Update on Straits Pond

Presented to the Board of Selectmen

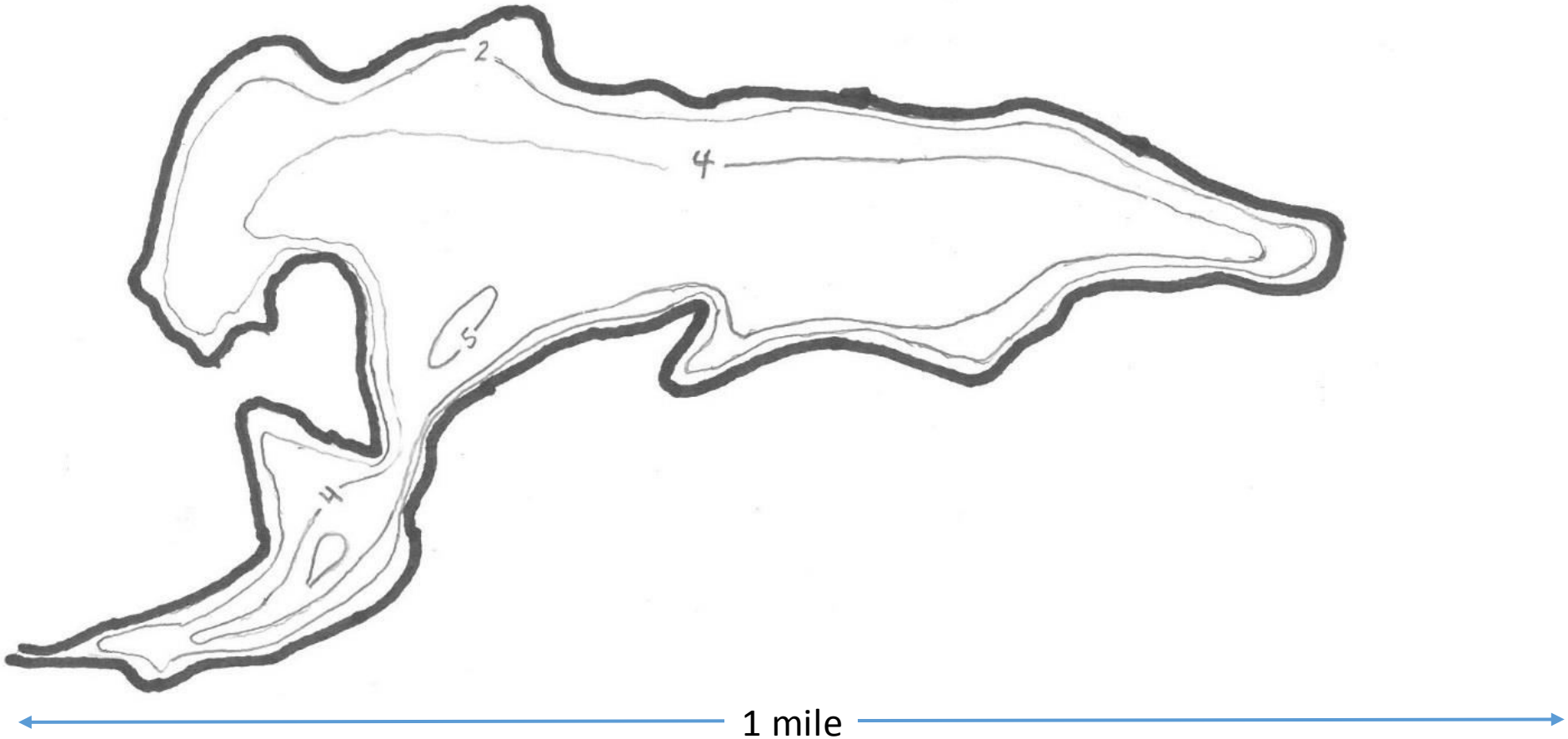
July 27, 2017

Issues of Concern raised by citizens along Straits Pond:

- Midges (?)
- Offensive odor
- Excessive Algae

Background:

Straits Pond is a 94 acre coastal salt pond that has experienced decades of human-induced perturbations that has degraded the ecosystem quality and ecology of the pond. Improvements to the pond's ecology and quality has occurred as a result of undersized and underutilized tide gates, which had limited the tidal exchange with the Weir River estuary, and from stormwater runoff that continues to provide a variety of pollution, including nutrients, which strongly impact this rather shallow (3-5 foot depth) pond (Figure 1). Restoration efforts have resulted in the elimination of individual septic systems of adjacent homes and the installation of a much improved tide gate system which appears to have contributed to the recovery of Straits Pond. Partners in the restoration projects include the Towns of Hull, Hingham, and Cohasset, Straits Pond and Weir River Watershed Associations, Office of Coastal Zone Management, Massachusetts Bays Program, National Oceanic and Atmospheric Administration, Conservation Law Foundation, Hull's state and federal elected representatives, and numerous others.



Bathymetry of Straits Pond
(redrawn from Environmental Science Services, Inc., 2002)

Figure 1

- A water quality survey was conducted by the Conservation Dept on 13 July, 2017 with assistance from Jason Burtner of MA CZM and Sam Campbell, local Hull citizen living along the Hull shore of Straits Pond. The results here are preliminary.
- Water quality measurements of salinity (ppt), dissolved oxygen (% sat.), and temperature (^{o}C) were recorded from 24 sites in Straits Pond. The location of these stations are shown by the white dots in figure 2. (Note, these results are preliminary as you might notice some of the stations fall onto the Cohasset shore as depicted in Figure 2. A correction of the SP shoreline will be coming shortly)
- Figure 2 also shows the spatial distribution of salinity in the surface water of Straits Pond. The pond was observed to be generally well-mixed, meaning that the water characteristics (for salinity, temperature, and dissolved oxygen) were generally the same in the surface water as it was for water at the bottom of the pond near the sediments. The salinity was nearly uniform across the pond, averaging 29.9 (+/- 0.5) parts per thousand (ppt), and was only slightly less than what was measured for the salinity of Massachusetts Bay water collected off of Nantasket Beach (= 31.0 ppt).

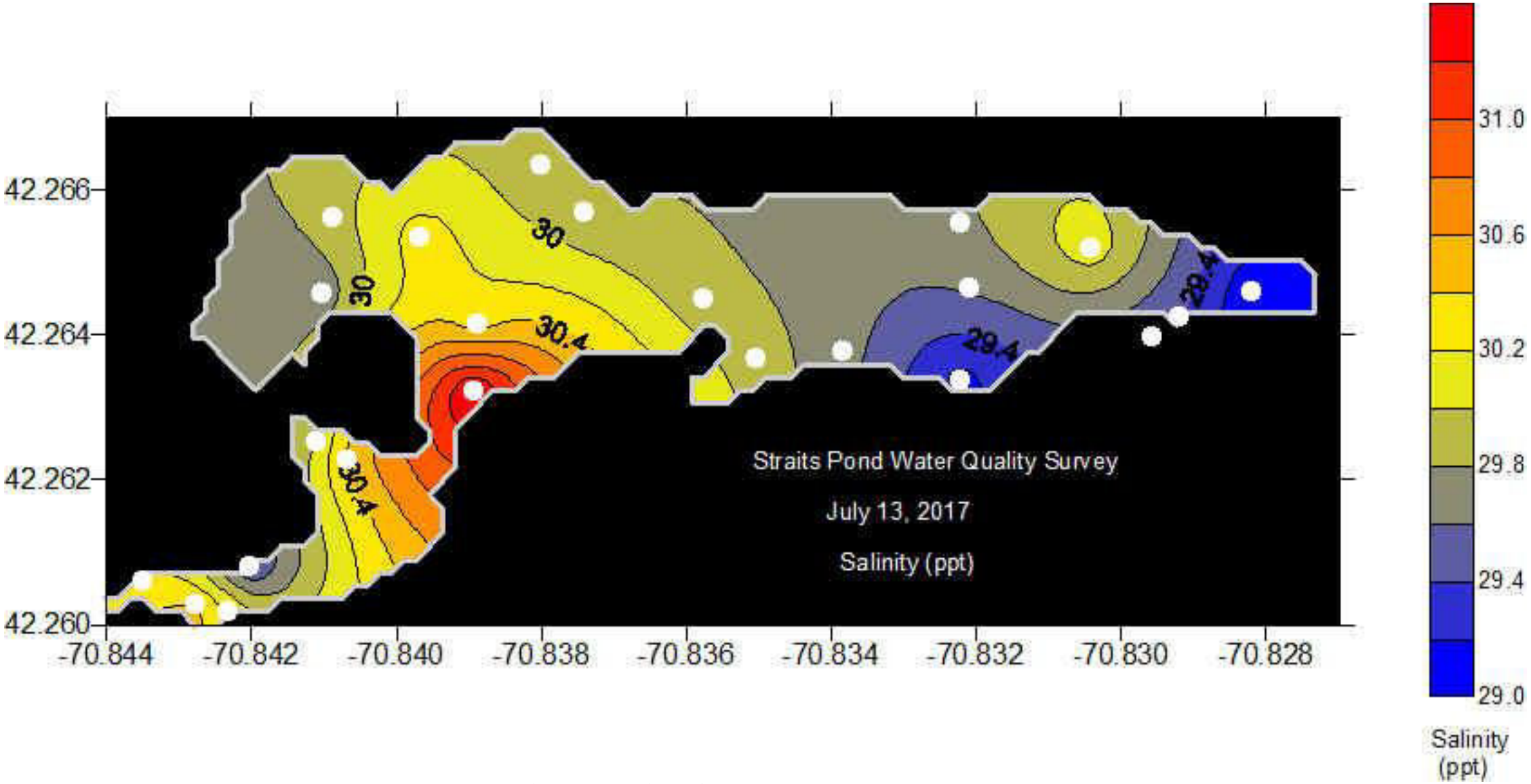


Figure 2: Spatial distribution of salinity (ppt). White dots indicate sampling locations

Even though the salinity was relatively uniform, Figure 2 shows some interesting features:

- Highest salinities observed in the narrow region between Straits Pond (SP) Island and the adjacent Cohasset shore (indicated by the orange-red color)
- Lowest water salinity was observed in the western portion of SP and along the Cohasset shoreline, possibly showing some minor influence from the ephemeral Rattlesnake Run creek located on the Cohasset side near the SE area of SP or possibly due to differences of groundwater input (?) to this region.

It is important to note that the spatial differences in salinity are very small. Also, note that this “snap shot” of salinity (and other water quality parameters) occurred during a sampling interval of ~ 2 hours during high tide.

Figure 3 shows the spatial distribution of temperature (°C) in the surface water of Straits Pond. The blue color indicates the cooler end of the temperatures observed (22-30 °C). Note that the "cooler" water coincides with where the higher salinity values were observed (see Figure 2). These data indicate where the newest water from the Weir River estuary was located during the survey. Keep in mind that the survey was conducted during high tide, after the water from the Weir River has entered SP and before the tidal flushing begins to return SP water back into the Weir River. Also note that when the Weir River is in its low tide stage, almost all of the water is removed from the estuary which had exited into Hull Bay in Boston Harbor. This is important, because the water then mixes in Boston Harbor (Hull Bay) and is not likely to return into SP.

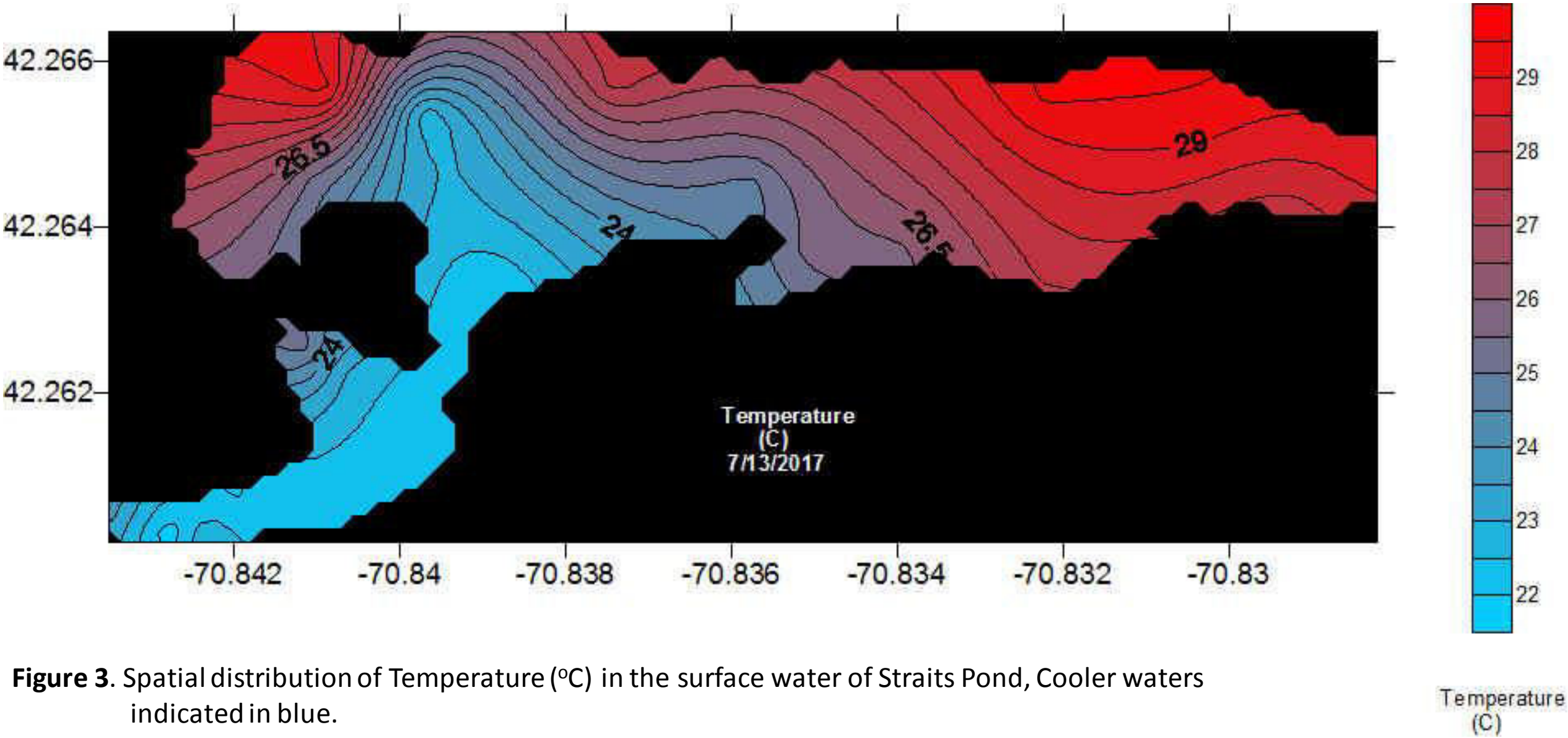
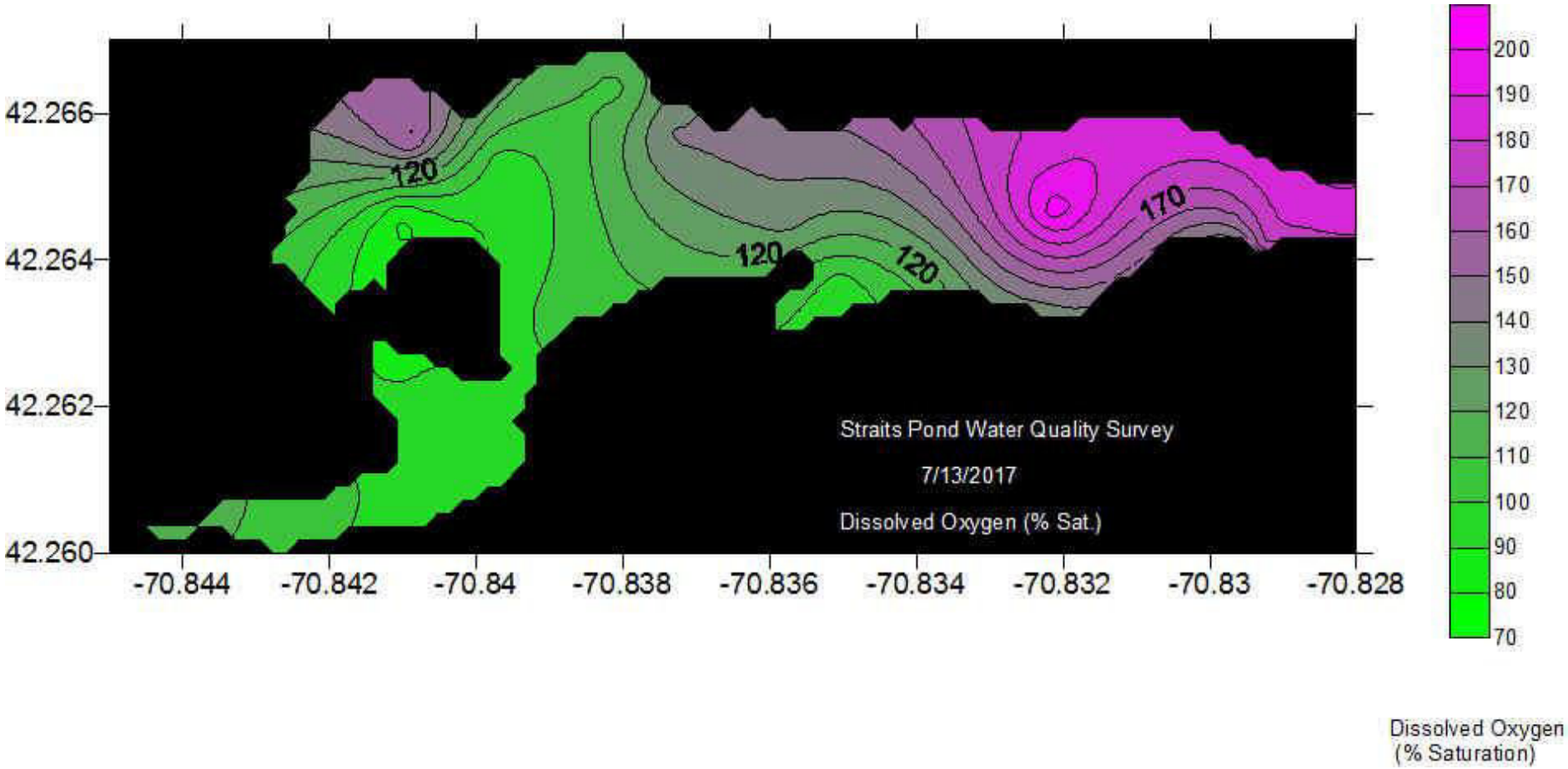


Figure 3. Spatial distribution of Temperature (°C) in the surface water of Straits Pond, Cooler waters indicated in blue.

Figure 4 shows the spatial distribution of dissolved oxygen. Here the data is presented as % saturation. If the water is 100% saturated it has all of the oxygen that it can "hold" at equilibrium with the atmosphere. You will notice that much of the water column exceeds 100 % saturation which means that oxygen is being added in excess of what can be provided by mere equilibrium with the atmosphere. Often supersaturation is an indication of primary productivity (plant growth) because plants produce oxygen (thank you) as a waste product of photosynthesis and typically pumps this oxygen into the water column.

SP water, at least during this survey, had a good deal of oxygen in it which benefits the aquatic organisms (like fish, clams, horseshoe crabs, etc) that need the oxygen to live. Much of the shallow regions of the pond in the western end had the highest levels of dissolved oxygen (> 150%)


42.266
42.264
42.262
42.260
-70.844
-70.842
-70.84
-70.838
-70.836
-70.834
-70.832
-70.83
-70.828
120
120
120
170
Straits Pond Water Quality Survey
7/13/2017
Dissolved Oxygen (% Sat.)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
Dissolved Oxygen
(% Saturation)

Ruppia sp. (widgeon grass, as it is most commonly known) was the most abundant aquatic plant observed in SP. Ruppia is a shallowly-rooted seagrass that supplies oxygen, not only directly to the water column, but into the sediment as well. For many years, SP sediment was black and anoxic (meaning it had little to no oxygen in the upper layers of sediment). The anoxic condition, along with the lower salinities observed in the recent past (~ 20 ppt) favored the larvae of midges which, when mature, became the pesky swarms of midges that most of the abutting neighbors of SP experienced before the tide gates were vastly improved. It was the flushing of SP with Boston Harbor water that raised the salinity to levels to where they are today(~30 ppt) and has prevented the colonization of midge larvae in the sediment.

Ruppia is important not only for its oxygen production, but it serves as an excellent nursery habitat for many of the desirable aquatic organisms found today in SP. Figure 5 shows Ruppia growing below the surface in SP.

Ruppia sp. in Straits Pond, July 2017

Ruppia grows vertically and at times exceeds in length the height of the water column and thus lays itself over along the top of the water, especially during low tide stages. At times this can confound the flushing of other co-occuring nuisance algae, like Cladophera (aka “hair” algae) which can form dense floating mats, or Ulva (aka Sea Lettuce) which floats in the water column. These algae, when they die off, consume oxygen through their decay and can contribute to the unpleasant odors currently being reported.

Ruppia did show signs of stress, indicated by the presence of epiphytes (small plants that grow on the surface of larger aquatic plants) which was observed on many of the stands of Ruppia in SP. The epiphytes were not analyzed, but looked to be of small single-celled brown algae, possibly the result of an intensive brown algae bloom observed over the last few months in the waters of Boston Harbor and along the coast of Massachusetts Bay.

Because of the measures taken to improve the exchange of water between SP and Boston Harbor, the marsh grass *Spartina alternaflora* is returning along the fringes of the SP shores, and displacing or replacing the strands of the invasive Phramites. Figure 6 shows the fringing *S. alternaflora* in from of a stunted or dying stand of the taller Phramites. This is another good indicator of the return of ecosystem quality of Straits Pond.

Figure 6. Fringing *Spartina alternaflora*, Straits Pond July 2017

Summary

- Straits Pond is recovering from many decades of degradation due to human activities that have resulted in contaminated sediments and excessive supply of nutrients to its water.
- Much of the recovery has resulted in improvements invested in the tide gates at the mouth of Straits Pond which has improved the tidal exchange between the pond and the Weir River Estuary.
- There is a legacy of contamination that was trapped in the sediments of Straits Pond that is now, because of the increased supply of oxygen to the sediments due in part to the proliferation of Ruppia, being released into the water column and providing fuel for the aquatic vegetation.
- Recovery is a process of which the time frame for a desirable outcome is unknown. Our observations during the survey indicate that Straits Pond is recovering faster than we (the observers) expected.
- Eels, small fish, horseshoe crabs, remnants of soft shell and razor clams, birds, and other aquatic life as well as high water clarity were observed. These conditions and aquatic wildlife were absent in SP only a few years ago. (We could see all the way to the bottom in areas among the Ruppia where the strands were absent.)
- In the meantime, problems continue, with excessive odor and nuisance aquatic plant growth. We will continue to explore ways to encourage improvements to SP's ecosystem quality through collaboration with our local and state partners.