Environmental Assessment for Phase III - Control of Invasive Non-native Plants in Wetlands On Private Property in the Lake Erie Watershed in Ohio

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SUMMARY

The objective of the proposed project is to improve wetland habitat on private property in a three county area of northern Ohio by controlling invasive, non-native plant species. Wetlands particularly throughout the Great Lakes region have been inundated by invasive, non-native plants which pose direct threats to native plant and animal diversity. Invasive aquatic and wetland plants will be controlled on properties using a variety of methods, including mechanical and chemical control.

Chemical control will be conducted using aerial and ground herbicide applications. The control work will be conducted by Certified Contractors specializing in wetland invasive plant control.

The alternatives considered in this Environmental Assessment include biological control, mechanical harvesting, hydrologic manipulation, and no action. While the first three alternatives can be used somewhat successfully for managing some aquatic and wetland invasive plants, herbicide application is the most successful and efficient control technique. No action would simply allow these invasive plants to increase in Lake Erie drainage wetlands in Ohio, decreasing plant and animal diversity in these important ecosystems.

The environmental impacts of not conducting the proposed invasive plant control project in these wetland sites are far greater than the methods proposed for control. This project will control a number of highly invasive wetland and aquatic plants on at least 33,000 acres in private wetlands in northern Ohio. Given the threat that invasive plants pose to the diversity of our wetlands, this project is an excellent opportunity to make great strides in the control and restoration of Lake Erie drainage wetlands in Ohio in approximately 1-2 years.

Environmental Assessment for the Control of Invasive, Non-native Aquatic and Wetland Plants in Wetlands in the Lake Erie Watershed in Ohio

I. AUTHORITY AND PURPOSE

The purpose of this document is to describe the environmental effects of proposed management efforts for invasive, non-native aquatic and wetland plants in the Lake Erie drainage, which includes three counties in Ohio. The ODNR Division of Wildlife (DOW) was granted $792,000 from the U.S. Fish and Wildlife Service (USFWS) to control non-native, invasive plants such as purple loosestrife (*Lythrum salicaria*), Phragmites (*Phragmites australis* ssp. *australis*), reed canary grass (*Phalaris arundinacea*), narrow-leaved cattail (*Typha angustifolia*), flowering-rush (*Butomus umbellatus*), curly pondweed (*Potamogeton crispus*), and Eurasian water-milfoil (*Myriophyllum spicatum*) on approximately 33,000 acres of wetlands in Ottawa, Erie, and Sandusky counties.

This project will target the non-native invasive plants that are having the greatest impact on Lake Erie drainage wetlands. Grant funding for this project was awarded through the $475 million Great Lakes Restoration Initiative included in Public Law 111-88, the Department of the Interior, Environment, and Related Agencies Appropriations Act, 2010, which is a furtherance of President Obama's Great Lakes Restoration Initiative announced in February 2009.

The objective of the proposed project is to improve wetland habitat on private wetlands in northern Ohio by controlling invasive non-native plant species. Wetlands particularly throughout the Great Lakes region have been inundated by invasive non-native plants which pose direct threats to native plant and animal diversity through habitat destruction and loss. Invasive aquatic and wetland plants including those mentioned above will be controlled on private properties using a variety of methods including mechanical and chemical control.

Mechanical methods include water level control and bush-hogging/mowing. Chemical control will be conducted using aerial and ground herbicide applications. Ground applications may include spray rigs mounted on wetland boats, ATVs, and tractors, as well as backpack sprayers and high-volume application by contractors. The control work will be conducted by private contractors specializing in wetland invasive plant control.

The environmental impacts of not conducting the proposed invasive plant control project in the proposed wetland sites in the Lake Erie watershed of Ohio are far greater than the methods proposed for control. This project will likely control a number of highly invasive wetland and aquatic plants on private in northern Ohio. No other project recently implemented by the Division of Wildlife can have such far-reaching and instrumental impacts on improving the quality of wetland habitats. This is an impressive opportunity using short-term GLRI grant funds to accomplish wetland restoration on approximately 33,000 acres in Ohio.

II. BACKGROUND

A. General Plant information

Phragmites or common reed, is an invasive plant that has proliferated and degraded marshes in numerous eastern and Midwestern states (Ailstock et al. 2001; MDEQ 2008; Saltonstall 2005). It typically grows in sunny coastal and interior wetlands, lakeshores and margins, riverbanks, roadside ditches, and other low, wet areas.

Recent research by Saltonstall et al. (2002) has clarified different subspecies of Phragmities in North America of which one subspecies, *Phragmites australis* ssp. *americanus* occurs in Ohio and currently listed as threatened. Studies indicate that the introduced subspecies has displaced native types and broadened the historical range of Phragmites. The non-native type is not visually distinct from the indigenous, making this a "cryptic invasion" and difficult to fully understand the extent of the invasion.

Phragmites is a tall, coarse perennial grass with stout rhizomes that are deeply embedded in its substrate. The thick stalk (5-15 mm in diameter), which in optimal conditions can reach up to 4.5 meters tall, is leafy throughout, the sheaths overlapping with a large, dense, terminal panicle. The leaves are flat, stiff, 1 to 6 cm wide and up to 60 cm long, tapering to long-attenuate tips. The panicle is terminal, plum-like, purplish or silvery, 15 to 50 cm long, with many branches.

Phragmites spreads by seed and vegetatively through rhizomes (Mal & Narine 2004). Although the plant does produce seeds prodigiously, few are viable and they will not germinate in water depths greater than 5 cm (Marks et al. 1994). This means that phragmites most often spreads via its stout, creeping rhizomes, which can exceed 60 feet in length, grow more than six feet per year, and readily grow into new plants when fragmented (Michigan Department of Environmental Quality (MDEQ) 2008). If broken by natural actions such as waves, or human actions such as disking, the rhizomes can quickly take root in new locations. The rhizomes are often cited as one of the predominant reasons for Phragmites' ability to colonize and form large monocultures (see Saltonstall 2005, Mal & Narine 2004, etc.).

Phragmites occurs in every state in the continental U.S. (USDA PLANTS database accessed 2011). However, the presence and subsequent spread of the non-native, invasive strand into the Great Lakes appear to be a more recent phenomenon, although it is not known exactly when it initially invaded. The study of phragmites' expansion and historical distribution are complicated because both native and non-native populations, which are morphologically similar, exist in North America and the Great Lakes region (Lynch & Saltonstall 2002; Saltonstall 2002). The current distribution of phragmites has been documented, as have the ecological effects of its expansion.

Reed canary grass is similar to Phragmites in that there are non-native and native strands; however, the distinction between the two strands (if there are morphological differences) is currently not clear. This species has proliferated in the last 50 years in wetlands throughout the Lake Erie drainage. It grows in a wide variety of wet habitats including marshes, swamps, meadows, ditches, riverbanks, pond and lake margins, and even dry, open habitats.

Reed canary grass is a large, coarse grass that attains a height of 0.6 to 2 m. The erect, hairless stem supports rough-textured, tapering leaves of 9 to 25 cm long and 0.6 to 2 cm wide. Flowers occur in dense clusters in May to mid-June and grains ripen in late June to July. It spreads by seed and vegetatively through rhizomes. Its extensive rhizomes form dense colonies overtaking native species and later prohibiting native species re-colonization. Reed canary grass also shares similar world distribution as Phragmites occurring on every continent except Antarctica. It occurs throughout North America and Ohio; it is common in the Lake Erie drainage.

Purple loosestrife is one of the most well-known and best documented non-native species in North America. This Eurasian species first came into North America as early as 1814 (Stuckey 1980). It occurs in a variety of wetland habitats from ditches, meadows, marshes, and margins of ponds, lakes and streams.

Purple loosestrife is a stout, erect perennial herb with a strongly developed taproot. The plant ranges in height from 0.5 to 2.0 m. The four-angled stem can be glabrous to pubescent. The sessile leaves are opposite or in whorls, lanceolate to narrowly oblong, with cordate bases. The inflorescence is spike-like, 1-4 dm long. Petals 5-7 are usually magenta, but sometimes white or light pink. Flowering period is from late June into late August.

Purple loosestrife is a prolific and aggressive invader out-competing native wetland vegetation forming extensive mono-cultures covering many acres. Since introduction it has spread throughout North America occurring in nearly all lower 48 states. Its current distribution and ecological effects are well documented. Because of its invasive nature, the species is banned from retail sale in many states.

Narrow-leaved cattail is an aggressive invader of sunny wetlands such as marshes, meadows, fens, pond and lake margins, and ditches. It may grow to a height of 3 m and produce a velvety brown spike of flowers. Flower spikes have a gap of 1 to 4 inches between the male and female flowers. The leaves are less than 2.5 cm wide and originate at the base of the stem and spread outward. Below ground, starchy rhizomes anchor the plant to the soil.

Narrow-leaved cattail was likely introduced into North America along the east coast sometime in the 1820s (Stuckey and Salamon 1987). Since introduction it has spread throughout the continent. It commonly hybridizes with the native broad-leaved cattail (T. latifolia). The hybrid, *T. x glauca*, is a frequent wetland invader as well.

Flowering-rush is a rhizomatous, perennial herb reaching a height to 1.2 m. Leaves are triangular shaped reaching a length of 10 dm. Twenty to 50 pink flowers are in an umbel. Flowering period is June to August. It also produces asexually by bulbils at the base of flower stalks and rhizomes. This species invades open wetlands such as marshes, meadows, pond margins, and in shallow waters of streams. It displaces wetland herbaceous plants such as rushes, grasses, and sedges.

Flowering-rush, a native of Eurasia, was first documented in North America in 1905 from the St. Lawrence River in Quebec, Canada (Stuckey 1968). Since its introduction, it has spread throughout the Great Lakes. In Ohio, it is found primarily in the Lake Erie drainage, but recently been found in south central part of the state.

European water-milfoil and curly pondweed are aquatic invasives out-competing native pondweeds and other aquatics. Both have become serious pests of lakes, ponds, marshes, ditches, canals, and slow-flowing streams.

European water-milfoil is a submersed aquatic perennial with long stems that branch near the water's surface creating a canopy of floating foliage. The plants are rooted and the stems usually reach 1 to 3 m in length, however they can be as much as 9 m long. Eurasian water-milfoil forms dense mats of bright green, finely dissected, whorled leaves. Each leaf has 12 to 21 segments giving it a feathery appearance. Eurasian water-milfoil flower spikes emerge above the water in mid-summer then fall horizontally when in fruit. Eurasian water-milfoil is native to Europe, Asia, and northern Africa. It was accidentally introduced into the United States and was discovered in the 1940s.

Curly pondweed is a perennial with submerged, oblong-shaped leaves arranged alternately on the stem. Leaf margins are wavy and have minute teeth along their entire length. It can grow up to 2 m in length. Flower stalk rises above the water. The fruit is flat with a pointed beak.

Curly pondweed is native to Eurasia, Africa and Australia. It was introduced to North America in the mid-1800s (Stuckey 1979). Both curly pondweed and Eurasian water-milfoil occur throughout North America and are common in Lake Erie wetlands in Ohio and adjacent states.

B. Invasive Nature and Effects of Target Non-native Invasive Plants

The Lake Erie coastal marshes and inland marshes are among the most biologically significant within the Great Lakes. These wetlands function as critical modifiers of biotic and abiotic materials, and they have been shown to improve water quality, reduce floods, and protect shorelines.

Further, the Lake Erie drainage marshes have long been recognized for their significance in providing habitat for a wide variety of flora and fauna, and in particular for migratory birds. As an example, the coastal wetlands and inland marshes of Ohio alone support an estimated 500,000 itinerant waterfowl during fall migration, and is the premier stopover point in the Great Lakes for long-distance migratory shorebirds. The western Lake Erie marshes have also been recognized as a globally significant 'Important Bird Area' by the National Audubon Society because of the diversity and abundance of wading birds, waterfowl, neo-tropical migrants, and shorebirds it supports throughout the year.

These populations are likely a microcosm of what originally habituated the once extensive coastal and marsh systems. Before European settlement of the region, far-reaching marshes occurred along the entire coast of Lake Erie. The marshes, which extended from the Detroit River to Vermillion, Ohio, reached lakeward into water 1.5 m (5 feet) deep, and were 3 km (2 miles) wide in places (Albert 1995).

The western Lake Erie landscape has suffered much anthropogenic alteration over the last 200 years. Today, most of the region's marshes and wetlands have been drained or replaced by shoreline development or have been further degraded by altered hydrology and sediment deposition patterns. Only 5% of the original 121,000 ha (307,000 acres) of Lake Erie marshes and swamps in northwestern Ohio remains (Bookhout et al. 1989), and habitat loss continues, further reducing the amount of habitat available for diverse wetland plant and animal communities. Therefore, preservation and restoration of existing Lake Erie coastal marsh sites is imperative.

But progress toward restoring coastal marshes throughout the Great Lakes has been significantly undermined by the proliferation of non-native, invasive species. Over 180 non-native species – many of which out-compete natives, short-circuit food webs, and ultimately degrade habitats – presently exist in the Great Lakes. And, even though early detection and prevention is the most cost-effective approach to reduce their effects, some invasive species have become so prolific and damaging that widespread treatment is needed to enhance Great Lakes' ecosystem health.

For western Lake Erie coastal marshes and inland marshes, one of the most ruinous threats is recruitment and propagation of non-native, invasive plants. The wetland and aquatic invasive plants included for control in this project have become pervasive throughout the Great Lakes and, especially, in the remaining coastal Lake Erie wetlands. Invasive plants alter the biotic and abiotic environment of wetlands, by excluding native species, reducing plant diversity, and modifying abiotic coastal processes. Consequently, near-monotypic stands of these invasive plants have replaced high-quality, complex communities over thousands of acres in Lake Erie wetlands and coastal areas.

The rapid expansion of non-native invasive plants has resulted in adverse ecological, economic, and social impacts on the natural resources and people of the Great Lakes. Overall, invasive plants have degraded the vitality of western Lake Erie marshes, which are some of the most productive and biologically diverse systems in the Midwest. Because invasive plants replace native vegetation such as native sedges, rushes, pondweeds and cattails, overall species richness and diversity decline. Migratory bird assemblages and native, resident animal species are negatively impacted by the invasion of non-native plant species.

By out-competing native wetland plants, non-native invasive plants disrupt food webs for wetland wildlife. For example, Phragmites proliferates in shallow and moist soil wetlands, foraging substrate for dabbling ducks and long-distance migrant shorebirds, like American golden-plover, dunlin, and shortbilled dowitcher, are lost. The destruction of habitat and diversity are additionally compounded and multiplied by the fact that Phragmites stands alter the water regime in marsh systems, which causes 'drying' of marsh soils through increased evaporation and trapping of sediments.

III. PREFERRED ALTERNATIVES

Given these non-native invasive species' profound impact on western Lake Erie and inland marshes, The Division of Wildlife proposes a regional approach to control and management of these invasive species. This effort will build from an existing program in which thousands of acres of wetland were treated through herbicide application (mostly aerially) on private property in Ottawa, Erie, and Sandusky Counties

The area encompassed with this project, means that approximately 33,000 acres in Lake Erie drainage wetlands could be treated in 2011 (see maps in Appendix A).

Research and literature shows that herbicide treatment is the recommended primary control method and the first step toward effective invasive plant management (Marks et al. 1994). Several of these invasive plants spread primarily by rhizomes, thus digging, tilling, and pulling the plants can expedite its spread. Landscape fabric has been used by some to smother patches of rhizomatous invasive plants however, such plots are then not able to support the growth of other plants.

Hence, the primary control method for the proposed wetland and aquatic invasive plants will be systemic herbicide application (glyphosate and imazapyr) using aircraft and amphibious equipment, with follow-up applications conducted via ATV and/or backpack application (e.g., Cowie et al. 1992; Ailstock et al. 2001; Rickey & Anderson 2004).

No technique used alone can fully control invasive plants and reinvasion is likely to occur if management is not maintained. For greatest efficacy, control should begin in the first season in which the invasive species is found, but, where the plant already exists in large well-established stands, multiple treatments using a combination of methods are required (see review in Marks et al. 1994). These may include such techniques as prescribed fire, mechanical treatment (e.g., mowing and raking), and water level manipulations. Follow-up methods will not only help provide multiple stresses on the plants, but will also prepare the site for subsequent years' herbicide treatments. This project will incorporate such follow-up regimes, making implementation a three-tiered approach:

1. Initial herbicide application (summer/fall of 2011)
2. Follow-up mechanical treatment (late winter/early spring 2012)
3. Spot-treatment of sites where invasive re-growth occurs (summer/fall 2012).

Two broad-spectrum herbicides, glyphosate and imazapyr (which are commercially available as Rodeo® and Habitat®, among others, respectively), are known to control the wetland invasive species. Both herbicides can be used individually or together and are approved by the USEPA for wetland use. Although the cost per gallon of imazapyr can be significantly higher than glyphosate, results from recent studies suggest that imazapyr used alone or in combination with glyphosate has a higher control rate and can prevent regrowth for a longer period of time (Mozdzer et al 2008). Further, imazapyr has a broader application time (i.e., summer up to the first killing frost). For these reasons, imazapyr has been selected as the primary herbicide, either alone or in conjunction (50/50 mix) with glyphosate, for initial treatments, with glyphosate employed for most follow-up and spot applications.

IV. ALTERNATIVES TO THE PROPOSED ACTION

Research and literature shows that herbicide treatment is the recommended primary control method and the first step toward effective management of invasive plants. Alternatives for the control of invasive plants include:

A. Biological Control

Biological control is rarely a practical option for controlling invasive plants because those organisms known to feed on the plants (moth larvae, aphids, leaf miners, gall midges, rodents, and birds) cause only incidental damage, with a few rare exceptions. Biological control has been very effective in the control of purple loosestrife in Ohio, but it is the only species with that alternative control option.

Regarding control with microorganisms and invertebrates, Cornell University researchers have tested over 150 different fungi, pathogens, and insects and have found only four wasp species that might control *Phragmites* (see on-line review at phragmites.org). Testing of their effectiveness is still ongoing, so practical implementation of *Phragmites* via invertebrate bio-control is not feasible currently.

Some breeding waterbirds and wetland mammals do use *Phragmites* as a food supply, although this grazing is neither reliable nor pervasive enough for adequate control. American coots, for instance, consume young shoots in the immediate area of their nests. Considerable damage to *Phragmites* shoots occurs locally by such species as muskrats and nutria, but like coot grazing, this is not an activity under the manager's control.

Controlled grazing has little effect on shoot density, but rhizomes that are repeatedly trampled will bear few shoots and recover slowly when grazing has ceased. If Phragmites stands are grazed for two years or more, vigor is reduced considerably. Because the amount of grazing required to reduce these stands would be detrimental to desirable plant species as well, grazing is not a recommended control measure on wildlife management areas.

Biological control is not a reasonable or available option for the control of the proposed invasive plant species in Ohio, with the exception of purple loosestrife. The Ohio Division of Wildlife has been using specific beetle species for the biological control of purple loosestrife in the Lake Erie marshes since 1994 and it has been very effective in recent years.

B. <u>Mechanical Harvesting</u>

Physical removal and mechanical control of the proposed invasive plants may include tilling, discing, and mowing. Such cutting and/or harvesting can be quite beneficial, particularly where stand vegetation is dense and composed of a limited number of species, and immediate results are needed. However, these control methods can be very expensive, and, at least when harvesting, a need for a disposal site can be prohibitive, too. Since some of these invasive plants reproduce primarily via rhizomes, most of these methods will actually help spread the plant in treatment areas, so it should not be considered as primary control resource.

Although difficult, mechanical treatments are possible on sites that are flooded or consistently moist. A rotary ditch digger can be used in flooded areas to chop through rhizome-packed substrates and till over existing plants. On drier sites, bulldozers, brush-cutters, discs, roto-tillers, mowers, crushers, and plows can be practical. Unfortunately, most of these methods also tend to break up and spread rhizome fragments across a site, thereby helping propagate the plant in the future. Dredging may be effective in some situations, but potential effects on wetlands and aesthetic considerations will limit its use. Even though it has been eliminated as a primary treatment method, mechanical manipulation is considered a helpful resource before conducting herbicide application, since mowing, brush-cutting, tilling, etc., can create openings in dense stands, thereby increasing the efficacy of herbicide (see Mal & Narine 2004, among others).

C. <u>Hydrologic Manipulation</u>

Water-level manipulation, where it can be used, can be a useful tool for controlling Phragmites, narrow-leaved cattail, and reed canary grass. Flooding will not alter established stands, but if water levels greater than 12 inches (30 cm) are maintained, colonies will not expand. At these depths, runners are unable to anchor and will float to the surface. Seedlings are easily killed by raising water levels, but timing of water-level manipulations must be carefully determined to be effective and to avoid conflicts with other management objectives.

D. <u>No Action</u>

No action to control target non-native invasive plants will cause further degradation of coastal and inland wetland habitats and the native species that inhabit them. Due to lack of treatment over the last decades, near-monotypic stands of these invasive plants have replaced high-quality, complex communities over thousands of acres in Lake Erie wetlands and coastal areas. This rapid expansion of monotypical non-native plant communities has resulted in adverse ecological, economic, and social impacts on the natural resources and people of the Great Lakes. Overall, these species have degraded the vitality of western Lake Erie marshes, which are some of the most productive and biologically diverse systems in the Midwest. Because these species replace native vegetation, such as native sedges, rushes, and cattails, they lower the overall plant species richness and diversity. The loss of native plant diversity further results in the decline of wildlife habitat, including that needed to support migratory bird assemblages and native, resident animal species.

Alternatives	Actions	Environmental Consequences
Biological control	Use insects or other organisms to control non-native plants; if available, the insects can be introduced to invasive plant populations.	This method can be very effective if available. Biocontrol is only available for purple loosestrife at this time, so it is not a feasible control option for the rest of the invasive plants addressed in this project.
Mechanical harvesting	Actions include mowing, cutting, tilling, and discing. These techniques set back invasive plant populations.	Mechanical methods set back invasive plant growth, but rarely do they eliminate the plants. They can be used in conjunction with other methods, but alone are not very effective in the long-term.
Hydrologic manipulation	Control of water levels in wetlands with the ability to flood or draw down units.	Water level control at appropriate times of the year can be effective in controlling Phragmites, reed canary grass, and cattail. It will also affect other vegetation and cannot be used effectively alone for long-term invasive plant control.
No action	No actions are taken to control invasive plant populations in these wetlands.	If no action is taken to control invasive plants in these wetland sites, the invasive aquatic and wetland plants will continue to increase their extent, displacing native wetland plants and animals, and reducing species and habitat diversity.

V. FEDERALLY-LISTED THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE SPECIES

The following listed species are located in the counties of the project area:

- Bald eagle, *Haliaeetus leucocephalus*
- Indiana bat, *Myotis sodalis*
- Eastern prairie fringed orchid, *Platanthera leucophaea*
- Eastern massasauga, *Sisturus catenatus*
- Kirtland's warbler, *Dendroica kirtlandii*
- Lake Erie watersnake, *Nerodia sipedon insularum*
- Lakeside daisy, *Hymenoxys herbacea*
- Piping plover, *Charadrius melodus*
- Rayed bean, *Villosa fabalis*

Bald eagle

While there have been nesting bald eagles in the area proposed for herbicide application, most herbicide application will be conducted after fledging. Any specific management activities near nest sites will be delayed until after the young have fledged. We do not anticipate that these actions will have any effect on the bald eagle.

Indiana bat
No potential roost trees will be disturbed by these actions and no impacts to the Indiana bat are anticipated. Although surveys have not been conducted for Indiana bat at these sites, there are no records documented within the vicinity of the proposed actions. The proposed actions to control invasive plants will not impact trees or woodlands as all the control efforts will be conducted in herbaceous wetlands. This project should have no effect on the Indiana bat.

Eastern prairie fringed orchid
This orchid is not known to occur in the area. Control of invasive plants in the orchid habitat is being conducted to specifically improve the habitat as the orchids are threatened by Phragmites, purple loosestrife, and reed canary grass at these sites. Herbicide application will be carefully timed to avoid impacting the orchids, yet conducted when it will have the greatest impact on invasive plants. There has been success in applying herbicides selectively to control invasive plants, while having an insignificant impact on the prairie fringed orchid population. Application is typically done late in the summer or early fall when the orchid plants are senescing and beginning to die back for the season. This action may affect, but is not likely to adversely affect the Eastern prairie fringed orchid and is expected to produce a beneficial impact on the habitat and for the species.

Eastern massasauga
The massasauga may occur in the action area. All spraying of invasive plants will be done by a Certified Contractor using ground spraying equipment including backpack sprayers and ATV-mounted sprayers. Although there is the potential for snakes to be run over during ATV-spraying activities, every precaution will be employed to minimize potential interactions with massasaugas. This action is not likely to adversely affect the Eastern massasauga. The actions are intended to improve wetland habitat by controlling invasive plants, such as Phragmites, reed canary grass, and purple loosestrife.

Other Species
The proposed actions also lie within the range (based on county range) of the Kirtland's warbler, Lake Erie watersnake, Lakeside daisy, piping plover, and rayed bean mussel. However, due to the project type and specific location, the project as proposed, will have no effect on these species. These species, as far as we know, do not occur within the sites that will be affected by these actions. Habitat in the project area is not suitable for these species; should the project be modified or new information becomes available that indicates these listed species may be affected, consultation will be initiated or the proposed action will be modified.

VI. ENVIRONMENTAL IMPACTS

Material data safety sheets for each of the two brand names are included within the appendices; however, the following are syntheses (from TNC's Weed Control Methods Handbook, Tu et al. 2001), which briefly describe environmental toxicity of the active glyphosate and imazapyr application, the active herbicides within the brand manes Rodeo® and Habitat®, respectively. In short, both chemicals are of low toxicity to animal communities, although care must be taken if a surfactant is used in conjunction with Rodeo.

A. Glyphosate

Glyphosate is of relatively low toxicity to birds and mammals (Evans & Batty 1986). The LD50 of glyphosate for rats is 5,600 mg/kg and for bobwhite quail, >4,640 mg/kg. EPA's Reregistration Eligibility Decision states that blood and pancreatic effects and weight gain were noted during subchronic feeding studies with rats and mice (EPA 1993). Other studies show developmental and reproductive impacts to animals given the highest dose.

Newton et al. (1984) examined glyphosate residues in the viscera of herbivores following helicopter application of glyphosate to a forest in Oregon and found residue levels comparable to those found in litter and ground cover (<1.7 mg/kg). These residue levels declined over time and were undetectable after day 55 (Newton et al. 1984). Although carnivores and omnivores exhibited much higher viscera residue levels (5.08 mg/kg maximum), Newton et al. (1984) concluded that carnivores were at lower risk than herbivores due to the lower relative visceral weights and a proportionally lower level of food intake.

Batt et al. (1980) found no effect on chicken egg hatchability or time to hatch when an egg was submerged in a solution of 5% glyphosate. Sullivan and Sullivan (1979) found that black-tailed deer showed no aversion to treated foliage and consumption of contaminated forage did not reduce total food intake. Significant impacts to bird and mammal populations due to large-scale habitat alterations following treatment of forest clearcuts with glyphosate have been reported (Morrison & Meslow 1984; Santillo et al. 1989a, b; MacKinnon & Freedman 1993).

Glyphosate itself is of moderate toxicity to fish. The 96-hour LC50 of technical grade glyphosate for bluegill sunfish and rainbow trout are 120 mg/L and 86 mg/L, respectively. Fish exposed to 5 mg/L of glyphosate for two weeks were found to have gill damage and liver damage was observed at glyphosate concentrations of 10 mg/L (Neskovic et al. 1996). The technical grade of glyphosate is of moderate toxicity to aquatic species, and the toxicity of different glyphosate formulations can vary considerably. For example, Touchdown 4-LC® and Bronco® have low LC50s for aquatic species (<13 mg/L), and are not registered for aquatic use. On the other hand, Rodeo® has relatively high LC50s (>900 mg/L) for aquatic species and is permitted for use in aquatic systems. The surfactant in Roundup® formulations is toxic to fish; however, Rodeo has no surfactant, and is registered for aquatic use.

The surfactant X-77 Spreader®, which is often used in conjunction with Rodeo®, is approximately 100 times more toxic to aquatic invertebrates than Rodeo® alone (Henry et al. 1994). The surfactant MONO818 is included in Roundup® formulations because it aids the break-down of surface tension on leaf surfaces, but it may also interfere with cutaneous respiration in frogs and gill respiration in tadpoles (Tyler 1997 a,b). In addition, MONO818 is highly toxic to fish (Folmar et al. 1979; Servizi et al. 1987). The LC50 of MONO818 is 2-3 mg/L for sockeye, rainbow, and coho fry (Folmar et al. 1979; Servizi et al. 1987; Tyler 1997 a,b). The LC50 of Roundup® for bluegill sunfish and rainbow trout is only slightly higher at 6-14 mg/L and 8-26 mg/L, respectively. Similarly for Daphnia, the 96-hour LC50 of glyphosate alone is 962 mg/L, but the LC50 of Roundup® drops to 25.5 mg/L (Servizi et al. 1987). Roundup® is therefore not registered for use in aquatic systems.

Despite these toxicity levels, Hildebrand et al. (1980) found that Roundup® treatments at concentrations up to 220 kg/ha did not significantly affect the survival of Daphnia magna or its food base of diatoms under laboratory conditions. In addition, Simenstad et al. (1996) found no significant differences between benthic communities of algae and invertebrates on untreated mudflats and mudflats treated with Rodeo® and X-77 Spreader®. It appears that under most conditions, rapid dissipation from aquatic environments of even the most toxic glyphosate formulations prevents build-up of herbicide concentrations that would be lethal to most aquatic species.

B. Imazapyr

Imazapyr is of relatively low toxicity to birds and mammals. The LD50 for rats is > 5,000 mg/kg, and for bobwhite quail and mallard ducks is >2,150 mg/kg (WSSA 1994). American Cyanamid reports that studies with rats indicate that imazapyr was excreted rapidly in the urine and feces with no residues accumulating in the liver, kidney, muscle, fat, or blood (Miller et al. 1991). Imazapyr has not been found to cause mutations or birth defects in animals, and is classified by the U.S. EPA as a Group E compound, indicating that imazapyr shows no evidence of carcinogenicity.

Imazapyr is of low toxicity to fish and invertebrates. The LC50s for rainbow trout, bluegill sunfish, channel catfish, and the water flea (Daphnia magna) are all >100 mg/L (WSSA 1994). As of September 2003, imazapyr (tradename Habitat®) is registered for use in aquatic areas, including brackish and coastal waters, to control emerged, floating, and riparian/wetland species. A recent study from a tidal estuary in Washington showed that imazapyr, even when supplied at concentrations up to 1600 mg/L, did not affect the osmoregulatory capacity of Chinook salmon smolts (Patten 2003). Similarly, the Washington State Department of Agriculture reported that the 96-hour LC50 for rainbow trout fry to be 77,716 mg/L (ppm) -22,305 ppm of the active ingredient- which represents a greater concentration of imazapyr than found in commercially-sold containers (J. Vollmer, pers. comm.).

The environmental impacts of not conducting the proposed invasive plant control project in the proposed wetland sites in the Lake Erie watershed of Ohio are far greater than the methods proposed for control. This project will likely control a number of highly invasive wetland and aquatic plants in both public and private wetlands in northern Ohio. No other project recently implemented by the Division of Wildlife can have such far-reaching and instrumental impacts on improving the quality of wetland habitats. This is truly an impressive opportunity using short-term GLRI grant funds to accomplish wetland restoration on at 33,000 acres in northern Ohio.

VI. REFERENCES

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