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STUDY TITLE: Assessment of PAH Composition of Diesel Fuel Sorbed to Marine Sediments and Their Toxicity to Aquatic Food Webs

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BACKGROUND: Polycyclic aromatic hydrocarbons (PAH) are a highly toxic group of compounds present in crude oil and many petroleum products. Estuarine salt marshes are critical marine habitat because of their high productivity and importance as nursery grounds for many commercially important species. They are susceptible to chronic and/or catastrophic inputs of petroleum hydrocarbons, such as PAH, because of the physical and geochemical character of salt marshes. Seldom, however, are studies of biological effects able to predict subtle, long-lasting ecological effects, especially in regards to functional interactions among organisms and trophic levels. We report here a microcosm approach to study the impacts of PAH on benthic bacteria within a Louisiana salt marsh.

OBJECTIVES: Our goal was to determine the influence of sublethal exposure to sediment-bound PAH on the physiological condition, activity, and abundance of sedimentary bacteria.

DESCRIPTION: The microcosm experiment portion was carried out at the LUMCON Marine Education Center in Cocodrie, LA. The benthic community used in the microcosm experiment was obtained from a shallow creek-fed pond in the Terrebone Bay estuary (29°15'N:91°21'W) adjacent to the LUMCON facility. Microcosms consisted of intact sediment samples that were collected by gently pushing 15.2 cm i.d. PVC pipe into marsh mud exposed at low tide. A base was placed on the microcosm, which was then transferred to the LUMCON facility and placed in one of four wet tables. Windows were cut in the side of microcosms and covered with Nitex mesh (62-µm) to allow exchange of water (but not meiofauna). Microcosms were placed in wet tables and irrigated with water pumped directly from the marsh near the LUMCON facility and illuminated with banks of fluorescent lights. Microcosms were treated with three levels of diesel-contaminated sediment. Uncontaminated sediment only was added to an additional set of microcosms and served as an "application control", *i.e.*, a control for the process of adding contaminants to microcosms.

SIGNIFICANT CONCLUSIONS: Rapid removal of PAH by bacteria suggests that even if the marsh were exposed to chronically high levels of petroleum hydrocarbons, chemical evidence of the contaminants would not be detected in sediments. Collectively, these results are consistent with the hypothesis that the bacterial community in this salt marsh has adapted to chronic exposure to petroleum hydrocarbons.

STUDY RESULT(S): Diesel contaminants in microcosms as determined from polycyclic aromatic hydrocarbon (PAH) concentration ranged from 0.55 to 55 ppm (dry weight). Bacterial metabolism (incorporation of ^{14}C-acetate and ^{3}H-leucine) and bacterial abundance were not affected by diesel-contaminated sediment at any concentration. Bacterial degradation of ^{14}C-phenanthrene, however, increased in direct proportion to the amount of diesel-contaminated sediment added. Ambient sediment also exhibited significant capacity to degrade PAH. The half life of phenanthrene (based on ^{14}C-phenanthrene-degradation experiments) ranged from 137 days in ambient sediments to 4.5 days in sediment chronically exposed to high levels of diesel-contaminated sediments for 28 days. Two- and three-ring PAH, including naphthalenes, phenanthrenes, and dibenzothiophenes constituted the bulk of PAH composition of diesel and were rapidly metabolized. Alkylated PAH were also readily metabolized. The rapid removal of PAH suggests that even if the marsh were exposed to chronically high levels of petroleum hydrocarbons, chemical evidence of the contaminants would not be detected in sediments. Collectively, these results are consistent with the hypothesis that the bacterial community in this salt marsh has adapted to chronic exposure to petroleum hydrocarbons.

STUDY PRODUCT: Carman, K.R and J.C. Means. 1998. Assessment of PAH composition of diesel fuel sorbed to marine sediments and their toxicity to aquatic food webs. OCS Study MMS 98-0057. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana, 34 pp.

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