Satucket River and Robbins Pond River Herring Habitat Assessment

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INTRODUCTION

The Satucket River is a 5.6 mile tributary of the Taunton River that begins in 124-acre Robbins Pond and flows through East Bridgewater to where it is joined first by the Matfield and then the Town River, after which it becomes the main stem of the Taunton River. It drains approximately 34.9 square miles and the impervious cover area for the watershed is less than 10%, while forest makes up approximately 44% of the watershed area. It has several tributaries including Poor Meadow Brook, Stoney Brook, and Black Brook. It is undammed except for the Carver Cotton Gin Mill Dam just downstream of the MA-106 / Plymouth Street and about a half-mile south of East Bridgewater center. It is a part of the historic Wampanoag Canoe Passage, a waterway utilized extensively by the local Wampanoag and colonists in years past.

While the Matfield River is heavily-impacted and polluted by stormwater runoff and discharge from the Brockton Wastewater Treatment Plant, the Satucket is a much more pristine river and Robbins Pond is home to many freshwater mussels including the Tidewater Mucket and the Eastern Pond Mussel, organisms that indicate good water quality. Currently a population of river herring and white suckers spawn beneath the Carver Cotton Gin Mill Dam each year.

I selected the Satucket River and Robbins Pond primarily because of its history as a large herring run important to the local Wampanoag (made evident by the fish weir just upstream of the Carver Cotton Gin Mill Dam) and also because of the enormous restoration potential afforded by the run. Now, no river herring can reach Robbins Pond, but before the fish ladder on the Carver Cotton Gin Mill Dam deteriorated a few decades ago a river herring run existed all the way up to Monponsett Ponds (528 acres), altogether providing almost 700 acres of river herring spawning habitat. The Carver Cotton Gin Mill Dam now no longer impounds much water since the sluiceway gate was opened in 2001, but still acts as an impassible barrier to river herring, American eels and white suckers migrating upstream.

Figure 1. Image of the Satucket River with labeled monitoring stations.

METHODS

The river herring habitat assessment methodology outlined in *MarineFisheries'* QAPP was followed as closely as possible, though the YSI 6-Series Sondes were not used due to budget constraints and thus not all parameters described in the QAPP could be measured. (Chase 2009)

The following water quality parameters were measured: water temperature, pH, dissolved oxygen (DO), specific conductivity, and salinity. Observations regarding Fish Passage, Stream Flow and Eutrophication were also recorded. Dissolved oxygen and temperature at the pond stations were recorded at the surface (0.3 m depth) and bottom (0.5 m from bottom) where deeper than a meter, while a drawback of the equipment used was that pH, conductivity and salinity measurements could only be made at the surface.

Data were collected at four stations at Robbins Pond, six along the Satucket and two along Poor Meadow Brook, all according to the Division of Marine Fisheries' Quality Assurance and Program Plan (QAPP) on water quality measurements for diadromous fish monitoring (Chase 2009). One of the four Robbins Pond stations was less than a meter deep and so only one pair of temperature and dissolved oxygen measurements was taken for that stations. Five measurements were taken at each station during late June and July 2010 due to the time constraints of the project. See Table A1 for a list of the stations and

their locations, and see Figure 1 above for an aerial view of the sampling stations. Tables A4 and A5 summarize the precision and accuracy experienced with the instruments used.

Equipment and Factory Specifications:

HI 9146 Portable Waterproof Microprocessor Dissolved Oxygen Meter

Accuracy:
± 1.5% Full Scale mg/L O_2 (typical deviation = ± 0.3 mg/L O_2)
± 1.5% Full Scale % O_2 (typical deviation = ± 3.5% O_2)
± 0.5 °C @ 25 °C

ExStik EC500 pH/Conductivity/TDS/Salinity and Temperature Meter

Accuracy:
±0.01 pH typical
± 2% Full Scale Conductivity
± 2% Full Scale Salinity

RESULTS

Massachusetts SWQS Criteria

Water Temperature. The QAPP / *Mass*DEP temperature criterion for the nursery period of July-October is ≤28.3 °C. Water temperature is important both for the metabolism and reproduction of ectothermic fish like river herring and also as a cue for fish migration. Two exceedances of 30.2 ºC and 29.0 ºC were recorded at shallow-water station RB1-N on June 30th and July 28th, respectively; however, 94.3 % of temperature measurements were at or below the 28.3 ºC cutoff and thus Robbins Pond's temperature classification is *Suitable* as river herring nursery habitat for July 2010. Mean station temperatures ranged between 26.84 and 27.74 °C. More data collection is necessary to determine whether temperatures in Robbins Pond are suitable as spawning habitat during the months of May-June (≤26 °C).

The Satucket River and Poor Meadow Brook were for the most part found to be suitable for river herring nursery habitat as well, with two exceedances at the station below the Robbins Pond culvert (RP-BC) and one exceedance at the Bennett Lane station (Bennett Ln), but nowhere else.

Water pH. Highly acidic or alkaline waters are lethal to some fish species, and can threaten the development of fish eggs and larvae. Low pH can also increase metal toxicity and disrupt ionoregulation at gill tissues. The QAPP and *Mass*DEP criterion for pH *Suitable* to support Aquatic Life is ≥6.5 to ≤8.3. There were no exceedances in Robbins Pond: the lowest single pH value was 6.55 while the station means ranged between 6.72 and 6.91. There were no exceedances along the Satucket River or Poor Meadow Brook either. Robbins Pond is thus classified as suitable for pH.

Dissolved Oxygen. Dissolved oxygen is essential for the respiration and metabolism of organisms like fish that live and breathe underwater. The *Mass*DEP and QAPP criterion for dissolved oxygen is 5 mg/L to be deemed *Suitable* for Aquatic Life. Only one exceedance of 4.82 mg/L was recorded at Robbins Pond station RB2-W. Station averages ranged from 5.55 to 6.42 mg/L. Robbins Pond is deemed *Suitable* for dissolved oxygen for July 2010.

The Satucket River had similarly suitable dissolved oxygen, apart from the Washington Street Bridge station (WSB) which had a station mean of 4.94 mg/L. Poor Meadow Brook had low dissolved oxygen levels as well.

Best Professional Judgement

Fish Passage. Passage was suitable for the downstream migration of juvenile herring during the sampling period, so it is most likely that there are no fish passage impediments during either the spring or fall other than the Carver Cotton Gin Mill Dam, which is impassable.

Stream Flow. Though at normal flows there are no passage impediments and fish passage is *Suitable* other than the Carver Cotton Gin Mill Dam, during the lowest-flow scenarios observed during the sampling period passage at the Washington Street Bridge (WSB) was narrowed to a three-foot-wide drop about 8 inches deep. Downstream of the Bridge Street Bridge (BSB) was rocky as well, though both were still most likely passable for juvenile herring. The outflow culvert from Robbins Pond also became shallower, though the channel could easily be improved. Though most likely not a problem, these three locations should continue to be monitored and passage improvements should be made where deemed beneficial.

Eutrophication. While there are aquatic plants, Robbins Pond is an infertile pond and did not exhibit any signs of eutrophication during the sampling period, such as low dissolved oxygen or algae blooms. The bottom was consistently clean. The portion of Robbins Pond adjacent to Robbins Reservoir did have more plant and algae growth, however.

Spawning Substrate. Though river herring eggs stick to whatever surface they encounter, it is clear in Massachusetts that clean gravel is a better surface for egg survival than fine silt or dense periphyton growth. Substrate at Robbins Pond varies from predominantly sand around the parking area with scattered cobbles to gravel between 10 and 50 mm in diameter around the island.

Additional Observations and Measurements

Specific Conductivity. Conductivity is a measure of the concentration of major ions in solution and specific conductivity is a measure of the resistance in a solution to electrical current corrected to 25 ℃. Since *Mass*DEP and the US EPA both do not have reference conditions for conductivity, there is no QAPP conductivity criterion, though conductivity

can reflect pollution from stormwater runoff. Seasonal means in Robbins Pond ranged between 126 and 142 uS for conductivity, low values possibly indicating low stormwater pollution. By the Washington Street Bridge station (WSB) conductivity had more than doubled to 332. The highest conductivity values were found on Poor Meadow Brook. (PMB@27, PMB@MA14)

CONCLUSION

Robbins Pond is classified as having suitable river herring nursery habitat during July 2010 due to suitable classifications for temperature, dissolved oxygen, pH, eutrophication and stream flow. The limiting factor in this system is the Carver Cotton Gin Mill Dam, the presence of which results in an *Impaired* classification for fish passage. Robbins Pond is a relatively shallow (average depth 6 feet, maximum depth 10 feet) infertile pond resulting in the absence of significant summer stratification, and was well-aerated with only a single DO exceedance. There were no pH exceedances and only two temperature exceedances at the shallow station. More data should be collected during the spawning season (May) to assess whether temperature is suitable (≤26.0 ºC).

Table 1. Summary of river herring habitat assessment criteria for Robbins Pond, June-July 2010. A classification of impaired for each water quality parameter results from exceedances >10% or >1 (when N < 10) for transect station samples.

Parameter	Units	Sample Size (No.)	Acceptable Criteria	Exceedance (%)	Classification
Temp. (nursery)	ºC	35	≤28.3 ºC	5.70%	*Suitable*
DO	mg/L	35	≥5 mg/L	2.86%	*Suitable*
pH	SU	20	≥6.5 to ≤8.3	0.00%	*Suitable*
Eutrophication	NA	NA	BPJ	NA	*Suitable*
Fish Passage	NA	NA	BPJ	100%	*Impaired*
Stream Flow	NA	NA	BPJ	NA	*Suitable*

RECOMMENDATIONS

Robbins Pond has the potential to host a particularly strong herring run given its favorable water quality and the fact that if the Carver Cotton Gin Mill Dam were removed river herring (and juveniles) would have efficient passage to and from the pond. Furthermore, if passage were restored to the Monponsett Ponds, almost 700 acres of total spawning habitat would be made accessible in the Satucket River watershed. While cranberry bog operations used to utilize water from Stump Brook, the river connecting Robbins Pond and Reservoir to West Monponsett, the area has since become the Burrage Pond Wildlife Management Area administered by the Division of Fish and Wildlife. Massachusetts Audubon also owns land on the other side of the brook constituting their Stump Brook Wildlife Sanctuary. The dam also no longer has value since it holds back very little water and is in such disrepair that it would have to be removed before a new one were built. With the great potential offered by the Satucket River up to Robbins Pond

and then to the Monponsetts, the Division of Marine Fisheries should prioritize dam removal and passage restoration on this tributary.

LITERATURE CITED

Chase, B.C. 2009. Quality Assurance Program Plan for Water Quality Measurements Conducted for Diadromous Fish Monitoring. Version 1.0, 2008-2012. Mass. Division of Marine Fisheries, New Bedford, MA.

Rojko, A. M. et al. 2001. Taunton River Watershed 2001 Water Quality Assessment Report. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester Massachusetts.

2010. Upper Mystic Lake River Herring Habitat Assessment. Version 2.0, 4/2010. Mass. Division of Marine Fisheries.

Table A1. Station locations that were sampled during June/July 2010.

Station No.	Latitude	Longitude	Depth Strata	Max. Depth	Sample (No.)	Location
RB1-N	42° 00.863	70° 90.812	shallow	.45 m	5	about 40 ft directly out from
RB2-W	42° 00.629	70° 90.894	mid	~1.5 m	5	between the western point of the western shore
RB3-S	42° 00.366	70° 90.645	mid	~1.5 m	5	halfway between the southern island and the southern shore
RB4-E	42° 00.624	70° 90.467	mid	~1.5 m	5	halfway between the eastern island and the eastern shore
RP-BC	42° 00.928	70° 90.756	shallow	N/A	5	Just below the Robbins Pond
WSB	42° 01.722	70° 91.770	shallow	N/A	5	just downstream of the Wash culvert
BSB	42° 02.259	70° 93.185	shallow	N/A	5	just upstream of the Bridge S
Bennett Lane	42° 02.320	70° 94.915	shallow	N/A	5	just downstream of the fish w off the path
Dam	42° 02.141	70° 95.106	shallow	N/A	5	just below the dam
SRF	42° 01.926	70° 95.218	shallow	N/A	5	down the river trail from Sac
PMB@27	42° 04.276	70° 89.820	shallow	N/A	5	just upstream from the MA27 Poor Meadow Brook
PMB @ MA 14	42° 05.876	70° 90.007	shallow	N/A	5	just upstream from the MA14 Poor Meadow Brook

Table A2. Water chemistry data collected at stations RB1-4 during July 2010.

Stations				Shallow		Deep	
RBP1-N	**pH**	**Sp. Cond., uS.**	**Salinity, ppm**	**Temp, ºC**	**dO, mg/L**	**Temp, ºC**	**dO, mg/L**
6/30, 4:43 pm	7.24	102.4	56	30.2	6.08		
7/16, 11:20 am	6.77	139.4	69	28	5.74		
7/20, 8:50 am	6.72	127.4	62.7	28.2	6.08		
7/22, 10:38 am	6.86	122.7	61.4	28.3	7.24		
7/28, 11:35 am	6.94	140.4	71.2	29	6.94		
s. mean=	6.906	126.46	64.06	28.74	6.416		
RBP2-W							
6/30, 5:15 pm	6.98	106.7	55.5	27.5	5.9	27	5.45
7/16, 10:35 am	6.72	138.9	69.1	27.5	5.61	26.9	5.17
7/20, 9:15 am	6.68	126.1	62.7	28.1	5.62	27.9	5.65
7/25, 11:55 am	6.55	138.8	69.8	28	5.41	26.1	4.82
7/27, 2:40 pm	6.93	142	70.7	27.1	7	26.3	6.68
s. mean=	6.772	130.5	65.56	27.64	5.908	26.84	5.554
RBP3-S							
6/30, 5:45 pm	6.83	105.5	51	27.7	5.6	27.6	5.3
7/16, 10:55 am	6.7	138.8	68	27.2	5.72	27	5.57
7/20, 9:33 am	6.7	127.4	63.8	27.8	5.56	27.5	5.4
7/25, 12:25 pm	6.72	140	69	28	6.81	27.1	6.27

7/28, 11:15 am	6.67	139	71.2	27.7	6.46	27.3	6.29
s. mean=	6.724	130.14	64.6	27.68	6.03	27.3	5.766
RBP4-E							
6/30, 6:15 pm	7	107	52.1	28.3	6.24	28.1	5.9
7/16, 11:15 am	6.76	140	69.4	27.1	5.24	26.9	5.31
7/20, 10:15 am	6.7	126.1	63.8	27.9	5.54	27.7	5.43
7/25, 12:45 pm	6.72	136.7	68	28	6.64	27.5	6.61
7/28, 11:25 am	6.93	138.6	68.3	27.4	5.75	26.8	5.73
s. mean=	6.822	129.68	64.32	27.74	5.882	27.4	5.796

Table A3. Water chemistry data collected at stations downstream of Robbins Pond.

Stations

RP-BC	**pH**	**Sp. Cond., uS.**	**Salinity, ppm**	**Temp, ºC**	**dO, mg/L**	**Notes**
6/30, 6:40 pm	6.99	110.7	56.6	28.6	5.44	
7/16, 10:05 am	6.77	139.9	69.8	27.8	6.08	
7/20, 10:40 am	6.84	130.2	64.4	28.5	6.15	
7/22, 10:55 am	6.88	122.8	62	27	8.03	
7/28, 11:45 am	6.63	139.8	70	29.5	6.15	
s. mean=	6.822	128.68	64.56	28.28	6.37	
WSB						
6/30, 7:15 pm	7.2	364	183	26.5	6.28	
7/16, 11:42 am	6.99	356	178	24.2	5.03	
7/19, 4:00 pm	6.62	333	166	26.5	5.01	
7/22, 11:16 am	6.83	303	151	24.7	4.89	
7/28, 12:00 pm	6.77	306	152	25	3.48	
s. mean=	6.882	332.4	166	25.38	4.938	
BSB						
7/5, 1:15 pm	7.1	349	175	25.5	6.45	
7/16, 12:10 pm	6.85	335	180	25.1	5.41	
7/19, 4:25 pm	6.53	316	156	26.8	5.1	
7/22, 11:40 am	6.86	351	173	24.6	7.65	
7/28, 12:15 pm	6.92	331	165	25.8	7.47	
s. mean=	6.852	336.4	169.8	25.56	6.416	
Bennett Lane						
7/5, 2:40 pm	7.32	305	176	28.6	8.68	
7/16, 1:41 pm	6.83	240	125	29.8	6.95	<---7/9, 2:23 pm for t/do
7/19, 5:20 pm	7.04	351	176	27.4	6.4	
7/22, 12:54pm	7.25	337	167	25.7	8.42	
7/28, 1:25 pm	7.21	301	149	27.9	8.15	
s. mean=	7.13	306.8	158.6	27.88	7.72	
Dam						
7/5, 1:55 pm	7.4	305	158	27.7	7.68	
7/16, 1:18 pm	6.92	261	132	26.1	6.33	
7/19, 5:00 pm	7.15	369	184	28.1	7.21	after rain

7/22, 12:25 pm	7.33	351	175	26	8.73	
7/28, 1:00 pm	7.5	302	151	27	7.87	
s. mean=	7.26	317.6	160	26.98	7.564	
SRF						
7/5, 1:35 pm	7.25	319	157	26.2	6.72	
7/16, 12:40 pm	7.01	271	135	26	6.35	
7/19, 4:45 pm	6.94	368	180	27.1	6.49	after rain
7/22, 12:05 pm	7.12	353	174	24.8	7.73	
7/28, 12:45 pm	6.07	303	152	25.3	6.07	
s. mean=	6.878	322.8	159.6	25.88	6.672	
PMB@27						
6/30, 4pm	7.05	374	180	26.2	4.22	
7/15, 5:05pm	6.85	448	219	25.5	3.55	<--- 7/9, 11:00 am for t/dO
7/19, 3:45 pm	6.85	447	222	26.6	4.76	
7/22, 10:10 am	7.05	482	242	24.7	4.02	
7/28, 10:30 am	6.87	408	201	23.9	3.73	
s. mean=	6.934	431.8	212.8	25.38	4.056	
PMB @ MA 14						
7/5, 2:45 pm	7.19	456	224	23.8	4.73	
7/16, 2:07 pm	6.86	432	211	27	3.24	<---7/9, 2:40pm for t/d0
7/19, 5:45 pm	6.8	478	243	25.3	4.49	
7/22, 1:35 pm	7.03	474	240	23.6	5.09	
7/28, 1:55 pm	7	472	236	23.4	4.75	
s. mean=	6.976	462.4	230.8	24.62	4.46	

Table A4. Instrument precision reporting: Relative Percent Differences. (≤ than 5 % acceptable)

	dO	**T**	**C**	**S**	**pH**
6/30, 4:43 pm	**5.44%**	0.00%	0.88%	0.18%	0.14%
7/1, 2:30 pm	0.63%	0.00%	0.96%	1.31%	0.56%
7/2, 10:00 am	2.41%	0.00%	0.89%	0.61%	0.56%
7/5, 1:15 pm	2.75%	0.78%	0.29%	1.73%	0.28%
7/6, 11:15 am	0.80%	0.43%	1.70%	3.28%	0.31%
7/8, 5:30 pm	1.09%	0.41%	0.11%	0.22%	0.61%
7/18, 12:30 pm	1.55%	0.00%	0.00%	0.52%	0.15%
7/19, 10:05 am	0.49%	0.36%	0.72%	0.29%	0.74%
7/19, 2:40 pm	1.94%	0.41%	0.00%	0.00%	0.14%
7/20, 10:40 am	0.33%	0.00%	0.15%	0.29%	0.44%
7/21, 10:58 am	0.86%	0.39%	0.24%	0.49%	0.15%
7/22, 11:16 am	0.62%	0.40%	0.66%	0.00%	0.15%
7/25, 1:40 pm	4.30%	0.00%	0.30%	0.00%	4.30%
7/26, 11:20 am	0.73%	0.40%	0.19%	0.37%	0.15%
7/27, 9:44 am	0.83%	0.42%	0.28%	0.57%	0.15%
7/28, 12:45 pm	0.39%	0.56%	0.33%	0.00%	0.33%
7/29, 10:45 am	3.11%	0.46%	0.00%	1.55%	0.15%

7/29, 1:45 pm	0.63%	0.71%	0.00%	0.00%	0.29%

Table A5. Instrument accuracy reporting: Deviation from standards.

		Deviation	
	Standard used	Full Scale	Units
pH, SU	4.01	0.00%	0 SU
	10.01	0.20%	0.02 SU
	7	0.14%	0.01 SU
Sp. Cond., uS	1413	0.35%	5 uS
	84	0.71%	0.6 uS
Temp, ºC*	18.0 ºC	N/A	1.4 ºC
(Hanna dO)	25.0 ºC	N/A	0.8 ºC
	30.0 ºC	N/A	0.2 ºC
(EC500)	18.0 ºC	N/A	0.2 ºC
	25.0 ºC	N/A	0.5 ºC
	30.0 ºC	N/A	0.4 ºC