First *in situ* imaging of large colonial *Phaeocystis* quantifies inefficient carbon export

Authors: Manon Laget[1]*, Andreas Rogge[2,3], Matthias Wietz[4,5], Lillian Musselman[1], Ying-Yu Hu[1], Niall McGinty[1,6], Sing-how Tuo[1,7], Moritz Holtappels[2], Zoe V. Finkel[1], Anya M. Waite[1,8]

[1] Department of Oceanography, Dalhousie University, Halifax, NS, Canada

[2] Benthic Ecology, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

[3] Institute of Environmental Physics, University of Bremen, Bremen, Germany

[4] Deep-Sea Ecology and Technology, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

[5] Institute for Chemistry and Biology of the Marine Environment, University of Oldenburg, Oldenburg, Germany

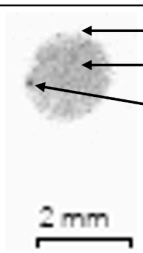
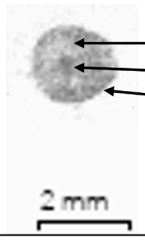
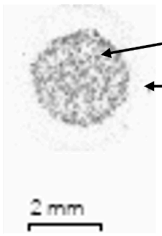
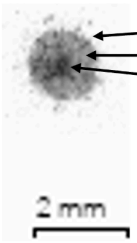
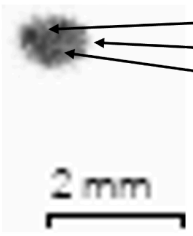
[6] Marine and Freshwater Research Institute (MFRI), Fornubúðir 5, 220 Hafnafjörður, Iceland

[7] Department of Oceanography, National Sun Yat-sen University, Kaohsiung, Taiwan

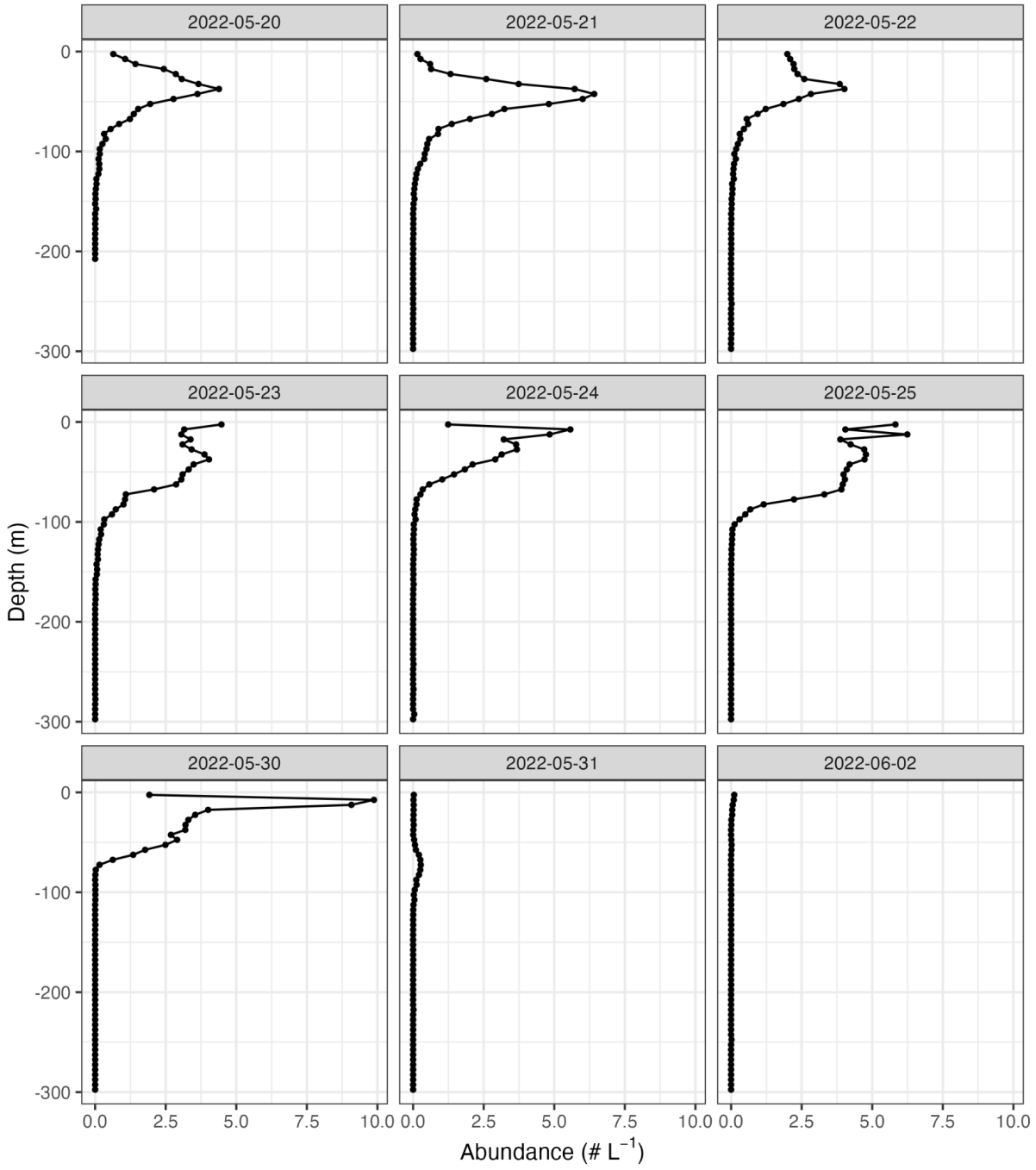
[8] Ocean Frontier Institute, Dalhousie University, 1355 Oxford Street, Halifax, NS, Canada

* Corresponding author

Corresponding author email address: manon.laget@protonmail.com

Phaeocystis sp.		- Smooth and regular edges - Color mostly uniform and homogenous structure within - Sometimes presence of very small, darker buds
Rhizaria X		- Grainy structure - Central darker dot - Darker edge
Colonial Collodaria		- Multiple dots (single collodarian cells) - Halo at the periphery (more or less visible)
Aulacanthidae (Phaeodaria)		- Spicules (more or less visible) - Grainy structure - Dark phaeodium in the center
Round detritus		- Grainy structure - Irregular edges - Possible presence of darker or lighter spots in the structure

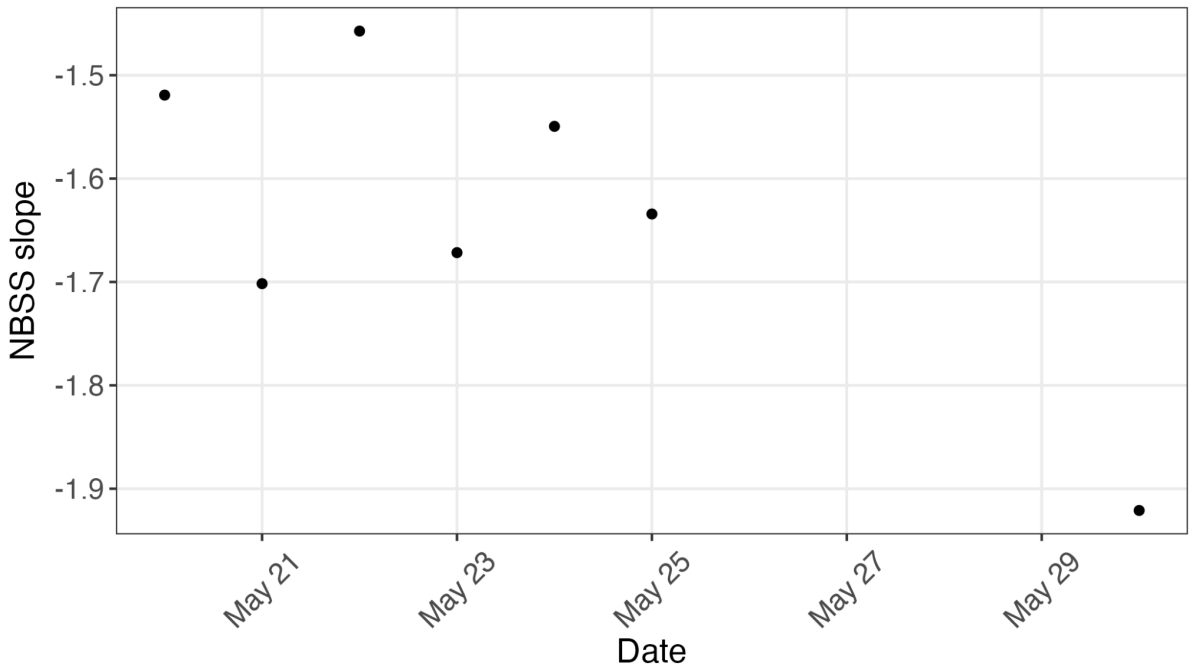
Supplementary Figure 1. Large *Phaeocystis* colony alongside objects that may be confused with it, with distinguishing features highlighted to differentiate them from *Phaeocystis* colonies. Rhizaria X and colonial Collodaria were observed in the Weddell Sea; Aulacanthidae and round detritus were observed in both the Labrador Sea and the Weddell Sea.



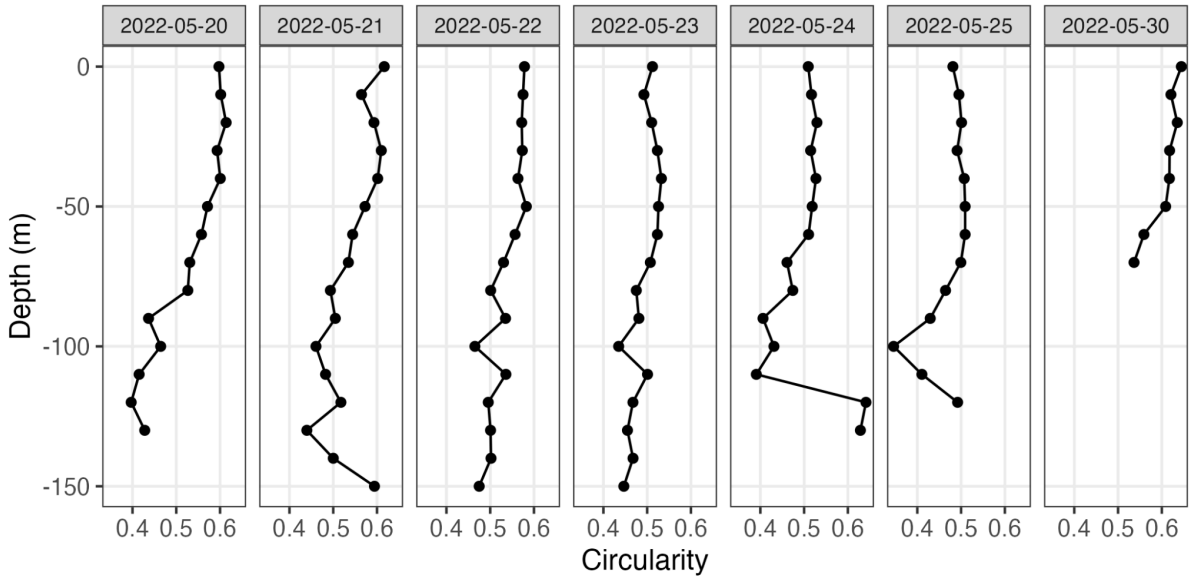
Supplementary Figure 2. Daily averaged abundance profiles of large (>600 µm) *Phaeocystis* colonies in the Labrador Sea.

Supplementary Table 1. Daily Spearman correlation coefficient between daily large (>600 µm) *Phaeocystis* colony abundance and chlorophyll a concentration in the Labrador Sea. Tests were performed with 146 depth bins for each day.

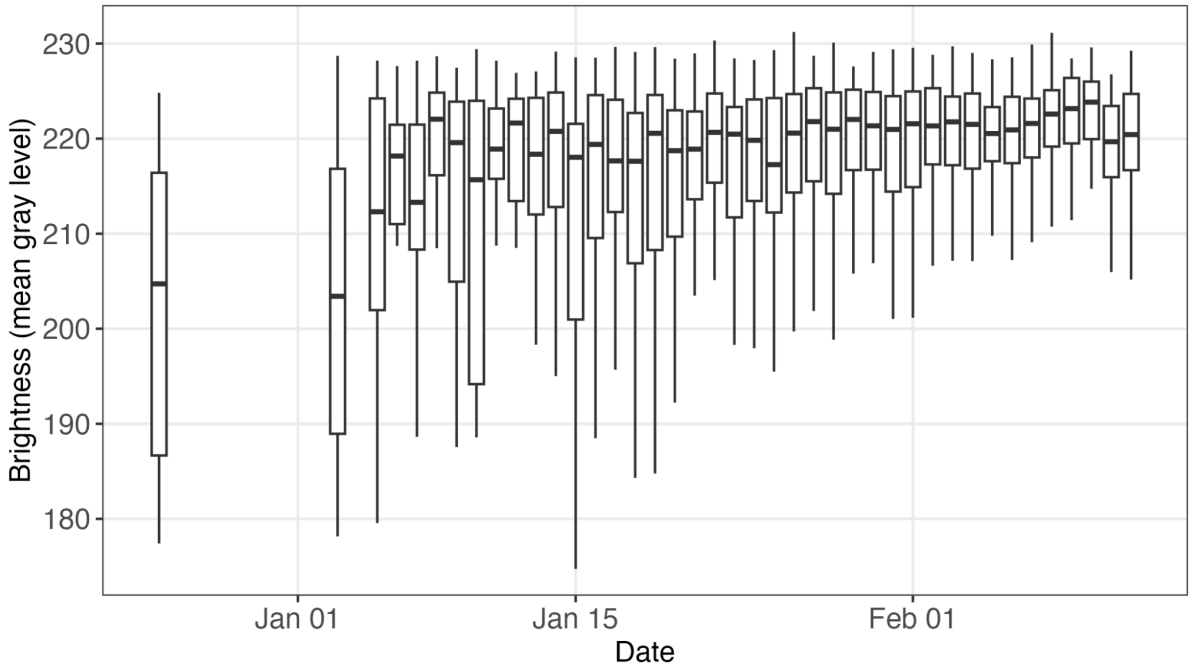
Date	**Spearman's ρ coefficient**	***p*-value**
20-05–2022	0.95	<0.001
21-05–2022	0.98	<0.001
22-05–2022	0.91	<0.001
23-05–2022	0.81	<0.001
24-05–2022	0.88	<0.001
25-05–2022	0.55	0.002
30-05–2022	0.93	<0.001
31-05–2022	0.65	<0.001
02-06-2022	0.60	<0.001



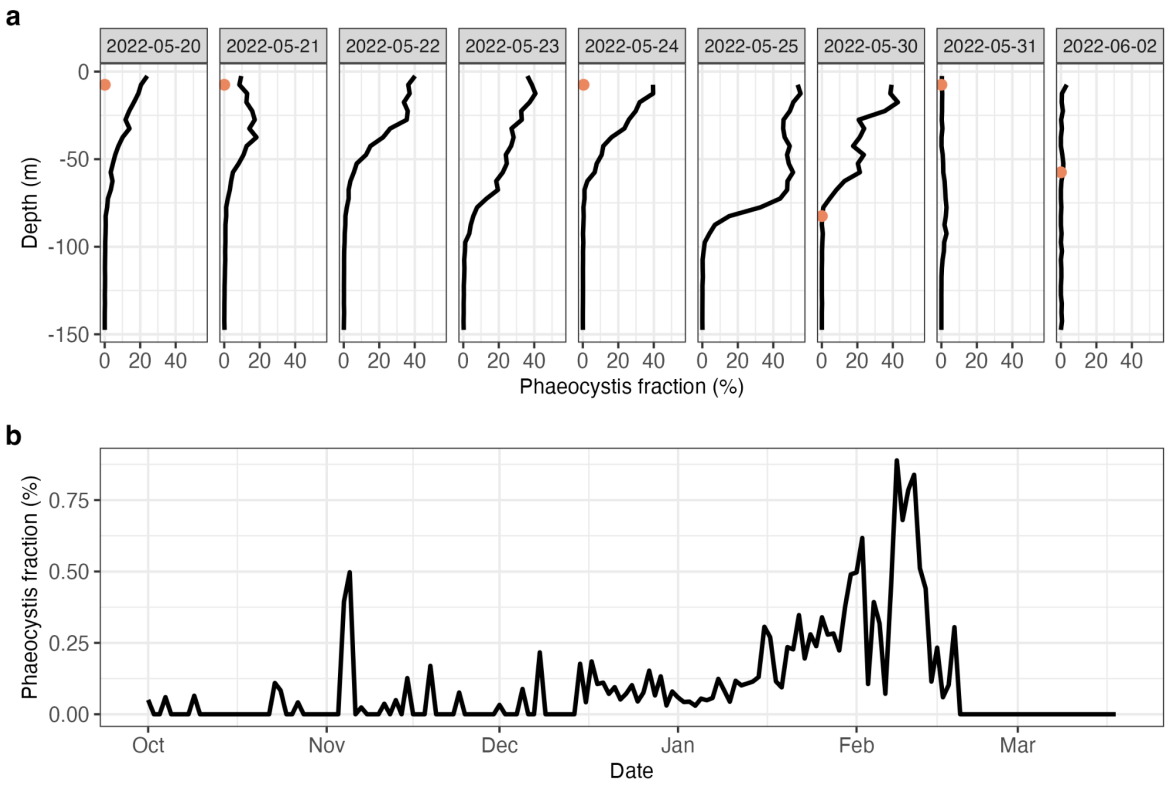
Supplementary Figure 3. Slope of the Normalized Biomass Size Spectrum estimated for each day using the biovolume of large (>600 µm) *Phaeocystis* colonies in the Labrador Sea.



Supplementary Figure 4. Evolution of mean circularity of large (>600 µm) *Phaeocystis* colonies with depth for each day in the Labrador Sea. Values are averaged over 10-m depth bins. Only bins with at least 5 images are shown.



Supplementary Figure 5. Distribution of mean gray level of pixels in large (>600 µm) *Phaeocystis* colony images for each day with at least 10 images recorded in the Weddell Sea.



Supplementary Figure 6. Contribution of large (>600 µm) *Phaeocystis* colony to >600 µm total biovolume in **a**, the Labrador Sea and **b**, the Weddell Sea. **a**, Points show the contribution of colonies to total particulate carbon.