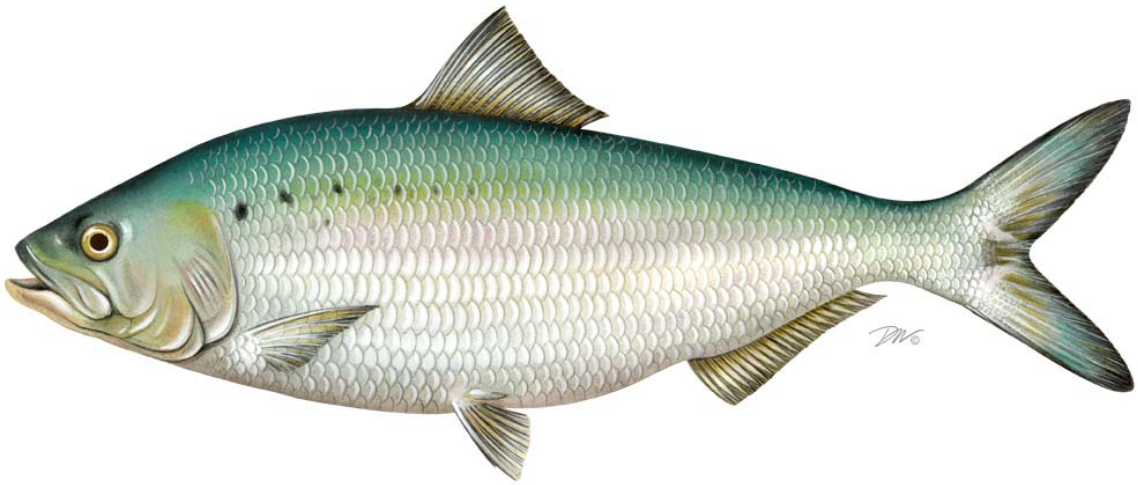
Maryland Department of Natural Resources
Fisheries Service

American Shad Habitat Plan



Prepared by:

Karen M. Capossela, Maryland Department of Natural Resources, Fisheries Service

Submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring

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Maryland's American Shad Habitat Plan

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Atlantic States Marine Fisheries Commission

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Karen M. Capossela
Maryland Department of Natural Resources
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kcapossela@dnr.state.md.us

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Habitat Assessment

Spawning Habitat:
Historical in-river spawning habitat: 448.5 km
Currently available spawning habitat: 441.6 km
Rearing Habitat:
Historical in-river rearing habitat: 382.2 km
Currently available rearing habitat: 382.2 km

Spawning and rearing habitat were calculated only for Maryland waters under Maryland jurisdiction (Funderburk et al. 1991; Table 1). Habitat behind dams with fish passage facilities were considered currently available habitat. Most of the dams in Maryland are located far enough up the watershed so as not to impact American shad use of habitat in Maryland waters.

Threat: Barriers to Migration

The inventory of dams included in this report can potentially be encountered by American shad (Table 2). As stated previously, most of the dams in Maryland are located far enough up the watershed so as to not impact American shad use of habitat in Maryland waters. Barriers to migration are primarily considered a threat in Maryland because the Conowingo Dam (the first dam in the Susquehanna River) is located in Maryland and affects the passage of American shad to other states' portions of the river.

Recommended Action 1 (See Task A1 in SRAFRC Habitat Plan): Develop and implement upstream passage plans and performance measures at the Conowingo hydroelectric dam to ensure that the facility passes at least 85 percent of the adult American shad reaching the tailrace. Incorporate upstream passage plans and evaluation requirements in FERC licenses. Recommend or conduct evaluation studies as necessary. Require additional fish passage capacity, as needed, to meet fish passage targets. Report fish passage results annually.

> **Agencies with Regulatory Authority:** SRAFRC (made up of MDNR, PFBC, SRBC, and USFWS members), and FERC.
> **Goal/Target:** Goals listed in the recommended action are to be met in conjunction with FERC relicensing and compliance.
> **Progress:** FERC relicensing is ongoing.
> **Cost:** SRAFRC member agencies are responsible for overhead. The dam owner's cost is dependent on the level of fishway improvement required to meet target levels.
> **Timeline:** Action goals are to be accomplished upon completion of FERC relicensing in 2014.

Recommended Action 2 (See Task A2 in SRAFRC Habitat Plan): Develop and implement downstream passage plan and measures for adult alosine species at the Conowingo hydroelectric dam to ensure at least 80 percent survival. Incorporate adult downstream passage plan and evaluation requirements in FERC licenses.

> **Agencies with Regulatory Authority:** SRAFRC (made up of MDNR, PFBC, SRBC, and USFWS members), and FERC.
> **Goal/Target:** Goals listed in the recommended action are to be met in conjunction with FERC relicensing and compliance.
> **Progress:** FERC relicensing is ongoing.
> **Cost:** SRAFRC member agencies are responsible for overhead. The dam owner's cost is dependent on the level of fishway improvement required to meet target levels.
> **Timeline:** Action goals are to be accomplished upon completion of FERC relicensing in 2014.

Recommended Action 3 (See Task A3 in SRAFRC Habitat Plan): Develop and implement juvenile downstream passage plan and performance measures at the Conowingo hydroelectric dam to ensure 95 percent survival of juvenile alosine species at this facility. Incorporate juvenile downstream passage plan and evaluation requirements in FERC licenses. Include operational measures at the hydroelectric dam as needed to enhance downstream passage survival of juvenile alosine species.

> **Agencies with Regulatory Authority:** SRAFRC (made up of MDNR, PFBC, SRBC, and USFWS members), and FERC.
> **Goal/Target:** Goals listed in the recommended action are to be met in conjunction with FERC relicensing and compliance.
> **Progress:** FERC relicensing is ongoing.
> **Cost:** SRAFRC member agencies are responsible for overhead. The dam owner's cost is dependent on the level of fishway improvement required to meet target levels.
> **Timeline:** Action goals are to be accomplished upon completion of FERC relicensing in 2014.

Recommended Action 4 (See Task A9 in SRAFRC Habitat Plan): Minimize delays at the Conowingo hydroelectric dam to foster adult spawning fish migration to the upper limits of historical spawning habitat in the watershed.

> **Agencies with Regulatory Authority:** SRAFRC (made up of MDNR, PFBC, SRBC, and USFWS members), and FERC.
> **Goal/Target:** Goals listed in the recommended action are to be met in conjunction with FERC relicensing and compliance.
> **Progress:** FERC relicensing is ongoing.
> **Cost:** SRAFRC member agencies are responsible for overhead. The dam owner's cost is dependent on the level of fishway improvement required to meet target levels.

Timeline: Action goals are to be accomplished upon completion of FERC relicensing in 2014.

Recommended Action 5: To continue to provide for fish passage at dams, and remove stream blockages wherever necessary to restore passage for migratory fishes to historical spawning grounds.

Agencies with Regulatory Authority: MDNR (Fish Passage Program), in cooperation with the Chesapeake Bay Program, Pennsylvania, Virginia, and the District of Columbia.
Goal/Target: MDNR has been part of the Chesapeake Bay Agreement (to provide fish passage at dams and remove stream blockages) since 1987. The current goal of the Agreement is to open 2,807 miles by 2014 and favors dam removals over fish ladders.
Progress: To date, MDNR's Fish Passage Program has completed 78 projects, reopening a total 454.2 miles of upstream spawning habitat (in Maryland).
Cost: Total cost and responsible agencies depend on the project. In Maryland, participants include but are not limited to MDNR, American Rivers, NFWF, NOAA, Simkins Industries, CBP, EBTJV, and the USFWS.
Timeline: The original goal of the Chesapeake Bay agreement was to reopen 1,300 miles in the Chesapeake Bay watershed for anadromous species (such as shad and herring) so they could reach upstream spawning habitat. After surpassing the original goal (1,838 miles reopened by 2005), the goal was expanded to 2,807 miles by 2014.

Threat: Land Use

MDNR has various programs that work to assess the health of Maryland's watershed and the impacts of development. There are few, if any, direct studies on the effects of land use on American shad in Maryland. The MDNR Fisheries Habitat and Ecosystem Program (FHEP) assesses the impacts of development on alosine (river herring, American shad, hickory shad) eggs and larvae in Piscataway Creek and the Bush River (higher levels of development), and Mattawoman and Deer Creeks (lower levels of development). The proportion of samples where alosine eggs and/or larvae were present was negatively correlated with the level of development, and alosine spawning became more variable in streams as watersheds developed (i.e., presence in new spawning sites and absence from past spawning sites; Uphoff et al. 2012b). Variability at higher levels of development could signify the redistribution and deterioration of spawning habitat due to urban and natural stream processes.

Fisheries managers do not have authority to manage land use and are limited to managing the harvest of fishes that may be threatened. The FHEP works to tie land use and fisheries management together; this program's research supports the 10% impervious surface threshold as the 'tipping point' beyond which little success is expected in maintaining sustainable fisheries. American shad fisheries are closed in Maryland, but an

explanation of Maryland's watershed fishery management priorities are as follows (Figure 1):

- Conserve - areas with less than 5% impervious surface; recommend harvest restrictions and stocking for effective fisheries management and watershed conservation for sound land management.
- Revitalize – areas with 5-10% impervious surface; recommend options to decrease harvest and increase stocking to compensate for effective fishery management, and conserve and revitalize watershed for sound land management.
- Re-engineer – areas with 10-15% impervious surface; fisheries are highly variable; traditional fishery management tools are not reliable. Recommend conserving and reconstructing degraded watershed for land management – typically re-engineering will address nutrient reductions for larger scale TMDL, but this is not expected to have local biological lift.
- 15% impervious – from a fishery management point of view, investments to enhance large scale fisheries are not expected to be effective; local re-engineering can address localized habitat stability needs, but are not expected to provide additional ecological lift.

Recommended Action: To continue to promote the conservation and revitalization of watersheds, especially in areas vulnerable to growth. Conserving watersheds at a target level of development is ideal [0.27 structures per hectare (C/ha) or 5% impervious surface cover; Uphoff et al. 2012a]. Once above this level of development, revitalization and reconstruction could consist of measures such as road salt management, stemming leaks in sewage pipes, improving septic systems, stormwater retrofits, stream rehabilitation, replenishment of riparian buffers, creation of wetlands, planting upland forests, and "daylighting" of buried streams (Uphoff et al. 2012b). Other effects that may exacerbate development related habitat stressors (i.e., climate change) should also be considered.

Agencies with Regulatory Authority: The planning authority is typically the local government, with the Maryland Department of Planning serving in an advisory capacity. Fisheries managers do not have authority to manage land use and are limited to managing the harvest of fishes that may be threatened.
Goal/Target: Maryland does not have a specific goal for protecting American shad from land use impacts, aside from the harvest controls that were put in place when Maryland established a moratorium in 1980. If the fishery reopens, fisheries managers can manage American shad differently at different levels of development.
Progress: Maryland established a moratorium in 1980 to help protect American shad populations from declining further due to a variety of causes, including habitat degradation.
Cost: NA
Timeline: NA

Threat: Climate Change Assessment

American shad may be vulnerable to climate change, although this risk is probably not high in Maryland. Alewife and blueback herring (alosine species), are considered to have a relatively high adaptive capacity to impacts of climate change because they are found throughout the region and are not inhibited in the watershed (except where there are dams; Kane 2013). As anadromous fish, American shad spend their adult lives in the Atlantic Ocean and migrate inshore to spawn. Migration and spawning are heavily influenced by water temperature. In Maryland, peak spawning time is mid-April through early June, with temperatures ranging from 55 to 68°F. Changes in water temperature may affect the timing of migration, which may affect spawning and juvenile success and lead to a match-mismatch between predator and prey species (Boesch 2008). Many fish and bird species are dependent on American shad throughout the watershed, and reduced spawning or juvenile success could affect these predators. The migration of juvenile American shad to the ocean in the fall is triggered by decreasing water temperature, and migration to the ocean may be delayed due to warmer fall temperatures (Kane 2013). If temperatures in the Chesapeake Bay region warm to resemble those of North Carolina or Florida, a northward shift in species distribution may affect species composition in the Chesapeake Bay and its tributaries. The Chesapeake Bay is at the mid-range for American shad, which may minimize distributional shifts of this species due to warmer water temperatures. However, competition for resources may be altered due to shifts in other species' distributions. Along with increases in water temperature, increased intense storm events and sea-level rise will affect salinity, dissolved oxygen, and sediment in the water column and may affect efforts to effectively manage water quality.

Recommended Action: Promote the assessment of climate change effects on American shad, and continue to promote water quality control efforts, habitat restoration, and reduction of ocean bycatch.

Agencies with Regulatory Authority: MDNR, ASMFC, MAFMC and NMFS
Goal/Target: Maryland does not currently have a goal for addressing the threat of climate change. It is likely that American shad will have a relatively high adaptive capacity.
Progress: NA
Cost: NA
Timeline: NA

References:

Boesch, D. (ed). 2008. Comprehensive Assessment of Climate Change Impacts in Maryland. Maryland Commission on Climate Change. Scientific and Technical Working Group. http://www.mde.state.md.us/programs/Air/ClimateChange/Documents/FINAL-Chapt%202%20Impacts_web.pdf

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Kane, A. 2013. Managing a Coastal Watershed to Address Climate Change: Vulnerability Assessment and Adaptation Options for the Middle Patuxent Subwatershed of the Chesapeake Bay. National Wildlife Federation.

Martin, E. H. and Apse, C.D. 2013. Chesapeake Fish Passage Prioritization: An Assessment of Dams in the Chesapeake Bay Watershed. The Nature Conservancy, Eastern Division Conservation Science. http://maps.tnc.org/erof_ChesapeakeFPP

Uphoff, J. H., Jr., and coauthors. 2012a. Marine and estuarine finfish ecological and habitat investigations. Performance Report for Federal Aid Grant F-63-R, Segment 2. Maryland Department of Natural Resources, Annapolis, Maryland.

Uphoff, J.H., Jr., and coauthors. 2012b. Marine and estuarine finfish ecological and habitat investigations. Performance Report for Federal Aid Grant F-63-R, Segment 3, Job 1. Maryland Department of Natural Resources, Annapolis, Maryland.

Table 1. Historical and currently accessible spawning and rearing habitat for American shad in waters regulated by the state of Maryland. Most of the dams in Maryland are located far enough up the watershed so as not to impact habitat use of American shad in Maryland waters.

Habitat Type	River (MD portion only)	Historical Habitat (km)	Current Habitat (km)	Percent Available	Limited By
Spawning	Susquehanna	22.5	22.5	100%	State Line
	Upper Bay/Susq Flats	21.4	21.4	100%	Habitat
	Principio Creek	2.4	2.4	100%	Natural Falls
	North East	13.2	13.2	100%	Natural Falls
	Elk Main	26.6	26.6	100%	Habitat
	C/O Canal	8.9	8.9	100%	Habitat
	Elk Trib	8.0	8.0	100%	Habitat
	Elk Trib	5.0	5.0	100%	Habitat
	Bohemia Main	20.1	20.1	100%	Habitat
	Sassafras Main	19.3	19.3	100%	Habitat
	Chester Main	43.5	43.5	100%	Habitat
	Chester Trib	7.1	7.1	100%	Habitat
	Chester Trib	5.8	5.8	100%	Habitat
	Tuckahoe	15.6	15.6	100%	Habitat
	Choptank Main	25.7	25.7	100%	Habitat
	Choptank Trib	6.6	6.6	100%	Habitat
	Marshyhope	35.9	35.9	100%	Habitat
	Nanticoke	16.9	16.9	100%	State Line
	Wicomico East	27.8	20.9	75%	Man Made Dam
	Manokin	14.5	14.5	100%	Habitat
	Pocomoke	45.1	45.1	100%	Habitat
	Patuxent	56.6	56.6	100%	Habitat
	TOTAL	**448.5**	**441.6**	**98%**	
Rearing	Upper Bay	156.1	156.1	100%	
	Chester	43.5	43.5	100%	
	Choptank	25.7	25.7	100%	
	Nanticoke	16.9	16.9	100%	
	Wicomico	24.1	24.1	100%	
	Manokin	14.5	14.5	100%	
	Pocomoke	45.1	45.1	100%	
	Patuxent	56.3	56.3	100%	
	TOTAL	**382.2**	**382.2**	**100%**	

Table 2. Inventory of dams in Maryland that American shad can potentially encounter. Most of the dams in Maryland are located far enough up the watershed so as to not impact American shad use of habitat (in Maryland). Data on height, width, length and storage come from the Maryland Department of the Environment's Dam Safety List/Database.

Dam Name	Passage Type	Latitude	Longitude	Dam Height (ft) 0=unknown	Dam Length (ft) 0=unknown	Surface Area (acres) 0=unknown	Normal Dam Storage (acre feet) 0=unknown
LITTLE FALLS DAM - POTOMAC RIVER	Notch	38.94816947	-77.13063919	12	1,300	0	0
WILLISTON MILL DAM	Denil	38.82775591	-75.84685157	18	630	52	390
BLOEDE DAM	Denil	39.24689315	-76.76182877	34	220	31	256
TUCKAHOE STATE PARK DAM	Denil	38.96752257	-75.9425857	14	1,700	86	26
REWASTICO POND	None	38.41072883	-75.75367182	10	460	16	40
JONES LAKE DAM	Steepass	39.24697315	-75.81795339	13	1,180	36	33
CONOWINGO DAM	Lift	39.66121204	-76.17317693	94	4,648	8,563	301,400
MILL CREEK DAM	None	38.59483626	-75.82670033	11	300	0	0
LAKE CHAMBERS	None	38.69635252	-75.76461336	0	0	0	0
HIGGINS MILL POND	None	38.51896254	-75.96464395	0	0	0	0
ANDERSON MILL POND	None	38.35571295	-75.67386571	11	240	15	39
ALAN TOWN POND	None	38.28323503	-75.68891565	8	400	35	96
ISABELLA ST. WEIR	None	38.37188718	-75.60276893	3	0	0	0
ELKTON DAM	Denil	39.61236765	-75.81723297	3	0	0	0
FT MEADE DAM	Denil	39.0927176	-76.76833659	9	0	0	0
WILSONS MILL DAM	Denil	39.61459477	-76.20603991	4	0	0	0
VAN BIBBER DAM	Steepass	39.46862521	-76.33476293	2	0	0	0

Figure 1. Fisheries watershed management priorities in Maryland. *Conserve* - areas with less than 5% impervious surface; recommend harvest restrictions and stocking for effective fisheries management and watershed conservation for sound land management. *Revitalize* – areas with 5-10% impervious surface; recommend options to decrease harvest and increase stocking to compensate for effective fishery management, and conserve and revitalize watershed for sound land management. *Re-engineer* – areas with 10-15% impervious surface; fisheries are highly variable; traditional fishery management tools not reliable. Recommend conserving and reconstructing degraded watershed for land management.