

APPENDIX E

MassDEP DWM 2002 Fish Toxics Monitoring in the Charles River Watershed and Summary of Lake Winthrop, Holliston Fish Toxics Monitoring

Introduction

Fish toxics monitoring is a cooperative effort between three Massachusetts Department of Environmental Protection (MassDEP) Offices/Divisions- Watershed Management (DWM), Research and Standards (ORS), and Environmental Analysis; the Massachusetts Department of Fish and Game (MA DFG); and the Massachusetts Department of Public Health (MA DPH). Fish toxics monitoring is typically conducted to assess the concentrations of toxic contaminants in freshwater fish, identify waterbodies where those concentrations may pose a risk to human health, and identify waters where toxic contaminants may impact fish and other wildlife.

In 2002 fish were collected by the MassDEP DWM at two sites in the Charles River Watershed - Lake Pearl in Franklin, MA and Box Pond in Bellingham, MA.

Project Objectives

Fish tissue monitoring is typically conducted to assess the levels of toxic contaminants in freshwater fish, identify waterbodies where those levels may impact human health, and identify waters where toxic chemicals may impact fish and other aquatic life. Nonetheless, human health concerns have received higher priority so fish tissue analysis has been restricted to edible fillets. The fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding groups (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals, polychlorinated biphenyls (PCBs) and chlorinated pesticides. In 2002 MassDEP DWM fish toxics monitoring was conducted according to procedures in the EPA-approved Fish Toxics Quality Assurance Project Plan (MassDEP 2003). Data quality objectives are presented in the above-mentioned QAPP. There were no deviations from the QAPP.

Methods

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing, and shipping fish collected for the fish toxics monitoring. All fish were collected using boat-mounted electroshocking gear and/or gill nets. Fish selected for analysis were placed in an ice filled cooler and brought back to the DWM laboratory for processing. Processing included measuring lengths and weights and visually inspecting fish for tumors, lesions, or other indications of stress or disease. Scales, spines, or pectoral fin ray samples were obtained from each sample to determine the approximate age of the fish. Fish were filleted (skin off) with stainless steel knives on glass cutting boards.

Results

The results of MassDEP 2002 Charles River Watershed fish toxics monitoring surveys described below are excerpted from *2002 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta *et al.* 2004). Data are presented in Table E1. All raw data files, field sheets, lab reports, chain of custody forms, and other metadata are maintained in databases at the MassDEP DWM office in Worcester. Quality assurance data are available in *Data Validation Report for Year 2002 Project Data* (MassDEP 2005).

Lake Pearl

In May 2002 Lake Pearl in Wrentham was sampled in the Charles River Watershed. As reported in Maietta *et al.* (2004) “*Although mercury was below the MDPH “trigger level” of 0.5 mg/kg in all samples, it should be noted that the yellow perch sample contained mercury just below the trigger level. Arsenic, lead, cadmium and selenium were either below MDLs or at concentrations that do not appear to be of concern. Also, trace concentrations of PCB Arochlor 1260, Congener BZ#180, DDD, and DDE were detected in fish from Lake Pearl, three of the five data points were qualified as “Estimated value-concentration <RDL or certain criteria not met”. In addition, all samples were below MDPH or USFDA criteria.*”

Box Pond

In October 2002, Box Pond, located in Bellingham and Mendon, was sampled in the Charles River Watershed. As reported in Maietta *et al.* (2004), "Mercury was well below the MDPH "trigger level" of 0.5 mg/kg in all samples. Arsenic, lead, cadmium and selenium were either below MDLs or at concentrations that do not appear to be of concern. A trace concentration of PCB Congener BZ#180 was detected in yellow bullhead from Box Pond, the data point was qualified as "Estimated value-concentration <RDL or certain criteria not met". The presence of DDT, DDE, and DDD in white sucker resulted in the issuance of an MDPH advisory recommending:

"Children under 12, pregnant women, nursing mothers, and women of childbearing age who may become pregnant should refrain from consuming white sucker from Box Pond to prevent exposure of developing fetuses, nursing infants and young children to DDT" and

"The general public should not consume white sucker caught from Box Pond".

The advisory was issued by the MA DPH (2007).

Table E1. 2002 Fish Toxics Monitoring data for Charles River Watershed Waterbodies (Lake Pearl, Franklin and Box Pond, Bellingham), (Maietta et al. 2004). Results, reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code ¹	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Arochlors and Congeners (µg/g)	Pesticides (µg/g)
Lake Pearl, Franklin, Charles River Watershed													
LPF02-1	5/16/02	LMB	37.4	760	2002004	<0.040	<0.20	0.35	<0.060	0.26	0.16	ND	DDE-0.012J
LPF02-2	5/16/02	LMB	37.1	800	(L2002161-1)								
LPF02-3	5/16/02	LMB	36.3	640	(L2002262-1)								
LPF02-4	5/16/02	YP	26.0	160	2002005	<0.040	<0.20	0.47	<0.060	0.20	0.09	ND	ND
LPF02-5	5/16/02	YP	29.3	280	(L2002161-2)								
LPF02-6	5/16/02	YP	25.0	180	(L2002162-2)								
LPF02-7	5/16/02	BB	31.1	450	2002006	<0.040	<0.20	0.08	<0.060	0.22	1.4	A1260-0.092	DDD-0.011J
LPF02-8	5/16/02	BB	31.8	460	(L2002161-3)							BZ#180-0.0021J	DDE-0.038
LPF02-9	5/16/02	BB	31.5	470	(L2002162-3)								
Box Pond, Bellingham, Charles River Watershed													
BXPF02-01	10/08/02	WS	45.1	1130	2002054	<0.040	<0.20	0.11	<0.060	0.28	3.0	ND	DDD-0.031
BXPF02-02	10/08/02	WS	45.7	1060	(L2002454-1)								DDE-0.086
BXPF02-03	10/08/02	WS	46.5	1100	(L2002456-1)								DDT-0.012J
BXPF02-04	10/08/02	LMB	34.4	680	2002055	<0.040	<0.20	0.15	<0.060	0.16	0.36	ND	DDE-0.0099J
BXPF02-05	10/08/02	LMB	34.9	640	(L2002454-2)								
BXPF02-06	10/08/02	LMB	33.0	620	(L2002456-2)								
BXPF02-07	10/09/02	YB	29.1	400	2002056	<0.040	<0.20	0.09	<0.060	0.17	0.61	BZ#180-0.0012J	DDE-0.0098J
BXPF02-08	10/09/02	YB	29.6	410	(L2002454-3)								
BXPF02-09	10/09/02	YB	29.0	390	(L2002456-3)								
BXPF02-10	10/10/02	B	18.3	120	2002057	<0.040	<0.20	0.09	<0.060	0.20	0.21	ND	DDE-0.0073J
BXPF02-11	10/10/02	B	18.9	140	(L2002454-4)								
BXPF02-12	10/10/02	B	18.8	140	(L2002456-4)								

¹ Species Code , Common Name, Scientific name
 (AE) American eel *Anguilla rostrata*
 (B) bluegill *Lepomis macrochirus*
 (BB) brown bullhead *Ameiurus nebulosus*
 (BC) black crappie *Pomoxis nigromaculatus*
 (BT) brown trout *Salmo trutta*
 (C) common carp *Cyprinus carpio*
 (LMB) largemouth bass *Micropterus salmoides*

(P) pumpkinseed *Lepomis gibbosus*
 (RB) rock bass *Ambloplites rupestris*
 (WP) white perch *Morone americana*
 (WS) white sucker *Catostomus commersonii*
 (YB) yellow bullhead *Ameiurus natalis*
 (YP) yellow perch *Perca flavescens*

² - Chlordane

ND - not detected or the analytical result is at or below the established method detection limit (MDL).

J-estimated value, concentration <RDL or certain QC criteria not met

RDL = reporting detection limit

< = result not detected above method detection limit, unless otherwise noted

References

MassDEP. 2003. *Quality Assurance Project Plan for Fish Toxics Monitoring*. CN96.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MassDEP. 2005. *Data Validation Report for Year 2002 Project Data*. CN202.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Maietta, R. J., J. Ryder, and R. F.Chase. 2004. *2002 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys*. CN99.0. Massachusetts Department of Environmental Protection, Divisions of Watershed Management and Environmental Analysis. Worcester and Lawrence, MA.

MA DPH. 2007. *Freshwater Fish Consumption Advisory List January 2007*. Massachusetts Department of Public Health. Boston, MA.

Lake Winthrop, Holliston Fish Toxics Monitoring Summary

1983 (TSB 1984)

Fish from Lake Winthrop were originally collected and analyzed by the Massachusetts Department of Environmental Quality Engineering for dioxin in 1983 as part of the *Six Ponds Dioxin Survey* (TSB 1984). The following data were excerpted from the report:

Fish samples collected September 1983 from Lake Winthrop, Holliston included brown bullhead (*Ictalurus nebulosus*) and yellow bullhead (*I. natalis*). Length, weight, and age data summarized below (TSB 1984):

Species	Length (mm)	Weight (gm)	Age (yrs)	Collected
Brown Bullhead	255	227	3+	9/1/83
Brown Bullhead	276	283	4+	9/1/83
Brown Bullhead	302	312	4+	9/2/83
Yellow Bullhead	300	454	4+	9/2/83
Brown Bullhead	275	283	3+	9/2/83

The concentration of 2,3,7,8-Tetrachlorodibenzo-p-dioxin in fish and sediment samples from Lake Winthrop were reported as 71 and 5.9 part per trillion (ppt), respectively - a positive confirmation of the presence of dioxin. TSB (1984) stated that the presence of dioxin in Lake Winthrop is of concern for two reasons:

- a. The 71 ppt found in fish exceeds the U.S. Food and Drug Administration guideline of 50 ppt in fish flesh for human consumption. Therefore, the situation may represent a public health concern.
- b. Lake Winthrop appears to have been treated very little over the years compared to the other lakes studied. Therefore, no explanation is apparent for the finding of dioxin in this lake and not the others.

1996 (Maietta undated-a)

Lake Winthrop was sampled by MassDEP again on 1 and 2 October 1996 in response to a public request. Electrofishing resulted in the collection of three largemouth bass (*Micropterus salmoides*), three yellow perch (*Perca flavescens*), two bluegill (*Lepomis macrochirus*), and one pumpkinseed (*Lepomis gibbosus*). Trot lines resulted in the collection of three yellow bullhead (Maietta undated-a). Although funding for dioxin analyses was not available, fish were collected and run for PCBs, pesticides and a number of metals (see data summary below excerpted from Maietta undated-a).

Three-fish composite sample Species	% lipids	Metals Concentrations (mg/Kg wet weight)				
		As	Cd	Hg	Pb	Se
Largemouth bass	0.190	<0.040	<0.02	0.625	<0.14	0.088
Yellow perch	0.085	<0.040	<0.02	0.325	<0.14	0.132
Bluegill and pumpkinseed	0.049	<0.040	<0.02	0.287	<0.14	0.200
Yellow bullhead	0.030	<0.040	<0.02	0.705	<0.14	0.089

The report stated that “mercury concentrations in exceedance of the MDPH trigger level were detected in the composite of largemouth bass and yellow bullhead. While the presence of elevated mercury concentrations in largemouth bass is fairly common, it was surprising to find the highest concentrations in a composite of yellow bullhead. Bullhead are normally the species with the lowest mercury concentrations in a given body of water. It is unclear as to the reason for elevated mercury in yellow bullhead...PCBs and organochlorine pesticides were below detection in all samples... The organochlorine pesticides analyzed by AOAC 983.21 Method (i.e., identified and quantified if present in sample) included: Aldrin, BHC, Lindane, DDD, DDE, DDT, Dieldrin, Endosulfan, Endosulfan sulfate, Endrin, Endrin aldehyde, Heptachlor, Heptachlor epoxide, Methoxychlor, Toxaphene, Chlordane, Hexachlorocyclopentadiene, Hexachlorobenzene, and Trifluralin” (Maietta undated-a).

1997 (Maietta undated-b)

Lake Winthrop was re-sampled on 5 and 6 June 1997 due to the availability of funds for outside laboratory assistance for the analysis of 2,3,7,8 TCDD (dioxin). Rod and reel fishing at Lake Winthrop

resulted in the collection of three largemouth bass. Gill nets and trot lines resulted in the collection of three yellow perch and three yellow bullhead.

Fishes from Lake Winthrop were filleted, composited, and wrapped in aluminum foil for dioxin analysis. The left fillets were prepared with the skin removed and the right fillets were prepared with the skin on and scales removed. Fish were delivered to the WES for packing and subsequent delivery to Alta Analytical Laboratory in El Dorado Hills, CA. Samples were analyzed using EPA Method 8290 for tetra to octa chlorinated dioxins and furans.

Dioxin concentrations reported for Lake Winthrop fish samples are as follows (Maietta undated-b):

Sample	% lipids	2,3,7,8 TCDD (Total TCDD) pg/g
Lwf97-1+2 (with skin)	0.0040	0.43 (0.43)
Lwf97-1+2 (skinless)	0.016	0.20 (0.20)
Lwf97-3 (with skin)	0.0040	0.20 (0.20)
Lwf97-3 (skinless)	0.0040	0.20 (0.20)
Lwf97-4-6 (with skin)	0.0040	0.12 (0.18)
Lwf97-4-6 (skinless)	0.02	0.15 (0.22)
Lwf97-7-9 (with skin)	0.036	0.42 (0.47)
Lwf97-7-9 (skinless)	0.0040	0.41 (0.46)

Conclusions stated in Maietta (undated-b): *“The dioxin problem originally documented in 1983 does not appear to be as significant a problem at the present time. Questions as to data quality of the earlier work are currently being resolved. Should the MDPH decide to re-assess the need for a fish consumption advisory, the 1996 mercury data will need to be taken into consideration. Yellow bullhead and largemouth bass fillet samples collected in 1996 contained mercury concentrations which exceed the MDPH’s trigger level of 0.5 mg/Kg. As a result it does not appear that the fish consumption advisory for Lake Winthrop will be lifted, however, it may be modified. It is unclear as to why mercury is highest in yellow bullhead. Nutrient enrichment of Lake Winthrop remains to be a concern. Maintenance of on-site septic systems is essential toward minimizing the effect of shoreline development on further eutrophication.”*

References

Maietta, R. J. undated-a. *1996 Fish Toxics Monitoring Public Request Surveys*. TM-S-6. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Maietta, R. J. undated-b. *1997 Fish Toxics Monitoring Public Request Surveys*. TM-S-9. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

TSB. 1984. *Six Ponds Dioxin Survey*. MR-C-1. Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control, Technical Services Branch. Westborough, MA.