A Nutrient Pollution Shoreline Survey on Walloon Lake, 2005

By Tip of the Mitt Watershed Council

INTRODUCTION

A shoreline survey to identify locations of potential nutrient pollution was conducted on Walloon Lake by the Tip of the Mitt Watershed Council during the summer of 2005. The survey documented *Cladophora* growth along the entire shoreline of Walloon Lake. The survey was funded by the Walloon Lake Association.

Cladophora is a branched, filamentous green algae that occurs naturally in small amounts in northern Michigan lakes. Its occurrence is governed by specific environmental requirements for temperature, substrate, nutrients, and other factors. It is found most commonly in the wave splash zone and shallow shoreline areas of lakes, and can also be found in streams. It grows best on stable substrates such as rocks and logs. Artificial substrates such as concrete or wood seawalls are also suitable. The preferred water temperature is 50 to 70 degrees Fahrenheit. This means that late May to early July, and September and October are the best times for its growth in northern Michigan lakes.

The nutrient requirements for *Cladophora* to achieve large, dense growths are greater than the nutrient availability in lakes with high water quality, such as Walloon Lake. Therefore, the presence of *Cladophora* can indicate locations where relatively high concentrations of nutrients, particularly phosphorus, are entering a lake. Sources of these nutrients can be due to natural conditions, including springs, streams, and artesian wells that are naturally high in nutrients due to the geologic strata they encounter; as well as wetland seepages that may discharge nutrients at certain times of the year. However, the majority of *Cladophora* growths can be traced to cultural sources such as lawn fertilization, malfunctioning septic systems, poor agricultural practices, soil erosion, and wetland destruction. These nutrients can contribute to an overall decline in lake water quality. Additionally, malfunctioning septic systems pose a potential health risk due to bacterial and viral contamination.

Although the size of the growth on an individual basis is important in helping to interpret the cause of the growth, growth features of *Cladophora* are greatly influenced

by such factors as current patterns, shoreline topography, size and distribution of substrate, and the amount of wave action the shoreline is subject to. Therefore, the description has limited value when making year to year comparisons at a single location or estimating the relative amount of shoreline nutrient input. Rather, the presence or absence of any significant growth at a single site over several years is the most valuable comparison. It can reveal the existence of chronic nutrient loading problems, and help interpret the cause of the problems and assess the effectiveness of any remedial actions. Comparisons of the total number of algal growths can reveal trends in nutrient input due to changing land use.

A shoreline survey can be a valuable lake management tool. Coupled with follow-up on-site visits and questionnaires, controllable sources of nutrients to the lake can be identified. Subsequently, a reduction in nutrient loading can often be achieved by working with homeowners to solve problems. These solutions are often simple and low cost, such as regular septic system maintenance, proper lawn care practices, and wise land use along the shoreline. Prevention of problem situations can also be achieved through the publicity and education associated with the survey.

According to databases stored at the Watershed Council office, shoreline surveys have been conducted on Walloon Lake along, at least, limited shoreline areas in 1979, 1985, 1987, 1990, 1998, and 2001. Periodic repetition of shoreline surveys are important for identifying chronic problem sites as well as recent occurrences. They are also valuable for determining long-term trends of nearshore nutrient inputs associated with land use changes, and for assessing the success of remedial actions.

METHODS

The presence of *Cladophora* and other shoreline features were surveyed along the entire 31-mile shoreline of Walloon Lake from May 24, 2005 to June 17, 2005. The shoreline was closely inspected for *Cladophora* growths by traveling as close to the shoreline as possible (usually within 20 feet) in kayaks. When a *Cladophora* growth was observed, it was described according to criteria used during past surveys and recorded on a field data sheet. The description included both an estimation of the length (feet) of shoreline it covered and the density of growth. Categories for growth density used are as follows:

- Very Light (VL)
- Light (L)
- Light to Moderate (L/M)
- Moderate (M)
- Moderate to Heavy (M/H)
- Heavy (H)
- Very Heavy (VH)

Although *Cladophora* density and shoreline length are subjective estimates, shoreline surveys of this nature have been very effective in locating areas where nutrient pollution is occurring.

Many species of filamentous green algae are commonly found growing in the nearshore regions of lakes. Positive identification of these species usually requires the aid of a microscope. However, *Cladophora* usually has an appearance and texture that is quite distinct to a trained surveyor, and these were the sole criteria upon which identification was based.

Other species of filamentous green algae can respond to an external nutrient source in much the same way as *Cladophora*, although their value as an indicator species is not thought to be as reliable. When other species occurred in especially noticeable, large, dense growths, they were recorded on the survey maps and

described the same as those of *Cladophora*.

Among other things, the distribution and size of each *Cladophora* growth is dependant on the amount of suitable substrate present. The extent of suitable substrate should therefore be taken into account when interpreting the occurrence of individual growths, and assessing the overall distribution of *Cladophora* along a particular stretch of shoreline. The presence or absence of suitable *Cladophora* growth substrate was recorded during the survey. In the database, properties with habitat throughout the shoreline were listed as "yes," without any habitat listed as "no," and those parcels possessing areas with habitat and without habitat were listed as "partial".

Shoreline structures were also noted during the field survey and included as a separate column in the database. Shoreline structures were noted in an "alteration" column with the following abbreviated descriptions:

SB = steel bulkhead (a.k.a seawall)
CB = Concrete bulkhead
WB = wood bulkhead
BB = boulder bulkhead
RR = rock rip-rap (see substrate categories for boulder vs rock sizes)
G = groin
BH= permanent boathouse
DR = dredged area
DP = discharge pipe

Sometimes abbreviations were mixed or vary from what is listed above.

Locations of *Cladophora* growth were documented by using Global Positioning Systems (GPS) and by noting property features. Two different GPS units were employed in the field: a Trimble GeoExplorer3 mapping grade GPS unit and a Ricoh Caplio Pro G3 Digital GPS camera. Photographs accompany GPS locations where the Ricoh GPS camera was used. Property features and their description (as viewed from the water) were recorded on field data sheets. All information was recorded in a database developed for this project.

After performing field work, GPS data were transferred to computer at the Watershed Council office and processed for use. GPS data were imported into a Geographical Information System (GIS) and joined to the field datasheet records to

produce maps and perform spatial analyses.

Property features included developed platted lots, undeveloped (vacant) lots, large undeveloped parcels, parks, preserves, public access sites, and county road endings. However, it was not possible to identify every distinct parcel in this manner. The database field containing the property description contains a sometimes cryptic descriptive phrase due to character space limits. For example, *Red 2 sty, brn rf, wht trm, fldstn chim, lg pine* means that the property has a red two-story house with a brown roof, white trim, fieldstone chimney, and a large pine tree in the yard. Wherever known, names of property owners and shoreline address of properties were included in the database.

Developed parcels were noted on field data sheets during the survey and included as a separate column in the database. Properties described as developed indicate the presence of buildings or other significant permanent structures, including roadways, boat launching sites, and recreational properties (such as parks with pavilions and parking lots). Properties with only mowed or cleared areas, seasonal structures (such as docks or travel trailers), or unpaved pathways were not considered developed. Additionally, relatively large parcels that may have development in an area far from the water's edge were not considered developed. The length and area of developed versus undeveloped shoreline was not calculated.

Tributaries are one of the primary conduits through which water is delivered to a lake or river from throughout its watershed. Tributaries also carry and deliver a variety of materials from throughout the watershed to the receiving water. This can include pollutants such as sediment, nutrients, bacteria, and toxins from human activities far removed from a lake or river. *Cladophora* growths and elevated conductivity levels often occur at the mouth of tributaries and therefore, tributary streams were documented during the survey and included in the database.

Additional information written on field data sheets was also inputted into the database. This information was added to a column entitled "comments".

During recent shoreline surveys, the Watershed Council parcel identification

system for Walloon Lake has gradually been linked to the digital parcel databases from the Emmet and Charlevoix County Equalization Departments. The advent and utilization of GPS in the field survey has improved the efficacy and reliability of this process. Watershed Council staff also conducted ground-truthing activities; traveling in car around the lake to match property descriptions in the shoreline survey database with street addresses and therefore, county equalization data. The entire shoreline survey database was linked to county equalization data via parcel identification numbers.

RESULTS

This survey documented shoreline conditions at 1002 locations (perceived as separate properties) on Walloon Lake. The shoreline was developed at approximately 840 of these locations (84%). Habitat generally considered suitable for *Cladophora* growth was present along at least part of the shoreline of 834 properties (83%). Noticeable growths of *Cladophora* or other filamentous green algae were found at 304 locations, which was 36% of properties with suitable habitat.

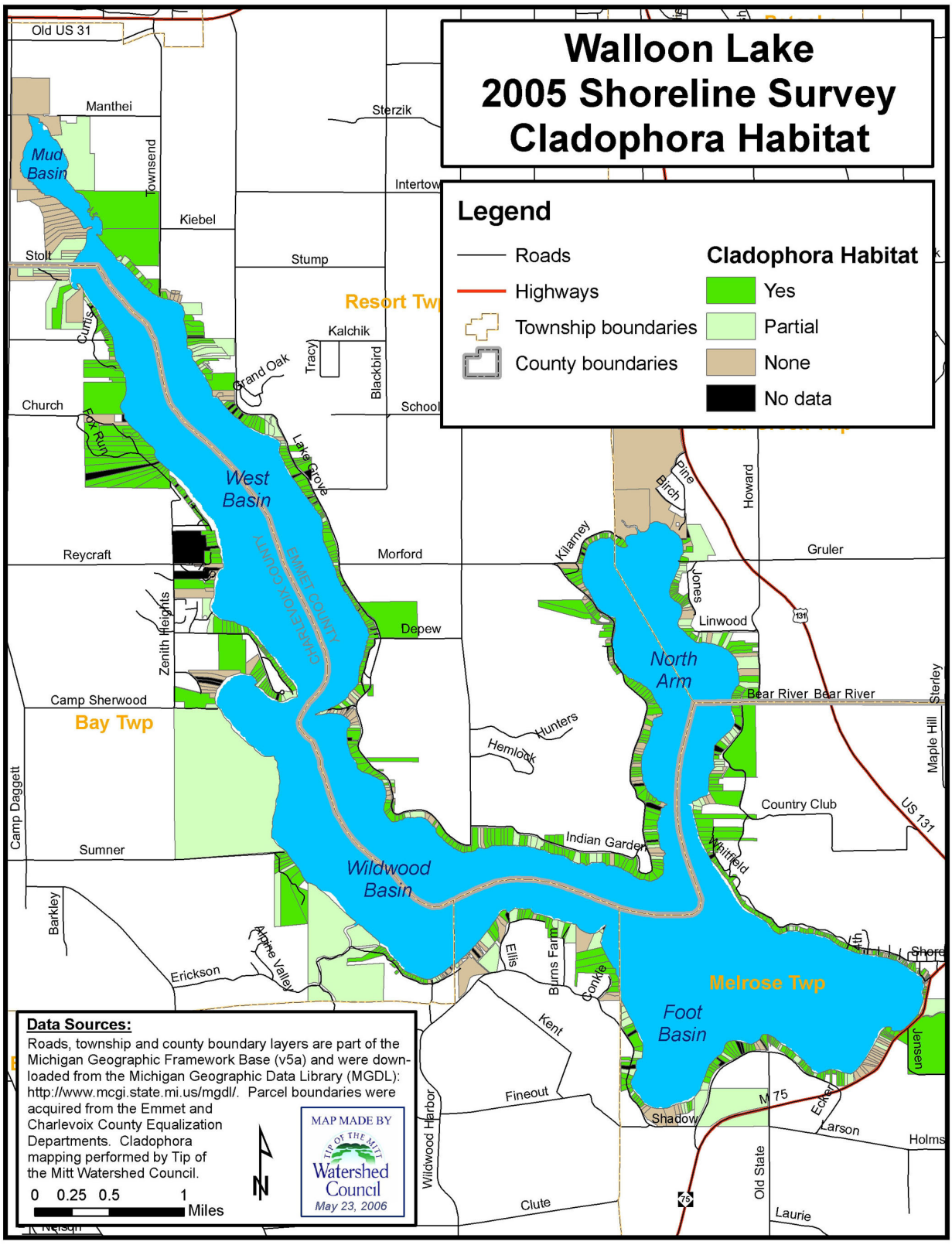
Cladophora growth densities were grouped into three main categories and the number of field observations for each category were as follows:

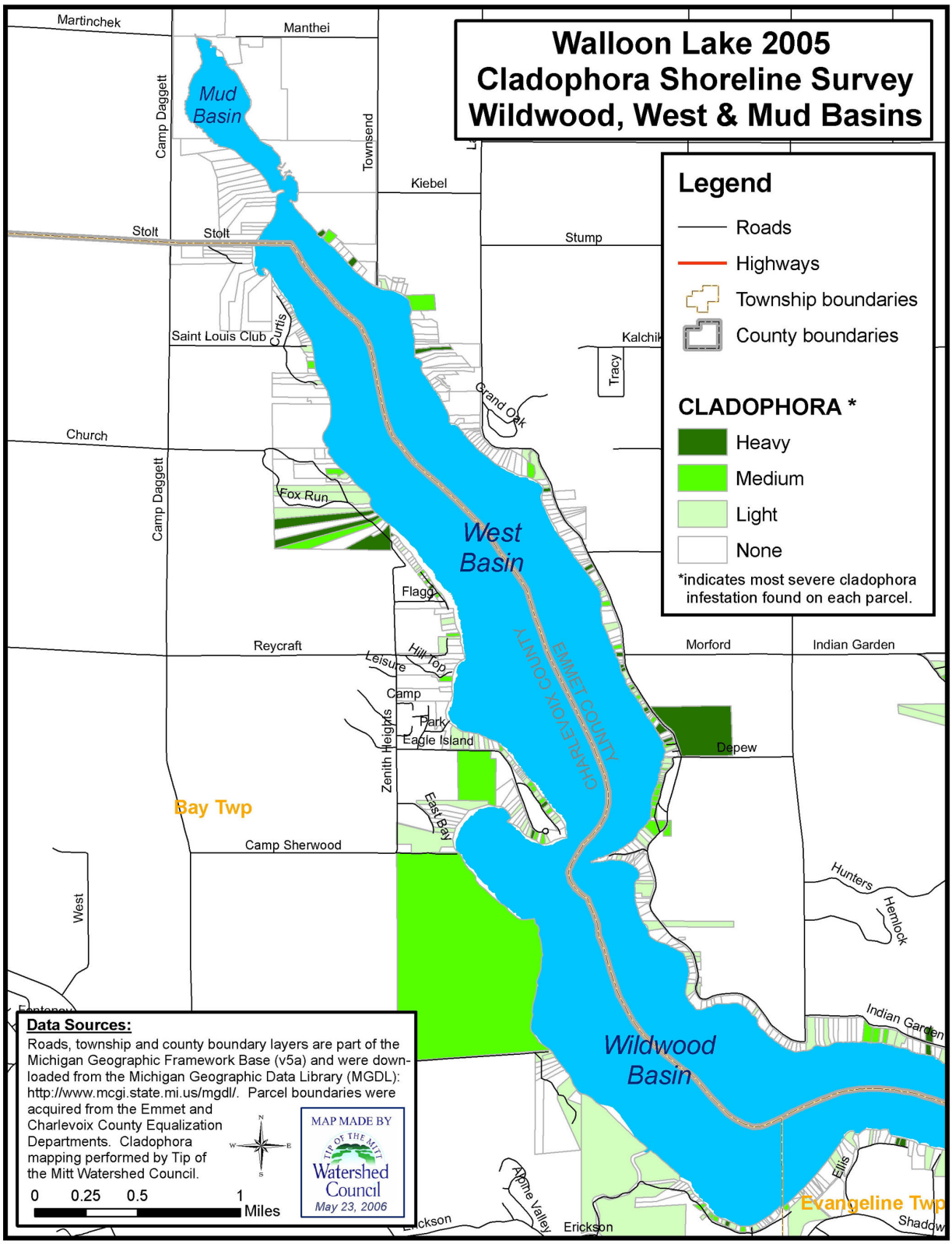
Light.....177
Moderate 82
Heavy 45

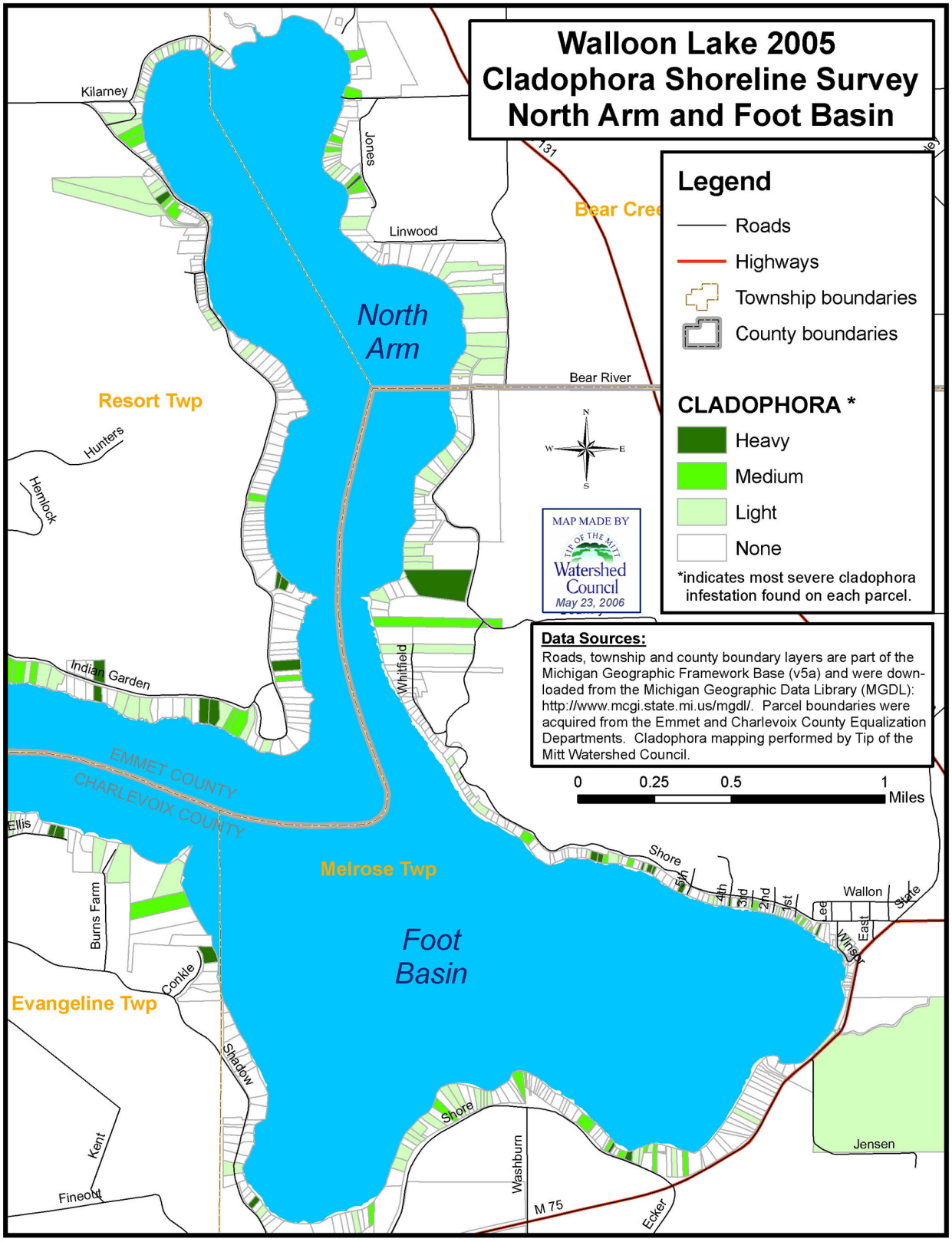
Although the greatest number of observed *Cladophora* growths fell in the light category (58%), over 40% of growths were noted as moderate to heavy. Most of the *Cladophora* growths were associated with developed shoreline properties (~96%).

Tributary streams were documented on 56 properties. Shoreline alterations were noted on 684 properties (68%).

The shoreline survey database, which was delivered to the Walloon Lake Association on a compact disc, contains a sequential listing of properties beginning at Gruler Road and traveling counterclockwise around the entire perimeter of the lake. The database contains all data collected in the field and identification numbers correspond to those on the large map.


Walloon Lake
2005 Shoreline Survey
Cladophora Habitat
Legend
Roads
Highways
Township boundaries
County boundaries
Cladophora Habitat
Yes
Partial
None
No data
Old US 31
Manthei
Sterzik
Mud Basin
Townsend
Kiebel
Stolt
Stump
Resort Twp
Kalchik
Curtis
Tracy
Blackbird
Grand Oak
Church
School
Fox Run
Lake Grove
West Basin
CHARLEVOIX COUNTY
EMMET COUNTY
Reycraft
Morford
Zenith Heights
Depew
Camp Sherwood
Bay Twp
Camp Daggett
Sumner
Barkley
Erickson
Maple Valley
Wildwood Basin
Ellis
Burns Farm
Conkle
Kent
Fineout
Wildwood Harbor
Clute
Kilarney
Pine
Birch
Howard
Gruler
Jones
Linwood
North Arm
Bear River
Bear River
Sterley
Maple Hill
Hunters
Hemlock
Country Club
US 131
Indian Garden
Whitfield
Melrose Twp
Foot Basin
Jensen
Shadow
M 75
Eckert
Larson
Holms
Old State
Laurie
Data Sources:
Roads, township and county boundary layers are part of the Michigan Geographic Framework Base (v5a) and were downloaded from the Michigan Geographic Data Library (MGDL): http://www.mcgi.state.mi.us/mgdl/. Parcel boundaries were acquired from the Emmet and Charlevoix County Equalization Departments. Cladophora mapping performed by Tip of the Mitt Watershed Council.
0 0.25 0.5 1
Miles
N
MAP MADE BY
TIP OF THE MITT
Watershed Council
May 23, 2006


Walloon Lake 2005
Cladophora Shoreline Survey
Wildwood, West & Mud Basins
Legend
Roads
Highways
Township boundaries
County boundaries
CLADOPHORA *
Heavy
Medium
Light
None
*indicates most severe cladophora infestation found on each parcel.
Mud Basin
West Basin
Wildwood Basin
Martinchek
Manthei
Camp Daggett
Townsend
Kiebel
Stolt
Stump
Saint Louis Club
Curtis
Tracy
Grand Oak
Church
Fox Run
Flagg
Reycraft
Leisure
Hill Top
Camp
Park
Eagle Island
Zenith Heights
Morford
Indian Garden
Depew
CHARLEVOIX COUNTY
EMMET COUNTY
Bay Twp
East Bay
Camp Sherwood
West
Hunters
Hemlock
Indian Garden
Evangeline Twp
Ellis
Shaddow
Erickson
Alpine Valley
Data Sources:
Roads, township and county boundary layers are part of the Michigan Geographic Framework Base (v5a) and were downloaded from the Michigan Geographic Data Library (MGDL): http://www.mcgi.state.mi.us/mgdl/. Parcel boundaries were acquired from the Emmet and Charlevoix County Equalization Departments. Cladophora mapping performed by Tip of the Mitt Watershed Council.
0 0.25 0.5 1 Miles
MAP MADE BY
Tip of the Mitt Watershed Council
May 23, 2006


Walloon Lake 2005
Cladophora Shoreline Survey
North Arm and Foot Basin
Legend
Roads
Highways
Township boundaries
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CLADOPHORA *
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*indicates most severe cladophora infestation found on each parcel.
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Data Sources:
Roads, township and county boundary layers are part of the Michigan Geographic Framework Base (v5a) and were downloaded from the Michigan Geographic Data Library (MGDL): http://www.mcgi.state.mi.us/mgdl/. Parcel boundaries were acquired from the Emmet and Charlevoix County Equalization Departments. Cladophora mapping performed by Tip of the Mitt Watershed Council.
0 0.25 0.5 1 Miles
North Arm
Foot Basin
Resort Twp
Melrose Twp
Evangeline Twp
Kilarney
Linwood
Bear River
Hunters
Hemlock
Indian Garden
Whitfield
Jones
EMMET COUNTY
CHARLEVOIX COUNTY
Ellis
Burns Farm
Conkle
Shadow
Kent
Fineout
Shore
Washburn
M 75
Ecker
Wallon
Jensen
Bear Cree
131

DISCUSSION

Many areas along the Walloon Lake shoreline show evidence of potential nutrient pollution. Although some of the algae growths are undoubtedly associated with septic system leachate or other factors associated with development and human activities, many are probably due to natural factors. There are numerous streams, springs and seeps flowing into Walloon Lake from virtually all sides that may be delivering nutrients and ions.

Compared to most recent of previous *Cladophora* surveys on Walloon Lake, the total number of properties where *Cladophora* growth was observed dropped by nearly 20%. However, this drop occurred primarily in observations in the light category. The number of medium and heavy growth observations, relative to the time period of the survey, increased by 5% in the medium category and 9% in the heavy category. Thus, in spite of an overall drop in *Cladophora* occurrence over the four-year period, the relative growth density increased.

***Cladophora* Growth**	**2001 Survey Results**	**2005 Survey Results**
Light	270 properties (72%)	177 properties (58%)
Medium	83 properties (22%)	82 properties (27%)
Heavy	22 properties (6%)	45 properties (15%)
TOTAL	375 properties	304 properties

The majority of properties had the same level of *Cladophora* growth (usually none) in both the 2001 and 2005 surveys (61%). *Cladophora* growth was greater on the shorelines of approximately 18% of properties and less on 21%. Statistics reveal some changes between time periods, but make clear the continued need to address nutrient pollution occurring in shoreline areas of Walloon Lake.

Recommendations

The full value of a shoreline survey is only achieved when the information is used to educate riparian property owners about preserving water quality, and to help them rectify any problem situations. The following are recommended follow-up actions:

1. Keep the specific results of the survey confidential--in other words, do not publish a list of sites where filamentous algae or high conductivity readings were found.

2. Send a general summary of the survey results to all shoreline residents, along with a packet of informational brochures produced by the Watershed Council and others to provide information about practical, feasible, effective actions to protect water quality. This would cost approximately $5 to $25 per household, depending on complexity and type of materials distributed.

3. Inform those owners of properties with *Cladophora* growths of the specific results for their property, ask them to fill out a questionnaire in an attempt to interpret causes of the growth/signals, and offer individualized recommendations for water quality protection. Following the questionnaire survey, site visits coupled with ground water testing are sometimes preformed in an effort to gain more insight into the nature of the findings. Again, it should be stressed that all information regarding names, specific locations, and findings be kept confidential to encourage property owner participation in this project.

4. Repeat some version of the survey periodically (every 3-5 years), coupled with the follow-up mailings described previously, in order to promote water quality awareness and good management practices in an ongoing basis. During each subsequent survey, more information about shoreline features is added to the database. The database greatly facilitates future surveys, resulting in a reduction

of staff hours needed for repeating the survey, and can be utilized for other water resource management applications.

5. Continue to update and improve the accuracy of the county parcel and shoreline survey databases. Although significant improvements were made during the 2005 shoreline survey, there are invariably more errors that will need to be addressed. In addition, due to the fact that parcel owners, parcel sizes, parcel development and buildings on parcels change over time, there is a continual need to update the databases. Improving the databases facilitates the identification and mapping of *Cladophora* growths during future shoreline surveys and helps with contacting property owners during follow-up activities. It is also useful for empowering the lake association to monitor shoreline activities, recruit new members, and compile and manage other water resource information.

6. Continue to document and map other shoreline features such as public access sites, shoreline erosion, greenbelts, wetlands, aquatic plants, and bottom substrate type. This will improve the utility of the maps by displaying additional shoreline features in relation to *Cladophora* growth locations.