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APPLICATION OF DISSOLVED ORGANIC MATTER FLUORESCENCE TO MONITOR BALLAST WATER EXCHANGE COMPLIANCE IN COMMERCIAL VESSELS

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Commercial shipping traffic has historically traded ballast tank water between destination ports and coastal environments during routine ship operations, thereby providing unintended transport for any entrained aquatic species. Unregulated ballast tank discharge provides repeated ecosystem exposure to non-native coastal adapted organisms and their propagules, some of which successfully establish new populations to local economic and ecological detriment. Nationally the United States Coast Guard (USCG) now monitors ballast water discharge for shipping traffic, mandating open ocean ballast water exchange (BWE) to treat ballast tanks in vessels arriving from outside of the United States exclusive economic zone. By trading port ballast for open ocean water, BWE aims to reduce the release of non-native organisms in coastal environments.

Current USCG monitoring of BWE compliance utilizes salinity measurements of ballast tank water, and is not universally applicable. Recently an alternative “chemical tracer” approach has been advanced, based on the premise that concentrations for selected tracers in port, coastal and ocean waters are distinguishable across all seasons. The fluorescence characteristics of seawater are well suited to identify water sources from a variety of environments, and the optical character and intensity of dissolved organic matter (DOM) has been explored as a more sophisticated tracer for the origin of ballast water. DOM is strongly influenced by biotic and abiotic input and removal processes tied to ecosystem structure and terrestrial forcing. Results from detailed surveys of DOM fluorescence in ports, coastal and offshore marine systems demonstrate distinctive features in these disparate environments. We build from these data to propose a novel but practical ecosystem-based approach incorporating handheld instrumentation and associated background data needed to achieve the projected verification requirements of the U.S. Coast Guard.