**Supplementary Materials**

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**Figure S1. Depth profiles for water parameters measured at sampling stations in Benham Rise.** (A) Temperature (T090C), (B) salinity (Sal00), (C) chlorophyll-a (WetStar), and (D) dissolved oxygen (DO).

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**Figure S2. Depth profiles of nutrients and carbonate parameters in Benham Rise**. Vertical profiles of chemical parameters for all 24 sampling stations (blue dots in map) covering ten depths per station.

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**Figure S3. Rarefaction curves for 16S rRNA libraries from the indicated sampling stations and depths.**

**Table S1.** Physical and chemical parameters of waters sampled for microbial analysis

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample ID** | **Stn** | **Lat**(deg) | **Long**(deg) | **Depth** (m) | **Temperature**(oC) | **Salinity**(psu) | **Turbidity**(mg/L) | **Chl-a**(mg/L) | **PO4** [uM] | **SiO3** [uM] | **NO3 + NO2** [uM] | **DO** [mg/L] | **Total Alkalinity** | **DIC** | **pH** |
| SURF 8 | 8 | 16.223 | 124.507 | 10 | 29.70 | 34.26 | 0.1217 | 0.00 | 0.11 | 1.16 | UD | 5.79 | 2250 | 1930 | 8.10 |
| SURF 17 | 17 | 16.232 | 123.519 | 10 | 29.75 | 34.62 | 0.1474 | 0.02 | 0.07 | 6.47 | UD | 5.54 | 2280 | 1963 | 8.06 |
| SURF 20 | 20 | 16.576 | 124.002 | 10 | 29.70 | 34.30 | 0.1157 | 0.00 | UD | 1.77 | UD | 5.64 | 2248 | 1938 | 8.09 |
| SURF 23 | 23 | 15.490 | 124.123 | 10 | 29.86 | 34.59 | 0.1161 | 0.00 | UD | 4.39 | UD | 5.61 | 2270 | 1951 | 8.07 |
| SURF 26 | 26 | 14.729 | 123.833 | 10 | 29.17 | 34.48 | 0.1306 | 0.00 | UD | 2.85 | UD | 5.81 | 2257 | 1933 | 8.14 |
| DCM 8 | 8 | 16.223 | 124.507 | 200 | 20.30 | 34.90 | 0.1234 | 0.00 | 0.15 | 1.84 | UD | 5.74 | 2292 | 1996 | 8.05 |
| DCM 20 | 20 | 16.576 | 124.002 | 160 | 24.58 | 34.92 | 0.1141 | 0.35 | 0.04 | 3.51 | 0.27 | 5.34 | 2290 | 2020 | 8.00 |
| DCM 23 | 23 | 15.490 | 124.123 | 140 | 24.63 | 34.97 | 0.1284 | 0.36 | UD | 2.74 | UD | 5.27 | 2302 | 2019 | 8.01 |
| DCM 26 | 26 | 14.729 | 123.833 | 90 | 24.51 | 34.94 | 0.1401 | 0.26 | UD | 5.57 | UD | 5.45 | 2295 | 2012 | 8.07 |
| UMP 8 | 8 | 16.223 | 124.507 | 300 | 16.60 | 34.67 | 0.1268 | 0.00 | 0.26 | 5.33 | UD | 5.34 | 2286 | 2053 | 7.94 |
| UMP 26 | 26 | 14.729 | 123.833 | 300 | 14.47 | 34.53 | 0.1378 | 0.00 | 0.42 | 14.26 | 7.23 | 5.03 | 2289 | 2109 | 7.86 |

legends: Stn – station, lat – latitude, long – longitude, deg – degree, UD – undetectable

**Table S2.** CTD data (see excel sheet)

**Table S3.** Chemical parameter data (see excel sheet)

**Table S4.** Statistical tests of microbial community structure similarity based on the Yue & Clayton and the Jaccard dissimilarity indices.

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| --- |
| **Parsimony test** |
| Yue & Clayton | Jaccard |
| Tree# | Groups | ParsScore | ParsSig | Tree# | Groups | ParsScore | ParsSig |
| 1 | DCM-SURF | 4 | 1 | 1 | DCM-SURF | 1 | 0.009 |
| 1 | DCM-UMP | 1 | 0.128 | 1 | DCM-UMP | 1 | 0.142 |
| 1 | SURF-UMP | 1 | 0.113 | 1 | SURF-UMP | 1 | 0.128 |
| **Unweighted UniFrac** |
| Yue & Clayton | Jaccard |
| Tree# | Groups | UWScore | UWSig | Tree# | Groups | UWScore | UWSig |
| 1 | DCM-SURF | 0.522015 | 0.793 | 1 | DCM-SURF | 1 | 0.036 |
| 1 | DCM-UMP | 1 | 0.332 | 1 | DCM-UMP | 1 | 0.37 |
| 1 | SURF-UMP | 1 | 0.282 | 1 | SURF-UMP | 1 | 0.047 |
| **Weighted UniFrac** |
| Yue & Clayton | Jaccard |
| Tree# | Groups | WScore | WSig | Tree# | Groups | WScore | WSig |
| 1 | DCM-SURF | 0.326649 | 0.199 | 1 | DCM-SURF | 1 | <0.0010 |
| 1 | DCM-UMP | 1 | <0.0010 | 1 | DCM-UMP | 1 | 0.043 |
| 1 | SURF-UMP | 1 | <0.0010 | 1 | SURF-UMP | 1 | <0.0010 |
| **AMOVA** |
| Yue & Clayton | Jaccard |
| DCM-SURF-UMP | Among | Within | Total | DCM-SURF-UMP | Among | Within | Total |
| SS | 1.34444 | 0.397095 | 1.74153 | SS | 1.32286 | 2.32542 | 3.64827 |
| df | 2 | 8 | 10 | df | 2 | 8 | 10 |
| MS | 0.672219 | 0.0496369 |   | MS | 0.661428 | 0.290677 |   |
| Fs: | 13.5427 |   |   | Fs: | 2.27547 |   |   |
| p-value: | 0.005 |   |   | p-value | <0.001 |   |   |
| **HOMOVA** |
| Yue & Clayton | Jaccard |
|   | Bvalue | P-value |   | BValue | P-value |
| DCM-SURF-UMP | 3.11732 | 0.565 | DCM-SURF-UMP | 0.0219614 | 0.191 |
| **ʃ-LIBSHUFF** |
| Yue & Clayton | Jaccard |
| Comparison | dCXYScore | Significance | Comparison | dCXYScore | Significance |
| DCM-SURF  | 0.00651325 | 0.866 | DCM-SURF  | 0.1159202 | 0.0072 |
| SURF-DCM  | 0.00567132 | 0.7401 | SURF-DCM  | 0.08439142 | <0.0001 |
| DCM-UMP  | 0.83380875 | 0.0679 | DCM-UMP  | 0.07416752 | 0.0692 |
| UMP-DCM  | 0.25853403 | 0.5279 | UMP-DCM  | 0.13417697 | 0.2675 |
| SURF-UMP  | 0.80135013 | <0.0001 | SURF-UMP  | 0.13425305 | 0.0499 |
| UMP-SURF  | 0.23286927 | 0.6656 | UMP-SURF  | 0.22891821 | 0.0499 |

**Table S5. Depth-associated OTUs.** Selected OTUs that differentiate between depths were identified using LEfSe. Selected OTUs responsible for differences in the grouping of samples were identified using indicator analysis.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OTU Number** | **Taxonomy** | **Depth** | **Test** | **p-value** |
| Otu00005 | Nitrosopumilaceae | UMP | LEfSe | 0.012 |
| Otu00007 | SAR86 | SURF | LEfSe | 0.013 |
| Otu00009 | Marine Group II | DCM | LEfSe | 0.023 |
| Otu00015 | SAR116 | SURF | LEfSe | 0.014 |
| Otu00310 | Nitrospina | UMP | Indicator | 0.019 |
| Otu00702 | Spirochaeta | UMP | Indicator | 0.026 |