



## **HOW WILL SEA LEVEL RISE CHANGE OUR TIDAL MARSHES?**

**Observations from the North Shore of Massachusetts**

## Climate Change: The Biggest Threat to our Tidal Marshes Today?

- Increased surface temperatures
- Increased water temperatures
- More Frequent/Intense Storms
- ...and Sea Level on the Rise



Our Climate Has Changed...  
...and **CONTINUES** to  
Change!

Global:

Surface temperatures  $+0.74^{\circ}$  C  
Arctic temperatures 2X

Snow and Ice:

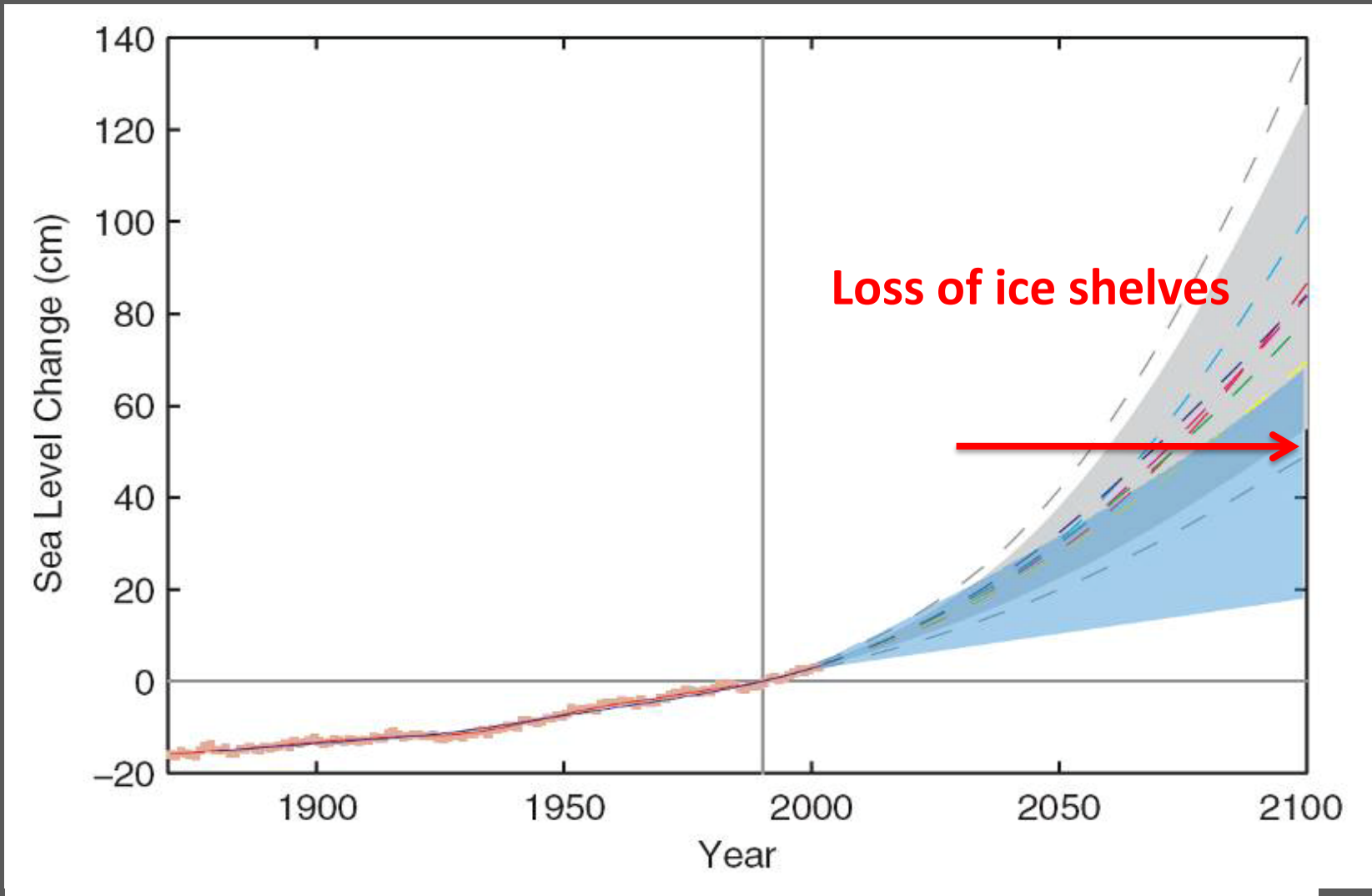
Snow cover decreasing  
Glaciers shrinking  
Arctic sea-ice decreasing  
Ice shelf losses

Thermal expansion of the oceans:

SLR has increased  
from 1.7 to 3.2 mm/yr



## Historic Trends and Current Predictions



Not Just Polar Bears: Local evidence of change is all around us...



## How do Marshes Keep Pace?

- Must maintain surface elevation



## How do Marshes Keep Pace?

- Must have access to mineral *and* organic sediment load
- Plants must build biomass, both above and below ground



## How do Marshes Keep Pace?

- Plants/communities must be able to migrate landward





## Is there Evidence when Marshes are Losing the Fight?

- Loss of High Marsh  
(in particular)



## Is there Evidence when Marshes are Losing the Fight?

- Loss or changes to plants and plant community structure



## Is there Evidence when Marshes are Losing the Fight?

- Expansion of sub-tidal habitat



## Is there Evidence when Marshes are Losing the Fight?

- Prolonged flooding



## Is there Evidence when Marshes are Losing the Fight?

- Changes in hydroperiod



## Is there Evidence when Marshes are Losing the Fight?

- Changes in pore water chemistry



## Is there Evidence when Marshes are Losing the Fight?

- Barren or subsiding areas



## Is there Evidence when Marshes are Losing the Fight?

- Rapid expansion of pannes and pools





Is there Evidence when Marshes are Losing the Fight?

- Bank collapse or excessive marsh bank erosion\*

\* - *bank edge erosion caused by many factors... but can be exacerbated by SLR*



## What can Exacerbate SLR Effects?

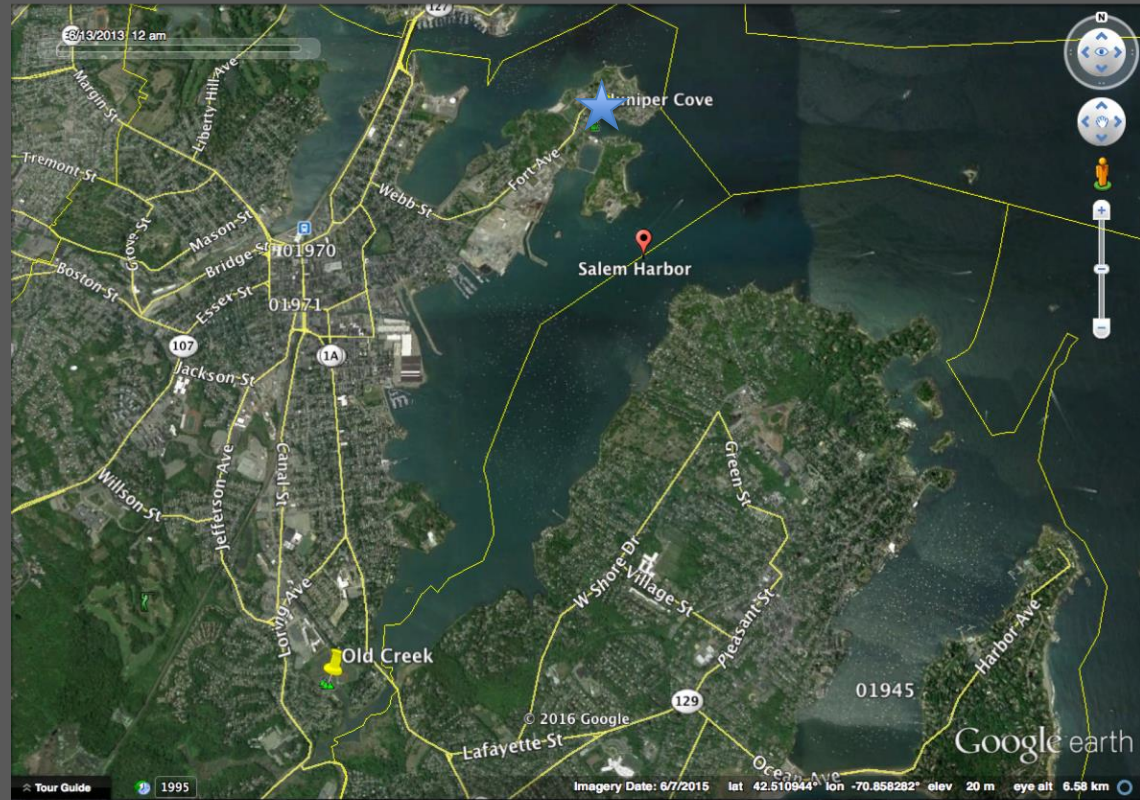
- Barriers and impediments to migration
- Physical structures (roads, seawalls, infrastructure, etc.)
- Reduction of sediment loads (tidal restrictions, dams, etc.)
- Marine structures that interfere with sediment supply (jetties, etc)
- Altered hydrology and stormwater mismanagement
- Invasive species



# LOCAL EXAMPLES

## Juniper Cove, Salem

- Exposed shore (JC)
- \



## Juniper Cove, Salem

- Evidence of SLR affects noted at both sites



## Juniper Cove, Salem

- Amplitude of effects greater due to exposure, where factors more extreme



## Juniper Cove, Salem

- Marsh bank erosion rates accelerated, factor of climate *and* SLR



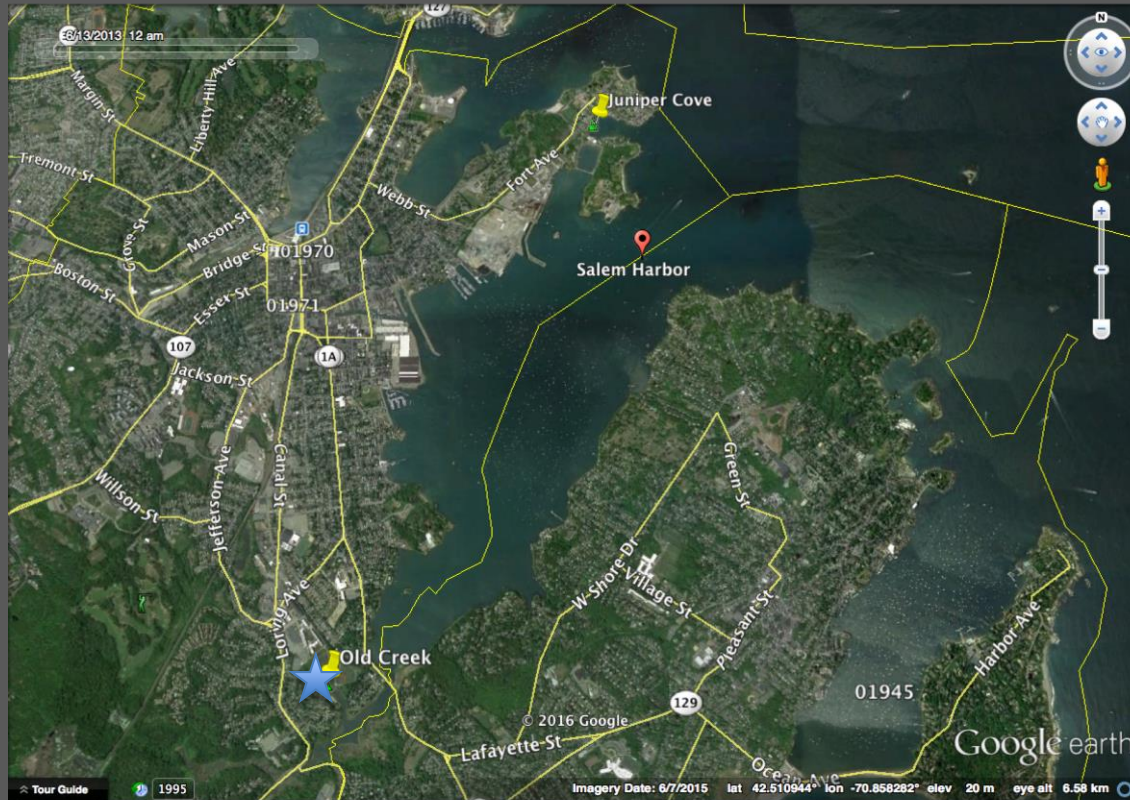
## Juniper Cove, Salem

- Salinity mapping/monitoring showing increased flood and salt stress
- Plant community changes, HM loss



## Old Creek, Salem

- Protected, inland marsh (JC)





## Old Creek, Salem

- SLR affects more subtle, but present



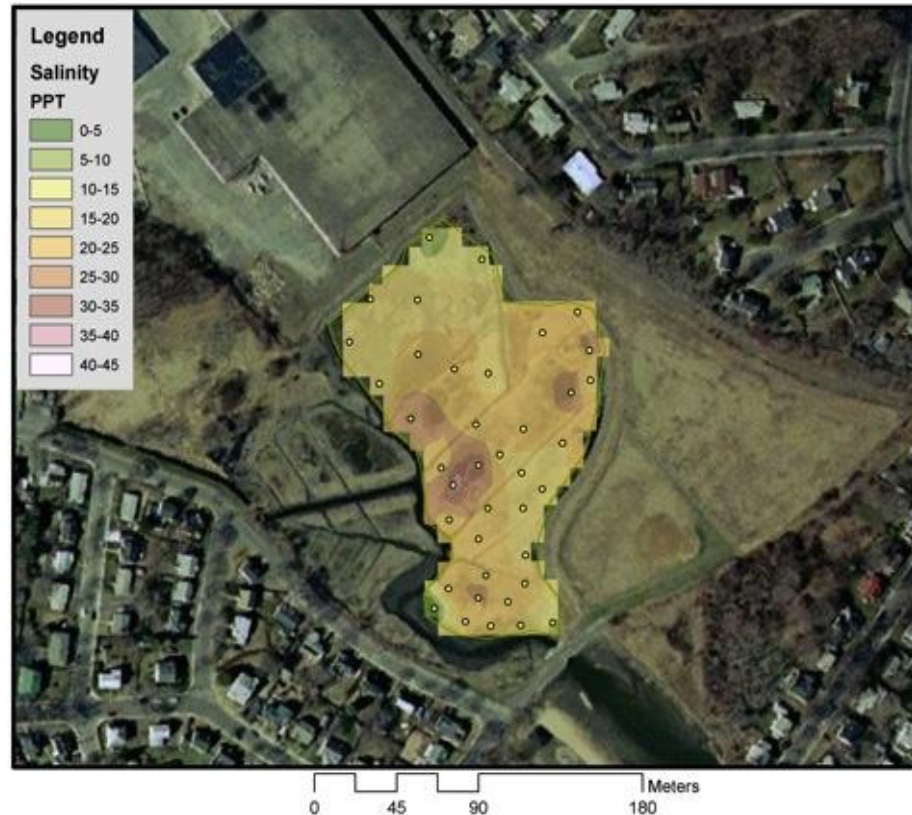
## Old Creek, Salem

- Prolonged surface flooding
- Minor bank erosion



## Old Creek, Salem

- Salinity mapping/monitoring showing increased flood and salt stress
- Plant community changes, expansion of short-form alterniflora



# WHAT CAN WE DO?

## Large Scale Efforts

- Remove barriers to migration



Beth Lambert of Mass DER. Photo: IRWA

# WHAT CAN WE DO?

## Large Scale Efforts

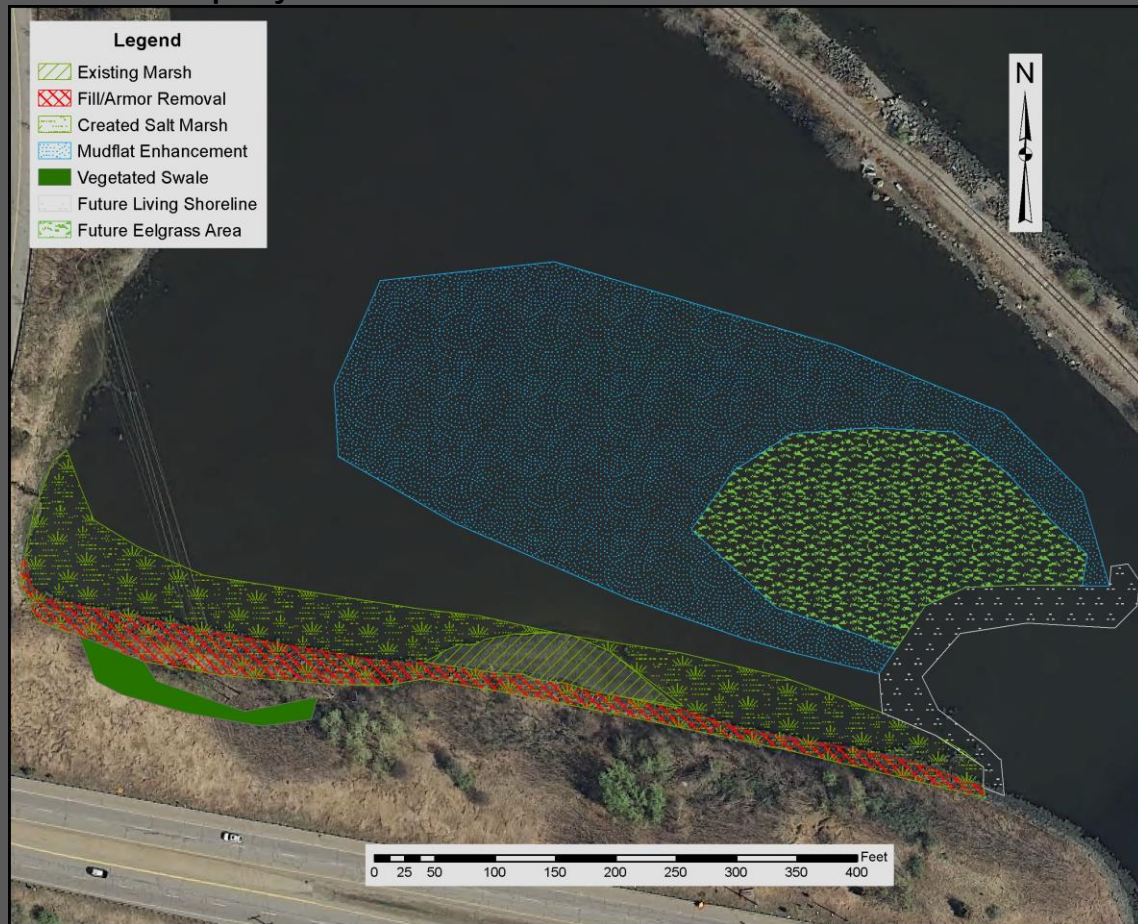
- Remove or redesign barriers to sediment transport



# WHAT CAN WE DO?

## Large Scale Efforts

- Develop Living Shoreline projects



# WHAT CAN WE DO?

## Large Scale Efforts

- Explore sediment augmentation, a.k.a. Thin Layer Deposition



# WHAT CAN WE DO?

## Smaller-Scale Projects we're doing: Innovations Welcomed!

- Replanting plans and wave reduction devices
- Mosquito control berm removal
- Runnels to reduce prolonged flooding
- Ditch remediation to build organic accumulation
- Others???





# WHAT CAN WE DO?

Smaller-Scale Projects we're doing: Innovations Welcomed!

- Replanting plans and wave reduction devices



# WHAT CAN WE DO?

## Smaller-Scale Projects we're doing: Innovations Welcomed!

- Mosquito control berm removal



# WHAT CAN WE DO?

## Smaller-Scale Projects we're doing: Innovations Welcomed!

- Runnels to reduce prolonged flooding



# WHAT CAN WE DO?

## Smaller-Scale Projects we're doing: Innovations Welcomed!

- Ditch remediation to build organic accumulation
- Others???



# WHAT CAN WE DO?

Things we ALL can do:

- Get involved



# WHAT CAN WE DO?

Things we ALL can do:

- Get REALLY involved



# WHAT CAN WE DO?

Things we ALL can do:

- Monitor!



# WHAT CAN WE DO?

Things we ALL can do:

- Involve the Public





# WHAT CAN WE DO?

Things we ALL can do:

- Report
- Share results



# ACKNOWLEDGEMENTS

The following Colleagues and Collaborators have contributed to this presentation:

David Burdick and Christopher Peter (UNH), Barbara Warren (SSCW), Alyssa Novak (BU), Peter Phippen (MVPC), Geoffrey Walker (Town of Newbury)

*With support from:*

Senator Bruce Tarr, Mass DER, and The Commonwealth of Massachusetts

