Supplement of

Stable isotopes track the ecological and biogeochemical legacy of mass mangrove forest dieback in the Gulf of Carpentaria, Australia

Yota Harada et al.

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**Table S1.** Mangrove seedling and sampling densities (ind. per m$^2$).

<table>
<thead>
<tr>
<th></th>
<th>Unimpacted (Mean, SE)</th>
<th>n</th>
<th>Impacted (Mean, SE)</th>
<th>n</th>
</tr>
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<tbody>
<tr>
<td>2016</td>
<td>6.2, 0.7</td>
<td>124</td>
<td>0.2, 0.1</td>
<td>143</td>
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<tr>
<td>2017</td>
<td>5.5, 0.5</td>
<td>161</td>
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<td>175</td>
</tr>
<tr>
<td>2018</td>
<td>13.8, 1.6</td>
<td>80</td>
<td>7.1, 0.5</td>
<td>117</td>
</tr>
</tbody>
</table>
Table S2. Leaf CNS isotope values across intertidal zones.

<table>
<thead>
<tr>
<th>Forest</th>
<th>Sampling plot</th>
<th>Mean</th>
<th>SE</th>
<th>d15N AIR</th>
<th>d13CVPDB</th>
<th>d34S VCDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unimpacted</td>
<td>forest edge, land</td>
<td>5.3</td>
<td>-28.6</td>
<td>20.0</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Unimpacted</td>
<td>high</td>
<td>4.1</td>
<td>-27.7</td>
<td>12.0</td>
<td>0.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Unimpacted</td>
<td>mid</td>
<td>4.4</td>
<td>-28.9</td>
<td>8.9</td>
<td>0.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Unimpacted</td>
<td>low</td>
<td>3.9</td>
<td>-29.4</td>
<td>7.1</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Unimpacted</td>
<td>forest edge, ocean</td>
<td>4.2</td>
<td>-27.6</td>
<td>14.9</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Impacted</td>
<td>forest edge, land</td>
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<td>-25.3</td>
<td>19.8</td>
<td>0.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Impacted</td>
<td>high</td>
<td>5.3</td>
<td>-25.6</td>
<td>16.6</td>
<td>0.7</td>
<td>0.5</td>
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<tr>
<td>Impacted</td>
<td>mid</td>
<td>5.2</td>
<td>-26.2</td>
<td>13.4</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Impacted</td>
<td>low</td>
<td>4.9</td>
<td>-26.7</td>
<td>9.8</td>
<td>0.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Impacted</td>
<td>forest edge, ocean</td>
<td>1.0</td>
<td>-25.4</td>
<td>7.9</td>
<td>1.1</td>
<td>0.7</td>
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</tbody>
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Table S3. Surface (<0.5cm) sediment C isotope values across intertidal zones.

<table>
<thead>
<tr>
<th>Forest</th>
<th>Sampling plot</th>
<th>Mean</th>
<th>SE</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>%C</td>
<td>d13CVPDB</td>
<td>%C</td>
</tr>
<tr>
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<td>forest edge, land</td>
<td>2.76</td>
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<td>forest edge, ocean</td>
<td>2.33</td>
<td>-23.6</td>
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<tr>
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<td>mud flat</td>
<td>1.02</td>
<td>-21.8</td>
<td>0.05</td>
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<td>forest edge, land</td>
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<td>-22.4</td>
<td>0.22</td>
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<td>Impacted</td>
<td>high</td>
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<td>-22.2</td>
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<td>-22.1</td>
<td>0.30</td>
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Table S4. Stable C, N and S isotopic compositions of animals

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<th>Forest</th>
<th>Year</th>
<th>Group</th>
<th>Taxa</th>
<th>$\delta^{13}$C</th>
<th>SE</th>
<th>$\delta^{15}$N</th>
<th>SE</th>
<th>$\delta^{34}$S</th>
<th>SE</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unimpacted</td>
<td>2016</td>
<td>algae feeder</td>
<td>Tubuca signata</td>
<td>-17.4</td>
<td>0.3</td>
<td>6.7</td>
<td>0.3</td>
<td>14.3</td>
<td>1.0</td>
<td>3</td>
</tr>
<tr>
<td>Unimpacted</td>
<td>2017</td>
<td>algae feeder</td>
<td>Tubuca signata</td>
<td>-17.1</td>
<td>0.8</td>
<td>6.0</td>
<td>0.2</td>
<td>14.2</td>
<td>0.2</td>
<td>3</td>
</tr>
<tr>
<td>Unimpacted</td>
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<td>algae feeder</td>
<td>Tubuca signata</td>
<td>-16.5</td>
<td>0.4</td>
<td>6.9</td>
<td>0.2</td>
<td>14.7</td>
<td>0.2</td>
<td>5</td>
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<tr>
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<td>2017</td>
<td>filter feeder</td>
<td>Saccostrea sp.</td>
<td>-19.3</td>
<td>0.2</td>
<td>7.8</td>
<td>0.1</td>
<td>13.5</td>
<td>0.4</td>
<td>3</td>
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<tr>
<td>Unimpacted</td>
<td>2018</td>
<td>filter feeder</td>
<td>Saccostrea sp.</td>
<td>-20.2</td>
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<td>0.2</td>
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<td>0.3</td>
<td>3</td>
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<tr>
<td>Unimpacted</td>
<td>2016</td>
<td>grazer</td>
<td>Telescopium telescopium</td>
<td>-20.3</td>
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<td>7.1</td>
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<tr>
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<td>grazer</td>
<td>Telescopium telescopium</td>
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<td>1.1</td>
<td>6.4</td>
<td>0.1</td>
<td>12.0</td>
<td>1.1</td>
<td>3</td>
</tr>
<tr>
<td>Unimpacted</td>
<td>2018</td>
<td>grazer</td>
<td>Telescopium telescopium</td>
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<td>7.3</td>
<td>0.2</td>
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<td>0.9</td>
<td>6</td>
</tr>
<tr>
<td>Unimpacted</td>
<td>2016</td>
<td>leaf feeder</td>
<td>Parasesarma or Episesarma</td>
<td>-21.0</td>
<td>0.3</td>
<td>7.7</td>
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<tr>
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<td>8.1</td>
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<td>leaf feeder</td>
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<td>7.9</td>
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<td>15.0</td>
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<tr>
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<td>2016</td>
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<td>7.5</td>
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<td>17.0</td>
<td>0.2</td>
<td>3</td>
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<td>Tubuca signata</td>
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<td>8.4</td>
<td>0.4</td>
<td>15.5</td>
<td>0.3</td>
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<td>Tubuca signata</td>
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<td>0.2</td>
<td>7.3</td>
<td>0.4</td>
<td>16.7</td>
<td>0.2</td>
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<tr>
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<td>filter feeder</td>
<td>Saccostrea sp.</td>
<td>-19.0</td>
<td>0.5</td>
<td>7.9</td>
<td>0.1</td>
<td>14.5</td>
<td>0.4</td>
<td>3</td>
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<tr>
<td>Impacted</td>
<td>2018</td>
<td>filter feeder</td>
<td>Saccostrea sp.</td>
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<td>0.0</td>
<td>7.5</td>
<td>0.1</td>
<td>15.2</td>
<td>0.2</td>
<td>3</td>
</tr>
<tr>
<td>Impacted</td>
<td>2016</td>
<td>grazer</td>
<td>Telescopium telescopium</td>
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<td>0.1</td>
<td>7.5</td>
<td>0.0</td>
<td>14.1</td>
<td>0.7</td>
<td>2</td>
</tr>
<tr>
<td>Impacted</td>
<td>2017</td>
<td>grazer</td>
<td>Telescopium telescopium</td>
<td>-16.7</td>
<td>0.8</td>
<td>7.2</td>
<td>0.1</td>
<td>14.7</td>
<td>0.4</td>
<td>3</td>
</tr>
<tr>
<td>Impacted</td>
<td>2018</td>
<td>grazer</td>
<td>Telescopium telescopium</td>
<td>-16.0</td>
<td>0.5</td>
<td>7.8</td>
<td>0.2</td>
<td>14.5</td>
<td>0.2</td>
<td>6</td>
</tr>
<tr>
<td>Impacted</td>
<td>2016</td>
<td>leaf feeder</td>
<td>Parasesarma or Episesarma</td>
<td>-18.6</td>
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<td>9.0</td>
<td>0.4</td>
<td>15.7</td>
<td>0.1</td>
<td>2</td>
</tr>
<tr>
<td>Impacted</td>
<td>2017</td>
<td>leaf feeder</td>
<td>Parasesarma or Episesarma</td>
<td>-18.3</td>
<td>0.1</td>
<td>9.0</td>
<td>0.3</td>
<td>16.0</td>
<td>0.5</td>
<td>3</td>
</tr>
<tr>
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<td>2018</td>
<td>leaf feeder</td>
<td>Parasesarma or Episesarma</td>
<td>-18.0</td>
<td>0.7</td>
<td>7.7</td>
<td>0.9</td>
<td>19.4</td>
<td>1.2</td>
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Table S5. C isotopic compositions in essential amino acids (EAAs)

<table>
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<tr>
<th>Forest</th>
<th>Common name</th>
<th>Taxa</th>
<th>n</th>
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<th>Ile (mean, SD)</th>
<th>Val (mean, SD)</th>
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<th>Phe (mean, SD)</th>
<th>mean of five EAAs</th>
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<tbody>
<tr>
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<td>Algae feeder</td>
<td>Tubuca signata</td>
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<td>-15.3, 2.1</td>
<td>-18.8, 1.3</td>
<td>-23.5, 1.1</td>
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<td>-27.5, 1.5</td>
<td>-21.9</td>
</tr>
<tr>
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<td>Leaf feeder</td>
<td>Sesarmidae</td>
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<td>-22.7, 1.9</td>
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<td>-29.7, 1.0</td>
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</tr>
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<td>Grazer</td>
<td>Telescopium</td>
<td>3</td>
<td>-18.1, 1.5</td>
<td>-21.3, 1.6</td>
<td>-25.9, 2.0</td>
<td>-26.3, 1.9</td>
<td>-28.3, 2.2</td>
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<tr>
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<td>Filter feeder</td>
<td>Crassostrea (oyster)</td>
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<td>-16.8, 0.6</td>
<td>-18.6, 0.2</td>
<td>-24.7, 0.3</td>
<td>-26.0, 0.3</td>
<td>-27.6, 0.2</td>
<td>-22.8</td>
</tr>
<tr>
<td>Unimpacted</td>
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<td>Sesarmidae</td>
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<td>Algae feeder</td>
<td>Tubuca signata</td>
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<td>Leaf feeder</td>
<td>Sesarmidae</td>
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<td>-22.9, 2.3</td>
<td>-23.2, 2.0</td>
<td>-20.7</td>
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</table>
Figure S1. Normalized $\delta^{13}C_{\text{EAA}}$ fingerprint patterns of four mangrove consumer groups and resources including mangrove leaves and MPB from the unimpacted and impacted mangrove sites during 2017 (20 months after the dieback). The values were normalized to the mean $\delta^{13}C$ value of five EAA in the sample as per Larsen (2009). Error bars show ± SD. The normalized $\delta^{13}C_{\text{EAA}}$ fingerprint patterns did not differ between the forests for all the samples (PERMANOVA p > 0.05, Table 3).