

Field Season Report- 2002

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Project Participants

Steven F. Oberbauer - P.I.
Tracey Baldwin - Graduate Research Assistant
Sarah Colby - Graduate Research Assistant
Inga Parker - Graduate Research Assistant
Andrea Kuchy - REU student, collaborating with MSU at Barrow and Atqasuk
Greg de la Bagassiere - REU student at Toolik
Dr. Craig Tweedie - collaborator, Michigan State University

Study Sites

Barrow, Atqasuk Toolik and associated collection sites along Dalton highway

Project design

The primary project consists of two experiments relating to lengthening of the growing season of tussock tundra at Toolik Field Station:

I) extends the growing season both at the beginning and at the end of the growing season along with a separate set of plots with a soil warming treatment

II) which separately tests the effects of early season extension from a late season extension.

Experimental treatments

I) Eighteen plots in tussock tundra consisting of: a) six unmanipulated control plots; b) six plots for which snow is removed on May 2nd each year since 1995 and snow accumulation is prevented until early June and from mid August until 4 Sept; c) six plots as (b) above but with soil heat addition using greenhouse soil warming coils installed in 1994. Snow accumulation on the plots is prevented by A-frame tents.

II) Eighteen plots in tussock tundra consisting of: a) six unmanipulated control plots; b) six plots for which snow is removed on May 2nd each year since 1997 and snow

accumulation is prevented until early June; c) six plots for snow accumulation is prevented from mid August until 4 September.

For both experiments, four additional plots for each treatment were established along with the 6 primary plots for destructive sampling (leaf nutrients).

Project measurements

1) Weekly phenology on eight study species in each plot of the primary experiments.

Species:

<i>Polygonum bistorta</i>	<i>Betula nana</i>
<i>Salix pulchra</i>	<i>Carex bigelowii</i>
<i>Eriophorum vaginatum</i>	<i>Ledum palustre</i>
<i>Vaccinium vitis-idaea</i>	<i>Cassiope tetragona</i>

2) Weekly measurements of soil depth of thaw

3) Twice weekly measurements of soil moisture

4) Twice monthly manual measurements of ecosystem carbon exchange using a Li-6200 portable photosynthesis system.

5) Weekly NDVI using a Dycam ADC camera

6) Weekly leaf area index using a LAI-2000 canopy analyzer.

7) Four times during the growing season soil solutions are collected for nutrient analysis

8) Four times during the growing season, the lichen *Cetraria cucullata* is measured for growth.

9) From mid June to peak season, CO₂ exchange was measured approximately three times weekly or as power supply from the VECO Firefly power unit permitted.

10) Once at peak season all plots are point framed using ITEX protocols

11) At peak season all study species are measured for quantitative growth responses.

12) On all plots soil temperature is measured hourly at 5 cm depth and logged with a Campbell micrologger.

13) Weekly potential quantum yield (F_v/F_m) is measured by an Optiscience OS-5 chlorophyll fluorometer for all study species.

2002 Season objectives

1) Monitor project experiments as per measurements documented above.

2) Measure leaf secondary compound content and concentration of *Ledum palustre* in response to latitudinal and resource gradients

- 3) Measure growth and physiological response of *Sphagnum girgensonii* to early season snow removal
- 4) Increase flux sampling on experiment I by running automated system as often as power supply permits.
- 5) Measure diurnal courses of CO₂ flux on the MSU Barrow and Atqasuk ITEX warming treatments on wet and dry sites.

Narrative - Toolik

Oberbauer and Baldwin arrived May 1. Snow cover was light and many bare areas were present in the Toolik vicinity. Plot excavation was started May 2 and study plots were completely dug out by May 3rd.

Snow depths were below average and in early May it appeared as if melt would be completed by mid-May. Moss plots were dug out by May 5th. On May 6th a windy snowstorm covered the tents, and plots had to be dug out again over the next few days. Oberbauer installed the micromet instrumentation. Craig Tweedie visited from Barrow May 14 - 19 in a cross project information exchange and to cross calibrate their gas exchange system with the FIU instrument that has been used at Barrow the last two years. Tweedie also helped with design of a tripod system for taking digital photos over the plots and an MS-Access query to post-process the flux data. Colby, Parker, and de la Bagassiere arrived on May 16.

Temperatures from mid to late May were extremely warm, resulting in rapid plant growth on the treatment plots and a very strong initial snow-removal treatment effect. The crew put up the VECO firefly wind generator and Oberbauer installed the solar panels. Oberbauer started the system with the new power monitor, a large improvement over previous years when no method for evaluating charging and energy use was available.

Complete melt out occurred on the study plots by 25 May. However, a series of snowstorms in the end of May and early June caused substantial frost damage to many plants, including some of the controls. The snowstorms also prevented installation of the autoflux system before Oberbauer left for a teaching commitment in Panama on May 30. Oberbauer returned June 14th and installed the autosystem at that time. Another snowstorm with substantial accumulation on the chambers bent some of the chamber supports but they were repaired successfully. A design modification is under consideration. However, the chambers were undamaged by a remarkable wind storm in early July that removed all of the ITEX OTCs at the wet and dry sites and moved some of the LTER greenhouses. Despite the occasional high winds, the amount of sun and wind were not sufficient to allow the autosystem to run more than 3 days per week and we still had to run the gas generator on occasion to top off the Firefly unit batteries. The occurrence of storms several times hampered our ability to collect data as scheduled.

Baldwin conducted several latitudinal transect samplings of *Ledum* along the Dalton Highway throughout the season.

At peak season the autoflux system chambers were removed for point framing. From that point all flux measurements were conducted manually.

Yet another snowstorm, this time very heavy (more than 15 inches of wet snow) on August 12 temporarily put a halt to further measurements until the plots were dug out. The plots were covered with the A-frame tents on August 14th until Sept 4th Parker, de la Begassiere, and Colby left on August 15th. A heavy rain on that evening caused melt out of the heavy snow and the foot bridge across the inlet stream to Toolik had to be removed to avoid its loss. Yet another snowstorm followed and access to the study site was limited until the footbridge was reinstalled. The snow persisted for a unusually long time for that time of year and measurements on the plots had to be restricted until snow melted by August 24th in order to maintain the unaltered snow cover on the controls.

Oberbauer pulled the instrumentation of the autoflux system and with the help of the Walker crew and others lowered the wind generator tower.

Baldwin left on August 30th and measurements continued at a much reduced level until Sept 5th when Oberbauer left for the season.

Narrative - Barrow and Atqasuk.

Kuchy arrived at Barrow 28 May. Snow cover was also light at Barrow and Atqasuk and melt out occurred on the dry sites shortly after her arrival. 2002 produced the best data set yet for the collaboration between FIU and MSU. We obtained 11 diurnal courses of CO₂ flux from Barrow and 5 from Atqasuk. Weather related travel logistics prevented us from obtaining a diurnal course from Atqasuk in August. An unusual concentration of polar bears at Barrow also hampered data collection there late season. Kuchy left 19 August with the rest of the MSU team. The automated data analysis developed by Tweedie for MS-Access allowed data processing while still in field. Data were largely analyzed by the time researchers left the site.