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NOTA BREVE / SHORT NOTE

FIRST REPORT ON THE DISTRIBUTION AND EXTENSION OF SEAGRASS MEADOWS IN QUITASUEÑO CORAL BANK, SOUTHWESTERN CARIBBEAN

Primer reporte de la distribución y extensión de praderas de pastos marinos en el banco Coralino Quitasueño

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ABSTRACT

Seagrass beds constitute one of the world's most productive marine ecosystems and are a source of food and shelter for a wide variety of species. The largest extension of seagrass meadows in the Seaflower Biosphere Reserve (Seaflower BR) is found around the Caribbean islands of San Andrés, Old Providence, and Santa Catalina, with small patches around the cays Bolívar, Albuquerque, and Serranilla. Previous studies have reported the presence of seagrass beds in the Quitasueño Bank; however, they remain undescribed, without previous information about their extent and distribution within the coral complex. In November 2021, during the Seaflower Plus 2021 scientific expedition, extensive seagrass meadows were detected, and their distribution was determined through the interpretation of satellite images and analyses of information obtained in the field through rapid ecological assessments. It was determined that these meadows cover 619.7 ha, positioning Quitasueño as the second largest area in terms of seagrass coverage in the Seaflower BR after Old Providence and Santa Catalina islands. This new information increases the representativeness of the seagrass ecosystem within the National System of Protected Areas of Colombia and should be considered in future research and management efforts.

Keywords: Marine habitats, Ecological maps, Seaflower Biosphere Reserve, Marine Protected Areas

RESUMEN

Los pastos marinos forman uno de los ecosistemas marinos más productivos del mundo y son fuente de alimento y refugio para una gran variedad de especies. La mayor extensión de las praderas de pastos marinos en la Reserva de Biosfera Seaflower (RB Seaflower), se encuentra alrededor de las islas San Andrés, Providencia y Santa Catalina, con pequeños parches alrededor de los cayos Bolívar, Albuquerque y Serranilla. Trabajos previos señalaron la presencia de pastos marinos en el Banco Quitasueño, sin embargo, permanecen sin describir y no hay información disponible sobre su extensión y distribución dentro del complejo coralino. En noviembre de 2021, durante la expedición científica Seaflower Plus 2021, se detectaron extensas praderas de pastos marinos, y se determinó su distribución mediante la interpretación de imágenes satelitales y el análisis de información obtenida en campo a través de evaluaciones ecológicas rápidas. Como resultado, se encontró que las praderas abarcan 619.7 ha, lo que posiciona a Quitasueño como la segunda área en cuanto a cobertura de pastos marinos en la RB Seaflower después de Providencia y Santa Catalina. Esta nueva información incrementa la representatividad del ecosistema de pastos marinos del Sistema Nacional de Áreas Protegidas de Colombia, y debe ser considerado en futuros esfuerzos de investigación y manejo del Banco Quitasueño.

Palabras clave: Hábitats marinos, Mapas ecológicos, Reserva de la Biosfera Seaflower, Áreas marinas protegidas

Seagrasses, which are submerged flowering plants, play a pivotal ecological role in coastal ecosystems by forming extensive habitats with high biodiversity (Traganos *et al*., 2018). Seagrass meadows provide various ecosystem services, such as nursery areas, shelter, and food for multiple species, some of which have commercial value. They also help prevent coastline erosion by collecting and fixing sediments and contribute to climate change mitigation by storing carbon (Green and Short, 2003; Unsworth *et al*., 2008; Fourqurean *et al*., 2012).

In Colombia, seagrasses are only found in the Caribbean, and 97 % of them cover an area of approximately 64586 ha, while the remaining 3 % (2033 ha; Gómez-López *et al*., 2014) is located in the oceanic Archipelago of San Andrés, Old Providence and Santa Catalina, within the Seaflower BR (Fig. 2). The largest seagrass meadows in the archipelago are situated around the islands of Old Providence and Santa Catalina, covering an area of 1549 ha, and in San Andrés Island, covering an area of 399.5 ha (Gómez-López *et al*., 2014). In addition, 85 ha of seagrasses are found in the Bolívar Cay, Albuquerque, and Serranilla atolls (Díaz *et al*., 2003; IDEAM *et al*., 2007; INVEMAR-ANH, 2012).

The Quitasueño Bank, also situated within the Seaflower BR, is located 77 km west of Serrana Bank and 76 km north of Old Providence and Santa Catalina Islands, the bank spans 101198 ha, measuring 63 km in length and extending for 23 km at its widest point, making it the largest coral area in Colombia (Millán and Garcia-Valencia, 2021). Despite its vast size and significance, only four published works provide information regarding the benthic habitats of this bank (Sánchez *et al*., 2005; Gavio *et al*., 2015; Millán and García-Valencia, 2021; Rivas *et al*., 2023); however, none provides information on the distribution and size of seagrass meadows within this reef complex, with the exception of a photograph and a brief mention by Sánchez *et al*. (2005).

The Seaflower Plus scientific expedition in November 2021, visited the Quitasueño bank to conduct an updated mapping of shallow ecosystems in the area (0-30 m) by studying the benthic community cover. At each sampling station, two researchers surveyed an area of approximately 100 m^2 and visually estimated the percentage of abiotic substrate cover (rock, sand, and rubble) and conspicuous functional or taxonomic groups. They identified scleractinian corals and seagrasses to the species level, using methods adapted from Díaz *et al*. (1995) and Garzón-Ferreira and Pinzón (1999).

In addition, the dominant substrate, and the most conspicuous organisms of the seascape were photographed. A total of 164 sampling stations were evaluated, and seagrass meadows were found in eight of them. The meadows were composed of manatee grass, *Syringodium filiforme* (Kützing) and turtle grass, *Thalassia testudinum* (Banks & Sol. ex K.D. Koenig) with variable shares. *S. filiforme,* was usually dominant with an average cover of around 70 %, whereas the contribution of *T. testudinum,* was often less than 12 %; macroalgae and bare sand also contributed to the benthic cover observed at each station. In these meadows, the stems of both seagrass species were seen frequently scattered and mingled, except for one site where some spatial segregation was apparent. In one station, meadows made up of *S. filiforme* and abundant mixed macroalgae were observed (Fig. 1).

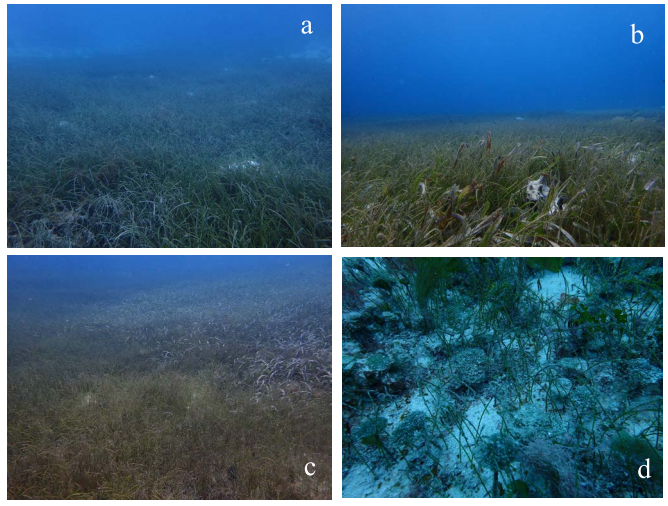

Figure 1. Seagrass meadows identified in Quitasueño Bank. Meadow dominated by *Syringodium filiforme* (a); mixed meadow with scattered and mingled steams of *Syringodium filiforme* and *Thalassia testudinum* (b); mixed meadow with steams gathered by species of *Syringodium filiforme* and *Thalassia testudinum* (c); meadow of *Syringodium filiforme* with coenocytic macroalgae (d).

The method to build the seagrass cover map for Quitasueño included visual interpretation of SENTINEL-2 images (ten satellite scenes acquired between December 2020 to November 2021), supported by information on seabed coverage at 164 sites sampled in the expedition, and recent cartography of this coral area (available at: https://areas-coralinas-de-colombia-invemar.hub.arcgis.com/).

To assist with image interpretation, six coverage types were established based on field data and previous cartography: 1) seagrass; 2) coral bottoms; 3) rubble; 4) macroalgae meadows; 5) sand; and 6) coral rock. The study resulted in a map displaying 619.7 ha of seagrass cover, distributed across 107 patches ($\bar{x}$ = 6.3 ± 25 ha) that are clustered within five bank sectors (Fig. 2). The majority of seagrass patches, including the largest one (245.7 ha), are located in the south and center of Quitasueño, in a sector where the lagoon narrows (Fig. 2A). Nearly 2 km north from there, and continuing for 6.5 km in the same direction, six seagrass patches are distributed over the lagoon basin that borders the lagoon terrace, covering around 90.9 ha ($\bar{x}$ = 15.1 ± 10 ha; Fig. 2B). In both sectors, seagrass meadows grow on sandy bottoms adjacent to shallow coral reefs, often with some sparse coral colonies, but also in bottoms exhibiting scattered reticulated coral patches

dominated by *Orbicella* species. Those sectors include small seagrass patches growing on the lagoon's terrace in-ground depressions surrounded by gravel, debris, and scattered coral colonies, some of which are located only 200 m from the reef crest (Fig. 2A and B). Between these two sectors, in a westbound direction and up to 8 km away from the reef crest, more than 20 small patches of seagrasses were dispersed throughout the area ($\bar{x}$ = 0.7 ± 1 ha) (Fig. 2C). In the north of the bank, four medium-sized ($\bar{x}$ = 6.2 ± 7 ha) seagrass patches were found in the lagoon, in an area dominated by sparse corals and sand (Fig. 2D). Lastly, five seagrass patches were recognized in a sector on the leeward pre-reef terrace, very close to the southeast side of the lagoon basin ($\bar{x}$ = 66.6 ± 13 ha). The particularity of these patches is the presence of a mixed habitat made up of seagrasses and macroalgae growing at a depth of 20 m, which is uncommon for seagrasses in Colombia. Among the most conspicuous macroalgal species in those patches are *Caulerpa* spp., *Halimeda* spp., and *Udotea* spp., and among seagrasses, *S. filiforme* stands out for its abundance (Fig. 2E).

This is the first mapping effort of seagrass meadows in Quitasueño. Their extension ranks the locality as second in seagrass cover within the Seaflower BR, after the islands of Old Providence and Santa Catalina (1549 ha) and prior to San Andres Island (399.5 ha). This report adds 619.7 ha to the extension of the ecosystem in the Seaflower BR, which now extends up to 2653 ha. It is the third Marine Protected Area in Colombia with the highest seagrass cover after the Sawairu Regional Integrated Management District (21900 ha) and Corales del Rosario y San Bernardo National Natural Park (3017 ha), which corresponds to an increase in the representation of this ecosystem within Colombia's marine protected areas from 28.2 % (Invemar database) in 2021 to 29 %. Quitasueño not only stands out, among the northern Colombian cays, for its high coral abundance and sizable habitat diversity (Sánchez *et al*., 2005), but it is also the only remote and uninhabited reef complex in Colombia with large seagrass extensions, which increases the already high diversity of habitats present. The unveiling of the distribution and extension of seagrass meadows in Quitasueño is a starting point for future research addressing several emerging questions. For instance, are well-known threats, such as climate change and pollution, affecting its seagrass cover and extension? Since past expeditions did not report on these meadows, have they likely increased their extension in recent years? What is the genetic variability within their seagrass patches? How do the composition and cover of seagrass species vary within the complex? Which organisms are associated with seagrass meadows in Quitasueño?

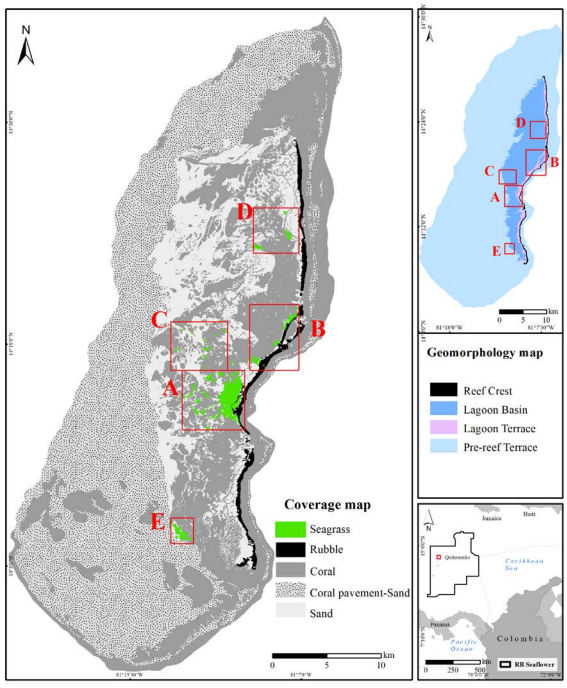

Figure 2. Spatial arrangement of seagrasses relative to the cover map (present report) and to the geomorphology map (Millán and Garcia-Valencia, 2021).

In conclusion, the information on the extension and distribution of the seagrass meadows in Quitasueño Coral bank constitutes a tool to guide management and decision-making processes. These data are contained in a cartographic layer freely available for viewing or downloading, from 2023 onwards, on the "Atlas de Áreas Coralinas de Colombia" digital platform (Invemar – MinAmbiente, 2020), or by direct request to Invemar (http://www.invemar.org.co/web/guest/acuerdo-de-acceso-uso-a-datos).

AUTHORS PARTICIPATION

The authors contributed to all aspects of the manuscript.

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CONFLICT OF INTEREST

The are no conflicts of interest.

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