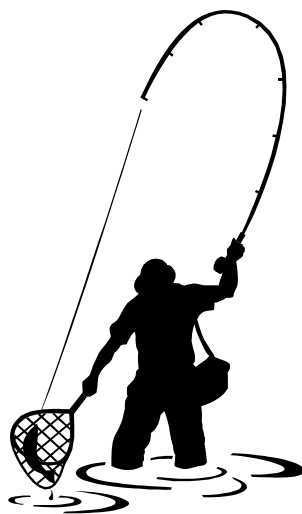


DIOXIN MONITORING PROGRAM

(Including data on Dioxin-like PCBs collected under the Surface Water Ambient Toxics Monitoring Program for fish consumption advisories)

2004

FINAL REPORT



DEPARTMENT OF ENVIRONMENTAL PROTECTION
AUGUSTA, MAINE

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OVERVIEW

This report contains the findings from the 2004 Dioxin Monitoring Program report with respect to the three primary goals of the program:

1. assessment of the nature and extent of dioxin contamination in waters and fisheries of the state and effect on human health,
2. evaluation of trends, and
3. measurement of compliance with the no discharge of dioxin provision of the 1997 Dioxin Law via the above/below (A/B) fish test.

The figures in this report also contain the (dioxin-like) coplanar PCB data gathered as part of DEP's Surface Water Ambient Toxics (SWAT) monitoring program. Coplanar PCB data are included in order to show the total exposure to dioxin-like compounds from consumption of certain fish from several Maine rivers in order to give a complete assessment of the fish consumption advisories. The coplanar PCB data are distinct from the dioxin data and the reporting requirements of the Above/Below test. Sources of the coplanar PCBs are not known, but likely include atmospheric deposition.

OVERALL FINDINGS

- All kraft pulp mills, except Lincoln Paper and Tissue, are in compliance with the Above/Below test, meaning they are no longer discharging dioxins. Lincoln could not submit a second year of data for compliance with the test in 2004 due to its shutdown.
- Trends in fish tissue levels are downward, but levels remain elevated at some locations due to residual levels of contamination from historical discharges. Any formal change in a Bureau of Health advisory would involve a comprehensive review of levels of all measured contaminants in fish tissue.

HUMAN HEALTH FINDINGS

- There are Fish Consumption Advisories for the **Androscoggin**, **Kennebec**, **Penobscot**, **Sebasticook**, and **Salmon Falls Rivers**, due to dioxins or a combination of dioxins and dioxin-like coplanar PCBs. These advisories are more restrictive than the statewide mercury advisory.
- An evaluation of the health implications of dioxin/furan concentrations in fish in Maine Rivers requires a comparison to a health benchmark. The Bureau of Health uses a health benchmark that is expressed as a specific fish tissue concentration of dioxins and furans, referred to as a "Fish Tissue Action Level" or FTAL. For the present report, the Bureau compares the most recent data on dioxins and furan levels in fish tissue to its current FTALc of 1.5 parts per trillion (ppt) for protection of cancer-related effects. The Bureau also compares dioxin, furans, and coplanar PCB levels to 1.8 parts per ppt to its FTALr for protection of noncancer or reproductive related effects. The Bureau additionally compares all data to a lower pFTALc of 0.4 ppt, which is under consideration as a potential revision to current FTALs to account for background dietary exposure to dioxins and furans.

- All sampling locations below the pulp and paper mills had average dioxin and furan concentrations in bass tissue that were below the current FTALc of 1.5 ppt (Figure 1), with the exception of the Rumford Point sampling location on the Androscoggin River.
- Most sampling locations had average levels of dioxins and furans that were above the potential lower pFTALc of 0.4 ppt. However, bass tissue samples at Riley and Livermore Falls were slightly under 0.4 ppt. Levels in sucker tissue were close to, or above, the current FTALc for all sampling locations (Figure 2).
- When the amounts of measured dioxin-like coplanar PCBs were added to the dioxin concentrations, there were exceedances for the current FTALr of 1.8 ppt at several stations on the river. These data were collected in the Surface Water Ambient Toxics (SWAT) monitoring program. Sources are unknown but likely include long-range transport and atmospheric deposition.
- Average dioxin and furan levels in Androscoggin Lake have not been reported above the current FTAL of 1.5 ppt in any species since 1996. However, with the exception of the 2000 sampling season, all other sampling seasons have yielded average levels in fish tissue near or above the potential lower-bound pFTALc of 0.4 ppt.
- Dioxin concentrations in bass from the West Branch of the Sebasticook River in Palmyra exceed the FTALc. Bass tissue from the East Branch are lower than the FTALc, but exceed the potentially lower pFTALc of 0.4 ppt.

Figure 1. Dioxin (DTE) and Coplanar PCB (CTE) toxic equivalents in smallmouth bass (and white perch WHP and rainbow trout RBT) from the Androscoggin (Axy), Kennebec (Kxy), Penobscot (Pxy), and Sebasticook (Sxy) rivers, 2004.

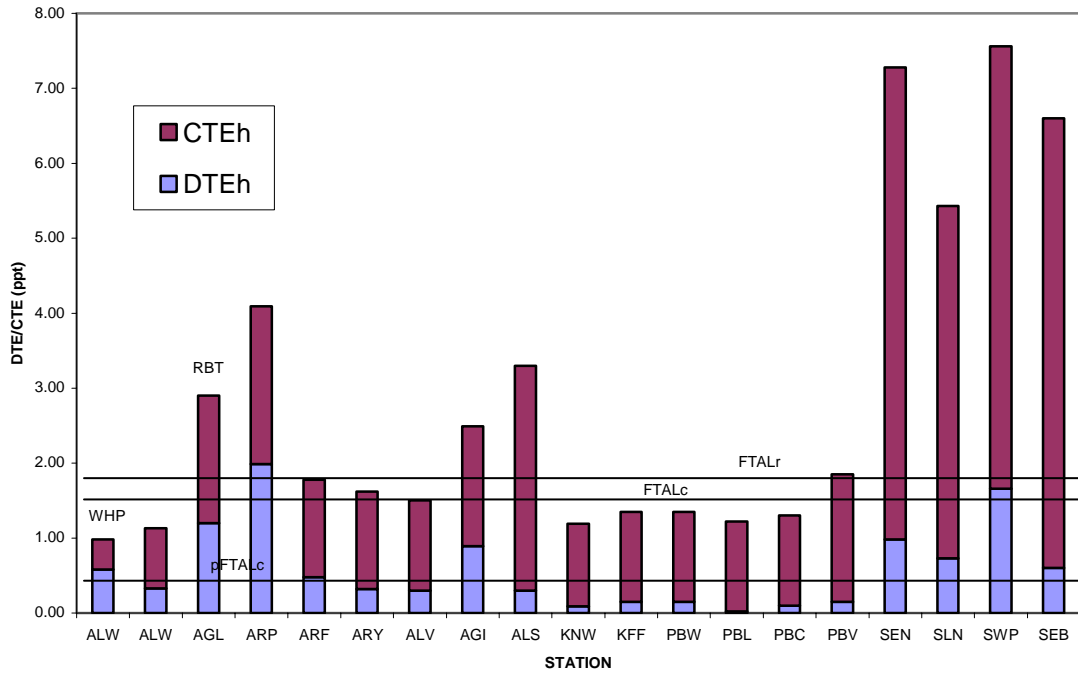
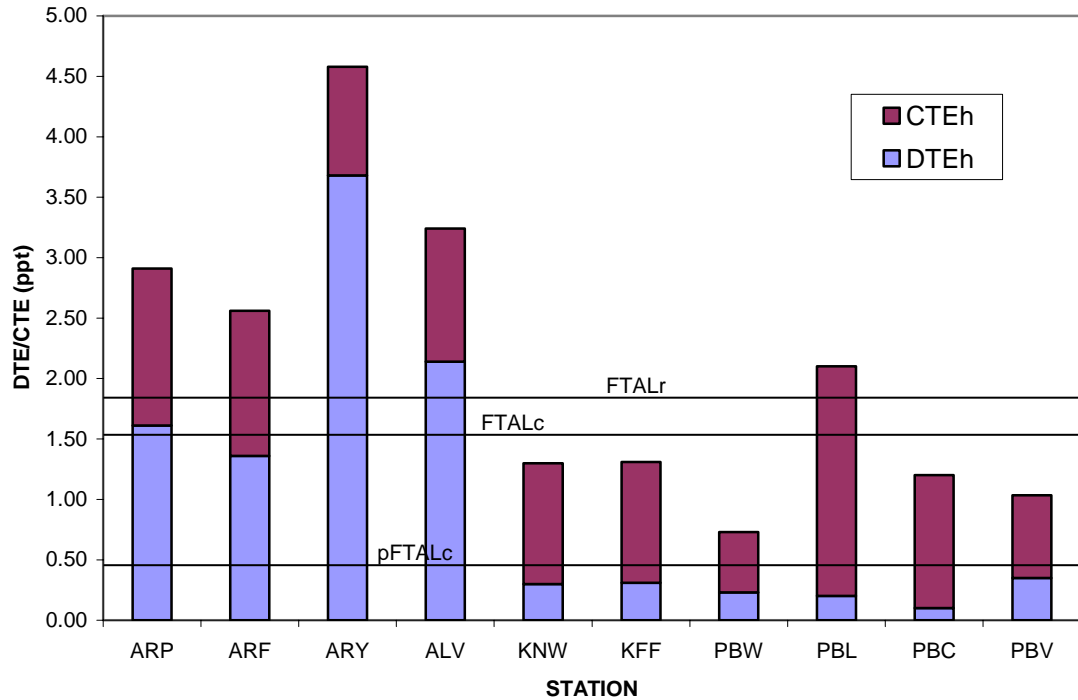


Figure 2. Dioxin (DTE) and coplanar PCB (CTE) toxic equivalents in white suckers from the Androscoggin (Axy), Kennebec (Kxy), and Penobscot (PBy) rivers, 2004.



FINDINGS ON DISCHARGES FROM BLEACHED KRAFT PULP AND PAPER MILLS

- Results of the Above/Below test (Table 2) indicate that there is no longer a discharge of dioxin from **MeadWestvaco** mill in Rumford, the **International Paper** mill in Jay, the **SAPPI-Somerset** mill in Skowhegan, or the **Georgia-Pacific** mill in Old Town.
- Continued elevated levels above background at some locations below mills in these rivers may be the legacy of the long history of discharges to the rivers.
- Results from 2003 indicate that the **Lincoln Paper and Tissue** mill may no longer be discharging dioxin. Since the mill was closed for several months at the beginning of 2004, no A/B test was conducted in 2004. Since at least 2 years data are needed, the test will continue in 2005.
- Annual compliance with the no discharge provision as currently required by 38 MRSA section 420 may be demonstrated by either of two methods. 1). Bleach plant effluent concentrations, monitored at least once per year and reported at the actual concentrations, rather than the nominal 10 ppq limit, must remain as low as in 2003 and 2004 when the A/B test indicated compliance. In addition, the mills must certify, based on a list of DEP criteria, that the bleach plant and other pertinent processes continue to operate and perform in a manner similar to that in 2003 and 2004. 2) Compliance may also be demonstrated by repeating the A/B fish test.
- The Dioxin Monitoring Program will need to be continued as currently specified by 38 MRSA § 420-A to monitor continuing elevated levels of dioxin in fish from some of these rivers for the Fish Consumption Advisories

Table 2. Evidence of dioxin discharge from bleached kraft pulp and paper mills

2003	MeadWestvaco	International Paper	SAPPI Somerset	Lincoln Paper	Georgia Pacific
Bass	N	N	N	N	N
Suckers	N	N	Y	N	N
Mussels	NS	N	N	NS	NS
POE	N	N	N	N	N
2004					
Bass	N	N	N	NS	Y
Suckers	N	N	Y	NS	N
Mussels	N	N	N	NS	N
POE	N	N	N	ND	N
NS = not sampled		N = no			
ND = not determined		Y = yes			

ABOVE/BELOW (A/B) TEST

- 1) The test will measure contaminant concentrations in 3 separate species: a) bass b) suckers, and c) caged mussels.
- 2) A preponderance of evidence (POE) approach will be used where passage of 2 of the 3 tests will be used to indicate no discharge.
- 3) To achieve an overall 95% confidence with the POE approach, the level of significance for each individual test is 0.135 for both type I and II errors.
- 4) Compounds to be measured will be 2378-TCDD and 2378-TCDF, combined into a single metric, TCDD + (TEF x TCDD), to equivalently weight both congeners.
- 5) Concentrations of these compounds will be based on lipid normalized values if there is a significant relationship between contaminant concentration and lipid from linear regression, or wet weight values if there is no significant correlation.
- 6) Concentrations less than the detection limit (<DL) will be calculated at ½ the DL.
- 7) Where all of the values for the samples at an above or below station are <DL, no statistical determination will be made.
- 8) To compensate for the sensitivity of the tests, a mill must show no evidence of a discharge for 2 consecutive years before being deemed in compliance. Periodic testing at the discretion of the Department in subsequent years will also be necessary to assure continued compliance.

BACKGROUND ON DIOXIN

Due to continuing controversy over the effects of dioxin on human and ecological health, the US Environmental Protection Agency (EPA) announced in 1991 it would begin a thorough scientific reassessment of dioxin. EPA proposed that the process would be open to the public and consequently held several meetings to share information and receive comments. A draft report was issued in 1994 and subsequent review in 1995 by EPA's Science Advisory Board called for revisions of some chapters. Revised drafts published in 2000 indicate that dioxin may exhibit reproductive and developmental effects, immuno-toxic effects, neuro-toxic effects, and cancer. In addition, the reports found that concentrations of dioxin in the environment have decreased since the 1970s. Also 'EPA currently estimates that the amount of dioxin in tissues of the general human population closely approaches within a factor of 10, the levels at which adverse effects might be expected to occur'. In March 2001 EPA's Scientific Advisory Board published its draft review of EPA's new revisions and is divided on whether or not dioxin is a carcinogen, but does believe EPA has underestimated non-cancer effects. The Scientific Advisory Board also does not agree that there is enough evidence to support EPA's statement about current body burdens and probable adverse health impacts.

DIOXIN MONITORING PROGRAM

Dioxin was first discovered to be a problem in Maine in 1985, when the results of an analysis of fish collected in 1984 from the Androscoggin River by the Maine Department of Environmental Protection (the Department), used as a reference station for EPA's National Dioxin Study, documented significant concentrations of dioxin. Consequently, the Maine Bureau of Health issued Maine's first fish consumption advisory in 1985. Additional sampling in 1985 and 1986 found similar levels in fish from other rivers below bleached kraft pulp and paper mills, but not from rivers or lakes without such sources. This led to including parts of the Kennebec River and Penobscot River in a revised fish consumption advisory in 1987. As a result there was a bill before the Maine legislature in 1988 to ban the discharge of dioxin, but the bill was amended to establish a monitoring program, Maine's Dioxin Monitoring Program (DMP) and enacted into law (38 MRSA section 420-A) to sunset in 1990. Discovery of continuing significant concentrations in fish from these and other rivers resulted in the DMP being reauthorized in 1990, 1995, 1997, and most recently in 2002 extending until 2007. The Department has issued reports of the results of monitoring annually. Fish consumption advisories have been issued or modified in 1985, 1987, 1990, 1992, 1994, 1997, and 2000.

The goal of Maine's Dioxin Monitoring Program is "to determine the nature of dioxin contamination in the waters and fisheries of the State". Charged with administration of the program, the Department is required to sample fish once a year below no more than 12 bleached pulp mills, municipal wastewater treatment plants, or other known or likely sources of dioxin. Costs for equipment, supplies, and analysis are assessed to the selected facilities annually, and could not exceed \$168,000 until 1997 when the limit was raised to \$250,000 to incorporate development of the Above/Below (A/B) fish test.

The Department is advised by the Surface Water Ambient Toxic (SWAT) Monitoring Program Technical Advisory Group in implementation of the program. An annual report is required to be

submitted to the Natural Resources Committee of the Maine Legislature by March 31 with the results from the previous year, including status of progress toward meeting the requirements of the Dioxin/Color law.

The primary objective of the Dioxin Monitoring Program is to monitor dioxin in fish for assessment of human health and ecological impact.

A second objective is to measure trends, progress toward reduction in environmental concentrations, and effectiveness and need for further controls.

The monitoring program is coordinated with other ongoing programs conducted by the Department, US Environmental Protection Agency (EPA), or dischargers of wastewater. The proposed annual monitoring plan must be submitted to the Surface Water Ambient Toxic (SWAT) monitoring program Technical Advisory Group (TAG), created under 38 MRSA section 420-B, for review and advice. The selected facilities must be notified of their inclusion in the proposed program at least 30 days prior to submittal to the TAG. The Department must incorporate the results of all studies into a report due the Natural Resources Committee by March 31 of the following year. A draft of the report is reviewed by the TAG before completion of the final report. Costs of sample collection and analysis are assessed as a fee to the selected facilities. Payment of the fees is a condition of the waste discharge license granted by the state for continued operation and discharge of wastewater to waters of the State. However, if the selected facility is a publicly owned treatment works (POTW), then the fees may be assessed to the known or likely industrial generator of dioxin and payment will not be a condition of the waste discharge license of the POTW.

1997 DIOXIN/COLOR LAW

A third objective, integrated into the DMP, comes from the Dioxin/Color law. In 1997 the Maine Legislature enacted LD 1633 "An Act to Make Fish in Maine Rivers Safe to Eat and Reduce Color Pollution", the Dioxin/Color law [38 MRSA section 420(2)(I)]. The key requirement is that 'a (bleach kraft pulp) mill may not discharge dioxin into its receiving waters after December 31, 2002. To determine compliance, there are interim tests and a final test. Two interim tests, of effluent from the bleach plant require that 1) TCDD (2378-tetrachlorodibenzo-p-dioxin, the most toxic of the 17 toxic dioxins and furans) must be below 10 ppq, parts per quadrillion or picograms per gram, pg/g by July 31, 1998 and 2) TCDF (2378-tetrachlorodibenzofuran) must be below the same detection limit by December 31, 1999. As the final test to confirm that there is no discharge, by December 31, 2002 fish (or surrogate) below a bleached kraft pulp mill must have no more dioxin than fish (or surrogate) above the mill, the so-called "above/below (A/B) fish test".

Since contamination levels in fish are likely to be highest in late summer to early fall, sampling for compliance with the December 31, 2002 deadline could not begin until summer 2003. Because laboratory results of summer data are not available in time to report by December 31 of any given year, the legislature amended the 1997 Dioxin/Color law in 2003 to delay the date of DEP's report by a year, to February 16, 2004. The amendment also delayed the date by which a

mill must demonstrate it no longer discharges, if the Department finds that it does, for a year after that. The amendment also requires the mills to make the demonstration annually. Additional legislation has combined reporting of compliance with the law with the annual Dioxin Monitoring Program report due March 31 of the year following data collection.

ABOVE/BELOW (A/B) TEST

DEP's report 'Dioxin Monitoring Program 2002-2003, Status of Dioxin in Maine's Rivers' dated February 25, 2004 established the A/B test as follows:

- 1) The test will measure contaminant concentrations in 3 separate species: a) bass b) suckers, and c) caged mussels.
- 2) A preponderance of evidence (POE) approach will be used where passage of 2 of the 3 tests will be used to indicate no discharge.
- 3) To achieve an overall 95% confidence with the POE approach, the level of significance for each individual test is 0.135 for both type I and II errors.
- 4) Compounds to be measured will be 2378-TCDD and 2378-TCDF, combined into a single metric, TCDD + (TEF x TCDF), to equivalently weight both congeners.
- 5) Concentrations of these compounds will be based on lipid normalized values if there is a significant relationship between contaminant concentration and lipid from linear regression, or wet weight values if there is no significant correlation.
- 6) Concentrations less than the detection limit (<DL) will be calculated at ½ the DL.
- 7) Where all of the values for the samples at an above or below station are <DL, no statistical determination will be made.
- 8) To compensate for the sensitivity of the tests, a mill must show no evidence of a discharge for 2 consecutive years before being deemed in compliance. Periodic testing at the discretion of the Department in subsequent years will also be necessary to assure continued compliance.

FISH CONSUMPTION ADVISORIES

There is a statewide fish consumption advisory due to mercury in all fresh waters. There are additional advisories for a number of rivers due to dioxins and dioxin-like (coplanar) PCBs (Appendix 1).

There are 75 dioxins and 135 related furans, 17 of which are considered toxic, but with different toxicities. The total toxicity of a sample (dioxin toxic equivalents=DTE or toxic equivalents=TEQ) can be calculated as the sum of the product of the concentration and toxicity

equivalency factor (TEF, relative to the most toxic dioxin, TCDD) for each of the 17 dioxin and furans.

For informing the public about potential risk from consuming fish contaminated with dioxin and dioxin-like compounds, the Maine Bureau of Health (BOH) publishes fish consumption advisories. These advisories are based on a comparison of a Fish Tissue Action Level (FTAL) for dioxin toxic equivalent (DTE) concentrations with the 95th percentile upper confidence limit on the mean DTE in fish tissue. Should a tissue concentration exceed an FTAL, a fish consumption rate (e.g., # meals per month) which is unlikely to result in deleterious effects is determined. Two FTALs have been derived for evaluating potential deleterious effects from exposure to dioxins and dioxin-like compounds. Both FTALs were developed using standard USEPA risk assessment methods (EPA 1997). For potential carcinogenic effects associated with long-term exposure, BOH has developed a FTALc of 1.5 ppt, while for reproductive and developmental effects potentially arising from shorter exposure durations, BOH has developed a FTALr of 1.8 ppt (Frakes, 1990). The FTALr for reproductive and developmental effects is relevant to women of childbearing age, pregnant women, and lactating women. The FTALs are compared to the concentration of DTE in edible portions of the fish, skinless filet data. Where whole fish data are reported, the DTE concentration is divided by a factor of 3.5, determined from previous studies with white suckers, to estimate skinless filet concentration. In this report all comparisons with DTE in fish are made with FTALc, since that is the lower of the two and protective against both effects.

WORKPLAN DESIGN

The primary emphasis of the 2004 workplan was to collect fish samples from the appropriate stations and species from each river such that accurate, complete, and current data are available to assess impact to wildlife and human consumers. The workplan design included sampling at least one station below each major source to document trends and sampling of historic stations that showed dioxin above background whether or not any fish consumption advisories were issued. Finally the workplan was modified to evaluate the A/B test.

The 2004 workplan was initially drafted by DEP according to the objectives listed above and sent to participating facilities for comment on May 21, 2004. After discussion of the draft workplan at a meeting of the SWAT Technical Advisory Group (TAG) on June 29, 2004, a final workplan was determined by the Commissioner generally following the recommendations of the SWAT TAG or independent peer review panel, which were sometimes different. One difference was that the peer review panel recommended use of caged mussels, where as the TAG was divided on the issue.

In 2004 all stations were to be monitored for ecological and/or human health assessment and trends. At least 5 game fish (bass or other important species) were to be collected from each station (Table 1). We were unable to capture brown trout of the right size from the Kennebec River at Fairfield and Sidney, nor enough bass from the Salmon Falls River at Berwick. White suckers were collected at several stations for use in both ecological and human health assessment. At some stations, the fish were analyzed individually, while at other stations, fish

were combined into composite samples in order to minimize cost and remain under the monetary cap.

Table 1. 2004 Dioxin Monitoring Program

STATION	SMB	WHS	MUSSELS	OTHER	FACILITY
Androscoggin R					
Gilead				5 RBT	SWAT
Rumford Point	10C3	10C3	10C10		Meadwestvaco
Rumford	10C3	10C3	10C10		Meadwestvaco
Riley	10C3	10C3	10C10		International Paper
Livermore Falls	10C3	10C3	10C10		International Paper
Turner (GIP)	5				Meadwestvaco
Lisbon	5				International Paper
Androscoggin L	2C5			2C5 WHP	Mead & IP
Kennebec R					
Norridgewock	10C3	10C3	10C10	5 BNT	SD Warren, SWAT
Fairfield	10C3	10C3	10C10	5 BNT	SD Warren
Sidney				5 BNT	KSTD
Penobscot R					
Woodville	2C5	2C5			Lincoln Paper & Tissue
S Lincoln	2C5	2C5			Lincoln Paper & Tissue
Milford	10C3	10C3	10C10		Georgia Pacific
Veazie	10C3	10C3	10C10		Georgia Pacific
Bangor					
Salmon Falls R					
S Berwick	5				Berwick Sewer Distict
W Br Sebasticook R					
Palmyra	5				Hartland

10C3 = 10 composites of 3 fish, etc.
species codes see Appendix 2

For the A/B test, the goal was to reduce the variability of results thereby decreasing the minimum significant difference (MSD) that could be detected statistically between the above and below stations. Decreasing the MSD increases the sensitivity and power of the A/B test. Two ways to reduce variability are to use composite samples instead of single fish and to use a large sample size. Given these objectives and realistic sampling effort and cost, the target was to collect 30 smallmouth bass and 30 white suckers at historical stations above and below each of the bleached kraft pulp and paper mills. The 30 fish were combined into 10 composites of 3 fish each, except on the Penobscot River at Costigan and Veazie, above and below the Georgia Pacific mill in Old Town, where we were unable to collect 30 fish of similar size at all stations.

At those two stations, 20 fish of each species was captured and combined into 10 composite samples of 2 fish each.

All samples were analyzed for all 2378-substituted dioxins and furans. All fish were analyzed for human health as skinless filets.

The preferred sampling time is late in the summer when fish are likely to be most contaminated after being exposed to higher concentrations of dioxin during low river flows and after significant growth has occurred. At some locations there has been a problem collecting enough fish later in the summer. At those locations sampling began in mid-May to try to insure that a suitable sample was collected. These stations were also visited after the beginning of July if there was time. If fish were captured during the later period, those samples were submitted for analyses. Otherwise, the fish collected during the early period were used. Sampling at other stations began in July. Actual dates of collection are shown in Appendix 6.

Caged mussels were deployed at the same A/B stations as the fish sampling. A total of 10 composite samples of 9-10 mussels each were collected from each station.

SAMPLING PROCEDURES

Fish were collected by DEP with assistance of state agencies and the Penobscot Indian Nation. Upon capture, fish were immediately killed, weighed and measured, rinsed in river water, wrapped in aluminum foil with the shiny side out, labeled, and placed in a cooler on ice for transport to the DEP lab. Chain-of-custody forms were used to record all field information and document all transfers. In the lab, all fish samples were frozen and later transported whole to the Pace Analytical Services lab in Minneapolis, Minnesota for analysis. All other procedures followed EPA's Sampling Guidance Manual for the National Dioxin Study (July 1984). A laboratory log was kept for an inventory of samples in the lab at any time and final disposition.

The caged mussel study was conducted following the protocol previously reported (Applied Biomonitoring, 2004).

Most of the facilities in the program already sample sludge or effluent as part of their Maine Sludge Spreading Permit or Waste Discharge License or Federal NPDES permit. Data from those programs provide adequate information about sources of dioxin. Therefore, no additional sludge samples were collected as part of this program. Effluent data are also used when available to indicate sources and any trends.

CALCULATIONS

In this report, dioxins are reported in different ways for each goal of the program. Given the uncertainty of true values when results are below the detection level, for the purpose of determining the range of possible concentrations, DTE are shown as a range with non-detects calculated at zero (DTEo) and at the detection limit (DTEd) as a mean for all samples of a given

species at each station (Appendix 7). For human health assessment, DTEh, calculated using non-detects at 1/2 the detection limit consistent with the policy of BOH were compared with the FTALc. The upper 95th percentile confidence limit (UCL) was used for these comparisons, consistent with the policy of the BOH. For the A/B test, TCDD and TCDF were used. Because raw values for TCDF are much larger than those for TCDD, and in order to give more equal influence to both, TCDF was converted to TCDD equivalents using its TEF. The TCDD equivalent was then added to the TCDD concentration, essentially calculating a TEQ or DTE for TCDD and TCDF only with non-detects at 1/2 the detection limit (DFTEh).

A related issue is that of estimated maximum possible concentrations (EMPC). Some compounds, particularly hydroxydiphenyl ethers (DPEs), are coextracted with furans. Various steps have successfully been taken to minimize these interferences, but some DPEs remain. In this report, EMPCs were treated as non-detects.

Statistical analyses of differences in DFTEh between stations were performed using either the t-test or non-parametric Mann-Whitney test. In this report statistically significant differences are those with a p-value less than or equal to 0.135.

Trends were determined using Kendall's tau, a rank-order correlation statistic, for the period 1997-2004 at a p-value of 0.05.

RESULTS AND DISCUSSION.

Results for each sampling station are discussed with respect to the three objectives of the program, 1) human health, 2) trends, and 3) where pertinent, the no discharge provision (A/B test). See Appendix 2 for raw dioxin data for 2004, Appendix 6 for fish sample data, and Appendix 7 for all historical dioxin data.

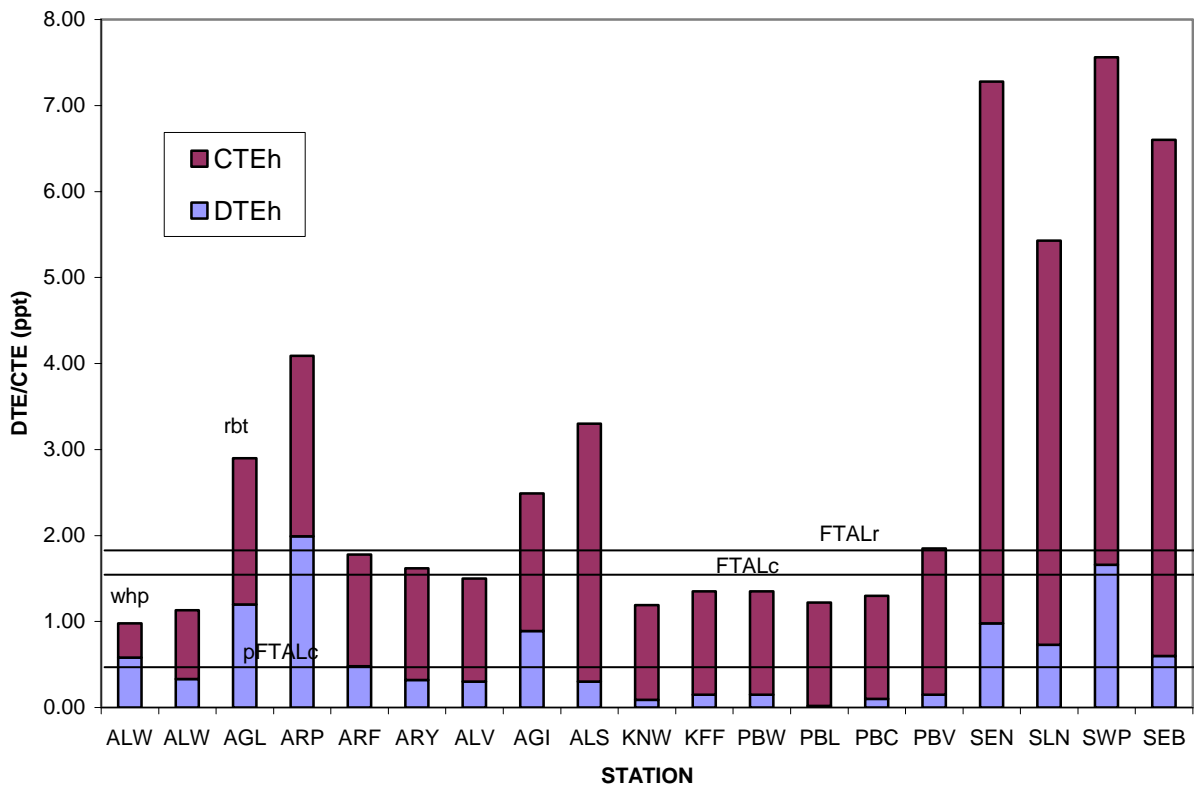
Dioxin concentrations in fish generally continued to decline from previous years, but there is some year-to-year variation in the trends. Concentrations remained elevated above natural background levels in fish at some stations, particularly on the Androscoggin and Sebasticook rivers, but approached background levels at some stations on other rivers. Dioxin toxic equivalents (DTEh), most likely from historical discharges from the mills, exceeded or, combined with (dioxin-like) coplanar PCBs (CTEh) contributed significantly to exceedances of the Bureau of Health's Fish Tissue Action Levels (FTAL) at many stations (Figures 1 & 2). DTEh are compared to existing FTALc and potentially new pFTALc for the cancer endpoint. The sum of DTEh and CTEh are compared to the existing FTALr for the reproductive endpoint. CTEh, which are measured in the SWAT program, were measured in bass, white perch, and rainbow trout in 2004. CTEh data for suckers, which was not collected in 2004, are taken from the most recent year sampled, 2001. Sources of CTEh, measured in DEP's SWAT program, are unknown but likely include combustion with long range transport and atmospheric deposition from local, regional, and national sources. Details are discussed below for each station.

Androscoggin River

Gilead- (AGL) and Rumford Point (ARP) A total of 5 rainbow trout were collected near Peabody Island in Gilead, while 30 bass and 30 white suckers were caught further downstream at Rumford Point and combined into 10 composites of 3 fish each (Appendix 6). As both stations are downstream of the American Pulp and Paper Co's bleached kraft mill in Berlin, New Hampshire, they show concentrations above background. Since there are no known or potential significant sources of dioxin between them, they are considered the same station relative to point sources.

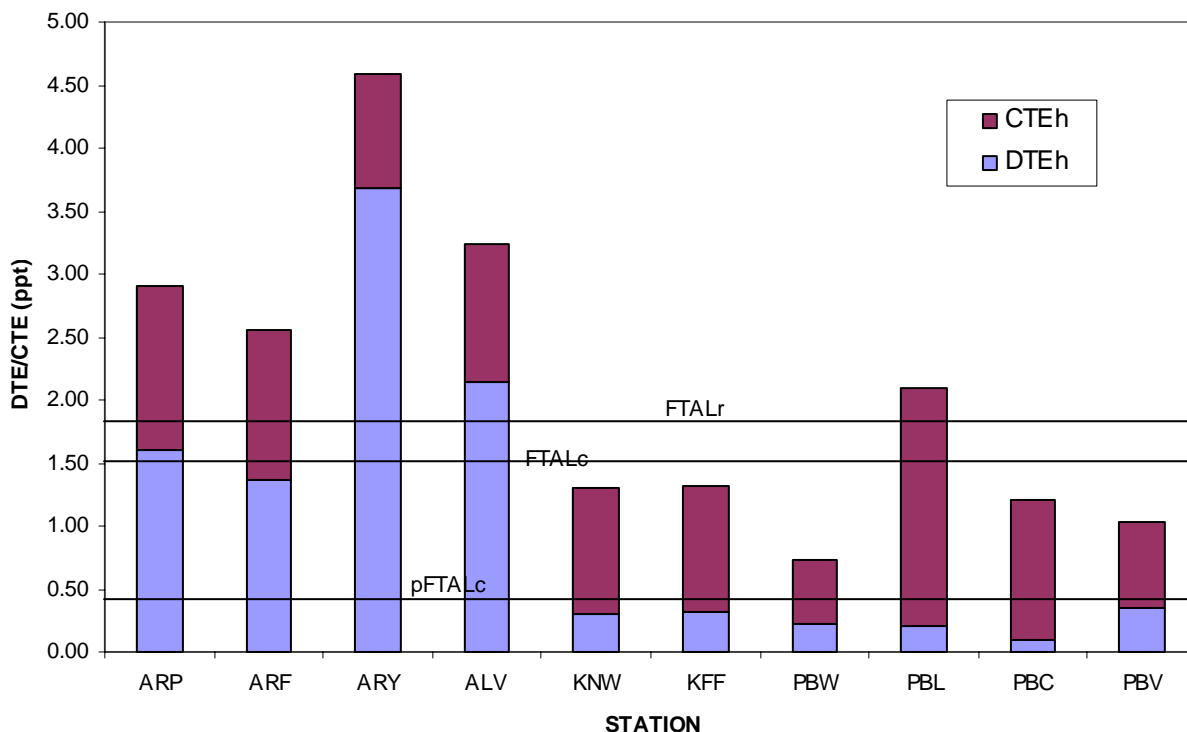
DTEh in rainbow trout, bass and suckers were 80%, 133%, and 108% of the FTALc respectively and all exceeded the pFTALc (Figures 1 & 2, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in higher levels of total toxic equivalents (TTEh) that further exceed the FTALr in bass and cause an exceedance in trout and suckers.

Figure 1. Dioxin (DTE) and Coplanar PCB (CTE) toxic equivalents in smallmouth bass (and white perch WHP and rainbow trout RBT) from the Androscoggin (Axy), Kennebec (Kxy), Penobscot (Pxy), and Sebasticook (Sxy) rivers, 2004.



Every year measured, TCDD and DTEh in fish have been significantly higher at this station than in fish from reference stations in Maine (Appendix 7). There was no significant trend for the period 1997-2004 for any species. The American Tissue mill in Berlin, New Hampshire, has reported to have switched to elemental chlorine free (ECF) bleaching (chlorine dioxide) in 1994. The mill closed in 2001 but the paper and pulp mills reopened in 2002 and 2003 respectively.

Figure 2. Dioxin (DTE) toxic equivalents in white suckers from the Androscoggin (Axy), Kennebec (Kxy), and Penobscot (PBy) rivers, 2004.



Rumford- (ARF) A total of 30 smallmouth bass and 30 white suckers were collected from the river reach from just below the discharge from MeadWestvaco Corporation's bleached kraft pulp and paper mill in Rumford downstream about 4 miles to Dixfield and combined into 10 composites of 3 fish each (Appendix 6).

Concentrations of DTEh in the bass and in the suckers were 32% and 91% of the FTALc respectively and both exceeded the pFTALc (Figures 1 and 2, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in higher levels of total toxic equivalents (TTEh) that approach the FTALr in bass and exceed the FTALr in suckers.

No sludge data have been reported since 1989. Concentrations of both TCDD and TCDF have been reported below variable detection levels in final effluent since 1993 and below a 10 ppq detection limit in bleach plant effluent since 1998 up through 2001, the latest that data are available (Appendix 4).

The 2003 Dioxin Monitoring Program report issued in February 2004 indicated higher levels of TCDDw (wet weight basis) in suckers below the mill at ARF than above at ARP. At the recommendation of the SWAT Technical Advisory Group in June 2004, data from both the above and below stations were pooled to explore the relationship with lipid, rather than exploring it at each station independently as was done for the 2003 report. The result was that the data

showed that normalizing to lipid was warranted. Examination of DFTEh on a lipid normalized basis showed that concentrations were not significantly different in either bass or suckers, the 2 species tested. (Table 2, Appendix 5). Evaluation of the 2004 A/B test also shows no significant difference in concentrations of DFTEh between the above and below) stations for bass, suckers, or caged mussels. As there are now 2 consecutive years where all species tested showed no significant difference in concentrations, the mill has passed the A/B test.

ARP is in an impoundment whereas ARF is in a free flowing stretch. Hydropower studies conducted by DEP and International Paper in Jay have shown that even low head run-of-the-river dams trap sediment that may increase contaminant levels in fish. Therefore, comparison of ARP with ARY, the next station downstream from ARF, may be more relevant. Concentrations at ARY are also not significantly greater than those at ARP for either species for either 2003 or 2004.

There is a significant declining trend for TCDD and DTEo for bass and suckers during the period 1997-2004. TCDD was no longer significantly greater than reference stations unimpacted by point source discharges on other Maine rivers but DTE were in both species (Appendix 7). Continued elevated levels of DTE below the mill are likely the legacy of the long history of discharges. This fact warrants some continued monitoring, which can also be used to document continuing compliance with the no discharge provision, all within the Dioxin Monitoring Program.

Table 2. Evidence of dioxin discharge from Maine bleached kraft pulp and paper mills (Yes/No)

2003	MeadWestvaco	International Paper	SAPPI Somerset	Lincoln Paper	Georgia Pacific
Bass	N	N	N	N	N
Suckers	N	N	Y	N	N
Mussels	NS	N	N	NS	NS
POE	N	N	N	N	N
2004					
Bass	N	N	N	NS	Y
Suckers	N	N	Y	NS	N
Mussels	N	N	N	NS	N
POE	N	N	N	ND	N
NS = not sampled ND = not determined					

Riley- (ARY) A total of 30 legal sized smallmouth bass and 30 white suckers were collected from the river above the Riley Dam about 19 miles downstream of MeadWestvaco Corporation and upstream of International Paper Company's discharge and combined into 10 composites of 3 fish each (Appendix 6).

Concentrations of DTEh in the bass and suckers were 22% and 245% of the FTALc respectively (Figures 1 and 2, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in total toxic equivalents (TTEh) that approach the FTALr in bass and add to the exceedance in suckers.

TCDD in bass and DTEh in both species were significantly greater than reference stations on other Maine rivers (Appendix 7). That concentrations of dioxin in suckers are higher here than upstream at ARF, in spite of the fact that there are no known or likely sources in between, may be due to the fact that ARY is in an impoundment whereas ARF is free-flowing. Nevertheless, concentrations are lower than at ARP for both 2003 and 2004. There is a significant declining trend for TCDD in bass only for the period 1997-2004.

Livermore Falls- (ALV) A total of 30 legal-sized smallmouth bass and 30 white suckers were captured in the Otis Impoundment approximately 2 miles downstream of the discharge from International Paper Company's Jay mill and combined into 10 composites of 3 fish each (Appendix 6).

Concentrations of DTEh in the bass and suckers were 2% and 143% of the FTALc respectively (Figures 1 and 2, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in total toxic equivalents (TTEh) that approaches the FTALr in bass and further exceeds it in suckers.

There are no new sludge data since 1996. Concentrations of TCDD and TCDF in bleach plant effluent and final effluent are well below EPA's reporting level up through 2000, the latest data are available (Appendix 4).

The 2003 Dioxin Monitoring Program report issued in February 2004 indicated higher levels of TCDDl (lipid weight basis) in suckers below the mill at ALV than above at ARY. DFTEh were not significantly different in either bass or suckers, the 3 species tested in 2003 (Table 2, Appendix 5). Evaluation of the 2004 A/B test also shows no significant difference in concentrations of DFTEh between the above and below) stations for bass, suckers, or caged mussels. As there are now 2 consecutive year where all species tested showed no significant difference in concentrations, the mill has passed the A/B test.

There is a significant declining trend for TCDD and DTEo in bass and TCDD in suckers for the period 1997-2004. TCDD in bass was no longer significantly greater than reference stations on other Maine rivers but it was in suckers and DTEh were in both species (Appendix 7). Continued elevation of levels of TCDD and DTE above background below the mill are likely the legacy of the long history of discharges and warrants some continued monitoring, which can also be used to document continuing compliance with the no discharge provision.

Auburn-GIP- (AGI) A total of 5 smallmouth bass were collected in Gulf Island Pond near the deep hole at Seagull Island, approximately 30 miles downstream of International Paper Company (Appendix 6). Concentrations of DTEh in the bass were 60% of the FTALc respectively and

exceeds the pFTALc (Figure 1, Appendix 2). The addition of dioxin-like (coplanar) PCBs, to DTEh results in higher levels of total toxic equivalents (TTEh) in these fish that exceeds the FTALr.

There is a declining trend in TCDD and DTEo in bass during the period 1997-2004. TCDD and DTEh concentrations were significantly greater than reference stations on other Maine rivers (Appendix 7). Continued elevation of levels of TCDD and DTE above background are likely the legacy of the long history of discharges. As this station is a popular fishing spot, it warrants some continued monitoring for assessment of the Fish Consumption Advisories.

Lisbon Falls- (ALS) A total of 5 smallmouth bass were captured in the Pejepscot Impoundment approximately 45 miles below International Paper Company (Appendix 6). Concentrations of DTEh were 20% of the FTALc (Figure 1, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in higher concentrations of total toxic equivalents (TTEh) in these fish that exceeds the FTALr.

There was no significant trend for the period 1997-2004 for bass. TCDD and DTEh were significantly greater than reference stations on other Maine rivers (Appendix 7). Continued elevation of levels of TCDD and DTE above background are likely the legacy of the long history of discharges.

Androscoggin Lake

Wayne- Androscoggin Lake in Wayne (ALW) and Leeds is a 4000 acre 38 foot deep mesotrophic lake with a unique reverse delta at the outlet formed by centuries of periodic backflow from the Androscoggin River via the Dead River into the lake. There is a dam on the Dead River that reduces, but does not prevent, the backflow into the lake, which usually occurs once or twice every year. Significant amounts of dioxin were found in fish from the lake beginning in 1996, but have been somewhat lower since.

In 2004, 10 smallmouth bass and 10 white perch were collected from the lake and analyzed as 2 composites of 5 fish each (Appendix 6). DTEh were 22%, and 39% of the FTALc for bass and white perch respectively, whereas DTEh in white perch exceeds the pFTALc (Figure 1, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) in these fish, which does not exceed the FTALr.

Concentrations in bass are generally lower in the recent years compared to when first monitored in 1996, although there is no trend in recent years. Concentrations of TCDD and DTEo in bass were no longer significantly greater than in game fish from all other lakes (n=8) or river reference stations that have been sampled but DTE in white perch appear slightly higher. (Appendix 7). Concentrations in bass were similar to those in bass from ALV, the nearest station on the river, but concentrations in white perch were slightly higher. Continued monitoring is needed.

Kennebec River

Norridgewock- (KNW) A total of 30 smallmouth bass and 30 white suckers were collected from the river at Norridgewock and combined into 10 composites of 3 fish each (Appendix 6). Although these locations are downstream of the discharge from Madison Paper Industries discharge in Madison, comparison of dioxin in fish from this station in 1998 and 1999 with that from fish caught at the Kennebec River reference station above Madison previously, showed no significant difference between the two locations. These locations therefore serve both as a reference for the river and the upstream station for the SAPPI Somerset mill.

DTEh in bass and suckers were 6% and 20% of the FTALc respectively (Figures 1 and 2, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) that are below the FTALr.

TCDD and DTEo were similar to those from previous years for this and other reference stations. The trace amount of DTE measured in these fish is likely due to long-range transport and atmospheric deposition from remote sources.

Fairfield- (KFF) A total of 30 smallmouth bass and 30 white suckers were collected from the river between the Shawmut Dam and the I-95 bridge, approximately 7-8 miles below SAPPI Somerset's bleached kraft pulp and paper mill in Skowhegan and combined into 10 composites of 3 fish each (Appendix 6).

Concentrations of DTEh in bass and suckers were 10%, and 20% of the FTALc respectively (Figures 1 and 2, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) that are below the FTALr.

There was a significant declining trend for TCDD and DTE for both species for the period 1997-2004.

Effluent data (Appendix 4) and sludge data (Appendix 3) document decreases in discharges over the years especially since early 1997 up to 2000, the latest data are available. Concentrations of TCDD and TCDF are well below the limits of the new law (<10ppq in the bleach plant).

Evaluation of the A/B test shows a significant increase in concentrations of DFTEh between the above station (KNW) and below station (KFF) for suckers, but not for bass or caged mussels, similar to the results in 2003 (Table 2, Appendix 5). By the preponderance of evidence approach, then, since 2 of the 3 tests show no evidence of a discharge, there is overall evidence of no discharge. As this is the second consecutive year with the same finding, the mill has passed the A/B test.

Additional periodic monitoring will be necessary to confirm continued reduced concentration and to confirm low levels in brown trout, fished heavily in this river reach.

Penobscot River

Woodville- (PBW) A total of 10 smallmouth bass and 10 white suckers were collected from the river at Woodville, downstream of Katahdin Paper's pulp and paper mills in Millinocket and East Millinocket, and combined into 2 composites of 5 fish each. Fish collected at this station in 1997 and 1998 had similarly low concentrations of dioxin as the historical reference station at Grindstone on the East Branch, uninfluenced by any mill. Therefore, this station serves as a reference station for the Penobscot River and the upstream station for Lincoln Paper and Tissue..

Concentrations of DTEh in bass and suckers were 10% and 15% of the FTALc respectively (Figures 1 and 2, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) that is still below the FTALr. Concentrations of TCDD and DTEh were similar to those of past years and at other reference stations (Appendix 7).

South Lincoln- (PBL) A total of 10 smallmouth bass and 10 white suckers were collected from the river near the boat ramp in South Lincoln, approximately 4 miles downstream of Lincoln Paper and Tissue Company's bleached kraft mill in Lincoln and combined into 2 composites of 5 fish each (Appendix 6).

Concentrations of DTEh in bass and suckers were 14% and 13% of the FTALc respectively (Figures 1 and 2, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) that is below the FTALr in bass but exceeds the FTALr in suckers due to CTEh alone.

There were no trends in TCDD or DTE either species for the period 1997-2004. This is interesting since there were decreased discharges from the mill as documented by decreased concentrations of TCDD and TCDF in sludge (Appendix 3) and in effluent since 1997. Reductions in effluent show compliance with the limits of the new law (Appendix 4) as a result of a change in the mill's bleaching process from chlorine based bleaching to primarily oxygen based bleaching in 1999.

The 2002-2003 Dioxin Monitoring Program report issued in February 2004 indicated higher levels of TCDDw (wet weight basis) in suckers below the mill at PBL than above at PBW in 2003. At the recommendation of the SWAT Technical Advisory Group in June 2004, data from both the above and below stations were pooled to explore the relationship with lipid, rather than exploring it at each station independently as was done for the 2003 report. The result was that the data showed that normalizing to lipid was warranted. Examination of DFTEh on a lipid normalized basis showed that concentrations were not significantly different in either bass or suckers, the 2 species tested. (Table 2, Appendix 5). Since the mill was closed for the first few months in 2004, no attempt was made to conduct the A/B test. Additional monitoring will be necessary.

Milford- (PBC) A total of 20 smallmouth bass and 20 white suckers were captured from the river at Freese Island near the boat ramp in Costigan, approximately 34 miles downstream of Lincoln Pulp and Paper Company's bleached kraft mill in Lincoln, and combined into 10 composites of 2 fish each (Appendix 6). This station is the upstream station for the above/below test for the Georgia Pacific mill about 5 miles downstream.

Concentrations of DTEh in bass and suckers were 7% and 28% of the FTALc (Figures 1 and 2, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) that is below the FTALr for both species. Trends were not evaluated.

Veazie- (PBV) A total of 20 smallmouth bass and 20 white suckers (Appendix 7) were collected from the Veazie Impoundment about 7-8 miles below Fort James' bleached kraft mill in Old Town and combined into 10 composites of 2 fish each (Appendix 6).

Concentrations of DTEh in bass and suckers were 7% and 26% of the FTALc respectively (Figures 1 and 2), Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) that is below the FTALr in suckers but exceeds the threshold in bass primarily due to CTEh.

There was no significant trend for the period 1997-2004 for either species. This is surprising since TCDD and TCDF bleach plant effluent concentrations at the Georgia Pacific mill have continued to decline since early 1998 and have met the limits of the new law.

The 2003 Dioxin Monitoring Program report issued in February 2004 indicated higher levels of TCDFw (wet weight basis) in bass below the mill at PBV than above at PBC. At the recommendation of the SWAT Technical Advisory Group in June 2004, data from both the above and below stations were pooled to explore the relationship with lipid, rather than exploring it at each station independently as was done for the 2003 report. The result was that the data showed that normalizing to lipid was warranted. Examination of DFTEh on a lipid normalized basis showed that concentrations were not significantly different in either bass or suckers, the 2 species tested. (Table 2). Evaluation of the 2004 test shows a significant increase in concentrations of DFTEh from the above station (PBC) to the below (PBV) station for bass, but none for suckers or caged mussels (Table 2, Appendix 5). By the preponderance of evidence approach, then, since 2 of the 3 tests show no evidence of a discharge, there is overall evidence of no discharge. As there are now 2 consecutive years where all species tested showed no significant difference in concentrations, the mill has passed the test.

Additional periodic monitoring will be necessary to confirm continued reduced concentrations.

Sebasticook River

East Branch at Newport-(SEN) A total of 5 smallmouth bass (Appendix 6) were collected from the river just above the County Road Bridge, a popular fishing spot at the inlet to Sebasticook Lake. This station is approximately 2 miles below the Corinna Sewer District discharge, 80% of which was from the Eastland Woolen Mill. This facility treated the waste from the Eastland Woolen Mill in Corinna until 1996, when the mill ceased operation. Since then groundwater and river sediments have been found to be contaminated with a number of pollutants from the mill precursors to the formation of dioxin. The site was placed on the National Priorities List of Superfund sites in 1999 and is currently being remediated.. The Eastland Woolen Mill has been removed along with most of the downtown buildings and contaminated soil. There has been a pump and treat system for contaminated groundwater.

Concentrations of DTEh were 65% the FTALc and exceeds the pFTALc (Figure 1, Appendix 2). Total toxic equivalents (TTEh), the combination of DTEh and dioxin-like PCBs, results in concentrations that greatly exceed the FTALr by much more than in previous years. . Sources of PCBs are unknown but may include the mill and/or long-range transport and atmospheric deposition.

TCDD and DTEh concentrations are similar to levels measured in 2001 and significantly greater than in fish from the upstream station above the mill at Corinna measured in 1997 (Appendix 7).

These results document a local source of dioxin to this reach of the river, most likely residues from Eastland Woolen Mill. Measurable amounts of furan were found in sludge from the Corinna Sewer District for a number of years, although there are no new sludge data since 1996 and no effluent data to show any recent changes in discharge levels (Appendix 3). The Corinna Sewer District discharge will be removed from the river by the end of 2005.

This fish sampling was funded by Maine's SWAT monitoring program. Since this station is heavily fished, monitoring needs to continue to assess the need for the Fish Consumption Advisories and document the effectiveness of remediation and removal of the Corinna discharge.

Sebasticook Lake- (SLN) A total of 5 smallmouth bass were collected from Sebasticook Lake, just downstream from SEN (Appendix 6). Concentrations of DTEh were slightly lower than at SEN at 48% of the FTALc and exceeds the pFTALc (Figure 2, Appendix 2). Total toxic equivalents (TTEh), the combination of DTEh and dioxin-like PCBs, result in concentrations that greatly exceed the FTALr. Sources of PCBs are likely similar to those at SEN immediately upstream. As this lake is heavily fished, continued monitoring for dioxins and PCBs is warranted.

West Branch at Palmyra (SWP) A total of 5 smallmouth bass were collected from the river near the US Route 2 bridge about 3-4 miles below the discharge from the Town of Hartland, whose effluent is about 85% effluent from Irving Tanning Company (Appendix 6).

Concentrations of DTEh were 111% of the FTALc (Figure 1, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in total toxic equivalents (TTEh) that greatly exceed the FTALr in these fish, by much more than in previous years.

These results document a current or historical local source of dioxin to this reach of the river, most likely the Irving Tanning discharge. Although the only effluent sample result reported (1996) showed no detectable amount of dioxin in effluent (Appendix 4), low solubility and high bioconcentration of dioxin make effluent data less meaningful than sludge data. Sludge data from 1989 show measurable levels of TCDF (Appendix 3), but more recent data in 2000 show concentrations below reasonably low detection levels. If these recent data are representative of reduced discharges, concentrations in fish should decrease in time, the length of which will be determined by how much residual dioxin remains in the system.

There were no significant trends for TCDD or DTEh during the period 1997-2004. Concentrations of TCDD and DTEh were significantly greater than in fish from the reference site upstream of the discharge in Great Moose Lake in years past (Appendix 7). As this station is heavily fished, continued monitoring is warranted.

Burnham- (SEB) A total of 5 smallmouth bass were collected from the main stem of the Sebasticook River after the confluence of the East Branch and West Branch (Appendix 6). . This reach, then, receives water from SEN and SWP.

Concentrations of DTEh were 40% of the FTALc and exceeds the pFTALc (Figure 1, Appendix 2). TCDD levels were elevated above those of reference stations likely reflecting the diluted effect of the West Branch influence. The addition of dioxin-like (coplanar) PCBs to DTEh results in total toxic equivalents (TTEh) that greatly exceed the FTALr in these fish, primarily due to CTEh. Continued monitoring for dioxins and PCBs is warranted.

Annual Demonstration of No Discharge

Annual continued compliance with the no discharge (of dioxin) provision of the 1997 Dioxin and Color Law (38 MRSA section (420(2)(I)(3) may be demonstrated by 1) a combination of monitoring of bleach plant effluent and certification that the performance of the bleach plant and other pertinent processes has not lowered since 2003 and 2004 when the A/B test indicated compliance or 2) repeating the A/B fish test.

Annual monitoring must be conducted at least once a year and demonstrate that actual (not nominal at 10 ppq) levels of TCDD and TCDF are as low as in 2003 and 2004.

For annual certification of the performance of the bleach plant and other pertinent processes, the mills must achieve and certify that they comply with the following requirements:

- Elemental Chlorine or hypochlorite was not and will not be used in the bleaching of pulp.
- The chlorine dioxide generating plant continues to be operated in a manner which minimizes or eliminates byproduct elemental chlorine generation.
- The chlorine dioxide generating plant continues to be operated in the supplier recommended manner.
- Any potential process changes that affect the chlorine dioxide plant and/or bleach plant operation must be reported to the Maine DEP for review. In reporting to MEDEP, the mill should explain the reason for the change and any possible adverse consequences if any.
- Mills will not use defoamers or other additives with known dioxin precursors.
- Mills must show that chlorine dioxide production or consumption based on a per ton of pulp basis has not increased.
- Effluent color numbers should be reported showing no increase from prior years.

References

Applied Biomonitoring, 2004. Final report, 2003 Kennebec River caged mussel study, submitted to Friends of Merrymeeting Bay, Richmond, Me. 71 pp.

APPENDIX 1.
FISH CONSUMPTION ADVISORIES

APPENDIX 2A.

SPECIES AND STATION CODES

SPECIES CODES

BNT brown trout
EEL eel
LMB largemouth bass
RBT rainbow trout
SMB smallmouth bass
WHP white perch
WHS white sucker

STATION CODES

AGL Androscoggin R at Gilead above MeadWestvaco
ARP Androscoggin R at Rumford Point above MeadWestvaco
ARF Androscoggin R below Rumford below MeadWestvaco
ARY Androscoggin R at Riley above International Paper
ALV Androscoggin R at Livermore Falls below International Paper
AGI Androscoggin R at Gulf Island Pond, Auburn below International Paper
ALS Androscoggin R at Lisbon Falls below International Paper
ALW Androscoggin Lake at Wayne below International Paper
KRM Kennebec R at Madison above SAPPI Somerset, Skowhegan
KNW Kennebec R at Norridgewock above SAPPI Somerset, Skowhegan
KHY Kennebec R at Hinckley, above SAPPI Somerset Skowhegan
KFF Kennebec R at Shawmut, Fairfield below SAPPI Somerset, Skowhegan
KRS Kennebec R at Sidney below SAPPI-Somerset & KSTD in Waterville
PBW Penobscot R at Woodville above Lincoln Pulp and Paper
PBM Penobscot R at Winn above Lincoln Pulp and Paper in Lincoln
PBL Penobscot R at S Lincoln below Lincoln Pulp and Paper in Lincoln
PBC Penobscot R at Costigan, Milford above Georgia Pacific in Old Town
PBV Penobscot R at Veazie below Georgia Pacific in Old Town
PBO Penobscot R at Orrington below Georgia Pacific in Old Town
PWD Presumpscot R at Windham above SAPPI Westbrook
PWB Presumpscot R at Westbrook below SAPPI Westbrook
SFS Salmon Falls R at S. Berwick below Berwick POTW and Prime Tanning
SEN E Br Sebasticook at Newport below Corinna and former Eastland Woolen mill
SED E Br Sebasticook at Detroit below Corinna and former Eastland Woolen mill
SWP W Br Sebasticook at Palmyra below Hartland POTW and Irving Tanning

APPENDIX 2.

DIOXIN AND FURAN CONCENTRATIONS IN 2004 FISH AND SHELLFISH SAMPLES

APPENDIX 3.

TCDD & TCDF IN SLUDGE FROM MAINE WASTEWATER TREATMENT PLANTS

APPENDIX 4.

TCDD & TCDF IN WASTEWATER FROM MAINE PULP AND PAPER MILLS

APPENDIX 5.

TCDD, TCDF, AND P-VALUES FOR 2004 A/B TEST

APPENDIX 6.
LENGTHS AND WEIGHTS FOR 2004 FISH SAMPLES

APPENDIX 7.

SUMMARY OF DIOXINS AND FURANS IN FISH AND SHELLFISH SAMPLES, 1984-2004