POTENTIAL USE OF HALOPHYTES AS BUFFERS ON AGRICULTURAL LAND ADJACENT TO SALT FLATS

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Introduction

Salt flats form a transition area between coastal areas and uplands. These environments are characterized by high evaporation, infrequent tidal flooding and hypersaline soils with plants that have morphological, physiological and phenological adaptations that allow them to grow and reproduce under these conditions (Fig. 1). Some adaptations found in halophytes include salt excretory glands, hypertrophied pores, succulent leaves and stems, air spaces that carry oxygen, short life cycle, waxes and specialized roots. Obligated halophytes such as *Salicornia bigelovii* survive only in high concentrations of salt, while facultative halophytes as *Paspalum vaginatum* tolerate wide ranges of salinity.

Conservation buffers are strips of permanent vegetation designed to reduce the velocity of runoff, stabilizing soils and reducing pollutant loads. In addition, they provide nesting areas, food and shelter for wildlife. The strategic location of these bands in salt flats adjacent to farmland reduces the movement of sediment (Fig. 2), nutrients and contaminants, protecting important coastal marine ecosystems such as coral reefs, mangroves and seagrass beds.

Objectives

- Identify species and attributes of selected dominant halophytes in salt flats in southern Puerto Rico.
- Determine the essential characteristics for commercial propagation of these species.
- Establish vegetative strips to demonstrate halophytes' ability to control erosion and reduce runoff.

Salicornia bigelovii *Batis maritima* *Spartina patens* *Sporobolus virginicus*

Fig. 1. Common halophytes in Puerto Rico

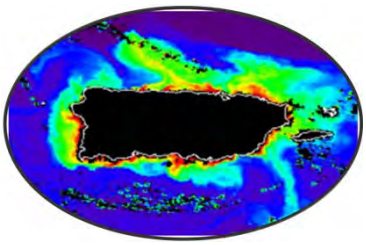


Fig. 2. Image (NASA MODIS) of suspended sediments (K490) near the coast of Puerto Rico after an episodic rainfall event in November 2003 (courtesy of Bio-Optics Laboratory, Department, Marine Sciences, UPRM).

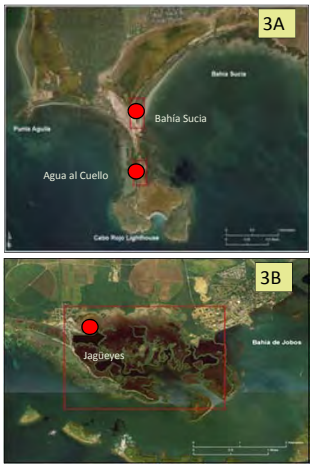


Fig. 3. Location of sampling stations in Cabo Rojo (Agua al Cuello and Bahia Sucia) (3A) and Salinas (Jagüeyes) (3B).

Fig. 4. Identification halophyte species, their attributes, and lifting the soil profile.

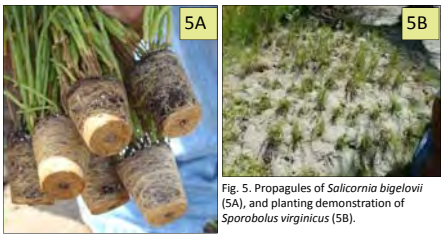


Fig. 5. Propagules of *Salicornia bigelovii* (5A), and planting demonstration of *Sporobolus virginicus* (5B).

Fig. 6. *Sesuvium portulacastrum* Plot (6A) and rainfall simulator plot of *Paspalum vaginatum* (6B).

Fig. 7. Water samples collected from rainfall simulator experiments: *Paspalum vaginatum* plot (7A), control plot (7B).

Table 1. Species of halophytes on salt flats in southern PR

Species
Gossypium hirsutum L.
Vachellia farnesiana (L.) Wight & Arn.
Avicennia germinans (L.) L.
Batis maritima L.
Coccoloba uvifera (L.) L.
Conocarpus erectus L.
Cyperus spp.
Euphorbia mesembrianthemifolia (Jacq.) Dugand
Fimbristylis cymosa R. Br.
Heliotropium curassavicum L.
Laguncularia racemosa (L.) C.F. Gaertn.
Neptunia plena (L.) Benth.
Paspalidium geminatum (Forssk.) Stapf
Paspalum vaginatum Sw.
Phyla nodiflora (L.) Greene
Rhizophora mangle L.
Salicornia bigelovii Torr.
Scirpus spp.
Sesuvium portulacastrum (L.) L.
Spartina patens (Aiton) Muhl.
Sporobolus virginicus (L.) Kunth
Sporobolus pyramidatus (Lam.) Hitchc.

Table 2. Dominant species of halophytes, attributes and soil characteristics

Species	Ground Cover (%)	Foliar Cover (%)	Soil pH	Soil Electrical Conductivity S/m-1
Sesuvium portulacastrum (L.) L.	6-45	60-98	8.3-9	7.73-17.70
Batis maritima L.	13-32	75-98	8.5-8.8	10.06-10.77
Sporobolus virginicus (L.) Kunth	11-29	85-90	8.1-8.4	3.9-16.72
Spartina patens (Aiton) Muhl.	36-64	88-92	8.3-8.5	3.26-16.01
Salicornia bigelovii Torr.	15	83	9.3	28.94
Paspalum vaginatum Sw.	17	83-88	8.3-8.5	12.98-13.01
Paspalidium geminatum (Forssk.) Stapf	26	85	8.3-8.4	3.24

Methodology

- Selected saltflat stations: Jagüeyes (Salinas), Agua al Cuello and Bahia Sucia (Cabo Rojo) (Fig. 3), Ensenada Las Pardas (Guánica).
- Characterized species, % leaf cover, % ground cover and soil characterization (slope, pH, electrical conductivity and nutrients) every two feet along transects (Fig.4).
- Measured height of the soil profile.
- Collected germplasm (vegetative and seed) of dominant halophyte species for germination observations / reproduction under controlled conditions (Fig. 5).
- Established demonstration plots to propagate material under natural conditions.
- Simulated rainfall (Fig. 6) to quantify sediment reduction and runoff (Fig. 7) in plots of mixed and homogeneous species.

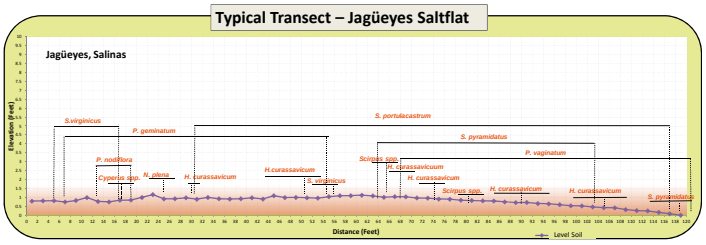
Observations

22 plant species (Table 1) were identified in the four saltflats evaluated: Jagüeyes (11), Agua al Cuello (8), Las Pardas (7), Bahia Sucia (5). Hypersaline conditions in Bahia Sucia explain the low species diversity. *Sesuvium portulacastrum*, *Batis maritima*, and *Sporobolus pyramidatus* were the most common species. *Sesuvium portulacastrum* was found at all stations evaluated, with a ground cover ranging from 6% in Agua al Cuello to 45% in Jagüeyes. *Spartina patens* found in Agua al Cuello and Las Pardas showed the greatest ground cover, at 36% and 64% respectively (Table 2).

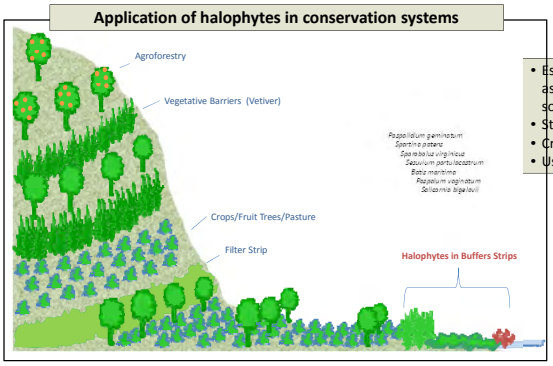
Work in Progress

The last phase of this project, in which the ability of several species to control erosion will be quantified, will be completed by March 2015. The zonation map of species based on soil salinity will be developed using an electrical conductivity meter.

Typical Transect – Jagüeyes Saltflat



Application of halophytes in conservation systems



- Establish salt flat buffers adjacent to crops such as tomatoes, peppers, plantains, bananas, corn, sorghum and soybeans.
- Stabilize sand dunes and salt flats.
- Create habitat for wildlife.
- Use as ornamentals.

References: This paper summarizes a grant project funded by the Caribbean Area Natural Resources Conservation Service (NRCS) to explore the potential use of halophytes in vegetative strips located at the edges of salt flats adjacent to farmland (#68-F352-10-002, 68-F352-09-02, 69-F-352-11-002)

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