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Dynamics of Carbon and Nitrogen in a Southern California Salt Marsh

A Dissertation submitted in partial satisfaction
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by

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ABSTRACT OF THE DISSERTATION

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This study explores three functional aspects of the salt marsh-estuarine ecosystem in the Tijuana Estuary (southern California): primary productivity of the salt marsh vascular plants, organic carbon cycle, and inorganic nitrogen cycle.

The productivity study was designed to test the hypothesis that the salt marsh vascular plants in the Tijuana Estuary are not as productive as those in eastern coastal marshes. Spartina foliosa was found to be the most productive individual species in terms of dry weight and carbon, but succulent plant species as a group contributed

more to the overall vascular plant productivity. On a dry weight basis net above-ground primary productivity (NAPP) averaged 0.8kg/m^2/yr which was approximately 240g C/m^2/yr. Carbon productivity of vascular plants was low in comparison to Atlantic and Gulf of Mexico marshes, and differences were attributed to the more saline soils of southern California. Standing dead biomass and litter averaged over the total marsh surface were constant throughout the study period. The decomposition rate of selected grass species was slower than that for succulent species and the decomposition rate for all plant material varied with elevation, being faster in the tidal creeks and slowest in the upper marsh.

The organic carbon study was designed to provide data on the quality and quantity of the various forms of organic carbon being transported to and from the marsh surface in the tidal waters. The data were used in conjunction with those generated from the productivity study to evaluate the hypothesis that the Tijuana Estuary salt marsh exports a substantial amount (45-50%) of the organic carbon produced and that a major portion of the export is as particulate organic carbon (POC). The concentration of POC, dissolved organic carbon (DOC), ATP and chlorophyll _a_ was measured in water samples collected periodically during a tidal cycle each month. Organic carbon was exported as DOC (40-110g C/m^2/yr) and showed a slight import of POC (5-6g C/m^2/yr). POC was mainly detrital carbon as opposed to biomass carbon. The Tijuana Estuary salt marsh exports substantially less than 50% of its NAPP, and export is in the dissolved form as opposed to particulate.

Results of this and other recent studies suggest that a re-evaluation of salt marsh carbon flow models is needed.

The purpose of the inorganic nitrogen study was to document the distribution of ammonium, nitrate and nitrite in the tidal waters draining the Tijuana Estuary salt marsh and to evaluate the tidal waters as a source of nitrogen for salt marsh vegetation. The inorganic nitrogen cycle was characterized by the annual import of ammonium and slight annual export of nitrate. Ammonium was found to be the dominant form of inorganic nitrogen except in the late spring when nitrate was dominant. Inorganic nitrogen import totalled 1.1-2.16g $N/m^2/yr$. The import of inorganic nitrogen accounted for 28% of the nitrogen required by salt marsh vascular plants, but only 6% of the combined productivity of vascular plants and benthic algae. Nitrogen regeneration processes within the salt marsh are important in meeting the nitrogen needs of salt marsh vegetation.