Economic Impact Survey

of Eurasian Watermilfoil Removal from Houghton Lake

Authors:
Jim Deamud, Houghton Lake Improvement Board
Jim E. Henderson, US Army Corps of Engineers
Mike C. Lennon, Aquatic Control Technology, Inc.
Mark S. Mongin, SePRO Corporation
Dick Pastula, Houghton Lake Improvement Board

July 2004

US Army Corps of Engineers

HLIB Houghton Lake Improvement Board

SePRO

TABLE OF CONTENTS

Executive Summary

Houghton Lake, located in the north central part of Michigan's Lower Peninsula, is the state's largest inland body of water. At nearly eight miles long and four miles wide, the lake encompasses over 22,000 acres of open water.

Eurasian Watermilfoil (EWM), *Myriophyllum spicatum*, an exotic invasive aquatic plant, was first discovered in 1994 and allowed to grow unmanaged until it eventually dominated over 50 percent of the native aquatic plant community of Houghton Lake. The EWM infestation developed into a major nuisance by 2001, negatively impacting the water quality and shoreline conditions of the lake. As a result of the EWM infestation, there were negative impacts throughout the tourism industry and the local economy of the Houghton Lake area.

To address the EWM problem, corrective action was taken in the spring/summer 2002 by the Houghton Lake Improvement Board to successfully remove EWM from the lake. Their selected strategy used the Integrated Method for Controlling Aquatic Plants (IMCAP*), which included a whole-lake, low dose, precision application of the aquatic herbicide Sonar*. An economic impact and property owner survey followed in October 2003. The results from this survey reported that a large majority (96 percent) of those responding were satisfied with the treatment of the lake, and that a majority, facing a similar situation in the future, would take similar corrective action. A summary of important survey observations follows:

- ***The local economy of Houghton Lake is dependent on tourism.***
- ***Many of the local businesses are strongly dependent on the health of the local economy, rather than economic forces outside of the area.***
- ***Water quality in the lake directly affects the health of the tourism industry and thus the health of the overall local economy.***
- ***As a whole, residents of the Houghton Lake community were discouraged by the EWM infestation.***
- ***Visitors were also discouraged by the lakes condition as a result of the EWM infestation.***
- ***A majority of the survey respondents noticed a decline in tourism as a result of the EWM infestation, between the years 1999 and 2000.***
- ***A large majority (96%) of those surveyed were satisfied with the Sonar treatment of the lake which successfully removed the EWM.***
- ***Most of those who responded would support the use of Sonar again if the situation with the EWM presented itself in the future.***
- ***Most of those who responded would encourage others to use Sonar if faced with a similar situation as Houghton Lake experienced in 1999/00.***
- ***The success of the treatment has positively affected the local tourism industry.***

The survey also found some concerns regarding the corrective action taken and the future of the lake. Specifically, respondents voiced a fear that long-term management of the lake would not continue and that economic losses would be repeated. In addition the survey found that most respondents believe they received a reasonable return on their investment into the Special Assessment levied to pay for the corrective measures. The majority of those surveyed also felt the amount assessed per unit was an affordable price to pay for the results received.

While the full economic impact of the EWM treatment of Houghton Lake is yet to be completely quantified, it is expected that, in time, many more real and tangible benefits will become realized.

** Trademark of SePRO Corporation*

OBJECTIVE

It is the purpose of this report to identify and document the effects on the local economy resulting from the 2002 Sonar* treatment of Houghton Lake. Through personal interviews and the analysis of an extensively distributed survey (Appendix A), the economic impact resulting from the successful removal of Eurasian Watermilfoil in Houghton Lake will be examined, both in terms of personal/communal satisfaction with the treatment and the impact on the local economy. This report will also compare past and present information on the local economy of the Houghton Lake area, and describe how the 2002 Sonar treatment affected the economic health of the lake.

Aquatic Plant Management scientists have long documented the negative impact of excessive nuisance and exotic plant growth. Invasive plants can have serious and detrimental consequences to the ecology of the aquatic environment and ultimately may impact the surrounding community and the local economy connected to the lake (Henderson and Kirk 2002). There are many challenges, however, in quantifying the values associated with the lake, making even an extensive survey, such as this, a "snap shot" or an incomplete evaluation.

"There are difficulties in estimating the economic impacts of aquatic weeds (or, conversely, the benefits of their control) due to the "public-good" nature of aquatic resources and the resulting fact that few of these impacts or benefits pass through economic markets"[1]. Economists have tried to find ways to quantify these impacts and benefits, in order to make more informed estimations concerning their values. The US Army Corps of Engineers have developed their own techniques to quantify almost un-quantifiable values such as: How much is a day of fishing worth to you? [2] And, although they have had success in estimating benefits associated with specific plant management levels, they admittedly realize their own system is limited in the ability to fully capture the estimates of economic loss. For this reason, the authors of this report elected not to follow a similar method for measuring the economic impact of the Houghton Lake EWM removal project[3].

Another method used to quantify impacts related to an aquatic plant infestation is to calculate "values-at-risk" by identifying losses that can be directly linked to the body of water in question. Calculating values-at-risk, however, is no easy feat either, and may perpetuate the use of broad speculation and rolling assumptions. In the following sections we will explore values-at-risk calculations for Houghton Lake in full detail.

The tools used, albeit imperfect, have proven to be effective in creating a cautiously consistent, accurate collection of studies concerning the economic impact of invasive aquatic plants. Using these tools, (i.e., questionnaire, survey, direct interviews, willingness to pay [contingent value], economic impact assessment, values at risk calculations), in conjunction with the project methodology, it is the goal of this project to estimate the economic impact from the corrective treatment to remove EWM from Houghton Lake.

---

[1] Rockwell, William H. Jr. Ph.D. *Summary of the Literature on the Economic Impact of Aquatic Weeds*. Aquatic Ecosystem Restoration Foundation. (10/1/03) www.aquatics.org/pubs/economics.htm (P.1)

[2] Henderson, Jim E. and Phil Kirk "'So how much is it worth?' Economic Impacts of Recreational Fishing Under Different Aquatic Plan Conditions". *Aquatic Plant Control Research Program* Vol-A02-1 (2002) pp.1-8. (p.2)

[3] Mongin, Mark S., Personal Interview 9/20/03.

METHODOLOGY

An extensive 27-question survey supplemented with personal interviews of area residents were two of the primary methods used to gather information for this report. In addition, public records with relevant economic indicator data were utilized to further investigate, better quantify and validate identified changes in the local economy. The preparation for the survey was a collaborative work with input from: Jim Henderson (USACE), Dick Pastula (HLIB), Jim Deamud (HLIB), Eric Bacon (Michigan DEQ), and Mark Mongin (SePRO). The survey, which utilized qualitative and quantitative questions, was mailed to more than 700 property owners who live around the lake and who all paid fees into the lake clean up fund. Each of the lakeshore property owners surveyed paid a Special Assessment Fee assigned specifically to fund the Eurasian Watermilfoil removal effort. The purpose of the survey was to collect general information regarding the local economy from the people who are most immediately affected by changes in the condition of the lake. The survey seeks to gain their perspective regarding the 2002 restoration treatment performed by the aquatic plant managers under the guidance of SePRO Corporation.

The survey response exceeded expectations, with a return of over 20 percent. The response data from this survey was utilized to create much of the analysis and conclusions in this report. Appendix B and C contain detailed information regarding specific responses and comments to questions as well as survey results.

The second primary method of information collection used in this study was personal interviews. These interviews, which took place during the week of September 22-26, 2003 in the Houghton Lake area, have been used to provide a historical perspective on the region's economy and complement, or contest, the information collected through the written survey. The interviews were held with individuals in the lake community who had a vested interest in the health of the lake, and those who represented a unique sector of the local economy – business owners. Based upon these criteria, interviews were conducted throughout the week with various members of the business community. It is recognized, however, that this process was greatly influenced by time and availability of the business owners, so the information obtained through individual interviews will not be used in conjunction with the survey responses to stand on its own, but rather to strengthen, or question, the data received through the survey. Also any hard data received from these interviewees will be used, in aggregate to help quantify "values-at-risk", and help us in drawing the conclusions of this report.[3]

INTRODUCTION

Houghton Lake, located in the north central part of Michigan's Lower Peninsula, is the state's largest inland body of water. At nearly eight miles long and four miles wide, the lake encompasses over 22,000 acres of open water. Its size, accessibility, and its proximity to large metropolitan areas in Michigan have made it an ideal recreational destination.

What was at one time a quaint lakeside community with weekend visitors in the summer, has turned into a multi-million dollar recreational destination, grossing over $13 million in motel revenue between 1996-2001.[4] Although a large portion of the area surrounding the lake,

[3] Rockwell, William H. Jr. Ph.D. *Summary of the Literature on the Economic Impact of Aquatic Weeds*. Aquatic Ecosystem Restoration Foundation. (10/1/03) <www.aquatics.org/pubs/economics.htm>

[4] Shea, Laura and Bob. Personal interview. 9/25/03.

comprised of four townships (Roscommon, Denton, Lake, and Markey), remains modest in appearance, life around the lake has changed.

Many people who spent their childhood summers in Houghton Lake have converted their once summertime cabins into larger, winterized retirement homes. Similarly, many of the "mom and pop" resorts, boasting individual cabins and fire pits are being sold off, and turned into modern condominiums to accommodate the growing desire of the baby boomer generation to retire on the lake. All of this change has had a marked difference on the demographics of the area, but has not altered the lake's primary attraction as a recreational destination.

Houghton Lake's appeal as a tourist destination has undoubtedly contributed the most to the growth of the economy in the area. Throughout the 1990s, the Houghton Lake economy prospered. Between the changing demographics of the area and the strong tourism base which came to enjoy the benefits of the lake, the townships surrounding the lake were experiencing unprecedented prosperity. In fact, the community and local economy was growing rapidly enough to attract both K-mart and Wal-Mart to the area during this time of expansion. This heyday of economic growth and prosperity, however, was soon to be called into check, and the townships that had invested their well being in the lake were called to perform some maintenance on the economic engine.

In 1994/1995, Donald Bonnette, a graduate student from Central Michigan University was studying the wild rice (*Zizania aquatica* L.) on Houghton Lake when he discovered what he knew to be an impending problem; he had discovered the first evidence of Eurasian Watermilfoil (*Myriophyllum spicatum* L.). Knowing that Eurasian Watermilfoil (EWM) was an aggressive exotic species, and that it could create catastrophic change to the lake's ecology, Bonnette sounded an alarm. In an effort to warn the community of the looming problem, Bonnette met with the County Board of Commissioners to explain what he had found, and the problems that could arise from its presence. Much to the future dismay of the community, the County Board of Commissioners, at that time, did not act aggressively enough on Bonnette's warning.

As a result of the failure to act on Bonnette's early warning, the townships surrounding the lake continued to enjoy economic prosperity unconcerned by the growing threat hidden below the surface. In fact, it wasn't until 1999 that the problem facing Houghton Lake again became publicly recognized. While researching for an application of Copper Sulfate to combat "swimmers itch", Doug Pullman, Ph.D., under contract with the Township of Denton, discovered higher, more widespread populations of EWM and again sounded an alarm. This time, however, people began to listen.[5] Pullman's report of the problematic EWM populations spurred the establishment of a local committee that studied the problem in 99/00 and called for the establishment of the Houghton Lake Improvement Board.[6] Thereafter, the project had momentum, and action to combat the EWM in Houghton Lake was soon underway.

By the summer of 2001, Houghton Lake, and the people who depend on it, were in the thick of a problem which showed no signs of letting up. At this time, nearly 50 % of the lake had been infested with EWM, and an estimated 4,000 acres were completely topped-out.[7] The rapidly growing infestations led to a myriad of problems throughout the lake and its surrounding communities. These problems included lake accessibility, aesthetics, and the overall health and viability of the local economy that depends on the marketability of the lake and its shoreline property.

---

[5] Faino, Joe. Personal interview. 9/23/03.
[6] Pastula, Dick. Personal interview. 9/25/03.
[7] ReMetrix LLC. *Multiyear Change Analysis for Eurasian Watermilfoil, Including 2002 Satellite and Field Data*. Carmel, IN: 2003. (p.5), & Smith, Craig S., Mark Mongin and Mark A. Heilman. "Houghton Lake, MI—Restoring the Aquatic Vegetation." *LakeLine* Vol. 23 No. 3 (Fall 2003): 30-33.

No longer willing to endure the problems the invasive aquatic plants were causing, and the economic detriment the exotic plant infestation was having on the community, the Houghton Lake Improvement Board (HLIB) mobilized. Determined not to suffer another season with the EWM, or wait to see if the grim scientific prophecies of complete lake coverage would come true, the HLIB moved into action. The board reviewed treatment methodologies, commissioned a lake management plan, solicited contractor bids, held public forums, and formed a tax district by which to pay for the implementation of an environmental restoration plan.

THE LOCAL MARKET

The economy of the Houghton Lake area predominately caters to the tourism industry the lake attracts. Although there is a rapidly expanding population of year-round residents, the combined population of Roscommon, Denton, Lake, and Markey townships is just above 11,000. And the population increases three-fold during the summer months and up to six-fold during the annual Tip-Up Town Festival.[8] To accommodate tourists, there are a variety of lodging opportunities including: modern hotel chains, family-owned resorts, and cabin rentals. In addition, there are many restaurants, bars, and shops to entertain guests visiting the lake. There are also a variety of ways for a visitor to enjoy the lake, from fishing, swimming and boating, to relaxing on the beach with a nice sunset on the beautiful clear calm water.

SURVEY RESULTS

In preparing a survey to explore the economic impacts of the 2002 Sonar* restoration treatment, it was necessary to ask a variety of questions in an effort to determine the perceptions of the local business community concerning the Sonar treatment. These questions were ordered randomly within the survey to break up any rhythmic pattern of answering, but have been re-grouped by common themes below, in an order specific to this report.

The following section will explore responses of all returned surveys. However, answers from all of the survey questions will not be interpreted. Responses from specific questions will be examined that have to do with overall perceptions of the EWM problem and the corresponding treatment. Decisions on management of natural resources requires understanding of the relationship between the natural resources—in this case the water and land resources of Houghton Lake—and the human uses and benefits of the lake. This initial section of the survey analysis examines perceptions of the relationships of aquatic plant management, water quality, tourism, and business or economic well being. The following section will be used to establish a set of conclusions that will be helpful in determining "values-at-risk" and will help in setting the stage for the final analysis of this report. After looking at the overall response from the survey, the analysis has been broken down into smaller sections, where each sub-section pertains specifically to one aspect of the lake and its treatment. Conclusions drawn in this "Overall Results" section will set the tone for the following sub-sections, and will provide great insight into the feelings of the business community regarding the effects of the 2002 Sonar treatment.

ORGANIZATION OF THE RESULTS

To clarify the survey results, a variety of approaches have been taken in interpreting the data collected. In the following sections, answers from specific survey questions will be isolated and looked at to find underlying commonality. Along with the statistical data, stories and anecdotes from the interviews have been incorporated to support the information gathered from

[8] ReMetrix LLC. *Houghton Lake Management Feasibility Study: Final Report*. Carmel, IN: 2002. (p.10)

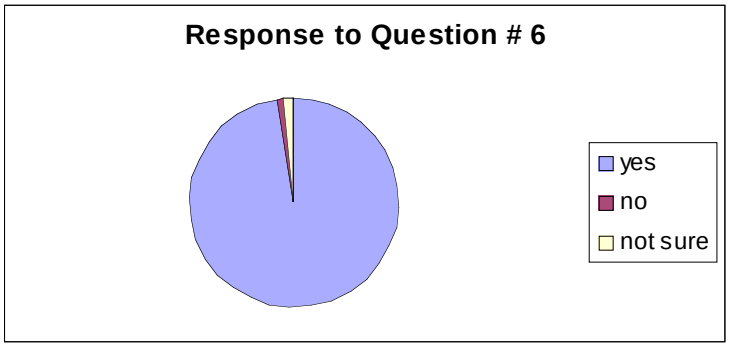
the survey. At the beginning of each section, reasons for commonality grouping will be discussed.

TOURISM AND THE ECONOMY

The following section will examine the survey responses, results of the survey and the overall response in order to determine a relationship between the lake, tourism, and the local economy. The discussions to come are carried forward to establish a set of relationships from which many conclusions of this report will stem.

The first survey question helped establish a relationship between tourism and the local economy. **"Do you feel that the local economy is dependent on tourism?"** This question was asked of interviewees in the Houghton Lake area and elicited a variety of responses. However, Mike Ryan of Harvey's Marine may have captured this relationship best by stating: "To all of those people who don't feel that they are connected to the lake, and wanted to leave it as it was, they don't understand that, in business, if there is no profit, there is no business. And, with no tourists there would be no profit, therefore, all of the businesses would leave." [9] Although this comment could be construed as overly presumptuous, it seems as though most of the business community was in agreement with Ryan. When asked in question # 6: "Do you feel that the local economy is dependant on tourism? - 97 percent responded "yes" (Figure 1).

Figure 1

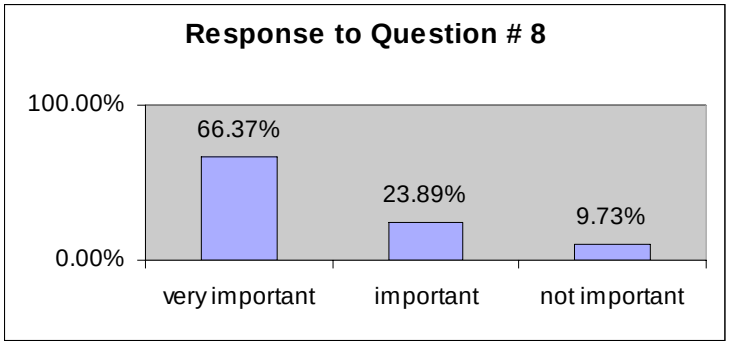


The conclusion that can be made from the response above establishes that the local economy *is*, or is at least perceived to be intimately connected to tourism. For that reason, it is practical to ask in question # 8: **"How important is the local economy to the health of your business?"** This question, and the perceptions it elicits, is an important piece of the economic puzzle. If it is established that a large percentage of the businesses in the Houghton Lake area are dependent on the local economy, it can be concluded that the health of the local economy is dependent on the health of the local tourism industry. If the local economy is not important to the health of local businesses, then the conclusion would, in contrast, be that changes in tourism do not affect the health of local businesses.

[9] Ryan, Mike. Personal interview. 9/25/03.

The response to the aforementioned question was strong with over 90 % of respondents answering "important" or higher, claiming that their businesses are dependent on the local economy (Figure 2).

Figure 2



Although the above argument may have seemed redundant, seemingly addressing the same question from a different angle, it was carried out to establish two critical points: First, the local economy is dependant on tourism. Secondly, most businesses in the area depend on the health of local economy. If the Houghton Lake area was also shared by other industries, such as manufacturing, it may have been that many of the industries would be more affected by economic situations outside the area. If this were the case the local economy would have still been reported as dependent on tourism, but the implications of this would not necessarily affect the livelihood of most people in the area. As it is, not only is the economy dependent on tourism, but so are the local people, their livelihood, and their way of life. As Mike Ryan, owner of Harvey's Marina stated: "I'm not only responsible for my business, but also for the 12 families my business provides for. If they don't have jobs, and money to go spend… other businesses will suffer…it's a slippery slope."[10]

Now that it has been established that the local economy and the businesses it supports are largely dependent on tourism it is only reasonable to ask: What is the tourism dependent on? This question, however, was not asked in the survey because it has long been understood that "the lake is what draws people up here".[11]

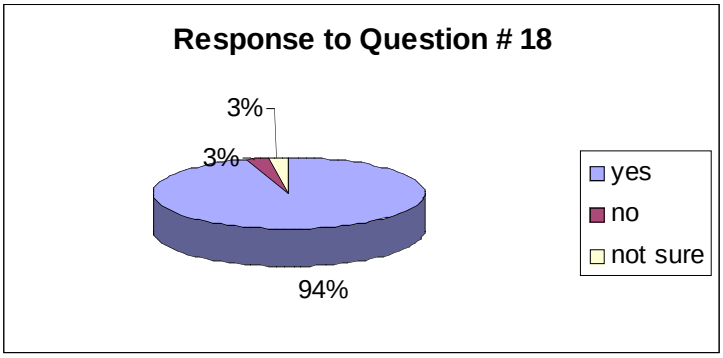
For that reason the next question we will discuss is #18 on the survey**: "Do you feel that the water quality of the lake directly affects tourism?"** The response to this question will help us finish a critical part of the interconnected economic cycle on which the Houghton Lake community depends. If one can assume that the water quality of the lake affects tourism, then it would be a reasonable conclusion, in light of what has been established above, that water quality not only affects tourism but has the potential for significant economic impact throughout the local economy. Although this report would not have been approached had this assumption not already been made, it is once again important to see how those who are most connected to the lake and its economy see the situation.

[10] Ryan, Mike. Personal interview. 9/25/03.
[11] Faino, Joe and Ron Eno. Personal interview. 9/23/03

For a number of local business owners, the reality of the interconnectedness of water quality and the tourism industry became all too real in the few years leading up to the treatment. Lyman Foster of Lyman's on the Lake, a local bait shop, claimed that he was even contemplating leaving the lake because the lake conditions had gotten so bad, stating, "if we don't get something going here in a year or two, I gotta go…you can't make a living selling bobbers and worms".[12]

The problems from the invasive aquatic plants even effected businesses not traditionally considered connected to the lake. Joe Faino, an appraiser at Roscommon County's Equalization Department, recalls the owner of 123 Lake St., a restaurant on the waterfront, complaining at a town meeting about the stench of the weeds in front of his restaurant, saying that the smell of the decaying weeds was so bad that it was driving away his customers.[13] These two anecdotal accounts support the conclusion that the water quality of the lake affected those businesses perceived as independent from the lake. However, the response to survey question eighteen was again a resounding "yes", with almost 95 percent of participants claiming that the water quality of the lake directly affects local tourism (Figure 3).

Figure 3



In the above discussions we have established direct connections between the local economy and the lake. Although many of these connections were assumed prior to the study, or even could have been assumed from the introduction to this report, the support of these assumptions was solidified by the one-sided survey responses. This is an important fact to note because many of the conclusions in this report are grounded in the idea that without tourism, much of the economic community would not exist.

Important observations drawn from this section:

- ***The local economy of Houghton Lake is dependent on tourism to the area.***
- ***Many of the local businesses are strongly dependent on the health of the local economy, rather than economic forces outside of the area.***
- ***Water quality in the lake directly affects the health of the tourism industry and thus the health of the overall local economy.***

[12] Foster, Lyman. Personal interview. 9/23/03
[13] Faino, Joe and Ron Eno. Personal interview. 9/23/03

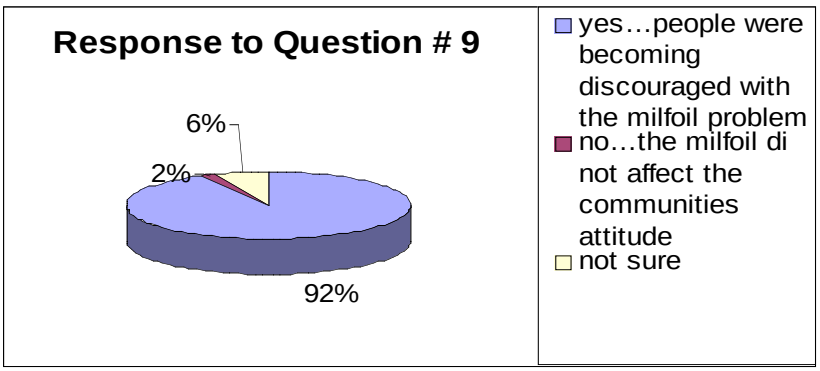
THE EWM PROBLEM

In the following section we will be looking at overall perceptions of Houghton Lake prior to the 2002 treatment that successfully removed the EWM. This section will be used to explore the community's awareness of the EWM problem, and its implications on the tourism industry.

As was discussed previously, the EWM problem facing the lake was a matter of great concern to the community. The EWM had rendered much of the lake useless, and had altered the way people interacted with the lake. No longer could you just go out on your boat and enjoy the lake, "you had to be on constant look out for the weed beds…you couldn't even get from point A to point B anymore".[14] This was a problem that not only affected those who lived on the lake, but also those visitors who came to boat on or otherwise enjoy the lake.

Because of the widespread concern for the lake and the tourism industry that depends on the lake, most everyone in the community was aware of the threat posed by the invasion of EWM and was therefore in a position to answer questions regarding the perceived impact of the exotic aquatic species invasion. The first of such questions is #9 of the survey which reads: **"As a whole, was the attitude of the Houghton Lake community affected by the Eurasian Watermilfoil?"** The response to this question was overwhelmingly one-sided with 92% of respondents answering, "Yes…people were becoming discouraged with the milfoil problem" (Figure 4). This response was not surprising considering the experience of many of the local residents and business owners who dealt directly with the Eurasian Watermilfoil infestation. In fact, Lyman Foster sold the boat rental portion of his business when the milfoil began to take over the lake. He blames the "weeds" for burning up at least "a motor a year" on his rental boats, and said "it was just too expensive to keep replacing them." Others claimed the exotic plant growth was so bad that they swore they could "walk across the top of the lake without getting wet." Many residents who lived along the canals could not even launch their boats from their docks because the boat would sit on top of the thick weed mat, never fully submerging. In fact, the problem got bad enough that The Detroit Free Press ran articles virtually telling people to find a new place to go because Houghton Lake was not a place for the resorting community.[15]

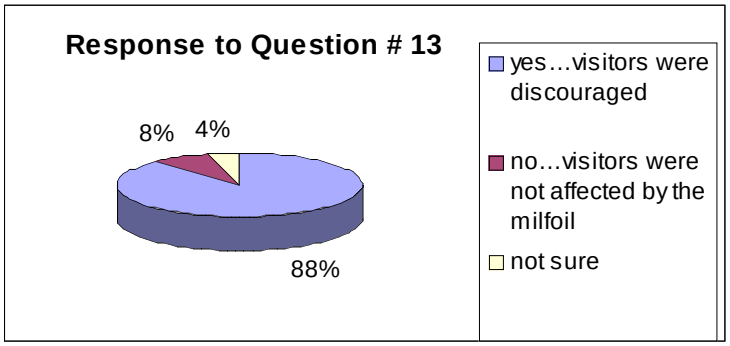
Figure 4



[14] Brian Tribelhorn. Personal interview. 9/23/03.
[15] Joe Faino

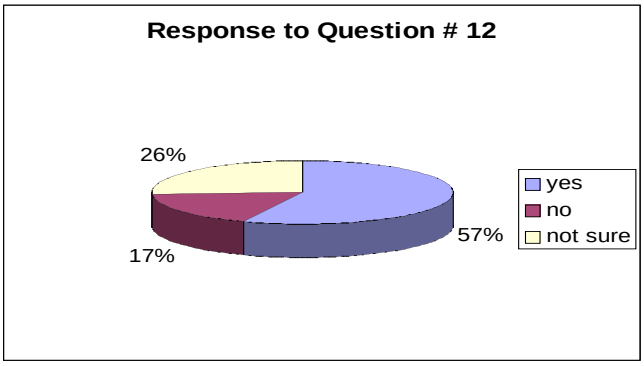
The next question explored this section, #13, is similar to question #9 asked above, yet asks respondents to answer on behalf of their observations of visitors. **"During the infestation did you notice if visitors were unhappy with the lake's condition?"** Although it is understood that not all of the respondents have an equal opportunity to interact with tourists, the question was asked with the assumption that in such a small community many people would have views on the subject. As suspected, more than 75% of respondents answered this question, and 88% of them said, "yes…visitors were discouraged" with the condition of the lake (Figure 5). In fact, the conditions on the lake were so bad, says Mike Rankin of the Houghton Lake Chamber of Commerce, that he was getting calls daily from visitors upset with the state of the lake. Many went as far as saying they were never coming back to Houghton Lake ever again.[16]

Figure 5



Question #12 closely relates to the last, and again asks respondents to offer their perceptions of effects on tourism. **"Did you notice a decline in tourism between the years of 1999-2000 while the watermilfoil began to infest the lake?"** Again, it is certain that not everyone who responded to the survey is in a position to say whether or not there was a decline in tourism, yet it is important to explore the community's perceptions of the situation. The response to this question was undoubtedly mixed with only fifty seven 57% of respondents answering "yes". Of the remaining 44%, seventeen percent of respondents said "no" -- tourism had not declined during these years", 26% responded that they were "not sure" if tourism had declined in these years (Figure 6).

Figure 6



[16] Rankin, Mike. Personal Interview. 9/24/03.

Although results from this question were mixed, with over 50% of the respondents answering "yes", there may have been a discernable difference in tourism over these few years. Also, because 26% said they were "not sure", it can be generalized that either they simply were not sure, or they felt that they were not in a position to answer this question fairly.

Important observations drawn from this section:

- ***As a whole, the Houghton Lake community was discouraged by the EWM.***
- ***Visitors were discouraged by the lake's condition as a result of the EWM infestation.***
- ***A majority of the survey respondents witnessed a decline in tourism as a result of the EWM between the years 1999 and 2000.***

THE 2002 SONAR TREATMENT

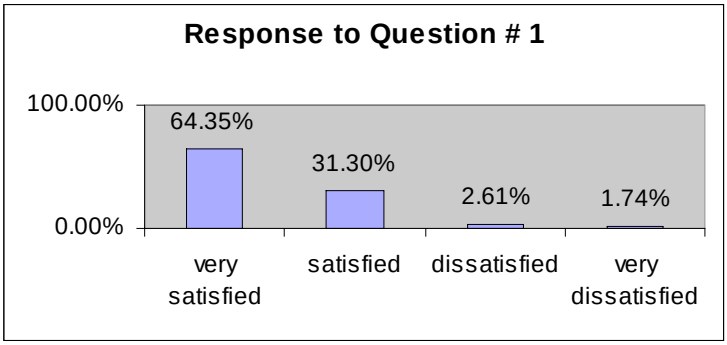
The survey results established a definite connection between the lake, the local economy, and the tourism industry. The changes in lake conditions resulted in a discernable difference in visitation and in perceptions of concern and discouragement on the part of the lake community and visitors. Also, research supports that the community and its visitors were discouraged with the condition of the lake, enough so to cause a noticeable difference in visitation. Due to this concern, SePRO Corporation was contracted in 2001 to help the community manage the EWM situation, and to set forth a management plan for the future control of EWM in the lake. SePRO's Sonar treatment followed in the summer of 2002, and successfully reduced EWM by 91% from 10,800 acres to less than 1,000 acres. In fact, EWM can now only be found in trace amounts within the lake.[17] Therefore, the next step in analyzing the overall survey data is to look at the community's satisfaction with the treatment.

"Please rate your satisfaction with the treatment of the Eurasian Watermilfoil in Houghton Lake." This first question in the survey, though quite obvious, was asked to determine the satisfaction of the community and to get a read on their perceptions on the success of the EWM removal program. This is an important question to ask, because the respondents represent a large portion of the funding provided for the treatment, and therefore had a vested interest in the success of the program.

[17] Smith, Craig S., Mark Mongin and Mark A. Heilman. "Houghton Lake, MI—Restoring the Aquatic Vegetation." *LakeLine* Vol. 23 No. 3 (Fall 2003): 30-33.

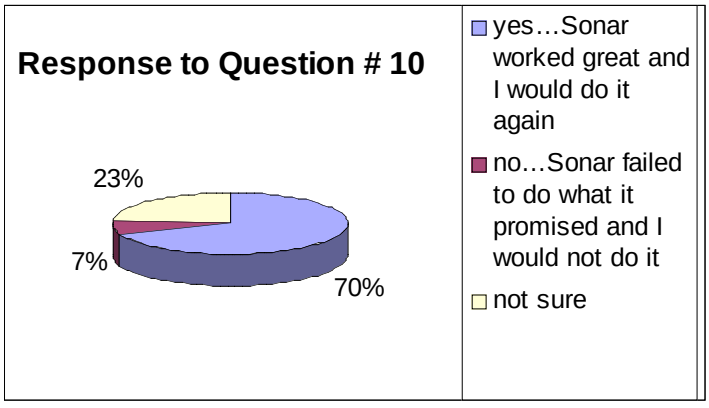
Throughout the interview process, people surveyed in the Houghton Lake community were posed this same question and the majority were satisfied, even surprised, by the dramatic results of the treatment. Dick Pastula (HLIB) stated, "I think I speak for 99 percent of the community when I say that I am extremely happy with the results of the treatment."[18] Almost 96% of the total respondents rated their satisfaction at "very satisfied" or "satisfied" (Figure 7).

Figure 7



In order to explore further the business community's satisfaction with the Sonar treatment, business owners were asked two hypothetical questions. The first question was # 10 in the survey and reads as follows**, "Imagine it is the year 2006, and the Eurasian Watermilfoil has rendered nearly 50% of the lake un-usable. Would you like the lake to be treated with Sonar, as was done, or would you find an alternative method of treatment?"** The response to this question was mixed, yet according to the data over two-thirds of those surveyed would treat the lake again with Sonar (Figure 8).

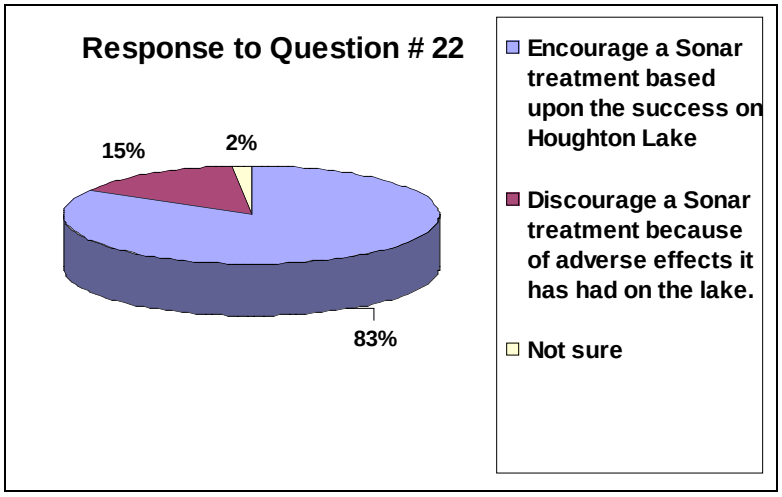
Figure 8



[18] Pastula, Dick. Personal Interview. 9/25/03. *Trademark of SePRO Corporation

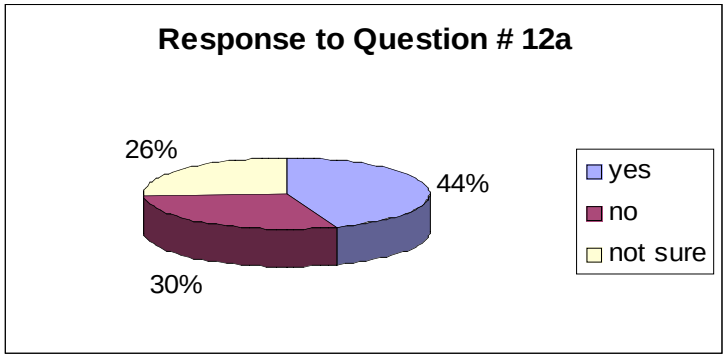
The second question intended to gauge the community's satisfaction is question #22 in the survey, "**If you were talking to a business owner on a different lake that was suffering the same fate as Houghton Lake in 2000 would you…?"** The possible responses for this question were: A. "Encourage a Sonar treatment based upon the success in Houghton Lake," B. "Discourage a Sonar treatment because of any adverse effects it has had on the lake", or C. "Not sure". Once again, those surveyed were in favor of the Sonar treatment with 83% answering "A", encouraging a Sonar treatment based upon their experience (Figure 9).

Figure 9



It can reasonably be concluded from the above information that the business community is overwhelmingly satisfied with the treatment of the lake. The survey report has only addressed half of the lake users, albeit a large and possibly more important half. It is also important to investigate the thoughts and feelings of the tourists. As previously noted, the community at large was facing a possibly disastrous situation with the EWM infestation in the lake. The problem had gotten bad enough to cause concern within the community and cause a downturn in tourism. The tourist community, however, can not be asked directly about their satisfaction with the treatment of the lake, and therefore can only really be gauged by rates of visitation. To touch upon this matter those surveyed were asked, **"Did you notice resurgence in tourism in 2002-2003."** This question elicited one of the most mixed results in the overall analysis of the survey, with only 44 percent saying yes there was resurgence in tourism after the treatment (Figure 10).

Figure 10



However, in looking at the response to this question it is important to keep in mind a number of factors. First, it is important to note that this study is taking place only a year after the EWM removal, and therefore the effects on recovery of the local tourism industry are still in progress. Secondly, the treatment of the lake was done swiftly, after only two really bad years of heavy milfoil infestation, so the local tourism industry was really just beginning to see what might have been a disastrous fallout in tourist numbers. Finally, and probably more importantly, the treatment itself was done less than a year after 9/11/01, when the nation as a whole had witnessed a drastic downturn in tourism and the economy. These three factors have undoubtedly had a significant impact on the local tourism industry of Houghton Lake and on the local perception of the industry.

The improved lake conditions have also been noticed by those who have visited the lake since the treatment was accomplished. Laura Shea of Shea's Lodge commented, "We've got some fisherman that are coming back in the fall, this will be the third time they are here this season, where normally they come just once…so we're getting people coming back 2 and 3 and 4 times to fish in a year."[19] And Lyman Foster, owner of Lyman's Bait & Tackle, said of the situation, "Considering we went from a bad couple of years when the economy was good…to a good couple of years when the economy was bad" the treatment has been a success and "people that said, two years ago, that they would never come back, were back".[20]

Important observations drawn from this section:

- ***A large majority (96%) of those surveyed are satisfied with the Sonar treatment of the lake.***
- ***Most of those who responded would use Sonar again if the situation with the EWM presented itself in the future.***
- ***Most of those who responded would encourage others to use Sonar if they were faced with a similar situation as Houghton Lake in 1999/00.***
- ***The success of the treatment has positively affected the local tourism industry.***

FINANCING THE TREATMENT

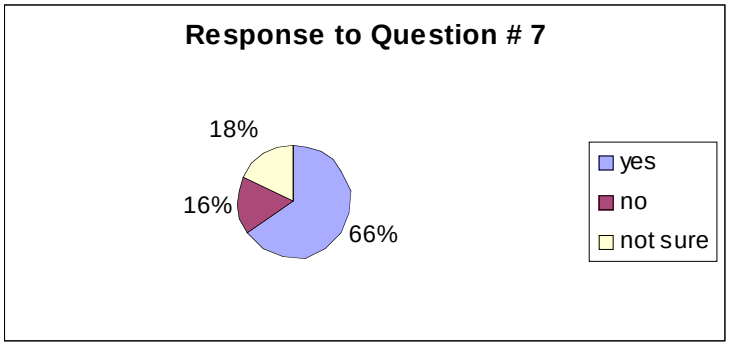
Although the overall satisfaction with the treatment appears to be extraordinarily positive, the above discussion did not include one of the more controversial aspects of the 2002 Sonar treatment. As was mentioned in the introduction, a Special Assessment District was formed to raise the funds necessary to pay for the EWM management. The goal of this assessment district was to raise $5 million over a period of five years in order to ensure capital for a thorough and complete management approach to the EWM situation they were faced with. Once an assessment district was established in accordance with the Michigan state law, those who were located within the district were charged a Special Assessment Fee based upon specific criteria. Essentially those located on, or close to, the lake are charged $200.00/year for five years and those located off the lake are charged $100.00/year. However, because of state law the "special assessment must reflect the relative benefits received by the property owners".[21] Therefore only those within a determined proximity to the lake are being charged, while others that live outside the district pay nothing. This situation created controversy, due to inequity of assessment fees. Many of those who felt they were being overcharged could see no reason why the funding was not spread more equally throughout the community. However, as was stated above, Michigan state law dictated

[19] Shea, Laura and Bob. Personal Interview. 9/25/03.
[20] Foster, Lyman. Personal interview. 9/23/03.
[21] *What's Up in Houghton Lake?*. Houghton Lake Improvement Board. 10/1/03 <http://www.roscommoncounty.net/milfoil%20handout.htm>

the circumstances under which the Special Assessment had to be constructed, and any other approach would have taken far longer, creating further delay in treatment and greater impacts on tourism, something most everyone wanted to avoid.[22]

To determine how satisfied the local business community was with their investment in the lake restoration project, the survey included a few questions regarding the Special Assessment. The first of these questions is question #7 reading, **"In your opinion, is the Special Assessment fee you pay annually a reasonable price to pay for the maintenance of Houghton Lake?"** The response was fairly mixed, yet the majority answered positively with 66% of respondents answering "yes", stating that they felt the Special Assessment fee is a reasonable price to pay for the maintenance of the lake (Figure 11).

Figure 11



The next question regarding the Special Assessment asked respondents to **"Rate the return on your investment of the Special Assessment Fee for the cleanup of Houghton Lake."** To evaluate return on investment, respondents were asked to rate the return from one to ten, where one was no return, and ten was a high return. To analyze the response from this question, researchers grouped the response data into two categories -- those who answered with five or below, and those who answered six and above. The basis for segmenting the data in this manner is based upon an assumption that those who answered five or below are unhappy with the return they have received from the Special Assessment Fee, while those who answered six and above feel that they have had a reasonable, or greater, return on their investment. As shown in Figure 13, 66% of the respondents answered with a score of six or better, while only 34% answered with a response of five or below.

Figure 12

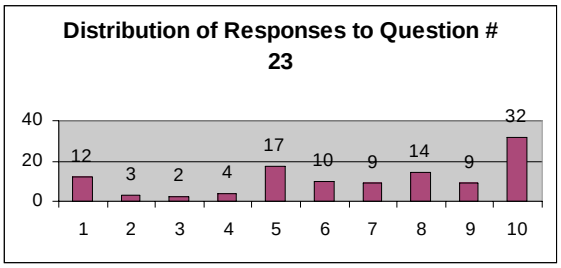
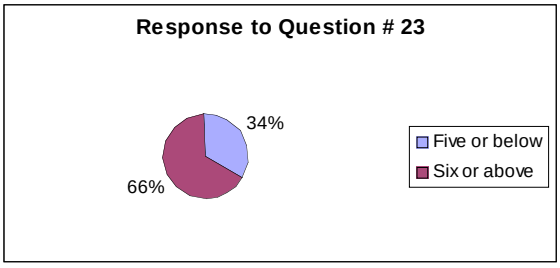


Figure 13



[22] Joe Faino, and Roland Eno. Personal Interview. 9/23/03.

From the above analysis it can be determined that a strong majority of those who were assessed the fee to help finance the lake's treatment are content with the cost incurred and are happy with the return they have received on their investment. This is not to imply, however, that everyone is satisfied. Figure 12 above demonstrates that 12 people, of the 112 answering this question, feel that they have had no return on their investment. For example, Ed Korbinski, local motel and bait shop owner, is paying the assessment on five lots because of a technicality within the construct of the Special Assessment that charges un-adjoined lots separately, while larger businesses such as Wal-Mart only pay one fee because their lots are adjoined.[23] From an outside observers point of view, it is conceivable that someone such as Ed Korbinski could be upset, but as Mike Ryan stated, "they never tried to say it was going to be fair (the Special Assessment Fee)…people on the lake had to pay the most because they have the most to lose".[24] Aside from a few exceptions, such as those previously noted the vast majority of Houghton Lake property owners reported that they were satisfied with the results received from the money they are investing.

Important observations drawn from this section:

- ***A majority of those who pay the Special Assessment Fee feel that it is a reasonable price to pay for the maintenance of the lake.***
- ***Most respondents feel that they have received a reasonable return on their investment into the Special Assessment.***

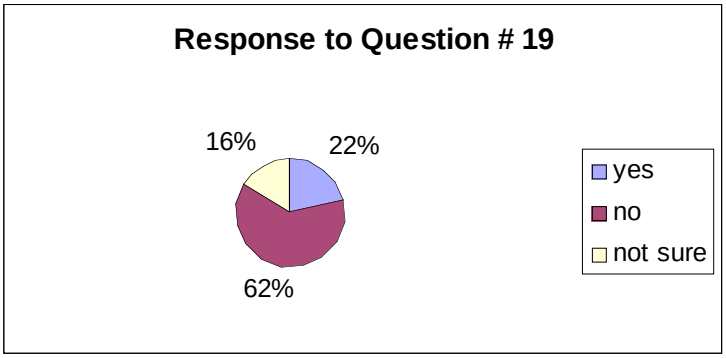
[23] Korbinski, Linda and Ed. Personal Interview. 9/24/03
[24] Ryan, Mike. Personal interview. 9/23/03

CONCERNS WITH EWM MANAGEMENT

Another aspect of the treatment the survey explores is the community's concern for the future management of EWM. To examine these concerns, those surveyed were asked a number of questions specifically related to future management and adverse future effects of the lake's management.

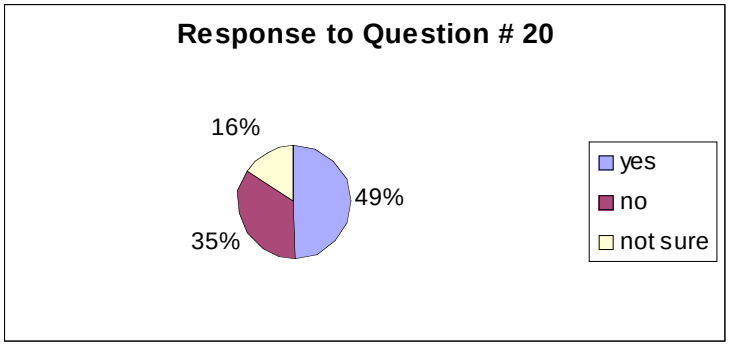
Question # 19 addresses possible concerns with the EWM management approach by asking, **"Do you have any concerns regarding the 2002 treatment of the lake with Sonar?"** Of those who responded, 62% answered "no," stating they were not concerned with the treatment the lake received in the summer of 2002 (Figure 14).

Figure 14



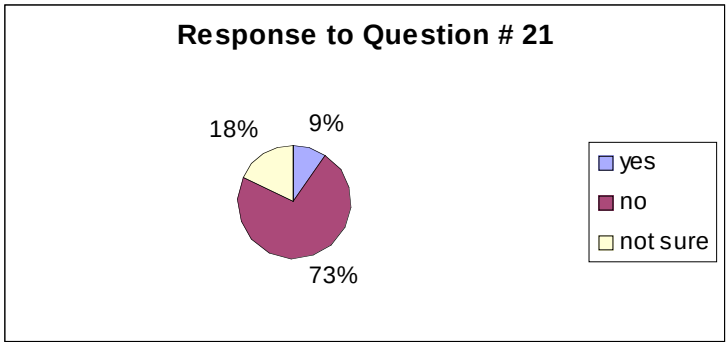
The second question that investigated concerns about the lake was # 20. This question asks, **"Do you have any concerns about the future management of the Eurasian Watermilfoil in Houghton Lake?"** Nearly 50% of the respondents had concerns regarding the future management of the lake (Figure 15). However, as their comments reveal, their concerns are not with the future EWM management practices, but rather that the EWM problem will return if proper steps are not taken to ensure management continues.

Figure 15



The final question in this series dealing with possible adverse effects, and concerns for the lake asks, **"Have you witnessed any adverse effects of the 2002 Sonar treatment?"** This question, #21, is possibly the most important of the three questions, because it once again gauges the community's satisfaction with the treatment of the lake. If the community members were unsatisfied with the condition of the lake it could be assumed that they would be dissatisfied with the overall treatment. However, this is not the case, as 73% of those surveyed responded that they have not witnessed any adverse effects as a result of the Sonar treatment (Figure 16).

Figure 16



Although the above section is brief it has been included in the overall analysis to determine how the community evaluated the 2002 Sonar treatment, its effect on the lake, and to gather thoughts on the future management of the lake. As the survey, located in Appendix A, exhibits, each of these three questions provided an opportunity for respondents to include additional comments on each question. All of these comments have been included in the report and can be found in Appendix B.

Important observations drawn from this section:

- ***Only a small percentage (22%) of the community surveyed has concerns about the 2002 Sonar treatment.***
- ***Almost half of those who responded to the survey have concerns regarding the future management of the EWM. However, the majority of comments about the future management were concerns that management will not continue and the EWM will return.***
- ***Very few respondents (9%) perceive any adverse effects to the lake as a result of the Sonar treatment.***

CONCLUSIONS FROM OVERALL REVIEW

From the analysis we have taken of the data thus far, it seems quite apparent that the 2002 Sonar treatment was perceived to have a positive effect on the Houghton Lake community. As was concluded above, the local economy and the livelihood of those in the area is very dependent on the lake and the tourism the lake attracts. It has also been established that water quality in the lake directly affects the tourism industry and thus the local economy. Furthermore, it has been concluded that the Houghton Lake community, and its visitors, were discouraged by the lake's condition as a result of the EWM infestation, resulting in a downturn in tourism. It has also been determined that an overwhelming majority of the community is satisfied with the 2002 Sonar treatment, and has witnessed a resurgence in tourism to the area. It has also been determined that a majority of those who responded to the survey are satisfied with the cost of the Special Assessment fee they paid to clean up the lake and further feel that the investment made had a return equal to -- or exceeding -- the fee itself. Finally, it has been concluded that most of the people surveyed have little concern about the 2002 treatment and have witnessed no adverse effects to the lake as a result of the Sonar application.

DIRECT VS INDIRECT LINKAGE – A COMPARISON

This section will once again present specific survey questions and corresponding answers; however, it will also reveal the role of the respondent being questioned. Rather than treating all businesses the same, and assuming an identical analogous dependence on the lake, the local economy survey response data will be split into two subsections – those that are *directly* linked to the lake - marinas boat rentals, and equipment sales - and those that are *indirectly* linked to the lake - restaurants, bars, professional services (see Figure 17). This distinction has been made so the commonalities can be shown within these two sects of the economy and a discussion can be presented based on the differences and similarities between the two. Also, specific industries within these distinctions have been isolated to allow comparison between certain industries. The following section will concentrate on questions from the survey that have not been addressed thus far, but will also reference some of the questions we have already discussed if significant difference presents itself.

Figure 17

Direct	Indirect
hotels	restaurants
motels	bars
property rentals	shops
marinas	real estate agencies
boat sales	insurance agencies
boat rentals	car washes
bait-shops	dentists
	attorneys
	construction companies
	investment companies
	travel agents
	laundromats
	carpenters
	banks

Businesses such as hotels, motels, property rentals, marinas, boat sales, boat rentals, and bait shops have been separated into the *direct* category and are believed to be directly linked to the lake, and directly impacted by the EWM infestation. Businesses in the *indirect* category include all other industries whose owners responded to the survey including: restaurants, bars, shops, real estate agencies, insurance agencies, entertainment facilities and all other miscellaneous responses. For these indirect businesses, the lake is not required for their business, but their business activity is affected when lake use drops.

EWM AND YOUR BUSINESS

As discussed previously, the survey sent to businesses in the Houghton Lake area contained many questions that focused on particular industries, specifically the hotel or lodging industry. These questions were posed intentionally to draw out answers from certain key industries, specifically those that would be most effected by slight changes in tourism. However, questions such as these can also be used to expose the difference between various areas of the economy. For example, a marina, which has an intimate link to a lake, is more likely to experience a downturn in revenue as a result of an aquatic plant infestation than an insurance agency located nearby. In fact, without looking at the survey data, the difference between these two industries can be easily exemplified by analyzing the response from two interviewees, one who runs an insurance agency, and another who owns a marina. When asked: "Do you feel that the 2002 Sonar treatment has effected your business?", Elizabeth Fortino, of State Farm Insurance, said that she was unsure whether or not she, or her business, had been affected by the treatment.[25] Conversely, Mike Ryan of Harvey's Marina commented that: "If it (the treatment) hadn't been done I would have been out of business in two years."[26] The reactions of these two respondents confirm how differently individuals in particular industries view the effect of the EWM problem, and therefore may have different opinions concerning the actions taken.

Question # 3 addresses this subject directly and asks, **"What effect did the presence of the Eurasian Watermilfoil have on your business?"** As illustrated in Figures 18 & 19 the response to this question is undoubtedly different between the *direct* and *indirect* sectors of the economy. Over two-thirds of the *direct* respondents claim that the EWM had a negative impact on their businesses. In comparison only a third of the *indirect* respondents associate the EWM problem with having negative effects on their businesses. Those who were categorized as *indirect* seem uncertain if they were affected at all, with over half the respondents answering "not sure". The difference between industries directly and indirectly linked to the lake is one that is real and tangible. Had there been no difference between these two distinct groupings, further exploration of this relationship would not have been necessary. However, as shown above, there is a difference between those industries that are directly linked to the lake compared to those that are indirectly linked to the lake.

Figure 18

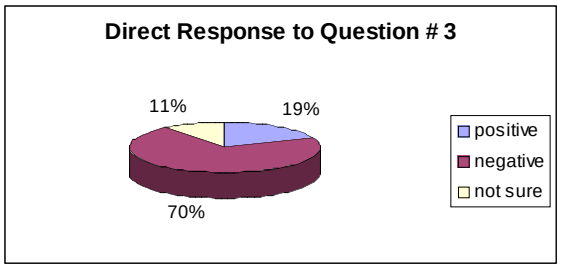
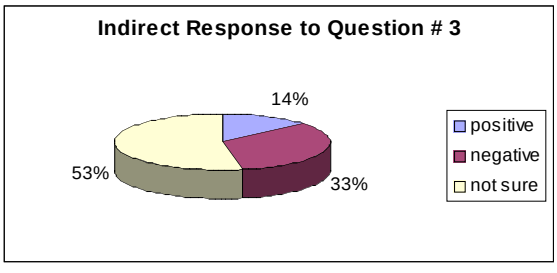


Figure 19



Those who were surveyed were also asked, **"Did your business experience a change in revenue as a direct or indirect result of the Eurasian Watermilfoil?"** A difference between the *direct* and *indirect* responses is evident. As shown below (Figures 20 & 21), 48% of *direct* respondents experienced a downturn in revenue that they attribute to the excessive EWM infestation of the lake. Conversely, only 14% of the *indirect* respondents witnessed a downturn in business that they could attribute to the presence of EWM. Another marked difference between the *direct* and *indirect* responses to this question is the percentage of those who answered either "revenue stayed the same" or "not sure". Of the *direct* respondents, 44% answered "revenue stayed the same" or "not sure", while 70% of the *indirect* answered with either of these two responses.

Figure 20

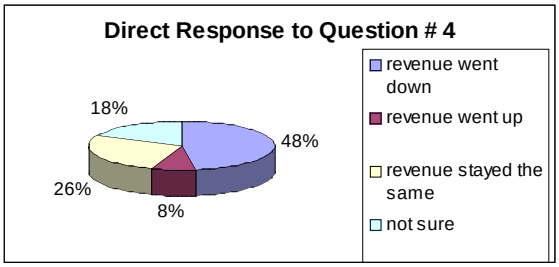
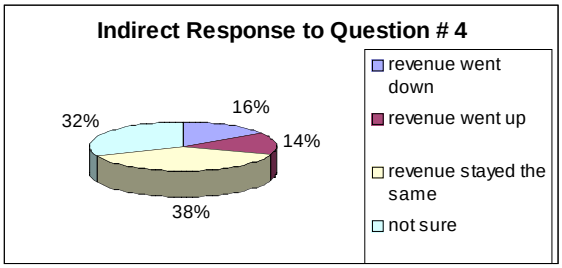


Figure 21



It is reasonable to conclude there is a noticeable difference between the *direct* and *indirect* businesses. It is particularly important to acknowledge the varying relationships these industry groups have with the lake. Because the intolerable conditions in Houghton Lake did not persist very long (one to two years), it is possible that indirect businesses may not have been realizing the impact it was having.

Important observations drawn from this section:

- ***70% of direct businesses feel they were negatively impacted as a result of the EWM, while only 33% of indirect businesses feel they were negatively affected by the infestation.***
- ***50% of direct businesses recorded a reduction in revenue associated with the EWM, compared to only 16% of indirect businesses.***
- ***It is possible that indirect businesses may not have realized the full impact of the EWM infestation.***

BUSINESS OWNERS AND THE LOCAL ECONOMY (DIRECT & INDIRECT)

In this analysis, it was concluded that over 90% of those who responded feel the health of the local economy is either important, or very important, to the viability of their business. Likewise, it was established that 97% of those surveyed perceive the local economy is dependent on tourism, and further that tourism is dependent on the health of the lake.

These conclusions are based upon answers from general questions that asked those surveyed to speculate for the entire local economy. To investigate more specifically how important tourism, and thus the lake, is to the certain sectors of the business community it is important to examine question #17. This question asked respondents, to **"Rate, on a scale from one to ten, the importance of the tourism industry to the health of your business."**, where "1" is the highest level of importance, and "10" being the lowest level of importance. The responses to this question confirm the assumption that many of the *indirect* businesses feel less dependent on the tourism industry. It also confirms the assumption that those industries which we have categorized as *direct* are dependent on the tourism the lake attracts.

Figure 22

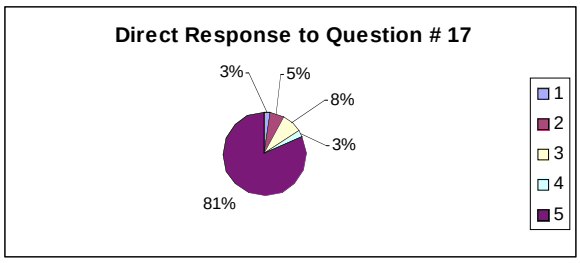
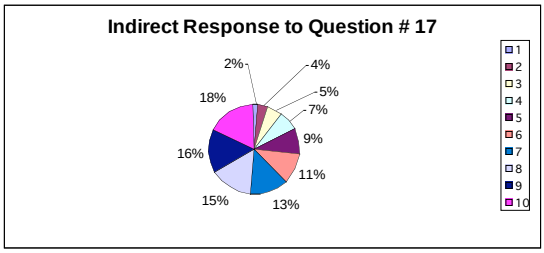


Figure 23



As shown above in Figure 23, the *indirect* industries have a range of perceptions, i.e., mixed feelings towards their dependence on tourism. This, however, is an anticipated outcome because of the wide array of businesses that have been grouped together into the *indirect* category. Businesses such as restaurants, although *indirect*, view themselves as dependent on tourism, while other businesses such as real estate agencies may feel they are less susceptible to fluctuations in tourism.

The next question in the survey to be addressed is #25. The question was stated, **"Has your business benefited from the aquatic plant conditions in 2003?"** The reply of the respondents in the *direct* group was positive with over 50% reporting that their business had improved in the year following the treatment (Figure 24).

More surprisingly, however, is the reply of the respondents in the *indirect* group. It was anticipated that the *indirect* response would be far less positive, or at least unrealized; however, 40% of the *indirect* respondents recorded beneficial earnings as a result of the more positive plant conditions in 2003 (Figure 25).

Figure 24

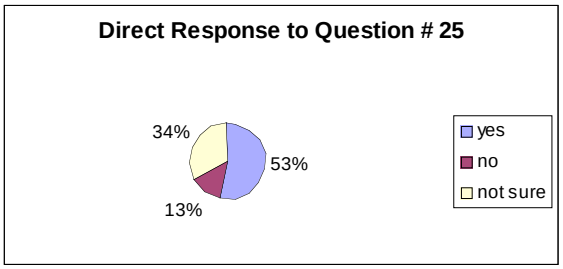
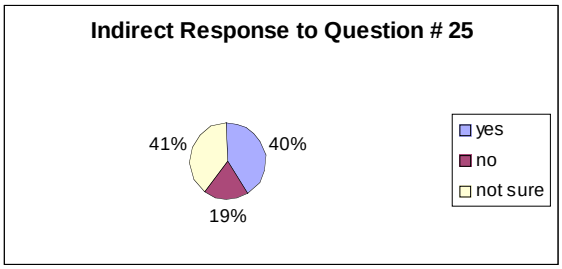


Figure 25



The conclusion that can be drawn from the analysis of Question #25 has strong implications for the future. The fact that nearly 45% of all businesses have experienced a perceived benefit from the removal of the EWM is an important statistic. Considering that corrective action was taken so soon after the EWM became a problem, and since only 28% of business owners stated their "revenue went down" as a result of the EWM infestation, it is interesting to observe 45% reported a financial benefit after the treatment. From this analysis it could be argued that more business owners than responded actually experienced losses as a result of the EWM infestation. As Mike Ryan stated in his interview referring to *indirect* businesses: "you may not have anything to do with the lake, but you have everything to do with the people that come to the lake." [27] It is this fact that helps build a bridge between those businesses that have been categorized as *direct* and those that have been categorized as *indirect*, and blurs the line that was created to distinguish the two.

[27] Ryan, Mike. Personal Interview. 9/23/03

The final question we will be discussing is #26 on the survey and it reads, **"Do you feel that the economic health of your business is directly related to the water quality of the lake"?** The response suggests a large portion of businesses do consider themselves to be ultimately connected to the water quality of the lake. In total, only 20% of the businesses that responded feel that they are not connected to the lake. Conversely, over 70% said that they consider themselves ultimately connected to the lake and its health. Consistently, a higher proportion of *direct* businesses than *indirect* businesses (89% vs. 56%) perceive business to be directly related to water quality of the lake (Figures 26 & 27). After reviewing the arguments made above, these numbers are not surprising. From the beginning of this investigation, it has been hypothesized that "the lake is the economic engine that drives the whole community". And, although arguments made in the first section of analysis concluded this fact, it is even more convincing to see that more than 55% of those business owners that have been categorized as indirect feel as though they are as connected to the lake as a marina or lakeside motel (Figure 27).

Figure 26

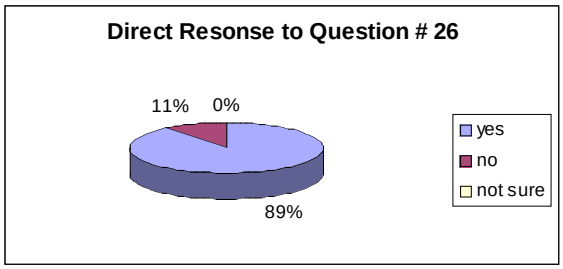
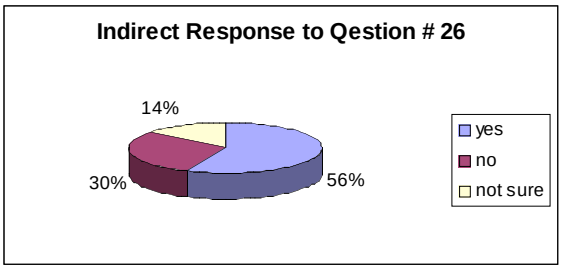


Figure 27



Important observations drawn from this section:

- ***Over 80% of direct businesses feel they are dependent on the local tourism industry.***
- ***Nearly 45% of all businesses have recorded some benefit from the improved plant conditions in 2002.***
- ***Over 50% of the indirect business respondents view a strong connection between their business and the water quality of the lake.***

CONCLUSIONS FROM THE DIRECT AND INDIRECT BREAKDOWN

The above section focused on the difference between those industries categorized as *direct* and *indirect*. In doing so, some critical differences and commonalities between the two groups were identified. Those businesses that were categorized as *direct* had an undeniably strong connection with the lake and the tourism it attracts. In all of the examined questions the *direct* group recorded a significantly stronger tie to the local tourism industry. However, the *indirect* category also showed a strong connection to the lake, the quality of its water, and the tourists it attracts. In total, this exercise demonstrates that local business owners realize the importance of the local tourism industry to the viability of their businesses. Most importantly, however, this exercise allows us to make assumptions for the future. Although only 16 percent (Figure 22) of the *indirect* businesses recorded lower earnings during the EWM infestation, nearly 60 percent (Figure 27) of these direct businesses claim that the health of their business is strongly linked to the condition of the lake. For this reason it can be assumed that if high levels of EWM persisted, or increased, the economic hardships that impacted almost 50% of the *direct* businesses would

have soon extended into those *indirect* businesses, and losses to *indirect* businesses would have increased far beyond the levels they experienced.

VALUES AT RISK

The objective of this report has been to examine connections between the tourism industry, the lake, and the local economy. Through careful research and examination of the survey responses, it has been confirmed that much of the local economy is, in fact, dependent on tourism. In establishing these connections, a platform has been created from which to forecast repercussions that might have occurred throughout the local economy, if a lake restoration project were not completed in a successful and timely manner.

"Invasive aquatic plants affect aesthetics, drainage for agriculture and forestry, commercial land, sport fishing, drinking water quality, fish and wildlife habitat, flood control, habitats of other plants, human and animal health, hydropower generation, irrigation, navigation, recreational boating, swimming, water conservation and transport, and ultimately land values."[28] Many of these losses are difficult to quantify. However, because Houghton Lake is interconnected with the local economy, certain assumptions are reasonable to make regarding what values are at risk.

The following section will examine a few of the quantifiable losses that could be realized in the event of a prolonged weed infestation in Houghton Lake. The discussion to follow is based upon information from the 2003 Roscommon County Equalization Department Report, and reflects the values from all four townships surrounding Houghton Lake.

[28] Rockwell, William H. Jr. Ph.D. *Summary of the Literature on the Economic Impact of Aquatic Weeds*. Aquatic Ecosystem Restoration Foundation. (10/1/03) <www.aquatics.org/pubs/economics.htm>

COMMERCIAL PROPERTIES

Through careful analysis of the survey conducted, it can be determined that a majority of the local economy is directly connected to the water quality. It is therefore logical to conclude that the values of commercial property would significantly drop if there were a major problem with the lake, such as limiting use to a large portion of the lake due to an infestation of EWM. If, for example, the EWM problem that faced the Houghton Lake area in 99/00 was never addressed, tourism to the area would have significantly declined. As a result of the reduction in tourism, commercial property values would be expected to decline. Even a small percentage drop in the area's commercial property values would result in millions of lost dollars. A conservative 10% reduction in the $167 million dollar commercial property market would equate to a total loss of over $16 million (Figure 28), while a liberal estimate of 50% reduction would translate into a loss of over $80 million between the four townships.[29] When considering these consequences, it is clear why corrective action was taken to prevent this level of economic disruption from occurring.

Figure 28

2002 Comercial Land Values (true cash value)			
Township	**$**	**% loss**	**$ loss**
Denton	$ 67,449,955.00	10	$6,744,995.50
Lake	$ 15,154,260.00	10	$1,515,426.00
Markey	$ 15,543,743.00	10	$1,554,374.30
Roscommon	$ 69,626,571.00	10	$6,962,657.10
Total	$ 167,774,529.00	10	**$16,77,452.90**

RESIDENTIAL PROPERTY

Although the value of residential property in the Houghton Lake area may not be affected as rapidly as some commercial properties in the case of an EWM infestation, prices of residential lots – particularly waterfront lots - would be expected to decline soon after the aquatic weed became a problem for lake access, or an aesthetic problem. A detailed study of the impact of aquatic plant infestations on residential property values was conducted at Lake Guntersville, AL as part of the Joint Agency Project between the Corps of Engineers and the Tennessee Valley Authority. Lake Guntersville residential properties experienced a 17% reduction in values due to the impact of a severe hydrilla (*Hydrilla verticillata)* infestation in the 1980's.

Examination of residential property values for the Houghton Lake townships (Figure 30) show a 2002 value of $ 1.2 billion. If the impact of EWM caused property values to be reduced by 10%, this would represent a loss of $120 million. Consider this effect on an individual waterfront home at Houghton. A waterfront home valued at $175,000 would lose $17,500 in value. In fact, in the case of waterfront property, it is reasonable to expect a percentage drop greater than the proposed 10%, creating a loss on any amenity "premium" associated with waterfront property.[30] For this reason, much of the treatment cost of the lake was put on the

[29] Roscommon County Equalization Department. *Roscommon County Equalization Report.* Roscommon, Michigan, 2003.

shoulders of those who owned property on the lake. In light of the potential losses that lakefront property owners faced, the cost of the special assessment appears to be a reasonable price to pay.

Considering potential overall effect on residential property values and taxes by applying the same 17% value reduction found at Lake Guntersville is illustrated in Figure 30. At Guntersville, a hedonic economic valuation model was used to relate residential values to overall market conditions, neighborhood effects, and property-specific characteristics, including aquatic plant levels. For developed and undeveloped waterfront lots, the presence of aquatic plants from shore to open water had a significant effect on the selling price. Complete control of aquatic plants increased property values by 17% for developed lots, and 35% for undeveloped properties. As an illustration of the effect of such impacts on residential property values, the 2002 property values for the four townships around Houghton Lake were adjusted using a 17% reduction in property values. Using this reduction in property value percentage from the Guntersville model, there is a total reduction in property value of $202 million. The residential housing market and other conditions in Michigan are obviously different from Lake Guntersville, so these results are intended only to show the potential magnitude of changes.

Figure 29

2002 Residential Property Values			
		Value of	
Township	2002 Property Values	17% Reducation	Adjusted Values
Denton	$ 476,837,289	$ 81,062,339	$ 395,774,950
Lake	$ 254,259,617	$ 43,224,135	$ 211,035,482
Markey	$ 234,377,082	$ 39,844,104	$ 194,532,978
Roscommon	$ 223,477,001	$ 37,991,090	$ 185,485,911
Total	**$ 1,188,950,989**	**$ 202,121,668**	**$ 986,829,321**

In reference to resort and lakefront properties, developers, real estate agents, and homeowners often talk about "shoreline frontage values", the value of a foot of waterfront property, and loss or changes in the front foot rates. Figure 30 uses information gathered from phone interviews with the tax assessors from each of the four respective townships around the lake.[30] The data assumes an 18 mile shoreline for each of the four townships, which creates some discrepancy; however, the magnitude of potential losses the table outlines is revealing. According to the 2003 front foot rates (price per/ft of waterfront property), a 10% decrease in lakeshore property alone could equate to a loss of over $100 million. With a total shoreline value over one billion dollars, a 10% decrease in lakeshore property alone could equate to a loss of over $100 million (according to the 2003 front foot rates – price per/foot of waterfront property at Houghton Lake.)

Figure 30

2003 Front Foot Rates (true cash value)			
Township	**$/ft**	**%loss**	**$loss**
Denton	$ 2,895.00	10	$ 27,514,080.00
Lake	$ 3,500.00	10	$ 33,264,000.00
Markey	$ 2,800.00	10	$ 26,611,200.00
Roscommon	$ 1,850.00	10	$ 17,582,400.00
Average	$ 2,761.25		
Total Value (75mi)	$ 1,049,716,800.00	10	$104,971,680.00

PUBLIC GOOD

As we have mentioned, economic impacts associated with an aquatic plant invasion are not easy to quantify. An invasive aquatic species can affect a lake community in a variety of different ways causing losses in a multitude of economic outcomes. However, many of these losses are difficult to fully quantify due to the "public-good" nature of the water body. For this reason researchers have found other methods with which to estimate economic losses. One of the more common approaches is a benefit/cost analysis. This method is frequently used to evaluate the "benefit" a community will receive compared to the cost of treatment. Although this approach does not attempt to estimate actual losses associated with an invasion of aquatic plants, it allows economists to speculate how much stands to be gained from the management of aquatic plants. By estimating total "benefit" we can understand potential, unrealized gain, which for our purposes can be otherwise viewed as a potential loss.[31]

Identifying and quantifying the benefits to direct and indirect industries, and to the community as a whole is a difficult task. Typically, flood loss reduction and increases in agricultural production can be readily quantified. Recreation, aesthetics, and preservation values are more difficult to quantify since they are non-market commodities. In an effort to get a general

[30] Gandolfi, Robert. Phone interview. 10/7/03, Kortage, Joanne. Phone interview. 10/7/03., Williams, Gary D. Phone interview. 10/7/03., Van Y-Grundas, Amy. Phone interview. 10/14/03.

[31] Rockwell, William H. Jr. Ph.D. *Summary of the Literature on the Economic Impact of Aquatic Weeds*. Aquatic Ecosystem Restoration Foundation. (10/1/03) <www.aquatics.org/pubs/economics.htm>

idea of potential benefits, Rockwell reviewed the limited data available and found that benefit to cost ratios for lake restoration projects range widely, from 5:1 to a 15:1 benefit to cost ratio.[32] In the case of Houghton Lake, which has budgeted $5 million for their project, this means they have the potential to gain $25- $75 million in total benefit from their aquatic plant management plan.

TOTAL LOSS

The research in the previous sections brings into light the values at stake for Houghton Lake property owners when they were considering lake restoration options. Assuming that Houghton Lake was never treated to remove the EWM, and as a result commercial and residential property values dropped 10%, the vicinity of Houghton Lake would have collectively lost over $135 million. This number becomes even more substantial when we include the $25 million of unrealized gains from the benefit/cost analysis, bringing the total loss to the area to $160 million.

CONCLUSION

Eurasian Watermilfoil, an exotic invasive aquatic plant, was first discovered in 1994 and allowed to grow unmanaged until it eventually dominated over 50% of the lake's native plant community. The EWM infestation developed into a major nuisance by 2001, negatively impacting the water quality and shoreline conditions of the lake. As a result of the EWM infestation, there were negative impacts throughout the tourism industry and the local economy of Houghton Lake.

To address the EWM problem, corrective action was taken in spring/summer 2002 by the Houghton Lake Improvement Board to successfully remove EWM from the lake. The corrective action was in the form of treatment with Sonar aquatic herbicide by SePRO Corporation. An economic impact and property owner survey was conducted in October 2003. The results from this survey reported that a large majority (96%) of those responding are satisfied with the treatment of the lake, and that a majority, facing a similar situation in the future, would take similar corrective action.

The survey also found some concerns regarding the corrective action taken and the future of the lake. Specifically, respondents voiced a fear that long-term management of the lake would not continue and that the economic losses would be repeated. In addition, the survey found that most respondents believe they have received a reasonable return on their investment into the Special Assessment, levied to pay for the corrective measures, and that the amount charged per unit was an affordable price to pay for the results received.

Although there were substantive differences between *direct* and *indirect* industries regarding perceived connection of the business to the lake, both business categories experienced significant negative economic impact from the EWM infestation, and both received positive impacts from the improved plant conditions in 2002.

While the conceivable economic impacts extend far beyond the three facets documented, the survey established quantifiable values-at-risk including: values of public-good, commercial property values, and residential property values.

It is recommended that a more thorough economic impact study be conducted at a later date when changes may be more accurately measured across a longer time scale.

[32] Rockwell, William H. Jr. Ph.D. *Summary of the Literature on the Economic Impact of Aquatic Weeds*. Aquatic Ecosystem Restoration Foundation. (10/1/03) <www.aquatics.org/pubs/economics.htm> (p.8)

APPENDIX A

HOUGHTON LAKE ECONOMIC IMPACT SURVEY

Your name:
Business name:
E-mail:
Please answer the following questions to the best of your ability. Circle the answer that most closely represents your view, and feel free to add comments where you see fit.

Friends of Houghton Lake:
The Houghton Lake Improvement Board and SePRO Corporation would like your input regarding the 2002 Eurasian watermilfoil treatment of Houghton Lake. In an effort to gauge your opinion, this short survey has been produced, seeking your participation. The survey is intended to gather information for the purpose of evaluating the economic impact on Houghton Lake businesses before, during, and after the Eurasian watermilfoil removal from the lake.

All information you disclose within this survey will be dealt with in strict confidence. Your individual answers or opinions will not be reproduced or shared and is intended only for this ongoing economic impact study. Published documents will represent only the collective summaries of all the participants. Any further information you would like to volunteer regarding your business—or your comments regarding the treatment of Houghton Lake are welcomed and encouraged.

Please take a moment to fill out this survey and return it in the self-addressed, stamped envelope that has been supplied. Answer the questions completely. Do not skip any questions. Please take enough time to consider each question carefully.

Your assistance is greatly appreciated.

Thank you.

1. Please rate your satisfaction with the the treatment of Eurasian watermilfoil in Houghton Lake.
A. Very satisfied
B. Satisfied
C. Dissatisfied
D. Very dissatisfied

2. In your opinion, what was the impact of the Eurasian watermilfoil on the economy?
A. Highly positive
B. Positive
C. Negative
D. Very negative

3. What effect did the presence of Eurasian watermilfoil have on your business?
A. Positive

B. Negative
C. Not sure

4. Did your business experience a change in revenue as a direct or indirect result of the Eurasian watermilfoil?
A. Revenue went down
B. Revenue went up
C. Revenue stayed the same
D. Not sure

5. Did you incur any direct loss or hardship as a result of the Eurasian watermilfoil? (i.e. burnt boat motor)
A. Yes
B. No
C. Not sure
If yes, please specify

6. Do you feel that the local economy is dependent on tourism?
A. Yes
B. No
C. Not sure

7. In your opinion, is the Special Assessment fee you pay annually a reasonable price to pay for the maintenance of Houghton Lake?
A. Yes
B. No
C. Not sure

8. How important is the local economy to the health of your business?
A. Very important
B. Important
C. Not important

9. As a whole, was the attitude of the Houghton Lake community affected by the Eurasian watermilfoil.
A. Yes...people were becoming discouraged with the milfoil problem.
B. No...the milfoil did not affect the community's attitude.
C. Not sure

9a. If yes, did the 2002 treatment of the lake breathe new life into the Houghton Lake community?
A. Yes
B. No
C. Not sure

10. Imagine it is the year 2006, and the Eurasian watermilfoil has rendered nearly 50% of the lake un-usable. Would you like the lake to be treated with Sonar*, as was done in 2002, or would you find an alternative method of treatment?

A. Yes...Sonar worked great and I would do it again.
B. No...Sonar failed to do what it promised to do and I would not do it again.
C. Not sure

11. How important do you feel it is to have native vegetation in Houghton Lake?
A. Very important
B. Important
C. Not important

12. Did you notice a decline in tourism between the years of 1999 - 2001 while the watermilfoil began to infest the lake?
A. Yes
B. No
C. Not sure

12a. If yes, did you notice a resurgence in tourism in 2002 - 2003?
A. Yes
B. No
C. Not sure

13. During the infestation did you notice if visitors were unhappy with the lake's condition?
A. Yes...visitors were discouraged.
B. No...visitors were not affected by the milfoil.
C. Not sure

14. As in many resort communities there are people and families that return on an annual basis. Did you notice if any of these so-called "regulars" stopped visiting the lake when it was choked off by the watermilfoil?
A. Yes
B. No
C. Not sure

15. Have you witnessed a return of these "regulars" as a result of the Sonar treatment?
A. Yes
B. No
C. Not sure

16. Have any visitors expressed concern regarding the herbicide treatment of the lake?
A. Yes
B. No
C. Not sure

17. Rate the importance of the tourism industry to the health of your business?
Low 1 2 3 4 5 6 7 8 9 10 High
not important very important

18. Do you feel that the water quality of the lake directly affects local tourism?
A. Yes
B. No
C. Not sure

19. Do you have any concerns regarding the 2002 treatment of the lake with Sonar?
A. Yes
B. No
C. Not sure
If yes, please specify

20. Do you have any concerns about the future management of the Eurasian watermilfoil in Houghton Lake?
A. Yes
B. No
C. Not sure
If yes, please specify

21. Have you witnessed any adverse effects of the 2002 Sonar treatment?
A. Yes
B. No
C. Not sure
If yes, please specify

22. If you were talking to a business owner on a different lake that was suffering the same fate as Houghton Lake in 2000 would you...
A. Encourage a Sonar treatment based upon the success in Houghton Lake.
B. Discourage a Sonar treatment because of any adverse effects it has had on the lake.
C. Not sure

23. Rate the return on your investment of the Special Assessment fee for the cleanup of Houghton Lake.
Low 1 2 3 4 5 6 7 8 9 10 High
waste of money great return on investment

24. Do you feel that the local economy has benefited as a result of SePRO's Sonar treatment?
A. Greatly
B. Moderately
C. Somewhat
D. Not at all

25. Has your business benefited from the aquatic plant conditions in 2003?
A. Yes
B. No
C. Not sure

26. Do you feel that the economic health of your business is directly linked to the water quality of the lake?
A. Yes
B. No
C. Not sure

27. Using 1999 as your bar, please rate your business's revenue change for the following years.
(Circle one for each year)
2000:
-50% -40% -30% -20% -10% 0% +10% +20% +30% +40% +50%
2001:
-50% -40% -30% -20% -10% 0% +10% +20% +30% +40% +50%
2002:
-50% -40% -30% -20% -10% 0% +10% +20% +30% +40% +50%
2003:
-50% -40% -30% -20% -10% 0% +10% +20% +30% +40% +50%

Upon completion of this survey, please use the enclosed stamped, self-addressed envelope provided and return.

Thank you for your participation.

APPENDIX B

COMMENTS FROM QUESTIONS

COMMENTS FROM QUESTION 5

Q. Did you incur any direct loss as a result of the Eurasian watermilfoil?

-2 burnt pontoon motors

-Burnt up 3 motors

-My business is commercial rentals - My rentals are: a lending bank, health care, and gift shop. Funds were cut in health care, so I lost business from that. I don't live on the lake or use the lake myself, however, we need to take care of our natural resources

-Lower tourist satisfaction.

-No--but customers had problems we addressed

-customers motors

-boat rental revenue down

-Extra man power to clean beaches and dispose of milfoil, very costly

-lower boat rental revenue

-could not fish in late summer---sold jet skis - could not run them due to EWM

-burnt motor

-Family got stranded on a waverunner.

-financially I was charged for 8 rental units I own (commercial). That's a lot!! I couldn't charge my -tenants for this special assessment

-70 HP Evinrude in need of repair.

-Expense $600 per year for 5 years. All business should have share in eradication.

-Rented a pontoon, got loaded with milfoil around prop, overheated, had to replace head gasket

-we depend on boaters, fishermen, and they were expressing concern about being able to continue using the lake

-hardship-- It took days to clean from beach

-We have two openings, so we would get everyone’s seaweed.

-other than weed stench on my shoreline

-Had to keep landfill/composter open more for weed removal

- 1.motor 2. stuck in weeds in watercraft

-boat motor burnt up by rentals

-the hardship of removing the stuff from my beach

-information in newspapers downstate--had some cancellations

-money spent to have waterfront cleaned

-burnt boat motor on a rental

COMMENTS FROM QUESTION 19

Q. Do you have any concerns regarding the 2002 treatment of the lake with Sonar?

-Long term effect?

-It's a chemical.

-Anytime chemicals are used anywhere, they have a chance to show up or affect humans in some way

-Of course…its not 100% natural. Not a major concern.

-have heard from other residents that we shouldn't eat the fish

-Will this help the zebra mussels?

-long term effects on fish population

-that it does not become an annual event

-long term effects

-How the flight duck will return in the next 5 to 10 years.

-fish kill

-I would like to be able to swim and eat the fish

-Felt that the DNR worked against the project

-"Chemicals in lake" has bad connotation, but late in the game it was the only choice

-What happens if they find out that DNR had planted the weed to begin with?

-return of the natural plants and fishing

-native vegetation, declined fishing

-possible changes in the lake we are not aware of

-I think that native vegetation was effected but is now returning

-I would like to see something else used that would kill off all vegetation

-health of wildlife

-noticed more dead fish in the spring 200-300 per day during April.

-It appears that Sonar has killed too much native vegetation

-long term affect in water systems

-long term affect on native habitat-plants/fish/animals. will there be any effect?

COMMENTS FROM QUESTION 20

Q. Do you have any concerns about the future management of the Eurasian watermilfoil in Houghton Lake?

-Long term effect?

-Hope to see continued effects.

-This lake needs to be watched. Thank you! "A big job well done"

-Must be monitored on a regular basis.

-It needs to be continued.

-I would like to see other ways to control milfoil now that the worst is gone

-Shouldn't wait as long to take action!!

-We need to address it on a long term basis

-how long milfoil will stay gone?

-to maintain a plan for the future

-just hope there is future management & all the good weeds return

-cost factor and the way its assigned

-keep milfoil levels down without ill effect to the lake

-needs to be monitored

-That this committee doesn't come up with excuses to perpetuate an expensive special assessment.

-How?

-I would prefer maintenance through biological controls, however, if it is not successful and the lake became infested again I would support chemical treatment

-Chemicals

-Will it continue in the future?

-how much treatment, how often + $$$$

-Worried that this will be a continuing problem; state and local government and certainly every business should share the cost to keep the lake clean and enjoyable

-That it won't be treated and the Eurasian watermilfoil will reappear.

-I don't want it to get out of control again. Weed need to keep on top if it.

-Wonder how the lake will freeze this winter?

-We must not let it get out of hand again.

-fish kill

-maintain the milfoil on a regular basis

-the concern is with the ability to raise money to pay for future treatment

-use the beetles as a check to keep it under control

-that they won't continue the program in the future

-continue monitoring

-we have to keep it out of the lake

-unsure of previous treatment, long term effect

-Nature has a way of refurbishing itself

-must be maintained

-does it kill off native vegetation?

-how long will it last? how much will it cost?

-What will keep the lake free from milfoil?

-How bad will it get before re-treatment? Will there be regular inspections?

-want a close check on the lake

-I feel we have very good knowledgeable people monitoring it

-delay in treating the lake in the event of a resurgence of watermilfoil

-Want to see necessary means taken to insure foil never comes back

-normal routine monitoring & treatment to keep things in check

-I would like to see it treated without chemicals

-1.Costs tons 2.health of lake 3.future return on milfoil

COMMENTS FROM QUESTION 21

Q. Have you witnessed any adverse effects of the 2002 Sonar treatment?

-too early

-I have heard numerous stories of over fishing the lake, now that is easier to catch fish. I know the Sonar treatment had to be done, but fishing needs to be controlled better now!

-Some natural (native) vegetation was effected, but it is coming back.

-eradicated native plants which made it look ugly for a while

-Not at this time...I'll let you know next year.

-The lake was not pretty for awhile.

-Now there are too many Pike I the lake instead of having a variety like perch, walleye, bass, etc.

...oxygen depleting to pan fish early in the year…time ill tell the truth

-Temporary loss of all weeds, but they seem to be coming back.

-I think native vegetation was effected but now has a chance to return to normal.

-More weeds in our area since the treatment

-there is an enormous population of zebra mussels-unsure of any correlation.

-fish kill on small species more than normal

-too much other vegetation killed and therefore affecting baitfish, etc.

APPENDIX C

SURVEY RESULTS

OVERALL SURVEY RESULTS

Q1	A	74	64.35%		very satisfied	64.35%
	B	36	31.30%		satisfied	31.30%
	C	3	2.61%		dissatisfied	2.61%
	D	2	1.74%		very dissatisfied	1.74%
		115				
Q2	A	20	17.86%		highly positive	17.86%
	B	27	24.11%		positive	24.11%
	C	30	26.79%		negative	26.79%
	D	35	31.25%		very negative	31.25%
		112				
Q3	A	15	13.89%		positive	13.89%
	B	51	47.22%		negative	47.22%
	C	42	38.89%		not sure	38.89%
		108				
Q4	A	31	28.18%		revenue went down	28.18%
	B	12	10.91%		revenue went up	10.91%
	C	38	34.55%		revenue stayed the same	34.55%
	D	29	26.36%		not sure	26.36%
		110				
Q5	A	28	24.14%		yes	24.14%
	B	76	65.52%		no	65.52%
	C	12	10.34%		not sure	10.34%
		116				
Q6	A	114	97.44%		yes	97.44%
	B	1	0.85%		no	0.85%
	C	2	1.71%		not sure	1.71%
		117				
Q7	A	76	65.52%		yes	65.52%
	B	19	16.38%		no	16.38%
	C	21	18.10%		not sure	18.10%
		116				
Q8	A	75	66.37%		very important	66.37%
	B	27	23.89%		important	23.89%

	C	11	9.73%		not important	9.73%
		113				
Q9	A	107	92.24%		yes…people were becoming discouraged with the milfoil problem	92.24%
	B	2	1.72%		no…the milfoil di not affect the communities attitude	1.72%
	C	7	6.03%		not sure	6.03%
		116				
Q9a	A	87	78.38%		yes	78.38%
	B	6	5.41%		no	5.41%
	C	18	16.22%		not sure	16.22%
		111				
Q10	A	80	69.57%		yes…Sonar worked great and I would do it again	69.57%
	B	8	6.96%		no…Sonar failed to do what it promised and I would not do it again	6.96%
	C	27	23.48%		not sure	23.48%
		115				
Q11	A	73	63.48%		very important	63.48%
	B	34	29.57%		important	29.57%
	C	8	6.96%		not important	6.96%
		115				
Q12	A	65	56.52%		yes	56.52%
	B	20	17.39%		no	17.39%
	C	30	26.09%		not sure	26.09%
		115				
Q12a	A	37	44.05%		yes	44.05%
	B	25	29.76%		no	29.76%
	C	22	26.19%		not sure	26.19%
		84				
Q13	A	103	88.03%		yes…visitors were discouraged	88.03%
	B	9	7.69%		no…visitors were not affected by the milfoil	7.69%
	C	5	4.27%		not sure	4.27%
		117				
Q14	A	51	43.59%		yes	43.59%
	B	24	20.51%		no	20.51%
	C	42	35.90%		not sure	35.90%
		117				

Q15	A	33	31.43%		yes	31.43%
	B	18	17.14%		no	17.14%
	C	54	51.43%		not sure	51.43%
		105				
Q16	A	50	42.74%		yes	42.74%
	B	52	44.44%		no	44.44%
	C	15	12.82%		not sure	12.82%
		117				
Q18	A	111	94.87%		yes	94.87%
	B	3	2.56%		no	2.56%
	C	3	2.56%		not sure	2.56%
		117				
Q19	A	25	21.55%		yes	21.55%
	B	72	62.07%		no	62.07%
	C	19	16.38%		not sure	16.38%
		116				
Q20	A	56	49.12%		yes	49.12%
	B	40	35.09%		no	35.09%
	C	18	15.79%		not sure	15.79%
		114				
Q21	A	11	9.48%		yes	9.48%
	B	84	72.41%		no	72.41%
	C	21	18.10%		not sure	18.10%
		116				
Q22	A	97	83.62%		Encourage a Sonar treatment based upon the success on Houghton Lake	83.62%
	B	2	1.72%		Discourage a Sonar treatment because of any adverse effects it has had on the lake.	1.72%
	C	17	14.66%		not sure	14.66%
		116				
Q24	A	49	42.24%		greatly	42.24%
	B	41	35.34%		moderately	35.34%
	C	18	15.52%		somewhat	15.52%
	D	8	6.90%		not at all	6.90%
		116				
Q25	A	45	41.28%		yes	41.28%
	B	19	17.43%		no	17.43%
	C	45	41.28%		not sure	41.28%
		109				

Q26	A	72	65.45%		yes	65.45%
	B	26	23.64%		no	23.64%
	C	12	10.91%		not sure	10.91%
		110				
Q23	>5	38	34%		Five or below	33.93%
	<5	74	66%		Six or above	66.07%
		112				

DIRECT SURVEY RESULTS

Q1	A	29	72.50%		very satisfied	72.50%
	B	10	25.00%		satisfied	25.00%
	C	1	2.50%		dissatisfied	2.50%
	D	0	0.00%		very dissatisfied	0.00%
		40				
Q2	A	7	17.95%		highly positive	17.95%
	B	6	15.38%		positive	15.38%
	C	10	25.64%		negative	25.64%
	D	16	41.03%		very negative	41.03%
		39				
Q3	A	7	18.92%		positive	18.92%
	B	26	70.27%		negative	70.27%
	C	4	10.81%		not sure	10.81%
		37				
Q4	A	18	47.37%		revenue went down	47.37%
	B	3	7.89%		revenue went up	7.89%
	C	10	26.32%		revenue stayed the same	26.32%
	D	7	18.42%		not sure	18.42%
		38				
Q5	A	19	47.50%		yes	47.50%
	B	17	42.50%		no	42.50%
	C	4	10.00%		not sure	10.00%
		40				
Q6	A	40	100.00%		yes	100.00%
	B	0	0.00%		no	0.00%
	C	0	0.00%		not sure	0.00%
		40				
Q7	A	25	62.50%		yes	62.50%
	B	6	15.00%		no	15.00%
	C	9	22.50%		not sure	22.50%
		40				
Q8	A	27	69.23%		very important	69.23%
	B	9	23.08%		important	23.08%
	C	3	7.69%		not important	7.69%
		39				
Q9	A	38	97.44%		yes…people were becoming discouraged with the milfoil problem	97.44%
	B	0	0.00%		no…the milfoil di not affect	0.00%

					the communities attitude	
	C	1	2.56%		not sure	2.56%
		39				
Q9a	A	29	74.36%		yes	74.36%
	B	1	2.56%		no	2.56%
	C	9	23.08%		not sure	23.08%
		39				
Q10	A	29	74.36%		yes…Sonar worked great and I would do it again	74.36%
	B	1	2.56%		no…Sonar failed to do what it promised and I would not do it again	2.56%
	C	9	23.08%		not sure	23.08%
		39				
Q11	A	26	66.67%		very important	66.67%
	B	10	25.64%		important	25.64%
	C	3	7.69%		not important	7.69%
		39				
Q12	A	25	62.50%		yes	62.50%
	B	6	15.00%		no	15.00%
	C	9	22.50%		not sure	22.50%
		40				
Q12a	A	11	39.29%		yes	39.29%
	B	11	39.29%		no	39.29%
	C	6	21.43%		not sure	21.43%
		28				
Q13	A	38	95.00%		yes…visitors were discouraged	95.00%
	B	2	5.00%		no…visitors were not affected by the milfoil	5.00%
	C	0	0.00%		not sure	0.00%
		40				
Q14	A	23	57.50%		yes	57.50%
	B	7	17.50%		no	17.50%
	C	10	25.00%		not sure	25.00%
		40				
Q15	A	14	38.89%		yes	38.89%
	B	6	16.67%		no	16.67%
	C	16	44.44%		not sure	44.44%
		36				
Q16	A	15	37.50%		yes	37.50%
	B	22	55.00%		no	55.00%

	C	3	7.50%		not sure	7.50%
		40				
Q18	A	40	100.00%		yes	100.00%
	B	0	0.00%		no	0.00%
	C	0	0.00%		not sure	0.00%
		40				
Q19	A	7	17.50%		yes	17.50%
	B	25	62.50%		no	62.50%
	C	8	20.00%		not sure	20.00%
		40				
Q20	A	20	51.28%		yes	51.28%
	B	16	41.03%		no	41.03%
	C	3	7.69%		not sure	7.69%
		39				
Q21	A	5	12.50%		yes	12.50%
	B	29	72.50%		no	72.50%
	C	6	15.00%		not sure	15.00%
		40				
Q22	A	34	85.00%		Encourage a Sonar treatment based upon the success on Houghton Lake	85.00%
	B	1	2.50%		Discourage a Sonar treatment because of any adverse effects it has had on the lake.	2.50%
	C	5	12.50%		not sure	12.50%
		40				
Q24	A	18	45.00%		greatly	45.00%
	B	13	32.50%		moderately	32.50%
	C	8	20.00%		somewhat	20.00%
	D	1	2.50%		not at all	2.50%
		40				
Q25	A	20	52.63%		yes	52.63%
	B	5	13.16%		no	13.16%
	C	13	34.21%		not sure	34.21%
		38				
Q26	A	33	89.19%		yes	89.19%
	B	4	10.81%		no	10.81%
	C	0	0.00%		not sure	0.00%
		37				

INDIRECT SURVEY RESULTS

Q1	A	39	60.94%		very satisfied	60.94%
	B	23	35.94%		satisfied	35.94%
	C	1	1.56%		dissatisfied	1.56%
	D	1	1.56%		very dissatisfied	1.56%
		64				
Q2	A	12	18.75%		highly positive	18.75%
	B	19	29.69%		positive	29.69%
	C	17	26.56%		negative	26.56%
	D	16	25.00%		very negative	25.00%
		64				
Q3	A	9	13.64%		positive	13.64%
	B	22	33.33%		negative	33.33%
	C	35	53.03%		not sure	53.03%
		66				
Q4	A	10	15.87%		revenue went down	15.87%
	B	9	14.29%		revenue went up	14.29%
	C	24	38.10%		revenue stayed the same	38.10%
	D	20	31.75%		not sure	31.75%
		63				
Q5	A	8	12.12%		yes	12.12%
	B	52	78.79%		no	78.79%
	C	6	9.09%		not sure	9.09%
		66				
Q6	A	63	95.45%		yes	95.45%
	B	1	1.52%		no	1.52%
	C	2	3.03%		not sure	3.03%
		66				
Q7	A	44	67.69%		yes	67.69%
	B	11	16.92%		no	16.92%
	C	10	15.38%		not sure	15.38%
		65				
Q8	A	44	67.69%		very important	67.69%
	B	15	23.08%		important	23.08%
	C	6	9.23%		not important	9.23%
		65				
Q9	A	62	93.94%		yes…people were becoming discouraged with the milfoil problem	93.94%
	B	0	0.00%		no…the milfoil di not affect the communities attitude	0.00%

	C	4	6.06%		not sure	6.06%
		66				
Q9a	A	50	79.37%		yes	79.37%
	B	4	6.35%		no	6.35%
	C	9	14.29%		not sure	14.29%
		63				
Q10	A	45	69.23%		yes…Sonar worked great and I would do it again	69.23%
	B	6	9.23%		no…Sonar failed to do what it promised and I would not do it again	9.23%
	C	14	21.54%		not sure	21.54%
		65				
Q11	A	43	66.15%		very important	66.15%
	B	17	26.15%		important	26.15%
	C	5	7.69%		not important	7.69%
		65				
Q12	A	37	56.92%		yes	56.92%
	B	12	18.46%		no	18.46%
	C	16	24.62%		not sure	24.62%
		65				
Q12a	A	25	50.00%		yes	50.00%
	B	11	22.00%		no	22.00%
	C	14	28.00%		not sure	28.00%
		50				
Q13	A	55	83.33%		yes…visitors were discouraged	83.33%
	B	6	9.09%		no…visitors were not affected by the milfoil	9.09%
	C	5	7.58%		not sure	7.58%
		66				
Q14	A	26	39.39%		yes	39.39%
	B	15	22.73%		no	22.73%
	C	25	37.88%		not sure	37.88%
		66				
Q15	A	17	28.81%		yes	28.81%
	B	12	20.34%		no	20.34%
	C	30	50.85%		not sure	50.85%
		59				
Q16	A	27	40.91%		yes	40.91%
	B	30	45.45%		no	45.45%
	C	9	13.64%		not sure	13.64%

		66				
Q18	A	60	90.91%		yes	90.91%
	B	3	4.55%		no	4.55%
	C	3	4.55%		not sure	4.55%
		66				
Q19	A	14	21.21%		yes	21.21%
	B	42	63.64%		no	63.64%
	C	10	15.15%		not sure	15.15%
		66				
Q20	A	35	54.69%		yes	54.69%
	B	19	29.69%		no	29.69%
	C	10	15.63%		not sure	15.63%
		64				
Q21	A	6	9.23%		yes	9.23%
	B	48	73.85%		no	73.85%
	C	11	16.92%		not sure	16.92%
		65				
Q22	A	55	83.33%		Encourage a Sonar treatment based upon the success on Houghton Lake	83.33%
	B	1	1.52%		Discourage a Sonar treatment because of any adverse effects it has had on the lake.	1.52%
	C	10	15.15%		not sure	15.15%
		66				
Q24	A	28	43.08%		greatly	43.08%
	B	24	36.92%		moderately	36.92%
	C	8	12.31%		somewhat	12.31%
	D	5	7.69%		not at all	7.69%
		65				
Q25	A	26	40.63%		yes	40.63%
	B	12	18.75%		no	18.75%
	C	26	40.63%		not sure	40.63%
		64				
Q26	A	36	56.25%		yes	56.25%
	B	19	29.69%		no	29.69%
	C	9	14.06%		not sure	14.06%
		64				

WORKS SITED

Combating the Economic and Environmental Devastation from Invasive Species. Western Governors' Association. 10/1/03 <http://www.invasivespecies.gov>

Costs Asssociated with Non-Indigenous Species in the United States. Cornell University. 10/1/03 <http://www.news.cornell.edu/relaeses/Jan99/species_costs.html>

Economic Impact of IPlants: Invasive Plants and the Nusery Industry. Brown University. 10/1/03 <http://brown.edu/Research/EnvStudies_Theses/full>

ENSR International. *Supplemental Environmental Impact Statement for the Control of Eurasian Watermilfoil in Lake George with Fluridone: Revised Draft.*. Willington, CT: 2001.

Faino, Joe and Ron Eno. Personal interview. 9/23/03.

Fortino, Elizabeth. Personal interview. 9/24/03.

Foster, Lyman. Personal interview. 9/23/03.

Gandolfi, Robert. Phone interview. 10/7/03

Henderson, Jim E. and Phil Kirk " 'So how mush is it worth?' Economic Impacts of Recreational Fishing Under Different Aquatic Plan Conditions". *Aquatic Plant Control Research Program* Vol-A02-1 (2002) pp.1-8.

Korbinski, Linda and Ed. Personal interview. 9/24/03.

Kortage, Joanne. Phone interview. 10/7/03.

Marcouiller, David W. "Water Economics: The Dismal Art of Valuing Common-Pool Resources". Lakeline. Vol. 23, No. 3 (Fall 2003): 14-17.

Nonindigenous Aquatic Species. Unites States Geological Survey. 10/1/03 <http://nas.er.usgs.gov/plants/docs/my_spica.html>.

Our Perspective. Aquatic Ecosystem Restoration Foundation. 10/1/03 <http:www.aquatics.org/perspective.htm>

Pastula, Dick. Personal interview. 9/25/03.

Pathways of Introduction and the Ecological and Economic Impacts of Invasive Species. Ortepa Antifoulants. 10/1/03 <http://www.ortepa.org/pages/ei26.htm>

Pimentel, David, Lori Lach, Rodolfo Zuniga, and Doug Morrison. *Environmental and Economic*

Rankin, Mike. Personal interview. 9/24/03.

ReMetrix LLC. *Multiyear Change Analysis for Eurasian Watermilfoil, Including 2002 Satellite and Field Data*. Carmel, IN: 2003.

---. *Houghton Lake Management Feasibility Study: Final Report*. Carmel, IN: 2002.

Rockwell, William H. Jr. Ph.D. *Summary of the Literature on the Economic Impact of Aquatic Weeds*. Aquatic Ecosystem Restoration Foundation. (10/1/03) <www.aquatics.org/pubs/economics.htm>

Roscommon County Equalization Department. *Roscommon County Equalization Report*. Roscommon, Michigan, 2003.

Ryan, Mike. Personal interview. 9/25/03.

Sensor, Sheila. Personal interview. 9/23/03.

SePRO Corporation. *2002 Michigan Permit Application for Houghton Lake*. Carmel, IN: 2002.

Shea, Laura and Bob. Personal interview. 9/25/03.

Smith, Craig S., Mark Mongin and Mark A. Heilman. "Houghton Lake, MI—Restoring the Aquatic Vegetation." *LakeLine* Vol. 23 No. 3 (Fall 2003): 30-33.

Theriot, Dr. Edwin. *The Growing Problem of Invasive Species.* Department of the Army. 10/1/03 <http://resourcescommittee.house.gov/108cong/fish/2003apr29/theriot.htm>

Tribelhorn, Brian. Personal interview. 9/23/03.

What's Up in Houghton Lake?. Houghton Lake Improvement Board. 10/1/03 <http://www.roscommoncounty.net/milfoil%20handout.htm>

Williams, Gary D. Phone interview. 10/7/03.

Van Y-Grundas, Amy. Phone interview. 10/14/03.