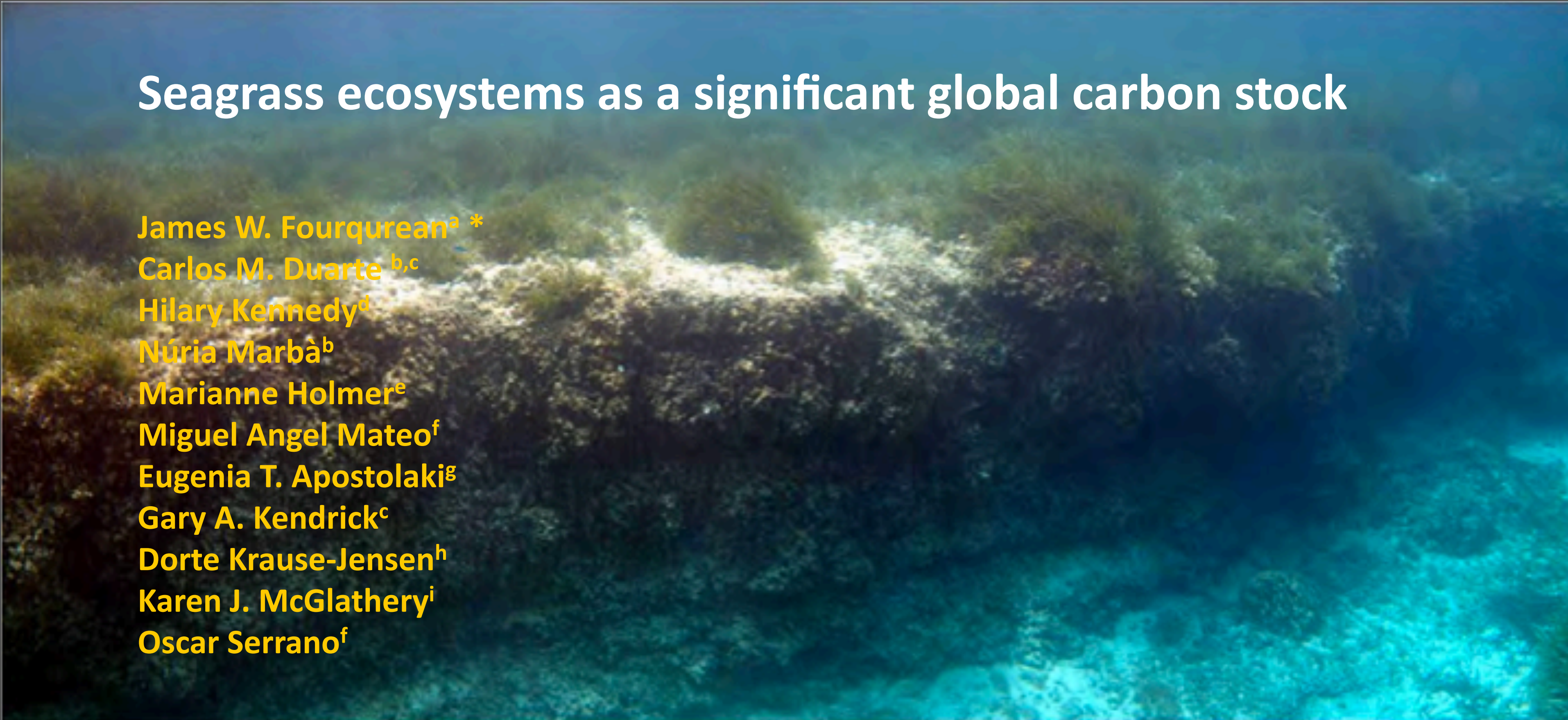

Seagrass ecosystems as a significant global carbon stock

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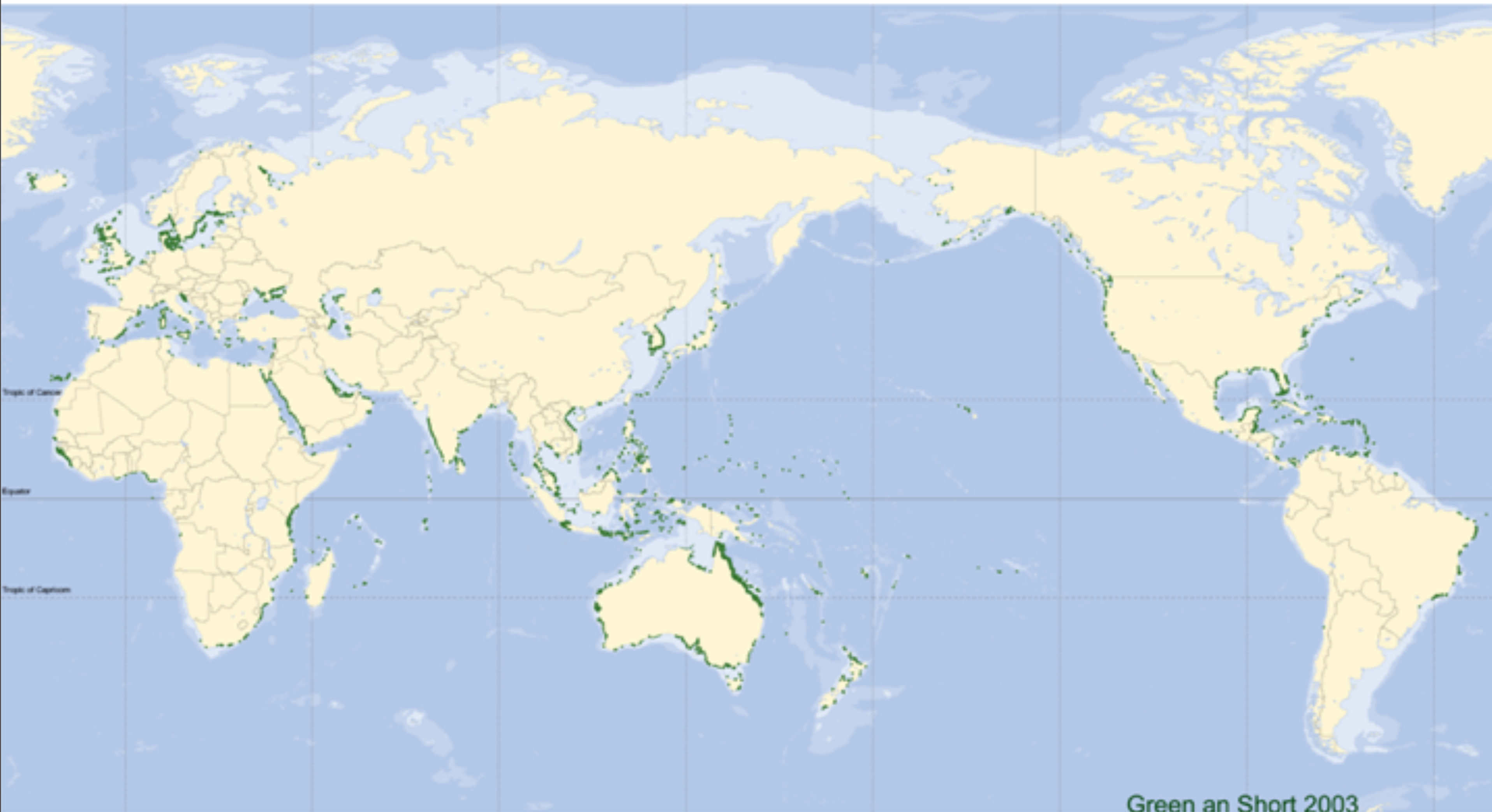
Seagrasses have a broad global distribution



Sediment stabilizers: seagrasses efficiently hold sediments in place, preventing resuspension and movement of sediment deposits

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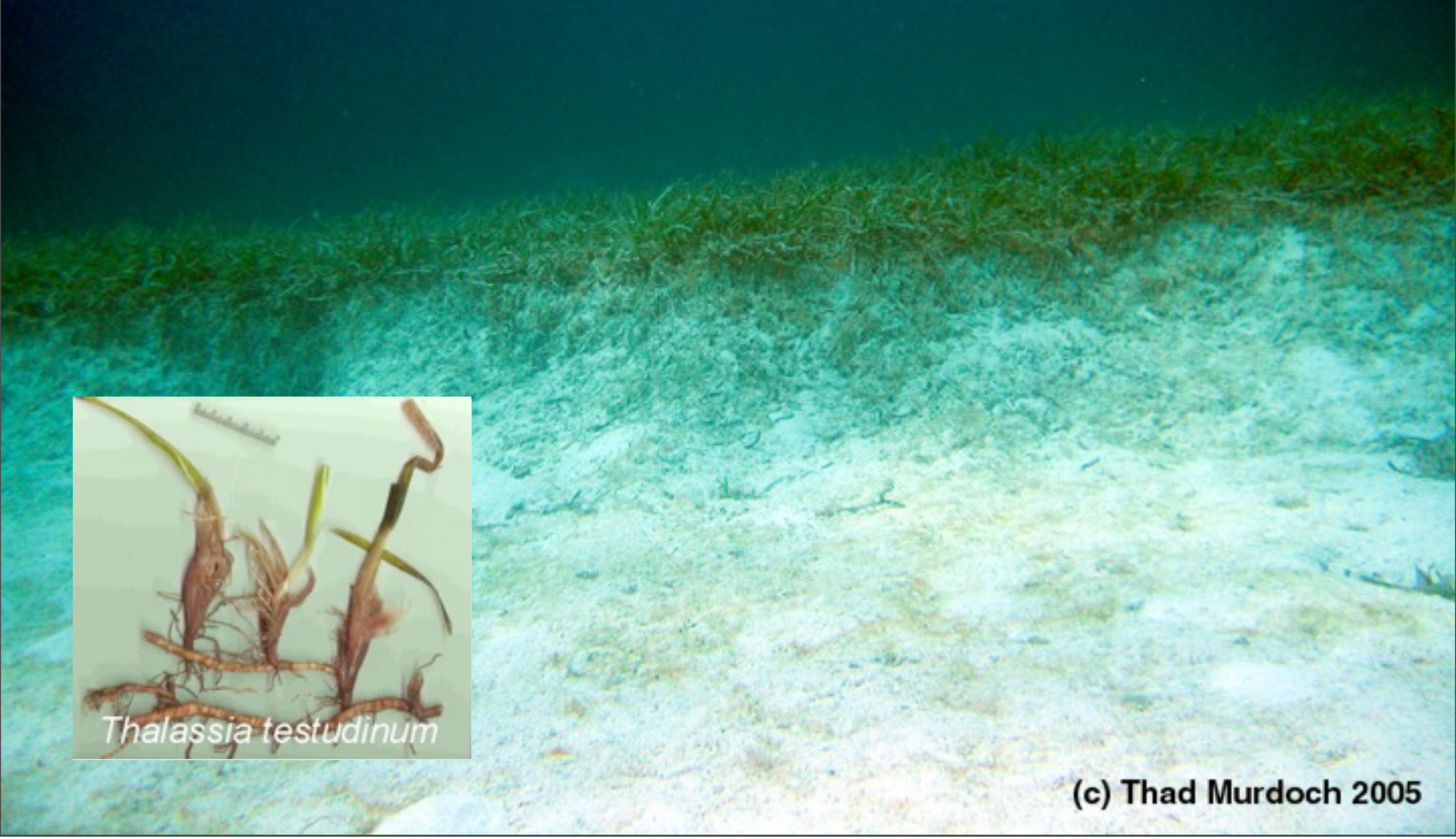
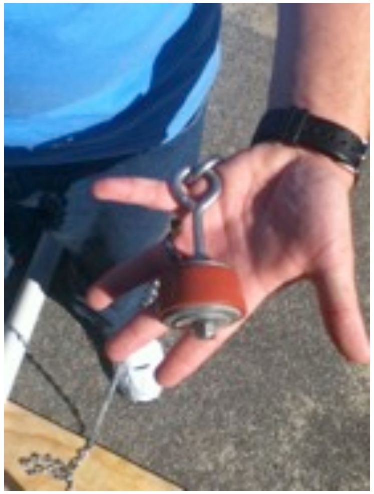


Measuring C stored in seagrass soils:
Piston corer to collect uncompressed cores

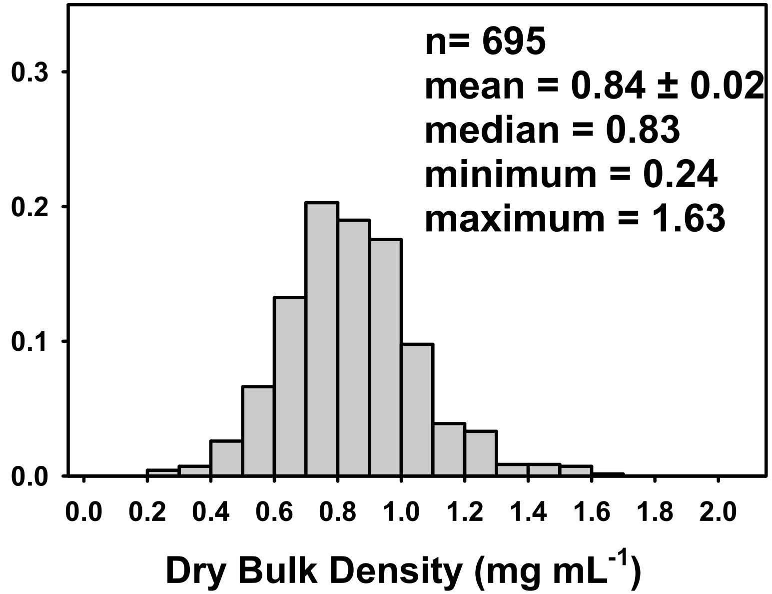


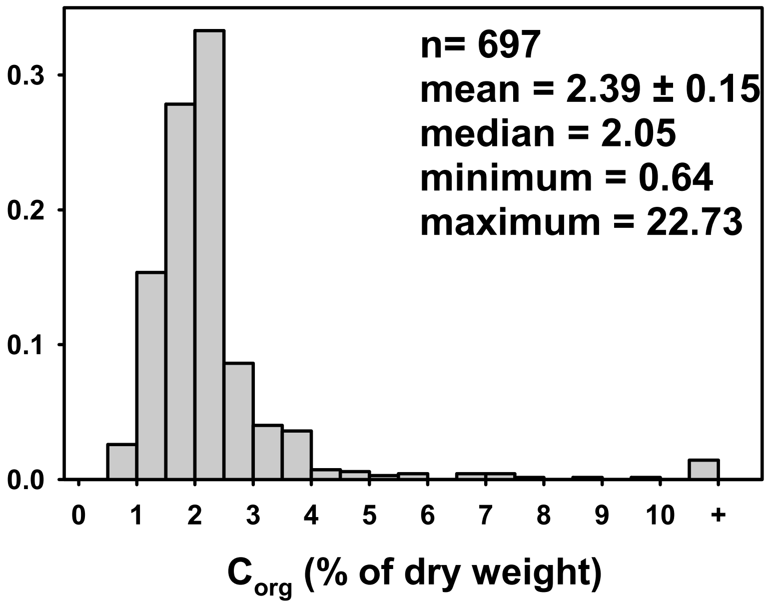
Measuring C stored in living biomass

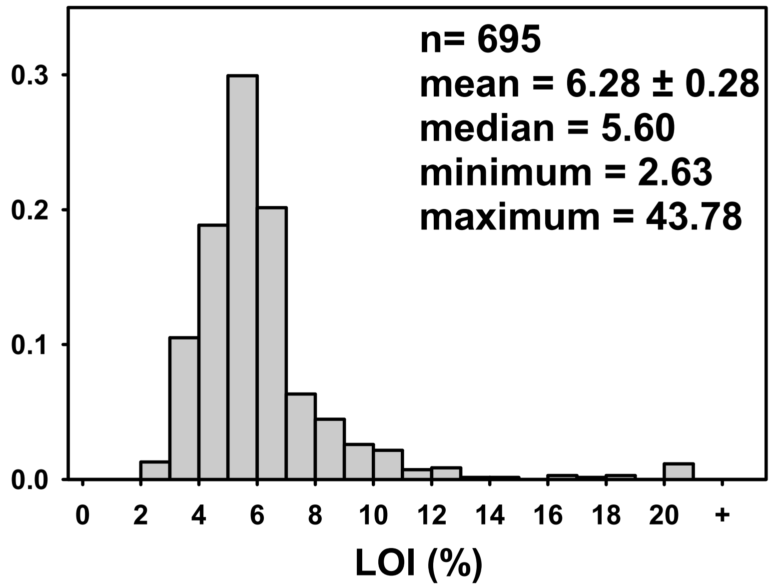

Need:

- **volumetric measures of Dry Bulk Density (mass of soil per volume)**
- **Carbon content of soil (as a fraction of mass)**
  - **Organic matter, or Loss on Ignition (LOI)**
  - **C_{org}**

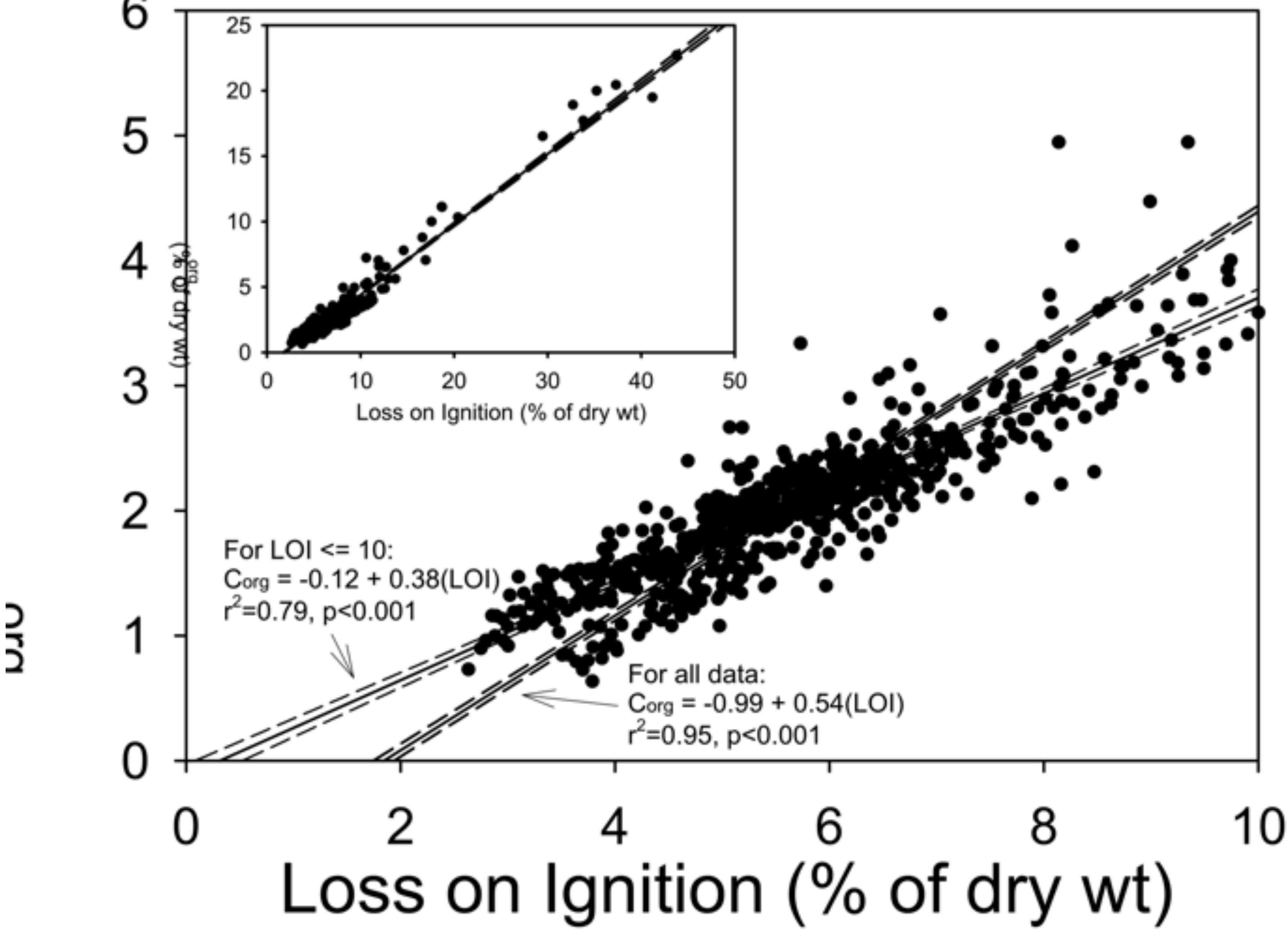
Case study: C stores in Florida Bay seagrasses







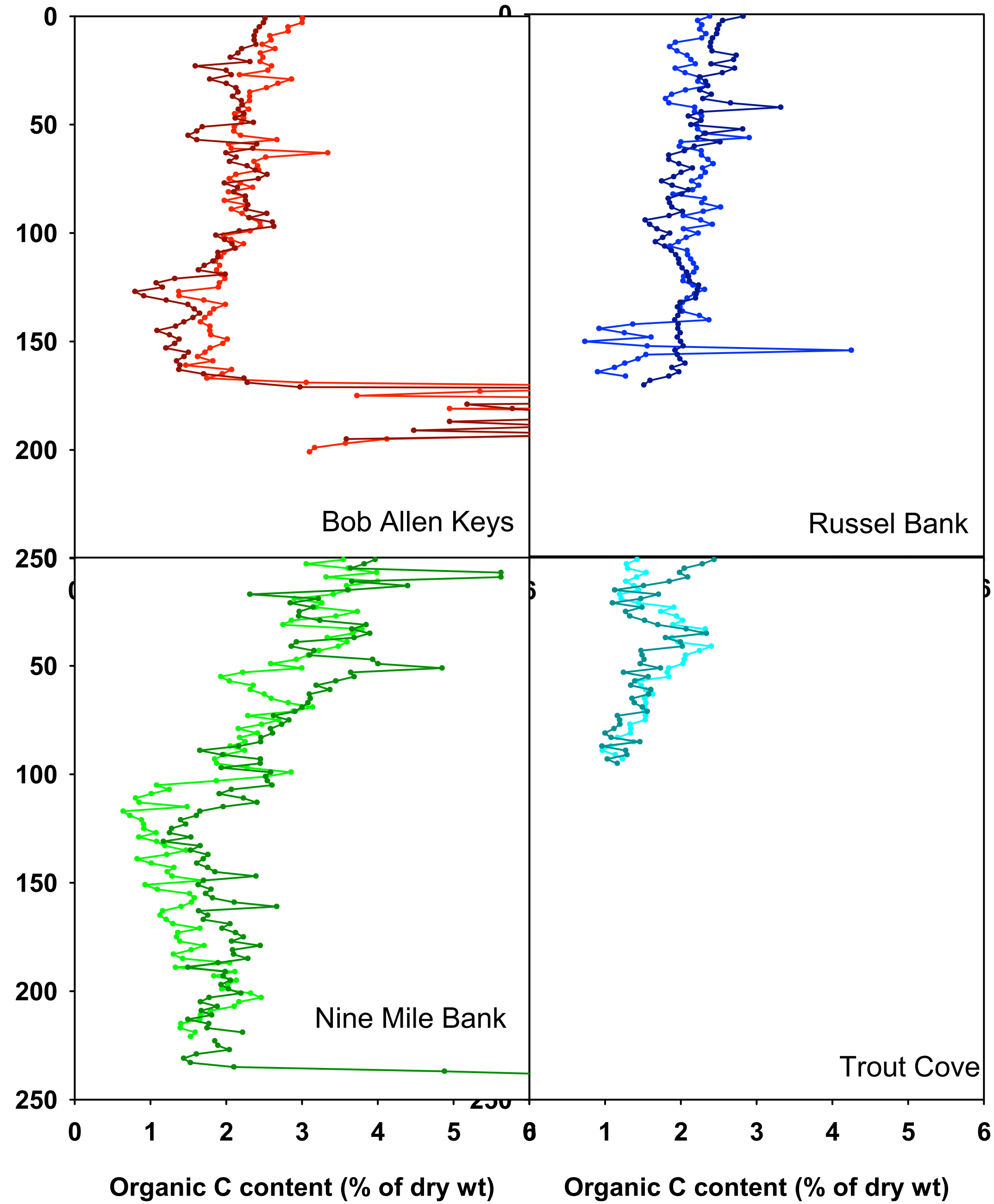
Tuesday, June 12, 2012



For LOI <= 10:
Corg = -0.12 + 0.38(LOI)
r2=0.79, p<0.001
For all data:
Corg = -0.99 + 0.54(LOI)
r2=0.95, p<0.001
Loss on Ignition (% of dry wt)
Corg (% of dry wt)
Loss on Ignition (% of dry wt)
org

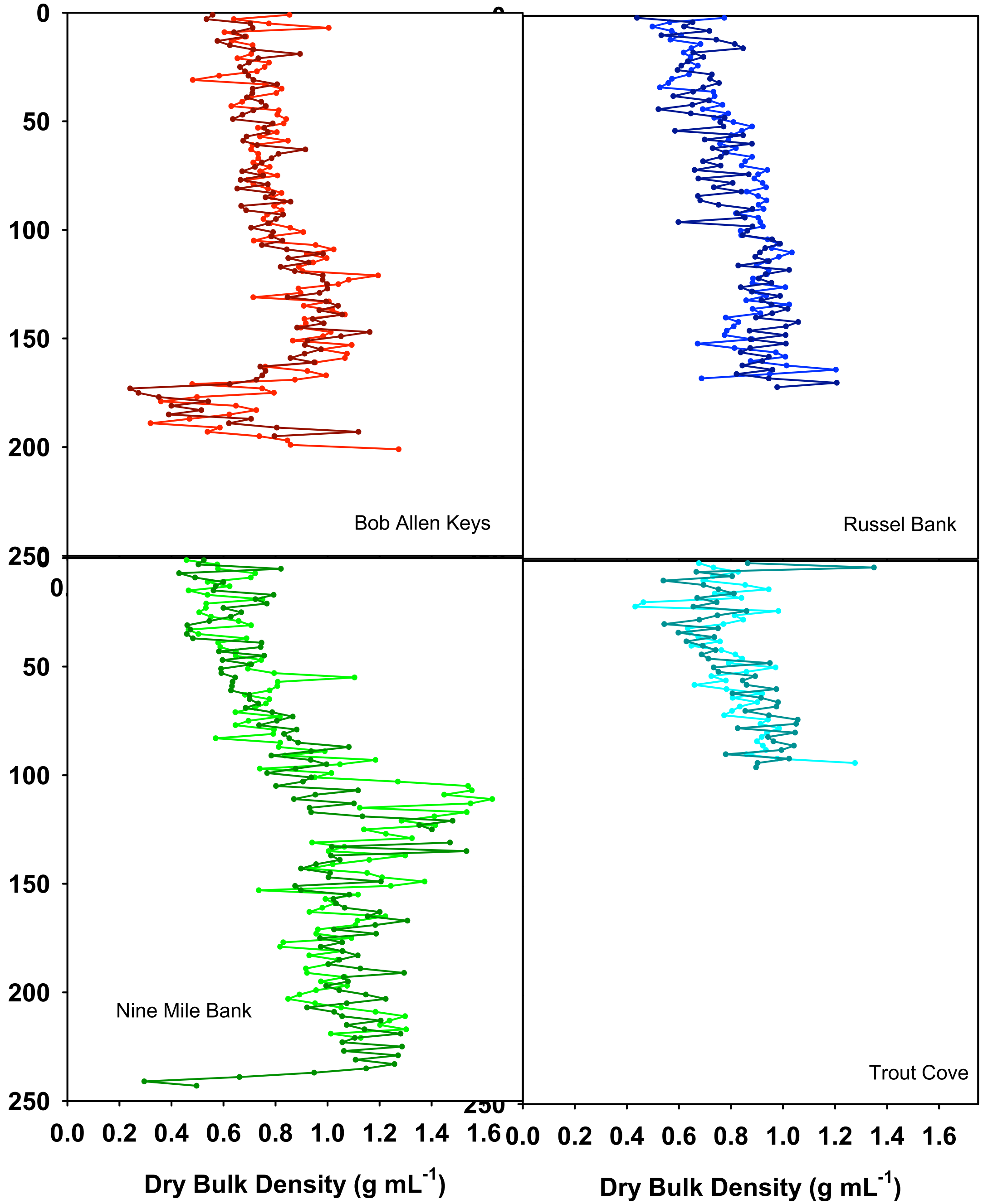
C_{org} generally decreases downcore in Florida Bay seagrass soils.

Buried peats have high C_{org}

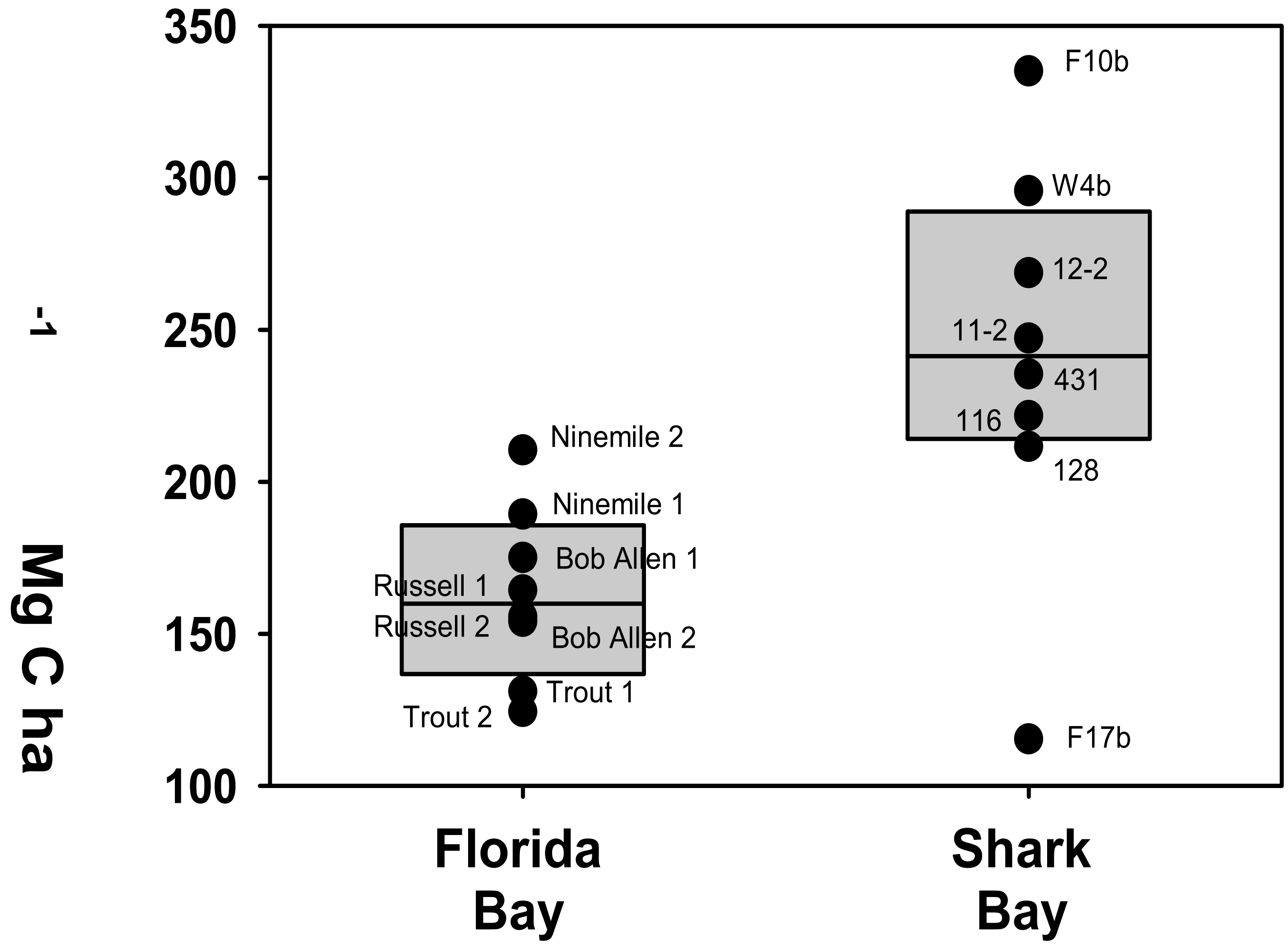


DBD generally increases downcore in Florida Bay seagrass soils.

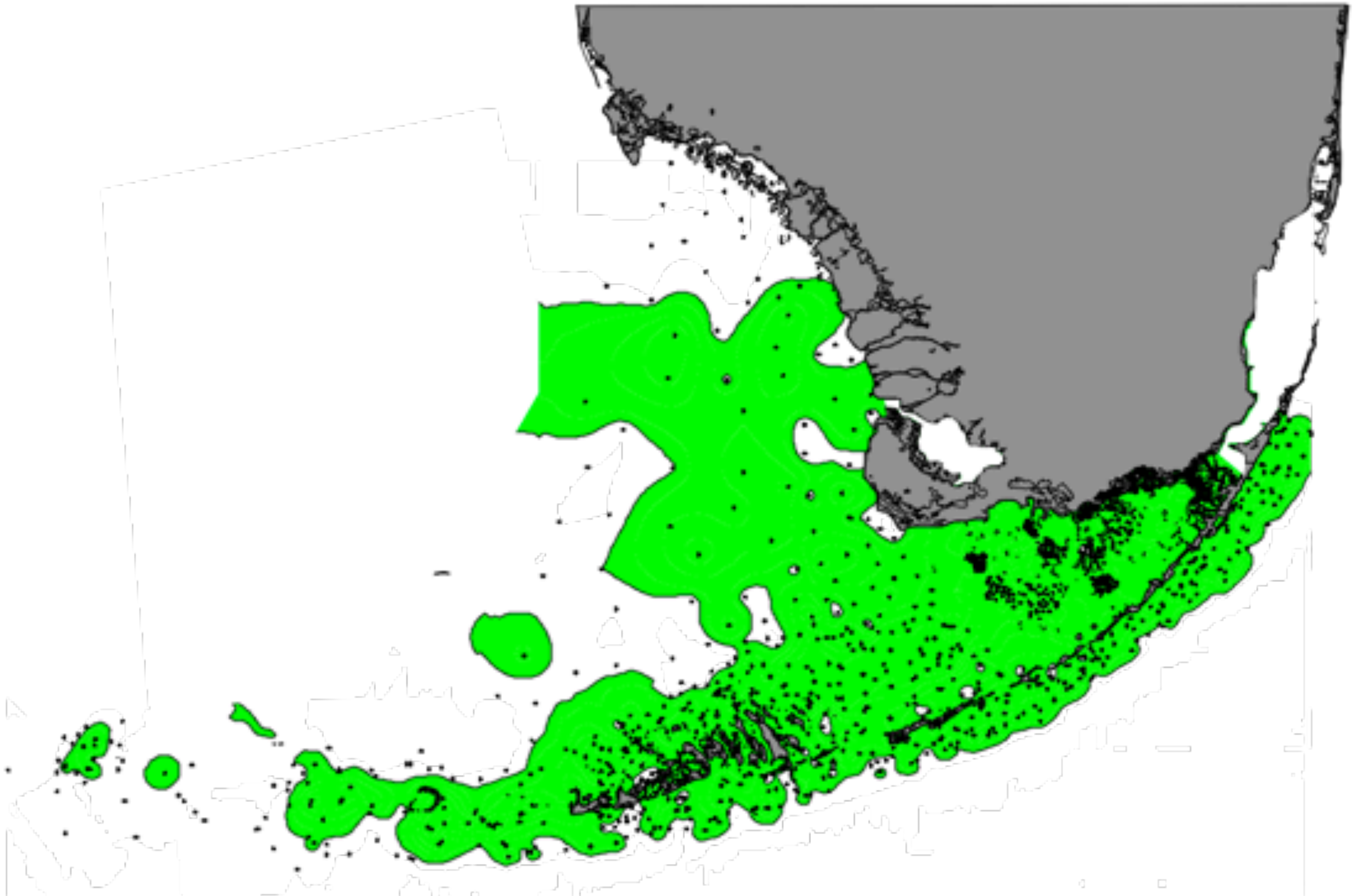
Buried peats have low DBD



C_{org} stocks in top m of seagrass beds



There are about 18,000 km^2 of seagrass beds in south Florida



A very rough estimate of carbon stored in the top meter of seagrass soils in south Florida:

18,000 km^2 of seagrasses
594 tons CO_2e ha^{-1}

1 x 10^9 tons CO_2e stored in the soils!

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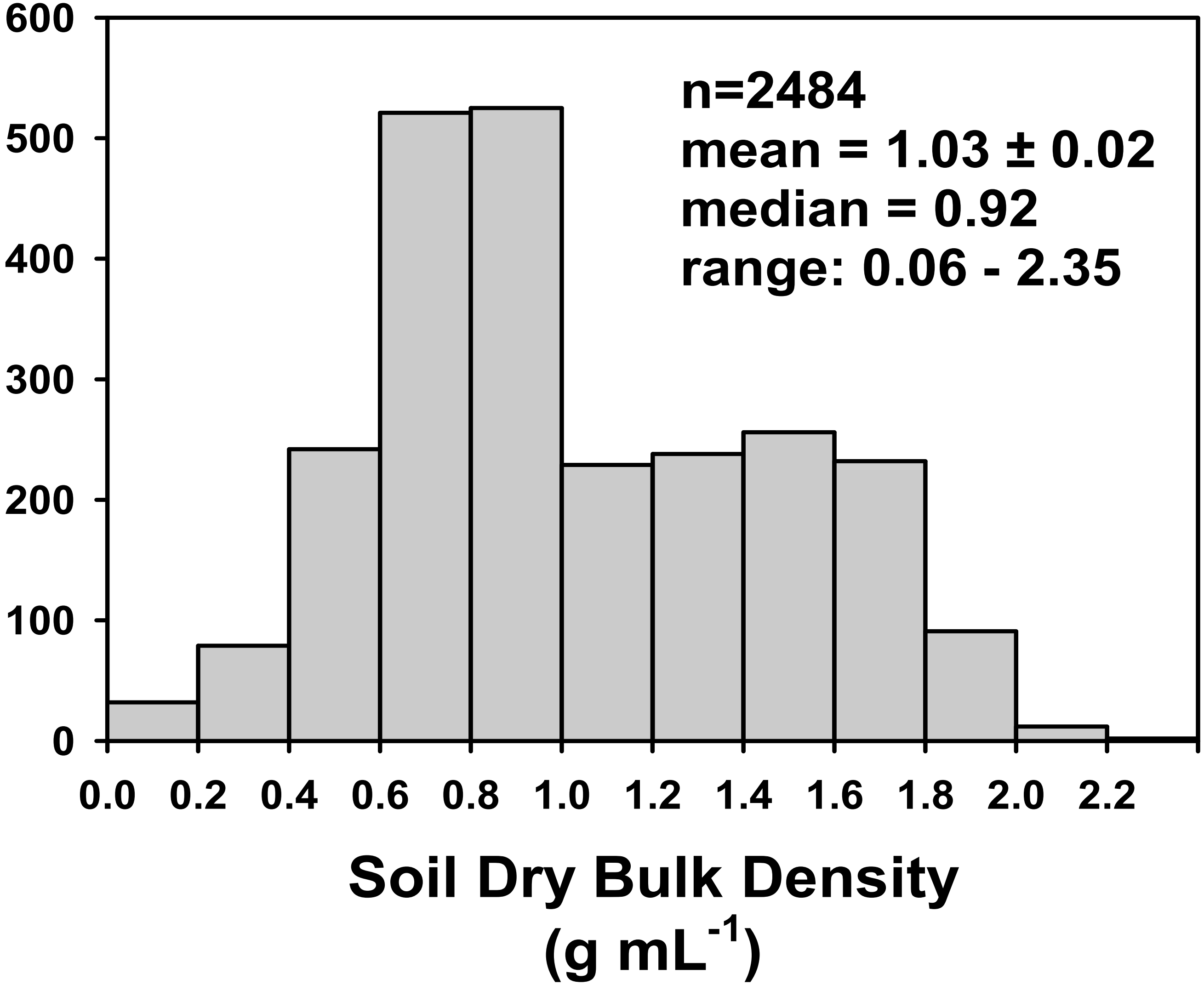
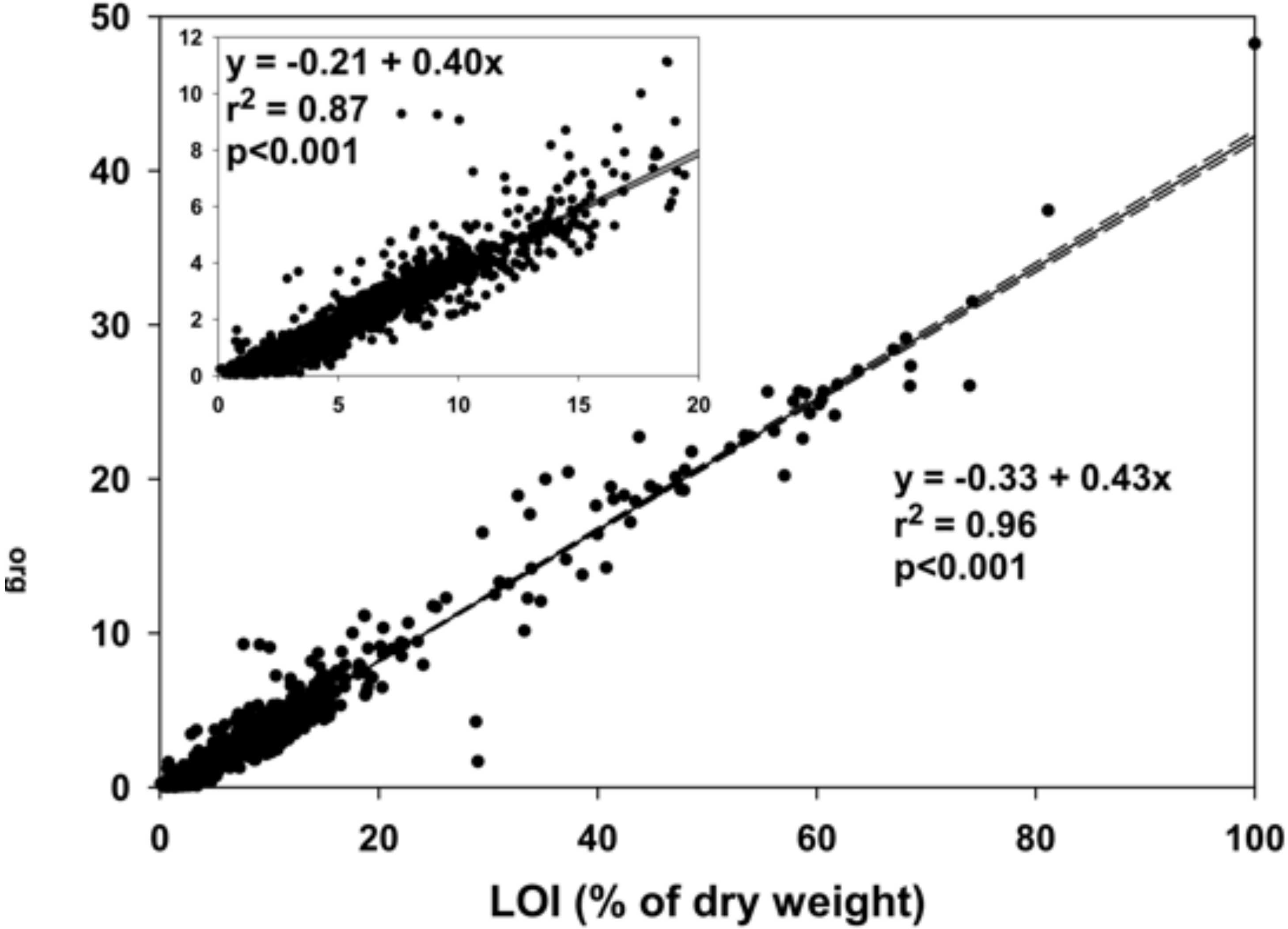
Anthropogenic CO_2e flux is about 29 x 10^9 tons y^{-1}

Distribution of seagrass C stock data

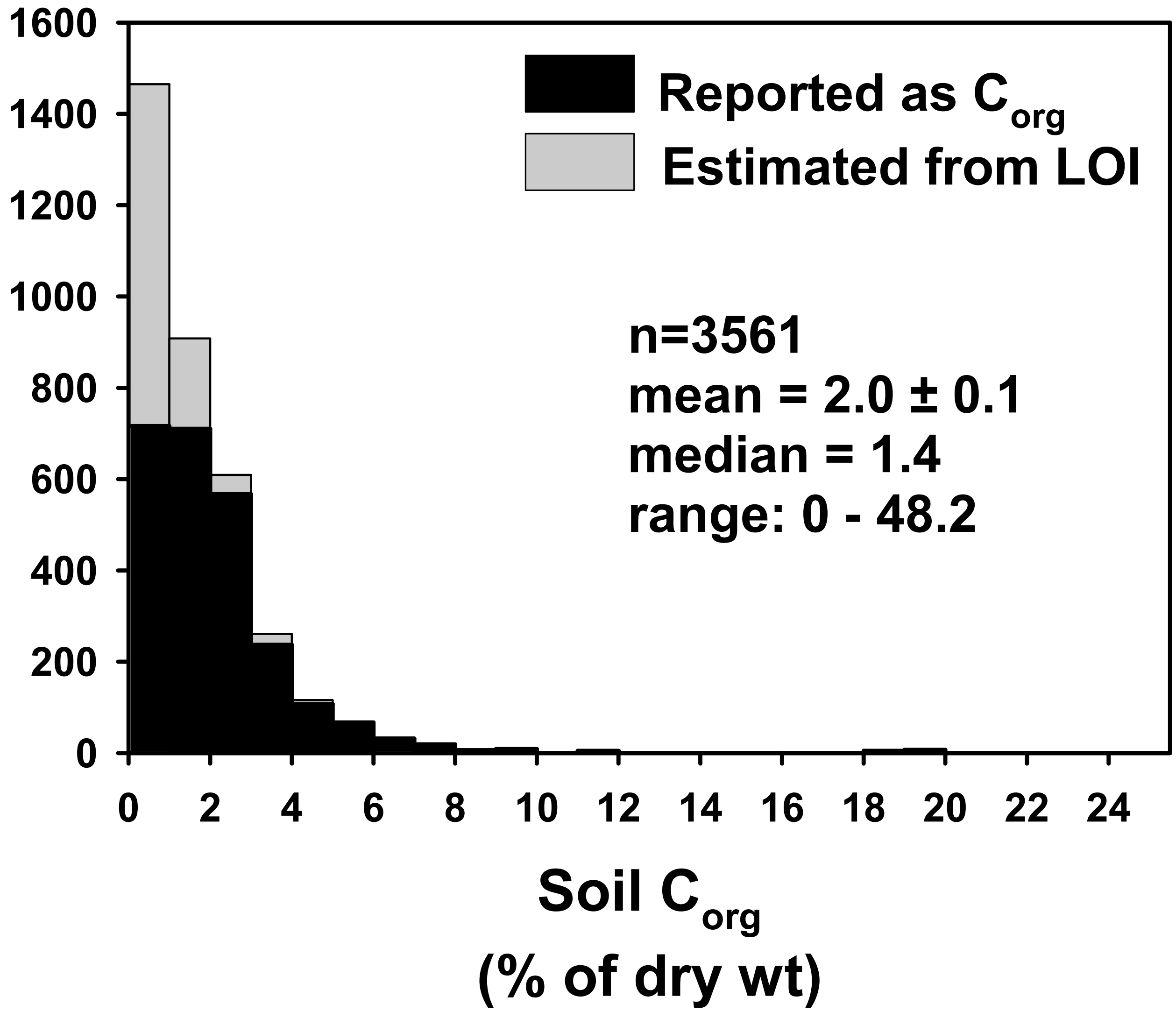
Global distribution of seagrass soil DBD



LOI can be used to predict C_{org}



Global distribution of soil C_{org} in



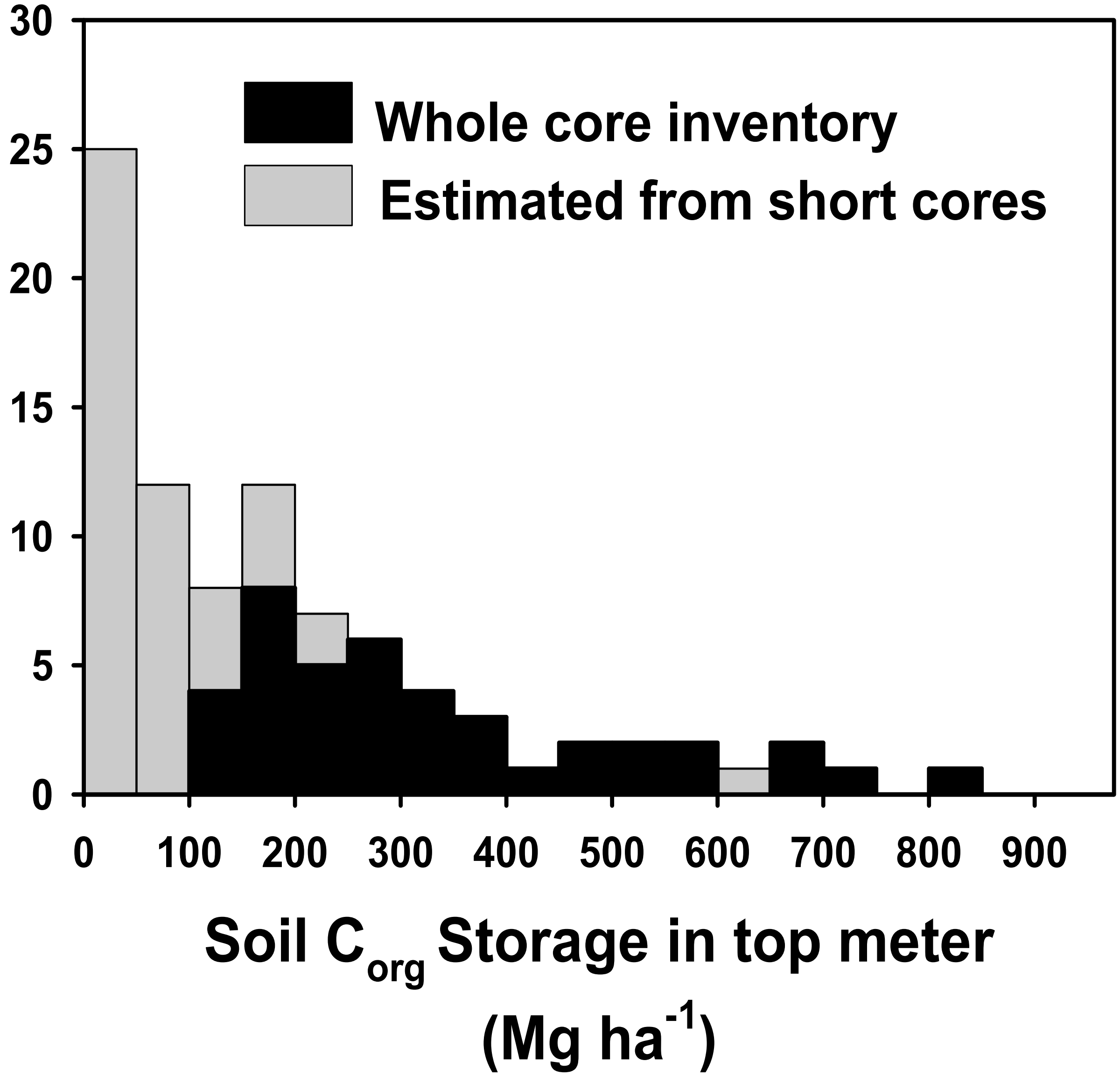
Global values for Seagrass abundance

	n	Range	Median	Mean ± 95%CI
Aboveground biomass Mg (dry weight) ha^{-1}	251	0.002 – 15.850	0.756	2.151 ± 0.364
Belowground biomass Mg (dry weight) ha^{-1}	251	0.002 – 50.957	1.542	5.008 ± 1.069
Total seagrass biomass Mg (dry weight) ha^{-1}	251	0.004 – 66.807	2.854	7.159 ± 1.399
Dry Bulk Density g (dry weight) mL^{-1}	2484	0.06 – 2.35	0.92	1.03 ± 0.02
Porosity %	1687	18.0 – 99.7	61.6	59.2 ± 0.8
Organic matter as LOI % of dry weight	2783	0.0 – 100.0	4.2	5.7 ± 0.3

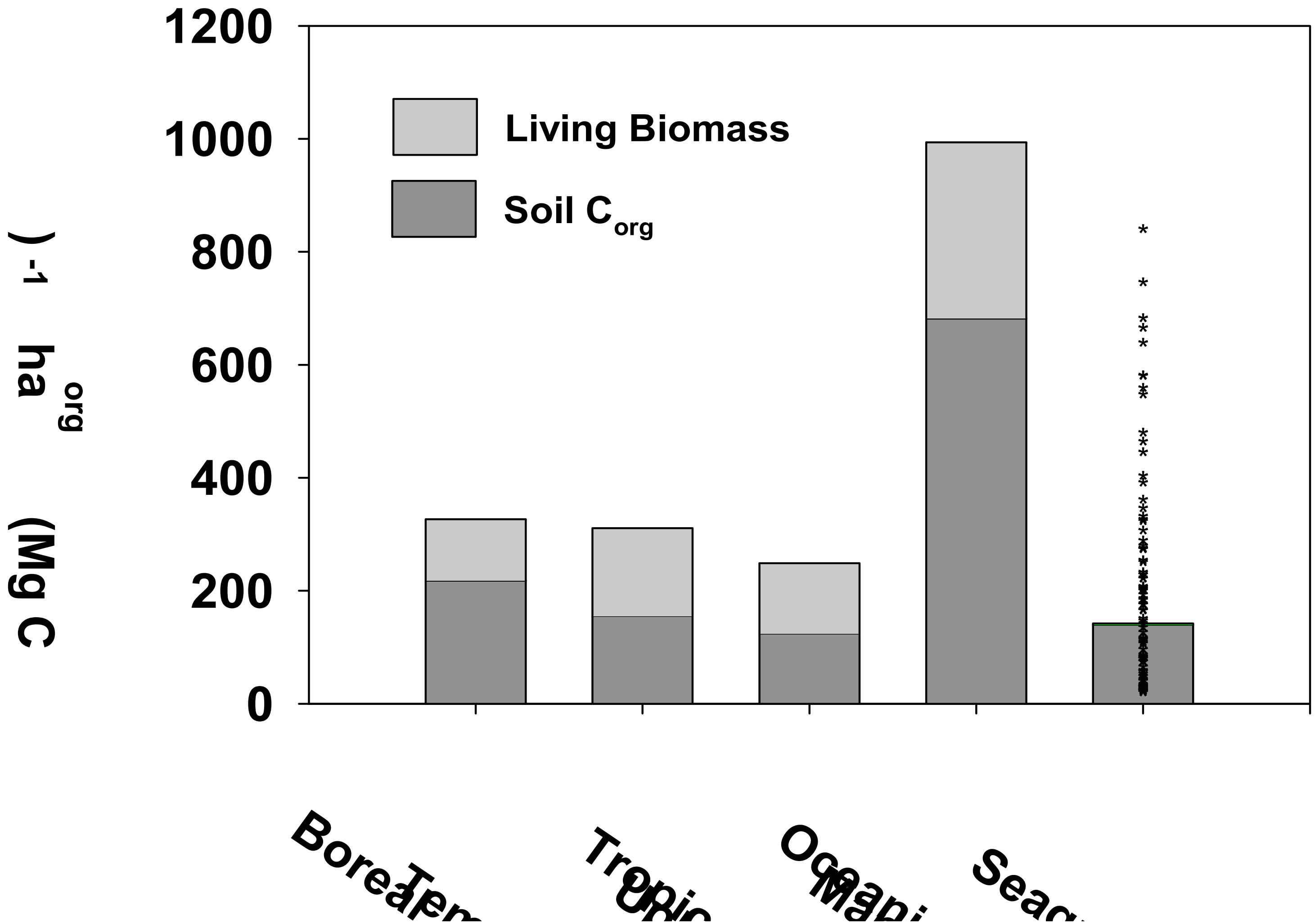
Global ranges of C_{org} density

	n	Range	Median	Mean ± 95%CI
Aboveground biomass Mg (C_{org}) ha^{-1}	251	0.001 – 5.548	0.264	0.755 ± 0.128
Belowground biomass Mg (C_{org}) ha^{-1}	251	0.001 – 17.835	0.540	1.756 ± 0.375
Total seagrass biomass Mg (C_{org}) ha^{-1}	251	0.001 – 23.382	1.000	2.514 ± 0.489
Soil C_{org} % of dry weight	2535 3561	0 – 48.2 0 – 48.2	1.8 1.4	2.5 ± 0.1 2.0 ± 0.1
Dry Bulk Density g (dry weight) mL^{-1}	2484	0.06 – 2.35	0.92	1.03 ± 0.02

Global estimates of seagrass soil C_{org}



Some seagrass beds rival C-rich



Seagrass bioregions

Regional estimates of Seagrass C_{org}

Region	Living Seagrass Biomass MgC ha^{-1}			Soil C_{org} MgC ha^{-1}	
	n	Mean ± 95%CI		n	Mean ± 95%CI
Northeast Pacific	5	0.97 ± 1.02		1	64.4
Southeast Pacific	0	ND		0	ND
North Atlantic	50	0.85 ± 0.19		24	48.7 ± 14.5
Tropical Western Atlantic	44	0.84 ±0.17		13	150.9 ± 26.3
Mediterranean	57	7.29 ± 1.52		29	372.4 ± 74.5
South Atlantic	5	1.06 ± 0.51		5	137.0 ± 56.8
Indopacific	47	0.61 ± 0.26		8	23.6 ± 8.3
Western Pacific	0	ND		0	ND
South Australia	40	2.32 ± 0.63		9	268.3 ± 101.7
Global Average	251	2.51 ± 0.49		89	194.2 ± 20.2

How big are Global Seagrass Blue

- 300,000-600,000 km^2 of seagrasses
- Median estimate of seagrass biomass:

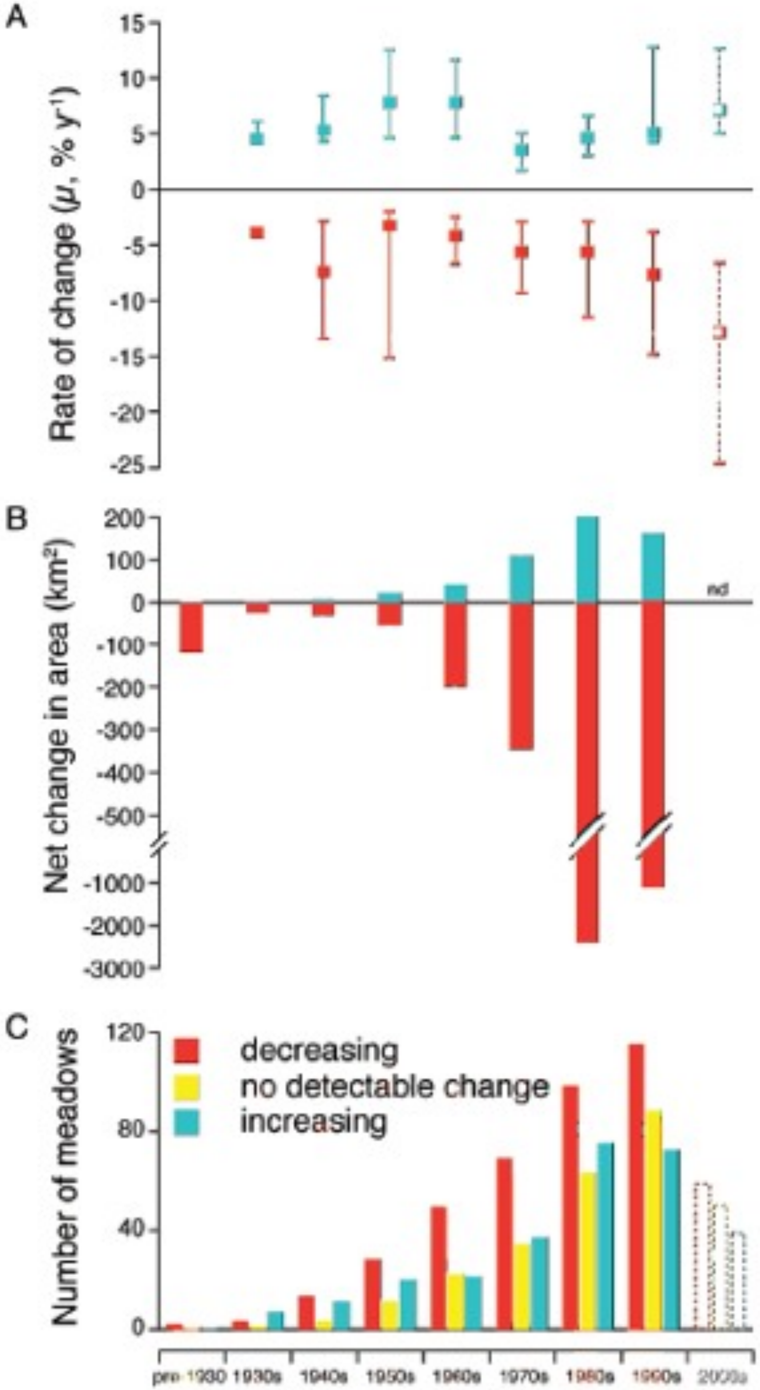
  2.5 Mg C_{org} ha^{-1}
- Median estimate of seagrass soil Corg (top meter)

  139.7 Mg C_{org} ha^{-1}
- Global seagrass biomass:

  75.5 and 151.0 Tg C
- Global seagrass Soil C_{org}:

  4.2 - 8.4 Pg C

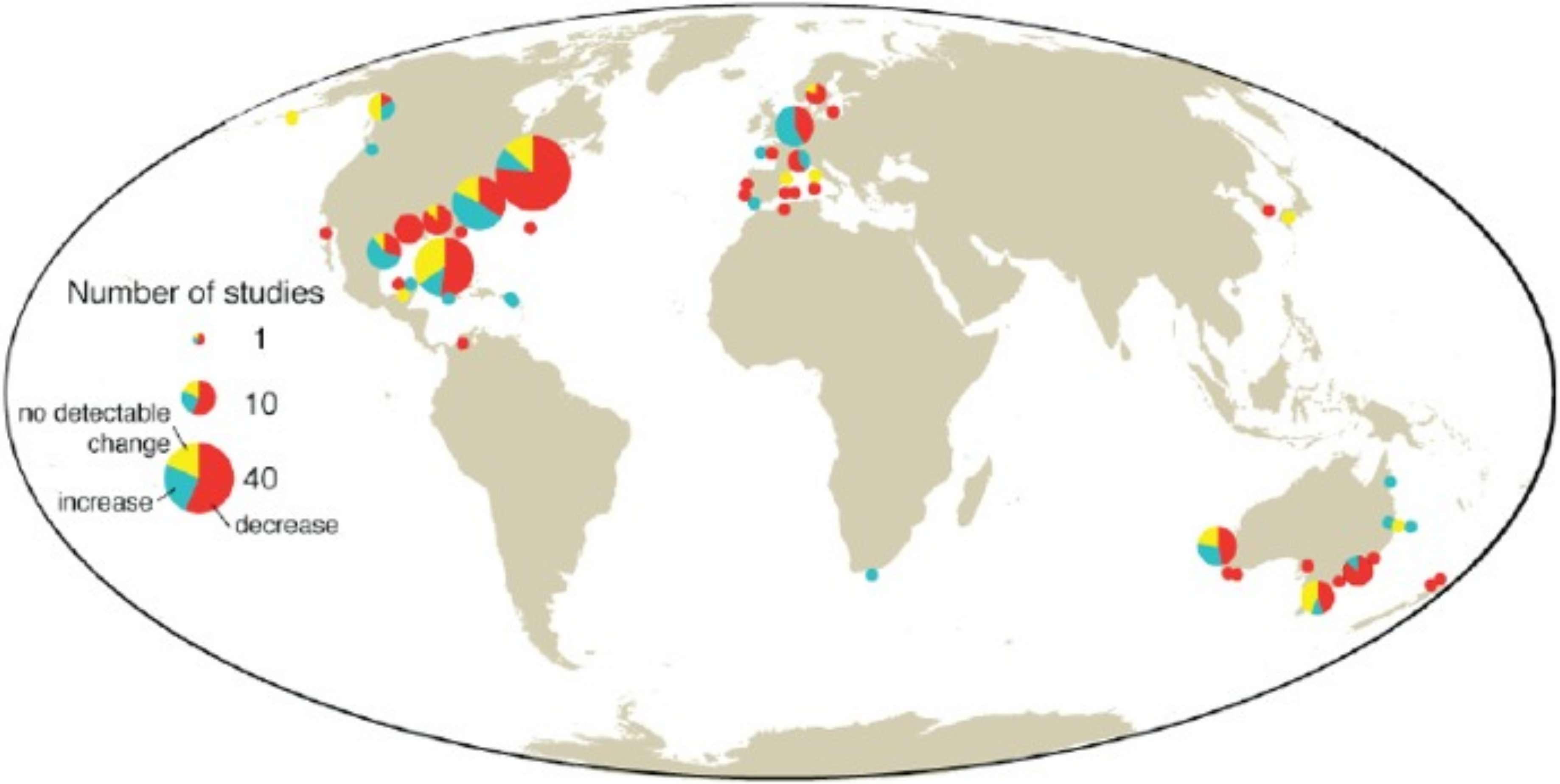
  (earlier estimate of salt marshes and mangrove combined is 10 Pg C



Reports of seagrass losses and the rates of decline are increasing dramatically

Waycott et al. 2009 *PNAS*

Seagrass ecosystems are declining globally



Waycott et al. 2009 *PNAS*

What are the consequences of seagrass

- Seagrass loss has averaged 1.5% y^{-1} since the beginning of the 20th century
- Resulting loss of seagrass biomass:

11.3 – 22.7 Tg C y^{-1}

- Resulting loss of seagrass soil C_{org} (top meter)

63 – 297 Tg C y^{-1}

- These rates are roughly 10% of total CO_2 fluxes