Title

Physical, chemical, and biological factors shaping phytoplankton community structure in King Harbor, Redondo Beach, California

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Physical, Chemical, and Biological Factors Shaping Phytoplankton Community Structure in King Harbor, Redondo Beach, California

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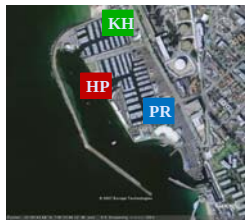
Introduction: Microalgal Blooms in Coastal Marine Environments

Assisting Municipalities in Understanding Microalgal Blooms

- **Chemical/physical environmental factors**
  Nutrient concentration & distribution, Stratification
- **Biological controls**
  Photosynthetic efficiency, Grazing, Vertical migration
- **Physical processes**
  Tidal forcing, Convergence zones, Physical barriers

High degree of spatial & temporal heterogeneity

Difficult to continuously study suite of factors simultaneously



King Harbor, Redondo Beach, CA

- **Small, semi-enclosed urban harbor**
  - Shallow marina basins (5m)
  - Restricted exchange with Santa Monica Bay
  - Strong tidal forcing (1-2m)
- **Site of recurring Red Tides in 2005, 2006**
  - Dinoflagellate and Raphidophyte dominated
  - Rapid compositional changes
  - **Relationship between tidal cycle, nutrient availability, and chlorophyll biomass**

Problem Description: Combined ENS and Human-mediated Sensing and Sampling

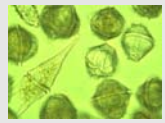
NAMOS Network in King Harbor

Sensor-equipped buoys, robotic boat, and dock-based winch system provide multiple scales of spatial and temporal data.

In situ Studies of Plankton Dynamics

Heterosigma akashiwo

Prorocentrum micans



Lingulodinium polyedra & Ceratium sp.

Alexandrium catenella

Intensive studies of the relationships between the physical/chemical environment and biological/physiological measurements provide more details

Proposed Solution: Multiple Modes of Sensing Reveal Relationships between the Biological and Physical Environment

NAMOS provides contextual environmental data.

- November 2008 bloom of dinoflagellate, *Akashiwo sanguinea*
  - Pronounced in King Harbor marina
  - Less growth at Harbor Patrol, Port Royal marina locations
  - Captured full range of bloom initiation, peak, and demise.

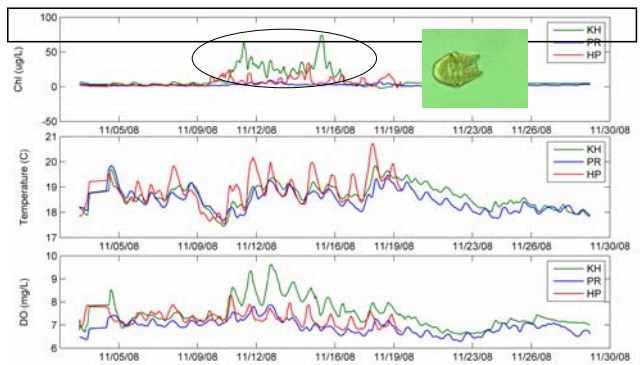
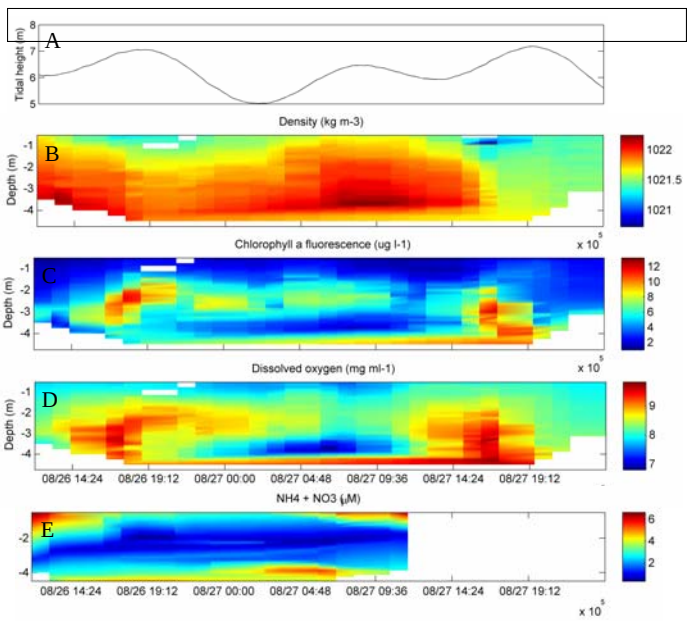


Figure 1: Time-series plots of chlorophyll fluorescence (top), temperature (middle), and dissolved oxygen (bottom), in King Harbor, Redondo Beach, during a bloom of the dinoflagellate, *A. sanguinea*, in November 2008. Green lines denote the King Harbor marina dock location (KH), in the north corner of the upper marina basin. Red lines denote the Harbor Patrol dock location (HP), near the entrance to the lower marina basin. Blue lines are data from a sensor placed in the Port Royal marina (PR), in the back corner of the lower basin.



Important role of tidal cycle in King Harbor

- Water column stratification
  - Introduction of low density seawater during ebb tide
- Highest surface nitrogen concentrations (NH_4 + NO_3) during ebb or low tide
  - Introduced via stormwater drainage?
- High N concentration at depth following low tide
  - Resuspension of nutrients from sediments

Phytoplankton growth and distribution

- Highest chlorophyll *a* fluorescence (and dissolved oxygen from photosynthesis) during late afternoon, flood and high tide
- Consistent population at 2-3m depth
- Do these distributions reflect *in situ* growth of the population?
  - Or are populations moving in via advective processes?
- Coming soon: harmonic analysis of multi-month time series to extract tidal signal from phytoplankton distribution

Figure 2: Water column data from a dock-based winched sensor package and discrete samples in King Harbor marina over an 18h period, 26-28 Aug 2008. (A) Tidal height (B) Seawater density (determined mainly by temperature, salinity changes) (C) Chlorophyll flurescence. (D) Dissolved oxygen. (E) Inorganic nitrogen concentration (NH_4 + NO_3 +NO_2)