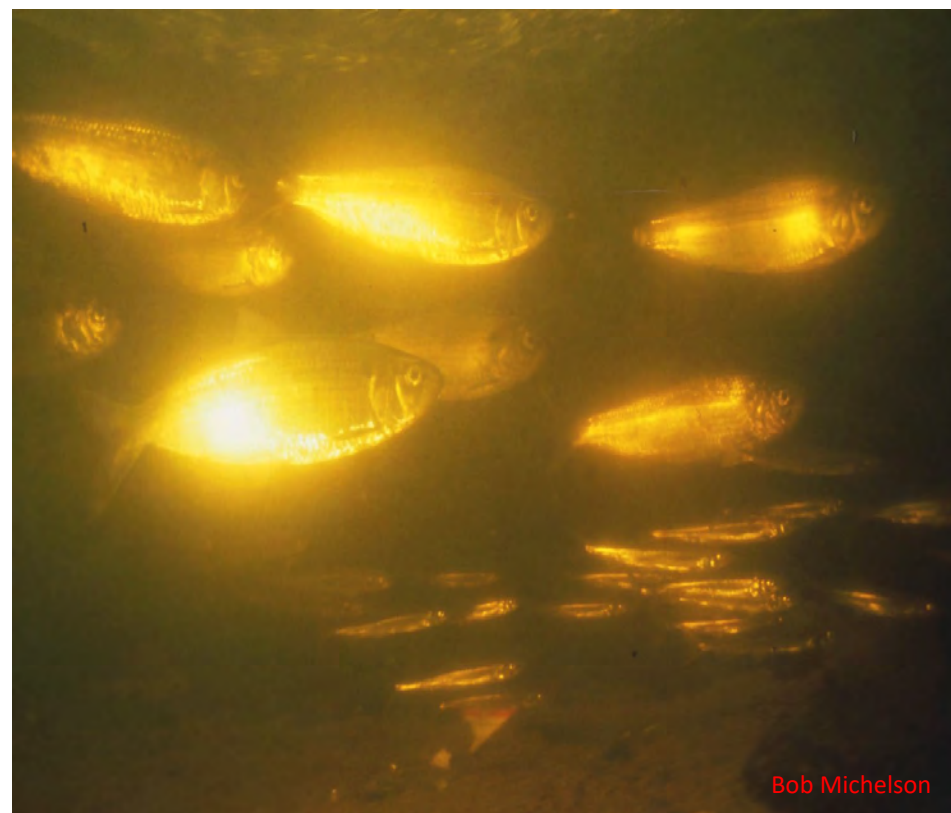


River Herring Habitat Assessment and Passage Restoration at Bourne Pond, Falmouth



Brad Chase, Mass. Div. of Marine Fisheries
WBNERR Pond Oxygenation Workshop
Falmouth - Nov. 8, 2023





Diadromous Fish in Massachusetts



- rainbow smelt
- American eel
- alewife
- blueback herring
- American shad
- white perch
- sea lamprey
- Atlantic tomcod
- sea-run trout
- striped bass



River Herring



American Eel



Bourne Pond Watershed, Falmouth



Project History

- 1916 – Earthen dike constructed to separate Bourne and Bog Pond. Herring passage provided at Bog Pond flume
 - Uncertain how passage occurred and when it became obstructed
- 2006 – Town of Falmouth and property owner discuss river herring restoration options
- 2008 – Town of Falmouth requests DMF assistance
- 2010 – DMF begins 2-year river herring habitat assessment and funds USFWS hydraulic engineer to investigate fishway feasibility and design
- 2015 – DMF conducts additional water elevation monitoring to support the USFWS scoping design for fish ladder
- 2016 – Cooperative project with DMF and Town of Falmouth to construct fishway

River Herring Spawning and Nursery Habitat Assessment



- Low-cost process to gain information on spawning, nursery, and migratory habitat status in individual runs



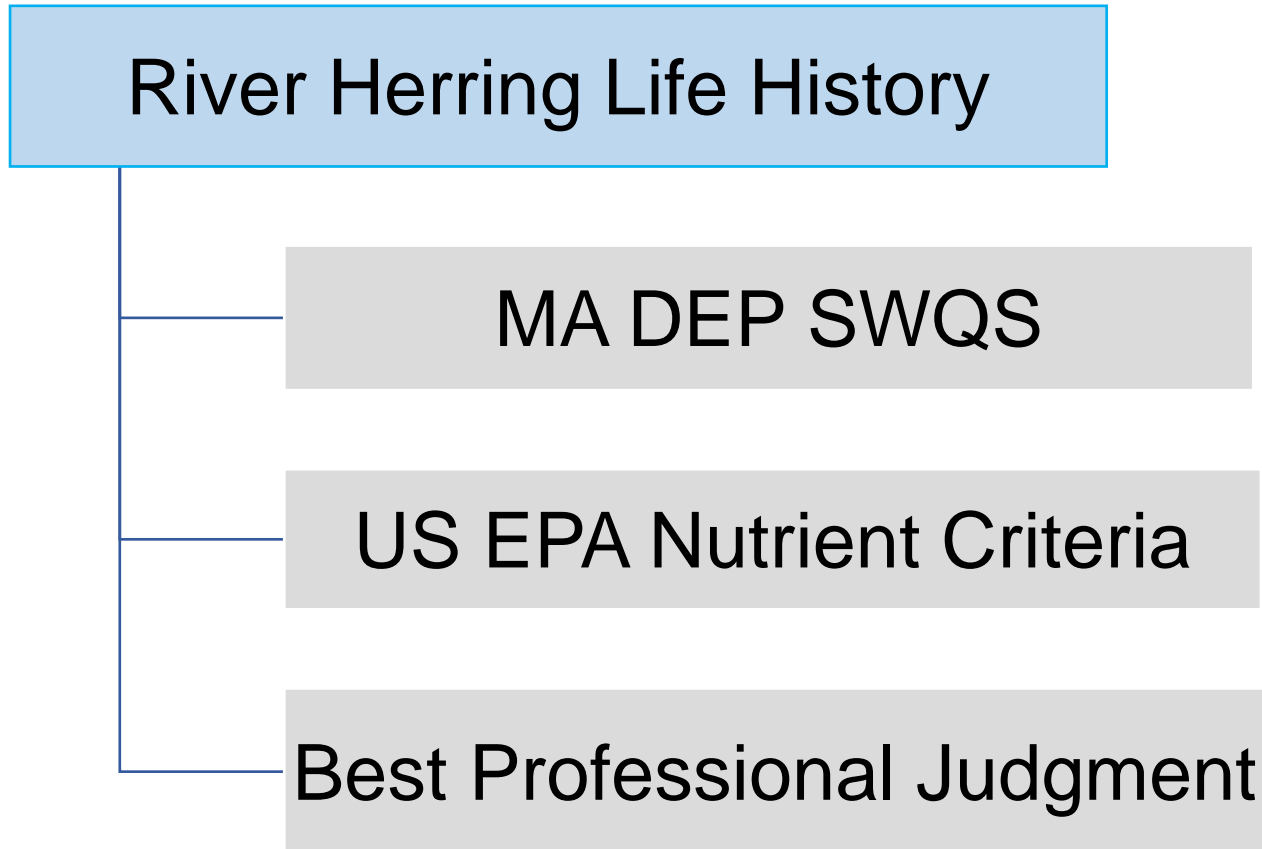
- Tool to identify freshwater habitat stressors
- Standardize methods and protocols in QAPP

River Herring Spawning and Nursery Habitat Assessments

Objectives

1. Inform management of individual river herring runs
2. Guidance on restoration planning for coastal river watersheds
3. Identify stressors of spawning, nursery and migratory habitats
4. Assist MA DEP Clean Water Act evaluations of water bodies

QAPP-based Habitat Classification



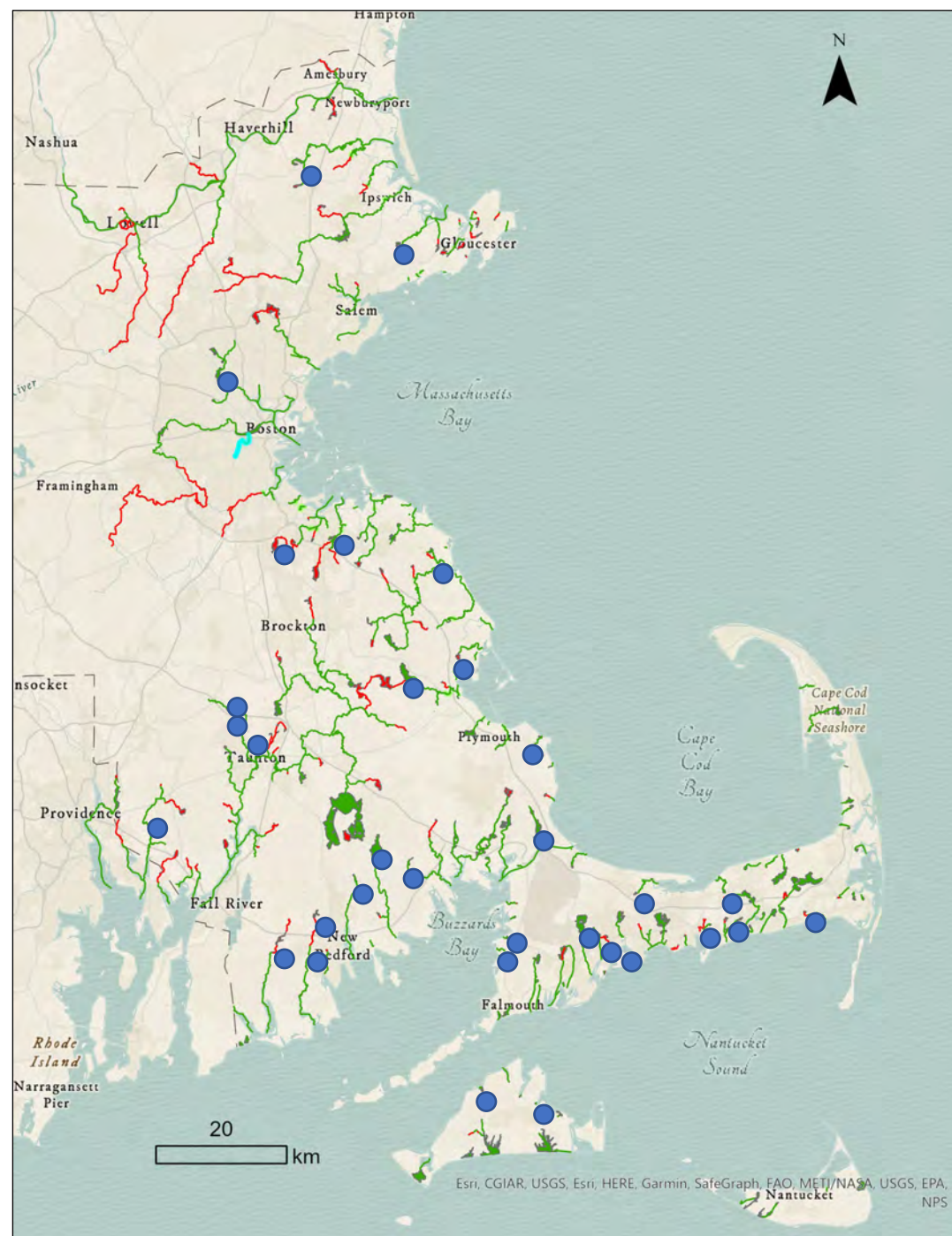
<https://www.mass.gov/service-details/marine-fisheries-technical-reports>

Habitat Assessment Methods

- Monthly sampling trips, May-September for 2 years
- Water chemistry sampling at spawning/nursery habitats
- Assessment of stream flow and fish passage status at migratory junctions in watershed
- Apply QAPP criteria for classifying suitability of habitats to support river herring early life history

River Herring Spawning and Nursery Habitat Assessments

- Over 40 ponds assessed to date
- 7 Technical Reports published
- Exploratory analysis
- Pooling samples by region and pond type



Habitat Assessment Classification Table

Table 1. Summary of river herring habitat assessment at Great Pond Reservoir, Braintree, 2008/2010.

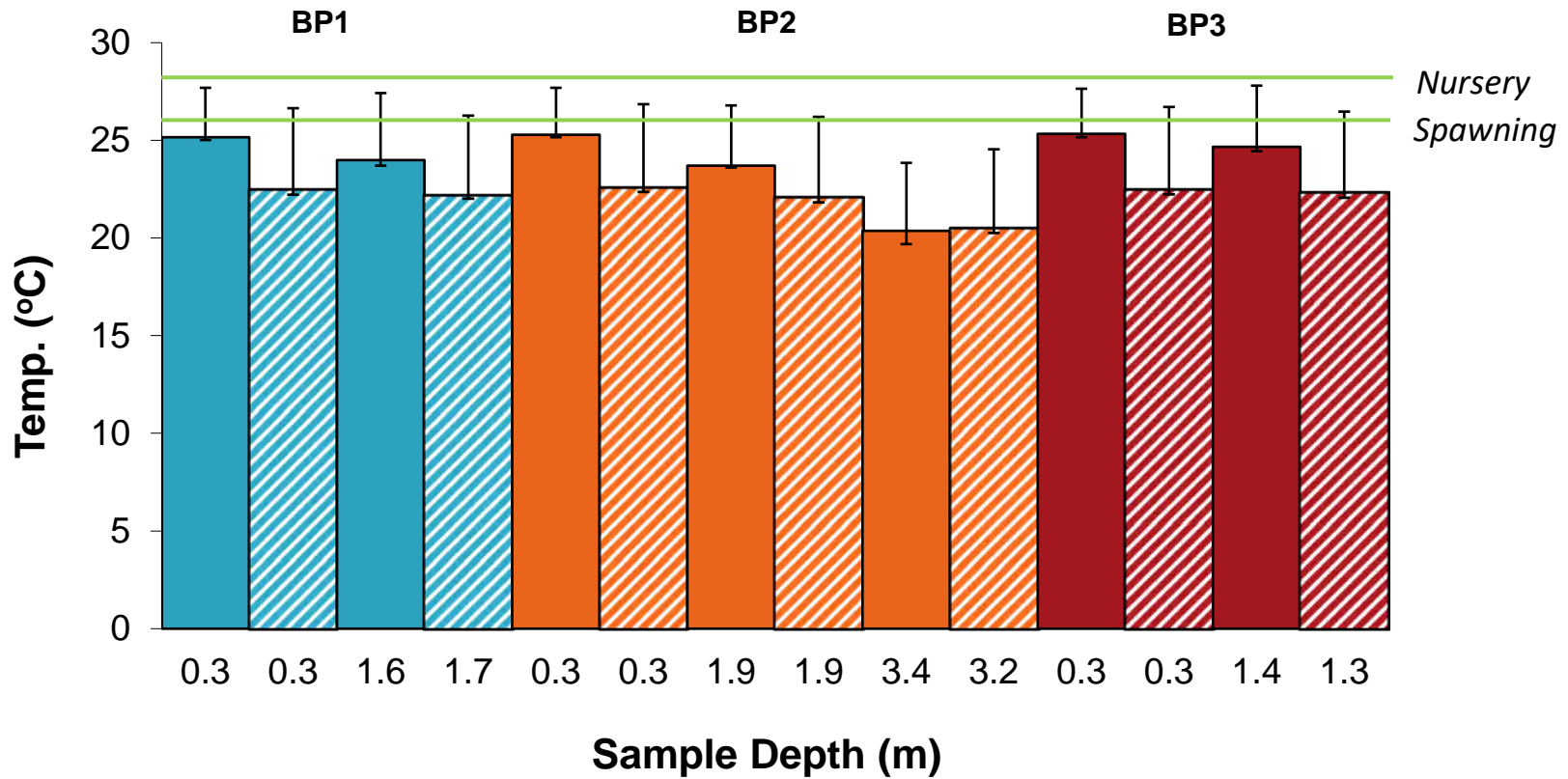
Parameter	Units	Sample (No.)	Sample (Mean)	Acceptable Criteria	Exceedance (%)	Classification
Temp. (nursery)	°C	31	20.51	<28.3	0	<i>Suitable</i>
Temp. (spawning)	°C	43	22.75	<26.0	0	<i>Suitable</i>
DO	mg/L	64	8.30	>5.0	2	<i>Suitable</i>
pH	SU	74	7.30	6.5 to <8.3	1	<i>Suitable</i>
Secchi	m	18	3.5	>2.0	0	<i>Suitable</i>
TN	mg/L	5	0.300	<0.32	40	<i>Impaired</i>
TP	ug/L	5	6.7	<8.0	20	<i>Impaired</i>
Fish Passage	NA	10		BPJ	100	<i>Impaired</i>
Stream Flow	NA	10		BPJ	100	<i>Impaired</i>

River Herring Spawning and Nursery Habitat Assessment, 2010-2011



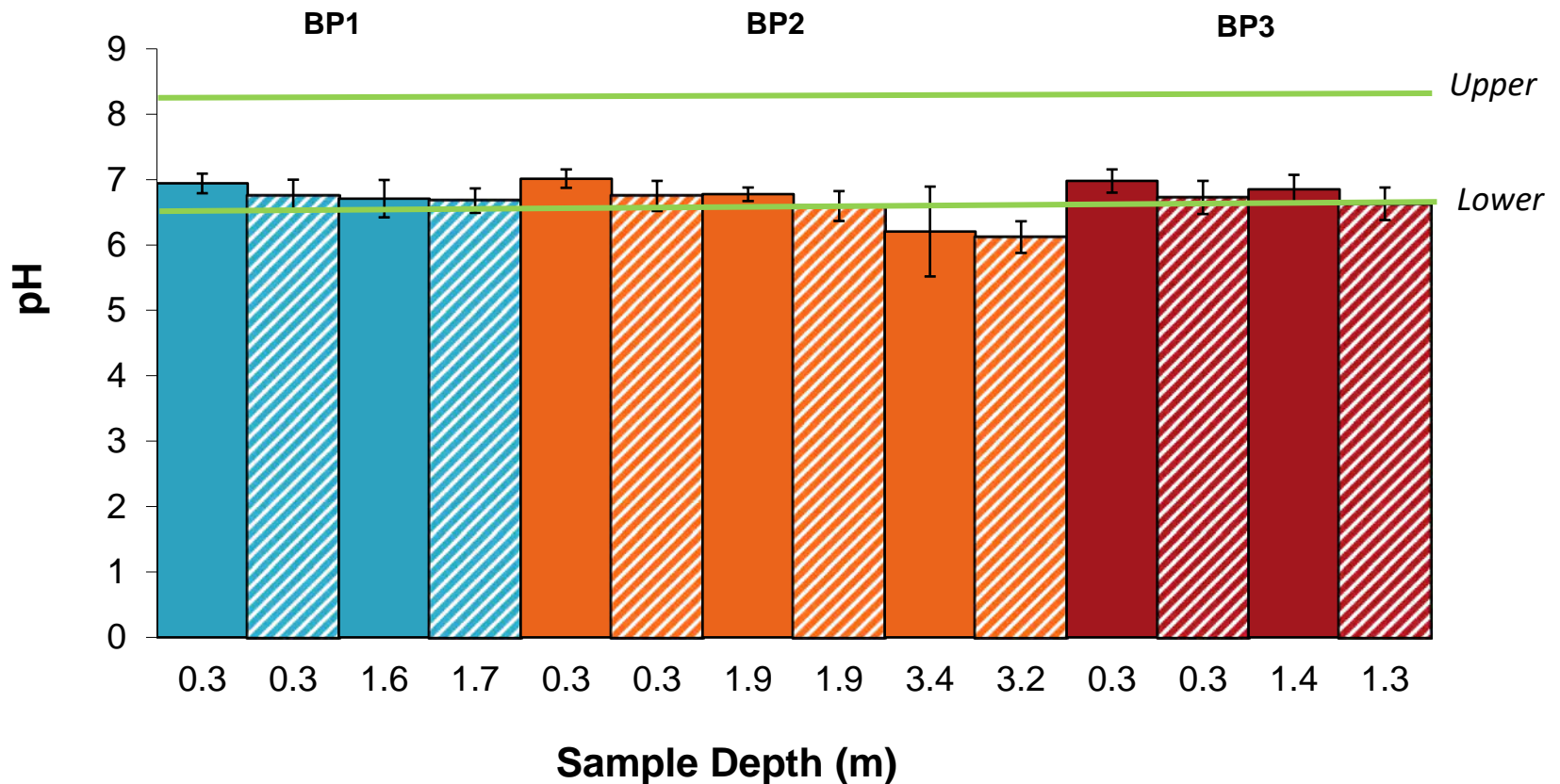
Water Temperature

Figure 9. Water temperature measurements taken at Bourne Pond, 2010 and 2011. Station averages (± 2 SE) are presented for 2010 (blank bars) and 2011 (striped bars). Five samples were recorded at each depth per season. The green horizontal lines mark the



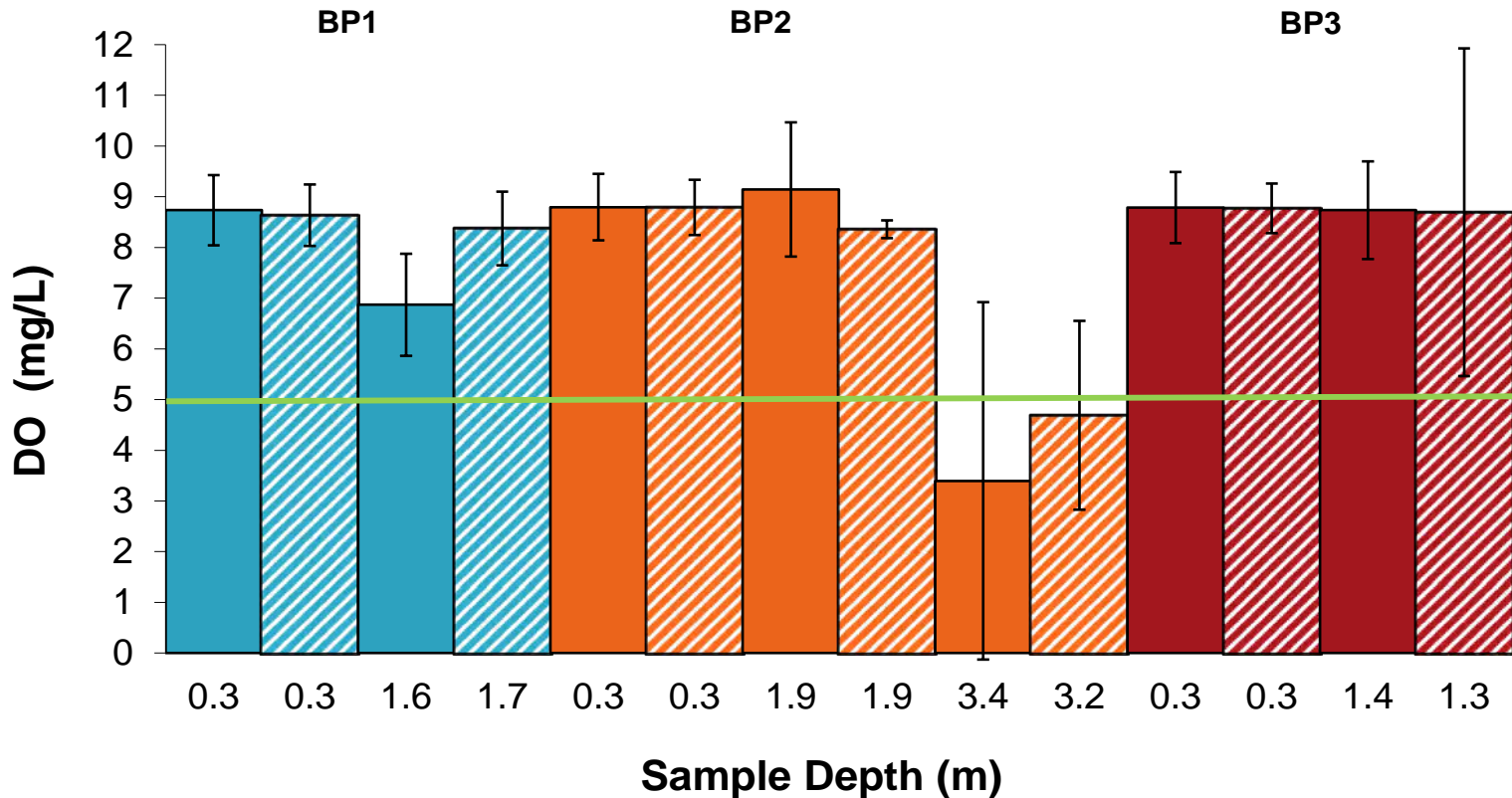
Water pH

Figure x. Water pH measurements taken at Bourne Pond, 2010 and 2011. Station averages (± 2 SE) are presented for 2010 (blank bars) and 2011 (striped bars). Five samples were recorded at each depth per season. The green horizontal lines mark the QAPP adopt



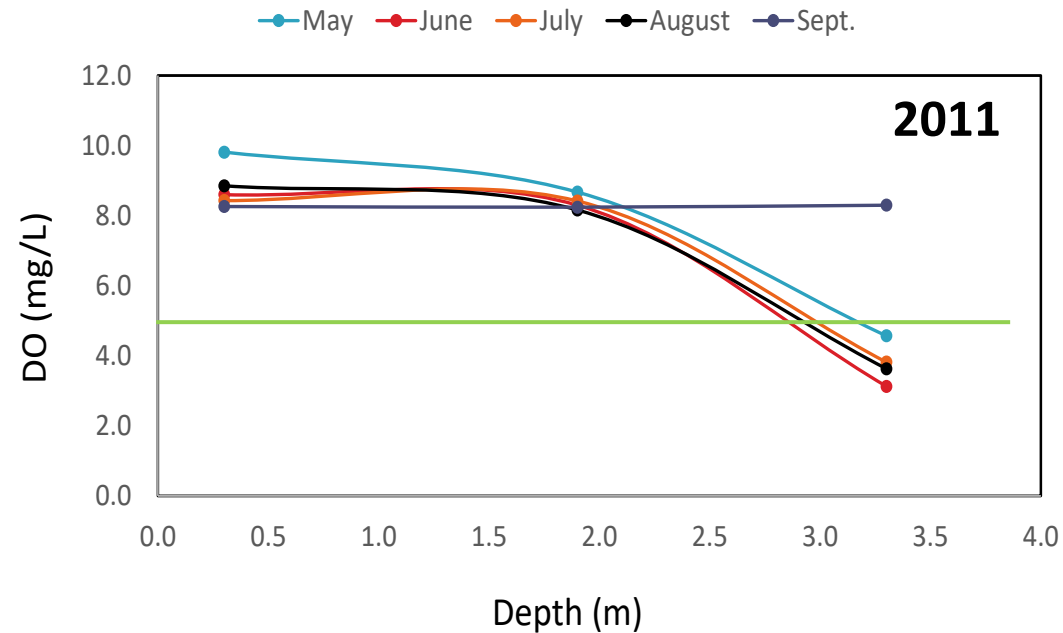
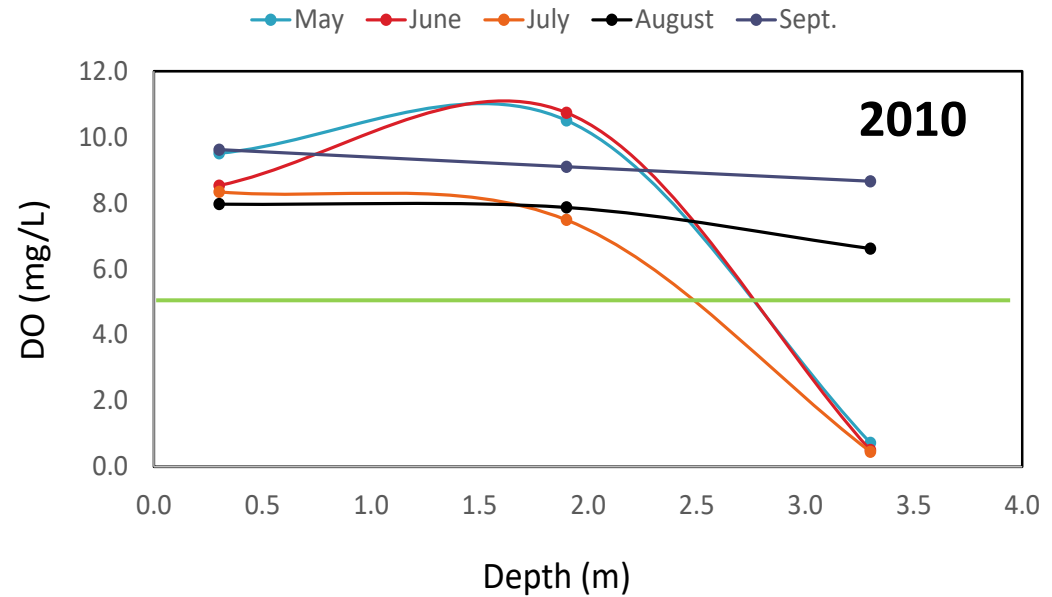
Dissolved Oxygen

Figure x. Dissolved oxygen measurements taken at Bourne Pond, 2010 and 2011. Station averages (± 2 SE) are presented for 2010 (blank bars) and 2011 (striped bars). Five samples were recorded at each depth per season. The green horizontal line marks the QAPP adopted criterion for DO.



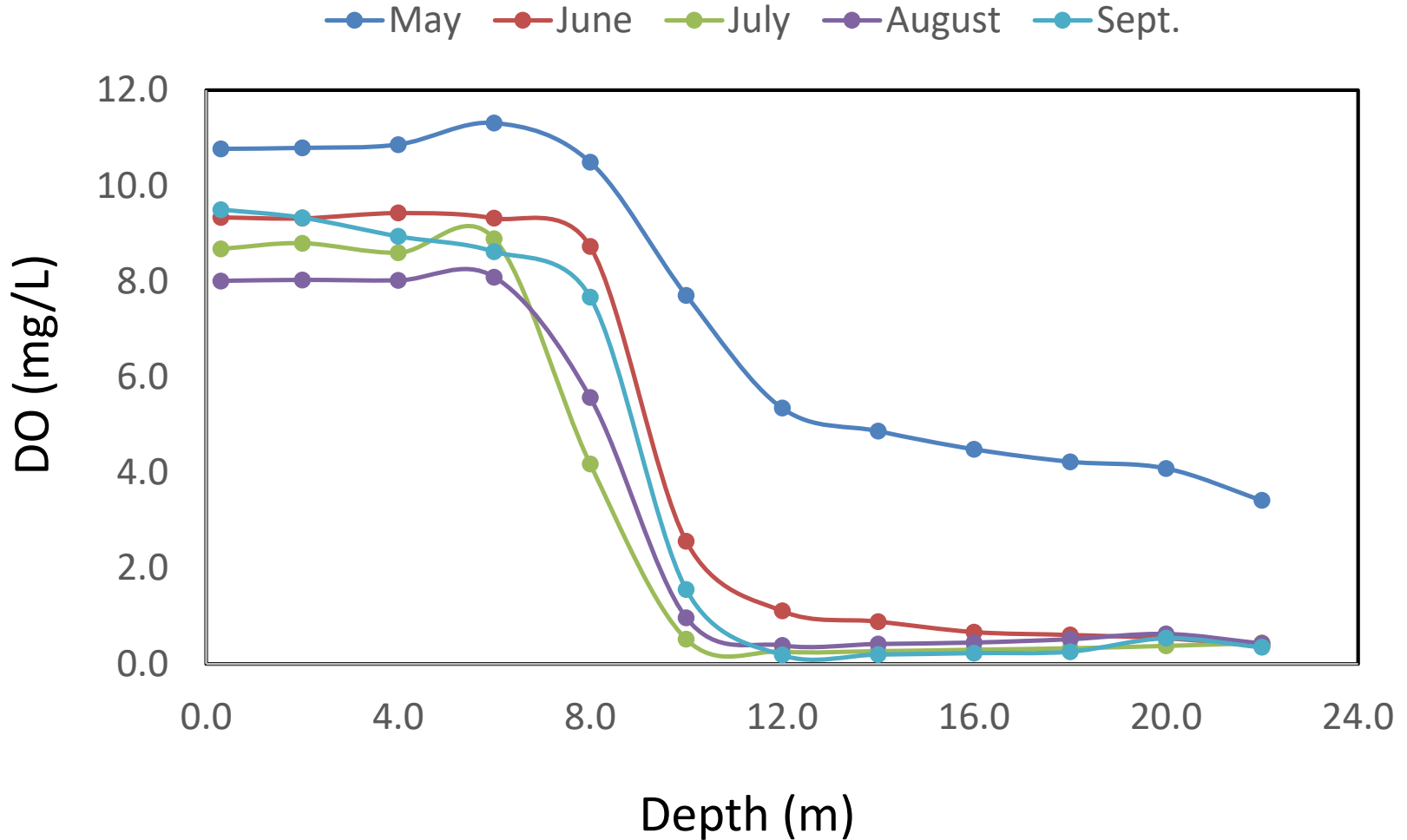
DO Profile at BP2

- Anoxic on bottom in 2010 for May-July
- Nearly hypoxic in 2011 for May-August
- Max. depth = 3.8 m



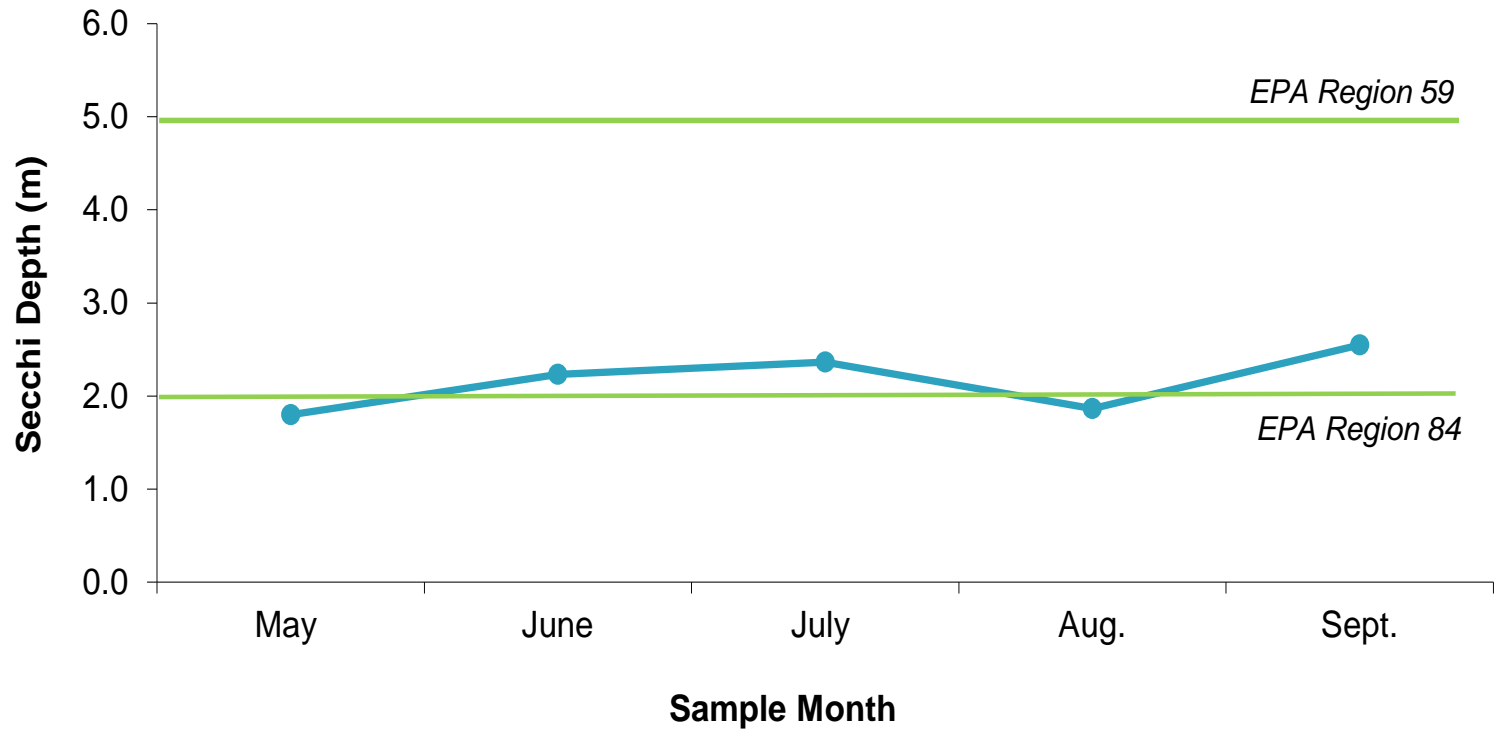
Mashpee Pond, Mashpee

Monthly DO at Depth

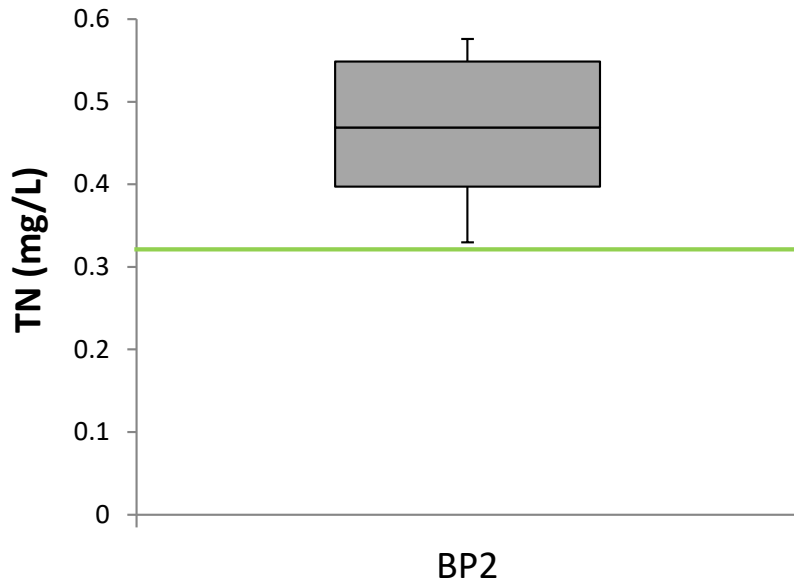


Secchi Disk Depth

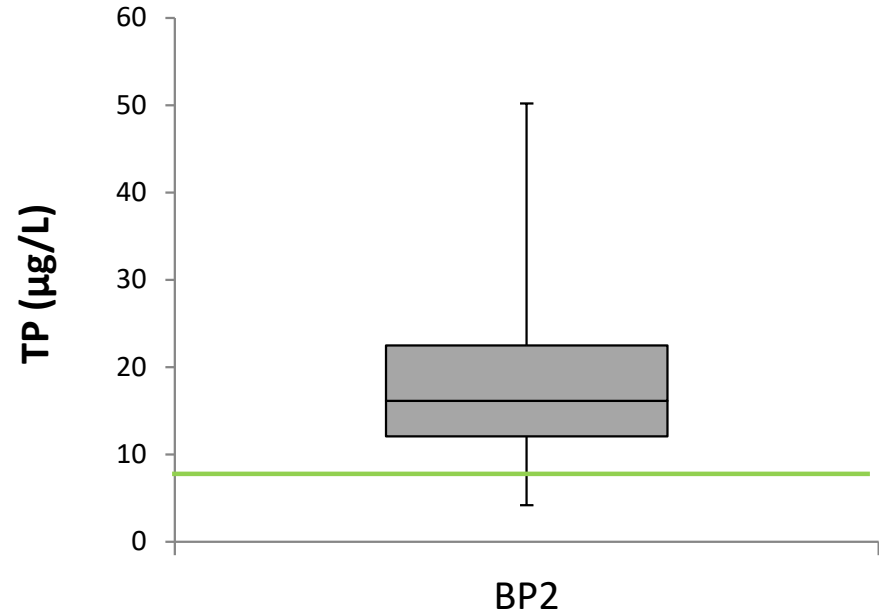
Figure x. Average Secchi disc measurements taken at Bourne Pond, 2010 and 2011. Secchi disc depth at two stations were averaged each month (target N = 4, with some missing samples).



Total Nitrogen



Total Phosphorus



TN and TP surface measurements at Bourne Pond deep station BP2

Fish Passage and Stream Flow



River Herring Spawning and Nursery Habitat Assessment – Bourne Pond

Table 1. Summary of river herring habitat assessment criteria for Bourne Pond, 2010-2011.

Parameter	Units	Sample Size (No.)	Sample (mean)	Acceptable Criteria	Exceedance (%)	Classification
Temp. (spawning)	°C	14	22.86	≤26.0	29	<i>Impaired</i>
Temp. (nursery)	°C	56	23.13	≤28.3	7	<i>Suitable</i>
DO	mg/L	60	8.65	≥5.0	0	<i>Suitable</i>
pH	SU	70	6.70	6.5 to ≤8.3	24	<i>Impaired</i>
Secchi	m	14	2.14	≥2.0	36	<i>Impaired</i>
TN	mg/L	10	0.462	≤0.32	100	<i>Impaired</i>
TP	ug/L	10	19.4	≤8.0	90	<i>Impaired</i>
Eutrophication	BPJ	10		BPJ	0	<i>Suitable</i>
Fish Passage	BPJ	10		BPJ	70	<i>Impaired</i>
Stream Flow	BPJ	10		BPJ	40	<i>Impaired</i>

River Herring Spawning and Nursery Habitat Assessment – Conclusions

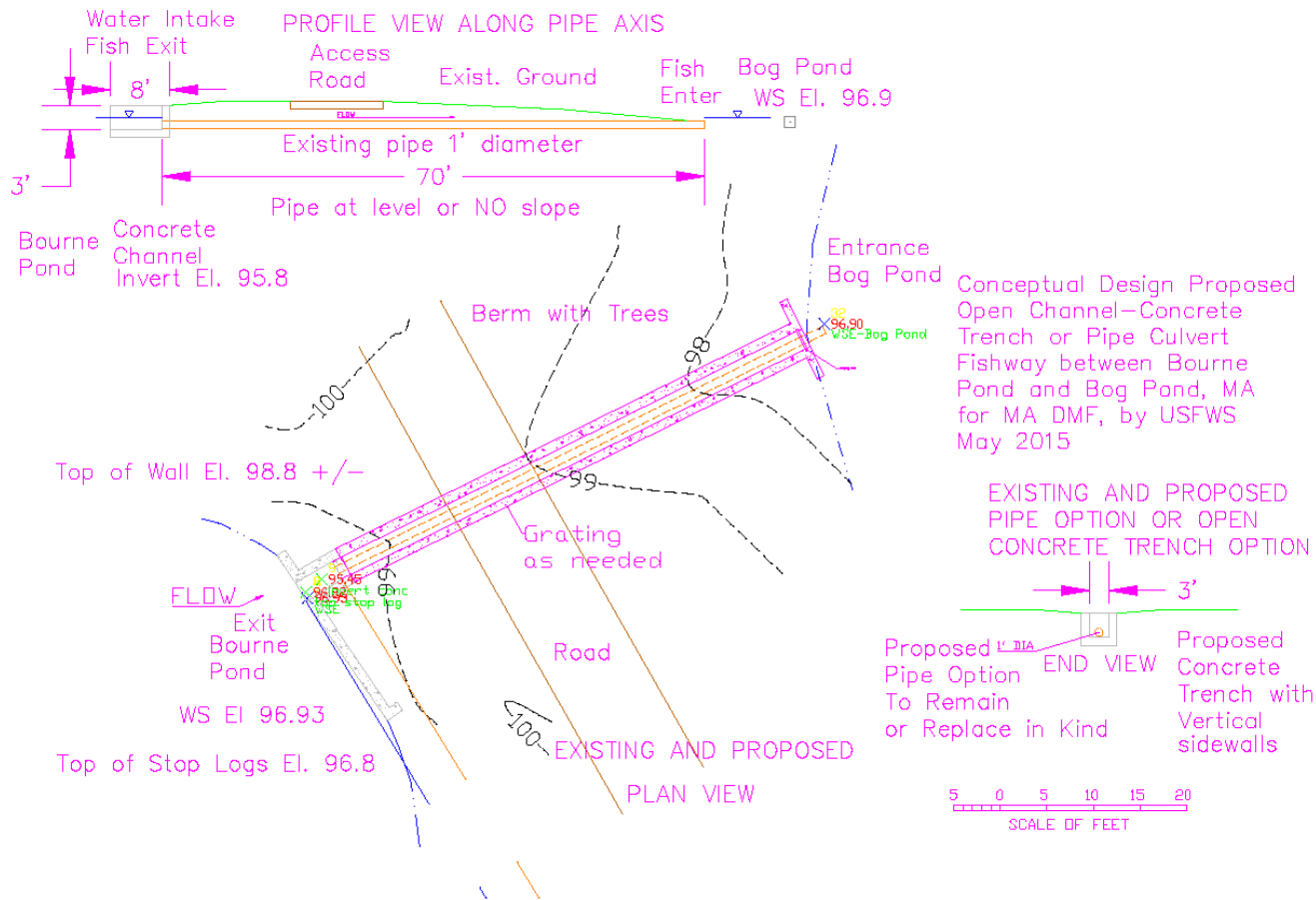
- Bourne Pond water and habitat suitable for early life stages of river herring. Bog Pond had limited habitat for river herring.
- Bog Pond Dam blocked fish passage; and the other two dams were partial obstructions.
- Low stream flow in summer and fall.
- Bog Pond channels obstructed by wetland plant growth, but no invasive plants observed in Bourne Pond.

Water surface elevations recorded in 2015 with depth loggers at the Bourne Pond outlet, Bog Pond outlet and stream below Bog Pond



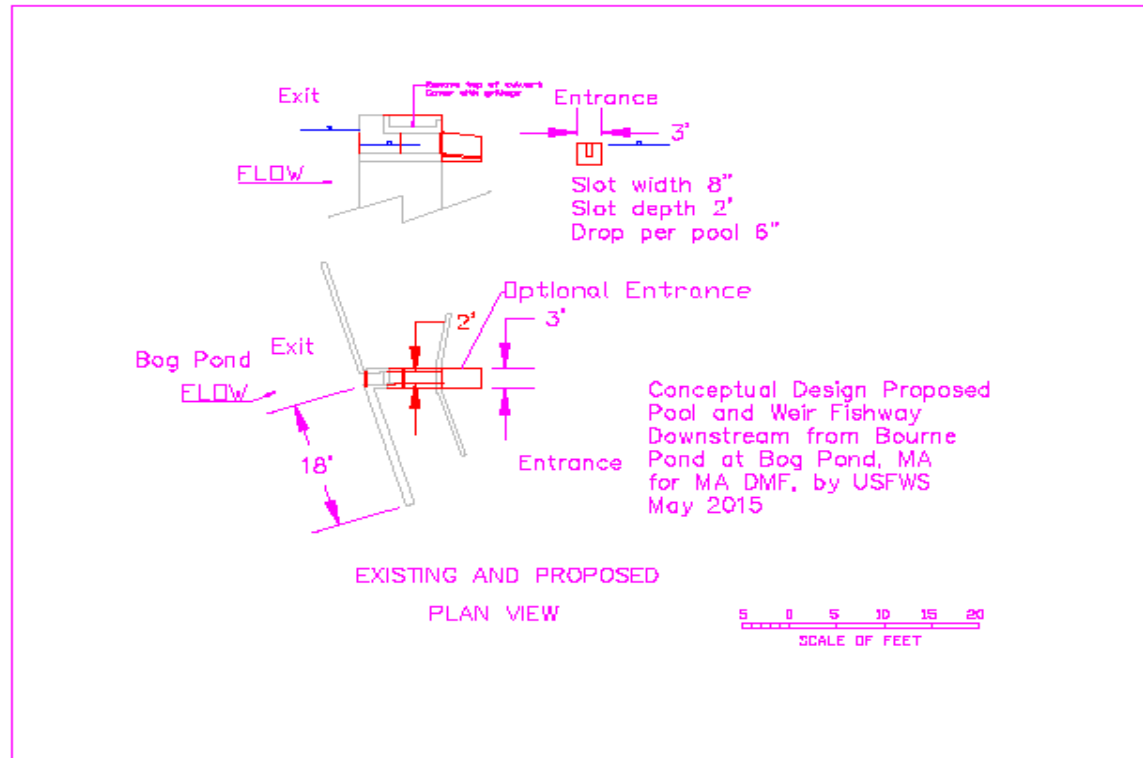
USFWS Project Survey

Bourne Pond to Bog Pond Culvert Daylighting



Relative Benchmark set next to Bourne Pond Outlet at 100.0 ft

Weir and Pool Fishway Option



Prepared by USFWS with hydrologic and survey data

Bog Pond, Falmouth - 2015



Town of Falmouth requests DMF assistance to improve diadromous fish passage

Bog Pond, Falmouth - 2016



Fishway Construction

Bog Pond, Falmouth - 2016



Removal of concrete dam in channel between Bog Pond and Caleb Pond

Post-Construction

Monitoring. Four years of weekly spring monitoring found few herring. Large run of glass eels occurred each year

Fishway Operations and Maintenance Plan. A fishway O&M was approved by DMF in 2020 with pond level targets for both ponds

Stocking. Began stocking herring in 2022



River Herring Habitat Stressors

Pond Water and Habitat Quality

- Low pH – primarily mill ponds in Buzzards Bay region
- Widespread high TN and TP
- Low Secchi Disk depth
- Low DO - expansive hypolimnion may reduce habitat
- Increasing presence of cyanobacteria and invasive vascular plants

Fish Passage and Stream Flow

- Fish passage impediments
- Stream flow limitations for juvenile emigration
- Stream obstruction from debris and vegetation overgrowth

<https://www.mass.gov/doc/dep-dmf-stream-maintenance-policy-april-2022/download>



Next Steps



- Apply assessment results to regional restoration planning
- Add assessment data to Diadromous Fish GIS Data Layer
[MassGIS Data: Diadromous Fish | Mass.gov](#)
- Carrying Capacity
- Evaluate Assessment Covariates
 - Environmental
 - Region
 - Pond Type
 - Thermocline dynamics

