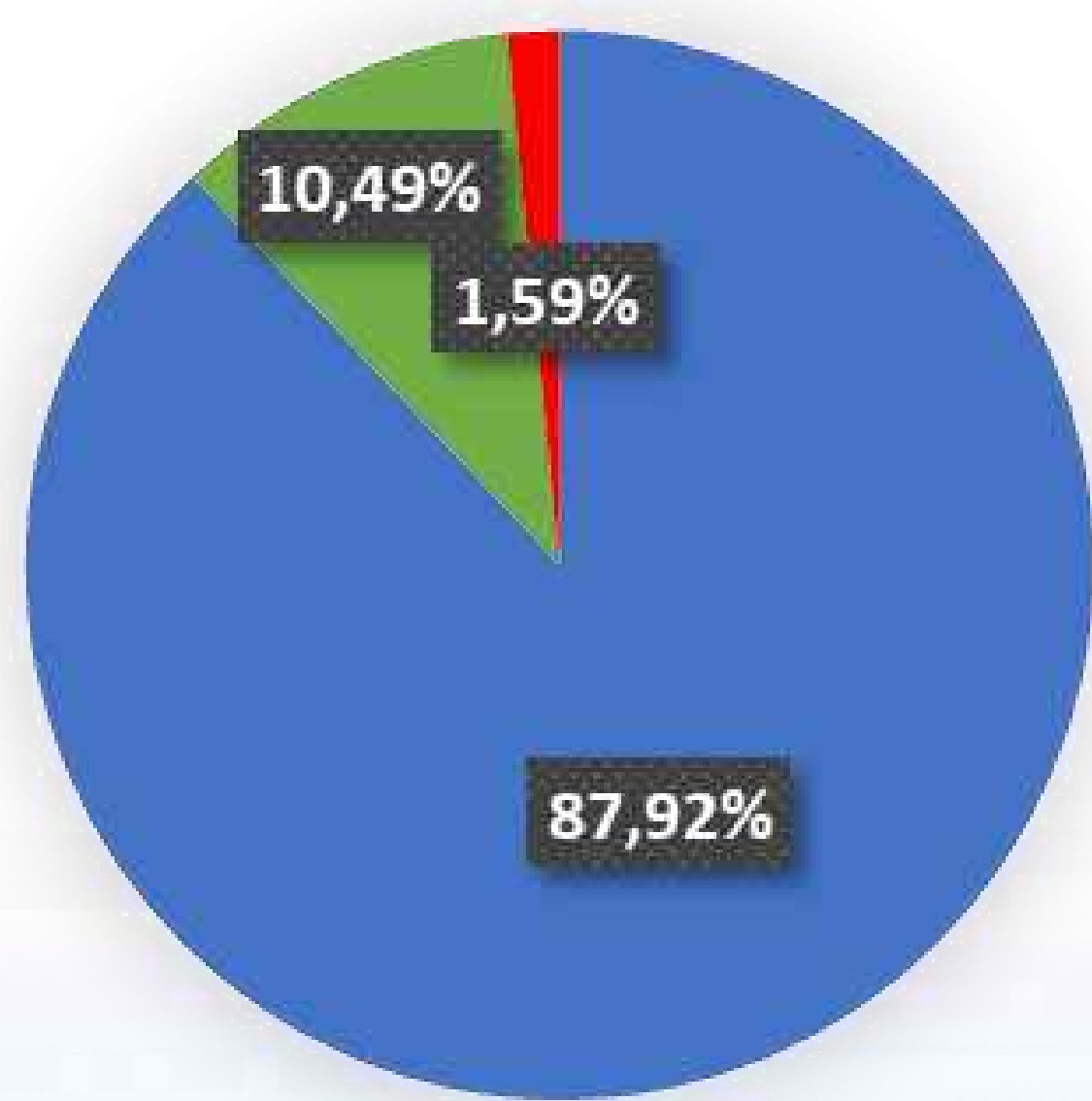


Environmental Observatory for the bay of Sept-Îles

SEDIMENT QUALITY

DATA SUMMARY

Summary of data collected in sediments in the bay of Sept-Îles
2013, 2014, 2016 and 2017



- Samples without criteria or recommendation
- Samples in compliance with criteria or recommendations
- Samples non-compliant with criteria or recommendations

FINDINGS

Metal and metalloids	Chromium, copper, nickel, zinc, and lead content did not exceed concentrations naturally found in postglacial clays despite that fact that chromium concentrations often exceeded the sediment quality criterion, especially in the surface sediment. However, arsenic, cadmium, and mercury enrichment factors were at or above the threshold for moderately contaminated sediment.
Linear hydrocarbons (paraffins)	Measurements indicated slight contamination in the bay, but levels at sites near areas with significant industrial operations were not particularly high compared to sites not considered to be affected by industrial activity.
Polycyclic aromatic hydrocarbons (PAH)	The highest total concentration, below the threshold for slightly contaminated sediment, was found in surface sediment at BSI_1_3, near the Alouette aluminum smelter. However, the second highest concentration was found west of Île Corossol.
Organic matter and stable carbon and nitrogen isotopes	Total sediment carbon content is thought to be a significant factor in the transport of hydrocarbons into the benthic environment. In the samples taken in 2016, hydrocarbon content increased with percent carbon. Based on the results of the stable isotope analysis of samples taken in 2014 and 2016, the main source of carbon and nitrogen in the surface sediment is organic matter of marine origin.

RECOMMENDATIONS

- Given that chromium, copper, nickel, zinc, and lead concentrations did not exceed levels naturally found in postglacial clays, despite chromium concentrations often exceeding the sediment quality criterion, especially in the surface sediment, and considering that the characterization of postglacial clays has provided natural baseline values that can be used as a contamination threshold in future studies, it is strongly recommended that provincial and federal authorities be consulted in order to establish criteria that reflect the geological characteristics of the North Shore.
- An additional study should be conducted to identify the sources of the three parameters, (arsenic, cadmium, and mercury) with enrichment factors at or above the threshold for moderately contaminated sediment.
- To provide a more accurate inventory of potential anthropogenic sources, it would be advisable to characterize the chemical makeup of the main bulk materials transhipped at the Port of Sept-Îles. This would establish a list of chemical signatures that could be used to check whether a particular substance is contributing to the chemical composition of the sediments.
- It is recommended that monitoring be continued near the Pointe-Noire and IOC mining facilities (BSI_2_2 and P4D respectively), where the highest arsenic, cadmium, and mercury concentrations in the clay fraction were found. Both sites also had the highest iron enrichment factors (i.e., iron concentrations that exceed levels naturally found in postglacial clays). Monitoring should also continue at BSI_3_3 and P1C, where there was significant contamination of the clay fraction by metals subject to quality criteria.
- Arsenic, cadmium, and mercury should be tracked, but molybdenum had the highest enrichment factor among the metals found in the sediment. It may come from a natural source, but as it is used in a number of industrial processes, it may come from anthropogenic sources. It would be advisable to draw up a list of products containing molybdenum used by various industries.
- The concentration of TBT, an organic lead compound similar to tetraethyl lead, in sediment was higher at P1C and P4D than at BSI_2_2 and BSI_3_3. The nature of this lead compound, which is more toxic than inorganic lead, needs to be confirmed to help identify the most probable source.
- A possible strategy for identifying sources of organic matter outside the bay would be to collect suspended particles using sediment traps placed along a spatial gradient from the bay toward the gulf. This would also be a way of measuring metal content (especially arsenic, which is naturally assimilated by phytoplankton during primary production) and hydrocarbons associated with imported organic matter of marine origin.

POTENTIAL SOURCES OF ARSENIC:

Based on concentrations of metals and metalloids that can be extracted from the surface sediment, river clays flowing into the bay, and two geochemical tracers, concentrations are high enough to contribute to marine surface sediments.

RECOMMENDATIONS

- To clarify this issue, an additional study should be conducted to measure sediment transport balances by sampling particulate matter in rivers running into the bay (as well as in the waters of the bay itself) using a temporal and spatial technique.
- Cadmium and mercury should be included in this study.

CHARACTERIZATION OF BENTHIC FAUNA

Benthic macroinvertebrates, or benthos: salt or fresh water bottom-dwelling aquatic organisms

Two types:

- Phytobenthos (benthic plants: algae, aquatic plants, etc.)
- Zoobenthos (benthic animals: worms, mollusks, fish, etc.)

Organisms with local ecological characteristics and subject to natural or anthropogenic fluctuations (effects of towed-gear fishing; shellfish farming; urban, industrial and agricultural effluents; oil pollution, introduction of exogenous species; etc.)

→ Indicators of aquatic ecosystem health

Characterization and long-term monitoring of the benthic community: Reliable technique for determining biodiversity in the Bay of Sept-Îles



Example of
Bipalponephlys neotena



FINDINGS

In 2016, 66 taxa in 9 different phyla were identified. No taxa were designated as "common," while 16 taxa were designated as "constant" across stations, and 50 as "rare."

In 2017, 91 taxa in 9 different phyla were identified. One taxon was designated as "common," 32 as "constant," and 58 as "rare."

Other species are probably present.

RECOMMENDATIONS

- It is recommended that an in-depth literature review be conducted on the toxicity of elements such as metals and PAHs in the sediment to the benthic species identified in the bay.
- Using existing studies, concentration thresholds for each substance could be determined to avoid negatively impacting benthic species in the study area.
- For species that have not been studied, test protocols could be used to measure the toxic effects of substances on these organisms in the laboratory.
- The status of the benthic population should be regularly monitored.

PHOTO CREDIT

¹ Larousse / ² Philippe-Olivier Dumais

³ <https://www.inaturalist.org/photos/1163044>

⁴, ⁷ Julie Carrière / ⁵ WoRMS / ⁶ Elliot Dreujou