Hummock Pond
Annual Report
2003

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Introduction:

Hummock pond is a eutrophic coastal pond located on the southwest side of Nantucket Island. Hummock is approximately 142 acres in size with a surface drainage basin of approximately 2,2227 acres and a groundwater drainage basin of approximately 2,000 acres.

The surface drainage basin extends north and east of the head of Hummock. The basin encompasses Maxy's Pond, Crooked Lane, and one third of Sunset Hill. The surface divide extends south to Academy Hill School, "Five Corners", part of Prospect Cemetery, and encompasses Burnt Swamp. The surface divide then follows the configuration of the pond to Cisco Beach extending just north of Hummock Pond Road.

The groundwater drainage basin starts north of Rams Pasture and follows in a northward direction reaching Capaum Pond. The divide stretches east to West Chester Street encompassing "No Bottom Pond" and to the southwest through Burnt Swamp, Rotten Pumpkin Pond, and Larrabee Swamp and to Cisco Beach.

Hummock Pond accumulates water during the winter and generally floods in the spring. Flooded conditions of Hummock Pond can reach Millbrook Swamp and Madaket Road. During flooded conditions, the surface area of the pond increases from 140 acres to approximately 425 acres (Kortman and Knoecklein 1994).

Hummock Pond is opened to the sea twice per year to alleviate flooded conditions and to enhance marine fisheries. In addition, pond openings decrease nutrient concentrations and remove organic matter that accumulates in the pond from the bordering wetlands. Based on nutrient concentrations, Hummock pond has impaired water quality.

Methods:

Tracy Curley and Keith Conant monitored water quality in Hummock Pond from April to November. Temperature, dissolved oxygen, salinity, secchi depth, water depth and nutrient concentrations are measured at two established sites depending on weather conditions. Nutrient constituents are processed by Envirotech Laboratories located in Sandwich, MA.

Hummock Pond has seven established sites in the pond. The four sites, which are consistently monitored, are located from the boat launch to the foot of the pond. This year sites 1, 3, and 5 were sampled.

Site 1 is located at the foot of Hummock Pond. This site is closest to the ocean and generally remains brackish throughout the year. The average depth is approximately 9ft. The bottom sediment is sand.

Site 3 is northward in a wider section of the pond. The water depth is approximately 6ft. The bottom sediment is mud.

Site 5 is located in front of the osprey nest. Water depth is approximately 6 feet.

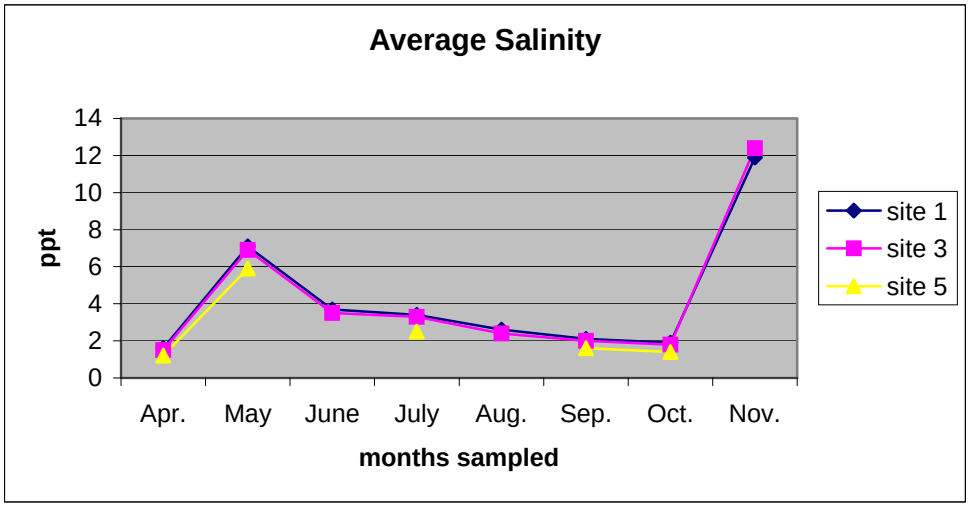
Sampling consisted of recording temperature, dissolved oxygen, and salinity at one-depth intervals. Secchi was recorded at each site. At mid depth water was taken for nutrient analysis. Nitrate, nitrite, TKN, total nitrogen, and phosphorus were calculated.

Prior to the spring opening, Hummock was approximately 3 feet higher in elevation. Hummock Pond was opened to the ocean on April 2 and October 24, 2003. The spring opening lasted 5 days and the fall opening, 4 days.

2003 Water Quality Monitoring Results

Salinity:

Hummock contained very low salinity (1.5ppt) in April prior to the spring pond opening. The pond increased in salinity to 7ppt after the opening. The length of time the pond remains open to the ocean determines the initial salinity change in the pond. This year, Hummock reached half the salinity as in past years when the pond had been open for 2 to 3 weeks. Salinity decreased throughout the summer as the pond filled with groundwater. The pond salinity was

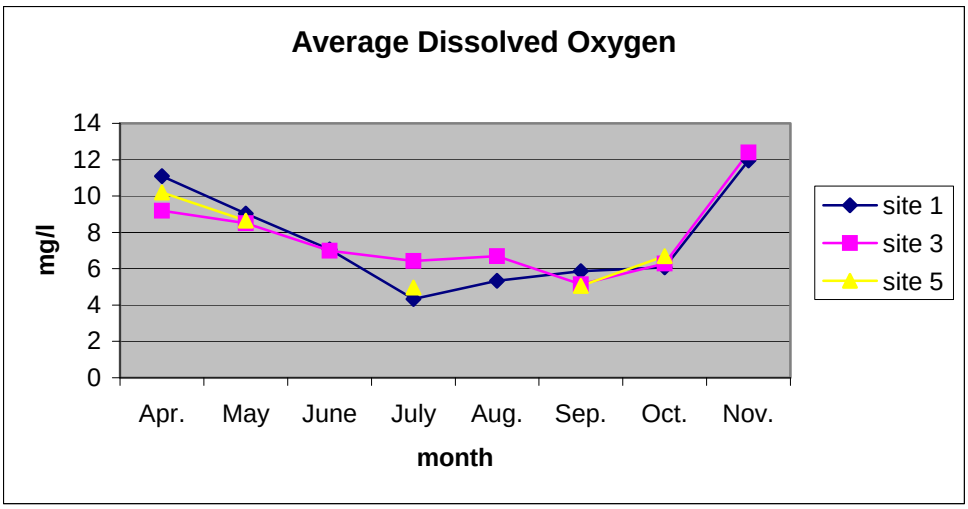


1.9ppt in October prior to the fall opening. Hummock pond, located in the outwash plains, cannot maintain saline conditions due to the physical configuration of the pond.

The recorded salinity range of Hummock was 1.2 ppt (closer to the head) to 12.3ppt (near the foot) for the water year. During the spring opening, the ocean fills approximately half the pond (site 1 to site 4). Groundwater and surface water fill the head of the pond (site 5 to site 7). A salinity gradient occurs in Hummock Pond forming a wedge. The foot of the pond retains the largest salinity while the head continues to become fresh.

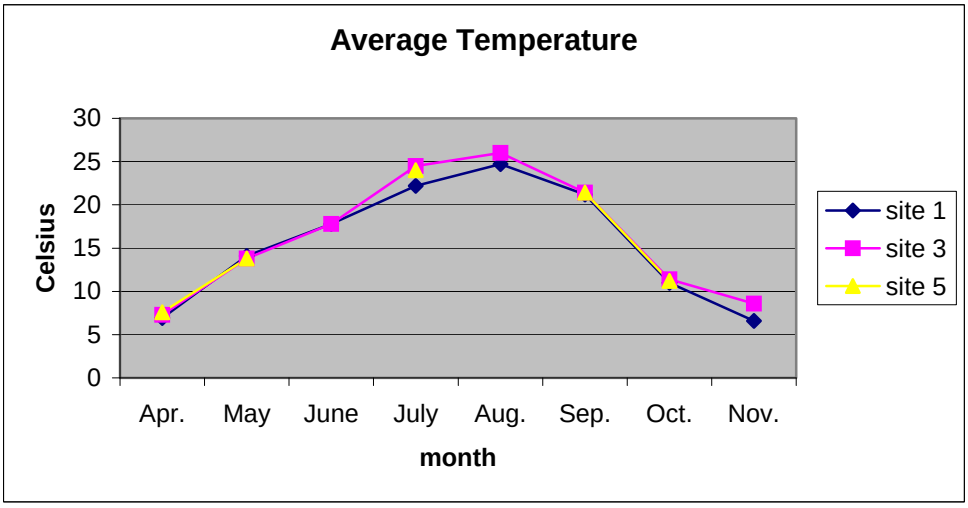
Dissolved Oxygen:

Dissolved oxygen concentrations are maximum in the winter, due to cooler water temperatures. The minimum dissolved oxygen concentrations are in July, August, and September when dissolved oxygen concentrations range between 4mg/l and 6mg/l. Site 1 and site 5 had the greatest fluctuations in dissolved oxygen concentrations probably due to salinity gradients at each site. Dissolved oxygen increases again in the fall.



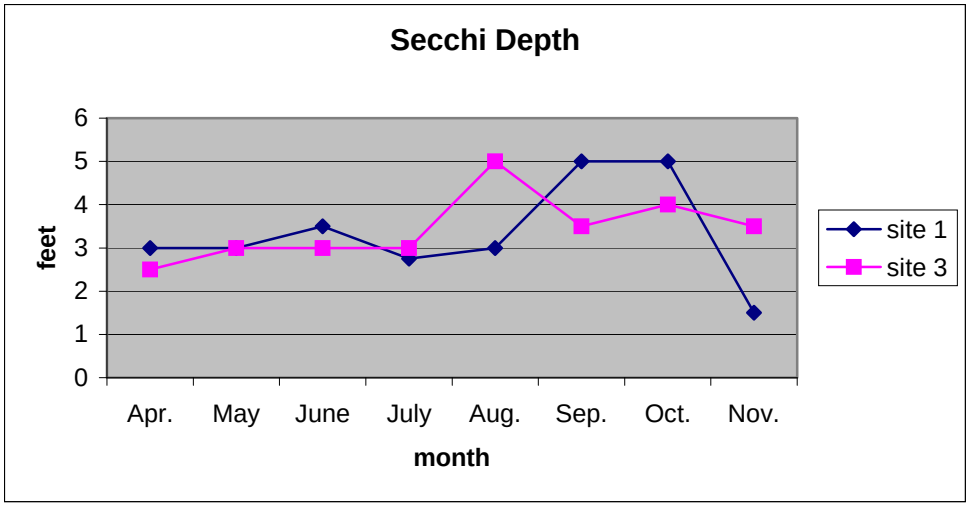
Temperature:

Hummock pond was frozen in January and February. Temperature was 2C or below. Temperature increased during the spring remaining relatively uniform vertically from station 1 to 5. Water temperature peaked in August reaching maximum average temperature of 25C. Temperature cooled in the fall following the annual temperature curve. Temperature decreased each subsequent month to reach average temperature of 7C, the last month sampled.

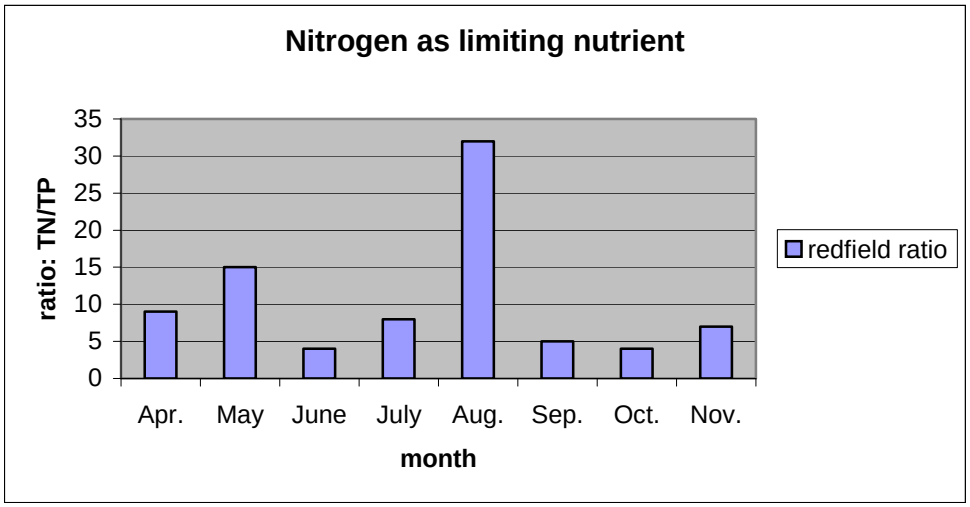


Secchi Depth:

Secchi depth ranged from a low of 1.5 feet in November to a high of 5 feet in August (site 3), September (site 1) and October (site 1). Secchi depth was high in August at site 3 when phosphorus concentrations (0.007mg/l) were at a minimum. Nitrogen was the limiting nutrient for all months sampled except August. Secchi depth was high at site 1 in September when phosphorus concentrations were low (0.083mg/l). Secchi depth was also high in October at site 1 when both nitrogen and phosphorus concentrations were high, 0.47mg/l and 0.115mg/l respectively.

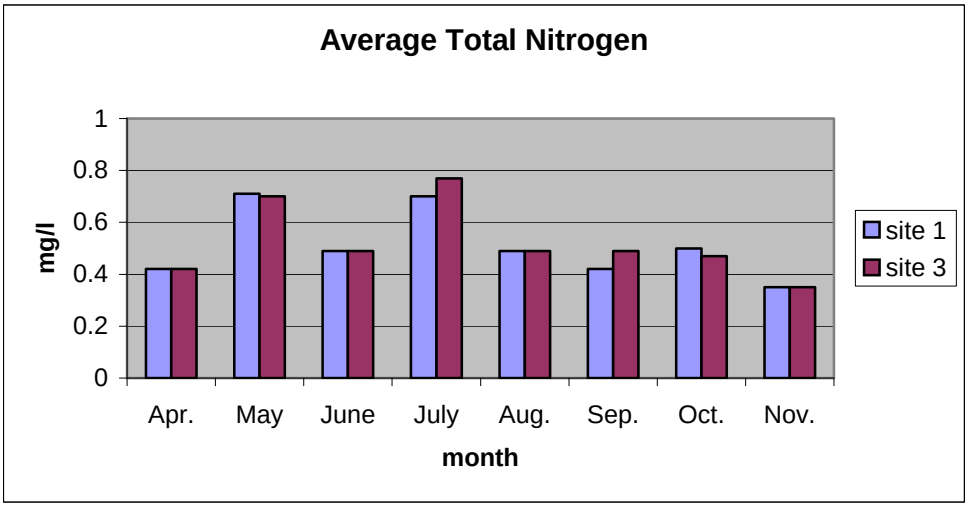


The Redfield ratio was calculated for the composition of sites 1 and 3. At ratios less than 16 suggest that addition of inorganic nitrogen will stimulate phytoplankton production. In August and possibly May, the limiting nutrient for phytoplankton production was switched from nitrogen to phosphorus.



Total Nitrogen:

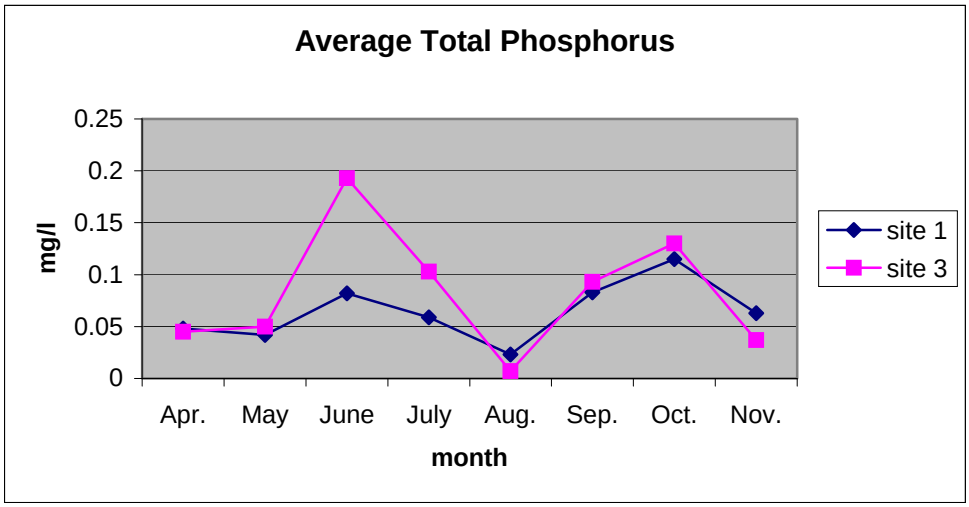
Total nitrogen above 0.7mg/l is eutrophic. Total nitrogen was below eutrophic conditions for month sampled with the exception of May after the pond opening. In May, the nitrogen:phosphorus ratio was 15, close to being phosphorus limited.



Total Phosphorus:

Average total phosphorus ranged from a low of 0.007mg/l in August to a high of 0.193 mg/l in June. The typical range for phosphorus has been 0.010 mg/l to 0.11 mg/l. Phosphorus is generally lower in the spring and increases in the summer. Generally phosphorus is in the greatest concentration prior to fall opening. This year phosphorus peaked twice, once in June and again in October.

Nitrate:



Nitrate nitrogen followed the identified bi-modal trend with a peak in May/June and in October. Nitrate was below detection for remaining months sampled. The spring peak occurred prior to the spring opening this year. The fall peak occurred later this year than previous years but prior to the fall opening.

Conclusions:
It is unclear whether opening Hummock Pond improves water quality based on the following conclusions for water quality data in 2003:

1) Hummock pond is generally nitrogen limited with the exception of August.
2) Dissolved oxygen is highest prior to spring opening in April.
3) Organic nitrogen was highest in May and in July.
4) Inorganic nitrogen in highest in May, June, and October and non-detect the other months.
5) Total nitrogen was highest in May and July.
6) Secchi depth is highest in the fall and lowest in April and July.
7) Dissolved oxygen was highest prior to spring opening and after fall opening.
8) Dissolved oxygen was lowest after the opening and during the summer.

After the spring opening, water quality decreased. Nitrogen increased while phosphorus remained static. Hummock may have received an input of nitrogen from the ocean. Nitrogen is incorporated into the plant tissue during the growing season. This was demonstrated in May when Hummock pond appeared to have an algal bloom. Evidence of the algal bloom was based on visual inspection, nitrogen concentration, secchi depth and dissolved oxygen levels. Nitrogen reached eutrophic levels in May and July. The water column cleared once during the sample year, at site 3 in August and at site 1 in September. After the fall opening, secchi depth dropped significantly again at site 1 indicating either an increase in turbidity or import of plant material. Dissolved oxygen levels increased after the fall opening and as a result of colder water temperatures, reduced nitrogen and phosphorus.

Opening Hummock Pond may not improve water quality or marine fisheries. Opening Hummock Pond for flood control at this point appears to be the only tangible reason to open the pond. Further investigation of ocean water quality conditions prior to pond openings should be determined.