Restoration & Management Notes

Volume 13 Number 2 Winter 1995

Published for the University of Wisconsin–Madison Arboretum

PROJECT REPORT

Cootes Paradise Marsh

Community Participation in the Restoration of a Great Lakes Coastal Wetland

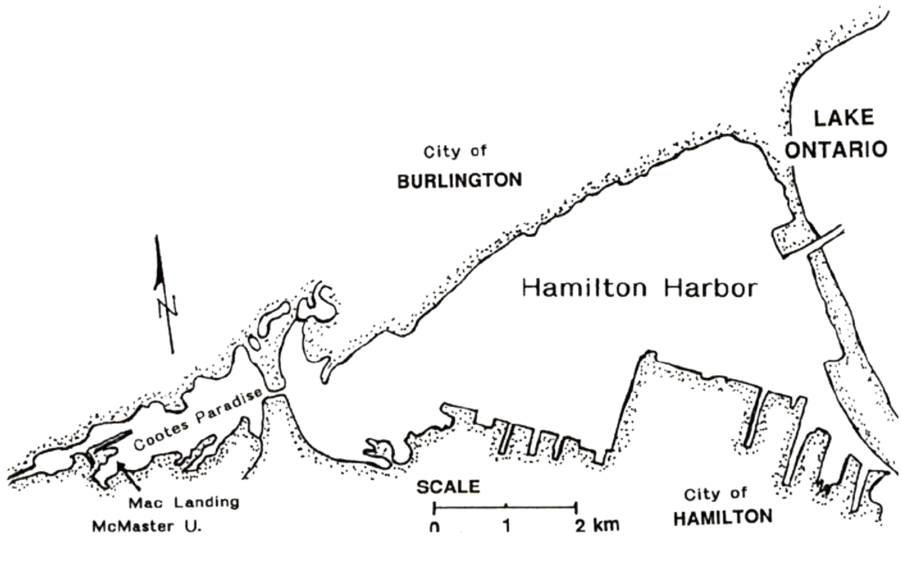
by Patricia Chow-Fraser and Lynda Lukasik

Volunteers, including some as young as six years old, are playing a key role in this marsh restoration project in Ontario.

Cootes Paradise Marsh is a 250-hectare marsh located in the city of Hamilton, Ontario, and situated at the extreme western end of L. Ontario. The surrounding watershed currently supports a population of over 500,000 and includes portions of the cities of Burlington and Hamilton in Ontario, Canada. The marsh once supported a diverse plant community including cattail (*Typha latifolia*), burreed (*Sparganium eurycarpum*) and wild rice (*Zizania aquatica*) as well as many species of floating and submersed aquatic plants, which provided excellent spawning and nursery habitat for both warmwater and coldwater fish and supported large populations of waterfowl and a variety of small mammals. Since the early 1930s, however, the health of the marsh has declined rapidly. Between 1934 and 1985, the cover of emergent vegetation decreased by 85 percent. Currently, vegetation has declined to only 10 percent cover and consists mainly of cattails and manna grass (*Glyceria maxima*), residual populations of a dozen other emergents, water lilies (*Nymphaea* spp.), and virtually no submersed species; the remaining area is essentially open water. A variety of factors seem to be responsible for the demise of Cootes Paradise, including:

- High water levels in the Great Lakes: The water level of Cootes is dependent on the water level of Lake Ontario; for the past three decades, mean water levels in the lake have been kept artificially high for navigation purposes and, as a result, water levels in the marsh have been similarly high. In addition, the lake itself is tilting, the eastern end rising while the western end—our end—subsides, a geological process referred to as "crustal rebound" that is a response to the retreat of glaciers from the area 10,000 years ago. The net effect has been that the mean water level in Cootes has increased by about 18 cm (7 in) over the past century, resulting in water levels that are too high to suport emergent aquatic vegetation in the marsh.
- Excessive nutrients: Cootes Paradise receives phosphorus and nitrogen from the Dundas Sewage Treatment Plant, three main creeks and two overflow outlets where excess stormwater is combined with sewage (referred to as combined sewer-overflows).
- High turbidity: Large inputs of particulates entering the marsh through the creeks and combined sewer-overflows are kept in suspension by wind and wave action and by a large population of common carp (*Cyprinus carpio*), which are not native to the Americas, and which churn up bottom sediments as they spawn and forage for food in shallow areas. High turbidity reduces light penetration and limits the growth of both submersed vegetation and the seedlings of emergent plants.

Although the marsh has been severely degraded over the past 60 years, Cootes Paradise is still recognized as an important Great Lakes coastal wetland (Fish and Wildlife Restoration Committee, 1992).



The Municipality of Hamilton-Wentworth recognizes the marsh and surrounding sanctuary (840 ha [2,075 acres] in total) as an "Environmentally Sensitive Area," and Ontario's Ministry of Natural Resources has classified Cootes Paradise as a Class I Provincially Significant Wetland (its highest rating), as well as an "Area of Natural and Scientific Interest." Also, Cootes Paradise is within an area recognized by the Canadian Wildlife Service as the second most important staging area for waterfowl on the Lake Ontario shoreline.

The decision to restore Cootes Paradise evolved out of the Hamilton Harbour Remedial Action Plan (HHRAP). Development of the HHRAP began in 1985, when 48 stakeholders representing McMaster University, environmental groups, industry, municipal, provincial and federal agencies, user groups and interested citizens met to develop a plan to restore the water quality and "beneficial uses" (the term adopted by the International Joint Commission of the Great Lakes) of the Hamilton-Harbour ecosystem. In 1991, after a series of professional workshops, the RAP team identified the restoration of degraded fish and wildlife habitat as a priority, and initiated the "Fish and Wildlife Habitat Restoration Project" (FWHRP). This group also created the FWHRP steering committee, which included environmental consultants, local officials from all three tiers of government, biologists from McMaster University (including the senior author), and scientists and managers from the Royal Botanical Gardens (RBG), the owner and manager of Cootes Paradise. A key component of the FWHRP is a plan to revegetate Cootes Paradise with a diverse community of aquatic plants that would tolerate current water-levels in the marsh, and that would eventually serve as nursery habitat for pike and bass. Since submersed vegetation will not recolonize in highly turbid water, the first step in the restoration plan was to re-establish emergent plants that would decrease water turbidity by reducing wave action and by trapping some of the suspended sediments.

From 1991 to 1993, the Steering Committee authorized a series of experiments to determine the effectiveness of different planting techniques. One method was to build cages (or "in-marsh exclosures") around planting plots to prevent carp and other wildlife from uprooting the newly planted vegetation. We tested a variety of designs and materials for these cages during the first two years and, by 1993, had settled on a 8-ft-square design that consisted of four panels of plastic snowfence on a frame of metal T-bar. Materials for one panel included: four 8-ft T-bars, 8.25 foot lengths of plastic snowfence (at least 5-ft wide), 16 plastic cable ties, and enough heavy metal wire to connect the T-bars together. To construct the panel, three bars were laid on a flat surface (a boardwalk is ideal) to make an "H", with the cross bar located approximately 5 feet from the top. Pre-drilled holes in the cross bar were lined up with those on the side bars, and the wire was threaded through these holes, and its ends were twisted tightly with pliers to make the perpendicular joints. The remaining bar was secured to the top of the "H" in the same fashion. We did not use bolts and nuts to construct the frame because wire was more convenient and less expensive to use. We laid the snowfence on the frame, leaving some extra material over each side, and secured the fence to each T-bar with four equally-spaced cable ties. We ferried completed panels to the planting site by canoe or boat, and inserted the free ends of the panel at least three feet into the sediment to create a cage about four-and-a-half feet high. We used cable ties to fasten the panels together at the corners of the cage. It took a team of four to five people an average of two to three hours to assemble all the panels and to install three sides of a cage in the marsh, the last panel being reserved until the planting was completed.

As members of the Steering Committee, we realized that this approach is labor-intensive and that it would be extremely expensive if contractors were paid to install the cages and do the planting. However, volunteers would greatly reduce the cost of running such a program and the senior author had already done some work with volunteers in July 1992. Pat Cameron, an enterprising teacher from St. Pat's Elementary School in Hamilton, had volunteered ten of her most enthusiastic students (grades six to eight) to work for three weeks at McMaster, planting and maintaining cattails in the greenhouse then transplanting these into a part of the marsh, where they used a primitive barrier of wooden stakes and chicken wire to exclude carp. Encouraged by this positive experience, the Steering Committee recognized that getting volunteers involved in the construction and installation of the exclosures would be an excellent way to get local citizens involved in the project and to garner the support of residents that is so crucial for such a large-scale community project. At one of the final planning meetings in the spring of 1993, the Steering Committee approved funds to hire the junior author to be the coordinator of the Volunteer-Planting Program.

Plant Stock

Emergent species we worked with in this program included cattail (*Typha latifolia*) and arrowhead (*Sagittaria latifolia*). Most of these were introduced as plants grown from root stock purchased from a nursery in Wisconsin. Some arrowhead were grown in the McMaster greenhouse from seeds collected from a wetland near Ottawa, Ontario. We also used some submersed species, including waterweed (*Elodea canadensis*), and a mixture of pondweeds (*Potamogeton natans* and *P. pectinatus*) that had been collected at a nearby marsh in the Cootes Paradise watershed.

Volunteer Planting Program

During the summer of 1993 we launched a volunteer-based marsh-planting program on a pilot scale. While this project itself involved a very small area of the marsh, and would be only a small step in the actual restoration, we began this way in order to determine the level of community interest in participating in marsh restoration activities and gain some experience running a volunteer program. In the process, we also hoped to learn something about carrying out experiments in the context of a volunteer-oriented program, and to foster a sense of stewardship that would encourage further involvement and a commitment to long-term maintenance of the marsh.

We began by determining the level of community interest in the planting program. Though we were aware that volunteer-based monitoring and habitat-enhancement programs had been carried out successfully in many parts of North America (see for example Kerr *et al.*, 1994; Gresham & Burbridge, 1994; Packard, 1994), no one had ever conducted such a program in our area, and we had no idea how successful it would be. We began recruiting by preparing a pamphlet describing the marsh and outlining the proposed volunteer program and distributing it on

Six-year-old Jason Walton of Hamilton, Ontario, the youngest of the Cootes Paradise volunteers, dons on waders for a planting session.

search questions, which we then compared with a list of our own research priorities that we had prepared earlier. Knowing that we had only enough material to construct 21 exclosures and enough time to hold seven planting sessions before the end of summer, we came up with a set of treatments designed to determine the effects of water depth and the use of polypropylene silt screen (Terrafix 24-15) on the re-establishment of waterweed and the two emergent species. We also wanted to compare the performance of locally-collected and Wisconsin-grown arrowheads and to conduct some trial plantings of the mix of pondweed species. We incorporated these trials into the experimental design as follows:

1. Effect of water depth on plant establishment.

   We planted mixed-community exclosures, in triplicate, at water depths of 20 cm (7.9 in), 30 cm (11.8 in), and 40 cm (15.8 in) for a total of nine exclosures. Each exclosure was planted with 30 each of waterweed, cattail, and arrowhead.
2. Stock comparison.

   We planted four exclosures on exposed mudflats—two with arrowhead grown from seed collected near Ottawa, and the other two with stock from Wisconsin. We planted these within exclosures to minimize grazing by muskrats and other small mammals and to protect the plants from carp during the spring, when water levels in the marsh would be much higher.
3. Silt screen.

   We planted four mixed-community exclosures containing 30 plants each of waterweed, arrowhead, and cattail, all at the same depth, with two of the four surrounded by silt screen to reduce turbidity, and the other two left unprotected.
4. Submersed plants.

   We used three of the remaining four exclosures for some trial planting of the pondweed mixture (one was on a mudflat and was therefore unsuitable for planting submersed plants). Since most of these plants did not have roots, we tied them to nuts and bolts to keep them anchored in the substrate until they took root.

Volunteers at Work

Volunteers carried out a total of seven planting sessions during the month of August, 1993. A typical planting day began with an orientation session during which we provided an outline of the day's events and emphasized the importance of safety at the planting site. Between 12 and 18 volunteers showed up for most sessions, and we divided these into three working teams of four to six members. Each team, under the direction of a crew leader, was responsible for constructing, installing, and planting one exclosure. We provided all of the equipment, including chestwaders (donated by local businesses) and tools for constructing the exclosure panels. Since Cootes Paradise Marsh is located behind McMaster University, a 10-minute hike took us right down to the planting site, which was located in an inlet known as Mac Landing. Each team spent the morning constructing and installing an in-marsh exclosure. This gave the volunteers a chance to get used to maneuvering around the marsh in chestwaders—a necessary exercise, since most of our participants had never enjoyed this experience before. The afternoon session was devoted entirely to planting. We began in the university greenhouse, where we demonstrated planting techniques and collected the aquatic plants needed for the afternoon planting session. We then returned to the marsh and carried out the planting. While planting was in progress, crew leaders taught volunteers several simple water-quality monitoring techniques, and explained the relationship between good water quality and plant re-establishment. Most volunteers learned how to measure water clarity with a Secchi disc and turbidimeter, and all were invited to participate in more detailed water-chemistry analyses at our laboratory after the planting session.

Results

We completed post-planting monitoring of our exclosures in mid-September 1993, two weeks following completion of the last planting session. Much to our dismay, we discovered that muskrats had chewed their way into eight of our nine "depth" treatments and eaten virtually all of the plants inside. Nevertheless, we hoped that at least some of the roots would survive the onslaught, and in fact when we inspected our exclosures in July, 1994, we found that an average of 10 percent of the cattails and 24 percent of the arrowheads planted in 20 cm (7.8 in) of water had become established. By contrast, none of the emergents planted at depths greater than 30 cm (11.8 in) survived. There was, however, some evidence that the silt screen had ameliorated some of the negative effects of deep water. In one pair of exclosures, none of the arrowheads in the unscreened exclosure survived, whereas all of those in the exclosure surrounded by silt screen survived despite a water depth of greater than 40 cm (15.8 in). In fact, all of the plants that were planted grew vegetative shoots from runners, so that by the end of August, 1994 we counted more than 100 plants in exclosures where we had planted only 30! Another good sign was that many of these plants had also set seed. We got similar results in another set of screened exclosures situated in shallower water (15 cm); the survival rate of cattails planted in the screened exclosure was more than double that of cattails planted in the unscreened exclosure. Arrowheads from Wisconsin and Ottawa survived equally well in exclosures on a mudflat. We counted more than 100 large plants in each exclosure at the end of August, 1994. Unfortunately, none of the waterweed or pondweed that were planted survived, probably because the water was too shallow to support their growth.

1994 Program

Encouraged by the positive response to the 1993 program, the senior author carried out another volunteer-based planting program in 1994 with the assistance of Tricia Frayn as a field supervisor. This time, exclosure panels were constructed with weld-wire fence instead of plastic snowfence to keep muskrats out. We also included an additional six species of emergent plants: softstem bulrush (*Scirpus validus*), swampdock (*Rumex verticillatus*), buttonbush (*Cephalanthus occidentalis*), sweetflag (*Acorus calamus*), swamp loosestrife (*Decodon verticillatus*) and water arum (*Calla palustris*). The last modification we made was to use plants grown from seed collected from Cootes Paradise because Levine and Wil-

Hand-planting of stock—here arrowhead—in exclosures evokes experience of paddy-style agriculture.

lard (1990) had documented the advantage of using local stock in restoration projects in other areas. In February of 1994, we recruited teachers and students from 76 local primary and secondary schools to grow plants for the experimental planting in a program known as the Classroom Aquatic Plant Nursery (CAPN) program. We gave teachers kits that included instructions and illustrations, a supply of potting soil, potting trays and a pan, and seeds from all eight emergent species that had been collected from Cootes in the fall of 1993 and held in water in the cold and dark to simulate dormancy conditions. In February, we distributed more than 200 kits to schools within a 20-mile radius of Hamilton. By June, students had brought more than 5,500 seedlings to the McMaster greenhouse for use in the 1994 planting program. Although students from junior kindergarten through upper-level high school were involved, we found the most enthusiastic and responsive group to be students between grades three and eight.

Future Research

Even though we found that arrowheads from Wisconsin and Ottawa survived equally well, we do not know whether Cootes' stock would grow better since we have not yet carried out a direct comparison of all three stocks. We will know conclusively by the end of summer, 1995 whether arrowheads and cattails grown from seeds of locally collected stock grow better or survive at higher rates than those collected from Wisconsin and Ottawa. This summer, we will collect more submersed vegetation and will experiment with new ways of propagating and rooting plants for planting in screen exclosures in deeper water. We will continue to monitor the progress of the plants and, as they become established, we will remove the exclosure panels and use them again for plantings at other sites. We also plan to connect adjacent exclosures to create larger and larger "islands". We hope that in five years all of Mac Landing will be revegetated with a mixed community of emergent and submersed aquatic plants.

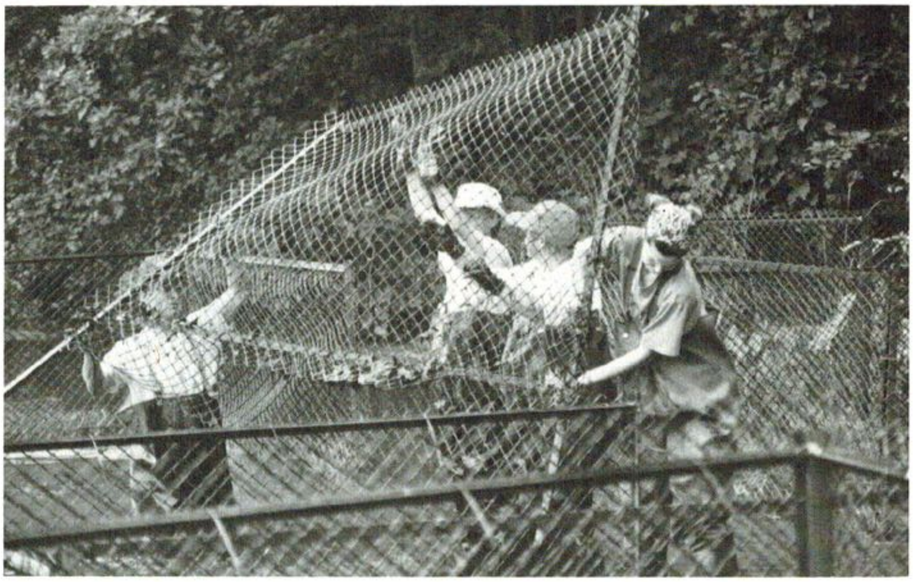
Community Stewardship

Our volunteer planting program had three goals. The first two were simply to replant an area of the marsh and to learn more about marsh restoration. The third was to promote community commitment to the stewardship of Cootes Paradise Marsh. At the outset of this program, we wondered how the community would respond. We also wondered how to promote stewardship, and how to motivate citizens to become stewards of their local environment. Looking back, we realize that a strong sense of environmental stewardship already existed among our volunteers before they became involved in marsh restoration. The problem was that there were no opportunities for positive action. We asked many of our volunteers why they chose to participate in our program, and their answers were all very similar:

> "I like to feel that I am contributing."
>
> "I like to help the environment."
>
> "Too often we have changed our environment in a negative way. I was hoping to take the opportunity to change things in a positive way."
>
> "This is such an exciting project. I wanted to get involved right away to help reconstruct the marsh. I love marshes!"

Responses such as these confirmed our belief that many people want and even need the chance to participate in local environmental restoration activities. This seems to be especially true of young children. Frequently, however, students from the primary schools are ignored, perhaps because restorationists assume that these youngsters lack the basic skills and abilities to participate in field work. Nevertheless, children between ages five and 12 make excellent volunteers because they tend to make up with enthusiasm for what they lack in skills. Our CAPN program procampus and in the shops and public places in neighborhoods near the marsh. We also distributed pamphlets at a local nature walkathon and an environmental festival. The pamphlet emphasized that we needed citizen help and that community members could bring about a real improvement in the local landscape by participating in the restoration activities. In addition to providing general information, the pamphlet included an invitation to an organizational meeting and a mail-in coupon for those unable to attend.

The meeting was held early in July, 1993, and we were pleasantly surprised when more than a hundred people showed up. Over three-quarters of these became volunteers. The ages of the volunteers ranged from six to over 60; most were between 16 and 40. Over half of the volunteers in this first year were younger than 25, mostly university and high school students who wanted some experience in environmental restoration. Most were from the nearby towns of Dundas and Ancaster and the cities of Burlington, Hamilton and Stoney Creek, but some came from towns more than 20 miles away. Only a handful had heard about the project through the media, even though we had advertised through public service notices on our local radio stations and community cable TV station. At the organizational meeting, we provided overviews of the RAP and an update of the FWHRP plan. We also provided a detailed description of the volunteer planting-program and showed a video of people working in the marsh. It was not until they understood conditions and hazards (including such things as falling into the water or getting stuck in the mud) that we invited citizens to enlist as volunteers. Applicants then filled out a personal information form and signed a waiver before participating in planting sessions. They also received an information package with more details about the restoration program, including illustrations and descriptions of the aquatic plants being used in the program, and brief instructions for building the in-marsh exclosures.



Eight-foot by eight-foot exclosures are built of four panels of weld-wire or plastic snowfence mounted with cable ties on T-bar frames. Volunteers construct the single panels on a board walk, and then carry them out into the marsh where the exclosures are assembled.

Experimental Design

Once we had set the volunteer recruiting process in motion, we turned our attention to developing an experimental design for the project. Although RBG staff had experimented with various techniques for propagation and planting during the 1993 season, we knew we had a lot more to learn, and decided to include further experimentation as part of the volunteer planting-program. During the community meeting, a dozen or so of the volunteers had expressed an interest in helping with the experimental design because they had research experience either through school or work, and we anticipated that these participants would be more enthusiastic about the planting program if they were involved in designing the experiments. Therefore, we invited them to join us along with the field crew of 10 high school and undergraduate summer assistants who were to serve as team leaders during the planting sessions. During this informal meeting, participants contributed to a list of revided an excellent opportunity for these junior environmentalists to become involved, while our planting program allowed some of the older children to get right in the marsh with their plants. Involvement in environmental rehabilitation has provided our volunteers with a sense of environmental empowerment where only a sense of helplessness existed before. Hands-on marsh restoration has also created a link between Hamilton-area residents and the local marsh ecosystem, of which they are an integral part. Volunteers have come to realize they can contribute to the enhancement of their local environment and, in so doing deepen their sense of responsibility for it. This awareness and commitment are what stewardship is all about. Because the Cootes Paradise Marsh restoration will take at least ten years and will require some maintenance indefinitely, building long-term community support for the project is crucial. We believe the Community Volunteer Planting-Program and the Classroom Aquatic Plant Nursery Program have both nurtured a community sense of stewardship toward the marsh by allowing individuals of all ages to convert their concerns about its degraded condition into effective action.

ACKNOWLEDGMENTS

This program would not have become a reality without the energy and enthusiasm of the following students: Amy Ayre, Brent Bullough, Krista Crawford, Barb Crosbie, Tricia Frayn, Nick Gupta, Sarah Hopkin, Laurie Joyce, Tamara Lahtinen, Vanessa Lougheed, Mel Major, Frank Palin, Mariëtte Prent, Beth Schurr, David Skye, David Spencer, Wanda Srdoc, Jay Takata, Stuart Taylor, and Christine Varnum. We would also like to thank RBG scientists Dr. Peter Rice and Mr. Len Simser and the RBG restoration staff for their help. We are especially grateful to Dr. Joe Minor and Mr. Art Yeas of McMaster University for their help in collecting plant material and in propagating plants. We thank Mr. Ken Hall of the Bay Area Restoration Council for making the initial contacts with the teachers and for funding potting materials for the CAPN program. Financial support for other parts of this project have been provided by the Great Lakes Clean-Up Fund, the Canada Trust Environment Fund, the Ontario Ministry of the Environment and Energy's Environmental Youth Corps and Campus Employment for Aboriginal/Native Youth programs, Employment and Immigration Canada's Summer Employment/Experience Development Program, and Environment Canada's Eco-Research Program for Hamiliton Harbour. We also thank Mr. Vic Cairns, Chair of the FWHRP Steering Committee, and Mr. John Hall, Project Manager of the FWHRP, for their advice and support throughout the project.

REFERENCES

Fish and Wildlife Restoration Committee. 1991. Fish and Wildlife Habitat Restoration in Hamilton Harbour & Cootes Paradise—Concept Summary. 605 James St. N., 3rd Floor, Hamilton, Ontario L8L 1K1, Canada.

Fish and Wildlife Restoration Committee. 1992. Fish and Wildlife Habitat Restoration in Hamilton Harbour and Cootes Paradise—Preliminary Scoping and Consultation. 605 James St. N., 3rd Floor, Hamilton, Ontario L8L 1K1, Canada.

Gresham, D. and J. Burbridge. 1994. Citizen involvement in the enhancement of Woodland Creek and Lake Lois. *Lake and Reservoir Management* 9: 14-17.

Kerr, M., E. Ely, V. Lee, and A. Mayio. 1994. A profile of volunteer environmental monitoring: national survey results. *Lake and Reservoir Management* 9:1-4.

Levine, D. A. and D.E. Willard. 1990. Regional analysis of fringe wetlands in the Midwest: creation and restoration. *In:* Wetland Creation and Restoration: the state of the science. Washington, D.C.: Island Press. J.A. Kusler and M.E. Kentula, eds. Pages 299-321.

Packard, S. 1994. Successional restoration: thinking like a prairie. *Restoration and Management Notes* 12(1):33-39.

Remedial Action Plan for Hamilton Harbour. 1992. Stage 1 Report (2nd Edition)-Environmental Conditions and Public Definition. Office of the Remedial Action Plan for Hamilton Harbour, 867 Lakeshore Road, P.O. Box 5050, Burlington, Ontario L7R 4A6.

Remedial Action Plan for Hamilton Harbour. 1992a. Stage 2 Report—Goals, Options, and Recommendations, Volumes 1 and 2 Main Report. Office of the Remedial Action Plan for Hamilton Harbour, 867 Lakeshore Road, P.O. Box 5050, Burlington, Ontario L7R 4A6.

Lynda Lukasik is currently enrolled in a multidisciplinary Ph.D program in environmental studies at the University of Waterloo, Ontario. Patricia Chow-Fraser is Director of the Community Volunteer Research Program and Leader of the Communications Group of the McMaster Eco-Research Program for Hamilton Harbour, and is Associate Professor in the Department of Biology at McMaster University, 1280 Main Street West, Hamilton, Ontario, L8S 4K1, Canada (905) 525-9140 (Ext. 27338). E-mail: chowfras@mcmail.cis.mcmaster.ca

---