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Monitoring Passerine Birds in Denali National Park and Preserve, Alaska, 2008

Version 1.1 (Annual Report to the Central Alaska Vital Signs Monitoring Network)

Natural Resource Report NPS/XXXX/NRXX—20XX/XXX

ON THE COVER
East Fork East minigrid campsite, June 2008.
Photograph by: Mark Paulson, Denali National Park and Preserve

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Natural Resource Report NPS/XXXX/NRXX—20XX/XXX

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Abstract

A series of 10-minute point transect surveys were conducted in Denali National Park and Preserve, Alaska, as part of the Central Alaska Network's Vital Signs passerine monitoring program. Surveys were conducted between 1 and 30 June between 0300 and 0900 hours. All birds detected (seen or heard) at each sampling point were recorded in one of four time intervals (0 to 3 min, >3 ≤5 min, >5 ≤8 min, and >8 ≤10 min) and one of 13 distance intervals (10-m intervals up to 100 m, 25-m intervals to 150 m, and >150-m). The survey crew sampled 187 points on 8 minigrids in 2008 and detected 1217 birds at 1170 detection events, including 29 to 272 birds per minigrid. Species richness ranged from 10 to 20 species per minigrid and 1.0 to 6.2 species per point. Fifty-six species were detected on minigrids (46 species on during the 10-minute counts and 10 species on the minigrids but not during the 10-minute counts). Most detections (94%) were of members of the Order *Passeriformes*, and 74% of all detections were members of four families, *Emberizidae* (57.2%), *Parulidae* (12.8%), *Fingillidae* (11.2%) and Turdidae (4.4%). White-crowned sparrow (n= 260 detections, 21.4% of all detections, detected on all grids) and fox sparrow (n= 149 detections, 12.3% of all detections, detected on 7 grids) were the most common species detected on the 10-minute point transect surveys. Fewer species and fewer detections were made on higher elevation alpine minigrids that were dominated by dwarf vegetation, bare ground, and ice.

Acknowledgments

We thank Nikki Demers and Bonni Burnell, NPS-Denali for administrative support, Clare Curtis, NPS-Denali for housing support, Tom Meier, NPS-Denali, for logistical support, and Sue Guers, Alaska Bird Observatory (ABO), for recruiting ABO personnel for this project. We also thank Eliot Miller, Nicole Smith, and Lawrence Clemente for their enthusiasm and persistence during the field season. This project was funded by the Central Alaska Monitoring Network (CAKN).

Introduction

The Central Alaska Network (CAKN) adopted a holistic view of network ecosystems and through the Vital Signs monitoring program and tracks the major physical drivers of ecosystem change and responses of the two major components of the biota: plants and animals (MacCluskie and Oakley 2005). CAKN identified *Fauna Distribution and Abundance* as one of its top three Vital Signs. Overall, CAKN aims to describe the distribution of fauna across the park's landscapes and track changes in both their distribution and abundance.

The *Fauna Distribution and Abundance* Vital Sign includes monitoring efforts for a suite of vertebrate species including birds. Birds make up >75% of the terrestrial vertebrates in CAKN and exhibit numerous characteristics that suggest their potential as ecological indicators at large scales (O'Connell et al. 2000) including high body temperature, rapid metabolism, and high ecological position in most food webs (Fancy and Sauer 2000, Peitz et al. 2002). Land birds make up >70% of the bird species in CAKN. Of all the land birds that occur in CAKN, those in the Order *Passeriformes* are relatively easy and economical to detect and a single survey often includes many common species. The order *Passeriformes* includes well-known songbirds such as kinglets, flycatchers, thrushes, warblers, and sparrows. Two goals of the CAKN integrated monitoring program are to quantify the relationships between environment, vegetation, and songbird distributions across Denali's landscape and to detect changes in these distributions in response to ecological changes over time.

Roland et al. (2003) developed a sampling design for CAKN where repeated measurements of the physical environment, vegetation and birds are made at randomly selected points. This probabilistic sampling design allows for detection of changes in the ecosystem at a landscape scale over time. The sampling design is comprised of five rows of five points, all 547 yards (500 m) apart, arranged in a grid pattern at each study site. These "minigrids" are arranged on a macro-grid with 10 or 20 km spacing (Figure 1). By utilizing a randomized site selection procedure, the program provides unbiased data about the status and trend of park resources over large spatial scales.

Passerine monitoring objectives

The passerine bird monitoring component of the CAKN Vital Signs monitoring program has three primary objectives:

1. Calculate densities of common passerines, assess variation in annual estimates of density, and detect trends in the density of as many passerines as possible during the breeding season.
2. Track changes in the breeding season composition and distribution of passerines.
3. Assess responses of passerine communities (community composition, abundance, distribution) to changes in vegetation structure and composition.

This report provides a brief summary of the data collection efforts in 2008. Trip reports and photographs from each minigrid are provided in Appendix B at the end of this report.

Methods

Spatial and temporal sampling framework

The sampling frame for the CAKN passerine monitoring in Denali consists of 24 minigrids located between the Parks Highway (eastern boundary) and the Kantishna area (western boundary) on the north side of the Alaska Range (Figure 1). All minigrids in the sampling frame are accessible by foot travel from the Denali park road. The temporal sampling design is based on a three-year sampling interval in which eight unique minigrids are sampled annually.

Survey team

The 2008 survey team consisted of Mark Paulson (NPS biological technician), Eliot Miller (ABO biologist), Nicole Smith (ABO intern), Anissa Berry-Frick (ABO intern; mid-May through mid-June) and Laurence Clemente (ABO intern; mid-June to end of season). All team members except Laurence completed an intensive two-week distance sampling and bird identification training program from 13 to 27 May 2008 in Denali. Laurence completed a similar training program in late May with the Alaska Bird Observatory in Fairbanks.

Two 2-person field crews completed the surveys in 2008. Each 2-person field crew consisted of one observer who conducted the survey, and one recorder who recorded the detections of the observer and other environmental data on standardized data sheets. Mark Paulson and Eliot Miller served as the observers and Nicole Smith, Anissa Berry-Frick, and Lawrence Clemente served as recorders. The two field crews used handheld two-way radios to stay in touch during the sampling day.

Survey methods

Observers used point transect sampling (PTS) with distance sampling (by fixed width intervals) and time-of-detection (removal) methods to sample for birds. Surveys were completed between 0300 (just prior to sunrise) and 0900 from 1 and 30 June and corresponded with peak singing times for many species of passerines in interior Alaska. Surveys were only conducted under conditions of good visibility, little or no precipitation, and light winds.

At each sampling point, the observer identified all birds detected aurally and visually to species and estimated the distance between them and the detection using a laser rangefinder. Further, all birds seen or heard at each sampling point were recorded during one of four time intervals (0 to 3 min, >3 $\leq$5 min, >5 $\leq$8 min, and >8 $\leq$10 min) and in one of 13 distance intervals (10 m intervals from 0 to 100-m, 25 m intervals from 100 to 150-m, and >150 m). Additionally, the type of detection (e.g., singing, calling, visual) was recorded for each detection. For most species, each individual bird was recorded as a separate observation. For species that occurred in clusters or flocks, the observer estimated the distance to the cluster or flock, not the individual bird.

During the 10-minute surveys, we attempted to get an "instantaneous count" of the birds present. Our survey method took into account the fact that birds closer to the observer had a higher probability of detection (if they were not flushed) than birds farther from the observer and that

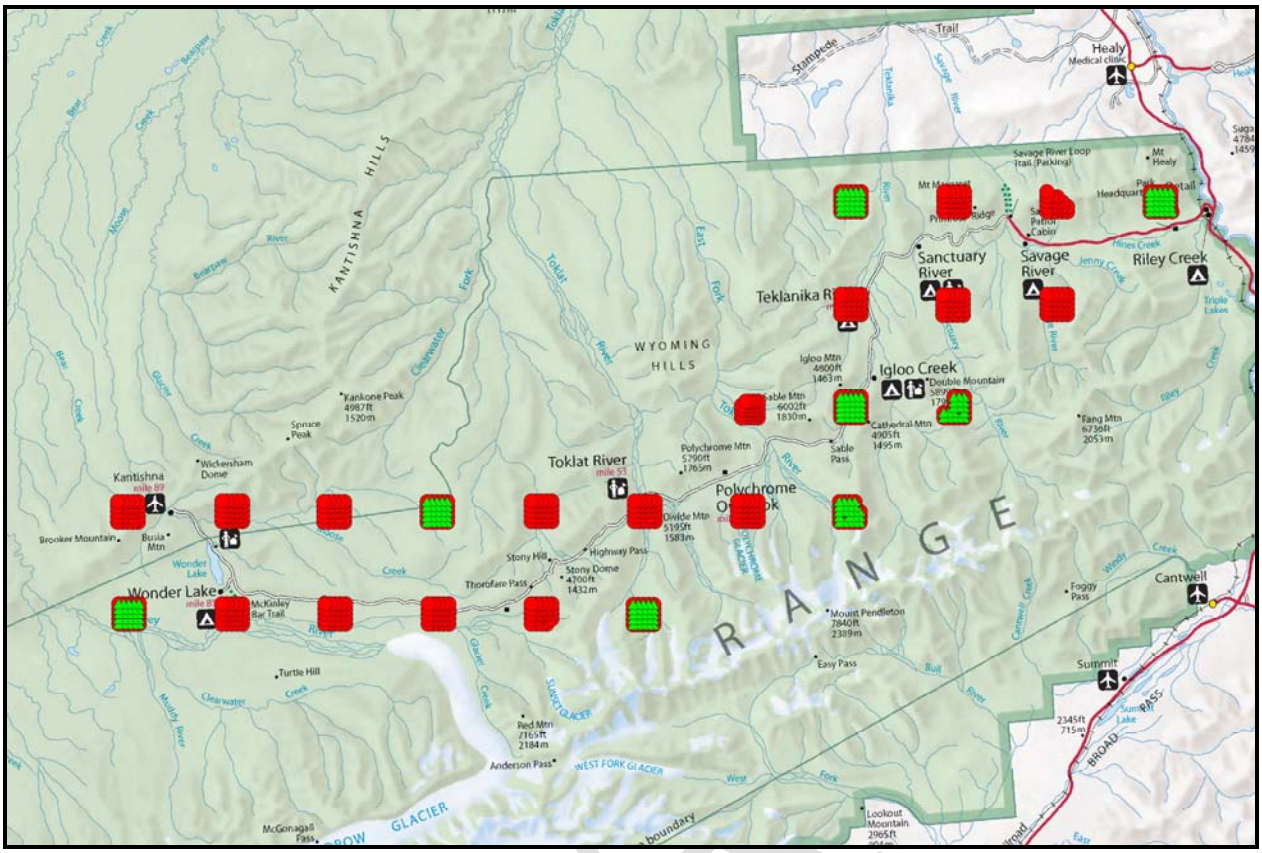

Figure 1. Sampling frame for passerine monitoring project in the Central Alaska Network on the north side of the Alaska Range in Denali National Park and Preserve, Alaska. The sampling frame includes 24 minigrids spaced 10-km apart within 10-km of the Denali park road. Each minigrid has 25 potential sampling points located 500-m apart. The eight minigrids marked with a series of triangles were sampled in 2008.

different species had different detection functions (i.e., the probability of detecting a bird at different distances from the observer). Surveyors made efforts to estimate the distances to all bird within 50-m of them before estimating the distances to birds further away from them.

After completing each 10-minute PTS, the observers hiked to the next sample point using a map, compass, and hand-held Global Positioning System (GPS) for navigation. Crew members recorded all bird species detected before and after each PTS, all species observed between points, and all species observed on the grid but not on the 10-minute PTS on standardized data sheets.

Taxonomy

Scientific names of species mentioned in this report are listed in Appendix A and not within the text of this report. This list incorporates changes made in the 42nd, 43rd, 44th, 45th, 46th, and 47th Supplements to the Check-list, as published in *The Auk* 117: 847-858 (2000); 119:897-906 (2002); 120:923-932 (2003); 121:985-995 (2004); 122:1026-1031 (2005); 123:926-936 (2006).

Results and Discussion

This was final year of the initial three-year sampling rotation for this project (2006-2008), marking the completion of sampling on 24 minigrids in the sampling frame. The sampling target for 2008 was 8 minigrids (n = 200 points) and we achieved 93.5% sampling success by sampling 187 points on these minigrids (Table 1). We could not sample 13 points due to dangerous river crossings, unstable and vertical terrain, or because points were centered in ponds or rivers. All minigrids required two days to sample all accessible points. Trip reports and photographs of the minigrids are in Appendix B.

Observers detected and identified 1207 birds at 1170 detection events on 8 minigrids in 2008, ranging from a low of 29 birds on the Double Mountain minigrid to a high of 271 birds on the Muddy River minigrid (Table 2). Species diversity ranged from 10 to 20 species per minigrid. Toklat West Branch minigrid had the lowest species diversity and Nika Ridge minigrid had the highest (Table 2).

Detection types included singing (74.0%), aerial (10.4%), calling (9.1%), and visual (6.4%). Most detections occurred within the first three minutes of the 10-minute PTS (Figure 2) and >50-m from the observer (Figure 3). Most detections were of individual birds (98.6%), but redpoll spp., Lapland longspur, and white-winged crossbill were detected in flocks.

Fifty-six species were detected on minigrids in 2008, including 46 species on the PTS (Table 3) and 10 species on the minigrids but not on the PTS (Table 4). Overall, 94% of all birds detected were in the Order *Passeriformes* (Figure 4). This survey platform was designed for monitoring passerine birds; hence, the lack of detections of members of other Orders was not surprising. Two species, white-crowned sparrow and redpoll spp., were detected on all minigrids (Table 4). Ten species, including four *Passeriformes*, were detected only once (Table 3). We detected 32 species of *Passeriformes* birds in 2008, representing 59% of the *Passeriformes* (N = 54 species) expected to occur in the study area. Of the 32 species of *Passeriformes* detected, only six (19%) had sufficient sample sizes for calculating estimates of annual abundance (including

Table 1. Sampling schedule for Central Alaska Network passerine monitoring project, Denali National Park and Preserve, Alaska, 2008.

		Number of points sampled	
Minigrid name	Sample dates	Day 1	Day 2
Nika Ridge	1 to 2 June	18	7
Rock Creek	4 to 5 June	14	11
East Fork East	10 to 11 June	14	8
Toklat West Branch	13 to 14 June	14	11
Igloo Canyon	15 to 16 June	15	10
Double Mountain	22 to 23 June	10	8
Muddy River	26 to 27 June	15	7
Moose Creek North Fork	29 to 30 June	22	3

Table 2. Summary statistics of survey effort and birds detected on 10-minute point transect surveys by minigrid, Central Alaska Network passerine monitoring program, Denali National Park and Preserve, Alaska, 2008.

Minigrid name	Points surveyed	# birds	# species	Mean number of species per point
Nika Ridge	25	181	20	4.52
Rock Creek	25	211	18	5.08
East Fork East[a]	22	65	12	1.59
Toklat West Branch[a]	25	38	10	1.12
Igloo Canyon	25	196	16	4.36
Double Mountain[a]	18	29	12	1.00
Muddy River	22	272	19	6.23
Moose Creek North Fork	25	225	15	5.64

[a] Higher elevation minigrids with little vertical vegetative structure. These minigrids were dominated by dwarf shrub vegetation, rock, snow and ice.

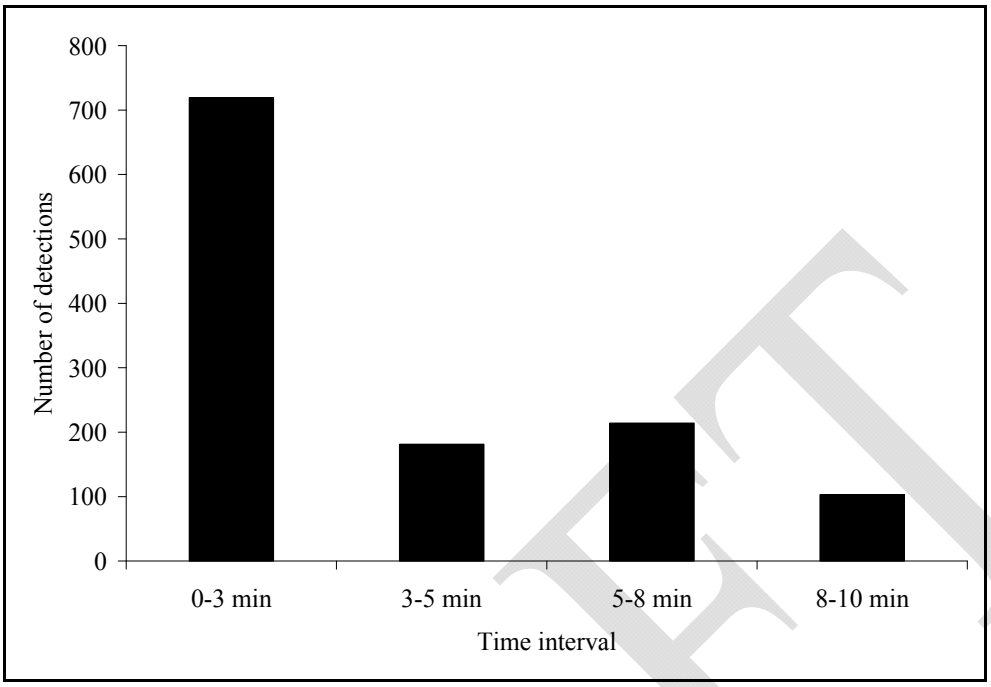

Figure 2. Detections of birds by time interval, Central Alaska Network passerine monitoring program, Denali National Park and Preserve, Alaska, 2008.

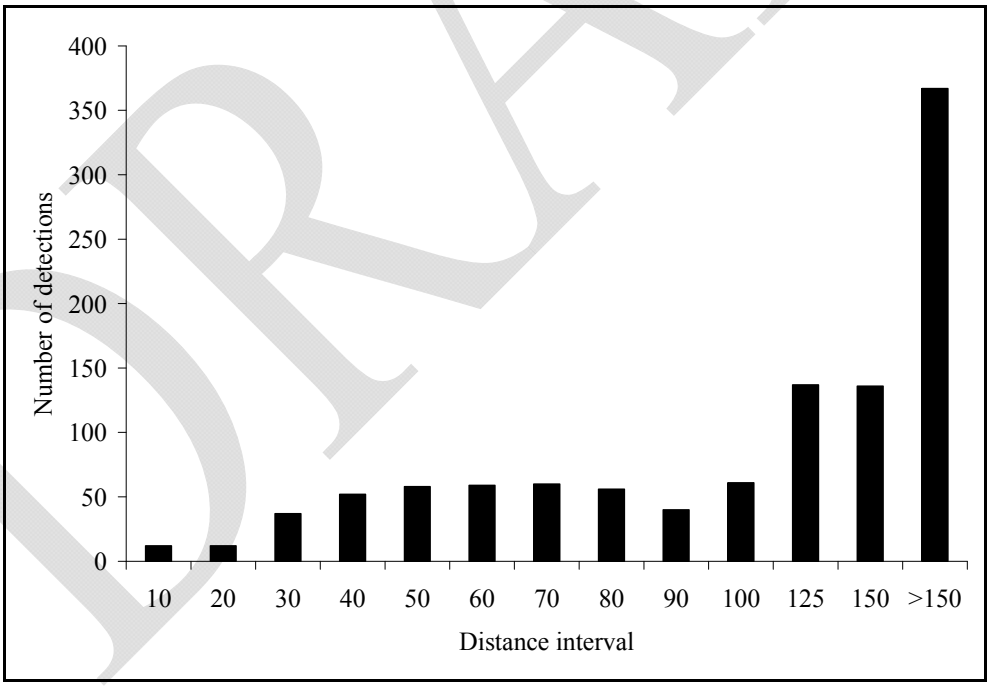

Figure 3. Detections of birds by distance intervals, Central Alaska Network passerine monitoring program, Denali National Park and Preserve, Alaska, 2008.

Table 3. Species detected on 10-minute point transect surveys on 8 minigrids, Central Alaska Network passerine monitoring program, Denali National Park and Preserve, Alaska, 2008.

	Detections		Minigrids	
Common name	**n**	**%**	**n**	**%**
Northern Pintail	1	0.08	1	12.5
Willow Ptarmigan	17	1.40	6	75.0
Rock Ptarmigan	1	0.08	1	12.5
White-tailed Ptarmigan	1	0.08	1	12.5
Northern Harrier	2	0.16	2	25.0
Golden Eagle	1	0.08	1	12.5
Gyrfalcon	1	0.08	1	12.5
American Golden-Plover	12	0.99	2	25.0
Semipalmated Plover	2	0.16	1	12.5
Whimbrel	8	0.66	1	12.5
Mew Gull	5	0.41	2	25.0
Long-tailed Jaeger	16	1.31	2	25.0
Northern Hawk Owl	1	0.08	1	12.5
Short-eared Owl	3	0.25	1	12.5
Alder Flycatcher	29	2.38	2	25.0
Say's Phoebe	1	0.08	1	12.5
Gray Jay	5	0.41	2	25.0
Black-billed Magpie	13	1.07	5	62.5
Common Raven	7	0.58	2	25.0
Horned Lark	5	0.41	1	12.5
Arctic Warbler	14	1.15	2	25.0
Northern Wheatear	2	0.16	1	12.5
Townsend's Solitaire	1	0.08	1	12.5
Gray-cheeked Thrush	1	0.08	1	12.5
Swainson’s Thrush	14	1.15	3	37.5
Hermit Thrush	24	1.97	4	50.0
American Robin	4	0.33	2	25.0
Varied Thrush	7	0.58	1	12.5
American Pipit	30	2.47	7	87.5
Orange-crowned Warbler	69	5.67	4	50.0
Yellow Warbler	3	0.25	1	12.5
Yellow-rumped Warbler	7	0.58	2	25.0
Blackpoll Warbler	1	0.08	1	12.5
Wilson’s Warbler	75	6.16	7	87.5
American Tree Sparrow	116	9.53	7	87.5

Table 3. (cont'd). Summary of species detected on the 10-minute point transect surveys on 8 minigrids, Central Alaska Network passerine monitoring program, Denali National Park and Preserve, Alaska, 2008.

	Detections		Minigrids	
Common name	**n**	**%**	**n**	**%**
Savannah Sparrow	105	8.63	5	62.5
Fox Sparrow	149	12.24	7	87.5
Lincoln's Sparrow	2	0.16	1	12.5
White-crowned Sparrow	260	21.36	8	100.0
Golden-crowned Sparrow	3	0.25	2	25.0
Dark-eyed Junco	29	2.38	4	50.0
Lapland Longspur	13	1.07	2	25.0
Snow Bunting	15	1.23	1	12.5
Gray-crowned Rosy Finch	15	1.23	3	37.5
White-winged Crossbill	22	1.81	1	12.5
Redpoll sp.[a]	98	8.05	8	100.0

[a] All redpolls are recorded as Redpoll sp..

Table 4. All species detected on minigrids during 2008 field sampling, Central Alaska Network passerine monitoring program, Denali National Park and Preserve, Alaska, 2008.

Common name	Number of minigrids	
	On-10 minute point transect surveys	Off-10 minute point transect surveys
Trumpeter Swan	0	1
Mallard	0	1
Northern Pintail	1	0
Green-winged Teal	0	1
Scaup Sp.	0	1
Spruce Grouse	0	1
Willow Ptarmigan	6	5
Rock Ptarmigan	1	0
White-tailed Ptarmigan	1	2
Common Loon	0	1
Northern Harrier	2	2
Golden Eagle	1	3
Gyrfalcon	1	1
American Golden-Plover	2	2
Semipalmated Plover	1	3
Whimbrel	1	1
Surfbird	0	1
Baird's Sandpiper	0	1
Wilson's Snipe	0	1
Mew Gull	2	4
Long-tailed Jaeger	2	2
Northern Hawk Owl	1	1
Short-eared Owl	1	0
Alder Flycatcher	2	2
Say's Phoebe	1	2
Gray Jay	2	3
Black-billed Magpie	5	3
Common Raven	2	1
Horned Lark	1	1
Boreal Chickadee	0	1
Arctic Warbler	2	2
Northern Wheatear	1	2
Townsend's Solitaire	1	1
Gray-cheeked Thrush	1	4
Swainson’s Thrush	3	3
Hermit Thrush	4	4
American Robin	2	2
Varied Thrush	1	2

Table 4. cont'd. All species detected on minigrids during 2008 field sampling, Central Alaska Network passerine monitoring program, Denali National Park and Preserve, Alaska, 2008.

Common name	Number of minigrids	
	On-10 minute point transect surveys	Off-10 minute point transect surveys
American Pipit	7	5
Orange-crowned Warbler	4	5
Yellow Warbler	1	1
Yellow-rumped Warbler	2	3
Blackpoll Warbler	1	0
Wilson's Warbler	7	6
American Tree Sparrow	7	7
Savannah Sparrow	5	6
Fox Sparrow	7	7
Lincoln's Sparrow	1	1
White-crowned Sparrow	8	8
Golden-crowned Sparrow	2	4
Dark-eyed Junco	4	3
Lapland Longspur	2	2
Snow Bunting	1	2
Gray-crowned Rosy Finch	3	4
White-winged Crossbill	1	1
Redpoll sp.	8	8

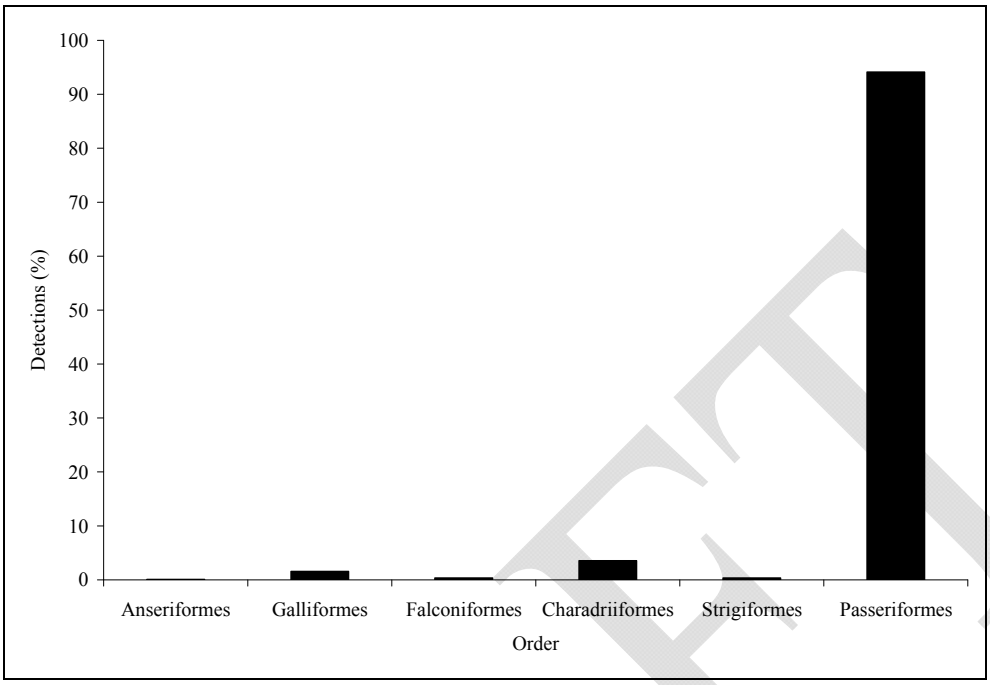

Figure 4. Summary of species diversity and detections of birds on 10-minute point transect surveys by Order, Denali National Park and Preserve, Alaska, 2008.

orange-crowned warbler, Wilson's warbler, American tree sparrow, savannah sparrow, fox sparrow, and white-crowned sparrow) using program DISTANCE. Program DISTANCE requires ≥60 detections of each species for reliable estimation of the detection function (Buckland et al. 2001).

We sampled three grids, Double Mountain, East Fork East, and Toklat West Branch, that occurred at higher elevations this year. The number of species and number of birds detected on these grids was substantially lower than on grids at lower elevations (Table 2); however, six species including golden eagle, white-tailed ptarmigan, semipalmated plover, Say's phoebe, snow bunting, and gray-cheeked rosy finch were recorded on one or more of these grids and were not detected on other minigrids. Minigrids in alpine areas usually contained dwarf vegetation with little vertical vegetative structures (medium to tall shrubs and smaller trees) and many areas of bare ground, rock and ice.

Plans for 2009

1. Complete data analyses of all PTS conducted from 2002 to 2008, including the three-year interval data set, and assess if current methods are meeting the project objectives. Steve Hoekman and Mark Lindberg, University of Alaska-Fairbanks, are conducting the analyses.
2. Upon completion of data analyses, complete progress report for all sampling conducted from 2002 to 2008.
3. Based on results of data analyses, revise protocol to optimize sampling effort and data analyses techniques and requirements.
4. Continue to use internship program with the Alaska Bird Observatory. Denali has agreed to continue to provide housing for the two ABO interns and the one ABO surveyor in the future.

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APPENDIX A. Common and scientific names of species mentioned in this report.

Common name	Genus species
Trumpeter Swan	*Cygnus buccinator*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Green-winged Teal	*Anas crecca*
Scaup spp.	*Aythya sp.*
Spruce Grouse	*Falcipennis canadensis*
Willow Ptarmigan	*Lagopus lagopus*
Rock Ptarmigan	*Lagopus mutus*
White-tailed Ptarmigan	*Lagopus leucurus*
Common Loon	*Gavia immer*
Northern Harrier	*Circus cyaneus*
Golden Eagle	*Aquila chrysaetos*
Gyrfalcon	*Falco rusticolus*
American Golden-Plover	*Pluvialis dominica*
Semipalmated Plover	*Charadrius semipalmatus*
Whimbrel	*Numenius phaeopus*
Surfbird	*Aphriza virgata*
Baird's Sandpiper	*Calidris bairdii*
Wilson’s Snipe	*Gallinago delicata*
Mew Gull	*Larus canus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Northern Hawk Owl	*Surnia ulula*
Short-eared Owl	*Asio flammeus*
Alder Flycatcher	*Empidonax alnorum*
Say's Phoebe	*Sayornis saya*
Gray Jay	*Perisoreus canadensis*
Black-billed Magpie	*Pica hudsonia*
Common Raven	*Corvus corax*
Horned Lark	*Eremophila alpestris*
Boreal Chickadee	*Poecile hudsonica*
Arctic Warbler	*Phylloscopus borealis*
Northern Wheatear	*Oenanthe oenanthe*
Townsend's Solitaire	*Myadestes townsendi*
Gray-cheeked Thrush	*Catharus minimus*
Swainson’s Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Varied Thrush	*Ixoreus naevius*

Appendix A (cont'd). Common and scientific names of species mentioned in this report.

Common name	Genus species
American Pipit	*Anthus rubescens*
Orange-crowned Warbler	*Dendroica celata*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Blackpoll Warbler	*Dendroica striata*
Wilson's Warbler	*Wilsonia pusilla*
American Tree Sparrow	*Spizella arborea*
Savannah Sparrow	*Passerculus sandwichensis*
Fox Sparrow	*Passerella iliaca*
Lincoln's Sparrow	*Melospiza lincolnii*
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Dark-eyed Junco	*Junco hyemalis*
Lapland Longspur	*Calcarius lapponicus*
Snow Bunting	*Plectrophenax nivalis*
Gray-crowned Rosy Finch	*Leucosticte tephrocotis*
White-winged Crossbill	*Loxia leucoptera*
Redpoll species	*Carduelis spp.*

APPENDIX B. Trip Reports for Central Alaska Network passerine monitoring program, Denali National Park and Preserve, Alaska, 2008.

Summary by Mark Paulson

Nika Ridge. The Nika Ridge minigrid is on the northwest slope of the large ridge on the west side of the Teklanika River directly west of Mount Wright. We hiked into Nika Ridge on 30 May 2008 and used 31 May 2008 as a reconnaissance day. We parked our vehicle along the Denali park road at the large pullout on the Teklanika Flats and hiked downstream along the Teklanika River bar. After crossing the main channel of the Teklanika River, we hiked up the ridge to the northwest, gaining a prominent ridgeline that brought us to the ridge top. We gained access to this ridge approximately 200m southwest of the rock outcrop along the Teklanika River bar where it narrows south of the Denali park road.

We established our spike camp between points 1 and 2 on the south side of the minigrid on a gravel patch overlooking the drainages. This was a well-drained area, but was exposed to wind. Water was readily available in numerous small potholes throughout the campsite. Habitat on this minigrid ranged from exposed rock, *Dryas spp.*, and grassy patches at higher elevations to a series of drainages filled with tall willow (*Salix spp*.), alder (*Alnus spp*.), and needleleaf (*Pinus spp.*) and deciduous forest (Populas spp.). Much of the area was covered with grassy tussocks, frost heaves and low scrub vegetation. On June 1, one team surveyed the points along the north and west edges of the minigrid and the other team started at point 16 and completed a similar but smaller pattern by surveying the inner points. The remaining southern points were sampled on June 2 before hiking back to the Denali park road.

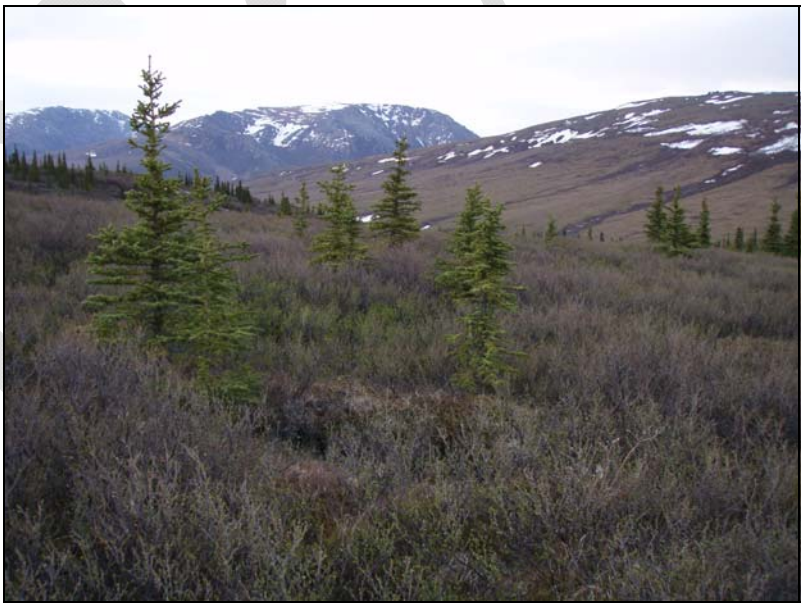

Figure B-1.Looking east towards Mount Wright and Primrose Ridge from point 24 on the Nika Ridge minigrid, 1 June 2008. NPS photograph by Mark Paulson.

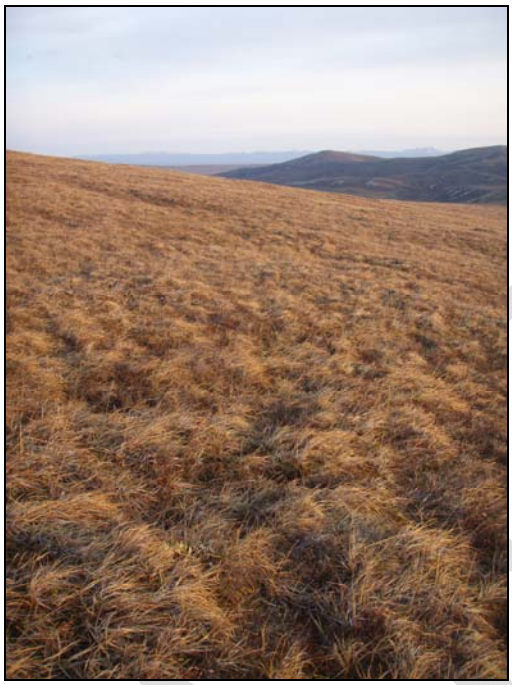

Figure B-2. Looking north towards the Toklat Basin from point 24 on the Nika Ridge minigrid, 2 June 2008. NPS photograph by Mark Paulson.

Figure B-3. Nike Ridge campsite at sunrise. Photograph by Eliot Miller.

Rock Creek. The Rock Creek minigrid straddles the Rock Creek drainage north of C-camp. We based out of C-camp and hiked to the grid to conduct the daily surveys, but strongly recommend camping in or near the grid in the future to reduce travel time. To gain access to points on the eastern side of Rock Creek we hiked the Rock Creek Trail near the water tank above C-camp and followed it until a social trail cut north, where the new path for the trail diverges. We followed the social trail northwest through the forest and then cut north and began climbing the southern slopes of Mount Healy. We used another social trail to gain access to the points on the western side of Rock Creek. This trail followed Rock Creek up the drainage on its western bank. Most of this minigrid was covered by dense willow and alder on steep terrain and travel was difficult and slow. There were pockets of closed mixed-forest and stands of closed needleleaf and deciduous forests. Dwarf shrubs and exposed rock dominated the higher elevation points. Snowdrifts were still abundant higher on the minigrid and we crossed several of them to gain access to all points. We surveyed the northwest portion of the minigrid on 4 June with one team surveying the points west of Rock Creek and the other team surveying the points on the east of Rock Creek. We worked in a south to north fashion to reduce gain and loss of elevation. We surveyed the eastern and southern points on June 5. The water level in Rock Creek was low and we leapt across it without getting wet.

Figure B-4. The mixed-open deciduous and needleleaf forest near point 1 on the Rock Creek minigrid, 4 June 2008. NPS photograph by Mark Paulson.

Figure B-5. Seasonal snowfields near point 17 on the Rock Creek minigrid, 4 June 2008. NPS photograph by Mark Paulson.

Figure B-6. Looking south towards C-Camp and Riley Creek from the southern edge of the Rock Creek minigrid, 4 June 2008. Photograph by Eliot Miller.

East Fork East. The East Fork East minigrid is a high elevation grid near the headwaters of the eastern most branch of the East Fork of the Toklat River. We hiked to the minigrid from the Denali park road along the eastern edge of the Sable Pass wildlife closure. We followed a well-used social trail from the Denali park road just east of the eastern Sable Pass closure sign, following the eastern edge of Igloo creek and then hiked up to the prominent ridge running east of Igloo Creek before crossing rolling hills to the minigrid. We established our spike camp on a flat, well-drained tundra bench about 1-km north of point 23. We found water in a few small depressions near camp. A large gorge with steep rock walls separated our camp from the minigrid. To gain access to the western points, we hiked into the gorge north of point 24 and followed the creek downstream until we reached a place where we could climb to the south. This allowed access to all points west of the middle row (3 to 23) except point 9 that was in a large cliff of loose rock. We gained access to the eastern points of the minigrid via the same gorge, but traveled farther to the east. We stayed high on the northeast side of the drainage over a few ravines before descending into the gorge at an easier entrance point. We followed the creek in the gorge upstream over snow bridges until a large vertical snowdrift and cliffs stopped us from hiking up the creek. From this point, we hiked up a talus slope on the southwest face to get onto the flats above the gorge near point 22. On June 10, one team surveyed the southwest points and the other team surveyed the southeast points. One team surveyed the center row of points on June 11 and the other team finished the points east of the ridge. Most of this minigrid was covered by talus slopes and cliffs littered with snow drifts. The western most points of this minigrid were covered by *Dryas spp*. and low scrub willow.

Figure B-7. Looking north towards Polychrome and the Wyoming Hills from the East Fork East minigrid along upper East Fork Toklat River, 10 June 2008. NPS photograph by Mark Paulson.

Figure B-8. Talus and blowing snow near point 2 on the East Fork East minigrid, 10 June 2008. NPS photograph by Mark Paulson.

Figure B-9. Steep talus slope on the East Fork East minigrid, 10 June 2008. Photograph by Eliot Miller.

Toklat West Branch. The Toklat West Branch minigrid is on the western branch of the Toklat River south of Divide Mountain. We hiked to this minigrid along the west branch of the Toklat River from the Toklat ranger station. We hiked along the west side of the river and needed to cross the river once on our way to the minigrid. We established camp on a bench above points 18, 19, 23, and 24 and found water in many smaller creeks and below snow patches. Most of the terrain was covered with loose talus, bands of exposed rock and snowdrifts. A few patches of *Dryas* spp. occurred at higher elevations, with low scrub willow covering the lower points. We used ridgelines to hike to the higher points, but traveling was often difficult due to narrow ridges covered with snow. One team member had to return to camp early due to vertigo on June 14. We had to cross the large stream that ran through the minigrid via an ice bridge to reach points 16, 21, and 22. Crossing this creek higher up the grid was not a problem.

Figure B-10. Looking southeast from point 6 on the Toklat West Branch minigrid, 13 June 2008. NPS photograph by Mark Paulson.

Figure B-11. Talus slope and steep terrain near point 7 on the Toklat West Branch minigrid, 13 June 2008. NPS photograph by Mark Paulson.

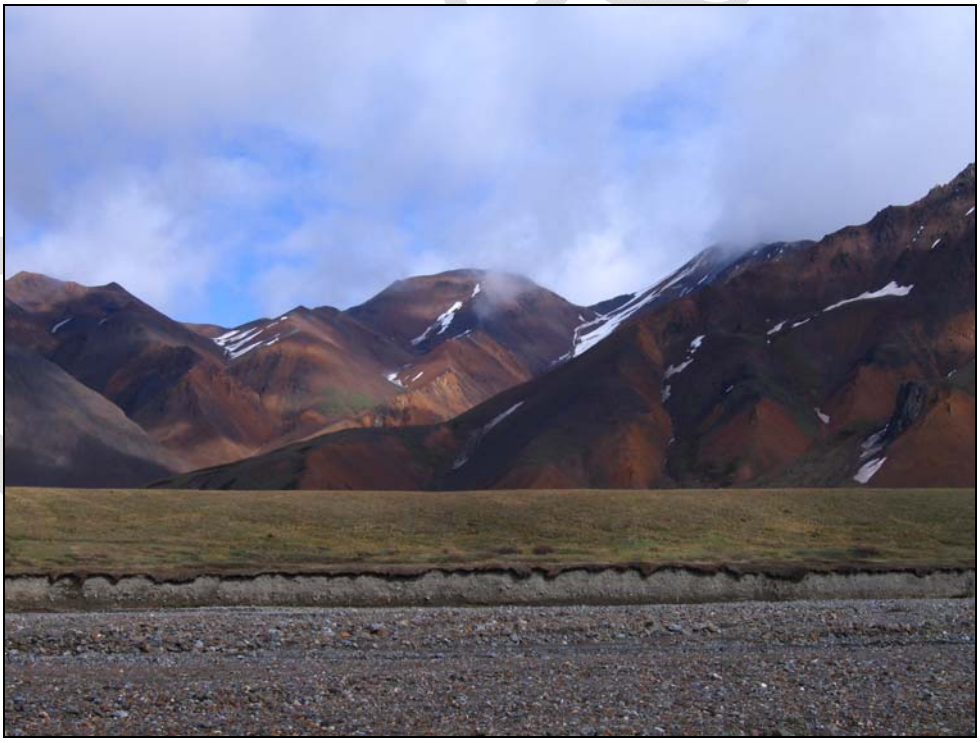

Figure B-12. Tundra and neighboring mountains near the Toklat West Branch minigrid, June 2008. Photograph by Eliot Miller

Igloo Canyon. The Igloo Canyon minigrid straddles the Denali park road near Tattler Creek and Cathedral Mountain. We stayed at the East Fork Research Cabin near mile 43 of the Denali park road when we surveyed this minigrid and drove to the parking area each morning. The drive to the minigrid from the cabin took about 25 minutes. We parked our vehicle in the large pullout on the east side of the Denali park road and hiked to the sampling points. The terrain within Igloo Canyon minigrid ranged from high alpine and loose talus descending to drainages choked with tall willow and alder. On June 15, one team surveyed points on the west side of the Denali park road and the other team began surveying the northeastern points. On June 16, one team finished surveying points 23 to 25 and the other team surveyed the southern points before meeting up to finish the middle of the minigrid. We recommend avoiding travel across the very steep terrain between points 1 and 6 and recommend reaching Point 1 via the large drainage that runs near point 7. We hiked to point 6 from point 11 without much difficulty, but it took over an hour to hike to point 1 from point 6. We used ice bridges and shelf ice to cross Igloo Creek. Point 13 was on the shelf ice, and may have a channel running below or near it.

Figure B-13. The view of "Little Sable Mountain" from Cathedral Mountain on the Igloo Canyon minigrid, 15 June 2008. NPS photograph by Mark Paulson.

Figure B-14. Snowshoe hare browse on shrub willow near point 23 on the Igloo Canyon minigrid, 15 June 2008. NPS photograph by Mark Paulson.

Figure B-15. Typical steep terrain on the Igloo Canyon minigrid, June 2008. NPS photograph by Mark Paulson.

Double Mountain. The Double Mountain minigrid is on the eastern slopes of Double Mountain on the west side of the Sanctuary River. We hiked to the Double Mountain minigrid from the Denali park road on June 20 and 21. We parked our vehicle along the Denali park road just uphill and east of the Teklanika Bridge and hiked across a stretch of scrub tundra and past the band of cliffs directly east of the bridge. We hiked below the cliffs to the prominent saddle north of Double Mountain and then followed the rolling ridgeline until the last drainage north of Double Mountain and cut south below the ridgeline. We could not reach the minigrid in one day and camped overnight about 3-km north of the minigrid. We continued hiking on June 21 and established our spike camp northwest of point 21. The hike from camp to the edge of the minigrid took about 15 minutes. We found water in the drainage just north of camp. This minigrid contained very steep talus slopes and numerous cliff bands making 14, 15, 19, 20, 24, and 25 inaccessible. A large landslide, actively sloughing material, also rendered point 7 inaccessible. The best way to get into the minigrid from camp was to follow the drainage just south of point 16. One team hiked up the ridge near point 11 and started surveying at point 6, and hiked around the east face of the summit to get to point 1. From there they surveyed point 2, 3, and 4. We followed the ridgeline between points 2 and 3 until we could hike down to point 3. In the future, we recommend following the north-running ridge between the points to find an easier route to point 3. The other team followed the largest drainage up through the minigrid to point 5 and surveyed points 10, 9, 13, and 18. On June 23, one team headed up to point 23 from the north along the ridge on the east side of the drainage. They completed surveying points 23, 22, and 21 and the other team finished the interior of the minigrid including points 8, 11, 12, 16, and 17. Most of the area was bare rock with patches of *Dryas* and some tall willow scrub in the drainages.

Figure B-16. Talus covered ridge near point 4 on the Double Mountain minigrid, 22 June 2008. NPS photograph by Mark Paulson.

Figure B-17. Active landslide/slump within the Double Mountain minigrid, 15 June 2008. Photograph by Eliot Miller.

Figure B-18. Dwarf vegetation on the Double Mountain minigrid, June 2008. Photograph by Mark Paulson.

Muddy River. The Muddy River minigrid is about 5-km west of the Wonder Lake campground and north of the junction of the Muddy and McKinley Rivers. We hiked to the minigrid from the Wonder Lake Campground along a well-used social trail that started near the water tank at the end of the Wonder Lake service road and then continued bushwhacking across the tundra to a prominent hill approximately 700 m northeast of point 21. We established camp near the eastern edge of the minigrid. The hike from Wonder Lake to the minigrid took approximately 6 hours, and the hike from camp to the edge of the minigrid took about 10 minutes. We found water in the numerous small ponds near our campsite. One team was tasked with installing permanent markers at as many points as possible on the minigrid. We installed permanent markers at points 9, 10, 14, 15, 19, 20, and 25, all to the north of the McKinley River on the western side of the minigrid. Points 3, 4, and 5 were on the river bar and were inaccessible due to a deep side channel of the McKinley River. We had a problem using the Garmin and Trimble GPS units, with the Trimble directing us 129 meters away from where the Garmin GPS zeroed out at a bearing of 244 degrees. Due to this problem, we cached the remaining five stakes and markers at point 19. The habitat on the Muddy River minigrid ranged from small ponds and boggy areas to thick scrub in drainages and around ponds. The area also included low scrub, ridgelines with lichens, exposed rock, and a needleleaf forest near the McKinley River. On June 26, one team surveyed the western-most points, starting with 25, and the other team started in the middle at point 23. We used a game trail that followed a ridgeline just north of the minigrid, which took us almost to point 25 from our camp. Both teams worked south towards McKinley River before heading north along the next row of points. On June 27, the remaining points were completed with one team finishing the west side of the minigrid (24 and 19) and the other team surveyed the points closer to camp.

Figure B-19. Shrub vegetation near point 11 on the Muddy River minigrid, 27 June 2008. NPS photograph by Mark Paulson.

Figure B-20. Typical working conditions on the Muddy River minigrid, 26 June 2008. NPS photograph by Mark Paulson.

Figure B-21. Looking south to Mount McKinley from the northern end of the Muddy River minigrid, June 2008. Photograph by Eliot Miller.

Moose Creek North Fork Upper East. The Moose Creek North Fork Upper East minigrid straddles the park's wilderness boundary northwest of Mount Galen and almost directly north of a pullout along the Denali park road at mile 73. We parked our vehicle in the pullout and hiked north across the tundra and over a very prominent ridge to the north. Our approach was relatively easy across the tundra with open tall scrub and minor stream crossings. We crossed the main channel of Moose Creek without getting wet near a braided channel in stand of Balsam Poplar, although a long leap was necessary to cross the stream. (We recommend wearing gaiters or rubber boots for future stream crossings). We established our spike camp approximately 400 m south of point 3 on a flat, well-drained bench overlooking a branch of the Moose Creek. The hike from the road to the minigrid took approximately 5 hours, and the hike from camp to the edge of the minigrid took about 15 minutes. We found water in a few small ponds on the hill above camp near point 2. The other possibility for water was in the drainages within the minigrid and below camp. Most of the minigrid was covered with alpine tundra with some exposed rock. At lower elevations the vegetation transitioned into low willow and birch scrub and then into tall willow and alder in the two drainages within the minigrid. We easily crossed the creeks within the minigrid, although we used a beaver dam to cross the creek nearest camp. On June 29, the teams started surveying the southeast and southwest points and worked north completing the farthest points from camp. The final three points were completed the morning of June 30. Overall, travel within the minigrid was not difficult and had great views of the surrounding area. Rubber boots were not needed within the minigrid, but are recommended for the hike in.

Figure B-22. Looking south from point 3 on Moose Creek North Fork Upper East minigrid, 30 June 2008. NPS photograph by Mark Paulson.

Figure B-23. Dwarf shrub vegetation and bare ground near point 17 on Moose Creek North Fork Upper East minigrid, 29 June 2008. NPS photograph by Mark Paulson.

Figure B-24. Moose Creek campsite, June 2008. Photograph by Eliot Miller.

Table B-1. List of species detected on 10-minute point transect surveys in Denali in 2008.

Common name	Double Mountain	East Fork East	Igloo	Moose Creek North Fork	Muddy River	Nika Ridge	Rock Creek	Toklat West Branch
Northern Pintail					Y			
Willow Ptarmigan	Y		Y	Y	Y	Y	Y	
Rock Ptarmigan						Y		
White-tailed Ptarmigan	Y							
Northern Harrier						Y		Y
Golden Eagle	Y							
Gyrfalcon				Y				
American Golden-Plover				Y		Y		
Semipalmated Plover								Y
Whimbrel						Y		
Mew Gull			Y		Y			
Long-tailed Jaeger				Y		Y		
Northern Hawk Owl					Y			
Short-eared Owl					Y			
Alder Flycatcher			Y		Y			
Say's Phoebe		Y						
Gray Jay					Y		Y	
Black-billed Magpie	Y	Y	Y			Y	Y	
Common Raven	Y					Y		
Horned Lark								Y
Arctic Warbler			Y	Y				
Northern Wheatear								Y
Townsend's Solitaire			Y					
Gray-cheeked Thrush				Y				
Swainson's Thrush					Y	Y	Y	
Hermit Thrush			Y	Y		Y	Y	
American Robin							Y	Y
Varied Thrush							Y	
American Pipit	Y	Y	Y	Y		Y	Y	Y
Orange-crowned Warbler			Y		Y	Y	Y	
Yellow Warbler					Y			
Yellow-rumped Warbler						Y	Y	
Blackpoll Warbler		Y						
Wilson's Warbler	Y	Y	Y	Y	Y	Y	Y	
American Tree Sparrow	Y	Y	Y	Y	Y	Y	Y	
Savannah Sparrow				Y	Y	Y	Y	Y
Fox Sparrow	Y	Y	Y	Y	Y	Y	Y	
Lincoln's Sparrow					Y			
White-crowned Sparrow	Y	Y	Y	Y	Y	Y	Y	Y
Golden-crowned Sparrow		Y					Y	
Dark-eyed Junco			Y		Y	Y	Y	
Lapland Longspur			Y	Y				
Snow Bunting		Y						
Gray-crowned Rosy Finch	Y	Y						Y
White-winged Crossbill					Y			
Redpoll spp.	Y	Y	Y	Y	Y	Y	Y	Y

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