Supplementary Materials:Environmental Variation and How its Spatial Structure Influences the Cross-Shelf Distribution of High-Latitude Coral Communities in South Africa

Sean N. Porter \* and Michael H. Schleyer

Oceanographic Research Institute, PO Box 10712, Marine Parade, 4056 Durban, South Africa; schleyer@ori.org.za

**Electronic Supplementary Material 8**

**Table S1.** Partial distance-based linear model marginal tests for correlations between the 75 spatial variables, and the environmental variables fitted as a group, with reef community structure (Model 4).

| **Variable** | **SS(Trace)** | **FPseudo** | **P(perm)** | **Proportion of variance** |
| --- | --- | --- | --- | --- |
| Group (Environmental variables) | 82057 | 16.544 | **0.0001** | 0.13782 |
| *S1* | 19906 | 14.423 | **0.0001** | 0.033432 |
| *S2* | 22714 | 16.539 | **0.0001** | 0.038149 |
| *S3* | 14910 | 10.71 | **0.0001** | 0.025041 |
| *S4* | 5325.1 | 3.7632 | **0.0011** | 0.008944 |
| *S5* | 26690 | 19.57 | **0.0001** | 0.044826 |
| *S6* | 10576 | 7.5411 | **0.0001** | 0.017763 |
| *S7* | 3503.7 | 2.4683 | 0.0165 | 0.005885 |
| *S8* | 2361.2 | 1.6603 | 0.0883 | 0.003966 |
| *S9* | 15335 | 11.024 | **0.0001** | 0.025755 |
| *S10* | 1755.7 | 1.2332 | 0.2272 | 0.002949 |
| *S11* | 7800.8 | 5.5359 | **0.0001** | 0.013102 |
| *S12* | 11125 | 7.9395 | **0.0001** | 0.018684 |
| *S13* | 3356.8 | 2.3643 | 0.022 | 0.005638 |
| *S14* | 4634.7 | 3.2714 | 0.0029 | 0.007784 |
| *S15* | 3600.5 | 2.537 | 0.0143 | 0.006047 |
| *S16* | 3039.7 | 2.1398 | 0.0328 | 0.005105 |
| *S17* | 2567.2 | 1.8057 | 0.0651 | 0.004312 |
| *S18* | 5142.8 | 3.6332 | **0.0015** | 0.008637 |
| *S19* | 4309.9 | 3.0405 | **0.0061** | 0.007239 |
| *S20* | 4150.4 | 2.9272 | **0.0062** | 0.006971 |
| *S21* | 3108.4 | 2.1884 | 0.032 | 0.005221 |
| *S22* | 7368.2 | 5.225 | **0.0002** | 0.012375 |
| *S23* | 3178.1 | 2.2377 | 0.0271 | 0.005338 |
| *S24* | 3210.6 | 2.2608 | 0.0207 | 0.005392 |
| *S25* | 3316.3 | 2.3356 | 0.0238 | 0.00557 |
| *S26* | 4641.3 | 3.2761 | **0.0022** | 0.007795 |
| *S27* | 4072 | 2.8715 | **0.0065** | 0.006839 |
| *S28* | 1747.4 | 1.2274 | 0.2423 | 0.002935 |
| *S29* | 2090.6 | 1.4693 | 0.1384 | 0.003511 |
| *S30* | 2996 | 2.1089 | 0.0342 | 0.005032 |
| *S31* | 1929.2 | 1.3555 | 0.1765 | 0.00324 |
| *S32* | 3646.6 | 2.5696 | 0.0136 | 0.006125 |
| *S33* | 3885 | 2.7388 | **0.0088** | 0.006525 |
| *S34* | 2606.5 | 1.8335 | 0.0658 | 0.004378 |
| *S35* | 2152.9 | 1.5133 | 0.1175 | 0.003616 |
| *S36* | 1940.7 | 1.3637 | 0.1713 | 0.00326 |
| *S37* | 2560.4 | 1.8009 | 0.0662 | 0.0043 |
| *S38* | 2341.8 | 1.6466 | 0.0938 | 0.003933 |
| *S39* | 1829.7 | 1.2854 | 0.2086 | 0.003073 |
| *S40* | 1653.1 | 1.161 | 0.2837 | 0.002776 |
| *S41* | 2803.9 | 1.973 | 0.0447 | 0.004709 |
| *S42* | 3465.3 | 2.4411 | 0.0159 | 0.00582 |
| *S43* | 1588.6 | 1.1156 | 0.3167 | 0.002668 |
| *S44* | 1898.6 | 1.3339 | 0.1904 | 0.003189 |
| *S45* | 2226.2 | 1.565 | 0.1107 | 0.003739 |
| *S46* | 1863.1 | 1.3089 | 0.1998 | 0.003129 |
| *S47* | 1918.2 | 1.3477 | 0.1845 | 0.003222 |
| *S48* | 3677.5 | 2.5916 | 0.0123 | 0.006176 |
| *S49* | 2197.6 | 1.5448 | 0.1215 | 0.003691 |
| *S50* | 1166.4 | 0.81851 | 0.5732 | 0.001959 |
| *S51* | 1746.3 | 1.2266 | 0.2412 | 0.002933 |
| *S52* | 1161.1 | 0.8148 | 0.5841 | 0.00195 |
| *S53* | 1304.2 | 0.9154 | 0.4831 | 0.00219 |
| *S54* | 1632.8 | 1.1467 | 0.2867 | 0.002742 |
| *S55* | 1931.3 | 1.357 | 0.1773 | 0.003244 |
| *S56* | 1618.2 | 1.1364 | 0.2997 | 0.002718 |
| *S57* | 876.97 | 0.6151 | 0.8094 | 0.001473 |
| *S58* | 1705.9 | 1.1982 | 0.2536 | 0.002865 |
| *S59* | 1396.3 | 0.98023 | 0.4171 | 0.002345 |
| *S60* | 2579.1 | 1.8142 | 0.064 | 0.004332 |
| *S61* | 1575.9 | 1.1066 | 0.3206 | 0.002647 |
| *S62* | 2253.3 | 1.5841 | 0.1054 | 0.003784 |
| *S63* | 2557.5 | 1.7989 | 0.0682 | 0.004295 |
| *S64* | 1528.9 | 1.0736 | 0.3305 | 0.002568 |
| *S65* | 1908.7 | 1.3411 | 0.1861 | 0.003206 |
| *S66* | 1937.8 | 1.3616 | 0.1703 | 0.003255 |
| *S67* | 1239.3 | 0.86977 | 0.5207 | 0.002081 |
| *S68* | 2245.6 | 1.5787 | 0.1093 | 0.003772 |
| *S69* | 1252.5 | 0.87901 | 0.511 | 0.002104 |
| *S70* | 2112.4 | 1.4847 | 0.1297 | 0.003548 |
| *S71* | 1279.4 | 0.89799 | 0.4884 | 0.002149 |
| *S72* | 1936 | 1.3603 | 0.183 | 0.003252 |
| *S73* | 1368.1 | 0.96037 | 0.4332 | 0.002298 |
| *S74* | 1366 | 0.95892 | 0.4363 | 0.002294 |
| *S75* | 2254.5 | 1.585 | 0.106 | 0.003786 |

Significant *P*-values are indicated in bold (α = 0.01). SS(Trace) = Sums of squares of trace statistic. *F*Pseudo = Pseudo *F*-statistic. *P*(perm) = Probability value by permutation.

**Table S2.** Partial distance-based linear model (Model 4) sequential tests for correlations between the 75 spatial variables and reef community structure after the effects of the four environmental variables have been considered showing the proportions of pure spatially structured variation associated with reef communities. The total cumulative variation in reef communities accounted for by the spatial variables amounted to 39%.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Adj. R2 | SS(Trace) | FPseudo | P(perm) | Proportion of variance | Cumulative  variance explained | Res. df | Regr. df |
| Group (Environmental variables) | 0.12949 | 82057 | 16.544 | **0.0001** | 0.13782 | 0.13782 | 414 | 5 |
| *+S5* | 0.16836 | 24109 | 20.352 | **0.0001** | 0.040492 | 0.17831 | 413 | 6 |
| *+S2* | 0.19665 | 17789 | 15.546 | **0.0001** | 0.029877 | 0.20818 | 412 | 7 |
| *+S12* | 0.21188 | 10061 | 8.9619 | **0.0001** | 0.016897 | 0.22508 | 411 | 8 |
| *+S3* | 0.22532 | 8968.2 | 8.1272 | **0.0001** | 0.015062 | 0.24014 | 410 | 9 |
| *+S18* | 0.2356 | 7095.4 | 6.5165 | **0.0001** | 0.011917 | 0.25206 | 409 | 10 |
| *+S6* | 0.24567 | 6937.2 | 6.4563 | **0.0001** | 0.011651 | 0.26371 | 408 | 11 |
| *+S22* | 0.25535 | 6689.3 | 6.3066 | **0.0001** | 0.011235 | 0.27495 | 407 | 12 |
| *+S9* | 0.26381 | 5953.1 | 5.6769 | **0.0001** | 0.009998 | 0.28494 | 406 | 13 |
| *+S13* | 0.27163 | 5560 | 5.359 | **0.0001** | 0.009338 | 0.29428 | 405 | 14 |
| *+S11* | 0.27808 | 4750.2 | 4.6194 | **0.0001** | 0.007978 | 0.30226 | 404 | 15 |
| *+S7* | 0.28453 | 4727.7 | 4.639 | **0.0005** | 0.00794 | 0.3102 | 403 | 16 |
| *+S27* | 0.29051 | 4445.5 | 4.3988 | **0.0004** | 0.007466 | 0.31767 | 402 | 17 |
| *+S42* | 0.29563 | 3934.2 | 3.9212 | **0.0006** | 0.006608 | 0.32428 | 401 | 18 |
| *+S31* | 0.30062 | 3844.8 | 3.8594 | **0.0006** | 0.006457 | 0.33073 | 400 | 19 |
| *+S33* | 0.30522 | 3610.8 | 3.6485 | **0.0004** | 0.006064 | 0.3368 | 399 | 20 |
| *+S25* | 0.30957 | 3458.8 | 3.5169 | **0.0007** | 0.005809 | 0.34261 | 398 | 21 |
| *+S20* | 0.31376 | 3350.2 | 3.4273 | **0.0004** | 0.005627 | 0.34823 | 397 | 22 |
| *+S1* | 0.31815 | 3458 | 3.5604 | **0.0006** | 0.005808 | 0.35404 | 396 | 23 |
| *+S17* | 0.32221 | 3252.3 | 3.3686 | **0.0007** | 0.005462 | 0.3595 | 395 | 24 |
| *+S30* | 0.3262 | 3208.3 | 3.3428 | **0.0012** | 0.005389 | 0.36489 | 394 | 25 |
| *+S23* | 0.33012 | 3152 | 3.3033 | **0.0005** | 0.005294 | 0.37019 | 393 | 26 |
| *+S16* | 0.33403 | 3136.6 | 3.3065 | **0.0009** | 0.005268 | 0.37545 | 392 | 27 |
| *+S26* | 0.3378 | 3047.7 | 3.2311 | **0.0011** | 0.005119 | 0.38057 | 391 | 28 |
| *+S55* | 0.34096 | 2699.6 | 2.8757 | **0.0032** | 0.004534 | 0.38511 | 390 | 29 |
| *+S34* | 0.344 | 2622.5 | 2.8066 | **0.0027** | 0.004405 | 0.38951 | 389 | 30 |
| *+S14* | 0.34697 | 2579.4 | 2.773 | **0.0029** | 0.004332 | 0.39384 | 388 | 31 |
| *+S41* | 0.35004 | 2617.7 | 2.8274 | **0.0029** | 0.004396 | 0.39824 | 387 | 32 |
| *+S48* | 0.35305 | 2585.3 | 2.8054 | **0.0026** | 0.004342 | 0.40258 | 386 | 33 |
| *+S4* | 0.35601 | 2541.5 | 2.7706 | **0.0035** | 0.004269 | 0.40685 | 385 | 34 |
| *+S37* | 0.35905 | 2584.1 | 2.8304 | **0.0028** | 0.00434 | 0.41119 | 384 | 35 |
| *+S21* | 0.36196 | 2497.9 | 2.7485 | **0.0041** | 0.004195 | 0.41538 | 383 | 36 |
| *+S24* | 0.36454 | 2313.7 | 2.5561 | **0.0055** | 0.003886 | 0.41927 | 382 | 37 |
| *+S63* | 0.36697 | 2224.9 | 2.4674 | **0.0066** | 0.003737 | 0.42301 | 381 | 38 |
| *+S8* | 0.36929 | 2156 | 2.3999 | **0.0084** | 0.003621 | 0.42663 | 380 | 39 |
| *+S10* | 0.37171 | 2204.2 | 2.4629 | **0.0062** | 0.003702 | 0.43033 | 379 | 40 |
| *+S38* | 0.3739 | 2075.9 | 2.3276 | 0.011 | 0.003486 | 0.43382 | 378 | 41 |
| *+S44* | 0.37606 | 2049.4 | 2.306 | **0.0097** | 0.003442 | 0.43726 | 377 | 42 |
| *+S70* | 0.37821 | 2043.1 | 2.3068 | 0.011 | 0.003431 | 0.44069 | 376 | 43 |
| *+S72* | 0.38027 | 1985.2 | 2.2488 | **0.0099** | 0.003334 | 0.44402 | 375 | 44 |
| *+S45* | 0.38231 | 1966.4 | 2.2349 | 0.0124 | 0.003303 | 0.44733 | 374 | 45 |
| *+S66* | 0.38427 | 1922.2 | 2.1916 | 0.0133 | 0.003228 | 0.45056 | 373 | 46 |
| *+S51* | 0.3862 | 1903 | 2.1766 | 0.0151 | 0.003196 | 0.45375 | 372 | 47 |
| *+S60* | 0.38804 | 1846.2 | 2.118 | 0.016 | 0.003101 | 0.45685 | 371 | 48 |
| *+S36* | 0.38987 | 1834 | 2.1103 | 0.0147 | 0.00308 | 0.45993 | 370 | 49 |
| *+S62* | 0.39162 | 1787.6 | 2.0628 | 0.0181 | 0.003002 | 0.46293 | 369 | 50 |
| *+S35* | 0.39332 | 1761 | 2.0378 | 0.0187 | 0.002958 | 0.46589 | 368 | 51 |
| *+S68* | 0.39502 | 1750.3 | 2.0312 | 0.02 | 0.00294 | 0.46883 | 367 | 52 |
| *+S49* | 0.39667 | 1723.2 | 2.0052 | 0.0203 | 0.002894 | 0.47173 | 366 | 53 |
| *+S75* | 0.39829 | 1703.4 | 1.9874 | 0.0175 | 0.002861 | 0.47459 | 365 | 54 |
| *+S15* | 0.39987 | 1675.2 | 1.9596 | 0.0259 | 0.002814 | 0.4774 | 364 | 55 |
| *+S58* | 0.40145 | 1669.9 | 1.9587 | 0.0239 | 0.002805 | 0.48021 | 363 | 56 |
| *+S46* | 0.40287 | 1583.9 | 1.8622 | 0.0308 | 0.00266 | 0.48287 | 362 | 57 |
| *+S65* | 0.40418 | 1527.9 | 1.8002 | 0.0383 | 0.002566 | 0.48543 | 361 | 58 |
| *+S54* | 0.40546 | 1503.3 | 1.7751 | 0.0365 | 0.002525 | 0.48796 | 360 | 59 |
| *+S53* | 0.40669 | 1473.2 | 1.7431 | 0.0444 | 0.002474 | 0.49043 | 359 | 60 |
| *+S47* | 0.40779 | 1410.6 | 1.6722 | 0.0553 | 0.002369 | 0.4928 | 358 | 61 |
| *+S39* | 0.4089 | 1407.9 | 1.6721 | 0.0529 | 0.002365 | 0.49516 | 357 | 62 |
| *+S32* | 0.40997 | 1382.6 | 1.645 | 0.0586 | 0.002322 | 0.49749 | 356 | 63 |
| *+S19* | 0.41103 | 1376.2 | 1.6403 | 0.0601 | 0.002311 | 0.4998 | 355 | 64 |
| *+S64* | 0.41198 | 1316.4 | 1.5716 | 0.0721 | 0.002211 | 0.50201 | 354 | 65 |
| *+S59* | 0.41292 | 1309.9 | 1.5663 | 0.0757 | 0.0022 | 0.50421 | 353 | 66 |
| *+S74* | 0.41381 | 1285.3 | 1.5393 | 0.0806 | 0.002159 | 0.50637 | 352 | 67 |
| *+S43* | 0.41466 | 1258.8 | 1.5097 | 0.0926 | 0.002114 | 0.50848 | 351 | 68 |
| *+S29* | 0.41546 | 1232.6 | 1.4804 | 0.1052 | 0.00207 | 0.51055 | 350 | 69 |
| *+S56* | 0.41624 | 1223.4 | 1.4713 | 0.1062 | 0.002055 | 0.51261 | 349 | 70 |
| *+S40* | 0.41698 | 1198.2 | 1.4428 | 0.1145 | 0.002012 | 0.51462 | 348 | 71 |
| *+S71* | 0.41774 | 1203.9 | 1.4516 | 0.1136 | 0.002022 | 0.51664 | 347 | 72 |
| *+S73* | 0.41849 | 1200.8 | 1.4497 | 0.1144 | 0.002017 | 0.51866 | 346 | 73 |
| *+S67* | 0.41919 | 1171.8 | 1.4164 | 0.1261 | 0.001968 | 0.52063 | 345 | 74 |
| *+S69* | 0.41986 | 1153.1 | 1.3954 | 0.1353 | 0.001937 | 0.52256 | 344 | 75 |
| *+S61* | 0.42047 | 1127.8 | 1.3663 | 0.1415 | 0.001894 | 0.52446 | 343 | 76 |
| *+S28* | 0.42102 | 1090.7 | 1.3225 | 0.1652 | 0.001832 | 0.52629 | 342 | 77 |
| *+S50* | 0.42145 | 1036.2 | 1.2574 | 0.2164 | 0.00174 | 0.52803 | 341 | 78 |
| *+S52* | 0.4218 | 990.12 | 1.2022 | 0.2478 | 0.001663 | 0.52969 | 340 | 79 |

Significant *P*-values are indicated in bold (α = 0.01). Adj. R2 = Adjusted R2. SS(Trace) = Sums of squares of trace statistic. *F*Pseudo = Pseudo *F*-statistic. *P*(perm) = Probability value by permutation. Res. df = Residual degrees of freedom. Regr. df = Regression degrees of freedom.