

Munro Lake Shoreline Survey 2014

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Signed,
Darbi O'Brien

Introduction

Northern Michigan has become increasingly popular as a summer vacation spot on one of this state's beautiful lakes. Cottages are occupied briefly for about a fourth of each year, as well as the fulltime residents enjoying the whole year in the northern lower peninsula and the lower upper peninsula. Summer populations' increasing means that the maintenance of the star attractions: Michigan's lakes. Conservation and resource management are important to maintain the flow of tourism and boosts for the economy. If the quality of lakes are lost, so are the summer masses. Preservation of natural resources is necessary.

Along with these masses comes the destruction associated with human development. Shoreline habitat must be prioritized in order to conserve the health of the lake. Riparian zones are often the first to be eliminated with property development. Riparian zones are the areas of terrestrial habitat that interact and impact waterways and serve as barriers of nutrient dumping which alter aquatic habitats greatly. The vegetation growing along the shoreline is known as the greenbelt; the richer and more well-equipped the greenbelt is, the less likely terrestrial nutrients will interact with the water. Development is the cause for most of greenbelt elimination.

Alterations the shoreline, man-made or natural can impact the quality of the water system. Erosion can occur naturally and cause excess sedimentation which raises water temperatures due the water absorbing more light than before (K. Cronk, 2009). This also attributes to an increase of suspended sediments to which nutrients can adhere and primary production can explode. This huge increase leads to algal blooms and die offs (K. Cronk 2009). Properties with inefficient greenbelts allow nutrient runoff from lawns and road ways to reach the shoreline and leak into the water.

In this study, Munro Lake's shoreline was surveyed on behalf of The Tip of the Mitt Watershed Council. Tip of the Mitt works with the community to preserve and reinstate the once pristine quality of northern Michigan aquatic habitats. Munro Lake is shallow and inland, located in Cheboygan County, Michigan. The lake is unique to others in the county because half of the shoreline is inhabited by state forest land run by the Michigan Department of Natural Resources and the rest of the lake predominantly occupied by private development. The survey includes assessment of each of the 127 parcels along the shore outlined by the Tip of the Mitt. The goal of this survey was to rate the greenbelt for each parcel along with additional identifying factors. These factors play a role in determining the effectiveness of the greenbelt. Included were overall greenbelt score, relative shoreline erosion, presence and density of *Cladophora* algae, and the availability of *Cladophora* habitat. This genus of filamentous green algae is an gauge of nutrient dumping or drainage. The quality of the greenbelt can be further assessed by combining observations of erosion levels with the level of *Cladophora* presence. After the survey is conducted, this information will assist Tip of the Mitt with deciding which property owners to contact in order to provide assistance with shoreline restoration and protection.

Methods

A shoreline survey of Munro Lake in Cheboygan County, Michigan was conducted in July, 2014. Each of the 127 parcels of shoreline property were surveyed from a canoe, traveling within 15 feet of the shoreline and recording qualitative data. Parcels were divided and distinguished by use of GPS maps overlaid with property lines from the Tip of the Mitt Watershed Council. The following criteria were surveyed and rated based on guidelines established by The Tip of the Mitt Watershed Council: property description, development, *Cladophora* growth and habitat, composition of substrate, altered shoreline habitat, erosion, greenbelt length, greenbelt depth, and the presence of wetlands and streams (Tip of the Mitt). Finally, a GPS camera was used to photograph each property.

Parcels were considered developed (Y=yes, N=no, P=partial) if permanent structures were present. Examples of permanent structures include buildings, paved roads, parking lots, boat launches, and pavilions. Undeveloped parcels include cleared land (ex. lawns), seasonal structures (such as campers or RV's), and unpaved roadways. Parcels were considered partially developed when a large percentage of the parcel was made up of natural, undeveloped habitat with one or more permanent structures present.

Cladophora density was estimated based on the amount of algae observed as each parcel. After density was assessed, the length of the affected shoreline was estimated and recorded as level x length (e.g. MX25 ft.) Table 1 details the parameters used to determine relative levels.

Category	Density
Very Light (VL)	A green shimmer
Light (L)	Up to 25% coverage (small bits of filamentous growth)
Light to Moderate (LM)	25-49% coverage
Moderate (M)	50-59% coverage
Moderate to Heavy (MH)	60-64% coverage (substrate mostly covered)
Heavy (H)	75-99% coverage (substrate entirely covered)

Very Heavy (VH)	100% coverage (long filamentous growth: shaggy)
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Table 1. Levels of *Cladophora* Density

*Parameters provided by the Tip of the Mitt Watershed Council

Substrate composition in each property was identified according to the following categories:

- M = Muck, a dark, soft or marl bottom
- S = Sand
- G = Gravel (0.1" to 2.5" diameter)
- R = Rocks (2.5" to 10" diameter)
- B = Boulders (greater than 10" diameter)
- W = Woody debris (logs, sticks, etc.)

Of these categories, gravel, rocks, boulders and woody debris are the only substrates on which *Cladophora* can persist. *Cladophora* habitat was then determined (yes or no) based on the presence of such substrates.

Observed anthropogenic alterations were identified based on the following categories:

- SB = steel bulkhead (i.e. seawall)
- CB = concrete bulkhead
- WB = wood bulkhead
- BH = permanent boathouse
- G = groin (extending into water to break waves)
- BB = boulder bulkhead
- RR = rock rip-rap
- BS = beach sand
- DP = discharge pipe

Relative shoreline erosion was categorized as light (L), moderate (M), or heavy (H) based on the observation and severity of erosional indicators: areas of bare soil on steep banks, undercut banks, leaning or downed trees, excessive sediment deposits, etc. After categorization, the length of the eroding shoreline was estimated and recorded as level x length (e.g. "MX25 ft." which indicates "moderate erosion for 25 feet").

Greenbelt length and depth ratings were assigned based on parameters defined in Tables 2 and 3. Measurements of greenbelt length and depth were subjective and based on observations of vegetation. Overall greenbelt scores were assigned to each parcel by adding greenbelt length scores to greenbelt depth scores. Scores were ranked as follows: 0 = Very Poor, 1-2 = Poor, 3-4 = Good, 5-6 = Good, 7 = Excellent.

Greenbelt Length Rating	Greenbelt Length Description
0	No vegetation present along shoreline
1	<10% of shoreline has vegetation present
2	10-25% of shoreline has vegetation present
3	25-75% of shoreline has vegetation present
4	>75% of shoreline has vegetation present

Table 2. Ratings for Greenbelt Length
 *Standards provided by Tip of the Mitt Watershed Council

Greenbelt Depth Rating	Greenbelt Depth Description
0	No vegetation present deeper in property
1	<10 ft vegetation present deeper in property
2	10-40 ft vegetation present deeper in property
3	>40 ft vegetation present deeper in property

Table 3. Ratings for Greenbelt Depth
 *Standards provided by Tip of the Mitt Watershed Council

After completion of the survey, all field data collected was transferred to a spreadsheet in Microsoft Excel. The GPS photographs taken at each property were cross checked with property descriptions and then labeled in the following fashion: MunroLake_ShorelineSurvey2014_Property#_Photo#. (For example, the second photo taken of parcel 35 would be labeled as: MunroLake_ShorelineSurvey2014_0035_02.) Maps of erosion, *Cladophora* presence / habitat and overall greenbelt scores were created using ArcMap 10.0. These particular criteria were chosen to map as they are key indicators of shoreline health and development, and results varied across 127 Munro Lake property parcels.

Methods

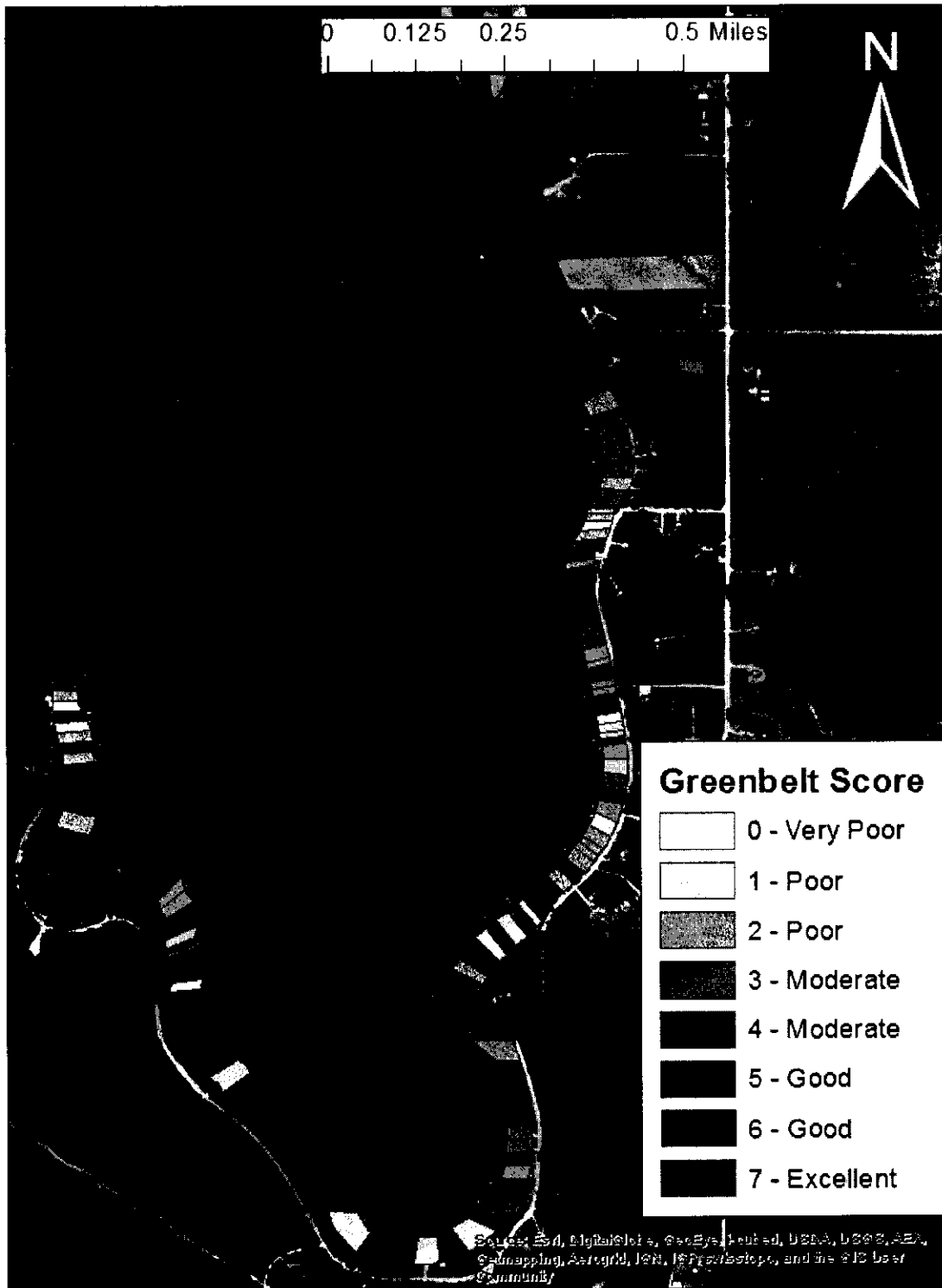
Property along the shoreline of Munro Lake consisted of 127 parcels. Total parcel lengths varied from 1800 ft (or about 1/3 of a mile) to less than 20 ft. 90 of 127 (70.87%) parcels were privately owned and either fully or partially developed. The remaining 37 plots were classified as undeveloped as they are managed by Michigan's Department of Natural Resources.

Greenbelt scores tended to be higher in undeveloped parcels and lower in developed parcels. A majority of the high greenbelt scores were found on large, undeveloped parcels where the natural habitat was maintained. Parcels with lower greenbelt scores tended to be located along the eastern shore of Lake Munro (Figure 1).

Greenbelt Score/Rating	Number of Parcels	Percent of Parcels
0 = Very Poor (absent)	2	1.57%
1-2 = Poor	41	32.28%
3-4 = Moderate	34	26.77%
5-6 = Good	18	14.17%
7 = Excellent	32	25.20%
TOTAL	127	100%

Table 4. Greenbelt score statistics

Munro Lake Greenbelt Score



Projection: Lambert Conformal Conic Source: Tip of the Mitt Watershed Council
 Shelly Gleason, Kate Laramie, Darbi O'Brien, Catrina Smith

Figure 1. Lake-wide greenbelt scores

The majority of parcels with heavy amounts of erosion occurred along the northern shore of Munro Lake (Figure 2). However, the most parcels had erosion ratings light, medium, or none (44.09%, 21.26% and 21.26%; Table 6).

Alteration Type	Number of Parcels	Percent of Parcels
Concrete bulkhead	4	3.15 %
Wood bulkhead	3	2.36 %
Groin (extending into water to break waves)	4	3.15 %
Boulder bulkhead	24	18.90 %
Rock riprap	49	38.58 %
Beach sand	14	11.02 %
Drain pipe	5	3.94 %
Other*	5	3.94 %

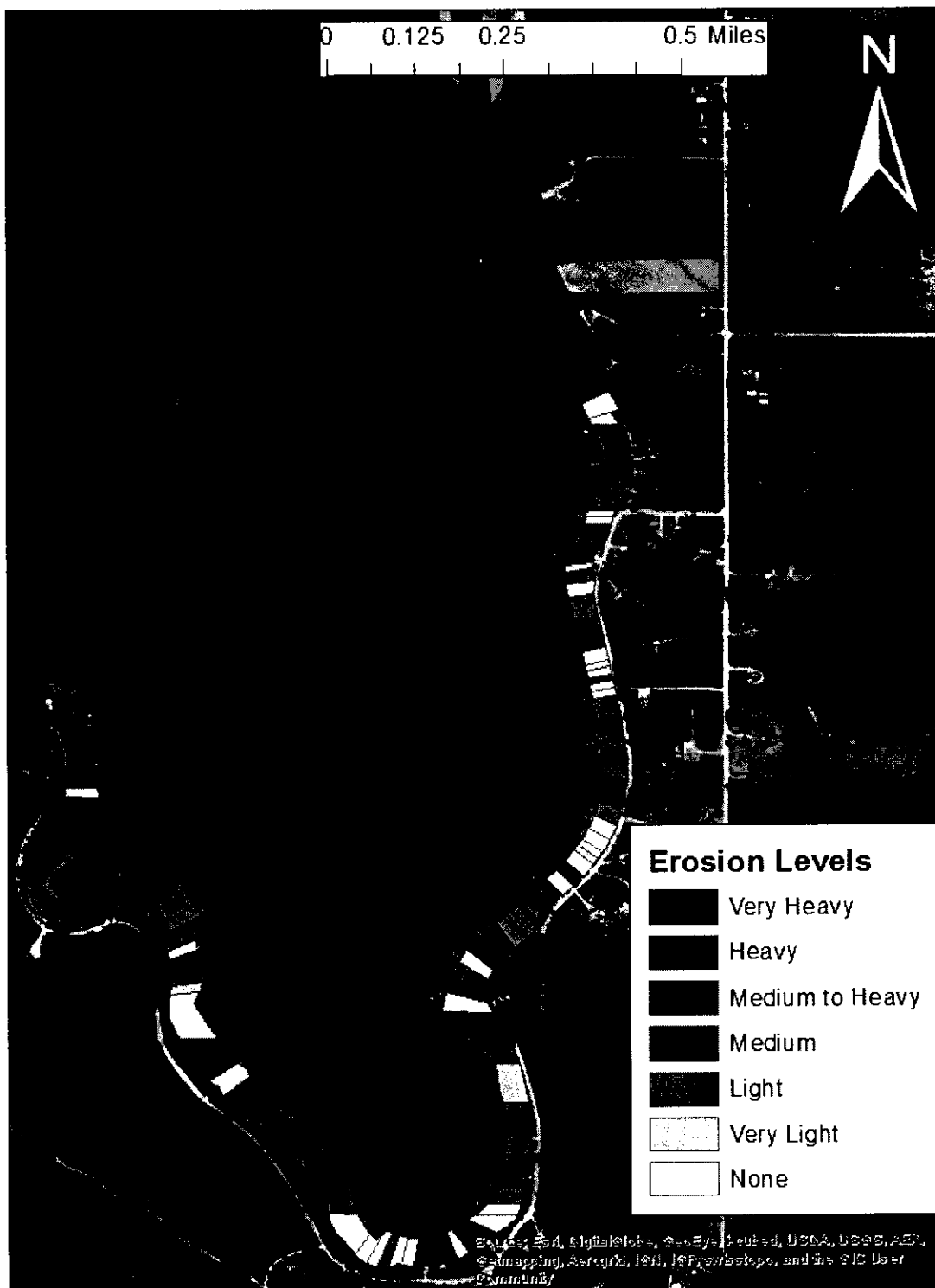
Table 5. Shoreline alteration statistics

*Other includes groin, boat ramp, concrete ramp, tarps and pumps. Properties may contain multiple alterations.

Erosion Level	Number of Parcels	Percent of Parcels
Very Heavy	3	2.36 %
Heavy	6	4.72 %
Medium to Heavy	1	0.80 %
Medium	27	21.26 %
Medium to Light	0	0 %
Light	56	44.09 %
Very Light	7	5.51 %
None	27	21.26 %
Total	127	100 %

Table 6. Erosion statistics

Munro Lake Erosion Levels



Projection: Lambert Conformal Conic Source: Tip of the Mitt Watershed Council
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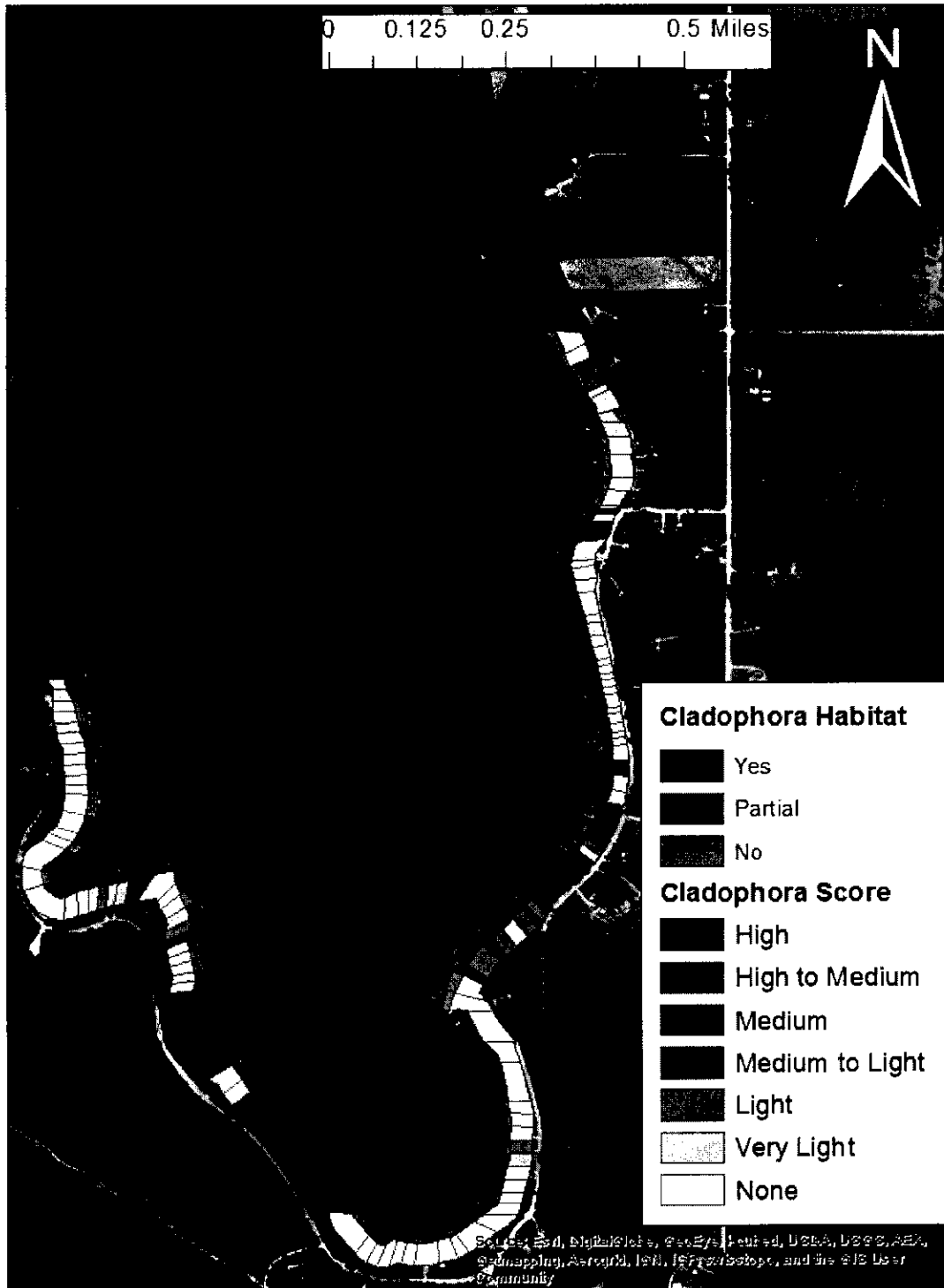
Figure 2. Erosion rating per parcel

Parcels with hard or rough substrates, such as rocks, boulders or woody debris, provide habitats for *Cladophora* to grow. Of the 127 parcels, 79 were noted as habitats suitable for *Cladophora* growth (62.20%), however *Cladophora* was only found to be present at 48 of 127 parcels (37.80%). Of these, the majority of *Cladophora* density levels were rated as either very light or light (33.33% and 22.92%, respectively; Table 7).

Cladophora Density	Parcels	Percent
Very Light	16	33.33 %
Light	11	22.92 %
Light to Moderate	4	8.33 %
Moderate	9	18.75 %
Moderate to Heavy	2	4.17 %
Heavy	6	12.50 %
TOTAL	48	100.00 %

Table 7. *Cladophora* density statistics from properties where *Cladophora* was present.

Munro Lake Cladophora Score



Projection: Lambert Conformal Conic Source: Tip of the Mitt Watershed Council
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Figure 3. Cladophora rating and habitat.

*Parcels labeled as "yes" for Cladophora habitat are areas in which there is potential for Cladophora growth.

Discussion

The survey results found several notable observations. *Cladophora* levels can be an indication of terrestrial nutrient runoff into a body of water; higher densities and blooms correlating with nutrient influxes. *Cladophora* levels were high for undeveloped parcels and those parcels adjacent, which is unexpected from parcels with excellently rated greenbelts. Established greenbelts usually provide a barrier preventing runoff from reaching the water. However, with the level of erosion occurring in the undeveloped parcels from lack of shoreline alteration prevention, the greenbelt effectively ebbs further into the water. The downed trees in the shallows provide hard substrate habitat for *Cladophora* to manifest in larger quantities that could not survive on the substrate types preferred by the residents of developed parcels. Therefore the respective levels of *Cladophora* for developed and undeveloped parcels are soundly explained. Nevertheless, *Cladophora* levels along the shoreline of Munro lake was overall low (Table 7). Out of 127 parcels, only 48 had *Cladophora* present. Of those 48, the majority were ranked as either very light or light.

The previously mentioned downed trees in these undeveloped areas are an additional source of nutrients being introduced into the aquatic system. The highly rated greenbelts would normally provide a nutrient barrier; however, if the riparian zone now extends into the water, new nutrients are being directly inserted into the lake. In a further study, it would be prudent to add chemical analysis into the survey to determine the extent to which the downed riparian zone affects the nutrient ratios in the water.

The greenbelt ratings were moderate, good, or excellent for over half of the 127 parcels. This is most likely attributed to the fact that a large part of the shoreline is undeveloped and/or state owned (Figure 1). This undeveloped land is commonly forested and little to no vegetation maintenance is practiced along the shoreline with little to no alterations as well. The greenbelt diversity, depth, and length of these parcels are higher than developed parcels. Accordingly, the erosion levels were also highest for the undeveloped parcels. Because there is no anthropogenic intervening with the shoreline, nothing prevents the water from eroding the soil in undeveloped parcels. This allows an unloading of large woody debris into the water and the establishment of habitat for *Cladophora*. Alterations like rock riprap and boulder bulkheads prevent erosion, and thus had the lowest erosional ratings (38.58% and 18.90%, Table 5). But that is not to say that alterations also prevent *Cladophora* blooms, because riprap and bulkheads provide a hard substrate for *Cladophora* to occupy. This being said, the majority of the 127 parcels had an erosion rating of medium, light, or none.

Recommendations

It is Tip of the Mitt's standard procedure to contact the owners of properties receiving a score of 2 or less in overall greenbelt ratings. Highly rated greenbelts act as more efficient buffers from terrestrial nutrient dumping so a continuous natural shoreline is important for the lake water quality. A majority of low rated greenbelts are found along the eastern shoreline of Munro Lake, a relatively densely

populated area. Property owners should be encouraged to plant shoreline vegetation in order to raise greenbelt ratings and build a larger buffer between maintained lawn and the shore.

Improvement of *Cladophora* ratings for undeveloped or partially developed properties in particular should focus on the addition of hard substrate and, in effect, new habitat for *Cladophora*. The downed trees add to the woody debris found in the observed substrate of undeveloped parcels. *Cladophora* rating improvement for developed parcels require attention paid to other qualities of the shoreline. As *Cladophora* presence is an indicator of high nutrient runoff, more investigation should be made before making recommendations. If the greenbelt score is low in addition to high levels of *Cladophora*, there could be a problem with their property practices like fertilization or a faulty septic system. Since there is no buffer between the terrestrial practices and the shore, the nutrients find their way into the water system and raise *Cladophora* levels. For parcels with high *Cladophora* levels and low greenbelt ratings, the parcel owners should be contacted. This is also true for parcels with high *Cladophora* levels and a drainpipe leading from the property into the water which could be depositing nutrients and causing high levels of *Cladophora*.

As found in the undeveloped parcels, erosion is much more prevalent with habitats that have no man-made alterations to the shoreline preventing interaction between the shore and the water. Erosion leads to an increase in sedimentation which can alter aquatic systems. Alterations like riprap and bulkheads were shown to decrease shoreline erosion and because of this, property owners should be encouraged to create their own barrier against erosion. This recommendation should be especially strong to properties with very low greenbelt ratings for the riprap to pose as a barrier instead of riparian zone. Shifting the focus to the natural shorelines, alterations should not be created until further analysis of sedimentation and particle suspension in Munro Lake has been conducted. If the results show a need for natural erosion to be prevented, alterations to the shoreline should be made.

Data gathered for this 2014 shoreline survey of Munro Lake lead to the conclusions and recommendations outlined in this report. In order to improve greenbelt ratings and hinder shoreline erosion, cooperation with selected property owners is necessary. It is important to note that a majority of the 127 parcels along Munro Lake shoreline are sustaining moderate to good overall greenbelt ratings and that erosion is mainly occurring along the natural forested parcels. The observed density levels of *Cladophora* did not raise serious concern over pollution or nutrient runoff. Further assessment may be needed to definitively conclude whether *Cladophora* levels are acceptable based on the standards set out by Tip of the Mitt.

References:

Cronk, Kevin L. "Burt Lake Shoreline Survey 2009." (2009); Tip of the Mitt Watershed Council. Web. 7 Aug. 2014.<<http://www.watershedcouncil.org/water%20resources/inland%20lakes/burt%20lake/files/2009%20Burt%20Lake%20Shoreline%20Survey.pdf>>.