INTEGRATED REGIONAL WETLANDS MONITORING PROJECT

Evaluating nutrient regimes and primary productivity in wetlands in the San Francisco Estuary.

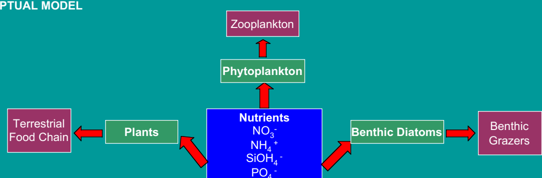
Risa Cohen, Frances Wilkerson, Vickie Hogue, Edward Carpenter, Richard Dugdale

BACKGROUND

Tidal wetlands in SFE have been greatly reduced in area, to where they now comprise only about 15% of their historical extent. This lead to a growing interest in and commitment to conservation and restoration programs, most notably the CALFED Bay/Delta Program. What has been lacking is a comprehensive monitoring program to evaluate how (or if) these restoration sites are changing over time, and which ecological functions are (or are not) returning to "normal". However, CALFED recently established the Integrated Regional Wetlands Monitoring (IRWM) Program for the North Bay and Delta. Initial funding for 2 years of pilot monitoring was established. This poster describes preliminary monitoring data of estimates of primary production by wetland autotrophs and the concentrations of inorganic nutrients in marsh waters, within both restored (Sherman, Bull, Pond 2A, Carls) and natural/reference (Brown, Coon) tidal wetlands in the Bay-Delta.

Little is known of the relative availability of nutrients in wetlands of the SF Bay/Delta. Changes due to restoration efforts may impact the different inorganic sources entering SFE, which in turn will influence the aquatic primary producers (both macro and micro) that grow and feed higher trophic levels. The balance of various constituents of the nitrogen cycle (e.g., NO_3 vs NH_4) may be important in determining the food web and plant species that result. $Si(OH)_4$ is required for diatoms, the key primary producers in short energetically efficient pelagic food chains and in benthic sediment ecosystems.

CONCEPTUAL MODEL



OBJECTIVE

To evaluate differences in nutrient availability and the contribution of different groups of autotrophs to primary production

METHODS

- Water samples were collected and filtered monthly during the growing season and analyzed for NO_3, NH_4, PO_4 and $Si(OH_4)$ using autoanalyzer and colorimetric techniques.

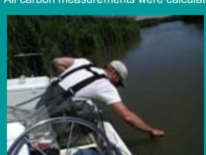
- Primary productivity of 3 groups of primary producers (phytoplankton, benthic diatoms, and low marsh vegetation) was determined by:

1) **Phytoplankton** were collected monthly at each site and the rates of C fixation were measured following incubations with radioactive ^{14}C.

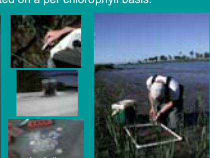
2) **Benthic diatoms** were collected by taking surface cores (5mm depth, 25mm diameter) and then incubating the cores in the presence of radioactive ^{14}C.

3) **Low marsh vegetation** productivity was measured using an IRGA. This way direct CO_2 uptake by the plants could be measured.

All carbon measurements were calculated on a per chlorophyll basis.



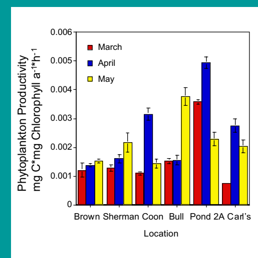
Water collection for nutrient and chlorophyll analysis and phytoplankton productivity.



Core collection for benthic diatom productivity an chlorophyll analysis.

IRGA measurements an biomass estimates for vegetation productivity.

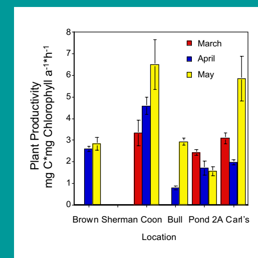
•Productivity data were analyzed using 2-factor ANOVA where appropriate.



There was a significant interaction between month and location on phytoplankton productivity ($p<0.0001$).

However, there was a general trend of increased productivity from March to April at all locations. In May, a decrease in productivity was evident at Coon, Pond 2A and Carls that corresponds with the depletion of NO_3 in the water column.

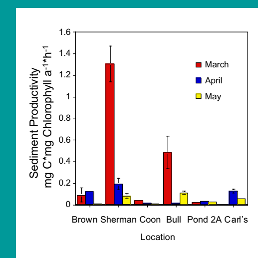
Interestingly, productivity at the Delta sites, Brown (ancient) and Sherman (restored) were similar.



There was a significant interaction between month and location on low marsh vegetation productivity ($p=0.0015$).

Productivity generally increased at the growing season progressed, with the highest values in May at all locations. Pond 2A was the exception; productivity decreased over time.

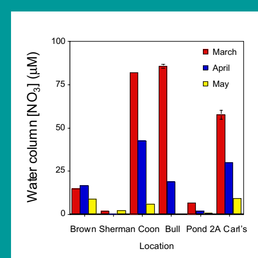
The ancient marsh in the Napa River, Coon, had higher productivity than either of the restored Napa River locations (Bull, Pond 2A) in all three months.



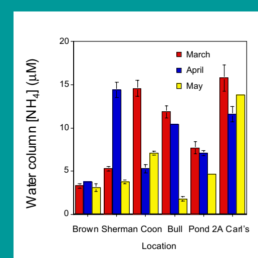
There was a significant interaction between month and location on benthic diatom productivity ($p<0.0001$).

Diatom productivity generally seemed to decrease with time, but this pattern is largely driven by the high values in March at Sherman and Bull.

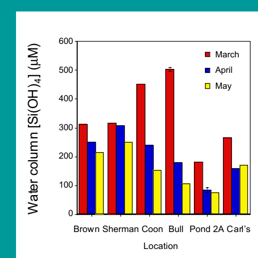
The high productivity at Sherman and Bull appears to correspond to high levels of $SiOH_4$ available in March.



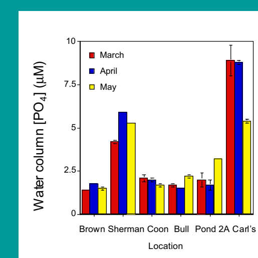
NO_3 concentrations showed variability with location, most likely related to the different river inputs. Values were greatest in march with maxima at Coon, Bull, and Carls Marsh (>50µM) compared to lower values (<20µM) at the Delta sites, Brown and Sherman. All sites showed reduction to almost limiting levels by May, except Sherman that had consistently low levels in all three months.



NH_4 concentrations tended to be high in March at all locations except at the Delta sites Brown and Sherman. Carls Marsh (supplied by Petaluma River) had highest concentrations (all samples >10µM) possibly due to anthropogenic inputs. NH_4 was reduced over the growing season at Sherman, Coon, Bull, Pond 2A but not at Brown or Carls Marsh.



$Si(OH)_4$ concentrations followed similar trends to NO_3, with highest values in March and decreasing with time. Highest concentrations (>400µM) were measured at Coon and Bull which are sites close together. Pond 2A showed the lowest levels of $Si(OH)_4$, analogous to the low NO_3 that occurred there also.



The PO_4 concentrations followed similar trends to NH_4 with highest values at restored wetlands Carls Marsh (almost 9µM), likely due to anthropogenic inputs. Lowest levels were measured at Brown, Coon, and Bull.

CALIFORNIA BAY-DELTA AUTHORITY

Conclusions:

1) There appeared to be no nutrient limitation at the start of the growing season with the exception of low NO_3^- at Sherman and Pond 2A.

2) The relationship between nutrients and productivity is very complex, but the general trends were:

A. A decrease in nutrient concentrations over the course of the growing season, and NO_3 levels were low at all locations by May.

B. Productivity generally increased as the growing season progressed, likely due to nutrient drawdown.

4) The order of autotroph productivity rates from greatest to least were:
Low marsh plants>benthic diatoms>phytoplankton

5) The preliminary data from this study are the first detailed measurements of nutrients and the dominant sources of primary productivity in SF Bay wetlands.

6) These data provide water quality and ecosystem productivity sampling and analytical strategies that may be implemented by resource managers.

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