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Memorandum

DIADROMOUS FISH RESTORATION PRIORITY LIST and GEOGRAPHIC INFORMATION SYSTEM DATALAYER

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Introduction

The Massachusetts Division of Marine Fisheries (DMF) has maintained a Diadromous Fish Restoration Priority List (Priority List) since 2005 to document the status of fish passageways and barriers and to guide decisions for restoration planning. The original version focused on river herring passage and was directly related to the location entries in the last DMF fish passage survey that was published in four parts by major coastal drainage areas (Reback et al. 2004-2005). The development of the survey and priority list depended on the institutional knowledge of past and present DMF diadromous fish biologists, extensive project files, and previous surveys conducted in 1967 (Reback and DiCarlo 1972) and early in the 20th century (Belding 1921). The first version of the Priority List also served as the basis for ranking river herring restoration projects in the Cape Cod Water Resources Restoration Project led by the National Resources Conservation Service (NRCS 2006).

The priority list was updated in 2011 to contain over 400 locations in the major coastal drainage areas and included consideration for a wider range of diadromous species, habitats, and restoration projects. The 2011 Priority List was also a data source for both a joint MassDOT/DMF project to develop a GIS datalayer to assist restoration and transportation planning, and the DMF time-of-year recommendation report (Evans et al. 2011). The Priority List was updated in 2016 as the 3rd version (V3). This version expanded the approach of the 2011 datalayer to include more information on additional diadromous fish species and restoration options and included a tuning of some valuation parameters definitions (see below) used to rank barrier locations. The V3 also integrated DMF river herring habitat assessments (Chase 2010 and Chase et al. 2020). to the Priority List, which allows this combined data source to be utilized by the Massachusetts Department of Environmental Protection (MassDEP) for identifying waters impaired because of barriers to diadromous fish passage as part of their Clean Water Act (CWA) Sections 305(b), 314, and 303(d) Integrated Reporting (IR) requirements (U.S. EPA 2013; MassDEP 2021 - [Final Massachusetts 2018/2020](#)).

The Priority List was revised again in 2020 (V4) mainly to update location information within an active aquatic restoration scene in Massachusetts with only minor changes to formatting. The 2022 update (V5) coincides with a revision of the Diadromous Fish GIS Datalayer to fully integrate the Priority List to the GIS datalayer and to publish the updated datalayer to MassGIS for wider use. This integration depended on extensive technical support from Tay Evans of the DMF Habitat Program and Kevin Robicheau of the Department of Fish and Game GIS team. This memo describes the present status of V5, how the Priority List is derived, and the integration of the Priority List to the GIS datalayer and MassDEP's Aquatic Life Use attainment evaluation methodology guidance for diadromous fish habitat-related impairments (MassDEP 2018 - [MassDEP 2018 CALM Guidance Manual](#)).

Valuation Parameters

The Priority List is an Excel spreadsheet with 15 location attributes (columns) and 13 valuation parameters (columns) that were created for the 1st version of the Priority List to score each location (rows) and rank the projects regionally. The approach used qualitative, numerical metrics for each parameter that depended on the best professional judgment (BPJ) of DMF Diadromous Fish Project biologists. The following 13 parameters are maintained in the Priority List V5 with minor changes to definitions and scoring from previous versions.

1. Obstruction Number. A negative score is assigned for each barrier in the river system between coastal waters and upstream spawning/nursery habitat. The first two versions assigned a -2 value for each barrier, regardless of the status of passage. This straight-forward approach could lead to low scores in rivers with many barriers despite successful fish passage. In 2016, the valuation was changed to a -1 value for each barrier with a functional fishway and -2 for impassible obstructions, with the allowance to assign no negative value for highly efficient fishways such as low gradient weir and pool.

2. Acreage. The scores for this metric are neutral (0) or positive (>0) and increase with the size of spawning and nursery habitat. The valuations were refined for V3 to allow higher scores for large spawning and nursery habitats: <5 acres = 0 points; 5 to <10 = 1-2; 10 to <30 = 3-4; 30 to <50 = 5-6; 50 to <100 = 7-8; 100 to <200 = 9-10; 200 to <300 = 11-12; 300 to <400 = 13-14; and >400 = 15 pts.

3. Population Status. A positive BPJ score running from 0 (no run present) to 10 (one of the largest river herring runs in the coastal drainage area) is awarded to sites for this metric. The focus is on river herring, although the population status of diadromous species other than river herring can be considered for scoring. Documented records of historical populations can allow the assignment of positive scores of 1-3 despite "no run present" depending on access to and the suitability of migratory/spawning/nursery habitat.

4. Stream Flow. A negative BPJ score (-10 to 0) is awarded to sites for this metric based on the ability of the watershed flows to support the different life stages of river herring and other diadromous fish. The sites with the lowest flows (i.e., that are least able to support fish) are given the lowest score. Sites with routinely adequate flows to support upstream and downstream migrations are given a score of zero.

5. Public Access. A positive BPJ score (0 to 5) is provided for this metric based on the existing or potential of the location to provide public access for river herring harvest (not presently allowed), passive and active recreation and natural resource viewing. Sites with no existing or potential access are given a score of zero; scores increase with the number and quality of potential and/or existing public access sites.

6. Water Quality. Scores for this BPJ metric decrease from 0 to -7 as water quality decreases. Sites with a score of 0 have water quality that is considered adequate for spawning and/or nursery habitat for the target fish populations. Water quality conditions that do not support successful spawning or nursery habitat receive a score of -5 or lower. When available, the results of a site-specific river herring spawning and nursery habitat assessment provide the basis for scoring. In the latter cases, a value of -1 can be assigned for each of the seven water quality variables related to the impairment of diadromous fish spawning and nursery habitat in the DMF QAPP Technical Reports (Chase 2010 and Chase et al. 2020).

7. Water Use Conflict. Scores for this metric range from -5 to 0 based on BPJ and decrease as the number or severity of water use conflicts increase. Sites with no known conflicts related to diadromous fish passage or habitats are given a score of 0. Examples of water use conflicts include recreation (e.g., impoundment dams that impede fish passage and water level and outflow maintained for boating, swimming etc.), water supply (e.g., surface and groundwater withdrawals that can influence fish passage), water withdrawals for farming, and flood control operations.

Water Quality Variables

Variable	Period	Suitable Criteria
Water Temperature (spawning)	May and June	$\leq 26.0^{\circ}\text{C}$
Water Temperature (nursery)	July - September	$\leq 28.3^{\circ}\text{C}$
pH	May - September	≥ 6.5 to ≤ 8.3
DO	May - September	≥ 5.0 mg/L
Water Column Anoxia	July and August	$\leq 50\%$
Secchi Disc Depth	May - September	≤ 2.0 m
Total Nitrogen	May - September	≤ 0.32 mg/L
Total Phosphorus	May - September	≤ 8.0 $\mu\text{g/L}$

8.) Project Feasibility. This score ranges from -5 to 0 with the lowest scores given to sites with property, structural or community factors that are at odds with project implementation or construction feasibility.

9.) Environmental Benefits. This score ranges from 0 to 5 and increases with additional environmental benefits of a given project beyond improvements to river herring migratory habitat, such as river connectivity, and benefits to other aquatic life, habitats, and multiple species of diadromous fish.

10.) Existing Funding. This score ranges from 0 to 5 and increases with the degree of funding available to advance the restoration project. A score of 0 is given for sites with no identified funding and a score of 5 is awarded to sites with funding that would fully cover the project through construction.

11.) Local Support. This BPJ score ranges from 0 to 5 and increases with the degree of non-monetary support and interest from public, local groups, property owners and Towns.

12.) Cost. Scores for this BPJ metric decrease with the magnitude of the project costs: $<\$10,000 = 0$ points; $\$10,000$ to $<\$50,000 = -1$; $\$50,000$ to $<\$100,000 = -2$; $\$100,000$ to $<\$500,000 = -3$ to -4 ; $>\$500,000 = -4$ to -5 points.

13.) Passage. Scores for this metric are based on BPJ and increase (from 0 to 10) as the severity of the impediment to fish passage increases. Depending on the species present and level of blockage, no obstruction = 0 points; a minor obstruction = 1-3 points; restricted passage = 4-6 points; severe impediment = 7-9 points; and 10 points for no possible passage. A classification of *Impaired* for a given structure will result in a score of ≥ 4 , and a classification of *Suitable* will be scored ≤ 3 for MassDEP applications (see below). If available, a site-specific river herring spawning and nursery habitat assessment will document with repeated field observations the conditions of passage impediments using the impairment list below.

- | | |
|---|--|
| 1. Excess vertical rise or grade change | 7. Shallow water depth for passage ($<6"$) |
| 2. Excess water velocity at outlet | 8. Sediment impacts |
| 3. High turbulence or irregular flow | 9. In-stream debris / excessive plant growth |
| 4. Low or no flow (via stream flow) | 10. Beaver dam blocking passage |
| 5. Low or no flow (due to diversion/operations) | 11. Vegetation blocking passage |
| 6. Inadequate attraction flow for passage | 12. Degraded passage structure |

Attribute Categories

The following attribute categories table contains the input information for some of the key columns in the V5 Priority List that allows for the evaluation and sorting of projects by location, region, species, existing status, and potential project. These attributes have changed little from earlier versions with the exception of additions to the Species, Location Status, and Project Type categories.

Region	Watershed	Species	Location Status	Project Type	Project Status	Project Scope
1 = TR-18	Merrimack River	alewife	channel limitation	fish ladder	conceptual	external partners
2 = TR-17	Parker River	blueback herring	culvert limitation	channel improvement	planning	internal (DMF)
3 = TR-16	Ipswich River	American shad	existing fishway	fishway improvement	construction	private
4 = TR-15	North Coastal	rainbow smelt	degraded habitat	passage improvement	completed	
	Boston Harbor	American eel	no present passage	culvert improvement	dormant	
	South Coastal	white perch	passage limitation	fishway maintenance	maintenance	
	Cape Cod	lamprey	water diversion	stream maintenance		
	Islands		sedimentation	barrier beach		
	Buzzards Bay		no passage limitation	dam breach		
	Narragansett Bay		dam removed	dam removal		
	Taunton River			water management		
				operational		
				eel pass		
				smelt spawning riffle		
				tidegate		
				channel daylighting		
				fish lift		
				beaver dam		
				none proposed		

New Attribute Columns. Three columns were added to V3 to note the availability of a *River Herring Spawning and Nursery Habitat Assessment*, an *Operation and Maintenance Plan* for fishways, and a *Stream Maintenance Plan* to support fish passage in a designated diadromous fish run. This addition does not affect rankings and is intended to alert users of the Priority List of site-specific information available from DMF.

Scoring and Ranking. The values assigned to the 13 parameters are added in the Excel spreadsheet. Scores are then sorted by rank in each of the four regions to generate the Priority List. Locations with completed projects since the first version are listed as *Complete* under project status and remain on the list but are removed from the ranking. The future status of completed projects can be updated as infrastructure ages and property use or restoration goals change.

Project Type. The Project Type attribute is the remediation recommended by DMF to address the condition listed under Location Status. In some cases, there is more than one possible Project Type. An existing fish ladder that is listed as fishway maintenance could change to a dam removal or fishway improvement project with a change in ownership goals or manifestation of a funding source. The management of the Priority List will remain flexible to allow updates in Location Status and Project Type as needed with concurrent adjustments in valuations.

Clean Water Act Integration

The U.S. EPA provides States with flexibility to assess and manage impairment of aquatic resources. In terms of IR reporting, waters are identified to be in one of five categories based on the overall support status. Categories 1-3 include those waters that are Fully Supporting, have Insufficient Information to assess, or are Not Assessed with respect to their attainment of designated uses. Waters exhibiting impairment for one or more uses are placed in either Category 4 (impaired but not requiring TMDLs) or Category 5 (impaired and requiring one or more TMDLs) according to the EPA guidance. Waterbodies with multiple causes of impairment remain in the highest list category. The CWA distinguishes between “pollution impairments” such as nutrients, metals, pesticides, solids, and pathogens that all require TMDLs and non-pollutant impairment (“pollution”) stressors such as hydrologic or other habitat alterations (e.g., fish passage barrier, non-native species infestations) that do not require TMDLs. List Category 4 is divided into three subcategories 4a (required TMDL approved by EPA), 4b ((waters where a pollution control requirement in place could reasonably be expected to result in attainment of the water quality standard within two years (category 4b is not in use by MassDEP)), and 4c (impaired solely by “pollution” impairments such as fish passage barrier but a TMDL is not required). Category 5 is the 303(d) list for which one or more TMDLs must be developed. Under the present revision of the Priority List and diadromous fish monitoring QAPP, DMF will inform the MassDEP Division of Watershed Management,

Watershed Planning Program staff (who are responsible for preparing the IR) of impairments due to significant alterations to aquatic habitats and/or the hydrologic regime that limit the use of migratory habitat by diadromous fish and/or exclude these fish from reaching spawning and nursery habitats. These impairments can then be systematically evaluated by MassDEP as part of their IR reporting process.

The V5 Priority List, updated MassGIS Diadromous Fish Datalayer, and the reporting of river herring habitat assessments will continue to build on the collaborative efforts of agency staff. Use attainment decision protocols developed by DMF and MassDEP staff can be found in the Massachusetts Consolidated Assessment and Listing Methodology (CALM) Guidance Manual for the 2018 reporting cycle (MassDEP 2018) (2022 CALM to be released shortly). Currently when population scores are > 0 , and passage scores are ≥ 4 , impairment decision will be made because of the lack of sufficient passage for diadromous fish (a fish passage barrier impairment will be made for the river and upstream lake waterbody assessment units where migration and spawning habitat should exist). These efforts collectively seek to improve identification, protection, maintenance, and restoration actions for diadromous fish migratory, spawning, and nursery habitats in Massachusetts within the CWA and IR reporting processes. Additionally, the integrated Diadromous Fish Restoration Priority List and Diadromous Fish GIS datalayer should become a useful tool for assisting multi-jurisdictional restoration, transportation and infrastructure planning.

Citations

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Mass. Div. of Marine Fisheries web link for all cited Technical Reports:
<http://www.mass.gov/eea/agencies/dfg/dmf/publications/technical.html>