

BACKGROUND AND HISTORY

Amphibians are vertebrate (meaning they have backbones) creatures with moist, glandular skins and toes devoid of claws. They are cold-blooded, which means they derive heat from outside sources and control their body temperatures by moving to cooler or warmer locations as necessary. The word “amphibian” is derived from the Greek language and means “living a double life”. This refers to their life cycle in that their young pass through a larval stage, usually aquatic (for example the tadpole stage of a frog) before they metamorphose into the adult form.

As both predators and prey, amphibians are vital parts of a healthy marsh ecosystem. Their presence (and absence), abundance, and distribution reveal much about the environment in which they live. With their intimate association with water, they are valuable indicators of water quality. Consequently, monitoring changes over time in an area’s amphibian population can give indications of long-term environmental and habitat change. In Cootes Paradise amphibian populations are monitored to measure the effects of the restoration activities of Project Paradise, and to determine the “health” of the local habitats.

While the historical abundance of amphibian life in Cootes Paradise can only be guessed at, it is likely that fairly large populations resided in the area due to the prevalence of suitable habitat. In fact the area was once derogatorily referred to as a “...long frog marsh...” by local businessman James Durand in 1810. Additionally, Cootes Paradise once supported a Bullfrog harvesting industry although its time frame and scope are unknown.

Between 1928 and 1950, a total of 14 species of amphibian (eight species of frog and toad and six species of salamander) were recorded in Cootes Paradise. By 1992, only 5 species, Redback Salamander, Spotted Salamander, American Toad, Northern Leopard Frog, and Green Frog were recorded regularly in the marsh. Eight species of amphibians that historically resided in Cootes Paradise have experienced extirpation since the turn of the century. The general lack of historical abundance data for the amphibian populations in Cootes Paradise make comparisons with current levels at best a difficult exercise. In general it is

unclear what population levels were for any species. It is assumed that presently existing species suffered population declines similar to the degree of experienced habitat loss, so current populations are thought to be small relative to historical levels.

The reasons for the loss of these species can be attributed to decreases in the amount of available habitat, decreases in water quality, disruption of nesting sites by non-native common carp, increased predation caused by the loss of sheltering aquatic vegetation and isolation from adjacent populations.



A view of a vegetated Cootes Paradise looking west towards Dundas, circa 1920.

METAPOPULATIONS AND AMPHIBIANS

The concept of “metapopulation” is important in understanding the dynamics of amphibian populations. A metapopulation is a population composed of smaller subpopulations linked together by traversable habitat. In a functioning metapopulation if one of the subpopulations becomes eliminated the area it occupied can become recolonized by individuals from the other subpopulations with which it is linked. Once these linkages are severed this recolonization can no longer occur. The survivability of the metapopulation itself diminishes if many of the subpopulations become eliminated and linkages between the survivors are severed.

As the area around Cootes Paradise became more developed and urbanized, the linkages joining the marsh’s amphibian populations to those of the surrounding area became severed by roads, railways, and urban development. As a consequence of severing these links, and several other factors, many of the



amphibian species in the marsh (and in the surrounding area) became extirpated, and most of the remainder existed only in isolated pockets.

In 1995, RBG began improving the strength of the amphibian metapopulation in Cootes Paradise by creating habitat for the formation of new subpopulations, and by reconnecting linkages with populations outside of the marsh. This conservation initiative is valuable not only to the amphibians resident in Cootes Paradise but for the amphibians in the region as a whole.

CURRENT STATUS

Since the commencement of Project Paradise, improvements in water quality and increases in the amount of amphibian-friendly habitat in Cootes Paradise have promoted many positive changes in the area's amphibian populations. Seven species of frogs and toads, and two species of salamanders have been recorded in Cootes Paradise since 1994. Of these, Northern Spring Peeper and Bullfrog were discovered in 1997, Wood Frog in 1998, and Grey Treefrog in 1999. A brief account of each species appears below.

SPECIES STATUS

Spotted Salamander (*Ambystoma maculatum*)

Found in moderate numbers along the north shore, concentrated mostly in forest areas and around the ponds at Hickory Valley, the Irrigation Pond, and ephemeral ponds along Homestead Trail. Occasionally found on the south shore in the Westdale region.



Redback Salamander (*Plethodon cinereus*)

Found in large numbers in forested areas along both the north and south shores. This species requires moist forest habitat and does not rely on pond habitat. Their habitat selection may provide clues to the health of forest habitat surrounding Cootes Paradise.

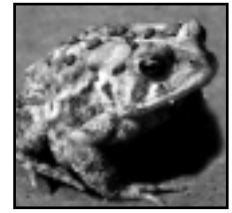


The population levels referred to above are: **Small**—less than five can be observed in one day. **Moderate**—between five and 10 can be observed in one day, at one or two sites. **Large**—more than 10 can be observed in one day, at more than one site.

Eastern American Toad

(*Bufo americanus americanus*)

Found in moderate to large numbers in appropriate habitats along both the north and south shores. Breeds extensively in Hickory Valley and in the western portion of Cootes Paradise/West Pond area.



Grey Treefrog (*Hyla versicolor*)

Recolonized in 1999. Extirpated from the area since sometime after 1950. At least five individuals were heard calling from Hopkin's Bay west of the Boardwalk Marsh. By 2000 had expanded to five sites from a single location in 1999.



Northern Spring Peeper

(*Pseudacris crucifer crucifer*)

Recolonized in 1997. Previously extirpated from the area since sometime after 1927. Between 10 and 20 were heard calling from the flooded channel leading into West Pond and from flooded areas west of the Upper Paradise Marsh Pond.



By 2000, they had spread to much of the western portion of the marsh. Thought to have recolonized from extant populations upstream of Spencer's Creek.

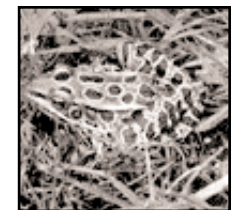
Wood Frog (*Rana sylvatica*)

Recolonized in 1998. A small number were heard at several locations in the western portion of the marsh. The inundation of several key areas between the marsh and a known adjacent extant population of Wood Frogs facilitated their movement into the marsh.



Northern Leopard Frog (*Rana pipiens*)

Found in moderate to large numbers in appropriate habitats throughout Cootes Paradise. Green Frog (*Rana clamitans clamitans*) found in moderate to large numbers in appropriate habitats throughout Cootes Paradise.



Bullfrog (*Rana catesbeiana*)

Two individuals were encountered during the summer of 1997. One was located in Double Marsh along the southern shore,



and the other was heard in the Boardwalk Marsh. Extirpated since sometime after 1950. Unknown if this represents a recolonization or some sort of remnant population overlooked by existing monitoring protocols. None encountered in 1998 or 1999. Information provided by a local homeowner suggests that these individuals were escapees from an adjacent ornamental pond.



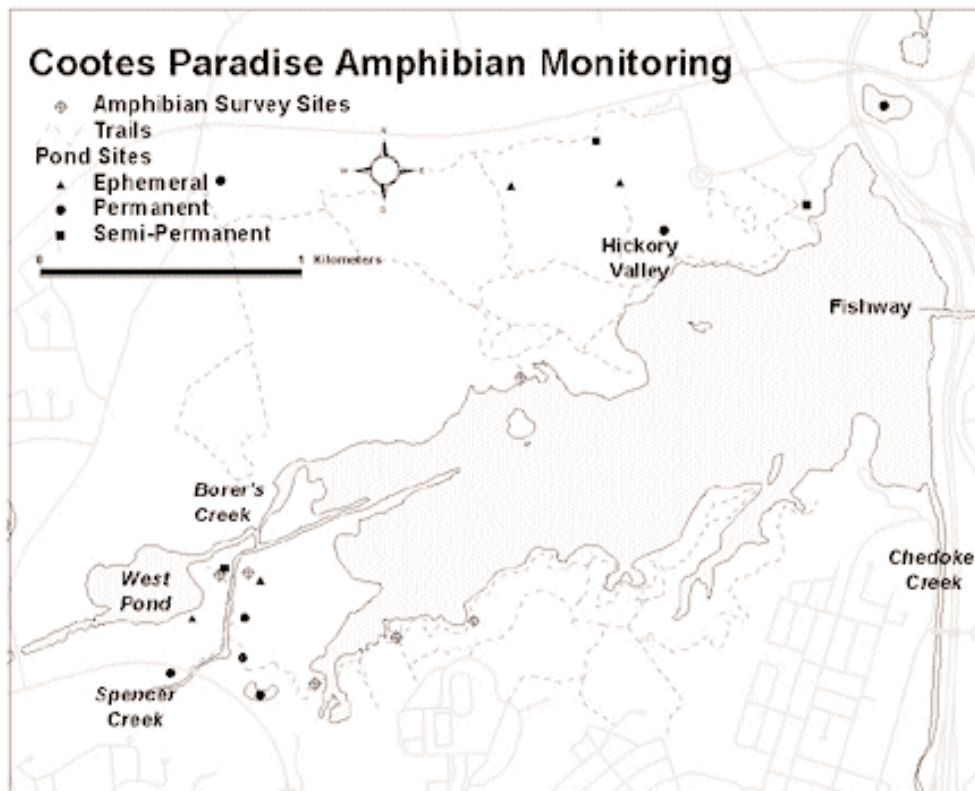
Amphibians in Cootes Paradise, extant and extirpated			
Species	Historical Presence	1990	2000
Mudpuppy	✓		
Red-Spotted Newt	✓		
Jefferson Salamander	✓		
Blue-Spotted Salamander	✓		
Spotted Salamander	✓	✓	✓
Redback Salamander	✓	✓	✓
Eastern American Toad	✓	✓	✓
Grey Treefrog	✓		✓
Northern Spring Peeper	✓		✓
Western Chorus Frog	✓		
Wood Frog	✓		✓
Northern Leopard Frog	✓	✓	✓
Pickerel Frog	✓		
Green Frog	✓	✓	✓
Bullfrog	✓		?

An example of the data collected by the Calling Amphibian protocol for a single site over the course of a spring.

AMPHIBIAN MONITORING

Changes in the amphibian population of Cootes Paradise are monitored by RBG science staff. Amphibians are very sensitive to environmental conditions, particularly in aquatic habitats, and fluctuations in their population are valuable indicators of habitat quality. Current amphibian monitoring efforts began in 1994 with two protocols in use. The first is the Calling Amphibian protocol from the Marsh Monitoring Program developed by the Canadian Wildlife Service and Bird Studies Canada. This protocol involves recording the number and species of calling amphibians at pre-determined sites three times during the spring at optimal temperature and weather conditions. The breeding activities of the various species of frogs and toads occur at different air temperatures during the spring so the three different sampling periods ensure that all the species are recorded.

The first number in the pair refers to the “Call Level” which is on a scale of 1 to 3. A “1” indicates that calls do not overlap, a “2” indicates there is some overlapping of calls, but each individual can be clearly distinguished, and a “3” indicates much over-lapping of calls and individuals are difficult to impossible to distinguish. The second number refers to the number of individuals heard calling.





Over a period of many years, these maps show in great detail the fluctuations of both amphibian populations and the habitat in which they reside.

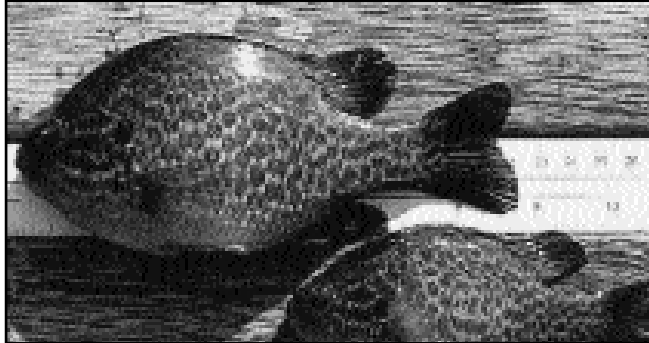
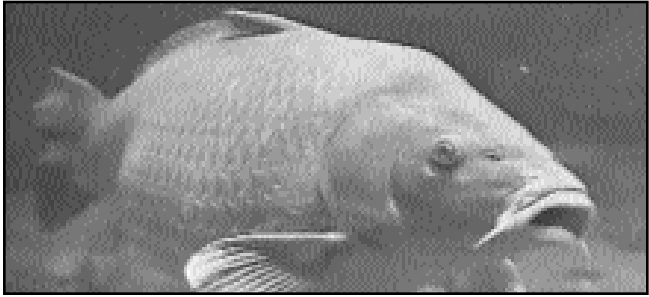
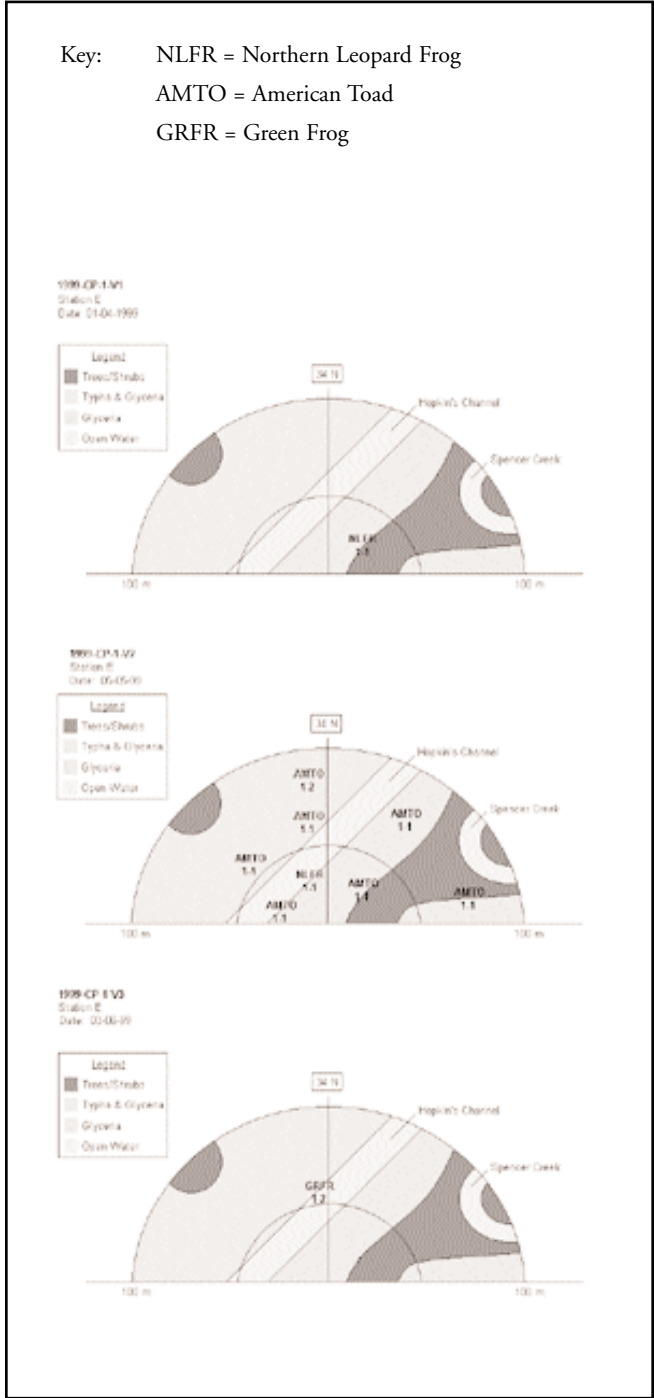
The second monitoring protocol performed at RBG involves counting amphibian egg masses at four sites along the north shore of Cootes Paradise to get an indication of the number of egg-laying females and the scope of breeding activity. This is particularly valuable for Ambystomids, which are not recorded by the calling amphibian protocol.

AMPHIBIANS IN COOTES PARADISE

In a typical year, amphibian breeding in the Cootes Paradise area occurs in “pond” habitat adjacent to the main marsh rather than in the main body of the marsh itself. The main body of Cootes Paradise experiences dramatic changes in water level during the time most amphibians commence egg laying. This can lead to exposure of the egg masses to drying in the open air, or to being submerged too deeply for transformation into larvae. The changes in water level also cause physical disruption of the vegetative substrate many amphibians use to secure egg masses, consequently dislodging them, which may cause the egg masses to drift into areas or conditions not appropriate for transformation into larvae.

Cootes Paradise also harbours many species of predacious fish, whereas the ponds, especially the ephemeral ponds, do not.

(Top to Bottom): The activities of carp can dislodge amphibian egg masses and bury them with sediment; Predacious fish such as the pumpkinseed will eat tadpoles and amphibian eggs; Dragonfly larvae can be predators to larval salamanders and tadpoles.





Before carp exclusion (*see Fishway Fact Sheet*), egg masses would also be susceptible to being disturbed by the feeding of carp, and to being covered in sediment resuspended by carp activity.

Three different pond types are present in Cootes Paradise. Permanent ponds are areas of standing water with a depth greater than one metre that support aquatic conditions year-round. Semi-permanent ponds are areas of standing water that support aquatic conditions through the growing season in most years. Ephemeral ponds are areas of standing water that do not hold water throughout the entire growing season like roadside ditches and tire ruts.

Successful amphibian reproduction has been documented for two of six ponds and five of seven pond complexes. It is likely that reproduction has taken place at all of these sites. A few tributaries and portions of the marsh edge also possess habitat quality and features sufficient for amphibian reproduction, but breeding has rarely been witnessed in these areas. The location of these ponds and pond complexes can be seen on the map shown on page 3.

The exceptionally dry winter of 1998-99, coupled with drought conditions experienced in 1998 left many of the ponds usually used for breeding dry. The amphibian population responded in two different ways. The first was to delay breeding. Spotted Salamanders, which normally breed in Cootes Paradise between the end of March and April, delayed egg laying until late May. Other species, such as the Green Frog and Northern Leopard Frog, bred in the main body of Cootes Paradise. Large numbers of tadpoles were found in the vicinity of McMaster Landing on large shallow mud banks. Presumably they transformed into larvae in slightly deeper areas then congregated in the shallows to escape predacious fish. The mortality rate of these tadpoles must have been fairly high, however, since the area did not offer much cover from wading birds such as herons.

Consequently, it is believed that in years with a "typical" water regime amphibians breed in the pond habitat surrounding Cootes Paradise, while in atypical years they either wait until these ponds fill with water or breed in the more sub-optimal main body of the marsh.

Once the marsh begins to become adequately vegetated it is likely that more amphibians will begin to breed in some of the more sheltered inlets of the main body of the marsh. The vegetation may alleviate some of the physical disruption on water

movement and provide shelter from predators. In part, signs of this have already been observed in Hopkin's Bay where revegetation has been dramatic, but it is too early and conditions have been too atypical to be conclusive.

Of great significance is the re-appearance and persistence of species previously extirpated from the marsh. Since the commencement of operations at the Cootes Paradise Fishway, 3 (possibly 4) "new" species of amphibian have been recorded in the area. These recolonization events, and the persistence of Northern Spring Peeper and Wood Frog, indicate that habitat conditions in Cootes Paradise have improved enough to attract and maintain at least small populations of amphibians to areas which at one time could not support them. In addition, the fact that amphibians can travel from extant populations to Cootes Paradise reveals that at least some degree of connectivity between the marsh and adjacent areas exists.

Despite the ability of at least some amphibians to successfully cross into Cootes Paradise, recent research by Royal Botanical Gardens science staff shows this is most likely the exception rather than the rule.



Roadways, railway lines, and urban areas are difficult for amphibians to traverse.



Mudpuppy, not observed recently in Cootes Paradise, will benefit from improvements in water quality and clarity in the marsh and adjacent Hamilton Harbour.



As the area around Cootes Paradise became more developed and urbanized, the linkages joining the marsh's amphibian populations to those of the surrounding area became severed by road, railways and urban development. Vehicles have a detrimental impact on amphibian communities especially during mass spring migrations. A study of the breeding migration of a population of Common Toad (*Bufo bufo*) in Europe estimated that a traffic volume of 60 cars per hour would kill 90% of adult toads while crossing roadways during the breeding season.

In a similar study conducted in 1987 at different sites documented 50% mortality of migrating individuals at traffic volumes of 24 to 40 cars per hour and 100% mortality at a rate of 26 cars per hour. Research on traffic volume and traffic mortality conducted during 1999 in areas surrounding Cootes Paradise showed a traffic rate of 868 cars per hour along Cootes Drive, and massive amphibian mortality, particularly during periods of rain.

Amphibian mortality from rail traffic is more speculative than road traffic. Train traffic volume is less than automobile traffic. However, the physical condition of the railway bed seems harsher than that of the surrounding roads, with sharp rocks and numerous puddles of oil and caustic fluids.

A number of culverts can be found under the road and railways surrounding the marsh but their functionality as conduits permitting amphibian movement are unknown. They may enhance dispersal through these obstacles, but research at other sites in North America has shown mixed results.

On a regional scale, physical features like the Niagara Escarpment and urban development are notable obstacles to genetic exchange and colonization because both exhibit significant barriers to dispersal. Hydroelectric corridor habitat, commonly considered as good dispersal routes for large species in riparian strips, may not provide suitable migration routes for amphibians. The quality of vegetation may also have detrimental effects on amphibian communities, especially if moisture levels are low.

Toxins can have a profound effect on any amphibian community. Compounds like ammonia and ammonium nitrate from the Dundas sewage treatment plant and sediment of West Pond exceed levels that are toxic to amphibian egg survival and, therefore, may be an important limiting factor on populations in Cootes Paradise. Researchers have found that toxic effects of ammonium nitrate occurred at concentrations commonly exceeded in agricultural areas. In one study, three species were tested that are found in the Cootes Paradise area:

Eastern American Toad, Northern Leopard Frog and Green Frog. Effects from toxic exposure in these species ranged from loss of movement, physical abnormalities, delayed development and mortality.

Acidity is not thought to be a factor limiting reproductive success in and around Cootes Paradise. Sensitivity ranges are typical pH values of 3.5 to 4.5 for species such as Grey Treefrog, Wood Frog, Bullfrog and Spotted Salamander. This range is well below that expected for Cootes Paradise and well below the neutral pH of ponds tested in the spring and summer of 1996. Acidity appears to play only a minor part in influencing species richness in similar areas of southwestern Ontario.

HICKORY VALLEY HABITAT PROJECT



The outflow pond at Hickory Valley, enhanced during the 1995 construction.

In 1995 RBG and several partners completed an amphibian habitat creation project in Hickory Valley. Located along the northern shore of Cootes Paradise, Hickory Valley is a two-hectare floodplain area that encompasses the conjunction of Hickory Brook and an unnamed tributary. At the time the area suffered from extensive erosion during spring run-off and periods of above average rainfall. To alleviate this, and provide habitat for amphibians, the channel containing the flow of Hickory Brook was remodeled, an existing obsolete water control structure was removed, and four ponds of varying depth were created, complementing the three already on site. Bio-enhancements such as substrate for basking turtles were also added.



In 1996 a viewing area was added to one of the ponds to facilitate educational programming by the RBG Nature Interpretive Centre and an observation area overlooking the valley was constructed.



The project has been a great success. The ponds provide permanent breeding sites for Spotted Salamanders which in previous years were forced to rely on sporadically occurring ephemeral ponds. Green Frogs, Northern Leopard Frogs, and Eastern American Toads also breed in the newly created habitat, and Redback Salamanders can be found inhabiting the surrounding woodland habitat. A second project, involving the creation of Spotted Salamander breeding ponds in the Pinetum area, commenced in 2000. These conservation initiatives are valuable not only to the amphibians resident in Cootes Paradise but for the amphibians in the region as a whole.

Hickory Valley is adjacent to Cootes Paradise and will act as a refuge for populations of amphibians inhabiting the marsh. In addition, should the physical reintroduction of previously extirpated species prove necessary Hickory Valley would function as a sheltered release site.

AMPHIBIAN RE-INTRODUCTIONS

While the degree and success of natural recolonization has been beyond expectations, it is not physically possible for all the desired species to return to the marsh on their own. The ultimate goal for Project Paradise in regard to amphibians is the restoration to Cootes Paradise of all previously extirpated species. To this end, on April 15, 1996, RBG hosted a symposium on amphibian re-introductions.



The Western Chorus Frog is a possible candidate for re-introduction.

Surfing the Web- Interesting Sites

Royal Botanical Gardens, www.rbg.ca

Environment Canada - Great Lakes Information, www.on.ec.gc.ca/water/greatlakes/intro-e.html

Hamilton Harbour Remedial Action Plan, www.on.ec.gc.ca/water/greatlakes/raps/ontario/hamilton/intro.html

Environment Canada's Green Lane, www.ec.gc.ca/envhome.html

Great Lakes Wetlands Information, www.great-lakes.net

McMaster University's Ecowise Project, www.mcmaster.ca/ecowise/

U.S Environmental Protection Agency - Great Lakes, www.epa.gov/glnpo/

National Wetlands Research Centre, www.nwrc.gov/

A wide variety of topics were covered, and after much consideration a rough outline for a successful re-introduction was produced. In brief, this involves waiting until conditions in the marsh are optimal for the chosen appropriate species, acquiring egg masses (where applicable) of the target species from a variety of local sources that experience similar environmental conditions as Cootes Paradise, and releasing the egg masses in as many appropriate sites as possible. An intensive monitoring effort will follow to determine the fate of the released organisms, and the ultimate degree of success of the re-introduction.

FUTURE PROJECTS

Future amphibian restoration efforts will continue to focus on providing quality breeding habitat. This is especially needed along the more urban southern shore of the marsh, where breeding habitat is in short supply.

Methods to facilitate the amphibian crossing of the roadways surrounding the marsh will also be investigated. If the overall improvement of habitat quality in Cootes Paradise continues to improve as dramatically as it has since the advent of carp exclusion by the Cootes Paradise Fishway, a re-introduction of a species as yet undetermined may commence.

USEFUL AMPHIBIAN RESOURCES

Local - The Reptiles and Amphibians of the Hamilton Area, Hamilton Naturalists' Club

Regional - Reptiles and Amphibians, Eastern/Central North America, Peterson Field Guides

Get Involved. Great Lakes Marsh Monitoring Program, coordinated by Bird Studies Canada utilizes volunteers for surveying amphibians and marshbirds in the Great Lakes Basin. For more information contact the Aquatics Surveys Officer at aqsurvey@bsc-eoc.org or call toll free 1-888-448-2473.



SUMMARY OF AMPHIBIAN FACT SHEET

- Cootes Paradise, located on the western end of Lake Ontario, is an important Great Lakes coastal wetland system. It provides invaluable feeding and reproduction habitat for a variety of amphibians, reptiles, birds, fish and mammals.
- The marsh was once host to a varied and abundant amphibian population of 15 species, and supported a small, local Bullfrog harvesting industry.
- A number of human-induced stresses have degraded Cootes Paradise over the years, resulting in diminished habitat quality and quantity. These stresses include the introduction of non-native carp, high rates of watershed erosion, and the isolation of the area from surrounding habitat. By the mid 1990s ten of the fifteen species of amphibian historically found in the marsh had become extirpated.
- In the interests of restoring lost amphibian populations, the RBG Science Department has been involved in a number of habitat recovery initiatives. These include the construction of breeding ponds and refugia away from the main body of the marsh, habitat improvements within Cootes Paradise itself, and restoring connectivity to surrounding habitats.
- To keep track of amphibian populations, and measure the success of restoration initiatives, the RBG Science Department employs a variety of techniques including, amphibian call counts, egg mass counts, and visual surveys. This monitoring also contributes to international efforts to monitor amphibian populations.
- Since carp exclusion was initiated in 1997 several species of amphibian have recolonized Cootes Paradise, and most species have shown increases in number. Planned future efforts will concentrate on returning more lost species.

For more information, contact

Royal Botanical Gardens, Project Paradise
P.O. Box 399, Hamilton, Ontario, L8N 3H8
Tel: 905-527-1158
Fax: 905-577-0375

Fish and Wildlife Habitat Restoration Project
605 James St. North, 3rd Floor
Hamilton, Ontario, L8L 1K1
Tel: 905-521-9334
Fax: 905-528-6282

Bay Area Restoration Council
McMaster University
Life Sciences Building, Room B130F
Hamilton, Ontario, L8S 4K1
Tel: 905-525-9140 ext. 27405
Fax: 905-522-6066 (address to BARC)

Hamilton Harbour RAP Office
Environment Canada
P.O. Box 5050, Burlington, Ontario, L7R 4A6
Tel: 905-336-6279/6278
Fax: 905-336-4906

Project Partners

- | | |
|---|--|
| <p>Bay Area Restoration Council (BARC)
Department of Fisheries and Oceans
Environment Canada
Friends of the Environment Foundation
Great Lakes 2000 Clean Up Fund
Halton Region Conservation Authority
Hamilton Harbour Commissioners
Hamilton Harbour Remedial Action Plan Stakeholders
Hamilton Naturalists' Club</p> | <p>Hamilton Region Conservation Authority
McMaster University
Ontario Ministry of Environment and Energy
Ontario Ministry of Natural Resources
Royal Botanical Gardens
The Regional Municipality of Hamilton-Wentworth
The Regional Municipality of Halton
Waterfront Regeneration Trust</p> |
|---|--|



**ROYAL
BOTANICAL
GARDENS**



Amphibian Fact Sheet prepared by Brian Pomfret. Published by Royal Botanical Gardens. Thanks to: Len Simser, Pamela Booker (under an HRDC grant), Margaret Walton, Tys Theysmeyer, and Robert Hagley.