The initial impacts of Corexit EC9500A on microbial activity and community structure in Barataria Bay, LA

Jessica Vaccare

Advsior: Dr. John R. White

Collaborators: Dr. Ashvini Chauhan and Dr. Rajneesh Jaswal

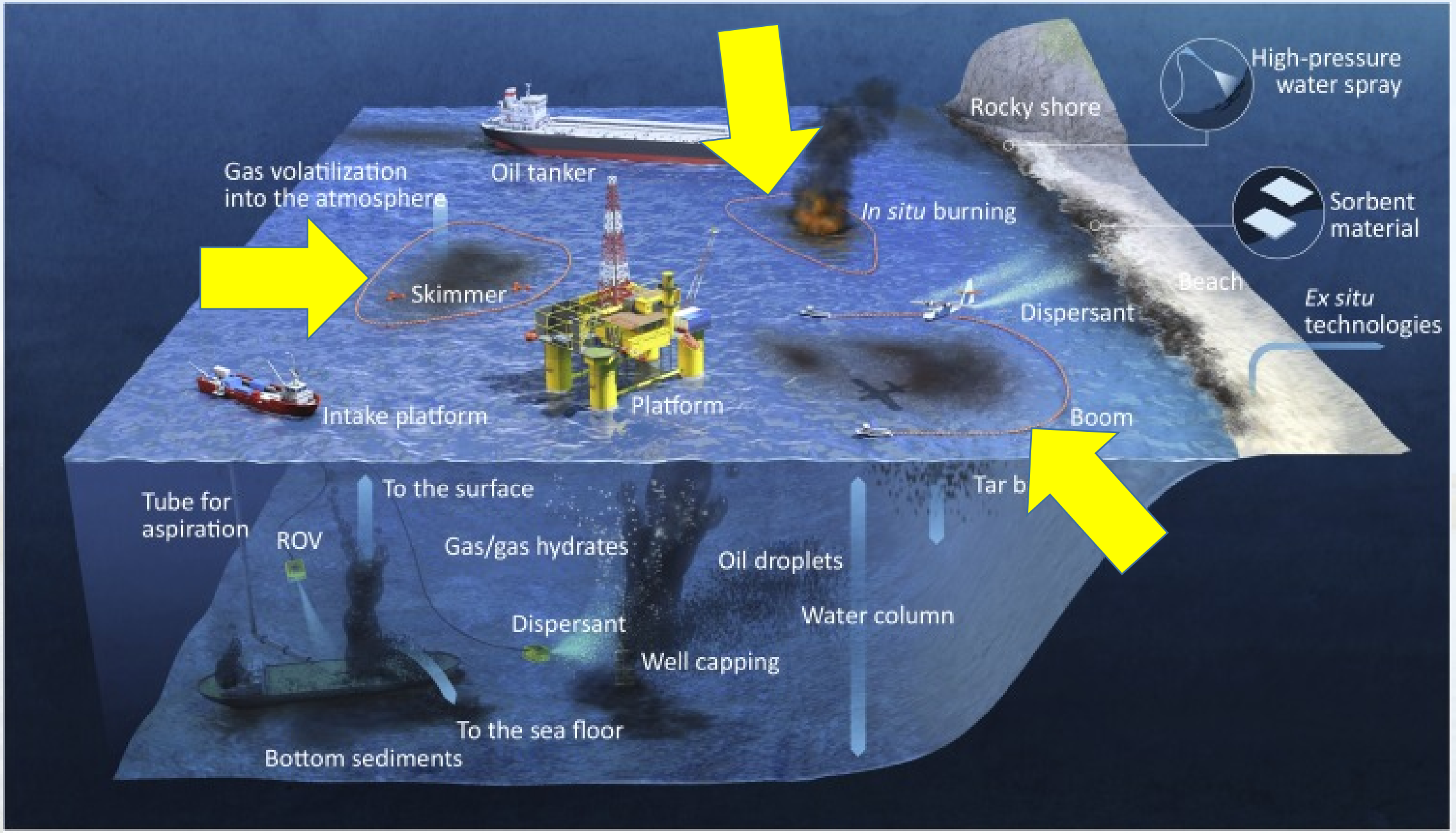
LSU | College of the Coast & Environment

BP- Deepwater Horizon Explosion

- April 20, 2010
- ~ 5 million barrels (795 million liters) of oil released over 87 days
- 42 miles off the coast of LA
- Impacted more than 1,000 miles of coastline
- $5.5 billion Clean Water Act penalty and up to $8.8 billion in natural resource damages
- Deep wellhead
- Physical barriers and sorbents

www.CNBC.com

www.CNN.com



(Mapelli et al., 2017)

Trends in Biotechnology

Chemical dispersants

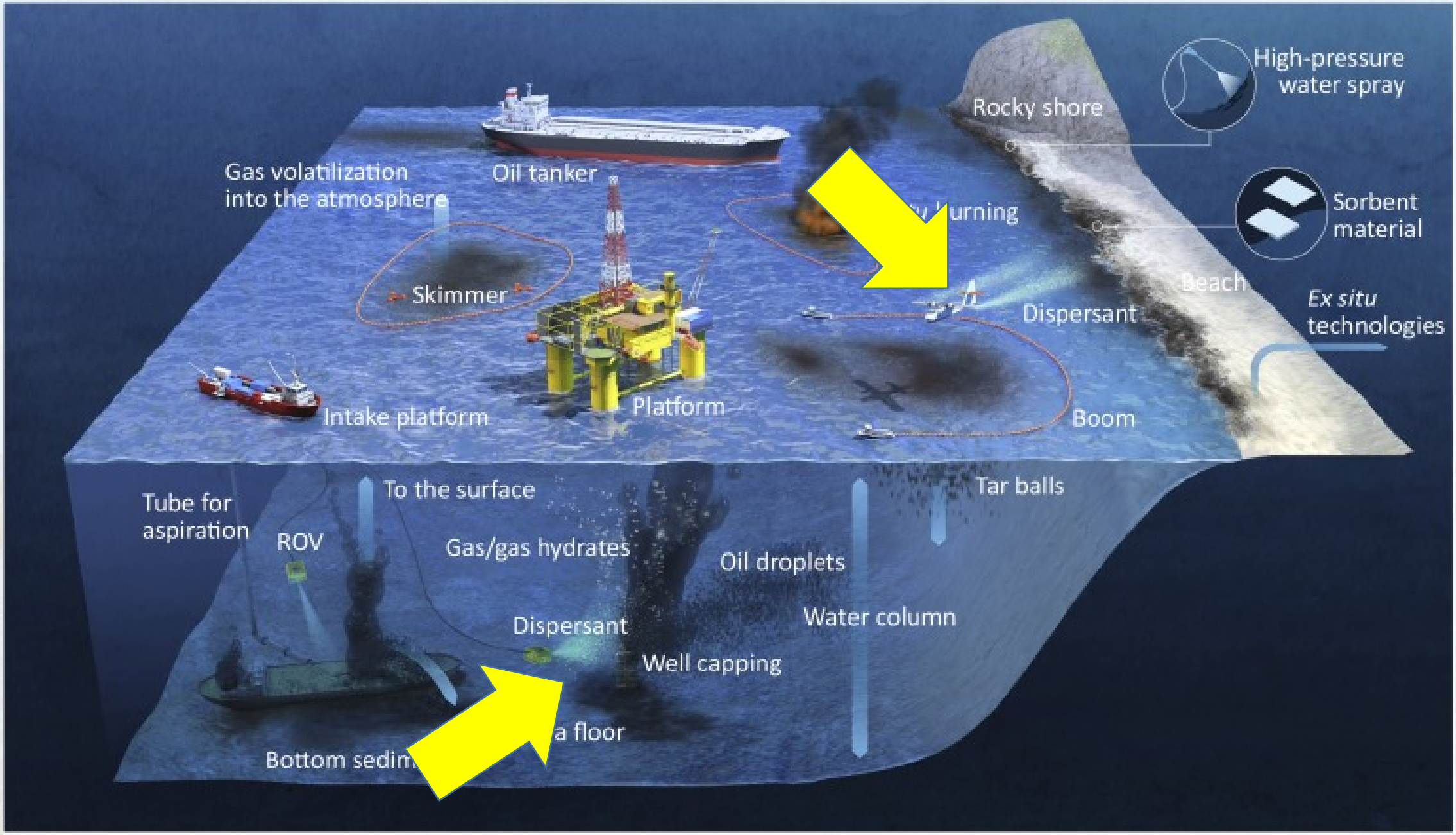
- Combination of hydrocarbon based solvents and surfactants

- Increase surface area of the oil
  - Increase degradation rates
  - Prevent surface oil slicks from reaching land

- Impacts
  - Numerous toxicity studies on plants and animals
  - Limited studies on the effect on microbes
    - Facilitate biogeochemical processes in wetlands
  - Recent access

www.Wikipedia.com

www.telegraph.co.uk



(Mapelli et al., 2017)

Chemical dispersants

- Combination of hydrocarbon based solvents and surfactants

- Increase surface area of the oil
  - Increase degradation rates
  - Prevent surface oil slicks from reaching land

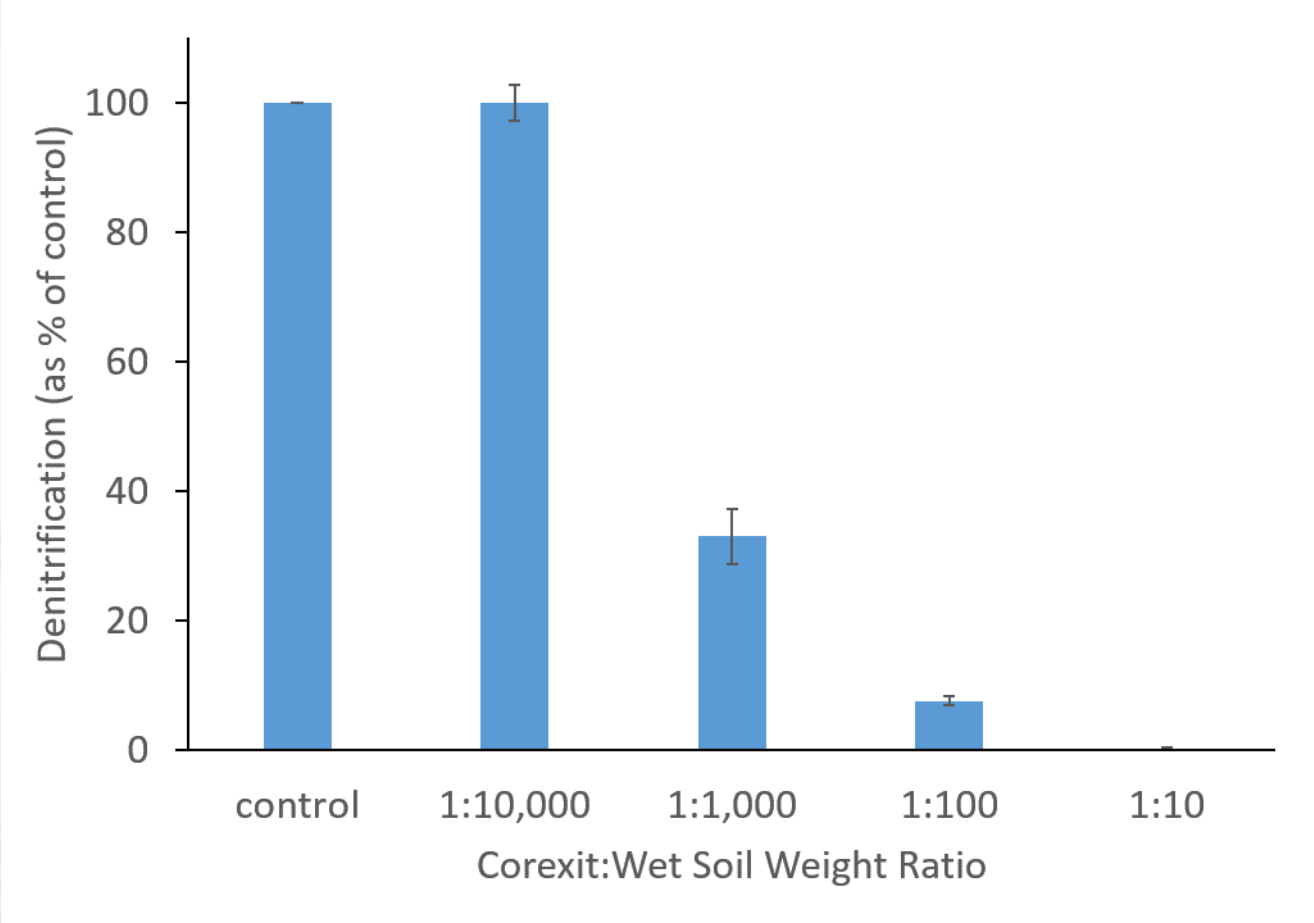
- Impacts
  - Recent access
  - Numerous toxicity studies for plants and animals
  - Limited studies about the effects on wetland microbes
    - Facilitate biogeochemical processes in wetlands

www.Wikipedia.com

www.telegraph.co.uk

Previous work

- Hamdan and Fulmer, 2011
  - Inhibition of hydrocarbon degrading bacteria
- Pietroski et al., 2015
  - Microbial biomass N
  - N mineralization
  - Severely impacted denitrification
- Previous work shows that Corexit has an impact on microbial processes



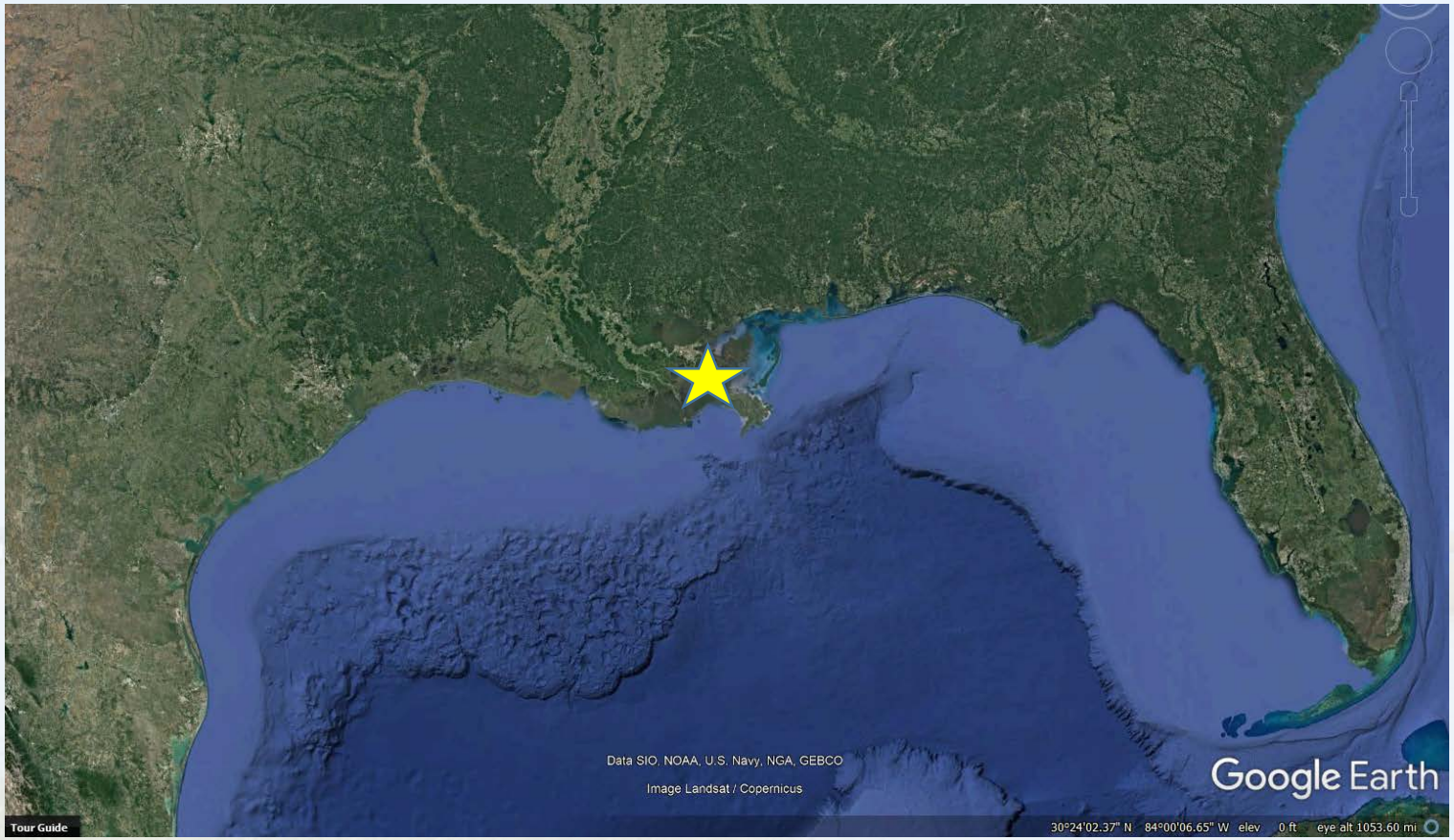
(adapted from Pietroski et al., 2015)

Experiment Objectives

- Goal
  - To find how microbial communities in the soil react to different levels of Corexit exposure
- Objectives
  - Measure heterotrophic microbial respiration
  - Metagenomics study - Dr. Chauhan and Dr. Jaswal at FAMU
- Obtain a more complete picture of how the addition of dispersant impacts the coastal wetland ecosystem
- Find links between shifts in microbial function and structure to possible shifts in ecosystem services

Sampling site

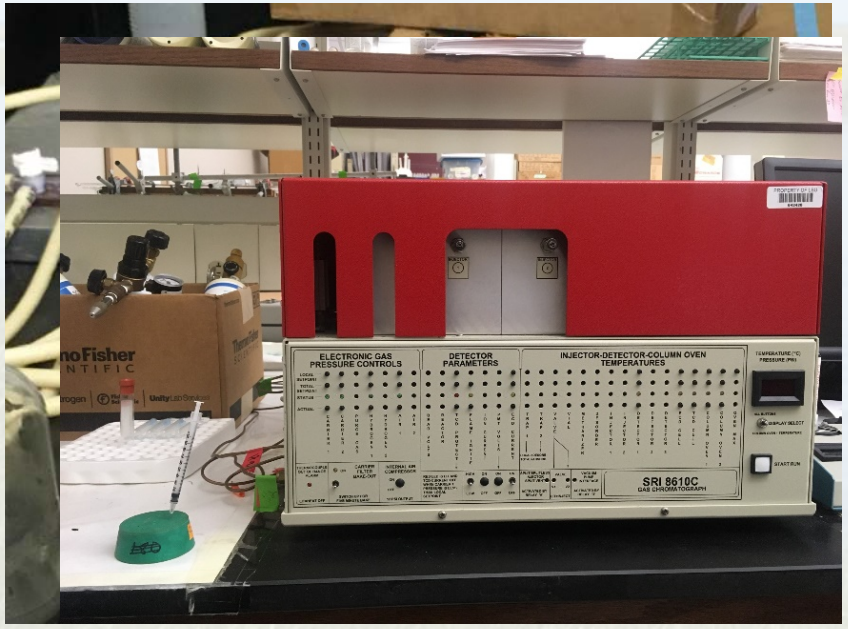
- Barataria Bay, LA
- Triplicate cores taken from marsh (marsh)
- Triplicate cores taken from about 200 m out (estuarine)



Methods

- Microbial biomass C & N, %LOI, bulk density, moisture content, TP, and TC/TN

- CO_2 production over time
  - Incubated at 25°C under anaerobic headspace
  - Corexit:wet soil ratios of 1:1,000, 1:100, 1:10, and control
  - Samples analyzed using a GC/FID for a week



Preliminary results

Soil Characterization data

	Marsh	Estuary
Moisture content	0.71 ± 0.01	0.5003 ± 0.01
%LOI	22.4 ± 1.45	6.98 ± 0.3
Bulk density (g/cm^3)	0.352 ± 0.04	0.732 ± 0.02
TC (g/kg)	113 ± 11.16	24.6 ± 2.32
TN (g/kg)	5.95 ± 0.29	1.72 ± 0.15
TP (mg/kg)	573 ± 8.19	527 ± 10.85
MBC (g/kg)	4.29 ± 0.33	1.55 ± 0.33
MBN (mg/kg)	23.2 ± 9.65	7.53 ± 1.05
Rate (mg CO_2-C/kg dry soil/hr) (Control cores)	0.63 ± 0.28	0.04 ± 0.03

Preliminary results

Soil Characterization data

	Marsh	Estuary
Moisture content	0.71 ± 0.01	0.5003 ± 0.01
%LOI	22.4 ± 1.45	6.98 ± 0.3
Bulk density (g/cm^3)	0.352 ± 0.04	0.732 ± 0.02
TC (g/kg)	113 ± 11.16	24.6 ± 2.32
TN (g/kg)	5.95 ± 0.29	1.72 ± 0.15
TP (mg/kg)	573 ± 8.19	527 ± 10.85
MBC (g/kg)	4.29 ± 0.33	1.55 ± 0.33
MBN (mg/kg)	23.2 ± 9.65	7.53 ± 1.05
Rate (mg CO_2-C/kg dry soil/hr) (Control cores)	0.63 ± 0.28	0.04 ± 0.03

Preliminary results

Soil Characterization data

	Marsh	Estuary
Moisture content	0.71 ± 0.01	0.5003 ± 0.01
%LOI	22.4 ± 1.45	6.98 ± 0.3
Bulk density (g/cm^3)	0.352 ± 0.04	0.732 ± 0.02
TC (g/kg)	113 ± 11.16	24.6 ± 2.32
TN (g/kg)	5.95 ± 0.29	1.72 ± 0.15
TP (mg/kg)	573 ± 8.19	527 ± 10.85
MBC (g/kg)	4.29 ± 0.33	1.55 ± 0.33
MBN (mg/kg)	23.2 ± 9.65	7.53 ± 1.05
Rate (mg CO_2-C/kg dry soil/hr) (Control cores)	0.63 ± 0.28	0.04 ± 0.03

Preliminary results

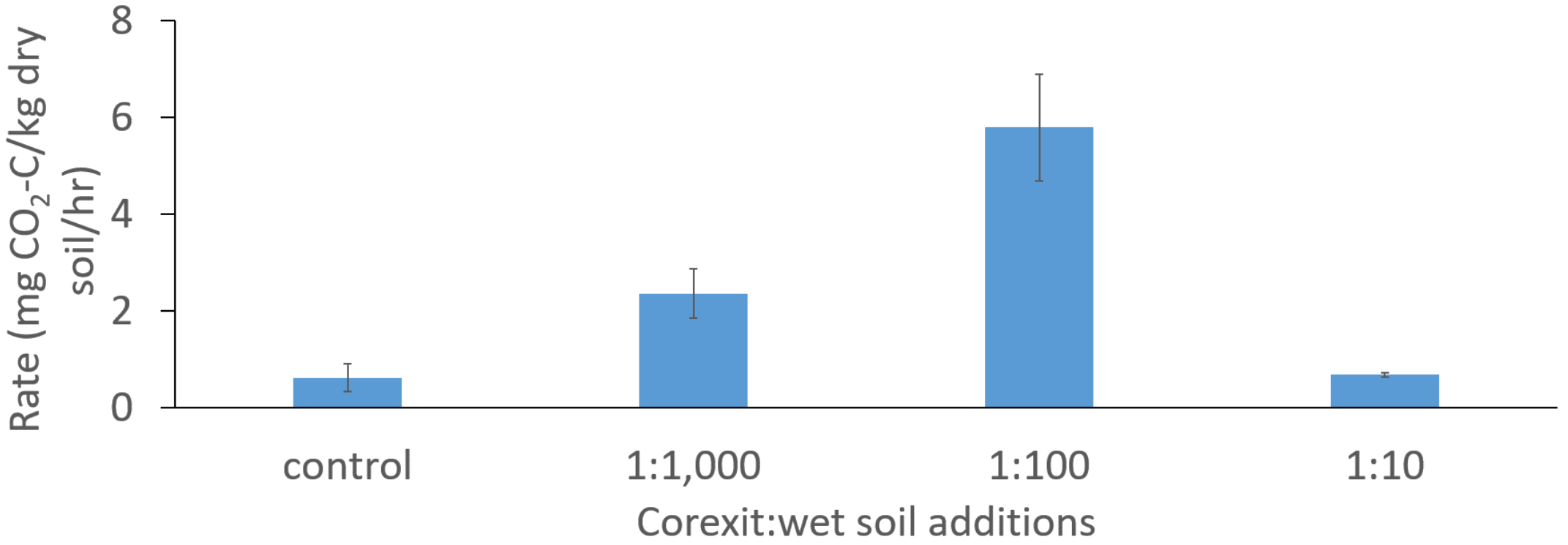
Soil Characterization data

	Marsh	Estuary
Moisture content	0.71 ± 0.01	0.5003 ± 0.01
%LOI	22.4 ± 1.45	6.98 ± 0.3
Bulk density (g/cm^3)	0.352 ± 0.04	0.732 ± 0.02
TC (g/kg)	113 ± 11.16	24.6 ± 2.32
TN (g/kg)	5.95 ± 0.29	1.72 ± 0.15
TP (mg/kg)	573 ± 8.19	527 ± 10.85
MBC (g/kg)	4.29 ± 0.33	1.55 ± 0.33
MBN (mg/kg)	23.2 ± 9.65	7.53 ± 1.05
Rate (mg CO_2-C/kg dry soil/hr) (Control cores)	0.63 ± 0.28	0.04 ± 0.03

Preliminary results

CO_2 production – **Marsh Cores**

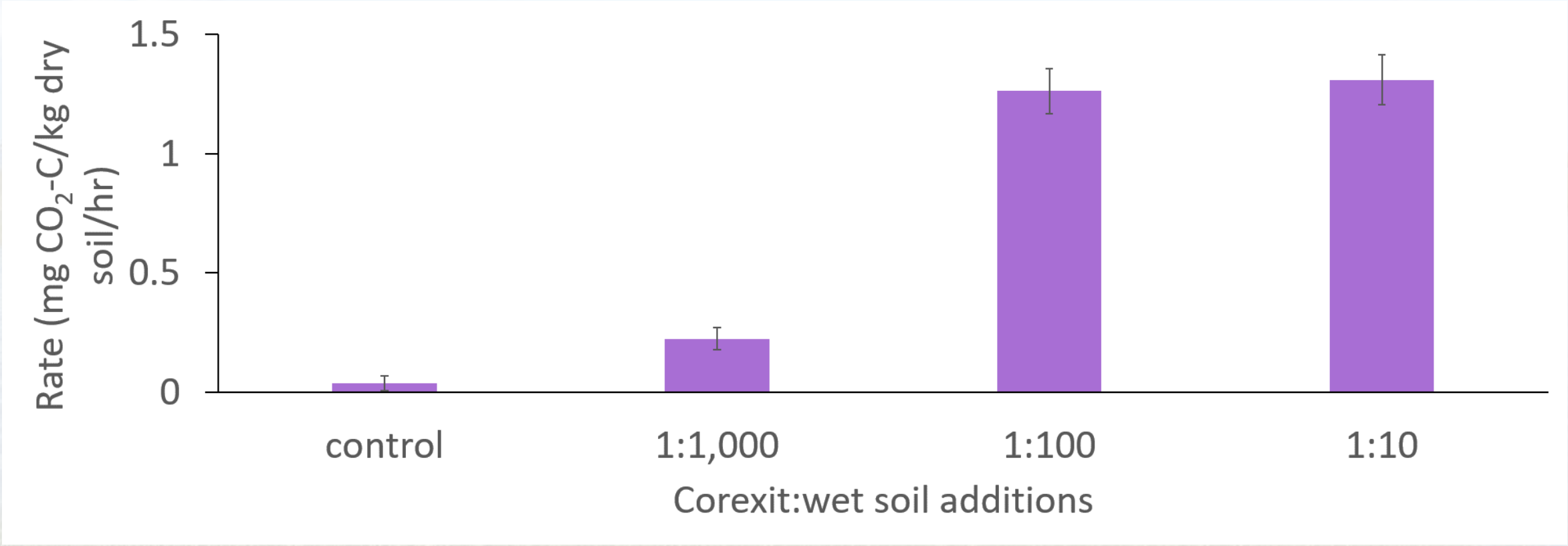
Respiration Rate (mg CO_2-C/kg dry soil/hr)		
Addition	**Marsh Averages**	**Estuary Averages**
control	0.63 ± 0.28^{a}	0.04 ± 0.03^{d}
1:1,000	2.37 ± 0.5^{b}	0.22 ± 0.05^{e}
1:100	5.8 ± 1.1^{c}	1.26 ± 0.09^{f}
1:10	0.68 ± 0.04^{a}	1.31 ± 0.1^{f}



Preliminary results

CO_2 production – **Estuary Cores**

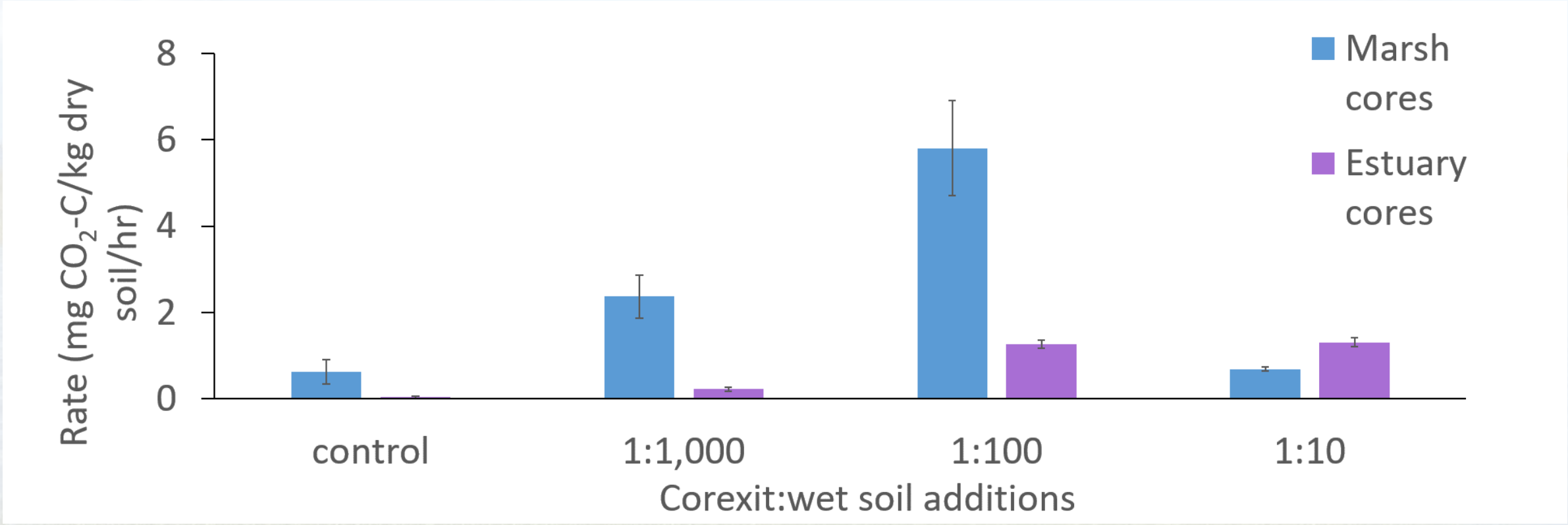
Respiration Rate (mg CO_2-C/kg dry soil/hr)		
Addition	**Marsh Averages**	**Estuary Averages**
control	0.63 ± 0.28^{a}	0.04 ± 0.03^{d}
1:1,000	2.37 ± 0.5^{b}	0.22 ± 0.05^{e}
1:100	5.8 ± 1.1^{c}	1.26 ± 0.09^{f}
1:10	0.68 ± 0.04^{a}	1.31 ± 0.1^{f}



Preliminary results

CO_2 production – **Both sites**

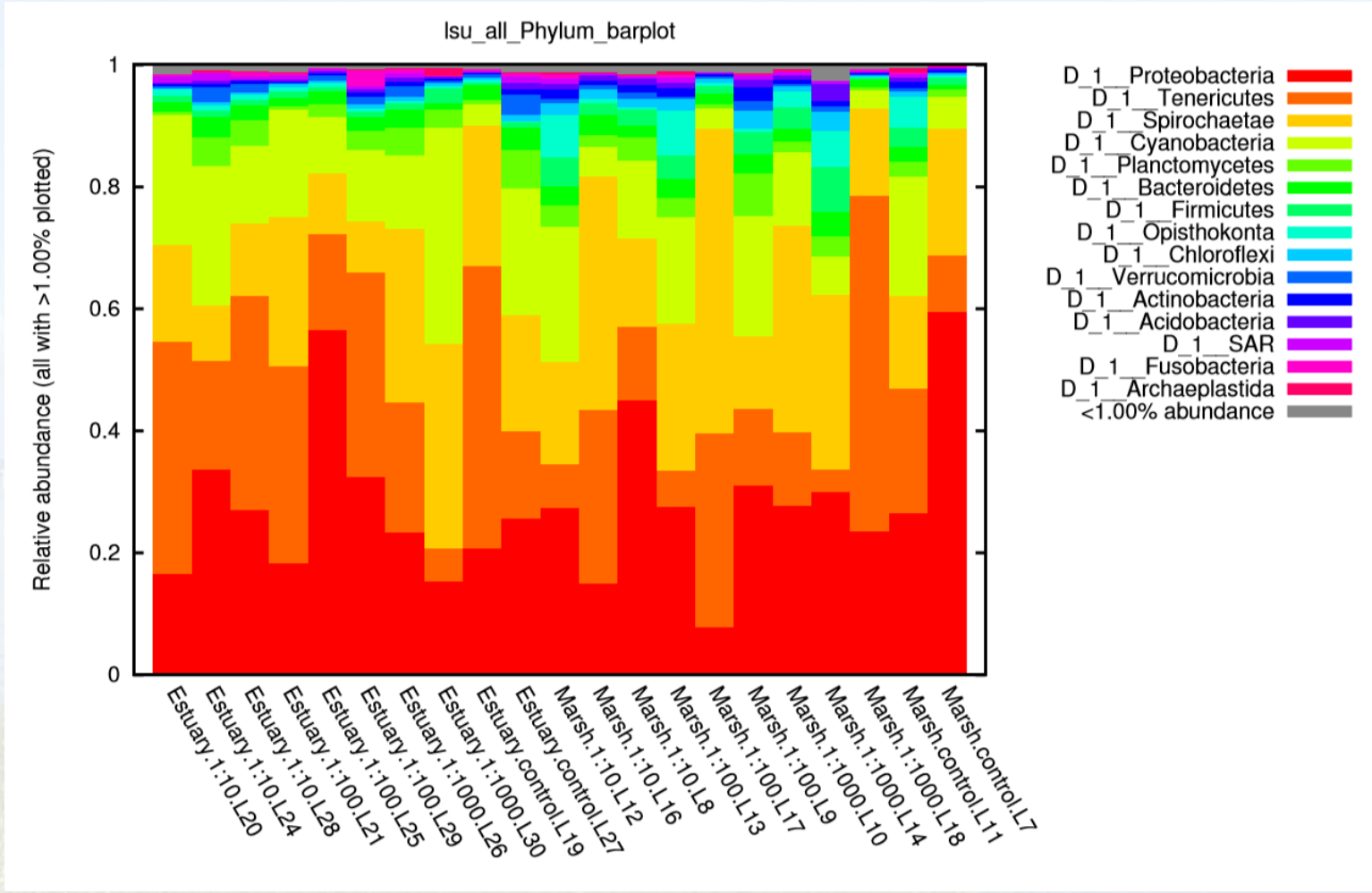
Respiration Rate (mg CO_2-C/kg dry soil/hr)		
Addition	**Marsh Averages**	**Estuary Averages**
control	0.63 ± 0.28^{a}	0.04 ± 0.03^{d}
1:1,000	2.37 ± 0.5^{b}	0.22 ± 0.05^{e}
1:100	5.8 ± 1.1^{c}	1.26 ± 0.09^{f}
1:10	0.68 ± 0.04^{a}	1.31 ± 0.1^{f}



Preliminary results

Metagenomics data - **Phylum**

- Proteobacteria
- Tenericutes
- Spirochaetae
- Cyanobacteria

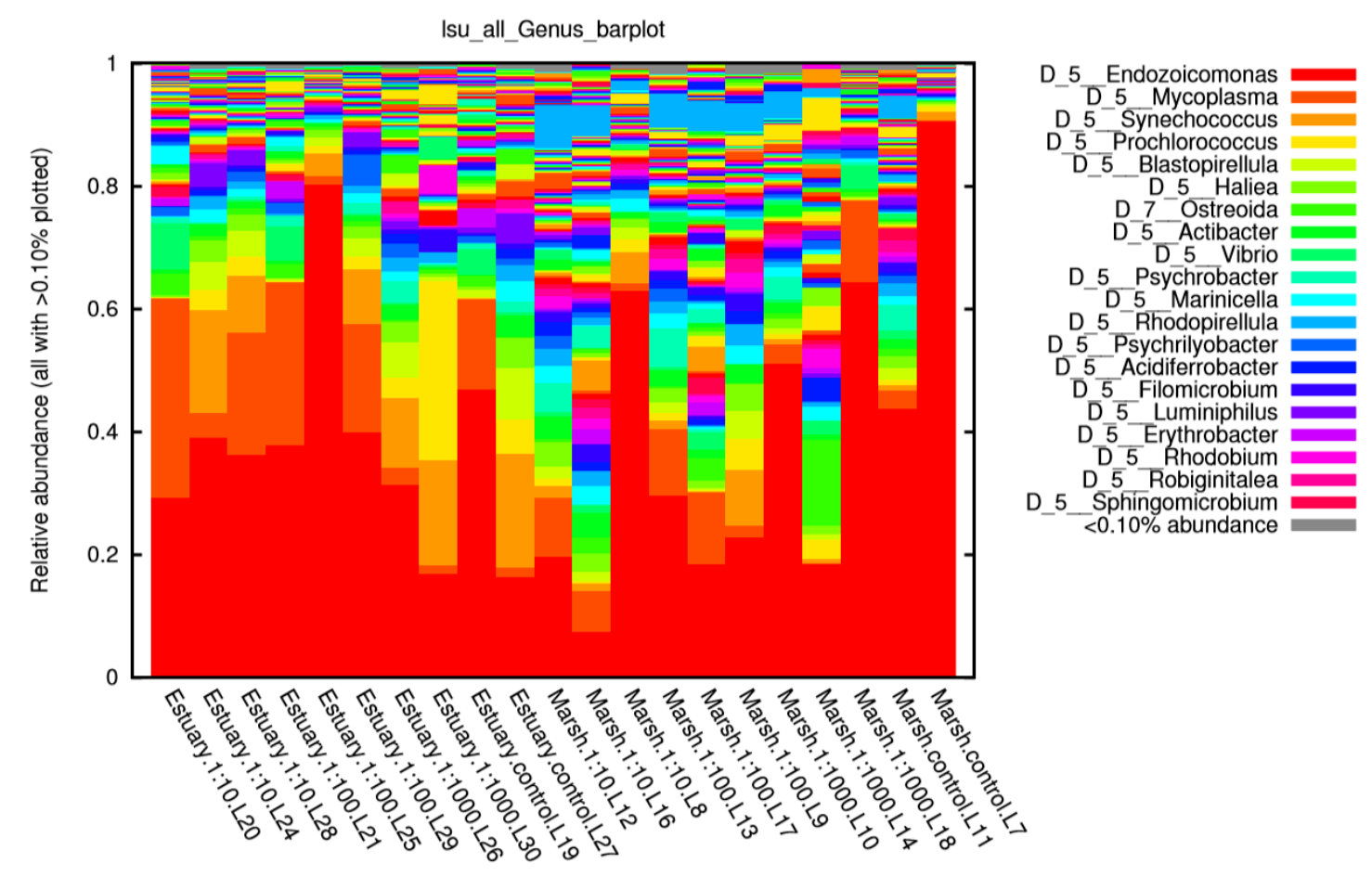


(Chauhan and Jaswal, personal communication)

Preliminary results

Metagenomics data - **Genus**

- Endozoicomonas
- Mycoplasma
- Synechococcus



(Chauhan and Jaswal, personal communication)

Future Work and Conclusions

- Implications for the use of dispersant and impacts on the coastline
- Detrimental effects with Corexit addition have been shown
- Lack of knowledge about the impacts of dispersant on wetland microbes
- Longer term studies may be useful

www.nationalgeographic.com

www.nytimes.com

Acknowledgements

- Dr. John R. White, Dr. Andy Nyman, and Dr. Kanchan Maiti
- Dr. Ashvini Chauhan and Dr. Rajneesh Jaswal
- CPRA
- My labmates: Katie Bowes, Alina Spera, and Amanda Fontenot
- M.P. Hayes and Ben Haywood

LSU | College of the Coast & Environment

Questions?