UCONN | COLLEGE OF LIBERAL ARTS AND SCIENCES
DEPARTMENT OF MARINE SCIENCES

Where Does the Oxygen Go?
Sediment Analysis in Wequetequock Cove

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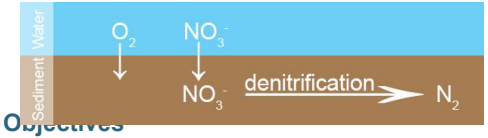
Background

Coastal sediments accumulate organic debris from the marine environment, which is then decomposed by bacteria in the sediments. Bacterial decomposition consumes oxygen and nitrate found in the water above (Hanne et al.,1992). By measuring oxygen consumption in Wequetequock Cove, we can determine the impact of the bacterial community on night time oxygen consumption. Additionally, microbes in the sediments convert nitrate (NO_3^-), a plant nutrient, into inert nitrogen gas (N_2) as part of its respiration process (Cameron et al. 1985). This conversion, also known as denitrification, improves the health of the system by reducing the amount of usable nitrate available for plant growth (Davis et al. 2004).



Objectives

a. To measure oxygen consumption of sediment in Wequetequock Cove in order to gauge the oxygen demand of the bacteria.
b. To measure the sediment denitrification rate to gauge how much nitrate is taken out of the system by the bacteria.

Methods

1. Six sediment cores were collected in October 2015 and again in 2016.
2. Cores were incubated in oxygen tight chambers in a water bath at a constant 20°C with gentle agitation of the overlying water. In 2015, nitrogen (40 µM) was added to the overlying water in order to estimate the nitrate demand.
3. Cores were sacrificed at incremental time points over a 24 hour period in both years, oxygen was measured, and water samples were collected for nitrate analysis.
4. Nitrate analysis was performed on SmartChem instrument.

Results

- The concentration of dissolved oxygen in the overlying water decreased at continually for 2015 and 2016 incubations (figure 1).
- Oxygen decreased by 0.093 ppm/L/hour in 2016 and 0.048 ppm/L/hour in 2015 (figure 1,table 1).
- Nitrate uptake for 2015 data equaled 2.2 x 10^{-3} ppm/L/hour (figure 2, table 1).
- Nitrate uptake corresponded to 40% of the total nitrate removed from the system.
- Oxygen uptake by sediment corresponded to ~1.63 ppm/ hour, accounting for only 5% of the oxygen consumption.
- Sediment denitrification could consume upwards of 0.5 ppm of nitrate over 24 hours. The average total dissolved nitrogen (TDN) concentration in the water in summer mornings is ~0.125 ppm. Thus, denitrification could remove up to ~40% of ambient TDN concentrations daily.

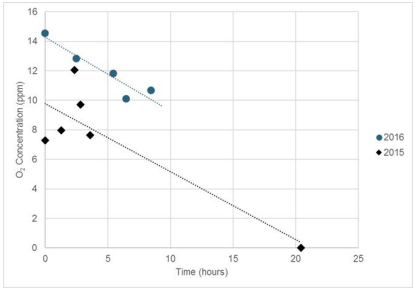


Figure 1. Rates of oxygen consumption for the years 2015 and 2016, given in parts per million over time in

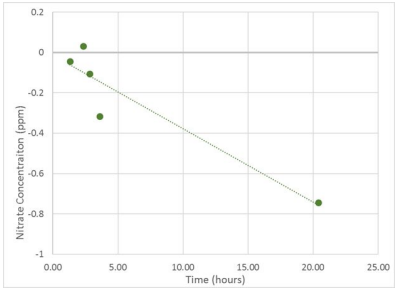


Figure 2. Nitrate concentrations in 2015 released by sediment cores given in parts per million over time in hours.

Photo of cores and core sampling devices

Year	Substance	Rate (ppm/L/hour)
2016	Oxygen (O_2)	0.048
	Oxygen (O_2)	0.093
2015	Nitrate (NO_3)	2.2e^-3

Table 1. Rates of oxygen and nitrate consumption for 2016 and 2015 given in ppm/L/hour.

Discussion

The total oxygen uptake by sediments in Wequetequock Cove amounts to only ~5% of overall night-time biological oxygen consumption, thus is not a sizeable oxygen sink.

Oxygen consumption by Wequetequock Cove sediment is similar to rates typically observed in coastal New England (Thurman et al. 1990).

Nitrate uptake by sediments results in sizeable removal of nitrate from the water, accounting for ~40% of ambient nutrient nitrogen (as TDN). However, these nitrate removal processes do not impact overall oxygen consumption.

In conclusion, sediment oxygen uptake and denitrification processes do not have a significant impact on the night time oxygen budget in Wequetequock Cove.

References

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