Why is the Benthos Important?
OR
Pre- and Post- Salt Pond Restoration Assessment of Benthic Communities in South San Francisco Bay

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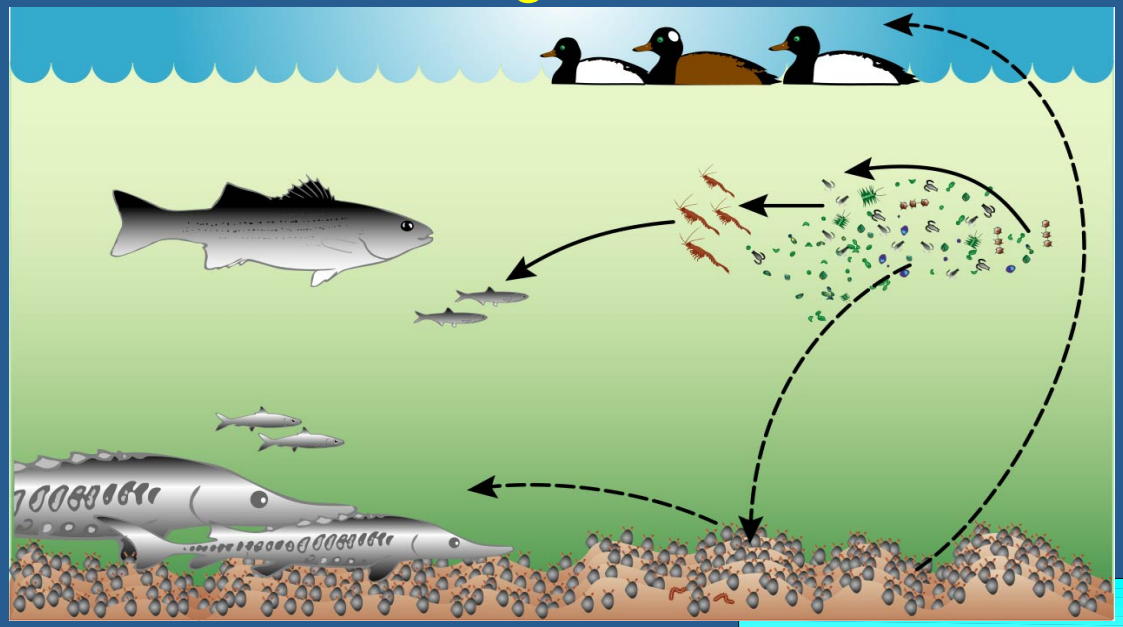
Menlo Park, USGS

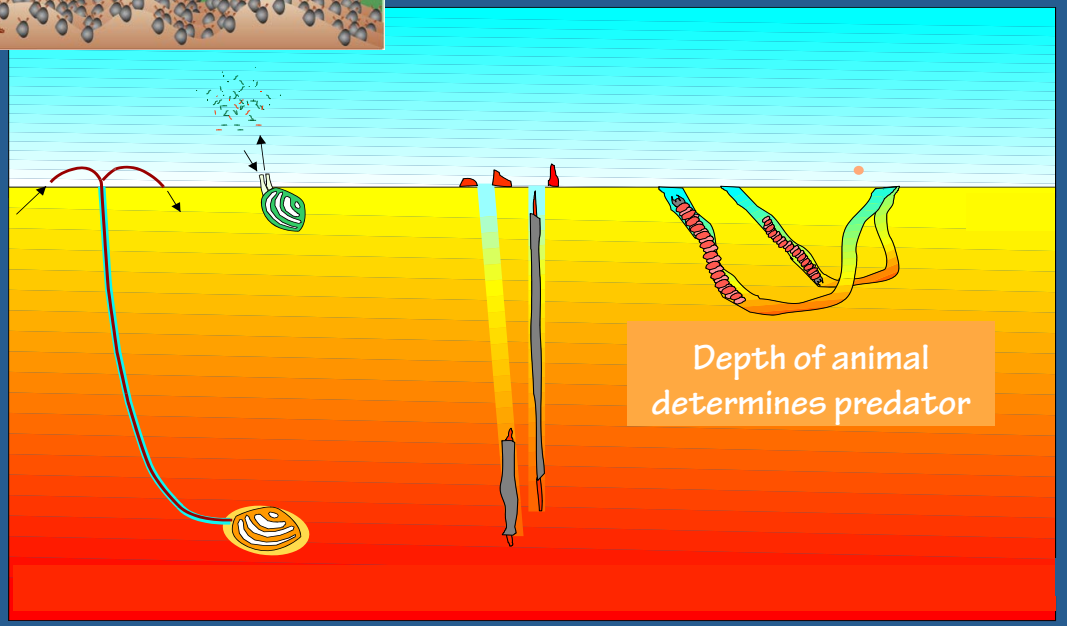
Benthic communities integrate ecosystem processes over wide spatial and temporal scales

- Therefore benthos are a critical part of the ecosystem that can help us understand if ecosystem function has changed.
- Preliminary results: an example of how a change in relative abundance or change of species can change function of the community.

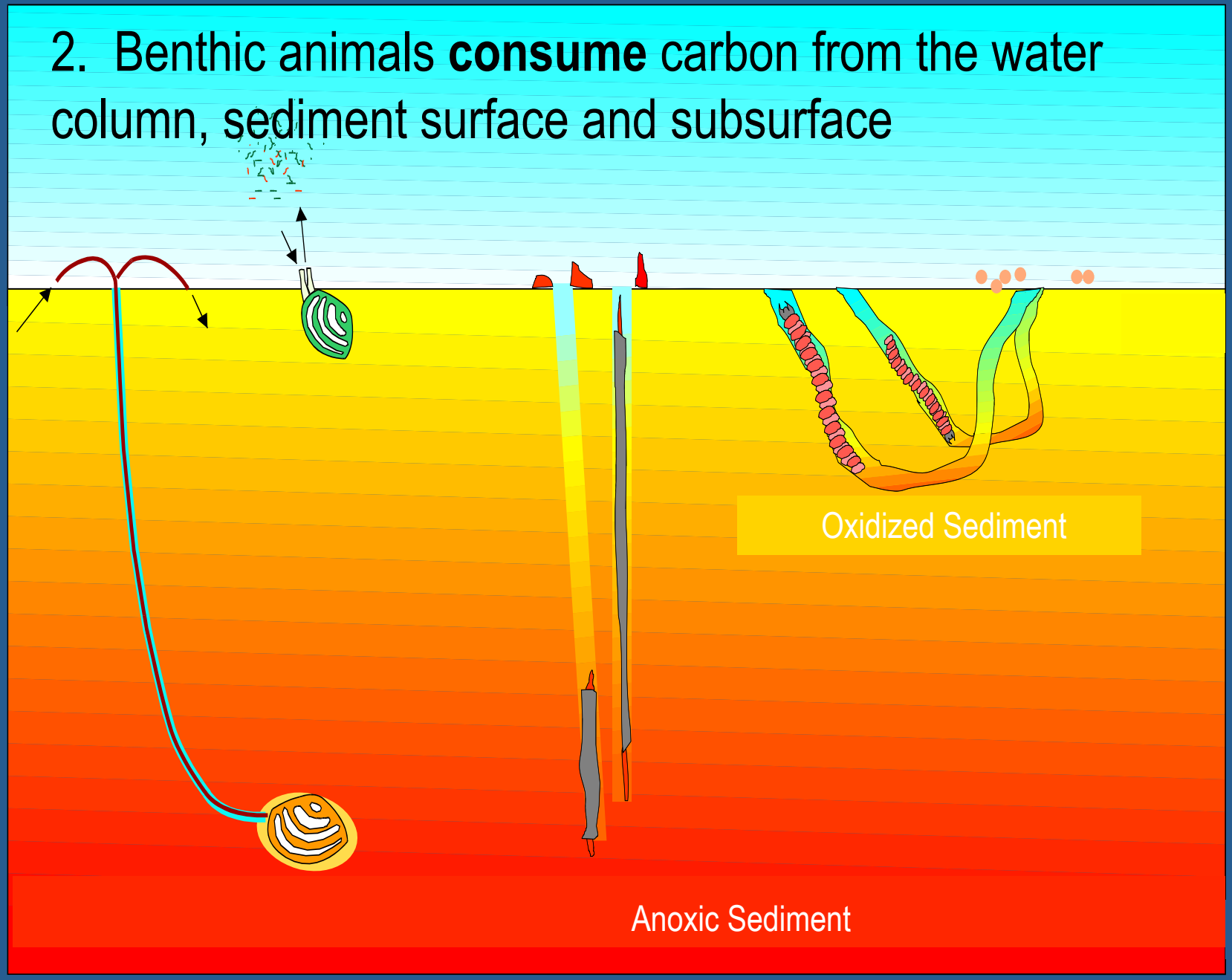
To start - What is the ecosystem function of the benthic community?

1. Benthic animals are important prey in the subtidal and intertidal regions

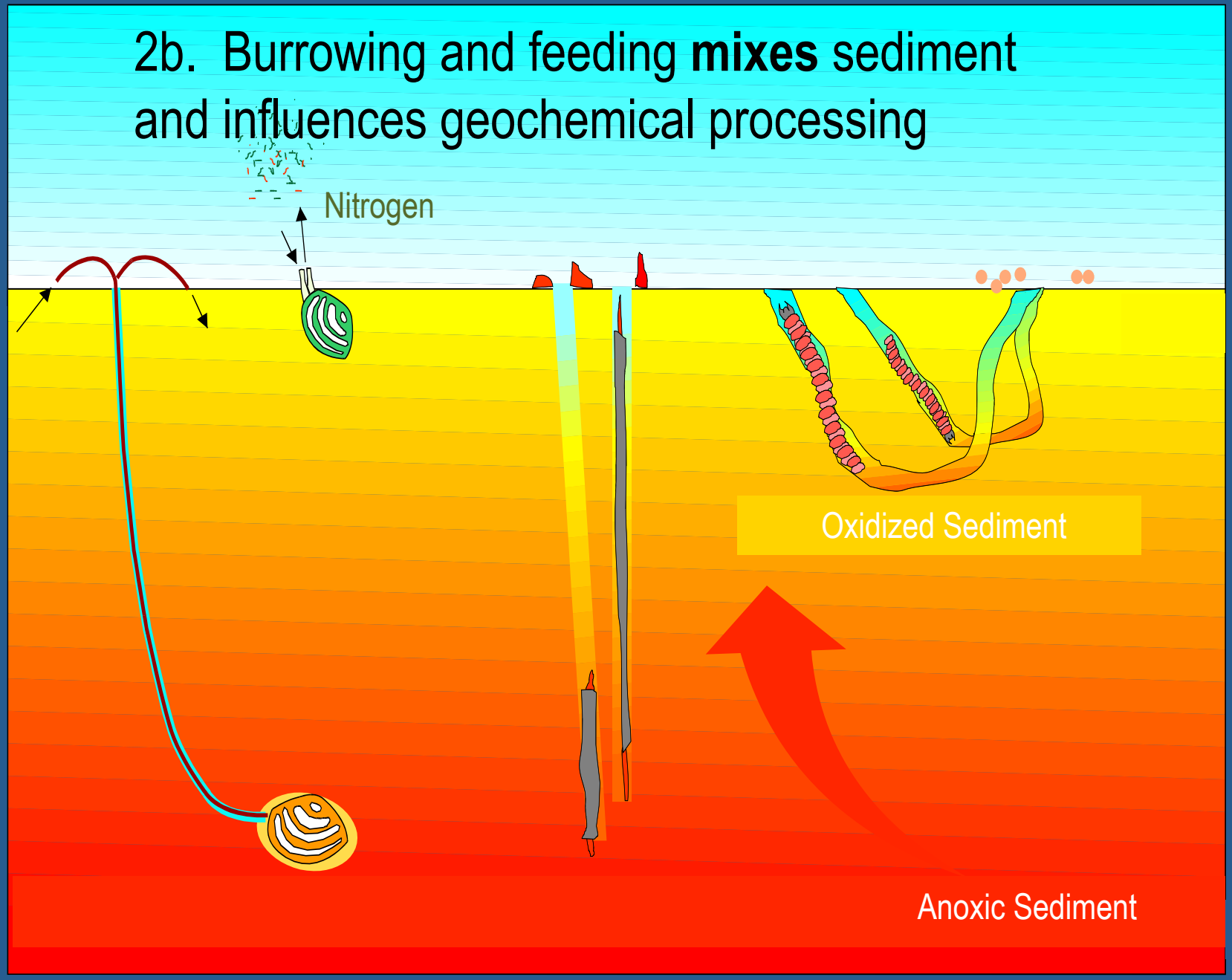




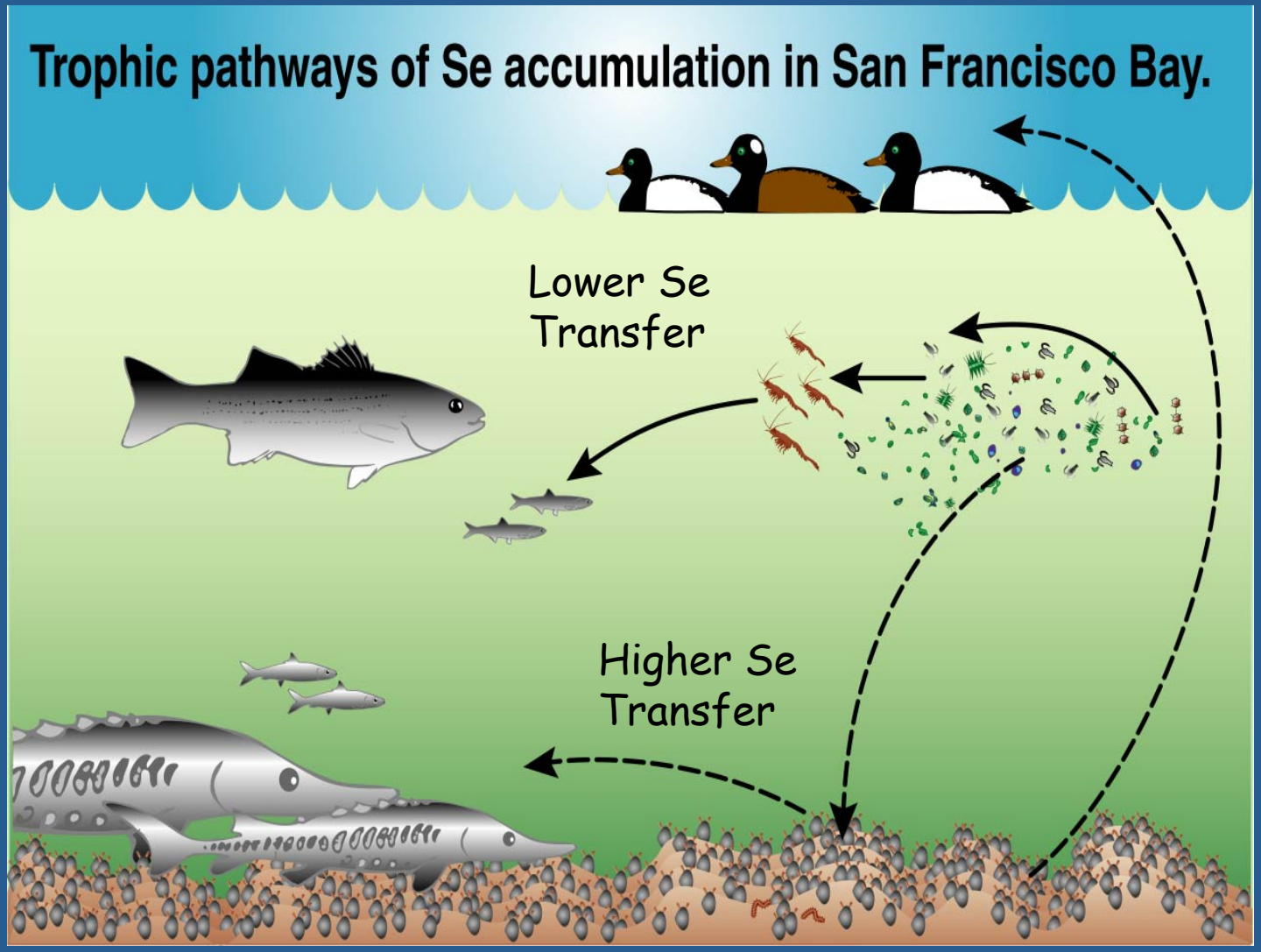
2. Benthic animals **consume** carbon from the water column, sediment surface and subsurface



2b. Burrowing and feeding **mixes** sediment and influences geochemical processing



3. Benthic animals are a vector for contaminants into the food web.



Courtesy Robin Stewart USGS, Menlo Park

Have any of these benthic functions changed due to restoration? We start by looking at 1993-1995 and 2006-2009 benthic community structure and function.

We need to know who the animals are to define their position in the functioning ecosystem.

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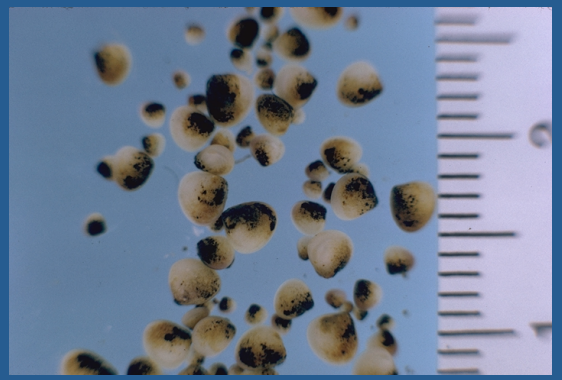
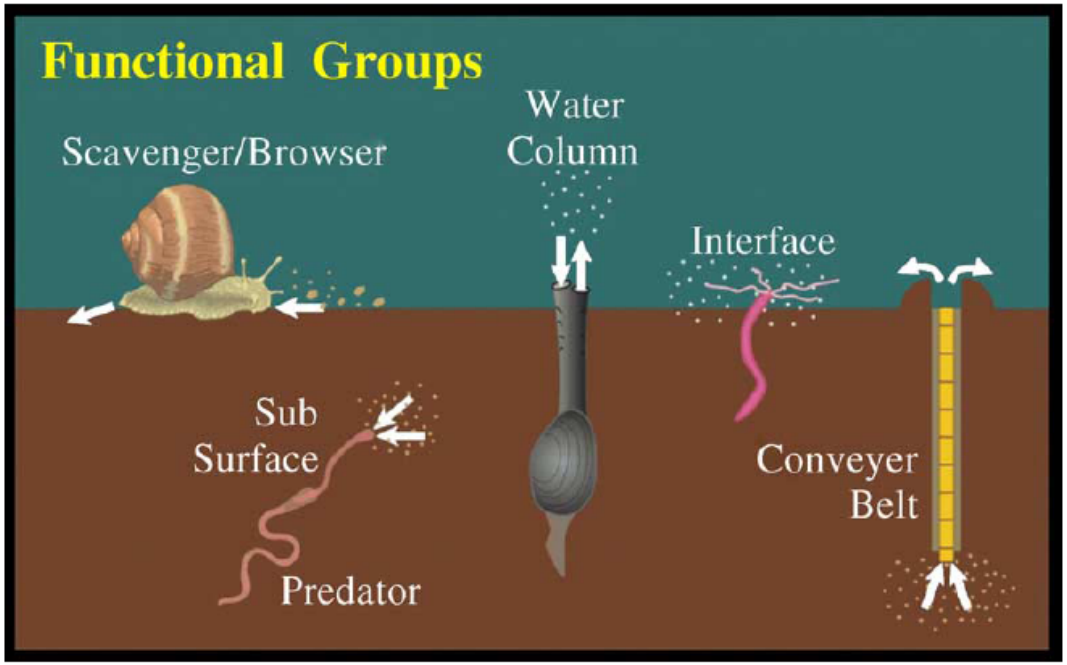


We then need to establish how & where the animals live before examining our 3 ecosystem functions (prey, consumer, vector).

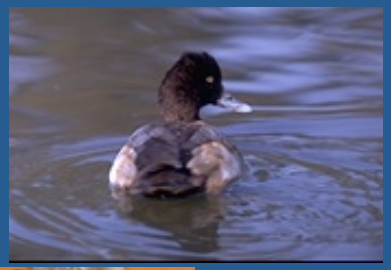
What they eat determines their position in food web and contaminant exposure.

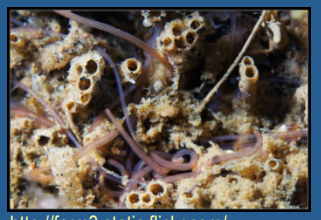
K.R. Tenore et al. / Journal of Experimental Marine Biology and Ecology 330 (2006) 392–402



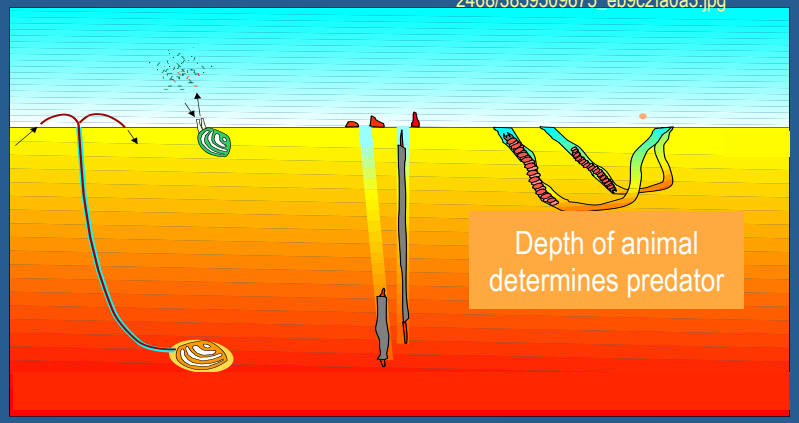
Where they live limits their predators.

1. Prey: Benthic community structure (species, size, habitat) limits predators.





http://farm3.static.flickr.com/2468/3859509675_eb9c2fa0a3.jpg



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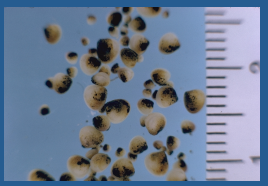


USGS

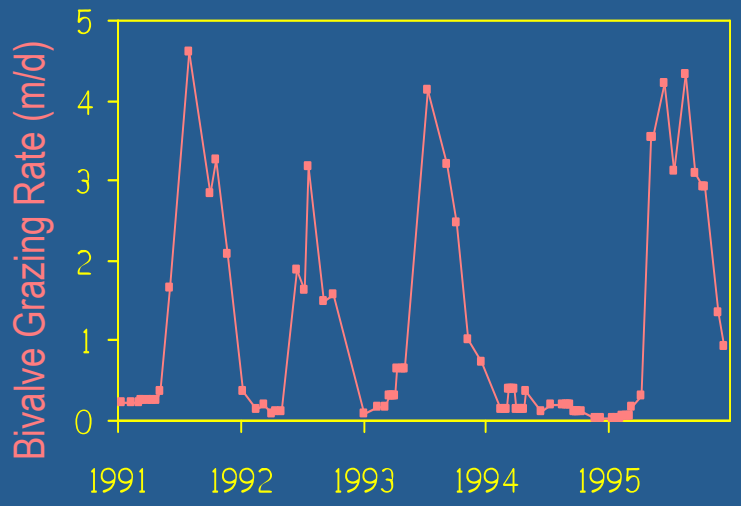
vims.edu

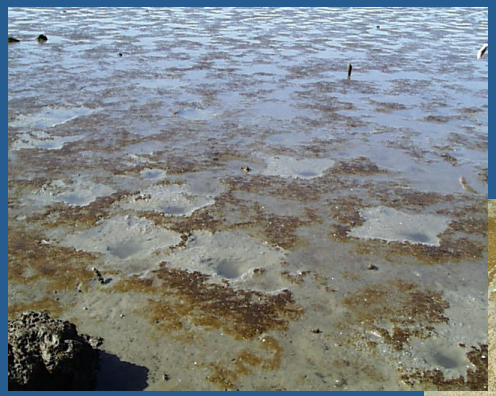
http://www.flickr.com/photos/8535738@N08/3312724793

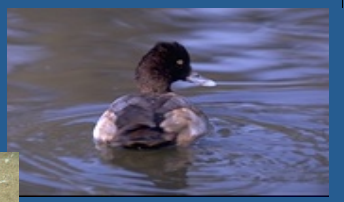
An example of what we can learn: We will explore the ecosystem effects of the recent change in abundance of the large species of bivalves in this system.

What we know: Bivalves have been a major prey source for birds and fish.

Bivalve biomass in shallows of South Bay are reduced each winter by seasonal bird and fish predation.

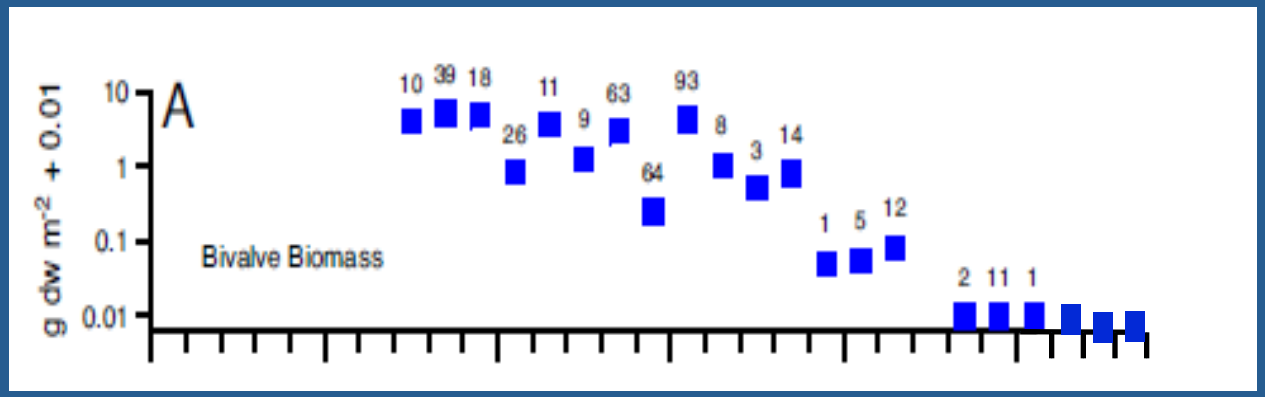


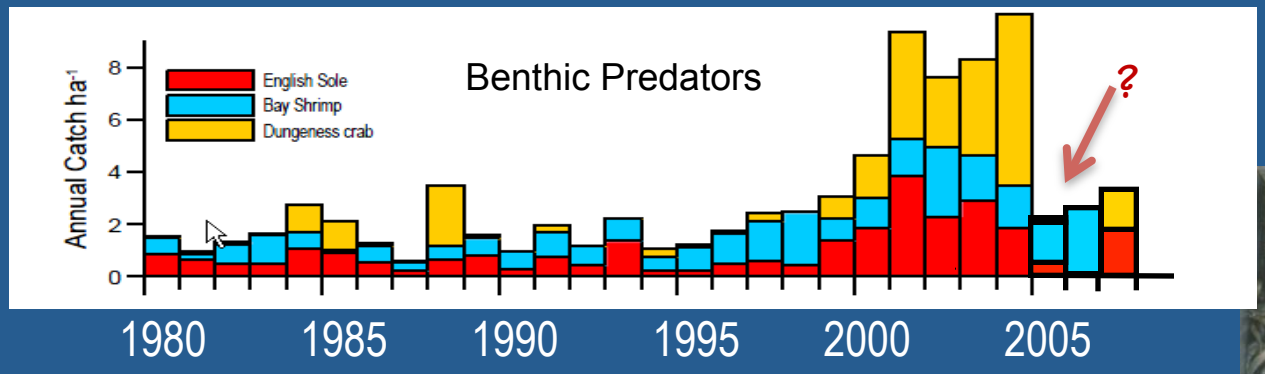




Poulton et al 2004
Thompson 2005, Thompson et al 2008

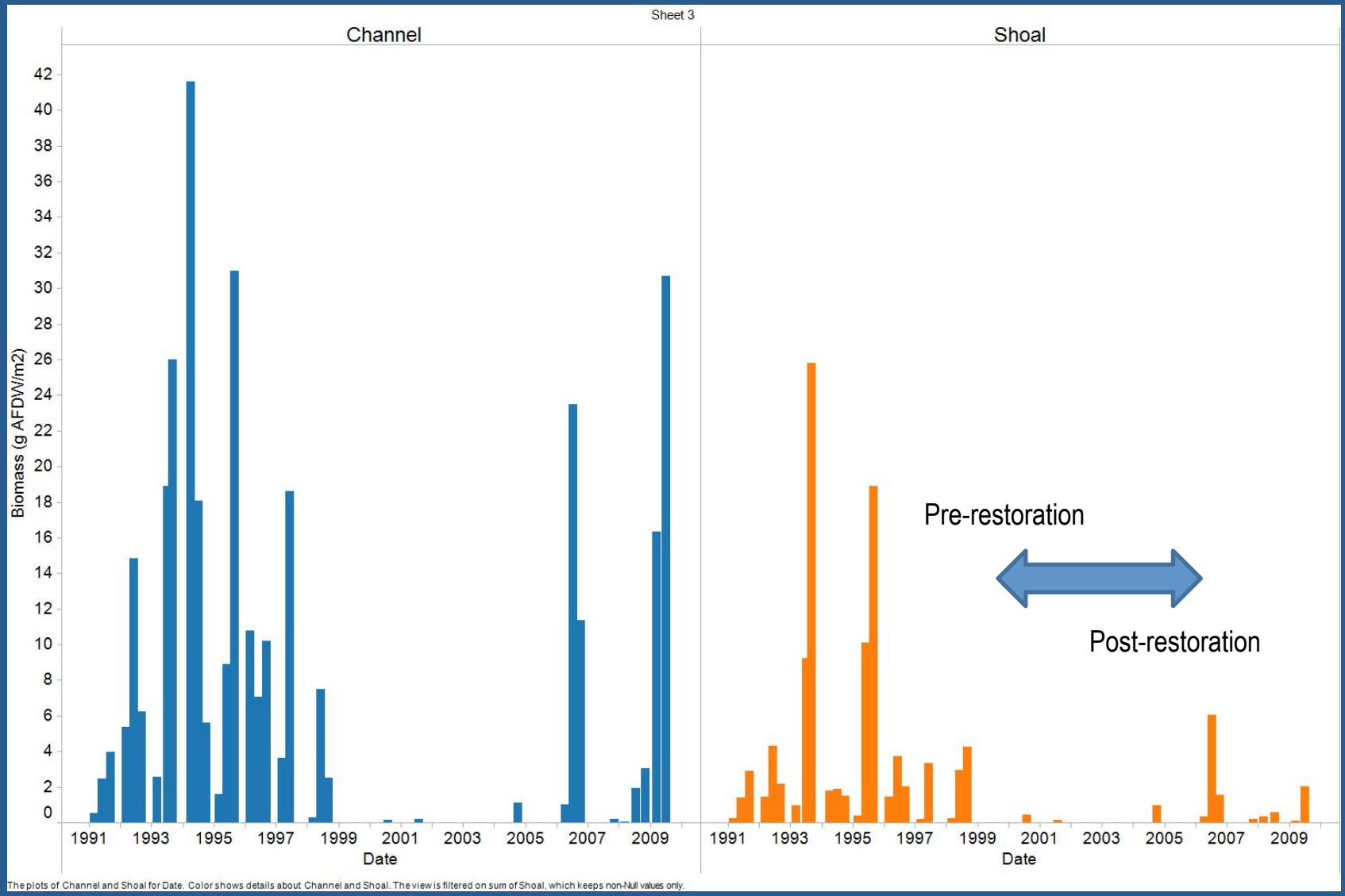
What we know: Decadal scale changes in predators with ocean life stages may reduce/increase bivalve biomass



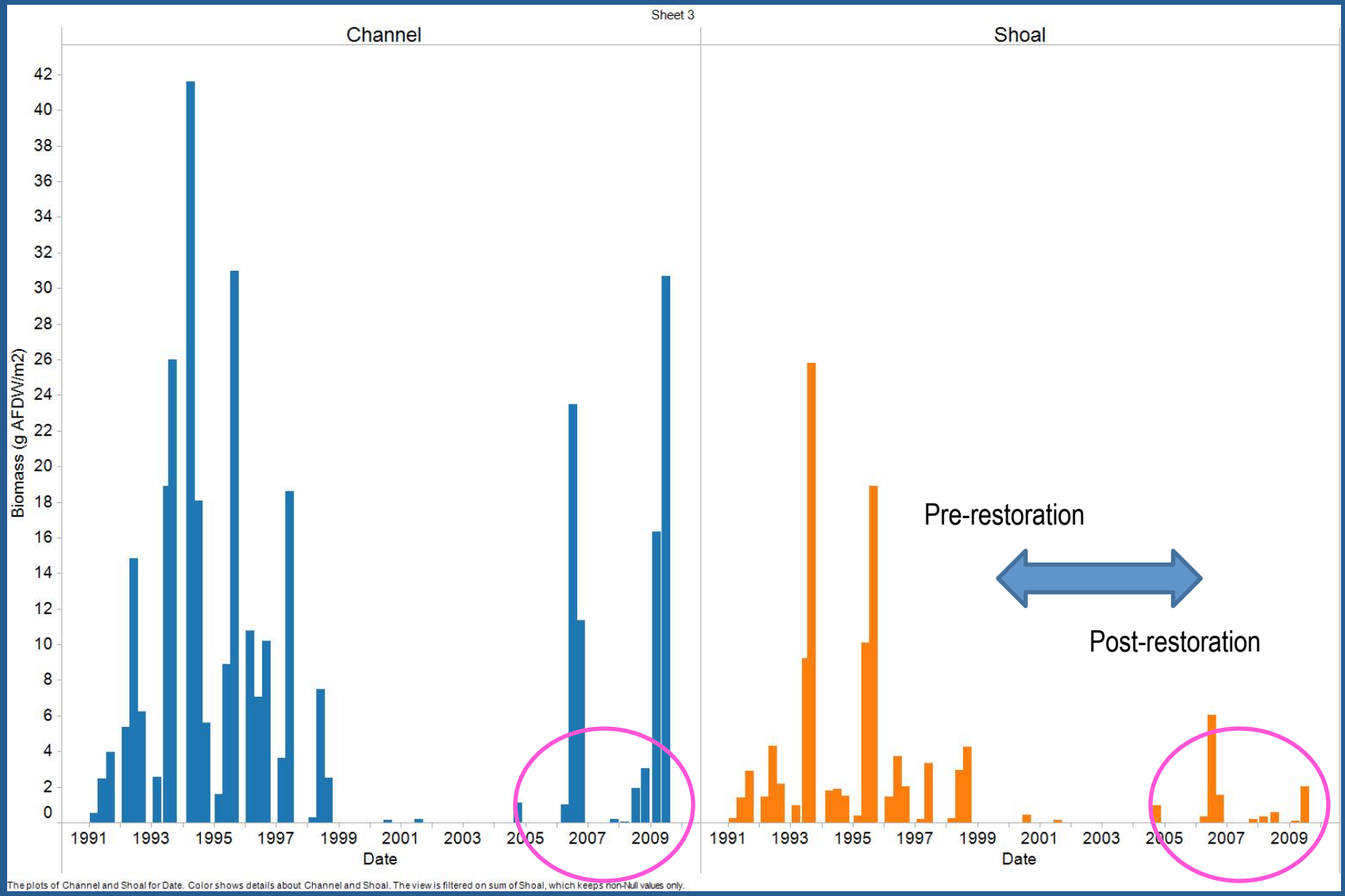


Cloern et al 2007
NCEAS Workgroup

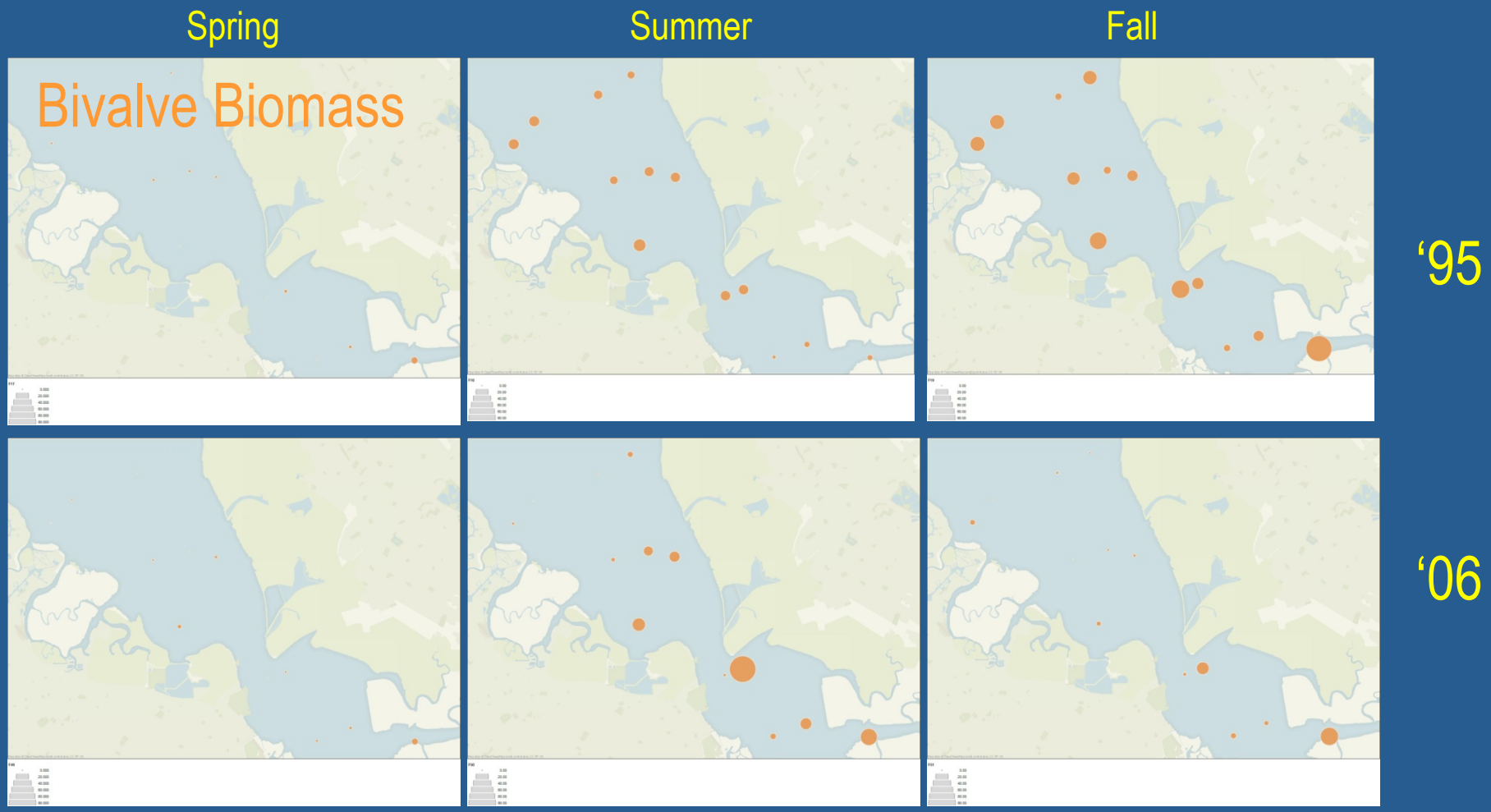
What we have learned so far: Bivalves have returned to the channel some years, less frequently in the shoals.



What we have learned so far: Offshore predator patterns will complicate our understanding of restoration effects.

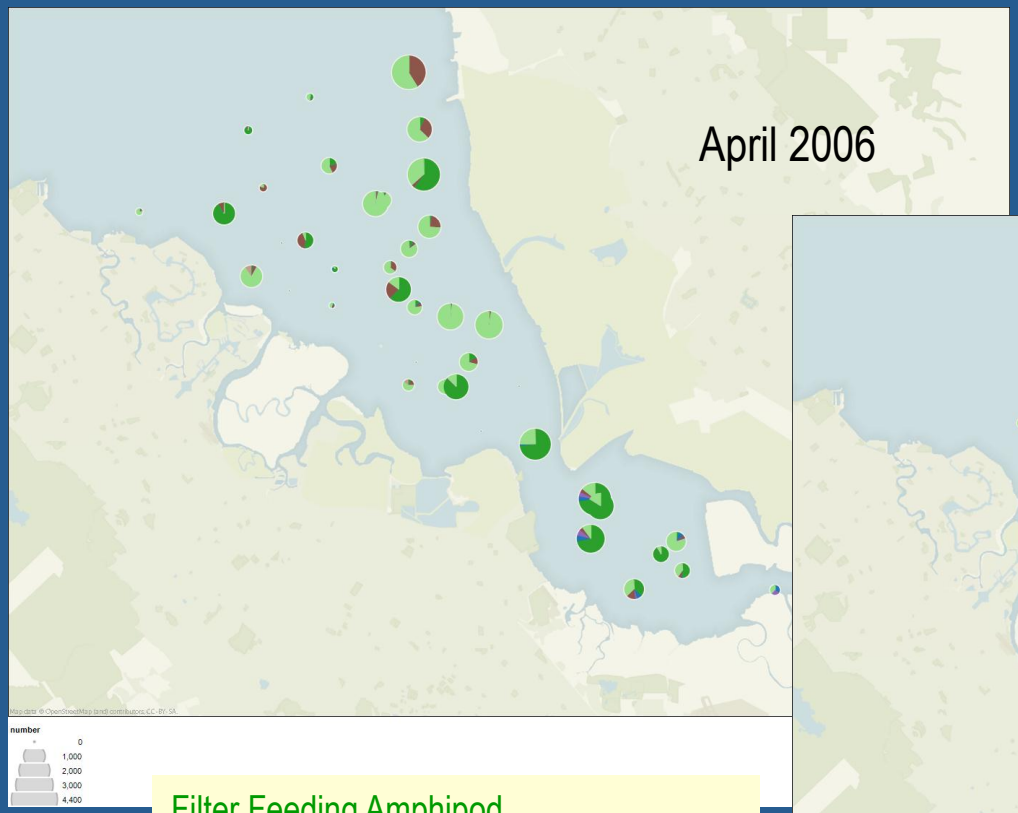


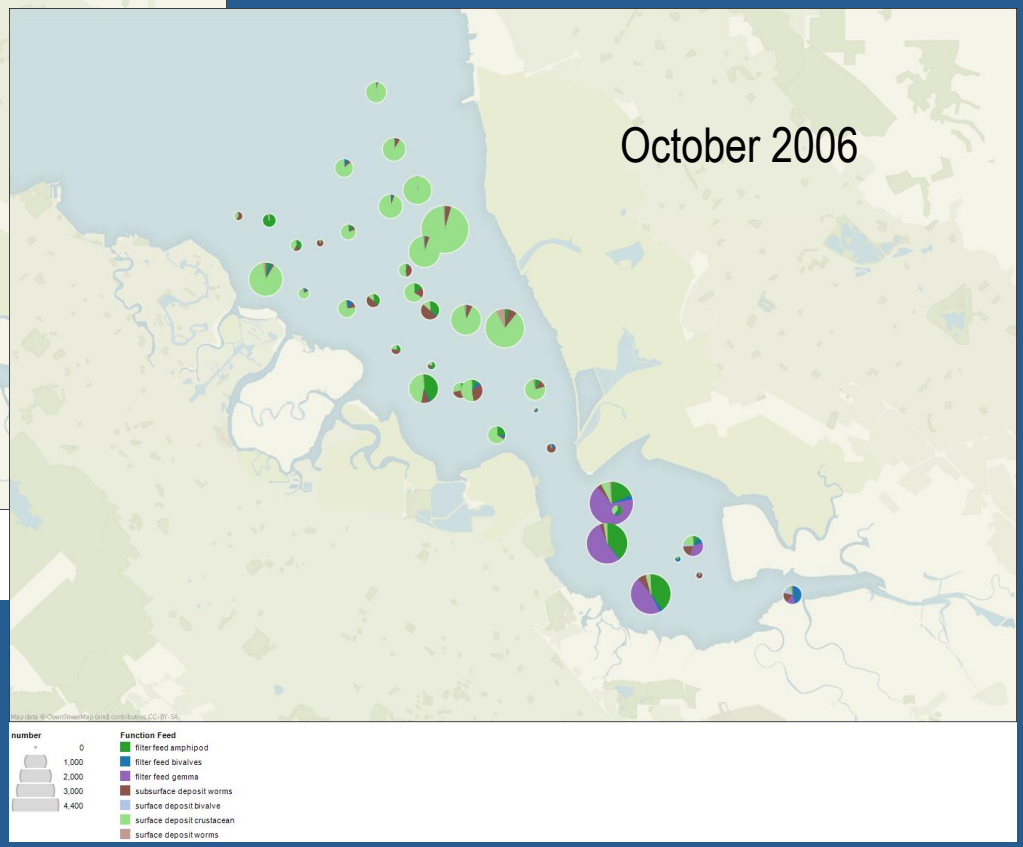
An observation/question : Bivalves came back in the south more strongly than in the north and disappeared earlier in 2006 than in 1995. Is this relevant?



An observation/question: Have surface deposit/filter feeding amphipods replaced the bivalves?

Is that good?

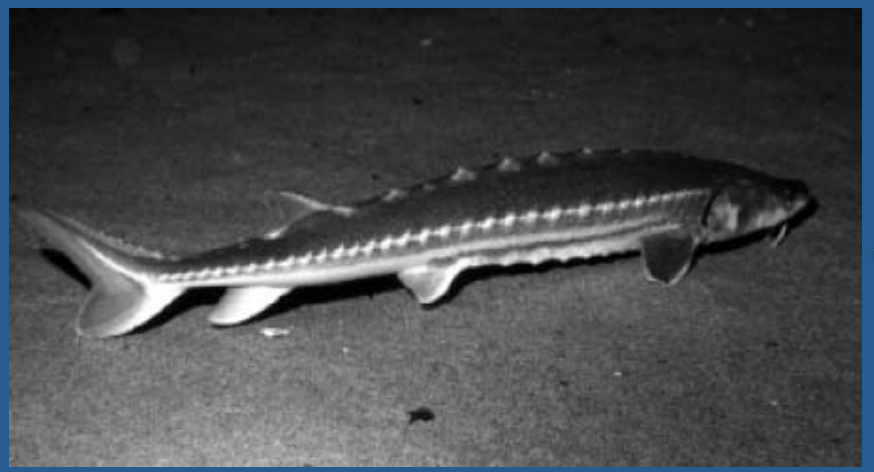




Filter Feeding Amphipod
Filter Feeding Bivalves
Filter Feeding *Gemma gemma*
Subsurface Deposit Feeding Worms
Surface Deposit Feeding Bivalves
Surface Deposit/Filter Crustacean
Surface Deposit Feeding Worms

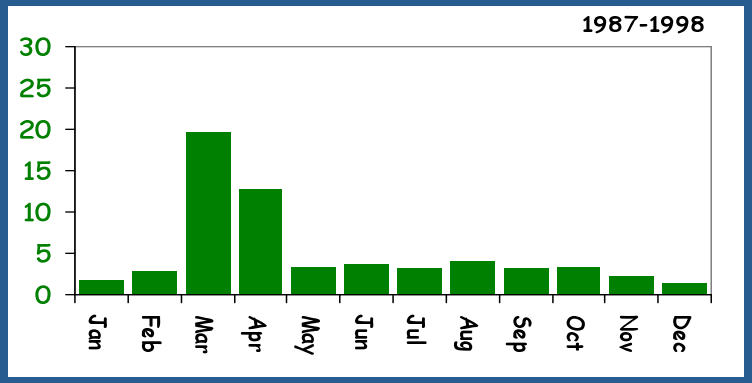
Future Question: How do these kinds of bivalve dynamics affect/reflect their predators success?

http://www.flickr.com/photos/8535738@N08/3312724793



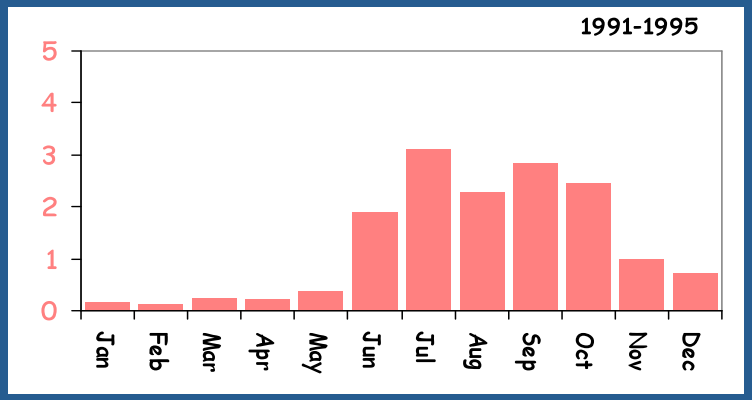
2. Consumers: What we have learned so far: Bivalve mortality, due to winter predation, allows an annual spring phytoplankton bloom to develop.

Monthly Average Chl a (µg/L)



Average Phytoplankton Biomass

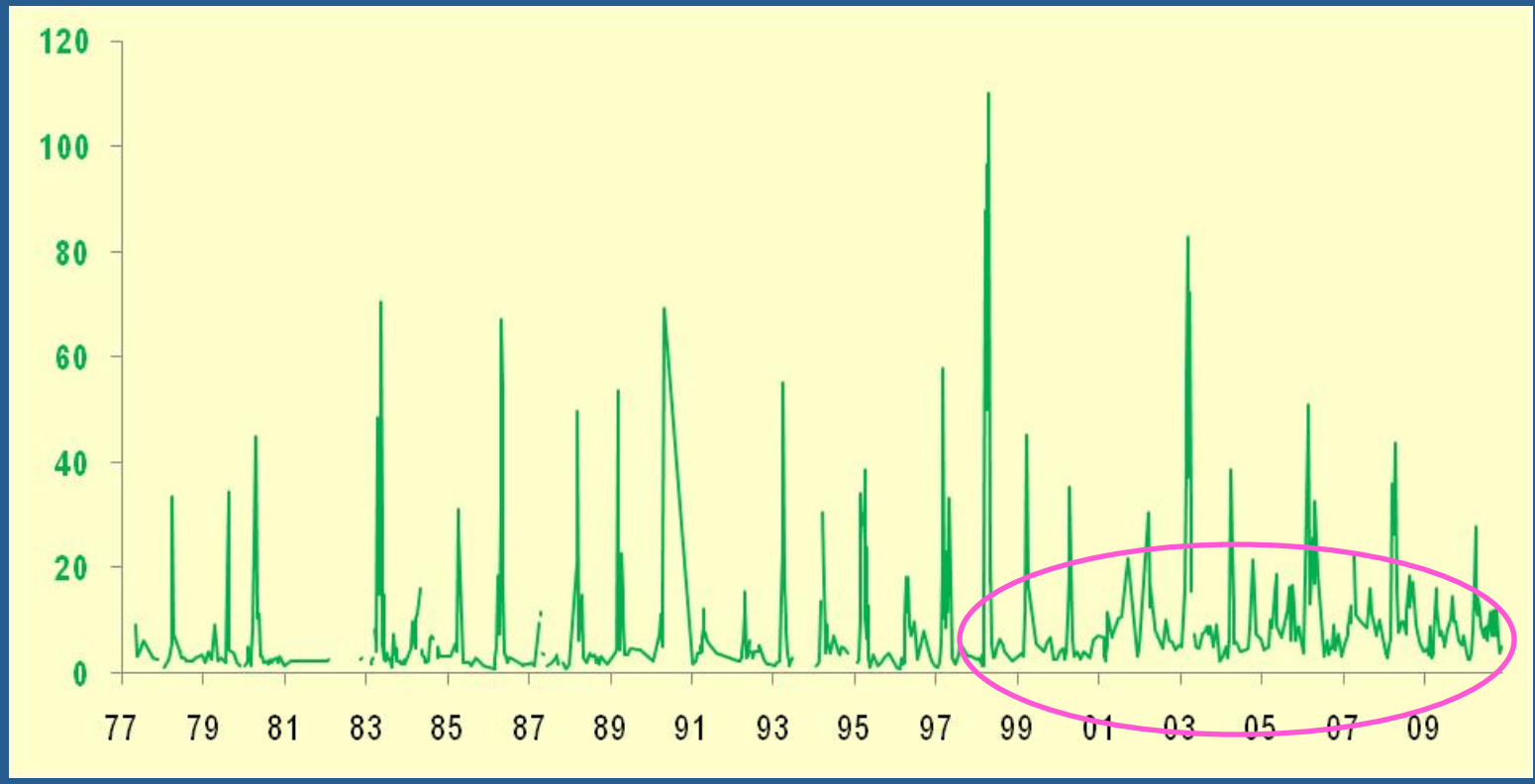
Monthly Average Grazing Rate ($m^3/m^2/d$)



Average Bivalve Grazing Rate

Thompson et al 2008

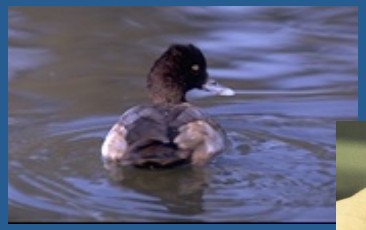
What we have learned so far: Phytoplankton biomass has increased since the decline in bivalves. Bivalve absence is likely to be part of the cause.

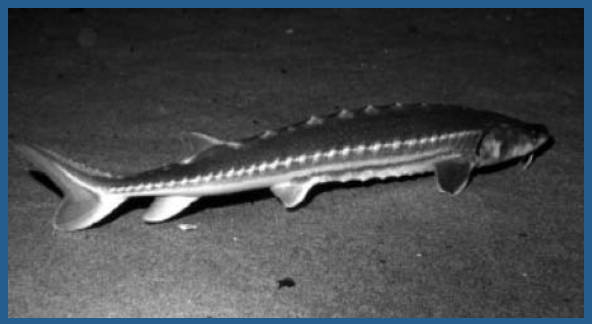


http://sfbay.wr.usgs.gov/access/wqdata/index.html

3. Contaminant Vector- What we have learned so far:

Species matter - Se concentrations in *Corbula* exceed the dietary toxicity threshold for birds and fish.





Selenium

8-12 µg g^{-1} dry wt

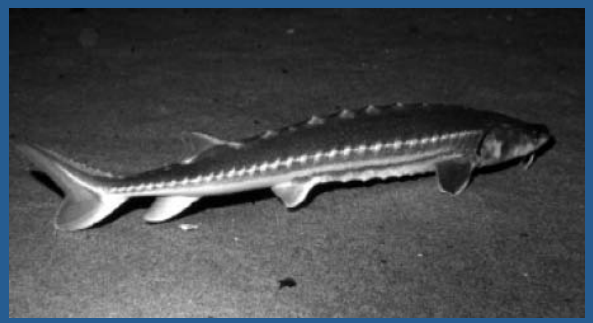
Dietary Threshold: 4.7-7.3µg g^{-1} dry wt

Courtesy of Robin Stewart
Stewart et al 2004

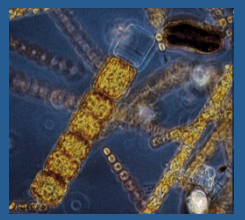
What we have learned so far: Seasonal cycles of growth and predation matter.

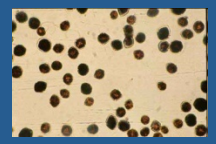
Maximum biomass when [Se] and predation is highest

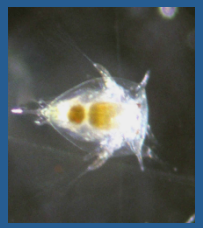
Minimum grazing in spring



Selenium







Thanks for your attention

Goal: We look at the benthos as an integrative component of the ecosystem that will reflect changes in function at a much broader scale than just the benthos.

Goal: Introduce some of our preliminary findings as an example of how we will do these analyses

Thanks to our funding sources

- South Bay Salt Pond Restoration Project BWAS 2009-021
- USGS Toxics Program
- USGS NRP Research Program
- USGS Priority Ecosystem Studies Program