

Maryland Darter Survey (May – September 2012)

Final Report

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Introduction

Since 2008, there has been a series of surveys to find the federally-endangered Maryland Darter (*Etheostoma sellare*) as part of an ongoing USFWS status assessment (Kilian et al. 2010; Normandeau Associates 2012; Raesly 2010). These surveys have focused on the three historical collection localities – Swan Creek, Gashey’s Run, and Deer Creek – and in other potential Maryland Darter habitats in the Susquehanna River mainstem, other Susquehanna tributaries, and tributaries to the Upper Chesapeake Bay.

From May to September 2012, we continued the effort begun in 2008 to find this rare species. We surveyed all three historical collection locations and potential habitats in Octoraro Creek, Mill Creek, and in the Susquehanna River mainstem. This report summarizes the results of this latest effort and provides recommendations regarding the federal status of this endangered fish.

Methods

Sampling Gear

We used backpack electrofishing/seining and snorkeling in our attempts to find the Maryland Darter. These gears have proven effective at collecting benthic fishes and have previously detected all other darter species known to occur in the study area (Kilian et al. 2010; Raesly 2010). Sampling gear used at each site was chosen based on depth of stream habitat and stream flow rates. When possible, we used a combination of these gears to improve our ability to detect numerically rare benthic fishes. Sampling gear used at each site is described in detail below.

Backpack electrofishing/seining: These two gears were used in combination to survey each tributary sampled during this effort. Seining was conducted using a three to four person crew. A 3 m ×1.5 m ×6 mm mesh seine was positioned perpendicular to stream flow and stream substrate within three meters upstream of the seine was disturbed by one or two people. A backpack electrofisher was used as substrate was disturbed to increase capture efficiency. This process was repeated throughout targeted riffle habitats in each of the tributaries during each site visit. During low flow periods when seining was not effective, backpack electrofishing was used to sample for fishes in shallow riffle and pool habitats.

Snorkeling: Snorkel surveys were conducted in Deer Creek, Octoraro Creek, and in the Susquehanna River. Snorkeling was done along transects where snorkelers, spaced an equal distance apart, swam parallel to each other in an upstream direction.

Summary of Sampling Effort

We sampled a total of 17 sites in the three historical tributaries, Octoraro Creek, Mill Creek, and the Susquehanna River. The majority of these sites were sampled on multiple occasions. Geographic coordinates, site location description, and sample frequency for each site are provided in Table 1.

Swan Creek: This tributary was the site of the first recorded collection of Maryland Darter (Radcliffe and Welsh 1913). The sampled reach of this tributary included multiple riffle/pool sequences from MD Route 132 (Old Post Road) downstream approximately 500 m. This reach overlies the Fall Line and includes habitats characteristic of the Piedmont and Coastal Plain physiographic provinces. We sampled this site on eight occasions from June to September 2012 (Table 1). Fishes were collected using backpack electrofishing.

Gashey’s Run: Maryland Darter was collected from Gashey’s Run in 1962 and 1965 in the lower riffle habitats located upstream of its confluence with Swan Creek (Knapp et al. 1963; Knapp 1976). We focused our efforts in the stream reach located immediately upstream of Oakington Road. The sampled reach extended upstream from this road crossing approximately 600m. We sampled this site on eight occasions from June to September 2012 (Table 1). Fishes were collected using backpack electrofishing.

Deer Creek: Most historical observations of Maryland Darter occurred in Deer Creek in the riffle below the Stafford Road Bridge (Knapp 1976; Raesly 1991; 1992). We focused our sampling effort in this riffle habitat where

the Maryland Darter was last observed in 1988 (Raesly 1992). We sampled this site a total of 10 times from June to September 2012 (Table 1). We used backpack electrofishing/seining to survey the riffle on five occasions. This site was also sampled using snorkeling on five occasions. We also surveyed stream reaches adjacent to the Stafford riffle. Three sites within the reach extending upstream from the Stafford Road crossing to the Baltimore Pumping Station were surveyed (each site on one occasion) using backpack electrofishing/seining. We also sampled downstream of the Stafford Road crossing in the first major riffle habitat upstream of the Susquehanna River confluence. This site was surveyed once in July and again in September. Fishes were collected using backpack electrofishing/seining.

Octoraro Creek: Octoraro Creek is considered a potential habitat for Maryland Darter due to its proximity to historical collection localities and to its similarity in habitat to Deer Creek (USFWS 2007). We sampled five sites in Octoraro Creek a total of 11 times from May to September 2012 (Table 1). These sites were located in the stream reach extending from the Susquehanna River confluence upstream to the riffle above the railroad crossing near Rt. 222. The majority of sampling effort was focused on the first major riffle above the railroad crossing. This location was surveyed six times. Fishes in Octoraro Creek were surveyed using electrofishing/seining and snorkeling.

Mill Creek: Mill Creek is a small tributary to Furnace Bay in Perryville, Maryland. As with Octoraro Creek, this tributary is located within close proximity to historical collection localities and is a potential habitat for Maryland Darter. To our knowledge, this tributary had not been previously surveyed for Maryland Darter. On one occasion, (September 12), we surveyed this tributary from approximately 200m below to approximately 50m above the Marion Tapp Parkway crossing in the Perryville Community Park (Table 1). Fishes were collected using backpack electrofishing.

Susquehanna River: The Susquehanna River has long been recognized as potential Maryland Darter habitat (Knapp 1976; USFWS 1985; Neely et al. 2003). Since 2008, this river has been the focus of recent efforts to find the species using a variety of sampling gears (Kilian et al. 2010; Normandeau Associates 2012; Raesly 2010). We surveyed the Susquehanna River at four sites in July, August, and September (Table 1). One of these sites, the Susquehanna River at the Deer Creek mouth, was surveyed on three separate occasions. Fishes were observed while snorkeling.

Table 1. Locations of sites sampled for Maryland Darter from May to September 2012.

Waterbody	Site Description	Upper Limit		Lower Limit	
		Latitude (83m)	Longitude (83m)	Latitude (83m)	Longitude (83m)
Swan Creek	Downstream of Old Post Road (Rt. 132)	39.52034	-76.13994	39.51639	-76.13919
Gashey's Run	Upstream of Oakington Road	39.52300	-76.12330	39.51901	-76.12603
Deer Creek	Riffle at Stafford Road bridge	39.62283	-76.16433	39.62216	-76.16305
	Riffle at Baltimore Pumping Station	39.61886	-76.16898	39.61798	-76.16821
	First riffle upstream of Stafford Rd. bridge	39.62077	-76.16561	39.62242	-76.16470
	First major riffle upstream of Susquehanna River confluence	39.62122	-76.15597	39.16959	-76.15505
	Riffle/run complex immediately downstream of Baltimore Pumping Station	39.61798	-76.16816	39.61942	-76.16615
Octoraro Creek	First major riffle above railroad bridge	39.65988	-76.15048	39.66007	-76.15304
	Rt. 222 bridge upstream to lower railroad bridge	39.66007	-76.15304	39.66028	-76.15691
	Confluence with Susquehanna River	39.65815	-76.15946	39.65620	-76.15865
	Riffle downstream of Rt. 222 bridge	39.66024	-76.15724	39.66009	-76.15564
	Riffle upstream of Rt. 222 bridge	39.66029	-76.15564	39.66032	-76.15671
Susquehanna River	Confluence of Rock Run	39.60899	-76.14375	39.60911	-76.14306
	Confluence of Octoraro Creek	39.65378	-76.15988	39.65529	-76.16189
	Confluence of Deer Creek	39.61338	-76.14910	39.61304	-76.14797
	Confluence of Deer Creek and lower 100m of Deer Creek	39.61621	-76.14998	39.60921	-76.14352
Mill Creek	Downstream of Marion Tapp Pkwy. in Perryville Community Park	39.55746	-76.06379	39.55688	-76.06063

Results

Swan Creek: Twenty-five species of fishes were detected across all sampling dates including two darter species *Etheostoma olmstedi* (Tessellated Darter) and *Percina bimaculata* (Chesapeake logperch). Tessellated Darter was the most abundant darter in Swan Creek, with 1,026 individuals observed during the study period (Table 2). This species was collected on all sampling dates. The Chesapeake logperch, first documented in Swan Creek in November 2009, was detected on three of eight sampling dates. Abundance of Chesapeake logperch on all three sampling dates was low, with only a total of 9 individuals observed.

Table 2. Fishes collected from Swan Creek from May – October 2012. Total numbers of individuals of all darter species collected are listed. Relative abundance codes are as follows: * 1-10; **11-99; ***>100. X: denotes species presence (abundance not recorded). Electrofishing (E) was used to sample fishes in Swan Creek.

Species	Common Name	Sample Date							
		May 31	July 1	July 13	Aug 9	Aug 30	Sept 7	Sept 13	Sept 20
<i>Anguilla rostrata</i>	American Eel	***	***	X	***	X	**	**	X
<i>Clinostomus funduloides</i>	Rosyside Dace	*	**		**	X	*	*	
<i>Cyprinella analostana</i>	Satinfin Shiner		*	X	**	X	**	*	X
<i>Cyprinella spiloptera</i>	Spotfin Shiner	**	**		**				
<i>Exoglossum maxillingua</i>	Cutlip Minnow	***	***	X	***	X	**	**	X
<i>Hybognathus regius</i>	Eastern Silvery Minnow	*	*			X			
<i>Luxilus cornutus</i>	Common Shiner	**	**	X	**	X	**	*	X
<i>Notropis proce</i>	Swallowtail Shiner	**	***	X	***	X	*	**	X
<i>Rhinichthys atratulus</i>	Eastern Blacknose Dace	***	***	X	***	X	**	**	X
<i>Semotilus atromaculatus</i>	Creek Chub	**	**	X	**	X	**	*	X
<i>Catostomus commersoni</i>	White Sucker	***	***	X	***	X	**	**	X
<i>Erimyzon oblongus</i>	Creek Chubsucker	**	*		**	X	*	*	X
<i>Hypentelium nigricans</i>	Northern Hogsucker	**	**	X	**	X	*		X
<i>Ameiurus nebulosus</i>	Brown Bullhead	**	**	X	**				
<i>Noturus insignis</i>	Margined Madtom	**	**	X	**	X	*	*	X
<i>Fundulus diaphanus</i>	Banded Killifish					X	*	*	X
<i>Morone saxatilis</i>	Striped Bass			X					
<i>Lepomis auritus</i>	Redbreast Sunfish	**	**	X	**	X	**	**	X
<i>Lepomis cyanellus</i>	Green Sunfish	***	**	X	**	X	*	*	X
<i>Lepomis gibbosus</i>	Pumpkinseed	***	**	X	***	X	**	**	X
<i>Lepomis macrochirus</i>	Bluegill	*	*	X	*	X	*	*	X
<i>Lepomis Hybrid</i>			*		*				
<i>Micropterus salmoides</i>	Largemouth Bass					X			X
<i>Etheostoma olmstedi</i>	Tessellated Darter	102	370	93	263	72	26	56	44
<i>Percina bimaculata</i>	Chesapeake Logperch	6	2		1				
<i>Perca flavescens</i>	Yellow Perch	*							
	Gear Used	E	E	E	E	E	E	E	E
	Effort (mnhrs)	4.2	3.4	5.3	4.3	7.5	3.4	1.7	2.9

Gashey's Run: Twenty-two species of fishes were detected across all sampling dates (Table 3). Tessellated darter was the only darter species observed in Gashey's Run. A total of 723 individuals were observed during the study period.

Table 3. Fishes collected from Gashey's Run from May – October 2012. Total numbers of individuals of all darter species collected are listed. Relative abundance codes are as follows: * 1-10; **11-99; ***>100. X: denotes species presence (abundance not recorded). Electrofishing (E) was used to sample fishes in Gashey's Run.

Species	Common Name	Sample Date							
		May 31	July 1	July 13	Aug 9	Aug 30	Sept 7	Sept 13	Sept 20

Species	Common Name	May 31	July 1	July 13	Aug 9	Aug 30	Sept 7	Sept 11	Sept 13
<i>Lampetra aepyptera</i>	Least Brook Lamprey					X		*	
<i>Anguilla rostrata</i>	American Eel	***	***	X	***	X	**	**	**
<i>Cyprinella analostana</i>	Satinfin Shiner			X					
<i>Cyprinella spiloptera</i>	Spotfin Shiner	*	**	X	**				
<i>Exoglossum maxillingua</i>	Cutlip Minnow								
<i>Hybognathus regius</i>	Eastern Silvery Minnow	*	*	X	*	X			
<i>Luxilus cornutus</i>	Common Shiner	*	**	X	*				
<i>Notemigonus crysoleucas</i>	Golden Shiner	*							
<i>Notropis hudsonius</i>	Spottail Shiner		*	X		X		**	
<i>Notropis procne</i>	Swallowtail Shiner	***	***	X	***	X	*	***	**
<i>Pimephales notatus</i>	Bluntnose Minnow	*		X	*	X		*	
<i>Rhinichthys atratulus</i>	Eastern Blacknose Dace	***	***	X	***	X	***	***	***
<i>Semotilus atromaculatus</i>	Creek Chub	***	***	X	***	X	***	**	***
<i>Catostomus commersoni</i>	White Sucker	***	***	X	***	X	**	**	***
<i>Erimyzon oblongus</i>	Creek Chubsucker	**	**		***	X	*	**	*
<i>Ameiurus nebulosus</i>	Brown Bullhead	**	**	X	**	X	*	*	
<i>Fundulus diaphanus</i>	Banded Killifish			X		X			
<i>Lepomis auritus</i>	Redbreast Sunfish					X		**	
<i>Lepomis cyanellus</i>	Green Sunfish	**	**	X	**	X	**	**	**
<i>Lepomis gibbosus</i>	Pumpkinseed	**	**	X	**	X	*	**	**
<i>Lepomis macrochirus</i>	Bluegill	*	*	X	*	X	*	***	
<i>Lepomis</i> Hybrid			*		*				
<i>Micropterus salmoides</i>	Largemouth Bass			X		X		*	
<i>Etheostoma olmstedii</i>	Tessellated Darter	98	140	56	270	65	25	44	25
	Gear Used	E	E	E	E	E	E	E	E
	Effort (mnhrs)	2.1	4.9	2.8	1.7	5.4	2.5	0.5	1.2

Deer Creek: Forty-four species of fishes were detected in Deer Creek across all sampling dates, including five darters – Tessellated Darter, Chesapeake Logperch, *Etheostoma blenniodes* (Greenside Darter), *Etheostoma zonale* (Banded Darter), and *Percina peltata* (Shield Darter; Table 4). Thirty-nine species were detected at the Stafford Road riffle, including the same five darter species. A total of 662 individuals of Tessellated Darter were observed in Deer Creek. This species was detected at every site and on every sampling occasion. A total of 101 Greenside Darters, 55 Banded Darters, 133 Chesapeake Logperch, and 206 Shield Darters were observed in Deer Creek during the study period.

Table 4. Fishes collected from five sites in Deer Creek from May – October 2012. Total numbers of individuals of all darter species collected are listed. Relative abundance codes are as follows: * 1-10; **11-99; ***>100. X: denotes species presence (abundance not recorded). Sampling gear used in Deer Creek included electrofishing/seining (ES) and snorkeling (SN).

		Sample Date and Location														
Species	Common Name	June 1 ^a	July 2 ^a	July 10 ^b	July 10 ^c	July 10 ^d	July 13 ^a	Aug 30 ^a	Sept 7 ^a	Sept 7 ^a	Sept 9 ^c	Sept 12 ^a	Sept 12 ^a	Sept 13 ^a	Sept 20 ^d	Sept 20 ^a
<i>Petromyzon marinus</i>	Sea Lamprey			*	*						*					
<i>Anguilla rostrata</i>	American Eel	***	***	***	***	***	**	*	***	*	***	X	*	*	**	***
<i>Camptostoma anomalum</i>	Central Stoneroller															*
<i>Clinostomus funduloides</i>	Rosyside Dace	*	*					**		*		X				
<i>Cyprinella sp.</i>								***		***			***	***		
<i>Cyprinella analostana</i>	Satinfin Shiner			*	*	*	**		**		**	X				*
<i>Cyprinella spiloptera</i>	Spotfin Shiner	**	**	**	***	***			**		**				***	**
<i>Cyprinus carpio</i>	Common Carp	*									*					
<i>Exoglossum maxillingua</i>	Cutlip Minnow	*	*	*	*				*		**	X		*		
<i>Hybognathus regius</i>	Eastern Silvery Minnow										*					
<i>Luxilus cornutus</i>	Common Shiner	*	*	**	*		*				*	X	*			
<i>Nocomis micropogon</i>	River Chub	**	**	**	**		**	***	***	***	***	X	***	***	*	**
<i>Notemigonus crysoleucas</i>	Golden Shiner												*			
<i>Notropis amoenus</i>	Comely Shiner														*	
<i>Notropis hudsonius</i>	Spottail Shiner	*		**	*			**								
<i>Notropis proce</i>	Swallowtail Shiner	*			*			**			*		*		**	
<i>Notropis rubellus</i>	Rosyface Shiner	*		*	**	**	*				*	X				*
<i>Notropis sp.</i>								**		***			**	**		
<i>Pimephales notatus</i>	Bluntnose Minnow			*												
<i>Rhinichthys atratulus</i>	Eastern Blacknose Dace	*	*	*			*	*		**	*	X				
<i>Rhinichthys cataractae</i>	Longnose Dace	**	**	***	**	**			**		*	X	*			*
<i>Semotilus atromaculatus</i>	Creek Chub	*	*					*	*	**						
<i>Semotilus corporalis</i>	Fallfish		*	**	*	*	*						**	*		
<i>Catostomus commersoni</i>	White Sucker	***	*	**	*		*	*		**	*		*	*		
<i>Hypentelium nigricans</i>	Northern Hogsucker	*		*			*	*		**	*	X	**	*		
<i>Moxostoma macrolepidotum</i>	Shorthead Redhorse	*	*				*	*					**	*		
<i>Ictalurus punctatus</i>	Channel Catfish						*	*					*			
<i>Noturus insignis</i>	Margined Madtom	**	**	**	**	*		*	**	*	**	X			*	*
<i>Ameiurus catus</i>	White Catfish												*			
<i>Fundulus diaphanus</i>	Banded Killifish	*					*									
<i>Cottus caeruleomentum</i>	Blue Ridge Sculpin	*	*	**					*							
<i>Morone americana</i>	White Perch					*										
<i>Morone saxatilis</i>	Striped Bass	*		*			*						*			
<i>Ambloplites rupestris</i>	Rock Bass	*	*	*	**	*	*				**					
<i>Lepomis auritus</i>	Redbreast Sunfish	*		*	*	*		**		*	**	X	**	**		*
<i>Lepomis cyanellus</i>	Green Sunfish	**	*	*	*						*					
<i>Lepomis gibbosus</i>	Pumpkinseed	*	*	*							*	X	*		*	*
<i>Lepomis macrochirus</i>	Bluegill	*	*					**		*	**	X	*			
<i>Micropterus dolomieu</i>	Smallmouth Bass		*		*		**	**		**	**		**	**		

<i>Micropterus salmoides</i>	Largemouth Bass		*	*				*					*	*		*
<i>Etheostoma blennioides</i>	Greenside Darter	2	1			51					47					
<i>Etheostoma olmstedi</i>	Tessellated Darter	56	184	63	83	51	29	18	27	6	47	38	6	11	22	21
<i>Etheostoma zonale</i>	Banded Darter	4	6	3	8	3			5			10	1		5	10
<i>Percina bimaculata</i>	Chesapeake Logperch	13	8	9	12	21	11	13	2	9	13	3	2	6		11
<i>Percina peltata</i>	Shield Darter	11	11	5	11	2	41	44	7	20	4	6	23	14		7
<i>Percina flavescens</i>	Yellow Perch		*	*	*	*										
	Gear Used	ES	ES	ES	ES	ES	SN	SN	ES	SN	ES	ES	SN	SN	ES	ES
	Effort (mnhrs)	3.2	4.4	3.8	2.4	3.2	3.7	4.0	0.9	3.0	5.9	4.7	2.3	1.8	0.4	0.7

^a Riffle at Stafford Road bridge

^b Riffle at Baltimore Pumping Station

^c First riffle upstream of Stafford Road bridge

^d First major riffle upstream of confluence with Susquehanna River

^e Riffle/run complex immediately downstream of Baltimore Pumping Station

Octoraro Creek: A total of 46 fish species were detected in Octoraro Creek during the study period including five darter species (Table 5). Tessellated Darter was the most abundant darter species observed during the survey, with 508 individuals captured. Eleven Greenside Darters, 84 Banded Darters, 18 Chesapeake Logperch, and 30 Shield Darters were observed in Octoraro Creek during the study period.

Table 4. Fishes collected from four sites in Octoraro Creek from May – October 2012. Total numbers of individuals of all darter species collected are listed. Relative abundance codes are as follows: * 1-10; **11-99; ***>100. X: denotes species presence (abundance not recorded). Sampling gear used in Octoraro Creek included electrofishing/seining (ES) and snorkeling (SN).

Species	Common Name	Sample Date and Location										
		June 1 ^a	July 2 ^a	Sept 9 ^b	July 13 ^a	Aug 30 ^c	Sept 7 ^a	Sept 12 ^a	Sept 12 ^d	Sept 13 ^c	Sept 20 ^c	Sept 20 ^a
<i>Petromyzon marinus</i>	Sea Lamprey			*								
<i>Anguilla rostrata</i>	American Eel	***	***	***	***	*	*	**	*		***	***
<i>Dorosoma cepedianum</i>	Gizzard Shad			*		**	*		*			*
<i>Camptostoma anomalum</i>	Central Stoneroller							*				
<i>Clinostomus funduloides</i>	Rosyside Dace	*										
<i>Cyprinella sp.</i>						***	**		***	**		
<i>Cyprinella analostana</i>	Satinfin Shiner				**							
<i>Cyprinella spiloptera</i>	Spotfin Shiner	***	***	***	**			**		**	***	
<i>Cyprinus carpio</i>	Common Carp		*	*	*	*			*			
<i>Exoglossum maxillingua</i>	Cutlip Minnow		*	**				*	**			*
<i>Luxilus cornutus</i>	Common Shiner		*				*	*				*
<i>Nocomis micropogon</i>	River Chub	*	**	**	*		*	**		*	**	
<i>Notemigonus crysoleucas</i>	Golden Shiner			*								
<i>Notropis amoenus</i>	Comely Shiner			*								
<i>Notropis hudsonius</i>	Spottail Shiner	**	*	**		**			**	*	*	
<i>Notropis procne</i>	Swallowtail Shiner	*	*					*	**	***	*	*
<i>Notropis rubellus</i>	Rosyface Shiner	**	**	**		**		*				*
<i>Notropis sp.</i>					*	***			**			
<i>Pimephales notatus</i>	Bluntnose Minnow	*										
<i>Rhinichthys atratulus</i>	Eastern Blacknose Dace	*					*	*				*
<i>Rhinichthys cataractae</i>	Longnose Dace	**	**	*				**				*
<i>Semotilus corporalis</i>	Fallfish		*						*			
<i>Carpoides cyprinus</i>	Quillback	*										
<i>Catostomus commersoni</i>	White Sucker	***	**	**		*		**		*	*	*
<i>Hypentelium nigricans</i>	Northern Hogsucker	*	**	*	*	*	*	**	*			**
<i>Moxostoma macrolepidotum</i>	Shorthead Redhorse					*	*		**	*		
<i>Ameiurus natalis</i>	Yellow Bullhead	*	*	*								
<i>Ameiurus nebulosus</i>	Brown Bullhead	*		*								
<i>Ictalurus punctatus</i>	Channel Catfish	**	*	**	**	**	**		***	*		
<i>Noturus insignis</i>	Margined Madtom	**	**	*	***			**	*		**	**
<i>Ameiurus catus</i>	White Catfish					*	*			*		
<i>Salmo trutta</i>	Brown Trout											*
<i>Fundulus diaphanus</i>	Banded Killifish			*				*				
<i>Morone americana</i>	White Perch					*						
<i>Morone saxatilis</i>	Striped Bass				*	**				*		
<i>Ambloplites rupestris</i>	Rock Bass	*	*									
<i>Lepomis auritus</i>	Redbreast Sunfish	*	**	**	**	**	*	*	**	**	*	**
<i>Lepomis cyanellus</i>	Green Sunfish	**	**	**								
<i>Lepomis gibbosus</i>	Pumpkinseed		*	*		*		*			*	
<i>Lepomis macrochirus</i>	Bluegill	*	*	*		**	*		**	*	*	*
<i>Micropterus dolomieu</i>	Smallmouth Bass			**	**	**	**		**	*	*	
<i>Micropterus salmoides</i>	Largemouth Bass		**	*		**		*		*		*
<i>Etheostoma blennioides</i>	Greenside Darter	1	3	3								1
<i>Etheostoma olmstedii</i>	Tessellated Darter	25	78	215	14	1	2	96	4		19	54
<i>Etheostoma zonale</i>	Banded Darter			15	1			42			6	20
<i>Percina bimaculata</i>	Chesapeake Logperch	3	5	5	3			2				
<i>Percina peltata</i>	Shield Darter	5	3	14	4				3			1
<i>Perc flavescens</i>	Yellow Perch	*		*					*			

	Gear Used	ES	ES	ES	SN	SN	SN	ES	SN	SN	ES	ES
	Effort (mnhrs)	3.0	4.0	6.7	4.0	3.7	2.7	1.0	2.3	1.5	2.0	0.7

^a First major riffle above the railroad crossing

^b Rt. 222 bridge upstream to lower railroad bridge

^c From confluence with Susquehanna River upstream approximately 200m

^d Riffle downstream of Rt. 222 bridge

^e Riffle upstream of Rt. 222 bridge

Mill Creek: Twenty-one fish species were detected in Mill Creek (Table 6). Two darter species, Tessellated Darter (30) and Chesapeake Logperch (5) were observed. This was the first record of Chesapeake Logperch, listed as Threatened in Maryland, from this tributary.

Susquehanna River: Thirty-nine species were detected in the Susquehanna River including four darters - Tessellated Darter (118), Banded Darter (15), Chesapeake Logperch (38), and Shield Darter (114; Table 6).

Table 6. Fishes collected from four sites in the Susquehanna River and one site in Mill Creek from May – October 2012. Total numbers of individuals of all darter species collected are listed. Relative abundance codes are as follows: * 1-10; **11-99; ***>100. X: denotes species presence (abundance not recorded). Sampling gear used to survey these sites included electrofishing (E) and snorkeling (SN).

Sample Date and Location

Species	Common Name	July 2 ^e	July 11 ^e	Aug 9 ^e	Sept 7 ^a	Sept 12 ^d	Sept 13 ^b	Sept 13 ^c
<i>Anguilla rostrata</i>	American Eel	**	*	*		***	*	
<i>Dorosoma cepedianum</i>	Gizzard Shad		*	*				**
<i>Clinostomus funduloides</i>	Rosyside Dace					*		
<i>Cyprinella sp.</i>		**	***	***				**
<i>Cyprinella analostana</i>	Satinfin Shiner					*		
<i>Cyprinella spiloptera</i>	Spotfin Shiner					**		
<i>Cyprinus carpio</i>	Common Carp		*	*	*			
<i>Exoglossum maxillingua</i>	Cutlip Minnow					*		
<i>Luxilus cornutus</i>	Common Shiner					***		
<i>Nocomis micropogon</i>	River Chub		*	*	**			
<i>Notropis hudsonius</i>	Spottail Shiner	**	**	**				
<i>Notropis proce</i>	Swallowtail Shiner	*	*	**				*
<i>Notropis rubellus</i>	Rosyface Shiner	**	**	**				
<i>Notropis sp.</i>								**
<i>Pimephales notatus</i>	Bluntnose Minnow			*				
<i>Rhinichthys atratulus</i>	Eastern Blacknose Dace			*		**		
<i>Rhinichthys cataractae</i>	Longnose Dace			*				
<i>Semotilus atromaculatus</i>	Creek Chub				*	**		
<i>Semotilus corporalis</i>	Fallfish			*		*		
<i>Catostomus commersoni</i>	White Sucker		**	**		**		**
<i>Erimyzon oblongus</i>	Creek Chubsucker					*		
<i>Hypentelium nigricans</i>	Northern Hogsucker		*					
<i>Moxostoma macrolepidotum</i>	Shorthead Redhorse			*				**
<i>Ameiurus nebulosus</i>	Brown Bullhead					*		
<i>Ameiurus catus</i>	White Catfish				*			
<i>Ictalurus punctatus</i>	Channel Catfish	*	*	**				
<i>Fundulus diaphanus</i>	Banded Killifish	***	*	*		**		
<i>Cottus caeruleomentum</i>	Blue Ridge Sculpin					*		
<i>Morone americana</i>	White Perch	*						
<i>Morone saxatilis</i>	Striped Bass	*		*				
<i>Ambloplites rupestris</i>	Rock Bass	*						
<i>Lepomis auritus</i>	Redbreast Sunfish	*	*	*		*	*	**
<i>Lepomis cyanellus</i>	Green Sunfish			*		**		
<i>Lepomis gibbosus</i>	Pumpkinseed					**		*
<i>Lepomis macrochirus</i>	Bluegill		*		*	*	*	
<i>Micropterus dolomieu</i>	Smallmouth Bass	*	**	**	*			**
<i>Micropterus salmoides</i>	Largemouth Bass		*	*		*	*	

<i>Etheostoma olmstedi</i>	Tessellated Darter	46	23	49	30				
<i>Etheostoma zonale</i>	Banded Darter	9	1	5					
<i>Percina bimaculata</i>	Chesapeake Logperch	13	1	24	5				
<i>Percina peltata</i>	Shield Darter	61	24	29					
<i>Sander vitreum</i>	Walleye	*							
	Gear Used	SN	SN	SN	SN	E	SN	SN	
	Effort (mnhrs)	7.5	4.2	4.0	1.3	5.0	1.8	1.5	

^a Susquehanna River at mouth of Rock Run

^b Susquehanna River at mouth of Octoraro Creek

^c Susquehanna River at mouth of Deer Creek

^d Mill Creek at Perryville Community Park

^e Susquehanna River and lower 100m of Deer Creek

Despite an estimated 155 man hours of sampling effort (i.e., time spent observing fishes) put forth at all historical collection localities and in other potential habitats, Maryland darter was not detected in this survey.

Variability in Species Occurrence

Species occurrence at the three historical collection localities was highly variable both in time and space (Kilian et al. 2010; Raesly 2010). In our survey, temporal variability was observed at sites sampled on multiple occasions. Only 48% and 36% of species collected in Swan Creek and Gashey's Run, respectively, were collected on every sampling occasion. In Deer Creek at the Stafford Road riffle, only 41% of species were collected during every sampling event in which the entire riffle was sampled using electrofishing/seining. We also noted differences in species detected in this survey compared to previous surveys. For example, Banded Darter, collected in Swan Creek in 2010, was not documented in this tributary during our survey.

Spatial variability in species occurrence was most notable in Deer Creek, where multiple reaches were sampled during the survey. Five species, including *Petromyzon marinus* (Sea Lamprey), *Hybognathus regius* (Eastern Silvery Minnow), *Notropis amoenus* (Comely Shiner), *Pimephales promelas* (Bluntnose Minnow), and *Morone americana* (White Perch) were detected in reaches adjacent to Stafford Road riffle, but not in the riffle itself. Spatial variability in species occurrence occurs at scales finer than stream reach. Raesly (2010) noted variability in species detected within microhabitats in the same riffle.

Conclusion

The near-continuous effort to find the Maryland Darter since 2008 is the largest collective effort put forth since the species was last seen in 1988. These surveys were extensive – focused in all three historical collection localities and in potential habitats in the Susquehanna River and its tributaries. These surveys were also intensive – habitats were sampled on multiple occasions throughout the year using a variety of sampling gears (Kilian et al. 2010; Normandeau Associates 2012; Raesly 2010). These efforts have failed to find any Maryland Darters. Although the variable nature of species occurrence hinders our ability to detect rare species, the likelihood that Maryland Darter is extant is low.

Our inability to prove that the Maryland Darter is extant does not prove that it is extinct. It is not unusual for long periods of time to pass between observations of rare species (Etnier 1994). There have been numerous examples of fish species erroneously declared extinct (Helfman 2007; Miller et al. 1989). In the recent past, the Maryland Darter was mistakenly declared extinct following 50 years of failed attempts to collect it from Swan Creek (Mattheison 1959). It was rediscovered three years later in Gashey's Run (Knapp et al. 1963).

Recommendations

The lack of recent records of Maryland Darter warrants a review of the current listing status of the species by USFWS. In the event the listing status of the species remains unchanged, we do not recommend continuing the level of survey effort that has occurred since 2008. However, we do recommend conducting periodic surveys of the historical collection localities and the Susquehanna River below Conowingo Dam, perhaps in conjunction with each five-year status review. If the Maryland darter is declared extinct and removed from the endangered species list, we do not believe that efforts to survey historical collection localities should be ceased in their entirety. Spatial and

temporal variation in fish species distributions, coupled with detection probabilities of less than 100%, create uncertainty in status assessments, especially with species as rare and localized as the Maryland darter.

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