Rev. Biol. Trop. 49. Supl. 2: 273-278, 2001
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# Requiem for an eastern Pacific seagrass bed

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(Received 23-VIII-2000.Corrected 17-X-2001. Accepted 01-XI-2001)

**Abstract:** Few papers concerning seagrasses of the eastern Pacific have been published. This paper presents the first ecological data on the seagrass, *Ruppia maritima*, from a non-lagoonal setting in the eastern Pacific. A 5 000 $m^2$ patch formed by *R. maritima*, at Playa Iguanita, Bahía Culebra, Pacific coast of Costa Rica was studied. Plant density and leaf length of *R. maritima* were determined along two transects on different dates. Above and below ground biomass were calculated along one transect. Plant density ranged from 1 590 to 8 630 individuals $m^{-2}$ along the two transects, with means of 5 990 ± 1 636 and 6 100 ± 1 876 plants $m^{-2}$ for transect 1 and 2, respectively. Longest leaf length per plant varied between 0.5 and 23.0 cm. Leaf biomass (LB) ranged from 10 to 97 $gm^{-2}$, and root-rhizome biomass (RB) from 31 to 411 $gm^{-2}$, resulting in RB:LB ratios of 3.07 to 15.27. Total biomass at Bahía Culebra was lower than at tropical lagoons on the Pacific coast of Mexico, but higher than in the Gulf of Mexico. The below ground: above ground biomass ratio was much higher at Bahía Culebra than at other sites on the Pacific coast of Mexico and the Gulf of Mexico. Another seagrass present at Bahía Culebra was *Halophila baillonii*, with low densities on the deepest section of the patch. At least 44 invertebrate species associated with the seagrass bed have also been identified. The patch at Playa Iguanita and other sites within Bahía Culebra, as well as their associated organisms, disappeared after a severe storm in June 1996. No seagrasses have been found in the area or in any other location on the Pacific coast of Costa Rica since then.

**Key words:** Seagrass, Costa Rica, *Ruppia maritima*, *Halophila baillonii*, eastern Pacific.

Seagrasses are flowering plants that live permanently and totally immersed in seawater. Only 48 species worldwide comply with this definition (Phillips and Meñez 1988) and only four species have been reported from the eastern Pacific (Davidse *et al.* 1994): *Ruppia maritima* Linnaeus, 1753, Family Potamogetonaceae; *Halophila baillonii* Ascherson, 1874, Family Hydrocharitaceae, *Najas marina* Linnaeus and *Halodule beaudettei* (Hartog).

Many papers and reports have been published on *R. maritima*, especially from the Gulf of Mexico (*e.g.* Lewis *et al.* 1985, Dunton 1990, Lazar & Dawes 1991). However there is very little published information about the eastern Pacific. One paper reports on production in a coastal lagoon complex (Edwards 1978), and another on seasonal biomass, in a lagoon (Flores-Verdugo *et al.* 1988), both in Mexico.

For Costa Rica there are only reports on the presence of two species, the main one being *R. maritime* (widgeon grass) which has a cosmopolitan distribution (Gómez 1984). The other documented species is *H. baillonii*, reported for the Caribbean Sea and Atlantic Ocean, and in Costa Rica only from the Pacific coast (Gómez 1984). Two other species, *N. marina* and *H. beaudettei*, may be present in Costa Rica, since

they have been reported from localities north and south of the country (Davidse *et al.* 1994). Gómez (1984) considers *H. beaudettei* as a synonym of *Halodule wrightii* Ascherson. If this is the case, *H. wrightii* will also be present in Costa Rica, although Davidse *et al.* (1994) consider them separate species.

This paper provides the first data, aside from distributional information, on *R. maritima* in Costa Rica, as well as the first ecological data on the species from a non-lagoonal environment in the eastern Pacific. Seagrass distribution on the Pacific coast of Costa Rica, data on the density and biomass of *R. maritima*, and the diversity of associated organisms from a seagrass bed in the northern Pacific coast of Costa Rica are presented.

## MATERIALS AND METHODS

**Localities with seagrasses:** While studying coral reefs a seagrass bed was serendipitously found at Playa Iguanita, Bahía Culebra, Pacific coast of Costa Rica (Fig. 1, 2a). This bed was studied in detail and is the subject of this paper. Later, an over-flight of Bahía Culebra was done and other patches were identified (Fig. 2b). From interviews with researchers, the location of patches in other parts of the coast were obtained.

**Plant density and leaf size:** At the Playa Iguanita seagrass bed (Fig. 1), an 8.5 cm inner diameter PVC corer, pushed 10 cm into the substrate, was used to collect 13 and 14 samples along two transverse transects, on 12.IX.1994 and 19.XI.1994, respectively. The number of plants per core was counted and adjusted to 1 $m^2$. In addition, the length of the longest leaf on each plant (which gives an indication of the maximum size that can be attained in that environment) was measured with a ruler.

**Biomass:** Above and below ground biomass was determined for transect 1 only. Roots and rhizomes were dried for 48 hours at 80C, then cooled in a desiccator and finally weighed on an analytical balance to determine root-rhizome biomass (RB). This procedure was repeated with the leaves to determine leaf biomass (LB). Practically no sessile epiphytes lived on the leaves so pre-analysis cleaning was not necessary.

**Associated fauna:** The fauna associated with the plants in the cores (described above) was separated and identified. Larger organisms at the study site were collected by hand.

## RESULTS

Only three sites along the Pacific coast of Cos-ta Rica have been found with seagrasses: Bahía Culebra (10°37'55"N, 85°35'45"W), with one large patch and five much smaller patches (<100 $m^2$, Fig. 1, 2b), Herradura (9°38'40"N, 84°39' 50"W), with one small patch (William Bussing, pers. com. 1996), and the mouth of Río Sierpe (8°46'30"N, 83°38'10"W) with one patch less than 500 $m^2$ (Ricardo Soto, pers. com. 1996) (Fig. 1). All three sites with seagrasses were located near river mouths.

The seagrass bed at Playa Iguanita was the largest of several patches found at Bahía Culebra (Fig. 1, 2a). It covered an area of approximately 5 000 $m^2$, and was inhabited primarily by *R. maritima*. The deepest zones, separated by a few centimeters from the main patch, were occupied by a sparse population of *H. baillonii*. The seagrass bed was approximately 100 m wide by 500 m long, started less than 10 m from the shore, and at low tide it was between 0.5 and 1.0 m deep.

The average density per quadrat of *R. maritima* for transect 1 was 5 990 ± 1 636 plants $m^{-2}$, with a range of 2 470 to 8 630 plants $m^{-2}$, and for transect 2 was 6 100 ± 1 876 plants $m^{-2}$, with a range of 1 590 to 8 110 plants $m^{-2}$. The differences were not significant (t-student, $p>0.05$).

The average length of the longest leaves of the plants of *R. maritima* in transect 1 was 11.6 ± 3.36 cm, with a range of 1.5 to 20.6 cm, and for transect 2 was 10.7 ± 2.29 cm, with a range of 0.5 to 23.0 cm. The differences were not significant (t-student, $p>0.05$).

Biomass results for *R. maritima* from transect 1, were divided into below ground (RB) and above ground (LB) biomass and the RB:LB ratios were calculated. Root-rhizome biomass was always higher than leaf biomass, with the ratio ranging from of 3.07 to 15.27. Below ground biomass ranged from 31 to 411 $gm^{-2}$ while above ground biomass ranged from

10 to 97 $gm^{-2}$. Total biomass of *R. maritima* extremes (Lazar & Dawes 1991). The tolerance

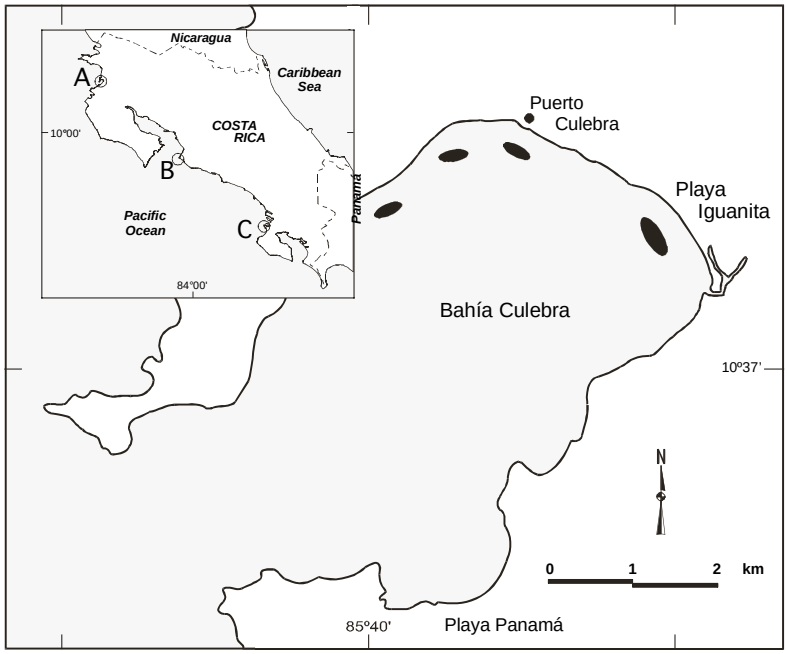


Fig. 1. Seagrass beds in Bahía Culebra, Guanacaste (dark areas), and other localities in Costa Rica (inset, in circles): A = Bahía Culebra, B = Herradura, and C = mouth of Río Sierpe.

ranged from 41 to 477 $gm^{-2}$.

At least 44 species associated with *R. maritime* were found, including 35 species of micromollusks, at least two species of crustaceans and at least six species of polychaetes. One species of algae, *Acanthophora specifera*, grew over the leaves of *R. maritima*. The most abundant organism living on *R. maritima* was the micro-gastropod *Alaba supralirata* Carpenter. The main macro-invertebrate associated with the *R. maritima* bed was the bivalve *Pinna rugosa* (Sowerby). The snail *Strombus gracilior* Sowerby, was found associated with *H. baillonii* in the deepest sections of the seagrass bed.

## DISCUSSION

*R. maritima* has a cosmopolitan distribution, from subtropical to tropical environments. It exhibits tolerance to an extremely wide range of salinities, from fresh water to normal seawater (Lewis *et al.* 1985), and to temperature and distribution ranges of *R. maritima* are so wide that this species probably represents a species complex.

*R. maritima* can be an important seagrass. For example, it predominates in the southern portions of Tampa Bay, Florida (Phillips 1962 in Lewis *et al.* 1985). Between 1980-1981, *R. maritima* was found in 15.5% of 226 samples from Tampa Bay´s seagrass meadows (Lewis & Phillips 1980 in Lewis *et al.* 1985). The species accounted for about 8.8% of the 5 750 ha of seagrass meadows in Tampa Bay (Lazar & Dawes 1991).

At Bahía Culebra, the density of *R. maritima* ranged from 1 590 to 8 630 plants $m^{-2}$, with a mean density of around 6 000 plants $m^{-2}$. Plant density in two subtropical estuaries in Texas was found to be much more variable. There plant density ranged from 0 - 1 600 plants $m^{-2}$ in winter, to 26 000 - 40 000 plants $m^{-2}$ in late summer (Dunton 1990). At Bahía Culebra, densities were not significantly different during the two

sampling times, and densities were never as high as in Texas during the summer.

Edwards (1978) reports production of *R. maritima* in a coastal lagoon in Mexico ranging from 0.36 to 3.64 $mgCg^{-1}$ of plant $hour^{-1}$, and a biomass range of 50 to 1 000 $gm^{-2}$. Another paper, also from a Mexican lagoon, presented seasonal biomass ranging from zero to 620 $gm^{-2}$

Fig. 2. a) Seagrass bed (dark areas under water) at Playa Iguanita, Bahía Culebra. b) Smaller patches (dark areas offshore) on the northwest end of Bahía Culebra. Photographs by Carlos Jiménez in 1996.

(Flores-Verdugo *et al.* 1988). Both of these tropical sites had greater total biomass than that found at Bahía Culebra.

In a study in Tampa Bay, Florida, *R. maritima* biomass was almost equally divided between below- and above-ground structures, being approximately 48 $gm^{-2}$ for each component during the spring (Lewis and Phillips 1980 in Lewis *et al.* 1985). A later study reported a below:above ground biomass ratio for *R. maritima* for Tampa Bay of 1.1 - 3.6 (Lazar & Dawes 1991). In Texas, biomass of *R. maritima* showed large seasonal changes, being lowest during the early spring months. Biomass ranged from 0 to a high of 330 $gm^{-2}$, and the average below: above ratio was 1.6 (Dunton 1990). Compared to the subtropical sites, overall biomass was higher and root-rhizome biomass was much higher at Playa Iguanita.

At least 44 species, mostly animals, were found associated with the seagrass at Playa Iguanita. The only epiphytic algae species was not abundant. This contrasts with the situation in Texas, in which macroalgae and microalgae epiphyte biomass on *R. maritima* usually equaled or exceeded that of the seagrass itself (Dunton 1990).

The differences between *R. maritima* at Bahía Culebra and the Mexican sites may be related to different environmental conditions. The Mexican sites are lagoons, with wide salinity fluctuations, while at Bahía Culebra the salinity range was small. The differences between tropical (Bahía Culebra in the eastern Pacific Ocean) and subtropical localities (Tampa Bay and Texas in the Gulf of Mexico) may be also due to latitudinal differences in climate, differences in ocean conditions, or to species interactions (*e.g.* herbivory).

Unfortunately, in June 1996 a severe storm with strong wave action and heavy rain destroyed the seagrass patch at Playa Iguanita, and other patches in Bahía Culebra. No *R. maritima* or *H. baillonii* has been found since then. Apparently *R. maritima* is very sensitive to storms as suggested by Bird *et al.* (1994) in North Carolina. No other seagrass bed has been found to date anywhere on the Pacific coast of Costa Rica.

## ACKNOWLEDGEMENTS

J. Gómez Laurito, Escuela de Biología, Universidad de Costa Rica, identified the seagrasses; C. Jiménez and E. Ruiz assisted with the field collections; and R. Vargas helped with the identification of the invertebrates. I thank H. Albertson, RSMAS Library for the help in obtaining copies of several of the key papers used here. The reviews of C. Lorion, K. Qualtrough, the editor of Revista de Biología Tropical, and two anonymous reviewers greatly improved the manuscript. This study was made possible thanks to the financial support of the Vicerrectoría de Investigación, Universidad de Costa Rica (projects No. 808-92-237 and 808-97-235).

## RESUMEN

Pocos estudios se han publicado sobre pastos marinos del Pacífico oriental. En este trabajo se presenta la primera información ecológica sobre el pasto marino *Ruppia maritima* (pasto de mareca, una especie de pato), en un ambiente no-lagunar del Pacífico oriental. Se estudió un lecho de 5 000 $m^2$ formado por *R. maritima* en Playa Iguanita, Bahía Culebra, costa Pacífica de Costa Rica. La densidad de plantas tenía un ámbito de 1 590 a 8 630 plantas $m^{-2}$, con promedios de 5 990 ± 1 636 y 6 100 ± 1 876 plantas $m^{-2}$ para el transecto 1 y 2, respectivamente. El largo promedio de la hoja más larga por planta tuvo un ámbito de 0.5 a 23.0 cm. La biomasa de rizomas fue de 31 a 411 $gm^{-2}$ y de hojas de 10 a 97 $gm^{-2}$; con una relación de biomasa sobre-bajo el sustrato de 3.07 a 15.27. La biomasa total de *R. maritima* en Bahía Culebra fue menor que en lagunas costeras en el Pacífico de México, pero mayor que en localidades subtropicales en el Golfo de México. La relación de biomasa sobre y bajo el sustrato en Bahía Culebra fue mucho mayor que otros sitios. Otro pasto marino presente en Playa Iguanita fue *Halophila baillonii*, con bajas densidades y en las partes más profun-das del parche. Por lo menos 44 especies asocia-das con el lecho de pasto marino han sido iden-tificadas. El lecho de pasto de Playa Iguanita y otros dentro de Bahía Culebra desaparecieron junto con su fauna asociada después de una tor-menta severa en junio, 1996. Desde entonces, no se ha

encontrado ningún pasto marino en Bahía Culebra o en ninguna otra localidad de la costa del Pacífico de Costa Rica.

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