Remediation and Restoration of an Oil Contaminated Wetland

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Introduction

- Louisiana contains over 30% of the nation's wetlands and its only national forest, Kisatchie National Forest, covers much of the central and northern regions of the state.
- Oil production and exploration take place in both of these environments, and as a result, they are at risk to petroleum contamination due to accidental spills, leaks, or discharges.

- Remediation practices have been developed for onshore spills, but they are not always applicable to all onshore sites.
- Remediation of inland contaminated sites may include incineration of the oil, landfarming the contaminated soil, or burial.
- These techniques are not always a viable option for remediation of a contaminated wetland or forest due to the limited access for equipment and the ecologically sensitive nature of these environments.

- There is an inadequate amount of literature that describes the impacts and remediation of oil contamination in forested wetland areas.
- As a result, it is difficult to determine the best and most beneficial remediation practices to employ to cleanup petroleum contaminated wetlands and forests.
- When spills in these environments do occur, it offers the opportunity to develop remediation practices that are best suited for these situations.

- One such opportunity occurred when an oil well blowout took place at Cravens, LA.
- Approximately 60-75 acres of Kisatchie National Forest and a freshwater wetland adjacent to the oil well was impacted by this oil and brine spill.
- Due to this blowout, numerous loblolly and longleaf pine trees in the vicinity died or were severely injured and the wetland was severely and adversely impacted.

Objectives

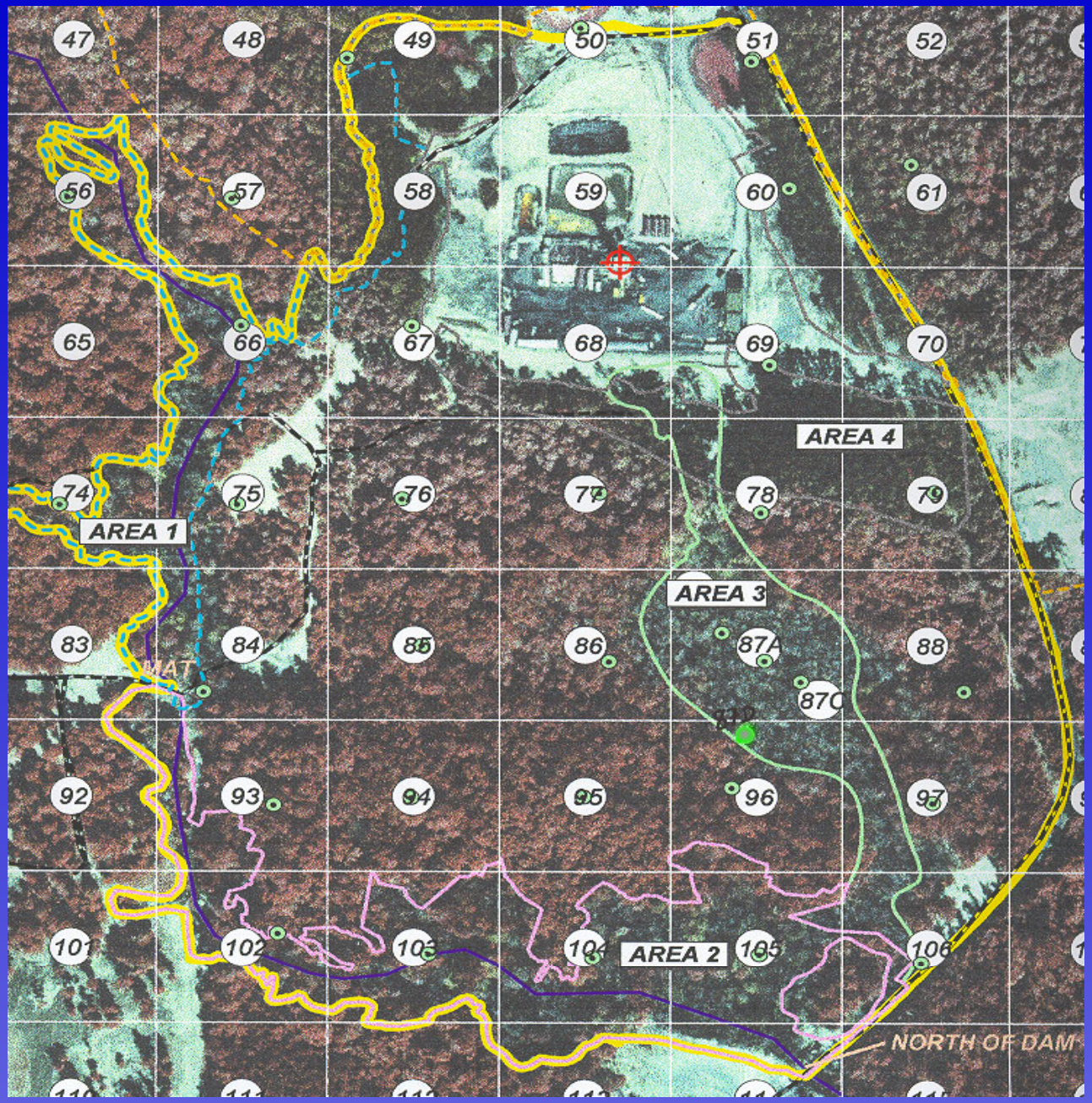
The general objective of this study is to develop and implement a remediation and restoration plan for the impacted forest and wetland. The study has the following specific objectives:

- To develop an approved remediation and restoration plan in conjunction with the U.S. Forest Service for the impacted wetland.
- To determine the exact cause of death of the loblolly and longleaf pines impacted by the blowout in a controlled green house study.
- To develop recommendations for the restoration and management of the affected forested areas.

Description of the Study Area

- The study area is located in Vernon Parish near Cravens, LA in Section 7, T1S, RW6 of the Sugrue, LA 7.5 minute quadrangle map.
- The impacted wetland lies approximately 1/4 mile south of the oil well. Overland flow of oil and brine also occurred west of the well into Little Sixmile Creek, which is located less than 1/4 mile west of the well.


Cravens, LA
Research Site
Vernon Parish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NORTH OF DAM

Soils

- The soils in the area surrounding the wetland have been mapped as Ruston fine sandy loam (Typic Paleudults) and Malbis fine sandy loam (Plinthic Paleudults).
- The wetland soil is a Guyton silt loam (Typic Glossaqualfs), a typical wetland soil.

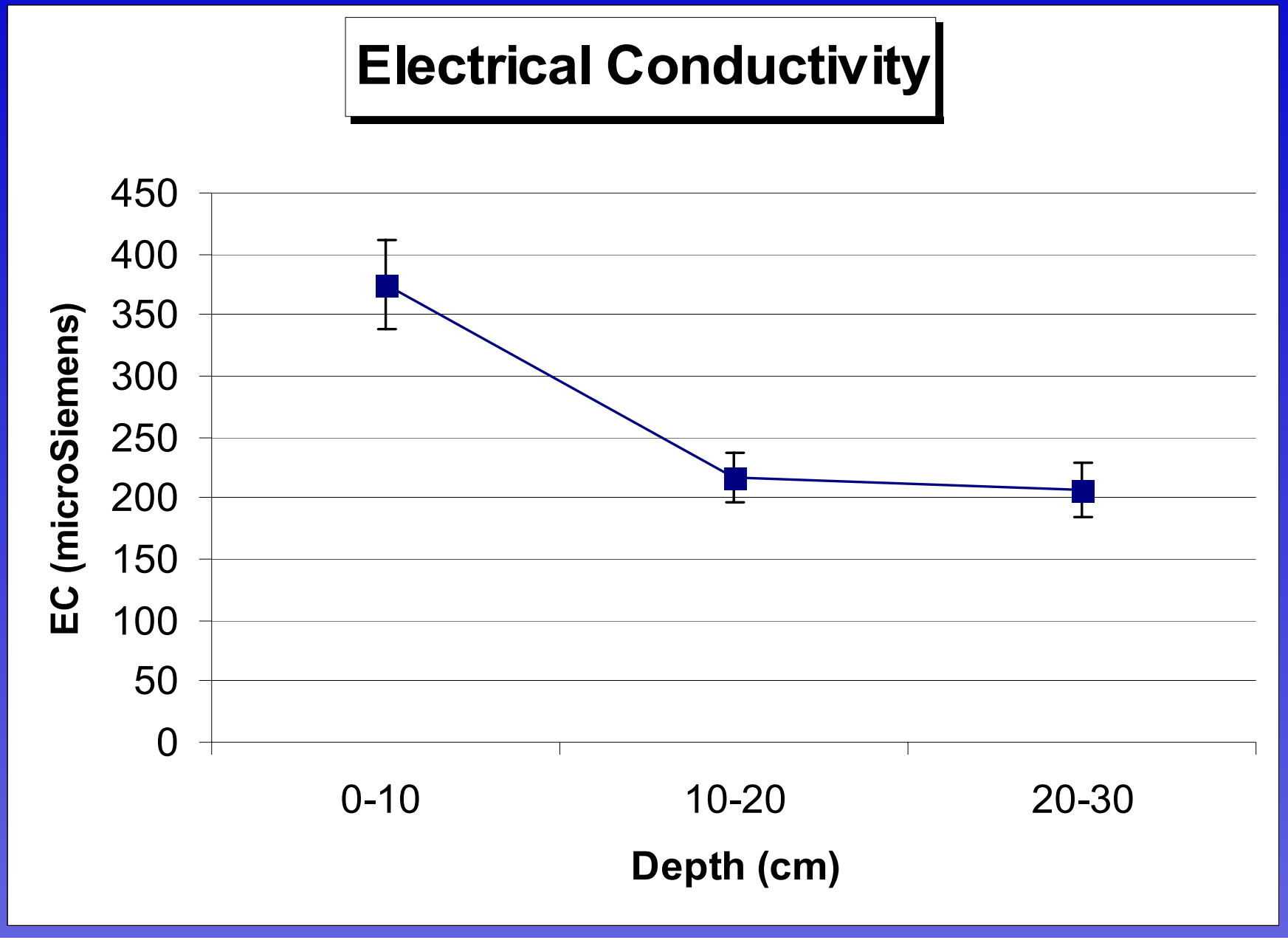
Vegetation

- Loblolly (*Pinus taeda*) and longleaf pine (*Pinus palustris*) dominate the vegetation of the forested area around the wetland.
- Vegetation within the wetland includes sweet gum *(Liquidambar styracifula*), tupelo gum *(Nyssa aquatica*), and black gum *(Nyssa sylvatica*).

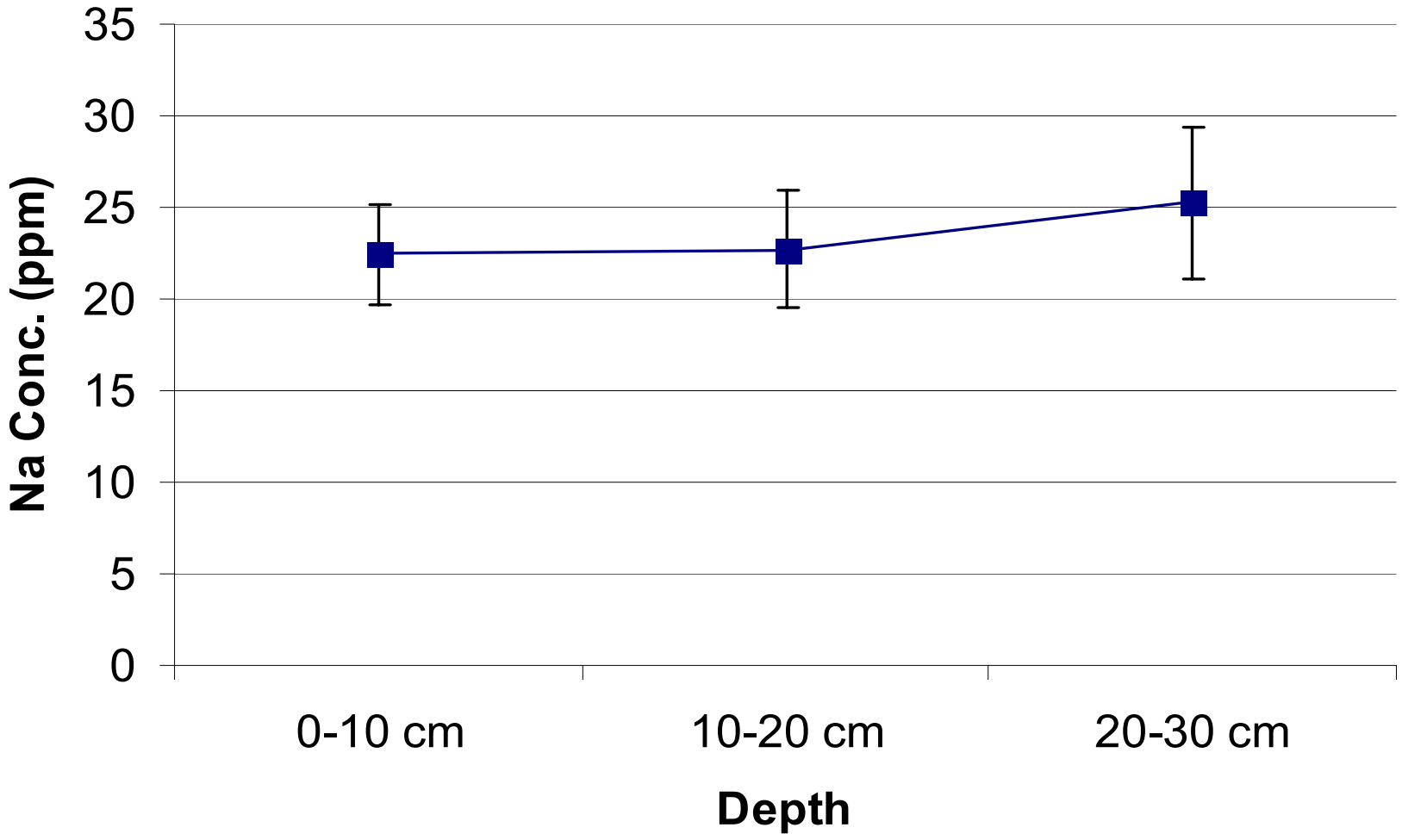
Materials and Methods

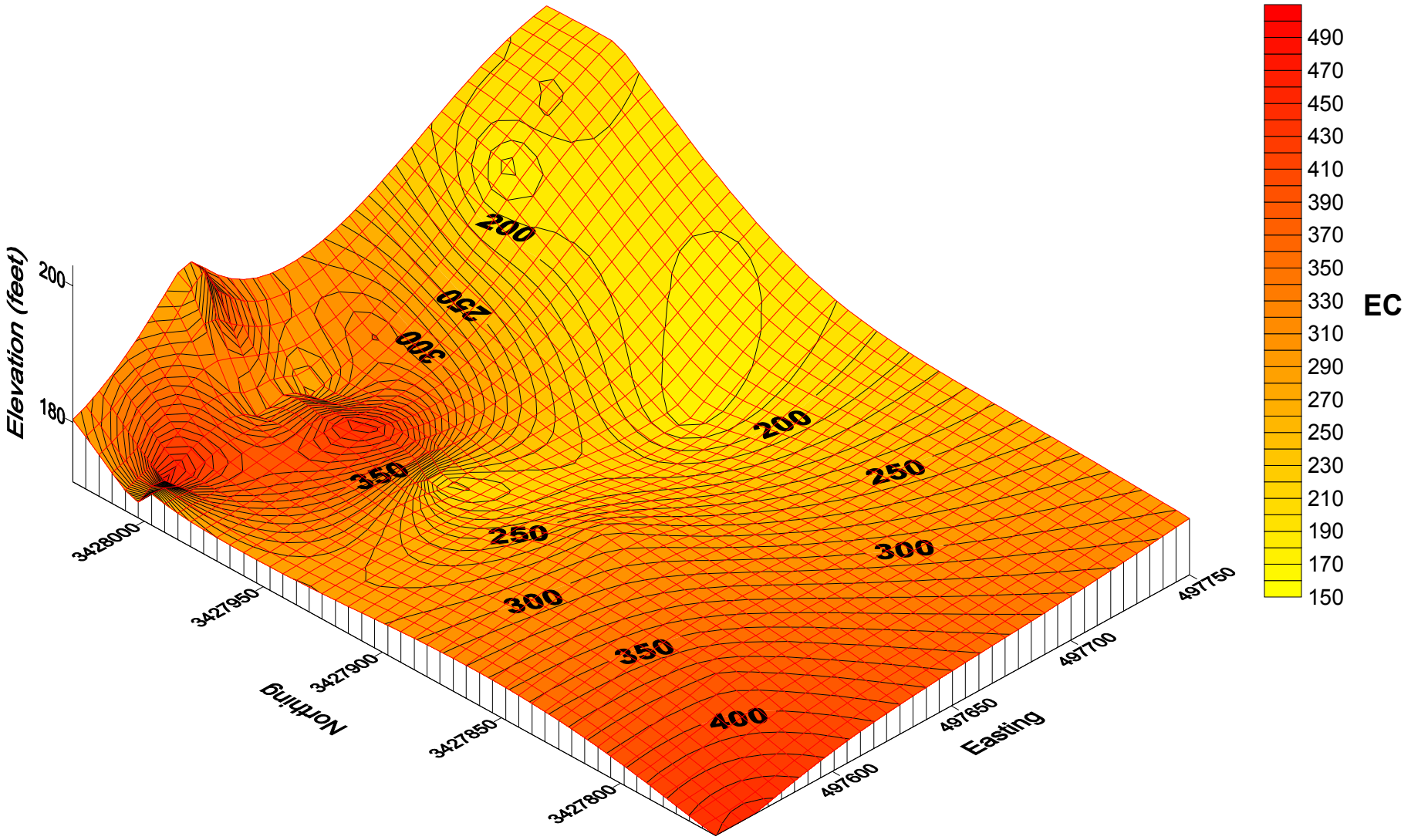
- The wetland was burned on December 18, 1998. Most of the surface oil was volatilized.
- Soil samples were taken three days after the burn and analyzed for pH, electrical conductivity (EC) and sodium concentration.
- Once these analyses were performed, isohaline and isopH maps were created using SURFER software.

Post-burn site characteristics



Na Concentration





Electrical Conductivity

- An alternative method to remediate oil spills using ammoniated bagasse has been developed.
- Cellulose fibers of this material are able to absorb large amounts of water and oil.
- Nitrogen is bound in slowly available organic forms that ensure a dependable N source for oil-degrading microbes.
- Accelerated degradation takes place because the microbes are provided with a favorable environment consisting of water, oxygen, and nutrients.

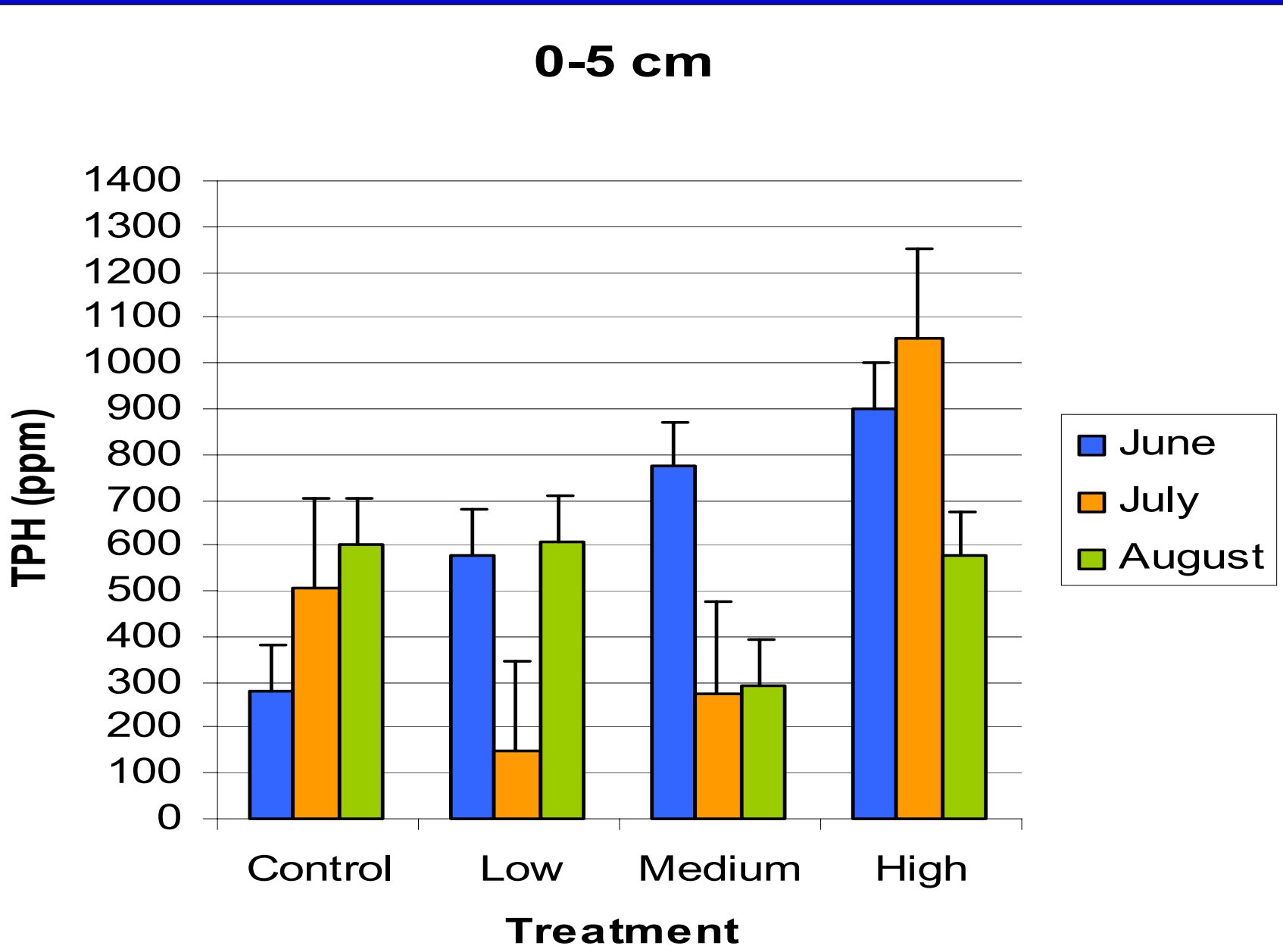
- Ammoniated bagasse was used in combination with $CaCO_3$ and topsoil to remediate the wetland.
- Test plots were constructed using open-ended cylinders (30 cm diam. / 105 cm). Bagasse, lime, and topsoil were added to each cylinder.
- Rates of bagasse added were 0, 50, 100, 200 kg/ha with five replications of each treatment.
- $CaCO_3$ was added at a rate of 1500 kg/ha and 15 g of topsoil added.


HIGH 3

- Samples were taken at 21-day intervals and analyzed for total petroleum hydrocarbons (TPH).
- After a 90-day study period soil samples were collected and analyzed for TPH, EC, pH, and water-soluble cations (Na, Ca, Mg, K, Fe, Al, Mn, Zn, Pb, Cu, Ni, Cd, and Se).

Results

- There was a decrease in total petroleum hydrocarbons.
- The 0-5 cm layer had the greatest concentration of total petroleum hydrocarbons.


0-5 cm
TPH (ppm)
1400
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Low
Medium
High
Treatment
June
July
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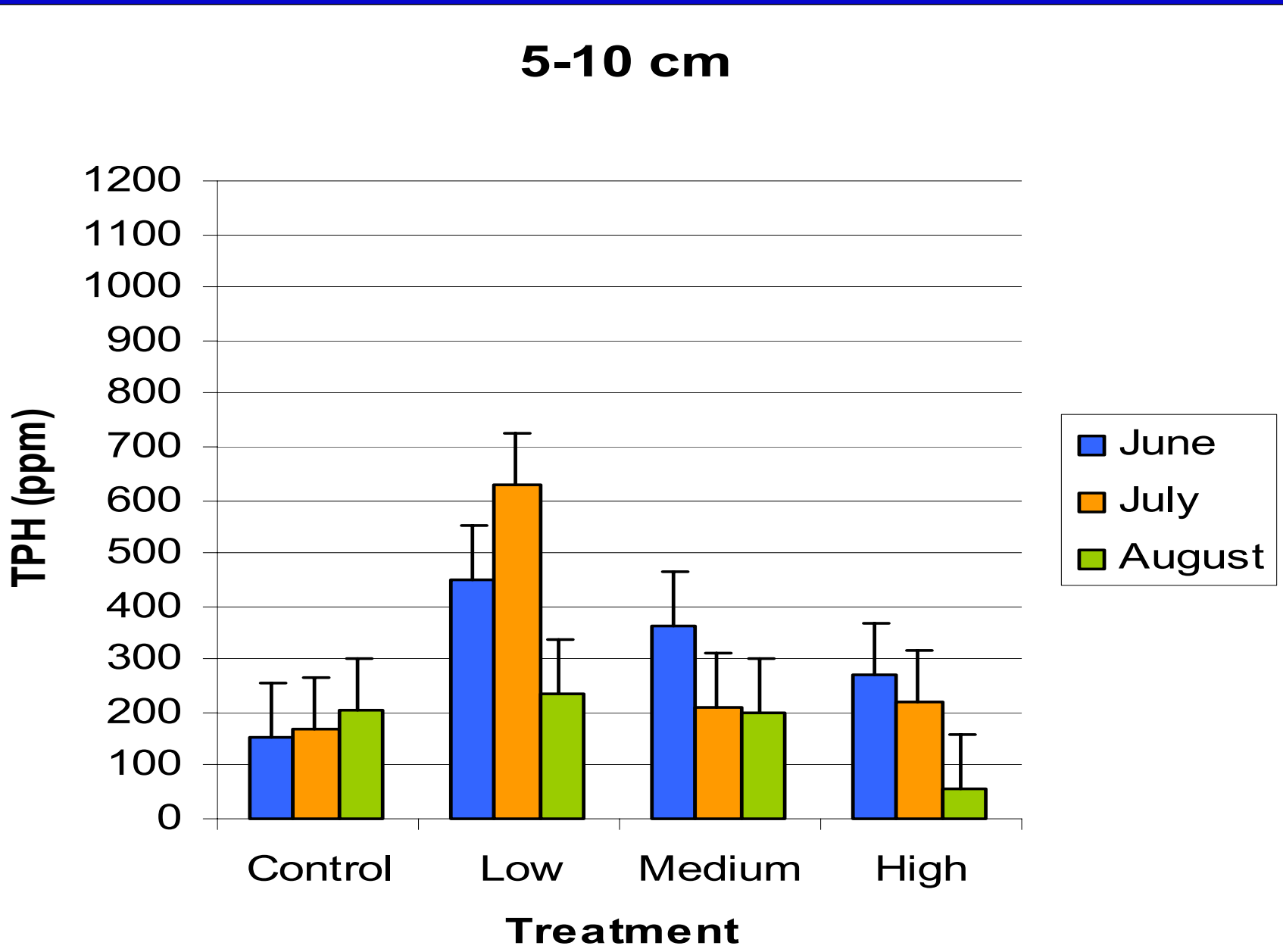
5-10 cm
TPH (ppm)
1200
1100
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Control
Low
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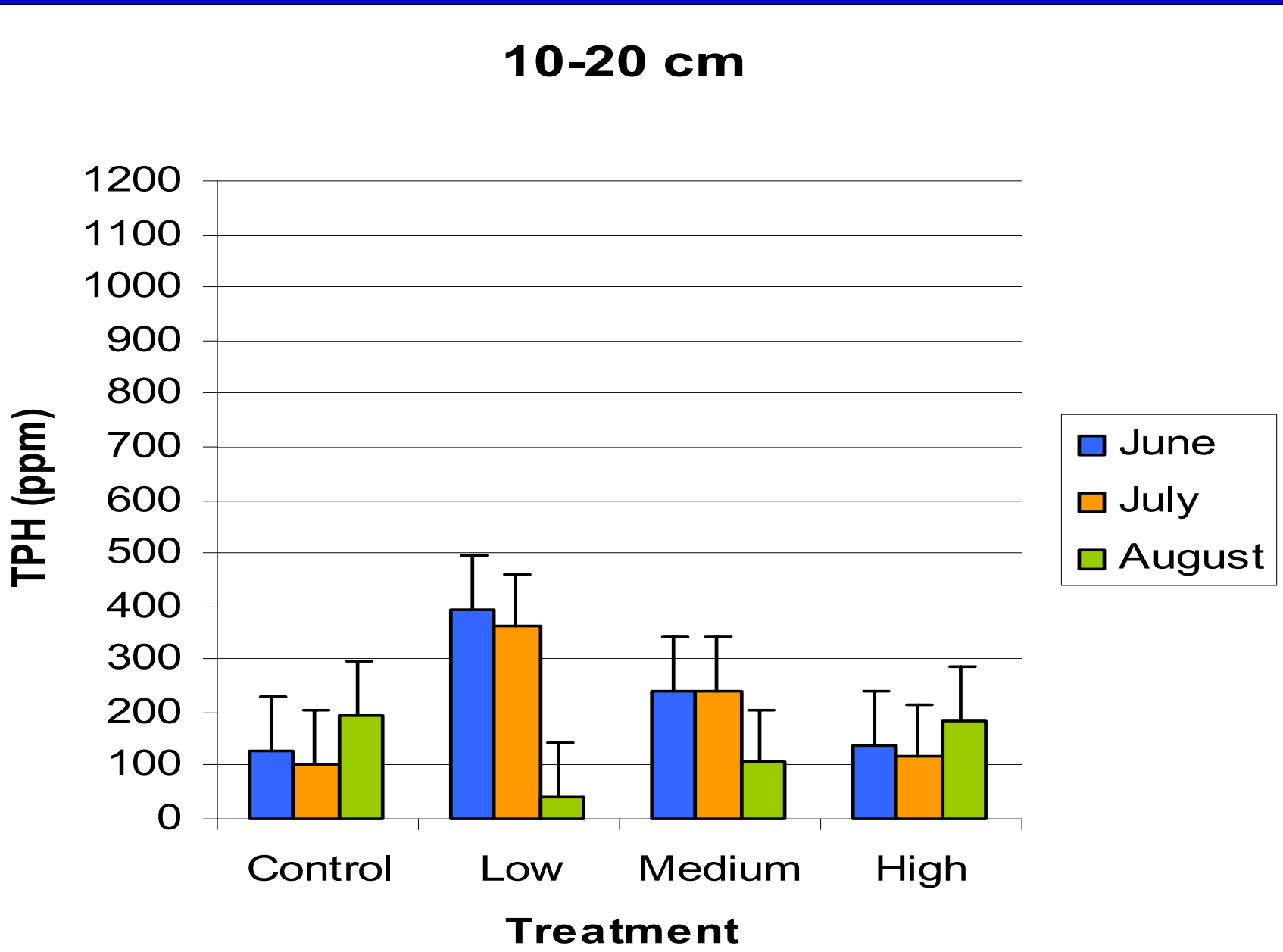
High
Treatment
June
July
August


10-20 cm
TPH (ppm)
1200
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100
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Control
Low
Medium
High
Treatment
June
July
August

Conclusions

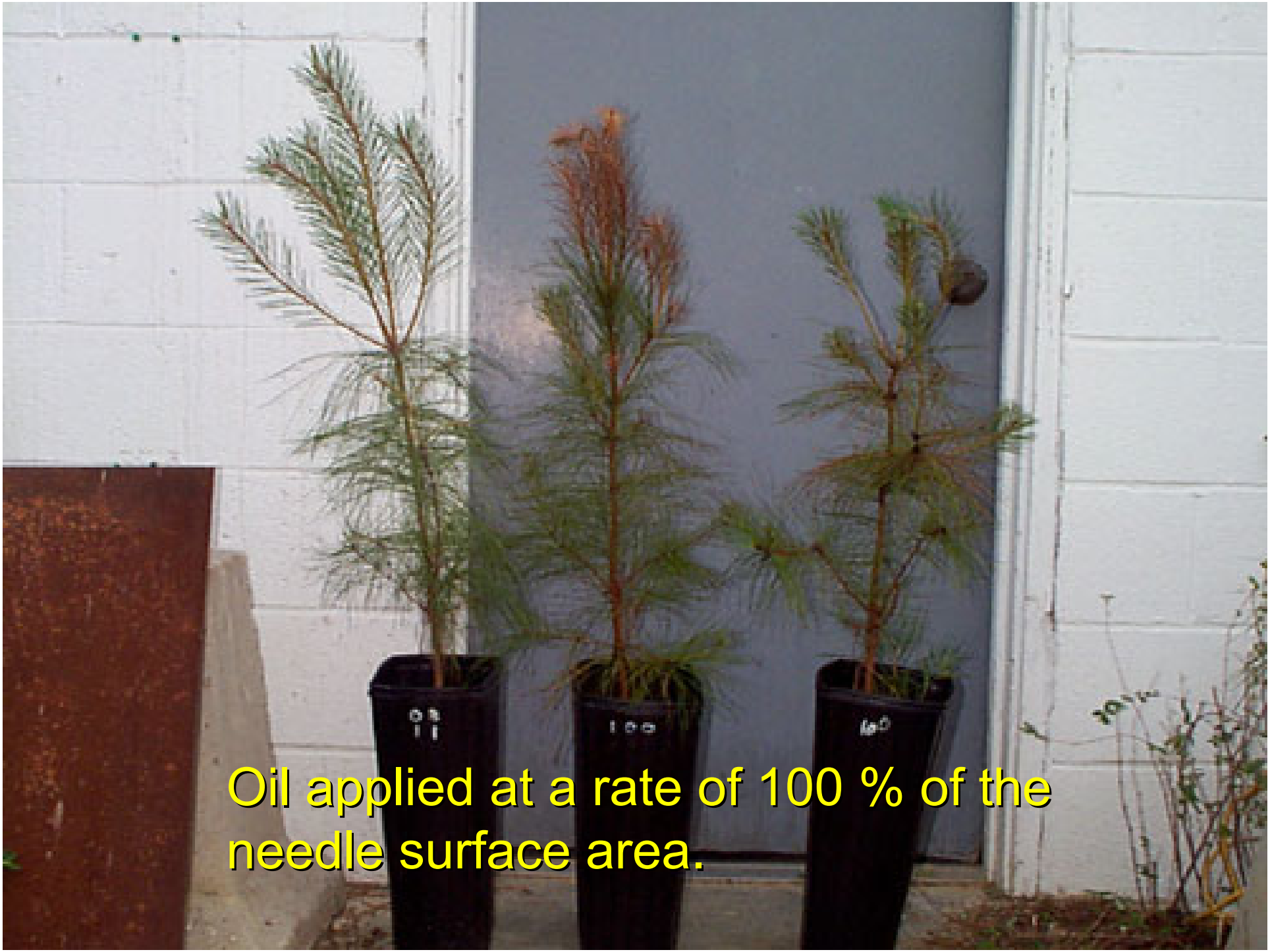
- A remediation plan based upon these results can be applied to an oil contaminated wetland.
- Agricultural lime should be applied to establish a pH of approximately 6.5.
- The bagasse should be inoculated with topsoil from a nearby soil to insure an adequate supply of diverse microbes.
- Apply NH_4 bagasse at 500 to 1000 kg/ha.

Green House Experiments

- To evaluate the physiological effects of oil and brine applied to the trees and the soil.
- To evaluate the potential effectiveness of NH_4 bagasse in oil bioremediation.

Results from adding oil

- Only when oil was applied twice directly to the trees at a rate to cover 100 % of the surface area of the needles was there any visual sign of injury.
- Death occurred within four days when 400 ml of oil were applied directly to the soil. No apparent effect when oil was applied at lower rates.


Oil applied at a rate of 100 % of the needle surface area.


400 ml of oil applied to the soil.

Results from adding brine

- Trees showed visual signs of injury within seven days when brine was sprayed onto the trees at a rate to cover 50 % of the surface area of the needles.
- Five days at the 100 % rate.
- No visual effect when 125 ml of brine were added to the soil.


Brine applied 50 and 100 %.

Acknowledgements

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