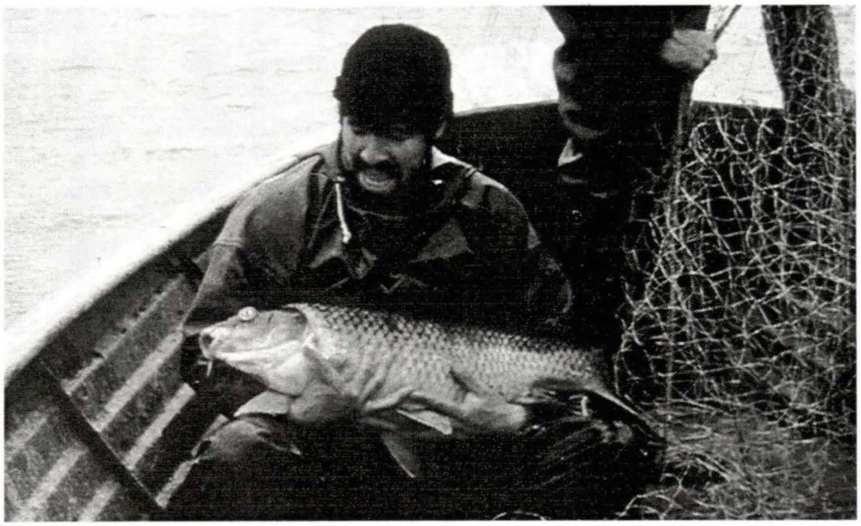
GREAT LAKES 2000 CLEANUP FUND — FONDS D'ASSAINISSEMENT DES GRANDS LACS 2000

Fact Sheet — **Fiche d'information**

Carp Control Techniques For Aquatic Plant Establishment

Over the years, fish and wildlife habitat in the Great Lakes basin has been dramatically altered by many factors including water level regulation, the introduction of exotic species and point and non–point source pollution. Efforts to restore and rehabilitate habitat are on the rise with numerous projects underway around the basin. While every project is unique, each addressing a different combination of impacts, many of the stresses on habitat are common and widespread. There is an opportunity to gain valuable insight into various habitat rehabilitation techniques by examining the success and failure of projects with similar impacts.



VIC CAIRNS

Carp (Cyprinus carpio)

One of these common and widespread stresses, particularly in coastal areas, is carp (*Cyprinus carpio*). Carp are known to displace emergent and submergent vegetation through feeding, rooting and spawning. If carp are a problem at a rehabilitation site, carp control or exclusion is necessary to protect aquatic vegetation.

This fact sheet outlines several techniques to control the movement of carp populations. These techniques involve the use of several types of barriers and exclosures. Also, there is a brief discussion on the origin of carp in the Canadian Great Lakes basin, its biology, its affect on aquatic vegetation, and issues to consider when deciding which technique to use.

CARP AND AQUATIC VEGETATION

Carp displace emergent and submergent vegetation through feeding and to some extent spawning activities. Their diet consists of molluscs, insects, worms, crustaceans, algae and aquatic plants (dead or living) and seeds. Carp uproot vegetation when searching for food and during feeding. During feeding, carp suck in and expel water, mud and debris; in doing so aquatic plants become uprooted, nutrients are released and sediments are resuspended causing an increase in water turbidity. High turbidity can reduce aquatic plant growth by limiting light penetration.

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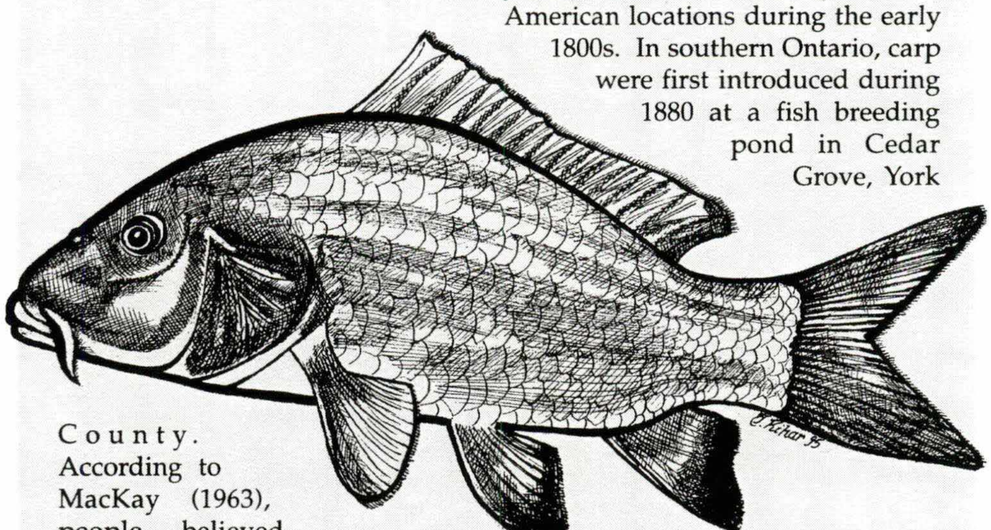
The spawning activities of carp can also displace vegetation. Spawning generally occurs throughout the Great Lakes from May to August, peaking mid–May to June. A water temperature of approximately 17 to 26 ^{o}C is necessary for spawning to occur. Carp usually spawn in groups of one female and three or four males although larger groups may also occur. During spawning, carp move into shallow, vegetated areas, where splashing and physical activity can uproot and flatten aquatic plants. Damage from feeding and spawning are likely more extensive from larger carp populations.

Damage to aquatic vegetation varies with both the depth of water and the type of plant community. It is more probable that aquatic vegetation will be displaced at low water levels. Deep water (10 m) inhibits feeding and spawning while shallow water (18–50 cm) facilitates these behaviours. The vulnerability of perennial plants is determined by the strength of the root system and its ability to resist uprooting in different soil types. Susceptibility of annual plants appears more dependent on the timing of seed production (carp consume seeds) and the seasonality of carp activities. Annuals that produce seed during periods of prime carp activity (May to August) can be more susceptible to carp damage.

It is important to note that carp activities are not solely responsible for the displacement or reduction in aquatic vegetation: shoreline development, recreation activities, pollution, natural water level fluctuations, and wind and wave action also play a role. Nevertheless, if there is no carp control it will be difficult to rehabilitate aquatic plant environments.

HISTORIC OVERVIEW

Carp, are a large bottom–feeding fish found throughout the Great Lakes basin. This species occurs naturally in Asia and Europe, but was deliberately introduced to many North American locations during the early 1800s. In southern Ontario, carp were first introduced during 1880 at a fish breeding pond in Cedar Grove, York County. According to MacKay (1963), people believed this fish would make an excellent addition to mill ponds because of their prolific nature, as well as their domestic and economic value. From 1880 onward, various ponds throughout southern Ontario and the U.S. basin states were stocked with carp. In ponds near Newmarket, Ontario, carp escaped into the Holland River during a sudden overflow of water in 1896. This single event was only one of several opportunities for this fish to become established in the Great Lakes basin. As their numbers increased, carp were considered a nuisance because of their ability to degrade aquatic habitats through the displacement of emergent and submergent vegetation and re–suspension of sediments.



CARP CONTROL TECHNIQUES

Several techniques have been developed to control the movement of carp populations at aquatic restoration projects throughout the Great Lakes. These techniques include: a fishway, carp exclosures, a water filled dam and a fencing system. The following descriptions provide an overview of each technique and contact names for further information.

Cootes Paradise Fishway

During the spring of 1995, construction of the fishway started on the Cootes Paradise side of the Desjardins Canal in Hamilton, Ontario. This remedial technique is just one of several initiatives to rehabilitate fish and wildlife communities in the Hamilton Harbour Area of Concern. The fishway prevents carp from entering Cootes Paradise marsh in the late winter and early spring while providing both upstream and downstream access for other species of fish such as pike, walleye and bass. It is proposed that this measure will help establish aquatic plants and reduce sediment suspension. It will also lead to long–term control of the carp population by restructuring the fish community to create a higher piscivorous (feeding on fish) population to feed on young–of–the–year carp. The fishway is comprised of three separate functioning sections:

1) A south end section allows all fish except carp to enter in Cootes Paradise. To reach the marsh, fish swim into one of six chambers (1.2 metres wide) where they become trapped. Personnel automatically raise the chambers and sort–out the carp while allowing all other fish to proceed.

2) A centre section consists of a series of grate openings (5 cm wide). The openings allow small fish to move freely from Cootes Paradise to Hamilton Harbour, but restrict access to 95 percent of the adult carp. Removal of these grates in early September enables any remaining carp to leave Cootes Paradise during their fall migration to overwinter in the Harbour. In mid–February the grates are reinstalled before the ice leaves the marsh and the carp return from the Harbour.

3) A north end section allows all fish to travel in one direction from Cootes Paradise to the Harbour.

The fishway is expected to be a very effective technique in limiting the movement of carp into Cootes Paradise. It is anticipated that the fishway will begin operation during February 1996.

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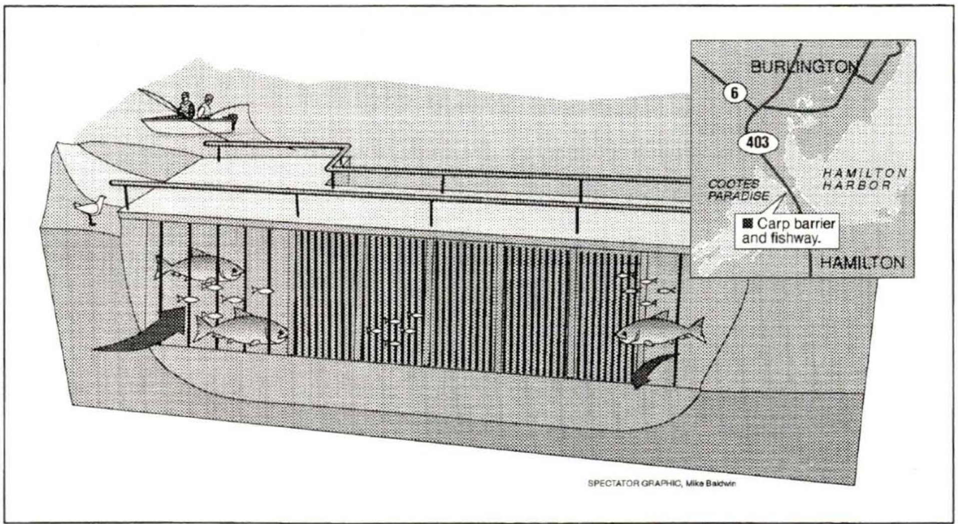

Cootes Paradise Carp Exclosures

Biologists at McMaster University in Hamilton have found an effective way to vegetate areas of Cootes Paradise damaged from carp and the grazing activities of other wildlife including muskrat, deer and waterfowl. Over the past three years, under the direction of Dr. Pat Chow-Fraser, a team of graduate and undergraduate students along with 200 citizen volunteers, have used fish and wildlife exclosures to restore a portion of Cootes Paradise with emergent vegetation.

The exclosures (2.43 square metres) provide a pen–like structure to keep out predators. They are made with weld-wire fence mounted on frames of metal T-bar (Figure 1). On the day of planting, these materials are transported to the marsh and assembled on a flat surface such as a boardwalk. The panels are then ferried by canoe to the planting site and inserted a metre deep into the sediment. It takes a team of four to five people approximately four hours to assemble, install and plant an exclosure in the marsh.

Seedlings of seven different taxa of emergent plants have been successfully transplanted into 44 exclosures. These include two species of cattail (*Typha latifolia* and *T. angustifolia*), arrowhead (*Sagittaria latifolia*), soft-stem bulrush (*Scirpus validus*), swamp dock (*Rumex verticillatus*), buttonbush (*Cephalanthus occidentalis*), sweetflag (*Acorus calamus*), and swamp loosestrife (*Decodon verticillatus*). The exclosures have also been colonized with other native species that are usually found in low numbers or in poor condition in other areas of the marsh including: swamp buttercup (*Ranunculus hispidus*) and beggar's tick (*Bidens* sp.).

Red–winged blackbirds have built nests in the vegetation in at least two exclosures. In addition, toads and spiders have increased in abundance inside the exclosures. Since plants within the exclosures are also colonizing areas outside the exclosures, researchers anticipate that the space between sets of exclosures will eventually fill in with vegetation.

The research team is now experimenting with different techniques to revegetate open-water areas of the marsh with submergent vegetation. They have added Terrafix siltscreen to the panels of 12 larger exclosures (7.3 square metres) to plant the submergent species. The purpose of the siltscreen is to reduce turbidity.

Trial plantings of waterweed (*Elodea* sp.) and sago pondweed (*Potamogeton pectinatus)* in the summer of 1994 have become established in some of the smaller exclosures with a minimum water depth of about 20 cm. The larger exclosures are located in waters with maximum depth of 60 cm and researchers plan to transplant a variety of submergent aquatic vegetation from nearby wetlands. Results of this summer's research will be used to help develop a large-scale volunteer planting program of submersed vegetation to restore the open-waters of Cootes Paradise.

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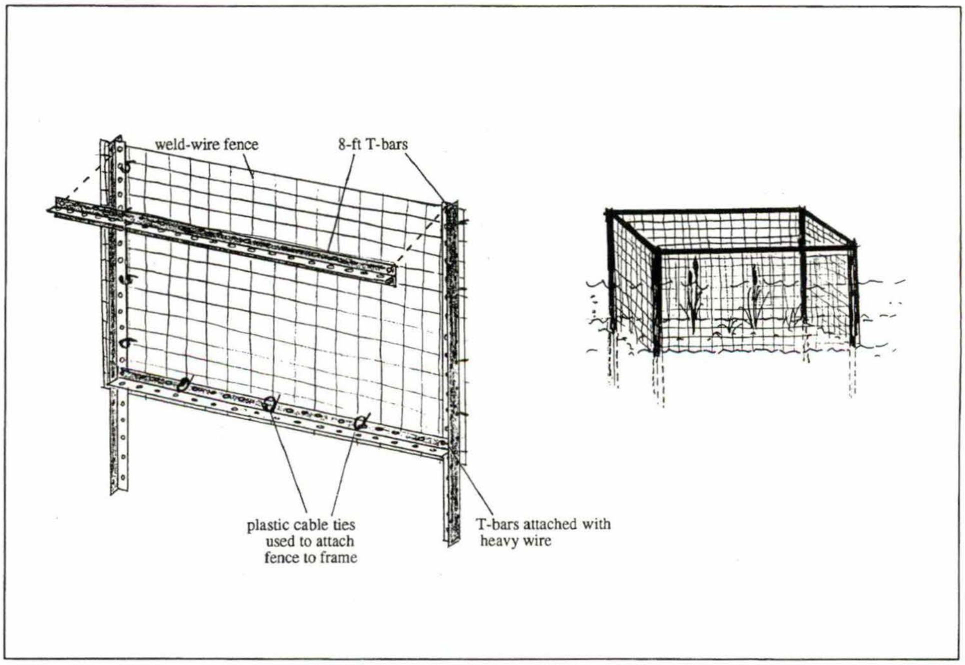

PATRICIA CHOW-FRASER

Figure 1:
Construction of a 2.43 m exclosure with weld–wire fencing and T–bars.

Collingwood Harbour Carp Exclosures

As part of a habitat rehabilitation strategy, the Collingwood Harbour Remedial Action Plan is planting emergent and submergent vegetation to recreate a wetland. Exclosures are being used to protect planted vegetation from the grazing and spawning activities of carp. The square pen–like barriers were built during the winter of 1993 and installed during the spring of 1994. The exclosures are a modified version of the ones used in Cootes Paradise. The Collingwood exclosures were made using reinforced rod and chicken wire.

Eventually the chicken wire had to be replaced with chain link fence because of muskrat damage and the constant wave action wore and broke the metal. The chain link exclosures were left in for the winter. They withstood several ice storms and successive freeze–thaws, but a very powerful storm during the end of February 1995 caused irreparable damage. Two of the exclosures were completely destroyed, and the remaining three were severely bent and twisted. During May 1995, new exclosures were placed in the same location. These exclosures were removed at the end of October 1995. Currently, plants within the exclosures are beginning to emerge and it appears as though the transplanting was successful.

Carp exclosures represent one method to facilitate the establishment of wetland vegetation in areas with high populations of carp. Although this method is labour intensive and requires a long–term commitment, it does exclude carp from the vegetation.

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RICK GRILLMAYER

Carp exclosures at Collingwood Harbour RAP.

Aqua Dam – Water–Filled Dam

The Royal Botanical Gardens (RBG) in Hamilton is currently involved with the restoration of Cootes Paradise and Grindstone Creek marshes in Hamilton Harbour. To facilitate the establishment of aquatic vegetation the RBG used an Aqua Dam. The Aqua Dam is a water–filled polyethylene and geotextile berm which allows for temporary impoundment, dewatering and exposure of marsh bottom to permit planting, seed germination and the expansion of existing vegetation stands.

Once a site has been selected for the Aqua Dam, the area is cleared of debris and the dam is unrolled into position and filled with water. Several sections can be joined together to create a dam hundreds of metres long. The water–filled dam used in Cootes Paradise was two metres high, six metres wide, and 610 metres in length, and was sturdy enough for people to walk on. The main purpose of the Aqua Dam is for the dewatering of an area. The dam protects plants from various disturbances including: high water levels; physical damage caused by wind and wave action; carp activities; and, poor water quality including enrichment and high turbidity which prevents light penetration into the water column.

After successful field trials in 1993, the Aqua Dam was used on a much larger scale in 1994. During this time, many set backs occurred including failure of initial installation, vandalism and product breakdown. Consequently, the area behind the installations remained dewatered for only three weeks. This was enough time to allow thousands of seedlings to germinate (e.g., *Scripus validus*, *Typha* sp.) on the mudflats and reach a height of five centimetres. However, when this area was reflooded, the majority of species succumbed to the activities of carp and high turbidity levels. This dewatering method represents a suitable model for establishing aquatic vegetation and controlling carp movement, but requires further product development. Investigations and discussions into the future use of the technology and dewatering technique are ongoing.

For more information please contact:
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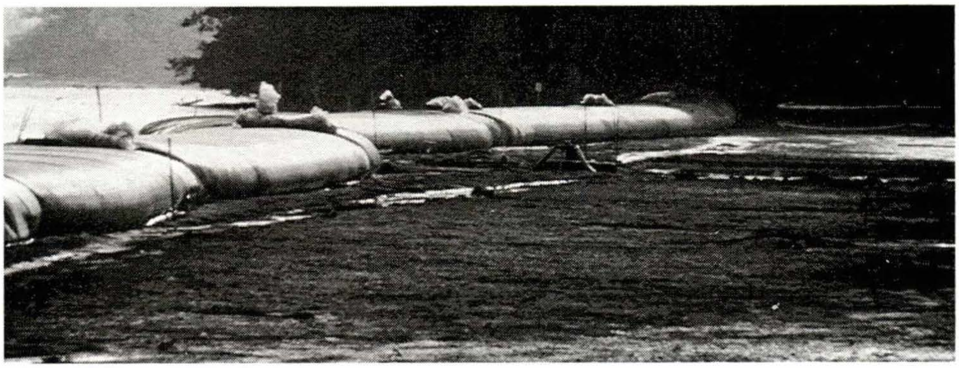

VIC CAIRNS

Aqua Dam providing protection to aquatic plants.

Oshawa Second Marsh Fencing System

A fencing system to limit carp access to specific areas within the marsh has been implemented at Second Marsh in Oshawa. A partially submerged carp control fence extends from a barrier beach to several flow deflecting islands and continues into a cattail bed creating a carp exclusion area of approximately half the marsh (60 hectares). The control system consists of a continuous chain link fence (1.8 metres high). Mesh openings (5 X 5 centimetres) restrict mature carp from accessing the eastern portion of the marsh while smaller fish species continue to access the entire marsh.

The fencing was installed recognizing the seasonal use of the marsh by carp. To effectively implement carp control, the fence post and chain link mesh were installed during the winter prior to ice break up and the movement of carp into the marsh. A section of the fencing will be removed each fall to allow any trapped carp, or other species, to exit the exclusion area before winter ice build up. During the first season of its use, it was found that regular monitoring and maintenance of the barrier was required to ensure its effectiveness. For instance, a gap was found in the fencing allowing carp to access the protected side of the marsh.

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PATRICIA LOWE

Carp control fencing at Second Marsh.

WHICH TECHNIQUE TO USE?

At this time it is too early to determine how successful each technique is at promoting long–term aquatic plant growth. Design and operational problems are still being addressed and more time is required to assess the techniques. However, much can be learned from the experiences to date. Table 1 provides an overview of the advantages, disadvantages and issues for each barrier/exclosure technique. The table also provides a starting point for managers when deciding which technique to use for their restoration project. Ultimately, the selection of a carp control technique will depend upon the goals, objectives, funding support, community support and physical features of the project site. The following provides an explanation of each table category:

Efficiency:

Indicates the effectiveness of the barrier at preventing the damaging activities of carp, and the relative size of the protection area for each technique.

Cost:

Lists the relative start–up cost for each technique as well as any additional operating or maintenance costs. Start–up costs refer to any expenditures relating to materials or labour associated with constructing the technique.

Durability / Maintenance:

Outlines the predicted life span or any physical wear that may occur with construction materials. Common maintenance tasks are also listed.

Labour:

Provides a relative level of intensity for constructing the barrier, a listing of additional work required to operate the technique, and any monitoring that may be necessary to maintain the structure.

Regulatory Review:

This section identifies the relative level of regulatory review for each technique; for instance, an environmental assessment or permit may be required before implementing the technique.

Natural Forces:

Comments on the barrier's susceptibility to natural forces such as ice flows, water level fluctuations, weather conditions and contact with floating debris.

Construction Materials:

A listing of the main construction materials required for each barrier.

Other:

Additional information relating to the technique.

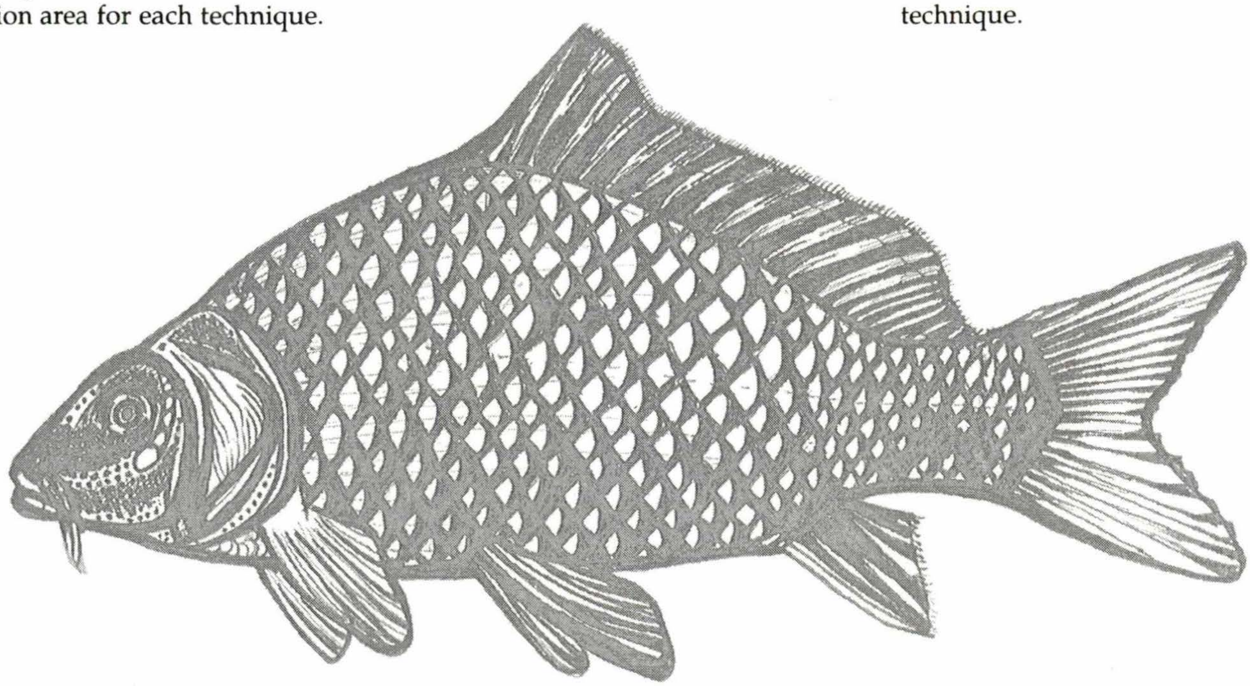

TABLE 1: Issues to consider when deciding which carp barrier /exclosure to use.

	CARP BARRIER/ FISHWAY	CARP EXCLOSURES	FENCING SYSTEM	AQUA DAM
EFFICIENCY	• long–term control • provides largest area of protection • very efficient • only small fish can pass through	• short–term control • protection area depends on size and number of exclosures (e.g., 2.43 X 2.43 m) • effective protection	• short to long–term control • large area protection • effective when carp are not trapped on both sides of fencing	• effective, but concept requires further development • large area protection
COST	• very high start–up cost • operating costs • occasional maintenance costs	• $100 to $250 for one exclosure, depends on construction materials (low start–up costs) • repair costs minimal	• moderate start–up costs • repair costs minimal	• high start–up cost • costly repairs
DURABILITY / MAINTENANCE	• 50 year life span • little maintenance	• siltscreen may wear • plastic and chicken wire fencing may be chewed by wildlife • debris accumulation	• gaps in fencing require repair • debris accumulation	• susceptible to UV radiation, life span short • repairs often required
LABOUR	• labour intensive • high level of construction • manual sorting of fish • regular monitoring	• low level of construction • regular monitoring	• moderate level of construction • regular monitoring	• medium level of construction • regular monitoring
REGULATORY REVIEW	• high	• low	• medium	• medium
NATURAL FORCES	• not susceptible to ice flow, bad weather or water level fluctuations	• susceptible to ice flow, floating debris and harsh weather, dependent on physical characteristics of the study area	• susceptible to ice flow, floating debris and harsh weather • carp may burrow under	• susceptible to ice flow, floating debris and harsh weather • carp may burrow under
CONSTRUCTION MATERIALS	• steel pipe–piles and structural steel parts	• steel T–bars, weld wire, plastic, chain link or chicken wire fencing, nuts & bolts, plastic tie–clips, wire (siltscreens optional)	• wood fence posts, steel fencing	• polyethylene and geotextile
OTHER ISSUES	• more permanent structure • enables migration of all other fish • facilitates research (e.g., fish movement through a marsh and impact of carp on coastal wetlands) • provides access point	• easily removable in spring • limits grazing by other wildlife • reduces turbidity when siltscreens used • provides opportunity to involve community volunteers for construction, planting and monitoring • provides safe habitat for amphibians and small fish	• removable • large systems are difficult to monitor • may obstruct movement of wildlife (e.g., turtles, mammals, birds)	• carp control not primary purpose • removable • concept is good, but product break down is common • vandalism can easily destroy this product

THE GREAT LAKES 2000 CLEANUP FUND

The Great Lakes 2000 Cleanup Fund is a significant component of Canada's Great Lakes 2000 Program to restore the Great Lakes Basin Ecosystem. Cleanup Fund resources focus on demonstrating technologies and remedial methods for restoring impaired beneficial uses in Canada's 17 Great Lakes Areas of Concern and other priority areas. One priority for the Cleanup Fund is the rehabilitation of fish and wildlife habitat. A full third of the Cleanup Fund's budget is spent on developing and demonstrating methods to rehabilitate fish and wildlife habitat.

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