Maps for monitoring long-term changes to vegetation structure and composition, Toolik Lake, Alaska

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Introduction

The Toolik-Arctic Geobotanical Atlas (http: //www.arcticatlas.org/) includes maps at seven scales from small plots to the circumpolar Arctic. Maps at the finest scale are intended to monitor long-term changes to the plant communities on two different-age glacial surfaces near the Toolik Field Station in northern Alaska. This poster presents the methods, example maps from the plots of the Toolik Grid, which is on the younger (late Pleistocene) glacial surface. Results from four repeat samplings of the Toolik and Imnavait Creek grids at 6-year intervals from 1989 to 2008 demonstrate the value of the data set for monitoring long-term changes in this Arctic landscape.

Method

Permanent 1 x 1-m plots were sampled in 1990 to establish a baseline for monitoring changes to the vegetation at 85 grid points of the 1.2 x 1.1-km Toolik Lake Grid (Figure 1) (Walker and Maier 2008). A similar grid with 72 grid points was sampled in the nearby Imavait Creek watershed. The grid points are spaced 100 meters apart. Each 1-m2 plot was located in a random direction from the grid stake within 2 m of the grid point stake and in the same vegetation type as at the stake. An aluminum point-quadrat frame was used for the sampling (Figure 2). A methodology developed for the International Tundra Experiment (ITEX) permits near-exact repositioning of the frame for long-term monitoring (Walker 1996). The plots are being monitored every 6 years using the same methods.

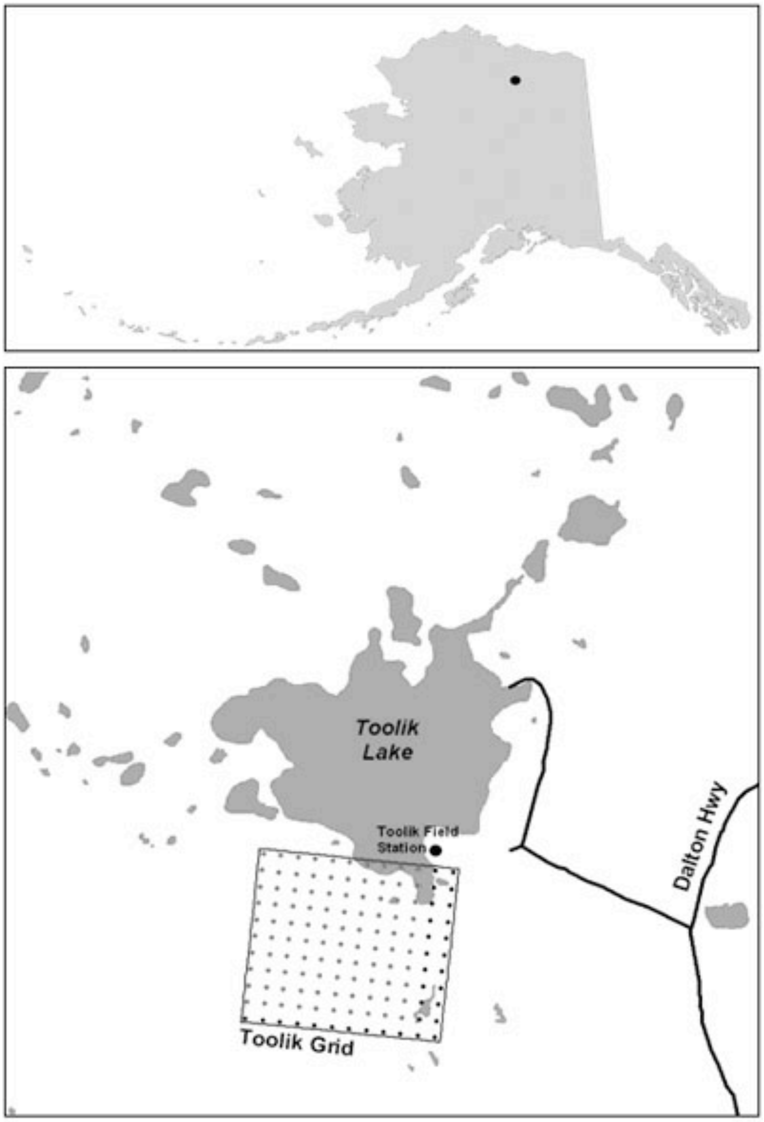

Figure 1: Top: Location of the study area within Alaska. Bottom: Location of the Toolik Grid within the Toolik Lake area. Red grid points are those that are included in the sampled data.

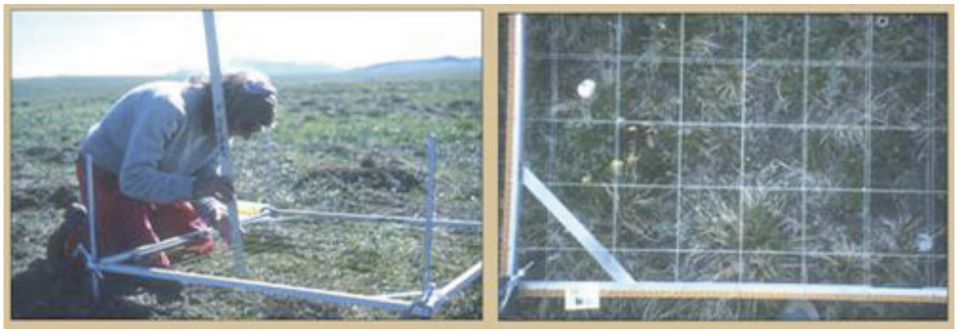

Figure 2: (Left) Point quadrat used in sampling. The vertical legs are positioned in metal guides that are nailed into the tundra. The frame can be repositioned exactly in successive sampling years by leveling the frame, clamping it securely, and aligning it to a set of metal registration points that are nailed into the tundra at 4 grid points (black «X» in the species plots in Figure 3). (Right) Two parallel grids of monofilament line, one above the other, are spaced 2 cm apart. Aligning the intersection points in both grids permits unambiguous identification of points in the plant canopy. We recorded the species at the top and bottom of the plant canopy at each point and the distance from the bottom monofilament line to the top and bottom species.

Results

The example (Figure 3) displays the canopy height, topography of the ground layer, and species recorded at 100 points in a 1 x 1-m plot.

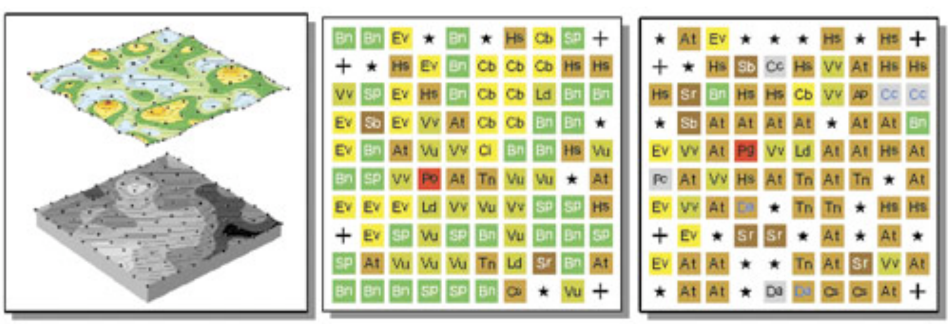

Figure 3: (Left) Maps of the plant canopy and ground surface topography of a 1 x 1-m sample plot. (Middle) Species at 10-cm intervals in the overstory. (Right) Species at 10-cm intervals in the understory. The color of the small squares correspond to plant growth forms (dark green, low shrubs; light green, erect dwarf shrubs; yellow, graminoids; red, forbs; light brown, non-Sphagnoid bryophytes; dark brown, Sphagnoid byophytes; gray, lichens), White boxes with symbols are non-plant occurrences: stars, litter; black «X», registration points for alignment of the grid. The letter codes in each box are first letters of the

Genus and species names of the plant encountered at that point; e.g. Bn = Betula nana.

Three maps of all 85 sampled plots in the Toolik Grid display (1) the topography of the top layer and bottom layer of the plant canopy, (2) the species at the top of the plant canopy, and (3) species at the bottom of the plant canopy. Fig. 4 shows the plots of 9 of the plots in the northwest corner of the grid. A similar set of maps was prepared for the plots in a grid at the nearby site of Imnavait Creek, which is on an older glacial surface.

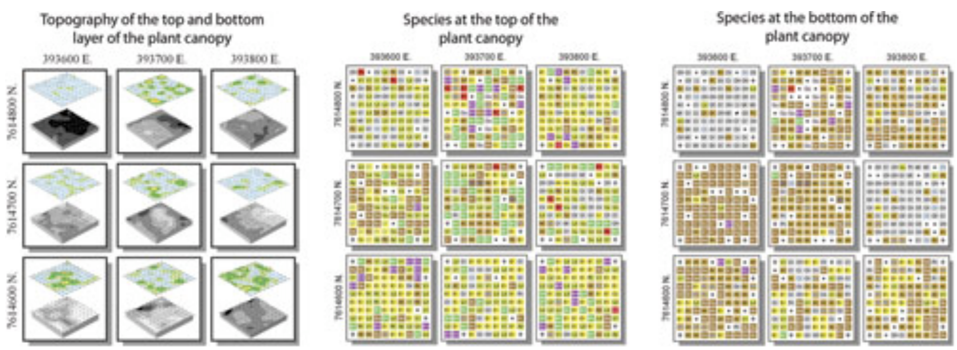

Figure 4: Detail showing structure and species composition in 9 sampled plots in the northwest corner of the Toolik Grid (of 85 total). The UTM coordinates of each plot are also shown.

The Toolik and Imnavait grids have been re-sampled at six-year intervals between 1989 and 2008. Preliminary results indicate that major changes to the structure and composition of the plant communities have occurred, with significant increases in the abundance of the dominant shrub, Betula nana, and decreases in the abundance of Sphagnum mosses (Figure 5). The long term monitoring has also revealed increases in the mean canopy height at both the Toolik and Imnavait grids. This may be due to a more dense canopy, a taller canopy, or a combination of these characteristics. Future analyses of the data set will examine the details of species occurrences with respect to terrain variables in the GIS map database and the dynamics of vegetation changes.

The cause of the apparent tripling of canopy heights at both grids is not known. It could be due to more dense vegetation (for example, more leaves on the deciduous shrubs) or actual changes in height or a combination of both.

Future analyses of the data set will examine the details of species occurrences with respect to terrain variables in the GIS map database and the dynamics of vegetation changes.

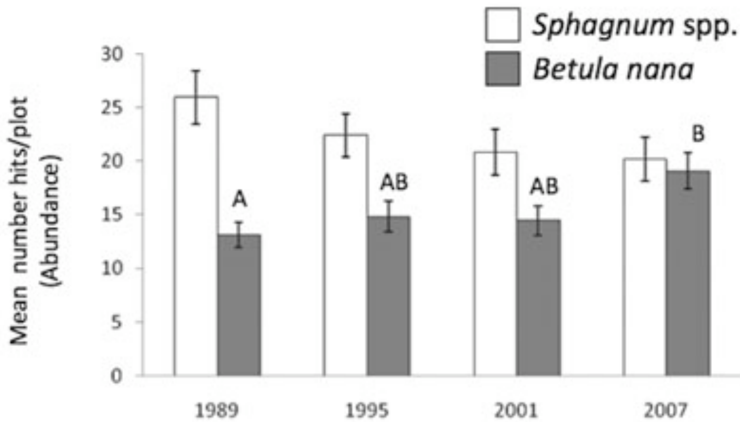

Figure 5: Changes in Betula nana and Sphagnum cover at Imnavait Creek (1989, 1995, 2001, 2007) Changes in the abundances of the deciduous shrub Betula nana and Sphagnum mosses from 1989 to 2007 at the Imnavait Creek Grid, AK. Letters indicate significant differences between years. Error bars are standard errors.

References

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