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October 27, 2021

Techniques and Concepts for Improving Coastal Ecosystem Resiliency to Benefit both People and Wildlife

Gary Casabona
State Biologist – Rhode Island
USDA – Natural Resources Conservation Service

Conservation of Two Imperiled Saltmarsh / Wetland Species:

NRCS representative on the Atlantic Coast Joint Venture Management Board

Focal species: Saltmarsh sparrow, Black rail, American Black duck

NRCS Program: Wetland Reserve Easements (WRE)
Within saltmarsh for Saltmarsh sparrow
Within either saltmarsh or freshwater wetlands for Black rail

Conservation of Two Imperiled Saltmarsh / Wetland Species:

In New England, most saltmarshes do have a history of agriculture -- salt marsh haying. Needed for land eligibility for WRE.

We have 4 current saltmarsh WRE projects with several more moving through the process. Local partner from “Save the Bay” already had relationships with several private landowners, and that was the key.

Conservation of Two Imperiled Saltmarsh / Wetland Species:

All eastern coastal states can potentially contribute to the effort through conservation practices and easements within either the breeding or non-breeding range – of one or both of these species.

Ammospiza caudacuta

Ammodramus caudacutus

Salt Marsh Birds

Image: Peter WC Paton

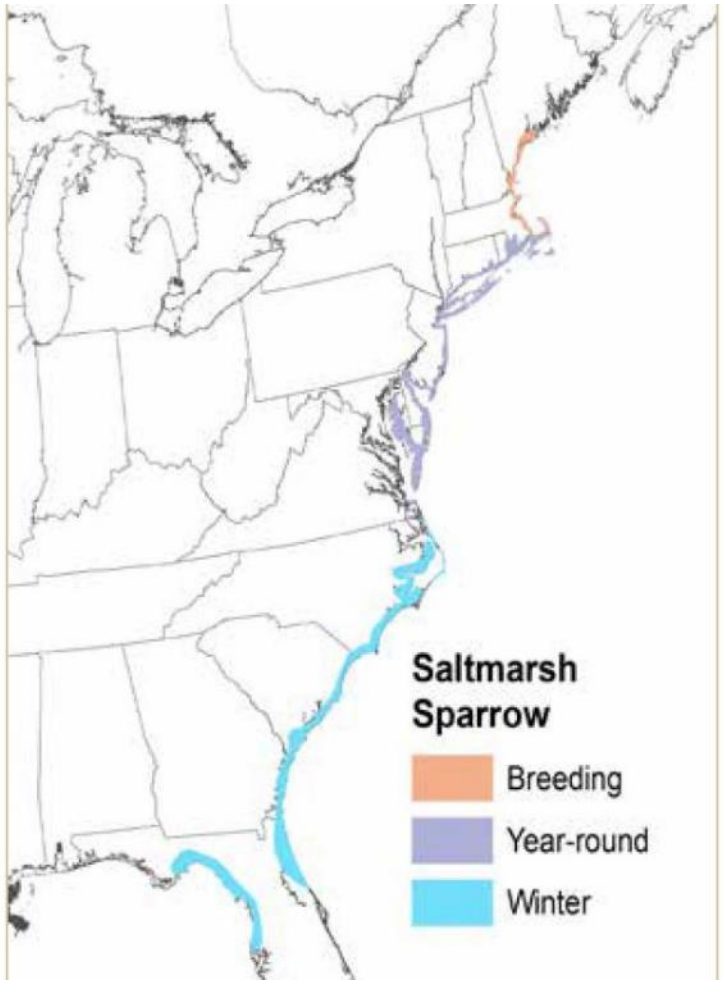
~See map disclaimer in profiles introduction

Distribution & Abundance

The Saltmarsh Sparrow, a superspecies that was split from Nelson's Sparrow in 1995, has a restricted nesting distribution along the Atlantic Coast from southern Maine to North Carolina . This species winters in coastal marshes from New York (casually from Massachusetts) to Florida. Saltmarsh Sparrows are restricted to salt marshes, where they breed, forage, and stopover during migration. They nest in the high marsh (i.e., marsh inundated on highest tides and dominated by Spartina patens and Juncus gerardii), and forage in the low marsh (i.e., marsh inundated daily by tides that is dominated by Spartina alterniflora) (Diquinzio et al. 2002). Saltmarsh

Saltmarsh Sparrow (*Ammospiza caudacuta*) is a tidal marsh-obligate songbird that spends its entire life in coastal salt marshes along the United States Atlantic and Florida Gulf coasts (Figure 1). Saltmarsh Sparrow is the only native breeding bird species endemic to the Northeastern United States; it breeds in all coastal states from Maine south to Virginia. Its wintering range includes the southern portion of its breeding range, extending south to coastal North Carolina, South Carolina, Georgia, and Florida (Greenlaw & Woolfenden 2007). Saltmarsh Sparrows forage in a range of microhabitats but generally nest only in the highest-elevation portions of "high marsh" (see Box on next page), those areas of salt marsh flooded least frequently, during twice-monthly spring tides or coastal storm events.

Saltmarsh Sparrow nests are constructed in salt marsh grasses just above the mean high water level. Their reproduction is particularly well suited to the lunar tide cycle (Shriver et al. 2007). As a result of synchronous nest failure and rapid renesting, Saltmarsh Sparrow nests are often synchronized with spring tides, and are able to withstand temporary tidal flooding if the eggs do not float out of the



https://www.acjv.org/documents/SALS_plan_final.pdf

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"At the observed rate of decline of 9% per year, the population has presumably shrunk from ~50,000 individuals (in 2011/2012) to fewer than 30,000 currently."

Conservation Plan

The Saltmarsh Sparrow Conservation Plan outlines the highest priority strategies needed to conserve the Saltmarsh Sparrow throughout its global range along the Atlantic coast.

DOWNLOAD PLAN

Photo: Ray Hennessy

Natural Resources Conservation Service

nrcs.usda.gov/

Atlantic Coast Joint Venture acjv.org

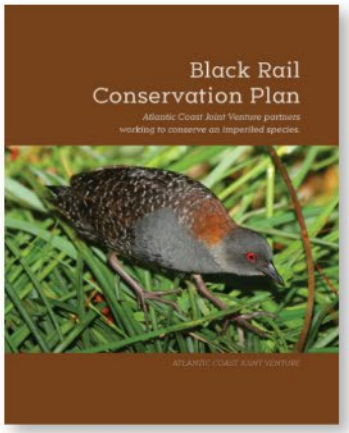
Conservation of Two Imperiled Saltmarsh / Wetland Species:

- Land management to mitigate flood inundation of nests
- Tidal channel restoration+ runnel creation
- Uplands provide for marsh migration and will be managed to benefit pollinators, Monarch butterfly, and migratory songbirds through seeding and native shrub planting

Laterallus jamaicensis

"This plan strongly emphasizes both the short-term need to create more non-tidal habitat that is safe from the threats of sea level rise and tidal flooding as well as the longer term need to facilitate marsh migration to provide future Black Rail habitat in tidal marsh systems."

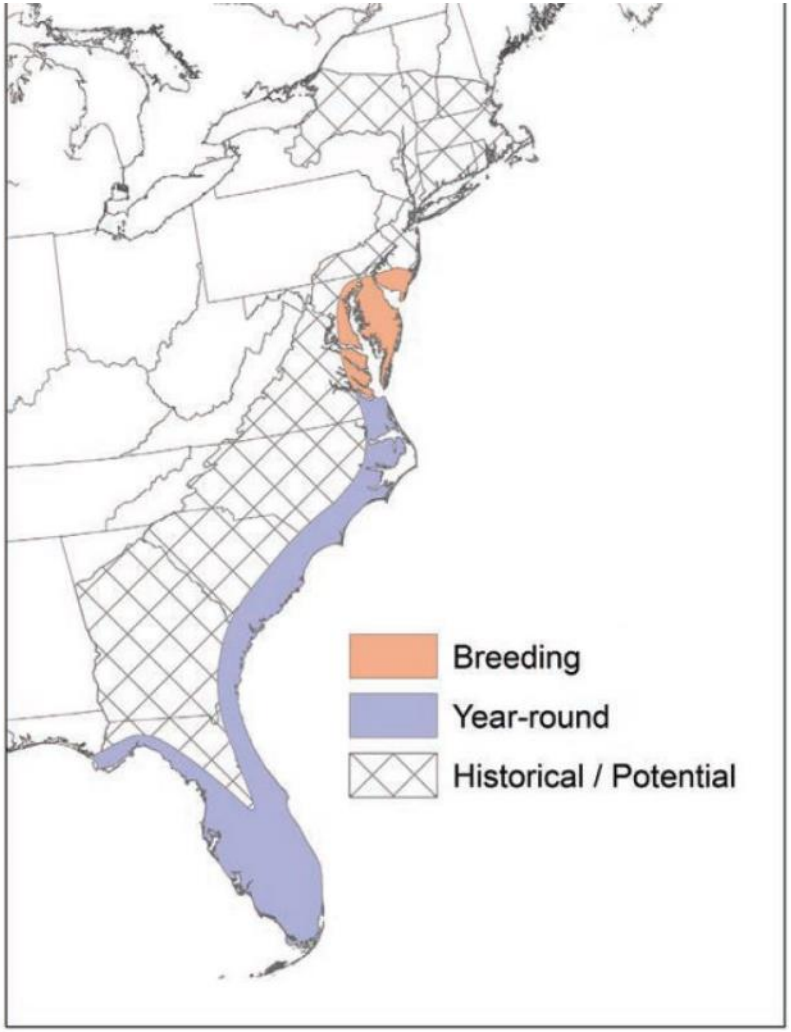
The Black Rail Conservation Plan



The Black Rail Conservation Plan outlines the highest priority strategies needed to conserve the Eastern Black Rail throughout its former range on the Atlantic and Florida Gulf coasts. The plan sets population and habitat targets for the short and long term with a goal of creating sufficient habitat to support a sustainable population of Black Rails within the ACJV area. This plan strongly emphasizes both the short-term need to create more non-tidal habitat that is safe from the threats of sea level rise and tidal flooding as well as the longer term need to facilitate marsh migration to provide future Black Rail habitat in tidal marsh systems..

The Black Rail (*Laterallus jamaicensis*) is the most secretive of the secretive marsh birds and one of the least understood bird species in North America. It is also the smallest and rarest of the rail species. Its existence was not confirmed in North America until 1836, when an adult and young were captured near Philadelphia (Allen 1900). Over the next 150 years, researchers slowly developed a picture of its North American distribution along with rudimentary knowledge of its ecology. Two North American subspecies have been identified — the California Black Rail (*L. j.coturniculus*), which is found in portions of California, Arizona, and Baja California, Mexico, and the Eastern Black Rail (*L. j. jamaicensis*), which is found in isolated populations across the Great Plains to the Atlantic and Gulf Coasts of the United States and Mexico. The eastern subspecies also occurs in several countries in Central America, the Caribbean, and Brazil. Within the Eastern Black Rail range, the greatest concentrations of rails have historically occurred in coastal salt marshes of the Atlantic Coast from Connecticut to Florida (Figure 1) and along the Gulf Coast from Florida to Texas .

https://www.acjv.org/documents/BLRA_Plan.pdf



Conservation of Two Imperiled Saltmarsh / Wetland Species:

•the use of water control structures to maintain appropriate vegetation and water depth in impounded wetlands;

•prescribed fire to set back woody vegetation;

•creation of freshwater sloped wetlands or wet meadows;

•use of dredge spoil or other materials that provide higher nesting areas
•in tidal marshes; and

•control of invasive plants in high marsh habitat.

Source: Atlantic Coast Joint Venture acjv.org

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Techniques and Concepts for Improving Coastal Ecosystem Resiliency to Benefit Both People and Wildlife

Christopher Miller USDA-NRCS, Cape May Plant Materials Center

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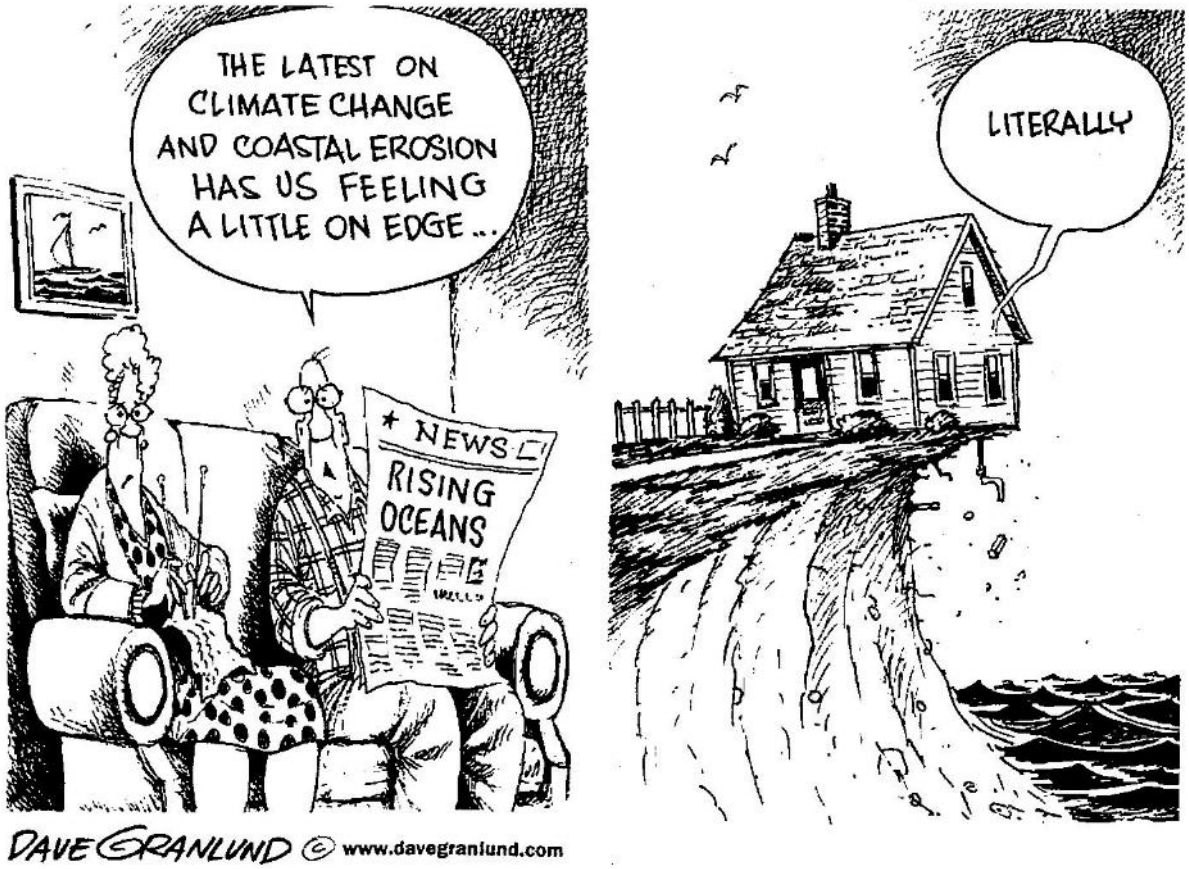
Climate Change Anxiety!

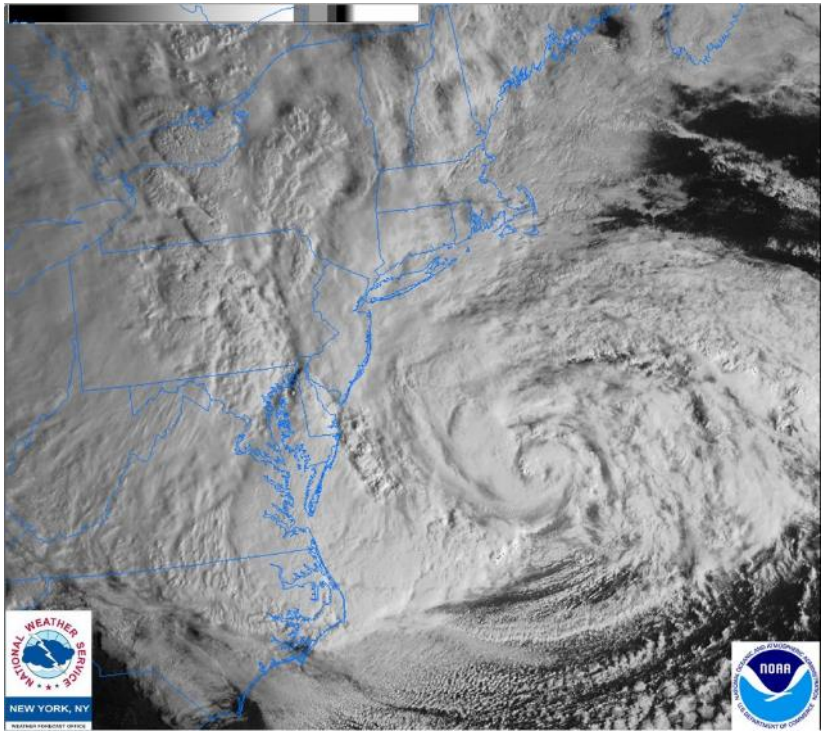


“There is no such thing as a natural disaster”

Neil Smith 2006- Social Science Research Council
Understanding Katrina SSRC.org

Superstorm Sandy - October 2012

Ground Zero-central NJ



Many Plants WERE Resilient

Magnolias in bloom in contrast to Sandy damage

Seaside Park, NJ Native Plant Demonstration comes alive after Sandy

Plant Adaptation-What makes a Resilient Coastal Plant?

1. Ability to rebound from scour or damage. (Stump sprouting, root suckering, rhizomes).

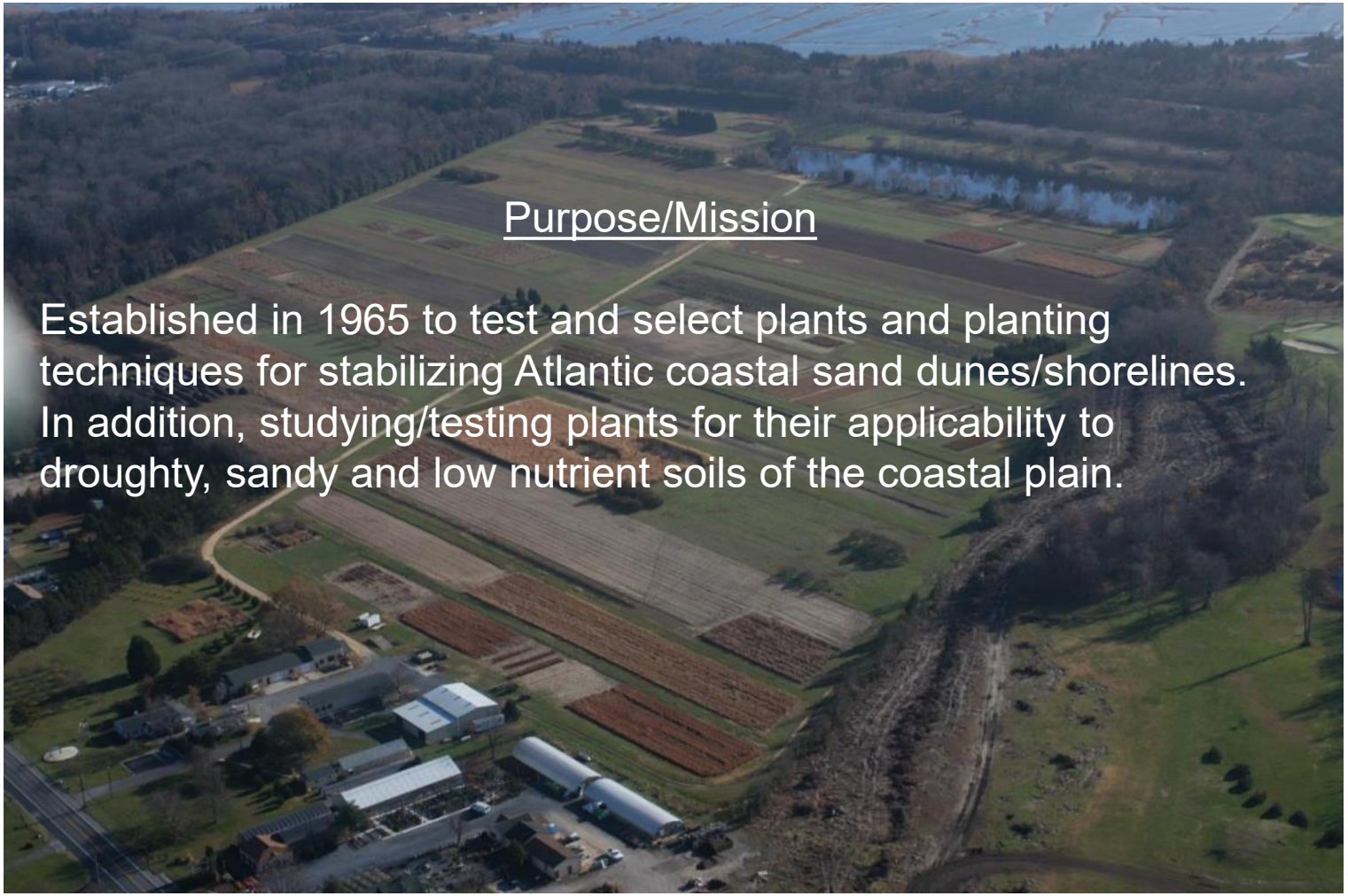
2. Ability to tolerate saltwater flooding and alternating wet/dry
   conditions.

3. Heat/drought tolerance

4. Spread rapidly by seed or rhizomes

5. Adaptable to varying environmental/soil conditions.

Cape May Plant Materials Center



Purpose/Mission

Established in 1965 to test and select plants and planting techniques for stabilizing Atlantic coastal sand dunes/shorelines. In addition, studying/testing plants for their applicability to droughty, sandy and low nutrient soils of the coastal plain.

NRCS Conservation Plant Selection

"Nature has evolved a plant for every purpose."

- Dr. Franklin J. Crider

General Concept:

Comparative Observation/Selection

Plant Materials Centers evaluate accessions both on and off Center.

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Dr. Steven Handel, Restoration Ecologist, Rutgers University

Shelter from the Storm (after Superstorm Sandy):

The long concern about restoring local genotypes of plants and animal may be a ruse. Successful restoration may require new genotypes of plant species from different locales that can tolerate the much changed conditions of the coming decades.

Ecological Restoration Vol 31. No. 4, 2013. Editorial

In other words, "We must take a proactive approach to introduce potentially adaptive and resilient plant species to solve natural resource issues."

Planting for Dune Stabilization

Plant zonation from frontal to back dune

Short Sighted Approach

Primary Dunes

American beach grass (*Ammophila breviligulata*) can grow further forward than most other species. However, it needs active sand accretion; it loses vigor when not growing on the foredune.

Most commercially available beachgrass is the 'Cape' variety. Origin: Cape Cod. Some availability: Bogue (NC) Germplasm

Caution: Do not use Great Lakes ecotypes on Atlantic Coast and vice versa.

Innovative Plant Technology Development

Coastal Dunes

- Develop dune seeding techniques (incl. hydroseeding) for multiple species to diversify plantings. (grasses, wildflowers and shrubs).
- Evaluate potential nurse crops: barley, Southeastern wildrye, and trailing wild bean.
- Evaluate bitter panicgrass (*Panicum amarum*) and sea oats (*Uniola paniculata*) on frontal dunes to complement beachgrass.
- Develop mycorrhizal fungi innoculation strategies for dune plantings.
- Improve commercial seed availability of a diversity species. (i.e. beach pea, trailing wild bean, seaside goldenrod, coastal little bluestem, beach heather)

The Beachgrass Dilemma

Beachgrass is a pioneer, early stabilizing plant on frontal dunes, however……..

In stable sand, it will lose vigor and yield to other, longer-lived species.

Growth and vigor suppressed in dredged sand-WHY?

Cape May City Dunes, Then and Now

Primary Dune

Bitter panicgrass (*Panicum amarum*)

- Establish vegetatively, slow to spread. Seed viability low. Longer lived than beachgrass.

Commercially available bitter panicgrass

- ‘Northpa’ variety. Origin: North Carolina
- Efforts to select northern Mid-Atlantic ecotype

Primary Dune

Sea Oats (*Uniola paniculata)-cold tolerant germplasm being tested for MD, DE, southern NJ.*

- *commercial production of local ecotypes- NC, FL and LA*

Future Release Development

Hamer Germplasm Sea Oats adapted to the northern Mid-Atlantic- FY22.

Virginia Seashore Mallow- a salt tolerant/flood tolerant value-added pollinator plant. FY 23.

Secondary Dunes

High diversity leads to high resilience

Secondary dunes can support more species, so in a healthy dune there should be a diverse mix of native species e.g.

- Saltmeadow cordgrass (*Spartina patens)*
- Coastal panicgrass (*Panicum amarum* var. *amarulum*)
- Coastal little bluestem (*Schizachyrium littorale*)
- Seaside goldenrod *(Solidago sempervirens)*
- Trailing wild bean *(Strophystyles helvola)*
- Beach pea *(Lathyrus japonicus)*

MD DNR Backdune Project Study

Plant Species	% Survival				Average
	Rep 1	Rep. 2	Rep. 3	Rep. 4	
Cape American beachgrass	50	10	25	45	**32.5**
Avalon saltmeadow cordgrass	100	90	75	100	**91.25**
Northpa bitter panicgrass	100	65	35	30	**57.5**
Coastal little bluestem	65	85	10	30	**47.5**

Spartina patens, saltmeadow Cordgrass

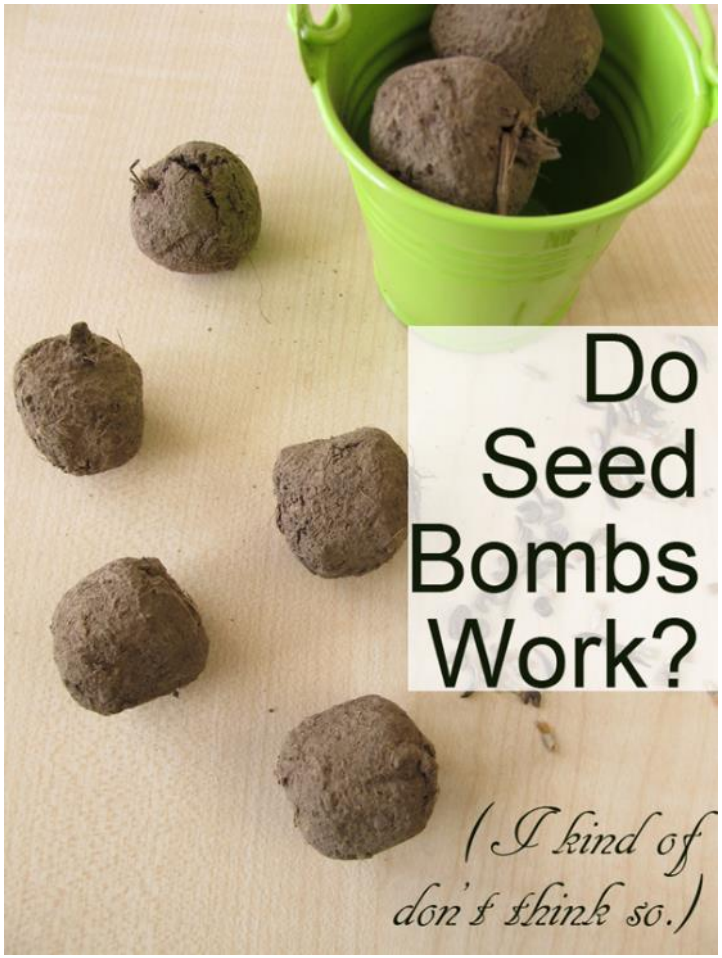
‘Avalon’ variety developed by NJPMC for coastal area north of the Carolinas

Warm season rhizomatous grass found in high marsh zones of brackish and salt marshes. **Grows on Dunes, Too!**

Dune Seeding Technology-1990's

Coastal panicgrass seeded in back dune-first growing season. Now specified by ACOE in many projects.

Alternative Seeding Method?



Seed “bombs”

Technology derived from the ideas of Masanobu Fukuoka
Author of “Sowing Seeds in the Desert.”

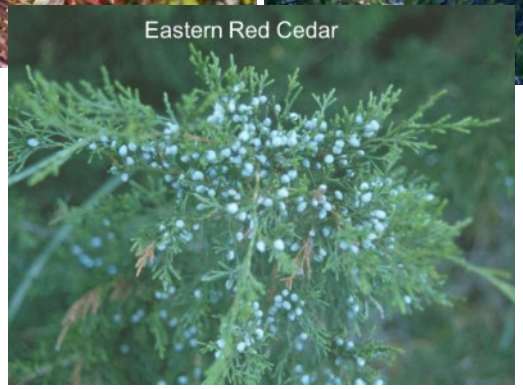
Also used by the Army Corps of Engineers to revegetate Army Training Lands.

Became popular on Long Island after Superstorm Sandy

Do they work? Maybe, Sometimes????????

Dune Planting- Woody Species

Groundsel (*Baccharis halimifolia*)
Bayberry (*Morella pensylvanica*)*
Virginia Creeper (*Parthenocissus quinquefolia*)
Beach Plum (*Prunus maritima*)*
Dwarf Sumac (*Rhus coppallina*)
Eastern Red Cedar (*Juniperus virginiana*)



Maritime Forests/Shrublands

Threatened and Fragmented Plant Community

A. Highly recommended and preferred by migratory songbirds:

Common Name	Scientific Name	Nutrient Content[1]			Antioxidant Properties[2]			
		Fat	Carbs	Energy	Antho.[a]	Vit E[b]	Phenols	TAC[c]
Arrowwood Viburnum	*Viburnum dentatum*	*High	High	High	High	High	High	High
Virginia Creeper	*Parthenocissus quinquefolia*	Med	High	High	Med	Low	High	High
Gray Dogwood	*Cornus racemosa*	High	Med	High	Low	N/A	Med	Low
Silky Dogwood	*Cornus amomum*	Low	High	Med	Med	N/A	Med	Low
Red Osier Dogwood	*Cornus sericea*	*Med	Med	High	Low	N/A	Med	Low

B. Recommended and eaten by many migratory songbirds:

Serviceberry	*Amelanchier spp.*	*Low	High	Med
Common Elderberry	*Sambucus canadensis*	Low	High	Med
Spicebush	*Lindera benzoin*	High	Low	High
Pokeweed	*Phytolacca americana*	Low	High	Low
Flowering Dogwood	*Cornus florida*	Med	Med	High
Chokecherry	*Prunus virginiana*	*Low	High	Low
Highbush Blueberry	*Vaccinium corymbosum*	*Low	High	Low

Antioxidants and Birds

Birds during migration experience oxidative stress when they burn fats to fuel their flights. Fruits with *high antioxidant capacity* can help to alleviate these stresses.

Vitamin E and *phenols in fruits*, especially colored compounds called *anthocyanins* that give fruits their bright purple-maroon coloration, are good dietary sources of antioxidants for birds.

Suggested citation: Smith, S. B. and S. R. McWilliams. 2015. Recommended plantings for migratory songbird habitat management. Rochester, NY: Rochester Institute of Technology and University of Rhode Island. 2 p.

Additional Desirable Shrub Species

C. Recommended and eaten by a few migratory songbirds and overwintering birds:

Northern Bayberry	*Myrica pennsylvanica*	*High	High	High
Winterberry	*Ilex verticillata*	*Low	High	Med
Black Chokeberry	*Aronia melanocarpa*	Low	High	Med
Mapleleaf Viburnum	*Viburnum acerifolium*	*Low	Low	Med
Nannyberry	*Viburnum lentago*	*Low	Med	Low

Suggested citation: Smith, S. B. and S. R. McWilliams. 2015. Recommended plantings for migratory songbird habitat management. Rochester, NY: Rochester Institute of Technology and University of Rhode Island. 2 p.

STRUCTURES OF COASTAL RESILIENCE
Rockefeller Foundation Funded After Superstorm Sandy

Narragansett Bay Team-Harvard School of Design

Think out of the "box" for Natural Based Designs

One potential solution "Attenuation Forest"

Utilize Trees and Shrubs that create a dense rhizomatic substrate with copse-like (thicket, grove) arrangement that creates a layer of growth that will attenuate and mitigate storm surge.

Disturbance creates injury which encourages more new sprouting/coppicing (root suckering/stump sprouting)

Resilient Salt Tolerant Trees and Shrubs

Tree Species

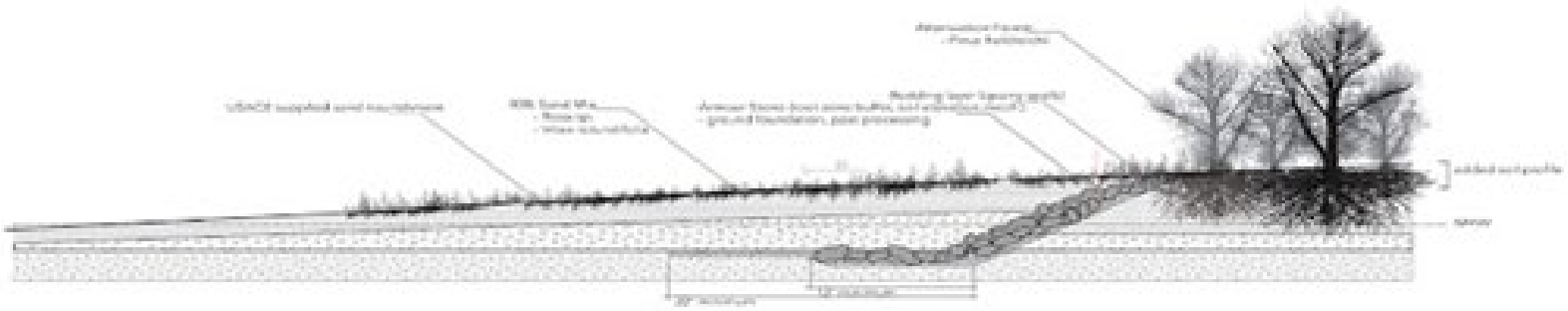
***Acer negundo*-boxelder**
***Acer saccharinum*- silver maple**
***Liquidambar styraciflua*-sweet gum**
***Populus deltoides*- E. cottonwood**
***Populus tremuloides*- quaking aspen**
***Prunus virginiana*-chokeberry**
***Quercus nigra*-water oak**
***Quercus palustris*- pin oak**
***Quercus phellos*-willow oak**
***Robinia pseudoacacia*-black locust**
***Salix nigra*-black willow**
***Sassafras albidum*-sassafras**

Shrub Species

***Amelanchier canadensis*-shadblow**
***Amorpha fruticosa* – indigo bush**
***Baccharis halimifolia*- groundsel**
***Clethra alnifolia*-sweet pepperbush**
***Cornus spp.*-shrub dogwood**
***Ilex spp.*-inkberry, smooth winterberry holly**
***Morella spp.*-wax myrtle. Bayberry**
***Prunus maritima*-beach plum**
***Rosa virginiana*-Virginia rose**
***Rhus spp.*-sumac**
***Sambucus canadensis*-elderberry**
Viburnum spp.

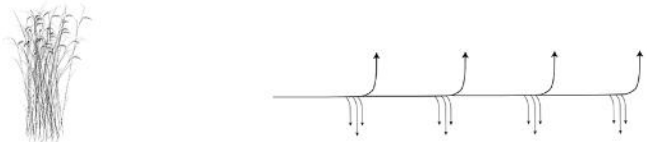
Source: Elkin, R.L. Beyond Restoration: Planting Coastal Infrastructure

Attenuation Forest Schematic
Harvard School of Design

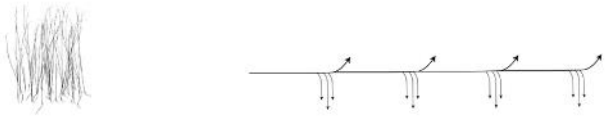


Coastal Resilient - Grasses

Root Architecture



Ammophila-beachgrass

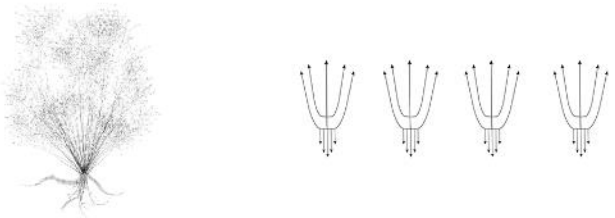


Spartina-smooth cordgrass

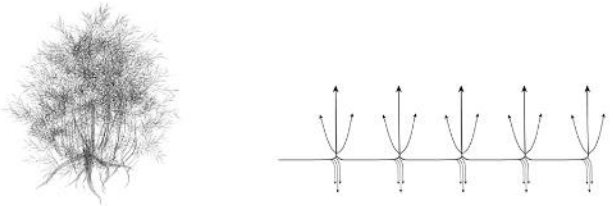
Source: Structures for Coastal Resilience, Harvard School of Design.

Coastal Resilient Trees and Shrubs

Root Architecture



Amelanchier-shadbush



Morella-bayberry

Source: Structures for Coastal Resilience, Harvard School of Design.

Innovative PMC Plant Technology Development

Tidal Marsh/Shoreline Applications

- Advance shoreline stabilization techniques through the development of seeding techniques.
- Selection/testing of woody plant species for soil bioengineering applications in brackish/saline water. (Baccharis, Iva, Salix)
- Screen shoreline species for saltwater adaptation/tolerances.
- Select/Test under-utilized plants for shorelines
  - Prairie cordgrass (*Spartina pectinata*), Eastern gamagrass (*Tripsacum dactyloides*), Giant cane (*Arundinaria gigantea/tecta*)

- Develop strategies to broaden plant diversity of phragmites stands.

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Developing Seeding Techniques for Tidal Marsh and Shoreline Stabilization

A Beneficial Use of Dredge Project

US Army Corps
of Engineers
New York District

Partners in Developing New Plant Sciences for the Tidal Marsh Restoration

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NRCS Natural Resources Conservation Service

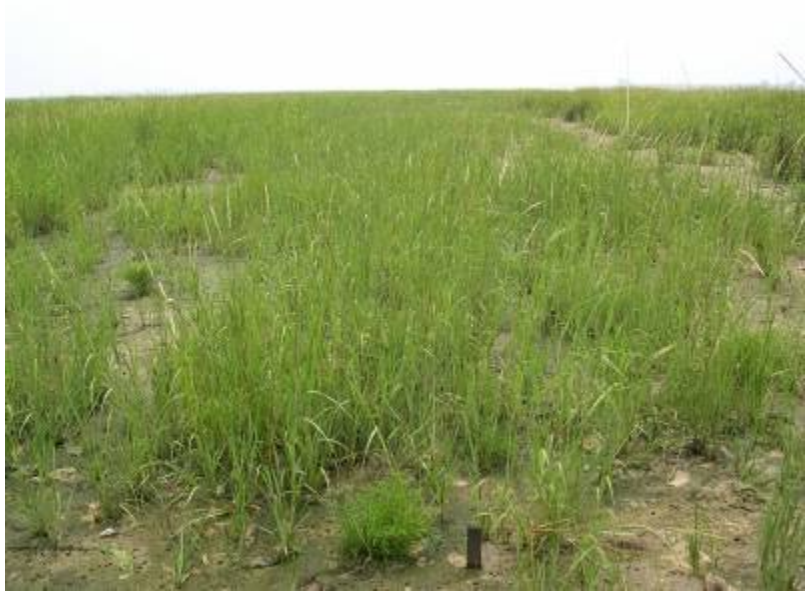
Cape May Plant Materials Center

Direct Seeding Technology for Marsh Establishment

Low Energy Site-Seeding

Sept. 07

July 08



Kasco Versa Seed Drill

Seed Drill Preparation/Calibration

Jamaica Bay-Spartina alterniflora Seeding

July 2012 seeding

September 2013

Conclusions

Seeding is a viable option in lower energy environments, in the upper ½ of the tidal range in coarse-textured (sand) dredge materials.

In higher energy sites, plant a shoreline fringe buffer of at least 50 foot with vegetative material. (upper 1/3 of tidal range)

High quality seed, properly stored and handled is necessary for seeding success.

Plant density from seeding takes 3 growing seasons to equal second growing season from vegetative plugs.

Drill seeding in high organic (muck) soils would be difficult and may have different results. (broadcast may work)

ACOE-Yellow Bar Project-Jamaica Bay, NY

Prime Hook NWR-After Dune/Marsh Restoration-2018

Mixing Marsh Species Seed for Aerial Appl.

BLM SOS seed and commercial supply

Let's Focus on Opportunities

Growing/Establishing Conservation Plants on Marginal Lands

Establish saltmeadow cordgrass (*Spartina patens*) for harvesting as a salt hay (mulch) crop.

Plant a biomass/fiber crop as a multifunctional buffer

- Switchgrass (*Panicum virgatum*)
- Coastal Panicgrass (*Panicum amarum var. amarulum*)
- Prairie cordgrass (*Spartina pectinata*)
- Seashore mallow (*Kosteletzka virginica*)

Harvest native shrub stems for soil bioengineering applications on brackish shorelines

- Groundsel bush (*Baccharis halimifolia*)
- High tide bush *(Iva frutescens*), Arrowwood (*Viburnum spp.*), Indigobush (*Amorpha fruticosa*)
- Willow (*Salix spp.*)-identify salt tolerant selections

Saltmeadow Cordgrass a.k.a. salt hay (*Spartina patens*)

Once harvested from the natural marsh for salt hay.

Valued as a weed free mulch.

Demand is still high but supply is low resulting in high cost.

Varietal selections being evaluated.

Advantages of Establishing Salt Hay

Provides erosion resistance between wetland and upland crop fields. Volunteers naturally when coastal farmland is abandoned.

Creates desirable and needed high marsh habitat

Potential income from harvesting. (3.5- 6.0 tons/ac. biomass potential)

Photo credit: Keryn Gedan, GWU

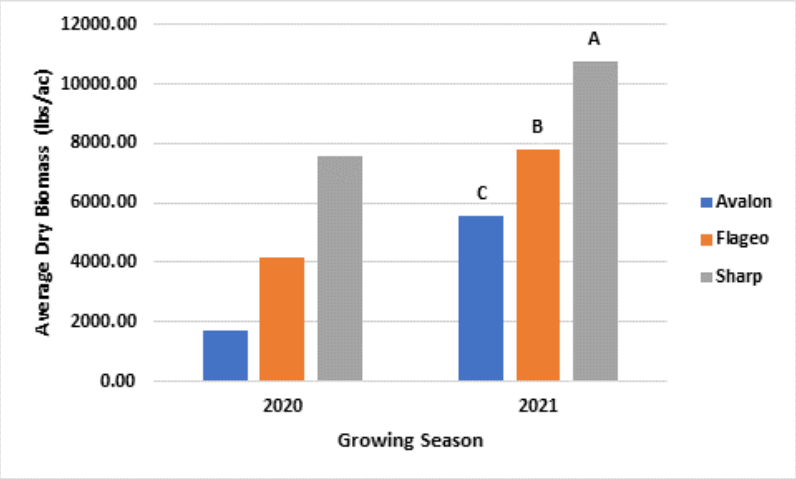
Agricultural land surrounding intertidal salt marsh in New Jersey along the Delaware Estuary (Google Earth).

sea level rise, such farmland will be intermittently flooded and be
uitable for salt-tolerant crops for, food, feed, non-food products

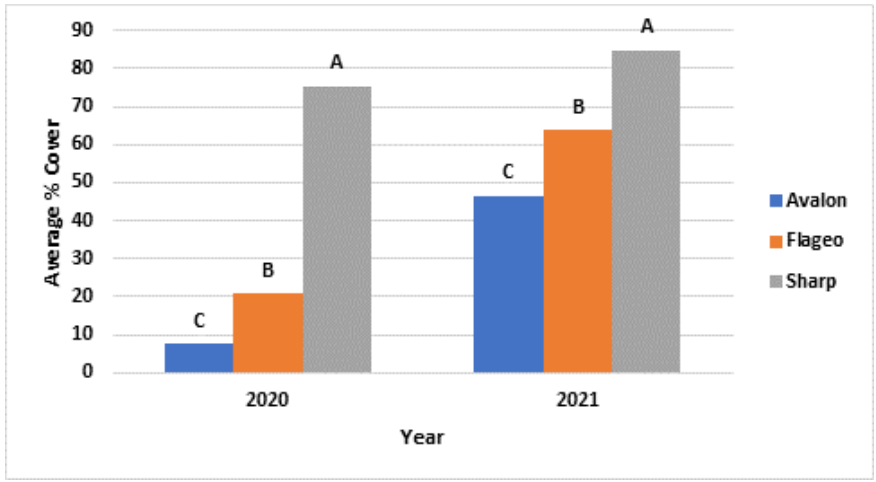
Sod Production in southern NJ Impacted by Sea Level Rise and Salts

Spartina Patens Variety Biomass Study

Dry matter biomass



Ave. percent cover



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Native Grass Species

High Tide Switchgrass

'Atlantic' Coastal Panicgrass

Southampton Prairie Cordgrass

Eastern gamagrass

Multifunctional Riparian Buffer

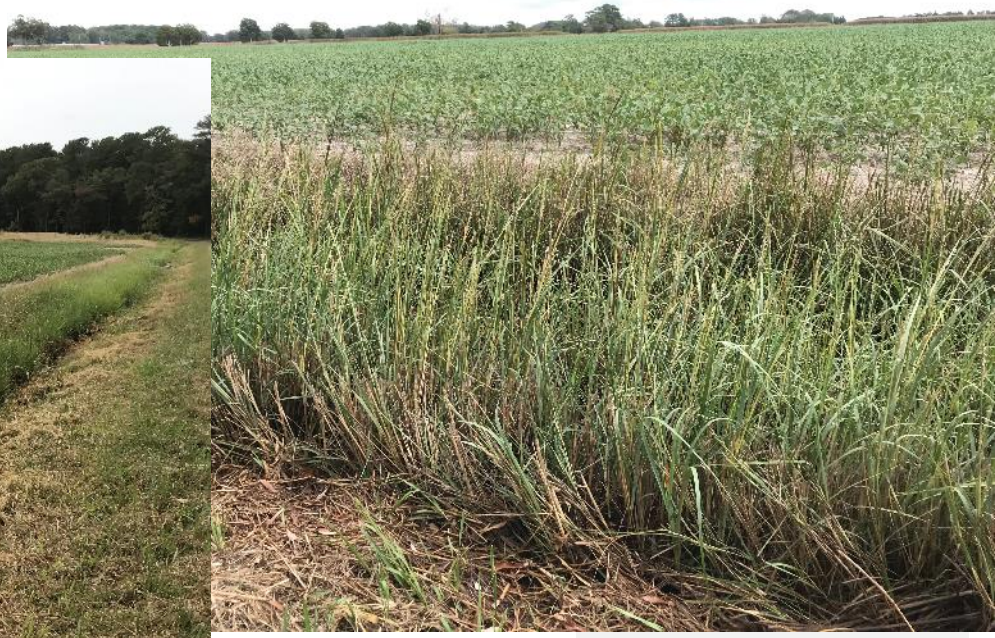
Grass Species:

Eastern gamagrass
Switchgrass
Coastal Panicgrass
Prairie Cordgrass

Flowering species

Goldenrod
Evening Primrose
Mountian mint
NY aster
Rose mallow
Seashore mallow

No Buffer-Vulnerable Crop Field



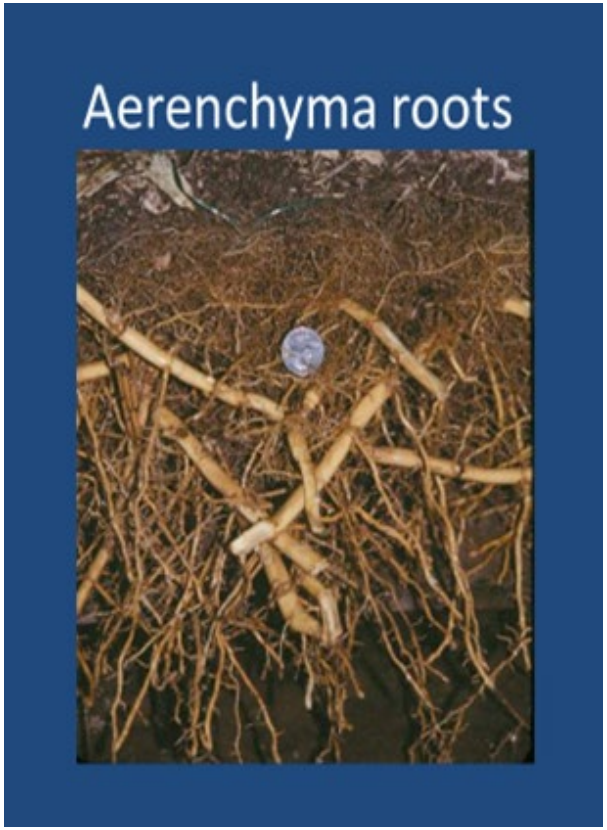
Brackish Ditchwater > 15 ppt.

Native Warm Season Grass Riparian Zone Study(w/USDA-ARS)

Cultivar	Survival (2006)	Vigor (2006)	Yield (2005)	Overall
	Relative ranking (1=best, 9=worst)			
Red River PC*	1	1	4	2.0
Hightide SG*	2	3	1	2.0
NY EG *	4	2	2	3.0
Shelter SG	3	4	3	3.3
Osage IG	7	5	7	6.3
Niagara BB	5.5	6	8	6.5
Suther BB	5.5	8.5	6	6.7
Suther IG	8	8.5	5	7.2
Bonilla BB	9	7	9	8.3

* Top 3 performing grasses also have some level of salt tolerance

Eastern Gamagrass



Willow

Switchgrass

It’s ALL in the ROOTS!

Anaerobic adapted roots

Photos courtesy of Dr. Ken Staver, UMD-Wye Research and Education Center

Transitioning Refreshable Buffer Zones

Abundant fine roots
for nutrient absorption.

Harvesting refreshes
capacity for retention.

Mechanisms of Salt Tolerance in Plants

- Halophytes- Plants that incorporate saline water into their tissue and exude through glands. (examples: Spartina, Distichlis, Salicornia.)

- Plants that tolerate some infrequent saltwater flooding/overwash. Salinity mimics drought (dune grasses, switchgrass, coastal panicgrass, eastern gamagrass.)

- Salt spray tolerance- beach plum, bayberry, American holly

- Plants that tolerate some salt in soil but not flooding (salt or fresh water). Some vegetable crops (asparagus, beets, potatoes), small grains (barley, rye, wheat), sorghum/sudangrass.


High Tide Germplasm switchgrass

High Tide Germplasm switchgrass collection site-

Upper Chesapeake Bay

Port Deposit, MD

High Tide Germplasm switchgrass

Collected in freshwater tidal-upper Chesapeake Bay.

Stabilizing scoured bank on Sedge Island (Dredge Containment Facility) on back bay behind Stone Harbor.

Tolerated salinity- 20-25 ppt (seawater is 35 ppt).

Cape May PMC Salinity Tolerance Screening Study

In a controlled greenhouse setting using ebb and flow tables, determine upper salinity tolerance limit of native grasses

Species to be studied initially:

- **Prairie cordgrass (*Spartina pectinata*) -completed**
- **Eastern gamagrass (*Tripsacum dactyloides*)**
- **Switchgrass (*Panicum virgatum*)**
- **Coastal Panicgrass (*Panicum amarum var amarulum*)**
- **Saltmeadow cordgrass (*Spartina patens*)- comparing varieties**

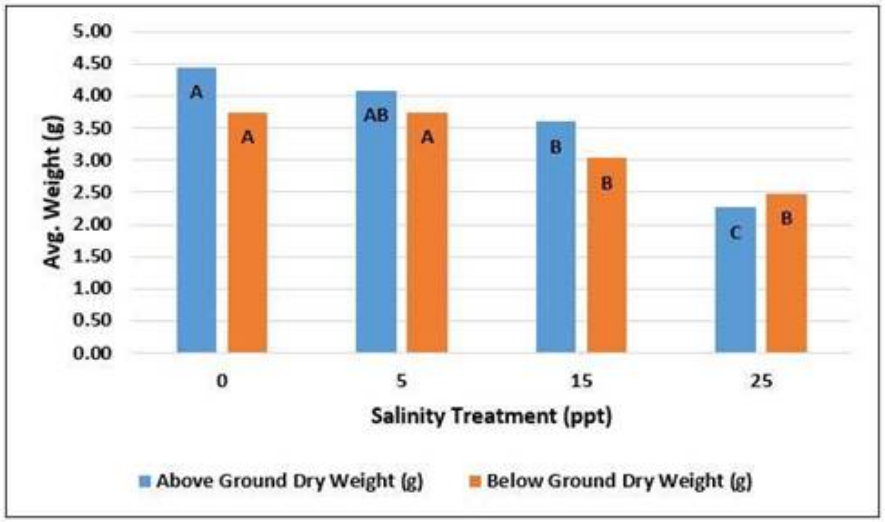
And then eventually;

- **Giant cane (Arundinaria spp.)**
- **Plumegrass (Saccharum spp.)**

PMC Greenhouse Salinity Tolerance Screening

Ebb and Flow Tables

Prairie Cordgrass (*Spartina pectinata*) Data- 8 weeks



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Seashore Mallow

***Kosteletzkya pentacarpos* (a.k.a. *K. virginica*)**

Brackish marshes – grows interspersed among other species
Delaware to Florida and Gulf of Mexico coast
Self or cross-pollinated
Perennial (lives 10 years)
Non-invasive
Relative of cotton & okra
No known diseases; little insect damage
Large seeds that contain 18-20% oil
Oil composition is similar to cottonseed oil which is used for biodiesel
Stems can be used to produce cellulosic ethanol
Seeds contain 20% protein.
Seeds can be planted and harvested with traditional farm equipment (on upland).
Salt-tolerant – can use resources not usable by food crops (saline land and water).

Source: Jack Gallagher, Univ. of DE

Seeding a transition crop

Planting in tilled sandy loam on the same farm.

Planting Seashore Mallow in a no-till setting on the Freeman farm in Sussex County, Delaware.

Seashore mallow

Seashore mallow (*Kosteletzkya pentacarpos*) as a salt-tolerant feedstock for production of biodiesel and ethanol

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ARTICLE INFO

ABSTRACT

Seashore mallow (*Kosteletzkya pentacarpos*) is a non-invasive perennial nonclonal halophytic oilseed-producing dicot that was investigated as a feedstock for production of biodiesel from seeds and ethanol from residual stem biomass. Seashore mallow seeds contained 19.3 mass % oil, which after extraction with hexane and pretreatment with catalytic sulfuric acid was converted into methyl esters in 94 mass % yield utilizing homogenous base catalysis. The principal components identified were methyl linoleate (48.9%), palmitate (24.4%) and oleate (18.3%). Fuel properties were characterized and compared to biodiesel standards ASTM D6751 and EN 14214. Also investigated were blends with petrodiesel. Lastly, seashore mallow stems were rich in neutral carbohydrates (51.8 mass %). After simultaneous saccharification and fermentation employing a native *Saccharomyces cerevisiae* yeast strain, the stems provided ethanol and xylose yields of 104 g/kg and 47.8 g/kg, respectively. Of the four pretreatment methodologies explored, dilute ammonium hydroxide provided the highest yield of sugars.

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Seashore mallow (*Kosteletzkya pentacarpos*) stems as a feedstock for biodegradable absorbents☆

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ABSTRACT

Seashore mallow (*Kosteletzkya pentacarpos* (L.) Ledebour) is a perennial halophyte producing multiple, harvestable stems per year which were examined for several bioabsorbent applications. Larger, debarked stems were milled and separated into three fractions by sieving. The largest fraction absorbed water readily and appeared to be an excellent bedding material for birds and small animals. The mid-sized fraction made an excellent base for biodegradable cat litter. The finest fraction efficiently absorbed diesel fuel which could be subsequently burned as a fuel. Smaller stems with bark (bast fibers) intact were milled to produce a material which performed excellently as hydraulically-applied mulch (hydromulch), with comparable properties to a commercial hydromulch.

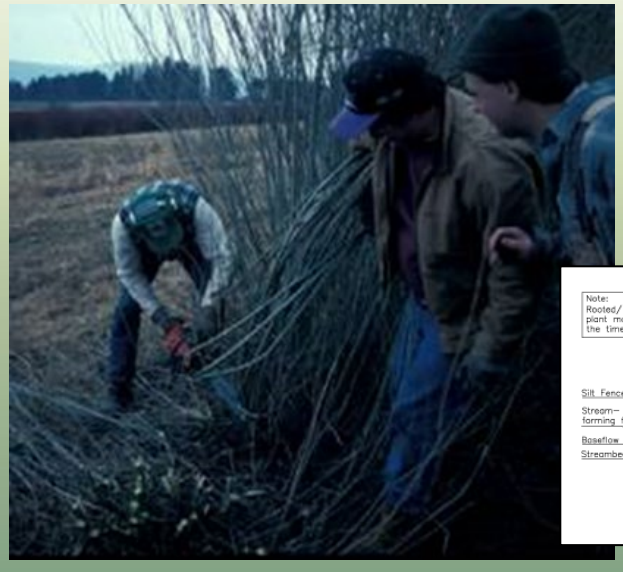
Expand Availability of Dormant Cuttings for Soil Bioengineering Applications

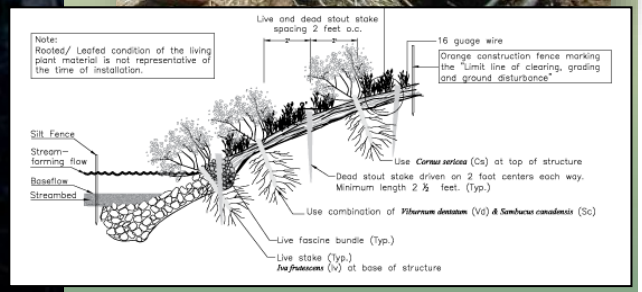
Groundsel Bush

Willow/Dogwood/Viburnum

Soil Bioengineering: Using Plants in a Structural Function

- 3:1 to 2:1 horizontal/ vertical
- Low to moderate energy environment
- Seeding may be included





Beneficial Use of Dredge Trial
Southern New Jersey

Natural Resources Conservation Service

nrcs.usda.gov/

Upland Dredge Material Planting

Abandoned Cropland/Disturbed Plant Communities

Desirable and/or undesirable (Invasive) vegetation. Can we intentionally improve the vegetation community to perform ecosystem services?

Phragmites

Phriend or Phoe??

(Depends on your perspective)

Phragmites
"A Sheep in Wolf's Clothing?"

Attributes

Raises marsh elevation to keep pace with sea level rise?

Some research shows it sequesters more pollutants and nutrients than Spartina marshes.

Adaptive management/modification of ecosystems is more sustainable.

Site by site evaluation necessary.

Problems

Capitalizes where disturbance occurs.

Aggressive colonizer discourages plant species diversity-monocultural stands.

Extensive control efforts may not be sustainable due to continual reinvasion.

Sources: Phragmites australis: A Sheep in Wolf's Clothing?, Estuaries and Coasts. April 2003

The Status and Future of Tidal Marshes in NJ Faced with SLR. Final Report. NJDEP. Science Advisory Board. August 2020

Controlling Invasive Species Spread

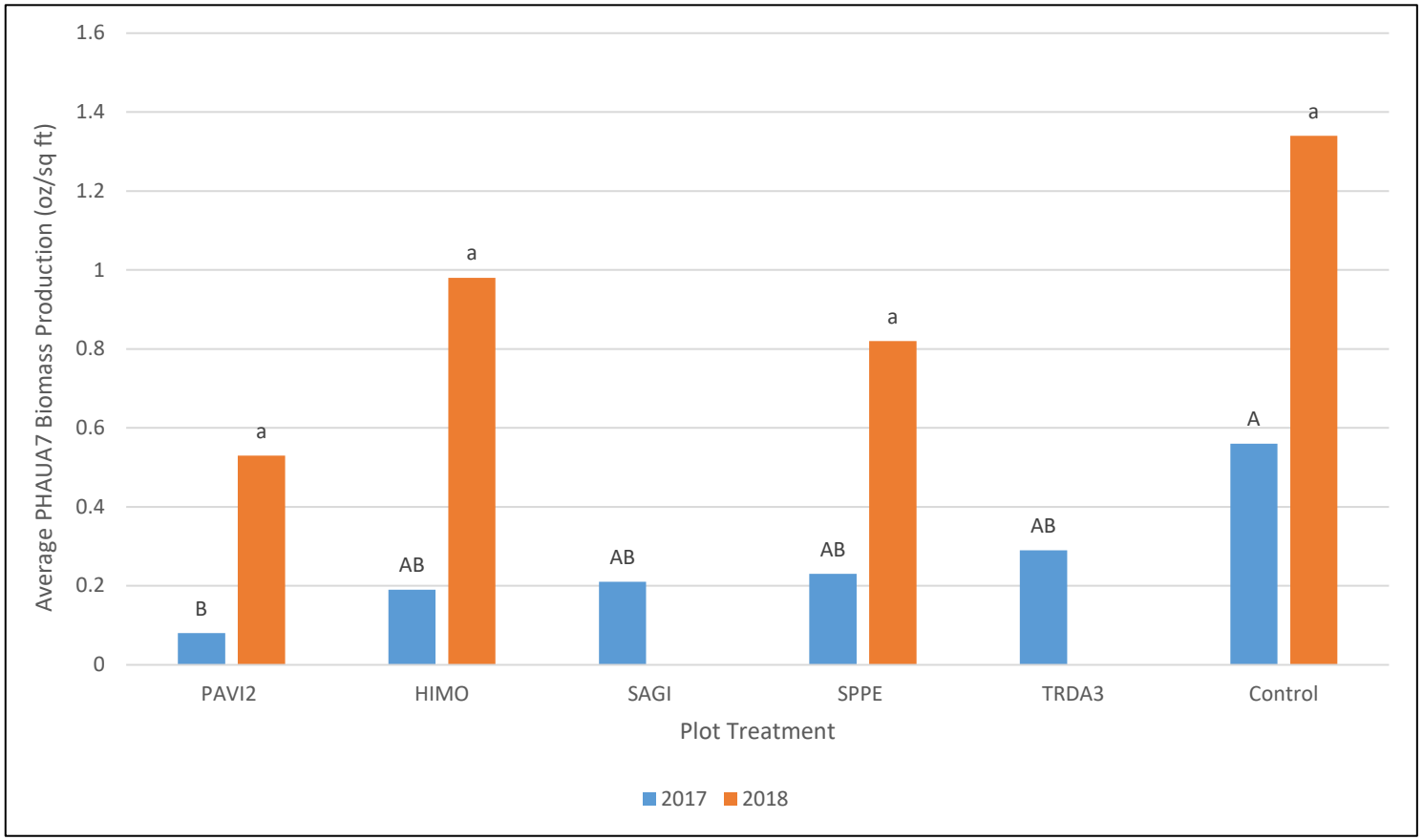
Cape May PMC Study

Planting Study of potential native species to minimize reinvasion of phragmites:

- High Tide Germplasm switchgrass
- Southampton Germplasm prairie cordgrass
- Crimson-eyed rose mallow
- Eastern gamagrass
- Sugarcane plumegrass

- **Additional potential species to evaluate:**
  - *Kosteletzkya pentacarpos* (Seashore mallow)
  - *Spartina cynosuroides* (giant cordgrass)
  - *Panicum amarulum* (coastal panicgrass)
  - *Arundinaria gigantea* (giant cane)
  - *Iva frutescens* (High tide bush)*
  - *Baccharis halimifolia* (Groundsel)*

PMC Phrag. Reinvasion 2 yr. Study
Site mowed/sprayed 2016



BMPs for Coastal Resilience

Select plant species that are tolerant to salinity changes and increased temperature.

Planting flood and salt tolerant plants inland from wetland systems to prolong viability to rising waters and increased flood frequency (in tidal systems).

Maintain and enhance diversity of plantings to help with changing salinity and flooding conditions.

Source: Maryland's Adaptation Website: www.dnr.state.md.us/climatechange

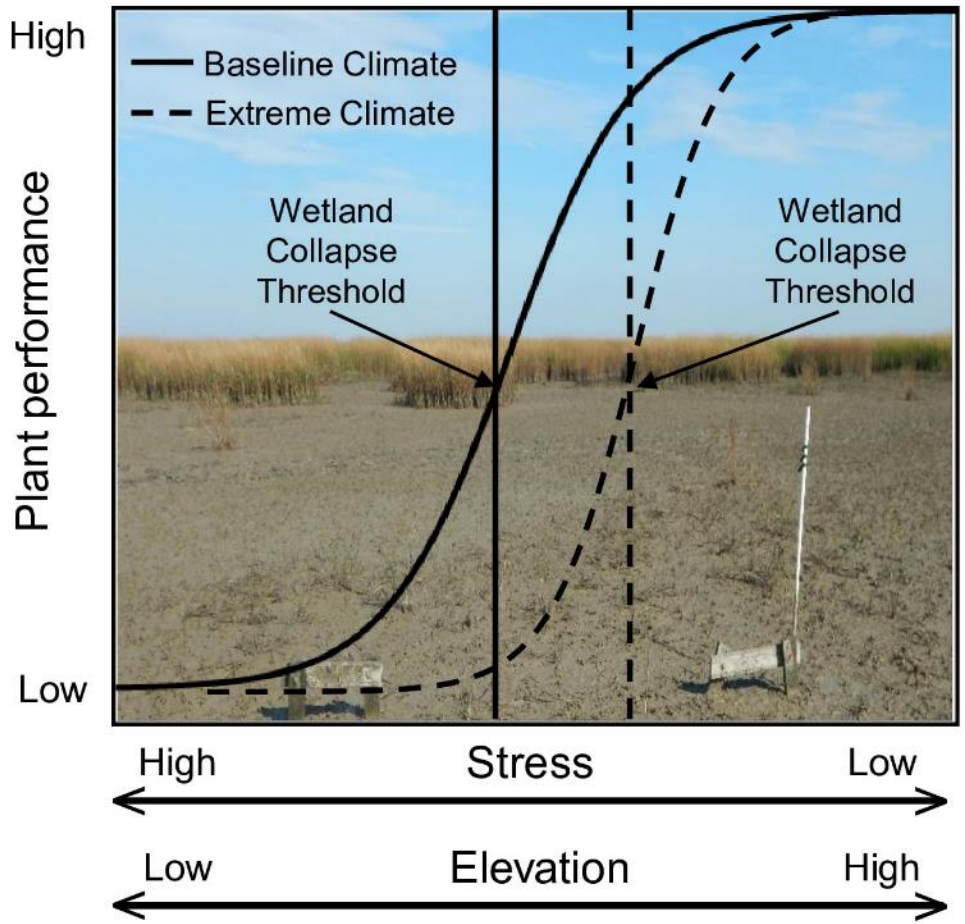
Guiding Principles- Coastal Resilience

1. Look landward and southward for future adaptation cues

2. Identify Tipping Points

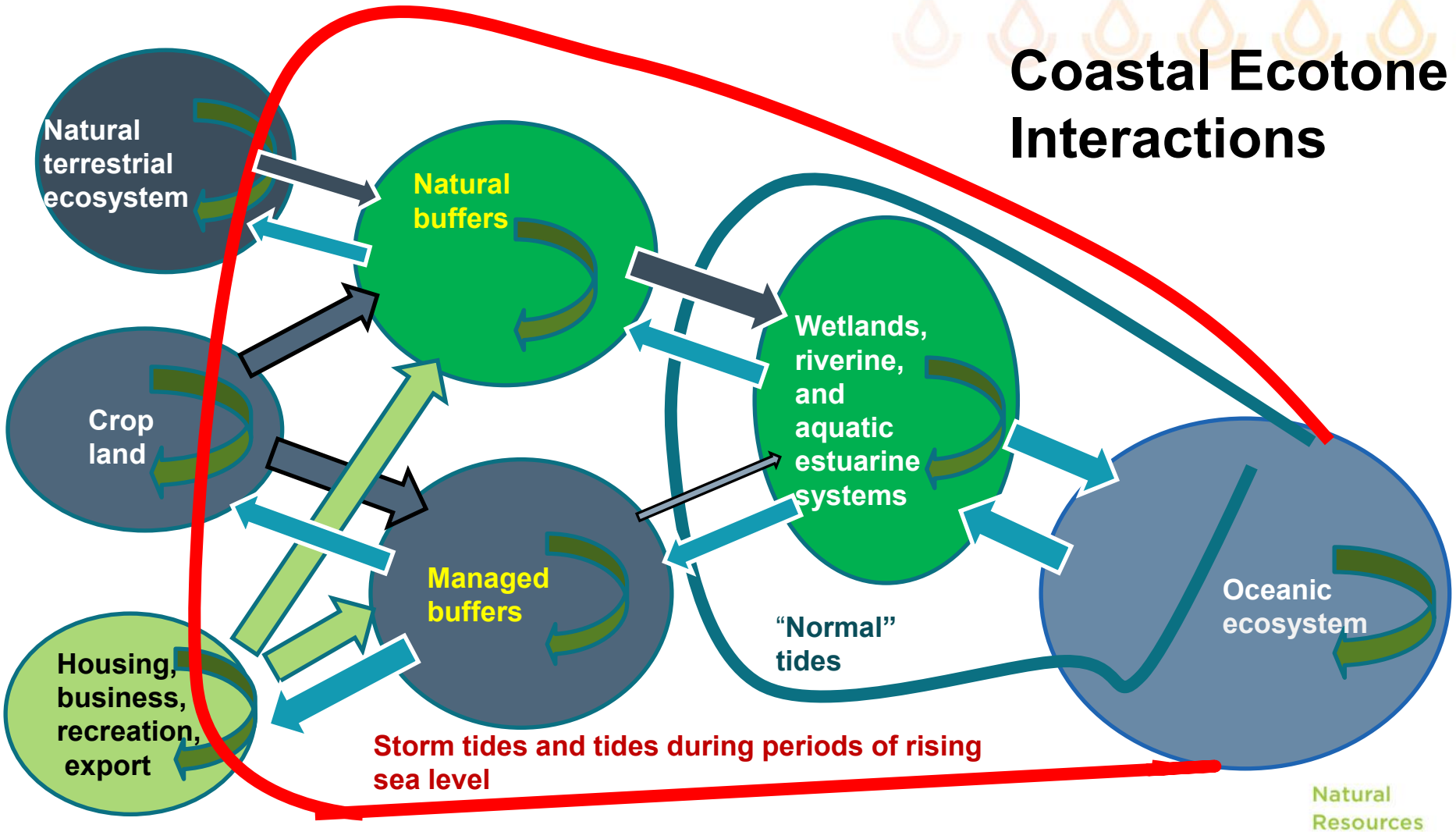
3. Changing Traditional Paradigms- “Think out of the box”

Marsh Plant Performance-Tipping Point



Stag, C.L. et al. Extreme Precipitation and Flooding Contribute to Sudden Vegetation Dieback in a Coastal Salt Marsh. *Plants* 2021

Coastal Ecotone Interactions



Natural Resources Conservation Service

nrcs.usda.gov/

Source: Dr. Jack Gallagher, University of Delaware

Maintained Dikes-Netherlands

Natural Resources Conservation Service

nrcs.usda.gov/

Etihad Airways Flies the World's First Flight Using Fuel Made in The UAE From Plants Grown in Saltwater by Khalifa University

January 2019-AbuDhabi to Amsterdam

Salicornia (glasswort)

Growing Halophytic Crops-Salicornia production-Netherlands

Gross income from 1 ha (2.5 acres)- $30,000-$35,000 for restaurant industry

"In most cases nature has evolved a plant for almost every growing condition."

Dr. Franklin J. Crider

"Father"- NRCS Plant Materials Program

Technical Resources

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USDA Climate Hubs - http://www.climatehubs.oce.usda.gov/