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# Ground Cover Changes Resulting from Low-Level Camping Stress on a Remote Site

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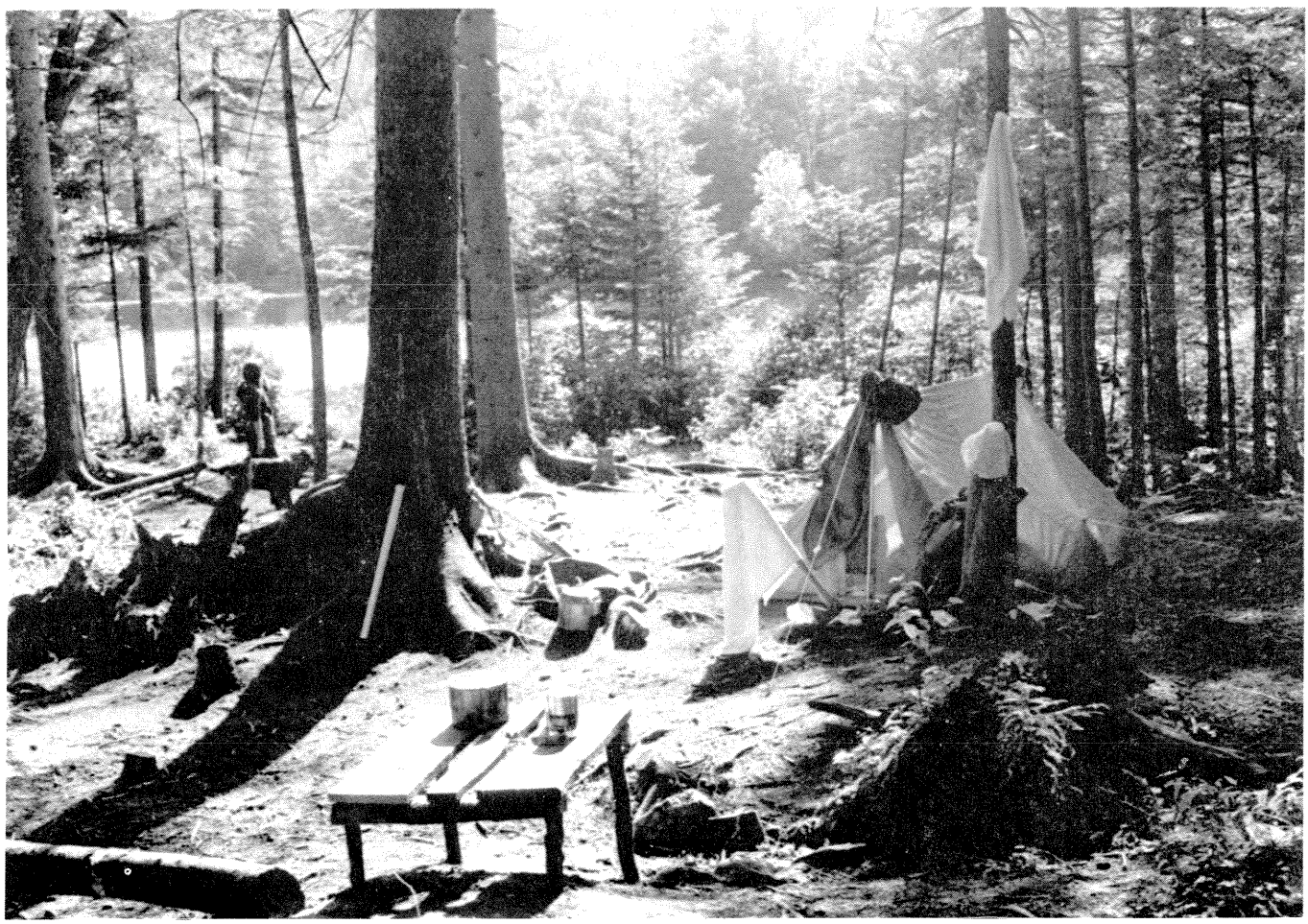

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## Abstract

This study reports the effects of low-level camping stress on vegetation in a remote site. South Big Garden Island in Penobscot Bay, Maine, was studied because (1) it had no prior recreational use; thus, comprehensive base line data could be obtained; and (2) the exact number of campers could be monitored throughout the study period. The continuous line-intercept method based on a single vegetation transect line was developed to monitor vegetation and ground cover changes over a 2-year-period. The low-level use (an average of 50 campers/year) that was recorded did not significantly reduce the total vegetation cover but did have an effect on species composition.

## Acknowledgment

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## Introduction

Many public and private land managers have encouraged the development of designated dispersed campsites (unimproved remote sites at least 200 feet from trails and sources of water), both to satisfy a growing number of users who prefer solitude and to relieve pressure on other intensively used recreation areas (Canon et al. 1979; Leonard et al. 1980). As interest in dispersed recreation continues to increase, it is desirable to evaluate the ecological effects of backcountry camping and hiking before the establishment of use patterns. These use patterns can be difficult or expensive to modify if they are found to have adverse effects on plant and soil communities. To evaluate the effects of such use, however, managers and landowners need "hard" information that either prescribes specific use levels for a given set of ecological conditions, or is able to predict changes in vegetation cover for given use loads. With such information in hand, managers will have the tools to understand the options available in a given set of circumstances and the likely consequences of their management decisions.

To conduct recreation research that ties specific use levels to specific ecological effects, researchers need to study areas that have little prior recreational use so they can gather base line information before camping and hiking take place. It is difficult to locate alpine camping areas in the East that do not have a history of prior use; so, we studied islands in the Northeast that are now in the low-level stages of use with attendant stress from camping activity (Gerber 1980). We expect that the results of these island studies will also be useful to backcountry alpine managers because of the similarity of plant communities and growing conditions (Hill 1919; 1923).

## Study Area

In June of 1980, a low-use camping study was initiated on South Big Garden Island, which is part of the Nature Conservancy's White Island Preserve—a small group of islands approximately 1 mile west of Vinalhaven in Penobscot Bay, Maine. The location and conditions of the study differed from previous studies in two important aspects. First, most studies of camping impact and ground cover changes (LaPage 1967; Monti and Mackintosh 1979; Cole 1981), have initiated measurements without comprehensive base line information on the kind and distribution of plant species before use. On South Big Garden, measurements were taken in an area that was undisturbed by prior recreational use. Second, in previous studies, use levels generally have been estimated, but in our study, precise numbers of campers were introduced to the study site on given dates through the cooperation of the Hurricane Island Outward Bound School.

The site was selected because it has physical boundaries of granite outcrops that effectively limit camping to the relatively small area where measurements were collected. The island is characterized by generally shallow soils that, for the most part, consist of organic material covering these granite ledges. The study plot itself is a 10-m by 16-m flat area underlain by a pocket of glacial till generally suited for camping. Sloping granite ledges running along either side of the study area begin at the sandy beach landing site and taper into each other at the inland end of the study site. The spruce trees on the site are well spaced with a relatively open canopy. Ground cover before use consisted of: moss, duff, lichens, grass, and a mixture of herbaceous and woody plants, including in order of dominance: *Rubus, Aster, Trientalis, Maianthemum, Solidago, Viburnum, Viola, Ribes,* and *Fragaria.* The Outward Bound students camped here because it was the only suitable camping area on this portion of the island.

All camping by the students consisted of overnight stays of 7 to 12 persons per visit. In the summer of 1980, a total of 29 students camped on South Big Garden in the course of three visits. In 1981, 58 students camped on the island during six visits; and in 1982, 12 students camped overnight. The dates that camping occurred, the number of users, and the measurement schedule are shown in Table 1.

**Table 1.—Use and measurement record**

| Date of use | Number of users | Measurement date |
|---|---|---|
| | | 06/10/80 |
| 06/14/80 | 12 | |
| 06/27/80 | 10 | |
| 06/31/80 | 7 | |
| | | 08/25/80 |
| 05/26/81 | 8 | |
| 06/17/81 | 10 | |
| 06/24/81 | 8 | |
| 07/16/81 | 11 | |
| | | 07/28/81 |
| 08/16/81 | 10 | |
| | | 09/04/81 |
| 09/17/81 | 11 | |
| 09/22/81 | 12 | |
| TOTAL: | 99 | 06/04/82 |

## Methods

A vegetation transect line was established and permanently located by nailing numbered tags to the bases of two reference trees. This transect extended beyond the length of the camping area to 26.2 m. The main transect forms the basis for the continuous line-intercept system developed by Leonard and McBride (1981). This system has three parts: (1) continuous sampling along the main transect; (2) continuous sampling along perpendicular transects; and (3) recording of individual plants.

Sampling along the main transect was accomplished by recording the distance along the transect to the nearest .05 m that each species or cover category intercepted the line. Each cover type was listed in order of dominance or greatest percentage of cover. Broad categories such as mossmat, duff, exposed organic soil, and specific herbs were used when describing ground cover.

Perpendicular transects were placed every half meter along the main transect. The length of the perpendiculars varied with the width of the study plot, but did not extend beyond 4 m on either side of the main transect. Ground cover was measured the same way along these perpendiculars as on the main transect. Perpendicular transects off the main transect meant that only one permanent transect needed to be established across the study plot.

Individual plants such as woody seedlings or single occurrences of forb species within 4 m on either side of the main transect were recorded. The positions of such plants were measured with a tape running perpendicular to the corresponding point on the main transect line.

## Analysis of Data

The data collected with this line-intercept system were tabulated for the center line, which was 26.2 m in length. Since camping impact did not extend beyond 16 m, tabulations included data only up to that point. From the line-intercept readings, vegetation categories were listed in order of dominance. For example, if a given sample point lists moss, duff, and grass, moss is the most dominant cover type, duff is second, and grass is third in dominance. Since we are primarily interested in the relative changes in percentage of cover of the various vegetation categories and of duff, we assigned percentages to each order of dominance in the following manner for analysis:

| Order of dominance | | |
|---|---|---|
| *1* | *2* | *3* |
| *Percent* | | |
| 100 | — | — |
| 60 | 40 | — |
| 60 | 35 | 05 |

While given sample points measured in the field may have differed by a few percentage points from the dominance categories shown above, we believe that the average of all sample points along the center line correspond closely to this idealized scheme used for analysis. For analysis, moss and lichens were sampled as mosses, and all herbs were included in one category.

Percentage of interception was calculated by multiplying the dominance percentages by a measured interval along the center line and dividing by the total length of the transect. For example, if moss occurs in the first order of dominance along 10 m of the center line, its percentage of interception was calculated as 10 m × 0.6 ÷ 16 m, or 37.5. Similarly, if grass occurs in the third order of dominance along 8 m of the center line, we calculated the percentage of interception of grass on the study site as 8 m × 0.05 ÷ 16 m, or 3. The calculations used in the second order of dominance depended on whether the field readings recorded two or three vegetation categories.

## Results and Discussion

The results of converting the order of dominance field readings to percentage of interception of the center line for the South Big Garden study site are presented in Table 2.

**Table 2.—Percentage of interception on center line shows ground cover changes resulting from camping activities on a remote site**

| Ground cover | Measurement date | | | | |
|---|---|---|---|---|---|
| | 06/10/80 | 08/25/80 | 07/28/81 | 09/04/81 | 06/04/82 |
| Moss | 41.3 | 29.4 | 16.1 | 12.9 | 11.6 |
| Duff | 32.3 | 42.9 | 49.1 | 42.6 | 41.6 |
| Grass | 11.9 | 16.1 | 20.3 | 31.0 | 20.6 |
| Herbs | 14.2 | 8.4 | 13.8 | 12.3 | 26.1 |
| Cumulative number of users to date | 0 | 29 | 66 | 76 | 99 |

The largest changes in ground cover area over the course of the study occurred in the moss category. Before camping, mosses comprised between one-third and one-half of the area (41.3 percent), but this percentage steadily decreased over the 2-year period in each of the five measurements. The consistent decline in moss cover over the period strongly indicates the susceptibility of mosses and lichens to camping stress.

It might be expected that the decrease in moss cover could have resulted in a corresponding increase in the duff category. Although the percent of duff cover did rise from 32.3 percent to 41.6 percent along the center line from the beginning to the end of the study, it seems that the elimination of mosses results only in an increase of unvegetated duff areas. Both herbs and grasses occupied some of the area formerly covered by mosses. The largest increase in the duff cover was recorded during the middle of the second season of measurement on July 28, 1981, when the cumulative number of users was 66. Thereafter, the total duff cover decreased while both herb and grass covers increased.

At the beginning of the study, grass cover formed a rather insignificant 11.9 percent of the total cover on the plot. It increased its percentage of interception on the center line through the next three measurements, and it reached 31.0, or approximately one-third of the cover, by September 4, 1981.

We hypothesize that the grasses, though on a relatively marginal site for luxuriant growth, are able to increase at the expense of mosses during camping because of the ability to sprout from underground stems or rhizomes. That is, where grasses are found growing (1) in an undisturbed condition, (2) in association with a moss-lichen mat, and (3) in a relatively open spruce woods, they are not very vigorous and do not cover a significant percent of the area. However, after some stress such as camping, which significantly reduces the moss mat, the grasses not only persist, but also increase occupation of the site through the extension of underground stems. At the last measurement date (June 4, 1982), the grasses seemed to be slightly less prevalent at the South Big Garden camping site. We do not know whether this finding is due to their retreating to a presence close to the base line condition or due to the fact that they have not yet fully developed at this point in the season. The general trend with grasses on this site indicates that they can react favorably to trampling as a result of camping stress and that they survive better than mosses when subjected to the same stress.

The herbs reacted somewhat differently from both the mosses and grasses. After part of a season's camping stress, they initially decreased in area coverage from 14.2 percent before use to 8.4 percent on August 25, 1980. However, after the August 1980 measurement, they began to increase again until they comprised 26.1 percent of the area coverage on the last measurement date.

We hypothesize that the scarification of the soil surface under the spruce canopy provides a more favorable seedbed for annuals like *Maianthemum, Trientalis, Solidago,* and *Aster* and allows these species to increase their presence on a site subject to low-level camping stress. We would expect the annual herbs on the South Big Garden site to continue to occupy a significant portion of the area formerly covered by mosses until the mosses recover some of their original area. If moss cover increases in the absence of further disturbance, probably the herb cover would begin to decrease since a moss-lichen mat would seem to be a less favorable seedbed for annually flowering herbs than duff disturbed by low-level camping stress.

## Conclusion

With a cumulative number of users approximating 100 over a 2-year period on a remote camping site, substantial changes in relative area coverage of four ground cover conditions did not occur. The greatest changes on the site probably occurred on the trail leading up from the landing site to the camping site. Mosses and lichens are examples of species of plants that are susceptible to damage and do not readily recover. However, both grasses and herbs are able to occupy most of the area previously occupied by mosses. Grasses appear to be able to increase by sprouting from underground stems, while herbs appear to benefit from the scarified seedbed that results from trampling during camping stress.

Although mosses did decrease over the course of the study and herbs initially declined before rebounding, we conclude that camping levels of 100 people over two seasons, when confined to groups averaging 10 persons per visit, did not have a deleterious effect on the vegetation of South Big Garden Island in Penobscot Bay. We estimate that the relative conditions we initially encountered will return to their precamping levels within a single growing season.

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**Keywords:** camping; low impact; vegetation impacts; trampling

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