Photopoint Monitoring in the Adirondack Alpine Zone

Julia Goren (PI) and Seth Jones
Adirondack High Peaks Summit Steward Program
Adirondack Mountain Club
summit@adk.org
PO Box 867, Lake Placid, NY 12946

Photopoint series were compared between mountains with and without a regular steward presence and showed a significant difference in vegetation change over time. While further analysis needed, preliminary results suggest that the Adirondack High Peaks Summit Steward program is making a difference in vegetation recovery in New York’s alpine region.

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Project Summary

• For ten years the Adirondack High Peaks Summit Steward program has utilized photopoint monitoring to document changes in alpine vegetation with a particular focus on areas subject to human trampling. Photopoints are photographs of a landscape area taken repeatedly from the same exact position, showing qualitative changes over a set time.

• In 2009, 40 of the 50 photopoints were re-taken, using a combination of film and digital cameras. Images were analyzed to examine changes in percent photocover of bare rock, exposed soil, and vegetation.

• Photopoint series were compared between mountains with regular steward presence versus mountains without a regular steward presence and showed a significant difference in change in vegetation over time.
Example Photopoint: MARCY 003- LB001-1992
Example Photopoint: MARCY 003- LB001-2009
The high peaks of the Adirondacks, comprising the alpine zone, shown in red.
Background and Justification

• Alpine ecosystems, located on the highest mountain summits, are a unique feature of the Northern Forest region. They are home to the region’s rarest plant species and its greatest recreational opportunities.

• The Adirondack alpine zone comprises a small area (approx. 173 acres) with a large number of rare/threatened/endangered plant species.

• Alpine species are adapted for harsh summit conditions, but fragile to human foot traffic.

• The Adirondack High Peaks Summit Steward Program was created in 1989 to protect the Adirondack alpine ecosystem through backcountry education, conservation, and research.
Background and Justification

• The Summit Steward program is a partnership of the Adirondack Mountain Club, the Adirondack Chapter of the Nature Conservancy, and the New York State Department of Environmental Conservation.

• Since 1999, the Summit Steward program has tracked vegetative change over time through a photographic monitoring system, using photographs from the mid-1960s through the mid-1980s as the baseline.

• Photopoint monitoring represents a long-term data set that illustrates rates of trampling, erosion, and vegetative re-growth. It also provides a tool for assessing the Summit Steward program.
Methods– Photopoint monitoring

- Photopoints were relocated, using a combination of GPS unit, map, directions, and prints of prior photographs.

- Once relocated, the camera tripod was set above the nail using the specified height, angle, and direction.

- The same camera employed by Matt Scott in 1999 was used in 2009 to minimize possible distortion resulting from lens curvature. A digital camera was also used to provide an instant field check of images.
Left: Summit Steward Lynn Metcalf compares the view in front of her with a print of an earlier photopoint to properly line up the image.

Photo: Seth Jones

Below: Photopoint Monitoring form with sketch map, used for relocation purposes.
Methods—Image processing

- All images were digitized, using either a high-resolution digital scanner, developing directly to disk, or downloading from digital camera.

- Best matches from each series were selected by visual estimation.

- Images from each photopoint were opened as layers of a single file, using the GNU Image Manipulation Program (GIMP). Each image was aligned with the baseline photo, using foreground and background features as reference points.

Right: Photopoint ALG 011 in GIMP, showing baseline image at 100%, 1999 image superimposed at 50% transparency.
Methods-- Analysis

• A 120 x 120 pixel grid was superimposed on aligned images.

• In each grid square, percent photocover was estimated in each of three coverage classes: bare rock, exposed soil, and vegetation. The process was repeated for each image in the series.

• Baseline photocover values were subtracted from most recent photocover values and divided by time lapse. Mountains were grouped into two categories (steward presence—Algonquin and Marcy, steward absence—Cascade, Colden, Dix, Gothics, Skylight, Whiteface, Wright).

<table>
<thead>
<tr>
<th>Point</th>
<th>Year</th>
<th>% Photocover ROCK</th>
<th>% Photocover SOIL</th>
<th>% Photocover VEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALG-011-LB007</td>
<td>1992</td>
<td>35.48</td>
<td>44.35</td>
<td>20.16</td>
</tr>
<tr>
<td>ALG-011-LB007</td>
<td>1999</td>
<td>39.81</td>
<td>31.48</td>
<td>28.70</td>
</tr>
<tr>
<td>ALG-011-LB007</td>
<td>2004</td>
<td>49.17</td>
<td>23.33</td>
<td>27.5</td>
</tr>
<tr>
<td>ALG-011-LB007</td>
<td>2008</td>
<td>48.39</td>
<td>11.29</td>
<td>40.32</td>
</tr>
</tbody>
</table>
Results

Vegetation, rock, and soil percent change over time with mean, standard deviation, and $p$-values for stewarded and non-stewarded peaks (1962-2009).

<table>
<thead>
<tr>
<th></th>
<th>Mean Steward</th>
<th>Mean Non-Steward</th>
<th>Standard Deviation Steward</th>
<th>Standard Deviation Non-Steward</th>
<th>$p$-value (t-test, two sample, one tail, equal variances)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation</td>
<td>.00701</td>
<td>.00173</td>
<td>.00942</td>
<td>.00829</td>
<td>.01827</td>
</tr>
<tr>
<td>Rock</td>
<td>-.00076</td>
<td>.00366</td>
<td>.00691</td>
<td>.007</td>
<td>.01416</td>
</tr>
<tr>
<td>Soil</td>
<td>-.00624</td>
<td>-.0054</td>
<td>.008</td>
<td>.00736</td>
<td>.34722</td>
</tr>
</tbody>
</table>

- There was a significant difference in changes in vegetation and bare rock on stewarded versus non-stewarded summits.

- Thus, a significant difference was found in recovery from human trampling in alpine areas on stewarded versus non-stewarded summits.
Results

• The increase in vegetation and decrease in rock over time suggest that alpine areas subject to human trampling are recovering.

• The observed difference in recovery rates suggests that the presence of a summit steward as an educator in these alpine areas may serve as a significant deterrent to further trampling in these areas. As educators, Summit Stewards are in the alpine zone, providing on-site interpretation of the fragile alpine ecosystem.
Above: Summit Stewards pack areas with rock to prevent further soil erosion.
   Photo: Brendan Wiltse

Below: Summit Steward Duncan Lennon educating hikers about alpine vegetation.
   Photo: Bill McManus
Results

- The decrease in the percentage of rock over time on stewarded peaks as compared to the corresponding increase on non-stewarded peaks furthers the hypothesis that summit steward serve as a deterrent to trampling. Bare rock appears after vegetation is trampled, dies, and exposed soil is eroded through wind and water. Summit Stewards counteract this process through education and placement of small stones to delineate the trail and pack eroding areas to prevent soil loss.

Right: Mean % change in rock, summit steward presence versus summit steward absence. Columns represent mean change in percent photocover over time, and error bars represent +/- 1 standard error from the mean.
Results

Soil

Left: Mean % change in soil, summit steward presence versus summit steward absence. Columns represent mean change in percent photocover over time, and error bars represent +/- 1 standard error from the mean.

- The lack of significant results in the category of bare soil was expected. This category reveals the least information about the nature of change occurring on the summits; bare soil can either be lost to erosion, revealing bare rock, or it can be colonized by vegetation, showing up in the vegetation category.
Photopoint: CASCADE 003 -EK003-2009
(Non-steward)
Photopoint: MARCY 002-EK126-1981
(Stewarded)
Photopoint: MARCY 002-EK126-2008 (Stewardred)
Photopoint: DIX 001-HP32-1966 (Non-stewardarded)
Photopoint: DIX 001-HP32-2009 (film camera)
(Non-stewardied)
Photopoint: ALGONQUIN 013- HP58
(Stewarded, showing original Ketchledge revegetation in process)
Photopoint: ALGONQUIN 013- HP58 -1999 (Stewarded)
Implications and applications in the Northern Forest Region

• The presence of stewards helps preserve vegetation on alpine summits in the Adirondacks.
  – Other Northern Forest alpine stewardship programs are found in Vermont, New Hampshire, and Maine

• Photopoint monitoring is a simple technique for monitoring change and evaluating the effectiveness of Northern Forest region stewardship programs.
  – This technique could be easily utilized by other stewardship programs. Assistance is being provided to a New Hampshire stewardship group that is working on starting their own photopoint monitoring.
Future directions:

• Our methods were designed to be employed and easily replicable without access to specialized software or advanced knowledge of statistics.

• Since a simplified technique was used, our results present an avenue for further study. Comparison with more sophisticated analysis would provide a better picture of the nature of alpine change and the precision of this methodology.

• Some images seem to show changes in treeline between the 1960s and 2009. Additional analysis could help determine whether this is evidence of climate change.

• The purpose of the photopoint monitoring project is to provide a visual record of change over time. The Summit Steward Program will continue to use this project to monitor changes in the Adirondack alpine zone. In 2010, three photopoints will be retaken and added to the library of images.
Does this represent a change in treeline?
• If so, is it evidence of climate change?
(Photo: Algonquin, 1962)
Does this represent a change in treeline?
• If so, is it evidence of climate change?
(Photo: Algonquin, 1999)
Does this represent a change in treeline?
• If so, is it evidence of climate change?
(Photo, Algonquin 2009)
Products and Outcomes: Educational Materials and Presentations

• This project added 40 new images and another monitoring cycle to the long-term photopoint monitoring library. These images are available for use by researchers as well as Summit Steward Program partners.

• Presentations on findings were made at three public lecture events (Lake Placid, Keene Valley, and Albany, NY) and to two different college classes.

• Small educational cards for use by the Summit Stewards have been printed showing using the updated images. These cards have proven tremendously effective in backcountry education efforts.
Products and Outcomes: Publications and Other written materials

• Goren, Julia. Twenty Years of the Summit Steward Program. *Adirondac.*

• Goren, Julia. 2009 Summit Steward Mid-season report. Circulated to partners and Northern Forest region alpine stewardship groups.

• Goren, Julia. 2009 Summit Steward End-of-season report. Circulated to partners and Northern Forest region alpine stewardship groups.