

# Organic Enrichment at Cold Water Aquaculture Sites—the Case of Coastal Newfoundland

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**Abstract** Benthic organic matter (OM) enrichment is a frequent environmental effect of coastal aquaculture. There is a need for simple, general methods of predicting and monitoring such effects. One approach uses a geochemical relationship between total sulfides and redox potential to define organic enrichment. This empirical relationship developed for shallow, macrotidal aquaculture sites in Southwest New Brunswick (SWNB), Canada, is used to determine organic matter (OM) loading and to monitor shifts in benthic quality. A similar relationship is seen for salmonid farm sites in coastal Newfoundland but not for sediments under mussel farms or at nearby reference sites. Overall, redox potentials and total sulfides are not correlated and 70% of observations fall below the relationship documented for SWNB. Sediments in Newfoundland coastal waters are often rich in OM, [1.5 to >30%, median 8% loss on ignition (LOI)]. In addition, they are seasonally (<0 °C) or always cold (–1.8 to <5 °C). Much of the coast is exposed to high-energy conditions often with an effective fetch exceeding 700 km. Inner basins of some bays and fjords are protected from the waves associated with such exposure and may naturally experience seasonal anoxia that will significantly influence sediment-water exchange processes. All these factors will moderate sedimentation, remobilization and

eventual remineralization of organic matter. The application of simple geochemical indices of organic enrichment as monitoring and assessment tools must be tempered with understanding of the environmental processes that regulate these factors under diverse geomorphological conditions.

**Keywords** Environmental effects of aquaculture · Organic enrichment · Redox potentials · Total sulfides · Temperature

### Abbreviations

Eh	redox potential
HDPE	high density polyethylene
LOI	loss on ignition
NHE	normal hydrogen electrode
OM	organic matter
PBS	performance-based standards
SRR	sulfate reduction rate
SWNB	South West New Brunswick, Canada

## 1

### Introduction

This chapter presents a case study to examine variables used as indicators of sediment organic enrichment with respect to the development of finfish and shellfish aquaculture in coastal areas of Newfoundland. Regulators within Fisheries and Oceans Canada are proposing the use of performance-based standards (PBS) to assist in both preliminary site assessments and ongoing site monitoring of aquaculture leases [1]. A monitoring method, based on an empirical relationship between total sulfides and redox potential [2, 3], has been proposed and tested as a method for monitoring salmon aquaculture sites in SWNB. In near-shore, depositional environments, increased organic loading with its effects on benthic organisms and chemistry has been shown to be closely related to a decrease in redox potentials (Eh), and increases in total sulfides and organic matter in surface sediments [4]. These easily measured variables are correlated and can be used independently to determine if organic loading from a farm is causing sediments to become anoxic and thus impact benthic community structure and functioning.

We undertook a study of the utility of measurements of sediment organic matter, redox potential and total sulfides as a means of monitoring surface sediments at finfish and mussel aquaculture sites in Newfoundland coastal waters. In this chapter, we relate our findings to those of Wildish et al. [2] and discuss applicability of these methods to environmental assessment and monitoring of aquaculture sites in Newfoundland.