

A multibiomarker approach on the Atlantic tomcod (*Microgadus tomcod*) in the St. Lawrence Estuary

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Abstract A multibiomarker approach was developed on juvenile Atlantic tomcod (*Microgadus tomcod*) to evaluate the pertinence of this approach for low-cost screening assessment of the environmental quality of various coastal sites within estuaries. Several biometric indices and biomarkers (ethoxyresorufin-*O*-deethylase (EROD) activity, metallothionein concentration, and immune responses) were investigated on immature and maturing tomcods (≤ 31 months) collected in four environmentally contrasted sites in the St. Lawrence Estuary (SLE). Simultaneous examination of various age classes provides the opportunity to detect short-term responses in sensitive young-of-the-year fish (e.g., EROD induction) and longer-time effects associated with chronic exposure and bioaccumulation (e.g., metallothionein induction). Principal component analysis was helpful to discriminate between responses possibly related to contaminant exposure (EROD, metallothionein) and responses that could be affected by upstream–downstream gradient (immune response, biometric indices). Measurement of a battery of biomarkers in young tomcods at several sites along the shore of the SLE is a low-cost screening

investigation useful to identify hot spots requiring further investigation with chemical analysis and additional reference sites.

Keywords Biometric indexes · EROD · Metallothionein · Immunotoxicity · Pollution · Fish

Introduction

Smith et al. (1979) had detected a high prevalence of hepatocellular carcinomas for the Atlantic tomcod (*Microgadus tomcod*) in Hudson River (USA), possibly related to elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) and halogenated aromatic hydrocarbons (HAHs) such as polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-*p*-dioxins/furans. During the next 40 years, the Atlantic tomcod has been considered as a candidate species to monitor the quality of estuarine waters in Canada (Couillard 2009), whereas resistance to HAHs and susceptibility to PAHs were demonstrated for the Hudson River's tomcod population