North Slope ARCSS/LAII Flux Study

DATE: 12 SEPTEMBER 1995
TO: LAII INVESTIGATORS, LAII STEERING COMMITTEE, ARCSS PROGRAM MANAGERS
FROM: LAII SMO
SUBJECT: SUMMARIES OF FIELD ACTIVITIES

SUMMARIES SUBMITTED THE WEEK OF 10 SEPTEMBER:

1. SKIP WALKER, JIM BOCKHEIM

1. VEGETATION-SOIL SITE CHARACTERIZATION AT THE 12 FLUX TOWER SITES:

By Skip Walker and Jim Bockheim

PARTICIPANTS: Skip Walker and Alisa Gallant (vegetation); Jim Bockheim, Jeff Munroe, and Lynn Everett (soils)

PERIOD OF STUDY: 12-26 August 1995

PURPOSE: To characterize and map the vegetation and soils at 10 flux tower sites of Terry Chapin et al. and two flux towers of Walt Oechel et al.

METHODS:

Aerial photos: Stereo color-infrared aerial photos of the Chapin's sites were obtained by Aeromap Inc. during two missions (July 14 and Aug 18, 1995; scale 1:3000 enlarged to 1:200). Quality of all the photos is excellent. The decision to include Oechel's towers in the site characterization was made after the aerial photos were flown, but both should be covered by other photo missions. Photos of the Happy Valley Grid were obtained for a digital terrain model and orthophoto topographic map of the site, and aerial photos of Oechel's Betty Pingo site should be available from Aeromap as part of the annual oil field photo missions.

Transects:

Each site consists of a 100x100-m square with corners and center point (flux tower site) marked in the field with air photo panels and 4-ft lath. 6 transects (4 50-m and 2 70-m transects) radiating from the center point are marked with wire flags spaced at 5-m intervals.

Vegetation:

Species composition, moss thickness, vegetation height: Species occurrence at the top and bottom of the plant canopy was sampled at each meter along the 6 transects using a Buckner optical point sampling device. Canopy height was sampled along the 6 transects at 1-m intervals by measuring to the height of a point intersected in the plant canopy at each meter mark along a measuring tape. Moss thickness was measured at 5-m intervals along each transect by removing a small plug of moss and measuring the thickness of the live green portion.

Vegetation communities: A list of vegetation communities were made for each site. The location of communities, maximum shrub heights within the communities, and transitions between communities were recorded along

each transect. Releves (vegetation samples using the Braun-Blanquet approach) were obtained for each of the major communities by recording the cover-abundance of all of the vascular, bryophyte, and lichen species within approximately 10x10-m areas. Site factors (surficial geomorphology, parent material, and subjective ratings of soil moisture, site moisture, snow regime, exposure, aspect, slope, etc.) Normally, 2-3 releves were obtained for each site. Soil pits on equivalent sites were described by Jim Bockheim. Vegetation and soil maps of each site will be prepared based on the transect information and photo-interpretation of the CIR photographs.

Soils: Small soil pits were dug by hand along the six transects at 10-meter intervals and at the plot center for a total of 49 pits. Measurements included thickness of the organic horizon and thawing depth. Each soil was classified, and a large-scale soil map was generated for each site. At each site from one to four soil pits measuring 1 meter by 1 meter were dug by hand to the frozen surface at and with a gasoline powered chisel to 100 cm. Detailed soil descriptions were made and samples were collected for field moisture content, bulk density, and chemical/physical analyses.

RESULTS:

Site descriptions, vegetation, and soil:

Site 1. Betty Pingo, moist site.
Location: Coastal Plain, Prudhoe Bay region, N70 17.01, W148 53.57, elev. 12 m.
Site description: Flat with mixed flat-centered and low-centered polygons; moist nonacidic tundra.
Vegetation communities: (1) Raised microsites, including polygon rims and raised centers: Moist Eriophorum triste, Carex membranacea, Dryas integrifolia, Tomentypnum nitens, Thamnolia subuliformis graminoid, prostrate-shrub tundra.
(2) Lower microsites, mainly polygon basins: Wet Eriophorum angustifolium, Carex aquatilis, Drepanocladus brevifolius graminoid tundra.
Cover of top 5 species: Eriophorum triste (22%), Dryas integrifolia (16%), Tomentypnum nitens (7%), Eriophorum vaginatum (4%), Carex aquatilis (2%).
Mean vegetation height: 3.1 +/- 3.0 s.d. cm
Mean live moss layer thickness: 1.8 +/- 0.9 cm
Soil taxa: Pergelic Cryoborolls (55%), P. Cryaquolls (16%), P. Cryaquepts (16%), others (13%).
Organic layer thickness: 12 +/- 1.7 S.E. cm. Thaw depth: 41 +/- 1.2 cm.

Site 2. Betty Pingo, wet site.
Location: Coastal plain, Prudhoe Bay region, N70 16.50, W148 55.14, elev. 12 m.
Site description: Flat with low-centered polygons; wet nonacidic tundra.
Vegetation communities: (1) Lower microsites, including polygon basins and troughs: Wet Eriophorum angustifolium, Carex aquatilis, Scorpidium scorpioides graminoid tundra. (2) Raised microsites, including polygon rims and hummocks: Moist Eriophorum triste, Dryas integrifolia, Tomenthypnum nitens graminoid, prostrate-shrub tundra.
Cover of top 5 species: Eriophorum angustifolim (28%), Scorpidium scorpioides (11%), Carex aquatilis (10%), Drepanocladus brevifolius (3%), Dryas integrifolia (3%)
Mean vegetation height: 4.1 +/- 3.9 cm

Mean live moss layer thickness: 0.8 +/- 0.7 cm
Soil taxa: Histic Pergelic Cryaquolls (39%), P. Cryaquolls (25%), P. Cryofibrists (24%), others (12%).
Organic layer thickness: 25 + 1.5 cm. Thaw depth: 44 + 1.6 cm.

Site 3. Sagwon, moist nonacidic site.
Location: Northern Foothills, Sagwon vicinity, N69 26.46, W148 40.22, elev. 269 m.
Site description: Hill, gentle northwest-facing slope (4 degrees) with nonsorted circles; moist nonacidic tundra.
Vegetation communities: (1) Vegetated nonsorted circles: Moist Eriophorum triste, E. vaginatum, Dryas integrifolia, Hylocomium splendens, Racomitrium lanuginosum, Thamnolia subuliformis graminoid, prostrate-shrub tundra. (2) Barren nonsorted circles: Dry Saxifraga oppositifolia, Juncus biglumis, Ochrolechia frigida forb, crustose-lichen barren (3) Areas between nonsorted circles: Moist Dryas integrifolia, Salix reticulata, Eriophorum triste, Tomentypnum nitens, prostrate-shrub, graminoid, moss tundra.
Cover of top 5 species: Carex bigelowii (20%), Dryas integrifolia (14%), Eriophorum triste (14%), Hylocomium splendens (10%), Eriophorum vaginatum (9%)
Mean vegetation height: 3.9 +/- 4.6 cm
Mean live moss layer thickness: 2.1 +/-1.4 cm
Soil taxa: Pergelic Cryaquolls (43%), P. Cryaquepts (18%), P. Cryoborolls (14%), others (25%).
Organic layer thickness: 9 + 1.2 cm. Thaw depth: 57 + 1.4 cm.

Site 4. Sagwon, moist acidic site.
Location: Northern Foothills, Sagwon Upland, N69 24.06, W148 40.22, elev. 360 m.
Site description: Flat hill crest, featureless, moist acidic tundra.
Vegetation communities: Moist Eriophorum vaginatum, Betula nana, Salix pulchra, Hylocomium splendens tussock-graminoid, dwarf-shrub tundra
Cover of top 5 species: Eriophorum vaginatum (24%), Ledum decumbens (9%), Betula nana (9%), Hylocomium splendens (8%), Salix pulchra (6%)
Mean vegetation height: 5.9 +/- 6.4 cm
Mean live moss layer thickness: 2.2 +/- 1.4 cm
Soil taxa: Pergelic Cryaquepts (79%), Histic Pergelic Cryaquepts (21%).
Organic layer thickness: 15 + 0.9 cm. Thaw depth: 37 + 1.0 cm.

Site 5. Imnavait Mountain, dry acidic site.
Location: Southern Foothills, Imnavait Mountain, N68 37.44, W149 37.09, elev. 1142 m.
Site description: Gentle (7 degrees) southwest-facing slope near summit of mountain, weathered sandstone and conglomerate bedrock (Fortress Mountain Formation); dry acidic tundra.
Vegetation communities: (1) Exposed sites: Dry Salix phlebophylla, Douglasia ochotensis, Alectoria nigricans prostrate-shrub, cushion-forb, lichen barren. (2) Slightly protected sites: Moist Salix phlebophylla, Carex microchaeta, Polytrichum piliferum prostrate-shrub, graminoid tundra.
Cover of top 5 species: Rhizocarpon sp. (9%), Salix phlebophylla (7%), White crustose lichen (4%), Seleginella sibirica (4%), Cetraria nigricans (3%)
Mean vegetation height: 0.1 +/- 0.3 cm
Mean live moss layer thickness: 0.1 +/- 0.2 cm
Soil taxa: Pergelic Cryochrepts (98%), P. Cryumbrepts (2%).
Organic layer thickness: trace. Thaw depth: >100 cm.

Site 6. Toolik Lake, water-track complex.
Location: Southern Foothills, Toolik Lake vicinity, N68 37.44, W149 37.09, elev. 777 m.
Site description: Gentle (3 degrees) north-facing slope, including water track and nonsorted circles (site of LTER weir, Joe McFadden's thesis experiment, and several other studies); moist acidic tundra and water-track complex.
Vegetation communities: (1) Tussock tundra areas between nonsorted circles: Moist Eriophorum vaginatum, Betula nana, Hylocomium splendens tussock-graminoid, dwarf-shrub tundra. (2) Vegetatated nonsorted circles: Dry Vaccinium vitis-idaea, Racomitrium lanuginosum, Cladina arbuscula prostrate-shrub, fruticos-lichen tundra. (3) Barren nonsorted circles: Dry Luzula arctica, Juncus, Anthelia juratzkana barren. (4) Water tracks: Wet Salix pulchra, Eriophorum angustifolium low-shrub tundra. (5) Shrubby water-track margins: Moist Betula nana, Rubus chamaemorus, Sphagnum girgohnsohnii dwarf-shrub tundra. (6) Water-track transitions: Wet Salix pulchra, Rubus chamaemorus, Sphagnum sp. dwarf-shrub tundra.
Cover of top 5 species: Eriophorum vaginatum (16%), Vaccinium vitis-idaea (12%), Betula nana (10%), Hylocomium splendens (9%), Ledum decumbens (7%)
Mean vegetation height: 5.8 +/- 7.7 cm
Mean live moss layer thickness: 1.8 +/- 1.0 cm
Soil taxa: Pergelic Cryaquepts (73%), Histic Pergelic Cryaquepts (27%).
Organic layer thickness: 15 + 1.0 cm. Thaw depth: 45 + 1.6.

Site 7. Imnavait Creek, wet acidic site.
Location: Southern Foothills, Imnavait Creek watershed, N68 36.66, W149 18.87, elev. 917 m.
Site description: Gentle (1 degree) north facing basin deposit with strangmoor, wetland hummocks, palsas; wet acidic tundra.
Vegetation communities: (1) Raised microsites in basin including hummocks and palsas: Wet Carex rotundata, C. rariflora, Betula nana, Salix fuscescens, Sphagnum lenense graminoid, dwarf-shrub tundra. (2) Footslope of west-facing hill: Moist Betula nana, Eriophorum vaginatum, Sphagnum spp. dwarf-shrub, tussock-graminoid tundra. (3) Lower microsites in basin including interhummock areas with standing water: Wet Eriophorum scheuchzeri, Carex rotundata, Sphagnum orientale, Drepanocladus revolvens graminoid tundra. (4) Marginal area of the basin with few shrubs: Wet Carex rotundata, Salix fuscescens, Sphagnum lenense graminoid, moss tundra. (5) Beaded pond of Imnavait Creek: Aquatic Sparganium hyperboreum, Hippuris vulgaris forb marsh.
Cover of top 5 species: Sphagnum lenense (13%), Carex rotundata (8%), Sphagnum warnstorfii (7%), Betula nana (6%), Sphagnum orientale (6%)
Mean vegetation height: 2.2 +/- 3.2
Mean live moss layer thickness: 2.0 +/- 1.0
Soil taxa: Histic Pergelic Cryaquepts (54%), P. Cryofibrists (35%), P. Cryaquepts (10%).
Organic layer thickness: 34 + 1.7 cm. Thaw depth: 55 + 1.7.

Site 8. Imnavait Creek, moist acidic site with watertracks.
Location: Southern Foothills, Imnavait Creek watershed, N68 36.66, W149 18.56, elev. 938 m.
Site description: Lower hillslope (15 degrees west-facing) with water tracks, scattered glacial erratics and nonsorted circles, moist acidic tundra, shrublands in water tracks (site of R4D studies, Kaye Everett's water-track weir)

Vegetation communities: Inter-water-track areas: (1) Moist Eriophorum vaginatum, Ledum decumbens, Vaccinium vitis-idaea, Sphagnum girgensohnii tussock-graminoid, dwarf-shrub tundra. (2) Water tracks: Wet Salix pulchra, Rubus chamaemorus, Sphagnum angustifolium low-shrub tundra, and moist Betula nana, Rubus chamaemorus, Sphagnum spp. dwarf-shrub tundra.
Cover of top 5 species: Eriophorum vaginatum (12%), Betula nana (11%), Vaccinium vitis-idaea (9%), Carex bigelowii (8%), Ledum decumbens (6%)
Mean vegetation height: 3.6 +/- 3.6
Mean live moss layer thickness: 2.5 +/- 1.1
Soil taxa: Pergelic Cryaquepts (82%), Histic Pergelic Cryaquepts (18%).
Organic layer thickness: 15 + 1.9 cm. Thaw depth: 43 + 1.2.

Site 9. Sagavanirktok River, riparian shrubland
Location: Northern Foothills, Happy Valley region, N69 03.87, W148 44.93, elev. 349 m.
Site description: Island in braided river complex of Sagavanirktok River floodplain, flat with some abandoned channels through the island, riparian shrubland.
Vegetation communities: (1) Flat areas: Dry Salix glauca, S. lanata, Arctous rubra, Hedysarum mackenzii, Hylocomium splendens low shrubland. (2) Small abandoned channels through the island: Moist Equisetum variegatum, Carex capillaris, Distichium capilaceum barrens.
Cover of top 5 species: Arctous rubra (23 %), Salix lanata (14%), Salix glauca (11%), Elymus innovatus (8%), Salix niphocladus (8%)
Mean vegetation height: 18.4 +/- 19.8,
Mean live moss layer thickness: 0.3 +/- 1.0
Soil taxa: Pergelic Cryorthents (100%).
Organic layer thickness: 1 + 0.2 cm. Thaw depth: >192 cm.

Site 10. Happy Valley, water-track complex
Location: Northern Foothills, Happy Valley region, N69 07.73, W148 35.57, elev. 537 m.
Site description: Well-developed water-track complex, southeast-facing slope (4 degrees); moist and wet acidic shrublands.
Vegetation communities: (1) Interwater track areas: Moist Betula nana, Rubus chamaemorus, Hylocomium spendens low-shrub tundra. (2) Water tracks: Wet Salix pulchra, Eriophorum angustifolium, Sphagnum spp. low-shrub tundra. (3) Transitional areas to water tracks: Wet Salix pulchra, Betula nana, Rubus chamaemorus, Petasites frigidus, Carex bigelowii, Sphagnum spp. low-shrub tundra.
Cover of top 5 species: Betula nana (27%), Hylocomium (20%), Salix pulchra (12%), Carex bigelowii (11%), Eriophorum vaginatum (5%)
Mean vegetation height: 13.8 +/- 14.0
Mean live moss layer thickness: 3.2 +/- 1.1
Soil taxa: Histic Pergelic Cryaquepts (54%), P. Cryaquepts (46%).
Organic layer thickness: 19 + 0.9 cm. Thaw depth: 46 + 1.2 cm.

DISCUSSION:

(1) The sites are representative of the major plant communities appearing on the preliminary Landsat classification of landcover types within the Kuparuk River basin.

(2) The homogeneous sites (Sites 3, 4, 5, 9) are probably the most useful for characterizing a broad suite of ecosystem properties at the landscape level. Sites 1 and 11 are homogeneous in the direction of the wind and the

site data can be easily stratified according to the windward and leeward sides of the sites. Site 2 is a common vegetation complex on the coastal plain (wet low-centered polygons) and an excellent site. Site 10 is ok as a water-track complex. Site 7 is representative of many acidic wetlands, but it is far from homogeneous; however, if large homogeneous acidic wetlands exist they are very rare. Sites 6, and 8, and 12 were chosen mainly to overlap with other existing studies and are not ideal homogeneous sites. The more heterogeneous sites require careful stratification of information because of strong microsite differences. The vegetation maps should permit stratification of the information obtained from the transects at each site.

(3) It would be desirable to prepare a set of tables that combines the information from several investigators working at the sites to include vegetation (Walker), soils (Bockheim, Ping), microtopography (Eugster), spectral reflectance (Fleming and Auerbach), and thaw depth (Nelson).