Center for Coastal Margin Observation & Prediction
Science Brief
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Are microorganisms signaling change?

ISSUE

The Columbia River estuary is commonly considered to represent a detritus-driven, heterotrophic ecosystem characterized by low primary productivity due to high turbidity and light limitation, which hinders photosynthesis. Yet for at least a decade, extensive patches of intense, vivid red-colored water have been anecdotally observed in late summer in the lower Columbia River estuary. The questions arise as to what organism is responsible for the red-water blooms, why they occur in the estuary while populations of other phytoplankton are not established, and what is the impact of the blooms on the Columbia River estuary ecosystem?

APPROACH

Lydie Herfort, Ph.D. and colleagues collected water in and out of the red water patches during the 2007 and 2008 bloom periods and in Ilwaco harbor in Baker Bay on the Washington bank of the Columbia River estuary in June-July 2009. Total DNA from the samples was extracted and the sequences of cloned 18S and 16S rRNA genes were determined to identify eukaryotic microbial taxa. This was accompanied by microscopic examination of microbial cells. Traditional ecological and molecular approaches were use to examine whether correlations in the measured physical, geochemical, and biological parameters exist. The interpretation of the results was guided by 3-D circulation models of the estuary.

This aerial photograph taken in 2008 shows a Myrionecta rubra bloom in the Columbia River estuary. Photo courtesy of Alex Derr

FINDINGS

Herfort et al. have shown that these red water blooms were the result of surface aggregation of a large number of *Myrionecta rubra* cells, a non-toxic bloom forming ciliate with the unique ability to steal chloroplasts and nuclei from cryptophyte algae, a process known as karyoklepty. Their data also suggest that *M. rubra* preys on the same species of cryptophyte each year and that its blooms have an important impact on the Columbia River estuary carbon and nitrogen pools.

The researchers have uncovered evidence that *M. rubra* enters the estuary from an oceanic source, and that *M. rubra* blooms first develop in Ilwaco harbor, where the ciliate acquires cryptophyte plastids before being transported on the flood tide into the Columbia River estuary main channels. These blooms are likely due to a combination of factors: (1) the ciliate has a wide tolerance range for temperature and salinity, (2) its Cryptophyte prey is well adapted to grow in dim, organic rich and recirculating intertidal environments such as Ilwaco harbor, and (3) *M. rubra* is able through "jumping" motility and phototaxis to propagate and partially maintain its populations in the estuary and thus, avoid being fully transported out to the plume.

IMPLICATIONS

M. rubra has been identified as a potential sentinel for environmental change in the Columbia River estuary and CMOP investigator Yvette Spitz is currently developing a *M. rubra* ecological model that will help determine the key parameters to *M. rubra* success in the Columbia River estuary.

MORE

Herfort et al. manuscript describing this work has been submitted to a peer-reviewed journal. This work was a cooperative, interdisciplinary CMOP effort involving scientists with expertise in the fields of molecular biology, biogeochemistry, microbial ecology and modeling.

CMOP
Center for Coastal Margin Observation & Prediction

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