

SMS 491/ EDW 472

Nitrate dynamics in an estuary  
Case study: Elkhorn slough

(This activity is modified after: *Adams L. G. and G. I. Matsumoto. 2007. Investigating coastal processes and nitrate level in the Elkhorn slough using real-time data. Oceanography 20:200-2004*)

Polluted runoff is thought to be a primary threat to the health of the delicate ecosystem of Elkhorn Slough (Monterey Bay, California). Growing population and agricultural areas are potentially a large source of that runoff. You were hired by the Elkhorn Slough Foundation to identify sources, pathways, and processes that are likely to affect nitrogen concentrations in the estuary, in order to help Elkhorn Slough's watershed managers to develop a management program to address nitrogen source pollution. To your aid are data collected by an array of moorings located throughout the slough (see attached map; data will be provided to you in class).

Prior to next class (April, 11) you are asked to:

1. Read ONLY the introduction and method section of the provided article (Chapin et al. 2004, *Estuaries*, 27:882-894).
2. Make yourself familiar with the map of the area and the location of moorings
3. Make yourself familiar with the area by visiting:  
<http://www.nerrs.noaa.gov/ElkhornSlough/welcome.html>  
(Please read the introduction and the cultural history page)

In preparation for your investigation, use the reading material and your general knowledge in Oceanography to address the followings (can work in teams but every student has to reflect in her/his own journal):

- Define the problem to be investigated
- Describe the study area
- Hypothesis what processes may affect nitrate concentrations and transport in the estuary
- Describe (briefly) the method for nitrate measurements and discuss some of the problems associated with the method (Chapin et al., 2004).

## CLASSROOM ACTIVITY

As we practice the case study (below) in class, think about the following questions. We will discuss them in a follow-up class on Thursday.

- What makes a good case study in science teaching?
- How does an instructor write a case study for a science course?
- In what formats can a case study be taught in a science course? (e.g., discussion format)
- What are some pluses and minuses of the case study approach?

Guiding questions and activities for the Elkhorn slough case study:

- What do you know about this area?  
(Geography, hydrology, ecology, history)
- Who are the stake holders in the area? What are some of the conflicts in the area?  
(Socio-economical aspects: environmentalists, farmers, developers)
- What processes may affect nitrate concentrations and transport in the estuary
- What are some the potential problems associated with the eutrication of an ecosystem?

Use the map of the area (a map can be found at <http://www.mbari.org/lobo/network.htm>) to predict the origin and pathways of nitrate in the slough. Use different color pencils to represent the natural sources and the anthropogenic sources.

Locate the buoys on the map:

Buoys L01-L05 are all located at areas that are heavily farmed, however buoys L01, L02, L04 and L05 are located within the boundaries of the Natural Estuarine Research Reserve system, which is tightly regulated whereas buoy is located in the Old Salinas river, a heavily farmed area with a less tightly regulation.

Buoy LML is located in Moss Landing Harbor and buoy M1 is located off shore from the estuary, in Monterey Bay.

Go to <http://www.mbari.org/lobo/loboviz.htm> where you can find real time data from the different buoys. You will be using these data to evaluate sources and pathways of nitrate in the Elkhorn slough.

Below are pointers that will help you in your investigation (Instructions on how to use the program are given in class):

- Compare the ranges of nitrate concentrations measured by the different buoys (using all data available).

- Is there a relationship between precipitation and nitrate levels ? (for precipitation look at CIMIS weather stations CASTROV-WX (# 129 on your map) and/or PAJARO-WX (# 19 on your map))
- Examine daily and seasonally fluctuations of nitrate in this ecosystem and the processes that may affect these fluctuations.

Plot: nitrate, water depth, salinity and temperature measured at buoys L01, L02 and L03 during 2006 for the following dates: January 9-14, March 9-14, June 9-14 and September 9-14.

1. Do you see any rhythmic and consistent pattern in your graphs?  
If yes, how would you explain this pattern?
2. Are there differences in the trends observed between the different months? Which month in your data set varies most?
3. Examine carefully the dynamics on June 9-14, 2006. You may notice two peaks of nitrate per day (for some days). Do these peaks derive from the same source?

Based on your finding redraw your map of how nitrate enters and circulate through the slough and write a brief report to the Elkhorn Slough Foundation that summarizes your results. In your summary, comment on sources and pathways of nitrate and potential problems associated with the available data.

- Group presentation of reports.