Phytoremediation of Soil Contaminants

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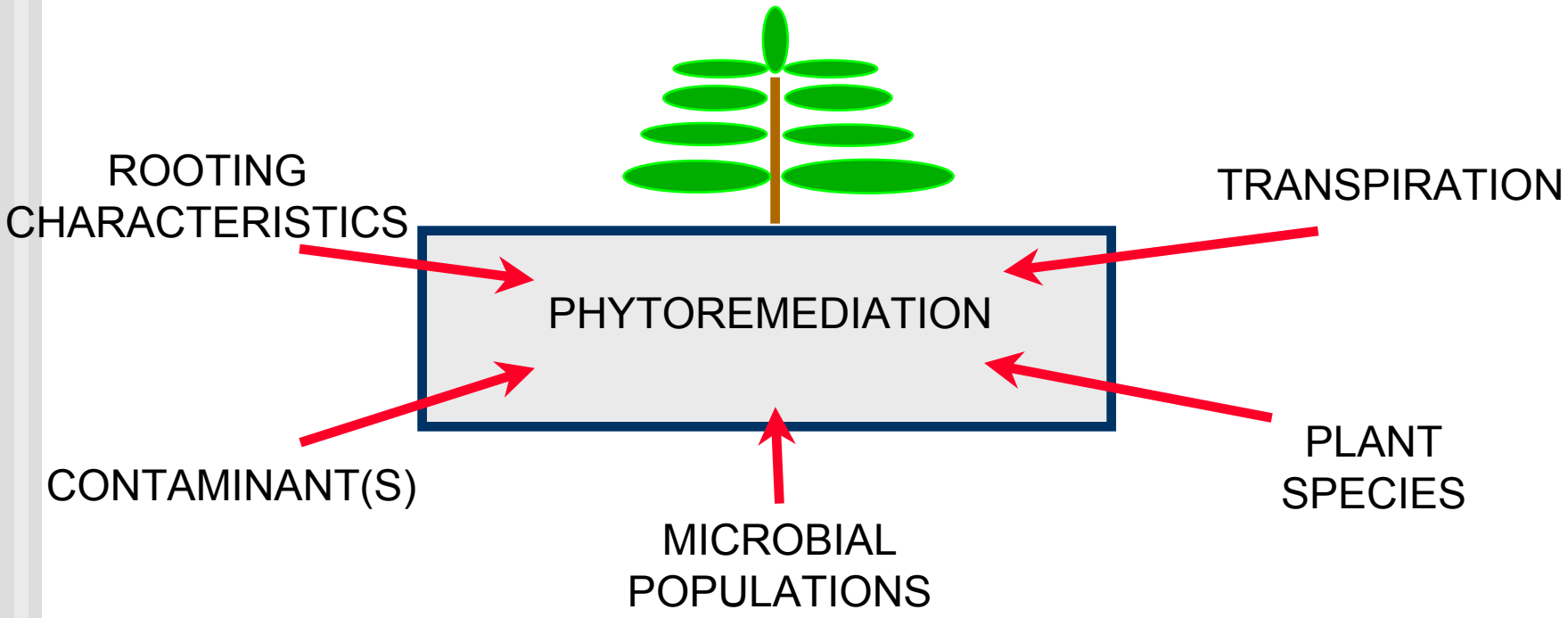
Phytoremediation Applications

- Phytoextraction – removal of contaminants from soils.
- Phytodegradation – plant degradation of contaminants after uptake.
- Phytoaccumulation – contaminant accumulation in above ground biomass.

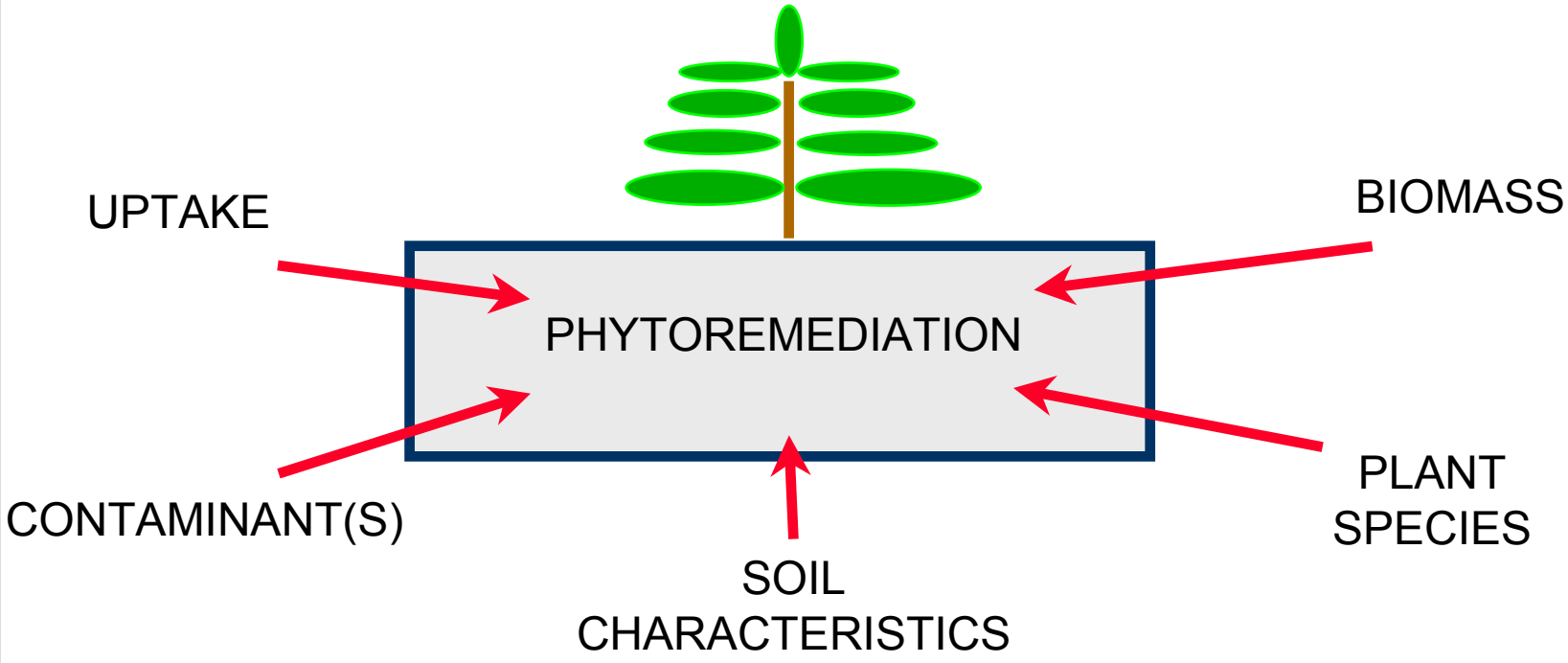
Phytoremediation Applications

- Rhizosphere Degradation – enhancement of rhizosphere microbial bioremediation.
- Groundwater Interception – plants with large water requirements reduce contaminated groundwater movement.
- Living Caps – Reduction of leachate in landfills.

Phytoremediation Processes Organic Contaminants



Phytoremediation Processes Heavy Metal Contaminants



Advantages

- Low-cost approach.
- Aesthetically pleasing and appealing to the public.
- Site use and remediation can occur simultaneously.

Disadvantages

- Long time period required for remediation.
- Unknown impact on ecosystems and bioavailability.
- Scientific understanding of mechanisms is limited.

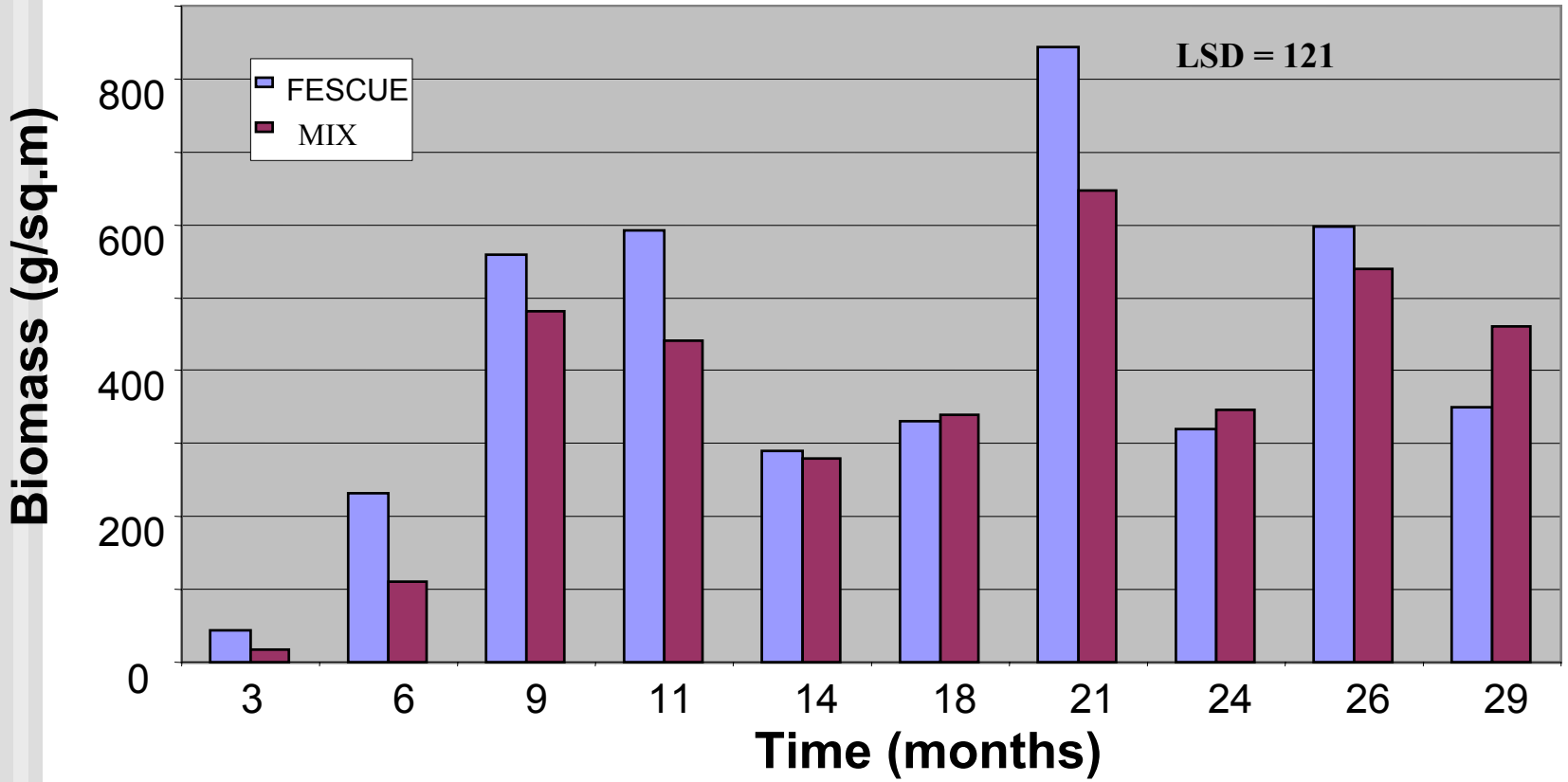
Field Sites

- ***Port Hueneme Site*** - Fuel oil contaminated soil located in test cells at a DoD National Test Site.
- ***Bedford Site*** - Manufactured gas plant site with high PAH contamination at depths of 3 to 6 feet.

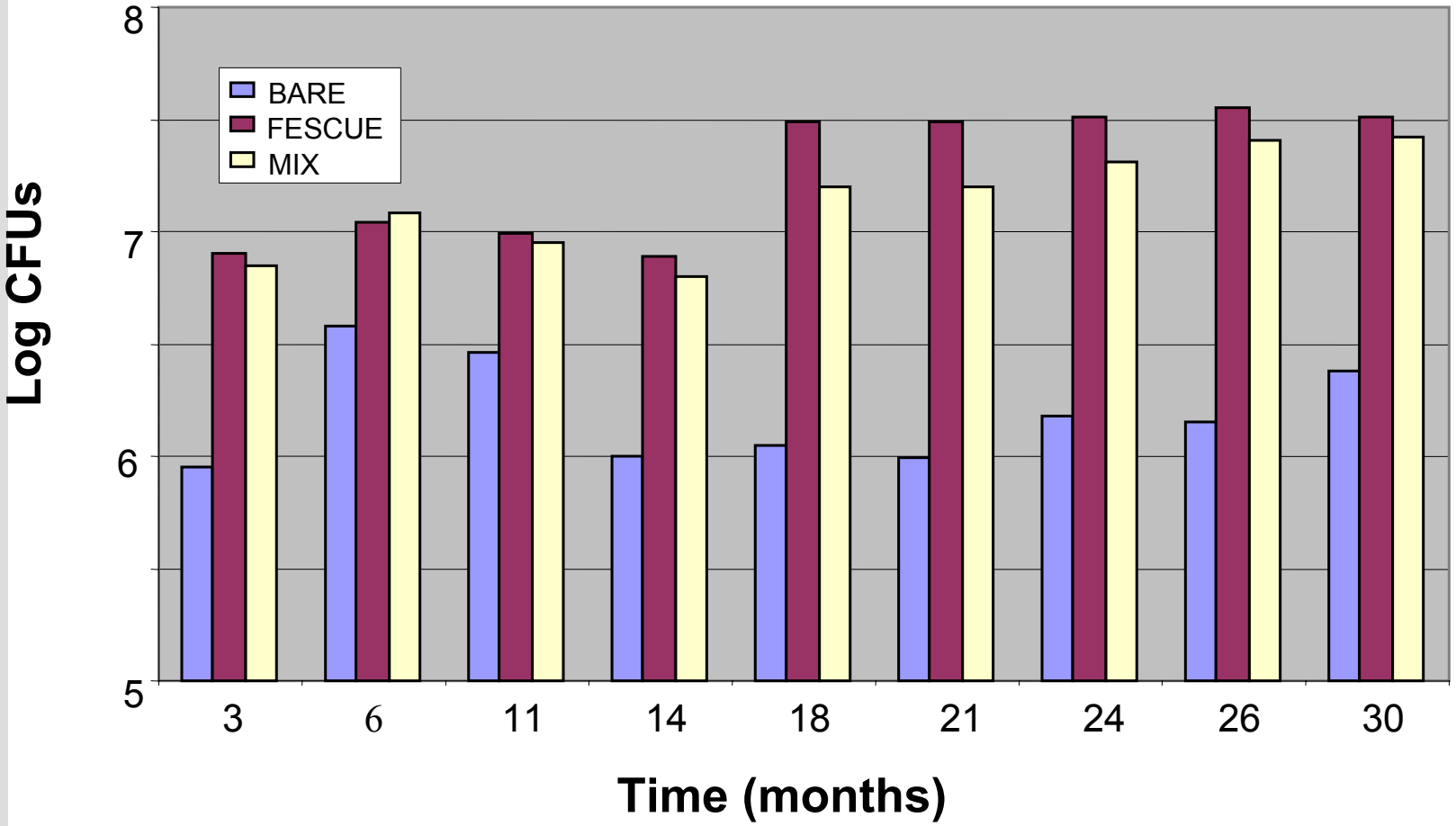
Port Hueneme Site (1997-2000)

- Site was located at the Port Hueneme DOD National Test Site.
- Study area consisted of 60’ x 100’ plots with three treatments and four replicates.
- Fertilizer and irrigation was used as needed.
- Soil samples were analyzed for petroleum contaminants, microbial characteristics, and toxicity for 30 months.

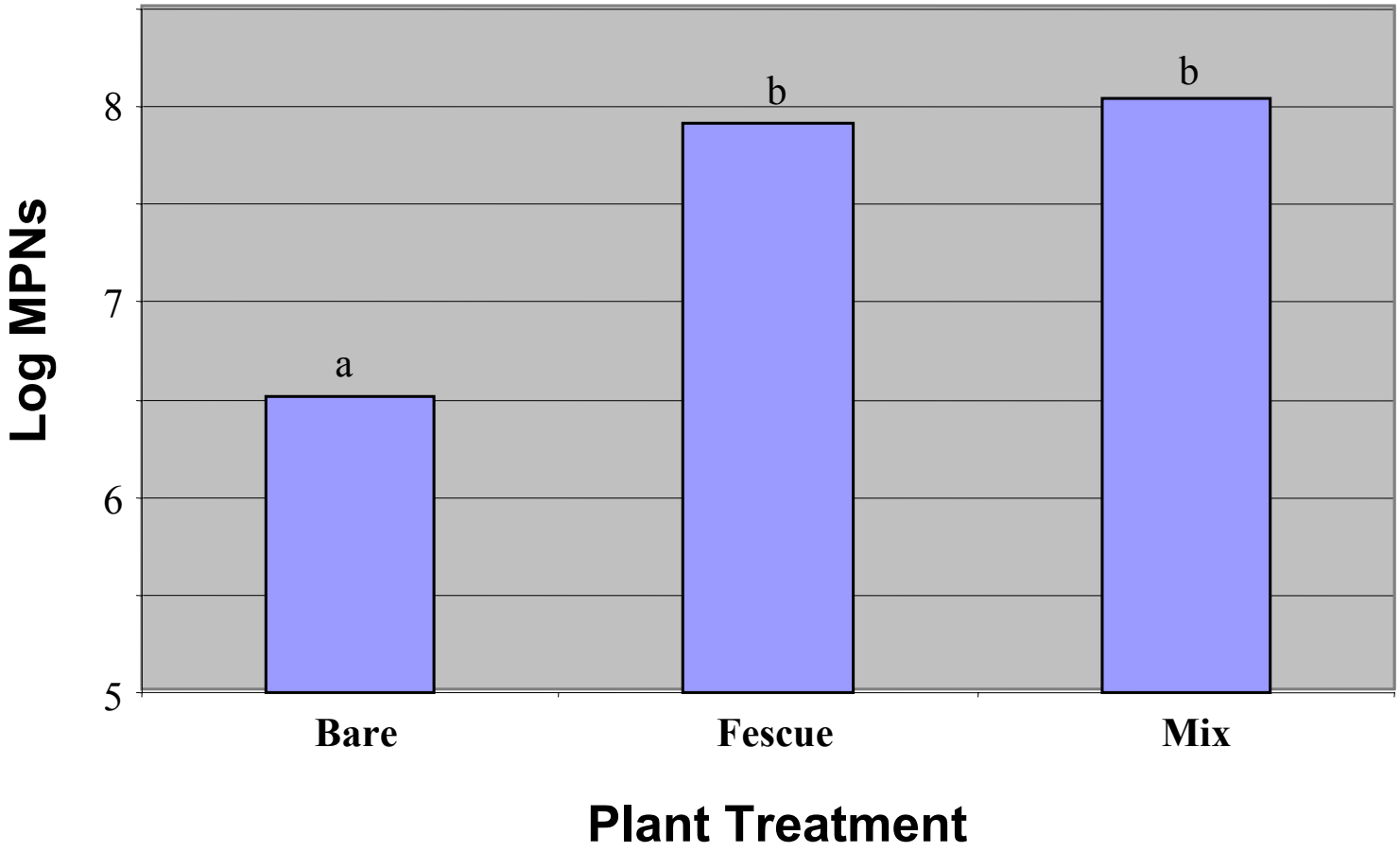
Above-Ground Biomass
Port Hueneme Site



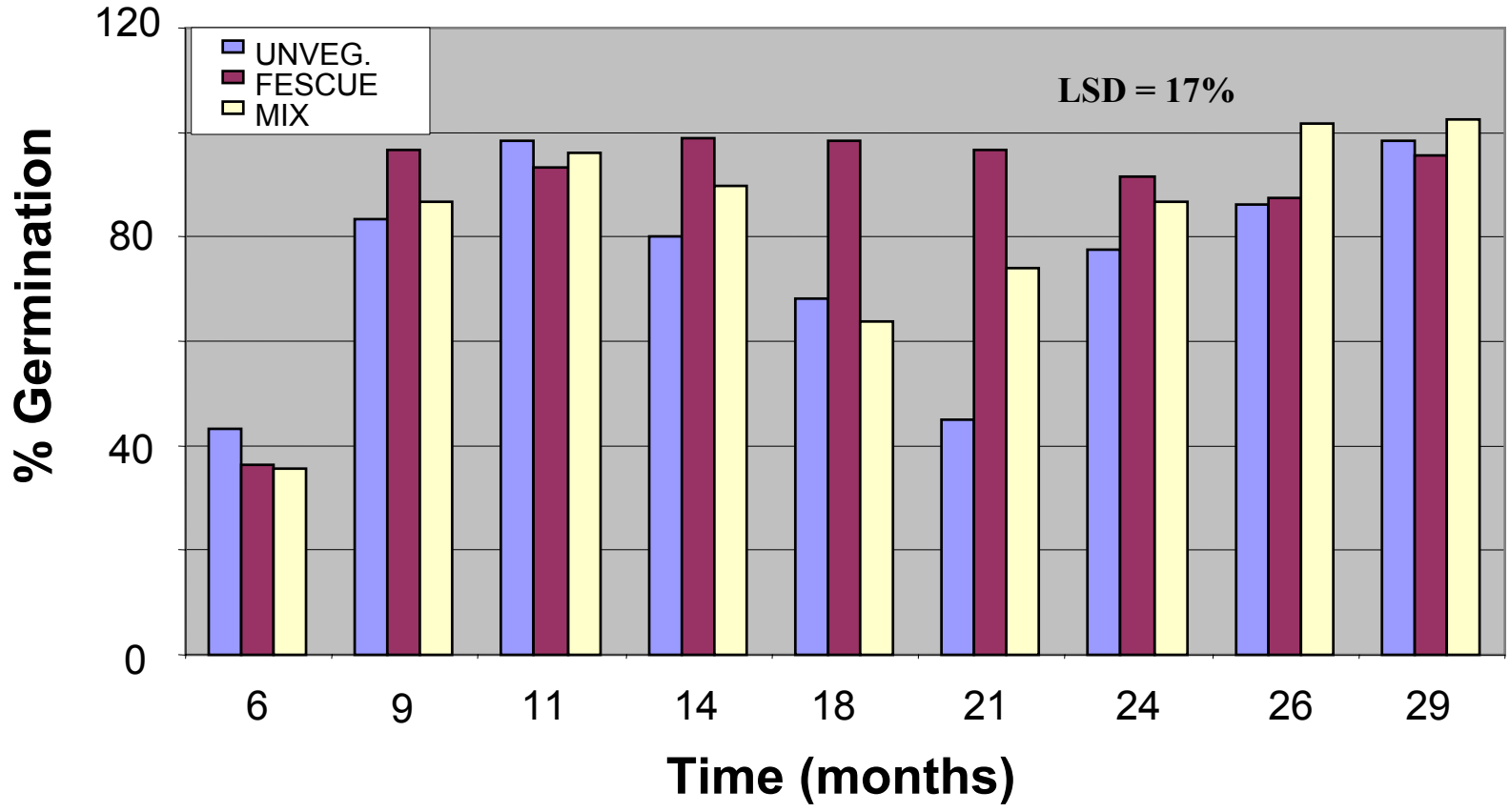
Microbial Analysis (Total Plate Counts) Port Hueneme Site



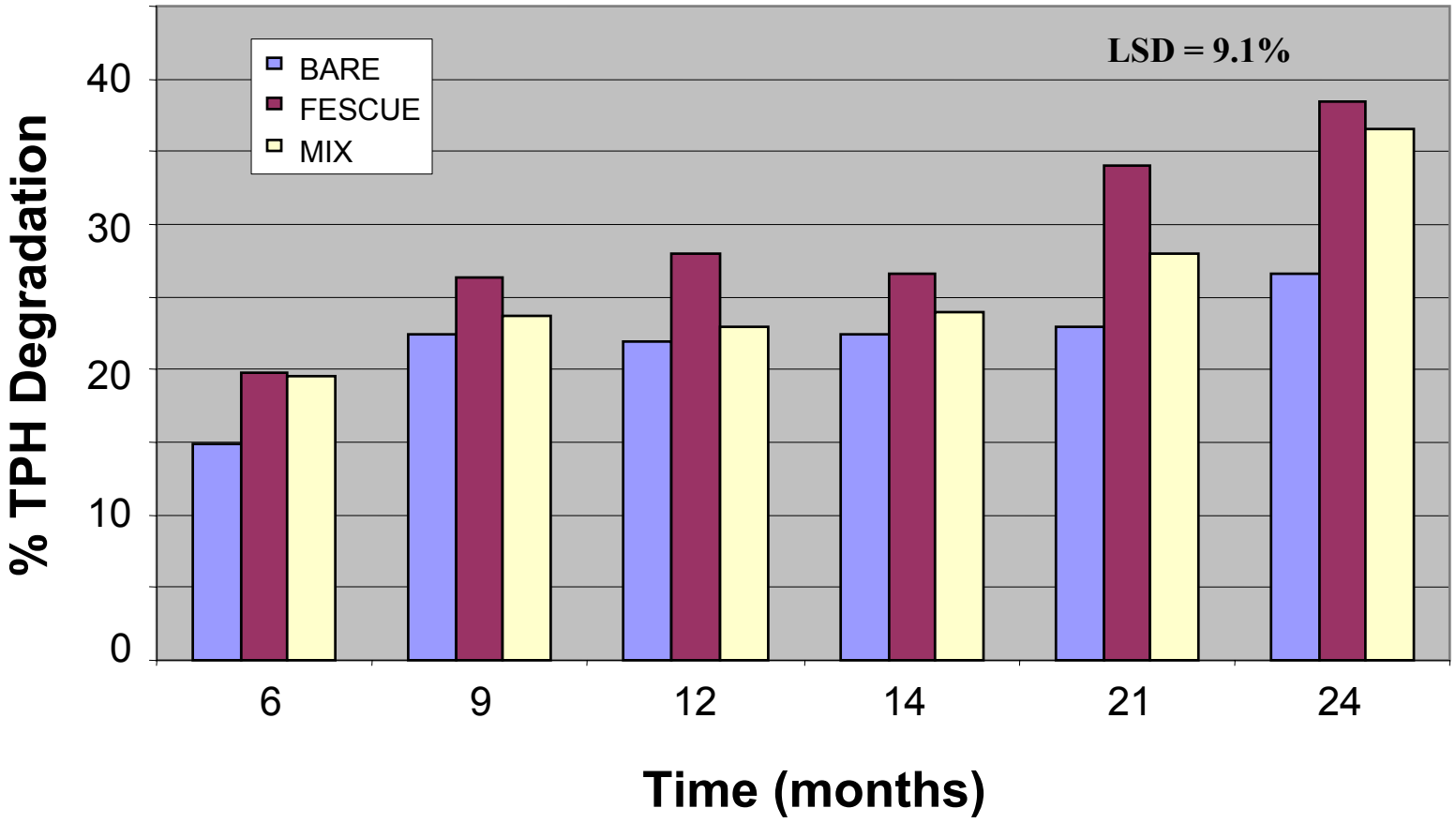
Microbial Analysis (Petroleum Degraders) Port Hueneme Site



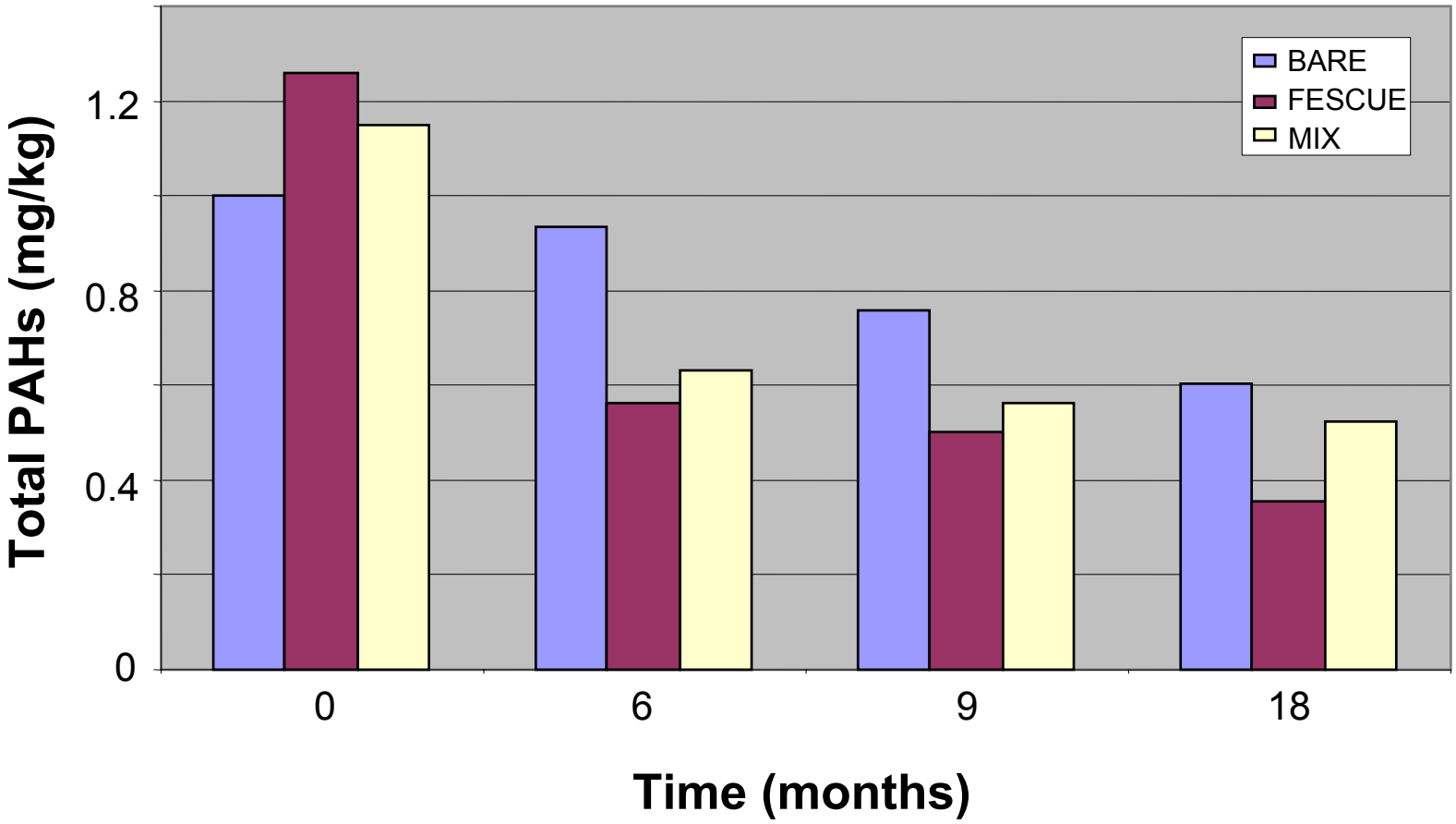
Toxicity Analysis (Germination)
Port Hueneme Site



TPH Degradation (%)
Port Hueneme Site



Contaminant Analysis (PAHs)
Port Hueneme Site



Bedford Site (1999-2002)

- MGP site with PAH contamination at depths between 3 and 6 feet.
- Two treatments are being compared; hybrid poplar/grass cover and natural attenuation.
- Fertilization and irrigation is used as needed.
- Soil from three depths are being analyzed for contaminant concentration, microbial characteristics, and toxicity over the three year study.


bobcat
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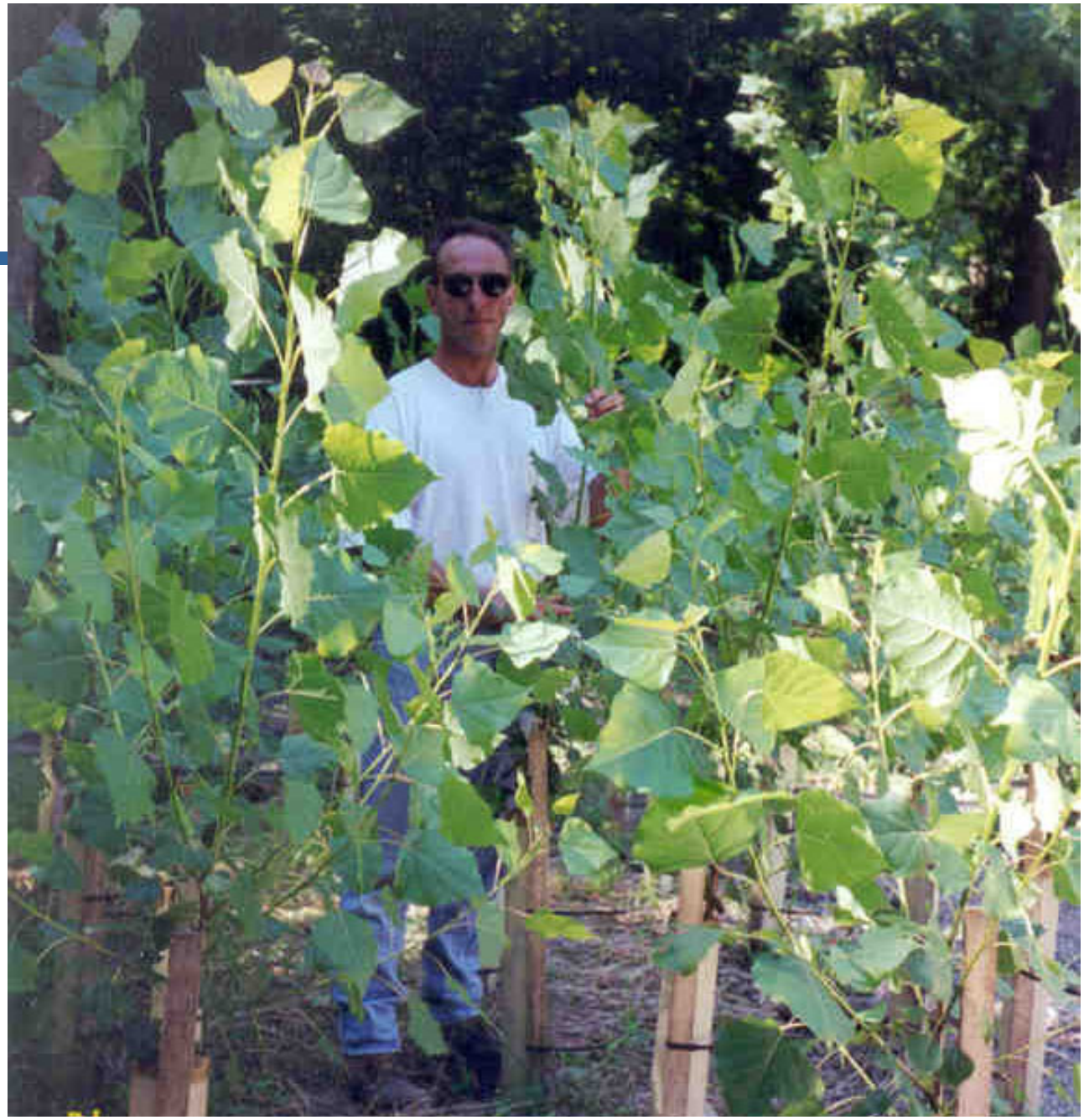
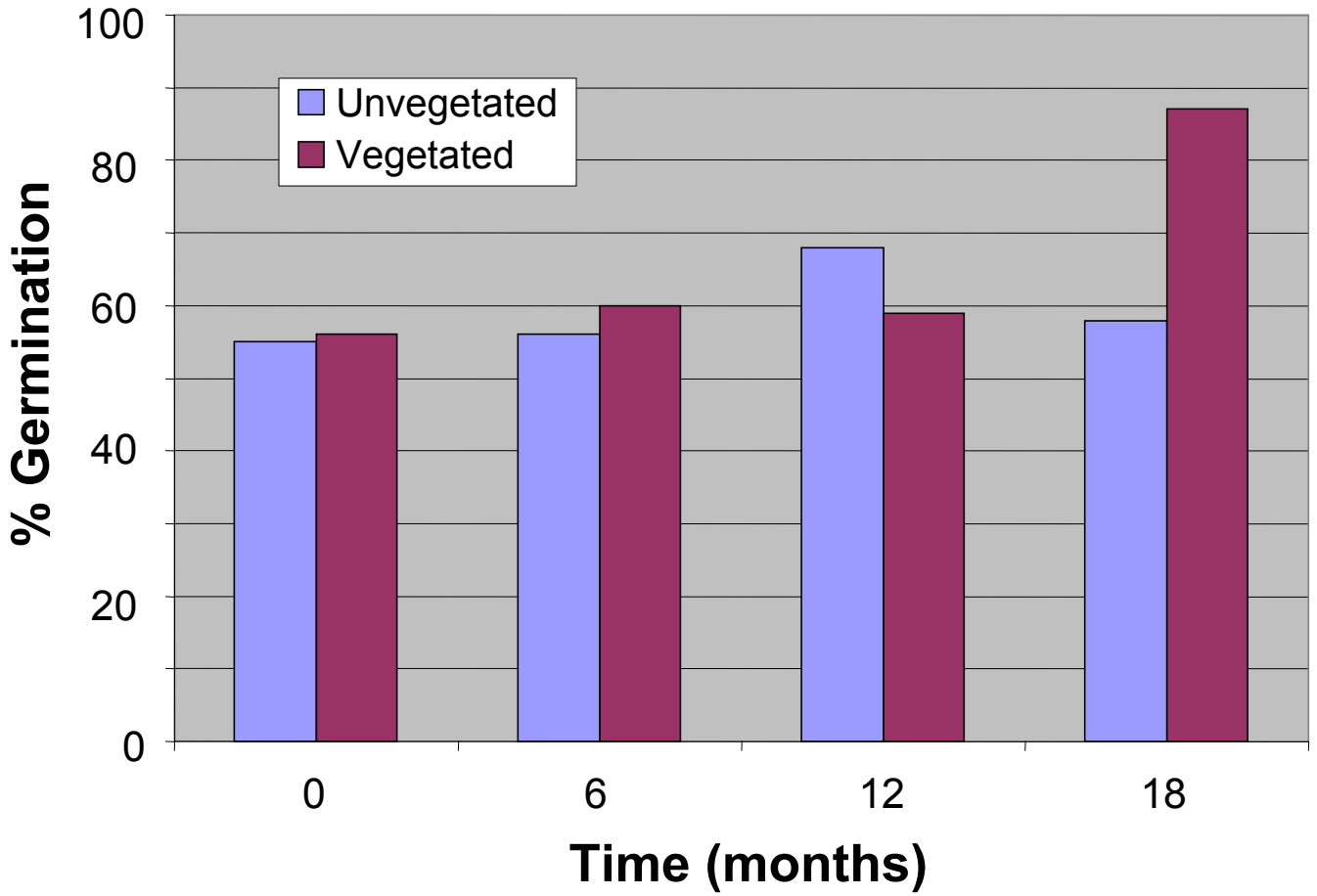
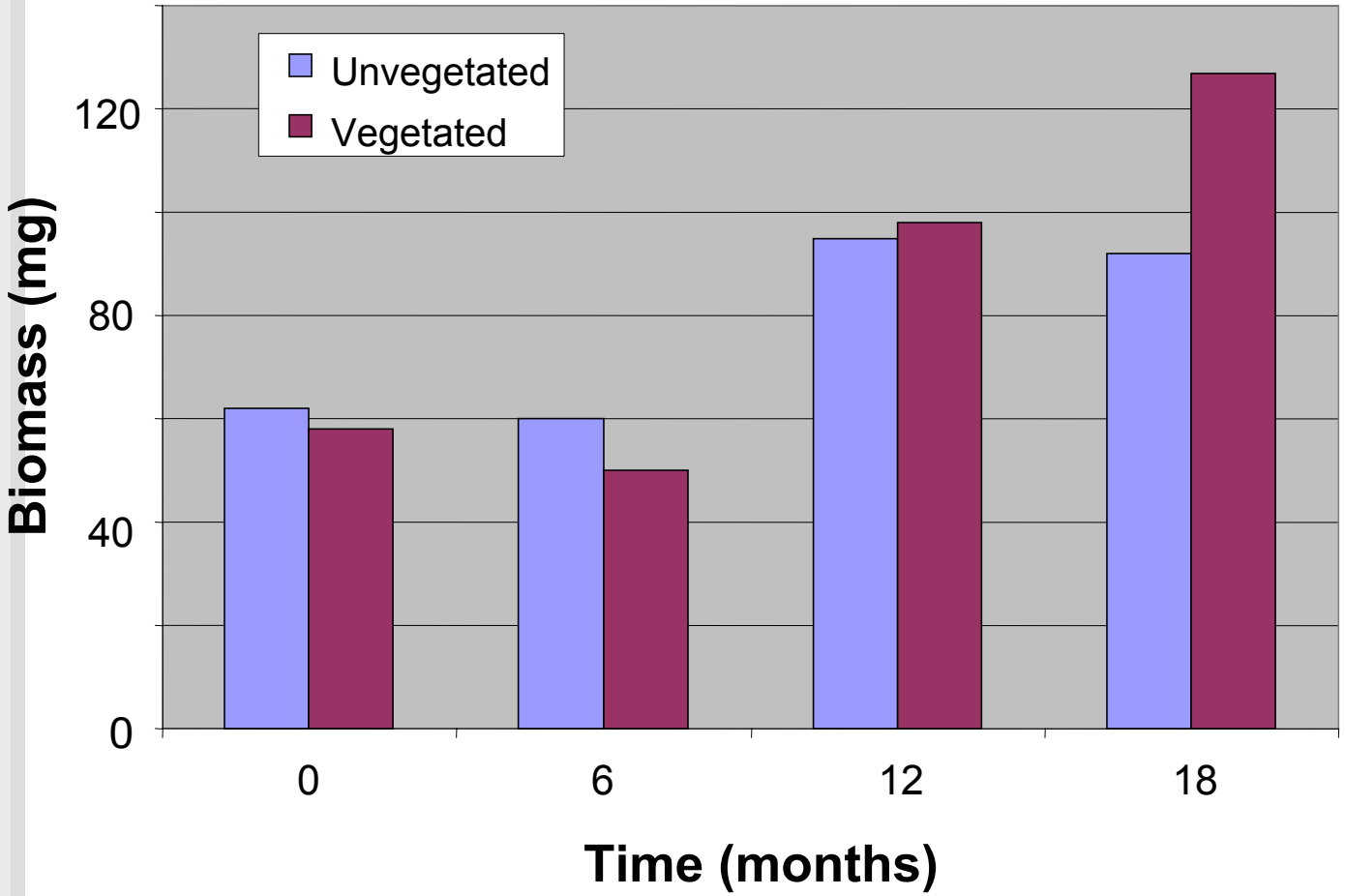


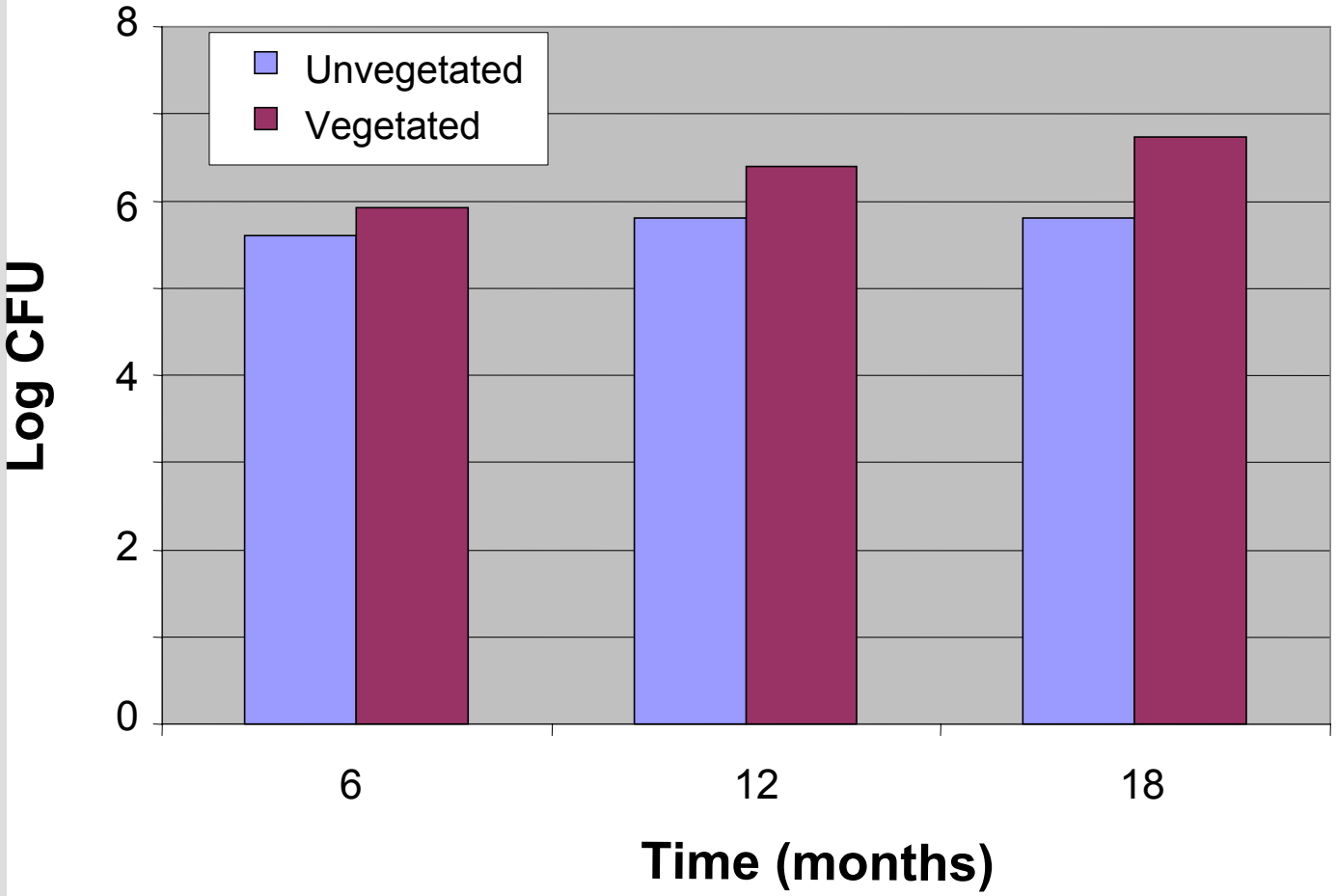
Toxicity Analysis (Germination) Bedford Site



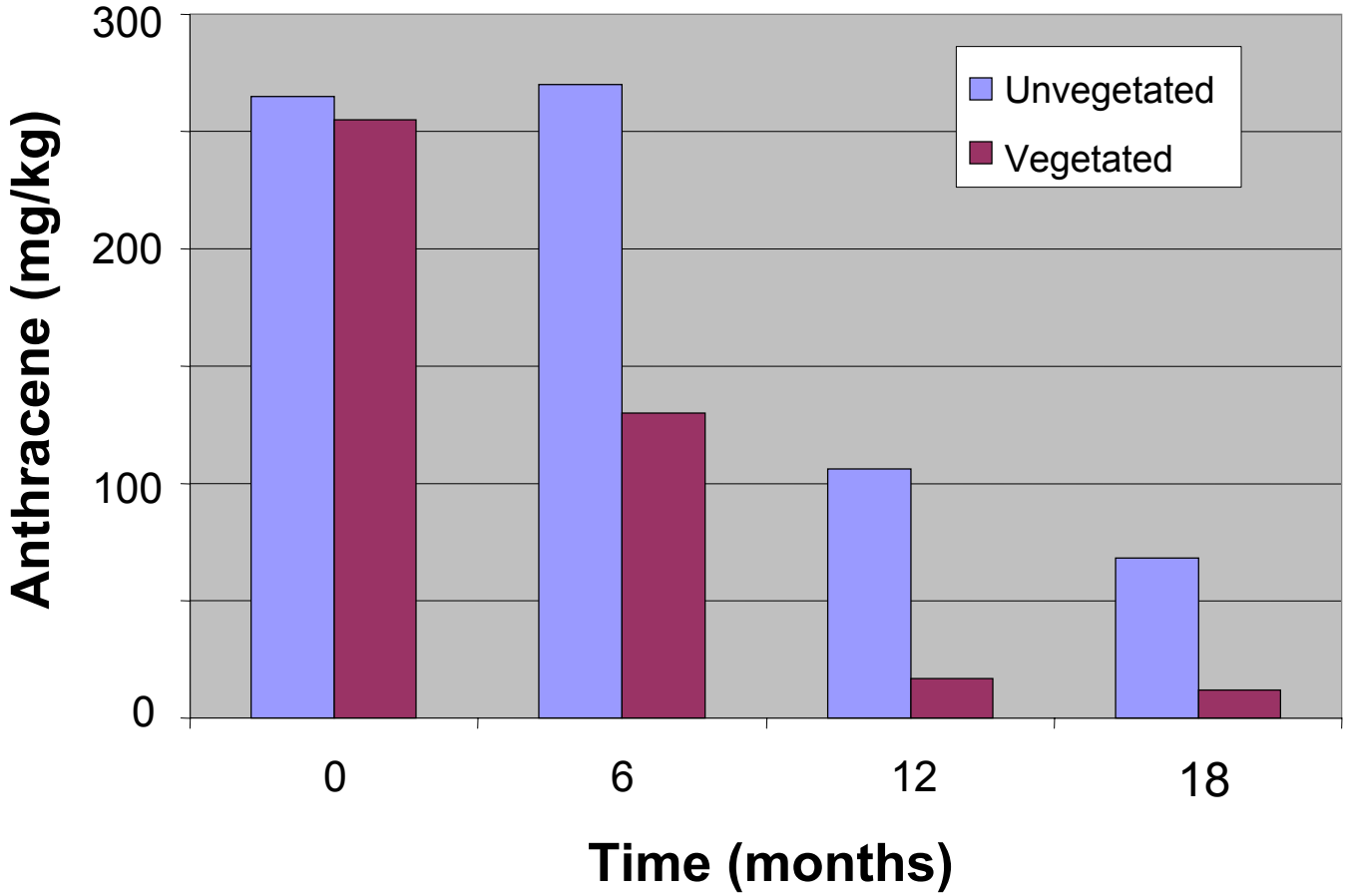
Toxicity Analysis (Earthworm) Bedford Site



Microbial Analysis (Petroleum Degraders) Bedford Site



Contaminant Analysis (PAHs) Bedford Site



Supporting Greenhouse Study
Bedford Site

- Soil cores were taken in the field and placed in the greenhouse.
- Trees (ash, poplar, and willow) were established in the columns with two takedowns (9 and 18 months).
- Water was added to the columns from the bottom to simulate field conditions.
- Contaminant concentrations, microbial characteristics, and toxicity was assessed.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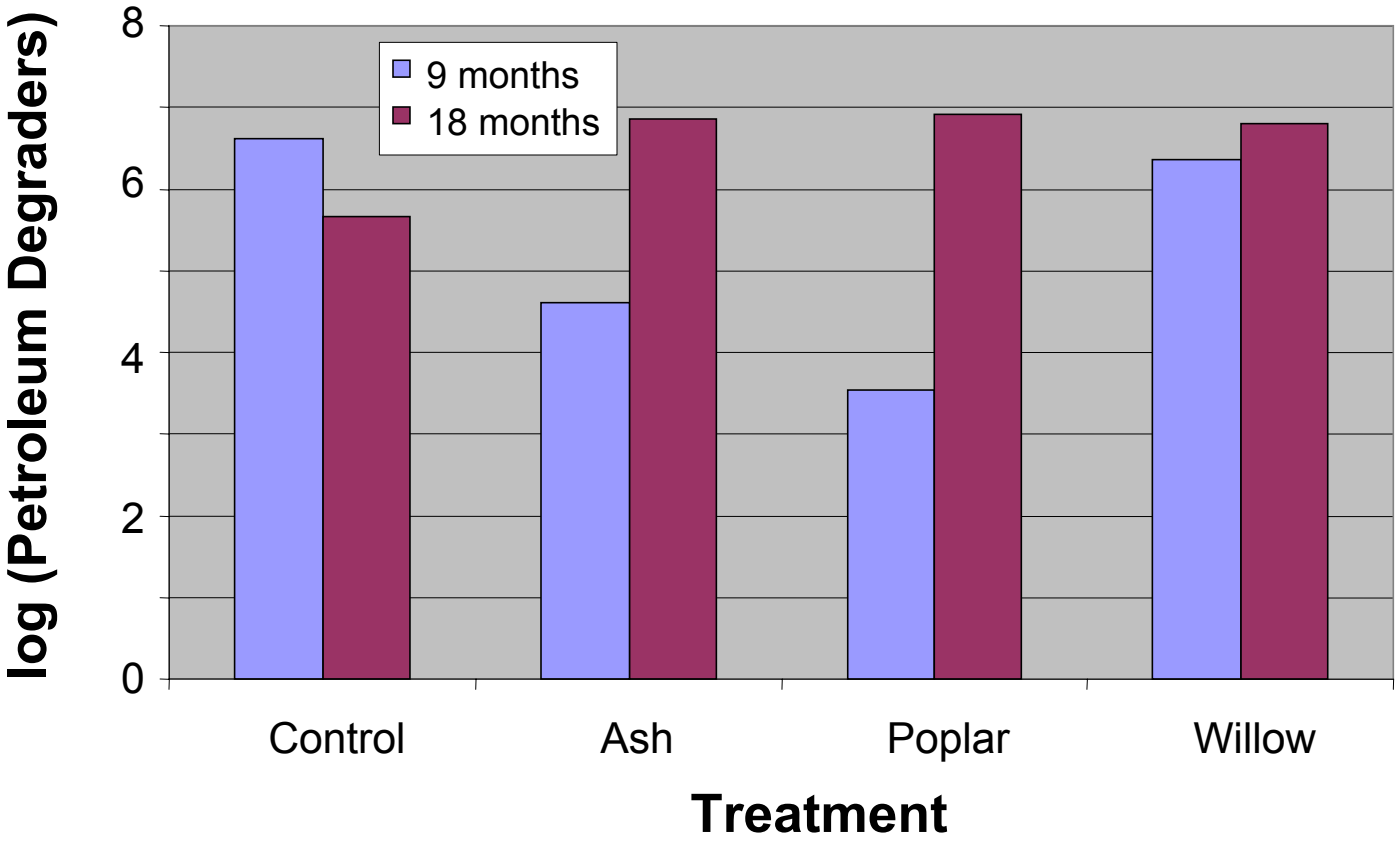
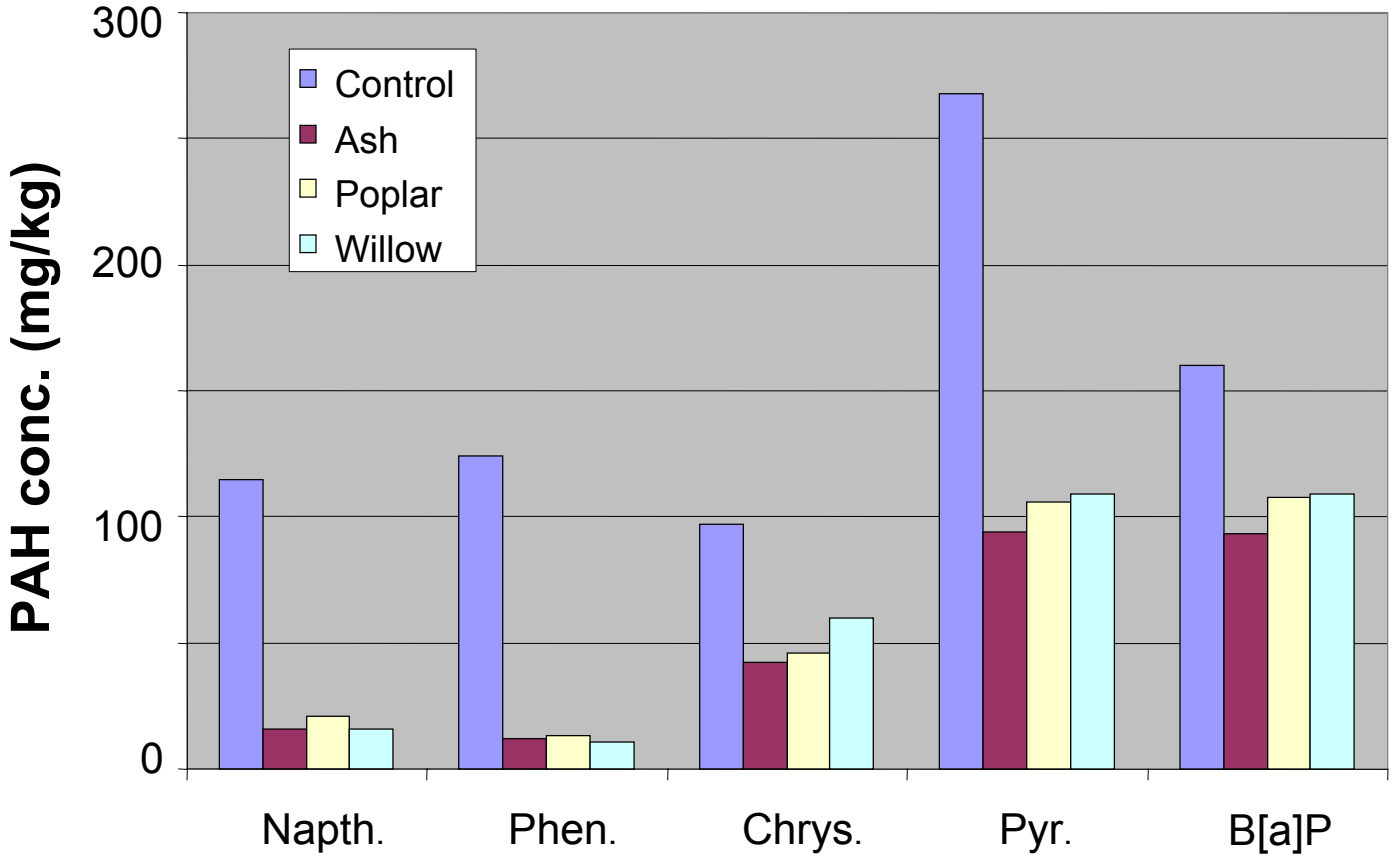
Microbial Analysis (Petroleum Degraders)
Bedford Greenhouse Study



Contaminant Analysis (PAHs)
Bedford Greenhouse Study



Summary and Outlook
Phytoremediation of Petroleum Contaminants

- Phytoremediation of petroleum contaminated soils has been successfully tested in the field.
- The impact of vegetation is related to the aging of the contaminants.
- Petroleum contaminated soil does not appear to be toxic to plants or invertebrates.
- PAH degradation parallels remediation of total petroleum hydrocarbons.
- The success of phytoremediation is closely related to the ability of roots to explore the soil.