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Project Summary

Production in Coastal Salt Marshes of Southern California

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This study was designed to answer four questions about macrophyte production in coastal salt marshes of southern California: 1) What levels of production are achieved by plant species and plant communities? 2) To what extent does production vary within and between marshes, especially those with and without regular tidal inundation? 3) What physical factors control or best explain variations in production? and 4) How does production in southern California salt marshes compare with that at other latitudes on the Pacific Coast and at similar latitudes on the Atlantic Coast?

Data were obtained by harvesting macrophytes and monitoring environmental factors (substrate salinity, pH, nitrogen, redox, water content, and tide level) at four locations—Sweetwater River Estuary, Los Penasquitos Lagoon, Upper Newport Bay, and Bolsa Bay—over an annual cycle beginning fall 1977.

Net aerial production estimates computed by summing production in individual species and adjusting for interval death and shedding and disappearance of dead material averaged 3196, 3787, 2150, and 2494 g $m^{-2}yr^{-1}$ for study sites, respectively. Production levels were highest on creek levees and transition to upland and lowest in back levee depressions, fore levee slopes, and pans—suggesting that habitat, especially drainage and salinity, exerts greater control over macrophyte production in the marsh than does tide level alone. High levels of production in *Salicornia virginica* and *Frankenia grandiflora* at Los Penasquitos Lagoon suggest that production in some plant species may be increased by reduced tidal contact.

Production estimates from this study, together with those of the same author and others, support an increase in salt marsh production with decreasing latitude along the Pacific Coast, and production levels in southern California appear to be equal to or greater than those of salt marshes at the same latitude on the Atlantic Coast.

This Project Summary was developed by EPA's Environmental Research Laboratory, Corvallis, OR, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

A growing literature suggests that coastal salt marshes are among the most productive of natural systems. Salt marshes occupy a fortunate position between the limits of tidal inundation. Nutrients entrained by terrestrial runoff are transported along with nutrients from coastal waters to marsh soils by tidal flux. While primary production in the marshes is high, marked variations in yield occur. Explanations for intermarsh variations in production have involved factors related to tides; such as frequency and duration of tidal inunda-

tion, tidal range, waterlogging, drainage density, and soil salinity. The level of soil nutrients, especially nitrogen, has been shown to influence yields.

Knowledge of salt marsh production in North America rests almost totally on investigations conducted along the Atlantic and Gulf Coasts. The productivity of Pacific marshes, especially those along the California Coast, has yet to be fully demonstrated.

Method

This investigation was initiated to estimate production levels in southern California salt marshes, to relate variations in macrophyte production within and between marshes to physical variables, and to compare production estimates with those of marshes on other coasts. Four study areas were selected to represent the variety and latitudinal extent of coastal salt marshes in southern California (Figure 1). Sweetwater River Estuary, located in southern San Diego Bay, contains 83 ha of salt marsh with high floristic diversity. The marsh is perennially open to tidal fluctuation. Los Penasquitos Lagoon is seasonally closed to tidal contact, supports a depauperate flora dominated by *Salicornia virginica*, contains 95 ha of salt marsh, and is located on the northern city limits of San Diego. Upper Newport Bay, 110 km north of Los Penasquitos Lagoon, is continually open to the Pacific Ocean. The salt marsh there is floristically diverse, low in stature, and covers 58 ha. Bolsa Bay, in north Oregon County, is highly disturbed by dredging and diking, floristically poor, and has been artifically closed to tidal fluctuation since 1899.

Transects containing sample macroplots were located in each study marsh parallel to the elevation gradient. Vegetation was harvested from within a 2.0 x 2.5 m frame at intervals of six to eight weeks from October 1977 to September 1978. Samples were sorted to species and dried to constant weight. Litter bags were placed in each marsh to estimate decomposition rate of dead material. Net production was estimated by a modification of the Smalley method which incorporated decomposition rates. At the time of each vegetation harvest a set of substrate measurements was taken from each macroplot, including salinity of interstitial and gravity water, pH, redox, ammonia, water content and temperature. Macroplot tidal elevation was surveyed and each macroplot was classified according to habitat type.

Results

Net production ranged from 164 g $m^{-2}yr^{-1}$ at a low site in Bolsa Bay to 6369 g $m^{-2}yr^{-1}$ for a mid-elevation site

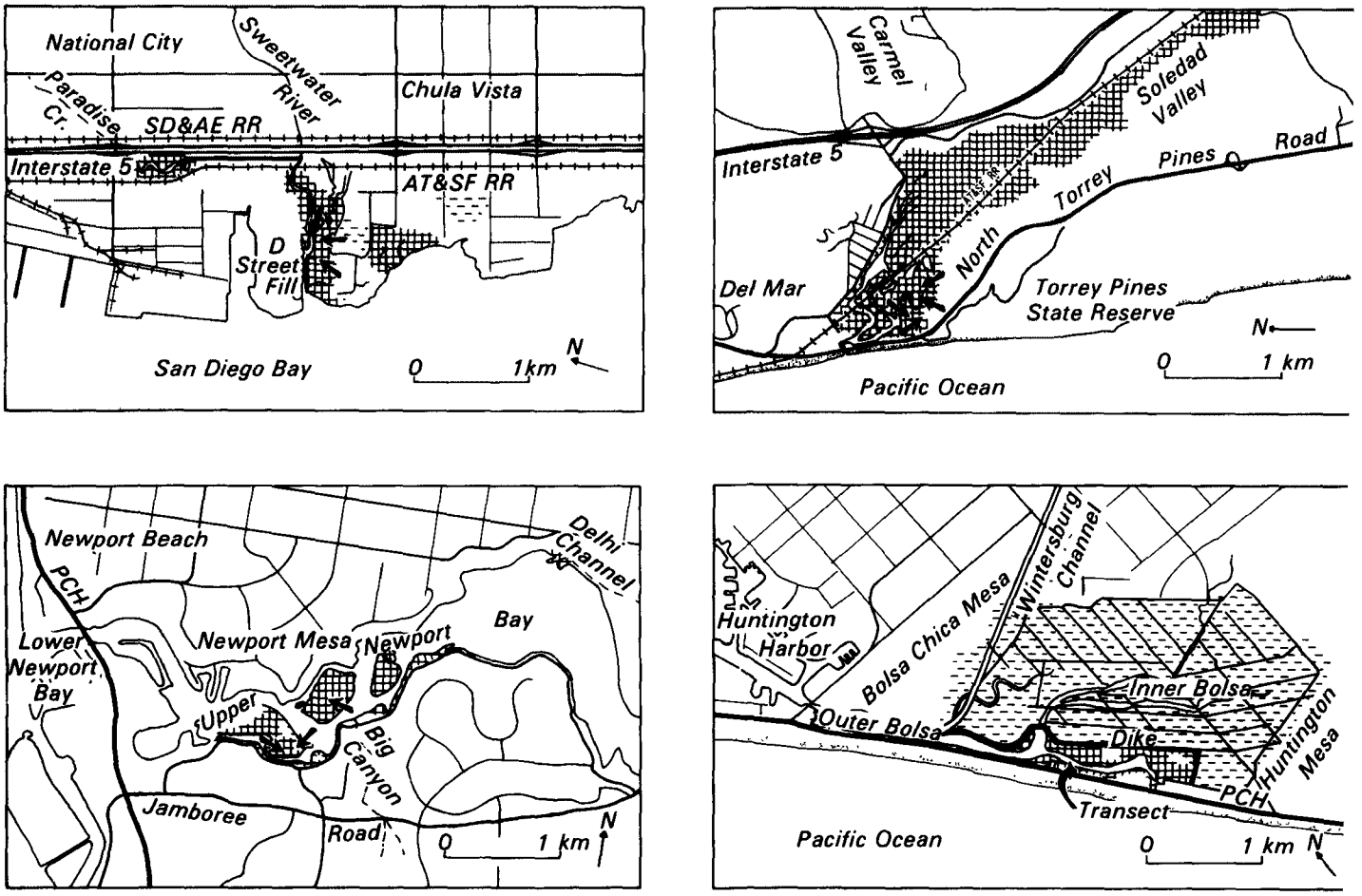

Figure 1. Study areas clockwise from upper left are Sweetwater River Estuary, Los Penasquitos Lagoon, Bolsa Bay, and Upper Newport Bay. Arrows denote locatoin of sampling transects.

at Los Penasquitos Lagoon. The overall mean was 2986 g $m^{-2}yr^{-1}$, and Los Penasquitos Lagoon was clearly the most productive marsh (Table 1). The most productive plant species overall were *Frankenia grandiflora, Salicornia virginica* and *Spartina foliosa* (means 1046, 1483, and 716 g $m^{-2}yr^{-1}$, respectively). Production tended to increase with elevation at all sites except Upper Newport Bay (Figure 2). Variation in production between habitats was significant and two habitat types, Levee Crest and Upland Transition, accounted for the greatest macroplot production (Figure 3). This suggested that good drainage and associated aerobic soils, moderate salinities, and moderate to low soil ammonia provided conditions associated with optimal plant growth. Regression analysis reinforced this observation.

Comparison of production levels in the four marshes studied with those published for other sites along the Pacific Coast is difficult because methods of estimation vary. However, there appears to be a tendency for production increase with decreasing latitude. Such a gradient of productivity has been discovered by investigations on the Atlantic Coast, and it appears that yields in southern California salt marshes are similar to those of low latitude Atlantic Coastal sites.

Table 1. Mean Annual Net Production Estimates (g $m^{-2}yr^{-1}$) and Standard Deviations

Marsh	Mean	S.D.	n
Sweetwater River Estuary	*3196*	*1330*	*31*
Los Penasquitos Lagoon	*3787*	*1528*	*21*
Upper Newport Bay	*2150*	*795*	*25*
Bolsa Bay	*2494*	*1731*	*5*

Conclusions

Several conclusions may be drawn from this study: 1) Macrophyte production varies within and between southern California salt marshes, 2) macrophyte production in some species may be increased by reduced tidal contact, 3) habitat, especially drainage and salinity, exerts greater control over macrophyte production in the marsh than does tide level alone, 4) production estimates support an increase in salt marsh production with decreasing latitude, and 5) levels of macrophyte production in southern California salt marshes are comparable to those at the same latitude on the Atlantic Coast.

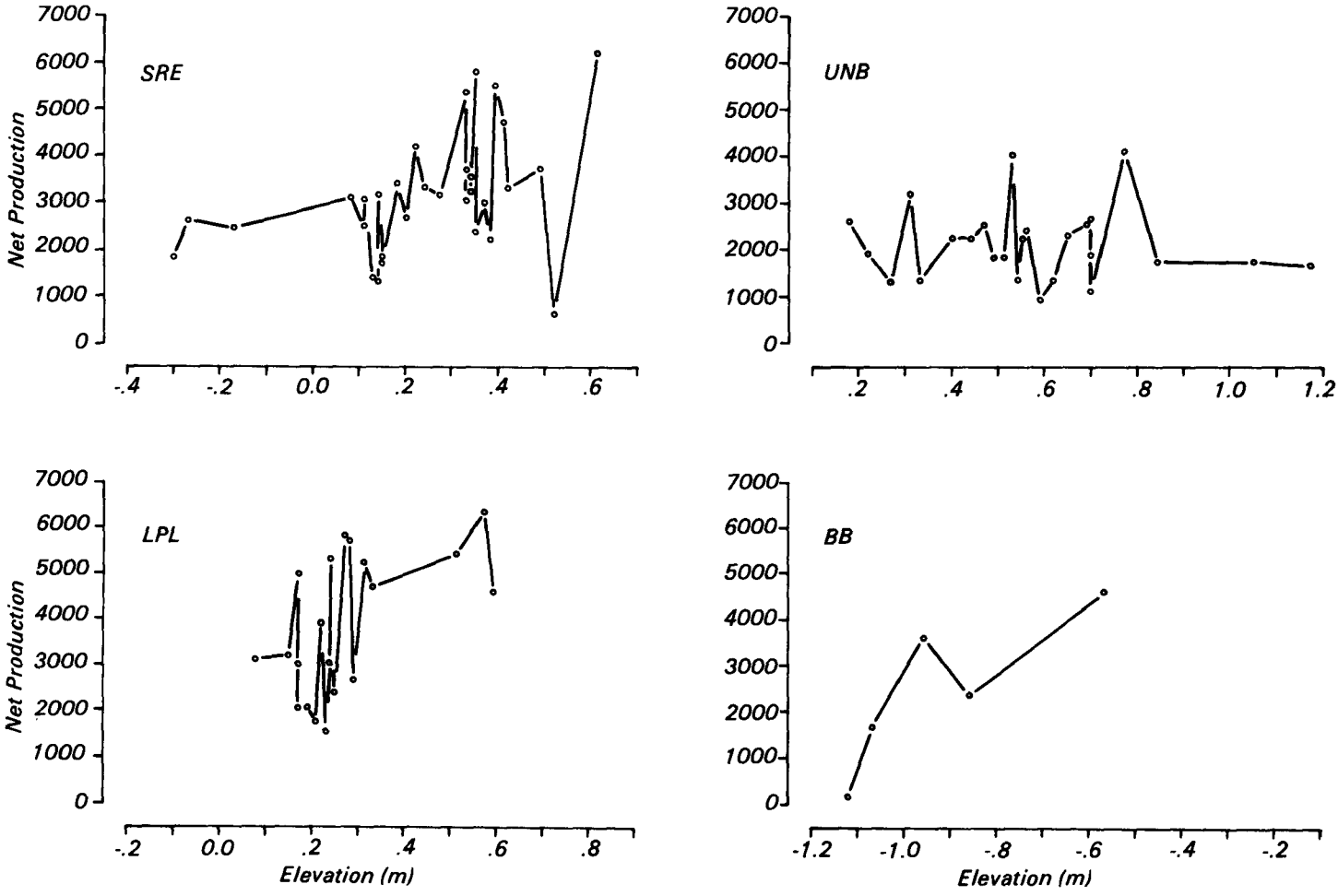

Figure 2. Macroplot net production (g $m^{-2}yr^{-1}$) and elevation (m). Abbreviations for study areas after Figure 1.

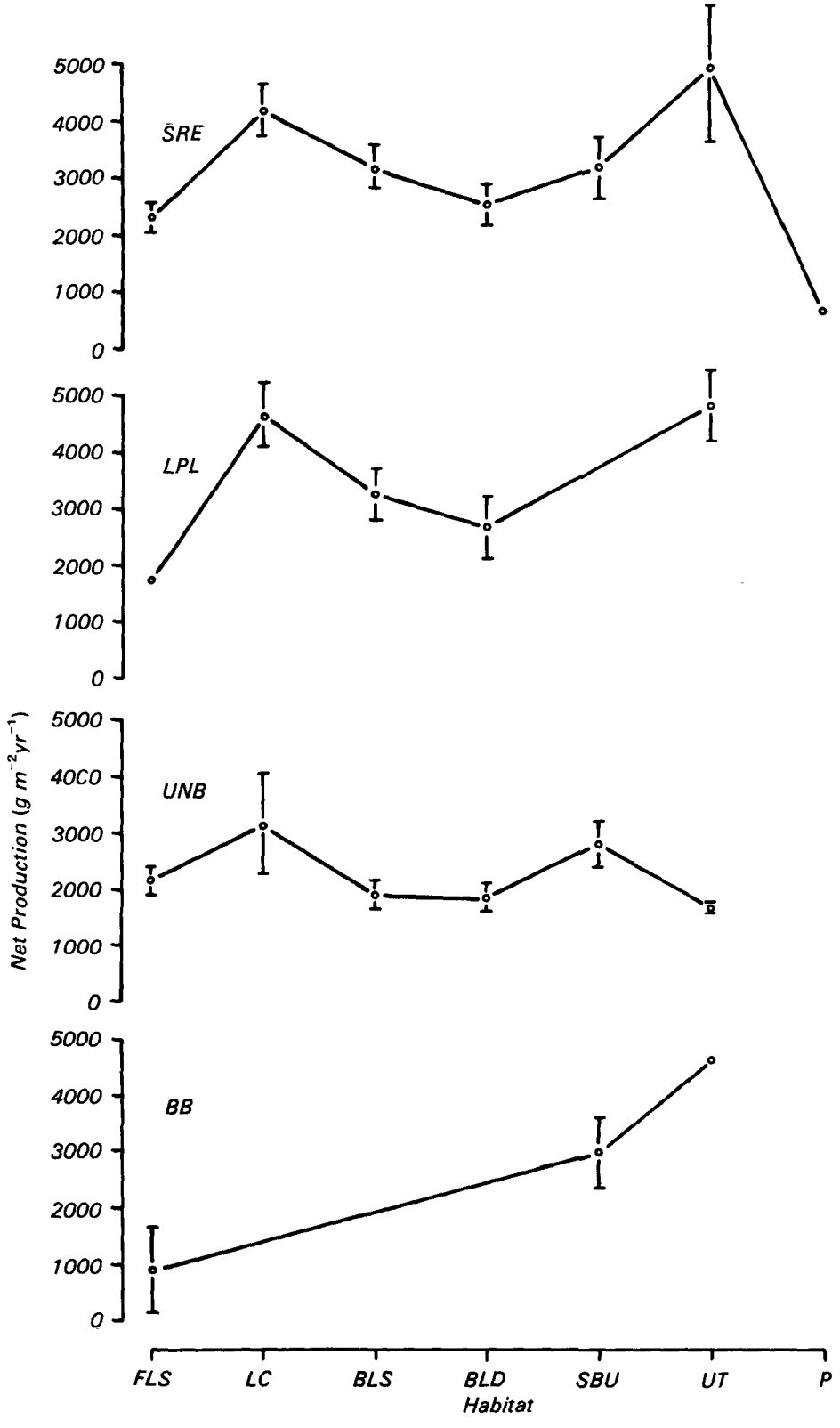

Figure 3. *Mean net production (g $m^{-2}yr^{-1}$ ± S.E.) by habitat type (Fore Levee Slope, Levee Crest, Back Levee Slope, Back Levee Depression, Slope Below Upland, Upland Transition, and Pan, respectively).*

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The complete report, entitled "Production in Coastal Salt Marshes of Southern California," (Order No. PB 81-171 845; Cost: $9.50, subject to change) will be available only from:
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5285 Port Royal Road
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