*Supporting Information for:*

# Effects of an anaerobic membrane bioreactor upset event on nitrogen speciation and microbial community in a downstream phototrophic membrane bioreactor

**12 Pages**
**13 Figures**
**3 Tables**

## FIGURES

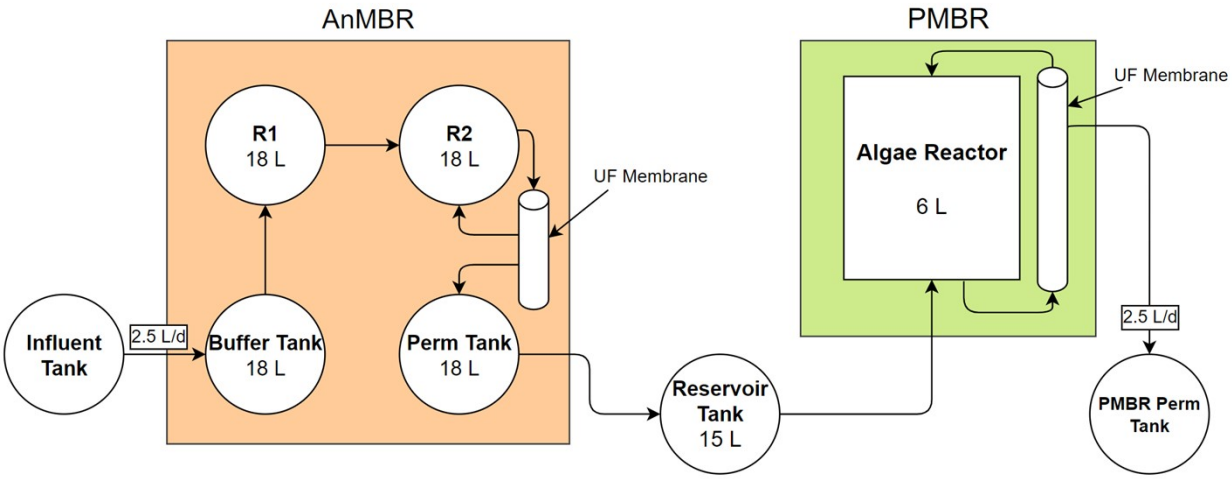



**Figure S1** – Diagram of anaerobic membrane bioreactor (AnMBR) and phototrophic membrane bioreactor (PMBR) integration. The reservoir tank acted as the intermediate tank between the two systems.

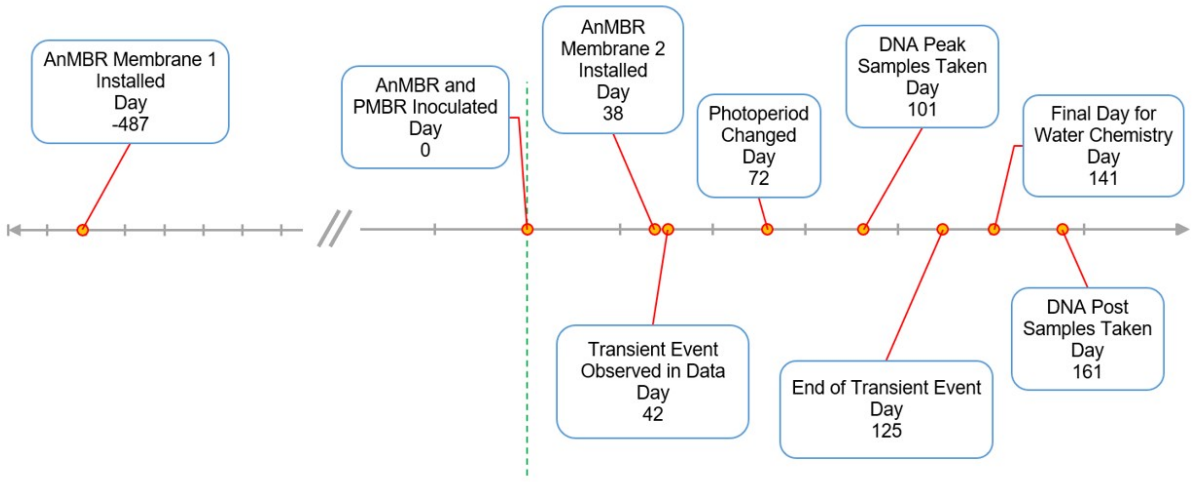



**Figure S2** – Timeline of events. Tick marks represent 28 days. Timeline has been cut to remove time between the anaerobic membrane bioreactor (AnMBR) Membrane 1 installed and the inoculation day for this study.

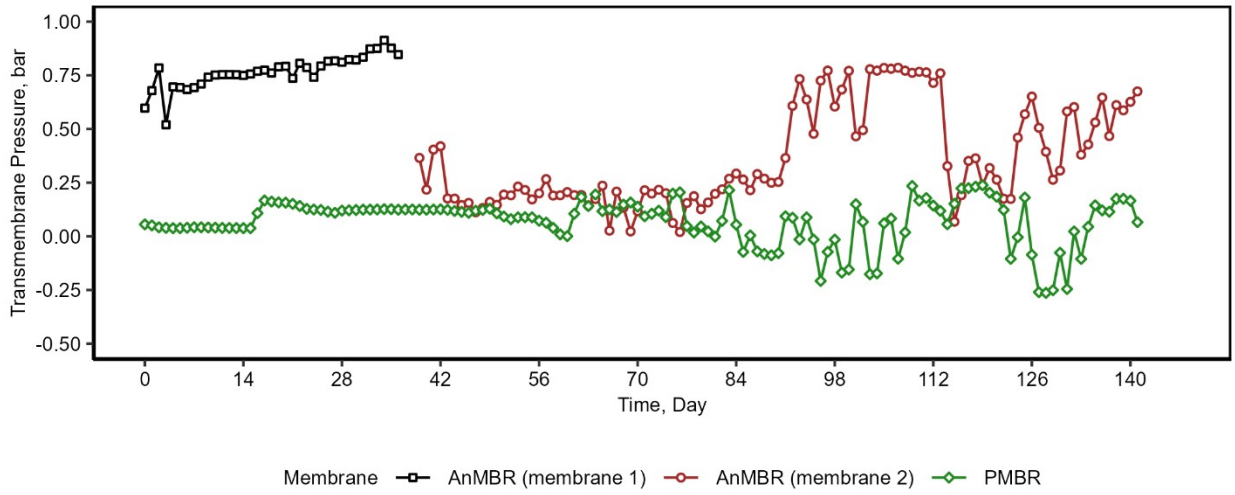



**Figure S3** – Transmembrane pressure (TMP) of the anaerobic membrane bioreactor (AnMBR) membranes and the phototrophic membrane bioreactor (PMBR) membrane. The first AnMBR membrane was replaced on day 38.

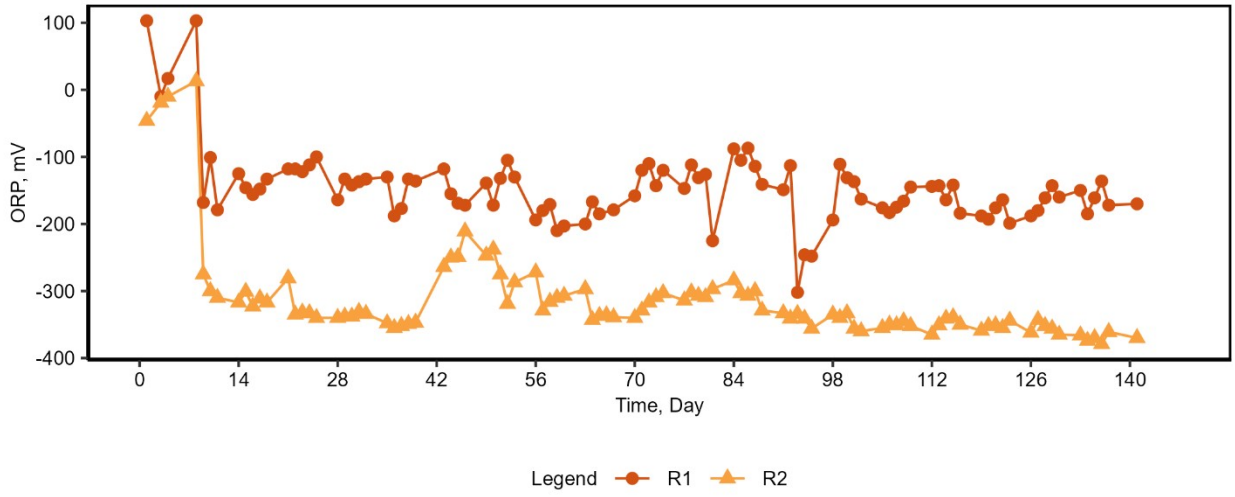



**Figure S4** – Oxidation reduction potential (ORP) in the anaerobic membrane bioreactor (AnMBR) reactor 1 (R1) and reactor 2 (R2).

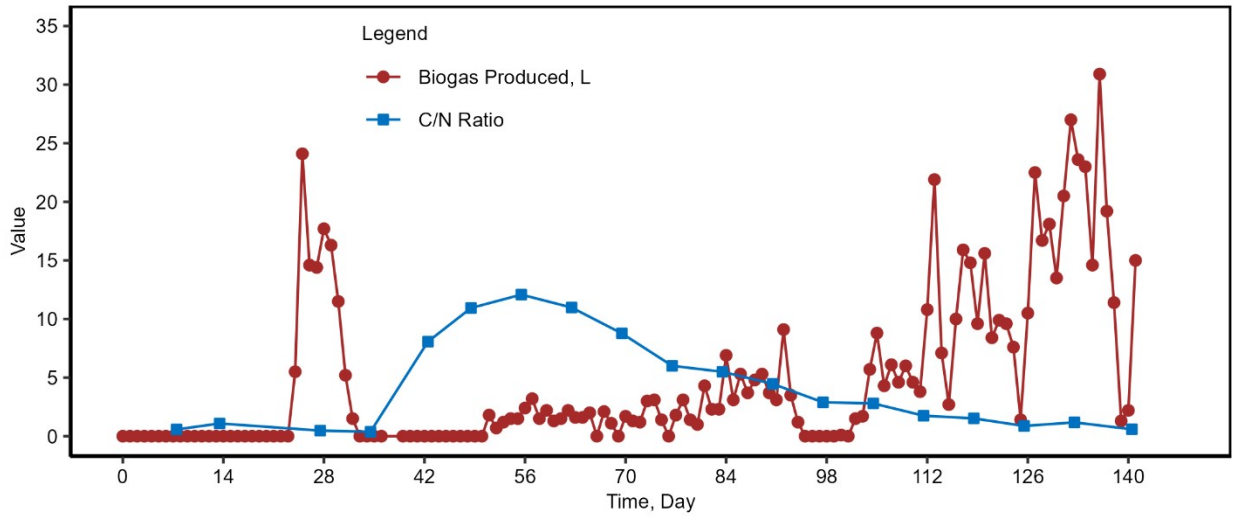



**Figure S5** – Average daily biogas production in liters for the anaerobic membrane bioreactor (AnMBR). The C/N ratio of the AnMBR permeate in the reservoir tank (RT) is also graphed.

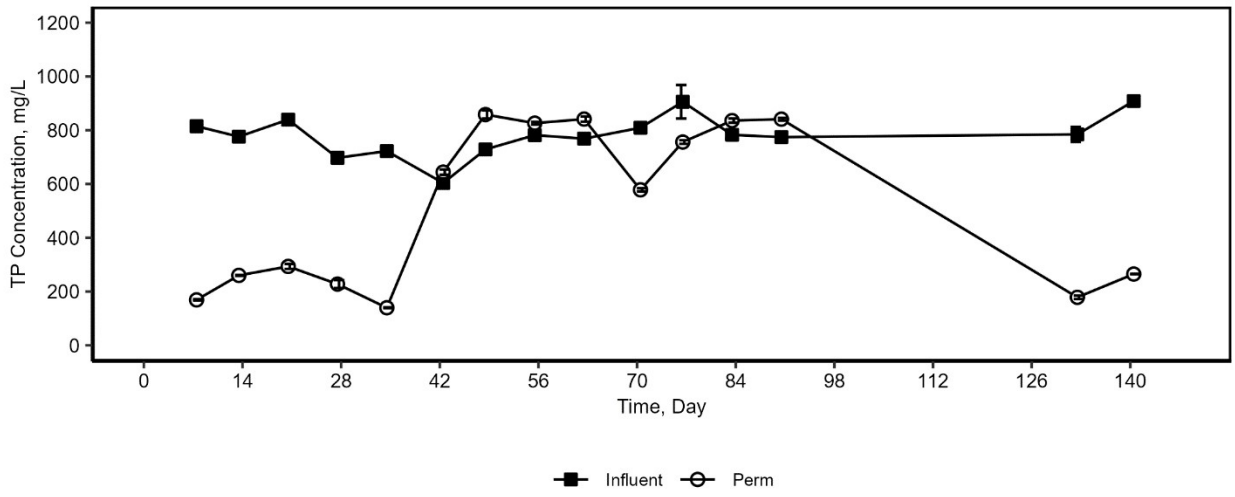



**Figure S6** – Total phosphate data for the anaerobic membrane bioreactor (AnMBR) influent and permeate.

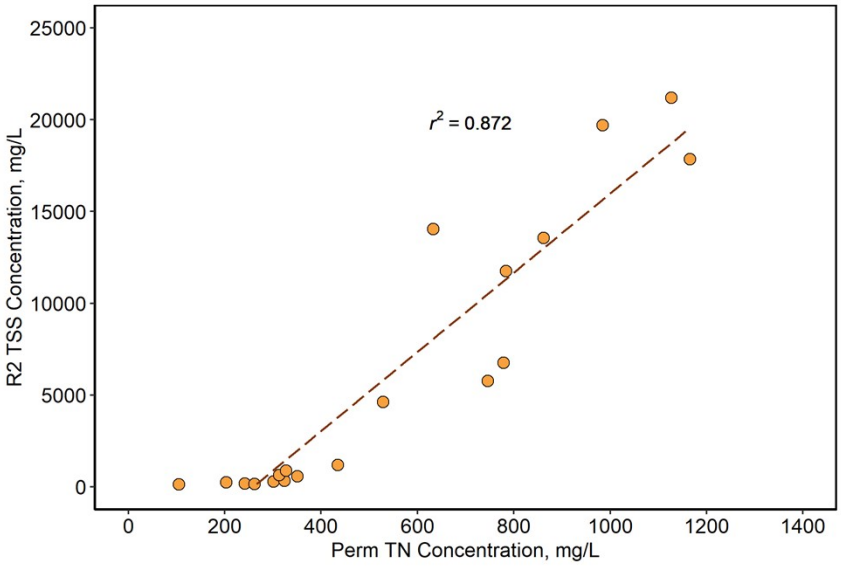



**Figure S7** – Correlation between the total nitrogen (TN) concentrations in the anaerobic membrane bioreactor (AnMBR) permeate and the total suspended solids (TSS) concentrations in R2. The trendline shows a linear relationship with $r^2$ value = 0.872.

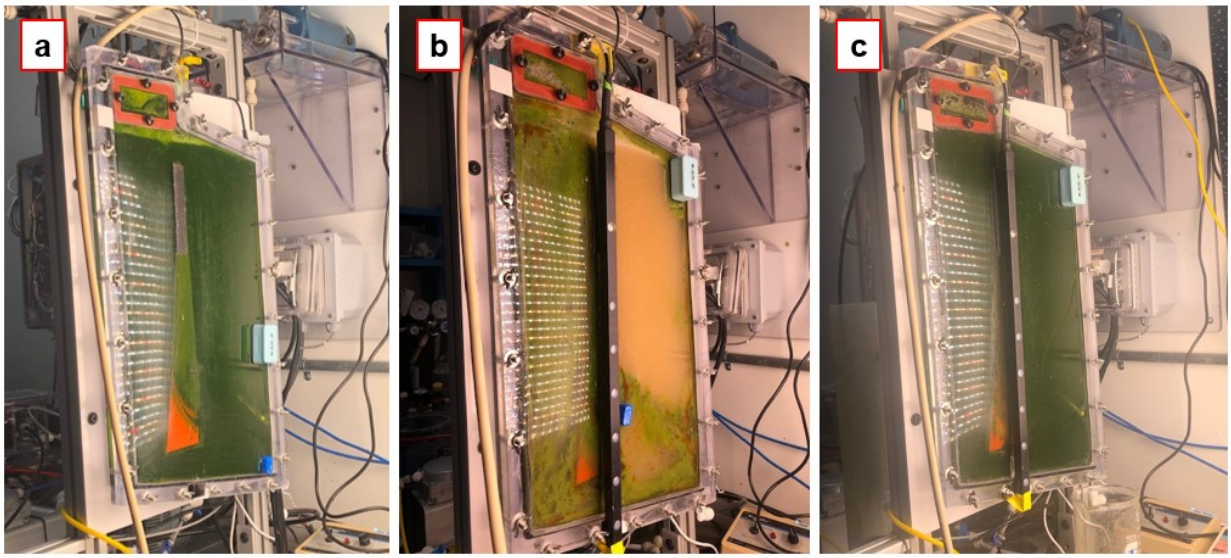



**Figure S8** – Pictures taken of the phototrophic membrane bioreactor (PMBR) during the study period: (a) PMBR before the transient event on Day 29, (b) PMBR during the transient event on Day 64, and (c) PMBR after the transient event on Day 130.

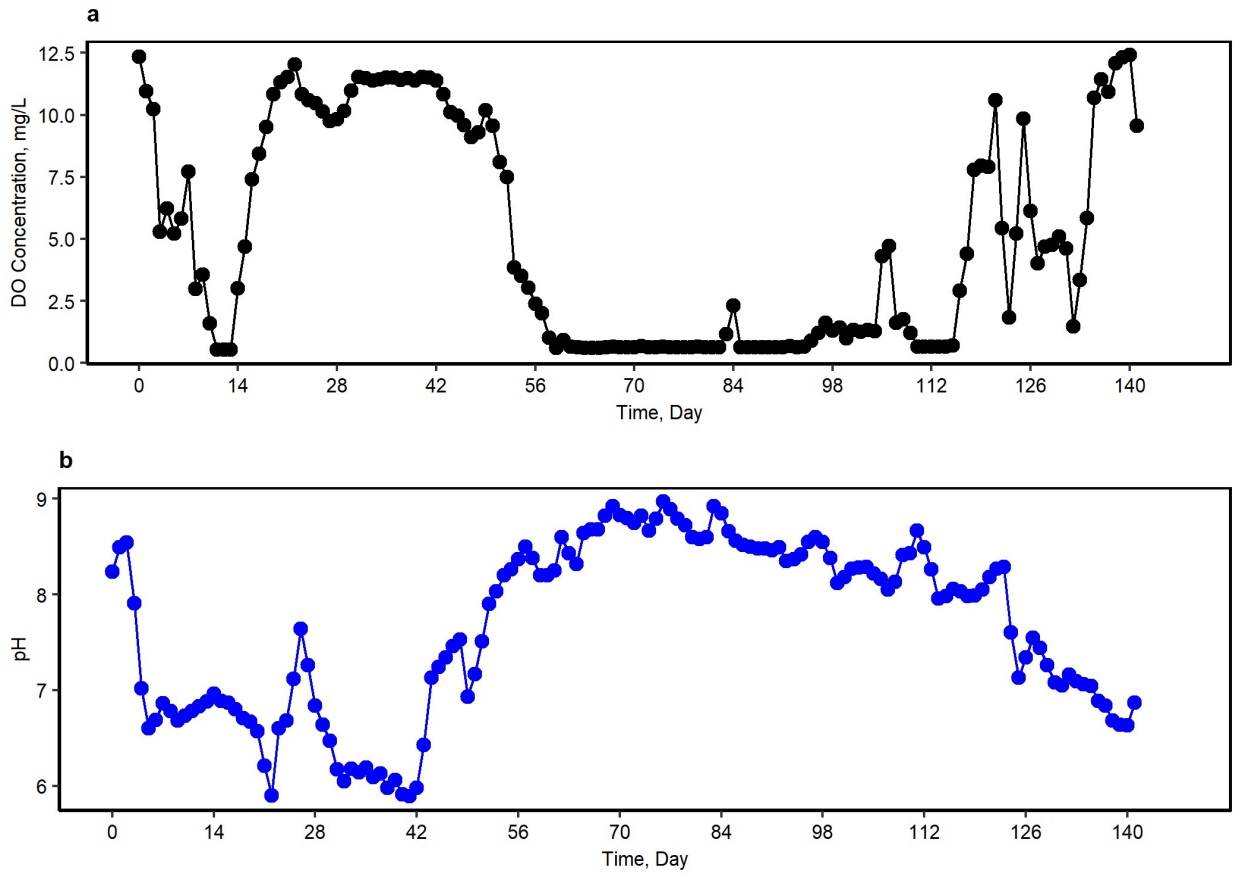



**Figure S9** – Average daily (a) dissolved oxygen (DO) concentration and (b) pH for the phototrophic membrane bioreactor (PMBR) reactor.

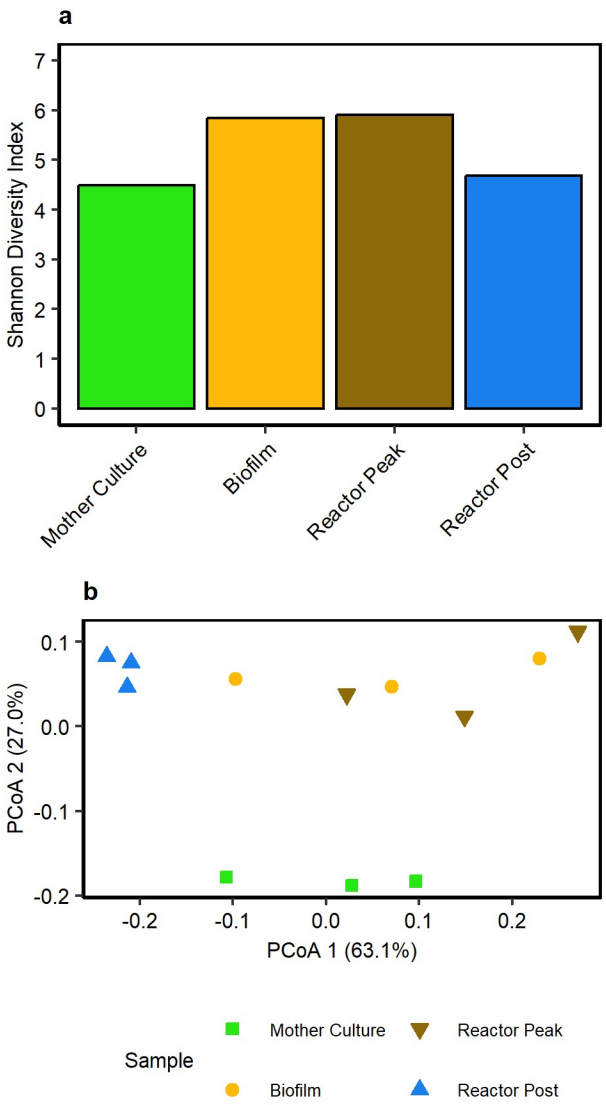
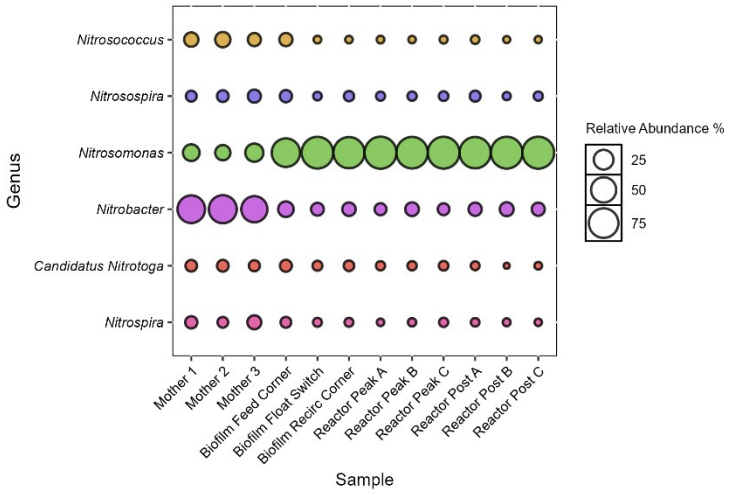



**Figure S10** – (a) Average Shannon diversity indices for the metagenomics samples taken from the PMBR. (b) Principal coordinate analysis representing Bray-Curtis beta diversity of the metagenomics data for mother culture, reactor biofilm at the peak of the transient event, reactor contents at the peak of the transient event, and reactor contents after the transient event.




| Sample | AOB/NOB Ratio |
|---|---|
| Mother 1 | 0.4 |
| Mother 2 | 0.4 |
| Mother 3 | 0.5 |
| Biofilm Feed Corner | 4.1 |
| Biofilm Float Switch | 9.9 |
| Biofilm Recirc Corner | 8.0 |
| Reactor Peak A | 15.0 |
| Reactor Peak B | 9.1 |
| Reactor Peak C | 12.6 |
| Reactor Post A | 10.4 |
| Reactor Post B | 10.3 |
| Reactor Post C | 12.6 |

**Figure S11** – Bubble plot illustrating the nitrifier genera diversity in the samples taken from the mother culture, reactor biofilm at the peak of the transient event, reactor contents at the peak of the transient event, and reactor contents after the transient event. Size of the bubble corresponds to the relative abundance percentage. Table shows the ratio between ammonia oxidizing bacteria (AOB) and nitrite oxidizing bacteria (NOB) for each sample.

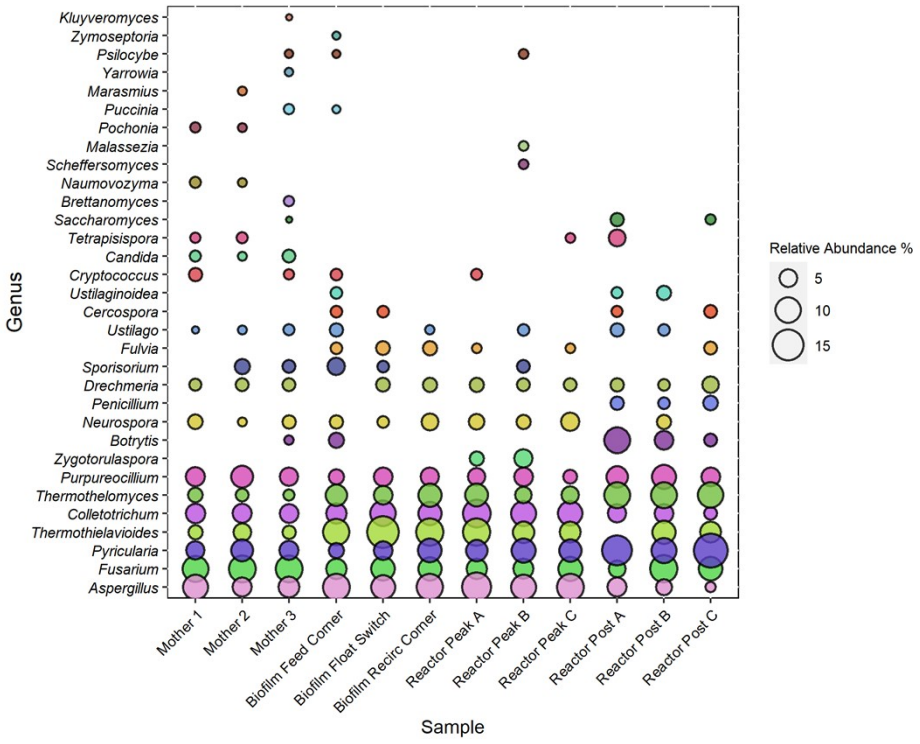



**Figure S12** – Bubble plot illustrating the fungal genera diversity in the samples taken from the mother culture, reactor biofilm at the peak of the transient event, reactor contents at the peak of the transient event, and reactor contents after the transient event. Size of the bubble corresponds to the relative abundance percentage. Genera with a relative abundance below 1% are not shown in the figure.

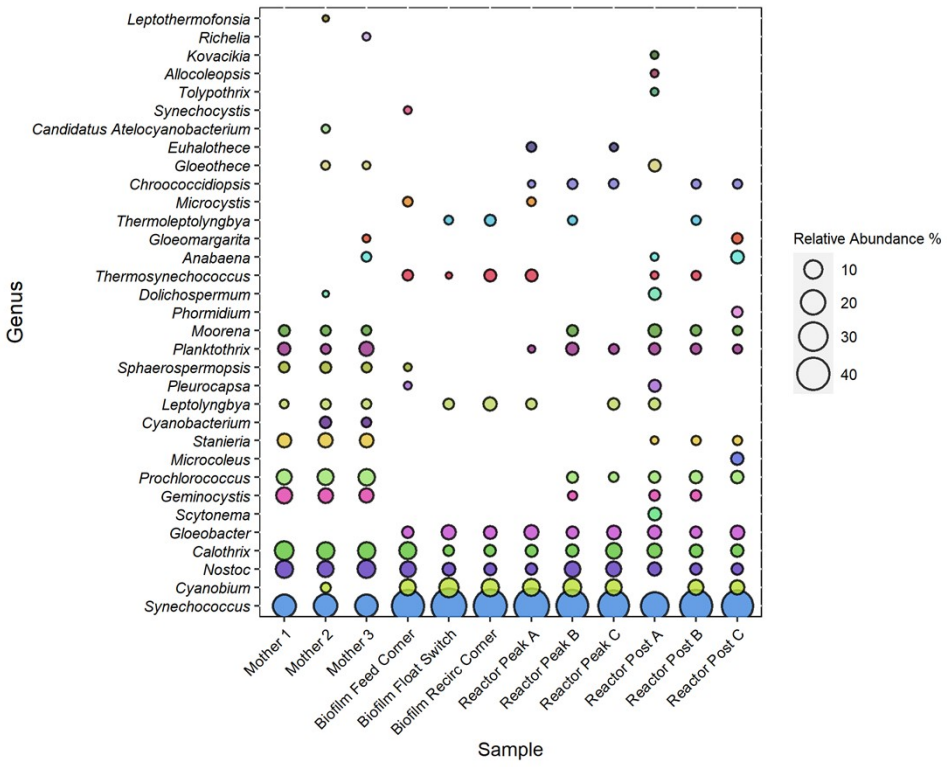



**Figure S13** – Bubble plot illustrating the cyanobacteria genera diversity in the samples taken from the mother culture, reactor biofilm at the peak of the transient event, reactor contents at the peak of the transient event, and reactor contents after the transient event. Size of the bubble corresponds to the relative abundance percentage. Genera with a relative abundance below 1% are not shown in the figure.

## TABLES

Table S1 – Chemical recipe of the medium used to grow the *C. sorokiniana* mother culture

| Compound | Concentration, mM |
|---|---|
| Ammonium chloride | 9.3 |
| Potassium phosphate monobasic | 5.3 |
| Dipotassium hydrogen phosphate | 8.3 |
| Magnesium sulfate heptahydrate | 0.241 |
| Calcium chloride dihydrate | 0.122 |
| Ammonium ferric citrate | 0.019 |
| Boric acid | 0.183 |
| EDTA dihydrate | 0.134 |
| Zinc sulfate heptahydrate | 0.076 |
| Manganese chloride tetrahydrate | 0.026 |
| Ferrous sulfate heptahydrate | 0.018 |
| Cobalt chloride | 0.0068 |
| Copper sulfate | 0.0063 |
| Ammonium heptamolybdate tetrahydrate | 0.0009 |

Table S2 – Concentrations of dissolved organic carbon, chemical oxygen demand, total suspended solids, total nitrogen, and total phosphate in the anaerobic membrane bioreactor influent.

| Parameter | Concentration, mg/L |
|---|---|
| Dissolved organic carbon, DOC | 2185 ± 271 |
| Chemical oxygen demand, COD | 41040 ± 15233 |
| Total Suspended Solids, TSS | 38851 ± 12300 |
| Total Nitrogen, TN | 294 ± 56 |
| Total Phosphate, TP | 780 ± 74 |

Table S3 – Concentrations of total nitrogen, ammonia, nitrate, and nitrate in mg/L for the nitrogen mass balance.

| Day | RT Total Nitrogen, mg/L | Colloidal NH4-N, mg/L | Colloidal NO3-N, mg/L | Colloidal NO2-N, mg/L | Dissolved NH4-N, mg/L | Dissolved NO3-N, mg/L | Dissolved NO2-N, mg/L | Theoretical biomass & volatilization fraction, mg/L |
|---|---|---|---|---|---|---|---|---|
| 7 | 338.3 | 5.0 | 7.2 | -9.8 | 74.2 | 34.2 | 81.0 | 126.8 |
| 13 | 205.5 | -1.1 | -1.8 | -5.6 | 31.8 | 45.0 | 50.0 | 70.2 |
| 20 | 243.9 | 2.5 | -5.3 | 0.4 | 16.2 | 140.8 | 1.2 | 77.4 |
| 27 | 307.9 | 0.2 | 1.4 | 2.2 | 37.3 | 82.2 | 39.4 | 145.2 |
| 34 | 268.0 | 0.8 | -10.8 | -0.2 | 36.0 | 192.6 | 0.3 | 27.4 |
| 42 | 253.4 | 0.5 | -3.2 | 0.2 | 13.8 | 189.0 | 0.1 | 46.6 |
| 48 | 279.2 | 0.8 | 4.4 | 5.4 | 5.7 | 145.5 | 6.3 | 111.2 |
| 55 | 303.0 | -0.8 | 5.1 | 1.3 | 45.9 | 21.0 | 14.6 | 214.2 |
| 62 | 262.8 | -2.9 | 5.1 | 1.8 | 2.9 | 9.2 | 1.9 | 239.0 |
| 69 | 257.2 | -4.8 | 1.0 | 0.9 | 14.6 | 0.1 | 0.0 | 235.8 |
| 76 | 336.9 | -9.7 | 8.6 | 0.2 | 9.8 | 1.4 | 0.1 | 307.1 |
| 83 | 375.0 | -44.7 | 8.1 | 11.3 | 45.0 | 1.5 | 1.6 | 262.7 |
| 90 | 548.3 | 5.8 | 0.2 | 0.1 | 107.5 | 0.3 | 0.0 | 434.5 |
| 97 | 531.6 | 0.3 | -1.8 | 44.1 | 0.5 | 7.5 | 24.1 | 453.2 |
| 104 | 683.9 | -2.1 | 0.5 | -3.2 | 5.0 | 4.9 | 22.8 | 645.4 |
| 125 | 839.5 | 4.0 | 11.8 | 25.0 | 23.5 | 22.5 | 58.0 | 694.6 |
| 132 | 726.9 | -5.9 | -7.0 | 1.4 | 139.5 | 77.0 | 81.8 | 414.3 |
| 140 | 949.9 | 21.4 | -2.0 | -0.9 | 114.0 | 161.9 | 30.4 | 619.3 |