

## MARINE AND MARSH VEGETATION

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The dominantly shallow, mud-flat character of the entire Bahía San Quintín estuary provides for its dominant vegetation characteristics which are of two kinds: 1, A marine flora consisting of extensive beds of *Zostera marina* covering many acres of mud flats that are only slightly submerged at low tide; 2, a salt marsh flora of extensive development along nearly half of the low-lying margins of the bay subject to tidal flooding. Some of the features of these two vegetations which are seldom contiguous, but usually separated by broader or narrower bands of barren, sandy or muddy flats exposed at low water, will be taken up in turn.

### The Salt Marsh

As shown in Figure 1, the areas of tidal salt marsh are most extensive along the northern and eastern margins of the east arm of the bay. This area consists largely of very low sand hills and flats with almost no rocky outcrops. The central and western parts of the bay, on the other hand, border rough lava flows from four extinct volcanos, and salt marshes occur only in four relatively small, flat shore areas between these prominences.

The most extensive marsh is that at the north end of the east arm, and it was here that collections and measurements were made. Observations showed, however, that all of the marsh areas around the bay are essentially identical in composition, and, thus, comparable to the one studied in more detail.

The lowest parts of the marshes in almost all areas consist of a band of *Spartina foliosa*<sup>1</sup>, standing in shallow water at low tide. Above the *Spartina* belt the dominant marsh cover consists of *Salicornia virginica* with occasional pure stands or subdominant mixtures of *Batis maritima* and *Suaeda californica*. Scattered plants or mixtures of *Frankenia grandiflora*, *Limonium californicum* var. *mexicanum* and *Monanthocleis littoralis* occur through this low, frequently flooded area, but one is impressed by the overwhelming dominance of *Salicornia* which covers an area of approximately 2½ square miles around the uppermost lobe of the east arm of the bay alone. A sample of this *Salicornia* marsh was taken for weighing by scraping off to ground level the vegetation within a measured square yard. The weight of this fresh sample taken April 22,

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<sup>1</sup>Identifications of the marsh plants were made by Dr. Robert F. Hoover, California Polytechnic College, San Luis Obispo.

1960 was 3500 grams (3 lbs. 11 oz. dry weight at room temperature, Santa Ynez, June 10, 1960). This gives an approximate figure of 27,104,000 kilograms of *Salicornia* marsh growth in this small area, exclusive of the root material which, according to washings made by Barnard from post-hole digger samples, (see preceding paper) is roughly equal to the weight of the above-ground portions of the plants.

The lower flats have numerous small meandering tidal channels running through the marsh, and the muddy bottoms of these at low water show frequent colonies of blue-green algae<sup>2</sup> and the widespread green alga *Enteromorpha* growing on the mud, apparently serving in considerable part as food for the exceedingly abundant gastropods (*Cerithidea*) inhabiting these waterways.

The *Salicornia* marsh grades rather abruptly in most areas into the arid scrub vegetation of higher ground. This narrow transition zone is occupied for the most part by three species of marsh plants not characteristic of those areas that are regularly flooded, but subject to inundation only at highest tides of winter and summer high water springs: *Salicornia subterminalis*, *Distichlis spicata*, *Frankenia palmeri*.

#### Marine Vegetation

Over 95% of the marine vegetation of Bahía San Quintín consists of the Eel Grass, *Zostera marina*. This plant forms broad, dense stands occupying that greater part of the muddy bottom of the bay which is neither exposed at lowest tide levels, nor submerged to depths exceeding 10 feet at high water (Fig. 1, 2). The best developed beds occur in the middle parts of the bay on flats which carry 1-3 feet of water at lowest tide. Many of the beds were observed to be in mature, flowering condition in April, 1960. Extensive windrows of cast *Zostera* fragments were noted along the entire middle east shore of the bay to which the wind drives dislodged and broken materials from the beds. The deep channels in the bay are uniformly free of *Zostera* which quite strictly borders their steep sides. The upper, east arm of the bay seems to support only scattered patches of depauperate plants which in April were only 8-10 inches long. These scattered patches were the only ones observed on mud flats exposed at low

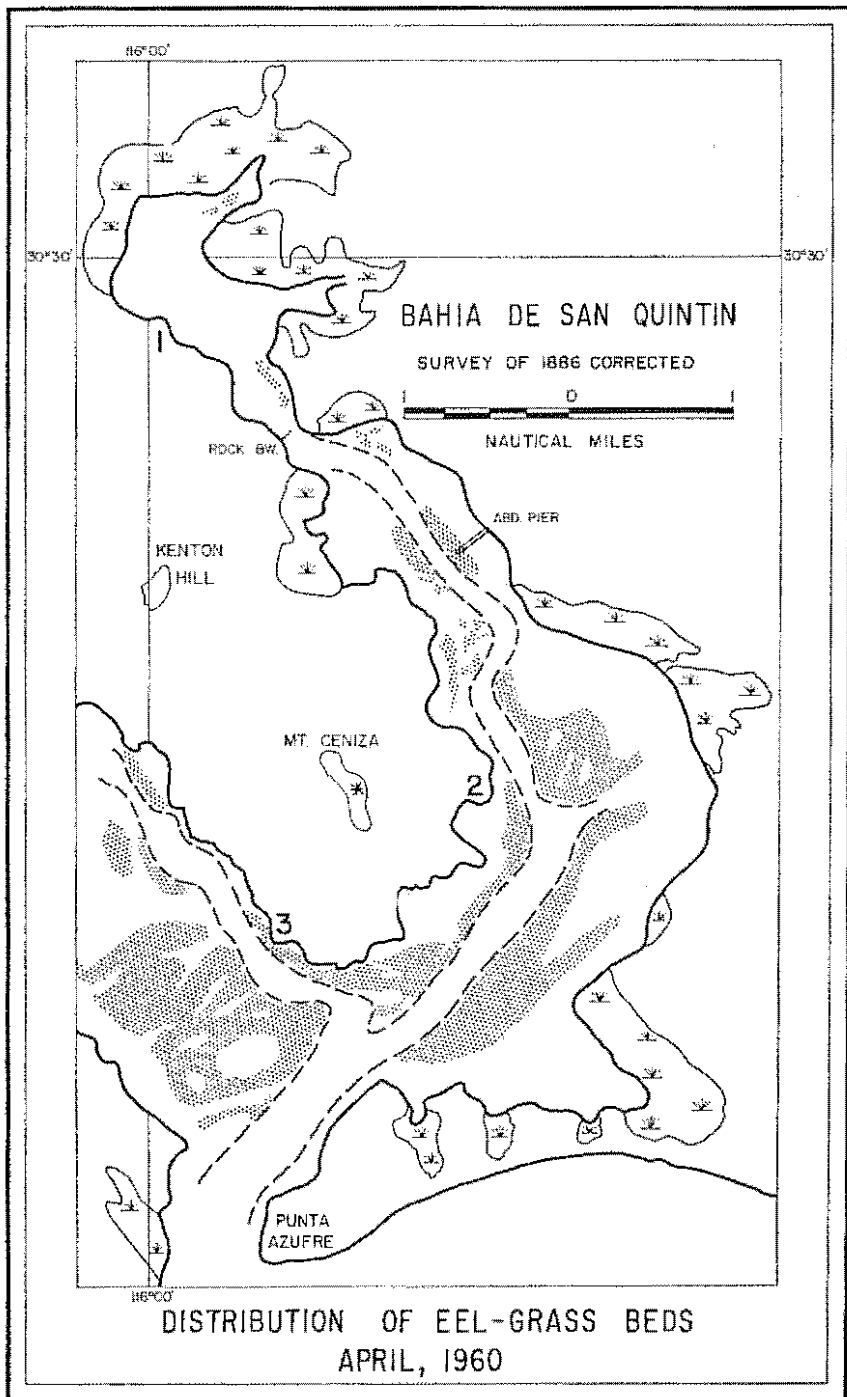
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<sup>2</sup>*Entophysalis deusta*, *E. conferta*, *Microcoleus chthonoplastes* and *Calothrix crustacea* (det. Francis Drouet).

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Fig. 1. Bahía San Quintín showing *Zostera* beds as observed and photographed at low water level, April 1960. The deep channels of the bay are outlined by broken lines. These represent depths of more than 4 feet at low water. All other depths are less than 4 feet at low water, and a large part of the shallows on the shoreward sides of the *Zostera* beds are exposed or nearly so at lowest low water springs.

The figures 1-3 represent the principal rocky shore localities within the bay at which marine algal collections were made. Approximate extent of the tidal marshes are outlined along the margins of the bay.



tide. More extensive patches of this plant were, however, observed in this area in December 1949. *Zostera* was heavily epiphytized in April by *Heteroderma minutula*.

Compared to the preponderance of *Zostera*, the algal vegetation of the bay is inconspicuous. Nevertheless, several species occur in moderate abundance, and the general composition and seasonal nature of the algal flora is of interest in establishing the present character of the vegetation for future comparison with conditions here and elsewhere along the Pacific Coast.

The algal flora at a given time consists of between 19 and 24 species, exclusive of Cyanophyta and other microscopic forms. Twenty three species were found in April, 1960, nineteen species in August, 1960, and twenty-four species in December, 1949. In each case six kinds of green algae were found, from none to three species of brown algae, and from thirteen to sixteen species of red algae. The following is a list of those plants that have been identified to date. The asterisks are explained below.

#### Green Algae

- \* *Ulva lactuca* L. *Chaetomorpha* sp aff. *C. cannabina* (Aresch.) Kjellm.
- \* *Ulva latissima* L. *Cladophora microcladioides* Coll.
- \* *Enteromorpha intestinalis* L. *Codium magnum* Daw.
- \* *Enteromorpha acanthophora* Kütz. \* *Derbesia marina* (Lyng.) Kjellm.
- \* *Enteromorpha compressa* (L.) Grøv.

#### Brown Algae

- \* *Ectocarpus granulosus* (Smith)
- C. Ag. \* *Colpomenia sinuosa* (Roth) D. & S.
- Ralfsia* sp. \* *Scytosiphon lomentaria* (Lyngbye) J. Ag.

#### Red Algae

- Gelidium johnstonii* S. & G.
- Heteroderma minutula* (Fosl.) Fosl. on *Zostera*
- \* *Lithothamnium lenormandii* (Aresch.) Fosl.
- Corallina pinnatifolia* (Manza) Daw.
- Lithothrix aspergillum* J. E. Gray
- \* *Hypnea cervicornis* J. Ag.
- Gracilariopsis* sp.
- Gracilaria subsecundata* S. & G.
- Gigartina canaliculata* Harv.
- Gigartina tepida* Hollenberg
- Lomentaria hokodatenensis* Yendo
- \* *Centroceras clavulatum* (Ag.) Mont.
- Ceramium caudatum* S. & G.
- Ceramium taylorii* Dawson
- Ceramium personatum* S. & G.
- \* *Spyridia filamentosa* (Wulf.) Harv.
- \* *Griffithsia tenuis* C. Ag.
- Griffithsia multiramosa* (S. & G.) Tayl.
- Dasya* sp.
- Hypoglossum attenuatum* Gardner
- \* *Polysiphonia mollis* Hook. & Harv.
- Chondria* sp.
- Laurencia* sp.

The collections and observations to date reveal a number of definitive generalities about this flora:

1. Except for a very few epiphytes on the *Zostera*, macroscopic, benthic algae are largely confined to the rocky shores along the central peninsula between the two arms of the bay.

2. Fifteen of the thirty identified species are of cosmopolitan or widespread distribution in the warm-temperate northern hemisphere and are to be expected in almost any such confined body of water as Bahia San Quintín (marked by asterisks).



Figure 1. Aerial view of the lower portion of San Quintin Bay to the sea yard (right) and the deep channel in the bay is visible, bordered by dark patches of *Zostera* grading into the mud flats.

3. All but six of the species detected in the flora thus far are known to occur in other similar, shallow bays or protected situations along the Baja California and southern California coast to the north.

4. A few species, notably *Gelidium johnstonii*, *Hypnea cervicornis*, *Gracilaria subsecundata*, *Ceramium personatum*, *Lomentaria hakodatensis* and *Hypoglossum attenuatum*, characteristic inhabitants of the Gulf of California, appear to be out of their normal range and to reach here in this protected estuary a northern distributional limit on the Pacific Coast.

5. A marked seasonal development is evident in which most of the plants are in juvenile or ill-developed stages during the spring (April) but show rich development during summer (August) and maturity or decline by late fall (November-December). This is especially true of *Codium magnum*, *Spyridia filamentosa*, *Polysiphonia mollis*, *Griffithsia tenuis*, *G. multiramosa*, *Gigartina tepida* and *Hypoglossum attenuatum*.

6. *Codium magnum* is a unique, massive plant, the largest member of the genus on record, and unknown elsewhere on the coast.

Three algal collecting areas were found to be distinctive along the central peninsula and are indicated on Fig. 1 as numbers 1, 2 and 3.

Station 1 exhibited a particularly marked seasonal development. Scarcely any macroscopic algae were evident, except for *Enteromorpha*, during the period of our April observations. Only a few bits of *Spyridia* and *Codium* were found, all in very young stages. By August, however, the *Spyridia* had become dominant and in good growth. *Hypnea*, *Centroceras*, *Chondria* and *Derbesia* were present, and the *Codium* had reached moderate size. By November the *Codium* was massive and almost past maturity (as it had been found also in late December, 1949) and the *Spyridia* was even more abundant than in August.

Station 2 is located in an area of much better circulation than station 1 and is subject to slight lapping surf from the broad expanse of the bay to the south. Again, the flora during April was found to be largely of juvenile plants except for occasional good colonies of *Enteromorpha*. By August, however, the algal flora proved to have advanced greatly toward maturity. Large masses of *Ulva*, *Gracilaria*, *Polysiphonia* and *Codium* were present along with a large, plant-like colonial hydroid. *Gigartina cunaticulata*, characteristically a plant of open, surfy shores, was prominent on the most exposed rocks on this point. By November the *Gracilaria* and *Codium* had passed maturity and were on the wane, but *Polysiphonia* and *Ulva* remained and were accompanied by abundant red clumps of *Griffithsia tenuis* and *G. multiramosa*, much of which was drifting in from its place of growth on the shallow bottom and on Eel Grass a short distance off shore.

Station 3 was not observed during April, but by August showed a heavy development of *Polysiphonia mollis*, *Codium magnum*, *Hypnea cervicornis*, *Griffithsia tenuis*, *Centroceras clavulatum*, *Gracilaria subsecundata* and *Lomentaria baileyana*. By November several of these had declined and only *Ulva*, *Codium* and *Centroceras* were abundant and conspicuous.