Supplementary Material

**Table S1.** Physical and carbonate chemistry parameters at each of the stations (mariculture, three reefs, and offshore). Stations are arranged from inshore to offshore. Values are mean ± standard deviation. Mean values between seasons across all stations are also reported. *n* = number of samples.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station | Season | n | Temperature (°C) | Salinity (PSU) | TA (µmol kg-1) | DIC (µmol kg-1) | pH | *p*CO2 (µatm) | ΩArag |
| Mariculture | Dry | 3 | 31.5 (0.1) | 33.1 (0.0) | 2178.3 (3.3) | 2018.2 (8.3) | 7.71 (0.01) | 953 (35) | 2.07 (0.05) |
|  | Wet | 3 | 30.5 (0.1) | 29.6 (0.1) | 2195.4 (0.8) | 1935.8 (12.5) | 7.97 (0.01) | 483 (25) | 3.16 (0.05) |
| Reef 1 | Dry | 6 | 31.3 (0.2) | 33.4 (0.0) | 2193.2 (2.4) | 1920.8 (7.1) | 7.94 (0.01) | 512 (15) | 3.22 (0.07) |
|  | Wet | 6 | 29.9 (0.7) | 30.5 (0.3) | 2186.9 (5.2) | 1942.5 (44.4) | 7.95 (0.08) | 525 (109) | 3.01 (0.47) |
| Reef 2 | Dry | 6 | 31.3 (0.1) | 33.4 (0.0) | 2183.5 (8.4) | 1913.2 (24.6) | 7.94 (0.03) | 514 (49) | 3.19 (0.17) |
|  | Wet | 6 | 29.6 (0.6) | 30.6 (0.3) | 2128.3 (3.9) | 1850.9 (14.4) | 8.03 (0.02) | 406 (22) | 3.31 (0.18) |
| Reef 3 | Dry | 6 | 31.0 (0.1) | 33.6 (0.0) | 2169.6 (14.2) | 1894.6 (7.1) | 7.95 (0.04) | 492 (47) | 3.22 (0.22) |
|  | Wet | 6 | 29.4 (0.4) | 31.2 (0.2) | 2115.2 (11.0) | 1863.6 (10.0) | 7.97 (0.02) | 464 (25) | 3.00 (0.11) |
| Offshore | Dry | 5 | 31.0 (0.1) | 33.6 (0.0) | 2182.7 (3.6) | 1900.0 (12.6) | 7.97 (0.02) | 477 (28) | 3.32 (0.12) |
|  | Wet | 3 | 29.3 (0.0) | 31.2 (0.0) | 2123.8 (4.0) | 1840.8 (5.0) | 8.03 (0.00) | 398 (3) | 3.32 (0.01) |
| Total | Dry | 26 | 31.2 (0.2) | 33.4 (0.1) | 2181.8 (11.3) | 1920.2 (39.7) | 7.92 (0.08) | 552 (153) | 3.10 (0.41) |
|  | Wet | 24 | 29.7 (0.6) | 30.7 (0.6) | 2147.5 (34.4) | 1886.4 (48.8) | 7.99 (0.05) | 459 (72) | 3.14 (0.28) |

**Table S2.** Summary of analyses (two-way ANOVA) comparing all variables among reef stations (Reef), between time of sampling (Season) and the interaction of the factors (Reef x Season). Data are log-transformed except for pH. *p*-values < 0.05 are highlighted. Df = degrees of freedom; Ss = sum of squares.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Reef | | | | Season | | | | Station x Season | | | |
|  | Df | Ss | F | *p* | Df | Ss | F | *p* | Df | Ss | F | *p* |
| Temperature (°C) | 2 | 0.0002 | 2.505 | 0.0990 | 1 | 0.005 | 128.912 | **< 0.0001** | 2 | 0.00002 | 0.279 | 0.7590 |
| Salinity (PSU) | 2 | 0.0003 | 16.135 | **< 0.0001** | 1 | 0.012 | 1435.369 | **< 0.0001** | 2 | 0.0001 | 7.336 | **0.0030** |
| TA (µmol kg-1) | 2 | 0.0006 | 97.837 | **< 0.0001** | 1 | 0.0005 | 182.532 | **< 0.0001** | 2 | 0.0002 | 32.318 | **< 0.0001** |
| DIC (µmol kg-1) | 2 | 0.001 | 21.397 | **< 0.0001** | 1 | 0.0003 | 10.999 | **0.0020** | 2 | 0.0006 | 11.071 | **0.0003** |
| pH | 2 | 0.008 | 2.831 | 0.0750 | 1 | 0.013 | 8.658 | **0.0060** | 2 | 0.010 | 3.538 | **0.0420** |
| *p*CO2 (µatm) | 2 | 0.017 | 3.928 | **0.0310** | 1 | 0.015 | 6.971 | **0.0130** | 2 | 0.018 | 4.128 | **0.0260** |
| ΩArag | 2 | 0.003 | 1.412 | 0.2590 | 1 | 0.002 | 2.015 | 0.1660 | 2 | 0.005 | 1.946 | 0.1610 |
| Nitrate (µM) | 2 | 0.584 | 5.700 | **0.0110** | 1 | 0.359 | 6.997 | **0.0150** | 2 | 0.061 | 0.599 | 0.5590 |
| Nitrite (µM) | 2 | 0.004 | 0.163 | 0.8510 | 1 | 0.383 | 33.382 | **< 0.0001** | 2 | 0.034 | 1.487 | 0.2490 |
| Ammonium (µM) | 2 | 0.045 | 0.722 | 0.4970 | 1 | 0.024 | 0.779 | 0.3880 | 2 | 0.255 | 4.094 | **0.0320** |
| Phosphate (µM) | 2 | 0.059 | 12.333 | **0.0003** | 1 | 0.352 | 147.495 | **< 0.0001** | 2 | 0.019 | 3.918 | **0.0360** |
| Silicate (µM) | 2 | 0.013 | 0.812 | 0.4570 | 1 | 0.217 | 26.849 | **< 0.0001** | 2 | 0.066 | 4.091 | **0.0320** |
| N:P ratio | 2 | 0.019 | 0.399 | 0.6760 | 1 | 0.721 | 29.502 | **< 0.0001** | 2 | 0.152 | 3.112 | 0.0660 |
| DO (mg L-1) | 2 | 0.019 | 3.253 | 0.0530 | 1 | 0.007 | 2.454 | 0.1280 | 2 | 0.014 | 2.367 | 0.1110 |
| Chl-a (µg L-1) | 2 | 3.004 | 16.85 | **< 0.0001** | 1 | 0.309 | 3.462 | 0.0770 | 2 | 2.948 | 16.535 | **< 0.0001** |
| Turbidity (FTU) | 2 | 0.438 | 7.799 | **0.0020** | 1 | 0.0007 | 0.026 | 0.8730 | 2 | 0.065 | 1.16 | 0.3270 |

**Table S3.** Water quality parameters at each of the stations (mariculture, three reefs, and offshore). Stations are arranged from inshore to offshore. Values are mean ± standard deviation. Mean values between seasons across all stations are also reported. *n* = number of samples.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station | Season | n | Nitrate (µM) | Nitrite (µM) | Ammonium (µM) | Phosphate (µM) | Silicate (µM) | N:P ratio | DO (mg L-1) | Chl-a (µg L-1) | Turbidity (FTU) |
| Mariculture | Dry | 3 | 0.48 (0.17) | 0.18 (0.01) | 12.71 (3.54) | 1.97 (0.26) | 8.98 (3.39) | 6.78 (1.57) | 2.96 (0.26) | 1.08 (0.36) | 0.50 (0.02) |
|  | Wet | 3 | 0.95 (0.71) | 0.06 (0.02) | 5.01 (2.79) | 0.48 (0.06) | 9.39 (0.53) | 12.68 (7.80) | 7.10 (0.15) | 11.04 (3.36) | 0.87 (0.07) |
| Reef 1 | Dry | 6 | 0.60 (0.20) | 0.14 (0.04) | 6.52 (2.16) | 0.92 (0.13) | 12.49 (2.76) | 7.81 (1.35) | 6.88 (1.72) | 0.35 (0.14) | 0.54 (0.21) |
|  | Wet | 3-6 | 0.93 (0.75) | 0.06 (0.02) | 8.95 (5.84) | 0.44 (0.02) | 13.69 (2.29) | 22.78 (12.90) | 6.81 (1.03) | 5.29 (2.16) | 0.50 (0.33) |
| Reef 2 | Dry | 6 | 0.80 (0.24) | 0.13 (0.02) | 7.09 (1.59) | 0.70 (0.06) | 11.13 (2.89) | 11.52 (2.81) | 5.65 (0.44) | 0.20 (0.17) | 0.29 (0.04) |
|  | Wet | 3-6 | 1.96 (1.06) | 0.09 (0.02) | 4.53 (1.70) | 0.43 (0.01) | 21.08 (4.12) | 15.12 (2.93) | 6.84 (0.11) | 0.13 (0.07) | 0.39 (0.13) |
| Reef 3 | Dry | 6 | 0.43 (0.24) | 0.13 (0.03) | 4.37 (1.05) | 0.65 (0.12) | 10.02 (1.91) | 7.70 (1.87) | 5.92 (0.31) | 0.35 (0.23) | 0.24 (0.04) |
|  | Wet | 3-6 | 0.78 (0.63) | 0.08 (0.02) | 10.78 (8.77) | 0.41 (0.01) | 17.33 (1.60) | 28.58 (21.32) | 5.91 (0.17) | 0.11 (0.04) | 0.24 (0.02) |
| Offshore | Dry | 3-5 | 0.45 (0.26) | 0.09 (0.02) | 4.41 (1.05) | 0.65 (0.08) | 7.33 (0.47) | 7.53 (1.08) | 6.06 (0.09) | 0.40 (0.31) | 0.18 (0.03) |
|  | Wet | 3 | 0.72 (0.46) | 0.03 (0.02) | 12.96 (9.87) | 0.42 (0.02) | 32.50 (4.58) | 32.24 (21.30) | 6.30 (0.01) | 0.16 (0.05) | 0.29 (0.01) |
| Total | Dry | 24-26 | 0.57 (0.25) | 0.14 (0.04) | 6.63 (3.14) | 0.90 (0.44) | 10.45 (2.84) | 8.54 (2.52) | 5.77 (1.39) | 0.41 (0.34) | 0.34 (0.17) |
|  | Wet | 15-24 | 1.07 (0.79) | 0.06 (0.03) | 8.45 (6.54) | 0.43 (0.04) | 18.80 (8.54) | 22.28 (14.97) | 6.56 (0.66) | 3.35 (4.73) | 0.43 (0.26) |

**Table S4.** Summary of results obtained from SeaFET pH sensor in each reef station.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station | Season | pH | | | | Temperature (°C) | | | |
|  |  | Mean | Min. | Max | Range | Mean | Min. | Max | Range |
| Reef 1 |  |  |  |  |  |  |  |  |  |
|  | Dry | 7.94 | 7.78 | 8.11 | 0.33 | 31.23 | 30.96 | 31.70 | 0.75 |
|  | Wet | 8.00 | 7.85 | 8.07 | 0.22 | 29.50 | 29.10 | 30.30 | 0.51 |
| Reef 2 |  |  |  |  |  |  |  |  |  |
|  | Dry | 8.03 | 7.83 | 8.18 | 0.35 | 30.94 | 30.43 | 31.55 | 1.12 |
|  | Wet | 7.95 | 7.86 | 8.04 | 0.18 | 29.04 | 28.77 | 29.30 | 0.54 |
| Reef 3 |  |  |  |  |  |  |  |  |  |
|  | Dry | 8.03 | 7.99 | 8.08 | 0.09 | 30.38 | 30.20 | 30.53 | 0.33 |
|  | Wet | 7.99 | 7.87 | 8.08 | 0.22 | 29.46 | 29.31 | 29.67 | 0.36 |

**Table S5.** Summary of results of diel variability of physical (temperature, salinity) and carbonate chemistry (TA, DIC, pH, *p*CO2, ΩArag) parameters obtained in each reef station. pH and temperature were recorded from the pH sensor, other parameters were obtained from diel sampling.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station | Season | Sample size | Temperature (°C) | | Salinity | | TA (µmol kg-1) | | DIC (µmol kg-1) | | pH | | *p*CO2 (µatm) | | ΩArag | |
|  |  |  | Mean | Range | Mean | Range | Mean | Range | Mean | Range | Mean | Range | Mean | Range | Mean | Range |
| Reef 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Dry | 8 | 31.2 | 31.0 - 31.5 | 33.4 | 33.3 - 33.5 | 2193.8 | 2182.7 - 2204.8 | 1920.8 | 1831.3 - 1984.2 | 7.94 | 7.82 - 8.10 | 527 | 326 - 706 | 3.24 | 2.58 - 4.20 |
|  | Wet | 15 | 29.5 | 29.1 - 30.1 | 30.6 | 30.2 - 31.6 | 2112.0 | 2087.8 - 2151.8 | 1854.2 | 1828.1 - 1890.2 | 7.99 | 7.95 - 8.04 | 441 | 390 - 494 | 3.09 | 2.88 - 3.40 |
| Reef 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Dry | 8 | 31.0 | 30.4 - 31.3 | 33.5 | 33.3 - 33.6 | 2184.9 | 2155.8 - 2224.4 | 1864.2 | 1767.9 - 2008.6 | 8.03 | 7.85 - 8.14 | 414 | 279 - 679 | 3.73 | 2.65 - 4.43 |
|  | Wet | 21 | 29.1 | 28.8 - 29.6 | 30.8 | 30.0 - 31.4 | 2122.4 | 2103.4 - 2152.3 | 1876.2 | 1845.1 - 1942.2 | 7.97 | 7.90 - 8.05 | 471 | 384 - 584 | 2.96 | 2.59 - 3.43 |
| Reef 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Dry | 7 | 30.3 | 30.1 - 30.5 | 33.3 | 33.1 - 33.5 | 2172.2 | 2160.3 - 2190.1 | 1862.6 | 1829.1 - 1894.0 | 8.03 | 8.00 - 8.06 | 399 | 357 - 431 | 3.59 | 3.45 - 3.81 |
|  | Wet | 16 | 29.5 | 29.2 - 29.7 | 31.6 | 31.5 - 31.8 | 2115.9 | 2092.3 - 2129.7 | 1850.8 | 1784.8 - 1884.0 | 7.99 | 7.94 - 8.07 | 440 | 344 - 512 | 3.14 | 2.82 - 3.64 |

**Table S6.** Results (model II linear regression) of the relationship between salinity-normalized dissolved inorganic carbon (nDIC) and salinity-normalized total alkalinity (nTA) for the three reef stations. *p*-values < 0.05 are highlighted. NCP:NCC ratio is also calculated.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station | Season | Slope | NCP:NCC ratio | Intercept | R2 | *p* |
| Reef 1 |  |  |  |  |  |  |
|  | Dry | -0.02 | -104.36 | 2199.53 | 0.03 | 0.7042 |
|  | Wet | 0.31 | 5.42 | 1570.30 | 0.29 | **0.0371** |
| Reef 2 |  |  |  |  |  |  |
|  | Dry | 0.29 | 5.96 | 1620.18 | 0.96 | **< 0.0001** |
|  | Wet | 0.32 | 5.28 | 1557.65 | 0.22 | **0.0300** |
| Reef 3 |  |  |  |  |  |  |
|  | Dry | 0.50 | 2.96 | 1208.23 | 0.52 | 0.0677 |
|  | Wet | 0.24 | 7.37 | 1687.18 | 0.61 | **0.0004** |

Table S7. Summary of percent cover of the benthos in each reef station per season derived from phototransect surveys and image analysis. Stations are arranged left to right with increasing proximity to mariculture area. Benthic components are classified by functional groups. Values are mean ± standard deviation. n = number of transects. Dry season data was obtained in February 2021.

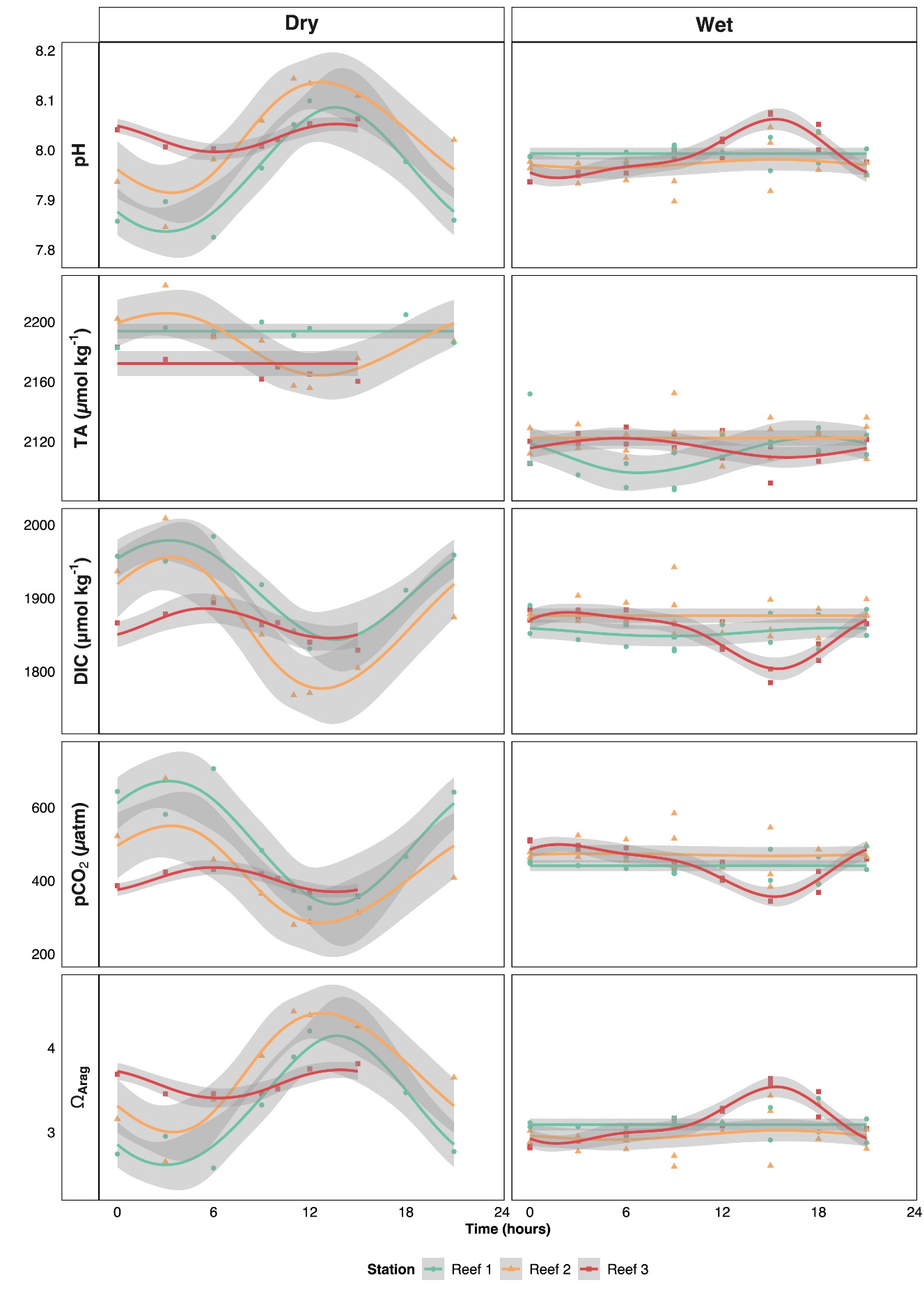
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station | Reef 1 | | Reef 2 | | Reef 3 | |
| Season | Dry | Wet | Dry | Wet | Dry | Wet |
| No. of transects | 4 | 5 | 5 | 5 | -- | 5 |
| Hard coral | NA | NA | 21.87 (3.96) | 18.96 (4.61) | -- | 28.49 (6.62) |
| Coralline algae | 4.58 (3.86) | NA | 6.15 (0.77) | 18.32 (2.52) | -- | 10.47 (1.79) |
| *Halimeda* | 0.92 (1.07) | 0.72 (1.14) | NA | NA | -- | NA |
| Fleshy macroalgae | 5.95 (5.00) | 7.28 (7.59) | 3.77 (2.50) | 7.36 (2.78) | -- | 5.21 (5.28) |
| Turf algae/dead coral with algae | 58.90 (2.25) | 68.48 (12.78) | 50.12 (4.02) | 29.08 (5.79) | -- | 39.08 (5.40) |
| Dead coral | 22.51 (3.32) | 12.12 (11.08) | 13.85 (5.05) | 20.60 (4.42) | -- | 2.96 (0.99) |
| Octocoral | 0.82 (0.49) | 1.52 (1.93) | 0.28 (0.33) | 0.36 (0.09) | -- | 10.81 (3.47) |
| Other lifeform | 0.47 (0.44) | 0.68 (0.48) | 0.32 (0.18) | 0.12 (0.11) | -- | 0.04 (0.09) |
| Rubble/sand/rock | 5.84 (4.11) | 9.20 (1.84) | 3.64 (1.54) | 5.20 (4.84) | -- | 2.95 (1.88) |

Table S8. PERMANOVA results of benthic cover during wet season based on Bray-Curtis distances with 999 permutations. Df: Degrees of freedom; Ss: sum of squares.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Source | Df | Ss | *R*2 | F | *p* |
| Station | 2 | 0.652 | 0.79 | 23.122 | **0.001** |
| Residuals | 12 | 0.169 | 0.21 | NA | NA |
| Total | 14 | 0.822 | 1.00 | NA | NA |

**Table S9.** Summary of analyses (ANOVA) comparing functional groups among reef stations during the wet season. Percentage cover data were arcsine-transformed prior to analysis. *p*-values < 0.05 are highlighted. Df: Degrees of freedom; MS: Mean square.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Functional group | Source | Df | MS | F | *p* |
| Hard coral | Station | 2 | 0.440 | 145.778 | **< 0.0001** |
|  | Error | 12 | 0.003 |  |  |
| Dead coral | Station | 2 | 0.114 | 4.963 | **0.0269** |
|  | Error | 12 | 0.023 |  |  |
| Turf algae | Station | 2 | 0.232 | 23.979 | **< 0.0001** |
|  | Error | 12 | 0.010 |  |  |
| Coralline algae | Station | 2 | 0.263 | 423.044 | **< 0.0001** |
|  | Error | 12 | 0.001 |  |  |
| Fleshy macroalgae | Station | 2 | 0.005 | 0.313 | 0.7368 |
|  | Error | 12 | 0.0144 |  |  |



**Figure S1.** Diel composite time series of carbonate chemistry parameters divided by season. Data were normalized as the change since midnight (Time = 0). The lines represent cyclic cubic spline fits of the data, shaded areas represent 95% confidence interval.

Chart, bar chart

Description automatically generated

**Figure S2.** Summary of percent cover of the benthos in each reef station per season derived from phototransect surveys and image analysis. Stations are arranged left to right with increasing proximity to mariculture area. Benthic components are classified by functional groups. Dry season data was obtained in February 2021.

Chart

Description automatically generated

**Figure S3.** Vertical profiles of seawater density, chlorophyll-a, and DO in the mariculture station, divided per season.