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ScienceDirect
Marine Pollution Bulletin 54 (2007) 9–21
MARINE POLLUTION BULLETIN
www.elsevier.com/locate/marpolbul

Focus

Sediment quality of the Lower St. Johns River, Florida: An integrative assessment of benthic fauna, sediment-associated stressors, and general habitat characteristics

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Abstract

Sediment quality of the lower St. Johns River (LSJR) estuary, Florida was evaluated using synoptic data on benthic community structure, levels of potential stressors (chemical contaminants, ammonia and sulfide), and other basic habitat characteristics (depth, dissolved oxygen, salinity, temperature) collected at seven stations, three times a year from July 2000–July 2002. Un-ionized ammonia and hydrogen sulfide were detected at toxic levels on at least one sampling occasion at four stations. Chemical contamination of sediment at probable bioeffect levels also was observed at four stations. Concentrations of pesticides or other chemical substances typically associated with human activities (e.g., PCBs) were detectable at all stations, though not always present at concentrations likely of causing significant bioeffects. A total of 251 taxa and 9783 individuals were identified and enumerated from the benthic infaunal samples. Polychaete worms and molluscs dominated the benthic fauna at all seven stations. The opportunistic and pollution-tolerant polychaete *Streblospio benedicti* was the most abundant species overall (from all samples combined), appearing as a dominant at five of the seven stations. Overall, the sites sampled as part of this study indicate a highly stressed benthos resulting from multiple anthropogenic impacts.
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Keywords: Benthos; Sediment quality; Porewater ammonia and sulfide; Chemical contamination; St. Johns River Florida

1. Introduction

In July 2000, a comprehensive two-year monitoring program was initiated to evaluate potential relationships between water and sediment quality, occurrences of harmful algal blooms (HABs), and the incidence of fish diseases and other biological impacts in the lower St. Johns River (LSJR) estuary, Florida (Landsberg et al., 2004). The overall program included a benthic monitoring component, which incorporated the analysis of chemical contaminants and other sediment-associated stressors (e.g., ammonia, sulfide) as a basis for evaluating the significance of HAB events in light of other potential multiple-stressor inputs and corresponding biological impacts. The soft-bottom benthos is a key component of coastal ecosystems, playing vital roles in detrital decomposition, nutrient cycling, and energy flow to higher trophic levels. Moreover, because of their relatively stationary existence within the sediments, benthic infauna can serve as reliable indicators of potential environmental disturbances such as chemical contamination, eutrophication, and physical disturbances (Gray, 1979; Pearson and Rosenberg, 1978).

The northward flowing St. John's River, located in the northeastern section of Florida, serves as a major transportation route to the city of Jacksonville and its deepwater ports, has two major US Navy installations located along it, and supports large commercial and sport-fishing industries. This river system was designated in 1998 as an American Heritage River, one of only 14 such rivers in the United States. The LSJR is the estuarine portion of the

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0025-326X/$ - see front matter Published by Elsevier Ltd.
doi:10.1016/j.marpolbul.2006.09.007

river and is best described as a coastal plain, riverine estuary with an area of 684 km^2 and an average depth of 3.4 m (Dame et al., 2000). The LSJR is subject to a multitude of potential environmental stressors from a variety of sources including shipping, marinas, commercial shipbuilding and repair, military bases, pulp and paper manufacturing, petroleum storage facilities, power generation, commercial and recreational fishing, urban and high-density residential development, and water-based recreation. The river also supports numerous agricultural activities throughout its watershed and includes several EPA-designated Superfund sites.

Previous published work on sediment quality of the LSJR has been limited. Mason (1998) reported on the macrobenthos of the LSJR, but the study was limited to the oligohaline portion of the river and did not include measures of sediment contamination. McRae et al. (1998), in their analysis of benthic infaunal community structure in relation to environmental variables throughout Florida estuaries, included data from two stations within the LSJR. Ouyang et al. (2002) also reported on heavy metal contamination in the Cedar and Ortega rivers, a sub-basin of the LSJR. More extensive information is available in technical reports through the St. John's River Water Management District, but the majority of benthic information is still limited to less saline areas south of the city of Jacksonville (Durell et al., 2004a,b; Evans and Higman, 2001; Winkler and Ceric, 2004).

In the present paper, we use data collected three times a year, from July 2000 to 2002, at seven stations within oligohaline to euhaline portions of the LSJR to evaluate current status in the ecological condition of this important estuarine system and to provide a baseline for identifying future trends. Condition is assessed from the perspective of sediment quality, based on combined measures of benthic infaunal community structure, levels of chemical contaminants and other sediment-associated stressors (ammonia and sulfide), and other natural environmental controlling factors (salinity, dissolved oxygen, depth, sediment grain size). The repeated sampling of these sites also provides a basis for examining temporal variability in the various measured indicators and thus evaluating potential pollution-induced degradation of the benthos relative to natural background variability.

2. Methods

Benthic samples were collected three times a year over a two-year period at each of seven fixed monitoring stations (Fig. 1). Sampling occasions were as follows: July 2000, December 2000, March 2001, July 2001, November 2001, March 2002, and July 2002. Samples were collected for

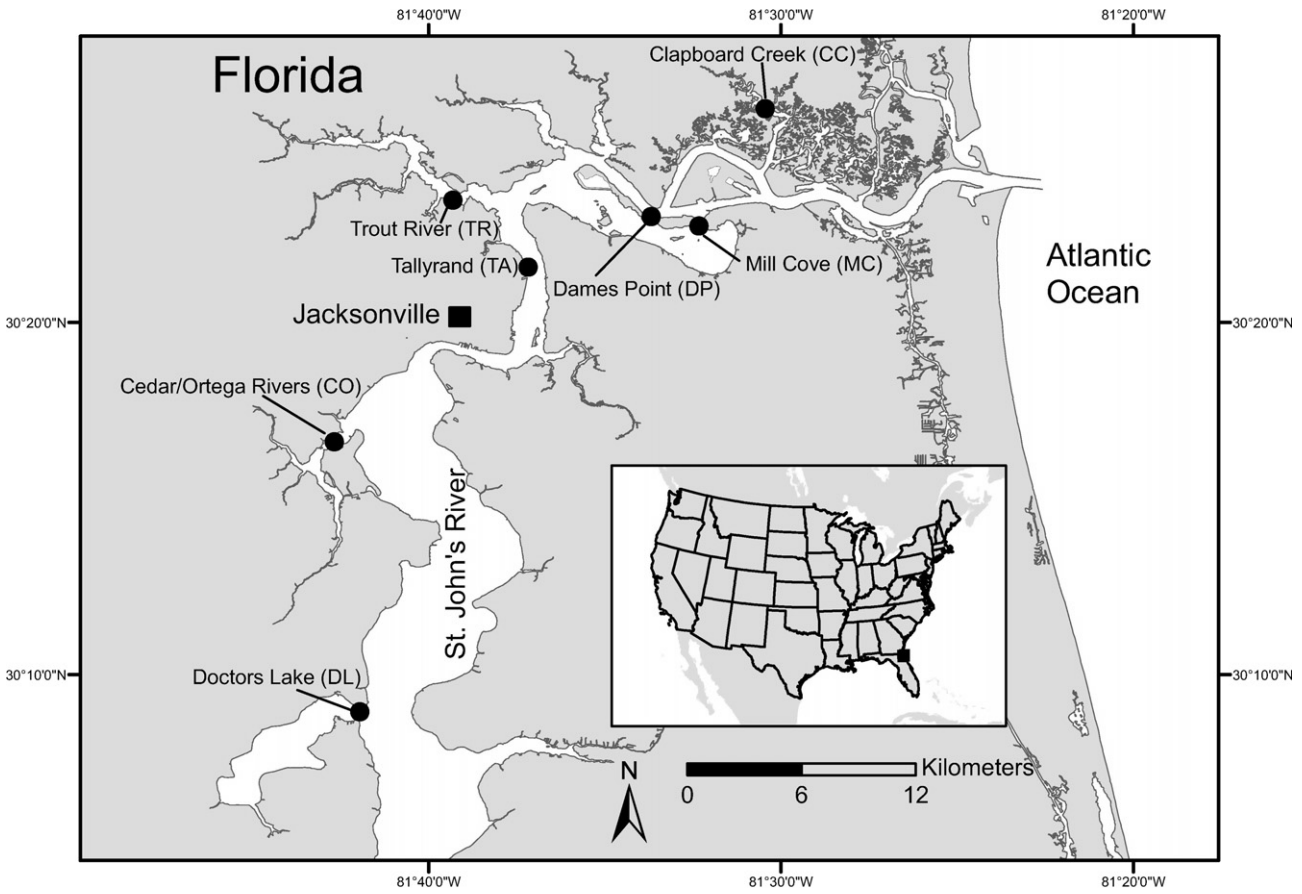

Fig. 1. Study area showing location of stations sampled within the LSJR July 2000–July 2002.