Supplementary Material

**1 Supplementary Tables**

**Supplementary Table 1.** Overview of the seabird census result from the two cruises headed in March and September 2017 on Huon and Surprise islets.

|  |  |  |  |
| --- | --- | --- | --- |
|   |   | Huon | Surprise |
| Total count | March | September | March | September |
| *Anous* | *minutus* |   |   | 569 | 9492 |
| *Anous* | *stolidus* | 2820 | 1674 | 26 | 104 |
| *Fregata* | *sp* |   | 3 | 390 | 4759 |
| *Gygis* | *alba* |   |   |   | 1 |
| *Onychoprion* | *fuscatus* |   | 3 |   | 4 |
| *Phaeton* | *lepturus* |   |   |   | 2 |
| *Phaeton* | *rubicauda* |   | 3 |   |   |
| *Sterna* | *bergii* |   | 16 |   | 12 |
| *Sterna* | *sumatrana* |   | 56 |   | 90 |
| *Sternula* | *nereis* |   |   |   | 1 |
| *Sula* | *dactylara* | 704 | 557 | 84 | 15 |
| *Sula* | *leucogaster* | 84 | 2270 | 215 | 55 |
| *Sula* | *sula* |   |   | 4498 | 14095 |
|   |   |   |   |   |   |
|  | Total | 3608 | 4582 | 5782 | 28630 |

**Supplementary Table 2.** Mean δ15N (‰) values ± *s.d,* mean δ13C (‰) values ± *s.d,* and number of sample (N) of dried guano samples per species and sites.

|  |  |  |  |
| --- | --- | --- | --- |
| Site | Species | δ15Nguano ± *s.d* | N |
| *Surprise* |   |   |   |
|   | black noddy | *Anous minutus* | 8.19 ± 1.04 | 6 |
|   | brown noddy | *Anous stolidus* | 6.81 ± 1.33 | 6 |
|   | frigatebird | *Fregata sp.* | 8.52 ± 0.85 | 5 |
|   | masked booby | *Sula dactylatra* | 7.95 ± 1.31 | 5 |
|   | red-footed booby | *Sula sula* | 7.61 ± 1.32 | 5 |
| *Huon* |   |   |   |
|   | brown noddy | *Anous stolidus* | 9.17 ± 0.48 | 4 |
|   | masked booby | *Sula dactylatra* | 8.03 ± 1.49 | 5 |
|   | brown booby | *Sula leucogaster* | 7.91 ± 1.57 | 5 |

**Supplementary Table 3.** Mean NOx concentrations (µM) values ± s.d and number of sample (N) for each site and seasons, and at each transect locations.

|  |  |  |
| --- | --- | --- |
|   |   | Mean [Nox] (µM) ± *s.d.* (N) |
|   |   | 25m | 50m | 100m | 400m | Control |
| Huon |   |   |   |   |   |   |
|   | March | 1.7 ± 0.05 (2) | 1.4 ± 0.07 (2) | 1.0 ± 0.05 (2) | 0.2 ± 0.11 (2) | 0.4 ± 0.02 (2) |
|   | September | 7.3 ± 0.35 (3) | 1.7 ± 0.03 (3) | 1.2 ± 0.07 (3) | 0.1 ± 0.03 (3) | 0.2 ± 0.03 (3) |
| Surprise |   |   |   |   |   |   |
|   | March | 0.7 ± 0.02 (2) | 0.5 ± 0.03 (2) | 0.3 ± 0.01 (2) | 0.1 ± 0.02 (2) | 0.5 ± 0.12 (2) |
|   | September | 1.4 ± 0.02 (3) | 0.5 ± 0.02 (3) | 0.5 ± 0.01 (3) | 0.3 ± 0.03 (3) | 0.1 ± 0.03 (3) |

**Supplementary Table 4.** Results of model selections as ANOVA tables and validation metrics corresponding to isotope values of coral tissues and zooxanthellae, macroalgae and POM samples.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | δ15N Tissues | δ15N Zoox. | δ15N Macroalgae | δ15N POM | [] NOx |
| Models slected structure | df | Sum. Sq. | F | p\_value | df | Sum. Sq. | F | p\_value | df | Sum. Sq. | F | p\_value | df | Sum. Sq. | F | p\_value | df | Sum. Sq. | F | p\_value |
| Transect | 4 | 2.27 | 134.4 | <0.001 | 4 | 132.34 | 96.87 | <0.001 | 4 | 13.168 | 234.19 | <0.001 | 4 | 33.80 | 11.65 | <0.001 | 4 | 54.89 | 1393.7 | <0.001 |
| Site | 1 | 0.03 | 7.85 | 0.007 | 1 | 12.85 | 37.63 | <0.001 | 1 | 0.08 | 42.98 | 0.03 | 1 | 3.96 | 5.45 | 0.04 | 1 | 5.39 | 547.6 | <0.001 |
| Season | 1 | 0.06 | 14.22 | <0.001 | 1 | 26.90 | 78.78 | <0.001 | 1 | 0.625 | 5.32 | <0.001 | - | - | - | - | 1 | 15.98 | 1623.2 | <0.001 |
| Transect:Season | 4 | 0.13 | 7.55 | <0.001 | 4 | 3.23 | 2.37 | 0.06 | 4 | 0.59 | 10.12 | <0.001 | - | - | - | - | 4 | 18.84 | 478.2 | <0.001 |
| Transect:Site | 2 | 0.12 | 13.84 | <0.001 | 2 | 2.46 | 3.598 | 0.03 | 4 | 4.58 | 78.71 | <0.001 | - | - | - | - | 4 | 26.57 | 674.7 | <0.001 |
| Site:Season | 1 | 0.02 | 3.64 | 0.06 | - | - | - | - | 1 | 0.00 | 0.02 | 0.89 | - | - | - | - | 1 | 3.26 | 331.1 | <0.001 |
| Transect:Site:Season | - | - | - | - | - | - | - | - | 4 | 0.76 | 13.08 | <0.001 | - | - | - | - | 4 | 11.14 | 283.0 | <0.001 |
| *Residuals* | 67 | 0.28 |   |   | 68 | 23.22 |   |   | 37 | 0.54 |   |   | 10 | 7.26 | - | - | 30 | 0.30 |   |   |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Models Validation Metrics | Test Statistic | p\_value | Test Statistic | p\_value | Test Statistic | p\_value | Test Statistic | p\_value | Test Statistic | p\_value |
| Durbin-Watson (D-W) | 2.41 | 0.52 | 2.54 | 0.28 | 2.29 | 0.634 | 1.58 | 0.13 | 3.02 | 0.218 |
| ShapiroWilk (W) | 0.99 | 0.71 | 0.99 | 0.74 | 0.95 | 0.01 | 0.96 | 0.68 | 0.96 | 0.12 |
| Bartlett (K2) or Levene (F) | 7.94 | 0.54 | 19.94 | 0.17 | 1.28 | 0.25 | 1.47 | 0.83 | 29.00 | 0.07 |
| Adjusted R2 | 0.91 |   | 0.88 |   | 0.96 |   | 0.76 |   | 0.99 |   |

**Supplementary Table 5.** Mean δ15N (‰) values ± *s.d* and number of sample (N) for each site and seasons, and at each transect locations.

|  |  |  |  |
| --- | --- | --- | --- |
|   |   |   | Mean δ15N (‰) ± *s.d.* (N) |
|   |   |   | 25m | 50m | 100m | 400m | Reference |
| Huon |   |   |   |   |   |   |   |
|  | **Macroalgae** |   |   |   |   |   |
|   |   | March | 6.2 ± 0.2 (5) | 5.2 ± 0.3 (5) | 3.8 ± 0.2 (5) | 2.1 ± 0.4 (5) | 2.1 ± 0.2 (5) |
|   |   | September | 8.2 (1) | 8.3 (1) | 6.0 (1) | 3.2 (1) | 3.0 (1) |
|   | **POM** |   |   |   |   |   |   |
|   |   | March | 5.4 (1)  | 5.4 (1)  | 3.8 (1)  | 1.9 ± 1 | 4.3 (1)  |
|   |   |   |   |   |   |   |   |
|   | **Coral tissues** |   |   |   |   |   |
|   |   | March |   | 6.5 ± 0.3 (5) | 6.1 ± 0.3 (5) | 5.4 ± 0.8 (5) | 4.4 ± 0.2 (5) |
|   |   | September |   | 6.4 ± 0.2 (5) | 6.2 ± 0.4 (5) | 4.8 ± 0.1 (6) | 4.8 ± 0.3 (5) |
|   | **Coral symbionts** |   |   |   |   |   |
|   |   | March |   | 4.8 ± 0.8 (5) | 3.9 ± 0.6 (5) | 3.1 ± 0.7 (5) | 1.9 ± 0.6 (5) |
|   |   | September |   | 6.1 ± 0.8 (5) | 4.4 ± 0.5 (5) | 3.8 ± 0.6 (6) | 3.2 ± 0.5 (5) |
| Surprise |   |   |   |   |   |   |
|   | **Macroalgae** |   |   |   |   |   |
|   |   | March | 10.5 ± 2.2 (5) | 10.4 ± 2.4 (5) | -0.3 ± 1 (5) | 1.7 ± 0.4 (5) | 2.1 ± 0.6 (5) |
|   |   | September | 10.0 (1) | 11.4 (1) | 4.3 (1) | 0.8 (1) | 3.2 (1)  |
|   | **POM** |   |   |   |   |   |   |
|   |   | March | 6.6 ± 0.7 (2) | 7.2 (1)  | 4.1 (1)  | 3.5 ± 0.9 (3) | 3.7 ± 0.5 (2) |
|   |   |   |   |   |   |   |   |
|   | **Coral tissues** |   |   |   |   |   |
|   |   | March | 7.4 ± 0.5 (5) | 6.6 ± 0.6 (5) | 5.6 ± 0.2 (5) |   | 5 ± 0.5 (5) |
|   |   | September | 8.9 ± 0.7 (5) | 7.3 ± 0.3 (5) | 5.8 ± 0.3 (5) |   | 5.6 ± 0.4 (5) |
|   | **Coral symbionts** |   |   |   |   |   |
|   |   | March | 6.1 ± 0.8 (5) | 5.4 ± 0.6 (5) | 4.3 ± 0.2 (5) |   | 3.3 ± 0.5 (5) |
|   |   | September | 7.9 ± 0.2 (5) | 6.7 ± 0.7 (5) | 5.3 ± 0.6 (5) |   | 4.8 ± 0.5 (5) |

**Supplementary Table 6.** Mean δ13C (‰) values ± *s.d* number of sample (N) for each site and seasons, and at each transect locations.

|  |  |  |  |
| --- | --- | --- | --- |
|   |   |   | Mean δ13C (‰) ± *s.d* (N) |
|   |   |   | 25m | 50m | 100m | 400m | Reference |
| Huon |   |   |   |   |   |   |
|   | **Macroalgae** |   |   |   |   |   |
|   |   | March |   |   |   |   |   |
|   |   | September |   |   |   |   |   |
|   | **POM** |   |   |   |   |   |   |
|   |   | March | -6.5 (1) | -5.6 (1) | -12.1 (1) | -20.3 ± 0.5 (3) | -14.7 (1) |
|   |   |   |   |   |   |   |   |
|   | **Coral tissues** |   |   |   |   |   |
|   |   | March |   | -12.9 ± 0.5 (5) | -13.8 ± 0.6 (5) | -14.5 ± 0.3 (5) | -15.6 ± 1.2 (5) |
|   |   | September |   | -13.1 ± 1.0 (5) | -16.9 ± 4.9 (5) | -15.6 ± 2.5 (6) | -15.1 ± 1.3 (5) |
|   | **Coral symbionts** |   |   |   |   |   |
|   |   | March |   | -12.6 ± 1.0 (5) | -14.0 ± 0.5 (5) | -14.5 ± 0.2 (5) | -15.4 ± 1.4 (5) |
|   |   | September |   | -10.9 ± 2.6 (5) | -13.1 ± 1.4 (5) | -14.2 ± 1.5 (6) | -13.1 ± 1.8 (5) |
|   |   |   |   |   |   |   |   |
| Surprise |   |   |   |   |   |   |
|   | **Macroalgae** |   |   |   |   |   |
|   |   | March | -10.6 ± 1.9 (5) | -10.6 ± 2.1 (5) | -9.8 ± 0.8 (5) | -7.0 ± 1.4 (5) | -4.5 ± 1.6 (5) |
|   |   | September |   |   |   |   |   |
|   | **POM** |   |   |   |   |   |   |
|   |   | March | -8.0 ± 4.0 (2) | -16.4 (1) | -17.1 (1) | -16.9 ± 4.8 (3) | -15.2 ± 4.3 (2) |
|   |   |   |   |   |   |   |   |
|   | **Coral tissues** |   |   |   |   |   |
|   |   | March | -14.1 ± 0.4 (5) | -14.4 ± 0.5 (5) | -13.7 ± 0.4 (5) |   | -15.2 ± 1.0 (5) |
|   |   | September | -14.3 ± 2.3 (2) | -14.0 ± 2.4 (5) | -12.6 ± 0.5 (4) |   | -14.6 ± 0.9 (4) |
|   | **Coral symbionts** |   |   |   |   |   |
|   |   | March | -14.0 ± 0.5 (5) | -14.4 ± 0.4 (5) | -13.6 ± 0.5 (5) |   | -15.0 ± 1.3 (5) |
|   |   | September | -13.9 ± 0.6 (5) | -12.8 ± 1.5 (5) | -13.1 ± 0.7 (5) |   | -14.5 ± 1.0 (5) |

**2 Supplementary figures**

**Supplementary Figure 1.** Mean monthly precipitation from the Global Precipitation Climatology Center and monthly averaged sea surface temperature (SST) calculated from the data collected by the Aqua-MODIS instrument, for one station located in the d’Entrecasteaux reefs during the year 2017 (Brown and Minnett 1999, Schneider et al., 2020).

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**Supplementary Figure 2.** Monthly averaged primary production in the d’Entrecasteaux reefs in March and September 2017 (Aqua-Modis, Chu et al., 2018).