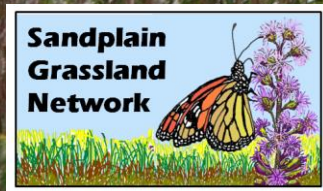


# Management and Restoration to Promote Biodiversity Conservation and Climate Resilience

Christopher Neill





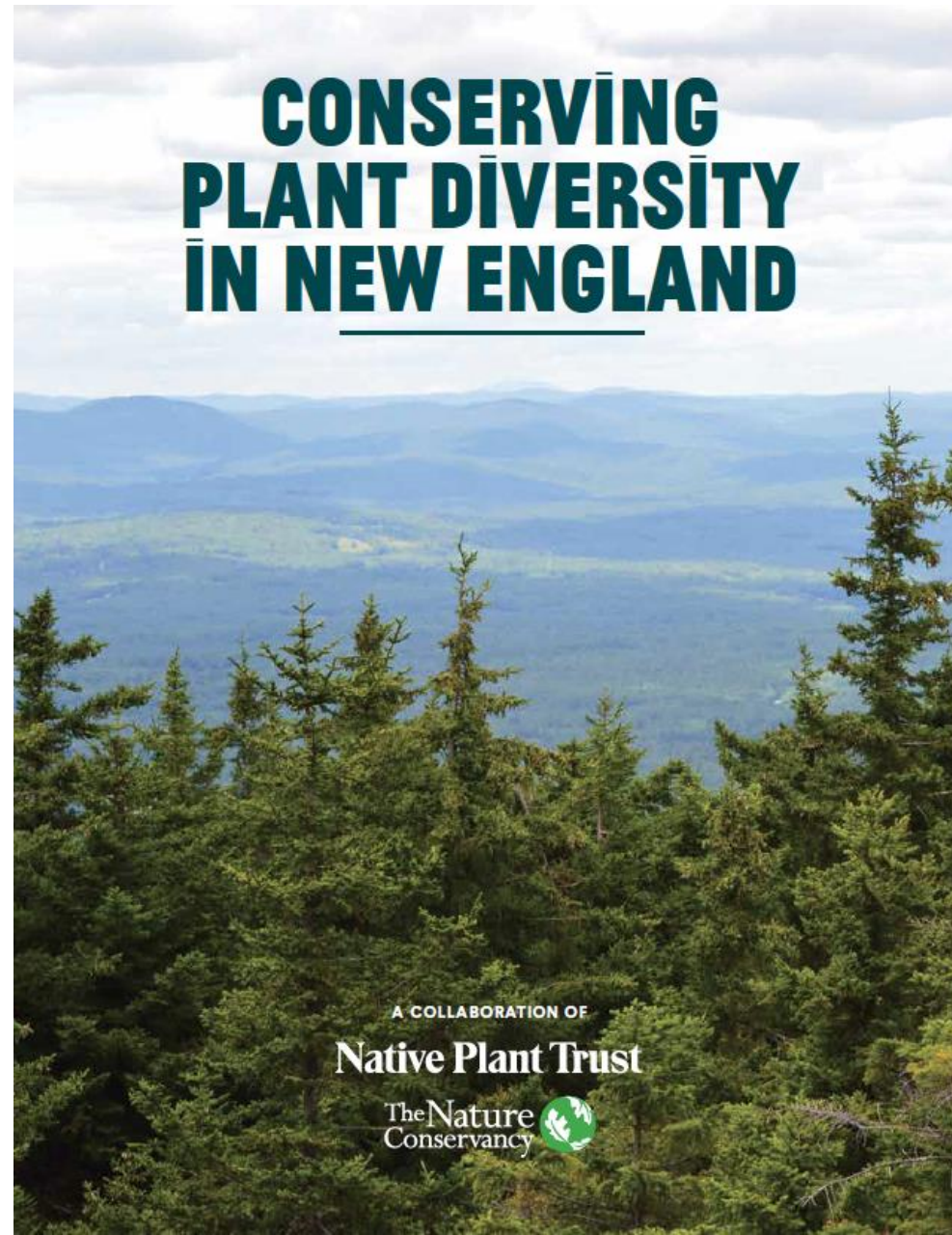
# A Human-Caused Biodiversity Crisis

“Our results signal an urgent need to address the ongoing threats of habitat loss, agricultural intensification, coastal disturbance, and direct anthropogenic mortality, all exacerbated by climate change.”

—*Rosenberg et al. 2019*



# A Human-Caused Biodiversity Crisis



# Patch-Forming Habitats

Patch-forming habitats are terrestrial plant communities that occur in small patches on the landscape, nested within, and often contrasting with, the background matrix of forests and wetlands

Although patch habitats make up only 2% of New England's natural land, and none of them has more than 150,000 acres of total extent, they are hotspots of plant diversity.





# Patch-Forming Habitats



Grasslands and heathlands



Freshwater wetlands



Pine barrens



# Grasslands and Heathlands

## Background:

- Known biodiversity hotspots
- Concerns that biodiversity is declining
- Concerns that current management does not maintain habitat

RESTORATION  
ECOLOGY  
The Journal of the Society for Ecological Restoration



REVIEW ARTICLE

### **Challenges, successes, and recommendations for management of coastal sandplain grasslands as regional biodiversity hotspots in the northeastern United States**

Sarah Bois<sup>1,2</sup>, Christopher Neill<sup>3</sup>, Michael Whittmore<sup>4</sup>, Lena Champlin<sup>5,6</sup>, Karen Beattie<sup>7</sup>, Russell Hopping<sup>8</sup>, Jennifer Karberg<sup>7</sup>, Karen Lombard<sup>9</sup>, Kelly Omand<sup>7</sup>, Polly Weigand<sup>10</sup>, Robert Wernerehl<sup>11</sup>

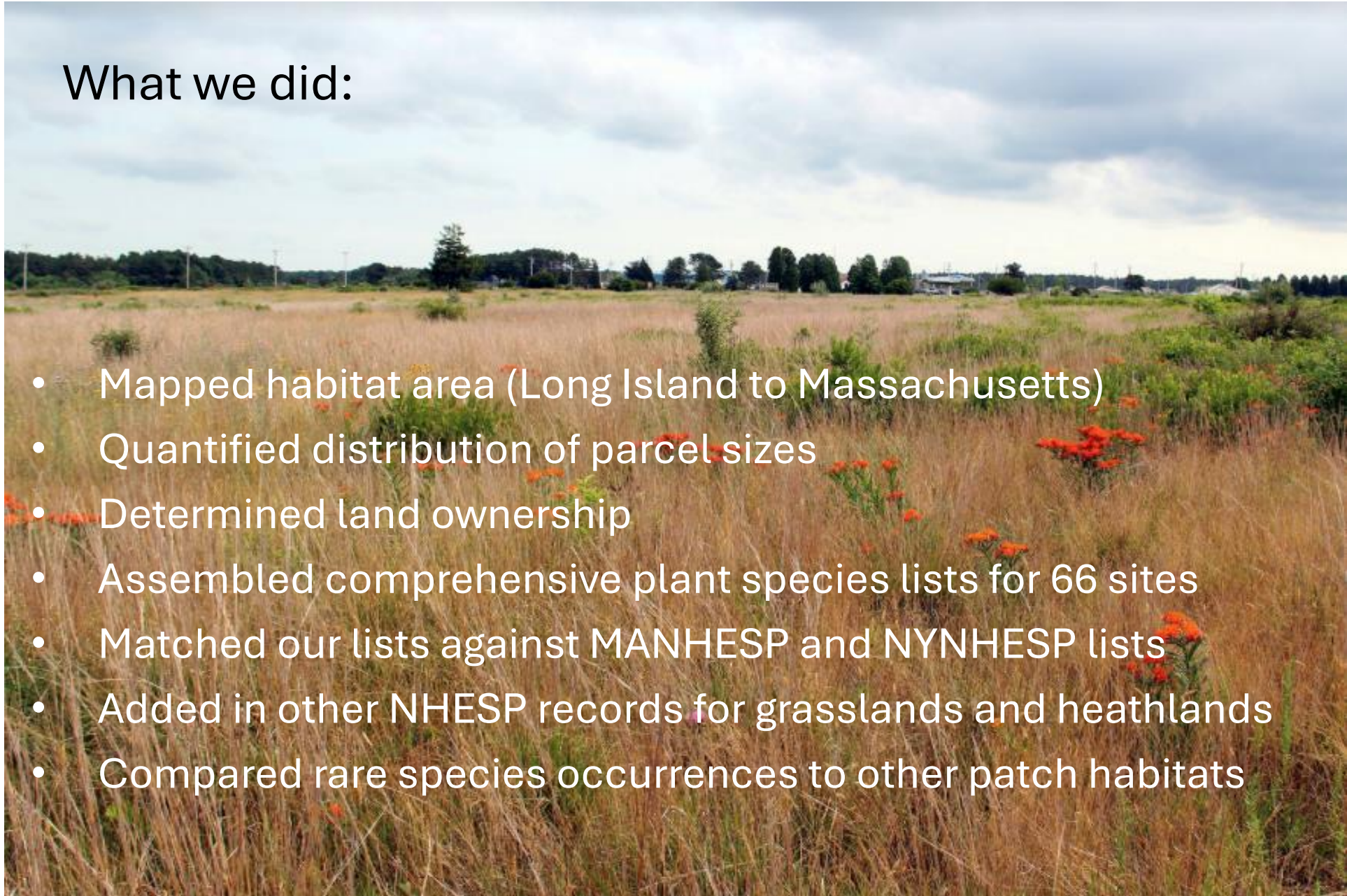
A high proportion of regional plant biodiversity occurs in hotspots of species richness that cover small areas created and maintained by disturbance. Sustaining plant diversity in these areas requires region- and habitat-specific management of disturbance and, increasingly, habitat expansion or restoration to offset species losses. Coastal sandplain grasslands are threatened, disturbance-controlled plant biodiversity hotspots in the northeastern United States. We formed a network of grassland managers and scientists to review the published and unpublished sandplain grassland literature. Addition-



# Grasslands and Heathlands

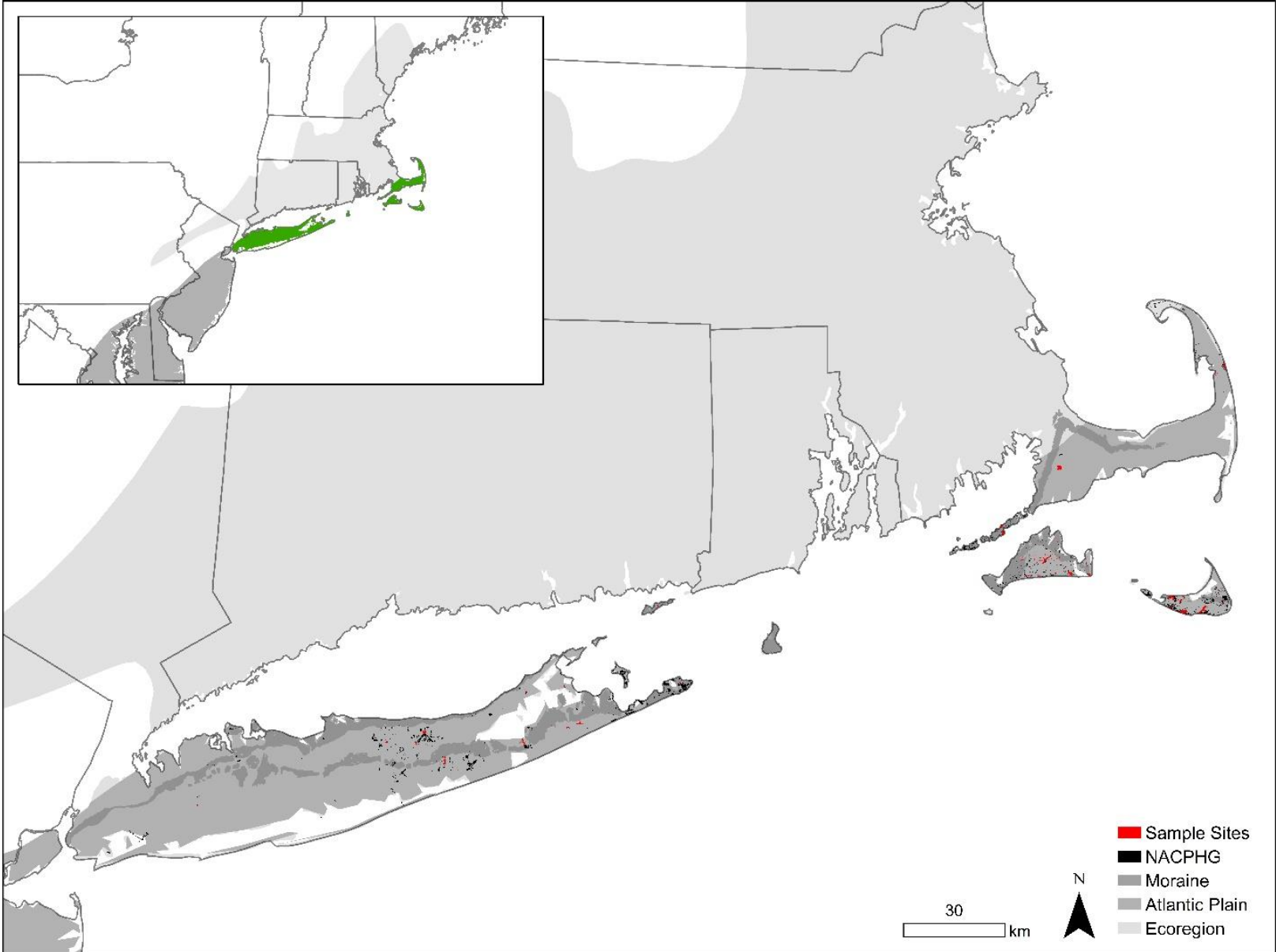
What we did:

- Mapped habitat area (Long Island to Massachusetts)
- Quantified distribution of parcel sizes
- Determined land ownership
- Assembled comprehensive plant species lists for 66 sites
- Matched our lists against MANHESP and NYNHESP lists
- Added in other NHESP records for grasslands and heathlands
- Compared rare species occurrences to other patch habitats





# Grasslands and Heathlands





# Grasslands and Heathlands

**12,254 ha total habitat**

1,416 total parcels

Vast majority < 10 ha

Only 7 parcels > 100 ha (6 of those are MA)

We had plant lists for 1,865 ha (15%)

48% owned by non-profit organizations

26% owned by municipalities

22% owned by states



# Grasslands and Heathlands

**639 plant species**

392 native, 247 non-native

60% forbs, 18% graminoids, 22% woody plants

74% perennials

**73 state listed species** (57 in MA, 34 in NY, 18 in both)

**18 additional listed species** on NHESP lists

High Floristic Quality Assessment Index



# Grasslands and Heathlands

## Top Quality Sites (FQAI)

Manual Corellus State Forest Fire Lanes

Frances Crane Wildlife Management Area

Oyster Watcha Grassland

Sayville Grassland

Martha's Vineyard Airport

Smooth Hummocks

Long Point Wildlife Refuge

Sandford Ram Pasture

Quansoo Grassland

Squam Farm

Head of Plains

Katama Airfield

Nantucket Airport

Linda Loring Nature Foundation



# Grasslands and Heathlands

Species that occurred on at least 60% of 22 high-quality surveyed sites that contained >10 rare species, arranged from most frequent to least frequent.

Species	Common Name	Native Status	Fed	NY	MA	Site Freq.
<b><i>Achillea millefolium</i></b>	Common yarrow	I				100
<b><i>Carex pensylvanica</i></b>	Pennsylvania sedge	N				100
<b><i>Schizachyrium scoparium</i></b>	Little bluestem	N				100
<b><i>Symphotrichum dumosum</i></b>	Rice button aster	N				95
<b><i>Danthonia spicata</i></b>	Poverty oatgrass	N				91
<b><i>Euthamia caroliniana</i></b>	Slender goldentop	N				91
<b><i>Euthamia graminifolia</i></b>	Flat-top goldentop	N				91
<b><i>Gaylussacia baccata</i></b>	Black huckleberry	N				91
<b><i>Morella pensylvanica</i></b>	Northern bayberry	N				91
<b><i>Quercus ilicifolia</i></b>	Scrub oak	N				91
<b><i>Solidago rugosa</i></b>	Wrinkleleaf goldenrod	N				91
<b><i>Baptisia tinctoria</i></b>	Horseflyweed	N				86
<b><i>Helianthemum dumosum</i> (*<i>Crocianthemum dumosum</i> (E.P. Bicknell) E.P. Bicknell)</b>	Bushy frostweed	N		T	WL	86
<b><i>Prunus serotina</i></b>	Black cherry	N				86
<b><i>Rumex acetosella</i></b>	Common sheep sorrel	I				86
<b><i>Solidago nemoralis</i></b>	Gray goldenrod	N				86

# Grasslands and Heathlands

SRANK	State Class	No. of Rare Species
	Northern Atlantic Coastal Plain Heathland & Grassland	91
<b>M</b>		
<b>S1</b>	Sandplain Grassland	64
<b>S1</b>	Sandplain Heathland	58
<b>S1</b>	Calcareous Basin Fen	26
<b>S1</b>	Maritime Juniper Woodland/Shrubland	23
<b>S1</b>	Freshwater Tidal Marsh	17
<b>S2</b>	Pitch Pine - Scrub Oak Community	73
<b>S2</b>	Red Maple - Black Ash - Tamarack Calcareous Seepage Swamp	59
<b>S2</b>	Hickory - Hop Hornbeam Forest/Woodland	54
<b>S2</b>	Scrub Oak Shrubland	51
<b>S2</b>	Calcareous Sloping Fen	48
<b>S2</b>	Red Maple - Black Gum Swamp	46
<b>S2</b>	Coastal Salt Pond Community	45
<b>S2</b>	Calcareous Rocky Summit/Rock Outcrop Community	43
<b>S2</b>	Major-river Floodplain Forest	39
<b>S2</b>	Ridgetop Pitch Pine - Scrub Oak Community	34
<b>S2</b>	Kettlehole Level Bog	31
<b>S2</b>	Maritime Forest/Woodland	29



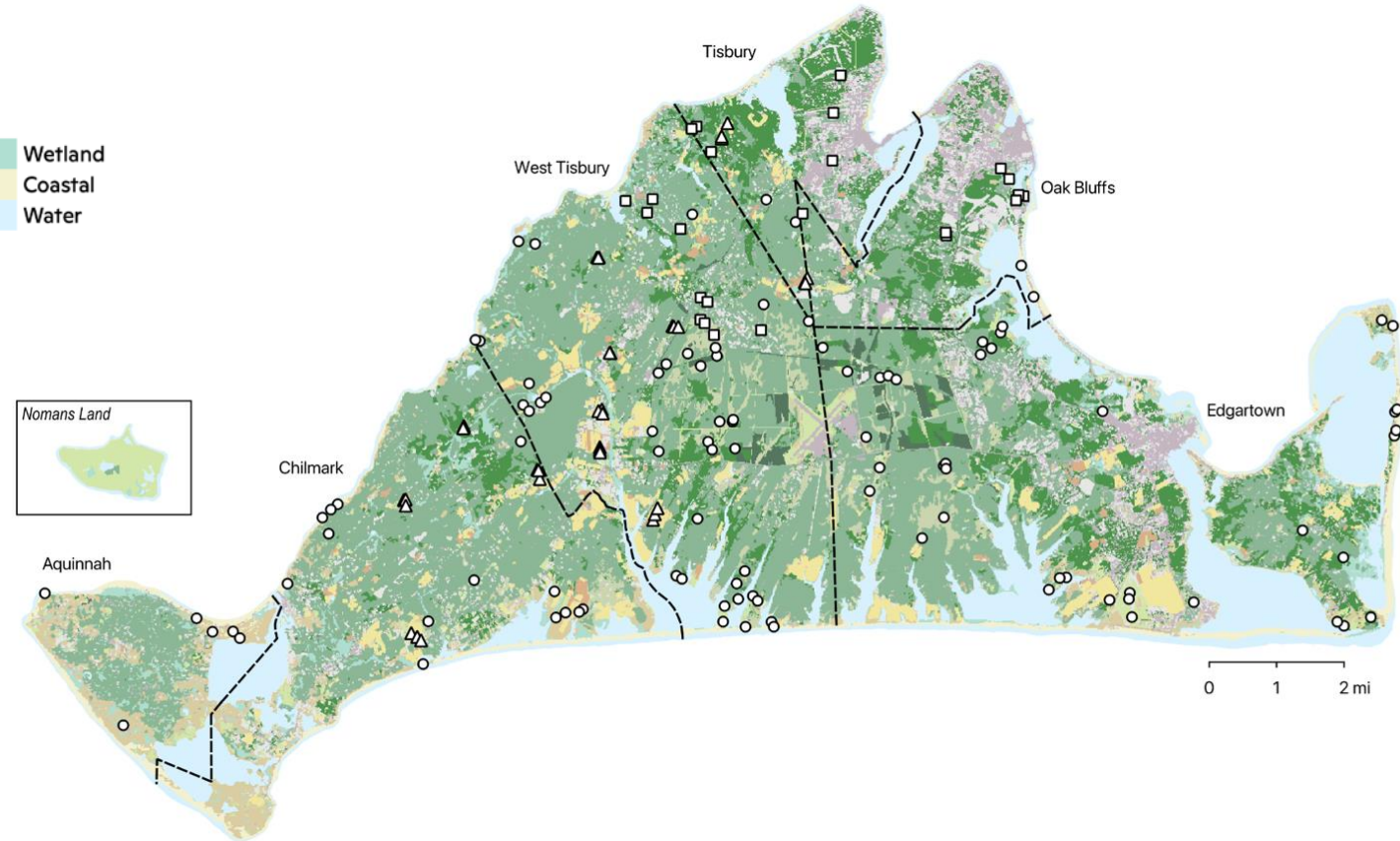
# Grasslands and Heathlands

## Sample sites

- Harvard Forest
- △ Agriculture
- Residential

## Land cover

- Deciduous Woodland
- Coniferous Forest
- Plantation Forest
- Scrub Oak
- Shrubland
- Grassland
- Cropland
- Pasture/Hay
- Developed
- Highly Developed
- Wetland
- Coastal
- Water



Forest



Scrub Oak



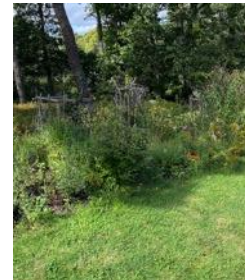
Shrubland



Grassland



Coastal



Residential



Agriculture



# Grasslands and Heathlands

## Collected plant species in 20 x 20 m plots:

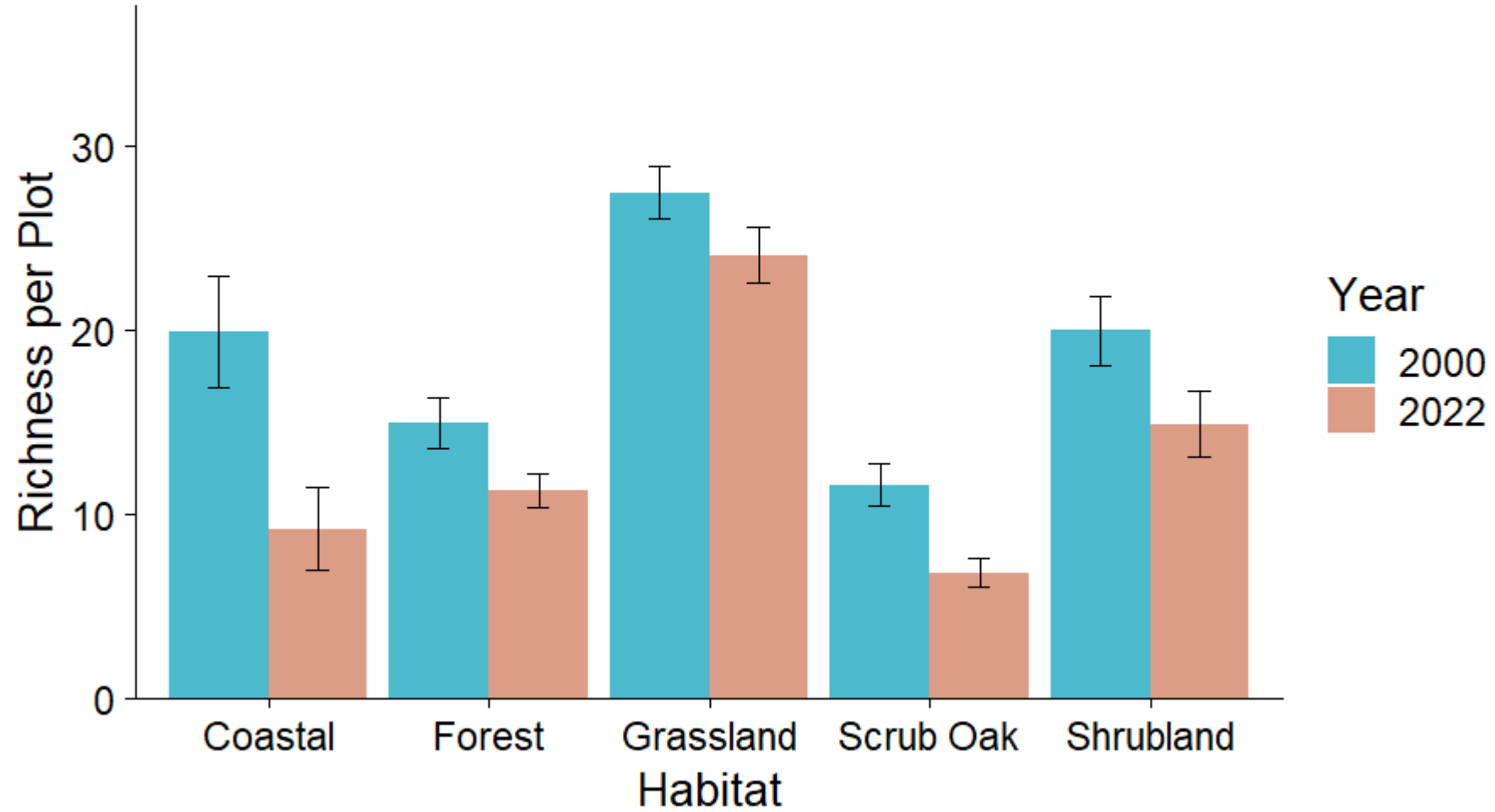
- Plots originally surveyed by Motzkin and Foster in 2000
- Presence/absence of all plants (species and the total number)
- Percent cover of each plant
- Stem diameter (DBH) and canopy cover of all trees > 2.5 cm





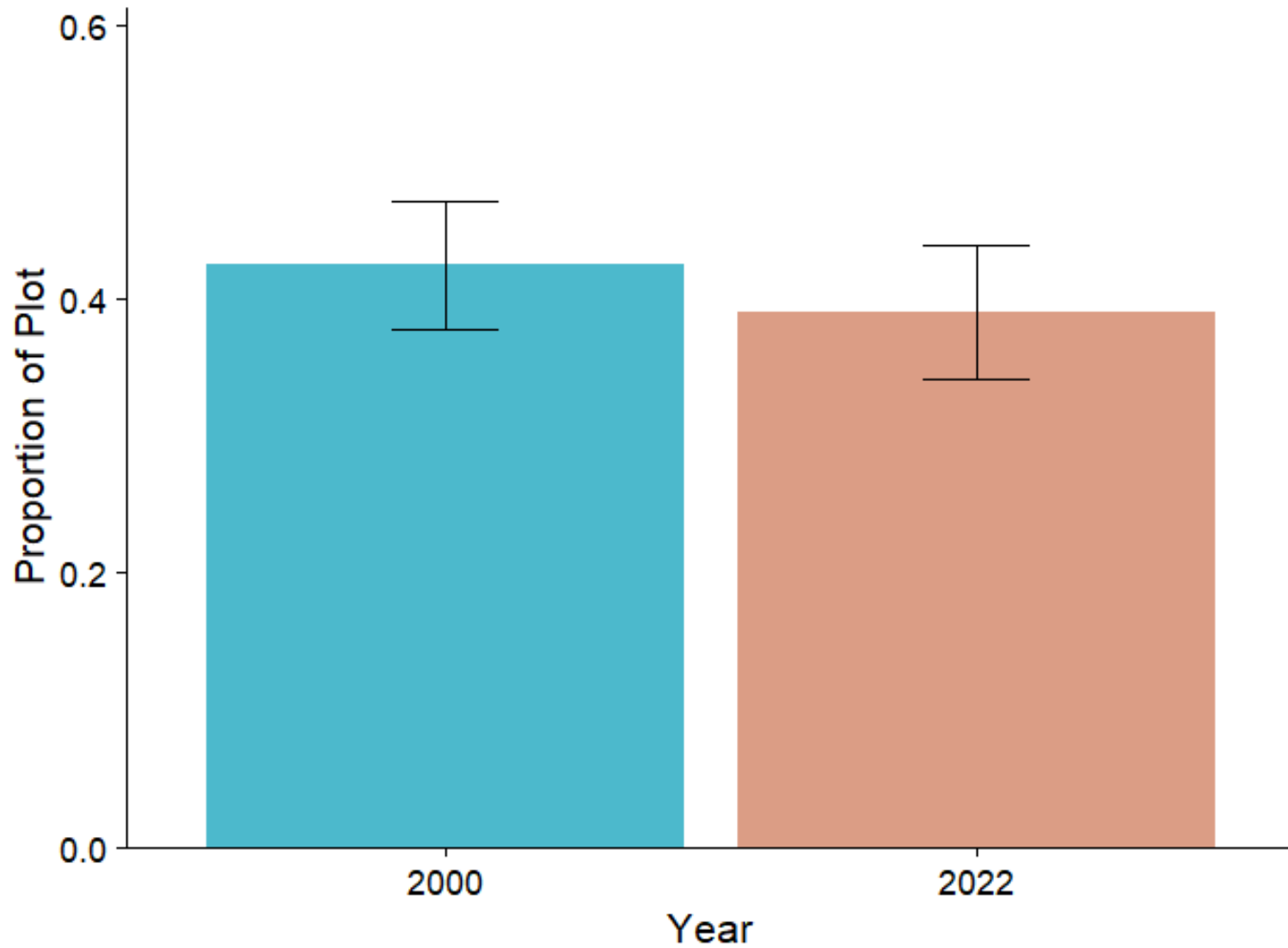
# Grasslands and Heathlands

## Plant Species Richness by Habitat



# Grasslands and Heathlands

## Woody Plant Cover in Grasslands





# Grasslands and Heathlands

## Reasons for Plant Biodiversity Declines

- Coastal erosion



# Grasslands and Heathlands

## Reasons for Plant Biodiversity Declines

- Coastal erosion
- Inadequate disturbance





# Grasslands and Heathlands

## Reasons for Plant Biodiversity Declines

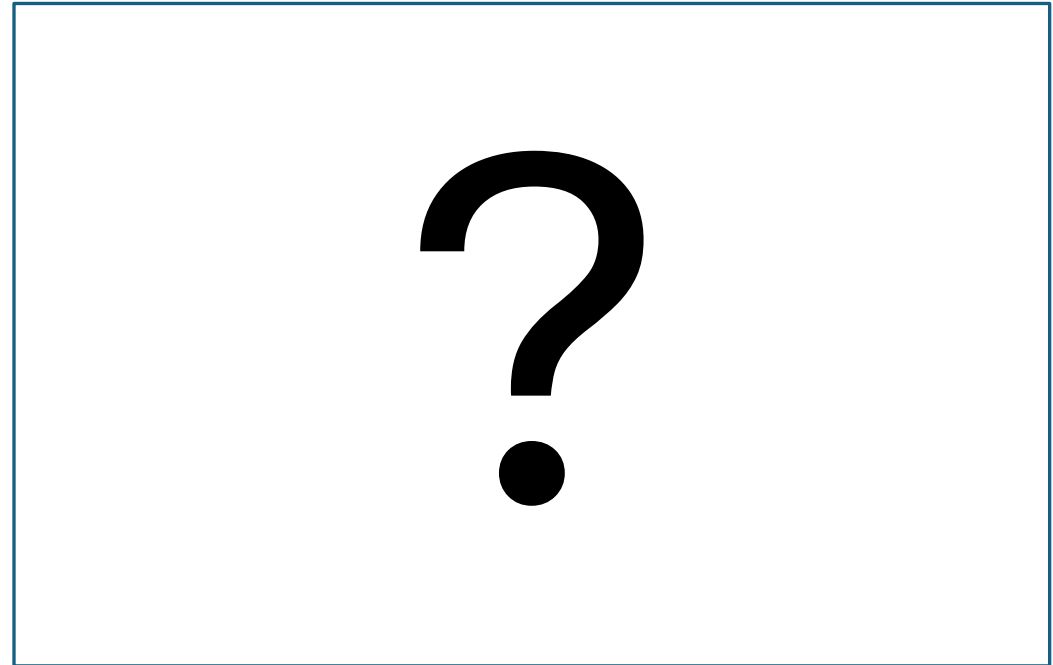
- Coastal erosion
- Inadequate disturbance
- White-tailed deer



# Grasslands and Heathlands

## Reasons for Plant Biodiversity Declines

- Coastal erosion
- “Inadequate” disturbance
- White-tailed deer
- Other reasons



# Grasslands and Heathlands

## **Translating Science into Conservation Action**

- Put coastal grasslands and heathlands on your radar
- Inventory biodiversity
- Develop management plans
- Continue to manage with regular disturbance
- Keep good records
- Participate in networks of experiments
- Pursue grants (Mass Wildlife Habitat Management Grants)
- Maximizing carbon storage everywhere will reduce the biodiversity in open habitats



# Freshwater Wetlands



[Science](#) [Politics & Policy](#) [Justice](#) [Fossil Fuels](#) [Clean Energy](#)

[Today's Climate](#) [Projects](#) [About Us](#)

## Inside Climate News

Pulitzer Prize-winning, nonpartisan reporting on the biggest crisis facing our planet.

[Politics & Policy](#)

### Natural Climate Solutions Could Cancel Out a Fifth of U.S. Emissions, Study Finds

Low-tech, time-tested forest, farm and land management techniques are effective, cheap and carry benefits well beyond tackling climate change.

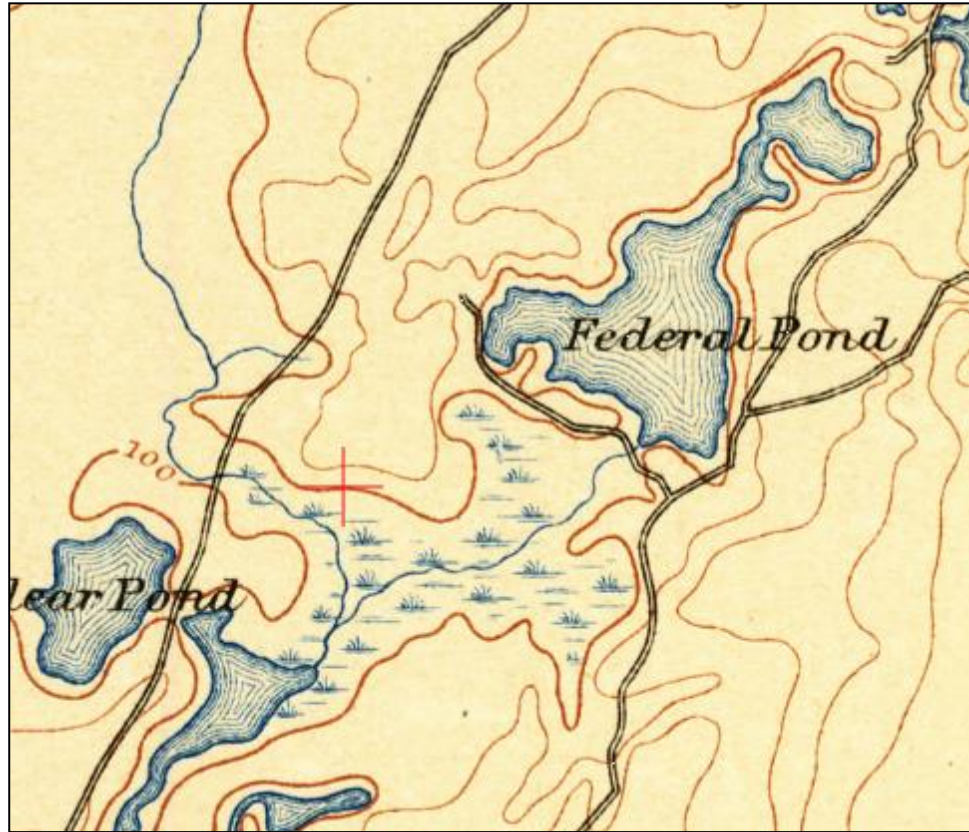


By [Georgina Gustin](#)   
November 14, 2018



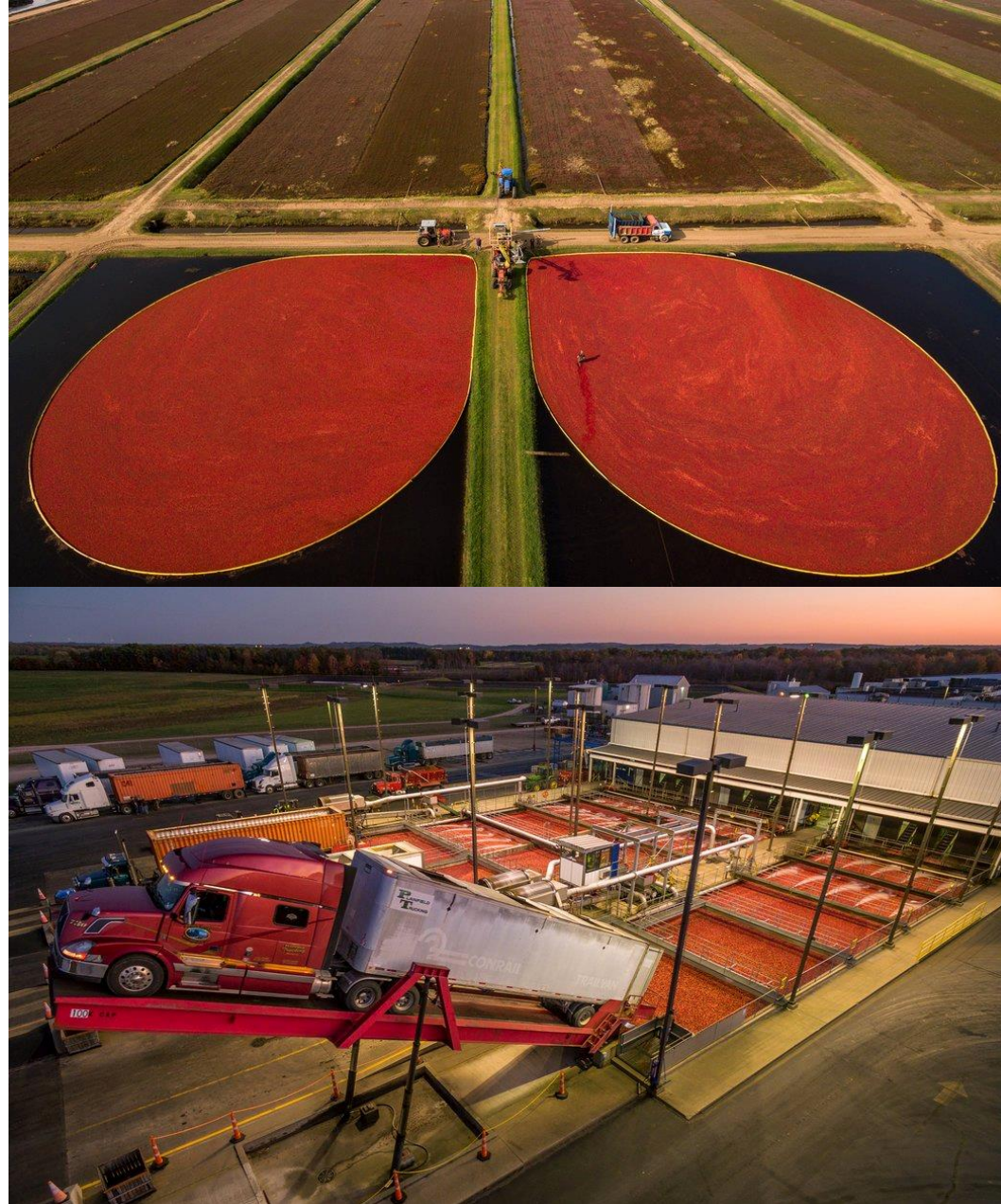


# Freshwater Wetlands





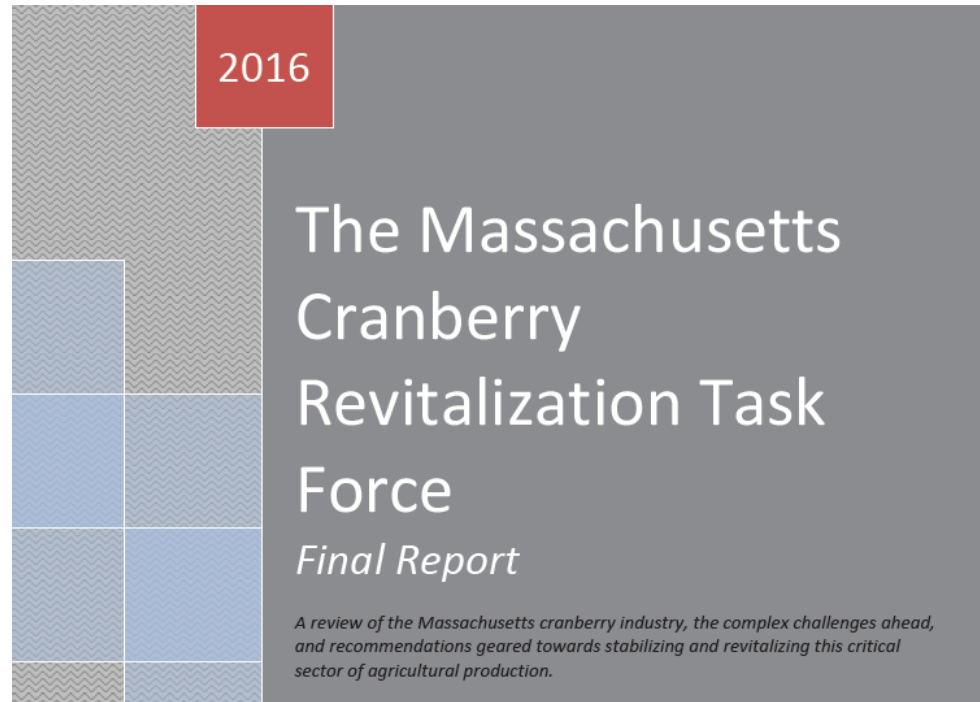
# Freshwater Wetlands



New York Times  
October 6, 2016



# Freshwater Wetlands

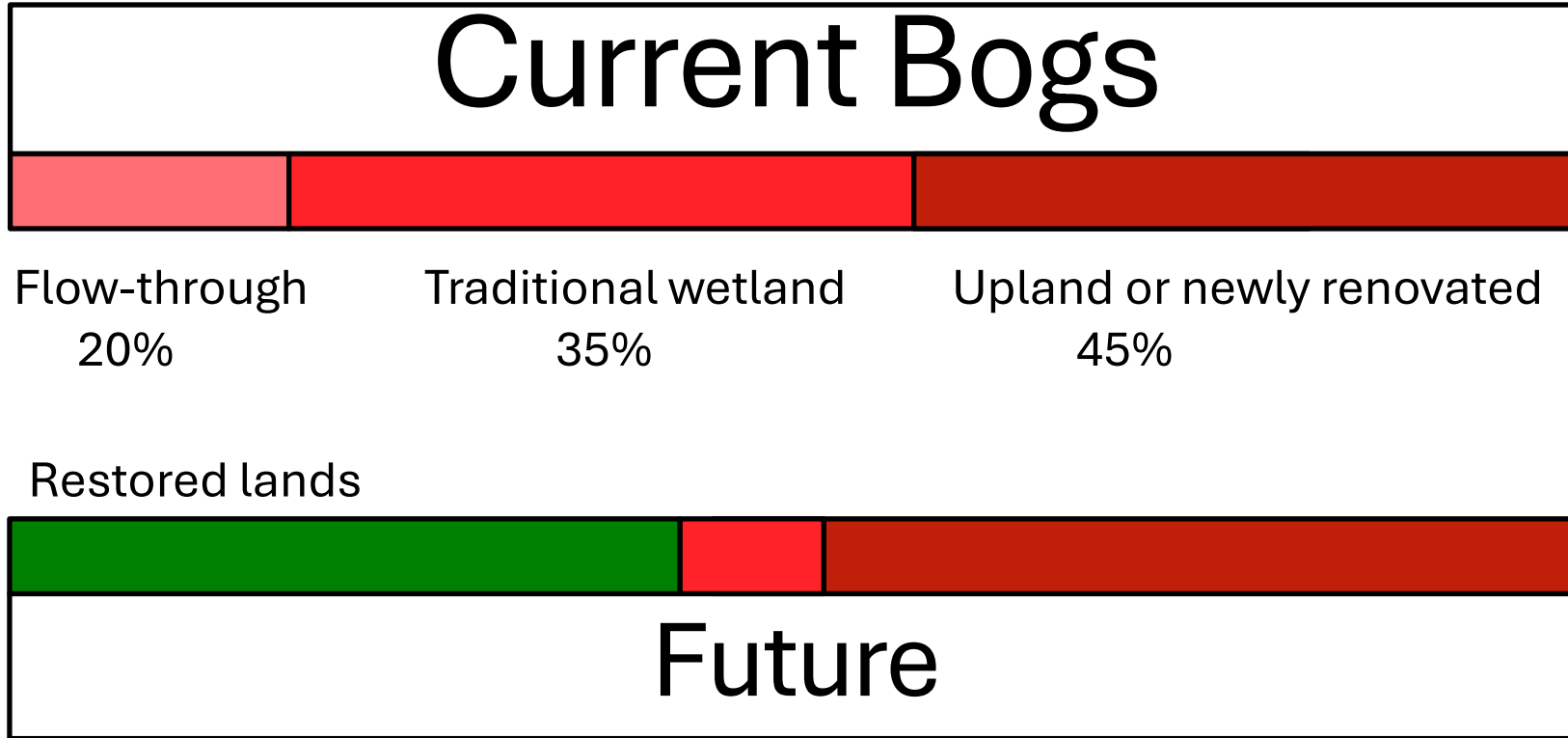


“Massachusetts today, with the largest number of commodity producers receiving below cost of production returns, is in dire straits.”

“Massachusetts also has the lowest yields per acre of the major growing regions due to proportionally larger numbers of acres planted to lower-yielding cranberry varieties.”

“Exit strategies provide potential options to retire bogs and provide an economic incentive for growers to maintain land for conservation purposes.”

# Freshwater Wetlands

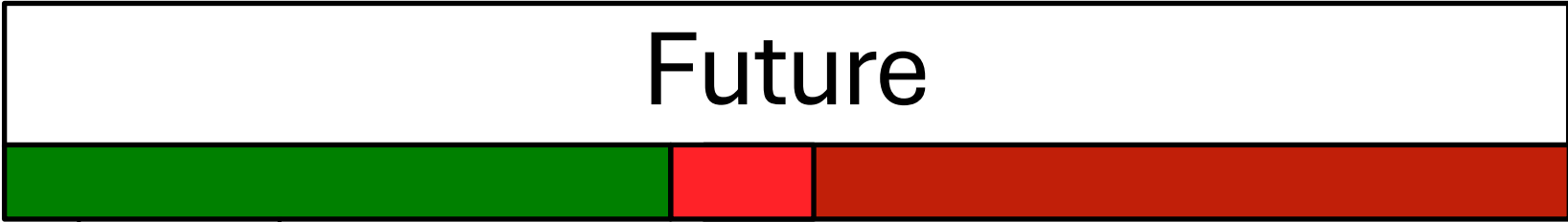


In Massachusetts

High potential	2,639 acres
Medium potential	4,687 acres
Low potential	6,115 acres



# Freshwater Wetlands



Passive  
Restoration  
(or other)



Active  
restoration





# Freshwater Wetlands





# Freshwater Wetlands



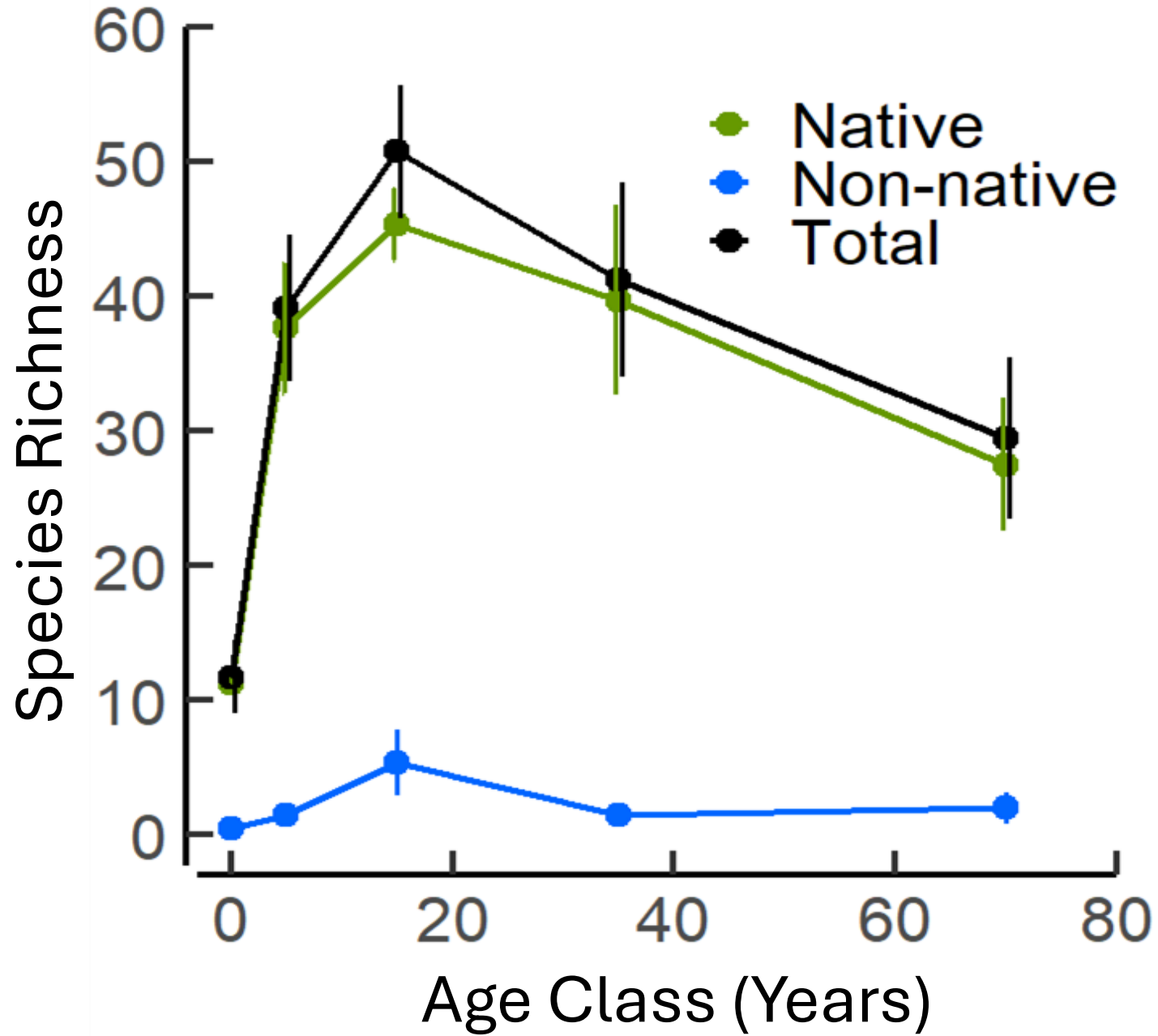
Passive Restoration



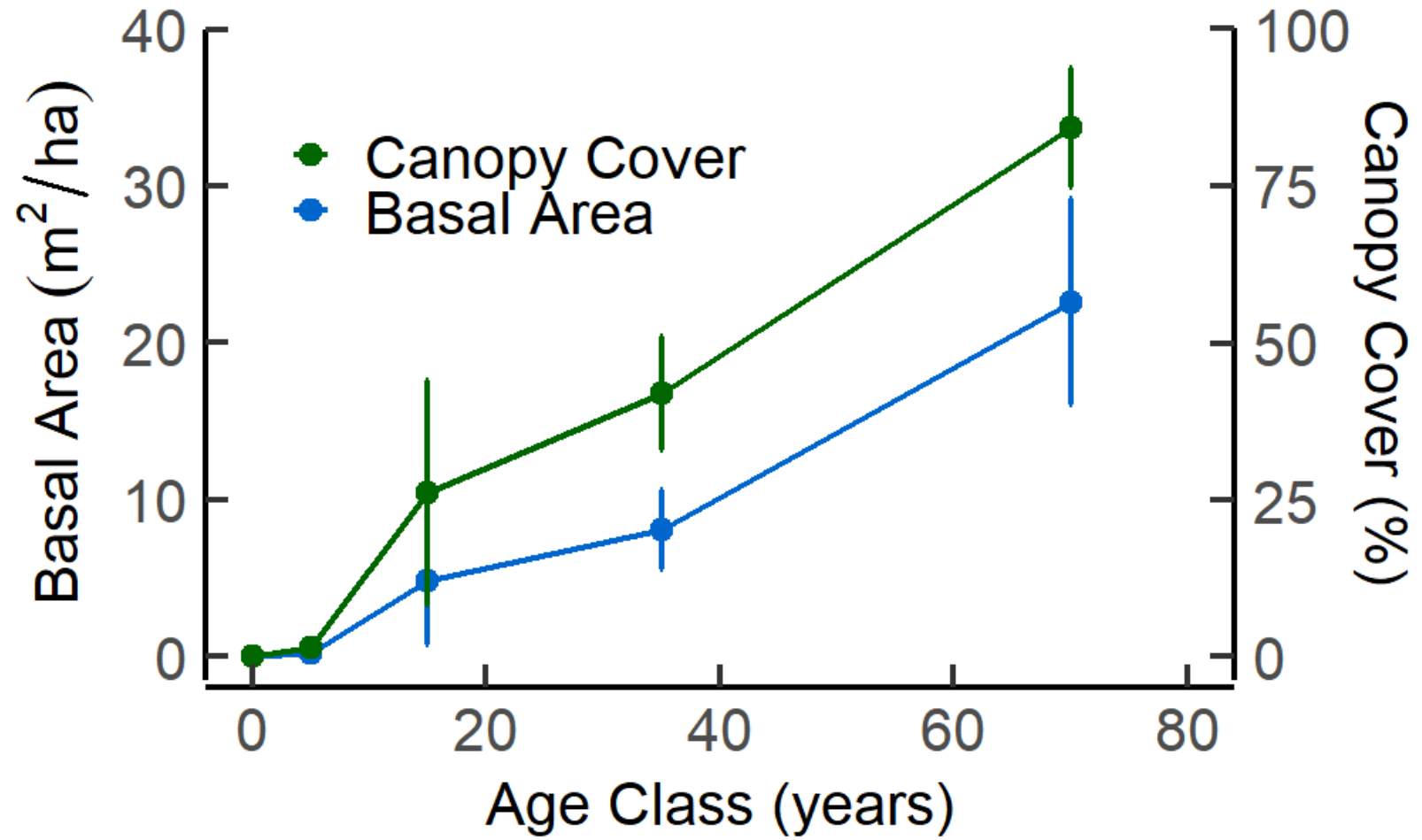
Active Restoration



# Freshwater Wetlands



# Freshwater Wetlands



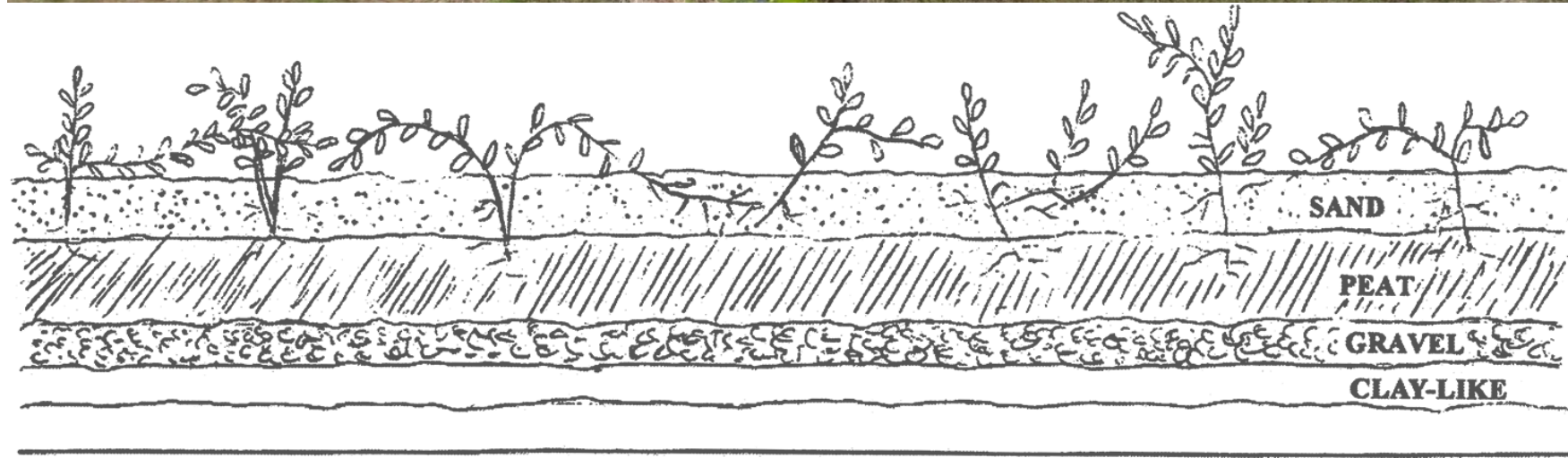
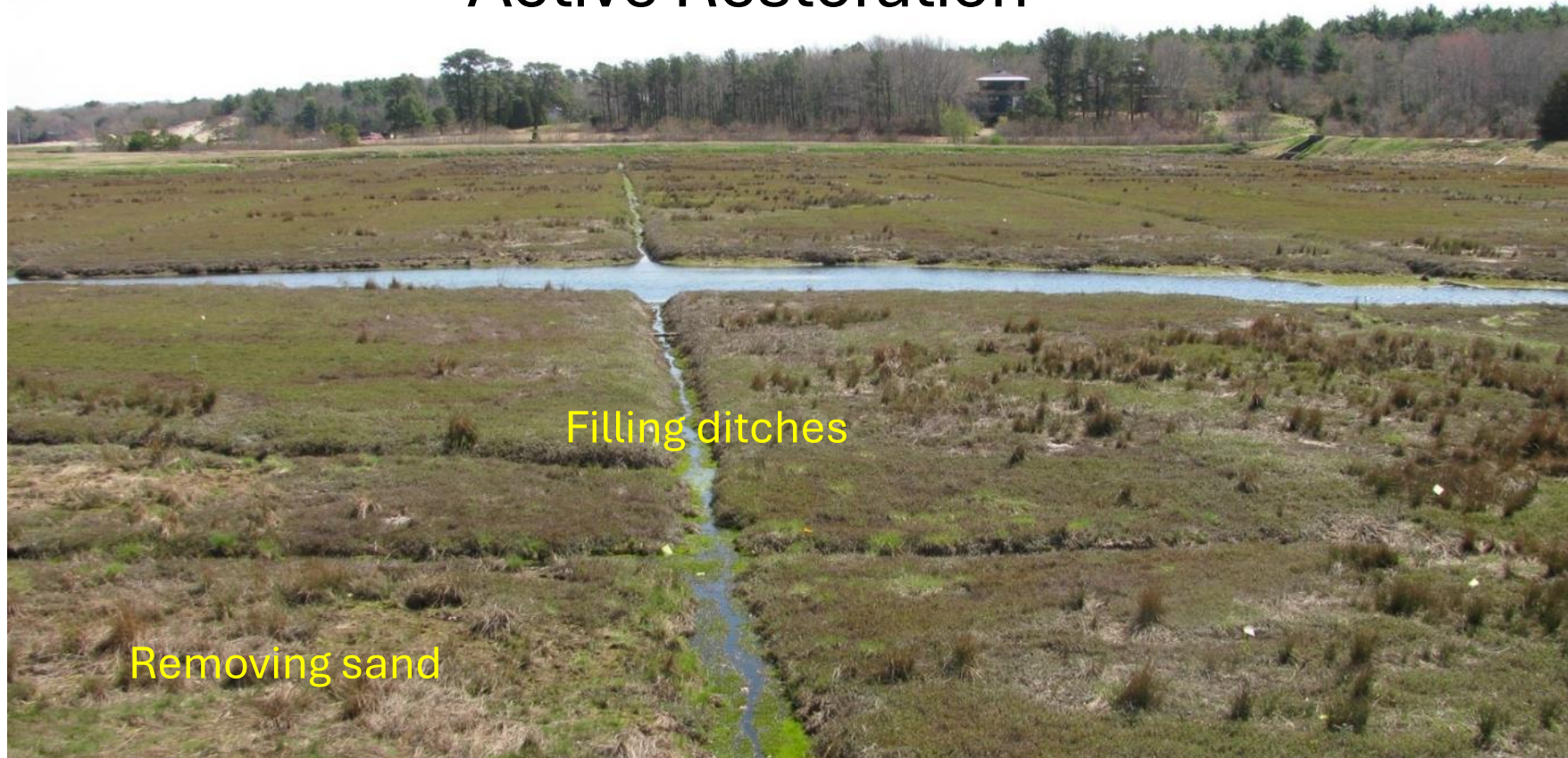


# Freshwater Wetlands





# Active Restoration





# Active Restoration



Reconfigured  
stream channel

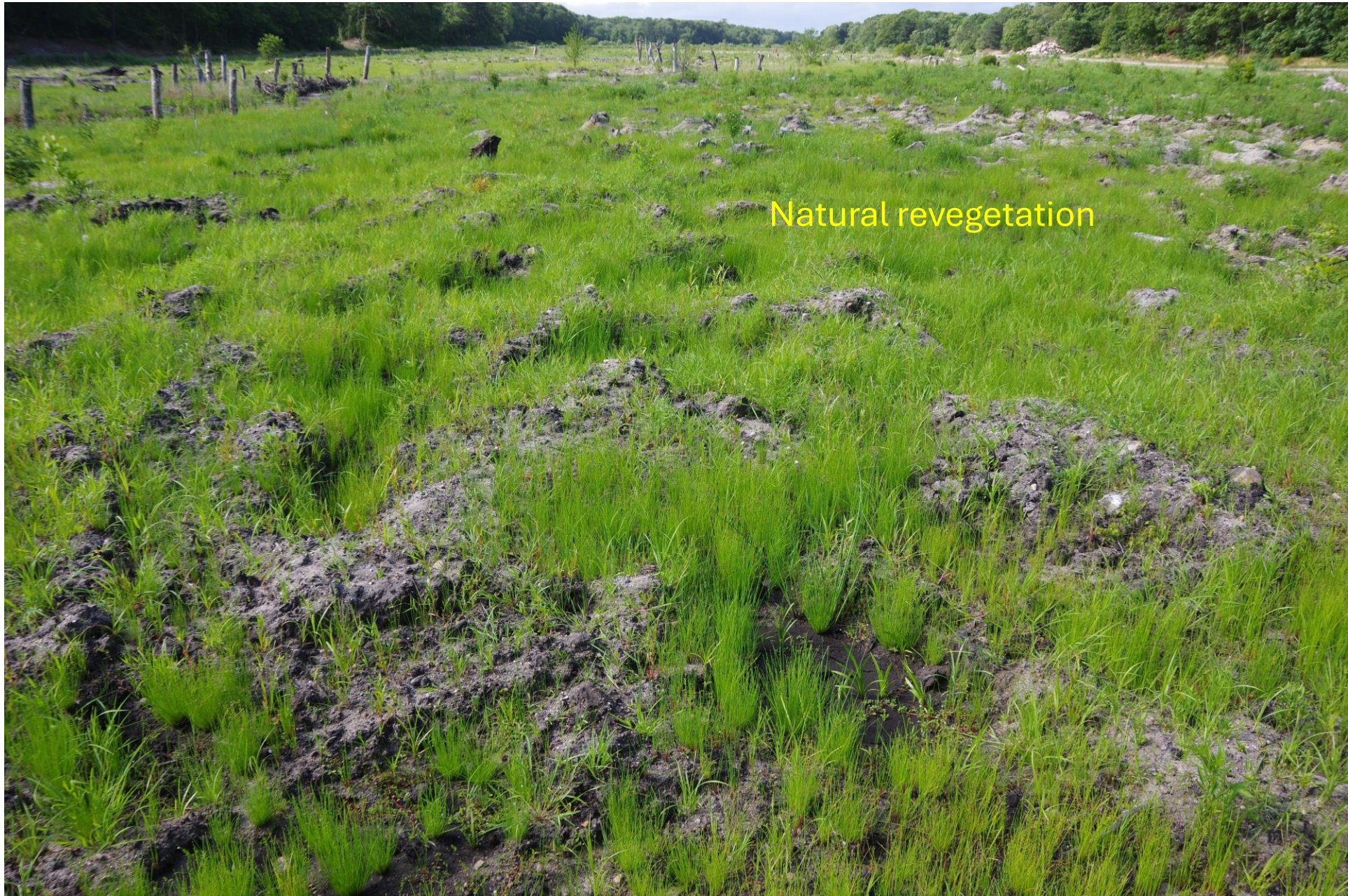
Woody debris

Microtopography

Minimal seeding



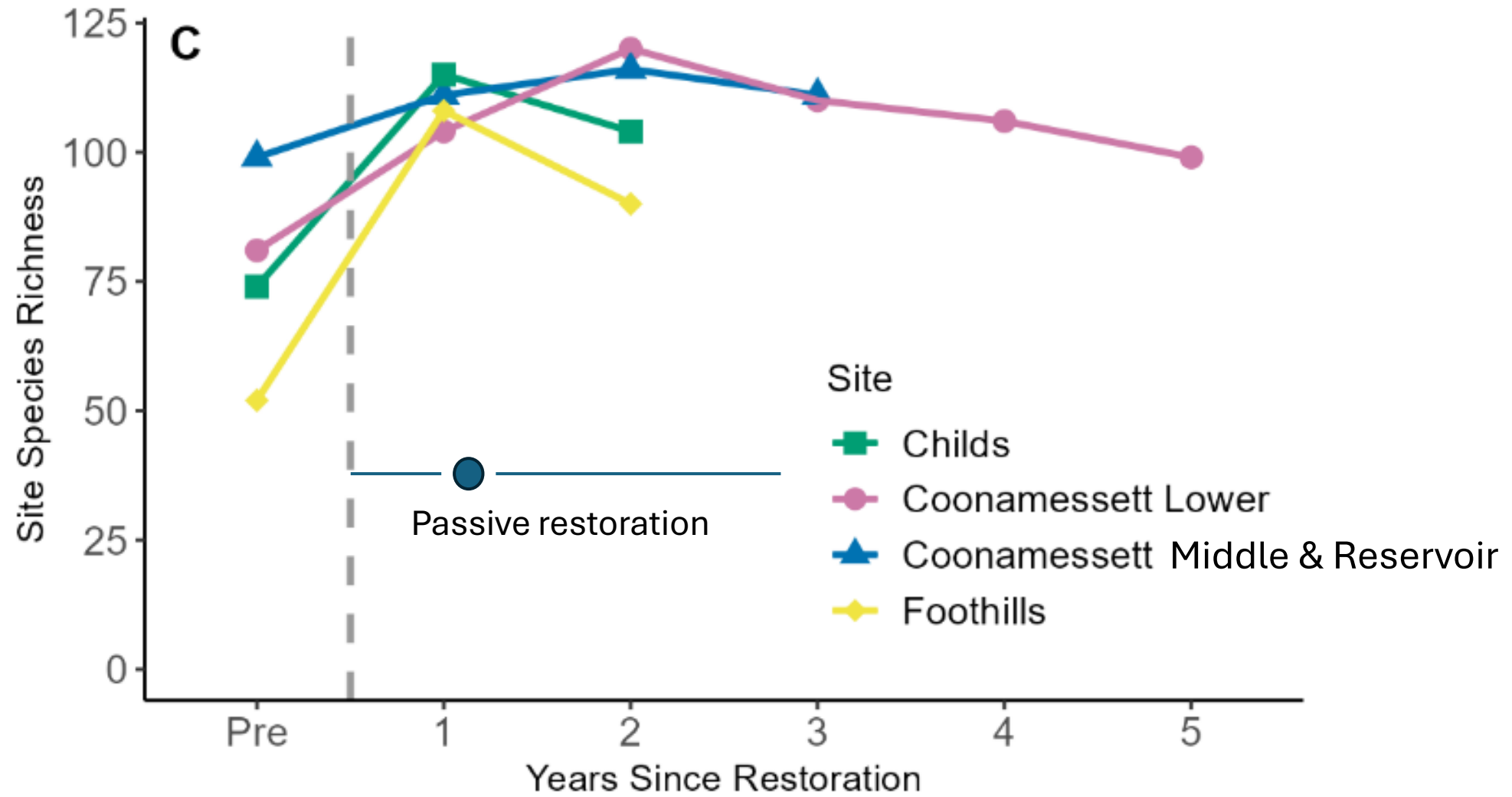
# Active Restoration



Natural revegetation



# Active Restoration





# Active Restoration



*Juncus canadensis*



*Cyperus dentatus*



*Cyperus strigosus*



# Active Restoration



*Juncus effusus*



*Carex lurida*



*Schoenoplectus pungens*



# Active Restoration



*Drosera intermedia*



*Sisyrrinchium atlanticum*



*Asclepias incarnata*



# Active Restoration



Windswept 2024



Mattapoissett 2024



Cold Brook 2024



# Active Restoration



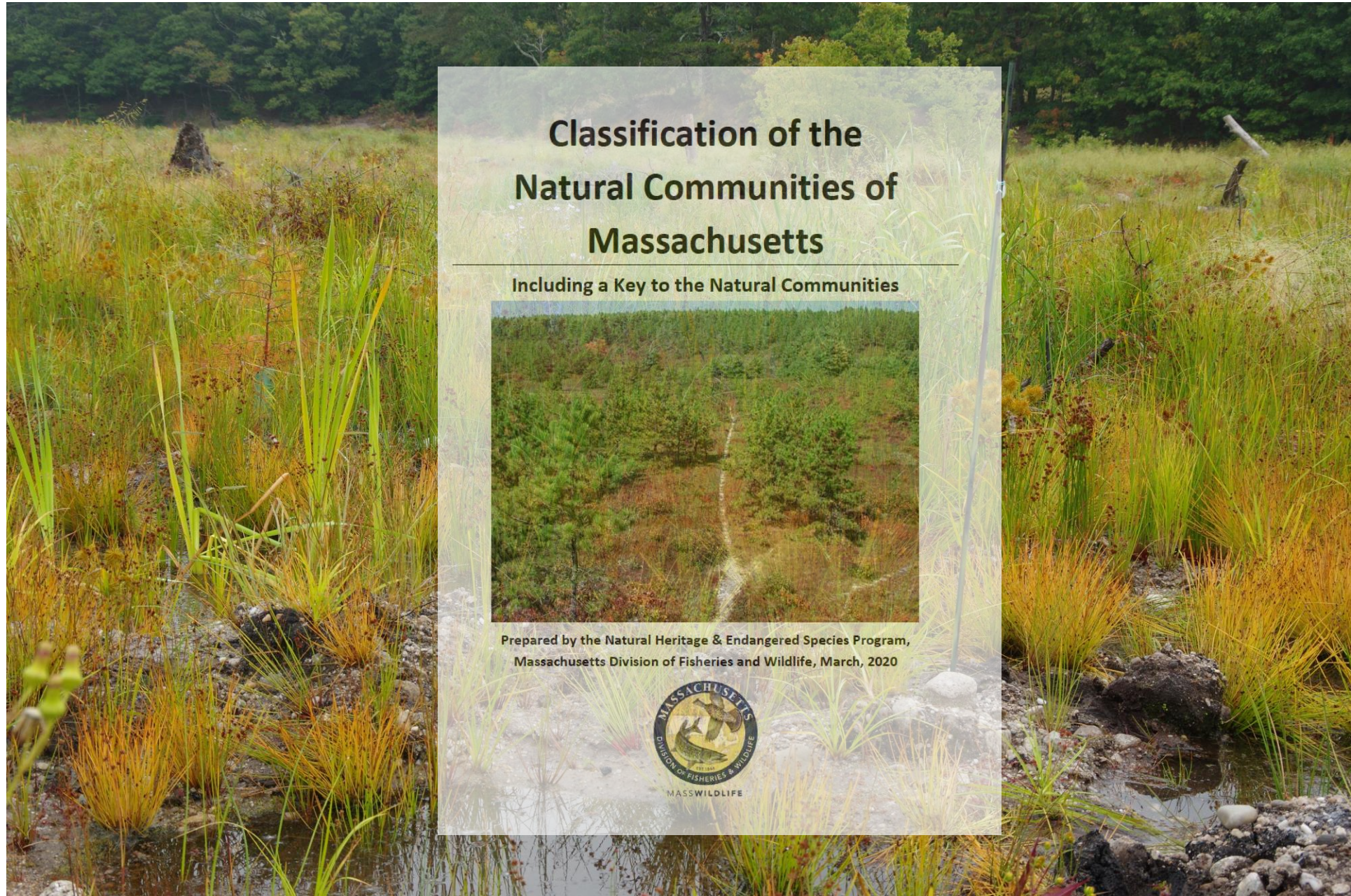
South African Fynbos



Eastern European Grasslands



# Active Restoration



## Classification of the Natural Communities of Massachusetts

Including a Key to the Natural Communities



Prepared by the Natural Heritage & Endangered Species Program,  
Massachusetts Division of Fisheries and Wildlife, March, 2020



MASSWILDLIFE



# Active Restoration

## **Translating Science into Conservation Action**

- Crated patch habitats of high biodiversity worthy of recognition
- Consider active restoration because of large biodiversity benefits
- Participate in pre- and post-restoration monitoring
- Consider being parts of experiments to test restoration techniques and lower costs



# Active Restoration

More restoration in the pipeline (~17 projects)!

Upper Coonamessett (Falmouth)

Marstons Mills (Barnstable)

Stuart (Rochester)

South Meadow (Carver)

Indian Brook (Plymouth)

Century (Wareham)

Hinckleys Pond (Harwich)

Mill Brook (Freetown)

Pinnacle (Plymouth)

Holmes (Plymouth)

Upper Bass River (Yarmouth)

Bayview (Barnstable)

Windswept Phase II (Nantucket)

Puritan (Bourne)

Jacks Marsh (Wareham)

Marks Cove (Wareham)

Thatcher (Harwich)

# Conclusions

Patch habitats are a valuable way of thinking about landscapes

Small patch habitats are disproportionately important for regional biodiversity

We in Southeast MA are blessed with **the** highest diversity patch habitats in the Northeast US

Land trusts can play a key role in understanding responses of patch habitats to land management

Watching patch habitats (and biodiversity) thrive can be one of the most rewarding and fun aspects of the jobs we do