Ontario

Information Report

Ottawa River Fish-Kill Event August of 2006

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Introduction / Executive Summary

This information report provides a record of the fish kill event that occurred on the Ottawa River between La Passe (downstream from Pembroke) and Rockland (downstream from the City of Ottawa) in August of 2006. The report describes the nature and extent of the event, documents agency responses, discusses the conditions that contributed to the fish kill, and presents the results of analysis conducted by the Ministry of Natural Resources (MNR) and the Ministry of the Environment (MOE).

Estimates based on MNR and MOE observations and on reports from the public indicate that the fish kill involved roughly 2,000 to 4,000 fish over a two-week period in mid-August on a 160-km section of the Ottawa River. The fish killed were almost exclusively channel catfish. The number of confirmed reports of other fish species being affected, including suckers, smallmouth bass and northern pike, was very low.

MNR has concluded, based on site visits, observations, and analysis of water quality and dead fish, that the cause of the fish kill was a fish disease called columnaris, caused by *Flavobacterium columnare*, which is commonly present in the environment. High temperatures, torrential rains and extreme runoff events in late July and early August, resulted in warm water temperatures in the Ottawa River and exacerbated other physical factors which combined to create a stressed environment in which the columnaris bacteria spread quickly through the channel catfish population, affecting mostly juvenile fish.

Timing and extent of event

Reports from the Public

On August 8, 2006 the Ministry of the Environment (MOE) Ottawa District Office and the Ministry of Natural Resources (MNR) Pembroke District Office, started receiving calls from the public reporting observations of dead fish appearing on shorelines along a section of the Ottawa River known as Lac Des Chats. Initial calls indicated that the area of concern was from the mouth of the Bonnechere River downstream to the Chats Falls Dam below Arnprior.

The first reports from the public of dead fish showing up on Ottawa river beaches, came in August 8.

Calls from the public continued and intensified through August 9 and 10, 2006, and into the following week.

By Monday August 14, 2006 there were reports from the public of dead fish upstream of the mouth of the Bonnechere River and downstream of the Chats Falls Hydro Dam. Further calls and investigations indicated that dead channel catfish were observed as far upstream as the village of La Passe and downstream as far as Petrie Island at the town of Rockland.

Some of the reports from the public included observations of fish species other than channel catfish, and observations of non-aquatic species such as seagulls and a turtle (later investigations indicated that the fish kill event almost exclusively involved channel catfish and that no non-aquatic species were affected).

Calls from the public continued throughout the duration of the event, and it is estimated that several hundred calls were received by numerous agencies, municipalities, and organizations including the local Townships, the Renfrew County and District Health Unit, the City of Ottawa Health Unit, MNR, MOE, Environment Canada, the Ottawa River Keeper, and the City of Ottawa.

Geographic Area

With the information provided through calls from the public, MNR was able to map (see Figure 1) the extent of the event, and the area where the highest numbers of dead fish were reported.

Initial reports and investigations were focused on Lac de Chats, a 40-km section of the river approximately 7,603 hectares in size, between the Chenaux Dam and the Chats Falls Dam at Fitzroy Harbour. Three tributaries enter this reach of the Ottawa River, the most significant being the Madawaska River at Arnprior, the Mississippi River at Morris Island and the Bonnechere River near Castleford.

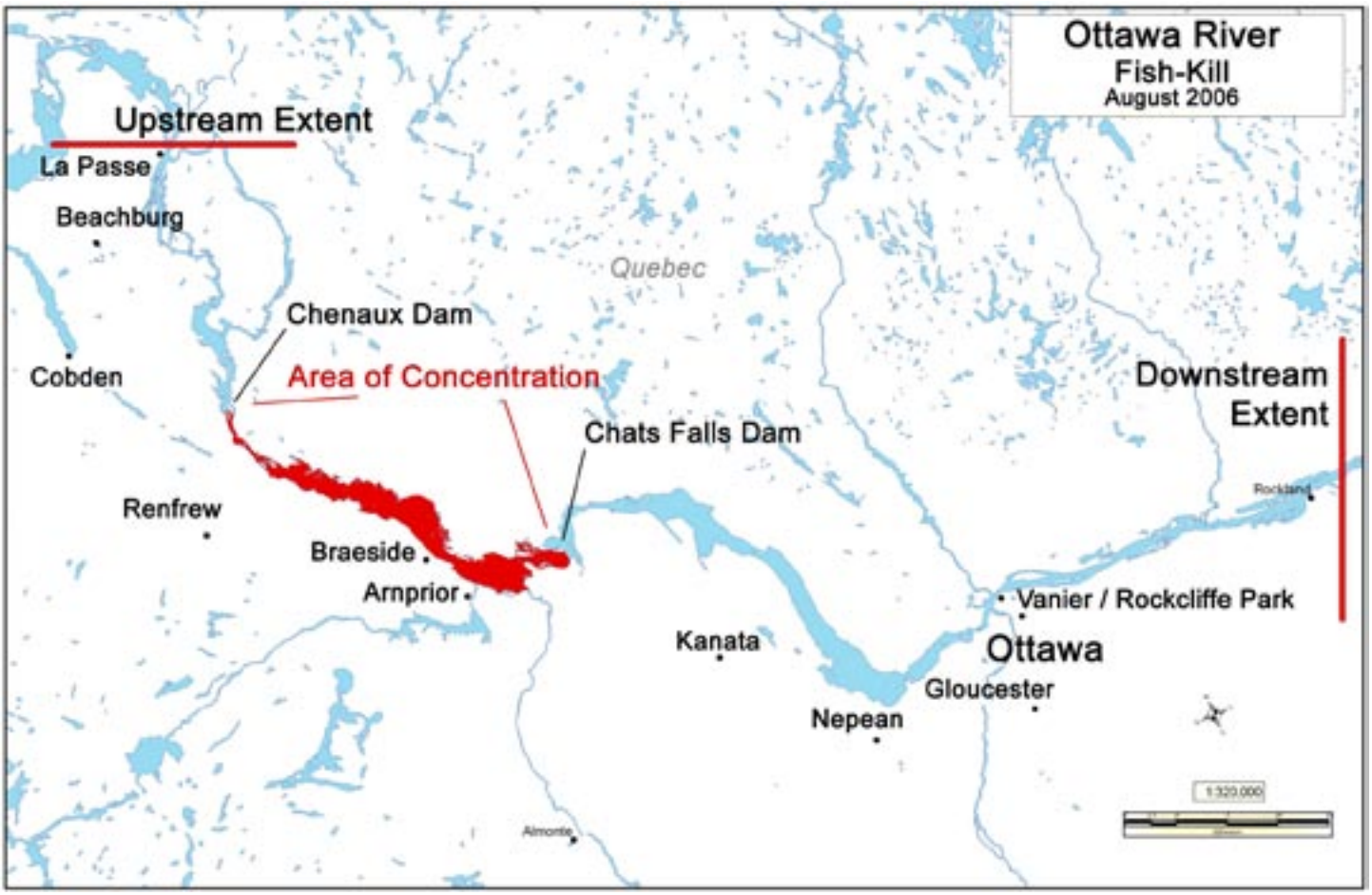


Figure 1: Catfish mortality was observed on the Ottawa River as far upstream as La Passe and as far downstream as Rockland. Most of the catfish mortality occurred in the area of concentration of Lac des Chats between Chenaux Dam and Chat's Falls Dam.

Later calls and investigations revealed channel catfish mortality on the Ottawa River as far upstream as the village of La Passe, approximately 35 river km from Chenaux, in the Township of Whitewater Region. Mortality was observed as far downstream as Petrie Island near the town of Rockland, approximately 98 river km from the Chats Falls Dam. By far, most of the dead catfish observed were in the Lac Des Chats area, shown as the area of concentration in Figure 1.

The fish community in this section of the Ottawa River is comprised of approximately 70 percent channel catfish (Haxton 1999).

Critical Dates

Initial reports of dead fish in the Lac des Chats section of the Ottawa River came August 8, 2006. By August 18, 2006 after a week of site visits, on-the-river sampling for water quality and aquatic health, and monitoring reports from the public, it was apparent that the fish kill event was over. No new dead fish were observed and no further reports of dead fish were received from the public.

Fish Mortality

Throughout the investigation period, the majority of mortality occurred with channel catfish between 25 and 35 cm in size (juvenile fish). Very few older or younger year classes were observed.

Reports of dead catfish as far downstream as Petrie Island near the town of Rockland were received by MNR over the investigation period.

Lac Colounge is the upper extent of the area where channel catfish mortality was observed. This is based on a reported observation of ten dead channel catfish by an angler who was participating in a bass tournament held at the village of La Passe.

Agency Response

MNR/MOE Response

MNR deployed a team of staff onto the river in the Lac des Chats section on Friday, August 11, 2006 to determine the extent of the event and collect samples of dead fish for analysis. Sampling continued through the week of August 14 to 18, 2006 with MOE personnel sampling for water quality. On Tuesday, August 15, 2006 four crews were deployed in Lac des Chats and one crew in Lac Deschenes looking at a 30-km section of the river below the Chats generating station. MNR and MOE also sent crews to visit homes and properties along the river during the week of August 14 to 18, 2006. Field crews collected samples, made observations and responded to reports from the public.

Water quality samples were processed through MOE. Fish samples were sent to the MNR fish health laboratory at the University of Western Ontario in Guelph.

Over a five-day period, a no-swim advisory was in effect on the Lac des Chats section of the Ottawa River.

Health Unit Responses

On Monday, August 14, 2006 the Renfrew County and District Health Unit issued a precautionary notice to the public, advising them not to swim in the Ottawa River between the Chenaux Dam and the Chats Falls Dam. The public was also advised not to use water directly from the river for drinking or cooking. This precautionary public advisory was in place until 4 pm Friday, August 18, 2006.

The City of Ottawa Health Department was also actively involved throughout the course of this event. The City of Ottawa Health Unit did not issue any beach closure advisories during the event, or any advisory regarding the use of water directly from the river for drinking or cooking.

Analysis and Results

As the fish kill event unfolded, MNR and MOE began an investigation into possible causes and implications. This investigation included on-site observations to determine the geographic extent of the incident, identify the species affected, obtain water quality and fish samples, and identify potential sources of contaminants introduced by human activities.

Point Source(s)

As the first reports of a fish kill came in, the investigation focused on a relatively small area of the river and serious consideration was given to the possibility that a point source spill was responsible for the release of an adverse contaminant into the Ottawa River. Several calls to MNR also indicated that there was public concern about a possible spill from a point source(s), including discharges from municipal sewage treatment plants (STPs), a pulp and paper mill and other facilities upstream of Lac des Chats. All known possible point sources of contaminants in the area of the fish kill were investigated. The only spills reported to the MOE during this period were related to sewage bypasses at the Renfrew, Arnprior, Cobden and Pembroke sewage treatment plants. The most significant of these occurred at the Renfrew STP. After reviewing sewage and water quality data from this bypass event, it was concluded that the discharge of untreated sewage did not directly cause the fish kill. No other reports or evidence of contaminant releases with the potential to cause this fish kill, were identified in the area.

As the fish kill event unfolded, and broadened to cover a very large area of the river over an extended period, point-source discharges were ruled out as a possible direct cause.

The first fish sample analyzed at the Ministry of Natural Resources Fish Health Lab in Guelph showed obvious signs of columnaris bacterial infection. This was later confirmed in other samples.

MNR's survey work indicated that whatever was killing catfish, was not impacting the overall health of the Ottawa River's aquatic ecosystem.

Other Species Affected

Some reports from the public indicated that many fish species were showing up dead on Ottawa River shorelines. MNR also received reports that non-fish species such as birds and turtles were being found dead on shorelines. All of these reports were followed up with site visits by MNR staff.

MNR's investigation concluded that although there may have been very small numbers of other fish species involved, such as sucker species, smallmouth bass and northern pike, the fish kill almost exclusively impacted channel catfish. MNR found no evidence that any non-fish species, such as birds, amphibians or mammals, were impacted by this event.

Aquatic Ecosystem Health

MNR and MOE field crews also assessed the aquatic health of the Ottawa River by inspecting and sampling different sites for a variety of indicator species including clams, minnows, invertebrates, insect larvae and crayfish over several days. The findings indicated that the aquatic ecosystem of the river appeared healthy with no adverse affects observed on these species.

The conclusion of the agencies was that the aquatic ecosystem of the Ottawa River, even in the concentrated area where most of the dead channel catfish were found, remained healthy throughout this event.

Public Health

The Renfrew County and District Health Unit, as a precaution while the cause of the fish kill was unknown, asked doctors and hospitals to monitor and report any human health issues that might be directly related to the water from the Ottawa River in the area where fish were dying. No evidence of impact on human health was observed.

The City of Ottawa Health Unit monitored the situation but did not put any public advisories in place restricting the use of water from the Ottawa River.

Water Quality

MOE staff conducted site visits with MNR crews, taking water quality samples in the area of the fish kill on the Ottawa River (see Figure 2). During the early stages of the investigations, while point-source discharges were still being considered, water quality samples were also taken in the Bonnechere River.

Water samples were collected as grabs into 250 ml glass and 500 ml plastic bottles supplied by the MOE laboratory in Toronto. Samples collected for metal analyses were preserved with nitric acid (20 drops). Samples for phenolics and bacteria were collected into bottles used specifically for these parameters and preserved with sulphuric acid and thiosulphate, respectively.

Water samples were sent to the MOE laboratory and analyzed for heavy metals, nutrients, pH, alkalinity, conductivity, phenolics, five-day biochemical oxygen demand BOD5, and solids (total, suspended and dissolved). Water quality sample results are presented in Appendix 2, and include all stations sampled between August 14 and August 16, 2006.

At each respective sampling station, water temperature, pH, specific conductivity and a dissolved oxygen reading were taken using a YSI 650 data logger and sonde (see Appendix 3).

Ambient river water quality data was obtained from the MOE's Provincial Water Quality Monitoring Network. Historical water quality data for the Ottawa River at the Chenaux Dam (Station No. 18000024002) is available between 1968 to 2000. Historic water quality data for the Bonnechere River east of Castleford (Station No. 18369001002) is available between 1966 to 2000. Current water quality data at Chats Falls (Station No. 18000017002) is available between 1966 to 2006. Summary statistics for these stations is included in Appendix 3.

All water samples were compared to the Provincial Water Quality Objectives (PWQO) (MOE, 1994). The PWQO are numerical and narrative criteria which serve as chemical and physical indicators of surface water quality. They are established on the basis of aquatic toxicity, bio-accumulation, mutagenicity effects, and the lowest effect concentration currently known with an added safety factor.

Analytical and field data results for the Ottawa River samples are presented in Appendix 1 and 2, and include all stations sampled on August 14 to 16, 2006. All sample results were compared to their respective PWQO, where available, and to historic water quality data collected as part of the Provincial Water Quality Monitoring Network (PWQMN) program.

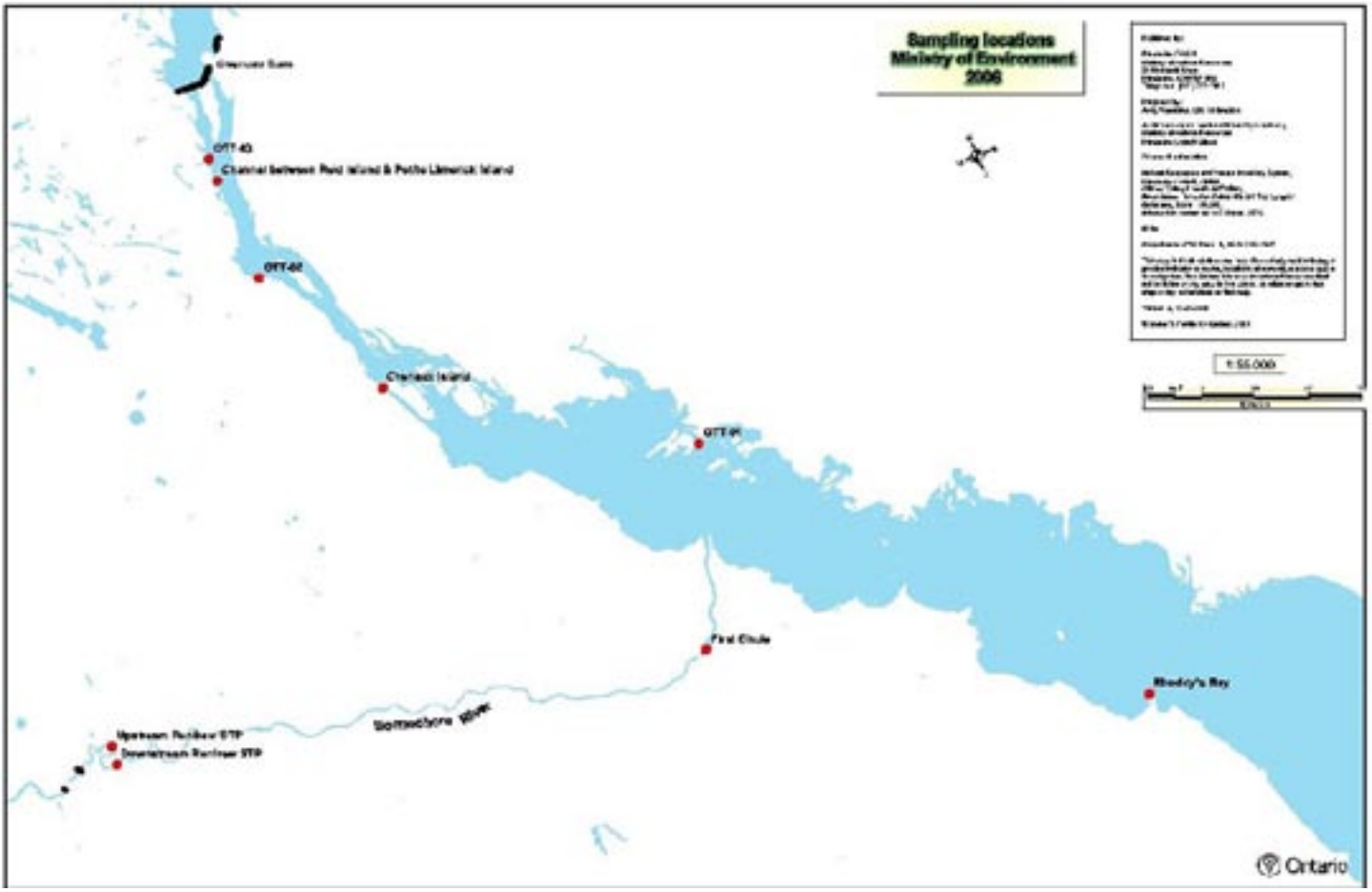


Figure 2: The location of water quality samples taken on the Lac des Chats section of the Ottawa River during the week of August 14 to 18..

For the Ottawa River samples collected on August 14 to 16, 2006 results revealed that most parameters were significantly below the PWQO, and were at concentrations consistent with long-term averages. Station OTT-02 had a pH level of 9.22 on August 15, 2006 as reported on the MOE laboratory sheet (Appendix 1). The Ottawa River results for the other stations were much lower, ranging between 7.37 and 7.86. The OTT-02 result seemed high for the Ottawa River and a re-measurement at the MOE laboratory showed a pH of 8.34. A review of the field data collected on the same day and location as OTT-02 indicated a pH level of 7.83 which is consistent with the other stations and the river as a whole (Appendix 2). The PWQO for pH is 6.5 to 8.5.

Total aluminum results for Ottawa River sample stations OTT-01 to OTT-03 exceeded the PWQO of 75 ug/L. It is noted, however, that the PWQO is based on total aluminum measured in clay-free samples. The MOE samples were not field-filtered which would explain the elevated results. A review of PWQMN data shows that ambient levels for total aluminum measured in the Ottawa River are naturally above PWQO levels.

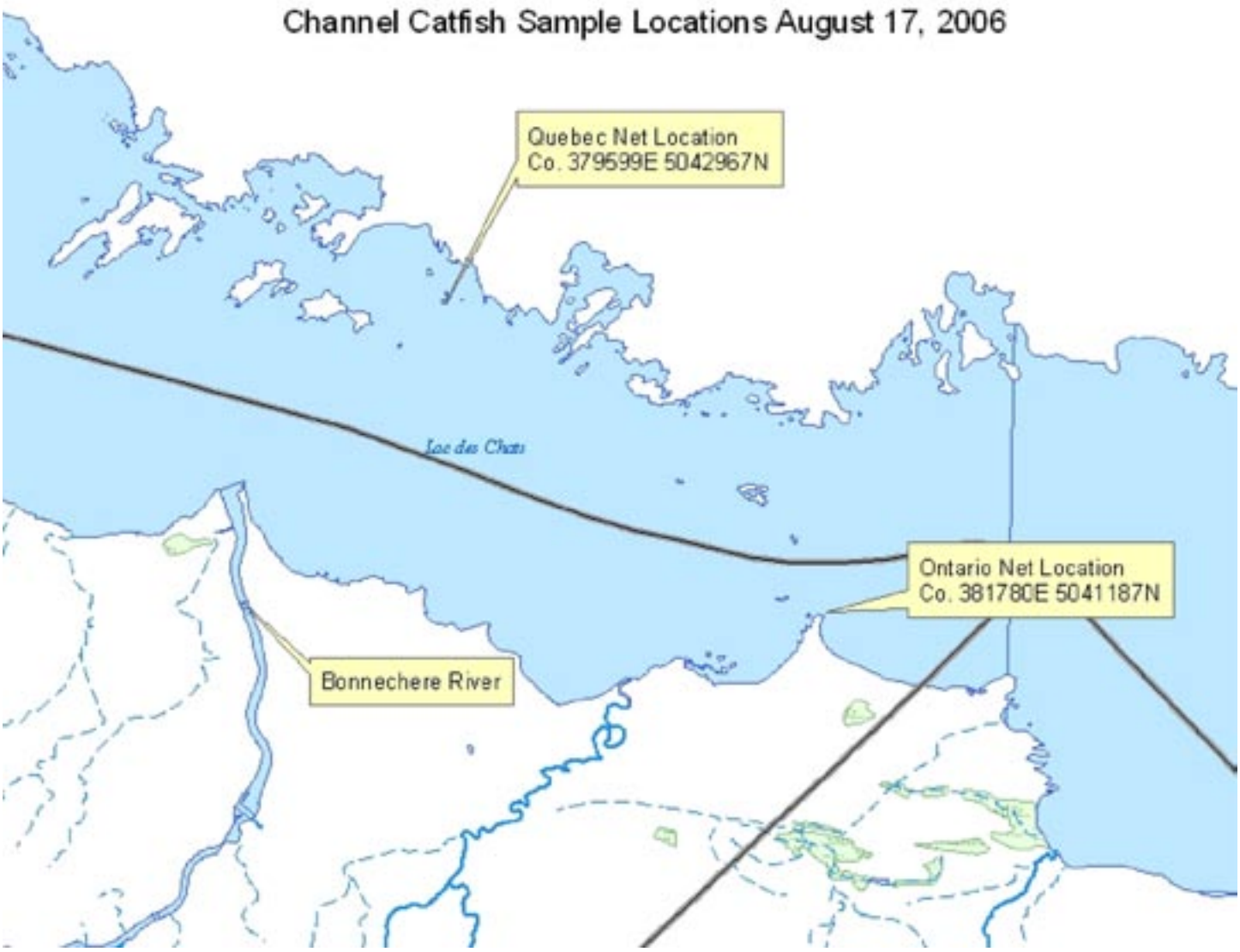


Figure 3: Locations of channel catfish live-net sampling in the Ottawa River August 17 2006. These samples confirmed the earlier indications of a columnaris outbreak in the catfish population

Dissolved oxygen concentrations in the Ottawa River were measured at each sampling station (see Field Data in Appendix 3). At two sites (OTT-03, Chenaux Island, B) dissolved oxygen and temperatures profiles were taken through the water column. Results show that the Ottawa River was well oxygenated during the sampling periods. No dissolved oxygen data is available for the period coinciding with the hot weather (i.e. July 31 to August 7), nor is any dissolved oxygen data available during night-time conditions, when oxygen depressing (sags) can occur as a result of plant and bacteria respiration.

Fish Samples

Dead and live (both infected and apparently healthy) channel catfish specimens were collected from the Ottawa River on August 11, 14, and 17, 2006. The samples collected on the 11th were badly decomposed and frozen therefore not considered acceptable for examination. A single heavily infected catfish was collected alive from Rhoddy's Bay on August 14th. This specimen was placed on ice and transported to the University of Guelph on August 15th where preliminary observations that day indicated the presence of columnaris disease which is caused by *Flavobacterium columnare*. This finding of columnaris in one sample of one fish taken from one location on the river, was not considered conclusive at that time.

MNR set two live trapnets in the Ottawa River August 16, 2006 (see Figure 3). A net was placed on both sides of the Ottawa River in locations known to have high catches determined from the 1998 Nearshore Community Index Netting (NSCIN). The purpose of this netting was to capture a representative sample of live fish specimens (all species), assess their visual condition to see whether there were any signs of the columnaris present, and to collect samples for examination by the pathology laboratory at the University of Guelph.

The nets were retrieved early Thursday morning, August 17, 2006. All other fish species captured in the netting sample appeared to be in perfect health and displayed no signs of abnormalities. Preliminary examination of the channel catfish from both nets revealed signs and symptoms of columnaris. Some of the catfish appeared to be severely infected. Some appeared to have minor infections but were otherwise healthy. Some appeared to be uninfected and in healthy condition. Samples of both healthy and infected catfish were collected and sent to the laboratory in Guelph for analysis.

All fish were visually examined at the Guelph laboratory for the bacteria. Only fish that showed signs or symptoms of being infected were sent for virology tests. The final results for the disease and pathogen testing were received on October 20, 2006 (Appendix 1). All tests for pathogens other than *Flavobacterium columnare* were negative.

Catfish infected with columnaris usually show brown to yellowish-brown lesions (sores) on their gills, skin and/or fins. Early signs of the disease include loss of pigmentation on the skin.

What We Know

Results of Analysis

For the Ottawa River water quality samples collected on August 14 to 16, 2006, results show that most parameters were significantly below the PWQOs, and were at concentrations consistent with long-term averages. The analysis did not provide any indication that the fish kill was directly related to water quality.

Columnaris was present in all dead samples and in some live samples of catfish taken from the Ottawa River. No viral infections were detected in the virology testing on the catfish sampled from the Ottawa River. The pathology testing in the sampled fish produced no significant findings beyond the presence of *Flavobacterium columnare*. All observations in the laboratory analysis were consistent with a columnaris outbreak in the population. Given the high water temperatures, high densities of catfish in the shallows, algal blooms, heavy rainfall event(s) and subsequent runoff preceding the catfish mortalities, it seems likely that columnaris was the major, if not sole, cause of mortality.

Although as a precautionary measure, the Renfrew County and District Health Unit issued a public health advisory restricting swimming and the public use of water from the river in the Lac des Chats section during the fish kill event, no evidence of any impact on human health was observed.

The Ottawa River

The Ottawa River is a large, cool-water river with high flows and a high flushing rate, draining an area the approximate size of the province of New Brunswick.

The Lac des Chats section of the river is more lake-like than other sections. The Quebec shoreline in this section has many back bays and shallow areas where the water has an opportunity to warm significantly during periods of extended higher temperatures.

Advanced skin lesions produced by columnaris are typically round or oval in shape, and yellowish-brown in colour, with an open ulcer at the center.

Ecology

The Lac des Chats section of the Ottawa River and the sections below Lac des Chats, support complex fish communities largely dominated by channel catfish.

The near-shore fish community in the Lac des Chats section is comprised of approximately 70 percent channel catfish.

Columnaris

Columnaris is a fish disease caused by *Flavobacterium columnare*. This bacteria is naturally occurring and commonly found in freshwater lakes and rivers.

Columnaris is the second most common cause of channel catfish mortality in the United States aquaculture industry (Durborow et al. 1998) In most cases it is caused by fish being exposed to stressful conditions such as high water temperature greater than 20 C, high fish densities and poor water quality (Tripathi et al. 2003). Studies have demonstrated that the transmission of F. columnare to gill tissue can be enhanced by high nitrite concentrations above 5mg/L, high organic content above 2mg/L, high water temperatures 28 C and rapid changes in water temperature of 5 C or greater, all of which can cause significant stress to fish. Fish exposed to skin infections can have longer clinical course (two to seven days). Fish with heavy infections may die within 48 hours (Tripathi et al. 2003). Fish with columnaris disease usually display signs on their gills and body surface.

Fish usually have brown to yellowish-brown lesions (sores) on their gills, skin and/or fins. The bacteria attaches to the gill surface, grow in spreading patches, and eventually cover individual gill filaments. Skin lesions produced by columnaris initially are very shallow and may appear as an area that has lost its natural shiny appearance. More advanced lesions may be round or oval in shape, yellowish-brown in colour, with an open ulcer in the center (see photo at right). A characteristic lesion produced by columnaris is a pale white band encircling the body, often referred to as saddleback condition. As the infection progresses, a yellowish-brown ulcer is often found in the center of the “saddle”. These symptoms were observed on many of the dead fish found throughout the area of Lac Des Chats. Once established, the infection can spread quickly and cause high mortality rates.

Channel Catfish Ecology

Channel catfish in Canada are found in lakes and moderate to large rivers (Scott and Crossman). In natural waters channel catfish live in moderate to swiftly flowing streams, but they are also abundant in large reservoirs, ponds and some sluggish streams (Wellborn 1988). They are usually found where the river bed is rock, sand, gravel or rubble, in preference to mud bottoms.

Channel catfish are freshwater fish but they can thrive in brackish water. Channel catfish generally prefer clear water streams and rivers. This section of the Ottawa River is ideal and the population is strong.

During the day catfish are usually found in deep holes wherever the protection of logs and rocks can be found. Most movement and feeding activity occurs at night just after sunset and just before sunrise. Juvenile fish feed heavily on aquatic insects such as mayflies, caddisflies, chironomids, crayfish, mollusks, green algae, and large water plants (Scott and Crossman 1998).

Young juvenile channel catfish frequently feed in shallow riffle areas while the adults seem to feed in deeper water immediately downstream from shoals and bars. Adults rarely move much from one area to another and are rather sedentary, while young fish tend to move about much more extensively, particularly at night when feeding (Wellborn 1988).

Feeding can occur during day or night, and they will eat a wide variety of both plant and animal material. Channel catfish usually feed near the bottom in natural waters but will take some food from the surface. Based on stomach analysis, young catfish feed primarily on aquatic insects. The juveniles have a much more varied diet which includes insects, snails, crawfish, green algae, aquatic plants, seeds and small fish. Fish become an important part of the diet for channel catfish larger than 45 cm total length, and in natural waters fish may constitute as much as 75 percent of their diet.

Weather and Related Events

Air Temperature and Rain

On August 1, 2006, the Ottawa Valley experienced a heat spell where the air temperature exceeded 36 C (see Table 1 and Appendix 5).

This heat wave was followed by a significant rain event during the night of August 2, 2006 which dropped approximately 75 mm of rain in the area between Pembroke and Renfrew. Areas outside the vicinity also received the rain but not to the same extent. The rainfall at Renfrew was estimated by Renfrew Power Generation to be in the amount of 75mm. This volume of rainfall was also observed near the town of Foresters Falls. A rainfall gauge just downstream from the mouth of the Bonnechere River near the community of Sand Point recorded 45 mm of rain on the night of August 2, 2006.

This storm dropped enough rainfall in local areas to cause major road damage, and local washouts and erosion. It also caused the Ottawa River to remain highly turbid in the Rocher Fendu section, just upstream of Lac des Chats for four or five days.

Date (2006)	Precipitation (mm)	Air Temperature (C)
July 25	31.8	27.2
July 26	0	29.1
July 27	1	29.8
July 28	0	27.7
July 29	0	30
July 30	0	25.1
July 31	19.2	30.5
August 1	21.2	36.3
August 2	32.4	30.4
August 3	1.4	27.5
August 4	0	29.4
August 5	0	24.1
August 6	0	27.5
August 7	0	29.6
August 8	0	24.1

Table 1: Source – Environment Canada – Daily Data Reports for July and August at the Ottawa Airport.

Siltation

Significant rainfall events, such as that experienced in the Renfrew areas the night of August 2, 2006, deposited large amounts of organic and inorganic materials in the local rivers and streams, causing the water to become turbid.

Catfish, which prefer clear water, can become stressed by elevated turbidity in the water.

Nutrient Loading

Heavy rainfall events also deposit higher than normal amounts of nutrients in rivers, as runoff from soils. Nutrient loading in a river can deplete oxygen levels, which can be a stressor on fish communities.

This rain event also overloaded the Renfrew STP, resulting in by-pass from the facility into the Bonnechere River, which also contributed nutrients into the Lac des Chats section of the Ottawa River. Smaller by-pass events were also reported at the Arnprior STP, Cobden STP and the Pembroke STP.

Bacteriological Impacts

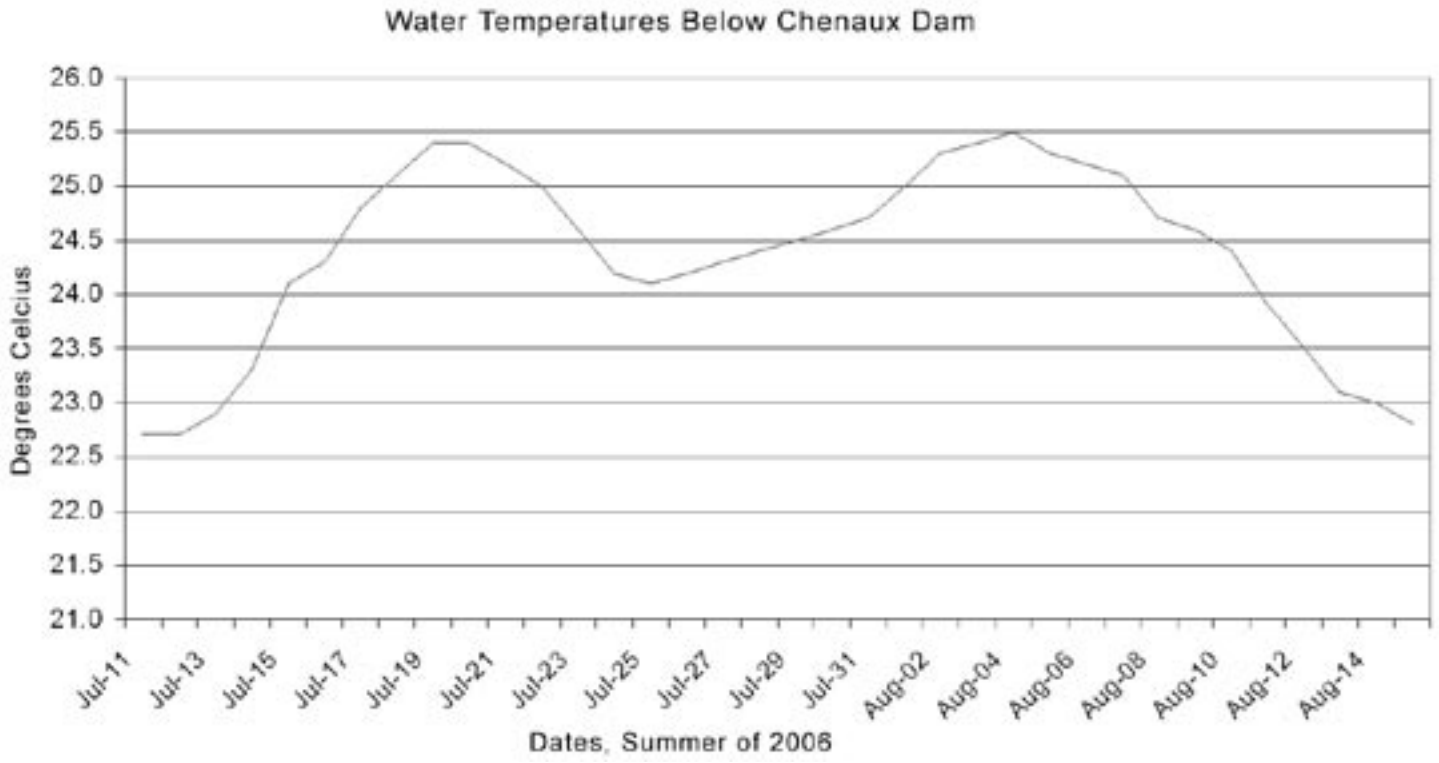
High run-off from the watershed entering the Ottawa River and its tributaries would have contained high bacteriological counts. Also, un-chlorinated sewage bypassed from the STPs was very high in E coli bacteria. The samples collected by the Renfrew County and District Health Unit on August 3, 2006 at the Horton Township boat launch (mouth of the Bonnechere River) showed elevated counts of E coli (> 1000 counts/ 100ml).

These pathogens may have contributed to increased stress levels in the fish communities.

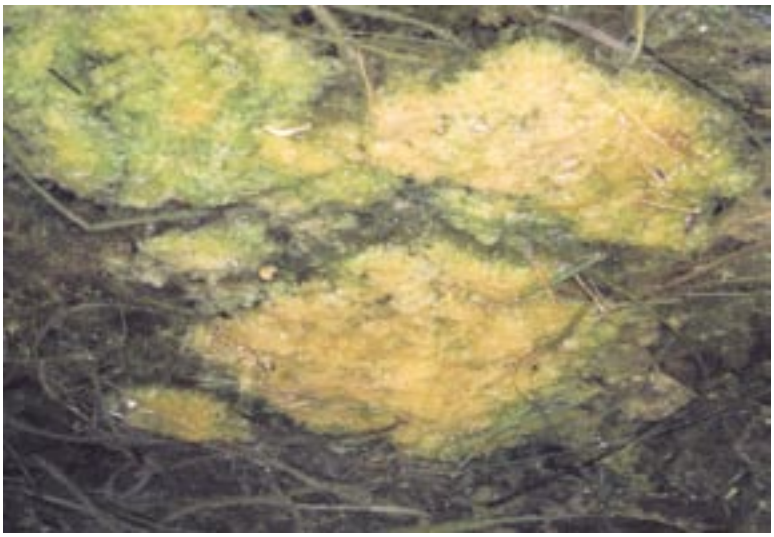
Water Temperature

Water temperature data was obtained from Ontario Power Generation (OPG) Chenaux for the months of July and August. A temperature station located downstream of the dam provided some water temperature data. The gauge is located approximately two meters below the surface. This data documents an increase in water temperature over the period leading up to the fish kill (See Table 2). This gauge does not monitor temperatures in shallower areas along the shorelines and in back bays, which would be significantly higher.

The data collected for July shows that water temperatures were reaching threshold levels for a columnaris outbreak (above 23 C). By July 17, 2006 the temperature reached 25 C and never dropped below 24 C until after August 11, 2006.



Algae and Macrophyte Growth



Algae growth in the Ottawa River was extensive during the summer of 2006.

Many of the calls received by the public during the fish kill event also made reference to higher than normal algae and plant growth being observed in the water in the Lac des Chats section. This was also observed further upstream in Rocher Fendu section. Many of the back bays and creek mouths were choked to a point where navigating with a boat was limited.

Heavy algae growth in a waterbody can deplete oxygen during the night-time period, which can be a stressor for fish.

Oxygen Levels

Dissolved oxygen concentrations in the Ottawa River were measured at each sampling station (Appendix 3). At two sites (OTT-03, Chenaux Island) dissolved oxygen and temperatures profiles were taken through the water column. Results indicate that the Ottawa River was well oxygenated during the sampling periods. No dissolved oxygen data is available for the period coinciding with the hot weather (i.e. July 31 to August 7), nor is any dissolved oxygen data available during night-time conditions, when oxygen depressions (sags) can occur as a result of plant and bacterial respiration.

Conclusions

The fish kill event observed in the Ottawa River during August of 2006 was directly related to an outbreak of columnaris disease, which is caused by *Flavobacterium columnare*, a bacterium that is naturally present in the environment.

The outbreak affected almost exclusively channel catfish, and almost exclusively juvenile channel catfish.

During this outbreak, the overall health of the aquatic ecosystem in the Ottawa River was not adversely affected.

There were no observed impacts on non-fish species, or on humans.

There are no formal records or anecdotal indications that an outbreak of columnaris or a fish kill of this magnitude has occurred in this section of the Ottawa River in the past.

This outbreak may have affected two to three percent of the channel catfish population in this section of the Ottawa River. There is no indication of any long-term impact on the channel catfish population.

Several factors probably combined to make this columnaris outbreak possible in 2006:

- warm temperatures allowed the river water to warm up to the threshold temperature for extreme growth of the columnaris bacterium

- heavy local rainfalls resulted in a period of higher than normal runoff activity, and caused sewage bypasses, which in turn resulted in high organic and inorganic loadings, increased nutrients, high bacteriological counts, and decreased water clarity in the Ottawa River – all of which placed an additional stress on fish

- heavier than normal algae and plant growth as a result of warmer water temperatures and higher than normal nutrient loadings

A juvenile channel catfish showing signs of columnaris infection, found in a shallow-water duck trap on the Ottawa River in August. The columnaris outbreak in the catfish population appears to be unlike outbreaks in other areas because it seems to have affected, almost exclusively, juvenile fish.

The direct impact on juvenile channel catfish may be related to the feeding behaviour of this age group, which put them into shallow water where they were more exposed and susceptible to columnaris.

- possible oxygen depressions in the river, particularly at night and in shallow areas, related to the decomposition process of algae and plant and bacterial respiration

- the behaviour of channel catfish in general, and particularly the shallow-water, night-time feeding behaviour of juvenile channel catfish

The Potential for Future Events

This outbreak of columnaris in the Ottawa River appears to have been triggered by weather events. Columnaris is common disease in catfish in warmer climates in the U.S. There is a possibility that climate change may have played a role in this outbreak, and that with shifting weather patterns, a similar outbreak may occur in the Ottawa River in the future. MNR will be looking at methods that may be used to monitor the potential for future outbreaks.

The Unique Nature of This Columnaris Outbreak

The 2006 columnaris outbreak in the Ottawa River, in many ways, had characteristics that are typical of columnaris outbreaks elsewhere, particularly in the U.S. However, this outbreak appears to be unique in that it almost exclusively affected juvenile channel catfish. This narrow impact on a specific age group in the catfish population does not appear to be typical and is not documented in any literature reviewed by MNR in 2006.

The mean total length of channel catfish during the NSCIN in 1998 was 47.4 cm and fish ranged from 26.0 cm to 74.5 cm respectively (Haxton 1999). This study also showed that all channel catfish below 40 cm in length were immature. The smallest mature channel catfish caught was 42.1 cm. The smallest mature female was 44 cm.

Lake des Chats has the second highest density of catfish surveyed on the Ottawa (29.4 catfish /ha) followed by Lac Du Rocher Fendu (29.2 catfish /ha). The highest levels were found in Lac Colounge (31.7 /ha) (Haxton and Punt 2004).

The 2006 Ottawa River channel catfish kill appears to have affected mainly juvenile fish between 25 cm and 35 cm, which feed heavily on invertebrates and insects. The feeding behaviour of this size range of channel catfish has been observed by MNR in Lac Du Rocher Fendu, with the fish entering the shallows at night and during storm events in the months of July and August.

An MNR biologist (K. Punt) has documented channel catfish entering waterfowl banding traps located in approximately 15 cm of water off a small rock island in the center of the basin over many years. As many as 50 channel catfish were caught in one overnight set (August 20, 2006, see photo on Page 15, bottom-right). Densities of channel catfish observed in these shallow areas at night were high. Observations indicated that there are similarities in the size of fish caught in the duck traps and size of the fish that were killed during the columnaris outbreak. Other observations made by Punt at this location on August 21, 2006, included several fish with the minor indications of columnaris infection.

The feeding behaviour of the juvenile channel catfish, entering the shallow littoral zone at night where they were exposed to high water temperatures, and possible oxygen depletion caused by decomposition of the higher than normal plant and algae growth, may have put these fish in a situation where they were more exposed to and more susceptible to columnaris.

References

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Appendix 1

Ministry of Natural Resources
Fish Health Laboratory
Inspection Reports

Ministry of Natural Resources

Fish Health Inspection Report

Shaded areas for Lab use only

Culture Station	**Case No.**
Pembroke MNR (Ottawa River)	**5494**

Date Received	**Reason for Examination:**
Aug. 15, 2006	*Monitoring* *Mortality Diagnosis* ✓ *Other (Specify)*

Samples Collected/Shipped by	**Condition and Type of Samples**	**Previous Disease History**
Kirby Punt	Fresh on ice	

Fish Samples						**Number of Fish Examined**				**Disease Agent Analysis and Results**								
										Positive +				**Negative -**			**Not Done O**	
Species Name	Lot No.	History Code	Quantity in Lot	Age (in months)	Rearing Unit Type or No.	Bacteriology	Virology	Parasitology	Other	IPN	IHN	VHS	BKD	ERM	FUR	WD	CS	Other (specify)
Channel Catfish	WILD			adult	Ottawa River	1	1	-	Gills 1	-	-	-	-	-	-	O	O	*F columnaris* +
									Skin 1									*A hydrophila* +

Comments - Culture Station

Comments - Fish Lab

Large numbers of bacteria typical of *Flavobacterium columnaris* observed on skin and gills. *Aeromonas hydrophila* was detected in broth enrichment of internal organs but not on direct streak indicating a low level infection which was likely secondary to Columnaris disease. No evidence of other bacterial or viral pathogens.

IPN - infectious pancreatic necrosis
IHN - infectious hematopoietic necrosis
VHS - viral hemorrhagic septicemia
BKD - bacterial kidney disease
ERM - enteric redmouth disease
FUR - furunculosis
WD - whirling disease
CS - ceratomyxosis

Signature of Fish Lab Official	**Date**	
S. Lord	**Dec. 13, 2006**	For virus sheets see case

Ministry of Natural Resources

Fish Health Inspection Report

Shaded areas for Lab use only

Culture Station	Case No.
Pembroke MNR (Ottawa River)	5496

Date Received	Reason for Examination:
Aug. 17, 2006	*Monitoring* *Mortality Diagnosis* ✓ *Other (Specify)*

Samples Collected/Shipped by	Condition and Type of Samples	Previous Disease History
Kirby Punt	Fresh on ice	*Columnaris* See 5494

Fish Samples						Number of Fish Examined				Disease Agent Analysis and Results								
										Positive +				Negative -			Not Done O	
Species Name	Lot No.	History Code	Quantity in Lot	Age (in months)	Rearing Unit Type or No.	Bacteriology	Virology	Parasitology	Other	IPN	IHN	VHS	BKD	ERM	FUR	WD	CS	Other (specify)
Channel Catfish	WILD			adult	Ottawa River	11	11	-	Gills 11	-	-	-	-	-	-	O	O	*F.columnaris* + *A.hydrophila* +

Comments - Culture Station

Comments - Fish Lab

Two groups of catfish received from a fish kill on the Ottawa River.:

Group I received in the morning via overnight courier. Most samples in advanced state of decay. Large numbers of bacteria typical of *Flavobacterium columnaris* observed on skin and/or gills of all four fish chosen for examination. Many skin scrapings also contained mixed bacterial populations as would be typical on a decaying fish. *Aeromonas hydrophila* also detected. This can be a primary pathogen but is a very common secondary invader. No evidence of other bacterial or viral pathogens.

Group II consisted of live caught, healthier, appearing fish from the Ontario and Quebec sides of the river. *F.columnaris* was detected on the skin and gills of 1 of 4 fish from the Quebec side and on the skin of 1 of 3 fish from the Ontario side. No other viral or bacterial pathogens were detected.

Given the reported high water temperatures and high densities of Catfish in the shallows of the river and the absence of detectable viral agents it seems likely that the high numbers of mortalities can be attributed to Columnaris disease .

For virus sheets see case

Signature of Fish Lab Official	Date
S. Lord	Dec. 13, 2006

IPN - infectious pancreatic necrosis
IHN - infectious hematopoietic necrosis
VHS - viral hemorrhagic septicemia
BKD - bacterial kidney disease
ERM - enteric redmouth disease
FUR - furunculosis
WD - whirling disease
CS - ceratomyxosis

Appendix 2

Ministry of the Environment
Water Chemistry Data Reports

Ontario Ministry of Environment
Central Laboratory - Resources Road
FINAL REPORT(manager.rdf)
Aug. 28, 2006 09:05 AM

Login: **C144056**

Program Code 130082103

Program: MOE OPERATIONS DIVISION
Study: WATER, SURFACE
Project: EASTERN REGION TECH SUPPORT
Activity: IMPACT ASSESSMENTS
Organization: District Manager Kingston

Org. Id: 4613

Mail this copy to :

CASTRO, VICTOR
MOE - KINGSTON REGIONAL OFFICE
133 DALTON AVENUE
KINGSTON,ONT
K7L 4X6

Final reports to: CASTRO, VICTOR

Inquires to: RUSTY MOODY Telephone : 416-235-5863
LORRAINE PETERS Telephone : 416-235-5860

LOGIN DESCRIPTION: BANNECHERE RIVER OTTAWA RIVER FISH KILL V. CASTRO MOE-KINGSTON 613-540-6862

Login: **C144056**

Field Id	Station ID	Sample Location Description	Sampling Date	Time	Zone	Sampler Information
UPSTREAM	Sample ID C144056-0001	BANNACHERE RIVER	14 AUG 2006		5	
		Sample Comment Description: UPSTREAM STP, GRAB				

MOE*LIMS Products Requested:

WS	E3171A	HARD3171	WS	E3179A	PHEN3179	WS	E3182A	BOD3182	WS	E3182A	BODC3182
WS	E3188B	TSD3188	WS	E3196A	IBC3196	WS	E3218A	PHALCO3218	WS	E3274A	LIC3274
WS	E3364A	DISNUT3364	WS	E3367A	TOTNUT3367	WS	E3370A	DCSI3370			

Field Id	Station ID	Sample Location Description	Sampling Date	Time	Zone	Sampler Information
RHODDY'SBAY	Sample ID C144056-0004	OTTAWA RIVER	14 AUG 2006		5	
		Sample Comment Description: RHODDY'S BAY GRAB				

MOE*LIMS Products Requested:

WS	E3171A	HARD3171	WS	E3182A	BOD3182	WS	E3182A	BODC3182	WS	E3188B	TSD3188
WS	E3196A	IBC3196	WS	E3218A	PHALCO3218	WS	E3274A	LIC3274	WS	E3364A	DISNUT3364
WS	E3367A	TOTNUT3367	WS	E3370A	DCSI3370	WS	E3371A	EC3371			

Field Id	Station ID	Sample Location Description	Sampling Date	Time	Zone	Sampler Information
FIRST CHUTE	Sample ID C144056-0003	BANNACHERE RIVER	14 AUG 2006		5	
		Sample Comment Description: FIRST CHUTE GRAB				

MOE*LIMS Products Requested:

WS	E3171A	HARD3171	WS	E3182A	BOD3182	WS	E3182A	BODC3182	WS	E3188B	TSD3188
WS	E3196A	IBC3196	WS	E3218A	PHALCO3218	WS	E3274A	LIC3274	WS	E3364A	DISNUT3364
WS	E3367A	TOTNUT3367	WS	E3370A	DCSI3370	WS	E3371A	EC3371			

Field Id	Station ID	Sample Location Description	Sampling Date	Time	Zone	Sampler Information
DOWNSTREAM	Sample ID C144056-0002	BANNACHERE RIVER	14 AUG 2006		5	
		Sample Comment Description: DOWNSTREAM GRAB				

MOE*LIMS Products Requested:

WS	E3171A	HARD3171	WS	E3179A	PHEN3179	WS	E3182A	BOD3182	WS	E3182A	BODC3182
WS	E3188B	TSD3188	WS	E3196A	IBC3196	WS	E3218A	PHALCO3218	WS	E3274A	LIC3274
WS	E3364A	DISNUT3364	WS	E3367A	TOTNUT3367	WS	E3370A	DCSI3370			

Login: **C144056**

	Field ID:	UPSTREAM				DOWNSTREAM				FIRST CHUTE			
	Sample ID:	C144056-0001				C144056-0002				C144056-0003			
	MOE LIMS ID:	2006WS33-00481				2006WS33-00482				2006WS33-00483			
	Station ID:												
	Collect Date:	14 AUG 2006				14 AUG 2006				14 AUG 2006			
	Sample Location Description:	BANNACHERE RIVER				BANNACHERE RIVER				BANNACHERE RIVER			
	Sample Comments Description:	UPSTREAM STP. GRAB				DOWNSTREAM GRAB				FIRST CHUTE GRAB			
Lisid	Parmname	Value	Units	Qual	Rmk1	Value	Units	Qual	Rmk1	Value	Units	Qual	Rmk1
3171L7	Calcium	17.7	mg/L			18.9	mg/L			22.0	mg/L		
	Magnesium	4.96	mg/L			5.36	mg/L			6.02	mg/L		
	Hardness	64.4	mg/L			69.2	mg/L			79.6	mg/L		
3179L1	Phenolics; 4-AAP	.2	ug/L	<=W		0.5	ug/L	<T					
3182L1	Oxygen demand; biochemical	0.8	mg/L as O2	<T		1.4	mg/L as O2			0.9	mg/L as O2	<T	
3182L2	Oxygen demand;BOD-carbonaceous	1.2	mg/L			2.0	mg/L			1.4	mg/L		
3188L1	Solids; suspended	3.4	mg/L			2.6	mg/L			2.8	mg/L		
	Solids; total	107.	mg/L		CRO	117.	mg/L		CRO	130.	mg/L		CRO
	Solids; dissolved	104	mg/L		CRO	114.	mg/L		CRO	127.	mg/L		CRO
3196L1	Ion balance calculation		%	NDID			%	NDID					
	Anions		meq/L	NDID			meq/L	NDID					
	Cations		meq/L	NDID			meq/L	NDID					
	Conductivity Estimated		uS/cm	NDID			uS/cm	NDID					
	Solids; Dissolved Estimated		mg/L	NDID			mg/L	NDID					
3218L1	Conductivity	160.	uS/cm			176.	uS/cm			195.	uS/cm		
	pH	8.02	none			7.90	none			8.16	none		
	Alkalinity; total fixed endpt	60.9	mg/L CaCO3			64.7	mg/L CaCO3			74.0	mg/L CaCO3		
3274L1	Langeliers index calculation		none	NDID			none	NDID					
	Saturation pH Estimated		none	NDID			none	NDID					
3364L1	Nitrogen; ammonia+ammonium	0.008	mg/L	<T		0.129	mg/L			0.010	mg/L		
	Nitrogen; nitrite	0.004	mg/L	<T		0.008	mg/L			0.008	mg/L		
	Nitrogen; nitrate+nitrite	0.009	mg/L	<T		0.044	mg/L			0.030	mg/L		
	Phosphorus; phosphate	0.0019	mg/L	<T		0.0037	mg/L			0.0026	mg/L		
3367L1	Phosphorus; total	0.017	mg/L			0.025	mg/L			0.018	mg/L		
	Nitrogen; total Kjeldahl	0.40	mg/L			0.62	mg/L			0.41	mg/L		
3370L1	Carbon; dissolved organic	6.7	mg/L			7.2	mg/L			6.7	mg/L		
	Carbon; dissolved inorganic	14.1	mg/L			14.9	mg/L			16.2	mg/L		
	Silicon; reactive silicate	2.82	mg/L			2.86	mg/L			2.68	mg/L		
3371L3	Escherichia coli									44.	c/100mL		

Login: **C144056**

	Field ID:	RHODDY'SBAY			
	Sample ID:	C144056-0004			
	MOE *UMS ID:	2006WS33-00484			
	Station ID:				
	Collect Date:	14 AUG 2006			
	Sample Location Description:	OTTAWA RIVER			
	Sample Comments Description:	RHODDY'S BAY GRAB			
LisSd	Parmname	Value	Units	Qual	Rmk1
3171L7	Calcium	6.45	mg/L		
	Magnesium	1.84	mg/L		
	Hardness	23.6	mg/L		
3182L1	Oxygen demand; biochemical	0.9	mg/L as O2	<T	
3182L2	Oxygen demand;BOD-carbonaceous	1.5	mg/L		
3188L1	Solids; suspended	1.2	mg/L	<T	
	Solids; total	46.0	mg/L	<T	CRO
	Solids; dissolved	44.0	mg/L	<T	CRO
3218L1	Conductivity	68.0	uS/cm		
	pH	7.61	none		
	Alkalinity; total fixed endpt	23.0	mg/L CaCO3		
3364L1	Nitrogen; ammonia+ammonium	0.018	mg/L		
	Nitrogen; nitrite	0.006	mg/L		
	Nitrogen; nitrate+nitrite	0.080	mg/L		
	Phosphorus; phosphate	0.0017	mg/L	<T	
3367L1	Phosphorus; total	0.016	mg/L		
	Nitrogen; total Kjeldahl	0.32	mg/L		
3370L1	Carbon; dissolved organic	6.5	mg/L		
	Carbon; dissolved inorganic	4.7	mg/L		
	Silicon; reactive silicate	1.74	mg/L		
3371L3	Escherichia coli	4.0	c/100mL	<	

Login: **C144056**

CODE	DESCRIPTION
<T	A MEASURABLE TRACE AMOUNT:INTERPRET WITH CAUTION
NDID	NO DATA: INSUFFICIENT DATA TO PERFORM CALC.
CRO	CALCULATED RESULT ONLY
<=W	NO MEASURABLE RESPONSE (ZERO): <REPORTED VALUE
<	ACTUAL RESULT IS LESS THAN THE REPORTED VALUE

Ontario Ministry of Environment
Central Laboratory - Resources Road
FINAL REPORT(manager.rdf)
Aug. 28, 2006 09:05 AM

Login: **C144223**

Program Code 130082103

Program: MOE OPERATIONS DIVISION
Study: WATER, SURFACE
Project: EASTERN REGION TECH SUPPORT
Activity: IMPACT ASSESSMENTS
Organization: District Manager Kingston

Org. Id: 4613

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K7L 4X6

Final reports to: CASTRO, VICTOR

Inquires to: RUSTY MOODY Telephone: 416-235-5863
LORRAINE PETERS Telephone: 416-235-5860

LOGIN DESCRIPTION: OTTAWA RIVER FISH KILL SAMPLING

Login: **C144223**

Field Id	Station ID	Sample Location Description	Sampling Date	Time	Zone	Sampler Information
OTT-01		OTTAWA RIVER, GRAB	15 AUG 2006		5	

Sample ID: C144223-0001

Sample Comment Description:

MOE*LIMS Products Requested:

WS	E3170A	COD3170	WS	E3171A	HARD3171	WS	E3179A	PHEN3179	WS	E3182A	BOD3182
WS	E3182A	BODC3182	WS	E3188B	TSD3188	WS	E3196A	IBC3196	WS	E3218A	PHALCO3218
WS	E3274A	LIC3274	WS	E3364A	DISNUT3364	WS	E3367A	TOTNUT3367	WS	E3370A	DCSI3370
WS	E3386A	MET3386									

Field Id	Station ID	Sample Location Description	Sampling Date	Time	Zone	Sampler Information
OTT-03		OTTAWA RIVER, GRAB	15 AUG 2006		5	

Sample ID: C144223-0003

Sample Comment Description:

MOE*LIMS Products Requested:

WS	E3170A	COD3170	WS	E3171A	HARD3171	WS	E3179A	PHEN3179	WS	E3182A	BOD3182
WS	E3182A	BODC3182	WS	E3188B	TSD3188	WS	E3196A	IBC3196	WS	E3218A	PHALCO3218
WS	E3274A	LIC3274	WS	E3364A	DISNUT3364	WS	E3367A	TOTNUT3367	WS	E3370A	DCSI3370
WS	E3386A	MET3386									

Field Id	Station ID	Sample Location Description	Sampling Date	Time	Zone	Sampler Information
OTT-02		OTTAWA RIVER, GRAB	15 AUG 2006		5	

Sample ID: C144223-0002

Sample Comment Description:

MOE*LIMS Products Requested:

WS	E3170A	COD3170	WS	E3171A	HARD3171	WS	E3179A	PHEN3179	WS	E3182A	BOD3182
WS	E3182A	BODC3182	WS	E3188B	TSD3188	WS	E3196A	IBC3196	WS	E3218A	PHALCO3218
WS	E3274A	LIC3274	WS	E3364A	DISNUT3364	WS	E3367A	TOTNUT3367	WS	E3370A	DCSI3370
WS	E3386A	MET3386									

Login: **C144223**

	Field ID:	OTT-01				OTT-02				OTT-03			
	Sample ID:	C144223-0001				C144223-0002				C144223-0003			
	MOE*LIMS ID:	2006WS33-00821				2006WS33-00822				2006WS33-00823			
	Station ID:												
	Collect Date:	15 AUG 2006				15 AUG 2006				15 AUG 2006			
	Sample Location Description:	OTTAWA RIVER, GRAB				OTTAWA RIVER, GRAB				OTTAWA RIVER, GRAB			
	Sample Comments Description:												
ListId	Parmname	Value	Units	Qual	Rmk1	Value	Units	Qual	Rmk1	Value	Units	Qual	Rmk1
3170L1	Oxygen demand; chemical	19.0	mg/L as O2			21.0	mg/L as O2			21.0	mg/L as O2		
3171L7	Calcium	7.65	mg/L			6.55	mg/L			6.40	mg/L		
	Magnesium	2.24	mg/L			1.72	mg/L			1.70	mg/L		
	Hardness	28.4	mg/L			23.4	mg/L			23.0	mg/L		
3179L1	Phenolics; 4-AAP	0.6	ug/L	<T		0.8	ug/L	<T		.2	ug/L	<=W	
3182L1	Oxygen demand; biochemical	0.8	mg/L as O2	<T		1.2	mg/L as O2			0.6	mg/L as O2	<T	
3182L2	Oxygen demand;BOD-carbonaceous	0.8	mg/L	<T		1.1	mg/L			0.7	mg/L	<T	
3188L1	Solids; suspended	1.4	mg/L	<T		3.2	mg/L			1.6	mg/L	<T	
	Solids; total	51.0	mg/L		CRO	46.0	mg/L	<T	CRO	43.0	mg/L	<T	CRO
	Solids; dissolved	50.0	mg/L		CRO	43.0	mg/L	<T	CRO	41.0	mg/L	<T	CRO
3218L1	Conductivity	76.0	uS/cm			66.0	uS/cm			63.0	uS/cm		
	pH	7.86	none			9.22	none			7.37	none		
	Alkalinity; total fixed endpt	28.2	mg/L CaCO3			22.4	mg/L CaCO3			22.0	mg/L CaCO3		
3364L1	Nitrogen; ammonia+ammonium	.002	mg/L	<=W		0.014	mg/L			0.014	mg/L		
	Nitrogen; nitrite	0.003	mg/L	<T		0.003	mg/L	<T		0.002	mg/L	<T	
	Nitrogen; nitrate+nitrite	0.040	mg/L			0.016	mg/L	<T		0.089	mg/L		
	Phosphorus; phosphate	0.0024	mg/L	<T		0.0017	mg/L	<T		0.0010	mg/L	<T	
3367L1	Phosphorus; total	0.015	mg/L			0.016	mg/L			0.013	mg/L		
	Nitrogen; total Kjeldahl	0.30	mg/L			0.36	mg/L			0.31	mg/L		
3370L1	Carbon; dissolved organic	6.8	mg/L			7.0	mg/L			6.6	mg/L		
	Carbon; dissolved inorganic	6.3	mg/L			4.3	mg/L			4.4	mg/L		
	Silicon; reactive silicate	1.76	mg/L			1.32	mg/L			1.74	mg/L		
3386L1	Aluminum	86.3	ug/L	+/-8		168	ug/L	+/-15		92.9	ug/L	+/-8	
	Barium	14.5	ug/L	+/-1.0		11.7	ug/L	+/-0.8		14.3	ug/L	+/-1.0	
	Beryllium	<.00364	ug/L	+/-0.02		.00695	ug/L	+/-0.02		.00479	ug/L	+/-0.02	
	Calcium	8.33	mg/L	+/-1.00		7.19	mg/L	+/-0.86		6.91	mg/L	+/-0.83	
	Cadmium	<.515	ug/L	+/-0.8		.0588	ug/L	+/-0.8		.00651	ug/L	+/-0.8	
	Cobalt	<.601	ug/L	+/-1.5		.114	ug/L	+/-1.5		.892	ug/L	+/-1.5	
	Chromium	.623	ug/L	+/-1.0		.204	ug/L	+/-1.0		.0235	ug/L	+/-1.0	
	Copper	1.97	ug/L	+/-0.8		2	ug/L	+/-0.8		1.29	ug/L	+/-0.8	
	Iron	141	ug/L	+/-11.3		264	ug/L	+/-21.1		165	ug/L	+/-13.2	
	Magnesium	2.19	mg/L	+/-0.24		1.79	mg/L	+/-0.20		1.73	mg/L	+/-0.19	
	Manganese	12.7	ug/L	+/-1.0		21.7	ug/L	+/-1.7		14.8	ug/L	+/-1.2	
	Molybdenum	<.0116	ug/L	+/-1.5		<.198	ug/L	+/-1.5		<.477	ug/L	+/-1.5	
	Nickel	.06	ug/L	+/-1.5		<.906	ug/L	+/-1.5		<.0191	ug/L	+/-1.5	
	Lead	<.868	ug/L	+/-11		1.25	ug/L	+/-11		.0376	ug/L	+/-11	
	Strontium	39.7	ug/L	+/-3.2		32.7	ug/L	+/-2.6		32.8	ug/L	+/-2.6	

Login: **C144223**

	Field ID:	OTT-01				OTT-02				OTT-03			
	Sample ID:	C144223-0001				C144223-0002				C144223-0003			
	MOE *UMS ID:	2006WS33-00821				2006WS33-00822				2006WS33-00823			
	Station ID:												
	Collect Date:	15 AUG 2006				15 AUG 2006				15 AUG 2006			
	Sample Location Description:	OTTAWA RIVER, GRAB				OTTAWA RIVER, GRAB				OTTAWA RIVER, GRAB			
	Sample Comments Description:												
Listid	Parmname	Value	Units	Qual	Rmk1	Value	Units	Qual	Rmk1	Value	Units	Qual	Rmk1
3386L1	Titanium	1.96	ug/L	+/-0.3		4.74	ug/L	+/-0.4		2.41	ug/L	+/-0.3	
	Vanadium	1.12	ug/L	+/-1.0		1.65	ug/L	+/-1.0		.534	ug/L	+/-1.0	
	Zinc	1.14	ug/L	+/-0.7		.801	ug/L	+/-0.7		.855	ug/L	+/-0.7	

Login: **C144223**

CODE	DESCRIPTION
<T	A MEASURABLE TRACE AMOUNT:INTERPRET WITH CAUTION
NDID	NO DATA: INSUFFICIENT DATA TO PERFORM CALC.
CRO	CALCULATED RESULT ONLY
<=W	NO MEASURABLE RESPONSE (ZERO): <REPORTED VALUE

Ontario Ministry of Environment
Central Laboratory - Resources Road
FINAL REPORT(manager.rdf)
Aug. 28, 2005 09:05 AM

Login: **C144406**

Program Code 130082103

Program: MOE OPERATIONS DIVISION
Study: WATER, SURFACE
Project: EASTERN REGION TECH SUPPORT
Activity: IMPACT ASSESSMENTS
Organization: District Manager Kingston

Org. Id: 4613

Mail this copy to :

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133 DALTON AVENUE
KINGSTON,ONT
K7L 4X6

Final reports to : CASTRO, VICTOR

Inquires to: RUSTY MOODY Telephone : 416-235-5863
LORRAINE PETERS Telephone : 416-235-5860

LOGIN DESCRIPTION: BONNECHERE RIVER & OTTAWA RIVER FISH KILL

Ontario Ministry of Environment
Central Laboratory - Resources Road
FINAL REPORT(manager.rdf)
Aug. 28, 2006 09:05 AM

Login: **C144406**

Field Id	Station ID	Sample Location Description	Sampling Date	Time	Zone	Sampler Information
2	Sample ID C144406-0002	CHANNEL BETWEEN RED & PETITE LIMERICK ISLAND	16 AUG 2006		5	

Sample Comment Description

MOE LIMS Products Requested:

WS	E3171A	HARD3171	WS	E3182A	BOD3182	WS	E3182A	BODC3182	WS	E3188B	TSD3188
WS	E3196A	IBC3196	WS	E3218A	PHALCO3218	WS	E3274A	LIC3274	WS	E3364A	DISNUT3364
WS	E3367A	TOTNUT3367	WS	E3370A	DCSI3370						

Field Id	Station ID	Sample Location Description	Sampling Date	Time	Zone	Sampler Information
1	Sample ID C144406-0001	CHENAUX ISLAND	16 AUG 2006		5	

Sample Comment Description

MOE LIMS Products Requested:

WS	E3171A	HARD3171	WS	E3182A	BOD3182	WS	E3182A	BODC3182	WS	E3188B	TSD3188
WS	E3196A	IBC3196	WS	E3218A	PHALCO3218	WS	E3274A	LIC3274	WS	E3364A	DISNUT3364
WS	E3367A	TOTNUT3367	WS	E3370A	DCSI3370						

Login: **C144406**

	Field ID:	1				2			
	Sample ID:	C144406-0001				C144406-0002			
	MOE*LIMS ID:	2006WS33-01001				2006WS33-01002			
	Station ID:								
	Collect Date:	16 AUG 2006				16 AUG 2006			
	Sample Location Description:	CHENAUX ISLAND				CHANNEL BETWEEN RED & PETITE LIMERICK ISLAND			
	Sample Comments Description:								
ListId	Parmname	Value	Units	Qual	Rmk1	Value	Units	Qual	Rmk1
3171L7	Calcium	6.35	mg/L			6.40	mg/L		
	Magnesium	1.72	mg/L			1.72	mg/L		
	Hardness	23.0	mg/L			23.0	mg/L		
3182L1	Oxygen demand: biochemical	1.1	mg/L as O2			0.7	mg/L as O2	<T	
3182L2	Oxygen demand:BOD-carboraceous	1.7	mg/L			1.1	mg/L		
3188L1	Solids; suspended	1.6	mg/L	<T		1.5	mg/L	<T	
	Solids; total	43.0	mg/L	<T	CRO	43.0	mg/L	<T	CRO
	Solids; dissolved	41.0	mg/L	<T	CRO	42.0	mg/L	<T	CRO
3218L1	Conductivity	63.0	uS/cm			64.0	uS/cm		
	pH	7.49	none			7.47	none		
	Alkalinity; total fixed endpt	21.5	mg/L CaCO3			21.5	mg/L CaCO3		
3364L1	Nitrogen; ammonia+ammonium	0.016	mg/L			0.020	mg/L		
	Nitrogen; nitrite	0.002	mg/L	<T		0.003	mg/L	<T	
	Nitrogen; nitrate+nitrite	0.092	mg/L			0.094	mg/L		
	Phosphorus; phosphate	0.0013	mg/L	<T		0.0036	mg/L		
3367L1	Phosphorus; total	0.011	mg/L			0.018	mg/L		
	Nitrogen; total Kjeldahl	0.31	mg/L			0.33	mg/L		
3370L1	Carbon; dissolved organic	6.5	mg/L			6.6	mg/L		
	Carbon; dissolved inorganic	4.5	mg/L			4.4	mg/L		
	Silicon; reactive silicate	1.72	mg/L			1.74	mg/L		

Login: **C144406**

CODE	DESCRIPTION
<T	A MEASURABLE TRACE AMOUNT:INTERPRET WITH CAUTION
NDID	NO DATA: INSUFFICIENT DATA TO PERFORM CALC.
CRO	CALCULATED RESULT ONLY

Appendix 3

Ministry of the Environment
Field Data Report

Field Data - August 14, 2006

BONNECHERE RIVER - UPSTREAM OF RENFREW SEWAGE TREATMENT PLANT

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/14	0	21.70	7.40	n/a	n/a

BONNECHERE RIVER - DOWNSTREAM OF SEWAGE TREATMENT PLANT

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/14	0	21.80	4.70	n/a	n/a

BONNECHERE RIVER AT FIRST SHOOT

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/14	0	21.80	8.90	n/a	n/a

Field Data - August 15, 2006

OTT-01 SAND BAY

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/15	0	23.49	9.26	8.38	0.078
	1	22.48	8.64	8.02	0.078

OTT-02 BROWN'S BAY

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/15	0	23.08	8.19	7.83	0.065

OTT-03 WEST SIDE OF PETITE LIMERICK ISLAND

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/15	0	22.79	7.97	7.58	0.065
	3	22.85	7.96	7.43	0.065
	5	22.86	7.95	7.41	0.065

Field Data - August 16, 2006

CHENAUX ISLAND

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/16	0	22.74	8.09	7.41	0.065
	1	22.72	7.84	7.39	0.065
	2	22.71	7.79	7.35	0.065
	3	22.73	7.77	7.36	0.065
	4	22.72	7.77	7.34	0.065
	5	22.71	7.76	7.34	0.065
	6	22.70	7.75	7.34	0.065
	7	22.70	7.74	7.33	0.065
	8	22.70	7.73	7.34	0.065
	9	22.71	7.73	7.32	0.065
	10	22.71	7.71	7.32	0.065

BONNECHERE RIVER MOUTH

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/16	0	22.04	10.18	8.50	0.175

BONNECHERE RIVER AT FIRST SHOOT

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/16	0	22.65	9.33	8.15	0.178
	1	21.88	9.23	8.05	0.177
	2	21.58	9.21	8.02	0.177
	3	21.43	9.12	7.98	0.177
	4	21.38	9.06	7.96	0.177

Powerhouse

Date	Depth (m)	Temp (°C)	DO Conc (mg/L)	pH	SpCond (µS/cm)
2006/08/16	0	22.60	7.80	7.38	0.064
	1	22.59	7.79	7.39	0.065

Appendix 4

Ministry of the Environment
Summary of Water Quality Statistics
for the Ottawa River at Chenaux and Chats Falls
and for the Bonnechere River at Castleford

Ottawa River at Chenaux Dam

summary statistics for the month of August only (1996 to 2005)

Parameter	n	minimum	median	maximum	mean	standard deviation	units
Oxygen Demand; Biochemical	4	0.2	0.4	0.8	0.45	0.251661148	mg/L
Solids; Suspended							mg/L
Conductivity	4	43	59	63	56	9	uS/cm
pH	4	7.1	7.3	7.5	7.3	0.2	n/a
Nitrogen; Ammonia+Ammonium							mg/L-N
Nitrogen; Nitrite							mg/L-N
Nitrogen; Nitrate+Nitrite							mg/L-N
Nitrogen; Total Kjeldahl	4	0.24	0.30	0.40	0.31	0.07	mg/L-N
Phosphorus; Phosphate	4	0.001	0.001	0.001	0.001	0.000	mg/L-P
Phosphorus; Total	4	0.006	0.011	0.012	0.010	0.003	mg/L-P
Aluminum; Total	3	9	57	70			ug/L
Copper; Total	3	0.2	1.1	1.3			ug/L
Iron; Total	3	128	138	161			ug/L
Lead; Total	2	1.6	2.4	3.2			ug/L
Zinc; Total	3	0.2	3.0	6.8			ug/L
Hardness; Total	4	16	21	22	20	3	mg/L-CaCO3

Ottawa River at Chenaux Dam

summary statistics for all months (1996 to 2005)

Parameter	n	minimum	median	maximum	mean	standard deviation	units
Oxygen Demand; Biochemical	16	0.2	1.5	23.6	6.925	8.741662695	mg/L
Solids; Suspended							mg/L
Conductivity	16	43	59	69	60	7	uS/cm
pH	16	7.1	7.4	7.8	7.4	0.2	n/a
Nitrogen; Ammonia+Ammonium							mg/L-N
Nitrogen; Nitrite							mg/L-N
Nitrogen; Nitrate+Nitrite							mg/L-N
Nitrogen; Total Kjeldahl	16	0.24	0.32	0.60	0.35	0.09	mg/L-N
Phosphorus; Phosphate	15	0.001	0.002	0.021	0.003	0.005	mg/L-P
Phosphorus; Total	16	0.006					mg/L-P
Aluminum; Total	13	9	83	150			ug/L
Copper; Total	13	0.2	1.2	2.0			ug/L
Iron; Total	13	128	178	230			ug/L
Lead; Total	7	0.5	1.7	9.7			ug/L
Zinc; Total	13	0.2	4.8	10.1			ug/L
Hardness; Total	16	16	21	25	22	3	mg/L-CaCO3

Ottawa River at Chats Falls

summary statistics for the month of August only (1996 to 2005)

Parameter	n	minimum	median	maximum	mean	standard deviation	units
Oxygen Demand; Biochemical	7	0.2	0.4	0.7	0.4	0.2	mg/L
Solids; Suspended	8	1.2	1.5	3.0	7.7	0.6	mg/L
Conductivity	8	66	71	80	72	5	uS/cm
pH	8	7.4	7.6	7.8	7.6	0.1	
Nitrogen; Ammonia+Ammonium	8	0.002	0.022	0.058	0.027	0.020	mg/L-N
Nitrogen; Nitrite	8	0.001	0.004	0.008	0.004	0.002	mg/L-N
Nitrogen; Nitrate+Nitrite	8	0.005	0.097	0.170	0.101	0.049	mg/L-N
Nitrogen; Total Kjeldahl	8	0.20	0.31	0.40	0.31	0.05	mg/L-N
Phosphorus; Phosphate	8	0.001	0.001	0.005	0.002	0.002	mg/L-P
Phosphorus; Total	8	0.012	0.018	0.024	0.017	0.004	mg/L-P
Aluminum; Total	8	27	50	90			ug/L
Copper; Total	8	0.6	1.0	1.4			ug/L
Iron; Total	8	70	119	139			ug/L
Lead; Total	8	-2.9	4.1	9.8			ug/L
Zinc; Total	8	0.6	1.4	2.0			ug/L
Hardness; Total	8	21	29	30	27	3	mg/L-CaCO3

Ottawa River at Chats Falls

summary statistics for all months (1996 to 2005)

Parameter	n	minimum	median	maximum	mean	standard deviation	units
Oxygen Demand; Biochemical	76	0.2	0.4	1.6	0.5	0.3	mg/L
Solids; Suspended	77	1.0	2.0	7.5	2.4	1.3	mg/L
Conductivity	77	60	82	778	93	61	uS/cm
pH	77	7.3	7.7	8.0	7.7	0.1	
Nitrogen; Ammonia+Ammonium	77	0.002	0.012	0.110	0.017	0.017	mg/L-N
Nitrogen; Nitrite	77	0.001	0.005	0.018	0.005	0.003	mg/L-N
Nitrogen; Nitrate+Nitrite	77	0.005	0.135	0.275	0.142	0.057	mg/L-N
Nitrogen; Total Kjeldahl	77	0.20	0.32	0.92	0.33	0.09	mg/L-N
Phosphorus; Phosphate	77	0.001	0.002	0.030	0.002	0.003	mg/L-P
Phosphorus; Total	77	0.002	0.015	0.066	0.016	0.009	mg/L-P
Aluminum; Total	77	27	82	183			ug/L
Copper; Total	77	0.2	1.0	2.8			ug/L
Iron; Total	77	70	153	279			ug/L
Lead; Total	77	-15.6	0.3	12.0			ug/L
Zinc; Total	77	0.4	1.8	18.0			ug/L
Hardness; Total	77	21	31	204	26	21	mg/L-CaCO3

Bonnechere River at Castleford

summary statistics for the month of August only (1996 to 2005)

Parameter	n	minimum	median	maximum	mean	standard deviation	units
Oxygen Demand; Biochemical	3	0.4	0.6	0.8	0.6	0.2	mg/L
Solids; Suspended							mg/L
Conductivity	3	151	174	207	177	28	uS/cm
pH	3	7.9	8.0	8.0	8.0	0.1	n/a
Nitrogen; Ammonia+Ammonium							mg/L-N
Nitrogen; Nitrite							mg/L-N
Nitrogen; Nitrate+Nitrite							mg/L-N
Nitrogen; Total Kjeldahl	3	0.44	0.44	0.52	0.47	0.05	mg/L-N
Phosphorus; Phosphate	3	0.005	0.009	0.011	0.008	0.003	mg/L-P
Phosphorus; Total	3	0.020	0.024	0.030	0.025	0.005	mg/L-P
Aluminum; Total	2	46	78	111			ug/L
Copper; Total	2	0.7	1.1	1.6			ug/L
Iron; Total	2	104	150	195			ug/L
Lead; Total	2	-2.2	-0.6	1.0			ug/L
Zinc; Total	2	1.8	11.3	20.8			ug/L
Hardness; Total	3	66	71	89	75	12	mg/L-CaCO3

Bonnechere River at Castleford
summary statistics for all months (1996 to 2005)

Parameter	n	minimum	median	maximum	mean	standard deviation	units
Oxygen Demand; Biochemical	15	0.4	0.8	2.8	1.133333	0.723746864	mg/L
Solids; Suspended							mg/L
Conductivity	15	151	176	257	187	28	uS/cm
pH	15	7.9	8.0	8.2	8.0	0.1	n/a
Nitrogen; Ammonia+Ammonium							mg/L-N
Nitrogen; Nitrite							mg/L-N
Nitrogen; Nitrate+Nitrite							mg/L-N
Nitrogen; Total Kjeldahl	15	0.32	0.44	0.76	0.45	0.11	mg/L-N
Phosphorus; Phosphate	15	0.001	0.009	0.014	0.008	0.004	mg/L-P
Phosphorus; Total	15	0.008	0.026	0.100	0.031	0.022	mg/L-P
Aluminum; Total	12	46	88	523			ug/L
Copper; Total	12	0.5	0.8	2.1			ug/L
Iron; Total	12	104	220	730			ug/L
Lead; Total	12	-2.8	1.1	32.5			ug/L
Zinc; Total	12	0.0	4.9	20.8			ug/L
Hardness; Total	15	64	79	117	81	16	mg/L-CaCO3

Appendix 5

Weather Records for Ottawa
July and August 2006

Environment Canada | Environnement Canada

Daily Data Report for July 2006

Notes on Data Quality.

OTTAWA MACDONALD-CARTIER INT'L A
ONTARIO

Latitude: 45° 19' N **Longitude:** 75° 40' W **Elevation:** 114.00 m
Climate ID: 6106000 **WMO ID:** 71628 **TC ID:** YOW

Daily Data Report for July 2006

Day	Max Tem °C	Min Tem °C	Mean Tem °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max G 10's Deg	Spd of Max G km/h
01†	25.8	13.3	19.6	0.0	1.6	17.6	0.0	17.6			<31
02†	28.9	15.3	22.1	0.0	4.1	1.2	0.0	1.2		30	56
03†	28.4	14.1	21.3	0.0	3.3	2.2	0.0	2.2		21	33
04†	27.0	16.8	21.9	0.0	3.9	T	0.0	T		24	35
05†	21.7	13.6	17.7	0.3	0.0	0.0	0.0	0.0		29	32
06†	22.8	13.1	18.0	0.0	0.0	0.0	0.0	0.0		29	32
07†	28.0	13.3	20.7	0.0	2.7	0.0	0.0	0.0			<31
08†	28.7	15.8	22.3	0.0	4.3	0.0	0.0	0.0		20	32
09†	28.6	15.8	22.2	0.0	4.2	0.0	0.0	0.0		20	33
10†	28.1	17.7	22.9	0.0	4.9	0.8	0.0	0.8			<31
11†	26.8	16.4	21.6	0.0	3.6	0.0	0.0	0.0			<31
12†	24.1	17.4	20.8	0.0	2.8	0.4	0.0	0.4			<31
13†	31.0	16.6	23.8	0.0	5.8	0.0	0.0	0.0			<31
14†	32.2	20.1	26.2	0.0	8.2	0.0	0.0	0.0			<31
15†	28.6	19.7	24.2	0.0	6.2	13.2	0.0	13.2		2	37
16†	33.0	19.1	26.1	0.0	8.1	0.0	0.0	0.0			<31
17†	33.0	18.8	25.9	0.0	7.9	12.8	0.0	12.8		31	65
18†	26.8	17.7	22.3	0.0	4.3	0.4	0.0	0.4			<31
19†	27.4	15.1	21.3	0.0	3.3	0.0	0.0	0.0			<31
20†	30.9	16.3	23.6	0.0	5.6	0.0	0.0	0.0			<31
21†	26.8	17.7	22.3	0.0	4.3	0.0	0.0	0.0			<31
22†	21.6	15.8	18.7	0.0	0.7	0.0	0.0	0.0			<31
23†	26.0	14.1	20.1	0.0	2.1	T	0.0	T			<31
24†	26.1	13.1	19.6	0.0	1.6	0.2	0.0	0.2			<31
25†	27.2	18.9	23.1	0.0	5.1	31.8	0.0	31.8			<31
26†	29.1	18.3	23.7	0.0	5.7	0.0	0.0	0.0			<31
27†	29.8	19.9	24.9	0.0	6.9	1.0	0.0	1.0		22	39
28†	27.7	18.9	23.3	0.0	5.3	0.0	0.0	0.0			<31
29†	30.0	17.7	23.9	0.0	5.9	0.0	0.0	0.0			<31
30†	25.1	15.3	20.2	0.0	2.2	0.0	0.0	0.0			<31
31†	30.5	17.5	24.0	0.0	6.0	19.2	0.0	19.2			<31
Sum				0.3	130.6	100.8	0.0	100.8			
Avg	27.8	16.6	22.2								
Xtrm	33.0	13.1								31	65

Environment Canada Environnement Canada

Daily Data Report for August 2006

Notes on Data Quality.

OTTAWA MACDONALD-CARTIER INT'L A
ONTARIO

Latitude: 45° 19' N **Longitude:** 75° 40' W **Elevation:** 114.00 m

Climate ID: 6106000 **WMO ID:** 71628 **TC ID:** YOW

Daily Data Report for August 2006

Day	Max Tem °C	Min Tem °C	Mean Tem °C	Heat Deg D C	Cool Deg D C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	36.3	22.3	29.3	0.0	11.3	21.2	0.0	21.2		26	35
02†	30.4	19.6	25.0	0.0	7.0	32.4	0.0	32.4		25	44
03†	27.5	18.2	22.9	0.0	4.9	1.4	0.0	1.4		5	32
04†	29.4	16.3	22.9	0.0	4.9	0.0	0.0	0.0		30	35
05†	24.1	14.1	19.1	0.0	1.1	0.0	0.0	0.0		30	32
06†	27.5	14.7	21.1	0.0	3.1	0.0	0.0	0.0			<31
07†	29.6	17.1	23.4	0.0	5.4	0.0	0.0	0.0		34	39
08†	24.1	14.2	19.2	0.0	1.2	0.0	0.0	0.0			<31
09†	26.5	11.8	19.2	0.0	1.2	0.0	0.0	0.0			<31
10†	24.7	14.3	19.5	0.0	1.5	T	0.0	T		1	33
11†	21.6	12.1	16.9	1.1	0.0	0.0	0.0	0.0		33	33
12†	21.9	8.3	15.1	2.9	0.0	0.0	0.0	0.0		33	35
13†	24.8	9.3	17.1	0.9	0.0	0.0	0.0	0.0			<31
14†	26.5	13.2	19.9	0.0	1.9	T	0.0	T		19	39
15†	26.1	14.0	20.1	0.0	2.1	0.0	0.0	0.0		28	35
16†	25.6	15.0	20.3	0.0	2.3	0.0	0.0	0.0			<31
17†	27.3	13.2	20.3	0.0	2.3	0.0	0.0	0.0			<31
18†	30.7	16.3	23.5	0.0	5.5	0.0	0.0	0.0			<31
19†	28.8	19.3	24.1	0.0	6.1	4.4	0.0	4.4			<31
20†	19.7	14.5	17.1	0.9	0.0	7.6	0.0	7.6		36	32
21†	25.3	11.6	18.5	0.0	0.5	0.0	0.0	0.0			<31
22†	24.9	14.9	19.9	0.0	1.9	0.0	0.0	0.0		35	39
23†	21.5	12.0	16.8	1.2	0.0	0.0	0.0	0.0			<31
24†	21.0	12.3	16.7	1.3	0.0	T	0.0	T			<31
25†	21.1	10.9	16.0	2.0	0.0	0.0	0.0	0.0			<31
26†	22.9	9.4	16.2	1.8	0.0	0.0	0.0	0.0			<31
27†	20.8	15.3	18.1	0.0	0.1	5.2	0.0	5.2			<31
28†	24.2	13.8	19.0	0.0	1.0	0.0	0.0	0.0			<31
29†	25.8	15.7	20.8	0.0	2.8	0.0	0.0	0.0		1	32
30†	20.5	9.5	15.0	3.0	0.0	0.0	0.0	0.0		36	33
31†	22.6	8.4	15.5	2.5	0.0	0.0	0.0	0.0			<31
Sum				17.6	68.1	72.2	0.0	72.2			
Avg	25.3	13.9	19.6								
Xtrm	36.3	8.3								25	44