Pleasant Bay Climate Adaptation Action Plan

Salt Marsh Resiliency Assessment

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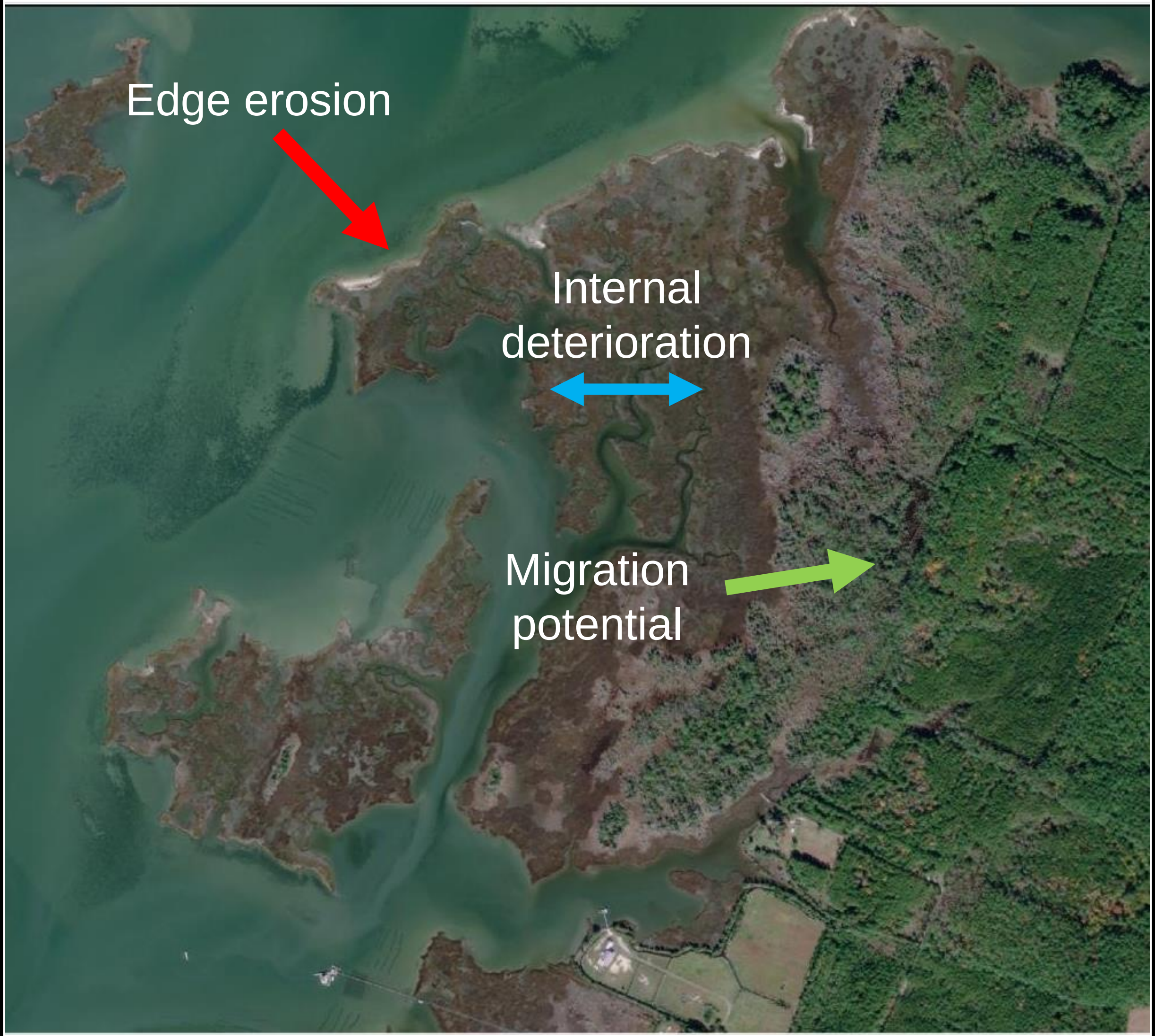
Why do we care about salt marshes?

- Provide important habitat for wildlife: mammals, reptiles, birds, fish, etc.
- Improve coastal water quality – coastal filter
- Store atmospheric carbon – reduce harmful greenhouse gases
- Protect coastline – storm surge and wave reduction
- Recreation and aesthetics

Vulnerability of salt marshes: a combination of processes



Marsh loss is a three-dimensional process

Sea-level rise, waves, and sediment deficits responsible for widespread marsh loss

Edge erosion caused by waves

Internal deterioration caused by multiple factors but diagnosed through open water conversion and elevation loss

Migration potential depends on slope, tidal inundation frequency, salinity, land use, vegetation cover

Acknowledgements:
Neil Ganju, Kate Ackerman, and Zafer Defne
U.S. Geological Survey, Woods Hole

USGS

Salt Marsh Resiliency Assessment Methodology

- Delineate marsh units
  - 180 hydrologically distinct units

Data from USGS MA Coastal Wetland Synthesis (Ackerman et al. 2021; Defne et al. 2023)

Salt Marsh Resiliency Assessment – Methodology

- Marsh Elevation

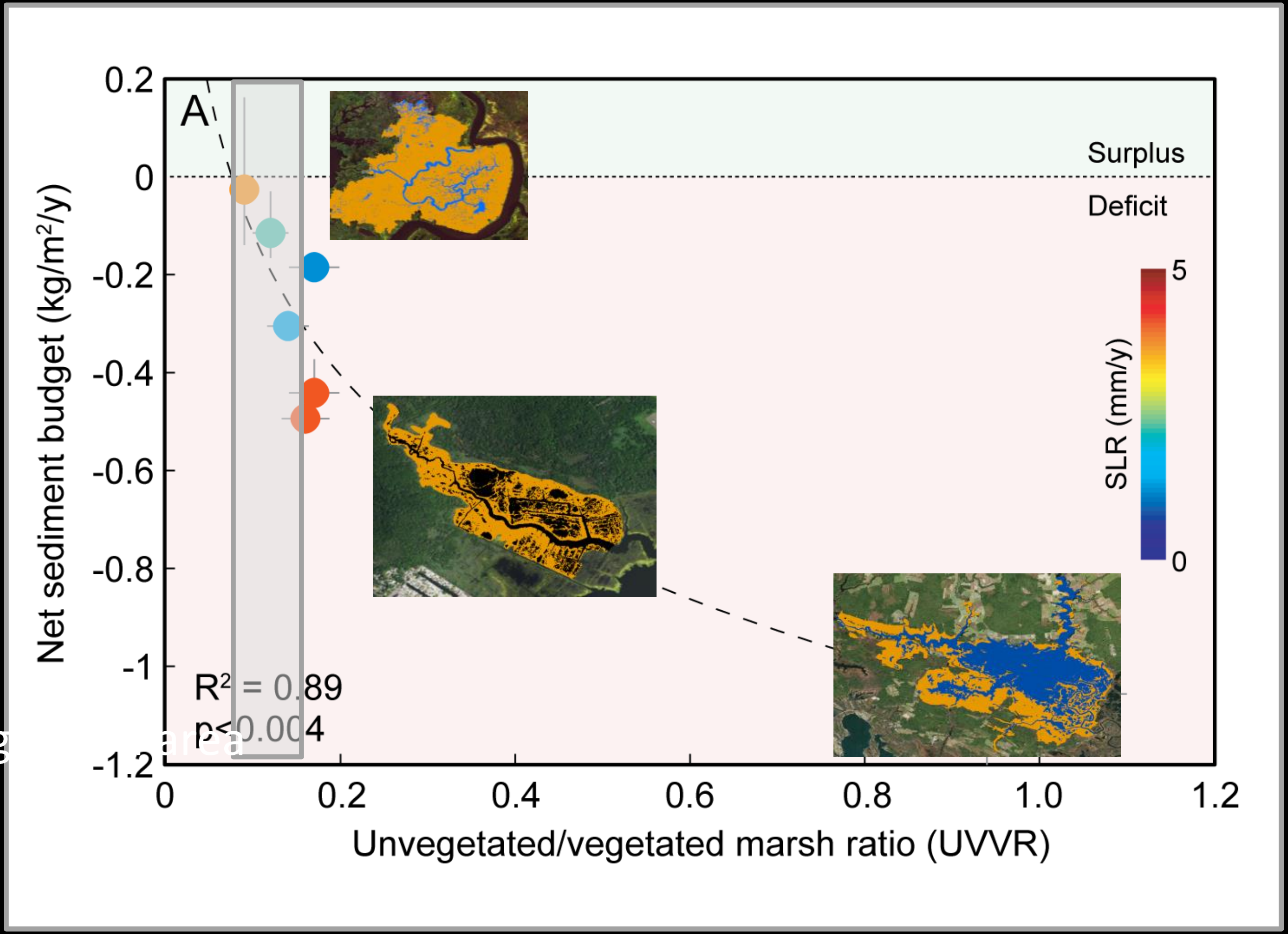
    – relative to mean tide (middle between MHW & MLW) in meters

    – determine mean optimal marsh elevation and elevation range for resiliency

Data from USGS MA Coastal Wetland Synthesis
(Ackerman et al. 2021; Defne et al. 2023)

Net sediment budget highly correlated with UnVegetated-Vegetated Ratio

- UVVR indicates disintegration of wetland complex
- Relationship ties SLR, sediment budget, and marsh processes together
- Marsh stability value ~ 0.10 – 0.15
- UVVR – **U**n**V**egetated – **V**egetated **R**atio
- – determine marsh unit area & veg
- – calculate UVVR



Ganju et al. 2020)

Salt Marsh Resiliency Assessment – Methodology

- Marsh Elevation
  - – relative to mean tide (middle between MHW & MLW) in meters
  - – determine mean optimal marsh elevation and elevation range for resiliency

- UVVR – **U**n**V**egetated – **V**egetated **R**atio
  - – determine marsh unit area & vegetated area
  - – calculate UVVR
  - – optimal marsh stability ~0.10-0.15

Data from USGS MA Coastal Wetland Synthesis
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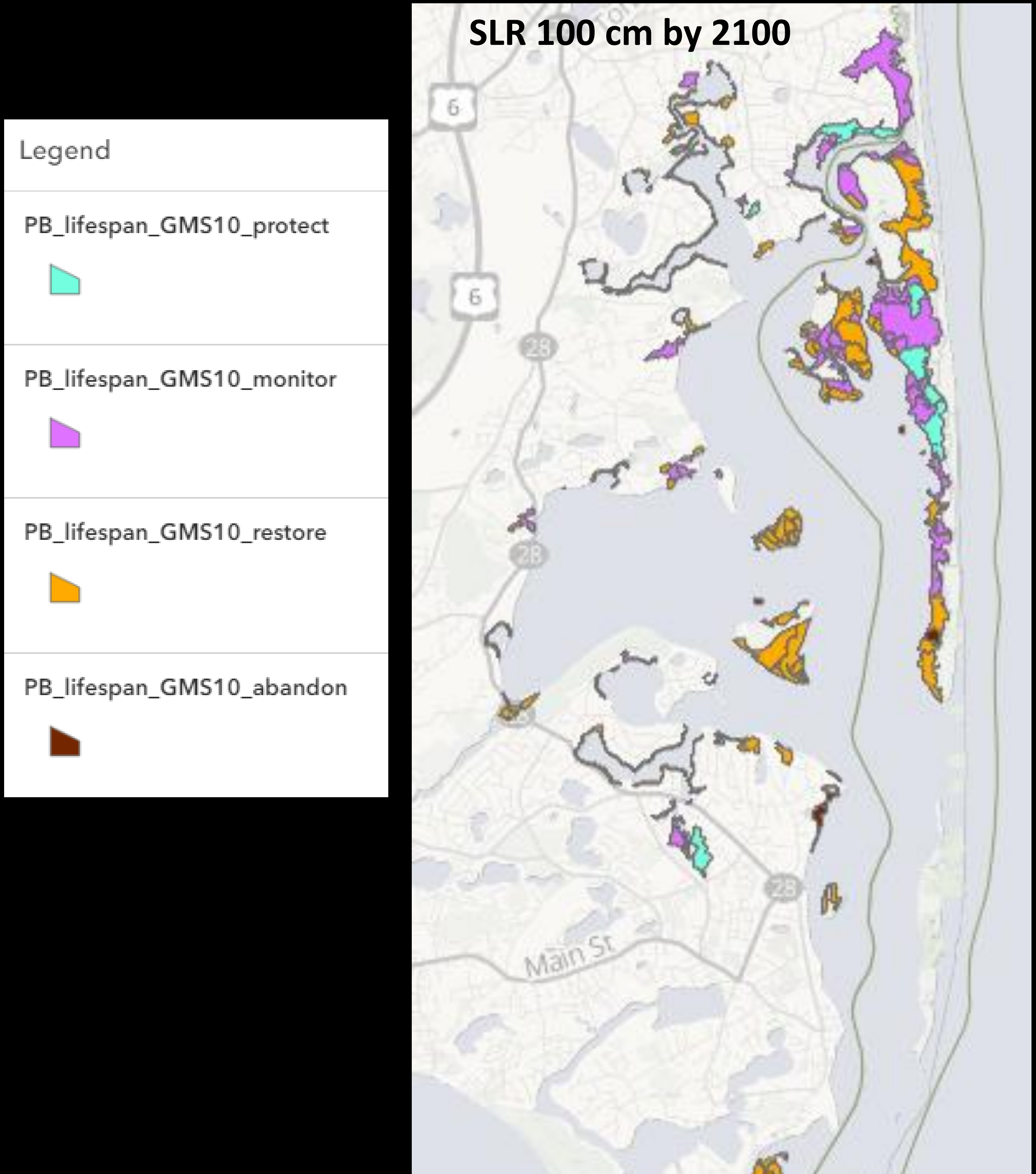
Salt Marsh Resiliency Assessment – Methodology

- Predict marsh resiliency using lifespan tool
    - calculate marsh lifespan under a Sea Level Rise (SLR) scenario
    - Increase of 100 cm Global Mean Sea Level (GMSL) by 2100
    - calculations incorporate UVVR, sediment movement, vegetation biomass, marsh elevation, and GMSL

Data from USGS MA Coastal Wetland Synthesis
(Ackerman et al. 2021; Defne et al. 2023)

Salt Marsh Resiliency Assessment

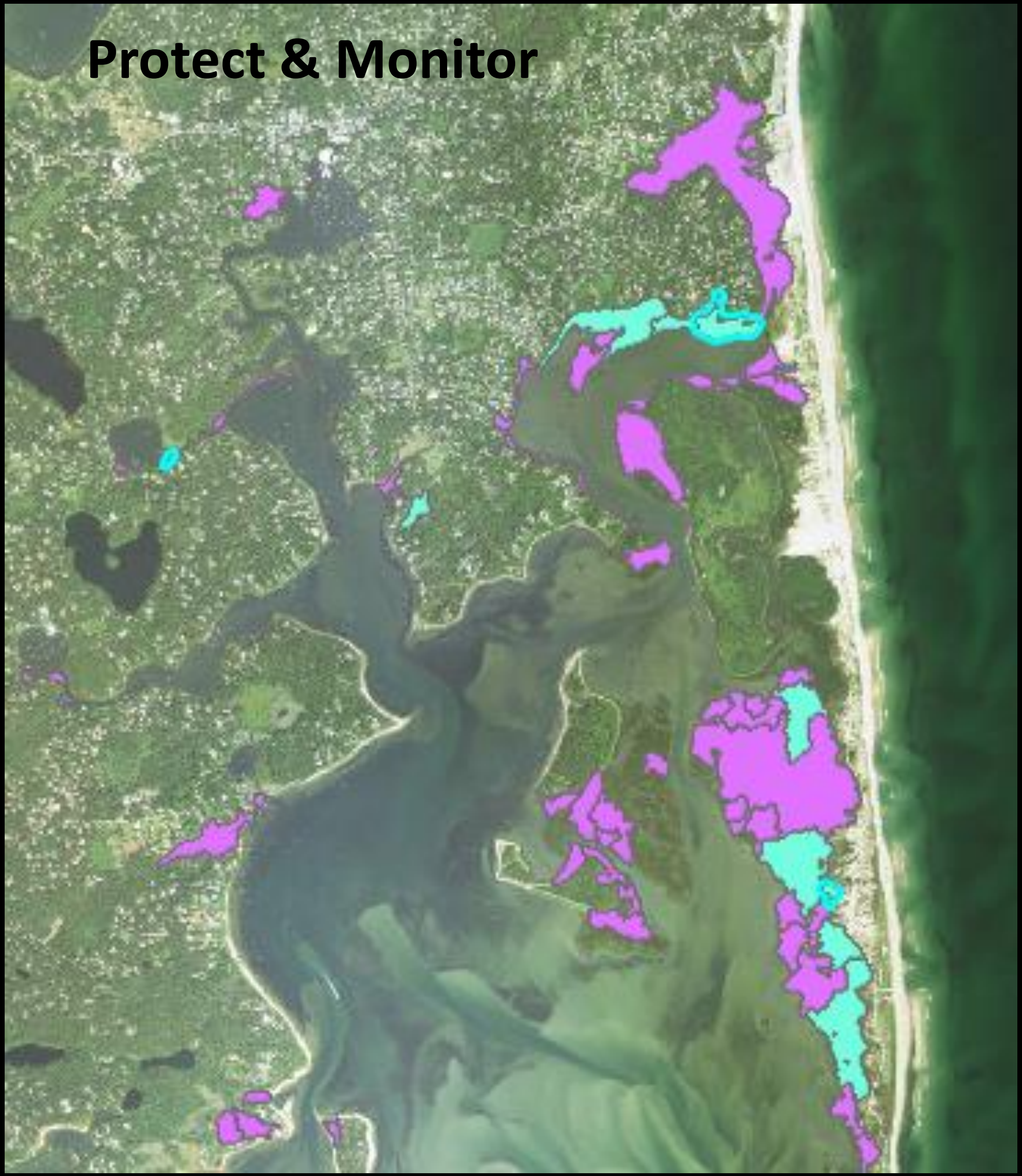
- Lifespan – 1 m sea level rise by 2100
- Blue/purple – more than 125 yrs
- Orange, red – less than 125 years



Salt Marsh Resiliency Assessment

- Lifespan – 1 m sea level rise by 2100
- Blue/purple – more than 125 yrs
- Protect & Monitor

Salt Marsh Resiliency Assessment



- Most of the sites are in Little Pleasant Bay and with CCNS
- Though a few key sites to examine in the main Bay

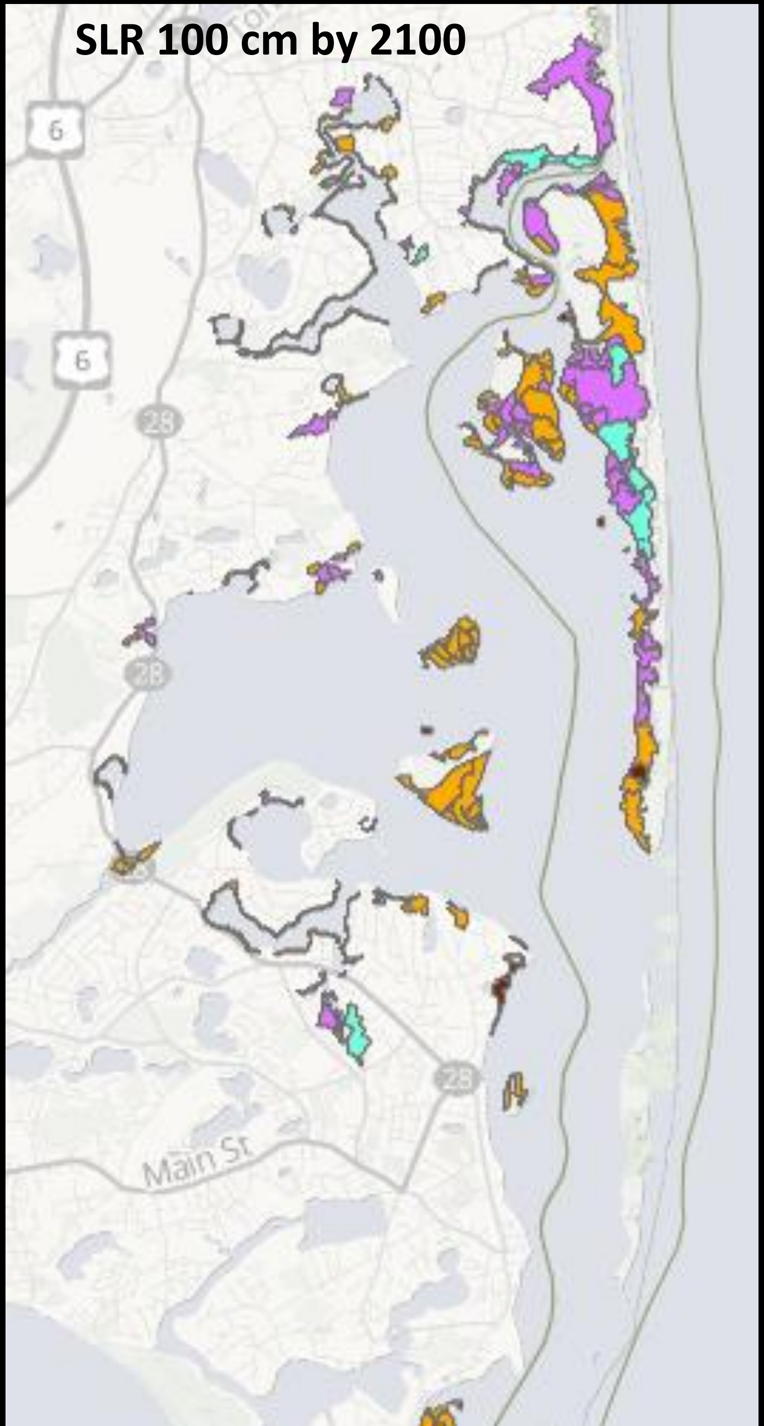
Salt Marsh Resiliency Assessment

- Orange sites are the focus of this prioritization/assessment
- Red sites are in a state of deterioration

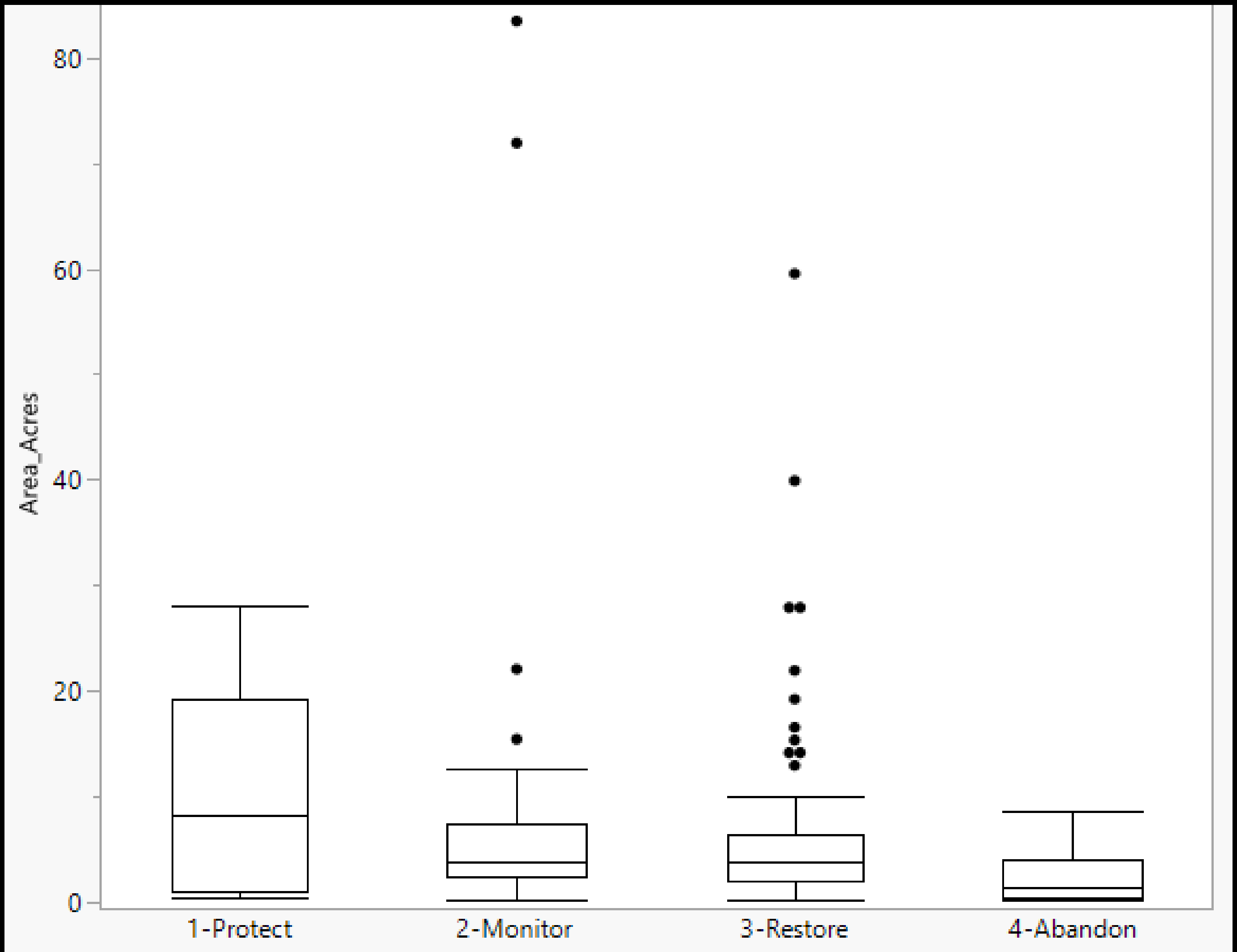
Next steps - Determining strategies: decision matrix

Determining strategies: decision matrix

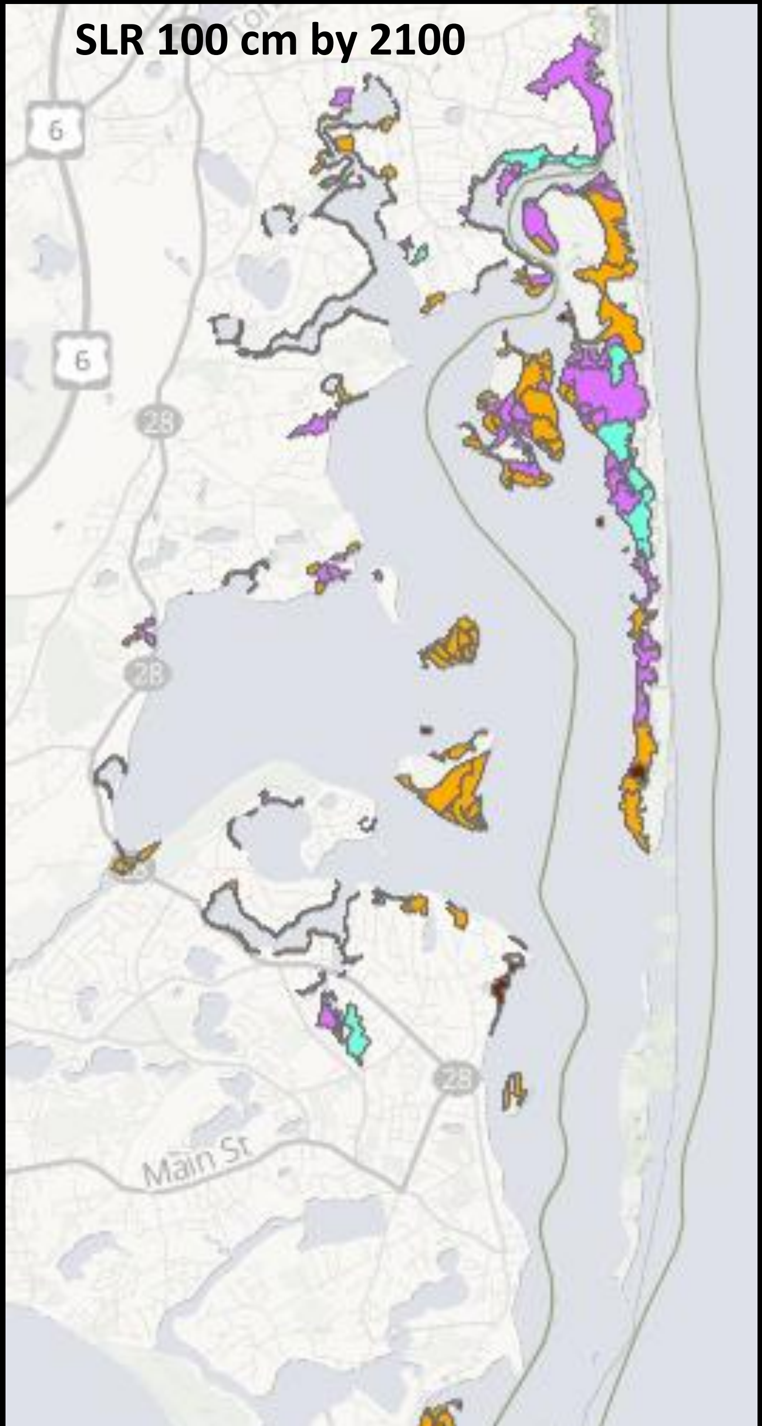
	100 cm SLR			
	Lifespan (yrs)	N		Area (acres)
Protect	>300	13		131
Monitor	125-300	61		437
Restore	25-124	92		565
Abandon	<25	14		31



Determining strategies: decision frameworks



The size of the marsh appears to contribute to integrity/persistence, and smaller marshes are the most vulnerable



Determining strategies: restoration decision matrix

UnVegetated-Vegetated Ratio (UVVR)

		Low	High
Elevation	High		
	Low		

Determining strategies: restoration decision matrix

UnVegetated-Vegetated Ratio (UVVR)

Low | High

Elevation

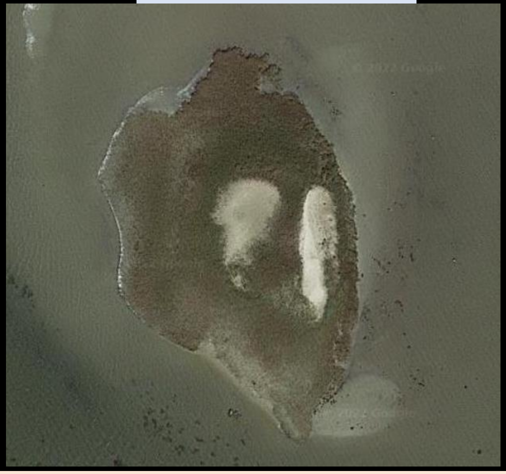
High

Protect

Restore

Low

Monitor closely



Do nothing/Abandon

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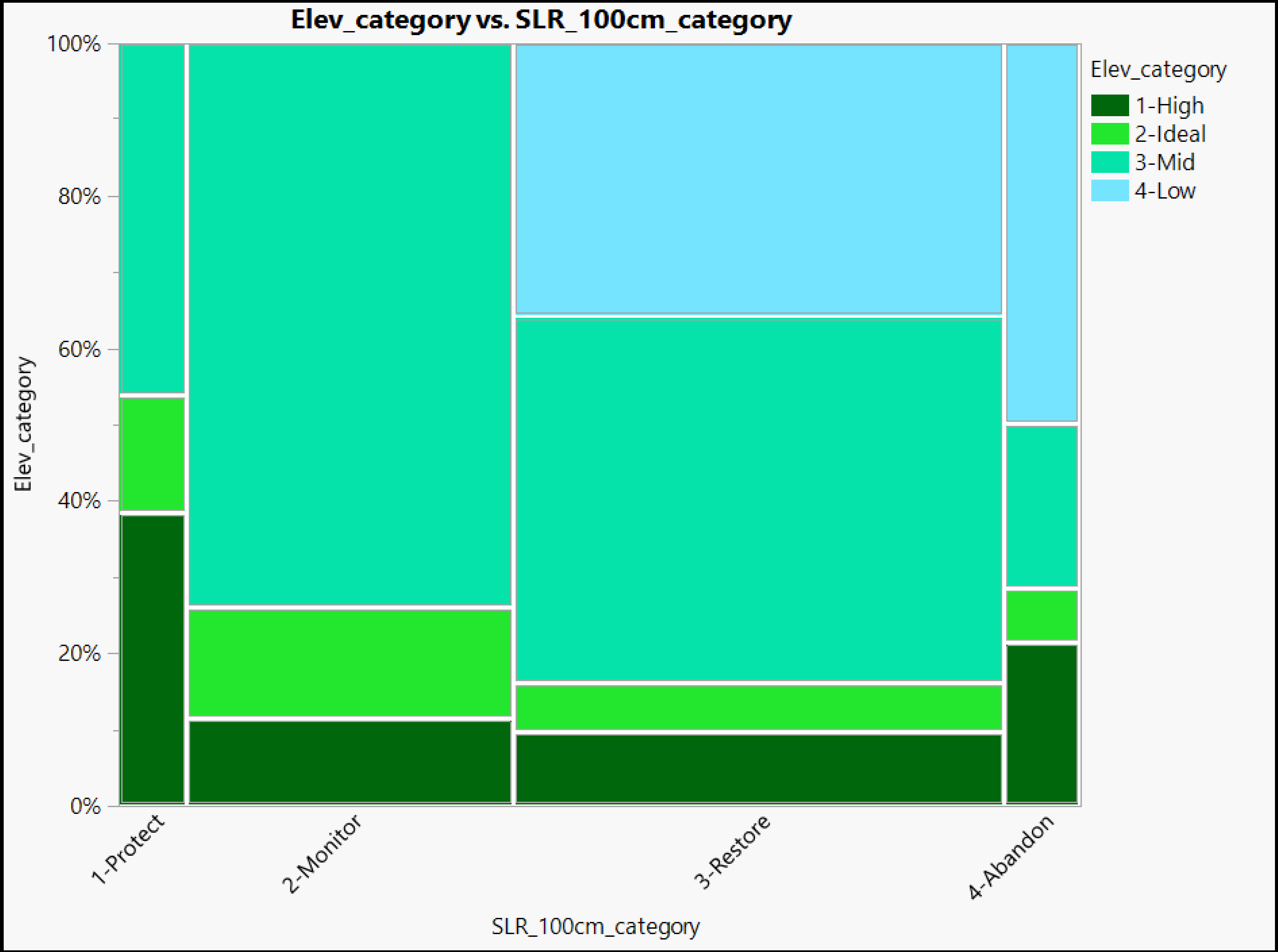
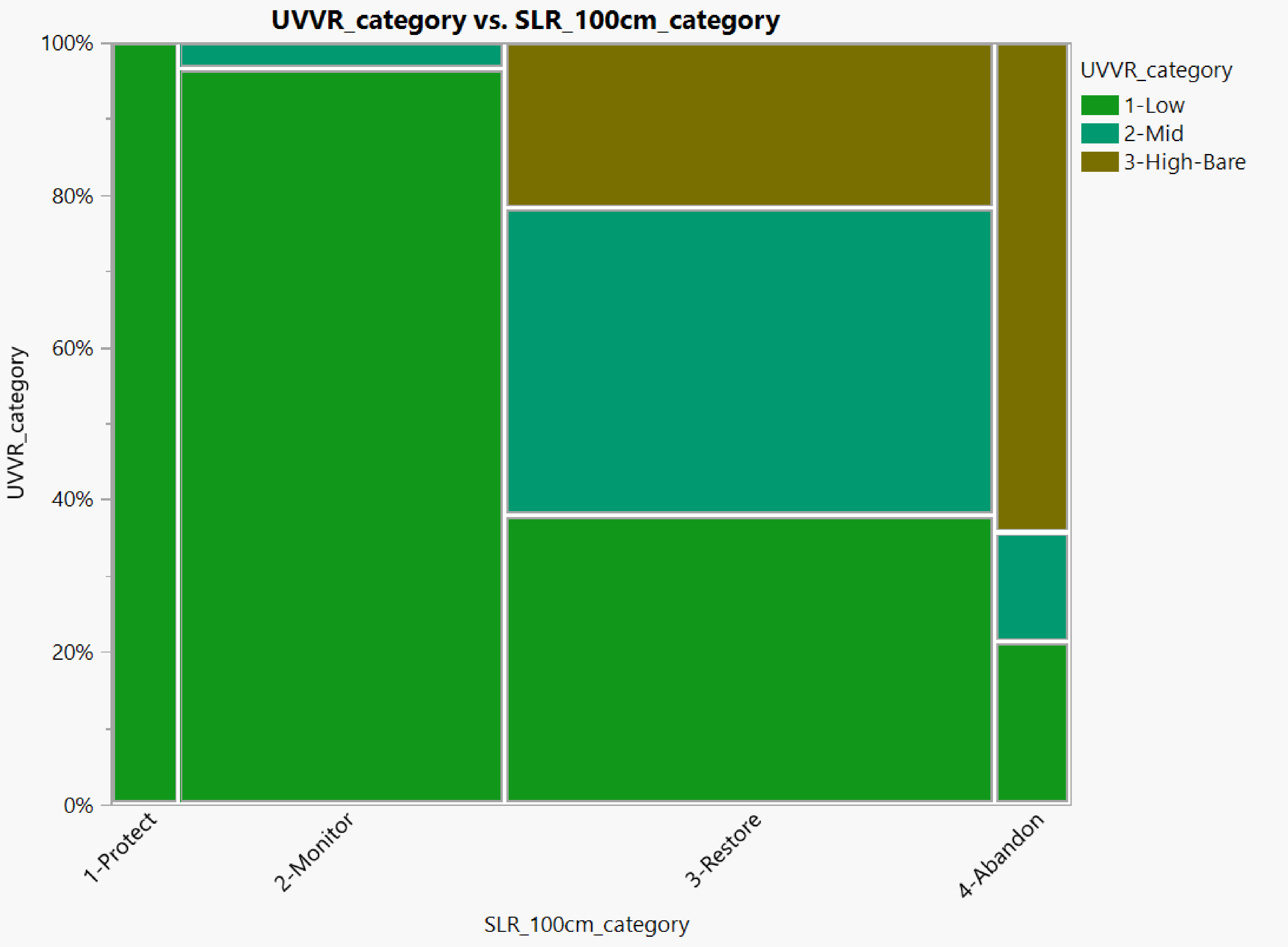

Elev_category vs. SLR_100cm_category
100%
80%
60%
40%
20%
0%
Elev_category
Elev_category
1-High
2-Ideal
3-Mid
4-Low
1-Protect
2-Monitor
3-Restore
4-Abandon
SLR_100cm_category


UVVR_category vs. SLR_100cm_category
100%
80%
60%
40%
20%
0%
UVVR_category
1-Protect
2-Monitor
3-Restore
4-Abandon
SLR_100cm_category
UVVR_category
1-Low
2-Mid
3-High-Bare

Next steps - Determining strategies: decision matrix

PB_protect

PB_monitor

PB_abandon

PB_restore

Next steps - Determining strategies: decision matrix

Maximize persistence of tidal marshes over time
Maximize lifespan
Maintain elevation relative to SLR
Minimize open water conversion and loss of vegetated cover
Maximize adjacent upland available for marsh migration
Minimize other stressors - marinas, docks, etc.
Maximize quantity of tidal marshes
Maximize number of systems
Maximize acreage
Maximize quality of tidal marshes
Maximize *contiguity* of marshes/*Minimize fragmentation*
Maximize cover of native marsh *plant* species
Maximize biodiversity
Maximize ecosystem services
Maximize coastal infrastructure protection
Maximize water quality
Maximize social value of tidal marshes to the public
Maximize natural and cultural history educational value
Maximize aesthetic/inspirational value
Maximize recreational value (e.g. birdwatching, kayaking)
Maximize fisheries
Maximize cultural value of park tidal marsh landscapes
Maximize protection of cultural resources
Maximize value to Tribes

Lifespan examples: restoration of a higher, ponded marsh

- High UVVR
- High elevation
- Longer lifespans

Nearly UNvegetated marsh parcel

Area = 35,000 m^2

UVVR = 0.58

Elevation of vegetated plain = 0.95 m above MSL

SLR = 0.007 m/y

Lifespan = 141 years

USGS

Lifespan examples: restoration of a higher, ponded marsh

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UVVR = 0.58
Elevation of vegetated plain = 0.95 m above MSL

SLR = 0.007 m/y

Lifespan = 141 years

If you drain the ponds, and revegetate half the plain

New UVVR = 0.225
Lifespan = 242 years

- Lower UVVR
- High elevation
- RESTORE

USGS

Thank you!!

Coyote at sunrise in the Narrows