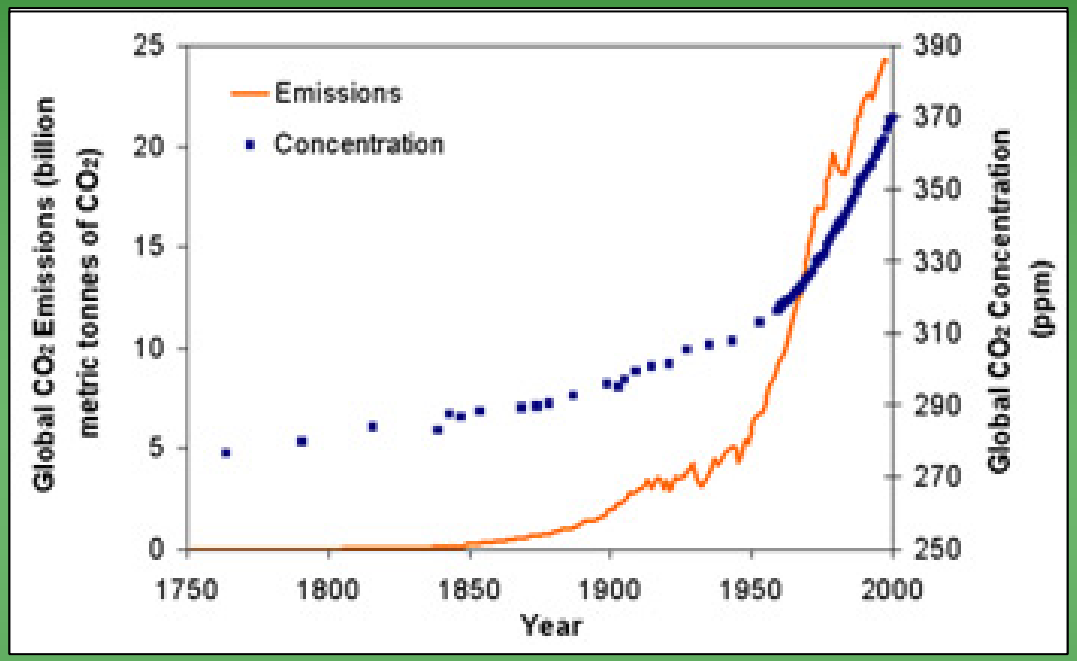
Soil Carbon

- **Subaqueous soils**
- **Subaerial soils**
- **Intertidal soils**

Global Carbon Issues



Increase in global temperatures over the past 200 years, mainly due to increased atmospheric CO_2 concentrations.

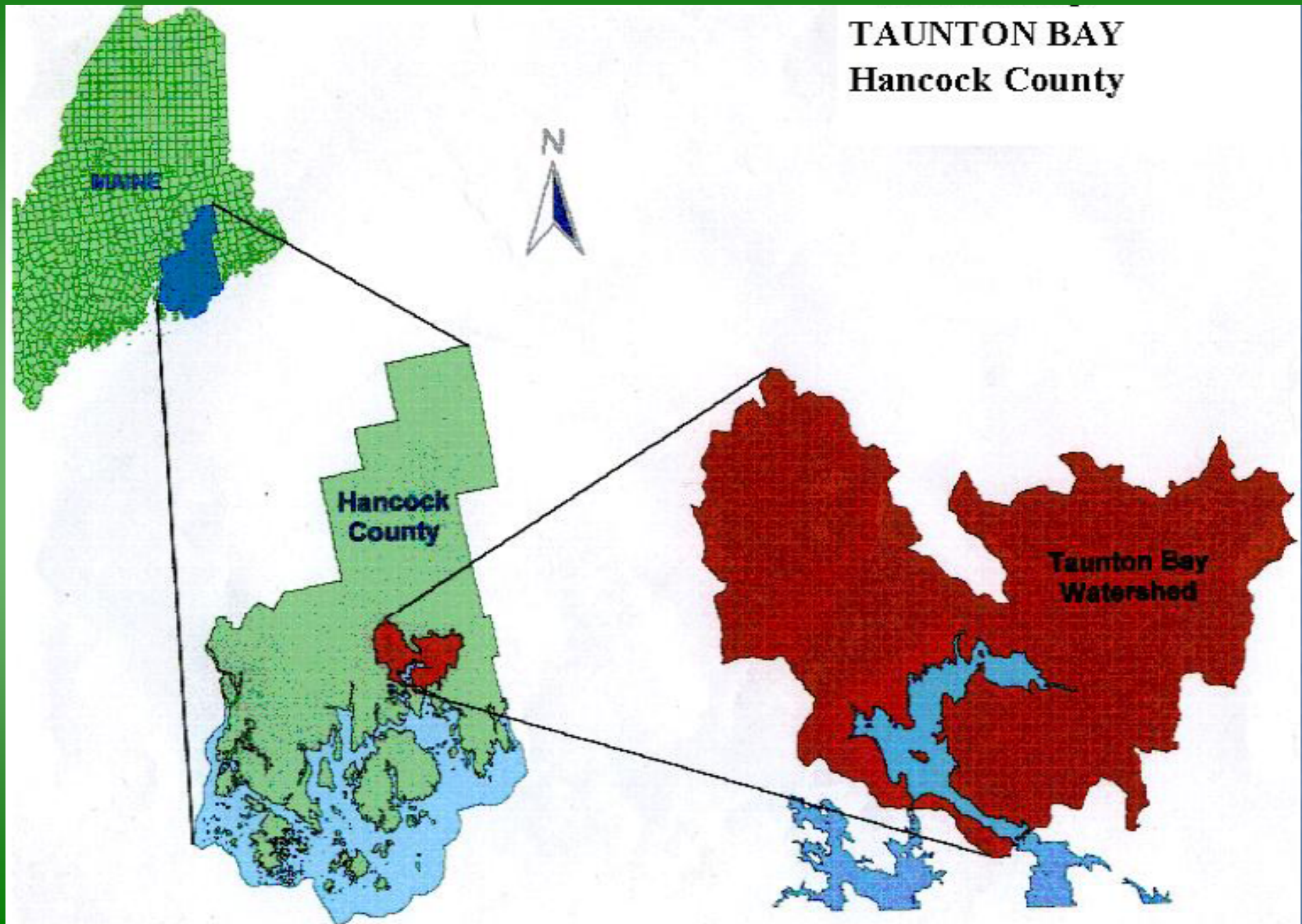
“Missing” Carbon Sink

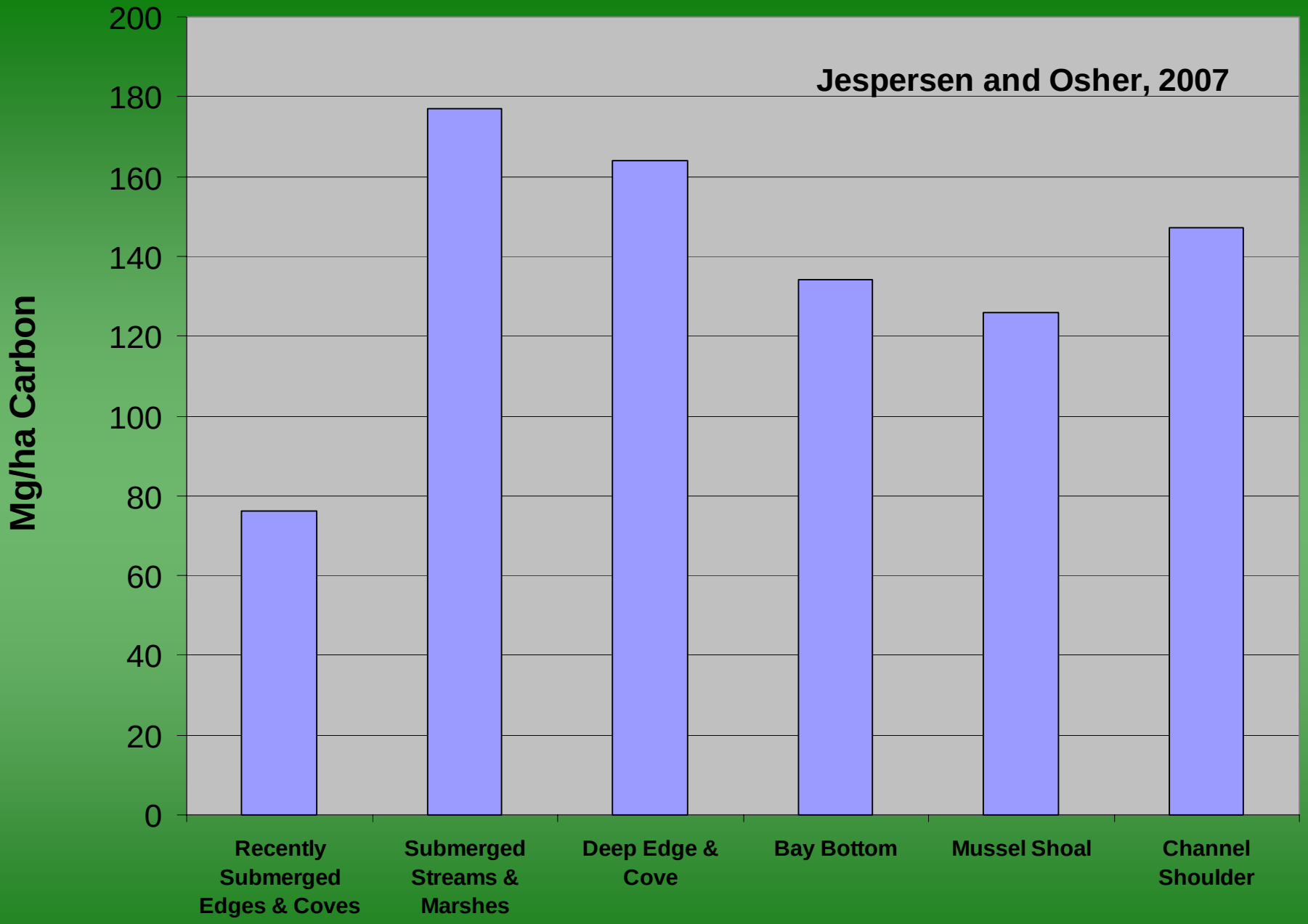
- Global C budget unbalanced.
  - More C is being sequestered than is given off.

- Somewhere there exists a “missing” C sink accounting for the missing part of the global C budget (estimated to be about 25% of the total C).

Carbon Pools in Subaqueous Soils

- Laurie Osher (Jen Jespersen)
  - Taunton Bay, Maine

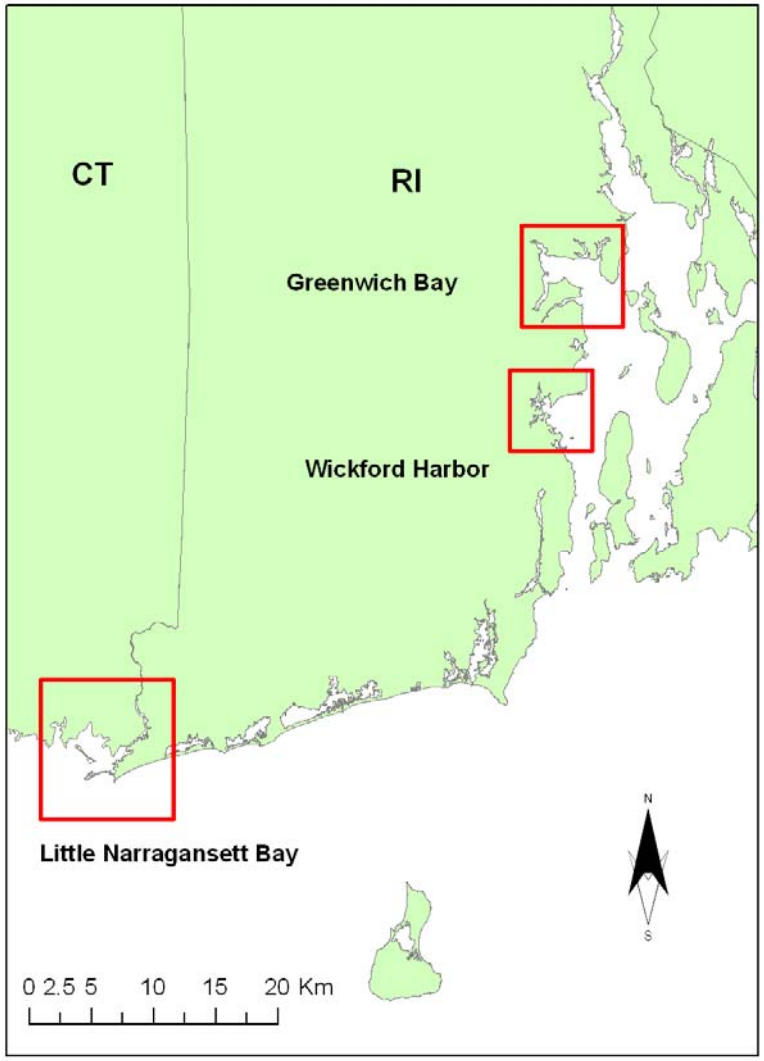

TAUNTON BAY
Hancock County
N
MAINE
Hancock County
Taunton Bay Watershed

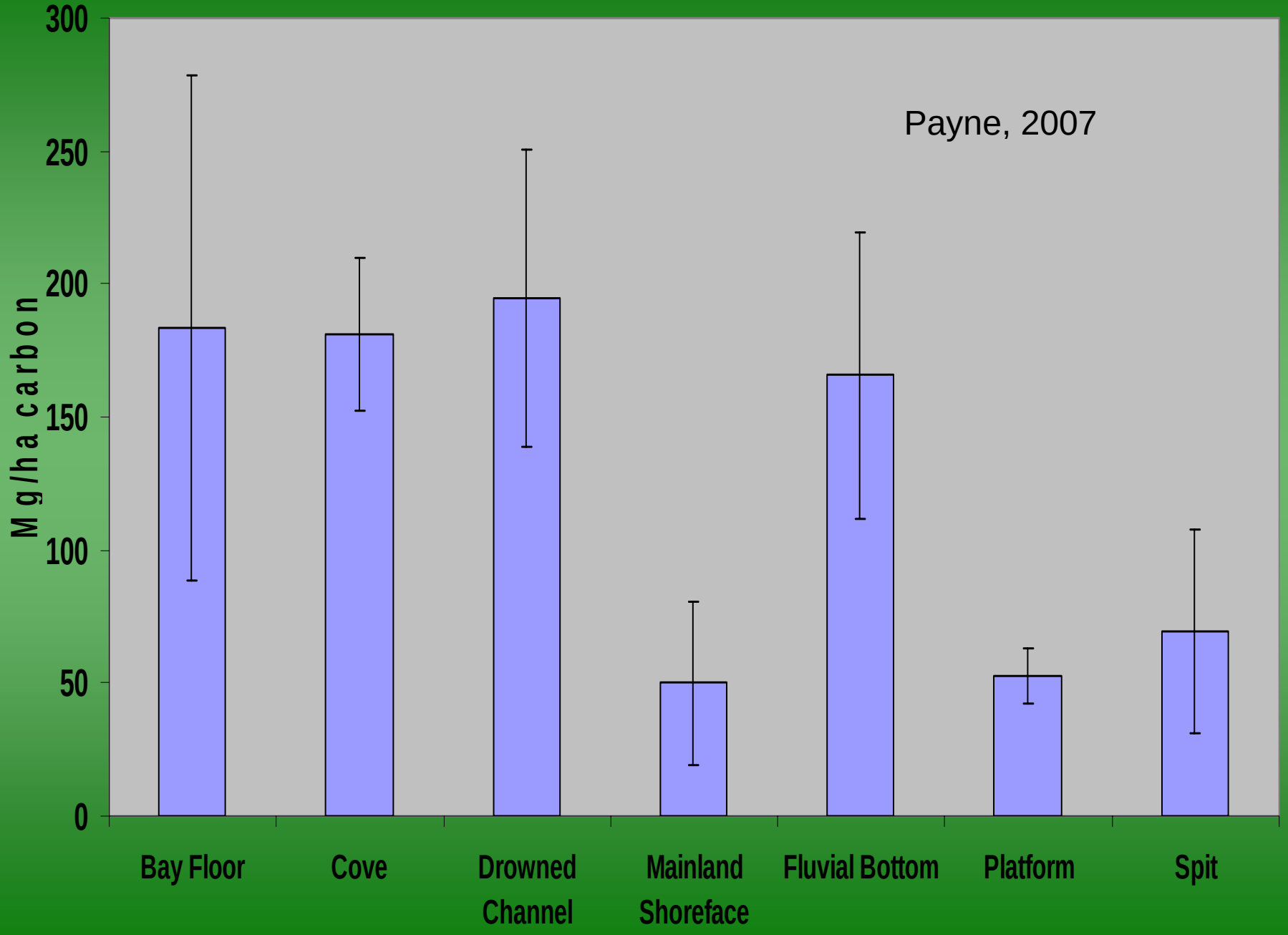

Jespersen and Osher, 2007
Mg/ha Carbon
200
180
160
140
120
100
80
60
40
20
0
Recently Submerged Edges & Coves
Submerged Streams & Marshes
Deep Edge & Cove
Bay Bottom
Mussel Shoal
Channel Shoulder

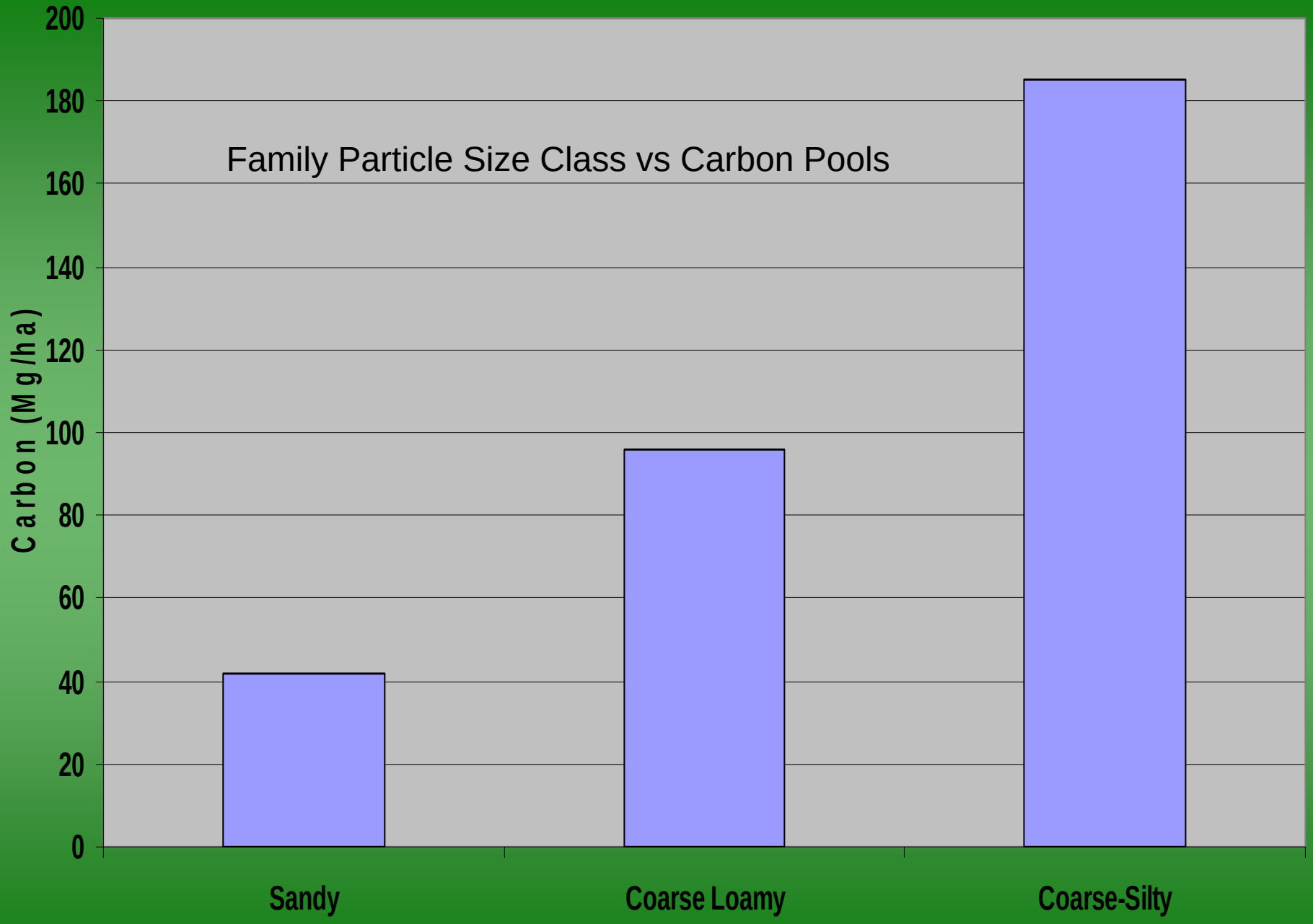
Study Locations

Payne, 2007

- Greenwich Bay (1200 ha)
- Wickford Harbor (160 ha)
- Little Narragansett Bay (1000 ha)




Payne, 2007
Mg/ha carbon
300
250
200
150
100
50
0
Bay Floor
Cove
Drowned Channel
Mainland Shoreface
Fluvial Bottom
Platform
Spit


Family Particle Size Class vs Carbon Pools
Carbon (Mg/ha)
200
180
160
140
120
100
80
60
40
20
0
Sandy
Coarse Loamy
Coarse-Silty

Soil Type	n	Mean Field Pool Size (Mg C ha^{-1})	CV (%)	Mean Forest Pool Size (Mg C ha^{-1})	CV (%)
Merrimac*	7	102	31	150	23
Sudbury*	9	118	27	154	24
Windsor**	20	nd	nd	110	15
Raypol**	20	nd	nd	187	31
Carlisle**	30	nd	nd	586	20
Subaqueous					
Wickford	11	na	na	158	30
Greenwich Bay	9	na	na	132	63
L-N-B	12	na	na	174	39

* Richardson, 2005 **Davis et al., 2004

So, is that carbon
accounted for?

Sequestration Rates in Forested Ecosystems

Site	Age (Years)	Forest Type	Difference Between Field and Forest Pools (%)	Whole Soil SOC Sequestration Rate (Mg C ha^{-1} yr^{-1})
St6	25	Coniferous	31	1.42
SR1	28	Coniferous	19	0.92
SNK2	28	Deciduous	12	0.61
S3	29	Deciduous	34	1.91
MC3	37	Coniferous	10	0.39
SBurr1	41	Deciduous	8	0.22
SC2	41	Deciduous	30	1.10
Me1-MA	42	Deciduous	13	0.34
MNK2	45	Deciduous	18	0.79
SG1	46	Deciduous	7	0.49
SR2	47	Coniferous	18	0.90
MNK10	50	Deciduous	22	0.52
SWG1	52	Coniferous	27	0.90
SC2-II	63	Coniferous	29	0.71
ME1	71	Coniferous	34	0.66
MHC1	79	Coniferous	54	1.31
MC2	86	Coniferous	60	1.11

Mean sequestration rate = 0.84 Mg C $ha^{-1}yr^{-1}$.

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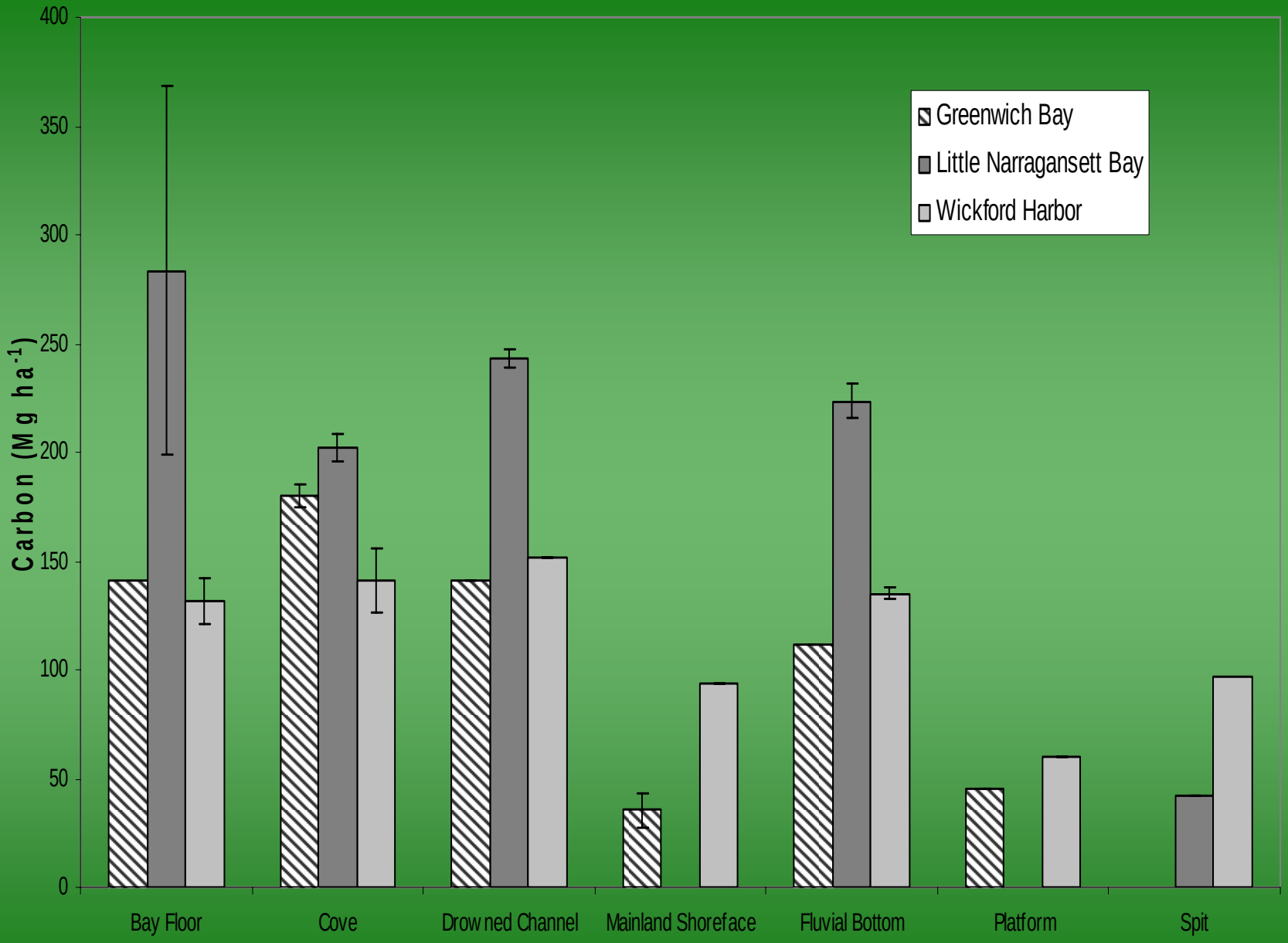
How fast does C accumulate in subaqueous soils?

Source of Carbon in Subaqueous Soils

- Jespersen and Osher (2007) used C and N isotopes to identify sources of C in Taunton Bay
- Data suggested that nearly all of the C was generated within the estuary
- Referred to as “marine organic matter” from algae and other marine organisms


Carbon (Mg ha-1)
400
350
300
250
200
150
100
50
0
Greenwich Bay
Little Narragansett Bay
Wickford Harbor
Bay Floor
Cove
Drowned Channel
Mainland Shoreface
Fluvial Bottom
Platform
Spit

Wood/Pawcatuck River

Past and Present Efforts to Map Subaqueous Soils

Factors controlling carbon sequestration in tidal marshes

Brian Needelman, University of Maryland

Approach

- Study is being conducted at Blackwater National Wildlife Refuge in Dorchester County, MD
- Examining two tidal marsh cells – one 5-acre cell, created with dredge material in 2003, and one natural marsh cell.
- Established 45 field plots per cell and laid down feldspar marker to identify the location of the original marsh surface.

Results

- The restored marsh is forming new peat at the soil surface at rates similar to those in natural marshes.
- Surface carbon accumulation of 1.8 Mg C ha-1 yr -1 (which doesn't include any belowground biomass inputs).
- Preliminary data showed unexpectedly high methane emissions, which would offset much of the carbon gains in terms of GHGs. Future data should help identify if this is a continuing problem.