Environmental Issues Regarding Fish Habitat, Water Quality, Biological Monitoring and Sediment Remediation, Gaspé: Sandy Beach, Québec, Canada

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Background/Objectives. Restoration of contaminated sediments by dredging is not without environmental impacts. However, application of adequate mitigation measures can limit these impacts on water quality and fish habitat. In 2016, Transport Canada has completed the remediation of 40,000 m^3 of sediments impacted with copper and polycyclic aromatic hydrocarbons (PAH) during the last century, near its port facilities at Gaspé - Sandy Beach.

Characterization of the seabed and inventory of the flora and aquatic fauna carried out before and after the dredging work gave indication on the different species abundance and the improvement of the quality of fish habitat. Also, a compensation program is being carried out to ensure the reconstitution of the eelgrass beds destroyed by the dredging.

Continuous measurements of the total suspended solid concentrations by turbidimetry near the work area and in the Gaspé Harbor were conducted to document the effect of the dredging on the water column.

Because seashell farms are operating in the west extremity of the Gaspé Harbour, an extensive shellfish monitoring program (mussels and scallops) was put in place to ensure that if contaminants were escaping from the work area they would by documented and special procedures would be put in place.

These programs also allowed the assessment of the effectiveness of the implemented mitigation and environmental protection measures.

Approach/Activities. Characterization of the seabed and inventory of the aquatic flora and fauna were carried out by scuba diving using an underwater camera and a two-way communication system. The divers transmitted to the surface crew various information related to the nature of the substrate and presence of remains, aquatic vegetation and fish or benthic organisms along defined transects. The reconstitution of the eelgrass habitat is carried out by transplantation from a donor bed near the site and the monitoring of the natural recolonization of eelgrass.

Turbidity monitoring consisted in continuous measurements of TSS concentrations by turbidimetry at 100 and 300 m downstream from dredging activities, and at a reference station located in an area not impacted by dredging work. This allowed us to take into account the ambient concentrations changing throughout summer in the Gaspé Harbor. Three depth wear monitoring at these three stations, 1m under surface, mid depth of the water column and 1 m over the seabed. The results from the 100 m station were used to verify compliance with the water quality criteria established at 25 mg/L over ambient concentrations. Exceedance of this criterion triggered a work stoppage to assess and correct the situation until the ambiance conditions were restored at the 100 m station.

Water quality monitoring program consisted in TSS, PAHs as well as total and dissolved metals concentrations in water samples taken at various depths in the work area, near the dredging equipment. It was carried out in the Gaspé Harbor and the mouths of major tributaries to

measure background levels. Chemical results were used to verify compliance with the acute toxicity criterion. Exceedance of this criterion triggered adjustments of the way to work.

Biological monitoring program started 3 weeks before the dredging operations with the launching of 2,592 scallops (*Chlamys islandica*) and 3,600 mussels (*Mytius edulis*) at three monitoring stations between seashell farms and the dredging site. All molluscs were taken from n the harbor from the producer to ensure that they were well adapted to the studied environment. A first sampling occurred the next day to evaluate the pre-operations conditions. A second sampling took place 3 weeks following the first day of dredging, and 2 other times during the operations. A last sampling occurred 30 days after the end of the first year of the sediment remediation project.

Several analyses have been performed on both species: metals and HAP concentration in flesh, condition index, growth, morphometry, enzyme activity (catalase and superoxide dismutase) and mortality.

Results/Lessons Learned. The remediation of contaminated sediments adjacent to the Transport Canada wharf in Gaspé has improved the quality of fish habitat by diversifying the nature of the substrates, and increasing favorable surfaces for colonization by divers fauna et flora, for example, laminaria, lobster, and different molluscs species. This is based on an increase in the abundance of individuals and the maintenance of diversity. Monitoring will be needed over the next few years to assess the eelgrass beds recovery progress.

The turbidity and water quality monitoring programs have helped to effectively assess turbidity and water quality during dredging work. The effects of dredging on the water column are essentially measurable near the immediate dredging area. Satellite imagery has also shown that significant variations in turbidity in the harbor could be attributed to natural phenomena such as river flooding.

All result variations during the monitoring have been linked to natural phenomena such as launching, breeding season, biofouling and natural metals concentration in Gaspé Harbor. Indeed, the monitoring of the water quality in the harbor allowed to confirm that observed results didn’t show any effects that could be linked to dredging operations.