APPENDIX B
Cape Cod Coastal Watershed
Summary of Fish Toxics Monitoring 2001 through 2009

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 (WES); 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 if consumed, and identify waters where toxic contaminants may impact fish and other wildlife.

Historically, mercury concentrations in largemouth bass collected from Wequaquet Lake in Barnstable were found to be elevated based on sampling conducted by MassDEP in October 1994 (Appendix B in DeCesare and Connors 2002). Subsequent sampling of fish from Wequaquet Lake was conducted in 2001, 2002, 2004, 2006, and 2008 as part of the MassDEP ORS Mercury Research Project (analysis of edible fillets conducted for Hg) (MassDEP 2006, Maietta 2007, Rose 2008). Fish from Dyer Pond in Wellfleet, Crystal Lake in Orleans, Slough, Round (East), and Horseleach ponds in Truro were also collected by a consultant and were analyzed for mercury at WES as part of the MassDEP ORS Mercury Research Project (Rose 2008). Additionally, fish from the following waterbodies were also collected by DWM to fulfill public requests and have been tested for mercury (Maietta 2007, Rose 2008, MassDEP 2008, and Maietta et al. 2010):

In 2006: Great, Herring, Duck, and Gull ponds in Wellfleet and Ryder Pond in Truro
In 2007: Baker Pond and Pilgrim Lake in Orleans, Snow and Great ponds in Truro, and Long Pond in Wellfleet,
In 2008: Spectacle and Kinnacum ponds in Wellfleet and Round Pond West in Truro
In 2009: Spectacle, Lawrence, and Peters ponds in Sandwich, Cliff Pond in Brewster, and Long Pond in Harwich.

Fish toxics monitoring was also conducted at eight additional ponds on Cape Cod in 2001 - Peters and Lawrence ponds in Sandwich, Hamblin and Shubael ponds in Barnstable, Hinckleys Pond in Harwich, Long Pond in Brewster/Harwich, Cliff and Sheep ponds in Brewster (Michaud 2008). This study was funded by a USEPA Special Purpose Grant to the Cape Cod Commission. Results of this study were submitted to MA DPH which issued fish consumption advisories as they deemed appropriate.

Methods

Field sampling methods are described in detail in the two project reports as well as the sample handling and preparation methods (MassDEP 1997 and MassDEP 2006). The analytical methods employed by the laboratory and precision and accuracy data are also described.

Results

The summary results of MassDEP ORS Mercury Research Project sampling for Wequaquet Lake are provided in Table B1. The fish toxics monitoring data generated from 2001, 2002, and 2004 surveys were excerpted from two reports published by the Department (MassDEP 1997 and MassDEP 2006) and no additional data validation procedures were conducted by DWM. The Wequaquet Lake 2004, 2006 and 2008 survey data were verified against the laboratory reports and the mean concentrations are also presented in Table 1. All raw data files, field sheets, lab reports, chain of custody forms, data entry QC documentation, and other metadata may be requested from MassDEP. Mercury data for fish collected by DWM from Ryder Pond in Truro and Herring, Great, Gull, and Duck ponds in Wellfleet in 2006 are summarized in Table B2 (Maietta *et al*. 2009). Mercury data for fish collected by DWM from Long Pond, Wellfleet, Snow and Great ponds, Truro, Baker Pond and Pilgrim Lake, Orleans in 2007 are summarized in Table B3 (Maietta *et al*. 2008). Mercury data for fish collected by DWM from Round Pond West, Truro and Kinnacum and Spectacle ponds, Wellfleet in 2008 are summarized in Table B4 (MassDEP 2008). Mercury data for fish collected in 2007 from Dyer Pond, Wellfleet, Slough Pond, Truro, and Crystal Lake, Orleans can be found in Tables B5, B6, and B7, respectively and for fish collected in 2008 from Round Pond East and Horseleach Ponds in Truro can be found in Tables B8 and B9, respectively (MassDEP 2008). Mercury data for fish collected in 2009, Spectacle, Lawrence, and Peters ponds in Sandwich, Cliff Pond in Brewster, and Long Pond in Harwich, can be found in Table B10 (Maietta *et al*. 2010).

Table B1. Summary of mean mercury concentrations (wet weight) in *Wequaquet Lake* fish tissue as reported by MassDEP (MassDEP 1997 and DeCesare and Connors 2002), the MassDEP ORS Mercury Research Project 1999 – 2004 (MassDEP 2006), and as calculated from 2006 and 2008 data (MassDEP 2008).

Sampling Year	Species Code[1]	Mean Hg concentration (µg/g)	Sample size (n)
1994	YP	0.103[2]	1 (five-fish composite)
1994	LMB	0.544[2]	1 (five-fish composite)
1994	BB	0.385[2]	1 (four-fish composite)
2001	YP	0.489	30
2001	LMB	0.554	30
2002	YP	0.380	30
2004	YP	0.296	30
2004	LMB	0.842	12
2006	YP	0.29H[3]	30
2006	LMB	0.91H[3]	15
2008	YP	0.33H[3]	30
2008	LMB	0.82H[3]	15

[1] Species code: YP = yellow perch (*Perca flavescens*), LMB = largemouth bass (*Micropterus salmoides*), BB = brown bullhead (*Ameiurus nebulosus*),

[2] Represents single sample concentration

[3] Data qualifier as reported by WES: H = USEPA holding time exceeded. Holding time not met but previous studies by Wall Experiment Station (WES) show that frozen fish samples are stable for mercury for at least one year.

Table B2. Analytical Fish Tissue Monitoring Results for Ryder Pond, Truro, and Herring, Great, Gull, and Duck ponds, Wellfleet sampled by DWM biologists in 2006 (Maietta *et al*. 2009). Results are reported in wet weight, fish fillets (skin off).

Sample ID	Collection Date	Species[1]	Length (mm)	Weight (g)	Laboratory Sample ID#	Hg (mg/kg)
Ryder Pond, Truro						
RP06-001	5/24/06	yellow perch	361	480	2006172-001	2.4H[2]
RP06-002	5/24/06	yellow perch	382	630	2006172-002	1.9H
RP06-003	5/24/06	yellow perch	364	560	2006172-003	1.5H
RP06-004	5/24/06	yellow perch	339	450	2006172-004	1.8H
RP06-005	5/24/06	yellow perch	355	480	2006172-005	1.7H
RP06-006	5/24/06	yellow perch	337	390	2006172-006	1.3H
RP06-007	5/24/06	yellow perch	263	160	2006172-007	0.47H
Herring Pond, Wellfleet						
HP06-001	5/24/06	white perch	266	300	2006171-001	0.19H
HP06-002	5/24/06	white perch	270	280	2006171-002	0.32H
HP06-003	5/24/06	white perch	280	300	2006171-003	0.29H
HP06-004	5/24/06	white perch	270	290	2006171-004	0.18H
HP06-005	5/24/06	white perch	278	290	2006171-005	0.28H
HP06-006	5/24/06	white perch	284	320	2006171-006	0.21H
HP06-007	5/24/06	white perch	284	300	2006171-007	0.26H
Great Pond, Wellfleet						
GT06-001	5/25/06	yellow perch	251	160	2006175-001	1.4H
GT06-002	5/25/06	yellow perch	218	120	2006175-002	0.80H
GT06-003	5/25/06	yellow perch	202	70	2006175-003	0.80H
GT06-004	5/25/06	yellow perch	177	60	2006175-004	0.87H
GT06-005	5/25/06	yellow perch	156	40	2006175-005	0.88H
GT06-006	5/25/06	yellow perch	230	120	2006175-006	0.86H
GT06-007	5/25/06	yellow perch	172	40	2006175-007	0.89H
Gull Pond, Wellfleet						
GP06-001	5/25/06	white perch	244	180	2006173-001	0.33H
GP06-002	5/25/06	white perch	277	240	2006173-002	0.41H
GP06-003	5/25/06	white perch	265	220	2006173-003	0.36H
GP06-004	5/25/06	white perch	249	200	2006173-004	0.49H
GP06-005	5/25/06	white perch	272	250	2006173-005	0.38H
GP06-006	5/25/06	white perch	255	200	2006173-006	0.48H
GP06-007	5/25/06	white perch	231	170	2006173-007	0.22H
Duck Pond, Wellfleet						
DP06-001	5/25/06	yellow perch	360	490	2006174-001	2.2H
DP06-002	5/25/06	yellow perch	320	400	2006174-002	1.6H
DP06-003	5/25/06	yellow perch	330	400	2006174-003	1.7H
DP06-004	5/25/06	yellow perch	374	460	2006174-004	2.3H
DP06-005	5/25/06	yellow perch	341	500	2006174-005	1.5H
DP06-006	5/25/06	yellow perch	160	40	2006174-006	0.67H
DP06-007	5/25/06	yellow perch	137	20	2006174-007	0.49H

[1] **Common Name (*Scientific Name*)**

white perch (*Morone Americana*),
yellow perch (*Perca flavescens*)

Data Qualifiers[2] as reported by WES

H = USEPA holding time exceeded. Holding time not met but previous studies by Wall Experiment Station (WES) show that frozen fish samples are stable for mercury for at least one year.

Table B3. Analytical Fish Tissue Monitoring Results for Long Pond, Wellfleet, Snow and Great ponds, Truro, Baker Pond and Pilgrim Lake, Orleans sampled by DWM biologists in 2007 (Maietta *et al*. 2008). Results, reported in wet weight, are from two or three fish composite or individual samples of fish fillets (skin off).

Sample ID	Collection Date(s)	Species[1]	Length (mm)	Weight (g)	Sample ID (laboratory sample #)	Hg (µg/g)
Long Pond, Wellfleet, Cape Cod Coastal Watershed						
LPF07-1	5/22-23/07	Yellow perch	330	340	2007172-001	2.4H[2]
LPF07-2	5/22-23/07	Yellow perch	320	210		
LPF07-3	5/22-23/07	Yellow perch	326	330		
Snow Pond, Truro, Cape Cod Coastal Watershed						
SPF07-1	5/23-24/07	largemouth bass	345	520	2007175-001	0.64H
SPF07-2	5/23-24/07	largemouth bass	349	520		
SPF07-3	5/23-24/07	largemouth bass	296	300	2007175-002	0.47H
SPF07-4	5/23-24/07	largemouth bass	305	330		
Great Pond, Truro, Cape Cod Coastal Watershed						
GPF07-1	5/22-24/07	yellow perch	274	210	2007173-001	0.83H
GPF07-2	5/22-24/07	yellow perch	279	250		
GPF07-3	5/22-24/07	yellow perch	252	170		
GPF07-4	5/22-24/07	brown bullhead	220	140	2007173-002	0.16H
GPF07-5	5/22-24/07	brown bullhead	222	160		
GPF07-6	5/22-24/07	brown bullhead	215	140		
GPF07-7	5/22-24/07	smallmouth bass	388	640	2007173-003	0.98H
GPF07-8	5/22-24/07	smallmouth bass	382	660		
GPF07-9	5/22-24/07	smallmouth bass	430	960		
Baker Pond, Orleans, Cape Cod Coastal Watershed						
BPF07-1	6/27/07	largemouth bass	315	500	2007264-001	0.48H
BPF07-2	6/27/07	largemouth bass	334	620		
BPF07-3	6/27/07	largemouth bass	320	560		
BPF07-4	6/27/07	pumpkinseed	142	80	2007264-002	0.20H
BPF07-5	6/27/07	pumpkinseed	147	90		
BPF07-6	6/27/07	pumpkinseed	136	80		
BPF07-7	6/27/07	yellow perch	197	100	2007264-003	0.50H
BPF07-8	6/27/07	yellow perch	180	70		
BPF07-9	6/27/07	yellow perch	166	60		
BPF07-10	6/27/07	brown bullhead	228	120	2007264-004	0.14H
BPF07-11	6/27/07	brown bullhead	207	120		
BPF07-12	6/27/07	brown bullhead	225	150		
Pilgrim Lake, Orleans, Cape Cod Coastal Watershed						
PLF07-1	6/28/07	largemouth bass	393	830	2007263-001	0.39H
PLF07-2	6/28/07	largemouth bass	380	770		
PLF07-3	6/28/07	largemouth bass	361	590		
PLF07-4	6/28/07	white perch	260	250	2007263-002	0.15H
PLF07-5	6/28/07	white perch	230	180		
PLF07-6	6/28/07	white perch	239	200		
PLF07-7	6/28/07	yellow perch	249	170	2007263-003	0.17H
PLF07-8	6/28/07	yellow perch	240	160		
PLF07-9	6/28/07	yellow perch	247	170		
PLF07-10	6/28/07	pumpkinseed	201	190	2007263-004	0.23H
PLF07-11	6/28/07	pumpkinseed	191	160		
PLF07-12	6/28/07	pumpkinseed	205	170		

[1] Common Name (*Scientific Name*)

brown bullhead (*Ameiurus nebulosus*), largemouth bass (*Micropterus salmoides*), pumpkinseed (*Lepomis gibbosus*), smallmouth bass (*Micropterus dolomieu*), white perch (*Morone Americana*), yellow perch (*Perca flavescens*)

Data Qualifiers[2] as reported by WES

H = USEPA holding time exceeded. Holding time not met but previous studies by Wall Experiment Station (WES) show that frozen fish samples are stable for mercury for at least one year.

Table B4. Analytical Fish Tissue Monitoring Results for Round Pond West, Truro, Kinnacum and Spectacle ponds, Wellfleet sampled by DWM biologists in 2008 (MassDEP 2008). Results, reported in wet weight, are from two or three fish composite samples of fish fillets (skin off).

Sample ID	Collection Date(s)	Species[1]	Length (mm)	Weight (g)	Sample ID (laboratory sample #)	Hg (µg/g)
Round Pond West, Truro, Cape Cod Coastal Watershed						
2008150-001A	5/27/08	Yellow perch	379	480	2008150-001	1.5
2008150-001B	5/27/08	Yellow perch	346	400		
2008150-001C	5/27/08	Yellow perch	376	500		
2008150-002A	5/27/08	Yellow perch	282	200	2008150-002	0.53
2008150-002B	5/27/08	Yellow perch	289	240		
2008150-002C	5/27/08	Yellow perch	268	170		
2008150-003A	5/27/08	Yellow perch	205	80	2008150-003	0.45
2008150-003B	5/27/08	Yellow perch	215	100		
2008150-003C	5/27/08	Yellow perch	204	70		
Kinnacum Pond, Wellfleet, Cape Cod Coastal Watershed						
2008148-001A	5/27/08	Yellow perch	295	300	2008148-001	0.36
2008148-001B	5/27/08	Yellow perch	290	280		
2008148-001C	5/27/08	Yellow perch	293	280		
2008148-002A	5/27/08	Yellow perch	364	580	2008148-002	0.63
2008148-002B	5/27/08	Yellow perch	399	840		
2008148-003A	5/27/08	Yellow perch	270	200	2008148-003	0.21
2008148-003B	5/27/08	Yellow perch	240	140		
2008148-003C	5/27/08	Yellow perch	231	120		
Spectacle Pond, Wellfleet, Cape Cod Coastal Watershed						
2008149-01A	5/27/2008	Largemouth bass	365	850	2008149-001	0.31
2008149-02A	5/27/2008	Yellow perch	211	60	2008149-002	0.63
2008149-02B	5/27/2008	Yellow perch	213	70		
2008149-02C	5/27/2008	Yellow perch	209	80		
2008149-03A	5/27/2008	Yellow perch	247	130	2008149-003	0.93
2008149-03B	5/27/2008	Yellow perch	255	160		
2008149-03C	5/27/2008	Yellow perch	259	160		

Table B5. Fish Tissue Monitoring Results MassDEP ORS Mercury Research Project sampling in Dyer Pond, Wellfleet (MassDEP 2008).

Sampling Year	Species Code[1]	Mean Hg concentration (µg/g)[2]	Sample size (n)
2007	YP	1.45H	30

[1] Species code: YP = yellow perch (*Perca flavescens*)
[2] Data qualifier as reported by WES: H = USEPA holding time exceeded. Holding time not met but previous studies by Wall Experiment Station (WES) show that frozen fish samples are stable for mercury for at least one year.

Table B6. Fish Tissue Monitoring Results MassDEP ORS Mercury Research Project sampling in Slough Pond, Truro (MassDEP 2008).

Sampling Year	Species Code[1]	Mean Hg concentration (µg/g)[2]	Sample size (n)
2007	YP	0.66H	30
2007	LMB	1.17H	12

[1] Species code: YP = yellow perch (*Perca flavescens*), LMB= largemouth bass (*Micropterus salmoides*)
[2] Data qualifier as reported by WES: H = USEPA holding time exceeded. Holding time not met but previous studies by Wall Experiment Station (WES) show that frozen fish samples are stable for mercury for at least one year.

Table B7. Fish Tissue Monitoring Results MassDEP ORS Mercury Research Project sampling in Crystal Lake, Orleans (MassDEP 2008).

Sampling Year	Species Code[1]	Mean Hg concentration (µg/g)[2]	Sample size (n)
2007	LMB	0.34H	15

[1] Species code: LMB= largemouth bass (*Micropterus salmoides*)
[2] Data qualifier as reported by WES: H = USEPA holding time exceeded. Holding time not met but previous studies by Wall Experiment Station (WES) show that frozen fish samples are stable for mercury for at least one year.

Table B8. Fish Tissue Monitoring Results MassDEP ORS Mercury Research Project sampling in Round Pond East, Truro (MassDEP 2008).

Sampling Year	Species Code[1]	Mean Hg concentration (µg/g)[2]	Sample size (n)
2008	YP	0.66H	30
2008	LMB	1.5H	15

[1] Species code: YP = yellow perch (*Perca flavescens*), LMB= largemouth bass (*Micropterus salmoides*)
[2] Data qualifier as reported by WES: H = USEPA holding time exceeded. Holding time not met but previous studies by Wall Experiment Station (WES) show that frozen fish samples are stable for mercury for at least one year.

Table B9. Fish Tissue Monitoring Results MassDEP ORS Mercury Research Project sampling in Horseleach Pond, Truro (MassDEP 2008).

Sampling Year	Species Code[1]	Mean Hg concentration (µg/g)[2]	Sample size (n)
2008	YP	0.23H	30
2008	LMB	0.67H	15

[1] Species code: YP = yellow perch (*Perca flavescens*), LMB= largemouth bass (*Micropterus salmoides*)
[2] Data qualifier as reported by WES: H = USEPA holding time exceeded. Holding time not met but previous studies by Wall Experiment Station (WES) show that frozen fish samples are stable for mercury for at least one year.

Table B10. Results of 2009 fish toxics monitoring in Cape Cod lakes excerpted from Maietta et al. 2010. 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 #)	Hg (mg/kg)
Spectacle Pond, Sandwich, Cape Cod Watershed						
2009150-001A	5/28/09	LMB	363	770	2009150-001	0.66H
2009150-001B	5/28/09	LMB	380	780		
2009150-001C	5/28/09	LMB	368	660		
2009150-002A	5/28/09	YP	249	220	2009150-002	0.23H
2009150-002B	5/28/09	YP	230	160		
2009150-002C	5/28/09	YP	219	130		
2009150-003A	5/28/09	SMB	320	480	2009150-003	0.58H
2009150-003B	5/28/09	SMB	330	480		
2009150-004A	5/28/09	SMB	425	940	2009150-004	1.1H
Cliff Pond, Brewster, Cape Cod Watershed						
2009143-001A	5/28/09	BB	290	280	2009143-001	0.28H
2009143-001B	5/28/09	BB	286	330		
2009143-001C	5/28/09	BB	251	200		
2009143-002A	5/28/09	YP	208	90	2009143-002	0.22H
2009143-002B	5/28/09	YP	188	80		
2009143-002C	5/28/09	YP	154	50		
2009143-003A	5/28/09	SMB	340	460	2009143-003	0.42H
2009143-003B	5/28/09	SMB	345	560		
2009143-003C	5/28/09	SMB	309	400		
2009143-004A	5/28/09	WS	369	530	2009143-004	0.19H
2009143-004B	5/28/09	WS	362	440		
2009143-004C	5/28/09	WS	368	480		

Table B10 (continued). Results of 2009 fish toxics monitoring in Cape Cod lakes excerpted from Maietta *et al*. 2010. 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 #)	Hg (mg/kg)
Lawrence Pond, Sandwich, Cape Cod Watershed						
2009141-001A	5/28/09	SMB	350	550	2009141-001	0.46H
2009141-001B	5/28/09	SMB	355	580		
2009141-001C	5/28/09	SMB	409	980		
2009141-002A	5/28/09	LMB	445	1280	2009141-002	0.97H
2009141-002B	5/28/09	LMB	391	820		
2009141-002C	5/28/09	LMB	423	1020		
2009141-003A	5/28/09	P	222	280	2009141-003	0.16H
2009141-003B	5/28/09	P	201	230		
2009141-003C	5/28/09	P	188	190		
2009141-004A	5/28/09	YP	280	300	2009141-004	0.18H
2009141-004B	5/28/09	YP	255	230		
2009141-004C	5/28/09	YP	245	200		
2009141-005A	5/28/09	CP	445	520	2009141-005	0.48H
2009141-005B	5/28/09	CP	445	500		
2009141-005C	5/28/09	CP	405	300		
Peters Pond, Sandwich, Cape Cod Watershed						
2009142-001A	5/29/09	SMB	436	1140	2009142-001	0.95H
2009142-001B	5/29/09	SMB	430	1090		
2009142-001C	5/29/09	SMB	430	1110		
2009142-002A	5/29/09	YP	312	430	2009142-002	0.53H
2009142-002B	5/29/09	YP	322	460		
2009142-002C	5/29/09	YP	317	430		
2009142-003A	5/29/09	P	227	280	2009142-003	0.18H
2009142-003B	5/29/09	B	213	230		
2009142-004A	5/29/09	LMB	430	1160	2009142-004	0.88H
2009142-004B	5/29/09	LMB	454	1270		
Long Pond, Brewster/Harwich,Cape Cod Watershed						
2009151-001A	9/23/09	SMB	470	1540	2009151-001	0.46H
2009151-001B	9/23/09	SMB	401	860		
2009151-002A	9/23/09	SMB	295	340	2009151-002	0.18H
2009151-002B	9/23/09	SMB	292	350		
2009151-003A	9/23/09	WS	446	850	2009151-003	0.20H
2009151-003B	9/23/09	WS	483	1070		
2009151-003C	9/23/09	WS	452	960		
2009151-004A	9/23/09	BB	270	320	2009151-004	0.11H
2009151-004B	9/23/09	BB	230	210		
2009151-005A	9/23/09	YP	365	580	2009151-005	0.47H

[1] Species Code	Common Name	*Scientific name*
B	bluegill	*Lepomis macrochirus*
BB	brown bullhead	A*meiurus nebulosus*
CP	chain pickerel	*Esox niger*
LMB	largemouth bass	*Micropterus salmoides*
P	pumpkinseed	*Lepomis gibbosus*
SMB	smallmouth bass	*Micropterus dolomieu*
WS	white sucker	*Catostomus commersoni*
YP	yellow perch	*Perca flavescens*

Data Qualifiers as reported by WES

H = USEPA holding time exceeded

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