

Table 3-1. Summary of Spring Sport Fish Survey Results for Black Bass

Tennessee Valley Authority Kingston, Tennessee

Location	Year	Catch Rate (#/hr)	% Parasites	% Anomalies
Emory River 2.5	2009	53.2	9.4%	1.3%
	2010	50.7	12.8%	2.6%
	2011	32.3	9.3%	5.7%
Clinch River 2.5	2002	51.8	0.0%	2.3%
	2003	48.1	0.3%	3.8%
	2004	42.7	0.4%	5.5%
	2005	42.0	3.6%	3.2%
	2009	62.7	13.0%	2.4%
	2010	59.7	6.7%	2.8%
	2011	27.8	9.6%	4.8%
	2011-B	31.0	10.2%	6.5%
Caney Creek	2002	78.0	0.2%	1.1%
	2003	61.2	0.5%	2.2%
	2004	58.5	0.9%	4.3%
	2005	52.3	1.3%	2.9%
	2006	42.5	0.8%	2.0%
	2007	65.5	1.8%	2.3%
	2008	93.3	2.9%	4.6%
	2009	71.5	8.9%	2.1%
	2010	96.5	7.1%	1.9%
	2011	56.3	4.7%	13.9%
Blue Springs	2002	44.7	0.0%	2.2%
	2003	52.2	0.0%	6.1%
	2004	45.7	0.4%	3.6%
	2005	51.5	0.6%	2.9%
	2006	60.2	0.0%	2.8%
	2007	50.2	3.3%	2.7%
	2008	67.2	5.2%	4.7%
	2009	53.8	10.2%	4.6%
	2010	56.3	8.6%	2.4%
	2011	46.0	5.4%	6.9%
Watts Bar Forebay	2002	53.5	0.0%	1.6%
	2003	65.0	0.5%	1.5%
	2004	60.8	0.5%	2.5%
	2005	45.7	0.7%	2.6%
	2006	51.8	0.0%	2.3%
	2007	45.8	3.6%	0.7%
	2008	61.3	7.3%	4.1%
	2009	64.7	8.5%	1.8%
	2010	75.8	4.4%	2.2%
	2011	54.3	5.8%	6.4%

#/hr = Number collected per hour.

% = Percent.

Table 3-2. Pre- and Post-Release Summary of Spring Sport Fish Survey Results for Black Bass
Tennessee Valley Authority Kingston, Tennessee

Location	Pre-Release¹			Post-Release²		
	Catch Rate (#/hr)	% Parasites	% Anomalies	Catch Rate (#/hr)	% Parasites	% Anomalies
Emory River 2.5	NA	NA	NA	45.4	10.5%	3.2%
Clinch River 2.5	46.2	1.1%	3.7%	50.6	9.9%	3.6%
Caney Creek	64.5	1.2%	2.8%	74.8	6.9%	6.0%
Blue Springs	53.1	1.4%	3.6%	52.0	8.1%	4.6%
Watts Bar Forebay	54.8	1.8%	2.2%	64.9	6.2%	3.5%
Reservoir Average:	54.6	1.4%	3.1%	57.5	8.3%	4.2%

Notes:

¹ Pre-release averages based on 2002 to 2005 for Clinch River 2.5 and 2002 to 2008 for Caney Creek, Blue Springs, and Watts Bar Forebay.

² Post-release averages for reservoir locations are based on 2009 to 2011; Clinch River 2.5 2011 data was averaged between two sampling events.

#/hr = Number collected per hour.

% = Percent.

NA = Not available.

Table 3-3. Summary of Spring Sport Fish Survey Recruitment for Largemouth Bass

Tennessee Valley Authority Kingston, Tennessee

Location	Pre-Release ¹		Post-Release ²	
	Year	Age 1 (#/hr) ³	Year	Age 1 (#/hr) ³
Emory River 2.5	2002	NA	2009	11.3
	2003	NA		
	2004	NA		
	2005	NA	2010	3.3
Site Average:		NA	2011	6.5
				7.0
Clinch River 2.5	2002	5.2	2009	10.8
	2003	1.5		
	2004	0.83		
	2005	1.7	2010	2.0
Site Average:		2.3	2011	3.8
				5.5

Notes:¹ Pre-release conditions are based on 2002 to 2005 for Clinch River 2.5 and 2002 to 2008 for Caney Creek, Blue Springs, and Watts Bar Forebay.² Post-release conditions are based on 2009 to 2011; Clinch River 2.5 2011 data was averaged between two sampling events.³ Age 1 size class defined as approximately 3 to 7 inches, based on information provided in Baker (2011b). Based on survey time of 12 locations per area and 30 minutes per location; yields 6 hours.

#/hr = Number collected per hour.

NA = Not available.

Table 3-4. Individual Metric Scores, Contributing Species, and Overall RFAI Scores for CRM 1.5, Autumn 2001-2010
 Tennessee Valley Authority Kingston, Tennessee

Table 3-4. Individual Metric Scores, Contributing Species, and Overall RFAI Scores for CRM 1.5, Autumn 2001-2010
 Tennessee Valley Authority Kingston, Tennessee

Clinch River Mile 1.5															
Metric		Gear	Common Name	2001		2003		2005		2007		2009		2010	
				Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
7	Percent non-indigenous species	Electrofishing	Common carp	<u>1.9%</u>	<u>2.5</u>	<u>2.3%</u>	<u>2.5</u>	<u>12.1%</u>	<u>0.5</u>	<u>0.9%</u>	<u>2.5%</u>	<u>11.0%</u>	<u>0.5</u>	<u>18.8%</u>	<u>0.5</u>
			Inland silverside	1.6%		1.9%		1.8%		0.6%		0.6%		0.4%	
			Striped bass	--	--	--	--	10.3%		0.3%		10.3%		18.3%	
			Yellow perch	0.3%		0.4%		--		--		0.1%		0.1%	
	Gill Netting		Common carp	<u>7.4%</u>	<u>1.5</u>	<u>9.8%</u>	<u>0.5</u>	<u>13.8%</u>	<u>0.5</u>	<u>13.0%</u>	<u>0.5</u>	<u>6.3%</u>	<u>1.5</u>	<u>9.8%</u>	<u>0.5</u>
			Hybrid striped-white bass	0.4%		3.5%		3.0%		2.6%		2.5%		4.0%	
			Striped bass	0.9%		--	--	--		--		--		--	
				6.1%		6.3%		10.8%		10.4%		3.8%		5.8%	
8	Number of top carnivore species	Combined	Black crappie	<u>11</u>	<u>5</u>	<u>12</u>	<u>5</u>	<u>11</u>	<u>5</u>	<u>10</u>	<u>5</u>	<u>10</u>	<u>5</u>	<u>12</u>	<u>5</u>
			Flathead catfish	12		1		--		2		2		4	
			Largemouth bass	6		15		7		8		1		11	
			Longnose gar	98		37		32		21		125		69	
			Rock bass	--	--	2		1		11		--		1	
			Sauger	--	--	--	--	--		--		3		3	
			Skipjack herring	4		4		8		--		14		5	
			Smallmouth bass	21		21		22		--		--		10	
			Spotted bass	6		2		21		1		23		8	
			Spotted gar	25		8		14		1		8		--	
			Walleye	--	--	1		--		1		1		--	
			White bass	5		6		6		1		3		17	
			White crappie	8		2		2		--		--		4	
			Yellow bass	19		22		14		5		5		32	
9	Percent top carnivores	Electrofishing	Black crappie	<u>10.7%</u>	<u>1.5</u>	<u>6.4%</u>	<u>1.5</u>	<u>5.3%</u>	<u>0.5</u>	<u>3.0%</u>	<u>0.5</u>	<u>5.9%</u>	<u>1.5</u>	<u>5.0%</u>	<u>0.5</u>
			Flathead catfish	0.1%		0.1%		--		--		--		0.2%	
			Hybrid bass	0.2%		0.8%		0.3%		0.1%		--		0.2%	
			Largemouth bass	--	--	--	--	--		--		--		--	
			Rock bass	8.0%		4.1%		2.6%		2.6%		4.6%		3.2%	
			Skipjack herring	--	--	--	--	--		--		0.1%		0.1%	
			Smallmouth bass	--	--	--	--	--		--		--		0.1%	
			Spotted bass	0.5%		0.2%		0.9%		0.1%		0.8%		0.3%	
			Spotted gar	1.5%		0.8%		1.2%		0.1%		0.4%		--	
			Striped bass	0.2%		--	--	0.3%		0.1%		--		0.1%	
			White bass	--	--	0.1%		--		--		0.0%		0.5%	
			White crappie	0.2%		0.2%		--		--		--		0.2%	
			Yellow bass	--	--	0.1%		--		--		--		--	
	Gill Netting		Black crappie	<u>42.0%</u>	<u>1.5</u>	<u>52.5%</u>	<u>2.5</u>	<u>48.6%</u>	<u>1.5</u>	<u>46.8%</u>	<u>1.5</u>	<u>37.9%</u>	<u>1.5</u>	<u>44.6%</u>	<u>1.5</u>
			Flathead catfish	4.8%		--	--	2.4%		2.6%		2.5%		0.6%	
			Hybrid striped x white bass	1.7%		5.6%		--		9.1%		1.3%		4.6%	
			Largemouth bass	0.9%		--	--	--		--		--		--	
			Longnose gar	1.7%		2.1%		1.8%		1.3%		2.5%		0.6%	
			Rock bass	--	--	1.4%		0.6%		14.3%		--		0.6%	
			Sauger	--	--	--	--	--		--		--		0.6%	
			Skipjack herring	1.7%		2.8%		4.8%		--		17.7%		2.9%	
			Spotted bass	9.1%		14.7%		13.2%		--		--		4.6%	
			Spotted gar	3.0%		0.7%		0.6%		--		1.3%		--	
			Striped bass	6.1%		6.3%		10.8%		10.4%		3.8%		5.8%	
			Walleye	--	--	--	--	--		1.3%		--		--	
			White bass	2.2%		3.5%		3.6%		1.3%		2.5%		5.2%	
			White crappie	2.6%		--	--	1.2%		--		--		0.6%	
			Yellow bass	8.2%		14.7%		8.4%		6.5%		6.3%		18.5%	

Table 3-4. Individual Metric Scores, Contributing Species, and Overall RFAI Scores for CRM 1.5, Autumn 2001-2010
 Tennessee Valley Authority Kingston, Tennessee

Clinch River Mile 1.5															
Metric		Gear	Common Name	2001		2003		2005		2007		2009		2010	
				Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
10	Percent omnivores	Electrofishing	Black buffalo	<u>25.2%</u>	<u>1.5</u>	<u>27.2%</u>	<u>1.5</u>	<u>32.2%</u>	<u>1.5</u>	<u>24.2%</u>	<u>1.5</u>	<u>9.5%</u>	<u>2.5</u>	<u>20.1%</u>	<u>2.5</u>
			Bluntnose minnow	--	--	--	--	0.2%	--	--	--	--	--	0.1%	
			Channel catfish	0.2%	--	1.6%	--	0.5%	--	0.5%	--	1.3%	--	3.9%	
			Common carp	1.6%	--	1.9%	--	1.8%	--	0.6%	--	0.5%	--	0.8%	
			Gizzard shad	21.6%	--	21.2%	--	29.4%	--	22.4%	--	6.9%	--	14.5%	
			Golden shiner	0.8%	--	0.6%	--	--	--	--	0.1%	--	--	--	
			River carpsucker	0.1%	--	--	--	--	--	--	--	--	--	--	
			Smallmouth buffalo	0.7%	--	1.3%	--	--	--	0.6%	--	0.1%	--	0.2%	
			Striped shiner	--	--	--	--	--	--	--	--	--	--	0.2%	
		Gill Netting	Black buffalo	<u>45.1%</u>	<u>1.5</u>	<u>1.5</u>	<u>37.1%</u>	<u>1.5</u>	<u>1.5</u>	<u>35.4%</u>	<u>1.5</u>	<u>39.0%</u>	<u>1.5</u>	<u>48.1%</u>	<u>0.5</u>
			Blue catfish	1.3%	--	--	10.5%	--	--	8.4%	--	9.1%	--	21.5%	--
			Channel catfish	13.9%	--	--	4.9%	--	--	3.0%	--	5.2%	--	8.9%	--
			Common carp	7.4%	--	--	3.5%	--	--	3.0%	--	2.6%	--	4.6%	--
			Gizzard shad	0.4%	--	--	14.7%	--	--	19.2%	--	14.3%	--	2.5%	--
			Smallmouth buffalo	16.9%	--	--	5.2%	--	--	3.5%	--	7.8%	--	12.7%	--
														17.3%	
11	Average number per run	Electrofishing		<u>77.9</u>	<u>0.5</u>	<u>54.9</u>	<u>0.5</u>	<u>64.7</u>	<u>0.5</u>	<u>52.1</u>	<u>0.5</u>	<u>142.1</u>	<u>1.5</u>	<u>115.8</u>	<u>1.5</u>
		Gill Netting		<u>23.1</u>	<u>1.5</u>	<u>14.3</u>	<u>1.5</u>	<u>16.7</u>	<u>1.5</u>	<u>7.7</u>	<u>0.5</u>	<u>7.9</u>	<u>0.5</u>	<u>17.3</u>	<u>1.5</u>
12	Percent anomalies	Electrofishing		<u>0.9</u>	<u>2.5</u>	<u>0.1</u>	<u>2.5</u>	<u>0.3</u>	<u>2.5</u>	<u>0.1</u>	<u>2.5</u>	<u>4.1</u>	<u>1.5</u>	<u>1.2</u>	<u>2.5</u>
		Gill Netting		<u>0.4</u>	<u>2.5</u>	<u>0</u>	<u>2.5</u>	<u>1.8</u>	<u>2.5</u>	<u>0</u>	<u>2.5</u>	<u>2.5</u>	<u>1.5</u>	<u>0.6</u>	<u>2.5</u>
RFAI Score				<u>42</u>		<u>44</u>		<u>41</u>		<u>34</u>		<u>36</u>		<u>42</u>	

% = Percent.

-- = No samples collected.

CRM = Clinch River Mile.

Obs = Observed.

RFAI = Reservoir Fish Assemblage Index.

Table 3-5. Individual Metric Scores, Contributing Species, and Overall RFAI Scores for CRM 4.4, Autumn 2001-2010
Tennessee Valley Authority Kingston, Tennessee

Clinch River Mile 4.4														
Metric	Gear	Common Name	2001		2003		2005		2007		2009		2010	
			Obs	Score										
6	Electrofishing	Bluegill	<u>52.2%</u>	<u>0.5</u>	<u>32.8%</u>	<u>1.5</u>	<u>36.1%</u>	<u>1.5</u>	<u>44.5%</u>	<u>0.5</u>	<u>36.4%</u>	<u>1.5</u>	<u>45.4%</u>	<u>0.5</u>
		Gizzard shad	52.2%	--	32.8%	--	--	36.1%	44.5%	--	36.4%	--	45.4%	--
	Gill Netting	Blue catfish	<u>16.9%</u>	<u>1.5</u>	<u>26.4%</u>	<u>1.5</u>	<u>11.0%</u>	<u>2.5</u>	<u>21.7%</u>	<u>1.5</u>	<u>25.5%</u>	<u>1.5</u>	<u>21.8%</u>	<u>1.5</u>
		Channel catfish	--	--	--	--	--	--	--	--	--	--	--	--
		Gizzard shad	--	--	26.4%	--	11.0%	--	21.7%	--	--	--	--	21.8%
		Striped bass	--	--	--	--	--	--	--	--	--	--	21.8%	--
		Yellow bass	16.9%	--	--	--	--	--	--	25.5%	--	--	--	--
7	Electrofishing	Common carp	<u>4.3%</u>	<u>1.5</u>	<u>1.8%</u>	<u>2.5</u>	<u>2.9%</u>	<u>2.5</u>	<u>4.8%</u>	<u>1.5</u>	<u>7.3%</u>	<u>0.5</u>	<u>22.3%</u>	<u>0.5</u>
		Inland silverside	3.8%	--	1.5%	--	1.9%	--	1.2%	--	1.0%	--	1.0%	--
		Yellow perch	--	--	--	--	0.9%	--	3.5%	--	6.2%	--	21.1%	--
	Gill Netting	Common carp	<u>4.7%</u>	<u>2.5</u>	<u>12.0%</u>	<u>0.5</u>	<u>16.5%</u>	<u>0.5</u>	<u>15.2%</u>	<u>0.5</u>	<u>7.6%</u>	<u>1.5</u>	<u>23.8%</u>	<u>0.5</u>
		Hybrid striped-white bass	3.8%	--	3.7%	--	6.4%	--	5.4%	--	3.8%	--	2.0%	--
		Striped bass	0.9%	--	8.3%	--	0.9%	--	9.8%	--	3.8%	--	21.8%	--
8	Combined	Black crappie	<u>10</u>	<u>5</u>	<u>12</u>	<u>5</u>	<u>10</u>	<u>5</u>	<u>9</u>	<u>5</u>	<u>10</u>	<u>5</u>	<u>12</u>	<u>5</u>
		Flathead catfish	5	--	2	--	3	--	--	--	3	--	3	--
		Largemouth bass	4	--	2	--	2	--	3	--	2	--	3	--
		Longnose gar	86	--	64	--	97	--	27	--	106	--	90	--
		Rock bass	--	--	--	--	--	--	--	--	3	--	--	--
		Sauger	9	--	4	--	6	--	5	--	12	--	5	--
		Skipjack herring	20	--	18	--	12	--	--	--	--	--	4	--
		Smallmouth bass	6	--	4	--	29	--	5	--	14	--	16	--
		Spotted bass	19	--	18	--	12	--	4	--	7	--	2	--
		Spotted gar	--	--	5	--	--	--	--	--	--	--	1	--
		Walleye	--	--	--	--	--	--	2	--	--	--	3	--
		White bass	17	--	6	--	2	--	3	--	2	--	12	--
		White crappie	1	--	1	--	3	--	--	--	2	--	3	--
		Yellow bass	38	--	32	--	9	--	8	--	28	--	3	--
		Black crappie	<u>12.2%</u>	<u>2.5</u>	<u>9.9%</u>	<u>1.5</u>	<u>11.1%</u>	<u>2.5</u>	<u>5.3%</u>	<u>0.5</u>	<u>8.1%</u>	<u>1.5</u>	<u>6.4%</u>	<u>1.5</u>
		Flathead catfish	0.2%	--	0.2%	--	0.3%	--	--	--	0.1%	--	0.2%	--
		Hybrid bass	0.1%	--	0.1%	--	0.1%	--	0.1%	--	--	--	--	0.1%
		Largemouth bass	--	--	--	--	--	--	--	--	--	--	0.1%	--
		Rock bass	9.2%	--	6.9%	--	7.4%	--	4.0%	--	6.4%	--	4.7%	--
		Skipjack herring	--	--	0.2%	--	--	--	--	--	--	--	--	--
		Smallmouth bass	0.7%	--	0.4%	--	2.0%	--	0.7%	--	0.9%	--	0.5%	--
		Spotted bass	1.6%	--	1.3%	--	1.0%	--	0.4%	--	0.3%	--	0.1%	--
		Spotted gar	--	--	0.6%	--	--	--	--	--	--	--	0.1%	--
		White bass	0.2%	--	--	--	--	--	--	--	--	--	0.5%	--
		White crappie	--	--	--	--	0.2%	--	--	--	0.1%	--	0.2%	--
		Yellow bass	0.2%	--	0.2%	--	0.1%	--	0.1%	--	0.1%	--	--	--

Table 3-5. Individual Metric Scores, Contributing Species, and Overall RFAI Scores for CRM 4.4, Autumn 2001-2010
Tennessee Valley Authority Kingston, Tennessee

			Clinch River Mile 4.4												
Metric	Gear	Common Name	2001		2003		2005		2007		2009		2010		
			Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	
9	Percent top carnivores (continued)	Gill Netting	44.1%	1.5	39.5%	1.5	42.1%	1.5	32.7%	1.5	49.1%	1.5	45.8%	1.5	
			Black crappie	1.4%	--	--	--	--	--	--	1.9%	--	--	--	
			Flathead catfish	1.4%	0.5%	0.9%	2.2%	1.9%	1.9%	1.9%	3.0%	5.0%	4.0%	--	
			Hybrid striped-white bass	--	--	0.9%	--	--	--	--	--	--	--	--	
			Largemouth bass	0.5%	0.9%	3.7%	--	--	1.1%	--	--	--	--	--	
			Longnose gar	--	0.5%	--	--	5.4%	11.3%	11.3%	5.0%	4.0%	--	--	
			Sauger	4.2%	1.9%	5.5%	5.4%	--	--	--	--	--	--	--	
			Skipjack herring	9.4%	7.4%	11.0%	--	--	--	--	--	--	--	--	
			Spotted bass	1.9%	2.8%	0.9%	1.1%	--	--	--	--	--	--	--	
			Striped bass	0.9%	8.3%	9.2%	9.8%	3.8%	3.8%	21.8%	21.8%	21.8%	21.8%	21.8%	
			Walleye	--	--	--	2.2%	--	--	--	3.0%	3.0%	3.0%	3.0%	
			White bass	7.0%	2.8%	1.8%	3.3%	1.9%	1.9%	1.9%	4.0%	4.0%	4.0%	4.0%	
			White crappie	0.5%	0.5%	0.9%	--	--	--	0.9%	--	--	--	--	
			Yellow bass	16.9%	13.9%	7.3%	7.6%	25.5%	25.5%	5.0%	5.0%	5.0%	5.0%	5.0%	
10	Percent omnivores	Electrofishing	15.3%	2.5	30.5%	1.5	39.1%	1.5	28.0%	1.5	15.6%	2.5	11.6%	2.5	
			Black buffalo	0.1%	0.3%	0.3%	--	0.3%	7.0%	0.1%	0.6%	0.2%	1.0%	0.6%	
			Bluntnose minnow	0.2%	0.2%	--	0.3%	1.5%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
			Channel catfish	0.8%	0.6%	0.5%	1.5%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	
			Common carp	3.8%	1.6%	1.9%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	
			Gizzard shad	9.5%	24.8%	36.1%	24.6%	6.4%	6.4%	6.4%	9.6%	9.6%	9.6%	9.6%	
			Golden shiner	0.1%	1.0%	--	0.1%	--	--	--	--	--	--	--	
		Gill Netting	Smallmouth buffalo	0.8%	2.0%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	
			Black buffalo	44.5%	1.5	51.9%	0.5	33.9%	1.5	45.6%	1.5	36.8%	1.5	35.7%	1.5
			Blue catfish	0.9%	--	--	--	14.1%	19.8%	--	--	--	--	--	
			Channel catfish	16.4%	12.0%	5.5%	4.6%	3.3%	10.4%	10.9%	10.9%	3.0%	3.0%	3.0%	
			Common carp	7.0%	4.2%	4.6%	5.4%	5.4%	3.8%	3.8%	2.0%	2.0%	2.0%	2.0%	
			Gizzard shad	3.8%	3.7%	6.4%	11.0%	21.7%	1.9%	1.9%	15.8%	15.8%	15.8%	15.8%	
11	Average number per run	Electrofishing	61.3	0.5	60	0.5	71	0.5	45.5	0.5	98.3	0.5	112.2	1.5	
		Gill Netting	21.3	1.5	21.6	1.5	10.9	0.5	9.2	0.5	10.6	0.5	10.1	0.5	
12	Percent anomalies	Electrofishing	1.3	2.5	0.2	2.5	1.2	2.5	0.4	2.5	2.8	1.5	1.1	2.5	
		Gill Netting	2.3	1.5	0	2.5	2.8	1.5	0	2.5	2.8	1.5	0	2.5	
RFAI Score			45		42		44		36		38		42		

% = Percent.

-- = No samples collected.

CRM = Clinch River Mile.

Obs = Observed.

RFAI = Reservoir Fish Assemblage Index.

Table 3-6. Individual Metric Scores, Contributing Species, and Overall RFAI Scores for ERM 2.5, Autumn 2001-2010
Tennessee Valley Authority Kingston, Tennessee

Emory River Mile 2.5							
Metric	Gear	Common Name	2009		2010		
			Obs	Score	Obs	Score	
1	Number of indigenous species	Combined	(Table 3)	<u>32</u>	<u>5</u>	<u>35</u>	<u>5</u>
2	Number of centrarchid species (less <i>Micropterus</i>)	Combined	Black crappie Bluegill Green sunfish Longear sunfish Redbreast sunfish Redear sunfish Warmouth White crappie	8 3 515 9 38 3 132 7 2	5 13 330 43 6 2 56 7 4	8 13 330 43 6 2 56 7 4	
3	Number of benthic invertivore species	Combined	Black redhorse Freshwater drum Golden redhorse Logperch Northern hog sucker Spotted sucker	5 1 6 2 -- 1 19	3 1 6 2 12 -- 28	5 1 6 2 12 -- 28	
4	Number of intolerant species	Combined	Black redhorse Brook silverside Longear sunfish Northern hog sucker Skipjack herring Smallmouth bass Spotted sucker	6 1 56 38 1 -- 2	5 1 29 6 -- 25 1 28	6 1 29 6 -- 25 1 28	
5	Percent tolerant individuals	Electrofishing	Bluegill Bluntnose minnow Common carp Gizzard shad Green sunfish Largemouth bass Redbreast sunfish Spotfin shiner White crappie	79.1% 39.5% 3.2% 1.0% 9.0% 0.7% 11.7% 0.2% 13.8% --	0.5 21.4% 1.2% 1.0% 41.1% 2.8% 7.7% 0.1% 3.1% 0.1%	78.5% 21.4% 1.2% 1.0% 41.1% 2.8% 7.7% 0.1% 3.1% 0.1%	
		Gill Netting	Bluegill Common carp Gizzard shad Largemouth bass White crappie	7.4% 0.9% 0.9% 2.8% 0.9% 1.9%	2.5 0.7% 1.5% 11.0% 0.7% 1.5%	15.4% 0.7% 1.5% 11.0% 0.7% 1.5%	

Table 3-6. Individual Metric Scores, Contributing Species, and Overall RFAI Scores for ERM 2.5, Autumn 2001-2010
Tennessee Valley Authority Kingston, Tennessee

Emory River Mile 2.5							
Metric	Gear	Common Name	2009		2010		
			Obs	Score	Obs	Score	
6	Percent dominance by one species	Electrofishing	Bluegill Gizzard shad	<u>39.5%</u> 39.5% --	<u>1.5</u>	<u>41.1%</u> -- 41.1%	<u>0.5</u>
		Gill Netting	Channel catfish Skipjack herring	<u>47.7%</u> 47.7%	<u>0.5</u>	<u>18.4%</u> 18.4%	<u>1.5</u>
7	Percent non-indigenous species	Electrofishing	Common carp Grass carp Inland silverside Striped bass Yellow perch	<u>1.4%</u> 1.0% -- -- 0.4%	<u>2.5</u>	<u>9.2%</u> 1.0% 0.1% 7.7% 0.1% 0.3%	<u>0.5</u>
		Gill Netting	Common carp Striped bass	<u>1.8%</u> 0.9% 0.9%	<u>2.5</u>	<u>4.4%</u> 1.5% 2.9%	<u>0.5</u>
8	Number of top carnivore species	Combined	Black crappie Flathead catfish Largemouth bass Sauger Skipjack herring Smallmouth bass Spotted bass Spotted gar Walleye White bass White crappie Yellow bass	<u>10</u> 3 180 1 -- 2 8 11 -- 1 2 1	<u>5</u>	<u>12</u> 13 125 4 25 1 11 2 1 8 4 22	<u>5</u>
9	Percent top carnivores	Electrofishing	Black crappie Flathead catfish Largemouth bass Smallmouth bass Spotted bass Spotted gar Striped bass White bass White crappie Yellow bass	<u>12.4%</u> -- -- 11.7% 0.2% 0.5% -- -- -- --	<u>2.5</u>	<u>9.7%</u> 0.8% 0.2% 7.7% 0.1% 0.4% 0.1% 0.1% 0.1% 0.1%	<u>1.5</u>

Table 3-6. Individual Metric Scores, Contributing Species, and Overall RFAI Scores for ERM 2.5, Autumn 2001-2010
Tennessee Valley Authority Kingston, Tennessee

Emory River Mile 2.5							
Metric	Gear	Common Name	2009		2010		
			Obs	Score	Obs	Score	
9	Percent top carnivores (continued)	Gill Netting	Black crappie	<u>22.3%</u>	<u>0.5</u>	<u>51.9%</u>	<u>2.5</u>
			Flathead catfish	2.8%		0.7%	
			Largemouth bass	0.9%		2.2%	
			Sauger	0.9%		0.7%	
			Skipjack herring	--		2.9%	
			Spotted bass	--		18.4%	
			Spotted gar	10.3%		0.7%	
			Striped bass	0.9%		0.7%	
			Walleye	--		2.9%	
			White bass	0.9%		0.7%	
			White crappie	1.9%		5.1%	
			Yellow bass	0.9%		15.4%	
10	Percent omnivores	Electrofishing	Black buffalo	<u>13.6%</u>	<u>2.5</u>	<u>44.4%</u>	<u>0.5</u>
			Bluntnose minnow	0.1%		0.2%	
			Channel catfish	3.2%		1.2%	
			Common carp	0.2%		0.7%	
			Gizzard shad	1.0%		1.0%	
			Smallmouth buffalo	9.0%		41.1%	
		Gill Netting	Black buffalo	0.1%		0.2%	
			Blue catfish	65.3%	<u>0.5</u>	<u>42.7%</u>	<u>1.5</u>
			Channel catfish	0.9%		--	
			Common carp	12.1%		11.8%	
			Gizzard shad	47.7%		13.2%	
			Quillback	0.9%		1.5%	
			Smallmouth buffalo	--		3.7%	
11	Average number per run	Electrofishing		<u>86.5</u>	<u>0.5</u>	<u>102.4</u>	<u>0.5</u>
		Gill Netting		<u>10.7</u>	<u>0.5</u>	<u>13.6</u>	<u>1.5</u>
12	Percent anomalies	Electrofishing		<u>4.3</u>	<u>1.5</u>	<u>1.6</u>	<u>2.5</u>
		Gill Netting		<u>0.9</u>	<u>2.5</u>	<u>0</u>	<u>2.5</u>
RFAI Score				<u>44</u>			<u>44</u>

% = Percent.

-- = No samples collected.

ERM = Emory River Mile.

Obs = Observed.

RFAI = Reservoir Fish Assemblage Index.

Table 3-7. Scoring Criteria for Forebay, Transition, and Inflow Sections of Upper Mainstream Reservoirs in the Tennessee River Valley
Tennessee Valley Authority Kingston, Tennessee

Metric	Gear	Scoring Criteria								
		Forbay			Transition			Inflow		
		1	3	5	1	3	5	1	3	5
1. Number of indigenous species	Combined	<14	14-27	>27	<15	15-19	>29	<14	14-27	>27
2. Number of Centrarchid species	Combined	<2	2-4	>4	<2	2-4	>4	<3	3-4	>4
3. Number of benthic invertivores species	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
4. Number of intolerant species	Combined	<2	2-4	>4	<2	2-4	>4	<2	2-4	>4
5. Percent tolerant individuals	Electrofishing	>62%	31-62%	<31%	>62%	31-62%	<31%	>58%	29-58%	<29%
	Gill netting	>28%	14-28%	<14%	>32%	16-32%	<16%			
6. Percent dominance by one species	Electrofishing	>50%	25-50%	<25%	>40%	20-40%	<20%	>46%	23-46%	<23%
	Gill netting	>29%	15-29%	<15%	>28%	14-28%	<14%			
7. Percent non-indigenous species	Electrofishing	>4	2-4%	<2%	>6%	3-6%	<3%	>17%	8-17%	<8%
	Gill netting	>16%	8-16%	<8%	>9%	5-9%	<5%			
8. Number of top carnivore species	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
9. Percent top carnivores	Electrofishing	<5%	5-10%	>10%	<6%	6-11%	>11%	<11%	11-22%	>22%
	Gill netting	<25%	25-50%	>50%	<26%	26-52%	>52%			
10. Percent omnivores	Electrofishing	>49%	24-49%	<24%	>44%	22-44%	<22%	>55%	27-55%	<27%
	Gill netting	>34%	17-34%	<17%	>46%	23-46%	<23%			
11. Average number per run	Electrofishing	<121	121-241	>241	<105	105-210	>210	<51	51-102	>102
	Gill netting	<12	12-24	>24	<12	12-24	>24			
12. Percent anomalies	Electrofishing	>5%	2-5%	<2%	>5%	2-5%	<2%	>5%	2-5%	<2%
	Gill netting	>5%	2-5%	<2%	>5%	2-5%	<2%			

Note:

Upper mainstream reservoirs include Chickamauga, Fort Loudoun, Melton Hill, Nickajack, Tellico, and Watts Bar.

% = Percent.

Table 3-9. Fathead Minnow Toxicity Analysis, Emory River

Tennessee Valley Authority Kingston, Tennessee

	SWERM1.0	SWERM2.0	SWERM3.0	SWERM4.0
Test 1: Chronic Survival				
Survival NOEC	100.0	100.0	NA	100.0
Survival LOEC	>100 %	>100 %	NA	>100 %
IC ₂₅	>100 %	>100 %	NA	>100 %
Test 1: Chronic Growth				
Growth NOEC	100.0	100.0	NA	80.0
Growth LOEC	>100 %	>100 %	NA	100.00%
IC ₂₅	>100 %	>100 %	NA	>100 %
Test 2 (UV Treated): Chronic Survival				
Survival NOEC	100.0	100.0	100.0	100.0
Survival LOEC	>100 %	>100 %	>100 %	>100 %
IC ₂₅	>100 %	>100 %	>100 %	>100 %
Test 2 (UV Treated): Chronic Growth				
Growth NOEC	100.0	100.0	100.0	100.0
Growth LOEC	>100 %	>100 %	>100 %	>100 %
IC ₂₅	>100 %	>100 %	>100 %	>100 %

Notes:

ERW = Emory River water.

IC₂₅ = Percent of concentration which resulted in 25% inhibition.

LOEC = Lowest observed effect concentration.

NA = Test did not meet minimum test acceptability criteria, ≥ 80% survival in the diluent control, ERW.

Kingston fossil plant has previously documented pathogen interference with Emory River water.

In a parallel test, UV treatment was used to control interference of fish pathogens.

NOEC = No observed effect concentration.

SWERM = Surface water at Emory River Mile.

UV = Ultraviolet.

Table 3-10. Relationship between ORNL and TVA Identifiers for Emory River Sediment**Samples Tested for Toxicity to Fathead Minnow Embryos and Larvae**

Tennessee Valley Authority Kingston, Tennessee

ORNL Sample ID	ORNL Toxicity Test ID	TVA Field Sample ID	Additional TVA ID
A	FA3	KIF-Bulk-RA--051210-ORNL-A	BulkAshA-WAA512
B	FA4	KIF-Bulk-RA--051210-ORNL-B	BulkAshB-WAB512
C	FA2	KIF-Bulk-RA--051310-ORNL-C	BulkAshC-WAC513
D	FA1	KIF-Bulk-RA--051310-ORNL-D	BulkAshD-WAD513
Reference	-	KIF-Bulk-Sed-051210-ORNL	-

ORNL = Oak Ridge National Laboratories.

TVA = Tennessee Valley Authority.

**Table 3-11. Percent Ash^a in Sediment Samples from the Emory River Tested for Toxicity to
Fathead Minnow Embryos and Larvae**
Tennessee Valley Authority Kingston, Tennessee

Sample	% Ash in Sample	Additional Description
A	67	None
B	75	Diatoms and organic particulates noted
C	78	Organic particulates noted
D	46	Diatoms and organic particulates noted

^a Characterization supplied by TVA analyst R.J. Lee.

% = Percent.

Table 3-12. Selected Chemical Analyses Conducted on Sediment Samples from the Emory River Tested for Toxicity to Fathead Minnow Embryos and Larvae
Tennessee Valley Authority Kingston, Tennessee

Sediment Sample Chemical Name	Units (dw)	A	B	C*	D	Reference
Total arsenic	mg/kg	59.4	84.0		45.8	2.5
Arsenate	mg/kg	52.0	70.0		32.1	1.7
Arsenite	mg/kg	7.1	2.9		22.5	0.2
Inorganic arsenic	mg/kg	59	73		55	2
Total mercury	µg/kg	82	145		109	28
Methyl mercury	µg/kg	0.02	0.01		0.01	0.32
Inorganic mercury	µg/kg	81	145		109	28
Total selenium	mg/kg	3.76	9.95		3.61	0.70
Selenite	mg/kg	2.88	6.30		1.71	0.99
Selenate	mg/kg	0.69	0.64		0.79	0.78
Organic selenium	mg/kg	0.88	3.60		1.90	0.99

* = Data unavailable for sample C.

dw = Dry weight.

µg/kg = Micrograms per kilogram.

mg/kg = Milligrams per kilogram.

TVA = Tennessee Valley Authority.

Bold indicates non-detects and analytical reporting limits: analytical results supplied by TVA.

Table 3-13. Summary Data from Fathead Minnow Embryo-Larval Toxicity Test of Emory River Sediment Sample A

Tennessee Valley Authority Kingston, Tennessee

Effluent Concentration (%)	No. Eggs at Start	Hatched at Termination		Dead at Test Termination		Deformed at Test Termination		Dead + Deformed at Test Termination		
		No.	%	No.	%	No.	%	No.	%	
Control	15	12	80.0	3	20.0	2	13.3	5	33.3	
	15	15	100.0	0	0.0	0	0.0	0	0.0	
	15	14	93.3	1	6.7	0	0.0	1	6.7	
	15	9	60.0	6	40.0	0	0.0	6	40.0	
	Mean (sd)	12.5 (2.6)	83.3 (17.6)	2.5 (2.6)	16.7 (17.6)	0.5 (1.0)	3.3 (6.7)	3.0 (2.9)	20.0 (19.6)	
	100%	15	12	80.0	3	20.0	0	0.0	3	20.0
100%	15	9	60.0	6	40.0	0	0.0	6	40.0	
	15	12	80.0	3	20.0	1	6.7	4	26.7	
	15	13	86.7	2	13.3	1	6.7	3	20.0	
	Mean (sd)	11.5 (1.7)	76.7 (11.5)	3.5 (1.7)	23.3 (11.5)	0.5 (0.6)	3.3 (3.8)	4.0 (1.4)	26.7 (9.4)	
	75%	15	12	80.0	3	20.0	0	0.0	3	20.0
	15	13	86.7	2	13.3	0	0.0	2	13.3	
75%	15	15	100.0	0	0.0	0	0.0	0	0.0	
	15	14	93.3	1	6.7	0	0.0	1	6.7	
	Mean (sd)	13.5 (1.3)	90.0 (8.6)	1.5 (1.3)	10.0 (8.6)	0.0 (0.0)	0.0 (0.0)	1.5 (1.3)	10.0 (8.6)	
	50%	15	13	86.7	2	13.3	2	13.3	4	26.7
	15	8	53.3	7	46.7	1	6.7	8	53.3	
	15	6	40.0	9	60.0	0	0.0	9	60.0	
50%	15	9	60.0	6	40.0	0	0.0	6	40.0	
	Mean (sd)	9.0 (2.9)	60.0 (19.6)	6.0 (2.9)	40.0 (19.6)	0.8 (1.0)	5.0 (6.4)	6.8 (2.2)	45.0 (14.8)	
	25%	15	10	66.7	5	33.3	0	0.0	5	33.3
	15	14	93.3	1	6.7	2	13.3	3	20.0	
	15	15	100.0	0	0.0	2	13.3	2	13.3	
	Mean (sd)	12.8 (2.2)	85.0 (14.8)	2.3 (2.2)	15.0 (14.8)	1.0 (1.2)	6.7 (7.7)	3.3 (1.3)	21.7 (8.4)	
0%	15	8	53.3	7	46.7	0	0.0	7	46.7	
	15	12	80.0	3	20.0	0	0.0	3	20.0	
	15	11	73.3	4	26.7	0	0.0	4	26.7	
	15	12	80.0	3	20.0	1	6.7	4	26.7	
	Mean (sd)	10.8 (1.9)	71.7 (12.6)	4.3 (1.9)	28.3 (12.6)	0.3 (0.5)	1.7 (3.3)	4.5 (1.7)	30.0 (11.5)	

% = Percent.

No. = Number of fish in sample.

(sd) = Standard deviation.

Table 3-14. Summary Data from Fathead Minnow Embryo-Larval Toxicity Test of Emory River Sediment Sample B

Tennessee Valley Authority Kingston, Tennessee

Effluent Concentration (%)	No. Eggs at Start	Hatched at Termination		Dead at Test Termination		Deformed at Test Termination		Dead + Deformed at Test Termination	
		No.	%	No.	%	No.	%	No.	%
Control	15	11	73.3	4	26.7	0	0.0	4	26.7
	15	10	66.7	5	33.3	0	0.0	5	33.3
	15	13	86.7	2	13.3	0	0.0	2	13.3
	15	14	93.3	1	6.7	0	0.0	1	6.7
	Mean (sd)	12.0 (1.8)	80.0 (12.2)	3.0 (1.8)	20.0 (12.2)	0.0 (0.0)	0.0 (0.0)	3.0 (1.8)	20.0 (12.2)
100%	15	13	86.7	2	13.3	0	0.0	2	13.3
	15	13	86.7	2	13.3	0	0.0	2	13.3
	15	13	86.7	2	13.3	1	6.7	3	20.0
	15	12	80.0	3	20.0	0	0.0	3	20.0
	Mean (sd)	12.8 (0.5)	85.0 (3.3)	2.3 (0.5)	15.0 (3.3)	0.3 (0.5)	1.7 (3.3)	2.5 (0.6)	16.7 (3.8)
75%	15	13	86.7	2	13.3	0	0.0	2	13.3
	15	10	66.7	5	33.3	0	0.0	5	33.3
	15	2	13.3	13	86.7	0	0.0	13	86.7
	15	8	53.3	7	46.7	3	20.0	10	66.7
	Mean (sd)	8.3 (4.6)	55.0 (31.0)	6.8 (4.6)	45.0 (31.0)	0.8 (1.5)	5.0 (10.0)	7.5 (4.9)	50.0 (32.9)
50%	15	12	80.0	3	20.0	0	0.0	3	20.0
	15	8	53.3	7	46.7	0	0.0	7	46.7
	15	10	66.7	5	33.3	0	0.0	5	33.3
	15	7	46.7	8	53.3	0	0.0	8	53.3
	Mean (sd)	9.3 (2.2)	61.7 (14.8)	5.8 (2.2)	38.3 (14.8)	0.0 (0.0)	0.0 (0.0)	5.8 (2.2)	38.3 (14.8)
25%	15	7	46.7	8	53.3	0	0.0	8	53.3
	15	12	80.0	3	20.0	0	0.0	3	20.0
	15	12	80.0	3	20.0	0	0.0	3	20.0
	15	11	73.3	4	26.7	0	0.0	4	26.7
	Mean (sd)	10.5 (2.4)	70.0 (15.9)	4.5 (2.4)	30.0 (15.9)	0.0 (0.0)	0.0 (0.0)	4.5 (2.4)	30.0 (15.9)
0%	15	10	66.7	5	33.3	0	0.0	5	33.3
	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	9	60.0	6	40.0	0	0.0	6	40.0
	15	6	40.0	9	60.0	0	0.0	9	60.0
	Mean (sd)	9.8 (3.3)	65.0 (22.0)	5.3 (3.3)	35.0 (22.0)	0.0 (0.0)	0.0 (0.0)	5.3 (3.3)	35.0 (22.0)

% = Percent.

No. = Number of fish in sample.

(sd) = Standard deviation.

Table 3-15. Summary Data from Fathead Minnow Embryo-Larval Toxicity Test of Emory River Sediment Sample C

Tennessee Valley Authority Kingston, Tennessee

Effluent Concentration (%)	No. Eggs at Start	Hatched at Termination		Dead at Test Termination		Deformed at Test Termination		Dead + Deformed at Test Termination	
		No.	%	No.	%	No.	%	No.	%
Control	15	15	100.0	0	0.0	0	0.0	0	0.0
	15	13	86.7	2	13.3	0	0.0	2	13.3
	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	15	100.0	0	0.0	0	0.0	0	0.0
	Mean (sd)	14.3 (1.0)	95.0 (6.4)	0.8 (1.0)	5.0 (6.4)	0 (0.0)	0 (0.0)	0.8 (1.0)	5.0 (6.4)
100%	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	9	60.0	6	40.0	0	0.0	6	40.0
	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	12	80.0	3	20.0	0	0.0	3	20.0
	Mean (sd)	12.3 (2.4)	81.7 (15.8)	2.8 (2.4)	18.3 (15.8)	0 (0.0)	0 (0.0)	2.8 (2.4)	18.3 (15.8)
75%	15	10	66.7	5	33.3	0	0.0	5	33.3
	15	10	66.7	5	33.3	0	0.0	5	33.3
	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	11	73.3	4	26.7	0	0.0	4	26.7
	Mean (sd)	11.3 (1.9)	75.0 (12.6)	3.8 (1.9)	25.0 (12.6)	0.0 (0.0)	0.0 (0.0)	3.8 (1.9)	25.0 (12.6)
50%	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	15	100.0	0	0.0	0	0.0	0	0.0
	15	14	93.3	1	6.7	0	0.0	1	6.7
	Mean (sd)	14.3 (0.5)	95.0 (3.3)	0.8 (0.5)	5.0 (3.3)	0.0 (0.0)	0.0 (0.0)	0.8 (0.5)	5.0 (3.3)
25%	15	12	80.0	3	20.0	0	0.0	3	20.0
	15	11	73.3	4	26.7	0	0.0	4	26.7
	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	12	80.0	3	20.0	0	0.0	3	20.0
	Mean (sd)	12.3 (1.3)	81.7 (8.4)	2.8 (1.3)	18.3 (8.4)	0.0 (0.0)	0.0 (0.0)	2.8 (1.3)	18.3 (8.4)
0%	15	12	80.0	3	20.0	0	0.0	3	20.0
	15	12	80.0	3	20.0	0	0.0	3	20.0
	15	13	86.7	2	13.3	0	0.0	2	13.3
	15	15	100.0	0	0.0	0	0.0	0	0.0
	Mean (sd)	13.0 (1.4)	86.7 (9.4)	2.0 (1.4)	13.3 (9.4)	0.0 (0.0)	0.0 (0.0)	2.0 (1.4)	13.3 (9.4)

% = Percent.

No. = Number of fish in sample.

(sd) = Standard deviation.

Table 3-16. Summary Data from Fathead Minnow Embryo-Larval Toxicity Test of Emory River Sediment Sample D
Tennessee Valley Authority **Kingston, Tennessee**

Effluent Concentration (%)	No. Eggs at Start	Hatched at Termination		Dead at Test Termination		Deformed at Test Termination		Dead + Deformed at Test Termination	
		No.	%	No.	%	No.	%	No.	%
Control	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	15	100.0	0	0.0	0	0.0	0	0.0
	15	15	100.0	0	0.0	1	6.7	1	6.7
	Mean (sd)	14.5 (0.6)	96.7 (3.8)	0.5 (0.6)	3.3 (3.8)	0.3 (0.5)	1.7 (3.3)	0.8 (0.5)	5.0 (3.3)
100%	15	11	73.3	4	26.7	0	0.0	4	26.7
	15	11	73.3	4	26.7	0	0.0	4	26.7
	15	14	93.3	1	6.7	0	0.0	1	6.7
	15	12	80.0	3	20.0	2	13.3	5	33.3
	Mean (sd)	12.0 (1.4)	80.0 (9.4)	3.0 (1.4)	20.0 (9.4)	0.5 (1.0)	3.3 (6.7)	3.5 (1.7)	23.3 (11.5)
75%	15	13	86.7	2	13.3	0	0.0	2	13.3
	15	10	66.7	5	33.3	0	0.0	5	33.3
	15	13	86.7	2	13.3	1	6.7	3	20.0
	15	12	80.0	3	20.0	0	0.0	3	20.0
	Mean (sd)	12.0 (1.4)	80.0 (9.4)	3.0 (1.4)	20.0 (9.4)	0.3 (0.5)	1.7 (3.3)	3.3 (1.3)	21.7 (8.4)
50%	15	12	80.0	3	20.0	0	0.0	3	20.0
	15	11	73.3	4	26.7	3	20.0	7	46.7
	15	8	53.3	7	46.7	2	13.3	9	60.0
	15	8	53.3	7	46.7	1	6.7	8	53.3
	Mean (sd)	9.8 (2.1)	65.0 (13.7)	5.3 (2.1)	35.0 (13.7)	1.5 (1.3)	10.0 (8.6)	6.8 (2.6)	45.0 (17.5)
25%	15	15	100.0	0	0.0	0	0.0	0	0.0
	15	6	40.0	9	60.0	0	0.0	9	60.0
	15	10	66.7	5	33.3	1	6.7	6	40.0
	15	6	40.0	9	60.0	2	13.3	11	73.3
	Mean (sd)	9.3 (4.3)	61.7 (28.5)	5.8 (4.3)	38.3 (28.5)	0.8 (1.0)	5.0 (6.4)	6.5 (4.8)	43.3 (32.0)
0%	15	11	73.3	3	20.0	0	0.0	3	20.0
	15	6	40.0	9	60.0	1	6.7	10	66.7
	15	12	80.0	3	20.0	0	0.0	3	20.0
	15	10	66.7	5	33.3	0	0.0	5	33.3
	Mean (sd)	9.8 (2.6)	65.0 (17.5)	5.0 (2.8)	33.3 (18.9)	0.3 (0.5)	1.7 (3.3)	5.3 (3.3)	35.0 (22.0)

% = Percent.

No. = Number of fish in sample.

(sd) = Standard deviation.

Table 3-17. Reproductive Indices Measured in Blugill Sunfish, Spring 2009 - Emory and Clinch Rivers

Tennessee Valley Authority

Kingston, Tennessee

Site ^a	Year	Fish Length (cm)	Fish Weight (g)	Ovary Weight (g)	GSI	Eggs/Oocytes Per Fish			Eggs/Oocytes Per Gram of Fish Weight		
						Atresia	Vitellogenic	Batch Fecundity	Atresia	Vitellogenic	Batch Fecundity
ERM 8.0	2009	<i>N</i> ^b	7	7	7	7	7	7	7	7	7
		Mean	14.6	54.2	3.93	7.39	25	8363	5315	0.40	157.03
		SEM	0.3	2.5	0.52	1.08	16	1243	1402	0.27	26.27
ERM 3.0	2009	<i>N</i>	11	11	11	11	11	11	11	11	11
		Mean	14.0	46.8	1.94	4.05	35	4447	3599	0.67	94.74
		SEM	0.2	2.4	0.27	0.53	22	755	540	0.41	17.18
ERM 0.9	2009	<i>N</i>	12	12	12	12	12	12	12	12	12
		Mean	13.7	45.8	3.86	8.48	166	7928	5240	2.87	177.35
		SEM	0.4	3.7	0.36	0.50	103	993	596	1.59	15.97
CRM 8.0	2009	<i>N</i>	11	11	11	11	11	11	11	11	11
		Mean	13.5	45.4	5.79	12.68	118	8714	4750	2.59	190.51
		SEM	0.3	3.0	0.63	0.76	48	831	473	0.97	9.26
CRM 1.5	2009	<i>N</i>	12	12	12	12	12	12	12	12	12
		Mean	14.2	47.3	3.06	6.43	148	7370	5551	2.62	151.41
		SEM	0.4	3.5	0.34	0.46	112	1176	894	1.72	15.17
LERM 2.0	2009	<i>N</i>	Site not sampled in 2009								

Notes:

Includes fish from impacted river reaches (ERM 3.0, ERM 0.9, and CRM 1.5) as well as upstream reference sites (ERM 8.0 and CRM 8.0).

^a ERM = Emory River mile; CRM = Clinch River mile; LERM = Little Emory River mile.^b N = Number of fish in sample.

cm = Centimeters.

g = Gram.

GSI = Gonadsomatic index.

SEM = Standard error of the mean.

Table 3-18. Reproductive Indices Measured in Bluegill Sunfish, Spring 2010 - Emory, Clinch, and Little Emory Rivers
Tennessee Valley Authority **Kingston, Tennessee**

Site ^a	Year	Fish Length (cm)	Fish Weight (g)	Ovary Weight (g)	GSI	Eggs/Oocytes Per Fish			Eggs/Oocytes Per Gram of Fish Weight		
						Atresia	Vitellogenic	Batch fecundity	Atresia	Vitellogenic	Batch fecundity
ERM 8.0	2010	<i>N</i> ^b	7	7	7	7	7	7	7	7	7
		Mean	14.6	53.2	3.54	6.52	193	7331	5557	4.16	136.30
		SEM	0.5	5.3	0.56	0.43	112	1073	478	2.61	9.01
ERM 3.0	2010	<i>N</i>	12	12	12	12	12	12	12	12	12
		Mean	14.5	55.5	4.72	8.60	442	10153	6100	8.09	184.46
		SEM	0.4	4.7	0.39	0.50	251	1024	882	4.82	14.13
ERM 0.9	2010	<i>N</i>	9	9	9	9	9	9	9	9	9
		Mean	14.2	52.1	5.35	10.12	864	9346	6740	17.04	178.96
		SEM	0.3	3.1	0.58	0.57	471	829	672	9.84	9.16
CRM 8.0	2010	<i>N</i>	9	9	9	9	9	9	9	9	9
		Mean	14.0	51.8	6.09	11.82	1540	9046	5600	29.81	175.08
		SEM	0.3	3.4	0.41	0.52	738	1151	799	14.05	21.14
CRM 1.5	2010	<i>N</i>	11	11	11	11	11	11	11	11	11
		Mean	12.8	36.8	3.37	9.34	364	7209	4332	11.84	197.55
		SEM	0.5	3.4	0.33	0.64	177	793	517	5.70	14.12
LERM 2.0	2010	<i>N</i>	10	10	10	10	10	10	10	10	10
		Mean	14.2	48.3	3.80	8.15	748	7862	4889	14.23	168.46
		SEM	0.4	2.9	0.34	0.83	621	651	587	12.01	17.42

Notes:

Includes fish from impacted river reaches (ERM 3.0, ERM 0.9, and CRM 1.5) as well as upstream reference sites (ERM 8.0, CRM 8.0, and LERM 2.0).

^a ERM = Emory River mile; CRM = Clinch River mile; LERM = Little Emory River mile.

^b N = Number of fish in sample.

cm = Centimeters.

g = Gram.

GSI = Gonadosomatic index.

SEM = Standard error of the mean.

Table 3-19. Reproductive Indices Measured in Largemouth Bass, Spring 2009 - Emory and Clinch Rivers
Tennessee Valley Authority **Kingston, Tennessee**

Site ^a	Year	Fish Length	Fish Weight	Ovary Weight	GSI	Eggs/Oocytes Per Fish				Eggs/Oocytes Per Gram of Fish Weight				
		(cm)	(g)	(g)		Atresia	Vitellogenic	Batch Fecundity	Annual Fecundity	Atresia	Vitellogenic	Batch Fecundity	Annual Fecundity	
ERM 8.0	2009	N ^b	11	11	11	11	11	11	11	11	11	11	11	
		Mean	43.7	1269.6	81.68	6.56	4302	133152	31636	124897	5.39	96.12	21.44	89.39
		SEM	1.7	143.3	10.36	0.71	3077	46218	12235	39935	4.43	22.71	6.88	20.11
ERM 3.0	2009	N	7	7	7	7	7	7	7	7	7	7	7	
		Mean	44.6	1337.3	57.61	4.34	12296	78084	17297	72959	8.06	57.96	13.72	55.22
		SEM	2.2	203.0	11.76	0.70	4994	15791	9581	20059	2.92	10.19	7.32	14.64
ERM 0.9	2009	N	11	11	11	11	11	11	11	11	11	11	11	
		Mean	43.8	1320.1	84.61	6.47	4802	84740	28145	94247	4.18	63.71	22.23	72.31
		SEM	1.6	145.2	10.03	0.41	1927	14109	4296	12497	2.17	7.03	3.79	5.72
CRM 8.0	2009	N	7	7	7	7	7	7	7	7	7	7	7	
		Mean	36.5	665.4	35.24	5.30	6742	38971	6751	32696	9.65	57.60	9.85	47.73
		SEM	1.0	71.5	5.63	0.63	2874	5843	2860	6432	3.81	4.28	3.65	6.04
CRM 1.5	2009	N	7	7	7	7	7	7	7	7	7	7	7	
		Mean	39.8	901.7	31.21	3.61	1185	38930	13078	43340	1.26	45.47	15.82	50.88
		SEM	1.1	92.8	2.87	0.36	627	4951	1646	4691	0.62	6.37	2.90	6.63
LERM 2.0	2009	N	Site not sampled in 2009											
		Mean												
		SEM												

Notes:

Includes fish from impacted river reaches (ERM 3.0, ERM 0.9, and CRM 1.5) as well as upstream reference sites (ERM 8.0 and CRM 8.0).

^a ERM = Emory River mile; CRM = Clinch River mile; LERM = Little Emory River mile.

^b N = Number of fish in sample.

cm = Centimeters.

g = Gram.

GSI = Gonadosomatic index.

SEM = Standard error of the mean.

Table 3-20. Reproductive Indices Measured in Largemouth Bass, Spring 2010 - Emory and Clinch Rivers

Tennessee Valley Authority

Kingston, Tennessee

Site ^a	Year	Fish Length	Fish Weight	Ovary Weight	GSI	Eggs/Oocytes Per Fish				Eggs/Oocytes Per Gram of Fish Weight				
		(cm)	(g)	(g)		Atresia	Vitellogenic	Batch Fecundity	Annual Fecundity	Atresia	Vitellogenic	Batch Fecundity	Annual Fecundity	
ERM 8.0	2010	N ^b	7	7	7	7	7	7	7	7	7	7	7	
		Mean	40.8	982.1	37.52	3.94	5190	34954	4281	28496	6.99	34.79	4.09	28.44
		SEM	1.9	152.3	6.86	0.56	3809	9614	1482	6642	5.04	6.40	1.26	4.09
ERM 3.0	2010	N	8	8	8	8	8	8	8	8	8	8	8	
		Mean	46.4	1587.2	70.87	4.54	414	77090	16020	75227	0.26	48.21	9.95	46.47
		SEM	1.2	154.9	9.65	0.46	239	13538	3110	14375	0.12	6.41	1.42	6.31
ERM 0.9	2010	N	8	8	8	8	8	8	8	8	8	8	8	
		Mean	43.8	1336.0	64.11	4.76	2557	71578	23758	68741	2.10	53.07	17.46	50.31
		SEM	2.5	257.1	12.56	0.39	1006	14509	5552	14333	0.72	3.33	3.01	3.76
CRM 8.0	2010	N	8	8	8	8	8	8	8	8	8	8	8	
		Mean	43.6	1386.0	77.47	5.72	3746	79830	19460	78991	2.26	58.70	13.67	57.60
		SEM	1.9	215.4	11.06	0.46	1930	12113	3506	11745	0.82	4.44	2.09	3.80
CRM 1.5	2010	N	7	7	7	7	7	7	7	7	7	7	7	
		Mean	42.8	1295.2	60.63	4.77	2467	86631	19273	78218	1.53	67.59	15.13	56.62
		SEM	3.5	358.2	17.46	0.49	1423	25257	6727	25939	0.72	7.54	3.75	5.62
LERM 2.0	2010	N	8	8	8	8	8	8	8	8	8	8	8	
		Mean	43.0	1206.0	49.60	3.88	1385	68839	12276	64001	0.81	54.00	10.77	49.39
		SEM	2.1	194.6	13.06	0.50	1146	18299	1707	17123	0.64	6.94	1.39	6.21

Notes:

Includes fish from impacted river reaches (ERM 3.0, ERM 0.9, and CRM 1.5) as well as upstream reference sites (ERM 8.0, CRM 8.0, and LERM 2.0).

^a ERM = Emory River mile; CRM = Clinch River mile; LERM = Little Emory River mile.^b N = Number of fish in sample.

cm = Centimeter.

g = Gram.

GSI = Gonadsomatic index.

SEM = Standard error of the mean.

Table 3-21. Reproductive Indices Measured in Redear Sunfish, Spring 2010 - Emory, Clinch, and Little Emory Rivers
Tennessee Valley Authority Kingston, Tennessee

Site ^a	Year	Fish Length (cm)	Fish Weight (g)	Ovary Weight (g)	GSI	Eggs/Oocytes Per Fish			Eggs/Oocytes Per Gram of Fish Weight		
						Atresia	Vitellogenic	Batch Fecundit	Atresia	Vitellogenic	Batch Fecundity
ERM 8.0	2010	N ^b	13	13	13	13	13	13	13	13	13
		Mean	18.3	94.1	7.18	7.46	81	12290	8341	0.94	129.56
		SEM	0.4	5.1	1.09	0.96	31	1440	819	0.36	11.66
ERM 3.0	2010	N	8	8	8	8	8	8	8	8	8
		Mean	19.8	118.0	9.04	7.99	71	16008	11805	0.64	141.45
		SEM	0.6	10.2	1.09	1.01	48	1512	879	0.42	15.76
ERM 0.9	2010	N	10	10	10	10	10	10	10	10	10
		Mean	19.0	107.3	8.38	7.94	232	11873	9747	2.26	102.14
		SEM	0.7	8.6	1.15	0.93	89	1757	1378	0.79	17.43
CRM 8.0	2010	N	7	7	7	7	7	7	7	7	7
		Mean	17.9	103.6	9.91	9.63	38	13535	9445	0.46	134.19
		SEM	0.4	11.0	1.14	0.60	38	1143	766	0.46	11.09
CRM 1.5	2010	N	9	9	9	9	9	9	9	9	9
		Mean	20.3	134.5	7.24	5.13	228	12426	11304	1.82	92.17
		SEM	0.9	17.6	2.40	1.17	117	2505	2000	0.95	9.96
LERM 2.0	2010	N	12	12	12	12	12	12	12	12	12
		Mean	17.2	73.2	3.70	5.12	60	6433	4850	0.95	88.51
		SEM	0.4	4.0	0.64	0.84	37	490	603	0.63	8.95

Notes:

Includes fish from impacted river reaches (ERM 3.0, ERM 0.9, and CRM 1.5) as well as upstream reference sites (ERM 8.0, CRM 8.0, and LERM 2.0).

^a ERM = Emory River mile; CRM = Clinch River mile; LERM = Little Emory River mile.

^b N = Number of fish in sample.

cm = Centimeters.

g = Gram.

GSI = Gonadosomatic index.

SEM = Standard error of the mean.

Table 3-22. Summary of 2010 Fish Species, Tissue Types Collected, Analyses Performed, and Sample Locations by Fish Tissue Type**Reaches of the Emory River, Clinch River, and Little Emory River****Tennessee Valley Authority Kingston, Tennessee**

Tissue Type	Species	Event	Reach	Location	Inorganic Sample Count	PCB Sample Count	Pesticide Sample Count
Carcass	Bluegill	Spring 2010	ER_R	ERM8.0	4	—	—
Carcass	Bluegill	Spring 2010	ER_R	LERM2.0	3	—	—
Carcass	Bluegill	Spring 2010	ER_C	ERM4.5	6	—	—
Carcass	Bluegill	Spring 2010	ER_B	ERM3.0	4	—	—
Carcass	Bluegill	Spring 2010	ER_A	ERM0.9	5	—	—
Carcass	Bluegill	Spring 2010	CR_R	CRM8.0	8	2	2
Carcass	Bluegill	Spring 2010	CR_B	CRM3.5	6	2	2
Carcass	Bluegill	Spring 2010	CR_A	CRM1.5	3	—	—
Carcass	Bluegill	Fall 2010	ER_C	ERM4.5	5	—	—
Carcass	Bluegill	Fall 2010	CR_B	CRM3.5	4	—	—
Carcass	Channel Catfish	Spring 2010	ER_R	ERM8.0	8	2	2
Carcass	Channel Catfish	Spring 2010	ER_C	ERM4.5	6	2	2
Carcass	Channel Catfish	Spring 2010	ER_B	ERM2.0	7	2	2
Carcass	Channel Catfish	Spring 2010	ER_A	ERM0.9	5	2	2
Carcass	Channel Catfish	Spring 2010	CR_R	CRM8.0	7	2	2
Carcass	Channel Catfish	Spring 2010	CR_B	CRM3.5	6	2	2
Carcass	Channel Catfish	Spring 2010	CR_A	CRM1.5	6	2	2
Carcass	Channel Catfish	Fall 2010	ER_C	ERM4.5	6	—	—
Carcass	Channel Catfish	Fall 2010	CR_B	CRM3.5	5	—	—
Carcass	Largemouth Bass	Spring 2010	ER_R	ERM8.0	3	1	1
Carcass	Largemouth Bass	Spring 2010	ER_R	LERM2.0	3	—	—
Carcass	Largemouth Bass	Spring 2010	ER_C	ERM4.5	6	1	1
Carcass	Largemouth Bass	Spring 2010	ER_B	ERM3.0	3	2	2
Carcass	Largemouth Bass	Spring 2010	ER_A	ERM0.9	3	1	1
Carcass	Largemouth Bass	Spring 2010	CR_R	CRM8.0	3	2	2
Carcass	Largemouth Bass	Spring 2010	CR_B	CRM3.5	6	2	2
Carcass	Largemouth Bass	Spring 2010	CR_A	CRM1.5	3	—	—
Carcass	Largemouth Bass	Fall 2010	ER_C	ERM4.5	6	—	—
Fillet	Bluegill	Spring 2010	ER_R	ERM8.0	6	—	—
Fillet	Bluegill	Spring 2010	ER_R	LERM2.0	6	—	—
Fillet	Bluegill	Spring 2010	ER_C	ERM4.5	6	—	—
Fillet	Bluegill	Spring 2010	ER_B	ERM3.0	6	—	—
Fillet	Bluegill	Spring 2010	ER_A	ERM0.9	5	—	—
Fillet	Bluegill	Spring 2010	CR_R	CRM8.0	11	—	—
Fillet	Bluegill	Spring 2010	CR_B	CRM3.5	6	—	—
Fillet	Bluegill	Spring 2010	CR_A	CRM1.5	6	—	—
Fillet	Bluegill	Fall 2010	ER_R	ERM8.0	6	—	—
Fillet	Bluegill	Fall 2010	ER_R	LERM2.0	6	—	—
Fillet	Bluegill	Fall 2010	ER_C	ERM4.5	5	—	—
Fillet	Bluegill	Fall 2010	ER_B	ERM3.0	6	—	—
Fillet	Bluegill	Fall 2010	ER_A	ERM0.9	6	—	—
Fillet	Bluegill	Fall 2010	CR_R	CRM8.0	6	—	—
Fillet	Bluegill	Fall 2010	CR_B	CRM3.5	7	—	—
Fillet	Bluegill	Fall 2010	CR_A	CRM1.5	6	—	—

Table 3-22. Summary of 2010 Fish Species, Tissue Types Collected, Analyses Performed, and Sample Locations by Fish Tissue Type**Reaches of the Emory River, Clinch River, and Little Emory River****Tennessee Valley Authority Kingston, Tennessee**

Tissue Type	Species	Event	Reach	Location	Inorganic Sample Count	PCB Sample Count	Pesticide Sample Count
Fillet	Channel Catfish	Spring 2010	ER_R	ERM8.0	8	2	2
Fillet	Channel Catfish	Spring 2010	ER_C	ERM4.5	6	2	2
Fillet	Channel Catfish	Spring 2010	ER_B	ERM2.0	7	2	2
Fillet	Channel Catfish	Spring 2010	ER_A	ERM0.9	5	2	2
Fillet	Channel Catfish	Spring 2010	CR_R	CRM8.0	7	2	2
Fillet	Channel Catfish	Spring 2010	CR_B	CRM3.5	6	2	2
Fillet	Channel Catfish	Spring 2010	CR_A	CRM1.5	6	2	2
Fillet	Channel Catfish	Fall 2010	ER_R	ERM8.0	—	1	1
Fillet	Channel Catfish	Fall 2010	ER_R	ERM8.0	6	—	—
Fillet	Channel Catfish	Fall 2010	ER_R	LERM2.0	6	—	—
Fillet	Channel Catfish	Fall 2010	ER_C	ERM4.5	6	—	—
Fillet	Channel Catfish	Fall 2010	ER_B	ERM3.0	—	1	1
Fillet	Channel Catfish	Fall 2010	ER_B	ERM3.0	6	—	—
Fillet	Channel Catfish	Fall 2010	ER_A	ERM0.9	—	1	1
Fillet	Channel Catfish	Fall 2010	ER_A	ERM0.9	6	—	—
Fillet	Channel Catfish	Fall 2010	CR_R	CRM8.0	—	1	1
Fillet	Channel Catfish	Fall 2010	CR_R	CRM8.0	6	—	—
Fillet	Channel Catfish	Fall 2010	CR_B	CRM3.5	5	—	—
Fillet	Channel Catfish	Fall 2010	CR_A	CRM1.5	—	1	1
Fillet	Channel Catfish	Fall 2010	CR_A	CRM1.5	6	—	—
Fillet	Largemouth Bass	Spring 2010	ER_R	ERM8.0	6	2	2
Fillet	Largemouth Bass	Spring 2010	ER_R	LERM2.0	6	—	—
Fillet	Largemouth Bass	Spring 2010	ER_C	ERM4.5	6	2	2
Fillet	Largemouth Bass	Spring 2010	ER_B	ERM3.0	6	2	2
Fillet	Largemouth Bass	Spring 2010	ER_A	ERM0.9	6	3	3
Fillet	Largemouth Bass	Spring 2010	CR_R	CRM8.0	6	2	2
Fillet	Largemouth Bass	Spring 2010	CR_B	CRM3.5	6	2	2
Fillet	Largemouth Bass	Spring 2010	CR_A	CRM1.5	6	2	2
Fillet	Largemouth Bass	Fall 2010	ER_R	ERM8.0	—	1	1
Fillet	Largemouth Bass	Fall 2010	ER_R	ERM8.0	6	—	—
Fillet	Largemouth Bass	Fall 2010	ER_R	LERM2.0	6	—	—
Fillet	Largemouth Bass	Fall 2010	ER_C	ERM4.5	6	—	—
Fillet	Largemouth Bass	Fall 2010	ER_B	ERM3.0	—	1	1
Fillet	Largemouth Bass	Fall 2010	ER_B	ERM3.0	7	—	—
Fillet	Largemouth Bass	Fall 2010	ER_A	ERM0.9	—	1	1
Fillet	Largemouth Bass	Fall 2010	ER_A	ERM0.9	6	—	—
Fillet	Largemouth Bass	Fall 2010	CR_R	CRM8.0	—	1	1
Fillet	Largemouth Bass	Fall 2010	CR_R	CRM8.0	6	—	—
Fillet	Largemouth Bass	Fall 2010	CR_B	CRM3.5	6	—	—
Fillet	Largemouth Bass	Fall 2010	CR_A	CRM1.5	—	1	1
Fillet	Largemouth Bass	Fall 2010	CR_A	CRM1.5	6	—	—
Fillet	Red Ear Sunfish	Spring 2010	ER_R	ERM8.0	6	—	—
Fillet	Red Ear Sunfish	Spring 2010	ER_R	LERM2.0	6	—	—
Fillet	Red Ear Sunfish	Spring 2010	ER_B	ERM3.0	6	—	—
Fillet	Red Ear Sunfish	Spring 2010	ER_A	ERM0.9	5	—	—
Fillet	Red Ear Sunfish	Spring 2010	CR_R	CRM8.0	6	—	—
Fillet	Red Ear Sunfish	Spring 2010	CR_A	CRM1.5	6	—	—

Table 3-22. Summary of 2010 Fish Species, Tissue Types Collected, Analyses Performed, and Sample Locations by Fish Tissue Type
Reaches of the Emory River, Clinch River, and Little Emory River
Tennessee Valley Authority Kingston, Tennessee

Tissue Type	Species	Event	Reach	Location	Inorganic Sample Count	PCB Sample Count	Pesticide Sample Count
Fillet	White Crappie	Spring 2010	ER_R	ERM8.0	3	—	—
Fillet	White Crappie	Spring 2010	ER_R	LERM2.0	6	—	—
Fillet	White Crappie	Spring 2010	ER_B	ERM3.0	6	—	—
Fillet	White Crappie	Spring 2010	ER_A	ERM0.9	6	—	—
Fillet	White Crappie	Spring 2010	CR_R	CRM8.0	6	—	—
Fillet	White Crappie	Spring 2010	CR_A	CRM1.5	6	—	—
Gut and Gut Content	Gizzard Shad	Spring 2010	ER_R	ERM8.0	3	—	—
Gut and Gut Content	Gizzard Shad	Spring 2010	ER_R	LERM2.0	3	—	—
Gut and Gut Content	Gizzard Shad	Spring 2010	ER_C	ERM4.5	3	—	—
Gut and Gut Content	Gizzard Shad	Spring 2010	ER_B	ERM3.0	3	—	—
Gut and Gut Content	Gizzard Shad	Spring 2010	ER_A	ERM0.9	3	—	—
Gut and Gut Content	Gizzard Shad	Spring 2010	CR_R	CRM8.0	3	—	—
Gut and Gut Content	Gizzard Shad	Spring 2010	CR_B	CRM3.5	3	—	—
Gut and Gut Content	Gizzard Shad	Spring 2010	CR_A	CRM1.5	3	—	—
Gut and Gut Content	Gizzard Shad	Fall 2010	ER_R	ERM8.0	3	—	—
Gut and Gut Content	Gizzard Shad	Fall 2010	ER_C	ERM4.5	3	—	—
Gut and Gut Content	Gizzard Shad	Fall 2010	ER_C	ERM4.5	2	—	—
Gut and Gut Content	Gizzard Shad	Fall 2010	ER_B	ERM2.5	3	—	—
Gut and Gut Content	Gizzard Shad	Fall 2010	ER_A	ERM0.9	3	—	—
Gut and Gut Content	Gizzard Shad	Fall 2010	CR_R	CRM8.0	6	—	—
Gut and Gut Content	Gizzard Shad	Fall 2010	CR_B	CRM3.5	6	—	—
Gut and Gut Content	Gizzard Shad	Fall 2010	CR_A	CRM1.5	6	—	—
Liver	Bluegill	Spring 2010	ER_R	ERM8.0	3	—	—
Liver	Bluegill	Spring 2010	ER_R	ERM8.0	3	—	—
Liver	Bluegill	Spring 2010	ER_B	ERM3.0	3	—	—
Liver	Bluegill	Spring 2010	ER_A	ERM0.9	3	—	—
Liver	Bluegill	Spring 2010	CR_R	CRM8.0	3	—	—
Liver	Bluegill	Spring 2010	CR_A	CRM1.5	3	—	—
Liver	Largemouth Bass	Spring 2010	ER_R	ERM8.0	3	—	—
Liver	Largemouth Bass	Spring 2010	ER_R	LERM2.0	3	—	—
Liver	Largemouth Bass	Spring 2010	ER_B	ERM3.0	3	—	—
Liver	Largemouth Bass	Spring 2010	ER_A	ERM0.9	3	—	—
Liver	Largemouth Bass	Spring 2010	CR_R	CRM8.0	3	—	—
Liver	Largemouth Bass	Spring 2010	CR_A	CRM1.5	3	—	—
Liver	Redear Sunfish	Spring 2010	ER_R	ERM8.0	3	—	—
Liver	Redear Sunfish	Spring 2010	ER_R	LERM2.0	3	—	—
Liver	Redear Sunfish	Spring 2010	ER_B	ERM3.0	3	—	—
Liver	Redear Sunfish	Spring 2010	ER_A	ERM0.9	3	—	—
Liver	Redear Sunfish	Spring 2010	CR_R	CRM8.0	3	—	—
Liver	Redear Sunfish	Spring 2010	CR_A	CRM1.5	3	—	—
Liver	White Crappie	Spring 2010	ER_R	ERM8.0	3	—	—
Liver	White Crappie	Spring 2010	ER_R	LERM2.0	3	—	—
Liver	White Crappie	Spring 2010	ER_B	ERM3.0	3	—	—
Liver	White Crappie	Spring 2010	ER_A	ERM0.9	3	—	—
Liver	White Crappie	Spring 2010	CR_R	CRM8.0	3	—	—
Liver	White Crappie	Spring 2010	CR_A	CRM1.5	3	—	—

Table 3-22. Summary of 2010 Fish Species, Tissue Types Collected, Analyses Performed, and Sample Locations by Fish Tissue Type**Reaches of the Emory River, Clinch River, and Little Emory River****Tennessee Valley Authority Kingston, Tennessee**

Tissue Type	Species	Event	Reach	Location	Inorganic Sample Count	PCB Sample Count	Pesticide Sample Count
Ovary	Bluegill	Spring 2010	ER_R	ERM8.0	5	—	—
Ovary	Bluegill	Spring 2010	ER_R	LERM2.0	5	—	—
Ovary	Bluegill	Spring 2010	ER_B	ERM3.0	5	—	—
Ovary	Bluegill	Spring 2010	ER_A	ERM0.9	5	—	—
Ovary	Bluegill	Spring 2010	CR_R	CRM8.0	4	—	—
Ovary	Bluegill	Spring 2010	CR_A	CRM1.5	5	—	—
Ovary	Largemouth Bass	Spring 2010	ER_R	ERM8.0	5	—	—
Ovary	Largemouth Bass	Spring 2010	ER_R	LERM2.0	5	—	—
Ovary	Largemouth Bass	Spring 2010	ER_B	ERM3.0	5	—	—
Ovary	Largemouth Bass	Spring 2010	ER_A	ERM0.9	5	—	—
Ovary	Largemouth Bass	Spring 2010	CR_R	CRM8.0	4	—	—
Ovary	Largemouth Bass	Spring 2010	CR_A	CRM1.5	5	—	—
Ovary	Redear Sunfish	Spring 2010	ER_R	ERM8.0	5	—	—
Ovary	Redear Sunfish	Spring 2010	ER_R	LERM2.0	5	—	—
Ovary	Redear Sunfish	Spring 2010	ER_B	ERM3.0	5	—	—
Ovary	Redear Sunfish	Spring 2010	ER_A	ERM0.9	5	—	—
Ovary	Redear Sunfish	Spring 2010	CR_R	CRM8.0	4	—	—
Ovary	Redear Sunfish	Spring 2010	CR_A	CRM1.5	5	—	—
Ovary	White Crappie	Spring 2010	ER_R	ERM8.0	3	—	—
Ovary	White Crappie	Spring 2010	ER_R	LERM2.0	5	—	—
Ovary	White Crappie	Spring 2010	ER_B	ERM3.0	5	—	—
Ovary	White Crappie	Spring 2010	ER_A	ERM0.9	5	—	—
Ovary	White Crappie	Spring 2010	CR_R	CRM8.0	4	—	—
Ovary	White Crappie	Spring 2010	CR_A	CRM1.5	5	—	—
Whole Body	Bluegill	Spring 2010	ER_R	ERM8.0	3	—	—
Whole Body	Bluegill	Spring 2010	ER_C	ERM4.5	3	—	—
Whole Body	Bluegill	Spring 2010	ER_B	ERM2.0	4	—	—
Whole Body	Bluegill	Spring 2010	ER_A	ERM0.9	3	—	—
Whole Body	Bluegill	Spring 2010	CR_R	CRM8.0	3	—	—
Whole Body	Bluegill	Spring 2010	CR_B	CRM3.5	8	—	—
Whole Body	Bluegill	Spring 2010	CR_A	CRM1.5	3	—	—
Whole Body	Gizzard Shad	Spring 2010	ER_R	ERM8.0	3	—	—
Whole Body	Gizzard Shad	Spring 2010	ER_R	LERM2.0	3	—	—
Whole Body	Gizzard Shad	Spring 2010	ER_C	ERM4.5	3	—	—
Whole Body	Gizzard Shad	Spring 2010	ER_B	ERM3.0	3	—	—
Whole Body	Gizzard Shad	Spring 2010	ER_A	ERM0.9	3	—	—
Whole Body	Gizzard Shad	Spring 2010	CR_R	CRM8.0	3	—	—
Whole Body	Gizzard Shad	Spring 2010	CR_B	CRM3.5	3	—	—
Whole Body	Gizzard Shad	Spring 2010	CR_A	CRM1.5	3	—	—
Whole Body	Gizzard Shad	Fall 2010	ER_C	ERM4.5	3	—	—
Whole Body	Gizzard Shad	Fall 2010	ER_B	ERM2.5	3	—	—
Whole Body	Gizzard Shad	Fall 2010	CR_R	CRM8.0	3	—	—
Whole Body	Gizzard Shad	Fall 2010	CR_B	CRM3.5	3	—	—
Whole Body	Gizzard Shad	Fall 2010	CR_A	CRM1.5	3	—	—

Table 3-22. Summary of 2010 Fish Species, Tissue Types Collected, Analyses Performed, and Sample Locations by Fish Tissue Type
Reaches of the Emory River, Clinch River, and Little Emory River
Tennessee Valley Authority Kingston, Tennessee

Tissue Type	Species	Event	Reach	Location	Inorganic Sample Count	PCB Sample Count	Pesticide Sample Count
Whole Body (minus gut content)	Gizzard Shad	Spring 2010	ER_R	ERM8.0	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Spring 2010	ER_R	LERM2.0	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Spring 2010	ER_C	ERM4.5	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Spring 2010	ER_B	ERM3.0	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Spring 2010	ER_A	ERM0.9	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Spring 2010	CR_R	CRM8.0	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Spring 2010	CR_B	CRM3.5	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Spring 2010	CR_A	CRM1.5	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Fall 2010	ER_R	ERM8.0	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Fall 2010	ER_C	ERM4.5	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Fall 2010	ER_C	ERM4.5	2	—	—
Whole Body (minus gut content)	Gizzard Shad	Fall 2010	ER_B	ERM2.5	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Fall 2010	ER_A	ERM0.9	3	—	—
Whole Body (minus gut content)	Gizzard Shad	Fall 2010	CR_R	CRM8.0	6	—	—
Whole Body (minus gut content)	Gizzard Shad	Fall 2010	CR_B	CRM3.5	6	—	—
Whole Body (minus gut content)	Gizzard Shad	Fall 2010	CR_A	CRM1.5	6	—	—

CR = Clinch River.

CRM = Clinch River mile.

ER = Emory River.

ERM = Emory River mile.

LERM = Little Emory River mile.

PCB = Polychlorinated biphenyl.

Table 3-23. Fish Tissue Critical Body Residues
Tennessee Valley Authority Kingston, Tennessee

Constituent	Body Part	ERED Database	
		NOAEL (mg/kg ww)	LOAEL (mg/kg ww)
Aluminum	Liver	4.36	43.6
	Muscle	1.15	11.5
	Ovary	--	--
	Whole Body	0.78	7.8
Antimony	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	--	--
Arsenic	Liver	0.569	5.69
	Muscle	0.076	0.76
	Ovary	8.4	84
	Whole Body	0.04	0.4
Barium	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	--	--
Beryllium	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	5.13	51.3
Boron	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	--	--
Cadmium	Liver	0.0000137	0.000137
	Muscle	0.03	0.12
	Ovary	--	--
	Whole Body	0.0019	0.019
Chromium	Liver	0.042	0.42
	Muscle	--	--
	Ovary	--	--
	Whole Body	0.128	1.28
Cobalt	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	--	--
Copper	Liver	6.52	65.2
	Muscle	3.4	34
	Ovary	--	--
	Whole Body	0.196	1.96

Table 3-23. Fish Tissue Critical Body Residues
Tennessee Valley Authority Kingston, Tennessee

Constituent	Body Part	ERED Database	
		NOAEL (mg/kg ww)	LOAEL (mg/kg ww)
Iron	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	0.9	9
Lead	Liver	0.0393	0.393
	Muscle	2.3	23
	Ovary	--	--
	Whole Body	0.0278	0.278
Magnesium	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	--	--
Manganese	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	0.22	2.2
Mercury	Liver	0.0009	0.009
	Muscle	0.08	0.8
	Ovary	--	--
	Whole Body	0.006	0.06
Molybdenum	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	--	--
Nickel	Liver	8.22	82.2
	Muscle	11.81	118.1
	Ovary	--	--
	Whole Body	--	--
Total PCBs ^(a)	Liver ^(a)	105	1050
	Muscle ^(a)	3280	32800
	Ovary ^(a)	8230	82300
	Whole Body ^(a)	5.40E-03	5.40E-02
Total Chlordane	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	0.001	0.01
Selenium	Liver	0.524	5.24
	Muscle	0.104	1.04
	Ovary	0.218	2.18
	Whole Body	0.018	0.18

Table 3-23. Fish Tissue Critical Body Residues
Tennessee Valley Authority Kingston, Tennessee

Constituent	Body Part	ERED Database	
		NOAEL (mg/kg ww)	LOAEL (mg/kg ww)
Silica	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	--	--
Silver	Liver	19	190
	Muscle	--	--
	Ovary	--	--
	Whole Body	0.0114	0.114
Strontium	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	--	--
Thallium	Liver	--	--
	Muscle	--	--
	Ovary	--	--
	Whole Body	0.027	0.27
Vanadium	Liver	0.03	0.30
	Muscle	--	--
	Ovary	--	--
	Whole Body	0.68	2.7
Zinc	Liver	3.4	34
	Muscle	--	--
	Ovary	--	--
	Whole Body	0.45	4.5

Acronyms

-- = Not available.

LOAEL = Lowest observed adverse effect level.

mg/kg = Milligrams per kilogram.

NOAEL = No observable adverse effect level.

PCB = Polychlorinated biphenyl.

ww = Wet weight.

(a) = PCB critical body residues presented in micrograms per kilogram.

Selection of Reference Values

Tissue values were selected using the following "rules" for each metal and tissue type.

1. Select the highest no effect value, if available.
2. Select the lowest low effect value, if available.
3. If a no effect value is not available divide the chosen low effect value by 10.
4. If no low effect value is available multiply the chosen no effect value by 10.
5. If the highest no effect value is greater than the lowest low effect value, the low effect value divided by 10 will be used for no effect value.

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Table 3-25. Summary of Comparison of 2010 Fillet Data to Critical Body Residues
Tennessee Valley Authority Kingston, Tennessee

	Fillet CBR (mg/kg)	Bluegill, Catfish, and Largemouth Bass (All Reaches, Fillet)	Channel Catfish																					
			CR_A				CR_B				CR_R				ER_A				ER_B					
			CRM1.5				CRM3.5				CRM8.0				ERM0.9				ERM2.0, ERM3.0					
			Fillet				Fillet				Fillet				Fillet				Fillet					
NOAEL	LOAEL	# N L	#	N	L	#	Significance	N	L	#	N	L	#	N	L	#	N	L	#	N	L	#	N	L
Aluminum	1.15	11.5	289	4	0	12				11			13			11			13			12		20
Antimony	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Arsenic	0.076	0.76	289	134	0	12	No	1	0	11			13			11	No	1	0	13	No	1	0	
Barium	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Beryllium	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Boron	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Cadmium	0.03	0.12	289	0	0	12			11			13			11			13			12		20	
Total Chlordane	--	--	39	0	0	3			2			3			3			3			2		3	
Chromium	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Cobalt	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Copper	3.4	34	289	8	0	12	No	1	0	11			13	NA	1	0	11	p < 0.05	2	0	13		12	
Iron	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Lead	2.3	23	289	0	0	12			11			13			11			13			12		20	
Magnesium	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Manganese	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	p < 0.05	--	
Mercury	0.08	0.8	289	118	0	12	No	6	0	11	No	7	0	13	NA	6	0	11	No	4	0	13	No	6
Molybdenum	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Nickel	11.81	118.1	289	0	0	12			11			13			11			13			12		20	
Total PCBs ^(a)	3280	32800	39	0	0	3			2			3			3			3			2		3	
Selenium	0.104	1.04	289	275	14	12	0.05 < p < 0.1	9	0	11	No	11	0	13	NA	11	0	11	p < 0.05	11	0	13	p < 0.05	13
Silver	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Strontium	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	p < 0.05	--	
Thallium	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Vanadium	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Zinc	--	--	289	0	0	12	--	--	11	--	--	13	--	--	11	--	--	13	--	--	12	--	--	
Summary			# N L	#	N L	#	N L	#	N L	#	N L	#	N L	#	N L	#	N L	#	N L	#	N L			
			7592	539	14	318			17	0	290	18	0	344			18	0	292	18	0	344		19
																						526		
																						29		
																						0		

Notes:

(a) = PCB CBRs in micrograms per kilogram.

= Total number of samples.

-- = No CBR.

Denotes a significant statistical test for a given reach.

CBR = Critical body residue.

CR = Clinch River.

CRM = Clinch River mile.

ER = Emory River.

ERM = Emory River mile.

L = Number of samples that exceed LOAEL-based CBR.

LERM = Little Emory River mile.

LOAEL = Lowest observed adverse effect level.

mg/kg = Milligrams per kilogram.

N = Number of samples that exceed NOAEL-based CBR.

NA = Not applicable.

NOAEL = No observable adverse effect level.

PCB = Polychlorinated biphenyl.

Table 3-26. Summary of Comparison of 2010 Whole Body Data to Critical Body Residues

Tennessee Valley Authority Kingston, Tennessee

	Whole Body CBR (mg/kg)	Bluegill and Gizzard Shad Whole Body w/o the Gut or Its Contents (All Reaches)			Gizzard Shad																
		CR_A			CR_B			CR_R			ER_A			ER_B			ER_R				
		CRM1.5			CRM3.5			CRM8.0			ERM0.9			ERM2.5, ERM3.0			ERM4.5				
		Whole Body			Whole Body			Whole Body			Whole Body			Whole Body			Whole Body				
NOAEL		#	N	L	#	N	L	#	Significance	N	L	#	Significance	N	L	#	Significance	N	L		
Aluminum	0.78	7.8	66	65	63	56	43	34	6	p < 0.05	6	6	6	NA	6	6	3	No	3	3	
Antimony	--	--	66	0	0	56	0	0	6	--	--	6	--	--	6	--	--	6	--	--	
Arsenic	0.04	0.4	66	66	27	56	56	3	6	p < 0.05	6	5	6	p < 0.05	6	6	6	NA	6	0	
Barium	--	--	66	0	0	56	0	0	6	p < 0.05	--	--	6	p < 0.05	--	--	3	--	--		
Beryllium	5.13	51.3	66	0	0	56	0	0	6	--	--	6	--	--	6	--	--	6	--	--	
Boron	--	--	66	0	0	56	0	0	6	--	--	6	--	--	6	--	--	6	--	--	
Cadmium	0.0019	0.019	66	53	8	56	13	1	6	p < 0.05	6	2	6	No	6	1	6	NA	6	0	
Chromium	0.128	1.28	66	49	3	56	12	0	6	p < 0.05	5	0	6	p < 0.05	6	0	6	NA	3	0	
Cobalt	--	--	66	0	0	56	0	0	6	p < 0.05	--	--	6	p < 0.05	--	--	3	No	3	0	
Copper	0.196	1.96	66	66	12	56	56	4	6	No	6	3	6	No	6	3	6	NA	6	2	
Iron	0.9	9	66	66	66	56	55	55	6	p < 0.05	6	6	6	p < 0.05	6	6	6	NA	6	6	
Lead	0.0278	0.278	66	64	19	56	49	1	6	p < 0.05	6	4	6	p < 0.05	6	3	6	NA	6	3	
Magnesium	--	--	66	0	0	56	0	0	6	--	--	6	--	--	6	--	--	6	--	--	
Manganese	0.22	2.2	66	66	66	56	56	55	6	No	6	6	6	No	6	6	6	NA	6	6	
Mercury	0.006	0.06	66	48	0	56	35	0	6	p < 0.05	6	0	6	No	4	0	6	NA	3	0	
Molybdenum	--	--	66	0	0	56	0	0	6	--	--	6	--	--	3	--	--	6	--	--	
Nickel	--	--	66	0	0	56	0	0	6	0.05 < p < 0.1	--	--	6	--	--	3	--	--	6	--	--
Selenium	0.018	0.18	66	60	60	56	56	56	6	No	6	6	6	No	6	6	6	0.05 < p < 0.1	6	6	
Silver	0.0114	0.114	66	0	0	56	0	0	6	0.05 < p < 0.1	0	0	6	--	--	6	--	--	6	--	--
Strontium	--	--	66	0	0	56	0	0	6	--	--	6	--	--	3	--	--	6	--	--	
Thallium	0.027	0.27	66	0	0	56	0	0	6	--	--	6	--	--	3	--	--	6	--	--	
Vanadium	0.68	2.7	66	11	0	56	0	0	6	p < 0.05	3	0	6	p < 0.05	2	0	6	--	--	6	
Zinc	0.45	4.5	66	66	66	56	56	56	6	No	6	6	6	No	6	6	6	No	6	6	
Summary		#	N	L	#	N	L	#	N	L	#	N	L	#	N	L	#	N	L		
		1716	683	390	1456	487	265	156	68	44	156	66	43	156	60	37	78	30	21	156	

Notes:

(a) = PCB CBRs in micrograms per kilogram.

= Total number of samples.

-- = No CBR.

Denotes a significant statistical test for a given reach.

CBR = Critical body residue.

CR = Clinch River.

CRM = Clinch River mile.

ER = Emory River.

ERM = Emory River mile.

L = Number of samples that exceed LOAEL-based CBR.

LERM = Little Emory River mile.

LOAEL = Lowest observed adverse effect level.

mg/kg = Milligrams per kilogram.

N = Number of samples that exceed NOAEL-based CBR.

NA = Not applicable.

NOAEL = No observable adverse effect level.

PCB = Polychlorinated biphenyl.

w/o = Without.

Table 3-27. Summary of Comparision of 2010 Liver Data to

Critical Body Residues

Tennessee Valley Authority

Kingston, Tennessee

	Liver CBR (mg/kg)	Bluegill and Largemouth Bass (All Reaches, Liver)	Bluegill																						
			CR_A				CR_R				ER_A				ER_B										
			CRM1.5				CRM8.0				ERM0.9				ERM3.0										
			Liver				Liver				Liver				Liver		Liver								
NOAEL	LOAEL	# N L	#	Significance	N	L	#	Significance	N	L	#	Significance	N	L	#	Significance	N	L							
Aluminum	4.36	43.6	36	14	0	3	0.05 < p < 0.1	2	0	3	NA	2	0	3	No	2	0	3	No	3	0	6	NA	4	0
Antimony	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Arsenic	0.569	5.69	36	2	0	3	p ≤ 0.05	2	0	3	--	--	--	3	0.05 < p < 0.1	0	0	3	p ≤ 0.05	0	0	6	--	--	--
Barium	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Beryllium	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Boron	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Cadmium	0.0000137	0.000137	36	36	36	3	0.05 < p < 0.1	3	3	3	NA	3	3	3	0.05 < p < 0.1	3	3	3	No	3	3	6	No	6	6
Chromium	0.042	0.42	36	10	0	3	No	2	0	3	NA	1	0	3	No	2	0	3	No	2	0	6	NA	3	0
Cobalt	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Copper	6.516	65.16	36	6	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Iron	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Lead	0.0393	0.393	36	2	0	3	No	1	0	3	--	--	--	3	--	--	3	--	--	6	NA	1	0		
Magnesium	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Manganese	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Mercury	0.0009	0.009	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Molybdenum	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Nickel	8.22	82.2	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Selenium	0.524	5.24	36	36	0	3	No	3	0	3	NA	3	0	3	p ≤ 0.05	3	0	3	p ≤ 0.05	3	0	6	NA	6	0
Silver	19	190	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Strontium	--	--	36	0	0	3	--	--	3	--	--	--	--	3	--	--	3	--	--	6	--	--	--		
Thallium	--	--	36	0	0	3	p ≤ 0.05	--	--	3	--	--	--	3	p ≤ 0.05	--	--	3	p ≤ 0.05	--	--	6	--	--	--
Vanadium	0.0296	0.296	36	33	2	3	p ≤ 0.05	3	2	3	NA	3	0	3	No	3	0	3	No	3	0	6	NA	6	0
Zinc	3.444	34.44	36	36	0	3	No	3	0	3	NA	3	0	3	No	3	0	3	No	3	0	6	NA	6	0
Summary			# N L	#	N L	#	N L	#	N L	#	N L	#	N L	#	N L	#	N L	#	N L						
			918	175	38	78		19	5	78		15	3	78		16	3	78		17	3	138		32	6

Notes:

(a) = PCB CBRs in micrograms per kilogram.

= Total number of samples.

-- = No CBR.

Denotes a significant statistical test for a given reach.

CBR = Critical body residue.

CR = Clinch River.

CRM = Clinch River mile.

ER = Emory River.

ERM = Emory River mile.

L = Number of samples that exceed LOAEL-based CBR.

LERM = Little Emory River mile.

LOAEL = Lowest observed adverse effect level.

mg/kg = Milligrams per kilogram.

N = Number of samples that exceed NOAEL-based CBR.

NA = Not applicable.

NOAEL = No observable adverse effect level.

PCB = Polychlorinated biphenyl.

Table 3-28. Summary of Comparision of 2010 Ovary Data to

Critical Body Residues

Tennessee Valley Authority

Kingston, Tennessee

	Ovary CBR (mg/kg)	Bluegill and Largemouth Bass (All Reaches, Ovary)	Bluegill															
			CR_A			CR_R			ER_A			ER_B			ER_R			
			CRM1.5			CRM8.0			ERM0.9			ERM3.0			LERM2.0, ERM8.0			
			Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary	
NOAEL	LOAEL	# N L	#	Significance	N L	#	Significance	N L	#	Significance	N L	#	Significance	N L	#	Significance	N L	
Aluminum	-- --	58 0 0	5	p ≤ 0.05	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Antimony	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Arsenic	8.4 84	58 0 0	5	p ≤ 0.05	0 0	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Barium	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Beryllium	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Boron	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Cadmium	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Chromium	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Cobalt	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Copper	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Iron	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Lead	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Magnesium	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Manganese	-- --	58 0 0	5	0.05 < p < 0.1	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Mercury	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Molybdenum	-- --	58 0 0	5	p ≤ 0.05	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Nickel	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Selenium	0.218 2.18	58 58 0	5	No	5 0	4	NA	4 0	5	No	5 0	5	No	5 0	10	NA	10 0	
Silver	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Strontium	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Thallium	-- --	58 0 0	5	p ≤ 0.05	-- --	4	-- --	-- --	5	p ≤ 0.05	-- --	5	p ≤ 0.05	-- --	10	-- --	-- --	
Vanadium	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Zinc	-- --	58 0 0	5	-- --	-- --	4	-- --	-- --	5	-- --	-- --	5	-- --	-- --	10	-- --	-- --	
Summary			# N L	#	N L	#	N L	#	N L	#	N L	#	N L	#	N L	#	N L	
			1508	58 0	130	5 0	104	4 0	130	5 0	130	5 0	260	10 0				

Notes:

= Total number of samples.

-- = No CBR.

Denotes a significant statistical test for a given reach (p <0.05).

CBR = Critical body residue.

CR = Clinch River.

CRM = Clinch River mile.

ER = Emory River.

ERM = Emory River mile.

L = Number of samples that exceed LOAEL-based CBR.

LOAEL = Lowest observed adverse effect level.

mg/kg = Milligrams per kilogram.

N = Number of samples that exceed NOAEL-based CBR.

NA = Not applicable.

NOAEL = No observable adverse effect level.

Table 3-28. Summary of Comparision of 2010 Ovary Data to

Critical Body Residues

Tennessee Valley Authority

Kingston, Tennessee

	Ovary CBR (mg/kg)	Bluegill and Largemouth Bass (All Reaches, Ovary)	Largemouth Bass															
			CR_A			CR_R			ER_A			ER_B			ER_R			
			CRM1.5			CRM8.0			ERM0.9			ERM3.0			LERM2.0, ERM8.0			
			Ovary			Ovary			Ovary			Ovary			Ovary			
NOAEL	LOAEL	# N L	#	N	L	#	Significance	N	L	#	Significance	N	L	#	Significance	N	L	
Aluminum	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Antimony	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Arsenic	8.4 84	58 0 0	5			4				5	p ≤ 0.05	0 0		5		10		
Barium	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	p ≤ 0.05	-- --	10	-- --
Beryllium	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Boron	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Cadmium	-- --	58 0 0	5	-- --	--	4		-- --	--	5	0.05 < p < 0.1	-- --	--	5	-- --	10	-- --	
Chromium	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Cobalt	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Copper	-- --	58 0 0	5	p ≤ 0.05	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Iron	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Lead	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Magnesium	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Manganese	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Mercury	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Molybdenum	-- --	58 0 0	5	p ≤ 0.05	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Nickel	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Selenium	0.218 2.18	58 58 0	5	No	5 0	4	NA	4 0		5	p ≤ 0.05	5 0		5	p ≤ 0.05	5 0	10 NA 10 0	
Silver	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Strontium	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Thallium	-- --	58 0 0	5	-- --	--	4		-- --	--	5	p ≤ 0.05	-- --	--	5	p ≤ 0.05	-- --	10	-- --
Vanadium	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Zinc	-- --	58 0 0	5	-- --	--	4		-- --	--	5		-- --	--	5	-- --	10	-- --	
Summary			# N L	# N L	# N L	# N L	# N L	# N L	# N L	# N L	# N L	# N L	# N L	# N L	# N L	# N L		
			1508	58 0	130	5 0	104	4 0	130	5 0	130	5 0	260		10 0			

Notes:

= Total number of samples.

-- = No CBR.

Denotes a significant statistical test for a given reach (p <0.05).

CBR = Critical body residue.

CR = Clinch River.

CRM = Clinch River mile.

ER = Emory River.

ERM = Emory River mile.

L = Number of samples that exceed LOAEL-based CBR.

LERM = Little Emory River mile.

LOAEL = Lowest observed adverse effect level.

mg/kg = Milligrams per kilogram.

N = Number of samples that exceed NOAEL-based CBR.

NA = Not applicable.

NOAEL = No observable adverse effect level.

Table 3-29. Occurrence of Downstream Spatial Gradients in Health Metrics

Tennessee Valley Authority Kingston, Tennessee

Bioindicator	Species - Seasonal Comparisons									
	Bluegill				Largemouth Bass				Channel Catfish	
	Spring 2009	Spring 2010	Fall 2009	Fall 2010	Spring 2009	Spring 2010	Fall 2009	Fall 2010	Fall 2009	Fall 2010
Condition factor	No	Yes	No	No	No	No	No	No	No	Yes
Liver-somatic index	No	S	Yes	No	Yes	Yes	No	No	S	Yes
Visceral-somatic or spleno-somatic index	No	No	Yes	No	Yes	No	No	No	No	Yes
Hematocrit	No	Yes	No	No	No	Yes	No	S	No	Yes
Liver histopath	No	S	No	Yes	S	No	Yes	No	Yes	No
Gill or ovary histopath	S	No	Yes	Yes	S	No	No	No	Yes	Yes
Ananine transaminase	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
Urea nitrogen	No	S	No	Yes	No	Yes	Yes	No	S	Yes
Glucose	No	No	S	No	No	Yes	S	S	Yes	Yes
Total protein	No	No	No	No	No	Yes	No	No	Yes	Yes
Calcium	No	No	Yes	No	No	No	No	Yes	Yes	Yes
Sodium or potassium	S	No	Yes	No	Yes	No	Yes	Yes	No	No
Stomach fullness	Yes	Yes	No	Yes	No	No	S	No		
Gall bladder color/size	No	No	No	Yes	No	S	No	No		

Yes = A spatial gradient was observed for a particular bioindicator in the Emory and Clinch Rivers downstream of the reference sites.

No = No spatial gradient was observed.

S = A moderate or slight spatial gradient was observed.

Table 3-30. Temporal Changes in the Integrated Health Status of Three Sentinel Fish Species using the Discriminant Analysis
Tennessee Valley Authority Kingston, Tennessee

Species - Season	Sites				References
	ERM 3.0	ERM 0.9	CRM 1.5	CRM 8.0	
<u>Bluegill</u> Spring 2009 - Spring 2010	NC	MS	LS	NC	
Fall 2009 - Fall 2010	MS	MS	LS	NC	all similar
Spring 2009 - Fall 2010	MS	MS	LS	NC	all similar
<u>Largemouth bass</u> Spring 2009 - Spring 2010	LS	MS	MS	NC	
Fall 2009 - Fall 2010	LS	MS	NC	NC	all similar
Spring 2009 - Fall 2010	LS	MS	MS	NC	all similar
<u>Channel catfish</u> Fall 2009 - Fall 2010	NC	NC	NC	NC	all similar

CRM = Clinch River mile.

ERM = Emory River mile.

LS = The integrated status of a species became less similar to the reference(s) over a season.

MS = The integrated health status of a species became more similar to reference(s) over a season.

NC = No change in the integrated health status compared to the reference(s) over a particular season.

Table 3-32. Analytical Data Table for Benthic Water - Metals
Tennessee Valley Authority Kingston, Tennessee

Constituent	USEPA Region 4 Freshwater: Acute ¹	USEPA Region 4 Freshwater: Chronic ¹	Units	Emory River Reach A	Emory River Reach B	Emory River Reach C	Emory River Reference Reach	Clinch River Reach A	Clinch River Reach B	Clinch River Reference Reach	Tennessee River Reach B	Tennessee River Reference Reach
Total Recoverable Metal Concentrations												
Aluminum ^b	0.750	0.087	mg/L	0.463	1.22	0.825	0.256	0.642	0.2	0.113	0.592	0.315
Antimony	1.3	0.160	mg/L	<0.00033	0.00043	<0.00033	<0.00033	0.00043	<0.00033	<0.00033	<0.00033	<0.00033
Arsenic ^c	0.360	0.190	mg/L	0.00184	0.00638	0.00422	0.00139	0.00198	0.00108	0.0005	0.00198	0.00147
Barium	NA	NA	mg/L	0.0443	0.0862	0.0701	0.0586	0.0496	0.04	0.037	0.0431	0.0415
Beryllium	0.016	0.00053	mg/L	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033
Boron	NA	0.750	mg/L	0.0225	0.0264	0.0253	0.0211	0.0222	0.0215	0.0196	0.018	0.0215
Cadmium	0.00179	0.00066	mg/L	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033
Calcium	NA	NA	mg/L	40.3	39.3	37.8	35.1	39.4	39.5	40.2	35.9	37.5
Chromium ^d	0.98432	0.11732	mg/L	0.00055	0.00108	0.00076	0.00033	0.00073	0.00049	<0.00033	0.00067	0.0004
Chromium IV	0.016	0.011	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	mg/L	0.00053	0.00105	0.00088	0.00051	0.00088	0.0004	<0.00033	0.0005	0.00042
Copper	0.0092	0.0065	mg/L	0.00246	0.00311	0.00203	0.00077	0.00318	0.00139	0.0008	0.00194	0.00166
Iron	NA	1.0	mg/L	0.372	0.779	0.734	0.51	0.586	0.201	0.14	0.542	0.326
Lead	0.03378	0.00132	mg/L	0.00069	0.00167	0.00118	0.00046	0.00145	0.00038	<0.00033	0.00083	0.00066
Magnesium	NA	NA	mg/L	11.9	11.6	11.1	10.2	11.7	11.8	11.8	10.6	10.8
Manganese	NA	NA	mg/L	0.0834	0.686	0.866	0.794	0.129	0.058	0.0456	0.231	0.122
Mercury	0.0024	0.000012	mg/L	0.000233	<0.00015	<0.00015	0.000151	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015
Molybdenum	NA	NA	mg/L	0.00091	0.00125	0.00113	0.00072	0.00086	0.00083	0.00099	0.00065	0.00087
Nickel	0.789	0.08771	mg/L	0.00096	0.00202	0.00136	0.00093	0.00142	0.00087	0.00067	0.00077	0.00079
Potassium	NA	NA	mg/L	1.71	1.72	1.67	1.7	1.61	1.63	1.6	1.66	1.7
Selenium	0.020	0.005	mg/L	0.00049	0.0007	0.00048	<0.00033	0.00043	0.00054	0.00033	0.00033	0.00055
Silver ^e	0.00123	0.000012	mg/L	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033	<0.00033
Sodium	NA	NA	mg/L	7.13	7.08	6.7	6.27	6.96	7.01	6.98	7.92	8.38
Strontium	NA	NA	mg/L	0.121	0.128	0.12	0.104	0.118	0.118	0.115	0.11	0.117
Thallium	0.140	0.004	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium	NA	NA	mg/L	0.00204	0.00467	0.0028	<0.001	0.00296	0.00142	<0.001	0.00223	0.00174
Zinc	0.06504	0.05891	mg/L	<0.0083	0.0122	<0.0083	<0.0083	<0.0083	<0.0083	<0.0083	<0.0083	<0.0083

Notes:

¹ Criteria shown are generic values from the USEPA Region 4 Waste Management Division Freshwater Surface Screening Values for Hazardous Waste Sites. Based on Region 4 Water Management Division, Water Quality Standards Unit's Screening List, using a hardness value of 50. They have not been adjusted to account for site specific hardness values. These values represent the chronic ambient water quality criteria values for the protection of aquatic life. A safety factor of ten was used to derive a chronic value if only acute information was available.

Data presented are the maximum detected values for each constituent. Where no constituent was detected, the maximum reporting limit is shown.

mg/L = Milligrams per liter.

NA = No data available.

Bold = Constituent concentrations exceeding USEPA Region 4 Freshwater Surface Water Screening Values for Hazardous Waste Sites Chronic criteria are bolded.

Shaded = Constituent concentrations exceeding USEPA Region 4 Freshwater Surface Water Screening Values for Hazardous Waste Sites Acute criteria are shaded.

Footnotes are as follows:

^a - Hardness value represents the minimum of hardness values sampled within a reach.

^b - Criteria are specific to a pH of 6.5 - 9.0.

^c - Screening values for arsenic III used as a surrogate

^d - Screening value for chromium III used as a surrogate

^e - Insufficient information available to derive a criterion, the lowest reported effect level was used with the application of a safety factor of 10 to protect for a more sensitive species.

