Unveiling the Endangered St. Lawrence Estuary Beluga's Skin Microbiome and It's Potential Utility in Halogenated Flame Retardant Exposure Monitoring

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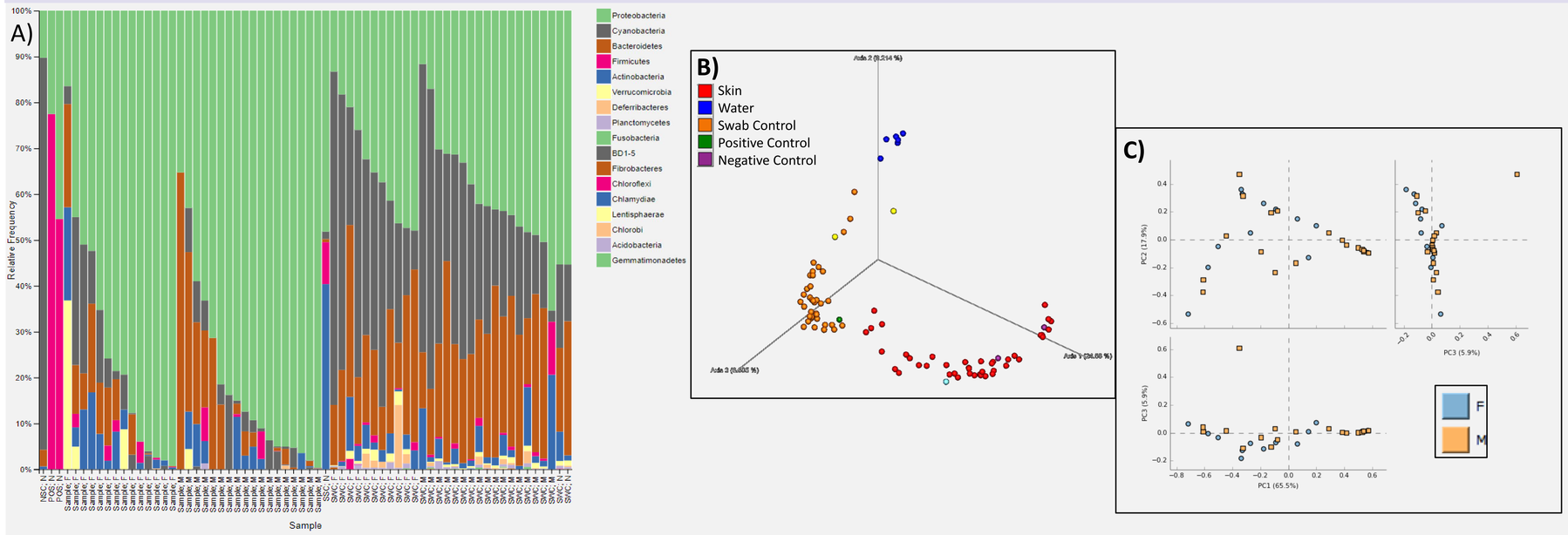
INTRODUCTION

- Marine mammals are integral part of the food web and an important socioeconomic benefit for coastal communities.
- St. Lawrence Estuary (SLE) beluga (*Delphinapterus leucas*) population is thought to be endangered by, among other stressors, elevated tissue concentrations of environmental contaminants (e.g. halogenated flame retardants)[1]. Flame retardants (FRs) like PBDEs and emerging FRs have been found to be a risk factor for dystocia in beluga females[2].
- Current contaminant monitoring relies on skin biopsies using a series a challenging and highly invasive procedures.
- The beluga skin microbiome has been uncharacterized, and represents an innovative and less destructive biomarker to monitor environmental contaminants and animal health.

Hypothesis:

The beluga skin microbiome changes as a function of beluga tissue contaminant concentrations, and will act as biomarkers of contaminant exposure for the non-invasive detection of altered ecosystem health.

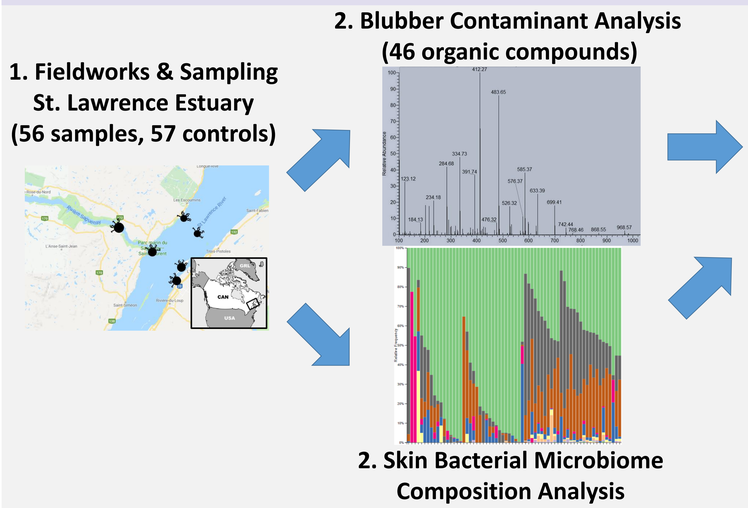
RESULTS – Skin Microbiome of Belugas



The Skin Microbiome of Belugas

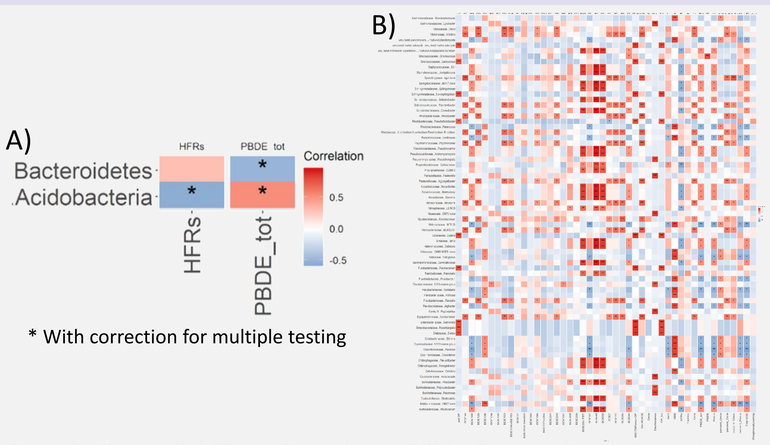
A) Relative abundance of bacterial phylum organized by sample source, sex and sample type (POS = positive control, NSC = negative control).
B) Principal component analysis (PCA) showing the distinct beluga skin (red) and surrounding water (blue) microbiomes.
C) PCA of the beluga skin microbiomes between males (orange) and females (blue) show no differences in microbiome between sexes.

METHOD



Schematic of the Microbiome Characterization and Biomarker Identification

RESULTS – Biomarker Identification



* With correction for multiple testing

Certain Bacterial Taxa Correlates With Contaminant Levels

A) Bacteroidetes and Acidobacteria correlates with total FR levels.
B) Other bacterial genera correlates with individual FR levels.

SUMMARY & FUTURE DIRECTIONS

- The beluga skin microbiome warrants further investigation as a non-invasive approach for monitoring of beluga and ecosystem health.
- The beluga skin microbiome is distinct from their environment/sea water. It does not appear to vary as a function of beluga sex or location.
- Two bacterial phyla, and additional genera, significantly correlated with PBDE or emerging FR concentrations in their blubber.
- Metagenomics could reveal microbial metabolic pathways associated with contaminant levels.

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References

1. Covaci A, et al. 2011. Environ. Int. 37, 532-556
2. Lair, S. et al. 2014. DFO Can. Sci. Advis. Sec.Res. Doc. 2013/119. iv + 37 p.