Field Report - Season 2000

Steven F. Oberbauer
North American ITEX program

Participants:

Steve Oberbauer - P.I.
Gregory Starr - Graduate Research Associate (now in postdoc at U. of Florida)
Lorraine Ahlquist - Graduate Research Associate
Joseph O'Brien - Graduate Research Associate (supported on another project)
Michael Rasser - Research Assistant
Carrie Beeler, Undergraduate Research Assistant
Elizabeth Elmore - Undergraduate Research Assistant
Tara Madsen - Undergraduate Research Assistant
Department of Biological Sciences
Florida International University
Miami FL 33199

The purpose of the project is to test the effect of increased season length on tussock tundra. This is year 6 of the original project treatments that consist of controls, snow removal early season and prevention of snow accumulation late season, and soil warming + snow removal early season and prevention of snow accumulation late season. In year 3 we initiated a second set of treatments in which we remove snow early in the season but do not prevent late season snow, and vice versa, late season snow accumulation is prevented until 4 September, but early season snow is not removed.

Season 2000 Objectives:

1) Examine effects of extended growing season and soil warming on long-term extended season study plots at Toolik Field Station. Install and test automated ecosystem flux system for primary study plots.
2) With University of Wyoming group, install minirhizotron tubes on sample plots immediately following plot clearing.
3) Measure ecosystem CO_2 fluxes at in conjunction with Michigan State group (Pat Webber) Barrow and Atqasuk ITEX warming treatments.

Study Sites: Toolik, Barrow, Atqasuk.

Narrative:

Toolik:

Starr and Oberbauer arrived at Toolik 1 May. Snow depths on study plots were deepest of the past 6 years (up to 1 m depth). Snow removal on the 24 plots was completed by 3 May and tents were installed on plots to melt out the remaining snow and prevent further accumulation. Soil heating was initiated 4 May. However, two snow storms with strong winds buried tents twice in the next two weeks (many of the plots remained snow free), but under 1 m of snow that was on top of the tents (Fig 1). Considerable effort was spent digging the plots out again and by the end of the second storm on some plots more than 2 m of snow had accumulated around the plots. Conditions such as these reinforce the idea despite the limitations of small plots, for this study there is really no alternative.

Due to problems with the soil auger engine and bit, the window of opportunity for installation of the minirhizotron tubes on our plots passed (thawing was too great) before they could be installed. Installation of the tubes has been delayed until next year.

Ahlquist, Elmore, Beeler, and Rasser arrived 16 May. O'Brien (brought up to help Oberbauer with installation of automated flux system because of his expertise with data loggers and familiarity with automated flux systems) arrived May 25 th. Elmore was trained in ecosystem gas exchange techniques by Starr and Oberbauer. Madsen arrived at Toolik 4 June. Snow cover remained on control plots until 8 June, also a record over the last 6 years. Oberbauer and O'Brien assemble automated system and construct the 18 chambers and their operating mechanisms. Oberbauer and O'Brien left on 8 June. Unfortunately, this record late snow melt prevented installation of the frames, cable and sample hose for automated flux system that we had planned to install on site. Ahlquist, Beeler, Rasser, and Madsen carry out seasonal measurements (described below) on study plots. Oberbauer returns June 25 and installs sample tubes, cables, automated control system (Figure 2).

VECO installs power system for automated system 2 July (Figure 3). Automated system started up 5 July with test chamber operating (Figure 4). Oberbauer leaves 7 July. Madsen installs an additional chamber. System runs in test mode the remainder of the season, with interruptions due to compressor failure and power unit failure. Ahlquist, Beeler and Rasser leave 14 August. Oberbauer returns 15 August for completion of installation of automated chamber frames, end of season measurements, and wrap up. Oberbauer and Madsen leave 4 September.

Figure 2. VECO FIREFLY power unit at near Toolik.

Unit consists of four 100 watt solar panels and a 300 watt wind turbine mounted on 25ft mast.
Two banks of four 6 V gell cells store the energy and a Trace Inverter converts the 24 V to
110 for use by the automated system. A Honda generator provides supplemental charging of
the batteries during periods of low sun (most of the summer) and low wind.

Figure 4. Automated flux chambers in upright position.

Barrow and Atqasuk:

Flux chambers and calibration gas were shipped to Barrow in April. Elmore and Starr left for Barrow 25 May. Starr continues training of Elmore. They set up for season long measurements of ecosystem gas exchange measurements on ITEX plots on bases installed by Starr and Hollister

in August 1999. Starr left Barrow 5 June leaving Elmore to work with Bob Hollister of Webber's group. Elmore with help conducts 4 sets of flux measurements at Atqasuk and more than twice that at Barrow. Elmore leaves Barrow 14 August.

Measurement taken:

Toolik:
Phenological monitoring of the 8 study species on the plots continued weekly. Species monitored were:
Eriophorum vaginatum, Carex bigellowii, Salix pulchra, Betula nana, Ledum palustre, Vaccinium vitis-idaea, Cassiope tetragona, Polygonum bistorta. Phenological measurements were continued through the 3rd week in August.

Whole system carbon exchange was measured weekly on the primary study plots during a 24 hour period through the last week of August. Whole system carbon flux was measured on the secondary study plots every two weeks whenever possible. In addition, soil respiration in the plots was measured monthly.

Plant canopy development was measured weekly using the Li-Cor LAI-2000 through the 4th week in August. Plots were also photographed with the Dycam ADC camera for calculation of NDVI weekly. One archival set of 35 mm slides taken of each plot in early August.

All plots were point-framed at peak season at the end of July. The main treatment plots (6 yr treatments) were measured for all hits, and the plots separately testing early season and late season treatment effects were measured for top and bottom hits.

Leaf nutrient were collected four times during the growing season on the destructive plots to document leaf N and P content in response to the treatments. Concurrent with the leaf nutrient samples, soil nutrient solution was sampled from the main treatment plots for phosphorus, ammonium, and nitrate.

Supplemental measurements
A small met station measures PAR, irradiance, net radiation, soil heat flux, wind speed, air temperature, soil moisture, and relative humidity every minute and stored as hourly averages. Supportive hourly averages of 1 min soil temperature measurements (5 cm) are taken in all plots plus profiles 1, 5, 10, 20, and 40 cm from one plot of each of the three treatments. During diurnal courses of CO_2 measurements, one minute readings of PAR and air temperature were also taken over the 24 hr period.

Weekly soil depth of thaw (2 measurements per plot) and depth to water table. Twice weekly soil moisture in all plots using CS615 moisture sensors.

Leaf level chlorophyll fluorescence measurements are conducted on the study species in the treatments plots using a Optisciences OS-5 chlorophyll fluorometer to document the physiological basis for changes in whole system carbon uptake capacity.