

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference
POSTER ABSTRACTS: Pelagic Organism Decline

Improved detection of ammonia, nitrate and total N in surface water samples

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Recent pelagic organism decline in western waterways, especially the San Joaquin and Sacramento River delta in northern California, USA, has increased interest in the nitrogen cycles in these systems. Ammonia, nitrate, nitrite, particulate and dissolved organic nitrogen, and total nitrogen are important part of the nutrient cycle and of the food web, and an overabundance of any of these nutrients can cause serious environmental problems. Relative levels of NO₃-N, NH₃/NH₄⁺-N (TAN), along with ambient flow, pH, and temperature will effect levels and toxicity of inorganic N, and as little as 0.07 mg/L TAN has been shown to affect NO₃-N uptake by diatoms. Detection of inorganic N compounds in surface waters necessitates the analysis of a minimum of four species: NO₃-N, TAN, NO₂-N and Total N. There exist several current analytical methods for detection of N compounds including ion-selective electrodes, colorometric methods, high temperature combustion with chemiluminescence detection, and conductimetric methods. The conductimetric method can has the advantage of automation, and recent developments have lowered the quantification limit to 5 µg/L, allowing accurate measurement of inorganic N species at biologically relevant levels. The objective of this study is to evaluate the performance of the conductimetric method for quantifying total TAN, nitrate (NO₃-N), and total N in a wide variety of environmental samples including surface water, wastewater effluent, biogas digester effluent, and agricultural drain water. Included is a comparison of the range of detection, minimum detection limits, accuracy, interferences, the time and level of difficulty, and the hazardous wastes created by various methods of analysis for these nutrients.

Key Words - *ammonia, nitrate, total N, water quality, analytical chemistry*

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Largemouth bass abundance and diet in the Sacramento-San Joaquin Delta: investigating temporal and spatial variation with respect to submerged aquatic vegetation

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Concurrent with the recent decline of numerous pelagic organisms in the Sacramento-San Joaquin Delta, fish assemblages in the littoral zone have also undergone dramatic changes. In particular, populations of largemouth bass and other non-native centrarchid fishes have grown remarkably. Previous field studies have hypothesized that the growth of largemouth bass populations is linked to the expansion of invasive aquatic macrophytes in shoreline areas of the Delta. This study investigates the potential role of the expanding largemouth bass population in the decline of pelagic organisms in the Delta as well as the association between largemouth bass with submerged vegetation. At thirty-three sites across the Delta, we surveyed fish assemblages, sampled largemouth bass diets, and quantified the biomass of the submerged vegetation on a bimonthly basis from October 2008 through August 2009. Fish assemblage varied regionally, with native fishes maintaining their strongest presence in the north and west Delta, while centrarchids dominated central, south, and eastern regions. Largemouth bass abundance and size structure varied with respect to the vegetation landscape rather than its biomass: large, piscivorous bass are found predominantly on patch edges and in structured shoreline areas where little or no submerged vegetation is present. However, juvenile bass are concentrated in the interior portions of the vegetation patches. Largemouth bass diet composition is dominated by vegetation-associated prey items across all seasons, such as smaller centrarchid fishes, crayfish, and amphipods, suggesting that largemouth bass do not stray far from nearshore areas to forage. These results indicate that the spread of submerged vegetation provides largemouth bass with prime nursery habitat to support the growing population and its dietary preferences.

Key Words - *largemouth bass; aquatic macrophytes; Delta littoral zone*

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Total and Un-ionized Ammonia Concentrations in the Upper San Francisco Estuary from 1974-2009: A Comparison of Ambient Data and Toxicity Thresholds

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Concerns have been raised about whether direct ammonia toxicity is contributing to the Pelagic Organism Decline (POD) in the San Francisco Estuary. In order to address these concerns, ammonia concentrations from over 11,800 water samples collected during 35 years (1974-2009) at 81 stations were screened for exceedances of US EPA acute and chronic toxicity criteria for ammonia. Monitoring stations were located throughout the legal Delta and Suisun Bay, and into San Pablo Bay. Stations were categorized as “estuarine” or “freshwater” using salinity data according to procedures established by the California Toxics Rule. This designation affected whether saltwater or freshwater EPA criteria were applicable for determining exceedances in individual water samples. At estuarine stations, the freshwater acute criterion was stricter than the saltwater acute criterion for ~90% of samples, but the saltwater chronic criterion was stricter than the freshwater chronic criterion for ~80% of samples. Over the entire record, the screening resulted in zero exceedances of the US EPA acute criterion, and only 2 exceedances of the US EPA chronic criterion. None of the measurements of ammonia exceeded Species Mean Acute Values for fish or invertebrate species in the current EPA freshwater and saltwater databases - including that of the most sensitive salmonid species (rainbow trout). None of the ammonia measurements exceeded the currently estimated 96h LC50 or LOEC for Delta smelt.

Key Words - *ammonia; toxicity; upper San Francisco Estuary*

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Phytoplankton productivity in Suisun Bay and Rio Vista may signal “bad” habitat conditions

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The need to understand causes of pelagic fish declines in the SF Estuary/Delta have led to food web studies to evaluate bottom-up effects. One hypothesis is that contaminants such as elevated anthropogenic ammonium (NH₄) or herbicides with riverine or Delta sources are inhibitory to phytoplankton resulting in little chlorophyll of poor food quality. Funded by CALFED, we proposed that phytoplankton physiology be used to indicate unfavorable conditions and underlying mechanisms. We compared phytoplankton productivity and nutrient uptake rates in Suisun Bay and Rio Vista to those of Central Bay and used “grow-out” experiments to evaluate phytoplankton status. A parameter, *f*, assessed the proportion of nitrate (NO₃) uptake compared to total inorganic nitrogen uptake (NO₃ plus NH₄ uptake). High NO₃ uptake (i.e. $f \geq 0.5$) correlates with bloom formation and high primary production. In Central Bay where NH₄ concentrations (and other contaminants) are low, chlorophyll blooms occurred; the phytoplankton used NO₃ and there was elevated primary production. Grow-outs showed complete NO₃ drawdown within 4 days. In Suisun Bay, with higher ambient NH₄, blooms were rare, nutrient uptake and primary production were low. Grow-outs showed slow NH₄ drawdown and delayed NO₃ uptake. In some grow-outs complete nutrient drawdown occurred after 5 days, with chlorophyll accumulation and higher *f* values. However at Rio Vista, influenced both by Sacramento River and Cache Slough sources of contaminants, NH₄ concentrations were the highest observed, chlorophyll was low and extremely low nutrient uptake and primary production rates were measured. All Rio Vista grow-outs showed no NO₃ drawdown and *f* was <0.5. Grow-outs, *f* and phytoplankton productivity could be developed as an adaptive management approach to evaluate habitat condition in the northern estuary and Delta.

Key Words - *phytoplankton; ammonium; primary productivity;*

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