PHYTOPLANKTON ABUNDANCE AND SEASONAL CHANGE IN RESPONSE TO UTILIZATION BY A HIGH DENSITY MUSSEL CULTURE SYSTEM, SOUTH PUGET SOUND, WASHINGTON, USA

AIMEE CHRISTY*, DANIEL P.CHENEY, ANDREW SUHRBIER, HECTOR BELTRAN

Aimee Christy
Pacific Shellfish Institute
Aimee@pacshell.org

ABSTRACT

Suspended mussel and oyster culture currently produces approximately 3 million pounds live weight on the US west coast. The growing popularity of floating aquaculture systems in Puget Sound warrants an investigation into how these structures interact with the surrounding environment. A two-year study is underway to evaluate phytoplankton abundance and seasonal change within and surrounding a mussel raft farm (*Mytilus edulis galloprovincialis*) in Totten Inlet. First year results indicate diatom concentrations peaking in spring with dinoflagellates increasing in late summer. Phytoplankton abundance was on average 56.3% lower in the center of the raft than the leading edge during incoming tides. Further data suggests that feeding effects on phytoplankton are localized and largely confined to the immediate raft vicinity. Despite reductions in phytoplankton abundance within the mussel unit, mussel yields were ultimately uniform throughout the system.

OBJECTIVES

1. Evaluate phytoplankton species and seasonal abundance in Totten Inlet
2. Determine how phytoplankton abundance changes as currents flow through the mussel raft
3. Compare phytoplankton abundance within the raft structure to mussel yields

METHODS

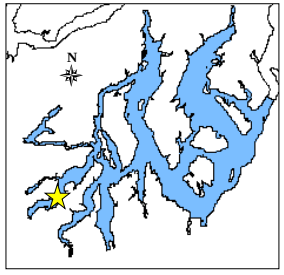
Research was conducted on one of eight suspended mussel rafts located in Totten Inlet in southern Puget Sound. Seawater samples were collected for phytoplankton analysis from March to September, 2002 using a programmable water sampling unit (ISCO® Model 6712) or manually collecting samples with a Niskin bottle.

ISCO® Model 6712

Water quality parameters (temperature, dissolved oxygen, salinity, chlorophyll, pH) were measured in and around the mussel raft every half hour using automated in-situ data loggers (YSI 6600) lowered to a depth of 2.5 meters. Six acoustic doppler velocimeters (ADVs) were deployed to measure water current speed and direction within and surrounding the immediate mussel raft system.

Aimee Christy at microscope

Phytoplankton identification and cell quantification (cells/L) were performed in the laboratory using an Olympus Inverted Research Microscope Model IMT-2



Totten Inlet, southern Puget Sound

Phytoplankton bloom passing through mussel farm from north to south

Raft comprised of six sub-units chained together

RESULTS

Phytoplankton displayed trends typical of cold temperate regions with chain-forming diatoms blooming in spring, sustained throughout the summer and giving rise to dinoflagellate species during periods of stratification in mid to late summer.

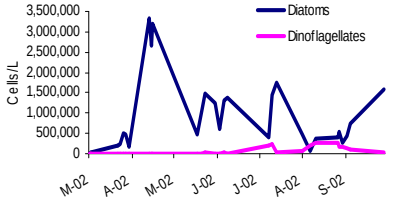
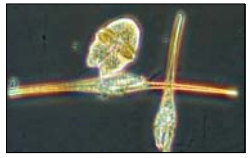


Figure 1. Seasonal Phytoplankton Abundance

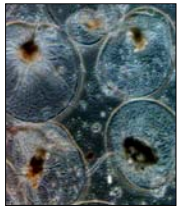
Chaetoceros spp. were the dominant species in the peak spring bloom comprising 91% of total phytoplankton. Three smaller blooms followed containing large numbers of *Chaetoceros spp*. and *Eucampia zodiacus.* At the height of the dinoflagellate bloom, *Akashiwo sanguinea* and *Ceratium fusus* constituted 36% and 21% of total phytoplankton, or 55% and 32% of total dinoflagellates.



Ceratium fusus & Akashiwo sanguinea

Eucampia zodiacus

Chaetoceros spp.



Noctiluca scintillans

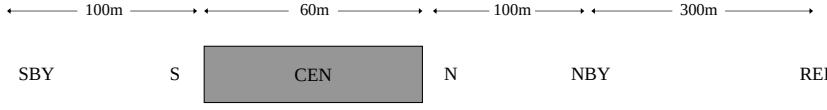


Figure 2. Diagram of Mussel Raft Transect (not drawn to scale)

Samples were collected at 2.5 meter depth along a transect comprised of the following stations: reference (REF), north buoy (NBY), north edge (N), raft center (CEN), south edge (S) and south buoy (SBY).

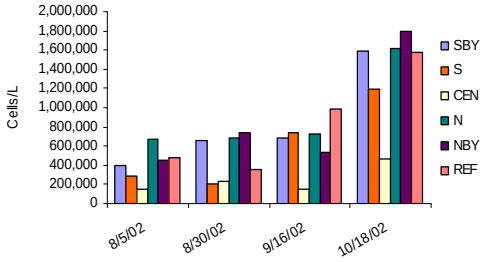


Figure 3. Phytoplankton Abundance Along Mussel Raft Transect

As water travels through the raft from north to south, feeding mussels reduce the amount of phytoplankton within the water column. During incoming tides, total phytoplankton concentrations were 56% lower at the center of the raft compared to the leading edge (p=.00015). Phytoplankton concentrations at the south edge were 33% lower than the north edge (p=.00126), whereas no significant decline was found 100 yards beyond the trailing edge (p=.22783).

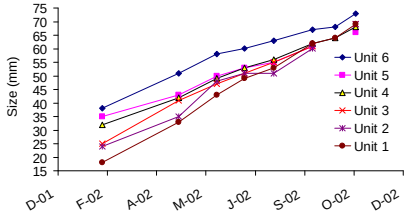


Figure 4. Cumulative Mussel Growth by Length
Despite reductions in phytoplankton abundance within the mussel unit, mussel yields were ultimately uniform throughout the system.

CONCLUSIONS

1. Phytoplankton demonstrate seasonal trends typical of Puget Sound with diatoms blooming in early spring, persisting to a lesser degree through the summer and giving rise to dinoflagellates in late summer.
2. Feeding effects on phytoplankton are highly localized and largely contained in the immediate raft system.
3. Despite reductions in phytoplankton abundance within the mussel unit, mussel yields were ultimately uniform throughout the system.

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