

Potomac River Fisheries Commission's
American Shad Fishing / Recovery Plan

Submitted to the
Atlantic States Marine Fisheries Commission

January 10, 2012

1. Sustainable Fishery Plan

In accordance with the guidelines provided in Amendment 3 to the Interstate Fishery Management Plan (IFMP) for Shad and River Herring, the Potomac River Fisheries Commission (PRFC) submits the following Sustainable Fishery Plan.

1a. Request for Fishery

The PRFC requests that the Shad and River Herring Management Board consider this request to continue a limited commercial by-catch allowance of American shad in the portion of the Potomac River under PRFC jurisdiction (Figure 1). Accordingly, the PRFC justifies this request based on the fact that the Board accepted the 2007 Shad Stock Assessment which established a benchmark goal for American shad recovery in the Potomac River and required the PRFC to continue monitoring the pound net fishery's by-catch allowance of American shad, including discards. The Stock Assessment stated "to continue stock rebuilding, there should be no new expansion of the fishery until the benchmark is reached". The benchmark goal identified in the 2007 Stock Assessment was approved as a restoration target and was exceeded in 2011.

1b. Definition of Sustainability

Amendment 3 to the IFMP for Shad and River Herring defines a sustainable fishery as one that will not diminish potential future stock reproduction and recruitment. The PRFC proposes to continue with the mandatory daily harvest reporting program with the fishermen on the Potomac River, in which they record daily harvest, effort and discard data. The continuation of this data collection enhances the long term data set that the PRFC maintains, updates and utilizes to monitor the progress of the American shad stock rebuilding and recovery in the Potomac River. The long-term American shad juvenile abundance index (JAI) for the Potomac River is provided by Maryland Department of Natural Resources (MD DNR) and will continue on an annual basis.

1c. Summary of current stock status

The Potomac River has been closed to the commercial and recreational directed harvest of American shad since March 1, 1982. The only allowable commercial harvest since then has been via a pound net by-catch provision that allowed up to 2% by volume of the total catch in possession to be American shad. Starting in 1996, the pound net by-catch provision was further limited to 2% by volume, but could not exceed one bushel per day per licensee. In 2004, a one-bushel limit of American shad by-catch for the gill net fishery was approved by the ASMFC Shad and River Herring Technical Committee and Board, and established by the PRFC. In the Potomac River, all directed commercial, recreational and charter boat fisheries for American shad remain closed.

1d. Benchmark goals and objectives or restoration goals/targets

In the 2007 ASMFC Shad Stock Assessment, a benchmark for American shad in the Potomac River was defined as the geometric mean (GM) CPUE of pound net landings reported in Walburg and Sykes (1957) for the years 1944 to 1952, or 31.1 pounds per net-day. It was concluded in the assessment that among Chesapeake Bay stocks of American shad, the Potomac River population showed the most promising signs of recovery. The gill net index, the pound net index, and the JAI depicted strongly increasing trends in relative abundance. To continue stock rebuilding in the Potomac River, it was recommended that there should be no new expansion of the fishery until the benchmark goal is reached, and that this requires continued monitoring of the pound net fishery,

including discards.

The ASMFC Shad and River Herring Management Board accepted the 2007 Shad Stock Assessment Report, which included the Potomac River benchmark. This benchmark goal of 31.1 became the restoration target for the Potomac River and was approved by the ASMFC Shad and River Herring Technical Committee (Figure 2).

We have been steadily approaching this restoration target over time (Table 2). The GM was calculated for CPUEs of total pound net data (catch + discards) for the years 1999 – 2011, and for the first time the GM exceeded the benchmark goal and restoration target with a value of 32.0 pounds per net-day. The GM has increased every year since 2002, so achieving the target in 2011 was not unexpected. The PRFC has reported this information in their annual compliance report every year.

1e. Proposed time frame for achievement

The benchmark goal identified in the 2007 Stock Assessment and approved as a restoration target was exceeded in 2011.

1f. Discussion of management measure(s) to be taken if sustainable target is not achieved within indicated timeframe

The target was achieved in 2011. The PRFC will continue monitoring the total pound net CPUE data as well as the MD DNR survey data.

2. Stock Monitoring Programs

2a. Fishery Independent

Since 1995, American shad have been taken from the Potomac River as brood stock for hatchery production by the Interstate Commission on the Potomac River Basin (ICPRB), under special collection permits issued by the PRFC (Table 3). The ICPRB participated in the Potomac Restoration Stocking Program for American shad from 1995 – 2002, at which time recovery was considered sufficient for natural reproduction. In 2003, restoration stocking of the Rappahannock River started using Potomac River origin eggs through a partnership between ICPRB, the Virginia Department of Game and Inland Fisheries (VDGIF), and the U. S. Fish & Wildlife Service (USFWS) Harrison Lake National Fish Hatchery. Stocking of the Potomac River continues, but now as “replacement stocking” to account for the Potomac shad sacrificed for another river system. Since 1995, the ICPRB has released nearly 22 million fry into the Potomac. The Maryland Department of Natural Resources (MD DNR) (since 2001), VDGIF (2003 - 2009) and the USFWS (since 2004) have also collected American shad for brood stock under special collection permits issued by this Commission. The MD DNR began replacement stocking in 2007, and has released about 600,000 fry into the Anacostia River, a tributary of the Potomac River in Washington D.C. The VDGIF reported a total of 4,668,448 fry and the USFWS reported 188,000 fry stocked in the Potomac River as mitigation for egg collections. The Potomac River has been the egg source for all of Maryland’s shad restoration projects, Virginia’s shad restoration program in the Rappahannock River, as well as the Susquehanna River (MD/PA) and some of Delaware’s rivers since 2002.

The ICPRB kept 890 American shad (approximately 2,519 lbs.) from the Potomac River in 2010

(Table 3). The MD DNR collected 1,203 American shad (approximately 3,404 lbs.) from the Potomac River in 2010 (Table 4) and analyzed the egg collections (Figure 4). The USFWS collected 2,151 American shad (approximately 6,087 lbs.) from the Potomac River in 2010 (Table 6). No American shad were removed from the Potomac River by VDGIF in 2010 for brood stocking. The total 2010 brood stock removals from the Potomac River amounted to 4,244 American shad or approximately 12,010 pounds (average weight of 2.83 lbs.). Summaries of MD DNR (Table 5) and USFWS (Table 6) brood stock collection activities are provided. The ICPRB, MD DNR, and USFWS were permitted again in 2011 to collect American shad as brood stock for hatchery production and stocking efforts.

i. Juvenile abundance indices

Maryland is required to provide an American shad juvenile index for the Potomac River and several other river systems throughout its portion of the Chesapeake Bay. The annual juvenile abundance survey has been conducted since 1954, with American shad data collected from 1959 to present. Fixed stations and some auxiliary stations are used each year for a beach haul seine survey in which the juveniles of all species encountered are identified and recorded. The American shad juvenile index for the Potomac River is derived from the Maryland DNR state wide annual young of the year survey as geometric mean CPUEs (Figure 3). The 2011 value of 1.99 was significantly higher than the 2010 value of 1.05. <http://www.dnr.state.md.us/fisheries/juvinindex/index.html>

ii. Adult stock monitoring

Maryland DNR has conducted a Striped Bass Spawning Stock Survey since 1985, using multi-panel drift gill nets in the Potomac River. Since 1997, adult American shad that were incidentally caught were processed to obtain length, sex and age (scale samples) and repeat spawning determination (Figure 5).

Data was collected on age, size and sex composition for some of the American shad collected for brood stock (Tables 7 – 12). These fish were processed by Michael Hendricks in Pennsylvania.

2b. Fishery Dependent

i. Commercial Fishery

The non-directed Potomac River pound net by-catch harvest in 2011 consisted of 2,419 pounds of American shad (Table 1). The PRFC's mandatory commercial daily harvest reporting system is the source of these data, collecting harvest as well as discards or released fish. The 2011 discards/released by-catch of American shad in excess of the daily landing limit from pound nets was 2,465 pounds. The 2011 harvest data was combined with 2011 discard data to identify the total catch of 4,884 pounds. There were no reports of American shad harvest or discards from any other gear types in 2011.

Pound net effort is expressed as "pound net fishing day" which is one net fished one time. During 2011, one hundred pound nets were licensed in the Potomac River; however most of them were not set during the early spring months (the shad run). The pound net fishery is a 'limited entry' fishery capped at 100 licenses (each net is licensed separately). Effort included 77 pound net fishing days for the American shad by-catch harvest.

New regulation effective January 1, 2011 – all pound nets in the Potomac River must have at least six PRFC approved fish cull panels properly installed in each pound net to help release undersize fish. This regulation will have a beneficial impact on the release of river herring, but will

not be effective in the release of adult shad. These fish cull panels were being used for by-catch reduction by some pound netters on a voluntary basis prior to 2011; they are now mandatory.

ii. Recreational Fishery

The Potomac River, under PRFC jurisdiction, recreational and charter boat fisheries for American shad remained closed in 2011 and 2012. The American shad fishery has been closed since 1982 in this portion of the Potomac River. We are unaware of any historical or current recreational activity within the PRFC's jurisdiction. A historical recreational fishery existed in the D.C. portion of the Potomac River, but that fishery is now closed.

Figure 1. Potomac River – PRFC jurisdiction is the main stem of the Potomac River downstream of Washington, DC

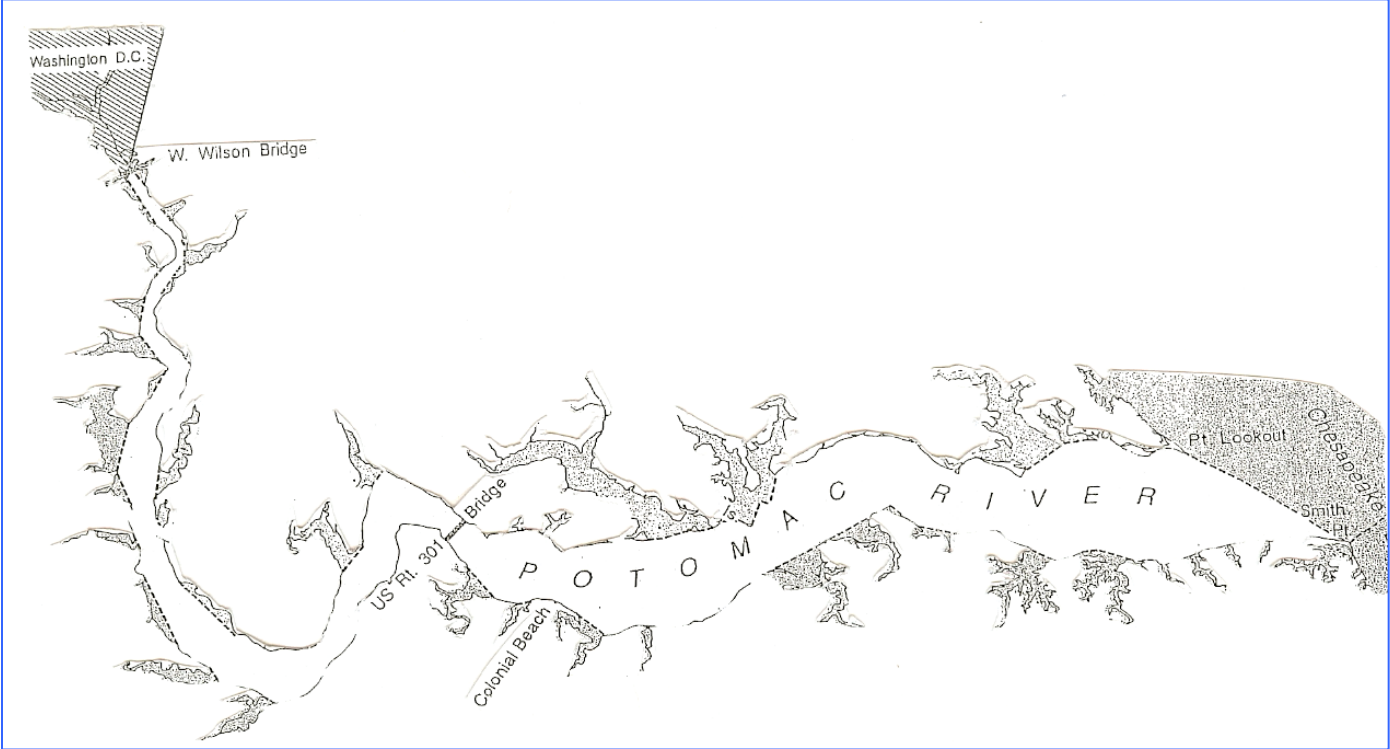


Figure 2

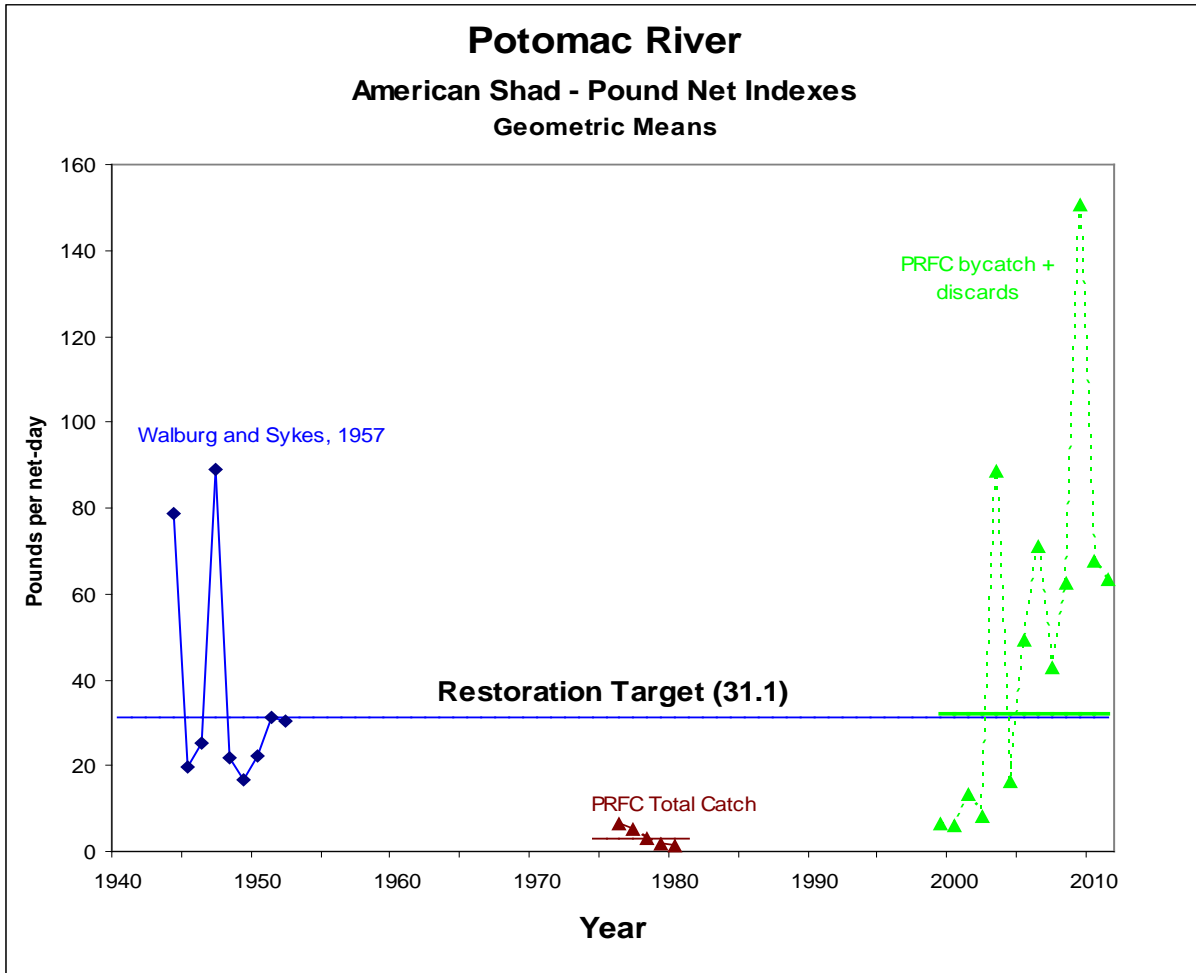


Figure 3

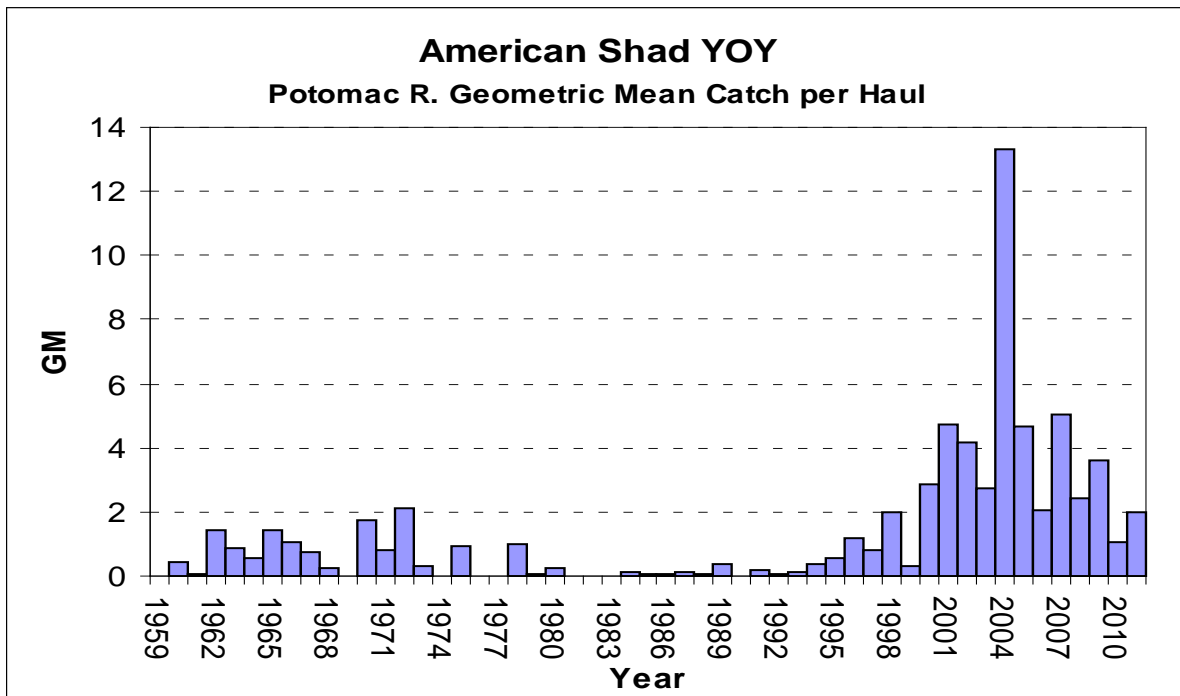


Figure 4

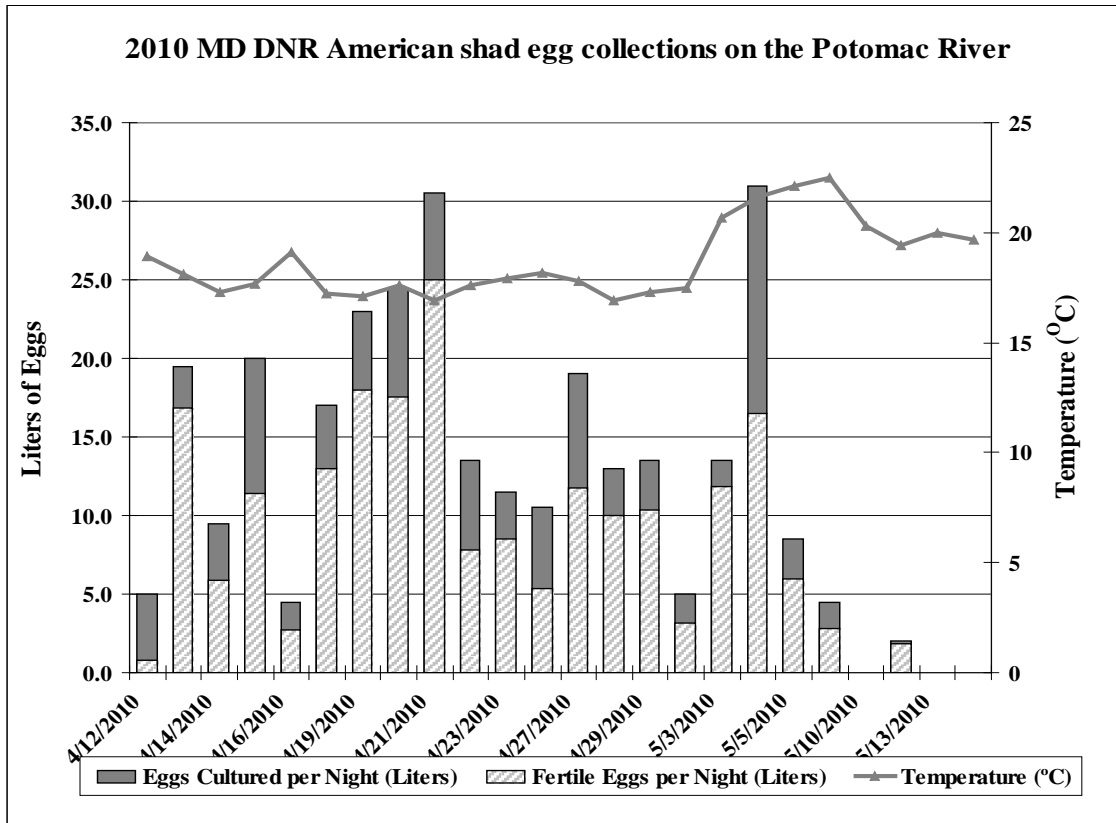


Figure 5

**MD DNR Potomac River American Shad CPUE
during MD Striped Bass spawning stock survey (1996-2011)
(DataSource = Eric Durell, MD DNR, Chart = ICPRB)**

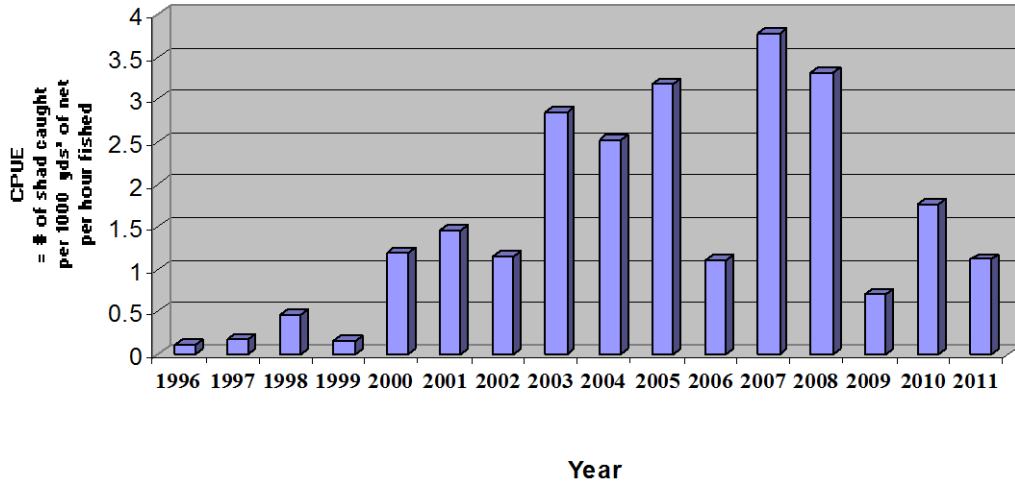


Table 1

POTOMAC RIVER FISHERIES COMMISSION
AMERICAN SHAD
Commercial Harvest (pounds) and Discard (pounds)

Year	HARVEST					DISCARD						
	Pound Net				Gill Net	Pound Net		Gill Net		Other Gear		Total
	Roe	Buck	Total	Net-days	Total	Roe	Buck	Roe	Buck	Roe	Buck	
1988	766	1,128	1,894	2,021								
1989	543	525	1,068	1,574								
1990	1,299	983	2,282	1,361								
1991	1,062	856	1,918	1,208								
1992	939	526	1,465	703								
1993	1,480	1,447	2,927	611								
1994	677	628	1,305	758								
1995	1,458	1,180	2,638	743								
1996	1,357	935	2,292	553								
1997	2,773	2,310	5,083	737								
1998	1,680	571	2,251	335								
1999	1,049	917	1,966	388		376	213	14	10			613
2000	897	611	1,508	258		28	56	55				139
2001	3,347	1,492	4,839	433		800	56	53		25		934
2002	1,727	1,035	2,762	348			59	25	2			86
2003	6,971	1,170	8,141	547		22,790	17,566	9,393	670	204	73	50,696
2004	4,408	643	5,051	493	293	1,800	1,100	1,053	54			4,007
2005	5,255	764	6,019	493	801	15,171	3,008	170	0			18,349
2006	3,847	409	4,256	260	413	10,178	4,000	17	4			14,199
2007	5,662	942	6,604	388	2,310	8,622	1,323	90		4		10,039
2008	6,310	505	6,815	274	160	8,282	2,000					10,282
2009	4,402	603	5,005	197	209	19,150	5,500			2		24,652
2010	3,790	95	3,885	117	31	3,907	131					4,038
2011	2,167	252	2,419	77	0	2,015	450					2,465

Table 2

Geometric Mean (GM) of Pound Net CPUE Data												
Time Series	44-52	76-80	99-02	99-03	99-04	99-05	99-06	99-07	99-08	99-09	99-10	99-11
GM	31.1	3.0	8.1	13.1	13.6	16.3	19.6	21.3	23.8	28.1	30.2	32.0

Table 3. Interstate Commission on the Potomac River Basin (ICPRB) Summary of the Number of American Shad Used, Eggs Collected, Fry Released, and CPUE of Shad Used for Project Period 1995-2011, Including Estimates of Shad Returns

	1995	1996	1997	1998	1999	2000	2001	2002	2003**	2004	2005	2006	2007	2008	2009	2010	2011	Totals
# Ripe females	135	166	245	105	119	373	338	245	240	387	246	316	441	349	183	379	244	4,328
# Green Females	78	51	92	50	44	93	135	141	120	127	49	72	93	150	48	226	122	1,643
# Spent Females	3	1	0	8	10	9	27	25	15	27	2	11	118	43	29	31	31	361
# Males	78	157	207	153	116	282	235	247	240	435	209	283	397	191	102	460	235	3,925
# Total Shad (Used)	294	375	544	316	289	757	735	658	615	976	506	682	1049	733	333	890	409	9,675
# Total Shad (Captured)								1801	1494	1852	1101	1010	1858	903	444	1096	789	11,904
# Shad Released								1143	879	896	595	328	809	170	111	206	380	5,517
# Eggs Collected x 1000	2,405	4,353	5,744	2,626	2,594	6,383	6,565	5,943	5,327	5,773	8,129	NA***	NA	NA	NA	NA	NA	NA
# Collections/# nets set	11per22	11per22	12pe 24	14/28	15/30	11per22	16/32	18/36	10per16	14/25	13/25	16/32	17/34	16/31	16/32	16/32	17/35	224/430 Avg. 21.9 Avg. 44.7
CPUE (# Shad Used/net-set)	13.4	17	22.7	11.3	9.6	34.4	22.9	18.3	35.9	39	20.2	21.3	30.9	23.6	10.4	27.8	11.7	21.9
CPUE (Total # shad/net-set)								50	93.4	74.1	44	31.6	54.6	29.1	13.9	34.3	22.5	44.7
# Eggs/Ripe-female	17,800	26,200	23,400	25,000	24,400	17,100	19,400	24,260	22,195	14,917	24,783	NA	NA	NA	NA	NA	NA	NA
# Fry stocked Pot. R.(x 1000)	1,175	1,989	1,535	1,589	1,304	3,176	3,336	1,531	200	400	919	1,158	728	884	528	510	488	21,451
# Fry stocked Rapp. R.(x 1000)									1,200	3,100	3,400	6,265	4,453	4,832	2,718	3,943	4,116	34,027
Total # Fry Stocked (x 1000)	1,175	1,989	1,535	1,589	1,304	3,176	3,336	1,531	1,400	3,500	4,319	7,423	5,181	5,716	3,246	4,453	4,604	55,478
# Fry Stocked per																		
Each Shad Collected	4,000	5,300	2,800	5,000	4,500	4,200	4,500	2,326	2,435	3,586	5,690	NA	NA	NA	NA	NA	NA	NA
Est. # of Shad Returning*	3,487	5,902	4,555	4,715	3,869	9,424	9,674	4,444	4,060	10,150	11,300	22,027	15,430	16,961	9,632	13,215	14,080	152,845
Est. # Shad Returning per																		
Each Shad Collected	11.9	15.7	8.4	14.9	13.4	12.4	13.5	6	5.9	10.6	14.9	NA	NA	NA	NA	NA	NA	NA

* Monitoring at the Conowingo Dam fish lifts (Hendricks 2000) found, on average, that it takes 337 hatchery fry stocked in the Susquehanna River to get one returning adult shad. Subsequent results have modified that number slightly, but the one shad returning per 337 stocked fry ratio has been used since 2001 as an assumed Potomac return rate to provide a constant estimate.

** The Potomac Restoration Stocking Program for American shad was conducted 1995 - 2002, at which time recovery was considered sufficient for natural reproduction. In 2003, restoration stocking of the Rappahannock River using Potomac River origin eggs was started through a partnership between ICPRB, VDGIF, and the USFWS's Harrison Lake National Fish Hatchery.

Stocking of the Potomac River continues, but now as "replacement stocking" to account for the Potomac shad sacrificed for another river system.

*** Not applicable (NA) is used after 2005 because these values could no longer be derived. Starting in 2006, we switched from using one boat to two-three boats for our collections. Since 2005, shad from all boats are pooled together during the collection process, and it became too difficult to separate or accurately estimate egg or fry totals for each individual boat contribution.

Note - CPUE is calculated by two methods in this project. The first CPUE (Shad used/net-set) is based on the number of shad used for egg collections and re-stocking of the Potomac and, starting in 2003, the Rappahannock. It does not include shad which were netted but released, i.e. the green females, spent females no longer spawning, or surplus males (we kept a 1:1 ratio of males to females). Starting in 2002, all shad netted were counted and a second CPUE (total shad netted/net-set) has been calculated, this time using all shad brought to the boat, even those released.

Table 4. 2010 Maryland Department of Natural Resources - American shad collection data from the Potomac River

Date	Temp (°C)	Males	Ripe	Green	Spent	Total shad	Liters of eggs	Liters good eggs per night	Egg viability	Eggs/liter	# of fertile eggs per liter
4/12/2010	18.9	4	10	23	0	37	5.0	0.8	0.155	40,700	6,300
4/13/2010	18.1	39	40	32	0	111	19.5	16.8	0.862	34,900	30,084
4/14/2010	17.3	32	20	17	0	69	9.5	5.9	0.618	33,800	20,899
4/15/2010	17.7	27	40	24	0	91	20.0	11.4	0.570	34,900	19,900
4/16/2010	19.1	8	10	17	0	35	4.5	2.7	0.601	35,600	21,399
4/18/2010	17.2	28	34	41	0	103	17.0	13.0	0.763	40,500	30,902
4/19/2010	17.1	10	33	18	4	65	23.0	18.0	0.783	37,300	29,198
4/20/2010	17.6	31	34	42	6	113	24.5	17.5	0.716	35,200	25,200
4/21/2010	16.9	50	57	12	5	124	30.5	25.0	0.820	37,800	31,000
4/22/2010	17.6	72	31	0	5	108	13.5	7.8	0.581	43,400	25,198
4/23/2010	17.9	42	12	9	7	70	11.5	8.5	0.740	33,800	24,998
4/25/2010	18.2	10	30	26	9	75	10.5	5.4	0.513	40,900	20,998
4/27/2010	17.8	20	36	1	3	60	19.0	11.8	0.620	39,200	24,300
4/28/2010	16.9	24	24	3	7	58	13.0	10.0	0.766	36,600	28,043
4/29/2010	17.3	59	28	0	2	89	13.5	10.3	0.765	40,000	30,600
4/30/2010	17.5	38	11	2	11	62	5.0	3.1	0.624	37,200	23,202
5/3/2010	20.7	3	28	2	4	37	13.5	11.8	0.875	39,100	34,201
5/4/2010	21.6	41	75	13	20	149	31.0	16.5	0.532	42,700	22,699
5/5/2010	22.1	25	23	4	19	71	8.5	6.0	0.706	46,900	33,102
5/6/2010	22.5	27	18	2	8	55	4.5	2.8	0.625	42,900	26,800
5/10/2010	20.3	2	0	0	17	19	0.0	0.0	0.000	0	0
5/12/2010	19.4	3	0	0	3	6	2.0	1.8	0.923	22,200	20,499
5/13/2010	20	6	4	0	6	16	0.0	0.0	0.000	0	0
5/17/2010	19.7	3	1	0	14	18	0.0	0.0	0.000	0	0
		604	599	288	150	1641	299.0				

Table 4 continued. 2010 Maryland Department of Natural Resources - American shad collection data from the Potomac River

Date	Total # of Eggs	Total fertile eggs	Moon Visibility %	Lunar Phase	# of nets used	feet of net used	Sq. ft. of net fished per night	
4/12/2010	203,500	31,502	6	Waning	4	1200	23700	0.001561
4/13/2010	680,550	586,634	2	Waning	4	1200	23700	0.004684
4/14/2010	321,100	198,536	0		4	1200	23700	0.002911
4/15/2010	698,000	398,000	0		4	1200	23700	0.003840
4/16/2010	160,200	96,296	1	Waxing	4	1200	23700	0.001477
4/18/2010	688,500	525,326	12	Waxing	4	1200	23700	0.004346
4/19/2010	857,900	671,564	20	Waxing	5	1500	29700	0.002189
4/20/2010	862,400	617,392	29	Waxing	5	1500	29700	0.003805
4/21/2010	1,152,900	945,493	40	Waxing	5	1500	29700	0.004175
4/22/2010	585,900	340,174	51	Waxing	5	1500	29700	0.003636
4/23/2010	388,700	287,483	62	Waxing	5	1500	29400	0.002381
4/25/2010	429,450	220,480	83	Waxing	5	1500	29400	0.002551
4/27/2010	744,800	461,702	96	Waxing	5	1500	29400	0.002041
4/28/2010	475,800	364,558	99	Full	4	1200	23400	0.002479
4/29/2010	540,000	413,100	99	Full	5	1500	29400	0.003027
4/30/2010	186,000	116,008	97	Waning	3	900	17400	0.003563
5/3/2010	527,850	461,710	79	Waning	3	900	17400	0.002126
5/4/2010	1,323,700	703,679	71	Waning	5	1500	28800	0.005174
5/5/2010	398,650	281,367	62	Waning	5	1500	28200	0.002518
5/6/2010	193,050	120,598	52	Waning	5	1500	28800	0.001910
5/10/2010	0	0	17	Waning	3	900	16800	0.001131
5/12/2010	44,400	40,999	5	Waning	3	900	16800	0.000357
5/13/2010	0	0	1	Waning	3	900	16800	0.000952
5/17/2010	0	0	9	Waxing	3	900	16800	0.001071
	11,463,350	7,882,600						

Table 5. Summary of American Shad Collected from the Potomac River by MD DNR and Eggs Obtained

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Totals
# Ripe Females	298	568	458	231	561	472	567	401	425	599	4,580
# Green Females		205	351	276	446	314	438	405	277	288	3,000
# Spent Females		147	60	183	192	98	178	141	144	150	1,293
# Males	143	1083	490	286	385	223	213	476	467	604	4,370
Total Shad	441	2,003	1,359	976	1,584	1,107	1,396	1,423	1,313	1,641	13,243
Liters of Eggs	101.8	309.6	222.6	137.5	246.0	249.0	294.7	213.5	205.5	299.0	2,279
Total # of Eggs	3,906,375	11,501,975	8,337,225	5,742,950	9,514,400	9,350,900	10,222,090	7,918,150	7,557,855	11,463,350	85,515,270
Total Fertile Eggs	1,687,629	5,898,446	3,260,799	3,268,708	4,466,611	3,207,860	3,508,795	3,921,239	4,554,483	7,882,600	41,657,170
# Re-stocked Fry							200,000	200,000	200,000		600,000

Table 6. Summary of American Shad Collected in the Potomac River by the USFWS

	2004	2005	2006*	2007*	2008*	2009*	2010*	Totals
# Females Caught			673	1,110	1,291	451	955	4,480
# Males Caught			117	272	284	510	1,196	2,379
Ripe Females	50			515	501	451		1,517
Ripe Males	39			271	284	510		1,104
# Shad Released	125		395	596	790	787	614	3,307
Total Shad Kept	89		382	786	785	771	2,151	4,964
Total Shad Caught	214	296	777	1,382	1,575	1,558	2,765	8,567
Avg. CPUE (shad/hr/ft ²)			0.001	0.002				0
Volume(L) of Eggs			99.3	183.9	194.4	138.0		616
# of Eggs			4,511,426	7,488,716	8,503,709	6,380,784		26,884,635

ViabE Eggs	2,003,222	2,875,455	3,491,069	1,885,500	10,255,246
Viability (%)	44.40	42.00	41.10	30.00	158
# Fry Re-stocked			188,000		188,000

* Scales & otoliths taken on 5% of fish

Table 7. 2006 POTOMAC RIVER OTOLITH AND SCALE AGING - from Mike Hendricks

LF by sex

Count of LG		
SEX	LG	Total
f	425	2
	450	19
	475	46
	500	79
	525	45
	550	19
	575	4
f Count		214
m	350	2
	375	1
	400	1
	425	5
	450	9
	475	13
	500	20
525	7	
550	1	
m Count		59
(blank)	(blank)	
	450	1
(blank) Count		1
Grand Total		274

Sex Ratio

Mean TL

TL		
Average of (mm)		
SEX	Total	
f	512.3224299	
m	485.6779661	
(blank)	469	
Grand Total		506.4270073

Count of (mm)		
SEX	Total	
f	214	
m	59	
(blank)	1	
Grand Total		274

StdDev of (mm)		
SEX	Total	
f	29.37907917	
m	39.70687454	
(blank)	#DIV/0!	
Grand Total		33.67214478

Mean Weight

Weight	
Average of (Kg)	
SEX	Total
f	1.530751174
m	1.213474576

Age frequency (otoliths)

otolith age			
Count of Site			
SEX	AGE2	Total	
f	4	3	
	5	13	
	6	11	
	7	2	
	9	1	
	m	1	
	(blank)	183	
	f Total		214
	m	4	1
5		4	
6		4	
7		1	
(blank)		49	
m Total		59	
(blank)	5	1	
(blank)	(blank)	6	
(blank) Total		7	
Grand Total		280	

Mean Weight

Weight	
StdDev of (Kg)	
SEX	Total
f	0.25805952
m	0.283871411

Age frequency (scales)

scale age			
Count of Site			
SEX	Age	Total	
f	3	1	
	4	8	
	5	16	
	6	15	
	7	3	
	8	1	
	not pressed	166	
	regen	3	
	(blank)	1	
	f Total		214
	m	4	4
5		7	
6		5	
not pressed		42	
(blank)		1	
m Total		59	
(blank)	5	3	
	6	1	
	7	1	
not pressed	1		
(blank)	1		
(blank) Total		7	
Grand Total		280	

Count of ALT #	
SEX	Total
f	214
m	59
(blank)	7
Grand Total	280

(blank)	1.25
Grand Total	1.461153846

(blank)	#DIV/0!
Grand Total	0.293855967

Count of (Kg)	
SEX	Total
f	214
m	59
(blank)	1
Grand Total	274

Table 7 Continued. 2006 POTOMAC RIVER OTOLITH AND SCALE AGING

scale age& repeats

Count of Site			
SEX	Age	repeats	Total
f	3	0	1
	3 Total		1
	4	0	6
		1	2
	4 Total		8
	5	0	8
		1	5
		2	3
	5 Total		16
	6	0	3
		1	4
		2	6
		3	2
	6 Total		15
	7	2	1
		3	2
	7 Total		3
	8	3	1
8 Total		1	
not pressed	(blank)	166	
not pressed Total		166	
regen	1	1	
	(blank)	2	
regen Total		3	
(blank)	(blank)	1	
(blank) Total		1	
f Total			214
m	4	0	2
		1	2
	4 Total		4
	5	0	1
		1	2
		2	4
	5 Total		7
	6	2	3
		3	2
	6 Total		5
not pressed	(blank)	42	
not pressed Total		42	
(blank)	(blank)	1	
(blank) Total		1	
m Total			59
(blank)	5	1	3
	5 Total		3
	6	2	1
	6 Total		1
	7	3	1
	7 Total		1
	not pressed	(blank)	1
	not pressed Total		1
	(blank)	(blank)	1
(blank) Total		1	
(blank) Total			7
Grand Total			280

otolith age& repeats

Count of Site			
SEX	AGE2	repeats	Total
f	4	0	2
		1	1
	4 Total		3
	5	0	8
		1	2
		2	1
		(blank)	2
	5 Total		13
	6	0	4
		1	4
		2	2
		(blank)	1
	6 Total		11
	7	2	1
		3	1
	7 Total		2
	9	2	1
	9 Total		1
	m	3	1
	m Total		1
(blank)	0	4	
	1	5	
	2	5	
	3	3	
	(blank)	166	
(blank) Total		183	
f Total			214
m	4	1	1
	4 Total		1
	5	1	2
		2	2
	5 Total		4
	6	1	1
		2	2
		3	1
	6 Total		4
	7	3	1
	7 Total		1
	(blank)	0	3
		2	3
	(blank)	43	
(blank) Total		49	
m Total			59
(blank)	5	(blank)	1
	5 Total		1
	(blank)	1	3
		2	1
		3	1
		(blank)	1
(blank) Total		6	
(blank) Total			7
Grand Total			280

Table 8. 2007 POTOMAC RIVER OTOLITH AND SCALE AGING - from Mike Hendricks

Sex Ratio

Count of SEX	
SEX	Total
F	19
M	21
(blank)	
Grand Total	40

mean FL

Average of (mm) ²	
SEX	Total
F	450.8421053
M	418.7142857
(blank)	
Grand Total	433.975

age frequency (scales)

Count of Age		
SEX	Age	Total
F	5	8
	6	9
	(blank)	
	F Total	17
M	4	4
	5	6
	6	9
	(blank)	
M Total	19	
(blank)	5	1
	6	1
(blank)	(blank)	
(blank) Total		2
Grand Total		38

mean wt.

Average of (Kg)	
SEX	Total
F	1472
M	1185
(blank)	
Grand Total	1322

StdDev of (mm) ²	
SEX	Total
F	19.96458853
M	28.82211453
(blank)	
Grand Total	29.56304649

StdDev of (Kg)	
SEX	Total
F	244
M	213
(blank)	
Grand Total	268

Count of (mm) ²	
SEX	Total
F	19
M	21
(blank)	
Grand Total	40

age frequency (otoliths)

Count of AGE2		
SEX	AGE2	Total
F	5	3
	6	6
	7	1
	(blank)	
F Total		10
M	4	1
	5	4
	6	8
	8	1
	(blank)	
M Total		14
(blank)	5	1
	6	2
	7	1
(blank) Total		4
Grand Total		28

Count of (Kg)	
SEX	Total
F	19
M	21
(blank)	
Grand Total	40

Table 8 Continued. 2007 POTOMAC RIVER OTOLITH AND SCALE AGING

scale age & repeats

Count of repeats				
SEX	Age	repeats	Total	
F	5	0	2	
		1	5	
		2	1	
	5 Total			8
	6	0	5	
		1	3	
		2	1	
	6 Total			9
	(blank)	(blank)		
	(blank) Total			
F Total			17	
M	4	0	1	
		1	3	
	4 Total			4
	5	0	3	
		1	3	
	5 Total			6
	6	0	1	
		1	2	
		2	4	
		3	2	
6 Total			9	
(blank)	(blank)			
(blank) Total				
M Total			19	
(blank)	5	0	1	
		5 Total		1
	6	0	1	
		6 Total		1
	(blank)	(blank)		
	(blank) Total			
(blank) Total			2	
Grand Total			38	

otolith age & repeats

Count of repeats				
SEX	AGE2	repeats	Total	
F	5	0	1	
		1	2	
	5 Total			3
	6	0	3	
		1	2	
		(blank)		
	6 Total			5
	7	1	1	
	7 Total			1
	(blank)	0	3	
		1	3	
		2	2	
		(blank)		
(blank) Total			8	
F Total			17	
M	4	1	1	
		4 Total		1
	5	0	1	
		1	3	
	5 Total			4
	6	0	3	
		1	1	
		2	3	
		3	1	
	6 Total			8
	8	1	1	
	8 Total			1
	(blank)	0	1	
1		2		
	2	1		
	3	1		
	(blank)			
(blank) Total			5	
M Total			19	
(blank)	5	0	1	
		5 Total		1
	6	0	1	
			(blank)	
	6 Total			1
	7	(blank)		
7 Total				
(blank) Total			2	

Table 9. 2008 POTOMAC RIVER OTOLITH AND SCALE AGING - from Mike Hendricks

sex ratio

Count of SEX	
SEX	Total
F	18
M	17
na (blank)	2
Grand Total	37

mean FL

Average of (mm) ²	
SEX	Total
F	508.7777778
M	463
na (blank)	#DIV/0!
Grand Total	486.5428571

age frequency (scales)

Count of Age		
SEX	Age	Total
F	4	2
	5	6
	6	5
	7	3
	8	1
	regen	1
F Total		18
M	4	2
	5	9
	6	3
	7	1
	regen (blank)	1
M Total		16
na	na	2
na Total		2
(blank)	5 (blank)	1
(blank) Total		1
Grand Total		37

mean weight

Average of (Kg)	
SEX	Total
F	1.66666667
M	1.30882353
na (blank)	#DIV/0!
Grand Total	1.49285714

StdDev of (mm) ²	
SEX	Total
F	25.30183801
M	23.26209363
na (blank)	#DIV/0!
Grand Total	33.37077169

StdDev of (Kg)	
SEX	Total
F	0.17149859
M	0.20784256
na (blank)	#DIV/0!
Grand Total	0.26069558

Count of (mm) ²	
SEX	Total
F	18
M	17
na (blank)	0
Grand Total	35

Count of (Kg)	
SEX	Total
F	18
M	17
na (blank)	2
Grand Total	37

age frequency (otoliths)

Count of AGE2		
SEX	AGE2	Total
F	4	1
	5	2
	6	6
	7	2
	(blank)	
F Total		11
M	4	3
	5	4
	6	3
	(blank)	
M Total		10
na	5 7	1 1
na Total		2
(blank)	4 5 6	1 1 1

(blank) Total	3
Grand Total	26

Table 9 continued. 2008 POTOMAC RIVER OTOLITH AND SCALE AGING - from Mike Hendricks

scale age & repeats

Count of repeats				
SEX	Age	repeats	Total	
F	4	0	1	
		1	1	
	4 Total			2
	5	0	1	
		1	4	
		2	1	
	5 Total			6
	6	1	2	
		2	3	
	6 Total			5
	7	1	2	
		2	1	
	7 Total			3
	8	2	1	
8 Total			1	
regen	(blank)			
regen Total				
F Total			17	
M	4	0	1	
		1	1	
	4 Total			2
	5	0	1	
		1	7	
		2	1	
	5 Total			9
	6	0	1	
		2	1	
		3	1	
	6 Total			3
	7	2	1	
	7 Total			1
	regen	(blank)		
regen Total				
(blank)	(blank)			
(blank) Total				
M Total			15	
na	na	na	2	
na Total			2	
na Total			2	
(blank)	5	1	1	
	5 Total		1	
	(blank)	(blank)		
	(blank) Total			

otolith age & repeats

Count of repeats				
SEX	AGE2	repeats	Total	
F	4	1	1	
	4 Total			1
	5	0	1	
		1	1	
	5 Total			2
	6	1	3	
		2	3	
	6 Total			6
	7	1	1	
		2	1	
	7 Total			2
	(blank)	0	1	
		1	3	
		2	2	
	(blank)			
(blank) Total			6	
F Total			17	
M	4	0	1	
		1	1	
		(blank)		
	4 Total			2
	5	0	1	
		1	3	
	5 Total			4
	6	0	1	
		2	1	
		3	1	
	6 Total			3
	(blank)	1	4	
		2	2	
		(blank)		
(blank) Total			6	
M Total			15	
na	5	na	1	
5 Total			1	
7	na	1		
7 Total			1	
na Total			2	
(blank)	4	(blank)		
	4 Total			
	5	1	1	
	5 Total			1
6	(blank)			

(blank) Total	1
Grand Total	35

6 Total	
(blank) Total	1
Grand Total	35

Table 10. 2009 POTOMAC RIVER OTOLITH AND SCALE AGING - from Mike Hendricks

Scale age frequency		scale age & repeats			otolith age & repeats		
Count of Age		Count of Rpts			Count of Rpts		
Age	Total	Age	Rpts	Total	AGE2	Rpts	Total
4	2	4	1	2	4	1	1
5	9	4 Total			2	2	1
6	7	5	1	4	(blank)		
7	2		2	4	4 Total		
??	1	(blank)			5	1	5
no scales	6	5 Total			8	2	2
regenerated	3	6	1	5	(blank)		
(blank)			2	2	5 Total		
Grand Total	30	6 Total			7	6	6
		7	1	1	7	2	3
			2	1	6 Total		
		7 Total			2	9	9
		??	1	1	7	1	1
		?? Total			1	2	1
		no scales	(blank)		(blank)		
		no scales Total				7 Total	
		regenerated	(blank)		(blank)	(blank)	
		regenerated Total				(blank) Total	
		(blank)	(blank)		Grand Total		
		(blank) Total				20	20
		Grand Total			20		

Otolith age frequency

Count of AGE2	
AGE2	Total
4	3
5	12
6	12
7	3
(blank)	
Grand Total	30

Table 11. 2010 POTOMAC RIVER OTOLITH AND SCALE AGING - from Mike Hendricks

Sex Ratio

Count of Sex	
Sex	Total
F	42
M	39
(blank)	
Grand Total	81

Mean Weight

Average of W (g)	
Sex	Total
F	1502
M	1054
(blank)	
Grand Total	1286

Age frequency (scales)

Count of Age			
Sex	Age	Total	
F	3	1	
	4	2	
	5	12	
	6	14	
	7	8	
	9	2	
	no scales	3	
	F Total		42
	M	3	1
4		4	
5		19	
6		12	
7		1	
regenerated		2	
M Total		39	
(blank)		no scales	1
(blank) Total		1	
Grand Total		82	

Mean FL

Average of FL	
Sex	Total
F	447
M	410
(blank)	
Grand Total	429

StdDev of W (g)	
Sex	Total
F	481
M	264
(blank)	
Grand Total	450

StdDev of FL	
Sex	Total
F	31.5
M	27
(blank)	
Grand Total	34.5

Count of W (g)	
Sex	Total
F	42
M	39
(blank)	
Grand Total	81

Count of FL	
Sex	Total
F	42
M	39
(blank)	
Grand Total	81

Age frequency (otoliths)

Count of AGE2			
Sex	AGE2	Total	
F	3	1	
	4	2	
	5	14	
	6	16	
	7	7	
	8	2	
	F Total		42
	M	3	1
4		5	
5		19	
6		11	
8		1	
crystalline		2	
M Total		39	
(blank)		7	1
(blank) Total		1	
Grand Total		82	

Table 11 continued. 2010 POTOMAC RIVER OTOLITH AND SCALE AGING

scale age& repeats

Count of spawner				
Sex	Age	spawner	Total	
F	3	(blank)		
	3 Total			
	4	(blank)		
	4 Total			
	5	1 (blank)	4	
	5 Total			4
	6	1 2 (blank)	10 2	
	6 Total			12
	7	1 2 3 (blank)	2 1 4	
	7 Total			7
	9	6	2	
	9 Total			2
	no scales		(blank)	
	no scales Total			
F Total			25	
M	3	(blank)		
	3 Total			
	4	1 2 (blank)	1 1	
	4 Total			2
	5	1 2 (blank)	5 6	
	5 Total			11
	6	1 2 3 (blank)	3 7 1	
	6 Total			11
	7	3	1	
	7 Total			1
	regenerated	(blank)		

otolith age& repeats

Count of spawner				
Sex	AGE2	spawner	Total	
F	3	(blank)		
	3 Total			
	4	2 (blank)	1	
	4 Total			1
	5	1 (blank)	5	
	5 Total			5
	6	1 2 3 (blank)	7 2 1	
	6 Total			10
	7	1 3	4 3	
	7 Total			7
	8	6	2	
	8 Total			2
	F Total			25
	M	3	(blank)	
3 Total				
4		1 2 (blank)	2 1	
4 Total			3	
5		1 2 (blank)	4 8	
5 Total			12	
6		1 2 3 (blank)	3 4 2	
6 Total			9	
8		(blank)		
8 Total				
crystalline		2 (blank)	1	
crystalline Total			1	

	regenerated Total	
M Total		25
(blank)	no scales (blank)	
	no scales Total	
(blank) Total		
Grand Total		50

M Total		25
(blank)	7 (blank)	
	7 Total	
(blank) Total		
Grand Total		50

Table 12. 2011 POTOMAC RIVER OTOLITH AND SCALE AGING - from Mike Hendricks

Sex Ratio

Count of Sex	Total
Sex	
could not read label on head	6
F	25
M	18
Grand Total	49

Mean Weight

Average of W (g)	Total
Sex	
could not read label on head	
F	1254.4
M	972.222222
Grand Total	1136.27907

Mean TL

Average of TL	Total
Sex	
could not read label on head	
F	494.8
M	447.6666667
Grand Total	475.0697674

StdDev of W (g)	Total
Sex	
could not read label on head	
F	249.701155
M	148.346001
Grand Total	253.724853

StdDev of TL	Total
Sex	
could not read label on head	
F	27.48029597
M	73.05356616
Grand Total	56.08216564

Count of W (g)	Total
Sex	
could not read label on head	
F	25
M	18
Grand Total	43

Count of TL	Total
Sex	
could not read label on head	
F	25
M	18
Grand Total	43

Table 12 continued. 2011 POTOMAC RIVER OTOLITH AND SCALE AGING

LF by sex

Count of Grp		
Sex	Grp	Total
could not read label on head	(blank)	
could not read label on head Total		
F	450	8
	475	7
	500	6
	525	3
	550	1
F Total		25
M	425	2
	450	10
	475	4
	525	1
	(blank)	
M Total		17
Grand Total		42

Age frequency (scales)

Count of Age		
Sex	Age	Total
could not read label on head	(blank)	
could not read label on head Total		
F		3
		4
		5
		6
	pressed scales are from 2 diff. fish	
regen		2
F Total		25
M		3
		4
		5
		6
M Total		18
Grand Total		43

Age frequency (otoliths)

Count of AGE2		
Sex	AGE2	Total
could not read label on head		5
		6
could not read label on head Total		6
F		4
		5
		6
		7
	cryst. (blank)	
F Total		20
M		4
		5
		6
	cryst. (blank)	
M Total		17

Table 12 continued. 2011 POTOMAC RIVER OTOLITH AND SCALE AGING

scale age& repeats

Count of spawner				
Sex	Age	spawner	Total	
could not read label on head	(blank)	(blank)		
	(blank) Total			
could not read label on head Total				
F	3	(blank)		
	3 Total			
	4	(blank)		
	4 Total			
	5	1	2	
		2	3	
		(blank)		
	5 Total			5
	6	1	2	
		2	4	
		(blank)		
	6 Total			6
	pressed scales are from 2 diff. fish		(blank)	
	pressed scales are from 2 diff. fish Total			
regen		(blank)		
regen Total				
F Total			11	
M	3	(blank)		
	3 Total			
	4	1	2	
		(blank)		
	4 Total			2
	5	1	7	
		2	1	
		(blank)		
5 Total			8	
6	1	1		
	2	3		
6 Total			4	
M Total			14	

otolith age& repeats

Count of spawner				
Sex	AGE2	spawner	Total	
could not read label on head	5	(blank)		
	5 Total			
	6	(blank)		
6 Total				
could not read label on head Total				
F	4	(blank)		
	4 Total			
	5	1	1	
		2	3	
		(blank)		
	5 Total			4
	6	1	2	
		2	3	
		(blank)		
	6 Total			5
	7		(blank)	
	7 Total			
	cryst.		2	1
	cryst. Total			1
(blank)		1	1	
(blank)		(blank)		
(blank) Total			1	
F Total			11	
M	4	1	2	
		(blank)		
	4 Total			2
	5	1	6	
		2	1	
		(blank)		
5 Total			7	
6	1	1		
	2	2		
6 Total			3	

Grand Total	25
-------------	----

cryst.	1	1
cryst. Total		1
(blank)	2	1
(blank) Total		1
M Total		14
Grand Total		25

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