# Overview of Environmental Effects Monitoring (EEM)

## The Pulp and Paper Sector in Quebec

*Fact Sheet*

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### Context

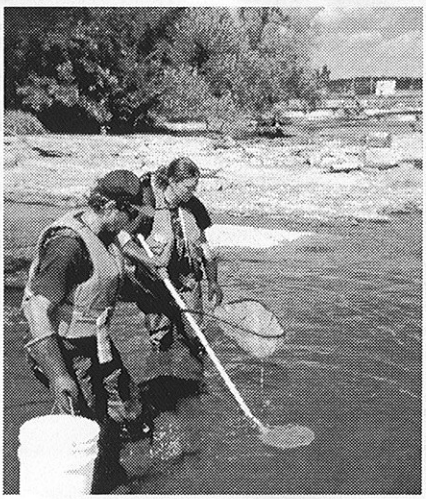
The Government of Canada, pursuant to the *Pulp and Paper Mill Regulations* of the *Fisheries Act,* requires all mills under its jurisdiction to complete Environmental Effects Monitoring (EEM) studies of their effluents. The regulations forbid the discharge of effluents that are acutely lethal to rainbow trout and impose standards regarding allowable biochemical oxygen demand and total suspended solids.

EEM studies are based on successive cycles of observation and interpretation over periods of three to four years each. The results of each cycle are used to establish the objectives and requirements for the next cycle. Two cycles of EEM studies (1992–1996 and 1996–2000) have been completed to date in the pulp and paper sector and a third one is now under way.

In the first EEM cycle, sampling and analysis methods were tested and reference conditions established for comparison with subsequent cycles. The observable effects of effluent on the aquatic environment were also preliminarily identified.

In Quebec, a total of 51 mills have completed the first cycle of EEM studies. These preliminary studies, however, were completed during a period of technological transition, meaning they were done prior to or immediately following the implementation of secondary treatment of the effluent, which had become necessary to comply with the new regulations.

From 1992 to 1995, transitional authorizations were granted to companies whose secondary treatment processes were not yet adequately operational. When monitoring studies were conducted, following the installation of secondary treatment equipment and the requisite break-in period, there was a significant reduction in the sublethal toxicity of the effluents. The same holds true for total suspended solids (drop of nearly 60% reduction from 1994 to 2001) and biochemical oxygen demand (over 90% from 1994 to 2001).



Environment Canada

Fish sampling



Environment Canada — Quebec Region
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## Fish and Fish Habitat

Most of the mills succeeded in completing their fish monitoring studies during Cycle 2. Some general statistical differences were found between fish in exposure areas and those in the reference (unexposed) zones. The findings confirmed trends observed in Cycle 1 in fish in the exposure areas: bigger fish, relative increase in liver weight and decrease in gonad weight. However, it was impossible to exclude the contribution of other types of effluents to these findings. These preliminary results therefore require more in-depth study.

It was also demonstrated that benthic community structure (abundance, diversity, etc.) is an effective measure of the relative quality of fish habitats upstream and downstream of pulp and paper mill effluents. Significant differences were observed, with benthic communities in exposure areas being more degraded than those in reference areas located upstream of pulp and paper mill effluents.

In Cycle 1, only one-third of such differences could be directly attributed to mill effluents. The observations were repeated in Cycle 2, this time using a suite of standard sampling parameters. While there were still statistical differences between exposed and unexposed areas, most of the mills did note that the structure of the benthic communities located within exposed environments had improved since Cycle 1. These positive changes may be attributed, for the most part, to upgraded effluent treatment processes. However, the relative impact of other factors, such as the presence of municipal or industrial effluents discharging in the study areas, has not yet been clearly established.

## Using Fisheries Resources

Without adequate control measures, the effluents discharged by pulp and paper mills could, by contaminating fish with unacceptable quantities of dioxins and furans or simply by changing how the fish tastes, restrict the use of fisheries resources by the human population.

The EEM studies have found very low levels of dioxins and furans in fish. This improvement would be directly attributable to the decreased use of elementary chlorine in the bleaching processes of certain mills. More recent measurements have shown that concentrations of these contaminants in areas exposed to mill effluents are the same as in unexposed areas. They are also clearly below Canadian standards for human consumption of fish.

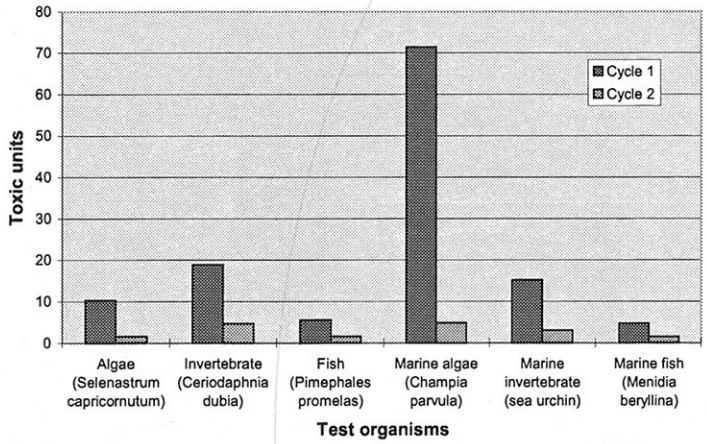
Mills are only required to measure the concentrations of dioxins and furans in fish tissue if the levels of these contaminants in their effluents exceed CEPA (*Canadian Environmental Protection Act*) standards. The number of pulp and paper mills having to perform this work has gone from nine in the first cycle to one in the second cycle, demonstrating a clear improvement.

As for the issue of flavour, only one mill, Tembec in Témiscaming, which discharges into the Ottawa River, has been the subject of complaints regarding the taste of fish caught in areas exposed to its effluent. The mill was required to complete an organoleptic assessment of these fish, which determined that the fish had a flavour described as unpleasant and extraneous to the natural taste of this type of fish.

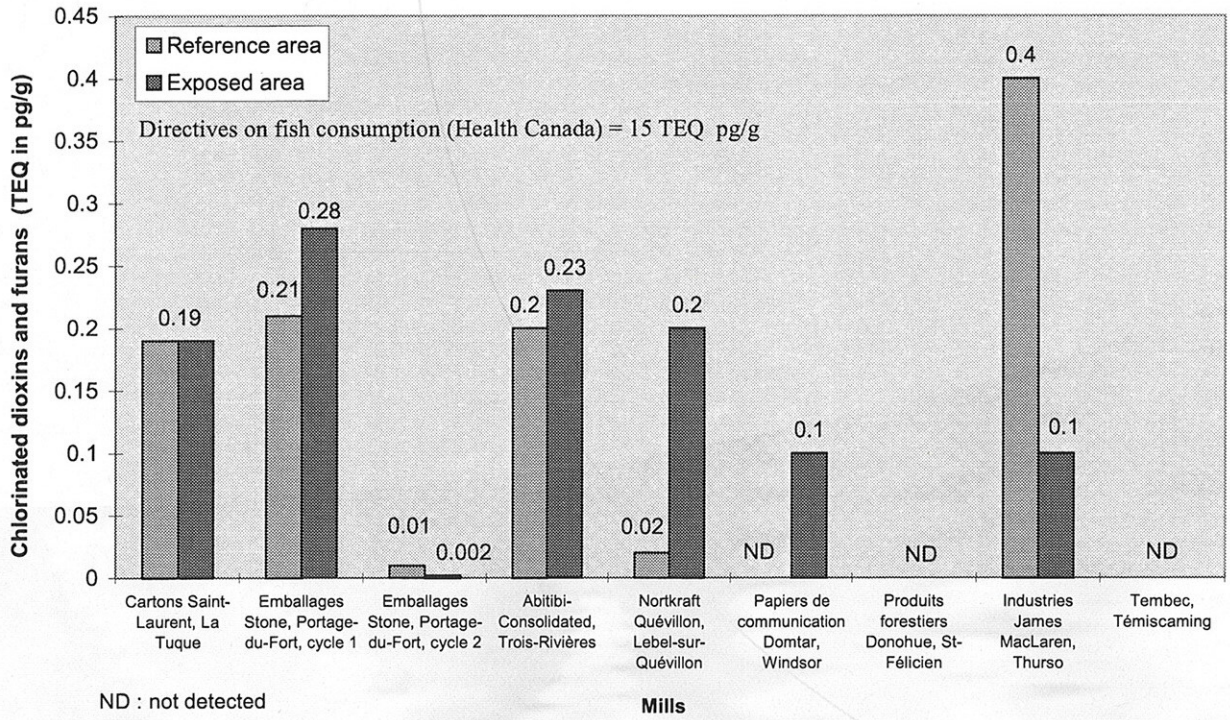
## Sublethal Toxicity

The Cycle 1 results showed that mills were able to substantially improve the quality of their effluents, as measured in terms of sublethal toxicity, by using secondary treatment systems. This observation was confirmed in Cycle 2, when the use of those treatment units was widespread. The results of the sublethal toxicity testing of invertebrates, fish and plants offer a good illustration of the improvement in effluent quality.

### Summary of toxicity assay results completed during Cycles 1 and 2




### Dioxins and furans in fish as measured during cycle 1 of the EEM program



## Effluents: Treatment Essential

Without adequate treatment, pulp and paper mill effluents can have a heavy impact on the quality of the receiving water. Substances contained in these effluents can have a toxic effect on aquatic organisms, while total suspended solids (TSS) loads may reduce light penetration through the water column and affect the food chain of fish.

Indeed, suspended solids can accumulate on watercourse beds and cover up fish spawning grounds. Decomposition of dissolved organic matter in effluents also consumes the oxygen contained in the water. The biochemical oxygen demand ($BOD_5$) that accompanies this decomposition changes the quality of the aquatic habitat. A high $BOD_5$ threatens the health of fish populations and may even become a direct cause of mortality.

Secondary treatment is based on the biological digestion of dissolved organic matter by micro-organisms: that is why this process is also called "biological treatment". It reduces $BOD_5$, TSS and the presence of contaminants, thus generally removing the acute toxicity of the effluent.

## Highlights of EEM

After two EEM cycles, we can conclude that there has been a general decrease in water pollution due to mill effluents. In affected environments, improvements have been particularly obvious at the benthic community level. As for fish populations, few changes have been observed as of yet because improvements in receiving environments are too recent. Upcoming cycles should demonstrate more convincing positive effects.

In light of all these observations, we can conclude that the imposed regulations have been effective, overall, in protecting aquatic habitats. Certain effects persist, however, and not every aspect of the short- and long-term impacts of effluent discharges has yet been perfectly elucidated. We must also take account of reaction time, which prevents us from seeing now all the benefits of initiatives undertaken. That is why it is essential to monitor these changes over several cycles of observation. Cycle 3 has already begun and should provide a new set of data by 2004.

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