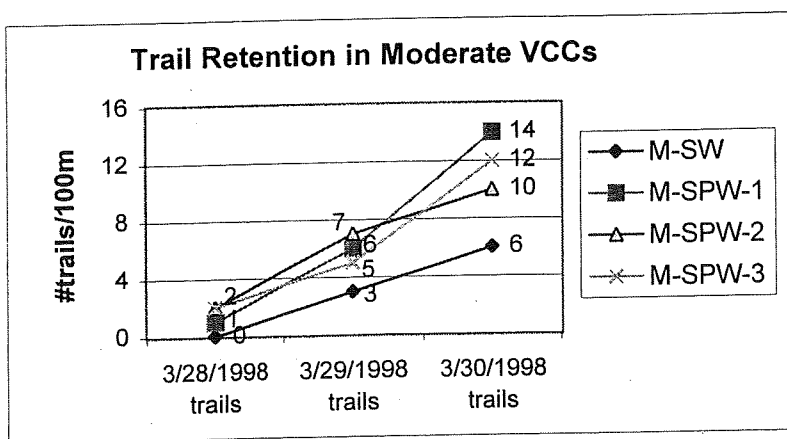


Fig. 8. Retention of snowshoe hare trails (1 trail = 4 tracks) in 4 moderately vegetated transects, snowshoe hare track count survey, eastern Gates of the Arctic National Park and Preserve, Alaska. Vegetation cover classes (VCCs) were defined as: M-SW = moderate cover (M), comprised mainly of spruce (S) and willows (W); and M-SPW = moderate cover of spruce, poplar (P), and willows. There was 1 transect in M-SW and 3 transects in M-SPW.

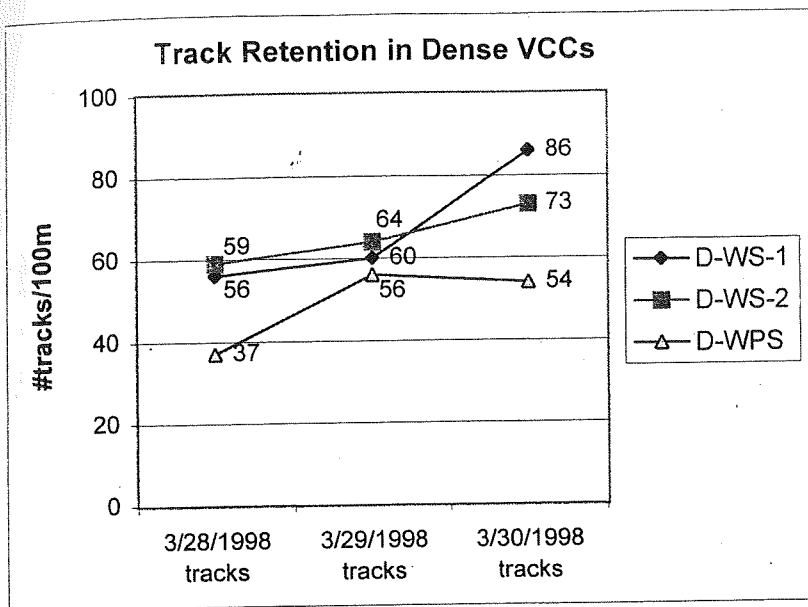


Fig. 9. Retention of snowshoe hare tracks in 3 densely vegetated transects, snowshoe hare track count survey, eastern Gates of the Arctic National Park and Preserve, Alaska. Vegetation cover classes (VCCs) were defined as: D-WS = dense cover (D), comprised mainly of willows (W) and spruce (S); and D-WPS = dense cover of willows, poplar (P), and spruce. There were 2 transects in D-WS and 1 transect in D-WPS.

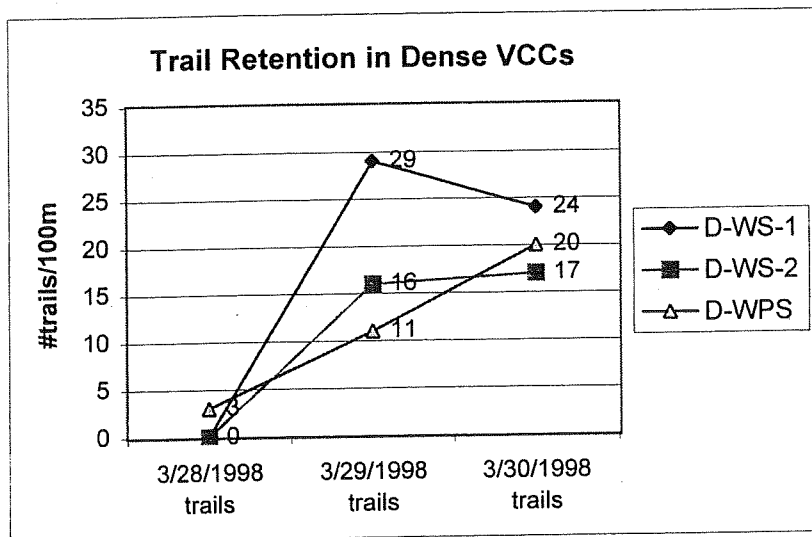


Fig. 10. Retention of snowshoe hare trails (1 trail = 4 tracks) in 3 densely vegetated transects, snowshoe hare track count survey, eastern Gates of the Arctic National Park and Preserve, Alaska. Vegetation cover classes (VCCs) were defined as: D-WS = dense cover (D), comprised mainly of willows (W) and spruce (S); and D-WPS = dense cover of willows, poplar (P), and spruce. There were 2 transects in D-WS and 1 transect in D-WPS.

Willows—Salix spp. were browsed in all 6 vegetation types found along the survey transect, as well as at the Washington Creek site. Girdling of willows was also evident in each of these areas except for L-WA. The average diameter at point of browse (dpb) ranged from 3.6mm in L-WA to 6.7mm in D-WS. The smallest browsed willow stem measured 2mm (in L-WA and L-SB) whereas the largest measured 14mm (in D-WS).

Balsam Poplar—Populus balsamifera were browsed in 3 of the 5 VCCs where they were found. Signs of girdling were apparent in M-SPW and D-WS, but not in M-SW. Average dpb was 6.1mm in M-SPW, 4.7mm in D-WS, and 4.4mm in M-SW. Although poplars represented only 5% of the vegetative cover in D-WS, approximately 85% of these were browsed.

White Spruce—Picea glauca were found in all vegetation types, including the Washington Creek site; however, browsing on this species was noticeable in only 3 of the areas: Washington Creek, M-SPW and D-WS. Only one stem was found browsed, at 6mm dpb, in M-SPW. Spruce stems ranging from 3-8mm (average 4.4mm dpb) were browsed and girdled in Washington Creek. D-WS also had some girdling and browsed stems of 2-5mm in diameter (average 3.7mm dpb).

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 (down to 1mm dpb) were browsed from shrub birch than other browsed species. Girdling of shrub birch, however, was noticed in L-WA, where stems up to 8mm dpb were browsed, averaging 4.7mm dpb in that VCC.

Alder—Alnus sp. were heavily browsed and girdled in Washington Creek, with an average of 4.5mm dpb. Alder was found in only one other vegetation type, L-WA. Only one bush was located along this transect. It had been browsed, but no measurements were taken.

Washington Creek Vegetation and Soil Analysis

Washington Creek was visited to observe the signs of snowshoe hares, as recommended by Jack Reakoff, a resident and experienced trapper of Wiseman. Reakoff reported that snowshoe hares could always be found in this area, even during periods of extremely low population levels. Brush on the hillsides lining the creek had been mostly browsed the year before. Signs of fresh browsing were readily apparent on brush in the creek floodplain, which was comprised mainly of willow and alder. Most of the shrubs had been clipped and partially or completely girdled also. While the larger spruce trees were left untouched, the smaller spruce, up to 4 or 5 feet tall, had been browsed by hares, which had eaten the branch tips and the tops of the trees where they could reach. Some small spruce saplings were girdled as well.

Mineral salts analyses of the 3 soil samples collected from bluffs along Washington Creek are summarized in Table 2. The samples were tested for Calcium, Potassium, Magnesium, Sodium and Chloride. In each of the samples, there were greater amounts of Magnesium and Calcium than the other elements. Sodium, which is considered an important

Table 1. Browse data collected from 6 vegetation cover and composition (VCC) classes along the Wiseman area snowshoe hare survey transect and Washington Creek, Gates of the Arctic National Park and Preserve, Alaska, 27-30 March 1998. In VCCs, the letters stand for the following: D = dense vegetation, M = moderate vegetation, L = light vegetation, W = willows, P = poplars, S = spruce, B = shrub birch, A = alder.

SPECIES	VCC	%COMP	%BROWSED	GIRDLED?	Avg DPB	Min	Max	Count
ALNUS	"WASH"	70	80	yes	4.5	3	6	15
BEGL	L-SB	30	no data	no	2.7	1.5	5	16
BEGL	L-WA	10	4	yes	4.7	2	8	15
BEGL	M-SW	5	75	no	3.2	1	5	16
PIGL	"WASH"	20	10	yes	4.4	3	8	12
PIGL	M-SPW	30	4	no	6.0	6	6	1
PIGL	D-WS	10	20	yes	3.7	2	5	15
POBA	M-SPW	35	30	yes	6.1	3	9	17
POBA	M-SW	30	25	no	4.4	3	7	16
POBA	D-WS	5	85	yes	4.7	2	8	15
SALIX	"WASH"	10	80	yes	4.9	3	8	15
SALIX	D-WPS	75	27	yes	5.3	4	7	15
SALIX	L-SB	20	no data	yes	4.0	2	7	15
SALIX	L-WA	40	25	no	3.6	2	5	16
SALIX	M-SPW	35	30	yes	5.4	3	8	18
SALIX	M-SW	25	25	yes	5.2	4	7	16
SALIX	D-WS	85	85	yes	6.7	4	14	20

Table 2. Results of the mineral analyses of soils from Washington Creek, near Wiseman in eastern Gates of the Arctic National Park and Preserve, Alaska, 1998.

	Units in mg/dry kg		
	Sample 1	Sample 2	Sample 3
Calcium	4820	423	977
Potassium	342	6	22
Magnesium	10000	191	6190
Sodium	428	25	77
Chloride	43	3	4

Table 3. Results of the mechanical analyses of soils from Washington Creek, near Wiseman in eastern Gates of the Arctic National Park and Preserve, Alaska, 1998.

	Sample 1	Sample 2	Sample 3
% Sand	34	50	38
% Silt	44	46	51
% Clay	22	4	11

nutritional component for most mammals, ranked third in each of the samples. Sample 1 contained the highest proportions of all 5 elements, sample 3 contained an intermediate amount, and sample 2 contained the lowest amounts of the mineral salts. A mechanical analysis was also performed on each sample. In this breakdown of particle sizes, Sample 1 contained 22.4% clay, compared to 11.2% clay in Sample 3 and only 4.4% clay in Sample 2 (Table 3).

DISCUSSION

The greater number of tracks and the abundance of freshly browsed vegetation were clear indicators of a larger hare population in 1998 than in 1997 (DiFolco 1997). A dramatic increase in the number of tracks deposited during the 1998 survey was observed. Light VCCs saw roughly 10 times the number of tracks as in 1997. Deposition data in 1998 most likely underestimates hare abundance in the moderately and densely vegetated VCCs due to the number of trails that formed. Although in several places it appeared that more than 4 hares had passed over a trail, it was impossible to determine the exact number. This bias will probably increase with increasing densities of hares. However, combining browse data with the track counts should provide enough information to accurately indicate relative population levels of hares in this area.

Wiseman residents predicted that, although the hare population was much higher in 1998, it would probably not reach its peak for another year or two (J. Reakoff, S. Schoppenhorst, pers. commun.). During the last snowshoe hare peak, hares "ate everything," residents reported, indicating that damage to vegetation from browsing hares was much greater than the current situation. At peak population levels, hares will not eat the buds of shrub birch and alder because these plants become so stressed by overbrowsing that they produce triterpenes at levels intolerable to hares (Dr. John Bryant, professor of plant ecology, University of Alaska Fairbanks, pers. commun.). Hares will eat the stems below the buds, but leave the buds in small piles where they have been browsing on these plant species. Piles of buds were not noticed during the 1998 survey, which may mean plants have not yet become stressed from over browsing to the point that these toxic compounds are produced at levels snowshoe hares can no longer tolerate.

Although several hares were seen daily during the track counts, Wiseman residents claimed that many more were visible during the last population explosion in the area (J. Reakoff, S. Schoppenhorst, pers. commun.). Hares would be especially conspicuous during the morning hours along the roadside of the Dalton Highway, eating the soil. According to the Dalton Highway Maintenance Division of the State Highway Department, calcium chloride is used in maintaining the Wiseman portion of the road during the summer months. Perhaps this mineral attracts hares to the roadside during peak population years.

Soil from the bare vertical bluffs along Washington Creek showed ample evidence of being consumed by snowshoe hares. Dall sheep, caribou and moose also are reported to ingest

the soil from these bluffs (J. Reakoff, pers. commun.). Dr. Bryant explained that very little is known about snowshoe hare nutrition, but offered two suggestions why hares might be eating soil. First, when hares ingest toxins, a lot of sodium is lost through urination that can be replaced by eating soil with concentrations of sodium. Secondly, soils with a high percentage of clay may help bind the toxins in the hare's gut to counteract the effects of plant toxins. In effect, the clay would act much like a commercial antacid such as "Tums," which is basically a clay tablet. Calcium is the active ingredient in Tums (Dr. Jerry Steed, pharmacist, Carrs Quality Center Pharmacy, pers. commun.). Other antacid drugs also use magnesium or aluminum.

Although this nutritional investigation is not directly related to the track count study, it has spawned some intriguing questions. Is the availability of certain minerals an important component of a snowshoe hare refugium? Does clay provide enough protection against plant toxins that more hares can survive a population crash than would otherwise be possible? Could hares crave a mineral besides sodium, such as calcium or magnesium? While sodium comprised only a small percentage of the soil samples, calcium and magnesium comprised relatively large amounts of the soils sampled at Washington Creek (Table 2). Due to the relatively high levels of clay in the Washington bluff soils and the correspondingly high levels of calcium and magnesium, it seems plausible that hares consume the soils as an antacid agent to counter the effects of plant toxins. However, with such a wide range of results in our three samples, and no control sample for comparison, it is difficult to pinpoint what the hares may be after.

Besides the many questions left unanswered following this study, the primary objective of the survey was met. Data collected on the numbers of snowshoe hare tracks in the various vegetation types indicate a considerable increase over the number of hares present in the area the year before. Browse data is an additional index to the population level, which is particularly useful when hare abundance is high and the number of hares travelling on trails cannot be easily distinguished. Based on the level of browsing and the insight of Wiseman residents, my conclusion is that the hares have not yet reached their peak population, but this may be expected to occur possibly in 1999 or 2000.

RECOMMENDATIONS TO MANAGEMENT

The methods used in this project seem to provide a useful index to snowshoe hare abundance, and, as outlined in last year's report (DiFolco 1997), it is recommended that the study continue throughout an entire snowshoe hare population cycle. In addition, the following recommendations are proposed for the 1999 survey:

1. Use the PLGR to relocate as precisely as possible the 100m transects used in the 1998 survey.

2. Continue collecting browse data for each VCC, particularly during high hare population years. Note if buds are left on the ground and from which species, indicating an avoidance of toxic secondary plant compounds.
3. Revisit Washington Creek to collect more soil samples, including (if possible) soil from a site not sought after by hares (or other animals) to compare test results. Snowmachines are the most feasible method of accessing the area (the machines can be hauled to Nolan by trailer, if preferred).

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Appendix I. GPS locations in decimal degrees of all vegetation cover class (VCC) starting points, some VCC ending points, and all 100m transect starting points for the 1998 snowshoe hare track count survey. VCCs and transects started at their eastern ends and progressed westward. Locations of soil samples taken from Washington Creek (WASHCK) are also listed.

WAYPOINT	TYPE	NAME	LATITUDE-DD	LATITUDE-DMS	LONGITUDE-DD	LONGITUDE-DMS
01	VCC	START	67.46610556	67 27 57.98	-150.26425	150 15 51.30
02	VCC	OPEN	67.46674444	67 28 00.28	-150.28665	150 17 11.94
05	VCC	EDGE	67.46487222	67 27 53.54	-150.2967	150 17 48.12
06	VCC	DENSE (START)	67.46393889	67 27 50.18	-150.2949889	150 17 41.96
07	VCC	DENSE (END)	67.46323056	67 27 47.63	-150.3006889	150 18 02.48
08	VCC	POPLAR (NEW MARK)	67.46383056	67 27 49.79	-150.3061861	150 18 22.27
09	VCC	BRUSH (START)	67.45746667	67 27 26.88	-150.3217139	150 19 18.17
10	VCC	BRUSH (END)	67.45635556	67 27 22.88	-150.3239056	150 19 26.06
11	100M	START1	67.46583056	67 27 56.99	-150.2658222	150 15 56.96
12	100M	START2	67.46687222	67 28 00.74	-150.2796361	150 16 46.69
13	100M	OPEN1	67.46617778	67 27 58.24	-150.2893583	150 17 21.69
14	100M	OPEN2	67.46553611	67 27 55.93	-150.2927028	150 17 33.73
15	100M	DENSE1	67.46414722	67 27 50.93	-150.2961583	150 17 46.17
16	100M	DENSE2	67.46366667	67 27 49.20	-150.2988806	150 17 55.97
17	100M	EDGE1	67.46431667	67 27 51.54	-150.3030667	150 18 11.04
18	100M	POPLAR1	67.46128333	67 27 40.62	-150.3148583	150 18 53.49
19	100M	POPLAR2	67.45890556	67 27 32.06	-150.3164167	150 18 59.10
20	100M	POPLAR3	67.45817222	67 27 29.42	-150.3185889	150 19 06.92
21	100M	BRUSH1	67.45725556	67 27 26.12	-150.3224056	150 19 20.66
22	WASHCK	SAMPLE1	67.51779167	67 30 56.00	-150.3355417	150 21 15.63
23	WASHCK	SAMPLE2	67.51555556	67 30 48.17	-150.3543417	150 22 58.93
24	WASHCK	SAMPLE3	67.51338056	67 31 04.05	-150.3830361	150 20 07.95

Appendix II. Deposition of tracks and trails on 100m transects from the 1998 snowshoe hare track count survey near Wiseman, Gates of the Arctic National Park and Preserve, Alaska. Due to poor snow and tracking conditions on 3/25/98, the counts from that day were not used in the final analysis. In VCCs, the letters stand for the following: D=dense vegetation, M=moderate vegetation, L=light vegetation, W=willows, P=poplars, S=spruce, B=shrub birch, A=alder.

NAME	VCC	3/25/1998	3/28/1998		3/29/1998		3/30/1998	
		tracks	tracks	trails	tracks	trails	tracks	trails
Start1	L-SB-1	5	11	0	14	0	9	0
Start2	L-SB-2	1	13	0	14	0	14	0
Open1	L-WA-1	1	5	0	10	0	5	0
Open2	L-WA-2	4	13	0	7	0	15	0
Edge1	M-SW	9	29	0	22	1	25	1
Poplar1	M-SPW-1	8	36	1	52	2	42	1
Poplar2	M-SPW-2	16	25	0	28	2	32	0
Poplar3	M-SPW-3	11	17	1	25	2	32	2
Dense1	D-WS-1	15	62	7	58	7	59	5
Dense2	D-WS-2	13	56	4	56	6	44	4
Brush1	D-WPS	23	47	2	64	4	46	2

Appendix III. Retention of tracks and trails on 100m transects from the 1998 snowshoe hare track count survey near Wiseman, Gates of the Arctic National Park and Preserve, Alaska. Due to poor snow and tracking conditions on 3/25/98, the counts from that day were not used in the final analysis. In VCCs, the letters stand for the following: D=dense vegetation, M=moderate vegetation, L=light vegetation, W=willows, P=poplars, S=spruce, B=shrub birch, A=alder.

NAME	VCC	3/25/1998	3/28/1998		3/29/1998		3/30/1998	
		tracks	tracks	trails	tracks	trails	tracks	trails
Start1	L-SB	6	16	0	37	1	34	1
Start2	L-SB	2	12	0	27	0	37	2
Open1	L-WA	2	5	0	13	0	21	0
Open2	L-WA	2	7	0	7	0	14	0
Edge1	M-SW	12	22	0	37	3	37	6
Poplar1	M-SPW	8	35	1	61	6	55	14
Poplar2	M-SPW	10	40	2	45	7	44	10
Poplar3	M-SPW	13	29	2	46	5	49	12
Dense1	D-WS	17	56	0	60	29	86	24
Dense2	D-WS	12	59	0	64	16	73	17
Brush1	D-WPS	17	37	3	56	11	54	20

Appendix IV. Weather data from the 1998 snowshoe hare track count, conducted March 25-30, near Wiseman, Gates of the Arctic National Park and Preserve, Alaska.

Date	TIME		TEMP (F)		WIND		SKY		Snowfall
	Start	Finish	Start	Finish	Start	Finish	Start	Finish	
3/25/1998	10:11	13:14	39	43	0	0	cloudy	partly cloudy	1mm
* 3/28/1998	10:02	12:16	20	22	1	1	cloudy	thin overcast	25mm**
3/29/1998	10:40	13:17	16	33	1	0	clear	thin overcast	2mm
3/30/1998	9:45	12:34	5	17	5 to 10	1	clear	clear	4mm

*Surveys were not conducted 3/26 or 3/27 due to falling snow.

**Approximately 25mm of snow had fallen since 3/25/98.