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SURFACE WATER AMBIENT TOXIC MONITORING PROGRAM

STATE OF MAINE

2000

DIVISION OF ENVIRONMENTAL ASSESSMENT
MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION
AUGUSTA, MAINE 04333

JULY 2002

INTRODUCTION

The 2000 Surface Water Ambient Toxic (SWAT) monitoring program final report is organized into an executive summary and 4 modules, 1) Marine and Estuarine, 2) Lakes, 3) Rivers and Streams, and 4) Special Studies. Within each module results are presented in the order of the 2000 workplan. There are also a separate appendix with fish lengths and weights for all modules, and separate complete final reports of the 1) Loon Effects Study and 2) Kennebec River Caged Mussel Study that were too large to include with the appropriate module report. All of the data have been used as soon as received in DEP's water quality management activities wherever appropriate.

The full report is available on DEP's website at
http://www.state.me.us/dep/blwq/monitoring.htm

Click on "programs", then scan down the page to "Surface Water Ambient Toxics Monitoring Program (SWAT)" and choose the module of your interest.

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Most chemical analyses were performed by the Senator George J. Mitchell Center for Environmental and Watershed Research Environmental Chemistry Laboratory (formerly the Water Research Institute) at the University of Maine. Other analyses were conducted as listed in reports of individual sections.

EXECUTIVE SUMMARY

Maine's Surface Water Ambient Toxics (SWAT) monitoring program was established in 1993 (38 MRSA §420-B) to determine the nature, scope and severity of toxic contamination in the surface waters and fisheries of the State. The program must be designed to comprehensively monitor the lakes, rivers and streams and marine and estuarine waters of the State on an ongoing basis. The program must incorporate testing for suspected toxic contamination in biological tissue and sediment, may include testing of the water column and must include biomonitoring and the monitoring of the health of individual organisms that may serve as indicators of toxic contamination. This program must collect data sufficient to support assessment of the risks to human and ecological health posed by the direct and indirect discharge of toxic contaminants.

The Commissioner of the Department of Environmental Protection (DEP) must prepare a 5 year workplan that outlines monitoring objectives for the following 5 years. The Commissioner must also develop an annual workplan that defines the work to be accomplished each year. A Technical Advisory Group (TAG), composed of 10 individuals with scientific backgrounds representing various interests and 1 legislator, is established to advise the Commissioner on the development of the 5-year and annual workplans.

The first 5-year plan, for the period 1994-1998, was an initial survey of waterbodies from watersheds around the entire state. The current 5-year plan, for the period 1999-2003, is focused on problems discovered in the initial sampling and is designed to confirm the initial findings and establish background conditions. Once those are established and a sufficient amount of time has elapsed, 5-10 years depending on what if any action has occurred to solve the problem, repeat sampling may be conducted to establish trends. The program also explores new issues.

The SWAT program is divided into 4 modules, 1) Marine and Estuarine, 2) Lakes, 3) Rivers and Streams, and 4) Special Studies. This annual report follows the outline of the 2000 workplan. Following is a summary of key findings from the 2000 SWAT program for each module.

1. MARINE AND ESTUARINE

- As part of a long-term status and trends program, shellfish tissue analysis is repeated at various baseline stations periodically. Mussel tissues were analyzed for metals, pesticides, PCBs, and PAHs (polynuclear aromatic hydrocarbons) from Englishman's Bay, Southwest Harbor, Blue Hill Falls, Belfast Harbor, and three locations in Boothbay Harbor. Mussels from Mill Cove in Boothbay Harbor had elevated copper and lead. All other results were within the normal range. Single samples were collected in 1986 and analyzed for metals at the three locations in Boothbay Harbor that were re-sampled in 2000. In Boothbay Harbor's Outer Harbor lead, copper, and mercury are no longer elevated. West Harbor no longer has elevated lead, nickel, copper and mercury. Copper and lead continue to be elevated in Mill Cove while nickel and zinc are no longer elevated. All other locations continue to have levels within the normal range when compared to previous samples taken between 1987 and 1991. At Southwest Harbor there was concern that copper was near the elevated level in 1991. In 2000, copper was lower and well within the normal range. Organic chemicals were not measured in the previous samples.

- Mercury levels in striped bass are similar at most locations in Maine, while PCB levels are more variable. Concentrations of PCBs in fish from the Kennebec River, that may be a river specific population, seem to be lower than in fish from other rivers, that may consist of fish from more contaminated regions south of Maine. Concentrations of both contaminants in fish from most rivers exceed the Maine Bureau of Health Fish Tissue Action Levels. Striped bass will be collected from 7 rivers in 2002 and analyzed for these contaminants to verify any geographic patterns.

- A study of the sediments of the Merrymeeting Bay area documented that the upstream Androscoggin and Kennebec Rivers have been and may continue to be significant sources of toxic heavy metals and dioxins to the Bay and nearshore Gulf of Maine.

2. LAKES

- Monitoring of mercury in rain, snow, and sleet at 4 locations in Maine as part of the national Mercury Deposition Network documented that coastal areas receive more mercury deposition than do inland areas. These results implicate the US eastern seaboard as well as other upwind states as significant sources of mercury to Maine. National data show that deposition is higher in most other eastern and mid-western states that are in the program and presumably closer to major sources.

- Analysis of fish from Maine lakes for mercury and DDT to help refine Fish Consumption Advisories documented that concentrations of mercury in most lakes exceeded the Maine Bureau of Health Fish Tissue Action Levels (FTAL) similar to those of recent years. Concentrations of DDT in fish from one pond near an orchard approached the FTAL, but concentrations in fish from other lakes were well below the FTAL.

- Studies of the effects of mercury on loons indicate that 30% of Maine’s loons are at risk, predicting an unsustainable population. Studies of sharptailed sparrows, black terns, mink and otter were initiated and continued in 2001. Mercury concentrations in some mink and otter fur samples exceeded critical levels (thresholds for adverse effects) for these species. Additional studies will be conducted in 2002 to expand the database and to begin to assess population level impacts.

- Despite some incidental reductions of air emissions of mercury since the enactment of the Clean Air Act of 1970 and the 1990 amendments, atmospheric deposition of mercury to Maine continues to increase and fish mercury generally follows suit. Analysis of a sediment core from one lake demonstrates that the mercury input to this remote lake began to increase above background in the mid-1800s and that this increase continues to the present. The brook trout and lake trout populations from this lake both had significant increases in mercury concentration over time. Fish mercury also significantly increased in two other brook trout populations, did not change significantly in two lake trout populations, and decreased in two white sucker populations. The results of this study are generally consistent with the literature, where increases in fish mercury concentration over recent time have been found for the majority of cases investigated. The decrease in white sucker mercury content may reflect some factor inherent in this species, or in the lakes from which they were collected. Directed reductions of emissions in Maine (municipal waste combustors and a chloralkali facility) since 1997 are too recent to be observed in reduced fish concentrations yet and too local to have been detected in this study of Northern Maine lakes.

3. RIVERS AND STREAMS

- Total PCB levels in fish from most rivers and streams with no known point sources exceed the Maine Bureau of Health Fish Tissue Action Level. Total PCB levels in fish from the Aroostook River downstream of Loring Air Force Base both in Maine and New Brunswick are similar to levels in fish from most of those stations with no point sources.

- Only eels from the Penobscot River below Brewer exceeded Maine Bureau of Health Fish Tissue Action Levels due to dioxin alone, but fish from several other rivers and stations did because of a combination of dioxins and dioxin-like coplanar PCBs.

- DDT levels in brook trout from two streams in Aroostook County were lower than in 1994, but levels in one of them, Prestile Stream, as well as concentrations in trout from Everett Brook, still exceed the Maine Bureau of Health Fish Tissue Action Level.

- In the Biomonitoring program, 35 stations were assessed for the condition of the benthic macroinvertebrate community. Of those, 16 failed to attain their aquatic life class probably due to toxic pollutants. Of the remaining 19 that meet or exceed the classification criteria, 13 exhibit natural aquatic communities, while the remaining 6 fail due to excessive nutients or other factors.

4. SPECIAL STUDIES

- DEP continued development of the use of semi-permeable membrane devices, SPMDs, as a potential surrogate for the fish above/below test for discharge of dioxins from bleached kraft pulp mills. Three deployments determined that uptake rates are increased in warmer months and biofouling is not a significant problem in month long exposures. No 2378-TCDD was measured in any deployment, but 2378-TCDF was measured in all samples. Within-site variability in concentrations was as great or greater than that measured in fish; therefore, sensitivity of SPMD tests were generally no better and sometimes worse than that of fish. Development of the SPMD method continued in 2001.

- Studies using caged mussels in the Kennebec River helped to locate areas of high PCB from Augusta to Merrymeeting Bay. Investigation of sources continues. Caged mussels were found to be not as useful as were fish in the dioxin above/below test.

- In a study funded by the 1999 SWAT program, 10 of 19 agrochemicals used in blueberry culture were screened for estrogenic activity using human mammary cells tissue in an E-Screen assay. Those found to have estrogenic activity include methoxychlor, propiconizol, and dichlorophenoxyacetic acid (2,4-D). Velpar was found not to be estrogenic confirming previous studies. The remaining 9 agrochemicals will be screened as soon as samples can be obtained. Additional studies of the androgenic or other endocrine mediated activity of these agrochemicals that may impact Atlantic salmon and other native species are needed.

CONTENTS

MODULE 1 MARINE AND ESTUARINE

1.1

ANTIBIOTICS

Antibiotic Compounds

Pharmaceutical chemicals in water has immerged as a world-wide concern. Most studies relate to large municipal waste outfalls and animal feedlots where pharmaceutical inputs are presumably high. Concern is focused on the issue of human health implications by exposure through drinking water. Ecological studies are few yet.   Two marine industries in Maine have been the topic of much speculation over the past 10 years, lobster pounds and finfish aquaculture. Both use antibiotics (Oxytetracycline) in medicated feed to control disease, although in the finfish industry, vaccination has dramatically lowered the need for medication. Studies in Washington State have shown antibiotic buildup in sediment under finfish net pens.

Because oxytetracycline does not act solely on the target pathogen but on beneficial bacteria as well that may be ecologically important in nutrient recycling, we proposed an initial survey to determine whether oxytetracycline is present and at what concentrations in and around lobster pounds and finfish aquaculture operations.

The study is being directed by the Maine Department of Marine Resources via a private consultant. The data are not yet available and will be reported in a later report.

1.2

SHELLFISH TISSUE ANALYSES

Shellfish Tissue Analyses
This project addresses multiple needs identified after analysis of historical data collected by SWAT and other studies.

In 1998, interim action levels for shellfish were developed by the State Toxicologist, Bureau of Health that enable data from mussel samples to be evaluated in the context of human health. In the 1980s and early 1990s, blue mussel sample results suggest that human health advisories may be warranted in some areas of the coast due to levels of lead and mercury. Although environmental lead levels have declined nationally in various media since its removal from automotive fuels, it is reasonable to resample these areas to determine if current lead and mercury levels warrant an advisory. When these older samples were taken, organic analyses were not affordable. Many of these areas are near human population centers and/or industry and commerce. To complete the human health assessment, both organic and metal analyses should be conducted.

The Departments of Marine Resources and Environmental Protection have an active program to restore shellfish beds to harvestable conditions by removing sources of human sewage. Once sanitary pollution criteria are met, the DMR can open the area if it is assured that toxic contaminants do not pose a human health threat. In cases where the historical clam population is no longer present, direct sampling of clams makes that assurance impossible. Since a clam restoration project is an expensive commitment, there is a need to have tool available that can predict what tissue levels might likely be once clams have been restored to the area. Blue mussels are found almost everywhere along the coast, even where clams are not. Since mussels can be used to reflect local conditions, it may be possible to develop a relationship between clams, mussels, and perhaps sediment in order to predict levels expected in clams.

In the original Five-Year Plan, establishment of benchmark stations to be monitored over time was identified as a high priority. Those stations have been established and sampled at least once.

Finally, areas of the coast have been identified as having elevated levels of PCBs and organo-chlorine pesticides. Mussels have been effectively used to localize sources. The Winter Harbor Landfill is known to have received PCB waste. Wildlife (eagles) in the area contain unexplained levels of PCBs.

During the 2000 sampling season the ME DEP sampled blue mussels from seven sampling stations. Copper and lead in mussel tissue from Mill Cove in Boothbay Harbor exceeded the upper limit of the normal baseline range for Maine. At other locations metals did not exceed the normal baseline range for Maine. When compared to NOAA Status and Trends elevated levels, organics were not elevated with the exception of total DDT in one replicate in West Boothbay Harbor. One other replicate was not elevated and another was slightly lower than the elevated level.

The human health assessment has not yet been evaluated.

TABLE 1.2.1 LEVELS OF MERCURY IN 2000 BLUE MUSSEL TISSUE SAMPLES

	Hg mg/kg (wet weight)	Hg mg/kg (dry weight)	% solid
reporting limit	0.0050	0.0556	9.0
Station			
SW Harbor 1	0.0106	0.0838	12.7
SW Harbor 1 rep	0.0105	0.0830	12.7
SW Harbor 2	0.0111	0.0853	13.0
SW Harbor 3	0.0099	0.0775	12.8
SW Harbor 4	0.0100	0.0800	12.5
Boothbay WH 1	0.0158	0.1364	11.6
Boothbay WH 2	0.0150	0.1339	11.2
Boothbay WH 2 rep	0.0156	0.1395	11.2
Boothbay WH 3	0.0149	0.1393	10.7
Boothbay WH 4	0.0134	0.1117	12.0
Blue Hill Bay Falls 1	0.0057	0.0506	11.2
Blue Hill Bay Falls 2	0.0062	0.0524	11.8
Blue Hill Bay Falls 3	0.0059	0.0553	10.6
Blue Hill Bay Falls 3 rep	0.0057	0.0542	10.6
Blue Hill Bay Falls 4	0.0059	0.0518	11.3
Belfast 1	0.0158	0.1427	11.1
Belfast 1 rep	0.0160	0.1441	11.1
Belfast 2	0.0171	0.1405	12.2
Belfast 3	0.0152	0.1394	10.9
Belfast 4	0.0164	0.1388	11.8
Englishman's Bay/Dunn Island 1	0.0094	0.0870	10.8
Englishman's Bay/Dunn Island 2	0.0084	0.0847	9.9
Englishman's Bay/Dunn Island 2 rep	0.0084	0.0848	9.9
Englishman's Bay/Dunn Island 3	0.0076	0.0749	10.1
Englishman's Bay/Dunn Island 4	0.0077	0.0773	10.0
Boothbay-Outer Harbor 1	0.0166	0.1788	9.3
Boothbay-Outer Harbor 2	0.0152	0.1685	9.0
Boothbay-Outer Harbor 3	0.0142	0.1574	9.0
Boothbay-Outer Harbor 3 rep	0.0130	0.1448	9.0
Boothbay-Outer Harbor 4	0.0139	0.1601	8.7
Mill Cove-Boothbay 1	0.0205	0.2075	9.9
Mill Cove-Boothbay 2	0.0206	0.1998	10.3
Mill Cove-Boothbay 3	0.0206	0.2059	10.0
Mill Cove-Boothbay 4	0.0200	0.2063	9.7
Mill Cove-Boothbay 4 rep	0.0195	0.2013	9.7

TABLE 1.2.2 HEAVY METALS IN 2000 BLUE MUSSEL TISSUE SAMPLES (ww)

Station	Ag mg/kg	Al mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Fe mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg
	DL	**DL**	**DL**	**DL**	**DL**	**DL**	**DL**	**DL**	**DL**
	0.050	0.50	0.05	0.10	0.50	1.25	0.10	0.10	0.25
Belfast 1	<0.050	16.79	0.14	0.13	0.85	26.75	<0.10	0.27	9.71
Belfast 1 rep	<0.050	16.70	0.15	0.13	0.86	27.17	<0.10	0.29	9.93
Belfast 2	<0.050	21.13	0.16	0.14	0.97	32.47	<0.10	0.30	11.20
Belfast 3	<0.050	15.03	0.13	0.12	0.76	24.08	<0.10	0.20	9.10
Belfast 4	<0.050	18.76	0.12	0.14	1.03	28.41	<0.10	0.19	10.81
BHB Falls 1	<0.050	21.62	0.13	0.14	0.87	25.40	<0.10	0.15	7.07
BHB Falls 2	<0.050	25.30	0.14	0.14	0.77	27.91	<0.10	0.19	8.45
BHB Falls 3	<0.050	20.19	0.12	0.11	0.71	23.74	<0.10	0.15	6.70
BHB Falls 4	<0.050	20.74	0.13	0.10	0.53	24.76	<0.10	0.18	7.14
Dunn Is 1	<0.050	30.90	0.14	0.15	0.83	34.46	<0.10	0.19	6.12
Dunn Is 1 rep	<0.050	32.59	0.13	0.15	0.75	36.83	<0.10	0.20	6.19
Dunn Is 2	<0.050	32.37	0.13	0.15	0.87	35.61	<0.10	0.16	6.13
Dunn Is 3	<0.050	25.79	0.11	0.13	0.49	29.13	<0.10	0.14	5.81
Dunn Is 4	<0.050	60.58	0.12	0.29	0.98	53.06	0.13	0.20	5.88
Mill Cove 1	<0.050	24.86	0.09	0.14	1.28	32.33	<0.10	1.13	9.71
Mill Cove 2	<0.050	32.10	0.09	0.14	1.24	38.07	<0.10	1.20	8.60
Mill Cove 3	<0.050	24.38	0.09	0.16	1.19	33.66	<0.10	1.37	11.56
Mill Cove 4	<0.050	25.04	0.08	0.17	1.47	33.56	<0.10	1.00	10.34
Outer Hbr 1	<0.050	12.92	0.10	0.13	1.06	23.77	<0.10	0.52	6.66
Outer Hbr 2	<0.050	14.12	0.15	0.13	0.76	23.14	<0.10	0.63	7.62
Outer Hbr 3	<0.050	10.81	0.12	0.11	1.17	19.54	<0.10	0.60	7.60
Outer Hbr 4	<0.050	11.45	0.11	0.11	0.67	19.39	<0.10	0.49	5.91
SW Hbr 1	<0.050	17.88	0.09	0.14	0.84	31.21	<0.10	0.67	6.30
SW Hbr 2	<0.050	21.19	0.10	0.13	0.90	32.88	<0.10	0.66	6.94
SW Hbr 3	<0.050	14.54	0.10	0.13	0.83	28.79	<0.10	0.70	6.70
SW Hbr 4	<0.050	15.29	0.09	0.17	1.06	29.08	<0.10	0.71	6.16
West Hbr 1	<0.050	15.87	0.10	0.11	0.92	20.54	<0.10	0.49	9.67
West Hbr 1 rep	<0.050	15.28	0.11	0.10	0.94	20.23	<0.10	0.48	9.70
West Hbr 2	<0.050	18.05	0.11	0.12	0.96	21.74	<0.10	0.44	10.94
West Hbr 3	<0.050	19.83	0.11	0.12	1.03	23.87	<0.10	0.44	12.55
West Hbr 4	<0.050	19.43	0.10	0.11	0.79	22.63	<0.10	0.39	11.56

Station	Ag mg/kg	Al mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Fe mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg
	DL	**DL**	**DL**	**DL**	**DL**	**DL**	**DL**	**DL**	**DL**
	0.050	0.50	0.05	0.10	0.50	1.25	0.10	0.10	0.25
Belfast 1	<0.56	151.30	1.25	1.17	7.63	240.96	<1.11	2.42	87.50
Belfast 1 rep	<0.56	150.41	1.31	1.18	7.77	244.82	<1.11	2.59	89.44
Belfast 2	<0.56	179.06	1.34	1.21	8.26	275.17	<1.11	2.52	94.92
Belfast 3	<0.56	141.82	1.22	1.11	7.14	227.20	<1.11	1.89	85.84
Belfast 4	<0.56	165.98	1.08	1.28	9.12	251.42	<1.11	1.65	95.66
BHB Falls 1	<0.56	193.03	1.13	1.23	7.78	226.83	<1.11	1.35	63.16
BHB Falls 2	<0.56	214.39	1.22	1.15	6.57	236.54	<1.11	1.65	71.59
BHB Falls 3	<0.56	190.44	1.17	1.03	6.66	223.94	<1.11	1.40	63.20
BHB Falls 4	<0.56	183.57	1.15	0.84	4.73	219.12	<1.11	1.58	63.14
Dunn Is 1	<0.56	286.09	1.28	1.38	7.66	319.06	<1.11	1.78	56.66
Dunn Is 1 rep	<0.56	301.77	1.23	1.37	6.90	341.01	<1.11	1.89	57.29
Dunn Is 2	<0.56	326.97	1.34	1.51	8.75	359.67	<1.11	1.65	61.87
Dunn Is 3	<0.56	255.31	1.09	1.33	4.85	288.44	<1.11	1.42	57.49
Dunn Is 4	<0.56	605.82	1.21	2.90	9.82	530.64	1.33	2.03	58.81
Mill Cove 1	<0.56	251.09	0.91	1.42	12.90	326.61	<1.11	11.38	98.08
Mill Cove 2	<0.56	311.66	0.84	1.41	12.06	369.63	<1.11	11.69	83.48
Mill Cove 3	<0.56	243.77	0.94	1.63	11.95	336.64	<1.11	13.69	115.60
Mill Cove 4	<0.56	258.13	0.83	1.73	15.20	345.98	<1.11	10.27	106.61
Outer Hbr 1	<0.56	138.94	1.09	1.42	11.40	255.61	<1.11	5.57	71.59
Outer Hbr 2	<0.56	156.87	1.64	1.39	8.47	257.13	<1.11	6.96	84.67
Outer Hbr 3	<0.56	120.07	1.34	1.21	13.05	217.11	<1.11	6.69	84.43
Outer Hbr 4	<0.56	131.64	1.32	1.31	7.72	222.85	<1.11	5.65	67.89
SW Hbr 1	<0.56	140.75	0.74	1.07	6.58	245.74	<1.11	5.27	49.61
SW Hbr 2	<0.56	163.01	0.79	0.99	6.92	252.94	<1.11	5.06	53.40
SW Hbr 3	<0.56	113.58	0.79	1.02	6.45	224.95	<1.11	5.49	52.37
SW Hbr 4	<0.56	122.34	0.72	1.33	8.47	232.64	<1.11	5.68	49.31
West Hbr 1	<0.56	136.84	0.90	0.93	7.95	177.04	<1.11	4.23	83.39
West Hbr 1 rep	<0.56	131.72	0.94	0.89	8.06	174.36	<1.11	4.18	83.59
West Hbr 2	<0.56	161.16	0.94	1.07	8.53	194.14	<1.11	3.97	97.69
West Hbr 3	<0.56	185.33	1.07	1.09	9.66	223.04	<1.11	4.14	117.27
West Hbr 4	<0.56	161.91	0.82	0.88	6.56	188.56	<1.11	3.28	96.33

TABLE 1.2.4 PESTICIDE ANALYSIS REPORT

DEP ID#		Belfast Hbr. 1	Belfast Hbr. 2	Belfast Hbr. 3	Belfast Hbr. 4
Analytes	**PQL (ug/Kg,dry weight)**				
Hexachlorobenzene	0.5	<DL	<DL	<DL	<DL
Lindane	0.5	<DL	<DL	<DL	<DL
Heptachlor	0.5	<DL	<DL	<DL	<DL
Aldrin	0.5	<DL	<DL	<DL	<DL
Heptachlor Epoxide	0.5	<DL	<DL	<DL	<DL
2,4-DDE	1.0	7.97	0.84	12.96	6.78
Endosulfan I	1.0	<DL	<DL	<DL	<DL
Chlordane (a)	1.0	<DL	<DL	<DL	<DL
Nonachlor	1.0	<DL	<DL	<DL	<DL
4,4-DDE	1.0	<DL	<DL	<DL	<DL
Dieldrin	0.5	<DL	<DL	<DL	<DL
Endosulfan II	1.0	<DL	<DL	<DL	<DL
2,4-DDD	1.0	<DL	<DL	<DL	<DL
4,4-DDD	1.0	3.82	0.95	6.67	2.98
2,4-DDT	1.0	13.9	2.16	33.5	16.1
4,4-DDT	1.0	<DL	<DL	<DL	<DL
Mirex	1.0	<DL	<DL	<DL	<DL
Sample weight (g, dry weight)		24.8	19.0	18.4	25.5
% Solids		28.7	25.6	24.9	28.2

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

DEP ID#		Boothbay W. Hbr. 1	Boothbay W. Hbr. 3	Boothbay W. Hbr. 4	Boothbay Mill Cove 3	Boothbay Mill Cove 4
Analytes	**PQL (ug/Kg,dry weight)**					
Hexachlorobenzene	0.5	<DL	<DL	<DL	<DL	<DL
Lindane	0.5	<DL	<DL	<DL	<DL	<DL
Heptachlor	0.5	<DL	<DL	<DL	<DL	<DL
Aldrin	0.5	<DL	<DL	<DL	<DL	<DL
Heptachlor Epoxide	0.5	<DL	<DL	<DL	<DL	<DL
2,4-DDE	1.0	7.48	31.22	31.27	8.85	3.98
Endosulfan I	1.0	<DL	<DL	<DL	<DL	<DL
Chlordane (a)	1.0	<DL	<DL	<DL	<DL	<DL
Nonachlor	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
Dieldrin	0.5	<DL	<DL	<DL	<DL	<DL
Endosulfan II	1.0	<DL	<DL	<DL	<DL	<DL
2,4-DDD	1.0	<DL	4.94	4.15	<DL	<DL
4,4-DDD	1.0	10.48	7.94	52.5	5.02	3.15
2,4-DDT	1.0	22.3	90.1	91.1	17.9	9.03
4,4-DDT	1.0	2.51	3.71	5.45	<DL	<DL
Mirex	1.0	<DL	<DL	<DL	<DL	<DL
Sample weight (g, dry weight)		21.9	25.1	20.0	24.5	21.6
% Solids		27.2	31.3	24.1	27.8	24.7

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

DEP ID#		Englishman's Bay 1	Englishman's Bay 2	Englishman's Bay 3	Blue Hill- Goose Falls 1	Blue Hill- Goose Falls 4	Southwest Hbr. 2
		1551	1552	1553	1547	1548	1539
Analytes	**PQL (ug/Kg,dry weight)**						
Hexachlorobenzene	0.5	<DL	<DL	<DL	<DL	<DL	<DL
Lindane	0.5	<DL	<DL	<DL	<DL	<DL	<DL
Heptachlor	0.5	<DL	<DL	<DL	<DL	<DL	<DL
Aldrin	0.5	<DL	<DL	<DL	<DL	<DL	<DL
Heptachlor Epoxide	0.5	<DL	<DL	<DL	<DL	<DL	<DL
2,4-DDE	1.0	2.53	9.48	21.7	0.96	10.3	4.20
Endosulfan I	1.0	<DL	<DL	<DL	<DL	<DL	<DL
Chlordane (a)	1.0	<DL	<DL	<DL	<DL	<DL	<DL
Nonachlor	1.0	<DL	<DL	<DL	<DL	<DL	<DL
4,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL	<DL
Dieldrin	0.5	<DL	<DL	<DL	<DL	<DL	<DL
Endosulfan II	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,4-DDD	1.0	<DL	<DL	<DL	<DL	<DL	<DL
4,4-DDD	1.0	2.84	8.60	<DL	0.96	6.24	2.23
2,4-DDT	1.0	6.96	22.2	35.2	2.71	20.0	7.03
4,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL	<DL
Mirex	1.0	<DL	<DL	<DL	<DL	<DL	<DL
Sample weight (g, dry weight)		19.4	19.3	18.5	25.1	25.8	19.8
% Solids		24.5	23.9	24.0	27.2	30.0	33.3

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

TABLE 1.2.5 PCB ANALYSIS REPORT

Analytes	**IUPAC#**	**PQL (ug/Kg, dry weight)**	Belfast Hbr. 1	Belfast Hbr. 2	Belfast Hbr. 3	Belfast Hbr. 4
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	0.35	0.24
2,2’,5-Trichlorobiphenyl	18	0.5	2.45	<DL	2.71	1.72
2,4,4’-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	0.61	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	<DL	0.58	<DL	<DL
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	0.66	<DL	<DL
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	1.01	1.45	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	<DL	<DL	<DL	<DL
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	1.02	0.77	0.89	1.54
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	1.26	1.89	2.06	1.44
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	1.06	1.87	1.66	2.25
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	1.85	2.01	1.97	3.01
Total PCBs			36.6	41.7	40.8	43.2
Sample weight (g, dry weight)			24.8	19.0	18.4	25.5
% Solids			28.7	25.6	24.9	28.2
Surrogate Recovery (%)	% rec (65-135)		82.3	108.0	65.3	101.0

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.

Analytes	IUPAC#	PQL (ug/Kg, dry weight)	Boothbay W. Hbr. 1	Boothbay W. Hbr. 3	Boothbay W. Hbr. 4	Boothbay Mill Cove 3	Boothbay Mill Cove 4
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	0.36	0.61	0.27
2,2’,5-Trichlorobiphenyl	18	0.5	2.87	<DL	<DL	2.55	1.55
2,4,4’-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	0.41	0.37	0.41	0.62
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	1.16	1.02	0.75	0.55	0.61
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	0.71	0.85	0.55	0.48	0.35
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	1.58	2.21	1.26	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	1.69	2.03	2.25	0.98	1.55
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	0.98	1.25	1.69	1.55	2.03
Total PCBs			38.1	32.9	30.6	30.2	29.6
Sample weight (g, dry weight)			21.9	25.1	20.0	24.5	21.6
% Solids			27.2	31.3	24.1	27.8	24.7
Surrogate Recovery (%)	% rec (65-135)		77.2	67.4	109	120.0	126.0

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.

Analytes	IUPAC#	PQL (ug/Kg, dry weight)	Englishman's Bay 1	Englishman's Bay 2	Englishman's Bay 3
2,4’-Dichlorobiphenyl	8	0.5	<DL	0.54	0.74
2,2’,5-Trichlorobiphenyl	18	0.5	0.80	2.13	6.22
2,4,4’-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	0.66	<DL	0.51
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	<DL	<DL	<DL
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	<DL	<DL	<DL
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	<DL	0.91	1.21
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	1.69	1.78	1.51
Total PCBs			13.3	22.7	43.1
Sample weight (g, dry weight)			19.4	19.3	18.5
% Solids			24.5	23.9	24.0
Surrogate Recovery (%)	% rec (65-135)		84.9	71.6	73.5

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.

Analytes	IUPAC#	PQL (ug/Kg, dry weight)	Blue Hill-Goose Falls 1	Blue Hill-Goose Falls 4	Southwest Hbr. 2
2,4’-Dichlorobiphenyl	8	0.5	<DL	0.52	<DL
2,2’,5-Trichlorobiphenyl	18	0.5	0.72	4.97	0.71
2,4,4’-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	0.45
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	<DL	<DL	<DL
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	<DL	<DL	<DL
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	<DL	<DL	0.51
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	1.05	1.35	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL
Total PCBs			11.3	29.0	14.5
Sample weight (g, dry weight)			25.1	25.8	19.8
% Solids			27.2	30.0	33.3
Surrogate Recovery (%)	% rec (65-135)		68.5	103.0	81.4

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.

TABLE 1.2.6 PAH ANALYSIS REPORT

Analytes	**DL (ug/Kg dry weight)**	Belfast Hbr. 1	Belfast Hbr. 2	Belfast Hbr. 3	Belfast Hbr. 4
naphthalene	1.0	<DL	0.60	0.32	<DL
1-methyl naphthalene	1.0	<DL	22.4	14.7	10.6
2-methylnaphthalene	1.0	0.75	3.05	11.1	2.14
biphenyl	1.0	<DL	<DL	<DL	<DL
2,6-dimethylnaphthalene	1.0	<DL	2.60	<DL	<DL
acenaphthylene	1.0	0.50	0.65	1.19	0.85
acenaphthene	1.0	<DL	0.80	<DL	<DL
2,3,5-trimethylnaphthalene	1.0	<DL	<DL	<DL	<DL
fluorene	1.0	<DL	<DL	<DL	<DL
phenanthrene	1.0	1.13	2.45	2.60	2.48
anthracene	1.0	2.63	4.65	4.84	6.11
1-methylphenanthrene	1.0	2.33	2.05	3.93	2.22
fluoranthrene	1.0	9.21	7.95	10.9	12.1
pyrene	1.0	13.0	14.2	17.1	15.0
benz(a)anthracene	1.0	9.29	10.5	17.4	12.6
chrysene	1.0	4.46	5.50	7.95	5.81
benzo(b)fluoranthene	2.0	11.6	9.00	9.95	7.65
benzo(k)fluoranthene	*				
benzo(a) pyrene	2.0	2.75	4.10	5.21	1.41
benzo(e)pyrene	2.0	<DL	1.15	1.00	<DL
perylene	2.0	<DL	<DL	<DL	<DL
ideno(1,2,3-cd)pyrene	2.0	<DL	<DL	<DL	<DL
dibenz(a,h)anthracene	**				
benzo(g,h,i)perylene	2.0	<DL	<DL	<DL	<DL
% Lipids		0.82	2.13	1.73	1.36
Sample weight (g, dry weight)		24.0	20.0	21.9	23.4
% Solids		28.7	25.6	24.9	28.2
Surrogates					
Nitrobenzene-d5	65-135				
2-Fluorobiphenyl	65-135				
p-Terphenyl	65-135				

* Benzo(k)fluoranthrene coelutes with Benzo(b)fluoranthrene.
** Dibenz(a,h)anthracene coelutes with ideno(1,2,3-cd)pyrene.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

Analytes	DL (ug/Kg dry weight)	Boothbay W. Hbr. 1	Boothbay W. Hbr. 2	Boothbay W. Hbr. 3	Boothbay W. Hbr. 4
naphthalene	1.0	<DL	1.11	<DL	1.29
1-methyl naphthalene	1.0	<DL	17.4	2.60	17.6
2-methylnaphthalene	1.0	<DL	1.61	1.90	3.15
biphenyl	1.0	<DL	<DL	<DL	<DL
2,6-dimethylnaphthalene	1.0	<DL	3.07	<DL	2.20
acenaphthylene	1.0	0.33	0.70	0.75	1.12
acenaphthene	1.0	<DL	1.16	0.50	<DL
2,3,5-trimethylnaphthalene	1.0	<DL	6.33	3.05	<DL
fluorene	1.0	<DL	0.60	<DL	<DL
phenanthrene	1.0	0.95	3.67	1.70	3.24
anthracene	1.0	3.20	9.05	3.90	7.18
1-methylphenanthrene	1.0	1.78	3.52	2.60	2.45
fluoranthrene	1.0	6.51	38.3	19.6	24.3
pyrene	1.0	4.44	18.2	7.15	9.25
benz(a)anthracene	1.0	4.27	5.98	6.70	12.0
chrysene	1.0	2.49	13.6	5.70	9.54
benzo(b)fluoranthene	2.0	2.12	28.0	17.2	6.76
benzo(k)fluoranthene	*				
benzo(a) pyrene	2.0	1.20	7.34	2.00	4.69
benzo(e)pyrene	2.0	<DL	<DL	<DL	1.41
perylene	2.0	<DL	<DL	<DL	<DL
ideno(1,2,3-cd)pyrene	2.0	<DL	<DL	<DL	<DL
dibenz(a,h)anthracene	**				
benzo(g,h,i)perylene	2.0	<DL	10.2	<DL	<DL
% Lipids		2.10	1.02	2.62	2.91
Sample weight (g, dry weight)		24.1	19.9	20.0	24.1
% Solids		27.2	20.3	31.3	24.1
Surrogates					
Nitrobenzene-d5	65-135				
2-Fluorobiphenyl	65-135				
p-Terphenyl	65-135				

* Benzo(k)fluoranthrene coelutes with Benzo(b)fluoranthrene.
** Dibenz(a,h)anthracene coelutes with ideno(1,2,3-cd)pyrene.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

Analytes	**DL (ug/Kg dry weight)**	Boothbay Mill Cove 1	Boothbay Mill Cove 2	Boothbay Mill Cove 3	Boothbay Mill Cove 4
naphthalene	1.0	3.20	0.52	1.70	1.05
1-methyl naphthalene	1.0	37.9	13.2	32.5	27.6
2-methylnaphthalene	1.0	8.35	2.38	7.05	3.55
biphenyl	1.0	<DL	<DL	1.30	0.93
2,6-dimethylnaphthalene	1.0	3.45	<DL	3.95	2.38
acenaphthylene	1.0	8.30	4.00	5.05	5.24
acenaphthene	1.0	<DL	1.14	1.45	0.97
2,3,5-trimethylnaphthalene	1.0	4.65	3.05	3.00	2.98
fluorene	1.0	3.35	<DL	2.10	1.69
phenanthrene	1.0	14.3	8.90	8.70	6.57
anthracene	1.0	26.7	18.3	19.8	18.6
1-methylphenanthrene	1.0	7.00	5.71	5.65	3.31
fluoranthrene	1.0	136	103	79.8	112
pyrene	1.0	147	91.8	80.6	80.2
benz(a)anthracene	1.0	110	40.1	50.2	104
chrysene	1.0	95.6	43.4	49.7	32.7
benzo(b)fluoranthene	2.0	157	46.3	70.6	97.9
benzo(k)fluoranthene	*				
benzo(a) pyrene	2.0	24.8	14.2	19.1	7.34
benzo(e)pyrene	2.0	5.30	<DL	3.40	1.13
perylene	2.0	<DL	<DL	<DL	<DL
ideno(1,2,3-cd)pyrene	2.0	36.2	13.9	21.4	15.1
dibenz(a,h)anthracene	**				
benzo(g,h,i)perylene	2.0	<DL	<DL	<DL	<DL
% Lipids		3.32	1.11	1.70	1.04
Sample weight (g, dry weight)		20.0	21.0	20.0	24.8
% Solids		20.4	23.9	27.8	24.7
Surrogates					
Nitrobenzene-d5	65-135				
2-Fluorobiphenyl	65-135				
p-Terphenyl	65-135				

* Benzo(k)fluoranthrene coelutes with Benzo(b)fluoranthrene.
** Dibenz(a,h)anthracene coelutes with ideno(1,2,3-cd)pyrene.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

Analytes	**DL (ug/Kg dry weight)**	Boothbay Outer Hbr. 1	Boothbay Outer Hbr. 2	Boothbay Outer Hbr. 3	Boothbay Outer Hbr. 4
naphthalene	1.0	1.34	<DL	0.55	<DL
1-methyl naphthalene	1.0	7.31	3.47	24.6	1.37
2-methylnaphthalene	1.0	1.27	0.84	3.18	0.62
biphenyl	1.0	0.62	<DL	<DL	<DL
2,6-dimethylnaphthalene	1.0	1.08	1.99	<DL	<DL
acenaphthylene	1.0	0.65	0.96	1.49	<DL
acenaphthene	1.0	1.08	1.08	1.29	<DL
2,3,5-trimethylnaphthalene	1.0	1.34	2.43	<DL	<DL
fluorene	1.0	1.09	1.35	3.08	1.00
phenanthrene	1.0	4.53	7.33	16.9	7.39
anthracene	1.0	26.6	23.0	69.6	40.1
1-methylphenanthrene	1.0	2.15	3.39	4.13	2.45
fluoranthrene	1.0	163	31.1	106	48.4
pyrene	1.0	46.5	37.8	63.8	42.3
benz(a)anthracene	1.0	80.6	30.9	87.0	33.4
chrysene	1.0	34.7	13.9	32.6	16.6
benzo(b)fluoranthene	2.0	48.4	34.3	73.6	22.0
benzo(k)fluoranthene	*				
benzo(a) pyrene	2.0	7.86	1.95	6.72	4.56
benzo(e)pyrene	2.0	4.15	2.07	2.44	2.57
perylene	2.0	<DL	<DL	<DL	<DL
ideno(1,2,3-cd)pyrene	2.0	36.5	8.05	20.0	15.4
dibenz(a,h)anthracene	**				
benzo(g,h,i)perylene	2.0	0.79	<DL	<DL	<DL
% Lipids		1.48	0.57	2.08	1.36
Sample weight (g, dry weight)		20.0	25.1	20.1	24.1
% Solids		19.7	22.9	18.5	18.6
Surrogates					
Nitrobenzene-d5	65-135				
2-Fluorobiphenyl	65-135				
p-Terphenyl	65-135				

* Benzo(k)fluoranthrene coelutes with Benzo(b)fluoranthrene.
** Dibenz(a,h)anthracene coelutes with ideno(1,2,3-cd)pyrene.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

Analytes	DL (ug/Kg dry weight)	Englishman's Bay 1	Englishman's Bay 2	Englishman's Bay 3	Englishman's Bay 4
naphthalene	1.0	<DL	<DL	0.60	0.60
1-methyl naphthalene	1.0	18.0	8.99	22.0	24.5
2-methylnaphthalene	1.0	2.49	1.64	2.74	5.07
biphenyl	1.0	<DL	<DL	<DL	<DL
2,6-dimethylnaphthalene	1.0	<DL	<DL	<DL	2.89
acenaphthylene	1.0	<DL	<DL	<DL	<DL
acenaphthene	1.0	<DL	<DL	0.70	<DL
2,3,5-trimethylnaphthalene	1.0	<DL	2.95	<DL	3.43
fluorene	1.0	<DL	<DL	<DL	<DL
phenanthrene	1.0	1.88	1.69	2.19	2.84
anthracene	1.0	2.96	4.59	6.56	7.06
1-methylphenanthrene	1.0	1.97	1.69	2.19	2.24
fluoranthrene	1.0	2.11	2.95	3.07	2.79
pyrene	1.0	1.88	1.84	2.47	1.64
benz(a)anthracene	1.0	2.44	2.80	5.72	<DL
chrysene	1.0	1.69	1.30	1.53	<DL
benzo(b)fluoranthene	2.0	<DL	<DL	<DL	<DL
benzo(k)fluoranthene	*				
benzo(a) pyrene	2.0	1.74	1.40	1.07	3.83
benzo(e)pyrene	2.0	0.75	1.21	0.88	2.89
perylene	2.0	<DL	<DL	<DL	<DL
ideno(1,2,3-cd)pyrene	2.0	<DL	0.87	<DL	<DL
dibenz(a,h)anthracene	**				
benzo(g,h,i)perylene	2.0	<DL	<DL	<DL	<DL
% Lipids		1.61	1.85	1.69	1.27
Sample weight (g, dry weight)		21.3	20.7	21.5	20.1
% Solids		24.5	23.9	24.0	25.6
Surrogates					
Nitrobenzene-d5	65-135				
2-Fluorobiphenyl	65-135				
p-Terphenyl	65-135				

* Benzo(k)fluoranthrene coelutes with Benzo(b)fluoranthrene.
** Dibenz(a,h)anthracene coelutes with ideno(1,2,3-cd)pyrene.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

Analytes	**DL (ug/Kg dry weight)**	Blue Hill-Goose Falls 1	Blue Hill-Goose Falls 2	Blue Hill-Goose Falls 3	Blue Hill-Goose Falls 4
naphthalene	1.0	<DL	<DL	1.45	<DL
1-methyl naphthalene	1.0	7.40	12.0	26.9	7.16
2-methylnaphthalene	1.0	1.64	2.90	4.10	1.52
biphenyl	1.0	<DL	<DL	<DL	<DL
2,6-dimethylnaphthalene	1.0	<DL	2.30	<DL	1.84
acenaphthylene	1.0	<DL	<DL	<DL	<DL
acenaphthene	1.0	0.60	<DL	<DL	1.32
2,3,5-trimethylnaphthalene	1.0	2.40	3.30	3.30	2.40
fluorene	1.0	<DL	<DL	<DL	1.00
phenanthrene	1.0	0.84	2.45	1.60	4.20
anthracene	1.0	1.44	3.55	3.90	2.20
1-methylphenanthrene	1.0	1.68	2.95	2.20	2.68
fluoranthrene	1.0	0.88	2.15	1.40	2.08
pyrene	1.0	1.24	<DL	<DL	1.04
benz(a)anthracene	1.0	1.36	<DL	<DL	<DL
chrysene	1.0	<DL	<DL	1.90	<DL
benzo(b)fluoranthene	2.0	<DL	<DL	5.40	<DL
benzo(k)fluoranthene	*				
benzo(a) pyrene	2.0	<DL	<DL	3.20	<DL
benzo(e)pyrene	2.0	<DL	<DL	<DL	<DL
perylene	2.0	<DL	<DL	<DL	<DL
ideno(1,2,3-cd)pyrene	2.0	<DL	<DL	<DL	<DL
dibenz(a,h)anthracene	**				
benzo(g,h,i)perylene	2.0	<DL	<DL	3.50	0.64
% Lipids		0.31	0.49	2.33	0.52
Sample weight (g, dry weight)		25.0	20.0	20.0	25.0
% Solids		27.2	22.2	20.9	30.0
Surrogates					
Nitrobenzene-d5	65-135				
2-Fluorobiphenyl	65-135				
p-Terphenyl	65-135				

* Benzo(k)fluoranthrene coelutes with Benzo(b)fluoranthrene.
** Dibenz(a,h)anthracene coelutes with ideno(1,2,3-cd)pyrene.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

Analytes	DL (ug/Kg dry weight)	Southwest Hbr. 1	Southwest Hbr. 2	Southwest Hbr. 3	Southwest Hbr. 4
naphthalene	1.0	<DL	<DL	0.76	1.04
1-methyl naphthalene	1.0	4.80	6.60	26.5	25.8
2-methylnaphthalene	1.0	1.15	1.36	4.28	4.92
biphenyl	1.0	<DL	<DL	<DL	<DL
2,6-dimethylnaphthalene	1.0	2.45	2.09	2.68	2.76
acenaphthylene	1.0	0.35	0.47	1.36	1.44
acenaphthene	1.0	<DL	<DL	<DL	<DL
2,3,5-trimethylnaphthalene	1.0	3.50	2.47	5.00	5.28
fluorene	1.0	0.70	<DL	1.56	<DL
phenanthrene	1.0	3.60	2.26	5.60	6.44
anthracene	1.0	11.7	6.34	13.1	14.1
1-methylphenanthrene	1.0	4.00	3.32	4.72	6.80
fluoranthrene	1.0	10.1	5.11	10.0	12.3
pyrene	1.0	3.30	2.55	7.08	6.72
benz(a)anthracene	1.0	3.30	1.36	7.84	11.8
chrysene	1.0	3.30	1.74	4.32	6.00
benzo(b)fluoranthene	2.0	2.30	1.23	4.28	6.44
benzo(k)fluoranthene	*				
benzo(a) pyrene	2.0	1.55	0.89	2.48	4.52
benzo(e)pyrene	2.0	<DL	<DL	<DL	2.04
perylene	2.0	<DL	<DL	<DL	<DL
ideno(1,2,3-cd)pyrene	2.0	<DL	<DL	<DL	<DL
dibenz(a,h)anthracene	**				
benzo(g,h,i)perylene	2.0	<DL	<DL	<DL	<DL
% Lipids		1.00	0.39	0.82	3.10
Sample weight (g, dry weight)		20.0	23.5	25.0	25.0
% Solids		36.8	33.3	16.4	18.9
Surrogates					
Nitrobenzene-d5	65-135				
2-Fluorobiphenyl	65-135				
p-Terphenyl	65-135				

* Benzo(k)fluoranthrene coelutes with Benzo(b)fluoranthrene.
** Dibenz(a,h)anthracene coelutes with ideno(1,2,3-cd)pyrene.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

1.3

MARINE SPORTFISH HEALTH ADVISORY

MARINE SPORTFISH HEALTH ADVISORY

Striped Bass There is a good sample of Striped Bass in the Kennebec (over 30 individual fish over various years. Limited data show differences in total PCB concentrations among sampling locations, but more data are needed. A good sample set of individual fish from various locations is needed to get a better estimate of a coastal statewide distribution for both mercury and PCB levels in striped bass. These data will provide a better understanding of the current fish consumption advisory and any necessary modifications. A total of 5-6 individual fish from the Androscoggin River near Brunswick, Saco Bay, the Sheepscot River were analyzed for both mercury and total PCBs. Results indicate that mercury concentrations are relatively similar in striped bass among all rivers (Table 1.3.1). Concentrations in fish from all rivers, except those from Saco Bay, exceed the Maine Bureau of Health’s Fish Tissue Action Level (FTAL=0.2 ppm)for mercury. PCB levels are more variable and seem to be highest in the Androscoggin River and lowest in the Kennebec River. Most samples exceed the FTAL (11 ppb) for PCB. It is curious that mercury levels are more similar among stations than are PCB.

Bluefish. There are only two data points on this species for mercury and one for PCB. From these data, it is unclear whether bluefish have higher or lower levels of mercury and PCBs than striped bass. Mercury levels in bluefish caught in Scarborough R. in 1998 were very similar (a bit lower) to levels in striped bass, but PCB levels were about 30% higher. More data are needed. We have been trying to collect 5 individual bluefish from 2 locations analyzed for both mercury and total PCBs. But bluefish have been scarce the last few years and we were not successful in collecting any in 2000. We will continue trying to collect bluefish in future years.

TABLE 1.3.1   MERCURY AND PCB LEVELS IN STRIPED BASS AND BLUEFISH

Waterbody & Location	Station Code	Species Code	1995 Hg	1997 Hg	1998 Hg	1999 Hg	2000 Hg
			ppm	ppm	ppm	ppm	ppm
Androscoggin R							
Brunswick					0.38		0.22
Kennebec R.							
Augusta	KAG	STB		0.33	0.40	0.32	
Phippsburg	KRP	STB	0.17, 0.53				
	KRP	BLF	0.53				
Saco Bay							
Saco							0.18
Scar R.							
Scarbrough	SRS	STB			0.37		
		BLF			0.33		
Sheepscot R							
Wiscasset	SRW	STB					0.22

Waterbody & Location	Station Code	Species Code	1995 Total PCB	1997 Total PCB	1998 Total PCB	1999 Total PCB	2000 Total PCB
Androscoggin R.			ppb	ppb	ppb	ppb	ppb
Brunswick	ABK	STB			40.7		59.8
Kennebec R.							
Augusta	KAG	STB		11.8	15.8	10.7	
Phippsburg	KRP	STB	17.4, 22.4				
	KRP	BLF	48.8				
Saco Bay							
Saco	SACO	STB			16.3		25.0

2000 DATA

DEP Sample ID	Length mm	HG mg/kg
STRIPED BASS		
Androscoggin River, Brunswick		
ARB-STB-1	595	0.223
ARB-STB-2	560	0.261
ARB-STB-3	565	0.133
ARB-STB-4	525	0.24
ARB-STB-5	535	0.226
MEAN	**556**	**0.22**
Sheepscot River, Wiscasset		
SRW-STB-1	555	0.264
SRW-STB-2	622	0.259
SRW-STB-3	685	0.212
SRW-STB-4	660	0.08
SRW-STB-5	685	0.137
SRW-STB-6	965	0.375
MEAN	**695**	**0.22**
Saco River, Saco		
SOS-STB-1	1117	0.364
SOS-STB-2	666	0.124
SOS-STB-3	660	0.209
SOS-STB-4	660	0.124
SOS-STB-5	660	0.143
SOS-STB-6	647	0.113
MEAN	**735**	**0.18**

Raw 2000 PCB data may be seen at Table 3.1.1.1

1.4

SEDIMENT CONTAMINANTS IN THE LOWER KENNEBEC/ANDROSCOGGIN RIVERS

SPATIAL AND TEMPORAL ASPECTS OF SEDIMENTARY CONTAMINANT CONCENTRATIONS IN THE TIDAL PORTIONS OF THE KENNEBEC/ANDROSCOGGIN RIVER SYSTEM

A Report to the

Surface Water Ambient Toxics Monitoring Program

Maine Department of Environmental Protection

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ABSTRACT

The concentrations of Cd, Cr, Cu, Ni, Pb, Sn and Zn in the surface sediments of 47 stations in the tidal Kennebec/Androscoggin system of the Gulf of Maine were determined. For data analysis purposes the region was divided into seven subregions consisting of five tributaries of Merrymeeting Bay, i.e. the Upper Kennebec, Muddy, Cathance, Abagadasset and Eastern Rivers, Merrymeeting Bay proper and the Lower Kennebec River connecting Merrymeeting Bay and the Gulf of Maine. Special emphasis was given to locating fine-grained depositional areas in this generally energetic, coarse grained system.

Most stations exhibited elevated metal concentrations. Statistically significant differences existed between the four small “local” tributaries and one or more of the three station groupings representing the main stem of the system. The distribution of metals indicated that the sources were the upstream Kennebec and Androscoggin watersheds. Metal levels in the upper reach of the lower Kennebec estuary were higher than found immediately upstream and downstream. This distribution can be explained by the existence of a turbidity maximum.

It is believed that the system is in a dynamic equilibrium with regard to particle and contaminant deposition and that further accumulation is negligible. This supports the hypothesis of Larsen and Gaudette (1995) that the Kennebec and Androscoggin watersheds are sources for contaminants observed in the nearshore Gulf of Maine.

INTRODUCTION

Elevated levels of toxic contaminants in the water, sediments and biota of several estuaries and embayments of the Gulf of Maine have been documented over the last three decades (Armstrong, *et al.*, 1976; Mayer and Fink, 1980; Lyons, *et. al.*, 1978; Goldberg, *et al.,* 1983; Larsen, *et al.*, 1983a, 1983b,1984; Ray and MacKnight, 1984; Gottholm and Turgeon; 1991, Larsen and Gaudette, 1995; Larsen, *et al.*, 1997; others). Taken together, these studies suggest considerable variability in the degree of enrichment as a function of source and transport mechanisms. A review of the environmental quality of the Gulf of Maine region (Larsen, 1992) suggests that the area between Cape Elizabeth and Boothbay is particularly complex and interesting. For instance, in the first comprehensive baseline survey of Casco Bay proper, Larsen, *et al.* (1983a) found all measured metals but cadmium to be elevated well above pre-industrial levels, as defined by Lyons, *et al.*, (1978). Geographic distributions suggested anthropogenic inputs associated with activities in and around the commercially important Portland Harbor. Subsequently, the NOAA National Status and Trends Program (NS&T) reported that Casco Bay sediments were moderately enriched with metals and other toxics and that metal levels in livers of non-migratory fish collected near Cape Small, not far from the mouth of the Kennebec estuary, ranked high on both a Gulf of Maine and national scale (Gottholm and Turgeon, 1991; Larsen 1992). Data from the EPA Mussel Watch Program indicated that mussels from the isolated and undeveloped Cape Newagen ranked surprisingly high in lead and zinc content (Goldberg, *et al.*, 1983; Larsen, 1992).

These patterns of toxics in both sediments and biota over a relatively large area demonstrate that the study area is affected by numerous sources and complex, dynamic processes. Surveys of limited geographic scope, while important for local management concerns, are inadequate for determining and evaluating larger scale processes which may dominate regional fluxes of contaminants. One such larger scale process that may be important in Maine's mid-coast region is the removal of contaminants from the large (27,700 km^2), industrialized Kennebec/Androscoggin River watershed and their passage through the tidal reaches of the system, including the energetic and ecologically important Merrymeeting Bay, into the nearshore Gulf of Maine. Evidence from the distribution of heavy minerals (Ross, 1967), hydrographic modeling (D.A. Brooks, personal communication) and anecdotal accounts of pulpwood drift support this possibility. Most recently, Stumpf and Goldschmidt (1992) used satellite imagery to show the development and dispersion of a sedimentary plume from the Kennebec River estuary into the Gulf of Maine as a result of a major (100 year) storm. This one event could have transported over 500,000 metric tons of sediments and associated toxics through the estuary (R. Stumpf, personal communication), and the dispersion of the plume in the days following the initial event could explain many of the contaminant distributions noted in the above site-specific studies. Clearly, baseline surveys were needed on appropriate scales to evaluate suspected operative mechanisms.

Prompted by the above reports of contaminant concentrations in sediments and biota from mid-coast Maine, Larsen and Gaudette (1995) undertook, in 1991, a broad scale surficial sediment sampling and analysis program. Their goals were to document geographic distributions of contaminants on a regional level and to gain insight into possible sources and transport mechanisms. Trace metals were used as surrogates for the suite of toxics moving through the region. Results reaffirmed the suspicion that the Kennebec/Androscoggin system may play a key role in regional contaminant dynamics. They concluded that more information was needed for both scientists and managers to understand the distribution and movements of contaminants in both space and time.

As an initial step in building a detailed understanding of the sources, movements and deposition of contaminants in the tidal Kennebec/Androscoggin system, Dr. Henri Gaudette of the University of New Hampshire and a graduate student undertook a focussed survey of the system. Sampling design and fieldwork was supervised by Dr. Peter Larsen as part of the Kennebec Area Research Endowment program. Once again, trace metals were used as surrogates for all contaminants that are associated with fine sediments and organic matter. Considerable effort was expended to locate stations with sufficiently fine sediments to provide a valid characterization of metal levels and distributions.

The resulting 1992 data set consisted of 47 stations between Hallowell, ME (52 km inland) and the lower Kennebec River estuary. With the exception of the lower Kennebec estuary, this system may be characterized as tidal fresh water. The distribution of stations within river segments is as follows: Lower Kennebec River(9), Merrymeeting Bay (includes lower Androscoggin River) (6), Upper Kennebec River (13), Muddy River (4), Cathance River (7), Abagadasset River (3) and Eastern River (5). The lower Androscoggin River is included as part of Merrymeeting Bay because no natural demarcation between them is evident. On the other hand, whereas it is commonly accepted that the northern limit of Merrymeeting Bay on the Kennebec River is the Richmond Bridge, we followed the convention of nautical charts and topographic maps and called everything north of Abagadasset Point the upper Kennebec River. Abagadasset Point is such a strong constriction that we assumed that the water above it is Kennebec water with only a slight dilution from the Eastern River. Fine sediments were sampled in the above areas and analyzed for seven trace metals (Cd, Cr, Cu, Pb, Zn, Sn and Ni) as well as major metals, grain size and organic carbon content.

Specific goals of the investigation included:

- Documentation of geographic distribution of metals in the dynamic Kennebec/Androscoggin system. The distribution of organic contaminants such as PAHs and dioxin should mirror the metal distribution because of similar affinities for fine grained sediments and organic particles.
- To gain insights into locations of possible sources.
- To gain insights into the generic activities which may produce the contamination.

- To gain insights into temporal trends in sediment metal concentrations.

METHODS

Forty-seven stations (Fig. 1, Appendix 1) were sampled in the summer of 1992 using a small, acid-cleaned stainless steel grab sampler of our own design (HEG). Undisturbed, surface sediment sub-samples (top 5 cm) for trace metal analysis were taken from the grab with acid-cleaned plastic scoops, transferred to clean polyethylene zip-lock bags and stored on ice for return to the laboratory. Separate sub-samples were taken for grain size analysis and organic matter determination.

Grain size distributions were determined by standard sieving and pipette methods (Folk, 1968). Organic matter in the sediments is expressed as percent weight loss on ignition obtained by heating a representative, dried subsample of the sediment to 540°C for 24 hours.

Trace metals were stripped off the sediment particle surfaces using the same strong acid leach process as Larsen, *et al.* (1983a). In brief, approximately 3 grams of dried sediment (60°C, 18-24 hours) were accurately weighed into a 100 ml glass beaker. Ten ml of concentrated reagent HNO_3 were added, and the samples evaporated to dryness. When cooled, each sample received 5 ml of 8% NH_4Cl (w/v), 5 ml of 0.02 M $Ca(NO_3)_2 \cdot 4H_2O$, and 15 ml of an acid solution (80 ml concentrated HNO_3 plus 20 ml concentrated HCl diluted to 1 liter with MilliQ water), and the volumes were reduced on a hot plate to 10-15 ml. Cooled samples were filtered using "Q" water; sediment trapped on the filter paper was washed several times with "Q" water, and the filtrate was brought to 50 ml total volume. These procedures have been shown to remove “environmentally available” metals without destruction of the mineral matrix (Tessler, *et al.*, 1979; Olsen, *et al.*, 1993).

The filtrates were analyzed by Atomic Absorption Spectrometry (AA) for Fe, Mn, Cd, Cr, Cu, Ni, Pb, Sn, and Zn, and concentrations as ug/gram dry weight sediment were calculated.

Analytical variability could not be determined by replicate analysis of standard sediment samples (U.S. Geological Survey standard MAG-1 (Marine Mud) and National Institute of Standards and Technology SRM 1646 (estuarine mud)) since our extraction procedure differed from the total dissolution procedures used to determine the certified values. Therefore, we have made within sample replicate analyses to estimate analytical error. These are: Cd 13.4%; Cr 4.4%; Cu 1.8%; Pb 4.8%; Zn 2.1%; Sn 20.9%; Ni

2.4%; Fe 5.9%; and Mn 1.3%. These uncertainty values are typical of AA analyses with the exception of Sn which was influenced by an outlier in the replicated samples.

The data were normalized to the fine sediment fraction by dividing the metal concentrations by the fraction of the sediment <63 µm (NOAA, 1988).

RESULTS

Results of the sediment metal analyses with the percentages of fine sediments and loss on ignition are presented in Table 1. Background material on concentrations of major metals, pre-normalized trace metal concentrations, grain size calculations and data and loss on ignition calculations are presented in Appendices 2-5, respectively. Examination of the summary statistics at the bottom of Table 1 demonstrates that the individual metal concentrations were distributed widely around the means. Nevertheless, only in the case of Pb does the standard deviation exceed the mean. Perusal of the Pb column reveals one very hardy outlier at Station UKR-4 located in the Kennebec River just upstream of Swans Island.

A linear correlation matrix, using unnormalized data of trace metals, major metals and salient environmental variables was constructed to gain insight into the relationships among them (Table 2). Nearly all of the correlations between the trace metals, Mn, Fe, percent fines and LOI are extremely significant. Pb correlations are low and not significant with percent fines and LOI at n=47. The removal of the above-mentioned outlier at UKR-4, however, resulted in improved Pb correlations with every variable. With the noted exception of Pb, the correlation matrix indicates that the trace metals are normally distributed in association with the fine grained and organic particles perhaps mediated by hydrous oxide coatings of Mn and Fe.

Grouping the stations by river segments and examining the summary statistics indicates that there is a clear and consistent geographic pattern exhibited by each of the seven trace metals (Table 3; Fig. 2). Trace metal concentrations are higher in the Upper Kennebec River (UKR), Merrymeeting Bay (MB) and Lower Kennebec River (LKR), the groupings that constitute the main stem of the system. Metal levels are uniformly lower in the four “local” Merrymeeting Bay tributaries, i.e. the Muddy (MR), Cathance (CR), Abagadasset (AR) and Eastern Rivers (ER).

An analysis to determine if the apparent differences in metal concentrations are statistically significant cannot be performed at the seven group level because MR and AR are represented by too few stations. These two small tributaries, together with CR, are located on the western side of Merrymeeting Bay. They have contiguous watersheds and have especially uniform trace metal loads with the standard errors of the means overlapping in each case save one (Cr between CR and AR)(Fig. 3, Table 3). Data from these three tributaries, therefore, can be grouped together to increase the power of statistical analysis. The new grouping is called western tributaries (WT). The means and standard errors of the resulting five groups are plotted in Fig.4.

A Kruskal-Wallis test, a nonparametric analysis of variance, for each metal across the five geographic groupings of stations indicates that there are very significant or extremely significant statistical differences between the levels of metals in the groups (Table 4). The nonparametric test is used because parametric analysis of variance assumes identical standard deviations. Bartlett's test suggests that there are the differences between standard deviations are significant in each case.

Table 4. The level of significance of differences in levels of each of the seven metals over the five geographic groups.

Metal	Significance Level
Cd	Very Significant
Cr	Extremely Significant
Cu	Extremely Significant
Pb	Extremely Significant
Zn	Extremely Significant
Sn	Very Significant
Ni	Extremely Significant

The results of Dunn's Multiple Comparisons Tests are presented in Table 5. This test examines the results of the Kruskal-Wallis tests to determine which contrasts between geographic groupings are responsible for the statistically significant results. In each case the significant differences are between one of the "local" tributaries, WT or ER, and one of the main stem groupings. To look at it another way, there is never a statistically significant difference detected between the "local" tributaries or between the main stem groupings.

A rank score analysis is applied to highlight the distributions of the metals over the entire study area. It this process, the stations are ranked for each metal from the highest concentration to the lowest (Tables 6-12). The results are presented in a geographical context in Figs. 5-11. Examination of the tables and figures indicates that there is considerable correspondence between the distribution of metals, i.e. a station with a high concentration of one metal is likely to have a high concentration of the other metals. In addition, the stations with the highest metal concentrations tend to be located along the main stem of the system, i.e. the Upper Kennebec River Channel, that western portion of Merrymeeting Bay, where Androscoggin River water enters, and in the Lower Kennebec River. With few exceptions, stations in the Western Tributaries and the Eastern River are in the third or fourth quartile of stations.

The data can be further reduced by summing the rankings across the seven metals (Table 13). For instance, Station UKR-8 in the Kennebec River just north of Swans Island is ranked number 1 for six of the seven metals and number 3 for the seventh. Summing these rankings results in a score of 9. Hence, we can conclude that station UKR-8 has the highest trace metal burden of the 47 stations. Station MB-6 with a sum rank score of 33 is second, LKR-4 with a total score of 34 is third, and so on through the 47 stations. The geographic distribution of these rankings by quartile is presented in Fig.12.

Several important insights are revealed by this summed rank score analysis. The 20 highest ranked stations are located in UKR, MB and LKR (Table 13). Furthermore, the most highly ranked stations among these are found in the UKR above Swans Island, in the confluence of the Androscoggin River and MB, and in the upper reaches of the LKR (Fig. 12). Stations in the minor tributaries are generally ranked in the third and fourth quartile. In fact, four of the five ER stations and four of the seven CR stations are in the lowest quartile. Stations from UKR, MB and LKR ranked in the lower two quartiles are located at sheltered sites.

Table 5. Results of Dunn's Multiple Comparisons Tests. * indicates significance at the <0.05 level; ** at the <0.01 level.

Metal	Comparison	Significance Lev
Cd	WT vs. MB	*
	ER vs. MB	**
	ER vs. LKR	*
Cr	WT vs. MB	*
	WT vs. LKR	*
	ER vs. MB	**
	ER vs. LKR	**
Cu	WT vs. LKR	*
	ER vs. UKR	*
	ER vs. MB	**
	ER vs. LKR	**
Pb	WT vs. MB	*
	WT vs. LKR	*
	ER vs. MB	*
	ER vs. LKR	*
Zn	WT vs. MB	*
	ER vs. MB	**
	ER vs. LKR	*
Sn	WT vs. LKR	**
Ni	WT vs. UKR	*
	WT vs. MB	*
	WT vs. LKR	**

Table 6. Stations ranked by the concentration of Cd.

Rank	Station	Cd Conc.	Quartile
1	UKR-8	1.820	1
2	MB-5	1.309	1
3	MB-6	1.263	1
4	LKR-4	1.236	1
5	MB-3	1.130	1
6	MB-4	1.128	1
7	LKR-1	1.036	1
8	LKR-2	0.991	1
9	UKR-1	0.976	1
10	UKR-4	0.955	1
11	LKR-6	0.892	1
12	CR-7	0.863	1
13	LKR-9	0.824	2
14	CR-5	0.789	2
15	MB-2	0.756	2
16	MR-4	0.751	2
17	MR-1	0.739	2
18	UKR-13	0.675	2
19	LKR-3	0.671	2
20	LKR-8	0.658	2
21	UKR-6	0.652	2
22	MR-2	0.648	2
23	UKR-9	0.636	2
24	UKR-3	0.622	2
25	UKR-10	0.622	2
26	MB-7	0.589	3
27	AR-2	0.588	3
28	AR-1	0.575	3
29	LKR-7	0.544	3
30	UKR-2	0.531	3
31	LKR-5	0.507	3
32	CR-3	0.505	3
33	UKR-7	0.484	3
34	ER-5	0.481	3
35	ER-4	0.465	3
36	MR-3	0.433	3
37	ER-2	0.421	4
38	AR-3	0.418	4
39	UKR-5	0.395	4
40	ER-3	0.369	4
41	CR-6	0.367	4
42	CR-8	0.328	4
43	ER-1	0.241	4
44	UKR-12	0.205	4
45	CR-2	0.200	4
46	CR-1	0.198	4
47	UKR-11	0.189	4

Table 7. Stations ranked by the concentration of Cr.

Rank	Station	Cr Conc	Quartile
1	UKR-8	218.54	1
2	UKR-2	175.08	1
3	MB-3	145.13	1
4	LKR-4	121.10	1
5	MB-6	108.57	1
6	MB-5	106.01	1
7	LKR-7	104.66	1
8	UKR-4	102.54	1
9	LKR-1	97.36	1
10	UKR-3	90.58	1
11	LKR-3	90.40	1
12	LKR-6	88.36	1
13	LKR-9	86.54	2
14	MB-4	85.64	2
15	UKR-1	84.57	2
16	LKR-2	74.64	2
17	UKR-9	73.20	2
18	AR-1	72.65	2
19	UKR-10	66.59	2
20	UKR-13	63.68	2
21	MB-2	60.33	2
22	CR-1	60.23	2
23	LKR-5	59.16	2
24	MR-2	58.30	2
25	AR-2	57.80	3
26	MR-1	57.58	3
27	LKR-8	55.95	3
28	MB-7	53.58	3
29	CR-7	50.71	3
30	UKR-6	50.45	3
31	MR-4	49.94	3
32	UKR-5	49.90	3
33	ER-4	48.13	3
34	CR-3	47.48	3
35	AR-3	47.05	3
36	UKR-7	46.61	3
37	CR-5	46.53	4
38	CR-6	45.33	4
39	ER-5	45.12	4
40	UKR-11	44.19	4
41	CR-2	42.56	4
42	ER-2	42.13	4
43	ER-3	40.41	4
44	ER-1	40.22	4
45	MR-3	37.71	4
46	UKR-12	30.80	4
47	CR-8	25.61	4

Table 8. Stations ranked by the concentration of Cu.

Rank	Station	Cu Conc	Quartile
1	UKR-8	98.43	1
2	UKR-2	78.28	1
3	MB-3	71.13	1
4	LKR-4	69.76	1
5	MB-5	64.38	1
6	MB-6	63.98	1
7	UKR-1	58.69	1
8	LKR-6	55.74	1
9	LKR-1	51.32	1
10	UKR-4	49.85	1
11	LKR-3	48.89	1
12	MB-4	46.78	1
13	LKR-9	45.19	2
14	LKR-2	45.14	2
15	LKR-7	42.64	2
16	UKR-3	41.51	2
17	UKR-9	40.95	2
18	UKR-10	35.14	2
19	LKR-5	33.52	2
20	UKR-13	32.67	2
21	CR-1	31.92	2
22	MB-2	31.64	2
23	MR-2	31.36	2
24	AR-2	30.61	2
25	MR-1	29.66	3
26	AR-1	29.59	3
27	LKR-8	29.39	3
28	CR-7	29.11	3
29	MR-4	28.91	3
30	CR-5	28.59	3
31	UKR-6	27.50	3
32	UKR-5	27.41	3
33	MB-7	27.03	3
34	AR-3	26.56	3
35	UKR-7	26.13	3
36	ER-4	24.80	3
37	CR-6	24.65	4
38	CR-2	23.63	4
39	UKR-11	23.37	4
40	ER-5	22.55	4
41	CR-3	22.44	4
42	ER-2	21.16	4
43	MR-3	20.34	4
44	ER-3	19.78	4
45	ER-1	19.24	4
46	UKR-12	15.70	4
47	CR-8	13.45	4

Table 9. Stations ranked by the concentration of Pb.

Rank	Station	Pb conc.	Quartile
1	UKR-4	284.68	1
2	UKR-1	111.25	1
3	UKR-8	94.27	1
4	UKR-2	80.47	1
5	MB-6	67.89	1
6	MB-5	66.40	1
7	MB-3	61.22	1
8	LKR-6	57.23	1
9	UKR-9	46.60	1
10	LKR-4	46.22	1
11	LKR-7	44.89	1
12	LKR-1	40.91	1
13	MB-4	40.52	2
14	LKR-2	39.59	2
15	UKR-10	38.85	2
16	LKR-9	37.29	2
17	LKR-3	35.38	2
18	MB-2	34.17	2
19	UKR-13	32.30	2
20	LKR-5	31.55	2
21	MR-1	29.81	2
22	UKR-11	29.72	2
23	MR-2	28.83	2
24	UKR-7	27.28	2
25	MB-7	27.03	3
26	CR-5	26.67	3
27	CR-1	26.34	3
28	MR-4	25.73	3
29	AR-2	25.46	3
30	UKR-5	25.39	3
31	CR-7	24.58	3
32	UKR-6	24.57	3
33	AR-3	24.29	3
34	ER-5	23.03	3
35	CR-6	22.27	3
36	ER-4	21.77	3
37	ER-2	21.19	4
38	ER-3	21.19	4
39	AR-1	20.97	4
40	CR-3	20.05	4
41	UKR-3	19.87	4
42	LKR-8	18.28	4
43	CR-2	16.45	4
44	ER-1	15.76	4
45	MR-3	14.40	4
46	UKR-12	10.05	4
47	CR-8	9.54	4

Table 10. Stations ranked by concentration of Zn.

Rank	Station	Zn conc	Quartile
1	UKR-8	474.61	1
2	MB-3	440.52	1
3	UKR-2	400.47	1
4	MB-5	343.71	1
5	MB-6	320.15	1
6	LKR-4	276.77	1
7	MB-4	256.92	1
8	UKR-4	248.46	1
9	LKR-1	236.85	1
10	LKR-3	215.24	1
11	LKR-2	209.47	1
12	UKR-3	198.84	1
13	UKR-1	185.79	2
14	LKR-9	180.88	2
15	LKR-6	179.49	2
16	UKR-9	172.91	2
17	UKR-13	155.29	2
18	UKR-10	154.41	2
19	CR-1	144.59	2
20	CR-7	143.99	2
21	MB-2	142.32	2
22	LKR-7	140.55	2
23	MB-7	132.39	2
24	MR-4	128.70	3
25	MR-2	128.70	3
26	AR-1	127.58	3
27	LKR-5	126.63	3
28	CR-5	121.86	3
29	AR-2	121.03	3
30	MR-1	119.36	3
31	LKR-8	116.56	3
32	AR-3	115.28	3
33	UKR-5	113.77	3
34	ER-4	107.28	3
35	UKR-7	102.25	3
36	CR-6	101.64	3
37	CR-2	100.71	4
38	ER-1	97.29	4
39	CR-3	96.41	4
40	ER-2	94.78	4
41	ER-5	93.16	4
42	ER-3	91.23	4
43	MR-3	88.21	4
44	UKR-11	86.96	4
45	CR-8	63.97	4
46	UKR-12	56.12	4
47	UKR-6	39.76	4

Table 11. Stations ranked by concentration of Sn.

Rank	Station	Sn Conc	Quartile
1	UKR-8	92.13	1
2	LKR-4	41.34	1
3	UKR-4	36.37	1
4	MB-5	34.89	1
5	UKR-2	34.61	1
6	MB-6	34.59	1
7	LKR-1	34.52	1
8	LKR-7	32.28	1
9	LKR-9	31.90	1
10	MB-3	31.04	1
11	LKR-3	30.04	1
12	UKR-1	28.84	1
13	LKR-2	27.30	2
14	LKR-6	26.87	2
15	UKR-13	22.78	2
16	UKR-10	21.23	2
17	UKR-9	20.46	2
18	LKR-8	20.38	2
19	MB-4	19.38	2
20	UKR-11	18.83	2
21	UKR-3	17.78	2
22	AR-2	16.26	2
23	ER-5	16.17	2
24	CR-1	15.99	2
25	AR-1	15.32	3
26	CR-5	14.91	3
27	CR-2	14.03	3
28	ER-3	13.90	3
29	MR-1	13.43	3
30	MB-2	13.36	3
31	ER-1	13.07	3
32	ER-2	12.82	3
33	LKR-5	11.95	3
34	ER-4	11.69	3
35	UKR-6	11.61	3
36	CR-3	11.14	3
37	UKR-7	10.76	4
38	MR-3	10.69	4
39	MR-2	10.55	4
40	AR-3	9.29	4
41	MB-7	9.16	4
42	UKR-5	9.03	4
43	MR-4	8.73	4
44	UKR-12	7.62	4
45	CR-6	7.52	4
46	CR-7	6.73	4
47	CR-8	6.11	4

Table 12. Stations ranked by the concentration of Ni.

Rank	Station	Ni Conc	Quartile
1	UKR-8	184.16	1
2	UKR-4	145.00	1
3	MB-6	95.35	1
4	LKR-4	89.30	1
5	LKR-7	79.35	1
6	UKR-1	78.80	1
7	UKR-2	73.76	1
8	LKR-9	69.14	1
9	LKR-2	66.68	1
10	MB-3	64.71	1
11	UKR-13	60.05	1
12	MB-5	58.82	1
13	LKR-6	55.90	2
14	LKR-1	53.27	2
15	UKR-10	52.72	2
16	AR-2	51.99	2
17	LKR-3	50.88	2
18	LKR-8	45.66	2
19	MB-4	41.16	2
20	CR-5	39.92	2
21	UKR-9	39.47	2
22	CR-2	37.54	2
23	LKR-5	35.04	2
24	UKR-3	34.43	2
25	ER-4	33.73	3
26	ER-1	33.68	3
27	UKR-7	33.59	3
28	UKR-12	33.29	3
29	AR-1	32.89	3
30	MR-1	32.87	3
31	CR-8	31.76	3
32	MB-7	31.66	3
33	AR-3	31.51	3
34	CR-3	31.12	3
35	ER-5	30.18	3
36	MB-2	30.06	3
37	UKR-5	30.06	3
38	UKR-11	29.79	4
39	MR-3	29.52	4
40	UKR-6	29.34	4
41	ER-3	26.82	4
42	ER-2	26.27	4
43	CR-1	26.19	4
44	MR-4	24.85	4
45	MR-2	24.22	4
46	CR-7	23.34	4
47	CR-6	18.79	4

COMPARISON WITH OTHER STUDIES

Comparisons between studies are often difficult due to differences in sampling techniques, analytical methodology and documentation. Nevertheless, even with the limitations, valuable insights can be discovered and the effort is usually rewarding. In the present case, there are a small number of recent studies that can be utilized. An initial observation is that, since the studies are all relatively recent, temporal comparisons would have little meaning.

The results, or selected results, of five studies are summarized in Table 14. Most of the included numbers represent means. The reader is reminded that there are variances around these mean values. The first three studies listed employ very comparable methodologies.

The first data set presented in Table 14 includes the mean concentrations of seven metals in the seven subregions of the present study. The previously noted concentration differences between the four smaller tributaries and the main stem regions are obvious. The results of Getchell (2002) from the nearby Boothbay region are included as a baseline. Her Gulf of Maine stations were taken 2-8 kilometers off Cape Newagen. Although no sites downwind of a continent are unimpacted by contaminants, these sites are isolated from direct inputs and may be considered to represent regional background contaminant levels. Her Boothbay and Inner Boothbay Harbor stations represent sites along a gradient of presumed increasing contaminant input. Comparison of the present results with Getchell's reveals that, with one exception, samples for the Kennebec/Androscoggin system contains elevated levels of metals. Zn appears to be especially elevated. The one exception is Pb that exhibits concentrations in the four small Merrymeeting Bay tributaries that are below our chosen Gulf of Maine background level.

There is good correspondence between the present results and those of Larsen and Gaudette (1995). Stations 23-25 of Larsen and Gaudette (1995) are located in the lower Kennebec River and in each case the range of values reported for these stations bracket the mean values reported for the LKR grouping in the present study. These authors had reported that metal levels in the region, especially in the main stem of the Kennebec estuary, were elevated above pre-industrial levels.

Results from the FOMB/DEP study are in general agreement with the present study for the two metals that were analyzed in common. Pb levels are near or below the Gulf of Maine baseline and Zn levels are in agreement for similar areas; for instance, in the Muddy River 127.9 vs. 116.2 and in the Abagadasset River

114.4 vs. 121.3. The FOMB/DEP study is still in production. Once it is complete with detailed methodology and specific sampling sites, it would be productive to do more thorough comparisons of these and other parameters.

Chilcote and Waterfield (1995) sampled 14 stations in the Merrymeeting Bay area. Because of the extremely sandy nature of their samples, and basic differences in methodology, we are not able to compare results.

DISCUSSION

The results of this study reveal a coherent explanation of the distribution and movement of trace metals into and through the Kennebec/Androscoggin River system. The major points are as follows. Metal levels are generally elevated above pre-industrial levels (Lyons *et al*., 1978; Larsen *et al*., 1983a) and above a Gulf of Maine baseline (Getchell, 2002) indicating that metals are presently entering the system (Table 14). There are statistically significant differences in metal levels between our seven defined subregions that show that the greatest concentration elevations are limited to the main stem of the system, i.e. the Kennebec River and estuary and Merrymeeting Bay that, in our groupings, includes the lower Androscoggin River (Table 4). The four small tidal rivers that enter Merrymeeting Bay, the Muddy, Cathance, Abagadasset and Eastern Rivers, have watersheds limited to the Merrymeeting Bay vicinity and exhibit less elevated metal levels. In the case of Pb, sediment concentrations are actually below the Gulf of Maine baseline (Getchell, 2002). We, therefore, may conclude that the major portion of the observed trace metals is from outside of our immediate study area, i.e. from upstream sources in the Kennebec River and Androscoggin River watersheds.

The conclusion that the Kennebec and Androscoggin watersheds are the principal sources of metals in the system is reinforced by the distribution of the stations that ranked the highest in terms of metal concentrations (Table 13, Fig.12). For instance, Stations MB –6, MB-5 and MB-3 are situated where the Androscoggin River broadens into Merrymeeting Bay. It is here where the currents would slow and the river would drop part of its suspended load. Likewise, highly ranked stations in the upper Kennebec are located where the river first meets the two-way tidal flow below the (former) dam in Augusta (Stations UKR-1 and UKR-2) or where the river first broadens out into upper Merrymeeting Bay (Stations UKR-4 and UKR-8).

Four stations in the upper reach of the lower Kennebec River estuary, the Sagadahoc estuary, also were highly ranked (Stations LKR-1,2,3&4). Whereas we cannot dismiss potential inputs from the population/industrial center of Bath, there is a hydrodynamic explanation why these stations would exhibit higher metal burdens than stations immediately upstream in Merrymeeting Bay. When fresh, river water collides with seawater to form an estuary, unique physical and chemical processes result. Seawater is denser than fresh water. As a result, in a constricted tidal estuary, it sinks and produces a bottom current with a net upstream movement. Conversely, the fresh water floats upon seawater and produces a surface current with a net downstream movement. Hence, as sediment particles carried by the downstream flowing river water sink, as they tend to do, they become entrained in the upstream moving bottom current. Further upestuary, the particles will be mixed back into the downstream surface current to sink again into the bottom current. Many particles become captured in this cyclic estuarine circulation. At the same time, when the fine river borne sediment and organic particles, with which the contaminants are associated, come into contact with the salts in the seawater, chemical and electrostatic changes occur. This causes changes in the solubility of many contaminant complexes and, very dramatically, it causes the small contaminant laden particles to floccolate, i.e. bind together, and become less buoyant. The result of these processes is that the upper reaches of estuaries are often characterized by a region of increased suspended loads and underlain by muddy deposits. This region is called the turbidity maximum and it is here where higher levels of contaminants would be expected. Hydrographic conditions in the Kennebec estuary allow for the formation of a turbidity maximum during periods of low or moderate flows which occur about three-quarters of the time (Kistner and Pettigrew, 2001). The location of the Kennebec turbidity maximum is most often in the upper reach where we encountered metal levels higher than at stations both upstream and downstream.

The fact that metals are entering the Kennebec/Androscoggin system from upstream does not mean that they are accumulating in the tidal portions of the system that we sampled. Olsen, *et al.* (1993) investigated a range of US east coast estuaries in an effort to explain patterns observed in estuarine particle retention or export. The Kennebec/Androscoggin system fits into their Type I where “sediment and contaminant accumulation are negligible”. Like our study area, Type I areas have noncohesive sediments strongly influenced by physical or biological mixing. They are in “a state of dynamic equilibrium with respect to sea level, river discharge, tidal currents and wave activity” and have “apparently obtained an equilibrium depth above which net particle and contaminant deposition is negligible, despite an excess of both.” They say further that the entire suspended sediment and contaminant load bypasses these areas. Any deposition that occurs is temporary due to resuspension by currents and waves.

The findings that the metals are being introduced into the lower Kennebec/Androscoggin system from upstream and are not accumulating in Merrymeeting Bay or the lower estuary supports the hypothesis of Larsen and Gaudette (1995) that the large Kennebec/Androscoggin watershed (27,700 km2) is the source for much of the contamination observed in the nearshore Gulf of Maine. Although we have emphasized trace metals in this research, the distribution of organic contaminants such as PAHs and dioxin should mirror the metal distribution because of similar affinities for fine-grained sediments and organic particles.

SUMMARY AND CONCLUSIONS

Metal levels in the Kennebec/Androscoggin study area sediments are generally elevated relative to background

Highest metal levels are found in the main stem of the system

Principal sources of the metals are the watersheds of the Kennebec and Androscoggin Rivers

The smaller tributaries with watersheds in the immediate Merrymeeting Bay area have statistically significant lower metal levels

Higher metal levels in the upper reach of the lower Kennebec estuary may be explained by the location of the Kennebec turbidity maximum

The system is in dynamic equilibrium in regards to particle and contaminant deposition. Accumulation of metals and, by inference, other contaminants in the system is negligible

These finding are further evidence that contaminants from the Kennebec/Androscoggin watershed are transported to the nearshore Gulf of Maine

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1.5

ESTUARINE SEDIMENT CHARACTERIZATION
(from 1999)

ESTUARINE SEDIMENT CHARACTERIZATION

Recent hazardous waste site assessments in lower river systems and estuaries have demonstrated the need for a better understanding of toxic contaminant levels in estuarine sediments. These areas, neither river nor marine, and a transition zone between erosional and depositional areas are not well characterized. Waste discharge license limits are based on ambient concentrations of a toxicant after mixing. Due to stoichiometric changes between fresh and salt water, many contaminants settle shortly after reaching saline conditions. The amount of contaminants deposited in these areas is a reflection of the actual load delivered from the river (and treatment plants) and is largely independent of ambient concentrations. Concern has been raised that although concentrations may be decreasing, loading may be actually increasing due to increased discharge flows.

Some estuarine sediment chemistry has been conducted, but most work has been in euryhaline areas. In the 1999-2003 five year plan, we intend to characterize sediments in the major estuarine areas at a rate of one estuary area each year. The Friends of Merrymeeting Bay helped collect samples from Merrymeeting Bay in 1999 and results were reported in the 1999 SWAT report. Samples for dioxins and furans, however, were not analyzed. New samples were collected for dioxin and furan analysis in 2000. Results are as follows.

STATIONS

AB	Abagadasset River near Bald Head N43:59.787, W69:51.073.
AR	Androscoggin River near Bayshore Road N43:57.446 W69:51.591
KR	Kennebec River near Abagadasset Point N43:59.915 W69:49.826
MR	Muddy River near Pleasant Point N43:58.205, W69:52.871
SI	Swan’s Island south end N43: 59.787 W69:51.073
WC	Whiskeag Creek mouth N43:56.169 W69:49.827

TABLE 1.5.1 DIOXIN IN 2000 MERRYMEETING BAY SEDIMENT SAMPLES

Sed ID		AR-1	SI-2	AR-2	KR-3	AR-3	WC-2
Congener	DL (ng/Kg, dry weight)						
2,3,7,8-TCDF	0.11	6.88	1.17	2.22	5.68	2.55	1.10
1,2,3,7,8-PeCDF	0.25	1.99	0.21	0.64	1.79	0.81	<DL
2,3,4,7,8-PeCDF	0.25	2.14	0.26	0.78	1.73	1.10	<DL
1,2,3,4,7,8-HxCDF	0.25	10.1	0.77	1.82	2.52	3.62	0.18
1,2,3,6,7,8-HxCDF	0.25	8.50	0.58	1.31	2.03	3.34	0.24
2,3,4,6,7,8-HxCDF	0.25	3.34	0.23	0.79	1.19	2.44	<DL
1,2,3,7,8,9-HxCDF	0.25	1.29	<DL	0.110	0.71	0.30	<DL
1,2,3,4,6,7,8-HpCDF	0.50	173	14.9	140.4	27.5	101	7.68
1,2,3,4,7,8,9-HpCDF	0.50	12.9	0.715	2.77	2.25	32.3	<DL
OCDF	0.50	282	8.77	156	85.4	227	20.7
2,3,7,8-TCDD	0.10	0.55	0.07	0.37	0.59	0.19	1.30
1,2,3,7,8-PeCDD	0.25	1.69	<DL	0.36	0.83	0.43	<DL
1,2,3,4,7,8-HxCDD	0.25	3.55	0.40	0.82	1.07	1.17	<DL
1,2,3,6,7,8-HxCDD	0.25	27.1	1.61	5.27	3.20	9.11	1.38
1,2,3,7,8,9-HxCDD	0.25	20.4	1.56	2.68	2.60	6.62	1.36
1,2,3,4,6,7,8-HpCDD	0.50	365	19.9	78.8	54.3	177	43.6
OCDD	0.50	4279	141	1183	1329	3166	450
TEQ ND=0		17.491	1.216	5.002	5.259	7.573	2.281
TEQ ND=DL		17.491	1.491	5.002	5.259	7.573	2.749
sample weight (g wet wt)		100	100	94	125	91	143
% solids		50	50	53	40	55	35
Sediment amounts are based on the % solids to give a 50 g sample weight of dry material.							

Sed ID		WC-3	AB-c3	MR-c2	AB-c3	MR-c3
Congener	DL (ng/Kg, dry weight)					
2,3,7,8-TCDF	0.11	1.62	<DL	<DL	<DL	<DL
1,2,3,7,8-PeCDF	0.25	0.81	<DL	<DL	<DL	<DL
2,3,4,7,8-PeCDF	0.25	0.81	<DL	<DL	<DL	<DL
1,2,3,4,7,8-HxCDF	0.25	1.01	<DL	<DL	<DL	<DL
1,2,3,6,7,8-HxCDF	0.25	1.02	<DL	<DL	<DL	<DL
2,3,4,6,7,8-HxCDF	0.25	0.45	1.05	3.02	1.05	3.02
1,2,3,7,8,9-HxCDF	0.25	<DL	2.26	4.98	2.26	4.98
1,2,3,4,6,7,8-HpCDF	0.50	18.6	66.5	112.0	66.5	112.0
1,2,3,4,7,8,9-HpCDF	0.50	0.98	<DL	6.95	<DL	6.95
OCDF	0.50	51.5	117	156	117	156
2,3,7,8-TCDD	0.10	0.33	<DL	<DL	<DL	<DL
1,2,3,7,8-PeCDD	0.25	0.69	<DL	<DL	<DL	<DL
1,2,3,4,7,8-HxCDD	0.25	0.67	<DL	<DL	<DL	<DL
1,2,3,6,7,8-HxCDD	0.25	2.96	<DL	<DL	<DL	<DL
1,2,3,7,8,9-HxCDD	0.25	2.20	<DL	<DL	<DL	<DL
1,2,3,4,6,7,8-HpCDD	0.50	65.9	106	332	106	332
OCDD	0.50	826	1776	2550	1776	2550
TEQ ND=0		3.397	2.25	5.58	2.25	5.58
TEQ ND=DL		3.422	2.87	6.20	2.87	6.20
sample weight (g wet wt)		125	51.0	51.0	51.0	51.0
% solids		40				

Sediment amounts are based on the % solids to give a 50 g sample weight of dry material.

MODULE 2 LAKES

2.1

MERCURY DEPOSITION NETWORK

MERCURY DEPOSITION NETWORK

Atmospheric deposition is thought to be a significant source of mercury to Maine surface waters. In order to determine the relative significance of sources throughout Maine and the Northeast region, Maine has joined the Mercury Deposition Network (MDN). The MDN was created as an adjunct to the National Atmospheric Deposition Program (NADP), that has been monitoring the effects of atmospheric deposition of other contaminants, including acid rain, across the US for over 10 years. Maine has 4 NADP stations, one each at Bridgton, Acadia National Park (ANP), Greenville, and Caribou.

The MDN measures mercury in wet deposition on a weekly basis and provides a measurement of annual deposition at each station. All stations use similar equipment, the same protocol, and all samples will be analyzed by the same lab. There is also a Northeast regional network of MDN and other types of stations that measures wet deposition, as well as dry and gaseous mercury in some locations, in the New England states and the Canadian Maritime provinces.

One goal of MDN is to continue monitoring for at least 5 years. In Maine there are currently MDN stations at Acadia National Park (ANP, since fall 1995), Bridgton (since July 1997), Greenville (since September 1996), and Freeport (since 1998). The ANP station was supported equally by the National Park Service (NPS) and DEP through SWAT ($6000). The Greenville station was funded entirely by SWAT ($16500). The Bridgton station was funded primarily by an EPA REMAP grant, with DEP providing the station operator and mailing of the samples ($3150 SWAT). The Freeport station was supported entirely by a grant from EPA.

Annual deposition is greatest for the coastal stations, Freeport and Acacia National Park, followed by Bridgton and Greenville. Mean volume weighted concentration generally follows the same pattern. Ratios of annual deposition to mean concentration show that higher deposition along the coast is not entirely due to higher concentrations, but also due to increased precipitation.

TABLE 2.1 MERCURY IN WET DEPOSITION AT MAINE MDN STATIONS

ANNUAL DEPOSITION (ug/m2)

STATION	ID	1995	1996	1997	1998	1999	2000
Bridgton	ME02			5.7e	6.9	6.9	6.9
Greenville	ME09		5.5e	5.4	6.7	6.9	5.2
Freeport	ME96				12.0e	8.4	7.9
ANP	ME98	5.2e	7.8	7.7	9.0	8.0	8.7

e= estimated, site started during year

MEAN CONCENTRATION (ng/l)

STATION	ID		1996	1997	1998	1999	2000
Bridgton	ME02			8.4e	6.6	6.3	6.4
Greenville	ME09		4.0e	5.9	5.9	5.5	5.1
Freeport	ME96				7.8	7.3	6.6
ANP	ME98	5.2e	6.0	6.8	6.1	6.1	7.0

e=estimated since station began during the year

Mercury Deposition Network: a NADP Network

MDN Objectives

The objective of the MDN is to develop a national database of weekly concentrations of total mercury in precipitation and the seasonal and annual flux of total mercury in wet deposition. The data will be used to develop information on spatial and seasonal trends in mercury deposited to surface waters, forested watersheds, and other sensitive receptors.
Analysis of precipitation samples for total- and methylmercury is performed by Frontier Geosciences, Inc., Seattle WA, USA. Frontier Geosciences provides the environmental sciences community with uncompromisingly high-quality contract research, project design and management, and analytical chemistry services concerned with the sources, fate and effects of trace metals.
The MDN began a transition network of 13 sites in 1995. Beginning in 1996, MDN became an official network in NADP with 26 sites in operation. Over 50 sites were in operation during 2000 (see site map). The MDN is anticipated to operate for a minimum of five years and will be managed at the NADP Coordination Office. The network uses standardized methods for collection and analyses. **Weekly** precipitation samples are collected in a modified Aerochem Metrics model 301 collector. The "wet-side" sampling glassware is removed from the collector every Tuesday and mailed to the **Hg Analytical Laboratory (HAL)** at Frontier Geosciences in Seattle, WA for analysis by cold vapor atomic fluorescence. The MDN provides data for total mercury, but also includes methylmercury if desired by a site sponsor. Data are available via this Web page for the transition network (1995) and for 1996 through the second quarter of 2000.
The following journal articles and presentations describe the network design, including the sampling and analytical protocols, used in the MDN:

Lindberg, S. and Vermette, S. 1995. Workshop on Sampling Mercury in Precipitation for the National Atmospheric Deposition Program. Atmospheric Environment. 29, 1219-1220.
Vermette, S., Lindberg, S., and Bloom, N. 1995. Field Tests for a Regional Mercury Deposition Network - Sampling Design and Preliminary Test Results. Atmospheric Environment. 29, 1247-1251.

Welker, M. and Vermette, S.J., 1996. Mercury Deposition Network: QA/QC Protocols. Paper 96-RP129.01, Proceedings of the 89th Annual Meeting of the Air and Waste Management Association, A&WMA, Pittsburgh, PA.
Sweet, C.W. and Prestbo, E. 1999. Wet Deposition of Mercury in the U.S. and Canada. Presented at "Mercury in the Environment Specialty Conference", September 15-17, 1999, Minneapolis, MN. Proceedings published by Air and Waste Management Association, Pittsburgh, PA.
(Available from NADP Program Office)

Image credit: Mackerel On Mercury by Scot F. Hacker , 1995.

MDN DATA FIELDS

SITE CODE: 2-letter state or province designator plus SAROAD county code (US) or sequential number (Canada).

START DATE: (mm/dd/yyyy)

END DATE: (mm/dd/yyyy)

SUBPPT: Rain Gauge (RG) precipitation amount in mm if available, otherwise precipitation amount in mm is calculated from the net rain volume caught in the sample bottle.

PPT: Precipitation amount in mm from the rain gauge (RG), if blank, no RG data.

HG CONC: total mercury concentration reported by the lab in ng/L.

DEPOSITION: product of SUBPPT and HG CONC, units are ng/m2.

Quality rating (QR) CODE: A = fully qualified with no problems

B = valid data with minor problems, used for summary statistics

C = invalid data, not used for summary statistics

BLANK= no sample submitted for this time period

SAMPLE TYPE:

W = wet sample, measurable precipitation (> or = 0.03 in.) on the rain gauge (RG) or net bottle catch (BC) = or > 10.0 mL if RG data are missing. Concentration and deposition data are reported unless the QR Code = C.

D = dry sample, no indication of sampler openings on the RG or net BC < 1.5 mL if RG event recorder data are missing. No concentration data are reported. ppt, subppt, and deposition are set to zero.

T = trace sample, RG shows openings or a trace precipitation amount (<0.03 inches). If the RG data are missing, a net BC between 1.5 and 10.0 mL (inclusive) will be coded as a T sample type. Concentration data may or may not be reported depending whether the BC is 1.5 mL or higher. If BC = 1.5 mL or higher, then ppt is blank , Subppt = BC, and deposition is based on the BC. If BC < 1.5 mL, then ppt subppt and deposition are all set to zero.

Q = sampler was used for a Quality assurance (QA) sample, no ambient sample submitted. No concentration values are reported (QA values will be published in the QA report).

Deposition is only reported where the value is zero (D or T samples with no measurable precipitation).

NOTES:	QR CODE	Valid for Summaries (Y/N)
s = short sample time (< 6days)	B	Y
e = extended sample time (> 8days)	B	Y
d = debris present (previously x)	B	Y

m = missing information (previously, r, no event recorder, and p, missing RG precipitation record)	B	Y
z = site operations problems	B	Y
h = sample handling problems (z and h include equipment and handling problems that don't seriously compromise the sample)	B	Y
i = low volume sample (1.49mL < net BC < 10.00mL) (Hg conc. data are reported but they are less certain than those for samples with a net BC of at least 10 mL)	B	Y
b = bulk sample (wet side open the whole time)	C	N
v = RG indicates precipitation occurred but BC < 1 mL or < 10% of indicated RG precipitation amount.	C	N
u = undefined sample (wet side open during dry periods)	C	N
f = serious problems in field operations that compromise sample integrity.	C	N
l = laboratory error	C	N
c = sample compromised due to contamination	C	N
p = no ppt data from either RG or BC	C	N
n = no sample submitted	--	N

Calculation of Deposition:

1. If a valid precipitation amount can be read from the rain gauge chart (RG >= 0.03 inches), the sample type is set to "W" (wet); and the value from the RG chart is used to calculate deposition (RG amount in mm times Hg concentration in ng/mL). If the RG chart event recorder shows no sampler openings, sample type is set to "D" (dry) and precipitation amount and deposition are set to 0.
2. If the precipitation amount from the RG chart is not available, the net bottle catch (BC) will be used to calculate deposition as long as BC > 1.49mL. If the BC < 1.5 mL, the precipitation amount will be set to 0 and the sample type set to "D" (dry). If the BC is between 1.5 and 10.0 mL, the sample type will be set to "T" (trace) and the BC used to calculate deposition. These samples are also coded with an "i" in the Notes field and downgraded to a "B" Quality Rating to indicate uncertainty due to low volume. If the BC is > 10 mL, the sample type will be set

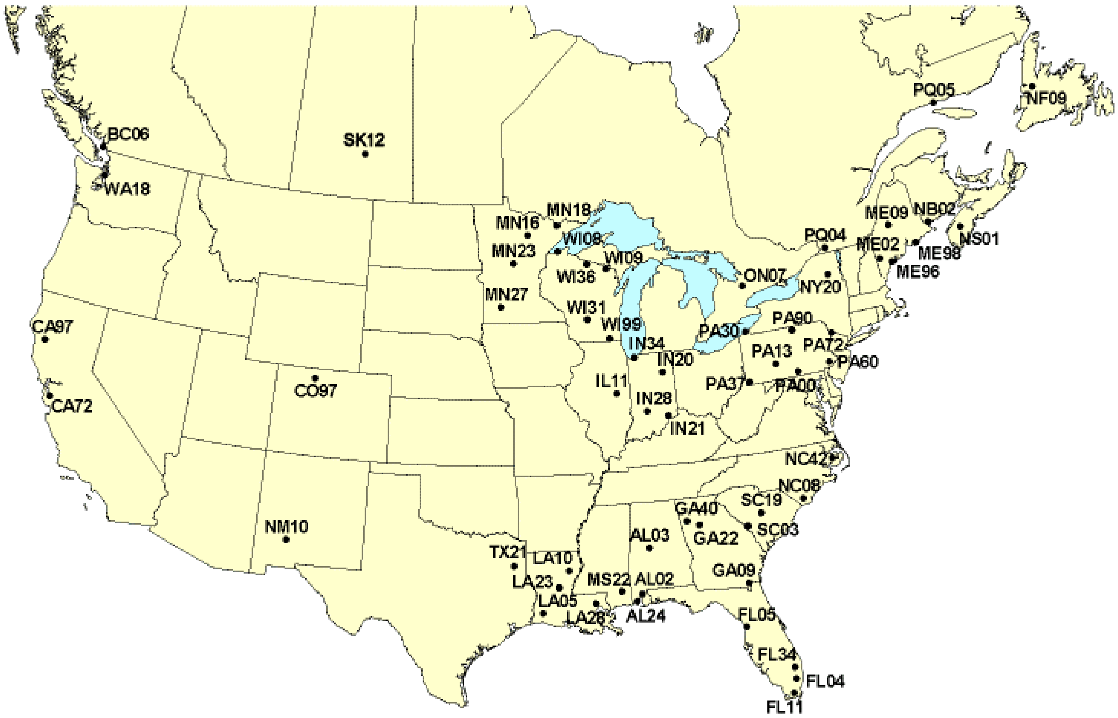
to “W” (wet) and the BC will be used to calculate deposition.

3. If the RG indicates sampler openings, but the precipitation amount can’t be determined accurately from the RG chart (RG < 0.03 inches) the sample type will be coded “T” (trace) and the BC will be used to calculate deposition as long as the BC is >= 1.5mL. If the BC is < 10mL, samples will be coded for low volume as in 2. If the BC is < 1.5mL, no concentration will be reported and the ppt, subppt, and deposition will be set to 0.

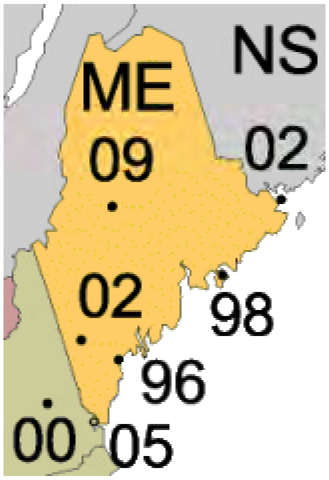
4. In cases where there is a valid precipitation amount from either RG or BC but invalid or missing concentration data, seasonal or annual summary deposition values will be calculated using the site-specific, seasonal, volume-weighted average concentration. This deposition value will not be displayed for individual weeks in the WEB database, but it will be used only for the calculation seasonal and annual average concentrations and deposition amounts on maps and other summary products.

MDN STATIONS

National Atmospheric Deposition Program
Mercury Deposition Network



Mercury Deposition Network Maine stations



Site ID	Site Name	Start Date	End Date	Elevation (meters)
Active Sites				
ME02	Bridgton	06/04/1997		222
ME09	Greenville Station	09/03/1996		322
ME96	Freeport	01/01/1998		15
ME98	Acadia National Park - McFarland Hill	09/26/1995		129
Inactive Sites				

National Atmospheric Deposition Program/MDN

Weekly Mercury Concentrations and Depositions

BRIDGTON ME02

Site	Date On	Date Off	Sub ppt mm	Pptrec mm	HgConc ng/L	HgDep ng/m²	QR	Sample Type	Notes
ME02	12/28/1999	01/04/2000	12.7	12.7	12.1	153.7	B	W	d
ME02	01/04/2000	01/11/2000	40.5	40.5	4.6	188.2	B	W	d
ME02	01/11/2000	01/18/2000	10.2	10.2	6.2	62.9	B	W	d
ME02	01/18/2000	01/25/2000	0.0	0.0	--	0.0	A	D	
ME02	01/25/2000	02/01/2000	22.9	22.9	2.8	63.2	B	W	dh
ME02	02/01/2000	02/08/2000	0.0	0.0	--	0.0	B	D	d
ME02	02/08/2000	02/15/2000	34.7	34.7	4.1	143.0	B	W	d
ME02	02/15/2000	02/22/2000	12.1	12.1	3.2	38.3	B	W	d
ME02	02/22/2000	02/29/2000	14.4	14.4	--	--	C	W	fv
ME02	02/29/2000	03/07/2000	3.0	3.0	12.8	39.1	B	W	d
ME02	03/07/2000	03/14/2000	29.5	29.5	5.2	154.5	B	W	d
ME02	03/14/2000	03/21/2000	11.4	11.4	4.4	50.1	B	W	d
ME02	03/21/2000	03/28/2000	45.7	45.7	4.7	216.6	B	W	dh
ME02	03/28/2000	04/04/2000	45.4	45.4	7.7	347.8	B	W	d
ME02	04/04/2000	04/11/2000	31.2	31.2	5.8	181.2	B	W	d
ME02	04/11/2000	04/18/2000	6.2	6.2	5.1	31.7	B	W	d
ME02	04/18/2000	04/25/2000	79.1	79.1	3.1	248.2	B	W	d
ME02	04/25/2000	05/02/2000	1.3	1.3	16.1	20.4	B	W	di
ME02	05/02/2000	05/09/2000	12.2	12.2	15.7	191.6	B	W	dh
ME02	05/09/2000	05/16/2000	30.4	30.4	9.6	292.4	B	W	d
ME02	05/16/2000	05/23/2000	10.2	10.2	7.5	76.9	A	W	
ME02	05/23/2000	05/30/2000	31.0	31.0	5.2	159.9	B	W	h
ME02	05/30/2000	06/06/2000	15.4	15.4	--	--	C	W	uz
ME02	06/06/2000	06/13/2000	22.2	22.2	10.0	222.0	B	W	d
ME02	06/13/2000	06/20/2000	8.0	8.0	13.2	105.4	B	W	d
ME02	06/20/2000	06/27/2000	18.8	18.8	5.5	103.1	B	W	h
ME02	06/27/2000	07/04/2000	44.5	44.5	--	--	C	W	ufd
ME02	07/04/2000	07/11/2000	26.4	26.4	--	--	C	W	bd
ME02	07/11/2000	07/18/2000	39.0	39.0	--	--	C	W	udf
ME02	07/18/2000	07/25/2000	2.0	2.0	26.0	52.8	A	W	
ME02	07/25/2000	08/01/2000	37.5	37.5	11.3	421.9	B	W	d
ME02	08/01/2000	08/08/2000	4.6	4.6	11.1	50.9	B	W	m
ME02	08/08/2000	08/15/2000	34.7	34.7	16.9	585.9	B	W	dm
ME02	08/15/2000	08/22/2000	3.9	3.9	12.4	48.8	B	W	dm

ME02	08/22/2000	08/29/2000	4.1	4.1	11.1	45.0	B	W	m
ME02	08/29/2000	09/05/2000	4.8	4.8	10.0	48.4	B	W	dm
ME02	09/05/2000	09/12/2000	0.0	0.0	--	0.0	B	D	m
ME02	09/12/2000	09/19/2000	21.6	21.6	--	--	C	W	fm
ME02	09/19/2000	09/26/2000	5.7	5.7	5.4	30.7	B	W	m
ME02	09/26/2000	10/03/2000	0.0	0.0	--	0.0	A	D	
ME02	10/03/2000	10/10/2000	32.7	32.7	4.9	161.8	B	W	dm
ME02	10/10/2000	10/17/2000	6.6	6.6	3.2	21.3	B	W	m
ME02	10/17/2000	10/24/2000	37.8	37.8	3.1	115.5	B	W	m
ME02	10/24/2000	10/31/2000	10.7	10.7	1.9	20.5	B	W	hm
ME02	10/31/2000	11/07/2000	16.1	16.1	7.9	127.8	B	W	dm
ME02	11/07/2000	11/14/2000	40.5	40.5	4.1	164.3	B	W	dm
ME02	11/14/2000	11/21/2000	27.6	27.6	2.0	55.4	B	W	dm
ME02	11/21/2000	11/28/2000	22.8	22.8	2.1	48.6	B	W	m
ME02	11/28/2000	12/05/2000	0.5	0.5	2.2	1.1	B	T	mi
ME02	12/05/2000	12/12/2000	15.0	15.0	0.0	0.0	B	W	dm
ME02	12/12/2000	12/19/2000	72.1	72.1	4.9	354.7	B	W	dm
ME02	12/19/2000	12/26/2000	4.2	--	3.2	13.3	B	W	m
ME02	12/26/2000	01/02/2001	0.0	0.0	4.5	0.0	B	W	m

National Atmospheric Deposition Program/MDN

Weekly Mercury Concentrations and Depositions

GREENVILLE MEO9

Site	Date On	Date Off	Sub ppt	Pptrec	HgConc	HgDep	Q R	Sample Type	Notes
			mm	mm	ng/L	ng/m²			
ME09	12/28/1999	01/04/2000	6.6	6.6	--	--	C	W	fd
ME09	01/04/2000	01/11/2000	30.9	30.9	--	--	C	W	fd
ME09	01/11/2000	01/18/2000	14.6	14.6	--	--	C	W	fdv
ME09	01/18/2000	01/25/2000	--	--	--	--	C	W	fm
ME09	01/25/2000	02/01/2000	34.3	34.3	--	--	C	W	fdm
ME09	02/01/2000	02/08/2000	0.0	--	--	0.0	B	T	m
ME09	02/08/2000	02/15/2000	38.9	38.9	1.7	65.4	B	W	dh
ME09	02/15/2000	02/22/2000	5.1	5.1	2.7	13.6	B	W	d
ME09	02/22/2000	02/29/2000	19.8	19.8	2.8	55.5	B	W	dm
ME09	02/29/2000	03/07/2000	13.1	13.1	3.7	48.9	B	W	d
ME09	03/07/2000	03/14/2000	31.8	31.8	3.7	118.3	B	W	d
ME09	03/14/2000	03/21/2000	8.3	8.3	2.8	23.5	B	W	h
ME09	03/21/2000	03/28/2000	0.6	0.6	17.9	11.4	B	T	i
ME09	03/28/2000	04/04/2000	56.4	56.4	3.0	171.2	B	W	d
ME09	04/04/2000	04/11/2000	82.2	82.2	4.4	361.5	B	W	d
ME09	04/11/2000	04/18/2000	9.0	9.0	2.7	24.4	A	W	
ME09	04/18/2000	04/25/2000	78.0	78.0	2.1	166.8	B	W	d
ME09	04/25/2000	05/02/2000	2.4	2.4	14.5	35.1	B	W	dh
ME09	05/02/2000	05/09/2000	11.4	11.4	--	--	C	W	cm
ME09	05/09/2000	05/16/2000	57.2	57.2	8.6	491.7	B	W	d
ME09	05/16/2000	05/23/2000	13.0	13.0	7.0	90.9	B	W	d
ME09	05/23/2000	05/30/2000	6.7	6.7	15.3	103.2	B	W	d
ME09	05/30/2000	06/06/2000	4.1	4.1	9.4	38.1	B	W	d
ME09	06/06/2000	06/13/2000	24.5	24.5	9.6	234.4	B	W	dh
ME09	06/13/2000	06/20/2000	0.8	0.8	18.2	13.8	B	W	di
ME09	06/20/2000	06/27/2000	6.4	6.4	6.9	43.8	B	W	d
ME09	06/27/2000	07/04/2000	51.4	51.4	8.4	433.8	B	W	h
ME09	07/04/2000	07/11/2000	12.1	12.1	15.1	182.6	B	W	d
ME09	07/11/2000	07/18/2000	10.4	10.4	13.5	140.4	B	W	d
ME09	07/18/2000	07/25/2000	21.6	21.6	11.4	245.4	B	W	d
ME09	07/25/2000	08/01/2000	0.0	0.0	--	0.0	A	D	
ME09	08/01/2000	08/08/2000	0.2	--	48.2	7.2	B	T	i
ME09	08/08/2000	08/15/2000	7.7	7.7	7.4	56.7	B	W	d
ME09	08/15/2000	08/22/2000	19.9	--	7.8	154.5	B	W	m

ME09	08/22/2000	08/29/2000	13.3	13.3	8.7	116.6	B	W	d
ME09	08/29/2000	09/05/2000	32.3	32.3	7.0	224.2	B	W	d
ME09	09/05/2000	09/12/2000	0.0	0.0	--	0.0	B	T	d
ME09	09/12/2000	09/19/2000	14.6	14.6	5.8	84.9	B	W	hd
ME09	09/19/2000	09/26/2000	7.1	7.1	7.9	56.1	B	W	hd
ME09	09/26/2000	10/02/2000	2.8	2.8	2.4	6.6	B	W	d
ME09	10/03/2000	10/10/2000	38.5	38.5	--	--	C	W	ufd
ME09	10/10/2000	10/17/2000	2.1	--	2.1	4.4	B	W	dm
ME09	10/17/2000	10/24/2000	13.8	13.8	1.9	26.3	B	W	d
ME09	10/24/2000	10/31/2000	29.0	29.0	2.5	72.5	B	W	d
ME09	10/31/2000	11/07/2000	5.1	5.1	0.7	3.8	B	W	d
ME09	11/07/2000	11/14/2000	1.7	1.7	6.1	10.0	B	W	di
ME09	11/14/2000	11/21/2000	38.4	38.4	1.3	49.2	B	W	hd
ME09	11/21/2000	11/28/2000	30.6	30.6	1.5	47.2	B	W	d
ME09	11/28/2000	12/05/2000	0.0	0.0	--	0.0	B	T	m
ME09	12/05/2000	12/12/2000	4.4	4.4	4.1	18.2	B	W	dm
ME09	12/12/2000	12/19/2000	84.2	84.2	7.1	597.6	B	W	d
ME09	12/19/2000	12/26/2000	18.8	18.8	1.2	22.7	B	W	d
ME09	12/26/2000	01/02/2001	19.3	19.3	2.1	41.0	A	W	

National Atmospheric Deposition Program/MDN

Weekly Mercury Concentrations and Depositions

FREEPORT ME96

Site	Date On	Date Off	Subppt mm	Pptrec Mm	HgConc ng/L	HgDep ng/m²	QR	Sample Type	Notes
ME96	12/28/1999	01/04/2000	3.8	3.8	15.4	58.5	B	W	d
ME96	01/04/2000	01/11/2000	47.5	47.5	4.5	214.4	B	W	d
ME96	01/11/2000	01/18/2000	12.4	12.4	5.2	64.0	B	W	d
ME96	01/18/2000	01/25/2000	0.0	0.0	--	0.0	A	D	
ME96	01/25/2000	02/01/2000	34.3	34.3	2.7	90.9	B	W	dh
ME96	02/01/2000	02/08/2000	0.0	0.0	--	0.0	B	D	dh
ME96	02/08/2000	02/15/2000	40.1	40.1	4.9	196.0	B	W	d
ME96	02/15/2000	02/22/2000	9.5	9.5	4.9	46.9	B	W	d
ME96	02/22/2000	02/29/2000	9.7	9.7	3.6	34.4	B	W	d
ME96	02/29/2000	03/07/2000	8.3	8.3	7.5	62.0	B	W	d
ME96	03/07/2000	03/14/2000	41.7	41.7	7.3	302.4	B	W	dh
ME96	03/14/2000	03/21/2000	13.7	13.7	4.6	63.1	B	W	d
ME96	03/21/2000	03/28/2000	9.4	9.4	8.2	76.9	B	W	dm
ME96	03/28/2000	04/04/2000	67.4	67.4	8.3	560.0	B	W	m
ME96	04/04/2000	04/11/2000	24.8	24.8	3.7	91.3	B	W	d
ME96	04/11/2000	04/18/2000	3.2	3.2	8.7	27.5	B	W	dh
ME96	04/18/2000	04/25/2000	99.7	99.7	2.5	247.1	B	W	d
ME96	04/25/2000	05/02/2000	3.9	3.9	15.7	61.9	B	W	d
ME96	05/02/2000	05/09/2000	10.8	--	21.4	229.6	B	W	m
ME96	05/09/2000	05/16/2000	32.8	32.8	10.2	334.9	B	W	d
ME96	05/16/2000	05/23/2000	8.4	8.4	14.3	119.6	A	W	
ME96	05/23/2000	05/30/2000	36.1	36.1	8.0	288.0	B	W	h
ME96	05/30/2000	06/06/2000	1.0	1.0	23.0	23.4	B	W	di
ME96	06/06/2000	06/13/2000	39.0	39.0	7.7	298.4	A	W	
ME96	06/13/2000	06/20/2000	17.2	17.2	7.5	129.9	B	W	d
ME96	06/20/2000	06/27/2000	16.8	16.8	7.7	129.4	B	W	d
ME96	06/27/2000	07/05/2000	37.0	37.0	14.5	538.6	A	W	
ME96	07/05/2000	07/11/2000	15.5	--	10.9	168.9	B	W	hm
ME96	07/11/2000	07/18/2000	49.4	49.4	3.4	165.6	B	W	d
ME96	07/18/2000	07/25/2000	17.1	17.1	22.0	376.3	B	W	d
ME96	07/25/2000	08/01/2000	15.9	15.9	7.3	115.6	A	W	
ME96	08/01/2000	08/08/2000	8.9	8.9	5.9	52.8	B	W	d
ME96	08/08/2000	08/15/2000	37.5	37.5	9.3	347.4	B	W	dh
ME96	08/15/2000	08/22/2000	1.6	--	19.7	31.6	B	W	dm
ME96	08/22/2000	08/29/2000	4.5	--	6.2	27.7	B	W	m

ME96	08/29/2000	09/05/2000	13.7	13.7	4.6	62.5	B	W	dh
ME96	09/05/2000	09/12/2000	0.0	0.0	--	0.0	A	D	
ME96	09/12/2000	09/19/2000	26.2	26.2	7.5	195.0	B	W	d
ME96	09/19/2000	09/26/2000	36.9	36.9	5.7	210.3	B	W	d
ME96	09/26/2000	10/03/2000	1.0	1.0	1.4	1.3	B	W	i
ME96	10/03/2000	10/10/2000	39.2	39.2	5.2	206.0	B	W	d
ME96	10/10/2000	10/17/2000	6.4	6.4	4.5	29.1	A	W	
ME96	10/17/2000	10/24/2000	30.6	30.6	4.1	126.0	B	W	d
ME96	10/24/2000	10/31/2000	24.8	24.8	1.2	28.8	A	W	
ME96	10/31/2000	11/07/2000	9.8	9.8	7.4	72.5	B	W	h
ME96	11/07/2000	11/14/2000	35.6	35.6	6.4	228.5	A	W	
ME96	11/14/2000	11/21/2000	37.5	37.5	3.1	115.0	B	W	d
ME96	11/21/2000	11/28/2000	42.7	42.7	1.8	75.7	B	W	h
ME96	11/28/2000	12/05/2000	0.0	0.0	--	0.0	A	T	
ME96	12/05/2000	12/12/2000	6.3	6.3	6.7	42.3	B	W	h
ME96	12/12/2000	12/19/2000	91.2	91.2	9.3	847.6	B	W	d
ME96	12/19/2000	12/26/2000	11.9	11.9	3.8	45.2	B	W	d
ME96	12/26/2000	01/02/2001	16.0	16.0	3.1	49.4	B	W	d

National Atmospheric Deposition Program/MDN

Weekly Mercury Concentrations and Depositions

ACADIA NATIONAL PARK ME98

Site	Date On	Date Off	Subppt mm	Pptrec Mm	HgConc ng/L	HgDep ng/m²	QR	Sample Type	Notes
ME98	12/28/1999	01/04/2000	14.2	14.2	20.2	286.6	B	W	dh
ME98	01/04/2000	01/11/2000	70.2	70.2	3.5	247.7	B	W	d
ME98	01/11/2000	01/18/2000	16.3	16.3	0.3	4.2	B	W	d
ME98	01/18/2000	01/25/2000	9.2	9.2	5.0	46.1	A	W	
ME98	01/25/2000	02/01/2000	22.2	22.2	5.9	131.1	B	W	hx
ME98	02/01/2000	02/08/2000	0.0	0.0	--	--	C	T	fd
ME98	02/08/2000	02/15/2000	59.9	59.9	8.1	486.1	B	W	dh
ME98	02/15/2000	02/22/2000	10.2	10.2	--	--	C	W	fvd
ME98	02/22/2000	02/29/2000	1.3	1.3	--	--	C	W	vm
ME98	02/29/2000	03/07/2000	19.1	19.1	2.7	51.0	B	W	dm
ME98	03/08/2000	03/15/2000	38.4	38.4	7.4	283.6	B	W	dh
ME98	03/14/2000	03/21/2000	10.7	10.7	--	--	C	W	vd
ME98	03/21/2000	03/28/2000	20.3	20.3	9.6	194.3	B	W	d
ME98	03/28/2000	04/04/2000	33.3	33.3	13.8	457.9	B	W	d
ME98	04/04/2000	04/11/2000	11.8	11.8	11.5	136.0	B	W	dh
ME98	04/11/2000	04/18/2000	8.8	8.8	7.3	64.4	B	W	d
ME98	04/18/2000	04/25/2000	177.7	177.7	5.1	913.0	A	W	
ME98	04/25/2000	05/02/2000	3.4	3.4	--	--	C	W	fvd
ME98	05/02/2000	05/09/2000	14.9	14.9	13.3	198.0	B	W	dh
ME98	05/09/2000	05/16/2000	49.4	49.4	7.6	376.7	A	W	
ME98	05/16/2000	05/23/2000	30.1	30.1	12.4	374.2	A	W	
ME98	05/23/2000	05/30/2000	31.6	31.6	6.0	189.0	B	W	h
ME98	05/31/2000	06/06/2000	0.0	0.0	--	0.0	A	T	
ME98	06/06/2000	06/13/2000	24.8	24.8	7.4	183.1	B	W	h
ME98	06/13/2000	06/20/2000	11.3	11.3	35.8	404.2	B	W	dh
ME98	06/20/2000	06/27/2000	11.4	11.4	9.2	105.7	B	W	h
ME98	06/27/2000	07/03/2000	3.6	3.6	52.4	186.3	B	W	d
ME98	07/03/2000	07/11/2000	26.0	26.0	15.5	404.3	B	W	d
ME98	07/11/2000	07/18/2000	59.7	59.7	5.8	343.2	B	W	dh
ME98	07/18/2000	07/25/2000	3.9	3.9	23.8	92.1	B	W	d
ME98	07/25/2000	08/01/2000	5.1	5.1	7.2	36.4	A	W	
ME98	08/01/2000	08/08/2000	5.1	5.1	9.4	47.9	B	W	d
ME98	08/08/2000	08/15/2000	4.2	4.2	19.2	80.3	B	W	h
ME98	08/15/2000	08/22/2000	9.0	9.0	11.8	106.6	B	W	h
ME98	08/22/2000	08/29/2000	7.0	7.0	3.5	24.5	A	W	

ME98	08/29/2000	09/05/2000	15.3	15.3	7.7	118.3	B	W	m
ME98	09/05/2000	09/12/2000	0.0	0.0	--	0.0	A	D	
ME98	09/12/2000	09/19/2000	34.2	34.2	6.5	221.3	B	W	h
ME98	09/19/2000	09/26/2000	20.8	20.8	9.0	186.6	B	W	m
ME98	09/26/2000	10/03/2000	0.0	0.0	--	0.0	A	D	
ME98	10/03/2000	10/10/2000	61.8	61.8	4.7	290.6	B	W	d
ME98	10/10/2000	10/17/2000	0.3	0.3	--	0.0	A	T	
ME98	10/17/2000	10/24/2000	21.7	21.7	4.6	100.6	A	W	
ME98	10/24/2000	10/31/2000	36.6	36.6	1.7	61.0	B	W	dh
ME98	10/31/2000	11/07/2000	31.3	31.3	2.9	90.2	B	W	h
ME98	11/07/2000	11/14/2000	1.0	1.0	6.8	6.9	B	W	hi
ME98	11/14/2000	11/21/2000	31.6	31.6	4.5	142.0	B	W	dh
ME98	11/21/2000	11/28/2000	62.7	62.7	1.7	104.0	B	W	d
ME98	11/28/2000	12/05/2000	2.7	2.7	9.3	24.7	A	W	
ME98	12/05/2000	12/12/2000	19.2	19.2	4.2	80.8	B	W	dh
ME98	12/12/2000	12/19/2000	64.7	64.7	6.8	440.1	B	W	h
ME98	12/19/2000	12/26/2000	27.7	27.7	9.8	271.7	B	W	dh
ME98	12/26/2000	01/02/2001	21.3	21.3	2.3	49.4	B	W	mh

Methyl Mercury in Precipitation at the Acadia National Park Station, Mercury Deposition Network

Terry A. Haines

Methyl mercury determination was added to the suite of analytes at the Acadia National Park station of the Mercury Deposition Network for the period July 2000 to June 2001. Samples were collected weekly, and there were 50 usable samples for total mercury and 47 for methyl mercury, however I dropped the methyl mercury data for July 1 as the results seemed unreasonably high (Table 1). For the weekly samples, methyl mercury concentration was about 0.9% of total mercury, 0.086 ng/L versus 9.29 ng/L. The annual volume-weighted mean concentrations were 6.32 ng/L for total mercury and 0.08 ng/L for methyl mercury, giving 1.27% methyl mercury. The Acadia MDN site has had annual volume-weighted mean total mercury concentration ranging from 6.0 to 6.8 ng/L during the period 1996-1999. Glass and Sorensen (1999) found a mean annual (volume-weighted) total mercury concentration in precipitation at six locations in the upper midwest during 1990-1995 to be 10.9 ng/L. The individual locations had mean total mercury concentrations ranging from 9.1 to 11.9 ng/L. Methyl mercury concentration, determined in only 36 weekly samples, averaged 0.18 ng/L.

Total mercury concentration was highest in rain samples, intermediate in snow, and lowest in mixed precipitation samples; however, methyl mercury concentration was highest in snow, intermediate in mixed, and lowest in rain samples (Table 1). In two small streams at Acadia National Park (Cadillac Brook and Hadlock Brook), mean total mercury concentrations were 0.6 and 1.5 ng/L, respectively, and methyl mercury averaged 0.05 and 0.07 ng/L, respectively, which represents 10% and 5% of total mercury in the two streams (K. Johnson and T. Haines, unpublished data). The estimate for Cadillac Brook methyl mercury may be high, as 0.05 ng/L is the detection limit for the analysis, and many samples were below detection. The mean was calculated by assuming that below detection results were half the detection limit. Concentrations of both total and methyl mercury were lower in stream water than in precipitation, but methyl mercury was higher relative to total mercury in the streams as compared to precipitation. This indicates that either there are sources of methyl mercury production in the watersheds, or that methyl mercury is less well retained in the watersheds relative to inorganic mercury.

Total mercury concentration in precipitation tends to be higher when precipitation volume is lower (Figure 1), which is probably related to wash-out of particulate mercury from the atmosphere. This pattern is not evident for methyl mercury (Figure 2) and in fact the arithmetic and volume-weighted annual mean concentrations are the same, suggesting that methyl mercury in the atmosphere may not be associated with particulate matter. In general, concentrations of total and methyl mercury follow the same temporal patterns (Figure 3), with high concentrations of total mercury normally accompanied by higher concentrations of methyl mercury. Although the source(s) of methyl mercury in the atmosphere is unknown, similar temporal trends in deposition suggests that at least some of the sources may be similar to those of inorganic mercury.

The annual deposition of total mercury for the period during which methyl mercury was determined was 6.65 $\mu g/m^2$, and deposition of methyl mercury was 0.082 $\mu g/m^2$, about 1.2%. During the period 1996-1999, total mercury deposition at the Acadia site ranged from 7.7 to 9.0 µg/m^2, so this year was the lowest on record. Glass and Sorensen (1999) determined mean annual deposition of total mercury at six sites to be 7.4 µg/m^2, with individual sites ranging from 5.9 to 8.9 µg/m^2, which agree well with our findings. Methyl mercury was determined in only 36 weekly samples from the seven sites. Samples for methyl mercury analysis were collected once monthly during June to October in 1993, and not all stations were sampled each month. The mean concentration of methyl mercury was 0.18 ng/L, and the calculated annual deposition from these samples was 0.18 µg/m^2. The calculated total mercury annual deposition from these samples was 13.99 µg/m^2. These values are much higher than the Maine data, and may be artifacts of projecting 36 weekly samples to an annual rate. In Sweden, mean annual total mercury deposition was 7 µg/m^2 at Svartberget and 10 µg/m^2 at Gårdsjön during the period 1994-1998 (Lee *et al*. 2000), which are also similar to results in Maine. Methyl mercury deposition was 0.08 and 0.12 µg/m^2 respectively for the two Swedish watersheds during this time, agreeing well with our findings. At Little Rock Lake, Wisconsin, total mercury mean annual wet deposition was 6.8 µg/m^2 from 1988-1992, somewhat lower than in Maine, and methyl mercury deposition was 0.1 µg/m^2, somewhat higher than in Maine (Watras *et al.* 1994).

The weekly deposition of total and methyl mercury followed a similar temporal pattern (Figure 4), as was the case for concentration. The highest weekly methyl mercury deposition generally occurred in the winter, which is to be expected inasmuch as the concentration of methyl mercury was highest in snow samples.

Atmospheric deposition of methyl mercury at the Acadia site was generally similar to that determined at other locations as reported in the scientific literature. Methyl mercury is present in wet deposition, and generally amounts to about 1% of total mercury. Although the source of methyl mercury is unknown, the similarity in pattern to total mercury deposition suggests similar sources. It is likely that atmospheric deposition is not a significant source of methyl mercury in aquatic environments in Maine. Production of methyl mercury in the environment from deposited inorganic mercury is probably much more important as a source of contamination to aquatic biota. I do not recommend continuation of the determination of methyl mercury in precipitation as the data collected indicate that it is probably not important in Maine, and also because it was very difficult to deal with the analytical laboratory to obtain the data.

Literature Cited

Glass, G., and J. Sorensen. 1999. Six-year trend (1990-1995) of wet mercury deposition in the upper midwest, U.S.A. Environ. Sci. Technol. 33: 3303-3312.

Lee, Y., K. Bishop, and J. Munthe. 2000. Do concepts about catchment cycling of methylmercury and mercury in boreal catchments stand the test of time? Six years of atmospheric inputs and runoff export at Svartberget, northern Sweden. Sci. Tot. Environ. 260: 11-20.

Watras, C., and others. 1994. Sources and fates of mercury and methylmercury in Wisconsin lakes. Pages 153-177 in C. Watras and J. Huckabee (editors), Mercury Pollution Integration and Synthesis. Lewis Publishers, Boca Raton, Florida.

Table 1. Summary statistics for total mercury and methylmercury in precipitation at Acadia National Park.

Variable	Sample Type	Number	Mean	Std. Dev.	Minimum	Maximum
Total Hg, ng/L	All Samples	50	9.29	9.33	0	52.38
	Rain	30	11.51	10.41	1.36	52.38
	Snow	10	7.08	8.73	0	27.46
	Mixed	10	4.82	2.18	1.67	9.79
Methyl Hg, ng/L	All Samples	46	0.086	0.141	0	0.82
	Rain	27	0.065	0.078	0	0.36
	Snow	10	0.15	0.27	0	0.82
	Mixed	10	0.075	0.059	0.006	0.18
Percent Methyl	All Samples	47	0.93			
	Rain	27	0.56			
	Snow	10	2.12			
	Mixed	10	1.56			

Figure 1. Plot of total mercury concentration versus precipitation volume for the Acadia National Park Mercury Deposition Network site for the period July 2000 to June 2001.

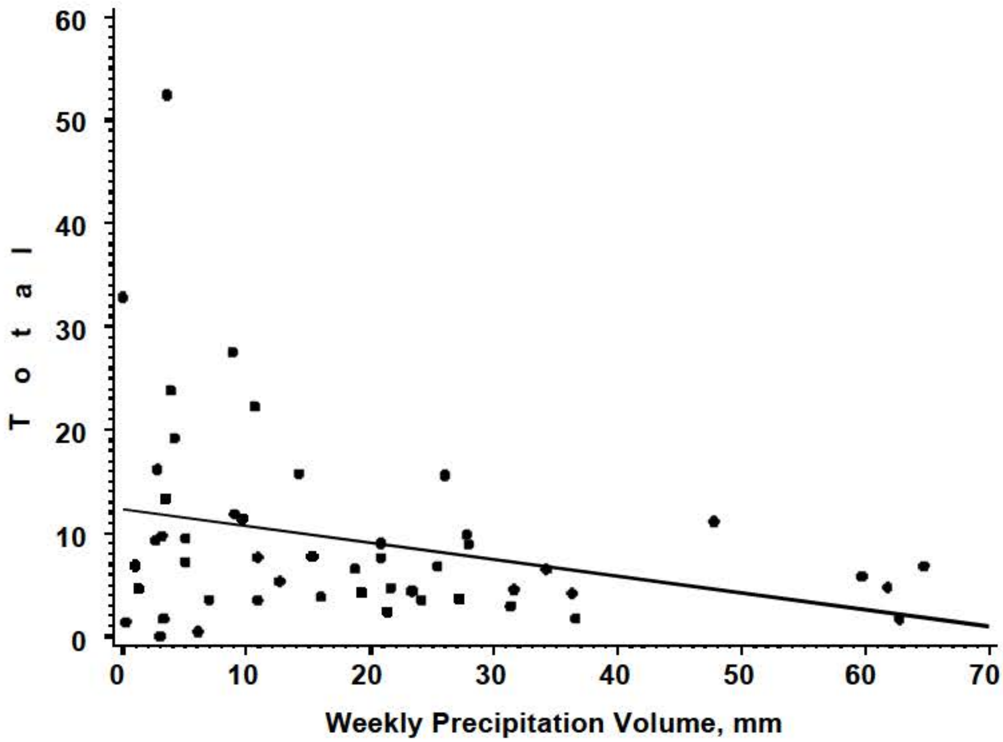


Figure 2. Plot of methyl mercury concentration versus precipitation volume for the Acadia National Park Mercury Deposition Network site for the period July 2000 to June 2001.

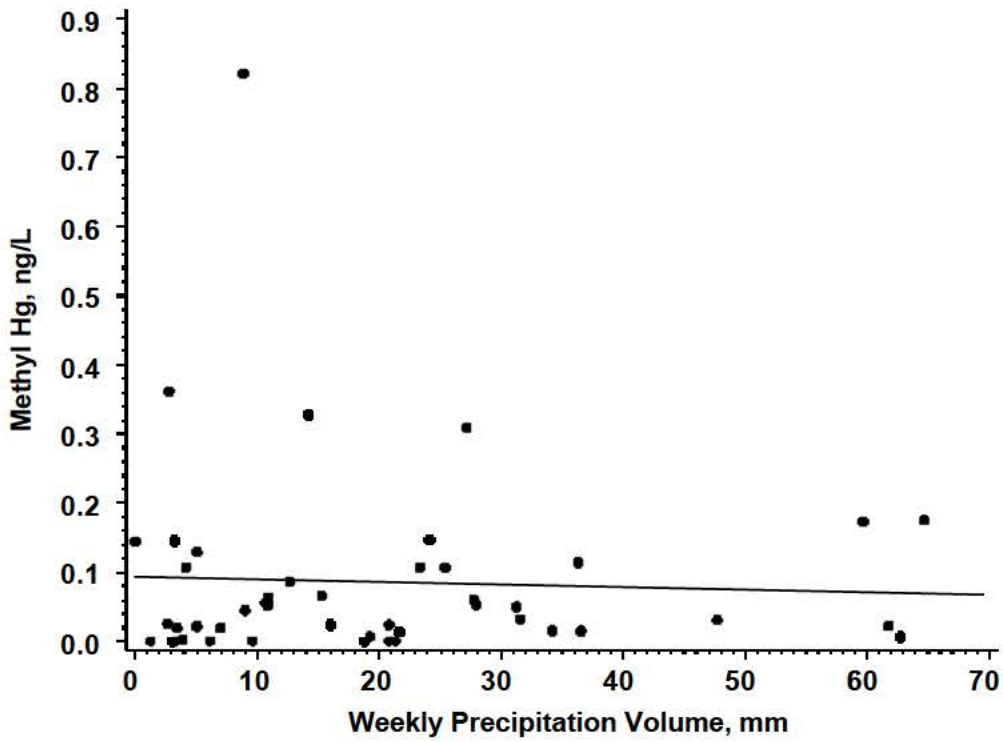


Figure 3. Plot of total and methyl mercury concentration for the Acadia National Park Mercury Deposition Network site for the period July 2000 to June 2001. Hg = solid line, MeHg = dashed line.

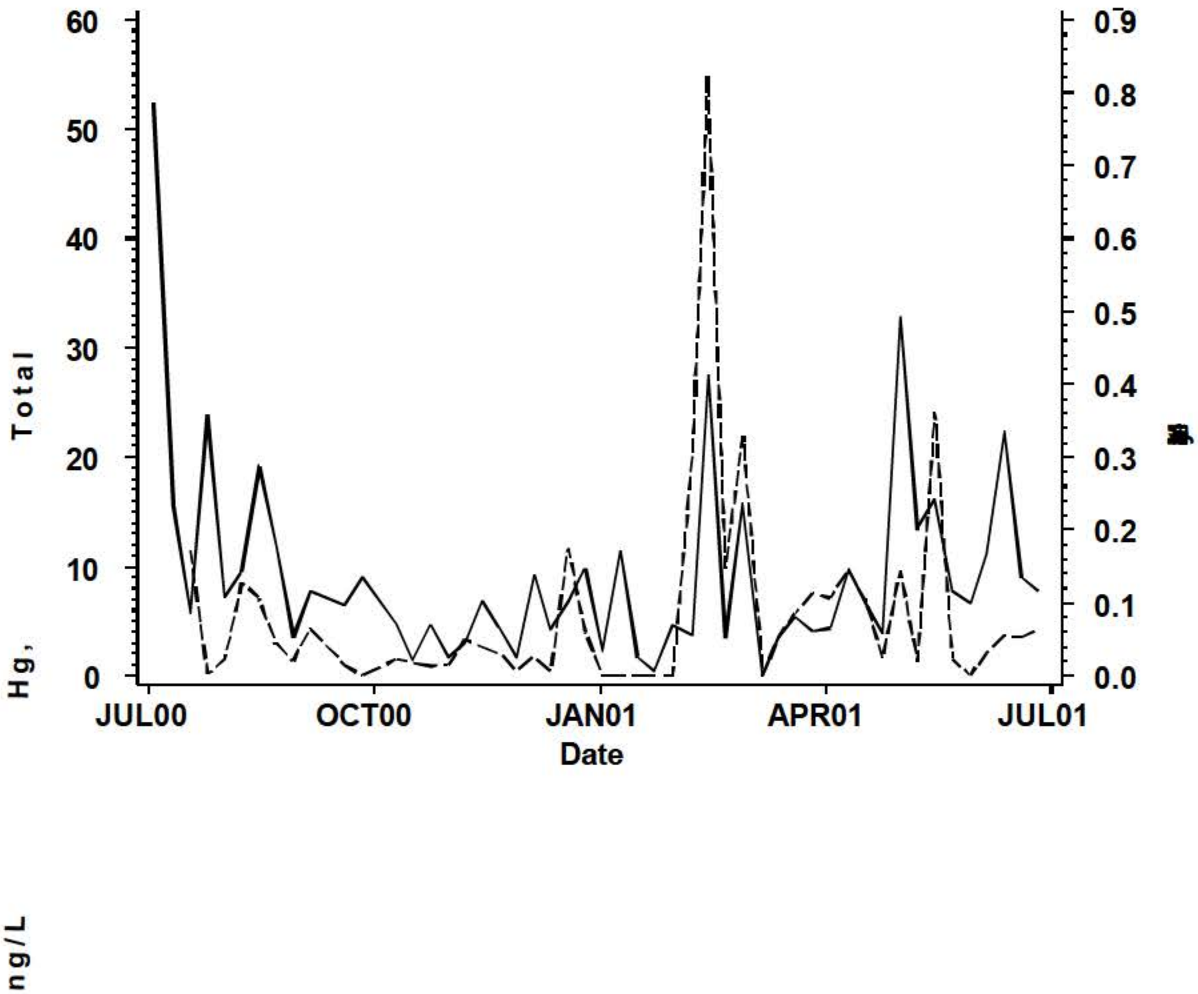
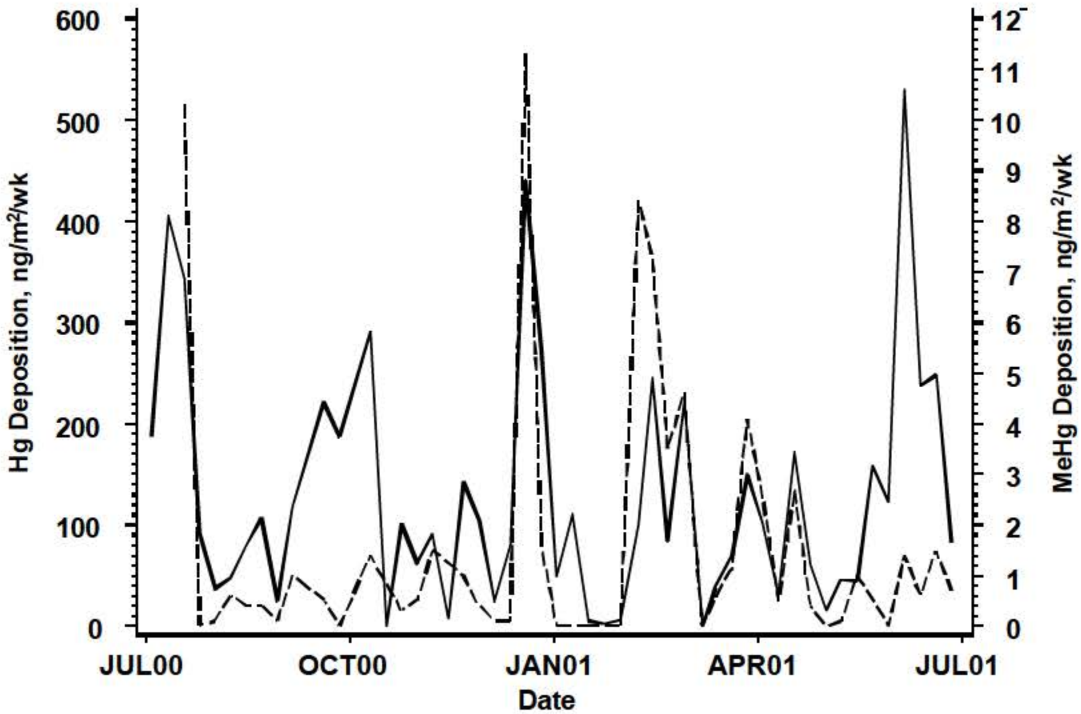


Figure 4. Plot of total and methyl mercury deposition for the Acadia National Park Mercury Deposition Network site for the period July 2000 to June 2001. Hg = solid line, MeHg = dashed line.



METHYLMERCURY LEVELS IN PRECIPITATION AT ACADIA NATIONAL PARK ME98

Site ID	Collection End Date	Precip. Hg Conc.	Weekly Hg Deposition	Precip. MHg Conc	Weekly MHg Deposition
ME98	07/03/00	52.38 ng/L	186.3 ng/m2	LE	LE
ME98	07/11/00	15.53 ng/L	404.3 ng/m2	1.187 ng/L	30.8 ng/m2
ME98	07/18/00	5.75 ng/L	343.2 ng/m2	0.173 ng/L	10.3 ng/m2
ME98	07/25/00	23.79 ng/L	92.1 ng/m2	0.002 ng/L	0.0 ng/m2
ME98	08/01/00	7.17 ng/L	36.4 ng/m2	0.021 ng/L	0.1 ng/m2
ME98	08/08/00	9.42 ng/L	47.9 ng/m2	0.128 ng/L	0.6 ng/m2
ME98	08/15/00	19.15 ng/L	80.3 ng/m2	0.106 ng/L	0.4 ng/m2
ME98	08/22/00	11.82 ng/L	106.6 ng/m2	0.044 ng/L	0.4 ng/m2
ME98	08/29/00	3.51 ng/L	24.5 ng/m2	0.019 ng/L	0.1 ng/m2
ME98	09/05/00	7.73 ng/L	118.3 ng/m2	0.065 ng/L	1.0 ng/m2
ME98	09/12/00	0.00 ng/L	0.0 ng/m2	0.000 ng/L	0.0 ng/m2
ME98	09/19/00	6.47 ng/L	221.3 ng/m2	0.014 ng/L	0.5 ng/m2
ME98	09/26/00	8.96 ng/L	186.6 ng/m2	0.000 ng/L	0.0 ng/m2
	Quarterly Sum:		**1847.7 ng/m2**		**44.1 ng/m2**
	Vol. Weighted Ave:	**9.84 ng/L**		**0.243 ng/L**	

Site ID	Collection End Date	Precip. Hg Conc.	Weekly Hg Deposition	Precip. MHg Conc	Weekly MHg Deposition
ME98	10/03/00	NA	NA	NR	0.0 ng/m2
ME98	10/10/00	4.70 ng/L	290.6 ng/m2	0.022 ng/L	1.4 ng/m2
ME98	10/17/00	1.36 ng/L	0.3 ng/m2	NR	0.0 ng/m2
ME98	10/24/00	4.64 ng/L	100.6 ng/m2	0.013 ng/L	0.3 ng/m2
ME98	10/31/00	1.67 ng/L	61.0 ng/m2	0.014 ng/L	0.5 ng/m2
ME98	11/07/00	2.88 ng/L	90.2 ng/m2	0.049 ng/L	1.5 ng/m2
ME98	11/14/00	6.83 ng/L	6.9 ng/m2	NR	0.0 ng/m2
ME98	11/21/00	4.49 ng/L	142.0 ng/m2	0.031 ng/L	1.0 ng/m2
ME98	11/28/00	1.66 ng/L	104.0 ng/m2	0.006 ng/L	0.4 ng/m2
ME98	12/05/00	9.26 ng/L	24.7 ng/m2	0.025 ng/L	0.1 ng/m2
ME98	12/12/00	4.20 ng/L	80.8 ng/m2	0.006 ng/L	0.1 ng/m2
ME98	12/19/00	6.80 ng/L	440.1 ng/m2	0.175 ng/L	11.3 ng/m2
ME98	12/26/00	9.79 ng/L	271.7 ng/m2	0.059 ng/L	1.6 ng/m2
	Quarterly Sum:		**1612.9 ng/m2**		**18.1 ng/m2**

	Vol. Weighted Ave:	4.27 ng/L		0.044 ng/m2	
Site ID	**Collection End Date**	**Precip. Hg Conc.**	**Weekly Hg Deposition**	**Precip. MHg Conc**	**Weekly MHg Deposition**
ME98	01/02/01	2.32 ng/L	49.4 ng/m2	0.00 ng/L	0.0 ng/m2
ME98	01/09/01	11.44 ng/L	110.4 ng/m2	0.00 ng/L	0.0 ng/m2
ME98	01/16/01	1.69 ng/L	5.6 ng/m2	0.00 ng/L	0.0 ng/m2
ME98	01/23/01	0.42 ng/L	2.5 ng/m2	0.00 ng/L	0.0 ng/m2
ME98	01/30/01	4.62 ng/L	5.9 ng/m2	0.00 ng/L	0.0 ng/m2
ME98	02/07/01	3.68 ng/L	99.9 ng/m2	0.31 ng/L	8.4 ng/m2
ME98	02/13/01	27.46 ng/L	244.1 ng/m2	0.82 ng/L	7.3 ng/m2
ME98	02/20/01	3.47 ng/L	83.8 ng/m2	0.15 ng/L	3.5 ng/m2
ME98	02/27/01	15.70 ng/L	223.3 ng/m2	0.33 ng/L	4.6 ng/m2
ME98	03/07/01	0.00 ng/L	0.0 ng/m2	0.00 ng/L	0.0 ng/m2
ME98	03/13/01	3.45 ng/L	37.7 ng/m2	0.05 ng/L	0.6 ng/m2
ME98	03/20/01	5.28 ng/L	67.1 ng/m2	0.09 ng/L	1.1 ng/m2
ME98	03/27/01	4.13 ng/L	149.8 ng/m2	0.11 ng/L	4.1 ng/m2
	Quarterly Sum:		**1079.5 ng/m2**		**29.6 ng/m2**
	Vol. Weighted Ave:	**5.21 ng/L**		**0.148 ng/L**	
Site ID	**Collection End Date**	**Precip. Hg Conc.**	**Weekly Hg Deposition**	**Precip. MHg Conc**	**Weekly MHg Deposition**
ME98	04/03/01	4.35 ng/L	101.6 ng/m2	0.11 ng/L	2.5 ng/m2
ME98	04/10/01	9.70 ng/L	30.8 ng/m2	0.14 ng/L	0.5 ng/m2
ME98	04/17/01	6.73 ng/L	171.0 ng/m2	0.11 ng/L	2.7 ng/m2
ME98	04/24/01	3.82 ng/L	61.1 ng/m2	0.02 ng/L	0.4 ng/m2
ME98	05/01/01	32.78 ng/L	15.5 ng/m2	0.14 ng/L	0.0 ng/m2
ME98	05/08/01	13.33 ng/L	45.7 ng/m2	0.02 ng/L	0.1 ng/m2
ME98	05/15/01	16.11 ng/L	45.0 ng/m2	0.36 ng/L	1.0 ng/m2
ME98	05/22/01	7.60 ng/L	158.3 ng/m2	0.02 ng/L	0.5 ng/m2
ME98	05/29/01	6.53 ng/L	122.7 ng/m2	0.00 ng/L	0.0 ng/m2
ME98	06/05/01	11.08 ng/L	529.3 ng/m2	0.03 ng/L	1.4 ng/m2
ME98	06/12/01	22.26 ng/L	237.4 ng/m2	0.06 ng/L	0.6 ng/m2
ME98	06/19/01	8.88 ng/L	248.1 ng/m2	0.05 ng/L	1.5 ng/m2
ME98	06/26/01	7.62 ng/L	83.2 ng/m2	0.06 ng/L	0.7 ng/m2
	Quarterly Sum:		**1849.7 ng/m2**		**11.7 ng/m2**
	Vol. Weighted Ave:	**8.63 ng/L**		**0.054 ng/L**	

2.2

FISH CONSUMPTION ADVISORIES

LAKE TROUT

NORTHERN PIKE

CHAIN PICKEREL

DDT

FISH CONSUMPTION ADVISORIES

We had hoped we could identify an indicator fish species and avoid the need to test multiple species for mercury contamination. However, our review of the data from the 'Indicator Species Study' in previous years does not appear to support this approach. The range of the ratios of mercury levels for the different species sampled does not seem consistent enough to identify a reliable predictor fish species, though this conclusion is somewhat compromised by the small number of lakes sampled.

Therefore, we are back to looking at obtaining data at the individual species level. Collapsing data into cold water versus warm water fish species is problematic because lake trout and brown trout have mercury levels more similar to warm water fish species than other cold water species, such as brook trout or landlocked salmon. Another important determinant of data needs is our desire to estimate a high percentile lake average fish-mercury concentration rather than the statewide mean. Anglers do not necessarily fish lakes randomly or fish a large number of water bodies (if they did, the mean would be the appropriate statistic). Rather, they may have one or just a few lakes or ponds they primarily fish (especially for those people living on a lake). Consequently, we believe we need to evaluate the likelihood that individuals may routinely consume fish from a high-end lake. To do this, we need sufficient data to estimate the statewide distribution for fish species routinely consumed and to estimate high percentile lakes (e.g., 75th to 95th percentile lake).

Based on the white perch data, we think this will require data on about 50 to 60 lakes (current data suggests percent relative standard deviations for lake averages for fish species generally ranging from 30 - 60%; white perch has a %RSD of 50%). For some important species such as lake trout (important based on angler consumption surveys and a survey of women of childbearing age), our current database is very limited (N=8). Brown trout (N=8) and pickerel (N=7) are other species that have very limited data. We have no data on pike and very little data on black crappie. Consequently, these species are our priorities for obtaining additional data.

As a general approach to obtaining additional data, we propose that we select a specific species or two for a focussed sampling program in a given year (e.g., this year we sampled lake trout, pike, and pickerel for study). We propose to continue this program until we reach our goal of 50 lakes per major fish species than re-evaluate where we are. This will likely take several years to accomplish.

Lake Trout Study. Current data for lake trout are very limited, and 90th and 95th percentile lake averages cannot be estimated with the desired degree of confidence. Importantly, this fish species was reported to be the second most commonly consumed fish species based on the preliminary results from our random survey of women of childbearing age. We currently have an 8 lake random sample from the REMAP study, and a 7 lake study where lakes were selected based on the presence of 4 predator species (warm and cold water species). Statistical tests indicate that these two data sets should not be pooled (underlying statistical distributions appear significantly different). Consequently there is a strong need to expand the current database to better characterize the statewide distribution.

To this end, DEP requested that DIFW collect lake trout in performance of its own duties, noting the following: a) which lakes they intended to sample in 2000, b) which lakes are considered to have significant angler pressure, and c) which lakes have primarily stocked versus natural populations. DIFW successfully provided samples of lake trout from 11 lakes and a sample of splake from 1 lake.

Mean size did not vary much among the lakes and was not correlated with mean mercury concentrations. Concentrations varied considerably, but the mean (0.36 mg/kg, n=11) (Table 2.2.1) was not significantly different from the REMAP data (0.46 mg/kg, n=8) or the indicator species (0.60 mg/kg, n=4) data for skinless fillets (Mann Whitney U test, p=0.05).

Northern Pike. There were no data on pike that are apparently found in a number of waters in central Maine, such as the Belgrade Lakes, Sabattus Lake, and the Annabessacook - Cobbosseeconte Chain. Pike are big predatory fish and would be expected to have higher mercury concentrations than even pickerel. The goal was to catch 5 pike from the Belgrade Lakes region, Sabattus Lake, and Annabessacook. Lake. We were able to capture pike from only Great Pond in Belgrade and Sabattus Pond in Sabattus. Concentrations were greatly different, being much higher in Great Pond and surprisingly low in Sabattus, even though those fish were smaller (Table 2.2.1). Collection of pike from Sabattus Pond was repeated in 2001.

Chain Pickerel. There are mercury data from only 7 lakes sampled for chain pickerel , which appear to be high in mercury, though standard deviations are low. More data were needed to get a better sense of the underlying distribution, but it was unclear whether new data would have much of an effect on the advisory. DEP asked DIFW to collect 5 pickerel from each of 5 lakes in the course of their normal duties. We received a sample from only Great Pond in Belgrade and the concentration was much lower than the previous data for chain pickerel from the REMAP project and also lower than from the pike in Great Pond. The study was repeated in 2001 and results will be reported in the 2001 report.

Confirming REMAP DDT analysis. From the 1993-94 REMAP study of Maine lakes, 15 lake/species samples were identified as having fish with elevated total DDT that exceeded Bureau of Health fish tissue action level (FTAL=64 ppb) in edible filets. Attempts were made to collect 5 fish for each of these combinations to be analyzed for total DDT. A total of seven samples of fish were captured from a total of 5 lakes. We were unable to capture some species from some lakes, other lakes were not visited. Total DDT concentrations were much lower than those from the REMAP project (Table 2.2.2). Most of the REMAP data were flagged for some sort of quality assurance exceedance. None of the 2000 samples exceeded the FTAL.

Table 2.2.1 Mercury concentrations in 2001 fish samples from some Maine lakes.

WATER	MIDAS No.	TOWN	SPECIES CODE	HG mg/kg
Auburn Lake	3748	Auburn	LKT	0.15
Allagash L	9787	T8R14 WELS	LKT	0.61
Eagle Lake	1634	Eagle Lake	LKT	0.37
E Musquash L	1088	Topsfield	LKT	0.63
Haymock L	2814	T8R11WELS	LKT	0.24
Hurd Pond	2064	T2R10WELS	LKT	0.24
Kezar Lake	0097	Lovell	LKT	0.38
Millimagasett L	3004	T7R8	LKT	0.44
Mattagamon Lake	4260	Trout Brook Twp	LKT	0.53
Nickerson Lake	1036	New Limerick	LKT	0.26
Pleasant Pond, Island Falls	0224	Caratunk	LKT	0.13
Thissell Pond	2726	T5R11WELS	SPK	0.24
Sabattus Pond	3796	Greene	PIK	0.06
Great Pond	5274	Belgrade	PIK	0.45
Great Pond	5274	Belgrade	PKL	0.28

DEP Sample ID	Length mm	HG mg/kg
LAKE TROUT		
Allagash L		
LK-9787-LKT-1	479	0.482
LK-9787-LKT-2	500	0.389
LK-9787-LKT-3	465	0.389
LK-9787-LKT-4	502	0.634
LK-9787-LKT-5	445	0.429
LK-9787-LKT-6	552	1.23
LK-9787-LKT-7	500	0.654
LK-9787-LKT-8	479	0.519
LK-9787-LKT-9	525	0.674
LK-9787-LKT-10	517	0.676
MEAN	**496**	**0.61**
Auburn L		
LK-3748-LKT-1	456	0.071
LK-3748-LKT-2	520	0.185
LK-3748-LKT-3	505	0.143
LK-3748-LKT-4	530	0.133
LK-3748-LKT-5	535	0.193
LK-3748-LKT-6	500	0.159
MEAN	**508**	**0.15**
Eagle Lake		
LK-1634-LKT-1	503	0.329
LK-1634-LKT-2	475	0.383
LK-1634-LKT-3	480	0.364
LK-1634-LKT-4	478	0.346
LK-1634-LKT-5	559	0.429
MEAN	**499**	**0.37**
E Musquash L		
EMQ-LKT-01	551	0.684
EMQ-LKT-02	596	0.785
EMQ-LKT-03	535	0.552
EMQ-LKT-04	460	0.499
MEAN	**536**	**0.63**
Haymock Lake		
LK-2814-LKT-1	605	0.225
LK-2814-LKT-2	551	0.262
LK-2814-LKT-3	617	0.265
LK-2814-LKT-4	618	0.211
LK-2814-LKT-5	615	0.354
LK-2814-LKT-6	564	0.299
LK-2814-LKT-7	443	0.161
LK-2814-LKT-8	427	0.18
LK-2814-LKT-9	492	0.133
LK-2814-LKT-10	510	0.299
MEAN	**544**	**0.24**

DEP Sample ID	Length mm	HG mg/kg
Hurd Pond		
LK-2064-LKT-1	355	0.143
LK-2064-LKT-2	383	0.3
LK-2064-LKT-3	404	0.183
LK-2064-LKT-4	410	0.259
LK-2064-LKT-5	424	0.307
MEAN	**395**	**0.24**
Kezar Lake		
LK-0097-LKT-1	446	0.321
LK-0097-LKT-2	582	0.544
LK-0097-LKT-3	506	0.326
LK-0097-LKT-4	515	0.303
LK-0097-LKT-5	482	0.415
MEAN	**506**	**0.38**
Mattagamon Lake		
LK-4260-LKT-1	491	0.542
LK-4260-LKT-2	423	0.517
LK-4260-LKT-3	444	0.316
LK-4260-LKT-4	574	0.679
LK-4260-LKT-5	486	0.589
MEAN	**484**	**0.53**
Millimagassett Lake		
LK-3004-LKT-1	530	0.356
LK-3004-LKT-2	663	0.451
LK-3004-LKT-3	620	0.522
LK-3004-LKT-4	536	0.442
LK-3004-LKT-5	557	0.44
MEAN	**581**	**0.44**
Nickerson Lake		
LK-1036-LKT-1	578	0.47
LK-1036-LKT-2	497	0.188
LK-1036-LKT-3	557	0.45
LK-1036-LKT-4	318	0.121
LK-1036-LKT-5	330	0.174
LK-1036-LKT-6	330	0.136
MEAN	**435**	**0.26**

DEP Sample ID	Length mm	HG mg/kg
Pleasant Pond, Caratunk		
LK-0224-LKT-1	482	0.069
LK-0224-LKT-2	536	0.117
LK-0224-LKT-3	516	0.107
LK-0224-LKT-4	547	0.154
LK-0224-LKT-5	516	0.103
LK-0224-LKT-6	559	0.148
LK-0224-LKT-7	502	0.102
LK-0224-LKT-8	523	0.115
LK-0224-LKT-9	570	0.256
LK-0224-LKT-10	510	0.127
MEAN	**526**	**0.130**
Thissell Pond		
LK-2726-SPK-1	395	0.209
LK-2726-SPK-2	425	0.26
LK-2726-SPK-3	425	0.237
LK-2726-SPK-4	391	0.191
LK-2726-SPK-5	467	0.31
MEAN	**421**	**0.24**
NORTHERN PIKE		
Sabattus Pond		
SPS-PKE-1	461	0.056
SPS-PKE-2	410	0.047
SPS-PKE-3	448	0.054
SPS-PKE-4	446	0.06
SPS-PKE-5	447	0.064
MEAN	**442**	**0.06**
Great Pond, Belgrade		
GRT-PIK-01	728	0.749
GRT-PIK-02	697	0.382
GRT-PIK-03	666	0.378
GRT-PIK-04	670	0.299
GRT-PIK-05	653	0.459
MEAN	**683**	**0.45**
CHAIN PICKEREL		
Great Pond, Belgrade		
GRT-PKL-01	393	0.204
GRT-PKL-02	380	0.261
GRT-PKL-03	465	0.347
GRT-PKL-04	497	0.313
MEAN	**434**	**0.28**

Table 2.2.2 Total DDT concentrations in 2000 fish samples from some Maine lakes

Location	Station Code	Species	Total DDX nd=1/2 mdl
Eagle Lake			
Eagle Lake	LK1634	LKT	2.9
Little Ossipee Pond			
Waterboro	LOW	LLS	3.0
Lovewell Pond			
Fryeberg	LPF	BNT	15.9
Round Pond	RPL	SMB	6.8
Livermore		WHS	61.9
Lower Range Pond	LRP	BNT	4.1
Poland		WHS	27.6

DEP ID# **Compound**	**DL** **ng/kg**	LK1634-LKT-1	LK1634-LKT-2	LK1634-LKT-3	LK1634-LKT-4	LK1634-LKT-5
2,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDE	1.0	0.25	0.19	0.31	0.56	0.47
2,4-DDD	1.0	0.34	0.65	0.22	0.48	0.79
4,4-DDD	1.0	<DL	<DL	<DL	<DL	<DL
2,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL
Total DDX		0.59	0.84	0.53	1.04	1.26
TCMX (% rec.	65-125	77.5	81.6	89.4	82.3	77.1
Sample weight (g)		24.9	25.1	24.9	25.0	24.9

DEP ID# **Compound**	**DL** **ng/kg**	LPF-BNT-1	LPF-BNT-2	LPF-BNT-3	LPF-BNT-4	LPF-BNT-5
2,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDE	1.0	<DL	<DL	0.88	1.28	0.75
2,4-DDD	1.0	2.87	1.59	2.66	10.93	8.15
4,4-DDD	1.0	1.32	1.15	1.44	3.20	2.66
2,4-DDT	1.0	3.24	2.97	2.36	4.24	3.87
4,4-DDT	1.0	4.48	3.88	4.87	3.32	4.01
Total DDX		11.92	9.59	12.21	22.97	19.44
TCMX (% rec.	65-125	77.1	81.4	70.2	80.2	91.0
Sample weight (g)		25.0	25.0	25.0	25.0	25.1

DEP ID# **Compound**	**DL** **ng/kg**	LOW-LLS-1	LOW-LLS-2	LOW-LLS-3	LOW-LLS-4	LOW-LLS-5
2,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
2,4-DDD	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDD	1.0	<DL	<DL	<DL	<DL	<DL
2,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL
Total DDX		0.00	0.00	0.00	0.00	0.00
TCMX (% rec.	65-125	75.5	88.7	70.3	70.0	75.3
Sample weight (g)		25.0	24.9	25.0	25.1	25.1

DEP ID# **Compound**	**DL** **ng/kg**	LRP-BNT-1	LRP-BNT-2	LRP-BNT-3	LRP-BNT-4	LRP-BNT-5
2,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDE	1.0	0.32	0.41	<DL	<DL	0.28
2,4-DDD	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDD	1.0	0.52	0.56	<DL	<DL	0.52
2,4-DDT	1.0	2.12	1.95	<DL	<DL	<DL
4,4-DDT	1.0	1.80	<DL	<DL	<DL	1.83
Total DDX		4.76	2.92	0.00	0.00	2.63
TCMX (% rec.	65-125	75.8	75.5	89.3	89.7	93.5
Sample weight (g)		25.0	25.0	25.1	25.0	25.1

DEP ID# Compound	DL ng/kg	RPL-SMB-1	RPL-SMB-2	RPL-SMB-3	RPL-SMB-4	RPL-SMB-5
2,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDE	1.0	0.40	<DL	0.69	0.28	0.34
2,4-DDD	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDD	1.0	0.48	<DL	1.18	0.48	0.51
2,4-DDT	1.0	2.04	1.77	4.73	1.96	2.18
4,4-DDT	1.0	<DL	1.81	4.53	1.88	2.01
Total DDX		2.92	3.58	11.13	4.60	5.04
TCMX (% rec.	65-125	84.2	76.2	72.4	65.4	68.4
Sample weight (g)		25.0	24.9	10.2	25.0	23.4

DEP ID# Compound	DL ng/kg	LRP-WHS-1	LRP-WHS-2
2,4-DDE	1.0	<DL	<DL
4,4-DDE	1.0	24.7	15.72
2,4-DDD	1.0	1.68	1.24
4,4-DDD	1.0	4.13	2.03
2,4-DDT	1.0	<DL	<DL
4,4-DDT	1.0	1.84	1.84
Total DDX		32.39	20.82
TCMX (% rec.	65-125	77.6	71.5
Sample weight (g)		24.9	25.0

DEP ID#	**DL**	RPL-WHS-1	RPL-WHS-2	RPL-WHS-3	RPL-WHS-4	RPL-WHS-5
Compound	**ng/kg**					
2,4-DDE	1.0	<DL	<DL	3.96	<DL	<DL
4,4-DDE	1.0	6.21	16.0	128	15.7	4.46
2,4-DDD	1.0	4.25	18.8	49.5	13.6	2.27
4,4-DDD	1.0	1.26	3.43	16.6	<DL	1.04
2,4-DDT	1.0	2.03	10.3	<DL	<DL	5.82
4,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL
Total DDX		13.75	48.57	198.49	29.28	13.59
TCMX (% rec.	65-125	79.6	86.3	87.6	68.9	69.1
Sample weight (g)		25.0	25.1	25.0	25.1	25.1

2.3

LOON EFFECTS STUDY

Assessing the impacts of methylmercury on piscivorous wildlife: as indicated by the Common Loon, 1998-2000

(Report BRI00-01)

2000 Final Report

Submitted to:

Maine Department of Environmental Protection
Surface Water Ambient Toxic Monitoring Program
State House Station 17
Augusta, Maine 04333

Submitted by:

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23 March 2001

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Executive Summary:

Anthropogenic inputs of mercury (Hg) into the environment have significantly increased in the past few decades. In conjunction, the current availability of methylmercury (MeHg) in aquatic systems has increased to levels posing risks to human and ecological health. Risk levels vary considerably in response to MeHg availability, which is affected by lake hydrology, biogeochemistry, habitat, topography, and proximity to airborne sources. We selected the Common Loon as the most suitable bioindicator of aquatic Hg toxicity, based on ecological, logistical, and other criteria, including public valuations of natural resources. Opportunistic and probability-based sampling efforts from 1994-2000 indicate New England's breeding loon population is at unacceptable levels of risk to Hg contamination, particularly in Maine. Based on risk categories developed from the literature and *in situ* studies by BioDiversity Research Institute and their collaborators, 30% of the breeding loon population in Maine is estimated to be at risk, while 46% of the eggs laid are potentially impacted.

Because results from national sampling indicated loons were at most risk from Hg in New England (particularly Maine), we identified several individual- and population-level parameters to better understand the extent of mercury toxicity across Maine. Between 1994-00, we collected 139 abandoned eggs as well as blood and feather samples from 253 adult and 103 juvenile wild loons captured in Maine. The Hg concentrations in these samples were used to characterize sublethal impacts of Hg on egg development, behavior, developmental stability, immunosuppression, individual survival, and overall reproductive success. In the Rangeley Lakes Study Area, a total of 185 loon territories were monitored on 43 lakes during 1998-00. Current monitoring efforts and historical data comprise 515 territory-years measured. Behavioral observations were conducted for over 1,500 hours on 16 lakes with 38 loon territories from 1998 to 2000.

Several reproductive measures significantly declined for loon pairs at high risk to prey MeHg availability, thereby corroborating studies in high-risk sites in Nova Scotia and Wisconsin that show Hg impacts reproductive success. Based on 223 loon territories representing 748 territory-years surveyed we found that extra-high risk pairs fledged 37% fewer young than pairs at low risk to Hg. We also found similar significant patterns of lower productivity on high and extra-high risk territories compared to low and moderate risk territories for other reproductive measures. We view the implication of long-term declines in these reproductive measures are serious and contend they would not be detected by traditional survey techniques.

Insight into why loons are facing Hg-based population declines can be seen through our hazard assessment process that is based on a weight of evidence approach. Physiological impacts of Hg are measured through two key biomarkers: corticosterone stress hormone levels and flight feather asymmetry. Circulating corticosterone hormone levels are strongly linked with increasing blood Hg levels and are not related to capture and handling stress. Corticosterone hormone levels increase on an average of 14.6% for every one ppm of increase in blood Hg levels (n=239). This indicates that loons with high blood Hg levels have higher rates of chronic stress and may therefore have compromised immune systems. Asymmetry measurements provide insights into developmental stability and potentially reproductive fitness. Three years of flight feather measurements have shown annual agreement that loon breeding populations with greater exposure to Hg have significantly greater asymmetry than populations at low risk (n=227). Greater asymmetry may indicate disruptions from stressors on their embryonic

development and current physiological status as well as a potential decline in reproductive fitness.

Many behavioral impacts that appear to be related to the neurotoxic effects of MeHg can rarely be observed in the field. We found adult loons in high risk situations left eggs uncovered 14% of the time, compared to 1% in controls. Several cases of direct field observations indicate that adult loons with high Hg body burdens avoid incubating their eggs and display atypical behaviors such as patrolling in front of, or sitting next to the nest. We documented a significant negative relationship between adult blood Hg and foraging behavior, and a significant positive relationship between adult blood Hg and brooding behavior. Recategorizing our data according to energy demands revealed a significant inverse relationship between blood Hg and time spent in high energy behaviors. Our findings are consistent with other studies linking Hg and lethargy, reduced motivation to hunt prey, and compromised foraging abilities.

Current levels of Hg in Maine's lacustrine ecosystems also appear to be impacting individual survival of adult and juvenile loons. Recaptured adult loons exhibit a significant annual increase of Hg (9% in males, 5.6% in females) that we predict will significantly reduce lifetime individual performance. A model of this impact indicates a decline of 13 to 8 young produced over a loon's lifetime. Further, juveniles from high-risk territories have significantly increasing blood Hg levels of 3% per day during the summer, potentially reaching dangerous levels after the final feather molt at 11 weeks of age.

Characterization of the risk imposed by MeHg bioavailability in aquatic systems to high trophic level obligate piscivores such as the Common Loon indicates negative population level impacts in Maine. Although the impacts of Hg on loons are varied, complex, and not yet fully understood, the combination of high exposure to a significant part of the breeding population and the "bottom-line" impact of reducing overall reproductive success to 37%, has created an aquatic landscape that is not sustainable for the Common Loon in Maine.

Current models indicate a negative population growth rate. Because of the loon's life history strategy (i.e., long lived, slow maturing, and low fecundity) the annual and continual impacts of this type of stressor causes an erosion of the non-breeding or buffer population that serves as a natural cushion to catastrophic events. Once this buffer population is exhausted, the occupancy of established territories will shrink and it will be more obvious that loon populations are declining. However, the realization of shrinking loon populations at that stage will require drastic and potentially expensive efforts to reverse the decline. Models based on a 25-year, statewide comprehensive monitoring effort in New Hampshire show approximately half of Maine's buffer population has been exhausted. Certain areas in Maine, such as the Allagash area that may be particularly impacted from Hg, may already exhibit exhaustion of the buffer population and a shrinking number of territorial pairs.

Continued refinement of model parameters and either a probability-based sampling scheme or new sampling efforts in northern Maine will provide higher confidence in our estimates that will therefore assist in state-based policy efforts as well as national regulations that reflect the ecological injury Hg is currently having on the freshwater landscape.

The full report is available with the 2000 SWAT report separately at http://www.state.me.us/dep/blwq/monitoring.htm

2.4

WILDLIFE CONTAMINANTS

Investigation of mercury exposure in Maine's Mink and River Otter: Final 2000 Report

(Report BRI-2001-06)

Submitted to:

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APPENDICES

OBJECTIVE

Obtain mink (*Mustela vison*) and river otter (*Lutra canadensis*) carcasses from trappers to analyze liver, brain, muscle, and fur for total mercury.

INTRODUCTION

Mercury and other aquatic-based persistent bioaccumulative toxins are prevalent in Maine's freshwater and marine environments (Maine DEP 1998). Methylmercury (MeHg) availability to fish and wildlife varies geographically and is strongly influenced by hydrology and biogeochemical factors (Evers and Reaman 1998, Evers et al. 1998b). To interpret exposure levels in wildlife established benchmarks are needed. Therefore, standardized sampling of target biosentinels provides a method for making informed comparisons and definitive interpretations, thereby helping to assess risks to wildlife and allow landscape-level extrapolations of the hazards.

The mink and the river otter are both widely distributed in New England and Maine. Both species have diets that include fish and crayfish, although mink are known generalists. Because of their high metabolism and piscivorous diet, both mink and river otters are highly susceptible to elevated levels of environmental MeHg.

Context

Lab-based, dose-response studies of mink (Wobeser et al. 1976) and otter (O'Connor and Neilson 1980) have shown that terminal total Hg concentrations occur at 25 ppm (ww) in the liver and kidney. Thompson (1996) estimated that 30 ppm (ww) of total Hg in the liver or kidney is at least sublethal and potentially lethal. He also reported that dietary MeHg concentrations of 2 to 6 ppm (ww) were "sufficient to cause mercury intoxication."

Although fish total Hg levels over 2 ppm occur in Maine, they are relatively rare. However, fish total Hg levels greater than 1 ppm are common. Evers and Reaman (1998) found fillets from Land-locked Salmon (*Salmo salar*)in Pierce Pond (1.06 ppm, ww for a 53 cm fish), Yellow Perch (*Perca flavescens*) in Mooselookmeguntic (1.11 ppm, ww for a 34 cm fish), and Yellow Perch in Flagstaff (1.26 ppm, ww for a 29 cm fish) exceeded these levels. They also found fillet Hg levels to significantly increase as fish size (indexed by length x weight) increased for Land-locked Salmon, Smallmouth Bass (*Micropterus dolomieu*), and Yellow Perch. Nearly all Hg in fish is MeHg (Wiener and Spry 1996).

As evidenced by empirical studies conducted by BioDiversity Research Institute (BRI) in Maine and comparisons with other studies (Table 1 and 2), mink and river otter are likely exposed to sufficient quantities of dietary Hg to cause sublethal impacts. Evers et al. (1998a) found Common Loon (*Gavia immer*) Hg levels to show an increasing west-east trend. Mean juvenile loon blood mercury levels from Maine were 4.5x higher than Alaska and 2x higher than the upper Great Lakes and Ontario. On several of Maine's reservoirs (e.g., Flagstaff Lake), juvenile loon blood Hg levels were up to 10x higher than Great Lakes sites.

Table 1. Concentrations of total Hg (ppm,ww) in river otter from various study sites. All values in parentheses are ranges and single values are means.

Site	Tissue	*Muscle*	Brain	Liver	Kidney	Fur*	Source
Ireland				(0.15-17.03)			Mason 1993
Denmark				(0.03-12.37)			Mason 1992
Britain				(0.17-4.33)	(0.08-2.02)		Mason 1988
New York				2.35			Mayack 1994
Ontario 1		36	30	96	58	47	Wren 1985
Ontario 2		0.89		2.97	1.05		Wren 1980
Ontario 3				(1.0-3.5)			Wren 1988
Wisconsin		1.44	0.74	3.44	8.47	6.47	Sheffy 1982

* fresh weight

Table 2. Concentrations of total Hg (ppm,ww) in mink from various study sites. All values in parentheses are ranges and single values are means.

Site		Muscle	Brain	Liver	Kidney	Fur*	Source
Wisc		1.26	0.46	2.08	2.33	7.61	Sheffy 1982
Conn				(1.1-8.47)			Major 1991
Mass				(0.008-1.92)			Major 1991
New York				2.35			Mayack 1994
Ohio				0.135			Lynch 1973
Quebec 1		1.87	0.83	9.23			Desai-Greenway 1976
Quebec 2		2.4 (0.41-6.2)		8.34 (2.21-20.0)			Langis 1999
Saskatchewan				58.2	31.9		Wobeser 1976

* Fresh weight

Because the otter and mink prey base is similar to the loon's, their body burdens of Hg may be comparable. For example, if a young loon has blood Hg levels 10x higher than same-aged loons in the Great Lakes, then otter from Wisconsin (i.e., liver mercury was 3.44 ppm, ww) (Table 1) should be 10x higher on high Hg lakes in Maine (i.e., 34.4 ppm, ww). Similarly, mink with 2.08 ppm of mercury in their liver in Wisconsin (Table 2) could potentially have up to 20.8 ppm, ww in Maine (Table 3). As mentioned, 30 ppm, ww in the liver or kidney is considered lethal (Wren (1985) and Wobeser (1976)).

STUDY AREA & METHODS

Study area

Previous mercury-based studies in Maine and throughout New England provided extensive information on known hotspots (Evers et al. 1998a), aquatic scenarios prone to enhanced MeHg availability (Evers and Reaman 1998), and species most at risk (Evers et al. 1998b). Flagstaff Lake, the North Branch of the Dead River and its watershed including Chain-of-Ponds, and the Dead River outflow from the Flagstaff dam have some of the highest levels of biotic Hg in the country. Because of this known hotspot and background information on the fish and crayfish mercury levels we focused collection of otter and mink carcasses from this area. Another focus area was the Seboomook Lake region, where trappers have reported extirpations of mink. However, trappers in the Seboomook Lake region took no animals. Collection of carcasses from other areas in Maine was opportunistic and based on availability (Appendix 1).

Sample collection and processing

We collected 8 river otter and 24 mink carcasses from licensed fur trappers during the 2000-2001 trapping season (Appendix 2 and 3). Carcasses were stored on-site in freezers and regularly retrieved by BRI staff. Brain, femoral muscle and liver tissue were removed using stainless-steel instruments and placed into I-CHEM® jars. Fur was taken from the foot of the animal using stainless-steel instruments then cleaned and placed into sealed envelopes. The tissues, once harvested, were refrozen until they were sent to the lab. The tissue samples were harvested at the University of Southern Maine’s Biology lab using techniques according to Tufts University Animal Wildlife clinic protocols (M. Pokras, pers. com.).

Fur, brain and liver tissues were analyzed for total mercury using Cold Vapor Atomic Absorption (CVAA) methods. Laboratory analysis was conducted by Texas A&M Trace Element Research Lab (TERL). Femoral muscle tissue were archived for future analysis. TERL has conducted BRI’s mercury analysis for bird tissues (blood, feathers, and eggs), fish, and crayfish for the past three years. Mercury level results are given as fresh weight for fur and wet weight for liver and brain. Methylmercury levels were not analyzed.

Contacts for retrieving carcasses

Dave Yates discussed logistics of carcass retrieval with the following trappers: Jim Arsenault of Dresden, Chester Brewer of Boothbay, Bobby Cercena of Eustis, Jerry Le Beau of North Anson, Yukkies Taxidermy of Stratton, Oscar Cronk of Wiscassett, and Brett Damm of Sumner. He also met trappers in the Boothbay area during a trapper safety course sponsored by Inland Fisheries and Wildlife (where he received his trapping certificate # METS-025-00-006).

RESULTS AND DISCUSSION

River Otter

Fur Hg concentrations ranged between 5 ppm in otters from Wiley Pond to 30.5 ppm on the St. John River. Otter fur Hg levels indicate individuals from several sites are elevated (Table 3). Brain total Hg levels ranged from 0.08 to 0.69 ppm while liver total Hg levels ranged from 0.24 to 4.74 ppm (Table 3).

Wren (1985) showed that Ontario river otters with mean fur Hg levels of 47 ppm had on average 30 ppm and 96 ppm total Hg in the brain and liver respectively. Lethal levels are considered 30 ppm total Hg in the liver (Thompson 1996) and 19 ppm total Hg in the brain (Mierle et al. 2000). Although our fur Hg levels approach lethal levels, brain and liver Hg levels indicate lower than expected exposure.

Table 3. Total Hg levels (ppm) in fur from river otters collected in Maine during 2000 trapping season.

Site	Sex	Total Fur Hg (ppm, fw)	Total Brain Hg (ppm, ww)	Total Liver Hg (ppm, ww)
Boothbay-Wiley Pond	Male	5.0	0.08	0.24
Boothbay-Wiley Pond	Male	5.2	0.09	-
Boothbay Harbor - Lewis Cove	Female	18	0.37	2.61
Flagstaff - Turner	Female	33.7	0.60	4.01
St. John River-T15 R11	Male	28.1	0.57	2.57
St. John River-T15 R11	Female	22.7	0.64	4.69
St. John River-T 15 R11	Female	30.5	0.69	4.74
Wiscasset-Dresden Bog	Male	29.6	0.54	2.13

Fur Hg levels reflect the total body burden bioaccumulated over time, particularly for individuals with high exposure. Consequently the animal's age may be a confounding factor in interpreting fur Hg results. Mierle et al. (2000) found that Hg concentrations in fur changed with age. It increased during the first four years in Ontario otters, but then declined. However, fur Hg levels in the Ontario study did not exceed 15 ppm in known age otters, and it is likely the animals were able to demethylate their Hg body burden. In our study, several otters had relatively high fur Hg levels, therefore it is not clear if these animals would be able to demethylate their body burden. Blood Hg levels reflect recent dietary uptake and would help explain fur Hg concentrations.

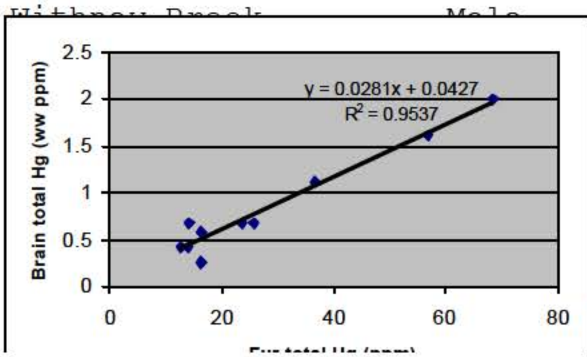
Mink

We analyzed 24 fur samples, and 10 brain and liver samples. Mink fur Hg concentrations ranged from 9.2 ppm on Adams Pond near Boothbay to 68.5 ppm on Dead River, Flagstaff Lake. Mink brain and liver Hg ranged from 0.26 (brain) and 0.77 (liver) to 2.0 (brain) and 8.0 ppm (liver) from Bog Brook in Hebron and Dead River respectively (Table 4).

There does not appear to be a relationship between the size and sex of the animal and tissue Hg levels, however sample size is limiting. All liver samples were below the lethal levels of 25 ppm as reported by Wobeser et al. (1976), although extrapolating findings from controlled lab experiments to wild populations are difficult. Additionally, liver total Hg levels are best used for historical comparisons. Recent work has shown the percentage of MeHg in the liver reaches an upper limit and does not correlate with total Hg levels (D. Evans, pers. com.). Therefore, evaluating the impact of Hg toxicity only using liver Hg levels is not recommended. There is a strong correlation between fur and brain (r^2=0.95) (Figure 1), and brain and liver (r^2=0.93) total Hg in mink (Figure 2).

Table 4. Total Hg levels (ppm) in mink fur, brain, and liver samples collected in Maine during 2000 trapping season.

Site	Sex	Total Fur Hg (ppm, fw)	Total Brain Hg (ppm, ww)	Total Liver Hg (ppm, ww)
Boothbay - Adams Pond	Male	9.2	0.15	0.049
Boothbay - Adams Pond	Female	13.4	0.26	0.60
Bog Brook	Male	16.3	0.26	0.77
Dresden Bog	Male	19.0	0.29	0.92
Flagstaff - Turner	Female	36.9	1.11	4.40
Flagstaff - Turner	Female	68.5	2.00	8.03
Boothbay - Cross River	Male	18.3	0.33	2.71
Boothbay - Lewis Cove	Male	22.9	0.52	1.82
Boothbay - Pleasant Cove	Male	11.2	0.13	1.06
Little Androscoggin River	Male	14.4	0.68	1.46
Little Androscoggin River	Female	25.9	0.68	2.61
Nezinscot River	Male	16.5	0.58	1.78
Nezinscot River	Male	10.5	0.20	1.17
Nezinscot River	Male	24.3	0.54	1.65
Nezinscot River	Male	32.6	1.20	4.79
Nezinscot River	Female	27.4	0.37	1.56
Nezinscot River	Male	17.6	0.48	1.49
Nezinscot River	Male	29.5	0.75	2.14
Sherman Lake	Male	27.8	0.49	1.25
St. John River	Female	23.7	0.67	3.01
St. John River	Female	34.1	1.06	6.29
St. John River	Male	14	0.42	2.06
West Branch Nezinscot River	Female	12.8	0.42	1.96
Withey Brook	Male	56.8	1.62	5.03



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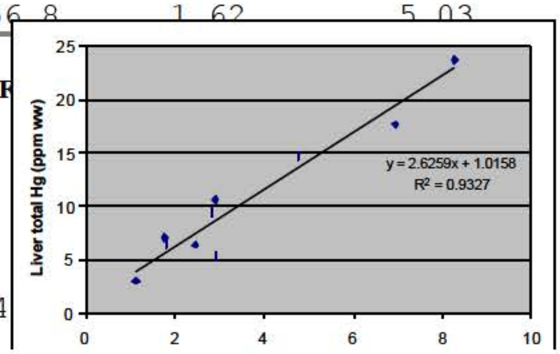

RECOMMENDATIONS

Because few trappers operate in the Flagstaff and Seboomook regions we recommend live trapping in these areas. Capturing a live animal permits blood sampling. Analysis of blood samples allow more meaningful comparisons among different sites and regions, because (1) blood Hg levels reflect a recent or short term Hg exposure of a piscivorous mammal and (2) should be independent of age. Because >95% of Hg in the blood is in the methyl form, measuring total Hg provides insight into the recent dietary uptake of MeHg. Collecting blood samples from recently killed animals is difficult because blood rapidly loses moisture after death; therefore, blood clots and whole blood Hg likely do not correlate (based on studies with loons). Conversely, much of the Hg in organs is inorganic. By sampling and analyzing fur and blood from live mammals we hope to establish a relationship between the two matrices that can be applied to future studies for Hg interpretation of live or dead animals. Because animals can be live-trapped in areas of low density, we avoid potential population impacts and provide a comparative template for other studies that cannot afford removing animals.

Live trapping also adds another matrix of Hg measurement that can be related to other compartments such as fur, liver, kidney, and brain. Each matrix provides different information. Mercury levels in fur are an indicator of long-term body burden and organs generally demethylate Hg and do not necessarily provide an accurate assessment on toxicity to the individual. There is now evidence that the brain can demethylate Hg (particularly in the otter, D. Evans pers. com.) so that compartment may not be helpful for chronic Hg loads. Sampling certain matrices, such as muscle or fur (since fur would likely reflect remobilization of MeHg in the muscle) can provide better insights into the lifetime body burden for the animal. This is crucial part of this investigation because the bioaccumulation rate of MeHg is one of the most important aspects of its toxicity to a population.

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Appendix 1. Otter carcasses provided by Maine trappers, 2001.

Date Trapped	Location	Sex	Body of Water	Body Weight (kg)	Length (cm)	Latitude	Longitude
11/10/00	Boothbay	Male	Wiley Pond	4500	60.5	43 54.072	69 38.218
11/10/00	Boothbay	Male	Wiley Pond	5800	69.5	43 54.072	69 38.218
11/5/00	Boothbay	Female	Lewis Cove	5200	65.5	43 51.266	69 36.793
11/23/00	Dead River	Female	Flagstaff - Turner	5400	68.5	45 8.226	70 10.188
12/1/00	T15 R11	Male	St. John River	5600	67.4	46 44.372	69 37.244
12/6/00	T16 R11	Female	St. John River	2800	60	46 45.644	69 34.734
11/15/00	T16 R11	Female	St. John River	4200	64.1	46 39.876	69 44.189
11/13/00	Wiscasset	Male	Dresden Bog	6700	87.5	44 5.720	69 41.154

Appendix 2. Mink carcasses provided by Maine trappers, 2001.

Date Trapped	Location	Sex	Body of Water	Body Weight (g)	Length (cm)	Latitude	Longitude
11/10/00	Boothbay	Male	Pleasent Cove	603.8	41	43 53.886	69 36.161
11/14/00	Boothbay	Female	Adams Pond	452.2	36	43 53.544	69 37.872
11/14/00	Boothbay	Male	Cross River	766.2	41.5	43 55.860	69 36.956
11/6/00	Boothbay	Male	Adams Pond	883.6	43	43 53.544	69 37.872
11/3/00	Boothbay	Male	Lewis Cove	940.3	44.8	43 51.266	69 36.793
11/6/00	Buckfield	Male	Nezinscot River	584	35	44 15.895	70 19.686
11/11/00	Buckfield	Male	Nezinscot River	635.5	38	44 15.895	70 19.686
11/9/00	Buckfield	Female	Nezinscot River	475.1	36.7	44 15.895	70 19.686
11/20/00	Dead River	Female	Flagstaff - Turner	422.1	36	45 8.226	70 10.188
11/20/00	Dead River	Female	Flagstaff - Turner	562.4	39.2	45 8.226	70 10.188
11/2/00	Dresden	Male	Dresden Bog	707.8	40.5	44 5.720	69 41.154
11/2/00	Hebron	Male	Bog Brook	769	37.5	44 13.651	70 20.754
11/7/00	Hebron	Female	L. Androscoggin R.	390	32.8	44 13.651	70 34.453
11/14/00	Newcastle	Male	Sherman Lake	828.7	41	44 0.351	69 35.589
11/2/00	Sumner	Female	Nezinscot R. - W. Br.	373	31	44 23.939	70 27.749
11/3/00	Sumner	Male	Nezinscot River	603	36	44 20.612	70 25.771
11/6/00	Sumner	Male	Nezinscot River	683	36.5	44 20.612	70 25.771
11/11/00	Sumner	Male	Nezinscot River	772.8	40.5	44 20.612	70 25.771
11/11/00	Sumner	Male	Nezinscot River	576.1	37.8	44 20.612	70 25.771
11/29/00	T12 R16	Female	St. John River	270.3	32	46 41.091	69 47.508
12/3/00	T12 R16	Female	St. John River	541.7	37	46 41.091	69 47.508
11/23/00	T12 R16	Male	St. John River	583.4	38	46 41.091	69 47.508
12/3/00	T5 R15	Male	Withney Brook	459.4	36.2	46 6.281	69 39.745
11/6/00	West Paris	Male	L. Androscoggin R.	410	32	44 19.404	70 34.453

SHARP-TAILED SPARROW STUDY

This report includes studies funded by SWAT for 2000 and 2001.

Mercury Exposure Profile for Sharp-tailed Sparrows Breeding in Coastal Maine Salt Marshes

(BRI 2002-11)

BioDiversity Research Institute is a Maine-based nonprofit research group dedicated to progressive environmental research and education that furthers global sustainability and conservation policies. Fundamental studies involve avian conservation and aquatic toxicology. We believe high trophic level piscivorous wildlife are vital indicators of aquatic integrity.

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Hg Exposure Profile for Sharp-tailed Sparrows Breeding in Coastal Maine Salt Marshes

(BRI 2002 – 11)

Submitted to:
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INTRODUCTION

Sharp-tailed sparrows (*Ammodramus* spp.) inhabit wet meadows, marshes, and salt marshes of central and eastern North America. The taxonomy, distribution, and evolutionary history of this group has been debated for over a century. In 1995, based on morphological and genetic evidence, the American Ornithologists Union committee on classification and nomenclature voted to separate this single species with five known sub-species into two species: a northern species, *Ammodramus nelsoni*, with 3 sub-species (*A. n. nelsoni, A. n. alterus*, and *A. n subvirgatus*) and a southern species, *A. caudacutus* with two sub-species (*A. c. caudacutus and A. c. diverus*), limited to coastal wetlands. *A. n. subvirgatus* (hereafter Nelson's Sparrow) and *A. c. caudacutus* (hereafter Saltmarsh Sparrow) are sympatric in coastal Maine, New Hampshire, and the northeast shore of Massachusetts.

The biomagnification of mercury (Hg) in aquatic biota is well known (Watras and Huckabee 1994), however its expression in insectivorous birds is not well studied (see review in Thompson 1996). Terrestrial species have recently been selected to serve as potential bioindicators of contaminants including Tree Swallows (*Tachycineata bicolor*) for Hg exposure (Gerrard and St. Louis 2001) and organochlorines (Secord et al. 1999) and American Robins (*Turdus migratorius*) for lead (Johnson et al. 1999).

We believe sharp-tailed sparrows are an appropriate indicator of methylmercury availability in coastal marshes. Our two target species spend their entire life-cycle in salt marsh habitats of the Atlantic coast. Their small breeding territories afford an excellent opportunity to determine contaminant exposure for target marshes and even specific areas within a marsh. Because of increasing urbanization surrounding these habitats a better understanding of contaminant ecological impacts has been identified and is of national interest (Newman et al. 2002).

The objectives of this study were to 1) determine the extent of Hg exposure in two species of sharp-tailed sparrows in coastal Maine salt marshes, 2) compare blood Hg between Saltmarsh and Nelson's sparrows, and 3) determine if there were differences in Hg exposure among five Maine salt marshes.

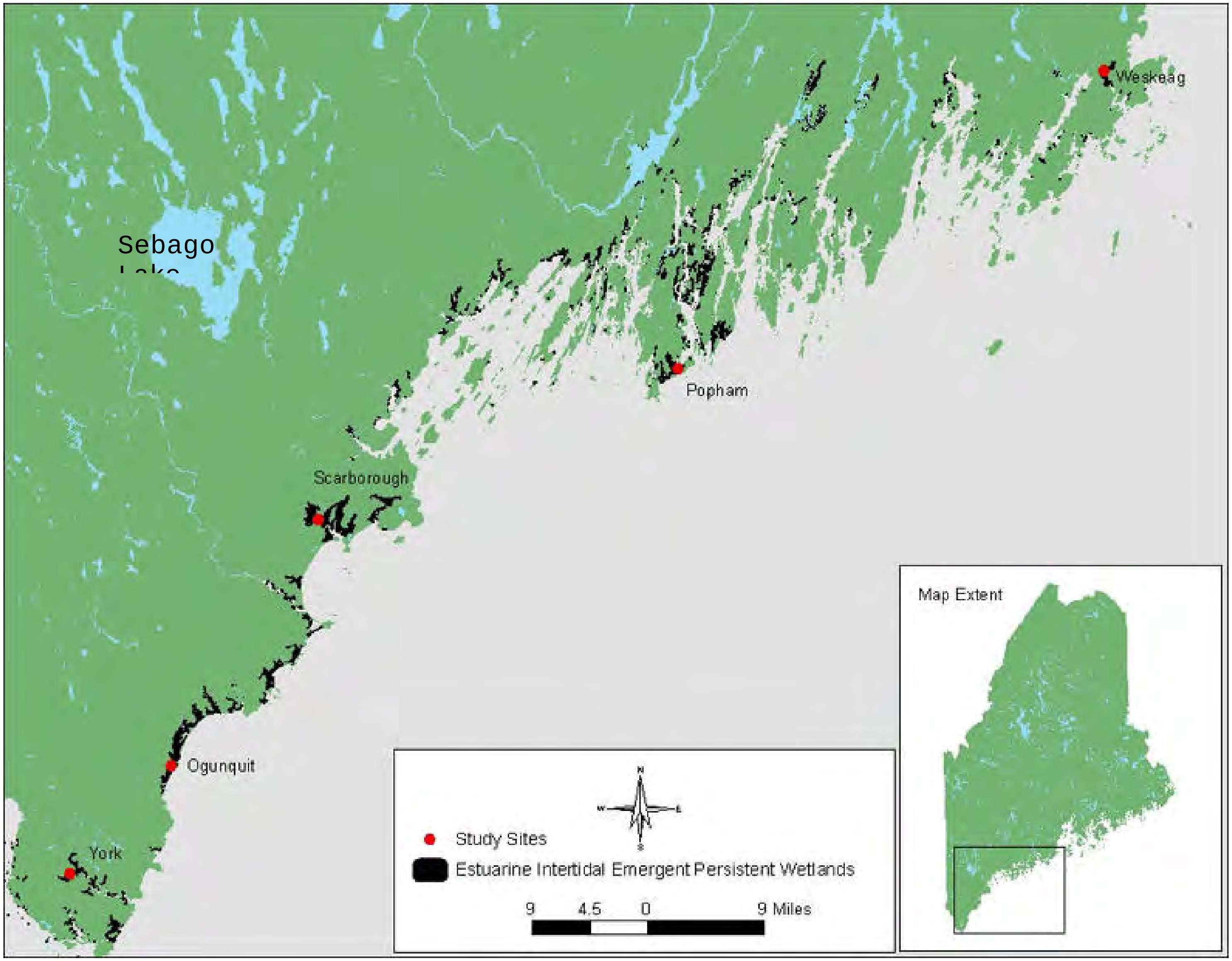
STUDY AREA & METHODS

We sampled sharp-tailed sparrows from 5 marshes along the Maine coast during the breeding seasons (15 June-1 August 2001) of 2000 and 2001 (Figure 1). We used mist nets to capture sparrows and attached a U.S. Fish and

Wildlife Service band and three color-bands to each individual. We used a wing cord ruler to measure unbended wing cord and dividers to measure tarsus length. We weighed all sparrows using a spring scale to the nearest 0.25 gm. We collected 30 µl – 50 µl of blood from the cutaneous ulnar vein for Hg contamination analysis using a micro-pipette. Micro-pipettes were stored in a test-tube and placed in a cooler immediately after collection. All samples were frozen on the day of collection and were maintained at <25^{o} (F) until contamination analyses were conducted. Blood Hg levels are generally not compromised by body burden Hg levels during the breeding season (Evers et al. 1998).

We used independent *t* tests to determine differences in blood Hg levels between species and sex. If differences were significant between species or sex we then conducted further analyses separately. We used ANOVA with Tukey's post-hoc tests to determine if differences existed in blood Hg levels among the 5 sites. If there were differences among sites we then used ANOVA to determine if there were weight (g) or wing cord (mm) differences between high and low Hg level sites. All means are presented ± 1 SE.

Figure 1. Study sites with estuarine wetlands.



RESULTS

We captured and drew blood from 81 sharp-tailed sparrows (28 Nelson's and 54 Saltmarsh) in 5 marshes on the Maine coast (Table 1). Saltmarsh Sparrows (mean = 0.69 ± 0.03) had 41% greater blood Hg levels than Nelson's Sparrows (mean = 0.41 +/- 0.03) (t = 6.338, df = 79, P < 0.001, Figure 2). There was no difference in blood Hg levels between males and females for either species (Nelson's t = 1.69, df = 23, P = 0.171; Saltmarsh t = 0.848, df = 48, P = 0.401). We detected a difference in blood Hg levels among sites for both species (Nelson's F = 7.402, df = 4, P = 0.001; Saltmarsh F = 6.154, df = 4, P < 0.001, Figure 3 A and B). Popham beech and Ogunquit were highest in blood Hg for both species (Figure 3A and B). Sparrow weight and wing cord did not differ between high and low Hg level sites for either species (Nelson's weight F = 0.128, df = 1, P = 0.723, Nelson's wing cord F = 4.097, df =1, P = 0.053; Saltmarsh weight F = 1.219, df = 1, P = 0.275, Saltmarsh wing cord F = 1.542, df = 1, P = 0.220). There was a significant difference in weight between sparrow species.

Figure 2. Differences in blood Hg between Nelson’s Sparrow and Saltmarsh Sparrow. Saltmarsh Sparrows had significantly more blood Hg than Nelson’s Sparrow.

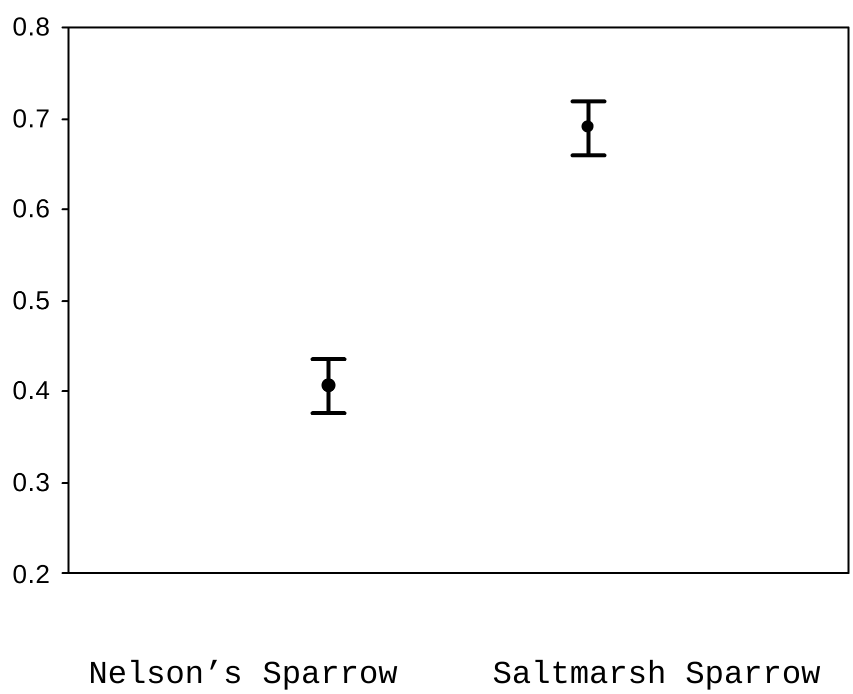


Figure 3. Differences in blood Hg between sites for A) Nelson's Sparrow and B) Saltmarsh Sparrow. Blood Hg levels were highest at Popham and Ogunquit for both species.

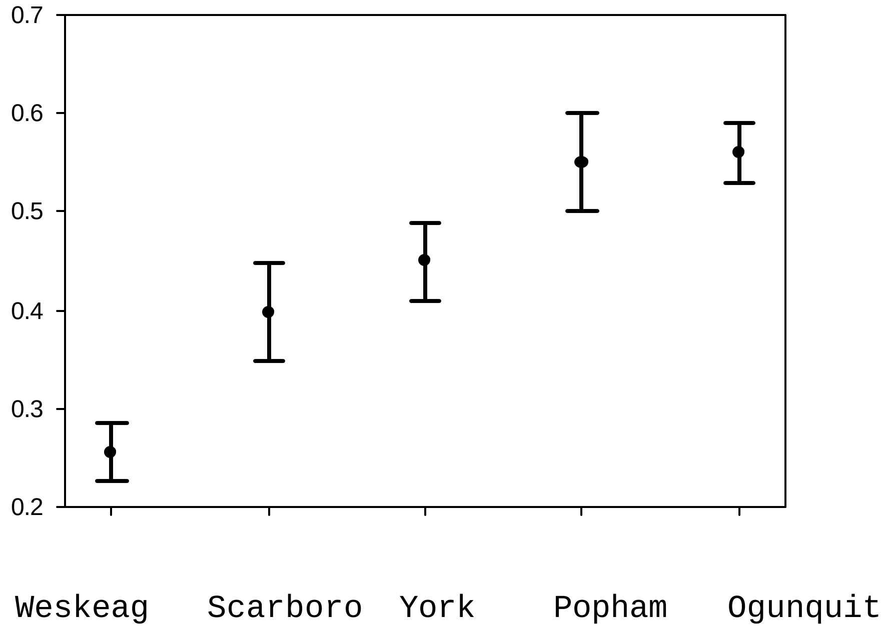


Table 1. Sampling locations, sample sizes and mean weight and wing cord for Saltmarsh and Nelson's Sharp-tailed Sparrows in coastal Maine (2000-2001).

		Saltmarsh Sharp-tailed Sparrow					Nelson's Sharp-tailed Sparrow				
Site	Lat / Long	Male	Female	Juvs	Mean Weight (g)	Mean Wing Cord (mm)	Males	Females	Juvs.	Mean Weight (g)	Mean Wing Cord (mm)
Weskeag	N 44 04.680 W 69 08.625	4	1	0	21.1 (0.6)	57.9 (2.2)	6	0	3	18.0 (0.8)	57.1 (1.1)
Popham	N 43 44.37 W 69 48.247	6	0	0	22.6 (0.5)	59.8 (0.8)	4	2	0	19.3 (0.7)	55.9 (1.6)
Scarborough	N 43 33.90 W 70 21.67	16	6	0	20.3 (1.6)	57.2 (1.3)	6	2	0	17.7 (1.7)	57.3 (2.1)
Ogunquit	N 43 17.02 W 70 34.92	7	4	0	20.3 (1.6)	57.6 (2.7)	3	0	0	18.3 (1.5)	56.8 (1.0)

York	N 43 09.64 W 70 44.01	6	1	3	19.2 (1.9)	56.9 (2.1)	2	0	0	18.4 (0.9)	57.0 (1.4)
TOTAL		39	12	3	20.7 +/- 1.3	57.9 +/- 1.1	21	4	3	18.3 +/- 0.6	56.8 +/- 0.5

DISCUSSION

We found nearly twice the Hg blood levels in Saltmarsh Sparrows than we did in Nelson's Sparrows at all five sites. This pattern was not predicted as both species spend their entire life-cycle in salt marsh habitat, presumably exposed to the same levels of contamination. Differential prey selection by sparrows could explain differences in the observed blood Hg levels. If Saltmarsh Sparrows, which are larger and have larger beaks, selected carnivorous prey while the smaller Neslon's Sparrows selected herbivorous prey, then we would expect to see higher levels of blood Hg in Saltmarsh Sparrows. Because these sparrows were recently split into two separate species (1995), little is known about dietary differences between them that may explain differences in blood Hg levels we found during this study.

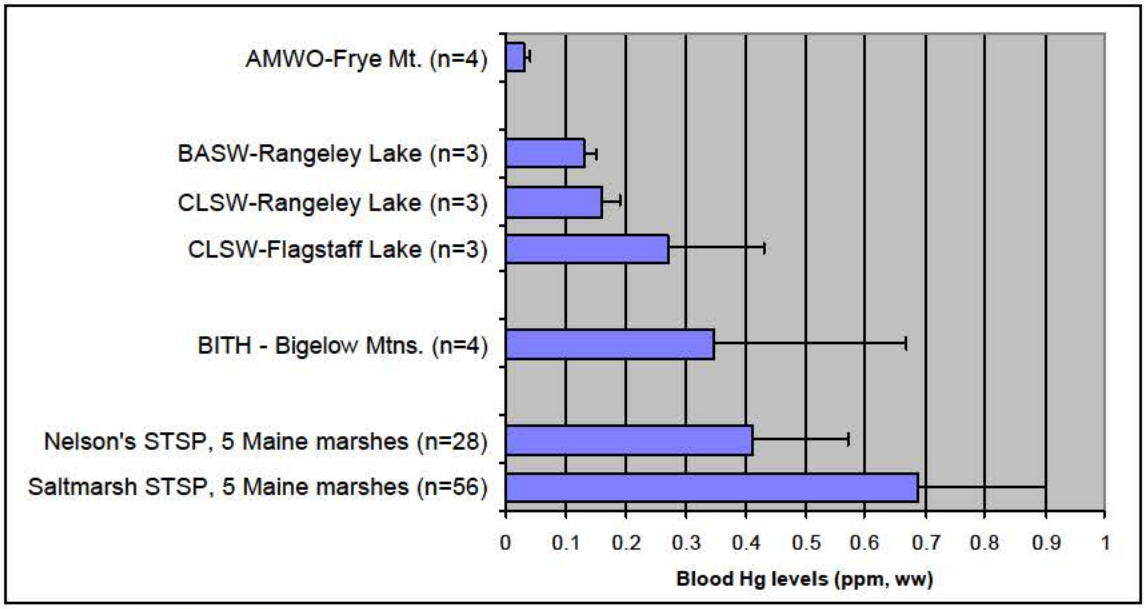
We also found differences among the five salt marshes we sampled; indicating that blood Hg levels in sharp-tailed sparrows may be used as an index to Hg contamination in the salt marshes. This finding was supported by the similar pattern in Hg levels within each species across the five sites. For both species, blood Hg levels were highest in Popham and Ogunquit, intermediate at York, and lowest in Scarborough and Weskeag. This consistency in blood Hg levels in the two species across the five sites indicates that theses sparrows may be potential indicators of salt marsh and estuarine Hg contamination.

Comparing our sparrow blood Hg levels with other related species is difficult. The handful of terrestrial bird Hg studies are not based on blood, rather their assessments use whole body analysis and/or organs (i.e., lethal sampling). However, our non-lethal sampling strategy for this project is comparable with other such collection efforts with insectivorous birds in Maine. BioDiversity Research Institute staff have sampled terrestrial birds including American Woodcock (*Scolopax minor*) (AMWO), Barn Swallow (*Hirundo rustica*) (BASW), Cliff Swallow (Petrochelidon pyrrhonota) (CLSW), and Bicknell's Thrush (Catharus bicknelli) (BITH) (Figure 4).

The sampling efforts with the swallows are particularly informative as a reference for Hg exposure. Swallows were sampled from two lakes that have thorough biotic Hg risk assessments based on fish and the Common Loon (*Gavia immer*) (Evers et al. 2002). Because swallow sample sizes are minimal statistical comparisons were not attempted. Barn and Cliff Swallows from Rangeley Lake, a low Hg risk system, had mean blood Hg levels considerably less than those found from both sharp-tailed sparrow species in each of the five marshes. Assuming a relationship exists between fish Hg levels and associated emerging insects, reference blood Hg levels for insectivorous birds are possibly less than 0.20 ppm (ww). Flagstaff Lake is well known for its elevated biotic Hg levels (Evers et al. 2002). Cliff Swallow blood Hg levels tended to be less on Flagstaff Lake than sharp-tailed sparrow blood Hg levels.

Further efforts with swallow species in areas with known biotic Hg assessments as well as at the sharp-tailed sparrow locations will provide further context for assessing hazards related to Hg levels in coastal Maine's salt marshes.

Figure 4. Blood Hg levels in selected insectivorous birds



in New England

RECOMMENDATIONS

1. Determine Hg exposure for sharp-tailed sparrows in other Maine coastal marshes with large breeding populations;
2. Determine Hg exposure for Tree Swallows with breeding territories in coastal marshes with sharp-tailed sparrows at some locations for comparative purposes;
3. Determine Hg exposure for swallow species with breeding territories in areas with known biotic Hg levels;
4. Determine prey base of sharp-tailed sparrows and analyze prey items for Hg;
5. Measure levels of other contaminants including polychlorinated biphenyls in sharp-tailed sparrows.

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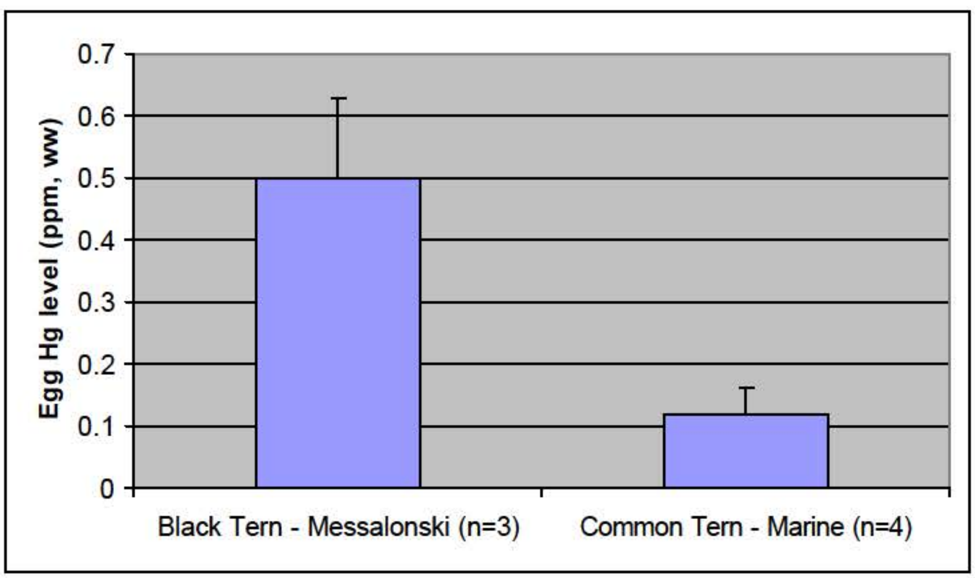
Black Terns

The Black Tern (*Chlidonias niger*) is a endangered species in Maine. It is a colonial nesting species using open emergent wetlands. In June 2001, three abandoned eggs were collected at one of the largest colonies in the state at Messalonskee Lake. These eggs were analyzed at Texas A&M Trace Element Research Lab for mercury (Hg). The mean egg Hg level was 0.50 +/- 0.13 ppm (wet weight) (Figure 1). Compared to Common Tern (*Sterna hirundo*) egg Hg levels from Stratton Island (a marine nesting site), Black Tern egg Hg levels were over four times greater. A similar pattern between marine and freshwater habitats has been demonstrated in the Belted Kingfisher (*Ceryle alcyon*) as well.

Although some evidence indicates impacts to bird reproduction and health occur when egg Hg levels exceed 0.50 ppm (ww), egg Hg levels in piscivorous birds likely need to approach 1.0 ppm (ww) before impacts occur. However, because this species is listed as endangered in Maine, further collections of tissues for Hg analysis is prudent.

Figure 1. Egg mercury levels for the Black Tern in Maine.



2.5

MERCURY TRENDS
(1999)

Temporal Changes in Fish Mercury Concentration in Maine Lakes

Final Report

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Introduction

Previous studies have demonstrated that many lakes in Maine contain fish with high mercury concentrations, commonly above 1 µg/g. We hypothesize that these levels are not natural but rather result from atmospheric transport and deposition of mercury from urban/industrial areas to the south and west of Maine to these waters. Sediment core studies from several lakes and bogs in Maine indicate that mercury deposition to sediment was relatively low and constant prior to about 1900, and then increased greatly to levels 2 to 5 times higher by 1970. At some locations, primarily in southern and coastal Maine, sediment mercury deposition then declines to the present. At other locations, primarily in northern and inland Maine, mercury deposition to sediment continues to increase to the present. One explanation for this is that mercury emissions from large point sources (coal-fired electric generating stations, solid waste incinerators) were reduced by implementation of the Clean Air Act in 1972, resulting in reduced mercury deposition from these sources. In more remote areas (northern and inland Maine) mercury deposition may result more from the global reservoir of mercury, which will likely decline very slowly. Further, the balance of precipitation between rain and snow is markedly different away from the coast, perhaps favoring less mercury deposition at inland sites. Lastly, air masses impinging on the coast during precipitation typically have storm tracks up the eastern U. S. seaboard, whereas northern Maine is more under the influence of Canadian air masses. At present there is no information to indicate if fish mercury concentration in Maine lakes is changing over time.

The earliest reliable fish mercury data in Maine are from a study of several species of fish from three lakes in the Allagash region that were sampled in 1978 (Akielaszek and Haines 1981). Several other studies, conducted from 1982-1984, determined mercury in brook trout (*Salvelinus fontinalis*) and white suckers (*Catostomus commersoni*) from nine small lakes in central and southern Maine (Haines *et al.* 1987; Hamilton and Haines1989; Haines and Brumbaugh 1994). Several of these lakes were cored for historical sediment analysis (stable lead isotopes, trace metals <u>not</u> including mercury, and diatoms) at the time fish were collected for mercury analysis.

The objective of this study was to determine if there has been any consistent, systematic change in fish mercury concentration in Maine lakes over the period from 1978 to the present. To accomplish this, we screened the list of lakes for which historical fish mercury data were available and selected candidate lakes that represented the various species of fish and physical and chemical conditions available. Fish of different food habits or life history may respond differently to changes in mercury supply or availability. Lakes of different size and location may have different mercury inputs, retention, or methylation rate, which may in turn affect fish mercury content. We also collected a sediment core from one lake, so that historical changes in sediment mercury accumulation could be compared to changes in fish mercury over the same time period.

Methods

Several species of fish from a number of Maine lakes were analyzed for mercury in the late 1970s to early 1980s (Akielaszek and Haines 1981; Haines and Brumbaugh 1994; Haines *et al*. 1987; Hamilton and Haines 1989). We screened this data set to identify suitable lakes to be resurveyed. Selection criteria included: no major change in access, watershed development, or fish management practices; relative ease of access; presence of robust fish population to be resampled; and a time interval between sample periods of at least 15 years. Seven lakes were selected to be resurveyed. They ranged in size from 2 to more than 2000 ha and included three species of fish: lake trout (*Salvelinus namaycush*, long-lived, carnivorous), brook trout (short-lived, omnivorous), and white sucker (long-lived, bottom-feeder). For the original survey, detailed field and laboratory records were available from data archives. These records described collection methods, locations, and times, fish species, number, and size collected, and laboratory analytical methods and quality assurance used to determine mercury content.

For the present survey, fish were collected by the same methods and in the same locations as in the original survey. The primary collection method was gill netting with Swedish experimental (graded mesh) nets, except that lake trout from Big Eagle Lake were collected by angling in 2001 and by both gill net and angling in 1978. The collection goal was 10 fish per species within a similar size range to those previously analyzed. Fish were placed in plastic bags, on ice, and returned to the laboratory as soon as practical. In the laboratory, fish were weighed (nearest g), measured (total length, mm), individually wrapped in plastic bags, and frozen. For analysis, the fish were thawed, and processed following the same procedure used to produce the prior mercury data. In the case of Big Eagle, Cliff, and St. Froid lakes (lake trout and brook trout), a strip of dorsal muscle tissue extending from just behind the head to the tail was removed from each fish, skinned, and homogenized. In the case of Mountain Pond (Coburn) and Mountain Pond (Rangeley) (brook trout), the whole fish was homogenized. And in the case of Green Lake and Horseshoe Pond (white sucker), the fish were first eviscerated and then homogenized.

In the original surveys, the fish tissue homogenate was wet-digested in acid, the precise nature of which varied with the survey, and analyzed by atomic absorption spectrometry, the standard method at the time. The moisture content of the homogenate was determined in some studies but not in others. In the Akielaszek and Haines (1981) study, the fish were analyzed at the University of Maine. For the other studies, the fish were analyzed at the National Fisheries Contaminant Research Center (now the Environmental Research Center) in Columbia, Missouri. In all cases a full quality assurance program was followed to ensure data precision and accuracy, including reagent and digestion blanks, sample duplicates, matrix spikes, and certified reference materials. For the recent samples, moisture content was determined on a subsample of the homogenate by use of a moisture balance. Total mercury was determined by digestion of approximately 0.5 g of homogenate in a 1:1 mixture of concentrated nitric acid and hydrogen peroxide with microwave energy, and analysis by automated atomic fluorescence spectrometry. The quality assurance program included the same components as that in the original surveys. Although these methods differed from those used in the original survey, the quality assurance programs in effect demonstrate that the results obtained were within accepted standards of accuracy and precision, and thus are comparable.

A sediment core was retrieved from Cliff Lake from a point just west of the deep hole, in water 58 feet deep, using a stationary piston coring head and acrylic core barrel with a 10 cm diameter. The 45 cm core was extruded and sectioned in the field as follows: 0 to 1 cm, 1 to 10 cm depth in 0.5 cm intervals, 10-30 cm in 1.0 cm intervals, and 30-42 cm in 2.0 cm intervals. Sediment was stored cold in Whirl-Pak™ bags prior to processing in the laboratory. Water concentration and organic matter concentration were determined for calculations associated with ^{210}Pb dating of the sediment. Water concentration was determined by heating the sediment at 35^{o}C to constant weight. Previous experience has demonstrated that no mercury is lost when heating at temperatures below 70 ^{o}C. Organic matter was determined by ramped heating of an aliquot of dried sample to 550^{o}C, for 3 hours (constant weight). ^{210}Pb gamma-ray activity was determined using the 46.52 keV emission. We used a Canberra germanium well detector (1 by 4 cm) with 22.5% efficiency for ^{60}Co. Data were processed using *GammaTrac* software (Oxford Instruments). Dried sediment in capped 1 by 4 cm polyethylene vial was counted for 43,200 to 259,200 seconds. Data were analyzed by Compton continuum subtraction of the peaks. Calibration of the detector was done using U.S. EPA National Exposure Research Laboratory aqueous standards (^{210}Pb, ^{241}Am, ^{226}Ra, ^{137}Cs, and ^{60}Co) in the same geometry as the sediment samples. The $^{210}Pb_u$(unsupported) activity was estimated by subtracting the constant background ^{210}Pb activity, deep in the core, from total $^{210}Pb_t$. The (integrated) $\Sigma^{210}Pb_u$ (Bq$^{210}Pb_u$/cm^2/core), necessary for dating, also assesses sediment focusing. Calculation of age of interval mid-points was based on the CRS model of Appleby and Oldfield (1983). We used linear interpolation between interval mid-point ages to determine ages of interval boundaries and thus the years represented by an interval.

This analytical method concurrently may measure other radionuclides of interest, including ^{134}Cs, ^{137}Cs, ^{241}Am, and ^{40}K. The first three have been commonly used to corroborate the ^{210}Pb method, which gives continuous dating of the sediment with depth. The age calculation was based on the CRS (**c**onstant **r**ate of **s**upply) model of Appleby and Oldfield (1978); however, we also tested the CIC model (**c**onstant **i**nitial **c**oncentration).

Separate aliquots of sediment intervals were analyzed for total Hg by atomic fluorescence spectrometry. QA/QC measures included: analysis of duplicate aliquots, multiple measurements of the sample aliquot, analysis of reagent blanks, and analysis of standard reference materials. Data from the chemical and radionuclide analyses were used to generate the relationship between flux of the metals to the sediment versus chronological time. This output can be compared to the history of the drainage basin to establish causal relationships between chemical changes and anthropogenic activities, and to the mercury concentration in fish at known time intervals.

The net accumulation rate for total Hg (ng Hg/cm^2/yr) equals:

Hg_T = [(mass of sediment/interval/cm^2)(concentration of Hg in interval)]/(years/interval) (1)

This total flux is composed of three components. (1) The natural background flux of Hg, Hg_B. Commonly, variations in % organic matter cause variations in Hg concentration. However, LOI does not vary appreciably in the background portion of the core and therefore we have made no correction for this effect. We use pre-1880 sediment for this estimate. (2) Variations in the gross sedimentation rate caused by human activities in the watershed cause variations in the flux of Hg, Hg_V. This variation is estimated from pre-1880 sediment using the ratio (sedimentation rate for any sediment interval [g/m^2/yr])/(pre-1880 sedimentation rate [g/m^2/yr]). (3) Variations in deposition of anthropogenic Hg directly to the lake and from leaching of Hg from the watershed to the lake, Hg_A. Thus:

$$\text{Total Hg (ng Hg/cm}^2\text{/yr)} = Hg_B + Hg_V + Hg_A \qquad (2)$$

Results

The seven lakes that were resurveyed ranged in surface area from 2 to 2153 ha, in maximum depth from 3 to 38 m, in elevation from 139 to 871 m, in watershed area from 13 to 104,600 ha, and in acid neutralizing capacity from 6 to 520 µeq/L (Table 1). The locations ranged from central Hancock County to northern Aroostook County (Figure 1). For two of the lakes resurveyed, only brook trout were collected, for an additional two only lake trout were collected, for one lake both brook trout and lake trout were collected, and for two lakes only white suckers were collected (Table 2). The fish collected in the recent survey were generally similar in size to those collected previously (Figure 2), and linear regressions of weight on length for each collection year for each species and lake were generally not different for slope or intercept (test for common regression, Freese 1967). However, the recent collections of white suckers from Green Lake and brook trout from Mountain Pond (Coburn) were significantly different for intercept but not slope, indicating that the relation between weight and length is similar, but that the recently-collected fish are significantly lighter in weight than fish of the same length in the previous survey.

Fish mercury concentration generally increased as fish size increased (Figure 3), although the regressions were not always statistically significant, especially for the collections with smaller sample sizes. Regressions of fish mercury concentration on either length or weight were similar, so tests of difference in fish mercury concentration among years were adjusted for difference in fish size by using length as the covariate. For brook trout, fish mercury concentration was significantly higher in the recent collection for all three lakes (Table 3), even in Mountain Pond (Coburn), where the fish in the recent collection were significantly smaller than in the earlier collection. Fish mercury concentration also increased over time for lake trout, but the difference was statistically significant only for Cliff Lake (Table 3). For white sucker, fish from both Green Lake and Horseshoe Pond were significantly lower in mercury concentration for the recent collection (Table 3). Although for Green Lake the fish in the recent collection were also smaller than in the earlier collection, which could contribute to the lower mercury concentration in the fish in the recent collection, this was not the case for Horseshoe Pond. These differences are large and statistically significant whether adjusted for fish size or not.

Dating of the sediment is based on a 12-point analysis of ^{210}Pb. There is a suggestion of some mixing of sediment or accelerated sediment accumulation in the upper 5-7 cm, indicated by a slightly less steep downward decrease in the activity of ^{210}Pb. Application of the CRS dating model yields a nearly linear decrease in age with increasing depth. The maximum activity of ^{137}Cs occurs in the sediment interval dated at 1958 (spanning 1956-1960), reasonably consistent with the known maximum atmospheric deposition caused by atmospheric nuclear bomb testing in 1963. ^{137}Cs occurs considerably deeper than sediment dated as 1963 and also persists to the surface. The former is likely caused by some downward bioturbation of early 1960s sediment as well as downward diffusion of ionic Cs. The latter is caused by upward bioturbation and diffusion from the maximum sediment activity as well as post 1960s wash-in from the watershed. ^{241}Am was too low in activity for use as a second independent estimate of the depth of 1963. We judge the chronological control to be very good in the last 50 years. The counting error at about 1900 yields an age estimate error of ±15 yr.

The concentration of Hg in sediment ranges from background values of approximately 185 µg/g prior to 1800 (poorly estimated age) to a maximum of about 335 µg/g in the 1980-1995 period. Concentration increased slightly in the first half of the 19th century and then linearly with time from 1850 to about 1915; it decreased slightly to about 1950 and then increased to about 300± until the time of coring in 2000 (Figure 4). The early onset of the increase (1850), while small in absolute value, is persistent and the earliest clear increase we have observed in Maine. The overall increase is modest, never reaching twice background, and is comparable to other remote lakes in northern Maine. The total flux of Hg to the coring site ranges from slightly over 2 ng/cm^2/yr prior to 1850 to nearly 10 ng/cm^2/yr (averaging the two widely disparate samples at the top of the core (Figure 5). The increase is relatively constant with little indication of a persistent change in slope. The error in analysis of the ^{210}Pb for any particular measurement is probably the poorest in precision of any parameter. These errors translate through the calculations for age of sediment intervals, length of time represented by intervals, and thus the flux of Hg. The running accumulation rate for total Hg based on 3-adjacent intervals yields a smooth increase in the total Hg flux over the last 130 years. The accumulation rate for the anthropogenic component of the total Hg flux (correcting for background and varying sediment accumulation rate) was determined with the assumption that background is the flux prior to 1875 (i.e., the mean anthropogenic flux prior to 1875 is 0 ng/cm^2/yr). Thus the flux increases from 0 to approximately 3 ng/cm^2/yr, using a 3-point running average to reduce the section to section variation (Figure 6). The increase is relatively constant, possibly with a plateau from 1920 to 1950. This is a typical profile for lakes in northern Maine.

The anthropogenic mercury accumulation rate during the time period for which fish mercury data are also available increases consistently (Figure 7), with the accumulation rate in 2000 being about 35% higher than in 1978. Fish mercury concentration in this lake has also increased over this time interval, by a factor of 2.5 for brook trout and 1.8 for lake trout.

Discussion

The lakes surveyed for this project were relatively undisturbed by human activity. There are no known local sources of mercury to these lakes, so atmospheric deposition is presumed to be the major source. At most there are a few seasonal roads and dwellings in the watersheds, and timber harvesting is the major watershed disturbance. Management of the fish populations has generally not changed, although brook trout were stocked into Horseshoe Pond annually from 1997 to 1999 (no trout were caught in the gill nets). There was evidence that angling pressure had increased significantly at Mountain Pond (Rangeley) between the two collection dates. At the time of the recent survey there was a very well-used ATV trail leading to the lake, and a large number of boats and canoes on the shore of the lake. At the time of the earlier survey there was only a little-used hiking trail to the lake, and a very small number of boats.

The same species and sizes of fish that were collected in the original survey were obtained in the recent survey. Fish were not aged because they had not been aged in the original survey, so changes in size-age relationships could not be determined. However, in two cases the length-weight regressions indicated that fish in the recent survey were lighter than fish of the same length in the original survey. Inasmuch as there had been no change in human activity in the watershed between collections, the change in size probably resulted from a change in population density or food supply, which then resulted in a decline in growth rate. The declines were small and probably had little effect on the mercury concentration results.

Although the amount of mercury on earth has not changed since the planet was formed, it is generally accepted that human activities have increased the amount of mercury cycling through the biosphere and that this increase is reflected in the mercury content of biota (USEPA 1997). Our results document an increase in mercury input to Maine lakes, as shown by the sedimentary record, and a concomitant increase in mercury concentration in some lake-dwelling fish. Mercury concentration in brook trout increased on average at the rate of 4.2 ng/g/yr, and in lake trout at 3.3 ng/g/yr (although for two out of the three populations the increase was not statistically significant). These findings are similar to those reported elsewhere. However, mercury concentration of white suckers decreased on average at the rate of 9.8 ng/g/yr. There were no previous studies of change in mercury content of this species in the literature, so it is unknown if this is a typical response for this species.

In Minnesota, Swain and Helwig (1989) surveyed the change in mercury concentration of northern pike (*Esox lucius*) in 9 lakes between 1970 and 1988, with time between sampling of 5 to 16 years, and found a mean increase of 17 ng/g/yr, from a mean concentration of 360 ng/g to 470 ng/g over an average time interval of 7.2 years. Håkanson (1991) determined mercury concentration in northern pike in 73 lakes in Sweden at various time intervals. Change in fish mercury concentration with time ranged from –135 ng/g/yr to +180 ng/g/yr, with 11% of the lakes having a decreasing trend, 45% having no change, and 44% having an increasing trend. Fabris *et al*. (1999) compared mercury concentration in black bream (*Acanthopagrus butcheri*) from brackish lakes in southeastern Australia with values obtained in another survey 18 years previously. Mercury concentration increased from 110 to 180 ng/g (least square mean size adjusted), for a rate of 3.9 ng/g/yr.

Several authors have compared mercury concentration in museum fish specimens to that in recently collected fish from the same location. Amrhein and Geis (2001) compared muscle mercury concentration in yellow perch (*Perca flavescens*) collected from five lakes in northern Wisconsin 1927-28 with that in 1988. There was a significant increase in mercury concentration in fish from two lakes (from 220 to 760 ng/g dry weight in one lake and from 370 ng/g to 670 ng/g in another), no change in two lakes, and a significant decrease in one lake (from 530 ng/g dry weight to 260 ng/g). There were some differences in size and age of fish between the two collection dates, which were not controlled in the analysis, making these results somewhat questionable. Swain and Helwig (1989) determined mercury concentration in northern pike and walleye (*Stizostedion vitreum*) collected in 1935-36 from six lakes in northern Minnesota and compared them with measurements for the same species and size of fish in 1983-86. Fish mercury concentration increased over time in four lakes, at rates ranging from 2 to 9 ng/g/yr, did not change in one lake, and decreased in one lake at a rate of 2 ng/g/yr. In contrast, Kelly *et al*. (1975) found little difference in mercury concentration of walleyes in Michigan when museum specimens collected between 1865 and 1936 were compared with specimens collected in 1971 from the same lakes. They noted that variation in fish mercury concentration was greater among locations than between collection periods. There are concerns with mercury results from analysis of museum specimens, chiefly regarding the loss of moisture and lipids to the storage medium (normally alcohol), but the above studies controlled for most of these problems, and the findings are consistent with other studies.

The only cases where fish mercury concentration declined over time were for white suckers. In both Green Lake and Horseshoe Pond, fish mercury concentration declined by a similar percentage: 34% in Green Lake and 28% in Horseshoe Pond. The rate of decrease was -5.8 ng/g/yr for Green Lake and -13.7 ng/g/yr for Horseshoe Pond. In the two studies cited above for which decreases in fish mercury concentration over time were reported, the rates were 2 ng/g/yr for northern pike (Swain and Helwig 1989) and 4.4 ng/g/yr for yellow perch (Amrhein and Geis 2001). A recent study of mercury concentration changes over time in eastern mosquitofish (*Gambusia holbrooki*) in south Florida (Stober *et al*. 2001) found that mean mercury concentration declined from 163 ng/g in 1995-96 to 123 ng/g in 1999, a rate of -13.3 ng/g/yr. The authors believe that mercury emissions to the atmosphere from waste incinerators declined in this area during this time period, and water concentrations of total mercury also declined during the wet season, from 1.96 ng/L in 1995-96 to 1.43 ng/L in 1999 (water mercury concentrations increased during the dry season over this time interval). The Everglades ecosystem is very shallow and mosquitofish are very small and short-lived, so this system may respond rapidly to reductions in mercury inputs. However, the authors also state that other studies have documented declines in mercury concentration of largemouth bass (*Micropterus salmoides*) of 66% since 1990, and in great egret nestling feathers of 50% from 1994 to 2000, so mercury may be declining quite rapidly in the entire system (the references cited for this work are abstracts from workshop proceedings, which are not available for inspection).

The earlier collections of white suckers were analyzed for mercury at the National Fisheries Contaminant Research Center (now the Columbia Environmental Research Center) in Columbia, Missouri. However, full quality assurance procedures were followed by the Columbia laboratory, and the mercury results obtained are believed to be at least as accurate as the analyses that were performed at the University of Maine. Further, the brook trout from Mountain Pond (Coburn) and Mountain Pond (Rangeley) were also analyzed at the Columbia laboratory in the initial survey, and fish mercury increased over time in these cases. The mercury concentration of white suckers is in the same range as that of brook trout, so there is no reason to suspect that there is any analytical bias in the mercury results. White suckers are not stocked into lakes, and are not harvested by anglers, unlike brook trout and lake trout. It is not known if these differences could contribute to the different response in mercury accumulation by these fish.

The sediment core was of high quality with little disturbance of the sediment-water interface observed during coring and sectioning. The profile of water and LOI down-core were typical for lake sediment in Maine and indicated no major disturbance of the sedimentary regime, such as slumping or a dramatic change in the accumulation rate of sediment. The ^{210}Pb chronology is good and consistent with the ^{137}Cs data. Although there is evidence of an increase in Hg concentration in the second half of the 19th century, and presumably an increase in the accumulation rate of Hg, the correction for this cannot be made because the limit of the dating is about 1850. The corrections would be slight and would not materially change the anthropogenic flux or trends. Sedimentation rate did increase rather abruptly about 1935+/- by nearly 100%. This may be related to a cycle of forest cutting in the catchment, with associated land scarification and erosion. This increase is factored into the results of Figures 5 and 6. Some unknown proportion of Hg associated with the increased sedimentation rate was derived from anthropogenic Hg deposited initially on the catchment, rather than directly on the lake. Thus Figures 5 and 6 combine anthropogenic Hg derived from three routes: direct deposition from the atmosphere to the lake, leakage of Hg from the terrestrial part of the catchment, and mechanical erosion of previously stored Hg.

Cliff Lake is relatively deep for Maine lakes and has a pronounced deep area. The result of this is a slight focusing of sediment at the coring site. This is most clearly seen in the integrated unsupported ^{210}Pb derived from atmospheric deposition. Approximately 17 pCi/cm^2 (6.2*10^{-1} bq/cm^2) exists at the coring site, nearly 50% higher than is delivered by precipitation. This suggests that the flux of Hg is probably overestimated, but trends are unaffected. The observation that Hg accumulation (total and anthropogenic) increases to the present (2000) cannot be interpreted as an increase in deposition. Retention of recently deposited Hg in the catchment may be in the range of 90 to 95%. Consequently, a change in Hg deposition from the atmosphere may take 30-40 years to reach steady state with export of Hg from the watershed to the lake. Independent paleolimnological and soil evidence (Evans *et al*. 2000; Norton *et al*. 1997) indicates that Hg deposition from the atmosphere probably peaked in Maine in the 1970s. However, the most recent 30 years of sediment Hg accumulation in Cliff Lake (Figure 7) do not reflect such a decline.

The Mercury Deposition Network (MDN) has conducted measurements of mercury content of weekly precipitation since 1996 at the station in Acadia National Park, and since 1998 at the station in Greenville. During this rather short time period, mean annual mercury concentration has been relatively constant at both locations (Figure 8). The mean annual mercury deposition rate has been constant at Acadia National Park, but may have declined slightly at Greenville (Figure 9). Note, however, that the data point for 2001 is for the first six months of the year only, and that 2001 has been a drought year in Maine. The presumed decrease in atmospheric deposition may take a few more years to be detectable in precipitation measurements, and a few decades to be reflected in a measurable reduction in export of Hg from the catchment to the lake. Any paleolimnological record typically lags atmospheric changes and is smeared through time by bioturbation and as a consequence of the time necessary for fine-grained sediment to reach the lake and be mechanically winnowed into deeper water. Sediment deposited at the deep hole is a mixture of modern and reworked older sediment. In spite of these reservations, it is clear that the supply of Hg to the coring location has not diminished over the last 30 years. The sedimentary mercury record for this lake is thus in general agreement with the fish mercury record.

Summary and Conclusions

The available scientific evidence demonstrates that human activity has increased the amount of mercury cycling through the atmosphere of the earth, and being deposited to the earth's surface. Although the increase in atmospheric mercury may have halted recently, or even declined at some locations, the sediment core from Cliff Lake demonstrates that the mercury input to this remote lake began to increase above background in the mid-1800s and that this increase continues to the present. The fish mercury record is in general agreement with the sedimentary record, increasing over time at six of the eight locations surveyed, although the increase was statistically significant at only four of the six locations. The only cases where fish mercury concentration declined over time were for white suckers from two lakes. The results of this study are generally consistent with the literature, where increases in fish mercury concentration over recent time have been found for the majority of cases investigated. Fish mercury decreases have been reported for other species in other lakes in a minority of cases, and may reflect normal lake-to-lake variability. It is not known if there is some unique feature related to white suckers as a species or the lakes from which they were collected that could account for the observed decline in mercury in this species.

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Table 1. Physical and chemical characteristics of the lakes resurveyed.

MIDAS	Name	Township	County	Surface Area (ha)	Max Depth (m)	Elevation (m)	Watershed Area (ha)	ANC, µeq/L
0160	Mountain Pd. (Coburn)	Johnson Mtn	Somerset	2	3	871	13	45
1610	St. Froid Lk.	Winterville Plt.	Aroostook	972	35	185	104596	504
2780	Cliff Lk.	T9 R12 WELS	Piscataquis	228	20	307	2436	520
2858	Eagle Lk. (Big)	Eagle Lake	Piscataquis	2153	38	294	44013	286
3540	Mountain Pd. (Rangeley)	Rangeley Plt.	Franklin	17	12	733	145	13
4790	Green Lk. (#2)	T35 MD	Hancock	26	4	139	114	110
0858	Horseshoe Pd.	Willimantic	Piscataquis	26	4	162	194	6

Table 2. Size-adjusted mean fish mercury concentration by species and lake for the early and recent collection dates. Mercury values are least square means, ng/g wet weight, using length as the covariate.

Species	Lake	Year	Hg, ng/g	p
Brook trout	Cliff Lake	1978	73	0.01
	Cliff Lake	2000	182	
	Mountain (Coburn)	1979	25	0.0004
	Mountain (Coburn)	2001	74	
	Mountain (Rangeley)	1979	95	0.0005
	Mountain (Rangeley)	2000	218	
Lake trout	Big Eagle Lake	1978	531	0.44
	Big Eagle Lake	2001	594	
	Cliff Lake	1978	187	0.006
	Cliff Lake	2000	341	
	St. Froid Lake	1978	558	0.87
	St. Froid Lake	2000	569	
White sucker	Green Lake	1984	140	0.0001
	Green Lake	2000	47	
	Horseshoe Pond	1983	342	0.0031
	Horseshoe Pond	2001	96	

Figure 1. Map of the state of Maine showing the location of lakes surveyed, and the location of the Mercury Deposition Network stations in Greenville and Acadia National Park.

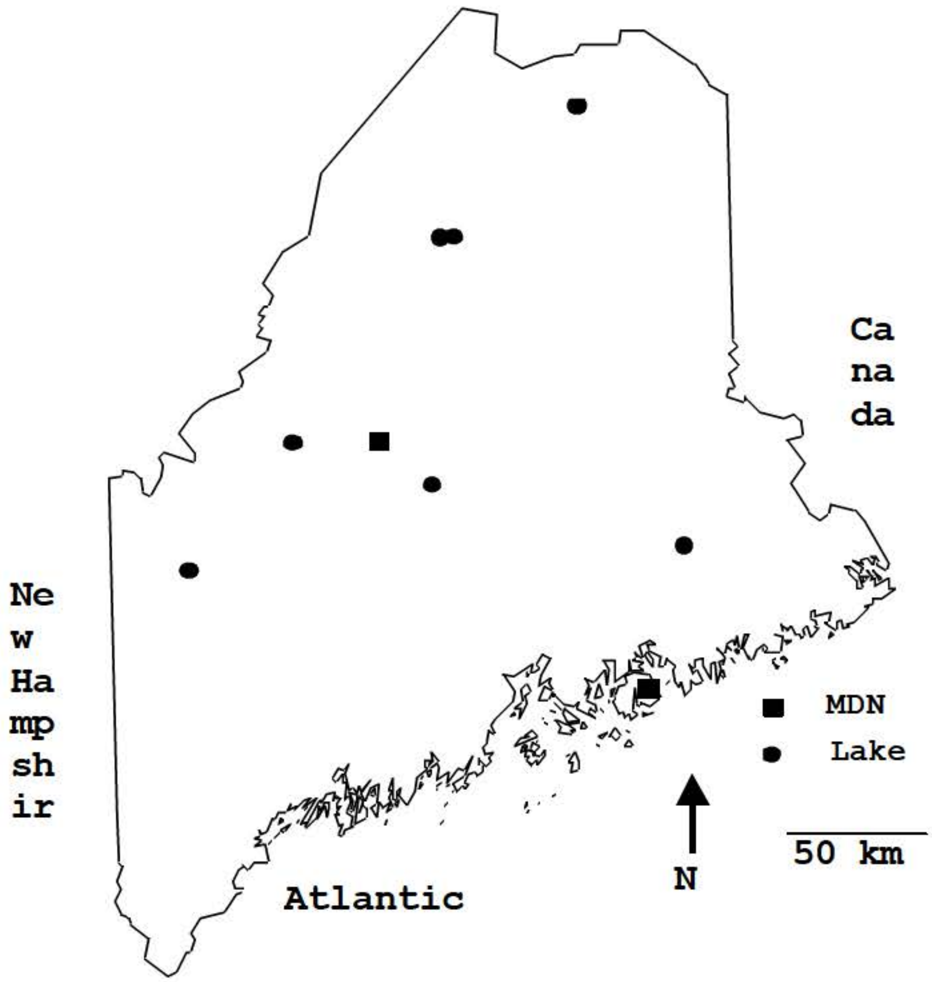


Figure 2a. Plot of fish weight on length for the two collection years. The regressions within each lake are not statistically different, except Mountain Pond (Coburn) are significantly different for intercept (Test of Common Regression, $F_{(1,9)}$ = 18.87), but not for

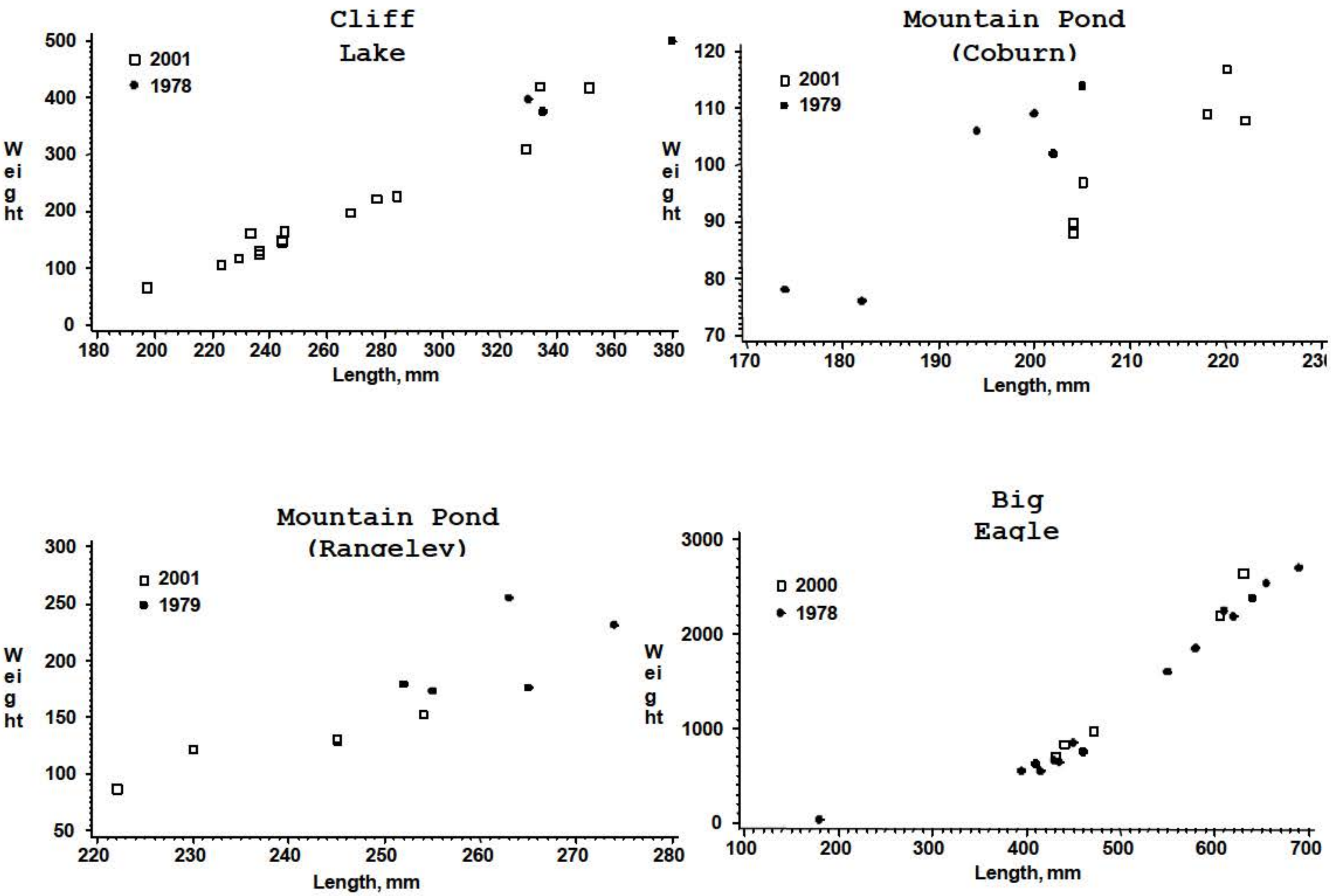


Figure 2b. Plot of fish weight on length for the two collection years. The regressions within each lake are not statistically different, except Green Lake are significantly different for

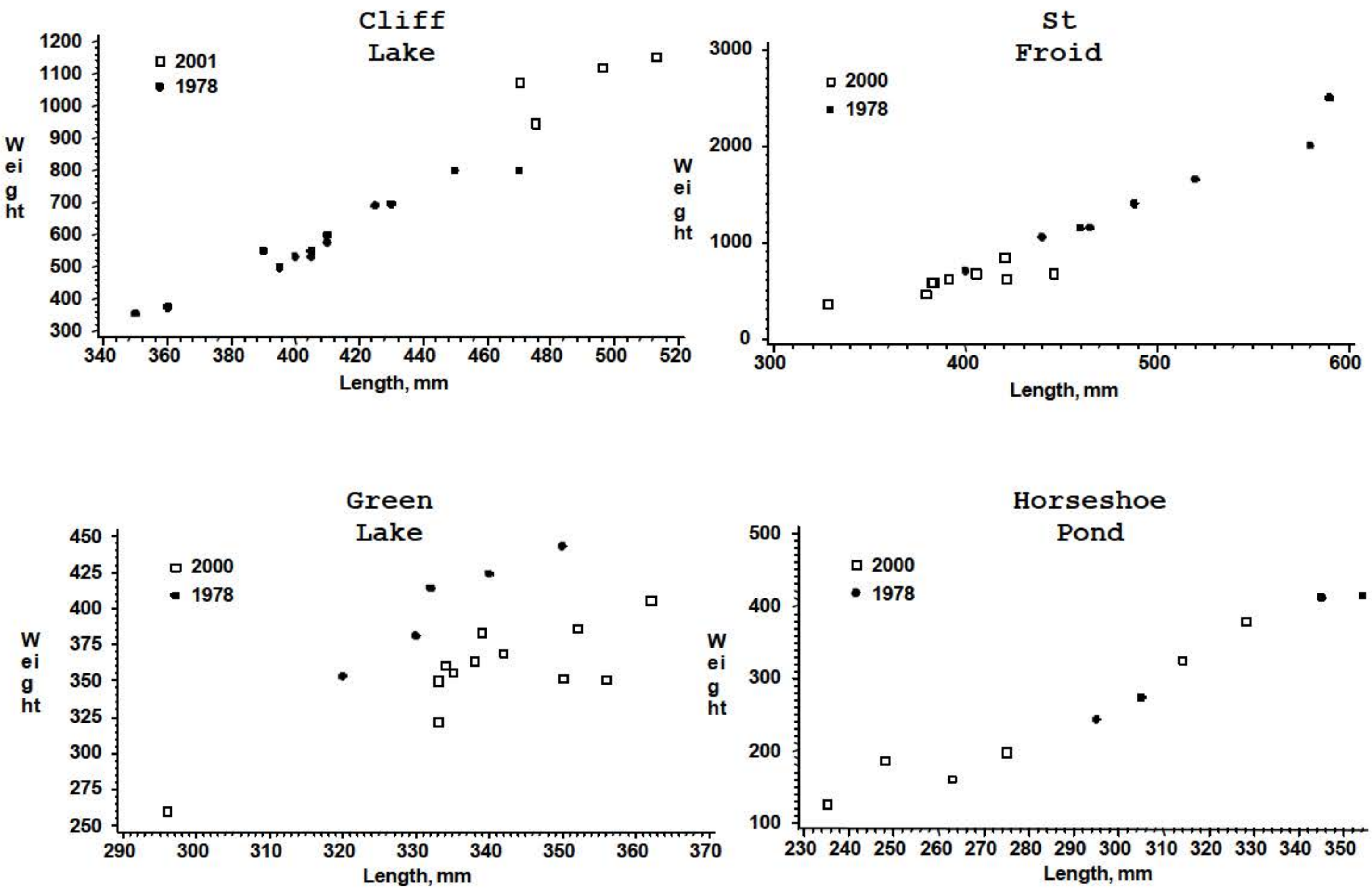


Figure 3a. Plot of fish mercury concentration on length for the two collection years by lake and species.

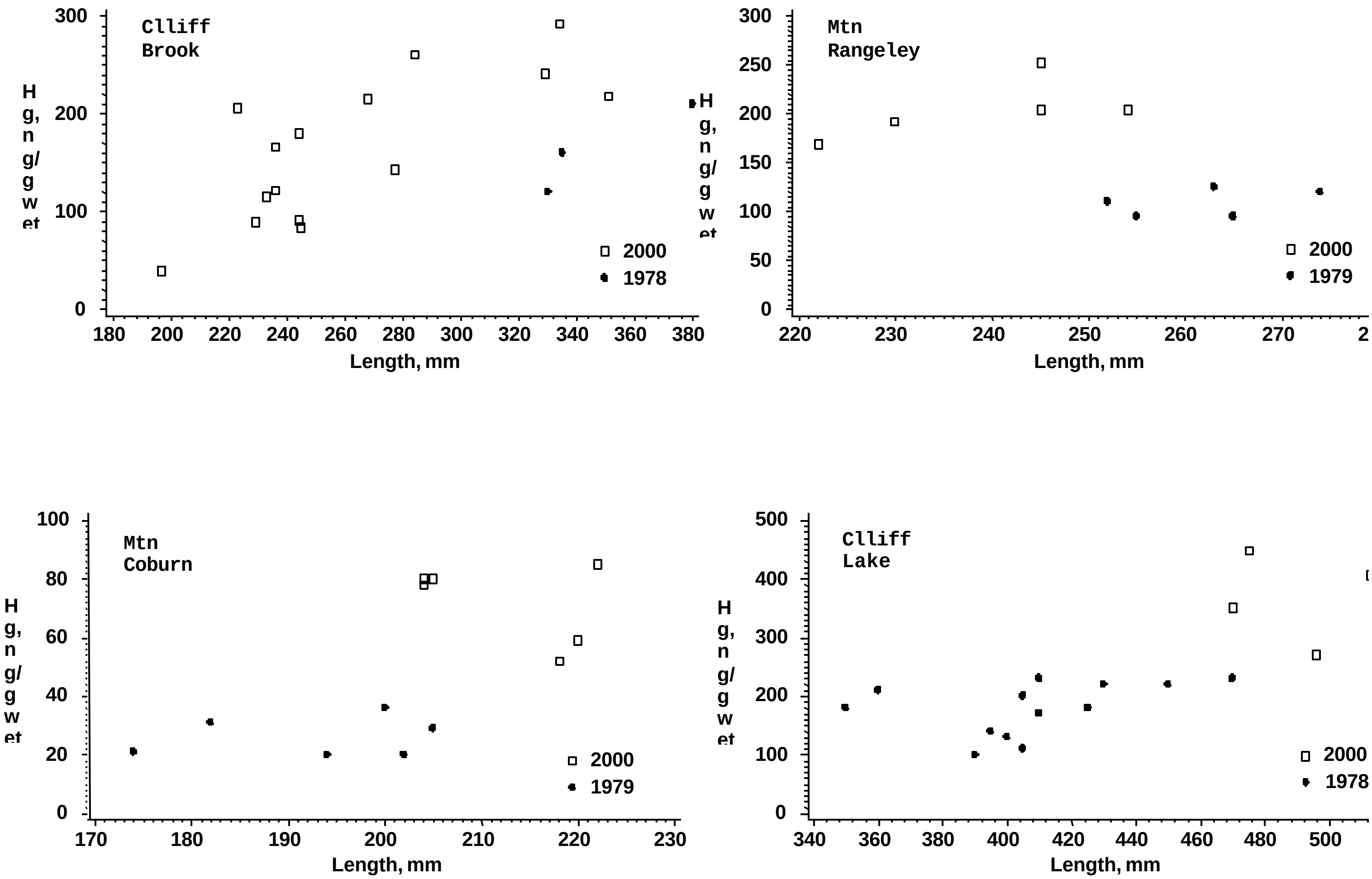


Figure 3b. Plot of fish mercury concentration on length for the two collection years by lake and species.

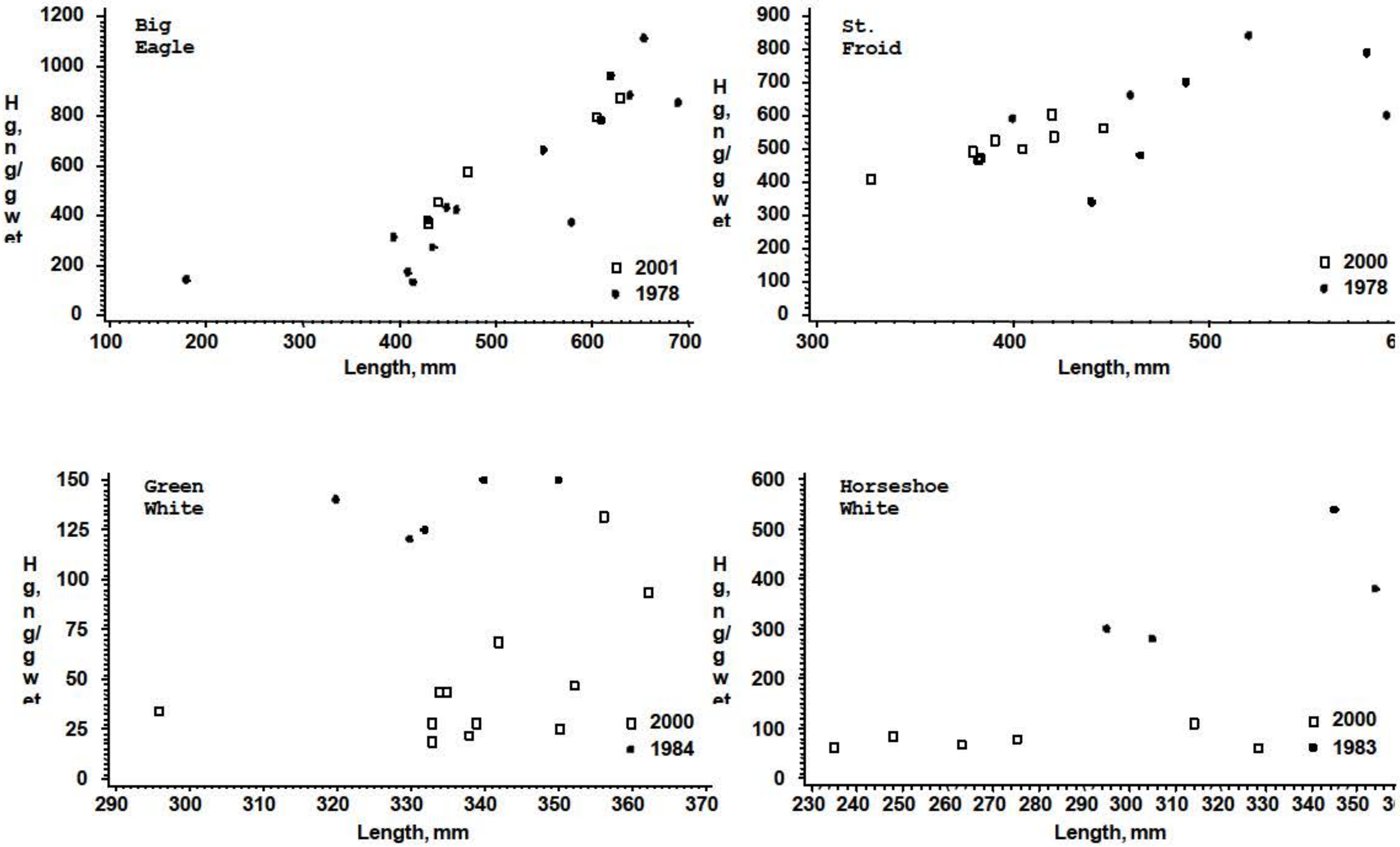


Figure 4. Total mercury concentration vs estimated age of sediment for Cliff Lake. Sediment age is estimated by ^{210}Pb dating.

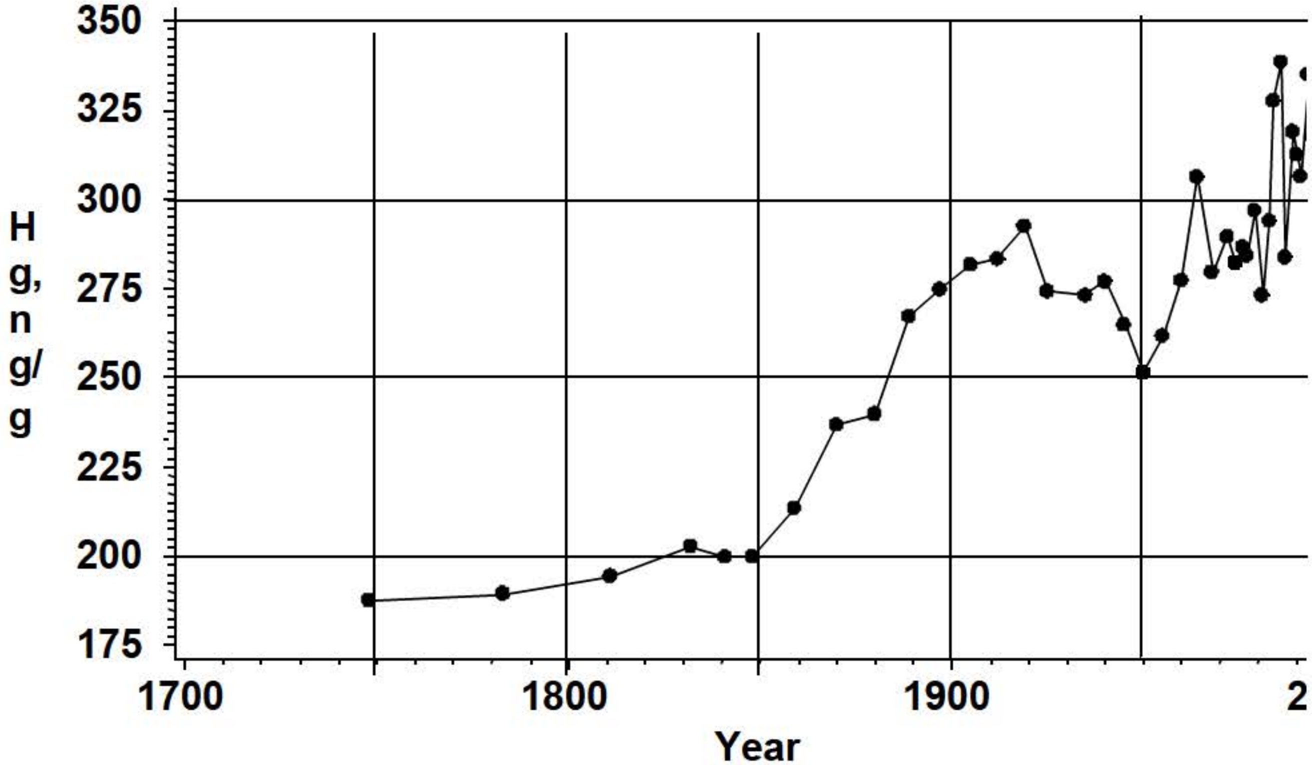


Figure 5. Total mercury accumulation rate vs estimated age of sediment for Cliff Lake. Sediment age is estimated by ^{210}Pb dating.

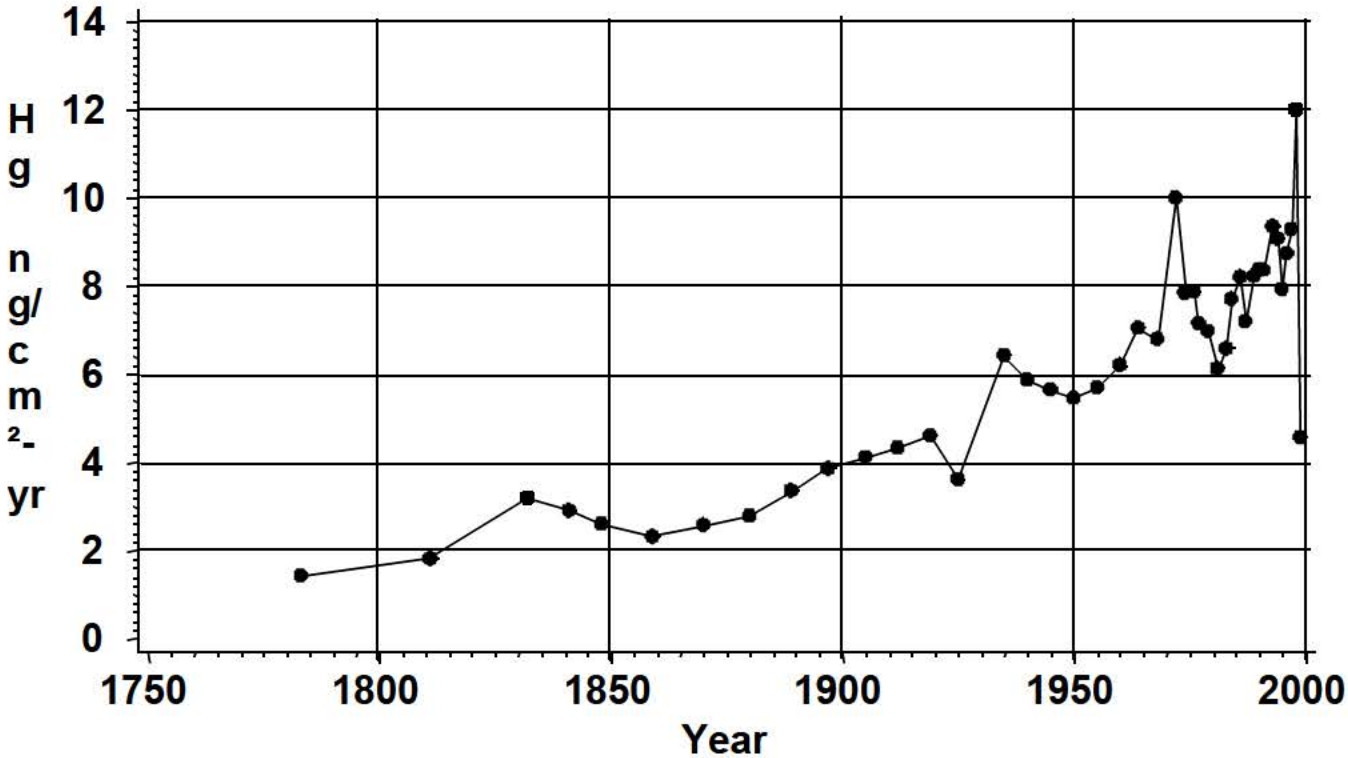


Figure 6. Anthropogenic mercury accumulation rate vs estimated age of sediment for Cliff Lake. Sediment age is estimated by ^{210}Pb dating. Anthropogenic accumulation rates are calculated by subtraction of the pre-1875 background rate and adjusting for changes in sediment accumulation rate. Raw data are plotted as calculated; 3-point average data are the mean of three consecutive measured rates centered on the plotted point.

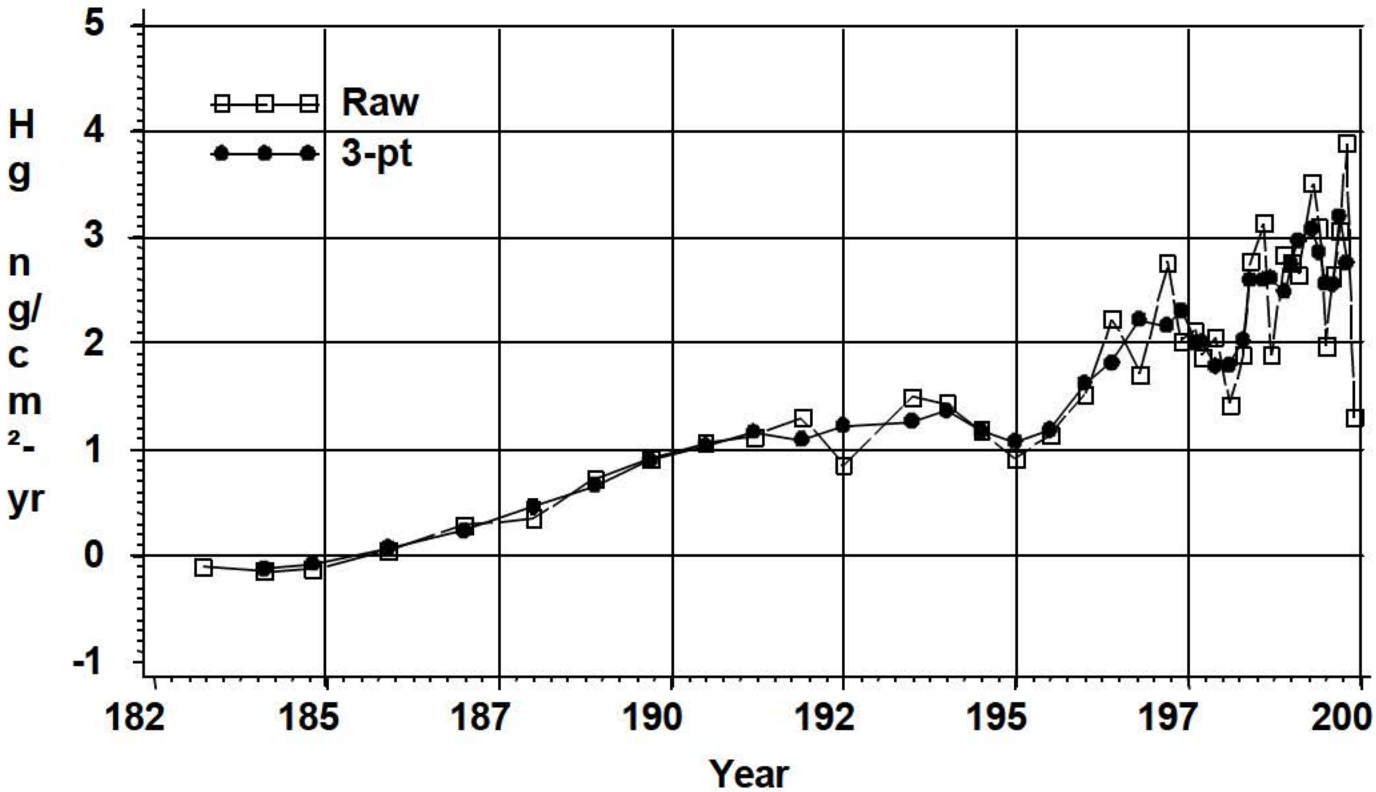


Figure 7. Linear regression of three-point running average anthropogen: accumulation rate vs estimated age of sediment for Cliff Lake for the pe during which fish mercury data are available. Sediment age is estimatec dating. Anthropogenic accumulation rates are calculated by subtraction (1875 background rate and adjusting for changes in sediment accumulation Three-point average data are the mean of three consecutive measured rat(

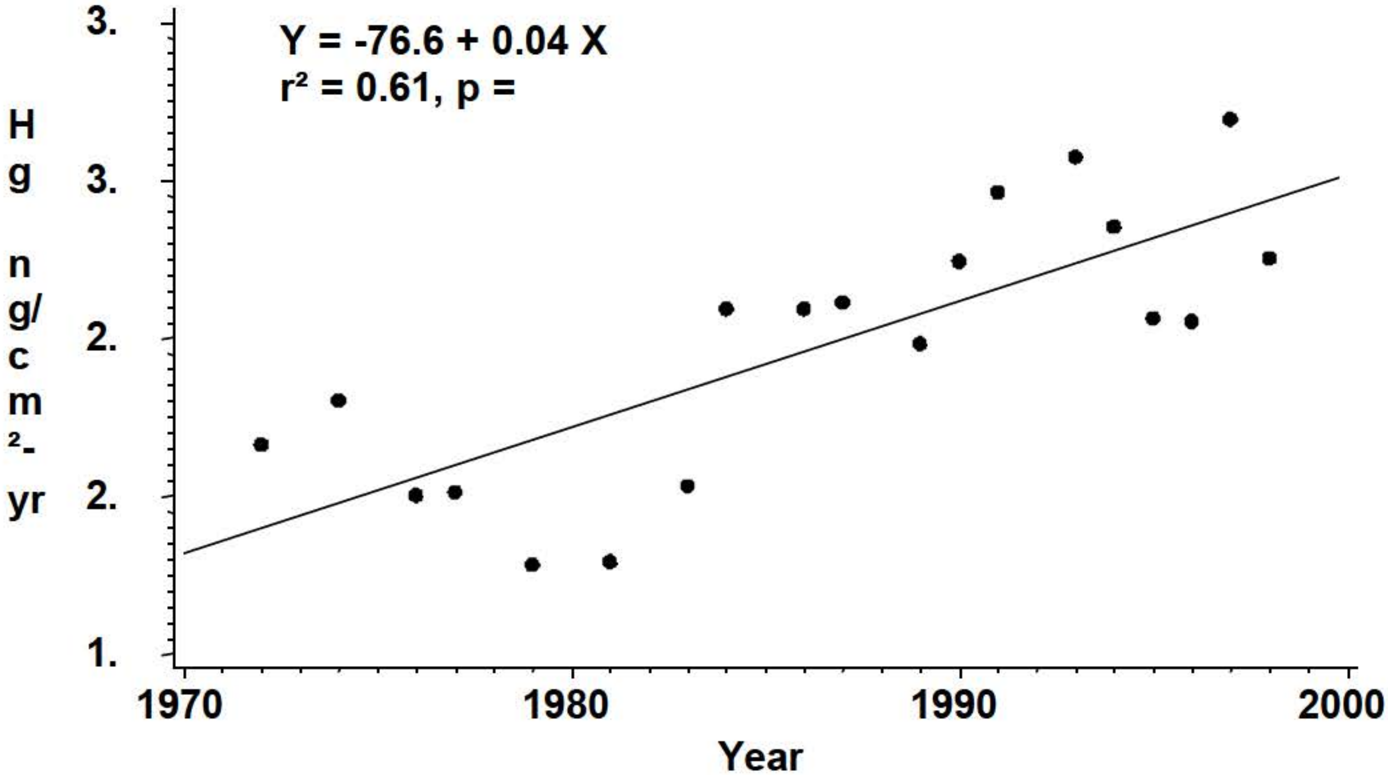


Figure 8. Annual mean mercury concentration at the Mercury Deposition Network stations at Acadia National Park and Greenville. *Data for 2001 are January to June only.

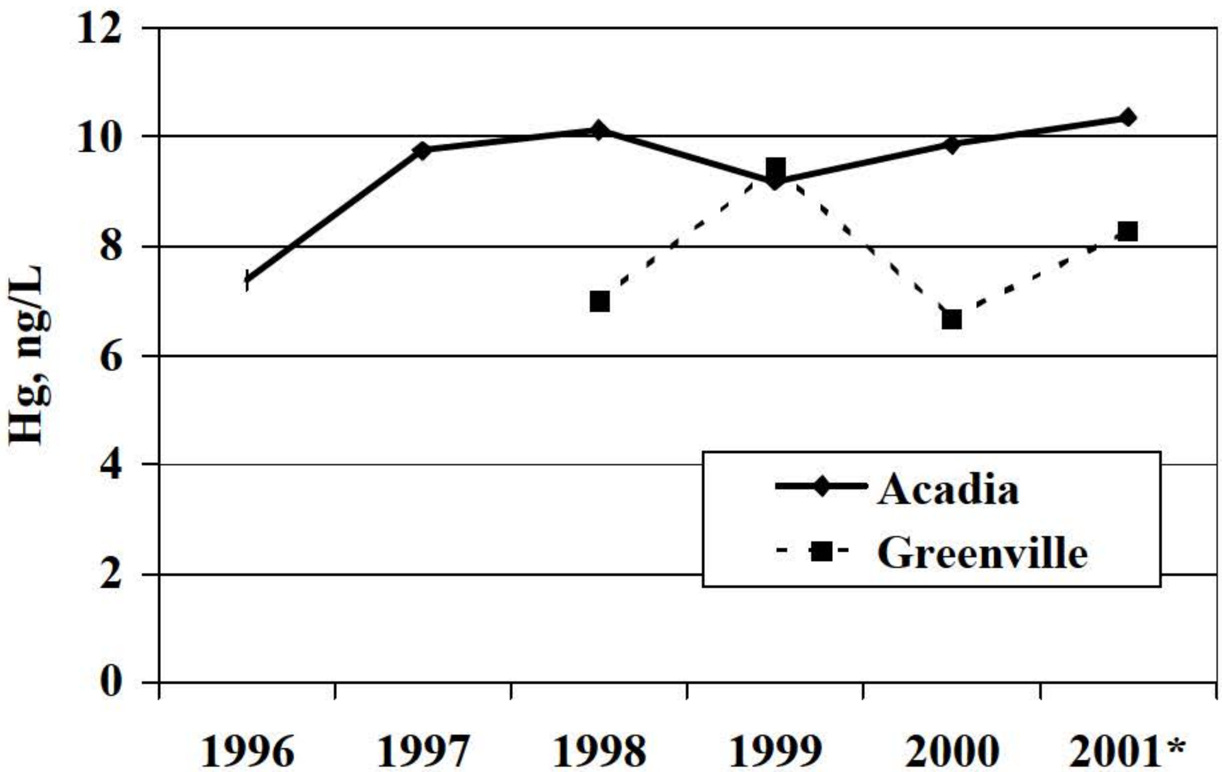
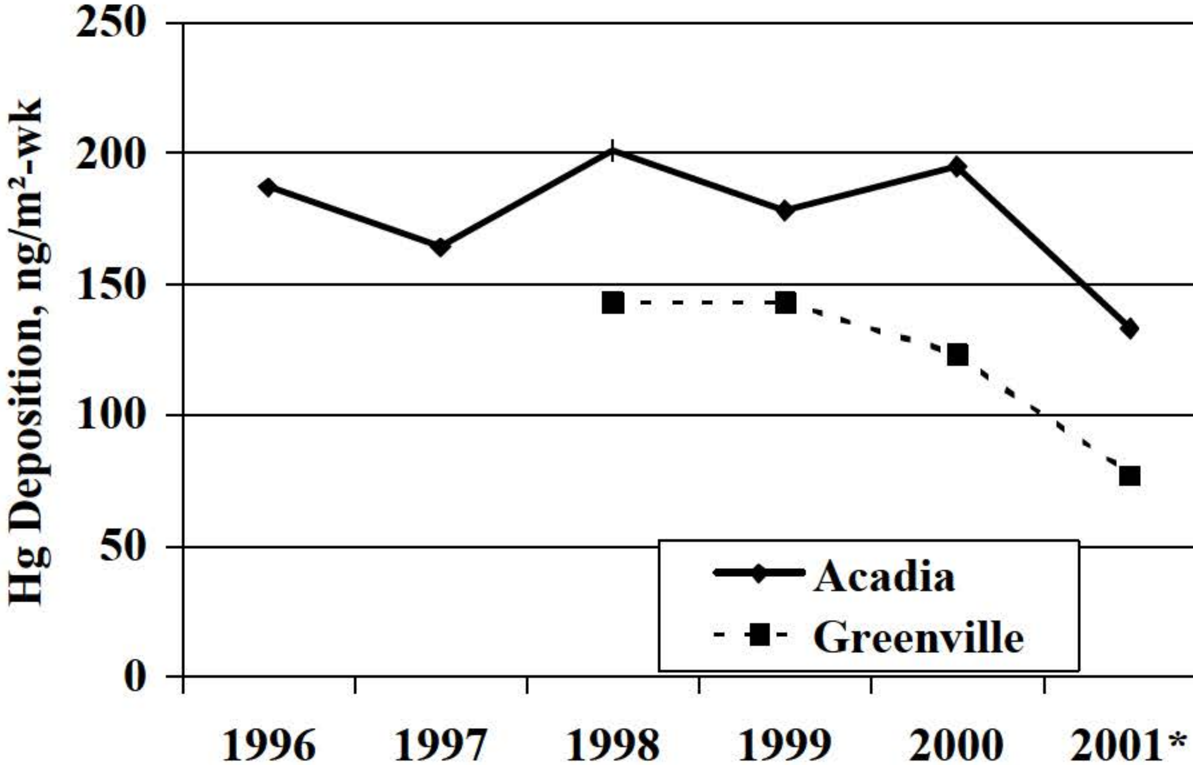


Figure 9. Annual mean mercury deposition at the Mercury Deposition Network stations at Acadia National Park and Greenville. *Data for 2001 are January to June only.



2.6

ANDROSCOGGIN LAKE SEDIMENTS

ANDROSCOGGIN LAKE SEDIMENTS

Monitoring of fish from Androscoggin Lake for dioxin as part of Maine's Dioxin Monitoring Program in 1996 documented concentrations of dioxins similar to those found in fish from the Androscoggin River nearby and higher than found in any other lake monitored in Maine (9 lakes). Since the Androscoggin River floods the lake one or more times each year, the river is the suspected source of dioxins to the fish in the lake. Additional fish samples collected in 1998, 1999, and 2000 have documented a continuing decline in dioxin concentrations to levels near background (Dioxin Monitoring Program Report, 2000 at http://www.state.me.us/dep/blwq/monitoring.htm).

In order to document the pathway, in 1999, surficial sediment samples were collected from 4 areas in the lake and analyzed for dioxins. Results were all below the detection limit (Table 2.6.1). To further explore the potential pathway, in 2000 sediment samples were collected at the lake outlet, as in 1999, at a station just upstream of the Dead River Dam and a station approximately half way between. Both surficial and subsurface samples were collected in order to determine historical and recent contamination. Results show that the lake outlet sample had significantly more dioxin than measured in 1999 and that both river stations also had measurable amounts. The difference between the 1999 and 2000 lake outlet concentrations may be due to the patchniness of sediments. Surficial sediment concentrations were slightly lower at the lake outlet and middle stations but much lower at the dam station than the subsurface samples, perhaps reflecting decreased discharges in recent years.

It is interesting that in 1999 the fish had more but the sediments had less than in 2000. The study should be repeated in 2002 to provide more documentation of sediment concentrations in the lake and river.

Table 2.6.1 Dioxin concentrations in Androscoggin Lake sediments.

Androscoggin Lake sediment DTE (ppt)

station	depth	1999 DTE	2000 DTE
L1	0-1"	0.1-0.7	7.6-8.1
	3-4"		8.0-8.2
L2	0-1"	0.03-0.7	
L3	0-1"	0.01-0.7	
L4	0-1"	0.06-0.7	
R1	0-1"		13.1-13.2
	2-3"		14.2-14.3
R2	0-1"		7.9-8.3
	1.5-2.5"		11.5-12.0

Ranges calculate for non-detects at 0 and at the detection limit.

DEP ID		ALW-SED-1	ALW-SED-2	ALW-SED-3	ALW-SED-4	ALW-SED-5	ALW-SED-6
Compound	**DL (ng/Kg, dry weight)**						
2378-tcdf	0.11	22.4	15.7	26.4	30.8	24.3	26.4
12378-pecdf	0.25	<DL	<DL	<DL	18.5	13.3	14.8
23478-pecdf	0.25	6.94	3.20	7.69	4.66	3.26	9.38
123478-hxcdf	0.25	4.22	2.88	6.29	6.29	7.69	12.7
123678-hxcdf	0.25	9.31	17.6	7.99	13.5	16.6	16.8
234678-hxcdf	0.25	<DL	<DL	<DL	<DL	2.11	1.99
123789-hxcdf	0.25	2.65	1.10	8.19	6.32	<DL	<DL
1234678-hpcdf	0.50	13.2	6.34	16.4	8.53	16.6	9.31
1234789-hpcdf	0.50	2.58	4.55	3.42	1.29	1.18	1.93
ocdf	0.50	8.75	37.5	8.45	8.12	10.6	6.63
2378-tcdd	0.10	<DL	<DL	1.03	1.36	<DL	<DL
12378-pecdd	0.25	<DL	0.13	2.93	3.63	<DL	<DL
123478-hxcdd	0.25	<DL	<DL	<DL	<DL	0.42	<DL
123678-hxcdd	0.25	<DL	<DL	<DL	<DL	1.18	<DL
123789-hxcdd	0.25	<DL	22.8	<DL	<DL	<DL	<DL
1234678-hpcdd	0.50	15.1	12.8	18.2	17.5	17.2	11.8
ocdd	0.50	94.8	105	129	104	108	82.6
Total TEQ (ND=0)		7.65	7.99	13.09	14.22	7.89	11.46
Total TEQ (ND=DL)		8.11	8.18	13.20	14.32	8.29	11.91
Sample weight (g dry weight)		45.3	48.9	51.9	50.2	50.4	50.2

Values less than the established MDLs are to be considered estimated values.

* = Values are influenced by the presence of diphenyl ethers and are estimated maximum concentrations.

MODULE 3 RIVERS AND STREAMS

3.1.1

FISH CONSUMPTION ADVISORIES- SPECIFIC RIVERS

FISH CONSUMPTION ADVISORIES – SPECIFIC RIVERS

During the period 1994-1998, the SWAT program surveyed contaminant levels in fish from all major watersheds in Maine to assess potential effects to human and wildlife consumers. Mercury has been detected in concentrations resulting in fish consumption advisories statewide. Concentrations of DDT and PCBs that also warrant advisories have been found in specific waters. More detailed monitoring is necessary to determine the extent of contamination and to determine sources of these contaminants. In 2000 sampling was focused on the St. John River watershed and the Presumpscot River watershed, with studies scheduled for 1999 but not completed due to inability to collect enough fish. Miscellaneous other sites were also monitored.

Salmon Falls. Our PCB data from Salmon Falls are very limited, only one sample of fish, smallmouth bass from 1995, yet the advisory is very restrictive. This does not allow us to calculate upper 95th confidence limits on the mean. Our goal was to collect 5 smallmouth bass or largemouth bass and 5 chain pickerel analyzed for total PCBs. We were successful in collection of 5 smallmouth bass from the Rollingsford Impoundment in S Berwick and analyzed them as a single five fish composite. The concentration exceeded the Bureau of Health's (BOH) Fish Tissue Action Level (FTAL=11 ppb) and was much higher than measured previously (Table 3.1.1.1).

Androscoggin River. We had two years (1994 and 1998) of data for total PCBs in fish from the Androscoggin River. We saw a 2 to 4 fold drop or more in the total PCBs from 1995 to 1998. We need to confirm that the PCB levels have indeed decreased. We have seen a similar reduction for 1995 versus 1997 and/or 1999 data for smallmouth bass caught in Augusta below Edwards Dam and Fairfield brown trout. There are two possible explanations - the levels may have indeed decreased over time (unusual for PCBs and given short time-period), or this may be due to analytical differences associated with switching from MRI to WRI laboratories during this period. We have reviewed the QA/QC data for WRI and have no reason to question the data. Using the newer data would result in a change in the advisory, but we are resistant to change until we can confirm the new lower levels. We were successful in collecting 5 smallmouth bass each at Lisbon, Auburn, Livermore Falls, Jay, Riley above IP, and Rumford for total PCB analyses. Results show that concentrations in 2000 were for the most part intermediate those of 1994 and 1998 but closer to those of 1998 (Table 3.1.1.1). There were some exceptions. Although concentrations of most fish samples were lower than those in 1994, many still exhibited concentrations exceeding the BOH FTAL (11 ppb).

Red Brook, Scarborough

In 1994, brook trout from Red Brook in Scarborough, downstream of a landfill from the RWS waste to energy incinerator, the Larson-Chapman landfill, and a junkyard with PCB contaminated soil, were found to contain elevated levels of PCB. A repeated study in 2000, found concentrations that were much lower, but still exceeding the BOH FTAL perhaps reflecting the remedial action taken at these sites (Table 3.1.1.1).

Table 3.1.1.1. Total PCBs in 2000 fish samples from Maine rivers and streams summary

Location	Station	Species	Tot PCBs 2000	Tot PCBs 1998	Tot PCBs 1997	Tot PCBs 1996	Tot PCBs 1995	Tot PCBs 1994
			ppb	ppb				ppb
Androscoggin River								
Gilead	AGL	BNT	84.6					
	AGL	RBT	28.1	10.8				
Rumford Point	ARP	SMB	9.88	3.9				
Rumford	ARF	SMB	21.0	8.9				97.2
Jay	ARY	SMB	15.0	7.0				42.4
Livermore Falls	ALV	SMB	38.2	15.4				48.6
	ALV	WHS	48.1	32.6		30.8		39.1
	ALF	SMB	26.0					
	ALF	WHS	41.9			57.7		
Turner	AGI	SMB	29.4	20.3				114
Lisbon	ALS	SMB	52.3	27.1				97.9
Brunswick	ARB	STB	59.8					
Aroostook River								
Ft Fairfield	ARO	BKT	34.4					
	ARO	WHS	42.1					
Kennebec River								
Norridgewock	KWL	BNT	3.07					
Fairfield	KFF	BNT			92.5			300
Sidney	KSD	BNT	34.1					8.6
	KSD	SMB	32.3		6.1			
Augusta	KAG	BNT			54.6			
	KAG	SMB		263 (99)	342			604
Penobscot River								
Bangor	PBB	EEL	253			37.4		
Veazie	PBV	ATS	18.9					
Red Brook								
Scarborough	RBP	BKT	21.6					60.2
Saco River								
Saco	SOS	STB	25.0					
Salmon Falls River								
South Berwick	SFS	SMB	82.6				29.8	
Sheepscot River								
Wiscasset	SRW	STB	24.4					

raw data

DEP ID#		PQL	AGL-BNT-	AGL-BNT-	AGL-BNT-	AGL-BNT-	AGL-BNT-
WRI ID			00-043	00-044	00-045	00-046	00-047
EXT ID#			1234	1237	1238	1239	1240
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	0.338	<DL	0.148	0.475
2,2',5-Trichlorobiphenyl	18	0.5	<DL	1.025	<DL	0.777	0.742
2,4,4'-Trichlorobiphenyl	28	0.5	2.854	3.678	3.860	4.503	2.659
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	2.228	<DL	2.078
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	0.591	0.601
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	0.941	<DL	0.913
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	0.665	0.564	2.781	1.754	1.836
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	0.411	0.591	0.897	0.421	0.330
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	0.419	0.680	1.000	0.487	0.659
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.747	1.068	0.661	1.993	1.028
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.994	1.319	1.234	0.722	1.288
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	0.521	0.913	0.487	0.402	0.662
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	1.789	2.958	3.740	1.529	1.330
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	2.298	2.838	2.905	2.379	2.034
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	1.745	1.759	1.891	2.081	2.452
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	0.637	0.332
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	0.610	<DL	0.212	0.166
Total PCBs			62.2	91.7	98.9	83.1	87.2
Sample weight (g, wet weight)			24.67	25.01	25.13	23.54	24.07
Surrogate Recovery		% rec (65-1	72.1	114	66.0	70.0	83.0

DEP ID#		PQL	AGL-RBT-1	AGL-RBT-2	AGL-RBT-3	AGL-RBT-4	AGL-RBT-5
WRI ID			00-048	00-049	00-050	00-051	00-052
EXT ID#			1236	1237	1238	1239	1240
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	<DL	<DL	<DL	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	0.854	0.254	0.954	0.653	0.995
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	0.524	<DL	0.356	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	0.448	0.326	0.472	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	1.022	0.687	0.994	1.147	0.825
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	0.326	0.547	0.661	0.459	0.397
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	0.662	0.754	0.701	0.559	0.258
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.784	0.884	1.021	0.659	0.774
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	1.025	0.978	1.214	0.669	0.845
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	0.774	0.625	0.338	0.914	0.526
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	0.355	<DL	0.578	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			23.71	32.08	30.45	33.32	21.03
Sample weight (g, wet weight)			25.0	25.0	25.0	25.0	25.0
Surrogate Recovery		% rec (65-1	81.0	92.6	84.3	79.5	82.7

DEP ID#		PQL	ARP-SMB-1	ARP-SMB-2	ARP-SMB-3	ARP-SMB-4	ARP-SMB-5
WRI ID			00-404	00-405	00-406	00-407	00-413
EXT ID#			1085	1086	1087	1088	1089
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	<DL	<DL	<DL	<DL	0.730
2,4,4'-Trichlorobiphenyl	28	0.5	0.199	0.361	0.626	0.514	0.322
2,4,5-Trichlorobiphenyl	29	0.5	0.591	0.651	<DL	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.515	0.401	0.398	0.625	0.455
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.625	0.448	0.765	0.935	0.715
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			9.65	9.30	8.95	10.37	11.11
Sample weight (g, wet weight)			25.10	24.94	24.85	18.87	24.83
Surrogate Recovery		% rec (65-1	68.7	65.0	68.1	84.2	73.7

DEP ID#		PQL	ARF-SMB-1	ARF-SMB-2	ARF-SMB-3	ARF-SMB-4	ARF-SMB-5
WRI ID			00-435	00-436	00-437	00-442	00-443
EXT ID#			1106	1107	1108	1126	1127
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	<DL	0.440	<DL	<DL	0.483
2,4,4'-Trichlorobiphenyl	28	0.5	1.560	0.840	0.443	0.599	0.241
2,4,5-Trichlorobiphenyl	29	0.5	0.760	0.200	0.201	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	0.515	0.487	0.665	0.358	0.411
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	<DL	0.455	<DL	<DL	<DL
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	0.668	0.794	0.994	0.584	0.821
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.618	0.775	0.914	0.634	0.558
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.857	1.025	1.114	0.567	0.841
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	<DL	0.569	<DL	<DL	<DL
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			24.89	27.92	21.65	13.71	16.78
Sample weight (g, wet weight)			25.00	25.00	24.84	25.05	24.85
Surrogate Recovery		% rec (65-1	86.7	66.8	81.5	67.3	74.6

DEP ID#		PQL	ARY-SMB-	ARY-SMB-	ARY-SMB-	ARY-SMB-	ARY-SMB-
WRI ID			00-424	00-425	00-426	00-427	00-428
EXT ID#			1080	1081	1082	1083	1084
Analytes							
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5-Trichlorobiphenyl	18	0.5	0.643	0.554	0.867	0.987	0.651
2,4,4’-Trichlorobiphenyl	28	0.5	0.335	0.512	0.671	0.885	0.405
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	0.484	0.723	0.418
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	0.351	0.687	0.559	0.323	0.847
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	0.445	0.981	0.662	0.489	0.784
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	0.698	<DL	<DL	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			12.34	13.67	16.21	17.13	15.52
Sample weight (g, wet weight)			24.91	25.04	24.78	24.91	24.68
Surrogate Recovery	% rec (65-1		83.7	93.1	66.4	110	78.1

DEP ID#		PQL	ALV-SMB-	ALV-SMB-	ALV-SMB-	ALV-SMB-	ALV-SMB-
WRI ID			00-454	00-455	00-456	00-457	00-458
EXT ID#			1136	1137	1138	1143	1144
Analytes							
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	0.320	<DL	<DL
2,2’,5-Trichlorobiphenyl	18	0.5	0.541	0.564	<DL	0.359	<DL
2,4,4’-Trichlorobiphenyl	28	0.5	0.815	0.604	0.680	0.521	0.560
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	0.481	0.512	0.322	0.478	0.621
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	0.897	1.025	1.014	0.679	0.897
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	0.451	0.589	0.384	0.401	0.598
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL	<DL	0.765
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	0.725	0.488	0.695	0.387
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	1.021	1.256	0.774	1.267	0.894
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	2.024	3.069	2.847	1.145	1.026
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	0.775	0.569	0.842	1.026	0.954
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			35.02	44.56	38.35	32.87	33.51
Sample weight (g, wet weight)			25.08	24.81	24.99	25.04	25.01
Surrogate Recovery	% rec (65-1		69.7	73.7	96.1	79.1	77.2

DEP ID#		PQL	ALV-SMB-	ALV-SMB-	ALV-SMB-	ALV-SMB-	ALV-SMB-
WRI ID			00-459	00-460	00-461	00-462	00-463
EXT ID#			1145	1146	1147	1148	1149
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	0.368	0.789	0.878	0.518	0.469
2,2',5-Trichlorobiphenyl	18	0.5	0.391	0.215	0.759	0.519	0.297
2,4,4'-Trichlorobiphenyl	28	0.5	0.644	0.311	0.498	0.439	0.343
2,4,5-Trichlorobiphenyl	29	0.5	<DL	0.290	<DL	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	0.485	0.331	0.319	0.581	0.602
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	0.402	0.656	0.741	0.889	0.942
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.421	0.298	0.355	0.542	0.598
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL	0.498	<DL
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	0.199
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	0.258	0.579	<DL	0.325	0.884
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.665	1.269	2.045	1.447	1.135
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.887	1.698	3.088	1.874	1.556
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	1.214	0.675	1.345	1.066	0.874
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			28.67	35.55	50.14	43.49	39.49
Sample weight (g, wet weight)			24.86	24.83	25.04	25.03	25.19
Surrogate Recovery	% rec (65-1		72.8	82.6	73.3	87.6	66.6

DEP ID#		PQL	ALV-WHS-	ALV-WHS-	ALV-WHS-	ALV-WHS-	ALV-WHS-
WRI ID			00-464	00-465	00-466	00-467	00-468
EXT ID#			1164	1165	1166	1167	1168
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	<DL	<DL	<DL	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	0.351	0.558	0.614	0.269	0.447
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	0.775	0.845	0.632	0.554	0.841
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	1.102	0.984	0.885	1.214	1.036
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.635	0.758	0.548	0.669	1.024
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	0.552	<DL	0.458	0.794
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	0.487	<DL	0.369	0.585
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	2.689	3.045	2.145	2.258	1.054
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	1.897	2.587	1.889	2.065	1.497
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.879	0.556	<DL	1.262	<DL
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	0.854	0.665	0.724	1.036	0.951
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			45.91	55.18	37.19	50.77	41.14
Sample weight (g, wet weight)			24.94	25.17	24.86	25.22	24.98
Surrogate Recovery	% rec (65-1		75.6	66.4	71.1	93.6	93.5

DEP ID#		PQL	ALV-WHS-	ALV-WHS-	ALV-WHS-	ALV-WHS-	ALV-WHS-
WRI ID			00-469	00-470	00-471	00-472	00-473
EXT ID#			1169	1170	1172	1173	1174
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	0.258	<DL	0.160	<DL
2,2',5-Trichlorobiphenyl	18	0.5	<DL	0.200	<DL	0.200	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	0.356	0.512	0.664	0.160	0.259
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	0.357	0.200	0.335	0.243	0.363
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	0.855	0.795	1.225	2.687	1.665
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.871	0.824	1.066	1.854	1.541
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	0.528	0.160	0.341	0.258	<DL
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	0.359	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	3.679	2.258	1.664	1.254	1.069
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	3.244	1.895	1.323	4.665	2.065
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.887	<DL	<DL	0.451	<DL
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	1.214	0.654	0.898	0.510	1.130
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	0.760	<DL	0.958	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	0.240	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			59.95	42.57	37.58	69.99	40.46
Sample weight (g, wet weight)			25.00	25.00	25.02	25.05	24.90
Surrogate Recovery		% rec (65-1	101	65.6	78.4	65.4	72.1

DEP ID#		PQL	ALF-SMB-	ALF-SMB-	ALF-SMB-	ALF-SMB-	ALF-SMB-
WRI ID			00-384	00-385	00-386	00-387	00-388
EXT ID#			1124	1131	1125	1098	1099
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	0.200	<DL
2,2',5-Trichlorobiphenyl	18	0.5	0.280	<DL	<DL	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	0.775	0.894	0.362	1.668	4.332
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	0.360	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	0.556	0.418	0.775	1.760	0.401
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	0.388	<DL	0.426	0.502
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	0.200	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.789	1.154	0.964	0.559	1.125
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.771	0.695	0.884	1.036	1.224
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL	0.687	0.714
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			15.8	17.7	14.9	34.4	41.5
Sample weight (g, wet weight)			25.02	24.86	24.86	25.00	24.93
Surrogate Recovery		% rec (65-1	69.6	110	83.3	72.4	93.5

DEP ID#		PQL	ALF-SMB-(	ALF-SMB-'	ALF-SMB-(	ALF-SMB-!	ALF-SMB-1
WRI ID			00-389	00-390	00-391	00-392	00-393
EXT ID#			1100	1102	1103	1104	1105
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	1.526	0.161	0.888	0.599	0.402
2,4,4'-Trichlorobiphenyl	28	0.5	0.843	2.889	0.444	3.036	0.281
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	0.525	0.360	0.241
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	0.569	0.884	0.612	0.748	0.502
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	0.841	<DL	0.564	<DL
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.674	1.554	1.116	0.547	0.334
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.854	0.647	1.155	1.064	0.887
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	<DL	<DL	0.995	0.871	<DL
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			22.3	34.9	26.7	38.9	13.2
Sample weight (g, wet weight)			24.91	24.92	24.77	25.03	24.88
Surrogate Recovery	% rec (65-1		67.2	81.1	88.1	90.7	77.7

DEP ID#		PQL	ALF-WHS-	ALF-WHS-:	ALF-WHS-:	ALF-WHS-4	ALF-WHS-
WRI ID			00-394	00-395	00-396	00-397	00-398
EXT ID#			1154	1155	1156	1157	1158
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	0.334	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	<DL	<DL	0.766	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	0.719	<DL	0.386	0.339	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	0.466	0.518	0.221	0.341
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	0.561	<DL	0.442	<DL	0.561
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	3.677	0.665	0.729	1.892	0.551
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.598	0.775	0.245	2.094	1.035
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	0.396	<DL	0.765	0.998
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	0.335	0.764
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	1.032	0.625	0.410	0.587	0.945
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	3.125	6.625	2.590	1.841	5.332
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	0.635	<DL	0.725	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			48.5	50.9	32.1	43.9	52.6
Sample weight (g, wet weight)			25.02	25.08	25.09	24.84	25.09
Surrogate Recovery	% rec (65-1		92.5	68.5	67.1	75.4	85.0

DEP ID#		PQL	ALF-WHS-(	ALF-WHS-'	ALF-WHS-{	ALF-WHS-(	ALF-WHS-
WRI ID			00-399	00-400	00-401	00-402	00-403
EXT ID#			1159	1160	1161	1162	1163
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	0.360	<DL
2,2',5-Trichlorobiphenyl	18	0.5	<DL	<DL	<DL	0.241	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	0.269	<DL	0.561	0.461	0.342
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	0.123	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	0.337	0.252	0.654	<DL	0.510
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	0.525	<DL	0.201	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	1.065	0.267	0.856	1.032	1.454
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.336	0.754	0.994	1.122	0.747
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	1.023	0.587	0.610	<DL
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	<DL	0.617	0.825	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.667	0.895	1.036	1.155	0.879
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	3.024	4.274	1.659	3.367	1.066
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	0.813	<DL	0.622	<DL	0.741
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	0.842	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			32.6	39.9	37.9	51.6	28.7
Sample weight (g, wet weight)			25.00	25.11	24.87	24.93	24.95
Surrogate Recovery		% rec (65-1	105	92.2	73.9	68.5	94.7

DEP ID#		PQL	AGI-SMB-1	AGI-SMB-2	AGI-SMB-3	AGI-SMB-4	AGI-SMB-5
WRI ID			00-120	00-121	00-122	00-123	00-124
EXT ID#			1150	1151	1299	1152	1153
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	0.366	<DL	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	<DL	<DL	<DL	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	<DL	<DL	0.280	<DL	0.733
2,4,5-Trichlorobiphenyl	29	0.5	2.750	1.558	2.369	3.357	3.894
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	0.355	0.268	0.441	0.307	0.258
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	0.122	<DL	<DL	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	1.150	0.985	0.778	1.036	0.885
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL	0.361	<DL
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	<DL	<DL	<DL	<DL	<DL
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.254	0.330	0.258	0.187	0.457
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	0.351	0.552	0.440	0.487	0.402
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	0.395	<DL	<DL	<DL	1.351
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			31.5	22.6	24.1	28.8	39.8
Sample weight (g, wet weight)			25.21	24.95	24.99	24.91	25.17
Surrogate Recovery		% rec (65-1	66.3	78.8	95.2	67.4	75.2

DEP ID#		PQL	ALS-SMB-1	ALS-SMB-2	ALS-SMB-3	ALS-SMB-4	ALS-SMB-
WRI ID			00-429	00-430	00-431	00-432	00-433
EXT ID#			1128	1129	1130	1132	1133
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	0.200	0.200	0.280	0.240	0.320
2,2',5-Trichlorobiphenyl	18	0.5	0.368	0.708	0.801	0.581	0.367
2,4,4'-Trichlorobiphenyl	28	0.5	2.760	1.950	1.908	2.118	2.098
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	0.240	<DL	0.280
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	0.365	0.544	0.678	0.265	0.661
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	1.105	0.984	2.042	1.657	1.224
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	0.894	0.775	1.025	0.687	0.994
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.745	0.623	0.858	0.428	0.798
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	1.254	0.200	<DL	0.701
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	0.240	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	<DL	0.521	0.422	<DL	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.995	1.321	0.847	0.654	0.598
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	1.254	1.657	2.065	1.114	0.978
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	0.400
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	0.564	0.784	0.669	0.721	0.611
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	0.959
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			46.25	56.60	60.17	43.53	54.94
Sample weight (g, wet weight)			25.00	25.05	25.00	25.00	25.02
Surrogate Recovery		% rec (65-1	95.5	91.8	83.1	78.8	87.7

DEP ID#		PQL	ARB-STB-1	ARB-STB-2	ARB-STB-3	ARB-STB-4	ARB-STB-5
WRI ID			00-640	00-641	00-642	00-643	00-644
EXT ID#			1395	1397	1398	1400	1403
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	0.662	0.714	0.574	0.332	0.258
2,2',5-Trichlorobiphenyl	18	0.5	0.248	<DL	0.383	0.821	1.118
2,4,4'-Trichlorobiphenyl	28	0.5	0.921	<DL	1.041	0.721	0.719
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	0.601	<DL	0.521	0.321	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	0.362	<DL	0.601	0.361	0.811
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	0.877	0.200	0.441	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	0.360	<DL	<DL	0.481	<DL
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	1.441	1.356	0.841	1.240	1.165
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	3.083	1.595	2.406	0.601	1.478
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	0.561	<DL	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	0.514	<DL	<DL	<DL	0.369
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	1.240	0.957	1.362	1.265	1.369
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	2.042	3.025	4.046	1.242	2.716
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	0.441	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	1.235	0.957	0.884	1.312	0.965
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	<DL	<DL	0.601	0.441	<DL
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	0.761	<DL	0.373	0.724	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	0.743	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			67.34	47.41	77.89	51.51	54.84
Sample weight (g, wet weight)			24.98	25.07	24.97	24.96	25.04
Surrogate Recovery		% rec (65-1	67.6	68.2	65.3	82.8	73.7

DEP ID#		PQL	ARO-BKT-1	ARO-BKT-2	ARO-WHS-1	ARO-WHS-2	ARO-WHS-3
WRI ID			00-730	00-731	00-732	00-733	00-734
EXT ID#			1287	1291	1284	1285	1286
Analytes							
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5-Trichlorobiphenyl	18	0.5	<DL	<DL	<DL	<DL	<DL
2,4,4’-Trichlorobiphenyl	28	0.5	0.281	0.467	0.245	0.341	0.625
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	0.200	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	<DL	<DL	0.481	0.669	0.745
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	<DL	<DL	0.801	0.789	0.637
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	0.481	0.554	0.601	0.521	0.199
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	0.321	0.469	1.212	0.368	0.239
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	<DL	<DL	1.026	0.754	0.358
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	1.042	1.470	1.843	0.889	0.677
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	2.486	1.695	1.766	0.803	1.234
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	0.698	1.256	2.203	0.562	0.518
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	0.625	0.774	1.996	0.602	0.995
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	0.962	0.160	0.361	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			34.48	34.22	63.67	31.49	31.14
Sample weight (g, wet weight)			24.94	24.94	24.96	24.91	25.11
Surrogate Recovery	% rec (65-1		91.9	89.7	126	91.2	101

DEP ID#		PQL	KNW-BNT-1	KNW-BNT-2	KNW-BNT-3	KNW-BNT-4	KNW-BNT-5
WRI ID			00-063	00-064	00-065	00-066	00-067
EXT ID#			1247	1248	1249	1250	1251
Analytes							
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5-Trichlorobiphenyl	18	0.5	<DL	<DL	<DL	<DL	<DL
2,4,4’-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	<DL	0.240	<DL	0.160	<DL
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	0.200	0.240	0.200	0.240	0.160
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	<DL	<DL	<DL	0.240	<DL
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	<DL	0.280	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	0.480	0.400	0.365	0.280	0.160
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			3.39	4.01	2.82	3.54	1.59
Sample weight (g, wet weight)			25.00	25.03	25.06	25.01	25.03
Surrogate Recovery	% rec (65-1		75.4	84.9	69.9	89.2	114

DEP ID#		PQL	KSD-BNT-1	KSD-BNT-2	KSD-BNT-3	KSD-BNT-4	KSD-BNT-5
WRI ID			00-058	00-059	00-060	00-061	00-062
EXT ID#			1241	1242	1243	1244	1246
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	0.199	<DL	<DL	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	0.566	0.712	0.524	0.665	0.756
2,4,5-Trichlorobiphenyl	29	0.5	0.624	0.802	0.698	0.799	0.836
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	0.487	0.248	0.336	0.265	0.676
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.259	0.661	0.854	1.199	0.438
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	0.514	0.265	0.457	0.320	1.711
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	0.478	0.158	0.302	0.226	0.159
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	0.332	0.154	0.624	0.894	1.791
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	<DL	<DL	<DL	<DL	<DL
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.279	0.336	<DL	0.600	1.671
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	0.399	<DL	<DL	0.959	0.199
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	<DL	0.189	0.225	0.240	<DL
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	0.199	<DL	<DL	0.440	0.318
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	0.279	0.406	0.487	0.326	0.239
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	0.879	1.025	0.559	0.748	1.552
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	0.514	<DL	<DL	0.119
Total PCBs			27.4	27.3	25.3	38.4	52.3
Sample weight (g, wet weight)			25.08	25.02	24.98	25.02	25.13
Surrogate Recovery	% rec (65-1		84.4	70.3	75.3	90.4	65.1

DEP ID#		PQL	KSD-SMB-1	KSD-SMB-2	KSD-SMB-3	KSD-SMB-4	KSD-SMB-5
WRI ID			00-650	00-651	00-652	00-653	00-654
EXT ID#			1299	1277	1278	1279	1280
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	0.602	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	0.401	<DL	<DL	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	0.200	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	0.351	0.568	0.442	<DL	0.340
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	0.962	<DL	<DL	0.775	0.591
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	0.841	<DL	<DL	0.511	0.498
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.532	0.239	<DL	<DL	<DL
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	0.723	<DL	<DL	0.279	<DL
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	0.533	<DL	<DL	0.451	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	0.481	0.657	0.544	0.754	0.468
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	1.520	1.336	1.745	1.438	1.062
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	0.628	1.239	0.602	0.717	0.842
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	1.049	0.559	0.923	1.115	0.963
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	0.805	<DL	0.201	0.199	0.201
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	0.327	0.239	0.481	0.319	0.401
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	0.421	<DL	0.201	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			48.87	24.18	28.69	32.78	26.83
Sample weight (g, wet weight)			24.96	25.11	24.93	25.11	24.93
Surrogate Recovery	% rec (65-1		92.3	80.6	132	105	65.2

DEP ID#		PQL	PBW-ATS-	PBV-ATS-1			
WRI ID			00-567	00-683			
EXT ID#			1263	1265			
Analytes							
2,4’-Dichlorobiphenyl	8	0.5	0.400	<DL			
2,2’,5-Trichlorobiphenyl	18	0.5	0.240	0.519			
2,4,4’-Trichlorobiphenyl	28	0.5	0.160	0.351			
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL			
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL			
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL			
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	0.559			
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	<DL	<DL			
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	0.520	0.487			
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	<DL			
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	<DL			
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	<DL			
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	<DL	<DL			
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	0.280	0.519			
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	0.520	0.998			
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	0.200	0.239			
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	0.240	0.359			
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	0.440	0.519			
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	<DL	<DL			
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL			
Total PCBs			15.00	22.75			
Sample weight (g, wet weight)			24.99	25.06			
Surrogate Recovery		% rec (65-1	102	120			

DEP ID#		PQL	PBB-EEL-(	PBB-EEL-(	PBB-EEL-(	PBB-EEL-C4	
WRI ID			00-478	00-475	00-474	00-476	
EXT ID#			1296	1293	1292	1294	
Analytes							
2,4’-Dichlorobiphenyl	8	0.5	0.200	0.280	<DL	0.160	
2,2’,5-Trichlorobiphenyl	18	0.5	1.480	0.360	0.400	9.623	
2,4,4’-Trichlorobiphenyl	28	0.5	1.880	1.440	0.960	1.457	
2,4,5-Trichlorobiphenyl	29	0.5	1.019	0.600	1.000	9.663	
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	0.880	0.880	0.240	2.236	
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	0.600	0.200	<DL	1.477	
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	3.520	<DL	1.920	6.349	
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	4.759	3.640	1.560	8.026	
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	1.520	0.760	<DL	1.398	
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	2.560	1.000	0.480	4.871	
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	<DL	0.240	0.280	
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	0.800	<DL	<DL	0.759	
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	5.879	3.280	1.120	7.706	
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	13.518	10.681	3.000	18.527	
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	6.959	2.800	1.120	6.109	
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	4.639	5.321	1.520	10.941	
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	9.759	5.258	0.320	1.797	
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	0.480	<DL	<DL	<DL	
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	
Total PCBs			302	183	69.4	457	
Sample weight (g, wet weight)			25.00	25.00	25.00	25.04	
Surrogate Recovery		% rec (65-1	131	89.2	105	94.5	

DEP ID#		PQL	RBP-BKT-1	RBP-BKT-2	RBP-BKT-3	RBP-BKT-4	RBP-BKT-5
WRI ID			00-033	00-034	00-035	00-036	00-037
EXT ID#			1252	1253	1255	1256	1257
Analytes							
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	0.227	<DL
2,2’,5-Trichlorobiphenyl	18	0.5	0.359	<DL	<DL	<DL	0.528
2,4,4’-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	0.366
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	0.162
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	0.609
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	0.718	0.838	0.440	0.590	1.381
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL	<DL	0.162
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	0.718	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	0.160	0.160	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	<DL	<DL	<DL	<DL	0.528
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	0.479	0.519	0.400	0.545	1.218
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	1.197	0.878	0.801	0.998	1.990
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	0.239	0.239	0.160	0.272	1.097
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	0.439	0.359	0.400	0.318	0.853
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	0.918	0.838	<DL	<DL	0.774
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	0.160	0.160	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			25.6	18.9	12.6	14.7	47.3
Sample weight (g, wet weight)			25.06	25.07	24.98	22.03	24.62
Surrogate Recovery		% rec (65-1	128	81.8	65.3	82.2	81.9

DEP ID#		PQL	RBP-BKT-6	RBP-BKT-7	RBP-BKT-8	RBP-BKT-9	RBP-BKT-10
WRI ID			00-038	00-039	00-040	00-041	00-042
EXT ID#			1258	1259	1260	1261	1262
Analytes							
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5-Trichlorobiphenyl	18	0.5	<DL	<DL	<DL	<DL	<DL
2,4,4’-Trichlorobiphenyl	28	0.5	<DL	0.379	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	0.657	0.569	0.885	0.323	0.794
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	0.190	<DL	<DL	<DL
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	0.758	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	0.885	0.474	1.025	0.794	1.115
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	0.253	0.806	0.217	0.244	0.569
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	0.694	0.379	0.452	0.339	0.478
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	0.774	0.616	0.359	0.441	0.885
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	0.253	0.758	<DL	0.427	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			17.58	26.3	17.8	13.8	21.4
Sample weight (g, wet weight)			23.72	21.10	18.45	16.41	17.34
Surrogate Recovery		% rec (65-1	90.1	75.7	84.4	76.9	134

DEP ID#		PQL	SFS-SMB-1	SFS-SMB-2	SFS-SMB-3	SFS-SMB-4	SFS-SMB-5
WRI ID			00-645	00-646	00-647	00-648	00-649
EXT ID#			1270	1272	1273	1274	1275
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	0.479	<DL	<DL	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	0.841	0.794	0.668	0.942	1.036
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.799	0.527	0.841	0.481	0.558
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	1.256	2.584	1.897	3.065	2.457
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	2.401	1.021	2.664	1.602	1.995
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	4.265	2.365	4.441	3.025	2.497
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	7.099	3.335	8.410	4.012	5.199
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	0.638	0.814	0.814	0.762	0.917
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	0.639	0.000	0.400	0.160	0.399
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	0.839	0.383	0.721	0.000	0.479
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	0.400	0.481	0.239
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			96.28	59.11	106	72.66	78.88
Sample weight (g, wet weight)			25.03	20.88	24.98	24.93	25.07
Surrogate Recovery		% rec (65-1	86.6	66.5	80.1	108	84.8

DEP ID#		PQL	SRW-STB-1	SRW-STB-2	SRW-STB-3	SRW-STB-4	SRW-STB-5
WRI ID			00-068	00-069	00-070	00-071	00-072
EXT ID#			1109	1110	1112	1113	1114
Analytes							
2,4'-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL	<DL
2,2',5-Trichlorobiphenyl	18	0.5	0.098	0.099	<DL	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	0.5	<DL	<DL	0.575	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	0.119	0.160	<DL	<DL
2,2',3,5'-Tetrachlorobiphenyl	44	0.5	0.256	0.304	0.187	<DL	0.298
2,2',4,6-Tetrachlorobiphenyl	50	0.5	0.117	<DL	0.120	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	<DL	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	0.5	1.172	0.437	0.220	0.240	0.854
2,2',3,4,5'-Pentachlorobiphenyl	87	0.5	0.469	0.298	0.339	0.421	0.398
2,2',4,5,5'-Pentachlorobiphenyl	101	0.5	<DL	<DL	<DL	0.100	<DL
2,2',4,6,6'-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	1.0	0.558	0.754	0.389	0.289	0.778
2,2',3,4,4',5'-Hexachlorobiphenyl	138	1.0	0.336	0.198	0.458	0.778	0.547
2,2',4,4',5,5'-Hexachlorobiphenyl	153	1.0	<DL	<DL	0.745	<DL	0.665
2,2',4,4',5,6'-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	1.0	0.137	0.514	0.687	0.140	0.428
2,2',3,4',5,6,6'-Heptachlorobiphenyl	188	1.0	0.313	0.199	0.402	0.260	0.336
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	200	1.0	0.487	1.065	<DL	1.241	0.874
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL	<DL
Total PCBs			20.4	25.5	26.9	19.7	31.5
Sample weight (g, wet weight)			51.20	50.30	50.10	50.00	50.10
Surrogate Recovery		% rec (65-1	75.3	66.1	67.2	75.4	75.2

DEP ID#		PQL	SRW-STB-6	SOS-STB-1	SOS-STB-2	SOS-STB-3
WRI ID			00-073	00-074	00-075	00-076
EXT ID#			1115	1116	1117	1119
Analytes						
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	<DL
2,2’,5-Trichlorobiphenyl	18	0.5	<DL	<DL	<DL	0.300
2,4,4’-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	0.400	0.380
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	0.447	0.304	0.451	0.560
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	0.300
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	0.755	0.721	1.185	0.660
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	0.487	0.220	0.382	0.520
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	<DL	0.401	0.357	0.380
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	0.805	0.336	0.614	0.260
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	0.551	<DL	<DL	<DL
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	<DL	<DL	<DL	<DL
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	<DL
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	0.698	0.556	0.611	0.000
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	0.287	1.857	0.321	0.260
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	<DL
Total PCBs			22.6	22.0	21.6	18.1
Sample weight (g, wet weight)			50.00	49.90	49.80	50.00
Surrogate Recovery	% rec (65-1		81.0	66.5	79.4	90.2

DEP ID#		PQL	SOS-STB-4	SOS-STB-5	SOS-STB-6	
WRI ID			00-077	00-078	00-079	
EXT ID#			1120	1122	1123	
Analytes						
2,4’-Dichlorobiphenyl	8	0.5	<DL	<DL	<DL	
2,2’,5-Trichlorobiphenyl	18	0.5	<DL	0.279	<DL	
2,4,4’-Trichlorobiphenyl	28	0.5	<DL	<DL	<DL	
2,4,5-Trichlorobiphenyl	29	0.5	<DL	<DL	0.340	
2,2’,3,5’-Tetrachlorobiphenyl	44	0.5	0.220	0.299	0.261	
2,2’,4,6-Tetrachlorobiphenyl	50	0.5	<DL	0.120	<DL	
2,2’,5,5’-Tetrachlorobiphenyl	52	0.5	<DL	<DL	<DL	
2,3’,4,4’-Tetrachlorobiphenyl	66	0.5	0.359	0.578	0.226	
2,2’,3,4,5’-Pentachlorobiphenyl	87	0.5	1.118	0.896	3.186	
2,2’,4,5,5’-Pentachlorobiphenyl	101	0.5	0.739	0.458	0.321	
2,2’,4,6,6’-Pentachlorobiphenyl	104	0.5	<DL	<DL	<DL	
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	1.0	0.459	0.610	0.541	
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	1.0	<DL	<DL	0.304	
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	1.0	<DL	<DL	0.350	
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	1.0	<DL	<DL	<DL	
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	187	1.0	0.700	0.923	0.721	
2,2’,3,4’,5,6,6’-Heptachlorobiphenyl	188	1.0	0.559	0.677	2.365	
2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl	195	1.0	<DL	<DL	<DL	
2,2’,3,3’,4,5’,6,6’-Octachlorobiphenyl	200	1.0	<DL	<DL	<DL	
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobiphenyl	209	2.0	<DL	<DL	<DL	
Total PCBs			20.8	24.2	43.1	
Sample weight (g, wet weight)			50.10	50.20	49.90	
Surrogate Recovery	% rec (65-1		74.4	79.2	87.1	

Kennebec River. Previous data show elevated total PCB levels in brown trout and bass in Fairfield and below the former Edwards Dam in Augusta, but we had no similar data for Sidney or Skowhegan (upstream). With removal of the Edwards dam there was a need to sample 5 brown trout and 5 bass in the reach between Waterville and Augusta. There is also a need to sample 5 brown trout in Skowhegan. Collections were successful and the results show that concentrations in brown trout at Norridgewock were below the FTAL (11ppb). Concentrations at Sidney exceeded the FTAL, unlike the results from 1994, and were similar to those in smallmouth bass (Table 3.1.1.1). The concentrations were lower than those in brown trout at Fairfield and Augusta and those in smallmouth bass at Augusta, however.

Sebasticook Lake. White perch and largemouth bass caught on the East Branch of Sebasticook River at the inlet to Sebasticook Lake have been found to have elevated levels of dioxin TEQ and coplaner PCBs. There is one year of dioxin data for Sebasticook Lake but no PCB data and no data at all below this point until the main stem. Our goal was to get dioxin and coplanar PCB data on 2 composites of 5 largemouth bass and 2 composites of 5 white perch from Sebasticook Lake and possibly an additional location below the outlet for the lake. We were able to collect 8 smallmouth bass and 10 white perch from the lake. Fish were composited into 2 equal composites for each species. Results show that the TCDD levels were similar to those found in largemouth bass in the lake in 1992, but dioxin toxic equivalents (DTE) were higher than in 1992. Concentrations of both TCDD and DTE were higher than those found at Corinna, upstream of the former Eastland Woolen mill, but lower than those found at the inlet to the lake, downstream of the former mill. Concentrations in white perch were lower in the lake than at the inlet to the lake. Concentrationsof coplanar PCB toxic equivalents (CTE) were higher than DTE and similar to those in 1997 (1.2-1.7 ppt) (Table 3.1.1.3).

Table 3.1.1.2 Dioxin concentrations in fish from the East Branch Sebasticook River

YEAR	SPECIES	SEC TCDD	SEC DTE	SEN TCDD	SEN DTE	SLN TCDD	SLN DTE
1986	lmb			<0.2			
1990	whp			1.0	1.6-2.1		
1991							
1992	lmb/smb					0.1	0.3
1993							
1994							
1995	lmb	0.1	0.2-1.1	0.3	1.1-2.0		
1996	whp			0.3	1.6-2.3		
1997	lmb	<0.1	0.1-0.7	0.1	1.2-1.4		
1998							
1999							
2000	smb					0.1	0.5-0.8
	whp					0.2	0.8-0.9

lmb= largemouth bass, smb= smallmouth bass, whp= white perch
SEC= East Branch Sebasticook R at Corinna,
SEN= East Branch Sebasticook R at County Rd bridge inlet to lake at Newport
SLN= Sebasticook Lake
TCDD= 2378 tetrachlorodibenzo(p) dioxin, DTE= dioxin toxic equivalents

DEP ID WRI ID		SLN-SMB-C1 00-661-C1	SLN-SMB-C2 00-660-C2	SLN-SMB mean	SLN-WHP-C1 00-668-C1	SLN-WHP-C2 00-670-C2	SLN-WHP mean
Compound	**DL (ng/Kg)**						
2378-tcdf	0.11	0.31	0.25	0.28	0.51	0.42	0.47
12378-pecdf	0.25	<DL	<DL		<DL	<DL	
23478-pecdf	0.25	0.18	<DL		0.245	0.21	
123478-hxcdf	0.25	<DL	<DL		<DL	<DL	
123678-hxcdf	0.25	<DL	<DL		0.21	0.35	
234678-hxcdf	0.25	<DL	<DL		<DL	<DL	
123789-hxcdf	0.25	<DL	<DL		<DL	<DL	
1234678-hpcdf	0.50	0.45	0.56		0.69	0.74	
1234789-hpcdf	0.50	<DL	<DL		<DL	<DL	
ocdf	0.50	<DL	<DL		<DL	0.89	
2378-tcdd	0.10	0.09	0.05	0.07	0.15	0.18	0.17
12378-pecdd	0.25	0.34	0.28		0.39	0.21	
123478-hxcdd	0.25	0.25	0.53		0.62	0.31	
123678-hxcdd	0.25	0.41	0.35		0.21	0.49	
123789-hxcdd	0.25	<DL	<DL		<DL	<DL	
1234678-hpcdd	0.50	0.66	0.41		0.56	0.82	
ocdd	0.50	1.03	0.85		1.26	0.75	
DTEo		0.628	0.403	**0.52**	0.830	0.668	**0.75**
DTEd		0.771	0.770	**0.77**	0.948	0.785	**0.87**
DTEh		**0.70**	**0.59**	**0.64**	**0.89**	**0.73**	**0.81**
DTEh sd				**0.08**			**0.11**
DTEh Confidence				**0.11**			**0.16**
DTEh 95 UCL				**0.75**			**0.97**
% FTAL				**50**			**64**
% Lipids		1.092	0.764		2.685	2.539	
Sample weight (g)		50.1	50.1		50.0	50.0	

TOTAL PCB in fish

Environment Canada is concerned about PCBs from the former Loring Air Force Base site contaminating the Aroostook River which crosses the border at Ft. Fairfield. DEP and Environment Canada have developed a cooperative program where each sampled fish from one site in the river on their respective sides of the border for PCBs. Two brook trout and 3 white suckers were collected from the river approximately 0.5 miles below the confluence with the Little Madawaska River. Concentrations of total PCB in both species exeeded the BOH FTAL (11ppb) (Table 3.1.1.1).

Concentrations of PCB in filets of smallmouth bass captured by Environment Canada from the Aroostook River below the Tinker Dam, just across the US Canada border, in 2000 were all less than 20 ppt, the same order of magnitude as the results from our data from the river. However, various species of whole fish captured about 250 meters across the border in the Tinker headpond in 2001 had much higher concentrations and exceed Canadian TRGs for avian and mammals (Table 3.1.1.3). From previous Maine data, ratios of PCB in whole brown trout, smallmouth bass, and white suckers to that in filets ranged from 4.7 to 13.7. Using the lowest ratio to estimate worst case concentrations in filets results in a range of 27-76 ppt for these fish, exceeding Maine's FTAL, but within the same order of magnitude as Maine's results.

Table 3.1.1.3. PCB levels in whole fish from Tinker headpond, NB, Canada, 2001

Sample #	Species	Length, cm	Weight, g	Condition Coefficient*	Total PCB Ng/g (ppb)
1	Fall Fish	19.0	115	1.7	152
2	Fall Fish	18.9	105	1.6	157
3	Fall Fish	14.6	49	1.6	129
4	Common Shiner	10.1	17	1.7	172
5	Yellow Perch	19.5	99	1.3	211
6	Fall Fish	13.7	35	1.4	359
7	Fall Fish	14.4	47	1.6	185
8	Bullhead	21.2	157	1.6	310
9	White Sucker	23.3	153	1.2	203
10	Fall Fish	20.6	140	1.6	130

TRG in whole fish   avian=95 ppt, mammals=70 ppt

* Condition Coefficient = weight/length^3 * 100

From Roy Parker, Environment Canada, Fredericton, NB

Coplanar PCB in Fish

In 2000 the SWAT program was again integrated with the Dioxin Monitoring Program (DMP) which has been in effect since 1988. All samples analyzed for dioxins were also analyzed for coplanar PCB. Mean coplanar PCB toxic equivalents (CTEh) varied in magnitude in relation to mean dioxin toxic equivalents (DTEh) as a percentage of total toxic equivalents (TTEh) (Table 3.1.1.4). All non-detects were calculated at half the detection limit. For comparison with the Bureau of Health (BOH) Fish Tissue Action Levels (FTAL), the 95^{th} upper confidence were used. DTEh are compared to the cancer action level, FTALc=1.5 ppt, and the TTEh (sum of both CTEh and DTEh) are compared to the reproductive and developmental action level, FTALr=1.8 ppt for bass from all stations and in suckers from Norridgewock and Fairfield on the Kennebec River, which were filets. Results show no samples where DTEh exceeded the FTALc, but several where the TTEh exceeded the FTALr. For the suckers from other stations, which were analyzed as whole fish, the FTALc and FTALr are 5.25 ppt and 6.3 ppt respectively. No samples of suckers exceeded these action levels.

DDT in Fish

Most of this study was scheduled for 1999 but was not completed due to difficulty in catching fish. Results from previous SWAT fish tissue monitoring found significant levels of DDT and/or metabolites in fish from the North Branch of Presque Isle Stream in Mapleton and Prestile Stream in Mars Hill. As a result the Maine Bureau of Health has issued a fish consumption advisories (FCA) for those streams. Additional sampling was needed to determine the extent of contamination in other rivers and streams in Aroostook County. Fourteen rivers and streams were selected from high use agricultural areas to be sampled in 2000. Fish were collected from 10 waters including the North Branch of Presque Isle Stream and Prestile Stream, 5 streams in agricultural areas, 2 from the forested part of the county, and the one from the upper Androscoggin River. For the 5 new stations in agricultural areas, a minimum of 10 brook trout were collected from each station and analyzed as 2 composites of skinless fillets to assess impact to human consumers. For the two stations in forested watersheds, Beaver Brook. Meduxnekeag R, and for the North Branch of Presque Isle Stream and Prestile Stream, that were part of the fish effects study to be described later, 12 –28 brook trout were collected and analyzed individually. From the Androscoggin River, 5 rainbow trout used for dioxin analysis were also analyzed individually for total DDT.

Results show concentrations in the North Branch of Presque Isle Stream and Prestile Stream are lower than measured in 1994, although concentrations in fish from the Prestile Stream still exceed the BOH FTAL (64 ppt) as do those from Everett Brook (Table 3.1.1.5). Concentrations in fish from all other waters were below the FTAL.

Table 3.1.1.4 Coplanar PCB and dioxins in 2000 fish samples.

WATER/STATION	SPECIES	DTEh mean	CTEh mean	TTEh mean	DTEh 95%UCL	CTEh 95%UCL	TTEh 95%UCL
ANDROSCOGGIN R							
Gilead	rainbow trout	1.1	1	2.1	1.4	1.5	2.9
	brown trout	0.7	0.2	0.9	0.7	0.2	0.9
	bass	1.0	0.5	1.5	1.2	0.5	1.7
	sucker	2.0	2.3	4.3	2.3	3.3	5.6
Rumford	bass	0.8	1.1	1.9	0.9	1.3	2.2
	sucker	2.1	1.4	3.5	2.3	1.5	3.8
Riley	bass	0.4	2.6	3.0	0.5	3.2	3.7
	sucker						
Livermore Falls	bass	0.8	1.3	2.1	0.9	1.7	2.6
	sucker						
Auburn-GIP	bass sm	0.7	0.6	1.3	0.7	0.8	1.5
Lisbon Falls	bass	0.7	1.6	2.3	1.0	2.1	3.1
Androscoggin L	bass	0.7	0.1	0.8	0.8	0.1	0.9
	w perch	0.5	0.1	0.6	0.5	0.2	0.7
	sucker	0.6	0.3	0.9	0.6	0.3	0.9
KENNEBEC R							
Norridgewock	bass	0.4	0.3	0.7	0.4	0.4	0.8
	brown trout	0.4	0.7	1.1	0.4	0.9	1.3
	sucker	0.4	1.0	1.4	0.4	1.2	1.6
Fairfield	bass	0.8	0.2	1.0	0.9	0.2	1.1
	brown trout	0.5			0.6		
	sucker	0.8	1.0	1.8	0.9	1.3	2.2
Sidney	bass	0.5	1.0	1.5	0.6	1.4	2
	brown trout	0.6	0.7	1.3	0.7	0.9	1.6
PENOBSCOT R							
Woodville	bass	0.5	0.6	1.1	0.5	0.7	1.2
	sucker	0.4	1.0	1.4	0.4	1.1	1.5
Winn	bass	0.4			0.4		
	sucker	0.4			0.5		
S Lincoln	bass	0.6	1.0	1.6	0.7	1.1	1.8
	sucker	1.3	2.8	4.1	1.4	3.1	4.5
Milford	bass	0.6	1.2	1.8	0.8	1.8	2.6
	sucker	1.4	1.5	2.9	1.5	1.8	3.3
Veazie	bass	0.8	1.6	2.4	0.9	1.9	2.8
	sucker	1.4	2.5	3.9	1.5	2.7	4.2
	eel	2.3	3.2	5.5	2.6	3.4	6
PRESUMPSCOT R							
Windham	bass	0.4	0.6	1.0	0.5	0.7	1.2
Westbrook	bass	0.5	0.5	1.0	0.5	0.6	1.1
SALMON FALLS R							
S Berwick	sm bass	0.5	0.5	1.0	0.6	0.7	1.3
SEBASTICOOK R							
Sebasticook L	bass	0.6	1.3	1.9	0.8	1.4	2.2
	white perch	0.8	1.4	2.2	1.0	1.9	2.9
W Br Palmyra	bass	1.5	0.1	1.6	1.6	0.1	1.7

Coplanar PCB (CTE), Dioxin (DTE) and total (TTE) toxic eqiivalents using
WHO 98 toxic equivalency factors (TEF) at ND=1/2 MDL.

DEP ID			AGL-RBT-1	AGL-RBT-2	AGL-RBT-3	AGL-RBT-4	AGL-RBT-5
WRI ID			00-48	00-49	00-50	00-51	00-52
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	21.6	18.7	36.4	20.6	15.3
2',3,4,4',5-PeCB	123	0.5	16.9	14.3	21.6	13.7	10.8
2,3',4,4',5-PeCB	118	0.5	52.3	31.8	106	24.2	35.9
2,3,4,4',5-PeCB	114	0.5	18.6	15.9	41.2	10.6	9.68
2,3,3',4,4'-PeCB	105	0.5	14.2	10.2	32.9	8.27	6.11
3,3',4,4',5-PeCB	126	0.5	9.65	7.75	18.3	5.06	5.30
2,3',4,4',5,5'-HxCB	167	1.0	3.81	4.91	5.27	3.39	2.68
2,3,3',4,4',5-HxCB	156	1.0	85.2	56.3	115	62.3	31.7
2,3,3',4,4',5'-HxCB	157	1.0	1.61	1.05	3.68	2.07	0.95
3,3',4,4',5,5'-HxCB	169	1.0	0.45	0.56	1.08	<DL	0.62
2,3,3',4,4',5,5'-HpCB	189	1.0	16.9	19.6	21.9	10.6	12.8
Total TEQ (ND=0)			1.034	0.827	1.943	0.551	0.565
Total TEQ (ND=DL)			1.034	0.827	1.943	0.551	0.565
% Lipids			1.62	1.05	2.12	0.93	0.81
Sample weight (g)			50.0	50.1	50.0	50.0	50.0

DEP ID			AGL-BNT-C1		ARP-WHS-C1	ARP-WHS-C2
WRI ID			00-43		00-415	00-414
congener	**IUPAC#**	**DL (ng/Kg)**				
3,3',4,4'-TCB	77	0.5	15.3		56.2	88.4
2',3,4,4',5-PeCB	123	0.5	2.65		31.4	41.2
2,3',4,4',5-PeCB	118	0.5	48.9		191	326
2,3,4,4',5-PeCB	114	0.5	10.3		13.6	21.5
2,3,3',4,4'-PeCB	105	0.5	3.56		34.2	74.8
3,3',4,4',5-PeCB	126	0.5	2.25		18.7	39.2
2,3',4,4',5,5'-HxCB	167	1.0	0.86		9.21	16.1
2,3,3',4,4',5-HxCB	156	1.0	21.4		112	188
2,3,3',4,4',5'-HxCB	157	1.0	0.25		8.21	6.35
3,3',4,4',5,5'-HxCB	169	1.0	<DL		2.24	1.24
2,3,3',4,4',5,5'-HpCB	189	1.0	6.21		37.3	59.8
Total TEQ (ND=0)			0.249		1.994	4.100
Total TEQ (ND=DL)			0.259		1.994	4.100
% Lipids			0.93		6.54	14.33
Sample weight (g)			50.1		50.0	50.0

DEP ID			ARP-SMB-1	ARP-SMB-2	ARP-SMB-3	ARP-SMB-4	ARP-SMB-5
WRI ID			00-404	00-405	00-406	00-407	00-408
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	5.28	10.6	8.75	15.4	6.69
2',3,4,4',5-PeCB	123	0.5	14.8	30.8	18.7	25.1	15.7
2,3',4,4',5-PeCB	118	0.5	144	85.6	167	291	185
2,3,4,4',5-PeCB	114	0.5	2.61	1.59	2.18	4.83	2.06
2,3,3',4,4'-PeCB	105	0.5	35.9	28.9	37.9	42.7	31.7
3,3',4,4',5-PeCB	126	0.5	2.87	3.30	4.01	4.85	3.39
2,3',4,4',5,5'-HxCB	167	1.0	2.11	5.97	8.63	10.3	2.47
2,3,3',4,4',5-HxCB	156	1.0	56.9	105	84.7	114	75.2
2,3,3',4,4',5'-HxCB	157	1.0	0.98	1.88	2.36	3.25	1.36
3,3',4,4',5,5'-HxCB	169	1.0	<DL	0.75	1.15	0.86	0.51
2,3,3',4,4',5,5'-HpCB	189	1.0	7.91	6.98	8.66	11.7	6.56
Total TEQ (ND=0)			0.338	0.408	0.481	0.593	0.408
Total TEQ (ND=DL)			0.348	0.408	0.481	0.593	0.408
% Lipids			0.26	0.68	0.60	1.16	0.29
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			ARP-SMB-6	ARP-SMB-7	ARP-SMB-8	ARP-SMB-9	ARP-SMB-10
WRI ID			00-409	00-410	00-411	00-412	00-413
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	18.7	6.61	12.8	24.1	18.4
2',3,4,4',5-PeCB	123	0.5	30.2	10.8	31.9	29.5	27.2
2,3',4,4',5-PeCB	118	0.5	245	169	154	321	234
2,3,4,4',5-PeCB	114	0.5	3.97	2.37	3.98	5.29	4.47
2,3,3',4,4'-PeCB	105	0.5	52.6	31.9	33.7	67.4	51.2
3,3',4,4',5-PeCB	126	0.5	6.01	3.36	3.94	5.14	4.81
2,3',4,4',5,5'-HxCB	167	1.0	7.84	2.89	7.21	8.68	5.29
2,3,3',4,4',5-HxCB	156	1.0	126	71.2	110	145	131
2,3,3',4,4',5'-HxCB	157	1.0	4.25	2.26	2.07	5.38	7.21
3,3',4,4',5,5'-HxCB	169	1.0	1.02	<DL	0.51	2.06	3.01
2,3,3',4,4',5,5'-HpCB	189	1.0	13.7	5.79	9.35	21.7	17.2
Total TEQ (ND=0)			0.714	0.396	0.481	0.659	0.617
Total TEQ (ND=DL)			0.714	0.406	0.481	0.659	0.617
% Lipids			1.34	0.36	0.78	2.18	0.86
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			ARF-SMB-1	ARF-SMB-2	ARF-SMB-3	ARF-SMB-4	ARF-SMB-5
WRI ID			00-434	00-435	00-436	00-437	00-438
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	16.2	15.6	14.2	20.6	10.1
2',3,4,4',5-PeCB	123	0.5	31.7	36.7	41.8	42.7	26.3
2,3',4,4',5-PeCB	118	0.5	296	321	335	384	225
2,3,4,4',5-PeCB	114	0.5	4.15	5.24	4.87	6.61	3.81
2,3,3',4,4'-PeCB	105	0.5	42.1	56.3	61.3	58.9	26.6
3,3',4,4',5-PeCB	126	0.5	6.69	10.2	8.58	15.2	8.32
2,3',4,4',5,5'-HxCB	167	1.0	7.81	9.55	10.6	13.6	7.24
2,3,3',4,4',5-HxCB	156	1.0	102	98.6	106	125	69.8
2,3,3',4,4',5'-HxCB	157	1.0	5.23	7.57	10.2	9.21	6.61
3,3',4,4',5,5'-HxCB	169	1.0	1.97	1.65	1.95	2.36	1.02
2,3,3',4,4',5,5'-HpCB	189	1.0	12.0	13.8	1537	18.7	10.4
Total TEQ (ND=0)			0.784	1.137	1.137	1.667	0.912
Total TEQ (ND=DL)			0.784	1.137	1.137	1.667	0.912
% Lipids			0.91	1.14	1.09	1.42	0.70
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			ARF-SMB-6	ARF-SMB-7	ARF-SMB-8	ARF-SMB-9	ARF-SMB-10
WRI ID			00-439	00-440	00-441	00-442	00-443
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	13.2	16.3	8.75	7.95	18.6
2',3,4,4',5-PeCB	123	0.5	34.5	30.2	22.2	27.3	38.7
2,3',4,4',5-PeCB	118	0.5	289	288	187	201	305
2,3,4,4',5-PeCB	114	0.5	6.02	3.98	2.71	3.26	5.01
2,3,3',4,4'-PeCB	105	0.5	42.3	49.7	20.3	22.4	62.1
3,3',4,4',5-PeCB	126	0.5	9.68	13.6	5.24	8.01	14.1
2,3',4,4',5,5'-HxCB	167	1.0	11.2	10.2	3.35	4.42	8.97
2,3,3',4,4',5-HxCB	156	1.0	81.7	91.3	51.1	45.3	109
2,3,3',4,4',5'-HxCB	157	1.0	7.01	8.33	4.02	7.12	11.6
3,3',4,4',5,5'-HxCB	169	1.0	1.52	1.41	0.94	0.75	1.25
2,3,3',4,4',5,5'-HpCB	189	1.0	9.94	16.9	6.52	8.96	17.2
Total TEQ (ND=0)			1.070	1.466	0.587	0.863	1.530
Total TEQ (ND=DL)			1.070	1.466	0.587	0.863	1.530
% Lipids			0.87	0.94	0.59	0.66	0.93
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			ARF-WHS-C1	ARF-WHS-C2
WRI ID			00-444	00-447
congener	**IUPAC#**	**DL (ng/Kg)**		
3,3',4,4'-TCB	77	0.5	25.6	30.6
2',3,4,4',5-PeCB	123	0.5	88.3	71.2
2,3',4,4',5-PeCB	118	0.5	491	463
2,3,4,4',5-PeCB	114	0.5	12.6	15.2
2,3,3',4,4'-PeCB	105	0.5	325	366
3,3',4,4',5-PeCB	126	0.5	13.7	11.7
2,3',4,4',5,5'-HxCB	167	1.0	48.1	41.2
2,3,3',4,4',5-HxCB	156	1.0	72.1	80.6
2,3,3',4,4',5'-HxCB	157	1.0	6.97	6.57
3,3',4,4',5,5'-HxCB	169	1.0	0.99	0.75
2,3,3',4,4',5,5'-HpCB	189	1.0	12.4	14.8
Total TEQ (ND=0)			1.520	1.324
Total TEQ (ND=DL)			1.520	1.324
% Lipids			14.29	14.25
Sample weight (g)			50.0	50.0

DEP ID			ARY-SMB-1	ARY-SMB-2	ARY-SMB-3	ARY-SMB-4	ARY-SMB-5
WRI ID			00-424	00-425	00-426	00-427	00-428
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	18.7	30.2	13.2	15.7	12.6
2',3,4,4',5-PeCB	123	0.5	22.6	26.7	18.6	20.4	16.5
2,3',4,4',5-PeCB	118	0.5	201	245	177	154	184
2,3,4,4',5-PeCB	114	0.5	14.6	22.8	13.5	20.6	18.6
2,3,3',4,4'-PeCB	105	0.5	82.4	69.7	48.5	71.9	62.5
3,3',4,4',5-PeCB	126	0.5	25.7	30.2	14.2	30.6	25.8
2,3',4,4',5,5'-HxCB	167	1.0	14.9	17.6	11.6	9.95	12.1
2,3,3',4,4',5-HxCB	156	1.0	127	118	98.7	75.8	113
2,3,3',4,4',5'-HxCB	157	1.0	20.3	25.3	14.3	18.6	15.6
3,3',4,4',5,5'-HxCB	169	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5,5'-HpCB	189	1.0	13.6	15.9	8.81	10.2	7.42
Total TEQ (ND=0)			2.685	3.142	1.510	3.145	2.682
Total TEQ (ND=DL)			2.695	3.152	1.520	3.155	2.692
% Lipids			0.73	0.85	0.49	0.58	0.51
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			ALV-SMB-1	ALV-SMB-4	ALV-SMB-5	ALV-SMB-7	ALV-SMB-9
WRI ID			00-454	00-457	00-458	00-460	00-462
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	20.7	33.2	51.3	31.6	11.3
2',3,4,4',5-PeCB	123	0.5	75.2	94.5	124	102	26.9
2,3',4,4',5-PeCB	118	0.5	124	318	355	299	81.7
2,3,4,4',5-PeCB	114	0.5	5.98	12.6	16.7	14.3	2.58
2,3,3',4,4'-PeCB	105	0.5	41.2	61.8	72.5	75.7	23.6
3,3',4,4',5-PeCB	126	0.5	8.81	15.3	18.9	13.6	5.67
2,3',4,4',5,5'-HxCB	167	1.0	18.9	26.9	31.0	22.1	10.2
2,3,3',4,4',5-HxCB	156	1.0	77.6	127	144	151	49.6
2,3,3',4,4',5'-HxCB	157	1.0	10.5	13.2	16.9	15.7	6.37
3,3',4,4',5,5'-HxCB	169	1.0	<DL	0.85	1.02	0.88	<DL
2,3,3',4,4',5,5'-HpCB	189	1.0	9.14	11.6	13.7	14.6	5.25
Total TEQ (ND=0)			0.955	1.667	2.051	1.512	0.611
Total TEQ (ND=DL)			0.965	1.667	2.051	1.512	0.621
% Lipids			0.21	0.94	1.38	1.02	0.28
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			AGI-SMB-1	AGI-SMB-2	AGI-SMB-3	AGI-SMB-4	AGI-SMB-5
WRI ID			00-120	00-121	00-122	00-123	00-124
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	10.6	4.27	8.15	7.75	9.81
2',3,4,4',5-PeCB	123	0.5	68.9	21.9	41.6	50.2	55.6
2,3',4,4',5-PeCB	118	0.5	114	41.8	89.7	75.4	107
2,3,4,4',5-PeCB	114	0.5	18.5	10.2	25.6	26.9	21.6
2,3,3',4,4'-PeCB	105	0.5	25.2	11.6	24.2	15.7	32.3
3,3',4,4',5-PeCB	126	0.5	8.31	3.91	5.47	5.10	6.18
2,3',4,4',5,5'-HxCB	167	1.0	6.09	2.84	6.31	4.21	5.99
2,3,3',4,4',5-HxCB	156	1.0	74.5	29.8	54.5	63.8	61.4
2,3,3',4,4',5'-HxCB	157	1.0	10.0	3.69	13.9	9.41	11.2
3,3',4,4',5,5'-HxCB	169	1.0	0.89	<DL	0.91	0.51	0.74
2,3,3',4,4',5,5'-HpCB	189	1.0	14.1	5.97	13.2	10.5	15.7
Total TEQ (ND=0)			0.915	0.421	0.621	0.581	0.695
Total TEQ (ND=DL)			0.915	0.431	0.621	0.581	0.695
% Lipids			0.39	0.13	0.35	0.30	0.35
Sample weight (g)			50.0	50.1	50.1	50.0	50.0

DEP ID			ALS-SMB-1	ALS-SMB-2	ALS-SMB-3	ALS-SMB-4	ALS-SMB-5
WRI ID			00-429	00-430	00-431	00-432	00-433
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	25.3	13.6	11.6	21.3	9.95
2',3,4,4',5-PeCB	123	0.5	78.2	35.7	29.1	58.7	18.3
2,3',4,4',5-PeCB	118	0.5	201	125	132	187	101
2,3,4,4',5-PeCB	114	0.5	21.6	12.8	9.06	25.3	8.84
2,3,3',4,4'-PeCB	105	0.5	91.6	46.9	56.7	102	41.8
3,3',4,4',5-PeCB	126	0.5	30.2	18.7	10.3	25.6	14.5
2,3',4,4',5,5'-HxCB	167	1.0	14.6	18.4	10.7	22.6	11.3
2,3,3',4,4',5-HxCB	156	1.0	141	102	95.6	128	79.5
2,3,3',4,4',5'-HxCB	157	1.0	18.6	10.3	11.2	15.4	8.21
3,3',4,4',5,5'-HxCB	169	1.0	1.02	0.75	0.51	0.89	<DL
2,3,3',4,4',5,5'-HpCB	189	1.0	35.6	22.6	13.7	28.4	15.2
Total TEQ (ND=0)			3.164	1.965	1.117	2.693	1.517
Total TEQ (ND=DL)			3.164	1.965	1.117	2.693	1.527
% Lipids			0.72	0.36	0.27	0.66	0.23
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			ALW-SMB-C1	ALW-SMB-C2	ALW-WHP-C1	ALW-WHP-C2
WRI ID			00-83	00-81	00-90	00-93
congener	**IUPAC#**	**DL (ng/Kg)**				
3,3',4,4'-TCB	77	0.5	3.75	4.06	2.68	4.89
2',3,4,4',5-PeCB	123	0.5	5.95	9.68	23.6	35.6
2,3',4,4',5-PeCB	118	0.5	28.6	35.8	54.7	98.7
2,3,4,4',5-PeCB	114	0.5	0.41	0.51	3.33	5.28
2,3,3',4,4'-PeCB	105	0.5	6.87	9.67	8.25	11.6
3,3',4,4',5-PeCB	126	0.5	<DL	<DL	0.51	0.75
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	3.67	4.29
2,3,3',4,4',5-HxCB	156	1.0	16.7	15.3	74.2	105
2,3,3',4,4',5'-HxCB	157	1.0	3.97	4.21	5.12	6.99
3,3',4,4',5,5'-HxCB	169	1.0	<DL	<DL	<DL	<DL
2,3,3',4,4',5,5'-HpCB	189	1.0	2.75	3.98	2.14	4.02
Total TEQ (ND=0)			0.015	0.016	0.101	0.149
Total TEQ (ND=DL)			0.075	0.076	0.111	0.159
% Lipids			0.19	0.25	2.00	2.46
Sample weight (g)			50.0	50.1	50.0	50.1

DEP ID			ALW-WHS-C1	ALW-WHS-C2	**Rechecks**
WRI ID			00-100	00-101	
congener	**IUPAC#**	**DL (ng/Kg)**			
3,3',4,4'-TCB	77	0.5	16.1	17.9	
2',3,4,4',5-PeCB	123	0.5	102	97.6	
2,3',4,4',5-PeCB	118	0.5	191	174	
2,3,4,4',5-PeCB	114	0.5	6.35	5.26	
2,3,3',4,4'-PeCB	105	0.5	26.3	31.8	
3,3',4,4',5-PeCB	126	0.5	1.58	1.02	
2,3',4,4',5,5'-HxCB	167	1.0	20.5	15.6	
2,3,3',4,4',5-HxCB	156	1.0	236	201	
2,3,3',4,4',5'-HxCB	157	1.0	10.4	7.48	
3,3',4,4',5,5'-HxCB	169	1.0	<DL	<DL	
2,3,3',4,4',5,5'-HpCB	189	1.0	11.5	5.69	
Total TEQ (ND=0)			0.319	0.242	
Total TEQ (ND=DL)			0.329	0.252	
% Lipids			10.02	9.06	
Sample weight (g)			50.2	50.1	

DEP ID		
WRI ID		
congener	**IUPAC#**	**DL (ng/Kg)**
3,3',4,4'-TCB	77	0.5
2',3,4,4',5-PeCB	123	0.5
2,3',4,4',5-PeCB	118	0.5
2,3,4,4',5-PeCB	114	0.5
2,3,3',4,4'-PeCB	105	0.5
3,3',4,4',5-PeCB	126	0.5
2,3',4,4',5,5'-HxCB	167	1.0
2,3,3',4,4',5-HxCB	156	1.0
2,3,3',4,4',5'-HxCB	157	1.0
3,3',4,4',5,5'-HxCB	169	1.0
2,3,3',4,4',5,5'-HpCB	189	1.0
Total TEQ (ND=0)		
Total TEQ (ND=DL)		
% Lipids		
Sample weight (g)		

DEP ID			ARP-SMB	ARP-SMB	ARP-SMB	ARP-SMB	ARP-SMB
WRI ID			00-408	00-409	00-411	00-412	00-413
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	9.15	16.2	8.21	15.3	20.1
2',3,4,4',5-PeCB	123	0.5	18.3	25.5	16.9	18.9	28.4
2,3',4,4',5-PeCB	118	0.5	204	215	121	228	247
2,3,4,4',5-PeCB	114	0.5	2.26	3.74	2.01	3.16	5.69
2,3,3',4,4'-PeCB	105	0.5	38.9	41.8	29.7	42.7	63.7
3,3',4,4',5-PeCB	126	0.5	5.11	6.63	3.21	2.66	5.58
2,3',4,4',5,5'-HxCB	167	1.0	5.94	8.01	4.68	5.81	6.29
2,3,3',4,4',5-HxCB	156	1.0	84.3	115	92.0	131	147
2,3,3',4,4',5'-HxCB	157	1.0	3.21	3.21	1.14	3.25	6.28
3,3',4,4',5,5'-HxCB	169	1.0	0.84	0.94	0.47	1.17	3.36
2,3,3',4,4',5,5'-HpCB	189	1.0	9.11	13.2	6.33	12.6	18.5
Total TEQ (ND=0)			0.592	0.765	0.392	0.378	0.709
Total TEQ (ND=DL)			0.592	0.765	0.392	0.378	0.709
% Lipids			0.85	1.11	0.45	0.81	1.37
Sample weight (g)			50.0	50.0	50.0	50.1	50.0

DEP ID			ARP-SMB	AGL-RBT		ARP-WHS	ARP-WHS
WRI ID			00-404-c	00-48-c		00-415-c1	00-414-c2
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	6.91	16.4		48.1	52.7
2',3,4,4',5-PeCB	123	0.5	14.8	16.1		33.7	39.4
2,3',4,4',5-PeCB	118	0.5	107	33.8		224	251
2,3,4,4',5-PeCB	114	0.5	2.68	12.2		11.2	15.6
2,3,3',4,4'-PeCB	105	0.5	25.4	9.87		30.6	35.9
3,3',4,4',5-PeCB	126	0.5	3.94	8.33		15.1	14.0
2,3',4,4',5,5'-HxCB	167	1.0	3.87	5.96		10.9	11.6
2,3,3',4,4',5-HxCB	156	1.0	84.2	63.6		134	161
2,3,3',4,4',5'-HxCB	157	1.0	1.01	1.26		9.22	8.25
3,3',4,4',5,5'-HxCB	169	1.0	<DL	0.77		1.94	1.00
2,3,3',4,4',5,5'-HpCB	189	1.0	7.39	21.5		31.6	41.3
Total TEQ (ND=0)			0.454	0.889		1.644	1.545
Total TEQ (ND=DL)			0.464	0.889		1.644	1.545
% Lipids			0.34	1.30		6.91	6.18
Sample weight (g)			45.0	50.0		50.1	50.0

DEP ID			ARF-WHS	ARF-WHS
WRI ID			00-447-c2	00-444-c1
congener	**IUPAC#**	**DL (ng/Kg)**		
3,3',4,4'-TCB	77	0.5	22.4	28.9
2',3,4,4',5-PeCB	123	0.5	91.6	80.2
2,3',4,4',5-PeCB	118	0.5	462	441
2,3,4,4',5-PeCB	114	0.5	10.3	12.4
2,3,3',4,4'-PeCB	105	0.5	302	341
3,3',4,4',5-PeCB	126	0.5	14.7	10.2
2,3',4,4',5,5'-HxCB	167	1.0	45.2	38.6
2,3,3',4,4',5-HxCB	156	1.0	75.6	78.2
2,3,3',4,4',5'-HxCB	157	1.0	7.06	6.23
3,3',4,4',5,5'-HxCB	169	1.0	1.25	0.88
2,3,3',4,4',5,5'-HpCB	189	1.0	10.2	15.6
Total TEQ (ND=0)			1.618	1.168
Total TEQ (ND=DL)			1.618	1.168
% Lipids			14.7	15.0
Sample weight (g)			50.0	50.1

DEP ID			ALV-SMB	ALV-SMB	ALV-SMB	ALV-SMB	ALV-SMB
WRI ID			00-454	00-457*	00-458	00-460*	00-462*
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	8.85	24.7	29.2	33.6	10.8
2',3,4,4',5-PeCB	123	0.5	20.6	88.3	69.7	121	21.7
2,3',4,4',5-PeCB	118	0.5	98.7	285	241	326	92.5
2,3,4,4',5-PeCB	114	0.5	6.36	10.0	12.7	11.5	3.61
2,3,3',4,4'-PeCB	105	0.5	35.8	44.8	41.3	70.2	20.4
3,3',4,4',5-PeCB	126	0.5	11.2	12.2	10.2	11.6	6.94
2,3',4,4',5,5'-HxCB	167	1.0	8.95	18.6	11.9	20.9	13.5
2,3,3',4,4',5-HxCB	156	1.0	81.3	107	74.2	168	56.8
2,3,3',4,4',5'-HxCB	157	1.0	7.85	9.64	6.91	16.2	7.78
3,3',4,4',5,5'-HxCB	169	1.0	0.47	0.64	0.55	1.01	0.35
2,3,3',4,4',5,5'-HpCB	189	1.0	10.6	8.25	4.97	16.3	7.21
Total TEQ (ND=0)			1.190	1.335	1.111	1.325	0.747
Total TEQ (ND=DL)			1.190	1.335	1.111	1.325	0.747
% Lipids			0.21	0.64	0.43	0.91	0.27
Sample weight (g)			45.0	34.5	50.0	36.5	33.0

DEP ID WRI ID			ALS-SMB 00-429*	ALS-SMB 00-430	ALS-SMB 00-431	ALS-SMB 00-432	ALS-SMB 00-433
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	10.8	9.95	12.6	23.7	10.5
2',3,4,4',5-PeCB	123	0.5	28.7	23.8	31.5	64.8	25.6
2,3',4,4',5-PeCB	118	0.5	69.7	74.2	114	201	102
2,3,4,4',5-PeCB	114	0.5	4.44	5.12	8.75	19.2	7.57
2,3,3',4,4'-PeCB	105	0.5	20.9	27.9	51.3	116	49.8
3,3',4,4',5-PeCB	126	0.5	6.12	8.25	8.91	18.5	7.21
2,3',4,4',5,5'-HxCB	167	1.0	7.21	11.3	13.6	20.6	10.2
2,3,3',4,4',5-HxCB	156	1.0	69.8	62.1	88.6	157	73.6
2,3,3',4,4',5'-HxCB	157	1.0	7.16	5.06	10.1	18.7	8.51
3,3',4,4',5,5'-HxCB	169	1.0	<DL	<DL	0.77	1.02	0.51
2,3,3',4,4',5,5'-HpCB	189	1.0	9.12	7.75	15.7	21.9	12.6
Total TEQ (ND=0)			0.667	0.876	0.975	2.001	0.791
Total TEQ (ND=DL)			0.677	0.886	0.975	2.001	0.791
% Lipids			0.16	0.17	0.26	0.56	0.25
Sample weight (g)			20.0	45.0	50.1	50.1	43.0

DEP ID WRI ID			ALW-SMB 00-80-c2	ALW-SMB 00-83-c1	ALW-WHS 00-100-c1	ALW-WHS 00-101-c2
congener	**IUPAC#**	**DL (ng/Kg)**				
3,3',4,4'-TCB	77	0.5	5.12	4.98	15.7	14.3
2',3,4,4',5-PeCB	123	0.5	10.30	9.15	98.2	101
2,3',4,4',5-PeCB	118	0.5	28.9	33.8	205	184
2,3,4,4',5-PeCB	114	0.5	0.68	0.42	5.14	6.31
2,3,3',4,4'-PeCB	105	0.5	11.30	8.85	30.4	33.9
3,3',4,4',5-PeCB	126	0.5	<DL	<DL	1.07	0.97
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	21.6	18.6
2,3,3',4,4',5-HxCB	156	1.0	14.2	12.6	201	223
2,3,3',4,4',5'-HxCB	157	1.0	5.91	4.01	11.6	9.89
3,3',4,4',5,5'-HxCB	169	1.0	<DL	<DL	<DL	<DL
2,3,3',4,4',5,5'-HpCB	189	1.0	4.47	3.26	10.7	6.08
Total TEQ (ND=0)			0.016	0.015	0.252	0.251
Total TEQ (ND=DL)			0.076	0.075	0.262	0.261
% Lipids			0.37	0.31	10.2	8.61
Sample weight (g)			50.0	50.1	50.1	50.1

DEP ID			KNW-BNT-1	KNW-BNT-2	KNW-BNT-3	KNW-BNT-4	KNW-BNT-5
WRI ID			00-63	00-64	00-65	00-66	00-67
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	4.01	4.38	2.95	5.22	7.26
2',3,4,4',5-PeCB	123	0.5	3.22	2.79	1.88	3.07	4.12
2,3',4,4',5-PeCB	118	0.5	35.1	74.9	48.2	65.2	126
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	6.15	7.51	3.66	6.61	13.4
3,3',4,4',5-PeCB	126	0.5	4.01	6.24	3.79	5.32	10.6
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	73.2	103	64.2	98.4	167
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	0.98	1.16	1.44	2.03	2.66
2,3,3',4,4',5,5'-HpCB	189	1.0	10.2	12.3	8.15	15.4	18.7
CTEo			0.453	0.697	0.432	0.611	1.187
CTEd			0.454	0.698	0.433	0.612	1.188
CTEh			**0.454**	**0.698**	**0.432**	**0.611**	**1.187**
Lipid (g)			0.35	0.74	0.30	0.69	1.39
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID		
WRI ID		
Congener	**IUPAC#**	**DL (ng/Kg)**
3,3',4,4'-TCB	77	0.5
2',3,4,4',5-PeCB	123	0.5
2,3',4,4',5-PeCB	118	0.5
2,3,4,4',5-PeCB	114	0.5
2,3,3',4,4'-PeCB	105	0.5
3,3',4,4',5-PeCB	126	0.5
2,3',4,4',5,5'-HxCB	167	1.0
2,3,3',4,4',5-HxCB	156	1.0
2,3,3',4,4',5'-HxCB	157	1.0
3,3',4,4',5,5'-HxCB	169	1.0
2,3,3',4,4',5,5'-HpCB	189	1.0
CTEo		
CTEd		
CTEh		
Lipid (g)		
Sample weight (g)		

DEP ID			KNW-SMB-1	KNW-SMB-2	KNW-SMB-3	KNW-SMB-4	KNW-SMB-5
WRI ID			00-125	00-126	00-237	00-238	00-239
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	1.74	1.02	3.48	3.12	1.34
2',3,4,4',5-PeCB	123	0.5	2.02	2.14	7.29	4.02	3.33
2,3',4,4',5-PeCB	118	0.5	34.4	26.3	77.4	31.4	29.7
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	1.97	1.66	5.21	2.48	3.17
3,3',4,4',5-PeCB	126	0.5	1.88	2.51	4.26	3.66	4.14
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	32.6	35.7	120	86.4	71.5
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	<DL	<DL	1.06	0.56	<DL
2,3,3',4,4',5,5'-HpCB	189	1.0	3.48	4.91	13.2	2.66	6.25
CTEo			0.209	0.272	0.507	0.419	0.454
CTEd			0.219	0.283	0.508	0.420	0.465
CTEh			**0.214**	**0.278**	**0.508**	**0.420**	**0.460**
Lipid (g)			0.23	0.17	0.91	0.62	0.37
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			KNW-SMB-6	KNW-SMB-7	KNW-SMB-8	KNW-SMB-9	KNW-SMB-10
WRI ID			00-240	00-241	00-242	00-243	00-244
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	1.89	3.89	3.05	2.41	3.36
2',3,4,4',5-PeCB	123	0.5	2.24	4.75	5.14	5.47	4.38
2,3',4,4',5-PeCB	118	0.5	22.8	33.6	29.8	41.6	38.6
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	2.17	4.02	3.78	3.55	2.79
3,3',4,4',5-PeCB	126	0.5	1.61	2.66	2.97	2.47	3.05
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	30.9	68.7	61.0	81.1	37.5
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	<DL	<DL	<DL	0.88	<DL
2,3,3',4,4',5,5'-HpCB	189	1.0	3.71	5.13	4.66	7.16	2.48
CTEo			0.180	0.305	0.332	0.302	0.329
CTEd			0.190	0.316	0.343	0.303	0.340
CTEh			**0.185**	**0.311**	**0.338**	**0.303**	**0.334**
Lipid (g)			0.28	0.66	0.51	0.80	0.27
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			KNW-SSMB-1	KNW-SSMB-2	KNW-SSMB-3	KNW-SSMB-4	KNW-SSMB-5
WRI ID			00-568	00-569	00-570	00-571	00-572
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	4.99	6.09	5.48	6.42	5.06
2',3,4,4',5-PeCB	123	0.5	5.36	3.15	5.04	6.94	5.24
2,3',4,4',5-PeCB	118	0.5	25.8	42.8	30.8	38.7	40.2
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	2.54	3.54	4.01	5.59	4.87
3,3',4,4',5-PeCB	126	0.5	2.49	4.06	3.64	4.78	4.25
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	22.3	33.8	24.2	44.3	31.6
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	3.30	4.16	3.78	3.06	2.25
2,3,3',4,4',5,5'-HpCB	189	1.0	3.91	3.75	4.26	4.77	3.67
CTEo			0.297	0.470	0.419	0.537	0.469
CTEd			0.298	0.471	0.420	0.538	0.470
CTEh			**0.298**	**0.471**	**0.419**	**0.537**	**0.470**
Lipid (g)			3.34	3.89	3.67	4.42	3.53
Sample weight (g)			50.1	49.9	50.1	49.9	50.0

DEP ID			KNW-SSMB-6	KNW-SSMB-7	KNW-SSMB-8	KNW-SSMB-9	KNW-SSMB-10
WRI ID			00-573	00-574	00-575	00-576	00-577
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	4.75	3.89	5.94	8.41	6.88
2',3,4,4',5-PeCB	123	0.5	4.69	3.66	6.25	9.67	7.21
2,3',4,4',5-PeCB	118	0.5	31.8	28.7	35.5	50.3	42.1
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	4.22	3.91	5.17	5.06	6.63
3,3',4,4',5-PeCB	126	0.5	3.84	2.15	4.88	5.84	5.24
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	28.9	36.7	40.5	45.7	51.7
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	1.55	1.97	2.75	3.99	3.26
2,3,3',4,4',5,5'-HpCB	189	1.0	2.47	3.02	4.91	5.08	5.97
CTEo			0.419	0.257	0.542	0.655	0.589
CTEd			0.420	0.258	0.542	0.655	0.590
CTEh			**0.419**	**0.258**	**0.542**	**0.655**	**0.590**
Lipid (g)			3.17	2.42	3.84	5.55	5.88
Sample weight (g)			50.1	46.0	50.1	46.0	40.0

DEP ID			KNW-WHS-C1	KNW-WHS-C2	KNW-WHS-C3	KNW-WHS-C4	KNW-WHS-C5
WRI ID			00-129-c1	00-146-c2	00-134-c3	00-139-c4	00-127-c5
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	15.7	18.9	15.4	14.3	10.6
2',3,4,4',5-PeCB	123	0.5	16.4	20.2	16.7	11.6	9.41
2,3',4,4',5-PeCB	118	0.5	159	176	188	135	127
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	14.2	16.3	13.2	12.4	10.7
3,3',4,4',5-PeCB	126	0.5	6.32	8.51	14.7	5.73	6.71
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	106	121	97.5	103	117
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	12.5	15.3	7.21	11.6	8.45
2,3,3',4,4',5,5'-HpCB	189	1.0	13.1	14.7	9.65	10.2	11.3
CTEo			0.832	1.089	1.615	0.759	0.831
CTEd			0.833	1.090	1.616	0.760	0.832
CTEh			**0.832**	**1.089**	**1.616**	**0.759**	**0.831**
Lipid (g)			2.57	2.67	3.42	3.12	2.41
Sample weight (g)			50.1	50.1	50.1	50.1	50.1

DEP ID			KNW-WHS-C6	KNW-WHS-C7	KNW-WHS-C8	KNW-WHS-C9	KNW-WHS-C10
WRI ID			00-130-c6	00-131-c7	00-135-c8	00-133-c9	00-151-c10
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	13.7	12.7	9.84	20.3	18.6
2',3,4,4',5-PeCB	123	0.5	11.6	13.4	8.58	18.4	15.2
2,3',4,4',5-PeCB	118	0.5	147	127	106	166	132
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	13.7	9.21	7.23	18.0	14.7
3,3',4,4',5-PeCB	126	0.5	9.89	11.9	5.81	7.25	6.69
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	156	127	94.3	134	115
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	10.5	8.10	6.31	19.5	22.6
2,3,3',4,4',5,5'-HpCB	189	1.0	16.9	9.81	8.07	17.1	15.4
CTEo			1.192	1.352	0.705	1.011	0.972
CTEd			1.193	1.352	0.706	1.012	0.973
CTEh			**1.193**	**1.352**	**0.706**	**1.011**	**0.972**
Lipid (g)			3.35	2.17	2.23	2.95	2.81
Sample weight (g)			50.1	50.0	50.1	50.0	50.1

DEP ID			KFF-SMB-1	KFF-SMB-2	KFF-SMB-3	KFF-SMB-4	KFF-SMB-5
WRI ID			00-247	00-248	00-249	00-250	00-251
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	3.24	4.02	4.65	3.84	2.81
2',3,4,4',5-PeCB	123	0.5	10.2	5.36	4.21	3.15	3.66
2,3',4,4',5-PeCB	118	0.5	50.1	41.7	31.6	42.6	53.7
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	5.36	3.06	1.51	2.88	5.03
3,3',4,4',5-PeCB	126	0.5	1.78	2.45	2.04	2.45	1.15
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	61.9	49.7	28.9	31.6	47.6
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	1.24	0.75	2.05	1.27	2.11
2,3,3',4,4',5,5'-HpCB	189	1.0	6.11	5.07	6.91	4.55	3.51
CTEo			0.229	0.283	0.244	0.279	0.167
CTEd			0.230	0.284	0.245	0.280	0.168
CTEh			**0.229**	**0.284**	**0.244**	**0.280**	**0.167**
Lipid (g)			0.63	0.90	1.39	0.80	0.62
Sample weight (g)			50.0	50.0	50.0	50.0	50.1

DEP ID			KFF-SMB-6	KFF-SMB-7	KFF-SMB-8	KFF-SMB-9	KFF-SMB-10
WRI ID			00-252	00-253	00-254	00-255A	00-255B
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	3.51	2.98	4.21	3.25	1.55
2',3,4,4',5-PeCB	123	0.5	2.84	1.87	3.42	1.74	0.52
2,3',4,4',5-PeCB	118	0.5	56.7	46.3	43.6	37.5	31.6
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	4.87	4.28	5.29	3.21	0.98
3,3',4,4',5-PeCB	126	0.5	1.56	0.83	1.26	1.06	0.75
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	33.7	49.7	41.3	37.8	31.5
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	1.88	1.48	1.81	1.25	0.84
2,3,3',4,4',5,5'-HpCB	189	1.0	4.42	5.37	6.31	3.66	2.42
CTEo			0.199	0.129	0.171	0.142	0.103
CTEd			0.200	0.129	0.172	0.143	0.104
CTEh			**0.199**	**0.129**	**0.171**	**0.143**	**0.103**
Lipid (g)			0.99	0.95	0.73	1.00	0.40
Sample weight (g)			50.1	50.1	50.0	50.0	50.0

DEP ID			KFF-SSMB-1	KFF-SSMB-2	KFF-SSMB-3	KFF-SSMB-4	KFF-SSMB-5
WRI ID			00-343	00-344	00-345	00-346	00-347
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	4.06	4.29	7.66	4.26	3.92
2',3,4,4',5-PeCB	123	0.5	12.4	11.3	22.3	12.6	11.0
2,3',4,4',5-PeCB	118	0.5	48.9	41.6	70.1	30.6	35.3
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	10.3	8.06	8.41	6.87	5.42
3,3',4,4',5-PeCB	126	0.5	3.26	4.12	7.22	4.26	6.91
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	41.8	32.8	70.3	69.3	41.3
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	1.54	2.07	2.95	1.75	1.05
2,3,3',4,4',5,5'-HpCB	189	1.0	6.37	4.21	6.05	4.98	3.21
CTEo			0.371	0.456	0.798	0.484	0.728
CTEd			0.371	0.457	0.799	0.485	0.729
CTEh			**0.371**	**0.456**	**0.798**	**0.484**	**0.728**
Lipid (g)			3.43	3.33	4.89	3.92	3.55
Sample weight (g)			50.1	50.0	50.1	50.0	50.0

DEP ID			KFF-SSMB-6	KFF-SSMB-7	KFF-SSMB-8	KFF-SSMB-9	KFF-SSMB-10
WRI ID			00-348	00-349	00-350	00-351	00-352
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	5.08	6.33	7.01	6.58	7.91
2',3,4,4',5-PeCB	123	0.5	12.9	14.2	18.9	20.3	24.3
2,3',4,4',5-PeCB	118	0.5	51.8	60.4	84.2	77.2	85.9
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	9.22	9.41	9.14	13.4	11.2
3,3',4,4',5-PeCB	126	0.5	5.97	6.89	6.63	5.59	4.69
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	57.9	61.4	62.5	74.6	88.2
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	2.99	2.03	2.54	2.99	3.36
2,3,3',4,4',5,5'-HpCB	189	1.0	5.31	6.49	7.61	9.54	10.1
CTEo			0.664	0.750	0.732	0.639	0.561
CTEd			0.665	0.750	0.733	0.640	0.561
CTEh			**0.665**	**0.750**	**0.733**	**0.639**	**0.561**
Lipid (g)			4.39	4.58	4.88	5.51	6.70
Sample weight (g)			50.1	50.1	50.0	50.0	44.2

DEP ID			KFF-WHS-C1	KFF-WHS-C2	KFF-WHS-C3	KFF-WHS-C4	KFF-WHS-C5
WRI ID			00-177-c1	00-213-c2	00-209-c3	00-189-c4	00-193-c5
Congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	4.61	5.31	5.24	6.58	4.26
2',3,4,4',5-PeCB	123	0.5	2.34	12.8	10.6	13.8	11.3
2,3',4,4',5-PeCB	118	0.5	154	224	147	206	105
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	2.21	9.45	5.21	8.51	4.26
3,3',4,4',5-PeCB	126	0.5	7.02	13.7	13.4	15.7	8.69
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	162	227	188	203	148
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	4.81	10.3	8.85	7.14	8.61
2,3,3',4,4',5,5'-HpCB	189	1.0	9.78	32.6	21.6	36.9	24.3
CTEo			0.848	1.615	1.541	1.770	1.044
CTEd			0.849	1.616	1.542	1.771	1.045
CTEh			**0.849**	**1.615**	**1.542**	**1.770**	**1.044**
Lipid (g)			1.94	4.22	3.98	4.13	3.41
Sample weight (g)			50.1	50.1	50.0	50.1	49.9

DEP ID			KFF-WHS-C6	KFF-WHS-C7	KFF-WHS-C8	KFF-WHS-C9	KFF-WHS-C10
WRI ID			00-184-c6	00-188-c7	00-179-c8	00-192-c9	00-181-c10
Congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	2.11	3.78	4.06	4.78	3.35
2',3,4,4',5-PeCB	123	0.5	1.89	8.89	9.55	7.21	4.05
2,3',4,4',5-PeCB	118	0.5	88.1	82.4	105	122	75.3
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	3.01	3.27	4.17	5.32	2.88
3,3',4,4',5-PeCB	126	0.5	1.69	6.77	3.66	5.87	5.09
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	120	109	214	175	141
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	5.72	4.26	6.25	7.78	6.38
2,3,3',4,4',5,5'-HpCB	189	1.0	8.35	11.9	15.6	20.7	18.9
CTEo			0.297	0.785	0.549	0.768	0.654
CTEd			0.297	0.786	0.550	0.769	0.655
CTEh			**0.297**	**0.786**	**0.550**	**0.769**	**0.654**
Lipid (g)			1.06	3.01	3.34	3.68	2.77
Sample weight (g)			50.1	49.8	50.0	50.1	50.0

DEP ID			KSD-BNT-1	KSD-BNT-2	KSD-BNT-3	KSD-BNT-4	KSD-BNT-5
WRI ID			00-58	00-59	00-60	00-61	00-62
Congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	7.06	4.25	8.14	7.55	10.5
2',3,4,4',5-PeCB	123	0.5	7.22	3.61	6.25	5.36	11.6
2,3',4,4',5-PeCB	118	0.5	35.6	25.9	59.7	49.1	106
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	5.81	2.26	4.81	5.06	6.32
3,3',4,4',5-PeCB	126	0.5	6.02	3.87	6.37	5.24	8.51
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	48.7	31.6	65.7	59.3	84.2
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	4.59	2.05	5.21	4.06	6.25
2,3,3',4,4',5,5'-HpCB	189	1.0	18.3	6.38	22.6	16.8	30.5
CTEo			0.680	0.428	0.732	0.603	0.972
CTEd			0.680	0.428	0.733	0.603	0.973
CTEh			**0.680**	**0.428**	**0.732**	**0.603**	**0.972**
Lipid (g)			0.80	0.14	1.34	0.83	2.43
Sample weight (g)			50.1	50.0	50.0	50.1	50.1

DEP ID			KSD-SMB-1	KSD-SMB-2	KSD-SMB-3	KSD-SMB-4	KSD-SMB-5
WRI ID			00-650	00-651	00-652	00-653	00-654
Congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	111.5	9.01	13.1	9.15	7.55
2',3,4,4',5-PeCB	123	0.5	20.6	16.8	24.6	13.4	13.2
2,3',4,4',5-PeCB	118	0.5	225	172	191	155	124
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	14.5	12.3	15.4	14.2	9.95
3,3',4,4',5-PeCB	126	0.5	14.0	6.72	9.26	6.45	1.65
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	188	154	241	184	136
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	16.3	13.7	13.4	13.6	12.5
2,3,3',4,4',5,5'-HpCB	189	1.0	21.4	20.5	19.7	14.8	16.9
CTEo			1.696	0.909	1.207	0.894	0.375
CTEd			1.697	0.910	1.208	0.894	0.376
CTEh			**1.697**	**0.909**	**1.207**	**0.894**	**0.376**
Lipid (g)							
Sample weight (g)							

DEP ID			PBW-SMB-2	PBW-SMB-3	PBW-SMB-6	PBW-SMB-7	PBW-SMB-9
WRI ID			00-509	00-510	00-511	00-512	00-513
congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	5.52	7.31	3.02	2.43	5.88
2',3,4,4',5-PeCB	123	0.5	6.43	4.97	1.36	1.15	5.01
2,3',4,4',5-PeCB	118	0.5	153	165	45.6	51.2	121
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	5.34	8.21	<DL	0.45	4.42
3,3',4,4',5-PeCB	126	0.5	6.21	8.76	2.26	3.95	6.05
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	131	176	71.2	55.2	145
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	4.72	6.79	1.54	1.97	5.76
2,3,3',4,4',5,5'-HpCB	189	1.0	5.23	7.32	2.03	2.39	5.88
Total TEQ (ND=0)			0.751	1.051	0.282	0.448	0.749
Total TEQ (ND=DL)			0.752	1.052	0.283	0.449	0.750
% Lipids			0.82	1.03	0.19	0.26	0.69
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			PBW-SMB-10	PBW-SMB-12	PBW-SMB-13	PBW-SMB-14	PBW-SMB-16
WRI ID			00-514	00-515	00-516	00-517	00-518
congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	2.75	3.25	5.47	3.66	4.75
2',3,4,4',5-PeCB	123	0.5	5.61	3.91	6.48	3.07	4.01
2,3',4,4',5-PeCB	118	0.5	148	57.2	88.7	66.5	78.2
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	6.62	0.75	4.15	<DL	1.06
3,3',4,4',5-PeCB	126	0.5	7.91	4.58	6.37	4.03	3.59
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	134	49.1	66.9	94.5	62.7
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	4.27	1.14	4.17	<DL	5.15
2,3,3',4,4',5,5'-HpCB	189	1.0	5.91	3.67	5.29	3.28	2.64
Total TEQ (ND=0)			0.918	0.501	0.723	0.458	0.451
Total TEQ (ND=DL)			0.918	0.502	0.724	0.469	0.452
% Lipids			0.99	0.33	0.53	0.25	0.45
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

Values less than the established MDLs are to be considered estimated values.

DEP ID			PBW-WHS-3	PBW-WHS-4	PBW-WHS-5	PBW-WHS-8	PBW-WHS-11
WRI ID			00-367	00-368	00-369	00-372	00-375
congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	15.7	8.85	10.5	13.7	6.22
2',3,4,4',5-PeCB	123	0.5	22.3	15.9	18.4	20.4	9.21
2,3',4,4',5-PeCB	118	0.5	250	199	205	261	174
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	11.8	7.24	8.14	12.9	7.42
3,3',4,4',5-PeCB	126	0.5	8.65	5.58	8.00	10.1	6.92
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	242	169	188	238	163
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	18.4	10.5	16.9	20.2	11.4
2,3,3',4,4',5,5'-HpCB	189	1.0	10.0	11.9	14.8	13.6	8.85
Total TEQ (ND=0)			1.201	0.772	1.089	1.363	0.908
Total TEQ (ND=DL)			1.202	0.773	1.089	1.364	0.909
% Lipids			6.56	3.68	4.12	6.22	3.27
Sample weight (g)			50.0	49.9	50.1	50.1	50.1

DEP ID			PBW-WHS-12	PBW-WHS-13	PBW-WHS-15	PBW-WHS-16	PBW-WHS-19
WRI ID			00-376	00-377	00-378	00-379	00-381
congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	7.04	12.4	9.51	10.4	16.1
2',3,4,4',5-PeCB	123	0.5	8.85	14.6	11.3	15.1	16.4
2,3',4,4',5-PeCB	118	0.5	159	221	187	225	242
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	6.39	10.7	6.23	8.54	15.1
3,3',4,4',5-PeCB	126	0.5	4.41	8.37	5.18	6.37	7.15
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	144	196	157	206	215
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	9.57	17.3	15.8	14.2	17.9
2,3,3',4,4',5,5'-HpCB	189	1.0	5.69	10.2	8.85	10.6	11.6
Total TEQ (ND=0)			0.627	1.135	0.777	0.909	1.032
Total TEQ (ND=DL)			0.628	1.136	0.778	0.910	1.032
% Lipids			2.88	4.63	4.00	4.00	4.93
Sample weight (g)			50.1	49.9	49.9	50.1	50.0

Values less than the established MDLs ar

DEP ID			PBL-SMB-1	PBL-SMB-2	PBL-SMB-3	PBL-SMB-4	PBL-SMB-5
WRI ID			00-499	00-500	00-501	00-502	00-503
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	5.38	9.45	8.06	13.7	6.75
2',3,4,4',5-PeCB	123	0.5	6.74	11.3	10.2	19.6	8.79
2,3',4,4',5-PeCB	118	0.5	86.9	145	121	201	125
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	6.03	9.95	6.34	14.7	5.41
3,3',4,4',5-PeCB	126	0.5	8.52	6.74	5.29	9.89	4.27
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	257	271	166	350	159
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	16.9	15.3	8.75	21.6	10.3
2,3,3',4,4',5,5'-HpCB	189	1.0	16.8	15.7	7.00	19.4	8.47
Total TEQ (ND=0)			1.162	0.982	0.715	1.407	0.625
Total TEQ (ND=DL)			1.162	0.982	0.716	1.408	0.626
% Lipids			1.05	1.01	0.70	1.46	0.62
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

DEP ID			PBL-SMB-6	PBL-SMB-7	PBL-SMB-8	PBL-SMB-10	PBL-SMB-11
WRI ID			00-504	00-505	00-506	00-507	00-508
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	7.29	10.6	6.65	8.79	9.42
2',3,4,4',5-PeCB	123	0.5	9.49	12.4	9.51	11.4	10.3
2,3',4,4',5-PeCB	118	0.5	152	166	127	148	157
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	7.29	10.9	7.24	8.95	8.81
3,3',4,4',5-PeCB	126	0.5	6.61	8.85	6.29	6.37	7.69
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	187	301	173	285	203
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	11.6	16.9	14.2	16.1	12.6
2,3,3',4,4',5,5'-HpCB	189	1.0	9.57	17.2	12.9	14.8	10.8
Total TEQ (ND=0)			0.889	1.226	0.874	0.960	1.016
Total TEQ (ND=DL)			0.890	1.227	0.875	0.960	1.017
% Lipids			0.71	1.10	0.84	1.05	0.84
Sample weight (g)			50.0	50.0	50.0	50.0	50.0

Values less than the established MDLs ar

DEP ID			PBL-WHS-2	PBL-WHS-3	PBL-WHS-7	PBL-WHS-9	PBL-WHS-13
WRI ID			00-353	00-354	00-356	00-358	00-360
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	20.6	16.2	17.3	15.9	19.4
2',3,4,4',5-PeCB	123	0.5	25.1	18.9	21.6	16.7	23.7
2,3',4,4',5-PeCB	118	0.5	388	261	288	245	271
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	26.7	22.7	25.2	22.1	24.7
3,3',4,4',5-PeCB	126	0.5	25.9	20.3	23.1	20.9	22.9
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	441	350	394	374	383
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	25.3	22.1	23.0	23.8	18.7
2,3,3',4,4',5,5'-HpCB	189	1.0	26.4	18.7	22.4	22.4	16.1
Total TEQ (ND=0)			3.112	2.460	2.774	2.547	2.704
Total TEQ (ND=DL)			3.113	2.461	2.775	2.548	2.705
% Lipids			12.80	8.95	10.90	9.99	11.79
Sample weight (g)			50.0	50.1	50.1	50.0	50.1

DEP ID			PBL-WHS-14	PBL-WHS-21	PBL-WHS-22	PBL-WHS-23	PBL-WHS-24
WRI ID			00-361	00-363	00-364	00-365	00-366
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	20.6	13.6	17.0	18.9	21.5
2',3,4,4',5-PeCB	123	0.5	21.5	14.9	16.8	24.6	26.3
2,3',4,4',5-PeCB	118	0.5	301	199	287	354	397
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	25.3	16.7	27.3	28.3	30.1
3,3',4,4',5-PeCB	126	0.5	21.6	14.2	24.6	28.7	26.9
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	372	235	369	406	421
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	20.6	16.1	19.4	21.3	26.9
2,3,3',4,4',5,5'-HpCB	189	1.0	19.4	14.2	21.6	19.8	27.3
Total TEQ (ND=0)			2.591	1.724	2.875	3.331	3.220
Total TEQ (ND=DL)			2.592	1.725	2.876	3.331	3.220
% Lipids			10.34	6.37	9.72	12.66	13.37
Sample weight (g)			50.1	50.0	50.0	50.1	50.0

Values less than the established MDLs ar

congener	IUPAC#	DL (ng/Kg)	PBC-SMB-1	PBC-SMB-2	PBC-SMB-3	PBC-SMB-4	PBC-SMB-5
DEP ID			PBC-SMB-1	PBC-SMB-2	PBC-SMB-3	PBC-SMB-4	PBC-SMB-5
WRI ID			00-537	00-538	00-539	00-540	00-541
3,3',4,4'-TCB	77	0.5	7.56	4.26	9.45	6.02	11.2
2',3,4,4',5-PeCB	123	0.5	7.32	3.39	8.61	4.75	9.86
2,3',4,4',5-PeCB	118	0.5	143	121	267	165	281
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	14.5	6.95	15.8	10.4	18.7
3,3',4,4',5-PeCB	126	0.5	12.9	3.35	14.3	5.91	16.0
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	177	98.5	203	135	235
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	8.89	2.81	10.9	4.86	13.7
2,3,3',4,4',5,5'-HpCB	189	1.0	15.3	6.69	18.7	10.9	21.4
Total TEQ (ND=0)			1.486	0.427	1.672	0.727	1.889
Total TEQ (ND=DL)			1.487	0.427	1.673	0.728	1.889
% Lipids			0.90	0.35	1.19	0.40	1.46
Sample weight (g)			50.0	50.0	50.1	50.1	50.0

congener	IUPAC#	DL (ng/Kg)	PBC-WHS-C1	PBC-WHS-C2	PBV-SMB-1	PBV-SMB-2	PBV-SMB-3
DEP ID			PBC-WHS-C1	PBC-WHS-C2	PBV-SMB-1	PBV-SMB-2	PBV-SMB-3
WRI ID			00-542	00-543	00-552	00-553	00-554
3,3',4,4'-TCB	77	0.5	13.2	10.4	27.3	30.1	24.2
2',3,4,4',5-PeCB	123	0.5	10.7	13.2	33.6	38.4	29.6
2,3',4,4',5-PeCB	118	0.5	334	298	325	297	275
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	17.4	15.7	20.9	17.6	22.4
3,3',4,4',5-PeCB	126	0.5	12.6	10.2	12.6	15.3	18.6
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	234	201	356	391	324
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	18.9	15.6	17.3	18.6	15.7
2,3,3',4,4',5,5'-HpCB	189	1.0	20.4	18.7	30.2	34.5	27.6
Total TEQ (ND=0)			1.606	1.312	1.655	1.953	2.217
Total TEQ (ND=DL)			1.606	1.313	1.655	1.954	2.218
% Lipids			9.35	8.22	1.23	1.46	1.27
Sample weight (g)			49.9	50.0	50.0	50.0	50.0

Values less than the established MDLs ar

DEP ID			PBV-SMB-4	PBV-SMB-5	PBV-WHS-C1	PBV-WHS-C2	
WRI ID			00-555	00-556	00-558	00-557	
congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	16.9	14.6	41.7	34.6	
2',3,4,4',5-PeCB	123	0.5	18.2	16.3	39.8	48.2	
2,3',4,4',5-PeCB	118	0.5	194	223	701	745	
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	
2,3,3',4,4'-PeCB	105	0.5	11.5	9.84	39.1	35.7	
3,3',4,4',5-PeCB	126	0.5	9.95	11.6	18.6	15.9	
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	
2,3,3',4,4',5-HxCB	156	1.0	201	187	712	644	
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	
3,3',4,4',5,5'-HxCB	169	1.0	8.74	10.4	31.4	36.8	
2,3,3',4,4',5,5'-HpCB	189	1.0	14.6	11.5	42.8	35.4	
Total TEQ (ND=0)			1.208	1.385	2.616	2.370	
Total TEQ (ND=DL)			1.209	1.386	2.617	2.371	
% Lipids			0.88	0.75	11.25	9.49	
Sample weight (g)			50.0	50.1	49.9	50.1	50.0

rechecks

DEP ID			PBB-EEL-C1	PBB-EEL-C2
WRI ID			00-478	00-474
congener	IUPAC#	**DL (ng/Kg)**		
3,3',4,4'-TCB	77	0.5	21.5	18.9
2',3,4,4',5-PeCB	123	0.5	56.9	48.7
2,3',4,4',5-PeCB	118	0.5	605	558
2,3,4,4',5-PeCB	114	0.5	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	33.4	26.9
3,3',4,4',5-PeCB	126	0.5	25.8	27.8
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	365	312
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	30.4	27.6
2,3,3',4,4',5,5'-HpCB	189	1.0	29.1	32.4
Total TEQ (ND=0)			3.141	3.280
Total TEQ (ND=DL)			3.142	3.281
% Lipids			19.81	16.50
Sample weight (g)				

Values less than the established MDLs ar

DEP ID			PBW-SMB-2	PBW-SMB-3	PBW-SMB-6	PBW-SMB-7	PBW-SMB-9
WRI ID			00-509	00-510	00-511	00-512	00-513
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	4.31	1.02	2.66	2.06	7.46
2',3,4,4',5-PeCB	123	0.5	4.89	1.16	1.51	0.98	6.81
2,3',4,4',5-PeCB	118	0.5	134	21.6	38.9	56.8	141
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	5.98	<DL	<DL	0.61	5.26
3,3',4,4',5-PeCB	126	0.5	5.02	2.41	1.85	3.24	6.31
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	116	45.9	68.9	61.8	105
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	3.99	2.68	1.69	1.54	5.49
2,3,3',4,4',5,5'-HpCB	189	1.0	5.14	3.01	1.88	1.95	5.68
Total TEQ (ND=0)			0.615	0.293	0.241	0.377	0.755
Total TEQ (ND=DL)			0.616	0.294	0.242	0.377	0.756
% Lipids			0.905	0.163	0.155	0.134	0.484
Sample weight (g)			50.1	49.0	50.1	50.1	50.0

DEP ID			PBW-SMB-10	PBW-SMB-12	PBW-SMB-13	PBW-SMB-14	PBW-SMB-16
WRI ID			00-514	00-515	00-516	00-517	00-518
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	8.27	3.32	2.56	4.26	4.25
2',3,4,4',5-PeCB	123	0.5	7.79	3.14	3.36	4.41	3.88
2,3',4,4',5-PeCB	118	0.5	174	48.9	71.2	81.7	81.6
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	6.39	0.51	2.55	1.69	1.29
3,3',4,4',5-PeCB	126	0.5	8.14	3.66	3.97	5.33	4.01
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	169	52.8	53.4	91.3	66.9
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	8.85	0.84	3.04	2.25	3.95
2,3,3',4,4',5,5'-HpCB	189	1.0	10.2	2.57	3.66	4.61	3.88
Total TEQ (ND=0)			1.008	0.407	0.462	0.611	0.483
Total TEQ (ND=DL)			1.008	0.407	0.463	0.612	0.484
% Lipids			1.96	0.173	0.237	0.321	0.438
Sample weight (g)			50.0	50.1	50.0	50.0	50.1

Values less than the established MDLs ar

DEP ID			PBL-SMB-1	PBL-SMB-2	PBL-SMB-3	PBL-SMB-4	PBL-SMB-5
WRI ID			00-499	00-500	00-501	00-502	00-503
congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	6.31	10.3	7.31	14.2	7.23
2',3,4,4',5-PeCB	123	0.5	5.24	10.8	8.52	16.9	7.14
2,3',4,4',5-PeCB	118	0.5	91.4	161	136	224	118
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	5.24	10.8	5.24	15.6	6.22
3,3',4,4',5-PeCB	126	0.5	6.11	8.38	6.01	8.55	5.84
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	226	256	149	315	147
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	14.8	17.4	7.02	18.7	8.25
2,3,3',4,4',5,5'-HpCB	189	1.0	12.5	15.9	6.33	16.6	7.31
Total TEQ (ND=0)			0.884	1.161	0.762	1.228	0.755
Total TEQ (ND=DL)			0.885	1.162	0.763	1.229	0.755
% Lipids			0.604	0.918	0.575	1.23	0.442
Sample weight (g)			50.1	50.1	50.0	50.1	50.1

DEP ID			PBL-SMB-6	PBL-SMB-7	PBL-SMB-8	PBL-SMB-10	PBL-SMB-11
WRI ID			00-504	00-505	00-506	00-507	00-508
congener	IUPAC#	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	6.35	6.69	7.21	7.15	8.87
2',3,4,4',5-PeCB	123	0.5	8.38	7.25	10.3	9.62	9.41
2,3',4,4',5-PeCB	118	0.5	132	123	141	136	147
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	7.22	6.21	8.32	9.01	7.63
3,3',4,4',5-PeCB	126	0.5	5.96	5.33	7.66	8.33	8.55
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	156	196	189	258	226
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	10.3	10.1	13.6	14.3	10.2
2,3,3',4,4',5,5'-HpCB	189	1.0	9.78	9.47	13.5	12.8	11.5
Total TEQ (ND=0)			0.793	0.747	1.015	1.122	1.088
Total TEQ (ND=DL)			0.794	0.748	1.015	1.123	1.089
% Lipids			0.419	0.579	0.858	0.838	0.581
Sample weight (g)			50.1	50.0	50.1	50.1	50.1

Values less than the established MDLs ar

DEP ID			PBL-WHS-2	PBL-WHS-3	PBL-WHS-7	PBL-WHS-9	PBL-WHS-13
WRI ID			00-353	00-354	00-356	00-358	00-360
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	19.7	17.4	17.9	17.8	18.1
2',3,4,4',5-PeCB	123	0.5	24.2	20.6	18.5	18.9	20.2
2,3',4,4',5-PeCB	118	0.5	398	278	306	269	242
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	27.5	23.9	26.7	23.5	21.6
3,3',4,4',5-PeCB	126	0.5	24.2	23.4	24.1	24.1	19.7
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	401	334	388	391	343
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	26.1	24.5	25.8	26.8	16.0
2,3,3',4,4',5,5'-HpCB	189	1.0	25.7	20.6	23.6	25.2	14.8
Total TEQ (ND=0)			2.931	2.788	2.901	2.909	2.333
Total TEQ (ND=DL)			2.932	2.789	2.902	2.910	2.334
% Lipids			13.18	9.36	11.13	10.52	12.67
Sample weight (g)			50.1	50.1	50.0	50.0	50.0

DEP ID			PBL-WHS-14	PBL-WHS-21	PBL-WHS-22	PBL-WHS-23	PBL-WHS-24
WRI ID			00-361	00-363	00-364	00-365	00-366
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	19.8	16.4	19.7	20.6	25.7
2',3,4,4',5-PeCB	123	0.5	18.7	16.6	18.6	28.7	30.1
2,3',4,4',5-PeCB	118	0.5	279	224	312	388	412
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	23.5	18.7	30.7	30.2	28.6
3,3',4,4',5-PeCB	126	0.5	24.3	19.2	29.4	31.4	29.1
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	355	265	375	387	455
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	18.7	18.3	22.6	25.6	30.4
2,3,3',4,4',5,5'-HpCB	189	1.0	16.1	15.4	24.1	22.4	28.6
Total TEQ (ND=0)			2.830	2.265	3.394	3.638	3.494
Total TEQ (ND=DL)			2.831	2.265	3.395	3.639	3.495
% Lipids			10.67	8.12	11.01	13.53	16.37
Sample weight (g)							

Values less than the established MDLs ar

3.50

DEP ID			PBV-SMB-1	PBV-SMB-2	PBV-SMB-3	PBV-SMB-4	PBV-SMB-5
WRI ID			00-552	00-553	00-554	00-555	00-556
congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	16.7	28.6	13.8	14.9	12.7
2',3,4,4',5-PeCB	123	0.5	21.2	31.2	15.9	16.7	15.3
2,3',4,4',5-PeCB	118	0.5	287	322	201	181	250
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	21.4	18.7	12.8	9.41	10.8
3,3',4,4',5-PeCB	126	0.5	15.6	15.1	10.6	7.23	9.41
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	306	355	301	223	165
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	15.4	20.2	8.87	5.31	11.3
2,3,3',4,4',5,5'-HpCB	189	1.0	22.9	31.6	15.9	10.6	12.7
Total TEQ (ND=0)			1.904	1.933	1.325	0.911	1.167
Total TEQ (ND=DL)			1.905	1.933	1.326	0.912	1.167
% Lipids			0.602	1.05	0.658	0.505	0.738
Sample weight (g)			50.1	50.0	50.1	50.1	50.1

DEP ID		
WRI ID		
congener	**IUPAC#**	**DL (ng/Kg)**
3,3',4,4'-TCB	77	0.5
2',3,4,4',5-PeCB	123	0.5
2,3',4,4',5-PeCB	118	0.5
2,3,4,4',5-PeCB	114	0.5
2,3,3',4,4'-PeCB	105	0.5
3,3',4,4',5-PeCB	126	0.5
2,3',4,4',5,5'-HxCB	167	1.0
2,3,3',4,4',5-HxCB	156	1.0
2,3,3',4,4',5'-HxCB	157	1.0
3,3',4,4',5,5'-HxCB	169	1.0
2,3,3',4,4',5,5'-HpCB	189	1.0
Total TEQ (ND=0)		
Total TEQ (ND=DL)		
% Lipids		
Sample weight (g)		

Values less than the established MDLs ar

ID			PWB-SMB-1 00-110	PWB-SMB-2 00-111	PWB-SMB-3 00-112	PWB-SMB-4 00-113	PWB-SMB-5 00-114
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	18.4	15.6	28.6	22.4	31.7
2',3,4,4',5-PeCB	123	0.5	10.5	12.1	18.7	15.9	22.6
2,3',4,4',5-PeCB	118	0.5	201	225	321	287	341
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	9.68	12.8	18.7	16.4	21.6
3,3',4,4',5-PeCB	126	0.5	3.12	2.06	4.68	3.79	5.59
2,3',4,4',5,5'-HxCB	167	1.0	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4',5-HxCB	156	1.0	95.6	84.2	125	157	166
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	0.75	<DL	1.25	1.49	1.55
2,3,3',4,4',5,5'-HpCB	189	1.0	5.58	4.21	6.91	6.05	8.23
Total TEQ (ND=0)			0.392	0.275	0.582	0.507	0.700
Total TEQ (ND=DL)			0.393	0.286	0.583	0.508	0.701
Lipid (g)			0.17	0.16	0.34	0.30	0.40
Sample weight (g)			50.1	50.0	50.1	50.0	50.1

ID			PWD-SMB-01 00-115	PWD-SMB-02 00-116	PWD-SMB-03 00-117	PWD-SMB-04 00-118	PWD-SMB-05 00-119
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	41.8	48.9	41.2	35.8	21.5
2',3,4,4',5-PeCB	123	0.5	94.8	121	98.7	77.2	68.9
2,3',4,4',5-PeCB	118	0.5	144	159	112	131	75.7
2,3,4,4',5-PeCB	114	0.5	<DL	<DL	<DL	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	86.9	78.6	62.8	48.7	45.3
3,3',4,4',5-PeCB	126	0.5	6.58	5.51	5.02	4.75	3.66
2,3',4,4',5,5'-HxCB	167	1.0	33.5	30.4	20.3	25.6	18.9
2,3,3',4,4',5-HxCB	156	1.0	98.7	114	84.5	62.1	71.2
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	1.15	<DL	<DL	<DL	<DL
2,3,3',4,4',5,5'-HpCB	189	1.0	20.6	18.6	15.3	17.5	11.6
Total TEQ (ND=0)			0.758	0.651	0.577	0.537	0.424
Total TEQ (ND=DL)			0.759	0.662	0.588	0.548	0.435
Lipid (g)			0.25	0.26	0.19	0.17	0.13
Sample weight (g)			50.0	50.0	50.1	50.0	50.0

ID			SFS-SMB-1 00-645	SFS-SMB-2 00-646	SFS-SMB-3 00-647	SFS-SMB-4 00-648	SFS-SMB-5 00-649
Congener	**IUPAC#**	**DL (ng/Kg)**					
3,3',4,4'-TCB	77	0.5	14.8	4.66	8.26	6.92	6.29
2',3,4,4',5-PeCB	123	0.5	41.2	15.7	32.8	18.7	17.3
2,3',4,4',5-PeCB	118	0.5	40.6	21.6	31.5	20.6	18.3
2,3,4,4',5-PeCB	114	0.5	0.75	<DL	0.35	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	20.3	8.47	12.4	9.21	9.45
3,3',4,4',5-PeCB	126	0.5	6.87	2.66	5.51	3.07	2.99
2,3',4,4',5,5'-HxCB	167	1.0	16.9	4.03	8.07	4.26	3.87
2,3,3',4,4',5-HxCB	156	1.0	23.7	5.21	14.6	8.88	7.62
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL	<DL	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	8.85	1.15	5.37	3.06	2.14
2,3,3',4,4',5,5'-HpCB	189	1.0	17.2	4.67	9.64	5.91	5.52
Total TEQ (ND=0)			0.801	0.286	0.622	0.348	0.330
Total TEQ (ND=DL)			0.802	0.286	0.622	0.349	0.331
Lipid (g)			0.77	0.14	0.33	0.18	0.12
Sample weight (g)			50.1	50.1	50.1	50.1	50.1

ID			SWP-SMB-C1 00-625	SWP-SMB-C2 00-626
Congener	**IUPAC#**	**DL (ng/Kg)**		
3,3',4,4'-TCB	77	0.5	3.71	2.51
2',3,4,4',5-PeCB	123	0.5	4.01	5.19
2,3',4,4',5-PeCB	118	0.5	5.42	6.33
2,3,4,4',5-PeCB	114	0.5	<DL	<DL
2,3,3',4,4'-PeCB	105	0.5	3.66	2.56
3,3',4,4',5-PeCB	126	0.5	<DL	<DL
2,3',4,4',5,5'-HxCB	167	1.0	4.89	3.15
2,3,3',4,4',5-HxCB	156	1.0	10.6	13.6
2,3,3',4,4',5'-HxCB	157	1.0	<DL	<DL
3,3',4,4',5,5'-HxCB	169	1.0	1.59	1.06
2,3,3',4,4',5,5'-HpCB	189	1.0	1.47	0.89
Total TEQ (ND=0)			0.023	0.019
Total TEQ (ND=DL)			0.124	0.120
Lipid (g)			0.29	0.32
			50.1	50.1

Table 3.1.1.5 Total DDT levels in fish samples from Maine rivers and streams, 2000

Location	Station Code	Species	Total DDX nd=1/2 mdl
Androscoggin River Gilead	AGL	RBT	10.3
Beaver Brook Portage	BBP	BKT	13.0
Caribou Str. Caribou	CAR	BKT	3.0
Everett Brook Ft Fairfield	EVT	BKT	241.5
Hockenhull Brook Ft Fairfield	HOC	BKT	3.0
Meduxnekeag River Bridgewater	MDB	BKT	4.7
N.Branch Presque Isle Str. Mapleton	NPI	BKT	43.8
Presque Isle Str Mapleton	PIS	BKT	3.0
Prestile Str. Westfield	PTW	BKT	96.0
Salmon Brook Washburn	SAL	BKT	37.6

DEP ID# Compound	DL ng/kg	AGL-RBT-1	AGL-RBT-2	AGL-RBT-3	AGL-RBT-4	AGL-RBT-5
2,4-DDE	1.0	0.51	0.24	0.72	1.36	0.36
4,4-DDE	1.0	4.58	3.16	6.32	5.16	3.88
2,4-DDD	1.0	0.64	0.60	0.72	0.32	0.64
4,4-DDD	1.0	2.33	1.60	2.48	2.48	0.48
2,4-DDT	1.0	1.95	2.32	2.48	2.44	0.56
4,4-DDT	1.0	0.68	0.64	0.76	0.40	0.84
Total DDX		10.69	8.56	13.48	12.16	6.76
TCMX (% rec.)	65-125	81.0	92.6	84.3	79.5	82.7
Sample weight (g)		25.0	25.0	25.0	25.0	25.0

DEP ID# Compound	DL ng/kg	BBP-BKT-1	BBP-BKT-2	BBP-BKT-3	BBP-BKT-4	BBP-BKT-5
2,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDE	1.0	0.28	<DL	0.28	0.28	0.34
2,4-DDD	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDD	1.0	<DL	<DL	0.48	0.48	0.52
2,4-DDT	1.0	1.95	1.92	1.87	2.13	<DL
4,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL
Total DDX		2.23	1.92	2.63	2.89	0.86
TCMX (% rec.)	65-125	76.9	72.4	74.2	83.2	72.9
Sample weight (g)		25.2	25.0	25.1	24.9	23.2

DEP ID# Compound	DL ng/kg	BBP-BKT-6	BBP-BKT-7	BBP-BKT-8	BBP-BKT-9	BBP-BKT-10
2,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDE	1.0	0.32	0.38	0.52	0.28	0.33
2,4-DDD	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDD	1.0	0.52	0.66	0.87	0.48	0.58
2,4-DDT	1.0	2.01	2.32	3.53	<DL	2.83
4,4-DDT	1.0	<DL	2.13	2.60	1.80	<DL
Total DDX		2.86	5.48	7.52	2.56	3.75
TCMX (% rec.)	65-125	82.6	73.2	79.8	76.4	89.0
Sample weight (g)		24.8	21.2	17.3	25.0	24.0

DEP ID# Compound	DL ng/kg	BBP-BKT-11	BBP-BKT-12	BBP-BKT-13	BBP-BKT-14	BBP-BKT-15
2,4-DDE	1.0	<DL	<DL	0.56	<DL	<DL
4,4-DDE	1.0	0.32	0.36	12.1	0.28	0.40
2,4-DDD	1.0	<DL	<DL	0.40	<DL	<DL
4,4-DDD	1.0	0.60	0.56	2.57	0.72	0.48
2,4-DDT	1.0	2.17	5.41	2.53	3.43	2.53
4,4-DDT	1.0	1.85	1.88	<DL	1.83	1.88
Total DDX		4.95	8.21	18.12	6.26	5.29
TCMX (% rec.)	65-125	71.9	97.6	103	106	88.1
Sample weight (g)		24.9	25.0	24.9	25.1	24.9

DEP ID# Compound	DL ng/kg	BBP-BKT-16	BBP-BKT-17	BBP-BKT-18	BBP-BKT-19	BBP-BKT-20
2,4-DDE	1.0	<DL	<DL	4.10	3.80	<DL
4,4-DDE	1.0	0.36	0.40	13.80	17.9	1.58
2,4-DDD	1.0	<DL	<DL	6.32	1.64	<DL
4,4-DDD	1.0	0.56	<DL	5.35	1.18	0.51
2,4-DDT	1.0	2.13	<DL	1.33	1.11	11.64
4,4-DDT	1.0	1.95	1.88	2.02	5.32	2.97
Total DDX		5.00	2.28	32.92	30.94	16.70
TCMX (% rec.)	65-125	95.8	87.6	82.4	66.3	92.1
Sample weight (g)		24.9	25.0	24.9	25.0	22.8

DEP ID# Compound	DL ng/kg	BBP-BKT-21	BBP-BKT-22	BBP-BKT-23	BBP-BKT-24	BBP-BKT-25
2,4-DDE	1.0	<DL	<DL	<DL	<DL	0.32
4,4-DDE	1.0	0.69	0.45	<DL	0.72	13.1
2,4-DDD	1.0	<DL	<DL	<DL	13.41	1.56
4,4-DDD	1.0	0.64	0.73	<DL	2.04	8.75
2,4-DDT	1.0	3.53	5.08	1.99	2.00	8.71
4,4-DDT	1.0	2.29	2.54	2.23	0.48	2.44
Total DDX		7.16	8.81	4.23	18.65	34.87
TCMX (% rec.)	65-125	78.6	73.3	76.8	78.3	86.3
Sample weight (g)		21.8	17.7	25.1	25.0	25.0

DEP ID# Compound	DL ng/kg	BBP-BKT-26	BBP-BKT-27	BBP-BKT-28
2,4-DDE	1.0	0.96	0.44	1.40
4,4-DDE	1.0	23.7	19.8	16.4
2,4-DDD	1.0	0.44	1.00	4.59
4,4-DDD	1.0	2.56	7.02	1.28
2,4-DDT	1.0	2.56	6.67	4.63
4,4-DDT	1.0	0.96	<DL	1.77
Total DDX		31.18	34.93	30.05
TCMX (% rec.)	65-125	68.1	66.5	83.5
Sample weight (g)		25.0	25.1	25.1

DEP ID# Compound	DL ng/kg	MBD-BKT-1	MBD-BKT-2	MBD-BKT-3	MBD-BKT-4	MBD-BKT-5
2,4-DDE	1.0	0.35	0.47	0.36	0.44	0.40
4,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
2,4-DDD	1.0	0.42	0.61	<DL	0.55	<DL
4,4-DDD	1.0	1.56	1.87	2.03	1.95	2.66
2,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL
4,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL
Total DDX		2.33	2.95	2.39	2.94	3.06
TCMX (% rec.)	65-125	81.4	90.4	79.1	87.3	69.7
Sample weight (g)		24.8	25.1	24.9	25.2	25.0

DEP ID# Compound	DL ng/kg	MBD-BKT-6	MBD-BKT-7	MBD-BKT-8	MBD-BKT-9	MBD-BKT-10
2,4-DDE	1.0	0.26	0.32	0.28	0.36	0.32
4,4-DDE	1.0	<DL	<DL	<DL	<DL	<DL
2,4-DDD	1.0	0.71	0.60	0.56	0.56	0.52
4,4-DDD	1.0	3.02	2.34	1.96	1.96	1.93
2,4-DDT	1.0	<DL	<DL	<DL	2.28	<DL
4,4-DDT	1.0	<DL	<DL	<DL	<DL	<DL
Total DDX		3.99	3.25	2.80	5.15	2.77
TCMX (% rec.)	65-125	74.2	65.3	81.6	95.6	77.8
Sample weight (g)		25.3	25.2	25.0	25.1	24.9

DEP ID# Compound	DL ng/kg	MBD-BKT-11	MBD-BKT-12
2,4-DDE	1.0	0.32	0.40
4,4-DDE	1.0	<DL	<DL
2,4-DDD	1.0	<DL	0.53
4,4-DDD	1.0	1.96	3.11
2,4-DDT	1.0	<DL	<DL
4,4-DDT	1.0	<DL	<DL
Total DDX		2.29	4.04
TCMX (% rec.)	65-125	77.6	74.9
Sample weight (g)		24.9	24.8

DEP ID# **Compound**	**DL** **ng/kg**	NPI-BKT-1	NPI-BKT-2	NPI-BKT-3	NPI-BKT-4	NPI-BKT-5
2,4-DDE	1.0	8.71	15.9	9.94	26.9	<DL
4,4-DDE	1.0	26.2	49.7	9.82	54.5	12.5
2,4-DDD	1.0	4.41	8.15	2.56	5.61	<DL
4,4-DDD	1.0	5.92	11.9	1.76	<DL	<DL
2,4-DDT	1.0	13.6	21.0	<DL	10.5	1.79
4,4-DDT	1.0	5.66	13.9	3.25	<DL	8.26
Total DDX		64.50	120.62	27.33	97.44	22.53
TCMX (% rec.)	65-125	72.5	92.8	81.7	84.3	87.6
Sample weight (g)		23.5	25.0	25.0	25.1	25.2

DEP ID# **Compound**	**DL** **ng/kg**	NPI-BKT-6	NPI-BKT-7	NPI-BKT-8	NPI-BKT-9	NPI-BKT-10
2,4-DDE	1.0	<DL	<DL	5.08	<DL	3.03
4,4-DDE	1.0	6.40	4.41	25.3	13.2	7.81
2,4-DDD	1.0	5.16	6.95	14.6	6.08	6.09
4,4-DDD	1.0	<DL	<DL	5.28	4.13	<DL
2,4-DDT	1.0	2.72	1.66	9.88	5.97	<DL
4,4-DDT	1.0	2.96	1.84	1.87	3.26	4.06
Total DDX		17.25	14.86	62.06	32.64	20.99
TCMX (% rec.)	65-125	106	72.6	88.6	85.2	79.5
Sample weight (g)		25.0	25.0	24.6	25.2	25.1

DEP ID# Compound	DL ng/kg	NPI-BKT-11	NPI-BKT-12	NPI-BKT-13	NPI-BKT-14	NPI-BKT-15
2,4-DDE	1.0	<DL	<DL	0.36	0.68	<DL
4,4-DDE	1.0	10.2	12.7	73.6	7.67	9.21
2,4-DDD	1.0	8.75	<DL	0.92	2.88	3.66
4,4-DDD	1.0	3.12	0.48	8.63	0.76	1.24
2,4-DDT	1.0	5.19	4.27	8.55	0.84	0.92
4,4-DDT	1.0	3.22	4.16	0.84	1.24	1.12
Total DDX		30.48	21.61	92.89	14.07	16.15
TCMX (% rec.)	65-125	75.2	81.7	78.6	73.1	80.5
Sample weight (g)		25.0	25.0	25.0	25.0	25.0

DEP ID# Compound	DL ng/kg	NPI-BKT-16	NPI-BKT-17
2,4-DDE	1.0	<DL	<DL
4,4-DDE	1.0	13.5	8.76
2,4-DDD	1.0	31.4	6.91
4,4-DDD	1.0	1.24	0.95
2,4-DDT	1.0	4.20	1.23
4,4-DDT	1.0	6.80	4.85
Total DDX		57.18	22.70
TCMX (% rec.)	65-125	74.3	69.2
Sample weight (g)		25.0	25.1

DEP ID# **Compound**	**DL** **ng/kg**	PTW-BKT-1	PTW-BKT-2	PTW-BKT-3	PTW-BKT-4	PTW-BKT-5
2,4-DDE	1.0	1.33	2.41	0.95	<DL	<DL
4,4-DDE	1.0	13.5	11.3	8.86	12.4	30.7
2,4-DDD	1.0	41.2	64.0	24.3	68.2	57.4
4,4-DDD	1.0	8.41	10.6	2.41	4.56	27.6
2,4-DDT	1.0	7.32	10.7	2.69	6.12	27.1
4,4-DDT	1.0	9.51	14.0	4.59	6.00	18.6
Total DDX		81.27	113.00	43.80	97.29	161.38
TCMX (% rec.)	65-125	79.7	74.6	81.3	74.2	76.6
Sample weight (g)		25.0	24.9	25.0	25.0	25.0

DEP ID# **Compound**	**DL** **ng/kg**	PTW-BKT-6	PTW-BKT-7	PTW-BKT-8	PTW-BKT-9	PTW-BKT-10
2,4-DDE	1.0	<DL	1.64	<DL	30.1	3.84
4,4-DDE	1.0	8.35	15.2	19.4	16.2	40.1
2,4-DDD	1.0	41.5	54.8	8.09	51.6	17.5
4,4-DDD	1.0	6.91	3.56	5.63	42.5	32.8
2,4-DDT	1.0	6.79	6.64	6.66	76.4	16.3
4,4-DDT	1.0	1.04	3.88	4.56	57.8	8.39
Total DDX		64.59	85.74	44.36	274.69	119.02
TCMX (% rec.)	65-125	73.7	80.4	76.7	78.1	84.3
Sample weight (g)		25.0	25.0	25.2	25.0	25.0

DEP ID# **Compound**	**DL** **ng/kg**	PTW-BKT-11	PTW-BKT-12	PTW-BKT-13	PTW-BKT-14	PTW-BKT-15
2,4-DDE	1.0	10.9	5.25	1.26	<DL	5.69
4,4-DDE	1.0	16.0	15.3	13.4	25.1	18.7
2,4-DDD	1.0	21.3	31.7	23.6	26.1	36.7
4,4-DDD	1.0	9.01	8.58	7.59	2.40	5.26
2,4-DDT	1.0	9.65	9.26	8.31	2.44	5.01
4,4-DDT	1.0	4.92	11.3	6.69	7.12	6.32
Total DDX		71.78	81.39	60.85	63.14	77.68
TCMX (% rec.)	65-125	97.7	84.6	81.4	90.4	78.3
Sample weight (g)		25.0	25.1	25.1	25.0	25.0

DEP ID# **Compound**	**DL** **ng/kg**	PTW-BKT-16	PTW-BKT-17	PTW-BKT-18	PTW-BKT-19	PTW-BKT-20
2,4-DDE	1.0	<DL	5.59	1.64	5.94	2.16
4,4-DDE	1.0	15.4	31.6	11.8	22.7	29.0
2,4-DDD	1.0	26.8	42.7	29.7	38.7	46.8
4,4-DDD	1.0	3.36	10.3	6.23	16.9	23.1
2,4-DDT	1.0	3.87	11.5	7.01	15.1	19.2
4,4-DDT	1.0	4.21	8.81	9.44	11.6	15.70
Total DDX		53.64	110.50	65.82	110.94	135.96
TCMX (% rec.)	65-125	85.1	87.3	88.2	74.3	65.1
Sample weight (g)		24.9	25.0	25.0	24.9	22.9

DEP ID# Compound	DL ng/kg	EVT-BKT-C1	EVT-BKT-C2	SAL-BKT-C1	SAL-BKT-C2
2,4-DDE	1.0	<DL	21.9	2.25	1.76
4,4-DDE	1.0	8.38	29.3	2.01	1.20
2,4-DDD	1.0	11.7	34.7	3.66	2.76
4,4-DDD	1.0	10.7	48.1	4.91	5.64
2,4-DDT	1.0	<DL	<DL	4.72	5.20
4,4-DDT	1.0	108	209	18.30	22.80
Total DDX		138.38	343.06	35.85	39.36
TCMX (% rec	65-125	76.3	73.8	70.3	68.3
Sample weight (g)		24.9	25.0	25.0	25.0

DEP ID# Compound	DL ng/kg	PIS-BKT-C1	PIS-BKT-C2	CAR-BKT-C1	HOC-BKT-C1
2,4-DDE	1.0	<DL	<DL	<DL	<DL
4,4-DDE	1.0	<DL	<DL	<DL	<DL
2,4-DDD	1.0	<DL	<DL	<DL	<DL
4,4-DDD	1.0	<DL	<DL	<DL	<DL
2,4-DDT	1.0	<DL	<DL	<DL	<DL
4,4-DDT	1.0	<DL	<DL	<DL	<DL
Total DDX		0.00	0.00	0.00	0.00
TCMX (% rec	65-125	71.3	82.4	80.4	79.3
Sample weight (g)		20.8	25.0	24.9	25.0

3.1.2

EFFECTS-BASED FISH STUDY

EFFECTS-BASED FISH STUDY

To date, most SWAT studies of fish have focused on the effects of persistent, toxic, and bioaccumulative (PBT) contaminants on human consumers, with some consideration of impacts to wildlife consumers as well. Direct effects on fish populations have been measured or estimated by other DEP programs able to detect only relatively severe impacts on survival, growth, and reproduction. Recent studies (Adams et al, 1992; Kavlock et al, 1996; Munkittrick et al, 1998; Rolland et al, 1997) have measured other more subtle effects on development, immune system function, and reproduction not normally seen in testing regimes historically used by DEP. These effects may be a result of long term exposure to relatively low levels of contaminants or cumulative effects of exposure to many low-level contaminants. These responses to pollutant challenge are often within the same magnitude as natural variation and therefore difficult to measure with the methods that are currently used. Many new techniques have been developed to measure some of these effects.

In 1999 Environment Canada (EC) initiated a large 3 year study of the St John River watershed. One objective is to determine the effects of discharges and other activities on the assimilative capacity and sustainability of the aquatic ecosystem in the watershed. This will be accomplished by performing cumulative effects-based studies. In 1999 the focus was on the upper river from the headwaters to Grand Falls. A variety of studies were initiated, including 1. On-station flow-through bioassay with fathead minnows, 2. A proposed invertebrate mesocosm study, 3. Laboratory studies of the responses of fish to changes in effluents before and after process changes, and 4. In-stream invertebrate and fish monitoring. Many agencies, industries, and other groups are involved.

Most of this work was conducted above and below Fraser's pulp mill in Edmundston, on the Canadian side of the river. These studies were repeated in 2000 to confirm some of the possible impacts that were measured. Among others, results document a potential impact on reproduction of sculpins and shift of energy from reproductive function to growth compared to the St Hilaire reference station but not compared to the FT Kent reference station, which seems to have elevated data compared to other Canadian reference stations.

Working with EC, in 1999 DEP collected a sample of slimy sculpins downsteam of Fraser Paper's paper mill in Madawaska, where whole effluent toxicity (WET) test data indicate a discharge highly toxic to the water flea, *Ceriodaphnia dubia*, one of DEP's two standard test species. Negative impacts measured in sculpins were an increased liver size (LSI) in males and decreased gonad size (GSI) in females compared to the St. Hilaire reference station and other Canadian reference stations but not so compared to the Ft Kent (Claire, NB) reference station. Therefore, in 2000, this study was repeated at stations on the St John River upstream of Ft. Kent/Claire to try to determine other sources. Results of the sculpin studies in 2000 showed GSI and LSI from Moody Bridge and Priestly Bridge were similar to those from other forested reference stations. There were no differences among other stations near Claire. In contrast 2001 sculpins exhibited significantly enlarged livers at stations downstream of a poultry farm upstream of Claire, thereby identifying the source of impacts seen at Claire in earlier studies.

In 1999 DEP attempted to conduct similar studies on brook trout from the North Branch of Presque Isle Stream and from Prestile Stream where high DDT concentrations were measured in

1994, but we were unable to collect enough fish due to flood conditions during the collection period in September. Working with EC, in August 2000 DEP successfully collected trout from these two experimental streams and two reference streams from forested watersheds, Beaver Brook in Portage, and the North Branch of the Meduxnekeag River at Bridgewater. It was impossible to find reference streams similar to the experimental streams in all aspects except agricultural land use. (i.e. DDT history). Basic productivity of the agricultural streams, as measured by conductivity (K), was much greater than in the reference streams, which were from the forested watersheds. As the streams reflect the bedrock and surficial geology of their watersheds, the difference in productivity of the watersheds is no doubt the reason for the difference in land use. The agriculture was in the limestone belt and the forested watersheds in more granitic geology. Therefore, interpretation of differences between experimental and reference streams with respect to DDT levels is confounded by basic differences in productivity. We measured DDT levels in tissue, examined population age, growth and condition factors, gonadosomatic indices, hepatosomatic indices, circulating sex-steroids and mixed function oxidase enzymes.

DDT concentrations in brook trout from Prestile Stream were higher than those in trout from the North Branch of Presque Isle Stream and Prestile Stream, and both were higher than in fish from the reference streams (Table 3.1.1.4). Impacts on reproduction are indicated for both experimental streams as indicated by significantly reduced gonadosomatic index (GSI) for males in the Prestile Stream and more so in both sexes in the North Branch of Presque Isle Stream compared to the mean of the reference streams ($p<0.05$, Table 3.1.2.1). In another species, there was no difference in GSI or LSI of slimy sculpin from Prestile Stream compared to reference stations on the upper St. John River (data not shown).

Table 3.1.2.1 GSI and LSI in brook trout from Aroostook County Streams, 2000

LOCATION	SEX	GSI	p	LSI	p	K (ms)
Beaver Bk	F	1.85		1.35		73
Meduxnekeag R	F	5.36		1.34		100
N Br Presque Isle St	F	0.74	0.0001	1.21	0.19	300
Prestile St	F	3.67	0.47	1.39	0.40	468
Beaver Bk	M	1.85		1.11		73
Meduxnekeag R	M	1.59		0.98		100
N Br Presque Isle St	M	0.47	0.00001	0.99	0.27	300
Prestile St	M	1.24	0.013	1.21	0.35	468
BBP	IM	0.05		0.76		

p from t-test compared to mean of reference stations

The largest difference from the reference streams was for N Br Presque Isle Stream where DDT levels were lower than in fish from Prestile Stream. This indicates that factors beyond DDT are involved with the impact on reproduction. There was no difference in LSI between experimental and reference streams. LSI is, among other things, an indicator of energy storage and may reflect a masking effect of increased productivity among streams over any negative impacts. Indeed, Prestile Stream is the most productive as indicated by K. However, there could be other factors affecting these responses. Without reference streams similar in all aspects but DDT levels, it is difficult to determine how much of an impact DDT is having.

Concentrations of the circulating sex steroids testosterone (T) and estradiol (E2) were measured from plasma of female trout, while T and 11ketotestosterone (11KT) were measured from plasma of male trout. Concentrations of T (4910 pg/ml) and E2 (3091pg/ml) were significantly higher in trout from Prestile Stream compared to the those of the two reference stations combined (2209 pg/ml and 1494 pg/ml respectively), while there was no significant difference between trout from the N Br Presque Isle Stream compared to the reference station data. These results are incongruent with the GSIs previously discussed. There may have been some problems with handling and storage of the plasma samples prior to analysis.

Liver samples collected for MFO analysis were not stored properly and there was no significant amount of MFO measured in any samples.

Condition factor was significantly higher for age 2+ trout from North Branch Presque Isle Stream and, but less so, for a sample of age 1+ and 2+ trout from Prestile Stream, than the two reference streams combined (data not shown). These results mirror the GSIs for the North Branch of Presque Isle Stream and may reflect reallocation of energy from reproduction to growth. Although the higher condition factor might be explained by the higher productivity of the two experimental streams, between them Prestile Stream is more productive and therefore should have higher condition factor unless other factors are controlling. Furthermore, only the GSI for male trout from Prestile Stream was significantly reduced from that of the reference streams, and condition factor for male trout was not different from the reference streams.

Length frequency plots indentified annual cohorts and indicated a typical age class structure with decreasing numbers with age for both experimental streams (Figures 3.1.2.1 and 3.1.2.2). Not enough fish and no young of the year trout were captured from the two reference streams to make a plot meaningful.

Population estimates were not calculated since the reference streams were of much lower productivity and so few fish were collected from them.

Figure 3.1.2.1 Length frequency for North Branch Presque Isle Stream brook trout

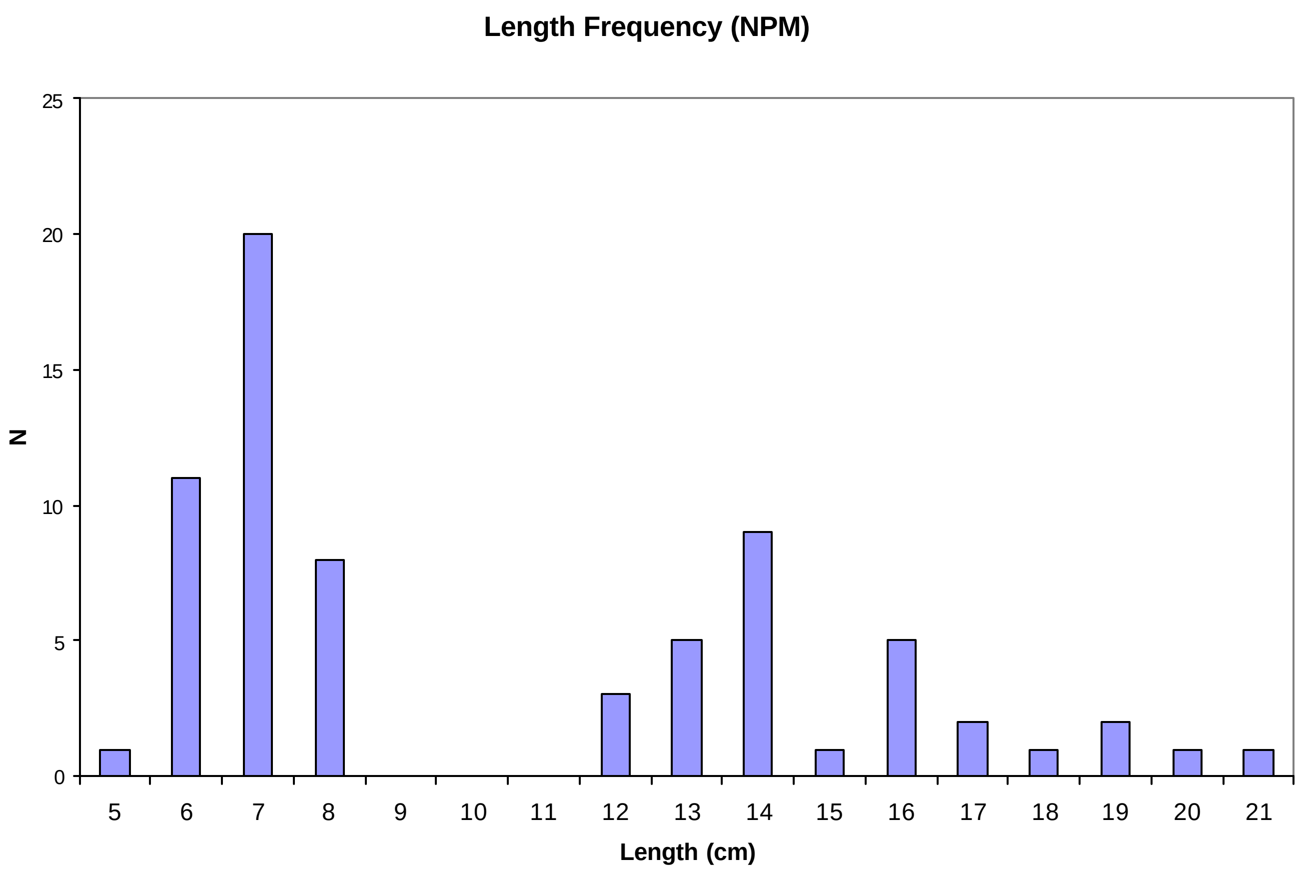
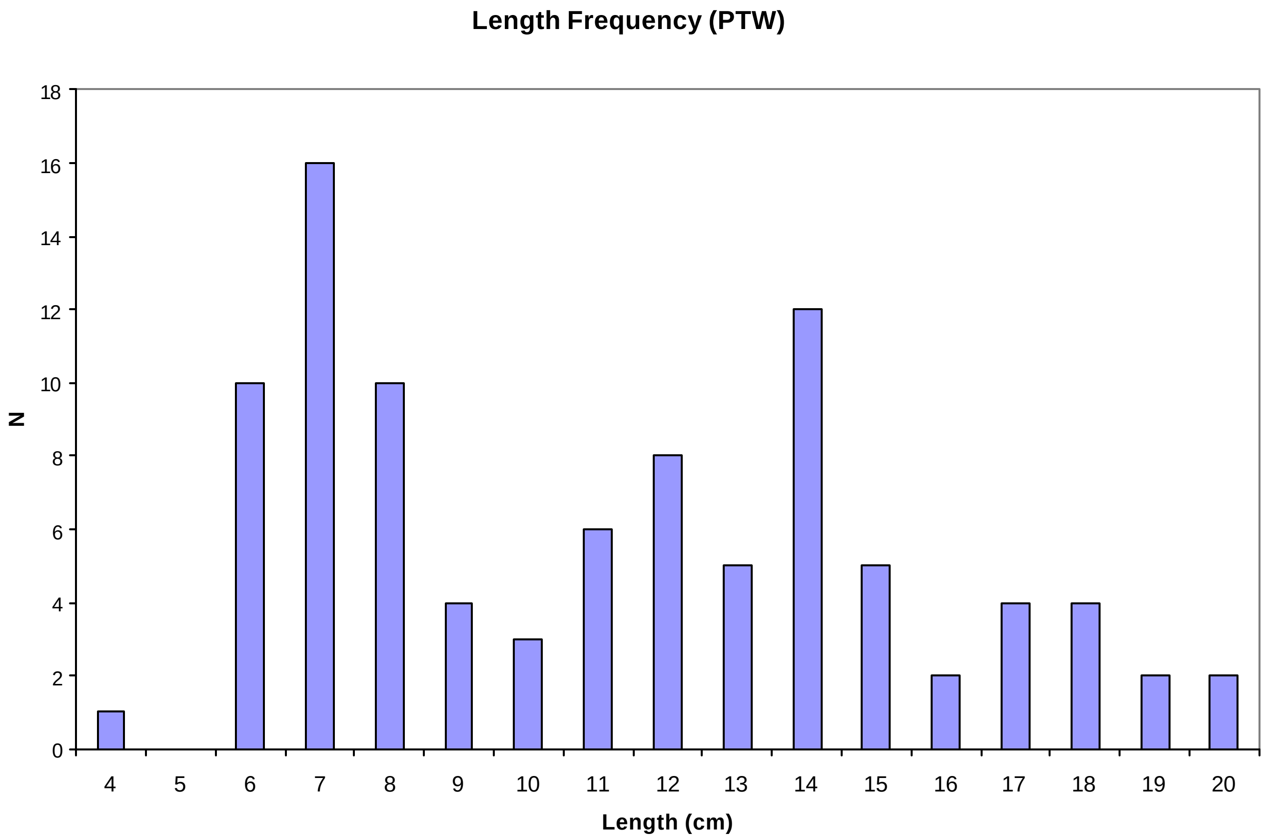


Figure 3.1.2.2 Length frequency for Prestile Stream brook trout



3.2

AMBIENT BIOLOGICAL MONITORING

AMBIENT BIOLOGICAL MONITORING

Thirty-five stations were sampled during the 2000 sampling season to evaluate benthic macroinvertebrate communities for evidence of impairment due to toxic contamination. Biological monitoring in 2000 was concentrated in the Presumpscot, Saco, and Piscataqua River Basins, in keeping with the Land and Water Bureau Five-Year Basin sampling rotation. The station list is essentially unchanged from that proposed in the 2000 SWAT workplan, except for minor substitutions.

Table 3.2.1 summarizes the results of biological monitoring activities for the 2000 SWAT Program, which are sorted by waterbody name. Since waterbodies are sometimes sampled in more than one location, each sampling event was assigned a “Log” number and each sampling station was assigned a “Station Number”, which are listed in Table 3.2.1. Table 3.2.1 also includes a “Map” number for each sampling event. Using the “Map” number and the “Station Number”, locations of each sampling location can be found on Maps 1-12. Individual data reports for each sampling event (Aquatic Life Classification Attainment Reports) are presented following the summary table and maps. Use the “Log” number associated with a sampling event to identify the correct Aquatic Life Classification Attainment Report.

Tables 3.2.2 and 3.2.3 summarize the supporting water chemistry samples.

Results Summary

- Thirty-five stations were assessed for the condition of the benthic macroinvertebrate community.
- Sixteen of the thirty-five stations fail to attain their aquatic life class.
- Nineteen of the thirty-five stations meet or exceed the aquatic life standards of the statutory class.
- Thirteen of the thirty-five stations exhibit natural aquatic communities (Class A).

Historical Notes

- When Station 337 on Goosefare Brook just below the Maine Turnpike was sampled in 1998, it attained Class B. In 2001, two weeks prior to retrieving our sample, a truck carrying flammable materials rolled over on the exit ramp immediately upstream of the station location. The truck burst into flames and melted the pavement. We suspect that the chemicals used to extinguish the blaze entered the stream and damaged the biological community, resulting in the Non-Attainment model outcome.

- In 1995, Deep Brook (Station 269) had a classification attainment of Non-Attainment. In 2001, the same site had a classification attainment of Class B.
- In 1998, Sunday River (Station 354) had a classification attainment of Class C. In 2001, the same site had a classification attainment of Class A.
- In 1997, Trout Brook (Station 302) had a classification attainment of Non-Attainment. In 1999, the same site had a classification attainment of Class B. In 2001, the same site had a classification attainment of Non-Attainment.

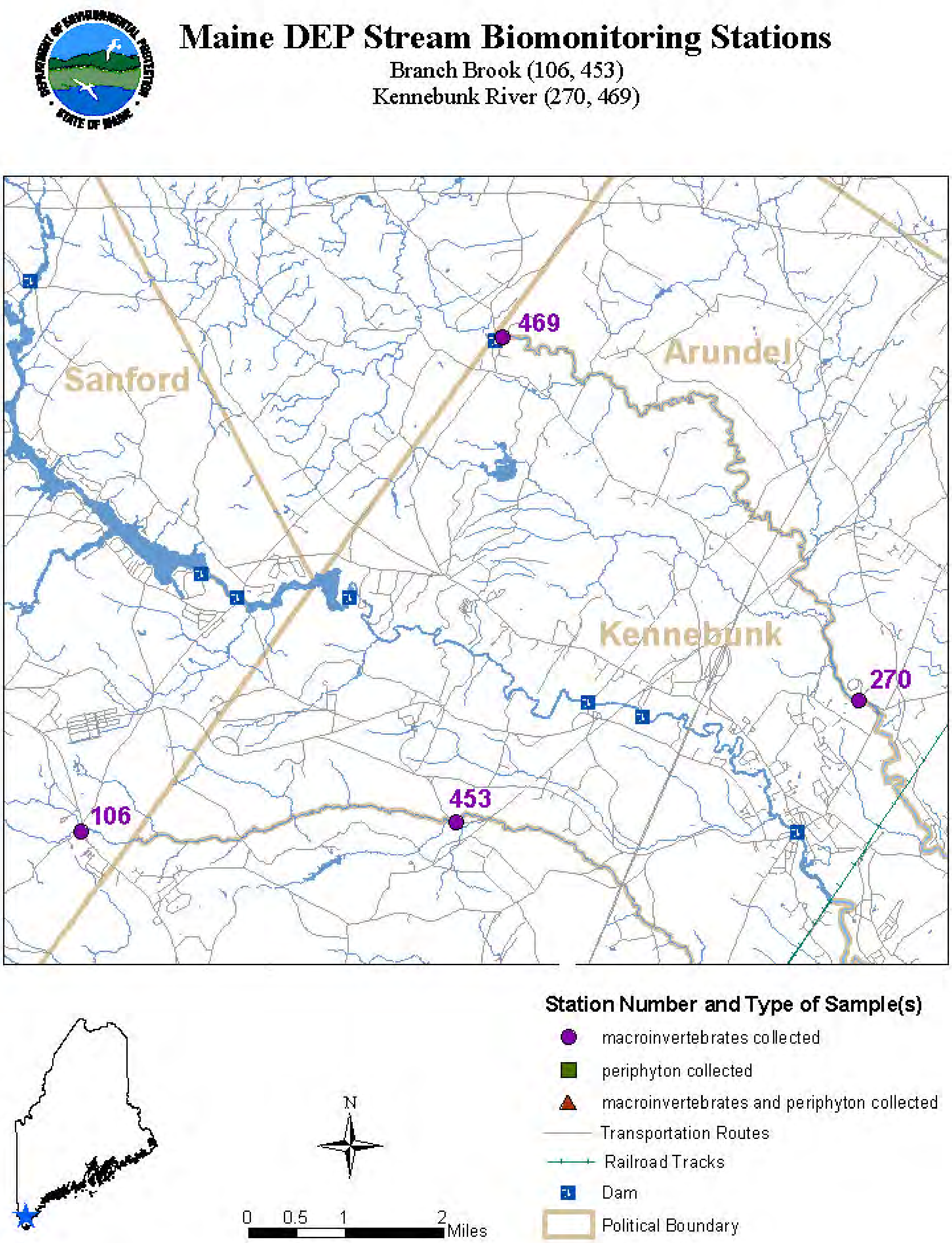
3.75

TABLE 3.2.3 – Metals in Water Samples

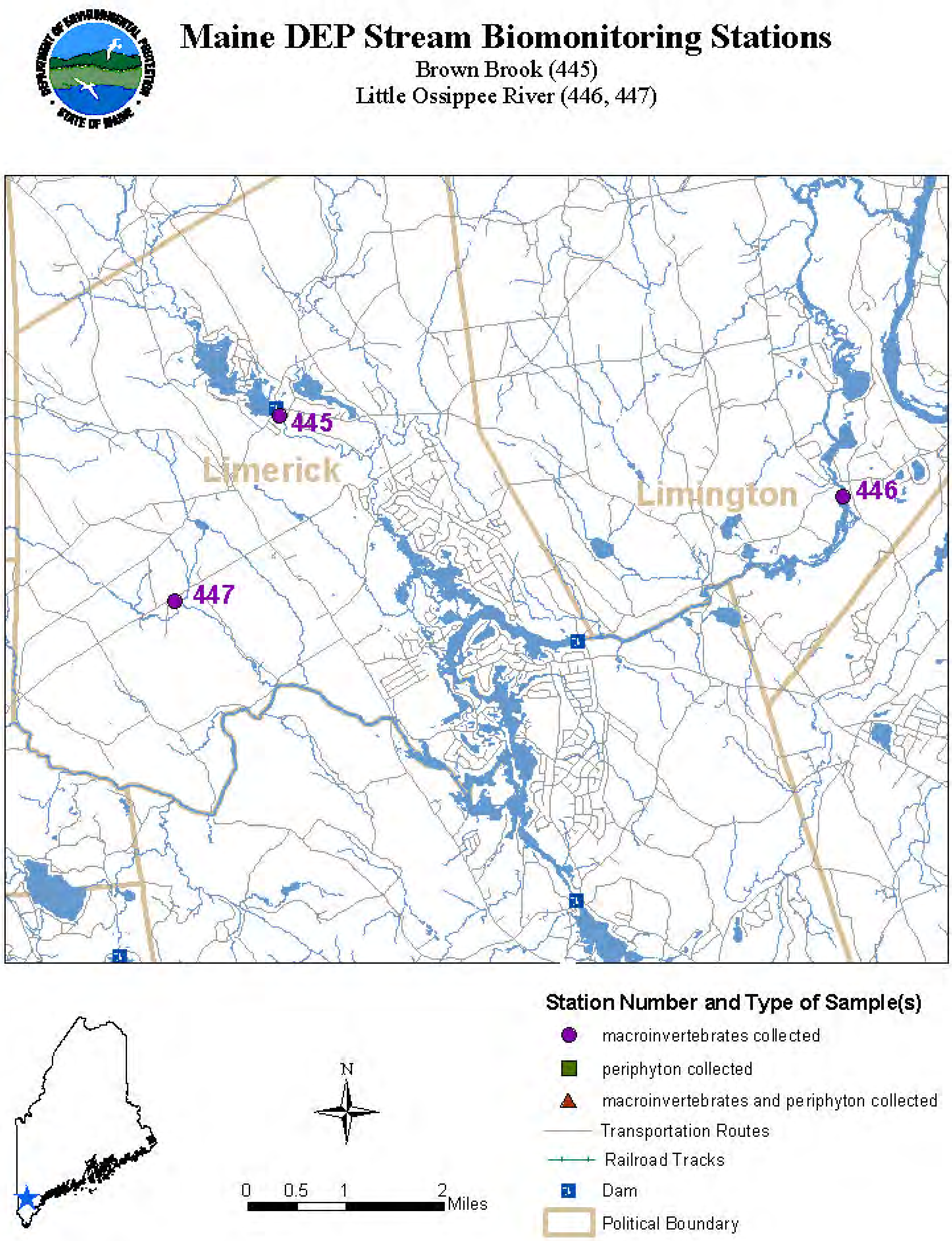
Log	Waterbody	Cd µg/L digest	Cr µg/L digest	Fe µg/L digest	Pb µg/L digest	Zn µg/L digest
876	W. Br. Sheepscot Weeks Mills	<0.05	<0.50	380	<0.50	1.78
877	Sheepscot River N. Whitefield	<0.05	0.50	421	<0.50	1.11
891	Stevens Brook – Above	0.053	0.56	1409	<0.50	6.42
892	Stevens Brook – Below	0.061	1.07	550	1.35	7.88
893	Cascade Brook – Above	<0.05	3.11	935	1.01	4.63
894	Cascade Brook – Below	<0.05	0.79	1096	<0.50	5.01
895	Merriland River – Above	<0.05	0.53	500	<0.50	2.76
896	Merriland River - Below	<0.05	<0.50	530	<0.50	2.77
897	Webhannet River	<0.05	0.53	583	<0.50	4.12
900	Chick's Brook	0.074	<0.50	839	0.96	3.76
901	Sandy River - Farmington	<0.05	<0.50	149	<0.50	1.39
907	Little Ossippe R.	<0.05	<0.50	256	<0.50	<1.00
908	Brown Brook	<0.05	<0.50	333	<0.50	1.81
911	Trout Brook - Below	<0.05	<0.50	432	<0.50	3.41
912	Thatcher Brook - Above	<0.05	2.09	3487	0.81	16.31
913	Thatcher Brook - Below	<0.05	<0.50	792	<0.50	2.69
914	West Brook	<0.05	0.52	771	0.56	5.29
917	Branch Brook - Above	<0.05	0.56	451	<0.50	3.42
918	Branch Brook - Below	<0.05	0.81	445	<0.50	1.90

Cd = cadmium, Cr = chromium, Fe = iron, Pb = lead, and Zn = zinc

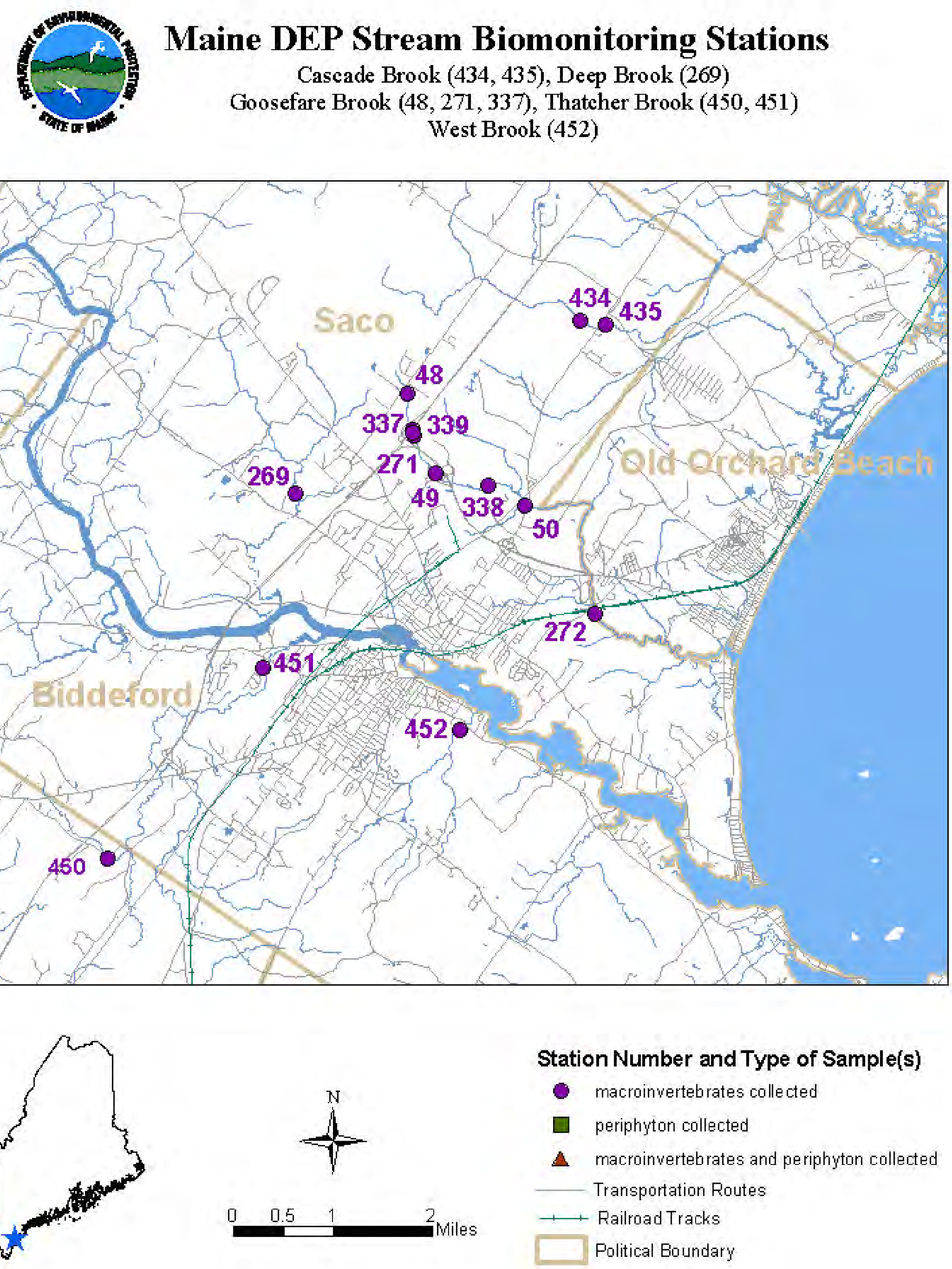
Map 1 – Branch Brook and Kennebunk River



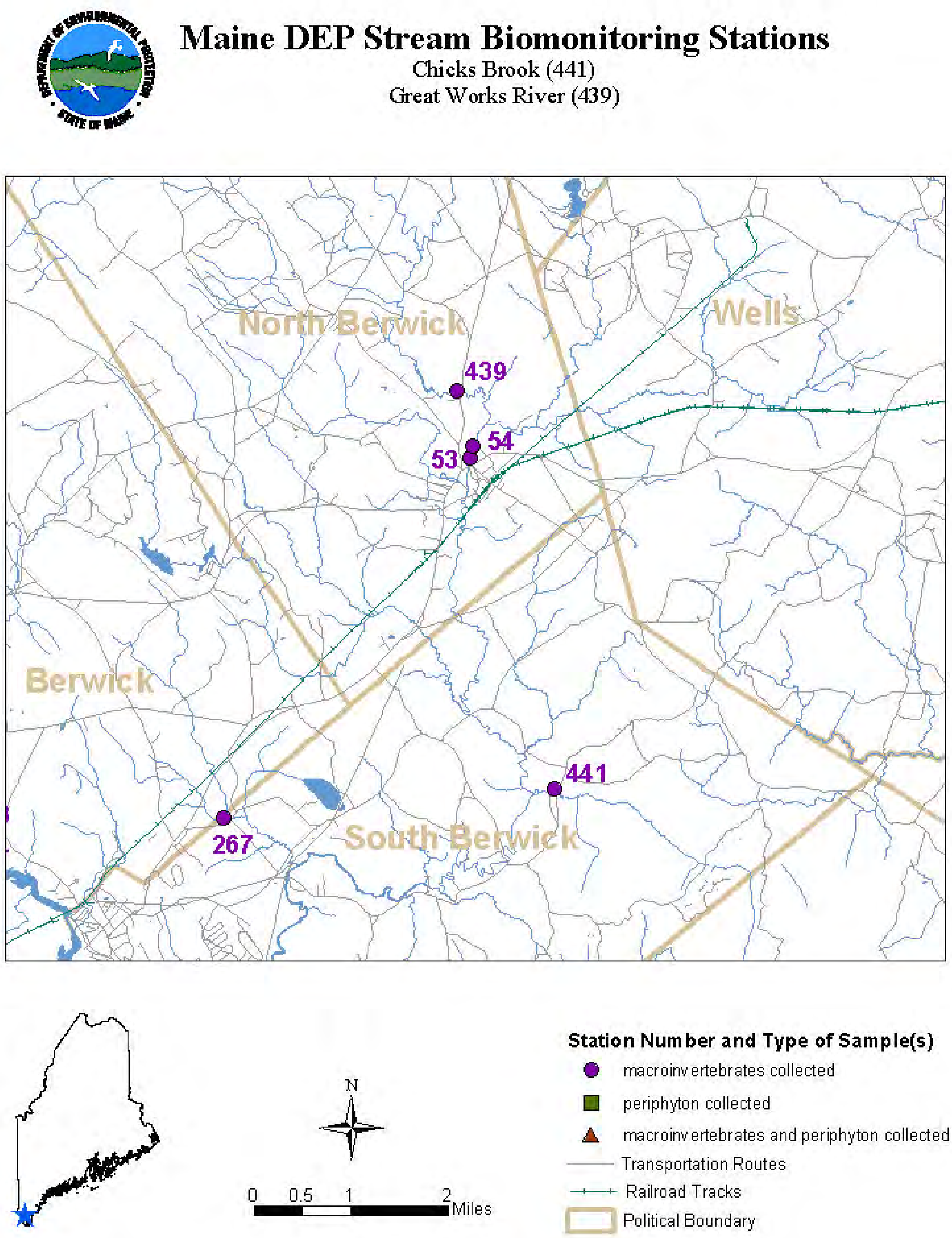
Map 2 – Brown Brook and Little Ossippee River



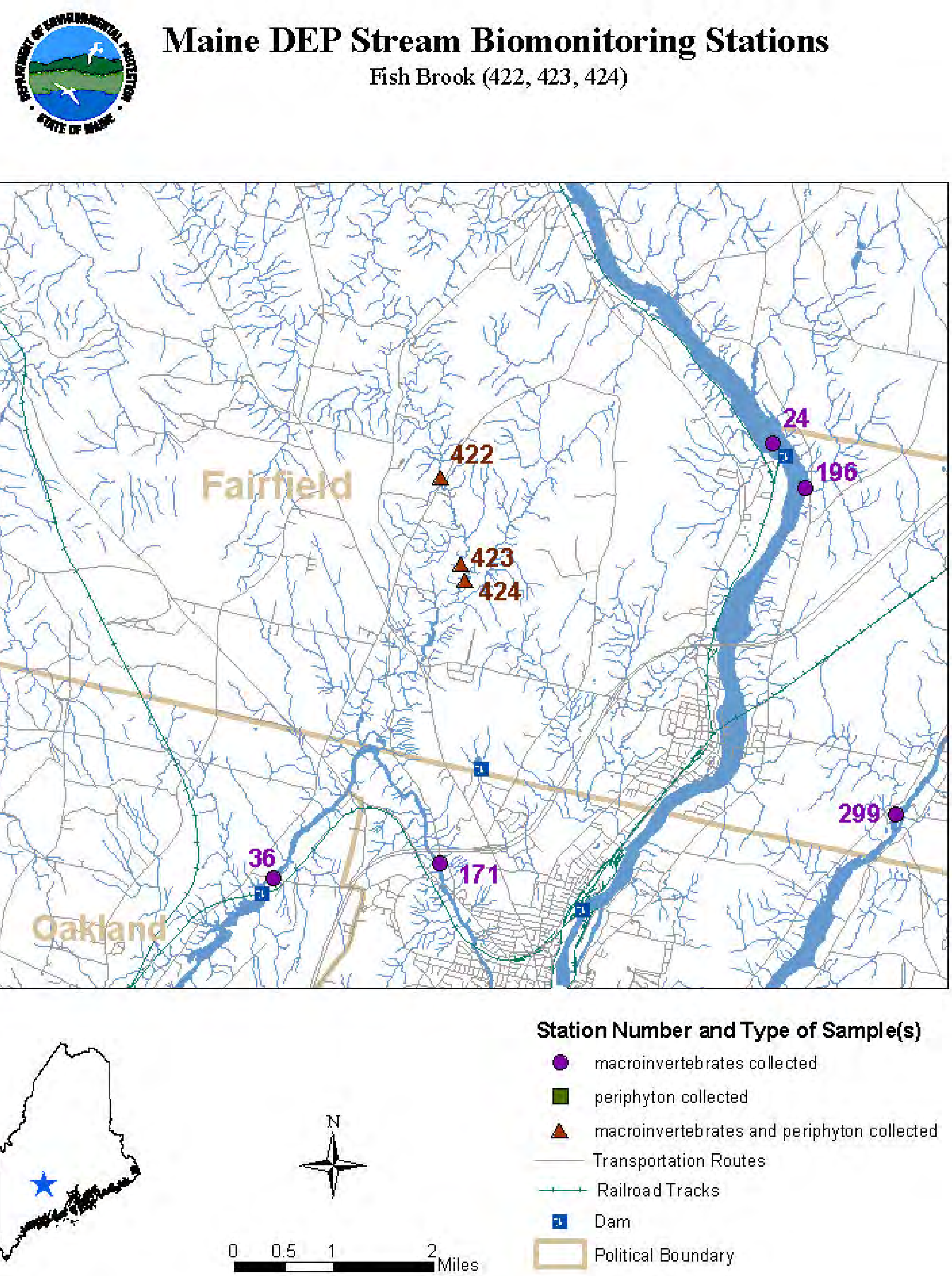
Goosefare Brook, Thatcher Brook, and West Brook



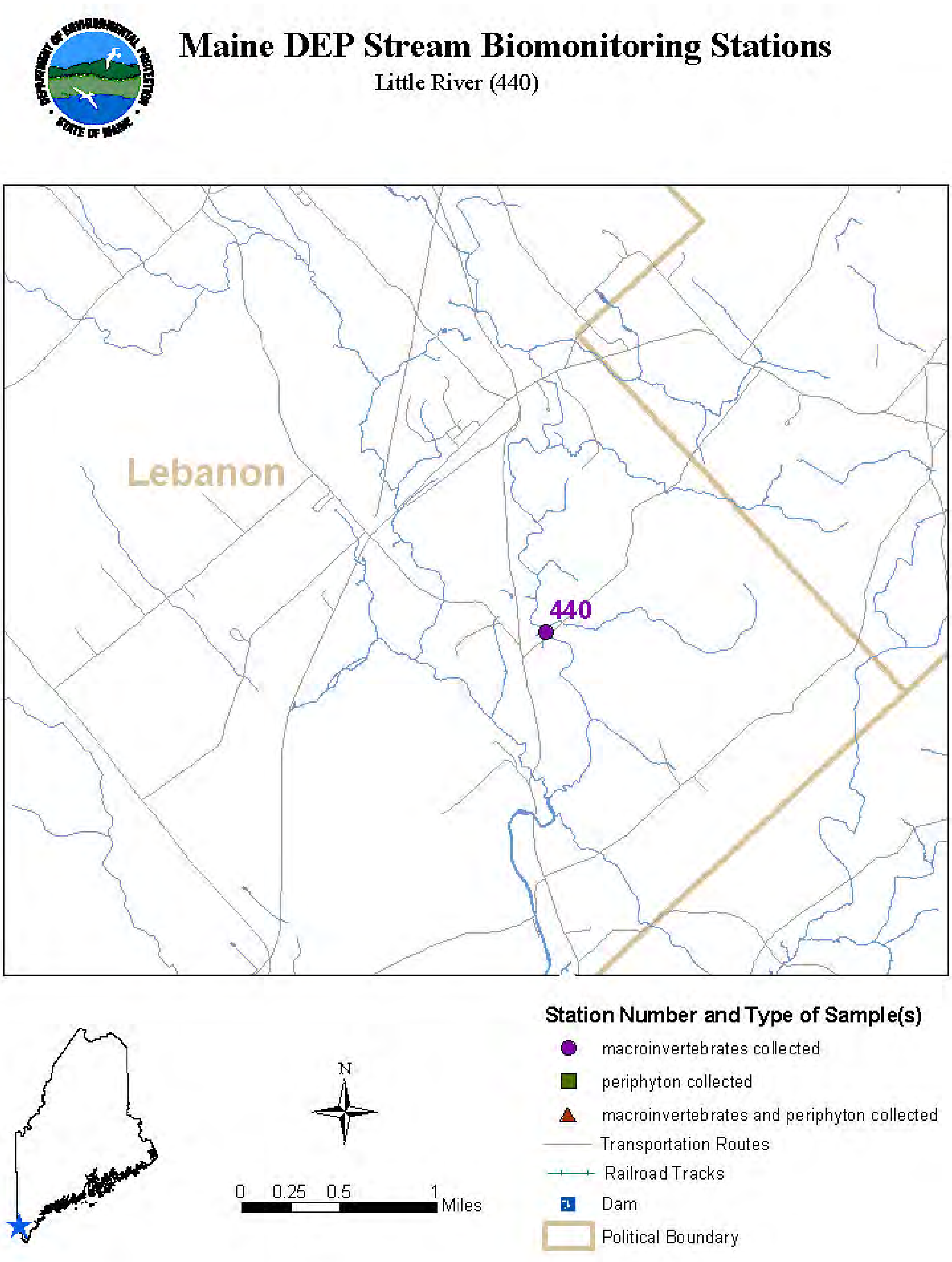
Map 4 – Chicks Brook and Great Works River



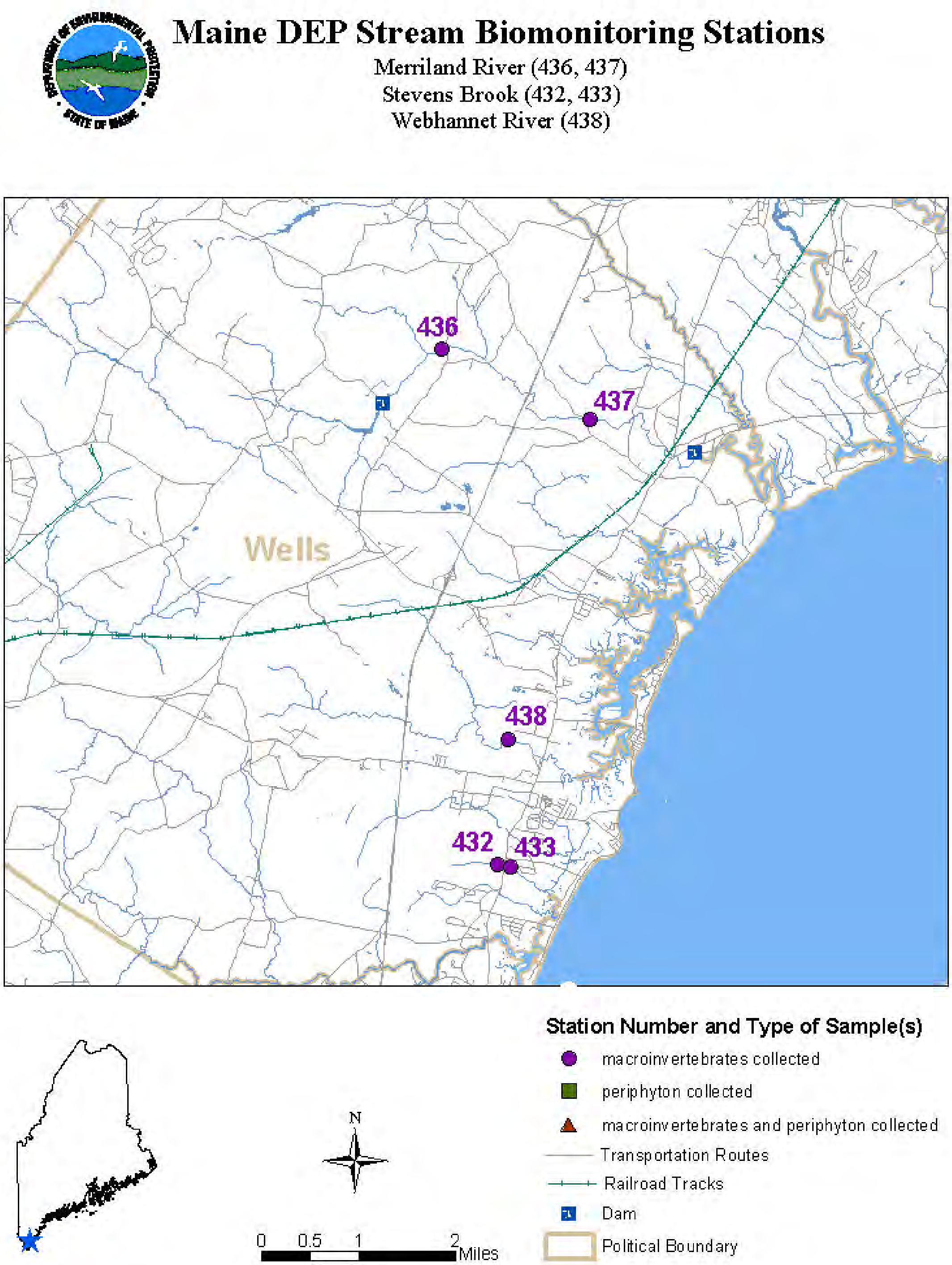
Map 5 – Fish Brook



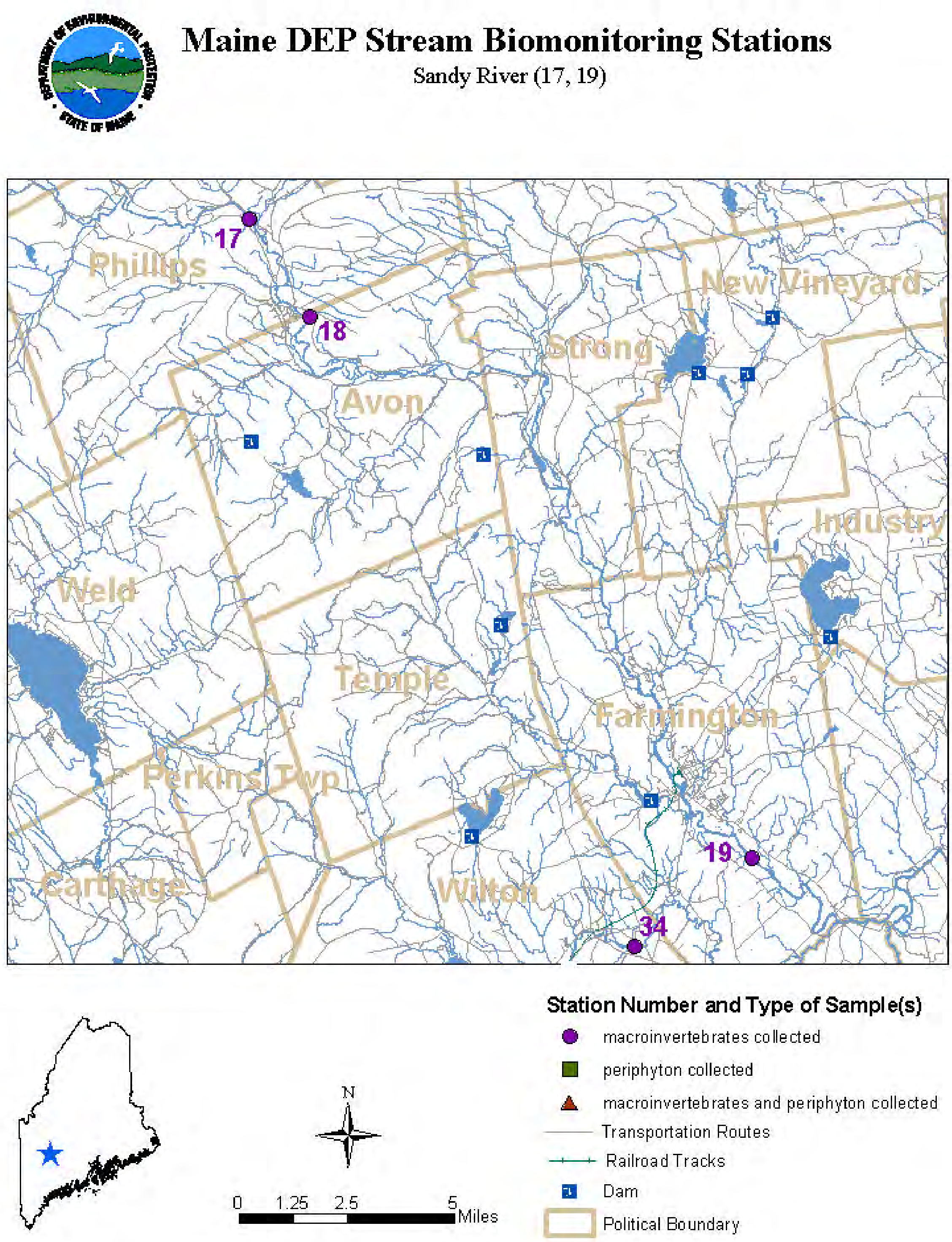
Map 6 – Little River



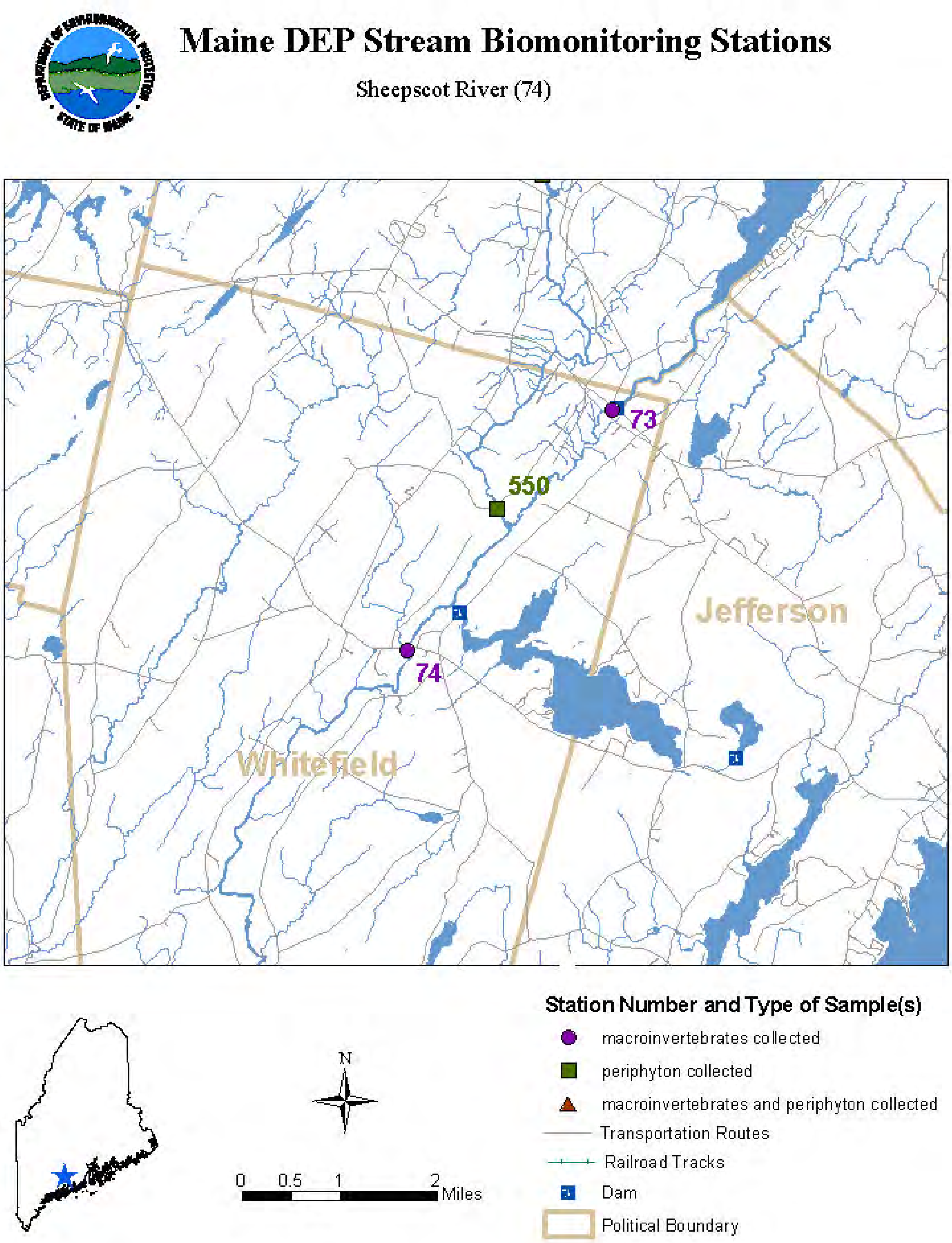
Map 7 – Merriland River and Webhannet River



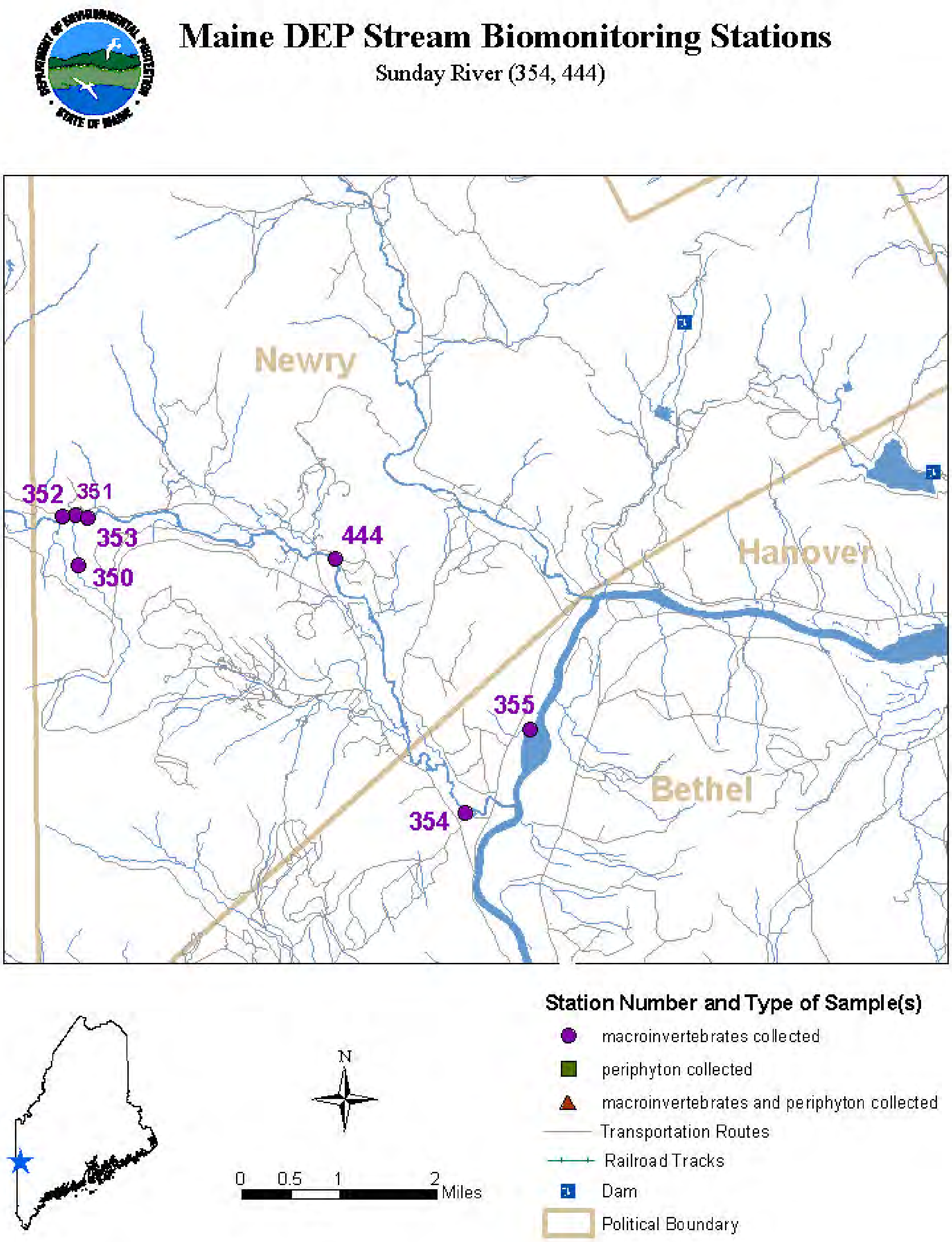
Map 8 – Sandy River



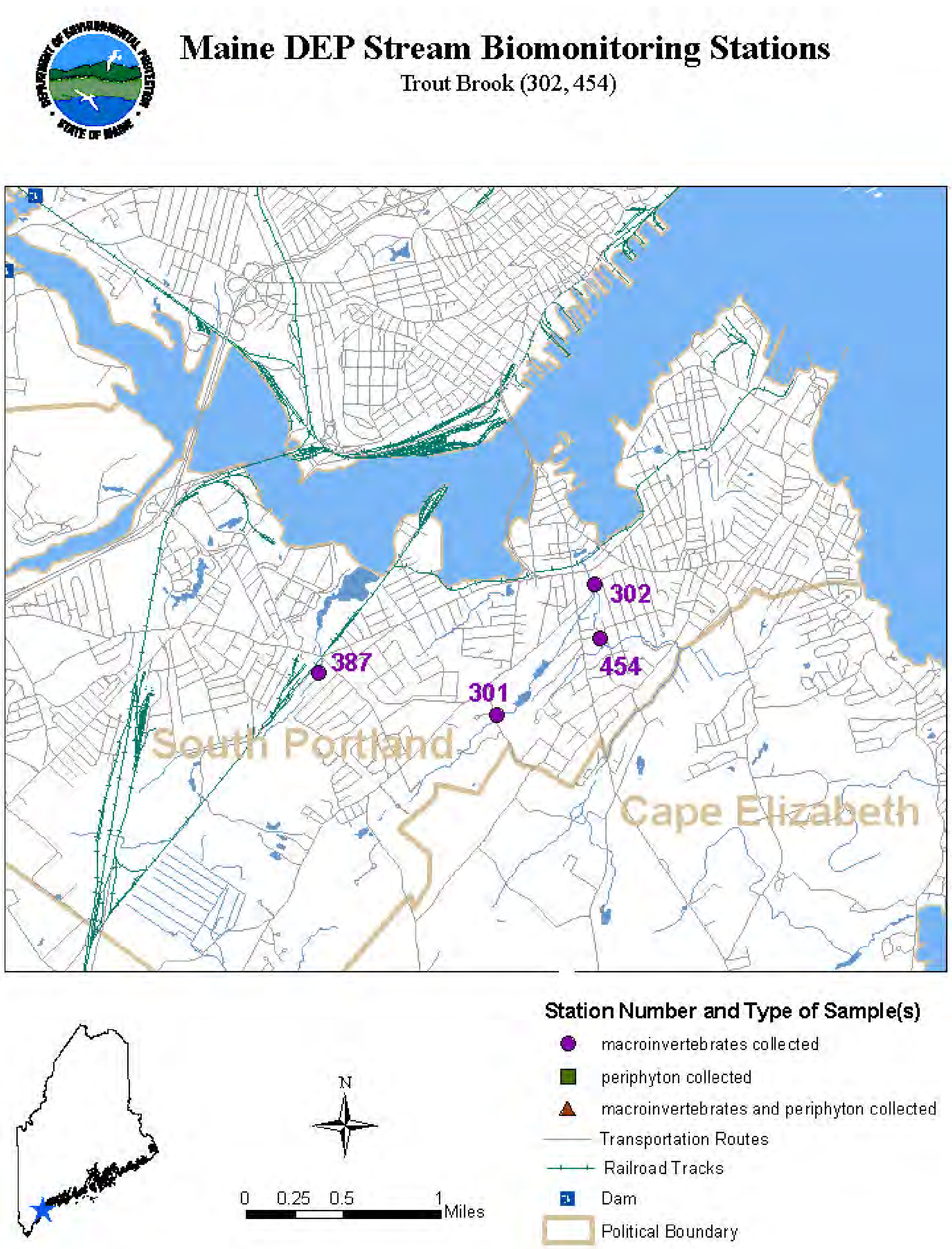
Map 9 – Sheepscot River



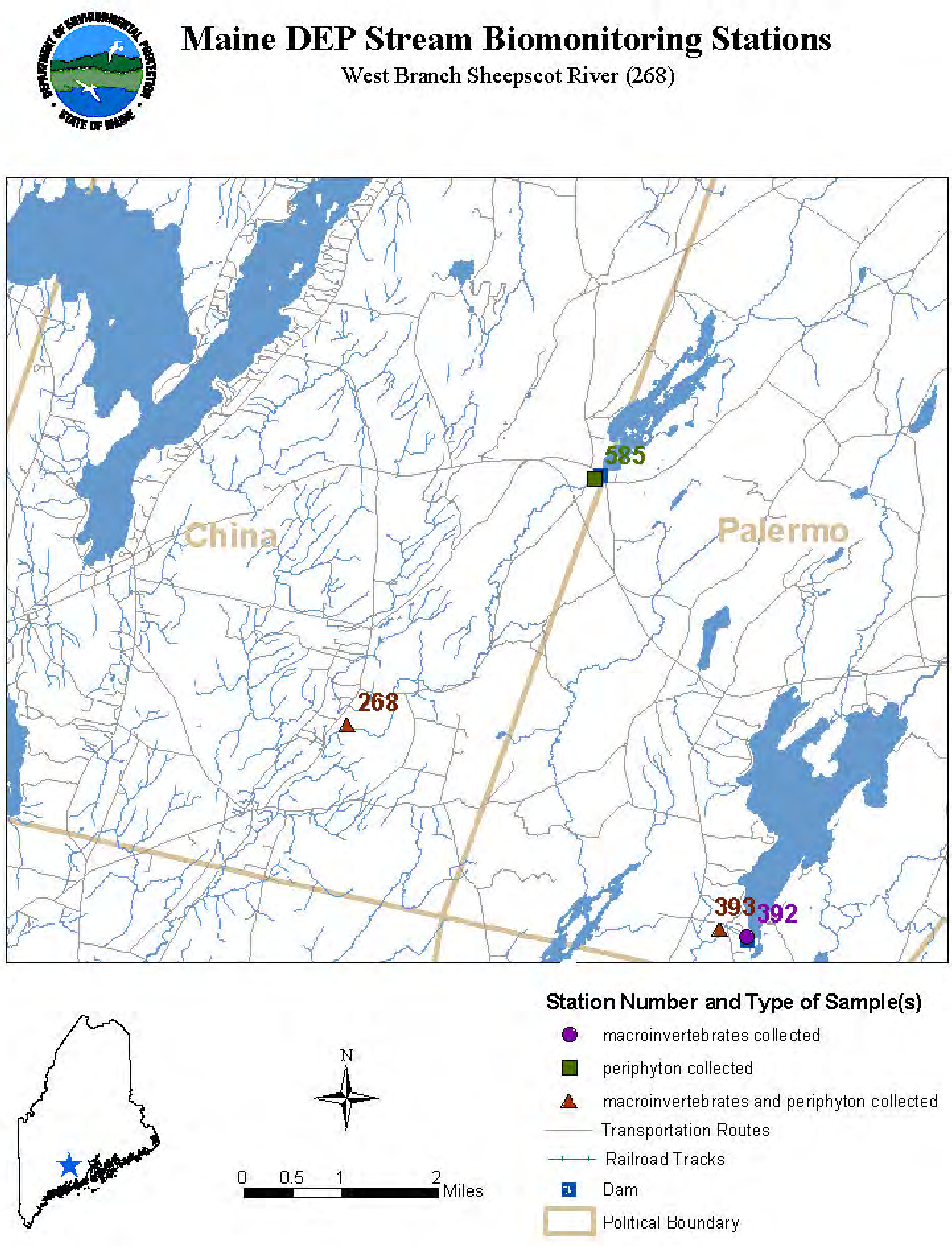
Map 10 – Sunday River



Map 11 – Trout Brook



Map 12 – West Branch Sheepscot



MODULE 4 SPECIAL STUDIES

4.1

SEMI-PERMEABLE MEMBRANE DEVICES

SEMI-PERMEABLE MEMBRANE DEVICES (SPMDS)

SPMDs

Semipermeable membrane devices (SPMDs) are integrative sampling devices which combine membrane diffusion and liquid-liquid partitioning to concentrate low to moderate molecular mass hydrophobic compounds from water (Huckins et al, 1996). SPMDs have some features that give them some advantages over monitoring contaminants in fish. SPMDs can be deployed in water to accumulate single, pulsed, or continuous contaminant releases over time. SPMDs are anchored to sample at specific locations, thereby avoiding any question of origin of contaminants caused by fish movement. SPMDs do not change function under stress, unlike gills of fish. There are no biotransformations or elimination like that in fish. There are, however, a number of conditions, such as temperature, DOC, solids which can effect the efficiency of these devices. And accumulation of contaminants does not occur by the same process of uptake in fish, thereby potentially limiting their use to accumulation in a relative sense.

Made of low density polyethylene lay-flat tubing (2.5 cm wide by 91.4 cm long), containing a thin film of neutral triolein and placed inside stainless steel canisters, SPMDs are deployed in the waterbody where they accumulate contaminants until retrieved. Laboratory handling of the SPMDs after field deployment involves the removal of biofouling, which is exterior debris and periphyton, before extraction. After this initial cleanup, the devices are then spiked with a cocktail of surrogates consisting of C-13 labeled analogs of the toxic native dioxin congeners in order to monitor recovery. After surrogate addition, individual SPMDs are dialyzed and the collected dialysates are cleaned by gel permeation chromatography followed by Florisil solid phase extraction. The extracts from the three SPMDs in each deployment site canister are then combined to enhance detection and each resulting sample is concentrated to ten microliters for HR GC/MS analysis.

In order to assess the potential of SPMDs to determine if mills are discharging dioxin, DEP has funded studies at the University of Maine Environmental Chemistry Laboratory (formerly the Water Research Institute) since 1999 through the Surface Water Ambient Toxics (SWAT) program. In 1999, the focus was development and refinement of field and laboratory techniques by deploying the SPMDs in the nearby Penobscot River for 3 one-month trials and then retrieving them for laboratory analysis.

In 2000, four studies or deployments were conducted as described below (Tables 4 and 5)and in more detail by Shoven (2001).

TABLE 4. Objectives of the 2000 Field Season Deployments

Objective	#	# of SPMDs
➢ Deployment Time Study: To determine SPMD uptake rates and biofouling over the 28-day deployment period. **Location: Androscoggin R. at Dixfield (10A,B)**	1, 2	20 SPMDs per deployment with 5 retrieved each week for 4 weeks

➢ Androscoggin Above/Below Study: To test the ability of SPMDs to detect differences in dioxin in the river Above/Below a mill. **Locations: Rumford Point (13) and Dixfield (10)**	4	20 SPMDs per site with all retrieved after 28 days
➢ Kennebec Above/Below Study: To test the ability of SPMDs to detect differences in the river Above/Below a mill. **Locations: Norridgewock (11) and Fairfield (12)**	3	10 SPMDs per site with all retrieved after the 54 days

TABLE 5. Descriptions of the 2000 Field Season Deployments

Deployment #	**Deployed**	**Retrived**	**Time (days)**	**Site**	**SPMDs per site**	**#SPMDs / sample**	**# Reps**
1	6/2/00	6/9/00	7	10-A	5	5	1
		6/16/00	14	10-B	5	5	1
		6/23/00	21	10-A	5	5	1
		6/30/00	28	10-B	5	1	5
2	7/7/00	7/14/00	7	10-A	5	5	1
	6/30/00	7/14/00	14	10-B	5	5	1
	7/7/00	7/28/00	21	10-A	5	5	1
	6/30/00	7/28/00	28	10-B	5	1	5
3	8/3/00	9/26/00	54	11	10	2	5
				12	10	2	5
4	9/19/00	10/17/00	28	10	20	2	10
				13	20	2	10

Results were as follows.

Deployment Time Study, Deployments 1 and 2

One objective was to determine differences in uptake in colder water (June) than in warmer water (July). Another objective was to determine if uptake rates were constant over time or if biofouling with growths of algae and accumulation of other materials would change the uptake rates. This is critical to know to help determine the optimum length of deployment time. Longer deployment times should result in more uptake of dioxin unless biofouling or other processes reduce or eventually stop further uptake. For these and all deployments, SPMDs were suspended from floats so as to be approximately 1 meter below the water surface in all water levels at a location that was at least 4 m deep.

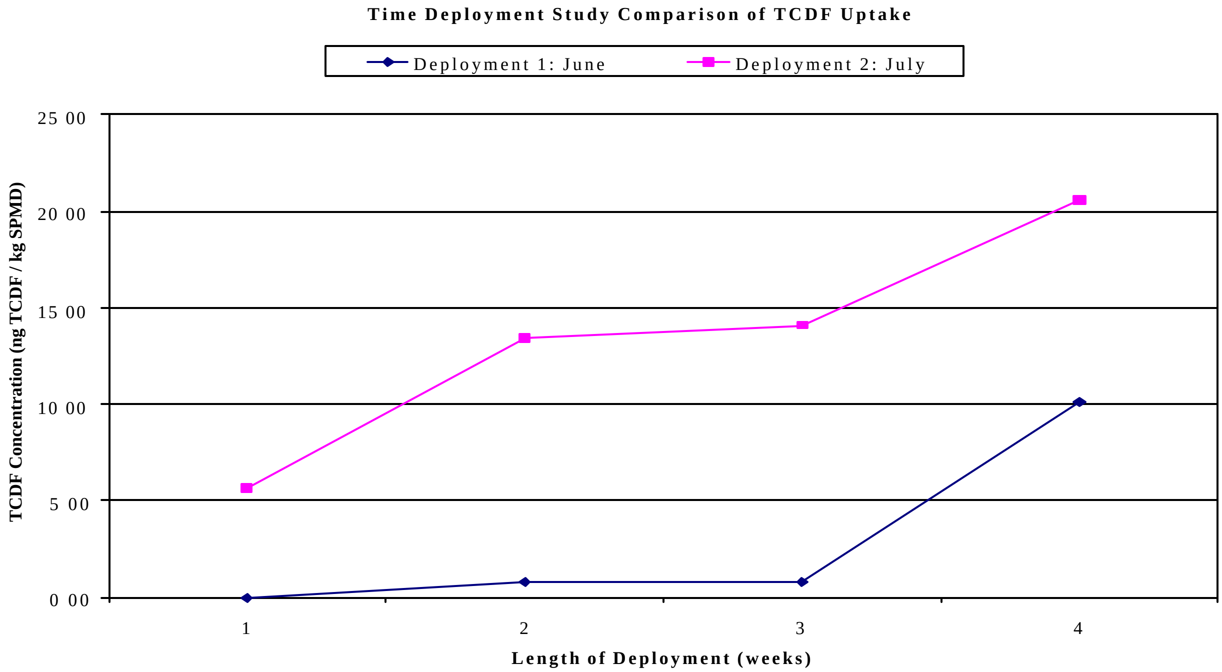
Results showed that uptake of TCDF continued over the 4 weeks in each month (Figure 1), as did uptake of many other furans as well (Table 6). No TCDD or PeCDD and only a few other dioxins were detected. The two curves show that uptake rates were considerably higher in warmer water (July) than in colder water (June)(Figure 1). The different slopes documented different uptake rates for each week for each deployment. In June uptake rates were relatively low for the first three weeks also likely reflecting lower temperatures during that period. Differences for all weeks may also be due to other factors including river velocities, dilution of dioxin levels in the river due to changes in river flow volume, suspended sediment load, dissolved organic carbon, and measurement error, among others.

Qualitatively, the biofouling on the membrane increased in coverage and changed characteristics over the four-week period progressing from tiny tan specs to larger army green, rod-like shapes. Each week the deployment canisters had more growth collected on the surfaces. Since uptake rates during week 4 was not diminished from earlier weeks in either month, biofouling did not seem to be an important factor in these 30 day exposures during June and July.

Kennebec Above/Below Study, Deployment 3

This study was conducted in conjunction with fish collections and caged mussel studies at the same two stations in order to be able to compare performance of all the studies in terms of MSDs for the above/below stations. This was a longer deployment than any of the others (Table 5). Results of deployment 3 show that TCDF was the most abundant congener detected (Figure 2). No TCDD nor any PeCDD or PeCDF were detected, but small amounts of other dioxins and furans were detected. Although TCDF appeared increased at Fairfield, the station below the SAPPI Somerset mill, the difference was not significant (error bars are 95% confidence limits). There were no significant differences in above/below concentrations for any other congener with the exception of OCDD, which was higher at the station above the mill. However, relatively small sample size (n=5) and considerable variation at each site (TCDF CV=24-40%, DTEo CV=26-29%) resulted in MSDs (105% for TCDF and 78% for DTEo) well above the target of 10%.

Figure 1.


Time Deployment Study Comparison of TCDF Uptake
Deployment 1: June
Deployment 2: July
TCDF Concentration (ng TCDF / kg SPMD)
25 00
20 00
15 00
10 00
5 00
0 00
1
2
3
4
Length of Deployment (weeks)

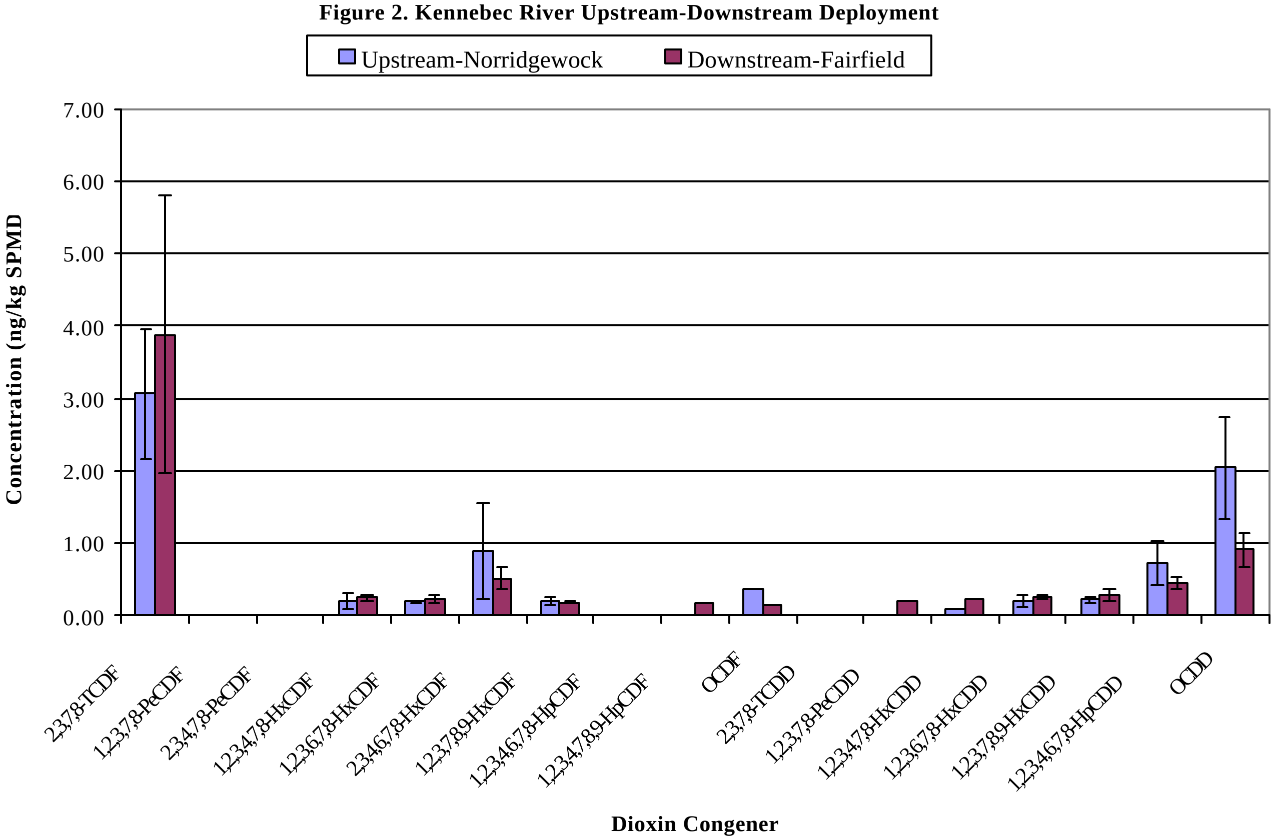
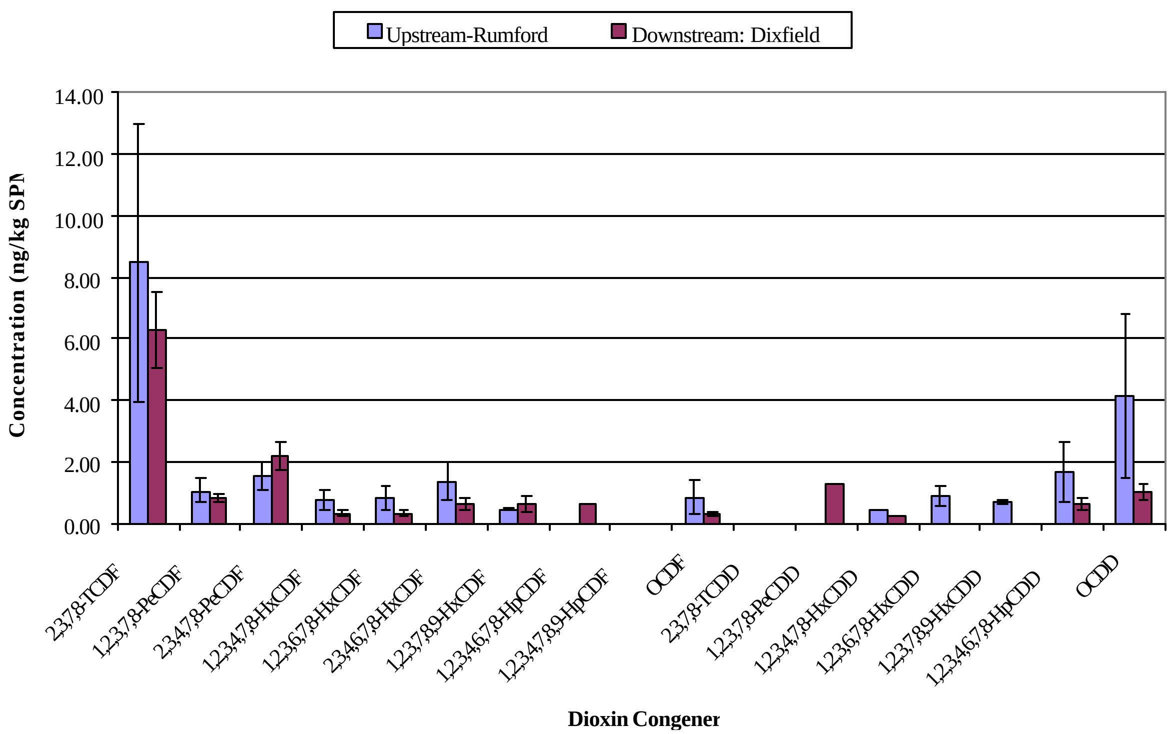


Figure 2. Kennebec River Upstream-Downstream Deployment
Upstream-Norridgewock
Downstream-Fairfield
Concentration (ng/kg SPMD
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2,3,7,8-TCDF
1,2,3,7,8-PeCDF
2,3,4,7,8-PeCDF
1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-HxCDF
2,3,4,6,7,8-HxCDF
1,2,3,7,8,9-HxCDF
1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF
OCDF
2,3,7,8-TCDD
1,2,3,7,8-PeCDD
1,2,3,4,7,8-HxCDD
1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD
1,2,3,4,6,7,8-HpCDD
OCDD
Dioxin Congener

Androscoggin Above/Below Study, Deployment 4

Like the Kennebec study, TCDF was most abundant, but appeared slightly higher upstream of the mill, although the difference was not significant. No TCDD was detected but most other congeners were at one or both stations. There were no significant differences between the two stations for any congener with the exception of OCDD which was significantly higher upstream. Although sample sizes were higher (n=10) than for the Kennebec study (n=5), so was the variance (TCDF CV=28-75%, DTEo CV=45-79%) resulting in MSDs (77% and 129% for TCDF and DTEo respectively) that were similar to those from the Kennebec, also well above the target of 10%.

Figure 3. Androscoggin River Upstream-Downstream Deployment 4



Conclusions

Comparison of deployments 1,2 and 4 showed uptake of TCDF (mean=8.66+-6.33 ng/kg) in mid September-mid October deployment were lower, similar to those of June (mean=10.08+-0.62 ng/kg), than those of July (mean=20.6+-7.09 ng/kg) likely resulting from temperature differences. Therefore, for maximum uptake, July and August would be better months for use of SPMDs. Uptake rates were not
constant probably due to a number of factors, but bio- fouling did not seem to be the problem in 30 day exposures. Deployment 3, a 54 day exposure on the Kennebec River resulted in lower uptake than the other deployments, which is most likely due to lower levels of dioxins and furans in the Kennebec compared to the Androscoggin.

4.2

BROMINATED ORGANICS

BROMINATED ORGANICS

The use of polybrominated biphenyls (PBBs) and diphenyl ethers (PBDEs) as fire retardants has significantly increased in the past 25 years. These compounds, structurally similar to their chlorinated counterparts, are showing up in the environment in increasing numbers. As the levels of PCBs and DDT are decreasing, the levels of the brominated compounds are on the increase. These compounds are currently used in the plastic components of computers, televisions, circuit boards, fabric for seat cushions in cars and buses and in various other textiles.

PBDEs were first discovered in the environment in 1981 in pike from Sweden. Data presented at the Dioxin 99 meeting in Venice, Italy, showed increasing amounts of these fire retardants in steelhead trout from Lake Michigan. In the May 1, 2000 issue of Environmental Science and Technology, scientists in the European community are proposing curbing the use of these compounds. The production of PBBs have been voluntary phased out by manufacturers because of environmental issues. PBDEs are also being phased out and replaced by tetrabromobisphenol A (TBBPA).

This study consists of screening for these compounds using the extracted archives from 35 previous DMP/SWAT dioxin/coplanar PCB samples. The extraction methods are similar so it is likely that these compounds exist in the extracts if they were present in the original samples. We will composite 2-5 samples from each species and sampling area, add labeled surrogates and analyze them using high resolution MS against calibrated standards. The values would not be quantitative since the surrogates would not have gone through the entire extraction process however the presence of these compounds would be an indication of potential contamination. At sites that have PBBs identified, we could then analyze the archived extracts from the past three years to determine if there is a historical pattern per site.

This study has not yet been performed but will be modified and performed during 2002.

4.3

PCB IN HATCHERY FISH

PCB STUDY OF HATCHERY FISH

In Maine, game fish species analyzed for PCBs as part of the REMAP program in 1993-4 contained 5 to 190 ppb total PCBs in whole fish. Wild fish had a mean total PCB concentration of 12 ppb (N=17) whereas hatchery fish had mean total PCB concentration of 21 ppb (N=11). The Maine Bureau of Health's Fish Tissue Action Level is 11 ppb for filets. From previous studies a factor of ~6.5 was determined for the ratio of concentrations of PCB in whole brown trout to that in filets. Using this factor then the estimated concentrations of PCB in hatchery fish and wild fish were ~ 3 ppb and 2 ppb respectively. In 2000 the Biological Resources Division of the US Geological Survey informed DEP that Pennsylvania, hatchery-reared trout stocked into state waters were found to have total PCB concentrations of 30 to 400 ppb (ng/g). It seems that hatchery fish in Maine may not be as contaminated as those in Pennsylvania, but there is some evidence that hatchery fish may be higher in PCBs than wild fish of the same species. Consequently, we proposed to determine the PCB burden of the major fish species produced in Maine hatcheries for stocking in state waters, as well as the PCB content of the major sources of commercial diets fed to the fish.

The three most numerous fish reared for stocking in Maine are brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*) and landlocked Atlantic salmon (*Salmo salar*). We collected five spring yearlings of each species from one or more hatcheries just prior to scheduled stocking. The fish from each hatchery were skinned, filleted, and combined into a single composite sample for congener-specific analysis of total PCBs. A sample of the feed for each lot of fish was also collected for the same analysis.

The results of this preliminary study show that most samples exceeded the Maine Bureau of Health's Fish Tissue Action Level for PCB (11 ug/kg) (Table 4.3.1). The mean (26.7 ppb) was slightly higher than that found in the REMAP program. Concentrations appear to be higher in brown trout from the Casco hatchery and in landlocked salmon than in brown trout from other hatcheries or in brook trout. Concentrations in the feed were much higher but quite variable. Reasons for lower concentrations in the REMAP fish might include 1) depuration and 2) growth dilution. The fish from REMAP were captured from lakes and ponds where their natural food presumably has lower concentrations of PCBs than hatchery feed. Therefore, the fish may depurate with time. In addition, growth dilution would account for reduced concentrations if there is less intake in the wild. There was not a good correlation between fish concentrations and feed concentrations. Because these results are from a preliminary study and the feed datum are significantly different from values reported in other studies and analyses, the tissue and feed samples have been sent out for retesting to confirm the results. As well, this study will be repeated in 2002 to verify the nature and extent of these concentrations in tissue, feed, and additional work on sediment from hatchery settling ponds. This second study will begin to investigate initial findings on growth and depuration effects on PCB in tissue samples.

Table 4.3.1

Total PCB in fish and feed from DIFW hatcheries, 2000 (ppb)

hatchery		date	brook trout	brown trout	salmon	species	feed type
Casco							
	fish	04/20/2001		40.6	55.3	BNT	Corey 4 pt Vigor
	feed				1024	LLS	#3 Corey
Dry Mills							
	fish	04/01/2001	15.2				
	feed		1579			BKT	Shur Gain trout brood stock B2N 5G7
Emden							
	fish	04/20/2001			45.2		
	feed				2362	LLS	Corey Aqua transfer 3 lot 353080
	type of feed						
Enfield							
	fish	04/19/2001	23.9				
	feed		240			BKT	Brook trout starter ration 3.5 mm B2N 6x8
	brood fish		8.75				
	brood fish eggs		25.1				
Grand Lake Stream							
	fish	05/03/2001			39.1		
	feed				694	LLS	Shur Gain 3.5 pt
New Gloucester							
	fish	04/20/2001		22.4			
	feed					BNT	Vigor 5 5212 ZBR
Palermo							
	fish	04/20/2001	4.94	11.2		BKT	Vigor #4 lot 520 ZBR
	feed		355			BNT	Vigor #4 lot 520 ZBR

4.4

CAGED MUSSEL DIOXIN BIOASSAY

CAGED MUSSEL DIOXIN BIOASSAY

This project was a cooperative one with the Maine Department of Inland Fisheries and Wildlife (DIFW) a Friends of Merrymeeting Bay (FOMB) assisted by a consultant, Applied Biomonitoring of Kirkland, Wa Caged bivalves have been used to monitor pulp and paper mill effluents in Finland for over 20 years. Environment Canada is currently considering caged bivalves as an alternative to the required adult fish su their Environmental Effects Monitoring after several successful pilot studies. Caged bivalves are a poten powerful tool because of their ability to quantify exposure and effects over space and time. Caged bivalv an advantage of increased sample size over fish that are often difficult to collect in desired numbers. The size range can be also be standardized. This should limit dioxin variability in mussel tissues thereby allov smaller MSDs to be detected. Caged mussels anchored in place represent exposure at a fixed point in spa unlike fish which may move around.

The approach was to measure survival, growth, and bioaccumulation of dioxins and furans in caged fresh mussels at the same time and locations above and below the SAPPI Somerset bleached kraft pulp and pap on the Kennebec River, Norridgewock and FAIRFIELD, as the fish collections and SPMD studies, in orc compare uptake of contaminants and MSDs among all these Above/Below tests. Freshwater mussels, *Ell complanata*, were collected by SCUBA divers from DIFW and FOMB from Nequasset Lake, an undevel lake in Woolwich serving as Bath's water supply. The mussels were weighed, sorted by length, and then randomly distributed by length to nylon mesh bags that were then attached to PVC frames and enclosed v polypropylene mesh predator guards according to the methods of Salazar and Salazar (2000). An initial s of 5 composites of 35 mussels was collected and subsequently analyzed for all 2378- substituted dioxins a furans, percent lipid and percent solids. Individual identities were noted by position within each mesh ba cages enabling calculation of survival and growth for each individual.

Ten cages of 35 mussels each were placed at both Norridgewock and Fairfield on August 3, 2000 and ret September 26, 2000, giving a 54 day exposure. Upon retrieval mussels were measured for length and we then shucked. Shell and soft tissues were then weighed. Tissues of mussels from each cage were composi one sample for analysis for all 2378- substituted dioxins and furans, percent lipid and percent solids. Ind mussels were also monitored for survival and growth.

Results of the initial 5 composite samples from Nequasset Lake showed no detectable dioxins or furans (' 4.4.1). This was interesting because feral fish from a number of other relatively undeveloped and somew developed lakes and ponds as well as rivers have always been found to contain measurable levels of TCD some other dioxins and furans. Nor at the end of the exposure did the mussels contain any measurable T' either. Measurable concentrations of TCDF, however, were found in all samples at both stations, and ma dioxins and furans were found as well in most samples. Concentrations were similar to those in bass at Norridgewock but 2-3 x lower than those in bass at Fairfield on a wet weight basis, and similar to those ir bass but higher than in small bass on a lipid weight basis at both stations. Concentrations were higher tha in suckers, sucker livers, and SPMDs on a lipid weight basis at both stations. MSDs were similar for TCl lower for DTEo to those of fish, but lower for TCDF and higher for DTEo than SPMDs (Table 4.4.2). T no significant difference in TCDD, TCDF, or DTEo between the two stations, unlike the results for fish.

Table 4.4.1 Dioxin and furan in caged mussels (ppt)

		KNW1	KNW2	KNW3	KNW4	KNW5
Compound						
2378-tcdf	0.11	0.52	0.31	0.62	0.47	0.33
12378-pecdf	0.25	0.36	0.54	<DL	0.21	<DL
23478-pecdf	0.25	<DL	<DL	<DL	<DL	<DL
123478-hxcdf	0.25	0.33	0.41	<DL	0.20	<DL
123678-hxcdf	0.25	<DL	<DL	<DL	0.17	<DL
234678-hxcdf	0.25	<DL	<DL	<DL	<DL	<DL
123789-hxcdf	0.25	1.02	0.75	0.41	0.26	0.51
1234678-hpcdf	0.50	0.33	0.42	0.61	<DL	<DL
1234789-hpcdf	0.50	<DL	<DL	<DL	<DL	<DL
ocdf	0.50	<DL	1.05	<DL	<DL	<DL
2378-tcdd	0.10	<DL	<DL	<DL	<DL	<DL
12378-pecdd	0.25	<DL	0.35	<DL	<DL	<DL
123478-hxcdd	0.25	<DL	<DL	<DL	<DL	<DL
123678-hxcdd	0.25	0.51	<DL	0.36	<DL	0.26
123789-hxcdd	0.25	0.15	0.22	0.34	<DL	<DL
1234678-hpcdd	0.50	0.75	1.22	0.83	0.5	0.35
ocdd	0.50	1.69	0.65	0.84	2.05	0.66
DTEo		0.72	1.04	0.17	0.55	0.09
DTEd		1.14	1.39	0.97	0.78	0.94
% Lipids		0.52	0.63	0.57	0.49	0.59

		KNW6	KNW7	KNW8	KNW9	KNW10	KNW
Compound							ave
2378-tcdf	0.11	0.19	0.36	1.15	0.28	1.06	0.45
12378-pecdf	0.25	<DL	0.31	0.61	0.25	0.42	
23478-pecdf	0.25	<DL	<DL	0.25	<DL	<DL	
123478-hxcdf	0.25	<DL	0.21	0.49	<DL	0.18	
123678-hxcdf	0.25	<DL	<DL	<DL	<DL	0.20	
234678-hxcdf	0.25	<DL	<DL	<DL	<DL	<DL	
123789-hxcdf	0.25	0.37	0.17	0.63	0.28	0.49	
1234678-hpcdf	0.50	<DL	0.25	0.36	0.51	0.19	
1234789-hpcdf	0.50	<DL	<DL	<DL	<DL	<DL	
ocdf	0.50	<DL	<DL	<DL	<DL	<DL	
2378-tcdd	0.10	<DL	<DL	0.10	<DL	<DL	<0.1
12378-pecdd	0.25	<DL	0.25	0.39	0.18	<DL	
123478-hxcdd	0.25	<DL	<DL	0.51	<DL	0.35	
123678-hxcdd	0.25	0.41	<DL	0.48	0.18	0.21	
123789-hxcdd	0.25	<DL	<DL	0.41	<DL	0.26	
1234678-hpcdd	0.50	0.69	1.06	1.35	0.51	1.14	
ocdd	0.50	0.48	0.69	1.51	0.72	0.61	
DTEo		0.06	0.52	1.14	0.38	0.89	0.51
DTEd		0.91	0.92	1.52	0.90	1.06	1.05
% Lipids		0.48	0.53	0.87	0.58	0.67	0.56

Table 4.4.2 Minimum Significant Differences for 2000 Above/Below test

STATIONS	SPECIES	N	TCDDw ppt	%bg	TCDFw ppt	%bg	DTEow ppt	%bg
FISH								
ARP/ARF	SMB	10	0.14	**280**	2.23	**384**	0.50	**526**
		20	0.10	**200**	1.58	**272**	0.35	**368**
KNW/KFF	SMB	10	0.17	**340**	0.53	**129**	0.2	**400**
		20	0.12	**240**	0.38	**93**	0.14	**280**
	sSMB	10	0.09	**180**	0.64	**139**	0.16	**267**
		20	0.06	**120**	0.45	**98**	0.11	**183**
	WHS	10	0.16	**320**	0.46	**164**	0.26	**520**
		20	0.11	**220**	0.32	**114**	0.18	**360**
PBW/PBL	SMB	10	0.09	**180**	0.15	**20**	0.15	**107**
		20	0.06	**120**	0.11	**15**	0.11	**79**
	WHS	10	0.31	**620**	0.88	**154**	0.39	**390**
		20	0.22	**440**	0.62	**109**	0.27	**270**
LIVERS								
KNW/KFF	WHS	10	1.23	**425**	13.31	**261**	2.87	**191**
		20						
MUSSELS								
KNW/KFF		10	<		0.57	**89**	0.69	**133**
		20	<		0.41	**64**	0.49	**94**
SPMDs								
KNW/KFF		5						
		10						
ARP/ARF		10						
		20						

STATIONS	SPECIES	N	TCDDL ppt	%bg	TCDFL ppt	%bg	DTEoL ppt	%bg
FISH								
ARP/ARF	SMB	10	19.6	**131**	189.7	**123**	57	**219**
		20	13.9	**93**	134.1	**87**	40.6	**156**
KNW/KFF	SMB	10	24.4	**176**	63.3	**71**	13.7	**127**
		20	17.2	**124**	44.8	**50**	9.7	**90**
	sSMB	10	1.49	**115**	8.7	**73**	2.3	**163**
		20	1.05	**81**	6.1	**51**	1.63	**116**
	WHS	10	2.57	**139**	8.4	**84**	5.5	**355**
		20	1.82	**98**	6	**60**	3.9	**252**
PBW/PBL	SMB	10	18.7	**117**	208.5	**95**	46	**41**
		20	13.2	**83**	147.5	**67**	32.5	**79**
	WHS	10	1.83	**153**	6.23	**48**	2.13	**107**
		20	1.3	**108**	4.76	**36**	1.5	**75**
LIVERS								
KNW/KFF	WHS	10	4.62	**453**	51.7	**272**	11.4	**193**
		20						
MUSSELS								
KNW/KFF		10	<		86.6	**78**	105	**119**
		20	<		61.2	**55**	74.5	**85**
SPMDs								
KNW/KFF		5	<		3.21	**105**	0.38	**78**
		10	<		2.27	**74**	0.26	**53**
ARP/ARF		10	<		6.5	**77**	1.89	**129**
		20	<		6.17	**73**	1.33	**90**

4.5

CAGED MUSSEL PCB STUDY

CAGED MUSSEL PCB STUDY

Previous SWAT studies have documented concentrations of PCBs in 3 species of freshwater fish from the Kennebec River below the former Edwards dam in Augusta that warrant a no consumption fish advisory. DEP has been trying to identify sources by analyzing sediments from the local area by use of an ELISA. Identification of sources by this method is limited by hydrological patterns of scouring and deposition. Areas where appropriate sediment can be found may not be adjacent to sources.

Caged bivalves have been used to monitor persistent bioaccumulative toxics such as PCBs for over 20 years. In southern California, caged bivalves were used to establish chemical gradients from suspected chemical sources for both DDT and PCBs. One advantage of caged bivalves is that they may be deployed at any location. We used caged mussels to supplement the current sediment approach for identify sources.

The proposed approach was to measure survival, bioaccumulation, and growth in caged freshwater mussels after *in situ* exposure to existing environmental conditions at 9 stations along a suspected longitudinal gradient of PCB contamination from above the former Edwards Dam to Merrymeeting Bay. Stations were selected to bracket potential existing or former industrial or municipal sources. A total of 3 cages were deployed in a transect across the river at each station. This facilitated identification of the hotspot area as well as define possible upstream and downstream boundaries or gradients. Cages of 20 mussels each were placed at each location along the transect for a period of 53 days. Tissues were pooled from each cage to establish one sample per cage to determine mean concentrations of PCBs, percent lipid and percent solids at the different sites (or to establish the gradient). Individual mussels were monitored for survival and growth. An initial sample of 5 composites of 35 mussels was analyzed for PCBs, percent lipid and percent solids. The study was coordinated with the Maine Department of Inland Fisheries and Wildlife, Friends of Merrymeeting Bay, and Applied Biomonitoring.

Results show that the highest concentrations were at the middle of the river at station 5, below the Augusta POTW outfall, and at station 6 west, below Hallowell (Table 4.5.1). These potential sources need to be investigated further to determine if there are continuing sources. These high values may also represent historical discharges. Sediment contamination from these two areas should be investigated. There was some variation along transects at most of the stations with the highest values not always where expected. Highest values at station 2 below Riggs Brook, which flows by the O'Connor PCB contaminated site on Route 17, were on the opposite (W) side of the river from the confluence with Riggs Brook. The highest value at station 3 below the former Edwards mill was in the middle of the river, where most of the flow goes. At the next station, 4, below Ft Western, which has been rumored to have had electrical transformers stored in a former warehouse on site, concentrations were low at all locations along the transect. At station 7 below Gardiner, the highest value was across the river on the east side. These results may represent the effects shifting location of the main current distributing the discharges from the potential sources across the river or indicate other unknown sources.

Survival was 95-100% at all stations. Mussels at all stations, except station 5 below Augusta, had significant increases in tissue weight during the exposure. Low tissue weights and low growth at station 5 middle and station 6 west were coincident with the highest PCB concentrations.

More details of this study and of the Caged Mussel Dioxin Bioassay may be seen in the final report from the consultant, Applied Biomonitoring, available with this 2000 SWAT report separately at http://www.state.me.us/dep/blwq/monitoring.htm The conclusions of that report are solely those of Applied Biomonitoring, and not necessarily those of DEP.

Table 4.5.1 PCB concentrations in caged mussels in the Kennebec River (ppb)

Station	East	Middle	West	Location
1	18.4	25.8	29.5	above Riggs Brook
2	18.4	26.9	45.8	below Riggs Brook
3	2.7	54.8	3.9	below Edwards mill
4	4.3	6.1	3.0	below Ft Western
5	16.5	188	31.5	below Augusta POTW
6	61.2	35.9	125	below Hallowell
7	50.3	6.6	24.8	below Gardiner
8	20.1	26.9	lost	below Gardiner POTW
9	64.2	16.7	lost	below Richmond

DEP ID#		DL	PC-01-08	PC-01-11	PC-01-15	PC-02-02	PC-02-26	PC-02-29
EXT ID#		ug/kg dw	1441	1445	1444	1426	1446	1427
Analytes	IUPAC#							
2,4'-Dichlorobiphenyl	8	1.0	0.639	0.360	0.480	0.561	0.400	0.761
2,2',5-Trichlorobiphenyl	18	1.0	<DL	<DL	0.360	<DL	<DL	<DL
2,4,4'-Trichlorobiphenyl	28	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	1.0	<DL	0.880	<DL	0.641	0.760	0.361
2,2',3,5'-Tetrachlorobiphenyl	44	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2',4,6-Tetrachlorobiphenyl	50	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2',5,5'-Tetrachlorobiphenyl	52	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,3',4,4'-Tetrachlorobiphenyl	66	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2',3,4,5'-Pentachlorobiphenyl	87	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2',4,5,5'-Pentachlorobiphenyl	101	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2',4,6,6'-Pentachlorobiphenyl	104	2.0	<DL	<DL	0.480	<DL	0.320	<DL
2,2',3,3',4,4'-Hexachlorobiphenyl	128	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2',3,4,4',5'-Hexachlorobiphenyl	138	2.0	0.599	<DL	0.480	<DL	1.001	0.801
2,2',4,4',5,5'-Hexachlorobiphenyl	153	2.0	1.159	0.640	<DL	<DL	<DL	0.921
2,2',4,4',5,6'-Hexachlorobiphenyl	154	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2',3,4',5,5',6-Heptachlorobipheny	187	2.0	0.559	<DL	<DL	<DL	<DL	0.120
2,2',3,4',5,6,6'-Heptachlorobipheny	188	2.0	3.357	1.680	0.480	7.813	5.643	<DL
2,2',3,3',4,4',5,6-Octachlorobipheny	195	3.0	0.200	0.160	<DL	<DL	<DL	0.521
2,2',3,3',4,5',6,6'-Octachlorobipher	200	3.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2',3,3',4,4',5,5',6,6'-Decachlorobi	209	5.0	<DL	<DL	<DL	<DL	<DL	<DL
Total PCBs			29.5	25.8	18.4	45.8	26.9	18.4
Sample weight (g, dry weight)			25.0257	25.0029	25.0022	24.959	24.9861	24.9616
Surrogate Recovery		% rec (65-1	91.0	88.2	98.3	103	70.4	80.0

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

DEP ID#		DL	PC-03-06	PC-03-21	PC-03-30	PC-04-12	PC-04-13	PC-04-19
EXT ID#		ug/kg dw	1074	1075	1076	1077	1078	1079
Analytes	IUPAC#							
2,4’-Dichlorobiphenyl	8	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,5-Trichlorobiphenyl	18	1.0	<DL	0.505	0.291	0.453	0.313	0.169
2,4,4’-Trichlorobiphenyl	28	1.0	<DL	0.269	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	1.0	<DL	24.020	<DL	<DL	<DL	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	1.0	<DL	<DL	<DL	0.113	0.267	<DL
2,2’,3,4,5’-Pentachlorobiphenyl	87	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,4,5,5’-Pentachlorobiphenyl	101	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,4,6,6’-Pentachlorobiphenyl	104	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	2.0	0.123	<DL	<DL	<DL	<DL	<DL
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	2.0	0.163	<DL	<DL	<DL	<DL	<DL
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	2.0	<DL	<DL	<DL	<DL	<DL	0.626
2,2’,3,4’,5,5’,6-Heptachlorobipheny	187	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,4’,5,6,6’-Heptachlorobipheny	188	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,6-Octachlorobipheny	195	3.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobipher	200	3.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobi	209	5.0	<DL	<DL	<DL	<DL	<DL	<DL
Total PCBs			3.9	54.8	2.7	3.0	4.3	6.1
Sample weight (g, dry weight)			24.4869	29.7253	27.5164	26.4663	21.1224	27.061
Surrogate Recovery		% rec (65-1	111	121	65.2	73.0	81.6	79.8

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

DEP ID#		DL	PC-05-09	PC-05-18	PC-05-27	PC-06-03	PC-06-14	PC-06-23
EXT ID#		ug/kg dw	1436	1437	1442	1443	1431	1429
Analytes	IUPAC#							
2,4’-Dichlorobiphenyl	8	1.0	<DL	1.398	0.400	0.759	3.078	1.202
2,2’,5-Trichlorobiphenyl	18	1.0	<DL	5.353	0.280	<DL	<DL	<DL
2,4,4’-Trichlorobiphenyl	28	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	1.0	1.439	2.037	<DL	1.438	1.159	<DL
2,2’,3,5’-Tetrachlorobiphenyl	44	1.0	<DL	2.557	<DL	<DL	0.120	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	1.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	1.0	<DL	<DL	0.600	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	1.0	<DL	0.959	<DL	<DL	<DL	<DL
2,2’,3,4,5’-Pentachlorobiphenyl	87	2.0	<DL	<DL	0.200	0.200	0.160	<DL
2,2’,4,5,5’-Pentachlorobiphenyl	101	2.0	<DL	0.360	<DL	<DL	<DL	0.120
2,2’,4,6,6’-Pentachlorobiphenyl	104	2.0	<DL	0.160	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	2.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	2.0	<DL	0.439	1.280	1.239	1.279	6.891
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	2.0	0.719	0.320	4.401	<DL	<DL	2.243
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	2.0	1.199	<DL	<DL	<DL	<DL	0.401
2,2’,3,4’,5,5’,6-Heptachlorobipheny	187	2.0	7.193	55.248	0.520	<DL	2.079	1.162
2,2’,3,4’,5,6,6’-Heptachlorobipheny	188	2.0	<DL	4.314	1.080	<DL	0.160	1.402
2,2’,3,3’,4,4’,5,6-Octachlorobipheny	195	3.0	<DL	0.200	2.160	<DL	<DL	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobipher	200	3.0	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachlorobi	209	5.0	<DL	<DL	<DL	<DL	<DL	<DL
Total PCBs			31.5	188.0	16.5	125.0	35.9	61.2
Sample weight (g, dry weight)			25.026	25.0328	24.9955	25.0272	25.0177	24.9617
Surrogate Recovery		% rec (65-1	92.5	122	72.1	76.6	95.5	70.4

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.
They are provided for information only.

DEP ID#		DL	PC-07-10	PC-07-17	PC-07-25	PC-08-05	PC-08-22	PC-09-01	PC-09-07
EXT ID#		ug/kg dw	1435	1432	1433	1430	1425	1428	1434
Analytes	IUPAC#								
2,4’-Dichlorobiphenyl	8	1.0	1.478	0.440	1.082	0.719	0.518	1.361	0.399
2,2’,5-Trichlorobiphenyl	18	1.0	<DL	<DL	<DL	<DL	<DL	<DL	<DL
2,4,4’-Trichlorobiphenyl	28	1.0	<DL	<DL	<DL	<DL	<DL	<DL	<DL
2,4,5-Trichlorobiphenyl	29	1.0	<DL	0.400	<DL	0.958	2.073	2.922	0.599
2,2’,3,5’-Tetrachlorobiphenyl	44	1.0	0.320	<DL	<DL	<DL	<DL	0.280	<DL
2,2’,4,6-Tetrachlorobiphenyl	50	1.0	<DL	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,5,5’-Tetrachlorobiphenyl	52	1.0	<DL	<DL	<DL	<DL	<DL	<DL	<DL
2,3’,4,4’-Tetrachlorobiphenyl	66	1.0	<DL	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,5’-Pentachlorobiphenyl	87	2.0	<DL	<DL	<DL	0.200	0.159	<DL	<DL
2,2’,4,5,5’-Pentachlorobiphenyl	101	2.0	<DL	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,4,6,6’-Pentachlorobiphenyl	104	2.0	0.120	<DL	<DL	0.200	<DL	<DL	<DL
2,2’,3,3’,4,4’-Hexachlorobiphenyl	128	2.0	<DL	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,4,4’,5’-Hexachlorobiphenyl	138	2.0	<DL	<DL	1.883	1.158	<DL	4.763	0.878
2,2’,4,4’,5,5’-Hexachlorobiphenyl	153	2.0	0.839	<DL	<DL	<DL	0.120	<DL	0.359
2,2’,4,4’,5,6’-Hexachlorobiphenyl	154	2.0	<DL	<DL	<DL	0.280	0.439	0.320	0.439
2,2’,3,4’,5,5’,6-Heptachlorobipher	187	2.0	6.633	<DL	1.803	0.359	0.120	4.282	0.758
2,2’,3,4’,5,6,6’-Heptachlorobipher	188	2.0	1.638	0.240	0.481	0.240	1.675	0.360	0.399
2,2’,3,3’,4,4’,5,6-Octachlorobiphe	195	3.0	0.240	0.120	0.200	0.240	<DL	0.160	<DL
2,2’,3,3’,4,5’,6,6’-Octachlorobiph	200	3.0	<DL	<DL	<DL	<DL	<DL	<DL	<DL
2,2’,3,3’,4,4’,5,5’,6,6’-Decachloro	209	5.0	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Total PCBs			50.3	6.6	24.8	20.1	26.9	64.2	16.7
Sample weight (g, dry weight)			25.0274	24.9961	24.9641	25.0409	25.0821	24.9865	25.05
Surrogate Recovery		% rec (65-1	108	83.8	79.0	74.3	103	66.2	66.0

The tissue blank is an oil matrix.
Values below the detection limit are estimated values and should be considered qualitative.

4.6

EEL STUDY

EEL STUDY

There are two principle fisheries for adult eels in Maine, a river fishery and a lake fishery. Most of the ee
sold outside Maine in US and international markets, although some are consumed in Maine. People fishi
need permits from either DMR or DIFW. DMR also funds several eel research projects at the University
Maine. Limited data from previous years show that eels from rivers are often among the species most hig
contaminated with a number of contaminants. Contaminant levels in eels from lakes are unknown. In 19
were captured from 3 lakes. In 1998 and 1999 we tried to get eels from 3 rivers as well, but were success
partially in one river. Therefore, in 2000, we attempted to work with commercial eel fishermen to collec
from each of three river, but were successful in collecting eels only from the Penobscot River below Bang
fish were analyzed as four composites of five fish each for PCBs. Results show a high concentrations (m
253 ppb) of PCB well above the Maine Bureau of Health Fish Tissue Action Level (Table 3.1.1.1 Rivers
This concentration is much higher than that from other species from the Penobscot River from previous S
studies in 1994 and 1996.

4.7

XENOESTROGENS (from 1999)

Progress Report
Project # 2000625

Department of Environmental Protection

Investigation of the Estrogenic Potential of Agrochemicals and their Effect on the Atlantic Salmon (*Salmo salar*)

20 March 2002

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Introduction

Numerous toxicants of natural and anthropogenic origin have been released into the environment in quantities sufficient to disrupt developing endocrine and nervous systems in wildlife and humans (Colborn and Clement, 1992). Many such toxicants have been identified as acute problems in Maine, including organophosphates and other pesticides, herbicides, organo-arsenic, organo-mercury, dioxins and polychlorinated biphenyls (PCBs). These chemicals are especially harmful during embryonic, fetal and early post-natal periods because they may mimic or interfere with hormones, neurotransmitters, growth factors and other signaling molecules that normally control developmental processes. For mammals, gestational exposure to toxicants reflects the lifetime of maternal exposure before pregnancy. Exposure occurs all during prenatal and early post-natal development because the chemicals are accumulated in maternal fat stores. In egg-laying species, the most critical exposure period is just prior to ovulation. Exposure during development may result in organizational and irreversible changes. Consequences of endocrine disruption can be profound because of the pivotal role that hormones play in controlling development and reproduction (Colborn and Clement, 1992; Birnbaum, 1994). The endocrine system is enormously complex; a single chemical can induce alterations through multiple mechanisms.

The Narraguagus River is one of seven Maine rivers populated by native Atlantic salmon (*Salmo salar*). Surveys conducted by the Atlantic Salmon Commission have found that 40-50% of the stocked Atlantic salmon never leave the river to go to sea. This suggests that these fish may not have successfully completed the smoltification process, the physiological transition from a freshwater to a saltwater dwelling fish. Of the fish that do smolt and leave for the ocean, less than 1% of the originally stocked fish ever return to spawn (Beland, *personal comm.*). This represents an extremely high mortality of both pre-smolt and mature Atlantic salmon, and the current numbers of returning salmon cannot sustain a viable population. The reason for this mortality is unknown. One hypothesis is exposure to agrochemicals introduced into the watershed from runoff.

Nineteen agricultural chemicals are currently registered for use in maintaining blueberry fields of Maine (**Table IA and B**). The Narraguagus River in Eastern Maine runs through many of these blueberry fields, and is therefore potentially exposed to these chemicals through the watershed. Certain environmental contaminants can mimic the action of hormones and function as endocrine disrupters. These have been shown to disrupt normal processes of growth, differentiation and reproduction in many organisms. Very little is known about the effects of these agrochemicals on Atlantic salmon populations. Madsen *et al.* (1977) reported delay the onset of smolting in Atlantic salmon exposed to 17 ß-estradiol or 4-nonylphenol. The target appears to be the gill Na^{+}/K^{+}ATPase. At present, the mechanism of action is unknown, although evidence has indicated that the effect may be indirect via the central neuroendocrine system. Both cortisol and growth hormone production in salmonids are inhibited by estradiol (Young, 1996).

It is important to determine the estrogenicity of the pesticides, herbicides and fungicides that are used in the area of the Narraguagus River, since this may provide information on the cause of the Atlantic salmon population decline. These data may provide insight into possible mechanisms of action used by xenoestrogens and their biological effects on this important sport fish.

Four of the chemicals used on Maine blueberry fields (hexazinone, diazinon, malathion and methoxychlor) have previously been tested for estrogenicity using the E-SCREEN test (Soto *et al.*, 1995). Only methoxychlor tested positive. These four chemicals are the active ingredients of several pesticides and herbicides. There are no data available on the estrogenicity of the formulation actually applied to the fields. In addition, no data exist on the biological effects of the other eight active components of herbicides/pesticides used in Maine (guthion, benomyl, phosmet, glyphosate, propiconazole, sethoxidim, clethodim and fluazifop-p-butyl). The degree of estragenicity of these twelve chemicals relative to 17 â-estradiol will be determined using E-SCREEN (Soto *et al*., 1995). The E-SCREEN test is based on two premises: (1) that a protein inherent in serum specifically inhibits proliferation of human estrogen-sensitive cells (MCF-7 cells, a human breast-cancer derived cell line; Soto *et al.*, 1995); (2) that estrogens (or compounds that mimic estrogen) induce cell proliferation by overriding the inhibitory effect.

Objectives

The long-term goal of our investigations is to determine whether exposure to agrochemicals affects the ability of the Atlantic salmon to successfully complete smoltification, enabling them to make the transition from freshwater to sea water. The specific aims addressed in this proposal were:

(1). To identify what chemicals are present in the water and sediments from selected Maine rivers.

(2). To determine if these chemicals have estrogenic activity using the E-SCREEN assay which measures proliferation of estrogen-responsive MCF-7 cells.

Materials and Methods

(1) <u>Identification of Agrochemicals</u> It has been established that Velpar (active ingredient, hexazinone) is present in the Narraguagus River all year (Haines, 2000). It was expected that other agrochemicals would also be detected in the river using GC/MS or high resolution GC/MS. Sediments were collected in borosilicate bottles with teflon caps from the Narraguagus River at three locations (Cherryfield, Deblois and Beddington) and stored at 4°C until extracted. Approximately 5 g of sediment was mixed, shaking, with an acetonitrile/water mixture (70:30, v/v) for 19 hrs. Agrochemical standards were prepared using serial dilutions in methanol. High (2.0ppb) and low (0.5 ppb) spikes were made. Standards were diluted to ~2.5 ppm in acetone/acetonitrile for use as standards on the GC/MS. Standards were run at the Sawyer Environmental Laboratory (University of Maine, Orono, ME). These included: azenphos-methyl, malathion, diazinon, methoxychlor, fluazifop-*p*-butyl, phosmet, hexazinone (active ingredient in Velpar), propiconazole and sethoxydim.

(2) <u>E-Screen Assay</u> A human breast cancer cell line (MCF-7) and the protocols for maintaining the cells and running the E-SCREEN were kindly provided by Drs. Ana Soto and Carlos Sonnenschein (Tufts University, Boston, MA). The cells were maintained in Dulbeccos Modified

Eagle Medium (GIBCO, Grand Island, NY) supplemented with 5% fetal bovine serum (GIBCO) in an atmosphere of 6.7% CO_2 under saturating humidity, at 37°C. Purified active ingredients were obtained from EPA repositories by Brian Perkins (University of Maine). All formulations applied in the field were provided by Dr. David Yarborough (Extension Blueberry Specialist, University of Maine). The 17 ß-estradiol was purchased from Sigma Chemical Co. (St. Louis, MO).

MCF-7 cells were plated at a concentration of 30,000-40,000 cells/well. The test compound was added directly to the medium, at different concentrations and incubated at 37° C for 5 days. Scoring of the estrogenic effects of each xenobiotic was done by first measuring the proliferative effect (PE), which is the ratio between the highest cell yield counted with the test chemical to the negative control (Soto *et al*., 1995). PE was then used to calculate the *relative proliferative effect* (RPE; *i.e.,* 100 times the ratio of the highest cell yield exposed to test chemical compared to estradiol, arbitrarily set at 100% (Soto *et al*., 1995). An RPE of 100% or greater indicates a full xenoestrogen, while a RPE score less than 100% indicates a partial xenoestrogen. A score close to zero indicates no estrogenic activity. These experiments will be repeated to enable us to perform statistical analysis. Details are given below.

Maintaining cell cultures - Cells were grown in 25cm^2 flasks with 5ml DMEM Dulbecco's Modified Eagle Medium) in 5% FBS with a media change every 3-4 days. Cells were at 90% confluency (~every 6-7 days) into 2 new flasks, using 100-200 ìl of cells and 5 ml media into each new flask. Cells were passed three times prior to the assay.

Dosing - Testing media was added 24 hours (+/- 3 hours) after subculturing cells. Growth media was removed, cells were rinsed and 1ml of CD FBS 5% experimental media was added to each well (DMEM without phenol red, with charcoal/dextran stripped FBS). Test chemicals were added, in three replicates, at 10nM, 1nM, 0.1nM, 10pM, 1pM. Cells were harvested on Day 5 after treatment.

Harvesting - Experimental media was aspirated, cells detached from plate by trypsinization and counted using a hemacytometer. A standard curve using estradiol was run in parallel with test samples

Results

Identification of Agrochemicals No pesticides were detected in sediment samples. Sediments were re-sampled and are awaiting analysis.

E-screen for estrogenic activity Compounds (analytical/pure) that have been tested and their RPEs are reported in **Table II**. Growth curves are shown in **Figs 1-4.** Those with estrogenic activity include methoxychlor, propiconizol, and dichlorophenoxyacetic acid (2,4-D). Since the active analytical compounds are applied in the field as mixtures with "inert" ingredients (such as surfactants), the analysis was repeated, using the formulations that were actually applied in the field. A comparison of the relative proliferative effects (RPEs) of the formulations to analytical compounds (at the percentage of active ingredient in formulation, % used in applying to field and full strength) is summarized in **Table III**. Orbit (active ingredient, 41.8% propiconizol) had an RPE of 86-93%. The RPE of Velpar (24-26%) was lower than its active ingredient, hexazinone (42-47%), suggesting that something in the formulation was inhibitory.

Discussion

2,4-D is a member of the chlorophenoxy compounds that act as broad-spectrum herbicides. During World War II, considerable effort was put toward their development, both to increase food production and as possible use in chemical warfare (Claassen, 2001). These compounds have been in continuous use since 1947. Their use has declined significantly in recent years primarily due to concerns over the presence of toxic contaminating compounds (*e.g.*, 2,3,7,8 tetrachlorodibenzo-*p*-dioxin, TCDD). 2,4-D mimics the action of auxins, growth-stimulating plant hormones. No hormonal activity has been reported in animals, although the mechanism of toxicity is still poorly understood. There is an extensive, and often contradictory, database on the toxicity of chlorophenoxy chemicals to mammals (Claassen, 2001). The carcinogenicity of 2,4-D containing formulations has been controversial, confounded by the presence of TCDD in many commercial preparations. The carcinogenicity of analytical grade 2,4-D has not been yet been tested in rodents.

Studies in our laboratory have shown that laboratory exposures of softshell clams (*Mya arenaria*) to 2,4-D result in a dose-dependent effect on gonadal maturation. Exposed animals do not develop mature gametes as compared to controls. These studies are currently being repeated. Data reported here suggest that 2,4-D has relatively high estrogenic activity *in vitro* in the MCF-7 breast cancer cell line. Taken together, our studies suggest that 2,4-D has possible hormonal effects in animals, and warrant further investigation.

Methoxychlor has been shown previously to possess estrogenic activity in the E-SCREEN assay with a RPE reproduced in our laboratory (Soto *et a.l*, 1995). Methoxychlor, a DDT analog, is a member of the family of dichlorordiphenylethane pesticides. Symptoms of acute toxicity in humans and animals include fatigue and lethargy. Chronic exposures result in alterations in EEG patterns and varied reproductive effects. Studies of methoxychlor toxicity in the mouse have revealed problems in initiating and maintaining pregnancy, alterations in the development of preimplantation embryos and estrogenic effects on the oviduct and uterus. (reviewed in Claassen, 2001).

Propiconizol is a fungicide often used in control of fungal diseases of turfgrass.

Work remaining

Future work includes repeating assays of those compounds that were positive (methoxychlor, 2,4 D, and propiconizole). Assays will also be done on analytical compounds that have just been received (benomyl, glyphosate, and carbendazim). In addition, the following formulations and their active chemicals will be tested: Benlate (benomyl), Diazinon, Imidan (phosmet), Round Up (glyphosate), and Select 2 (Clethodim). We are also attempting to obtain Marlate (methoxychlor), Sinbar (terbacil), Cythion (malathion), Sethoxydim, and Fluazifop-*p*-butyl. In addition to being able to screen individual chemicals, the E-SCREEN assay can also be used to test mixtures of chemicals. Soto *et al.* (1994) have shown that estrogenic chemicals may act in a cumulative fashion. Compounds found to possess estrogenic activity *in vitro* will be further investigated *in vivo*, using fish models.

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Table IA: Analytical Compounds tested by E-SCREEN

Analytical Compound	manufacturer	Use*	E-SCREEN # of assays
clethodim	Valent	H	1
diazinon	Syngenta	I	1
fluazifop-p-butyl	Aeneca	H	-
hexazinone	DuPont	H	2
malathion	Cheminova	I	2
methoxychlor	Kincaid enterprises	I	4
phosmet	Zeneca	I	1
propiconizol	Syngenta	D	1
sethoxydim	BASF	H	1
terbacil	DuPont	H	-
(*not yet obtained*)			
benomyl		D	
glyphosate		H	
carbendazim		H	
2,4-D		H	

* H, herbicide; I, insecticide; D, disease control.

Table IB: Formulations used in Blueberry Culture

Formulation Compound	Active Ingredient	% Active Ingredient	Manufacturer	%/dilution in field	# [1]Assays
Benlate	benomyl	50%	DuPont		
Diazinon	diazinon				
Imidan 25EC	phosmet				
Imidan 70W	phosmet	70%	Gowan		
Round Up	glyphosate	41%	Monsanto		
Select 2	clethodim	25-27%	Valent		
Velpar	hexazinone	25%		5%	1
Orbit	propiconizol	41.8%	Syngenta	1:900	1
Super BK32	2,4-D[2]	16%	Agway		
	2 (2,4)-D p[3]	16%			
(*not yet obtained*)					
Marlate	methoxychlor				
Sinbar	terbacil				
Cythion	malathion				
Poast	sethoxydim, fluazifop-*p*-butyl				

—

[1] limited information available; [2] 2,4- dichlorophenoxyacetic acid; [3]2 (2,4) dichlorophenoxy propionic acid

Table II: RPE values for Purified Test Compounds

Compound	Usage	RPE
Methoxychlor	Insecticide	57% 26% 38% 64%
Malathion	Insecticide	25% 22%
Hexazinone	Weed control	14%
Diazinon	Insecticide	12%
Clethodim	Weed control	20%
Phosmet	Insecticide	17%
Sethoxydim	Weed control	31%
Propiconizol	disease control	80% * 73% *
2,4-Dichlorophenoxy -acetic acid	weed control	91% * 66%*
2,4-Dichlorophenoxy -propionic acid	weed control	91% * 45% 14%

Table III Comparison of E-SCREEN results of formulations and analytical compounds

Formulation	Active ingredient	RPE
Velpar	(hexazinone, 25%)	26%
		24%
	hexazinone 25%[1]	47%
	hexazinone 5%[2]	42%
Orbit	(propiconizole, 41.8%)	93%
		86%
	propiconizole 41.8%[1]	92%
		65%
Super BK32	(16% 2,4D-acetic &	52%
	16% 2,4D propionic acid)	27%
	2,4D Acetic 16%[1]	42%
		30%
	2,4D Propionic 16%[1]	43%
		8%

[1] the percentage of active ingredient in formulation
[2] the percentage used in field applications

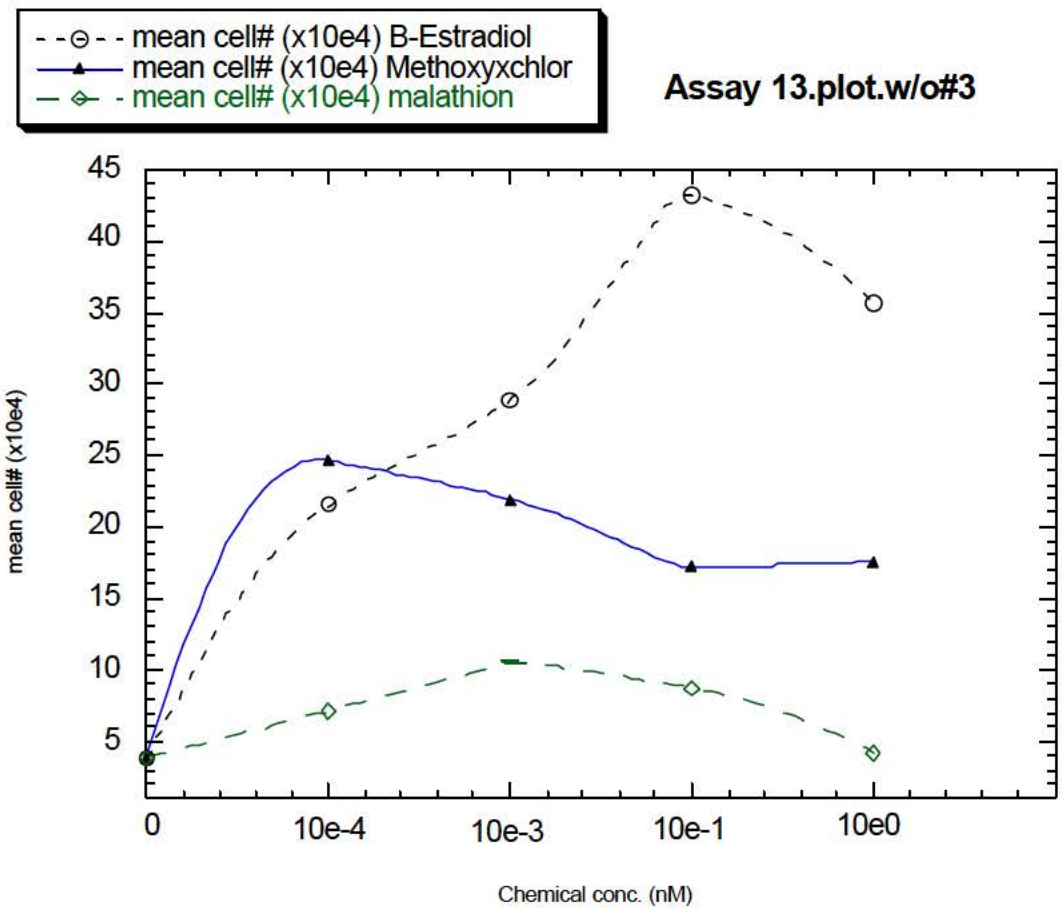

Fig 1. Cell growth in 17 ß-estradiol, compared to cells treated to methoxyclor and malathion.

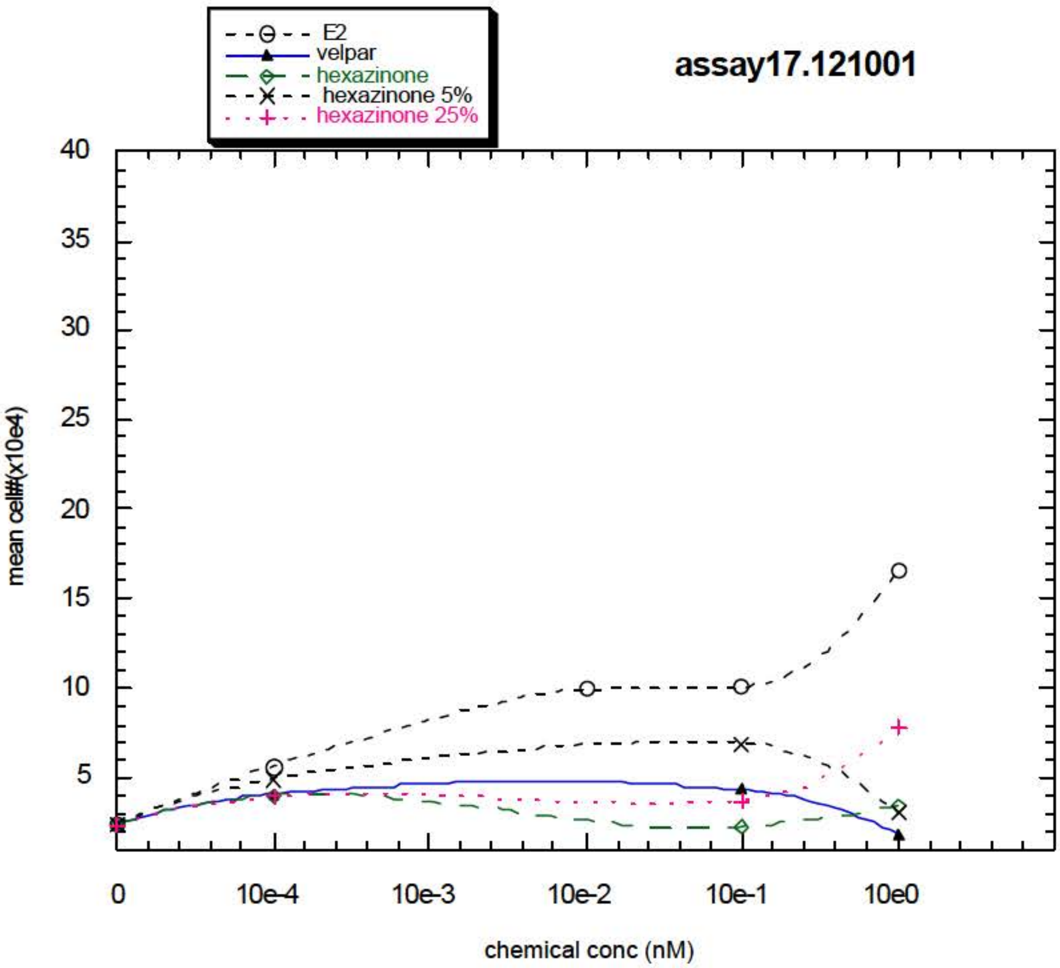

Fig 2. Comparison of cells grown in estradiol (E2) to those exposed to Velpar and its active ingredient hexazinone.

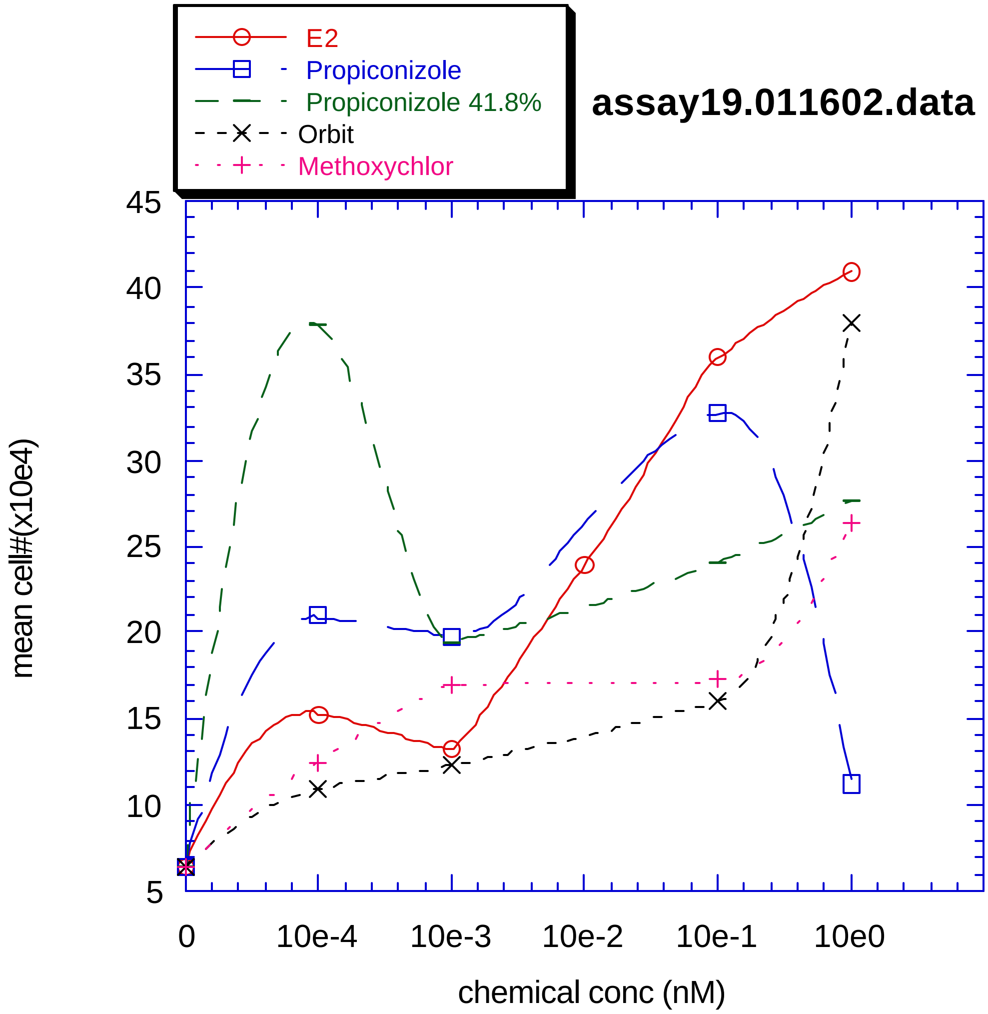

Fig 3. Cell growth in estradiol compared to cells exposed to Orbit, its active ingredient, propriconozol , and methoxychlor.

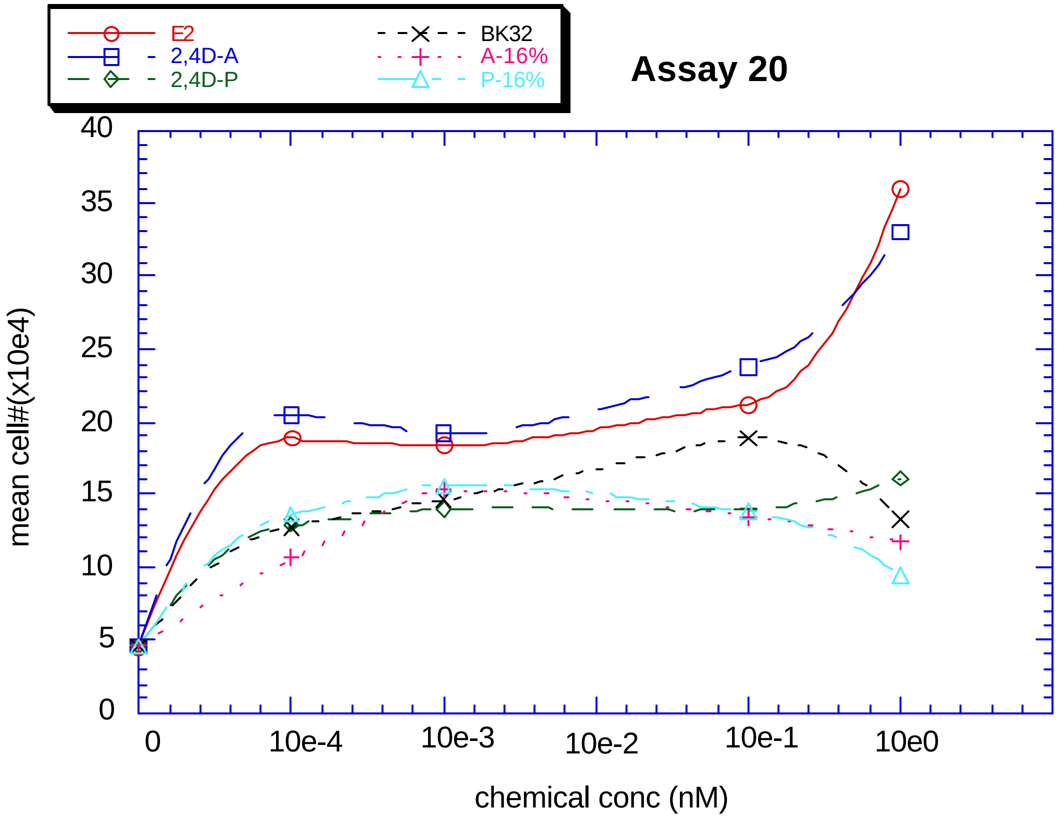

Fig 4. Comparison of MCF-7 cells grown in the presence of estradiol (E2)to those exposed to 2,4 D acetic acid (2,4D-A) and propionic acid (2,4D-P) forms and the formulation Super BK32.

field ID	Date	Length mm	Weight gm.
DMP			
ANDROSCOGGIN RIVER			
Gilead			
AGL-RBT-1	05/17/2000	261	220
AGL-RBT-2	05/17/2000	322	320
AGL-RBT-3	05/18/2000	301	315
AGL-RBT-4	05/18/2000	286	245
AGL-RBT-5	05/18/2000	285	250
AGL-BNT-1	05/14/2000	398	660
AGL-BNT-2	05/17/2000	325	310
AGL-BNT-3	05/17/2000	347	405
AGL-BNT-4	05/17/2000	387	520
AGL-BNT-5	05/18/2000	456	920
Rumford-above			
ARP-SMB-1	07/12/2000	376	730
ARP-SMB-2	07/14/2000	358	660
ARP-SMB-3	07/20/2000	365	790
ARP-SMB-4	07/20/2000	391	1000
ARP-SMB-5	07/20/2000	363	680
ARP-SMB-6	07/20/2000	366	680
ARP-SMB-7	07/20/2000	300	450
ARP-SMB-8	07/20/2000	348	540
ARP-SMB-9	07/20/2000	377	900
ARP-SMB-10	07/20/2000	279	320
ARP-WHS-1	07/12/2000	430	880
ARP-WHS-2	07/12/2000	428	960
ARP-WHS-3	07/13/2000	431	920
ARP-WHS-4	07/13/2000	397	690
ARP-WHS-5	07/13/2000	448	930
ARP-WHS-6	07/13/2000	442	930
ARP-WHS-7	07/13/2000	445	950
ARP-WHS-8	07/13/2000	422	810
ARP-WHS-9	07/14/2000	426	765
ARP-WHS-10	07/14/2000	438	840
Rumford			
ARF-SMB-1	07/24/2000	335	490
ARF-SMB-2	07/24/2000	332	545
ARF-SMB-3	07/24/2000	340	580
ARF-SMB-4	07/24/2000	362	660
ARF-SMB-5	07/24/2000	330	520
ARF-SMB-6	07/24/2000	345	540
ARF-SMB-7	07/24/2000	365	720
ARF-SMB-8	07/24/2000	356	650
ARF-SMB-9	07/24/2000	355	590
ARF-SMB-10	07/24/2000	357	640
field ID	Date	Length mm	Weight gm.
ARF-WHS-1	07/25/2000	435	990
ARF-WHS-2	07/25/2000	419	920
ARF-WHS-3	07/25/2000	445	1160
ARF-WHS-4	07/25/2000	446	1140
ARF-WHS-5	07/25/2000	416	990
ARF-WHS-6	07/25/2000	430	1040
ARF-WHS-7	07/25/2000	442	1110

ARF-WHS-8	07/25/2000	421	1020
ARF-WHS-9	07/25/2000	425	1020
ARF-WHS-10	07/25/2000	425	860
Riley			
ARY-SMB-1	07/25/2000	330	490
ARY-SMB-2	07/25/2000	330	540
ARY-SMB-3	07/25/2000	325	460
ARY-SMB-4	07/25/2000	305	395
ARY-SMB-5	07/25/2000	310	380
Livermore Falls Otis			
ALV-SMB-1	07/26/2000	335	480
ALV-SMB-2	07/26/2000	352	585
ALV-SMB-3	07/26/2000	355	585
ALV-SMB-4	07/26/2000	334	530
ALV-SMB-5	07/26/2000	339	560
ALV-SMB-6	07/26/2000	355	640
ALV-SMB-7	07/26/2000	340	560
ALV-SMB-8	07/26/2000	342	500
ALV-SMB-9	07/26/2000	335	500
ALV-SMB-10	07/26/2000	355	620
ALV-WHS-1	07/26/2000	410	800
ALV-WHS-2	07/26/2000	384	775
ALV-WHS-3	07/26/2000	389	780
ALV-WHS-4	07/26/2000	399	800
ALV-WHS-5	07/26/2000	410	1040
ALV-WHS-6	07/26/2000	395	800
ALV-WHS-7	07/26/2000	397	715
ALV-WHS-8	07/26/2000	390	720
ALV-WHS-9	07/26/2000	395	880
ALV-WHS-10	07/26/2000	410	885
Livermore Falls below dam			
ALF-SMB-1	07/27/2000	350	700
ALF-SMB-2	07/27/2000	336	560
ALF-SMB-3	07/27/2000	355	715
ALF-SMB-4	07/27/2000	330	540
ALF-SMB-5	07/28/2000	347	690
ALF-SMB-6	07/28/2000	340	620
ALF-SMB-7	07/28/2000	350	640
ALF-SMB-8	07/28/2000	340	620
ALF-SMB-9	07/28/2000	342	640
ALF-SMB-10	07/28/2000	350	640
field ID	Date	Length mm	Weight gm.
ALF-WHS-1	07/27/2000	380	650
ALF-WHS-2	07/27/2000	406	790
ALF-WHS-3	07/27/2000	390	620
ALF-WHS-4	07/27/2000	407	720
ALF-WHS-5	07/27/2000	402	760
ALF-WHS-6	07/27/2000	387	750
ALF-WHS-7	07/27/2000	380	670
ALF-WHS-8	07/27/2000	390	640
ALF-WHS-9	07/27/2000	397	800
ALF-WHS-10	07/27/2000	403	920
Androscoggin Lake			
SEDIMENTS	25-Sep	depth "	
DR MOUTH T		0-1	
DR MOUTH B		3-4	
MIDDLE T		0-1	

MIDDLE B		2-3	
DAM T		0-1	
DAM B		1.5-2.5	
ALW-SMB-1	07/17/2000	406	830
ALW-SMB-2	07/17/2000	290	315
ALW-SMB-3	07/17/2000	358	560
ALW-SMB-4	07/17/2000	350	515
ALW-SMB-5	07/18/2000	327	440
ALW-SMB-6	07/18/2000	329	470
ALW-SMB-7	07/18/2000	425	840
ALW-SMB-8	07/18/2000	345	625
ALW-SMB-9	07/21/2000	320	420
ALW-SMB-10	07/21/2000	322	405
ALW-WHP-1	07/17/2000	305	380
ALW-WHP-2	07/17/2000	293	315
ALW-WHP-3	07/17/2000	295	335
ALW-WHP-4	07/17/2000	252	210
ALW-WHP-5	07/17/2000	295	340
ALW-WHP-6	07/17/2000	280	305
ALW-WHP-7	07/17/2000	296	360
ALW-WHP-8	07/17/2000	278	280
ALW-WHP-9	07/17/2000	274	265
ALW-WHP-10	07/17/2000	280	265
ALW-WHS-1	07/17/2000	446	1040
ALW-WHS-2	07/17/2000	445	1000
ALW-WHS-3	07/17/2000	445	1000
ALW-WHS-4	07/17/2000	446	1060
ALW-WHS-5	07/17/2000	436	900
ALW-WHS-6	07/17/2000	447	1080
ALW-WHS-7	07/17/2000	442	1060
ALW-WHS-8	07/17/2000	442	1065
ALW-WHS-9	07/17/2000	420	800
ALW-WHS-10	07/17/2000	421	860
field ID	Date	Length mm	Weight gm.
Turner			
AGI-SMB-1	07/20/2000	311	410
AGI-SMB-2	07/20/2000	319	440
AGI-SMB-3	07/20/2000	315	380
AGI-SMB-4	07/20/2000	313	400
AGI-SMB-5	07/20/2000	314	400
Lisbon Falls			
ALS-SMB-1	07/28/2000	290	360
ALS-SMB-2	07/28/2000	312	460
ALS-SMB-3	07/28/2000	337	500
ALS-SMB-4	07/28/2000	323	475
ALS-SMB-5	08/05/2000	330	
Fish Brook			
FBF-BKT-01	07/24/2000	131	22
FBF-BKT-02	07/24/2000	180	60
FBF-BKT-03	07/24/2000	180	60
FBF-BKT-04	07/24/2000	149	40
FBF-BKT-05	07/24/2000	143	25
FBF-WHS-01	07/24/2000	284	200
FBF-WHS-02	07/24/2000	293	240
FBF-WHS-03	07/24/2000	294	200
FBF-WHS-04	07/24/2000	280	200
FBF-WHS-05	07/24/2000	259	170
KENNEBEC RIVER			

Norridgewock			
KNW-BNT-01	06/01/2000	478	905
KNW-BNT-02	06/02/2000	412	700
KNW-BNT-03	06/02/2000	405	545
KNW-BNT-04	06/06/2000	251	170
KNW-BNT-05	06/06/2000	373	460
KNW-BNT-10	08/22/2000	429	830
KNW-BNT-11	06/20/2000	441	840
KNW-BNT-12	06/20/2000	346	390
KNW-SMB-1		300	330
KNW-SMB-2		310	350
KNW-SMB-3		312	470
KNW-SMB-4		311	420
KNW-SMB-5		300	370
KNW-SMB-6		325	420
KNW-SMB-7		290	340
KNW-SMB-8		295	340
KNW-SMB-9		300	390
KNW-SMB-10		288	300
KNW-SMB-11		283	300
KNW-SMB-12		335	460
field ID	Date	Length mm	Weight gm.
KNW-SSMB-20	08/30/2000	190	90
KNW-SSMB-21	08/30/2000	197	95
KNW-SSMB-22	09/11/2000	200	100
KNW-SSMB-23	09/11/2000	178	70
KNW-SSMB-24	09/11/2000	170	65
KNW-SSMB-25	09/11/2000	172	50
KNW-SSMB-26	09/11/2000	162	50
KNW-SSMB-27	09/11/2000	170	60
KNW-SSMB-28	09/11/2000	165	50
KNW-SSMB-29	09/11/2000	152	45
KNW-SSMB-30	09/11/2000	147	40
KNW-SSMB-31	09/11/2000	155	50
KNW-WHS-1		425	920
KNW-WHS-2		430	1070
KNW-WHS-3		425	910
KNW-WHS-4		441	980
KNW-WHS-5		421	870
KNW-WHS-6		442	1000
KNW-WHS-7		420	900
KNW-WHS-8		436	1090
KNW-WHS-9		444	1050
KNW-WHS-10		440	1060
KNW-WHS-11		416	750
KNW-WHS-12		440	1010
KNW-WHS-13		440	960
KNW-WHS-14		425	1080
KNW-WHS-15		440	1000
KNW-WHS-16		430	920
KNW-WHS-17		450	940
KNW-WHS-18		440	910
KNW-WHS-19		415	780
KNW-WHS-20		432	1010
KNW-WHS-21		445	1000
KNW-WHS-22		430	1000
KNW-WHS-23		428	930
KNW-WHS-24		415	950
KNW-WHS-25		406	860

KNW-WHS-26		425	840
KNW-WHS-27		419	920
KNW-WHS-28		435	1020
KNW-WHS-29		432	1080
KNW-WHS-30		432	1000
KNW-WHS-31		438	1070
KNW-WHS-32		445	1100
KNW-WHS-33		445	1060
KNW-WHS-34		425	1020
KNW-WHS-35		432	1010
KNW-WHS-36		420	870
KNW-WHS-37		420	900
KNW-WHS-38		425	850
KNW-WHS-39		425	800
KNW-WHS-40		445	1090
KNW-WHS-41		405	830
KNW-WHS-42		432	940
KNW-WHS-43		432	1000
KNW-WHS-44		432	950
KNW-WHS-45		413	910
field ID	Date	Length mm	Weight gm.
KNW-WHS-46		406	810
KNW-WHS-47		419	1000
KNW-WHS-48		432	1080
KNW-WHS-49		413	940
KNW-WHS-50		432	970
Fairfield			
KFF-BNT-01	07/29/2000	496	1500
KFF-BNT-02	09/18/2000	415	940
KFF-BNT-03		430	910
KFF-BNT-04		430	920
KFF-BNT-05		384	730
KFF-SMB-1	09/06/2000	300	400
KFF-SMB-2	09/06/2000	310	430
KFF-SMB-3	09/06/2000	325	420
KFF-SMB-4	09/06/2000	335	520
KFF-SMB-5	09/06/2000	309	400
KFF-SMB-6	09/06/2000	345	530
KFF-SMB-7	09/06/2000	295	390
KFF-SMB-8	09/06/2000	325	480
KFF-SMB-9	09/06/2000	310	430
KFF-SMB-10	09/08/2000	310	380
KFF-SMB-11	09/08/2000	303	370
Small bass			
KFF-sSMB-1	09/06/2000	200	100
KFF-sSMB-2	09/06/2000	200	100
KFF-sSMB-3	09/06/2000	205	110
KFF-sSMB-4	09/06/2000	200	100
KFF-sSMB-5	09/06/2000	205	110
KFF-sSMB-6	09/06/2000	205	110
KFF-sSMB-7	09/06/2000	200	100
KFF-sSMB-8	09/06/2000	182	80
KFF-sSMB-9	09/06/2000	162	60
KFF-sSMB-10	09/06/2000	152	50
KFF-WHS-01	177	450	1180
KFF-WHS-03	179	440	1030
KFF-WHS-05	181	425	1000
KFF-WHS-06	182	440	1100
KFF-WHS-07	183	425	1000
KFF-WHS-08	184	415	900
KFF-WHS-11	187	430	980
KFF-WHS-13	189	415	1000
KFF-WHS-14	190	430	1100
KFF-WHS-15	191	444	1150
KFF-WHS-16	192	430	1100

KFF-WHS-17	193	412	980
KFF-WHS-18	194	420	980
KFF-WHS-21	197	445	1000
KFF-WHS-25	201	410	1010
KFF-WHS-26	202	434	1120
KFF-WHS-27	203	440	1010
KFF-WHS-28	204	440	1040
KFF-WHS-29	205	415	1010
KFF-WHS-30	206	410	950
field ID	Date	Length mm	Weight gm.
KFF-WHS-31	207	420	1040
KFF-WHS-32	208	420	1060
KFF-WHS-33	209	420	1000
KFF-WHS-34	210	410	900
KFF-WHS-35	211	430	1000
KFF-WHS-36	212	420	780
KFF-WHS-37	213	438	1130
KFF-WHS-38	214	440	1100
KFF-WHS-39	215	415	900
KFF-WHS-40	216	418	870
KFF-WHS-41	217	436	1090
KFF-WHS-42	218	444	1230
KFF-WHS-43	219	435	1200
KFF-WHS-44	220	438	1040
KFF-WHS-45	221	420	960
KFF-WHS-46	222	415	950
KFF-WHS-47	223	424	1020
KFF-WHS-48	224	415	920
KFF-WHS-49	225	425	910
KFF-WHS-50	226	430	1020
KFF-WHS-51	227	445	1200
KFF-WHS-52	228	440	1100
KFF-WHS-53	229	416	930
KFF-WHS-54	230	423	1000
KFF-WHS-55	231	432	1100
KFF-WHS-56	232	440	1170
KFF-WHS-57	233	438	1010
KFF-WHS-58	234	440	1140
KFF-WHS-59	235	420	930
KFF-WHS-60	236	420	960
NOTE: FEMALE KFF-WHS TO BE STUDIED SEPARATELY			
KFF-WHS-02 **(F)**	**178**	450	1180
KFF-WHS-04 **(F)**	**180**	435	1100
KFF-WHS-09 **(F)**	**185**	445	1090
KFF-WHS-10 **(F)**	**186**	445	1200
KFF-WHS-12 **(F)**	**188**	430	830
KFF-WHS-19 **(F)**	**195**	450	1200
KFF-WHS-20 **(F)**	**196**	435	1100
KFF-WHS-22 **(F)**	**198**	450	1180
KFF-WHS-23 **(F)**	**199**	430	1180
KFF-WHS-24 **(F)**	**200**	450	1080
Winslow			
KWL-BNT-01	06/07/2000	364	450
KWL-BNT-02	06/07/2000	382	490
KWL-BNT-03	06/08/2000	423	685
KWL-BNT-04	06/08/2000	418	745
KWL-BNT-05	06/08/2000	370	490
Sidney			
KSD-SMB-1	09/06/2000	355	540
KSD-SMB-2	09/06/2000	305	380
KSD-SMB-3	09/06/2000	320	450
KSD-SMB-4	09/06/2000	325	430
KSD-SMB-5	09/06/2000	355	600
field ID	Date	Length	Weight

		mm	gm.
PENOBSCOT RIVER			
Woodville			
PBW-ALS-1	09/19/2000	23"	2360
PBW-SMB-01	09/14/2000	443	825
PBW-SMB-02	09/14/2000	358	575
PBW-SMB-03	09/19/2000	367	625
PBW-SMB-04	09/19/2000	404	825
PBW-SMB-05	09/19/2000	394	775
PBW-SMB-06	09/19/2000	390	750
PBW-SMB-07		373	675
PBW-SMB-08		350	525
PBW-SMB-09	10/11/2000	367	600
PBW-SMB-10	10/11/2000	363	550
PBW-SMB-11	10/11/2000	353	550
PBW-SMB-12	10/11/2000	370	525
PBW-SMB-13	10/11/2000	358	550
PBW-SMB-14	10/11/2000	346	500
PBW-SMB-15	10/12/2000	356	600
PBW-SMB-16	10/13/2000	356	625
PBW-WHS-01	09/12/2000	475	1180
PBW-WHS-02	09/14/2000	415	900
PBW-WHS-03	09/14/2000	455	1100
PBW-WHS-04	09/14/2000	452	1100
PBW-WHS-05	09/14/2000	442	1000
PBW-WHS-06	09/14/2000	433	1000
PBW-WHS-07	09/15/2000	439	975
PBW-WHS-08	09/15/2000	440	950
PBW-WHS-09	09/19/2000	435	875
PBW-WHS-10	09/19/2000	460	1100
PBW-WHS-11	09/19/2000	450	1000
PBW-WHS-12	09/19/2000	460	1025
PBW-WHS-13	09/19/2000	445	1025
PBW-WHS-14	09/19/2000	465	1025
PBW-WHS-15	09/19/2000	448	1000
PBW-WHS-16	09/19/2000	445	925
PBW-WHS-17	09/19/2000	431	900
PBW-WHS-18	09/19/2000	414	900
PBW-WHS-19	09/19/2000	444	1000
PBW-WHS-20	09/19/2000	437	1000
PBW-WHS-21	09/19/2000	407	775
PBW-WHS-22	09/19/2000	477	1225
PBW-WHS-23	09/19/2000	463	1000
PBW-WHS-24	09/19/2000	454	1025
PBW-WHS-25	09/19/2000	432	925
PBW-WHS-26	09/19/2000	445	975
PBW-WHS-27	09/19/2000	454	1125
Mattawamkeag			
PBM-SMB1	10/17/2000	390	725
PBM-SMB2	10/18/2000	357	610
PBM-SMB3	10/18/2000	360	600
PBM-SMB4	10/19/2000	365	640
PBM-SMB5	10/19/2000	381	800
PBM-SMB6	10/19/2000	360	620
PBM-SMB7	10/20/2000	355	600
PBM-SMB8	10/20/2000	360	580
field ID	Date	Length mm	Weight gm.
PBM-WHS-01	10/17/2000	450	1100
PBM-WHS-02	10/17/2000	432	900
PBM-WHS-03	10/17/2000	450	1000
PBM-WHS-04	10/17/2000	460	1025
PBM-WHS-05	10/17/2000	455	1050
PBM-WHS-06	10/17/2000	430	1000
PBM-WHS-07	10/17/2000	450	1150
PBM-WHS-08	10/17/2000	435	975

PBM-WHS-09	10/18/2000	475	1080
PBM-WHS-10	10/18/2000	450	1120
PBM-WHS-11	10/19/2000	444	1000
Lincoln			
PBL-SMB-01	08/23/2000	373	725
PBL-SMB-10	09/07/2000	375	750
PBL-SMB-11	09/08/2000	386	750
PBL-SMB-12	09/08/2000	337	500
PBL-SMB-02	08/23/2000	360	650
PBL-SMB-03	08/23/2000	372	700
PBL-SMB-04	08/23/2000	343	550
PBL-SMB-05	08/23/2000	374	725
PBL-SMB-06	08/23/2000	362	650
PBL-SMB-07	08/24/2000	377	750
PBL-SMB-08	09/06/2000	375	525
PBL-SMB-09	09/07/2000	448	625
PBL-WHS-01	08/23/2000	459	1075
PBL-WHS-02	08/24/2000	441	1000
PBL-WHS-03	08/24/2000	440	1075
PBL-WHS-04	08/24/2000	450	1050
PBL-WHS-05	09/06/2000	421	950
PBL-WHS-06	09/06/2000	485	1250
PBL-WHS-07	09/06/2000	444	1025
PBL-WHS-08	09/06/2000	439	950
PBL-WHS-09	09/06/2000	447	1150
PBL-WHS-10	09/06/2000	422	950
PBL-WHS-11	09/06/2000	460	1000
PBL-WHS-12	09/06/2000	340	475
PBL-WHS-13	09/06/2000	430	950
PBL-WHS-14	09/06/2000	440	975
PBL-WHS-15	09/06/2000	419	1000
PBL-WHS-16	09/06/2000	452	1125
PBL-WHS-17	09/06/2000	372	625
PBL-WHS-18	09/06/2000	326	425
PBL-WHS-19	09/07/2000	430	900
PBL-WHS-20	09/07/2000	463	1125
PBL-WHS-21	09/07/2000	447	1050
PBL-WHS-22	09/07/2000	448	1125
PBL-WHS-23	09/07/2000	445	1050
PBL-WHS-24	09/07/2000	442	1100
Costigan			
PBC-SMB-1	08/23/2000	440	1100
PBC-SMB-2	08/23/2000	415	825
PBC-SMB-3	09/06/2000	442	1225
PBC-SMB-4	09/06/2000	402	825
PBC-SMB-5	09/13/2000	385	850
field ID	Date	Length mm	Weight gm.
PBC-WHS-01	08/23/2000	448	2000
PBC-WHS-02	08/23/2000	445	1100
PBC-WHS-03	08/24/2000	441	1000
PBC-WHS-04	08/24/2000	438	975
PBC-WHS-05	08/24/2000	438	1000
PBC-WHS-06	09/06/2000	479	1250
PBC-WHS-07	09/06/2000	462	1150
PBC-WHS-08	09/06/2000	442	900
PBC-WHS-09	09/06/2000	469	1175
PBC-WHS-10	09/06/2000	515	1500
PBC-WHS-11	09/06/2000	475	1275
PBC-WHS-12	09/06/2000	442	1050
PBC-WHS-13	09/06/2000	490	1275
PBC-WHS-14	09/06/2000	453	1275
PBC-WHS-15	09/06/2000	440	1075
PBC-WHS-16	09/06/2000	492	1425
PBC-WHS-17	09/06/2000	431	950
PBC-WHS-18	09/06/2000	505	1200

PBC-WHS-19	09/07/2000	455	1000
PBC-WHS-20	09/07/2000	442	1100
PBC-WHS-21	09/07/2000	444	1000
PBC-WHS-22	09/07/2000	433	925
Veazie			
PBV-SMB-1	09/28/2000	396	850
PBV-SMB-2	09/29/2000	410	1000
PBV-SMB-3	09/29/2000	386	760
PBV-SMB-4***	10/10/2000	380	700
PBV-SMB-5	10/11/2000	406	820
PBV-SMB-6	10/11/2000	402	800
PBV-SMB-7	10/11/2000	360	630
PBV-SMB-8	10/11/2000	356	600
PBV-WHS-01	09/29/2000	415	965
PBV-WHS-02	10/10/2000	475	1475
PBV-WHS-03	10/10/2000	475	1325
PBV-WHS-04	10/10/2000	515	1650
PBV-WHS-05	10/11/2000	453	1150
PBV-WHS-06	10/11/2000	419	950
PBV-WHS-07	10/11/2000	443	1120
PBV-WHS-08	10/11/2000	460	1130
PBV-WHS-09	10/11/2000	460	1125
PBV-WHS-10	10/11/2000	480	1400
PBV-WHS-11	10/11/2000	407	800
PBV-WHS-12	10/11/2000	429	1000
PBV-WHS-13	10/11/2000	505	1525
PBV-WHS-14	10/11/2000	410	920
PBV-WHS-15	10/11/2000	420	925
PBV-WHS-16	10/11/2000	415	920
PBV-WHS-17	10/11/2000	400	900
PBV-WHS-18	10/11/2000	420	925
PBV-WHS-19	10/11/2000	427	975
PBV-ATS-1		592	1761
field ID	Date	Length mm	Weight gm.
Winterport			
PBB-EEL-01	07/19/2000	670	475
PBB-EEL-02	07/19/2000	660	500
PBB-EEL-03	07/19/2000	610	350
PBB-EEL-04	07/19/2000	670	460
PBB-EEL-05	07/19/2000	630	405
PBB-EEL-06	07/19/2000	615	420
PBB-EEL-07	07/19/2000	670	575
PBB-EEL-08	07/19/2000	630	460
PBB-EEL-09	07/19/2000	595	380
PBB-EEL-10	07/19/2000	650	420
PBB-EEL-11	07/19/2000	655	445
PBB-EEL-12	07/19/2000	615	415
PBB-EEL-13	07/19/2000	710	540
PBB-EEL-14	07/19/2000	640	405
PBB-EEL-15	07/19/2000	750	815
PBB-EEL-16	07/19/2000	625	480
PBB-EEL-17	07/19/2000	700	575
PBB-EEL-18	07/19/2000	550	295
PBB-EEL-19	07/19/2000	670	420
PBB-EEL-20	07/19/2000	670	490
PBB-EEL-21	07/19/2000	595	420
PBB-EEL-22	07/19/2000	690	630
PBB-EEL-23	07/19/2000	590	290
PBB-EEL-24	07/19/2000	640	450
PBB-EEL-25	07/19/2000	470	175
PBB-EEL-26	07/19/2000	680	510
PBB-EEL-27	07/19/2000	645	450

PRESUMPSCOT RIVER			
Windham			
PWD-SMB-1	06/22/2000	322	460
PWD-SMB-2	06/22/2000	295	310
PWD-SMB-3	06/22/2000	408	780
PWD-SMB-4	06/22/2000	450	1020
PWD-SMB-5	06/22/2000	425	925
Westbrook			
PWB-SMB-1	06/21/2000	250	160
PWB-SMB-2	06/21/2000	290	275
PWB-SMB-3	06/21/2000	201	260
PWB-SMB-4	06/21/2000	260	200
PWB-SMB-5	06/21/2000	263	200
SALMON FALLS RIVER			
S. Berwick			
SFS-SMB-1	09/13/2000	360	680
SFS-SMB-2	09/13/2000	265	220
SFS-SMB-3	09/13/2000	290	300
SFS-SMB-4	09/13/2000	260	260
SFS-SMB-5	09/13/2000	265	230
SFS-SMB-6	09/13/2000	270	270

field ID	Date	Length mm	Weight gm.
SEBASTICOOK RIVER			
W BR -Palmyra			
SWP-SMB-1	09/14/2000	392	830
SWP-SMB-2	09/14/2000	381	780
SWP-SMB-3	09/28/2000	415	1000
SWP-SMB-4	09/28/2000	400	990
SWP-SMB-5	09/28/2000	422	970
SWP-SMB-6	09/28/2000	382	730
SWP-SMB-7	09/28/2000	382	700
SWP-SMB-8	09/28/2000	374	700
SWP-SMB-9	09/28/2000	284	310
SWP-SMB-10	09/28/2000	287	320
SEBASTICOOK LAKE			
SLN-SMB-1	09/12/2000	327	450
SLN-SMB-2	09/12/2000	425	1120
SLN-SMB-3	09/12/2000	397	800
SLN-SMB-4	09/12/2000	369	630
SLN-SMB-5	09/12/2000	393	810
SLN-SMB-6	09/12/2000	403	1010
SLN-SMB-7	09/12/2000	327	490
SLN-SMB-8	09/12/2000	323	470
SLN-WHP-1	09/12/2000	230	200
SLN-WHP-2	09/12/2000	242	230
SLN-WHP-3	09/12/2000	248	240
SLN-WHP-4	09/12/2000	241	220
SLN-WHP-5	09/12/2000	233	210
SLN-WHP-6	09/12/2000	267	310
SLN-WHP-7	09/12/2000	230	230
SLN-WHP-8	09/12/2000	226	200
SLN-WHP-9	09/12/2000	248	240
SLN-WHP-10	09/12/2000	249	240

field ID	Date	Length mm	Weight gm.
SWAT			
Beaver bk.			
BBP-BKT-01	08/15/2000	195	65
BBP-BKT-02	08/15/2000	208	80
BBP-BKT-03	08/15/2000	214	95
BBP-BKT-04	08/15/2000	167	35
BBP-BKT-05	08/15/2000	153	29
BBP-BKT-06	08/15/2000	165	36
BBP-BKT-07	08/15/2000	142	27
BBP-BKT-08	08/15/2000	136	22
BBP-BKT-09	08/15/2000	173	45
BBP-BKT-10	08/15/2000	150	28
BBP-BKT-11	08/15/2000	244	134
BBP-BKT-12	08/15/2000	227	134
BBP-BKT-13	08/15/2000	218	101
BBP-BKT-14	08/15/2000	194	62
BBP-BKT-15	08/15/2000	180	60
BBP-BKT-16	08/15/2000	220	86
BBP-BKT-17	08/15/2000	201	80
BBP-BKT-18	08/15/2000	190	55
BBP-BKT-19	08/15/2000	153	30
BBP-BKT-20	08/15/2000	147	29
BBP-BKT-21	08/15/2000	147	25
BBP-BKT-22	08/15/2000	135	22
BBP-BKT-23	08/15/2000	247	155
BBP-BKT-24	08/15/2000	242	136
BBP-BKT-25	08/15/2000	199	82
BBP-BKT-26	08/15/2000	215	101
BBP-BKT-27	08/15/2000	186	59
BBP-BKT-28	08/15/2000	181	54
Meduxnekeag R.			
MDB-BKT-01	08/16/2000	188	68
MDB-BKT-02	08/16/2000	236	123
MDB-BKT-03	08/16/2000	201	83
MDB-BKT-04	08/16/2000	207	105
MDB-BKT-05	08/16/2000	217	100
MDB-BKT-06	08/16/2000	200	84
MDB-BKT-07	08/16/2000	180	54
MDB-BKT-08	08/16/2000	186	68
MDB-BKT-09	08/16/2000	189	68
MDB-BKT-10	08/16/2000	170	46
MDB-BKT-11	08/16/2000	175	58
MDB-BKT-12	08/16/2000	195	74
N.Br. Presqe Isle str.			
NPI-BKT-01	08/14/2000	148	29

NPI-BKT-02	08/14/2000	206	83
NPI-BKT-03	08/14/2000	215	92
NPI-BKT-04	08/14/2000	190	70
NPI-BKT-05	08/14/2000	170	38
NPI-BKT-06	08/14/2000	202	85
NPI-BKT-07	08/14/2000	160	39
NPI-BKT-08	08/14/2000	145	35
NPI-BKT-09	08/14/2000	148	44
NPI-BKT-10	08/14/2000	168	51
NPI-BKT-11	08/14/2000	169	49
field ID	Date	Length mm	Weight gm.
NPI-BKT-12	08/14/2000	167	45
NPI-BKT-13	08/14/2000	143	31
NPI-BKT-14	08/14/2000	193	75
NPI-BKT-15	08/14/2000	168	46
NPI-BKT-16	08/14/2000	181	66
NPI-BKT-17	08/14/2000	172	49
Prestile str.			
PTW-BKT-01	08/16/2000	170	45
PTW-BKT-02	08/16/2000	156	41
PTW-BKT-03	08/16/2000	166	48
PTW-BKT-04	08/16/2000	175	58
PTW-BKT-05	08/16/2000	154	34
PTW-BKT-06	08/16/2000	155	40
PTW-BKT-07	08/16/2000	197	75
PTW-BKT-08	08/16/2000	177	60
PTW-BKT-09	08/16/2000	147	31
PTW-BKT-10	08/16/2000	205	83
PTW-BKT-11	08/16/2000	180	57
PTW-BKT-12	08/16/2000	180	60
PTW-BKT-13	08/16/2000	170	45
PTW-BKT-14	08/16/2000	189	72
PTW-BKT-15	08/16/2000	204	84
PTW-BKT-16	08/16/2000	181	71
PTW-BKT-17	08/16/2000	160	40
PTW-BKT-18	08/16/2000	140	33
PTW-BKT-19	08/16/2000	147	34
PTW-BKT-20	08/16/2000	142	27
Everett Bk	Aug-00		
BKT-01			
BKT-02			
BKT-03			
BKT-04			
BKT-05			
BKT-06			
BKT-07			
BKT-08			
BKT-09			
BKT-10			
Salmon Bk	Aug-00		
BKT-01		190	76
BKT-02		200	84
BKT-03		272	204
BKT-04		225	120
BKT-05		185	65
BKT-06		208	91
BKT-07		220	121
BKT-08		195	78
BKT-09		185	60
BKT-10		185	69

field ID	Date	Length mm	Weight gm.
Presque Isle St			
BKT-01	Jun-00	164	45
BKT-02		184	65
BKT-03		250	160
BKT-04		184	65
BKT-05		176	65
BKT-06		214	110
BKT-07		226	120
BKT-08		178	60
BKT-09		190	75
BKT-10		194	80
Caribou St			
BKT-01	06/17/2000	234	130
BKT-02	07/14/2000	222	105
Hochenhull B			
BKT-01	06/14/2000	176	56
BKT-02		200	85
BKT-03		187	71
BKT-04		174	56
BKT-05		184	60
BKT-06		180	67
BKT-07		173	60
BKT-08		190	77
BKT-09		182	64
Aroostook R			
BKT-01	06/18/2000	192	75
BKT-02	07/14/2000	198	85
WHS-01	07/02/2000	418	690
WHS-02		395	640
WHS-03		420	730
Red Brook			
RBP-BKT-01	06/13/2000	214	100
RBP-BKT-02	06/13/2000	257	200
RBP-BKT-03	06/13/2000	202	90
RBP-BKT-04	06/13/2000	192	75
RBP-BKT-05	06/13/2000	180	70
RBP-BKT-06	06/13/2000	177	75
RBP-BKT-07	06/13/2000	171	60
RBP-BKT-08	06/13/2000	165	55
RBP-BKT-09	06/13/2000	160	50
RBP-BKT-10	06/13/2000	164	50
ANDROSCOGGIN RIVER			
Brunswick			
ARB-STB-1	07/20/2000	595	2200
ARB-STB-2	07/20/2000	560	1800
ARB-STB-3	07/27/2000	565	1875
ARB-STB-4	07/27/2000	525	1700
ARB-STB-5	07/27/2000	535	1800
field ID	Date	Length mm	Weight gm.
SHEEPSCOT RIVER			
SRW-STB-01	06/13/2000	555	1580
SRW-STB-02	06/14/2000	622	2835
SRW-STB-03	06/14/2000	685	2721
SRW-STB-04	06/14/2000	660	
SRW-STB-05	06/14/2000	685	

SRW-STB-06	06/14/2000	965	10206
Saco River			
SOS-STB-01	06/15/2000	1117	13608
SOS-STB-02	06/15/2000	666	3175
SOS-STB-03	06/15/2000	660	2721
SOS-STB-04	06/15/2000	660	3175
SOS-STB-05	06/15/2000	660	2721
SOS-STB-06	06/15/2000	647	2721
LAKES			
Little Ossipee L.			
LOW-LLS-01	07/06/2000	376	460
LOW-LLS-02	07/06/2000	370	410
LOW-LLS-03	07/10/2000	367	400
LOW-LLS-04	07/10/2000	430	700
LOW-LLS-05	07/10/2000	410	600
Lovewell P.			
LPF-BNT-01	07/05/2000	355	400
LPF-BNT-02	07/05/2000	427	700
LPF-BNT-03	07/05/2000	405	620
LPF-BNT-04	07/05/2000	475	1020
LPF-BNT-05	07/05/2000	438	690
Range P.			
LRP-BNT-01	06/28/2000	514	1560
LRP-BNT-02	06/28/2000	510	1490
LRP-BNT-03	06/28/2000	543	1845
LRP-BNT-04	06/28/2000	464	1200
LRP-BNT-05	06/28/2000	395	720
LRP-WHS-01	06/28/2000	485	1350
LRP-WHS-02	06/28/2000	490	1540
Round P LK3818			
RPL-SMB-01	06/27/2000	346	500
RPL-SMB-02	06/27/2000	424	880
RPL-SMB-03	06/27/2000	327	480
RPL-SMB-04	06/27/2000	415	870
RPL-SMB-05	06/27/2000	334	465
RPL-WHS-01	06/27/2000	439	845
RPL-WHS-02	06/27/2000	455	910
RPL-WHS-03	06/27/2000	464	1025
RPL-WHS-04	06/27/2000	410	730
RPL-WHS-05	06/27/2000	436	855
field ID	Date	Length mm	Weight gm.
Sabattus P.			
SPS-PKE-01	08/01/2000	461	580
SPS-PKE-02	08/01/2000	410	480
SPS-PKE-03	08/01/2000	448	510
SPS-PKE-04	08/01/2000	446	600
SPS-PKE-05	08/01/2000	447	550
Thissel P			
LK-2726-SPK-1	09/29/2000	395	560
LK-2726-SPK-2	09/29/2000	425	750
LK-2726-SPK-3	09/29/2000	425	740
LK-2726-SPK-4	09/29/2000	391	540
LK-2726-SPK-5	09/29/2000	467	930
Allagash L			
LK-9787-LKT-1		479	1060

LK-9787-LKT-2		500	1070
LK-9787-LKT-3		465	860
LK-9787-LKT-4		502	940
LK-9787-LKT-5		445	760
LK-9787-LKT-6		552	1500
LK-9787-LKT-7		500	1010
LK-9787-LKT-8		479	780
LK-9787-LKT-9		525	1120
LK-9787-LKT-10		517	1400
L Auburn			
LK3748-LKT01	07/21/2000	456	820
LK3748-LKT02		520	1320
LK3748-LKT03		505	1220
LK3748-LKT04		530	1320
LK3748-LKT05		535	1280
LK3748-LKT06		500	1040
Eagle L.			
LK1634-LKT-01	09/19/2000	503	1150
LK1634-LKT-02	09/19/2000	475	1070
LK1634-LKT-03	09/19/2000	480	1150
LK1634-LKT-04	09/19/2000	478	1000
LK1634-LKT-05	09/19/2000	559	1540
Haymock Lake			
LK-2814-LKT-1	06/21/2000	605	1890
LK-2814-LKT-2	06/21/2000	551	1570
LK-2814-LKT-3	06/21/2000	617	2480
LK-2814-LKT-4	06/21/2000	618	2150
LK-2814-LKT-5	06/21/2000	615	2250
LK-2814-LKT-6	06/21/2000	564	1670
LK-2814-LKT-8	06/21/2000	443	760
LK-2814-LKT-9	06/21/2000	427	700
LK-2814-LKT-10	06/21/2000	492	1050
LK-2814-BKT-7	06/21/2000	510	1410

field ID	Date	Length mm	Weight gm.
Hurd P			
LK2064-LKT01		355	330
LK2064-LKT02		383	410
LK2064-LKT03		404	480
LK2064-LKT04		410	550
LK2064-LKT05		424	635
LK2064-LKT06		451	680
LK2064-LKT07		466	860
LK2064-LKT08		477	800
LK2064-LKT09		504	1050
LK2064-LKT10		510	1300
Kezar L			
LK0097-LKT01	08/01/2000	446	
LK0097-LKT02	08/01/2000	582	
LK0097-LKT03	08/01/2000	506	
LK0097-LKT04	08/01/2000	515	
LK0097-LKT05	08/01/2000	482	
Mattagamon L.			
LK4260-LKT-01	11/28/2000	491	1100
LK4260-LKT-02	11/28/2000	423	625
LK4260-LKT-03	11/28/2000	444	800
LK4260-LKT-04	11/28/2000	574	1720
LK4260-LKT-05	11/28/2000	486	1900

Millimagassett L.			
LK3004-LKT-01	08/23/2000	530	1450
LK3004-LKT-02	08/23/2000	663	2950
LK3004-LKT-03	08/23/2000	620	2475
LK3004-LKT-04	08/23/2000	536	1600
LK3004-LKT-05	08/23/2000	557	1680
LK3004-LKT-06	08/23/2000	557	1825
LK3004-LKT-07	08/23/2000	562	1775
LK3004-LKT-08	08/23/2000	558	1525
LK3004-LKT-09	08/23/2000	552	1650
LK3004-LKT-10	08/23/2000	587	1780
Nickerson L			
LK1036-LKT01	08/30/2000	578	1800
LK1036-LKT02	08/30/2000	497	1070
LK1036-LKT03	08/30/2000	557	1450
LK1036-LKT04	08/30/2000	318	230
LK1036-LKT05	08/30/2000	330	255
LK1036-LKT06	08/30/2000	330	260
Pleasant P.			
LK-0224-LKT-01	8/3	482	1100
LK-0224-LKT-02	8/3	536	1520
LK-0224-LKT-03	8/3	516	1460
LK-0224-LKT-04	8/3	547	1470
LK-0224-LKT-05	8/3	516	1350
LK-0224-LKT-06	8/3	559	1760
LK-0224-LKT-07	8/3	502	1280
LK-0224-LKT-08	8/3	523	1460
LK-0224-LKT-09	8/3	570	1700
LK-0224-LKT-10	8/3	510	1320
field ID	Date	Length mm	Weight gm.
E Musquash L			
EW1	07/14/2000	551	1350
EW2	07/14/2000	596	2050
EW3	07/14/2000	535	1350
EW4	07/14/2000	460	900
Great Pond			
PIK01	3/1/01	728	2800
PIK02	3/1/01	697	2300
PIK03	3/1/01	666	2275
PIK04	3/1/01	670	2475
PIK05	3/1/01	653	2030
CHP01	3/1/01	393	375
CHP02	3/1/01	380	370
CHP03	3/1/01	465	850
CHP04	3/1/01	497	950
HATCHERY STUDY			
Casco			
BNT1	04/19/2001	254	200
BNT2	04/19/2001	217	120
BNT3	04/19/2001	204	100
BNT4	04/19/2001	214	120
BNT5	04/19/2001	186	80
LLS1	04/19/2001	203	100
LLS2	04/19/2001	184	80
LLS3	04/19/2001	207	90
LLS4	04/19/2001	198	90
LLS5	04/19/2001	189	70
Dry Mills	04/19/2001		
BKT1	04/19/2001	216	90

BKT2	04/19/2001	227	120
BKT3	04/19/2001	206	80
BKT4	04/19/2001	244	160
BKT5	04/19/2001	190	80
Emden			
LLS1	04/20/2001	197	90
LLS2	04/20/2001	190	80
LLS3	04/20/2001	180	70
LLS4	04/20/2001	192	85
LLS5	04/20/2001	180	70
Enfield			
BKT1	04/19/2001	270	225
BKT2	04/19/2001	230	150
BKT3	04/19/2001	250	180
BKT4	04/19/2001	250	180
BKT5	04/19/2001	260	230
BKT6	04/19/2001	468	1350
field ID	Date	Length mm	Weight gm.
New Gloucester	04/19/2001		
BNT1	04/19/2001	223	140
BNT2	04/19/2001	215	110
BNT3	04/19/2001	195	80
BNT4	04/19/2001	211	110
BNT5	04/19/2001	195	80
Palermo			
BKT1	04/20/2001	248	210
BKT2	04/20/2001	272	260
BKT3	04/20/2001	255	260
BKT4	04/20/2001	234	180
BKT5	04/20/2001	232	290
BNT1	04/20/2001	170	50
BNT2	04/20/2001	200	100
BNT3	04/20/2001	200	100
BNT4	04/20/2001	205	90
BNT5	04/20/2001	203	110
Grand Lake Stream			
LLS1	05/03/2001	200	93
LLS2	05/03/2001	200	86
LLS3	05/03/2001	190	76
LLS4	05/03/2001	200	88
LLS5	05/03/2001	190	74