Influence of a River Plume on Ice Algal Communities in Southwestern Hudson Bay in Spring 2005

Kary Proteau[1], Christine Michel[2], Michel Poulin[3], Bernard LeBlanc[2] & Michel Gosselin[1]

[1] Institut des sciences de la mer de Rimouski, Université du Québec à Rimouski, QC G5L 3A1

[2] Freshwater Institute, Fisheries and Oceans Canada, Winnipeg, MB R3T 2N6

[3] Research Division, Canadian Museum of Nature, Ottawa ,ON K1P 6P4

1. Introduction

- Recent global climate models indicate increases in both air temperature and precipitation in the Hudson Bay area (Wang et al. 1994).
- Western Hudson Bay is affected by an important annual freshwater discharge (e.g., Churchill River) and climate change could have a strong impact on river runoff and snow precipitation.
- River plumes provide an important pathway for undiluted transport of land-derived substances which and affect the salinity, chemistry and optical properties of coastal waters (Granskog et al. 2003). River plumes also influence the development and composition of ice algal communities (Legendre et al. 1992), which are important primary producers in seasonally ice-covered environments.
- The main objective of this project is to study the influence of a river plume on the abundance, biomass, and species composition of bottom ice-algal communities in southwestern Hudson Bay, near the Churchill River.

2. Materials & Methods

- Sampling was conducted on the western coast of Hudson Bay, offshore the Churchill River, from 3 to 21 April 2005. A marine (station A: 58° 48.509' N, 094° 17.238' W) and a brackish site (station B: 58° 47.537' N, 094° 11.344' W) were visited every second day (Figure 1).
- At each station, four ice cores were extracted from the land-fast ice under low (< 10 cm) and high (> 15 cm) snow cover depth, using a motorized ice auger and ice corer. Snow depth, ice thickness, freeboard, and surface water temperature and salinity were measured at each sampling site.
- Surface water samples were collected with a hand pump for the determination of salinity.
- The bottom 3-5 cm of the ice cores were cut and kept in isothermal containers for subsequent laboratory analyses of the following variables: salinity, nutrients (nitrate, phosphate and silicic acid), dissolved and total organic carbon, exopolymeric substances, particulate organic carbon and nitrogen, biogenic silica, chlorophyll a (chl a) and pheopigments (2 fractions: >5 µm and total), and cell counts and identification.

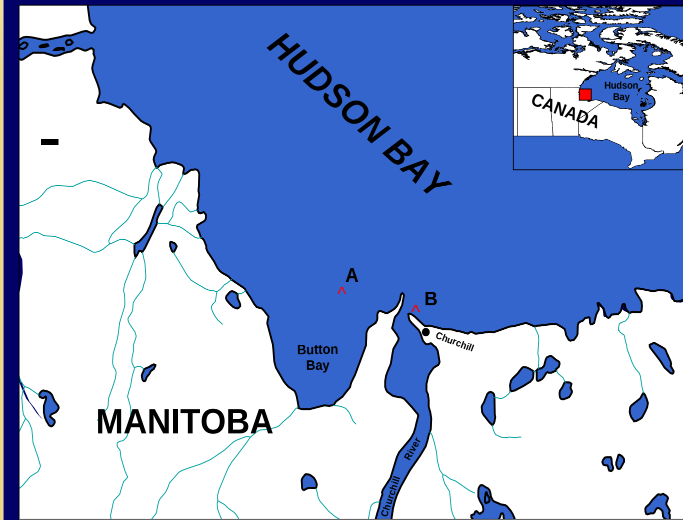

Figure 1. Position of the marine (A) and brackish (B) stations offshore the Churchill River sampled during 3-21 April 2005.

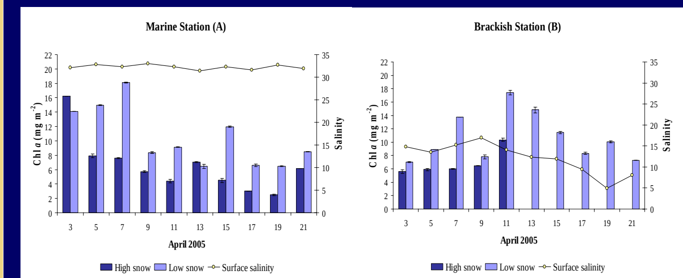

Figure 2. Variations in the bottom ice chl *a* concentration (mg m-2) under low and high snow cover depth, and surface water salinity at the marine (A) and brackish (B) stations off Churchill River, 3-21 April 2005. For chl *a*, mean ± SD.

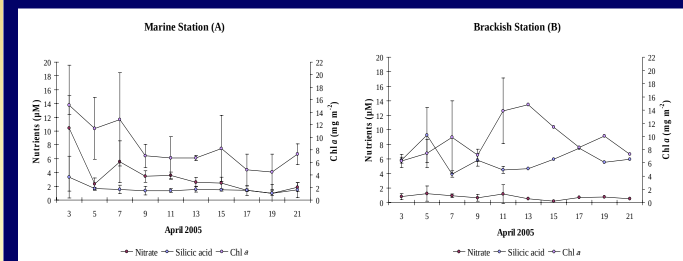

Figure 3. Variations in the bottom ice chl *a* concentration (mg m-2), nitrate and silicic acid (µM) at the marine (A) and brackish (B) stations off Churchill River, 3-21 April 2005. Mean ± SD.

3. Results

- Snow cover depth appears to affect the bottom ice chl *a* concentrations at both marine and brackish stations, with high chl *a* values under low snow depth (Figure 2A, B).
- Surface water salinity was constant at the marine station and two times higher than at the brackish station (Figure 2A, B).
- After 9 April, both surface water salinity and chl a concentration gradually decreased at the brackish station (Figure 2B).
- At the marine station, silicic acid in the bottom ice was in low concentration compared to nitrate (Figure 3A).
- In contrast, silicic acid was the most abundant nutrient at the brackish station (Figure 3B).

4. Discussion

- As in other studies (e.g., Gosselin et al. 1985; Welch and Bergmann 1989; Mundy et al. 2005), our results indicate that snow cover depth has an influence on bottom ice chl *a* concentrations. This effect is observed at both stations (Figure 2A, B).
- The decreases in chl *a* concentration and surface water salinity observed at the brackish station between 7 and 21 April are probably related to enhanced freshwater discharge from the Churchill River (from 25 700 to 30 200 cubic foot second at Leaf Rapids; Manitoba Water Stewardship, 2005).
- The nutrient data suggest a potential limitation of the ice algae by nitrate in the brackish water and by silicic acid in the offshore marine water.
- The species composition of the bottom ice algae is likely to be different in these two physically and chemically contrasted environments. Further analysis of the taxonomic composition of the algae will permit to test this hypothesis.

5. References

- Gosselin et al. 1985. Can J Fish Aquat Sci 42:999-1006; Granskog et al. 2003. J Geophys Res 108 (C8):3253; Legendre et al. 1992. Polar Biol 12:445-453; Manitoba Water Stewardship. 2005. URL : http://www.gov.mb.ca/waterstewardship/water_info/lake_river/river_report.html; Mundy et al. 2005. J Mar Syst 58: 107-120; Wang et al. 1994. J Phys Oceanography 24(12):2515-2533; Welch & Bergmann. 1989. Can J Fish Aquat Sci 46:1793-1804.

6. Acknowledgements

- The authors gratefully acknowledge NCE ArcticNet, Natural Sciences and Engineering Research Council (NSERC) of Canada, Fisheries and Oceans Canada, Canadian Museum of Nature, Institut des sciences de la mer de Rimouski (ISMER) and Québec-Océan for financial support. We are grateful to the Churchill Northern Science Center staff for logistical support during the fieldwork and to CJ Mundy for coordination of the field program. We also thank S Belt and G Massé for field work assistance. This is a contribution to the research program of Québec-Océan.