2010
Fish Toxics Monitoring
Public Request Surveys

pumpkinseed
Lepomis gibbosus

Massachusetts Department of Environmental Protection
Divisions of Watershed Management
and Environmental Analysis

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Introduction

Public Request Surveys (Interagency Committee on Freshwater Fish Toxics Monitoring and Assessment)

Due in part to an increasing public demand for fish toxics data, a formal protocol for the public to request fish toxics monitoring surveys of the Commonwealth's waterbodies was initiated in 1993/94. While public requests for fish testing had been fulfilled prior to this time, increased requests beyond the scope of the resources available made formal prioritization necessary. The following protocol is the result of a collaborative effort between the Massachusetts Department of Environmental Protection (MassDEP), the Massachusetts Department of Public Health (MDPH), and the Massachusetts Department of Fish and Game (MDFG). It consists of a Memorandum of Understanding (MOU) (Appendix B), a form for requesting fish testing (Appendix C), and the criteria used for ranking testing requests (Appendix D).

The process is as follows: completed request forms are sent to the MassDEP Division of Watershed Management (DWM) in Worcester. Representatives of the aforementioned agencies make up the Interagency Committee on Freshwater Fish Toxics Monitoring and Assessment (Interagency Committee). The Interagency Committee meets each year in February to prioritize all requests received between February 1st of the previous year and February 1st of the current year. Variables used to prioritize requests include fishing pressure (determined by Division of Fisheries and Wildlife (DFW) and the requester) and the presence of known or potential point and non-point sources of pollution (determined by MassDEP, DFW, and the requester). The number of requests fulfilled during any given year is determined by the amount of field and laboratory resources available in that year. All requesters are notified regarding the status of their request. If a request is denied, re-application in following years is allowed. Request forms are available through each of the agencies involved in the MOU, at the following locations:

Massachusetts Department of Environmental Protection

Division of Watershed Management 627 Main Street, 2nd Floor Worcester, MA 01608 (508) 792-7470	Division of Environmental Analysis Senator William X. Wall Experiment Station 37 Shattuck Street Lawrence, MA 01843 (978) 682-5237
Office of Research and Standards One Winter Street Boston, MA 02108 (617) 292-5510	

Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
250 Washington Street, 7th Floor
Boston, MA 02108-4619
(617) 624-5757

Massachusetts Department of Fish and Game
Division of Fisheries and Wildlife (DFW)
Field Headquarters
One Rabbit Hill Road
Westborough, MA 01581
(508) 389-6300

Objective and Scope

The objective of Public Request Surveys is to screen edible fillets of fishes for potential contaminants (i.e. mercury and/or other metals, polychlorinated biphenyls (Aroclors), and organochlorine pesticides). The list of contaminants for which tissue samples are analyzed is determined on a case-by-case basis. All data are sent to the MDPH and the MassDEP Office of Research and Standards (ORS) for assessment and advisory issuance if appropriate.

PCB Arochlors analyzed for include, Arochlors 1232, 1242, 1248, 1254, and 1260. Organochlorine pesticides analyzed for include, Chlordane, Toxaphene, a-BHC, b-BHC, d-BHC, Lindane, Hexachlorocyclopentadiene, Trifluralin, Hexachlorobenzene, Heptachlor, Heptachlor Epoxide, Methoxychlor, DDD, DDE, DDT, Aldrin, Endrin, and Endosulfan I. All organics analyses include lipid determination. Mercury is the only metal which is currently being routinely analyzed for. All analyses for variables listed above are performed at the Senator William X. Wall Experiment Station (WES). Additional variables are addressed on a site-specific basis.

In order to assess the level of contamination present in fish of different trophic guilds and habitat types, fish species targeted include at a minimum; largemouth bass, *Micropterus salmoides,* and/or chain pickerel, *Esox niger,* (predators); yellow perch, *Perca flavescens,* and/or white perch, *Morone americana,* (water column invertivores/omnivores); and bullhead, *Ameiurus* sp. and/or common carp, *Cyprinus carpio,* (bottom feeding omnivores). Average-sized fish (above legal length limit when applicable) are analyzed as composite samples. Additional species or substitute species are chosen on a site-by-site basis.

During 2010, a total of five locations were sampled as a result of recommendations from the Interagency Committee. A list of all of the sampling sites with pertinent locational information is presented in the following table.

Waterbody	Watershed	Town	USGS Quadrangle
Jamaica Pond PALIS#[1] 72052	Charles River	Boston	Boston South MASSACHSETTS.
Leverett Pond PALIS#[1] 72060	Charles River	Brookline/Boston	Boston South MASSACHSETTS
Lake Mattawa PALIS#[1] 35112	Millers River	Orange	Orange MASSACHUSETTS.
Moores Pond PALIS#[1] 35048	Millers River	Warwick	Northfield MASSACHUSETTS.
Pleasant Pond PALIS#[1] 92049	Ipswich River	Wenham/Hamilton	Salem MASSACHUSETTS.

[1] Interim PALIS# = Pond and Lake Identification System number (Mar 16, 2000)

Field Methods

Waterbodies were sampled using an electrofishing boat. Electrofishing was performed by maneuvering the boat through the littoral zone and shallow water habitat of a given waterbody, and collecting most fish shocked. Fish collected by electrofishing were stored in a live well until the completion of sampling. Fish to be included in the sample were dispatched, stored on ice, and transported to the Massachusetts Department of Environmental Protection (MassDEP) Division of Watershed Management (DWM) laboratory in Worcester where they were prepared (filleted and composited) and frozen. In all cases, live fish that were not included as part of the sample, were released.

Field Results

The collection method used during the 2010 season was limited to boat electrofishing. The collection dates, species retained for analysis, and other species observed can be found in the following table.

Waterbody	Sampling Date	Collection Method(s)	Species Retained[1]	Other species observed[1]
Jamaica Pond	5/28/2010	boat electrofishing	LMB, YB, YP,B	AE, P, RT,AS
Leverett Pond	5/21/2010	boat electrofishing	C, YP, B, WP, LMB	not recorded
Lake Mattawa	6/10/2010	boat electrofishing	LMB, B, BB, YB	AE, CP, P, BC, YP
Moores Pond	5/26/2010	boat electrofishing	AE, BB, B, CP	not recorded
Pleasant Pond	6/16/2010	boat electrofishing	LMB, YP, B, BB	P, BC, CP

[1]Species codes are defined in Table 1 of Appendix A

Laboratory Methods

Fish transported to the MassDEP DWM laboratory in Worcester were processed using protocols designed to assure accuracy and prevent cross-contamination of samples. Specimen lengths and weights were recorded along with notes on tumors, lesions, or other anomalies noticed during an external visual inspection. Scales and spines were obtained for use in age determination. Species, length, and weight data can be found in Appendix A Table 1. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. All equipment used in the filleting process was rinsed in tap water and then rinsed twice in de-ionized water before and after each sample. All samples were placed in VWR high density polyethylene (HDPE) cups with covers. Composite samples were composed of portions of two or three fillets from like-sized individuals of the same species (occasionally the same genus). Samples prepared at DWM in Worcester were tagged and frozen for subsequent delivery to the Department's Wall Experiment Station (WES).

Methods used at WES for metals analysis include the following: Mercury was analyzed by Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry using EPA method 7473. (Batdorf 2009). PCB Aroclor, and organochlorine pesticide analyses were performed on a gas chromatograph equipped with an electron capture detector "according to the modified AOAC 983.21 procedure for the analysis of PCB Aroclors, and Organochlorine Pesticides."(MassDEP 2002). Additional information on analytical techniques used at WES is available from the laboratory.

Laboratory Results

Twenty one samples were delivered to WES for analysis. All fish tissue data passed WES QC acceptance limits, however, seventeen (80 %) of the mercury results were reported with "qualification" (See Quality Control Section). Mercury (MDL 0.0020 mg/kg) was detected in all twenty one samples analyzed. Concentrations ranged from 0.044 mg/kg to 0.83 mg/kg. Mercury concentrations varied greatly between waterbodies and species. Waterbody mean mercury concentrations and ranges are detailed below. Complete results of the mercury analysis can be found in Appendix A Table 1.

Nine samples were analyzed for PCB Aroclors, and organochlorine pesticides. PCB Aroclors were detected in one sample and DDT and/or it's metabolites DDE and DDD were detected in three of the nine samples analyzed (33%). Complete results for PCB Aroclors and organochlorine pesticides analysis can be found in Appendix A Table 1.

Waterbody	Mean Total Hg (mg/kg wet weight)	Total Hg Range (mg/kg (min-max))
Jamaica Pond	0.20 (n=4)	0.066-0.35
Leverett Pond	0.11 (n=5)	0.068-0..16
Lake Mattawa	0.28 (n=4)	0.14-0.41
Moores Pond	0.35 (n=4)	0.16-0.53
Pleasant Pond	0.29 (n=4)	0.044-0.83

Quality Control

Eighty percent of the mercury data were reported with "qualification". The qualification in all cases involved "EPA holding time" exceedances. Mercury was analyzed after the U.S. Environmental Protection Agency (EPA) recommended holding time of 28 days and samples were qualified as "Holding time not met but previous studies by WES show that frozen fish samples are stable for mercury for at least one year." It should be noted that three sets of samples were delivered to WES after the USEPA 28 day holding time. One set of samples was delivered within 15 days of collection and one set was delivered within 21 days of collection.

In addition to holding time exceedences, four of the mercury results were qualified due to duplicate result RPDs which were out of the acceptance range of 0 - 20 RPD. For the rest of the mercury results, lab duplicate precision estimates for mercury were within the acceptance criteria range of 0 – 20 RPD. Lab accuracy estimates for mercury using lab-fortified matrix samples were within the acceptable range from 70-130 % recovery. Mercury quality control sample recoveries were within the acceptable range of 70-130 % recovery. Lab fortified blank recoveries for mercury were within the acceptable range of 85-115% recovery. Lab blanks were all acceptable at ND (analyzed for, but not detected above MDL). Complete quality control data for mercury are available upon request from WES or DWM.

PCB Aroclor and organochlorine pesticide results which were "qualified" as being greater than the Method Detection Limit but less than the Minimum Reporting Limit (>MDL but< MRL) were flagged by WES and appear so designated in the data tables (See Appendix A, Table 1).
All laboratory blanks for organics resulted in non-detectable concentrations. Duplicate samples analyzed for PCB Aroclors, and organochlorine pesticides in all cases had resultant RPDs within the acceptance criteria range of 0-35%. The laboratory fortified blank sample recoveries for PCB Aroclors and laboratory fortified matrix sample recoveries for organochlorine pesticides were within the acceptance criteria range of 60-140% recovery. All surrogate PCNB analyses resulted in percent recoveries within the acceptance criteria of 60-140 % recovery. Complete quality control data for PCB Aroclors, and organochlorine pesticides are available upon request from WES or DWM.

Discussion

Edible tissue total mercury continues to be both widespread and detectable at concentrations that at times can exceed the USEPA water quality criterion (0.3 μg/g methyl mercury), the MDPH trigger level (0.5 μg/g total mercury) and/or the USFDA Action level (1.0 μg/g methyl mercury). (USEPA 2005 and USFDA 2009). Mercury concentrations are addressed in the individual waterbody discussions that follow. MDPH is currently assessing the 2010 mercury data with regard to the need for waterbody specific advisory issuance where warranted.

PCB Aroclors and organochlorine pesticides are occasionally found in freshwater fishes from Massachusetts. They are usually found in fishes from waterbodies that have received historical discharges or are associated with known waste sites. As such, they are mostly found in rivers, although their presence in fishes from lakes and ponds can't be entirely ruled out. Current USFDA Action Levels (for fish, edible portion) include chlordane, and mirex, (0.3 μg/g for each individually), aldrin and dieldrin (0.3 μg/g combined) and for DDT and its metabolites DDE and DDD (5.0 μg/g combined) (USFDA 2009). Historic USFDA "Action Levels" were also available for PCBs (2.0 μg/g), however these were not listed in the current reference document. In addition, the MDPH has "trigger levels" for PCBs (1.0 μg/g total Aroclors) and DDT and/or its metabolites (0.06 μg/g). PCB Aroclors and organochlorine pesticides (DDT and its metabolites) were found in a thirty three percent of the samples analyzed in 2010. Concentrations were generally below levels of concern with the exception of one sample from Leverett Pond (2010150-001 for DDT and its metabolites). These data and the mercury results are addressed in the individual waterbody discussions that follow.

Jamaica Pond: Jamaica Pond is a 63 acre (25.4 hectare ha) kettle hole, great pond located in the City of Boston (Ackerman 1989). The immediate shoreline is mostly parklands with paved walking paths. Land use within the pond's watershed is almost entirely developed with high density residential, commercial, and transportation infrastructure. There are a number of storm drains which discharge into Jamaica Pond and it appears that fishing pressure is very heavy, especially in the spring. The pond is stocked by MassWildlife with both trout and Atlantic salmon broodstock.

Mercury was below the MDPH "trigger level" of 0.5 mg/kg in the four samples analyzed (including largemouth bass, a predatory species). PCBs and organochlorine pesticides were not detected in fish samples from Jamaica Pond. It should be noted that common carp, which are usually worst- case when it comes to PCBs and organochlorine pesticides, were not collected or analyzed from Jamiaca Pond. Although the 2010 data set will most likely not result in any type of advisory from the MDPH, it would be interesting to analyze common carp in order to assess the worst-case potential for PCBs and organochlorine pesticides.

Leverett Pond: Leverett Pond is a 7 acre (2.8 ha.) shallow impoundment of the Muddy River located just downstream from Jamaica Pond between Brookline and Boston. The immediate shoreline is mostly parklands with paved and unpaved walking paths and access roads. Land use within the pond's watershed is almost entirely developed with high density residential, commercial, and transportation infrastructure. It should be noted that there are a number of storm drains which discharge into Leverett Pond. Although there was some evidence of fishing pressure, no fishermen (or women) were observed fishing on either the day of the reconnaissance survey or the sampling date.

Mercury was below the MDPH "trigger level" of 0.5 mg/kg in the five samples analyzed (including largemouth bass, a top level predator). PCB Aroclor 1260 was detected in common carp (0.051 mg/Kg) but concentrations were well below the MDPH trigger level of 1.0 mg/Kg. Total concentrations of DDT (and it's metabolites DDD and DDE) exceeded the MDPH trigger level in common carp but were below the trigger level in bluegill and white perch. It should be noted that common carp are considered worst-case for PCBs and organochlorine pesticides due to their bottom feeding behavior as well as the high lipid (fat) content of their edible fillets. PCBs and pesticides are lipophilic compounds which accumulate in fatty tissue.

Although it is unclear where the organochlorine pesticides might be originating, given the incredible amount of residential and commercial development within the watershed, sources are most likely from historical pesticide use. Observed concentrations do not appear to be indicative of ongoing point source contamination. The presence of DDT (and or it's metabolites) in common carp will most likely result in the issuance of a MDPH fish consumption advisory.

Lake Mattawa: Lake Mattawa is a 112 acre (45.3.4 ha.) mesotrophic lake located in the Town of Orange. The lake is primarily spring fed and flows via North Pond Brook to the Millers River, and via an unnamed tributary, to the Middle Branch Swift River. The water is clear and the bottom substrate is predominantly sand and gravel and only sparsely vegetated (MDFW 1993).

The shoreline is approximately eighty to ninety percent developed with residences and there is a road which runs along the entire western shoreline of the lake. Land use within the lakes watershed is mostly forested, with residential landuse limited primarily to the immediate shoreline. State Route 2 also passes within the lakes watershed.

Mercury was below the MDPH "trigger level" of 0.5 mg/kg in all four samples analyzed, including two largemouth bass samples. It should be noted that although all largemouth bass analyzed were longer than the legal length limit, none were larger than approximately two pounds. All mercury results were qualified by the laboratory due to exceedances in the "USEPA 28 day holding time" as well as problems with duplicate result RPDs as described in the Quality Control section.

Moores Pond: Moores Pond is a 31 acre (12.5 ha.) great pond located in the town of Warwick. (Ackerman 1989). The shoreline is approximately thirty-five percent developed residentially. Land-use within the pond's watershed is a mix of low (and very low) density residential and forested land-uses.

Although this is a great pond, the pond to some extent impounds Grace Brook and there is a large vegetated wetland on it's northern (upstream) end. The water is fairly clear and vegetation is confined to the shallower areas. The pond is stocked with trout annually and 21 percent of the water is considered to be "trout water" by the MassWildlife (MDFW 1993).

Composite samples of American eel and chain pickerel were found to contain mercury in excess of the MDPH trigger level of 0.5 μg/g. All mercury results were qualified by the laboratory due to exceedances in the "USEPA 28 day holding time" as described in the Quality Control section. It should be noted that although the American eel were fairly large, the chain pickerel were below the legal length limit of 15 inches and still exceeded the trigger level. In light of the high mercury in smaller pickerel it is highly probable that other predatory species such as largemouth bass also contain mercury concentrations which may be elevated.

The MDPH will most likely issue an advisory with regard to the consumption of chain pickerel and American eel from Morres Pond.

Pleasant Pond: Pleasant Pond is a 43 (17.4 ha.) mesotrophic great pond located in the Town of Wenham (Ackerman 1989). The immediate shoreline is approximately sixty to seventy percent developed residentially and land-use within the watershed is primarily a mix of medium density residential and forested. The water is relatively clear but aquatic vegetation is dense in the shallower areas of the pond. Public access for shore fishing and boats is available via town owned property along the western shoreline. The pond is stocked with trout annually (spring and fall) by the MDFW and some of these trout are reported to "holdover" (MDFW 1993).

Mercury exceeded the MDPH "trigger level" of 0.5 μg/g in largemouth bass. All other fish were below the MDPH trigger level for mercury. The MDPH will most likely issue an advisory with regard to the consumption of largemouth bass from Pleasant Pond.

Conclusions

While mercury concentrations were mostly below the MDPH trigger level, the 2010 Public Request and Watershed Surveys data set supports previous findings that bioaccumulation of mercury is a widespread problem, and that, although individual ponds or regions may be at higher risk, it is primarily a problem in predatory or piscivorous species. It is presumed that the mercury present in freshwater fish is due mainly to atmospheric deposition (near and far field emissions from incinerators and coal burning power plants) and possibly bedrock sources. Reducing direct human health risks associated with eating freshwater fish can only be accomplished through educating the public with regard to both fish bioaccumulation patterns as well as the implications of various levels of fish consumption.

It should be noted that although the fish toxics monitoring program addresses the human health risk associated with the consumption of freshwater fishes, the mercury problem also poses threats with regard to ecological risks to piscivorous wildlife (Eisler 1987). Studies have shown that mercury poses a health risk to eagles, loons, and ospreys as well as many other species. Reductions in the amount of mercury in the municipal waste stream and the emissions noted above will also reduce the environmental consequences of this contaminant. It is unclear how rapidly mercury concentrations will respond to recent changes in air emissions standards, however, recent studies of sediment cores from lakes suggest that mercury deposition rates may be decreasing. (MassDEP 2005)

PCBs remain essentially a problem in rivers or other waterbodies that have received historic PCB discharges. With regard to organochlorine pesticides however, it appears that certain species of fish do bioaccumulate significant levels of DDT (and/or it's metabolites DDD and DDE) from rivers and/or lakes where these contaminants have been historically used. These historic uses appear to include general residential use.

The DWM will continue to screen for contaminants in freshwater fishes as part of Public Request and Year 2 watershed surveys, as resources allow. DWM will also continue to cooperate with other state and federal agencies in an effort to better understand not only the distribution of fish tissue contaminants, but also temporal changes that may be taking place with regard to fish tissue contaminant levels.

This report has been forwarded to the departments involved with the Interagency Committee, the individuals requesting work, and DEP's regional offices. Additional copies of this report are available from the MassDEP, Division of Watershed Management, 627 Main Street 2nd Floor, Worcester, MA 01608. They will also eventually be available online at *http://www.mass.gov/dep/.*

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LIST OF APPENDICES

APPENDIX A

Table 1. Analytical Results for 2010 Fish Toxics Monitoring Public Request Surveys. Results reported in wet weight, are from composite samples of fish fillets (skin off).

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Total Hg (mg/kg)	% Lipids (%)	PCB Arochlors (µg/g)	Pesticides (µg/g)
Jamaica Pond, Boston, Charles River Watershed									
2010149-001A 2010149-001B 2010149-001C	5/28/2010 5/28/2010 5/28/2010	LMB LMB LMB	395 380 385	870 760 930	2010149-001	0.35H	0.06	ND	ND
2010149-002A 2010149-002B 2010149-002C	5/28/2010 5/28/2010 5/28/2010	YB YB YB	290 245 246	420 230 240	2010149-002	0.18H	0.22	ND	ND
2010149-003A 2010149-003B 2010149-003C	5/28/2010 5/28/2010 5/28/2010	YP YP YP	208 194 183	100 80 80	2010149-003	0.22H	0.05	ND	ND
2010149-004A 2010149-004B 2010149-004C	5/28/2010 5/28/2010 5/28/2010	B B B	180 179 171	120 120 110	2009149-004	0.066H	0.06	ND	ND
Leverett Pond, Brookline/Boston, Charles River Watershed									
2010150-001A 2010150-001B 2010150-001C	5/21/2010 5/21/2010 5/21/2010	C C C	494 483 581	2300 2000 2980	2010150-001	0.096H	4.9	A1260-0.051M	DDE-0.37 DDD-0.56 DDT-0.033
2010150-002A 2010150-002B 2010150-002C	5/21/2010 5/21/2010 5/21/2010	YP YP YP	249 212 213	200 120 120	2010150-002	0.068H	0.12	ND	ND
2010150-003A 2010150-003B 2010150-003C	5/21/2010 5/21/2010 5/21/2010	B B B	197 192 181	160 160 120	2010150-003	0.16H	0.18	ND	DDE-0.014M DDD-0.015M
2010150-004A 2010150-004B 2010150-004C	5/21/2010 5/21/2010 5/21/2010	WP WP WP	201 182 185	100 80 100	2010150-004	0.11H	0.26	ND	DDE-0.030 DDD-0.022
2010150-005A 2010150-005B	5/21/2010 5/21/2010	LMB LMB	343 343	710 640	2010150-005	0.15H	0.06	ND	ND

Table 1. Continued Analytical Results for 2010 Fish Toxics Monitoring Public Request Surveys. Results reported in wet weight, are from composite samples of fish fillets (skin off).

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Total Hg (mg/kg)	% Lipids (%)	PCB Arochlors (µg/g)	Pesticides (µg/g)
Lake Mattawa, Orange, Chicopee River Watershed									
2010147-001A	6/10/2010	LMB	390	840	2010147-001	0.41H,J	-	--	-
2010147-001B	6/10/2010	LMB	410	920					
2010147-001C	6/10/2010	LMB	410	950					
2010147-002A	6/10/2010	LMB	330	500	2010147-002	0.29H,J	-	-	-
2010147-002B	6/10/2010	LMB	353	580					
2010147-002C	6/10/2010	LMB	355	570					
2010147-003A	6/10/2010	B	240	290	2010147-003	0.14H,J	-	-	-
2010147-003B	6/10/2010	B	186	140					
2010147-003C	6/10/2010	B	165	100					
2010147-004A	6/10/2010	BB	359	730	2010147-004	0.29H,J	-	-	-
2010147-004B	6/10/2010	YB	311	450					
2010147-004C	6/10/2010	YB	285	320					
Moores Pond, Warwick, Millers River Watershed									
2010148-001A	5/26/2010	AE	726	720	2010148-001	0.53H	-	-	-
2010148-001B	5/26/2010	AE	701	780					
2010148-001C	5/26/2010	AE	726	950					
2010148-002A	5/26/2010	BB	301	420	2010148-002	0.16H	-	-	-
2010148-002B	5/26/2010	BB	310	410					
2010148-002C	5/26/2010	BB	315	400					
2010148-003A	5/26/2010	B	203	170	2010148-003	0.21H	-	-	-
2010148-003B	5/26/2010	B	202	170					
2010148-003C	5/26/2010	B	199	180					
2010148-004A	5/26/2010	CP	312	200	2010148-004	0.53H	-	-	-
2010148-004B	5/26/2010	CP	331	200					
2010148-004C	5/26/2010	CP	286	160					

Table 1. Continued Analytical Results for 2010 Fish Toxics Monitoring Public Request Surveys. Results reported in wet weight, are from composite samples of fish fillets (skin off).

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Total Hg (mg/kg)	% Lipids (%)	PCB Arochlors (µg/g)	Pesticides (µg/g)
Pleasant Pond, Wenham/Groveland, Ipswich River Watershed									
2010145-001A	6/16/2010	LMB	410	1020	2010145-001	0.83	-	-	-
2010145-001B	6/16/2010	LMB	423	1030					
2010145-001C	6/16/2010	LMB	329	490					
2010145-002A	6/16/2010	YP	216	120	2010145-002	0.11	-	-	-
2010145-002B	6/16/2010	YP	205	100					
2010145-002C	6/16/2010	YP	186	80					
2010145-003A	6/16/2010	B	191	170	2010145-003	0.044	-	-	-
2010145-003B	6/16/2010	B	196	160					
2010145-003C	6/16/2010	B	199	150					
2010145-004A	6/16/2010	BB	301	300	2010145-004	0.20	-	-	-
2010145-004B	6/16/2010	BB	290	240					
2010145-004C	6/16/2010	BB	326	410					

[1] Species Code	Common Name	*Scientific name*	Data Qualifiers as reported by WES
			H = USEPA holding time exceeded. Holding time not met but previous studies by WES show that frozen fish samples are stable for mercury for at least one year.
AE	American eel	*Anguilla rostrata*	J = Duplicates were run on two samples from this lake. The RPDs were above 20 for both samples.
B	bluegill	*Lepomis macrochirus*	M = analyte concentration greater than Method Detection Limit but less than Minimum Reporting Limit
BB	brown bullhead	*Ameiurus nebulosus*	ND = analyzed for, but not detected above Method Detection Level
C	common carp	*Cyprinus carpio*	- = not analyzed for
CP	chain pickerel	*Esox niger*	
LMB	largemouth bass	*Micropterus salmoides*	
WP	white perch	*Morone Americana*	
YB	yellow bullhead	*Ameiurus natalis*	
YP	yellow perch	*Perca flavescens*	

Table 2. 2010 Fish Toxics Analytical Methods, Project Quantitation Limits, Method Detection and Reporting Detection Limits.

Analyte/Compound	Units	Project Quantitation Limit (PQL)	Achievable Laboratory Method Detection Limit (MDL)	Laboratory Reporting Detection Limit (RDL)	Method
Lipid Concentration	%	N/A	N/A	N/A	Modified AOAC 983.21
Mercury	ug/g wet	0.5*	0.020	0.060	EPA 7473
PCB Arochlor 1232	µg/g wet	1.0** (total)	0.019	0.057	Modified AOAC 983.21
PCB Arochlor 1242	µg/g wet	1.0** (total)	0.043	0.13	Modified AOAC 983.21
PCB Arochlor 1248	µg/g wet	1.0** (total)	0.038	0.11	Modified AOAC 983.21
PCB Arochlor 1254	µg/g wet	1.0** (total)	0.038	0.11	Modified AOAC 983.21
PCB Arochlor 1260	µg/g wet	1.0** (total)	0.031	0.093	Modified AOAC 983.21
Chlordane	µg/g wet	0.3***	0.11	0.33	Modified AOAC 983.21
Toxaphene	µg/g wet	Unknown	0.25	0.75	Modified AOAC 983.21
a-BHC	µg/g wet	Unknown	0.0060	0.018	Modified AOAC 983.21
b-BHC	µg/g wet	Unknown	0.010	0.030	Modified AOAC 983.21
Lindane	µg/g wet	Unknown	0.0060	0.018	Modified AOAC 983.21
d-BHC	µg/g wet	Unknown	0.028	0.084	Modified AOAC 983.21
Endrin	µg/g wet	Unknown	0.0036	0.011	Modified AOAC 983.21
Endosulfan I	µg/g wet	Unknown	0.021	0.063	Modified AOAC 983.21
Hexachlorocyclopentadiene	µg/g wet	Unknown	0.10	0.30	Modified AOAC 983.21
Hexachlorobenzene	µg/g wet	Unknown	0.084	0.25	Modified AOAC 983.21
Trifluralin	µg/g wet	Unknown	0.047	0.14	Modified AOAC 983.21
Heptachlor	µg/g wet	0.3***	0.0060	0.018	Modified AOAC 983.21
Heptachlor Epoxide	µg/g wet	Unknown	0.014	0.043	Modified AOAC 983.21
Methoxychlor	µg/g wet	Unknown	0.026	0.078	Modified AOAC 983.21
DDD	µg/g wet	0.06**(total)	0.0070	0.021	Modified AOAC 983.21
DDE	µg/g wet	0.06**(total)	0.010	0.030	Modified AOAC 983.21
DDT	µg/g wet	0.06**(total)	0.011	0.033	Modified AOAC 983.21
Aldrin	µg/g wet	5.0***	0.0080	0.024	Modified AOAC 983.21
PCNB	% recovery	NA	NA	NA	Modified AOAC 983.21

Notes:
* MDPH trigger level
** MDPH trigger level for "total arochlors and/or total DDT and metabolites DDD and DDE
*** USFDA Action Level
1) "NA"= Not Applicable, no data provided
2) "Unknown" = no information available or no Data Quality Objective defined at this time.
3) Analyte MDL/RDL values are based on most recent analyses by WES (2004), and as all Detection Limit values, subject to change.
4) Methods
-EPA 7473 – Mercury in Tissues by Cold Vapor
-Modified AOAC 983.21 - Organochlorine Pesticide and Polychlorinated Biphenyl Residues in Fish, Gas Chromatographic Method, Method 983.21. In Association of Official Analytical Chemists (AOAC) Official Methods of Analysis, 15th ed., AOAC, Arlington, VA.

Appendix B

Interagency Committee on Freshwater Fish Toxics Monitoring and Assessment

MEMORANDUM OF UNDERSTANDING
April 1994

MEMBERSHIP: The Committee is comprised of representatives from the following Departments and programs:

- Department of Environmental Protection -
  - Office of Watershed Management (OWM)
  - Division of Water Pollution Control (DWPC)
  - Office of Research and Standards (ORS)
  - Division of Environmental Analysis (DEA)
- Department of Public Health
  - Environmental Toxicology Program (ETP)
  - Physician Education Unit (PEU)
  - Community Assessment Unit (CAU)
  - Environmental Laboratory (EL)
- Department of Fisheries, Wildlife and Environmental Law Enforcement
  - Division of Fisheries and Wildlife (DFW)

INTRODUCTION: The freshwater fish toxics testing efforts of Massachusetts are headed by the MA Department of Environmental Protection (DEP) in cooperation with the MA Department of Public Health (DPH), the Department of Fisheries, Wildlife and Environmental Law Enforcement (DFWELE). The DPH leads efforts to determine the public health impacts of consuming contaminated fish from various locations. These collaborative efforts ensure the state's ability to conduct limited testing and evaluation of contaminants in fish tissue for purposes of protecting public health and the environment. This Memorandum of Understanding (MOU) is limited to the freshwater environment.

PURPOSE: This Memorandum of Understanding is issued by the Interagency Committee to formalize and communicate its goals, objectives and responsibilities for monitoring and assessing toxic contaminants in fresh water fish in Massachusetts.

AUTHORITY: Specific legal mandates do not exist for testing freshwater fish for toxic contaminants. This work, however, is viewed as desirable by the three agencies relative to their respective authorities and mandates, including but not limited to, protecting public health, controlling toxic substances in the environment and protecting wildlife resources. This committee does not have responsibility to direct testing of fish for contaminants at hazardous material sites, but does participate in the process as part of the Superfund programs.

OBJECTIVES: The primary objective of the MOU is to establish a formal interagency mechanism to facilitate the communication, coordination and

dissemination of information pertaining to contaminants in freshwater fish. The objectives of the fish monitoring efforts are described below. Monitoring and assessment activities are planned annually and are based on the agencies' respective available resources. Therefore, in any given year, the scope of the monitoring and assessment efforts may or may not fulfill some or all of the following objectives.

- To determine the public health impacts from human consumption of contaminated fish species from various freshwater bodies in the Commonwealth.
- To develop appropriate technical support documents and public health advisories.
- To develop outreach strategies and environmental education programs for health care professionals, local health agencies and the potentially exposed target populations.
- To coordinate posting efforts with appropriate local, state and federal agencies.
- To provide information useful in managing and controlling toxic pollutants.
- To provide fish monitoring data for use as part of the overall assessment of the health of ecosystems.
- To respond to public requests for fish testing through a standardized questionnaire and ranking process to identify priority sites to be tested.
- To establish and maintain a statewide toxics-in-fish database for use by state and federal agencies, research and educational institutions and other interested parties.
- To conduct research and development projects to enhance fish monitoring activities and the overall health of the fish populations and associated ecosystems of the Commonwealth.

RESPONSIBILITIES: Each of the three agencies named in this MOU have responsibilities unique to its mission. Specific responsibilities that relate to current activities are described below:

- All members of the Interagency Committee participate in the overall planning of the Massachusetts fish toxics program, including the prioritization of testing sites, publication of fish toxics data and their use in assessing the health of ecosystems in Massachusetts.
- The Director of the Office of Research and Standards chairs and coordinates the activities of the Interagency Committee.
- DPH-ETP will formalize a protocol for evaluating the public health risks of consuming contaminated fish. DEP-ORS will work closely with DPH on this protocol to ensure that DEP's risk analysis program is considered.
- DPH-ETP will develop a standard interim protocol for development of fish advisories by spring of 1994. DPH is responsible for decisions regarding the need for public health advisories and for implementing them.

- DPH-ETP in conjunction with DPH-CAU will identify & notify human populations whose health may be affected due to consumption of contaminated fish.
- DPH-ETP in conjunction with DPH-PEU will provide relevant health information to health professionals (Boards of Health, medical community, etc.) and the public regarding potential hazards related to consumption of contaminated fish.
- DEP-OWM will plan and conduct annual fish sampling efforts in conjunction with DFWELE-DFW. DEP-OWM will collect and prepare fish samples, manage data and report results to the committee.
- DEP-OWM will utilize monitoring results for decisions on NPDES permits, for managing nonpoint pollution sources and to provide information for the Chapter 21E site discovery program in cases where oil and hazardous material contaminant levels are found in fish.
- DEP-DWPC will use monitoring results for determining compliance with Surface Water Quality Criteria and water use impairments.
- DFW is responsible for managing and regulating fishing as well as protecting, maintaining, and restorating the Commonwealth's freshwater fish populations.
- DEP-DEA provides QA/QC technical support to the OWM and the Interagency Committee dealing with fish sampling and sample management.
- DEP-DEA analyzes fish and related samples for toxic chemicals and other contaminants, and provides the validated data to the OWM and the Interagency Committee. DPH-EL will provide review and comment on analytical laboratory issues.
- In cooperation with the OWM and the Interagency Committee, DEP-DEA & ORS conduct and publish research dealing with the development and improvement of methods for the analysis of toxic and other contaminants in fish and other aquatic organisms; this includes evaluation of methods for assessing the exposure of fish populations to toxicants (e.g., approaches involving biomarkers and toxicity testing).
- DEP-DEA & ORS advise the OWM and the Interagency Committee on all matters related to the laboratory analysis of fish samples.

MEETINGS: Meetings are scheduled as needed. Meetings in the fall and early winter months generally focus on planning annual sampling activities. Spring meetings generally focus on the evaluations of laboratory analyses and appropriate agency responses.

This MOU will be reviewed and revised as necessary on an annual basis. The following signatures indicate that the three participating agencies view their work duties as set forth in this Memorandum of Understanding as being part of their respective responsibilities for controlling toxic contaminants in the environment, protecting the public health and protecting wildlife resources.

Tom Powers
Acting Commissioner
Department of Environmental Protection

David Mulligan
Commissioner
Department of Public Health

Wayne F. MacCallum
Director
Division of Fisheries & Wildlife
Department of Wildlife & Environmental Law Enforcement

Appendix C

FORM FOR REQUESTING FISH TESTING

The following information will be reviewed by representatives of the Departments of Environmental Protection, Public Health and Fisheries and Wildlife to reach a decision regarding the need for the state to conduct freshwater fish toxics testing. Please answer these questions to the extent possible.

1. Name of the pond/lake river:_____

2. Location (city/town):_____

3. Why do you think that testing is necessary?_____

_____

_____

_____

4. If known, what type of testing is requested? Please state what chemical(s) or compounds are suspected:

_____

_____

5. Do you know of any private testing that has been done at this location? If so, please submit the results, including the quality assurance and control data:_____

_____

_____

_____

_____

6. Do you and your family fish at this location? (Please check one):

Yes___ No___

7. Please estimate how many fish meals you and your family consume over the course of a year of fish caught at this location? (Please check one):

None (0)____ One (1) Meal a Month _____ 2-4 Meals a Month_____

8. What kind of fish do you eat from this location?:_____

_____

_____

_____

_____

9. Please not below any additional information you think might be useful in reviewing this request (Example: known or suspected pollution source):

_____

_____

_____

_____

_____

_____

Your Name: _____

Address: _____

Telephone: _____

Thank you for taking the time to provide us with the above information. We will consider your request and will respond to you in mid to late February.

Please return this form to:

Robert Maietta
Department of Environmental Protection
Division of Watershed Management
627 Main Street, 2nd Floor
Worcester, MA 01608

Appendix D

CRITERIA FOR RANKING FISH TOXICS TESTING REQUESTS

Criteria for evaluating and ranking requested fish toxics studies have been developed for the purpose of ensuring that the state's fish toxics testing efforts are aimed at the situations that are most critical for protecting public health and the environment. In addition to prioritizing state efforts, the criteria and ranking scheme provide that all requested studies will be evaluated consistently.

A requested fish testing study will fall into one of four possible categories, where Category A is the highest priority and Category D is the lowest. Table 1 is followed by specific definitions of the criteria used.

TABLE 1

CATEGORY A		
	1.	The location is **heavily-fished**, and
	2.	Have **strong evidence** which indicates a potential for fish contamination.
CATEGORY B		
B1	1.	The location is **moderately-fished**, and
	2.	Have **strong evidence** which indicates a potential for fish contamination.
B2	1.	The location is **heavily-fished**, and
	2.	Have **some evidence** which indicates a potential for fish contamination.
CATEGORY C		
C1	1.	The location is **lightly-fished**, and
	2.	Have **strong evidence** which indicates a potential for fish contamination.
C2	1.	The location is **moderately-fished**, and
	2.	Have **some evidence** which indicates a potential for fish contamination.
C3	1.	The location is **heavily-fished**, and
	2.	Have **no evidence** which indicates a potential for fish contamination.
CATEGORY D		
D1	1.	The location is **lightly-fished**, and
	2.	Have **some or no evidence** which indicates a potential for fish contamination.
D2	1.	The location is **moderately-fished**, and
	2.	Have **no evidence** which indicates a potential for fish contamination.

DEFINITION OF CRITERIA

A. Criteria to estimate the frequency of exposure to fish that is consumed from a *single* location over the course of a year.

1. **Heavily-fished** - the location is one where the amount of fish caught comprise a substantial fraction of diets of individuals. A substantial fraction of the diet is classified when it is estimated that the number of fish meals exceeds four per month or when in the range of two to four meals per month.
2. **Moderately-fished** - the location is one where the amount of fish caught comprise some fairly consistent fraction of diets of individuals and is at a moderate level. A moderate level of fish consumption is classified when the number of fish meals is estimated at one a month throughout the year.
3. **Lightly-fished** - information indicates that fishing and consumption of fish from the location is rare or null.

B. Criteria to estimate the weight of evidence for a potential fish contamination problem at a given location.

1. **Strong evidence** – exists when there is knowledge that

    a. known sources release chemicals into the location (sources include point and/or nonpoint sources), and

    b. the chemicals are ones that tend to bioaccumulate/biomagnify in fish (ex. mercury, PCBs) and have been associated with human health effects traced to the consumption of contaminated fish.

    c. In addition to the above or in combination with either (a) or (b), the fish populations at the location have been shown to indicate evidence of toxic exposure, for example, fish are contaminated or are exposed to toxics associated with fish tumors, lesions, abnormal growth, or reproductive effects.

2. **Some evidence** – exists when there is knowledge that

    a. known sources release chemicals into the location (sources include point and/or nonpoint sources), and

    b. the chemicals are ones that do not bioaccumulate/biomagnify extensively in fish (ex. heavy metals) and have not been commonly associated with human health effects traced to the consumption of contaminated fish.

    c. The fish populations at the location have not been shown to indicate evidence of toxic exposure to toxics associated with fish tumors, lesions, abnormal growth, or reproductive effects.