2. Dirty Waters

Rosemary G. Hasner, TRCA

Stormwater carries dust, litter, oil and grease from roads into local rivers.

Rosemary G. Hasner, TRCA

Common household chemical products find their way to our rivers and lake through combined sewers, storm sewers, or in sewage treatment effluent.

Rosemary G. Hasner, TRCA

Stormwater is a significant non-point source of contaminants. Toronto alone has 2,600 sewer outlets.

Three types of water pollution affect health and activities in the Toronto waterfront and watersheds:

- **Bacterial** pollution discharged directly to the waterfront by combined sewer overflows and storm sewers, and to the tributaries by contaminated runoff from rural and urban areas. Bacteria pose a threat to the health of people swimming, windsurfing or boating in polluted waters.

- **Contaminants** such as trace metals and organic chemicals from combined sewer overflows and storm sewers discharging to the waterfront as well as from the rivers and creeks draining urban and industrial areas. These contaminants may be taken up by aquatic life and impair their health, or the health of animals that feed on them. Once waterborne contaminants enter the system they will react with sediment particles in the water and settle to the bottom, resulting in areas of contaminated sediments. These sediments impair the quality of the benthic community and provide an entry point for contaminants to the food chain.

- **Nutrient** enrichment from treated sewage effluent, combined sewer overflows and storm sewers to the waterfront, as well as from the flows of the Don, Humber and Rouge Rivers and Etobicoke, Mimico and Highland Creeks. Excesses of nutrients, in particular phosphorus, stimulate nuisance growths of algae which reduce water clarity, form objectionable deposits, alter the natural algae community and reduce the oxygen content of water.

These pollutants come from four main sources:

- Local point sources, such as combined sewer overflows and water pollution control plant outfalls, which discharge directly to the waterfront and in some cases the lower tributaries. They are the most direct targets for remediation.

- Watershed non-point sources, which deliver pollution to the rivers, creeks and waterfront from the rural and urban areas in the watersheds. They represent a diffuse and less easily-managed problem.

- Lake-wide sources, such industries upstream in the Niagara River and the other Great Lakes, which result in contaminants such as Mirex, in the Toronto area. They cannot be managed by remedial action in Toronto.

- Historic sources, such as sediments and soils that were contaminated by activities which have since ceased.

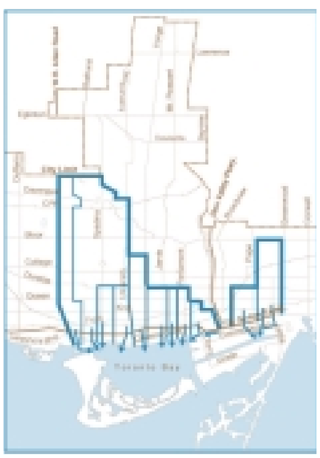
The local point and watershed non-point sources contribute the most serious pollution to the Toronto waterfront and watersheds, and are the target of the Toronto Remedial Action Plan. Table 3 uses examples of four key measures of pollution to demonstrate the importance of remediating these sources, focussing on storm water, combined sewer overflows (CSOs) and treatment plant bypasses. Chemical makeup of wet weather flows is highly variable and often peaks in the first flush, as rain washes the accumulated contaminants from roads, parking lots and rooftops. A National Water Research Institute study of stormwater and CSO in Toronto and Hamilton found that the greatest toxicity was in stormwater associated with winter highway maintenance and sites having high traffic densities. This toxicity was mainly from oils, metals, and road salt. Stormwater was found to be more toxic than CSO, and the highest toxic responses were from first flush samples (Rochfort, NWRI 2000).

Table 3.
Provincial Water Quality Objectives and average event mean concentrations of pollutants from different sources in the Toronto Area of Concern.

		STORM SEWER			UNTREATED SANITARY SEWAGE		
	PWQO	Dry Flow	Wet – Residential	Wet – Other Areas	Raw Sewage	Plant Bypass	CSO
Total Suspended Solids (mg/L)	–	16	91 - 237	25 - 331	226	476	193
Total Phosphorus (mg/L)	0.03	0.12	0.36 - 0.82	0.12 - 0.70	6.1	14.8	3.2
Copper (mg/l)	0.005	0.019	0.025	0.016 - 1.180	0.25	0.59	0.51
E. coli (#/100 ml)	100.00	15,300	25,000 - 430,000	1,000 - 10,000	50,000,000	4,080,000	6,300,000

Source: calculated for modeling purposes from various studies for the City of Toronto Wet Weather Flow Master Plan, 2001

Figure 4.
Toronto Bay Sewershed



City Works, 1997

Dry weather flows contain high concentrations of some pollutants, primarily from illegal sanitary cross connections and spills. However they do not contribute such high total loadings as wet weather flows, since volumes are considerably lower. Ashbridge's Bay Sewage Treatment Plant bypasses during periods of very heavy rainfall contain high concentrations of pollutants. Bypasses occurred 19 times in 1997, discharging an estimated total of 3,216 million litres (Waterfront Regeneration Trust, 1999). Volumes will decline as the plant is expanded and wet weather flow management improves.

To illustrate the magnitude of the problem, Toronto Bay (Figure 4) alone receives inputs from 11 CSOs and 17 storm sewers, as well as the Don River (which itself receives effluent from 30 CSOs and 872 storm sewers). Every year, an estimated 9,800 tonnes of suspended solids, 2,800 kg of lead, 5,600 kg of zinc, 47 kg of total polyaromatic hydrocarbon (PAH) and 23 tonnes of total phosphorus are contributed to Toronto Bay. Even in dry weather, inputs to the Bay still exceed provincial water quality objectives for phosphorus, copper and lead despite substantial reductions in these pollutants (40%, 50% and 75% respectively) over the past two decades (Boyd et al, 2000).

In this chapter, we review the effects of pollution by bacteria, nutrients and contaminants. We compare conditions in 1987, when the Toronto Area of Concern was designated, with current conditions, and provide conclusions about the sources of the problems, and how they should be addressed.

Rosemary G. Hasner, TRCA

Post-rainfall flood waters laden with sediments.

2.1 BACTERIA

"Progress is being made towards restoration of designated beaches, but rivers, creeks and areas around waterfront outfalls remain polluted."

Toronto Bay Initiative

Toronto Bay Initiative hosts an annual plunge in the Bay to educate the City's residents about water quality.

The RAP goal for Toronto waterfront beaches is: *"Lake water at bathing beaches contains less than 100 E. coli/100ml of water for over 95% of the swimming season"* (Clean Waters, Clear Choices, 1994). This goal is based on the provincial water quality objective, which is intended to protect people engaged in water contact recreation and may also indicate other more harmful agents in the water. The principal cause of fecal coliform contamination of designated beaches on the Toronto waterfront is discharges from urban storm sewers and combined sewer overflows (see Table 3).

In the late 1980s, the RAP Stage 1 report noted that direct sewer discharge was the major cause of elevated E. coli along the Eastern Beaches, while in the Sunnyside area the beaches were affected by both direct discharges and the Humber River. The central waterfront area was affected by direct discharges and by the Don River. Upstream agricultural inputs of bacteria played a relatively minor role at lakefront beaches during dry weather, because of time to travel down the river and natural bacteria die-off, but during wet weather, agricultural inputs contributed relatively more to the problem.

By 2000 (see Figure 5) there were still significant numbers of postings at many of Toronto's waterfront beaches, with the exception of the Toronto Islands (Hanlan's Point, Centre Island and Ward's Island), Clarke (Cherry) Beach and the Eastern Beaches (Woodbine, Beaches Park, Kew Beach and Balmy). The Toronto Islands and Clarke Beach have always been least affected by sources of bacteria and continue to meet bathing criteria most often. See Figure 2 (previous chapter) for locations of these beaches.

BEACH watch

Pollution in need of a solution

Citizens Willing to Help Clean Up City Beaches

A day at the beach shouldn't have to end at the water's edge. That's the message the Toronto Environmental Alliance (TEA) delivered to local residents through its Beach Watch program, launched this summer to promote clean beaches by 2006.

Beach-goers agreed.

Toronto's beaches may look busy on a hot summer day, but look beyond the sand and no one is swimming. TEA's Beach Watch Patrol surveyed 640 citizens, of whom 88% admit they stay out of the water because of pollution, and 99% want the city to clean up its beaches. More significant, 80% are willing to personally take action to reduce pollution by disconnecting their home downspouts (raingutters) from the nearby storm sewer, install a rainbarrel, replace pavement on their property with grass and stop spraying pesticides. Citizens surveyed are also willing to pay for clean up, with 75% enthusiastic that they would come to the beach more often if they could swim.

Citizens also had a few tips for the City. "No Swimming" signs need details on the type of pollution, source and health risks. Lifeguards and Public Service Announcements can help educate the public about pollution and solutions. Few (7% of those surveyed) use the City's beach hotline or website to get information.

Beach Watch received generous support from Labatt People In Action; TD Canada Trust Friends of the Environment Foundation; and Sparks Communications.

TRCA

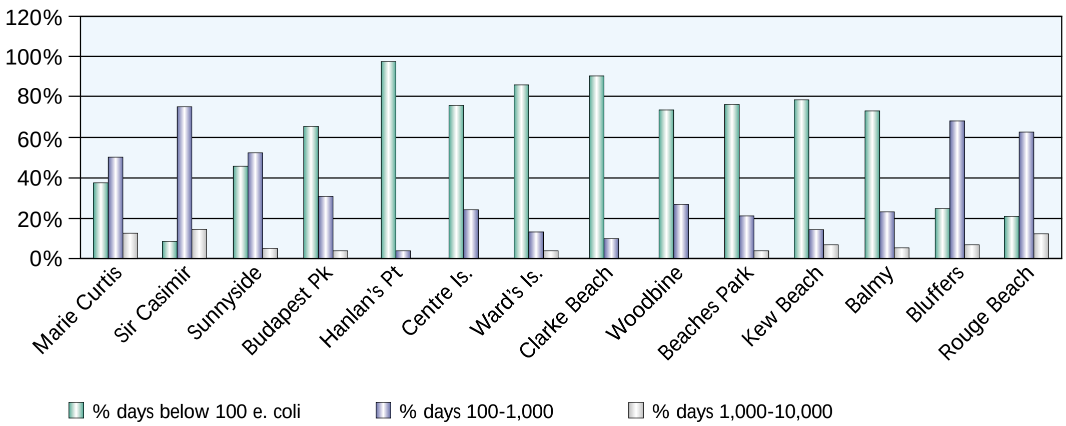
A posted beach is a warning that waters may be unsafe for swimming.

Posted versus Closed

A posted beach is a warning that waters may be unsafe for swimming. A posting occurs if sampling reveals that bacteria levels exceed the geometric mean set by provincial guidelines. A closure occurs when there is a hazard concern such as a toxic spill or abundance of blue-green algae. Readers should be aware that is it not mandatory under provincial regulation to test beach water quality and post warning signs.

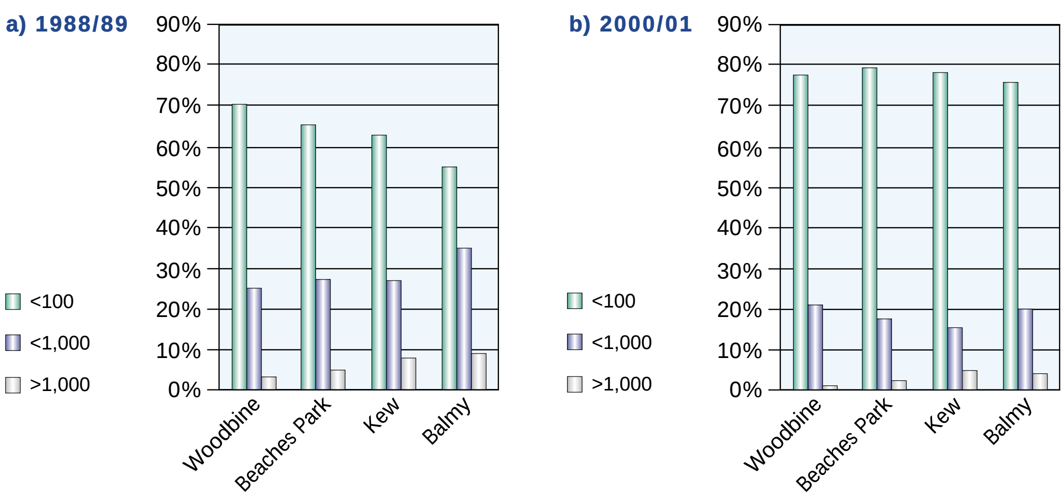
In the City of Toronto, designated swimming beaches are sampled seven times per week. Toronto's waterfront beaches have rarely been closed, although most of them are regularly posted when water sampling indicates that E coli levels exceed the provincial guideline.

Figure 5.
Bacteria counts at Toronto waterfront beaches, 2000.



Bars show percentage of sampling days (range of 47-77 days, median = 48) in which E. coli *exceeded 1,100, and 1000 counts per 100/ml.in the summer of 2000. Data provided by the City of Toronto, Works and Emergency Services.*

Figure 6.
Bacteria counts in the Eastern Beaches, 1988-89 and 2000-01.



Bars show percentage of sampling days (range of 47-77 days, median = 48) in which E. coli *exceeded 1,100, and 1000 counts per 100/ml. Data provided by the City of Toronto, Works and Emergency Services.*

City of Toronto WES

City of Toronto WES

The Eastern Beaches storage tanks, shown at left inside prior to operation and above ground where the tanks lie under the beach, have reduced the number of beach postings in the area.

Improvements at the Eastern Beaches are largely due to the installation of two underground storage tanks (1990 and 1995) to store stormwater and sewage after rainfall events until the Ashbridge's Bay Treatment Plant has the capacity to treat them. As a result, *E. coli* counts at Woodbine, Beaches Park, Kew and Balmy beaches have been reduced (Figure 6) from pre-1990 levels to the point that bathing criteria are met nearly 80% of the swimming season.

In the Western Beaches area, a 3.7km tunnel extending from Parkside Drive to Strachan Avenue, with three huge storage shafts and a combined capacity of 85,000 cubic metres, has recently been built to collect and treat combined sewer flows. When fully operational in spring 2002, it is expected to reduce postings at the Sir Casimir Gzowski, Sunnyside and Budapest beaches by about 75%, creating significant improvements in recreational opportunities.

Marie Curtis beach in Etobicoke, and Bluffers and Rouge beaches in Scarborough are primarily affected by waterfront stormwater outfalls and pollution loads from the rivers and creeks. The City of Toronto's Wet Weather Flow Plan, currently being prepared, will recommend measures to reduce pollution from these sources.

In addition to designated beaches, the public long term goal is to reduce bacteria levels to provide safe conditions for water-contact recreation throughout the waterfront, rivers and creeks. In Toronto Bay for example, bay waters generally meet the criterion for water-contact recreation during dry weather. However, wet weather flows typically cause sudden and dramatic increases in bacterial levels. Bacteria levels in the rivers and creeks are currently so high that water-contact recreation is unsafe over 70-80% of the time in Etobicoke and Mimico Creeks, and over 98% of the time in Highland Creek. In the Don, the guideline is exceeded over 74% of the time, with some tributaries containing E.coli counts as low as 20 per 100 ml in dry weather but regularly over 100,000 in wet weather conditions. In the Humber and Rouge, the 100 count is exceeded only about 5-25% of the time, depending on sampling location (TRCA, November 1998).

CONCLUSIONS

Significant progress is being made towards restoration of water quality at designated waterfront beaches, but rivers and creeks remain problems in their own right, as well as sources of bacterial contamination to the waterfront. The key actions required to address this issue are to:

- improve stormwater management in the watersheds to reduce pollution contributions from non-point sources such as agricultural and urban runoff,
- eliminate cross-connections of sewage pipes to the stormwater system, and
- eliminate combined sewer overflows and water pollution control plant by-passes.

From Panfish to Trophy fish: a Profile of Fishing and Fish Consumption in the Toronto area (Kraft, 2000)

From surveys of 1,531 individuals fishing along the Toronto waterfront and adjacent municipalities, between '95-'97

- 77% of people had not eaten fish caught in the Toronto area during the 12 months prior to be interviewed
- of the 23% who had eaten fish in the past 12 months, 60% said they had eaten 1-11 meals over that time, 19% had eaten 12-25 meals, and 15% 26-95 meals
- most common fish eaten were rainbow trout, largemouth bass, smallmouth bass, common carp, brown trout, Chinook salmon, catfish, yellow perch, northern pike, and walleye
- only 37% of the consumers used the Guide to Eating Sport Fish
- only 3% reported eating other wildlife in the past 12 months (mainly mallard and Canada goose); of those, 53% only consumed 1-5 meals during past 12 months

2.2 CONTAMINANTS

Contaminants in the water and sediments contribute to restrictions on fish consumption as well as restrictions on dredging operations. They may also be a factor in the degradation of fish and wildlife populations, although more research is required to determine this.

2.2.1 Restrictions on Fish Consumption

"Decreased contaminant concentrations but advisories remain."

The 2000-2001 *Guide to Eating Ontario Sport Fish* (MOE/MNR, 2000) has the following advice for people fishing on the Toronto waterfront and the lower reaches of the Humber and Rouge. It recommends no consumption of lake trout larger than 55cm, and only limited consumption of Chinook salmon, brown trout, and carp of the same size, whether taken offshore or nearshore between Humber Bay Park and Ashbridge's Bay. In addition, restrictions are placed on consumption of smaller fish such as white perch, rainbow smelt, rock bass, and brown bullhead from nearshore areas. The contaminants of concern continue to be PCB (polychlorinated biphenyl), mercury and mirex, as they were in 1987 when Toronto was designated an Area of Concern. Although trends in consumption advisories are difficult to assess (mainly due to changes in sampling, testing and reporting methods), raw data show that contaminant levels have been going down, although the rate of decrease has slowed in recent years (A. Hayton, MOE, pers. comm.). Nevertheless, the advisories remain.

Mercury levels in Toronto fish are generally similar to those found in fish collected in less urbanized areas of the Lake Ontario basin. No sources of mirex exist in the Toronto area and contaminant levels in fish are from lakewide pollution, mainly from Niagara River inputs.

So the local contaminant of concern that must be addressed through actions in the Toronto area is PCB. The Stage I report noted that studies of young-of-the-year spottail shiners from 1977 - 1987 showed that contamination varied across the waterfront, with significantly higher PCB residues in fish from Humber Bay than those from Bluffers Park and the Rouge River (Environment Canada et al. 1989).

Monitoring undertaken in 1992 in the tributaries by the Ontario Ministry of the Environment (MOE, 1994) showed that PCB levels in forage fish consistently exceeded the IJC guideline for the protection of fish-eating birds and mammals in 92% of the stream sites sampled. In the Humber and Don Rivers, 4 of 5 sites and 5 of 5 sites, respectively, had common shiner populations with PCB residues above the guideline. All fish collected in Etobicoke and Mimico Creeks had PCB above the guideline, but it should be noted that few fish were found in Mimico Creek. In the Rouge watershed, residues in common shiners were surprisingly highest upstream of Markham and lowest at the Glen Rouge Site at Hwy. 401.

TRCA

The 2000-2001 Guide to Eating Ontario Sport Fish recommends only limited consumption of salmon caught on the Toronto waterfront.


TRCA

Fishing on the Toronto waterfront.

An analysis of wet weather flow from waterfront outfalls in 1989/1990 showed that average event mean concentrations for PCBs and other contaminants generally exceeded provincial water quality objectives or guidelines (PWQO/PWQG) (Theil and Beak, 1995). A 1991/1992 tributary discharge study revealed both dry and wet weather sources of PCBs from Toronto streams. Waterborne PCB levels frequently exceeded the PWQO, confirming that the Etobicoke, Mimico, Humber and Don watersheds are problem sources of PCBs, particularly in wet weather (Table 4).

Table 4.
Percent of samples from Toronto area watersheds in which PCB concentrations exceeded the PWQO of 0.001 µg/L in 1991-92.

LOCATION	DRY FLOW	WET FLOW
Etobicoke Creek	38%	63%
Mimico Creek	6%	67%
Humber Creek	32%	44%
Don River	13%	84%
Highland Creek	0%	8%
Rouge River	9%	6%

Results reflect a total of 221 samples.
Source: MOE, 1999

CONCLUSIONS

Fish consumption remains an impaired use on the Toronto waterfront. The main contaminant from **local** sources contributing to the fish consumption advisories is PCBs, with mercury and mirex a result of historical sources or currently originating elsewhere in the Great Lakes.

Inputs of PCBs to the waterfront are from CSOs, water pollution control plant bypasses, and the rivers and creeks. Most of the PCBs are contributed in wet weather conditions, with some dry weather contributions, especially in Etobicoke Creek and Humber River. The specific sources are not known, and Environment Canada and the Ontario Ministry of the Environment are currently conducting a study to track down sources in the Etobicoke watershed. The City of Toronto has 148 storage sites (down from 371 in 1995) where PCBs are stored until they can be properly disposed of, but these are considered to be well-secured.

Endocrine Disruptors

Evidence has been presented in recent years that the endocrine systems (gland and harmone systems that guide development, growth, reproduction, behaviour and other bodily functions) of certain fish and wildlife have been disrupted by chemicals that contaminate their habitats. Although effects have been observed, it has been difficult to prove that a specific chemical caused a particular endocrine effect. However, in many cases, the chemicals thought to be associated with the effects have already been identified as problem substances due to their toxicity and persistence. Examples include DDT, PCB, and certain heavy metals (US EPA, Feb. 1997). No studies have been conducted in the Toronto Area of Concern.

United States Environmental Protection Agency. February 1997.
Fact Sheet: EPA Special Report on Endocrine Disruption. Office of Research and Development

2.2.2 Degradation of Fish, Wildlife and Plankton Communities

"Probably not impaired, but requires further assessment."

TRCA

Further study of the incidence and cause of fish tumours is required to assess extent of impairment.

When the Toronto Area of Concern was designated in 1987, there were concerns that contaminants in the water and sediments were causing harmful effects on fish and wildlife through deformities, tumours and reproductive problems, and on the diversity and health of phytoplankton and zooplankton communities. However there was insufficient information to properly assess these potential problems.

Fish Tumours and Deformities

Unequivocal information on fish tumours and deformities across the Toronto AoC is still not available. Anecdotal reports from biologists working along the Toronto waterfront are that serious external deformities are rarely observed. However, surveys of fish in the tributaries reveal fairly high incidence of various types of tumours.

Surveys of epidermal papillomas and liver tumours in white suckers from the Don, Humber and Rouge Rivers are reported in Table 5. Lip papillomas were found in white suckers from the three sites. The prevalence of lip papillomas (10-32%) is similar to that found at other urban sites on Lake Ontario (Hamilton Harbour 66-73%, Ganaraska River 30-40%, and Sixteen Mile Cr. 30-41%). Viruses have been implicated in the etiology (causes or origins) of lip papillomas in white suckers, suggesting that the lip papilloma may not be a useful indicator of environmental conditions.

Liver tumours are useful indicators of environmental conditions, particularly the occurrence of hepatocellular (liver cell) and cholangiolar (bile duct) carcinomas. The prevalence of liver tumours was highest in white suckers from the Don River and lowest in the Rouge River. Unfortunately, there were only 64 fish in the Don River sample and the survey should be repeated to confirm findings.

Table 5.
Incidence of tumours and papillomas in white suckers in the Don, Humber and Rouge Rivers.

Location	Year	Number of Fish	Lip Papillomas (%)	Body Papillomas (%)	Ha (%)	HCa (%)	Ca (%)	Cca (%)	% Total Liver Neoplasms	Total Carcinomas (%)
Don	1994	64	10.9	0.0	1.6	1.6	3.1	6.3	12.5	8.7
Humber	1987	192	29.6	not available	1.6	0.5	1.6	1.0	4.7	1.3
Humber	1996	200	34.5	3.0	2.0	1.0	1.5	1.0	5.5	1.5
Rouge	1987	199	9.9	13.5	0.5	0.0	2.5	0.5	3.5	0.5
Rouge	1994	121	32.5	1.0	0.0	0.0	3.3	0.8	4.1	0.8

Source: Victor Cairns, Department of Fisheries and Oceans, Personal Communication.
Ha= hepatoma
Hc= hepatocellular carcinoma
Ca= cholangioma
Cca= Cholangiocarcinoma

Wildlife Deformities and Reproductive Problems

Cormorant nests on the Toronto waterfront have increased from zero in 1976 to over 3,000 in the year 2000.

In the early 1970s, there were documented effects of chlorinated organics on the reproductive success of herring gull, black-crowned night-heron, and other colonial waterbird species throughout the Great Lakes. Congenital anomalies such as crossed bills, malformed eyes, and extra limbs were abnormally prevalent in chicks of some fish-eating birds in Lake Ontario.

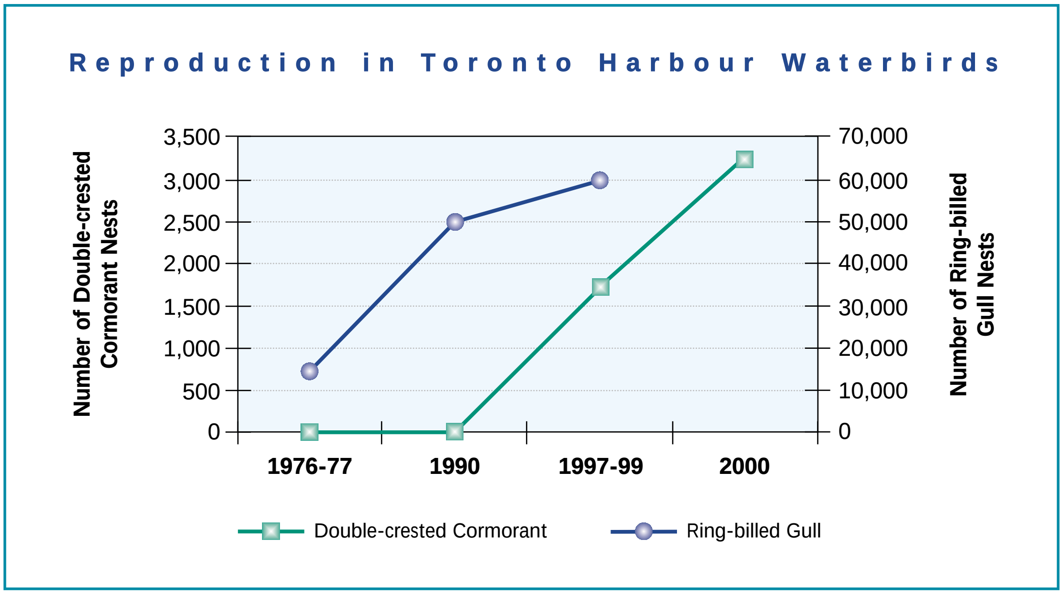
The initial resurgence of cormorant numbers in the Great Lakes following the ban of DDT was attributed to declining contaminant levels and an abundant food supply (Price and Weseloh, 1986). Levels of DDE in herring gull eggs declined 91.6% between 1974 and 1997 at Toronto Harbour, while levels of PCBs were down 93.5%, and 2,3,7,8-TCDD ("dioxin") levels were down 80.2% (Weseloh and Pekarik, 1999). These represent substantial declines in contaminant burdens, which should be accompanied by increased reproductive success and decreases in deformities. However, a recent assessment by MOE showed that PCBs in juvenile fish in the Toronto area remain elevated above the IJC guideline for protection of fish-eating birds and mammals (MOE, November 1999).

A recent study by the Canadian Wildlife Service (Bishop et al. 1996) found elevated concentrations of PCB (0.5 - 3.3 ppm) and DDE (0.06 - 0.35 ppm) in snapping turtle eggs collected in areas to the west and east of Toronto (Hamilton Harbour, Cranberry Marsh in Oshawa and Lynde Creek in Whitby), suggesting that contaminant burdens may still be of concern in the region.

The number of black-crowned night-heron nests in the Toronto Harbour increased from 56 in 1976 to over 1,200 in 2000. A subsequent decline to 769 in 2001 may reflect lack of suitable habitat or competition with other species.

Despite the possibility of unacceptably high levels of contaminants, surveys of reproductive success by the Canadian Wildlife Service (C. Weseloh, pers. comm.) show that there is very little population degradation among waterbirds at the Toronto waterfront. The number of cormorant nests has increased from 0 in 1976-77, to 3 in 1990, and over 3000 in the year 2000 (Fig. 7), while ring-billed gull nests have increased by a factor of 4 over the same time period. Herring gull nests have also increased, from 57 in 1976-77 to 111 in 1997-99. 1n 1998, hatching success of herring gulls was assessed on peninsulas A and B at Tommy Thompson Park. Fifty-seven nests showed an average clutch size of 2.6 eggs/nest and an overall hatching success of 71.9% (CWS, unpubl. data). These figures are comparable to those from clean control areas elsewhere on the Great Lakes and in North America (Weseloh et al. 1979, Pierotti and Good 1994).

Figure 7.
Increased nesting in Toronto-area waterbirds.



Data from Canadian Wildlife Service

Phytoplankton and Zooplankton Communities

Local stressors affecting phytoplankton and zooplankton communities are typically nutrients and toxic contaminants. Along the Toronto waterfront, nutrient levels have declined except near outfalls and river mouths, and are not expected to negatively impact the overall waterfront community. However no studies have been undertaken to determine the toxicity of the nearshore waters to phytoplankton and zooplankton species.

Rosemary G. Hasner, TRCA

Further studies are required to verify preliminary analysis of phytoplankton and zooplankton.

CONCLUSIONS

Although existing information suggests that the degradation of fish and wildlife populations, and phytoplankton and zooplankton communities in the Toronto area is not widespread or severe, further studies are required confirm this. Specifically, we recommend:

- a survey of the incidence of liver tumours and external deformities in white suckers and brown bullheads, to compare the situation in Toronto with less polluted areas on the Great Lakes;
- a formal survey of the incidence of deformities among birds or snapping turtles; a survey of contaminant levels in young-of-the-year forage fish in more locations than is currently sampled; and/or an ecological risk assessment to assess the occurrence of deformities in wildlife;
- bioassays to assess the survival, growth, and reproduction of phytoplankton and zooplankton in Toronto waterfront and watershed waters in order to determine whether phytoplankton and zooplankton are degraded due to toxic contaminants.

Salt – A New Substance of Concern

Environment Canada released its five-year analysis of road salt in August 2000. The draft Priority Substances List Assessment Report classified road salt as an environmental toxin of significance when used in present concentrations and quantities for de-icing.

The Ontario Provincial Water Quality Standard cites 250 mg/L. as the upper limit for chlorides, while natural background amounts range from 10-50mg/L. Monitoring of storm sewer outfall mixing zones in rivers and creeks across the City and in parts of York Region revealed consistently elevated chloride levels, with concentrations exceeding PWQS by as much as 156 times. Winter averages for the Don River range from 570 - 1250 mg/L. in the winter with estimated summer concentrations of ~250mg/L. (City of Toronto, W.E.S., Feb. 2001)

In addition to water quality concerns, salt spray significantly damages roadside vegetation. City of Toronto estimates that yearly average salt use of 130-150,000 tonnes can be cut by at least 40% with the implementation of comprehensive Best Management Practices. Consideration should also be give to alternative de-icers such as CMA where snow melt discharges remain high in chloride concentration. Completion and implementation of the City's Wet Weather Flow Plan will move us closer to achieving this target and addressing one of the recommendations in the RAP Stage 2 report: "reduce the total amount of sodium chloride and other chemicals used on area roads" (Action 50, *Clean Waters, Clear Choices*, 1994).

2.2.3 Restrictions on Dredging Activities

"Improving, but still impaired in specific areas."

Waterfront Regeneration Trust

Dredging is required in a few locations on the Toronto waterfront for navigation or flood protection purposes.

Contaminant levels in sediments have always shown considerable variation across the Toronto waterfront, with high levels of nutrients, organics, and metals in areas of poor water circulation (embayments, slips) and near tributary mouths and sewage/water treatment plant discharges. When the Toronto waterfront was designated an Area of Concern in 1987, many areas contained sediment deposits that exceeded the Provincial guideline for disposal in open water, including Humber Bay, the Inner Harbour, Keating Channel, Ashbridge's Bay, and at Highland Creek near the water pollution control plant.

Sediment quality has improved since 1987, with much of the improvement attributable to various control measures like sewer use by-laws and the elimination of leaded gas. However, there are still significant quantities of sediment being contributed from construction sites throughout the watersheds.

At present, sediments from three locations where dredging is undertaken still exceed open-water disposal guidelines and require confined disposal. In the Keating Channel, 35,000-40,000 cubic metres of sediment from runoff and erosion upstream in the Don River are removed each year. Dredged material is placed in the Confined Disposal Facility (CDF) on the Leslie Street Spit. In the Inner Harbour, approximately 3,000 cubic metres of sediment are dredged every three years and transported to the CDF.

Maintenance dredging of the opening into Ashbridge's Bay Park is done every few years. The most recently dredged material was transported to the CDF.

Sediments dredged from the Eastern and Western Gaps are not from the watersheds but are the result of erosion processes along the waterfront. They are suitable for open water disposal, and Eastern Gap sediments have been used to create parkland enhancements at Tommy Thompson Park.

CONCLUSIONS

Although contaminant levels in dredged areas of the Toronto waterfront have declined from historic levels, they still limit the open-water disposal of dredged materials. Future contributions of contaminated sediments should be reduced by implementing source controls in the watersheds (through municipal sewer use by-laws, and Toronto's Wet Weather Flow Management Master Plan). It will also be necessary to ensure that future activities do not re-suspend deep sediments, for example in association with lowered lake levels, new dredging activities and/or lakefill construction.

Rosemary G. Hasner, TRCA

One source of excessive sediment is poor construction practices.

2.3 NUTRIENTS, TURBIDITY, AND AESTHETICS

Waterfront Regeneration Trust

The Port Authority regularly skims litter and debris from the surface of the Inner Harbour.

Nutrient enrichment and high volumes of silt and muddy substrates are the most likely cause of the degradation of waterfront benthic invertebrate communities, which are the base of much of the aquatic food web. Aesthetic quality is degraded by turbidity, oily films, odours, garbage and other debris, and the nuisance growth of algae.

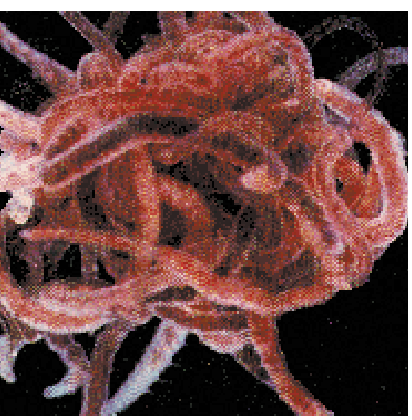
When Toronto was designated an Area of Concern, nutrient levels across the Toronto waterfront often exceeded the provincial water quality objectives, although they were much lower than they had been in the 1960s. Significant reductions in phosphorus had already been achieved due to controls on the use of phosphates in laundry detergents, and improved treatment of sewage at the water pollution control plants.

More recently, monitoring of waterfront water quality between Mimico Creek and Ashbridge's Bay in 1997 confirmed that phosphorus levels are still declining (MOE, November 1999). Nutrient levels and water clarity in the nearshore have improved to the extent that wild celery is now growing in places in Toronto Bay (Gord MacPherson, TRCA, pers. comm.). In 2000, Toronto Region Conservation initiated water quality surveys, including an assessment of phosphorus, at 16 waterfront sites in order to provide more systematic information about changing conditions.

Compared to the waterfront, water in the rivers and creeks still consistently exceeds the provincial water quality objectives (PWQO) in both wet and dry weather. A summary of the Ontario Water Quality Monitoring Network data for 1990-1996 (TRCA, November 1998) indicated that phosphorus fails to meet the PWQO over 40% of the time in all watercourses, except the headwaters of the Humber (20%). In the Don, the PWQO is exceeded 80-100% of the time.

2.3.1 Degradation of Benthos

"Pollution tolerant communities occur near storm and combined sewer outfalls, and mouths of rivers and creeks."



Trefor Reynoldson

Oligocheate worms are common in Toronto sediments, being tolerant of polluted conditions.

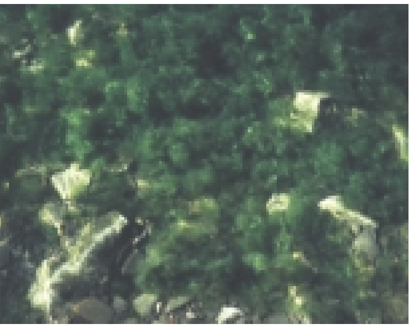
The health and composition of benthic invertebrate communities are generally affected by contaminants, nutrients and substrate types. A comprehensive synthesis of information regarding sediments and the benthic community of the Toronto Harbour from 1970 to 2001 has recently been completed (TRCA, 2001-DRAFT). This synthesis shows that the structure of the benthic community in the Toronto Harbour does not appear to respond to contaminant levels in substrates. Copper and lead levels have declined over time, and although problem areas (i.e., areas exceeding MOE Sediment Quality Guidelines) still exist near CSO discharges, metal bioavailability is low. It appears that the physical characteristics of the substrates (their fine sediment and organic content) are more important in determining the types of benthic communities in the harbour. Areas of organic enrichment continue to support benthic communities dominated by pollution tolerant forms.

CONCLUSIONS

The benthic invertebrate community of the Toronto waterfront is still adversely affected by the fine silts and organic muds in the areas near stormsewer and CSO outfalls and the mouths of the rivers and creeks. Measures required to improve this situation include implementation of the City of Toronto's Wet Weather Flow Plan, improved stormwater management in the upstream municipalities, and reductions in sediment inputs from construction sites and streambank erosion.

2.3.2 Undesirable Algae

"Nuisance occurrences of algae still occur along the Etobicoke waterfront and in localized areas along the Toronto Islands and Scarborough waterfront."

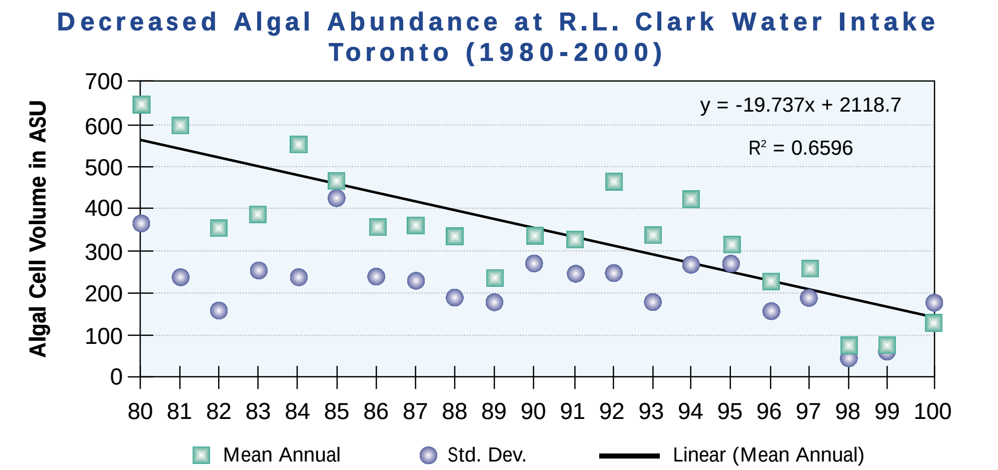


Halton Region Conservation Authority

Algae growing on rocky substrate.

Excessive nuisance growth of algae and blooms of phytoplankton are not a major feature of the Toronto waterfront, except for localized problem areas. For example, as shown in Figure 8, algal densities have decreased at the R.L. Clark water intake since the 1970s, indicating a major improvement in water quality.

Figure 8.
Declining algal abundance on the Toronto waterfront, 1980-2000.



Declines prior to 1988 reflect reduced nutrient loading. Post 1988 declines reflect decreased nutrient loading as well as filter feeding by zebra and quagga mussels. Data courtesy of Environmental Monitoring and Reporting Branch, MOE.

Cladophora, the most common form of nuisance algae in the Toronto area, prefers cold water (< 18°C), hard substrate, phosphorus concentrations in excess of 5 µg/L and depths of 6m or less (T. Howell, MOE, pers.comm.). It may therefore grow in deeper waters in early summer, being fed by storm-derived nutrient pulses, then senesce (reach maturity) and wash inshore when waters become warmer. No systematic surveys of *Cladophora* have been undertaken along the Toronto waterfront. However, personal surveys (T. Howell, MOE) reveal that it is abundant in the Toronto area, whereas it does not occur in areas of Lake Ontario where habitat is suitable but lack nearshore nutrient sources.

Along the western Toronto waterfront (Etobicoke Creek to Mimico Creek), nuisance algae are an unpleasant problem for local residents, boaters and park users. This is the only stretch of Toronto waterfront where extensive natural rock substrate exists for the attachment of *Cladophora*. Nuisance algae have been observed in the vicinity of most stormwater outfalls along the entire Toronto waterfront (Milo Sturm, and others, personal observation), suggesting that the high contributions of nutrients from urban and agricultural runoff are a causal factor. High concentrations of nuisance algae were also observed on the shores of the Toronto Islands in 2001, probably related to the low water levels (J. Kidd pers.comm.). In addition, they also occur periodically in some areas of the rivers and creeks.

Algae as a biomonitor for upstream contributions of nutrients

The TRCA, in conjunction with Prof. Marianne Douglas at the University of Toronto, is developing and implementing a protocol for monitoring periphytic (attached) algae in the streams, as a cost-effective "early-warning" system of change in the watersheds. To date, the protocol has been pilot tested in the Humber River. When fully implemented, the resulting information will be extremely useful to the RAP in determining sources of nutrients requiring control.

CONCLUSIONS

Although no formal surveys have been undertaken, the existence of nutrient enrichment in the nearshore areas of Toronto's waterfront, combined with anecdotal observations of problem algae growth in a number of locations, suggest that improvements will result from nutrient reductions in stormwater and treatment plant effluents, and the elimination of CSOs.

2.3.3 Other Aesthetic Issues

"Aesthetic quality is degraded in many parts of the waterfront and tributaries."

Waterfront Regeneration Trust

Spills, stormwater runoff, and litter all contribute to degraded aesthetics.

In addition to the problems caused by undesirable algae, there are several other causes of degraded aesthetics in the Toronto Area of Concern. Spills can cause objectionable deposits, unnatural colour and sometimes unpleasant odours, but they are not widespread nor persistent along the waterfront and in the watersheds. Sheltered embayments along the waterfront, as well as the rivers and creeks, are a murky brown and may smell unpleasant following heavy rainfall, but usually return to a normal colour and odour within a day or two. Garbage, litter and other debris are found throughout the river valleys and along the waterfront. Floating litter is routinely collected from quays along Toronto Bay.

In the past, there have been no systematic surveys of aesthetic quality in the Toronto waterfront and watersheds. In 2001 TRCA initiated a community-based visual survey for the public to assess the aesthetic quality of their local stretch of stream or waterfront (called Stream-watch and Waterfront-watch respectively).

CONCLUSIONS

Degraded aesthetics occur in localised areas throughout the Toronto Area of Concern but are not a persistent problem throughout the area. We recommend increased efforts in cleanup programs, litter reduction, spill prevention, erosion control, management of construction sites, and stormwater management.

The Contribution of Spills

A Ryerson study of spills in the Toronto area reports about 3.8 million litres of oil spilled to Lake Ontario from the GTA between 1988 and 1997, of which the City of Toronto contributed 480,000 litres. The largest volume of oil was spilled from storage depots and service stations, jointly producing about 68% of total spill volume within the City of Toronto. The primary causes were human error or equipment failure. Upstream, in the "905" municipalities of the RAP, the MOE Spills Action Centre recorded 3350 oil spills between 1988 and 1997. The largest number of spills was on roads, contributing 30-37% of total spill volume within each region (Li, 2001a and 2001b).

Rosemary G. Hasner, TRCA

Clean up activities.