An applied paleolimnological assessment of anthropogenic impact in a back-barrier lagoon: Pictou Landing, Nova Scotia, Canada*

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An applied paleolimnological assessment of environmental impact was carried out on a back-barrier lagoon – Sitmu'k, also called Moodies Cove – that is recreationally and culturally important to the nearby community of Pictou Landing First Nation. Since the 1880s the region has experienced significant industrial impact; more recently, local residential development has taken place. There has been concern over water quality degradation at the site over the past 50 years. In our study, the paleolimnological method was used to investigate environmental change in the lagoon. Issues identified include degraded water quality and the potential environmental legacy of local and regional industrial activity.

Sediment gravity cores were collected from 8 locations within Sitmu'k. A high resolution (0.5 cm interval) bulk geochemical analysis of one sediment core was conducted using X-ray fluorescence (XRF) to determine elemental concentrations; total Carbon (C), total Nitrogen (N), and stable isotope analyses ($\delta^{13}C$, $\delta^{15}N$) were also employed, as well as top-bottom analyses on cores throughout the basin. The data from Sitmu'k was then compared to paleolimnological data from nearby reference sites (Fergusons Cove, Chance Harbour Estuary, and Boat Harbour Estuary). C/N isotope data indicate that carbon input at Sitmu'k is primarily from marine sources, whereas XRF analyses indicate that metal concentrations (Pb, Cu, Zn) do not exceed marine interim sediment quality guidelines (ISQGs). All metal content data were at or below reference site averages. A limnological survey of the site in 2018 indicated a gradual and consistent increase over the summer in temperature (max 31.79 °C) and total coliforms, nitrate (>1.6mg/L) and total phosphorus (>0.59 mg/l) levels, placing the lagoon in a eutrophic to hypereutrophic state. Elevated $\delta^{15}N$ levels (compared to reference sites) in top-of-core samples throughout Sitmu'k indicate the potential influence of local septic system discharge. Air photo and satellite imagery indicate significant landward migration (>50 m) of the barrier beach (Lighthouse Beach) in the last 15 years. Sediment redistribution from the beach into Sitmu'k has resulted in shallowing and circulation constriction resulting in higher water temperatures, limited circulation, and elevated nutrient and coliform levels.

Collectively, the data suggest that a legacy of past industrial activity is not present at the site. Water quality degradation noted over the past 50 years can be attributed to both the rapid natural landward migration of the barrier-beach complex and the impact of increased local residential development, which may be significant and warrants further, longer-term investigation.

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