

Deep Creek Lake, Maryland

Citizen Science and Crowd-Sourced Data Educational Outreach Programs

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Executive Summary

This project examined the opportunities for civic engagement at Deep Creek Lake, Maryland's largest inland lake, in Garrett County. Many private and governmental organizations support environmental citizen science and crowd-sourced data collection. These volunteer technical programs support various scientific and professional conservation projects of the ecosystem around Deep Creek Lake. The projects are for all ages, from school-aged children to senior citizens, and range from conservation information collection to advanced methods of training. The training includes an educational presentation on sampling methods for various environmental, physical and chemical characteristics; wildlife identification; and proper documentation. Projects and programs evaluated for citizen science included efforts at Lake George, Minneapolis Chain Lakes in Minnesota, Lake Tahoe in California, and Lake Michigan in Michigan and Indiana. The funding levels vary based on the complexity of the project or program selected. The research identified multiple potential governmental and nongovernmental funding opportunities for various levels of environmental education.

Deep Creek Lake, Maryland Citizen Science and Crowd-Sourced Data Educational Outreach Programs

Deep Creek Lake is the largest freshwater lake in Maryland covering 3,900 acres of space and 65 miles of shoreline. The lake is manmade and was created for hydroelectric power by the damming of Deep Creek. It has an average depth of 25 feet and a maximum depth of 75 feet and serves the community as a spot for tourism, boating, fishing, kayaking, swimming and other water sports (Garrett County Chamber of Commerce, n.d.). Deep Creek Lake State Park covers 1,800 acres and adjoins Deep Creek Lake Natural Resource Management Area, also administered by the MD Department of Natural Resources (DNR) – both are also home to swimming, hiking and biking, camping and educational events (Maryland Department of Natural Resources, n.d.). As both tourism and development in the area grows, protecting the lake's water quality and natural resources is important. Environmental education and outreach can be a vital tool to help achieve this goal.

Environmental education and outreach allows individuals to explore environmental issues, engage in problem solving and act to improve the environment. It allows people to develop a better understanding of issues in the environment and gives them skills to make better and more informed decisions. A successful environmental education program should include 1.) Awareness of the environment and its challenges 2.) Knowledge that provides an understanding of the environment and its problems 3.) Concern for the environment and a desire to improve it 4.) Skills to recognize and help to solve environmental problems 5.) Participation in activities that will result in the resolution of environmental problems (US Environmental Protection Agency, 2018). Environmental education and outreach programs can be important tools to inform people how the choices they make impact the environment and can lead to changes in

individual behaviors and lifestyles that improve the environment. Connections should be made on why the issue should matter to the individual and expressed in terms and concepts that are easily understood.

Currently, the Deep Creek Lake area has several environmental education topics that are applicable to visitors and users of the lake. Most notably, water quality issues and invasive species are topics that could benefit greatly from environmental education and outreach to visitors. The lake's water quality varies in response to annual and seasonal cycles in water temperature and mixing as well as changes in inputs from nutrient runoff. For example, as winter snow melts and spring rain begins, stormwater carries pollutants into surface waters like the lake causing increases in sodium and chloride concentrations. This can threaten aquatic life sensitive to salt levels and damage vegetation and soil (MDE, n.d.). Additionally, nitrogen and phosphorus pollution can be introduced from overuse of residential and agricultural fertilizers (Deep Creek Lake Science, 2018). Deep Creek Lake managers also conduct voluntary boat inspections at the Deep Creek Lake State Park boat ramp to prevent introductions of aquatic invasive species (AIS). Other on-going AIS efforts include herbicide treatments to control the invasive aquatic plant species *Hydrilla verticillata* and monitoring the lake for zebra mussels, another AIS of concern. Other important environmental issues for Deep Creek Lake include shoreline stabilization efforts and the creation of fish habitats, including monitoring submerged aquatic vegetation populations (Maryland Department of Natural Resources, 2020).

These topics are all important issues because the lake supports tourism, swimming, boating, fishing, and other recreational activities. Currently, Maryland Park Service staff conduct some environmental education and outreach efforts at the Discovery Center, which provides an educational and interpretive center for the public. Unfortunately, at the time of this report the

Discovery Center was closed for repairs. However, they have held past events including hands-on science experiments and activities, bird festivals, and field trips for students. The Discovery Center has an aviary which houses birds of prey and a Monarch Butterfly program. Additionally, there are some water quality and other ecological reports available online at the Eyes on the Bay website (Maryland Department of Natural Resources, n.d.). Maryland DNR has an online resource which displays water quality data to the public including dissolved oxygen, nutrient concentration and water temperature (Maryland Department of Natural Resources, 2018). Users can view this data and read the more technical reports, however there is a need to translate the scientific information into a format more easily understood by the public.

There is room for much improvement on environmental education and outreach materials for Deep Creek Lake visitors, both online and in person at various locations around the lake. Possible locations for distributing these materials range from visitor centers located in McHenry and Oakland, Maryland; local businesses including restaurants and boat-rental facilities; summer events, fairs and festivals; the Wisp Resort for winter sports and golfing; nearby state parks including Deep Creek Lake, Swallow Falls, Herrington Manor and New Germany state parks; RV and camper sites including Double G RV Park and Bumble Bee RV Park and Campground; and local vacation rental agencies including Taylor-Made Deep Creek Vacations, Offlake Realty and Rentals, Stillwater Haven, LLC. and Railey Vacations.

In an effort to identify some effective options, this report examines other large freshwater lakes' existing educational outreach programs and materials to determine their applicability for Deep Creek Lake, including materials for beginner, intermediate and advanced audiences. The report also examines funding options including available grants for outreach programs.

Research Methods

Freshwater lakes that were examined for this report include Lake George in New York, Lake Harriet in Minneapolis Minnesota, the Lake Tahoe Region in California, and Lake Michigan in Michigan and Indiana. Information was obtained through phone calls, emails and online searches. Due to various COVID-19 shutdowns across the country during the research of this report, there was some difficulty reaching some parties directly by phone or email resulting in a large volume of the material to be collected from online searches. Where applicable and available, further information and contacts are provided in the Appendix.

Lake George, New York

Beginner Materials

The New York Department of Environmental Conservation maintains a webpage with a list of PDFs, printable activities for elementary school-aged children. It has various journaling activities for children to log things that they observe in the wilderness. These range from observations made at different times of the day, as well as engaging all the senses – observing what they see in the environment, what they hear, or what they smell. Several bingo activities give them things to look for or listen to and mark off as they observe them (NY DEC, n.d.b.). These are great activities to help build observational skills in children and develop awareness of their surroundings. There are also similar activities but designed for going on a hike. This helps encourage exercise, rather than remaining in a single location for the activity.

They also have a large selection of informational sheets that can be printed out. These are great for children who learn better by absorbing information. There are sheets that inform

children of the various mammals they might see in the area, or reptiles, or fish, or trees (NY DEC, n.d.b.). Each sheet has a picture of the animal or plant and gives a paragraph of information about them. Some specifically target invasive plant and animal species. These help to educate children to be on the lookout for species that conservation agencies may want to eradicate in the area. There are sheets that educate children on food chains of some of the animals in the area, as well as rocks and minerals in the area. These help to establish an understanding of the local ecosystem. There are also worksheets that give information on various natural state symbols: state animal, bird, fish, tree, etc.

Other sections give informational worksheets on activities in the outdoors and teach them responsible ecological management. Several sheets give information on camping and stewardship of nature, managing a camp fire and distinguishing between safe and unsafe fires, and on leaving no trace behind of one's presence. Another section is devoted to various recycling practices and issues in New York State, as well as the recycling process and waste cycle. These are excellent tools to begin building environmental best practices at a young age. These activities are provided for general use by the NY DEC, not specifically at Lake George.

Many of these activities could be used at Deep Creek Lake. They have something for all learning types, activating multiple senses in learning and applying to the full range of environmental systems in the area, as well as challenges and threats to those systems. Having them available for download on a website would also be very cost effective as opposed to being pre-printed and put together in packs, as it would allow parents and children to decide from a list of activities and reading materials and only print out the ones that were most interesting to them. Many of these could be converted with little effort. A website could maintain activities that pertain to the Deep Creek Lake area, and informational sheets about the flora and fauna in and

around Deep Creek Lake and Garrett County. Sheets on Maryland state symbols would be popular and worksheets on invasive species in the area would be very beneficial. Worksheets regarding recycling and natural management would be applicable as well and would only need to be changed regarding jurisdictional-specific requirements and practices. Parents could be made aware of the availability of these sources by links on DCL tourist sites and at information desks in visitor centers and hotels.

Intermediate Materials

Lake George is a long, narrow lake in the Adirondacks, so it has a similar geography to Deep Creek Lake. It is a natural lake formed by glaciers, making its history of formation much different from DCL. The Lake George Association (LGA) maintains a boat as a floating classroom. This is their centerpiece educational activity. The classroom can hold 30 passengers. It is open to the public during the months of July and August and is available for student field trips May through June and September through the middle of October. The program for the floating classroom runs about two hours and is often combined with a stream monitoring program for fieldtrips (LGA, 2020c).

The floating classroom program teaches students and other passengers the basics about Lake George's ecology and geography, as well as its geological history. It also teaches them about water quality issues while showing students how to test the water for pH and clarity, temperature and dissolved oxygen content (LGA, 2020b). Students also net and observe plankton from the lake, as well as learning about how the lake is affected by invasive species and how non-point pollution affects the lake. Students are able to learn techniques for helping to protect the quality of the lake.

To make a full-day field trip, the floating classroom program is coupled with a monitoring program along one of the streams feeding into the lake. This program complements the floating classroom by looking at many of the same issues from the perspective of the lake's watershed. Students collect aquatic inspect specimens and are taught to observe if they are healthy. They learn about what makes up the watershed and how pollution affects the lake by being carried into it from the streams. They also learn about erosion and invasive plant species in the stream and how they affect the lake. Schools with groups of more than 30 students participating on the same day are split into two groups, one group starting on the floating classroom first, and the other on the stream monitoring (LGA, 2020d).

The Lake George Association also has a number of science programs designed for in-class use. These align to NY State teaching standards and take about an hour to complete (LGA, 2020a). These programs cover many of the same topics as the field trip programs do. They are broken up into elementary, middle and high school-level lessons that teach about the watershed, aquatic life, stormwater drainage and pollution, invasive species and the human impact on the environment. The LGA also makes lesson plans available for teachers to use with the science programs.

The LGA receives funding for its floating classroom and stream monitoring programs from membership fees and donations, and from state and local grants. The LGA makes fieldtrips free to students from schools within the Lake George watershed and gives those schools priority of scheduling because of limited availability. After schools within the watershed have had a chance to book, the LGA opens up booking to school districts outside the watershed (LGA, 2017).

Because of the narrow nature of the lake, we think DCL would be a suitable location for a similar program. DCL could also host a similar stream monitoring program in its feeder streams and could potentially add educational programs related to the dam, covering monitoring and maintenance, architecture and engineering, and hydroelectric systems. A potential drawback would be DCL's location in a sparsely populated region of Maryland. Hosting fieldtrips for local schools may not be feasible as it could be cost-prohibitive due to the low number of schools. However, since Deep Creek Lake is a popular tourist destination during the summer months, it could be feasible as an attraction for the general public at that time. Summer camps and schools with distance-learning programs are also potential summertime clients.

Advanced Materials

The New York Department of Environmental Conservation hosts two programs for women to become acquainted and comfortable with outdoor activities. Called BOW (Becoming an Outdoors-Woman) and Beyond BOW, these programs are structured workshops geared towards promoting competence and confidence in women in a variety of outdoor skills (NY DEC, n.d.a.). The workshops cover an extensive list of skills needed for the procurement of food, wilderness survival, and recreational activities: shooting (rifle or shotgun), archery, hunting (deer and turkey), bowhunting, fishing, camping, backpacking, trapping, canoeing, kayaking, outdoor cooking, fish and game cooking, using a compass and a map, birdwatching, wildlife identification, wilderness first aid, and survival skills, among other possibilities (Talbot, 2020). They are particularly designed for women who do not have much experience with outdoor activities.

The BOW program is an annual, three-day weekend event that is hosted at different locations throughout New York state. Women get to choose four workshops from a list of close to 50 topics to take part in over the three-day weekend. These workshops give participants a broad introduction to the skills they have selected. Beyond BOW programs are half- or full-day programs that concentrate on one of these skills and go into further depth. These are hosted at various locations throughout the year. A common course for Beyond BOW is the hunter education course, which goes into field dressing, game cooking, tree stand safety and ethics, as well as using a rifle or shotgun. The BOW weekend is designed for about 130 women, while the Beyond BOW classes usually have about 30 (Talbot, 2020). The Lake George Association links to the NY DEC website for BOW as an activity of interest.

This is a popular program that I think could easily be adapted for use at Deep Creek Lake. These skills are of interest to many men as well, so I think this could be used as a template to design programs for both men and women. New York designed this specifically to interest women in greater participation in outdoor activities, but there is not any reason that it needs to be limited to women. Depending on interest, it may be worthwhile to have a program just for women for those who may feel more comfortable or safer in a group of other women, but also a program that is open to all. Deep Creek Lake is an ideal setting for many of these activities. It is also far enough away from the Baltimore-Washington and Pittsburgh metro areas to be appealing as a weekend getaway from the city, while not being so far away to make it a burden to travel to. It may be less appealing to travel to DCL for a half-day program, so Beyond BOW-type classes might be better suited to the interests of the local population and held less infrequently.

Chain of Lakes/Lake Harriet Minneapolis, Minnesota

Lake Harriet as well as other lakes in Minneapolis are similar in physical characteristics to Deep Creek Lake, such as depth, and similar amount of total shoreline. Both lake areas are used for the purpose of recreation and tourism in their respective states. With development around both lakes growing, emphasis on environmental education has helped in the prevention of decreased water quality and the preservation of natural resources.

Lake Harriet is one of the largest lakes in the Chain of Lakes, sitting between Bde Maka Ska and Minnehaha Creek, and has an area of 335 acres and a maximum depth of 85 feet. Lake Harriet and other Minneapolis lakes are popular for recreation, with activities such as sailing, paddling, fishing and swimming, and are popular for out of town visitors in the summer months. It also offers a system of bike and pedestrian trails, and a parkway system that connects with Bde Maka Ska on the north end of Lake Harriet and the Minnehaha Creek trail system at the southeast side of the lake. At the lakes, there are rose and rock gardens, bird sanctuaries, concerts, and special events at the bandshell. Lake Harriet has high rankings and reviews from visitors and is known for beautiful scenery, large variety of plant and wildlife, water clarity, and low levels of bacteria (Minneapolis Parks & Recreation Board, 2020).

Educational Material

One type of educational activity practiced at Lake Harriet is measuring water transparency with a Secchi disk by lowering a disk from the shaded side of a boat until it cannot be seen. This activity is performed in boats in different locations of the lakes by natural resource managers, as well as private owners from their properties, and records the point where the disk reappears from its point beyond visibility. The readings compare and determine trends in water quality of Lake Harriet over time with different factors such as, operator perspective, and color

or suspended particles in the water. This activity is a fun way of comparing transparency of the lakes in a way that children can understand (Minneapolis Parks & Recreation Board, 2020).

Lake Harriet contains a large variety of different species of fish compared to other lakes of its size, and guidelines have been placed on the consumption of these species due to contamination with mercury and other substances in the water and sediment. The Parks and Recreations board as well as many nature reserve centers at the Chain of Lakes teach environmental lessons about the importance of increasing water clarity and reasons for fluctuation in clarity due to environmental factors. Secchi readings are done regularly and are scheduled up to every two years by lake management. Teaching visitors about water clarity helps them become aware of their actions and presence at the lakes.

Another issue brought to the attention of visitors is the high bacteria levels that can occur immediately after rain events in Minneapolis. Visitors are taught at the time of arrival to clean up after any pets that visit with their owners due to the increased bacteria levels from waterfowl and pet wastes in the parks that wash into lakes as the result of a heavy rain. Visitors are cautioned to avoid swimming after a rainfall at the Chain of Lakes due to the occasional elevated bacterial levels until levels return to normal levels within 48 hours of a rainfall. Visitors are also warned to avoid swimming if they are sick so that they do not transmit disease, and to practice good hygiene while visiting by being careful to not drink the lake water, washing their hands before eating, and to shower after swimming when possible. The Minneapolis Parks and Recreations Board also tests for pathogenic bacteria, such as E. coli, to ensure the safety of the lake's beaches. Only when the water quality of the swimming areas safe are recreational activities allowed to be practiced, but are occasionally shut down briefly due to the high levels of bacteria in the area (Minneapolis Parks & Recreation Board, 2020)

The informational content provided for the visitors and agencies of the lake also warns swimmers of swimmer's itch, which can occur occasionally. Swimmer's Itch is described to the visitors as small, irritating red welts that appear after swimming, and could itch for several weeks. Swimmers itch occasionally affects the Minneapolis lakes and beaches and is usually irritating but harmless. Visitors are warned to avoid infection by towel drying immediately after exiting the water and showering afterwards. Swimmer's Itch can occur after swimming on hot, still summer days, and is caused by a parasite that infects birds and snails during different stages of its life, although unable to live in humans (Minneapolis Parks & Recreation Board, 2020). The importance of these informational warnings for the visitors of the Minneapolis lakes allows those who come from Minneapolis and other parts of the country to stay safe and have fun as well as protect others and the environment around them.

Environmental Programs and Activities

The Minneapolis Chain of Lakes has an abundance of environmental educational programs and activities that allow visitors to understand the ecosystem and enjoy what the lakes have to offer. The goal is to promote knowledge and understanding of the natural world through discussion and meaningful experiences. Although the Chain of Lakes is surrounded by a large urban area, they are still surrounded by wildlife and plants, where the lakes provide nature walks, canoeing trips, and the observation of birds and other animals. These programs can take place at a variety of locations, such as at an environmental learning center or on camping trips in the lakes' wilderness areas (Hendel, 2019).

Nature programs for children at the lakes and parks include Junior Naturalists, a group for children ages 6 to 12 years. These children participate and learn different topics such as the

animals and plants that live within the habitat around them. Regional parks also offer Nature Nuts for four and five-year old children. This program consists of mostly outdoor play sessions with activities for participants and is casually based around ideas such as plants, insects, water, reptiles, and seasons (Parks & Recreation Board, 2020). These children's programs are a benefit to the visiting families because the environmental educators provide people with children in the family care while adults can have the time to enjoy meaningful experiences in nature at the parks and lakes. Participants learn teamwork, research activities, and educational games about forests, wetlands, animals and pollution (Hendel, 2019). Activities are hosted by those working for Parks and Recreations at the Chain of Lakes and are available to register at various prices based on class.

Bird-watching programs are also available to anyone. Certain programs are geared towards more-experienced bird watchers while others are more encouraging to families and those wanting to learn about bird watching in a more casual setting. There are different watching programs that include early birders and beginning birding at various Minneapolis Regional Parks (Parks & Recreation Board, 2020). Nature Connections programs are also available for adults over the age of 55 which consists of weekly outdoor walking groups and nature activities at select parks and park recreation centers. They include a nature-focused walking group, floral arranging, and birding from the indoors (Parks & Recreation Board, 2020).

Environmental experts in the Minneapolis areas find that nature programs for children in the chain of lakes area was a great opportunity to teach them environmental issues as well as allowing them to understand how the Parks and Recreations board monitors and cares for the ecosystem and the health and safety of the people who visit. For participants of the nature

education programs, building confidence and having adventure during their stay encourages further exploration into the experience (Hendel, 2019).

Lake Tahoe Region

D.L. Bliss & Emerald Bay State Park-

The parks include six miles of Lake Tahoe's western shore and cover 1,830 acres of California's Sierra Nevada. Emerald Bay was designated a National Natural Landmark in 1969. The park website describes the park's history including the history of native people, introduction of settlers and miners, notable persons, buildings, and geological formations.

The park's website describes the underwater preserve. The park contains several underwater shipwrecks as well as natural beauty and prehistoric sites from the native people who once inhabited the region. The underwater preserve is accessible by the Maritime Heritage Underwater Trail. Scuba and snorkel divers are encouraged to explore several sites along the underwater trail. Underwater interpretive panels have been placed at four of the dive sites and waterproof interpretive cards are available for divers at park visitor centers and local dive shops. Information is also available at the Sierra State Parks Foundation's website.

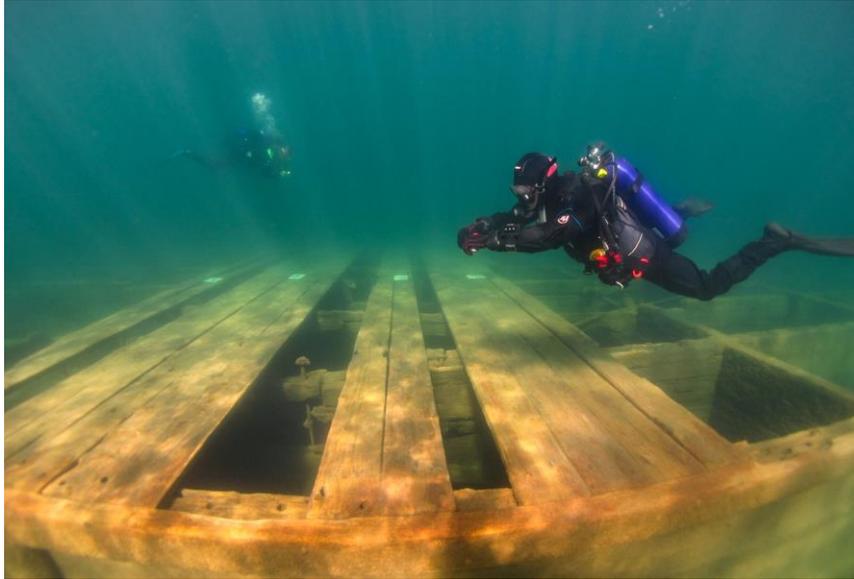


Figure 1. Caption. Source: https://www.parks.ca.gov/?page_id=29931

Creating an underwater trail system could give DCL an opportunity to show visitors a different aspect of the amazing natural beauty and resources the park has to offer. This activity could also attract visitors who would otherwise not visit the park. While a limited subset of visitors would be interested in scuba or snorkeling, this activity could be a unique way to attract new guests as well as highlight some of the interesting environmental aspects of the lake. Participants could learn about biodiversity, habitat, water quality and if any remnants of the structures that were inundated when the dam remain, they too would provide interesting sites for divers.

Spooner Lake and Backcountry, NV-

Spooner Lake is a small man-made lake in Nevada approximately 1 square mile in area, on the north east side of Lake Tahoe. The lake is surrounded by 12,000 acres of forested and open spaces. They park offers several recreational activities on and off the water; two activities

of note are cross-country skiing and snowshoeing during winter months as well as periodic guided tours provided by Lake Tahoe Nevada State Parks.

The winter cross-country skiing and snowshoeing trails are made possible from a partnership that Spooner Lake has with the Nevada Nordic non-profit group. The group's goal is to bring groomed ski trails to Nevada. Spooner Lake also maintains a Facebook page which promotes Lake Tahoe Nevada State Park's periodic guided tours. These tours vary depending on the season and what the environment has to offer at that time. They include a wildflower walk, wildlife talks, and guided snowshoe hikes.



Figure 2. Caption Source: <https://nevadanordic.org/#nordic-center>

Although DCL is open to visitors during winter months and trails are open for snowshoeing and skiing, providing groomed snow trails for cross-country skiing and

snowshoeing could make DCL an ideal location to participate in these winter activities. Grooming snow trails could be expensive and labor intensive for DCL but could attract visitors during winter months who may otherwise choose to go to nearby ski resorts or other parks instead. Spooner Lake maintains these trails through a partnership with a non-profit group, and perhaps DCL could find similar interested advocates for snowshoeing and cross-country skiing to help maintain the trails and provide necessary funding.

The Lake Tahoe Nevada State Parks guided tours provide outreach and environmental education to visitors. Snowshoeing tours during the winter months would be a unique experience for visitors and would be an excellent environmental outreach opportunity for DCL. Tour guides could directly interact with visitors and provide information tailored to the hike such as wildlife during winter and water quality issues from runoff and road salts. When guided tours are not available, visitors could be provided with trail maps or brochures with interesting information as well as having informational signs along the trail route.

North Tahoe Regional Park, CA

North Tahoe Regional Park, in Tahoe Vista CA, encompasses 124 acres and offers a variety of recreational activities. A unique experience is the treetop adventure course. The park has partnered with Tahoe Treetop Adventure Parks to create a treetop adventure course. Visitors are able to explore the tree canopy by traversing 70 tree platforms which are connected by bridges and ziplines. Visitors are kept safe using safety harnesses which are connected to a safety cable. The treetop adventure course allows people from beginner to advanced abilities to uniquely explore the Lake Tahoe forest.



Figure 3. Caption Source: <https://www.tahoetreetop.com/>

According to the Tahoe Treetop Adventure Park website, the park is designed and constructed in a way to prevent harm to the trees. They employ a compression method that prevents harm, allows the tree to continue to grow, and they can be removed if tree or forest needs arise. The park also protects the trees at ground level by marking designated paths between the courses and trees. One of the most harmful impacts in a forested area is compaction of the root zones at the base of trees. A compacted root zone does not allow fluid and natural nutrients to flow to the tree roots and can slowly kill trees (Tahoe Treetop Adventure Park, 2020). They mark paths and create removable ground platforms to keep the root zones healthy. The adventure park is always vigilant about invasive insects and other species that threaten the actively used trees as well as surrounding trees. Besides providing activities for visitors the adventure park also works with the Tahoe Regional Planning Agency to study and measure the effects the treetop adventure course is having on the trees. The Tahoe Treetop Adventure Park's commitment to protecting the health of their trees is supported by the consulting arborists they employ. The arborists use the latest testing and measurement methods to collect data which allows them to establish a baseline tree health and continued monitoring into the future.

If a partnership could be established or if DCL could build a park like this it would provide a unique way to experience DCL and its trees. DCL could use an adventure park to offer a curriculum for students and visitors teaching about the forest land around DCL. Students and other interested participants would have a bird's eye view of the various trees in the area and have firsthand knowledge of the resiliency and amazing features of those trees.

Lake Michigan

Lake Michigan is the lone Great Lake entirely within the United States and connects with Lake Huron. The lake is surrounded by four states: Michigan is to the east and north; Wisconsin is to the west; Illinois is the southwest; Indiana is to the southeast. The runoff area into the lake is approximately 45,500 square miles. Several major cities border the lake, including Chicago. From north to south, the lake is around 321 miles in length, and from the east to west, it is approximately 118 miles in length. The surface area of the lake is about 22,300 square miles, with an average depth of over 200 feet. The land next to Lake Michigan is low and has a gentle slope towards the lake. However, wind and wave erosion has carved several bluffs of rock. Of note is the sand dunes which occur with the confines of the Indiana Dunes National Lakeshore and State Park (Great Lakes Commission, n.d.).

MiCorps' (Michigan Clean Water Corps) Cooperative Lakes Monitoring Program (CLMP) provides technical assistance, training, and other support to volunteers who monitor the Lake Michigan. The MiCorps works to ensure that data collecting methods work reliably and produce reliable, good-quality data. The basic program is detailed as follows. The data they collect includes various aspects of water quality, biological activity, and other weather/environmental conditions. Some items that they volunteer scientists from the community

collect are water depth, phosphorus concentration, chlorophyll, clarity, and temperature. The data is collected via a partnership with Science Starter (Great Lakes Commission, n.d.). The kits cost about \$25 from the website <https://scistarter.org/cooperative-lakes-monitoring-program>. This project is a lower risk opportunity due to the fact most of the data collection would be near populated areas, and risk from hazardous environmental conditions is limited (Scistarter, 2020).

Also, from the Michigan Corps is a moderately more difficult program that is similar to the lake monitors the inlet waterways. The same information is collected as on the lake, but due to the difficulty in obtaining the data. The remoteness, flora, and fauna impediments increase the risk to citizen scientists/volunteers. Due to the remoteness of the sites, it may be problematic and risky for the youth and the elderly to participate (Great Lakes Commission, n.d.).

The Michigan Corps website provides excellent support that is downloadable for use by citizen scientists. The website offers detailed guides to the various monitored characteristics such as algae growth and oxygen content. Furthermore, the organization provides regular newsletters and handbooks for those involved in monitoring. These guides provide easy to follow methods to collect and share their data. Moreover, it is possible to access and filter data that has been obtained to support academic and environmental research (Great Lakes Commission, n.d.).

Zoomin is an observational project that helps identify animals around the Lake Michigan Area. This project looks for animals in the area to better understand the relationships between predators and prey, behavior, distribution, and more by classifying the images captured by remote cameras throughout the state. The website for this project is <https://www.zooniverse.org/projects/michiganzoomin/michigan-zoomin>. Due to the risks of

interacting with wildlife, this project is riskier. It would require additional training and liability waivers for this innovative venture (ZoomIn Michigan, n.d.). Additionally, this would be considered more advanced plan for citizen scientists than the average citizen.

The Zooniverse is a project organizational website with multiple opportunities to build and collect data. The website is merely a tool for the hosts and has many suggestions for refining projects. Still, the projects are wholly managed by the project owner. It is an excellent method to collaborate and collect data; the information and publications are unique to a particular project. This uniqueness leads to challenges in adapting the project to Maryland (ZoomIn Michigan, n.d.).

Established Maryland State Programs

More advanced programs that can be incorporated in the Deep Creek Lake citizen science programs include established programs from the Maryland Department of Natural Resources. The Maryland governmental sponsored volunteer programs include the Stream Waders and the Maryland Naturalist programs. Both of these volunteer organizations incorporate extensive educational, scientific, and data collection systems. The Stream Waders are a cohort of environmental supporters with varied backgrounds and skills which focus on the ecological conditions of the streams of the state. There is currently a program in the Deep Creek Lake area (Friends of Deep Creek Lake, 2020). These paraprofessional volunteers have the potential to be utilized in the Deep Creek Lake conservation activities. By using their skills and knowledge to support other citizen science programs that are developed. The Stream Waters are trained in developing sampling plans, sample preservation methods, and other scientific sampling protocols (Maryland Stream Waders, 2012).

Additionally, the Maryland Master and Junior Naturalist program is an established program that utilized volunteers to support the state's ecological efforts; also, they are required to "pay it forward" by training future naturalists. Their training includes education classes on ecology, wildlife identification, and astronomy, among other topics (Master Naturalist Training, n.d.). Additionally, these programs have various state funding available via the Maryland Department of Natural Resources. The Deep Creek Lake natural resources community has utilized these state volunteer programs in the past to collect information on the watershed status (Funding Opportunities, n.d.).

Grants

The EPA Environmental Education Grants program seeks grant applications to support environmental education projects. These projects must promote environmental awareness, stewardship and provide people with the skills to act to protect their environment. Projects should design, demonstrate and/or disseminate environmental education practices, methods or techniques. State environmental agencies are eligible to apply with the total estimated funding in EPA Region 3 of up to \$300,000. In 2020 the Region expects to award three or four grants between \$50,000 to \$100,000 each. Applicants will need to demonstrate how they can provide non-federal matching funds for at least 25% of the total cost of the project. This year's application deadline has passed but will open again from October 2020 to January 2021 (US Environmental Protection Agency, 2020). More information can be found at <https://www.epa.gov/education/grants>

The Chesapeake Bay Trust offers an Outreach and Restoration Grant Program for outreach activities that increase stewardship of natural resources and restoration activities for

Maryland's natural resources. The grant provides up to \$30,000 for knowledge building projects and \$50,000 for behavior changing projects for programs located in the state of Maryland and are not restricted to the Chesapeake Bay watershed. Municipal, County, Regional, and State agencies are eligible to apply, with an anticipated program open date of May 2020 (CBTrust, 2020). More information can be found at https://cbtrust.org/wp-content/uploads/Outreach-and-Restoration_RFP_FY20_Final.pdf

Captain Planet Foundation offers ecoSTEM Kit grants. The Watershed ecoSTEM kit is a collection of hands-on learning tools that leave kids with knowledge of how their choices impact the health of a local watershed enabling them to model evaporation and precipitation. They can also investigate stream health by testing physical and chemical parameters or searching for pollution-sensitive macroinvertebrates. Their website also provides information on what is included in the kits (Captain Planet, 2020). More information can be found at <https://captainplanetgrants.communityforce.com/Funds/Search.aspx#4371597136646D517975544F5976596D4E73384E69673D3D>

The National Park Service offers a Conservation, Protection, Outreach and Education Grant to support projects complementary to the National Park Service program efforts in resource conservation and protection, and environmental sustainability. Projects may include community outreach and education and can receive \$2,000 up to \$925,000. State and local governments are eligible to apply (Federal Grants, 2020). More information can be found at <https://www.federalgrantswire.com/national-park-service-conservation-protection-outreach-and-education.html#.XpIGL8hKhPZ>

Conclusion

Deep Creek Lake would benefit from additional environmental educational and outreach materials for visitors. This report details many options that have been successfully implemented at other large freshwater lakes across the country and are likely to also benefit Deep Creek Lake. The cost of the programs and funding that Deep Creek Lake can obtain to implement programs should be considered. It is recommended that based on funding available, that materials that can reach the most number of visitors and the widest range of ages and educational background level be chosen to ensure the greatest impact of the program(s). Some of the best fit options that would be recommended for Deep Creek Lake would include water clarity and quality programs that could be broadened to test for additional contaminants outside of the normal substance screening already performed. Extending educational outdoor programs for different demographic groups and developing volunteering data collection programs to help train those who would assist in Deep Creek Lake environmental maintenance. Educational materials should not be solely supplied to management of Deep Creek lake, but distributed online and/or to various locations around the area that visitors are likely to visit ranging from local businesses to rental agencies to state parks and at local events. Deep Creek Lake managers could keep track of the amount of materials taken by visitors and/or make an online survey available to gain feedback from visitors on the success of the materials. This information could be used to reevaluate which materials are most popular amongst visitors and can help direct future funds and education and outreach efforts to the right areas.

References

Captain Planet. (2020). Captain Planet Foundation. Retrieved from

<https://captainplanetgrants.communityforce.com/Funds/Search.aspx>

CBTrust. (2020). 2020 Outreach and Restoration Grant Program. Retrieved from

https://cbtrust.org/wp-content/uploads/Outreach-and-Restoration_RFP_FY20_Final.pdf

Deep Creek Lake Science. (2018). Water Quality. Retrieved from

<http://deepcreekscience.com/waterquality.php>

EPA. (2005, September). Nutrient Concentrations in the Minneapolis Chain of Lakes Nearly

Returned to Presettlement Conditions. Retrieved from NONPOINT SOURCE

PROGRAM SUCCESS STORY: https://www.epa.gov/sites/production/files/2015-11/documents/mn_chain.pdf

EPA. (2019, December 1). Environmental Protection Agency. Retrieved from Citizen Science

for Environmental Protection: <https://www.epa.gov/citizen-science>

Federal Grants. (2020). National Park Service Conservation, Protection, Outreach, and

Education. Retrieved from <https://www.federalgrantswire.com/national-park-service-conservation-protection-outreach-and-education.html#XnfM5ohKhPY>

Friends of Deep Creek Lake. (2020, April 2). Friends of Deep Creek Lake. Retrieved from

Facebook: <https://www.facebook.com/FriendsOfDCL/>

Garrett County Chamber of Commerce. (n.d.). Deep Creek Lake Fast Facts - Garrett County

Chamber of Commerce, MD. Retrieved from <https://www.visitdeepcreek.com/deep-creek-lake-fast-facts>

Great Lakes Commission. (n.d.). Lake Michigan. Retrieved from Great Lakes Commission:

<https://www.glc.org/lakes/lake-michigan>

Great Lakes Commission. (n.d.). Lake Monitoring. Retrieved from Michigan Clean Water Corps:

<https://micorps.net/lake-monitoring/>

Hendel, E. (2019). Environmental Education in the City. Retrieved from Do It Green, Minnesota:

<https://doitgreen.org/topics/environment/environmental-education-city/>

Lake George Association. (2017). Floating classroom booking policy. Lake George Association.

Retrieved from: <https://www.lakegeorgeassociation.org/wp-content/uploads/2017/03/lga-floating-classroom-booking-policy.pdf>

Lake George Association. (2020a). Education programs. Lake George Association. Retrieved

from: <https://www.lakegeorgeassociation.org/educate/education-programs/>

Lake George Association. (2020b). Floating classroom. Lake George Association. Retrieved

from: <https://www.lakegeorgeassociation.org/educate/floating-classroom/>

Lake George Association. (2020c). Floating classroom schedule. Lake George Association.

Retrieved from: <https://www.lakegeorgeassociation.org/product/floating-classroom-schedule/>

Lake George Association. (2020d). Plan your floating classroom fieldtrip. Lake George

Association. Retrieved from: <https://www.lakegeorgeassociation.org/educate/floating-classroom/field-trips-for-teachers/>

Maryland Department of Natural Resources. (n.d.). Deep Creek Lake State Park. Retrieved from

<https://dnr.maryland.gov/publiclands/pages/western/deepcreek.aspx>

Maryland Department of Natural Resources. (2018, May 30). Deep Creek Lake Water Quality

Monitoring Data Now Online. Retrieved from

<https://news.maryland.gov/dnr/2018/05/30/deep-creek-lake-waterquality-monitoring-data-now-online/>

Maryland DNR. (2020). Winter 2020 Update Concerning Deep Creek Lake. Retrieved from

<http://eyesonthebay.dnr.maryland.gov/dcl/documents/DNR2020WinterUpdate.pdf>

Maryland Department of Natural Resources. (n.d.). Funding Opportunities. Retrieved from

Department of Natural Resources:

<https://dnr.maryland.gov/ccs/Pages/funding/fundingopp.aspx>

Maryland Department of Natural Resources. (n.d.). Master Naturalist Training. Retrieved from

Maryland Department of Natural Resources:

<https://dnr.maryland.gov/wildlife/Pages/Education/MDNaturalistTraining.aspx>

Maryland Stream Waders. (2012). Maryland Stream Waders. Annapolis: Maryland Department

of Natural Resources. Retrieved from

<https://www.garrettcounty.org/resources/watershed/pdf/Publications/Maryland/MSW-10Year-Report.pdf>

MDE. (n.d.). The 411 on Road Salt. Retrieved from

<https://mde.state.md.us/programs/Marylander/Pages/roadSalt.aspx>

Minneapolis Parks & Recreation Board. (2020). Lake Harriet Park. Retrieved from Minneapolis

Parks & Recreation Board:

https://www.minneapolisparcs.org/park_care__improvements/water_resources/lake_water_resources/lake_harriet_water_resources/

NY Department of Environmental Conservation. (n.d.a). Becoming an outdoors-woman. New

York Department of Environmental Conservation. Retrieved from:

<https://www.dec.ny.gov/education/68.html>

NY Department of Environmental Conservation. (n.d.b). Nature activities. New York

Department of Environmental Conservation. Retrieved from:

<https://www.dec.ny.gov/education/72444.html>

Parks & Recreation Board. (2020). Nature Activities. Retrieved from Minneapolis Park &

Recreation Board: https://www.minneapolisparcs.org/activities__events/nature-activities/

Scistarter. (2020, March 15). Cooperative Lakes Monitoring Program. Retrieved from Scistarter:

<https://scistarter.org/cooperative-lakes-monitoring-program>

Talbot, K. (Personal communication, March 12, 2020).

US Environmental Protection Agency. (2018, November 5). What is Environmental Education?

Retrieved from <https://www.epa.gov/education/what-environmental-education>

US Environmental Protection Agency. (2020, January 2). Environmental Education (EE) Grants.

Retrieved from <https://www.epa.gov/education/grants>

U.S. Government. (2010). Garrett County, Maryland. Retrieved from U.S. Census:

<https://www.census.gov/quickfacts/garrettcountrymaryland>

ZoomIn Michigan. (n.d.). ZoomIn Michigan. Retrieved from Help us investigate wildlife in

Michigan!: <https://www.zooniverse.org/projects/michiganzoomin/michigan-zoomin>

Appendix

New York

NY DEC Printable Materials - <https://www.dec.ny.gov/education/72444.html>

Outdoor Observations and Journaling -

https://www.dec.ny.gov/docs/administration_pdf/myfieldjournal.pdf

Seek and Find Hikes - https://www.dec.ny.gov/docs/administration_pdf/2008jrnat3.pdf

All About Animals - https://www.dec.ny.gov/docs/administration_pdf/2005jrnat9.pdf

Camping and Stewardship - https://www.dec.ny.gov/docs/administration_pdf/2003jrnat3.pdf

Floating Classroom Information –

- Maximum passengers: 30 (LGA, 2020c)
- School booking limits: 60 students per day for a total of three days and one full grade per school (LGA, 2017).
- Costs for field trips: Schools within Lake George watershed: free; schools outside watershed: \$150 per program; summertime fieldtrips for all schools: \$250 per program (LGA, 2020b).
- Costs for summertime general admission: \$18 per adult, \$17 per senior, \$12 per child (LGA, 2020a).

- Contact Information: Kristen Wilde - Lake George Association
 - Tel: 518.668.3558
 - Email: kwilde@lakegeorgeassociation.org; info@lakegeorgeassociation.org
 - Website: <https://www.lakegeorgeassociation.org/educate/>

NY DEC BOW Program Contact Information: Katrina Talbot – Wildlife Biologist; BOW Coordinator. New York Department of Environmental Conservation

- Tel: 518.402.8963
- Email: katrina.talbot@dec.ny.gov
- Website: <http://www.dec.ny.gov/education/68.html>

Minnesota

Minneapolis Chain Of Lakes Environmental Informational Research Booklet -

http://www.minneapolismn.gov/www/groups/public/@cped/documents/webcontent/convert_284600.pdf

Minneapolis Parks and Recreations Board -

[https://www.minneapolisparcs.org/park_care_improvements/water_resources/lake_water_re
sources/lake_harriet_water_resources/](https://www.minneapolisparcs.org/park_care_improvements/water_resources/lake_water_resources/lake_harriet_water_resources/)

Nature Centers located within Chain of Lakes, Minneapolis:

- Dodge Nature Center 365 Marie Ave W W. St. Paul, MN 55118 651-455-4531
- Springbrook Nature Center 100 85th Ave NE Fridley, MN 55432 763-572-3588

- Staring Lake Outdoor Center 8080 Mitchell Road Eden Prairie, MN 55344-4485 952-949-8479
- Wargo Nature Center 7701 Main Street Hugo, MN 55038 651-429-8007
- Eastman Nature Center 13351 Elm Creek Rd. Osseo, MN 55369 763-420-4300
- Richardson Nature Center 8737 E Bush Lake Road Bloomington, MN 55438 952-941-7993

Minneapolis Parks & Recreations Board: 2117 West River Road, Minneapolis, MN 55411
612-230-6400 (Mon–Fri 8:00–4:30)

Lake Tahoe Region

D.L. Bliss and Emerald Bay State Parks

Contact Information: D.L. Bliss and Emerald Bay State Parks Hwy. 89/P.O. Box 266,
Tahoma, CA 96142

- D.L. Bliss (530) 525-7277
- Emerald Bay (530) 541-3030 (summer only)
- Sierra District Headquarters (530) 525-7232
- Education/Interpretation Programs 530-525-9524

Online Sources: General Park website listing park information, activities, maps, and where the informational brochure can be downloaded - https://www.parks.ca.gov/?page_id=506

Information regarding the Emerald Bay Maritime Heritage Trail - https://www.parks.ca.gov/?page_id=29931

Park Brochure -

<https://www.parks.ca.gov/pages/506/files/DLBlissEmeraldBayFinalWeb122917.pdf>

Spooner Lake & Backcountry

Contact Information: P.O. Box 6116 Incline Village, NV 89452

- 775-831-0494
- ltensp@parks.nv.gov

Jenny Ramella (media contact) Education & Information Officer –

- (775) 684-2704
- jmramella@parks.nv.gov

Online Sources: General park website - <http://parks.nv.gov/parks/lake-tahoe-nevada-state-park-1>

Nevada Nordic non-profit group - <https://nevadanordic.org/#nordic-center>

LTNSP - Spooner Lake Facebook page

<https://www.facebook.com/sandharborofficial/?fref=ts>

North Tahoe Regional Park

Contact Info: North Tahoe Regional Park Mailing address PO Box 139, Tahoe Vista, CA 96148 Call (530) 546-4212 Fax (530) 546-2652

Tahoe Treetop Adventure Parks PO Box 6687 Tahoe City, CA 96145 530-807-1004

Online Sources: General Park Website <https://northtahoeparks.com/north-tahoe-regional-park>

Tahoe Treetop Adventure Park Website <https://www.tahoetreetop.com/>

Lake Michigan

Indiana Dunes, National Park Service - <https://www.nps.gov/indu/index.htm>

Lake Monitoring -

Michigan Lakes and Streams Association, P. O. Box 303, Long Lake, Michigan 48743

- Phone - 989-257-3715
- E-mail - jroth@mlswa.org
- Website - <https://micorps.net/lake-monitoring/>

Lake Monitoring Brochure -

<https://cdn2.cloud1.cemah.net/wpcontent/uploads/sites/63/2019/12/CLMP-Brochure.pdf>

Silver Lake State Park, Michigan Department of Natural Resources -

<https://www2.dnr.state.mi.us/parksandtrails/Details.aspx?type=SPRK&id=493>

Michigan Corps - <http://www.michigancorps.org/>

For inquiries, e-mail info@michigancorps.org or call (313) 451-1217

Science Starters - <https://scistarter.org/cooperative-lakes-monitoring-program>

Maryland Department of Natural Resources

Master Naturalist –

<https://dnr.maryland.gov/wildlife/Pages/Education/MDNaturalistTraining.aspx>

Stream Waders - <https://dnr.maryland.gov/streams/Pages/streamWaders.aspx>

Friends of Deep Creek -

- Phone - 3018731519
- Email - contact@friendsofdcl.org
- Facebook - https://www.facebook.com/pg/FriendsOfDCL/about/?ref=page_internal
- Website - <http://friendsofdcl.org>