



Bar Harbor Project Center

Trail View: Acadia National Park

An Interactive Qualifying Project
Submitted to the Faculty of
Worcester Polytechnic Institute
in partial fulfillment of the requirements for the
Degree of Bachelor of Science

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Abstract

Environmental awareness has become a worldwide subject. Recent technological advancements have allowed for viewing various aspects of our world from different perspectives. The objective of the Trail View project was to create an interactive website that documents in-depth visual, auditory, and physical information pertaining to Acadia National Park. The website presents a map feature similar to that of Google Street View, containing panoramas of Acadia's hiking trails. The attributes benefit outdoor enthusiasts and promote education, public awareness, and respect for the environment.

Executive Summary

As advancements in technology are made, information becomes more readily available to the public. Although the experience is limited, people can encounter various aspects of the world in a relatively short amount of time. Despite this, consumers may become immersed in other artificial environments that technology can create. Our goal is to link people back to the national parks.

Trail View is an interactive website that conservationists and outdoor enthusiasts can use to enhance their hiking experience in Acadia National Park. The objective of Trail View is to document hiking trails using modern technology. This website's archives of atmospheric, auditory, and visual information set it apart from similar projects. It will be capable of aiding outdoor recreationalists if they wish to obtain more information about the conditions of an Acadia National Park trail.

The user will be able to explore a trail from the comfort of the user's browser, as the program works similar to that of Google Maps' *Street View*. With the proposed Trail View map, hikers would be able to see the trail they are going to travel before deciding if they want to trek it. In this way, they can note potential preparations for their hike, such as conditioning themselves physically and mentally, or by packing the appropriate gear. Being informed in this manner provides for a more involved and a more interactive experience with the trails.

In order to complete the project, the team collected data while hiking a trail. Upon arrival, the team took its first panoramic photo so as to include a picture of the head of the trail. At this point, wind speed and temperature data were collected and recorded. This process was to be

repeated each time the trail curved. Intermittently, the group took audio recordings and still photos, logging their location.

Originally, the team intended on using only the map feature as the final product of this project. Due to bandwidth constraints and budgeting, the full website could not be hosted on viewyourtrail.com. Trail View was built locally and contained information in addition to the map feature. Designed for user-friendliness and accessibility, Trail View features interactive menus which contain pop-up links to the still photos of flora and fauna, audio clips, and atmospheric data such as temperature and wind speed. The final product was a compilation of all data samples on the Trail View website.

An Application Programming Interface (API) is a software program that acts as an interface so as to allow two software components to communicate. The Google Street View API, was one of the major building blocks of the Trail View software. This API allowed for the panoramic imaging technology available in Google Street View to be harnessed for other purposes; in this case, to document trail images for the map function. The Google API accepts panoramic images and puts them together to simulate a three-dimensional (3D) image, able to be browsed by a user.

In order to create the map function and simulate a trail using the Google API, one had to specify the order of the panoramic photos, and then upload them to the website. To customize Trail View, the group made edits to the Google API by utilizing Javascript. Changing font sizes and inserting custom overlays are examples of some of the edits made to the API.

The ultimate goal of this project was to create a proof of concept for expansion of Trail View. By the end of the project, the team had completed the photographic documentation of the Great Head Trail and had done a portion of both the Jordan Pond Path and the Pemetic Northeast

Face Trail. The portions of the Jordon Pond Path and the Pemetic Northeast Face Trail that were completed worked as practice of the methodology.

Trail View is a website that documents Acadia National Park's hiking trails using modern technology. The website features still photos, audio clips, wind speed and temperature data, and a map feature of the trails. The equipment the group used included an iPhone, an anemometer, a Tascam audio recorder, and a Nikon D70 camera. The collected data was then compiled on the website, viewyourtrail.com. To further this project, future groups should seek funding or collaboration. However, the team feels that as a proof of concept, the project was very successful.

1.0 Introduction

The purpose of Trail View is to document hiking trails using 21st century technology. Trail View is an interactive website that conservationists and outdoor recreationalists can use to enhance their hiking experience in Acadia National Park. This website is an archive of relevant hiking data including atmospheric, auditory, and visual information. It will be capable of aiding outdoor recreationalists if they wish to obtain more information about the conditions of an Acadia National Park trail. Potentially, this technology will indirectly keep track of environmental changes, migratory patterns of some wildlife, and the presence of flora and fauna.

The user will be able to explore a trail from the comfort of his or her browser, as the program works similar to that of Google Maps' *Street View*. Street View allows a user to virtually tour a roadway by toggling the point of view on panoramas pieced together. With the proposed Trail View map, hikers would be able to see the trail they are going to travel before trekking it. In this way, they can know how to prepare for their hike, whether by conditioning themselves physically and mentally, or by packing the appropriate gear. Being informed in this manner provides for a more involved and a more interactive experience with the trails.

In addition to the practical purposes, Trail View is important for documentation. For example, in 1947, an immense fire devastated a significant area of Mount Desert Island, destroying the majority of Acadia National Park. Without proper documentation, the topography of the trails prior to the fire would be lost. An example in which there was proper documentation is "Tilting Rock,"¹ a rock formation near Seal Harbor on the southeast side of Day Mountain.

¹ Pathmakers

The Tilting Rock was toppled by vandals in 1922 and later reset by the Seal Harbor Village Improvement Society.

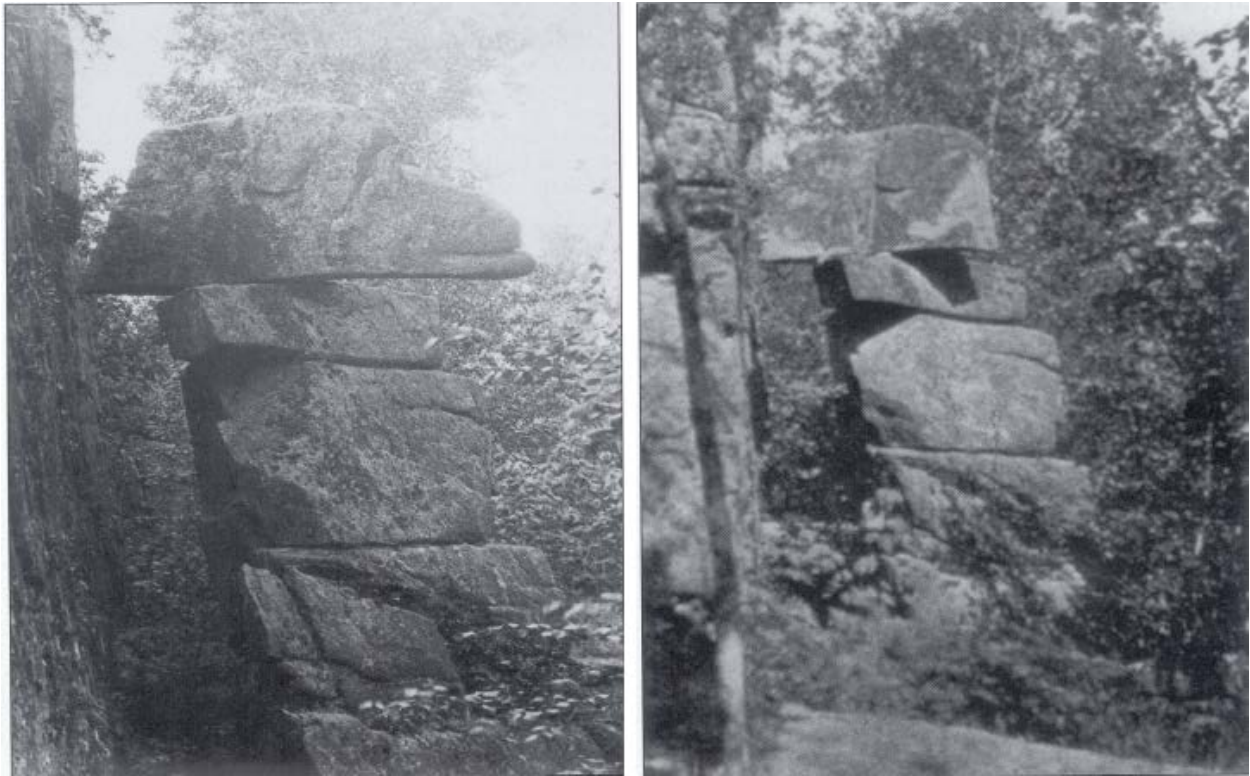


Figure 1: Tilted Rock, circa 1900 (left) and 1928 (right).

Trail View is a website which uses a modern method of documenting Acadia National Park's hiking trails. The website provides visual, atmospheric, and auditory records of the trails for practical and archival purposes. It utilizes a series of panoramic images to present this information in an interactive form. Trail View will be useful for outdoor recreationalists and conservationists.

2.0 Background

2.1 Mount Desert Island History

Mount Desert Island is the largest island off the coast of Maine. Located in Hancock County, the island consists of four towns; Mount Desert, Southwest Harbor, Tremont, and Bar Harbor; each with multiple villages within the town. The lakes, mountaintops, and overall shape of the island were formed by a continental glacier about 25,000 years ago. The Wabanaki people who were native to the island referred to their land as ‘Pemetic’, meaning sloping land. On September 5, 1604, French explorer Samuel de Champlain landed on the island. He dubbed it ‘Isles des Monts Désert,’ French for island of the bare mountains.

Bar Harbor is a busy tourist town on Mount Desert Island in the summer. The Wabanaki people called Bar Harbor ‘Manesayd’ik’, or clam-gathering place. It was settled in 1763 and was incorporated on February 23, 1796 as Eden. Because of its proximity to Acadia National Park, Bar Harbor attracts summer tourists. With several hotels, shops, inns, taverns, and restaurants, it is usually the place visitors come to on Mount Desert Island.



Figure 2: Map of Mount Desert Island

George B. Dorr (1855-1944) is known as the father of Acadia National Park. He was a wealthy citizen who lived in Bar Harbor and later felt that the land needed to be preserved. On September 12, 1901, he became one of the founders of the Hancock County Trustees of Public Reservations. This committee was incorporated for the purpose of “acquiring, owning, and holding lands and other property in Hancock County for free public use.”²

² Acadia National Park, Hancock County Trustees of Public Reservations

On July 8, 1916, the park was established under its first name, Sieur de Monts National Monument, with Dorr as the monument's first superintendent. The name was changed on February 26, 1919 to Lafayette National Park. It retained that name for almost a decade until January 19, 1929, when the park was given its current name of Acadia National Park. From 1915 to 1933 John D. Rockefeller, Jr. donated over 11,000 acres of land to the park and had carriage trails built throughout it.

The current 47,000 acres of Acadia National Park consist of several types of terrain. This includes woodlands, lakes, ocean shoreline, and mountains. Cadillac Mountain, named after the French explorer Antoine Laumet de La Mothe, sieur de Cadillac, is the tallest mountain on the U.S. East Coast and the first place in the United States to see the sunrise³. The park is also home to Somes Sound, the only fjord on the East Coast. A fjord consists of a long, narrow bay surrounded by steep cliffs formed by glacial erosion. Mount Desert Island has an eclectic assortment of topography and a distinguished history, which makes it a unique and intriguing area.

2.2 Trail History

Many of the trails in Acadia National Park were once used for travel by the native peoples and European settlers, until modern roads became the island's central routes for transportation. Before these modern roads were built, the trails were not only used for everyday transportation, but also for recreational purposes, such as enjoying the landscape. These mid-1800s recreationalists were settlers who owned summer cottages in Acadia.

³ TripAdvisor, Acadia National Park: Cadillac Mountain

In 1891, the Road and Paths Committee of the Bar Harbor Village Improvement Association (VIA) was initiated and began drafting plans for new trails⁴. People would donate the funds required to build a new trail, and in return they could name the trail in honor of anyone they wanted. On many occasions, there were plaques placed along the trails in memory of the honoree. This system proved to be a catalyst in the creation of new hiking paths. Waldron Bates was the chairman of the Road and Paths Committee of the Bar Harbor VIA from 1900 until 1909. His pioneering work on the park's trail



Figure 3: First Path Map of Eastern Part of Mount Desert Island (1896)

construction included incorporating stone stairways and iron-rung ladders to traverse steep areas. He also wrote the first trail handbook for the actual constructors of the trails and was the lead author of the first island hiking path map. At the head of the Cadillac Cliffs Trails and the Gorham Mountain Trail is a plaque, honoring him as the 'Pathmaker'. As a result of the Road and Path Committee's work, there were more than 200 miles of trails on Mount Desert Island by 1915.

⁴ A Guide's Guide To Acadia National Park

After the Great Depression, the Civilian Conservation Corps (CCC) was introduced to Acadia National Park. The CCC was a public relief program that operated from 1933 to 1942 as a result of Franklin D. Roosevelt's New Deal. The New Deal made manual labor jobs related to conservation of natural resources available to unemployed men of a certain age. The CCC set up two sites of operation on the island. Their work on the trails was extensive, demonstrated by the addition of new trails and the renovation of older trails.

2.3 Surveying History

Mount Desert Island was first documented by a series of visitors, referred to as “rusticators”⁵. These rusticators consisted of artists, surveyors, and tourists. One famous surveyor was Charles Thomas Jackson, who mapped the mountains of Maine from 1836 to 1838⁶. Figure 4 shows a progression of trail maps on Mount Desert Island from 1830 to 1890. Figure 5 shows a map of contour elevations on Mount Desert Island.

⁵ Brown, et al, Pathmakers.

⁶ Pathmakers

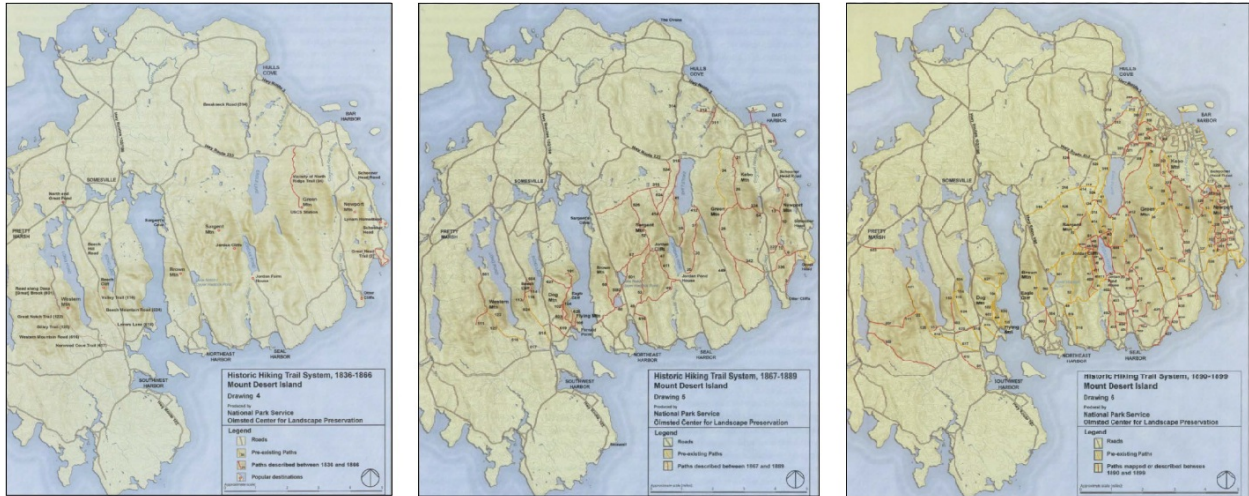


Figure 4: Maps of Mount Desert Island Trails, 1830 (left), 1870 (center), 1890 (right).

The first method of geodetic survey was through triangulation, a method of measurement that calculates an unknown distance using the geometry of a triangle. However, this method was proven to be flawed. In 1718, Jean Picard and the Cassini family finished their research using triangulation to determine the Earth's shape. They concluded that the Earth is a prolate ellipsoid, which conflicted with Newton's 1687 theory that the Earth was oblate. In 1733, the length of the meridian was measured across both France and the Lapland. The expedition found that one degree of the meridian is shorter at the equator than in France, thus proving that Newton was correct that the Earth is oblate⁷.



Figure 5: Mount Desert Island Trails with Elevation

⁷ NOAA, 2006

A theodolite is an instrument used for measuring angles in horizontal and vertical planes. In 1790, the French invented the repeating theodolite⁸. Because the repeating theodolite had many moveable parts and mechanical motions, there were many sources of error. Modern theodolites are more efficient and precise. Today, theodolites are primarily used for surveying, but have recently been modified for metrology and rocket launch technology.



Figure 7: 1820 Repeating Theodolite⁶



Figure 6: Modern Theodolite⁷

In 1937 the first electronic digital computing device was constructed: the Atanasoff-Berry Computer. This creation introduced a new era for surveying. By 1953 the first electronic distance measuring instrument, the Model 1 Geodimeter, was invented. Its successor, the Model 2 Geodimeter, was created in 1956. Surveyors worked to fashion a lightweight model that worked with different mediums of measurement reading technology, such as lasers and microwaves⁹. By 1993 the Global Positioning System (GPS) was invented. The GPS uses a network of satellites and a receiver to determine latitude, longitude, and altitude¹⁰.

⁸ NOAA, 2006

⁹ NOAA

¹⁰ National Park Service, Global Positioning Systems

2.4 Information Distribution

In order to promote business, railroad and steamship companies printed advertisements of Mount Desert Island in the late 1860s and the 1870s. As the number of visitors began to grow, writers published travel guides that portrayed the natural scenery, the first of which was written by Clara Barnes Martin in 1867¹¹. Some of the trails that were described in the guides were more developed than others, and the trails that saw a lot of visitors began to develop on their own. These travel guides provided the first source for visitors to find information about Mount Desert Island.

Since their incorporation in 1890, the Bar Harbor VIA have been publishing annual reports, documenting all the work they did in Bar Harbor, including the construction of new

trails. As the park grew, the new travel guides began to incorporate information about the various resources available to the visitors. In the early 1900s, travel guides and brochures were the main source of information about Acadia National Park.

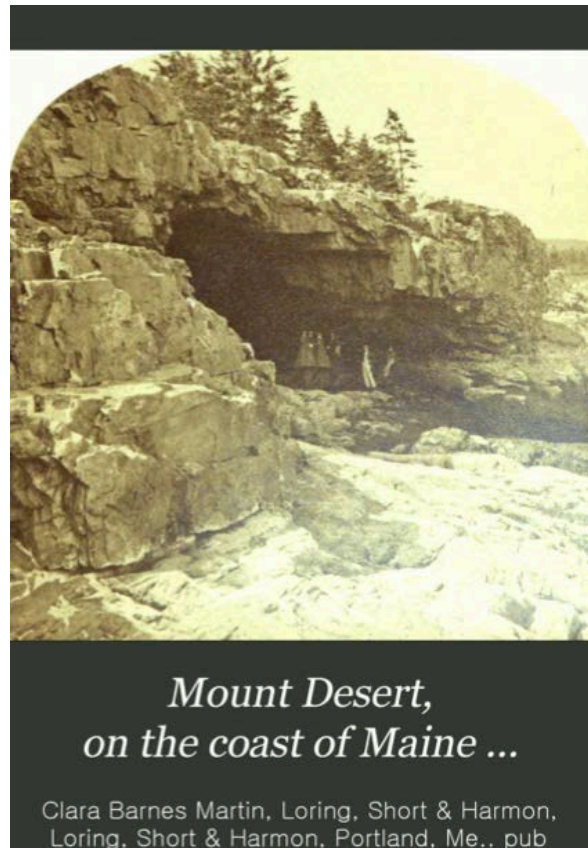


Figure 8: *The First Mount Desert Island Travel Guide*

¹¹ Pathmakers

Today, Acadia National Park uses media such as the National Park Service website (<http://www.nps.gov/acad/index.htm>) to provide information about the park. The variety of topics covered on the website is vast, with information such as directions to Acadia National Park, GPS coordinates of various locations, current park alerts, maps, the park history, the animals found there, park news, and more. Also available on the website are the current brochures that the park uses. These brochures can be downloaded directly to one's computer. In addition to these brochures is the *Guide's Guide to Acadia National Park*. Besides the back-end personnel this guide is intended for, the public has access to this surplus of information concerning Acadia National Park.

2.5 Similar Projects

2.5.1 Acadia National Park

Acadia National Park uses online resources to distribute information about the park. On its website, one can access visual data under the 'Photos and Multimedia' section, which constitutes a photo gallery, webcam, virtual tour, and multimedia presentations. The Internet is one of the Park's primary tools to provide as much information to visitors as possible. One can experience aspects of the park from the comfort of one's home.

The webcam component of the Photos & Multimedia section links to CAMNET. The page on CAMNET gives the user "Realtime Air Pollution & Visibility Monitoring"¹² and updates the web page every fifteen minutes with a picture of Frenchman Bay accompanied by various atmospheric data. This includes temperature, humidity, wind speed, wind direction, and

¹² CAMNET

precipitation. In addition to these meteorological conditions, there is data on air pollution. This is comprised of levels of ozone and fine particles in the air. With this data, one can determine if the level of visibility in the photo is attributed to pollution or natural causes. For example, if the visibility is low, but the fine particles and the ozone levels are high, then the level of visibility is attributed to pollution.

One example of a virtual tour and of visual and auditory data on the Acadia National Park website is eCruise. The Acadia National Park eCruise is a virtual journey of the waters around Mount Desert Island, accompanied by: informative text; still photos and panoramic images; videos of park rangers presenting information and history; time lapsed videos of tides; audio samples of the ocean; and both audio and video samples of wildlife.

In the Photos and Multimedia section, there is an extensive photo gallery. There are photos of earthquake effects, the founders of Acadia National Park, the changing of the seasons, Baker Island, and more. In addition to these galleries, there is a section titled PanoramAcadia, which contains panoramic images of Mount Desert Island. The images are along various coastlines of Mount Desert Island. One is on top of Dorr Mountain, which is the third tallest mountain on the island.

The Multimedia Presentations section contains audio and video presentations that share various aspects of the park. There is a collection of one-minute audio and video clips of nature called 'The Acadia National Park Minute Out In It'. These clips include video and audio samples of wildlife. The 'Ranger Minutes' are short audiocasts and videocasts in which park rangers offer information about the park's history and resources. In addition to these presentations is a section titled 'More Movies'. This is a group of films that demonstrate the events and programs that take place in Acadia National Park.

2.5.2 Nature Valley Trail View

Nature Valley Trail View (<http://www.naturevalleytrailview.com>) allows users to view several national park trails in Yellowstone National Park, the Grand Canyon, and the Great Smokey Mountains. One can travel along the trails just as one can travel along Google Maps Street View. In addition to the trails, Nature Valley highlights several 'Points of Interest,' the length of the trail, the difficulty of the trail, and the elevation along the trail. The Yellowstone National Park features twenty-seven trails, the Grand Canyon features eleven trails, and the Great Smokey Mountains features eighteen trails. The Nature Valley Trail View website also has a biography section on the people who worked to create the project, along with other sections on how it was made.

2.5.3 Google Earth Outreach

Google Earth Outreach is an organization that seeks to aid nonprofit and public benefit organizations. They do this through providing education, resources, and grants so that nonprofit and public benefit organizations can utilize Google Earth and Maps for their purposes. There are extensive educational opportunities available to the organizations by way of video tutorials, conferences, and workshops, all of which can be found on the Google Earth Outreach website (<http://www.google.com/earth/outreach/index.html>).

There are two different kinds of grants that organizations can apply for. One is a software grant, in which Google Earth Outreach provides some of their mapping technologies. This gives the organizations advanced products to work with, such as Google Earth Pro, Google SketchUp Pro, and Google Maps API for Business. The other grant is a developer grant. This provides the user with the developers necessary to make their vision of the Google Earth and Maps application come to fruition. The developers can solve issues the organizations may be struggling

with, or enhance what they already have. The website also has success stories of organizations utilizing Google Earth and Maps for their purposes. These case studies can be viewed on the website, each accompanied with examples of the software developed, a video about the project, and a written summary of the project.

2.5.4 Google Street View

Released May 25, 2007, Google Street View is a technology in Google Earth and Google Maps which provides 360° panoramic views of many streets of the world. In Street View, the user can zoom in and out, rotate the picture in all directions, and move to the next panorama. In order to create the panoramic images, Google uses the Street View Car. Mounted on the roof of the car is a fifteen-lens camera that takes 360 degrees of pictures. The images taken by this camera are stitched and used for Google Street View.



Figure 9: Google Street View Screenshot of Boynton Hall at WPI

2.6 Information Collection

2.6.1 Panoramic Photos

Panoramic photography is a technique in which images are captured with elongated fields of view. It is not known when the idea of panoramic photography first emerged, but it is widely believed that it has been around since photography began. Early panoramic images were a series of images placed next to each other, creating the effect of a widened field of view. Stitched panoramas are made by matching up similar points in two or more pictures to create a single seamless image. Today's panoramas are created using stitching software on a computer, in a digital camera, or on a Smartphone.



Figure 10: Panorama created by Microsoft Photosynth on the iPhone

2.6.2 Audio

The team will be taking intermittent audio recordings using a TASCAM. As the group finds interesting sounds along the trails, such as water crashing along the beach, wind blowing

through the leaves, or birds flying overhead, the group will record these sounds and mark the latitude and longitude of the place it was recorded.

2.6.3 Atmospheric

At each point where the group takes a panoramic image, the team will take atmospheric readings. These will include wind speed, temperature, latitude and longitude, and elevation. In order to collect the wind speed and temperature, the group will be using an anemometer. To measure the latitude, longitude and elevation, the group will be using an iPhone.

2.6.4 Flora

The natural remedies in this paper are provided solely for the purpose of discussion. Many of them have not been tested in a scientific setting and could potentially be dangerous. None of the medical information in this section is to be considered medical advice; all “remedies” are simply provided to provide historical insight of common beliefs. The authors of this paper are not recommending their use, especially as a replacement for peer-reviewed medicine or advice from a professional physician.

Flora includes all flowering and non-flowering plants, algae, and mushrooms. Maine is home to a diversity of flora, since there are many different ecosystems present.

Mushrooms are part of the fungi classification. Several mushroom species found in Maine include the edible oyster mushroom, the poisonous Destroying Angel, and the collared Earthstar.



Figure 11: Oyster mushroom

Algae are divided into three groups: red algae, green algae, and brown algae. Red and brown algae live almost exclusively in salt water, whereas green algae live in fresh water, salt



Figure 12: Tree clubmoss

water, and on land. It is believed that land plants evolved from green algae. Some algae in New England include sea lettuce, which is found attached to rocks or free floating, and Northern kelp, which has been proven to be a viable source of energy, as it produces methane while it decays. Another common alga in the area is Irish moss, which can be used to assist many intestinal disorders.

Lichen is an organism formed as a result of a symbiotic relationship between fungi and green algae. Humans have historically used lichens as nutrition, medicine, dye, fiber, and as a natural tool for monitoring the environment, as lichens are indicators of ecosystem quality. New England lichens include ring lichen, map lichen, Pyxie cup, and reindeer lichen.

Green land plants are named for the typical green color found in chlorophyll, which are part of plant cell walls. These plants are unique in the fact that they collect energy from sunlight by photosynthesis. Some of the earliest green land plants were spore plants. Spore plants, comprised of mosses, clubmosses, horsetails, and ferns, reproduce via spores as opposed to seeds. Some spore plants found in Maine include haircap moss, tree clubmoss, water horsetail, and sensitive fern. Haircap moss and tree clubmoss can be found on the edges of bogs. Horsetail can be used as a diuretic, for bone diseases such as arthritis and osteoporosis, and for inflammation and muscle cramps. Sensitive fern is named because it has a defense mechanism in which its fronds close when touched.



Figure 13: Sensitive Fern



Figure 14: Identifying a Tree-Crown Shape

A diversity of trees and shrubs exists in Maine, categorized by three visual characteristics: crown shape, bark color and texture, and leaf shape and arrangement (Figures 14 and 15). Common juniper, sweet birch, slippery elm, horse chestnut, large cranberry, wild red raspberry, Northern bayberry, and witch hazel all have medicinal properties. The common juniper berries act as a diuretic, which helps treat bladder and kidney infections. Bark tea from the Sweet Birch has anti-inflammatory and pain relief properties. Slippery elm bark salve aids in mucosal membrane diseases in which the respiratory and digestive tracts are affected. Horse chestnut seeds and leaves can prevent bruising and reduce pain and swelling. Cranberries are used for urinary tract infections. Wild red raspberry leaves soothe female ailments such as morning sickness, hot flashes, menstrual and uterine cramps, and heavy menstrual bleeding. Both the Northern bayberry root bark and the leaves and bark of witch hazel work as astringents, and witch hazel can also work as an antipruritic.



Figure 15: Identifying Tree-Leaf Shapes and Leaf Arrangements

New England has over 2,000 species of flowering plants in more than 100 families. Wildflowers are identified by features of their flowers (Figure 16). Yarrow, Canada thistle, boneset, dwarf dandelion, rough-stemmed goldenrod, coltsfoot, great lobelia, wild ginger,

common evening primrose, fringed gentian, sea lavender, marsh skullcap, alfalfa, red clover, St. John's wort, and common mullein all grow in Maine and have medicinal properties. For example, yarrow, Canada thistle, alfalfa, and boneset all contain anti-inflammatory agents. Boneset and common mullein work as laxatives. Diuretic plants consist of dwarf

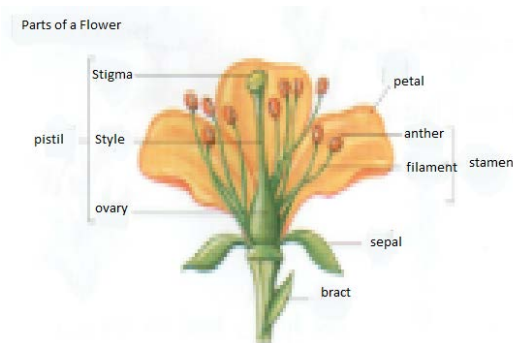


Figure 16: Parts of a Flower

dandelion, yarrow, rough-stemmed goldenrod, and alfalfa. Maine is not only known for its wildflowers but also for its wild blueberries. Low and high bush blueberries grow wild all along the trails in Acadia National Park and are high in antioxidants and nutrients.

2.6.5 Fauna

Fauna is all animal life. This section is limited to spiders and kin, insects, amphibians, reptiles, birds, and mammals, focusing on those common to Maine.

Hundreds of insects live in Acadia. All insects have three main anatomical parts: the head, thorax and abdomen. Insects usually have four wings and six legs, which are attached to the thorax. The abdomen usually houses the reproductive and other internal organs. Some insects include silverfish, mayflies and dragonflies. There are many types of dragonflies, such as the northern bluet, the common whitetail, and the twelve-spotted skimmer (Figure 17). Other native insects are the American cockroach, the European earwig, the northern walkingstick, and the praying mantis.

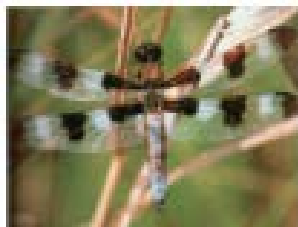


Figure 17: Twelve Spotted Skimmer

Spiders frequently found in the New England area include the goldenrod spider, the daring jumping spider and the American house spider. Two potentially dangerous kin are the wood tick and the deer tick, both of which tend to carry Lyme disease and survive by drinking blood.

There are many types of grasshoppers and kin, such as the true katydid (Figure 18), green lacewings, periodical cicadas, and the snowy tree cricket. Some beetles found in Maine are the brown tiger beetle, the European caterpillar hunter, Pennsylvania firefly, convergent lady beetle, and the red milkweed beetle. There are, however, beetles not



Figure 19: True katydid

native to Maine. For example, a few decades ago, the Japanese beetle was introduced to the wild and has become an invasive pest. The phantom crane fly, golden saltmarsh mosquito, greenhead



Figure 18: Question mark

flies, and the house mosquito constitute the flies and mosquitos found in Maine. Ants, wasps and bees consist of the northeastern sawfly, red mound ant, northern paper wasp, bald-faced hornet, and the American bumble bee. The question mark (Figure 19), the luna moth, the ultronia underwing moth, and the cecropia moth form the butterflies and moths group.

Although the climate is not always warm, amphibians and reptiles exist in Maine. The eastern red-backed salamander, spotted salamander, spring peeper, gray tree frog, bullfrog, and pickerel frog are a few native amphibians. Reptiles consist of the spotted turtle, common box turtle, and snapping turtle. Reptiles also include the milk snake the smooth green snake, and the ring necked snake, all of which are not venomous. The timber rattlesnake and copperhead are both venomous reptiles.

Bird watching is a common activity in Acadia. One can see up to 300 species in a year in New England alone, with the greatest variety seen during migration. Some local species are the common loon (Figure 20), glossy ibis,

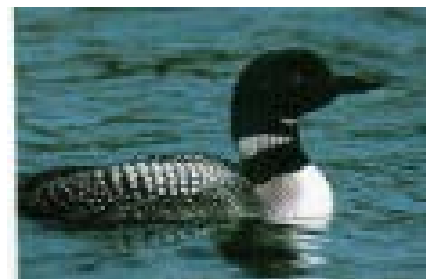


Figure 20: Common loon

chimney swift, ruby-throated hummingbird and belted kingfisher. Native herons include great egret, great blue heron, and snowy egret. Maine waterfowl are the mute swan, the Canada goose, the wood duck, the common goldeneye, and the hooded merganser (Figure 21).



Figure 21: Hooded merganser

Birds of prey that are active during the daytime are often called ‘raptors’. The turkey vulture, the bald eagle, the northern goshawk, the peregrine falcon, and the American kestrel are



*Figure 22:
Northern Flicker*

a few to name among New England raptors. Shorebirds include the whimbrel, the ruddy turnstone, and the American woodcock. Several gulls and terns, such as the common tern, the black skimmer, and the Atlantic puffin, live in Maine due to its extensive shoreline. Owls are comprised of the snowy owl, and the eastern screech-owl. Woodpeckers are the red-bellied woodpecker, and the northern flicker (Figure 22). Songbirds include

the blue-gray gnatcatcher, the cedar waxwing, the red-eyed vireo, the chestnut-sided warbler, the black and white warbler, the scarlet tanager, and the red-winged blackbird.

Mammals are warm-blooded organisms that are born, as opposed to being hatched, excepting the platypus and the echidna. Some mammals in Maine are the Virginia opossum, star-nosed mole, little brown myotis and brown bat. Hares and rabbits consist of the eastern cottontail and snowshoe hare. Rodents include the woodchuck, southern flying squirrel, common muskrat, and common porcupine. Coyote, black bear, common raccoon, long tailed weasel, striped skunk,

Northern river otter, and bobcat are among the carnivores native to the state. Hoofed mammals include white-tailed deer and moose.

As urban development has increased, the plants and animals have decreased in number and in quality of life. With large designated sects of reserve land, such as Acadia National Park, flora and fauna are able to reestablish strong roots and territory.

3.0 Methodology

3.1 Choosing a Trail

3.1.1 Initial assessment

In the initial assessment of the Acadia National Park trails, team members hiked an assortment of trails, which varied by levels of difficulty: very easy, easy, moderate, and strenuous. In order to collect substantial data, this project required determining a trail which provided an eclectic combination of characteristics, including aesthetic scenery and atmospheric conditions. Trails of varying difficulty and scenery were explored to determine the most appropriate trails on which to focus. Appendix III shows a table containing the available trails in Acadia National Park, along with short descriptions and the level of difficulty.

While hiking a trail during the initial assessment, group members observed and took notes of desired characteristics to measure during the data collection. Because a photographic documentation of a trail would require many trips, the level of accessibility of a trail was taken into account. The group speculated on hiking Great Head Trail and Jordan Pond Trail, due to their level of difficulty and appealing characteristics for using technology. Upon arriving in Bar Harbor, a portion of Pemetic Northeast Face Trail was documented. The short length of the area proved for a suitable proof of concept.

3.1.2 Documented Trails

The Jordan Pond Path is a level trail that follows the water's edge of Jordan Pond. The terrain is mostly evergreen forest, with the exception of the rocky pond shoreline. This trail is listed as moderate in Acadia National Park's "Historic Hiking Trails"¹³ and is a 3.2-mile loop.

The Great Head Trail is listed by Acadia National Park as a moderate trail, with some steep grades and some level stretches. The trail offers a variety of scenery as it goes from the beach, to an evergreen forest, to tall sea cliffs. This trail is a 1.5-mile loop, which is ideal for Trail View, as it would bring one back to the point at which they started. If tide permits, it is possible to take a different route within the Great Head Trail along Sand Beach.



Figure 23: Great Head Trail Coastline View

The Pemetic Northeast Face Trail is a 2.4-mile trail that begins along the shore of Bubble Pond and ends at the top of Pemetic Mountain. This trail is a less steep alternative to the Bubbles-Pemetic Trail. Although it is much more moderate than the strenuous Bubbles-Pemetic Trail, The Pemetic Northeast Face Trail is longer.

¹³ Historic Hiking Trails

3.2 Camera Selection

There are thousands of cameras on the market, and with most professional Google Street View projects using prohibitively expensive custom cameras, there were very few affordable tried-and-true recommendations available to the group. Because most of the cameras capable of taking panoramic pictures exceeded the group budget, it was decided that it was best to use a readily available camera and use software to stitch the pictures together.

There were two feasible methods of obtaining photographic data. One method involved taking panoramic images using smartphone applications, including the Photosynth application on the iPhone and the Photaf application on the Android. These applications take a series of photos and automatically ‘stitch’ them together. Stitching is defined as combining pictures by matching up similar points in two or more pictures to create a seamless single image. The other method was to use a Nikon D70 to take a series of photos and then to upload those photos into a computer program that would stitch them together. In addition, the Nikon D70 was used to take still photos of flora and fauna, bridges, and plaques.

3.3 Compiling Trail Data into Product

To complete the project, the team collected data while hiking a trail. Upon arrival, the team took its first panoramic photo so as to include a picture of the head of the trail. At this point, wind speed and temperature data were collected and recorded in a Notepad-like application on a team member’s Android smartphone. This process was to be repeated at an interval of 25 meters, but it was later found to be more successful if the interval was shortened. Intermittently, the group took audio recordings and still photos, and logged their location in Notepad as well.

Originally, the team intended on using only the map feature as the final product of this project. Due to bandwidth constraints and budgeting, the full website could not be hosted on viewyourtrail.com. The website was built locally and contained information in addition to the map feature. The website was designed for user-friendliness and accessibility. The website features interactive menus which contain pop-up links to the still photos of flora and fauna, audio clips, and atmospheric data such as temperature and wind speed. The pop-up windows can be viewed while using the map feature. The final product was a compilation of all data samples on the website, Trail View (<http://www.viewyourtrail.com>).

3.4 Application Programming Interface

An Application Programming Interface (API) is a software program that acts as an interface so as to allow two software components to communicate. The Google Street View API, was one of the major building blocks of the Trail View software. This API allowed for the panoramic imaging technology available in Google Street View to be harnessed for other purposes; in this case, to document trail images. The Google API accepts panoramic images and puts them together to simulate a three-dimensional (3D) image, able to be browsed by a user much like the 3D environment one would encounter in a digital simulation or video game.

In order to simulate a trail using the Google API, one had to specify the order of the panoramic photos, and then upload them to the website. To customize Trail View, the group made edits to the Google API by utilizing Javascript. Javascript is the programming language used in the API. Changing font sizes and inserting custom overlays are examples of some of the edits the team made to the API.

4.0 Results and Analysis

The group designed an interactive website capable of helping conservationists and outdoor recreationalists. The team utilized modern technology to document Acadia National Park's hiking trails. Documentation covered visual, atmospheric, and auditory records of the trails, all of which were transformed into a comprehensible and appealing interactive entity. While the project has much room for improvement, it has the potential to expand in many ways.

4.1 Choosing a Trail

Before arriving in Bar Harbor, the team considered the difficulties of the trails while deciding which one should be documented. This was important for several reasons. The group wanted to document an easy to moderate trail so the energy could be focused on the project and perfecting the methodology, as opposed to focusing on the physical demand of hiking. Another reason why the team wanted to refrain from a strenuous trail was because the group would be returning to the trail on several occasions to complete the documentation. Safety and equipment preservation were also taken into consideration.

Another concern the team had was the length of the trails. The team did not want to document a long trail, due to time constraints and hosting and data space availability. In addition, the team found that the iPhone could only hold a charge for about five hours while in a no service area, turned on to Airplane Mode, with the GPS function turned on. This strictly limited how long a trail could be worked on at one time.

The team wanted to document photographically aesthetic and topographically varied trails. The group chose Jordan Pond Path because it is a relatively flat and straight path, and has views of Jordan Pond and the Bubble Mountains. Pemetic Northeast Face Trail was chosen because it has views of Bubble Pond and it is particularly secluded. The group chose Great Head Trail because of its widely varying terrain, including a forest and rocky cliffs that overlook the Atlantic Ocean. The team also wanted to observe differences in the atmospheric data. On Jordan Pond Path and Pemetic Northeast Face Trail there was little variation in wind speed and temperature. However, on Great Head Trail, the team found that the temperature varied distinctly between the cliffs and the forest, and recorded many gust wind speeds along the cliffs and shoreline.

At some points, there were issues with accessibility to the trails. One mistake the group made was in visiting Great Head Trail via the Sand Beach entrance. The team paid a \$10.00 entrance fee and later bought a \$40.00 season pass, only to discover another parking lot with no fee which is strictly intended for Great Head Trail parking. This parking lot is closer to Great Head Trail than the Sand Beach entrance. Additionally, weather played a role in times that the group could go out to a trail and take high quality pictures. If there was rain, high winds or thunderstorms, then some trails were inaccessible due to safety factors such as slippery rocks and flying debris. Poor weather also prevented the group from taking panoramas and increased the chance of equipment damage.

4.2 API

By modifying the Google Street View API to accept digital images of trails using the Street View feature, one could implement a digital service to monitor a trail. This allows 3D

imaging of roads to be browsed in real-time, and its features are smoothly translated from roads to hiking trails. The API was adapted for single panoramic pictures. A website capable of accepting digital images was set up within a week of the idea being presented.

Difficulties with the Google API stemmed from vague tutorial documentation. For example, code for presenting a single panoramic image in Street View existed publicly. However, there was no code for presenting multiple images, and only one article briefly mentioned how to do this with no clear explanation. The team discovered a few example websites that had used the API for similar purposes. Through reverse reasoning, the group manipulated the code such to successfully import custom panoramic images into Google's API.

Some useful aspects of the Google API include Street View's functionality and ability to display virtual representations of physical locations. The 'Maps' function of the Google API allows Trail View to load as a two-dimensional map of the area surrounding the trails on Mount Desert Island. Trail markers are placed on the map at each point where a panoramic trail exists. These markers link to 3D representations of the trail. To leave the trail being browsed, the user clicks on the upper right-hand 'X' button in the corner of the screen, bringing the user back to the two-dimensional map.

While the Google API was not written for displaying numerical data such as wind speed and temperature, it has the ability to show GPS coordinates. Panoramas integrate GPS data, which the Google API uses for placing the positions of the images on a map. The GPS location information is inherently apparent as opposed to a numerical manner. The user can therefore comprehend the given location by looking at the spot on a map instead of by assessing the numerical GPS coordinates.

One disadvantage of the Google API is the large amount of bandwidth required for presenting high-resolution images. As website traffic increases, the website will use an excessive amount of data usage over the allotted bandwidth. To reduce the number of times this happens, the group managed to decrease the bandwidth usage by compressing the panoramic images to smaller files as well as slicing the zoom images. This was done without sacrificing the photo quality, since the Google API restricts the maximum image size to 640 x 640 pixels. The Zoomify software automatically splits panoramic images into 256 x 256 tiles, which load at separate zoom levels. This method of loading trail images reduced bandwidth usage over 50 percent.

4.2.1 Automation

Several issues arose during the programming process. Granted, some resourceful documentation, such as that of the Dutch website “Kerken Kijken met Street View,”¹⁴ was available publicly. However, a few problems did not have a direct solution and could only be solved by trial and error. One such issue was the automation process for uploading images to the website. The team searched for licensed third-party software that would properly upload panoramas and automatically generate a fully-developed trail. This software encompasses processes like automatic image recognition and procedural code generation. However, this was difficult to find because it is still relatively new in its field.

To work around the automation issues, the group decided to require that all the panoramas be positioned statically. In other words, if a person is to walk down a trail in a straight line, the center of the panorama must be at their line of sight. This way, if the panorama were to

¹⁴ Boer, 2010

be stretched into a two-dimensional photo, the center of the photo would correlate to the center of the trail. This eliminated the need for manual input when uploading a trail, as the properties for linking between panoramas can remain consistent.

4.3 Technical Issues

4.3.1 Camera Selection

A particular concern that the team encountered early on in the project was camera and stitching software selection. The original selection was a Nikon D70 for taking series of photos, and the photos would then be imported into free stitching software called Huggin. This process worked well, but took a fair amount of time for each photo, and, because the results were not automatically created, was not always reliable. A team member could spend several minutes taking a series of photos (that would ultimately become a single panoramic image), only to import the photos into Huggin, and discover that Huggin was either having difficulty stitching the photos, or that once stitched, the photo did not cover all of the necessary spherical view.



Figure 24: The Nikon D70

Simultaneously, Huggin began regularly crashing at the same time a team member discovered Occipital, a \$0.99 application on the iPhone that takes panoramic photos. Occipital was unique because after taking a series of photos, it stitched them, so the results could be seen almost automatically. The team questioned the quality capabilities of an iPhone, and immediately began running tests to compare the iPhone to the Nikon. The results found that the Nikon had



Figure 25: The iPhone

higher resolution photos, but upon upload the API lowers the resolution of the photos to a constant. This allowed the group to decide between the cameras based on convenience.

Through the group's series of test runs the possibility of pairing the Nikon with the free stitching software Microsoft Image Composite Editor, which worked significantly better than Hugin, and was considered. The team searched for a comparable application for the Android phone, but no application was found. The final decision was made to use the iPhone with the Microsoft Photosynth application, which was free, and was found to stitch

pictures faster and with higher quality than Occipital.



Figure 26: Trail View map feature

4.3.2 Tripod vs. Monopod

An issue that the team ran into was refining the quality of photos. This was directly affected by the support devices we used. At first, the team tried holding the iPhone by hand with no support while taking pictures, which resulted in poor quality photos and was too time consuming. The team then jury rigged a makeshift tripod: an iPhone tripod affixed to a camera tripod. Ultimately, this caused a high potential for equipment damage. The best possible camera support was a monopod, based on an Occam's razor solution: while hiking, a straight stick was found and used as a monopod. Microsoft Photosynth is meant to be used in a way such that the iPhone is at the axis of rotation. The human tendency is to use one's body as the axis of rotation, but by applying a monopod, one can transfer the axis of rotation to the camera lens of the phone. The monopod significantly enhanced the quality of the photos, which sped up to photo-taking process.

4.3.3 Spacing between Data Points

In determining the spacing between each photo, the team consulted Google Street View. Google Street View suggested taking a photo every 50 meters, or 164 feet. If a trail was one mile long, or 5280 feet, and the team took a photo every 164 feet, there would be 32 photos total. The team did not feel that this would be a sufficient number of photos to document the trail, so the group decided to double the number of photos that would be taken, which would halve the distance between data collection points. The group decided to take a photo every 25 meters, or 82 feet.

When the team arrived at the trails, it was discovered that the Google API required the start point of Panorama B to be seen at the end point of Panorama A. In this way, each photo had to connect to the next photo. Each time the trail curved, the team had to take a photo, as to meet

this requirement. The group found that the trail curved more often than every 82 feet, and as a result ended up with much more than 64 photos. On Great Head Trail, which is approximately 1.25 miles, the team collected 115 panoramic photos, which was significantly more than originally expected.

4.4 Website

The website designed for this project met the basic goals for displaying the trail data. The group wanted the website to show the map feature alongside other collected data, which included sounds, still photos, temperature and wind speed. In order to keep the data presentation straightforward and organized, the site was contained in a two-column template. A left panel listed all the links within the site, and a right panel displayed content. A screenshot of the main page of Trail View is shown in Figure 27. To accommodate the visually impaired, the website was designed with large font and mostly with colors unassociated with color blindness. However, colorblind users may still have issues using the map feature because of the presence of green and red.

The website design focused on accessibility. The site was constructed with the most up-to-date markup language, HTML 5, and was edited with a free program called Notepad ++. This language works on the majority of browsers, making the website available to a wider audience. The first draft of the website, however, did not work well in older browsers, such as Internet Explorer 6. While it works in many modern browsers, Google Chrome best supports the Trail View features. The team assumed that the typical visitor was a person with any level of computer experience. Under this assumption, the site was built so that it is ergonomic and user-friendly. For those who continue the project, the coding was organized so that the website could function

as fast as possible and require little maintenance. The website was made locally and is still unavailable on the World Wide Web as there is no hosting yet. The map feature is available on the Internet and is hosted at <http://www.viewyourtrail.com>.

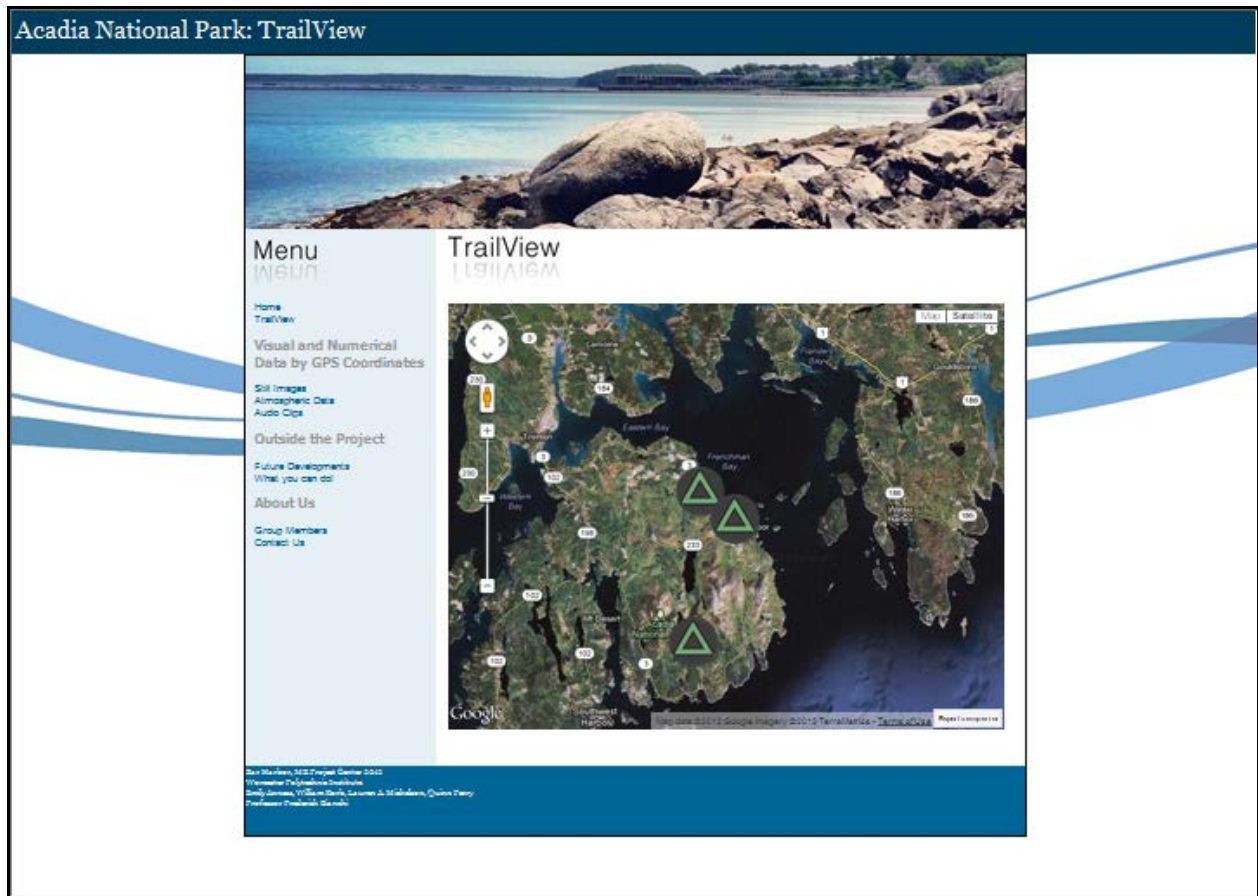


Figure 27: Trail View website screenshot

5.0 Recommendations

The group is pleased with the results of Trail View and strongly urges teams in the future to further its use. Continued developments can expand the project to outside influence, including but not limited to education, public awareness, and high-efficiency crowdsourcing. Alongside these concepts come technological advancements, allowing ideas to branch out in less time. The unique recommendations for Trail View make this project ideal for long-lasting continuation.

5.1 Data Collection

Changes in data collection should be considered for the continuation of this project. The group encountered issues pertaining to the efficiency of technology, such as battery longevity. Should future groups continue to use the iPhone as their primary panoramic camera, the group recommends purchasing several iPhone battery expansions. In this way, future teams can charge all of the iPhone battery expansions prior to documenting the trails, and be able to work for a full day, as opposed to a four to five hour stretch.

5.1.1 Camera Selection

When researching cameras, the lack of funds was the most hindering obstacle. Most commercial 360-degree cameras cost thousands of dollars. If this project is to be continued with funding, the use of one of these cameras is recommended. The Nature Valley Trail View Team used the Dodeca 2360 Camera System, which records 360-degrees of video and comes with “software tools for post-production, integration, distribution, and viewing”¹⁵. This camera

¹⁵ Immersive Media Company

system is priced around \$45,000. To document a trail, they used a custom-built camera mount that was attached to a backpack, which could potentially be obtained in collaborating with Nature Valley. It should be noted that the backpack weighed over forty pounds¹⁶, which could be a burden on the hiker. Despite this, a trail could be documented much more quickly than with an iPhone and would greatly increase efficiency.

If a camera is used for taking pictures as opposed to recording video, it would be necessary to stitch the pictures using stitching software capable of creating 360-degree panoramas. The group suggests trying the last image stitching software that the group attempted to use. Microsoft Image Composite Editor was very successful in that it accurately and seamlessly pieced panoramas together. The only reason this software was not used is because without a 360-degree camera, it was challenging and time-consuming to take enough pictures for a 360-degree panorama. Microsoft Image Composite Editor is free and should be considered before any money is spent on alternative stitching software. Because the group did not anticipate any funding for this project, the team cannot recommend any stitching software other than the free software considered for this project.

5.2 Data Presentation

5.2.1 Additional Website Components

Although Trail View is interactive in some respects, the group would like to see extra components that give visitors a more ‘whole’ experience. Additional resources, such as a news feed, social networking, a feedback section, and links to Acadia-related websites, would better

¹⁶ The New York Times

inform visitors about current events and extensive information pertaining to national parks. Outside resources may include the Sierra Club, Friends of Acadia, Schoodic Education and Research Center (SERC), and the Audubon Society.

The website has the potential to not only be informative about the trails, but also about other aspects to Acadia National Park. A possible interactive component to add is a webcam on the trails, which would offer the possibility of observing time-lapsed changes. Other potential educational and informative sections are interactive modules that quiz the visitor on various topics. These applications may involve history, species identification, sounds of nature, land use awareness, and geographical predictions.

Currently, the website has a menu panel that links to pop-up windows containing collected trail data. At some point, the website should be compressed such that the non-visual data is integrated into the map feature. While this requires complex programming with the Google API, this combined aspect would make the website easier to navigate and faster to load. Currently, all data points open in separate windows. However, too many pop-up windows can impede on the virtual experience with the map feature and become overwhelming. The team would like to see fewer pop-up windows on the website in the future.

5.2.2 Crowdsourcing

Currently, the Trail View project only displays trail data provided by the server owner, limiting the website's functionality. With only one party able to provide the website with panoramic trail imaging and other data, many prospective applications of the website become impossible to achieve. Global reach and time-lapse data, such as atmospheric data, require contributions from multiple parties to produce environmental surveys.

Crowdsourcing is the process of outsourcing tasks to a large group of people, oftentimes the general public, and pooling their results into a single project. It allows for seemingly impossible to budget tasks, such as a worldwide team of hikers collecting trail data, to be completed for little to no cost. Due to lack of funding and manpower, the crowdsourcing idea could not be carried out during the allotted project period. However, the group assembled the preliminary building blocks for the website to be able to accept data from a crowdsourcing application.

The crowdsourcing component can be accomplished for the Trail View website with the creation of a smartphone application capable of the following:

- taking photographs
- stitching said photographs into panoramic pictures
- combining multiple panoramic pictures, likely with the help of user input, into a browsable trail
- generating code, which the user can choose to submit to the Trail View website
- recording atmospheric data and audio clips

The user, on their trail of choice, would take photographs in a procedure similar to that described for this project. The crowdsourcing application would then stitch the images together into a full panorama, removing glitches simultaneously. The stitched panorama will be inserted to the current trail to which the user contributes. Once a complete trail of panoramic images is finalized, the user will be prompted to add intersection points of panoramas by pressing the point at which they converge. When this process is complete, the application will generate a folder containing a Google API Javascript file and all images taken, ready to be uploaded to the Trail View website.

While this application will require an immense amount of time and effort, the result will be worthwhile. The proposed crowdsourcing application will allow Trail View to become not just an application, but a community of recreationalists all over the globe, contributing content at an exponential rate. The application would be provided free of charge, as to appeal to a large group of people. It would ideally be available on multiple platforms. It is also strongly recommended that the development platform be both Android and iPhone, due to their popularity.

5.3 Trail View in the Community

5.3.1 Technology and Education

Schools nationwide are expanding their curriculums so that students can learn about environmental issues and changes. Curriculums typically include education about local history and geography, which has the ability to expand into learning about ecosystems and native flora and fauna. Teaching children and young adults about local environment and biodiversity can promote ecosystem preservation.

The group would like to see Trail View make its way into classrooms. Students in elementary through high school could gain from the use of Trail View when studying the environment. The map feature brings students right to the hiking trails regardless of where they are and without traveling expenses. Students can also listen to audio samples to learn more about species identification and to compare different environments.

The crowdsourcing feature that Trail View possesses is ideal for raising public awareness of environmental degradation, invasive species, increasing sound and light pollution, and further human encroachment on previously untouched lands. With the panoramic and audio attributes, a user can see some direct effects of various types of environmental intrusion. For example,

increasingly widespread noise pollution can be inferred by a compilation of audio clips. Sound levels can, in turn, be mapped. Invasive species, such as zebra mussels and Asian long horned beetles, can be monitored with the map feature as well as still photos. If Trail View were developed for various ecosystems, it could be used in aquamarine environments, allowing for new research to take place and raised environmental awareness.

5.3.2 Technology and Health

While Trail View is intended to show what the Acadia hiking trails look like from a browser, it may be used in research pertaining to physical and mental health. Although there are studies indicating a correlation between time spent in the wilderness and increased wellness¹⁷, there is little record shown as to whether people benefit from simulations of the outdoors. The map and data presentations can incite the desire to travel to see the park in person. The group feels that Trail View could provide a similar effect to people whose mobility limits them from visiting the trails.

5.4 Collaborations and Funding

This project was completed with little to no funding. Resources and funding would be necessary for the continuation and expansion of Trail View. This could be acquired by collaborating with various organizations on Mount Desert Island or with The Nature Valley Trail View Team. A majority of the organizations on Mount Desert Island have already collaborated with each other in the past, which means that establishing a relationship with at least one is a good first step for partnering with the others. The funds obtained would be needed for purchasing

¹⁷ Davis-Berman, 1994

a 360-degree camera, the Google Maps API for Business, and potentially image stitching software. The Google Maps API for Business provides enhanced features that the free API does not. For example, the Business API does not reduce the quality of the pictures being uploaded. This would mean that the quality of a camera would have to be more of a consideration than it was in this project.

There are a few potential sponsors on Mount Desert Island that could work with a group continuing this project, one of which is Friends of Acadia, a nonprofit organization. Friends of Acadia works closely with Acadia National Park and has programs, such as the Acadia Youth Technology Team, that enhance the experience of visitors by incorporating technology into the park. After meeting with the Acadia Youth Technology Team, it was apparent that Friends of Acadia wanted to expand on the use of technology and could be interested in Trail View.

Nature Valley has already done panoramic documentations of several trails in Yellowstone National Park, the Grand Canyon, and the Great Smokey Mountains. Contact has been made with the Nature Valley Trail View Team. They expressed interest in working with the Trail View project, but they are unsure of their future endeavors. If they are not to continue documenting trails, it is possible that they would be willing to donate some of their equipment, or sell it at a reduced price. Nature Valley is a great resource because they have already realized many of the things that the Trail View project could ultimately accomplish.

L.L. Bean is one of the biggest sponsors in Maine. They have worked with Friends of Acadia since 2002 in order to help preserve and protect Acadia National Park.¹⁸ L.L. Bean focuses on aiding recreation and conservation organizations and takes pride in doing so. With Trail View making the aesthetic qualities of the park more readily available to the public, L.L.

¹⁸ L.L. Bean

Bean may see this as an opportunity to promote the park. It is likely that through collaborating with Friends of Acadia, a team continuing this project could be receive funding that originated from L.L. Bean.

The Schoodic Education and Research Center (SERC) Institute is a nonprofit organization dedicated to supporting SERC of Acadia National Park¹⁹. The mission statement of SERC Institute is “to guide present and future generations to greater understanding and respect for nature by providing research and learning opportunities”²⁰. The research center facilities are capable of being used for a variety of purposes. There is also a committee of Friends of Acadia, called the Friends of Schoodic, who work specifically in the Schoodic District of Acadia National Park. The Friends of Schoodic are partners with the SERC Institute and have donated funds to them.

The group suggests searching for other collaborators aside from those previously mentioned. Funding will relieve the budgets necessary for acquiring quality equipment and for website hosting. Due to the possibility of high traffic and excessive data usage, the product of this collection requires a host that provides sufficient bandwidth. Aside from funding, networking with outside sources will allow WPI to reach out to educational and professional opportunities.

¹⁹ Welcome to the Schoodic Education and Research Center

²⁰ Welcome to the Schoodic Education and Research Center

6.0 Conclusions

The ultimate goal of this project was to create a proof of concept for expansion of Trail View. By the end of the project, the team had completed the photographic documentation of the Great Head Trail and had done a portion of both the Jordan Pond Path and the Pemetic Northeast Face Trail. The portions of the Jordan Pond Path and the Pemetic Northeast Face Trail that were completed worked as proof of concept trial runs. By the time the team began the Great Head Trail, the group had mastered the methodology of taking the panoramic pictures. The quality of the panoramas was increasing and the time it took to take a panorama was decreasing as the team took more pictures. With this increased efficiency came the opportunity for pictures to be uploaded to Trail View more quickly.

The database on the website contains still photos, audio clips, and atmospheric data, in addition to the map feature. This aspect of the website sets Trail View apart from Google Street View and Nature Valley Trail View. With the crowdsourcing application of the website, Trail View will become a culmination of information over the years. This information, along with the panoramic images, will provide unprecedented historical documentation of the park. Also, Trail View may attract more visitors to the park, as the crowdsourcing application makes hiking the trails a more interactive experience.

In order to continue and further this project, future groups must seek funding or collaboration with other organizations. This would allow future groups to meet the costs of supporting the necessary bandwidth requirements to maintain the website. In addition, future teams could seek funding for higher quality data-collecting devices, such as a 360-degree camera and the Google Maps Business API.

Trail View is a website that documents Acadia National Park's hiking trails using modern technology. The website features still photos, audio clips, wind speed and temperature data, and a map feature of the trails. The team collected this data on Great Head Trail, Pemetic Northeast Face Trail, and Jordan Pond Path. The equipment the group used included an iPhone, an anemometer, a Tascam audio recorder, and a Nikon D70 camera. The collected data was then compiled on the website, viewyourtrail.com. To further this project, future groups should seek funding or collaboration. However, the team feels that as a proof of concept, the project was very successful.

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Appendix I: Flora

- **Mushrooms**
 - king boletus
 - fly amanita
 - artist's fungus
 - chicken mushroom
 - birch polypore
 - Chanterelle
 - alcohol inky
 - meadow mushroom
 - morels
 - giant puffball
 - emetric russula
- **Algae**
 - dulse
 - knotted wrack
 - bladder rockweed
- **Lichens**
 - dog lichen
 - british soldiers
- **Spore plants**
 - Ppeat mosses
 - staghorn clubmoss
 - field horsetail
- **Ferns**
 - hay-scented fern
 - bracken
 - Northern maidenhair
 - New York fern
 - common polypody
 - cinnamon fern
 - royal fern
 - interrupted fern
 - Northern lady fern
 - spinulose wood fern
 - common oak fern
 - Christmas fern
 - ostrich fern
- **Trees and shrubs**
 - Northern white cedar
 - Atlantic white cedar
 - Eastern red cedar
 - balsam fir
 - tamarack
 - Morway spruce
 - white/black/blue/red spruce
 - red pine
 - pitch pine
 - Eastern white pine
 - Eastern hemlock
 - scotch pine
 - Canada yew
 - American chestnut
 - American beech
 - white oak
 - swamp white oak
 - scarlet oak
 - bear oak
 - pin oak
 - Northern red oak
 - chestnut oak
 - post oak
 - black oak
 - yellow birch
 - paper birch
 - gray birch
 - American hornbeam
 - Eastern hop hornbeam
 - poison sumac
 - flowering dogwood
 - black tupelo
 - Northern hackberry
 - Siberian elm
 - American elm
 - American holly
 - sassafras
 - American basswood
 - yellow poplar
 - sweet bay magnolia
 - striped maple
 - Norway maple
 - red maple
 - silver maple
 - sugar maple
 - mountain maple

- white mulberry
- black ash
- white ash
- green ash
- honey locust
- black locust
- ailanthus
- downy serviceberry
- cockspur hawthorn
- sweet crab apple
- apple
- American plum
- pin cherry
- black cherry
- American mountain ash
- London planetree
- American sycamore
- pignut hickory
- shagbark hickory
- mockernut hickory
- Eastern cottonwood
- white poplar
- bigtooth aspen
- quaking aspen
- black willow
- weeping willow
- winged sumac
- smooth sumac
- alternate-leaf dogwood
- gray dogwood
- red osier dogwood
- sheep laurel
- mountain laurel
- labrador tea
- rhodora
- rosebay rhododendron
- pink azalea
- white swamp azalea
- lowbush/ highbush blueberry
- winterberry
- American elder
- maple-leaf viburnum
- hobblebush viburnum
- nannyberry
- Northern arrowwood
- cranberry viburnum
- spicebush
- buttonbush
- beachplum
- common chokecherry
- multiflora rose
- swamp rose
- beach rose
- virginia rose
- highbush blackberry
- sweet fern
- sweet gale
- sweet pepperbush
- bebb willow
- pussy willow
- **Wildflowers**
 - skunk cabbage
 - sweetflag
 - water arum
 - Jack-in-the-pulpit
 - arrow arum
 - common ragweed
 - white snakeroot
 - dusty miller
 - mugwort
 - heath aster
 - calico aster
 - spotted knapweed
 - stiff aster
 - New England aster
 - purple-stemmed aster
 - nodding bur marigold
 - chicory
 - bull thistle
 - horseweed
 - daisy fleabane
 - orange hawkweed
 - spotted joe-pye-weed
 - lance-leaved coreopsis
 - common burdock
 - rough-leaved sunflower
 - oxeye daisy
 - black-eyed susan
 - pearly everlasting
 - saltmarsh fleabane
 - golden ragwort
 - Canada goldenrod

- lance-leaved goldenrod
- blue-stemmed goldenrod
- seaside goldenrod
- prickly sow-thistle
- common tansy
- common dandelion
- New York ironweed
- yellow goatsbeard
- Indian tobacco
- common bellflower
- harebell
- cardinal flower
- oriental bittersweet
- swollen bladderwort
- Japanese knotweed
- Pennsylvania smartweed
- sheep sorrel
- curly dock
- American bur-reed
- white baneberry
- wood anemone
- wild columbine
- marsh marigold
- goldthread
- round-lobed hepatica
- common buttercup
- creeping buttercup
- tall meadow rue
- rue anemone
- Eastern prickly pear
- water hemlock
- Queen Anne's lace
- water parsnip
- golden alexanders
- poison ivy
- broad-leaved cattail
- spreading dogbane
- periwinkle
- bunchberry
- lesser duckweed
- eelgrass
- fireweed
- viper's bugloss
- true forget-me-not
- Plymouth gentian
- wild geranium
- wild sarsaparilla
- lamb's quarters
- wild cucumber
- Virginia creeper
- wild grapes
- wild rice
- saltmarsh cordgrass
- common reed
- American beach grass
- round-leaved greenbrier
- spotted wintergreen
- wintergreen
- shinleaf
- Indian-pipe
- bearberry
- trailing arbutus
- twinflower
- larger blue flag
- yellow flag
- pointed blue-eyed grass
- bluebeard lily
- trout lily
- Canada lily
- day lily
- Turk's-cap lily
- Indian cucumber root
- Canada mayflower
- wood lily
- hairy solomon's seal
- false solomon's seal
- purple trillium
- large-flowered trillium
- painted trillium
- sessile bellwort
- purple loosestrife
- swamp loosestrife
- bluets
- partridgeberry
- swamp rose mallow
- musk mallow
- Virginia meadow beauty
- swamp milkweed
- common milkweed
- orange milkweed
- fringed polygala
- wild basil

- ground ivy
- henbit
- wild mint
- wild bergamot
- self-heal
- blue curls
- hedge bindweed
- common winter cress
- American sea-rocket
- Dame's rocket
- peppergrass
- true watercress
- wood nettle
- clearweed
- stinging nettle
- Jimson weed
- bittersweet nightshade
- yellow lady's slipper
- pink lady's slipper
- grass pink
- ragged fringed orchid
- nodding ladies' tresses
- Helleborine
- rose pogonia
- groundnut
- yellow wild indigo
- crown vetch
- showy tick trefoil
- beach pea
- bird's-foot trefoil
- wild lupine
- rabbit-foot clover
- white sweet clover
- palmate hop clover
- white clover
- cow vetch
- pickernelweed
- Deptford pink
- ragged robin
- bouncing bet
- white campion
- common chickweed
- bladder campion
- Northern pitcher plant
- English plantain
- common plantain
- pokeweed
- celandine
- Dutchman's breeches
- bloodroot
- whorled loosestrife
- swamp candles
- Eastern starflower
- narrow-leaved spring beauty
- beach heath
- rough-fruited cinquefoil
- wild strawberry
- meadowsweet
- steeplebush
- blue toadflax
- butter-and-eggs
- square-stemmed monkeyflower
- common speedwell
- Asiatic dayflower
- round-leaved sundew
- wild teasel
- orange jewelweed
- blue vervain
- sweet white violet
- Canada violet
- common blue violet
- bird's-foot violet
- downy yellow violet
- fragrant water-lily
- yellow pond-lily
- yellow wood sorrel
- Northern wood sorrel

Appendix II: Fauna

- Invertebrates
 - Marine
 - Lion's mane
 - Moon jellyfish
 - Northern red anemone
 - Sea gooseberry
 - Clam worm
 - Slime feather duster
 - Sinistral spiral tube worm
 - Mottled red chitin
 - Tortoise-shell limpet
 - Common periwinkle
 - Common slipper snail
 - Northern moon snail
 - Atlantic dogwinkle
 - Knobbed whelk
 - Red-gilled nudibranch
 - Ribbed muscle
 - Edible muscle
 - Atlantic bay scallop
 - Atlantic deep-sea scallop
 - Common jingle shell
 - Eastern oyster
 - Northern quahog
 - Common razor clam
 - Atlantic surf clam
 - Soft-shelled clam
 - Atlantic long-finned squid
 - Atlantic horseshoe crab
 - Northern rock barnacle
 - Sand shrimp
 - Northern lobster
 - Flat-clawed hermit crab
 - Lady crab
 - Blue crab
 - Green crab
 - Atlantic rock crab
 - Sand fiddler
 - Smooth sun star
 - Spiny sun star
 - Blood sea star
 - Northern sea star
 - Green sea urchin
 - Freshwater and Land
 - Common sand dollar
 - Orange-footed sea cucumber
 - Spiders and Kin
 - Black and yellow garden spider
 - Funnel-web grass spider
 - Carolina wolf spider
 - Daddy-long-legs
 - Insects
 - Snow flea
 - Dragonflies
 - Ebony jewelwing
 - Slender spreadwing
 - Variable dancer
 - Eastern forktail
 - Canada darner
 - Common green darner
 - Common baskettail
 - Calico pennant
 - Halloween pennant
 - Eastern pondhawk
 - Widow skimmer
 - Blue dasher
 - Wandering glider
 - Eastern amberwing
 - Yellow-legged meadowhawk
 - German cockroach
 - Grasshoppers and kin

- Carolina locust
- Red-legged locust
- Field cricket
- Dogday harvestfly
- Meadow spittlebug
- Antlions
- Eastern dobsonfly
- Water boatmen
- Common water strider
- Small milkweed bug
- Green stink bug
- Beetles
 - Six spotted green tiger beetle
 - Large whirligig beetle
 - Rose chafer
 - May beetle
 - Japanese beetle
 - Two-spotted lady beetle
- Flies and Mosquitos
 - Crane flies
 - Black flies
 - American horse fly
 - Deer fly
 - Blue bottle fly
 - House fly
- Ants, Wasps, Bees
 - Pigeon horntail
 - Black carpenter ant
 - Little black ant
 - Eastern yellow jacket
 - Eastern carpenter bee
 - Honey bee
- Butterflies and Moths
 - Black swallowtail
 - Spicebush swallowtail
 - Eastern tiger swallowtail
 - Mustard white
 - Cabbage white
 - Clouded sulphur
 - Orange sulphur
 - American copper
 - Coral hairstreak
 - Banded hairstreak
 - Striped hairstreak
 - Brown elfin
 - Eastern pine elfin
 - Gray hairstreak
 - Spring azure
 - Eastern tailed-blue
 - Silvery blue
 - Great spangled fritillary
 - Silver-bordered fritillary
 - Pearl crescent
 - Baltimore checkerspot
 - Eastern comma
 - Compton tortoiseshell
 - Mourning cloak
 - American lady
 - Red admiral
 - White admiral
 - Red-spotted purple
 - Viceropy
 - Little wood satyr
 - Common ringlet
 - Common wood nymph
 - Monarch
 - Silver-spotted skipper
 - Northern cloudywing
 - Dreamy duskywing
 - Juvenal's duskywing
 - Least skipper
 - European skipper
 - Peck's skipper
 - Long dash

- Hobomok skipper
 - Dun skipper
 - Tent caterpillar moth
 - Polyphemus moth
 - Tomato hornworm moth
 - Hummingbird moth
 - Woolly bear caterpillar moth
 - Fall webworm moth
 - Virginia ctenuchid moth
 - Gypsy moth
 - Eight-spotted forester
- Vertebrates
 - Saltwater
 - Sea lamprey
 - Atlantic hagfish
 - Basking shark
 - White shark
 - Shortfin mako
 - Smooth dogfish
 - Blue shark
 - Little skate
 - Atlantic sturgeon
 - Alewife
 - American shad
 - Atlantic menhaden
 - Cusk
 - Atlantic cod
 - Haddock
 - Silver hake
 - Atlantic tomcod
 - Pollock
 - Goosefish
 - Hummichog
 - White hake
 - Threespine stickleback
 - Atlantic needlefish
 - Atlantic silverside
 - Northern pipefish
 - Lined seahorse
 - Acadian redbfish
 - Lumpfish
 - Freshwater and Saltwater
 - White perch
 - Striped bass
 - Sea raven
 - Grubby
 - Longhorn sculpin
 - Black sea bass
 - Bluefish
 - Tautog
 - Cunner
 - Scup
 - Ocean pout
 - Atlantic wolfish
 - Sand lances
 - Atlantic bonito
 - Atlantic mackerel
 - Bluefin tuna
 - Swordfish
 - Summer flounder
 - Windowpane
 - Winter flounder
 - Atlantic halibut
 - Yellowtail flounder
 - Hogchoker
 - Ocean sunfish

- Amphibians
 - Salamanders
 - Eastern newt
 - Dusky salamander
 - Blue-spotted salamander
 - Frogs
 - American toad
 - Woodhouse's toad
 - Green frog
 - Wood frog
- Reptiles
 - Turtles
 - Painted turtle
 - Spotted turtle
 - Common box turtle
 - Common musk turtle
 - Snapping turtle
 - Snakes
 - Racer
 - Milk snake
 - Brown snake
 - Smooth green snake
 - Ring-necked snake
 - Northern water snake
 - Eastern ribbon snake
 - Common garter snake
 - Timber rattlesnake (venomous)
 - Copperhead (venomous)
- Birds
 - Horned grebe
 - Pied-billed grebe
 - Greater shearwater
 - Sooty shearwater
 - Wilson's storm-petrel
 - Northern gannet
 - Double-crested cormorant
 - Great cormorant
 - Black-crowned night-heron
 - Green heron
 - American bittern
 - Raptors
 - Osprey
 - Northern harrier
 - Sharp-shinned hawk
 - Cooper's hawk
 - Red-shouldered hawk
 - Broad-winged hawk
 - Red-tailed hawk
 - Rough-legged hawk
 - Merlin
 - Ring-necked pheasant
 - Spruce grouse
 - Wild turkey
 - Northern bobwhite
 - Virginia rail
 - Sora
 - Common moorhen
 - American coot
 - Waterfowl
 - Brant
 - Snow goose
 - American black duck
 - Green-winged teal
 - Northern pintail
 - Mallard
 - Blue-winged teal
 - American wigeon
 - Greater scaup
 - Canvasback
 - White-winged scoter
 - Ring-necked duck
 - Common eider
 - Oldsquaw
 - Bufflehead
 - Common merganser
 - Red-breasted merganser
 - Shorebirds
 - Black-bellied plover
 - Semipalmated plover

- Piping plover
- Killdeer
- American oystercatcher
- Greater yellowlegs
- Lesser yellowlegs
- Solitary sandpiper
- Spotted sandpiper
- Willet
- Semipalmated sandpiper
- Dunlin
- Purple sandpiper
- Sanderling
- Pectoral sandpiper
- Least sandpiper
- White-rumped sandpiper
- Hudsonian godwit
- Short-billed dowitcher
- Common snipe
- Red knot
- Gulls and Terns
 - Laughing gull
 - Parasitic jaeger
 - Bonaparte's gull
 - Ring-billed gull
 - Herring gull
 - Iceland gull
 - Glaucous gull
 - Great black-backed gull
 - Roseate tern arctic tern
 - Least tern
 - Black tern
 - Black guillemot
 - Razorbill
- Doves
 - Rock dove
 - Mourning dove
- Owls
 - Northern saw-whet owl
 - Great horned owl
 - Short-eared owl
 - Barred owl
- Random
 - Black-billed cuckoo
- Common nighthawk
- Whip-poor-will
- Northern cardinal
- Rose-breasted grosbeak
- Eastern towhee
- American tree sparrow
- Chipping sparrow
- Field sparrow
- Savannah sparrow
- Fox sparrow
- Song sparrow
- Swamp sparrow
- White-throated sparrow
- Dark-eyed junco
- Bobolink
- Eastern meadowlark
- Rusty blackbird
- Common grackle
- Brow-headed cowbird
- Baltimore oriole
- Pine grosbeak
- American goldfinch
- Purple finch
- House finch
- Common redpoll
- Fine siskin
- Evening grosbeak
- House sparrow
- Woodpeckers
 - Bed-bellied woodpecker
 - Yellow-bellied sapsucker
 - Downy woodpecker
 - Hairy woodpecker
 - Pileated woodpecker
 - Northern flicker
- Songbirds
 - Eastern wood-pewee
 - Least flycatcher
 - Eastern phoebe
 - Great crested flycatcher

- Eastern kingbird
- Horned lark
- Purple martin
- Tree swallow
- Northern rough-winged swallow
- Bank swallow
- Cliff swallow
- Barn swallow
- Gray jay
- Blue jay
- American crow
- Common raven
- Black-capped chickadee
- Tufted titmouse
- Red-breasted nuthatch
- White-breasted nuthatch
- Brown creeper
- Carolina wren
- Winter wren
- House wren
- Marsh wren
- Golden-crowned kinglet
- Ruby-crowned kinglet
- Eastern bluebird
- Bicknell's thrush
- Veery
- Swainson's thrush
- Hermit thrush
- Wood thrush
- American robin
- Northern mockingbird
- Gray catbird
- Brown thrasher
- Northern shrike
- European starling
- Yellow-throated vireo
- Solitary vireo
- Warbling vireo
- Warblers
 - Wood warblers
 - Blue-winged warbler
 - Northern parula
 - Golden-winged warbler
 - Nashville warbler
 - Yellow warbler
 - Magnolia warbler
 - Cape may warbler
 - Black-throated blue warbler
 - Black-throated green warbler
 - Prairie warbler
 - Blackburnian warbler
 - Pine warbler
 - Yellow-rumped warbler
 - Palm warbler
 - Blackpoll warbler
 - American redstart
 - Ovenbird
 - Northern waterthrush
 - Louisiana waterthrush
 - Mourning warbler
 - Common yellowthroat
 - Hooded warbler
 - Wilson's warbler
 - Canada warbler
- Mammals
 - Northern short-tailed shrew
 - Hairy-tailed mole
 - Bats
 - Eastern red bat
 - Hare and Rabbit
 - Eastern cottontail
 - Showshoe hare
 - Rodents
 - Eastern chipmunk
 - Red squirrel
 - Eastern gray squirrel
 - American beaver
 - White-footed mouse
 - Brown rat

- Meadow vole
- Southern red-backed vole
- Meadow jumping mouse
- Carnivores
 - Red fox
 - Common gray fox
 - Short tailed weasel
 - Fisher
 - Mink
- Marine animals
 - Harbor seal
 - Gray seal
 - Minke whale
 - Fin whale
 - Humpback whale
 - Black right whale
 - Long-finned pilot whale
 - Bottle-nosed dolphin

Appendix III: Acadia National Park Trails

Trail	Distance (mi/km)	Difficulty	Description
Acadia Mtn	2.5 / 4.0	S	Somes Sound, steep descent to fire road
Bar Harbor Shore Path	1.0 / 1.6	VE	Harbor and island view
Bar Island	Varies	E	Sand bar to forested island
Beech Mtn	1.2 / 1.9	M	Vista of Long Pond on the NW route
Beehive	0.8 / 1.3	S	Woods to exposed cliffs
Bowl	1.4 / 2.2	M	Forest to granite ledges and pond
Bubble Rock	1.0 / 1.6	M	Forest, Jordan Pond view
Cadillac Mtn N Ridge	4.4 / 7.0	M	Open ascent, Bar Harbor View
Cadillac Mtn S Ridge	7.4 / 12.8	S	Forest opening to gentle granite ascent
Cadillac Summit	0.3 / 0.5	VE	Panoramic views of Frenchman Bay
Champlain Mtn (Beachcroft)	2.4 / 3.8	S	Rocky open slopes
Champlain Mtn (Bear Brook)	2.2 / 3.6	M	Pine slope, vistas of Frenchman Bay
Dorr Mtn	4.8 / 7.7	S	Forest to steep granite ascent
Gorham Mtn	1.8 / 2.8	M	Forest opening to granite ascent
Great Head	1.4 / 2.2	M	Sea cliffs
Jordan Pond Nature	1.0 / 1.6	VE	Forest
Jordan Pond Shore	3.3 / 4.3	M	Follows Water's edge, rocky sections
Mansell Mtn	2.0 / 3.2	S	Rocky stairstep with Long Pond views
Most Carriage Roads	Varies	M	Varies
Norumbega Mtn	1.0 / 1.6	S	Steep ascent wooded summit
Ocean	3.0 / 6.0	VE	Sand Beach to sea cliffs
Pemetic Mtn	2.4 / 3.8	S	Forest to Ocean and lake view
Precipice	1.6 / 2.6	S	Exposed cliffs and ledges
Wonderland	1.4 / 2.2	VE	Forest to rocky shoreline

Note: VE = Very Easy, E = Easy, M = Moderate, S = Strenuous