Promoting Sustainable Behavior Through Environmental Literacy: Park Trail and Interpretive Systems in a High Tech World

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Client:
Valles Caldera National Preserve
1. Overview

Introduction
An interdisciplinary team of University of Michigan School of Natural Resources and Environment, School of Information, and College of Engineering students address the challenge of promoting environmental stewardship through enhancing the connections between the public and recreational properties such as National Parks. The perspectives of Landscape Architecture, Environmental Education, Behavioral Psychology, Human-Computer Interaction and Computer Science and Engineering are applied to Valles Caldera National Preserve as a model park. The project aims to develop a model trail and interpretive system for National Parks to enhance visitor experience, convey the benefits of sustainable development and increase the public’s awareness of environmental concerns in the context of individual impact.

Through a series of property visits and remote research the project team determines existing resources and conditions visitors experience. Theories of behavioral change and community engagement along with the use of higher technology applied to this experience leads to innovative opportunities for increasing visitor’s sense of ownership of recreation properties and stewardship behaviors. The team provides concepts for innovative interpretative signage, sustainable trail systems, and engagement in environmental stewardship.

Key Impacts/outcomes
The project aims to devise a process of trail suitability analysis that promotes the visitor experience while minimizing impact to ecological systems; provide location and navigation services to reduce human disruption of sensitive areas while maximizing viewing opportunities; increase the visibility of stewardship behaviors and their impact on the park; create immersive experiences that connect visitors to the natural processes and environmental changes the park is experiencing.

Key Partners/Stakeholders
United States National Park System
Valles Caldera Administration, including Jorge Silva-Banuelos, Preserve Superintendent
Park Visitors
Local Special Interest Groups (specific to properties, i.e. Local Valles Caldera Pueblos)
2. Project Scope

This project seeks to design a model of sustainable trail and interpretive system for NPS, exploring innovative ways to incorporate high technology, like mobile app, augmented reality and touch user interface, to enhance public awareness of sustainability through engaging environmental education, working with Valles Caldera National Preserve to create a stakeholder informed model that could be implemented across other recreational properties.

- Design low maintenance trails that highlight park features while protecting vulnerable habitats and culturally sensitive areas providing opportunity for visitors to experience and make meaningful connections with the park features without disturbing these habitats.

- Develop an application on mobile devices designed to support innovative signage systems in the park, providing connection to additional educational and locational information. By increasing familiarity with natural resources and relative environmental concerns, we would foster a sense of stewardship and promote sustainable behaviors among visitors. Citizen science data collections provide visitors opportunities to contribute to resource management programs. Moreover, site photos and reviews from visitors can be accessed by off site users. Such easily accessed information will support exploration of parks remotely as well as attracting more potential visitors.

  App Functions:
  - Location and navigation
  - Site pinpoint with photos and reviews
  - Information on points of interest
  - Augmented reality (label natural features/mountain names)
  - Common native species identification (pictures/descriptions of a native species would show up at its habitats)
  - Invasive plants pulling contest (pictures/descriptions of invasive plants with pulling techniques; check-in with ranger for supplies and disposal of pulled invasives)

- Design interactive stations augmented with narrative information, visualizations and individualized experiences to increase stewardship of parks by encouraging citizen science participation and demonstrating stewardship activities for individuals and families.

3. Expected Outcomes and Implications

Suitability analysis for sustainable trails will promote trails that will provide legible circulation, viewing options for visitors and protect cultural sensitive areas. In addition to supporting human activities, these trail systems will be designed/constructed with minimum disruption to the ecosystem and low future maintenance.
Location and navigation app functions will decrease off trail excursions by assisting visitors to locate appropriate routes between destinations and points of interest along the way.

Interactive opportunities to identify native or naturalized species and contribute to combating invasive plants help visitors to apply new skills and environmental stewardship activities.

Citizen Science collections connect individual efforts to broader initiatives, showing visitors the results of their voluntary involvement.

Augmented reality stations provide educational information in multimedia formats to address different learning styles and reinforce environmental stewardship with illustrations people can easily relate to their own familiarity.

4. Progress and Achievements Accomplished to Date

Properties Visited:
- Antelope Canyon Navajo Tribal Park
- Bandelier National Monument
- Cathedral Canyon Navajo Tribal Park
- Denali National Park
- Glen Canyon National Recreation Area
- Isle Royale National Park
- Kenai Fjords National Park
- Muir Woods National Monument
- Valles Caldera National Preserve*
- Wrangell – St. Elias National Park
- Yosemite National Park

* indicates project model

Research and Analysis of Model Park
Onsite research consisted of a week of hiking existing logging roads and trails, exploration of trail connectivity possibilities, guided tours of targeted prime visitor areas, identification of interpretive opportunities, historical context, policy and governance implications, and immersion in the Caldera experience. Team representatives continued remote research into trail suitability analysis methods, sustainable trail construction techniques and materials, storm shelters, and site history.
Team representatives consulted staff for insight into unique and identifying features of the preserve. Information on highly sensitive areas as well as areas of high danger due to previous fires was also collected. At first glance the Caldera appears to be a pristine remnant of western American wilderness. However, over 2,000 miles of logging road, gas lines, and centuries of human use there are a number of areas targeted for restoration. Recent major wildfires that have consumed forest along the caldera’s fracture rim pose great opportunity to highlight a new approach to fire management and showcase progression of forest recovery.

The preserve has noted the presence of some invasive plants. At this time, the invasive populations are not overwhelming. Interventions implemented now will have greater success rates and noticeable results visitors would be able to relate to. Additionally, the lifecycle and migration of some larger mammals on the preserve as well as a variety of bird species make animal tracking something even novice visitors can participate in.

Onsite research led team representatives the following conclusions:

- Preserve Locator Application would be enhanced with a wayfinding function
- Ability to upload and share photos of points of interest would serve to connect past and future visitors
- Implementation of citizen science projects incorporated into the application would allow for visitors to track progress and see the results of contributions they have made (Aspen Carvings Locations, Invasive Plant Removal, Species Diversity Tracking, Migration Tracking, etc)
- Direct Links to further information would help people learn more and connect to their local sources about topics introduced in interpretive signage
- Augmented Realities incorporated into interpretive signage stations would set the scene for visitors to experience the caldera’s formation and history as well as what could be given current trajectories or overall societal changes that promote environmental stewardship

**Trail Suitability Analysis for Model Park**

Based on literature review on recreational trail design, a “Least-Cost” approach will be used on the trail suitability analysis. The combined effect of multiple factors will be analyzed in ArcGIS, and three alternatives of a least cost trail route will be generated based on different cost estimate criteria. Main factors to be considered include:

- Connectivity to pre-existing trails and points of interest;
- Construction difficulty (Slope, Soil, Land Cover);
- Conservation (Habitats, Artifact Sites, Streams);
- Maintenance (Slope, Soil, Land Cover, Runoff Pattern)

Most of the data were given by Valles Caldera National Preserve Administration Office. Topography and soil data were collected from USGS and GSDA GIS data website.
Expansion to Other Properties

Site visits indicate a need for non-internet based navigation programs that provide information about nearby points of interest. While some properties have cellular network coverage, more remote properties and areas remain uncovered. Periodic hotspots could be implemented at interpretive stations to allow for location updates throughout parks. Routing from current locations to selected destinations would provide users with expectations for proper use of trails, discouraging user-made trail systems and disruption of vulnerable habitats.

Features of the app system allowing for upload of user photos at pined locations increase interaction with the park. The opportunity to view other’s uploads and keep track of citizen science projects increase the visibility of parks to at home viewers. Additionally, the citizen science projects help to reinforce human impact (both negative and positive) on the parks.

Ongoing Work on Project

Project team continues to work on development of innovative signage, interactive stations, mobile applications and sustainable trails. Concepts for these elements are described above. Ongoing work includes carrying out suitability analysis for trail placement and trail design. This will be completed and applied to Valles Caldera National Preserve day use areas. Work toward development of a model mobile application also customized for Valles Caldera National Preserve continues to be completed. Use of innovations in augmented reality and interactive activities designed to better foster human-nature relationships are also being incorporated into interpretive signage for Valles Caldera National Preserve day use areas.
5. Appendix I

Welcome Page & Feature Selection Page Mockup
6. Supporting Publications


