

**Alma/Moon Lake District Lake Protection Grant
Restoration of Shoreline Habitat Project Performance Report
April 10, 2011**

Project Title: Restoring Shoreline Habitat on Moon Lake, Vilas County, to Improve Lake Water Quality and to Evaluate Ecological Benefits

Project Summary

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Summary: A large shoreline restoration project was conducted on the Moon Beach Camp property on Moon Lake, Vilas County May 2008 – August 2010. This property consists of 4,800 feet of shoreline on Moon Lake and hosts >2000 visitors per year to the camp and lodge facilities. Fifty years of operation of the facility has resulted in moderate to severe erosion along 1500' of shoreline that is heavily impacted by run-off and pedestrian traffic. Impervious surface run-off has enhanced the impacts. Much of the impacted stretch of shoreline has little native vegetation and is at risk of losing mature white and red pine, and contributes large quantities of sediment to the lake during heavy rain events. In addition, much of the coarse woody material and few downed trees are found along the property shoreline, as well as little aquatic macrophytes, resulting in little habitat for fish and their spawn.

We corrected erosion problems through development of rain gardens to prevent run-off as well as use of biodegradable erosion control products to reduce bank erosion. We planted the shoreline into native vegetation, including native trees, shrubs, and ground cover that are appropriate for the Moon Lake ecosystem.

This project was coordinated with ongoing Wisconsin DNR Science Services research project evaluating the ecological benefits of shoreline habitat restoration on 6 lakes in Vilas County. Consultation and plant material were provided by local landscapers with over 10 years experience conducting riparian restoration projects. All project partners have a documented history of successful completion of successful projects.

Background

Moon Lake, Vilas County—Moon Lake is the largest of three seepage lakes connected by shallow channels in the Town of St. Germain, Vilas County. Moon Lake is 130 acres and has a maximum depth of 38'. There are no public boat landings on Moon Lake, but there is on Alma Lake from which access to Moon is available via shallow channel. The Alma/Moon Lake Protection and Rehabilitation District was established in 1980, self-help monitoring has occurred since 1986, and water chemistry since 2001. The average summer secchi disk of Moon Lake (WBIC 1005800) was 17.3 feet and reported as Clear and Blue. The average summer Chlorophyll was 3.3 ug/L, total Phosphorus 12.0 ug/L, with an overall trophic index of 44, suggesting Moon Lake is Mesotrophic.

Moon Beach Camp Property-The Moon Beach property is one of two owned by United Church Camps Incorporated (UCCI). UCCI is a wholly owned subsidiary of the Wisconsin Conference of the United Church of Christ. (WCUCC) The mission of Moon Beach is to provide opportunities for people of all ages, races, creeds, and abilities. For over fifty years, Moon Beach has offered families year round silent sports, arts and crafts, and nature programs. Drawing on one hundred acres of land, four lakes, twenty-two cabins, and a beautiful Lodge, Moon Beach hopes to provide safety, hospitality, and ministry to all that come. The camp hosts over 2,000 guests per year. June 1 to August 15 would be 800 of that 2,000.

Moon Lake, St. Germain Township, Vilas County



**Map 1. Moon Lake Restoration Vegetation Plot Locations
Red = Treated (Restored) Yellow = Control**



Map 2. Moon Lake Restoration Wildlife Survey Locations

Photo Series 1 – Moon Beach Camp Shoreline – Before Restoration



Photo Series 1 (cont.) Moon Beach Camp Shoreline – Before Restoration



Shoreland Impacts

Total Moon Beach Camp acreage is just under 100. Used/developed acreage is best estimated at 23 acres. Estimated Camp shoreline on Moon Lake is in the neighborhood of 4,800 feet with the Lodge to Vesper Point accounting for 2,000 of that. A high level of use and pedestrian traffic has led to loss of vegetation from the shoreline beginning to the south of the Camp beach to Vesper Point. Also, a high level of run-off from roof-tops and asphalt drives occurs after moderate-heavy rainfalls and has led to bank erosion and sediment run-off. A narrow concrete walkway leads from the Lodge to several Cabins along the shoreline. This entire stretch of shoreline is lacking proper vegetation and is experiencing bank erosion. The roots of mature pines are also exposed, and several of the mature trees are likely to fall lakeward over the next few years. These will be used for fish habitat enhancement when appropriate (see below).

Following the restoration efforts, Moon Beach Camp has been working with the project to place signs and offer orientation information to prevent guests from using the lake bank to access the lake from the sidewalk. Lake access will now focus around the Camp beach area that has been established in front of the lodge for the past 50 years as well as at Vesper Point.

Photo Series 2 – Extensive Impervious Surface and Compacted Soil near Lodge Area



Photo Series 3 - Moon Beach Camp Cabin Frontage

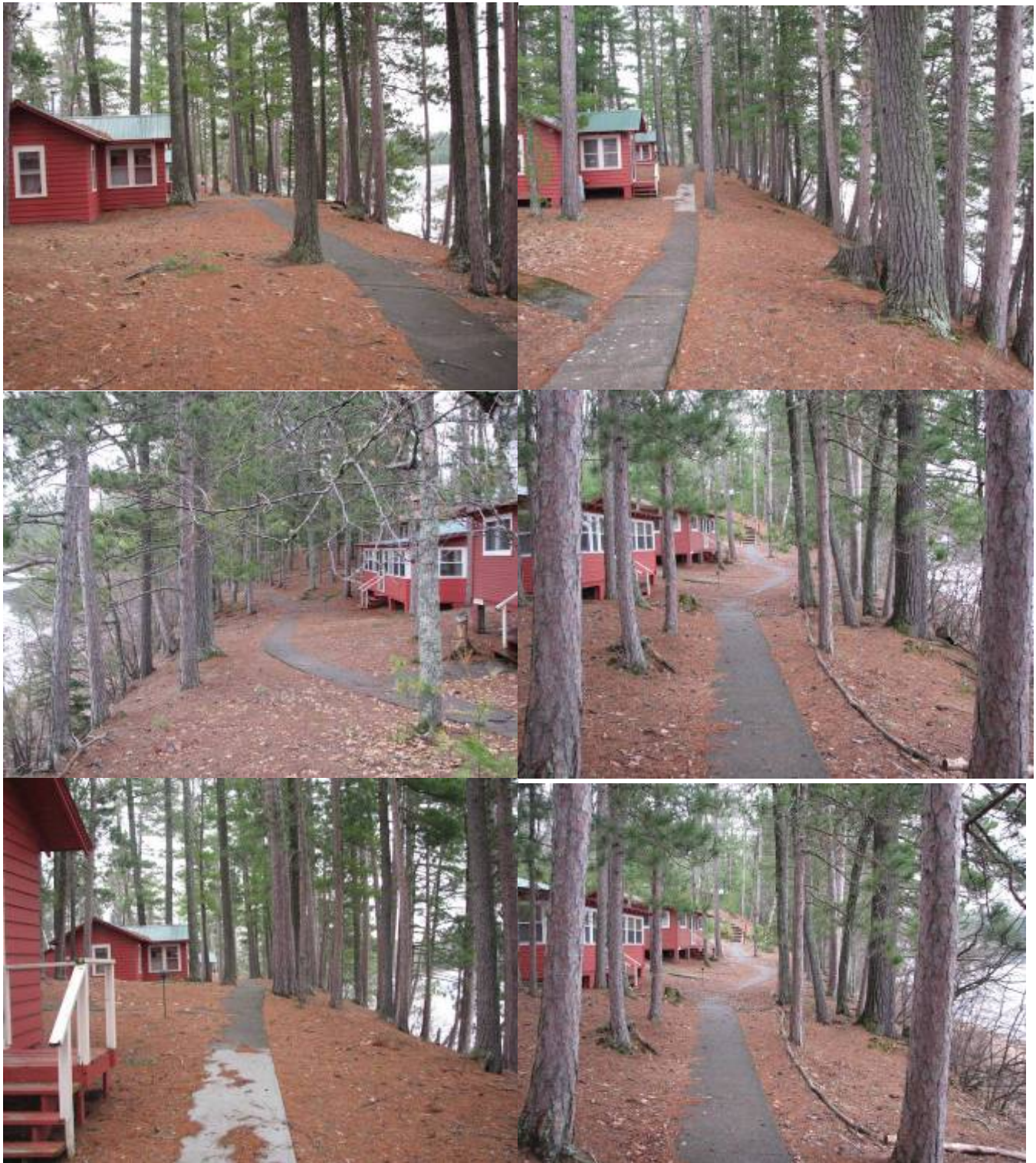


Photo Series 4 – Moon Beach Camp Significant Erosion Areas



Photo Series 4 (cont.) – Moon Beach Camp Significant Erosion Areas



Restoration Implementation

The restoration project was initiated at Moon Beach Camp during the winter of 2008/2009 through installations of a series of tree drops designed to improve fish habitat. Five trees were moved to the shoreland area from a timber harvest on Moon Beach Camp property during the winter of 2009. Boulders were placed on site during the fall of 2008 and trees were placed between the boulders and secured in place with duck-billed anchors. Tree drop installation was supervised by Steve Gilbert, WDNR Fisheries Biologist. Half-log small mouth bass breeding territories were also established between the tree drops. An electroshocking survey was conducted by S. Gilbert in the fall of 2008 prior to installation of the habitat improvements

Photo Series 5 Tree Drops



Installation of fencing and irrigation occurred during 2009, as did the majority of the native plant restoration and erosion control. Sidewalks were also widened with material designed to lessen impervious run-off. Final plantings occurred during the spring of 2010, along with installation of rain gardens, rain barrels, cabin gutters, signage, and final erosion control enhancements. Dan Haskell, Michigan Technical University, Houghton, MI was contracted to conduct the project installations and to conduct the wildlife and vegetation surveys. His Performance Report follows this Project Summary

Photo Series 6 – Moon Beach Camp Shoreline - After Restoration



Photo Series 7 – Rain Gardens



During the spring and summer of 2009, 184 trees of 16 species, 1558 shrubs of 23 species, 21 vines of two species, 9684 forbs and grasses of 89 species were planted within the 35' buffer zone and along approximately 1300' of linear lakeshore. Two rain gardens were also installed, designed to intercept rainwater run-off from asphalt drives and parking areas. Rain barrels were also installed to reduce water run-off from roof-tops



Photo Series 8 – Completed Restoration at Moon Beach Camp 2010



Photo Series 8 (cont.)– Completed Restoration at Moon Beach Camp 2010



Performance Report

Dan Haskell
Michigan Technological University
Houghton, MI

I. Restoration Implementation

Irrigation

Prior to the initial planting on Moon Beach, three bids were received from contractors to install an underground irrigation system. This system was installed by Green Lawn Underground Sprinklers, a certified irrigation contractor, based out of Merrill, WI. Green Lawn guaranteed 100% coverage, has been used in previous restoration project from local landscapers, and was highly recommended by local landscapers and private nursery businesses. A Hunter brand irrigation components were used on this project, which included Hunter Pro C outdoor controller with rain sensor, Hunter PGP[®] and PGH[®] shrub rotors, PGV control valves, 100 psi pipe with lifetime warranty, and a two horse power Berkley pump with Dekora Rock cover and stainless steel filter. The irrigation mainline and control wires were buried using a vibratory plow to minimize soil disruption and damage to tree roots, however, in some places it was necessary to hand dig lines in or leave them exposed for short distances due to a number of mature trees and exposed tree roots. The irrigation heads were placed along the concrete walking path and aimed to spray down the embankment (towards lake) and in some areas irrigation heads were installed at the base of embankment spraying up the hill (toward inland). Final installation of irrigation system was completed in May 2009. Additionally coverage was added in June 2010 to cover a rain garden which was completed in June 2010.

Plant Material Installed

In the spring and summer months of 2009, 184 trees of 16 species, 1558 shrubs of 23 species, 21 vines of two species, 9684 forbs and grasses of 89 species were planted within the 35' buffer zone and along approximately 1300' of linear lakeshore.

Spring Bare Root Trees & Shrubs: Because spring bare root trees and shrubs can be substantially less in cost, up to 50% less than container plants, 70 trees of 10 species and 215 shrubs of 12 species were planted in May 2009. Eight species of spring bare root tree and 12 species of shrubs were matched with a container plant of the same species. Each individual tree and shrub (container and spring bare root) was tagged and measured, which will be followed in subsequent years to compare survival and growth rates between these two techniques (Table 1).

Table 1. Spring bare root tree & shrub species planted at Moon Beach in May 2009. Each species was matched with container plant and each individual plant was tagged and measured.

Spring Bare Root Tree and Shrub Species	Number Planted	Tagged & Matched with Container Plant
Red Maple- <i>Acer Rubrum</i>	2	Yes
Serviceberry- <i>Amelanchier laevis</i>	10	Yes
American Plum - <i>Prunus americana</i>	2	Yes
Northern Pin Oak - <i>Quercus ellip</i>	3	Yes
Northern Red Oak - <i>Quercus rubra</i>	2	Yes
Showy Mountain Ash- <i>Sorbus decora</i>	1	Yes
American Mountain Ash- <i>Sorbus Americana</i>	10	Yes
Choke cherry - <i>Prunus virginiana</i>	20	Yes
Black Chokeberry - <i>Aronia Melanocarpa</i>	20	Yes
Red Osier Dogwood- <i>Cornus stonelifera</i>	25	Yes
Gray Dogwood - <i>Cornus racemosa</i>	20	Yes
American Hazelnut - <i>Corylus americana</i>	20	Yes
Bush Honeysuckle- <i>Dervilla lonicera</i>	10	Yes
Winterberry- <i>Ilex verticellata</i>	10	Yes
Common Ninebark- <i>Physocarpus opulifolius</i>	20	Yes
American Elder - <i>Sambucus canadensis</i>	15	Yes
Snowberry- <i>Symphoricarpos albus</i>	20	Yes
High bush Cranberry- <i>Viburnum opulus</i>	10	Yes
Lowbush Blueberry - <i>Vaccinium</i>	20	Yes

Gravel Culture Trees & Shrubs: Gravel culture is a term to describe a technique that is used at a local nursery to prepare spring bare root trees and shrubs for use in the summer months. These plants are lower in cost, depending on the species, anywhere from 25-50% less than container trees and shrubs. In July, 48 gravel culture trees of four species and 280 gravel culture shrubs of 10 species were planted. All eight species of shrubs were matched with container species and tagged and measured, which will be followed up in subsequent years to compare survival and growth rates between these two techniques (Table 2).

Table 2. Gravel culture tree & shrub species planted at Moon Beach in July 2009. Each species was matched with container plant and each individual plant was tagged and measured.

Gravel Culture Tree and Shrub Species	Number Planted	Tagged & Matched with Container Plant
Serviceberry- <i>Amelanchier laevis</i>	8	Yes
American Plum - <i>Prunus Americana</i>	4	Yes
American Mountain Ash- <i>Sorbus Americana</i>	6	Yes
Choke cherry - <i>Prunus virginiana</i>	30	Yes
Black Chokeberry - <i>Aronia Melanocarpa</i>	25	Yes

Red Osier Dogwood- <i>Cornus stonelifera</i>	25	Yes
Gray Dogwood - <i>Cornus racemosa</i>	2	Yes
American Hazelnut - <i>Corylus americana</i>	10	Yes
Bush Honeysuckle- <i>Dervilla lonicera</i>	10	Yes
Common Ninebark- <i>Physocarpus opulifolius</i>	10	Yes
American Elder - <i>Sambucus canadensis</i>	5	Yes
Snowberry- <i>Symphoricarpos albus</i>	25	Yes
Lowbush Blueberry - <i>Vaccinium</i>	20	Yes
Beaked Hazelnut - <i>Corylus cornuta</i>	15	Yes

All trees and shrubs were planted with approximately one liter of compost, which was integrated into the soil when backed filled. All trees and shrubs were mulched with shredded cedar bark mulch. Mulch was deployed around the base of trees and shrubs approximately one inch depth and one foot radius.

Erosion Control Devices:

EnviroLok Bags: The EnviroLok™ bag system is bio-engineered vegetated retaining wall and these walls are strong, environmentally-friendly, and create beautiful natural landscapes. In addition, the EnviroLok™ system is an erosion control and slope stabilization system that utilizes ecologically advanced soil bag and interlocking grid technologies. Approximately 400 EnviroLok™ bags were installed in May 2009 and another 400 bags in July 2009 at areas that were experiencing severe erosion on steep slopes and with the threat of losing mature white & red pines along the lakeshore. These bags were integrated into the contour of the slopes and native shrubs, forbs and grasses were planted within the bags. Approximately 400 bare root and gravel culture shrubs of 4 species, and 1008 forbs and grasses of 20 species were planted in May and July into the EnviroLok™ bags (Figure 1).



Figure 1. Photos A & B: before EnviroLok™ bags were installed. Photos C & D: after EnviroLok™ were installed on Moon Beach during the spring and summer of 2009.

Coconut Erosion Control Blanket: Approximately 300 square yards of coconut erosion control blanket was installed at various places along the lakeshore at moderate erosion areas. Blankets were secured by six and eight inch sod staples and various shrubs, forbs and grasses were planted into the blanket (Figure 2).



Figure 2. Coconut Erosion Control Blanket installed at Moon Beach during the summer of 2009 at moderate erosion areas (Photo by D. Haskell).

Rain Garden: Water run-off from large asphalt driveway, parking lot and surrounding wooded upland was channeling around cabins and into the restoration area. This run-off was causing severe erosion to occur in the upland and on the beach area directly below the cabins. Approximately, 2000 square feet of asphalt was removed by local contractor and area excavated to specification by consultant. The goals of this rain garden are listed:

- Catch run-off from high velocity surface flow from blacktop drive and parking lot.
- Accept surface run-off from surrounding wooded upland.
- Continue to provide foot and wheel chair access to cabins.
- Provide educational opportunities.
- Provide native plant cover to aid infiltration of water.
- Enhance wildlife usage.

A local contractor was hired to excavate the rain garden to specification and to delivery and install additional materials. Elevation grades were established for water to run through rock cobble at the end of asphalt driveway and then into an area planted with native sedges, shrubs, forbs and ferns. Water run-off would be guided through this area by means of 30' long log, anchored approximately in the center of rain garden and angled towards planted area. After water reached the planted area, a gradual grade of three feet deep (depression) and 10 feet wide was excavated to hold water until it filter through the soil. A gravel pathway along the edge of rain garden and a wooden bridge over the depression was constructed to allow access to cabins (Figure 3).



Figure 3. Construction of Rain Garden at Moon Beach in June of 2009. Photo A: asphalt being removed, photo B: excavation of rain garden, photo C: wooden bridge constructed over depression, Photo D: completed rain garden holding water during and after rain event.

Herbivory Abatement

Fence: Approximately 3000 linear feet of eight foot tall, nylon mesh, UV protected fence was constructed along the lakeshore which enclosed the restoration area. This fence protected the new sweet tender plants from the over abundant deer in the area. To hold the fence upright, 5.5 foot steel T-post were pounded into the ground every 16 feet apart. A five foot long, $\frac{3}{4}$ inch diameter, steel electrical conduit was attached to T-post with six inch long, 16 gauge tie wire. A $\frac{1}{8}$ inch diameter, 7x7 braided steel cable was attached to the top of post assemblies and strung the entire length of fence. The cable was attached to corner posts with a $\frac{5}{16}$ inch diameter by six inch long turn-buckle which was attached to a $\frac{1}{4}$ inch diameter by two inch long eye bolt. The cable then was secured to the turn-buckle by two cable clamps. Wooden braces were installed at each 90 degree corner and at various places along fence and gate entrances which strengthen and provided rigidity to the fence encase of high winds, wind driven rain, freezing precipitation, monstrous blizzards, crashing wave action, and crushing ice heaves throughout the seasons. These braces were secured to the post assemblies by $\frac{1}{4}$ inch diameter by 2 $\frac{1}{2}$ inch long hex bolts, nuts and flat washers. After the post assemblies, corner braces and cable were erected, then the nylon mesh fence was strung up to the post assemblies and attached with six and eight inch long, UV protected zip-ties. The nylon mesh fence was also zip-tied to the cable securing the top of the fence and six and eight inch long sod pins secured the bottom of the fence to the ground. Entrance gates were placed in various places along fence (Figure 4).

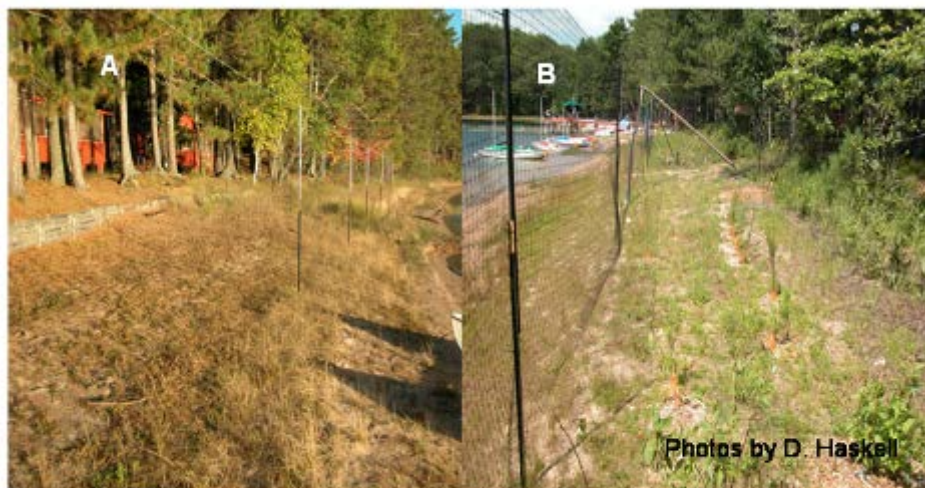


Figure 4. Fence constructed in 2009 to prevent herbivory by white-tailed deer on restoration plants at Moon Beach. Photo A: showing placement of T-post and steel cable, photo B: showing nylon mesh attached to T-post and cable.

White-tailed Deer Repellent: Prior to finalizing the construction of the fence, plants had to be protected from the white-tailed deer that frequent the area. Liquid Fence™ was sprayed on newly planted trees and shrubs every two-three weeks until fence was completed.

II. Measuring the Value of Fish and Wildlife Habitat Restoration at Moon Lake

The goal of this long-term inventory and monitoring project is to assess whether wildlife habitat structure and native vegetative diversity increases on Moon Lake with restored vegetative buffer and whether the restored habitats approximate the reference lake (Jag), low-development lakeshore.

Experimental Design

The Before-After-Control-Impact-Paired (BACIP) design was implemented to contrast 500 m of the impact (restoration lakeshore) with 500 m of the control (control lakeshore) on Moon Lake and, additionally, a paired low-development lake, Jag Lake (reference lakeshore). The reference lakeshore was paired with Moon Lake to similar attributes (surface area, substrate, and lake type) as the restored shoreline and used as a reference. This design is commonly used for impact assessment with subsamples taken at all sites before and after treatment and sites are sampled simultaneously over time.

Vegetation Sampling

Each restoration, control, and reference lakeshores were divided into 50 m segments using GIS (Geographic Information System) software and was labeled with numbers (1, 2, 3,). Each 50 m segment was divided into 10 m sub-segments and coded as follows 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 2d, 2e, etc (1a through 1e represents the first 50 m segment and 2a through 2e the second segment). The intention was to survey a 10 m × 10 m (1 are = 100 m²) vegetation plot every 50 m. An attempt was made to survey every point that fell on the letter “a” (i.e. 1a, 2a, 3a). Each

survey plot always began to the right of the point (start of 10 m × 10 m plot at point, end of plot to the right when facing shore from the lake). However, if a point fell on a usage area or access area to the lake then a sub-segment was randomly picked, using a random number table, until the vegetation plot did not fall on usage or access area. For example, if plot 3a fell on a usage area then another point was randomly picked such as 3b, 3c, 3d or 3e. A metal rebar (1.25 cm × 15 cm) with a 1.25 cm flat washer welded to one end was used for a permanent survey stake and driven flush with the ground at an inland corner of the vegetation plot. The metal stakes can be relocated in subsequent years with a metal detector to resample the plots. Each plot was divided into four 5 m × 5 m subplots (Figure 5).

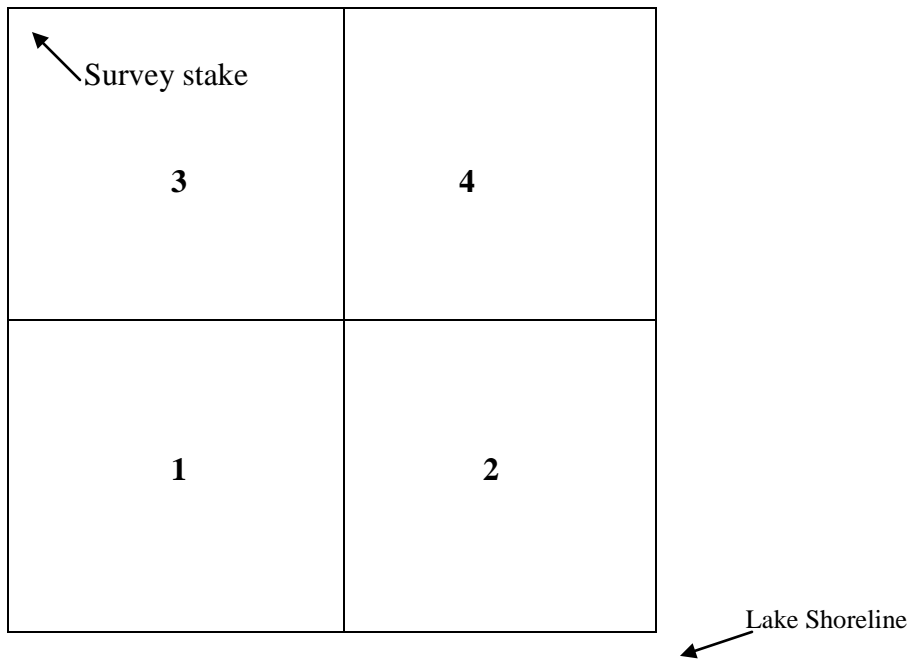


Figure 5. Example of 10 m × 10 m vegetation sampling plot with four 5 m × 5 m subplots Jag and Moon Lakes in 2007. All live trees ≥ 5 cm DBH were recorded in plot and live saplings and shrubs were recorded in two subplots. Figure 5 shows location of survey stake.

All living trees and woody plants in the plots that were ≥ 5 cm diameter breast height (dbh; 1.37 m) within restored, control and reference lakeshores were identified to species and their dbh recorded (Table 3). Two subplots were randomly chosen and all live deciduous and coniferous saplings and shrubs that were ≥ 30 cm in height but having ≤ 5 cm dbh were identified to species and tallied. Tree (Figure 6), sapling (Figure 7), and shrub density were calculated for each plot and the means computed for each treatment

Table 3. Total number of tree species/transect on Moon and Jag Lakes in 2007.

Species	Control	Reference	Treatment
Balsam Fir	0	1	0
Paper Birch	1	12	0
Red Maple	0	10	5
Red Oak	8	3	2
Red Pine	33	87	45
White Pine	30	28	21
Grand Total	72	141	73

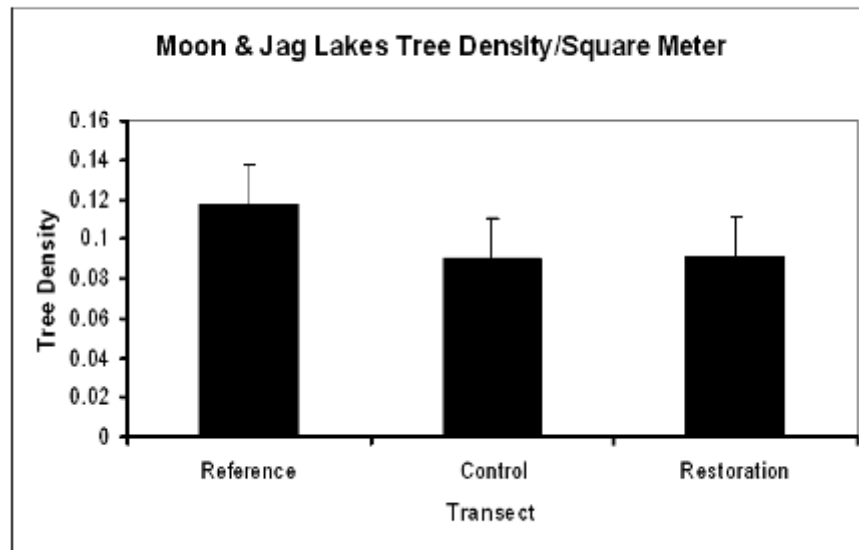


Figure 6. Moon and Jag Lakes tree density/hectare on each transect, data recorded in 2007.

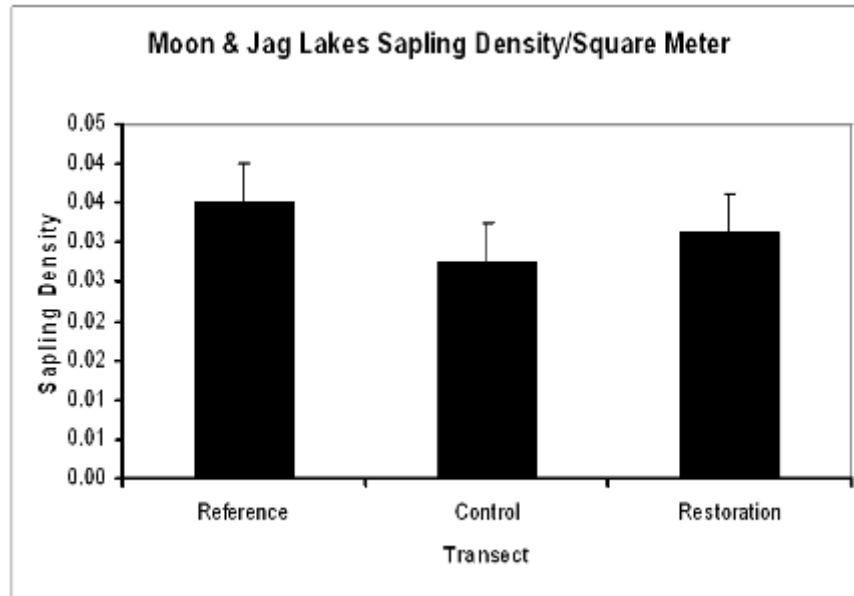


Figure 7. Moon and Jag Lakes sapling density/hectare on each transect, data recorded in 2007.

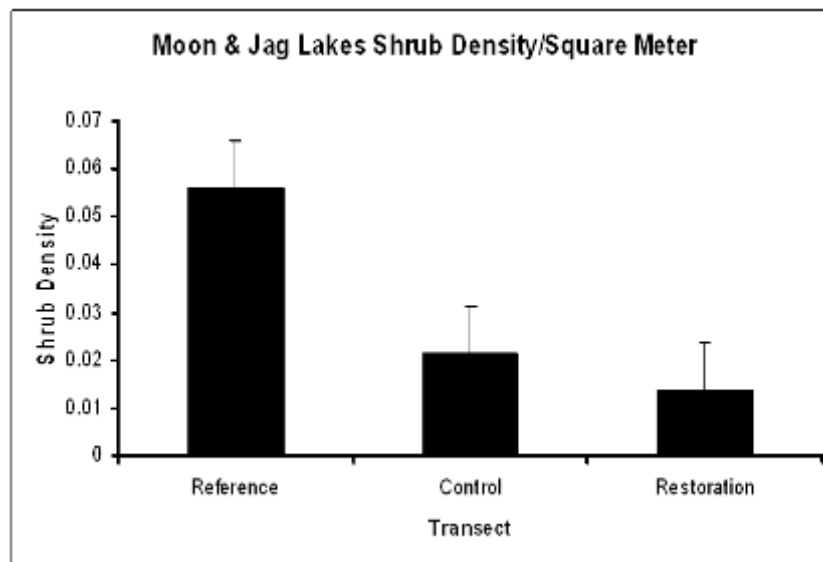


Figure 8. Moon and Jag Lakes shrub density/hectare on each transect, data recorded in 2007.

In order to measure canopy cover, gap fraction was calculated using a digital hemispherical photograph (Nikon Cool Pix 5000 and FC-E8 fisheye converter) at 50 cm above the ground and centered in each plot. Gap fraction is defined as a fraction of pixels classified as open sky in a region in the image [$Gap\ fraction = \text{number of pixels classified as sky in a region} / \text{total number of pixels in a region}$]. Digital hemispherical photographs were analyzed with the software WinSCANOPY (WinScanopy 2005). The results are revealed in table 4.

A density board or checker board (0.5m x 3m) with 10 cm × 10 cm grid squares to measure understory foliage density and to estimate the percent cover at four different height categories (0-0.3 m, 0.3-1 m, 1-2 m, 2-3 m). Squares at least 50% obstructed by green vegetation were counted and converted to a relative index of percent cover. The density board was placed at 1 m, 5 m, and 9 m inland from the shoreline at the edge of each plot. This gave a height and density profile within each plot at three different distances from the shoreline. Each measurement was taken 10 m away while observer and density board moved perpendicular away from the shoreline (table 4). All vegetation sampling was conducted on Moon Lake in 2007.

Table 4. Gap Fraction and Understory Foliage Density data collected on Moon and Jag Lakes in Vilas County, Wisconsin. Gap fraction was determined by digital hemispherical photograph.

Variable	Shoreline (Treatment)	N	Mean	Std. Deviation	Variance
Gap Fraction	Reference	12	15.1	1.6	2.5
	Control	8	21.6	6.8	46.3
	Restoration	8	18.2	6.0	36.2
Understory Foliage Density (%)					
0-0.3 m	Reference	12	47	23	5
	Control	8	23	18	3
	Restoration	8	28	21	5
0.3-1 m	Reference	12	28	16	2
	Control	8	22	20	4
	Restoration	8	24	22	5
1-2 m	Reference	12	22	12	2
	Control	8	35	27	7
	Restoration	8	32	18	3
2-3 m	Reference	12	28	12	1
	Control	8	41	21	5
	Restoration	8	35	15	2

Avian Surveys:

A dependent, double-observer 250 m line transect (LT) method was used to characterize breeding bird communities along targeted lakeshores. Transects were placed in three lakeshore treatments: 1) control, 2) impact (restored), and 3) paired (reference). Volunteers from the North Lakeland Discovery Center Bird Club conducted the bird surveys concurrently on Moon and Jag lakes in two separate visits in June 2007-2010. Transects followed the shoreline, and all birds seen and heard on the terrestrial side of the transect were recorded and tallied. Bird surveys were conducted between 0600 and 1000 hrs. Surveys were not conducted during rain or high winds (>20 km/hr), or when wave noise influenced bird song rates and/or detectability. Bird species

diversity, richness and abundance were calculated for each treatment (table 5). A summary of bird guilds in presented by lake, shoreline and year in Tables 6-8.

Table 5. Summary of bird species richness (S), total bird abundance (N), Shannon’s index of diversity (H'), and evenness (E) separated by lake, treatment and year for Moon and Jag Lakes in Vilas County, Wisconsin. Data has not been analyzed for 2010.

Lake	Treatment	2007				2008			
		S	N	H'	E	S	N	H'	E
Moon	Control	14	20	2.56	0.97	18	36	2.71	0.94
	Restoration	18	34	2.79	0.96	15	23	2.61	0.96
Jag	Reference	17	28	2.68	0.95	16	35	2.64	0.95
		2009				2010			
Moon	Control	14	34	2.77	0.90	NA	NA	NA	NA
	Restoration	24	46	2.98	0.96	NA	NA	NA	NA
Jag	Reference	11	28	2.05	0.66	NA	NA	NA	NA

Table 6. Summary of bird foraging guild richness (G), total bird abundance within guides (N), Shannon’s index of diversity (H'), and evenness (E) separated by lake, treatment and year for Moon and Jag Lakes in Vilas County, Wisconsin. Data has not been analyzed for 2010.

Lake	Treatment	2007				2008			
		G	N	H'	E	G	N	H'	E
Moon	Control	6	19	1.24	0.69	6	26	1.80	1.00
	Restoration	8	25	1.75	0.84	6	31	1.36	0.76
Jag	Reference	7	23	1.68	0.86	7	20	1.33	0.68
		2009				2010			
Moon	Control	8	19	1.87	0.90	NA	NA	NA	NA
	Restoration	9	23	1.95	0.93	NA	NA	NA	NA
Jag	Reference	5	12	1.06	0.51	NA	NA	NA	NA

Lake	Treatment	2007	2008
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		G	N	H'	E	G	N	H'	E
Moon	Control	4	19	1.12	0.81	4	30	0.25	0.18
	Restoration	4	23	1.01	0.73	4	22	0.23	0.17
Jag	Reference	4	20	0.59	0.73	4	29	0.26	0.19
		2009				2010			
Moon	Control	4	19	0.94	0.68	NA	NA	NA	NA
	Restoration	6	25	0.46	0.99	NA	NA	NA	NA
Jag	Reference	3	10	0.64	1.37	NA	NA	NA	NA

Table 7. Summary of bird diet guild richness (G), total bird abundance within guild (N), Shannon's index of diversity (H'), and evenness (E) separated by lake, treatment and year for Moon and Jag Lakes in Vilas County, Wisconsin.

Table 8. Summary of bird nesting guild richness (G), total bird abundance within guild (N), Shannon’s index of diversity (H'), and evenness (E) separated by lake, treatment and year for Moon and Jag Lakes in Vilas County, Wisconsin. Data not calculated for 2010.

Lake	Treatment	2007				2008			
		G	N	H'	E	G	N	H'	E
Moon	Control	6	17	1.53	0.86	5	27	1.28	0.80
	Restoration	6	24	1.62	0.90	7	21	1.73	0.89
Jag	Reference	6	22	1.65	0.92	6	28	1.65	0.92
		2009				2010			
Moon	Control	6	16	1.63	1.01	NA	NA	NA	NA
	Restoration	6	22	1.57	0.81	NA	NA	NA	NA
Jag	Reference	6	12	1.68	0.94	NA	NA	NA	NA

Small Mammal Surveys:

Small mammal surveys were conducted in late June to late July of 2007-2010, two visits/transect. Sherman traps were placed parallel with each other and with the shoreline and within 10 m of the shoreline along a 250 m long transect. One line of traps was placed within 1 m of the shoreline and the second line was approximately 10 m from the shoreline. Traps were placed at 10 m intervals along both trap lines for a total of 52 traps per transect. Each trap was baited with a mixture of rolled oats and peanut butter, and a handful of polyethylene fiber was added for bedding. Traps were covered with a ½-gallon cardboard milk container that provided captured animals with additional protection from inclement weather. Traps were opened for three nights at each transect, checked every morning and closed, and reopened in the late evening hours. All small mammals were identified to genus and species when possible. Data on sex, reproductive condition, overall condition, and weight were recorded for each captured animal; all animals were released at point of capture. See results in table 9.

Table 9. Summary of Small Mammal Captures on Moon and Jag Lakes

Common Name	Scientific Name	Year	Reference	Control	Restoration
Unk. Mouse	<i>Peromyscus sp.</i>	2007	5	0	0
		2008	3	2	2
		2009	6	4	6
		2010	14	13	20
Unk. Shrew	<i>Sorex sp</i>	2007	3	0	0
		2008	0	0	0
		2009	0	0	1
		2010	1	0	0
Red Squirrel	<i>Tamiasciurus hudsonicus</i>	2007	1	1	1
		2008	0	1	2
		2009	0	0	0
		2010	0	2	3
Eastern Chipmunk	<i>Tamias striatus</i>	2007	2	2	8
		2008	0	11	8
		2009	5	3	6
		2010	5	10	8
M. Jumping Mouse	<i>Zapus hudsonius</i>	2007	1	1	1
		2008	6	1	1
		2009	1	0	1
		2010	1	0	0
Short-tailed Shrew	<i>Blarina brevicauda</i>	2007	0	0	0
		2008	0	0	0
		2009	3	0	2
		2010	0	0	0
S. Red-backed Vole	<i>Clethrionomys gapperi</i>	2008	0	0	0
		2009	0	0	0
		2010	1	1	0
S. Flying Squirrel	<i>Glauckmys volans</i>	2007	0	0	0
		2008	1	1	0
		2009	1	0	0
		2010	1	1	0
House Mouse	Mus musculu	2007	0	2	1
Meadow Vole	<i>Microtus pensylvanicus</i>	2008	1	1	0
		2009	0	0	0

Carnivore Snow Track Surveys

Presence and abundance of carnivores reflect the health of an ecosystem and they play an important role in structuring communities. The absence of carnivore in an ecosystem can have a significant impact on the relative abundance of herbivores and rodent species, because one or two species may dominate a community, therefore decreasing biodiversity. Thus, the preservation of carnivore species becomes an important consideration in managing ecosystems.

During January – February 2008 and 2010, snow track surveys were conducted to detect carnivore presence and estimate relative abundance. Transect surveys were conducted 48 to 96 hours following snowfalls of greater than or equal to 2.5 cm, at temperatures above 0 degrees F, and with winds less than 10 mph. The transects will begin at the point of lake access (e.g. boat landing) and travel 1500 linear meters following the shoreline on Moon and Jag Lakes. All carnivore tracks encountered 10 m on each side of the transect were recorded. In addition, encounters with non-carnivore species were tallied: micro-tine rodents, Snowshoe Hare (*Lepus americanus*), Eastern Cottontail Rabbit (*Sylvilagus floridanus*), *Sciuridae* species, White-tailed deer (*Odocoileus virginianus*), and Domestic Dog (*Canis familiaris*). An index to categorize the abundance of these species was developed: 0 If no tracks were detected, 1 = 1 to 5 tracks, 2 = 6 to 10 tracks, 3 = > 10 tracks for each transect. Both lakes were surveyed sequentially the same day with no more than 30 min between surveys periods.

In 2008 one red fox and mink were detected on Moon Lake and three coyotes, two fishers, one bobcat, and two ermines were detected on Jag Lake. A total of four species were detected on Jag Lake while only two species were detected on Moon Lake (Table 10). In 2010 the results were similar, but five species were detected on Jag Lake (Table 10).

Table 10. The total number of carnivore species encountered during snow track surveys on Moon and Jag Lakes in Vilas County, Wisconsin. Data was collected in January and February of 2008 & 2010.

Species		Lake			
		2008		2010	
Common Name	Scientific Name	Moon	Jag	Moon	Jag
Coyote	<i>Canis lantrons</i>	0	3	0	4
Bobcat	<i>Lynx rufus</i>	0	1	0	1
Fisher	<i>Martes pennanti</i>	0	2	0	1
Ermine	<i>Mustele erminea</i>	0	2	0	2
Mink	<i>Mustele vison</i>	1	0	1	1
Red fox	<i>Vulpes vulpes</i>	1	0	1	0

As for non-carnivore species, there seems to be an inverse relationship with white-tailed deer numbers on these two lakes, where Moon Lake contains an abundant amount of deer. In addition, snow-shoe hare are totally absent on Moon Lake but abundant on Jag Lake (Table 11).

Table 11. Non-carnivore species detected during snow track surveys on Moon and Jag Lakes in Vilas County, Wisconsin. Species were assigned categories based on the average frequency detected on Moon and Jag lakes. Data was collected during the winter of 2008 and 2010. If no tracks were detected, 1 = 1 to 5 tracks, 2 = 6 to 10 tracks, 3 = > 10 tracks for each transect.

Species		Lake			
		2008		2010	
Common Name	Scientific Name	Moon	Jag	Moon	Jag
Domestic Dog	<i>Canis familiaris</i>	1	2	2	0
White-tailed Deer	<i>Odocoileus virginianus</i>	3	2	3	0
Squirrels	<i>Sciuridae</i> spp.	3	1	3	3
Micro-tine rodents	NA	1	1	2	2
Eastern Cottontail	<i>Sylvilagus floridanus</i>	1	0	0	0
Snowshoe Hare	<i>Lepus americanus</i>	0	2	0	3

Final Words

Moon Beach is an outdoor ministry program associated with the [United Church of Christ](#) and the [Wisconsin Conference](#) of the UCC. While many of our campers are members at local UCC churches across Wisconsin, many other campers come from out of the state or attend other churches. Some of our participants attend no church, but find that the community and sanctuary of our sites feed their spiritual and environmental needs. Our camp provides a place apart from the sometimes-rough and tumble world where we can relax and rejuvenate – and express our faith in tangible ways.

Moon Beach offers a peaceful reprieve from the stresses and demands of the world, if only for a few days or a week. Our programs are open to anyone regardless of race, color, ethnic background, sex, gender identity, or sexual orientation. We have program offerings for people of all ages. We make every effort to accommodate differing abilities in our programs and on our facilities. These are more than words we speak – it is how we run our programs and live our lives. Our staff stands ready to welcome everyone into the community at Moon Beach.

Moon Beach partnered with the Alma / Moon Lake Protection District knowing that it fit very well into our mission to “recognize and honor God’s abundant creation and to preserve these sacred spaces for spiritual renewal for current and future generations.” On a practical level, the intended outcome is to preserve and strengthen the shoreline that supports our cabins, a walkway and Vesper Point (a sacred space). Additionally, mitigating water runoff via rain barrels, retention ponds and bio-bags helped us steward the enhancement of water quality issues for Moon Lake.

On a deeper level, this project has put our camp users, staff and the Wisconsin Conference with practical, hands-on experience with lake and shoreline restoration methods. This project invested them in the real stewardship of the resources we are charged to preserve and enhance. Furthermore, the added benefit of partnering with landscape architects, WIDNR and MTU research staff, as well as Vilas county resource specialists has given a deeper appreciation of the agencies work, scientific/research methods and educational outreach to other lake groups. That blends well into our mission encourage our outreach to other “secular partners to sustain, strengthen and grow the ministry of UCCI.”

Moon Beach and UCCI have added to the project with additional funds from the proceeds of our Managed Forest project totaling nearly \$12,000. By featuring the shoreline work, managed forest work, and a fish habitat project, we strive to feature the educational opportunity for both our camp groups and public user groups like Lake Associations, county conservationists and botany and wildlife specialists we hope to be a showcase for DNR projects. We were also able to add features like a widened walking path for to make our shoreline path more accessible to strollers and wheelchairs. We incorporated memorial tree plantings and refurbish the space at Vesper point. Two rain gardens were also developed and have become a focus for the entire project. Installations of interpretive signage were added to provide relevant information about the project and a lasting tribute to the partners involved in the project. As the largest land owner in the Alma / Moon Lake Protection District, it has been our honor and privilege to serve the land, water and people of this project.

Respectfully Submitted,
Glenn Svetnicka – Director Moon Beach