Summary of studies of climate change – from Jane Harris

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Subject: Climate change - expected changes and studies re: Forests and Salt Marshes

Hi All, I put together a few studies for your review as they relate to expected changes in MA from climate changes. Additionally, re: natural systems on Cape Cod and carbon storage and mitigation.

Some facts for you to consider: MA EOEA models climate changes in MA -

1. Current observed increase since 1895 in temp 2.9 degrees F; by 2090 will be increased to 7.2 degrees (between 4 degrees F to 11 degrees F)

2. Current observed days over 90 degrees; by 2090 will be increased to 25-90

3. Current observed increase in SLR 11 inches since 1922; by 2090 will be 4-10.2 feet Relative to 2000 Mean Sea Level.

4. A 55% increase in heavy precipitation since 1958 ; by 2090 will be increased by another 47% in 2 inch precipitation days

Forests and CO 2

Forests provide both carbon storage and carbon sequestration. There are five carbon pools in forests - soils, roots, leaf litter, dead trees, and living trees. Old growth forest (over 100 years old) store the most amount of carbon, typically greater than 100 to 120 metric tons per acre. Current forests, between 80 and 100 years old, store approximately 60 to 80 metric tons per acre. The most effective forest type for carbon storage and sequestration is red oak/pine which stores 82 metric tons per acre. Other forest types include spruce/fir at 77 mt/acre and Oaks/Hickory at 69mt/acre.

The rate of Carbon sequestration in trees peaks out at about 20 years for the average tree and continues for another 50-60 years. Carbon storage starts at about 10 years and increases over time where it maxes out at about 200 years. A mature tree absorbs carbon dioxide at a rate of 48 pounds per year. In one year, an acre of forest can absorb about twice the CO2 produced by the average car's annual mileage.

Salt Marshes

Salt marshes sequester and store even more carbon than forests, and is referred to coastal blue carbon. some estimate it to be between three and 11 times more effective than forests Most of the carbon storage takes place in the peat/soil of salt marshes. The carbon sink in salt marsh Soils has advantages over those in freshwater wetlands and terrestrials soil‘s. The presence of abundant sulfate limits release of the potent greenhouse gas, methane, which can be released in substantial quantities from freshwater wetland soils.

Salt marshes turnover of carbon occurs on timescales of hundreds to thousands of years whereas the carbon content of terrestrials soils in a decade to 100 years. In many marshes carbon sequestration will continue or perhaps increase with higher rates of sea level rise accompanying global warming as soil accretion rates will be greater. However, human impact on many soil salt marshes (altering hydrologic regimes or displacing sediment supplies) limits their sustainability in the face of higher rates of sea level rise and the future of these carbon sinks is threatened.

Recent studies have indicated that salt marshes capacity to store carbon may be threatened by nitrogen pollution, as it stimulates the release of CO2, possibly altering the capacity of salt marshes to hold carbon over time. Research at MBL suggests that when nitrate is abundant, a change occurs in the microbial community in saltmarsh sediments that increases the microbes’ capacity to degrade organic matter. This potentially reduces the ability of the marsh the store carbon.