Fecal Coliform Bacteria Populations on Inter-tidal Sediment in Oakland Bay 2007-10

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Oakland Bay (Shelton, Washington) is a shellfish harvest area of tribal and national significance. A portion of the upper bay near monitoring station DOH 614 is currently closed to harvest during the summer months because of elevated fecal coliform (FC) concentrations in the water column. This phenomenon was particularly acute during the summers of 2005 and 2006 (see chart).

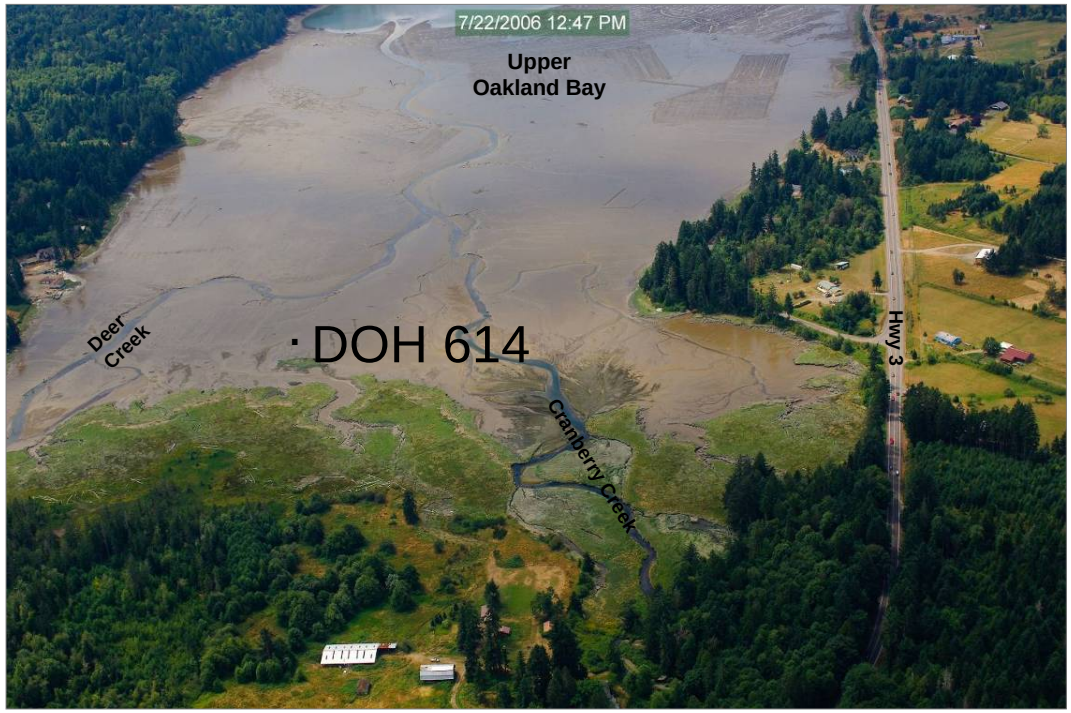
The absence of typical stormwater-driven, nonpoint pollution transport mechanisms during the summer has led to the development of an alternative hypothesis for the observed bacteria. It is that wind-driven wave action re-suspends bacteria resident on inter-tidal sediment surfaces into the water column. This phenomenon is strongest in the late summer months when FC populations on the sediment surface peak (see chart) and is enhanced by the SW-NE geographic orientation of Oakland Bay. A 2008 draft TMDL technical report completed by the Department of Ecology confirmed this observation though independent means.

One interesting aspect of the bacteria population dynamics is that while the FC numbers are highest at the end of warmest period of the summer, their numbers tend to linger at elevated levels through the end of the year. The lowest FC counts are not found until early spring.

Survival of FC outside of mammalian digestive tracts is enhanced in nutrient-rich environments. So, there may be some association between sediment bacteria population levels, marine snow cycles and dissolved inorganic nitrogen (DIN) concentration in the water column. Highest DIN levels are found at the end of the year just after the peak of plankton activity and after salmon spawning season (see chart).

The question remains as to the source of the summer bacteria and whether they replicate or merely accumulate on sediment surfaces. Data from a laboratory microcosm experiment simulating environmental conditions in Oakland Bay suggests that that FC do not live long on the sediment surface (see table). If this is true, accumulation from some unidentified source must continue throughout the summer months since there would be very little replication.

Accumulation is enhanced by winter sediment transport because only 1/4 to 1/3 of FC entering upper Oakland Bay from creeks like Deer and Cranberry are free-floating. Two-thirds to 3/4 of FC move in association with, or attached to, sediment particles (see table). This data supports a 2008 TMDL implementation recommendation to eliminate suspended sediment output at creek mouths as an important bacteria remediation strategy.



Microcosm Results

Sediment FC (MPN/100 gr DW)	*Day 0*	*Day 3*	*Day 7*	*Day 14*	*Day 21*
Geomean	4523	586	43	12	13

FC Transport Mechanism

Creek Mouth	*Range (cfu/100 ml)*	*Sediment-attached (w)*	*Free-floating (wo)*	*TSS (mg/L)*
Deer Creek	w: 26-320 / wo: 6-92	68%	32%	8.5
Cranberry Creek	w: 26-63 / wo: 4-12	76%	24%	12.5