Appendix 2: Pilot program to assess methods of measuring caribou/habitat interactions.

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INTRODUCTION

The objective of this study was to assess several possible methods of investigating caribou-habitat interactions. Pilot studies were initiated in 1989, and it is anticipated that some of these will be expanded beginning in 1991. The 1989 work involved the Central Arctic Herd (CAH), because access and logistics were easy to arrange. Three projects were designed, each focused on a different aspect of habitat use by caribou:

1. Calving site selection. The objective of this project was to determine whether CAH caribou used certain habitat types preferentially for calving. Loss of preferred calving habitat is a possible impact of oil development, and effective mitigation will require information about selection of habitat types during calving.

2. Fecal analysis. The basic objective was to obtain a partial list of important spring and summer forage species. If development occurs in ANWR, it will be necessary for managers to assess the relative values of habitat types and/or areas for caribou. This will require better information than is currently available on diet composition and preferred forage species.

3. Exclosures. The objective was to establish a long-term study of forage use by CAH caribou. Comparison of exclosures and adjacent control plots will give some indication of the intensity of grazing in two important habitat types. If grazing pressure is sufficiently high, the more heavily used species should eventually increase in abundance in the exclosures relative to control plots. Combined with analysis of feces, exclosures should contribute to understanding of the relative values of different plant species and habitat types for caribou.

DATA COLLECTION

Calving Site Selection

A calving site was defined as a site where a cow was observed with a calf less than 2 days old. Twelve sites were located from the air (Supercub or helicopter) and marked with radio collars. Ten were relocated, the vegetation was described, and fecal samples were collected for analysis.

Vegetation was described along 4, 50-m transects radiating from the spot where the cow and calf were observed. A tape was laid along each transect and vegetation was classifed in each 50 cm segment. Thus 200 linear meters of vegetation were sampled at each site, and the data consisted of proportions of each of the vegetation types encountered. Vegetation was classified as:

1. Dry shrub/lichen tundra
2. Moist sedge tundra
3. Tussock tundra
4. Wet sedge tundra
5. Very wet sedge tundra
6. Open water and ice

The percentage occurrence of moist/dry tundra in the ten calving sites was compared with that in the townships where the sites occurred. Data for the townships were obtained from Walker and Acevedo (1987). Their type III (dry/moist herbaceous tundra) was considered equivalent to our categories 1, 2 and 3 combined. Comparisons were made using the median test (Conover 1980).

Fecal Analysis

Samples were collected from ten calving sites, as noted above. In addition, a total of 63 samples was collected on 9 dates between 7/15/89 and 8/8/89. Only one sample was obtained from a calf; the rest were from adults of known sex. All fecal samples were oven dried at 60°C within a few hours of collection. Analysis of the samples for botanical composition is expected to begin early in 1990.

Exclosures

Exclosures were erected at 3 sites within the Kuparuk concentrated calving area and 2 in the peripheral calving area. At each site, one exclosure was placed in moist sedge/shrub tundra and one in dry shrub/lichen tundra. Exclosures were constructed of wire fencing (1 m high) and steel fence posts (1.5 m high), and were 5-m square. An equal-sized control plot was marked with permanent stakes within 10 m of each exclosure, in the same vegetation type.

Initial cover data were collected for all exclosures and control plots using a 10-pin point frame placed 200 times in a systematic grid pattern.

RESULTS

Calving Site Selection

For calving sites, the median percentage of land area occupied by moist/dry tundra was 95% (Table 1a). The corresponding value

for the townships in which the sites occurred was 51% (Table 1b). This difference was statistically significant (P =0.02).

Fecal Analysis

Fecal pellets will be examined microhistologically during the spring of 1990.

Exclosures

No differences between exclosures and control plots due to grazing were expected, as cover data were collected only about 2 weeks after the exclosures were erected. Effects of grazing, if any, may be apparent in 1990 or may take several years to develop.

Cover data were grouped into major cover types and tabulated for each vegetation type in order to check for any obvious differences in initial conditions between the exclosures and control plots. The results indicated that the control plots and exclosures were quite similar, but that there was considerable variability within treatments.

CONCLUSIONS

The results of the calving site study indicated that female CAH caribou selected dry and moist habitat types for calving, and avoided wet habitats. This study also served to demonstrate a feasible method of collecting and analysing this type of information. If future research plans call for investigation of calving habitat in ANWR, a similar approach could be used. Some modifications (e.g. a random sampling procedure) would be necessary due to the much larger number of animals involved. For example, marking the sites with radio collars might not be practical as the supply of collars is limited. One alternative would be to classify vegetation from a helicopter at the same time that calving sites are identified. Data on availability of habitat types in different areas of the refuge are sparse at present, but an adequate data set should be available after the 1990 field season.

No conclusions are expected from the exclosure study until at least 1990, and possibly not for several years. Next field season will show whether the exclosures were constructed strongly enough to last through the winter, or whether design changes are needed. The 1989 data indicated that initial conditions were similar in exclosures and control plots, although quite variable. Thus any substantial differences that arise over the years can be attributed to grazing, if other effects of exclosures can be ruled out. Very small changes due to grazing or other effects will probably not be detectable.

Table 1a. Habitat composition of calving sites (% of land area).

Site	Moist/Dry tundra	Wet/Very wet tundra	Snow
1	95.0	5.0	0.0
2	65.5	34.5	0.0
3	93.8	5.2	1.0
5	80.5	18.9	0.6
6	90.4	1.9	7.7
7	81.4	18.6	0.0
8	90.9	3.4	5.8
9	93.2	2.9	3.9
10	63.5	36.5	0.0
11	100.0	0.0	0.0
Median	90.7	5.1	0.3

Table 1b. Habitat composition of townships in which calving sites were located (% of land area). (Calculated from data of Walker and Acevedo 1987.)

Township	Range	Moist/Dry tundra	Wet/Very wet tundra	Sparse/ barren
10	10	50.9	49.1	0.0
11	11	40.7	58.1	1.1
12	11	57.2	41.4	1.4
12	12	49.2	49.7	1.2
12	13	38.7	54.7	6.6
13	10	51.3	44.6	4.1
13	11	54.7	41.6	3.7
Median		49.1	50.9	1.4

Table 2. Comparison of major cover classes between exclosures and control plots in the dry shrub/lichen vegetation type (n = 5).

Cover type	Exclosures		Controls	
	Mean (%)	SD	Mean (%)	SD
Fruticose lichens	8.6	3.2	8.5	5.2
Foliose lichens	0.7	0.9	0.8	0.8
Crustose lichens	5.4	3.4	4.8	3.0
Grasses	0.5	0.6	0.2	0.2
Sedges	1.4	0.7	2.1	2.5
Legumes	2.2	2.0	2.3	1.3
Forbs	3.0	1.1	4.5	2.4
Willows	5.1	5.1	4.7	4.0
Evergreen shrubs	25.7	5.6	24.5	7.0
Moss	8.8	4.0	10.5	5.7
Litter	50.3	13.0	50.9	11.6
Bare ground	4.9	4.4	7.4	8.2

Table 3. Comparison of major cover classes between exclosures and control plots in the moist sedge/shrub vegetation type (n = 5).

Cover type	Exclosures		Controls	
	Mean (%)	SD	Mean (%)	SD
Fruticose lichens	3.1	2.4	4.6	4.0
Foliose lichens	0.2	0.2	0.1	0.2
Crustose lichens	0.0	0.0	0.1	0.2
Grasses	0.3	0.4	0.2	0.4
Sedges	13.2	2.7	9.6	2.5
Legumes	0.3	0.2	0.0	0.0
Forbs	0.7	0.6	1.5	0.7
Willows	7.8	8.7	8.2	5.9
Evergreen shrubs	7.2	7.2	5.3	4.0
Moss	32.9	5.4	32.2	6.7
Litter	67.3	6.0	64.6	10.4
Bare ground	0.5	0.6	0.1	0.2

RESEARCH PROSPECTUS

No continuation of the calving site study is planned for 1990, but related studies may be developed for 1991 and beyond.

Current plans do not call for any additional collection of fecal samples in the 1990 field season. Analysis of the samples already collected is expected to take several months. This study may be expanded after 1990 if the inital results indicate fecal analysis is a useful tool for describing diets of CAH and PCH caribou.

Exclosures and control plots will be revisited in 1990. Any necessary repairs will be made, and cover data will be collected according to the same sampling scheme as in 1989.

LITERATURE CITED

Conover, W. J. 1980. Practical Nonparametric Statistics, 2nd. edition. John Wiley & Sons, New York.

Walker, D. A. and Acevedo, W. 1987. Vegetation and a Landsat-derived land cover map of the Beechey Point Quadrangle, Arctic Coastal Plain, Alaska. U.S. Army Cold Regions Research and Engineering Laboratory, Report 87-5.

Appendix 3. 1989 vegetation classification scheme, coastal plain, Arctic National Wildlife Refuge, Alaska

Level A Moisture	Level B MSS class	Level C Broad veg. type incl. complexes	Level D Inclusion of lev C >10% or landform	Level E Char. sp or other descriptor
H - water	FR frozen WR liquid	IC - ice, snow WA - water		RIVE - river DEEP - deep SHAL - shallow
W - wet	PB - part barren	PV - partially vegetated (<50%)	FP - flat centered polygons inclusions of WS,MS	COBB - cobble GRAV - gravel SAND - sand MUD - mud PUPH - Pucc.phry. WALG - white scum algae
	AQ - aquatic	AG - aquatic graminoid	LE - lake edge LP - low centered polygon	ARFU - Arctophila CAAQ - Carex aqua CARO - C.rotundata
		HG - H2O/graminoid complex	BS - beaded stream LP - low cent. pol. SG - strang inclusions of MS,HS	RALG - red algae WALG - white algae CARA - C.rariflora CASU - C.subspath. DUFI - Dupontia ERAN - E.angust.
	WG - wet graminoid	WS - wet sedge	DG - drainage LP - low cent. pol. MP - mixed polygons SG - strang FB - frost boils SN - snow bank inclusions of AG, BA,HS,MS,ST,or WA	CACH - C.chord. CAAT - C.atrofusc. CARO - C.rotundata CASU - C.subspath. DUFI - Dupontia SAOV - Salix oval. SPHA - Sphagnum WALG - white algae
		MW - moist/wet complex	SG - strang LP - low cent. pol. MP - mixed polygons default - hummocky mix	DRIN - Dryas int. (on moist rims)

M - moist	MG - moist graminoid	MS - moist sedge	HP - high cent. pol. FP - flat cent. pol. LP - low cent. pol. MP - mixed polygons BK - bank RT - river terrace SG - strang LS - lush DG - drainage CT - coastal inclusions of AG,WS, HS,TT,ST default - nonpatterned	CAMI - C.misandra DRIN - Dryas int. SAOV -Salix oval. SPHA - Sphagnum VAVI - Vacc.vitis MOSS - high % moss cover
		MT - moist sedge/ tussock tundra complex	default - water track pattern on slope	
		HT - hummocky sedge tundra	FB - w/frost boils BK - bank HP - high cent.pol. with inclusions of AG,MS,WS,WA or TT default - slope	CATE - Cassiope EQUI - Equisetum ERAN - E. angust. RALA - Rac.lanug. SAPH - S.phlebo. WALG -white algae
		TM - complex of hcp's, deep troughs & thermokarst pits. Usually includes MS,TT,HS,ST,WG and/or AG	HP - high cent.pol. MP - mixed polygons	ERIC - ericaceous ERVA -E.vaginatum ERAN - E. angust. BENA - Betula CAAQ - C. aquat. SAPL - S. planif. DRIN - Dryas int.
		TT - tussock tundra	HP - high cent.pol. FB - frost boils inclusions of MS, WS,HS,ST,TS default - slope	ERIC - ericaceous CABI -C.bigelowii ACID - acid,SPHAG BASE - basic,DRIN SPHA - Sphagnum
		TS - tussock shrub tundra	HP - high cent.pol. BK - bank inclusions of WS,MS,ST default - slope	

	SH - shrub	ST -shrub tundra	HP - high cent.pol. BK - bank SN - snowbank inclusions of MS, TT,WS,DR or AG	ERIC - ericaceous SPHA - Sphagnum SAPL - SAPL>BENA SAPH-Salix phleb.
		SM - shrub moss		RUCH -Rubus cham. HYSP - Hylocomium SPHA - Sphagnum
		RS - riparian shrub	OP - open <40% CL - closed >40% FO - forb rich HP - high cent.pol. BK - bank inclusions of BA,WS,DT default - floodplain	LOW - <20 cm tall MED - 20cm - 1m TALL - >1m tall
D - dry	DS -dryas	DT - dryas terrace	HP - hcp near coast inclusions of BA, RS, or WS default - river terrace	CRUS -crust.lich. LICH -high lichen MOSS - high moss TONI - Tomenthyp. CATE - Cassiope VAUL - Vacc.ulig. LUAR - Lupinus SAPH-Salix phleb. OXBO -Oxyt.borea.
		DR - dryas ridge	FB - frost boils inclusions of ST,BA default - ridge or slope	ERIC - ericaceous
	PB - partly	PV - partly vegetated	inclusions of MS, RS,DT,DR default - ridge for DR, floodplain for RS or DT inclusions	SAND - sand GRAV - gravel COBB - cobbles
	NV - non vegetated	BA - barren (<5% vegetated)	CT - coast FL - floodplain	SAND - sand GRAV - gravel COBB - cobble

Appendix 4. Criteria used to categorize soil moisture and vegetation types on the Arctic National Wildlife Refuge. Vegetation types follow N. Felix[a].

SOIL MOISTURE

1. Moist: Soil feels damp to the touch but when stepped upon, no water appears around the foot.
2. Wet: Less than 1 cm of standing water or when soil is stepped upon, water appears around the foot.
3. Flooded: Standing water between 1 and 10 cm.
4. Aquatic: Standing water $\geq$ 10 cm.

VEGETATION TYPES

Aquatic Graminoid Marsh (AGM)

- dominated by emergent grass or sedges
- permanently flooded sites
- > 10 cm standing water throughout summer
- found in ponds, lake margins, and some areas of low-centered polygons with deep basins
- mosses generally absent

Emergent Arctophila fulva grass marsh (deeper water, up to 2 m)

Emergent Carex aquatilis, Eriophorum angustifolium, E. scheuchzeri sedge marsh (shallower water)

Wet Graminoid Tundra (WGT)

- sedge or grass dominated communities
- poorly drained, seasonally flooded sites
- up to 10 cm water, but sometimes dry by mid-summer
- low moss cover, limited to higher microsites
- typical locations included low-centered polygons, drained lake basins, lake and stream margins, intermittent drainages, abandoned floodplains, strangmoor, and tidal mud-flats

Wet Carex aquatilis, Eriophorum angustifolium, Pedicularis sudetica ssp. albolabiata, Scorpidium scorpioides, Drepanocladus spp. meadow

Wet Carex aquatilis, C. chordorrhiza, Eriophorum angustifolium, Drepanocladus spp. sedge meadow

Moist Sedge-shrub Tundra (MSST)

- upland slopes and flat or poorly developed high-center polygons
- moist, more or less well-drained
- usually dominated by sedges or willows (may include Dryas)
- variable moss and willow cover
- < 30% hummock and frost scar cover
- < 15% tussock cover
- commonly intermixed with areas of wet tundra, barren complex, tussock tundra, or shrub tundra

Moist Eriophorum angustifolium, Carex aquatilis, Salix planifolia ssp. pulchra sedge, dwarf shrub tundra

Moist Eriophorum angustifolium, Carex Bigelowii, Carex aquatilis, Salix planifolia ssp. pulchra, S. reticulata, Tomenthypnum nitens, Hylocomium splendens sedge, dwarf shrub, moss tundra

Moist Graminoid/Barren Tundra Complex (MGT)

- moist, well-drained graminoid communities, generally found on slopes and ridges
- > 30% hummock or frost scar cover
- barren complex sites dominated by sedges and Dryas integrifolia (ericaceous shrubs may be dominant on some locations)
- up to 15% tussock cover
- tussocks may form distinct rings around the frost features
- includes hummocky, old river floodplains

Moist Carex bigelowii, Eriophorum angustifolium, E. vaginatum, Artagrostis latifolia, Dryas integrifolia, Salix phlebophylla, S. reticulata, Tomenthypnum nitens

Moist Sedge Tussock Tundra (MSTT)

- > 15% cover by cottongrass tussocks
- typical landforms include gentle slopes, floodplain deposits, and high-center polygons
- up to 30% hummock and frost scar cover

Moist Eriophorum vaginatum, Carex Bigelowii, Salix planifolia ssp. pulchra, S. reticulata, Hylocomium splendens, Tomenthypnum nitens sedge tussock, dwarf shrub tundra

Moist Eriophorum vaginatum, Betula nana, Salix planifolia ssp. pulchra, Ledum palustre ssp. decumbens, Vaccinium vitis-idaea, Hylocomium splendens, Sphagnum spp. sedge tussock, dwarf shrub tundra

Moist Shrub Tundra (MST)
- non-riparian
- found on palsas and high-centered polygons
- acidic soils
- variable shrub coverage (from erect birch communities with closed canopies to dwarf, ericaceous mats)
- up to 15% cover by cottongrass tussocks
- shrub tundra frequently intergrades with moist sedge-shrub tundra or tussock tundra

Moist Betula nana, Salix planifolia ssp. pulchra, Eriophorum vaginatum, Ledum palustre ssp. decumbens, Vaccinium vitis-idaea, Hylocimium splendens, Sphagnum spp. dwarf shrub, tussock tundra

Riparian Shrubland (RS)
- open or closed willow communities
- found on gravel bars and floodplains of streams and rivers and extending up stream banks and river bluffs
- moist and well drained soils
- > 30% vegetative cover

Moist Salix brachycarpa ssp. niphoclada, S. lanata, S. reticulata, Equisetum variegatum, Astragalus spp., Oxytropis spp., Tomenthypnum nitens open low shrub, forb, moss tundra

Dryas Terrace (DT)
- dominated by Dryas integrifolia
- dry sites
- found on ridges, bluffs, and river terraces

Dry Dryas integrifolia, Salix reticulata, Oxytropis nigrescens, Equisetum variegatum, Tomenthypnum nitens, Dicranum spp., Lecanora epibryon, Pertussaria spp. dwarf shrub, forb, crustose lichen tundra (Dryas river terrace)

Sparsley Vegetated or Barren (SVB)
- < 30% vegetative cover
- typical sites are active floodplains, sand dunes, mud flats, gravel outcrops on ridges and river bluffs, and gravel strand

Moist or dry Epilobium latifolium, Salix alaxensis, S. lanata, Bromus pumpellianus, Castilleja caudata, Hedysarum spp., Astragalus alpinus, Artemisia arctica herb, shrub gravel bar

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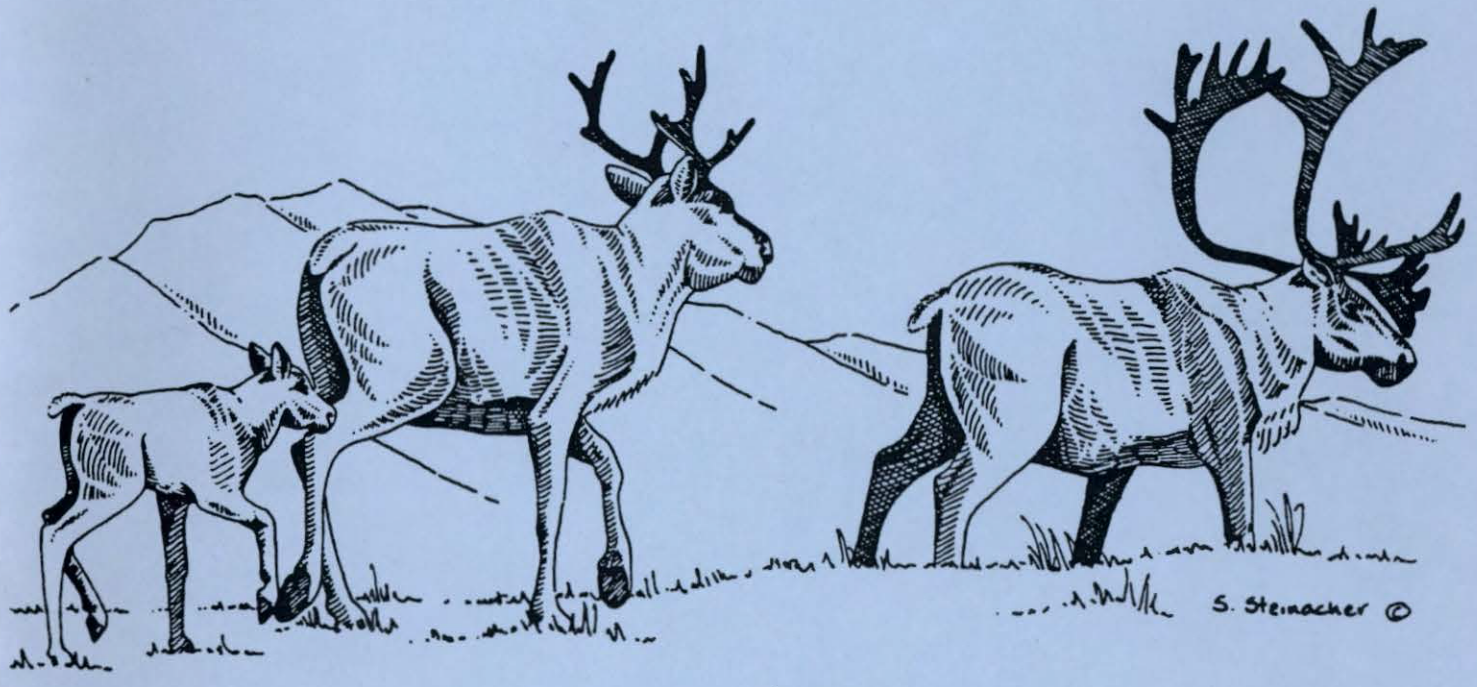
[a]These descriptions were reproduced from a 1985 memo from N. Felix to ANWR personnel.

TERRESTRIAL RESEARCH

1002 AREA - ARCTIC NATIONAL WILDLIFE REFUGE



Annual Progress Report

Field Season - 1989

Submitted by : Alaska Fish and Wildlife Research Center
&
Arctic National Wildlife Refuge