Long-term oiling from the 2010 Deepwater Horizon spill: Impact on salt marsh denitrification

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Objectives

- Problem with nitrate
- Explain denitrification, and its value as an ecological service
- Describe research on the impact of oil on salt marsh denitrification
- Discuss results and implications

Denitrification process

Distribution of bottom water dissolved oxygen July 28–August 3, 2015 west of the Mississippi River delta. Black line denotes dissolved oxygen less than 2 mg/L.

Data source: Nancy N. Rabalais, LUMCON, and R. Eugene Turner, LSU
Funding sources: NOAA Center for Sponsored Coastal Ocean Research and U.S. EPA
Gulf of Mexico Program

April 20th, 2010
Deepwater Horizon Oil Spill

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3680451/figure/pone-0065087-g003/

Effects of oil on wetland soils

- Oil from the DWH spill is still present in salt marsh soils
- Little is known about how coastal wetland soil functions respond to long-term oiling

Experimental Design

A. Determine if long-term presence of oil has toxic affect on denitrifying soil microbes
   1. Measure maximum potential denitrification in oiled layer

B. Investigate impact of buried oil on nitrate reduction under field conditions
   1. Determine areal nitrate reduction under environmentally relevant conditions in intact cores
   2. Investigate potential denitrification with depth from intact cores

Data Analysis

- Anova: Single factor
- Significant differences: p<0.05
Methods

Potential Denitrification
- 4 oiled and 4 unoiled cores collected
- Top 10 cm incubated as a homogenous, shaken slurry under an anaerobic headspace
- Non-limiting C as glucose and N as nitrate
- Acetylene block method prevents N₂O→N₂
- N₂O measured on GC-8A equipped with an electron capture detector

Methods

Areal nitrate reduction
- 4 oiled and 4 unoiled cores collected
- Filtered water from site added to headspace
- Water brought to 2 mg/L NO₃-N
- Cores kept in dark
- 10 samples taken over 10 days
- Water samples analyzed by colorimetric analysis

Results

Potential denitrification rates in 0-10 cm soil interval after 48 hours

Results

Average potential denitrification after 24 hours for 5 cm sample depths from intact core
Discussion

• Experiment on 0-10 cm section shows oil is toxic to denitrifying bacteria

• Experiment on 5 cm sections from intact cores shows rates of denitrification through soil column
  • Significantly lower where oil is present

Conclusion

• This is the only known study to document the lasting presence of buried oil 5 years after the DWH spill

• Potential denitrification results show buried oil is still toxic to denitrifying bacteria 5 years after the spill

• Areal nitrate reduction is higher in oiled cores suggesting the presence of oil may not have significant impacts on ability of salt marshes to perform denitrification

Implications

Discussion

• Intact core study shows nitrate reduction rates increased in oiled cores
  • Soil above and below oiled layer is able to perform denitrification
  • Increase could be attributed to less oxygen in soil column

Thank you

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Any questions?