2001 SUMMARY REPORT
of
DRUCE LAKE

Lake County, Illinois

Prepared by the

LAKE COUNTY HEALTH DEPARTMENT
ENVIRONMENTAL HEALTH SERVICES
LAKES MANAGEMENT UNIT
3010 Grand Avenue
Waukegan, Illinois 60085

Christina L. Brant
Michael Adam
Mary Colwell
Joseph Marencik
Mark Pfister

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Druce Lake, located partially in Avon Township and partially in Warren Township, is a glacial lake that was dammed in 1958. Approximately 2/3 of the lake is located within the Village of Third Lake. The lake is dominated by a residential shoreline and is managed by the Village of Third Lake and Associations made up of residents on the northeast shore. Druce Lake is an oval shaped lake with a surface area of 88.3 acres and mean and maximum depths of 9.3 and 32.5 feet, respectively. It is used by residents for swimming, fishing, and aesthetics, with a boat launch on the south shore and many beaches around the perimeter of the lake.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature and water clarity were measured and the plant community was assessed each month from May-September 2001. Druce Lake was thermally stratified all summer, but almost 80% of the lake volume remained oxygenated and could be inhabited by aquatic life. Phosphorus levels in both the epilimnion and hypolimnion were well below the County medians. Hypolimnetic concentrations were four times as high as the epilimnetic concentrations, but this phosphorus remained isolated in the hypolimnion throughout the summer, preventing planktonic algae blooms in the surface waters. As a result of the low phosphorus concentrations, total suspended solids levels were also very low all summer and Secchi depths (water clarity) were higher than average all summer. Conductivity in both the epilimnion and the hypolimnion was much higher than the County average and had increased dramatically since 1996. Since conductivity is related to chloride ions in highly residential areas, the chloride concentration of the July water sample was measured and was found to be high. These elevated conductivity and chloride levels are cause for some concern, but there may not be much that residents can do to reduce them.

Druce Lake had a diverse and healthy plant community, with 18 different plant species observed. Only two exotic species (Eurasian watermilfoil and Curly leaf pondweed) were present among these and the Eurasian watermilfoil was being heavily damaged by the milfoil weevil. This very healthy plant community provided Druce Lake with excellent fish habitat and kept water clarity high by reducing sediment resuspension and competing with planktonic algae for resources.

Virtually none of the shoreline along Druce Lake was exhibiting erosion and much of the shoreline along the north end of the lake (wetland and woodland) provided good wildlife habitat. Wetland, buffer and woodland shorelines should be maintained as much as possible, and the addition of manicured lawns, seawalls and rip rap should be discouraged. Buckthorn, purple loosestrife and reed canary grass were present along 65.5% of the shoreline of Druce Lake.

Although they have not been found in Druce Lake, zebra mussels have been found in Gages Lake, which drains into Druce Lake. It may be impossible to prevent the mussels from entering the lake via storm flow from Gages Lake, but steps should be taken to prevent its invasion via boats.

LAKE IDENTIFICATION AND LOCATION

Druce Lake is located partially in Avon Township and partially in Warren Township, just west of U.S. Hwy 45 and north of Washington St. (T 45N, R 10-11E, S 19, 24). Most of the lake (2/3rds) is part of the Village of Third Lake, while much of the east shoreline is unincorporated Lake County. Druce Lake is a relatively oval shaped lake with a surface area of 88.3 acres and mean and maximum depths of 9.3 feet and 32.5 feet, respectively. It has a volume of 819.2 acre-feet and a shoreline length of 1.5 miles. Druce Lake receives water from Gages Lake through a stormwater pipe on the south shore and empties into Third Lake through an outlet stream on the northwest shore. Druce Lake also receives water through an inlet creek from several detention basins draining Mariner's Cover subdivision southwest of the lake and from a stormwater inlet draining an older neighborhood on the east shore. The lake is located in the Mill Creek sub basin, within the Des Plaines River watershed.

BRIEF HISTORY OF DRUCE LAKE

Druce Lake is of glacial origin, created during the last ice age. In 1958, a four foot high dam was installed on private property at the lake's outlet. The dam was breached some years ago and does not currently exist. In the early 1800's, Druce Lake was known as Second Lake (second in the ordered flow of glacial lakes from Gages (First Lake) to Druce (Second Lake) to Third to near Fourth Lake). The H. Mallory Hotel was located on the western shore during the late 1800's and good bass, perch and pickerel fishing could be found. In the recent past, new residential neighborhoods have been built around the southwestern end of the lake. The east shore is an unincorporated area with homes on septic systems, while the new homes on the south shore are serviced by sanitary sewer, which flows to North Shore Sanitary District, Gurnee. The northwest shore, which has the largest stretch of beach on the lake, is owned by a Serbian Monastery. Currently, the lake is managed by the Village of Third Lake, with a Lakes Commission that meets once a month, and by Associations made up of residents on the northeast shore who meet several times per year.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Access to Druce Lake, as controlled by the Village of Third Lake is open to Village residents only. The Village has no control over the unincorporated shoreline along the east side of the lake. There are two beaches on this side of the lake that can be accessed by neighborhood residents. The Druce Lake Subdivision Beach, located at the end of Cottage Avenue, is used by residents of the community, particularly those residents of Cottage Avenue. Powell's Subdivision Beach is owned by a private lake resident and is used by members of the Druce Lake Homeowner's Association who pay a fee in order to use the beach. Most members of this Association do not own lakefront property. The boat launch and beach on the southwest side of the lake are owned by the Mariner's Cove Homeowner's Association and are open to the residents of that subdivision (Figure 1).

The lake's main uses are swimming and fishing. No gas motors are permitted on the lake, but many residents fish off the shore or from small boats. The Mariner's Cove Beach was sampled every two weeks by the Lake County Health Department to test for the presence of high fecal coliform counts. Fecal coliform (FC) is found virtually everywhere, but are in very high numbers in the feces of animals and humans. FC, which includes *E. coli* bacteria may indicate the presence of other pathogens such as *Giardia*, which can cause serious illness in humans. During the summer of 2001, fecal coliform counts at Mariner's Cove Beach did not exceed 20 FC colonies/100 ml. A beach is not closed until this concentration reaches 500 FC colonies/100 ml. This indicates that fecal contamination was not a problem at the Mariner's Cove Beach this past summer. Currently, the biggest management concerns on Druce Lake are the aquatic plant community and increased conductivity levels as a result of road salt.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Druce Lake were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected at 3 foot and 27-29 foot depths (depending on water level) from the deep hole location in the lake (Figure 1). Druce Lake was thermally stratified from May-September. Thermal stratification occurs when a lake divides into an upper, warm water layer (epilimnion) and a lower, cold water layer (hypolimnion). When stratified, the epilimnetic and hypolimnetic waters do not mix, and the hypolimnion typically becomes anoxic (dissolved oxygen = 0 mg/l) by mid-summer. This phenomenon is a natural occurrence in deep lakes and is not necessarily a bad thing if enough of the lake volume remains oxygenated. During most of the summer, stratification in Druce Lake was strongest at approximately 12-16 feet and anoxia did not begin to occur until 16-20 feet. This means that only about 20% of the lake volume was without oxygen during the summer and more than enough oxygenated water was available for aquatic life to inhabit. Since some parameters differed between surface and bottom water layers throughout the summer, data from both will be discussed.

The surface waters of Druce Lake were well oxygenated during the summer and dissolved oxygen (DO) concentrations did not fall below 5.0 mg/l (a level below which aquatic organisms become stressed) at any time during the study period. Hypolimnetic DO concentrations were near 0.0 mg/l throughout the summer. However, this is expected in a deep lake which stratifies, and, as mentioned above, almost 80% of the lake volume remained oxygenated and could be inhabited by aquatic life.

Phosphorus is a nutrient that can enter lakes through runoff or be released from lake sediment, and high levels of phosphorus typically trigger algal blooms or produce high plant density. The average surface phosphorus concentration in Druce Lake was 0.024 mg/l, while the hypolimnetic average phosphorus concentration was 0.114 mg/l (Table 1,

Appendix A). Both were well below the County median epilimnetic and hypolimnetic phosphorus concentrations of 0.047 mg/l and 0.165 mg/l, respectively. This means that Druce Lake phosphorus concentrations were lower than the majority of the lakes studied in Lake County since 1995. The hypolimnetic phosphorus concentration was four and a half times higher than the epilimnetic concentration. This is as expected in a stratified lake. During stratification, oxygen is depleted in the hypolimnion, triggering chemical reactions at the sediment surface. These reactions result in the release of phosphorus from the sediment into the water column, known as internal phosphorus loading. Since the hypolimnion is thermally isolated from the epilimnion during the summer, phosphorus builds up in the bottom waters and does not reach the sunlit surface waters of the epilimnion until fall turnover. Unless external sources are significant, phosphorus concentrations in the epilimnion remain low, preventing surface algae blooms. Fall turnover distributes the hypolimnetic phosphorus throughout the water column and can produce late season algae blooms. However, a large lake volume may dilute the redistributed phosphorus to a concentration where no algae bloom occurs.

The average epilimnetic phosphorus concentration in 1996 (0.018 mg/l) was approximately 33% lower than in 2001 (0.024 mg/l), but monthly concentrations were relatively similar throughout the summer (Table 1, Appendix A). The average hypolimnetic phosphorus concentration in 1996 (0.413 mg/l) was much higher than the average 2001 concentration (0.114 mg/l). The difference in the hypolimnetic phosphorus concentrations between the two years is believed to be the function of sampling technique. During 1996, bottom water samples were taken less than two feet from the sediment surface, and were taken within one foot of the sediment on three occasions. The 2001 samples were taken at least two, and often three, feet from the sediment surface. Since phosphorus is released from the sediment and because there is very little mixing occurring in the hypolimnion during stratification, phosphorus concentrations are higher near the sediment surface. Additionally, the Van Dorn Sampler used to collect water samples creates a small but strong current as it snaps shut. If close enough to the sediment surface, this current can resuspend sediment into the water column just below the sampler. A small amount of this sediment in a water sample being tested for phosphorus can increase concentrations dramatically. Therefore, the closer a sample is taken to the sediment, the higher the phosphorus concentration in that sample is likely to be. Difference in sampling technique, rather than a difference in the amount of phosphorus being released from the sediment, is most likely the reason for the phosphorus concentration variation between the two years.

Total suspended solids (TSS) is a measure of the amount of suspended material, such as algae or sediment, in the water column. High TSS values are typically correlated with poor water clarity and can be detrimental to many aspects of the lake ecosystem, including the plant and fish communities. A large amount of material in the water column can inhibit successful predation by sight-feeding fish, such as bass and pike, or settle out and smother fish eggs. High turbidity caused by sediment or algae can shade out native aquatic plants, resulting in their reduction or disappearance from the littoral zone. This eliminates the benefits provided by plants, such as habitat for many fish species and stabilization of the lake bottom. The average epilimnetic TSS concentration on Druce Lake (2.2 mg/l) was less than half of the median value for Lake County Lakes (5.7 mg/l) and was much lower than the average County concentration (10.0 mg/l). The low TSS values resulted in high water clarity, which was confirmed by higher than average Secchi depth measurements that coincided with low TSS concentrations (Figure 2). A strong relationship existed between total phosphorus (TP) and TSS concentrations (Figure 3). Since total volatile solids (TVS, a measure of organic matter, such as algae, in the water column) concentrations were not strongly correlated with TSS concentrations, the relationship between TP and TSS indicates that clay particles with attached TP (not algae) may have made up much of the TSS in the water column.

TSS concentrations have remained virtually unchanged when compared to 1996 sampling concentrations. The average epilimnetic concentration increased slightly and the hypolimnetic concentration decreased slightly in 2001. This coincided with the increase in epilimnetic TP and the decrease in hypolimnetic TP in 2001.

As a result of the low TP and TSS concentrations throughout the summer, Secchi depth (water clarity) on Druce Lake was higher than the County average (5.12 feet) every month during the summer of 2001, and reached a maximum of 9.0 feet in August. This high water clarity allowed a healthy and diverse plant community to thrive in Druce Lake and helped to prevent algae dominance. Secchi depth measurements have been collected and recorded by volunteer lake monitors each year since 1986. Average Secchi depth has not changed substantially over the past 15 years and has remained between approximately 6.0 and 10.0 feet (Figure 4). Differences from year to year can result from a number of things including rainfall amounts, external phosphorus loading, percent plant coverage, or water temperature (which affects algae growth). The absence of significant change in the water clarity of Druce Lake is a very positive indicator that urban development in the watershed over the years has not had negative impacts on the overall water quality of the lake.

Although epilimnetic nitrogen concentrations were lower than the County average, the average hypolimnetic concentration (3.48 mg/l) was almost twice as high as most of the lakes in the County (median TKN = 2.15 mg/l). A hypolimnetic ammonia-nitrogen (NH_3-N) concentration twice the County average was to blame for this high TKN level. Ammonia-nitrogen is naturally formed during anaerobic (without oxygen) decomposition in the hypolimnion. High levels of NH_3-N may simply indicate that a large amount of organic matter was present in the lake before stratification and that a great deal of decomposition was occurring in the hypolimnion after anoxic conditions had become established.

Average 2001 epilimnetic and hypolimnetic conductivities (1.214 mS/cm and 1.247 mS/cm, respectively) had increased substantially since sampling in 1996 when averages were 0.816 mS/cm and 0.909 mS/cm, respectively. Epilimnetic and hypolimnetic conductivities were very similar and much higher than the County averages (0.7557 mS/cm and 0.7919 mS/cm, respectively) throughout the summer. Conductivity is the measure of different chemical ions in solution. As the concentration of these ions increases, conductivity increases. The conductivity of a lake is dependent on the lake and

watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, and evaporation and bacterial activity. Conductivity has been shown to be highly correlated (in urban areas) with chloride ions found in road salt mixtures. A chloride test was run on the water sample collected in July 2001. Chloride levels were found to be 250 mg/l in the epilimnion and 245 mg/l in the hypolimnion. These levels were slightly below what was expected based on our regression equation between conductivity and chloride (273 mg/l), but were still very high. Additionally, epilimnetic total dissolved solids (TDS) concentrations, which have also been shown to be correlated with conductivity, were well above the County average (452 mg/l) during every month of the study (Table 1, Appendix A). Conductivity changes can occur seasonally and even with depth, but over the long term, increased conductivity levels can be a good indicator of potential watershed or lake problems and an increase in pollutants entering the lake if the increasing trend is noted over a period of years. High conductivity levels (which often indicate an increase in sodium chloride) can eventually change the plant community, as more salt tolerant plants take over. Sodium and chloride ions can bind substances in the sediment, preventing their uptake by plants and reducing native plant densities. Additionally, juvenile aquatic organisms may be more susceptible to high chloride concentrations. The increase in conductivity levels in Druce Lake is most likely the result of increased residential development in the watershed of the lake. More houses mean more impervious surfaces and more roads to be salted each winter. An overall increase in the amount of road salt deposited around Druce Lake over the years has contributed to an increase in TDS and conductivity. Additionally, an exceptional amount of snowfall fell in December 2000 and early January 2001. This necessitated frequent applications of road salt, most of which eventually ended up in the lake and may have raised conductivity levels for the summer of 2001. The high conductivity levels in Druce Lake are cause for concern, but there may not be much that residents can do about it. Non-point runoff, such as that which picks up road salt and enters the lake during rain events, is very difficult to control. A potentially easy measure that lake shore residents can take to try to reduce the amount of road salt entering Druce Lake is to convince the Village of Third Lake or the Township to reduce the amount of road salt laid down each winter. Often, excess road salt is laid down at the end of the winter season (when it is not really necessary) in order to use up left over stores. Residents should appeal to the appropriate government entity to use only the necessary amount of salt to keep roads safe each winter.

Typically, lakes are either phosphorus (P) or nitrogen (N) limited. This means that one of these nutrients is in short supply relative to the other and that any addition of phosphorus or nitrogen to the lake might result in an increase of plant or algal growth. Other resources necessary for plant and algae growth include light or carbon, but these are typically not limiting. Most lakes in Lake County are phosphorus limited, but to compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) is used. Ratios less than or equal to 10:1 indicate nitrogen is limiting. Ratios greater than or equal to 15:1 indicate that phosphorus is limiting. Ratios greater than 10:1, but less than 15:1 indicate that there are enough of both nutrients to facilitate excess algal or plant growth. Druce Lake had an average TN:TP ratio of 41:1. This indicates that the lake is highly phosphorus limited and that a small increase in phosphorus concentrations in the epilimnion could result in algae blooms in the future. Although the average epilimnetic total Kjeldahl nitrogen (TKN) concentration is lower than the majority of the lakes in Lake County, high nitrogen concentrations relative to phosphorus concentrations resulted in this high ratio. Unfortunately, nitrogen can come from many sources, including septic systems, watershed runoff, soils and the atmosphere, and is very difficult to control. As a result of lower TP concentrations in 1996 as compared to 2001, the average TN:TP ratio in 1996 was 57:1. The average TKN concentration has remained virtually the same, but a higher TP concentration in 2001, decreased the ratio substantially. It appears, however, that the lake has maintained good water quality, despite the small phosphorus increase, which may have resulted from a decrease in Eurasian watermilfoil (EWM) density. Since EWM plants store phosphorus during the summer, a decrease in the density of these plants would increase the amount of phosphorus dissolved in the water column. Good water quality may not last as TP levels increase further, and care should be taken to maintain current TP concentrations as much as possible.

Phosphorus levels can also be used to indicate the trophic state (productivity level) of a lake. The Trophic State Index (TSI) uses phosphorus levels, chlorophyll *a* (algae biomass) levels and Secchi depth to classify and compare lake trophic states using just one value. The TSI is set up so that an increase in phosphorus concentration is related to an increase in algal biomass and a corresponding decrease in Secchi depth. A moderate TSI value (TSI=40-49) indicates mesotrophic conditions, typically characterized by relatively low nutrient concentrations, low algae biomass, adequate DO concentrations and relatively good water clarity. High TSI values indicate eutrophic (TSI=50-69) to hypereutrophic (TSI ≥70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO levels, a rough fish population, and low water clarity. Druce Lake had an average phosphorus TSI (TSIp) value of 48.5, indicating mesotrophic conditions. This means that the lake is a moderately enriched system with good water quality. Water quality on Druce Lake is higher than average. The lake ranked 12th out of 102 lakes in Lake County and was one of only 17 lakes to fall into the mesotrophic category. This may be partly due to its glacial origin. Most man-made lakes in this geographical area fall into the eutrophic and hypereutrophic categories, while many of the glacial lakes rank higher (Table 2, Appendix A).

Most of the water quality parameters just discussed can be used to analyze the water quality of Druce Lake based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Druce Lake provides *Full* support of aquatic life and swimming, and *Partial* support of recreational activities (such as boating) as a result of a high percent plant coverage. The lake provides *Full* overall use.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (See Appendix B for methodology). Shoreline plants of interest were also recorded.

However, no quantitative surveys were made of these shoreline plant species and these data are purely observational.). Light level was measured at one-foot intervals from the water surface to the lake bottom. When light level falls below 1% of the level at the water surface, plants are no longer able to grow. Using this information, it can be determined how much of the lake has the potential to support aquatic plant growth. Based on 1% light level, Druce Lake could have supported plants over approximately 71% of the lake. Plants grew over almost the entire area they were able to, covering 65% of the lake surface area during 2001 and growing to a maximum depth of 9.5 feet. The inability of aquatic plants to grow in all areas they could have as determined by percent light level may be explained by the presence of inadequate substrate in various parts of the lake. Very sandy sediment, which does not support all plant species, dominates the lake bottom in the shallow northern area and many spots were absent of plants along here. Eighteen different plant species were present in Druce Lake during the summer of 2001 (Tables 3 & 4). Only two of these (Eurasian watermilfoil and curly leaf pondweed) were exotic species. This very healthy plant community provided Druce Lake with excellent fish habitat and kept water clarity high by reducing sediment resuspension in the littoral zone and competing with planktonic algae for resources.

A plant survey was conducted on Druce Lake in 1994. Fourteen plant species were found, including water stargrass, which was not present in 2001. Plants observed in 2001 that were not present in 1994 included leafy pondweed, flatstem pondweed, thread leaf pondweed, southern naiad, and *Elodea*. Most plant species found during both years had similar percent occurrences. Percent occurrence of Illinois pondweed, curly leaf pondweed, and slender naiad had decreased since 1994, while percent occurrence of large leaf pondweed, floating leaf pondweed, and white water lily had increased since 1994 (Table 5, Appendix A). The increase in number of plant species in 2001 is likely due to a difference in sampling dates and a change in the growth of EWM. Two of the five new species found in 2001were found at only one sampling site and only in September. Since sampling was not conducted in September during the 1994 plant survey, these plant species may have been present after sampling had already been completed for the summer. Additionally, as discussed below, although percent occurrence of EWM was only slightly lower in 2001 (Tables 4 & 5), EWM plants were not topped out in 2001 as they were in 1994. This resulted in less shading by EWM and enabled other plants to take advantage of the sunlight. It is recommended that the “no action” plant management plan currently in place on Druce Lake be continued indefinitely.

Eurasian watermilfoil was one of the dominant plants in the lake in 2001, occurring in 49% of the plant sampling sites throughout the summer. This exotic plant species invaded Druce Lake in the early 1990’s and by 1994 had formed a ring around the eastern and southern half of the lake. In 1995, the milfoil weevil (*Euhrychiopsis lecontei*) was observed in the lake. This very tiny insect serves as a biological control for EWM, and when present in large enough numbers, can cause significant damage to milfoil beds. In 1995, the weevil had caused a decrease in the density of the EWM in Druce Lake. The ring of EWM had returned by early summer 1996, but was again diminished by the end of the summer. On two occasions during the summer of 2001, staff snorkeled the EWM beds along the southwest, south and east shoreline. On July 6, 2001, virtually no EWM was found in the area out from the boat launch and along the southern shore (where the ring of EWM has been very dense in the past), and weevil damage was found on plants that were present. A relatively large bed of EWM was found on the east side of the lake, but the plants had been completely destroyed by weevil damage. Most plants had severe damage and those plants that were sprouting new growth were already being utilized by weevils (eggs were found on these few healthy plant tips). Some new growth was observed on the lake bottom, but all large plants were bent over as a result of the damage. Staff returned to Druce Lake on August 10, 2001. All of the EWM observed earlier in the season was dead, absent of leaves, covered in algae, marl and sediment and lying on the bottom. New growth was beginning to emerge from both the dead plants and from the sediment surface, but adults were already laying eggs on this new growth. This was some of the most dramatic weevil-induced damage ever observed in Druce Lake and is a very positive indication that the EWM is under the control of the weevil population. The EWM may make a comeback in future years, as the weevil population oscillates from year to year based on EWM density. However, if nature is left to take its course (no management techniques are employed to treat the EWM in the lake), EWM density should remain in check and should not reach nuisance levels in Druce Lake in the future.

Of the seven emergent plant and trees species observed along the shoreline of Druce Lake, three (purple loosestrife, reed canary grass, and buckthorn) are invasive species that do not provide ideal wildlife habitat and have the potential to dominate the emergent plant community.

FQI (Floristic Quality Index) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts (Nichols, 1999). Each floating or submersed aquatic plant is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). An FQI is calculated by multiplying the average of these numbers by the square root of the number of these plant species found in the lake. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for 2000-2001 Lake County lakes is 14.0. Druce Lake has an FQI of 22.8, the 8th highest of all County Lakes studied in 2000 and 2001. Its high diversity of plant species places Druce Lake well above the average lake, by Lake County standards.

Table 3. Aquatic and shoreline plants in Druce Lake, May-September 2001.

Aquatic Plants	
Coontail	*Ceratophyllum demersum*
Chara	*Chara* sp.
American Elodea	*Elodea canadensis*
Eurasian Watermilfoil	*Myriophyllum spicatum*
Slender Naiad	*Najas flexilis*
Southern Naiad	*Najas guadalupensis*
Spiny Naiad	*Najas marina*
Yellow Pond Lily	*Nuphar advena*
White Water Lily	*Nymphaea tuberosa*
Largeleaf Pondweed	*Potamogeton amplifolius*
Curlyleaf Pondweed	*Potamogeton crispus*
Threadleaf Pondweed	*Potamogeton filaformus*
Leafy Pondweed	*Potamogeton foliosus*
Illinois Pondweed	*Potamogeton illinoensis*
Floatingleaf Pondweed	*Potamogeton natans*
Sago Pondweed	*Stuckenia pectinatus*
Common Bladderwort	*Utricularia vulgaris*
Shoreline Plants	
Blunt Spikerush	*Eleocharis obtusa*
Purple Loosestrife	*Lythrum salicaria*
Reed Canary Grass	*Phalaris arundinacea*
Common Buckthorn	*Rhamnus cathartica*
Common Arrowhead	*Sagittaria cuneata*
Softstem Bulrush	*Scirpus validus*
Common Cattail	*Typha latifolia*

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Druce Lake on July 17, 2001. The shoreline was assessed for a variety of criteria (See Appendix B for methods), and based on these assessments, several important generalizations could be made. Approximately 88% of Druce Lake's shoreline is developed and the majority of the developed shoreline is comprised of rip rap (28.3%) and buffer (26.0%) (Figure 5). The remainder of the developed shoreline consists of beach (16.5%), seawall (8.4%), manicured lawn (8.1%), wetland (7.4%) and woodland (5.3%). The undeveloped portions of the lake are made up of wetland, woodland and buffer. Manicured lawn is considered undesirable because it provides a poor shoreline-water interface due to the poor root structure of turf grasses. These grasses are incapable of stabilizing the shoreline and typically lead to erosion. Woodland and wetland are more desirable shoreline types, providing wildlife habitat and, typically, protecting the shore from excessive erosion. Seawall is not an ideal shoreline type unless used solely for erosion control. Seawalls do not provide any wildlife habitat and can often increase sediment resuspension as waves are reflected back into the lake by the seawall. Although rip rap is not an ideal shoreline type with regard to wildlife habitat, it does help to prevent shoreline erosion. Buffer is an ideal shoreline type because it also prevents shoreline erosion, as well as providing wildlife habitat. As a result of the dominance of rip rapped and buffered shoreline, 98.5% of Druce Lake's shoreline exhibited no erosion. Slight erosion was occurring on 0.6% of a seawalled shoreline, while moderate erosion was occurring on 0.9% of a rip rapped shoreline (Figure 6). Wetland, buffer and woodland shorelines should be maintained as much as possible, and the addition of manicured lawns, seawalls and rip rap should be discouraged.

Dramatic water level fluctuation can increase shoreline erosion, especially if the fluctuations occur over short periods of time. The water level in Druce Lake did not vary by more than 0.67 feet throughout the summer. A decrease of 0.27 feet between July and August may have been the result of the destruction of a beaver dam between Druce and Third Lake, but the exact time of dam removal is not known. Erosion occurs when water levels drop and newly exposed soil, which may not support emergent plant growth, is subjected to wave action. However, at this time, there does not appear to be a problem with significant lake level fluctuations in Druce Lake.

Although almost no erosion was occurring around Druce Lake, invasive plant species, including reed canary grass, buckthorn and purple loosestrife were present along 67.5% of the shoreline. These plants are extremely invasive and exclude native plants from the areas they inhabit. Buckthorn provides very poor shoreline stabilization and may lead to increasing erosion problems in the future. Reed canary grass and purple loosestrife inhabit mostly wetland areas and can easily outcompete native plants. Additionally, they do not provide the quality wildlife habitat or shoreline stabilization that native plants provide. Since the relative density of these three invasive plants was not extremely high along Druce Lake (the plants were found in small patches around the lake), steps to eliminate these plants should be carried out before they become a nuisance.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See Appendix B for methodology). Although wildlife habitat in the form of wetland and woodland areas was relatively limited around Druce Lake, only a moderate number of wildlife species were observed (Table 6). The beaver was not actually observed by Lakes Management Staff, but was included in the species list because of a report of the presence of a beaver lodge along the outlet creek. The moderate number of species observed was likely a function of the highly residential shoreline and the fact that, in general, the lake is located in a very urban area. It is, therefore, very important that the wetland, woodland and buffer areas around the lake be maintained to provide the appropriate habitat for birds and other animals in the future. It is also important that areas with manicured lawns down to the shoreline establish a buffer strip of native plants to provide additional habitat and reduce the possibility of erosion.

In 2001, zebra mussels (*Dreissena polymorpha*) were discovered in Gages Lake, which drains into Druce Lake. As of the writing of this report, zebra mussels have not been found in Druce Lake. However, it may be just a matter of time before this occurs. These mussels are believed to have been spread to this country in the mid 1980's by cargo ships from Europe that discharged their ballast water into the Great Lakes. The mussels spread throughout the Great Lakes and by 1991 had made their way into the Illinois and Mississippi Rivers. In 1999, the first sighting of the mussel in Lake County (besides Lake Michigan and the Chain of Lakes) occurred. Currently, five inland lakes in the County are known to be infested with the zebra mussel, but this number could be much higher, since the mussel has probably gone unnoticed in many lakes. Due to their quick life cycle and explosive growth rate, zebra mussels can quickly edge out native mussel species. Negative impacts on native bivalve populations include interferences with feeding, habitat, growth, movement and reproduction. The impact that the mussels have on fish populations is not fully understood. However, zebra mussels feed on algae, which is also a major food source for planktivorous fish, such as bluegills, which are food for bass and pike. Zebra mussels have also caused economic problems for large power plants, public water supplies, and industrial facilities, where they clog water intake pipes. Recent studies on the transport of the zebra mussel have shown that they can be found in any area of a boat that holds water, including the engine cooling system, bilge water, and bait buckets used in fishing. The researchers also found that many of the mussel larvae were being transported via aquatic plants that were taken from one lake to another on boats or boat trailers. The larvae did not appear to be transported by attaching to the sides of the boats themselves. There are several methods of control which include both removal and eradication. These methods include chemical molluscicides, manual removal, thermal irritation, acoustical vibration, and ultraviolet light.

Although it may be impossible to prevent zebra mussels from entering Druce Lake via direct flow from Gages Lake, several steps can be taken to prevent the introduction of the mussel via transport by boat. It is recommended that residents (1) educate themselves on what the species looks like and how it can be spread; (2) remain diligent about removing plants and emptying all sources of water from boats being transferred from any lake back into Druce Lake; and (3) post signs at the Mariner's Cove Boat Launch educating boaters about the zebra mussel (and Eurasian watermilfoil), the negative impacts it can have on a lake and ways to prevent the spread of the organism. These signs can be purchased for approximately $15.00 from the Indiana-Illinois Sea Grant College Program web site at http://www.iisgcp.org. Once on the home page, go to Outreach, Biological Resources, Publications, Exotic Species Advisory Sign. It is important that the presence of the zebra mussel in Druce Lake (if they are ever observed) be reported to the Lakes Management Unit immediately so that records can be updated and steps can be taken to prevent its further spread.

Table 6. Wildlife species observed at Druce Lake, May-September 2001.

Birds	
Canada Goose	*Branta canadensis*
Mallards	*Anas platyrhnchos*
Wood Duck	*Aix sponsa*
American Coot	*Fulica americana*
Ring-billed Gull	*Larus delawarensis*
Great Blue Heron	*Ardea herodias*
Turkey Vulture	*Cathartes aura*
American Crow	*Corvus brachyrhynchos*
American Robin	*Turdus migratorius*
Red-winged Blackbird	*Agelaius phoeniceus*
Mammals	
Beaver	*Castor canadensis*
Insects	
Milfoil Weevil	*Euhrychiopsis lecontei*

EXISTING LAKE QUALITY PROBLEMS

- *Invasive Shoreline Plant Species*

  Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. The outcome is a loss of plant and animal diversity. Purple loosestrife is responsible for the "sea of purple" seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Due in part to an extensive root system, large seed production (estimates range from 100,000 to 2.7 million per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Purple loosestrife, buckthorn and reed canary grass (another exotic species) are present along 67.5% of the shoreline of Druce Lake and attempts should be made to control their spread.

- *Limited Wildlife Habitat*

  Although much of the northwest shoreline of the lake is dominated by wetland and woodland, most of Druce Lake's shoreline is dominated by residential homes, which do not always encourage a diverse bird and animal community. Many of the residents along Druce Lake already have buffer strips in place along their property's shoreline. However, many of the residents also have rip rap and beaches along their shoreline. It is recommended that those residents that already have buffer consider widening their strips and that those residents that do not have a buffer strip consider planting 10-20 feet of native plants along their shoreline.

- *Presence of Zebra Mussels in Gages Lake*

  Because zebra mussels have been found in Gages Lake, which drains into Druce Lake via a storm pipe, it may be impossible to prevent the spread of these exotic species into Druce Lake in future years. However, steps can be taken to prevent the spread of zebra mussels into the lake via boat transport. These steps are outlined in the above Wildlife Assessment section.

POTENTIAL OBJECTIVES FOR THE DRUCE LAKE MANAGEMENT PLAN

I. Eliminate or Control Exotic Species
II. Enhance Wildlife Habitat Conditions

Objective I: Eliminate or Control Exotic Species

Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. Plants such as purple loosestrife (*Lythrum salicaria*), buckthorn (*Rhamnus cathartica*), and reed canary grass (*Phalaris arundinacea*) are three examples. The outcome is a loss of plant and animal diversity. This section will address terrestrial shoreline exotic species.

Purple loosestrife is responsible for the “sea of purple” seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Due in part to an extensive root system, large seed production (estimates range from 100,000 to 2.7 million seeds per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Reed canary grass is an aggressive plant that if left unchecked will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of purple loosestrife, buckthorn, and reed canary grass are discussed below. However, these control measures can be similarly applied to other exotic species such as garlic mustard (*Allilaria officianalis*) or honeysuckle (*Lonicera* spp.) as well as some aggressive native species, such as box elder (*Acer negundo*).

Presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. For example, reed canary grass was imported for its erosion control properties. It still contributes to this objective (offering better erosion control than commercial turfgrass), but needs to be isolated and kept in control. Many exotics are the result of garden or ornamental plants escaping into the wild. One isolated plant along a shoreline will probably not create a problem by itself. However, problems arise when plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. A monitoring program should be established, problem areas identified, and control measures taken when appropriate. This is particularly important in remote areas of lake shorelines where the spread of exotic species may go unnoticed for some time.

Option 1: No Action

No control will likely result in the expansion of the exotic species and the decline of native species. This option is not recommended if possible.

Pros

There are few advantages with this option. Some of the reasons exotics were brought into this country are no longer used or have limited use. However, in some cases having an exotic species growing along a shoreline may actually be preferable if the alternative plant is commercial turfgrass. Since turfgrass has shallow roots and is prone to erosion along shorelines, exotics like reed canary grass or common reed (*Phragmites australis*) will control erosion more effectively. Native plants should take precedent over exotics when possible. A table in Appendix A lists several native plants that can be planted along shorelines.

Cons

Native plant and wildlife diversity will be lost as stands of exotic species expand. Exotic species are not under the same stresses (particularly diseases and predators) as native plants and thus can out-compete the natives for nutrients, space, and light. Few wildlife species use areas where exotic plants dominate. This happens because many wildlife species either have not adapted with the plants and do not view them as a food resource, the plants are not digestible to the animal, or their primary food supply (i.e., insects) are not attracted to the plants. The result is a monoculture of exotic plants with limited biodiversity.

Recreational activities, especially wildlife viewing, may be hampered by such monocultures. Access to lake shorelines may be impaired due to dense stands of non-native plants. Other recreational activities, such as swimming and boating, may not be effected.

Costs

Costs with this option are zero initially, however, when control is eventually needed, costs will be substantially more than if action was taken immediately. Additionally, the eventual loss of ecological diversity is difficult to calculate financially.

Option 2: Biological Control

Biological control (bio-control) is a means of using natural relationships already in place to limit, stop, or reverse an exotic species' expansion. In most cases, insects that prey upon the exotic plants in its native ecosystem are imported. Since there is a danger of bringing another exotic species into the ecosystem, state and federal agencies require testing before any bio-control species are released or made available for purchase.

Recently two beetles (*Galerucella pusilla* and *G. calmariensis*) and two weevils (*Hylobius transversovittatus* and *Nanophyes marmoratus*) have offered some hope to control purple loosestrife by natural means. These insects feed on either the leaves or juices of purple loosestrife, eventually weakening or killing the plant. In large stands of loosestrife, the beetles and weevils naturally reproduce and in many locations, significantly retard plant densities. The insects are host specific, meaning that they will attack no other plant but purple loosestrife. Currently, the beetles have proven to be most effective and are available for purchase. There are no designated stocking rate recommendations, since using bio-control insects are seen as an inoculation and it may take 3-5 years for beetle populations to increase to levels that will cause significant damage. Depending on the size of the infested area, it may take 1,000 or more adult beetles per acre to cause significant damage.

Pros

Control of exotics by a natural mechanism if preferable to chemical treatments. Insects, being part of the same ecological system as the exotic (i.e., the beetles and weevils and the purple loosestrife) are more likely to provide long-term control. Chemical treatments are usually non-selective while bio-control measures target specific plant species. This technique is beneficial to the ecosystem since it preserves, even promotes, biodiversity. As the exotic dies back, native vegetation can reestablish the area.

Cons

Few exotics can be controlled using biological means. Currently, there are no bio-control techniques for plants such as buckthorn, reed canary grass, or a host of other exotics. One of the major disadvantages of using bio-control is the costs and labor associated with it.

Use of biological mechanisms to control plants such as purple loosestrife is still under debate. Similar to purple loosestrife, the beetles and weevils that control it are not native to North America. Due to the poor historical record of introducing non-native species, even to control other non-native species, this technique has its critics.

Costs

The Department of Natural Resources at Cornell University (607-255-2821) sells overwintering adult beetles (which will lay eggs the year of release) for $2 per beetle and new generation beetles (which will lay eggs beginning the following year) at $0.25 per beetle. Some beetles may be available for free by contacting the Illinois Natural History Survey (217-333-6846).

<u>Option 3: Control by Hand</u>

Controlling exotic plants by hand removal is most effective on small areas (< 1 acre) and if done prior to heavy infestation. Some exotics, such as purple loosestrife and reed canary grass, can be controlled to some degree by digging, cutting, or mowing if done early and often during the year. Digging may be required to ensure the entire root mass is removed. Spring or summer is the best time to cut or mow, since late summer and fall is when many of the plant seeds disperse. Proper disposal of excavated plants is important since seeds may persist and germinate even after several years. Once exotic plants are removed, the disturbed ground should be planted with native vegetation and closely monitored. Many exotic species, such as purple loosestrife, buckthorn, and garlic mustard are proficient at colonizing disturbed sites.

Pros

Removal of exotics by hand eliminates the need for chemical treatments. Costs are low if stands of plants are not too large already. Once removed, control is simple with yearly maintenance. Control or elimination of exotics preserves the ecosystem's biodiversity. This will have positive impacts on plant and wildlife presence as well as some recreational activities.

Cons

This option may be labor intensive or prohibitive if the exotic plant is already well established. Costs may be high if large numbers of people are needed to remove plants. Soil disturbance may introduce additional problems such as providing a seedbed for other non-native plants that quickly establish disturbed sites, or cause soil-laden run-off to flow into nearby lakes or streams. In addition, a well-established stand of an exotic like purple loosestrife or reed canary grass may require several years of intense removal to control or eliminate.

Costs

Cost for this option is primarily in tools, labor, and proper plant disposal.

Option 4: Herbicide Treatment

Chemical treatments can be effective at controlling exotic plant species. However, chemical treatment works best on individual plants or small areas already infested with the plant. In some areas where individual spot treatments are prohibitive or unpractical (i.e., large expanses of a wetland or woodland), chemical treatments may not be an option due to the fact that in order to chemically treat the area a broadcast application would be needed. Since many of the herbicides that are used are not selective, meaning they kill all plants they contact; this may be unacceptable if native plants are found in the proposed treatment area.

Herbicides are commonly used to control nuisance shoreline vegetation such as buckthorn and purple loosestrife. Herbicides are applied to green foliage or cut stems. Products are applied by either spraying or wicking (wiping) solution on plant surfaces. Spraying is used when large patches of undesirable vegetation are targeted. Herbicides are sprayed on growing foliage using a hand-held or backpack sprayer. Wicking is used when selected plants are to be removed from a group of plants. The herbicide solution is wiped on foliage, bark, or cut stems using a herbicide soaked device. Trees are normally treated by cutting a ring in the bark (called girdling). Herbicides are applied onto the ring at high concentrations. Other devices inject the herbicide through the bark. It is best to apply herbicides when plants are actively growing, such as in the late spring/early summer, but before formation of seed heads. Herbicides are often used in conjunction with other methods, such as cutting or mowing, to achieve the best results. Proper use of these products is critical to their success. Always read and follow label directions.

Pros

Herbicides provide a fast and effective way to control or eliminate nuisance vegetation. Unlike other control methods, herbicides kill the root of the plant, which prevents regrowth. If applied properly, herbicides can be selective. This allows for removal of selected plants within a mix of desirable and undesirable plants.

Cons

Since most herbicides are non-selective, they are not suitable for broadcast application. Thus, chemical treatment of large stands of exotic species may not be practical. Native species are likely to be killed inadvertently and replaced by other non-native species. Off target injury/death may result from the improper use of herbicides. If herbicides are applied in windy conditions, chemicals may drift onto desirable vegetation. Care must also be taken when wicking herbicides as not to drip on to non-targeted vegetation such as native grasses and wildflowers. Another drawback to herbicide use relates to their ecological soundness and the public perception of them. Costs may also be prohibitive if plant stands are large. Depending on the device, cost of the application equipment can be high.

Costs

Two common herbicides, triclopyr (sold as Garlon™) and glyphosate (sold as Rodeo® or Round-up™), cost approximately $100 and $65 per gallon, respectively. Only Rodeo® is approved for water use. A Hydrohatchet®, a hatchet that injects herbicide through the bark, is about $300.00. Another injecting device, E-Z Ject® is $450.00. Hand-held and backpack sprayers costs from $25-$45 and $80-150, respectively. Wicking devices are $30-40.

Objective II: Enhance Wildlife Habitat Conditions

The key to increasing wildlife species in and around a lake can be summed up in one word: habitat. Wildlife need the same four things all living creatures need: food, water, shelter, and a place to raise their young. Since each wildlife species has specific habitat requirements, which fulfill these four basic needs, providing a variety of habitats will increase the chance that wildlife species may use an area. Groups of wildlife are often associated with the types of habitats they use. For example, grassland habitats may attract wildlife such as northern harriers, bobolinks, meadowlarks, meadow voles, and leopard frogs. Marsh habitats may attract yellow-headed blackbirds and sora rails, while manicured residential lawns attract house sparrows and gray squirrels. Thus, in order to attract a variety of wildlife, a mix of habitats are needed. In most cases quality is more important than quantity (i.e., five 0.1-acre plots of different habitats may not attract as many wildlife species than one 0.5 acre of one habitat type).

It is important to understand that the natural world is constantly changing. Habitats change or naturally succeed to other types of habitats. For example, grasses may be succeeded by shrub or shade intolerant tree species (e.g., willows, locust, and cottonwood). The point at which one habitat changes to another is rarely clear, since these changes usually occur over long periods of time, except in the case of dramatic events such as fire or flood.

In all cases, the best wildlife habitats are ones consisting of native plants. Unfortunately, non-native plants dominate many of our lake shorelines. Many of them escaped from gardens and landscaped yards (i.e., purple loosestrife) while others were introduced at some point to solve a problem (i.e., reed canary grass for erosion control). Wildlife species prefer native plants for food, shelter, and raising their young. In fact, one study showed that plant and animal diversity was 500% higher along naturalized shorelines compared to shorelines with conventional lawns (University of Wisconsin – Extension, 1999).

<u>Option 1: No Action</u>

This option means that the current land use activities will continue. No additional techniques will be implemented. Allowing a field to go fallow or not mowing a manicured lawn would be considered an action.

> ***Pros***
>
> Taking no action may maintain the current habitat conditions and wildlife species present, depending on environmental conditions and pending land use actions. If all things remain constant there will be little to no effect on lake water quality and other lake uses.
>
> ***Cons***
>
> If environmental conditions change or substantial land use actions occur (i.e., development) wildlife use of the area may change. For example, if a new housing

development with manicured lawns and roads is built next to an undeveloped property, there will probably be a change in wildlife present.

Conditions in the lake (i.e., siltation or nutrient loading) may also change the composition of aquatic plant and invertebrate communities and thus influence biodiversity. Siltation and nutrient loading will likely decrease water clarity, increase turbidity, increase algal growth (due to nutrient availability), and decrease habitat for fish and wildlife.

Costs

The financial cost of this option may be zero. However, due to continual loss of habitats many wildlife species have suffered drastic declines in recent years. The loss of habitat effects the overall health and biodiversity of the lake's ecosystems.

Option 2: Increase Habitat Cover

This option can be incorporated with Option 3 (see below). One of the best ways to increase habitat cover is to leave a minimum 25 foot buffer between the edge of the water and any mowed grass. Allow native plants to grow or plant native vegetation along shorelines, including emergent vegetation such as cattails, rushes, and bulrushes (Table 7, Appendix A for costs and seeding rates). This will provide cover from predators and provide nesting structure for many wildlife species and their prey. It is important to control or eliminate non-native plants such as buckthorn, purple loosestrife, garlic mustard, and reed canary grass, since these species outcompete native plants and provide little value for wildlife.

Occasionally high mowing (with the mower set at its highest setting) may have to be done for specific plants, particularly if the area is newly established, since competition from weedy and exotic species is highest in the first couple years. If mowing, do not mow the buffer strip until after July 15 of each year. This will allow nesting birds to complete their breeding cycle.

Brush piles make excellent wildlife habitat. They provide cover as well as food resources for many species. Brush piles are easy to create and will last for several years. They should be place at least 10 feet away from the shoreline to prevent any debris from washing into the lake.

Trees that have fallen on the ground or into the water are beneficial by harboring food and providing cover for many wildlife species. In a lake, fallen trees provide excellent cover for fish, basking sites for turtles, and perches for herons and egrets.

Increasing habitat cover should not be limited to the terrestrial environment. Native aquatic vegetation, particularly along the shoreline, can provide cover for fish and other wildlife.

Pros
Increased cover will lead to increased use by wildlife. Since cover is one of the most important elements required by most species, providing cover will increase the chances of wildlife using the shoreline. Once cover is established, wildlife usually have little problem finding food, since many of the same plants that provide cover also supply the food the wildlife eat, either directly (seeds, fruit, roots, or leaves) or indirectly (prey attracted to the plants).

Additional benefits of leaving a buffer include: stabilizing shorelines, reducing runoff which may lead to better water quality, and deterring nuisance Canada geese. Shorelines with erosion problems can benefit from a buffer zone because native plants have deeper root structures and hold the soil more effectively than conventional turfgrass. Buffers also absorb much of the wave energy that batters the shoreline. Water quality may be improved by the filtering of nutrients, sediment, and pollutants in run-off. This has a "domino effect" since less run-off flowing into a lake means less nutrient availability for nuisance algae, and less sediment means less turbidity, which leads to better water quality. All this is beneficial for fish and wildlife, such as sight-feeders like bass and herons, as well as people who use the lake for recreation. Finally, a buffer strip along the shoreline can serve as a deterrent to Canada geese from using a shoreline. Canada geese like flat, open areas with a wide field of vision. Ideal habitat for them are areas that have short grass up to the edge of the lake. If a buffer is allowed to grow tall, geese may choose to move elsewhere.

Cons
There are few disadvantages to this option. However, if vegetation is allowed to grow, lake access and visibility may be limited. If this occurs, a small path can be made to the shoreline. Composition and density of aquatic and shoreline vegetation are important. If vegetation consists of non-native species such as or Eurasian water milfoil or purple loosestrife, or in excess amounts, undesirable conditions may result. A shoreline with excess exotic plant growth may result in a poor fishery (exhibited by stunted fish) and poor recreation opportunities (i.e., boating, swimming, or wildlife viewing).

Costs
The cost of this option would be minimal. The purchase of native plants can vary depending upon species and quantity. Based upon 100 feet of shoreline, a 25-foot buffer planted with a native forb and grass seed mix would cost between $165-270 (2500 sq. ft. would require 2.5, 1000 sq. ft. seed mix packages at $66-108 per package). This does not include labor that would be needed to prepare the site for planting and follow-up maintenance. This cost can be reduced or minimized if native plants are allowed to grow. However, additional time and labor may be needed to insure other exotic species, such as buckthorn, reed canary grass, and purple loosestrife, do not become established.

<u>Option 3: Increase Natural Food Supply</u>

This can be accomplished in conjunction with Option 2. Habitats with a diversity of native plants will provide an ample food supply for wildlife. Food comes in a variety of forms, from seeds to leaves or roots to invertebrates that live on or are attracted to the plants. Plants found in the table in Appendix A should be planted or allowed to grow. In addition, encourage native aquatic vegetation, such as water lily (*Nuphar* spp. and *Nymphaea tuberosa*), sago pondweed (*Stuckenia pectinatus*), largeleaf pondweed (*Potamogeton amplifolius),* and wild celery (*Vallisneria americana*) to grow. Aquatic plants such as these are particularly important to waterfowl in the spring and fall, as they replenish energy reserves lost during migration.

Providing a natural food source in and around a lake starts with good water quality. Water quality is important to all life forms in a lake. If there is good water quality, the fishery benefits and subsequently so does the wildlife (and people) who prey on the fish. Insect populations in the area, including beneficial predatory insects, such as dragonflies, thrive in lakes with good water quality.

Dead or dying plant material can be a source of food for wildlife. A dead standing or fallen tree will harbor good populations of insects for woodpeckers, while a pile of brush may provide insects for several species of songbirds such as warblers and flycatchers.

Supplying natural foods artificially (i.e., birdfeeders, nectar feeders, corn cobs, etc.) will attract wildlife and in most cases does not harm the animals. However, "people food" such as bread should be avoided. Care should be given to maintain clean feeders and birdbaths to minimize disease outbreaks.

Pros

Providing food for wildlife will increase the likelihood they will use the area. Providing wildlife with natural food sources has many benefits. Wildlife attracted to a lake can serve the lake and its residents well, since many wildlife species (i.e., many birds, bats, and other insects) are predators of nuisance insects such as mosquitoes, biting flies, and garden and yard pests (such as certain moths and beetles). Effective natural insect control eliminates the need for chemical treatments or use of electrical "bug zappers" that have limited effect on nuisance insects.

Migrating wildlife can be attracted with a natural food supply, primarily from seeds, but also from insects, aquatic plants or small fish. In fact, most migrating birds are dependent on food sources along their migration routes to replenish lost energy reserves. This may present an opportunity to view various species that would otherwise not be seen during the summer or winter.

Cons

Feeding wildlife can have adverse consequences if populations become dependent on hand-outs or populations of wildlife exceed healthy numbers. This frequently happens when people feed waterfowl like Canada geese or mallard ducks.

Feeding these waterfowl can lead to a domestication of these animals. As a result, these birds do not migrate and can contribute to numerous problems, such as excess feces, which is both a nuisance to property owners and a significant contribution to the lake's nutrient load. Waterfowl feces are particularly high in phosphorus. Since phosphorus is generally the limiting factor for nuisance algae growth in many lakes in the Midwest, the addition of large amounts of this nutrient from waterfowl may exacerbate a lake's excessive algae problem. In addition, high populations of birds in an area can increase the risk of disease for not only the resident birds, but also wild bird populations that visit the area.

Finally, tall plants along the shoreline may limit lake access or visibility for property owners. If this occurs, a path leading to the lake could be created or shorter plants may be used in the viewing area.

Costs

The costs of this option are minimal. The purchase of native plants and food and the time and labor required to plant and maintain would be the limit of the expense.

Option 4: Increase Nest Availability

Wildlife are attracted by habitats that serve as a place to raise their young. Habitats can vary from open grasslands to closed woodlands (similar to Options 2 and 3).

Standing dead or dying trees provide excellent habitat for a variety of wildlife species. Birds such as swallows, woodpeckers, and some waterfowl need dead trees to nest in. Generally, a cavity created and used by a woodpecker (e.g., red-headed or downy woodpecker, or common flicker) in one year, will in subsequent years be used by species like tree swallows or chickadees. Over time, older cavities may be large enough for waterfowl, like wood ducks, or mammals (e.g., flying squirrels) to use. Standing dead trees are also favored habitat for nesting wading birds, such as great blue herons, night herons, and double-crested cormorants, which build stick nests on limbs. For these birds, dead trees in groups or clumps are preferred as most herons and cormorants are colonial nesters.

In addition to allowing dead and dying trees to remain, erecting bird boxes will increase nesting sites for many bird species. Box sizes should vary to accommodate various species. Swallows, bluebirds, and other cavity nesting birds can be attracted to the area using small artificial nest boxes. Larger boxes will attract species such as wood ducks, flickers, and owls. A colony of purple martins can be attracted with a purple martin house, which has multiple cavity holes, placed in an open area near water.

Bat houses are also recommended for any area close to water. Bats are voracious predators of insects and are naturally attracted to bodies of water. They can be enticed into roosting in the area by the placement of bat boxes. Boxes should be constructed of rough non-treated lumber and placed >10 feet high in a sunny location.

Pros

Providing places were wildlife can rear their young has many benefits. Watching wildlife raise their young can be an excellent educational tool for both young and old.

The presence of certain wildlife species can help in controlling nuisance insects like mosquitoes, biting flies, and garden and yard pests. This eliminates the need for chemical treatments or electric “bug zappers” for pest control.

Various wildlife species populations have dramatically declined in recent years. Since, the overall health of ecosystems depend, in part, on the role of many of these species, providing sites for wildlife to raise their young will benefit not only the animals themselves, but the entire lake ecosystem.

Cons

Providing sites for wildlife to raise their young have few disadvantages. Safety precautions should be taken with leaving dead and dying trees due to the potential of falling limbs. Safety is also important when around wildlife with young, since many animals are protective of their young. Most actions by adult animals are simply threats and are rarely carried out as attacks.

Parental wildlife may chase off other animals of its own species or even other species. This may limit the number of animals in the area for the duration of the breeding season.

Costs

The costs of leaving dead and dying trees are minimal. The costs of installing the bird and bat boxes vary. Bird boxes can range in price from $10-100.00. Purple martin houses can cost $50-150. Bat boxes range in price from $15-50.00. These prices do not include mounting poles or installation.