2000 SUMMARY REPORT
of
Cranberry Lake

Lake County, Illinois

Prepared by the

LAKE COUNTY HEALTH DEPARTMENT
ENVIRONMENTAL HEALTH SERVICES
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LAKE IDENTIFICATION AND LOCATION

Cranberry Lake is located in Avon Township at the corner of Hainesville Road and Washington Street in the village of Hainesville (T45N, R10E, Section 28, NE ¼). Cranberry Lake is a 17.5 acre glacial pothole lake. The lake is nearly round in shape except for a shallow north-south arm, which has very little open water, off the east side (Figure 1). The lake is totally surrounded by a wide cattail fringe that is slowly encroaching. The lake has a shallow shelf (1-7 feet) extending far out into the lake where the depth then increases quickly. The current maximum water depth is 19.5 feet with an average depth of 9.8 feet (Lake County Health Department – Lakes Management Unit estimate). Lake volume is estimated to be approximately 173 acre feet (LMU surface area * LMU average depth). Cranberry Lake is in the Long Lake watershed, which is part of the Fox River watershed. Cranberry Lake is the headwaters of the Round Lake drainage basin. Cranberry Lake drains into Highland Lake during periods of high water via a creek. From Highland Lake, water drains into Round Lake, which then drains into Long Lake and eventually into Fox Lake.

BRIEF HISTORY OF CRANBERRY LAKE

Deerpoint Homes is the current owner of Cranberry Lake and the land immediately surrounding the lake. In the past fishing was allowed by permission only by the previous landowner. Currently no one is allowed access to the lake. Recently there has been discussion of turning management of Cranberry Lake over to The Land Conservancy of Lake County. The conservancy would manage the lake with funds from a special tax assessment on residents of the nearby Cranberry Lake subdivision. Until recently it was thought that Cranberry Lake was a shallow slough. Recent depth soundings by the LCHD-LMU have recently disproved this.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Access to the lake is very limited and consists of a narrow path through the cattails at the Northeast corner of the lake near the intersection of Washington Street and Hainesville Road. Due to the limited access the only suitable watercraft would be a canoe, Jon boat, or small rowboat. Historically, the lake has been used for fishing and waterfowl hunting. After several winter fish kills, the first recorded as early as 1945, fishing success has slowly declined. However, there have been reports of large fish still being caught. Reports of smaller fish are few, which probably means there is minimal recruitment occurring. Additionally, there was a fish kill during the winter of 2000/2001. Supposedly, the previous owner has stocked the lake a few times over the years. Motor boats have never been allowed on Cranberry Lake. Due to new ownership, fishing and hunting are no longer allowed on the property. Currently, with continual fish kills and with no stocking, quality fishing opportunities in Cranberry Lake will cease. The best

use of the lake at this time is aesthetic enjoyment (plants, waterfowl, other wildlife). However, future uses of the lake are uncertain at this point in time. However, all precautions should be taken to protect this highly valuable resource.

LIMNOLOGICAL DATA – WATER QUALITY

Samples were collected at 3 feet and 2 feet from the bottom (15-18 feet) at the deep hole location in the lake (Figure 1). Cranberry Lake was thermally stratified during the entire course of the study. This means that the lake was divided into warm upper water (epilimnion) and cool lower water (hypolimnion). The strength of stratification dictates whether these layers mix. Thermal stratification is measured in relative thermal resistance to mixing (RTRM). At an RTRM of 20, layers generally do not mix. On Cranberry Lake, peak RTRM ranged from 47 in May to 86 in July (Figure 2). This strong thermal stratification prevented the high nitrogen (4.7 mg/L) and phosphorus (0.35 mg/L) concentrations, released during biological processes, in the hypolimnion from mixing into the epilimnion. Mixing of these nutrients into the epilimnion during the summer months could cause a variety of water quality problems. During turn over, these nutrients are mixed throughout the lake but are diluted to lower levels. The extent of dilution is dependent on the water volume of the different layers. Without a bathymetric map, and accompanying morphometric data, this determination can not be made.

The region in between the epilimnion and hypolimnion is called the metalimnion and is an area of changing water temperature and dissolved oxygen (D.O.) levels. Due to the process of stratification, oxygen is unable to mix into the hypolimnion. Therefore, as oxygen consuming biological processes (such as decomposition of plant material) increase, hypolimnetic oxygen is stripped from the water and becomes anoxic as the summer progresses. Within the metalimnion is the anoxic boundary, which is the point at which D.O. drops below 1.0 mg/L. At this level, no aquatic organisms (except non-photosynthetic bacteria) can live. The oxic volume becomes more shallow as summer progresses (the epilimnion becomes smaller; hypolimnion becomes larger). In Cranberry Lake the anoxic boundary in May was at 15.9 feet and was at its shallowest in August at 7.8 feet (Figure 2). However, D.O. levels in the epilimnion were dangerously low (below 5.0 mg/L) in August and September. These low D.O. levels can cause fish stress. Continual stress can eventually lead to mortality. Low oxygen levels are characteristic of natural, boggy lakes such as Cranberry. These low oxygen levels are not problematic unless sport fishing is a management concern. Many low quality fish species are able to withstand these low oxygen conditions.

Overall, Cranberry Lake has *excellent* water quality. Several water quality parameters had outstanding concentrations[*]. Average total suspended solids (TSS), on Cranberry

[*] In relation to some water quality parameters, such as measurement of solids and nutrient levels, the lower the level the better the water quality (below average is good). With some parameters, such as alkalinity and pH, being too low (or too high) is considered problematic. With Secchi disk, the deeper the reading the better the water quality (above average is good).

Lake during the study was 1.18 mg/L. This is over seven times lower than the County average. In fact, Cranberry Lake had the lowest single sample TSS (0.6 mg/L) of any lake sampled in Lake County by the LMU in the last five years. Nonvolatile suspended solids (NVSS), which is the part of TSS that is related to sediment particles, was also very low (0.72 mg/L) and was the lowest of any lake analyzed in the County. In general, all of the solids measured were below average reinforcing the quality of water at Cranberry Lake. Due to low TSS (and lack of excessive algal growth), Secchi disk depth was very good. The average Secchi disk depth on Cranberry Lake was 11.0 feet (Lake County average is 5.0 feet). The deepest Secchi readings were in June (13.6 feet). This was the fifth best Secchi disk reading the LMU has recorded in the last five years.

Water quality is partially affected by external inputs such as runoff from the surrounding watershed, stream inflow, etc. If these sources are of poor quality, water quality will be negatively effected. Cranberry Lake does not receive an appreciable amount of its water from these inputs. Instead, Cranberry Lake receives most of its water through direct rainfall into the lake, which affects water quality very little in this area of the country. This is especially evident in the seasonal water levels. Over the course of the study, water levels in Cranberry Lake decreased 14.2 inches. The largest decrease in water level occurred from May to June. This is contradictory to rainfall amounts, which were high during this period (Figure 3). This shows that Cranberry Lake receives little water from the surrounding watershed because it is small.

The average epilimnetic pH level on Cranberry Lake was 7.8, which was slightly below average (Lake County average is 8.7 and neutral pH is 7.0). During the course of the study the pH gradually decreased from 8.4 in May to 7.31 in September. Furthermore, average hypolimnetic pH in Cranberry Lake was acidic (below neutral of 7.0). In fact, Cranberry Lake had the lowest hypolimnetic pH of any lake sampled by the LMU (1995-2000 data). Hypolimnetic pH are lower than epilimnetic pH due to biological processes. These low pH values, in both the epilimnion and the hypolimnion are not unusual for a boggy lake such as Cranberry. This is due to high levels of organic sediment (from cattails and other vegetation), that are sources of acidic compounds such as tannins.

Alkalinity levels in Cranberry Lake varied slightly over the course of the summer. This was partially due to the lake's acidic nature but also in part to the formation of marl on aquatic vegetation. Marl ($CaCO_3$) forms on plants during utilization of bicarbonate ions (HCO_3^-). Bicarbonate is used as an alternative to CO_2 when levels of bicarbonate are high (and CO_2 is low). Glacial lakes commonly have higher levels of bicarbonate due to parent bedrock. During marl formation, hydroxide ions (OH^-) are stripped from the water. This causes a lowering of alkalinity and pH. This phenomenon commonly occurs in waters that are alkaline in nature and have dense aquatic plant growth.

Another important measurement of water quality are nutrient levels. Algae need light and nutrients, most importantly carbon, nitrogen (N) and phosphorus (P), to grow. Light and carbon are not normally in short supply (limiting). This means that nutrients (N&P) are the limiting factors in algal growth. To compare the availability of these nutrients, a ratio of total nitrogen to total phosphorus is used (TN:TP). Ratios < 10:1 indicate nitrogen is

limiting. Ratios of >15:1 indicate phosphorus is limiting. Ratios >10:1, <15:1 indicate that there is enough of both nutrients for excessive algal growth. Cranberry Lake has a TN:TP ratio of 50:1, which means that the lake is *highly* phosphorus limited. This means that any additions of phosphorus, even small influxes, could result in drastic increases in algal biomass. Average epilimnetic phosphorus concentration in Cranberry Lake is 0.02 mg/L (Lake County average is 0.06 mg/L). These low levels of phosphorus, along with a healthy aquatic plant population, help keep algae growth to a minimum.

Another way to look at phosphorus levels and how they affect productivity of the lake is to use a Trophic State Index (TSI) based on phosphorus. TSI values are commonly used classify and compare lakes productivity levels (trophic state). The higher the phosphorus levels the greater amount of algal biomass, which then results in a higher TSI and corresponding trophic state. Based on a TSI phosphorus value of 50, Cranberry Lake is classified as *eutrophic* ($\geq$50, <70 TSI). A eutrophic lake is defined as an over productive system that has above average nutrient levels and high algal biomass (growth). However, this definition does not hold completely true for Cranberry Lake. The eutrophic classification was due to slightly elevated phosphorus levels. These elevated levels did not cause high algal biomass, which phosphorus TSI trophic states are partially based (Cranberry Lake phosphorus TSI was borderline). Based on a Secchi TSI of 43, Cranberry Lake is classified as *mesotrophic* (moderately productive). Most glacial lakes dominated by macrophyte growth fall into this trophic state. However, Cranberry Lake is a highly productive body of water, which is apparent in the lush aquatic plant growth and should be considered eutrophic. So overall, the trophic state of Cranberry Lake is borderline between *eutrophic* and *mesotrophic* and is dependent on which parameter is used to calculate the TSI. Based on the phosphorus TSI, Cranberry Lake ranks 16th out of 87 lakes studied by the LMU between 1988-2000 (Table 2). This further reinforces the extremely good quality of Cranberry Lake.

TSI values along with other water quality parameters can be used to make other analysis of Cranberry Lake based on use impairment indexes established by the Illinois Environmental Protection Agency (IEPA). Most water quality standard impairment assessments were listed as *None*. However, widespread aquatic vegetation was the source of impairments based on excessive plant growth (*High* use impairment), exotic species (*Slight* use impairment). Furthermore, based on IEPA indices. Cranberry Lake is listed as providing *Partial* support for Recreational Use and *Full* support of Swimming and Aquatic Life Use. Based on these indices, Cranberry Lake is listed as providing *Full* Overall Use support.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for duration of the study (*Appendix A* for methodology). Cranberry Lake has an ***exceptional*** aquatic plant population consisting of *27* different species (Table 3). The extent to which these plants grow is largely dictated by light availability. Plants need at least 1% of surface light levels in

order to survive. Based on the depth of 1% light level, depth at which plant growth could occur in Cranberry Lake varied on a monthly basis. However, due to the extremely good water clarity in Cranberry Lake, which is largely due to the aquatic vegetation, plants were able to grow throughout the lake regardless of depth. Measurements show that aquatic plants could have grown from a depth of < 10 feet (September) to as deep as 14.5 feet (May). However, surveys of aquatic plants show that vegetation was found at depths of up to 19 feet. Coontail was the only species of plant was found at this depth and was the only species found in water deeper than 9 feet. This phenomenon, with coontail occurring beyond the 1% light penetration depth, occurred in all months of the study. Coontail plants deeper than the 1% light level were reduced in structure and had a noticeable dark appearance to them. This is typical of coontail found at depths beyond that of adequate light can penetrate. From depths of 1 to 8 feet there was high species diversity of aquatic vegetation. Cranberry Lake has a very healthy and well-balanced aquatic plant population with no one species dominating. This is largely due to lack of disruption and human intervention. However, some species were more frequent than others throughout the study (Table 4).

Some species were of great interest due to their rarity. Humped bladderwort, one of the most common plants in Cranberry Lake, is considered rare and has never before been officially documented within Lake County. As the summer progressed, occurrence of humped bladderwort increased (Table 4). It was found at none of the sites in May and by September it was found at 88% of sample sites. There were two other plant species that are found in Cranberry Lake that are on the Illinois endangered species list: grass-leaved pondweed and small bladderwort. Great care should be taken to preserve the well being of these rare, highly desirable plants. Other species, such as large leaf pondweed (48 % of sample sites), *Chara* (55 % of sample sites), common bladderwort (40 % of sample sites), and flat-stem pondweed (48 % of sample sites) were more common but are still considered desirable. These desirable native plants kept problematic species such as coontail (55 % of sample sites), northern water milfoil (57% of sample sites) under control.

Another positive attribute of Cranberry Lake is the ***absence*** of Eurasian water milfoil (EWM). Many lakes throughout the County are infested with this problematic aquatic weed. This makes containing the spread from one lake to another very difficult. If Cranberry Lake undergoes some type of development (walking trails, fishing and observations piers, etc.), usage will undoubtedly increase. Therefore precautions should be taken to prevent introduction of EWM into Cranberry Lake. Educational materials such as signs should be posted stating that Cranberry is an EWM free lake and also list proper ways to ensure that EWM is not introduced. Furthermore, it would be advisable to ban all public watercraft on the lake, as this is a common route of EWM introduction.

Table 3. Aquatic and Emergent Plants Found in Cranberry Lake. (May-September 2000)

Submersed	
Coontail	*Ceratophyllum demersum*
Chara (macroalgae)	*Chara* sp.
Largeleaf Pondweed	*Potamogeton amplifolius*
Threadleaf Pondweed	*Potamogeton filaformus*
Leafy Pondweed	*Potamogeton foliosus*
Grass-leaved Pondweed*	*Potamogeton gramineus*
Illinois Pondweed	*Potamogeton illinoensis*
American Pondweed	*Potamogeton nodosus*
Floatingleaf Pondweed	*Potamogeton natans*
Small Pondweed	*Potamogeton pusillus*
Flatstem Pondweed	*Potamogeton zosterifomis*
Sago Pondweed	*Stuckenia pectinatus*
Horned Pondweed	*Zannichellia palustris*
Northern Water Milfoil	*Myriophyllum sibiricum*
Slender Naiad	*Najas flexilis*
Spiny Naiad	*Najas marina*
Water Bulrush	*Scirpus subterminalis*
Vallisneria (eel grass)	*Vallisneria americana*
Water Stargrass	*Zosterella dubia*
Rooted Floaters	
Water Shield	*Brasenia schreberi*
Yellow Pond Lily	*Nuphar advena*
White Water Lily	*Nymphaea fuberosa*
Free-Floaters	
Slender Riccia	*Riccia fluitans*
Humped Bladderwort	*Utricularia gibba*
Small Bladderwort*	*Utricularia minor*
Purple Bladderwort	*Utricularia purpurea*
Common Bladderwort	*Utricularia vulgaris*
Emergent	
Joe-Pye Weed	*Eupatorium maculatum*
Purple Loosestrife	*Lythrum salicaria*
Hardstem Bulrush	*Scirpus acutus*
Common Cattail	*Typha latifolia*
Narrow-Leaved Cattail	*Typha angustifolia*

*State of Illinois endangered species

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

The water-cattail interface does not experience erosion or other problems that plague normal shorelines. A major concern with regard to the "shoreline" on Cranberry Lake is the continual encroachment by cattails. Cranberry Lake is at an elevated risk of encroachment due to the expansive, shallow shelf around the perimeter of the lake. The current extent of the cattails should be maintained and expansion should not be allowed. This will help to slow the gradual filling in of the shallow areas of Cranberry Lake. Another major concern is eliminating/preventing the spread of invasive species, which were observed at scattered locations around the lake.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Wildlife observations were made on a monthly basis during water quality and plant sampling actives. All observations were visual. Several types of waterfowl were observed during the course of the study (Table 5). Included in these was the pied-billed grebe, which is an Illinois threatened species. The healthy populations of cattails provide good habitat for a variety of bird species. Additionally, there are several shrub areas that provide habitat for smaller bird and mammal species. Purple Loosestrife and Buckthorn have been noted in several areas around the lake. These plants are seldom used by wildlife for food or shelter. They should be eliminated before they spread and displace other native and more desirable plant species. As stated above, due to the low D.O. levels in the lake, the presence of quality game fish may be limited. However, Cranberry Lake may contain important non-game fish species including those that are threatened or endangered. Fishery studies would need to be conducted in order to determine the condition of the fishery in Cranberry Lake.

Other interesting organisms found on Cranberry Lake were weevil species Euhrychiopsis *lecontei* and *Phytobius leucogaster*. Commonly know as the water milfoil weevils. These are herbivorous insects that feed exclusively on milfoil (northern and Eurasian). Due to recent surveys the weevils have been documented on 18 lakes throughout Lake County. Commercially, *Euhrychiopsis lecontei* is used as a biocontrol method to combat Eurasian water milfoil. The presence of both of these weevils could be another reason why Cranberry Lake does not have a nuisance vegetation problem despite the presence of northern water milfoil.

Tragically, recent current management decisions have not been ecologically sound. In May, an environmental consulting firm hired by Deerpointe Homes conducted a prescribed burn of the cattail fringe. This burn was originally well intentioned but was carried out erroneously. The burn was initially planned for much earlier in the spring. However, due to above average rainfall and uncooperating wind, the burn was conducted much later than planned. Despite the knowledge of nesting waterfowl and other birds, the consulting firm still conducted the burn. This caused senseless disruption and

destruction of bird and waterfowl nests. Visual observation of burnt nests and charred eggs were documented by the LMU. Consequently, numerous nesting geese lost entire clutches. A pair of swans produced one signet despite numerous eggs on the nest before the burn. Typically, mute swans rear at least two to three signets.

Table 5. Observed Wildlife Species on Cranberry Lake. (May-September 2000)

Birds	
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Pied-billed Grebe+	*Podilymbus podiceps*
Bufflehead	*Bucephala albeola*
Mute Swan	*Cygnus olor*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Red-winged Blackbird	*Agelaius phoeniceus*
Wood Duck	*Aix sponsa*
Reptiles	
Painted Turtle	*Chrysemys picta*
Snapping Turtle	*Chelydra serpentina*

+Threatened in Illinois

EXISTING LAKE QUALITY PROBLEMS

Cranberry Lake is a ***high*** quality lake and is among the best in Lake County. This is evident in many aspects of water quality as well as plant and wildlife populations, which are superior to almost all of the other lakes in the County. There is very little that can be done to improve Cranberry Lake. Listed below are a few *minor* quality issues on Cranberry Lake. Most of these problems are of little concern considering the undisturbed nature and minimal usage of the lake. All measures should be taken to minimize human impacts and to preserve Cranberry Lake for future generations to enjoy. Additionally, it would also be very beneficial to place signs around the lake educating the public about Cranberry Lake and its exceptional residents. This would be the most appropriate use of Cranberry if there were an increase in access due to development (paths, piers, etc.) by Deerpoint Homes (or The Land Conservancy of Lake County).

- *Lack of Bathymetric Map*

  Most lake management techniques rely on the existence of a bathymetric (depth contour) map and accompanying morphometric table. Currently, Cranberry Lake does not have any type of bathymetric map, historical or otherwise. Anecdotal accounts of the lake's depth and morphometry were found to be untrue by the Lakes Management Unit. If any type of management of Cranberry Lake were to be undertaken, creation of a bathymetric map should first priority.

- *Potential Impacts from Development*

  Due to nearby housing developments Cranberry Lake will/could be directly impacted by these activities. Currently, these building practices seem to have no effect on the quality of Cranberry Lake. However, it is imperative that current development (to the south) as well as future (to the northeast) impacts Cranberry Lake as little as possible. Cranberry Lake is a well-balanced, natural system that is fragile. Any impact, no matter how seemingly insignificant, could bring about major changes in Cranberry Lake. All the proper development measures should be taken to protect Cranberry Lake. This includes proper installation of silt fences, minimizing site disturbance, and the use of cover crops to minimize erosion.

- *Invasive Species Management*

  Currently, there are only a few invasive species in or around Cranberry Lake. Coontail and northern water milfoil (NWM) are two aquatic invasive that are of concern. Northern water milfoil is less of a problem than the coontail. This is due to the balanced aquatic plant community and the presence of milfoil weevils, which both help keep NWM densities in check. Coontail is an aggressive, weedy plant that can be very problematic in small lakes such as Cranberry. Currently, growth of coontail is confined to deeper waters where few other plants are able to grow due to light restrictions. If current conditions are not maintained and the balance is disrupted (due to human intervention) NWM and coontail densities could expand and become a nuisance. This could lead to the loss of other plant species as well as disruption of the rest of the ecosystem.

  Two terrestrial species that are of concern are buckthorn and purple loosestrife. Both of these noxious weeds can easily be controlled using several different management techniques. The spread of these two aggressive species must be stopped before they become established around Cranberry Lake. Both of these species provide minimal no food or habitat benefit to wildlife. Furthermore, both species are extremely aggressive and will displace desirable, native vegetation, which will lead to further loss of food and habitat. The cattail fringe is also of some concern. Yearly or alternate year burnings of the fringe would be beneficial in slowing its encroachment.

These burning should be conducted as early in the year as possible to avoid any conflicts with migrating and/or nesting birds.

- *Low Epilimnetic Dissolved Oxygen Levels*

  Due to the shallow morphometry and massive biological oxygen demand during the mid-summer months, Cranberry Lake experiences low dissolved oxygen levels in the epilimnion. D.O. levels in the epilimnion were dangerously low in August and September. Low D.O. levels can cause fish stress and if continual, stress can eventually lead to fish mortality. Historically, Cranberry Lake has experienced fish kills. It is almost certain that Cranberry Lake will continue to experience fish kills. This has lead to a very poor quality sport fishery. If fishing were to become a priority at Cranberry Lake, besides a stocking program, the low D.O. problems would have to be remedied. Additionally, it would be beneficial to determine what volume of the epilimnion on hypolimnion to aid in better management of the lake. This could be accomplished by making a bathymetric map.

POTENTIAL OBJECTIVES FOR CRANBERRY LAKE MANAGEMENT PLAN

I. Creation of a Bathymetric
II. Eliminate or Control Invasive Species

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

Objective I: Creation of a Bathymetric Map

A bathymetric (depth contour) map is an essential tool for effective lake management since it provides critical information on the morphometric features of the lake (i.e., acreage, depth, volume, etc.). This information is particularly important when intensive management techniques (i.e., chemical treatments for plant or algae control, dredging, fish stocking, etc.) are part of the lake's overall management plan. Some lakes in Lake County do have a bathymetric map, but they are frequently old, outdated and do not accurately represent the current features of the lake.

Maps can be created by agencies like the Lake County Health Department - Lakes Management Unit or other companies. Costs vary, but can range from $3,000-10,000 depending on lake size.

Objective II: Eliminate or Control Invasive 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, buckthorn, 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 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. **All of the techniques below should consider the well being of wildlife such as nesting waterfowl.**

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. Appendix B 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).

Option 3: Control by Hand

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 cattails, can be controlled to some degree by digging, cutting, burning or mowing if done early and often during the year. Digging may be required to ensure the entire root mass is excavated. Spring or summer is the best time to cut, mow or burn, since late summer and fall is when many of the plant seeds disperse. Burning requires permits and individuals trained in prescribed burning techniques. 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. All of the above techniques should keep in mind the well being of wildlife such as nesting waterfowl.

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. Table 6 contains herbicides that are approved for use near water for control of nuisance vegetation. Included in this table are rates, costs, and restrictions on use.

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: See Table 6 for herbicide rates and prices. A Hydrohatchet®, a hatchet that injects herbicide through the bark, is about $300.00. Another injecting devise, E-Z Ject® is $450.00. Hand-held and backpack sprayers costs from $25-$45 and $80-150, respectively. Wicking devices are $30-40. Costs for elimination/control of invasive species on Cranberry Lake would be low because of the low occurrence of these species.