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**ANALYSIS AND FATE OF SEWAGE-DERIVED POLAR ORGANIC
CONTAMINANTS IN THE COASTAL MARINE ENVIRONMENT**

A Dissertation Presented

by

Patrick Lee Ferguson

to

The Graduate School

in Partial Fulfillment of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

in

Coastal Oceanography

Stony Brook University

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Abstract of the dissertation

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Detailed studies of the distribution and fate of many potentially estrogenic, sewage-derived contaminants in the environment have been hampered by the limited sensitivity, selectivity, or applicability of routinely available analytical techniques. In this work, I have developed highly specific analytical approaches, based on HPLC with electrospray mass spectrometry detection, for determining alkylphenol ethoxylate surfactants (APEOs) and their metabolites, as well as steroid estrogens, in environmental matrixes such as wastewater, receiving waters, and sediments.

The developed methods were applied to detailed studies of the environmental fate and transport of APEOs in Jamaica Bay, NY, a heavily sewage-impacted U.S. estuary.

Results indicated that nonylphenol ethoxylate (NPEO) and octylphenol ethoxylate (OPEO) metabolites were present in sediments throughout the bay, although the concentrations varied according to organic carbon content of the sediments and proximity to wastewater treatment plant outfalls. Chlorinated and brominated nonylphenol were identified as wastewater-disinfection byproducts in many sediments throughout the Bay. Biodegradation of APEOs in surface water and sorption to suspended particulate matter were important removal mechanisms for these compounds in estuarine water.

Analysis of dated sediment cores taken from a highly depositional basin within Jamaica Bay proximal to a major wastewater treatment plant revealed that NPEO concentrations and ethoxymers distribution patterns in dated sections of the cores were reflective of use patterns of these compounds in the United States over time as well as changes in wastewater treatment technologies. Importantly, examination of NPEO concentrations and ethoxymers distributions in matched cores from Jamaica Bay indicated that these compounds may persist relatively unaltered over decade time scales in deep estuarine sediments under anoxic conditions.

Finally, the pathways and relative rates of NPEO degradation in oxic and anoxic estuarine sediment were examined in laboratory experiments using radiolabeled NPEOs to effectively track degradation products in sediment slurry bottles. Results indicated that NPEOs were more persistent in sediments under anaerobic conditions than in the presence of oxygen. In addition, it was illustrated that NPEO degradation proceeded via separate pathways in oxic and anoxic sediment.