**Supplementary Information**



Supplementary Figure 1: Living position traits of macro-infaunal taxa at each station (A) Proportion of number of taxa with a particular trait, and (B) Proportion of abundance-weighted taxa with a particular trait (trait occurrence x taxa abundance).

Supplementary Table 1. Characteristics of sediments in multicorer samples, including % composition of grain size categories, average volume of biogenic material, average sponge spicule abundance within the sediment on a relative scale (0 = no spicules to 3 = high abundance of spicules), CaCO3 and organic content (OC), and pigment concentration [chlorophyll *a* (chl *a*) and phaeophytin (phaeo), μg g-1 sediment]. Sediment samples from core site C16 were not available for analysis.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station | Core site | Region | Depth (m) | Sediment grain size category | Biogenic material (ml) | Sponge spicule (0-3 scale) | CaCO3 | OC | Chl *a* | phaeo |
|  |  |  |  | Clay | Silt | Fine sands | Medium sand | Coarse sand | Gravel | Pebble |  |  |  |  |  |  |
| 27 | C1 | Shelf | 286 | 0.02 | 3.49 | 56.37 | 27.35 | 10.06 | 1.45 | 1.26 | 330 | 3.0 | 1.91 | 0.8 | 0.06 | 1.84 |
| 45 | C2 | Shelf | 849 | 0.71 | 19.70 | 59.99 | 1.81 | 0.44 | 0.00 | 17.34 | 380 | 2.5 | 0.04 | 2.2 | 0.43 | 3.90 |
| 63 | C3 | Shelf | 511 | 0.63 | 15.75 | 78.59 | 3.99 | 1.05 | 0.00 | 0.00 | 20 | 1.0 | 0.45 | 2.8 | 0.00 | 7.28 |
| 88 | C5 | Shelf | 360 | 0.00 | 3.58 | 70.20 | 21.26 | 4.96 | 0.00 | 0.00 | 20 | 2.0 | 0.76 | 0.9 | 0.00 | 4.36 |
| 98 | C4 | Shelf | 450 | 0.13 | 10.98 | 75.35 | 8.59 | 4.96 | 0.00 | 0.00 | 80 | 1.0 | 0.04 | 1.7 | 0.00 | 1.90 |
| 137 | C17 | Slope | 1604 | 0.02 | 4.35 | 33.71 | 6.42 | 3.61 | 5.04 | 46.85 | 120 | 1.0 | 1.02 | 1.3 | 0.00 | 0.41 |
| 138 | C17 | Slope | 1600 | 0.06 | 8.94 | 65.70 | 5.84 | 4.08 | 3.65 | 11.72 | 495 | 1.0 | 0.64 | 1.4 | 0.00 | 0.12 |
| 152 | C26 | Slope | 822 | 0.66 | 11.52 | 34.01 | 6.70 | 8.96 | 8.01 | 30.14 | 140 | 1.5 | 37.72 | 1.7 | 0.00 | 0.08 |
| 163 | C25 | Slope  | 510 | 0.16 | 3.75 | 30.87 | 13.32 | 15.88 | 12.23 | 23.79 | 110 | 1.0 | 42.67 | 2.3 | 0.00 | 0.08 |
| 172 | C18 | Slope | 2214 | 2.18 | 51.22 | 41.61 | 1.97 | 0.83 | 2.19 | 0.00 | 380 | 1.0 | 0.36 | 2.0 | 0.00 | 0.44 |
| 191 | C30 | Abyss | 3198 | 1.08 | 31.05 | 58.01 | 2.95 | 1.07 | 2.44 | 3.39 | 860 | 1.0 | 1.70 | 2.0 | 0.00 | 0.12 |
| 192 | C30 | Abyss | 3245 | 2.92 | 20.61 | 66.12 | 4.15 | 2.36 | 3.84 | 0.00 | 62 | 0.5 | 2.67 | 1.7 | 0.00 | 0.22 |
| 233 | C33 | Abyss | 3543 | 3.21 | 39.22 | 50.96 | 1.88 | 0.63 | 4.10 | 0.00 | 65 | 0.2 | 0.12 | 2.3 | 0.00 | 0.15 |
| 236 | C33 | Abyss | 3553 | 4.45 | 67.05 | 26.88 | 1.26 | 0.36 | 0.00 | 0.00 | 50 | 0.0 | 0.04 | 2.2 | 0.00 | 0.07 |
| 286 | C35 | Abyss | 3403 | 10.51 | 79.31 | 10.13 | 0.05 | 0.00 | 0.00 | 0.00 | 29 | 0.0 | 0.04 | 3.1 | 0.00 | 0.25 |
| 287 | C35 | Abyss | 3419 | 11.09 | 88.91 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 30 | 0.0 | 0.13 | 2.8 | 0.00 | 0.41 |

Supplementary Table 2. Dissimilarity (%) between mega-epifaunal communities at each site. Analysis was performed using the SIMPER procedure within PRIMER, on untransformed data.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **Shelf**  |  |  |  |  |  |  |  | **Slope** |  |  |  |  |  | **Abyss** |  |
|  | **Site** | **C1** | **C2** | **C3** | **C4** | **C5** | **D3** | **D4** | **D34** | **C15** | **C16** | **C17** | **C18** | **C25** | **C26** | **C27** | **D27** | **D28** | **D45** | **C30** | **C33** | **C35** |
| **Shelf** | **C1** | **X** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C2** | 84.63 | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C3** | 79.73 | 82.47 | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C4** | 70.38 | 87.46 | 80.21 | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C5** | 64.82 | 88.85 | 83.04 | 85.22 | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **D3** | 85.40 | 85.58 | 56.71 | 82.64 | 86.88 | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **D4** | 76.81 | 57.25 | 51.62 | 79.64 | 84.26 | 60.90 | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **D34** | 79.43 | 70.59 | 84.95 | 88.11 | 93.00 | 68.63 | 79.43 | X |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C15** | 84.99 | 92.47 | 90.13 | 96.58 | 95.94 | 95.10 | 93.02 | 94.48 | X |  |  |  |  |  |  |  |  |  |  |  |  |
| **Slope** | **C16** | 96.21 | 69.79 | 93.21 | 95.87 | 97.14 | 96.99 | 78.78 | 79.46 | 91.16 | X |  |  |  |  |  |  |  |  |  |  |  |
| **C17** | 95.04 | 71.39 | 93.62 | 95.66 | 94.51 | 96.38 | 80.85 | 77.78 | 92.48 | 48.69 | X |  |  |  |  |  |  |  |  |  |  |
| **C18** | 95.75 | 91.26 | 92.74 | 97.61 | 97.19 | 92.00 | 95.24 | 96.37 | 70.94 | 96.77 | 85.46 | X |  |  |  |  |  |  |  |  |  |
| **C25** | 94.94 | 95.49 | 96.61 | 98.08 | 93.82 | 94.52 | 97.36 | 96.85 | 70.27 | 94.95 | 94.22 | 95.31 | X |  |  |  |  |  |  |  |  |
| **C26** | 90.85 | 89.36 | 93.31 | 96.68 | 89.80 | 92.80 | 91.60 | 93.29 | 81.76 | 92.46 | 95.55 | 96.05 | 84.93 | X |  |  |  |  |  |  |  |
| **C27** | 96.33 | 95.10 | 98.09 | 99.06 | 96.71 | 96.23 | 96.86 | 97.59 | 94.63 | 96.79 | 97.15 | 96.13 | 90.39 | 88.97 | X |  |  |  |  |  |  |
| **D27** | 93.23 | 66.67 | 93.16 | 95.32 | 93.36 | 94.38 | 77.18 | 76.39 | 91.61 | 49.81 | 41.51 | 96.11 | 94.02 | 94.30 | 96.24 | X |  |  |  |  |  |
| **D28** | 94.63 | 56.11 | 92.46 | 95.49 | 97.16 | 96.19 | 70.28 | 81.84 | 79.83 | 57.09 | 44.68 | 73.29 | 96.84 | 95.73 | 98.07 | 50.08 | X |  |  |  |  |
| **D45** | 88.16 | 93.63 | 90.61 | 97.10 | 95.28 | 94.62 | 94.00 | 96.95 | 74.38 | 91.18 | 75.96 | 67.24 | 88.71 | 88.23 | 94.34 | 93.01 | 77.23 | X |  |  |  |
| **Abyss** | **C30** | 98.60 | 94.27 | 96.08 | 99.08 | 97.44 | 93.88 | 97.10 | 95.97 | 97.25 | 97.80 | 91.58 | 81.89 | 92.74 | 98.45 | 98.42 | 94.58 | 94.42 | 91.04 | X |  |  |
| **C33** | 99.58 | 99.02 | 99.41 | 99.81 | 99.31 | 98.75 | 99.20 | 98.82 | 99.44 | 99.44 | 97.33 | 94.64 | 98.25 | 99.48 | 99.49 | 97.49 | 98.88 | 96.90 | 85.55 | X |  |
| **C35** | 96.77 | 86.64 | 94.04 | 97.68 | 96.95 | 93.61 | 94.70 | 92.88 | 90.54 | 92.65 | 86.34 | 87.96 | 89.16 | 93.14 | 97.23 | 88.24 | 91.63 | 89.79 | 70.60 | 90.07 | X |

Supplementary Table 3. Dissimilarity (%) between macrofaunal communities at core sampling sites. Analysis was performed using the SIMPER procedure within PRIMER, on untransformed data. Percentage similarity within sites is also shown (in bold) for Core sites at which replicate samples (sites) were analysed.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Shelf** |  |  |  |  | **Slope** |  |  |  |  | **Abyss** |  |  |
|  | **Site** | **C1** | **C2** | **C3** | **C5** | **C4** | **C16** | **C17** | **C26** | **C25** | **C18** | **C30** | **C33** | **C35** |
| Shelf | **C1** | **43.18** |  |  |  |  |  |  |  |  |  |  |  |  |
| **C2** | 71.31 |  |  |  |  |  |  |  |  |  |  |  |  |
| **C3** | 58.13 | 61.54 |  |  |  |  |  |  |  |  |  |  |  |
| **C5** | 52.15 | 73.43 | 47.37 |  |  |  |  |  |  |  |  |  |  |
| **C4** | 50.89 | 67.77 | 51.02 | 37.25 |  |  |  |  |  |  |  |  |  |
| Slope | **C16** | 92.67 | 94.55 | 95.06 | 92.89 | 92.86 |  |  |  |  |  |  |  |  |
| **C17** | 82.66 | 82.33 | 86.3 | 87.04 | 85.52 | 80.09 | **35.71** |  |  |  |  |  |  |
| **C26** | 82.22 | 81.33 | 88.12 | 86.42 | 83.05 | 75.00 | 71.38 |  |  |  |  |  |  |
| **C25** | 87.71 | 82.46 | 87.95 | 89.52 | 86.00 | 82.35 | 67.26 | 61.11 |  |  |  |  |  |
| **C18** | 91.61 | 89.00 | 92.34 | 92.78 | 93.81 | 90.00 | 80.45 | 89.56 | 87.46 |  |  |  |  |
| Abyss | **C30** | 96.57 | 92.95 | 95.86 | 96.25 | 95.51 | 93.73 | 87.43 | 94.05 | 90.6 | 90.07 | **18.47** |  |  |
| **C33** | 95.11 | 92.03 | 95.26 | 95.63 | 95.03 | 95.05 | 91.34 | 95.58 | 94.2 | 89.09 | 79.62 | **27.14** |  |
| **C35** | 98.25 | 96.10 | 97.44 | 97.99 | 97.12 | 97.93 | 94.51 | 98.12 | 96.46 | 94.92 | 83.17 | 81.45 | **15.30** |

Supplementary Table 4. Partial CCA results (regression/canonical coefficients of standardised variables) for relationship between macro-infauna and the axes from the mega-epifauna CA analysis.

|  |  |  |
| --- | --- | --- |
|  |  | CCA axes (% of total variation explained) |
|  |  | axis1 (18%) | axis2 (13%) | axis3 (7%) | axis4 (4%) |
| mega-epifauna CA | axis1 | 0.1763 | 0.6348 | 0.3987 | -0.6161 |
| axis2 | 0.6462 | -0.2765 | -0.1865 | 0.0661 |
| axis3 | -0.1478 | -0.2348 | 0.4073 | -0.3779 |
| axis4 | 0.0822 | 0.0366 | 0.3008 | 0.339 |

Supplementary Table 5. Output of distance based linear model (DistLM) investigating the relationship between untransformed mega-epifaunal communities, and sea ice, productivity and flux variables at each site. Analyses were conducted using Primer 7.

DistLM

Distance based linear models

*Resemblance worksheet*

Name: Resem\_mega\_nt

Data type: Similarity

Selection: 1-21

Resemblance: S17 Bray-Curtis similarity

*Predictor variables worksheet*

Name: ROAVERRS\_IPY\_envExtract\_CPR2\_PRIMER

Data type: Environmental

Sample selection: 56-76

Variable selection: All

Selection criterion: Adjusted R^2

Selection procedure: Step-wise

*VARIABLES*

 1 SeaIce\_mean Trial

 2 SeaIce\_sd Trial

 3 chl\_mean Exclude

 4 chl\_sd Exclude

 5 flux\_mean Trial

 6 flux\_sd Trial

 7 Depth\_2 Include

 8 closePack\_mean Trial

 9 closePack\_sd Trial

10 iceFree\_mean Trial

11 iceFree\_sd Trial

12 marginal\_mean Trial

13 marginal\_sd Trial

14 openPack\_mean Exclude

15 openPack\_sd Exclude

16 vgpm\_mean Trial

17 vgpm\_sd Trial

Total SS(trace): 80422

*MARGINAL TESTS*

Variable SS(trace) Pseudo-F P Prop.

Depth\_2 9180.1 2.4483 0.001 0.11415

SeaIce\_mean 6016.9 1.5365 0.057 0.074817

SeaIce\_sd 5799.2 1.4766 0.069 0.07211

flux\_mean 9480.1 2.539 0.001 0.11788

flux\_sd 8367.3 2.2064 0.001 0.10404

closePack\_mean 4125.4 1.0273 0.413 0.051297

closePack\_sd 6986.5 1.8076 0.016 0.086873

iceFree\_mean 7185 1.864 0.009 0.089342

iceFree\_sd 9284.4 2.4798 0.002 0.11545

marginal\_mean 3572.4 0.88323 0.589 0.044421

marginal\_sd 3880.5 0.96326 0.485 0.048252

vgpm\_mean 9984.9 2.6934 0.001 0.12416

vgpm\_sd 8318.1 2.1919 0.003 0.10343

res.df: 19

*START SOLUTION*

 Adj R^2 R^2 RSS No.Vars Selections

 0.067526 0.11415 71241 1 7

*SEQUENTIAL TESTS*

Variable Adj R^2 SS(trace) Pseudo-F P Prop. Cumul. res.df

+iceFree\_sd 0.14315 9223.4 2.677 0.001 0.11469 0.22884 18

+vgpm\_mean 0.20916 7957.5 2.5023 0.001 0.098948 0.32779 17

+flux\_mean 0.2584 6348.2 2.1288 0.002 0.078936 0.40672 16

+marginal\_mean 0.2662 3452.6 1.1701 0.27 0.042931 0.44965 15

+vgpm\_sd 0.26937 3129.1 1.0651 0.358 0.038909 0.48856 14

*BEST SOLUTION*

 Adj R^2 R^2 RSS No.Vars Selections

 0.26937 0.48856 41131 6 5,7,11,12,16,17

*Percentage of variation explained by individual axes*

 % explained variation % explained variation

 out of fitted model out of total variation

Axis Individual Cumulative Individual Cumulative

 1 30.29 30.29 14.8 14.8

 2 27.18 57.47 13.28 28.08

 3 18.43 75.9 9.01 37.08

 4 11.26 87.16 5.5 42.58

 5 7.13 94.29 3.48 46.07

 6 5.71 100 2.79 48.86

*dbRDA coordinate scores*

 Sample dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6

tan0802\_025 37.284 2.564 10.927 -31.956 2.6337 3.8798

tan0802\_040 -6.7361 32.881 -4.8905 2.1323 -11.958 31.466

tan0802\_055 27.275 16.046 -4.7156 0.22209 6.3099 -5.6119

tan0802\_065 15.546 26.29 -7.2332 21.626 1.3865 -13.679

tan0802\_069 5.656 34.33 -7.2538 4.4551 -34.74 1.7406

tan0802\_076 -2.3034 33.457 -13.599 21.318 23.107 4.6875

tan0802\_080 38.612 5.0449 5.207 7.216 21.752 9.2786

tan0802\_093 42.085 11.395 -4.2439 -21.081 -1.6545 -11.449

tan0802\_105 -31.528 23.446 0.43916 -9.7182 0.81835 -19.633

tan0802\_108 -41.975 15.574 -4.9784 -0.73939 0.057172 -11.433

tan0802\_114 -18.318 1.1744 26.456 -18.854 3.2575 1.8586

tan0802\_120 -26.334 -3.368 20.217 -6.3811 5.7368 3.9486

tan0802\_130 -40.663 3.5647 0.54329 -6.8393 7.1629 1.9228

tan0802\_141 3.0749 -29.58 17.193 19.948 -2.1378 2.8749

tan0802\_150 3.39 -22.871 32.768 18.386 -5.6395 0.95868

tan0802\_159 11.659 -16.218 32.101 -3.7686 -8.478 -5.111

tan0802\_166 0.81895 -21.929 2.1733 17.358 -5.8452 -4.2345

tan0802\_169 -15.815 -19.578 -3.6989 0.96888 3.318 6.3511

tan0802\_186 13.94 -32.555 -32.503 8.9343 -8.6071 -8.1656

tan0802\_228 -4.8635 -27.98 -36.153 -14.646 -3.8514 8.7436

tan0802\_285 -10.807 -31.688 -28.754 -8.579 7.3724 1.6056

*Relationships between dbRDA coordinate axes and orthonormal X variables*

*(multiple partial correlations)*

Variable dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6

Depth\_2 0.214 0.635 0.724 -0.054 0.083 -0.128

iceFree\_sd -0.522 0.482 -0.383 -0.431 0.301 -0.268

vgpm\_mean 0.583 0.388 -0.486 0.240 0.367 0.285

flux\_mean 0.549 -0.197 -0.069 -0.781 -0.102 -0.184

marginal\_mean 0.188 0.140 -0.244 0.353 -0.396 -0.777

vgpm\_sd -0.072 0.394 -0.168 -0.137 -0.775 0.439

*Weights*

*(Coefficients for linear combinations of X's in the formation of dbRDA coordinates)*

Variable dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6

Depth\_2 -0.014326 0.008841 0.026417 0.0029311 0.001552 0.0072267

iceFree\_sd -651.08 547.88 -350.84 -337.21 193.01 -116.52

vgpm\_mean 0.032455 0.029027 -0.05455 0.090147 0.089303 -0.0096908

flux\_mean 2.3649 -0.46216 -0.58715 -1.9543 -0.48756 -0.80727

marginal\_mean 353.6 187.66 -296.51 379.34 -331.98 -555.96

vgpm\_sd 0.0079875 0.051134 0.0057419 -0.11525 -0.20714 0.044044

*Outputs*

Plot: Graph7

**Supplementary Table 6.** Output of distance based linear model (DistLM) investigating the relationship between untransformed macro-infaunal communities, and sea ice, productivity and flux variables at each site. Analyses were conducted using Primer 7.

DistLM

Distance based linear models

*Resemblance worksheet*

Name: Resem\_CM\_nt

Data type: Similarity

Selection: All

Resemblance: S17 Bray-Curtis similarity

*Predictor variables worksheet*

Name: Subset\_envExtract\_CM

Data type: Environmental

Sample selection: All

Variable selection: 1,2,5-13,16,17

Selection criterion: Adjusted R^2

Selection procedure: Step-wise

*VARIABLES*

 1 SeaIce\_mean Trial

 2 SeaIce\_sd Trial

 5 flux\_mean Trial

 6 flux\_sd Trial

 7 Depth\_2 Trial

 8 closePack\_mean Trial

 9 closePack\_sd Trial

10 iceFree\_mean Trial

11 iceFree\_sd Trial

12 marginal\_mean Trial

13 marginal\_sd Trial

16 vgpm\_mean Trial

17 vgpm\_sd Trial

Total SS(trace): 42478

*MARGINAL TESTS*

Variable SS(trace) Pseudo-F P Prop.

SeaIce\_mean 3312.2 0.93023 0.466 0.077973

SeaIce\_sd 6141.9 1.8593 0.051 0.14459

flux\_mean 11116 3.899 0.003 0.26169

flux\_sd 9328.1 3.0953 0.001 0.2196

Depth\_2 12411 4.5405 0.001 0.29217

closePack\_mean 2303.7 0.63075 0.811 0.054232

closePack\_sd 7561.2 2.382 0.018 0.178

iceFree\_mean 6241.9 1.8948 0.041 0.14694

iceFree\_sd 2031.6 0.55252 0.895 0.047826

marginal\_mean 3847.4 1.0955 0.332 0.090574

marginal\_sd 6051.8 1.8275 0.066 0.14247

vgpm\_mean 10998 3.8431 0.001 0.25891

vgpm\_sd 7584.5 2.391 0.006 0.17855

res.df: 11

NO STARTING TERMS

*SEQUENTIAL TESTS*

Variable Adj R^2 SS(trace) Pseudo-F P Prop. Cumul. res.df

+Depth\_2 0.22782 12411 4.5405 0.001 0.29217 0.29217 11

+vgpm\_mean 0.36918 7737.2 3.4649 0.001 0.18214 0.47431 10

+flux\_mean 0.42131 3893.8 1.9008 0.015 0.091665 0.56598 9

+iceFree\_mean 0.43724 2499.8 1.2549 0.222 0.058849 0.62483 8

+SeaIce\_sd 0.46115 2584.6 1.355 0.197 0.060845 0.68567 7

+marginal\_sd 0.47603 2223.3 1.1987 0.328 0.052341 0.73801 6

+closePack\_sd 0.48313 1980.6 1.0825 0.425 0.046626 0.78464 5

*BEST SOLUTION*

 Adj R^2 R^2 RSS No.Vars Selections

 0.48313 0.78464 9148.2 7 2,5,7,9,10,13,16

*Percentage of variation explained by individual axes*

 % explained variation % explained variation

 out of fitted model out of total variation

Axis Individual Cumulative Individual Cumulative

 1 39.49 39.49 30.98 30.98

 2 25.81 65.29 20.25 51.23

 3 11.91 77.2 9.34 60.58

 4 9.34 86.54 7.32 67.9

 5 5.45 91.98 4.27 72.17

 6 4.94 96.93 3.88 76.05

 7 3.07 100 2.41 78.46

*dbRDA coordinate scores*

Sample dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6 dbRDA7

 C1 37.313 10.17 -5.5774 11.474 3.6664 5.3966 22.864

 C2 21.692 5.6093 1.8027 -46.059 3.3239 15.739 2.1454

 C3 32.392 15.014 -6.4965 -12.885 2.9683 -25.364 -7.2387

 C5 46.992 20.98 -3.1204 12.956 -1.8799 7.7391 -18.505

 C4 37.98 17.623 7.0219 18.533 -7.3724 1.393 4.0699

 C16 -3.3849 -36.236 4.9376 7.6674 6.8537 6.027 -1.188

 C17 -13.964 -24.076 -20.7 5.9599 23.121 1.7409 -3.2047

 C26 -5.646 -43.377 22.077 1.4957 -12.594 8.9038 -4.3331

 C25 3.2283 -35.161 14.143 -5.2817 -8.2159 -21.96 5.3113

 C18 -26.442 -12.722 -33.449 4.2572 -6.8814 3.2872 -2.32

 C30 -43.353 20.905 -23.083 -3.9286 -9.6154 -4.696 4.301

 C33 -44.783 31.944 12.833 1.165 -16.113 4.7663 -1.6906

 C35 -42.027 29.328 29.611 4.6461 22.739 -2.9718 -0.2111

*Relationships between dbRDA coordinate axes and orthonormal X variables*

*(multiple partial correlations)*

Variable dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6 dbRDA7

Depth\_2 0.868 -0.484 0.048 0.039 0.003 -0.077 0.053

vgpm\_mean 0.463 0.734 -0.126 -0.397 -0.046 0.223 -0.145

flux\_mean 0.162 0.453 0.103 0.673 -0.157 -0.346 0.400

iceFree\_mean 0.031 0.094 0.877 0.115 0.110 0.066 -0.437

SeaIce\_sd -0.019 0.013 0.331 -0.243 0.405 0.319 0.751

marginal\_sd -0.059 0.000 0.257 -0.562 -0.335 -0.687 0.176

closePack\_sd -0.034 -0.110 0.162 0.018 -0.828 0.496 0.171

*Weights*

*(Coefficients for linear combinations of X's in the formation of dbRDA coordinates)*

Variable dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6 dbRDA7

Depth\_2 0.012588 -0.027833 0.037372 -0.010471 0.00066581 0.0035451 -0.001477

vgpm\_mean 0.055819 0.089484 -0.083369 -0.017623 0.06512 -0.040701 -0.06445

flux\_mean 0.68503 1.4915 -2.0513 1.6653 -0.51415 -0.64376 0.96426

iceFree\_mean 41.44 101.98 634.81 73.826 69.257 29.74 -160.85

SeaIce\_sd 1.5578 6.519 9.3922 -4.5828 24.033 -6.3059 2.8519

marginal\_sd -446 -128.7 1068.6 -1812.4 -1281 -1366.5 399.92

closePack\_sd -293.76 -541.2 718.43 -342.81 -2055.5 700.33 352.85

*Outputs*

Plot: Graph7

Supplementary Table 7. Output of distance based linear model (DistLM) investigating the relationship between untransformed mega-epifauna abundance weighted feeding traits, and sea ice, productivity and flux variables at each site. Analyses were conducted using Primer 7.

DistLM

Distance based linear models

*Resemblance worksheet*

Name: Resem5

Data type: Similarity

Selection: All

Resemblance: S17 Bray-Curtis similarity

*Predictor variables worksheet*

Name: TAN0802\_DTIS\_envExtract\_CPR2\_PRIMER

Data type: Environmental

Sample selection: All

Variable selection: All

Selection criterion: Adjusted R^2

Selection procedure: Step-wise

*VARIABLES*

 1 SeaIce\_mean Trial

 2 SeaIce\_sd Trial

 3 chl\_mean Exclude

 4 chl\_sd Exclude

 5 flux\_mean Trial

 6 flux\_sd Trial

 7 DepthIBSCO Include

 8 iceClosePack\_mean Trial

 9 iceClosePack\_sd Trial

10 iceFree\_mean Trial

11 iceFree\_sd Trial

12 iceMarginal\_mean Trial

13 iceMarginal\_sd Trial

14 iceOpenPack\_mean Exclude

15 iceOpenPack\_sd Exclude

16 vgpm\_mean Trial

17 vgpm\_sd Trial

Total SS(trace): 37869

*MARGINAL TESTS*

Variable SS(trace) Pseudo-F P Prop.

DepthIBSCO 11317 8.0986 0.001 0.29886

SeaIce\_mean 3740.5 2.0824 0.081 0.098774

SeaIce\_sd 3816.3 2.1293 0.078 0.10078

flux\_mean 10274 7.0738 0.001 0.2713

flux\_sd 10904 7.6835 0.001 0.28795

iceClosePack\_mean 1716.1 0.90187 0.463 0.045316

iceClosePack\_sd 6802.1 4.1601 0.005 0.17962

iceFree\_mean 5732.2 3.389 0.01 0.15137

iceFree\_sd 2332.9 1.2473 0.273 0.061604

iceMarginal\_mean 2723.7 1.4725 0.224 0.071924

iceMarginal\_sd 1663 0.87273 0.498 0.043916

vgpm\_mean 10736 7.5175 0.001 0.28349

vgpm\_sd 9033.4 5.9522 0.002 0.23854

res.df: 19

*START SOLUTION*

 Adj R^2 R^2 RSS No.Vars Selections

 0.26195 0.29886 26552 1 7

*SEQUENTIAL TESTS*

Variable Adj R^2 SS(trace) Pseudo-F P Prop. Cumul. res.df

+flux\_mean 0.44705 7706 7.3603 0.001 0.20349 0.50235 18

+vgpm\_sd 0.56321 4785.9 5.7868 0.001 0.12638 0.62873 17

+iceFree\_sd 0.61006 2246.3 3.0425 0.013 0.05932 0.68805 16

+vgpm\_mean 0.62086 1045.2 1.4559 0.234 0.0276 0.71565 15

+SeaIce\_mean 0.62592 851.95 1.2028 0.34 0.02250 0.73814 14

*BEST SOLUTION*

 Adj R^2 R^2 RSS No.Vars Selections

 0.62592 0.73814 9916.2 6 1,5,7,11,16,17

*Percentage of variation explained by individual axes*

 % explained variation % explained variation

 out of fitted model out of total variation

Axis Individual Cumulative Individual Cumulative

 1 47.62 47.62 35.15 35.15

 2 33.12 80.74 24.45 59.6

 3 11.57 92.31 8.54 68.14

 4 4.86 97.18 3.59 71.73

 5 2.09 99.26 1.54 73.27

 6 0.74 100 0.54 73.81

*dbRDA coordinate scores*

Sample dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6

 25 35.963 -10.867 11.355 -11.587 2.3925 -8.0669

 40 32.183 -3.6585 -17.342 19.669 4.7788 -2.4084

 55 30.483 -8.4039 -0.14431 -9.2702 2.0128 -0.47387

 65 24.279 14.375 -9.6699 -8.5124 5.5297 -1.0002

 69 26.265 -7.5425 -7.1311 19.324 -2.51 -2.514

 76 21.643 14.105 -16.18 -3.0184 6.2002 7.3305

 80 29.544 -4.0052 13.279 -3.6048 5.675 6.2431

 93 33.779 -37.041 15.46 -1.0925 -8.1723 3.1783

 105 0.88948 10.807 -15.082 -8.7969 -9.6913 -0.73158

 108 -14.544 15.209 -18.331 -2.6453 -6.0151 0.17089

 114 2.0492 10.574 6.4982 0.44029 -9.1154 0.23547

 120 -10.203 19.34 0.83352 -0.027906 -4.3076 0.30178

 130 -17.002 11.411 -13.483 -2.1509 -4.1811 0.38365

 141 -23.786 25.001 9.4005 3.4947 3.8359 0.8811

 150 -16.805 34.012 21.215 8.1486 2.4288 0.64455

 159 -2.3032 11.817 23.753 4.3829 -4.8302 -0.53757

 166 -24.29 11.19 5.7492 0.3125 5.315 -1.6611

 169 -22.768 2.336 -5.3214 -5.2043 4.2051 -3.4982

 186 -33.817 -28.879 2.2346 -1.4507 5.987 -1.4846

 228 -32.917 -49.194 -3.6097 6.5178 -0.77752 1.8721

 285 -38.642 -30.585 -3.4852 -4.9287 1.2397 1.135

*Relationships between dbRDA coordinate axes and orthonormal X variables*

*(multiple partial correlations)*

Variable dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6

DepthIBSCO 0.744 0.560 0.215 -0.046 -0.290 0.001

flux\_mean 0.225 -0.673 0.445 -0.294 -0.348 -0.301

vgpm\_sd 0.276 -0.232 -0.307 0.785 -0.090 -0.390

iceFree\_sd 0.058 -0.163 -0.647 -0.210 -0.612 0.365

vgpm\_mean 0.558 -0.363 -0.188 -0.125 0.610 0.367

SeaIce\_mean 0.073 0.144 -0.456 -0.486 0.201 -0.700

*Weights*

*(Coefficients for linear combinations of X's in the formation of dbRDA coordinates)*

Variable dbRDA1dbRDA2dbRDA3dbRDA4dbRDA5 dbRDA6

DepthIBSCO 0.0055771 0.027071 0.0040927 0.0073113 -0.0025304 0.0018376

flux\_mean 1.2207 -2.8768 0.74957 -0.62094 -0.42427 -0.2604

vgpm\_sd 0.052985 -0.15783 0.033979 0.15921 -0.057249 -0.010484

iceFree\_sd 77.676 -184.14 -429.57 -90.498 -173.04 61.266

vgpm\_mean 0.0214 0.0517 -0.039983 -0.057717 0.040828 0.010072

SeaIce\_mean 0.57949 0.53765 -0.8195 -1.123 0.44157 -0.67971

*Outputs*

Plot: Graph1 [RDA\_DTIS\_trait\_abundance.png]

Supplementary Table 8. Output of distance based linear model (DistLM) investigating the relationship between untransformed macro-infauna abundance weighted feeding traits, and sea ice, productivity and flux variables at each site. Analyses were conducted using Primer 7.

DistLM

Distance based linear models

*Resemblance worksheet*

Name: Resem2

Data type: Similarity

Selection: All

Resemblance: S17 Bray-Curtis similarity

*Predictor variables worksheet*

Name: TAN0802\_MUC\_envExtract\_CPR2

Data type: Environmental

Sample selection: 1-3,7,8,12,13,15,16,18-21

Variable selection: All

Selection criterion: Adjusted R^2

Selection procedure: Step-wise

*VARIABLES*

 1 SeaIce\_mean Trial

 2 SeaIce\_sd Trial

 3 chl\_mean Exclude

 4 chl\_sd Exclude

 5 flux\_mean Trial

 6 flux\_sd Trial

 7 DepthIBSCO Include

 8 iceClosePack\_mean Trial

 9 iceClosePack\_sd Trial

10 iceFree\_mean Trial

11 iceFree\_sd Trial

12 iceMarginal\_mean Trial

13 iceMarginal\_sd Trial

14 iceOpenPack\_mean Exclude

15 iceOpenPack\_sd Exclude

16 vgpm\_mean Trial

17 vgpm\_sd Trial

Total SS(trace): 25967

*MARGINAL TESTS*

Variable SS(trace) Pseudo-F P Prop.

DepthIBSCO 16197 18.234 0.001 0.62373

SeaIce\_mean 2515.8 1.1801 0.31 0.096884

SeaIce\_sd 3423.1 1.6702 0.198 0.13182

flux\_mean 12508 10.223 0.002 0.48169

flux\_sd 11239 8.3944 0.002 0.43283

iceClosePack\_mean 1243.8 0.55338 0.622 0.047898

iceClosePack\_sd 5568.8 3.003 0.062 0.21445

iceFree\_mean 6866 3.9539 0.037 0.26441

iceFree\_sd 961.2 0.42282 0.719 0.037016

iceMarginal\_mean 4219.8 2.1344 0.128 0.16251

iceMarginal\_sd 6004.1 3.3083 0.046 0.23122

vgpm\_mean 10909 7.9686 0.003 0.42009

vgpm\_sd 5998 3.3039 0.049 0.23098

res.df: 11

*START SOLUTION*

 Adj R^2 R^2 RSS No.Vars Selections

 0.58952 0.62373 9770.9 1 7

*SEQUENTIAL TESTS*

Variable Adj R^2 SS(trace) Pseudo-F P Prop. Cumul. res.df

+flux\_mean 0.7432 4213.8 7.5828 0.006 0.16227 0.786 10

+iceClosePack\_sd 0.80139 1689 3.9299 0.025 0.065044 0.85104 9

+iceFree\_mean 0.82993 923.87 2.5104 0.067 0.035578 0.88662 8

+SeaIce\_sd 0.85289 715.79 2.2485 0.042 0.027565 0.91419 7

+iceMarginal\_mean 0.86343 455.16 1.5401 0.218 0.017528 0.93171 6

+iceFree\_sd 0.86577 320.94 1.1049 0.362 0.012359 0.94407 5

+flux\_sd 0.87545 374.17 1.3882 0.24 0.014409 0.95848 4

+vgpm\_mean 0.88471 329.65 1.3213 0.336 0.012695 0.97118 3

+iceMarginal\_sd 0.89999 315.61 1.4583 0.296 0.012154 0.98333 2

+vgpm\_sd 0.90228 221.4 1.047 0.459 0.008526 0.99186 1

-vgpm\_mean 0.91373 161.93 0.76578 0.555 0.0062358 0.98562 2

*BEST SOLUTION*

 Adj R^2 R^2 RSS No.Vars Selections

 0.91373 0.98562 373.38 10 2,5-7,9-13,17

*Percentage of variation explained by individual axes*

 % explained variation % explained variation

 out of fitted model out of total variation

Axis Individual Cumulative Individual Cumulative

 1 69.02 69.02 68.02 68.02

 2 22.4 91.42 22.08 90.1

 3 4.36 95.77 4.29 94.39

 4 2.18 97.95 2.15 96.55

 5 0.96 98.91 0.94 97.49

 6 0.59 99.5 0.58 98.07

 7 0.55 100.05 0.54 98.61

 8 0.18 100.23 0.18 98.79

 9 0.03 100.26 0.03 98.82

 10 -0.26 100 -0.26 98.56

*dbRDA coordinate scores*

Sample dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6 dbRDA7 dbRDA8 dbRDA9 dbRDA10

 29 38.218 16.973 3.147 2.6297 -0.28429 -1.3429 -2.1057 4.3346 1.3647 1.9615

 88 37.075 24.352 7.3543 -5.1514 -2.3576 2.637 -3.6109 -2.9435 0.64949 -1.8823

 98 40.172 19.456 5.8006 -1.9072 -0.3255 0.94101 -1.0514 1.5487 -2.1444 -1.1745

 63 39.048 6.8805 0.87231 -1.0196 -0.84008 -4.0157 6.0181 -1.9508 -0.094885 4.184

 45 28.977 -7.2923 -6.7547 14.797 0.046448 -2.421 2.3638 -0.67397 0.25703 -4.7265

 163 1.0332 -25.854 -2.1395 -15.675 -1.2668 -3.7488 2.5916 0.54456 0.32045 -2.6281

 152 26.146 -12.605 -10.76 -1.9372 9.1898 6.7503 0.49 -0.96932 0.2575 1.139

 124 -1.4378 -36.036 -5.4438 0.71356 1.4719 -3.6148 -7.124 0.26336 -0.46941 1.2487

 138 -10.386 -25.355 0.10045 5.7181 -8.0692 3.9268 1.2485 -0.14944 -0.39667 2.4086

 172 -38.577 -17.045 18.377 0.92169 -2.1065 2.8772 -0.02622 -0.33864 0.52173 -0.70017

 191 -53.745 6.1801 8.6946 1.1595 6.7547 0.28658 3.6181 1.9584 -0.27498 -0.61746

 286 -51.53 27.125 -20.163 -3.0199 -5.132 2.0032 0.32558 0.99459 0.051162 -0.45598

 233 -54.993 23.221 0.91446 2.7702 2.9191 -4.2787 -2.7375 -2.6186 -0.041696 1.2431

*Relationships between dbRDA coordinate axes and orthonormal X variables*

*(multiple partial correlations)*

Variable dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6 dbRDA7 dbRDA8 dbRDA9 dbRDA10

DepthIBSCO 0.938 -0.262 0.056 -0.179 -0.074 -0.021 -0.066 0.053 0.044 -0.022

fluxSeabed\_mean 0.092 0.696 0.260 -0.461 -0.075 -0.179 -0.032 0.133 -0.408 0.052

iceClosePack\_sd 0.032 -0.036 0.122 0.219 0.634 0.007 -0.671 0.113 -0.260 -0.044

iceFree\_mean 0.152 0.339 -0.530 -0.080 0.190 0.045 -0.143 -0.612 0.165 0.339

SeaIce\_sd 0.040 0.148 -0.729 0.069 -0.226 0.083 -0.179 0.534 -0.117 -0.228

iceMarginal\_mean 0.142 0.013 -0.121 0.190 0.446 0.224 0.621 0.232 -0.346 0.349

iceFree\_sd 0.004 -0.170 0.007 0.369 -0.476 -0.253 -0.199 -0.085 -0.446 0.546

fluxSeabed\_sd 0.051 0.281 0.177 0.188 0.005 -0.053 -0.114 0.452 0.631 0.483

iceMarginal\_sd -0.086 -0.217 -0.225 -0.215 0.271 -0.859 0.133 0.113 0.069 0.042

vgpm\_sd 0.235 0.391 0.075 0.665 -0.011 -0.322 0.192 -0.170 0.036 -0.417

*Weights*

*(Coefficients for linear combinations of X's in the formation of dbRDA coordinates)*

Variable dbRDA1 dbRDA2 dbRDA3 dbRDA4 dbRDA5 dbRDA6 dbRDA7 dbRDA8 dbRDA9 dbRDA10

DepthIBSCO 0.019785 -0.03376 -0.021556 0.00031959 0.01058 -0.011791 -0.010161 -3.932E-05 -0.00040504 0.00080349

fluxSeabed\_mean

 -2.2897 0.99693 2.0432 -1.2047 -1.1516 0.27318 0.23892 0.2534 -0.047486 -0.73159

iceClosePack\_sd -833.25 -3119.7 -23.882 638.98 1845 -1386 -1329.1 209.62 -151.39 131.68

iceFree\_mean 517.33 483.67 -308.7 22.239 17.821 72.054 66.709 -64.055 0.13428 80.452

SeaIce\_sd -1.1666 16.195 -11.596 -5.9098 -11.999 6.0468 6.3562 0.97111 0.77673 -3.2764

iceMarginal\_mean 1354.9 668.81 -173.92 329.25 156.12 402.38 348.69 13.404 -47.006 171.25

iceFree\_sd -75.938 -1017.5 -117.42 336.14 355.3 -437.47 -333.86 35.12 -65.987 154.84

fluxSeabed\_sd 4.9521 4.6751 -0.18313 1.2647 -0.13738 0.60197 0.80363 -0.60763 0.31493 1.6626

iceMarginal\_sd -1896.2 -3546.7 -523.74 -23.663 1413.4 -1864.3 -949.55 172.1 -73.673 75.178

vgpm\_sd 0.32182 0.49099 0.065811 -0.0098426 -0.18427 0.19251 0.21152 -0.05389 0.015081 0.0098268

*Outputs*

Plot: Graph1 [RDA\_MUC\_trait\_abundance.png]