



Salt marsh restoration, migration, and coastal forest retreat at Cape Cod National Seashore



Stephen Smith, PhD
Cape Cod National Seashore
stephen_m_smith@nps.gov

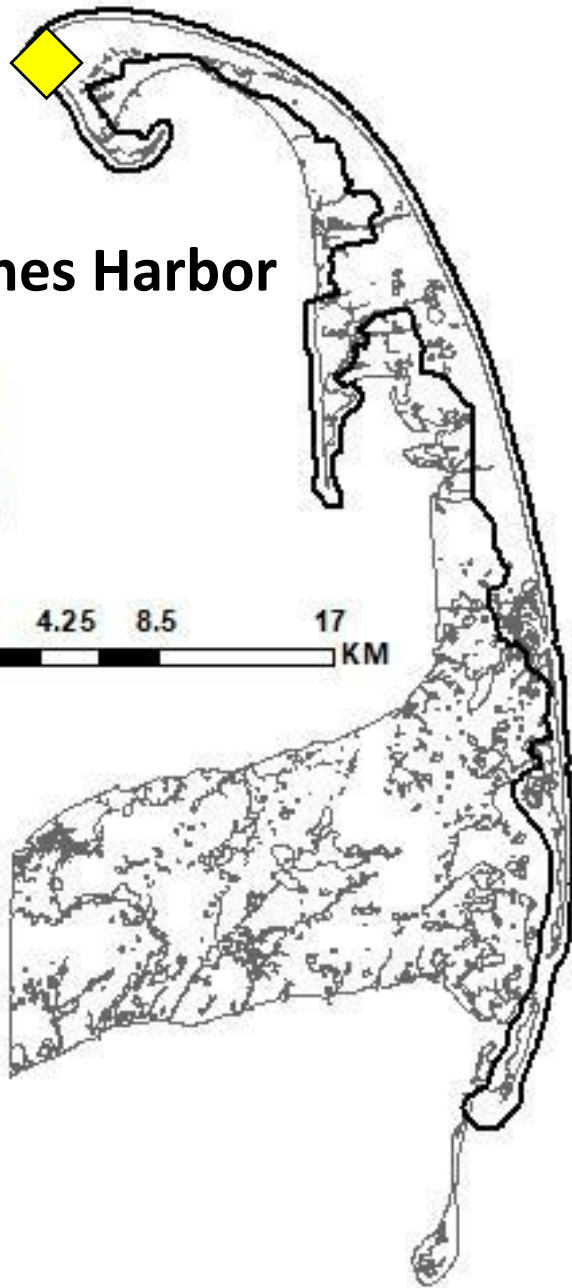


CCNS tidal restoration sites (n=3)

Hatches Harbor



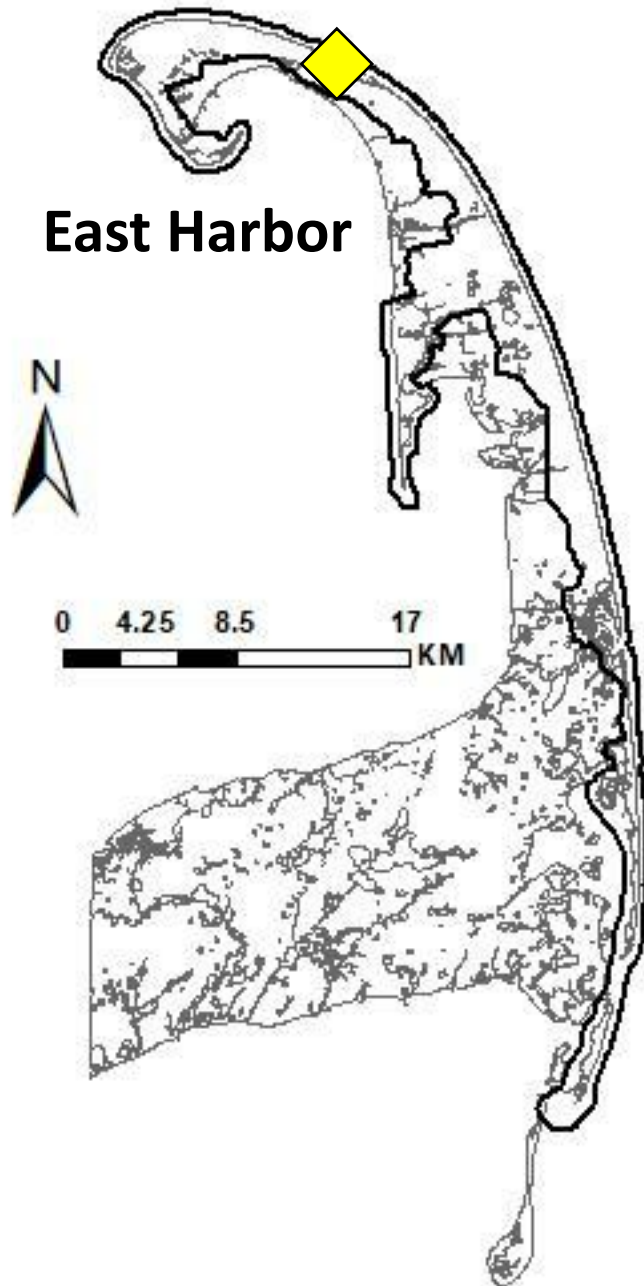
0 4.25 8.5 17 KM



Restoring since 1998
(restricted since 1930s)



Restoring since 2001 (restricted since 1800s)





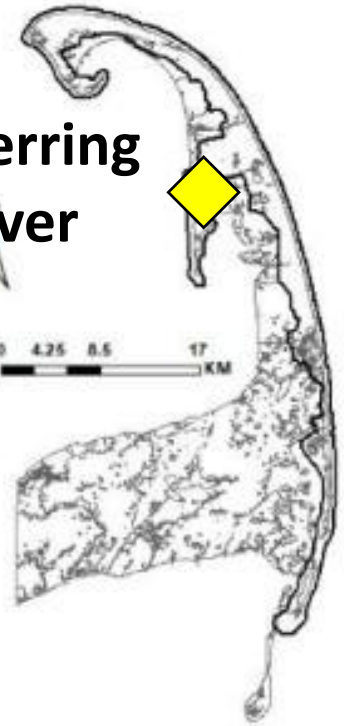
1,100 acres of tidally-



Herring
River



0 4.25 8.5 17
KM





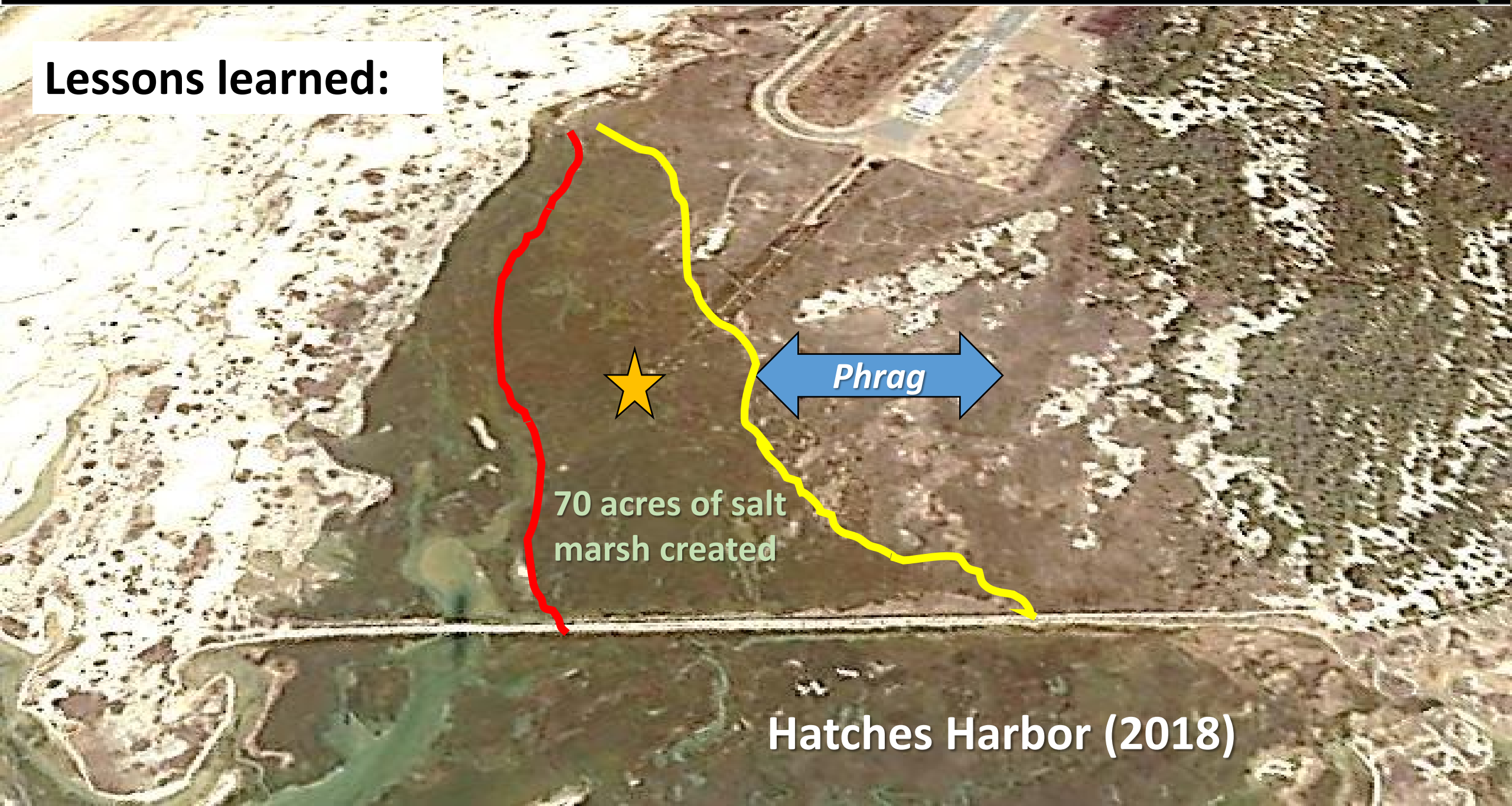
Lessons learned:



Hatches Harbor (2001)



Lessons learned:



70 acres of salt
marsh created

Phrag

Hatches Harbor (2018)



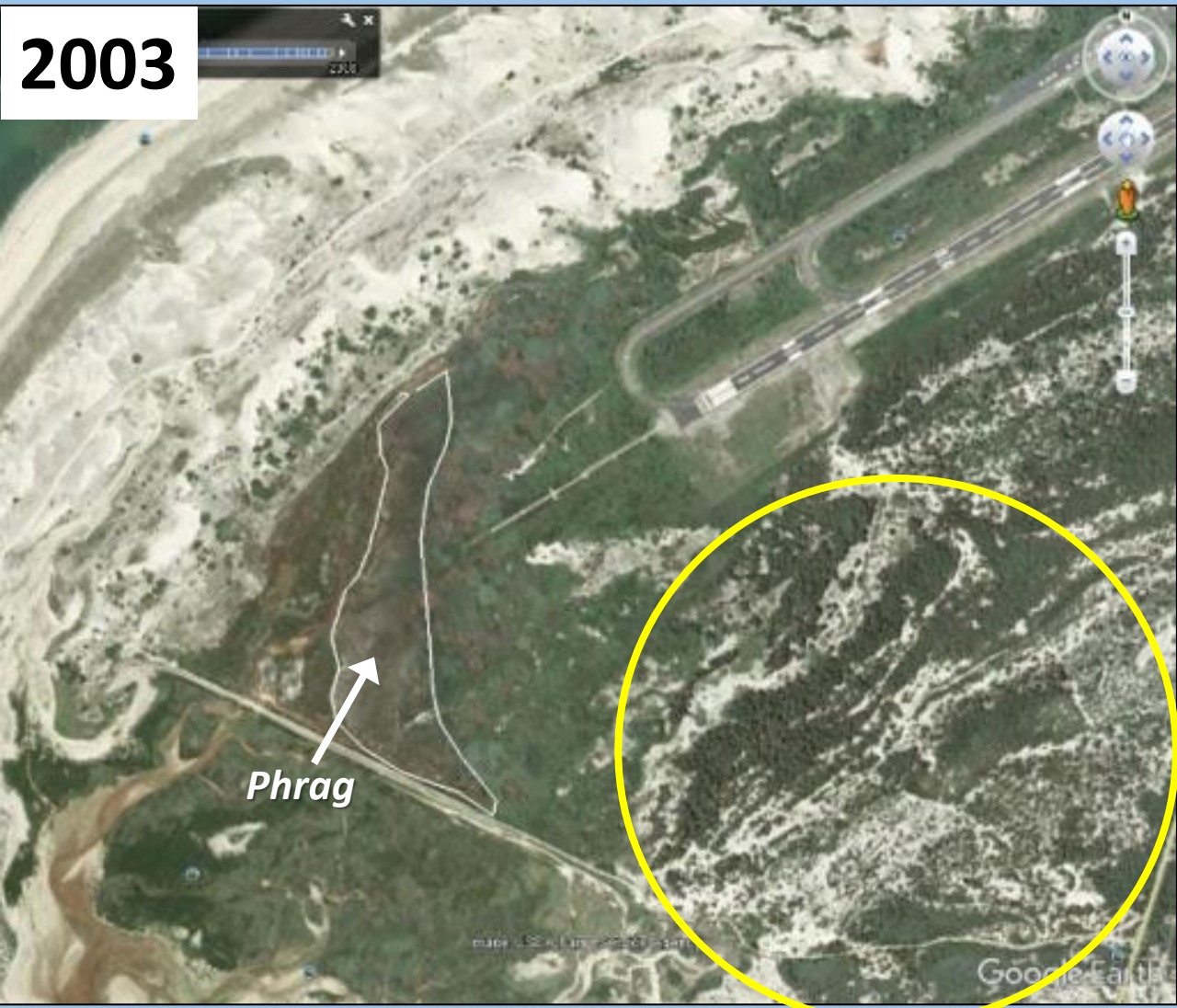
- *Phragmites* likes zone of 10-25 ppt, where it has no interspecific competition but does not suffer excessive physiological stress



- *Phragmites* did not disappear; it moved upslope as this salinity niche moved upslope
- Pre-restoration eradication of *Phragmites* is preferable if possible



Adjacent terrestrial forest/shrub vegetation has not been impacted by restoration (still recovering from deforestation)

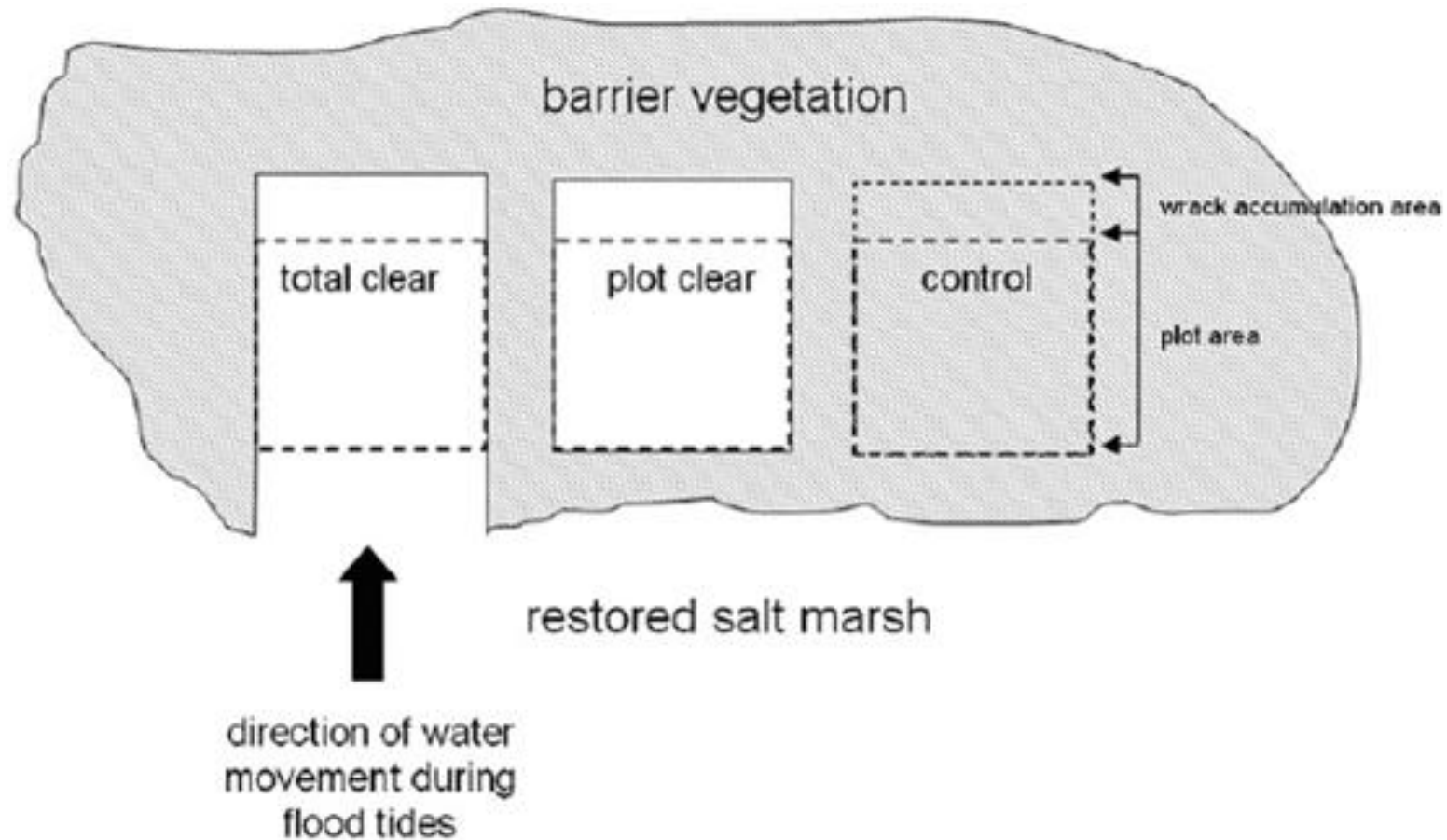




Salt-killed *Phragmites*




Effects of salt-killed standing
vegetation on salt marsh expansion



Smith, S.M. 2007. Removal of salt-killed vegetation during tidal restoration of a New England salt marsh: effects on wrack movement and the establishment of native halophytes. *Ecological Restoration* 24:268-273.



Table 1. Mean (\pm SE) and total numbers of seedlings for each halophyte taxon recorded in September 2006. Cover class values are listed for salt-marsh hay; treatment groups with the same letter are statistically equal). Treatment effects were significant for cordgrass (ANOVA; $F_{2,9} = 13.1$, $p = 0.002$) and glasswort (ANOVA; $F_{2,9} = 5.31$, $p = 0.03$).

Species	Pre-treatment			Post-treatment					
	TC	PC	C	TC	PC	C			
		0	0	468 (114)	a	172 (54)	a	26 (16)	b
		0.2	4.4	290 (109)	a	228 (106)	a	24 (15)	b
		0.2	0	0	a	0.2 (0.2)	a	0	a
		0.4	0.4	0	a	0.4 (0.4)	a	0.4 (0.4)	a
		0	0	0	a	1.0 (0.63)	a	0.6 (0.6)	a
		0.6	0.6	0.6	a	0.2	a	0.6	a
		0	0	1873		860		128	
		1	22	1158		1140		122	
		0	0	0		1		0	
		0	11	0		2		2	
	0	0	0		5		3		
	3	2	3		3		1		
<i>Spartina patens</i> (sum cover)	3								

cleared

controls



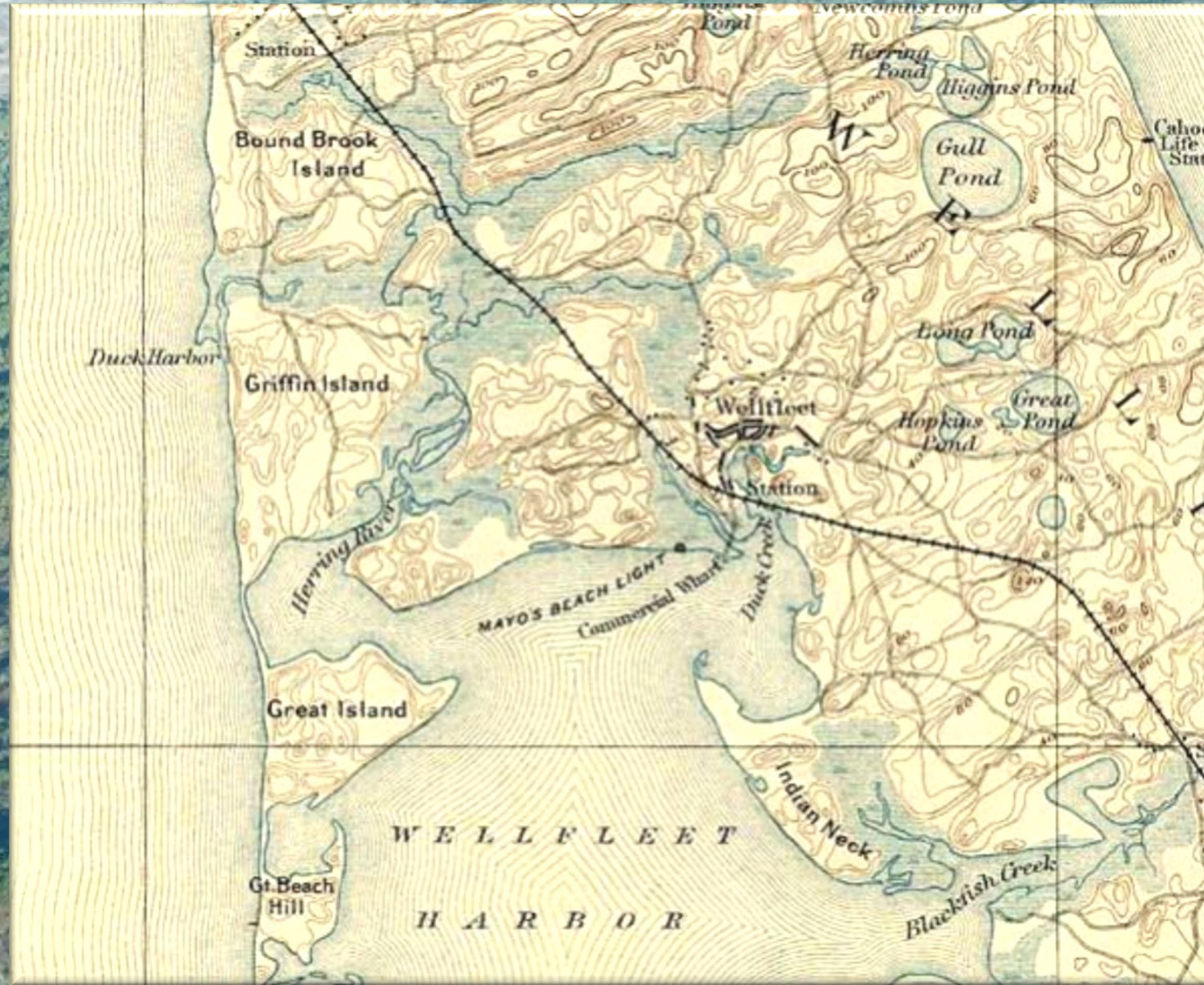
Changes occur over long time (but still no shrub/forest impacts)

2003 – 2 years of restoration



2018 – 17 years of restoration





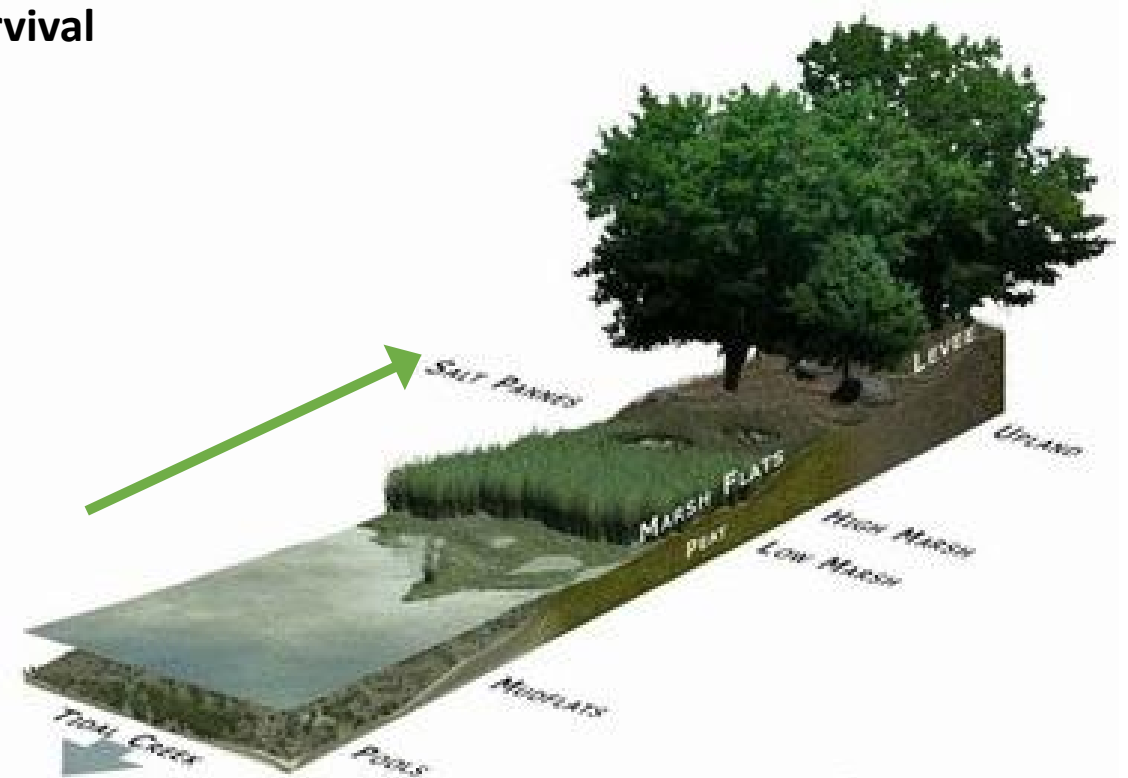
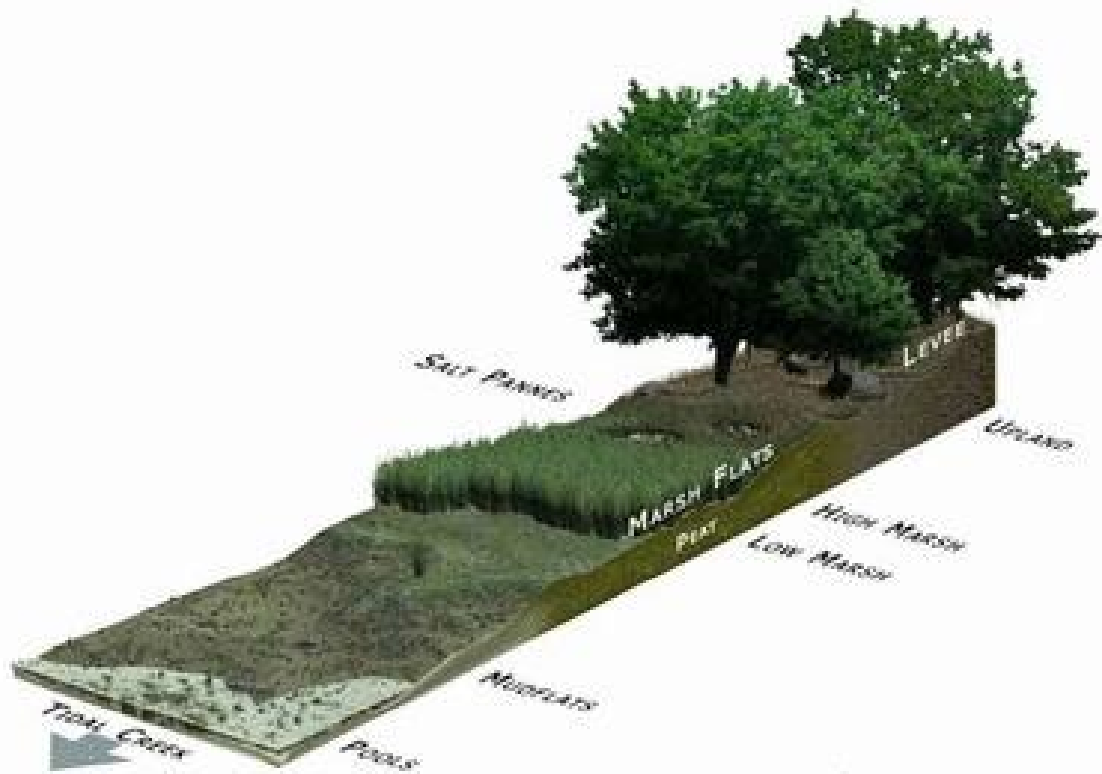
Herring River





Salt Marsh Migration at CCNS

When vertical accretion lags behind SLR, horizontal migration becomes more important for survival





Some, but little evidence of marsh migration into terrestrial habitat..





Isolated areas of salt marsh intrusion into low lying areas (often adjacent freshwater wetlands)





Pleasant Bay responses to sudden changes in hydrology

August 8, 2012 Pre-Isaac



September 2, 2012 Post-Isaac





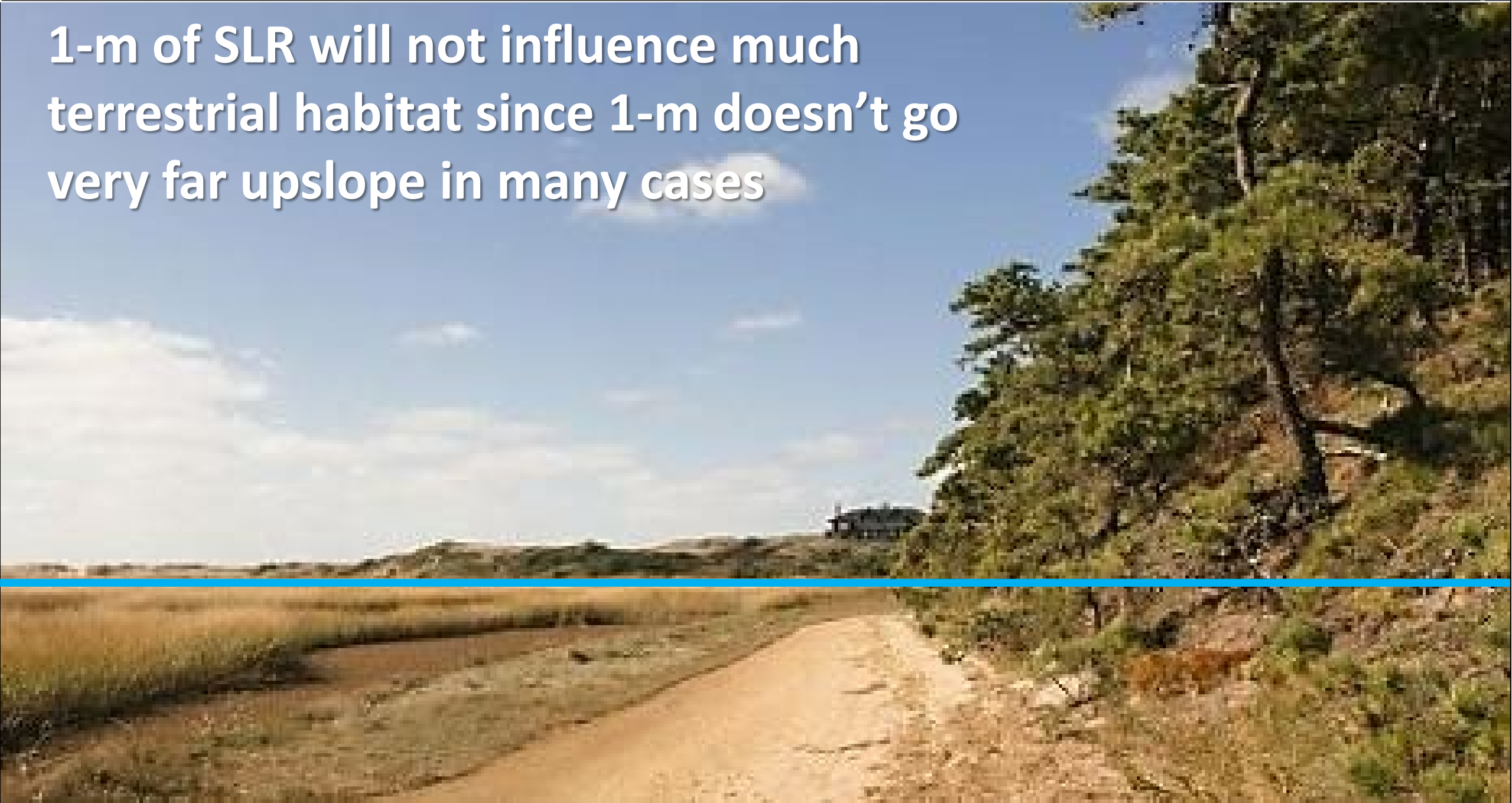


No forest changes with rapid rise in tide heights, amplitude after barrier beach breaks



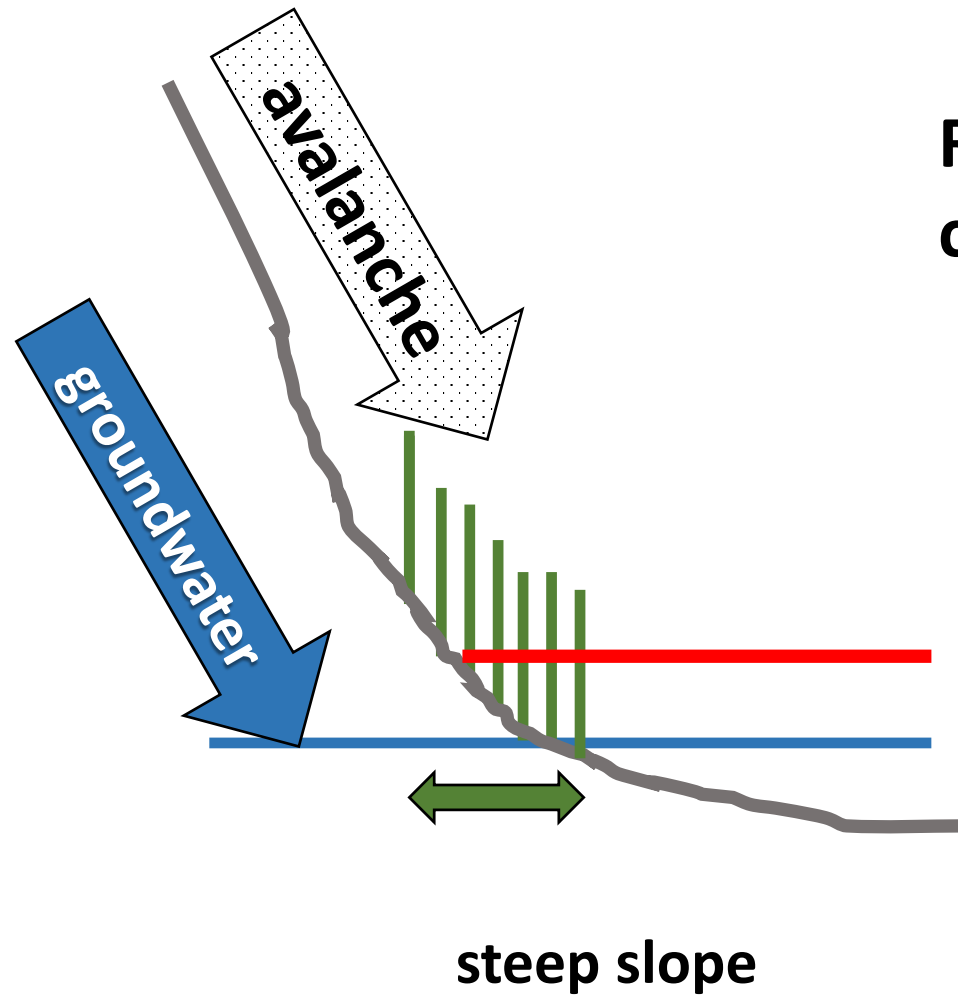


1-m of SLR will not influence much
terrestrial habitat since 1-m doesn't go
very far upslope in many cases

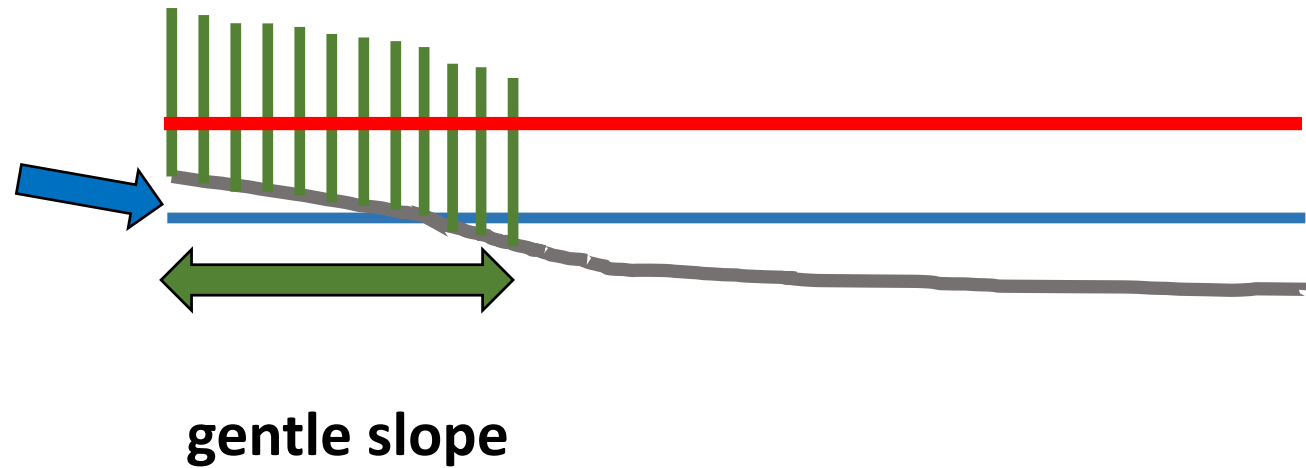


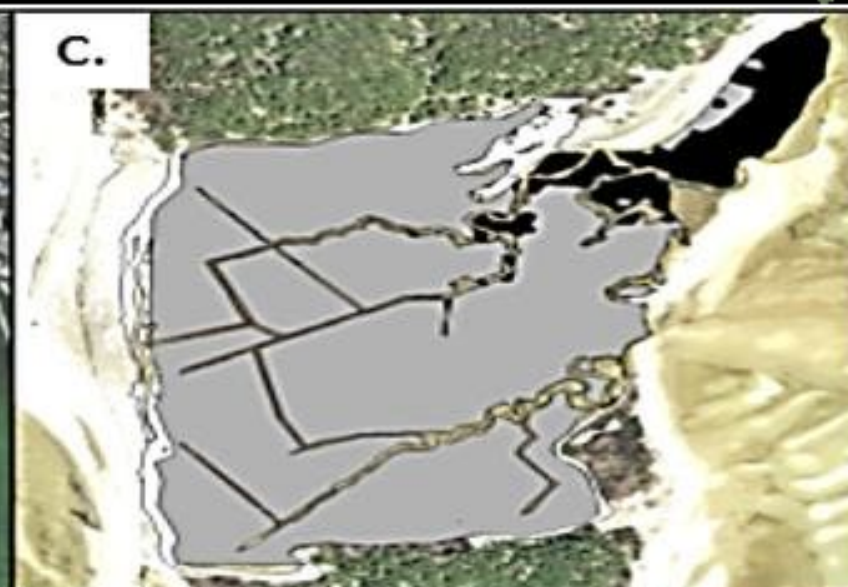
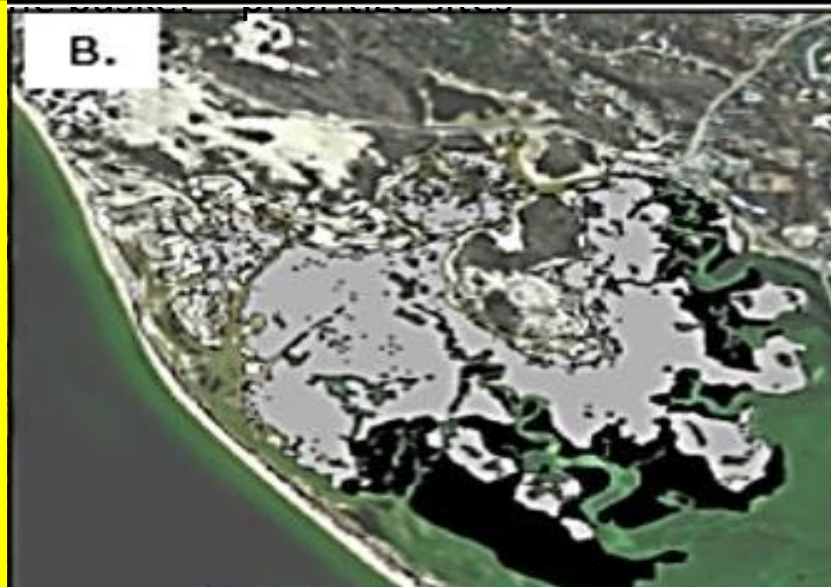


At CCNS, land-use not a huge issue, but upland topography is.



Rainfall (climate change effects on salinity conditions at this boundary?)







Thank you!

